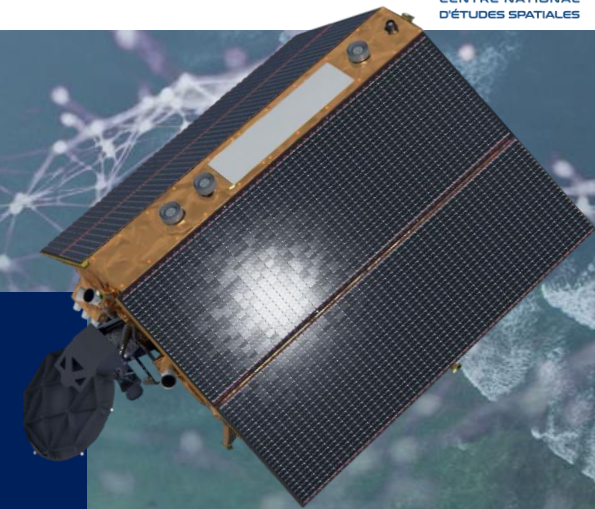


New DORIS-VLBI interference measurements at the Geodetic Observatory Wettzell

Thomas Klügel

Federal Agency for Cartography and Geodesy
Geodetic Observatory Wettzell, Germany

*Co-authors: Daniel Amberger, Christian Plötz (BKG, Germany)
Florian Kroner, Simon Seidl (TUM, Germany)*



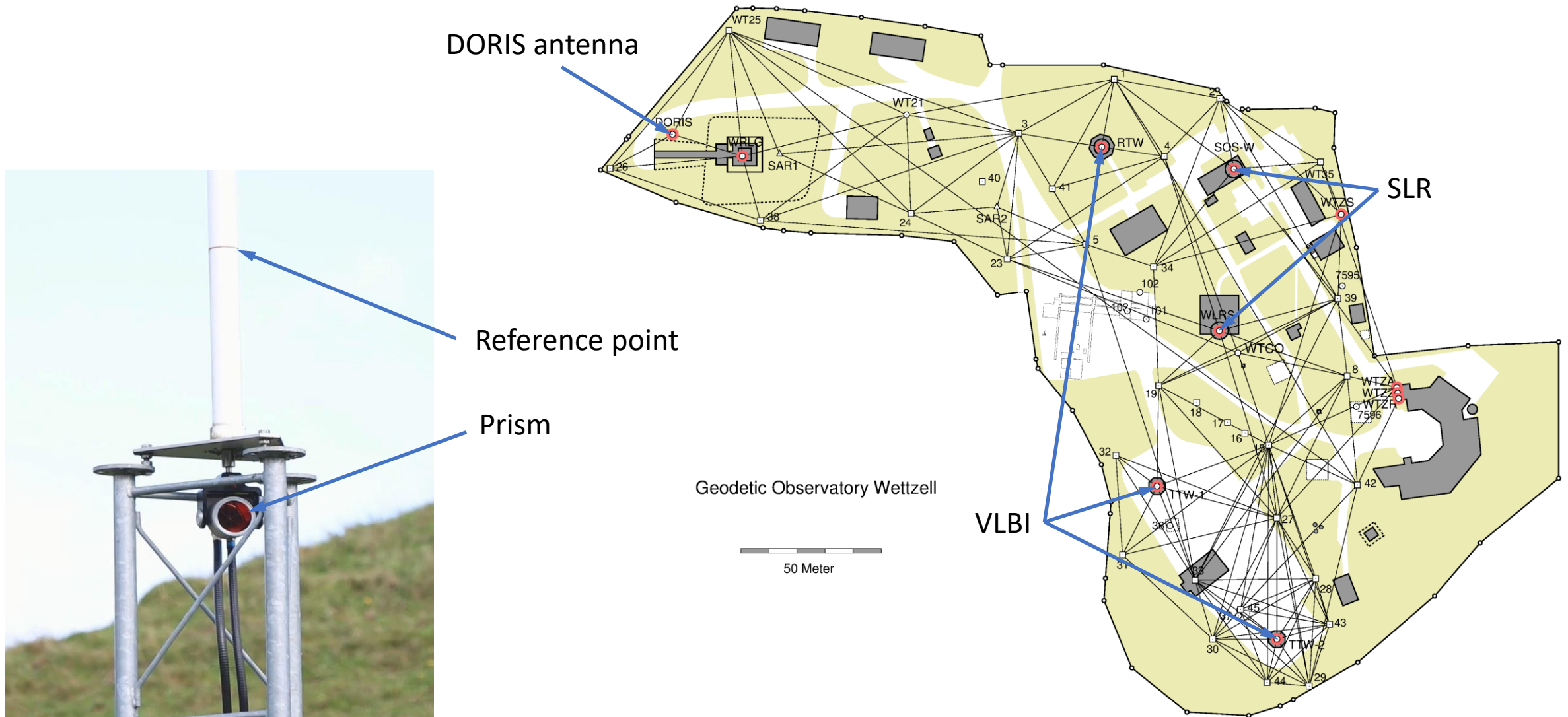
DORIS Installation in Wettzell

- 2014 – 2015: Site investigation, VLBI compatibility tests
- Since 09/2016: Operation in nominal mode
- Since 10/2022: New beacon (generation 4), H-maser frequency as reference



Local Ties with other Space Techniques

IDS Workshop

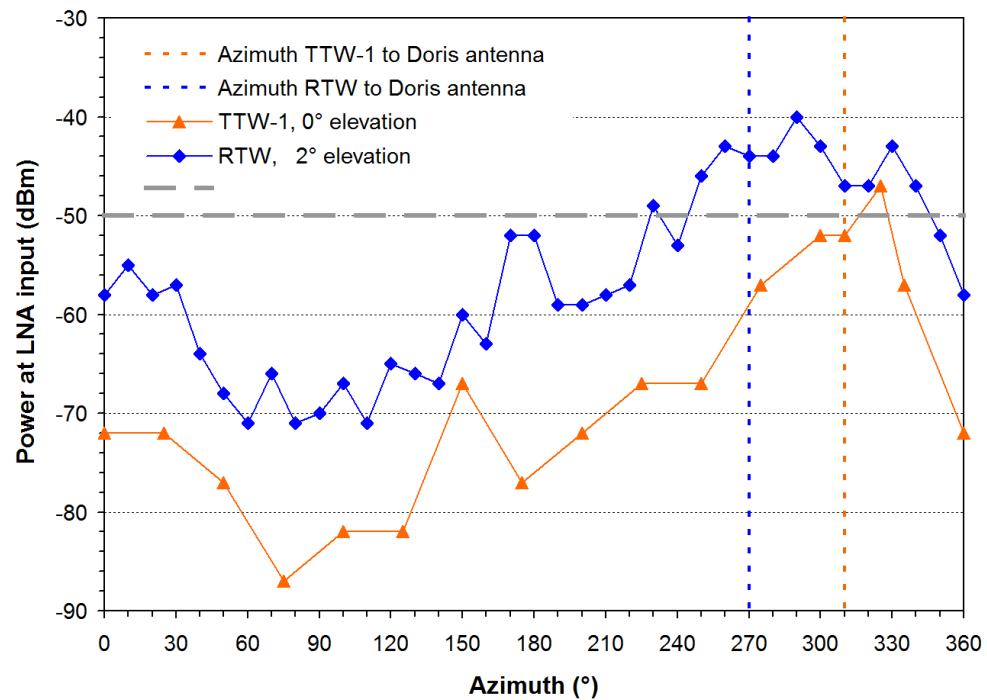


2015 RFI Test

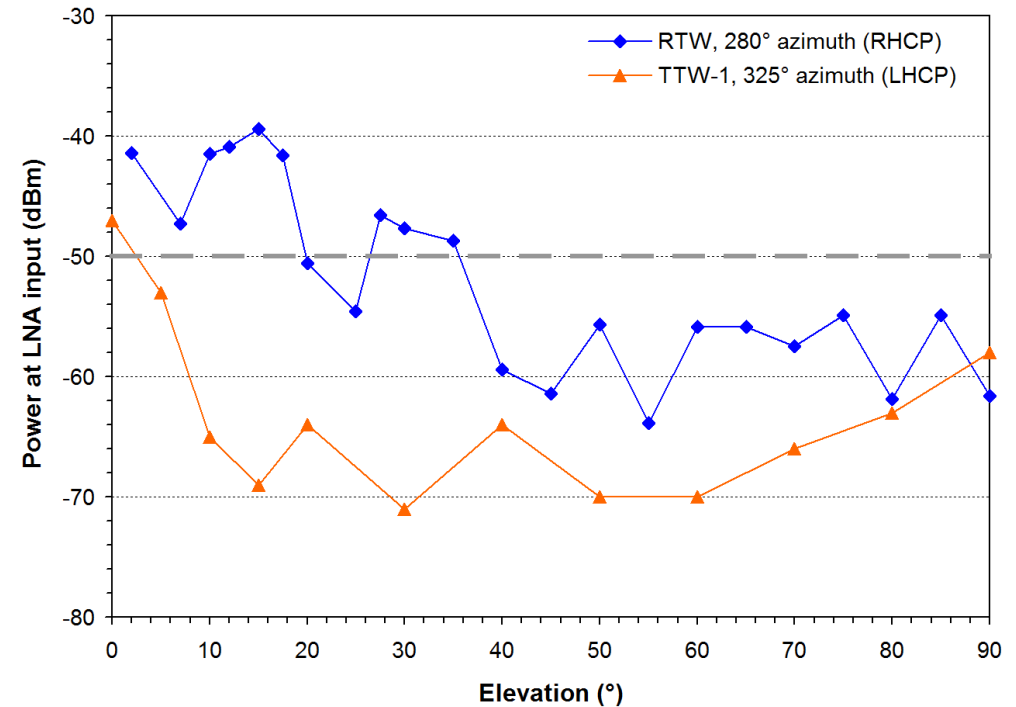
- DORIS Beacon (+40 dBm at 2036 MHz)
- Site A3
 - 155 m to RTW (S/X-Band)
 - 215 m to TTW1 (S/X-Band)
- Varying VLBI telescope orientation



Azimuth dependence



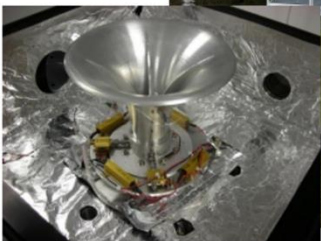
Elevation dependence



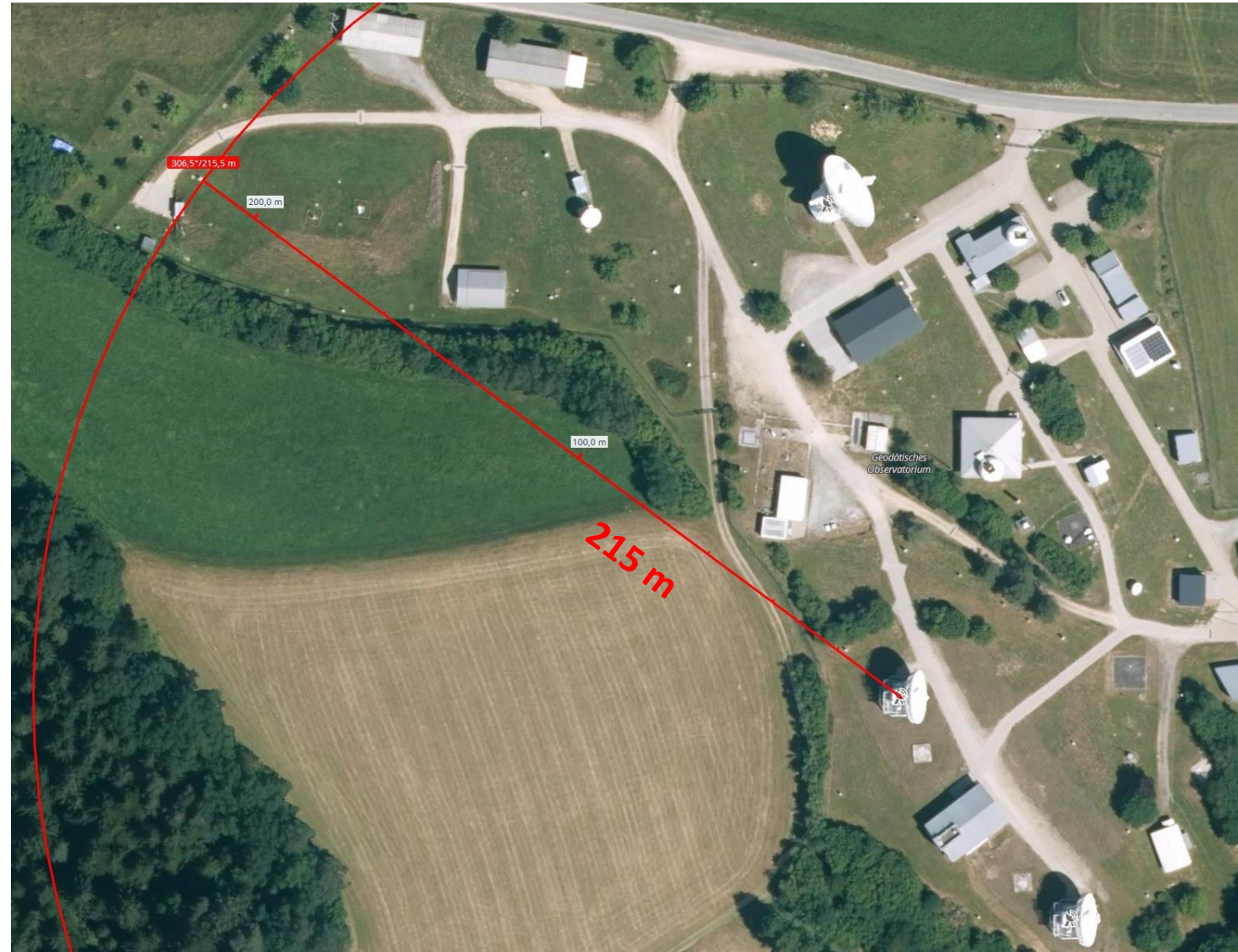
2026 RFI Test

Twin Telescope Wettzell 1 (TTW1 / Wn)

- VGOS mode, QRFH Broadband Feed
- Frequency range: <1 – 15 GHz
- Cryogenic LNAs
 - Overload limit: -55 dBm
 - Destruction limit -10 dBm



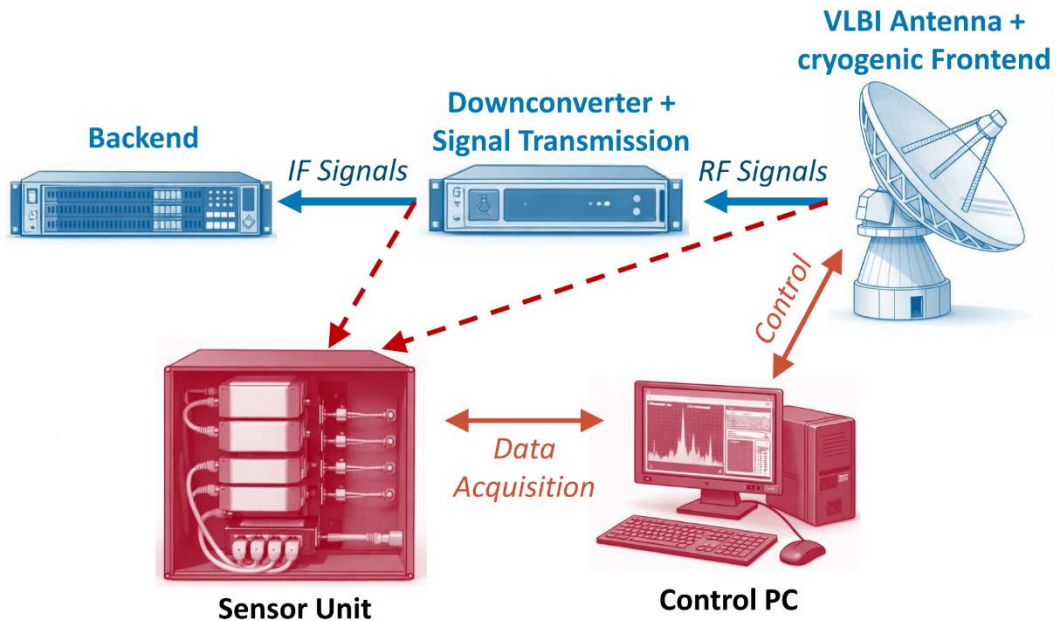
VGOS QRFH Feed



Test Setup

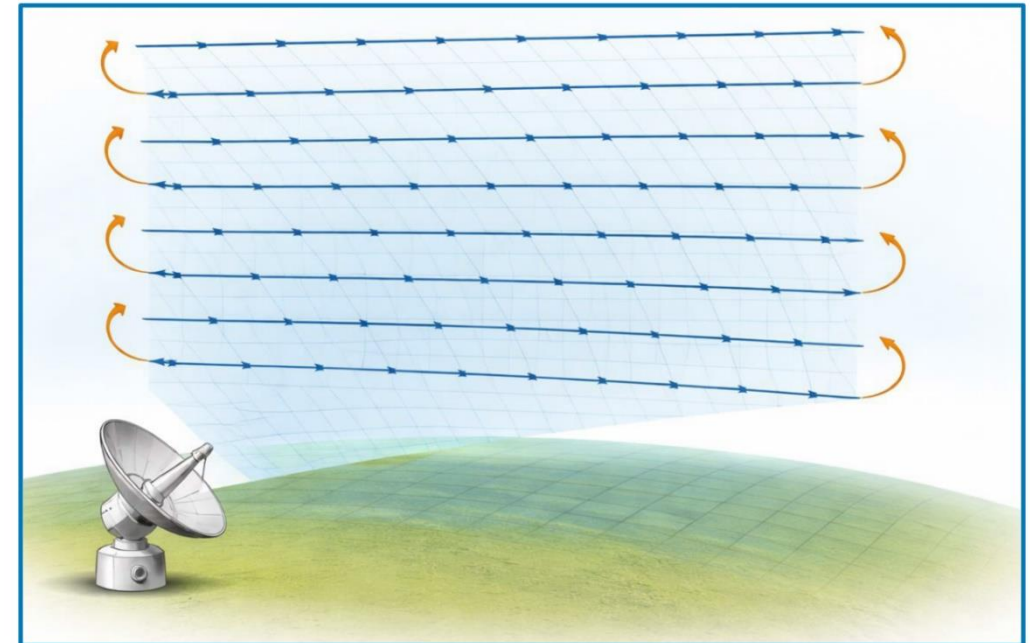
Hardware Setup

- Broadband power sensors for total received power (2-14 GHz)
- Frequency-selective power sensors for narrowband analysis (up to 100 MHz bandwidth)



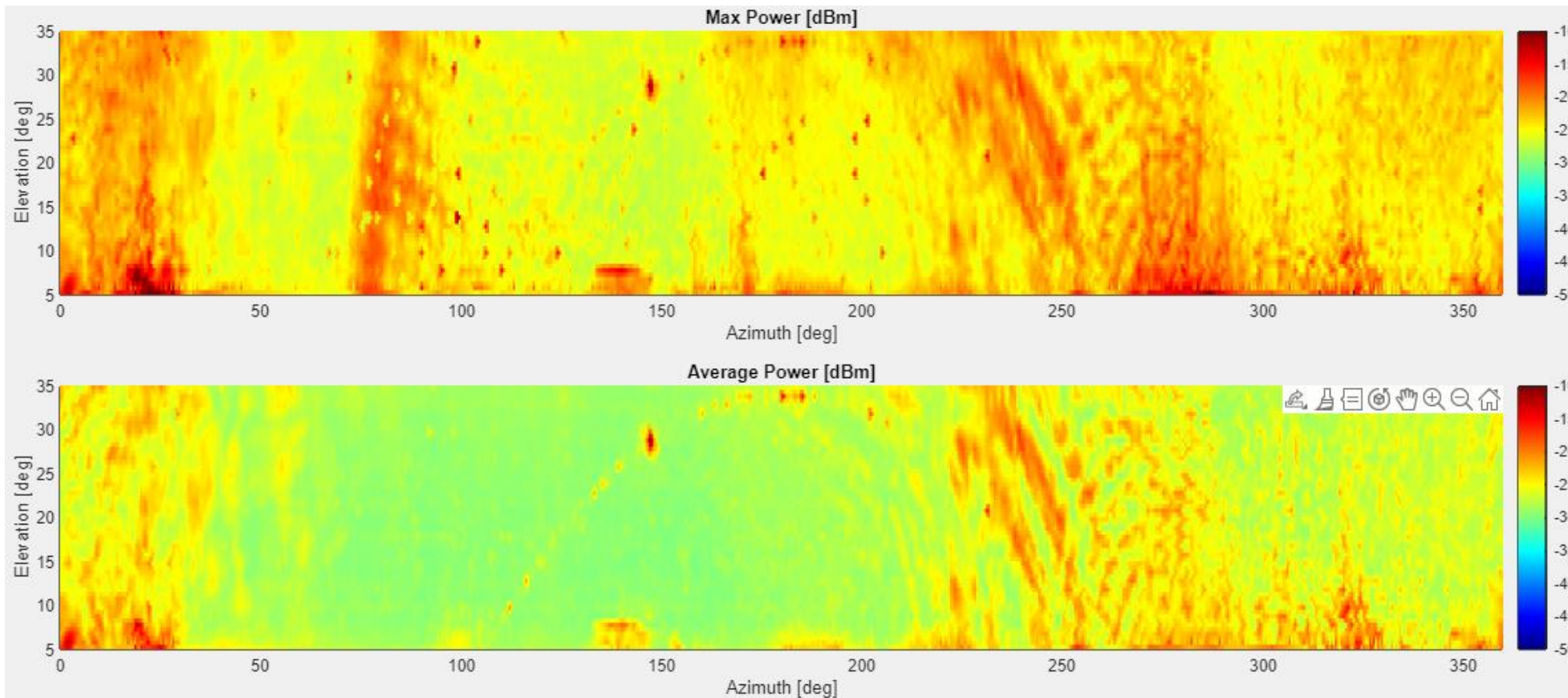
Automated Horizon Scan

- Regular azimuth/elevation raster
- Power levels at each position
→ $P(\text{Az}, \text{El})$.



TTW1, Broadband Scan

- Broadband Scan (2 – 14 GHz) at LNA output (+40 dB)
- 0 – 360° Azimuth, 5 – 35° Elevation, step size 1°

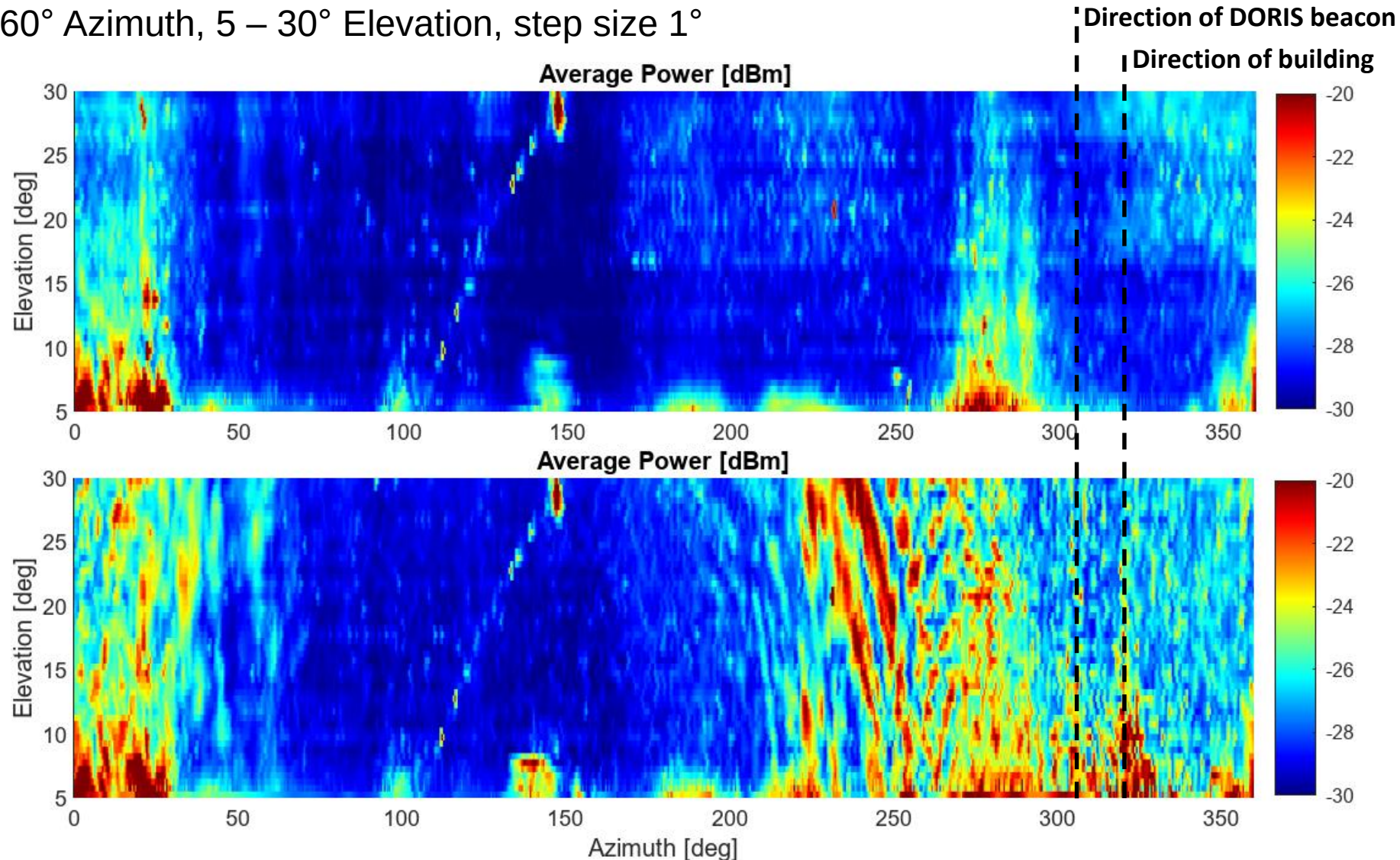


Max. Power

Average Power

TTW1, DORIS Frequency Scan

- Scan at 2.03625 GHz (+/- 100 kHz) at LNA output (+40 dB)
- 0 – 360° Azimuth, 5 – 30° Elevation, step size 1°

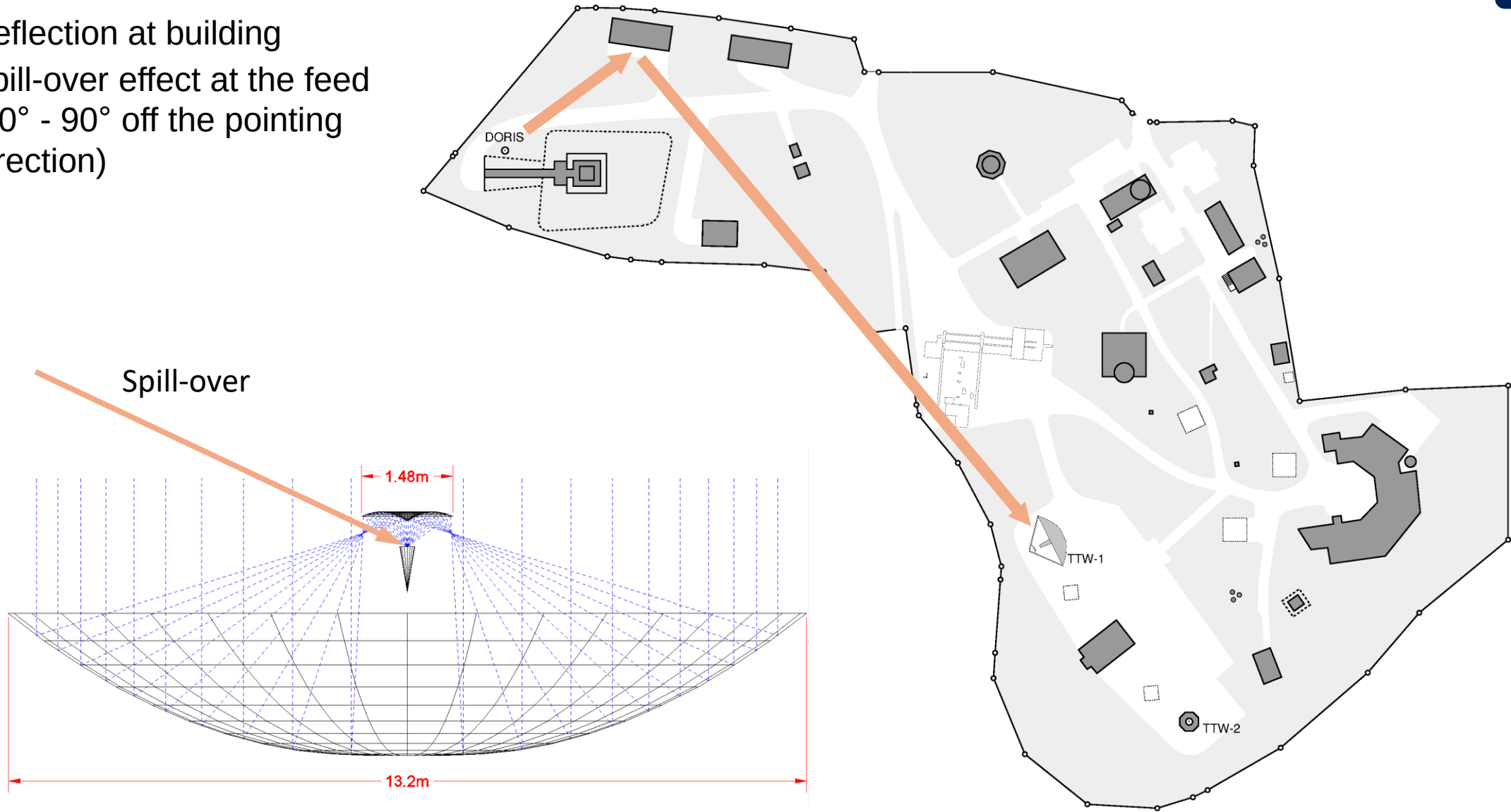


DORIS off

DORIS on

Possible Transmission Path

- Reflection at building
- Spill-over effect at the feed (60° - 90° off the pointing direction)



Usage of RF Blocker

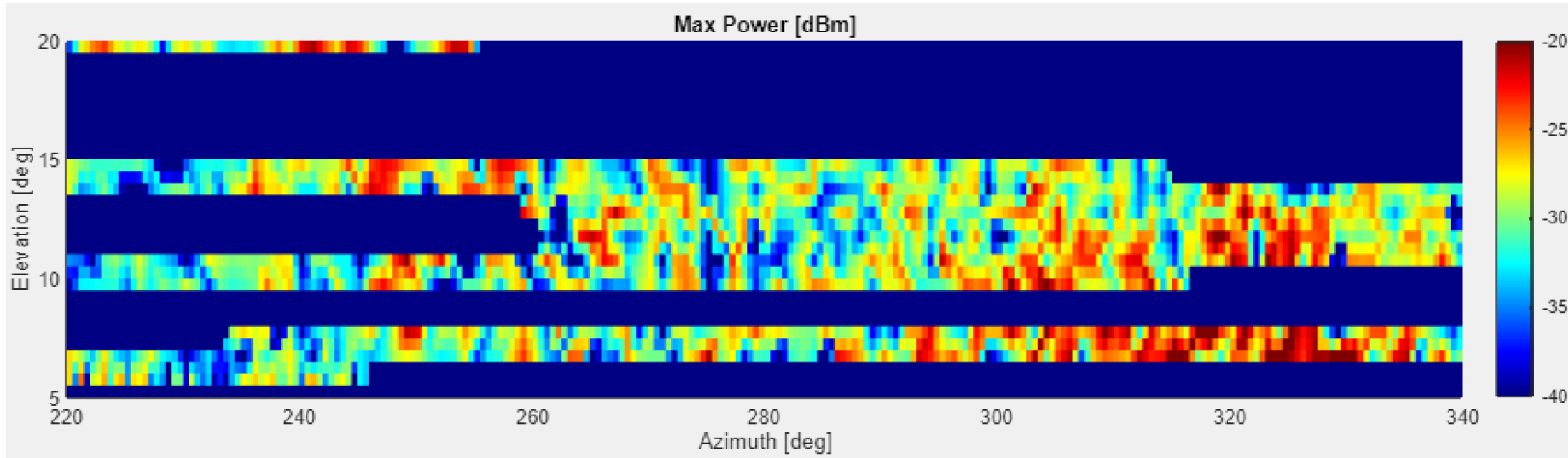
- 4 RF blocker panels, type COMTEST MT65
- 1,2 m x 2,4 m in total
- Placed between DORIS antenna and building



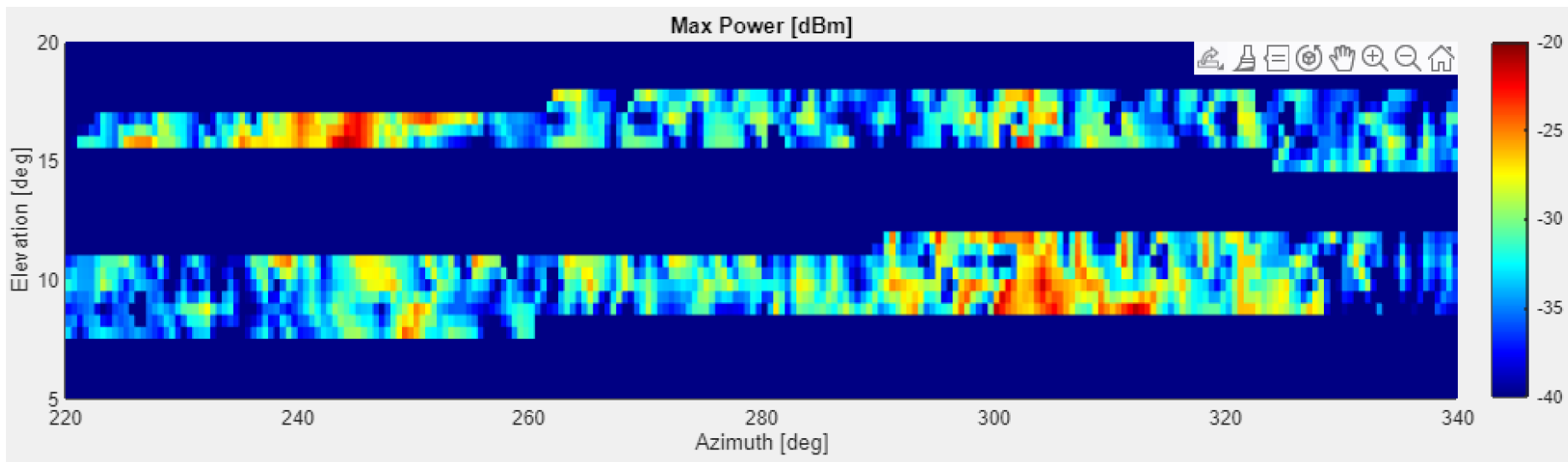
TTW1, Scan with RFI Blocker

IDS Workshop

- Scan at 2.03625 GHz (+/- 50 kHz), 220 - 340° Azimuth, 5 – 20° Elevation



Without blocker



With blocker

Conclusions

- General problem: VGOS broadband feeds “see” all RFI between 1 and 15 GHz
- Different RFI sources: WiFi, satellites, radar systems, and DORIS
- DORIS emits permanently (when enabled)
- Beacon behind ring laser hill → no direct line of sight to any radio telescope
- Full 360° scan: Significant power level reaches telescope TTW1
- Apparent transmission path: Reflection at building and spill-over
- RF blocker seem to considerably attenuate the reflected signal
- Repeat experiment with beacon permanently switched on

References:

Daniel Amberger, Simon Seidl, Christian Plötz & Alexander Neidhardt: RFI Horizon Characterization for Broadband VLBI Systems. Poster, 14th IVS General Meeting, Garmisch-Partenkirchen, April 12 - 17, 2026.