



# Spectrum Protection



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# 01

## Section title

Spectrum Management and Radio Frequency Interference



# ● Agenda

- 01 Protected sites
- 02 RFI in protected KCAAA
- 03 RFI at HartRAO
- 04 Aviation RFI
- 05 Low Earth Orbit (LEO) satellite
- 05 Investigations on the Protection of Geodetic VLBI

## ● Protected sites



Karoo Astronomy Advantage Areas is protected for Radio Astronomy purpose



South African Geodesy Working Group



HartRAO is located in urban area that has background radio frequency transmissions



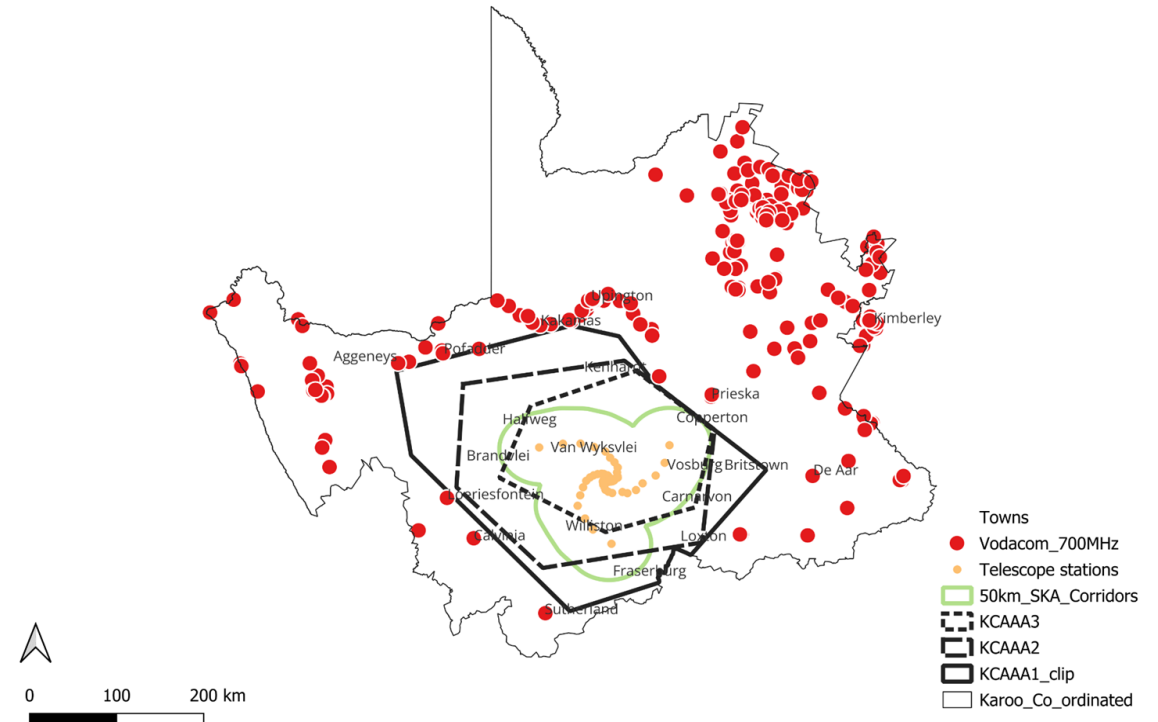
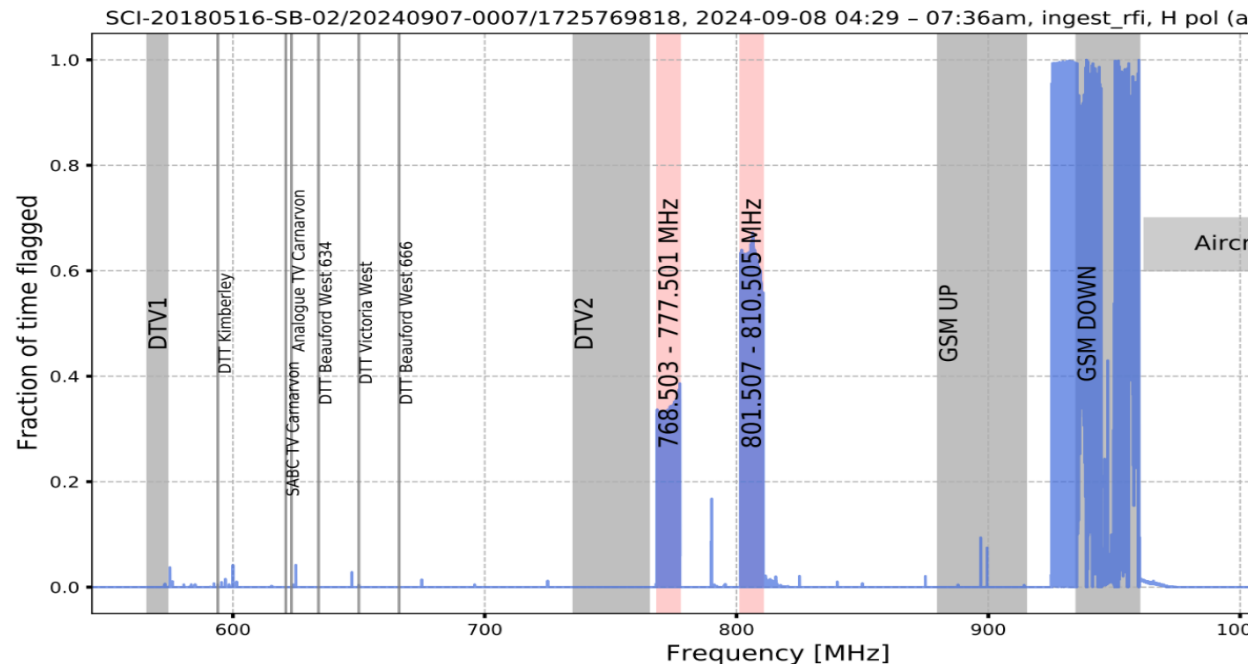
Matjiesfontein is a remote area that currently having few radio frequency transmissions

# ● RFI in protected KCAAA

Identified the possible emission types:

- 768 - 778 MHz: Vodacom 700 MHz downlink band
- 801 - 811 MHz: MTN 800 MHz downlink band
- 811 - 821 MHz: Telkom 800 MHz downlink band

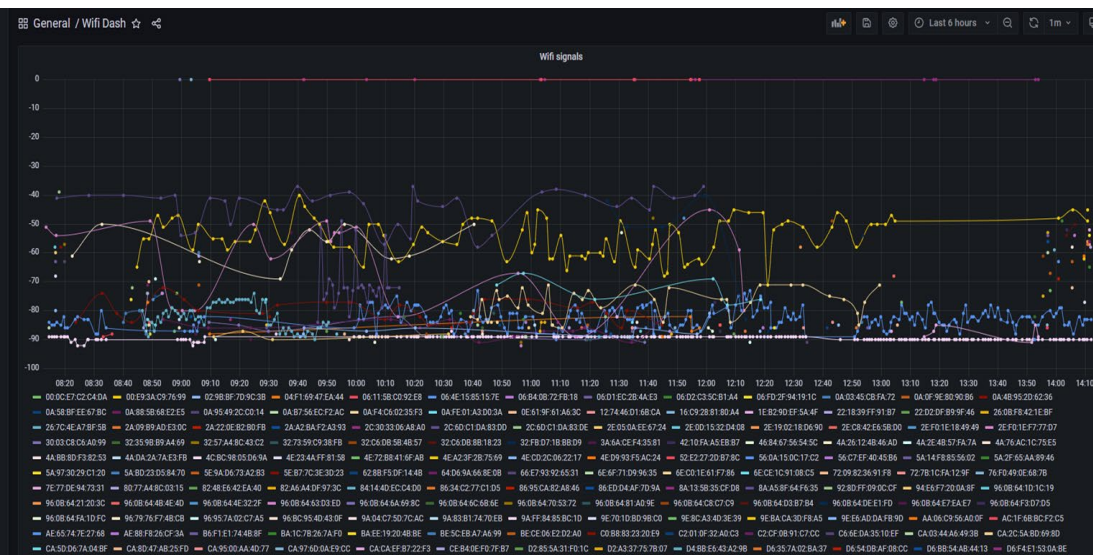
Sources of interference are located outside the protected KCAAA



## ● RFI at HartRAO



- **Low**
- Data and the results to be less reliable.
- **Medium**
- Amplifiers to saturate and the data and results to be useless.
- **High**
- The interference causes damage costing hundreds of thousands of Rand to replace.

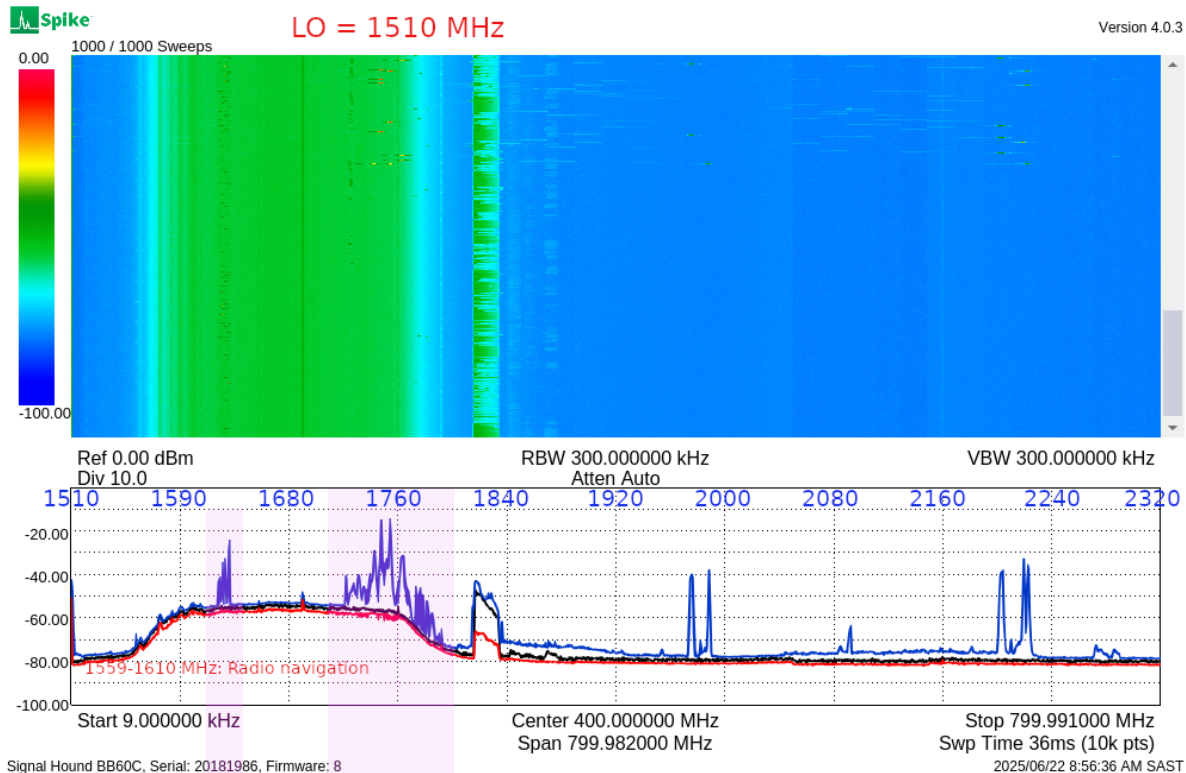


# ● RFI at HartRAO

**L-BAND** frequency: 1608 - 1727 MHz

Suspected main interference sources:

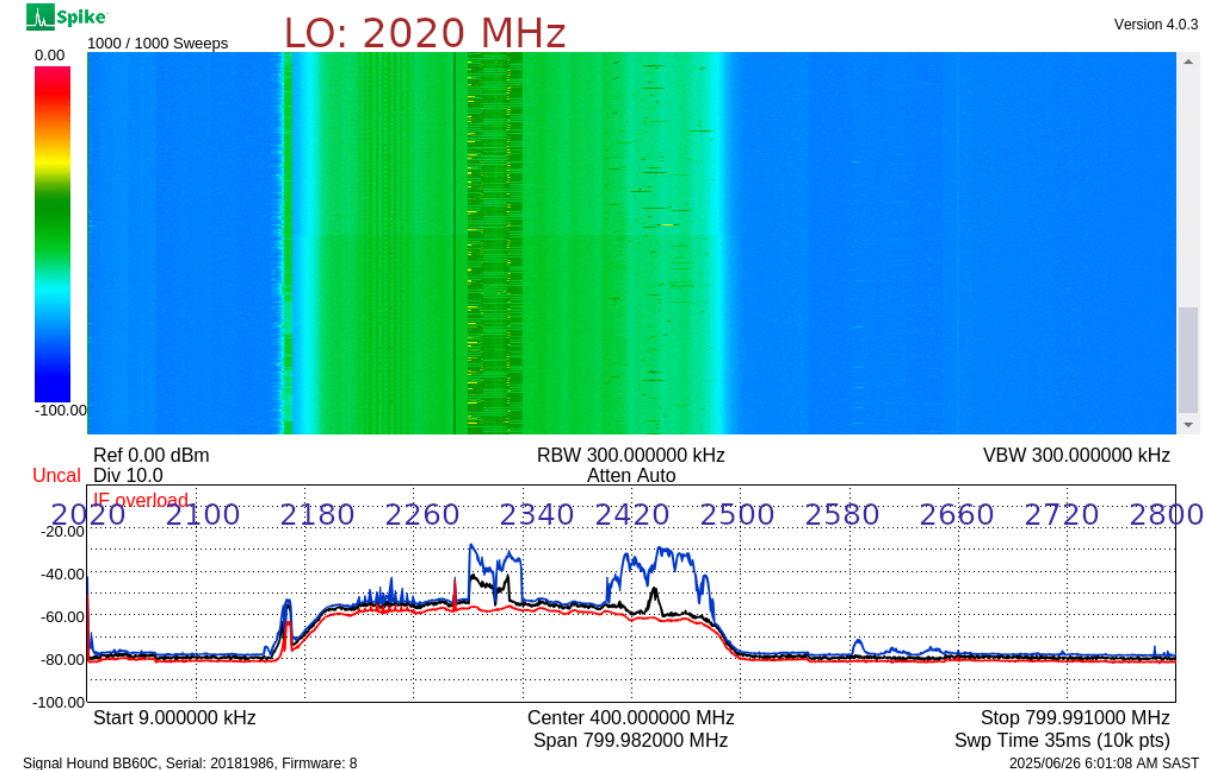
- Radio navigation
- Mobile networks



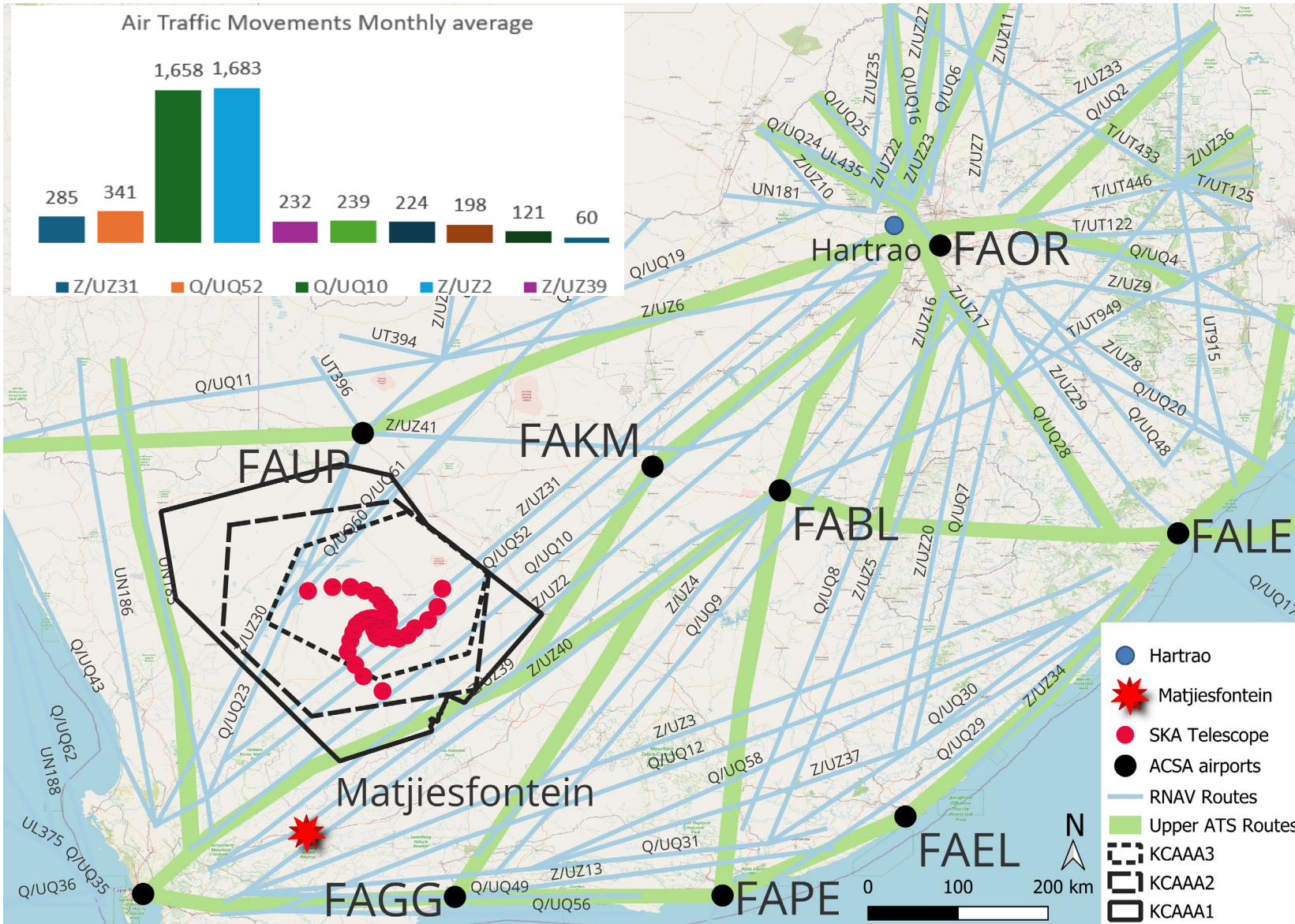
**S-BAND** Frequency: 2210 - 2450 MHz

Suspected main interference sources:

- Mobile networks
- WiFi and bluetooth

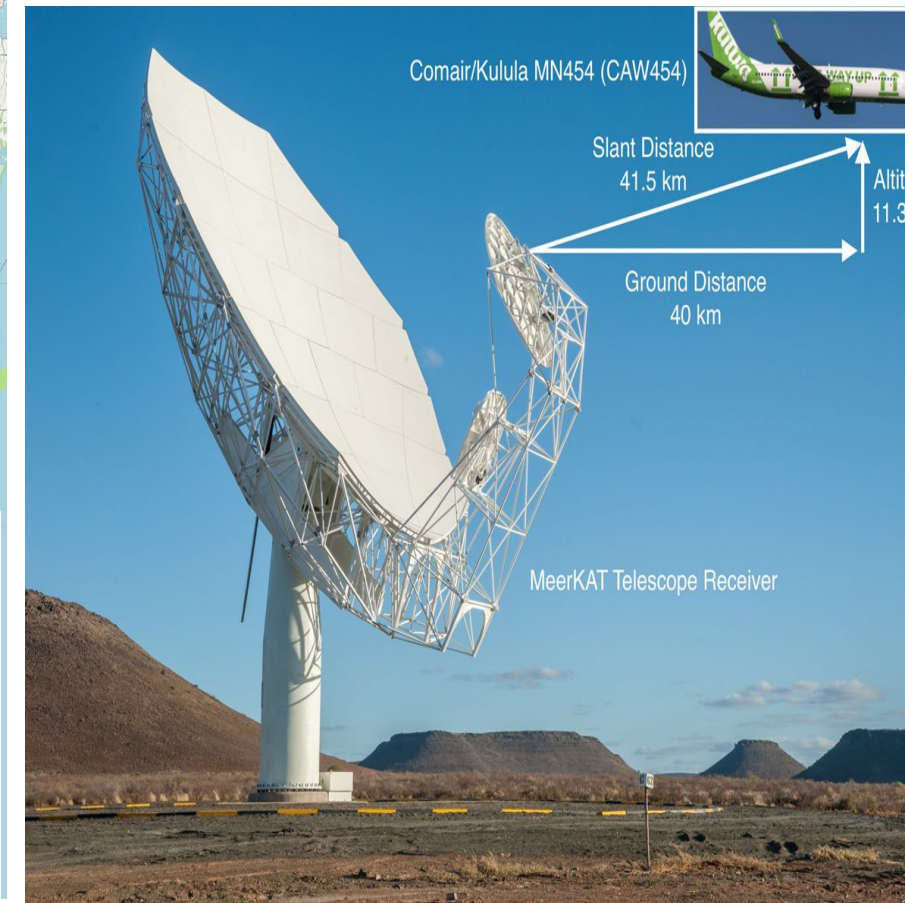


# ● Aviation and Astronomy



ADS-B at the 1030 MHz and 1090 MHz

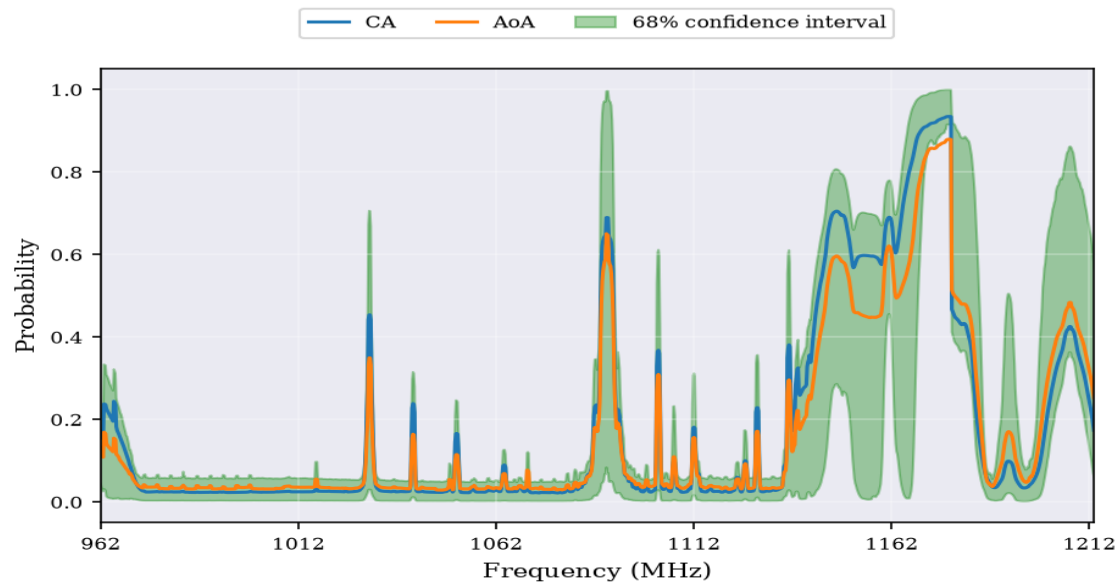
Aircraft 962 - 1213 MHz) and



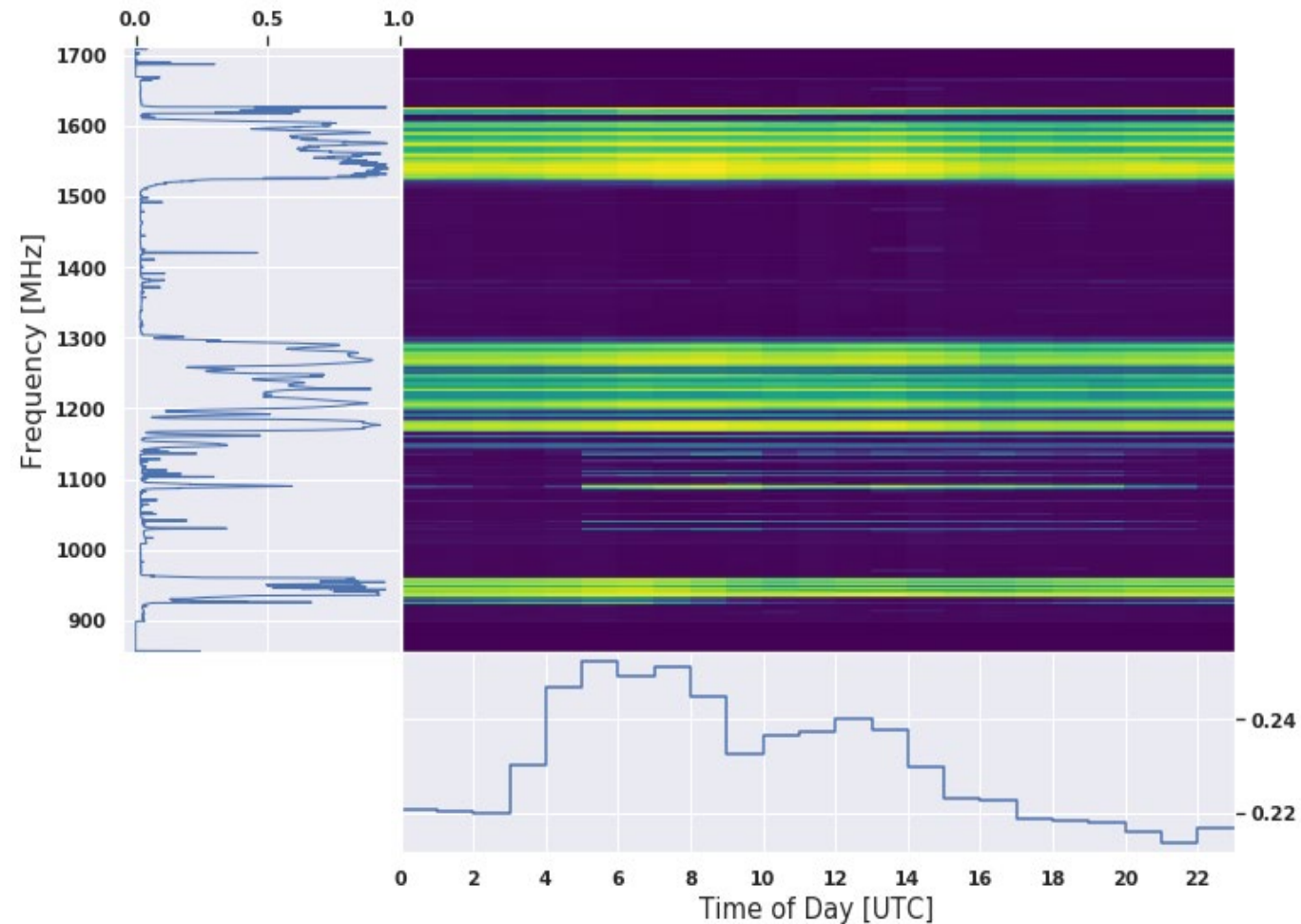
# ● Wide-Band RFI Environment



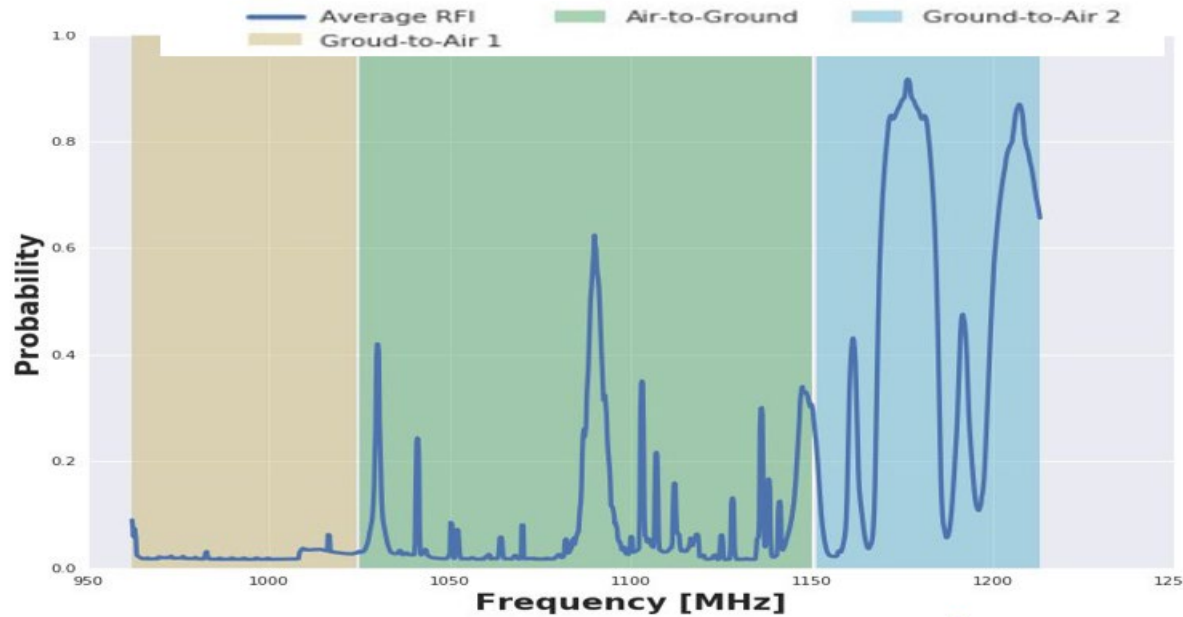
Aviation estimated RFI probability:  $P(962-1024) < P(1025-1150) < P(1151-1213)$ .



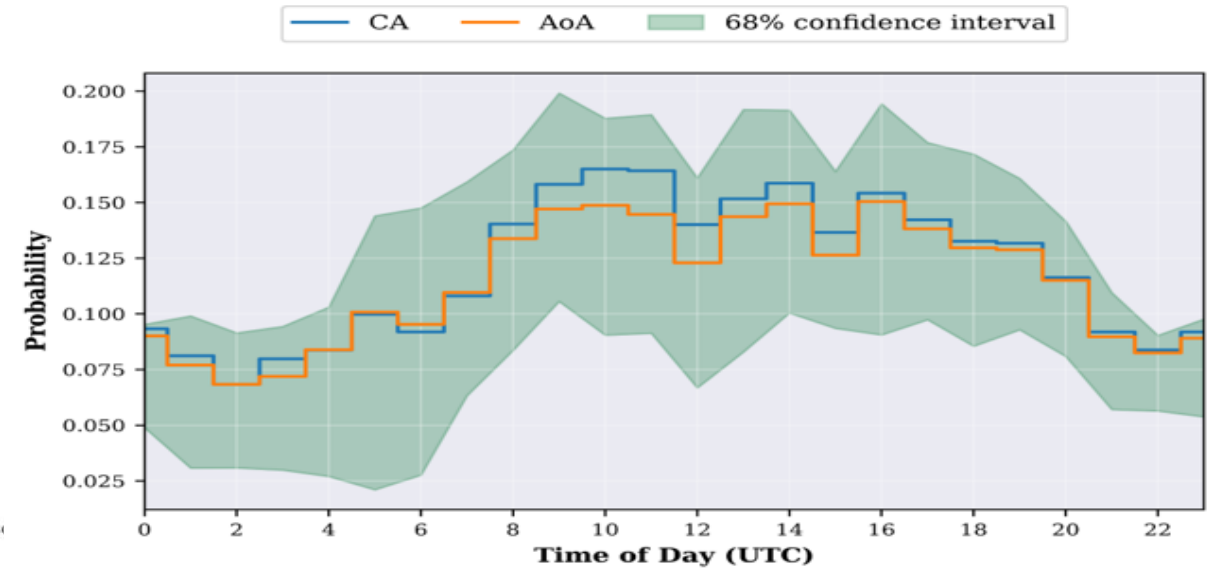
- Mobile Communication(GSM) (900 - 960 MHz)
- aircraft transponders (1000 - 12000 MHz),
- GPS satellites (1482 - 1600 MHz & 1169 - 1280 MHz).



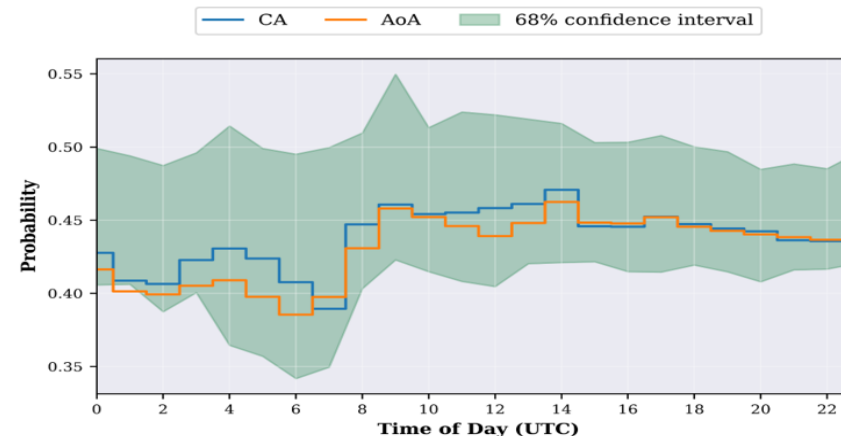
# ● Aviation RFI



DME Frequency Region 1025–1150 MHz (Air-to-Ground)



DME Frequency Region 1151–1213 MHz (Upper Ground-to-Air)



Upper ground-to-air DME signal between 1151–1213 MHz is the highest RFI

Air-to-ground DME (1025–1150 MHz) shows daytime increase of RFI that decrease in the evening. Sub-band is time dependent over the 24-hour cycle.

# ● Low Earth Orbit (LEO) satellite

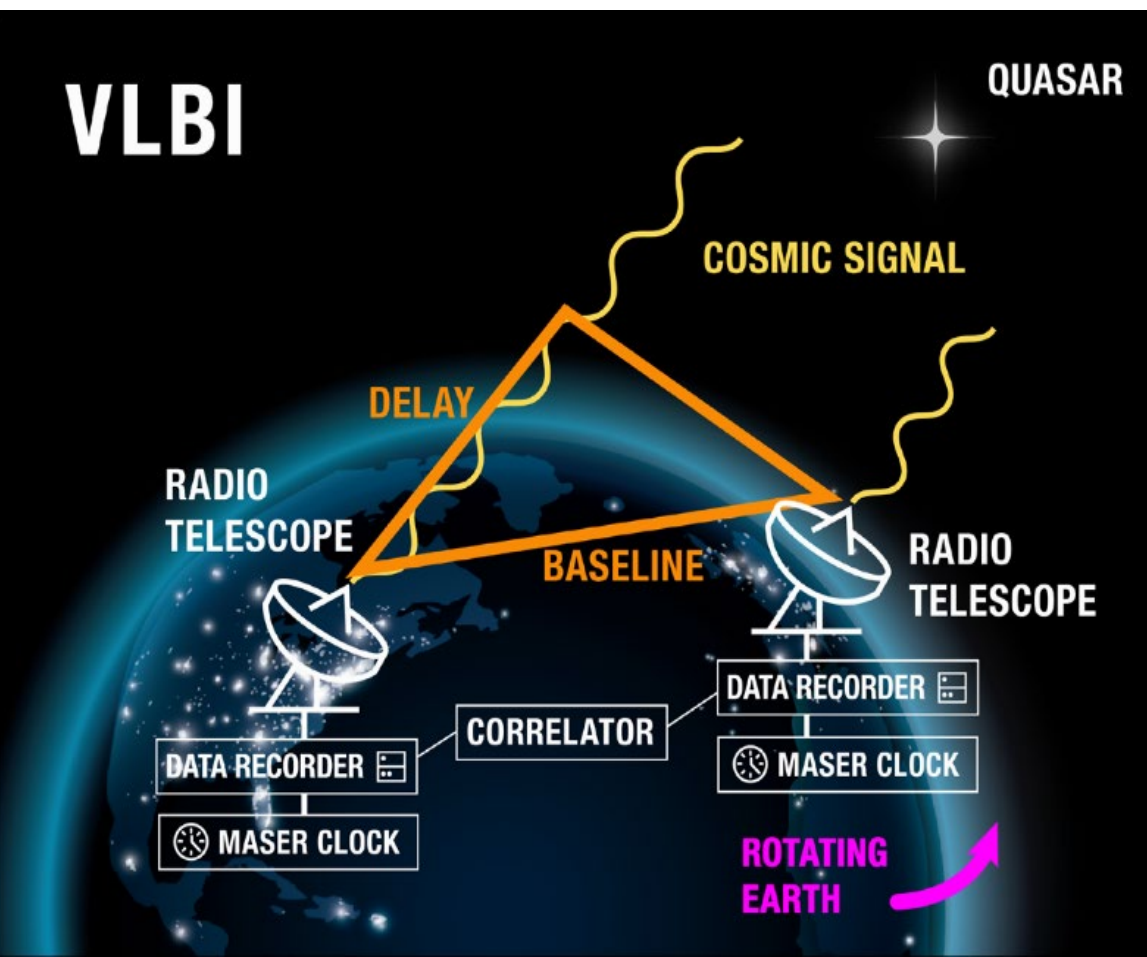
| Provider        | Regional Strategy & Local Partner                                                                                                                                                                                     | Expected Launch             |
|-----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------|
| Amazon Leo      | Partnered with Herotel to launch the evry network.<br>Not an exclusive partnership.                                                                                                                                   | 2027                        |
| SpaceX Starlink | Awaiting regulatory changes; rival firms like Vodacom have announced adjacent partnerships.                                                                                                                           | Pending licensing approvals |
| Eutelsat OneWeb | Partnerd with QKON and Paratus. Vox offers enterprise low-Earth orbit (LEO) satellite connectivity across South Africa through a partnership with Q-KON using the Eutelsat OneWeb network via the Twoobii-LEO service | 2025                        |

# Investigations on the Protection of Geodetic VLBI



The targeted VGOS sub-bands correspond to the following bands of the Radio Regulations:

|             | VGOS-channel bands    | Radio Regulations equivalent bands |
|-------------|-----------------------|------------------------------------|
| Sub-band A: | 3.0004 - 3.3844 GHz   | 2 900 – 3 400 MHz                  |
| Sub-band B: | 4.8244 - 5.8164 GHz   | 4 500 – 5 830 MHz                  |
| Sub-band C: | 8.7604 - 9.7524 GHz   | 8 750 – 9 800 MHz                  |
| Sub-band D: | 12.9844 - 13.9764 GHz | 12.75 – 14 GHz                     |

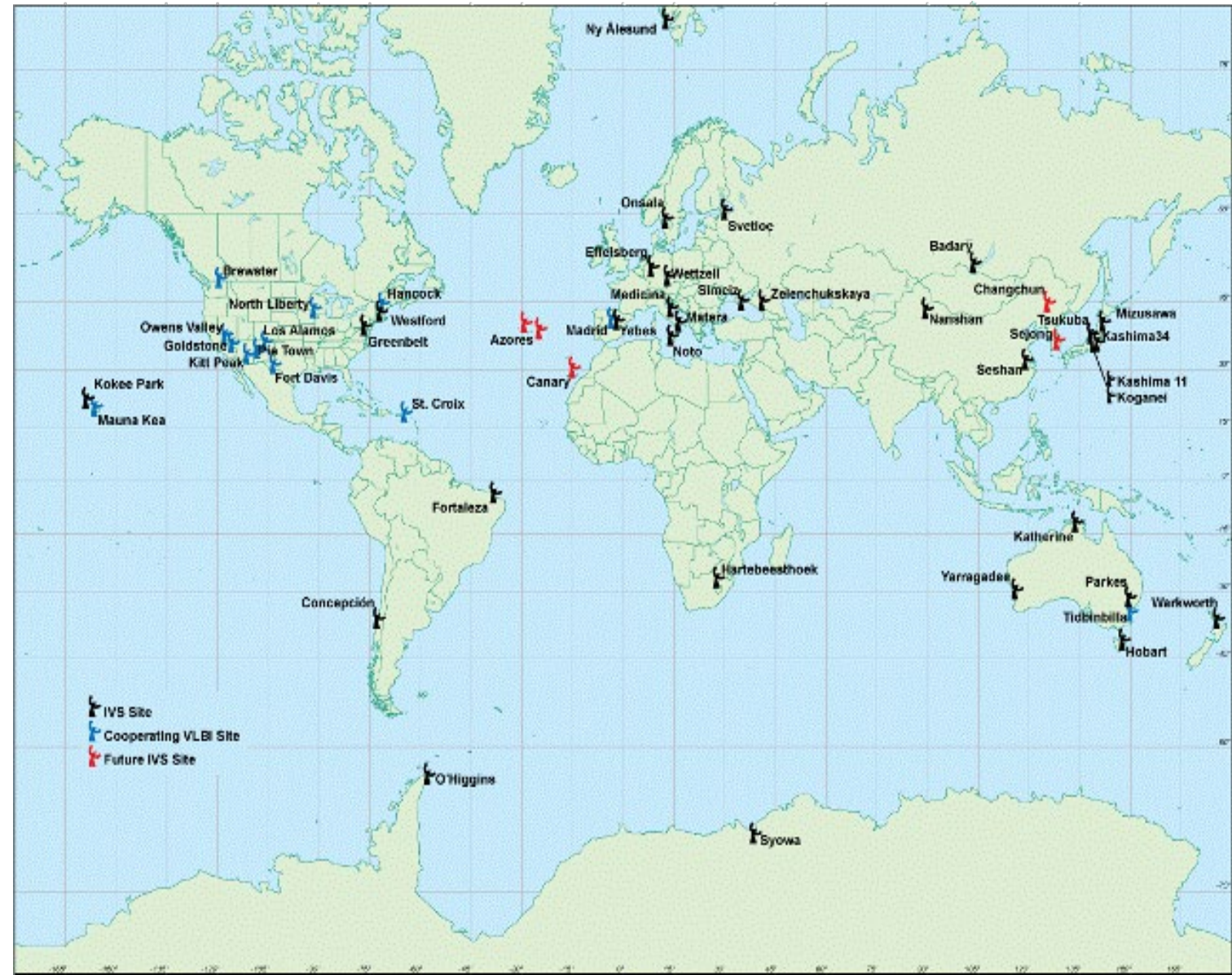


## 5.6 ASTRONOMY FACILITIES OUTSIDE THE DECLARED AREAS

The radio instruments located at Hartebeesthoek Radio Astronomy Observatory near Pretoria are registered in the ITU-R MIFR and they include HART15M, HARTRAO and HARTVGS. The observations undertaken by these instruments in RAS bands are globally recognised and internationally protected. The applications and services operating within a 15 km radius from the location; Latitude 25°53'24.06"S and Longitude 27°41'7.45"E; must coordinate with SARAO and give due consideration when operating stations in frequency bands listed under No. 5.149, also identified in the NRFP2021 table of frequency allocation.

# ● Significance - where we are and how we move

- **International Celestial Reference Frame**
- Pointing of antennas
- **International Terrestrial Reference Frame**
- Positioning on Earth (placement of antennas)
- **Hartebeesthoek '94 Datum**
- Surveying reference point for Africa
- **Global Navigation Satellite Systems**
- Accuracy of satellite positioning systems
  - automatic pilot, GPS farming,
  - country borders, mining, etc.
- **Satellite Laser Ranging**
- Confirming and updating orbits



# Thank you



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