Purpose of Experiment

Introduction

Aethero Space Inc. ("Aethero") has designed a non-geostationary orbit ("NGSO") satellite, Titan, to operate in Low-Earth-Orbit (LEO). Titan will carry a total of two (EO) Electro-Optical sensors for the purpose of remote sensing and remote onboard edge computing, specifically weather observation by mapping cloud coverage, land cover mapping and potential resource exploration with insights produced onboard from the edge computing module. Aethero will also simulate rendezvous and proximity operations ("RPO") to stress test a more powerful onboard processer. Titan will not actually conduct RPO maneuvers with any on-orbit spacecraft. Aethero seeks authority to operate Titan from October 1, 2026 to October 1, 2028. Titan's integration date is no-later-than August 1, 2026.

Aethero notes that it has a small satellite license with the Space Bureau[1] and a recently authorized test satellite through OET.[2] Although that space station, Deimos, is a test and demonstration satellite Aethero sought to take advantage of the streamlined process for its first mission. Here, Titan is also an experimental space station intended to demonstrate capabilities and Aethero is now seeking an experimental authorization for the Titan mission.

The Titan satellite, a 4U CubeSat, will be deployed by SpaceX's Transporter 16 launch vehicle at an altitude of approximately 510 km. Titan will conduct operations to demonstrate how on-orbit edge computing can facilitate the efficient processing of electro-optical data and deliver accurate and timely earth observation data. Titan will be equipped with an Enpulsion EP propulsion systems.

Upon completion of its missions, the Titan satellite will passively de-orbit into the Earth's atmosphere in a manner consistent with the Commission's rules.

Edge computing could play a significant role in processing and delivering time-sensitive earth observation data to anywhere on earth. Moving edge computing into orbit will yield benefits for public interest matters such as sensing and observation data.[3] The ability to process data on-orbit will allow space systems to refine data before transmitting to the earth. This will lower the amount of data space stations will need to downlink, limiting the need for spectrum while delivering the same or better-quality data product. These same benefits translate to RPO missions, where enhanced processing power can enable more safe and autonomous on-orbit operations in the event of limited or interrupted connectivity with operators on the ground.

Grant of this application consistent with the public interest. Aethero's Titan mission will demonstrate how its uniquely powerful on-orbit edge computer will significantly improve earth observation operations and products. The Titan mission will certify its edge processing computer for space and demonstrate how edge computing can reduce the time it will take to deliver processed imaging. The success of the Titan mission will also have benefits through the space industry by enabling Aethero to demonstrate the value of edge computing to the broader space industry.

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[1] *See* Call Sign: S3189.

[2] *See* File Number: 0780-EX-CN-2025.

[3] https://www.satellitetoday.com/space-economy/2023/05/12/size-of-the-prize-how-will-edge-computing-in-space-drive-value-creation/.

Mission Description

During this mission, Aethero will demonstrate the capabilities of the Titan and collect invaluable data for future Earth observation and RPO missions to be conducted by Aethero's customers. Below is a detailed description of the Titan mission. Once deployed, Titan will make contact with its ground station network, as described below, to locate the satellite and issue initial commands. Titan is equipped with a receiver onboard to provide precise GPS locations, which will be used to refine the orbital determination of the satellite for the mission duration.

Titan will be launched by Transporter 16 no earlier than February 1, 2026. Transporter 16 will deploy Titan at approximately 510 km in a Sun-Synchronous Orbit ("SSO") with an approximate inclination of 97.4°. At the injection orbit, Aethero will conduct a thorough and extensive evaluation and systems check of the sensor suite and control algorithms on Titan to confirm everything is performing nominally.

Once Aethero confirms that Titan is operating nominally, it will begin its mission of imaging the Earth and the local space environment for testing and demonstration purposes. Titan will use its onboard edge computer to process these images on-orbit before transmitting to the ground. This approach will demonstrate to potential customers how Aethero's unique edge computing technology can enable more efficient data collection and enhances the safety of on-orbit operations.

Upon completion of this demonstration, Titan will have completed its mission. At that time, Aethero will purposefully decommission Titan as it falls into a passive decay orbit.

On-board the Titan will be the most powerful onboard edge computer launched into space by a non-government operator, the Nvidia x NX/Nano Edge Computing Module (NxN-ECM). The standard for on-orbit edge computers is currently 5 trillion operations per second, the NxN-ECM is capable of 100 trillion operations per second. This 20x increase in compute power enables satellite systems to train AI/ML models onboard for data compression and analysis, which allows earth observation systems to reduce downlink needs by over 100x and achieve in-space autonomy for navigation, rendezvous, and proximity operations. Titan will validate the NxN-ECM ahead of its deployment onboard an orbital transit vehicle system in 2026.

Satellite Description

Titan

Titan will be equipped with TT&C transceivers that receive in the 2025-2110 MHz range ("S-band uplink"). Titan will transmit in the 2200-2290 MHz band ("S-band downlink") and the 8025-8400 MHz band ("X-band") w. Titan will also host one Multispectral Electro-Optical RGB Sensor for the purpose of remote sensing and remote onboard edge computing, specifically weather observation by mapping cloud coverage, land cover mapping and potential resource exploration with insights produced onboard from the edge computing module.

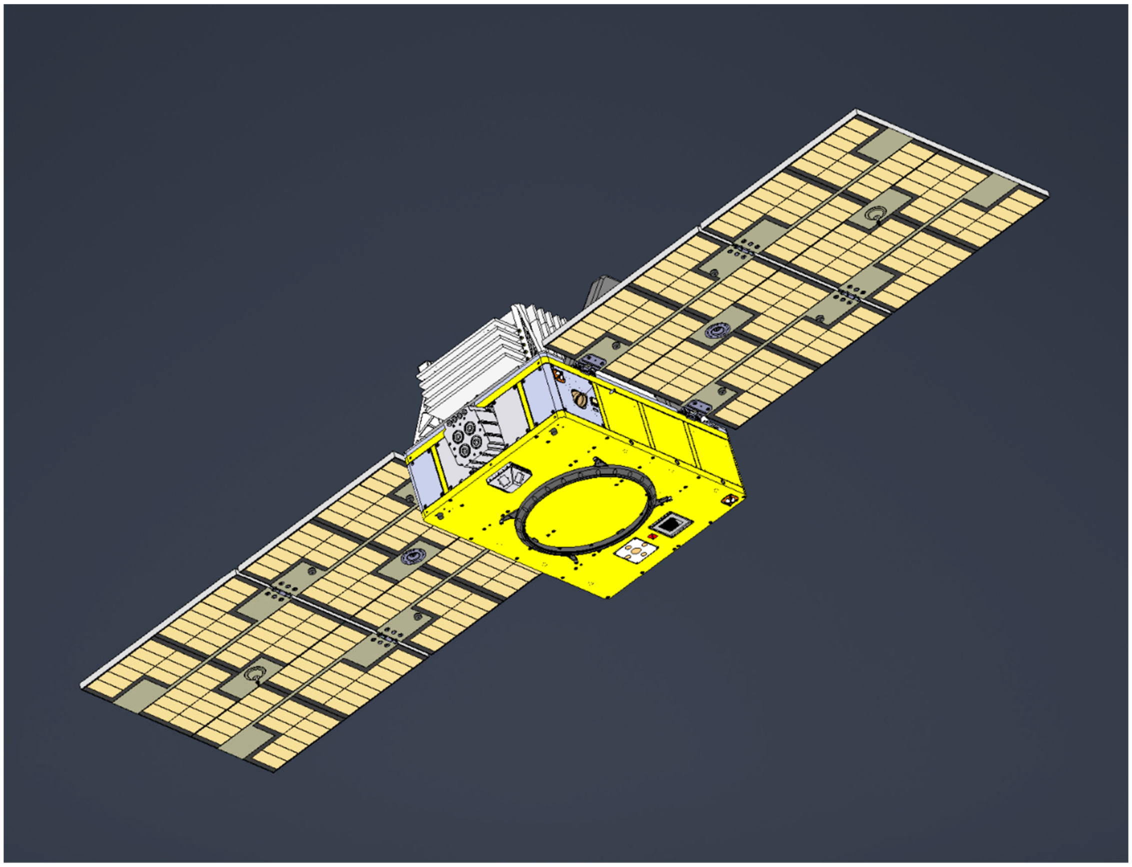

Figure 1. Titan Endurosat Bus

Technical Description

Earth Station Network

Titan will also communicate with a limited number of third-party operated earth stations for TT&C and Data communications. Below is an overview of the third-party ground network that will support the Titan Mission.

Type	Earth Station Location/Operator	Coordinates
S-band (Uplink), X-band (Downlink)	Deadhorse, Alaska, USA, RBC Signals	70.2119, -148.4376
S-band (Uplink and Downlink), X-band (Downlink)	Pretoria, South Africa, RBC Signals	-25.8607, 28.4533

S-band (Uplink and Downlink), X-band (Downlink)	Boden, Sweden, RBC Signals	65.3372, 21.4249
S-band (Uplink and Downlink), X-band (Downlink)	Punta Arenas, Chile	-52.9411, -70.8497

Spectrum Use

Below is an overview of the planned frequency use for the Titan satellite. The overview identifies the planned nature of the frequency use as well as other relevant technical considerations.

Coordination with Federal Systems

Aethero recognizes that all of the bands in which it seeks to operate in will require coordination with U.S. Federal agencies. Aethero has commenced this coordination prior to filing this application and understands that it must finalize the coordination agreements before receiving a Commission authorization.

Aethero anticipates being able to successfully coordinate its proposed frequency use. The characteristics and timetable of Aethero's proposed use of spectrum are limited and consistent with other commercial missions that have been able to complete coordination with Federal agencies.

Band-by-Band Analysis

S-Band Uplink (2025-2110 MHz)
Titan will receive command signals in the 2025-2110 MHz band. Aethero understands that all operations in this band will be on a non-interference basis. Aethero will coordinate its planned use of the band with U.S. Federal agencies to ensure that it does not cause harmful interference. The short-term duration of the mission, along with the limited duty cycle, and the use of software defined radios should facilitate coordination in an available band segment.

Aethero will seek to operate two uplink channels in S-band, one for TT&C and another for data uplink. These channels will be technically identical. The following table identifies the potential center frequency in S-band uplink for the Titan satellite. Aethero is coordinating the use of this S-band uplink center frequency with Federal Government spectrum users. This S-band uplink carrier has been selected based upon past guidance from NASA and NOAA regarding frequency ranges least likely to cause interference with federal operations. Aethero is currently coordinating operations around center frequencies of 2030 and 2080 MHz.

Aether will not use its 250 kHz channel centered around the 2030 MHz frequency below 479 km altitude in order to comply with the applicable PFD limits.

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
SU11	250	2030	RHCP
SU12	2000	2080	RHCP

S-Band Downlink (2200-2290 MHz)
Titan will transmit remote sensing data in the 2200-2290 MHz band. Aethero understands that this band is allocated internationally and in the U.S. for non-federal EESS use on a primary basis. Aethero will use the 2200-2290 MHz band for EESS downlinks. Since Titan is an EESS satellite that will image the Earth using a multi-spectral electro-optical imager, use of these frequency bands is consistent with the international and domestic frequency allocations. Aethero is currently coordinating operations with federal spectrum stakeholders.[4]

Spectrum sharing in the proposed EESS frequencies is feasible because Titan and satellites in other similar systems transmit or receive only for short durations while they are withing view of an earth station. For harmful interference to occur, satellites from different systems would need to be visible to the same earth station and actively transmitting or receiving using the same frequencies at exactly the same time. In such an unlikely event, the resulting in-line interference could be mitigated by coordinating satellite transmissions to avoid simultaneous operations. Accordingly, there is no mutual exclusivity between Titan and other NGSO EESS systems operating in the same frequency band.

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[4] Aethero has already agreed to accept the following condition from NASA in this band: *Power flux-density levels at the surface of the Earth resulting from Aethero Space TITAN space-to-Earth operations in the 2200-2290 MHz band must not exceed the limits in Table 21-4 of the ITU Radio Regulations and must meet the limits/protection criteria in Recommendation ITU-R SA.1157-1 and ITU-R SA.609-2. Aethero Space has not provided information to validate the transmissions achieving the deep space protection criteria and Aethero Space stated it is unknown if measured data can be provided. Therefore, Aethero Space shall cease TITAN space-to-Earth transmissions centered at 2240.75 MHz when the TITAN spacecraft is within radio line-of-sight of the earth station locations listed in Table 3 of Recommendation ITU-R SA.1014-4 (or current in-force SA.1014). Submission of measured performance or proposals of any alternative mitigation techniques to achieve the deep space interference protection criteria shall be successfully coordinated with NASA prior to departure from the radio line of sight restriction. Aethero Space shall provide the FCC, with copy to NASA, the specific alternative mitigation technique(s) to protect the deep space stations within ten business days of the conclusion of the coordination with NASA.*

Aethero intends to use a channel with a bandwidth not to exceed 2 MHz and the short-term duration of the Titan mission, along with the limited duty cycle, and the use of software defined radios should facilitate coordination in an available band segment.

Aethero will seek to operate two channels around its center frequency in S-band downlink, one for TT&C and the other for data downlink. These channels will be technically identical. The following table identifies the center frequency in S-band downlink for the Titan satellite, which Aethero is coordinating with Federal Government spectrum users.

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
SD11	250	2230	RHCP
SD12	2000	2250	RHCP

X-Band Downlink (8025-8400 MHz)

Titan will transmit remote sensing data in the 8025-8400 MHz band. Aethero understands that this band is allocated internationally and in the U.S. for non-federal EESS use on a primary basis. Aethero will use the 8025-8400 MHz band for EESS downlinks. Since Titan is an EESS satellite that will image the Earth using a multi-spectral electro-optical imager, use of these frequency bands is consistent with the international and domestic frequency allocations. Aethero is currently coordinating operations around center frequencies of 8125 MHz and 8275 MHz bands.

Spectrum sharing in the proposed EESS frequencies is feasible because Titan and satellites in other similar systems transmit or receive only for short durations while they are withing view of an earth station. For harmful interference to occur, satellites from different systems would need to be visible to the same earth station and actively transmitting or receiving using the same frequencies at exactly the same time. In such an unlikely event, the resulting in-line interference could be mitigated by coordinating satellite transmissions to avoid simultaneous operations. Accordingly, there is no mutual exclusivity between Titan and other NGSO EESS systems operating in the same frequency band. Aethero will also comply with the technical requirements set forth in Part 25 of the Commission's rules, adhere to applicable ITU rules and recommendations, and complete coordination with the Federal operators as required.

Aethero intends to use a channel with a bandwidth not to exceed 36 MHz and the short-term duration of the Titan mission, along with the limited duty cycle, and the use of software defined radios should facilitate coordination in an available band segment.

Aethero will seek to operate two channels around its center frequency in X-band, one for TT&C and the other for data downlink. These channels will be technically identical. The following table identifies the center frequency in X-band for the Titan satellite, which Aethero is coordinating with Federal Government spectrum users.

Channel ID	Bandwidth (kHz)	Center Frequency (MHz)	Polarization
XD11	170000	8125	RHCP
XD12	170000	8275	RHCP

Antenna Beam Projections

This section provides the predicted antenna gain contours for each transmit and receive beam. Contours are depicted on an area map with the beam shown on the surface of the earth with the space stations' peak antenna gain pointed at nadir to a latitude and longitude within the proposed service area. Furthermore, each contour is shown at 2 dB intervals down to 10 dB below the peak gain with additional contours at 15 dB and 20 dB below peak (where applicable). While the regulation states to show intervals of 2 dB down to 10 dB below the peak gain and at 5 dB intervals between 10 - 20 dB below the peak gain, the nature of many of the antennas, and orbital altitude of the spacecraft limit the visibility of the contours in the schematics. Specifically, the SRX and STX beams only have -2 dB, -4 dB, and -6 dB contours that fall onto the Earth's surface. The -8 dB, -10 dB, -15 dB, and -20 dB contours project beyond the limb of the Earth.

S-Band receive, X-band transmit gain contours, and S-band transmit gain contours are provided in Figures below over all GW ES sites listed in the Titan earth station network table above. Titan will only transmit in the S-band downlink outside the United States and therefore the S-band transmit antenna beam projections are provided for foreign earth station locations only.

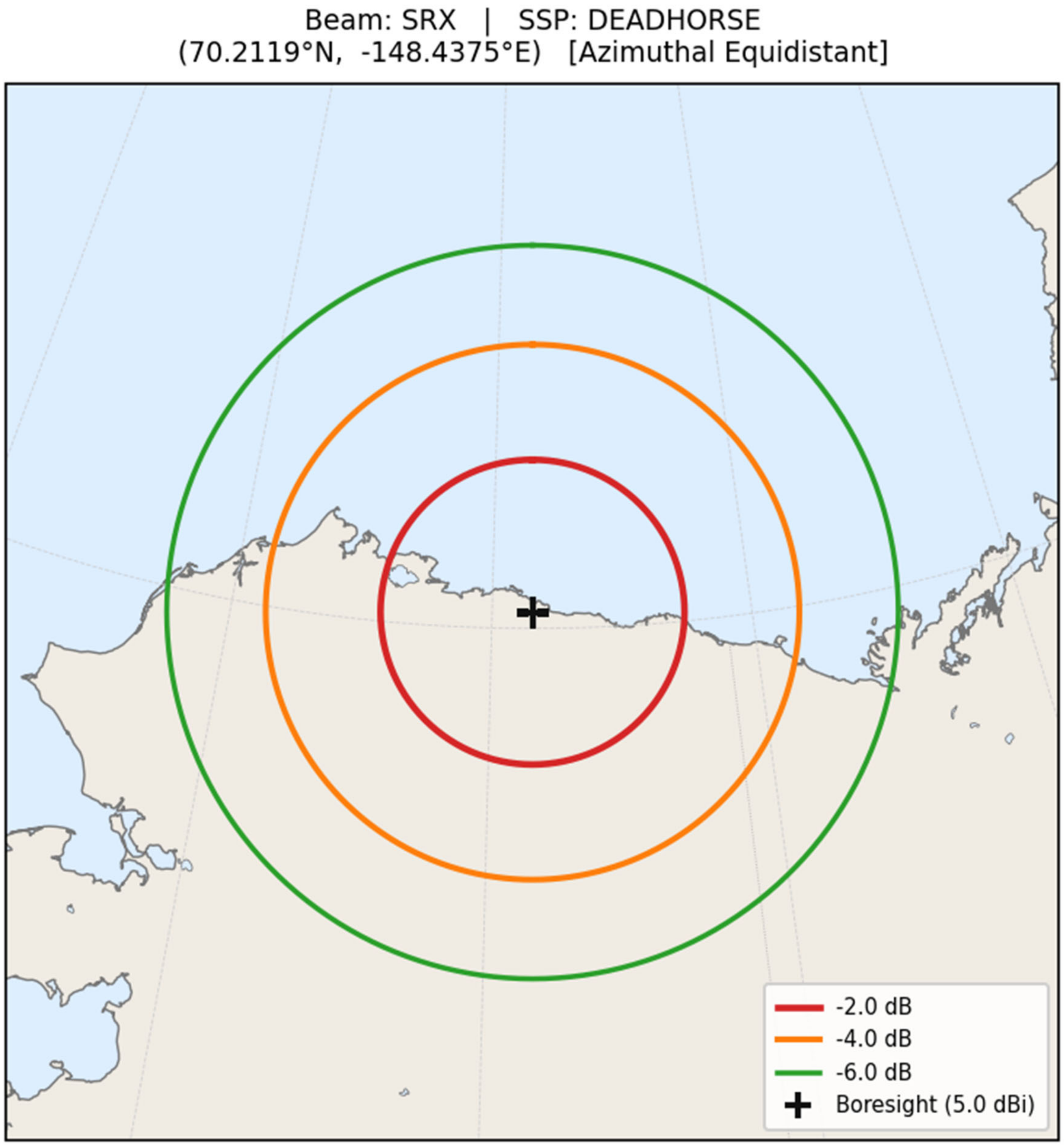

Figure 2.1 S-Band receive uplink (SRX) gain contours over Deadhorse, Alaska (350 km)

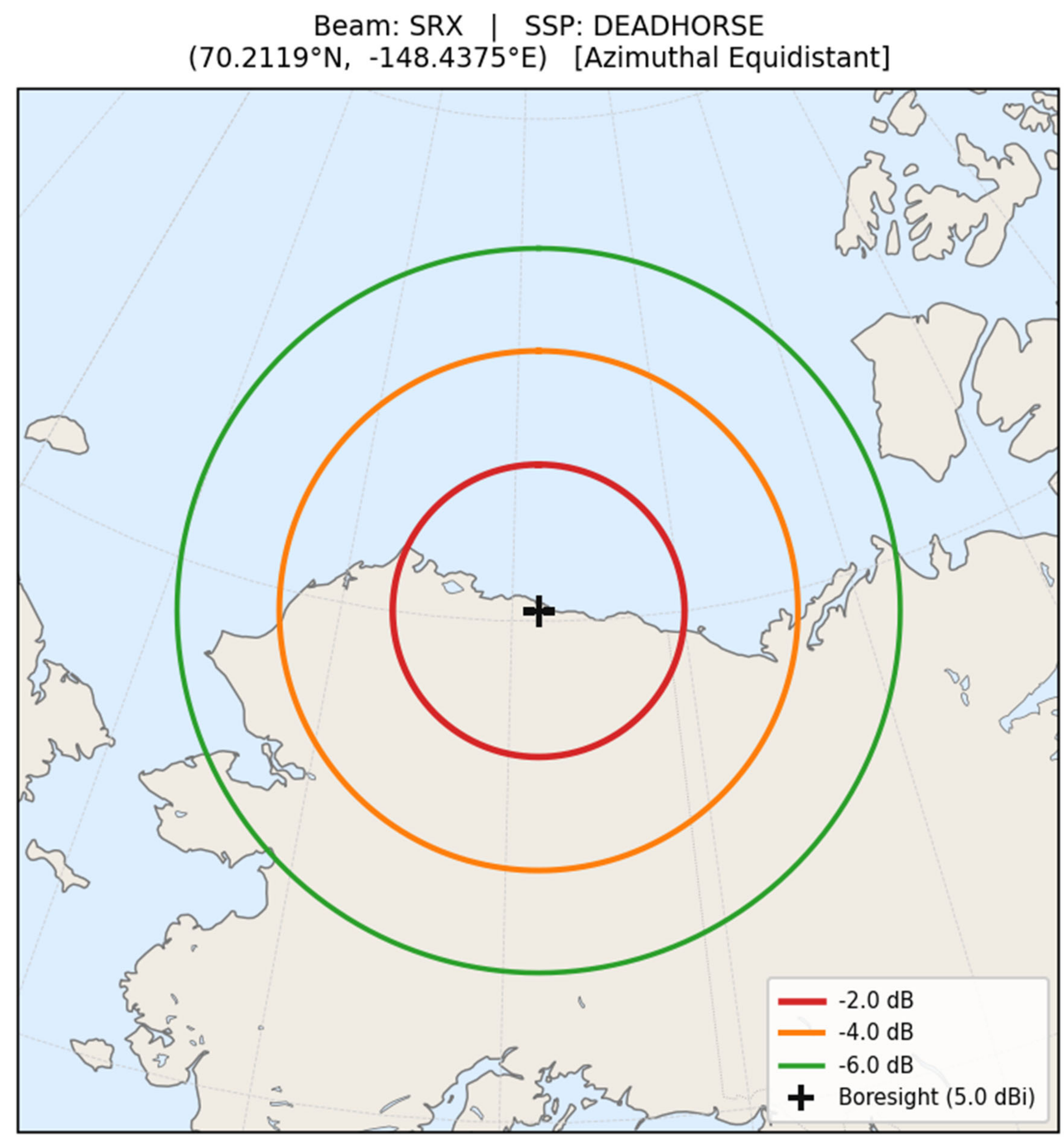

Figure 2.2 S-Band receive uplink (SRX) gain contours over Deadhorse, Alaska (510 km)

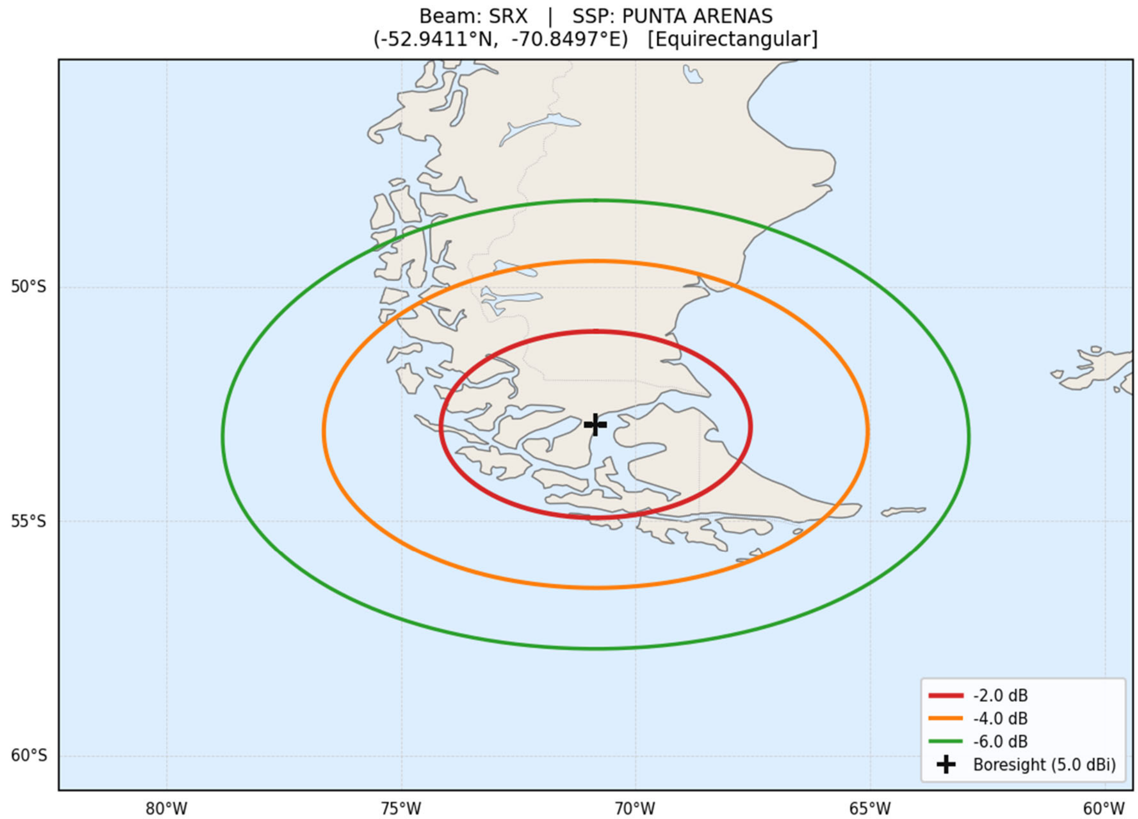

Figure 2.3 S-Band receive uplink (SRX) gain contours over Punta Arenas, Chile (350 km)

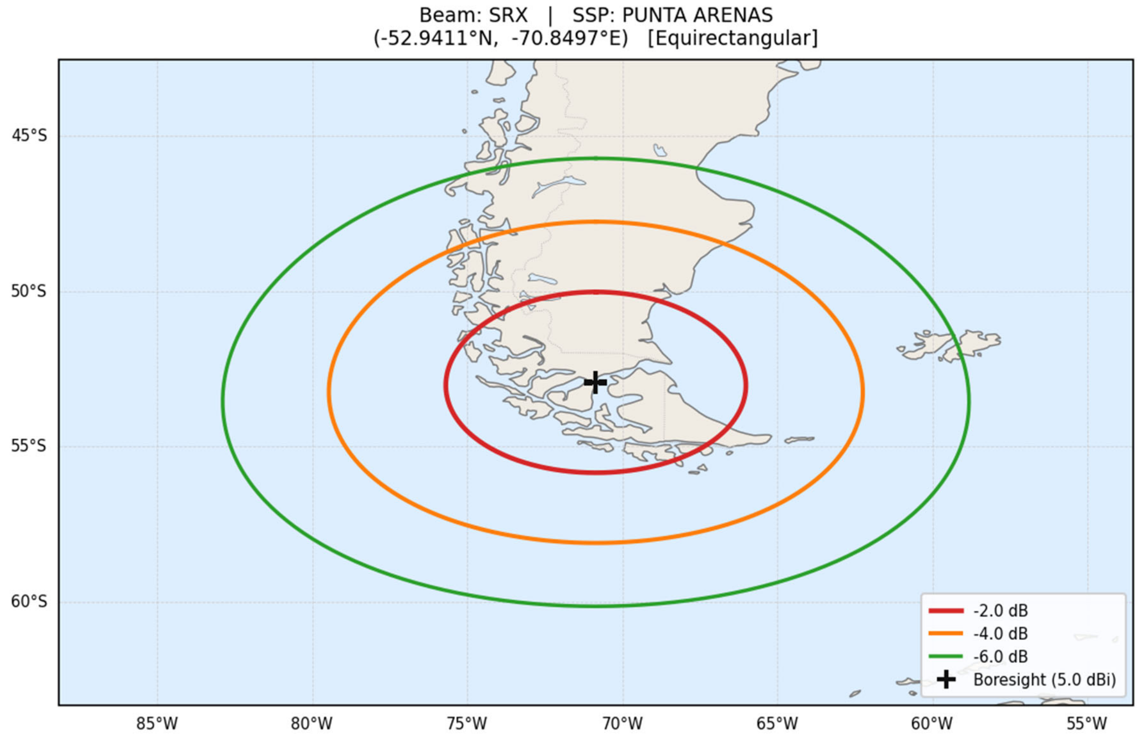

Figure 2.4 S-Band receive uplink (SRX) gain contours over Punta Arenas, Chile (510 km)

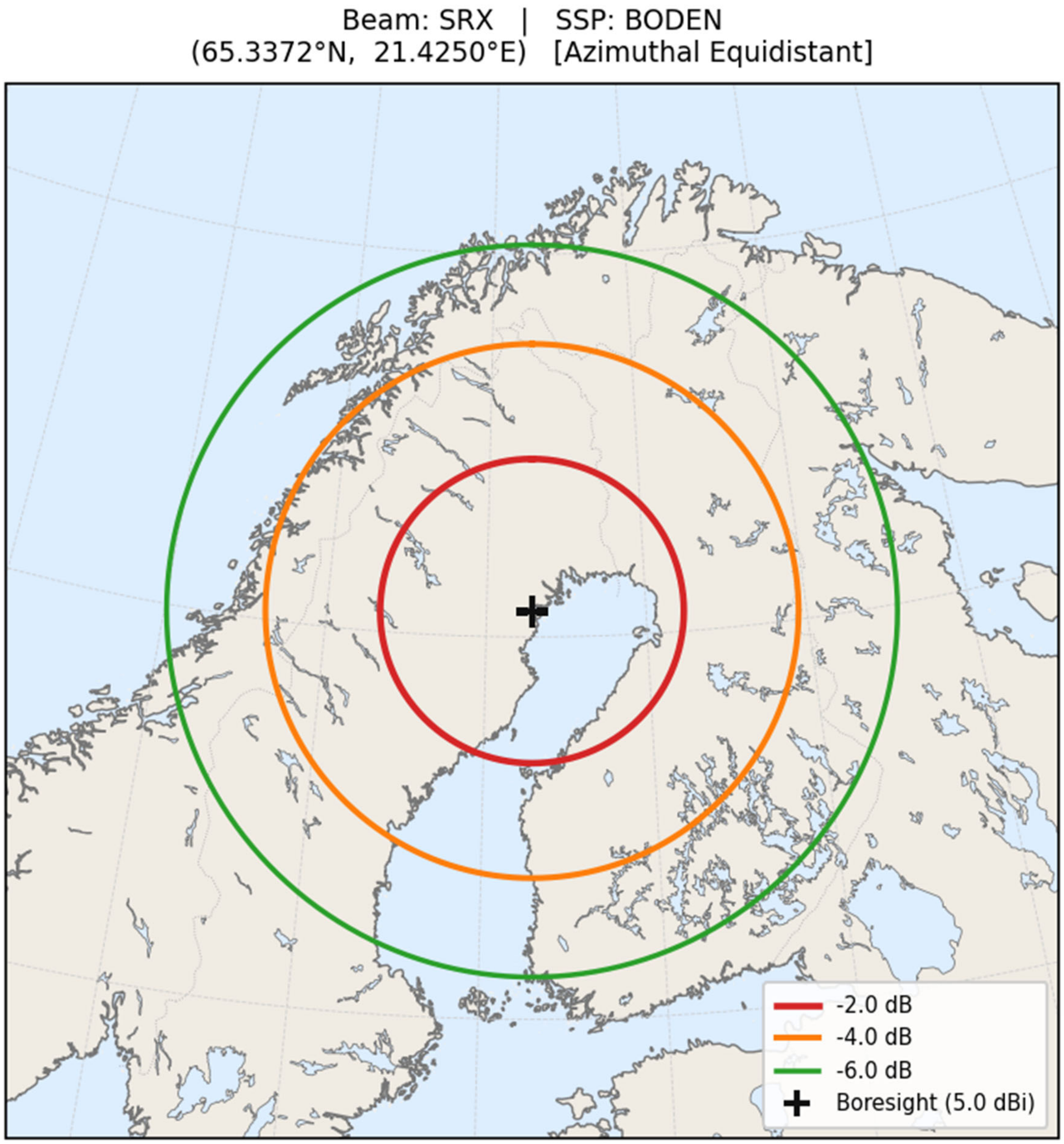

Figure 2.5 S-Band receive uplink (SRX) gain contours over Boden, Sweden (350 km)

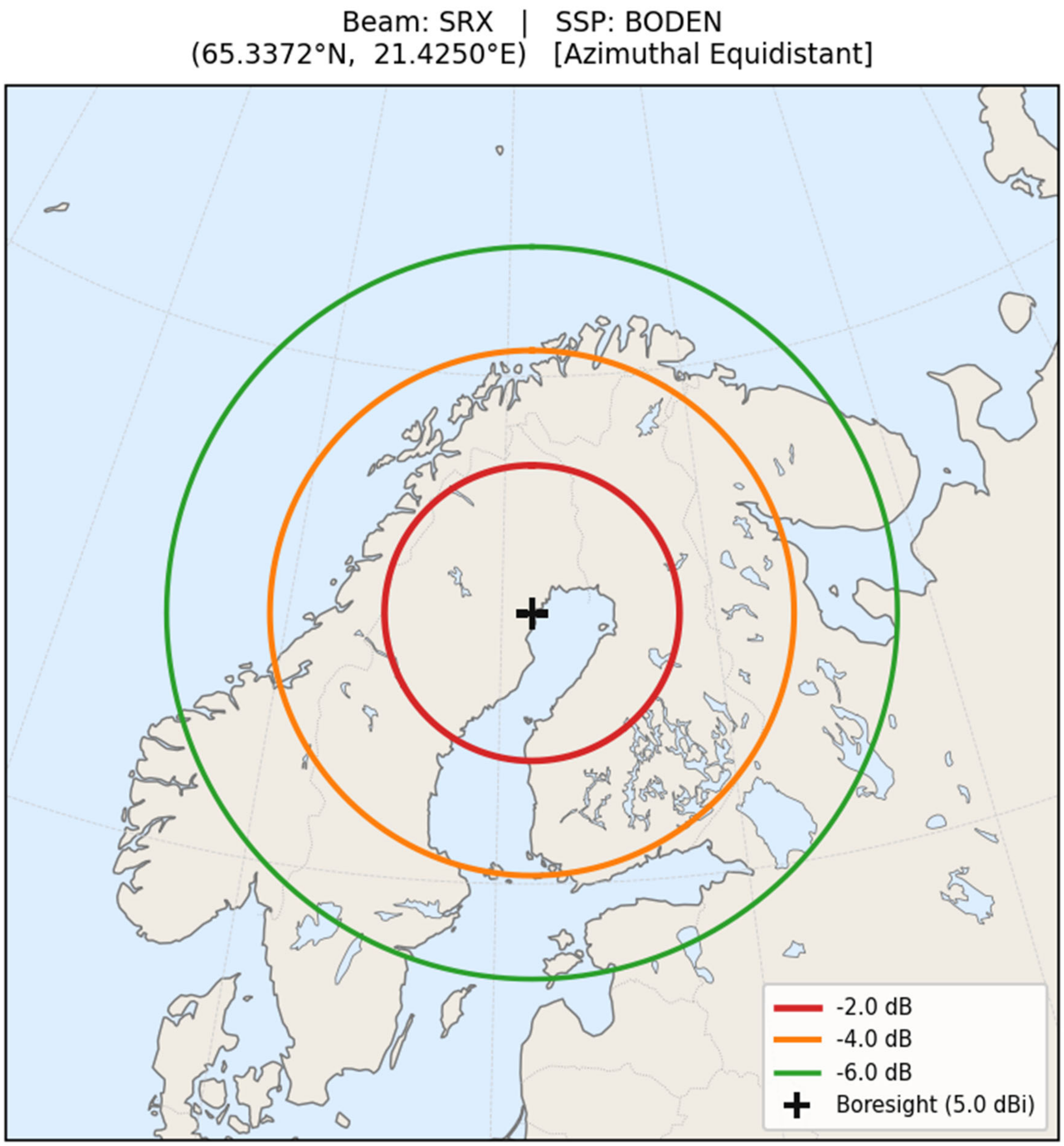

Figure 2.6 S-Band receive uplink (SRX) gain contours over Boden, Sweden (510 km)

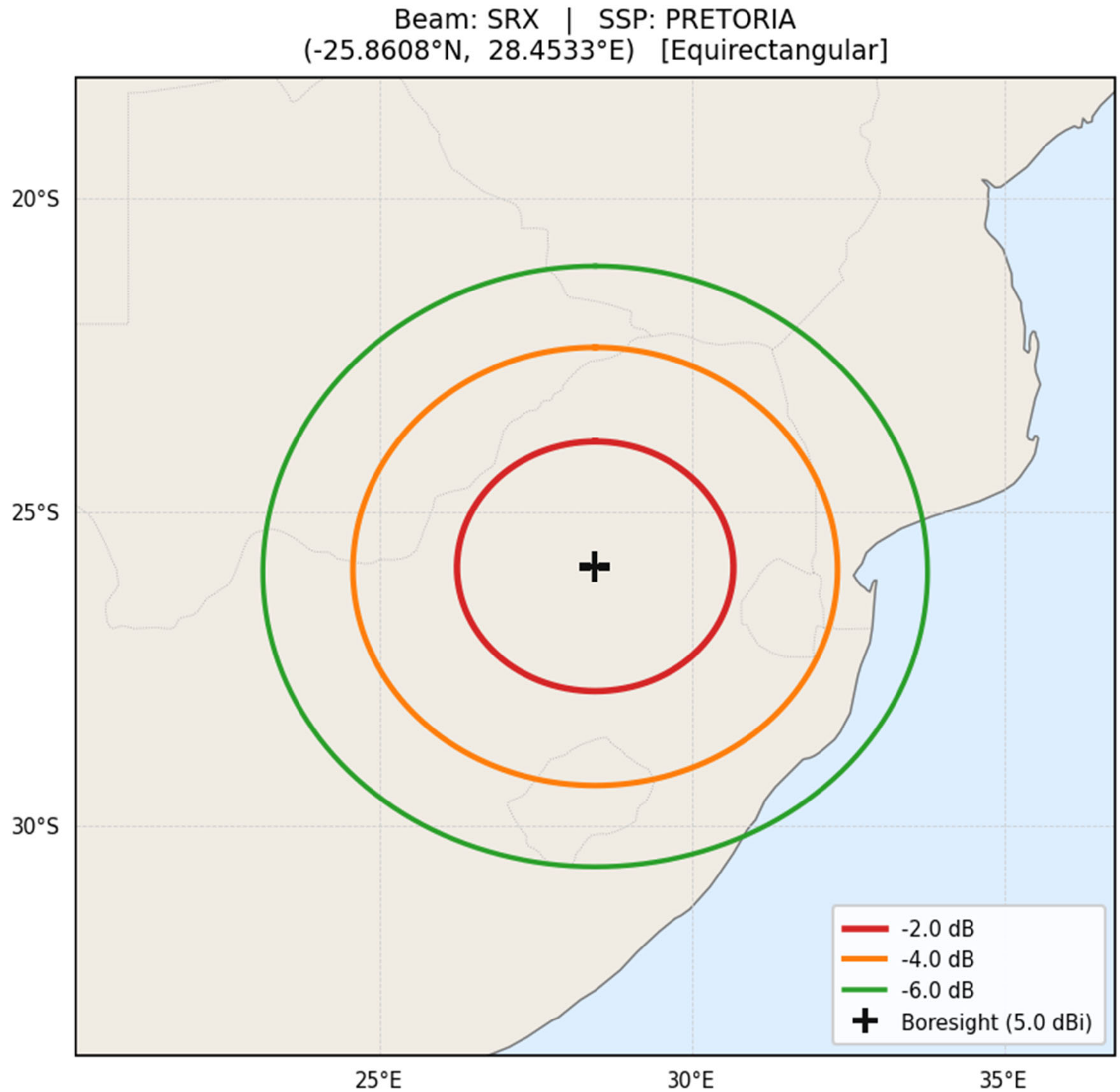

Figure 2.7 S-Band receive uplink (SRX) gain contours over Pretoria, South Africa (350 km)

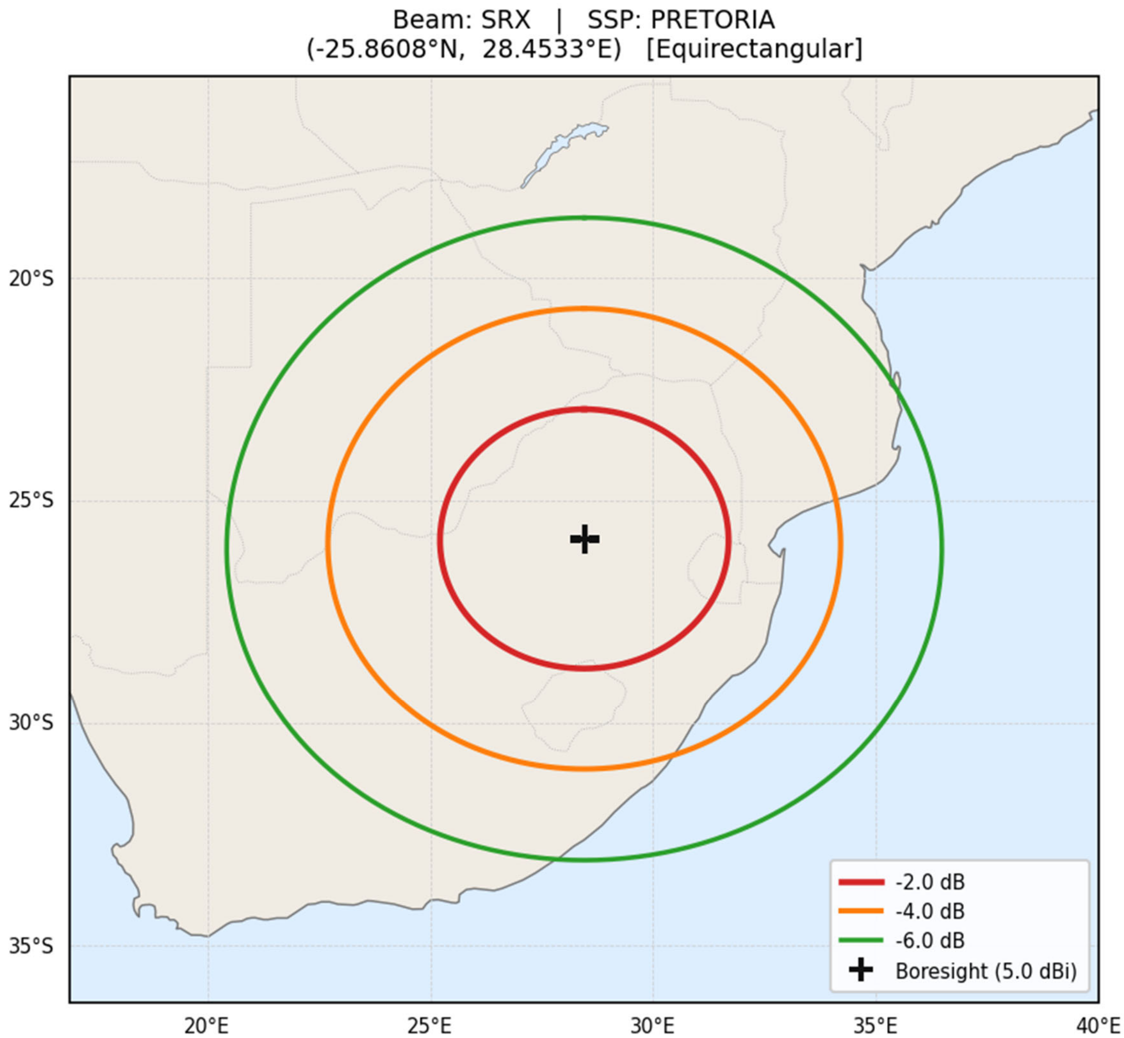

Figure 2.8 S-Band receive uplink (SRX) gain contours over Pretoria, South Africa (510 km)

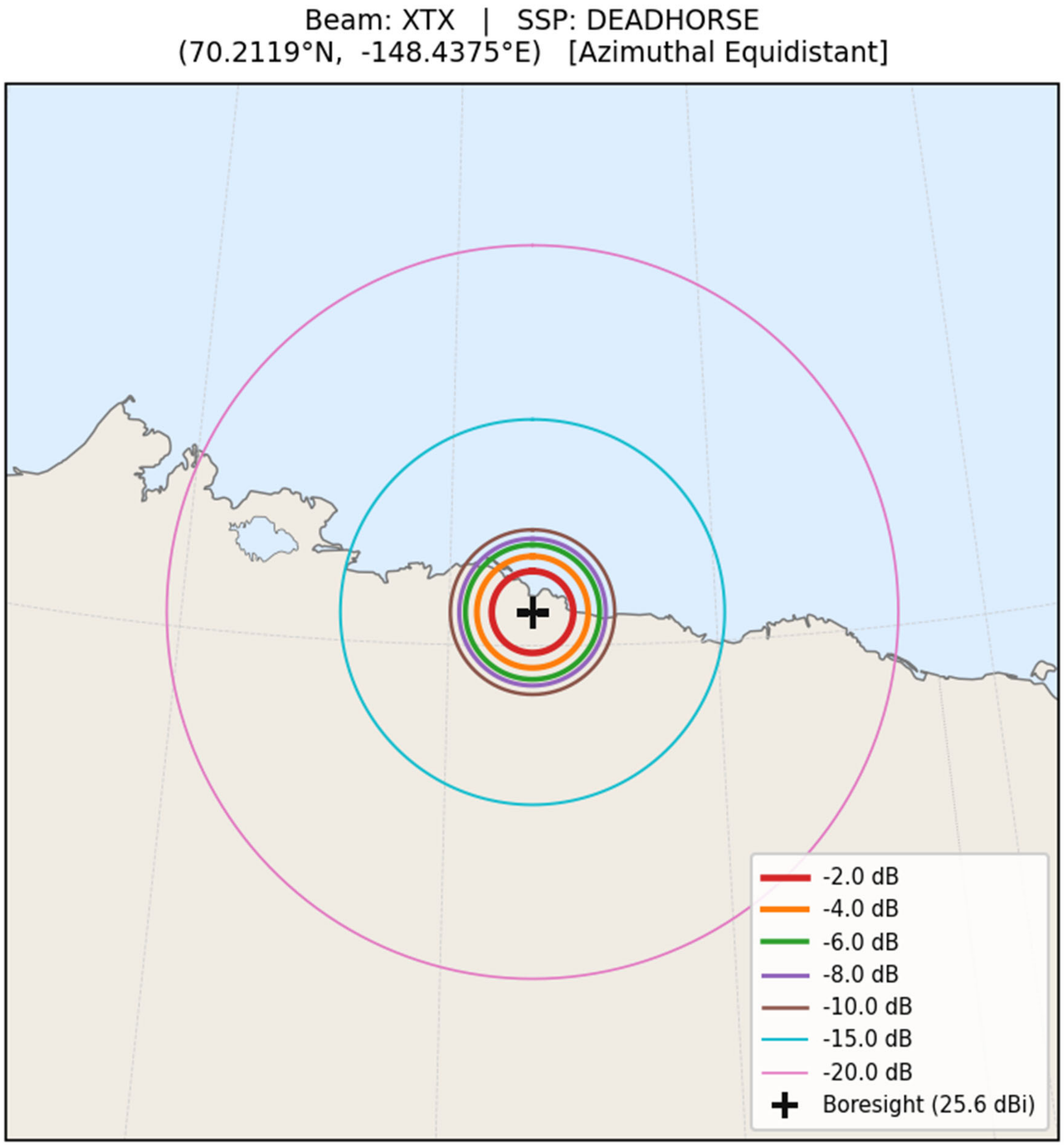

Figure 3.1 X-Band transmit downlink (XTX) gain contours over Deadhorse, Alaska (350 km)

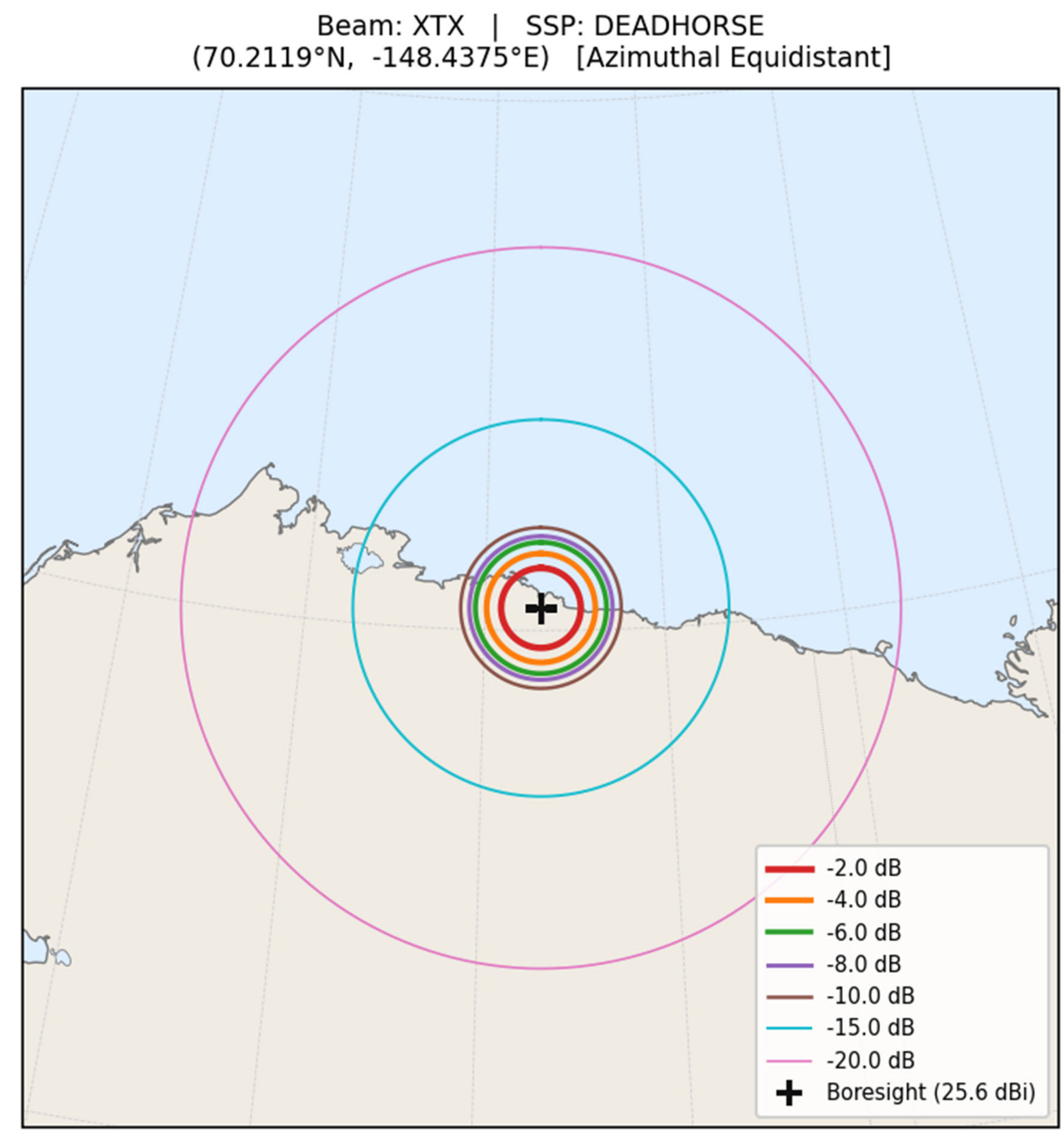

Figure 3.2 X-Band transmit downlink (XTX) gain contours over Deadhorse, Alaska (510 km)

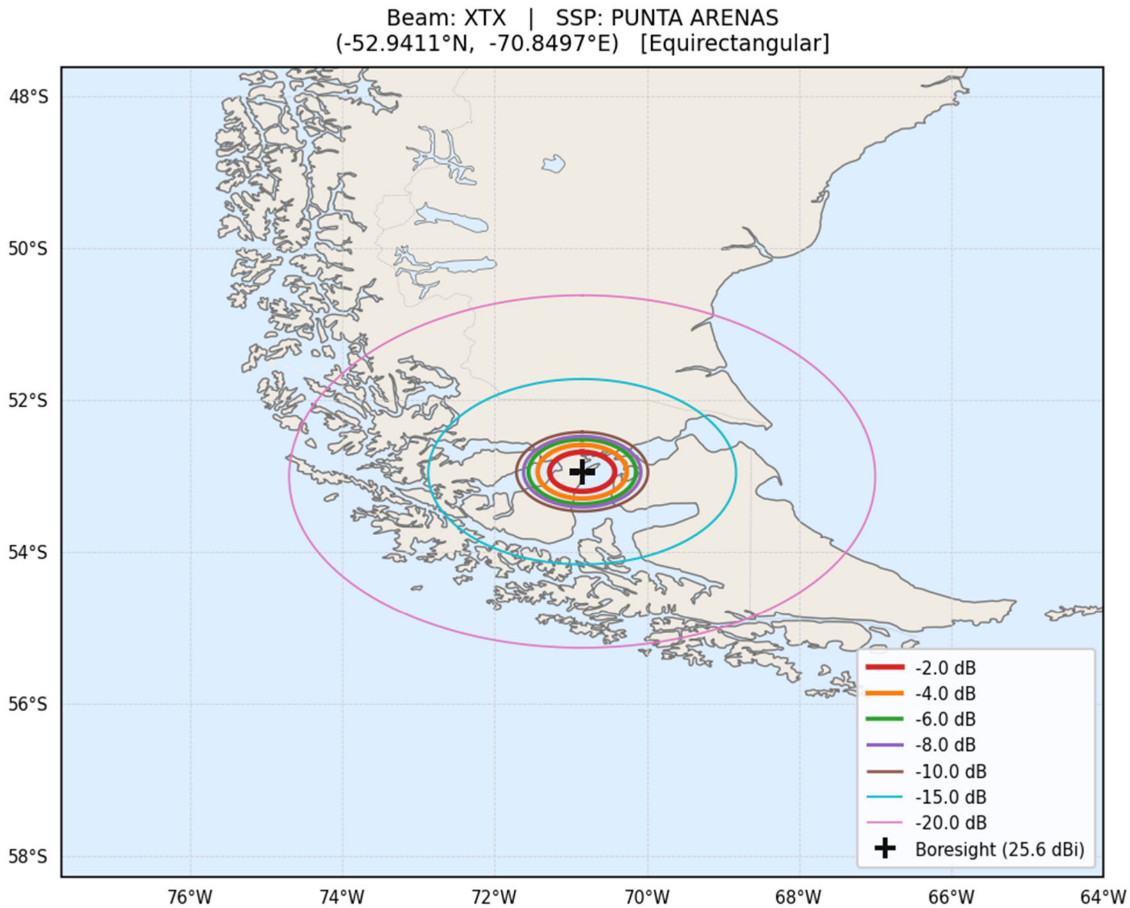

Figure 3.3 X-Band transmit downlink (XTX) gain contours over Punta Arenas, Chile (350 km)

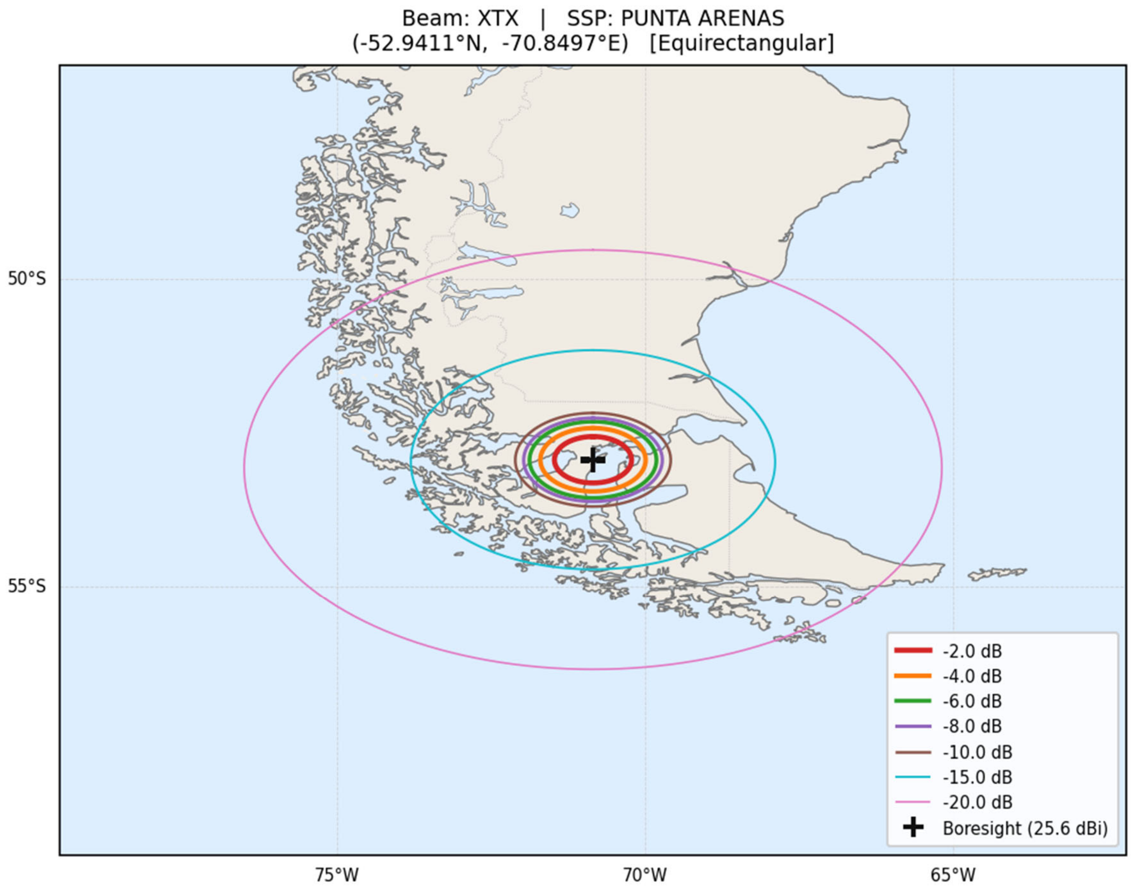

Figure 3.4 X-Band transmit downlink (XTX) gain contours over Punta Arenas, Chile (510 km)

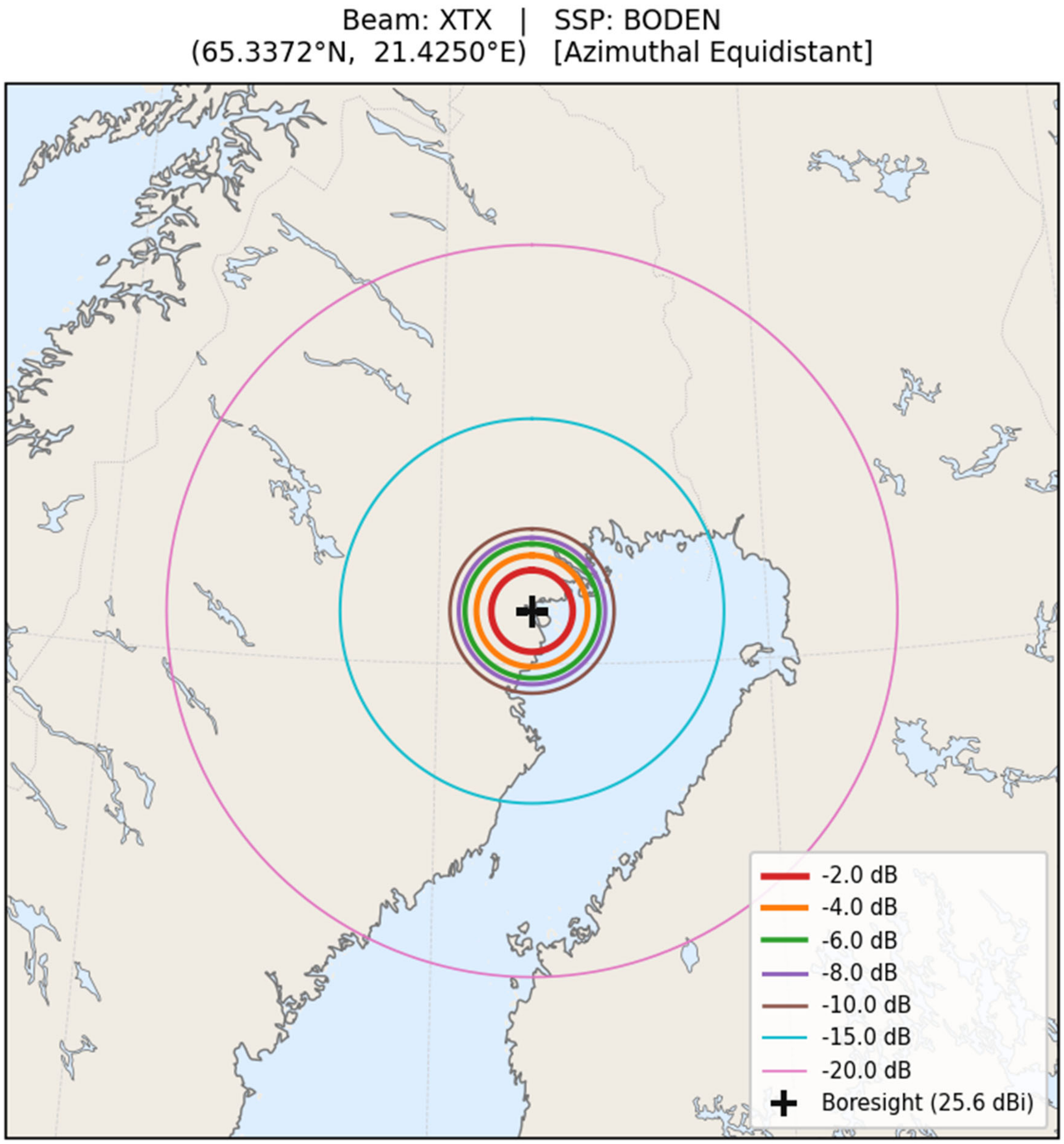

Figure 3.5 X-Band transmit downlink (XTX) gain contours over Boden, Sweden (350 km)

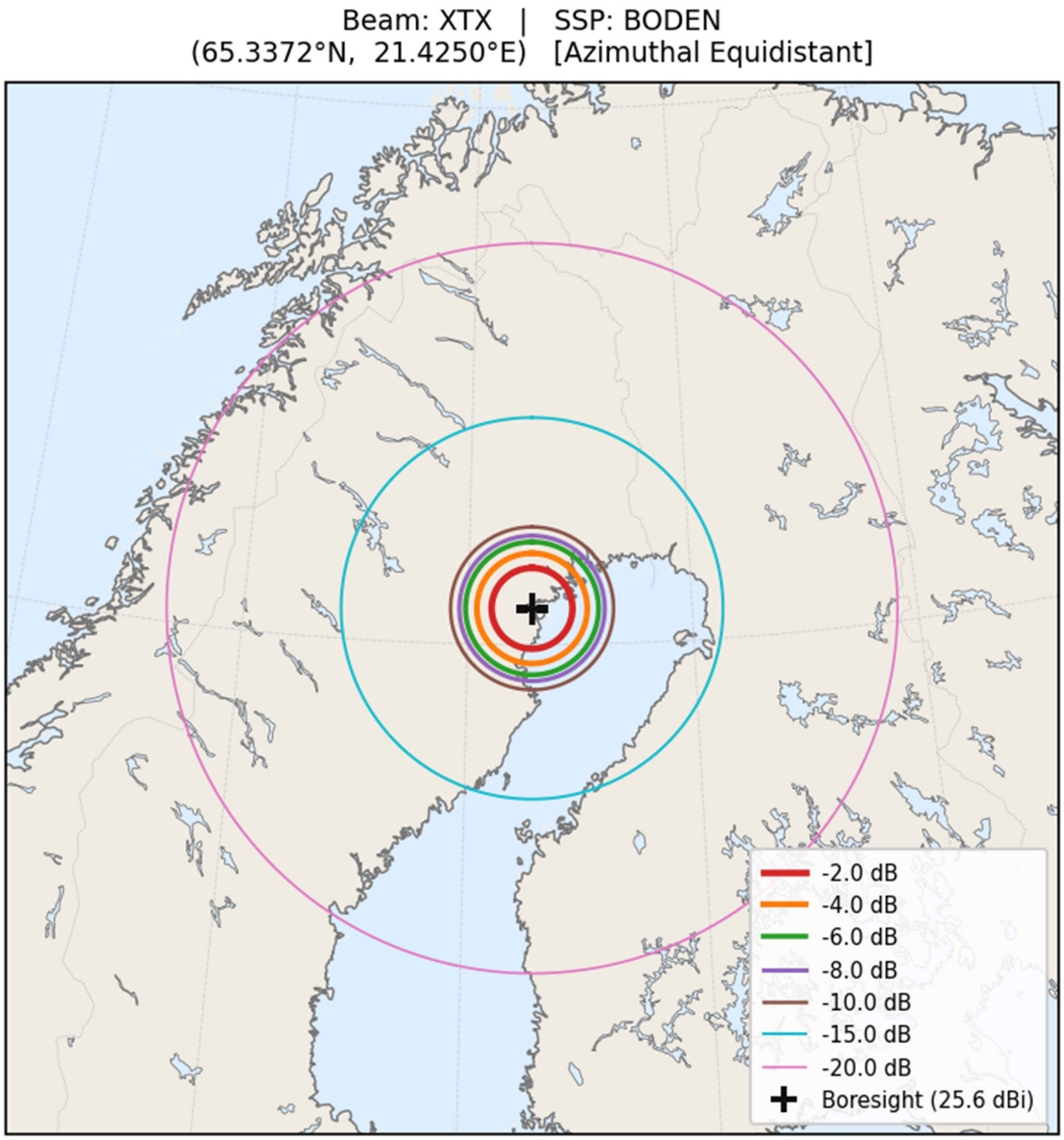

Figure 3.6 X-Band transmit downlink (XTX) gain contours over Boden, Sweden (510 km)

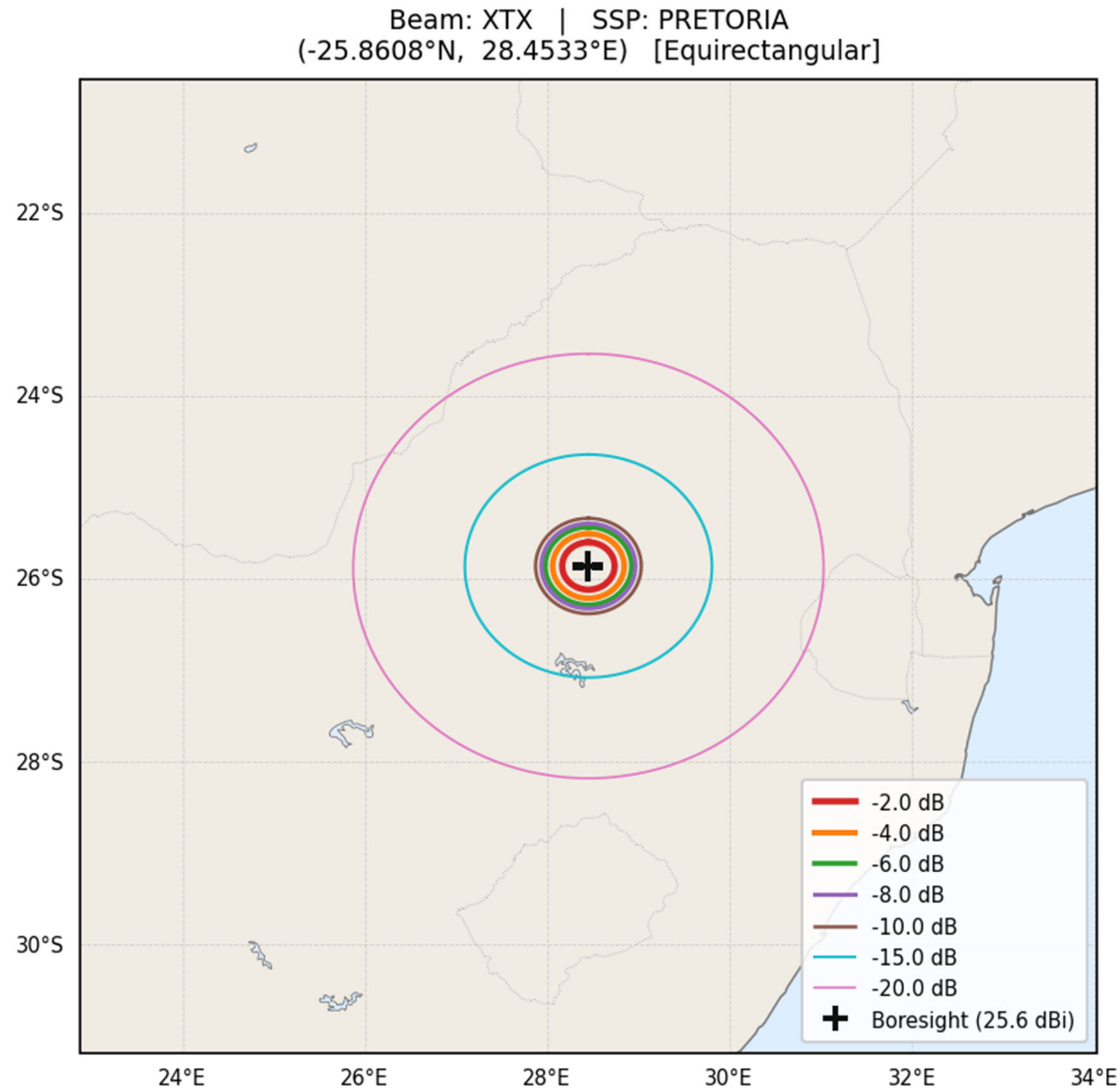

Figure 3.7 X-Band transmit downlink (XTX) gain contours over Pretoria, South Africa (350 km)

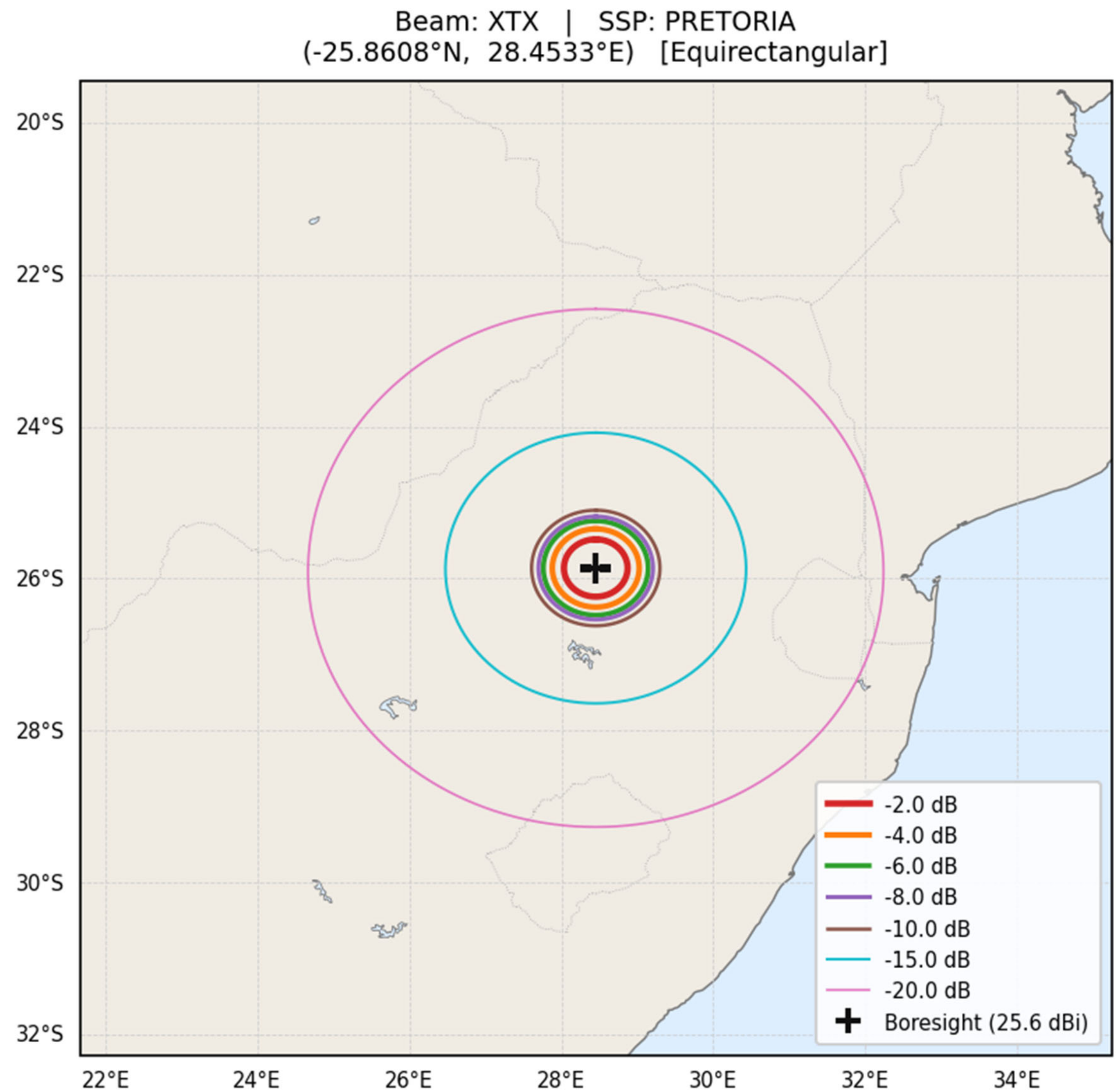

Figure 3.8 X-Band transmit downlink (XTX) gain contours over Pretoria, South Africa (510 km)

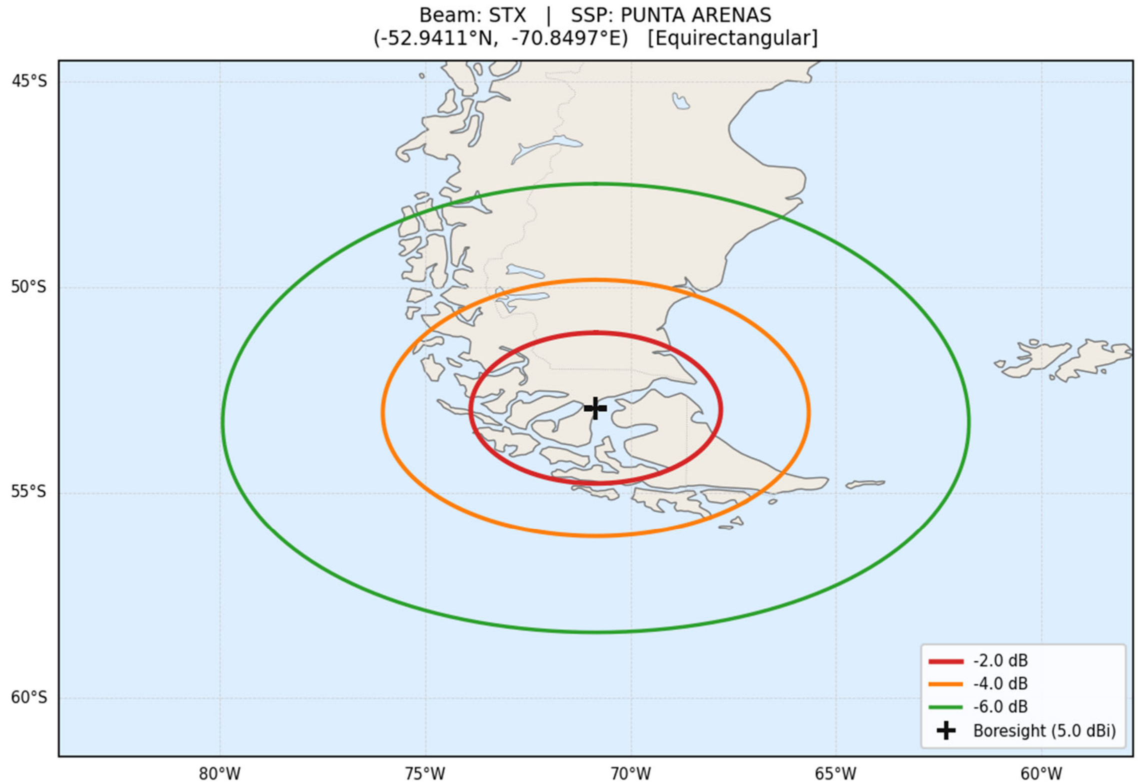

Figure 4.1 – S-band transmit downlink (STX) gain contours over Punta Arenas, Chile (350 km)

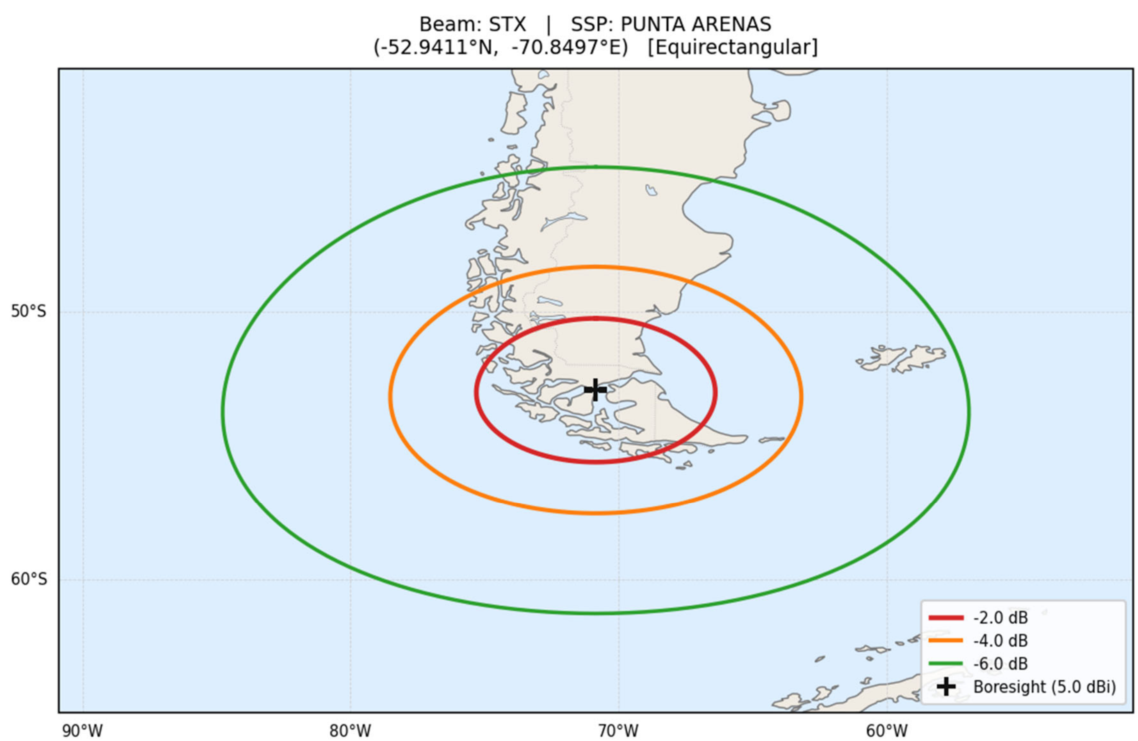

Figure 4.2 – S-band transmit downlink (STX) gain contours over Punta Arenas, Chile (510 km)

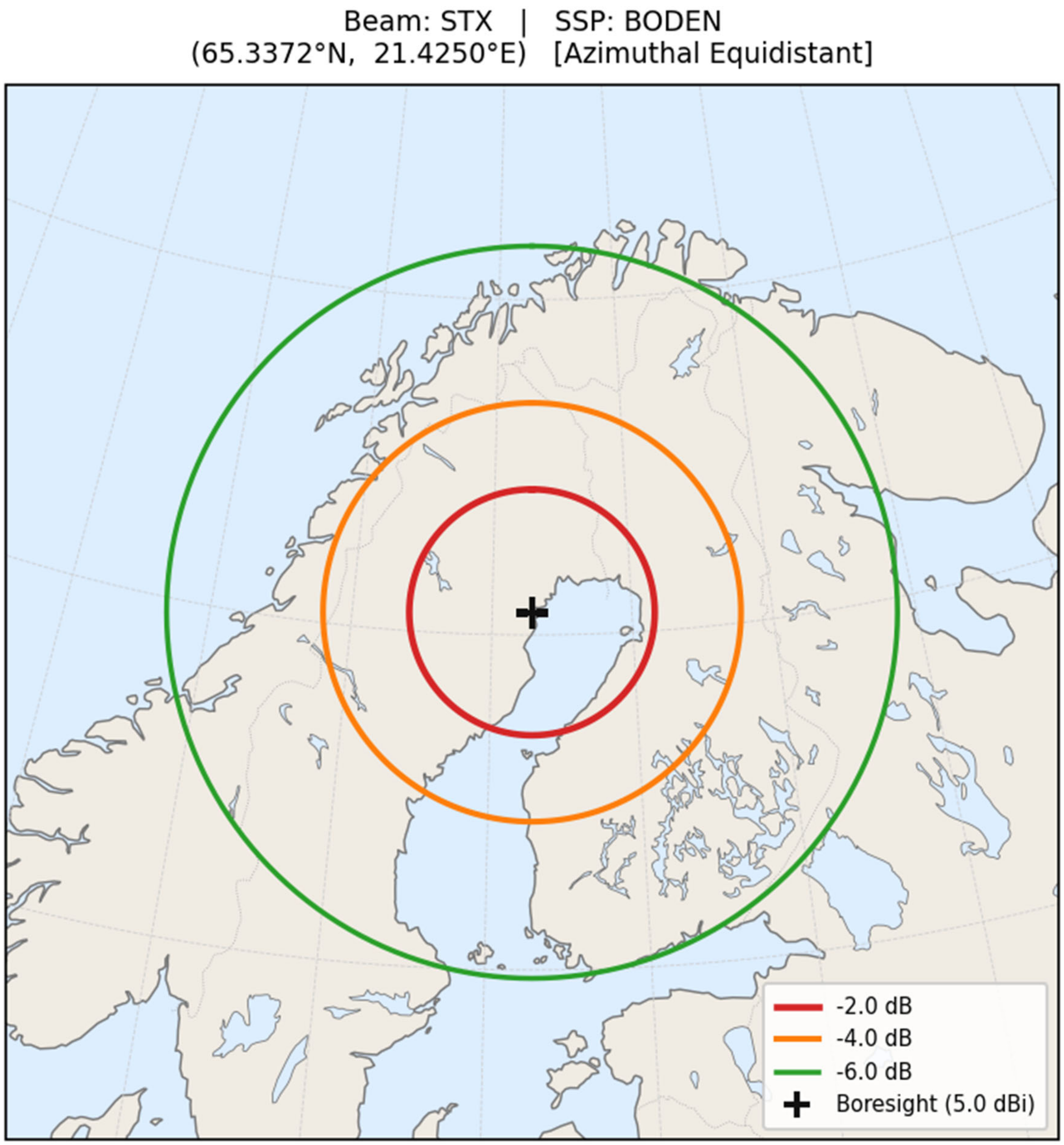

Figure 4.3 – S-band transmit downlink (STX) gain contours over Boden, Sweden (350 km)

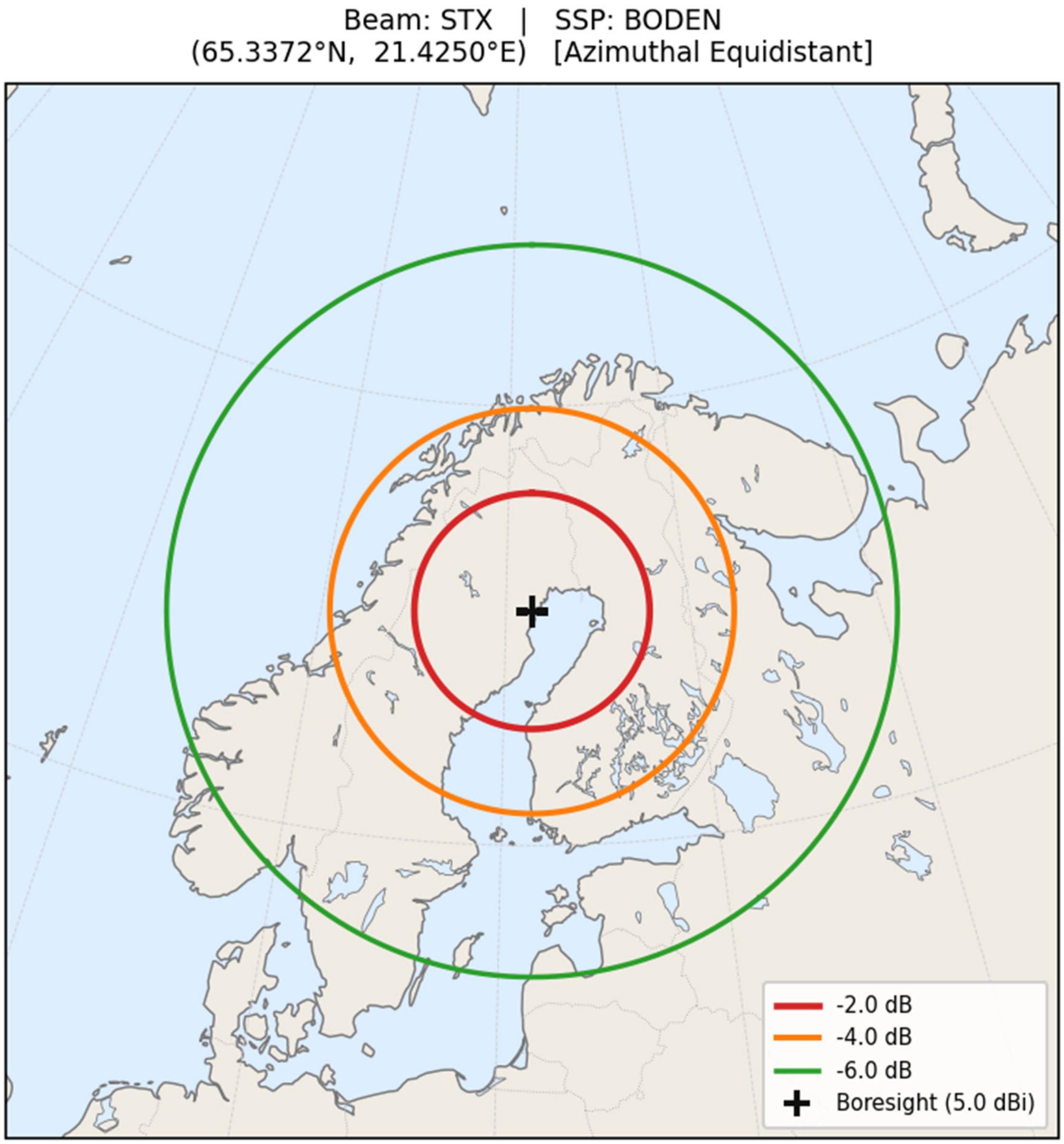

Figure 4.4 – S-band transmit downlink (STX) gain contours over Boden, Sweden (510 km)

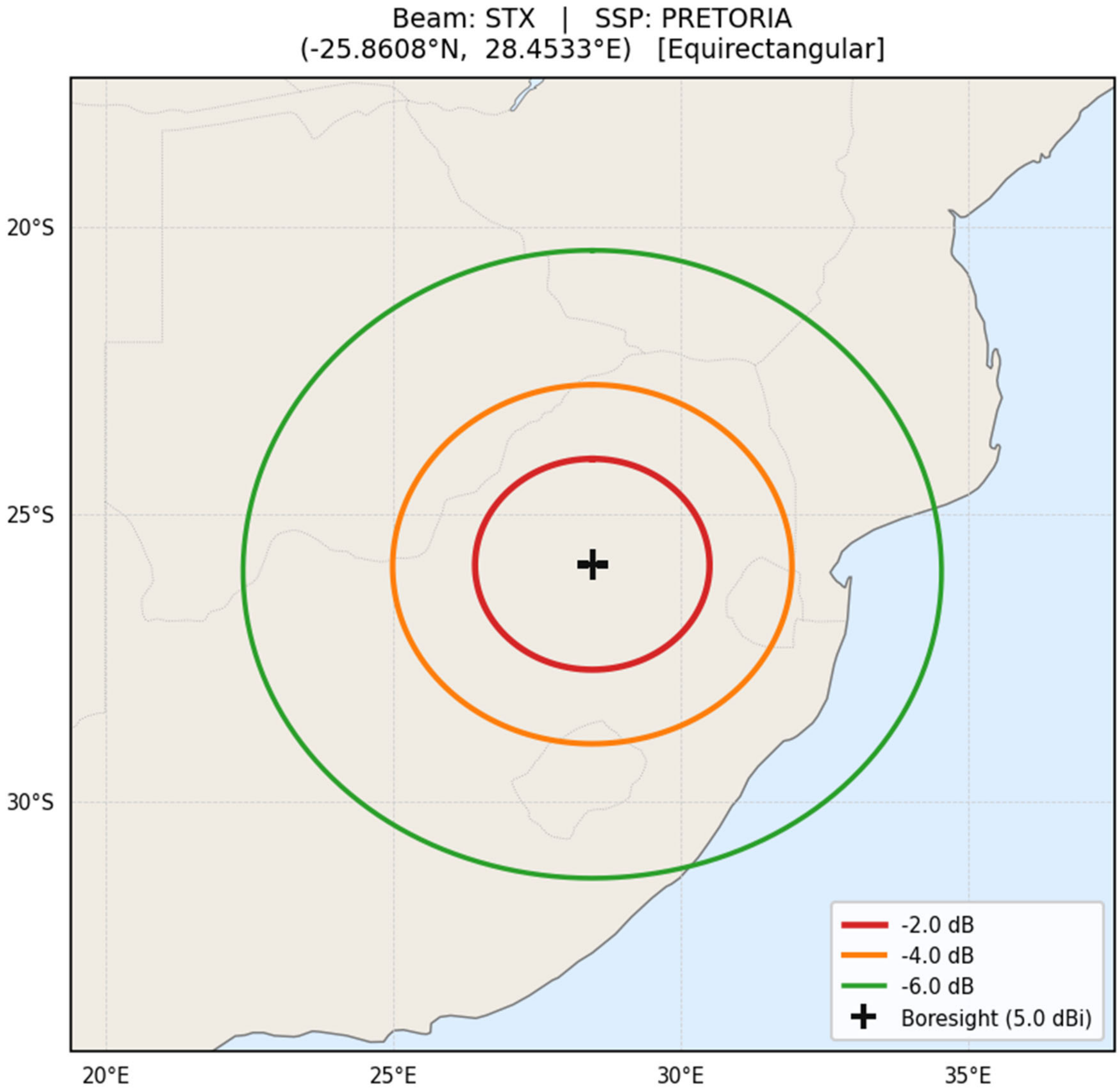

Figure 4.5 – S-band transmit downlink (STX) gain contours over Pretoria, South Africa (350 km)

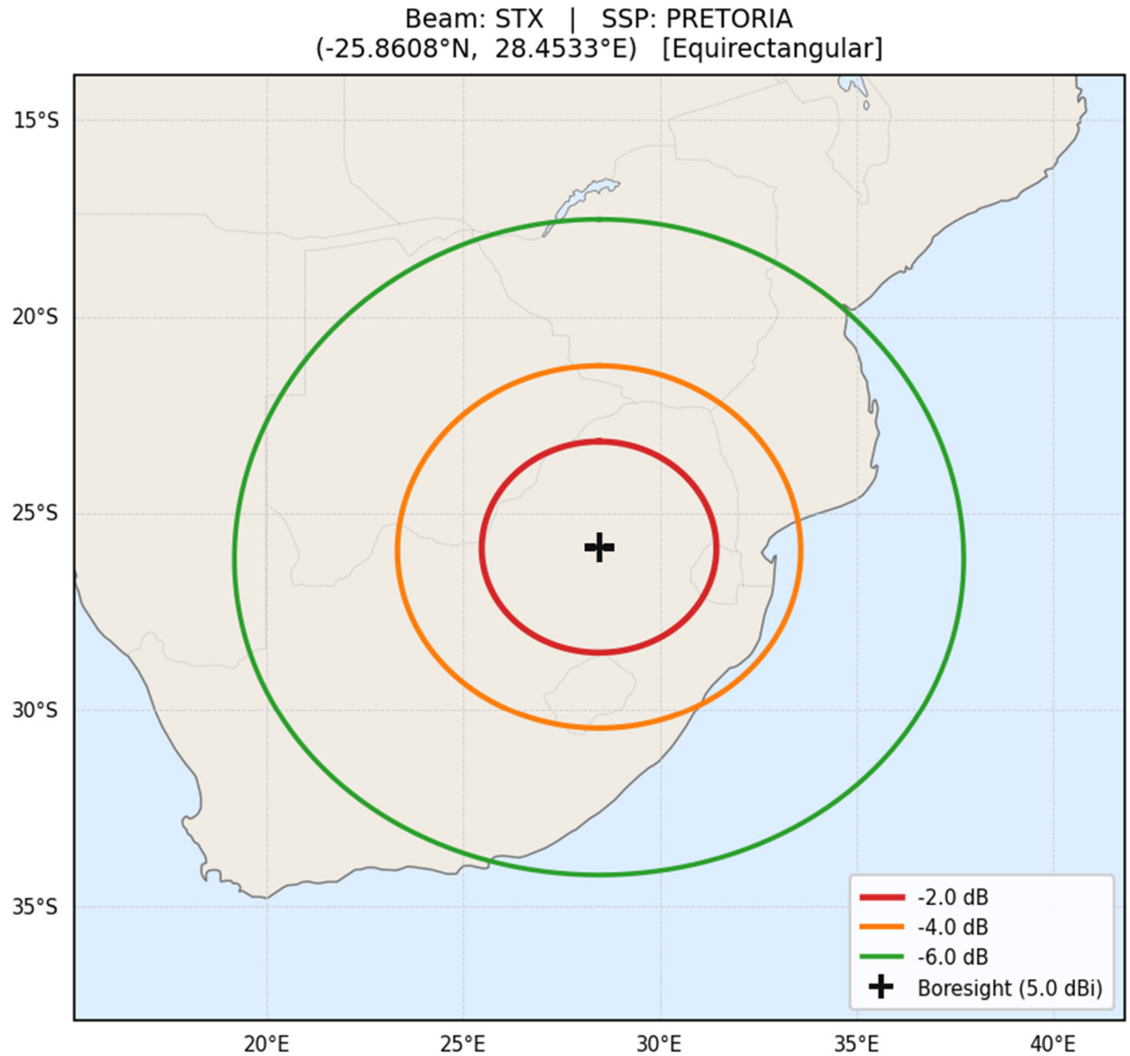

Figure 4.6 – S-band transmit downlink (STX) gain contours over Pretoria, South Africa (510 km)

Interference Showings

2200-2290 MHz

The Commission's rules do not specify a PFD limit for the 2200-2290 MHz band. However, rule No. 21.16 of the International Telecommunication Union (ITU) Radio Regulations does. Aethero has calculated the maximum PFD levels for transmissions from Phobos in accordance with these ITU PFD limits.

Figure 4 below represents the maximum transmitted EIRP at the nominal altitude of 500 km. Figure 5 below represents the maximum transmitted EIRP at the worst-case altitude of 350 km.

Frequency	**2230 GHz**				
P_transmitter [dBm]	29	Elevation angle [deg]	Distance [km]	PFD	limit Art. 21
P_transmitter [W]	0.7943282	1	2490.9	-157.8780343	-154
P_transmitter [dBW]	-1	2	2386.9	-157.5074433	-154
Channel Total Losses [dB]	7	3	2287.6	-157.1384183	-154
P_ant [dBW]	-8.00	4	2193.0	-156.7717101	-154
Antenna Gain [dBi]	7.0	5	2103.1	-156.4080327	-154
Bandwidth [MHz]	0.250	6	2017.7	-156.0480537	-153.5
Bandwidth_ref [kHz]	4	7	1936.8	-155.6923862	-153
Orbit [km]	510	8	1860.1	-155.3415834	-152.5
		9	1787.6	-154.9961353	-152
		10	1719.0	-154.6564669	-151.5
		11	1654.3	-154.3229385	-151
		12	1593.1	-153.9958481	-150.5
		13	1535.4	-153.6754338	-150
		14	1481.0	-153.3618783	-149.5
		15	1429.6	-153.0553136	-149
		16	1381.2	-152.7558255	-148.5
		17	1335.5	-152.4634591	-148
		18	1292.3	-152.1782239	-147.5
		19	1251.6	-151.9000985	-147
		20	1213.1	-151.6290351	-146.5
		21	1176.8	-151.3649639	-146
		22	1142.5	-151.107797	-145.5
		23	1110.0	-150.8574317	-145
		24	1079.3	-150.6137533	-144.5
		25	1050.2	-150.3766385	-144
		26	1022.7	-150.145957	-144
		27	996.6	-149.9215738	-144
		28	971.9	-149.7033509	-144

Figure 4 S-band PFD from 510 km Orbit Altitude with EIRP of -1 dBW over a Bandwidth of 250 kHz

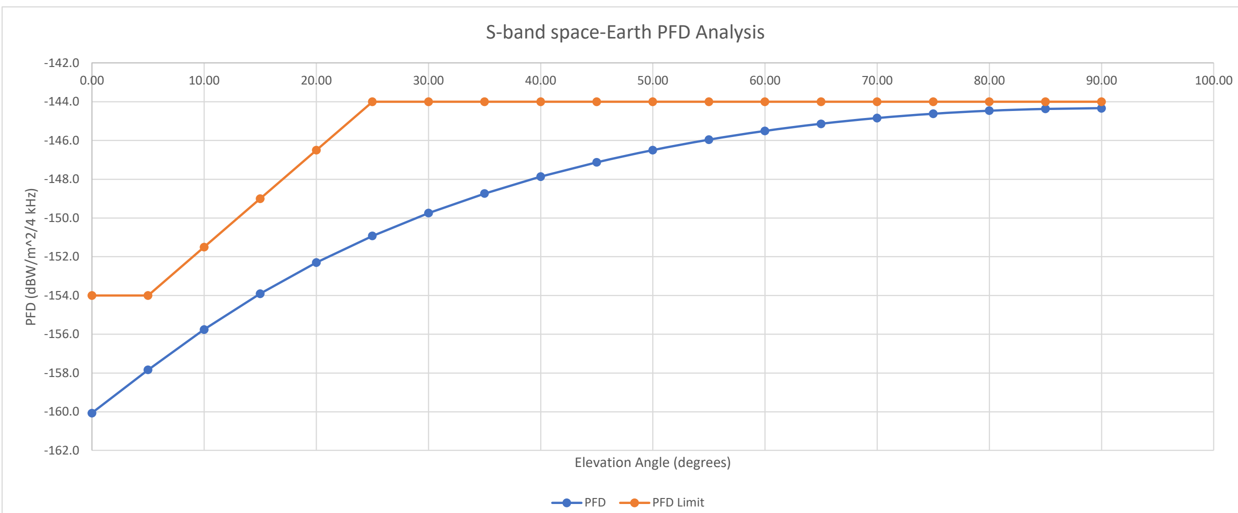

Figure 5 S-band PFD from 479 km Orbit Altitude with EIRP of -4.5 dBW over a Bandwidth of 250 kHz

(Aethero will only operate this carrier down to 479 km)

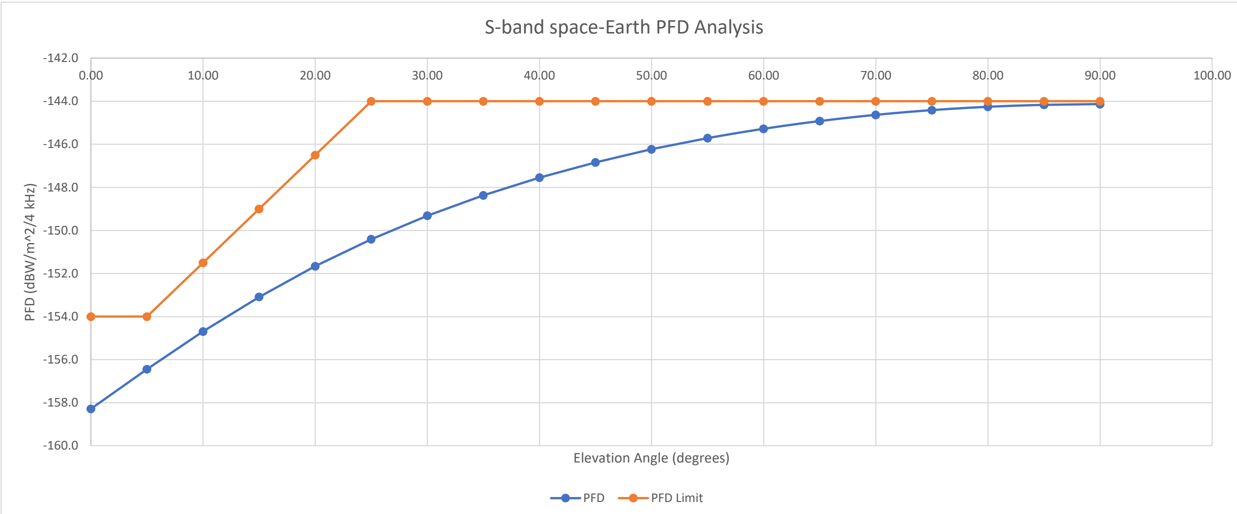

Figure 6 S-band PFD from 510 km Orbit Altitude with EIRP of 8 dBW over a Bandwidth of 2 MHz

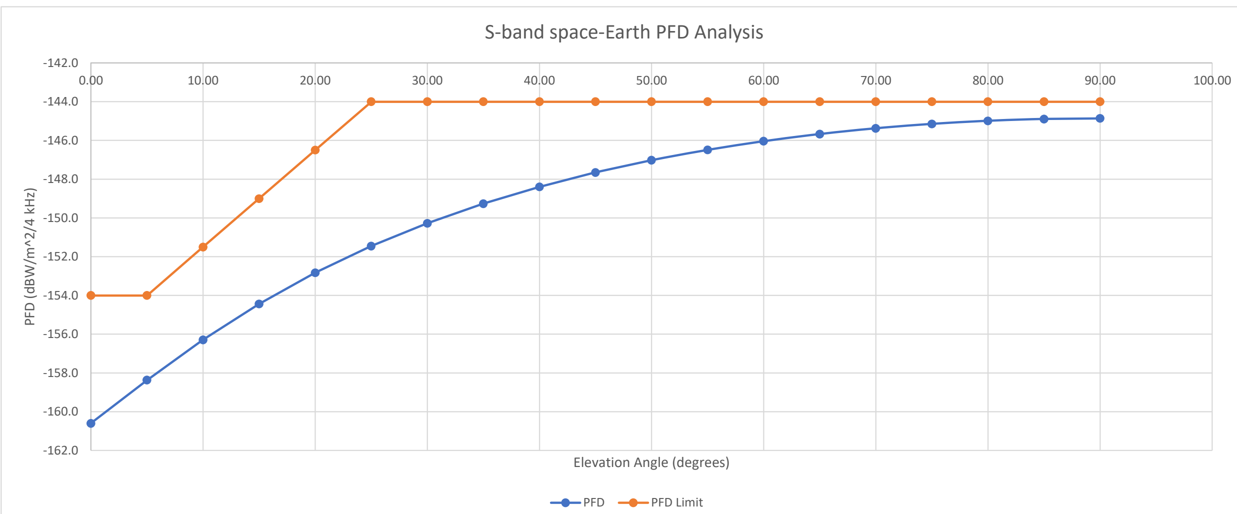

Figure 7 S-band PFD from 350 km Orbit Altitude with EIRP of 4 dBW over a Bandwidth of 2MHz

Phobos will have the ability to reduce the power and power density of its downlink transmissions as it descends in altitude. Aethero will actively manage and reduce power as needed to ensure compliance with applicable PFD limits.

8025-8400 MHz

The Commission's rules do not specify a PFD limit for the 8025-8400 MHz band. However, rule No. 21.16 of the International Telecommunication Union (ITU) Radio Regulations does. Aethero has calculated the maximum PFD levels for transmissions from Titan in accordance with these ITU PFD limits. Aethero's operations will also be consistent with the ITU Recommendation SA.1157-1 in order to protect adjacent band deep-space research operations.

Figures 5-8 below represents the maximum transmitted EIRP at both the nominal orbit altitude of 510km and the worst-case altitude of 350 km, for the X-band downlinks.

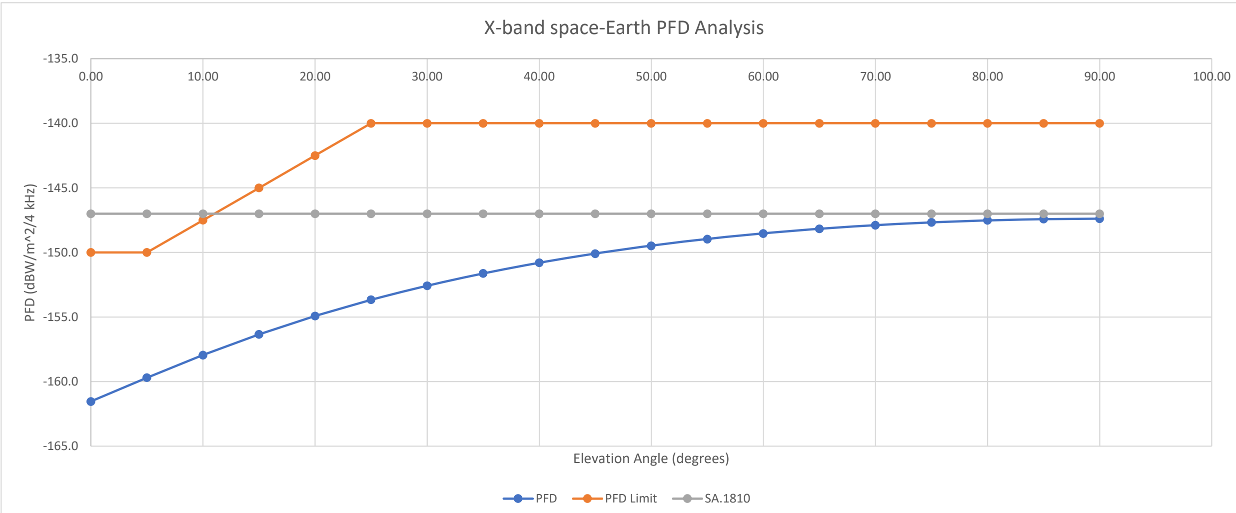

Figure 8 X-band PFD from 510 km Orbit Altitude with EIRP of 22.6 dBW over a Bandwidth of 170 MHz

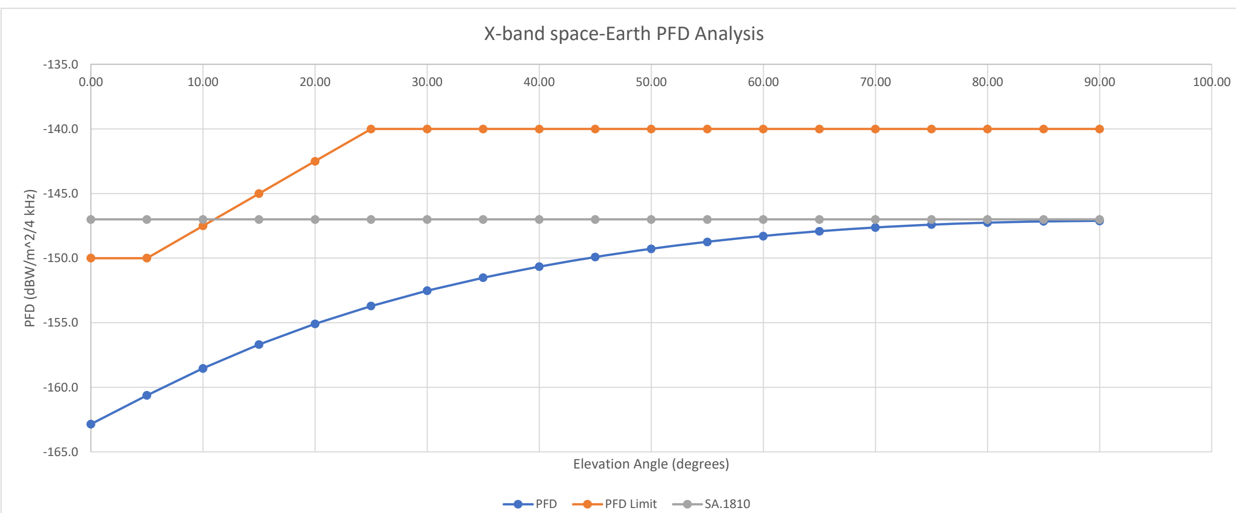

Figure 9 X-band PFD from 350 km Orbit Altitude with EIRP of 19.6 dBW over a Bandwidth of 170 MHz

Titan will have the ability to reduce the power and power density of its downlink transmissions as it descends in altitude. Aethero will actively manage and reduce power as needed to ensure compliance with applicable PFD limits.

NOAA Authorization

Aethero will submit a NOAA application for its Titan satellite. Aethero will provide the Commission with confirmation that it has received its NOAA license once it has been granted or if it is determined that a NOAA license is not required for the Titan mission.

Orbital Debris Mitigation

Aethero has designed the Titan satellite to comply with the Commission's orbital debris regulations and affirms that all operations will comply with 47 C.F.R. 5.64 of the Commission's Rules. Below, Aethero provides an overview of how Titan will meet the Commission's orbital debris rules, including the provision of an Orbital Debris Assessment Report that demonstrates that Aethero's satellite will not exceed any of the limits set forth by the Commission rules.

Aethero affirms that Titan will be identifiable by a unique signal-based telemetry marker, distinguishing it from other space stations, and that its tracking will be passive. Aethero will register with, the 18th Space Defense Squadron ("18th SDS") and will share information regarding initial deployment, ephemeris, and/or planned maneuvers. In the event of a conjunction event, Aethero will take all necessary precautions to mitigate a potential collision including providing ephemeris data and undertaking avoidance maneuvers.

Orbital Debris Assessment Report

Aethero has provided an Orbital Debris Assessment Report (ODAR) with this application and has also included debris mitigation strategies related to debris release, small debris, accidental explosions, collision risks with large objects, trackability, planned proximity operations and its post-mission disposal plans.