EIA REPORT

APPENDIX H:

Application for Environmental Authorisation

Scoping and **Environmental Impact Assessment** for the Proposed Development of a 75 MW Solar Photovoltaic Facility (KENHARDT PV 2) on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt, Northern Cape Province

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

APPLICATION FORM FOR ENVIRONMENTAL AUTHORISATION

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), (the Act) and the Environmental Impact Assessment Regulations, 2014 the Regulations)

PROJECT TITLE

Scoping and Environmental Impact Assessment for the Proposed Development of a 75 MW Solar Photovoltaic Facility (KENHARDT PV 2) on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt, Northern Cape Province

Kindly note that:

1. This application form is current as of 08 December 2014. It is the responsibility of the applicant to ascertain whether subsequent versions of the form have been published or produced by the competent authority.

2. The application must be typed within the spaces provided in the form. The sizes of the spaces provided are not necessarily indicative of the amount of information to be provided. Spaces are provided in tabular format and will extend automatically when each space is filled with typing.

3. Where applicable **black out** the boxes that are not applicable in the form.

4. The use of the phrase "not applicable" in the form must be done with circumspection. Should it be done in respect of material information required by the competent authority for assessing the application, it may result in the rejection of the application as provided for in the Regulations.

5. This application must be handed in at the offices of the relevant competent authority as determined by the Act and Regulations.

6. No faxed or e-mailed applications will be accepted. An electronic copy of the signed application form must be submitted together with two hardcopies (one of which must contain the original signatures).

7. Unless protected by law, all information filled in on this application form will become public information on receipt by the competent authority. Any interested and affected party should and shall be provided with the information contained in this application on request, during any stage of the application process.

8. Should a specialist report or report on a specialised process be submitted at any stage for any part of this application, the terms of reference for such report and declaration of interest of the specialist must also be submitted.

9. Proof of payment must accompany this application. The application will not be processed without proof of payment unless one of the exclusions provided for the Fee Regulations (Fees for consideration and processing of applications for environmental authorisations and amendments thereto Government Notice No.141, published on 28 February 2014) is applicable AND such information in section 1 of this application form has been confirmed by this Department.

Departmental Details

The application must be addressed to the Chief Directorate: Integrated Environmental Authorisations at:

Postal address:
Department of Environmental Affairs
Attention: Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia
Pretoria

Queries must be addressed to the contact below:

Tel: 012 399 9372
E-mail: EIAAdmin@environment.gov.za

Please note that this form must be copied to the relevant provincial environmental department/s.

View the Department's website at http://www.environment.gov.za/ for the latest version of the documents.

2

1. PROOF OF PAYMENT

Applicants are required to tick the appropriate box below to indicate that either proof of payment is attached or that, in the applicant's view, an exclusion applies. Proof and a motivation for exclusions must be attached to this application form in **Appendix 1**.

Proof of payment attached as **Appendix 1** ✓

Exclusion applies [redacted]

An applicant is excluded from paying fees if:

The activity is a community based project funded by a government grant; or
The applicant is an organ of state.

TYPE OF EXCLUSION	Tick where applicable. Proper motivation must be attached to the application
The activity is a community based project funded by a government grant	[redacted]
The applicant is an organ of state	

FEE AMOUNT	Fee
Application for an environmental authorisation for which basic assessment is required in terms of the Environmental Impact Assessment Regulations	[redacted]
Application for an environmental authorisation, for which S&EIR is required in terms of the Environmental Impact Assessment Regulations	R10 000

Department of Environmental Affairs' details for the payment of application fees:

Payment Enquiries: Tel: 012 399 9119 Email: eiafee@environment.gov.za Banking details: ABSA Bank Branch code: 632005 Account number: 1044 2400 72 Current account Reference number: Reference number to be provided in the specific format indicating centre point coordinates of site in decimal degrees to 5 or 6 decimal places: latitude/longitude eg. -33.918861/18.423300 Proof of payment must accompany the application form: Indicate reference number below. Tax exemption status: Status: Tax exempted
Reference number: **-29.227248/21.305166** **Note from the CSIR: A single reference number is being used as the Applicant is proposing to construct three 75 MW Solar Photovoltaic (PV) facilities on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt, Northern Cape Province. A separate Application for Environmental Authorisation will be lodged for each project (i.e. Kenhardt PV 1, Kenhardt PV 2 and Kenhardt PV 3). Therefore, a single payment of R 30 000 was made with the above reference number, which shows the approximate centre point co-ordinates of all three projects (i.e. Kenhardt PV 1, Kenhardt PV 2 and Kenhardt PV 3).**

3

2. PROJECT DESCRIPTION

Please provide a **detailed** description of the project.

Scatec Solar SA 163 (PTY) Ltd is proposing to develop three 75 Megawatt (MW) Solar Photovoltaic (PV) power generation facilities and associated electrical infrastructure (including 132 kV transmission lines for each 75 MW facility) on the remaining extent of Onder Rugzeer Farm 168 and the connection points to the Eskom Nieuwehoop Substation on the remaining extent of Portion 3 of Gemsbok Bult Farm 120, approximately 80 km south of Upington and 30 km north-east of Kenhardt within the !Kheis Local Municipality, Northern Cape Province. Scatec Solar SA 163 (PTY) Ltd consists of various subsidiary companies, one of which is Scatec Solar SA 350 (PTY) Ltd. Scatec Solar SA 350 (PTY) Ltd (hereinafter referred to as Scatec Solar) is the Project Applicant for this proposed 75 MW solar PV project (referred to as Kenhardt PV 2).

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) and the 2014 NEMA Environmental Impact Assessment (EIA) Regulations promulgated in Government Gazette 38282 and Government Notice (GN) R982, R983, R984 and R985 on 8 December 2014, a full Scoping and EIA Process is required for the construction of the three Solar PV facilities. A separate Basic Assessment Process will be undertaken for the development of the proposed transmission lines and associated electrical infrastructure required for the connection to the Eskom Nieuwehoop Substation. The Applicant has appointed the Council for Scientific and Industrial Research (CSIR) to undertake the separate EIA and Basic Assessment Processes in order to determine the biophysical, social and economic impacts associated with undertaking the proposed activity.

Since the three proposed 75 MW Solar PV facilities are located within the same geographical area and constitute the same type of activity, an integrated Public Participation Process (PPP) will be undertaken for the proposed projects. However, separate Applications for Environmental Authorisation (EA) are being lodged with the Competent Authority (i.e. the National Department of Environmental Affairs) for each proposed Scoping and EIA project. Separate Applications for EA will be lodged at a later stage for each Basic Assessment project. Furthermore, separate reports (i.e. Basic Assessment, Scoping and EIA Reports) will be compiled for each project. The Basic Assessment Reports will be released to Interested and Affected Parties (I&APs) for review together with the EIA Reports during the EIA Phase.

The proposed 75 MW Solar PV facility projects (requiring a Scoping and EIA Process) are referred to as:

- Kenhardt PV 1;
- Kenhardt PV 2 (i.e. **this Application for EA**); and
- Kenhardt PV 3.

The proposed supporting electrical infrastructure (which includes the 132 kV transmission line) projects (requiring a Basic Assessment Process) are referred to as: Kenhardt PV 1 – Transmission Line; Kenhardt PV 2 – Transmission Line; and Kenhardt PV 3 – Transmission Line.

This Application for EA is therefore only focussed on the proposed **Kenhardt PV 2** project.

A summary of the key components of the proposed project is described below. It is important to note at the outset that the exact specifications of the proposed project components will be determined during the detailed engineering phase.

This project (Kenhardt PV 2) is being developed to have a generation capacity of 75 MW Alternating Current (AC) and up to 100 MW Direct Current (DC). The proposed 75 MW Solar PV facility will cover an approximate area of 250 hectares (ha). A preferred and alternative site (referred to as Kenhardt PV 2b) will be considered in the Scoping Phase. The preferred site will be assessed during the EIA Phase. The preferred site includes approximately 540 ha of land. Due to the fact that this project only requires 250 ha of land, there is scope to avoid major environmental constraints through the final design of the facility.

4

Once a Power Purchase Agreement (PPA) is awarded, the proposed facility will generate electricity for a minimum period of 20 years. The property on which the facility is to be constructed will be leased by Scatec Solar from the property owner for the life span of the project.
The solar facility will consist of the following components:

- Solar Field:
  - Solar Arrays;
  - PV Modules;
  - Tracking structures;
  - Solar module mounting structures comprised of galvanised steel and aluminium; and
  - Foundations which will likely be drilled and concreted into the ground.
- Building Infrastructure:
  - Offices;
  - Operational and maintenance control centre;
  - Warehouse/workshop;
  - Ablution facilities;
  - Converter station;
  - On-site substation building; and
  - Guard House.
- Associated Infrastructure
  - 132 kV overhead transmission line (**as mentioned above this will be subject to a separate Basic Assessment Process, referred to as Kenhardt PV 2 – Transmission Line**);
  - Associated electrical infrastructure at the Eskom Nieuwehoop Substation (including but not limited to feeders, Busbars, transformer bay and extension to the platform at the Eskom Nieuwehoop Substation) **(as mentioned above this will be subject to a separate Basic Assessment Process, referred to as Kenhardt PV 2 – Transmission Line)**;
  - On-site substation;
  - Internal transmission lines/underground cables;
  - Underground low voltage cables or cable trays;
  - Access roads;
  - Internal gravel roads;
  - Fencing;
  - Panel maintenance and cleaning area;
  - Stormwater channels;
  - Water pipelines; and
  - Temporary work area during the construction phase (i.e. laydown area).

The overall locality of the proposed project, including the alternative site (referred to as "Kenhardt PV 2b"), is shown in Appendix 6 of this Application for EA.

Does the project form part of any of the Strategic Infrastructure Projects (SIPs) as described in the National Development Plan, 2011?	[redacted]	NO ✓

If YES, please indicate which SIPs are applicable in **Appendix 2**. You are also required to provide confirmation of SIP applications from the relevant sector representative which must be attached in **Appendix 2.**

<u>Note from the CSIR</u>: **The proposed project does not form part of any of the Strategic Infrastructure Projects.**

5

Please indicate which sector the project falls under by crossing out the relevant block in the table below:

Table 1

Green economy + "Green" and energy-saving industries		Greenfield transformation to urban or industrial form (including mining)	
Infrastructure – electricity (generation, transmission & distribution)	X	Biodiversity or sensitive area related activities	
Oil and gas		Mining value chain	
Biofuels		Potential of metal fabrication capital & transport equipment – arising from large public investments	
Nuclear		Boat building	
Basic services (local government) – electricity and electrification		Manufacturing – automotive products and components, and medium and heavy commercial vehicles	
Basic services (local government) – area lighting		Manufacturing – plastics, pharmaceuticals and chemicals	
Infrastructure – transport (ports, rail and road)		Manufacturing – clothing textiles, footwear and leather	
Basic services (local government access roads)		Forestry, paper, pulp and furniture	
Basic services (local government) – public transport		Business process servicing	
Infrastructure – water (bulk and reticulation)		Advanced materials	
Basic services (local government) – sanitation		Aerospace	
Basic services (local government) – waste management		Basic services (local government) – education	
Basic services (local government) water		Basic services (local government) – health	
Agricultural value chain + agro-processing (linked to food security and food pricing imperatives)		Basic services (local government) - housing	
Infrastructure – information and communication technology		Basic services (local government) security of tenure	
Tourism + strengthening linkages between cultural industries and tourism		Other	
Basic services (local government) – public open spaces and recreational facilities			

Table 2

Does the listed activity/ies applied for form part of a larger project which is not a listed activity itself e.g. a road that is a listed activity that is needed to access a drilling site where the drilling does not constitute a listed activity.	[redacted]	NO ✓
If indicated yes above, please provide a brief description on how the activity/ies relate to the larger project that forms part there of: **Note from the CSIR: Not Applicable**		

6

3. GENERAL INFORMATION

Applicant name:	Scatec Solar SA 350 (Pty) Ltd		
Registration number (if applicant is a company)	2012/103589/07		
Trading name (if any)	Scatec Solar SA 350		
Responsible person name (If the applicant is a company):	Mitchell Hodgson		
Applicant/Responsible person ID number:	8602075840087		
Responsible position, e.g. Director, CEO, etc.:	Project Development		
Physical address:	Unit 109B, The Foundry, 75 Prestwich Street, Green Point, Cape Town, 8005		
Postal address:	Unit 109B, The Foundry, 75 Prestwich Street, Green Point, Cape Town		
Postal code:	8005	Cell:	072 810 2006
Telephone:	087 702 5868	Fax:	086 560 3828
E-mail:	mitchell.hodgson@scatecsolar.com	BBBEE status	Not applicable

Provincial Authority:	Department of Environment and Nature Conservation (Kimberly Head Office)		
Contact person:	A. Yahphi		
Postal address:	Private Bag X6102, Kimberly		
Postal code:	8300	Cell:	[redacted]
Telephone:	053 807 7430	Fax:	053 807 7367
E-mail:	nyaphi@ncpg.gov.za		

Local municipality	!Kheis Local Municipality		
Contact person:	H. T. Scheepers		
Postal address:	Private Bag X2, Groblershoop		
Postal code:	8850	Cell:	[redacted]
Telephone:	054 833 9500	Fax:	054 833 9509
E-mail:	teresascheepers@vodamail.co.za		

In instances where there is more than one local authority involved, please attach a list of those local authorities with their contact details as **Appendix 3**.

<u>Note from the CSIR:</u> The !Kheis Local Municipality is the only designated Local Authority relevant to the proposed project. However, the adjacent Kai! Garib Local Municipality, as well as the ZF Mgcawu District Municipality (within which the !Kheis Local Municipality and the Kai! Garib Local Municipality) have been included on the project database of pre-identified stakeholders and authorities (including I&APs).

Landowner:	VAN NIEKERK GESINSTRUST		
Contact person:	Andre Van Niekerk		
Postal address:	18 du Toit Straat, Stellenbosch		
Postal code:	7600	Cell:	076 070 2515
Telephone:	[redacted]	Fax:	[redacted]
E-mail:	andre.vanniekerk10@gmail.com / kraaines@mweb.co.za		

7

In instances where there is more than one landowner, please attach a list of those landowners with their contact details as **Appendix 4**. If the applicant is not the owner or person in control of the land, proof of notice to the landowner or person in control of the land on which the activity is to be undertaken must be submitted in **Appendix 4**.

Note from the CSIR: Van Niekerk Geinstrust is the only owner of the land on which the proposed project will take place (i.e. the remaining extent of Onder Rugzeer Farm 168). Since the Applicant is not the owner or the person in control of the land; proof of notice to the landowner and permission from the landowner is included in Appendix 4 of this Application for EA.

Identified Competent Authority to consider the application:	National Department of Environmental Affairs
Reason(s) in terms of S 24C of NEMA 1998 as amended	The National Department of Environmental Affairs (DEA) based in Pretoria will be the Competent Authority (CA). This is based on a directive that was issued by the Department of Minerals and Energy (now operating as the Department of Energy) in 2009 indicating that all energy-related EIAs must be fast-tracked and that the National DEA must be the CA. Since the proposed project is a renewable energy project, the responsibility of deciding whether to grant EA remains with the DEA.

4. ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP) INFORMATION

EAP:	Surina Laurie		
Professional affiliation/registration:	▪ Registered Professional Natural Scientist with the South African Council for Natural Scientific Professions (Registration Number: 400033/15). ▪ International Association for Impact Assessment, South African Affiliate.		
Contact person (if different from EAP):	[redacted]		
Company:	Council for Scientific and Industrial Research (CSIR)		
Physical address:	11 Jan Celliers Street, Stellenbosch, 7599		
Postal address:	PO Box 320, Stellenbosch		
Postal code:	7599	Cell:	082 468 0962
Telephone:	021 888 2490 or 021 888 2661	Fax:	021 888 2693
E-mail:	SLaurie@csir.co.za		

If an EAP has not been appointed please ensure that an independent EAP is appointed as stipulated by Regulation 12 of GN R.982, dated December 2014, prior to the commencement of the process.

The declaration of independence and the Curriculum Vitae (indicating the experience with environmental impact assessment and the relevant application processes) of the EAP must also be submitted to the Department.

Note from the CSIR: Kindly refer to Appendix 9 of this Application Form for the Declaration of Independence and the Curriculum Vitae of the EAP.

5. SITE DESCRIPTION

Provide a detailed description of the site involved in the application.

Province	Northern Cape
District Municipality	ZF Mgcawu District Municipality
Local Municipality	!Kheis Local Municipality
Ward number(s)	Not Applicable

8

Nearest town(s)	Kenhardt
Farm name(s) and number(s)	Preferred Site (Kenhardt PV 2): ▪ Remainder of farm Onder Rugzeer Number 168 Alternative Site (Kenhardt PV 2b): ▪ Remainder of farm Onder Rugzeer Number 168
Portion number(s)	Preferred Site (Kenhardt PV 2): ▪ Portion 0 Alternative Site (Kenhardt PV 2b): ▪ Portion 0

SG 21 Digit Code(s)
(If there are more than 4, please attach a list with the rest of the codes as **Appendix 5**)

C	0	3	6	0	0	0	0	0	0	0	0	0	1	6	8	0	0	0	0	0

[redacted]

1	2	3	4	5

Note from the CSIR: Kindly refer to Appendix 6 of this Application Form for a map illustrating the property details relevant to the all three proposed PV projects (i.e. Kenhardt PV 1, Kenhardt PV 2 and Kenhardt PV 3), as well as adjacent properties. Please note that only ERF 168 is relevant to the proposed projects.

Are there any other applications for Environmental Authorisation on the same property?	YES ✓	[redacted]
If YES, please indicate the following:		
Competent Authority	**Please refer to Appendix 10 of this Application Form.**	
Reference Number	**Please refer to Appendix 10 of this Application Form.**	
Project Name	**Please refer to Appendix 10 of this Application Form.**	
Please provide details of the steps taken to ascertain this information: **Please refer to Appendix 10 of this Application Form.**		

Note from the CSIR: Kindly refer to Appendix 10 of this Application Form for the complete list of other applications for EA on the same property (i.e. remaining extent of Onder Rugzeer Farm 168).

9

6. ACTIVITIES TO BE AUTHORISED

For an application for authorisation that involves more than one listed activity that, together, make up one development proposal, all the listed activities pertaining to this application must be indicated.

Detailed description of listed activities associated with the project	
Listed activity as described in GN R 983, 984 and 985	**Description of project activity that triggers listed activity**
<u>**GN R 983: Activity 9 (i) and (ii)**</u> The development of infrastructure exceeding 1000 metres in length for the bulk transportation of water or storm water: (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where: a) such infrastructure is for bulk transportation of water or storm water or storm water drainage inside a road reserve; or b) where such development will occur within an urban area.	The proposed solar PV facility will be constructed on the remaining extent of Onder Rugzeer Farm 168, approximately 80 km south of Upington and 30 km north-east of Kenhardt within the !Kheis Local Municipality, Northern Cape Province. Hence the proposed project will take place outside of an urban area. The proposed project will entail the construction of stormwater channels and water pipelines. These structures may exceed 1000 m in length, may have an internal diameter of 0.36 m or more, and possibly a peak throughput of 120 l/s or more. Water pipelines may need to be constructed in order to transfer groundwater from existing boreholes to the proposed solar facility. The Project Applicant intends to make use of existing boreholes to source groundwater (if available and if suitable) for the solar panel cleaning process. The groundwater will be stored on site in suitable containers or reservoir tanks (or similar) during the operational phase. <u>*The Geohydrological Assessment, which will be undertaken during the EIA Phase, will confirm whether the groundwater is sufficient and suitable for use.*</u>
<u>**GN R 983: Activity 10 (i) and (ii)**</u> The development and related operation of infrastructure exceeding 1000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes: (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where - a) such infrastructure is for bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes inside a road reserve; or b) where such development will occur within an urban area.	The proposed project may entail the construction drainage structures (i.e. French drains) for the transfer of waste water generated by the proposed facility. These structures may exceed 1000 m in length, may have an internal diameter of 0.36 m or more, and possibly a peak throughput of 120 l/s or more. The proposed solar PV facility will be constructed on the remaining extent of Onder Rugzeer Farm 168, approximately 80 km south of Upington and 30 km north-east of Kenhardt within the !Kheis Local Municipality, Northern Cape Province. Hence the proposed project will take place outside of an urban area.
<u>**GN R 983: Activity 12 (x) and (xii)**</u> The development of: (x) buildings exceeding 100 square metres in size; (xii) infrastructure or structures with a physical	The proposed solar PV facility will be constructed on the remaining extent of Onder Rugzeer Farm 168, approximately 80 km south of Upington and 30 km north-east of Kenhardt within the !Kheis Local Municipality, Northern Cape Province. Hence the proposed project will take place outside of an urban area.

Detailed description of listed activities associated with the project	
Listed activity as described in GN R 983, 984 and 985	**Description of project activity that triggers listed activity**
footprint of 100 square metres or more; where such development occurs- a) within a watercourse; b) in front of a development setback; or c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding- (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; or (ee) where such development occurs within existing roads or road reserves.	The proposed 75 MW Solar PV facility (i.e. Kenhardt PV 2) will entail the construction of building infrastructure and structures (such as the solar field, offices, workshop, ablution facilities, on-site substation, laydown area and security enclosures etc.). Based on the preliminary sensitivity screening undertaken for the site, two rivers flow through the farm (as shown in Appendix 6 of this Application for EA) and the buildings and infrastructure are expected to exceed a footprint of 100 m^2 and some are likely to occur within 32 m of the watercourses. *Additional information regarding the presence of watercourses on site will be provided in the Ecological Impact Assessment, which will be undertaken during the EIA Phase.*
<u>**GN R 983: Activity 19 (i)**</u> The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from – (i) a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving- a) will occur behind a development setback; b) is for maintenance purposes undertaken in accordance with a maintenance management plan; or c) falls within the ambit of activity 21 in this Notice, in which case that activity applies.	The proposed project may entail the excavation, removal and moving of more than 5 m^3 of soil, sand, pebbles or rock from the nearby watercourses. The proposed project may also entail the infilling of more than 5 m^3 of material into the nearby watercourses. Based on the preliminary sensitivity screening undertaken for the site, two rivers flow through the farm (as shown in Appendix 6 of this Application for EA). Construction of the internal gravel access road and/or the potential construction of infrastructure within drainage lines may require the removal of material. *Additional information regarding the presence of watercourses on site will be provided in the Ecological Impact Assessment, which will be undertaken during the EIA Phase. Confirmation regarding whether material will be infilled or excavated from the watercourses will be provided in the EIA Report.*
<u>**GN R 983: Activity 24 (ii)**</u> The development of – (ii) a road with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres; but excluding – a) roads which are identified and included in activity 27 in Listing Notice 2 of 2014; or b) roads where the entire road falls within an	Existing roads (such as a private Transnet Service Road or an unnamed farm road) will be used to gain access to the preferred site. The Transnet Service Road can be accessed from the R27 and the farm road can be accessed from the R383 Regional Road also via the R27 National Road. An internal gravel road may be constructed from either the Transnet Service Road or the unnamed farm road to the proposed project site. The internal gravel road is not expected to exceed 6 m in width. The length of the internal gravel road will be confirmed as the location, design and layout of the facility progresses.

Detailed description of listed activities associated with the project	
Listed activity as described in GN R 983, 984 and 985	**Description of project activity that triggers listed activity**
urban area.	The proposed solar PV facility will be constructed on the remaining extent of Onder Rugzeer Farm 168, approximately 80 km south of Upington and 30 km north-east of Kenhardt within the !Kheis Local Municipality, Northern Cape Province. Hence the proposed project will take place outside of an urban area.
<u>GN R 983: Activity 28 (ii)</u> Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture or afforestation on or after 01 April 1998 and where such development: (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare; excluding where such land has already been developed for residential, mixed, retail, commercial, industrial or institutional purposes.	The proposed project will take place on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt in the Northern Cape. It is understood that the land is currently used for agricultural purposes (mainly grazing). The proposed 75 MW solar PV facility (i.e. Kenhardt PV 2), which is considered to be a commercial/industrial development, will have an estimated footprint of approximately 250 ha. The Kenhardt PV 1, PV 2 and PV 3 proposed projects will have a collective footprint of approximately 750 ha.
<u>GN R 984: Activity 1</u> The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more, excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs within an urban area.	The proposed project will entail the construction of a 75 MW Solar PV facility (i.e. facility for the generation of electricity from a renewable resource). The proposed project will be constructed on the remaining extent of Onder Rugzeer Farm 168, approximately 80 km south of Upington and 30 km north-east of Kenhardt within the !Kheis Local Municipality, Northern Cape Province. Hence the proposed project will take place outside of an urban area.
<u>GN R 984: Activity 15</u> The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for: (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	The proposed 75 MW solar PV facility (i.e. Kenhardt PV 2) will have an estimated footprint of approximately 250 ha. The Kenhardt PV 1, PV 2 and PV 3 proposed projects will have a collective footprint of approximately 750 ha. As a result, more than 20 ha of indigenous vegetation could possibly be removed for the construction of the proposed Solar PV facility. *Additional information regarding the presence of indigenous vegetation on site will be provided in the Ecological Impact Assessment, which will be undertaken during the EIA Phase.*

<u>Notes from the CSIR regarding the identification of potential listed activities:</u>

- **It should be noted that a precautionary approach was followed when identifying listed activities (for inclusion in the Application for EA), i.e. if the activity potentially forms part of the project, it is listed. However, the final project description will be shaped by the findings of the EIA Process and certain activities may be added or removed from the project proposal. The DEA and I&APs will be informed in writing of such amendments accordingly.**
- **Based on the preliminary sensitivity screening undertaken for the site, the proposed project area does not fall within any threatened ecosystems, National Protected Areas, National Protected Area Expansion Strategy Focus Areas or areas of conservation planning. The closest protected area is approximately 113 km away from the proposed project site. An Ecological Support Area (i.e. a buffer around the Hartbees River) is located approximately 14 km west of proposed project as part of the Namakwa District Biodiversity Sector Plan. Furthermore, there is no conservation plan for the !Kheis Local Municipality and the ZF Mgcawu District Municipality, hence Critical Biodiversity Areas are not present or defined.**

Therefore, the listed activities relating to specific geographic areas contained in GN R985 of the 2014 NEMA EIA Regulations do not apply to the proposed project at this stage. However, this will be confirmed during the EIA Phase as part of the relevant specialist studies.

- **The relevant listed activities applicable to the construction of the proposed transmission lines and associated electrical infrastructure at the Eskom Nieuwehoop Substation will be included in the separate Applications for EA for the BA projects. As mentioned above, the Applications for EA for the BA Processes will be lodged separately with the DEA during the EIA Phase, in order to comply with the timeframes stipulated in Regulation 19 (1) of GN R982.**

Please note that any authorisation that may result from this application will only cover activities specifically applied for. Co-ordinate points indicating the location of each listed activity must be provided with the relevant report (i.e. either BAR or EIR).

Please provide a project map indicating any sensitive areas (e.g. critical biodiversity area, World Heritage Site, etc.) overlaid by the study area in **Appendix 6**.

Note from the CSIR: Kindly refer to Appendix 6 of this Application Form for project maps, which show the proposed locality and sensitive areas (i.e. watercourses and wetland areas).

A project schedule, indicating the different phases and timelines of the project, must be attached as **Appendix 7**.

Note from the CSIR: Kindly refer to Appendix 7 of this Application Form for a project schedule.

7. PUBLIC PARTICIPATION

Provide details of the public participation process proposed for the application as required by Regulation 41(2) of GN R .982, dated December 2014.

As noted above, due to the fact that the proposed Scoping and EIA projects, consisting of Kenhardt PV 1, Kenhardt PV 2 (i.e. **this Application for EA**), and Kenhardt PV 3; and the proposed Basic Assessment projects (i.e. Kenhardt PV 1 – Transmission Line; Kenhardt PV 2 – Transmission Line; and Kenhardt PV 3 – Transmission Line) are located adjacent to each other, the PPP will run concurrently. Although separate reports for the six projects will be compiled and distributed for comment and authorisation, it is proposed that an integrated PPP be undertaken for all the phases.

The integrated PPP will include the following:

- **Site Notices:**
  - Notice boards have been placed during the project initiation phase at the:
    - entrance to the Transnet Service Road (which serves as one of the access routes to the preferred and alternative project sites) (in Afrikaans);
    - entrance of the site from the alternative access road (unnamed farm road) (in English);
    - Kenhardt Petrol Station (in Afrikaans); and
    - Kai !Garib Municipality Offices in Kenhardt (in English).

    These site notice boards have been placed for the commencement of the Basic Assessment, Scoping and EIA Processes. Therefore, three notice boards were placed for the proposed projects. A copy of the notice boards and proof of placement thereof will be included in the Scoping, Basic Assessment and EIA Reports.
- **Written Notices:**
  - During the project initiation phase, written notification letters were sent to pre-identified

I&APs (including the owner of the site, occupiers of the site (lessee), neighbouring property owners (i.e. adjacent to the site), ward councillor, and commenting authorities and key stakeholders, including (but not limited to) the local and district municipalities (i.e. Kheis Local Municipality, the Kai! Garib Local Municipality, as well as the ZF Mgcawu District Municipality), Department of Water and Sanitation, Department of Environmental and Nature Conservation (Northern Cape), SANParks, Square Kilometre Array (SKA), and Eskom). These letters were sent to notify and inform the potential I&APs of the proposed projects and invite I&APs to register on the project database. These letters regarding the commencement of the Basic Assessment, Scoping and EIA Processes were mailed to all pre-identified key stakeholders on the database (where postal, physical and email addresses were available). This letter, dated 30 July 2015, provided I&APs with a 30-day period to register their interest on the project database. Letter 1 to I&APs included a Background Information Document developed for the project as well as a Comment and Registration Form. A copy of this notice will be included in the Scoping, Basic Assessment and EIA Reports.

- During the Scoping Phase, letters will be sent to registered and pre-identified I&APs to notify them of the release of the Scoping Reports and the comment period. These letters will be sent via registered mail and/or email (where postal, physical and email addresses are available for I&APs and organs of state on the project database);
- During the combined Basic Assessment and EIA Phase, letters will also be sent to registered and pre-identified I&APs to notify them of the release of the Basic Assessment and EIA Reports and the comment period. These letters will be sent via registered mail and/or email (where postal, physical and email addresses are available for I&APs and organs of state on the project database).

- **Newspaper Adverts:**
  - During the project initiation phase, a single advertisement was placed in a local newspaper advertising the commencement of the Basic Assessment, Scoping and EIA projects (i.e. Kenhardt PV 1; Kenhardt PV 2 (i.e. **this Application for EA**); Kenhardt PV 3; Kenhardt PV 1 – Transmission Line; Kenhardt PV 2 – Transmission Line; and Kenhardt PV 3 – Transmission Line). The newspaper advertisement was placed in the Gemsbok newspaper on 29 July 2015 in order to notify and inform the public of the proposed projects and invite I&APs to register on the project database. A copy of this advertisement will be provided in the Scoping and Basic Assessment Reports.
  - During the combined Basic Assessment and EIA Phase, one advertisement will also be placed in a local newspaper to notify potential I&APs of the availability of the Basic Assessment and EIA Reports.
  - During the decision-making phase, one advertisement will also be placed in a local newspaper to notify I&APs of the outcome of the decision-making phase (should an EA be granted for the proposed projects) and associated appeal process.
  - It is not anticipated that the projects will have an impact beyond the boundary of the Local Municipality; therefore local newspapers will be used during the PPP.

Regulation 41 (2) (e) of the GN R982 states "*using reasonable alternative methods, as agreed to by the competent authority, in those instances where a person is desiring of but unable to participate in the process due to (i) illiteracy; (ii) disability; or any other disadvantage*". This particular regulation is not applicable at this stage, however it will be complied with as agreed by the Competent Authority should the need arise as part of the PPP.

General

- I&APs on the project database will be notified of the application for the proposed activities via registered mail and email (where postal, physical and email addresses are available).
- All project information throughout the Basic Assessment and EIA Processes will be made available to I&APs through a project website.
- Telephonic consultations will take place with I&APs as required. Notes of telephonic consultations

14

will be kept and included in the relevant reports. ▪ The I&AP database will be regularly updated throughout the Basic Assessment and EIA Processes to indicate, amongst others, requests to register interest, correspondence sent to I&APs and comments received from I&APs.

8. OTHER AUTHORISATIONS REQUIRED

LEGISLATION	AUTHORISATION REQUIRED		APPLICATION SUBMITTED	
SEMAs				
National Environmental Management: Air Quality Act	[redacted]	NO	[redacted]	NO
National Environmental Management: Biodiversity Act* **Note from the CSIR: Refer to explanation below**	YES	NO	[redacted]	NO
National Environmental Management: Integrated Coastal Management Act	[redacted]	NO	[redacted]	NO
National Environmental Management: Protected Areas Act* **Note from the CSIR: Refer to explanation below**	YES	NO	[redacted]	NO
National Environmental Management: Waste Act	[redacted]	NO	[redacted]	NO
National legislation				
Mineral Petroleum Development Resources Act* **Note from the CSIR: Refer to explanation below**	YES	NO	[redacted]	NO
National Water Act* **Note from the CSIR: Refer to explanation below**	YES	NO	[redacted]	NO
National Heritage Resources Act* **Note from the CSIR: Refer to explanation below**	YES	NO	[redacted]	NO
Others: Please specify	[redacted]	NO	[redacted]	NO

If authorisation is necessary in terms of the National Environmental Management: Waste Act, please contact the Department for guidance on the **Integrated Permitting System**.

Note from the CSIR: *The need for authorisation in terms of the National Environmental Management: Biodiversity Act, National Environmental Management: Protected Areas Act, Mineral Petroleum Development Resources Act, National Water Act and National Heritage Resources Act will be confirmed during the Basic Assessment and EIA Processes.

National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004)

The objective of the NEMBA is to provide for the conservation of biological diversity, regulate the sustainable use of biological resources and to ensure a fair and equitable sharing of the benefits arising from the use of genetic resources. An amendment to the NEMBA has been promulgated, which lists 225 threatened ecosystems based on vegetation types present within these ecosystems. Should a project fall within a vegetation type or ecosystem that is listed, actions in terms of NEMBA are triggered. Based on the preliminary sensitivity screening undertaken for the proposed site, none of the threatened ecosystems occur within the study area. However, this will be confirmed as part of the Ecological Impact Assessment study to be undertaken during the Basic Assessment and EIA Phase.

National Environmental Management: Protected Areas Act (NEMPA) (Act 31 of 2004)

As noted above, based on the preliminary sensitivity screening undertaken for the site, the proposed project area does not fall within any threatened ecosystems, National Protected Areas, National Protected Area Expansion Strategy Focus Areas or areas of conservation planning. The closest protected area is approximately 113 km away from the proposed project site. An Ecological Support Area (i.e. a buffer around the Hartbees River) is located approximately 14 km west of proposed project as part of the Namakwa District Biodiversity Sector Plan. However, this will be confirmed during the Basic Assessment and EIA Phase as part of the relevant specialist studies.

Mineral Petroleum Development Resources Act

The applicability of this act will be confirmed during the Basic Assessment and EIA Phase.

National Water Act (NWA) (Act 36 of 1998)

Section 21 of the NWA identifies certain land uses (e.g. activities resulting in stream-flow reduction such as afforestation and cultivation of crops), infrastructural developments (e.g. altering the bed, banks, course or characteristics of a watercourse), water supply/demand and waste disposal (from land-based activities) as 'water uses' that require authorisation (i.e. licensing) by the Department of Water and Sanitation (DWS).

Any activities that take place within a water course or within 500 m of a wetland boundary require a Water Use Licence (WUL) under the Section 21 of the NWA. The need for a WUL will be determined as part of the Ecological Impact Assessment, which will be conducted during the EIA Phase. However, it is important to note that considerable efforts will be made to place the proposed solar field and project infrastructure outside of wetland areas. The DWS will be consulted with during the EIA Process to confirm the need for a WUL, as well as to seek comment on the proposed project.

The National Heritage Resources Act (NHRA) (Act 25 of 1999)

A Heritage Impact Assessment (including Archaeology and Cultural Landscape) and a desktop Palaeontological Impact Assessment will be undertaken during the Basic Assessment and EIA Phase of the proposed project. The need for a permit in terms of the NHRA will be determined during the Basic Assessment and EIA Phase.

9. LIST OF APPENDICES

		SUBMITTED	
Appendix 1	Proof of Payment	YES	
Appendix 2	Strategic Infrastructure Projects		N/A
Appendix 3	List of Local Municipalities (with contact details)		N/A
Appendix 4	List of land owners (with contact details) and proof of notification of land owners.	YES	
Appendix 5	List of SGIDs	YES	
Appendix 6	Project map	YES	
Appendix 7	Project schedule	YES	
Appendix 8	Declaration of Applicant	YES	
Appendix 9	Declaration of EAP	YES	
Appendix 10	Applications for EA on the same property	YES	

APPENDIX 1
PROOF OF PAYMENT/ MOTIVATION FOR EXCLUSION

Standard Bank of South Africa

The Standard Bank of South Africa Limited Registered Bank Reg. No 1962/000738/06

CUSTOMER ALL PAYMENTS FINAL AUDIT REPORT

Customer No	201111965		
User ID	SCA11	User Name	SCATEC SOLAR SA 162 PTY LTD
Sub Module	SSVS	Reference	2015247001
Description	0068FIN2015VC	Action date	20150904
Finalreleasingoperators	FSD53 MARNA LANDMAN		N/A

Sub-batch 001 From Account no 000421057200 From Account Name SCATEC 162 - REVENUE

Trans No	27
Account No	1044240072
Branch No	632005
Statement Ref	29.227240 / 21.30516
Account Name	DEA
Creditor Code	
Amount	30,000.00
StatusDescription	FINAL AUDIT TO BE DOWNLOADED
RTGS/RTC	
ISN/Bus Ref	0
Pay Alert	N

DATE : 2015-09-04 14:21:00 Page : 27

17

APPENDIX 2
STRATEGIC INFRASTRUCTURE PROJECTS

Note from the CSIR: The proposed project does not form part of any of the Strategic Infrastructure Projects.

SIP 1: Unlocking the northern mineral belt with Waterberg as the catalyst
- Unlock mineral resources
- Rail, water pipelines, energy generation and transmission infrastructure
- Thousands of direct jobs across the areas unlocked
- Urban development in Waterberg - first major post-apartheid new urban centre will be a "green" development project
- Rail capacity to Mpumalanga and Richards Bay
- Shift from road to rail in Mpumalanga
- Logistics corridor to connect Mpumalanga and Gauteng.

SIP 2: Durban-Free State-Gauteng logistics and industrial corridor
- Strengthen the logistics and transport corridor between SA's main industrial hubs
- Improve access to Durban's export and import facilities
- Integrate Free State Industrial Strategy activities into the corridor
- New port in Durban
- Aerotropolis around OR Tambo International Airport.

SIP 3: South-Eastern node & corridor development
- New dam at Mzimvubu with irrigation systems
- N2-Wild Coast Highway which improves access into KwaZulu-Natal and national supply chains
- Strengthen economic development in Port Elizabeth through a manganese rail capacity from Northern Cape
- A manganese sinter (Northern Cape) and smelter (Eastern Cape)
- Possible Mthombo refinery (Coega) and transshipment hub at Ngqura and port and rail upgrades to improve industrial capacity and performance of the automotive sector.

SIP 4: Unlocking the economic opportunities in North West Province
- Acceleration of investments in road, rail, bulk water, water treatment and transmission infrastructure
- Enabling reliable supply and basic service delivery
- Facilitate development of mining, agricultural activities and tourism opportunities
- Open up beneficiation opportunities in North West Province.

SIP 5: Saldanha-Northern Cape development corridor
- Integrated rail and port expansion
- Back-of-port industrial capacity (including an IDZ)
- Strengthening maritime support capacity for oil and gas along African West Coast
- Expansion of iron ore mining production and beneficiation.

SIP 6: Integrated municipal infrastructure project

Develop national capacity to assist the 23 least resourced districts (19 million people) to address all the maintenance backlogs and upgrades required in water, electricity and sanitation bulk infrastructure. The road maintenance programme will enhance service delivery capacity thereby impacting positively on the population.

SIP 7: Integrated urban space and public transport programme

Coordinate planning and implementation of public transport, human settlement, economic and social infrastructure and location decisions into sustainable urban settlements connected by

densified transport corridors. This will focus on the 12 largest urban centres of the country, including all the metros in South Africa. Significant work is underway on urban transport integration.
SIP 8: Green energy in support of the South African economy Support sustainable green energy initiatives on a national scale through a diverse range of clean energy options as envisaged in the Integrated Resource Plan (IRP2010) and support bio-fuel production facilities. ***Indicate capacity in MW:***
SIP 9: Electricity generation to support socioeconomic development Accelerate the construction of new electricity generation capacity in accordance with the IRP2010 to meet the needs of the economy and address historical imbalances. Monitor implementation of major projects such as new power stations: Medupi, Kusile and Ingula. ***Indicate capacity in MW:***
SIP 10: Electricity transmission and distribution for all Expand the transmission and distribution network to address historical imbalances, provide access to electricity for all and support economic development. Align the 10-year transmission plan, the services backlog, the national broadband roll-out and the freight rail line development to leverage off regulatory approvals, supply chain and project development capacity.
SIP 11: Agri-logistics and rural infrastructure Improve investment in agricultural and rural infrastructure that supports expansion of production and employment, small-scale farming and rural development, including facilities for storage (silos, fresh-produce facilities, packing houses); transport links to main networks (rural roads, branch train-line, ports), fencing of farms, irrigation schemes to poor areas, improved R&D on rural issues (including expansion of agricultural colleges), processing facilities (abattoirs, dairy infrastructure), aquaculture incubation schemes and rural tourism infrastructure.
SIP 12: Revitalisation of public hospitals and other health facilities Build and refurbish hospitals, other public health facilities and revamp 122 nursing colleges. Extensive capital expenditure to prepare the public healthcare system to meet the requirements of the National Health Insurance (NHI) system. The SIP contains major builds for 6 hospitals.
SIP 13: National school build programme A national school build programme driven by uniformity in planning, procurement, contract management and provision of basic services. Replace inappropriate school structures and address basic service backlog and provision of basic services under the Accelerated School Infrastructure Delivery Initiative (ASIDI). In addition, address national backlogs in classrooms, libraries, computer labs and admin buildings. Improving the learning environment will strengthen outcomes especially in rural schools, as well as reduce overcrowding.
SIP 14: Higher education infrastructure Infrastructure development for higher education, focusing on lecture rooms, student accommodation, libraries and laboratories, as well as ICT connectivity. Development of university towns with a combination of facilities from residence, retail to recreation and transport. Potential to ensure shared infrastructure such as libraries by universities, FETs and other educational institutions. Two new universities will be built - in Northern Cape and Mpumalanga.
SIP 15: Expanding access to communication technology Provide for broadband coverage to all households by 2020 by establishing core Points of Presence (POPs) in district municipalities, extend new Infraco fibre networks across provinces linking districts, establish POPs and fibre connectivity at local level, and further penetrate the network into deep rural areas.

19

While the private sector will invest in ICT infrastructure for urban and corporate networks, government will co-invest for township and rural access, as well as for e-government, school and health connectivity.
The school roll-out focus is initially on the 125 Dinaledi (science and maths-focussed) schools and 1525 district schools. Part of digital access to all South Africans includes TV migration nationally from analogue to digital broadcasting.

SIP 16: SKA & Meerkat
SKA is a global mega-science project, building an advanced radio-telescope facility linked to research infrastructure and high-speed ICT capacity and provides an opportunity for Africa and South Africa to contribute towards global advanced science projects.

SIP 17: Regional integration for African cooperation and development
Participate in mutually beneficial infrastructure projects to unlock long-term socio-economic benefits by partnering with fast growing African economies with projected growth ranging between 3% and 10%.
The projects involving transport, water and energy also provide competitively-priced, diversified, short and medium to long-term options for the South African economy where, for example, electricity transmission in Mozambique (Cesul) could assist in providing cheap, clean power in the short-term whilst Grand Inga in the DRC is long-term.
All these projects complement the Free Trade Area (FTA) discussions to create a market of 600 million people in South, Central and East Africa.

SIP 18: Water and sanitation infrastructure
A 10-year plan to address the estimated backlog of adequate water to supply 1.4m households and 2.1m households to basic sanitation.
The project will involve provision of sustainable supply of water to meet social needs and support economic growth. Projects will provide for new infrastructure, rehabilitation and upgrading of existing infrastructure, as well as improve management of water infrastructure.

APPENDIX 3 (IF APPLICABLE)
LIST OF LOCAL MUNICIPALITIES

Note from the CSIR: The !Kheis Local Municipality is the only designated Local Authority relevant to the proposed project. However, the adjacent Kai! Garib Local Municipality, as well as the ZF Mgcawu District Municipality have been included on the project database.

APPENDIX 4
LIST OF LAND OWNERS
PROOF OF NOTIFICATION OF LAND OWNERS

Note from the CSIR: Van Niekerk Geinstrust is the only owner of the land on which the proposed project will take place (i.e. the remaining extent of Onder Rugzeer Farm 168). Since the Applicant is not the owner or the person in control of the land; proof of notice to the landowner and permission from the landowner is included in this appendix.

RESOLUTION

I / We, the undersigned ....André van Niekerk....

duly authorized by ....***Van Niekerk Gesinstrust***....

owner of property ....***Remainder Onder Rugzeer 168***....

do hereby authorize the developers of the Proposed Kenhardt PV Cluster Solar Project development, namely :

Veroniva (Pty) LTd

And / Or

Scatec Solar 163 (Pty) Ltd

Represented by **Claude Bosman** and **Etian Louw**

To:

Lodge all applications necessary in terms of the Environmental Impact Assessment (EIA) Regulations under the National Environment Management Act 1998 (Act No 107 of 1998), and in respect of any other applicable legislation for the Proposed Kenhardt PV Cluster Solar Project in respect of the above identified property;

Signed at ....Bellville.... this ....26th....day of ....August.... 2015 in the presence of the undersigned witnesses.

OWNER / REPRESENTATIVE:

....

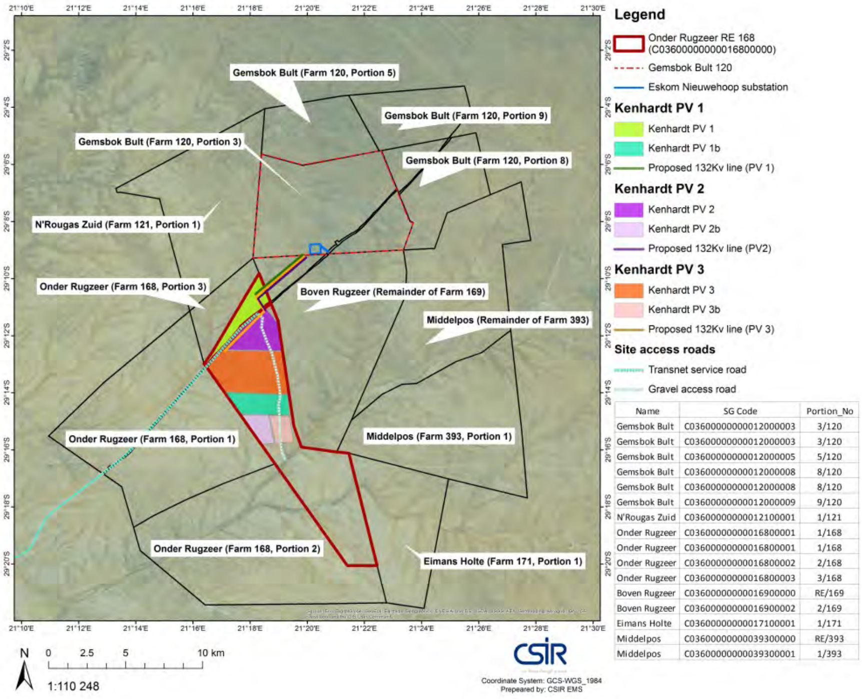
COMMISSIONER OF OATHS
PETRUS BURTON FOURIE
Advocate of the High Court of South Africa
Vineyards Square North
The Vineyards Office Estate
99 Jip de Jager Road
Bellville, Cape Town

23

APPENDIX 5 (IF APPLICABLE)
LIST OF SGIDS

Note from the CSIR: The proposed project will take place on the remaining extent of Onder Rugzeer Farm 168 and only the following Surveyor-general 21 digit site reference number applies. A map illustrating the property details relevant to the all three proposed PV projects (i.e. Kenhardt PV 1, Kenhardt PV 2 (i.e. this application) and Kenhardt PV 3); as well as adjacent properties is shown below. Please note that only ERF 168 is relevant to the proposed projects.

C	0	3	6	0	0	0	0	0	0	0	0	0	1	6	8	0	0	0	0	0
[redacted]																				
1			2			3						4						5		



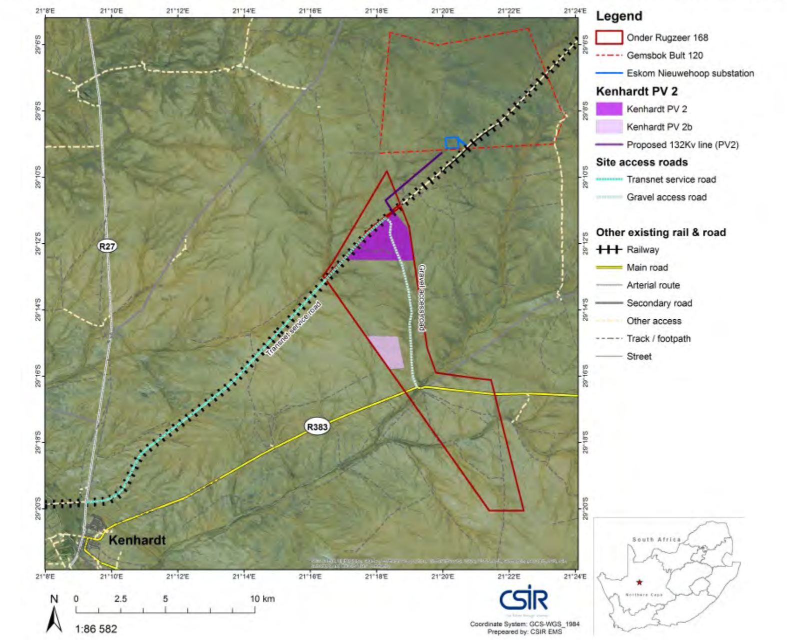
Name	SG Code	Portion_No
Gemsbok Bult	C03600000000012000003	3/120
Gemsbok Bult	C03600000000012000003	3/120
Gemsbok Bult	C03600000000012000005	5/120
Gemsbok Bult	C03600000000012000008	8/120
Gemsbok Bult	C03600000000012000008	8/120
Gemsbok Bult	C03600000000012000009	9/120
N'Rougas Zuid	C03600000000012100001	1/121
Onder Rugzeer	C03600000000016800001	1/168
Onder Rugzeer	C03600000000016800001	1/168
Onder Rugzeer	C03600000000016800002	2/168
Onder Rugzeer	C03600000000016800003	3/168
Boven Rugzeer	C03600000000016900000	RE/169
Boven Rugzeer	C03600000000016900002	2/169
Eimans Holte	C03600000000017100001	1/171
Middelpos	C03600000000039300000	RE/393
Middelpos	C03600000000039300001	1/393

25

APPENDIX 6
PROJECT MAPS

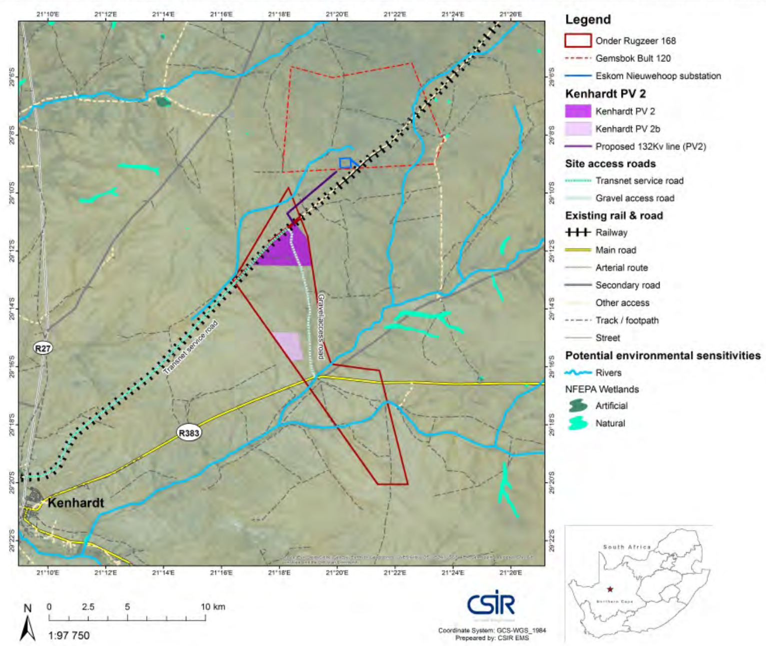
26

LOCALITY MAP SHOWING THE PREFERRED SITE FOR THE PROPOSED KENHARDT PV 2 PROJECT, AS WELL AS THE ALTERNATIVE SITE (REFERRED TO AS KENHARDT PV 2 B)



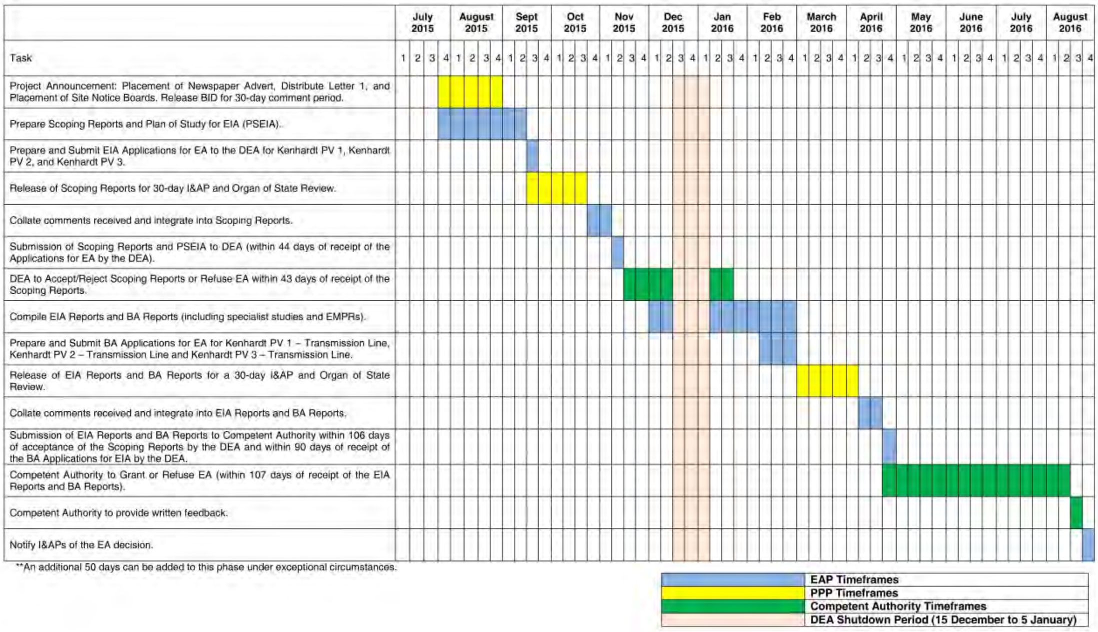
27

PROJECT MAP INDICATING SENSITIVE AREAS (WETLANDS AND RIVERS) OVERLAID BY THE STUDY AREA FOR THE PROPOSED KENHARDT PV 2 PROJECT, AS WELL AS THE ALTERNATIVE SITE (REFERRED TO AS KENHARDT PV 2 B)



28

APPENDIX 7
PROJECT SCHEDULE


July 2015
August 2015
Sept 2015
Oct 2015
Nov 2015
Dec 2015
Jan 2016
Feb 2016
March 2016
April 2016
May 2016
June 2016
July 2016
August 2016
Task
Project Announcement: Placement of Newspaper Advert, Distribute Letter 1, and Placement of Site Notice Boards. Release BID for 30-day comment period.
Prepare Scoping Reports and Plan of Study for EIA (PSEIA).
Prepare and Submit EIA Applications for EA to the DEA for Kenhardt PV 1, Kenhardt PV 2, and Kenhardt PV 3.
Release of Scoping Reports for 30-day I&AP and Organ of State Review.
Collate comments received and integrate into Scoping Reports.
Submission of Scoping Reports and PSEIA to DEA (within 44 days of receipt of the Applications for EA by the DEA).
DEA to Accept/Reject Scoping Reports or Refuse EA within 43 days of receipt of the Scoping Reports.
Compile EIA Reports and BA Reports (including specialist studies and EMPRs).
Prepare and Submit BA Applications for EA for Kenhardt PV 1 – Transmission Line, Kenhardt PV 2 – Transmission Line and Kenhardt PV 3 – Transmission Line.
Release of EIA Reports and BA Reports for a 30-day I&AP and Organ of State Review.
Collate comments received and integrate into EIA Reports and BA Reports.
Submission of EIA Reports and BA Reports to Competent Authority within 106 days of acceptance of the Scoping Reports by the DEA and within 90 days of receipt of the BA Applications for EIA by the DEA.
Competent Authority to Grant or Refuse EA (within 107 days of receipt of the EIA Reports and BA Reports).
Competent Authority to provide written feedback.
Notify I&APs of the EA decision.
**An additional 50 days can be added to this phase under exceptional circumstances.
EAP Timeframes
PPP Timeframes
Competent Authority Timeframes
DEA Shutdown Period (15 December to 5 January)

30

APPENDIX 8
DECLARATION OF THE APPLICANT

I, Mitchell Hodgson, declare that I -

- am, or represent[1], the applicant in this application;
- have appointed / will appoint (delete that which is not applicable) an environmental assessment practitioner to act as the independent environmental assessment practitioner for this application / will obtain exemption from the requirement to obtain an environmental assessment practitioner[2];
- will provide the environmental assessment practitioner and the competent authority with access to all information at my disposal that is relevant to the application;
- will be responsible for the costs incurred in complying with the Regulations, including but not limited to –
  - costs incurred in connection with the appointment of the environmental assessment practitioner or any person contracted by the environmental assessment practitioner;
  - costs incurred in respect of the undertaking of any process required in terms of the Regulations;
  - costs in respect of any fee prescribed by the Minister or MEC in respect of the Regulations;
  - costs in respect of specialist reviews, if the competent authority decides to recover costs; and
  - the provision of security to ensure compliance with conditions attached to an environmental authorisation, should it be required by the competent authority;
- will ensure that the environmental assessment practitioner is competent to comply with the requirements of the Regulations and will take reasonable steps to verify that the EAP
  - know the Act and the regulations, and how they apply to the proposed development
  - know any applicable guidelines
  - perform the work objectively, even if the findings do not favour the applicant
  - disclose all information which is important to the application and the proposed development
  - have expertise in conducting environmental impact assessments
  - complies with the Regulations
- will inform all registered interested and affected parties of any suspension of the application as well as of any decisions taken by the competent authority in this regard;
- am responsible for complying with the conditions of any environmental authorisation issued by the competent authority;
- hereby indemnify the Government of the Republic, the competent authority and all its officers, agents and employees, from any liability arising out of the content of any report, any procedure or any action which the applicant or environmental assessment practitioner is responsible for in terms of these Regulations;
- will not hold the competent authority responsible for any costs that may be incurred by the applicant in proceeding with an activity prior to obtaining an environmental authorisation or prior to an appeal being decided in terms of these Regulations;
- will perform all other obligations as expected from an applicant in terms of the Regulations;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

[1] If this is signed on behalf of the applicant, proof of such authority from the applicant must be attached.
[2] If exemption is obtained from appointing an EAP, the responsibilities of an EAP will automatically apply to the person conducting the environmental impact assessment in terms of the Regulations.

[signature]

Signature[3] of the applicant[4]/ Signature on behalf of the applicant:

Scatec Solar SA 350 (Pty) Ltd.

Name of company (if applicable):

21-09-2015

Date:

[3] Only original signatures will be accepted. No scanned, copied or faxed signatures will be accepted.
[4] If the applicant is a juristic person, a signature on behalf of the applicant is required as well as proof of such authority. An EAP may not sign on behalf of an applicant.

32

Scatec Solar
Improving our future™

Scatec Solar SA 350 (Pty) Ltd
Reg. No 2012/103589/07

21 September 2015

Resolution:

The following has been resolved by the Sole Director:

1. That Scatec Solar SA 350 (Pty) Ltd is the Applicant for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), (the Act) and the Environmental Impact Assessment Regulations, 2014 the Regulations);

2. and that Mitchell Hodgson (8602075840087) is duly authorized to represent Scatec Solar SA 350 (Pty) Ltd in such applications.

....
Marna Landman

Director.

Scatec Solar SA 350 (Pty) Ltd
Unit 109B, The Foundry
75 Prestwich Street
Green Point
Cape Town
8500.

Reg. No. 2012/103589/07

Director:
Mrs. M Landman.

APPENDIX 9
DECLARATION OF THE EAP

I, Surina Laurie declare that –

General declaration:

- I act as the independent environmental practitioner in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting environmental impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the Regulations when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence in terms of regulation 48 of the Regulations and is punishable in terms of section 24F of the Act.

Disclosure of Vested Interest (delete whichever is not applicable)

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

- ~~I have a vested interest in the proposed activity proceeding, such vested interest being:~~

____

____

____

____

Signature of the environmental assessment practitioner:

CSIR

Name of company:

29/09/2015

Date:

35

Curriculum Vitae of Surina Laurie – EAP and Project Leader

Name of firm	CSIR
Name of staff	Surina Laurie
Profession	Environmental Assessment Practitioner
Position in firm	Project Manager
Years' experience	4 years
Nationality	South African

Biographical sketch

Surina has 4 years' experience as an Environmental Assessment Practitioner (EAP). She completed both her BSc in Conservation Ecology and MPhil in Environmental Management (part-time) at the University of Stellenbosch. With her honours project, she worked closely with the Endangered Wildlife Trust Riverine Rabbit Working Group and was responsible for determining the conservation opportunity for the Riverine Rabbit in the Karoo. With this project, she gained valuable experience in how to interact and manage stakeholders in such a way that a project's objectives and conservation goals are met without the stakeholders not being included in the decision-making process. The management of stakeholders and the ability to incorporate their needs into the objectives of a project is seen as an essential component of an Environmental Impact Assessment (EIA) process.

With her Masters' thesis she researched and addressed why there is a need to undertake a Cost Benefit Analysis (CBA) as part of any EIA. The need for a CBA stems from the fact that losing environmental services will have an economic impact on a regional/national level in the long term but this is usually not considered during an EIA process. A CBA will look at both the economic benefits (profit) from a project and the economic losses because of loss of ecosystem services or rehabilitation costs. By including a CBA in an EIA, both the economic and environmental financial implications (not just the environmental significance of an impact) of a project will be considered by the decision making authority prior to the issuing of Environmental Authorisations or permits.

She has experience in undertaking Basic Assessments and Scoping and Environmental Impact Assessments for various sectors, including renewable energy, industry and tourism. She also has experience in undertaking environmental audits, due diligence assessments and the compilation of Environmental Management Programmes.

Registered Professional Natural Scientist (Pr. Sci. Nat.) in Environmental Science (Reg. No: 400033/15) with the South African Council of Natural Scientific Professions.

Education

2015 (current)	Certificate in Environmental Economics, University of London (SOAS)
2013	Project Management Course, University of Cape Town Graduate School of Business
2011-2012 (Part-time)	MPhil Environmental Management, University of Stellenbosch
2007-2010	BSc Conservation Ecology, University of Stellenbosch

Employment Record

Feb 2014 to present	CSIR, Project Manager, EAP
Sept 2011 to Jan 2014	WSP Environmental (Pty) Ltd, Environmental Consultant
Nov 2010 to Aug 2011	EnviroAfrica, Junior Environmental Consultant

Experience record *Abridged experience in Environmental Impact and Basic Assessment processes:*

Date	Project Description	Role	Client
2014 - present	Integrated Scoping and EIA process for the construction of three Photovoltaic (PV) or Concentrated Photovoltaic (CPV) Solar Facilities with a generating capacity of 75 MW each on the farms remaining extent of	Project Manager	Mulilo Renewable Project Development (Pty) Ltd

36

Date	Project Description	Role	Client
	Portion 3 of the Farm Gemsbok Bult 120 and Boven Rugzeer remaining extent of 169, located 30 km north-east of Kenhardt. Two of the projects will be located on the farm remaining extent of Portion 3 of the Farm Gemsbok Bult 120 and one on Boven Rugzeer remaining extent 169.		
2014 - present	Integrated Scoping and EIA process for the development of twelve (12) Photovoltaic (PV) or Concentrated Photovoltaic (CPV) Solar Facilities with a generating capacity of 75 MW/100MW each, near Dealesville, Free State.	Project Manager	South Africa Mainstream Renewable Power Developments (Pty) Ltd
2013-2014	Basic Assessment for the construction of three additional petroleum storage tanks at the Cape Town Harbour.	Environmental Consultant	FFS Refiners (Pty) Ltd
2013-2014	Scoping and EIA for the construction of a Sewage Package Plant on Robben Island.	Environmental Consultant	Department of Public Works
2013	Development of an EMPr for the undertaking of maintenance work on the Stilbaai Fishing Harbour's Slipway located in Stilbaai, Western Cape, South Africa. In order to be compliant to the requirements of the National Environmental Management Act (Act 107 of 1998) and Environmental Impact Assessment (EIA) Regulations, a Maintenance Management Plan (MMP) needed to be developed to manage the environmental impacts associated with maintenance work that is scheduled to be undertaken on the Stilbaai Fishing Harbour's Slipway as well as any future on-going maintenance requirements.	Environmental Consultant	Department of Public Works
2012-2014	Waste Management License for the proposed storage of Ferrous HMS 1+2, Shredded Ferrous and Bales located at the K/L Berth at Duncan Road, Port of Cape Town	Environmental Consultant	The New Reclamation Group (Pty) Ltd
2012-2014	Scoping and EIA for the construction a biodiesel refinery in the Coega Industrial Development Zone (IDZ). The proposed project entails the import of used vegetable oil from the USA and converting it through various processes to biodiesel which will be exported to Europe. The proposed project requires an Air Emissions License, a Waste Management License and Environmental Authorisation.	Environmental Consultant	FIS Biofuels (Ltd)
2013-2013	Basic Assessment for the proposed redevelopment of Berths B, C and D in Duncan Dock at the Port of Cape Town.	Assistant Environmental Consultant	FPT (Pty) Ltd
2011- 2012	Development of an EMPr for the Eerstelingsfontein Opencast Project (EOP).	Assistant Environmental Consultant	Exxaro Resources Limited
2011-2014	Basic Assessment for the proposed reinstatement of the Blue Stone Quarry located on Robben Island.	Assistant Environmental Consultant	Department of Public Works
2011	Scoping and EIA for the proposed upgrade to the Struisbaai WWTW.	Assistant Environmental Consultant	Cape Agulhas Municipality
2011	Basic Assessment for the construction of a cellular mast.	Environmental Consultant	MTN (Pty) Ltd
2010-2011	Basic Assessment for the construction of a Heritage Centre.	Environmental Consultant	Waenhuiskrans Arniston Community Development Trust
2010-2011	Scoping and EIA for the rezoning of the area from open space to residential, the construction of six residential units and the upgrading of the existing Waste Water Treatment Plant.	Environmental Consultant	Private developer

Abridged experience in undertaking the role of an Environmental Control Officer and compliance auditing:

Date	Project Description	Role	Client
2013- 2014	The proposed extension project involved the installation of five new above ground storage tanks. The two largest tanks have a tank capacity of 2,500m³ each and a height of 18m. The three smaller tanks have a tank capacity of 2,300m3, 1,350m³ and 212m³ and heights of 18m, 10.8m and 10.8m respectively, giving an additional 8862m³ storage capacity to the current FFS operation	ECO	FFS Refiners (Pty) Ltd
2012- 2014	Compliance auditing of drum re-conditioners for the used oil industry in the Western Cape.	Assistant Environmental Consultant	The Rose Foundation
2012	Environmental legal compliance auditing of various Much Asphalt sites. The audit entailed review of national, provincial legislation and municipal by-laws and a site visit in order to determine whether the sites were compliant to the relevant environmental legislation.	Environmental Consultant	Much Asphalt
2011- 2013	Construction of a new De-Ashing Plant for FFS Vissershok Construction of a De-Ashing Plant. This project involved the monthly independent audits and reports of all the environmental and social aspects of the construction phase the new De-Ashing Plant at Vissershok.	ECO	FFS Refiners (Pty) Ltd
2011- 2012	Construction of the new 1200m³ Tank at FFS Cape Town Harbour Site. This project involved two site audits per month to ensure compliance to the Environmental Authorisation and Environmental Management Plan for the proposed project.	ECO	FFS Refiners (Pty) Ltd

Language capabilities		*Speaking*	*Reading*	*Writing*
	Afrikaans	Excellent	Excellent	Excellent
	English	Excellent	Excellent	Excellent

38

APPENDIX 10:
APPLICATIONS FOR EA ON THE SAME PROPERTY

1	Competent Authority	National Department of Environmental Affairs
	Reference Number	Pending
	Project Name	Proposed development of a 75 MW Solar PV Facility (Kenhardt PV 1) on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt, Northern Cape Note that the EIA Process has commenced (as described above) and the EA is pending.
2	Competent Authority	National Department of Environmental Affairs
	Reference Number	Pending
	Project Name	Proposed development of a 75 MW Solar PV Facility (Kenhardt PV 3) on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt, Northern Cape Note that the EIA Process has commenced (as described above) and the EA is pending.
3	Competent Authority	National Department of Environmental Affairs
	Reference Number	Pending
	Project Name	Kenhardt PV 1 - Transmission Line: Proposed development of a 132 kV Transmission Line to connect to the proposed 75 MW Solar PV Facility (Kenhardt PV 1) on the remaining extent of Onder Rugzeer Farm 168 and the remaining extent of Portion 3 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape. Note that the PPP for the Basic Assessment Process has commenced (as described above) and the EA is pending. The Application for EA will be lodged separately with the DEA during the EIA Phase of Kenhardt PV 1, Kenhardt PV 2 (i.e. this application) and Kenhardt PV 3.
4	Competent Authority	National Department of Environmental Affairs
	Reference Number	Pending
	Project Name	Kenhardt PV 2 – Transmission Line: Proposed development of a 132 kV Transmission Line to connect to the proposed 75 MW Solar PV Facility (Kenhardt PV 2) on the remaining extent of Onder Rugzeer Farm 168 and the remaining extent of Portion 3 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape. Note that the PPP for the Basic Assessment Process has commenced (as described above) and the EA is pending. The Application for EA will be lodged separately with the DEA during the EIA Phase of Kenhardt PV 1, Kenhardt PV 2 (i.e. this application) and Kenhardt PV 3.
5	Competent Authority	National Department of Environmental Affairs
	Reference Number	Pending
	Project Name	Kenhardt PV 3 – Transmission Line: Proposed development of a 132 kV Transmission Line to connect to the proposed 75 MW Solar PV Facility (Kenhardt PV 3) on the remaining extent of Onder Rugzeer Farm 168, and the remaining extent of Portion 3 of Gemsbok Bult Farm 120, north-east of Kenhardt, Northern Cape. Note that the PPP for the Basic Assessment Process has commenced (as described above) and the EA is pending. The Application for EA will be lodged separately with the DEA during the EIA Phase of Kenhardt PV 1, Kenhardt PV 2 (i.e. this application) and Kenhardt PV 3.
	Please provide details of the steps taken to ascertain this information: ▪ The CSIR has been appointed by Scatec Solar (the Project Applicant), to undertake the EIA and Basic Assessments listed above.	

EIA REPORT

APPENDIX I:

DEA Correspondence

Scoping and **Environmental Impact Assessment** for the Proposed Development of a 75 MW Solar Photovoltaic Facility (KENHARDT PV 2) on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt, Northern Cape Province

Appendix I.1: Pre-Application Meeting with DEA

Agenda of the Pre-Application Meeting with DEA on 17 September 2015

CSIR
our future through science

AGENDA

PRE-APPLICATION MEETING FOR THE PROPOSED MULILO AND SCATECH SOLAR PHOTOVOLTAIC (PV) PROJECTS NEAR KENHARDT IN THE NORTHERN CAPE

DEA offices: Environment House, 473 Steve Biko, Arcadia, Pretoria

17 September 2015

11H00-13H00

Purpose of meeting:

This meeting constitutes the Pre-Application Meeting with DEA to discuss the Environmental Impact Assessments (EIAs) for the proposed Mulilo and Scatech Solar PV projects that are currently being undertaken by CSIR. The meeting is to confirm the proposed EIA processes, i.e. the Applications for Environmental Authorisation, Approaches to the Public Participation Process-, Scoping- and EIA Process, EIA Schedules and the Requirements of the Scoping and EIA processes.

Topic	Responsibility	Time
1. Welcome and Introductions	DEA (Mr Muhammad Essop/ Mr Coenrad Agenbach)	11:00 – 11:10
2. Overview of the Mulilo and Scatech PV solar projects near Kenhardt: • Background and location • Proposed EIA Approaches • Proposed Schedules • Current status of the projects	CSIR (Ms Surina Laurie and Ms Minnelise Levendal)	11:10 – 11:30
3. Questions and Discussion regarding Point 2. • Confirmation of EIA Approaches • Confirmation of Schedules	All	11:30 – 12:00
4. Questions and Discussion regarding the requirements of the Scoping and EIA processes, e.g: - • Application • Scoping requirements • EIA requirements • Alternatives • Public Participation Process	All	12:00 – 12:45
5. Way forward and Closure	DEA (Mr Muhammad Essop/ Mr Coenrad Agenbach)	12:45 – 13:00

Notes of the Pre-Application Meeting with DEA on 17 September 2015

CSIR
our future through science

MINUTES

MEETING NOTES FROM PRE-APPLICATION MEETING WITH DEA TO DISCUSS THE PROPOSED MULILO AND SCATEC SOLAR PHOTOVOLTAIC PROJECTS NEAR KENHARDT IN THE NORTHERN CAPE

17 September 2015, 11H00-13H00, DEA Office, Environment House, Pretoria

Attendance:

Name	Organisation
Herman Alberts (HA)	DEA
Mmamohale Kabasa (MK)	DEA
Minnelise Levendal (ML)	CSIR
Surina Laurie (SL)	CSIR

Apologies: Muhammad Essop (ME) (DEA) and Coenrad Agenbach (CA) (DEA) could not attend the meeting as they had to attend an internal strategy workshop.

Purpose of the meeting:

Pre-Application Meeting with DEA was requested to discuss the Environmental Impact Assessments (EIAs) for the proposed Mulilo and Scatec Solar Photovoltaic (PV projects), near Kenhardt in the Northern Cape, that are currently being undertaken by CSIR. The main aims are to discuss the EIA processes, i.e. the Applications for Environmental Authorisation, Approaches to the Public Participation Process, Scoping and EIA Processes, EIA Schedules and the Requirements of the Scoping and EIA processes under the 2014 NEMA EIA Regulations.

1. **Welcome and introductions**

   HA welcomed all participants to the meeting. The participants introduced themselves.

2. **Overview of the Scatec and Mulilo Solar Photovoltaic Projects**

   SL and ML presented an overview of the proposed projects (see Appendix 1 for the full presentation):

   - **Scatec Solar Photovoltaic (PV) Facilities near Kenhardt in the Northern Cape:**
     - Three Solar PV facilities of 75 MW each are proposed and three alternative sites.

    - Proposed Scoping and EIA Approach - Three separate Applications, three separate Scoping Reports and three separate EIA Reports will be prepared and submitted to DEA for decision-making. In addition to this, 3 separate Basic Assessment (BA) Reports for the electrical infrastructure will be prepared and submitted to DEA for decision-making.
    - One Integrated Public Participation Process (PPP) will be followed.
- **Mulilo Solar PV Facilities near Kenhardt in the Northern Cape**
    - Seven Solar PV facilities of 75 MW each are proposed and seven alternative sites.
    - Proposed Scoping and EIA Approach – Seven separate Applications, One Integrated Scoping Report and seven separate EIA Reports will be prepared and submitted to DEA for decision-making.
    - One Integrated Public Participation Process (PPP) will be followed.
    - The Mulio projects will be located within the same geographical area and the sites have the same environmental conditions or attributes. It is therefore proposed that one integrated Scoping Report be prepared and submitted to DEA for all seven projects. A similar approach was followed by CSIR for the Kentani Solar PV Project near Dealesville in the Free State which comprised 12 projects. Twelve Applications for Environmental Authorisation (EA) were submitted, one integrated Scoping Report was prepared and submitted and 12 different EIA reports were submitted to DEA for decision-making. This approach was accepted by DEA. A similar approach is therefore proposed for the seven Mulilo Solar PV Facilities near Kenhardt in the Northern Cape.

Background on the proposed Mulilo project:

- Mulilo is also undertaking another solar energy project, i.e. the Mulilo Nieuwehoop Solar Development ("Phase 1") comprising three projects. The Final EIA Reports have been submitted to the DEA in March 2015 for decision-making. These reports are currently being reviewed by the DEA and the outcomes of the applications are pending.
- The project under discussion for this meeting is the Mulilo "Phase 2" Nieuwehoop Solar Development which will occur directly adjacent to the Scatec project and on the same properties as the Mulilo Phase 1 project.

It should be noted that both projects (i.e. the Scatec and Mulilo Phase 2 Solar PV Projects) aim to have an Environmental Decision on the EA Applications by August/September 2016 to qualify for the Integrated Power Producer Procurement bidding window in 2016.

3. **Key Questions and Discussion**

CSIR question	DEA response	Action
Is the Scatec proposal to produce 3 separate Applications, 3 separate Scoping-, 3 separate EIA and 3 separate BA Reports but undertaking an integrated PPP acceptable? This would mean that there are still ultimately 6 EA decisions that would be issued by DEA.	Proposal for Scatec process/approach (i.e. to undertake separate processes for all the applications) is acceptable	CSIR to proceed with the proposed approach to submit 6 separate Applications, 3 separate BA Reports, 3 separate Scoping- and 3 separate EIA Reports, but to undertake one integrated PPP.
Is the Mulilo proposal to produce 7 separate EA Applications, an integrated Scoping Report, 7 separate EIA reports but undertaking an integrated PPP acceptable? This would mean that there are still ultimately 7 EA Decisions that would be issued by DEA.	HA indicated that it will be easier to review separate Scoping Reports for administrative reasons. HA further indicated that the 7 Applications may be assigned to more than one case officer. Recommendation from CSIR: Can we produce and submit one integrated Scoping Report, but provide DEA with multiple copies of the report for reviewing purposes? HA and MK propose to clarify this issue with ME and CA. They advised CSIR to email this query to DEA.	CSIR to send email to DEA (HA) requesting confirmation on the question. HA to discuss this question with ME and CA and provide feedback to CSIR. Feedback from ME and CA following the Pre-Application Meeting on the recommendation from CSIR to prepare one Integrated Scoping Report, but provide multiple copies of the report to DEA for reviewing purposes: No. Seven separate applications must be submitted. This must be followed by 7 separate Scoping Reports and 7 separate EIA Reports. Specialist studies must be included in the Scoping Report and this must be site specific. Note that the Scoping Report is either accepted or the Application for EA is refused. This has implications for all 7 applications if 1 scoping report is submitted.

CSIR question	DEA response	Action
Is it acceptable to release Scoping Report for comment (30 days) prior to submitting the Application for EA to DEA? Can the Application for EA and Scoping Report be submitted simultaneously to DEA after commenting period?	This approach is acceptable. -30 day PPP can be done prior to submitting the Application for EA to DEA. -It is advisable to do most of the work upfront to meet the strict timeframes. -DEA will comment on the Draft Scoping Report within the prescribed timeframe. Provided that an application has been submitted to the DEA. -Once the EA Application is submitted, the EAP has 44 days to submit the draft Scoping Report that has been subjected to Public Participation for at least 30 days. Within that timeframe there is a 30-day period for DEA to review and comment on the Draft Scoping Report, leaving 14 days for EAP to submit Final Scoping Report incorporating/addressing comments from DEA. - It is however important to note that EAP should not submit Scoping Report to DEA without an Application Form, otherwise it will not be processed.	
What level of detail is required in the site assessment matrix and the assessment of alternatives that need to be included in the Scoping Report under the new 20104 NEMA EIA Regulations? How do we screen	EAP can list advantages and disadvantages of the alternatives to identify the most feasible or preferred alternative/s in the Scoping Phase. EAP can assess alternatives in Scoping Report and motivate for the most preferred alternative/s to be taken forward into	Feedback from ME and CA following the Pre-Application Meeting: Specialist studies to be included with the Scoping Report.

CSIR question	DEA response	Action
alternatives in the Scoping Phase as it was normally assessed by the specialists in the EIA Phase under the 2010 EIA Regulations.	the EIA phase. The specialists to undertake assessments of the preferred alternative/s in EIA phase of the project. Ideally the EAP needs to scope out all possible alternatives during the Scoping Phase and only take forward preferred alternatives in the EIA phase. DEA may authorise any of the alternative/s assessed in the EIA, therefore it is imperative that only reasonable and feasible alternatives be taken forward into the EIA Phase.	
If Scoping Report is refused, do you re-start the whole Application Process (i.e. paying the application fee, undertaking the PPP again?)	The Scoping Report is either accepted or the Application for EA is refused. Upon receipt of the Scoping Report DEA will acknowledge receipt and will comment on the Scoping Report (e.g. request any outstanding information). Should the Application for EA be refused, the Applicant will need to wait for the appeals process to conclude and can than re-apply including payment, undertake the PPP again. An amended Scoping Report must be submitted to DEA addressing all initial issues.	
Scatec proposes to make use of borrow pits, thus they require a mining permit. Is the Department of Mineral Resources (DMR) the Competent Authority to approve this activity or can this listed activity be approved by DEA as	HA and MK propose to clarify this issue with ME and CA. They advised CSIR to email this query to DEA.	CSIR to send email to DEA (HA) requesting confirmation on the question. HA to discuss this question with ME and CA and provide feedback to CSIR.

Page 5 of 8

CSIR question	DEA response	Action
part of the EIA process?		Feedback from DEA following the Pre-Application Meeting: Please note that the DMR is the CA to approve the activity relating to the borrow pits.
Can one Application for EA be split into separate Environmental Authorisations? The CSIR is of the opinion that Regulation 25 (2) of the NEMA EIA Regulations makes provision for the Competent Authority to issue a single or multiple Environmental Authorisations in terms of an Application. The CSIR would like to understand under what scenarios can this provision in the Regulations be implemented.	DEA to confirm whether this interpretation is correct, and if not provide the correct interpretation to clarify how this regulation can be applied. HA and MK propose to clarify this issue with ME and CA. They advised CSIR to email this query to DEA.	CSIR to send email to DEA (HA) requesting confirmation on the question. HA to discuss this question with ME and CA and provide feedback to CSIR. Feedback from ME and CA following the Pre-Application Meeting: This applies to projects previously approved.
Regulation 21 (1) states that if a S&EIR must be applied to an application, the applicant must, within 44 days of receipt of the application by the CA, submit to the CA a Scoping Report which has been subjected to a PPP of at least 30 days and which reflects the incorporation of comments received, including any comments from the CA. What is the best way to reflect the comments received in the Scoping Report that will be submitted to the DEA? If there are no substantial comments requiring amendments to the report, then can a separate appendix be	This approach is acceptable. It must be noted that all questions and issues raised during the PPP must be addressed and included in the Report prior to submission of the Report to DEA.	

Page 6 of 8

CSIR question	DEA response	Action
compiled, noting all the comments received during the 30-day review of the Consultation Scoping Report and appropriate responses from the EAP. The appendix will also note the PPP undertaken for the release of the Consultation Scoping Report. This separate appendix will then be submitted to the DEA with the Scoping Report for decision-making. It is planned to only provide copies of this appendix and Scoping Report to the DEA (and not to I&APs via courier or library).		

- **Recommendations from DEA on the EIA process following queries from CSIR:**

  - CSIR to submit separate EA Applications for each project.
  - Make sure that you have all the information before starting with the EIA process.
  - If timeframes under the 2014 NEMA EIA Regulations are not met, the Application will lapse and a new Application for EA would need to be submitted.
  - Letters should be distributed to Interested and Affected Parties (I&APs) via registered mail.
  - The commenting period starts on the date that the Application or Report is received by DEA. CSIR does not have to wait for a letter of acknowledgement of receipt. DEA will try to email the letter of acknowledgement to the EAP and Applicant on the same day of receipt or the following day, but delays may occur.
  - 2010 NEMA EIA Regulations allowed possibility of downgrading of EIA to BA with motivation. There is no provision for this under the 2014 NEMA EIA Regulations.
  - Environmental Authorisation issued under the 2010 NEMA Regulations will follow Appeal Process prescribed under the 2010 NEMA Regulations.
  - Background Information of project desirability should be project specific and avoid generalising to South Africa.
  - DEA advises that the necessary specialist studies be undertaken (e.g. Radio Frequency Interference (RFI) as the projects are located in close proximity to the Square Kilometre Array (SKA) Project.
  - DEA encourages that most of the work should be done upfront to adhere to timeframes.
  - Pre-Application Meetings are useful and assist undertaking efficient Application process.
  - CSIR to send Scoping and EIA Reports to DEA Biodiversity Directorate for comment.
  - DEA will provide comments on the Scoping Report. CSIR to take these comments into consideration when preparing the final Scoping Report or EIA Report. CSIR can motivate if comments are not relevant to specific project.
  - Applicant to make sure that only reasonable and feasible project developments are presented in the EIA Report. DEA may approve any one of these options, and not necessarily the preferred alternative proposed by the EAP or Applicant.

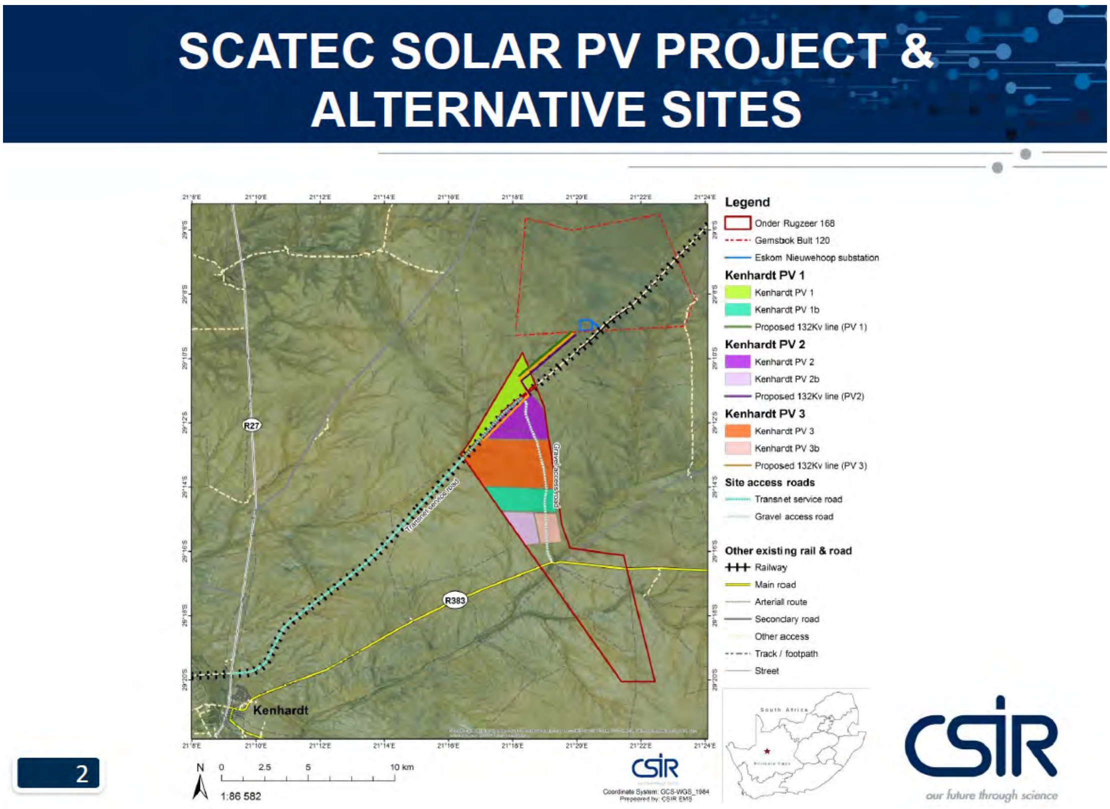
4. Way forward and Closure

- ML to draft an email to HA and MK (and copy ME and CA) to seek clarity on issues that could not be finalised at the meeting. HA and MK will then discuss these issues further with ME and CA and provide feedback to CSIR.
- ML and SL to draft the meeting notes and send to DEA for approval and sign-off.
- HA re-iterated that CSIR should not hesitate to contact or request meetings with the DEA case officer/s if they have queries regarding the EIA processes.
- The meeting notes must be included in the Scoping and EIA Reports.

ML and SL thanked DEA for the opportunity to meet with them and for providing feedback on the queries relating to the Scoping and EIA approaches and processes currently being undertaken by CSIR under the 2014 NEMA EIA Regulations for the proposed Mulilo and Scatec Solar PV Facilities near Kenhardt in the Northern Cape.

THE MEETING ADJOURNED AT 12H30.

CSIR Presentation given at the Pre-Application Meeting with DEA on 17 September 2015



SCATEC SOLAR EIA PROCESSES

- Three (3) EIA Applications
- Three (3) BA Applications for the electrical infrastructure

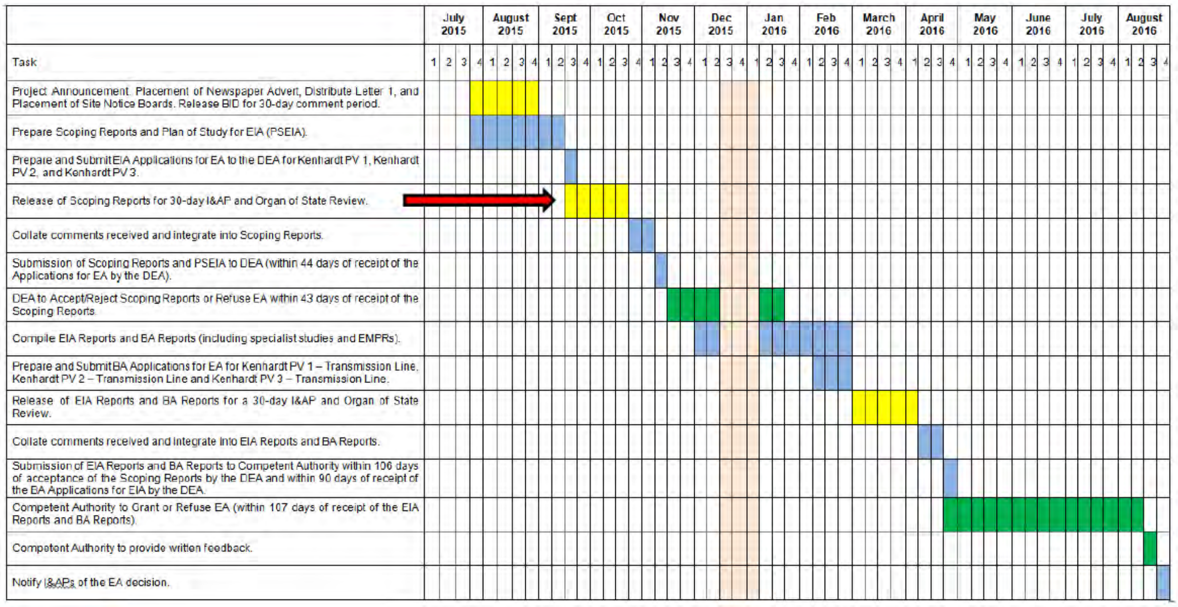
Scoping and EIA Processes: Proposed 75 MW Solar PV Facilities	Basic Assessment Processes: Proposed 132 kV Transmission Lines
• Kenhardt PV 1 • Kenhardt PV 2 • Kenhardt PV 3	• Kenhardt PV 1 – Transmission Line • Kenhardt PV 2 – Transmission Line • Kenhardt PV 3 – Transmission Line

- Three separate Scoping Reports
- Three separate EIA Reports
- Three separate BA Reports
- Six separate Environmental Decisions

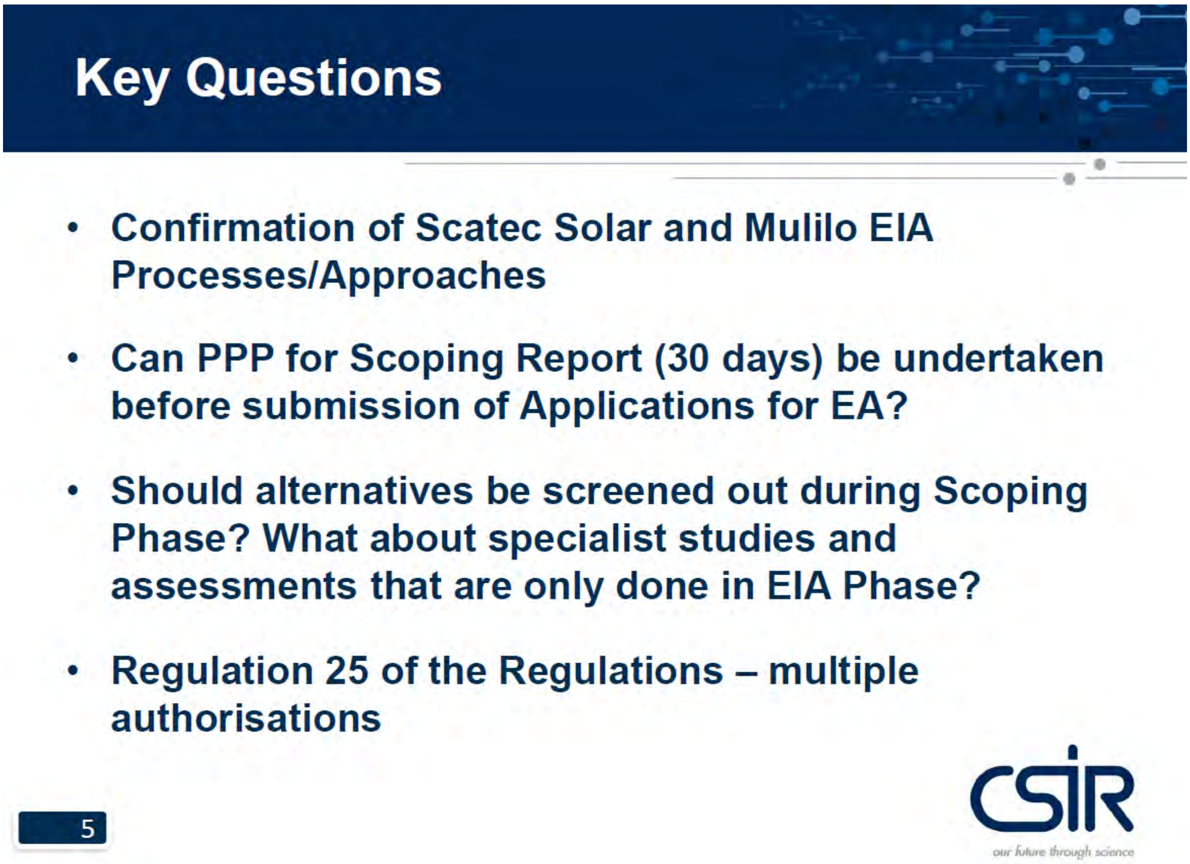
3

CSIR
our future through science

SCATEC PROJECT SCHEDULE



4


Key Questions
• Confirmation of Scatec Solar and Mulilo EIA Processes/Approaches
• Can PPP for Scoping Report (30 days) be undertaken before submission of Applications for EA?
• Should alternatives be screened out during Scoping Phase? What about specialist studies and assessments that are only done in EIA Phase?
• Regulation 25 of the Regulations – multiple authorisations
5
CSIR
our future through science


FURTHER QUESTIONS AND DISCUSSION
THANK YOU!
CSIR
our future through science
Minnelise Levendal (mlevendal@csir.co.za)
Surina Laurie (slaurie@csir.co.za)

Appendix I.2: DEA Acknowledgement of Receipt of Application for EA and Scoping Report for Comment

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Private Bag X 447 · PRETORIA · 0001 · Environment House · 473 Steve Biko Road, Arcadia · PRETORIA

DEA Reference: 14/12/16/3/3/2/838
Enquiries: Ms Julliet Mahlangu
Tel: 012 399 9320 **E-mail:** JMMahlangu@environment.gov.za

Surina Laurie
Council for Scientific and Industrial Research
P O BOX 320
STELLENBOSCH
7599

Tel: (021) 888 2490
Email: SLaurie@csir.co.za

PER EMAIL / MAIL

Dear Surina Laurie

ACKNOWLEDGEMENT OF RECEIPT OF A NEW APPLICATION FOR ENVIRONMENTAL AUTHORISATION (SCOPING PROCESS) AND A DRAFT SCOPING REPORT FOR THE PROPOSED DEVELOPMENT OF A 75 MW SOLAR PHOTOVOLTAIC FACILITY (KENHARDT PV 2) ON THE REMAINING EXTENT OF ONDER RUGZEER FARM 168, NORTH-EAST OF KENHARDT, NORTHERN CAPE PROVINCE

The Department confirms having received the application for environmental authorisation and the Draft Scoping report for the abovementioned project on 02 October 2015. You have submitted these documents to comply with the Environmental Impact Assessment Regulations, 2014.

Further note that in terms of regulation 45 of the EIA Regulations, 2014 this application will lapse if the applicant fails to meet any of the time-frames prescribed in terms of these Regulations, unless an extension has been granted in terms of regulation 3(7).

You are hereby reminded of Section 24F of the National Environmental Management Act, Act No 107 of 1998, as amended, that no activity may commence prior to an environmental authorisation being granted by the Department.

Yours sincerely

Soobramany

Mr Sabelo Malaza
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs:
Letter signed by: Ms Senisha Soobramany
Designation: Control Environmental Officer (Grade A): Integrated Environmental Authorisations
Date: 23 October 2015

CC:	Mitchell Hodgson	Scatec Solar SA 350 (PTY)	Email: Mitchell.hodgson@scatecsolar.com
	A Yahphi	Department of Nature Conservation	Email:nyaphi@ncpg.gov.za

Appendix I.3: DEA Acknowledgement of Receipt of finalised Scoping Report for Decision-Making

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Private Bag X 447· PRETORIA · 0001· Environmental House · 473 Steve Biko Road · PRETORIA
Tel (+ 27 12) 399 9972

DEA References: 14/12/16/3/3/2/836
: 14/12/16/3/3/2/837
: 14/12/16/3/3/2/838
Enquiries: Muhammad Essop
Tel: 012 399 9406 **E-mail:** MEssop@environment.gov.za

Surina Laurie
Council for Scientific and Industrial Research
P O BOX 320
STELLENBOSCH
7599

Tel: (021) 888 2490
Email: SLaurie@csir.co.za

PER EMAIL / MAIL

Dear Surina Laurie

ACKNOWLEDGEMENT OF RECEIPT OF THE FINAL SCOPING REPORTS FOR THE PROPOSED DEVELOPMENT OF THREE SOLAR PHOTOVOLTAIC (PV) FACILITIES (KENHARDT PV1, KENHARDT PV2 AND KENHARDT PV3) ON THE REMAINING EXTENT OF ONDER RUGZEER FARM 168, NORTH-EAST OF KENHARDT, NORTHERN CAPE PROVINCE

The Department confirms having received the Final Scoping Reports dated 11 November 2015 for the above-mentioned project on 12 November 2015.

You are hereby reminded that the activity may not commence prior to an environmental authorisation being granted by the Department.

Yours sincerely

Soobramany

Mr Sabelo Malaza
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs
Letter signed by: Ms Senisha Soobramany
Designation: Control Environmental Officer (Grade A): Coordination and Strategic Planning and Support
Date: 23 November 2015

Appendix I.4: DEA Acceptance of finalised Scoping Report

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

Private Bag X 447· PRETORIA · 0001· Environment House · 473 Steve Biko Road · Arcadia · PRETORIA
Tel (+ 27 12) 399 9372

DEA Reference: 14/12/16/3/3/2/838
Enquiries: Mr Herman Alberts
Telephone: (012) 399 9371 **E-mail:** HAlberts@environment.gov.za

Ms Surina Laurie
Council for Scientific and Industrial Research
PO Box 320
STELLENBOSCH
7599

Telephone Number: (021) 888 2490
Email: SLaurie@csir.co.za

PER EMAIL / MAIL

Dear Ms Laurie

ACCEPTANCE OF THE SCOPING REPORT FOR THE PROPOSED DEVELOPMENT OF A 75 MW SOLAR PHOTOVOLTAIC FACILITY (KENHARDT PV 2) ON THE REMAINING EXTENT OF ONDER RUGZEER FARM 168, NORTH-EAST OF KENHARDT, NORTHERN CAPE PROVINCE

The Scoping Report (SR) and Plan of Study for Environmental Impact Assessment (PoSEIA) dated November 2015 and received by this Department on 12 November 2015 refer.

This Department has evaluated the submitted SR and the PoSEIA dated November 2015 and is satisfied that the documents comply with the minimum requirements of the Environmental Impact Assessment (EIA) Regulations, 2014. The SR is hereby accepted by the Department in terms of Regulation 22 (a) of the EIA Regulations, 2014.

You may proceed with the Environmental Impact Assessment process in accordance with the tasks contemplated in the PoSEIA and the requirements of the EIA Regulations, 2014.

All comments and recommendations made by all stakeholders and Interested and Affected Parties (I&APs) in the draft SR and submitted as part of the SR must be taken into consideration when preparing an Environmental Impact Assessment report (EIAr) in respect of the proposed development. Please ensure that all mitigation measures and recommendations in the specialist studies are addressed and included in the final EIAr and Environmental Management Programme (EMPr).

Please ensure that comments from all relevant stakeholders are submitted to the Department with the final EIAr. This includes but is not limited to the Northern Cape Department of Environment and Nature Conservation, the Department of Agriculture, Forestry and Fisheries (DAFF) and the provincial Department of Agriculture, the South African Civil Aviation Authority (SACAA), the Department of Transport, the Kagisano-Molopo Local Municipality, the Dr Ruth Segomotsi Mompati District Municipality, the Department of Water and Sanitation (DWS), the Department of Communications, Eskom Holdings SOC Limited, the South African National Roads Agency Limited (SANRAL), the South African Heritage Resources Agency (SAHRA), EWT, BirdLife SA, the Department of Mineral Resources, the Department of Rural Development and Land Reform, the Department of Environmental Affairs: Directorate Biodiversity and Conservation and the Square Kilometre Array (SKA).

Please be advised that the contact person for renewable projects at the SKA office is Dr Adrian Tiplady and he can be contacted on Tel: (011) 442 2434 or E-mail: atiplady@ska.ac.za.

Please ensure that the EIAr and EMPr comply with Appendix 3 and Appendix 4 of the EIA Regulation 2014, before submission to the Department. You are also required to address all issues raised by organs of state and I&APs prior to the submission of the EIAr to the Department.

Proof of correspondence with the various stakeholders must be included in the EIAr. Should you be unable to obtain comments, proof should be submitted to the Department of the attempts that were made to obtain comments.

In addition, the following additional information is required for the EIAr:

i. This Department requests the EAP familiarise themselves with the requirements with Appendix 3 of GNR 982 of the EIA Regulations, 2014 and ensure that the final EIAr submitted to this Department for consideration meets the requirements in terms of the assessment and providing mitigation measures of the impacts on the preferred sites.

ii. Clarity must be provided regarding GN R.983 Item 9 (i) or (ii) and GN R.983 Item 10 (i) or (ii). An amended application must be submitted.

iii. The EIAr must include the following:
   - GN R.983 Item 19: With regards to infilling and excavation of watercourses for the construction of the PV Solar Energy facility, this Department requires the applicant to provide an indication of the preferred and alternate locations from which the material used for infilling will be sourced and where excavated material will be stored and/or disposed of. In addition, the impacts associated with this activity must be adequately assessed in the EIAr.

iv. The EIAr must provide an assessment of the impacts and mitigation measures for each of the listed activities applied for.

v. It is imperative that the relevant authorities are continuously involved throughout the EIAr process.

vi. The listed activities represented in the EIAr and the application form must be the same and correct.

vii. It is noted that no activity under GN R 985 is being applied for. However, should they at a later stage be found to be applicable, an amended application form as well as written comments must be obtained and submitted to this Department confirming their applicability to the proposed development. In addition, a graphical representation of the proposed development within the respective geographical areas must be provided.

viii. The Social Impact Assessment to be compiled by CSIR as indicated in the final SR must be peer reviewed by an external specialist.

ix. The EIAr must provide the technical details for the proposed facility in a table format as well as their description and/or dimensions. A sample for the minimum information required is listed under point 2 of the EIA information required for solar energy facilities below.

x. The EIAr must provide the four corner coordinate points for the proposed development site (note that if the site has numerous bend points, at each bend point coordinates must be provided) as well as the start, middle and end point of all linear activities.

xi. The EIAr must provide the final detailed EMPr and final detailed layout plan with the information as requested in this letter.

xii. The EIAr must provide the following:
   - Clear indication of the envisioned area for the proposed solar energy facility; i.e. placing of photovoltaic panels and all associated infrastructure should be mapped at an appropriate scale.
   - Clear description of all associated infrastructure. This description must include, but is not limited to the following:
     - Power lines;
     - Internal roads infrastructure; and;
     - All supporting onsite infrastructure such as laydown area, guard house and control room etc.

2

- All necessary details regarding all possible locations and sizes of the proposed satellite substation and the main substation.

xiii. The EIAr must also include a comments and response report in accordance with Appendix 3 of the EIA Regulations, 2014.

xiv. The EIAr must include the detail inclusive of the PPP in accordance with Regulation 41 of the EIA Regulations.

xv. Details of the future plans for the site and infrastructure after decommissioning in 20-30 years and the possibility of upgrading the proposed infrastructure to more advanced technologies.

xvi. Information on services required on the site, e.g. sewage, refuse removal, water and electricity. Who will supply these services and has an agreement and confirmation of capacity been obtained? Proof of these agreements must be provided.

xvii. The EIAr must provide a detailed description of the need and desirability, not only providing motivation on the need for clean energy in South Africa of the proposed activity. The need and desirability must also indicate if the proposed development is needed in the region and if the current proposed location is desirable for the proposed activity compared to other sites.

xviii. A copy of the final site layout map and alternatives. All available biodiversity information must be used in the finalisation of the layout map. Existing infrastructure must be used as far as possible e.g. roads. The layout map must indicate the following:
- PV positions and its associated infrastructure;
- Permanent laydown area footprint;
- Internal roads indicating width (construction period width and operation period width) and with numbered sections between the other site elements which they serve (to make commenting on sections possible);
- Wetlands, drainage lines, rivers, stream and water crossing of roads and cables indicating the type of bridging structures that will be used;
- The location of sensitive environmental features on site e.g. CBAs, heritage sites, wetlands, drainage lines etc. that will be affected by the facility and its associated infrastructure;
- Substation(s) and/or transformer(s) sites including their entire footprint;
- Connection routes (including pylon positions) to the distribution/transmission network;
- All existing infrastructure on the site, especially roads;
- Buffer areas;
- Buildings, including accommodation; and
- All "no-go" areas.

xix. An environmental sensitivity map indicating environmental sensitive areas and features identified during the EIA process.

xx. A map combining the final layout map superimposed (overlain) on the environmental sensitivity map.

xxi. A shapefile of the preferred development layout/footprint must be submitted to this Department. The shapefile must be created using the Hartebeesthoek 94 Datum and the data should be in Decimal Degree Format using the WGS 84 Spheroid. The shapefile must include at a minimum the following extensions i.e. .shp; .shx; .dbf; .prj; and, .xml (Metadata file). If specific symbology was assigned to the file, then the .avl and/or the .lyr file must also be included. Data must be mapped at a scale of 1:10 000 (please specify if an alternative scale was used). The metadata must include a description of the base data used for digitizing. The shapefile must be submitted in a zip file using the EIA application reference number as the title. The shape file must be submitted to:

Postal Address:
Department of Environmental Affairs
Private Bag X447
Pretoria
0001

Physical address:
Environment House
473 Steve Biko Road
Pretoria

For Attention: Muhammad Essop
Integrated Environmental Authorisations
Strategic Infrastructure Developments
Telephone Number: (012) 399 9406
Email Address: MEssop@environment.gov.za

The Environmental Management Programme (EMPr) to be submitted as part of the EIAr must include the following:

i. All recommendations and mitigation measures recorded in the EIAr and the specialist studies conducted.
ii. The final site layout map.
iii. Measures as dictated by the final site layout map and micro-siting.
iv. An environmental sensitivity map indicating environmental sensitive areas and features identified during the EIA process.
v. A map combining the final layout map superimposed (overlain) on the environmental sensitivity map.
vi. An alien invasive management plan to be implemented during construction and operation of the facility. The plan must include mitigation measures to reduce the invasion of alien species and ensure that the continuous monitoring and removal of alien species is undertaken.
vii. A plant rescue and protection plan which allows for the maximum transplant of conservation important species from areas to be transformed. This plan must be compiled by a vegetation specialist familiar with the site and be implemented prior to commencement of the construction phase.
viii. A re-vegetation and habitat rehabilitation plan to be implemented during the construction and operation of the facility. Restoration must be undertaken as soon as possible after completion of construction activities to reduce the amount of habitat converted at any one time and to speed up the recovery to natural habitats.
ix. An open space management plan to be implemented during the construction and operation of the facility.
x. A traffic management plan for the site access roads to ensure that no hazards would result from the increased truck traffic and that traffic flow would not be adversely impacted. This plan must include measures to minimize impacts on local commuters e.g. limiting construction vehicles travelling on public roadways during the morning and late afternoon commute time and avoid using roads through densely populated built-up areas so as not to disturb existing retail and commercial operations.
xi. A transportation plan for the transport of components, main assembly cranes and other large pieces of equipment.
xii. A storm water management plan to be implemented during the construction and operation of the facility. The plan must ensure compliance with applicable regulations and prevent off-site migration of contaminated storm water or increased soil erosion. The plan must include the construction of appropriate design measures that allow surface and subsurface movement of water along drainage lines so as not to impede natural surface and subsurface flows. Drainage measures must promote the dissipation of storm water run-off.
xiii. A fire management plan to be implemented during the construction and operation of the facility.
xiv. An erosion management plan for monitoring and rehabilitating erosion events associated with the facility. Appropriate erosion mitigation must form part of this plan to prevent and reduce the risk of any potential erosion.
xv. An effective monitoring system to detect any leakage or spillage of all hazardous substances during their transportation, handling, use and storage. This must include precautionary measures to limit the possibility of oil and other toxic liquids from entering the soil or storm water systems.

xvi. Measures to protect hydrological features such as streams, rivers, pans, wetlands, dams and their catchments, and other environmental sensitive areas from construction impacts including the direct or indirect spillage of pollutants.

The EAP must provide detailed motivation if any of the above requirements is not required by the proposed development and not included in the EMPr.

The EIAr must include a **cumulative impact assessment** of the facility since there are other similar facilities in the region. The specialist studies e.g. biodiversity, visual, noise, avifauna etc. must also assess the facility in terms of potential cumulative impacts. The specialist studies as outlined in the PoSEIA which is incorporated as part of the SR must also assess the facility in terms of potential cumulative impacts.

Please ensure that all the relevant Listing Notice activities are applied for, that the Listing Notice activities applied for are specific and that they can be linked to the development activity or infrastructure in the project description.

You are hereby reminded that should the EIAr fail to comply with the requirements of this acceptance letter, a negative environmental authorisation will be issued.

The applicant is hereby reminded to comply with the requirements of Regulation 45 with regard to the time period allowed for complying with the requirements of the Regulations, and Regulations 43 and 44 with regard to the allowance of a comment period for interested and affected parties on all reports submitted to the competent authority for decision-making. The reports referred to are listed in Regulation 43(1).

Furthermore, it must be reiterated that, should an application for Environmental Authorisation be subject to the provisions of Chapter II, Section 38 of the National Heritage Resources Act, Act 25 of 1999, then this Department will not be able to make nor issue a decision in terms of your application for Environmental Authorisation pending a letter from the pertinent heritage authority categorically stating that the application fulfils the requirements of the relevant heritage resources authority as described in Chapter II, Section 38(8) of the National Heritage Resources Act, Act 25 of 1999. Comments from SAHRA and/or the provincial department of heritage must be provided in the EIAr.

You are requested to submit two (2) electronic copies (CD/DVD and two (2) hard copies of the EIAr to the Department as per Regulation 23(1) of the EIA Regulations, 2014.

Please also find attached information that must be used in the preparation of the EIAr. This will enable the Department to speedily review the EIAr and make a decision on the application.

You are hereby reminded of Section 24F of the National Environmental Management Act, Act No 107 of 1998, as amended, which stipulates that no activity may commence prior to an Environmental Authorisation being granted by the Department.

Yours faithfully

Mr Sabelo Malaza
Chief Director: Integrated Environmental Authorisations
Department of Environmental Affairs
Letter Signed by: Mr Coenrad Agenbach
Designation: Deputy Director: Strategic Infrastructure Developments
Date 08/12/2015

cc:	Mitchell Hodgson	Scatec Solar SA 330 (Pty) Ltd	E-mail: Mitchell.hodgson@scatecsolar.com
	A Yahphi	NC: DENC	E-mail: nyaphi@ncpg.gov.za

A. EIA INFORMATION REQUIRED FOR SOLAR ENERGY FACILITIES

1. General site information

The following general site information is required:

- Descriptions of all affected farm portions
- 21 digit Surveyor General codes of all affected farm portions
- Copies of deeds of all affected farm portions
- Photos of areas that give a visual perspective of all parts of the site
- Photographs from sensitive visual receptors (tourism routes, tourism facilities, etc.)
- Solar plant design specifications including:
  - Type of technology
  - Structure height
  - Surface area to be covered (including associated infrastructure such as roads)
  - Structure orientation
  - Laydown area dimensions (construction period and thereafter)
  - Generation capacity
- Generation capacity of the facility as a whole at delivery points

This information must be indicated on the first page of the EIAr. It is also advised that it be double checked as there are too many mistakes in the applications that have been received that take too much time from authorities to correct.

2. Sample of technical details for the proposed facility

Component	Description / dimensions
Height of PV panels	
Area of PV Array	
Number of inverters required	
Area occupied by inverter / transformer stations / substations	
Capacity of on-site substation	
Area occupied by both permanent and construction laydown areas	
Area occupied by buildings	
Length of internal roads	
Width of internal roads	
Proximity to grid connection	
Height of fencing	
Type of fencing	

3. Site maps and GIS information

Site maps and GIS information should include at least the following:

- All maps/information layers must also be provided in ESRI Shapefile format
- All affected farm portions must be indicated
- The exact site of the application must be indicated (the areas that will be occupied by the application)
- A status quo map/layer must be provided that includes the following:
  - Current use of land on the site including:
    - Buildings and other structures

- Agricultural fields
- Grazing areas
- Natural vegetation areas (natural veld not cultivated for the preceding 10 years) with an indication of the vegetation quality as well as fine scale mapping in respect of Critical Biodiversity Areas and Ecological Support Areas
- Critically endangered and endangered vegetation areas that occur on the site
- Bare areas which may be susceptible to soil erosion
- Cultural historical sites and elements

➢ Rivers, streams and water courses
➢ Ridgelines and 20m continuous contours with height references in the GIS database
➢ Fountains, boreholes, dams (in-stream as well as off-stream) and reservoirs
➢ High potential agricultural areas as defined by the Department of Agriculture, Forestry and Fisheries
➢ Buffer zones (also where it is dictated by elements outside the site):
- 500m from any irrigated agricultural land
- 1km from residential areas

➢ Indicate isolated residential, tourism facilities on or within 1km of the site

- A slope analysis map/layer that include the following slope ranges:
  ➢ Less than 8% slope (preferred areas for PV and infrastructure)
  ➢ between 8% and 12% slope (potentially sensitive to PV and infrastructure)
  ➢ between 12%and 14% slope (highly sensitive to PV and infrastructure)
  ➢ steeper than 18 % slope (unsuitable for PV and infrastructure)
- A site development proposal map(s)/layer(s) that indicate:
  ➢ Foundation footprint
  ➢ Permanent laydown area footprint
  ➢ Construction period laydown footprint
  ➢ Internal roads indicating width (construction period width and operation period width) and with numbered sections between the other site elements which they serve (to make commenting on sections possible)
  ➢ River, stream and water crossing of roads and cables indicating the type of bridging structures that will be used
  ➢ Substation(s) and/or transformer(s) sites including their entire footprint.
  ➢ Cable routes and trench dimensions (where they are not along internal roads)
  ➢ Connection routes to the distribution/transmission network (the connection must form part of the EIA even if the construction and maintenance thereof will be done by another entity such as ESKOM)
  ➢ Cut and fill areas at PV sites along roads and at substation/transformer sites indicating the expected volume of each cut and fill
  ➢ Borrow pits
  ➢ Spoil heaps (temporary for topsoil and subsoil and permanently for excess material)
  ➢ Buildings including accommodation

With the above information authorities will be able to assess the strategic and site impacts of the application.

4. Regional map and GIS information

The regional map and GIS information should include at least the following:

- All maps/information layers must also be provided in ESRI Shapefile format
- The map/layer must cover an area of 20km around the site
- Indicate the following:
  ➢ roads including their types (tarred or gravel) and category (national, provincial, local or private)

7

- Railway lines and stations
- Industrial areas
- Harbours and airports
- Electricity transmission and distribution lines and substations
- Pipelines
- Waters sources to be utilised during the construction and operational phases
- A visibility assessment of the areas from where the facility will be visible
- Critical Biodiversity Areas and Ecological Support Areas
- Critically Endangered and Endangered vegetation areas
- Agricultural fields
- Irrigated areas
- An indication of new road or changes and upgrades that must be done to existing roads in order to get equipment onto the site including cut and fill areas and crossings of rivers and streams

5. Important stakeholders

Amongst other important stakeholders, comments from the National Department of Agriculture, Forestry and Fisheries must be obtained and submitted to the Department. Any application, documentation, notification etc. should be forwarded to the following officials:

Ms Mashudu Marubini
Delegate of the Minister (Act 70 of 1970)
E-mail: MashuduMa@daff.gov.za
Tel 012- 319 7619

Ms Thoko Buthelezi
AgriLand Liaison office
E-mail: ThokoB@daff.gov.za
Tel 012- 319 7634

All hardcopy applications / documentation should be forwarded to the following address:

Physical address:
Delpen Building
Cnr Annie Botha and Union Street
Office 270
Attention: Delegate of the Minister Act 70 of 1970

Postal Address:
Department of Agriculture, Forestry and Fisheries
Private Bag X120
Pretoria
0001
Attention: Delegate of the Minister Act 70 of 1970

In addition, comments must be requested from Eskom regarding grid connectivity and capacity. Request for comment must be submitted to:

Mr John Geeringh
Eskom Transmission
Megawatt Park D1Y38
PO Box 1091
JOHANNESBURG
2000

Tel: 011 516 7233
Fax: 086 661 4064
John.geeringh@eskom.co.za

B. AGRICULTURE STUDY REQUIREMENTS

- Detailed soil assessment of the site in question, incorporating a radius of 50 m surrounding the site, on a scale of 1:10 000 or finer. The soil assessment should include the following:
  - Identification of the soil forms present on site
  - The size of the area where a particular soil form is found
  - GPS readings of soil survey points
  - The depth of the soil at each survey point
  - Soil colour
  - Limiting factors
  - Clay content
  - Slope of the site
  - A detailed map indicating the locality of the soil forms within the specified area,
  - Size of the site
- Exact locality of the site
- Current activities on the site, developments, buildings
- Surrounding developments / land uses and activities in a radius of 500 m of the site
- Access routes and the condition thereof
- Current status of the land (including erosion, vegetation and a degradation assessment)
- Possible land use options for the site
- Water availability, source and quality (if available)
- Detailed descriptions of why agriculture should or should not be the land use of choice
- Impact of the change of land use on the surrounding area
- A shape file containing the soil forms and relevant attribute data as depicted on the map.

C. ASTRONOMY GEOGRAPHIC ADVANTAGE ACT, 2007 (ACT NO. 21 OF 2007)

The purpose of the Act is to preserve the geographic advantage areas that attract investment in astronomy. The entire Northern Cape Province excluding the Sol Plaatjie Municipality had been declared an astronomy advantage area. The Northern Cape optical and radio telescope sites were declared core astronomy advantage areas. The Act allowed for the declaration of the Southern Africa Large Telescope (SALT), MeerKAT and Square Kilometre Array (SKA) as astronomy and related scientific endeavours that had to be protected.

You are requested to indicate the applicability of the Astronomy Geographic Advantage Act, Act No. 21 of 2007 on the application in the BAR/EIR. You must obtain comments from the Southern African Large Telescope (SALT) if the proposed development is situated within a declared astronomy advantage area.

EIA REPORT

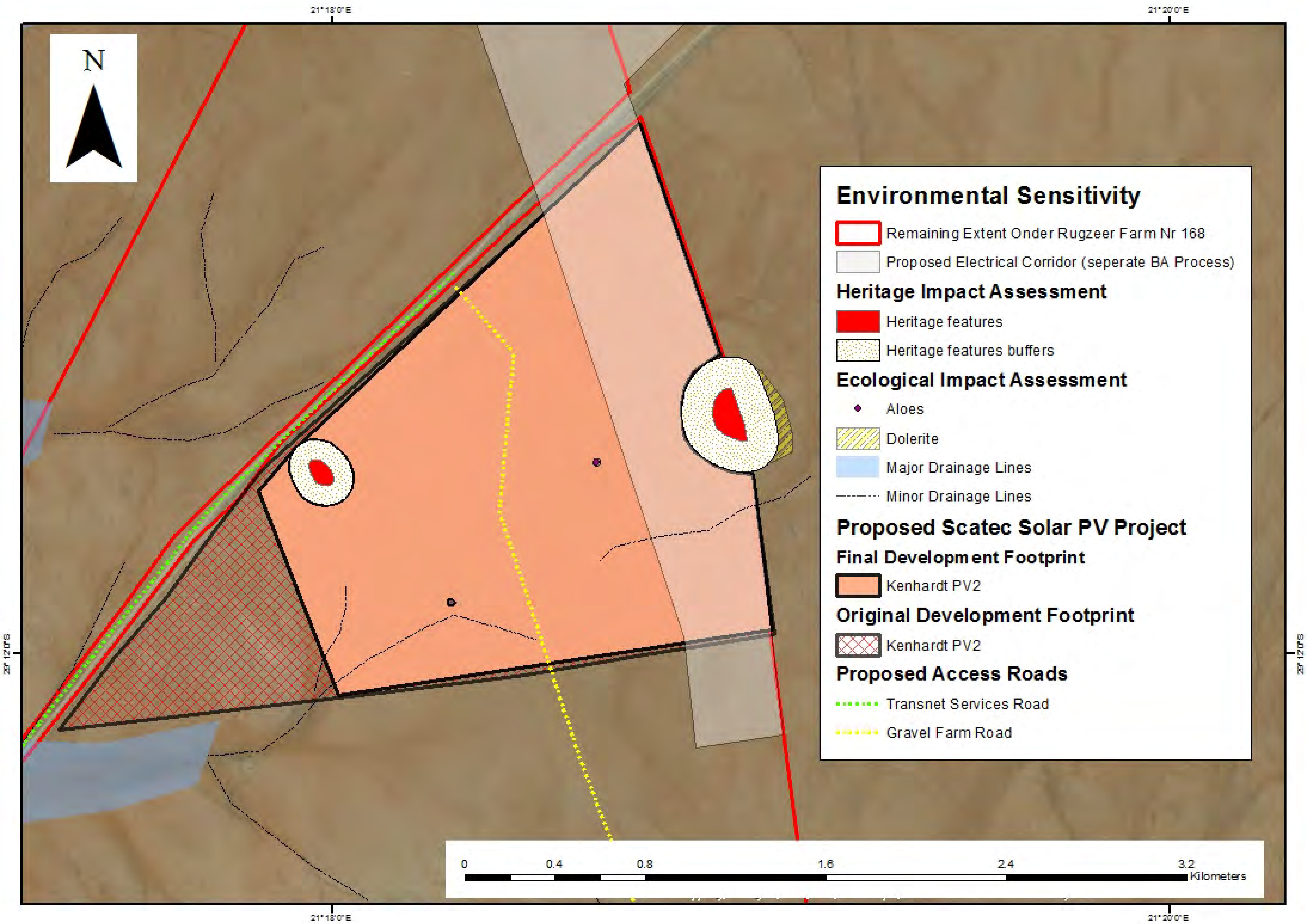
APPENDIX J:

Maps and Title Deeds

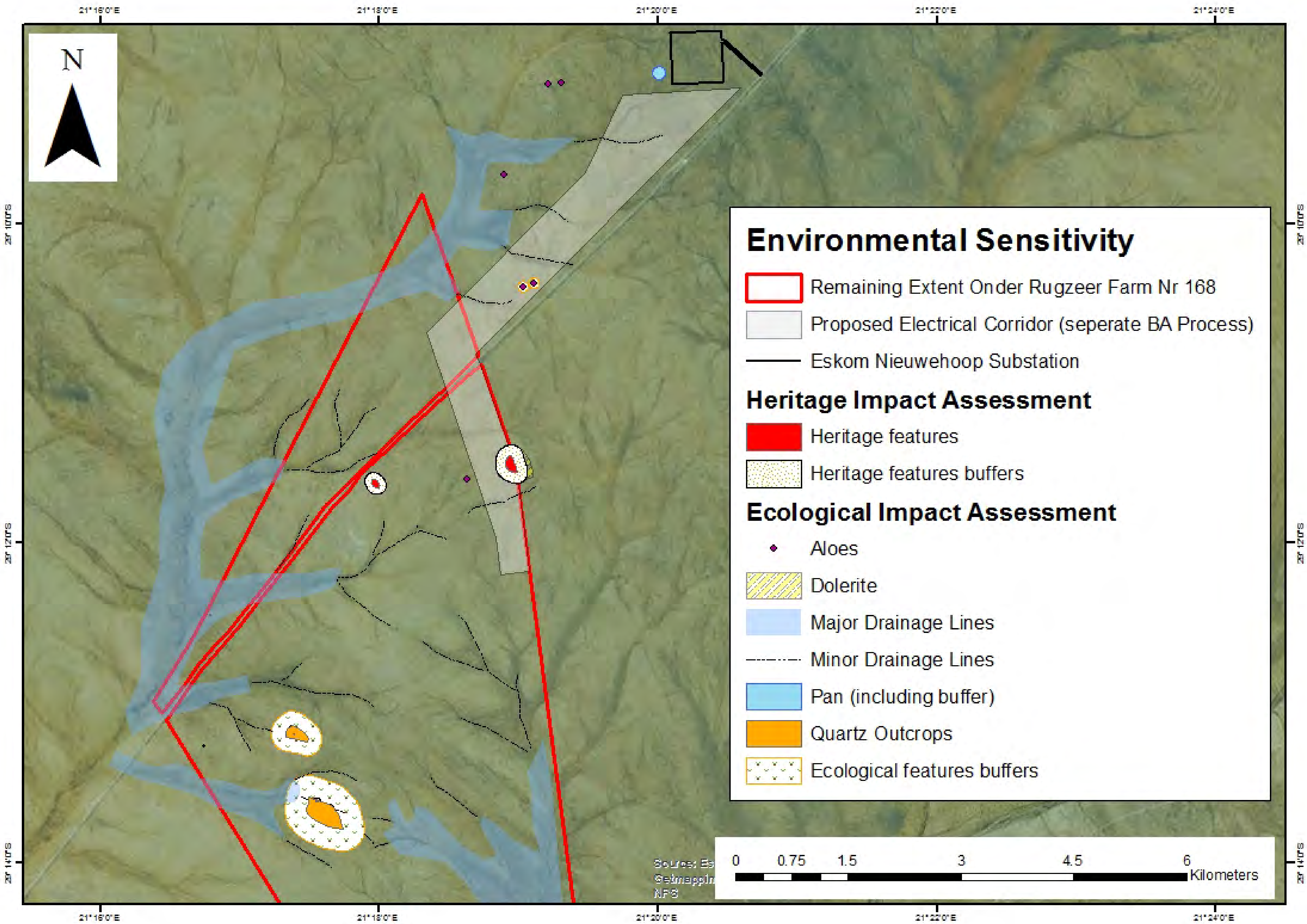
Appendix J.1 Environmental Sensitivity Map
Appendix J.2 Layout Plan
Appendix J.3 Title Deeds

Scoping and **Environmental Impact Assessment** for the Proposed Development of a 75 MW Solar Photovoltaic Facility (KENHARDT PV 2) on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt, Northern Cape Province

Appendix J.1: Environmental Sensitivity Map



Sensitivity Map for Kenhardt PV 2



Combined Sensitivity Layout Map for Kenhardt PV 1, 2 and 3

Appendix J.2: Layout Map

Appendix J.3: Title Deed for Remaining Extent of Onder Rugzeer Farm 168

```
DRQ001M2   PRODUCTION   DEEDS REGISTRATION SYSTEM  MODE: PC
APR 23,2015                 GENERAL ENQUIRY                      DRQ001MA
*OFFICE: 08  CAPE TOWN                                           11:36 AM
                                                          USER: DRS08192
------------------------------------------------------------------------
 FIRM NUMBER..: AKTEKANTOOR KAAPSTAD
 FIRM FILE NO.: PREP                                                 999
 DOCUMENT.....: T1519/1996
                                            LATEST MICRO: 1996 0052 3096
                         SCREEN START INDEX...: 1
YEAR ROLL BLIP  YEAR ROLL BLIP  YEAR ROLL BLIP  YEAR ROLL BLIP  YEAR ROLL BLIP
---- ---- ----  ---- ---- ----  ---- ---- ----  ---- ---- ----  ---- ---- ----
1996 0052 3096

* DIRECT COMMAND: ______________________________________________
ENTR=CONFM,F1=HELP,F2=RETRN,F3=QUIT,F7=BKWRD,F8=FRWRD,F12=MAIN
```

151
MARAIS MÜLLER

Opgestel deur my:

TRANSPORTBESORGER
HOFMEYR M T S

SEËLREG
DUTY R..........

FOOI
FEE R 100,00

VERBIND · MORTGAGED

VIR
FOR R 450 000,00

B 1475 / 96

10 01 96

REGISTRATEUR/REGISTRAR

T 1519 / 96

TRANSPORTAKTE

HIERBY WORD BEKENDGEMAAK:

DAT ~~JOHANNES HENDRIK VAN DER VYVER~~ KRISTO STOFBERG
voor my, Registrateur van Aktes
verskyn het te **KAAPSTAD**
hy, die genoemde komparant synde behoorlik daartoe gemagtig deur 'n volmag aan hom verleen deur

THERESA VAN NIEKERK
Identiteitsnommer 401106 0045 00 5
Getroud buite gemeenskap van goed

gedateer die 31ste dag van OKTOBER 1995, en geteken te STELLENBOSCH

151

En genoemde Komparant het verklaar dat Sy voorsegde Prinsipaal werklik en wettiglik verkoop het op 31 Mei 1995

en dat hy in sy voornoemde hoedanigheid hierby in volkome en vrye eiendom sedeer en transporteer aan en ten gunste van

Die Trustees indertyd van die VAN NIEKERK GESINSTRUST
Nr. T. 4311/94

Of diese regverkrygendes

1. DIE RESTANT van die Plaas **ONDER RUGZEER NR. 168** in die Afdeling van Kenhardt, Provinsie van die Noord-Kaap;

   GROOT: 5677,5041 (Vyf Duisend Ses Honderd Sewe en Sewentig Komma Vyf Nul Vier Een) hektaar;

   OORSPRONKLIK OORGEDRA kragtens Grondbrief gedateer 8 Maart 1890 (Carnarvon Erfpagte Boekdeel 3 Nr. 18) met Kaart wat daarop betrekking het en gehou kragtens Transportakte Nr. T.46901/92. (para 1)

   A. **ONDERHEWIG** aan die voorwaardes waarna verwys word in Grondbrief gedateer 8 Maart 1890 (Carnarvon Erfpagte Boekdeel 3 Nr. 18), waarvan paragraaf V. soos volg lees:

      "V. That all rights to gold, silver and precious stones found or discovered at any time on or in the said land, shall be reserved to the State, together with a right of ingress to and egress from any mines or works undertaken for mining or prospecting purposes by any person or persons authorised by the Commissioner; but subject always to the provisions of the Act No. 44 of 1887 or any other Act to be hereafter passed with regard to prospecting and mining for precious stones or minerals."

   B. **ONDERHEWIG VERDER** aan die bepalings van 'n endossement gedateer 21 Maart 1980 aangebring op Verdelingstransportakte Nr. T.2938/1952, welke endossement soos volg lees:

"Endossement ingevolge Artikel 2A.(2) van die Spoorweg & Hawe Aankoopwet 1977 (Wet 47/1977) soos gewysig deur Wet 80/1979

Aangesien Die Republiek van Suid Afrika (in sy Administrasie van Spoorweë & Hawens) die grond groot ongeveer 47,664 hektaar wat deur die Suid Afrikaanse Yster & Staal Industriële Korporasie Bpk. kragtens onteienings Kennisgewing No. 108(c) onteien is, van die genoemde Korporasie gekoop het, vestig die gemelde grond ingevolge die bepalings van Artikel 2A. (1) van die bovermelde Wet in die Republiek van Suid Afrika (in sy Administrasie van Spoorweë en Hawens) vanaf 21 Maart 1980.

(Onteienings-endossement/e gedateer 11 September 1974 hierop verwys / Onteienings-endossement vervat as voorwaarde op bladsy hierin verwys).

Aansoek weggelê as T.7080/1980."

2. DIE RESTANT van die Plaas **BOVEN RUGZEER NR. 169** in die Afdeling van Kenhardt, Provinsie van die Noord-Kaap;

GROOT: 7200,3699 (Sewe Duisend Twee Honderd Komma Drie Ses Nege Nege) hektaar;

OORSPRONKLIK OORGEDRA kragtens Grondbrief gedateer 13 Mei 1890 (Carnarvon Erfpagte Boekdeel 3 Nr. 25) met Kaart wat daarop betrekking het en gehou kragtens Transportakte Nr. T.46901/92. (para 2)

ONDERHEWIG aan die voorwaardes waarna verwys word in Transportakte Nr. T.14345/1944.

Weshalwe die Komparant afstand doen van al die regte en titel wat die genoemde TRANSPORTGEWER

voorheen op genoemde eiendom gehad het en gevolglik ook erken dat die genoemde TRANSPORTGEWER geheel en al van die besit daarvan onthef en nie meer daartoe geregtig is nie en dat, kragtens hierdie akte, bogenoemde TRANSPORTNEMER TRUSTEES

Of die se Regverkrygendes tans en voortaan daartoe geregtig is, ooreenkomstig plaaslike gebruik, behoudens die regte van die Staat en ten slotte erken dat die volle koopsom ten bedrae van **R550 428,00** behoorlik betaal en verseker is.

Ten bewyse waarvan ek, genoemde Registrateur van Aktes tesame met die Komparant hierdie Akte onderteken en dit met die ampseël bekragtig het.

Aldus gedoen en verly op die kantoor van die Registrateur van Aktes

te KAAPSTAD

op 18 Januarie 1996

In my teenwoordigheid,

Registrateur van Aktes.

q.q.

EIA REPORT

APPENDIX K:

Technical Report: Cumulative Topographical Analysis of Proposed PV Projects in AGA Area

Scoping and **Environmental Impact Assessment** for the Proposed Development of a 75 MW Solar Photovoltaic Facility (KENHARDT PV 2) on the remaining extent of Onder Rugzeer Farm 168, north-east of Kenhardt, Northern Cape Province

MESA Solutions (Pty)Ltd

THE SCIENCE OF MEASUREMENT

Technical Report:

Cumulative Topographical Analysis of Proposed PV Projects in AGA Area

---

Work done for: Scatec Solar SA 163 (Pty) Ltd.

Scatec Solar

Improving our future™

A. J. Otto and P. S. van der Merwe

Document Number:	SCA/16/01/29
Revision Number:	REV1
Document Date:	10 February 2016

Document Approval

	Name	Affiliation	Designation	Signature
Submitted	A. J. Otto	MESA Solutions	Managing Director	
	P. S. van der Merwe	MESA Solutions	Managing Director	

Accepted	C. Bosman	Veroniva	Project Manager	

Document History

Revision	Date of Issue	Comments
REV0	29 January 2016	Final Report Submission (SCA/16/01/29/REV0).
REV1	10 February 2016	Statement on compliance of Kenhardt PV developments.

Company Details

Name	MESA Solutions (Pty) Ltd.
Physical Address	Aan-de-wagen Centre Aan-de-wagen Rd. Stellenbosch 7600
Tel.	+27(0)72 317 9784 / +27(0)82 494 6204
Website	http://www.mesasolutions.co.za/

Executive Summary

MESA Solutions was asked by *Scatec Solar* to do a topographical analysis of the terrain profiles between various p hotovoltaic (PV) project locations in the Astronomy Geographic Advantage (AGA) area and the closest and core-site SKA telescopes. A total of three *Scatec Solar* sites (*Kenhardt PV1 to PV3*), as well as ten *Mulilo* sites (*Boven PV1 to PV4; Gemsbok PV1 to PV6*) in close proximity, are considered in this cumulative assessment.

EMI Characterisation of Representative Plant

Conducted Measurements

- TD conducted measurements on supply cables to the *Tracking Units* show large pulses when the plant is *ON*.
- Majority of the pulse energy extends up to at least 500 MHz.
- Equivalent FD measurements on the wireless antenna and pressure switch cables agree.
- Comparison with radiated results show higher frequencies radiate into the environment more efficiently.
- Better part of noise is likely to emanate from the inverter.
- *Tracking Unit* emissions are somewhat aggravated by the wireless communication.
- Switching noise associated with the tracking of the panels creates broadband interference.
- Biggest part of switching interference is generated by the pump contactor and relays.

Radiated Measurements

- Radiated results for the plant *ON* and in *STANDBY* mode show similar emissions levels.
- This confirms that interference producing systems are never completely *OFF*.
- Emissions associated with the *Inverter* units are dominant and occupy frequencies between 300 MHz and 2 GHz
- Peak levels identified range between 30 - 35 dBμV/m as measured at 10 m below 1 GHz and at 3 m above 1 GHz for both polarisations.
- For purposes of RFI mitigation, the fixed line communication would be the preferred implementation.
- The *String Cabinet* shows mostly broadband interference between 300 MHz and 800 MHz for both polarisations.
- Comparative measurements made with the doors to the *Inverters* and *Tracking Units* open show the limited levels of shielding provided by these enclosures.
- It is possible to improve the shielding by incorporating conductive gasketting.

Propagation Analysis

A preferred and alternative site location was included for the Mulilo developments in terms of the total path loss to the SKA receivers. This study attempts to define an E-field upper limit, as a function of frequency, at which the plants are allowed to radiate without exceeding emission limits (SARAS protection and receiver saturation limits) at the various SKA telescope locations. The conformance of the plant can be determined by comparing representative measured results, made at Scatec Solar's 75 MW Dreunberg plant, to the calculated levels provided.

From the results it is shown that:

- Radiated emissions at levels below that of CISPR 11/22 Class B are required (especially in the case of the closest telescope).
- Negligible terrain loss exists between majority of sites and closest SKA telescope.
- Predictions for the maximum allowed E-field level, as measured according to CISPR 11/22 Class B, are given in Figs. (a) to (c) below. A comparison with measured emission levels for each plant is shown.
- Based on plant emission and maximum allowed levels, the required (red) mitigation or surplus (green) attenuation for the closest, second closest and core-site telescopes are given in Tables 1 2 and 3 respectively.

The three proposed Kenhardt plants are shown in Table 1 to exceed the SARAS protection levels by up to 38 dB toward the closest SKA telescope. This includes the cumulative effect of a total of $N = 13$ PV plants developed. However, Boven PV1, PV3 and PV4 exceed this limit by approximately 50 dB in this scenario.

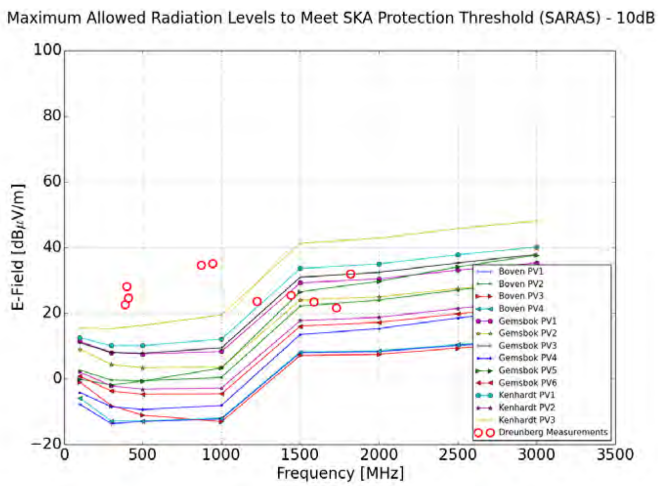
For the case where only the three Kenhardt plants are developed, the exceedance will reduce to 31.6 dB with a cumulative effect for $N = 3$ plants considered.

Mitigation Measures

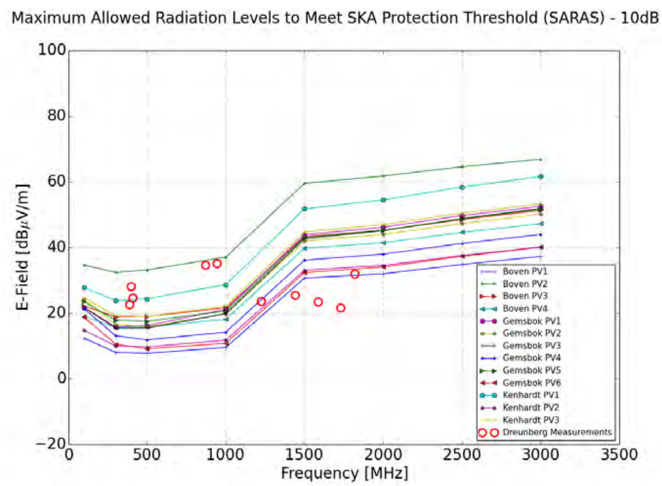
It is strongly recommended that the following **mitigation practises** be incorporated into the plants design:

- The inverter units, transformers, communication and control units for an array of panels all be housed in a single shielded environment.
- For shielding of such an environment ensure:
  - RFI gasketting be placed on all seams and doors.
  - RFI Honeycomb filtering be placed on all ventilation openings.
- Cables to be laid directly in soil or properly grounded cable trays (not plastic sleeves).
- The use of bare copper directly in soil for earthing is recommended.
- Assuming a tracking PV plant design, care will have to be taken to shield the noise associated with the relays, contactors and hydraulic pumps of the tracking units.
- All data communications to and from the plant to be via fibre optic.

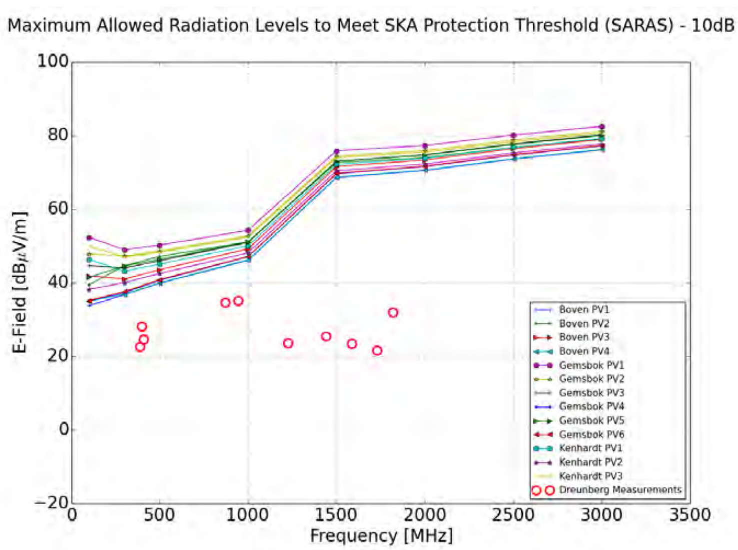
It is MESA's expectations that, if the mitigation measures that are specified are implemented correctly, attenuation of between 20 dB and 40 dB can be achieved. The required maximum mitigation 50 dB for some plant especially towards the closest telescope would require significant attention to detail. *It is important to note that the success of the mitigation measures cannot be guaranteed or confirmed until measurements on a representative mock-up installation with mitigation measures implemented are performed. Furthermore, the findings from this assessment are for the client's own edification, and will be taken into account by SKA-SA during their own propagation analysis. This study is therefore not meant to supersede any investigation done by SKA-SA or relevant RFI working groups. It remains the responsibility of the developer to meet compliance to the SKA requirements, and MESA Solutions cannot accept responsibility for any assessments made in this report which could cause non-compliance.*



(a)



(b)



(c)

Maximum allowed measured E-Field (CISPR 22 Class B) to ensure levels are 10 dB below SARAS protection levels toward: (a) Closest SKA telescope; (b) Second closest SKA telescope; and (c) SKA core-site telescopes compared to measured results at 75 MW Scatec Dreunberg PV plant.

Site Location	387.38 MHz	399.19 MHz	409.52 MHz	871.57 MHz	942.42 MHz	1223.81 MHz	1441.27 MHz	1584.12 MHz	1728.57 MHz	1819.05 MHz
Kenhardt PV1	12.55	18.03	14.58	23.06	23.28	1.96	-5.57	-10.4	-12.54	-2.51
Kenhardt PV2	25.23	30.77	27.38	37.53	37.99	17.28	10.17	5.52	3.5	13.6
Kenhardt PV3	6.94	12.37	8.87	15.98	16.03	-5.57	-13.22	-18.11	-20.3	-10.3
Boven PV1	36.02	41.47	37.99	47.05	47.43	26.85	19.92	15.43	13.61	23.82
Boven PV2	23.16	28.66	25.23	34.35	34.79	13.48	5.88	0.97	-1.29	8.67
Boven PV3	32.07	37.73	34.44	47.17	47.95	27.69	20.76	16.27	14.45	24.66
Boven PV4	35.48	40.95	37.5	46.79	47.17	26.59	19.66	15.17	13.35	23.56
Gemsbok PV1	14.85	20.36	16.94	26.52	26.91	5.98	-1.29	-6.01	-8.08	1.99
Gemsbok PV2	18.72	24.26	20.87	31.2	31.68	11.01	3.92	-0.72	-2.73	7.38
Gemsbok PV3	14.75	20.25	16.81	25.63	25.9	4.6	-2.93	-7.77	-9.92	0.09
Gemsbok PV4	31.52	37.06	33.66	43.06	43.38	22.1	14.54	9.64	7.38	17.34
Gemsbok PV5	24.01	29.42	25.92	32.36	32.29	9.96	1.69	-3.63	-6.27	3.43
Gemsbok PV6	26.8	32.34	28.94	39.25	39.73	19.02	11.88	7.2	5.14	15.21

Table 1: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the closest SKA telescope.

Site Location	387.38 MHz	399.19 MHz	409.52 MHz	871.57 MHz	942.42 MHz	1223.81 MHz	1441.27 MHz	1584.12 MHz	1728.57 MHz	1819.05 MHz
Kenhardt PV1	-1.38	4.07	0.59	7.05	6.94	-15.35	-23.55	-28.78	-31.31	-21.52
Kenhardt PV2	12.74	18.24	14.81	23.39	23.6	2.36	-5.07	-9.89	-12.05	-2.03
Kenhardt PV3	3.57	9.07	5.63	13.31	13.36	-8.6	-16.59	-21.69	-24.06	-14.19
Boven PV1	14.73	20.23	16.8	25.52	25.77	4.64	-2.72	-7.48	-9.58	0.46
Boven PV2	3.73	9.21	5.76	13.68	13.81	-7.7	-15.32	-20.25	-22.51	-12.57
Boven PV3	3.73	9.21	5.76	13.68	13.81	-7.7	-15.32	-20.25	-22.51	-12.57
Boven PV4	6.95	12.43	8.98	17.08	17.24	-4.17	-11.73	-16.61	-18.82	-8.84
Gemsbok PV1	6.64	12.1	8.64	14.75	14.56	-7.66	-15.72	-20.84	-23.23	-13.37
Gemsbok PV2	6.39	11.91	8.49	15.91	15.87	-6.01	-13.88	-18.9	-21.21	-11.29
Gemsbok PV3	7.22	12.7	9.25	15.89	15.77	-6.42	-14.51	-19.67	-22.11	-12.27
Gemsbok PV4	10.1	15.65	12.27	21.01	21.18	-0.36	-8.05	-13.0	-15.27	-5.33
Gemsbok PV5	4.92	10.42	6.99	14.78	14.84	-7.04	-14.98	-20.04	-22.4	-12.51
Gemsbok PV6	12.72	18.28	14.91	24.24	24.5	3.19	-4.35	-9.23	-11.45	-1.48

Table 2: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the second closest SKA telescope.

Site Location	387.38 MHz	399.19 MHz	409.52 MHz	871.57 MHz	942.42 MHz	1223.81 MHz	1441.27 MHz	1584.12 MHz	1728.57 MHz	1819.05 MHz
Kenhardt PV1	-21.33	-15.96	-19.51	-14.15	-14.35	-36.27	-44.03	-48.97	-51.19	-41.21
Kenhardt PV2	-18.46	-13.12	-16.7	-12.06	-12.35	-34.46	-42.33	-47.32	-49.57	-39.61
Kenhardt PV3	-24.93	-19.53	-23.04	-16.73	-16.81	-38.43	-46.01	-50.85	-52.99	-42.97
Boven PV1	-15.48	-10.18	-13.79	-9.87	-10.25	-32.51	-40.46	-45.49	-47.77	-37.84
Boven PV2	-19.45	-14.12	-17.69	-13.13	-13.44	-35.56	-43.45	-48.44	-50.7	-40.74
Boven PV3	-19.45	-14.12	-17.69	-13.13	-13.44	-35.56	-43.45	-48.44	-50.7	-40.74
Boven PV4	-15.58	-10.28	-13.89	-10.0	-10.38	-32.64	-40.59	-45.62	-47.89	-37.95
Gemsbok PV1	-26.86	-21.45	-24.96	-18.6	-18.67	-40.28	-47.85	-52.69	-54.83	-44.81
Gemsbok PV2	-25.18	-19.78	-23.3	-17.06	-17.15	-38.81	-46.41	-51.27	-53.42	-43.41
Gemsbok PV3	-22.2	-16.84	-20.39	-15.06	-15.27	-37.2	-44.97	-49.91	-52.13	-42.16
Gemsbok PV4	-16.1	-10.82	-14.44	-10.79	-11.19	-33.51	-41.49	-46.53	-48.82	-38.89
Gemsbok PV5	-22.7	-17.32	-20.87	-15.26	-15.43	-37.26	-44.97	-49.88	-52.07	-42.09
Gemsbok PV6	-16.36	-11.07	-14.68	-10.91	-11.31	-33.62	-41.61	-46.65	-48.94	-39.0

Table 3: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the core-site SKA telescopes.

Contents

Nomenclature

AC	Alternating Current
AF	Antenna Factor
AGA	Astronomy Geographic Advantage
BW	Bandwidth
CISPR	Comitè International Spècial des Pertubations Radioèlectriques (French)
CISPR	International Committee on Radio Interference (English)
CM	Common Mode
CP	Current Probe
dB	Decibel
dBμA	Decibel Micro-Ampère
dBμV	Decibel Micro-Volt
dBμV/m	Decibel Micro-Volt per Metre
DC	Direct Current
DEM	Digital Elevation Model
DUT	Device Under Test
E-Field	Electric Field
EMI	Electromagnetic Interference
FD	Frequency Domain
FFT	Fast Fourier Transform
FSPL	Free Space Path Loss
GPS	Global Positioning System
ITM	Irregular Terrain Model
ITWOM	Irregular Terrain With Obstruction Model
KAT	Karoo Array Telescope
kV	Kilovolt
LOS	Line-of-Sight
mV	Millivolt
MW	Megawatt
NF	Noise Floor
PV	Photovoltaic
RBW	Resolution Bandwidth

RFI	Radio Frequency Interference
RFI-WG	Radio Frequency Interference Working Group
RTA	Real Time Analyser
SA	Spectrum Analyser
SARAS	South African Radio Astronomy Services
SKA	Square Kilometre Array
SKA-SA	Square Kilometre Array South Africa
SPLAT	Signal Propagation, Loss And Terrain - Analysis Tool
TD	Time Domain
TL	Terrain Loss
TPL	Total Path Loss
Z_T	Transfer Impedance

List of Figures

DIRECTORS: H. C. Reader, A. J. Otto and P. S. van der Merwe | www.mesasolutions.co.za | EMAIL: info@mesasolutions.co.za
REG NO: 2002/025186/07 | POSTAL ADDRESS: P.O. Box 12572, Die Boord, Stellenbosch, 7613

DIRECTORS: H. C. Reader, A. J. Otto and P. S. van der Merwe | www.mesasolutions.co.za | EMAIL: info@mesasolutions.co.za
REG NO: 2002/025186/07 | POSTAL ADDRESS: P.O. Box 12572, Die Boord, Stellenbosch, 7613

List of Tables

1 Introduction

MESA Solutions was asked to investigate the cumulative effect and possible impact of a number of photovoltaic (PV) plants on the Square Kilometre Array (SKA) project. It is proposed that development of these plants take place in the Astronomy Geographic Advantage (AGA) area described in [1]. The proposed sites include three developments by *Scatec Solar*, as well as ten developments by *Mulilo Renewable Project Developments* in close proximity. From the terrain evaluation we are able to determine what influences, if any, natural topographical features will have on the total expected interference attenuation based on the location of the site. This determines the maximum allowable emission levels which the facility may generate in order to still comply with SKA threshold limits as specified in [2]. An initial study investigating the effect of three of the ten sites, namely *Boven PV1*, *Gemsbok PV1* and *Gemsbok PV2*, on the closest and core SKA telescopes were undertaken in [3].

The following additional sites considered in this cumulative study include:

Scatec Solar

- Kenhardt PV1
- Kenhardt PV2
- Kenhardt PV3

Mulilo Renewable Project Developments

- Boven PV2
- Boven PV3
- Boven PV4
- Gemsbok PV3
- Gemsbok PV4
- Gemsbok PV5
- Gemsbok PV6

For each of the additional Mulilo sites, a preferred and an alternative site location is considered in terms of the total path loss to the closest and core SKA telescopes. The purpose is to identify the recommended site location based on minimum potential impact.

The aim of this investigation is to define emission limits at relevant discrete frequencies to which *in situ* measurements, conducted once the project is built, have to adhere. Compliance to these limits, given the propagation analysis presented, will ensure that emissions will not exceed the SARAS protection or receiver saturation threshold levels. The report is not a prediction of what interference levels will be at each of the telescopes, but rather stipulates a requirement for the developer to ensure conformance. Assuming the same technology, the conformance of the plant can be determined by comparing representative measured results, from the 75 MW Scatec Dreunberg PV plant in Section 2, to the calculated levels provided in Section 6.

In the case where there are more than one PV plant (source of interference) emitting at a specific frequency, it is important that the cumulative effect be considered by taking into account:

$$P_{\text{Cumulative}} = 10 \log_{10} (N) \quad (1)$$

where N=13 is the number of PV plants considered in this investigation. This could results in an accumulative effect of up to $P_{\text{Cumulative}}$=11.1 dB for power transmitted at a specific frequency.

It is important to note that the findings from this assessment are for the client's own edification, and will be taken into account by SKA-SA during their own propagation analysis. This study is therefore not meant to supersede any investigation done by SKA-SA or relevant RFI working groups. It remains the responsibility of the developer to meet compliance to the SKA requirements, and MESA Solutions cannot accept responsibility for any assessments made in this report which could cause non-compliance.

2 EMI Characterisation of 75 MW Dreunberg PV Plant

The cumulative study firstly requires the characterisation of electromagnetic interference (EMI) generated by a representative plant using similar technology as what will be implemented on the proposed sites. Secondly, by making use of the identified interference from the facility in propagation analysis, the potential impact of the sites on both the closest and core-site SKA telescopes are determined. Finally, recommendations for the mitigation of interference based on the anticipated impact and plant layout are given.

2.1 Background & Scope

The AGA act specifies that the declared astronomy advantage areas are to be protected, preserved and properly maintained in terms of radio frequency interference (RFI). Therefore, the potential impact from new developments in terms of emissions, specifically on the SKA SA project, have to be determined. MESA Solutions will assist *Scatec Solar* in trying to establish the impact of interference from all the proposed projects on both the closest and core-site SKA stations. It is, however, important to take into account the fact that all measured results in this report include background interference which is dependent on the representative plant's location.

MESA's philosophy for identifying RFI generated by an electric/electronic system is to do both radiated and conducted measurements. Conducted interference, in the form of common mode (CM) current on the cables connected to the system, could radiate if a resonant galvanic path exists. CM current measurements made throughout a system using a current probe (CP), are therefore a diagnostic tool which helps to determine the likely source of interference. Radiated measurements, usually made using active antennas, provide information about how much of the conducted interference is being radiated into the environment. Differences in spectral content between the two methods mean that some interference radiates directly from parts of the system. Levels of radiated interference are, furthermore, subject to multi-path interference and as a consequence have to be made at various separation distances.

Another level of investigation is to repeat some the radiated and conducted measurements in the time domain using a *MESA Product Solutions'* Real Time Analyser (RTA-3). This allows the capture of transient signals usually associated with switching events which a conventional sweeping spectrum analyser (SA) is unlikely to capture. While they might only last for a short duration, the consequence could be a frequency spectrum filled with interference (fast rise time pulse results in broadband frequency content). The combination of these measurement techniques is relied upon to provide information about the total amount of interference produced by a device under test (DUT). Current measurements were made from 70 MHz to 1 GHz due to the operational frequencies of interest (lower limit) and CP (upper limit). Radiated measurements were made from 70 MHz to 3.6 GHz which covers the band of conducted interference and provides some additional information.

2.2 Measurement Locations

A diagram of the plant layout is shown in Fig. 1. The plant is divided into an eastern and western section. Measurement positions were chosen in the eastern section close to inverters 22 and 23 (Position 1) as well as inverters 1 and 2 (Position 2). The two positions were evaluated because of differences in communication methods between the tracking units at each location. The associated global positioning system (GPS) coordinates for the two position are:

- **Position 1:** 30° 50.167' S, 26° 12.930' E
- **Position 2:** 30° 49.944' S, 26° 13.204' E

Figure 1: Diagram of plant layout showing measurement location at inverters 22 and 23.

The Dreunberg plant makes use of a horizontal single-axis tracking facility operated hydraulically. Each inverter/transformer station is supplied by six arrays of panels each operated by two tracking units. The measurement location was chosen to provide characteristic emissions of a typical *Inverter* station, as well as nearby *String* and *Tracking* cabinets.

The *String* cabinets (Fig. 2) combines all the direct current (DC) supplies for a particular part of the plant onto positive and negative 1000 V DC cables. The *String* cabinet also contain a smart solar energy monitoring system that monitors the voltage, current and power output from the various PV panels (or strings) that feed DC into the *String* cabinet. The *Tracking* cabinets located on the *Tracking* unit contain all the control electronics for the array movement. The hydraulic system makes use of a master and slave hydraulic rams situated either side of a particular array. Depending on the direction the panels are moved in, only one will operate at any given time. Communication between the *Tracking* units are done via a local wireless network for most units in the plant, except at a few units close to Position 2. For the wireless system (Position 1), each pair of *Tracking* units has a unique operating frequency to ensure exclusive communication. For the wired implementation (Position 2), a fixed *RS-485* communication cable runs underground connecting each pair of *Tracking* units.

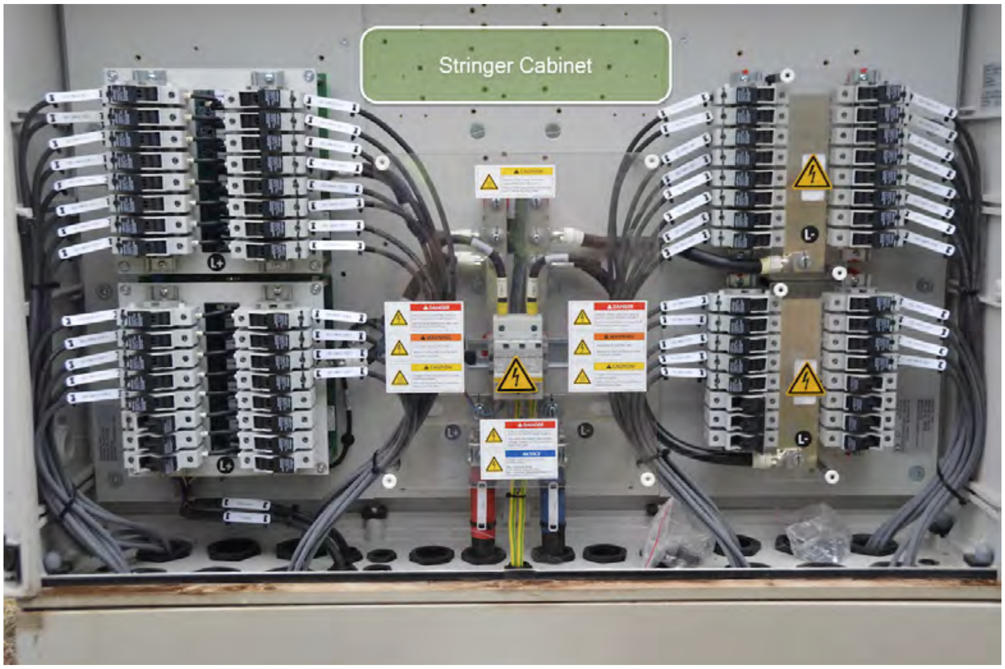


Figure 2: String Cabinet layout where supply from each panel is monitored.

2.3 Conducted Measurements

Conducted measurements were made using an *ETS-Lindgren EMCO* CM CP. Measurements in the time domain (TD) were made using a 800 MHz instantaneous bandwidth (BW) *MESA Product Solutions RTA-3* (Real Time Analyser) capable of measurements up to 2.6 GHz, while frequency domain (FD) measurements were made with a *Rohde & Schwarz ZVH-4* (70 MHz to 3.6 GHz) cable and antenna analyser (SA). In cases where strong low-frequency emissions compressed the receivers, a 100 MHz high pass filter was added.

The majority of measurements were made on cables close to the *Tracking Unit* and *String Cabinets* at Position 1 and 2. Measurements were also made on the cables connected to one of the weather stations located throughout the facility. A number of conducted interference measurement locations are shown in Figs. 3 to 5:

- Positive direct current (DC) panel cables
- Earth strap at the back of the PV panels
- DC cable bundle at the back of the PV panels
- Communication cable in String Cabinet
- Tracking Unit Position 1 wireless antenna cable
- Pressure switch cable (Tracking Unit)
- Tracking Unit communication cable Position 2
- Weather station cable

Measurements were made with the plant in full power generation mode, referred to as the *ON* state. After sunset the plant no longer produces power and enters an idle/standby mode. It is important to note, however, that most control and monitoring systems remain on during this period. This is referred to as the *STANDBY* state of operation and was also evaluated. With most systems remaining on, emissions levels will not necessarily change between *ON* and *STANDBY* modes of operation.

Figure 3: CP measurements on the panel earth strap.

Figure 4: CP measurements on cables connected to Tracking Cabinet.

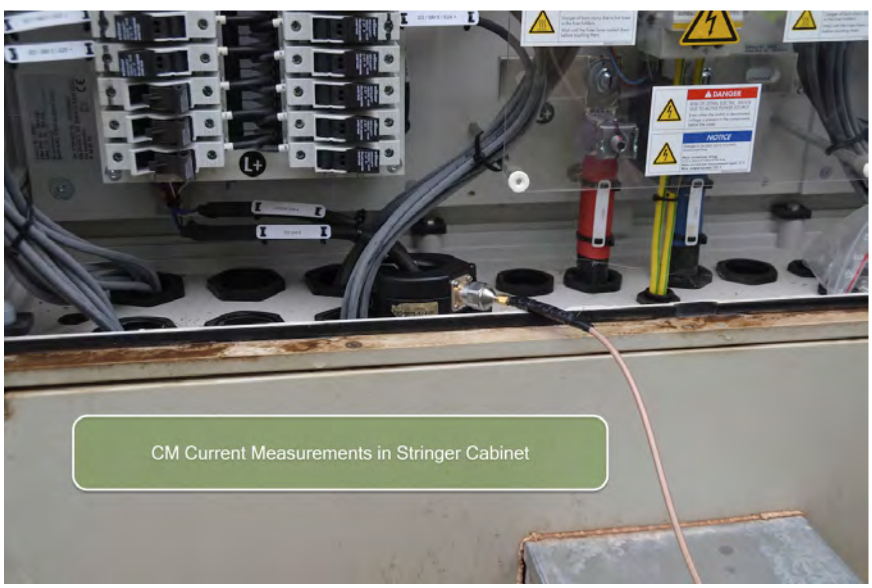


Figure 5: CP measurements on the communication cable inside the String Cabinet.

2.3.1 Frequency Domain Measurements

FD results obtained with the CM CP and SA are shown in Figs. 6 to 12. In these results the measured voltage levels [dBμV] are converted to current levels [dBμA] by removing the transfer impedance (Z_T [dBΩ]) of the probe. Each figure displays the frequency content measured from 70 MHz to 1 GHz. The dominating low-frequency content occasionally required the use of a low pass filter with a cut-in frequency of 100 MHz. The effect therefore on band of interest is negligible. In most cases the pre-amplifier was used with a 100 kHz resolution bandwidth (RBW) which is the closest option to CISPR equivalent RBW of 120 kHz for frequencies below 1 GHz.

Included in all results are the CISPR 11/22 Class B (more stringent standard for household applications) equivalent current limit. It is derived from antenna theory that any cable in free space carrying a CM current level of 5 μA (or 13.98 dBμA) above 230 MHz, will produce a worst-case E-field strength of 37 dBμV/m at a distance of 10 m from the DUT. This will only occur if the cable has resonant properties at a given frequency. The 37 dBμV/m limit is relaxed by 10 dB for CISPR 22 Class A (industrial applications). While the SKA, because of its sensitivity, enforces much more stringent limits than CISPR, it is purely included as a well-known reference.

Most of the results show a comparison between the *ON* and *STANDBY* modes of operation. Because the plant never fully switches off, evaluation of the *STANDBY* mode is relevant. In all cases where *STANDBY* measurements were made, the comparison with *ON* results confirms that there are no appreciable difference in terms of the interference generated. A prominent broadband interference signal seen on the DC cable bundle is visible at a lower level on the single panel DC cable. Also visible in the two DC results is a particularly strong narrowband emission at 872 MHz. It was also measured on the panel earth strap, the pressure switch and wireless antenna cables. Its narrowband feature and the fact that it was not measured on the cables connected to the *String* or fixed line *Tracking Cabinets* suggest it to be some local oscillator or clock frequency only visible at Position 1.

Other significant levels of conducted interference are seen on the pressure switch, wireless antenna and *Tracking Cabinet* communication cable. These levels are above the equivalent current limit between 100 MHz and 350 MHz and seem to be broadband in nature. The wireless antenna and pressure switch cables show narrowband higher frequency interference not measured anywhere else. The similarity in spectral content on these two cables can be attributed to their close proximity of the *Tracking Unit*, with the source likely to be the wireless communication system. Similar interference is not visible on the communication cable of the *Tracking Unit* at Position 2 where the wireless system is not used. A simple comparison of conducted and radiated interference will subsequently be presented to determine the contribution of CM current to the overall radiated emissions.

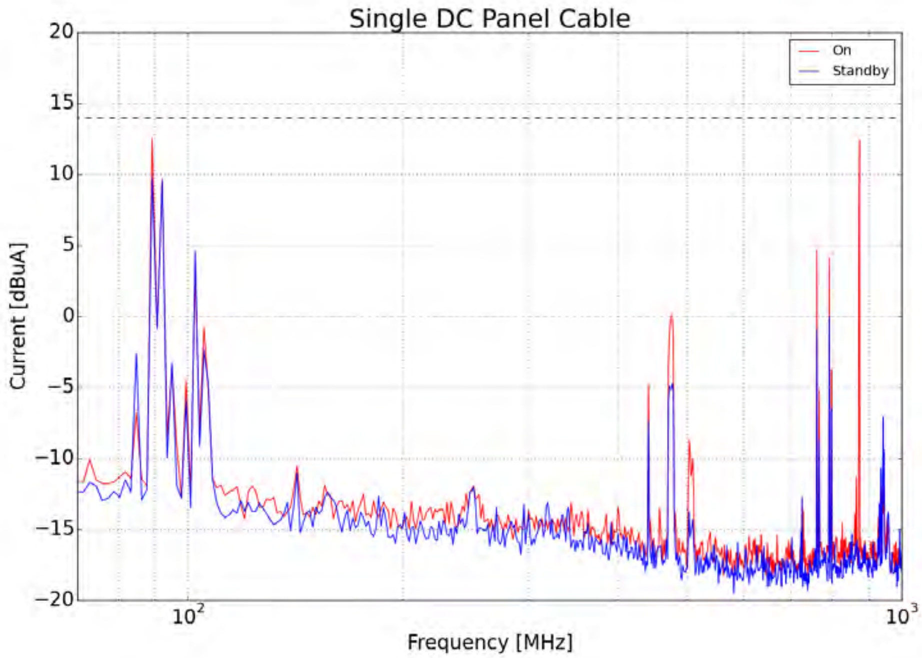


Figure 6: Frequency domain current probe measurements on the PV panel DC cables for the plant *ON* and in *STANBY* mode.

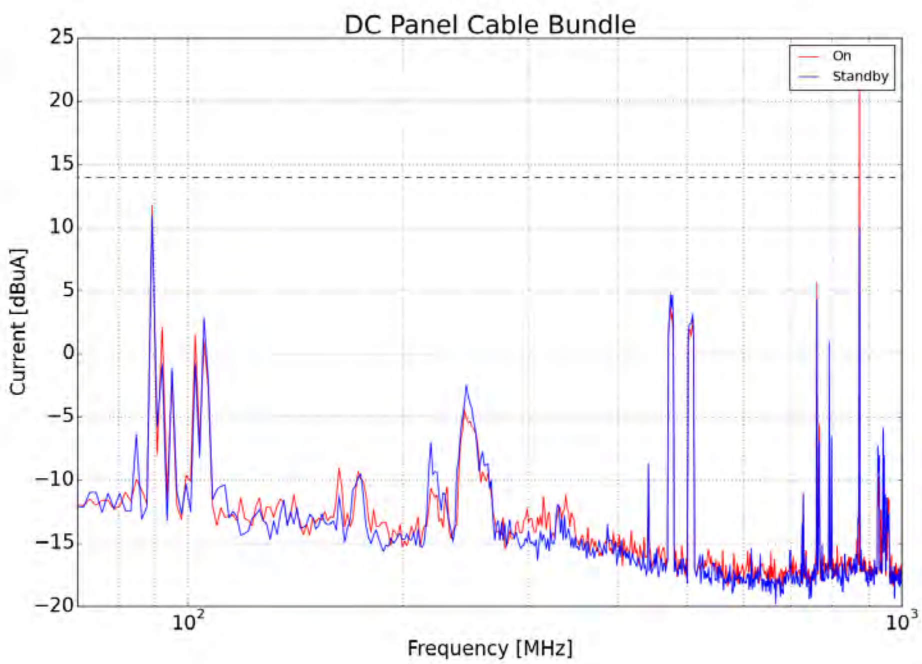


Figure 7: Frequency domain current probe measurements on DC cable bundle at the back of the PV pannels for the plant *ON* and in *STANDBY* mode.

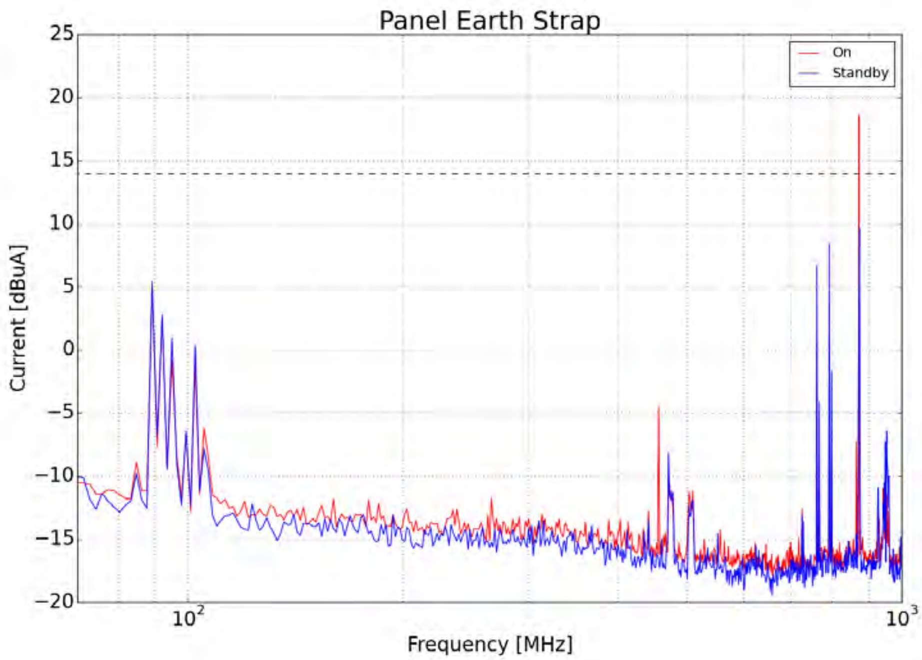


Figure 8: Frequency domain current probe measurements on PV earth strap for the plant *ON* and in *STANBY* mode.

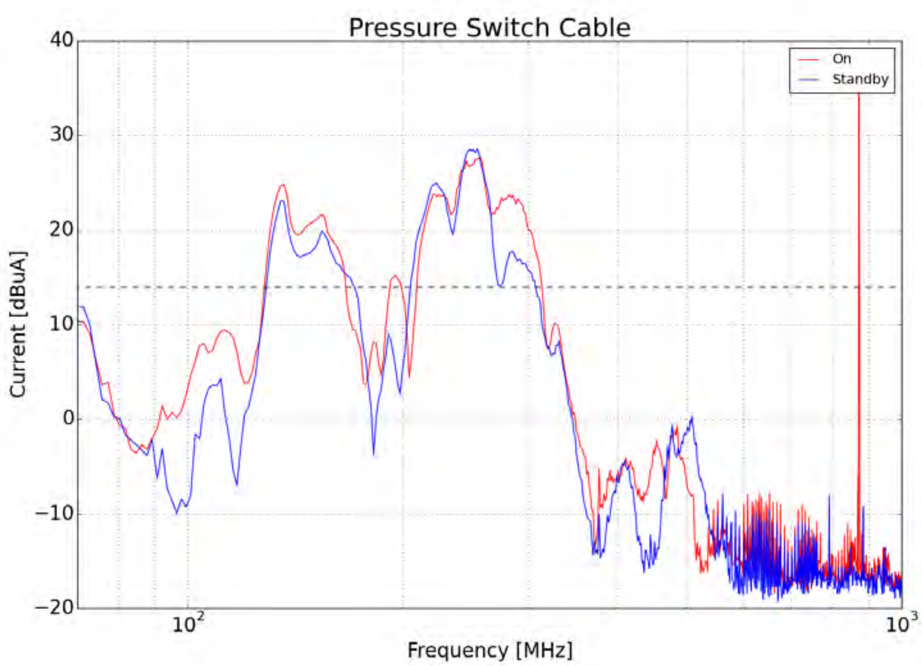


Figure 9: Frequency domain current probe measurements on the hydraulic pressure switch located at the Tracking Unit for the plant *ON* and in *STANDBY* mode.

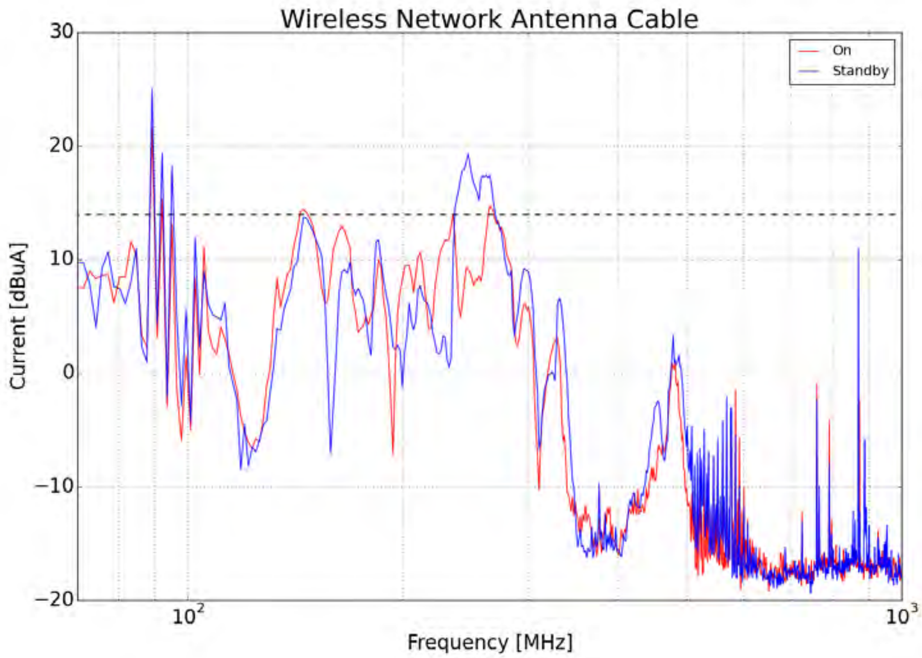


Figure 10: Frequency domain current probe measurements on wireless antenna cable located at the Tracking Unit at Position 1 for the plant *ON* and in *STANBY* mode.

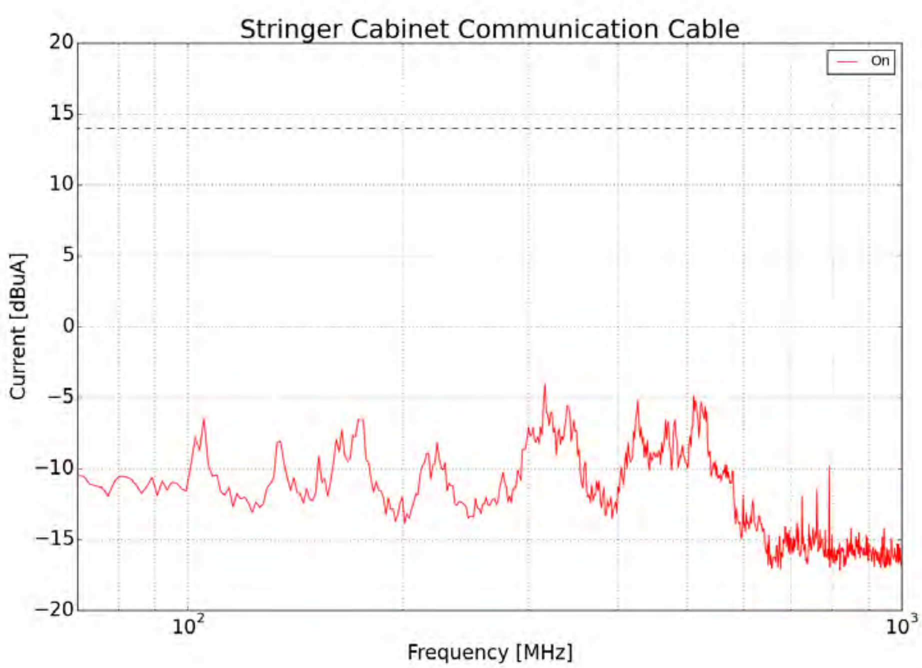


Figure 11: Frequency domain current probe measurements on String Cabinet communication cable for the plant *ON* and in *STANDBY* mode.

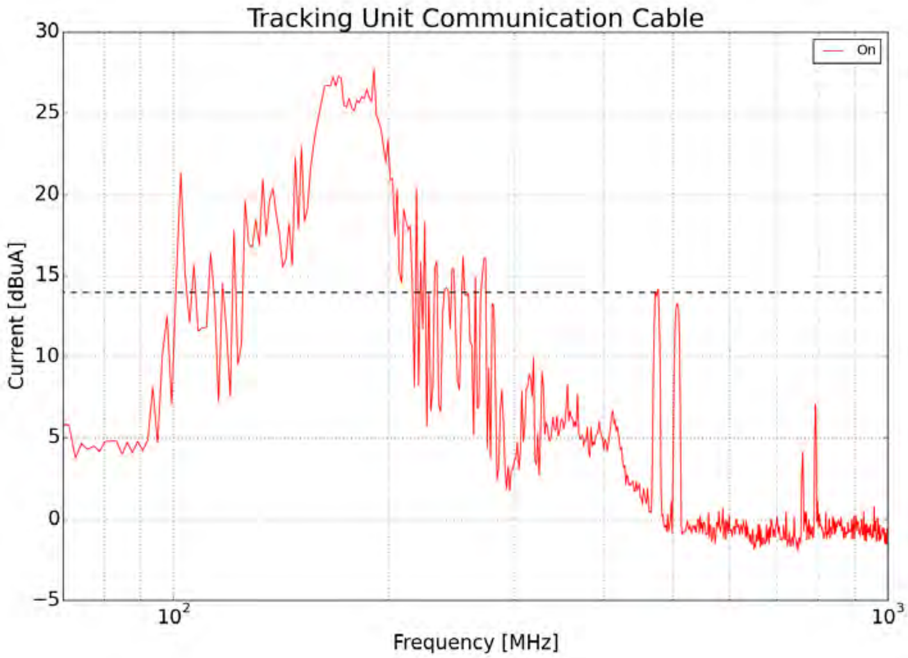


Figure 12: Frequency domain current probe measurements on Tracking Cabinet communication cable at Position 2 for the plant *ON* and in *STANBY* modes.

2.3.2 Time Domain Measurements

TD conducted measurements, focussing particularly on the *Tracking Unit* operation were made, as shown in Fig. 4. A typical TD transient pulse, as well as its corresponding Fast Fourier Transform (FFT) FD spectrum, captured on supply cables entering the cabinet of the unit at Position 1 with the RTA-3 and EMCO CM CP are shown in Fig. 13 and Fig. 14 respectively.

In both of the results shown above, the resultant spectrum gives the frequency content only associated with the particular pulse captured. The fast changing nature of the pulses cannot be captured using a conventional sweeping SA, so both TD and FD data have to both be considered. In the event of the supply cable that was measured, levels exceeding the CISPR equivalent current limit are seen from approximately 100 MHz across most of the frequency band. The pulse therefore suggests relatively strong transient events which will distribute to all cables closely spaced to this supply cable. A comparison with radiated results also measured in the TD in close proximity to the *Tracking Unit* are presented in Section 2.4.4.

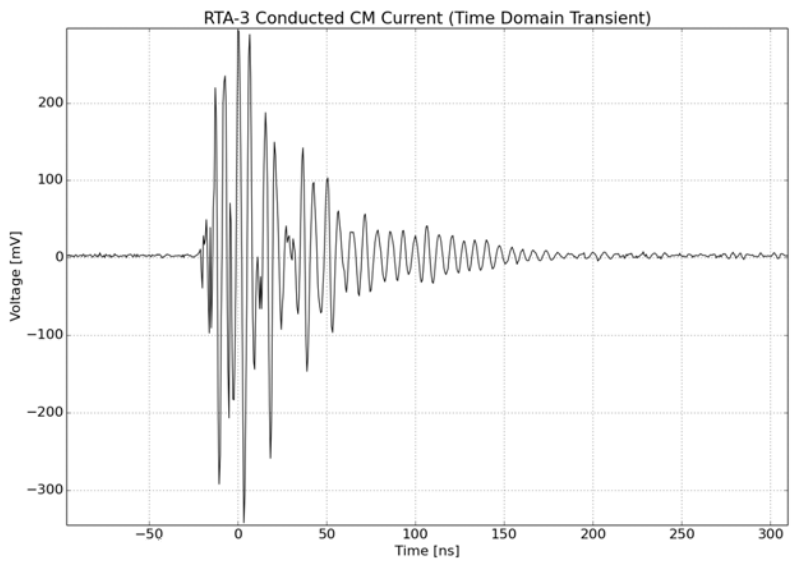


Figure 13: Typical CM current transient pulse captured with RTA-3 on supply cables to the Tracking Unit at Position 1.

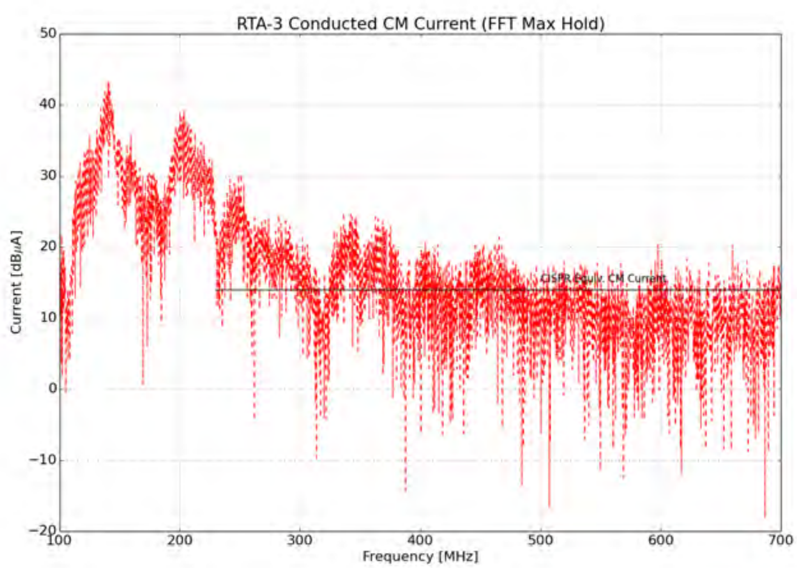


Figure 14: Equivalent Fast Fourier Transform spectrum for the conducted interference measured on supply cable to the Tracking Unit at Position 1.

2.4 Radiated Measurements

2.4.1 Frequency Domain Measurements

Inverters 22 and 23 Position 1

Radiated measurements were made in the TD and FD using the same conventional sweeping SA and RTA-3. A log periodic dipole array (LPDA) antenna in both active and passive modes were used as the receiver. Measurements were made between 70 MHz and 3.6 GHz, with measured voltage levels [dBμV] transformed into electric field (E-field) [dBμV/m] by incorporating the appropriate antenna factor (AF) values [dB/m].

Radiated measurements were made at Position 1 (Fig. 1) of Inverters 22 and 23 as well as the closest *Tracking* and *String Cabinets* at separation distances of 1, 3, 10 m as shown in Figs. 15 (a) and (b). Measurements were also made at Position 2 (Fig. 1) of the *Tracking Cabinet* at a location in the plant were fixed-line communication is used between the *Tracking Units*. A comparison of results for the two positions give an indication of the possible increased high frequency interference associated with the wireless communication network.

In addition to evaluating emissions as a function of distance, measurements were also made with the doors to the *Inverter* enclosures and *Tracking Cabinet* open. Both sets of results help to identify interference produced only by the plant. In all cases measurements were made during full power production (*ON*), and when no power was being generated (*STANDBY*) for both polarisations.

(a) (b)

Figure 15: Radiated measurements of (a) Inverter and Transformer units and (b) Tracking Cabinet.

Results as measured for *Inverters* 22 and 23 at Position 1 with the system *ON* and in *STANDBY* mode for both polarisations are given in Figs. 16 and 17. These results are with all doors to enclosures closed.

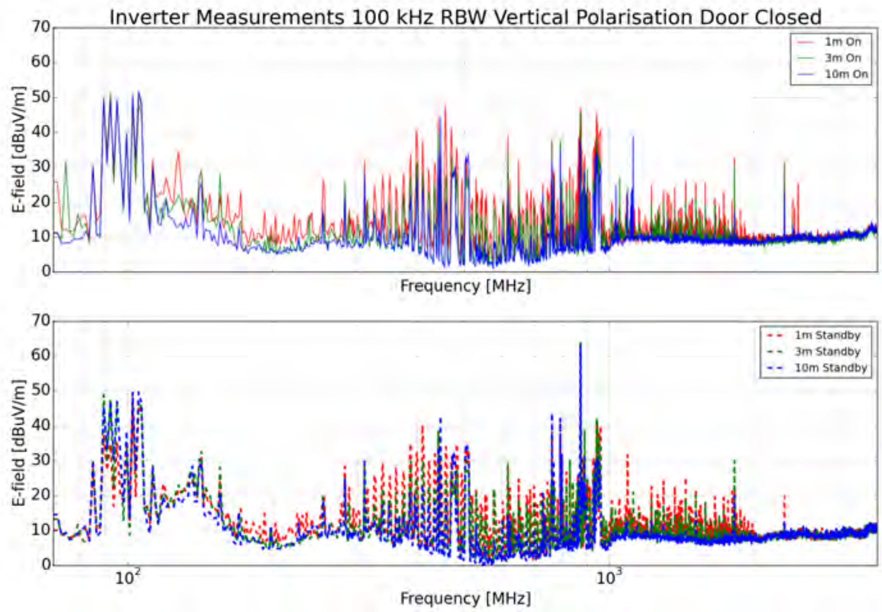


Figure 16: **Vertical** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Inverters at Position 1 for both *ON* and *STANDBY* modes of operation with door **closed**.

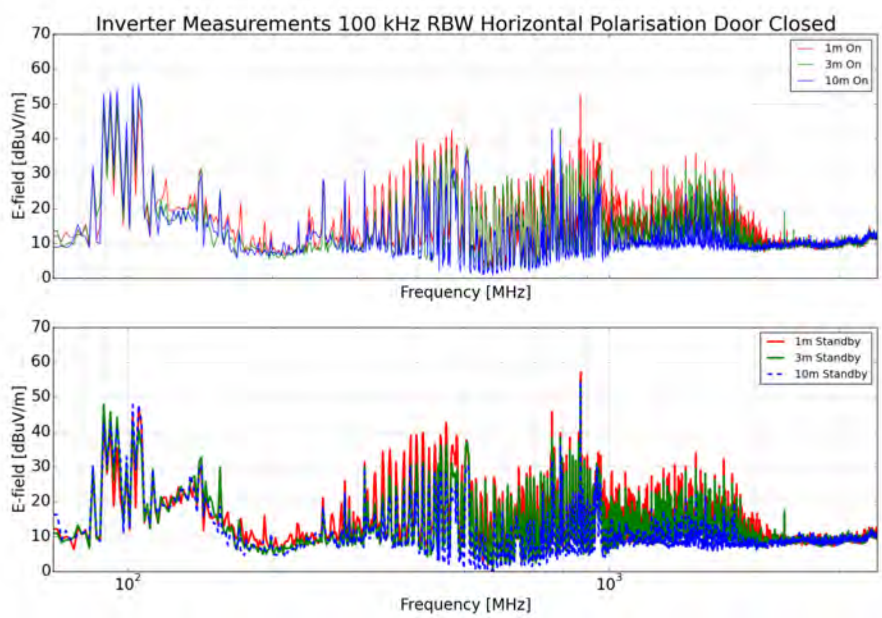


Figure 17: **Horizontal** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Inverters at Position 1 for both *ON* and *STANDBY* modes of operation with doors **closed**.

Similar levels of interference are measured for both polarisations, as well as for the plant *ON* and in *STANDBY* mode. Variation with distance can be seen from 300 MHz up to 2 GHz, and peak emission levels reach 48 dBμV/m at 1 m for vertical polarisation and 42 dBμv/m at 1 m for horizontal polarisation. A particularly strong emission at 872 MHz can be seen in all results shown.

Results for a repeat measurement as a function of distance, but with the doors to the *Inverter* enclosures open, are shown in Fig. 18 for vertical polarisation and in Fig. 19 for horizontal polarisation. In both cases results are shown for the plant *ON* and in *STANDBY* mode.

The comparison shows emission in the vertical polarisation to increase, especially between 1 and 2 GHz. Peak levels for vertical polarisations have increased to above 50 dBμV/m compared to 48 dBμV/m for the door closed. In the case of horizontal polarisation signal levels have increased by at least 10 dB for measurements with the inverter and transformer doors open. The variation with distance and level increase with the doors open, albeit less than expected at some frequencies, confirms the radiating source to be the *Inverters*.

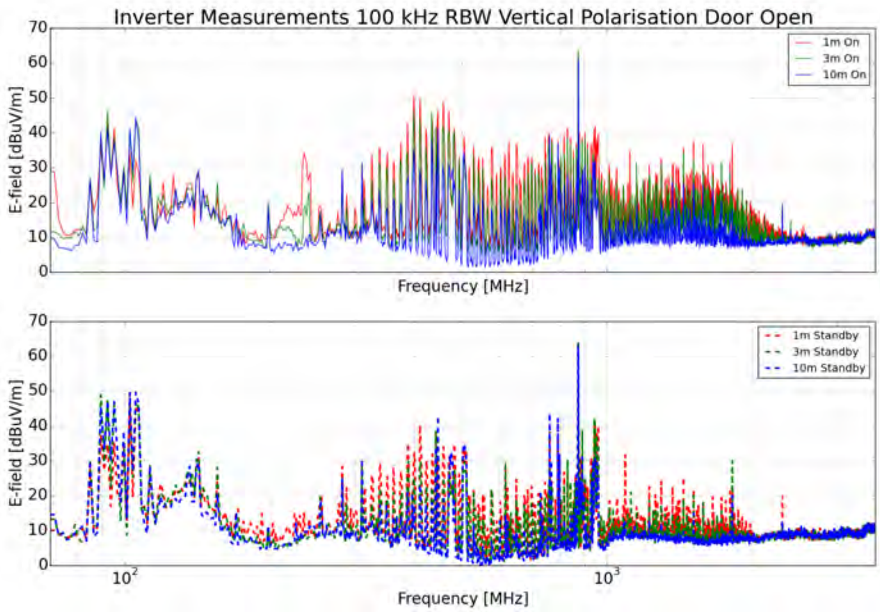


Figure 18: **Vertical** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Inverter at Position 1 for both *ON* and *STANDBY* modes of operation with doors **open**.

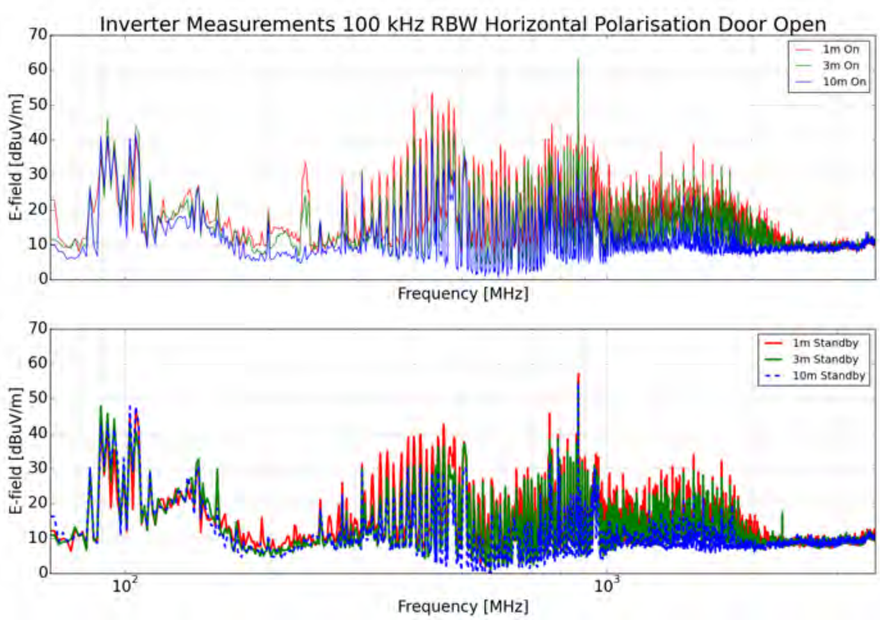


Figure 19: **Horizontal** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Inverters at Position 1 for both *ON* and *STANDBY* modes of operation with doors **open**.

Tracking Unit Position 1
Results measured for one of the *Tracking Units* at Position 1 with the plant *ON* and in *STANDBY* mode are given in Figs. 22 and 21. These results are for the door of the *Tracking Cabinet*, visible in Fig. 15(b), closed.

Peak interference levels for both polarisations can be seen around 250 MHz as well as between 500 MHz and 1 GHz. A decrease in amplitudes when moving away from the cabinet is also visible, but for some frequencies this is less than predicted free space loss. This can be attributed to the reflective nature of the surroundings and uncertainty about where the measurement point is in the far-field of the radiating source is. However, these measurements indicate specifically that the source has been correctly identified.

String Cabinet Position 1
Emissions from one of the *String Cabinets* at Position 1 with the plant *ON* and in *STANDBY* mode for both polarisations are given in Figs. 24 and 25. With the *String Cabinet* being made of fibre glass, measurements with the door open were not required, so only comparisons for 1, 3, and 10 m are given.

The spectrum shows predominantly wideband interference between 300 MHz and 800 MHz for both polarisations and with the plant *ON* and in *STANDBY* modes. Variation in amplitude when moving from 1 m to 10 m are between 14 dB and 16 dB for vertical polarisation, and between 7 dB and 15 dB for horizontal polarisation. This is less that the predicted 20 dB free space reduction, which again confirms the influence of the complex reflective environment between the panels. The precise source of radiating interference are therefore influential.

Tracking Cabinet Position 2
Below are results showing the difference in radiated emissions from the *Tracking Unit*'s cabinet as measured at Position 1 and 2 (Fig. 1). It shows the difference in radiated interference when comparing the wireless and fixed line communication systems that are implemented. Results are only shown for the plant *ON*. The measurements being compared were all made using a 100 kHz RBW with the cabinet door closed.

The comparison for both polarisations at all three separation distances clearly show more frequency content for the wireless implementation, especially between 500 - 700 MHz. Prominent wideband interference between 200 - 300 MHz are also not present for the fixed line implementation, suggesting that for purposes of radio interference mitigation, this would be a better implementation.

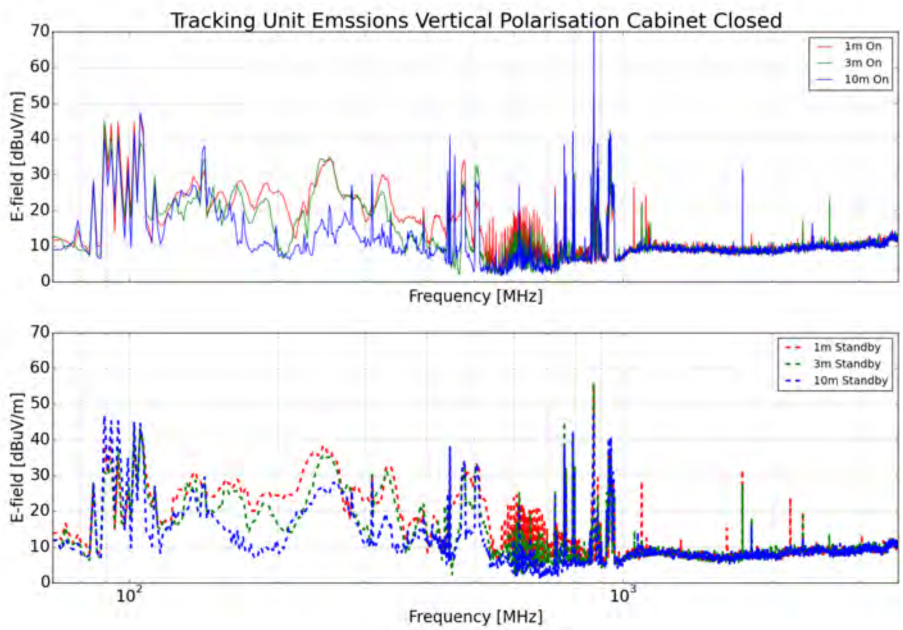


Figure 20: **Vertical** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Tracking Unit at Position 1 for both *ON* and *STANDBY* modes of operation with cabinet **closed**.

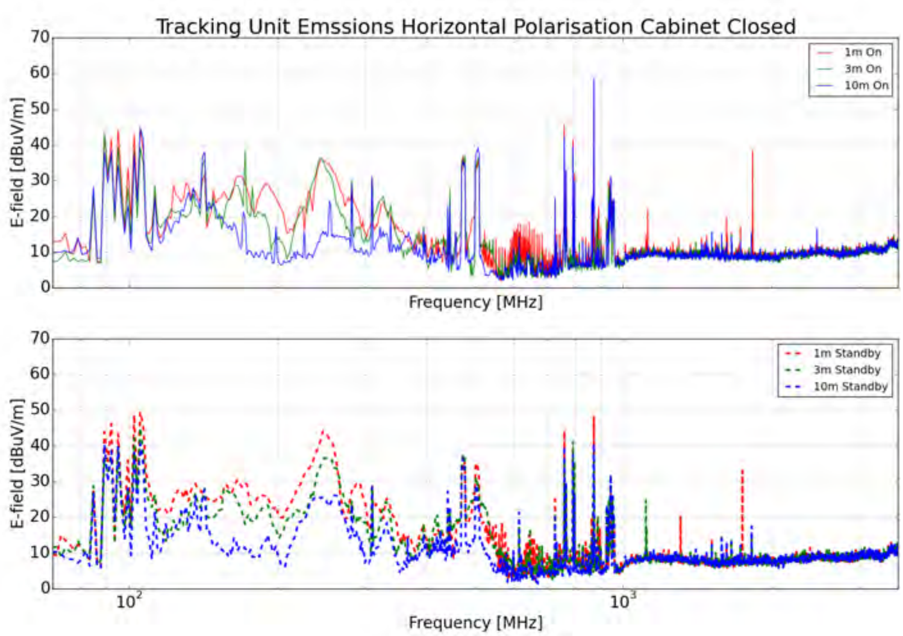


Figure 21: **Horizontal** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Tracking Unit at Position 1 for both *ON* and *STANDBY* modes of operation with cabinet **closed**.

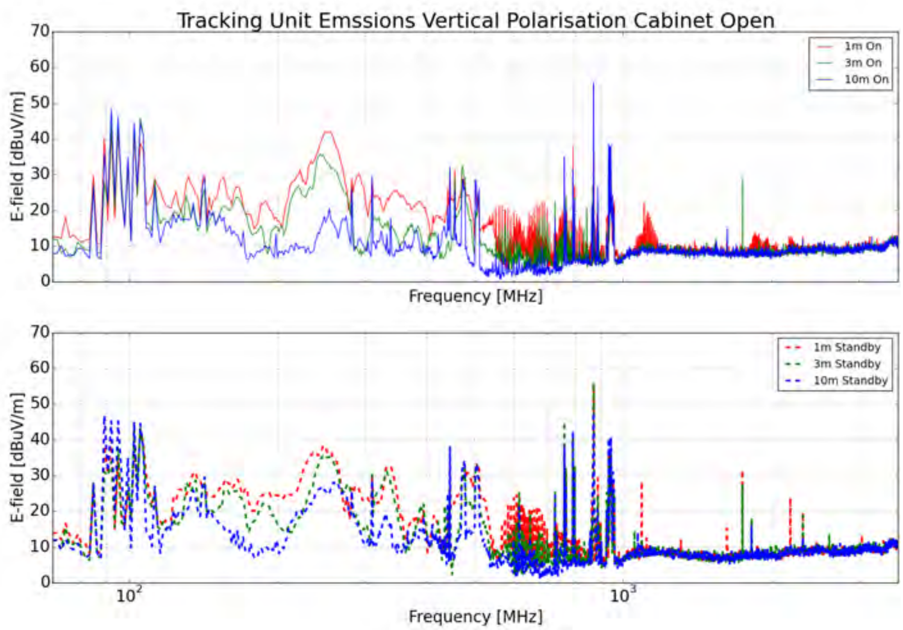


Figure 22: **Vertical** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Tracking Unit at Position 1 for both *ON* and *STANDBY* modes of operation with cabinet **open**.

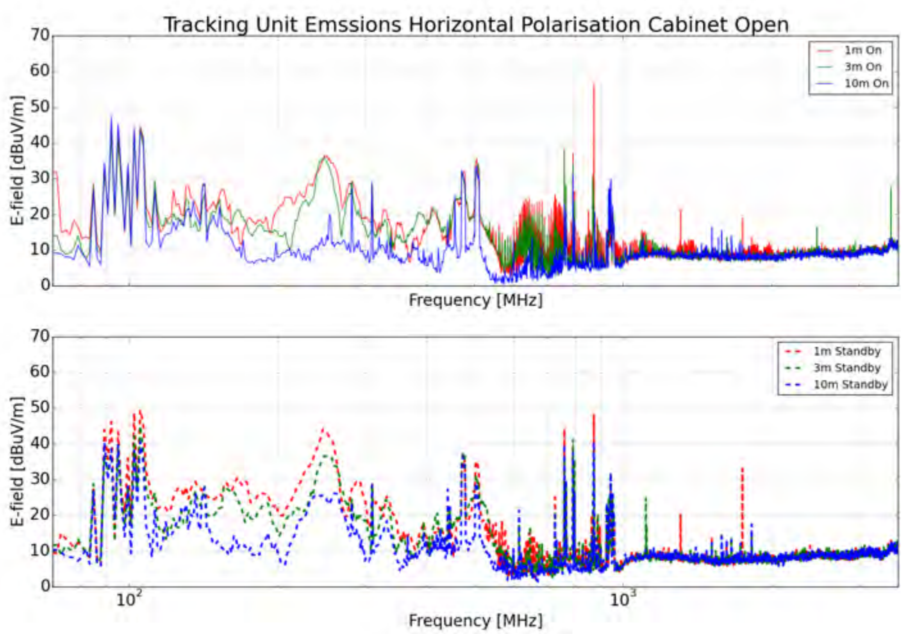


Figure 23: **Horizontal** polarisation E-field measurements at a distance of 1, 3 and 10 m form the Tracking Unit at Position 1 for both *ON* and *STANDBY* modes of operation with cabinet **open**.

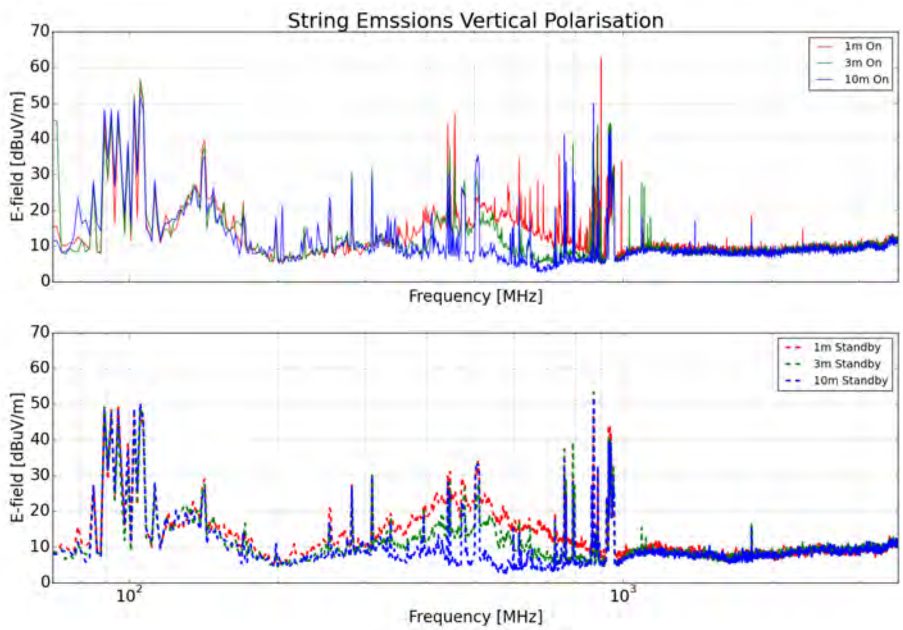


Figure 24: **Vertical** polarisation E-field measurements at a distance of 1, 3 and 10 m form the String Cabinet at Position 1 for both *ON* and *STANDBY* modes of operation.

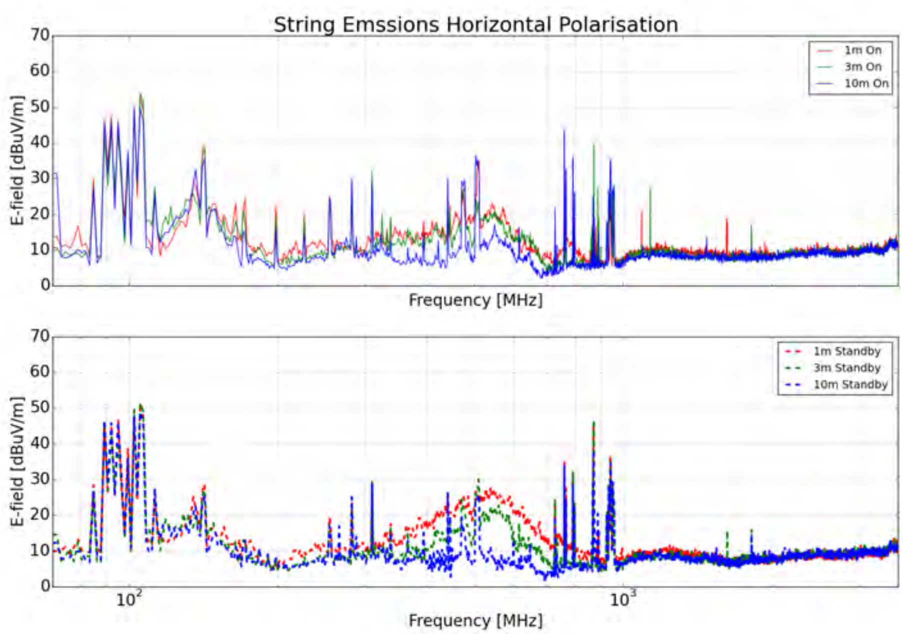
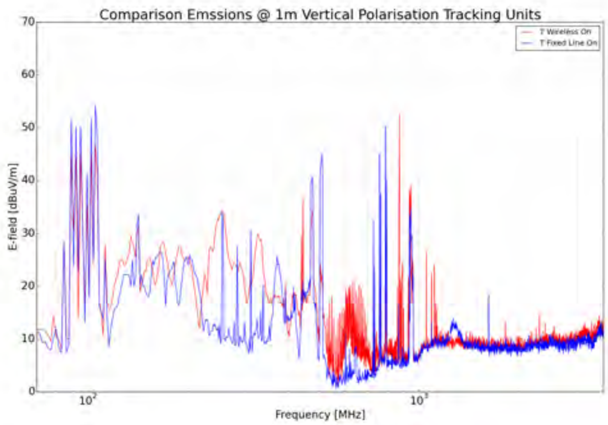
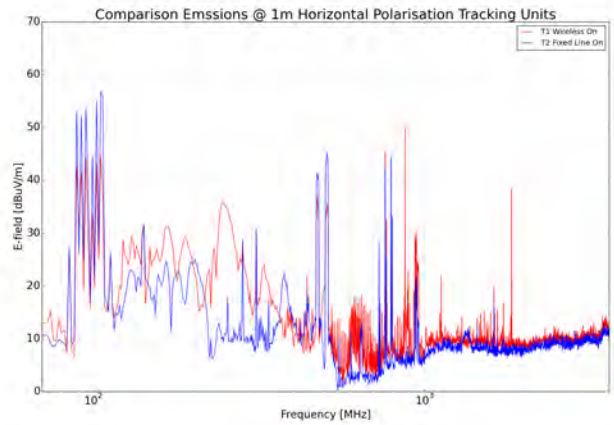


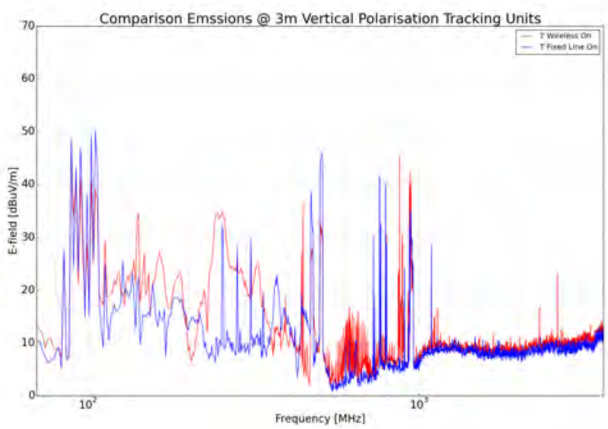
Figure 25: **Horizontal** polarisation E-field measurements at a distance of 1, 3 and 10 m form the String cabinet at Position 1 for both *ON* and *STANDBY* modes of operation.



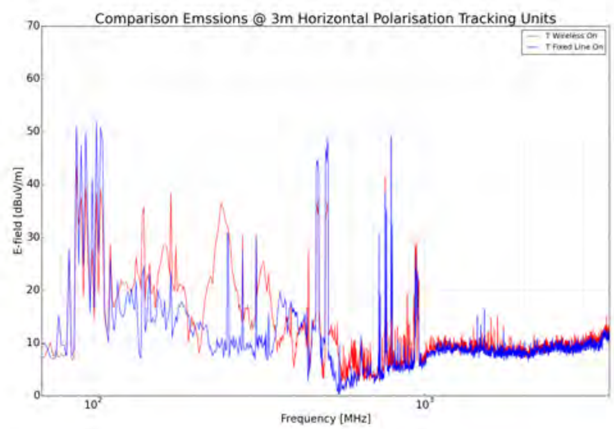
(a)



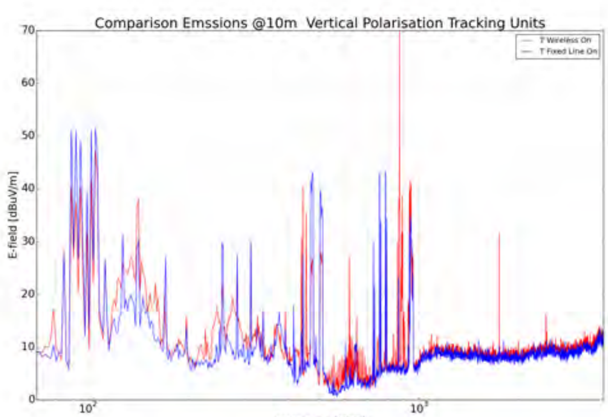
(b)



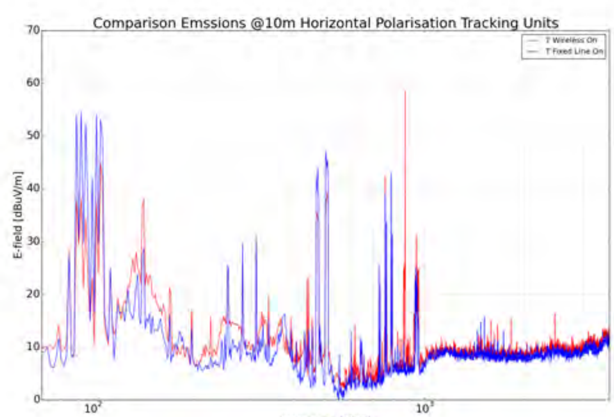
(c)



(d)



(e)



(f)

Figure 26: Comparison of radiated emissions measured for the Tracking Units at Position 1 and Position 2. Figures (a), (c) and (e) are for vertical polarisation at 1 m, 3 m, and 10 m and (b), (d) and (f) are for horizontal polarisation.

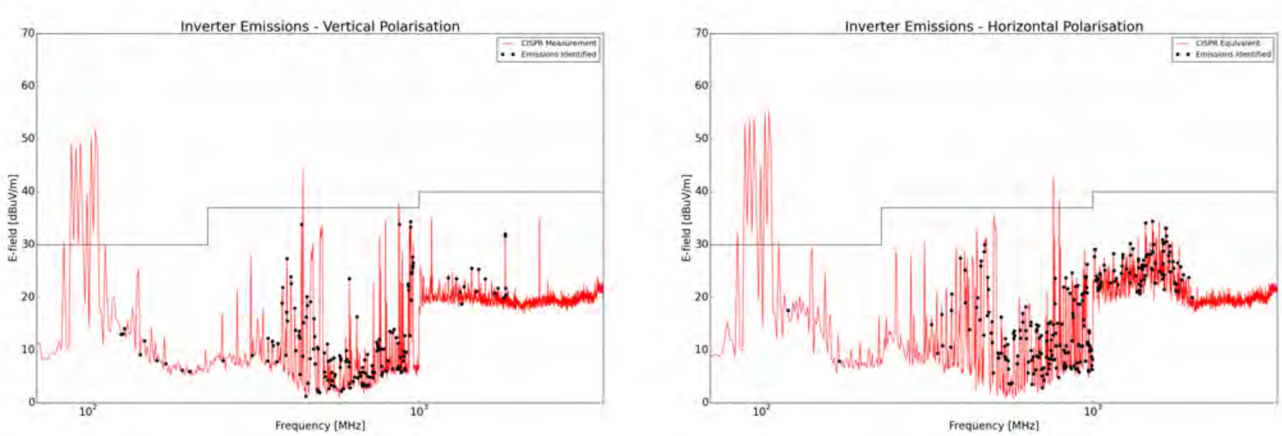
2.4.2 Interference Frequency Identification

Required for the subsequent propagation analysis are the maximum emission levels and associated frequencies identified to be generated by the plant. This is obtained by comparing emissions measured for the *Inverters*, *Tracking Units* and *String Cabinets* at 1, 3, and 10 m as discussed in Section 2.4. This is according to specifications in CISPR 11/22 Class B standard which is used as a well-known reference. It requires measurements at 3 m for frequencies above 1 GHz to use a 1 MHz RBW, and at 10 m below 1 GHz to use a 120 kHz RBW. The comparison to CISPR 11/22 Class B standard will subsequently be related to protection and saturation levels as specified by SKA-SA in [2].

To identify emissions generated by the plant, differences in measured levels at 1 m and 10 m are compared to the expected 20 dB free space path loss. However, from variations observed in the results in Section 2.4 due to the complex reflective environment, the 20 dB reduction was relaxed to 10 dB. The subsequent identified frequencies were then used in a second comparison of emissions measured at 3 m and 10 m, for which levels are expected to reduce by 10.46 dB. Again, considering the typical reduction seen in the radiated results, this criteria was relaxed to a 3 dB variation. All comparisons were were done using measurements made with a 100 kHz RBW, but the resulting frequency list in each case was used to identify the correct emission levels at 10 m for frequencies below 1 GHz (100 kHz RBW) and at 3 m for frequencies above 1 GHz (1 MHz RBW).

The results in Figs. 27 to 30 show both the total measured spectrum according to CISPR 11/22 Class B requirements as well as the plant-generated emissions using the search criteria just described for the *Inverters*, *Tracking Units* at both positions and *String Cabinet*. Included for reference purposes is the CISPR 11/22 Class B limit.

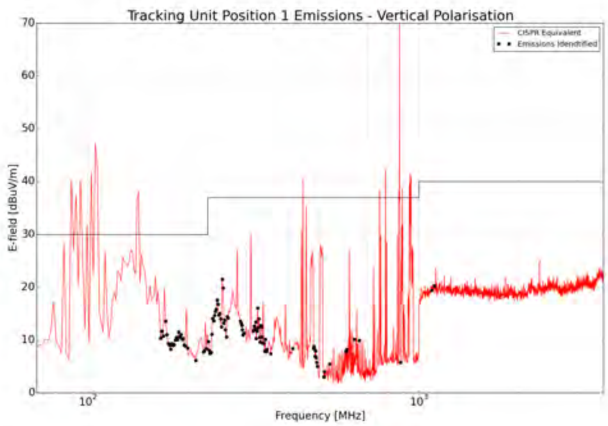
Inverters 22 and 23 Position 1



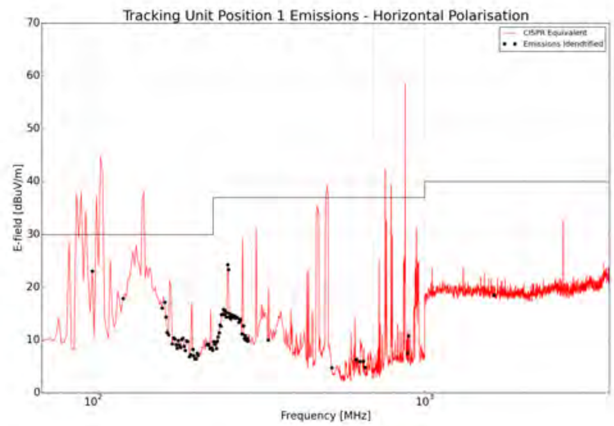
(a) (b)

Figure 27: Inverter radiated emissions as measured according to CISPR 11/22 Class B specifications identified for (a) vertical and (b) horizontal polarisations.

Tracking Unit Position 1



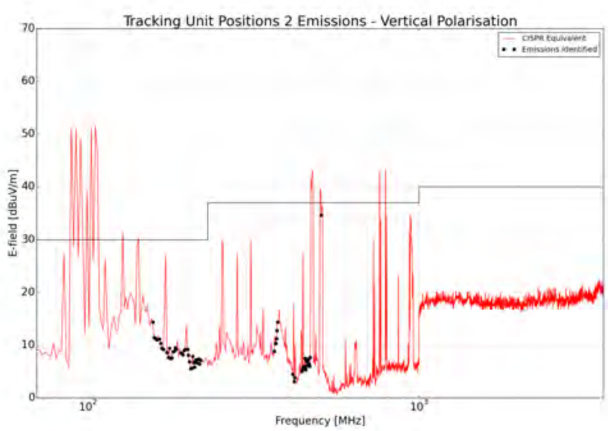
(a)



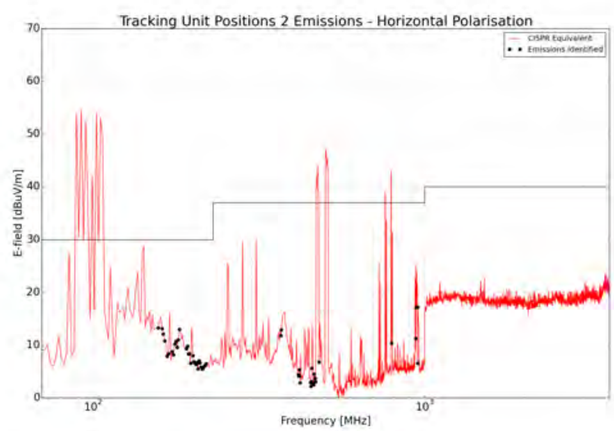
(b)

Figure 28: Tracking Unit at Position 1 radiated emissions as measured according to CISPR 11/22 Class B specifications identified for (a) vertical and (b) horizontal polarisations.

Tracking Unit Position 2



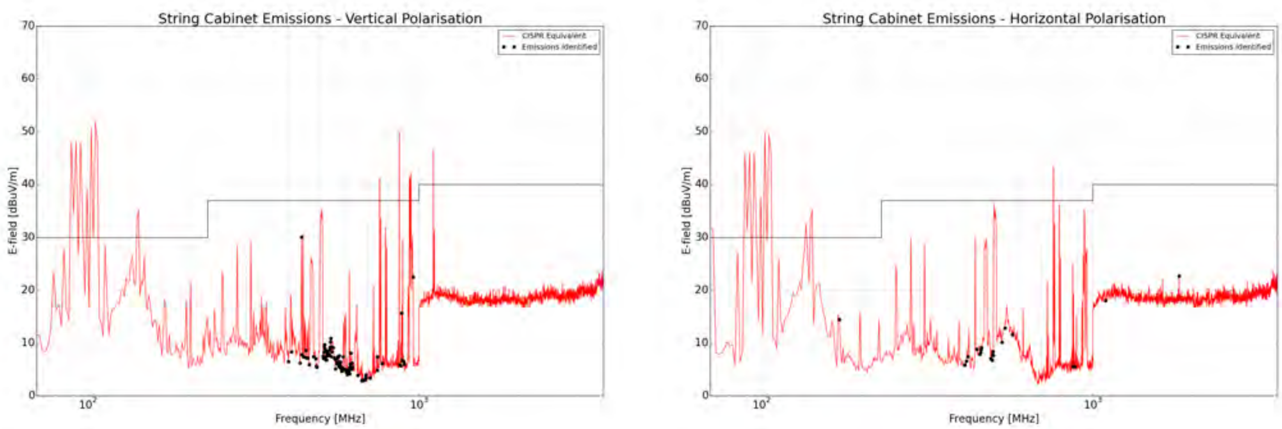
(a)



(b)

Figure 29: Tracking Unit at Position 2 radiated emissions as measured according to CISPR 11/22 Class B specifications identified for (a) vertical and (b) horizontal polarisation.

String Cabinet



(a) (b)

Figure 30: String Cabinet at Position 1 radiated emissions as measured according to CISPR 11/22 Class B specifications identified for (a) vertical and (b) horizontal polarisations.

2.4.3 CM Current and Radiated Emission Comparison

When comparing radiated with conducted FD results we make use of the identified peaks for the Position 1 *Tracking Unit* emissions presented in Fig. 28, but only focus on frequencies between 230 MHz and 1 GHz. The radiated results will be compared to conducted interference measured on the pressure switch cable shown in Fig. 9. Similarities can be seen in the narrowband conducted interference between 500 MHz and 700 MHz. The broadband conducted interference measured on the cable between 100 MHz and 300 MHz can be seen to exceed the equivalent CM current limit and should therefore produce radiated interference also exceeding the limit if a resonant cable length exist. With the majority of cables running below ground, however, this seem to attenuate resonant effects at the longer wavelengths and therefore do not radiate efficiently. Table 4 gives a comparison of the five frequencies identified in Fig. 28 between 500 MHz and 700 MHz.

The results in brackets are the difference between the measured level and theoretical 13.98 dBμA for conducted CM current interference, and 37 dBμV/m for E-field levels		
Frequency [MHz]	**CM Current [dBμA]**	**E-field V-pol [dBμV/m]**
536	-11.74 (-25.72)	5.4 (-31.6)
599	-9.5 (-23.47)	7.7 (-29.3)
603	-7.92 (-21.89)	8.1 (-28.9)
636	-8.31 (-22.28)	10.16 (-26.84)
660	9.98 (-27.02)	-8.81 (-22.78)

Table 4: Comparison of conducted and radiated emission levels based on theoretically predicted levels for the Tracking Unit at Position 1.

DIRECTORS: H. C. Reader, A. J. Otto and P. S. van der Merwe | www.mesasolutions.co.za | EMAIL: info@mesasolutions.co.za
REG NO: 2002/025186/07 | POSTAL ADDRESS: P.O. Box 12572, Die Boord, Stellenbosch, 7613

A second comparison between conducted and radiated interference is shown Table 5 for the communication cable of the *Tracking Unit* at Position 2. For this comparison the identified radiated emissions, shown in Fig. 29 between 230 MHz and 1 GHz, were again used. In some cases the identified frequencies give measured levels close to or on the noise floor of the instrument. These were therefore not considered as they might not be accurate in amplitude.

The results in brackets are the difference between the measured level and theoretical 13.98 dBμA for conducted CM current interference, and 37 dBμV/m for E-field levels		
Frequency [MHz]	**CM Current [dBμA]**	**E-field V-pol [dBμV/m]**
373	5.05 (-8.93)	14.33 (-22.67)
451	1.59 (-12.39)	7.49 (-29.51)
459	2.02 (-11.96)	7.3 (-29.7)
506	13.20 (-0.78)	35.1 (-1.9)

Table 5: Comparison of conducted and radiated emission levels based on theoretically predicted levels for the Tracking Unit at Position 2.

It is clear that for measurements at both positions, significant levels of low frequency broadband interference visible between 100 MHz and 300 MHz do not radiate very efficiently. They exceed the equivalent current limit as indicated, but do not produce radiated interference that exceed the indicated CISPR 11/22 Class B limit by the same amount. For the *Tracking Unit* at Position 1 the results in Table 4 show better agreement between conducted and equivalent radiated levels (taking into account the reflective environment for frequencies between 500 MHz and 700 MHz). The difference in measured levels compared to the limits for both conducted and radiated interference are within an acceptable margin. This confirms that this interference originates at the *Tracking Unit* and associated systems.

The measurements of the *Tracking Unit* at Position 2, which incorporates the fixed line communication, again show significant levels of low-frequency conducted interference with reduced levels between 500 MHz and 700 MHz. In this case, however, none of the spectral content in the CM results seem to radiate efficiently when considering the levels in Table 5. Only at 506 MHz is there acceptable correlation with no frequencies identified beyond this point. The results therefore confirm that while high levels of conducted CM current are present at both positions, they are not efficiently converted to radiated interference. High frequency conducted noise is less for the fixed line communication and therefore are not being radiated.

2.4.4 Time Domain Measurements

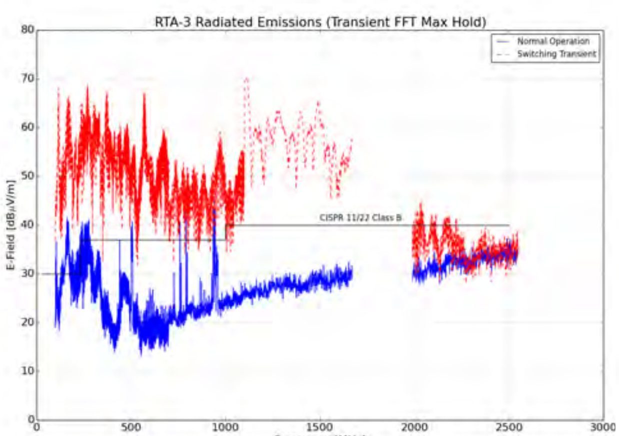
Tracking Units Position 1 and Position 2

A big concern is the switching noise generated every time the plant starts tracking. The system makes use of hydraulic rams which is operated by a small hydraulic pump located inside the hydraulic fluid reservoir located on top of each ram. The reservoir, a fully metallic enclosure, provides some level of attenuation of radiated interference generated by the pump. A cable still supplies the pump with power through a hole on top of the reservoir, but this can be mitigated.

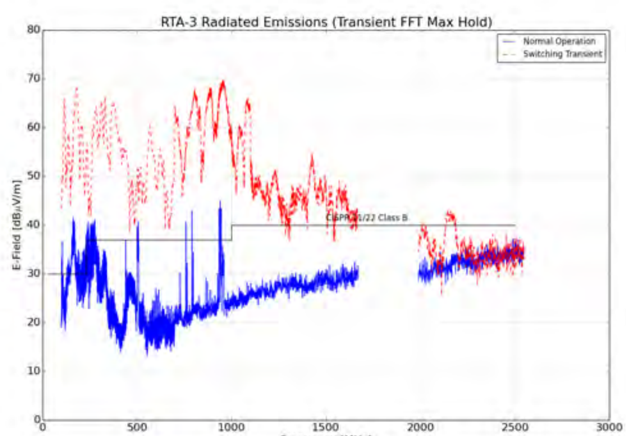
A bigger contributor to transient interference is the switching contactor that operates the pump. An arcing effect can clearly be seen each time the pump switches on and off, and this produces wideband interference. Measurements were made at Position 1 and 2 as shown in Fig. 31. Typical spectrums when the plant is tracking compared to when it is stationary are shown in Fig. 32 (a) and (b) for vertical and horizontal polarisation respectively.

Peak level for measurements conducted at Position 1 are between 60 and 70 dBμV/m as measured at 1 m. This will however be influenced by likely near-field coupling. Transforming these levels to 10 m using the free space propagation loss, and accounting for a difference in RBW between the sweeping analyser and RTA-3 of approximately 7 dB, produce levels between 33 and 43 dBμV/m @ 10 m. A comparison with identified interference for the *Tracking Unit* at Position 1, given in Fig. 28, show higher levels in the TD. It should be considered that a sweeping analyser is inefficient at capturing transient events. The significance of these results should be the broadband nature of the interference.

Figure 31: Radiated time domain measurements of Tracking unit.



(a)



(b)

Figure 32: Time domain radiated interference associated with the switching of the hydraulic pump to move the panels. The results can be seen for the system operating and stationary for (a) vertical polarisation and (b) horizontal polarisation as measured at Position 1.

A second measurement was done for the *Tracking Unit* at Position 2 making use of a fixed line communication. The radiated measurements were, however, made at a separation distances of 10 and 30 m to determine how efficiently the interference propagate with distance. This was again done with the system tracking and stationary, and the results are shown in Fig. 33. The absence of a trace for the system tracking below is because no reliable triggering of of interference from the plant could be established.

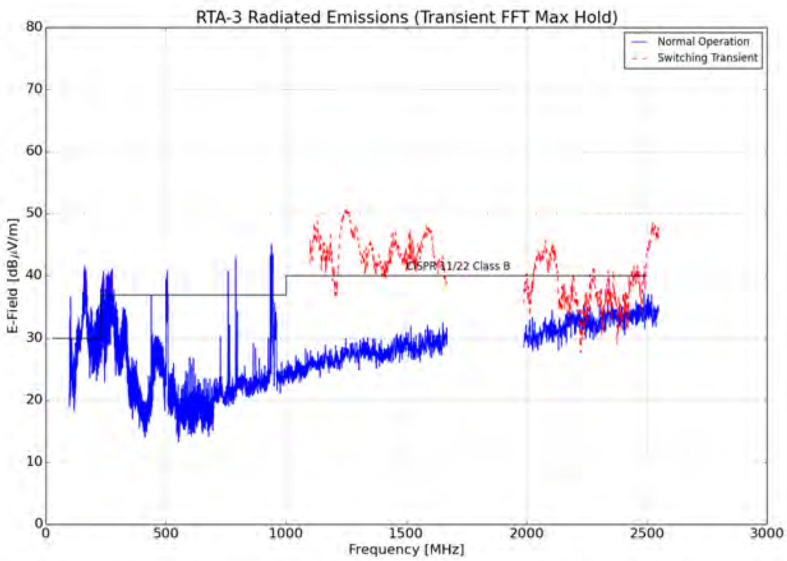


Figure 33: Time domain radiated interference associated with the switching of the hydraulic pump to move the panels. The results can be seen for the system operating and stationary for vertical polarisation as measured at Position 2.

2.5 Electric Fence Measurements

A radiate time domain pulse produced by a loose wire on the electric fence surrounding the PV plant (Fig. 36) are shown in Fig. 34. The equivalent FFT spectrum is given in Fig. 35.

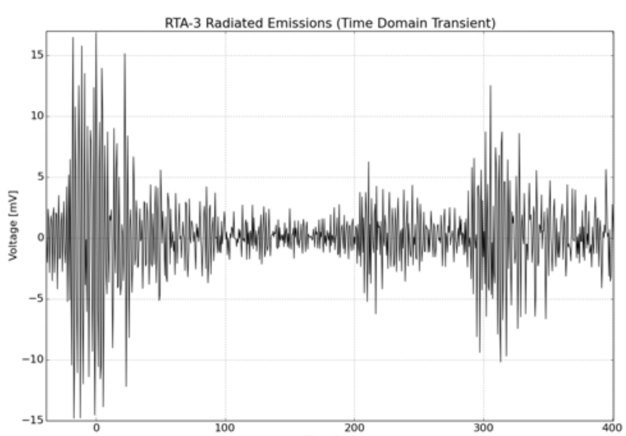


Figure 34: Radiated time domain pulse measured for a loose wire of the electric fence.

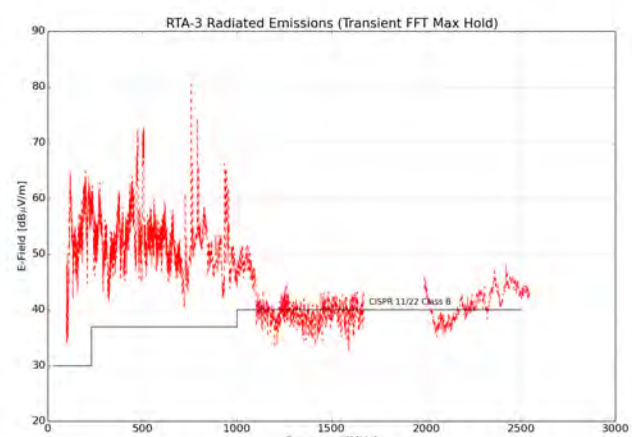


Figure 35: Equivalent Fast Fourier Transform spectrum for the radiated interference associated with a sparking electric fence.

Figure 36: Electric fence surrounding the perimeter of the Dreunberg PV plant.

Significant interference above the CISPR 11/22 Class B limit can be seen. While this is not directly associated with the operation of the plant, it will likely also be built on the proposed sites and could produce problematic levels of broadband interference.

2.6 Administration Building Emissions

An additional measurement of possible RFI culprits located at the Administration building (Fig. 37) were measured and the result is shown in Fig. 38. The results from this investigation are not meant to be comprehensive as it is unclear whether an Administration building will ultimately be built on the proposed site locations. This does, however, show some of the interference typically associated with such a building.

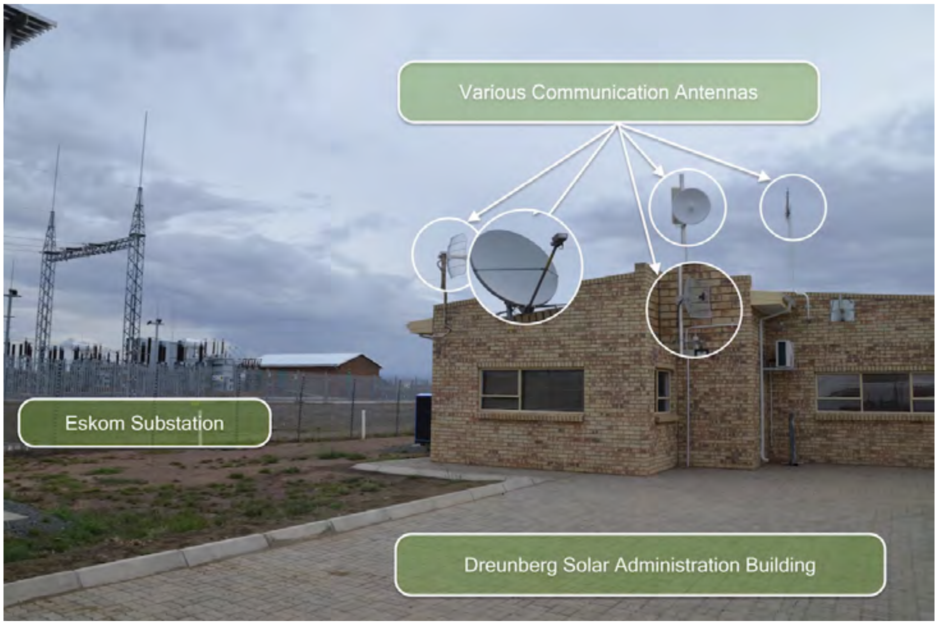


Figure 37: Administration building with potential RFI culprits

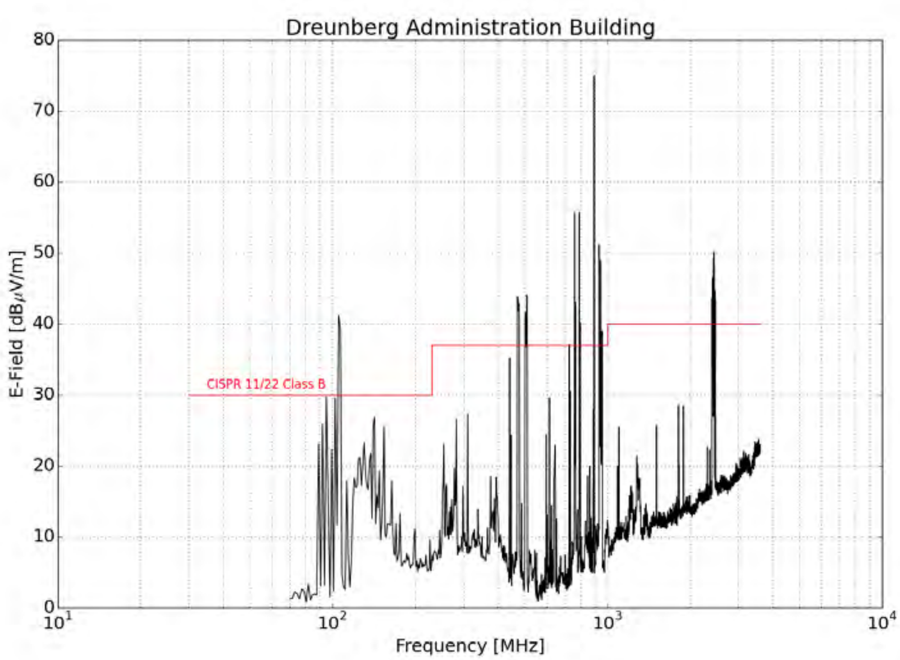


Figure 38: Radiated frequency domain emissions of the Administration building as measured at 10 m.

2.7 Discussion

2.7.1 Conducted Measurements

TD conducted measurements on supply cables to the *Tracking Unit* at Position 1 show large pulses when the plant is *ON*. When considering the FD content of these captured TD pulses (by applying the FFT), the majority of the energy extends up to at least 500 MHz. Equivalent FD measurements, particularly on the wireless antenna and pressure switch cables, agree with this, and additionally show trace peaks at frequencies around 150 MHz and 250 MHz. The higher frequencies seem to radiate into the environment more efficiently as confirmed by comparison with radiated results.

Conducted measurements, again made on the *Tracking Unit* at Position 2, still show significant levels of low frequency interference, but less higher frequency noise. This would indicate that the majority of the noise is likely to be in the vicinity of the inverter. The *Tracking Unit* emissions are somewhat aggravated by the wireless communication method. This is again confirmed with the radiated measurements.

Switching noise associated with the tracking of the panels, which were measured as conductive interference on cables connected to the *Tracking Unit* creates broadband interference. This happens both when the tracking pump switches *ON* and produces multiple pulses when it switches *OFF*. While some of the interference could be generated by the hydraulic pump, the majority is believed to be generated by the pump contactor.

2.7.2 Radiated Measurements

Radiated results for the plant *ON* and in *STANDBY* mode generally show similar emissions levels, confirming that interference producing systems are never completely *OFF*. Emissions associated with the *Inverter* units are dominant and occupy frequencies between 300 MHz and 2 GHz. Peak levels identified range between 30 - 35 dBμV/m as measured at 10 m below 1 GHz and at 3 m above 1 GHz for both polarisations.

Results for the *Tracking Unit* measured at Position 1 (wireless communication) show dominating frequencies around 250 MHz, with some additional components identified between 500 MHz and 1 GHz. Peak levels are again similar for both polarisations and are lower than *Inverter* emissions at 20 - 25 dBμV/m as measured at 10 m below 1 GHz and at 3 m above 1 GHz. In the case of emissions measured for the *Tracking Unit* at Position 2 (fixed line communication), broadband interference are present between 200 MHz and 300 MHz, and narrowband interference visible between 500 MHz and 700 MHz. Levels are lower by at least 10 dB, but this is only because of the limit in measurement sensitivity at 10 m. The results in Figs. 29 (a) and (b) show levels for many of the identified interference which are close to the measurement noise floor. Their exact levels can therefore be lower if sensitivity is improved. It shows that for purposes of RFI mitigation, the fixed line communication would be the preferred implementation.

The *String Cabinet* shows mostly broadband interference between 300 MHz and 800 MHz for both polarisations. Identified levels are again close to the measurement noise floor, with an exception at 440 MHz. The levels there are 30 dBμV/m.

Comparative measurements made with the doors to the *Inverters* and *Tracking Units* open not only helps to identify interference generated by the plant, but also show the limited levels of shielding provided by these enclosures. It is therefore possible to improve the shielding by incorporating conductive gasketting around the edges of the door and properly defining cable interfaces. This will help to reduce the level of radiated interference emitted by the devices. Radiated TD measurements of the *Tracking Units* at Position 1 and 2 show broadband interference across the 3.6 GHz frequency range. Levels of between 33 and 43 dBμV/m can be expected at 10 m. The main contributor is believed to be the switching relays and contactor inside the *Tracking Cabinet*. This, however, can be improved by proper shielding of the cabinet interfaces and apertures.

3 Site Location Data

The proximity of the proposed PV plant locations to the closest and core-site SKA telescopes are shown in Figs. 39 to 49, while separation distances, azimuth angles, transmitter and receiver heights for preferred and alternative site locations are given in Tables 6 to 24.

3.1 Scatec PV1, PV2 and PV3

Scatec PV1 Pref	**Closest Telescope 1**	**Closest Telescope 2**	**SKA Core Site**
Distance	20.92 km	56.60 km	169.79 km
Azimuth	86.21 ^{o}	163.45 ^{o}	173.55 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

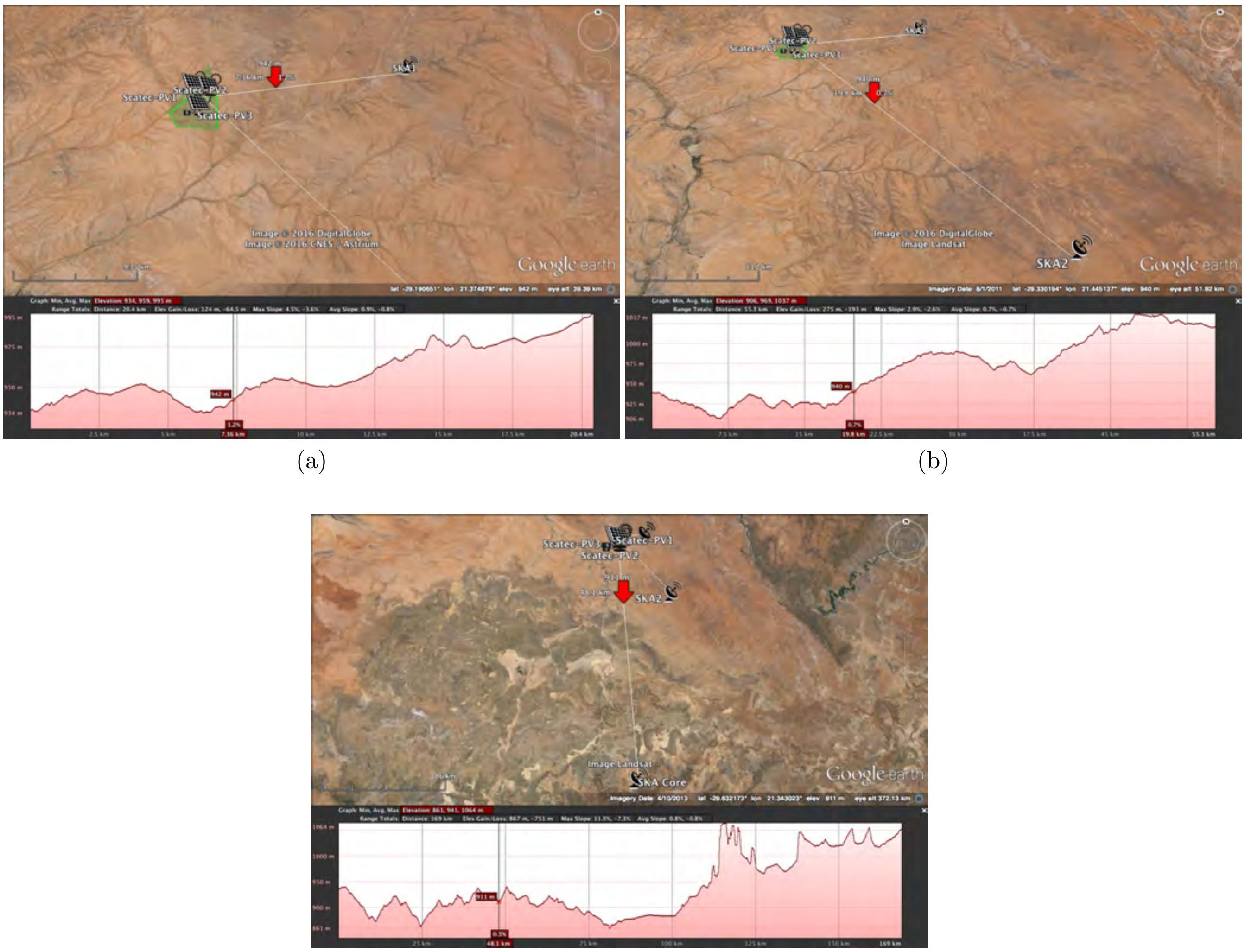
Table 6: Specifications of location Scatec PV1 solar farm relative to the SKA core and closest telescopes.

Scatec PV2 Pref	**Closest Telescope 1**	**Closest Telescope 2**	**SKA Core Site**
Distance	19.43 km	55.30 km	169.33 km
Azimuth	83.77 ^{o}	163.86 ^{o}	174.24 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 7: Specifications of location Scatec PV2 solar farm relative to the SKA core and closest telescopes.

Scatec PV3 Pref	**Closest Telescope 1**	**Closest Telescope 2**	**SKA Core Site**
Distance	20.57 km	54.09 km	167.02 km
Azimuth	75.12 ^{o}	162.75 ^{o}	173.91 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 8: Specifications of location Scatec PV3 solar farm relative to the SKA core and closest telescopes.

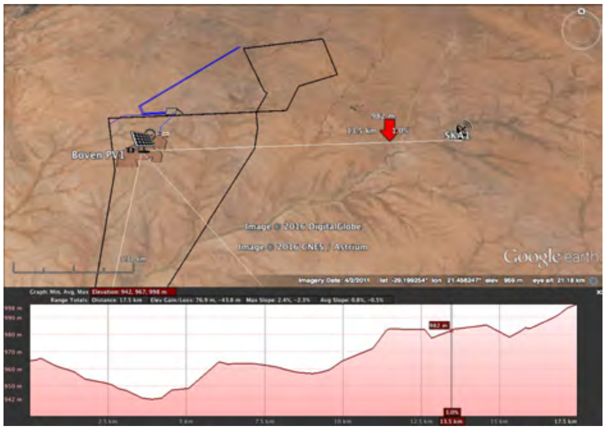


(a) (b)

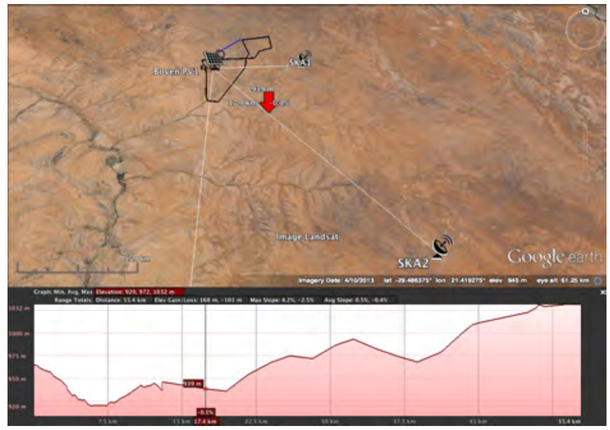
(c)

Figure 39: Google Earth terrain profile for Scatec PV1 to PV3 to (a) closest and (b) second closest and (c) core SKA telescopes.

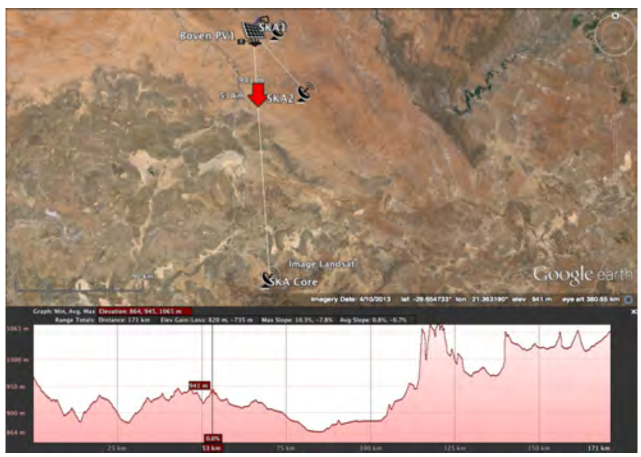
3.2 Boven PV1



(a)



(b)



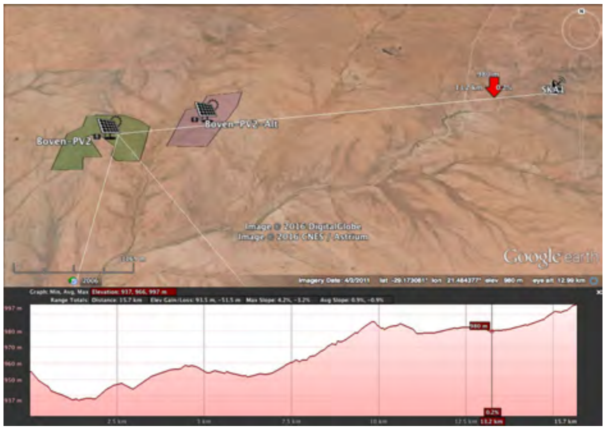
(c)

Figure 40: Google Earth terrain profile for Boven PV1 to (a) closest and (b) second closest and (c) core SKA telescopes.

Boven PV1	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	17.37 km	55.45 km	171.10 km
Azimuth	90.92 ^{o}	165.13 ^{o}	175.10 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 9: Specifications of location Boven PV1 solar farm relative to the SKA core and closest telescopes.

3.3 Boven PV2



(a)

(b)

(c)

Figure 41: Google Earth terrain profile for Boven PV2 to (a) closest and (b) second closest and (c) core SKA telescopes.

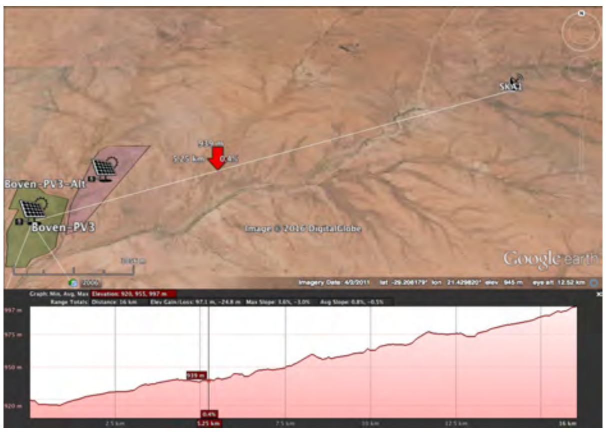
Boven PV2 Pref	**Closest Telescope 1**	**Closest Telescope 2**	**SKA Core Site**
Distance	15.00 km	52.46 km	169.08 km
Azimuth	80.68 ^{o}	140.60 ^{o}	177.13 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 10: Specifications of **preferred** location Boven PV2 solar farm relative to the SKA core and closest telescopes.

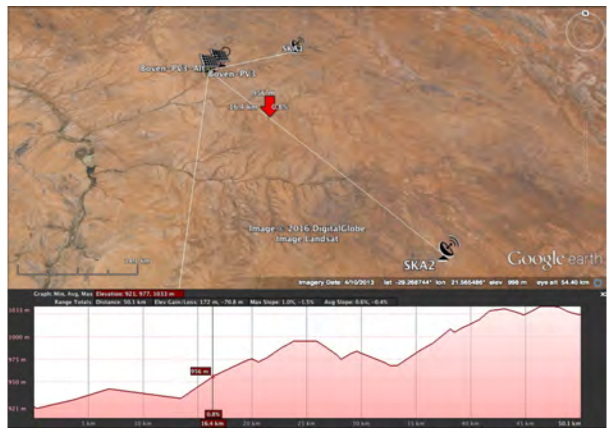
Boven PV2 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	12.52 km	52.07 km	170.30 km
Azimuth	84.93 ^{o}	143.50 ^{o}	177.93 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 11: Specifications of **alternative** location Boven PV2 solar farm relative to the SKA core and closest telescopes.

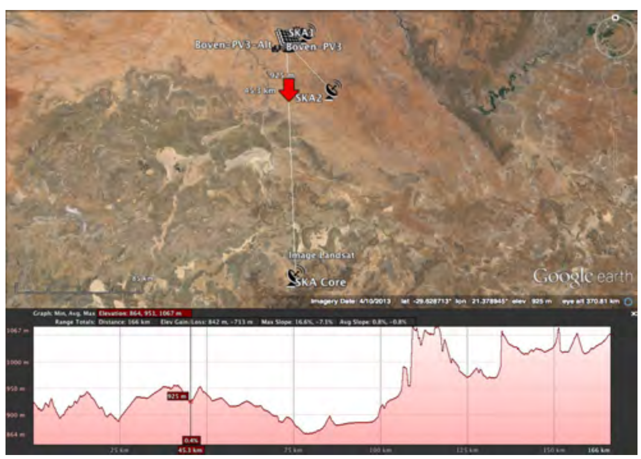
3.4 Boven PV3



(a)



(b)



(c)

Figure 42: Google Earth terrain profile for Boven PV3 to (a) closest and (b) second closest and (c) core SKA telescopes.

Boven PV3 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	15.69 km	50.06 km	166.01 km
Azimuth	69.50 ^{o}	138.46 ^{o}	177.11 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 12: Specifications of **preferred** location Boven PV3 solar farm relative to the SKA core and closest telescopes.

Boven PV3 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	13.79 km	50.41 km	167.63 km
Azimuth	73.94 ^{o}	140.96 ^{o}	177.63 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 13: Specifications of **alternative** location Boven PV3 solar farm relative to the SKA core and closest telescopes.

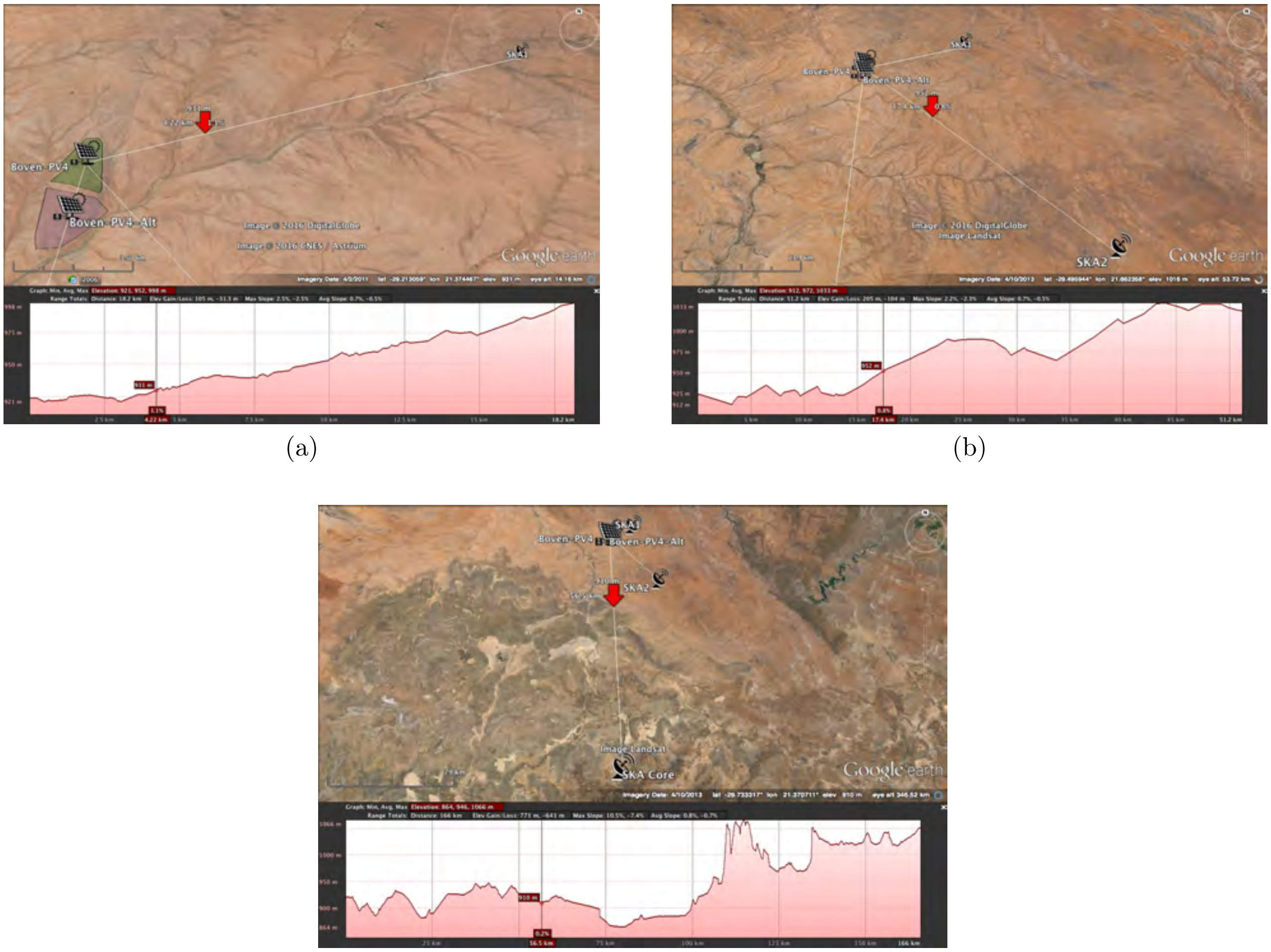
3.5 Boven PV4

Boven PV4 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	17.94 km	51.16 km	165.60 km
Azimuth	70.38 ^{o}	136.24 ^{o}	176.36 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 14: Specifications of **preferred** location Boven PV4 solar farm relative to the SKA core and closest telescopes.

Boven PV4 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	18.72 km	49.62 km	163.48 km
Azimuth	64.21 ^{o}	134.58 ^{o}	176.32 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 15: Specifications of **alternative** location Boven PV4 solar farm relative to the SKA core and closest telescopes.



(a) (b)

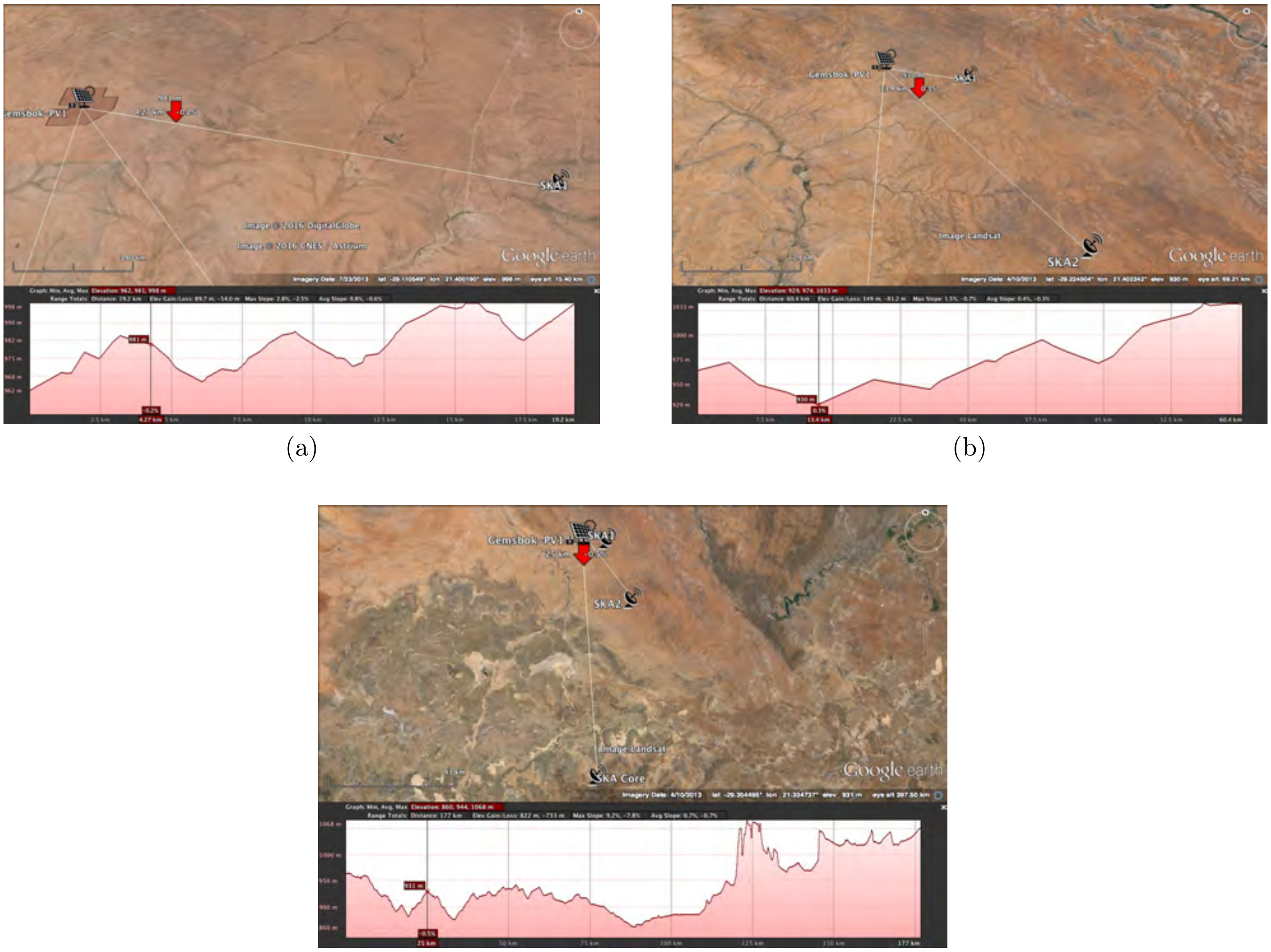
(c)

Figure 43: Google Earth terrain profile for Boven PV4 to (a) closest and (b) second closest and (c) core SKA telescopes.

3.6 Gemsbok PV1

Gemsbok PV1	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	19.12 km	60.45 km	176.67 km
Azimuth	113.77 ^{o}	166.26 ^{o}	174.59 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 16: Specifications of location Gemsbok PV1 solar farm relative to the SKA core and closest telescopes.



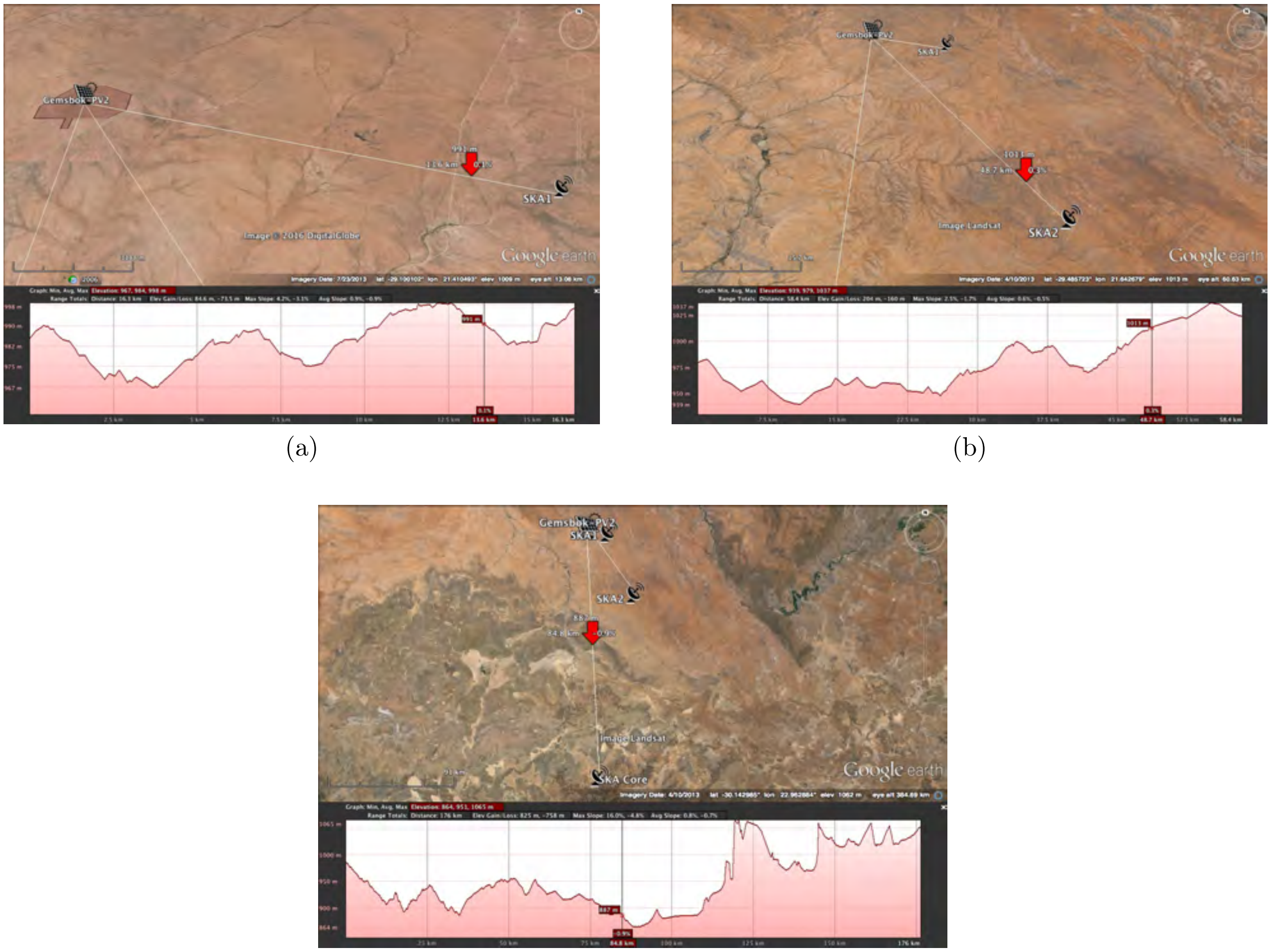
(a) (b) (c)

Figure 44: Google Earth terrain profile for Gemsbok PV1 to (a) closest and (b) second closest and (c) core SKA telescopes.

3.7 Gemsbok PV2

Gemsbok PV2	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	16.14 km	58.41 km	176.19 km
Azimuth	115.27 ^{o}	167.15 ^{o}	175.95 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 17: Specifications of location Gemsbok PV2 solar farm relative to the SKA core and closest telescopes.



(a) (b) (c)

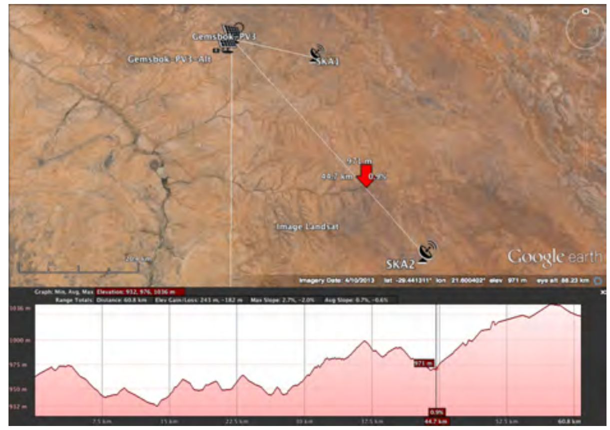
Figure 45: Google Earth terrain profile for Gemsbok PV2 to (a) closest and (b) second closest and (c) core SKA telescopes.

3.8 Gemsbok PV3

Gemsbok PV3 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	19.46 km	61.16 km	177.36 km
Azimuth	106.87 ^{o}	142.65 ^{o}	176.05 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 18: Specifications of **preferred** location Gemsbok PV3 solar farm relative to the SKA core and closest telescopes.

(a)



(b)

(c)

Figure 46: Google Earth terrain profile for Gemsbok PV3 to (a) closest and (b) second closest and (c) core SKA telescopes.

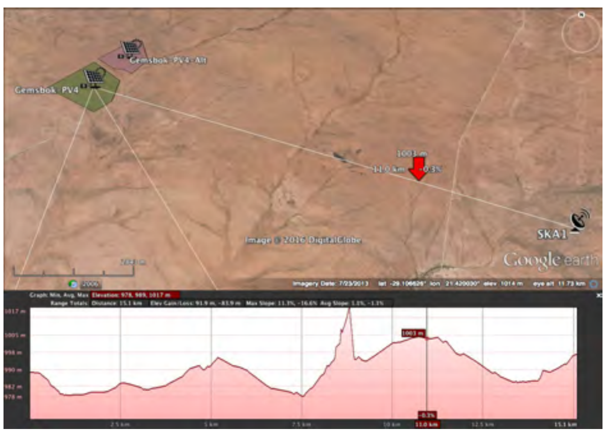
Gemsbok PV3 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	19.53 km	59.47 km	174.71 km
Azimuth	98.67 ^{o}	140.55 ^{o}	175.77 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 19: Specifications of **alternative** location Gemsbok PV3 solar farm relative to the SKA core and closest telescopes.

3.9 Gemsbok PV4

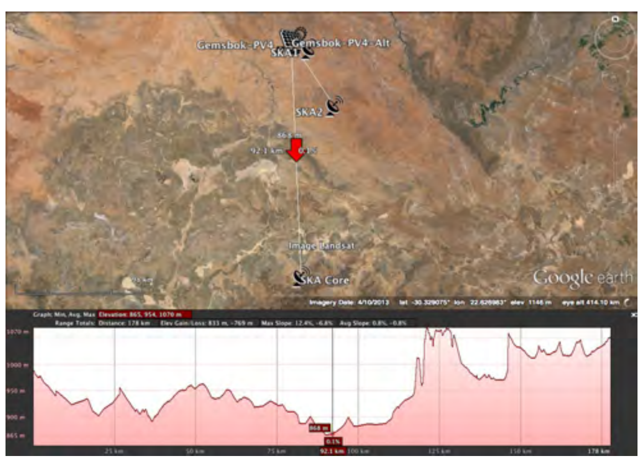
Gemsbok PV4 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	15.24 km	58.87 km	177.62 km
Azimuth	113.85 ^{o}	146.57 ^{o}	177.54 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 20: Specifications of **preferred** location Gemsbok PV4 solar farm relative to the SKA core and closest telescopes.



(a)

(b)



(c)

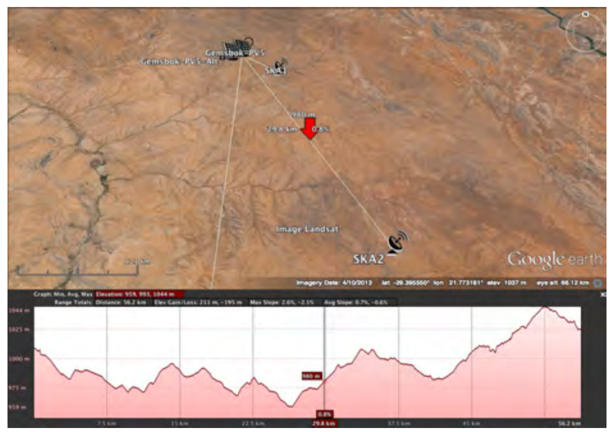
Figure 47: Google Earth terrain profile for Gemsbok PV4 to (a) closest and (b) second closest and (c) core SKA telescopes.

Gemsbok PV4 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	15.31 km	59.95 km	179.43 km
Azimuth	121.55 ^{o}	148.25 ^{o}	177.85 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 21: Specifications of **alternative** location Gemsbok PV4 solar farm relative to the SKA core and closest telescopes.

3.10 Gemsbok PV5

(a)



(b)

(c)

Figure 48: Google Earth terrain profile for Gemsbok PV5 to (a) closest and (b) second closest and (c) core SKA telescopes.

Gemsbok PV5 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	10.59 km	56.39 km	178.01 km
Azimuth	129.26 ^{o}	151.72 ^{o}	179.37 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 22: Specifications of **preferred** location Gemsbok PV5 solar farm relative to the SKA core and closest telescopes.

Gemsbok PV5 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	11.83 km	56.56 km	177.00 km
Azimuth	118.57 ^{o}	149.27 ^{o}	178.67 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 23: Specifications of **alternative** location Gemsbok PV5 solar farm relative to the SKA core and closest telescopes.

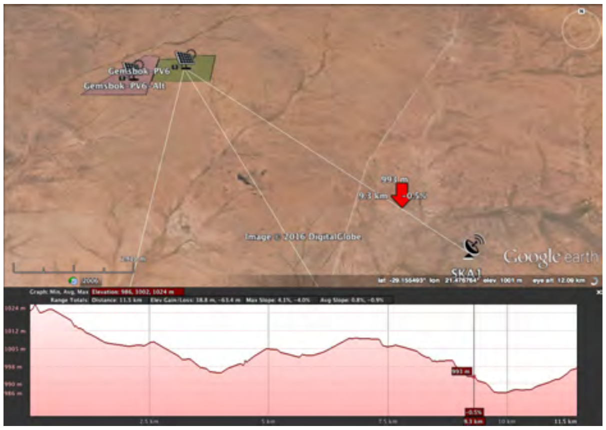
3.11 Gemsbok PV6

Gemsbok PV6 Pref	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	11.48 km	57.56 km	179.32 km
Azimuth	134.26 ^{o}	152.32 ^{o}	179.37 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 24: Specifications of **preferred** location Gemsbok PV6 solar farm relative to the SKA core and closest telescopes.

Gemsbok PV6 Alt	Closest Telescope 1	Closest Telescope 2	SKA Core Site
Distance	12.50 km	57.86 km	178.64 km
Azimuth	125.74 ^{o}	150.31 ^{o}	178.76 ^{o}
PV Tx Height	3 m	3 m	3 m
SKA Rx Height	15 m	15 m	15 m

Table 25: Specifications of **alternative** location Gemsbok PV6 solar farm relative to the SKA core and closest telescopes.



(a)

(b)

(c)

Figure 49: Google Earth terrain profile for Gemsbok PV6 to (a) closest and (b) second closest and (c) core SKA telescopes.

4 Signal Propagation Loss and Terrain Analysis

The default propagation analysis software used by MESA Solutions is called SPLAT!, which is a **S**ignal **P**ropagation, **L**oss **A**nd **T**errain analysis tool based on the *Longley-Rice Irregular Terrain Model (ITM)*, as well as the *Irregular Terrain With Obstructions Model (ITWOM 3.0)*. The software takes into account actual terrain elevation data, to ultimately predict the total path loss (TPL) between a transmitter and a receiver. As part of the analysis, certain assumptions are made regarding the source characteristics. For this investigation the various parameters defining the SPLAT! propagation model are listed in Table 26. The digital elevation model (DEM) makes use of 3-arc-second (90 m) elevation resolution data.

For this investigation, the frequency range of interest is defined from 100 MHz to 3 GHz. While the upper frequency limit of the standard in [2] is specified to at least 10 GHz, the span is limited to what is practically measurable and representative of the majority of expected interference. In the analysis the allowable SKA radiation limits defined by SARAS in citeAGA2007, including an additional 10 dB safety margin, are used as the reference level. This defines the maximum allowable levels of radiated interference than can be tolerated at the telescope.

This maximum level, which is given as a power spectral density (PSD) in dBm/Hz, is compensated for by the TPL as predicted by SPLAT!, to provide an equivalent PSD associated with the closest and core-site telescopes. This PSD for each case is then converted to an equivalent electric field (E-field) as measured at either 10 m (frequency $<$ 1 GHz) or 3 m (frequency $>$ 1 GHz) away from the plant. The 3 and 10 m separation distances is in accordance with measurement specifications defined in the latest international special committee on radio interference's (CISPR) 11/22 Class B standard. This standard is used for reference purposes as it is internationally know and used for industry qualification. This calculation is done for a number of representative frequencies within the band of interest and defines an E-field upper limit which the plant is allowed to radiate without exceeding emission limits at the various telescope locations. Ultimately, conformance of the plant can then be determined by comparing representative measured results to the calculated levels provided.

SPLAT! Analysis Parameters	
Frequency [MHz]	100 - 3000
Earth Dielectric Constant (Relative Permittivity [F/m])	4.000
Earth Conductivity [S/m]	0.001
Atmospheric Bending Constant	301
Radio Climate	4 (Desert)
Polarisation (Vertical=1; Horizontal=0)	1
Fraction of Time	0.05
Fraction of Situations	0.05

Table 26: SPLAT! parameters for predicted 100 MHz to 3 GHz emissions from proposed PV projects to SKA core and closest telescope.

5 Total Path Loss

Shown in Tables 27 to 45 are the values for the free space path loss (FSPL), terrain loss (TL), and total path loss (TPL) at each of the frequencies chosen for the investigation. The 0 dB TL at 100 MHz is a purely mathematical limitation of the software indicating a negligible contribution at that frequency over this particular terrain. The attenuation maps for 100, 1000, 2000 and 3000 MHz calculated at each of the site location are given in Figs. 50 to 69.

5.1 Scatec PV 1 Site Location

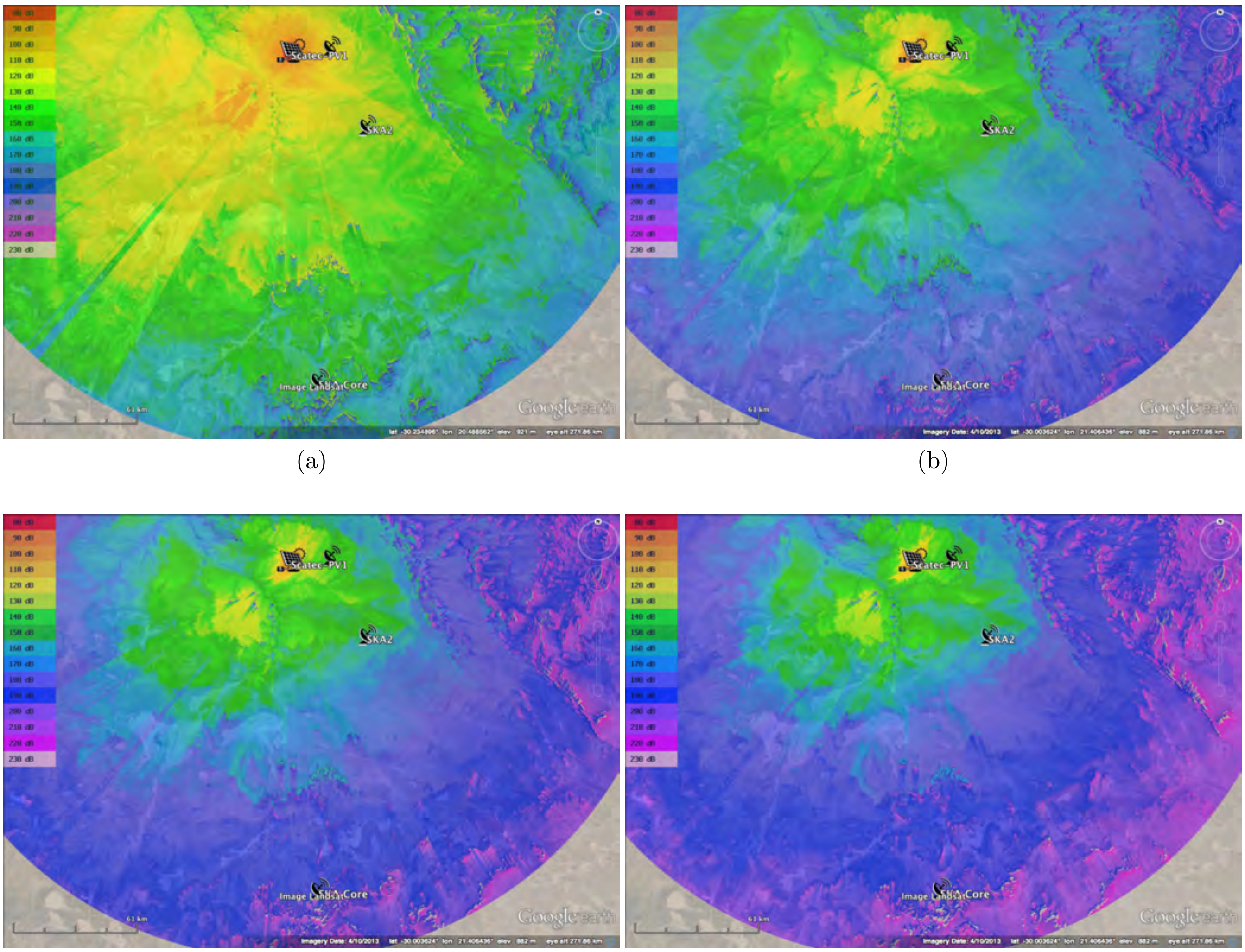
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	98.85dB	25.85dB	**124.7dB**	107.5dB	32.55dB	**140.05dB**	117.04dB	41.49dB	**158.53dB**
300MHz	108.4dB	22.11dB	**130.51dB**	117.04dB	27.16dB	**144.2dB**	126.58dB	36.97dB	**163.55dB**
500MHz	112.83dB	21.54dB	**134.37dB**	121.48dB	27.13dB	**148.61dB**	131.02dB	38.31dB	**169.33dB**
1000MHz	118.85dB	22.67dB	**141.52dB**	127.5dB	30.64dB	**158.14dB**	137.04dB	42.46dB	**179.5dB**
1500MHz	122.37dB	24.04dB	**146.41dB**	131.02dB	33.55dB	**164.57dB**	140.56dB	44.38dB	**184.94dB**
2000MHz	124.87dB	25.12dB	**149.99dB**	133.52dB	35.96dB	**169.48dB**	143.06dB	45.72dB	**188.78dB**
2500MHz	126.81dB	25.97dB	**152.78dB**	135.46dB	37.92dB	**173.38dB**	145.0dB	46.77dB	**191.77dB**
3000MHz	128.4dB	26.75dB	**155.15dB**	137.04dB	39.58dB	**176.62dB**	146.58dB	47.63dB	**194.21dB**

Table 27: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Scatec PV1 emissions.

5.2 Scatec PV 2 Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	98.21dB	16.04dB	**114.25dB**	107.3dB	19.65dB	**126.95dB**	117.02dB	33.37dB	**150.39dB**
300MHz	107.75dB	10.55dB	**118.3dB**	116.84dB	13.63dB	**130.47dB**	126.56dB	33.87dB	**160.43dB**
500MHz	112.19dB	8.9dB	**121.09dB**	121.28dB	12.7dB	**133.98dB**	131.0dB	35.77dB	**166.77dB**
1000MHz	118.21dB	8.42dB	**126.63dB**	127.3dB	13.91dB	**141.21dB**	137.02dB	40.56dB	**177.58dB**
1500MHz	121.73dB	8.83dB	**130.56dB**	130.82dB	15.07dB	**145.89dB**	140.54dB	42.73dB	**183.27dB**
2000MHz	124.23dB	9.49dB	**133.72dB**	133.32dB	16.21dB	**149.53dB**	143.04dB	44.18dB	**187.22dB**
2500MHz	126.17dB	10.26dB	**136.43dB**	135.25dB	17.3dB	**152.55dB**	144.98dB	45.28dB	**190.26dB**
3000MHz	127.75dB	10.93dB	**138.68dB**	136.84dB	18.3dB	**155.14dB**	146.56dB	46.16dB	**192.72dB**

Table 28: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Scatec PV2 emissions.



(a) (b) (c) (d)

Figure 50: TPL attenuation maps for site location of Scatec PV1 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

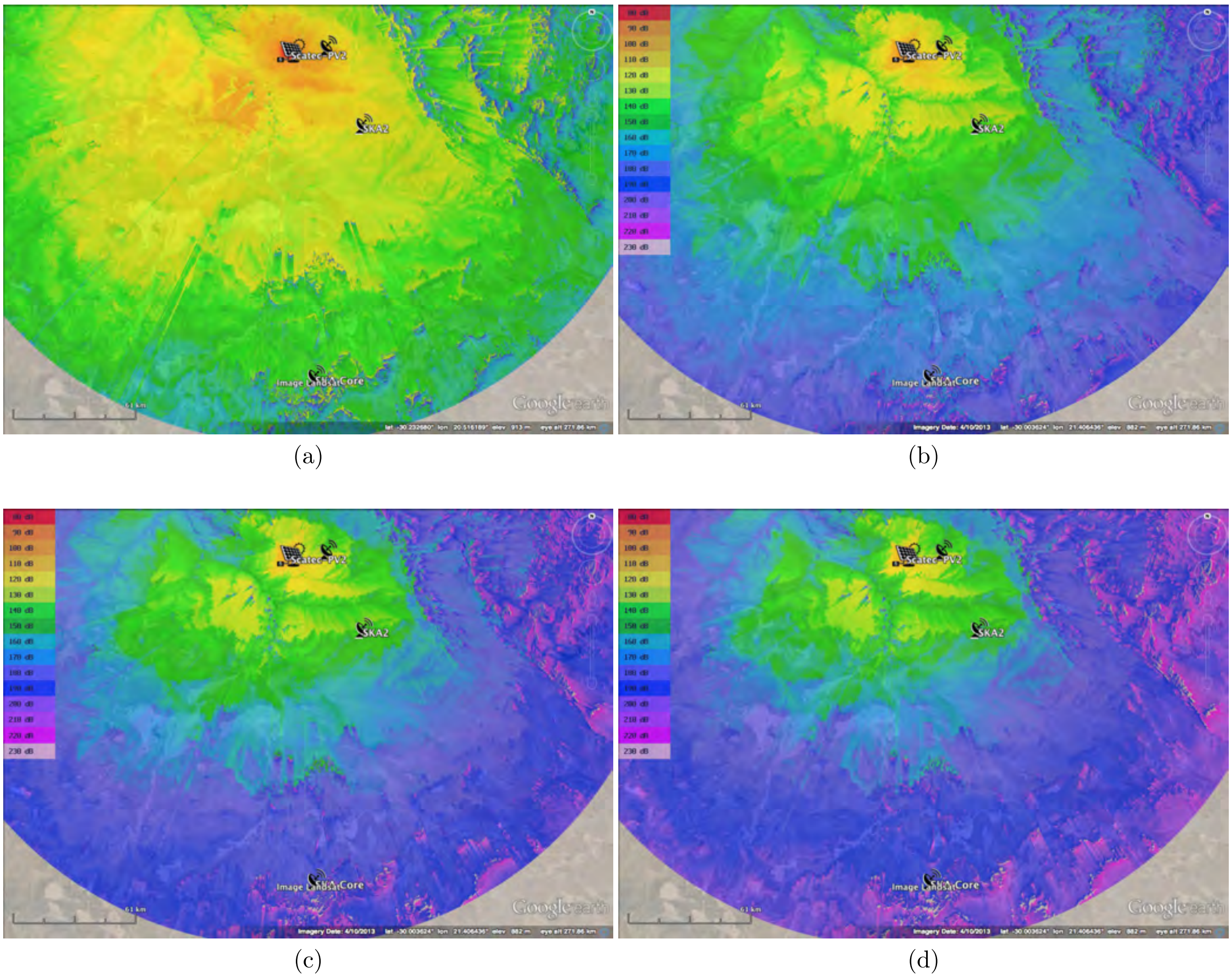
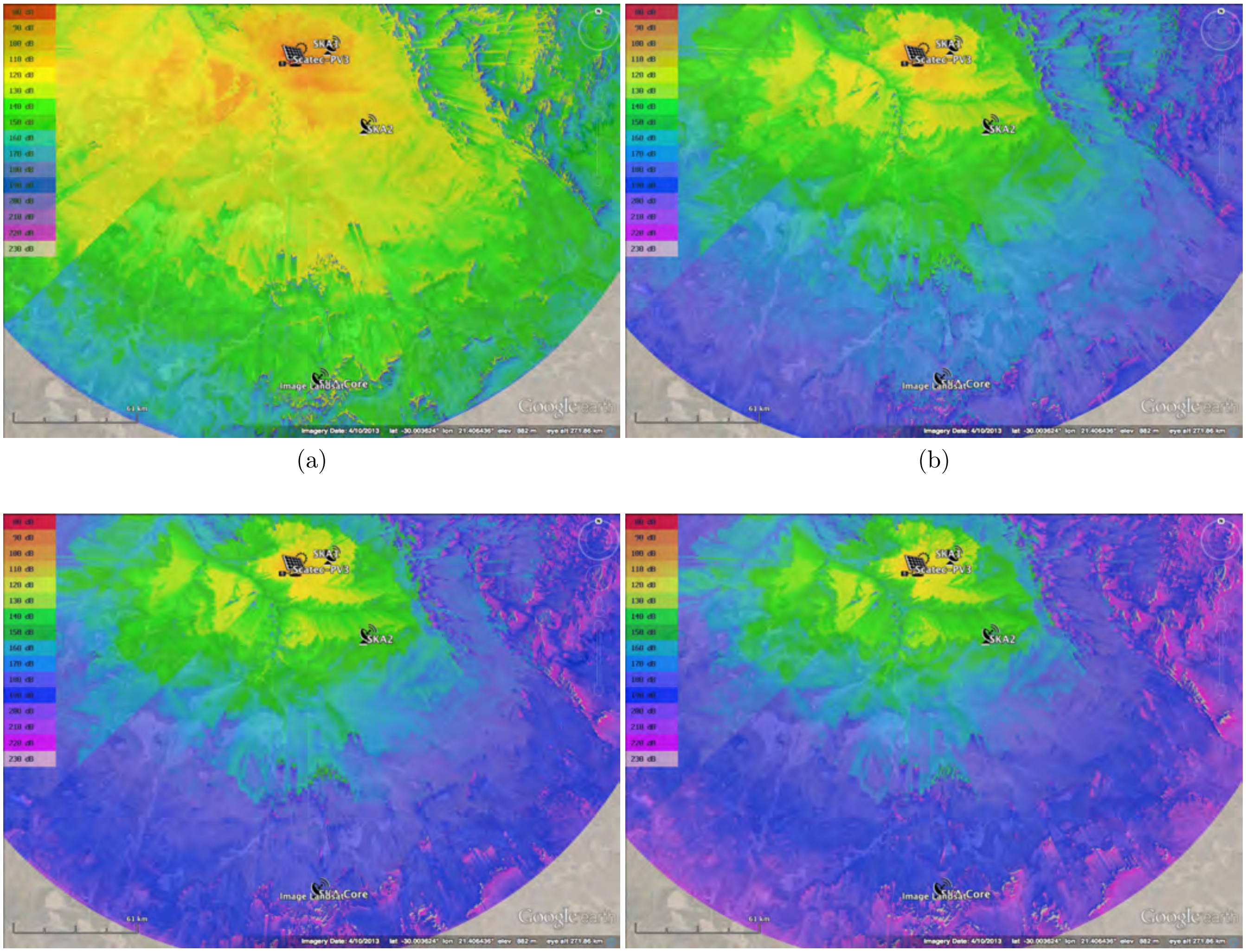


Figure 51: TPL attenuation maps for site location of Scatec PV2 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

DIRECTORS: H. C. Reader, A. J. Otto and P. S. van der Merwe | www.mesasolutions.co.za | EMAIL: info@mesasolutions.co.za
REG NO: 2002/025186/07 | POSTAL ADDRESS: P.O. Box 12572, Die Boord, Stellenbosch, 7613

5.3 Scatec PV 3 Site Location



(a) (b) (c) (d)

Figure 52: TPL attenuation maps for site location of Scatec PV3 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

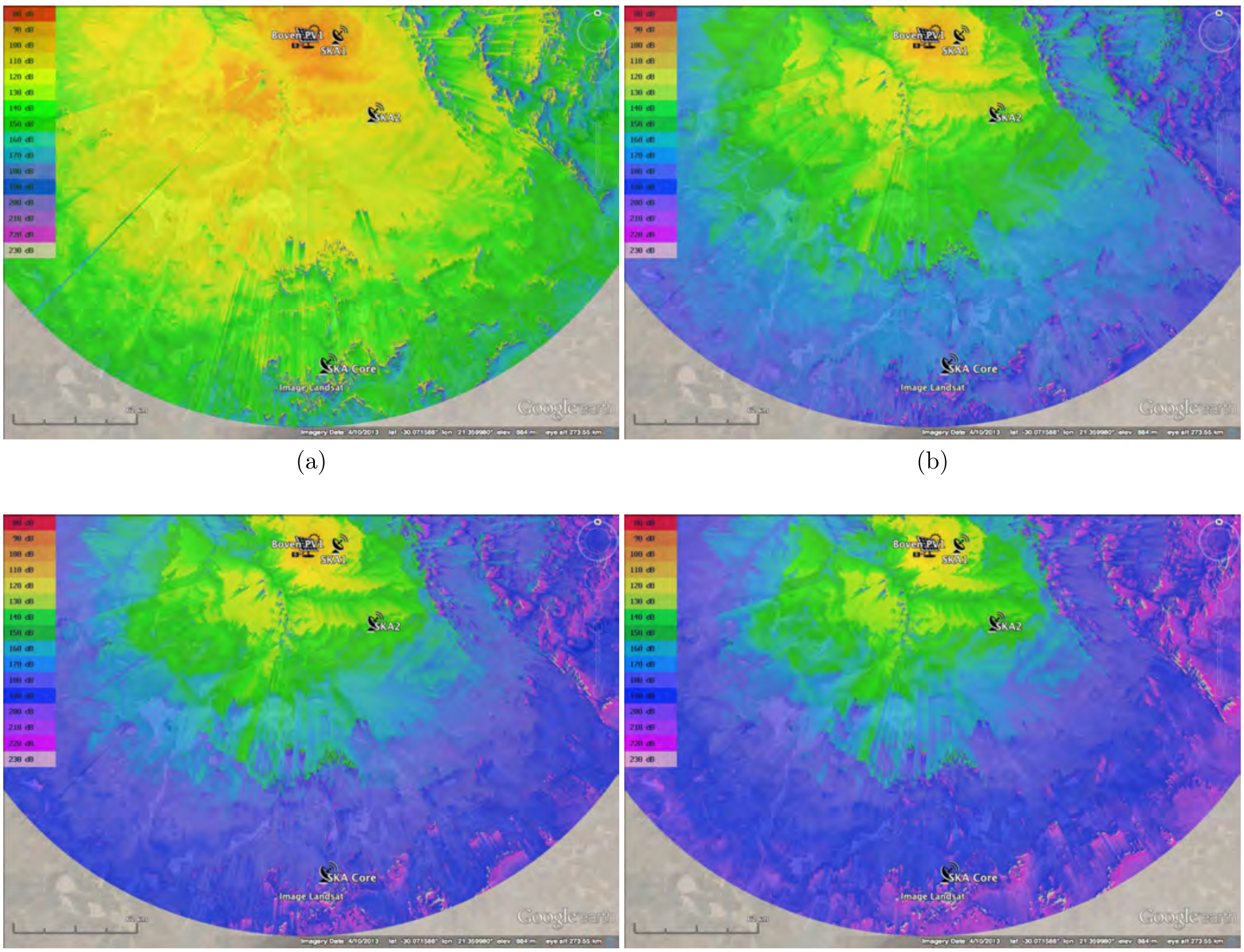
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	98.71dB	28.91dB	**127.62dB**	107.1dB	29.76dB	**136.86dB**	116.9dB	45.22dB	**162.12dB**
300MHz	108.25dB	27.45dB	**135.7dB**	116.65dB	22.96dB	**139.61dB**	126.44dB	41.0dB	**167.44dB**
500MHz	112.69dB	27.82dB	**140.51dB**	121.08dB	22.11dB	**143.19dB**	130.88dB	41.68dB	**172.56dB**
1000MHz	118.71dB	30.21dB	**148.92dB**	127.1dB	24.49dB	**151.59dB**	136.9dB	44.96dB	**181.86dB**
1500MHz	122.23dB	31.86dB	**154.09dB**	130.63dB	26.93dB	**157.56dB**	140.42dB	46.44dB	**186.86dB**
2000MHz	124.73dB	33.11dB	**157.84dB**	133.12dB	28.84dB	**161.96dB**	142.92dB	47.53dB	**190.45dB**
2500MHz	126.67dB	34.08dB	**160.75dB**	135.06dB	30.38dB	**165.44dB**	144.86dB	48.43dB	**193.29dB**
3000MHz	128.25dB	34.86dB	**163.11dB**	136.65dB	31.62dB	**168.27dB**	146.44dB	49.2dB	**195.64dB**

Table 29: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Scatec PV3 emissions.

5.4 Boven PV1 Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	97.24dB	7.21dB	**104.45dB**	107.32dB	17.22dB	**124.54dB**	117.11dB	28.82dB	**145.93dB**
300MHz	106.78dB	0.0dB	**106.78dB**	116.86dB	11.61dB	**128.47dB**	126.65dB	30.53dB	**157.18dB**
500MHz	111.22dB	0.0dB	**111.22dB**	121.3dB	10.71dB	**132.01dB**	131.09dB	33.05dB	**164.14dB**
1000MHz	117.24dB	0.0dB	**117.24dB**	127.32dB	11.7dB	**139.02dB**	137.11dB	38.43dB	**175.54dB**
1500MHz	120.76dB	0.0dB	**120.76dB**	130.84dB	12.67dB	**143.51dB**	140.63dB	40.79dB	**181.42dB**
2000MHz	123.26dB	0.0dB	**123.26dB**	133.34dB	13.63dB	**146.97dB**	143.13dB	42.36dB	**185.49dB**
2500MHz	125.19dB	0.0dB	**125.19dB**	135.28dB	14.53dB	**149.81dB**	145.07dB	43.52dB	**188.59dB**
3000MHz	126.78dB	0.0dB	**126.78dB**	136.86dB	15.39dB	**152.25dB**	146.65dB	44.46dB	**191.11dB**

Table 30: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation site Boven PV1 emissions.



(a) (b)

(c) (d)

Figure 53: TPL attenuation maps for site location of Boven PV1 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.5 Boven PV2 Site Location

5.5.1 Boven PV2 Preferred Site Location

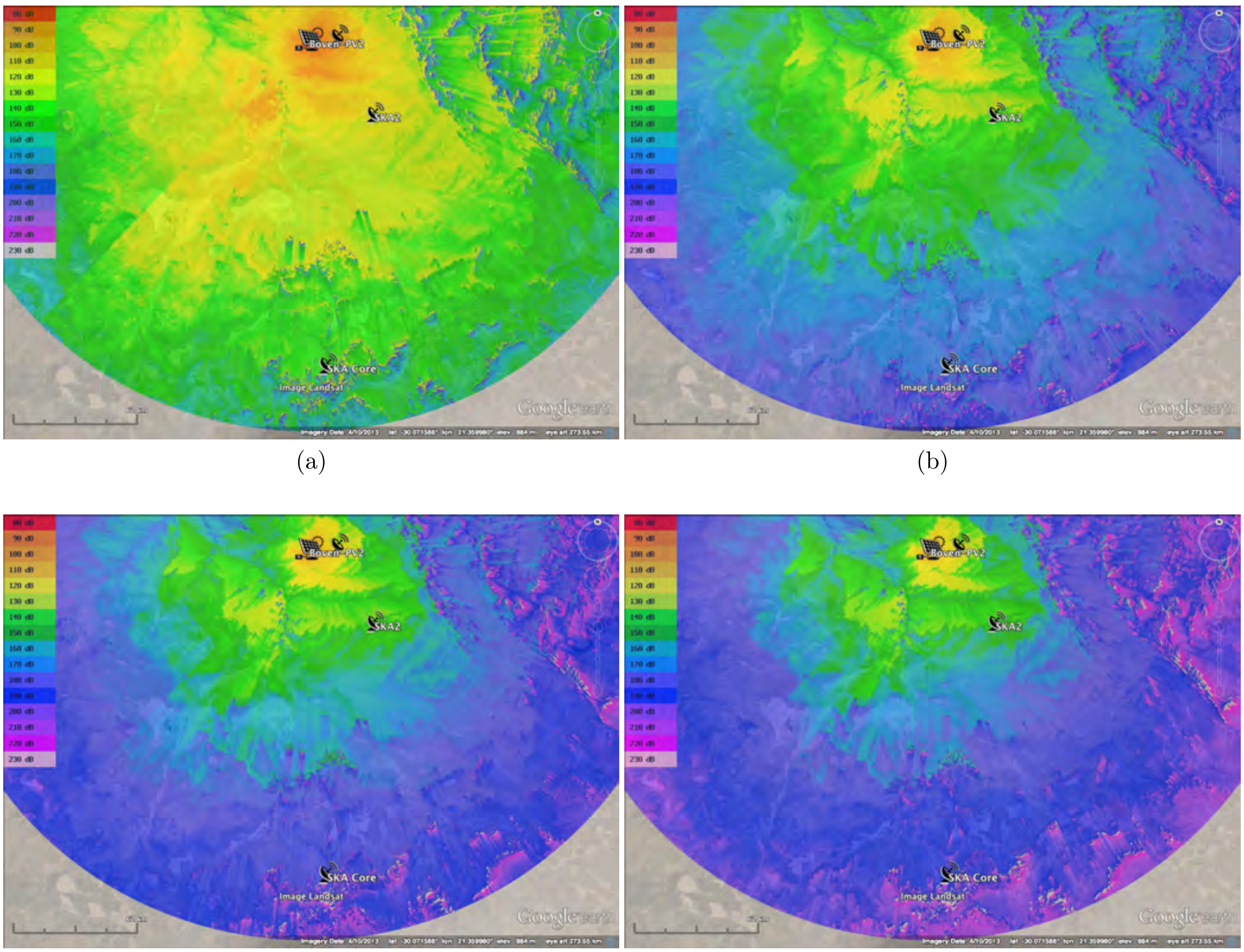
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	96.35dB	9.89dB	**106.24dB**	106.96dB	19.16dB	**126.12dB**	117.03dB	28.24dB	**145.27dB**
300MHz	105.89dB	1.91dB	**107.8dB**	116.5dB	13.49dB	**129.99dB**	126.57dB	30.09dB	**156.66dB**
500MHz	110.33dB	0.0dB	**110.33dB**	120.94dB	12.54dB	**133.48dB**	131.01dB	32.71dB	**163.72dB**
1000MHz	116.35dB	0.0dB	**116.35dB**	126.96dB	13.45dB	**140.41dB**	137.03dB	38.18dB	**175.21dB**
1500MHz	119.87dB	0.0dB	**119.87dB**	130.48dB	14.41dB	**144.89dB**	140.55dB	40.57dB	**181.12dB**
2000MHz	122.37dB	0.0dB	**122.37dB**	132.98dB	15.38dB	**148.36dB**	143.05dB	42.15dB	**185.2dB**
2500MHz	124.31dB	0.0dB	**124.31dB**	134.92dB	16.31dB	**151.23dB**	144.99dB	43.32dB	**188.31dB**
3000MHz	125.89dB	0.0dB	**125.89dB**	136.5dB	17.18dB	**153.68dB**	146.57dB	44.26dB	**190.83dB**

Table 31: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Boven PV2 emissions.

5.5.2 Boven PV2 Alternative Site Location

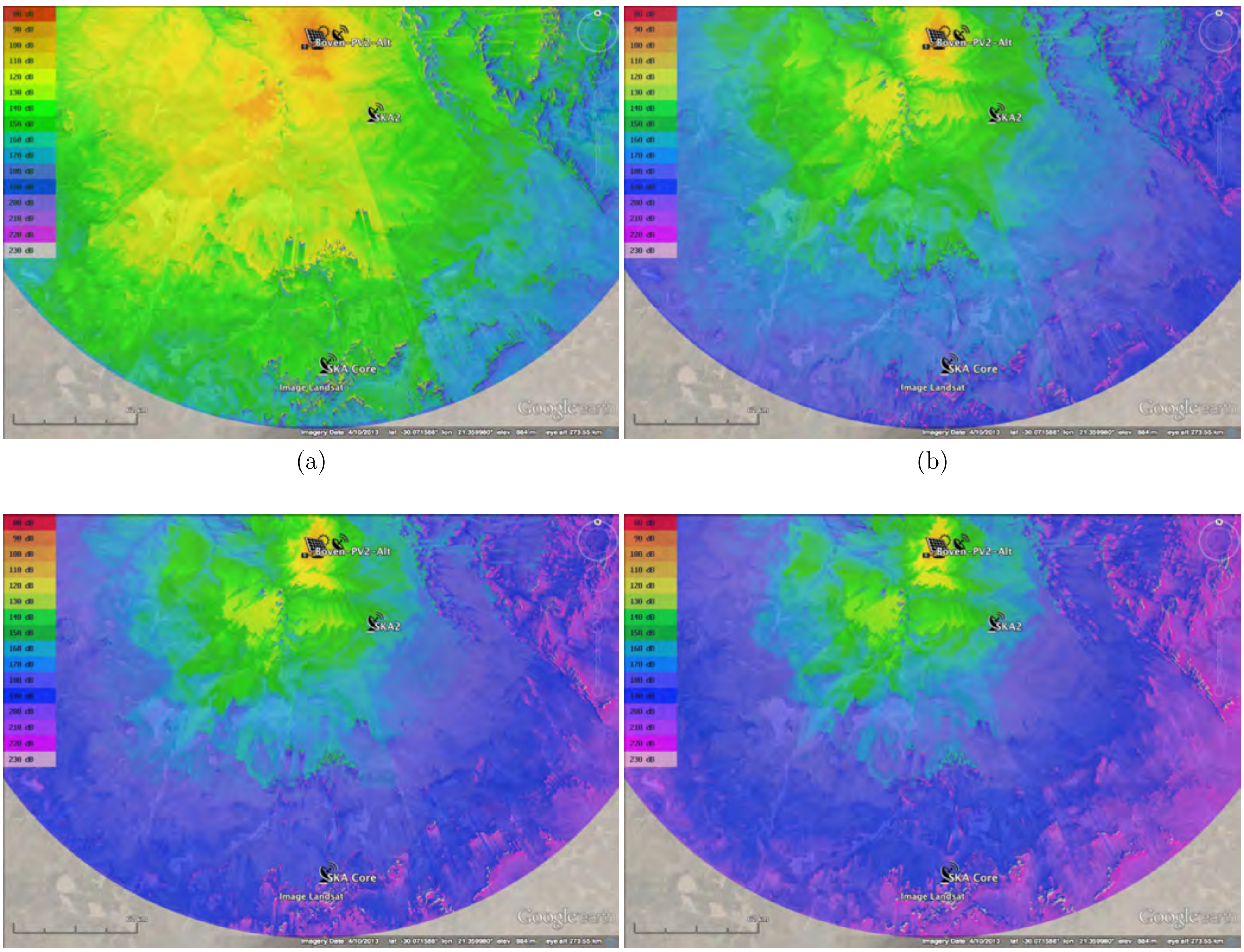
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	94.37dB	20.47dB	**114.84dB**	106.75dB	40.07dB	**146.82dB**	117.06dB	34.54dB	**151.6dB**
300MHz	103.91dB	16.13dB	**120.04dB**	116.29dB	36.53dB	**152.82dB**	126.61dB	38.39dB	**165.0dB**
500MHz	108.35dB	15.23dB	**123.58dB**	120.73dB	36.68dB	**157.41dB**	131.04dB	40.36dB	**171.4dB**
1000MHz	114.37dB	15.55dB	**129.92dB**	126.75dB	39.76dB	**166.51dB**	137.06dB	43.52dB	**180.58dB**
1500MHz	117.89dB	17.09dB	**134.98dB**	130.27dB	42.09dB	**172.36dB**	140.59dB	44.88dB	**185.47dB**
2000MHz	120.39dB	18.56dB	**138.95dB**	132.77dB	43.98dB	**176.75dB**	143.08dB	45.91dB	**188.99dB**
2500MHz	122.33dB	19.72dB	**142.05dB**	134.71dB	44.87dB	**179.58dB**	145.02dB	46.76dB	**191.78dB**
3000MHz	123.91dB	20.82dB	**144.73dB**	136.29dB	45.56dB	**181.85dB**	146.61dB	47.49dB	**194.1dB**

Table 32: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Boven PV2 emissions.



(a) (b) (c) (d)

Figure 54: TPL attenuation maps for **preferred** site location of Boven PV2 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b) (c) (d)

Figure 55: TPL attenuation maps for **alternative** site location of Boven PV2 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.6 Boven PV3 Site Location

5.6.1 Boven PV3 Preferred Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	96.4dB	14.84dB	**111.24dB**	106.43dB	27.93dB	**134.36dB**	116.85dB	37.22dB	**154.07dB**
300MHz	105.94dB	6.35dB	**112.29dB**	115.98dB	23.3dB	**139.28dB**	126.39dB	35.02dB	**161.41dB**
500MHz	110.38dB	2.78dB	**113.16dB**	120.41dB	22.83dB	**143.24dB**	130.83dB	36.95dB	**167.78dB**
1000MHz	116.4dB	0.0dB	**116.4dB**	126.43dB	24.64dB	**151.07dB**	136.85dB	41.82dB	**178.67dB**
1500MHz	119.92dB	0.0dB	**119.92dB**	129.96dB	26.23dB	**156.19dB**	140.37dB	44.02dB	**184.39dB**
2000MHz	122.42dB	0.0dB	**122.42dB**	132.46dB	27.74dB	**160.2dB**	142.87dB	45.49dB	**188.36dB**
2500MHz	124.36dB	0.0dB	**124.36dB**	134.39dB	29.1dB	**163.49dB**	144.81dB	46.61dB	**191.42dB**
3000MHz	125.94dB	0.0dB	**125.94dB**	135.98dB	30.29dB	**166.27dB**	146.39dB	47.51dB	**193.9dB**

Table 33: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Boven PV3 emissions.

5.6.2 Boven PV3 Alternative Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	95.25dB	19.28dB	**114.53dB**	106.47dB	29.2dB	**135.67dB**	116.93dB	35.52dB	**152.45dB**
300MHz	104.79dB	13.64dB	**118.43dB**	116.01dB	22.11dB	**138.12dB**	126.47dB	34.12dB	**160.59dB**
500MHz	109.23dB	11.02dB	**120.25dB**	120.45dB	20.61dB	**141.06dB**	130.9dB	36.33dB	**167.23dB**
1000MHz	115.25dB	8.35dB	**123.6dB**	126.47dB	21.35dB	**147.82dB**	136.93dB	41.43dB	**178.36dB**
1500MHz	118.77dB	7.28dB	**126.05dB**	129.99dB	22.42dB	**152.41dB**	140.45dB	43.71dB	**184.16dB**
2000MHz	121.27dB	6.94dB	**128.21dB**	132.49dB	23.61dB	**156.1dB**	142.95dB	45.19dB	**188.14dB**
2500MHz	123.21dB	7.07dB	**130.28dB**	134.42dB	24.82dB	**159.24dB**	144.88dB	46.32dB	**191.2dB**
3000MHz	124.79dB	7.19dB	**131.98dB**	136.01dB	26.06dB	**162.07dB**	146.47dB	47.21dB	**193.68dB**

Table 34: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Boven PV3 emissions.

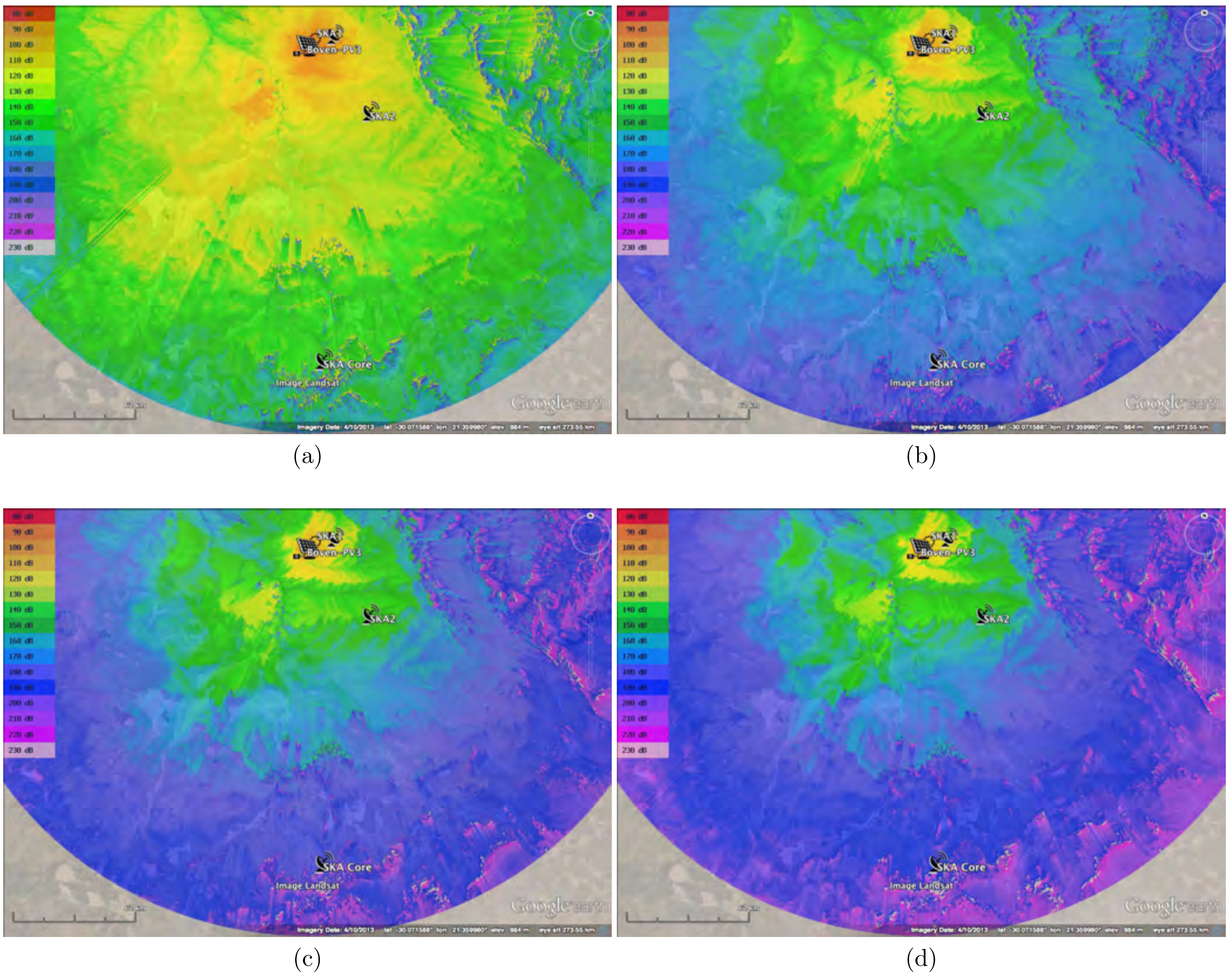
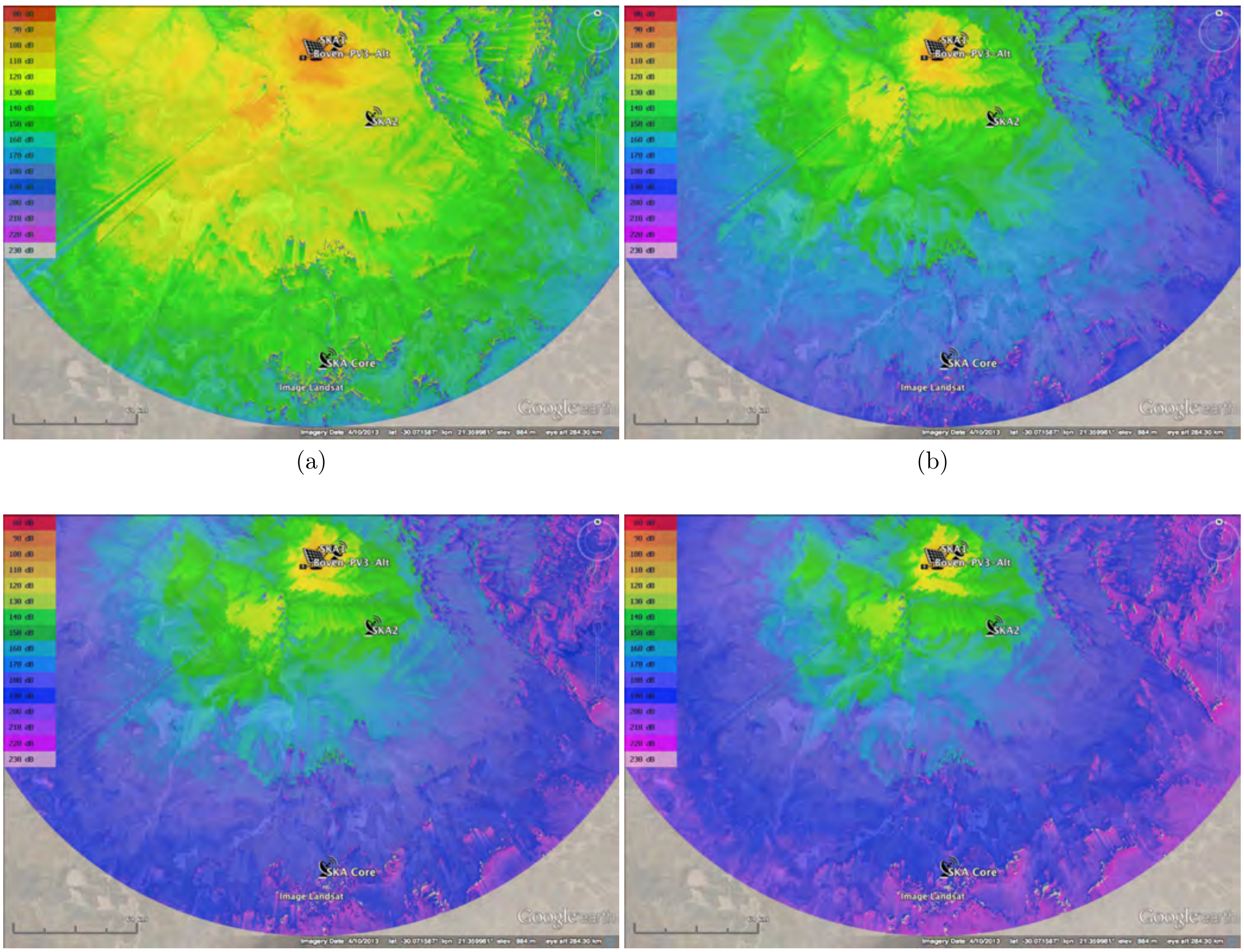


Figure 56: TPL attenuation maps for **preferred** site location of Boven PV3 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b) (c) (d)

Figure 57: TPL attenuation maps for **alternative** site location of Boven PV3 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.7 Boven PV4 Site Location

5.7.1 Boven PV4 Preferred Site Location

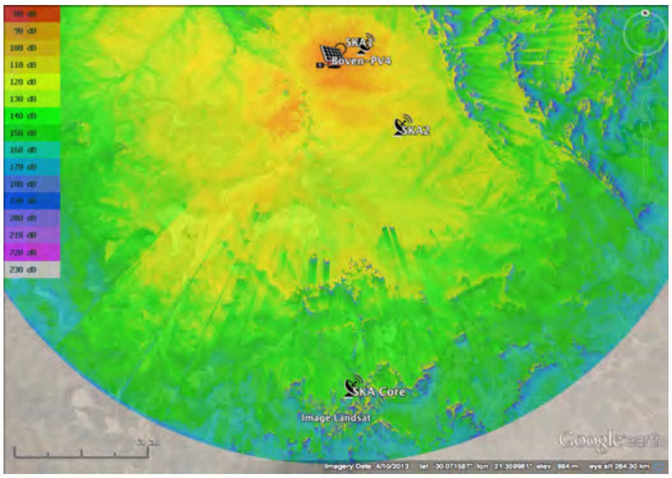
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	97.5dB	8.88dB	**106.38dB**	106.62dB	24.55dB	**131.17dB**	116.83dB	30.34dB	**147.17dB**
300MHz	107.04dB	0.51dB	**107.55dB**	116.16dB	19.93dB	**136.09dB**	126.37dB	30.91dB	**157.28dB**
500MHz	111.48dB	0.0dB	**111.48dB**	120.6dB	19.39dB	**139.99dB**	130.81dB	33.43dB	**164.24dB**
1000MHz	117.5dB	0.0dB	**117.5dB**	126.62dB	21.0dB	**147.62dB**	136.83dB	38.85dB	**175.68dB**
1500MHz	121.02dB	0.0dB	**121.02dB**	130.14dB	22.44dB	**152.58dB**	140.35dB	41.2dB	**181.55dB**
2000MHz	123.52dB	0.0dB	**123.52dB**	132.64dB	23.77dB	**156.41dB**	142.85dB	42.75dB	**185.6dB**
2500MHz	125.45dB	0.0dB	**125.45dB**	134.58dB	24.99dB	**159.57dB**	144.79dB	43.92dB	**188.71dB**
3000MHz	127.04dB	0.0dB	**127.04dB**	136.16dB	26.09dB	**162.25dB**	146.37dB	44.86dB	**191.23dB**

Table 35: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Boven PV4 emissions.

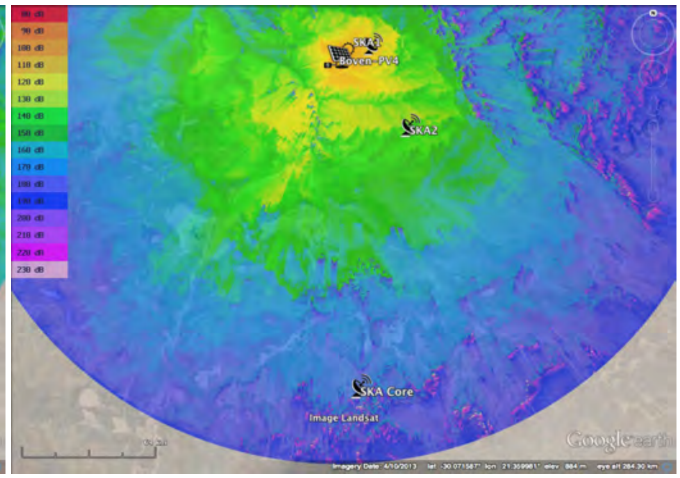
5.7.2 Boven PV4 Alternative Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	97.85dB	14.26dB	**112.11dB**	106.31dB	28.21dB	**134.52dB**	116.71dB	33.63dB	**150.34dB**
300MHz	107.39dB	6.09dB	**113.48dB**	115.85dB	23.98dB	**139.83dB**	126.25dB	32.17dB	**158.42dB**
500MHz	111.83dB	2.74dB	**114.57dB**	120.29dB	23.59dB	**143.88dB**	130.69dB	34.53dB	**165.22dB**
1000MHz	117.85dB	0.0dB	**117.85dB**	126.31dB	25.52dB	**151.83dB**	136.71dB	39.82dB	**176.53dB**
1500MHz	121.37dB	0.0dB	**121.37dB**	129.83dB	27.17dB	**157.0dB**	140.23dB	42.14dB	**182.37dB**
2000MHz	123.87dB	0.0dB	**123.87dB**	132.33dB	28.64dB	**160.97dB**	142.73dB	43.67dB	**186.4dB**
2500MHz	125.81dB	0.0dB	**125.81dB**	134.27dB	29.94dB	**164.21dB**	144.66dB	44.83dB	**189.49dB**
3000MHz	127.39dB	0.0dB	**127.39dB**	135.85dB	31.1dB	**166.95dB**	146.25dB	45.75dB	**192.0dB**

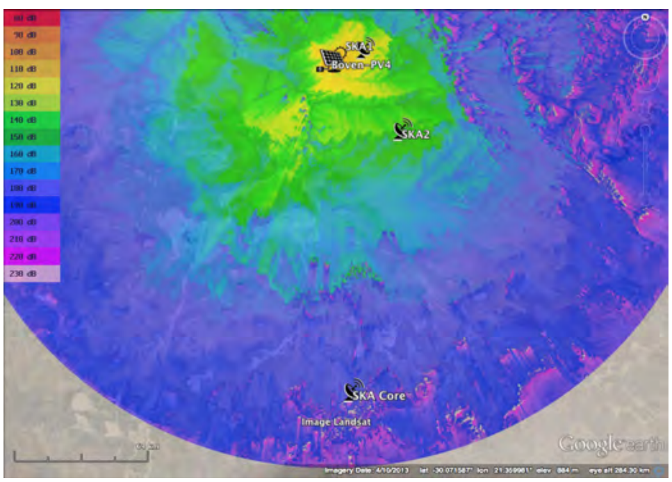
Table 36: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Boven PV4 emissions.



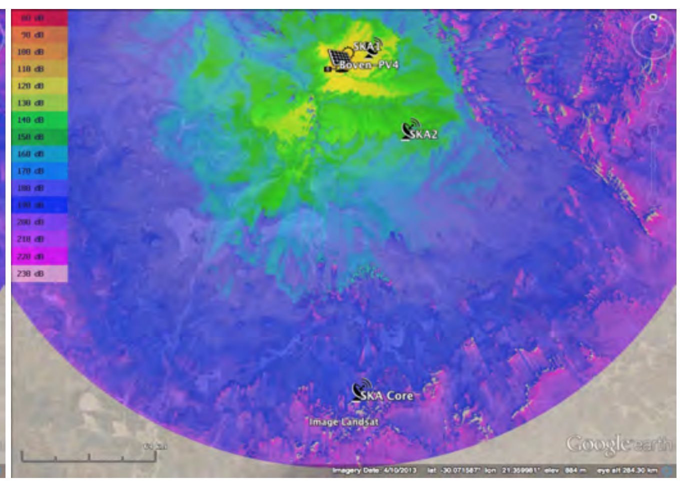
(a)



(b)

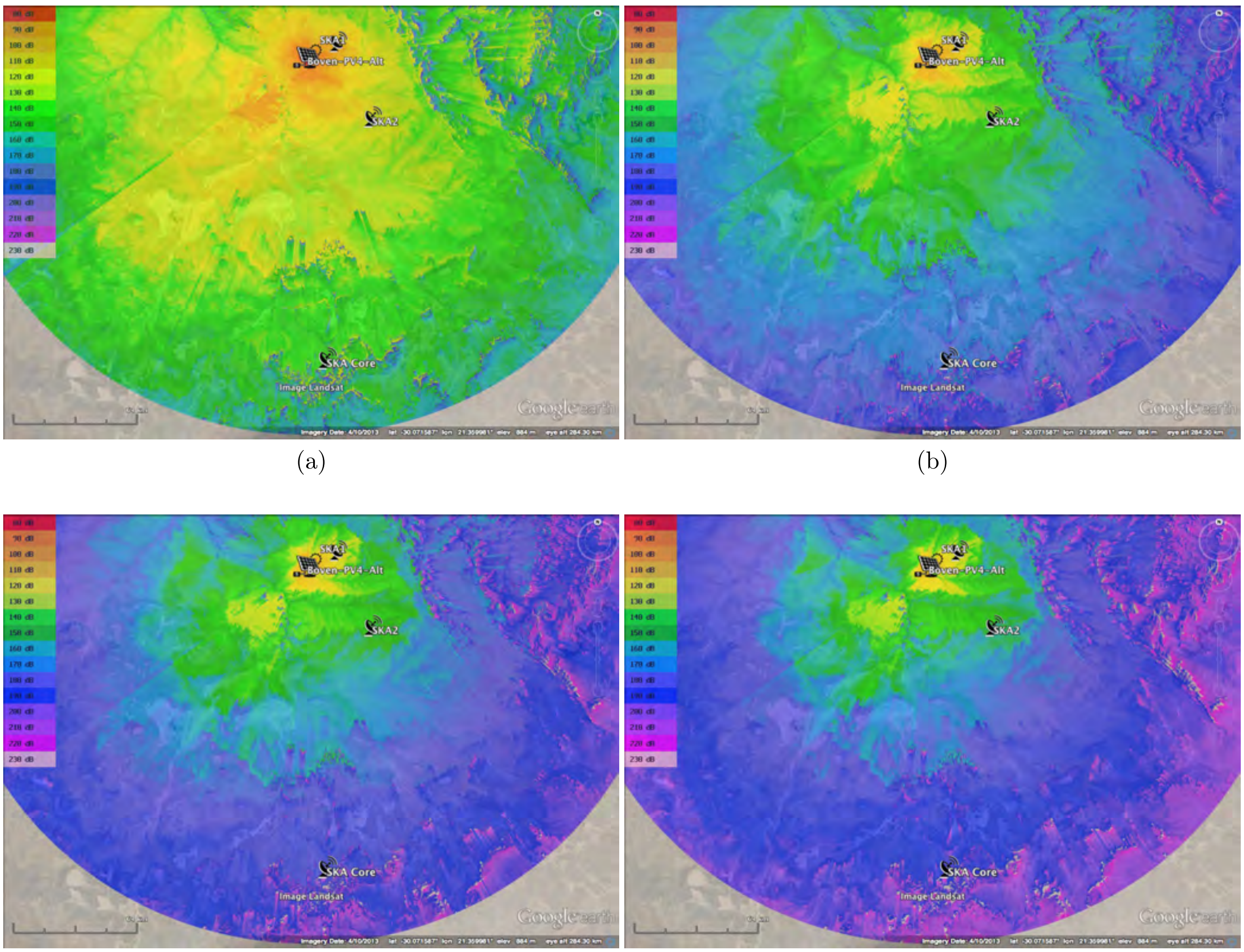


(c)



(d)

Figure 58: TPL attenuation maps for **preferred** site location of Boven PV4 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b)

(c) (d)

Figure 59: TPL attenuation maps for **alternative** site location of Boven PV4 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.8 Gemsbok PV1 Site Location

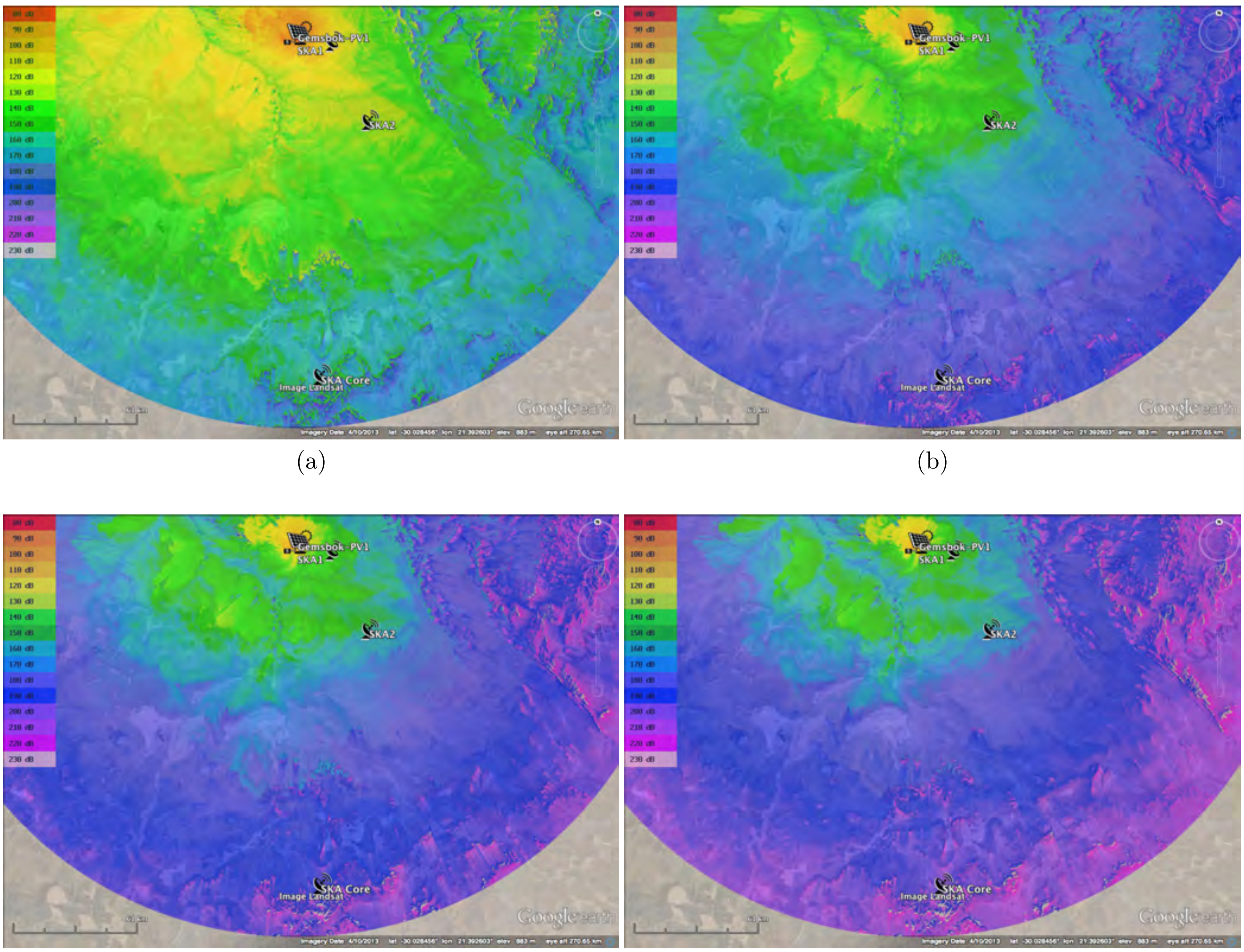
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	98.07dB	25.55dB	**123.62dB**	108.07dB	25.82dB	**133.89dB**	117.38dB	47.18dB	**164.56dB**
300MHz	107.62dB	20.83dB	**128.45dB**	117.61dB	18.67dB	**136.28dB**	126.93dB	42.44dB	**169.37dB**
500MHz	112.05dB	19.71dB	**131.76dB**	122.05dB	18.41dB	**140.46dB**	131.36dB	43.12dB	**174.48dB**
1000MHz	118.07dB	19.69dB	**137.76dB**	128.07dB	22.52dB	**150.59dB**	137.38dB	46.33dB	**183.71dB**
1500MHz	121.6dB	20.46dB	**142.06dB**	131.59dB	25.11dB	**156.7dB**	140.91dB	47.79dB	**188.7dB**
2000MHz	124.09dB	21.31dB	**145.4dB**	134.09dB	27.08dB	**161.17dB**	143.41dB	48.88dB	**192.29dB**
2500MHz	126.03dB	22.05dB	**148.08dB**	136.03dB	28.68dB	**164.71dB**	145.34dB	49.78dB	**195.12dB**
3000MHz	127.62dB	22.7dB	**150.32dB**	137.61dB	29.94dB	**167.55dB**	146.93dB	50.54dB	**197.47dB**

Table 37: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV1 emissions.

5.9 Gemsbok PV2 Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	96.6dB	24.61dB	**121.21dB**	107.77dB	28.62dB	**136.39dB**	117.36dB	42.67dB	**160.03dB**
300MHz	106.14dB	18.66dB	**124.8dB**	117.31dB	19.64dB	**136.95dB**	126.9dB	40.76dB	**167.66dB**
500MHz	110.58dB	17.02dB	**127.6dB**	121.75dB	18.42dB	**140.17dB**	131.34dB	41.51dB	**172.85dB**
1000MHz	116.6dB	16.31dB	**132.91dB**	127.77dB	21.37dB	**149.14dB**	137.36dB	44.85dB	**182.21dB**
1500MHz	120.12dB	16.69dB	**136.81dB**	131.29dB	23.52dB	**154.81dB**	140.88dB	46.39dB	**187.27dB**
2000MHz	122.62dB	17.31dB	**139.93dB**	133.79dB	25.19dB	**158.98dB**	143.38dB	47.52dB	**190.9dB**
2500MHz	124.56dB	17.93dB	**142.49dB**	135.73dB	26.59dB	**162.32dB**	145.32dB	48.44dB	**193.76dB**
3000MHz	126.14dB	18.52dB	**144.66dB**	137.31dB	27.83dB	**165.14dB**	146.9dB	49.22dB	**196.12dB**

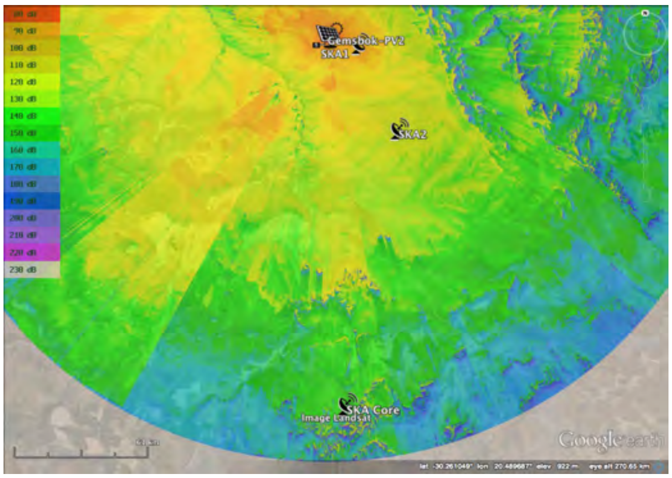
Table 38: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV2 emissions.



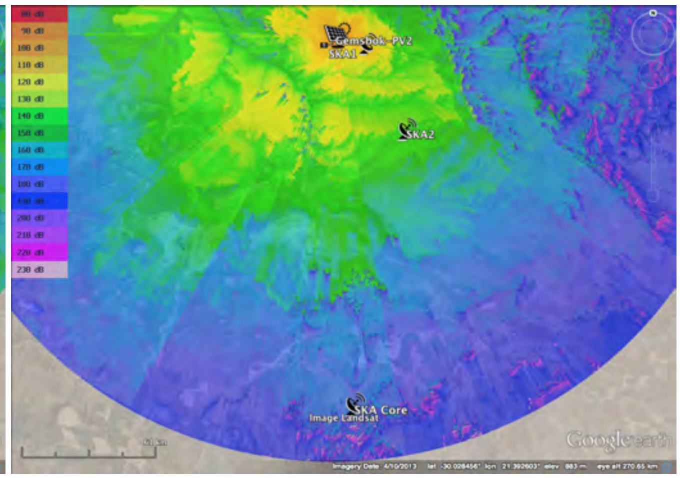
(a) (b)

(c) (d)

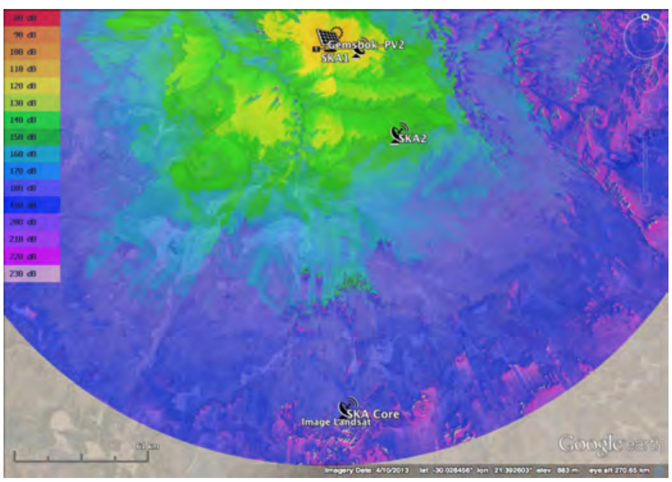
Figure 60: TPL attenuation maps for site location of Gemsbok PV1 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



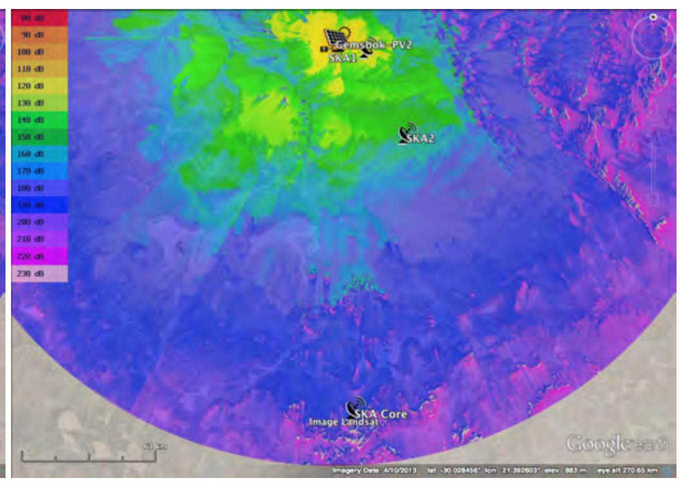
(a)



(b)



(c)



(d)

Figure 61: TPL attenuation maps for site location of Gemsbok PV2 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.10 Gemsbok PV3 Site Location

5.10.1 Gemsbok PV3 Preferred Site Location

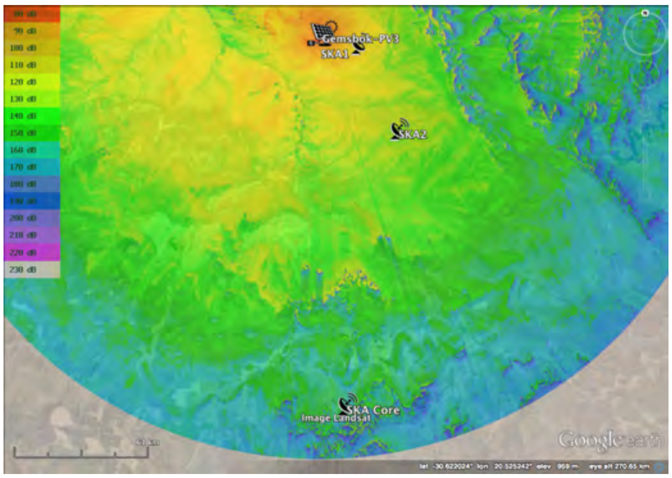
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	97.99dB	25.22dB	**123.21dB**	108.12dB	25.82dB	**133.94dB**	117.42dB	39.45dB	**156.87dB**
300MHz	107.53dB	20.88dB	**128.41dB**	117.66dB	18.16dB	**135.82dB**	126.96dB	37.44dB	**164.4dB**
500MHz	111.97dB	20.06dB	**132.03dB**	122.1dB	17.61dB	**139.71dB**	131.4dB	38.83dB	**170.23dB**
1000MHz	117.99dB	20.88dB	**138.87dB**	128.12dB	21.2dB	**149.32dB**	137.42dB	43.0dB	**180.42dB**
1500MHz	121.51dB	22.26dB	**143.77dB**	131.64dB	23.86dB	**155.5dB**	140.94dB	44.94dB	**185.88dB**
2000MHz	124.01dB	23.39dB	**147.4dB**	134.14dB	25.99dB	**160.13dB**	143.44dB	46.29dB	**189.73dB**
2500MHz	125.95dB	24.34dB	**150.29dB**	136.08dB	27.72dB	**163.8dB**	145.38dB	47.34dB	**192.72dB**
3000MHz	127.53dB	25.35dB	**152.88dB**	137.66dB	29.22dB	**166.88dB**	146.96dB	48.2dB	**195.16dB**

Table 39: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV3 emissions.

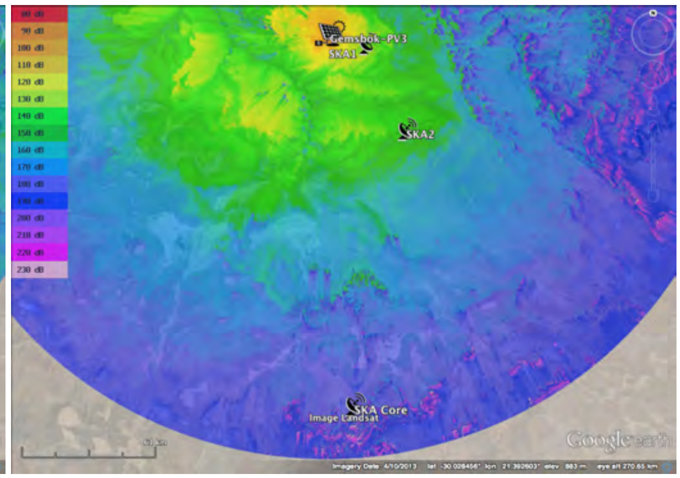
5.10.2 Gemsbok PV3 Alternative Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	98.2dB	18.49dB	**116.69dB**	107.92dB	23.74dB	**131.66dB**	117.29dB	44.43dB	**161.72dB**
300MHz	107.75dB	12.49dB	**120.24dB**	117.46dB	15.51dB	**132.97dB**	126.84dB	42.4dB	**169.24dB**
500MHz	112.18dB	10.59dB	**122.77dB**	121.9dB	14.23dB	**136.13dB**	131.27dB	43.11dB	**174.38dB**
1000MHz	118.2dB	9.57dB	**127.77dB**	127.92dB	16.2dB	**144.12dB**	137.29dB	46.37dB	**183.66dB**
1500MHz	121.73dB	9.76dB	**131.49dB**	131.44dB	18.4dB	**149.84dB**	140.81dB	47.85dB	**188.66dB**
2000MHz	124.22dB	10.06dB	**134.28dB**	133.94dB	20.27dB	**154.21dB**	143.31dB	48.95dB	**192.26dB**
2500MHz	126.16dB	10.56dB	**136.72dB**	135.87dB	21.9dB	**157.77dB**	145.25dB	49.85dB	**195.1dB**
3000MHz	127.75dB	11.06dB	**138.81dB**	137.46dB	23.32dB	**160.78dB**	146.84dB	50.62dB	**197.46dB**

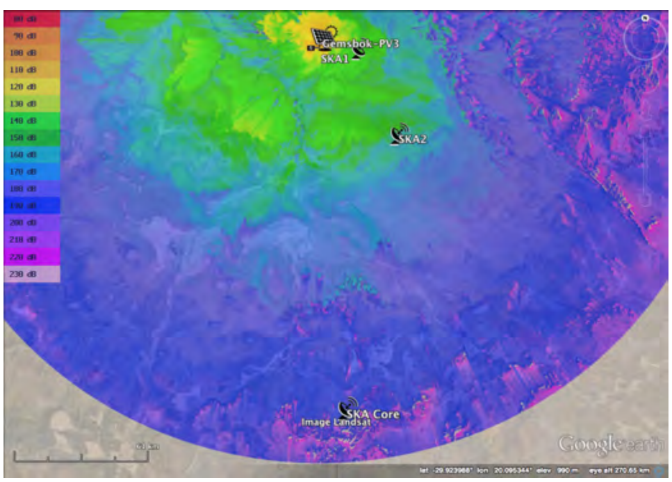
Table 40: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Gemsbok PV3 emissions.



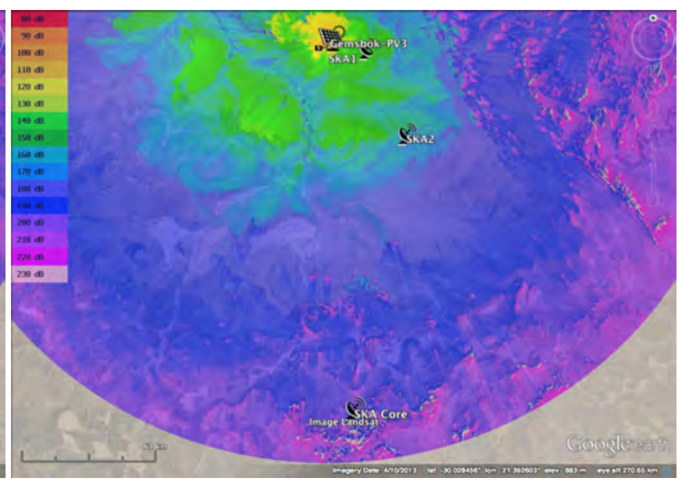
(a)



(b)

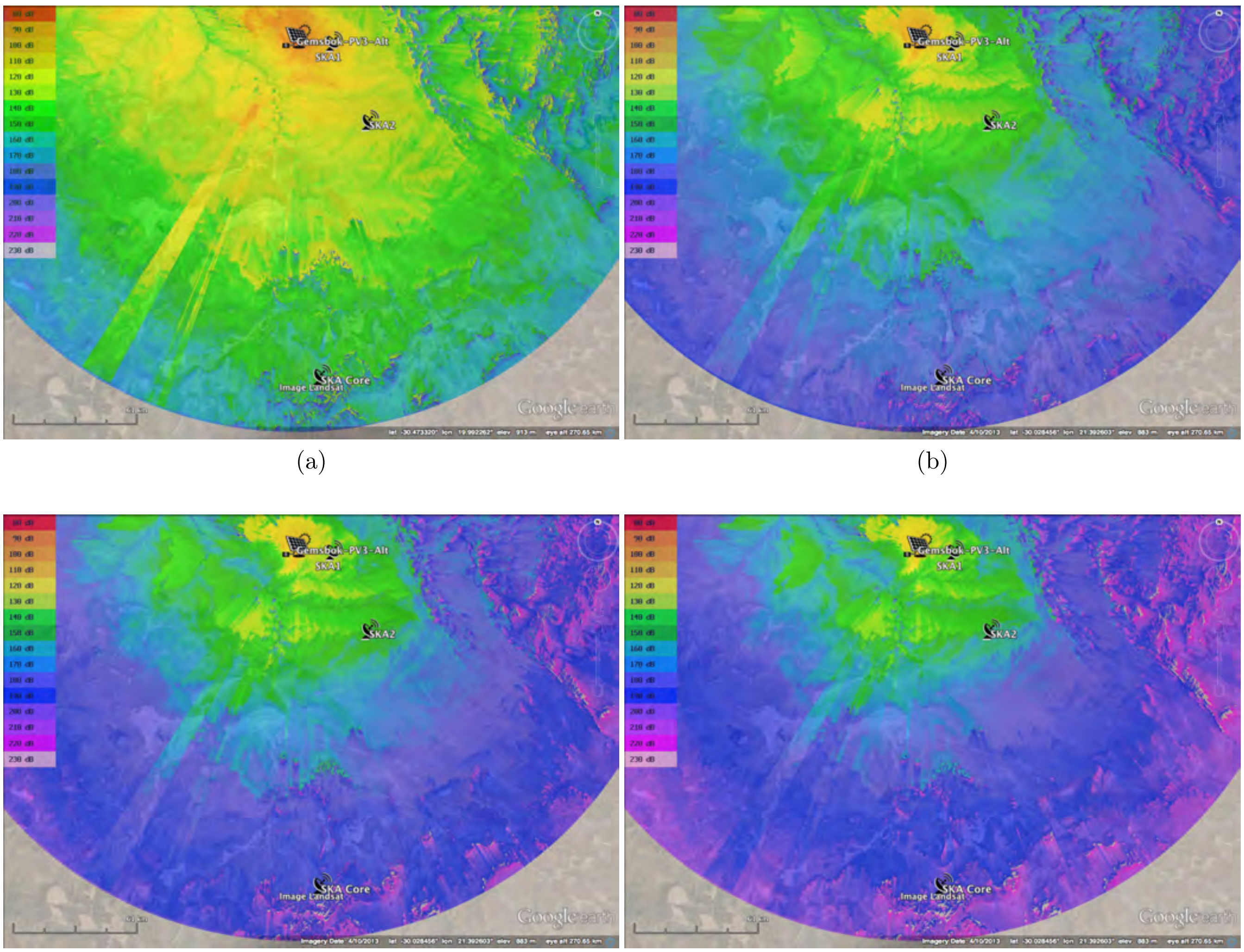


(c)



(d)

Figure 62: TPL attenuation maps for **preferred** site location of Gemsbok PV3 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b)

(c) (d)

Figure 63: TPL attenuation maps for **alternative** site location of Gemsbok PV3 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.11 Gemsbok PV4 Site Location

5.11.1 Gemsbok PV4 Preferred Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	95.97dB	12.08dB	**108.05dB**	107.81dB	25.75dB	**133.56dB**	117.43dB	29.85dB	**147.28dB**
300MHz	105.51dB	6.43dB	**111.94dB**	117.35dB	16.16dB	**133.51dB**	126.97dB	30.72dB	**157.69dB**
500MHz	109.95dB	4.92dB	**114.87dB**	121.79dB	14.32dB	**136.11dB**	131.41dB	33.51dB	**164.92dB**
1000MHz	115.97dB	5.38dB	**121.35dB**	127.81dB	15.86dB	**143.67dB**	137.43dB	39.08dB	**176.51dB**
1500MHz	119.49dB	6.82dB	**126.31dB**	131.33dB	17.61dB	**148.94dB**	140.95dB	41.51dB	**182.46dB**
2000MHz	121.99dB	8.29dB	**130.28dB**	133.83dB	19.13dB	**152.96dB**	143.45dB	43.1dB	**186.55dB**
2500MHz	123.93dB	9.6dB	**133.53dB**	135.77dB	20.44dB	**156.21dB**	145.39dB	44.28dB	**189.67dB**
3000MHz	125.51dB	10.59dB	**136.1dB**	137.35dB	21.62dB	**158.97dB**	146.97dB	45.23dB	**192.2dB**

Table 41: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV4 emissions.

5.11.2 Gemsbok PV4 Alternative Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	95.99dB	13.57dB	**109.56dB**	107.95dB	23.3dB	**131.25dB**	117.51dB	29.92dB	**147.43dB**
300MHz	105.54dB	8.15dB	**113.69dB**	117.49dB	13.5dB	**130.99dB**	127.05dB	30.93dB	**157.98dB**
500MHz	109.97dB	6.76dB	**116.73dB**	121.93dB	11.53dB	**133.46dB**	131.49dB	33.66dB	**165.15dB**
1000MHz	115.99dB	6.87dB	**122.86dB**	127.95dB	12.79dB	**140.74dB**	137.51dB	39.17dB	**176.68dB**
1500MHz	119.51dB	8.7dB	**128.21dB**	131.47dB	14.43dB	**145.9dB**	141.03dB	41.6dB	**182.63dB**
2000MHz	122.01dB	9.91dB	**131.92dB**	133.97dB	15.87dB	**149.84dB**	143.53dB	43.17dB	**186.7dB**
2500MHz	123.95dB	10.9dB	**134.85dB**	135.91dB	17.15dB	**153.06dB**	145.47dB	44.34dB	**189.81dB**
3000MHz	125.54dB	11.74dB	**137.28dB**	137.49dB	18.3dB	**155.79dB**	147.05dB	45.28dB	**192.33dB**

Table 42: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Gemsbok PV4 emissions.

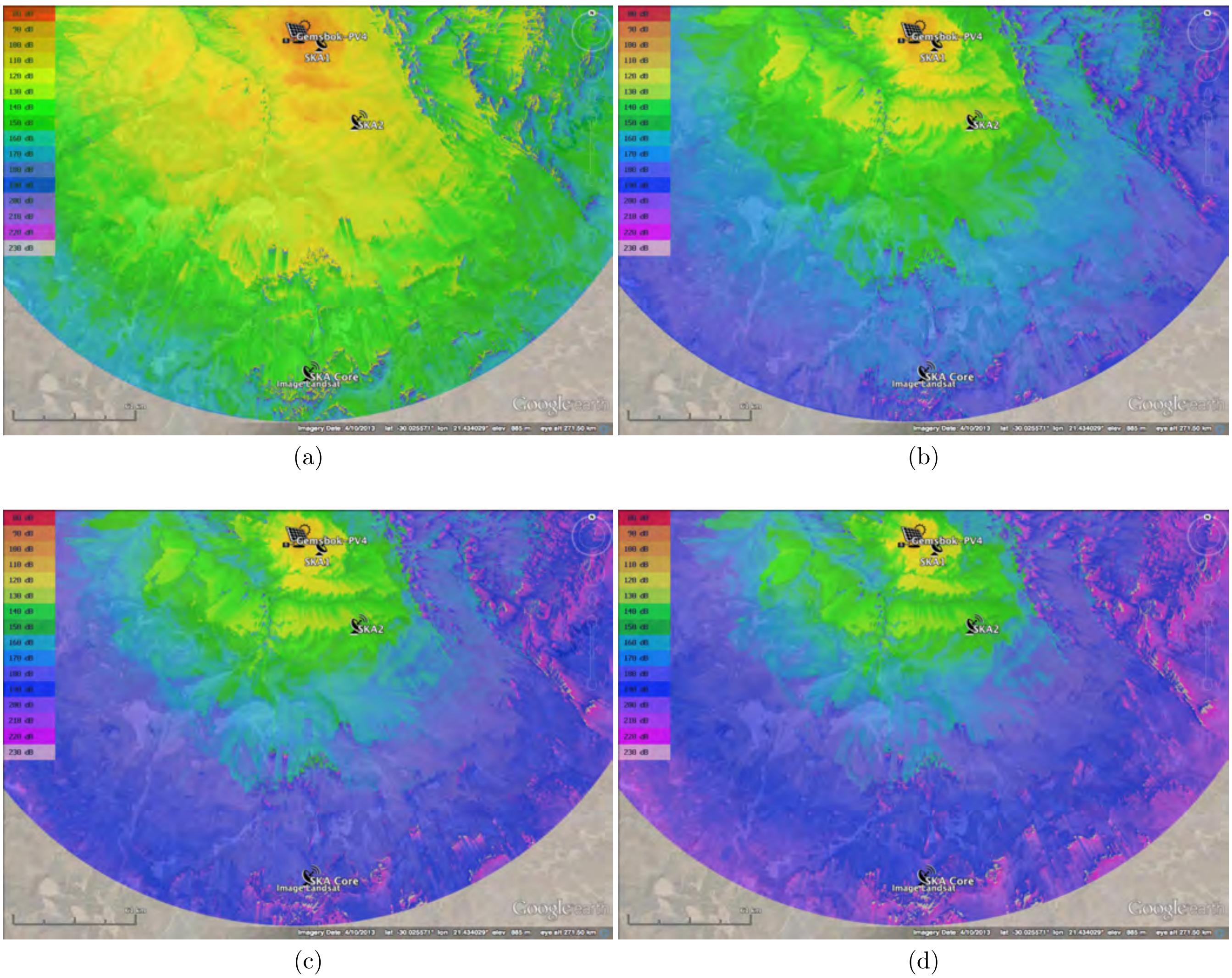
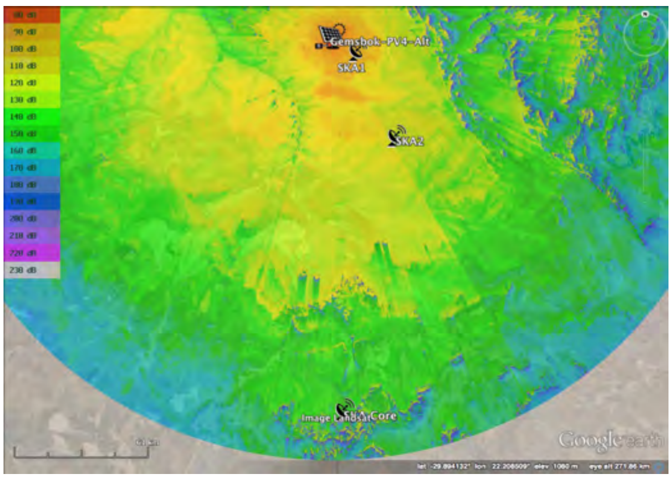
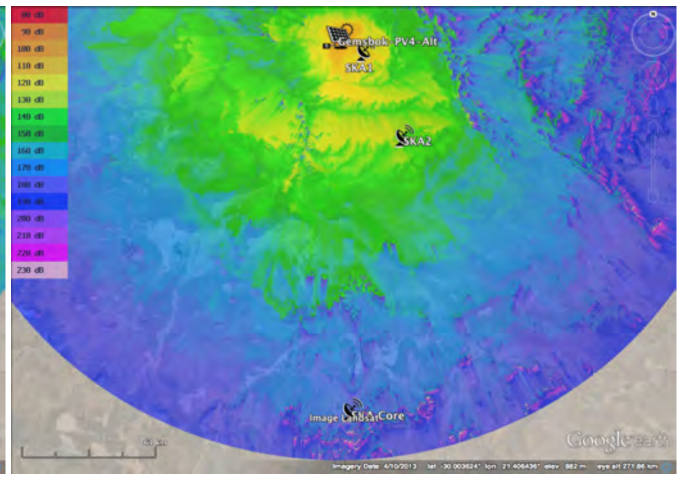


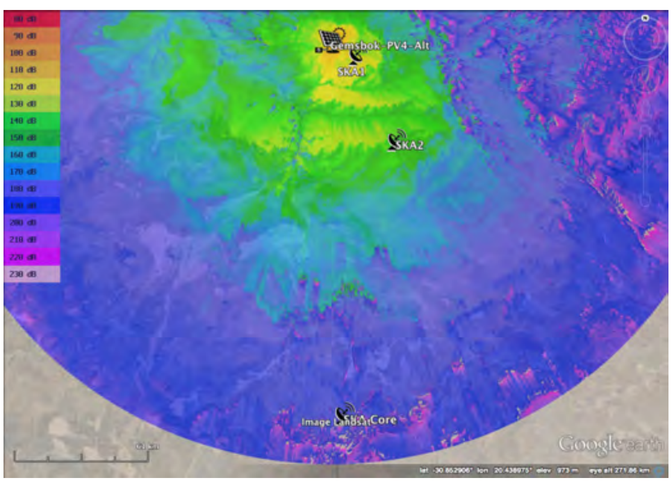
Figure 64: TPL attenuation maps for **preferred** site location of Gemsbok PV4 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



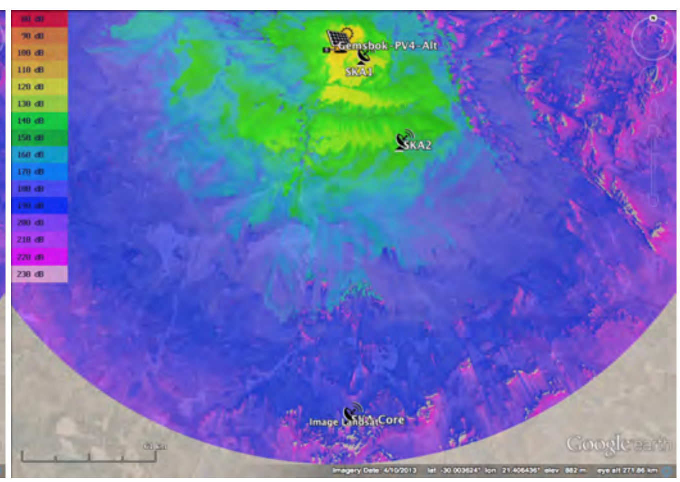
(a)



(b)



(c)



(d)

Figure 65: TPL attenuation maps for **alternative** site location of Gemsbok PV4 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.12 Gemsbok PV5 Site Location

5.12.1 Gemsbok PV5 Preferred Site Location

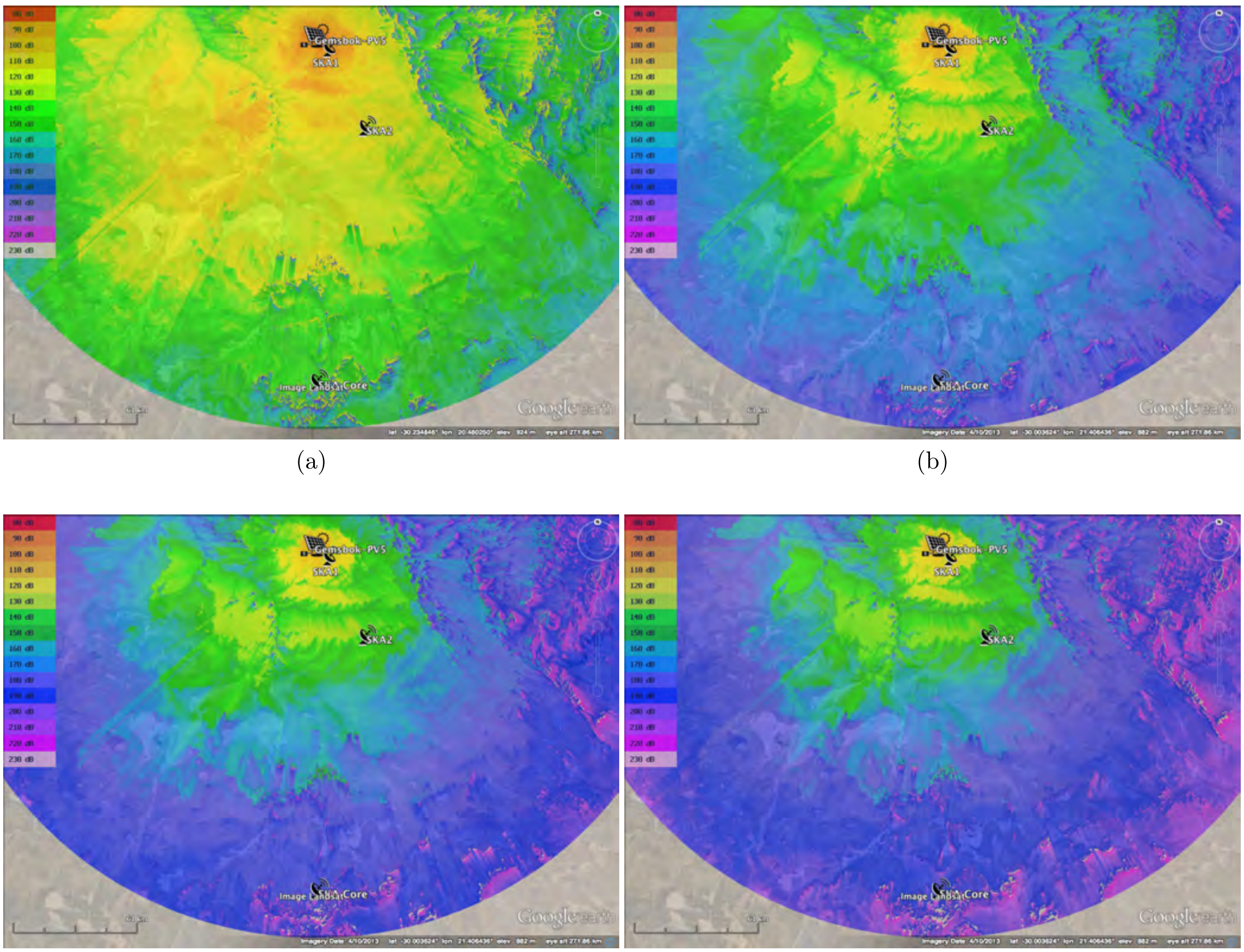
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	92.9dB	7.24dB	**100.14dB**	107.45dB	20.82dB	**128.27dB**	117.45dB	28.14dB	**145.59dB**
300MHz	102.44dB	0.0dB	**102.44dB**	116.99dB	13.65dB	**130.64dB**	126.99dB	30.17dB	**157.16dB**
500MHz	106.88dB	0.0dB	**106.88dB**	121.43dB	12.2dB	**133.63dB**	131.43dB	33.06dB	**164.49dB**
1000MHz	112.9dB	0.0dB	**112.9dB**	127.45dB	13.15dB	**140.6dB**	137.45dB	38.71dB	**176.16dB**
1500MHz	116.42dB	0.0dB	**116.42dB**	130.97dB	14.19dB	**145.16dB**	140.97dB	41.19dB	**182.16dB**
2000MHz	118.92dB	0.0dB	**118.92dB**	133.47dB	15.32dB	**148.79dB**	143.47dB	42.78dB	**186.25dB**
2500MHz	120.86dB	0.0dB	**120.86dB**	135.41dB	16.45dB	**151.86dB**	145.41dB	43.96dB	**189.37dB**
3000MHz	122.44dB	0.0dB	**122.44dB**	136.99dB	17.68dB	**154.67dB**	146.99dB	44.91dB	**191.9dB**

Table 43: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV5 emissions.

5.12.2 Gemsbok PV5 Alternative Site Location

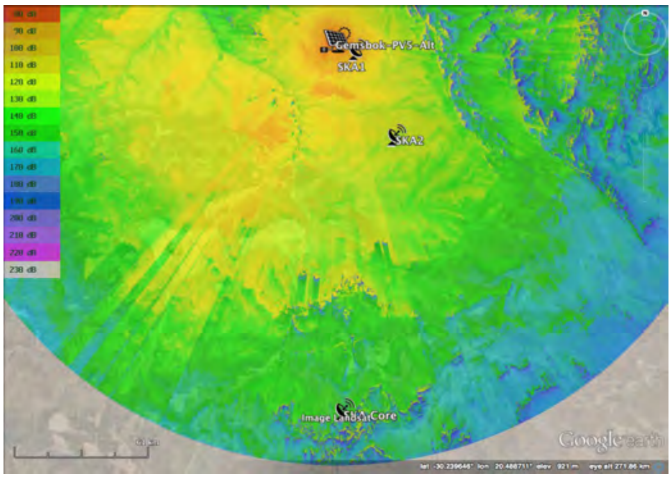
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	93.79dB	18.23dB	**112.02dB**	107.45dB	28.16dB	**135.61dB**	117.39dB	36.27dB	**153.66dB**
300MHz	103.33dB	15.23dB	**118.56dB**	116.99dB	21.32dB	**138.31dB**	126.94dB	38.02dB	**164.96dB**
500MHz	107.77dB	15.77dB	**123.54dB**	121.43dB	20.35dB	**141.78dB**	131.37dB	39.27dB	**170.64dB**
1000MHz	113.79dB	18.96dB	**132.75dB**	127.45dB	22.65dB	**150.1dB**	137.39dB	43.16dB	**180.55dB**
1500MHz	117.31dB	22.04dB	**139.35dB**	130.97dB	24.96dB	**155.93dB**	140.91dB	44.95dB	**185.86dB**
2000MHz	119.81dB	24.86dB	**144.67dB**	133.47dB	26.79dB	**160.26dB**	143.41dB	46.22dB	**189.63dB**
2500MHz	121.75dB	27.33dB	**149.08dB**	135.41dB	28.31dB	**163.72dB**	145.35dB	47.22dB	**192.57dB**
3000MHz	123.33dB	29.32dB	**152.65dB**	136.99dB	29.63dB	**166.62dB**	146.94dB	48.04dB	**194.98dB**

Table 44: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Gemsbok PV5 emissions.

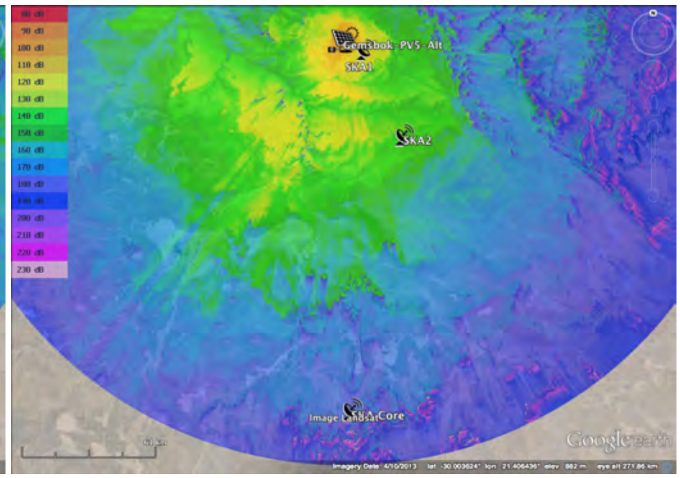


(a) (b) (c) (d)

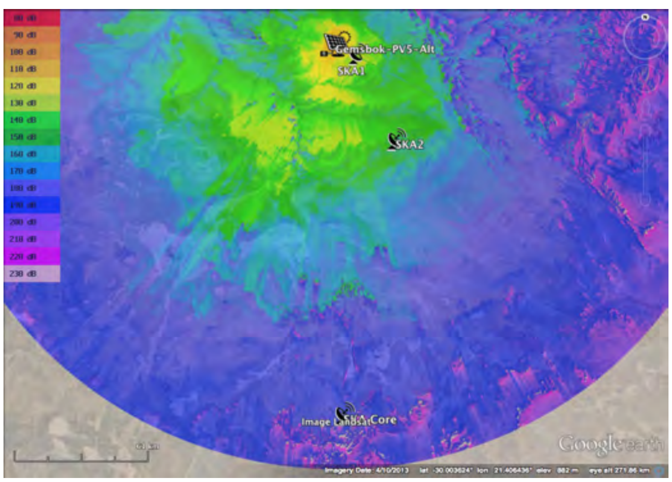
Figure 66: TPL attenuation maps for **preferred** site location of Gemsbok PV5 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



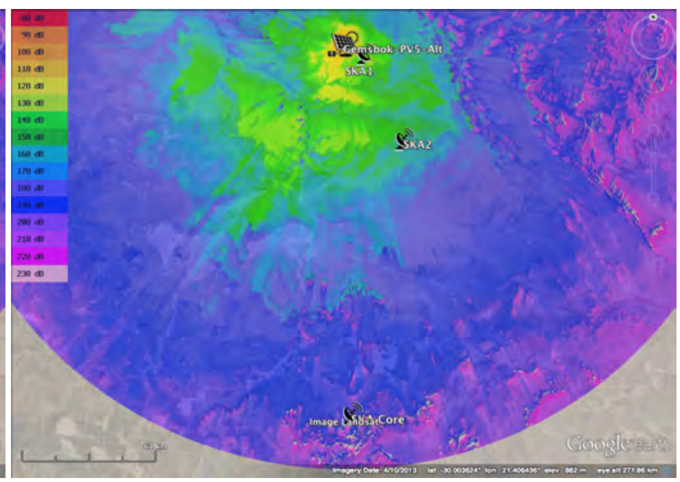
(a)



(b)



(c)



(d)

Figure 67: TPL attenuation maps for **alternative** site location of Gemsbok PV5 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

5.13 Gemsbok PV6 Site Location

5.13.1 Gemsbok PV6 Preferred Site Location

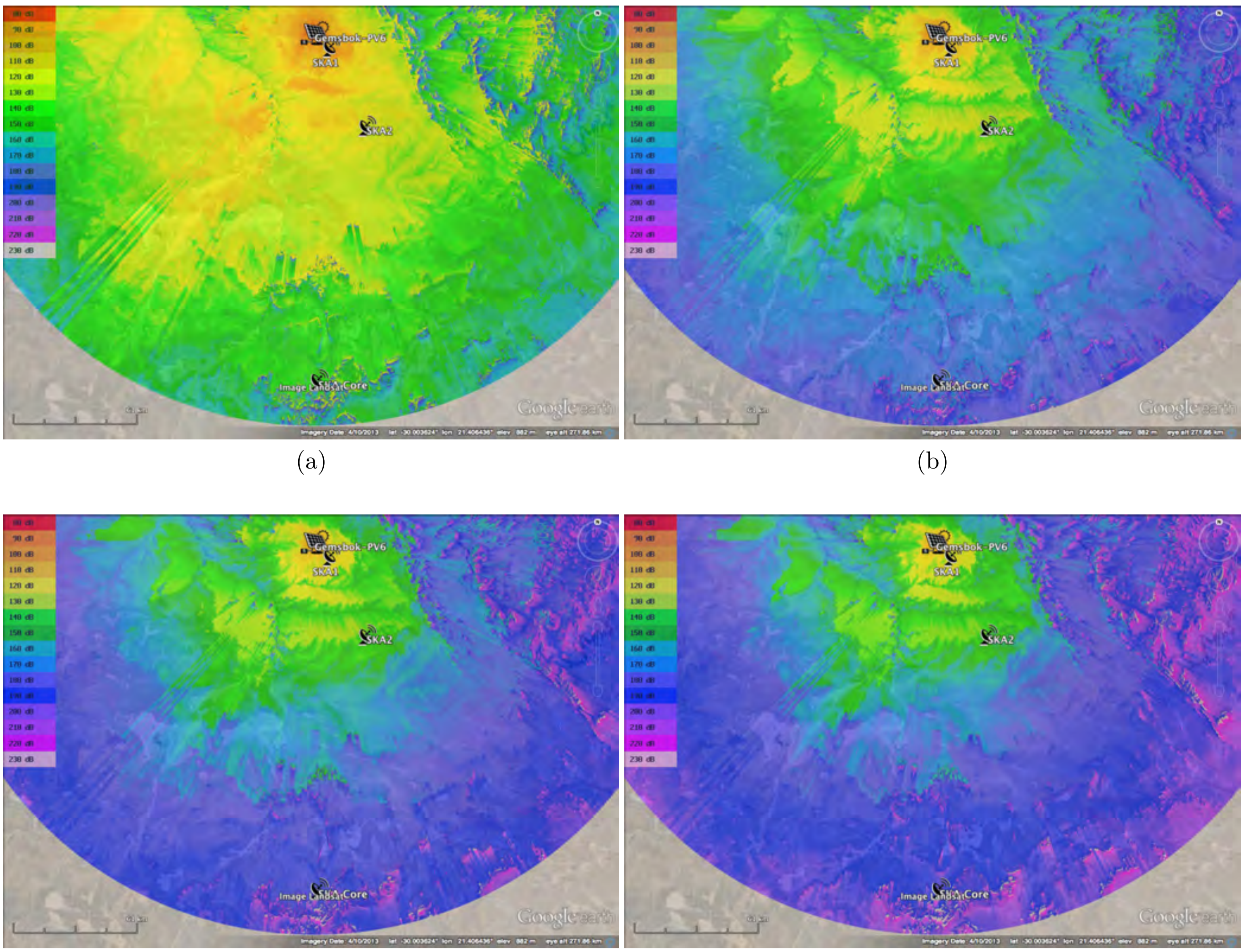
	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	93.64dB	19.39dB	**113.03dB**	107.64dB	23.34dB	**130.98dB**	117.52dB	29.84dB	**147.36dB**
300MHz	103.18dB	13.52dB	**116.7dB**	117.18dB	13.78dB	**130.96dB**	127.06dB	30.93dB	**157.99dB**
500MHz	107.62dB	11.93dB	**119.55dB**	121.62dB	11.78dB	**133.4dB**	131.5dB	33.61dB	**165.11dB**
1000MHz	113.64dB	11.22dB	**124.86dB**	127.64dB	12.63dB	**140.27dB**	137.52dB	39.09dB	**176.61dB**
1500MHz	117.16dB	11.7dB	**128.86dB**	131.16dB	14.04dB	**145.2dB**	141.04dB	41.54dB	**182.58dB**
2000MHz	119.66dB	12.51dB	**132.17dB**	133.66dB	15.39dB	**149.05dB**	143.54dB	43.12dB	**186.66dB**
2500MHz	121.6dB	13.19dB	**134.79dB**	135.6dB	16.69dB	**152.29dB**	145.48dB	44.3dB	**189.78dB**
3000MHz	123.18dB	13.98dB	**137.16dB**	137.18dB	17.89dB	**155.07dB**	147.06dB	45.24dB	**192.3dB**

Table 45: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **preferred** site Gemsbok PV6 emissions.

5.13.2 Gemsbok PV6 Alternative Site Location

	Closest Telescope 1			Closest Telescope 2			SKA Core Site		
Frequency	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**	**FSPL**	**TL**	**TPL**
100MHz	94.3dB	15.79dB	**110.09dB**	107.68dB	27.14dB	**134.82dB**	117.49dB	32.67dB	**150.16dB**
300MHz	103.84dB	11.16dB	**115.0dB**	117.23dB	17.25dB	**134.48dB**	127.03dB	32.01dB	**159.04dB**
500MHz	108.28dB	10.33dB	**118.61dB**	121.66dB	15.36dB	**137.02dB**	131.47dB	34.33dB	**165.8dB**
1000MHz	114.3dB	10.76dB	**125.06dB**	127.68dB	17.13dB	**144.81dB**	137.49dB	39.51dB	**177.0dB**
1500MHz	117.82dB	12.25dB	**130.07dB**	131.21dB	18.9dB	**150.11dB**	141.01dB	41.82dB	**182.83dB**
2000MHz	120.32dB	13.61dB	**133.93dB**	133.7dB	20.34dB	**154.04dB**	143.51dB	43.39dB	**186.9dB**
2500MHz	122.26dB	14.71dB	**136.97dB**	135.64dB	21.62dB	**157.26dB**	145.45dB	44.56dB	**190.01dB**
3000MHz	123.84dB	15.65dB	**139.49dB**	137.23dB	22.76dB	**159.99dB**	147.03dB	45.5dB	**192.53dB**

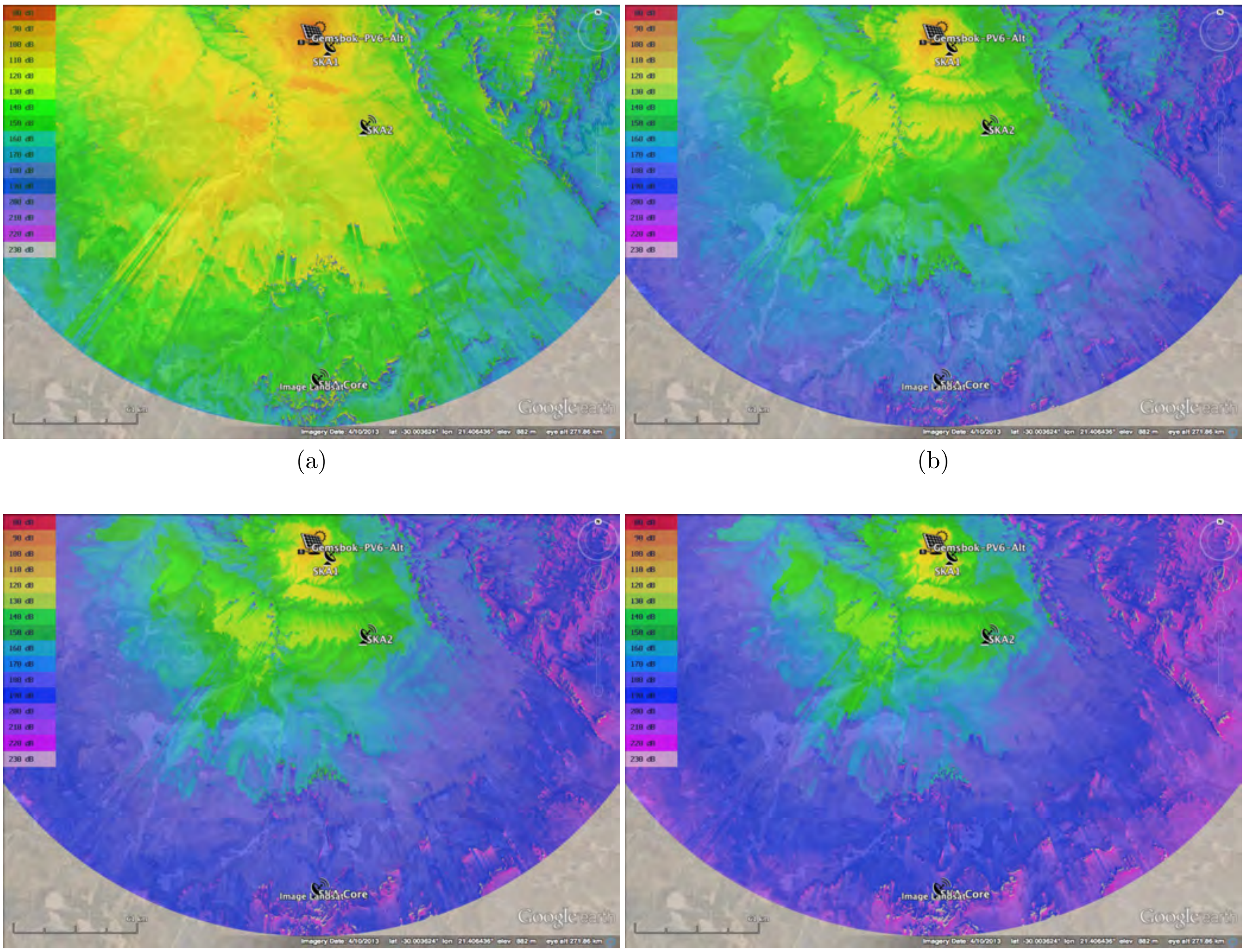
Table 46: SPLAT! Free Space Path Loss (FSPL), Terrain Loss (TL) and Total Path Loss (TPL) for vertical polarisation **alternative** site Gemsbok PV6 emissions.



(a) (b)

(c) (d)

Figure 68: TPL attenuation maps for **preferred** site location of Gemsbok PV6 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.



(a) (b) (c) (d)

Figure 69: TPL attenuation maps for **alternative** site location of Gemsbok PV6 to the closest and core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

6 SKA Threshold Limits

SKA threshold limits are defined as *Protection Limits* (dBm/Hz as defined by SARAS) and *Receiver Saturation Limits* (-100 dBm). Using the attenuation maps and topographical profiles calculated in Section 5 , we next compare the acceptable levels as measured at 10 m from each plant (according to CISPR 11/22 class B) that will produce radiated emission levels 10 dB below the SKA threshold as defined by SARAS. The 10 dB theoretical value is a safety margin to ensure that each of the plants complies with the SKA threshold, and attempts to take into account any multi-path effects (6 dB variation) and any measurement uncertainties. The required level 10 dB below the threshold takes into account the TPL calculated by SPLAT! and are indicated as *Required Radiation Levels After Propagation Loss*. The required PSD of the radiated emission levels experienced at each telescope are given by Eq. 2 below. The required levels are represented by the *black squares* in Figs. 70 (b) to 72 (b) for projects to the closest and core SKA telescope sites respectively.

$$PSD_{\text{Required}}\,[dBm/Hz] = PSD_{\text{SARAS Continuum}}\,[dBm/Hz] - 10\,dB \tag{2}$$

Considering the TPL, the required PSD at the source of the interference, indicated as *Required Radiation Levels Before Propagation Loss at PV Plant* in Figs. 70 (b) to 72 (b), is given by:

$$PSD_{\text{Source}}\,[dBm/Hz] = PSD_{\text{Required}}\,[dBm/Hz] + TPL\,[dB] \tag{3}$$

The effective isotropic radiated power (EIRP) level at the source, that will result in an E-field E_0 as measured according to the CSIPR 11/22 Class B standard with a RBW and separation distance of 120 kHz and 10 m for f $<$ 1 GHz, and 1 MHz and 3 m for f $>$ 1 GHz respectively, is given by:

$$EIRP\,[dBm] = PSD_{\text{Source}}\,[dBm/Hz] + 10\log_{10}(RBW)\,[Hz] \tag{4}$$

The electric field (E_0) levels associated with the EIRP defined in Eq. 4, again as measured according to the CISPR 11/22 Class B standard, are shown in Figs. 70 (c) to 72 (c) and given by:

$$E_0\,[dB\mu V/m] = EIRP - 20\log_{10} D + 104.8 \tag{5}$$

The maximum EIRP levels of the source, to ensure the *Receiver Saturation Limit* of -100 dBm is met, are shown in Figs. 70 (a) to 72 (a) and given by:

$$EIRP_{\max}\,[dBm] = -100\,dBm + TPL\,[dB] \tag{6}$$

6.1 Cumulative Impact Assessment

In the case where there are more than one source of interference for a specific frequency, the cumulative effect should be considered by taking into account:

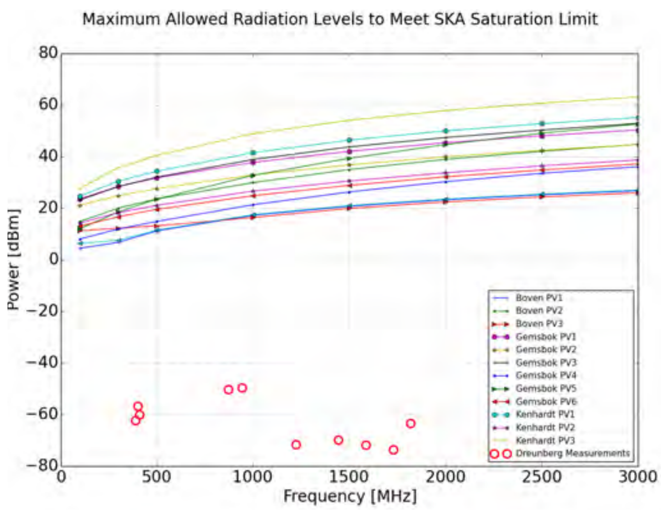
$$P_{\text{Cumulative}} = 10\log_{10}(N) \tag{7}$$

where $N = 13$ is the number of PV plants. This implies an increase in interference levels of up to 11.1 dB and is therefore subtracted from the maximum allowable radiated limits in Figs 70 to 72.

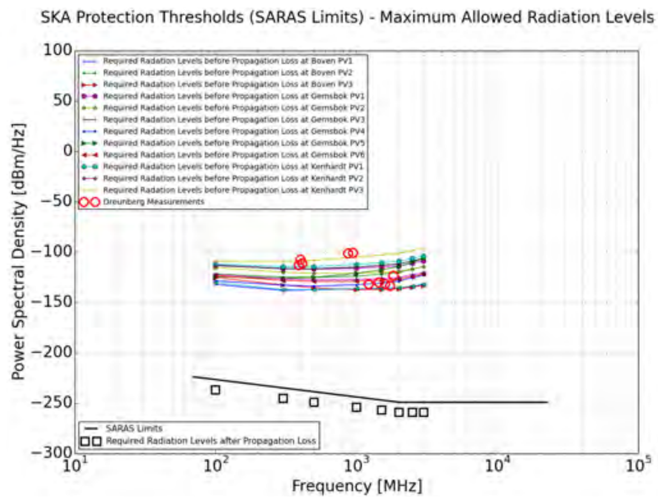
6.2 Maximum Allowed Radiation Levels

Below are given the maximum allowed radiation levels to meet both SKA *Saturation* and *Protection Threshold* (SARAS) limits for the two closest and core site telescopes for each of the proposed sites.

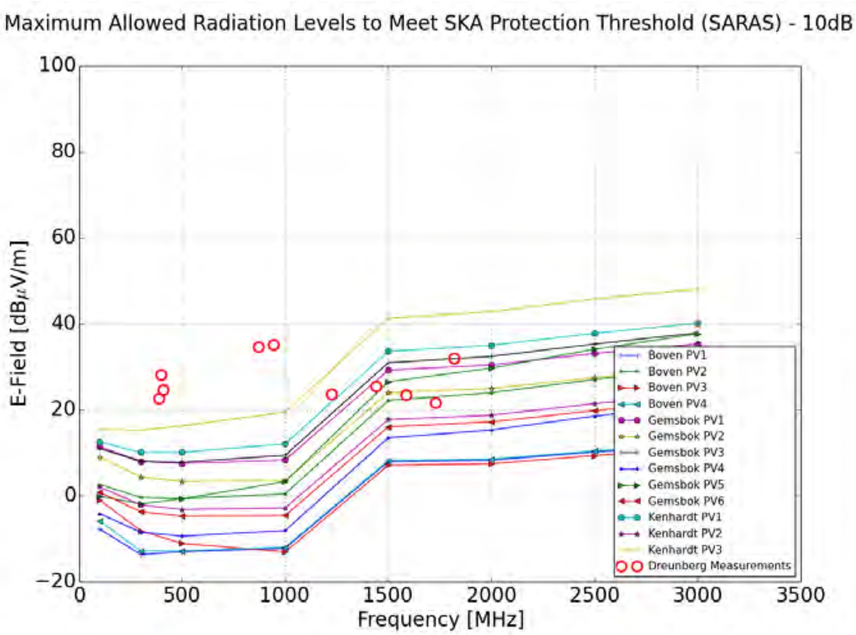
6.2.1 Closest SKA Telescope



(a)



(b)



(c)

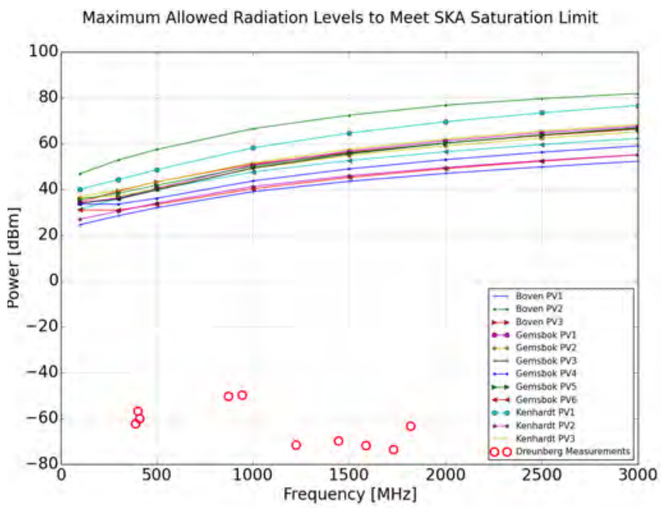
Figure 70: Closest SKA telescope receiver: (a) Maximum allowed EIRP to ensure levels are below the SKA saturation limit of -100 dBm at the telescope receiver; (b) Maximum allowed PSD to ensure levels are 10 dB below SARAS protection levels; (c) Maximum allowed measured E-Field (CISPR 22 Class B) to ensure levels are 10 dB below SARAS protection levels.

Given in Table 47 is a comparison between measured plant RFI and maximum allowed emission levels as shown in Fig. 70. It shows the approximate required mitigation (red), or surplus attenuation (green) for each recommended plant in relation to the closest SKA telescope. Required mitigation or surplus attenuation varies based on plant location and frequency. However, mitigation measures will have to be applied based on the highest required level. The required 50 dB of shielding at Boven PV1 @ 942 MHz, for example, would require significant attention to detail to achieve.

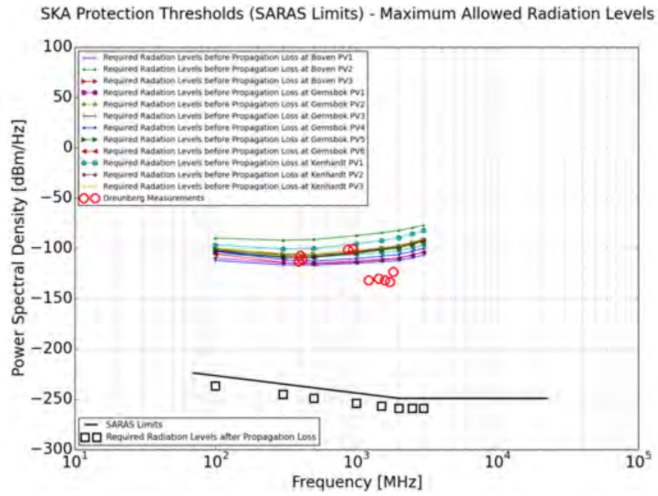
Site Location	387.38 MHz	399.19 MHz	409.52 MHz	871.57 MHz	942.42 MHz	1223.81 MHz	1441.27 MHz	1584.12 MHz	1728.57 MHz	1819.05 MHz
Kenhardt PV1	12.55	18.03	14.58	23.06	23.28	1.96	-5.57	-10.4	-12.54	-2.51
Kenhardt PV2	25.23	30.77	27.38	37.53	37.99	17.28	10.17	5.52	3.5	13.6
Kenhardt PV3	6.94	12.37	8.87	15.98	16.03	-5.57	-13.22	-18.11	-20.3	-10.3
Boven PV1	36.02	41.47	37.99	47.05	47.43	26.85	19.92	15.43	13.61	23.82
Boven PV2	23.16	28.66	25.23	34.35	34.79	13.48	5.88	0.97	-1.29	8.67
Boven PV3	32.07	37.73	34.44	47.17	47.95	27.69	20.76	16.27	14.45	24.66
Boven PV4	35.48	40.95	37.5	46.79	47.17	26.59	19.66	15.17	13.35	23.56
Gemsbok PV1	14.85	20.36	16.94	26.52	26.91	5.98	-1.29	-6.01	-8.08	1.99
Gemsbok PV2	18.72	24.26	20.87	31.2	31.68	11.01	3.92	-0.72	-2.73	7.38
Gemsbok PV3	14.75	20.25	16.81	25.63	25.9	4.6	-2.93	-7.77	-9.92	0.09
Gemsbok PV4	31.52	37.06	33.66	43.06	43.38	22.1	14.54	9.64	7.38	17.34
Gemsbok PV5	24.01	29.42	25.92	32.36	32.29	9.96	1.69	-3.63	-6.27	3.43
Gemsbok PV6	26.8	32.34	28.94	39.25	39.73	19.02	11.88	7.2	5.14	15.21

Table 47: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the closest SKA telescope.

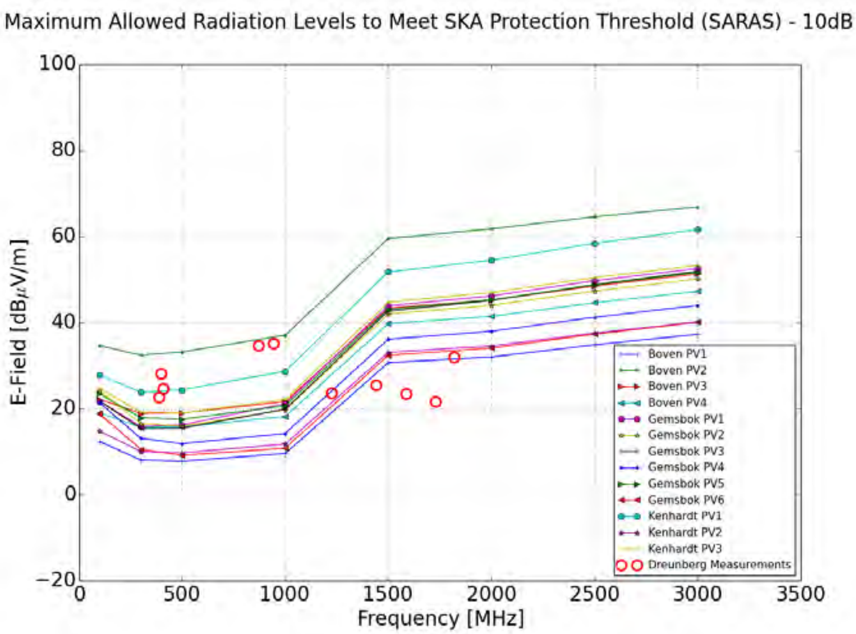
6.2.2 2nd Closest SKA Telescope



(a)



(b)



(c)

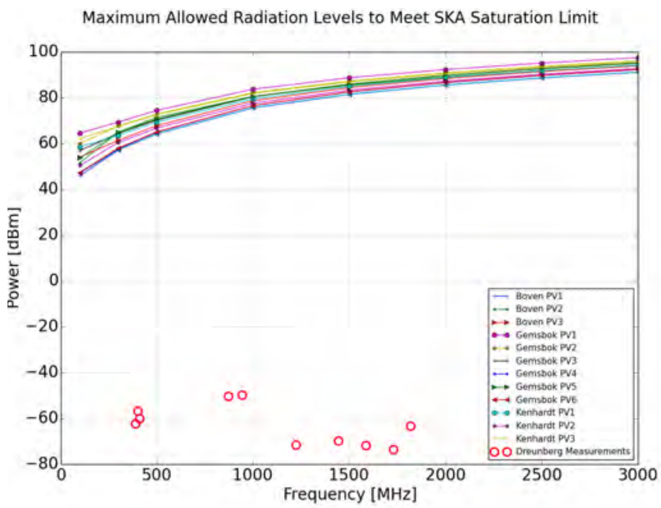
Figure 71: 2nd closest SKA telescope receiver: (a) Maximum allowed EIRP to ensure levels are below the SKA saturation limit of -100 dBm at the telescope receiver; (b) Maximum allowed PSD to ensure levels are 10 dB below SARAS protection levels; (c) Maximum allowed measured E-Field (CISPR 22 Class B) to ensure levels are 10 dB below SARAS protection levels.

Given in Table 48 is a comparison between measured plant RFI and maximum allowed emission levels as shown in Fig. 71. It shows the approximate required mitigation (red), or surplus attenuation (green) for each recommended plant in relation to the second closest SKA telescope. Required mitigation or surplus attenuation varies based on plant location and frequency. However, mitigation measures will have to be applied based on the highest required level. The required 50 dB of shielding at Boven PV1 @ 942 MHz, for example, would require significant attention to detail to achieve.

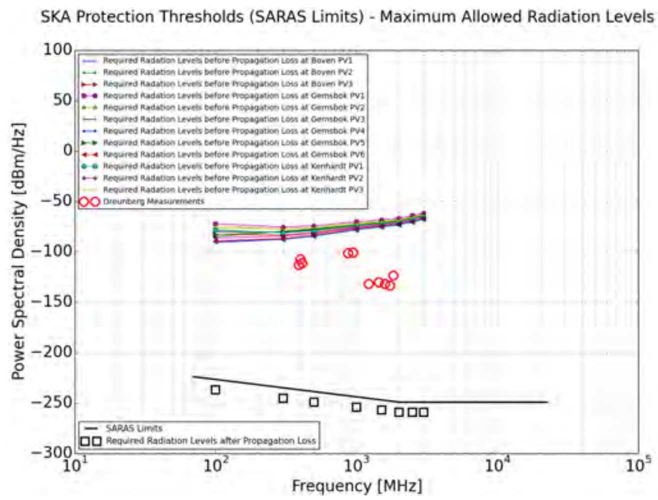
Site Location	**387.38 MHz**	**399.19 MHz**	**409.52 MHz**	**871.57 MHz**	**942.42 MHz**	**1223.81 MHz**	**1441.27 MHz**	**1584.12 MHz**	**1728.57 MHz**	**1819.05 MHz**
Kenhardt PV1	-1.38	4.07	0.59	7.05	6.94	-15.35	-23.55	-28.78	-31.31	-21.52
Kenhardt PV2	12.74	18.24	14.81	23.39	23.6	2.36	-5.07	-9.89	-12.05	-2.03
Kenhardt PV3	3.57	9.07	5.63	13.31	13.36	-8.6	-16.59	-21.69	-24.06	-14.19
Boven PV1	14.73	20.23	16.8	25.52	25.77	4.64	-2.72	-7.48	-9.58	0.46
Boven PV2	3.73	9.21	5.76	13.68	13.81	-7.7	-15.32	-20.25	-22.51	-12.57
Boven PV3	3.73	9.21	5.76	13.68	13.81	-7.7	-15.32	-20.25	-22.51	-12.57
Boven PV4	6.95	12.43	8.98	17.08	17.24	-4.17	-11.73	-16.61	-18.82	-8.84
Gemsbok PV1	6.64	12.1	8.64	14.75	14.56	-7.66	-15.72	-20.84	-23.23	-13.37
Gemsbok PV2	6.39	11.91	8.49	15.91	15.87	-6.01	-13.88	-18.9	-21.21	-11.29
Gemsbok PV3	7.22	12.7	9.25	15.89	15.77	-6.42	-14.51	-19.67	-22.11	-12.27
Gemsbok PV4	10.1	15.65	12.27	21.01	21.18	-0.36	-8.05	-13.0	-15.27	-5.33
Gemsbok PV5	4.92	10.42	6.99	14.78	14.84	-7.04	-14.98	-20.04	-22.4	-12.51
Gemsbok PV6	12.72	18.28	14.91	24.24	24.5	3.19	-4.35	-9.23	-11.45	-1.48

Table 48: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the second closest SKA telescope.

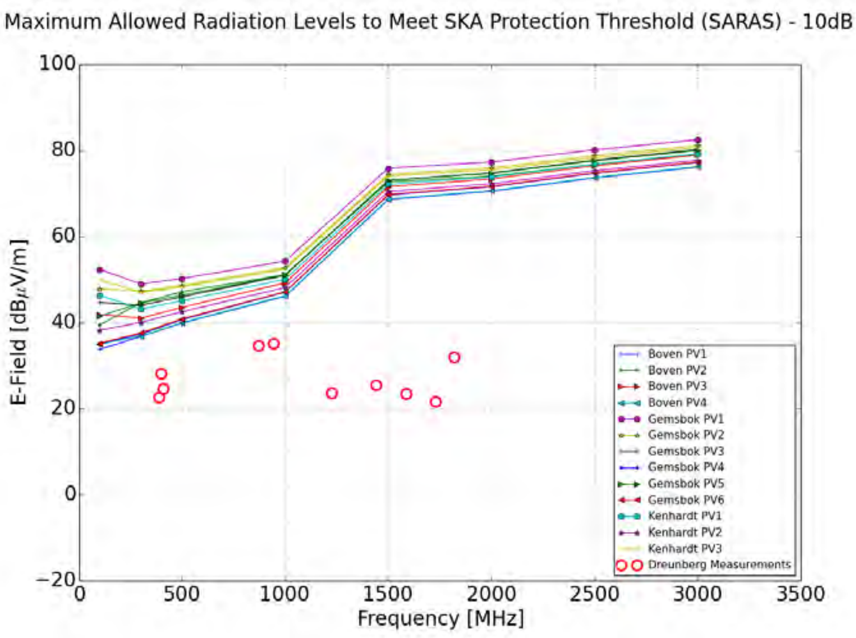
6.2.3 Core SKA Telescopes



(a)



(b)



(c)

Figure 72: Core SKA telescope receivers: (a) Maximum allowed EIRP to ensure levels are below the SKA saturation limit of -100 dBm at the telescope receiver; (b) Maximum allowed PSD to ensure levels are 10 dB below SARAS protection levels; (c) Maximum allowed measured E-Field (CISPR 22 Class B) to ensure levels are 10 dB below SARAS protection levels.

Given in Table 49 is a comparison between measured plant RFI and maximum allowed emission levels as shown in Fig. 72. It shows the approximate required mitigation (red), or surplus attenuation (green) for each recommended plant in relation to the closest SKA telescope. Required mitigation or surplus attenuation varies based on plant location and frequency. However, mitigation measures will have to be applied based on the highest required level. Towards the core site sufficient path attenuation exist to ensure emissions are below required limits.

Site Location	**387.38 MHz**	**399.19 MHz**	**409.52 MHz**	**871.57 MHz**	**942.42 MHz**	**1223.81 MHz**	**1441.27 MHz**	**1584.12 MHz**	**1728.57 MHz**	**1819.05 MHz**
Kenhardt PV1	-21.33	-15.96	-19.51	-14.15	-14.35	-36.27	-44.03	-48.97	-51.19	-41.21
Kenhardt PV2	-18.46	-13.12	-16.7	-12.06	-12.35	-34.46	-42.33	-47.32	-49.57	-39.61
Kenhardt PV3	-24.93	-19.53	-23.04	-16.73	-16.81	-38.43	-46.01	-50.85	-52.99	-42.97
Boven PV1	-15.48	-10.18	-13.79	-9.87	-10.25	-32.51	-40.46	-45.49	-47.77	-37.84
Boven PV2	-19.45	-14.12	-17.69	-13.13	-13.44	-35.56	-43.45	-48.44	-50.7	-40.74
Boven PV3	-19.45	-14.12	-17.69	-13.13	-13.44	-35.56	-43.45	-48.44	-50.7	-40.74
Boven PV4	-15.58	-10.28	-13.89	-10.0	-10.38	-32.64	-40.59	-45.62	-47.89	-37.95
Gemsbok PV1	-26.86	-21.45	-24.96	-18.6	-18.67	-40.28	-47.85	-52.69	-54.83	-44.81
Gemsbok PV2	-25.18	-19.78	-23.3	-17.06	-17.15	-38.81	-46.41	-51.27	-53.42	-43.41
Gemsbok PV3	-22.2	-16.84	-20.39	-15.06	-15.27	-37.2	-44.97	-49.91	-52.13	-42.16
Gemsbok PV4	-16.1	-10.82	-14.44	-10.79	-11.19	-33.51	-41.49	-46.53	-48.82	-38.89
Gemsbok PV5	-22.7	-17.32	-20.87	-15.26	-15.43	-37.26	-44.97	-49.88	-52.07	-42.09
Gemsbok PV6	-16.36	-11.07	-14.68	-10.91	-11.31	-33.62	-41.61	-46.65	-48.94	-39.0

Table 49: Required (red) and surplus (green) attenuation levels [dB] to meet SARAS protection limits at the core-site SKA telescopes.

7 Plant Design Overview

RFI associated with the regular switching of relays and contactors to operate the single axis tracking systems has subsequently been found by MESA Solutions to be contributors of significant levels of broadband interference. Assuming a tracking PV plant design, significant care and effort will be required to shield the broadband interference generated during operation of the tracking units.

7.1 Expected Sources of Interference

The biggest RFI producing culprits for a plant layout incorporating a similar tracking philosophy were identified to be the inverter units and solar power tracker and monitoring controllers. Coupled to this is the way cabling is distributed throughout the plant. The combination of all three factors will influence the level of interference each plant is likely to produce.

- **Inverters**
  - The inverters are considered to be the main source of interference due to their switching operation through which the direct current (DC) from the panels is converted to alternating current (AC) supplied to the transformers. This interference can be in the form of CM current present on the cables connected to the units, or through direct radiation.
- **Solar Power Tracker and Monitoring Controller**
  - RFI associated with the regular switching of relays and contactors to operate the single axis tracking systems has recently been found to be prominent sources of interference. These relays will switch the motors or hydraulic pumps on and off on a regular basis during the day, resulting in broadband interference with substantial frequency content. Furthermore, RFI generated by the tracking controller is typically due to the default system operation implementing a wireless mesh network for communication purposes between units. A number of other electrical components, which are also likely sources of interference, form part of the controller.
- **Cable Routing and Earthing**
  - The way noise-producing equipment in the plant are interconnected has a significant influence on the level of RFI emitted. Cabling is the means by which interference in the form of common mode current (CM) is distributed. When sections of cabling become resonant, the interference is radiated into the environment. Depending on a number of factors such as height of transmission, frequency, emission level at source and topography, the interference will have a certain severity at the nearest SKA telescope as well as the core-site.

7.2 Mitigating Measures

It is strongly recommended that the following **mitigation practises** be incorporated into the plants design. The inverter units, transformers, communication and control units for an array of panels all be housed in a single shielded environment. For shielding of such an environment ensure RFI gasketting be placed on all the seams and doors. Furthermore, RFI Honeycomb filtering should be placed on all ventilation openings. It is important to ensure that the cables to be laid directly in soil or properly grounded cable trays (not plastic sleeves). The use of bare copper directly in soil for earthing is recommended to shunt CM interference currents to ground. In the case of a tracking PV plant design, care will have to be taken to shield the noise associated with the relays, contactors and hydraulic pumps/motors of the tracking units. It is recommended that data communications to and from the plants to be via fibre optic.

DIRECTORS: H. C. Reader, A. J. Otto and P. S. van der Merwe | www.mesasolutions.co.za | EMAIL: info@mesasolutions.co.za
REG NO: 2002/025186/07 | POSTAL ADDRESS: P.O. Box 12572, Die Boord, Stellenbosch, 7613

7.3 Expected RFI Reductions due to Mitigation Measures

By simply following good practices such as implementing an adequate earthing philosophy, and paying attention to the cabling interconnections and layout below ground, a reduction of at least 20 dB in the typical plant emissions across the frequency range of interest can be achieved. With added attention to detail, particularly regarding the shielding of enclosures, defining cable interfaces by correctly terminating cable screens or armouring, and the use of galvanic earthed cable trays for short cable runs above ground, a total reduction of 40 dB is likely. A further 20 dB reduction would require detailed analysis of the required enclosure shielding and gasketting, more stringent filtering at all cable interfaces, and implementing additional cable screening that could include using fully enclosed metallic cable conduits. It is therefore MESA's expectations that if the mitigation measures specified are implemented correctly, an improvement of between 20 and 40 dB in emissions levels are likely. The required maximum mitigation of 50 dB towards the closest telescopes for some plant locations would therefore require significant care. **It is important to note that this is purely predicted values and cannot be guaranteed or confirmed until measurements on operating plants (or representative installations) with recommended mitigation measures have been performed.**

8 Conclusions

MESA Solutions was asked by *Scatec Solar* to do a cumulative topographical analysis of the terrain profile between three proposed *Scatec Solar* PV projects, as well as ten proposed *Mulilo* PV projects, towards the closest and core-site SKA Telescopes. The purpose of the investigation is to define a level that can be verified through measurements which will result in an equivalent emission level that is 10 dB below the SKA threshold limit. This measurement level is influenced by the TPL between both telescope locations. However, the TPL is a function of topography and frequency as well as characteristics such as the transmitter and receiver heights. The measurement level is related to the well-known CISPR 11/22 Class B standard that is defined at a measurement distance of 10 m for frequencies below 1 GHz and at 3 m for frequencies above 1 GHz.

From the results in Section 6 it is clear that radiated emissions at levels below that of CISPR 11/22 Class B are required (especially in the case of the closest telescope). This is mainly due to the absence of any TL over this short distance. This requirement relaxes slightly toward the second closest telescope, while allowable measured levels increase to slightly above the CISPR limit due to the additional TL toward the core. The possibility exists that, due to the large number of sites that are proposed in that area, the overall lower levels would have to be achieved to limit interference to the closest telescopes as much as possible. A comparison between measured plant RFI and required mitigation or surplus attenuation have been provided for the closest and core site telescopes

It is strongly recommended that the following **mitigation practises** be incorporated into the plants design:

- The inverter units, transformers, communication and control units for an array of panels all be housed in a single shielded environment.
- For shielding of such an environment ensure:
  - RFI gasketting be placed on all seams and doors.
  - RFI Honeycomb filtering be placed on all ventilation openings.
- Cables to be laid directly in soil or properly grounded cable trays (not plastic sleeves).
- The use of bare copper directly in soil for earthing is recommended.
- Assuming a tracking PV plant design, care will have to be taken to shield the noise associated with the relays, contactors and hydraulic pumps/motors of the tracking units.

The three proposed Kenhardt plants are shown in Table 47 to exceed the SARAS protection levels by up to 38 dB toward the closest SKA telescope. This includes the cumulative effect of a total of $N = 13$ PV plants developed.

However, Boven PV1, PV3 and PV4 exceed this limit by approximately 50 dB in this scenario. For the case where only the three Kenhardt plants are developed, the exceedance will reduce to 31.6 dB with a cumulative effect for $N = 3$ plants considered.

It is MESA's expectations that, if the mitigation measures that are specified are implemented correctly, an improvement of between 20 and 40 dB in emissions levels are likely. However the maximum required attenuation for some of the plants towards the closest telescope would require significant attention to detail to achieve shielding levels of 50 dB. If required attenuation for the closest telescope is achieved, the second closest and core site will comply. *It is important to note that this is purely predicted values and cannot be guaranteed or confirmed until measurements on a representative mock-up installation with mitigation measures implemented are performed. It remain the developers responsibility to ensure that compliance to SKA requirements is met and MESA Solutions cannot accept responsibility for any assessments made in this report which could cause non-compliance.*

MESA Solutions
Drs A. J. Otto and P. S. van der Merwe
January 2016

References

[1] *Astronomy Geographic Advantage Act, 2007*, No. 21 of 2007, Government Gazette, Vol. 516, No. 31157, Cape Town, Republic of South Africa, 17 June 2008.

[2] P. Dewdney and G. Han Tan, *SKA EMI/EMC Standards and Procedures*, Technical Report SKA-TEL-SKO-0000202, Revision 1, Square Kilometre Array (SKA) Organisation, Jodrell Bank Observatory, UK, 10 January 2015.

[3] A. J. Otto and P. S. van der Merwe, *Topographical Analysis of Proposed Nieuwehoop PV Projects*, Technical Report, MUL/NH/15/07/28, MESA Solutions (Pty) Ltd., Stellenbosch, Western Cape, South Africa, 7600, 31 July 2015.

[4] A. J. Otto and P. S. van der Merwe, *Basic Site Assesment of Proposed Prieska Photovoltaic Plant*, Technical Report, SUN/14/08/22, Revision 0, MESA Solutions Pty (Ltd), Stellenbosch, South Africa, 22 August 2014.

Appendix

A Fresnel Zones and Line of Sight

The Fresnel zones and elevation profiles, including the earth curvature, are shown in Figs. 73 to 132. In all case the profiles are given towards the two closest and core-site SKA telescopes. A more detailed terrain profile shows features not visible in a normal Google Earth profile. This profile is then compensated for the earth curvature, clearly visible for the longer distance toward the core site. Important to note is the scale used in these figures. The elevation change is in meters but the separation distance varies in kilometres. The earth curvature representation is therefore somewhat enhanced.

A.1 Boven PV1 to Closest SKA

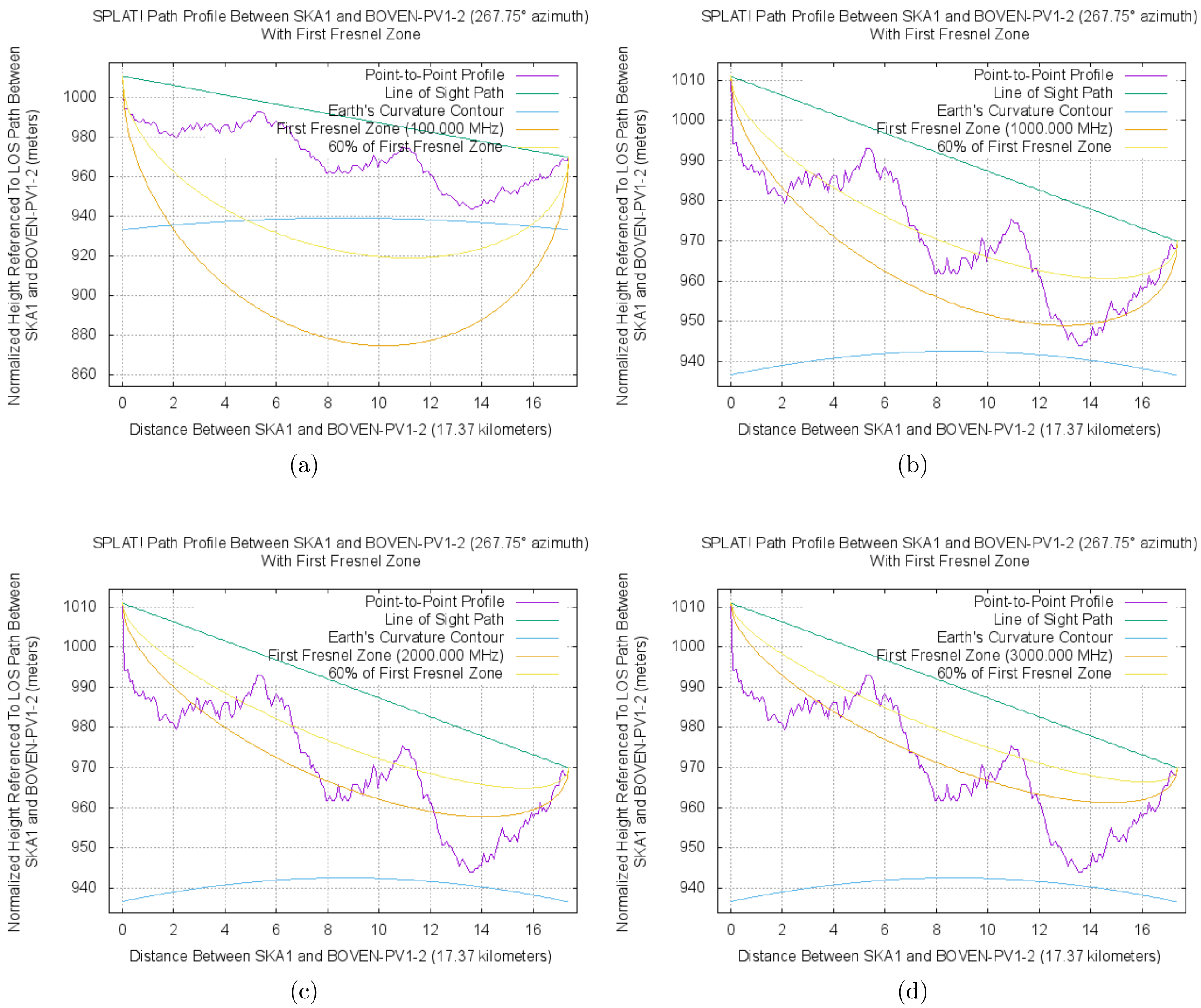


Figure 73: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV1 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.2 Boven PV1 to 2nd Closest SKA

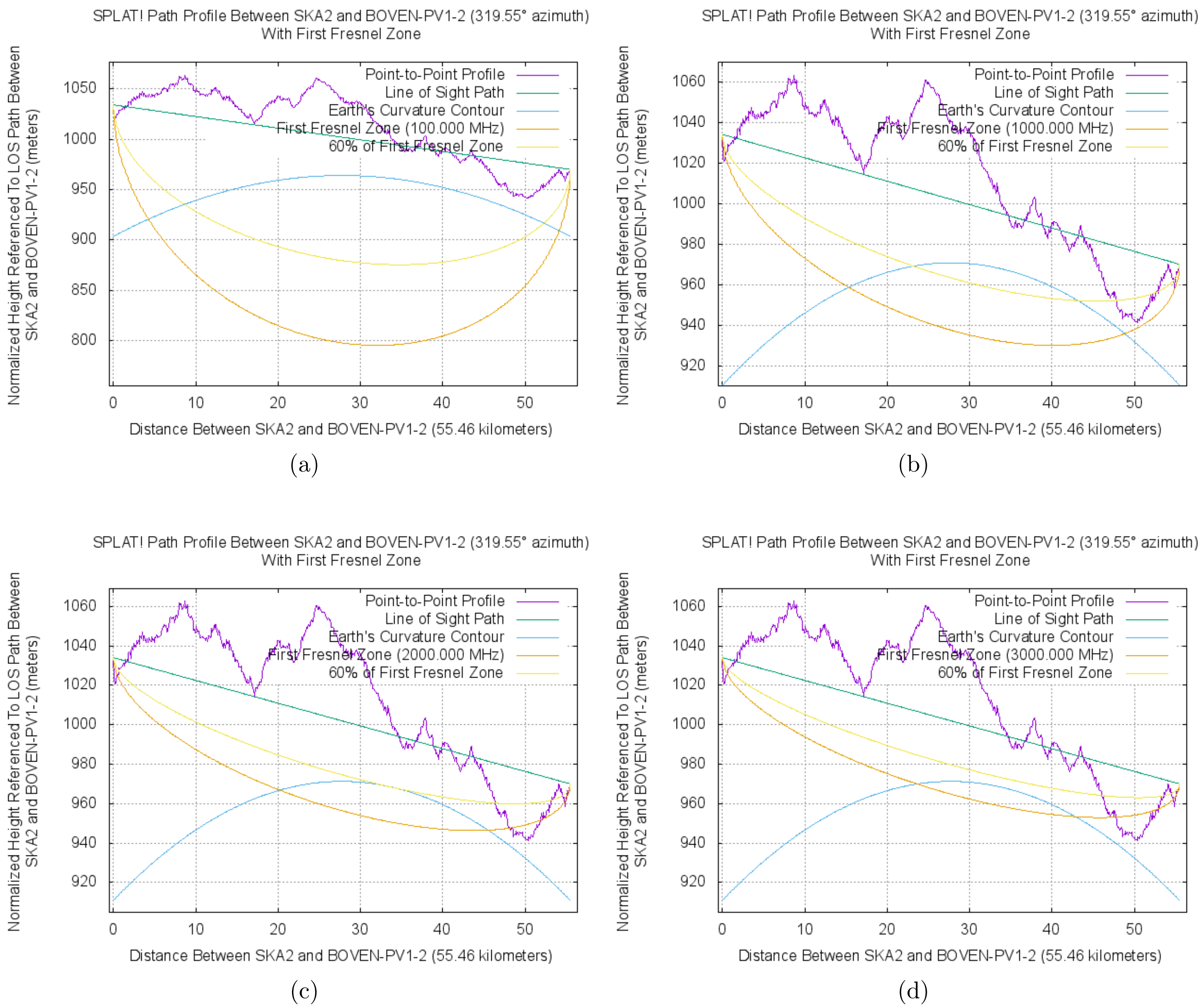


Figure 74: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV1 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.3 Boven PV1 to Core SKA

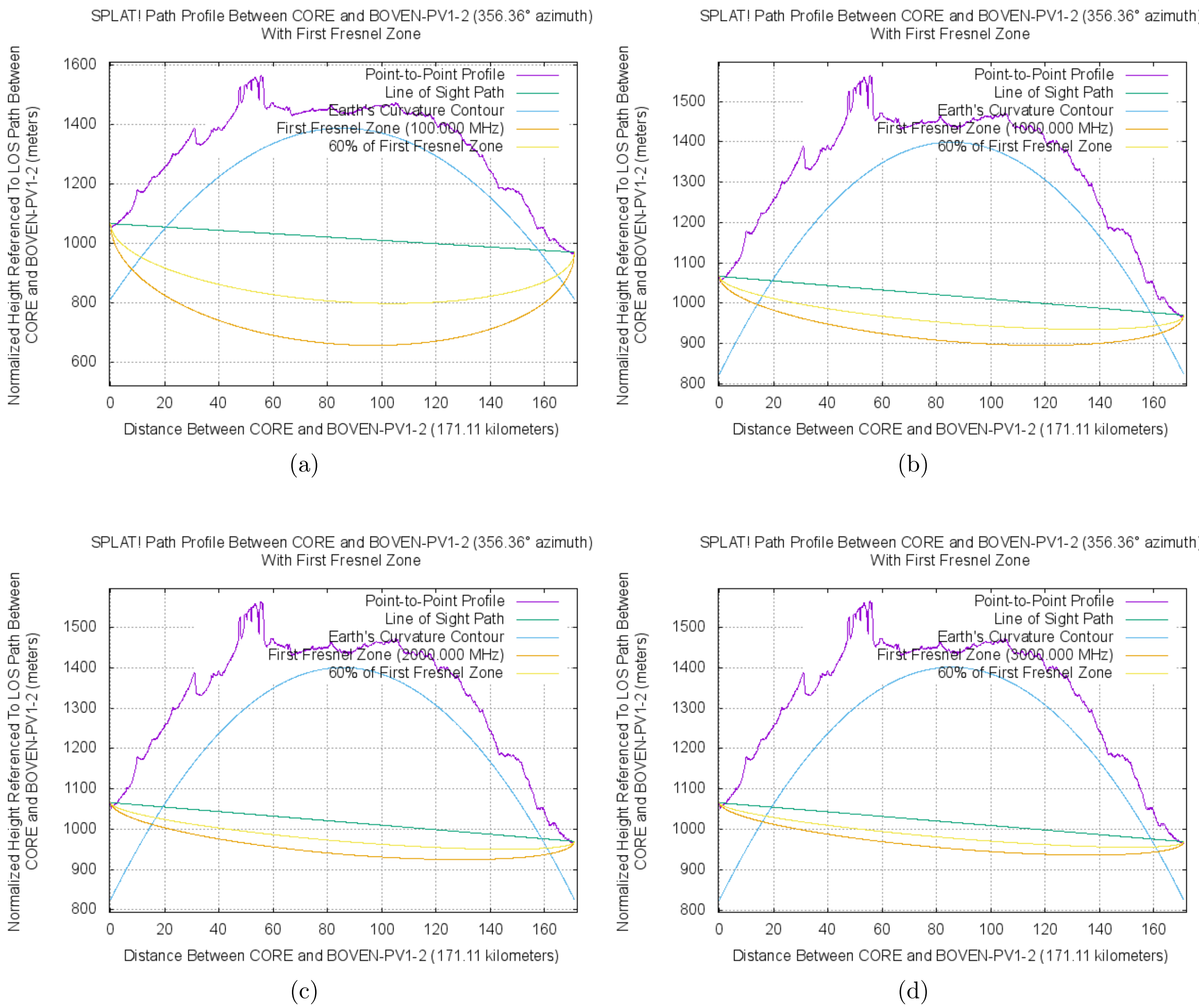


Figure 75: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV1 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.4 Boven PV2 to Closest SKA

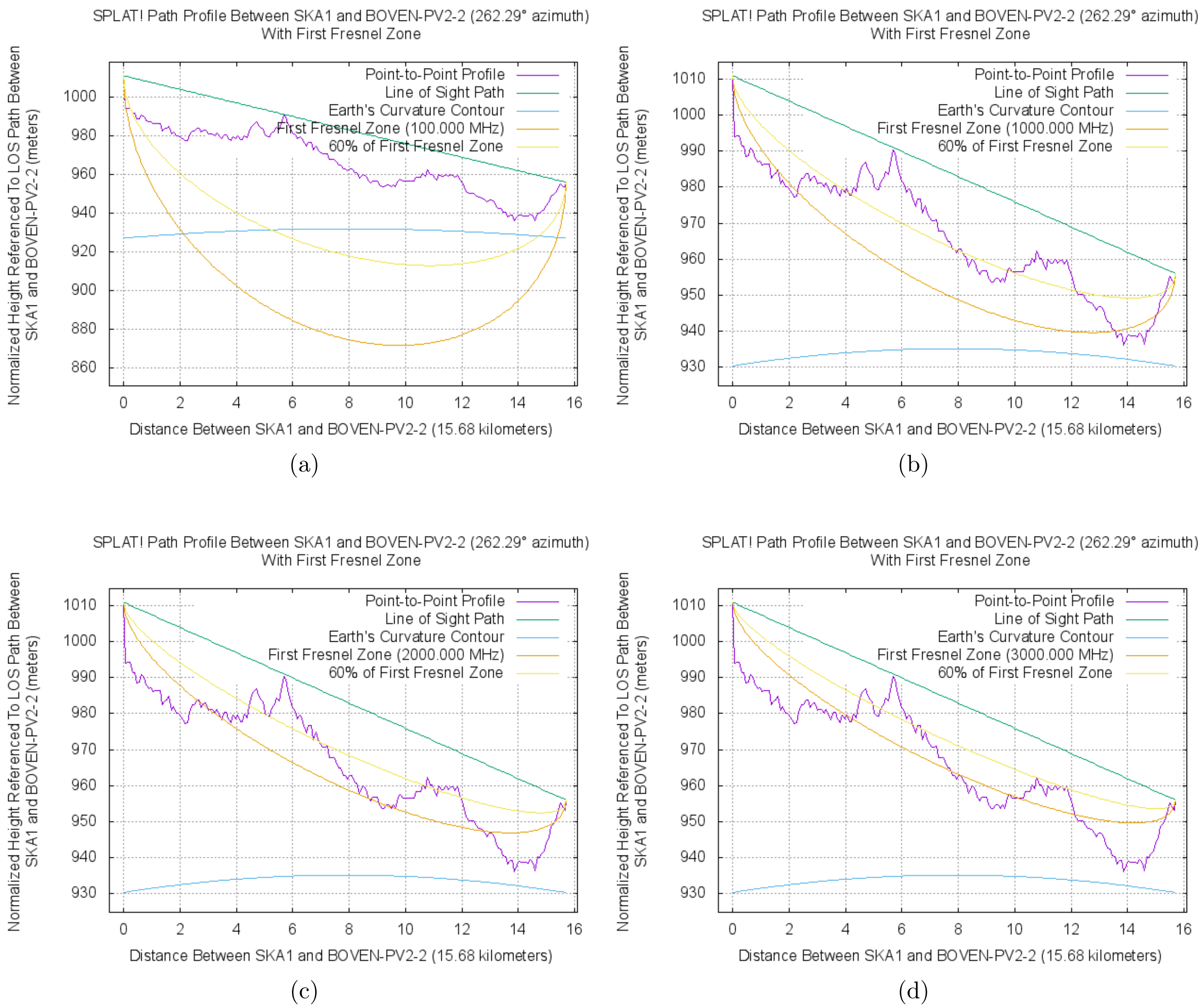


Figure 76: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.5 Boven PV2 to 2nd Closest SKA

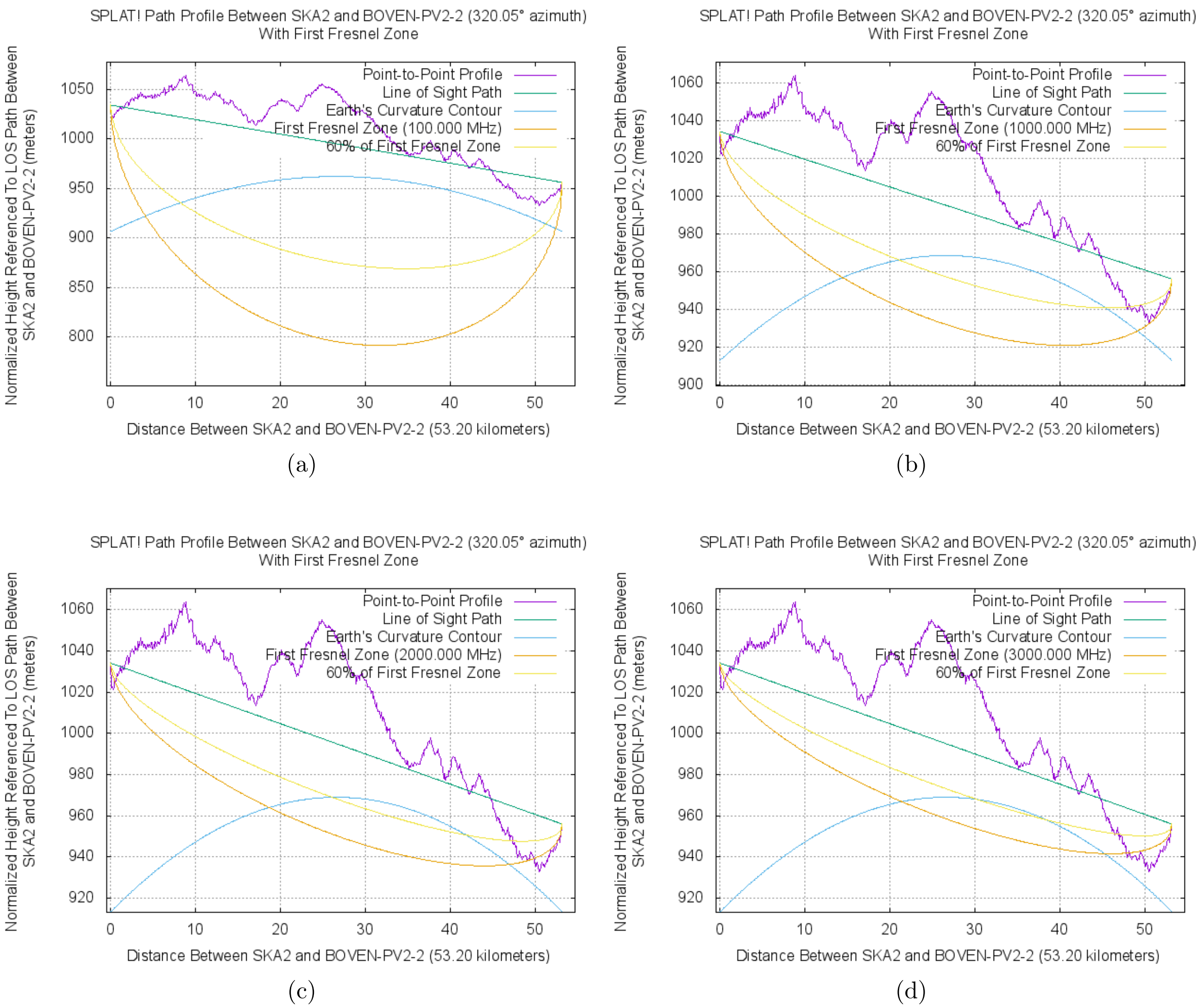


Figure 77: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.6 Boven PV2 to Core SKA

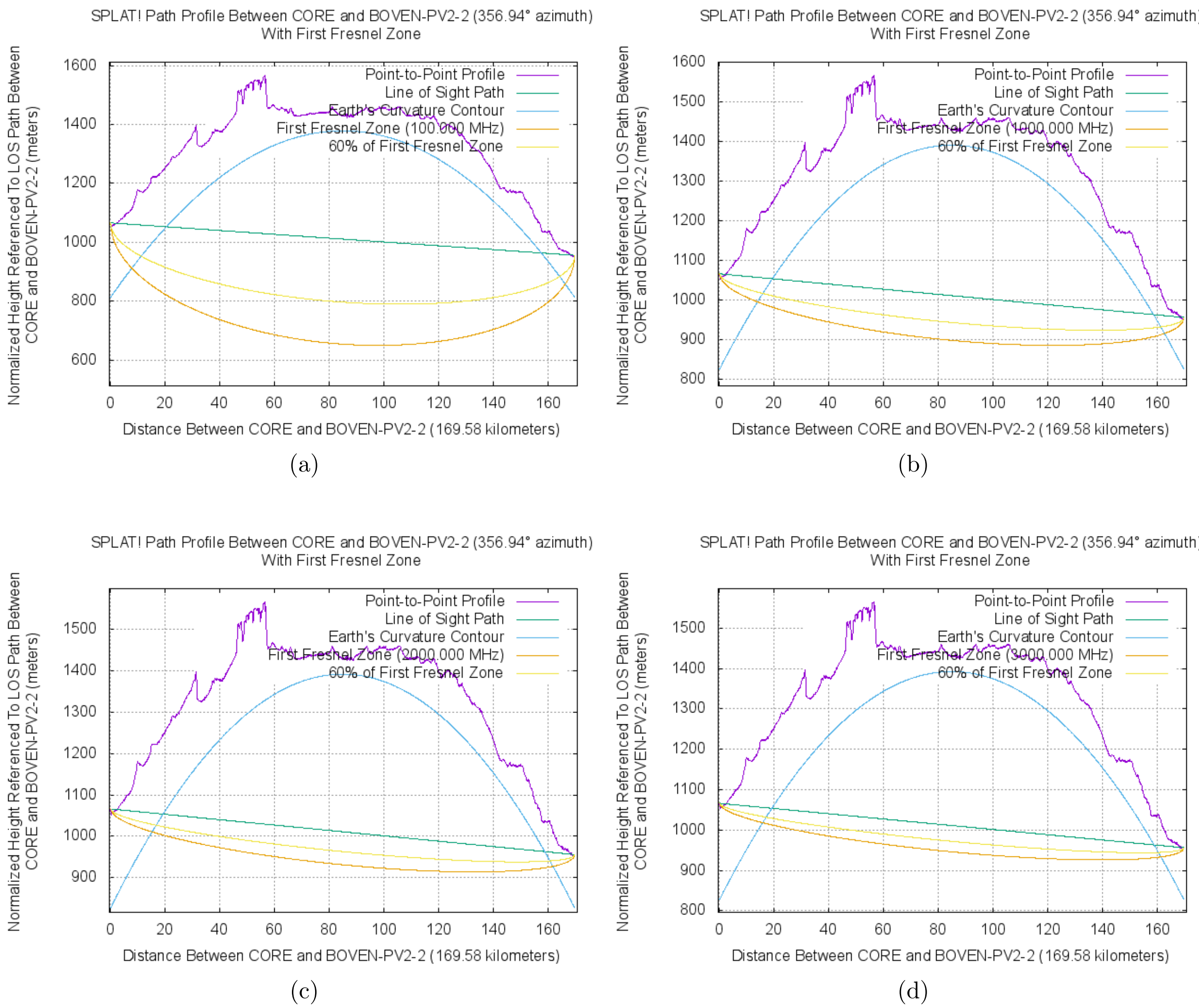
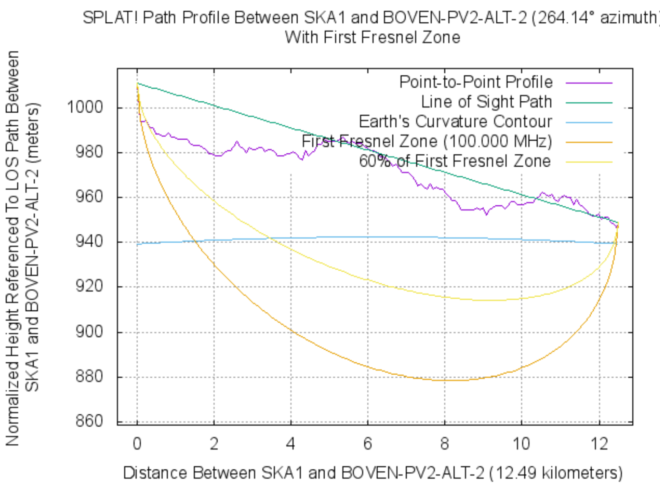
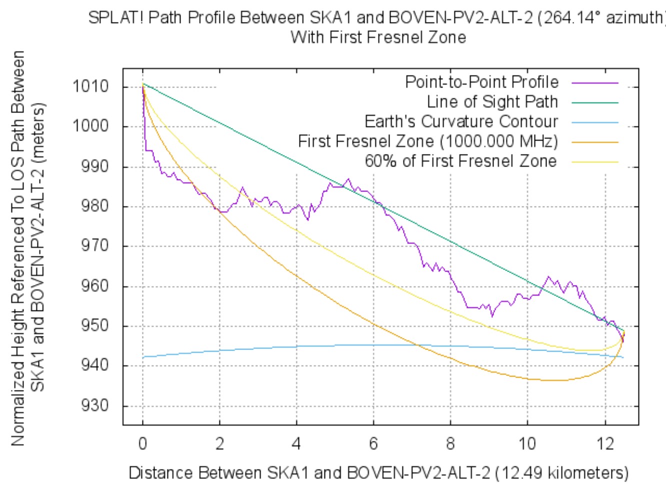


Figure 78: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

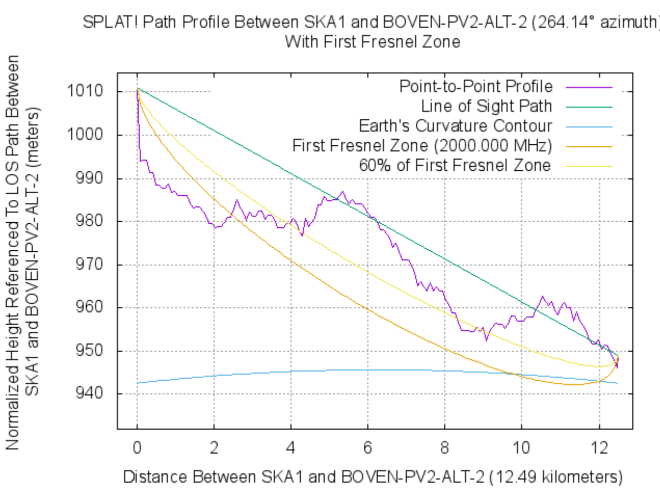
A.7 Boven PV2 Alternative to Closest SKA



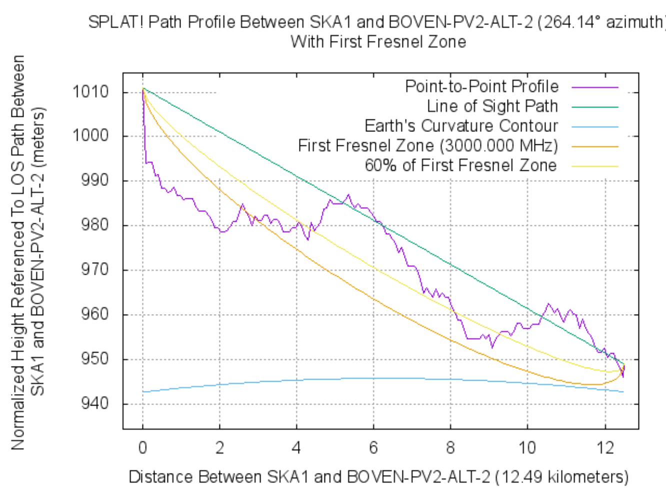
(a)



(b)



(c)



(d)

Figure 79: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.8 Boven PV2 Alternative to 2nd Closest SKA

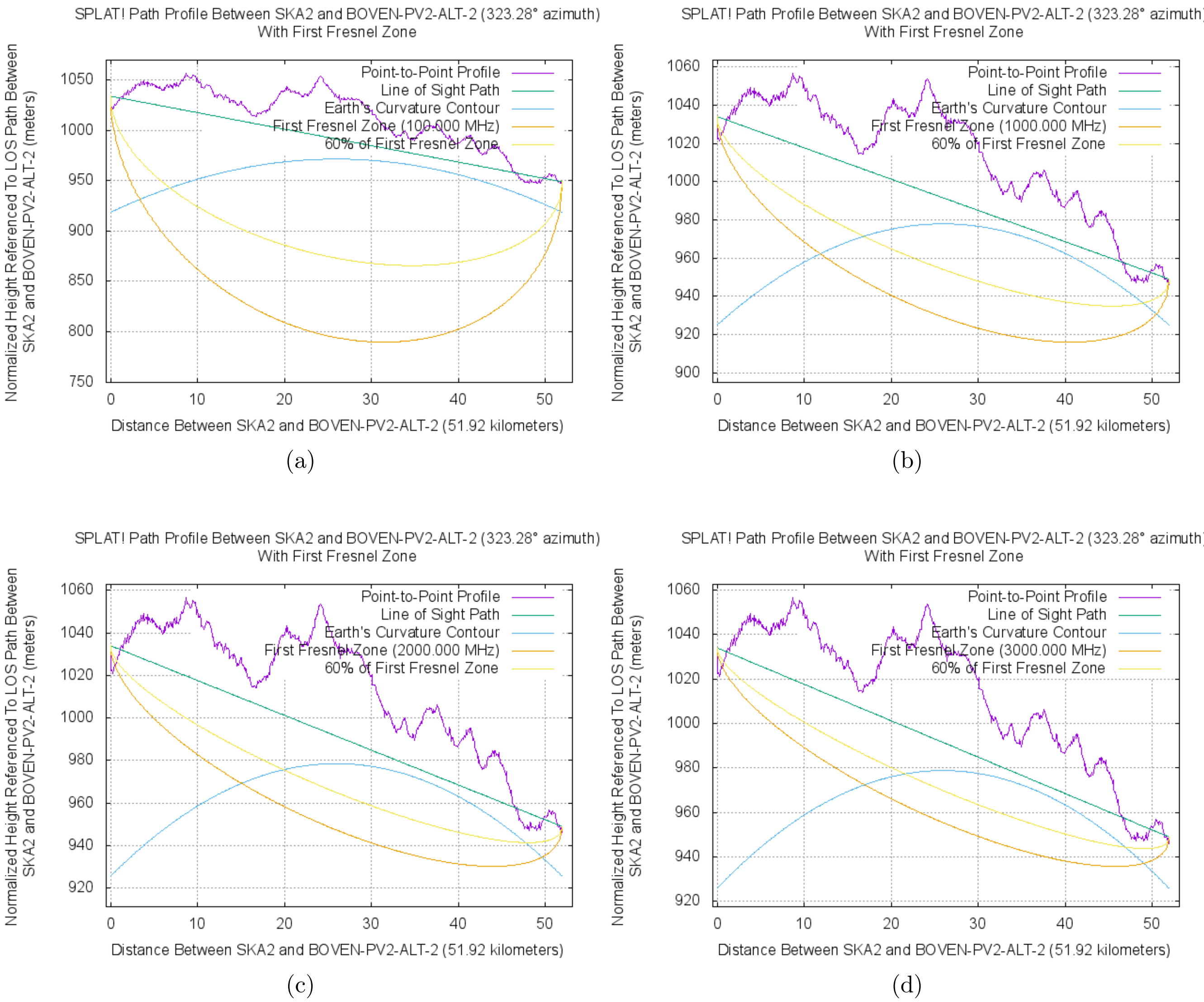


Figure 80: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.9 Boven PV2 Alternative to Core SKA

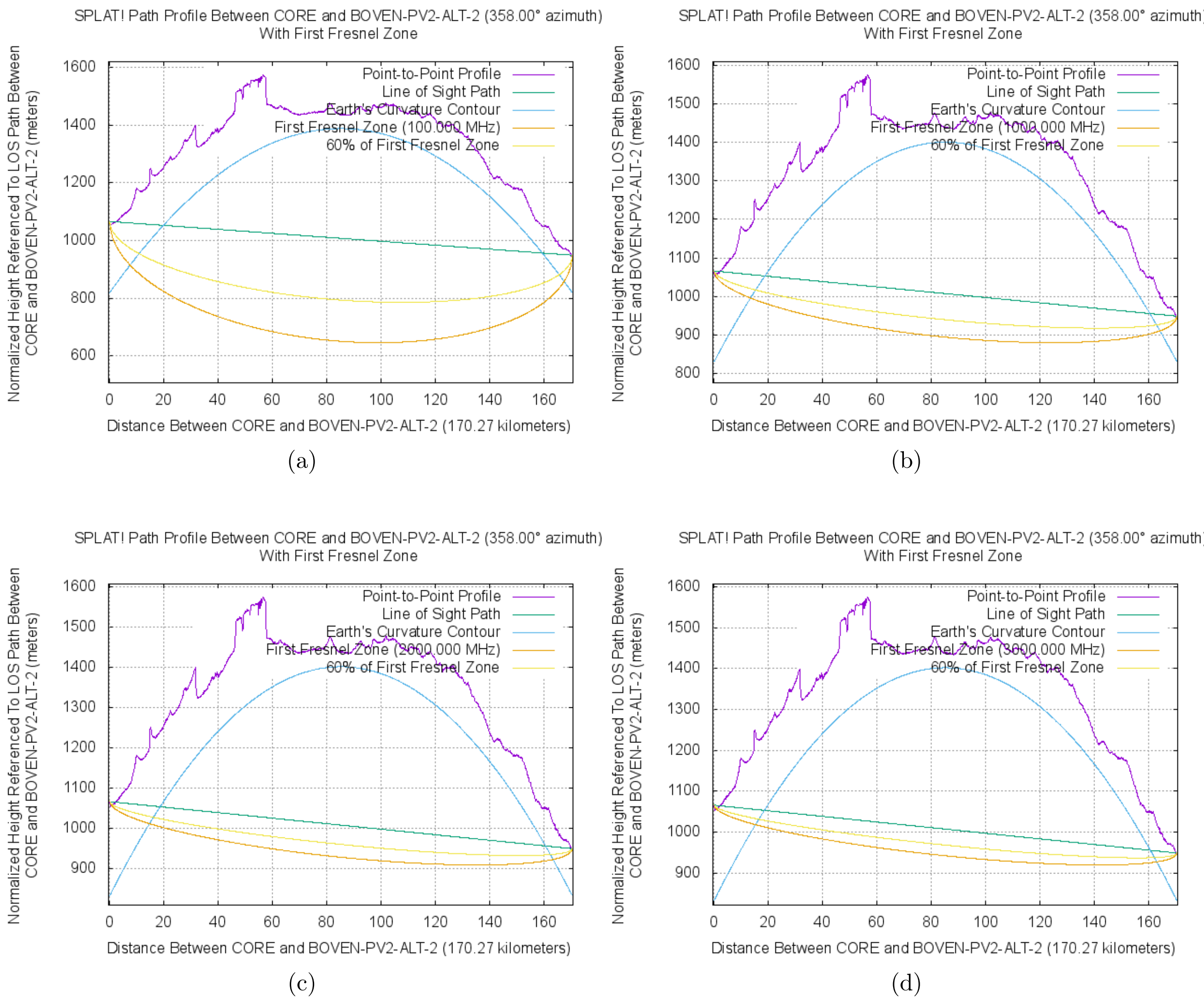


Figure 81: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV2 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.10 Boven PV3 to Closest SKA

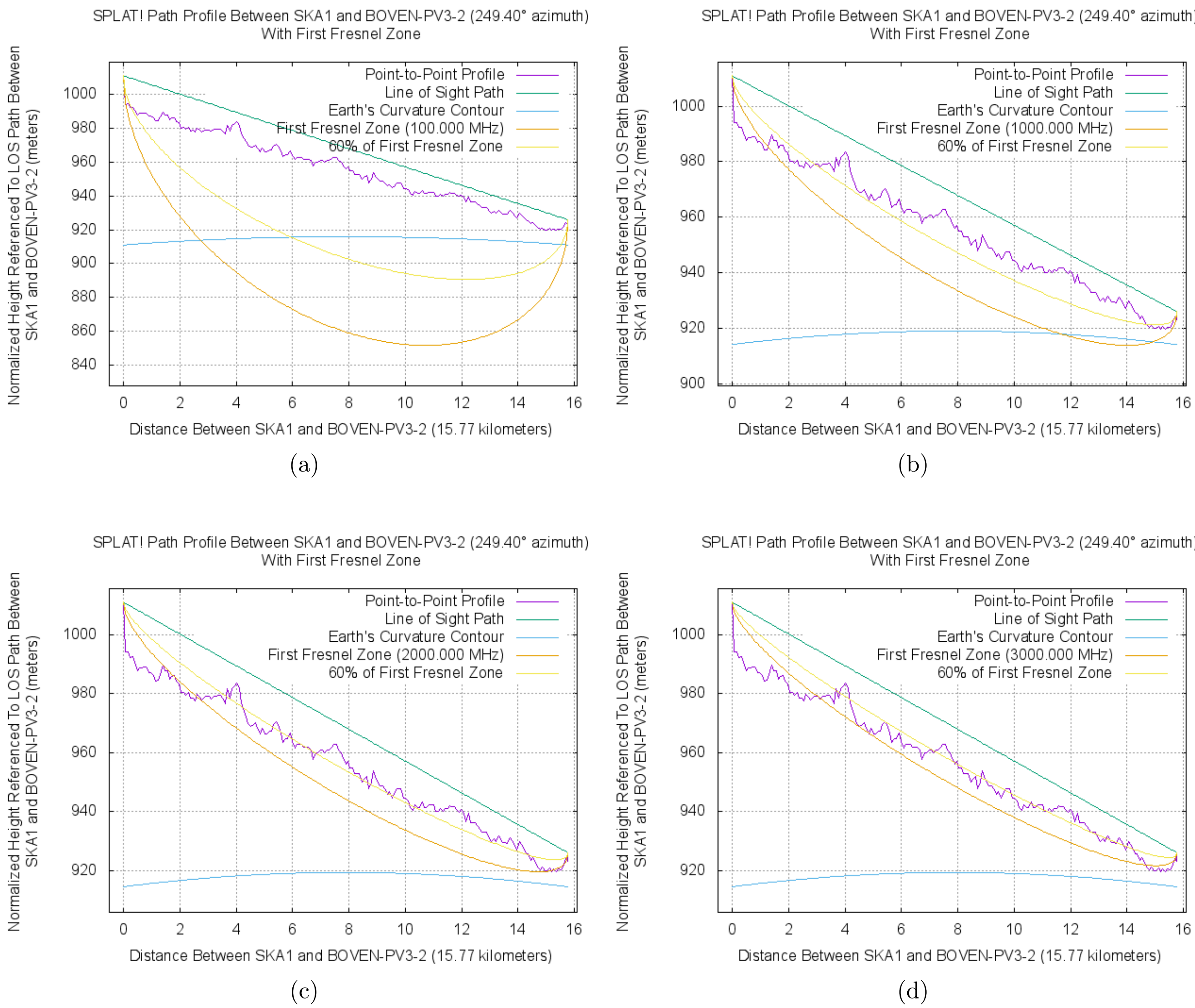


Figure 82: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.11 Boven PV3 to 2nd Closest SKA

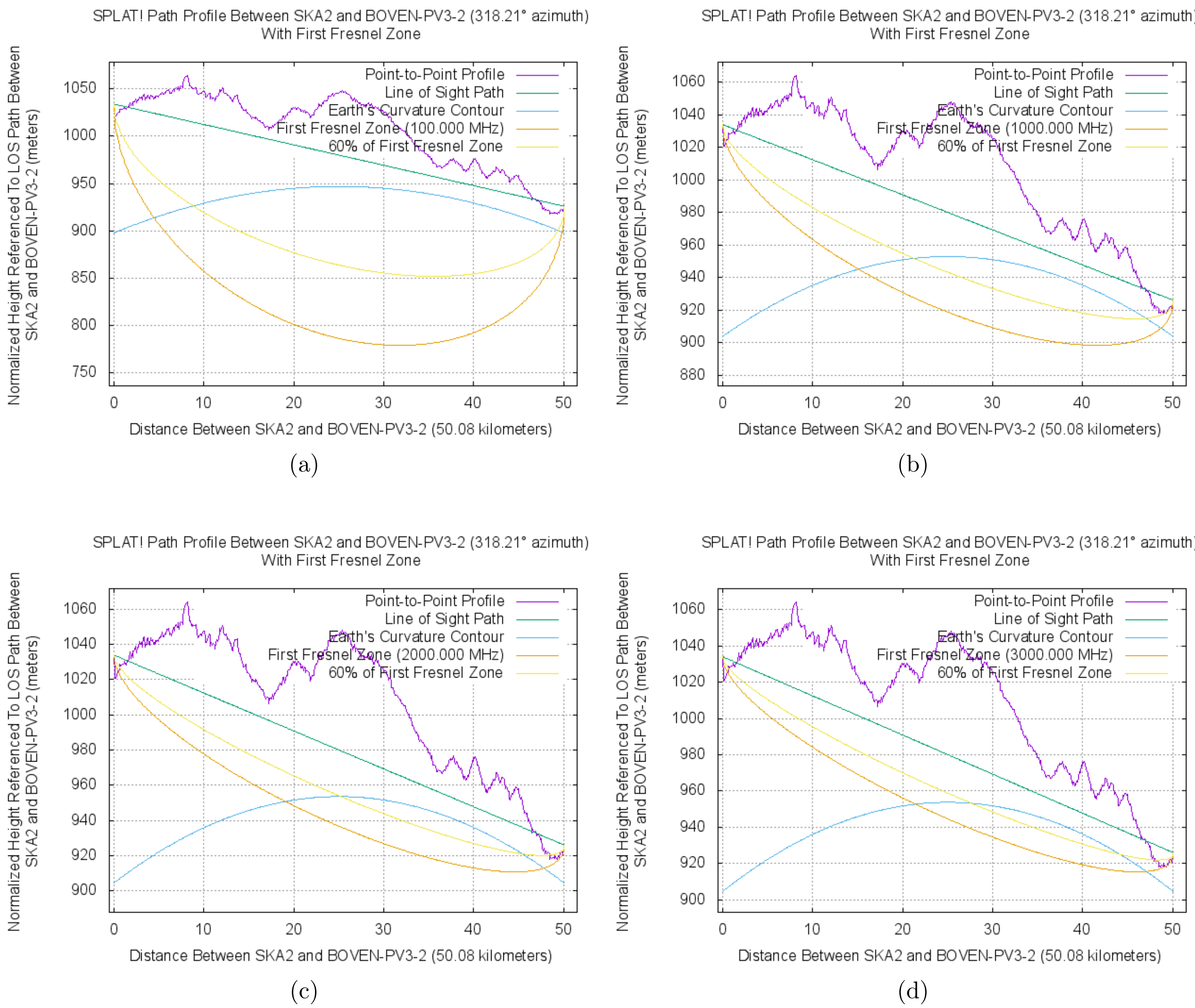


Figure 83: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.12 Boven PV3 to Core SKA

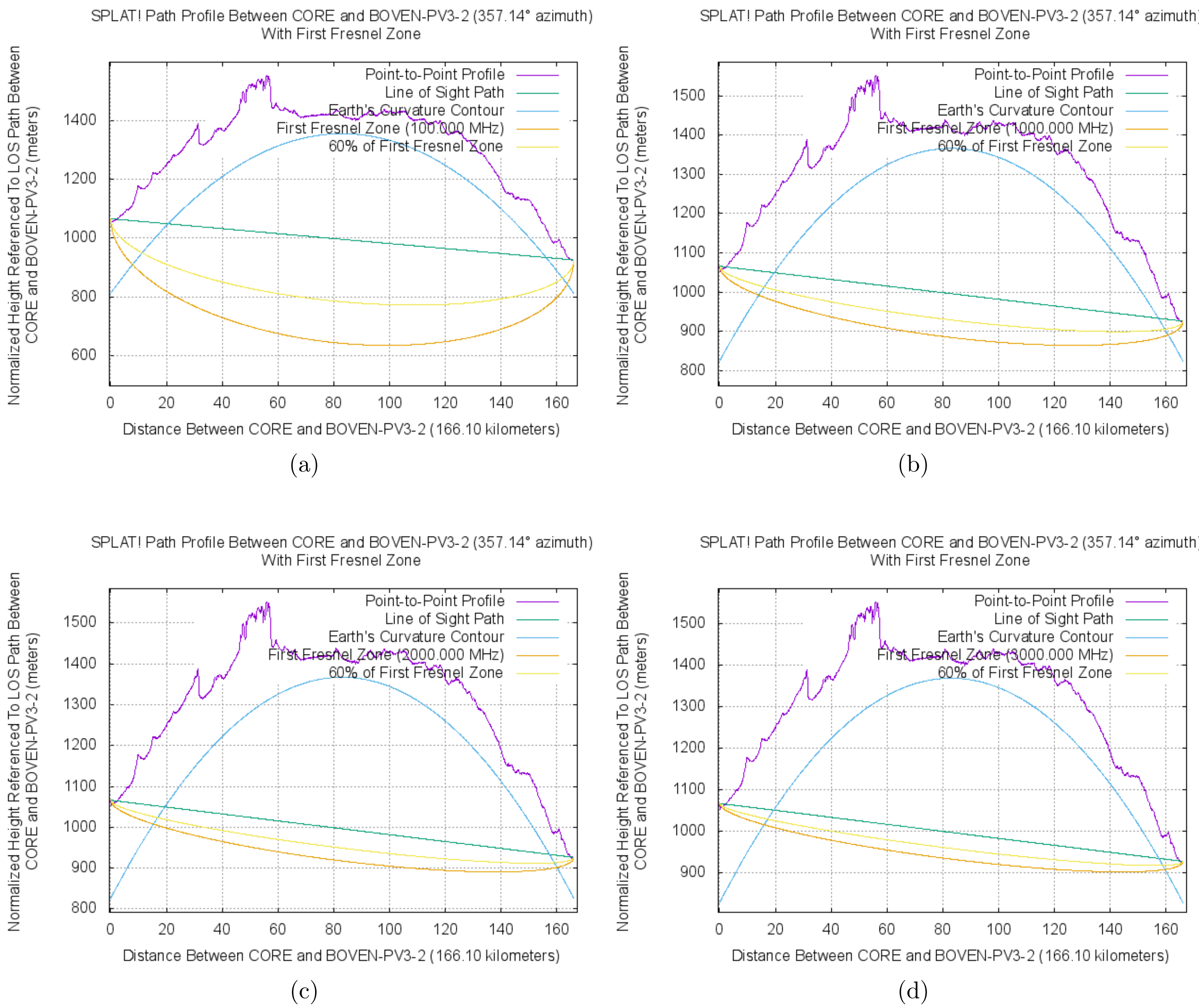


Figure 84: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.13 Boven PV3 Alternative to Closest SKA

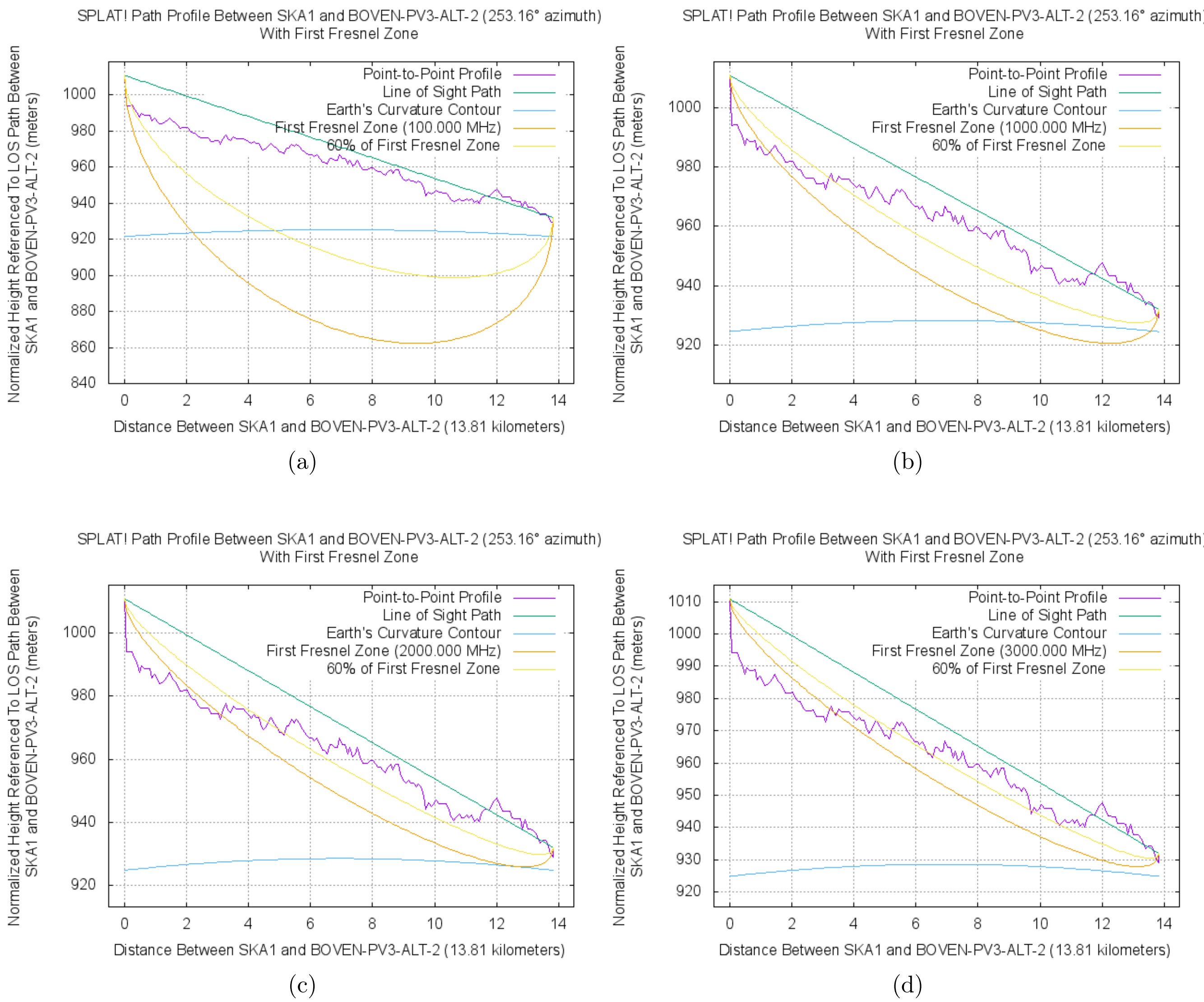
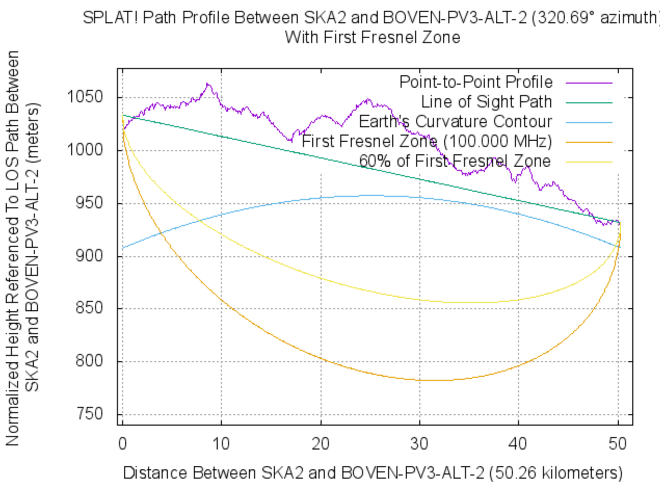
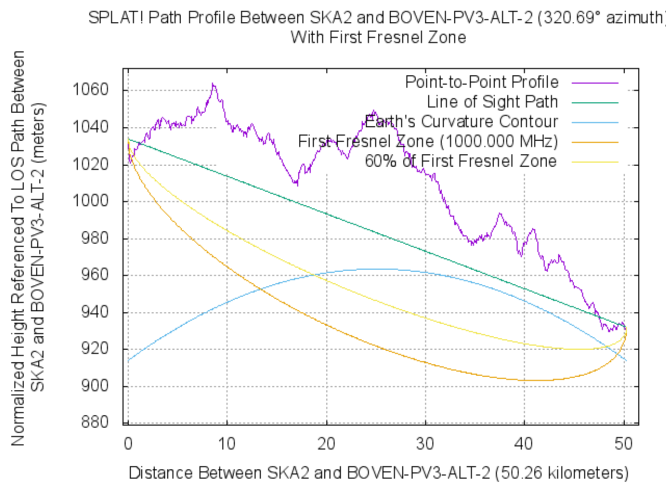


Figure 85: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

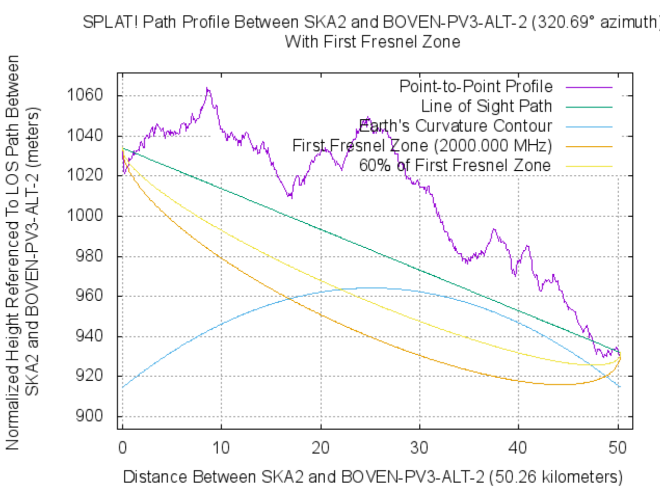
A.14 Boven PV3 Alternative to 2nd Closest SKA



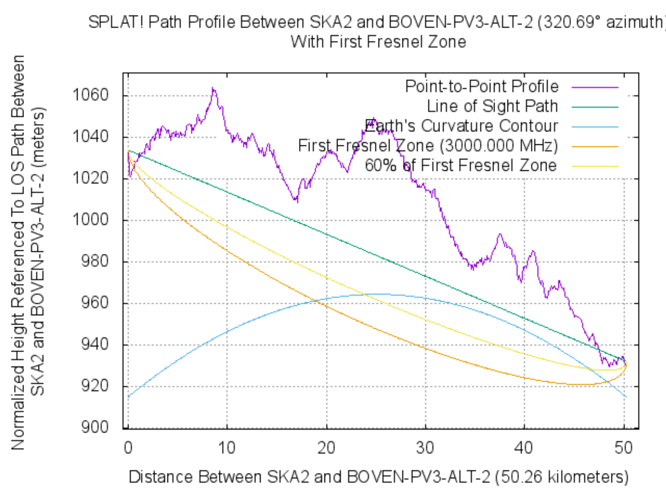
(a)



(b)



(c)



(d)

Figure 86: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.15 Boven PV3 Alternative to Core SKA

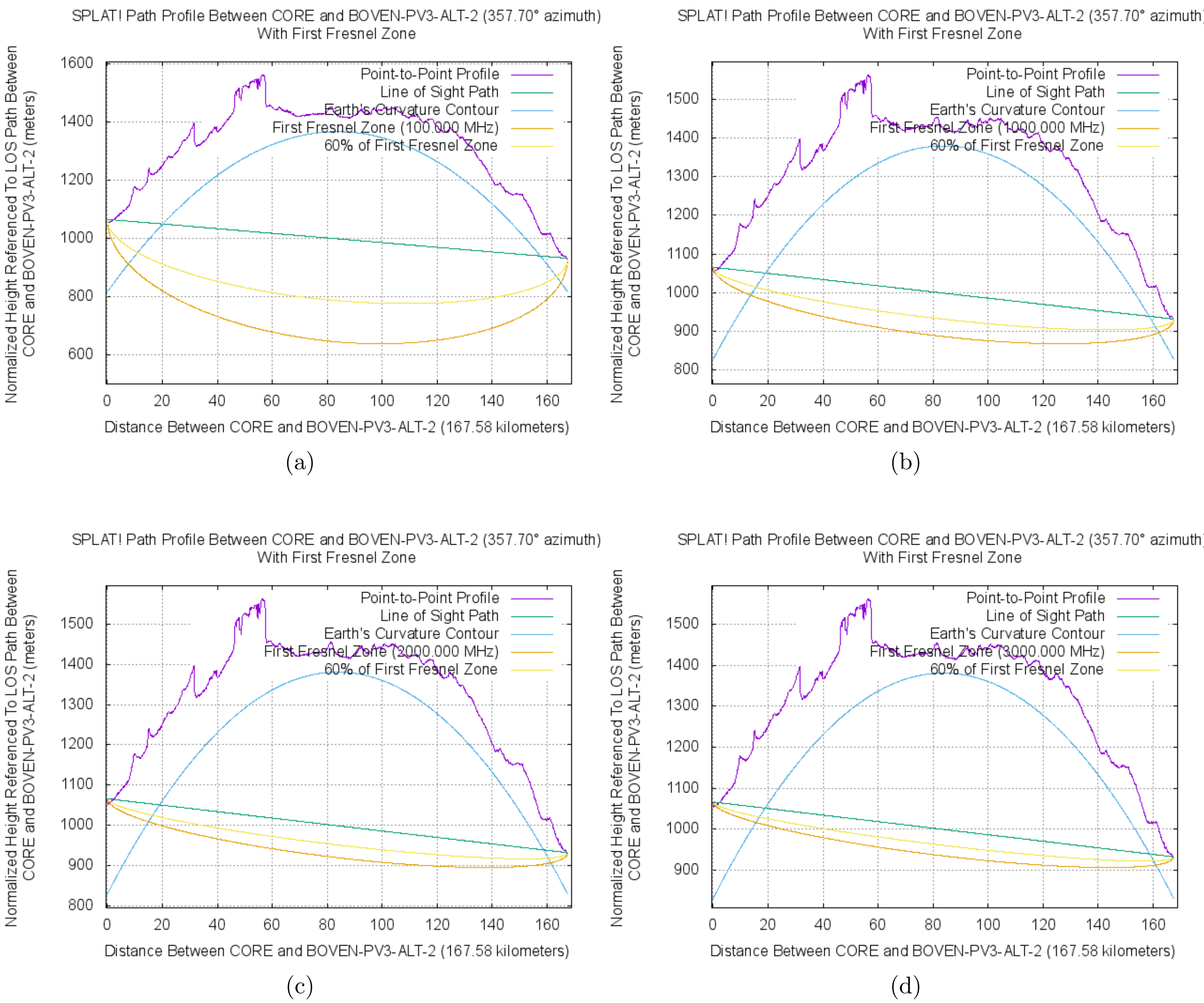


Figure 87: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV3 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.16 Boven PV4 to Closest SKA

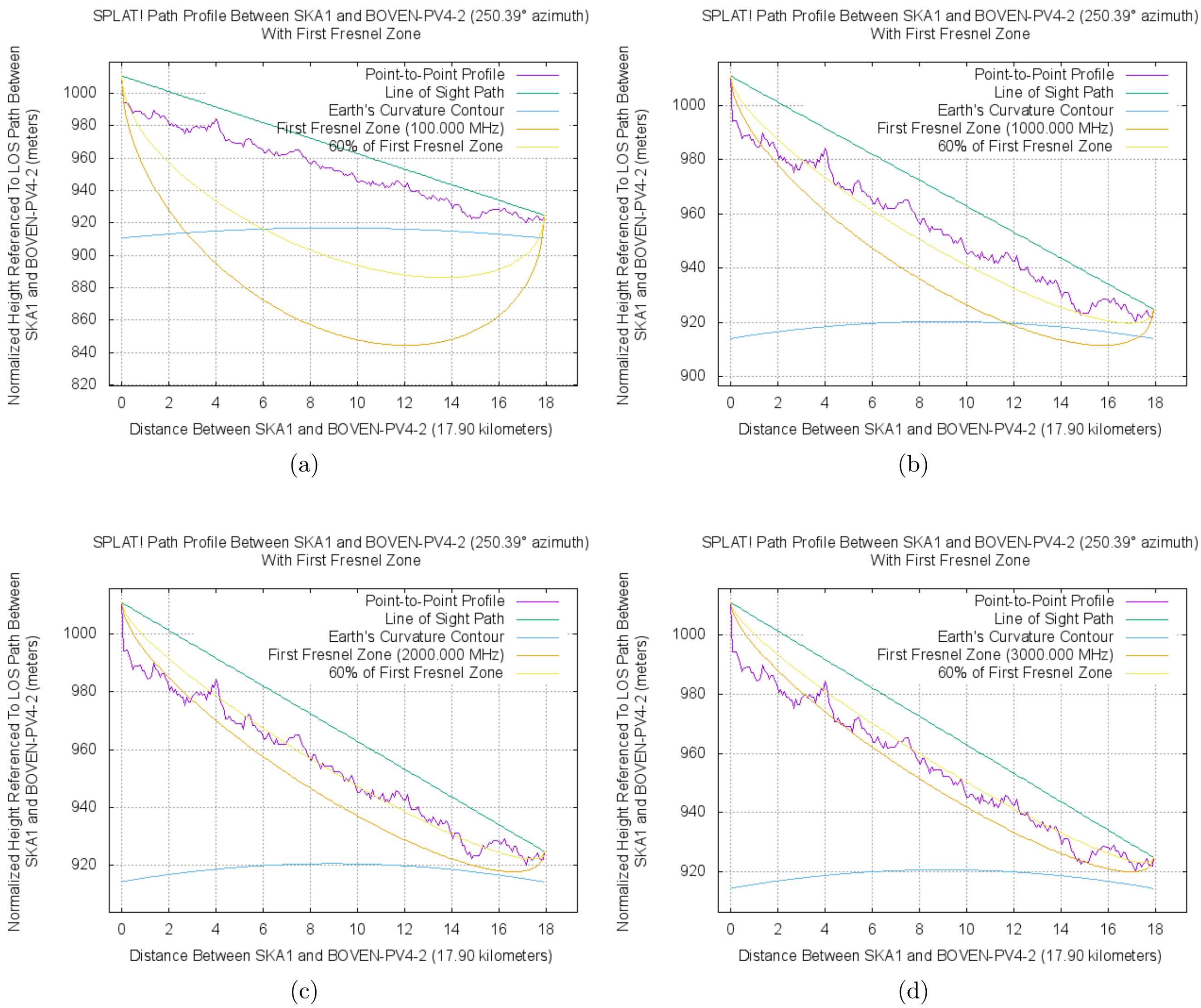


Figure 88: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.17 Boven PV4 to 2nd Closest SKA

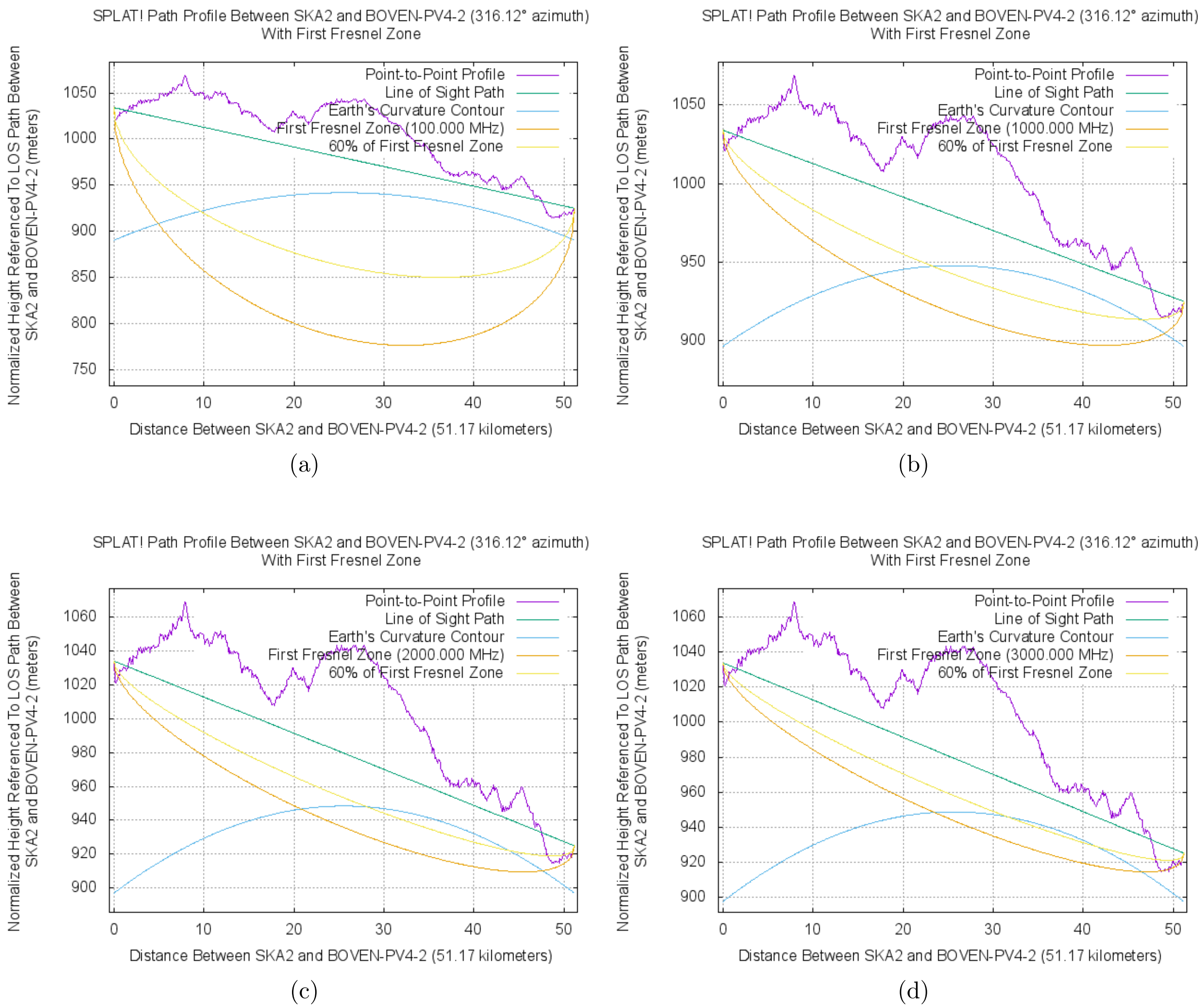
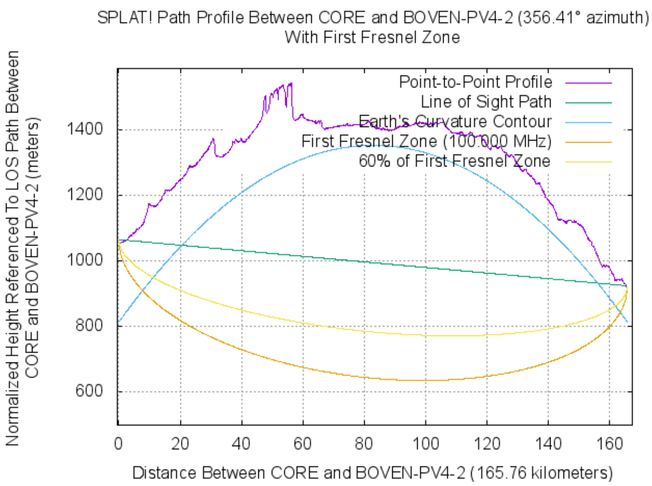
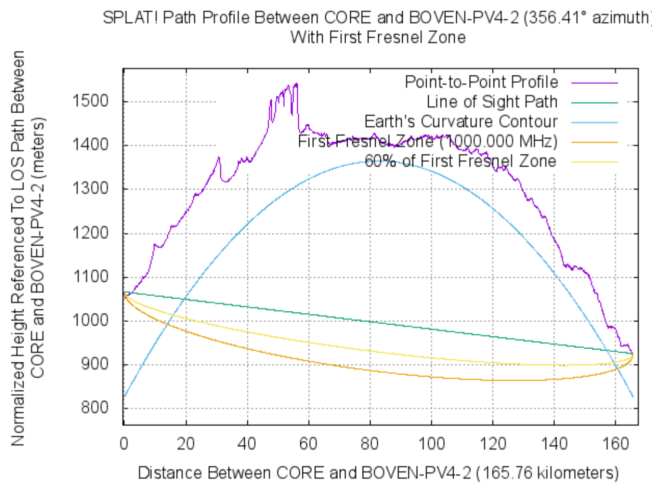


Figure 89: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

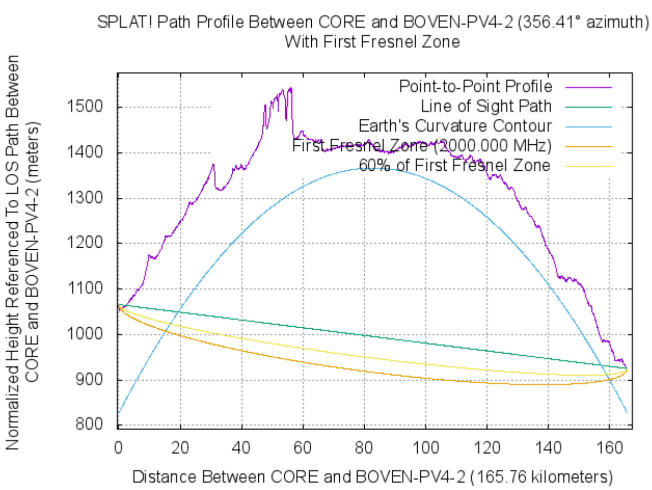
A.18 Boven PV4 to Core SKA



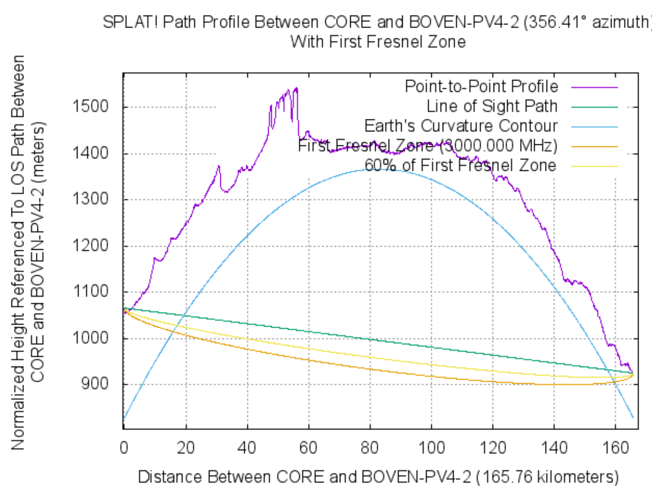
(a)



(b)



(c)



(d)

Figure 90: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.19 Boven PV4 Alternative to Closest SKA

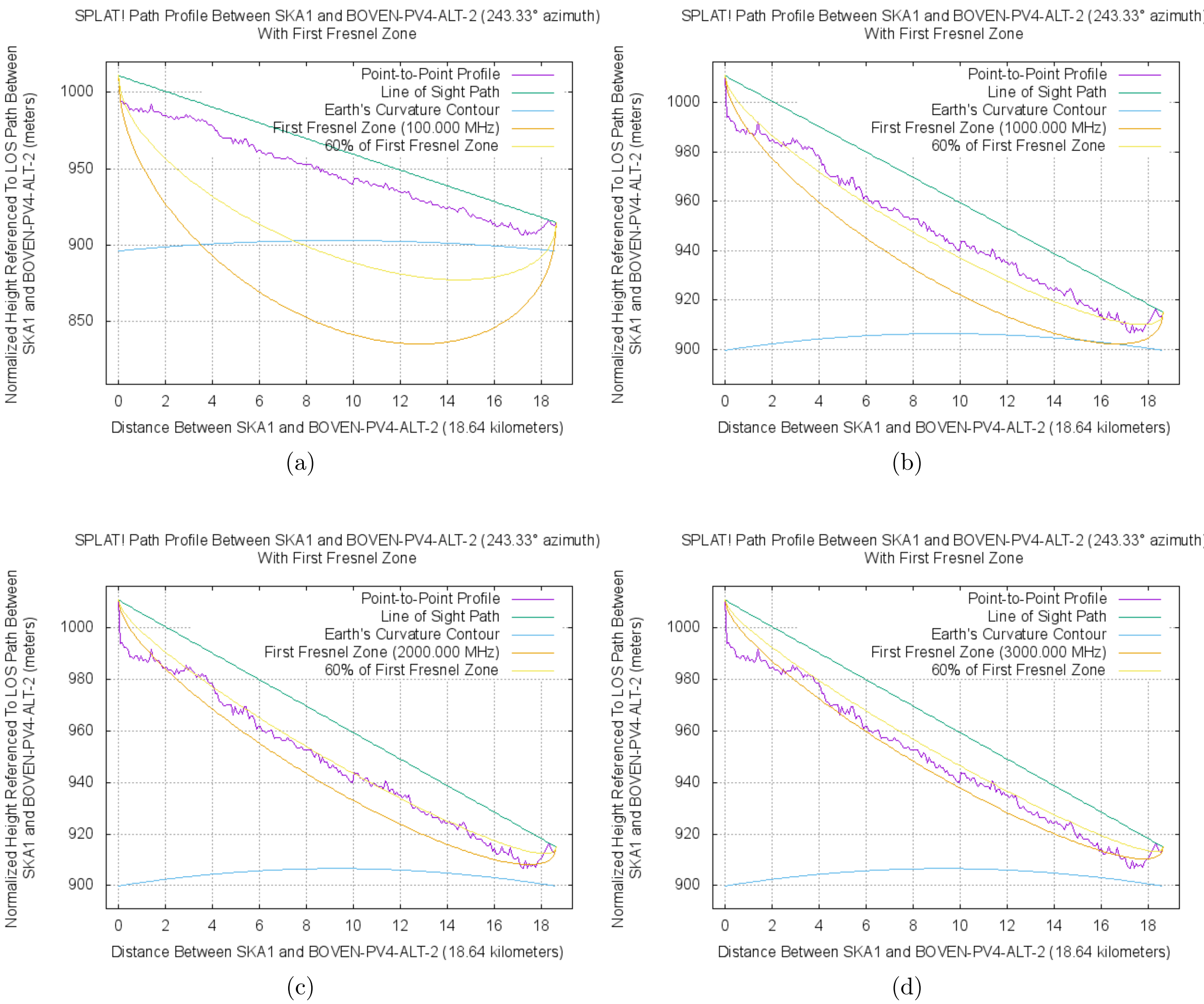


Figure 91: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.20 Boven PV4 Alternative to 2nd Closest SKA

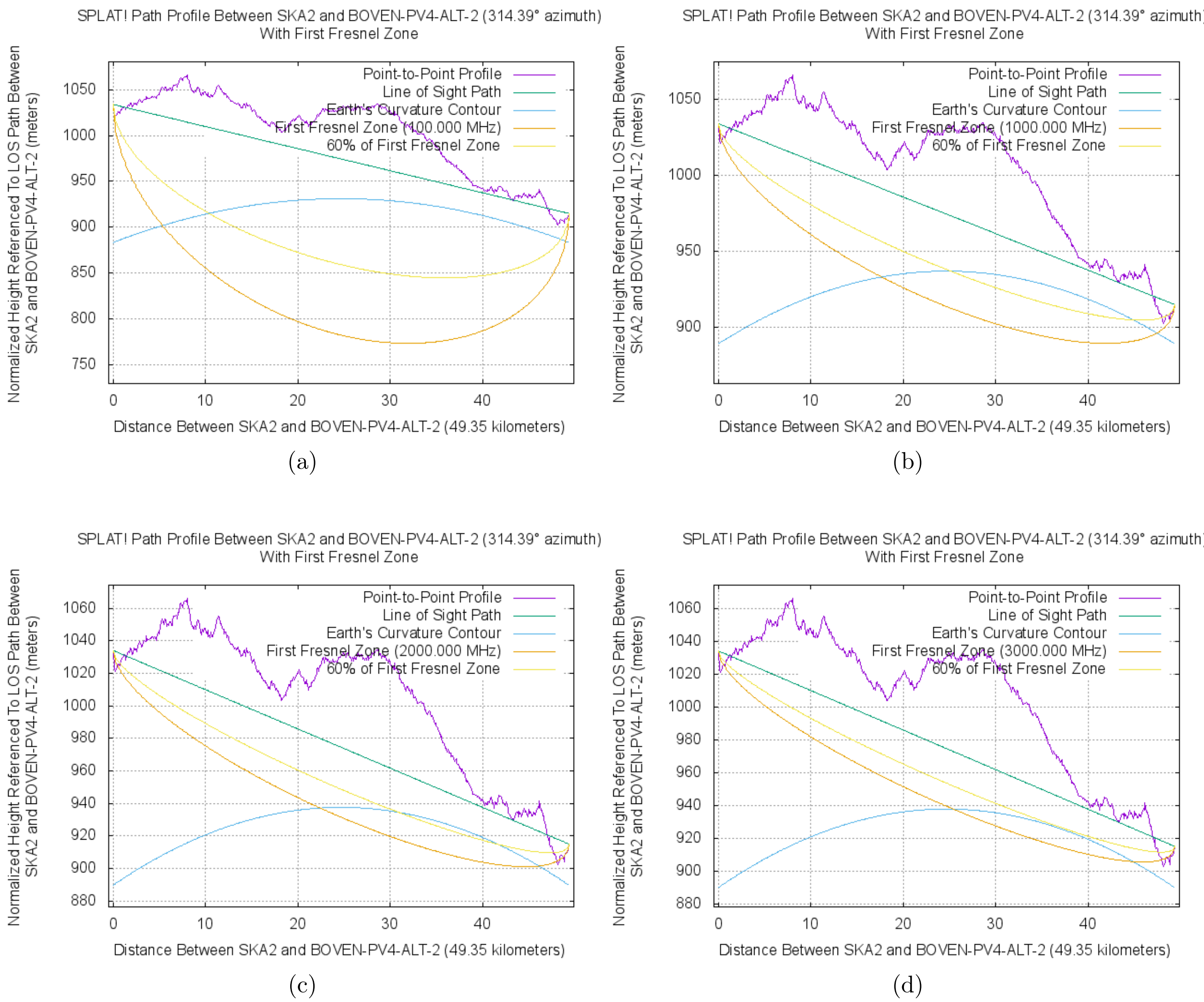


Figure 92: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.21 Boven PV4 Alternative to Core SKA

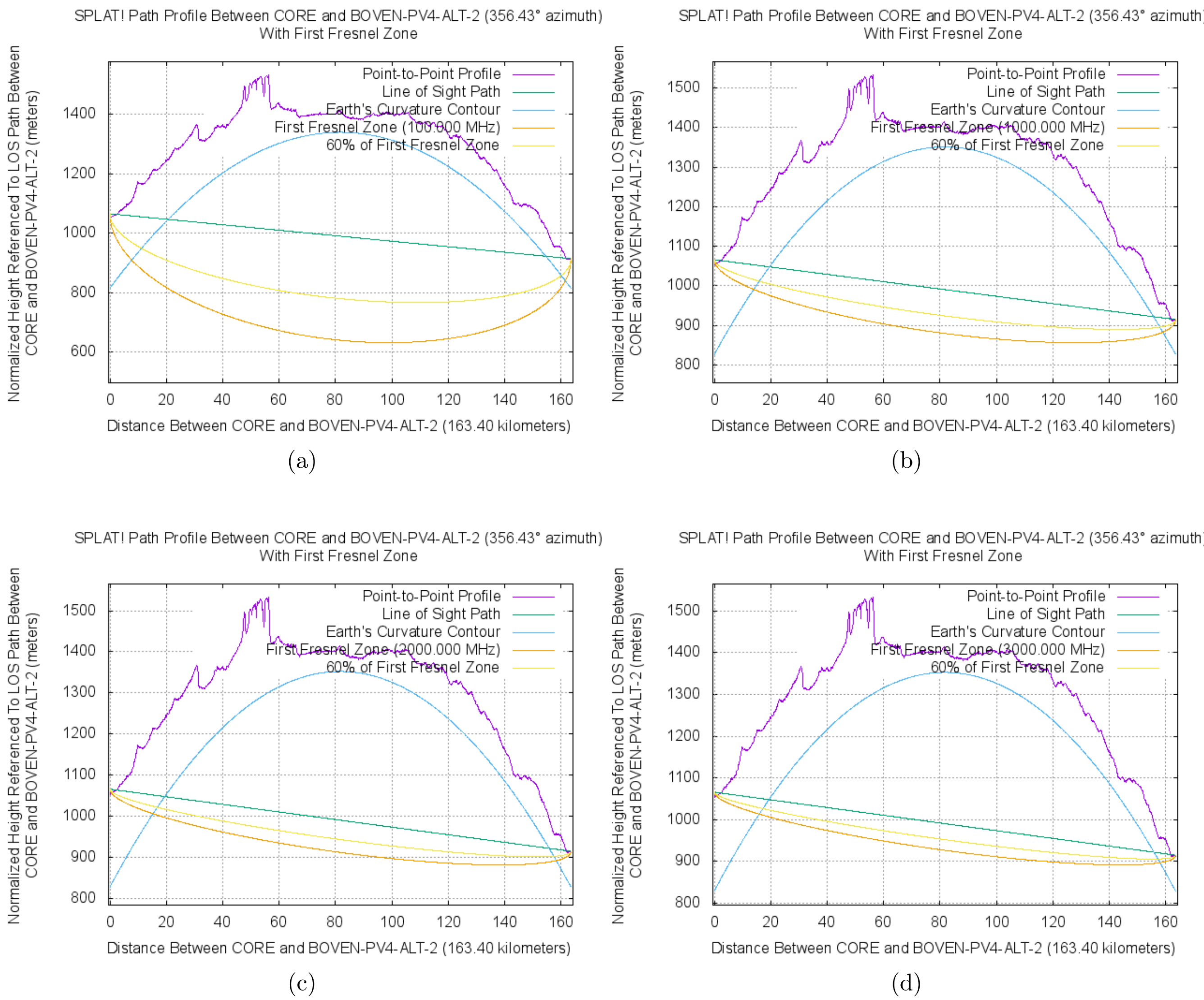


Figure 93: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Boven PV4 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.22 Gemsbok PV1 to Closest SKA

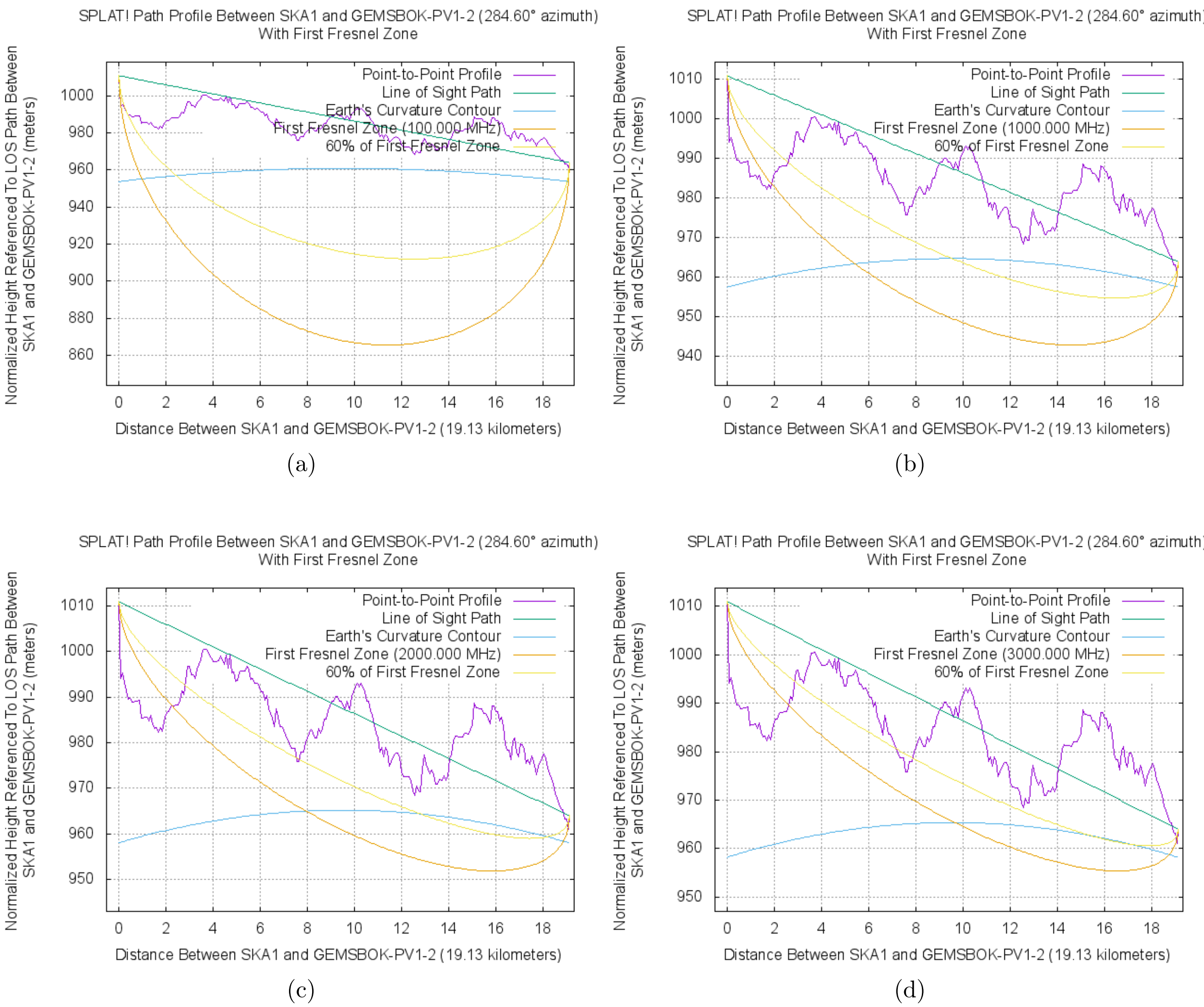


Figure 94: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV1 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.23 Gemsbok PV1 to 2nd Closest SKA

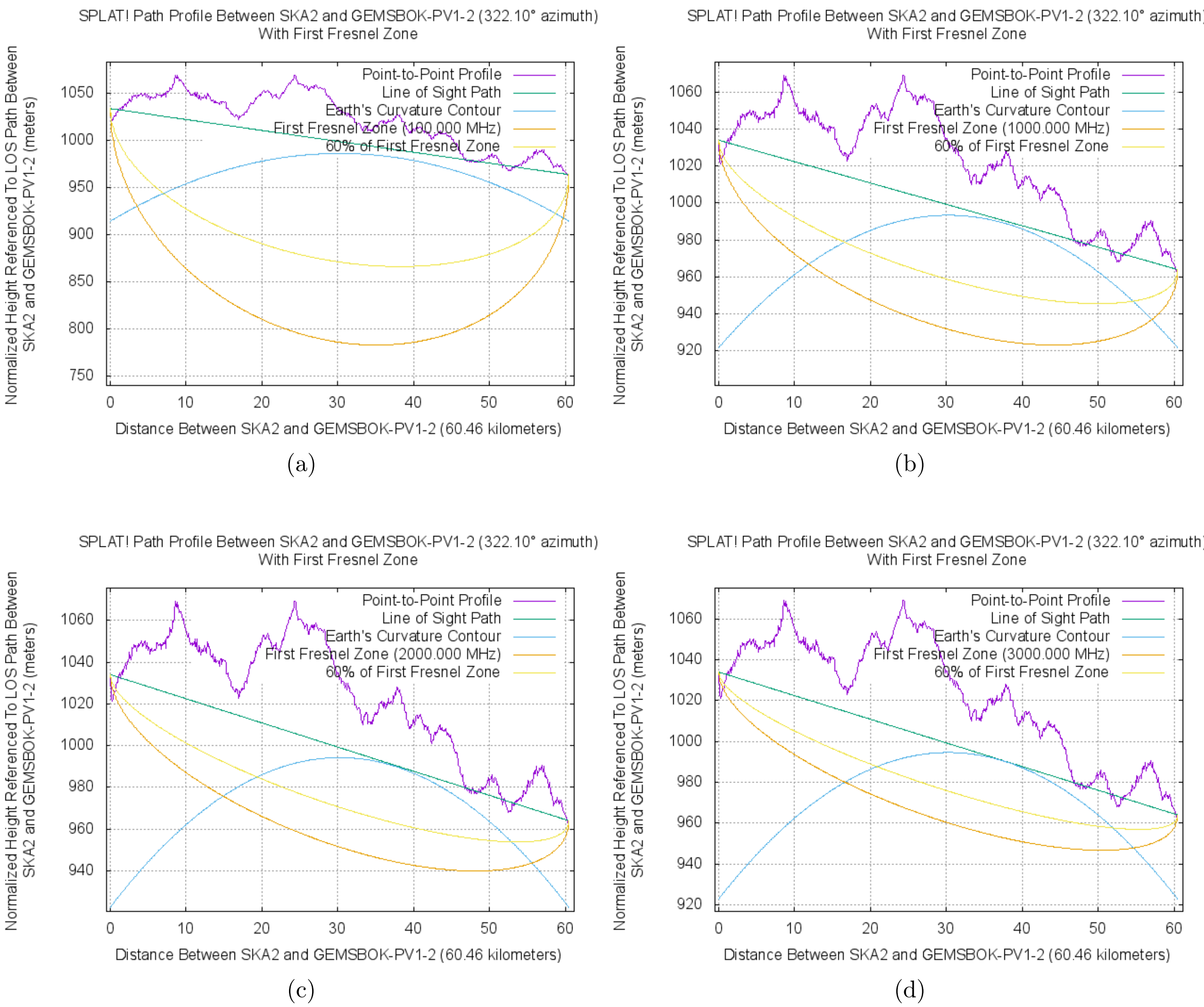


Figure 95: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV1 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.24 Gemsbok PV1 to Core SKA

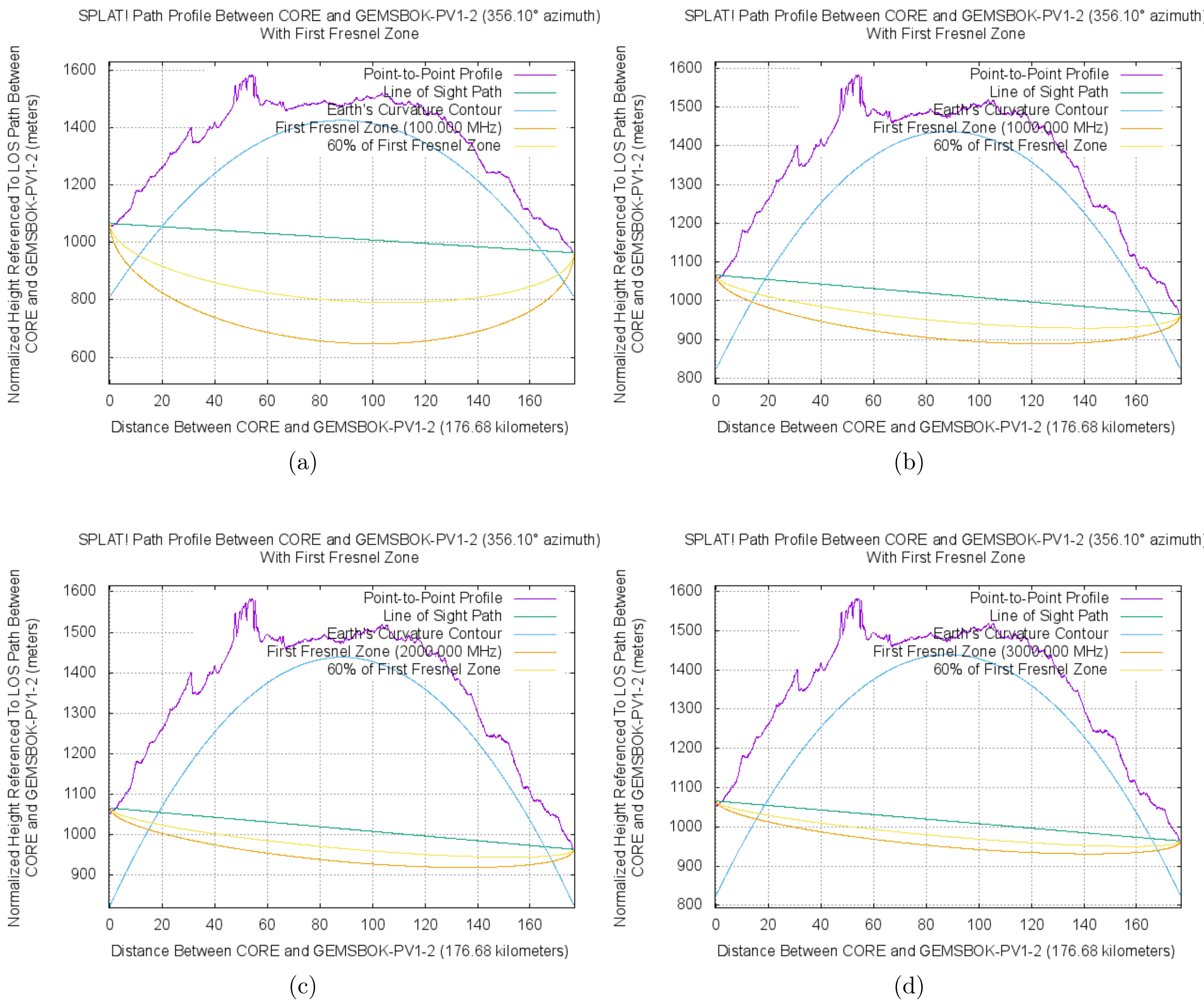
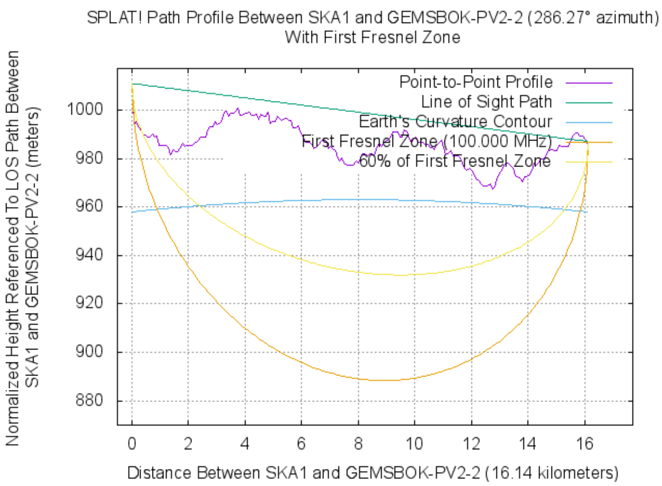
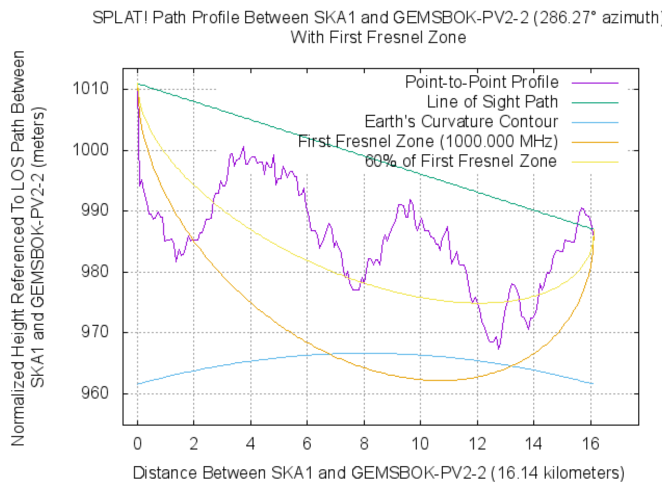


Figure 96: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV1 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

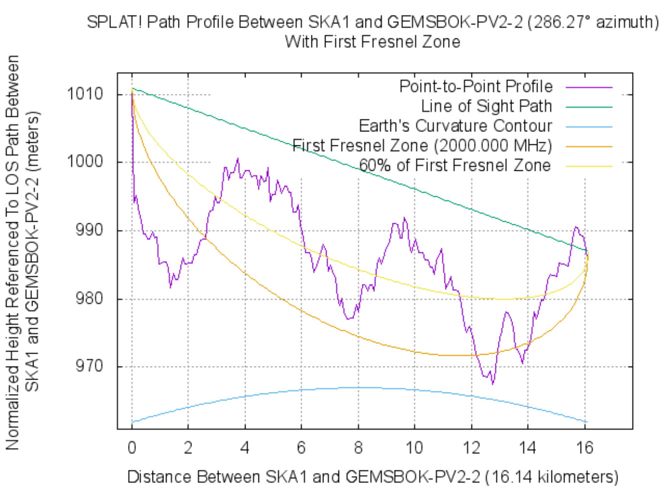
A.25 Gemsbok PV2 to Closest SKA



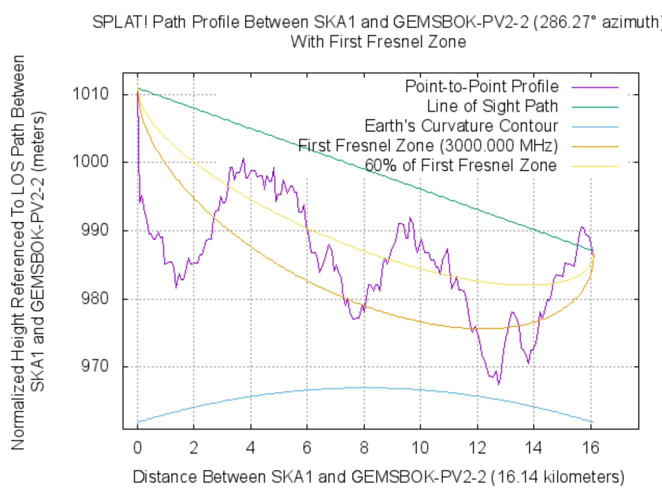
(a)



(b)



(c)



(d)

Figure 97: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV2 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.26 Gemsbok PV2 to 2nd Closest SKA

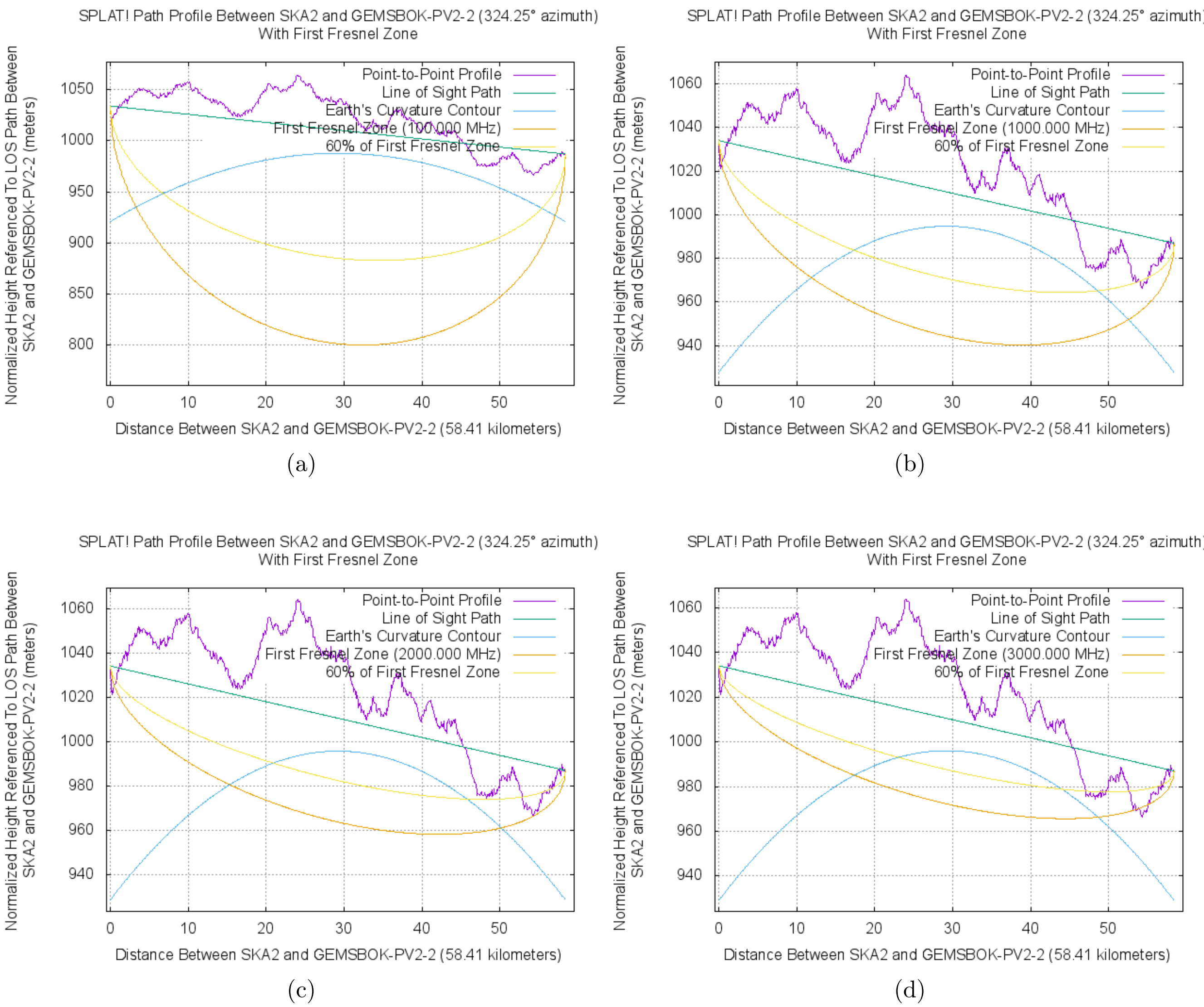


Figure 98: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV2 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.27 Gemsbok PV2 to Core SKA

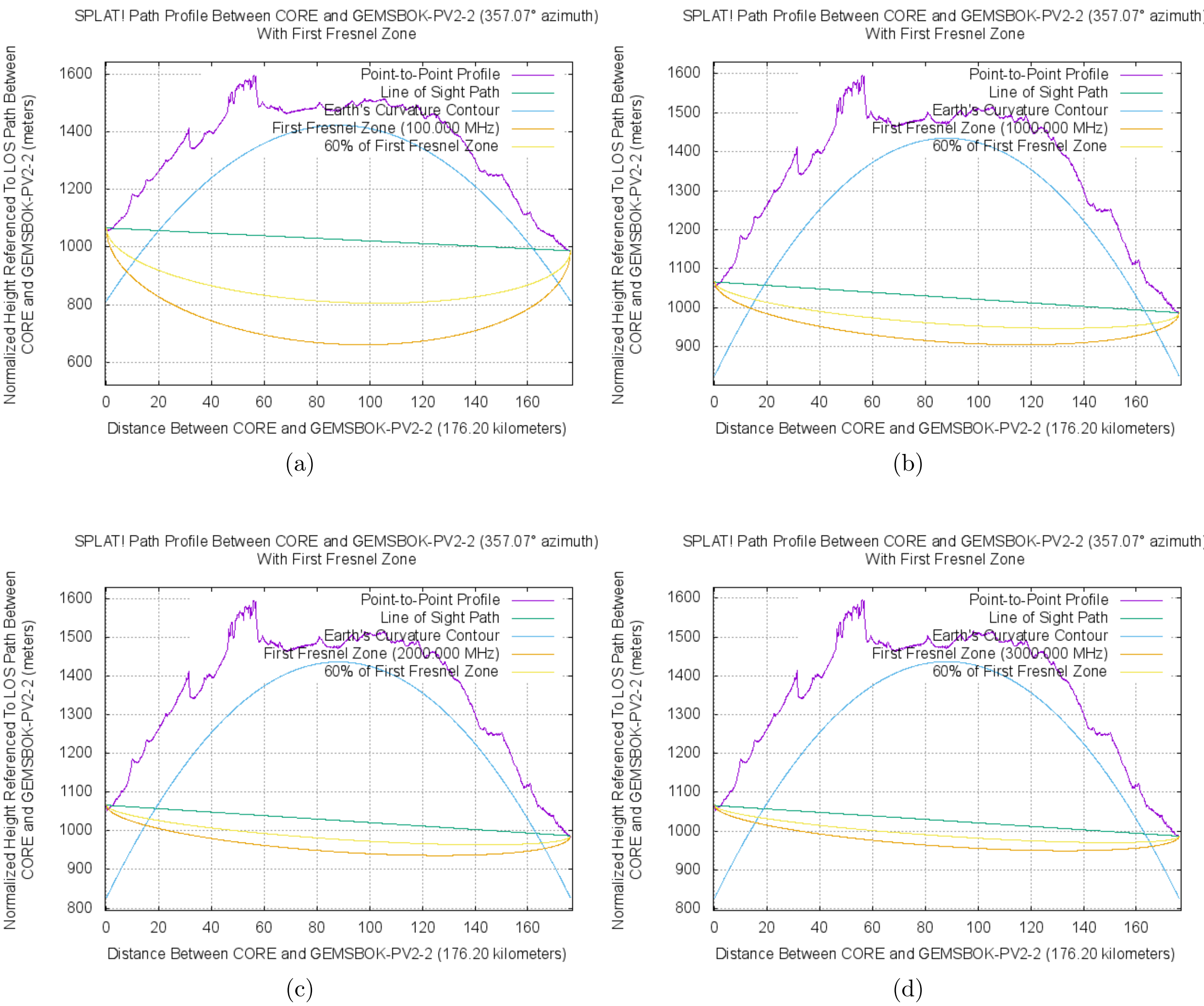


Figure 99: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV2 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.28 Gemsbok PV3 to Closest SKA

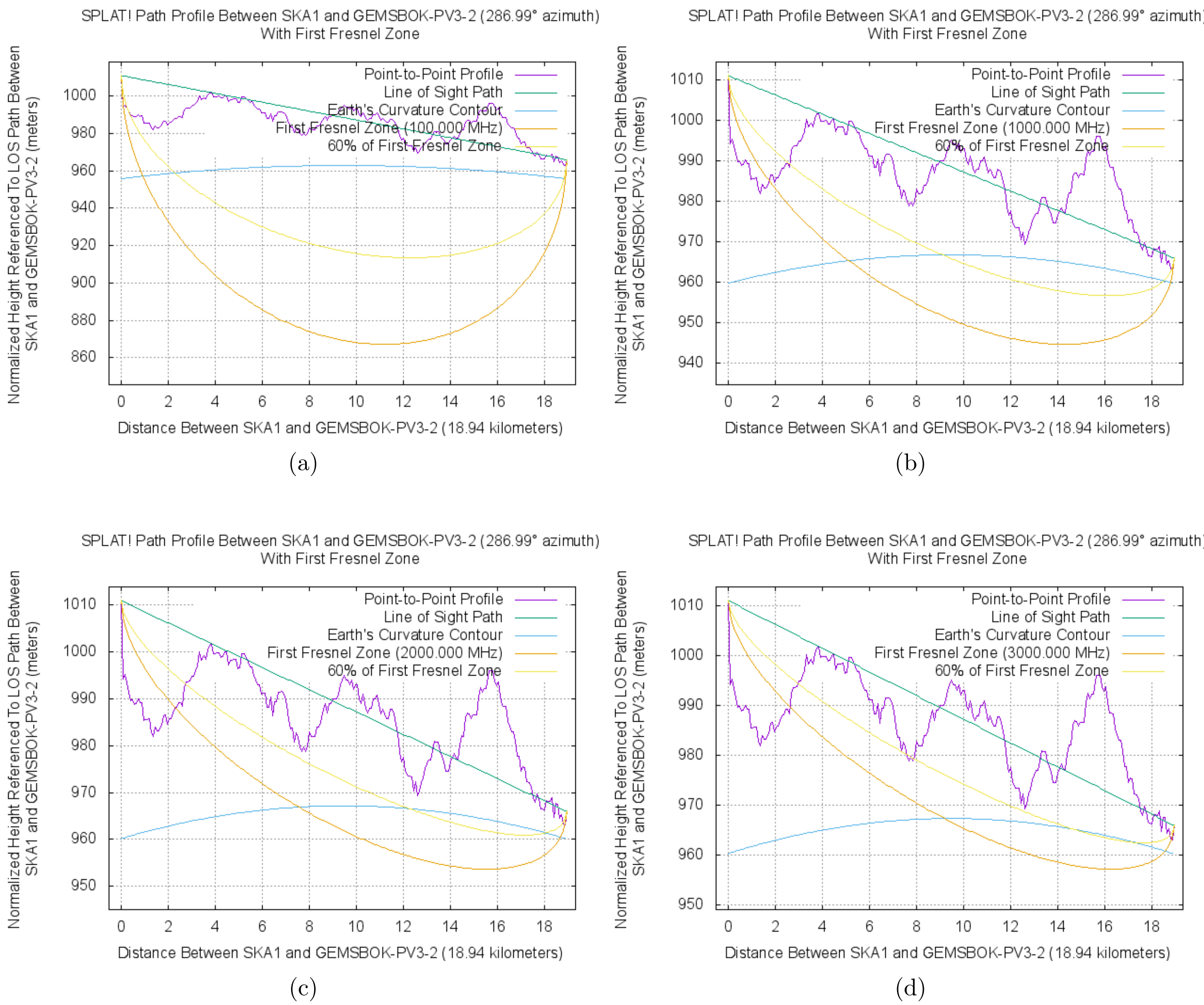
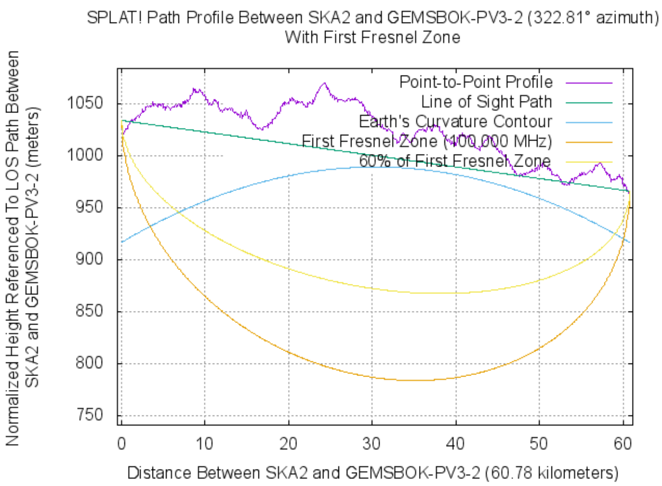
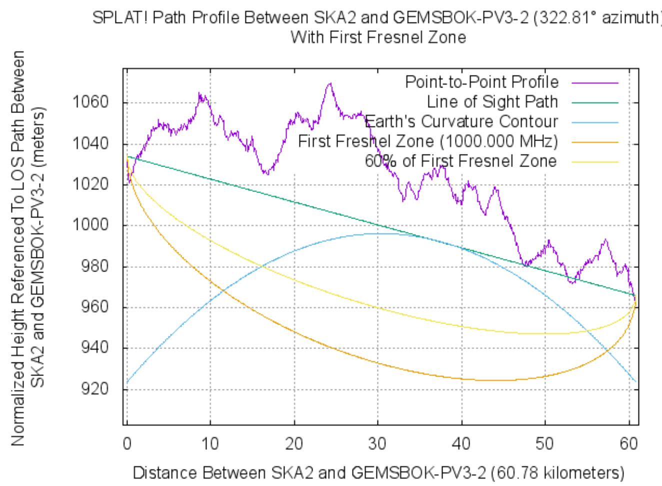


Figure 100: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

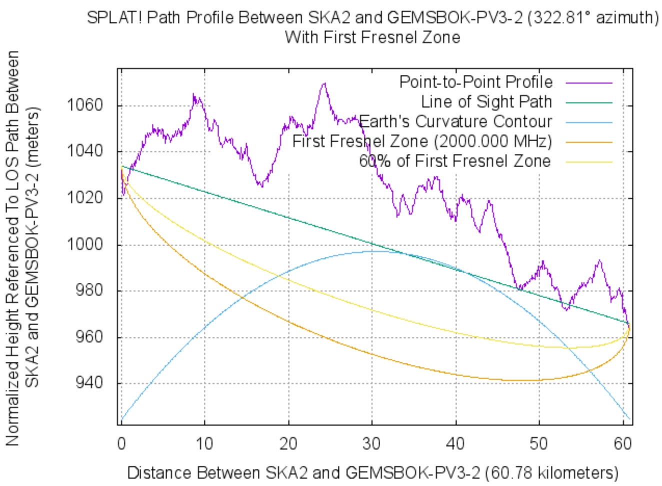
A.29 Gemsbok PV3 to 2nd Closest SKA



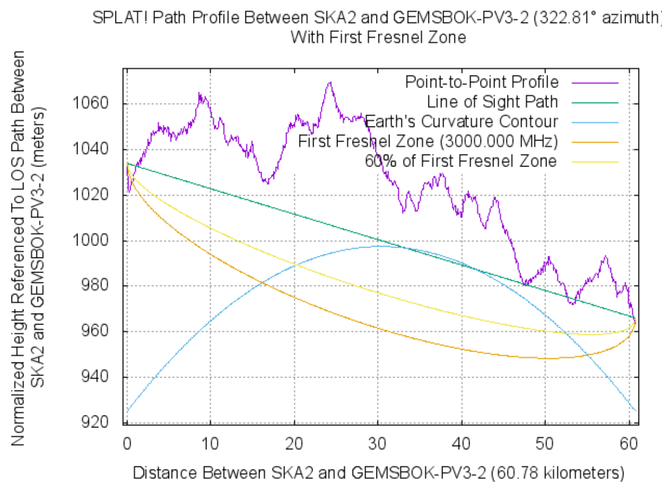
(a)



(b)



(c)



(d)

Figure 101: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.30 Gemsbok PV3 to Core SKA

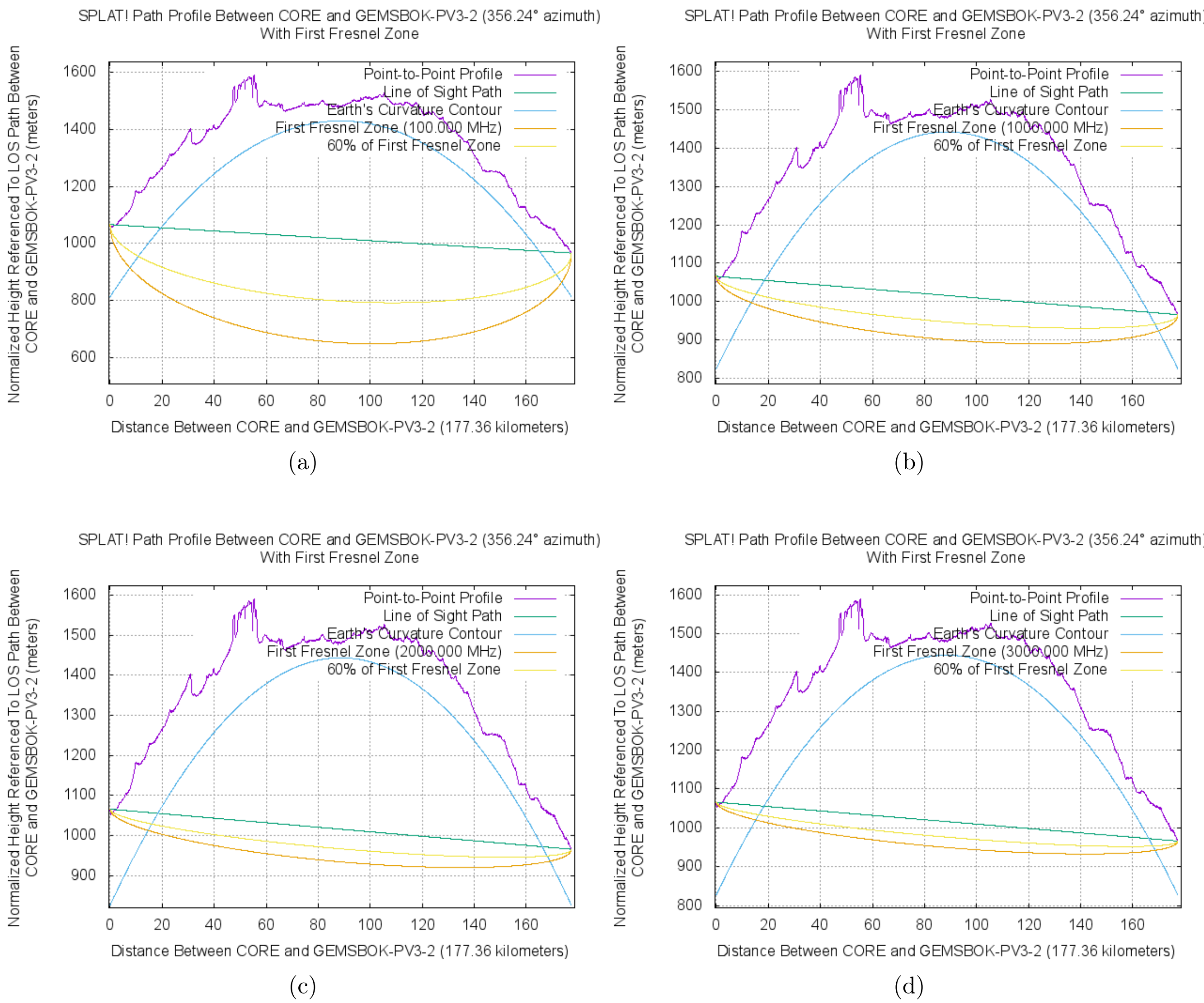


Figure 102: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.31 Gemsbok PV3 Alternative to Closest SKA

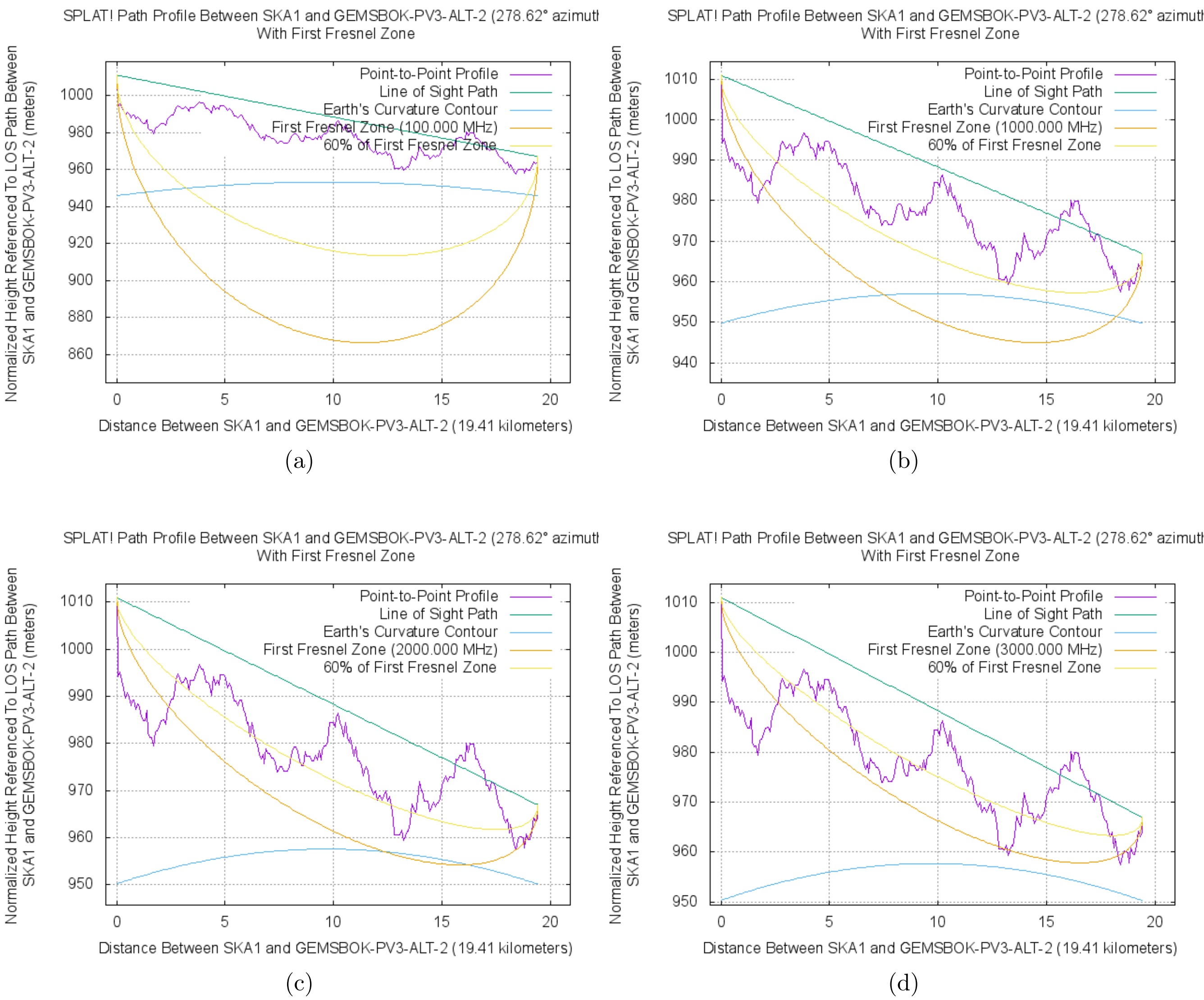
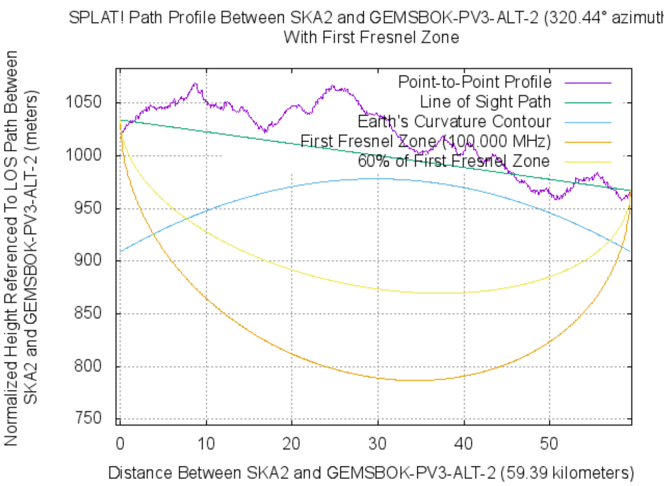
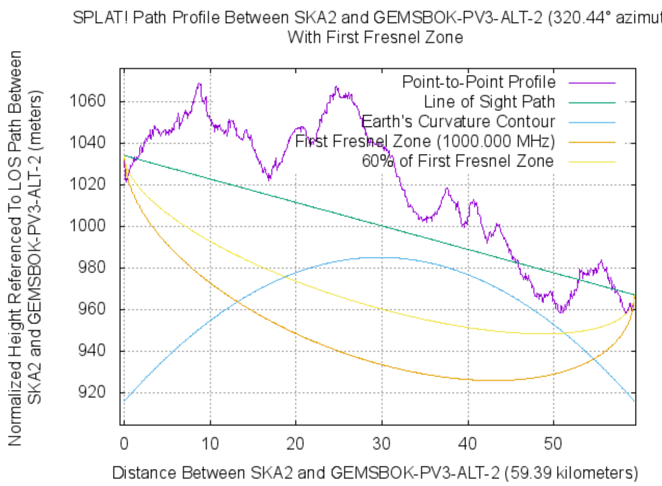


Figure 103: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

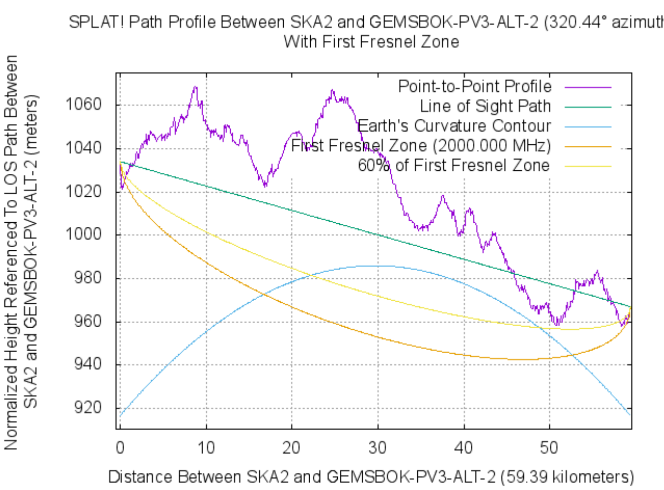
A.32 Gemsbok PV3 Alternative to 2nd Closest SKA



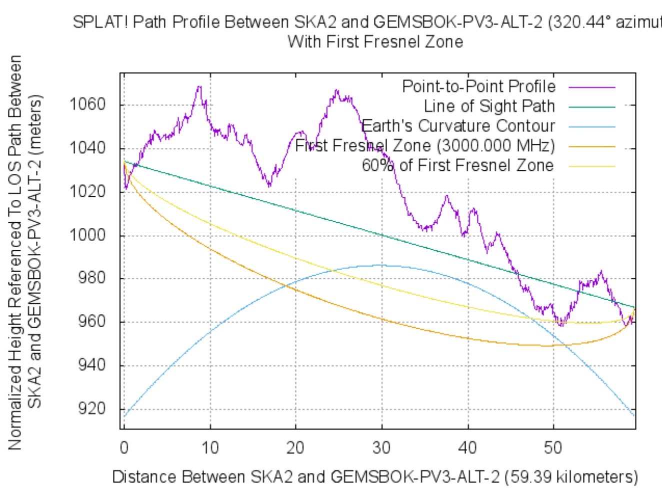
(a)



(b)



(c)



(d)

Figure 104: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.33 Gemsbok PV3 Alternative to Core SKA

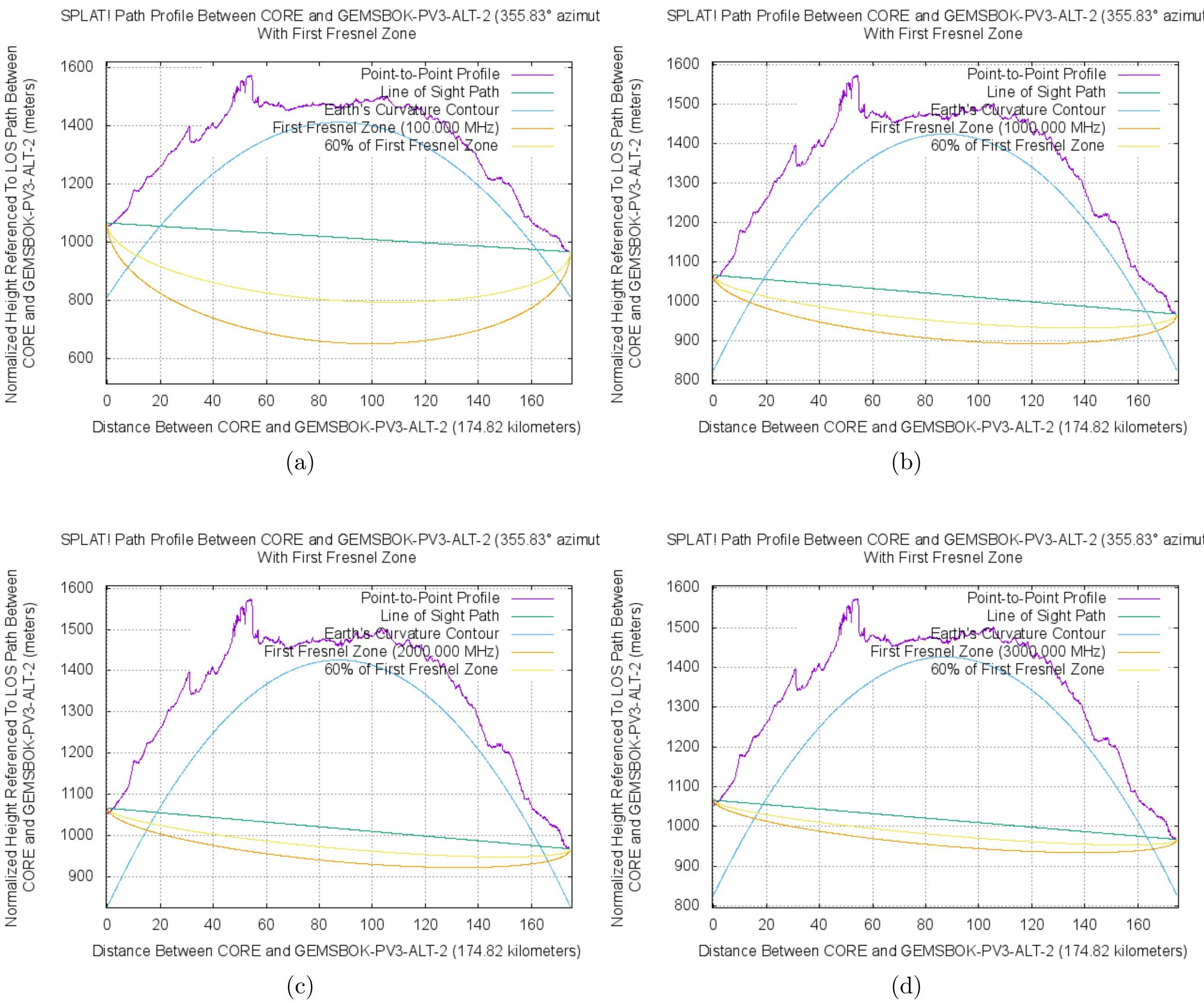


Figure 105: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV3 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.34 Gemsbok PV4 to Closest SKA

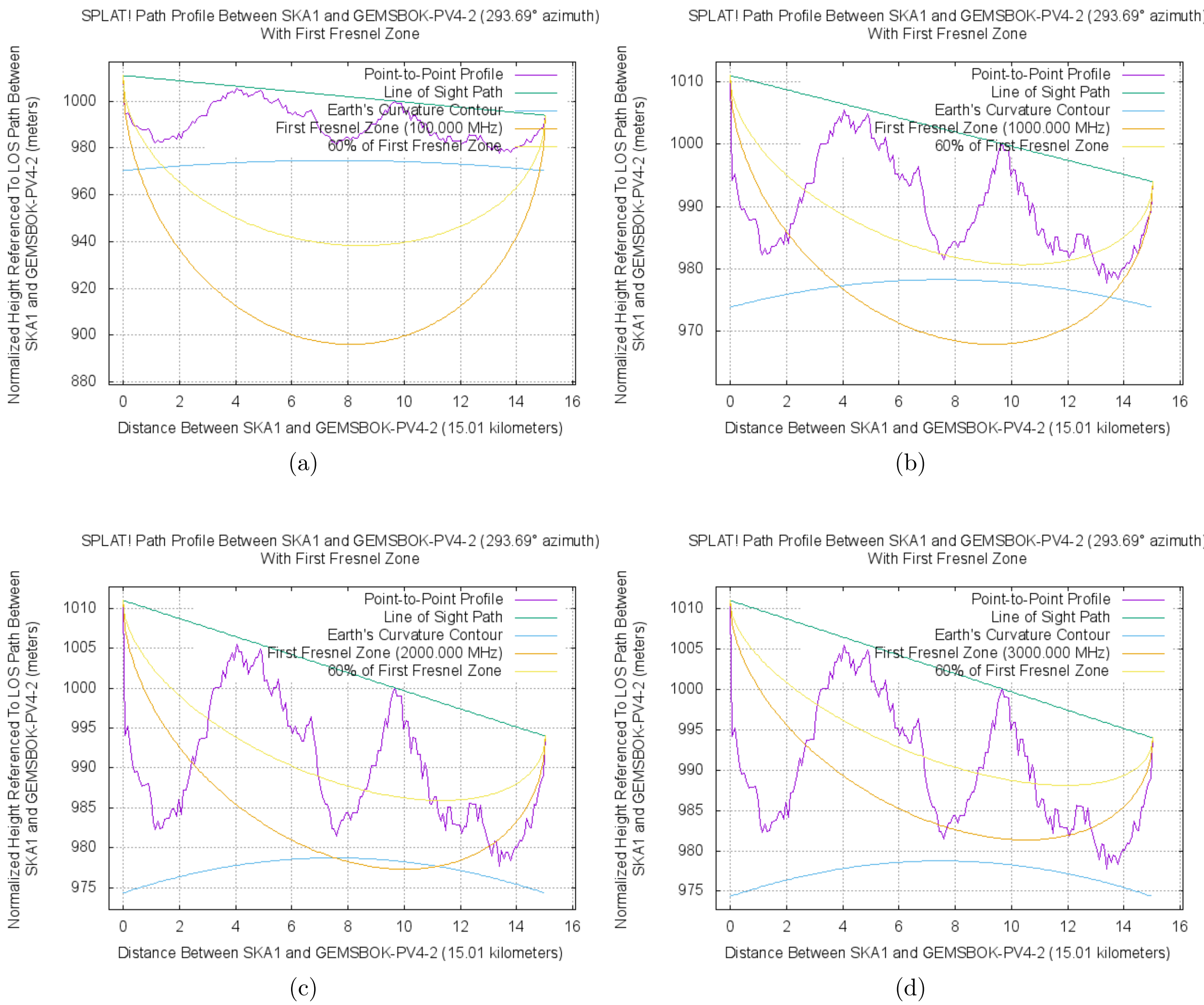


Figure 106: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.35 Gemsbok PV4 to 2nd Closest SKA

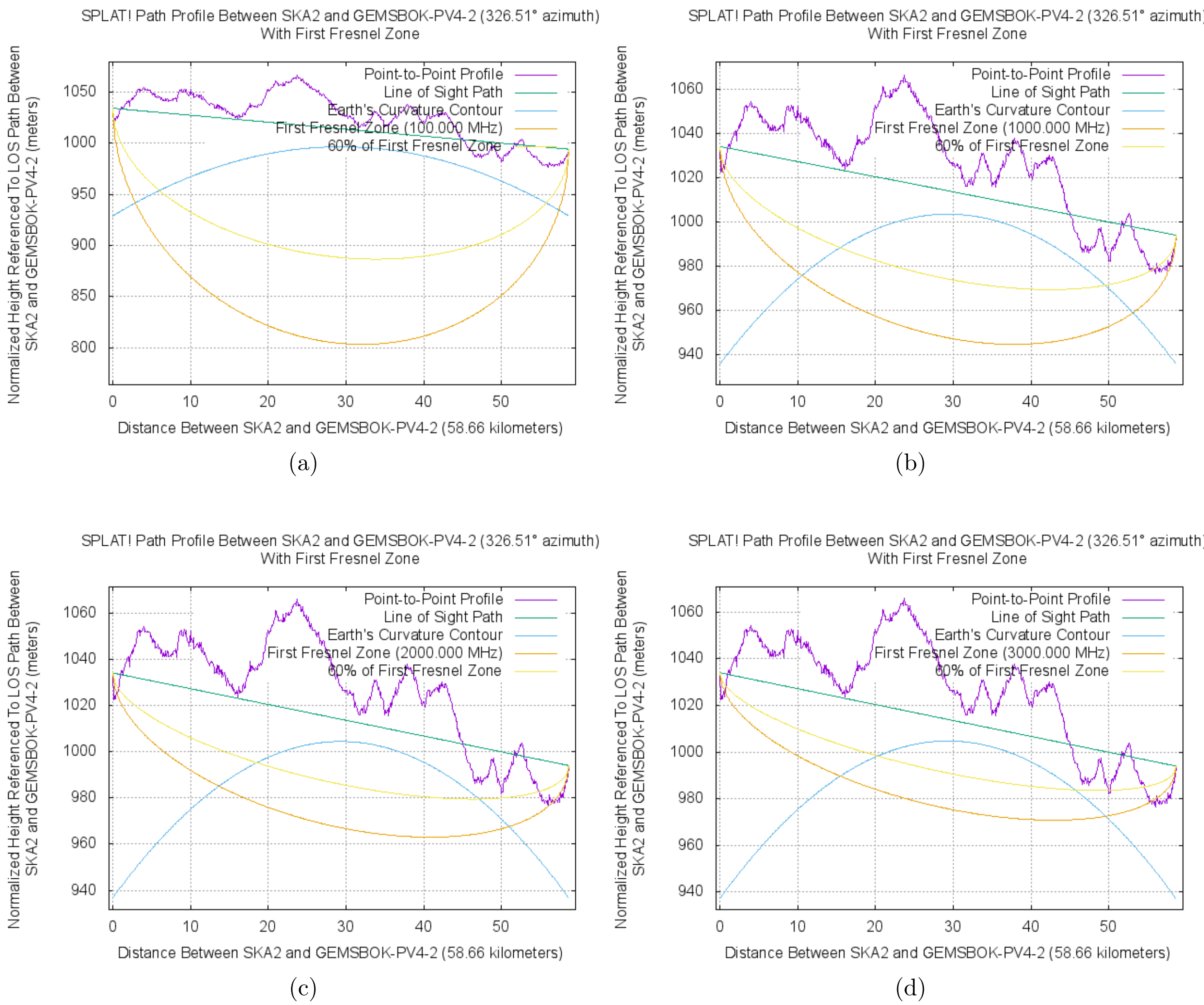


Figure 107: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.36 Gemsbok PV4 to Core SKA

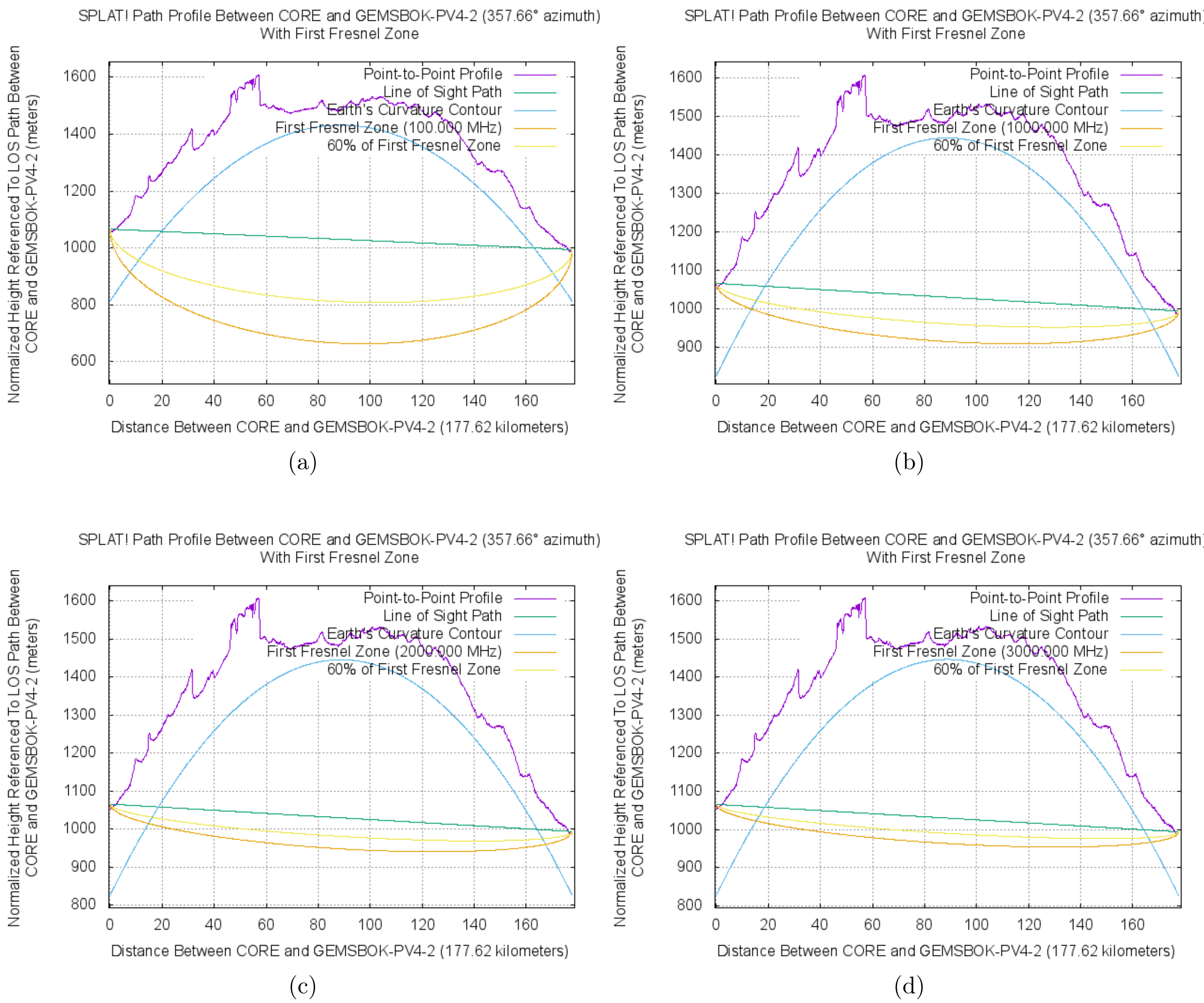


Figure 108: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.37 Gemsbok PV4 Alternative to Closest SKA

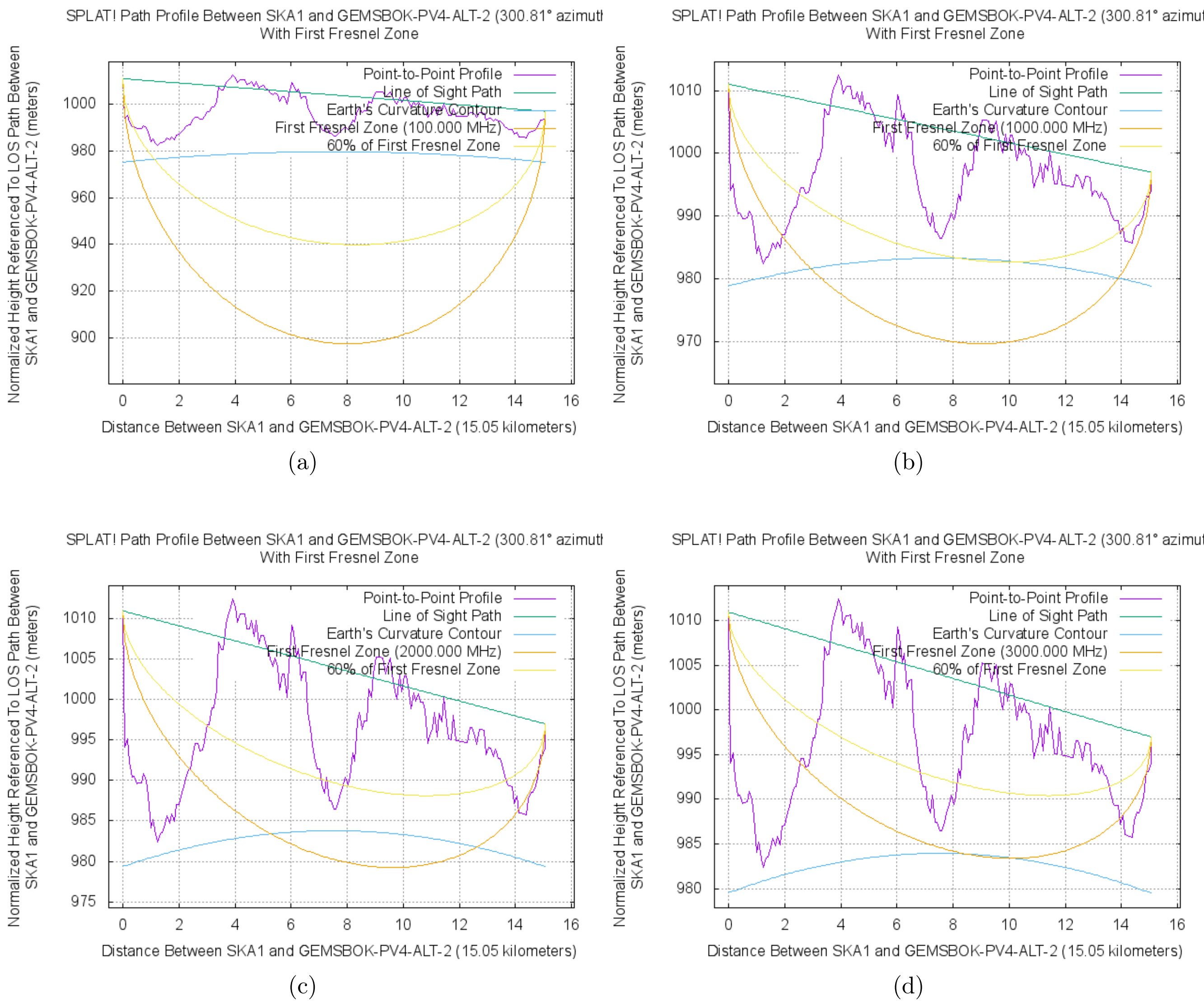


Figure 109: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.38 Gemsbok PV4 Alternative to 2nd Closest SKA

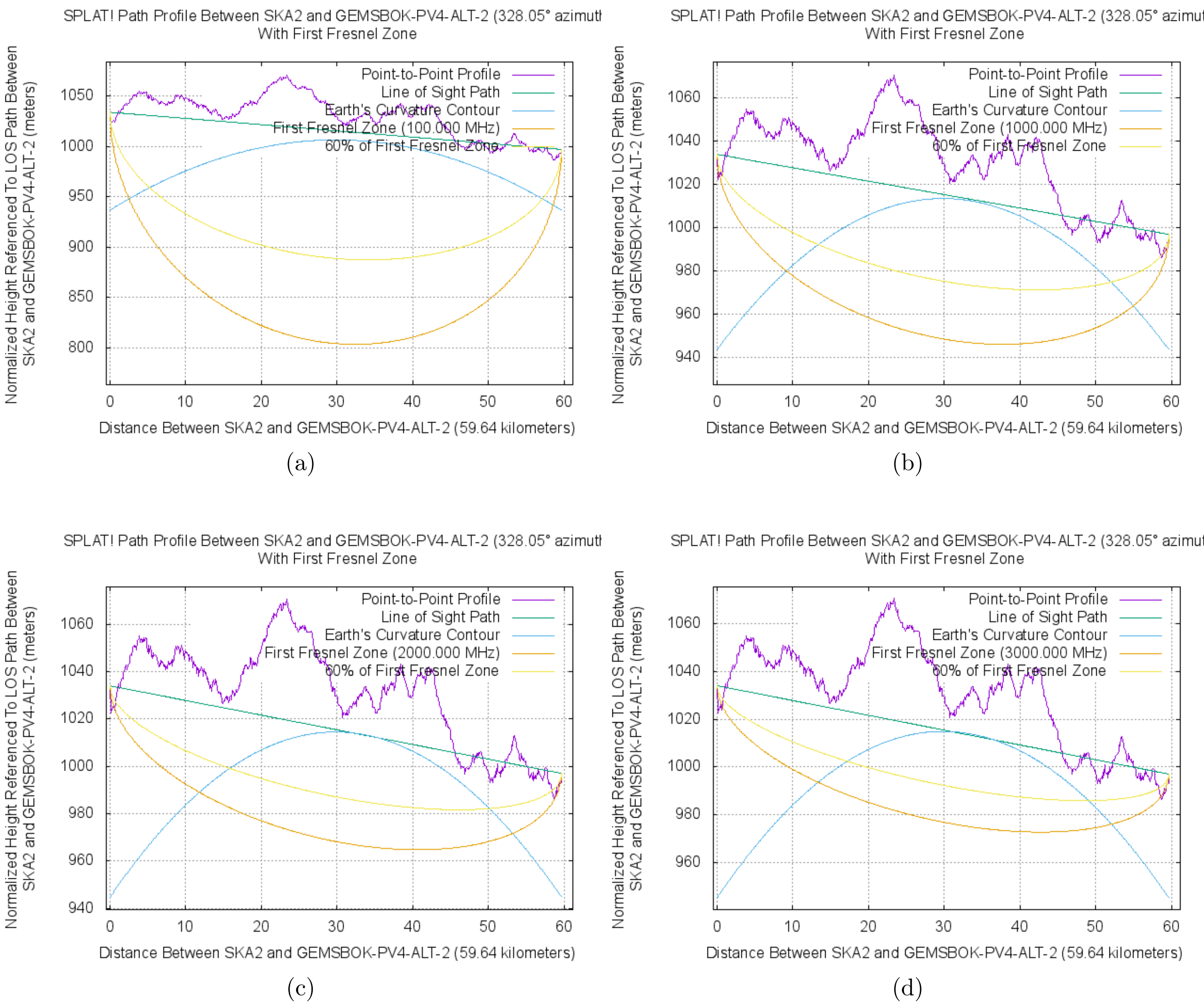
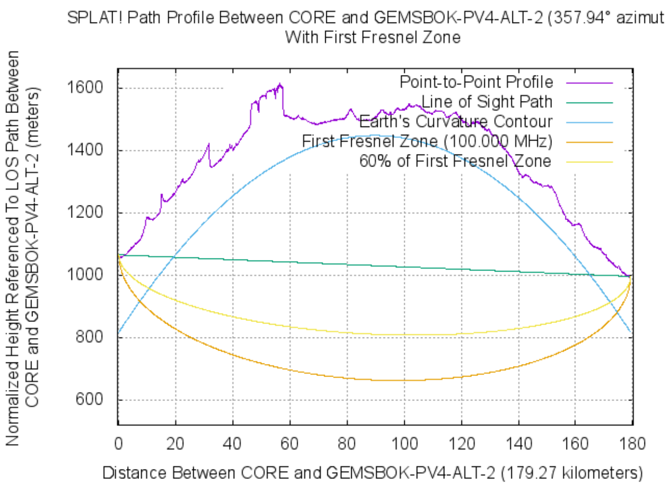
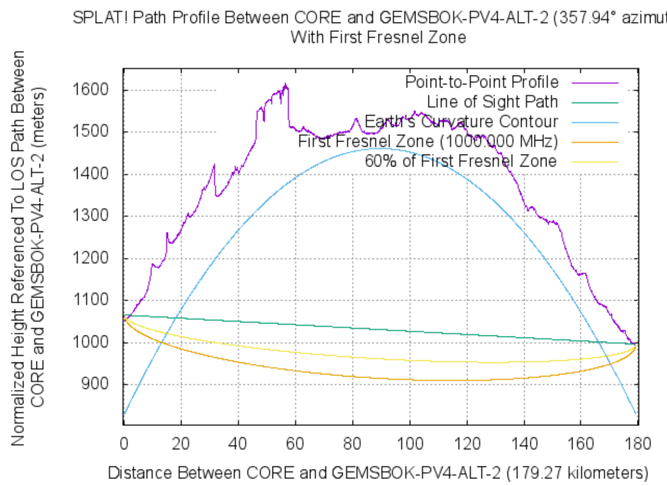


Figure 110: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

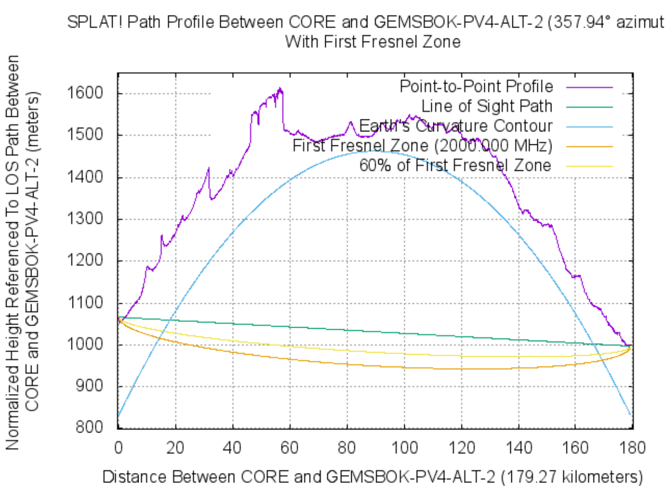
A.39 Gemsbok PV4 Alternative to Core SKA



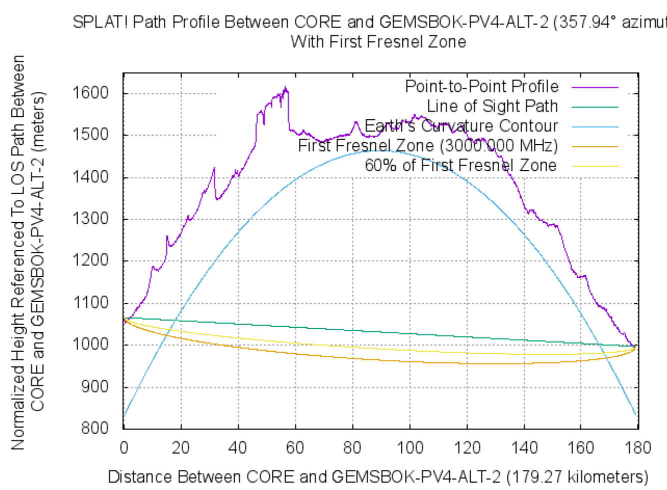
(a)



(b)



(c)



(d)

Figure 111: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV4 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.40 Gemsbok PV5 to Closest SKA

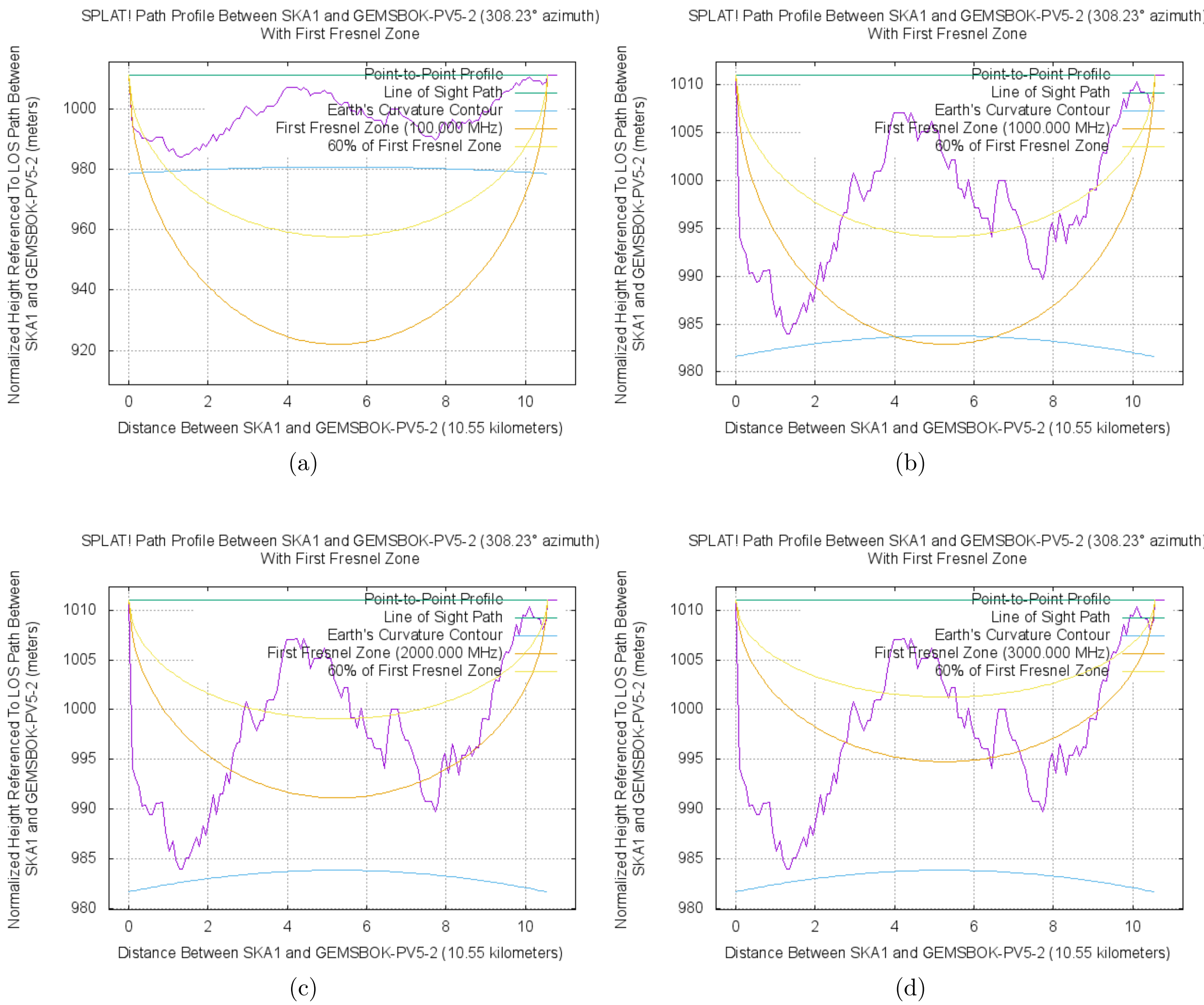


Figure 112: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.41 Gemsbok PV5 to 2nd Closest SKA

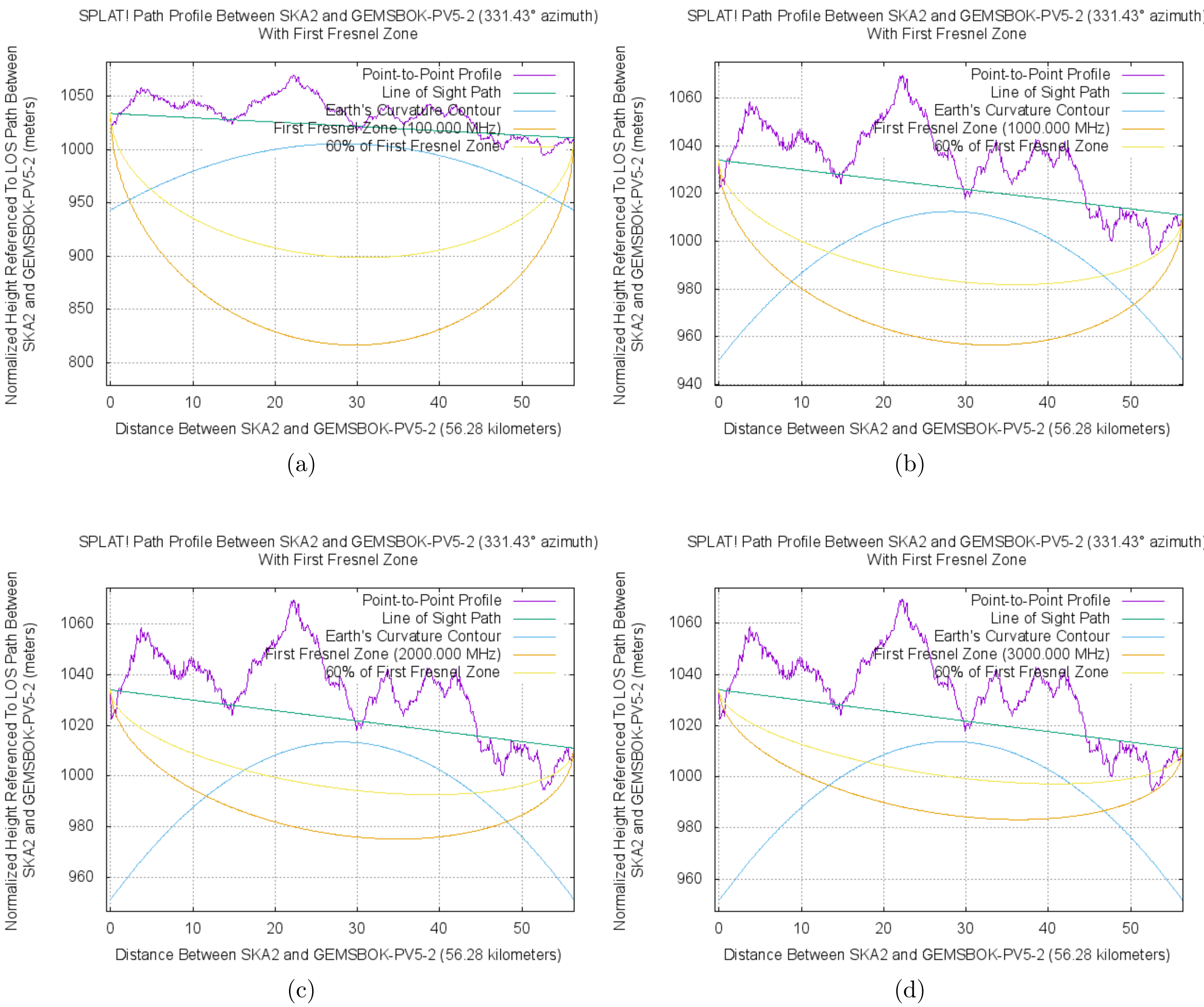


Figure 113: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.42 Gemsbok PV5 to Core SKA

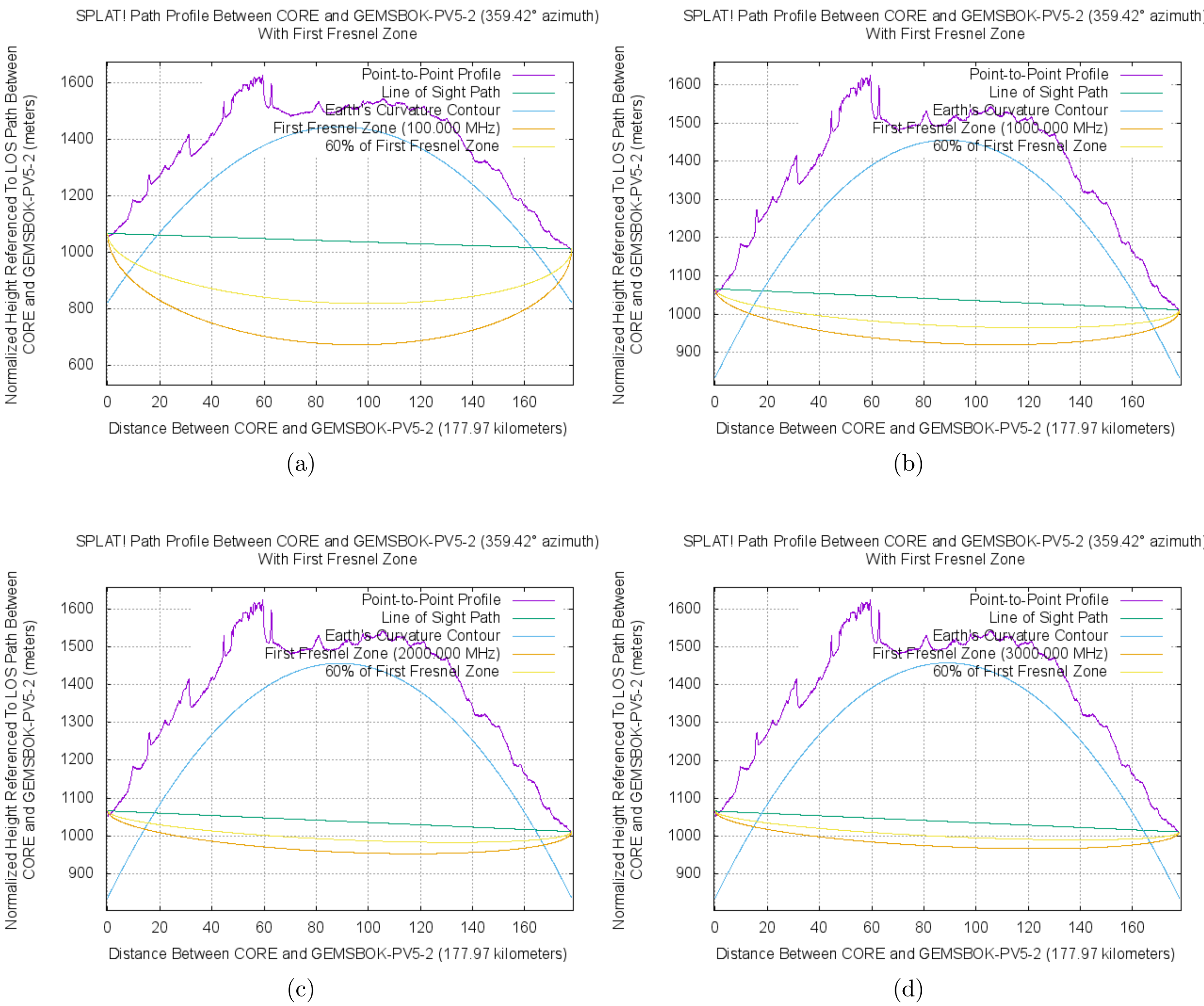


Figure 114: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.43 Gemsbok PV5 Alternative to Closest SKA

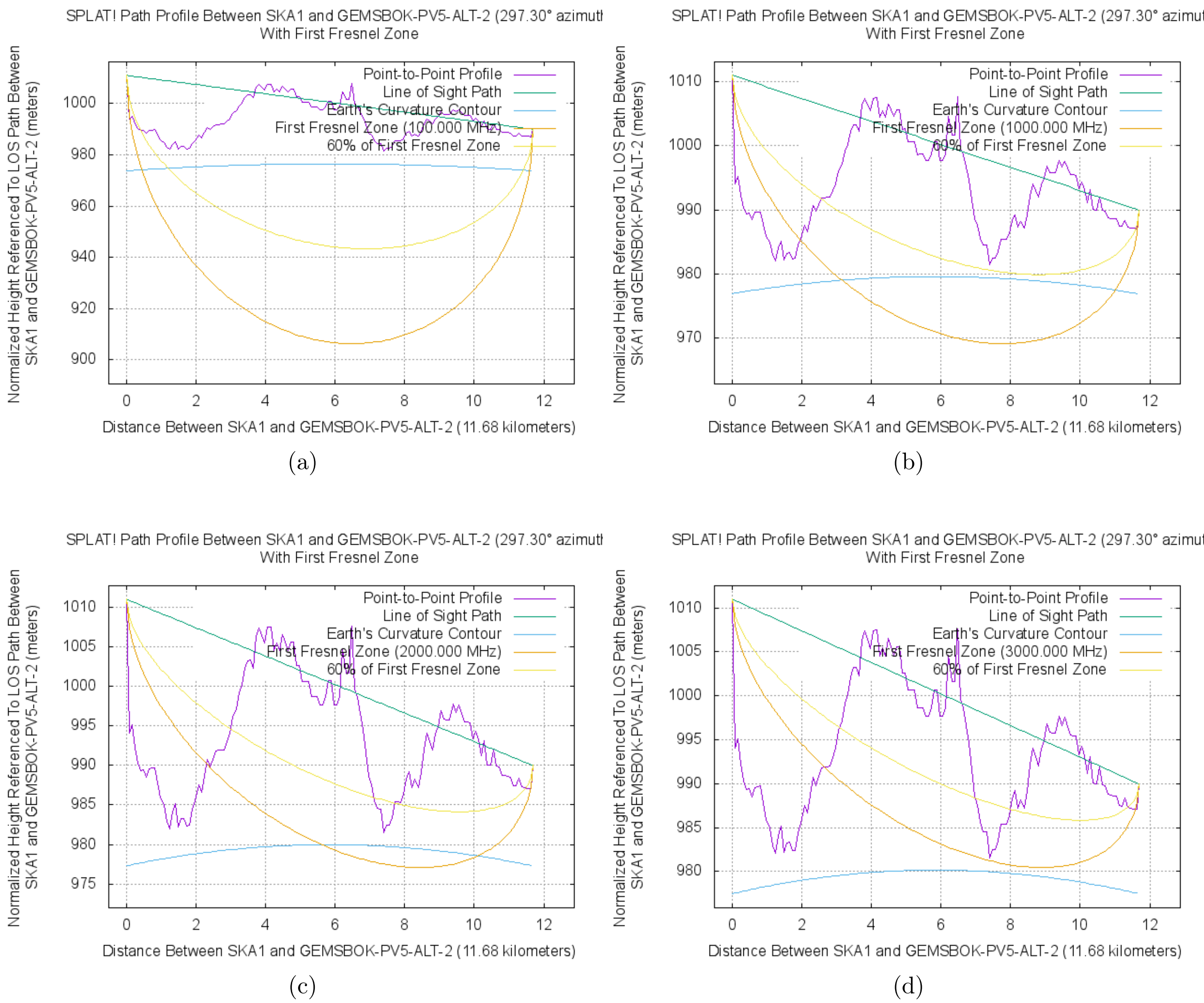


Figure 115: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.44 Gemsbok PV5 Alternative to 2nd Closest SKA

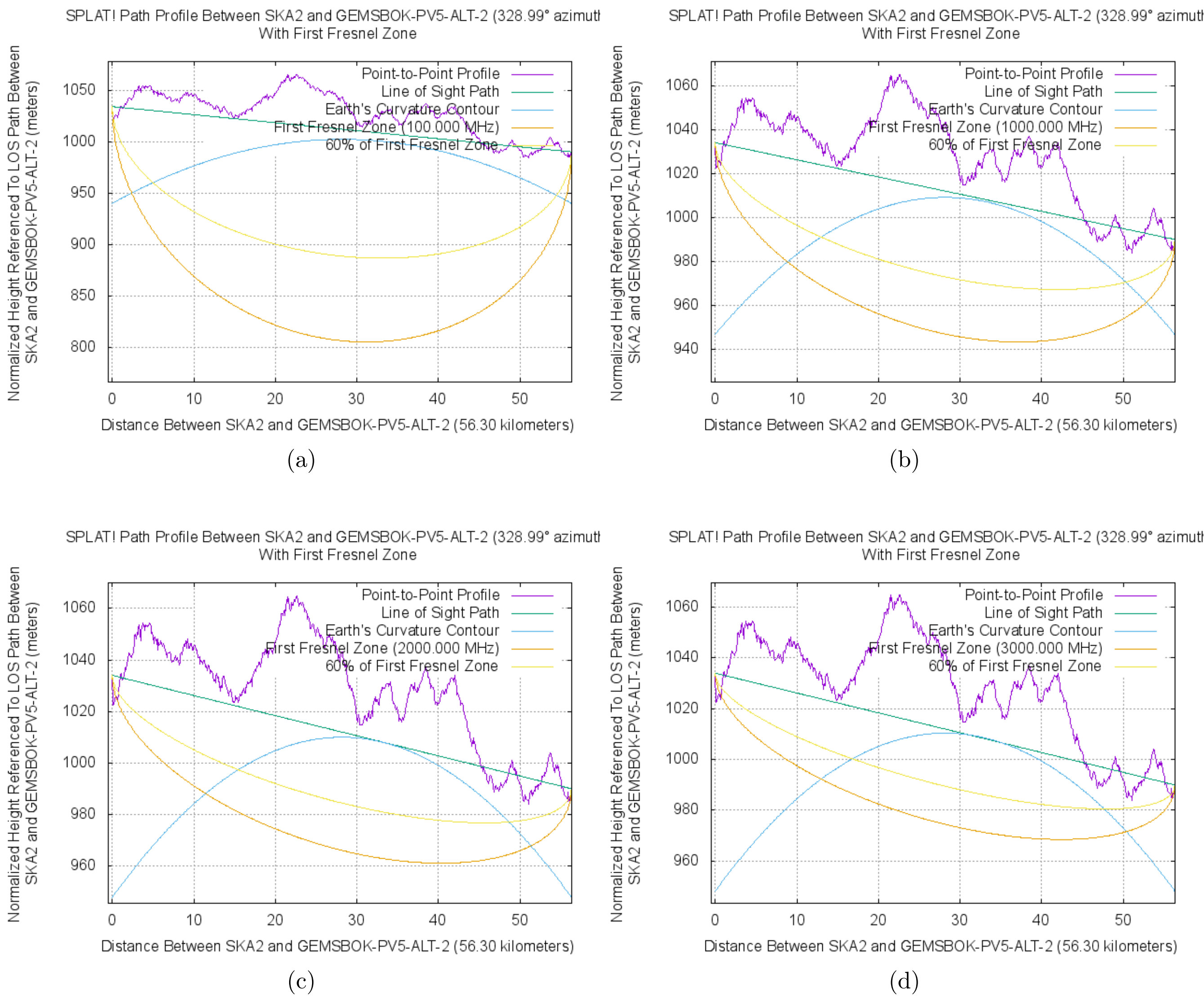
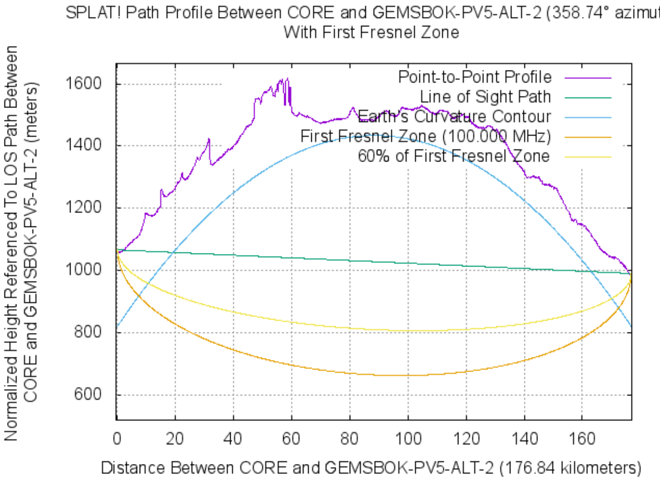
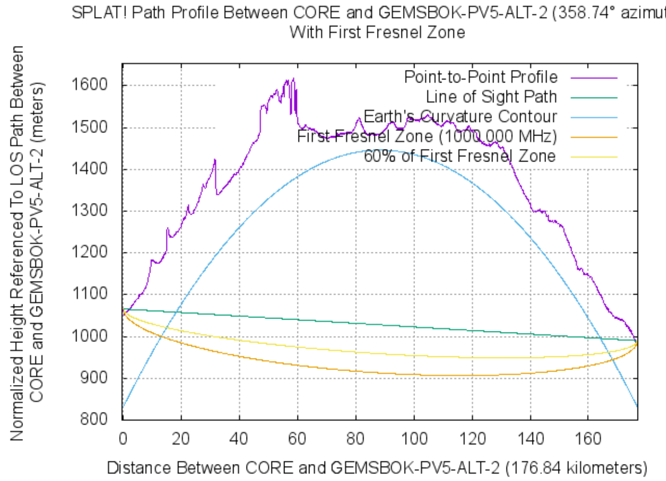


Figure 116: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

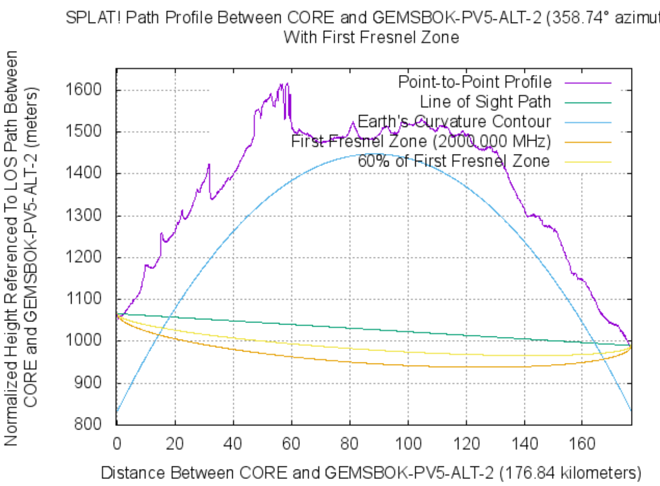
A.45 Gemsbok PV5 Alternative to Core SKA



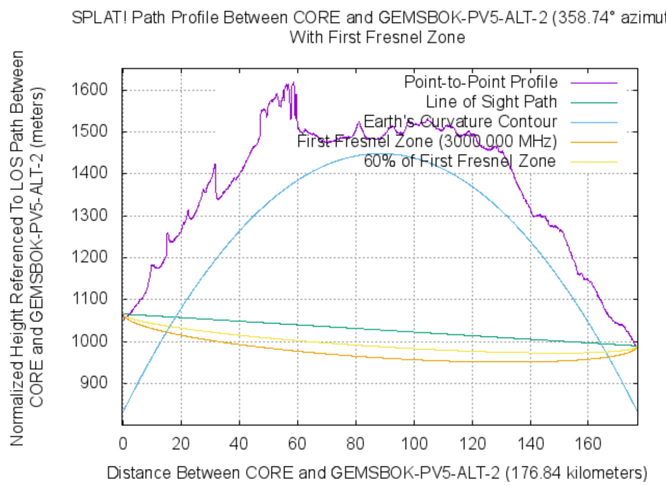
(a)



(b)



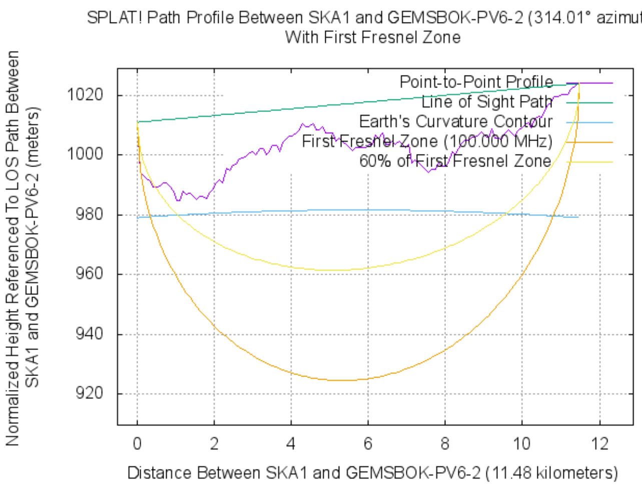
(c)



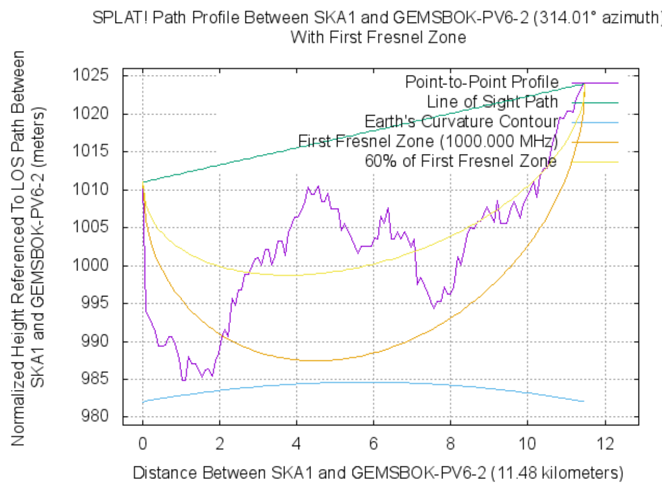
(d)

Figure 117: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV5 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

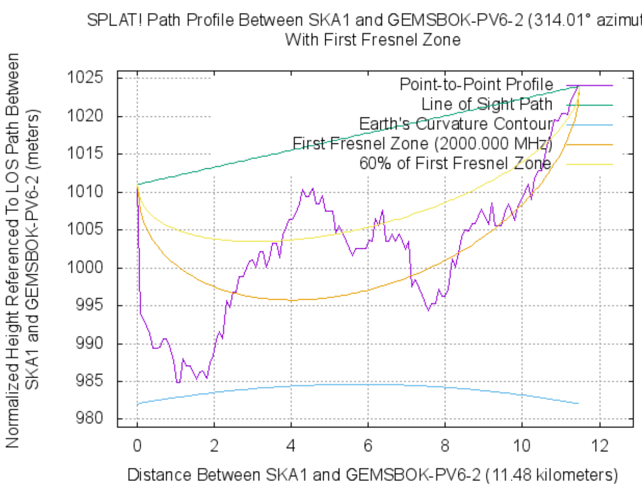
A.46 Gemsbok PV6 to Closest SKA



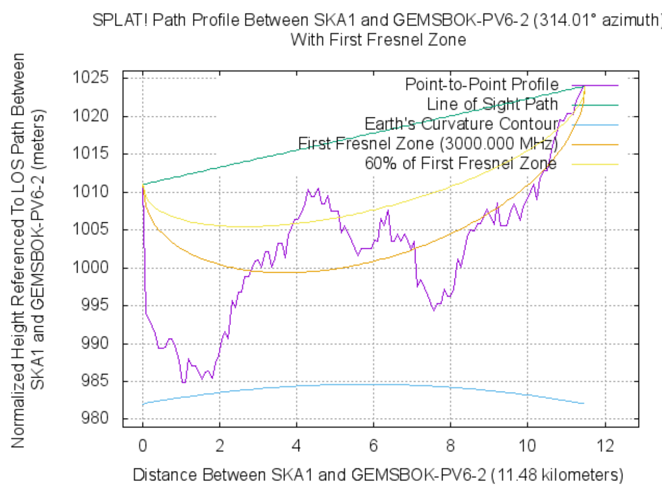
(a)



(b)



(c)



(d)

Figure 118: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.47 Gemsbok PV6 to 2nd Closest SKA

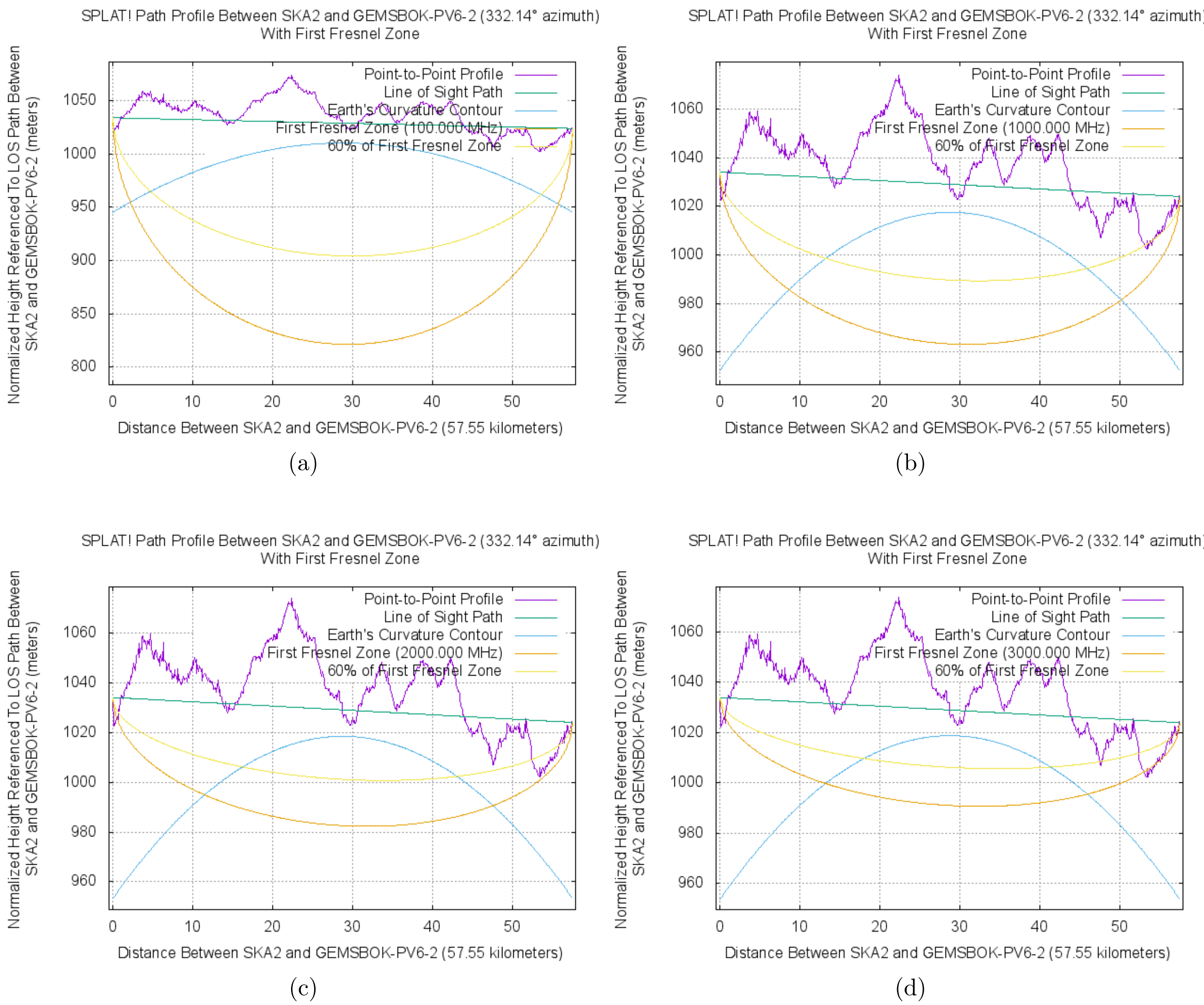
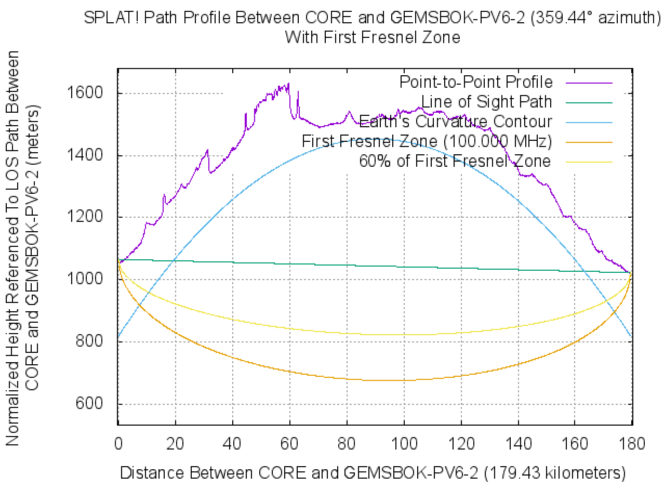
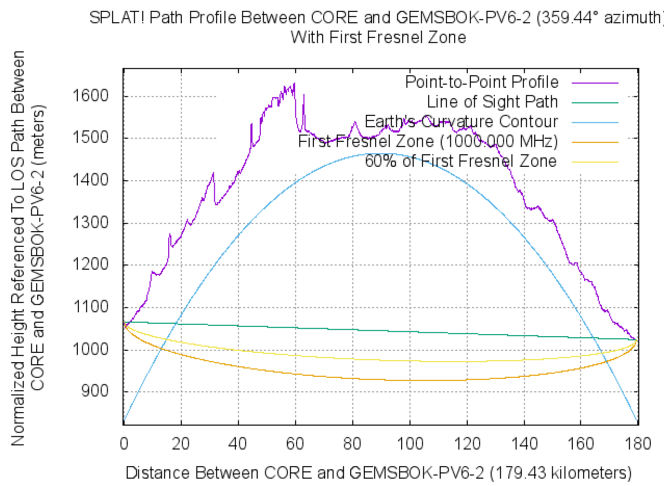


Figure 119: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

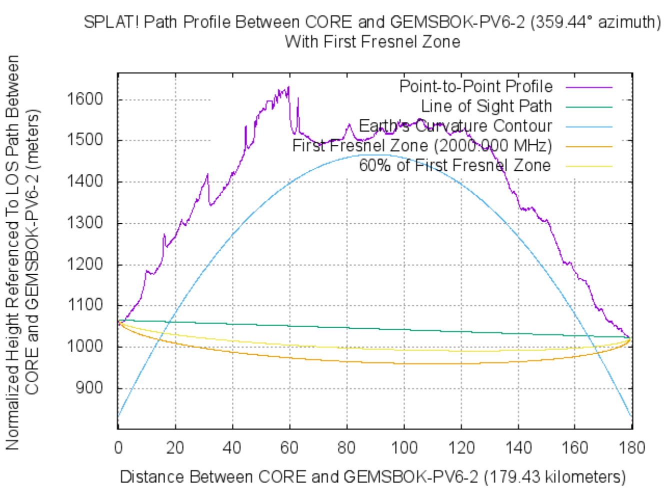
A.48 Gemsbok PV6 to Core SKA



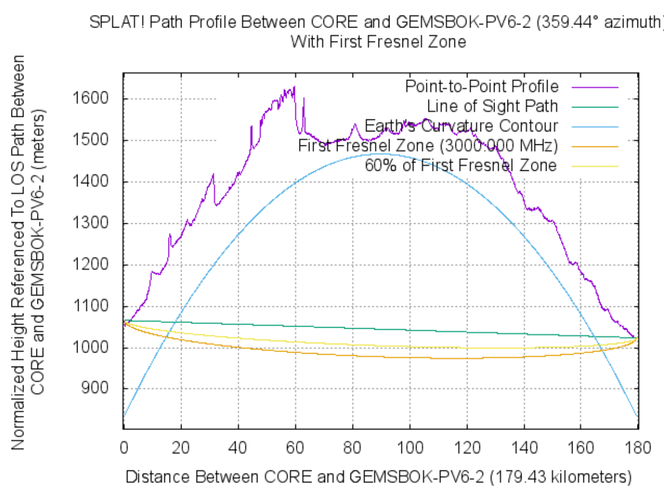
(a)



(b)



(c)



(d)

Figure 120: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.49 Gemsbok PV6 Alternative to Closest SKA

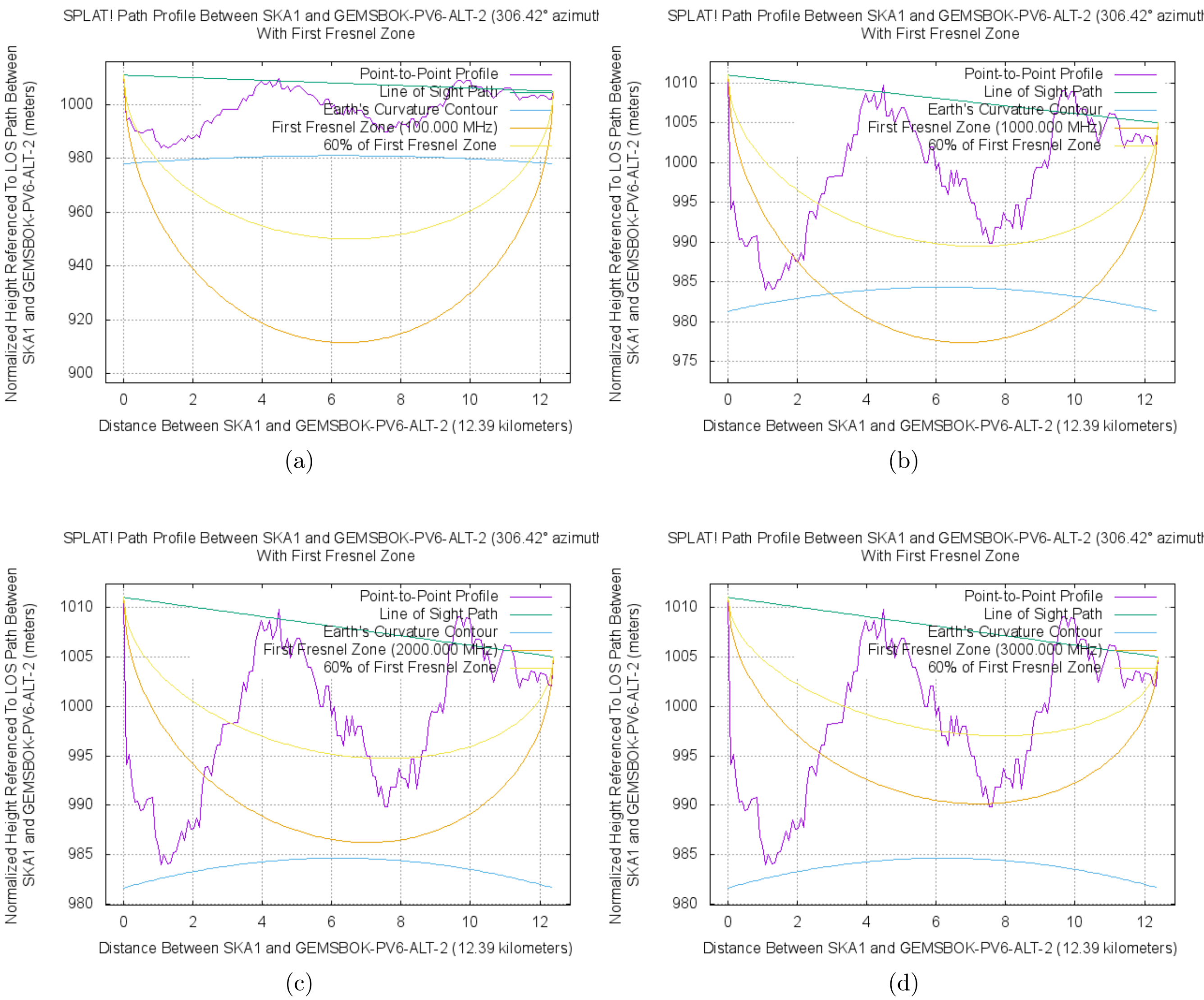


Figure 121: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 Alternative to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.50 Gemsbok PV6 Alternative to 2nd Closest SKA

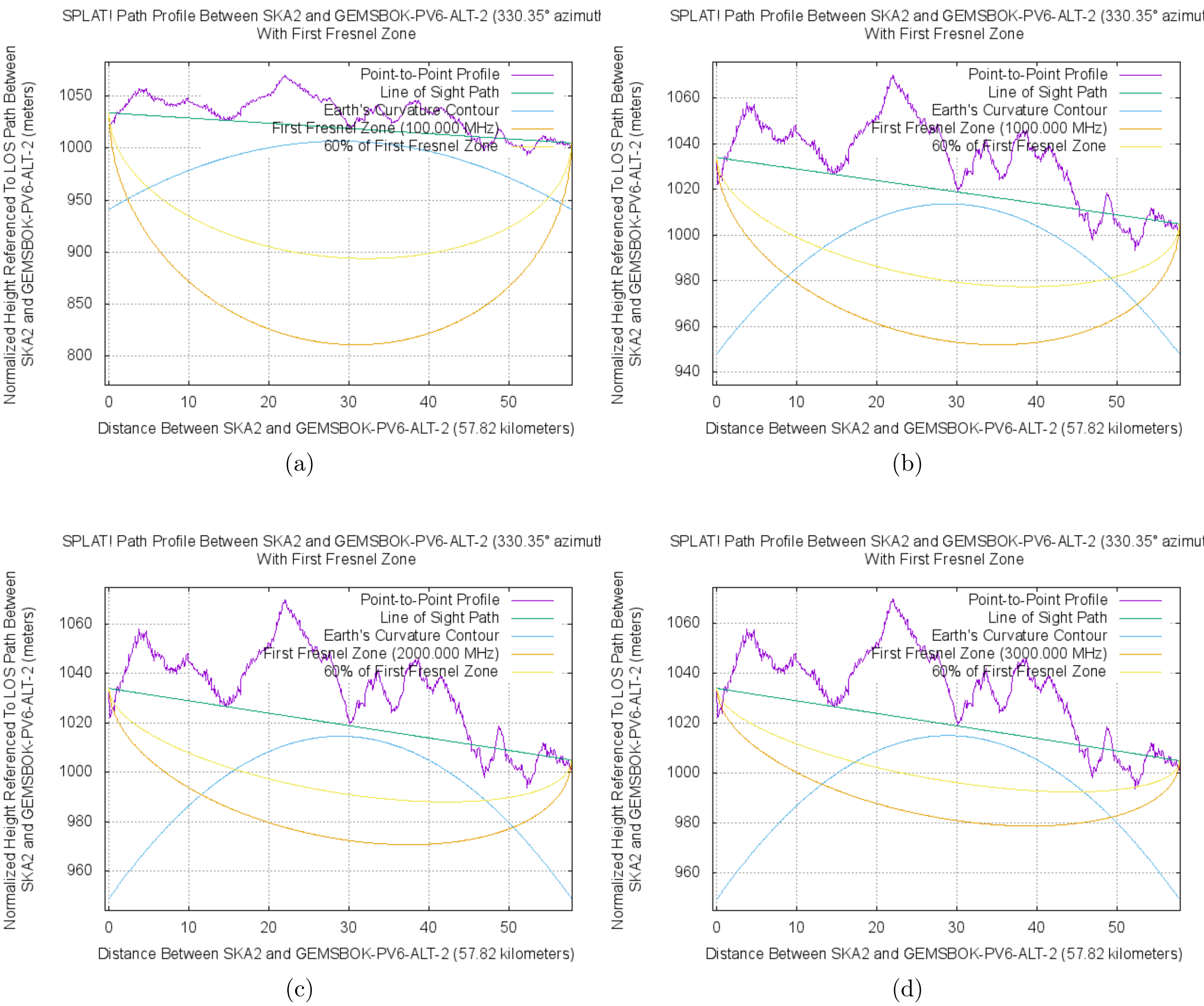


Figure 122: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 Alternative to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.51 Gemsbok PV6 Alternative to Core SKA

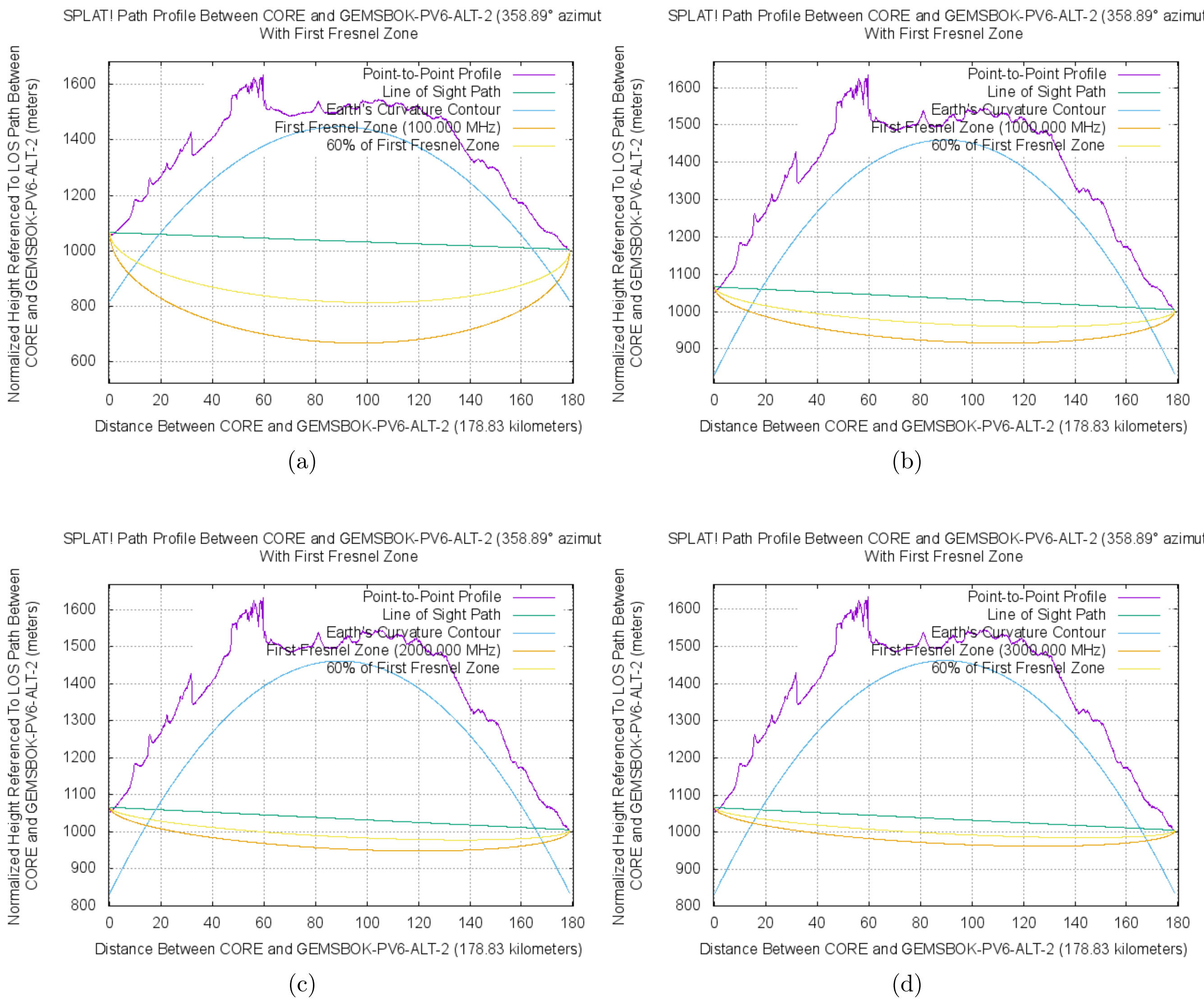
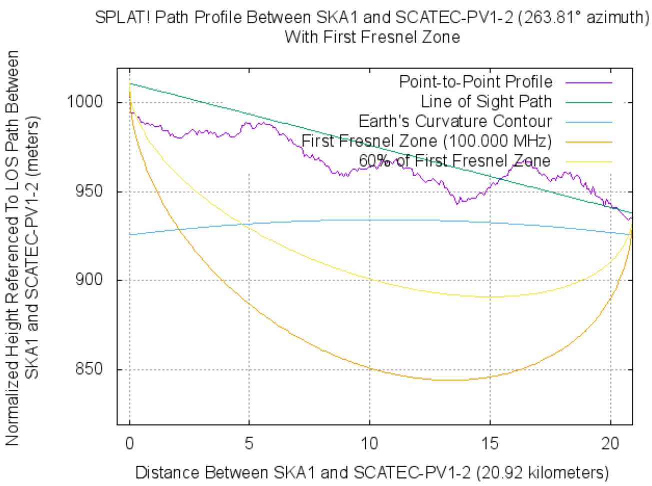
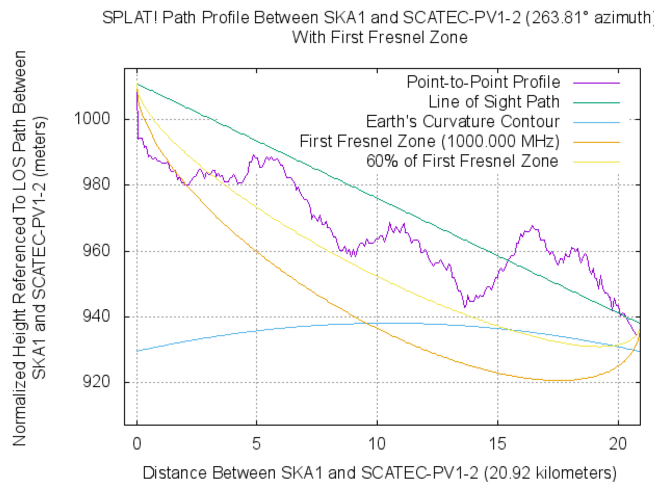


Figure 123: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Gemsbok PV6 Alternative to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

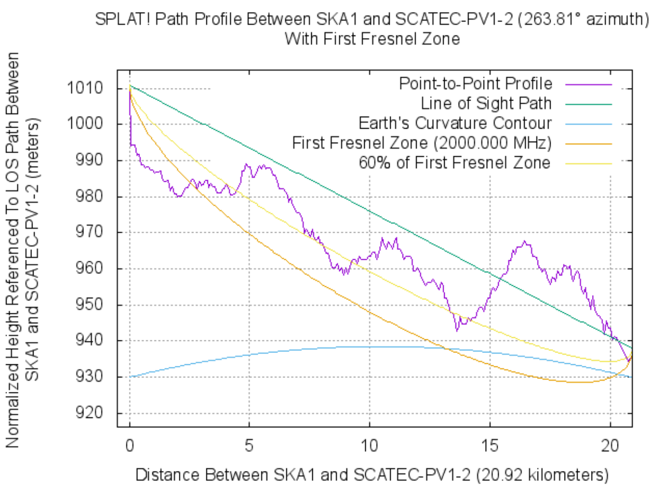
A.52 Scatec PV1 to Closest SKA



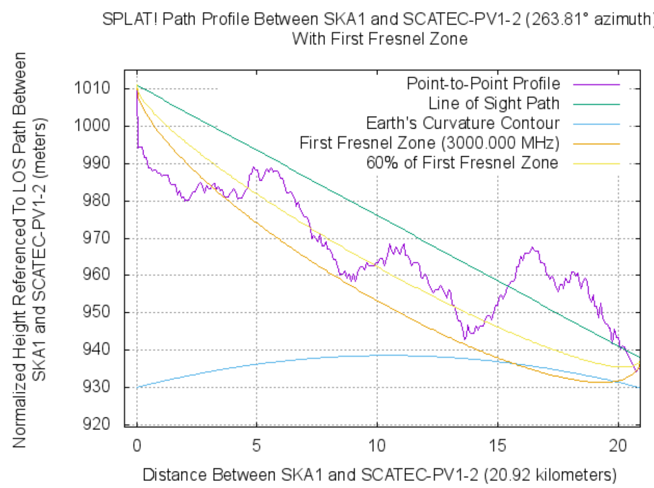
(a)



(b)



(c)



(d)

Figure 124: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV1 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.53 Scatec PV1 to 2nd Closest SKA

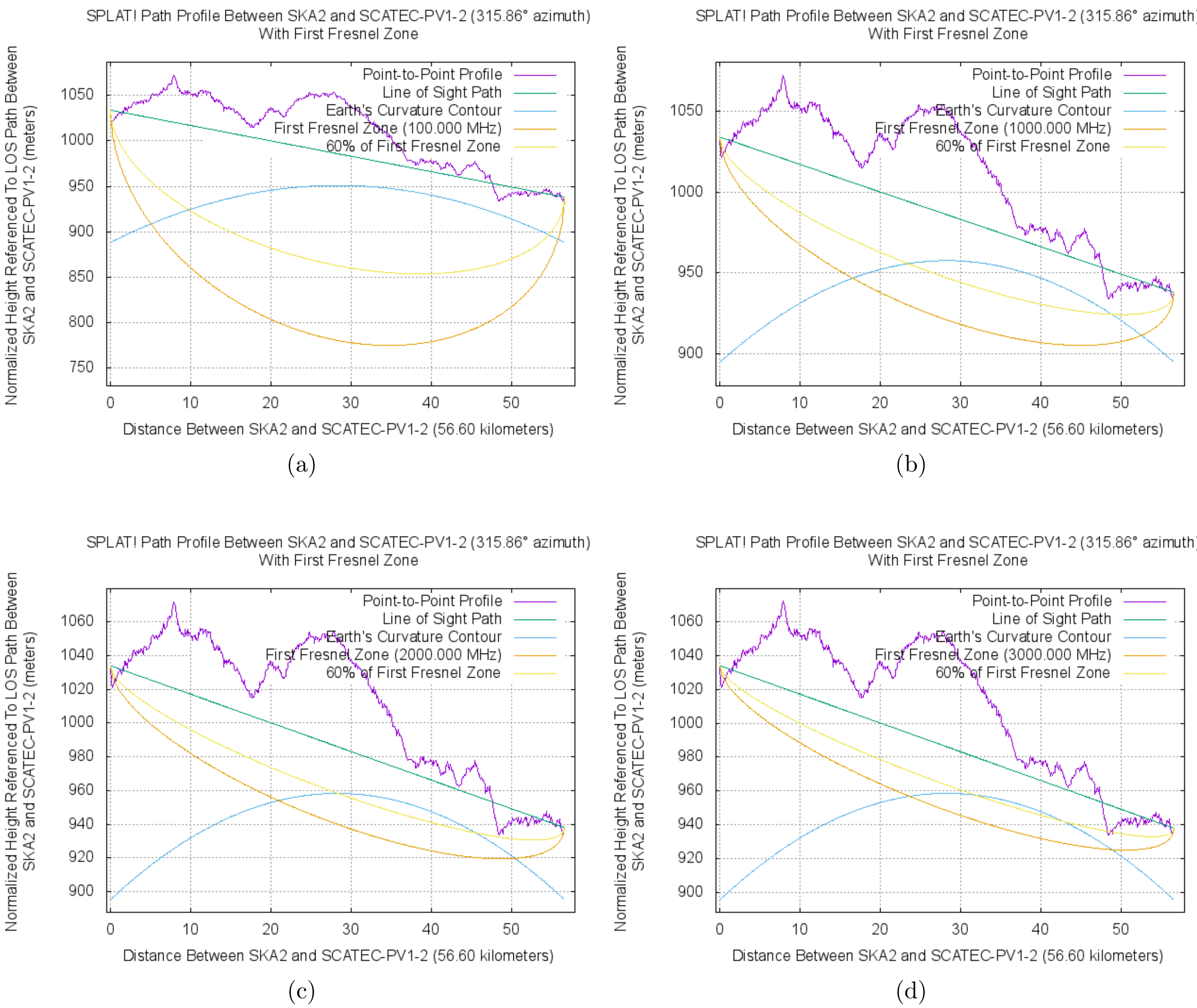
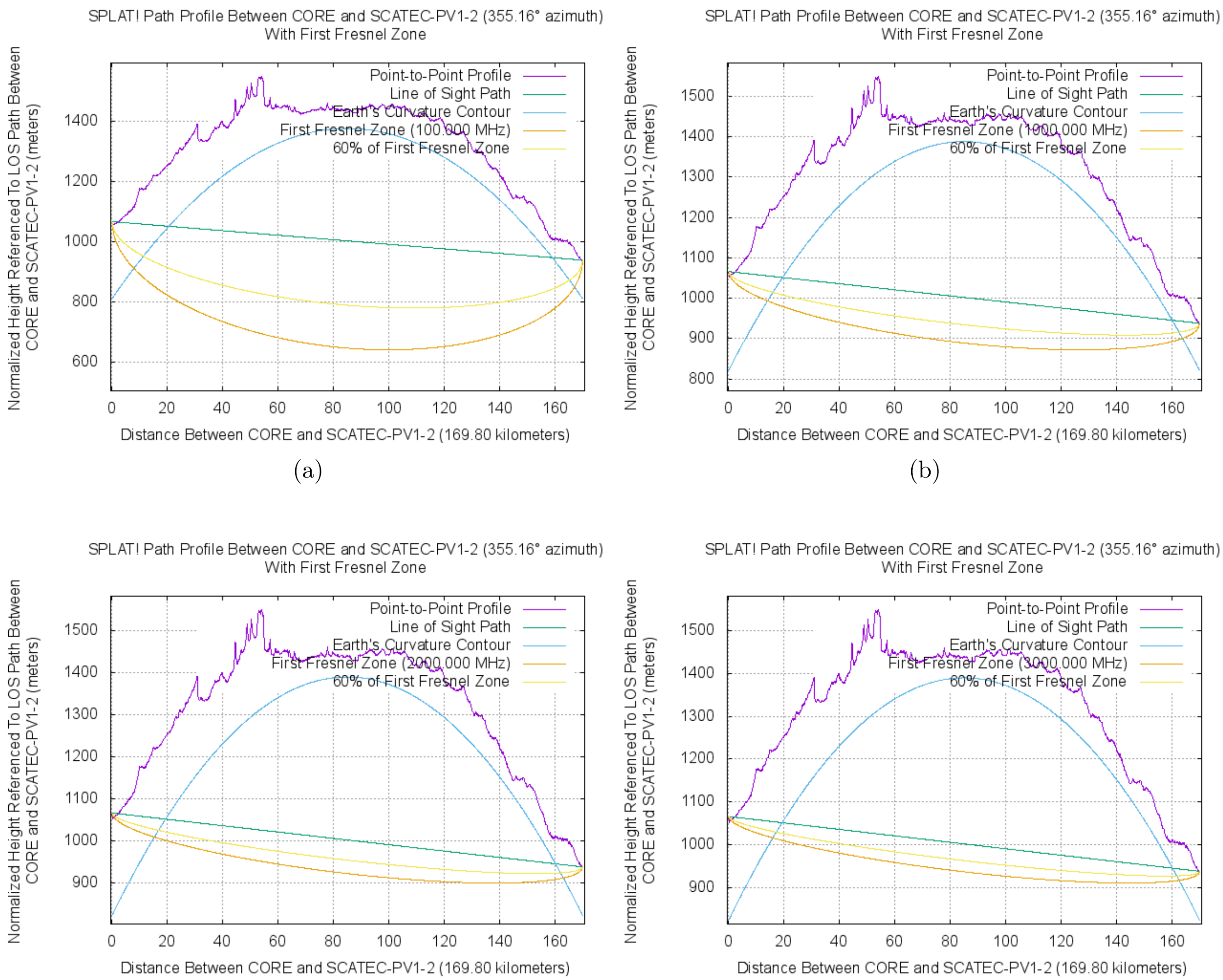


Figure 125: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV1 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

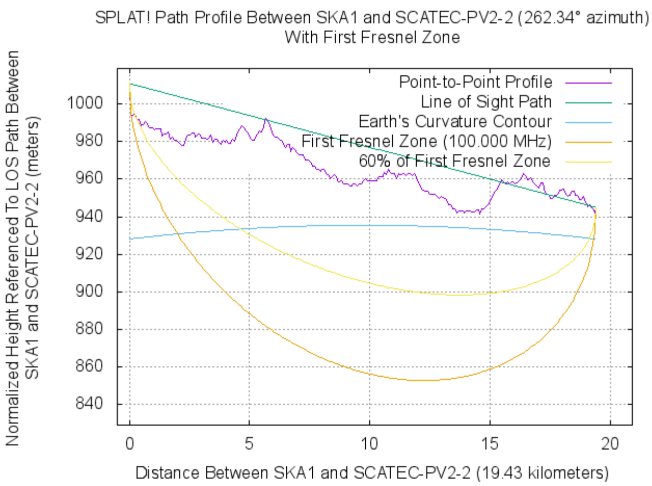
A.54 Scatec PV1 to Core SKA



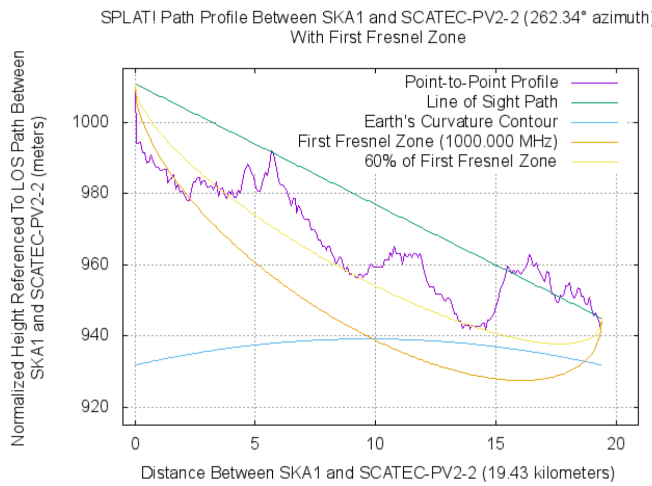
(a) (b) (c) (d)

Figure 126: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV1 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

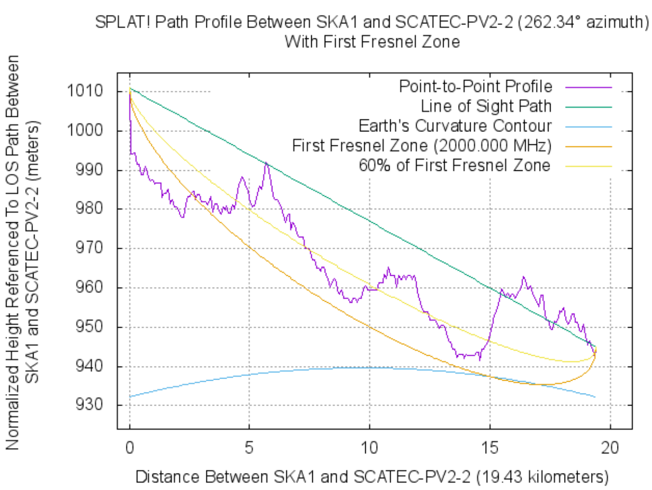
A.55 Scatec PV2 to Closest SKA



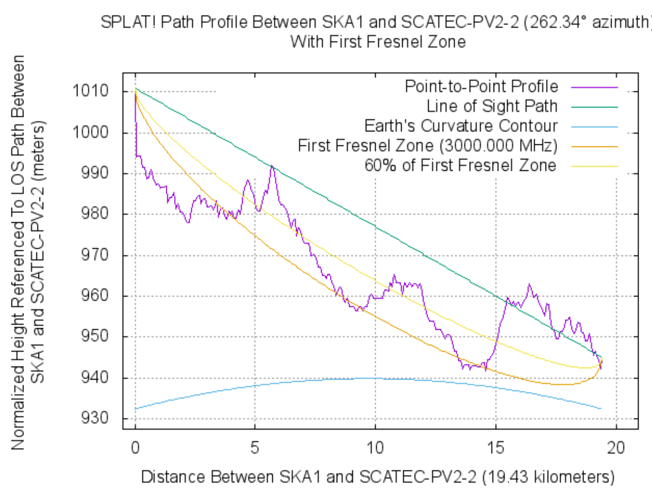
(a)



(b)



(c)



(d)

Figure 127: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV2 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.56 Scatec PV2 to 2nd Closest SKA

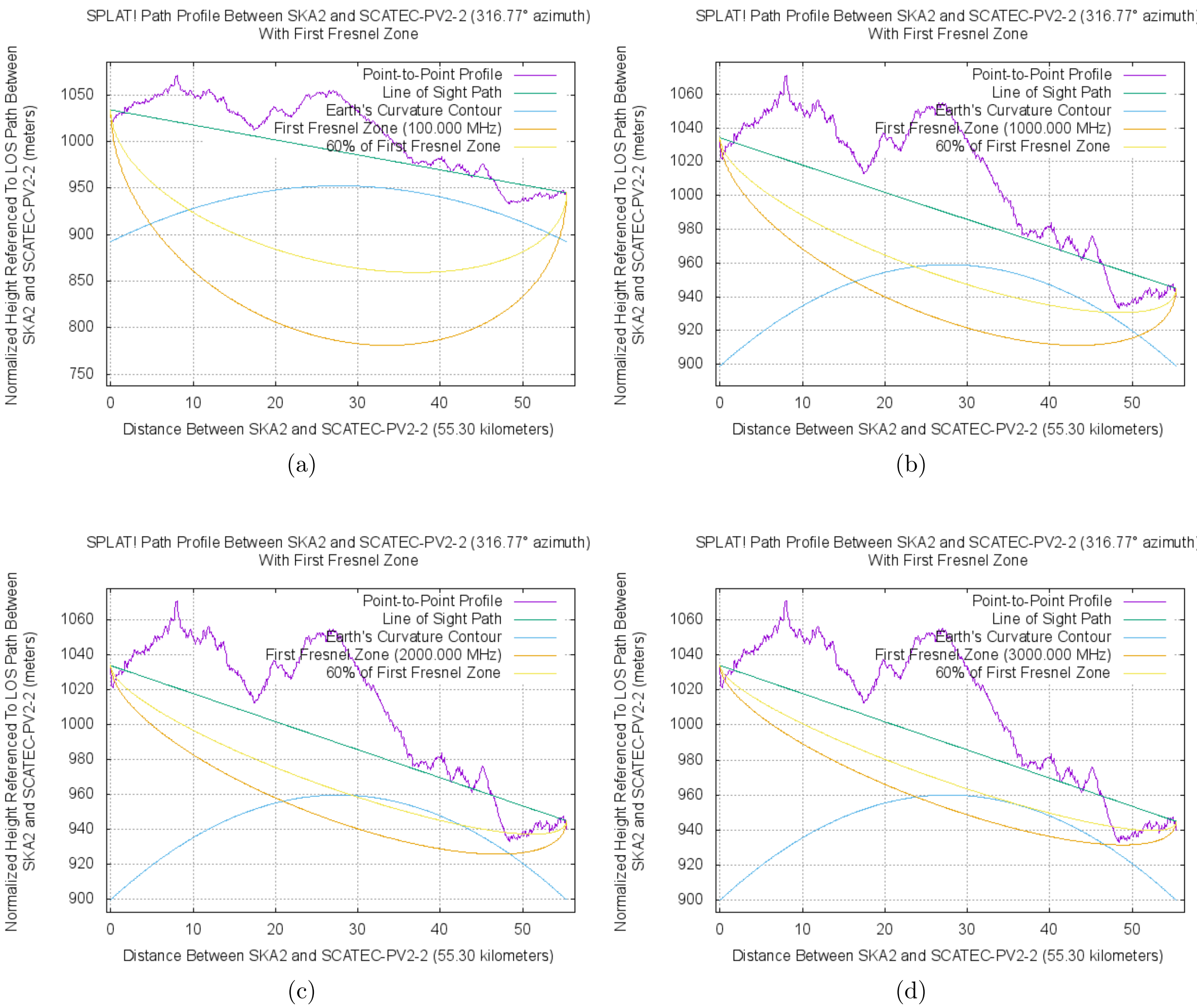
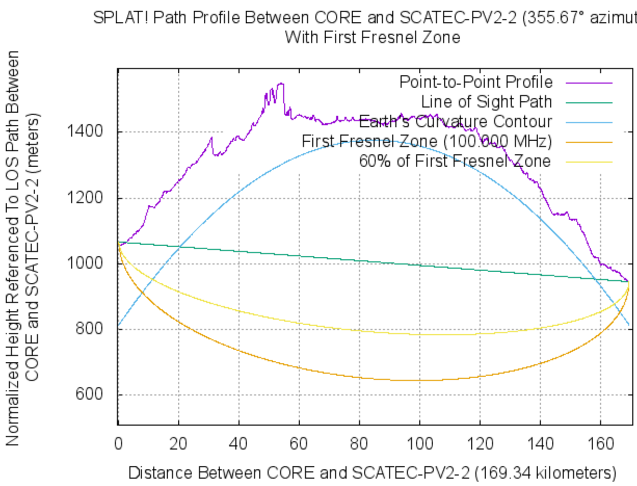
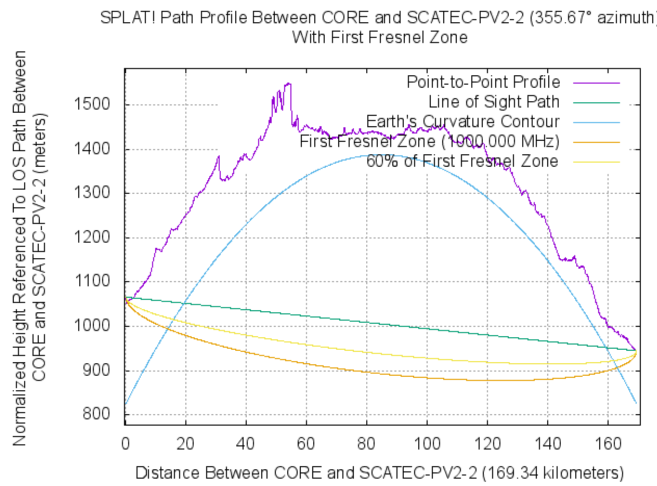


Figure 128: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV2 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

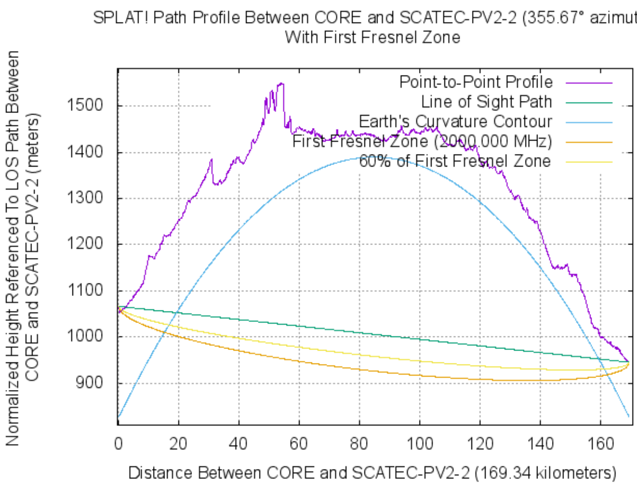
A.57 Scatec PV2 to Core SKA



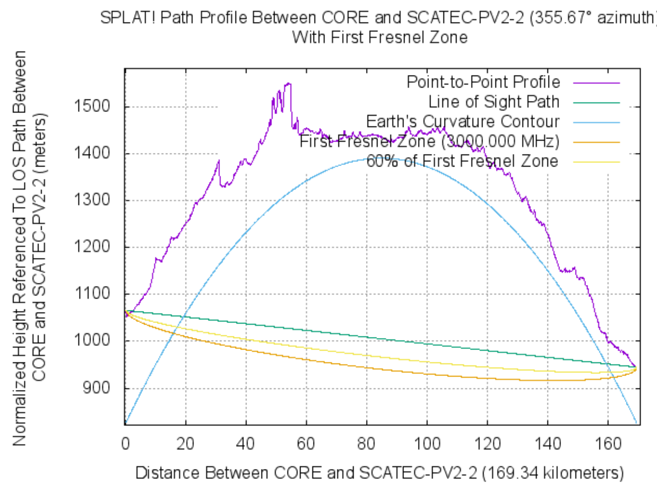
(a)



(b)



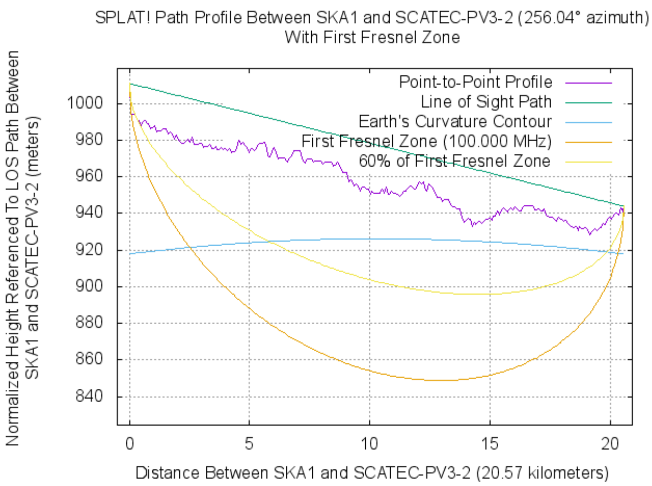
(c)



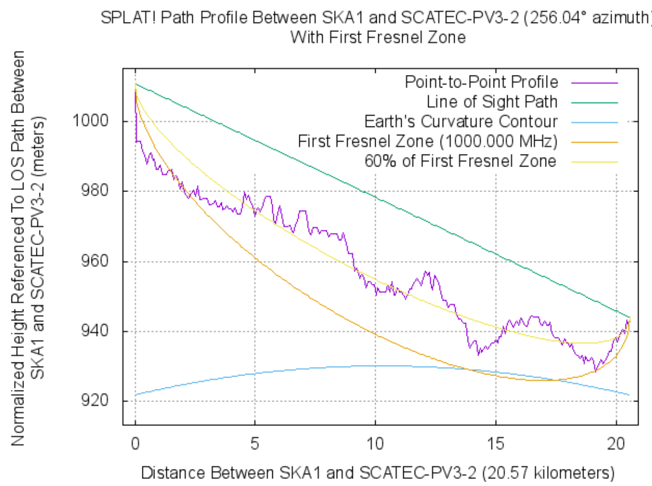
(d)

Figure 129: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV2 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

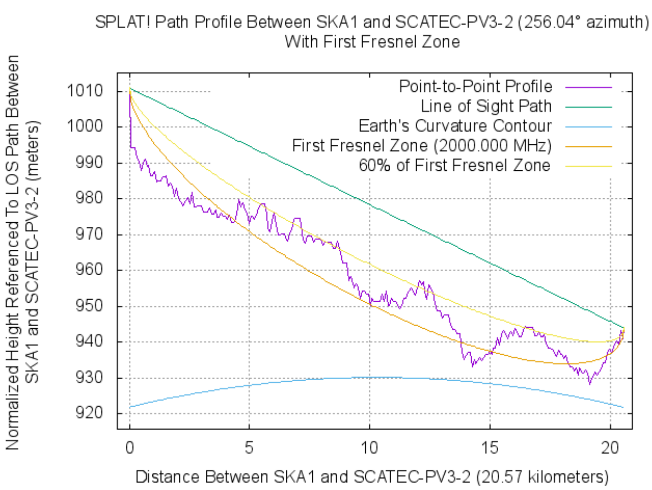
A.58 Scatec PV3 to Closest SKA



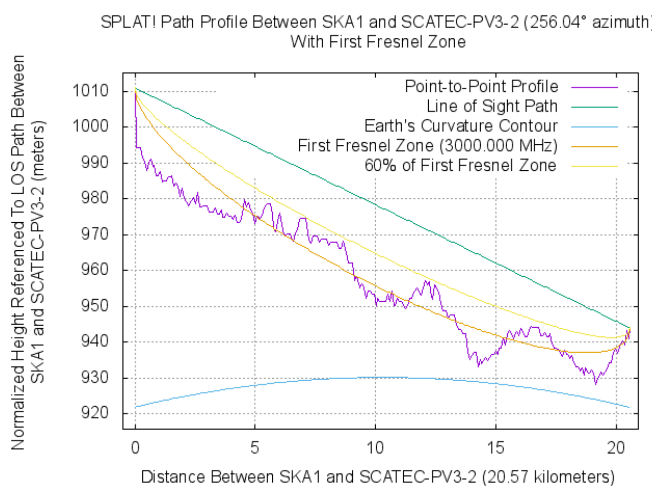
(a)



(b)



(c)



(d)

Figure 130: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV3 to the closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.59 Scatec PV3 to 2nd Closest SKA

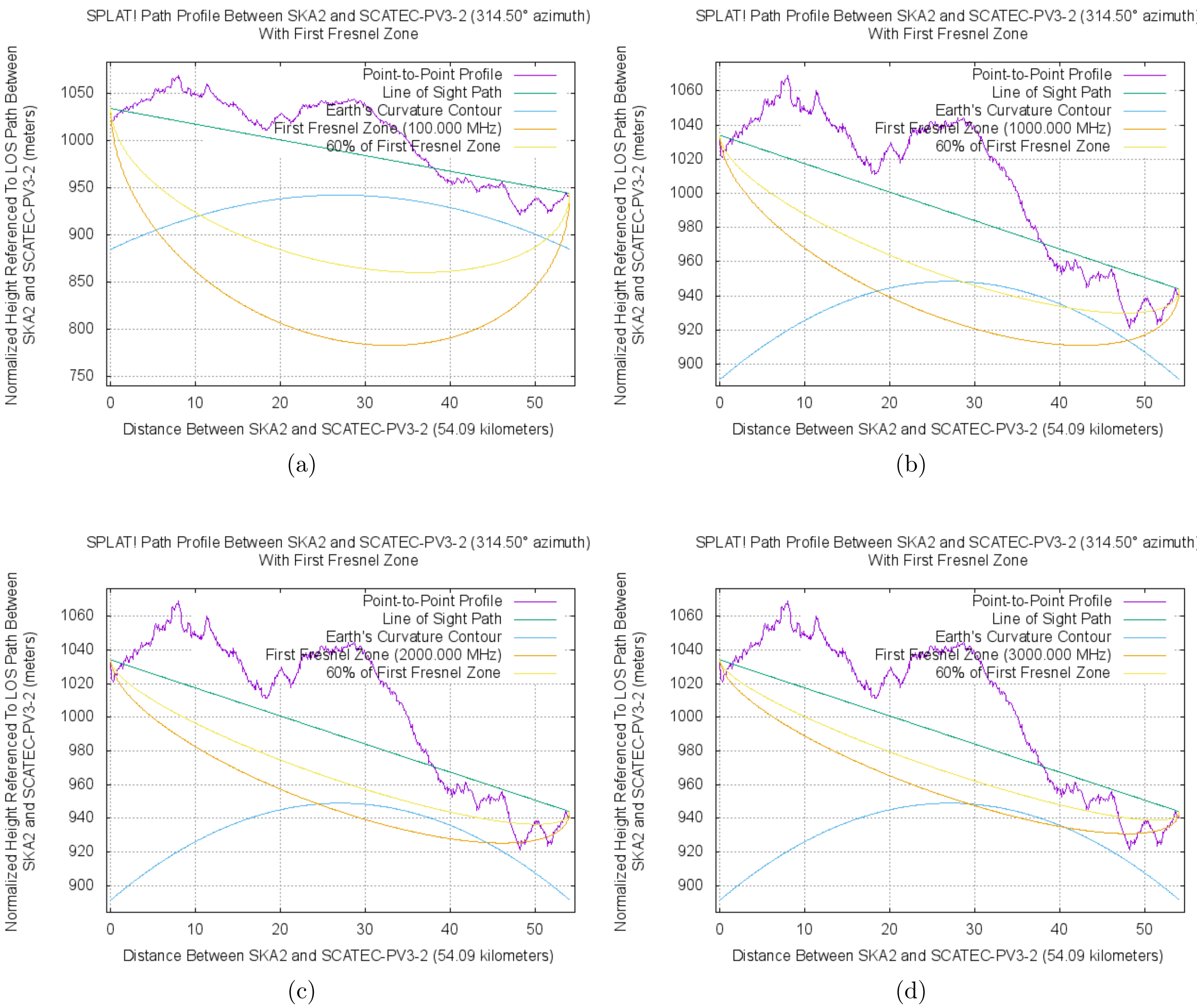


Figure 131: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV3 to the second closest SKA telescope for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.

A.60 Scatec PV3 to Core SKA

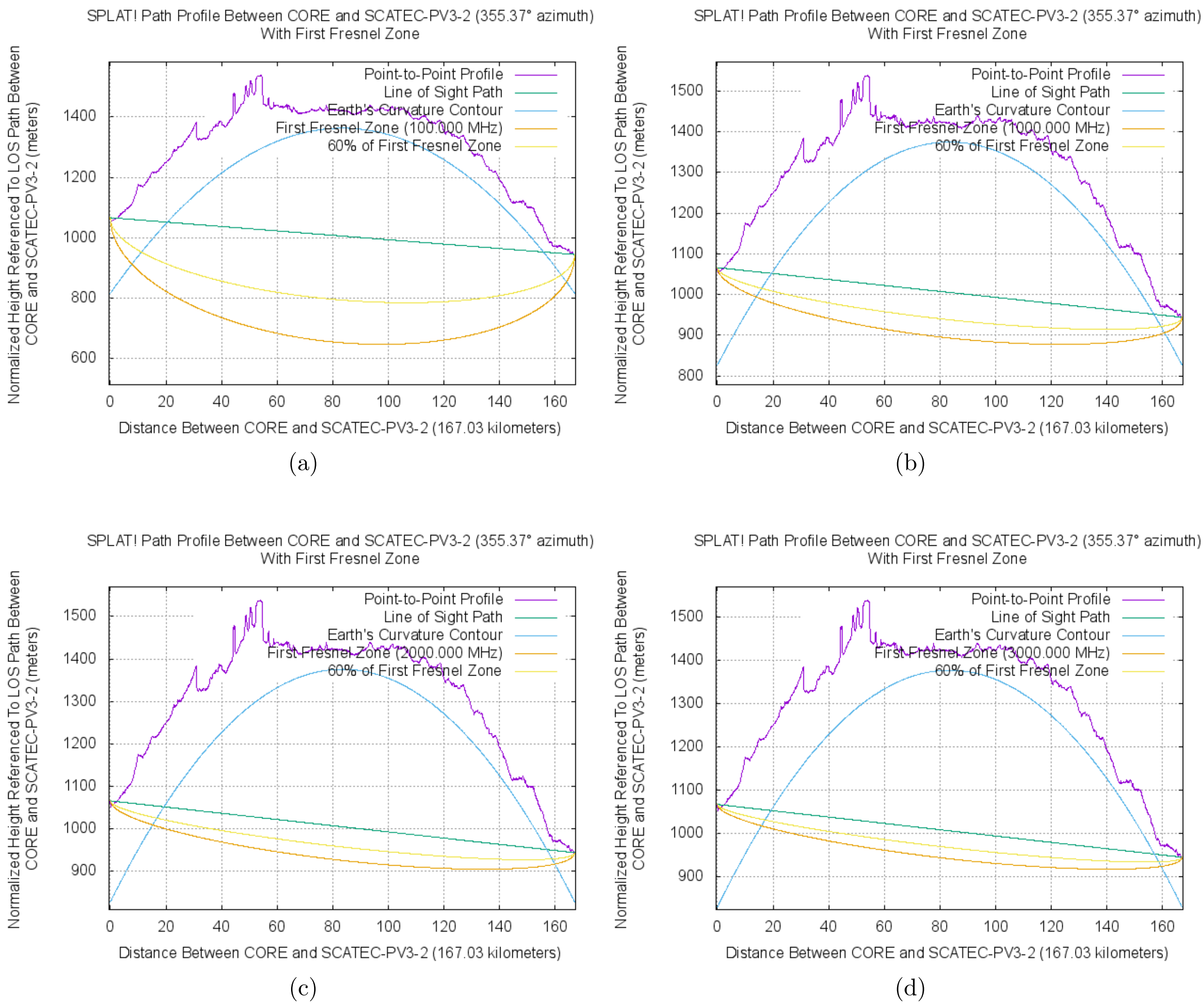


Figure 132: Fresnel zone, LOS and 60% of first Fresnel zone for site location of Scatec PV3 to the core SKA telescopes for (a) 100 MHz (b) 1000 MHz (c) 2000 MHz and (d) 3000 MHz.