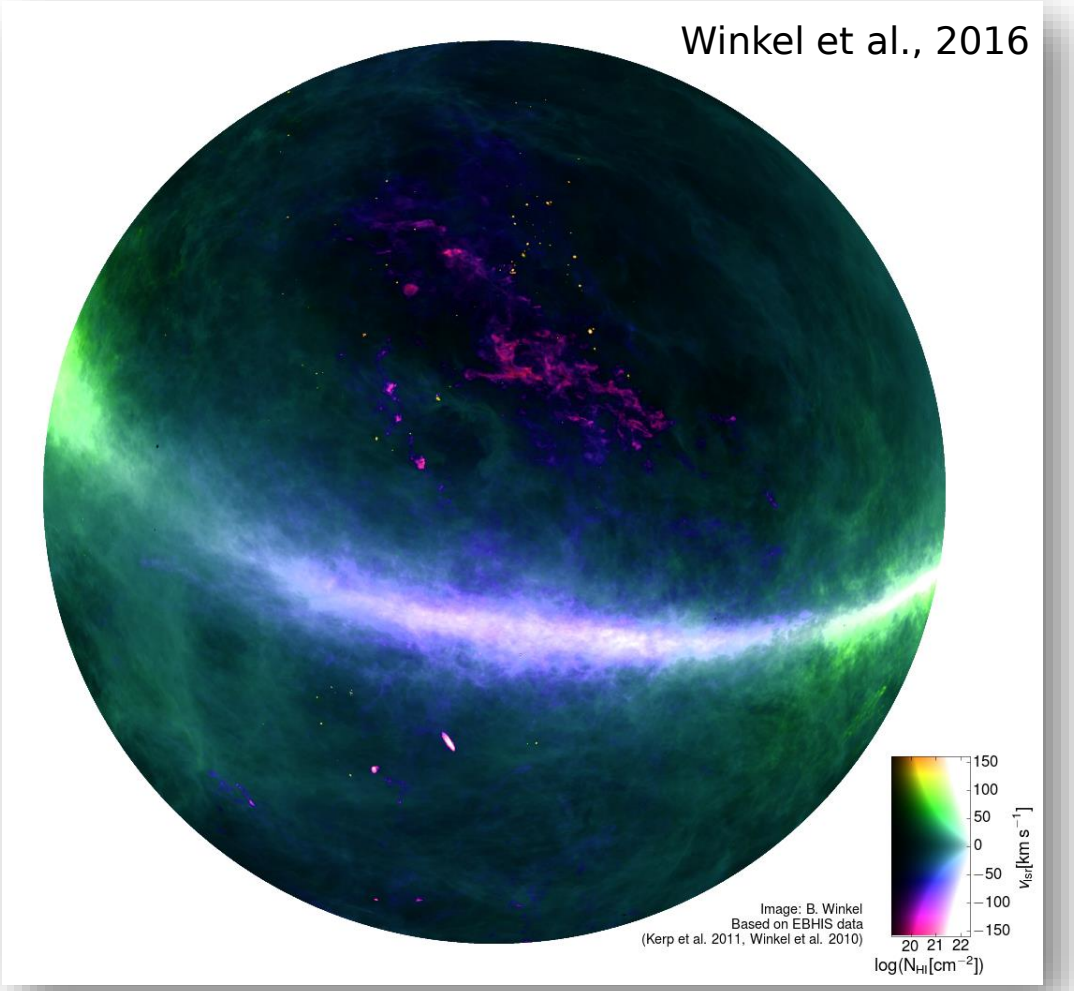
CORF Spring Meeting: CRAF Update

Benjamin Winkel

About me

- Astronomer (MPIfR, Bonn, Germany)
  - Staff member at Effelsberg observatory
  - HI Surveys (EBHIS, HI4PI)
  - Software (data pipelines, observing tools)
- German CRAF delegate since 2016
  - Compatibility calculations
  - Focus on IMT & satellites
- CRAF Chair since Oct 2022



Overview

- Organisation and management
  - Re-structuring in 2018/2019
  - New Management tools and work processes
- Some highlights of our recent work
  - Compatibility calculations with pycraf
  - Protection from 2nd harmonics from aerial MFCN user equipment
  - Extra protection from Starlink (few countries only…)
- Current serious issues in CEPT
  - Attack on passive bands (SRD > 100 GHz; new guidelines for sharing!?)
  - Loosing the alcohol (IMT into 6.65 GHz methanol band?)

Part 1: Organisation and Management

Re-structuring in 2018/2019

- New management structure of CRAF
- Why?
  - Few active members
  - Mostly run by Chair & Frequency Manager
  - Link into science community was weak

Re-structuring in 2018/2019

New management structure

Stakeholder's Forum

- Platform of Directors
- Improve link between CRAF and science community
- Involved in strategic decisions and priority setting
- Oversees budget and employment of FM

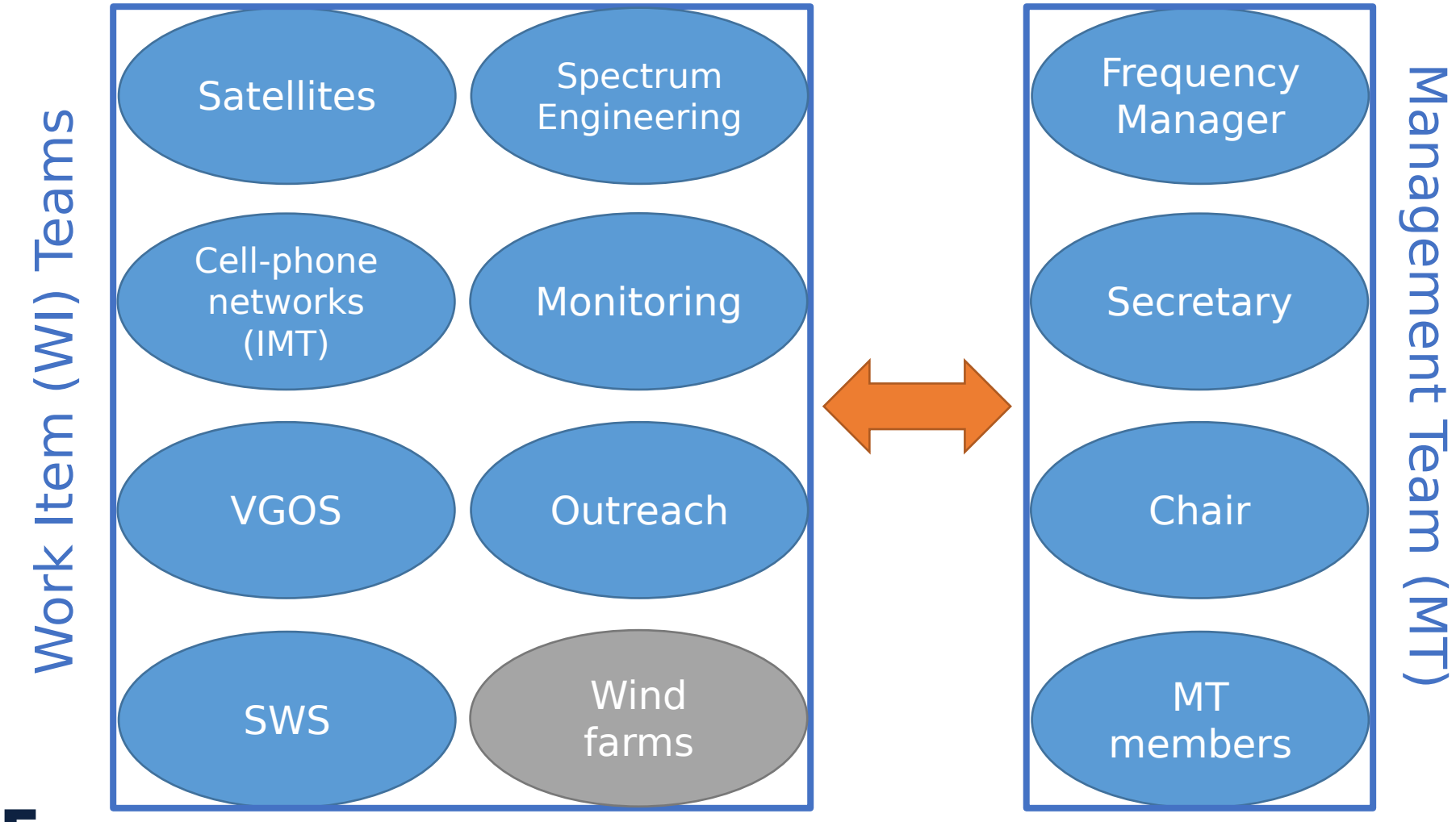
Management Team

- Represent member institutes paying a full share + Chair + FM + Secretary
- Weekly meetings
- Organisation, management & strategic decisions of CRAF
- Resilience

Work Item (WI) teams

- Some tasks need smaller groups to be effective
- Teach new CRAF members
- Want domain experts (e.g., cell-phone networks, satellite constellations)
- Match personal taste / home institute's needs

Re-structuring in 2018/2019



Management tools & processes

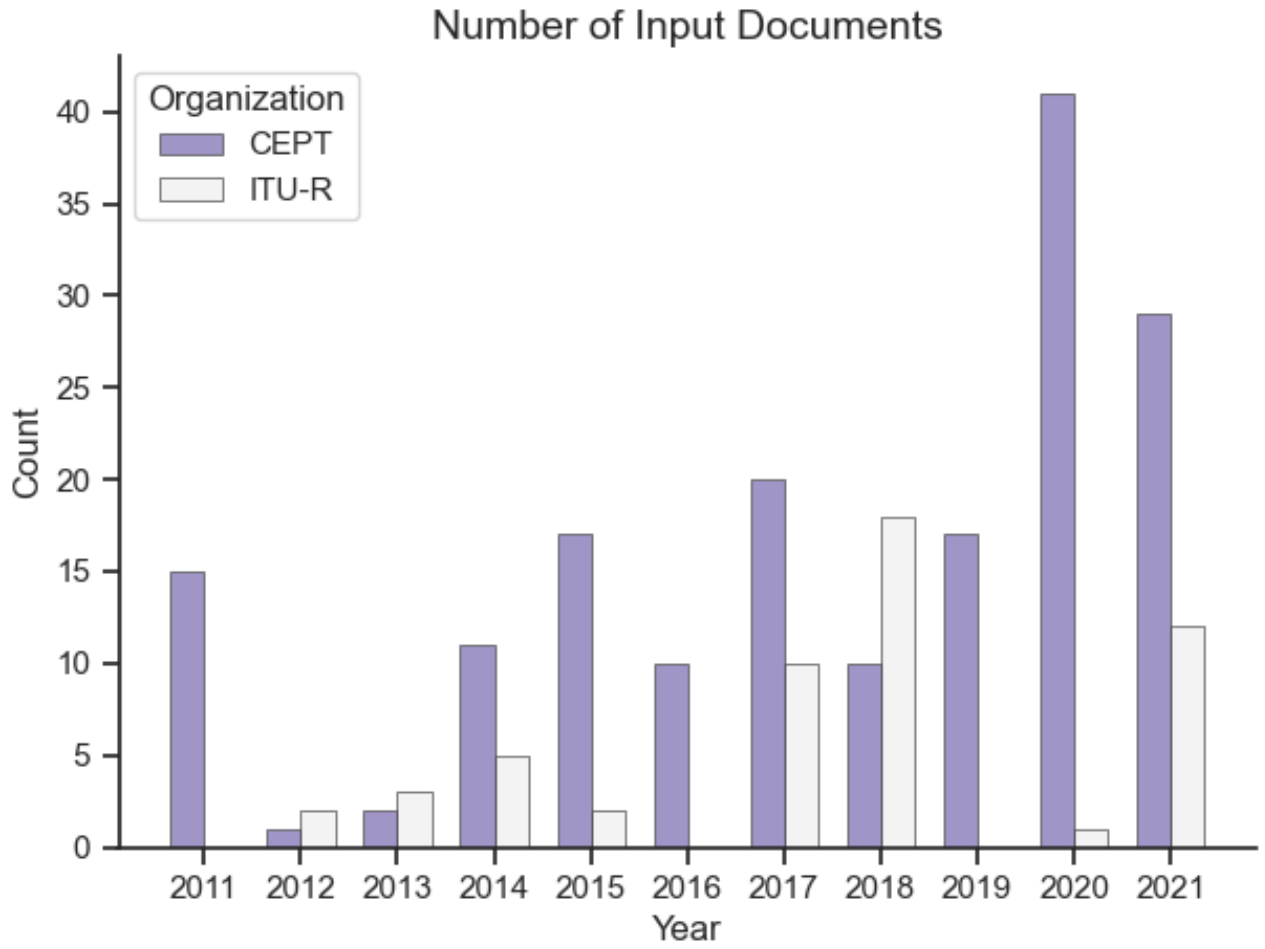
Processes

- Project management software
- Teams
  → Meet regularly and frequently
  → Produce meeting minutes
  → Make consequent use of action items
- Bi-annual plenary meetings
  → WI team reports
  → Update: WRC prep.
  → FM report
- MT: Bi-annual reports to Stakeholders

Software tools

- Redmine
- Mattermost
- Zoom
- Python eco-system for compatibility studies
- Word for documents ☹

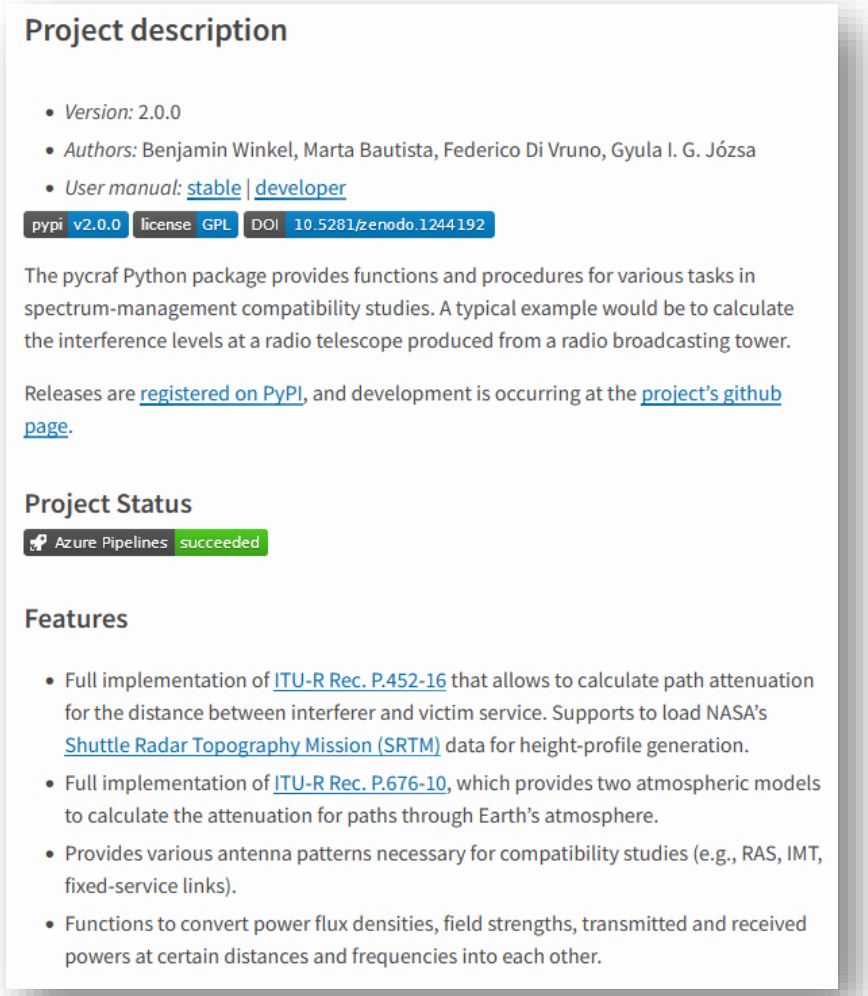
CRAF input documents



Part 2: Highlights of our work

Compatibility calculations & software

- Implements many ITU-R algorithms in Python
- Not stand-alone software, but Python library
  → Provide basic tools; easy to extend
- Free open-source software
- Hosted on GitHub
- Full manual, many tutorials
- Easy installation
  `pip install pycraf` or
  `conda install -c conda-forge pycraf`



Project description

- *Version:* 2.0.0
- *Authors:* Benjamin Winkel, Marta Bautista, Federico Di Vruno, Gyula I. G. Józsa
- *User manual:* stable | developer

pypi v2.0.0 | license GPL | DOI 10.5281/zenodo.1244192

The pycraf Python package provides functions and procedures for various tasks in spectrum-management compatibility studies. A typical example would be to calculate the interference levels at a radio telescope produced from a radio broadcasting tower.

Releases are registered on PyPI, and development is occurring at the project's github page.

Project Status

Azure Pipelines succeeded

Features

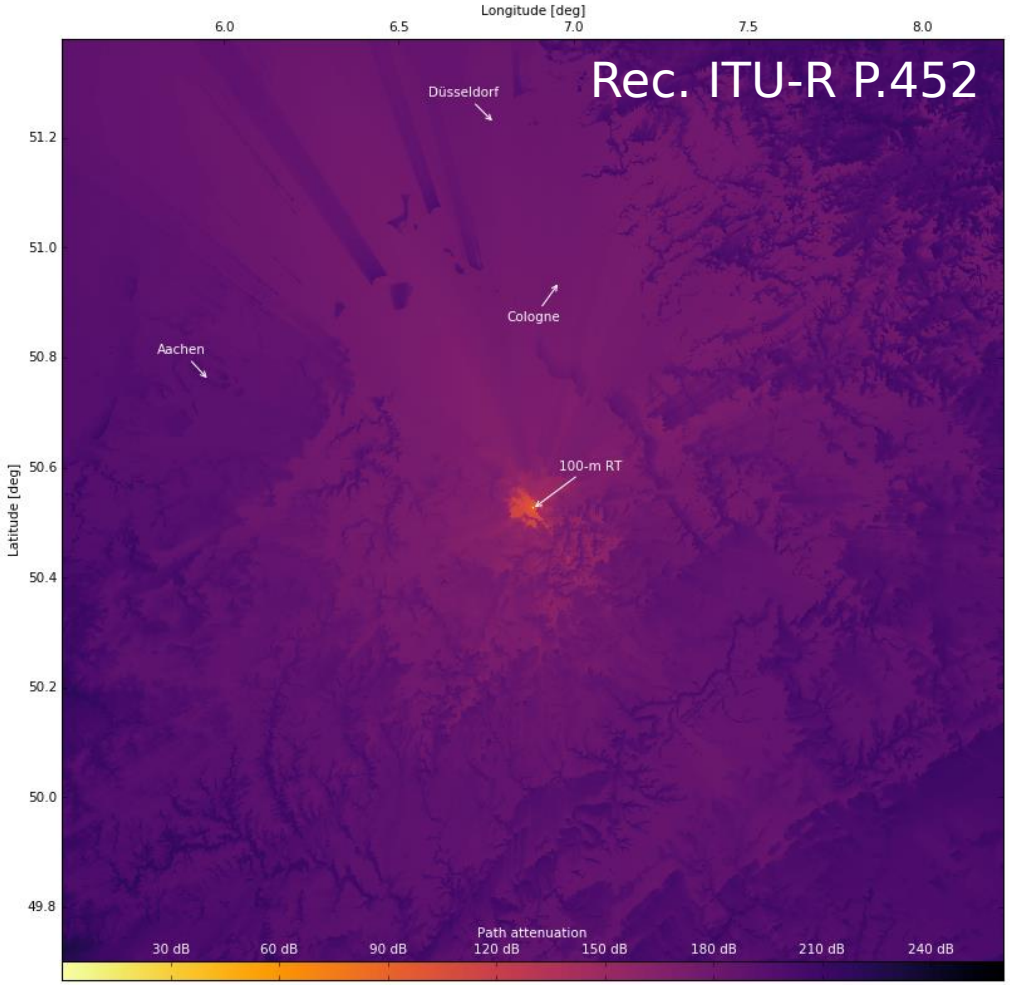
- Full implementation of ITU-R Rec. P.452-16 that allows to calculate path attenuation for the distance between interferer and victim service. Supports to load NASA's Shuttle Radar Topography Mission (SRTM) data for height-profile generation.
- Full implementation of ITU-R Rec. P.676-10, which provides two atmospheric models to calculate the attenuation for paths through Earth's atmosphere.
- Provides various antenna patterns necessary for compatibility studies (e.g., RAS, IMT, fixed-service links).
- Functions to convert power flux densities, field strengths, transmitted and received powers at certain distances and frequencies into each other.

https://pypi.org/project/pycraf/

Compatibility calculations & software

Features

- Path propagation loss (attenuation)
- Antenna patterns
- Atmospheric attenuation
- Satellite simulations
- Aircraft studies
  (CRAF bought a FlightRadar24 data set)
- Easy to combine with other GIS data sets,
  e.g. Corine land-cover (clutter zones),
  Open-street map (OSM) road data



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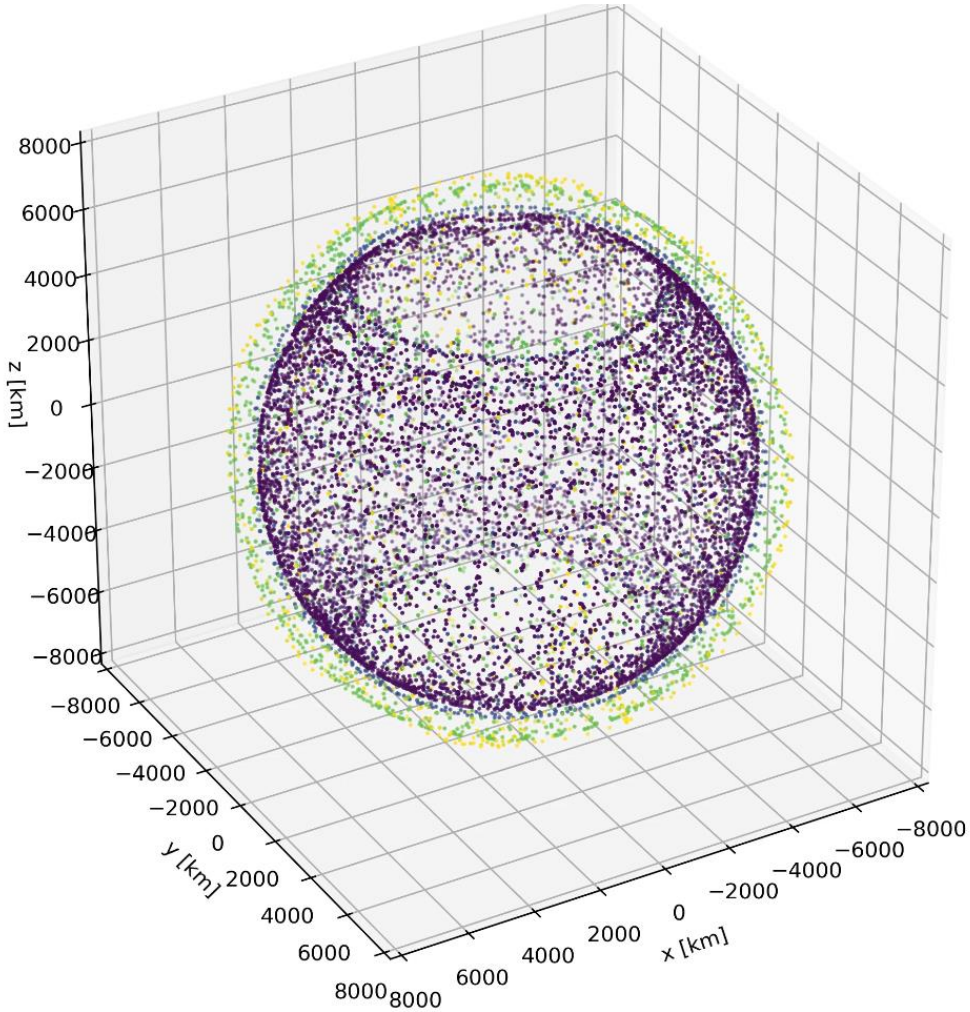
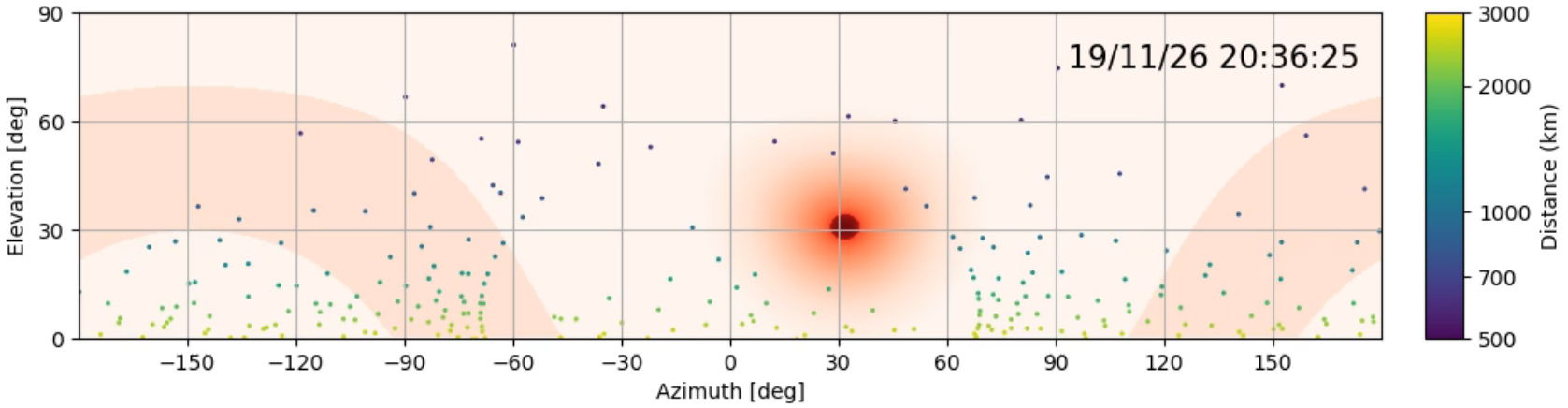
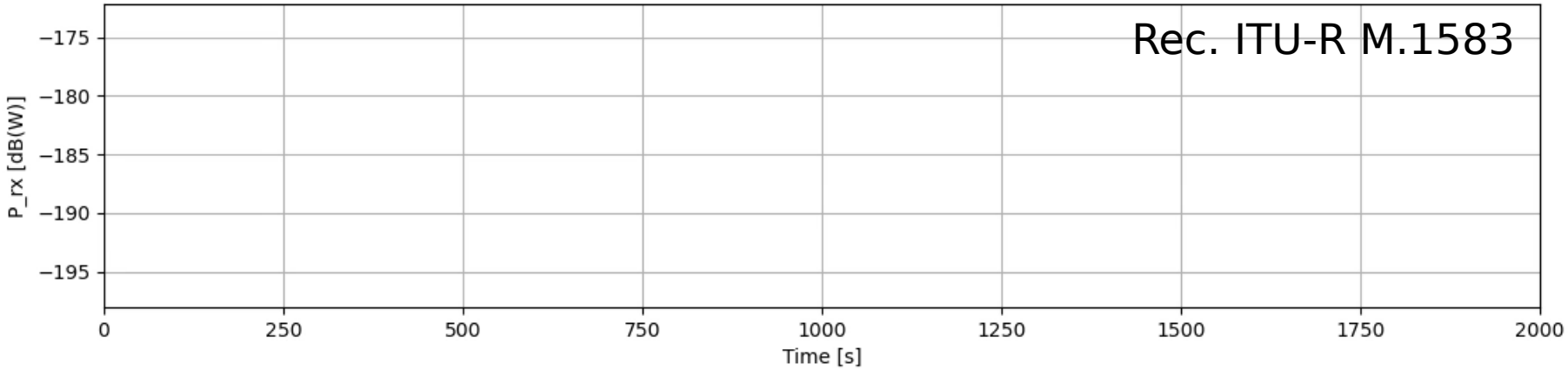
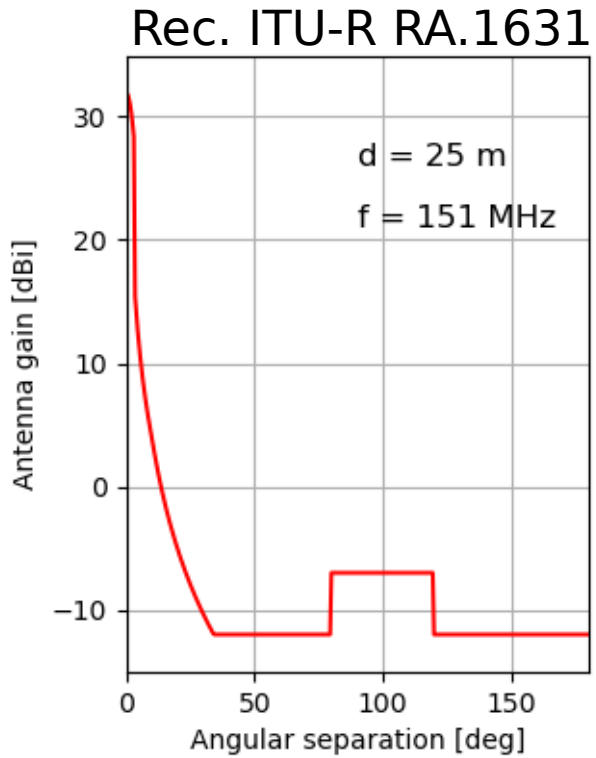


*With additional software: cysgp4

Compatibility calculations & software





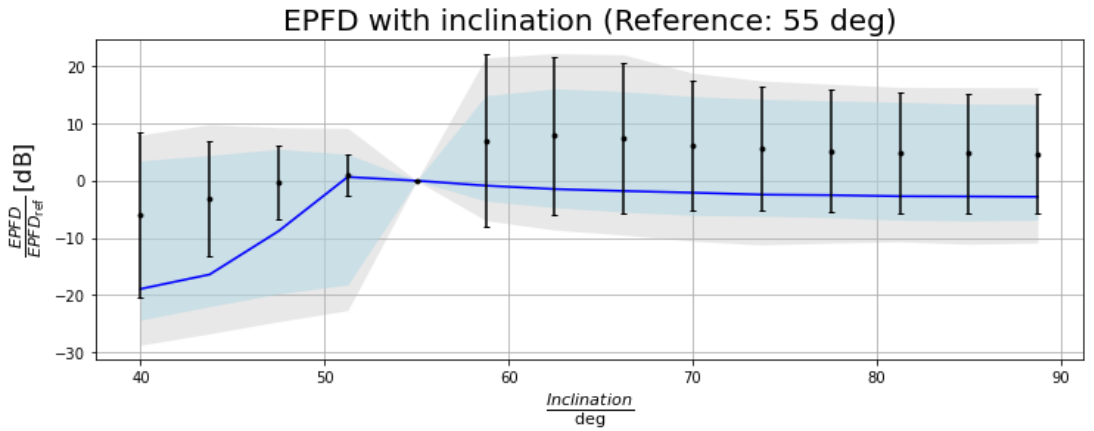


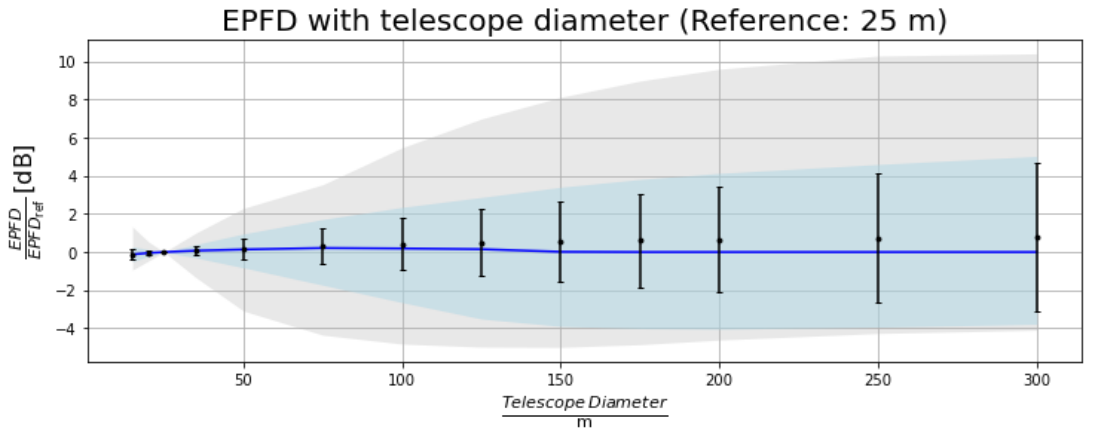
In collaboration with SKAO (F. Di Vruno)

Compatibility calculations & software

Draft New ECC Report [Satellite Aggregation]

- Rec. ITU-R RA.1513: 2% data loss from one system, 5% from all (per band)
  → Not implemented for sat constellations
- ECC admins refused regulatory work, but accepted a technical work item
  → Study aggregation





Study by G. Jozsa (work in progress)

Compatibility calculations & software

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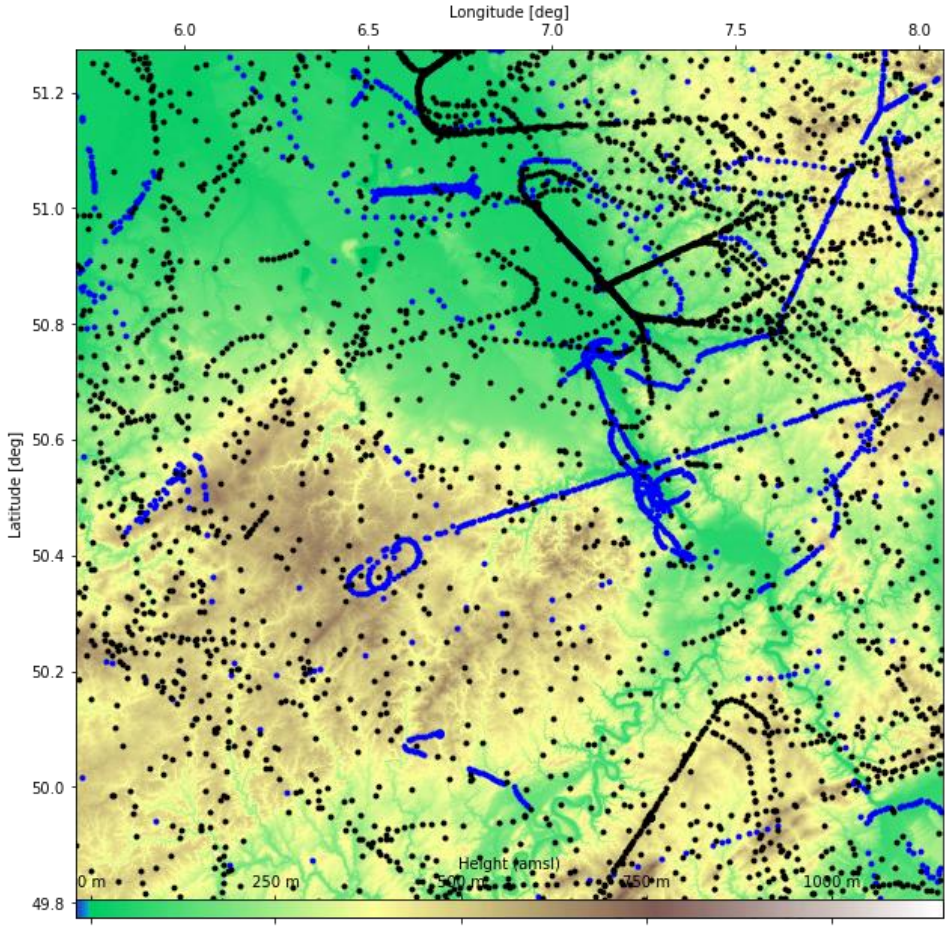

One hour of data

Compatibility calculations & software

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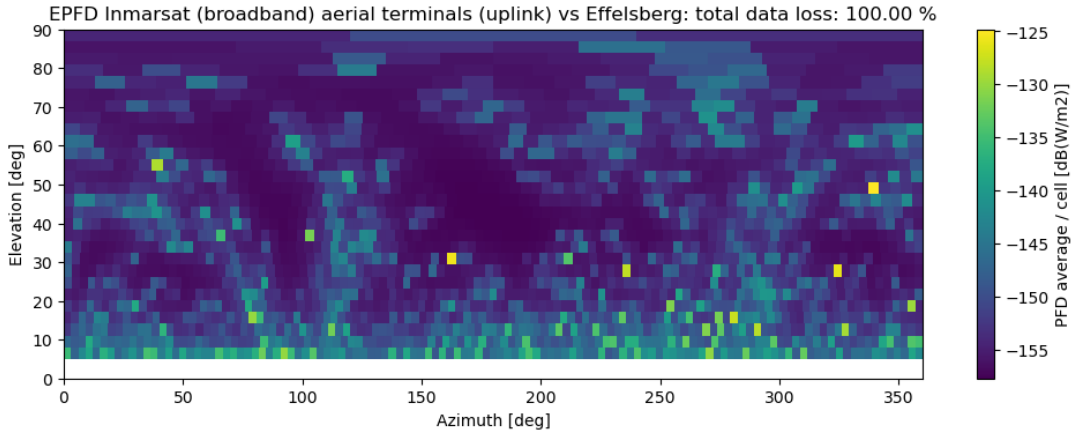

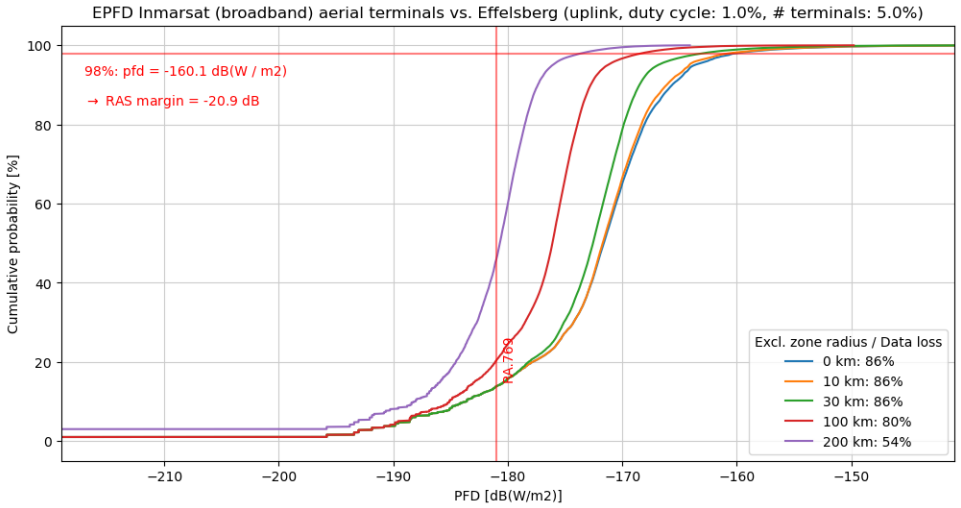

Note: technical parameters not yet finalized!

Compatibility calculations & software

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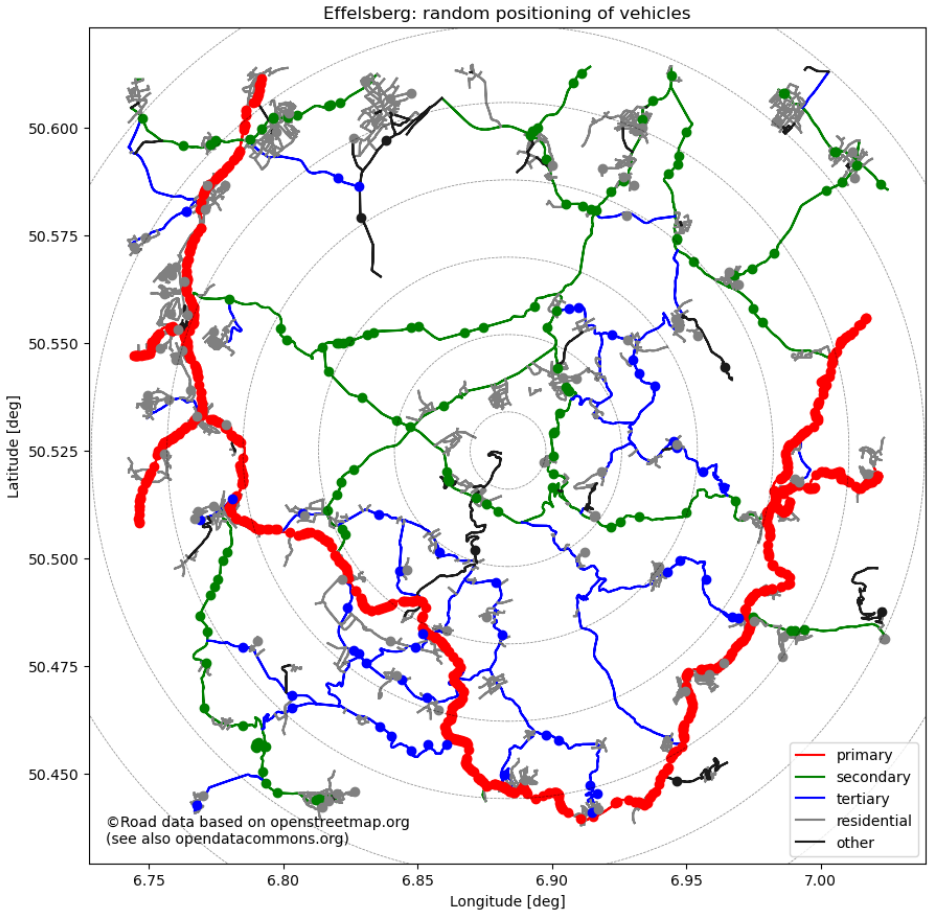

See ECC Report 327 for details

Compatibility calculations & software

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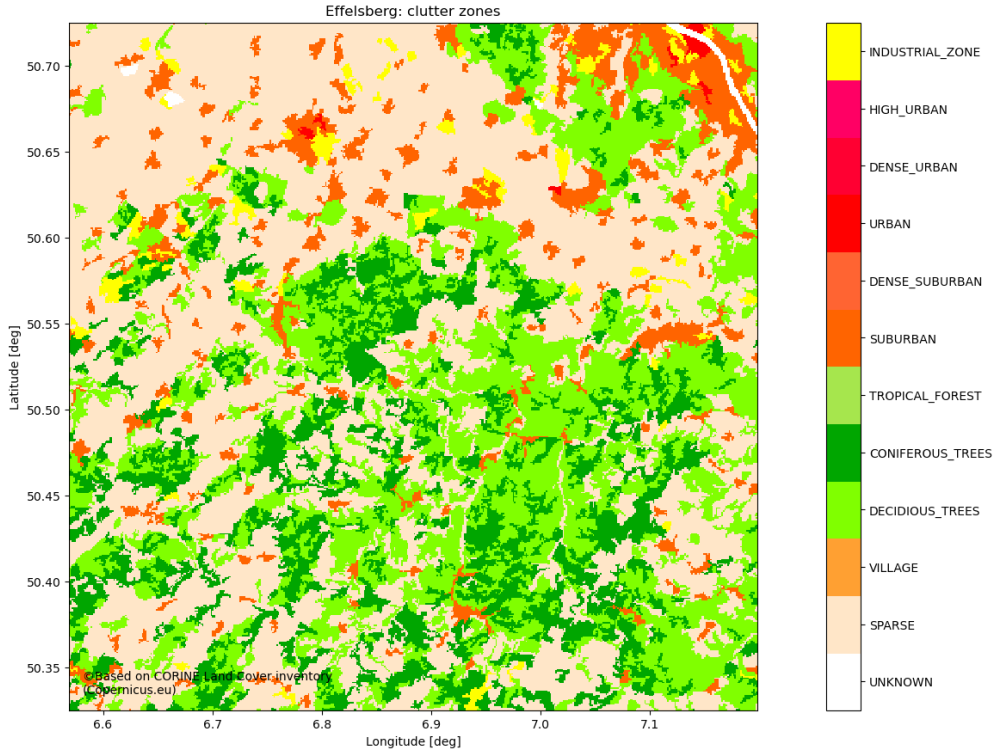
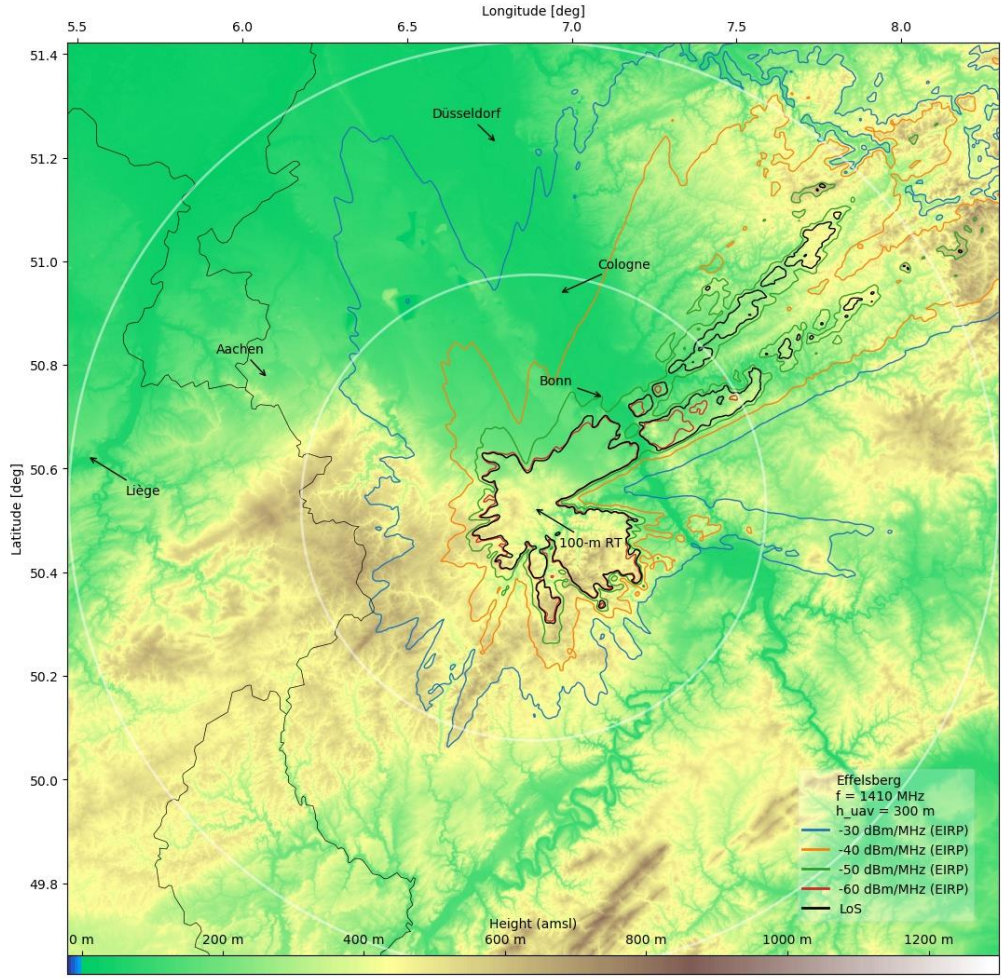


2nd harmonics from aerial MFCN UE

CEPT: want to use MFCN user equipment on-board (commercial) drones and aircraft

- In almost all European MFCN bands
- Protection needed for
  - → LTE700 2nd harmonics into 1.4 GHz
  - → LTE800 2nd harmonics into 1.66 GHz
  - → LTE2600 OOB into 2.7 GHz
  - → 5G@3.4 GHz into 3.35 GHZ
- Regulation (Draft New ECC Decision):
  - → Special aerial SIM card
  - → No-fly/no-transmit zones *and/or*
  - → Stricter BEMs



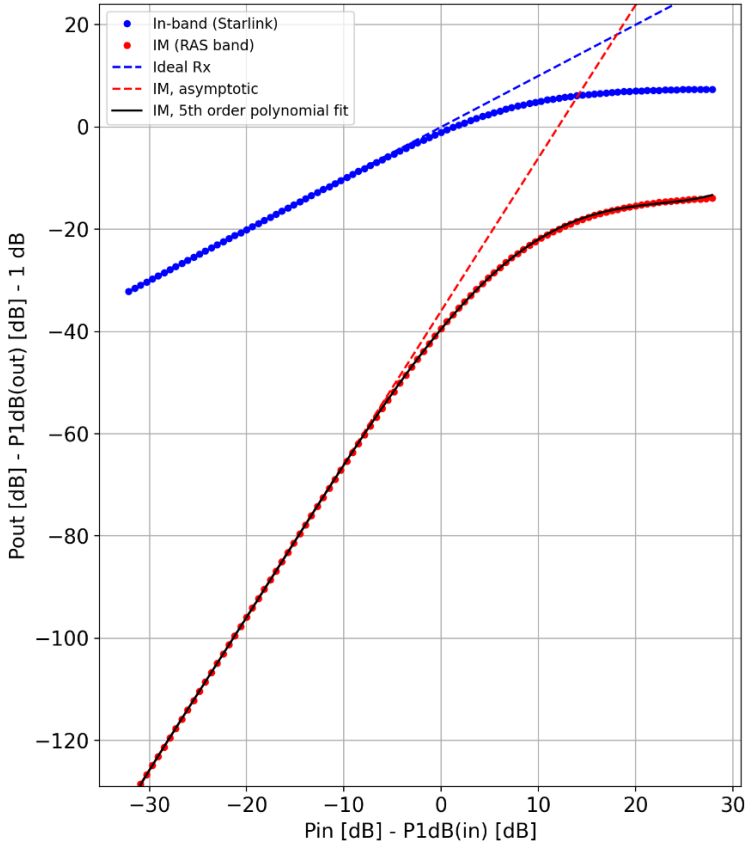
See ECC Report 309 for details

Additional protection from Starlink satellites

CEPT: OneWeb and Starlink studied in detail in ECC Report 271, including RAS at 10.7 GHz

- Guard band to protect RAS (lowest carrier above 10.95 GHz!)
- However, we will “loose” almost 2 GHz (in terms of opportunistic observations)
- Threat: high Starlink downlink power could saturate/block RAS receivers
  → Based on a CRAF study, a few European countries (Germany, Italy, Spain) ask Starlink to switch off beam over RAS station

Broadband intermodulation products



See ECC Report 271 for details

Part 3: Current issues in CEPT

Attack on passive bands

RR Footnote 5.340: “All emissions are prohibited in the following bands […].”

- This is our strongest sword
- Recently, industries/administrations try to get other applications into these bands
  → UWB Radars between ~2 and 12 GHz (backed by EC Decisions!*)
  → ITU-R Resolution 731: Sharing conditions above 71 GHz?
  → RDI-S above 116 GHz
  → Security scanners in C-band (off-the-table for now)
- Every time it’s “an exception”, of course → Pandora’s Box
- Huge strategic importance
  → We must heavily oppose, even if compatibility is possible on paper

*European Commission Decisions cannot be ignored by member states (while ECC Decisions can)

Agenda Item 1.2: Methanol band @ 6.65 GHz

AI 1.2: New IMT identification in “mid band” (~3–11 GHz)

- Important methanol line at 6.65 GHz only protected via RR 5.149 (no allocation)
- Resolution 245 phrased in a way that RAS studies are deemed out of scope
  → Tried ITU-R Report at 7D, but delayed at least until after WRC
- CRAF compatibility studies
  → Huge separation distances for base stations (in-band)
  → Multilateral solution necessary, BUT 5.149 is about assignment, only
- This is only about Region 1, but will seriously affect VLBI!
- If no IMT identification, CEPT may allow WAS/RLAN (WiFi)

Conclusions

- CRAF functions very well
  → High number of active members
  → Professionalized management and processes
  → Versatile software tools developed
- A number of serious threats has to be handled
  → Attack on 5.340 bands
  → Methanol line at 6.65 GHz at stake (AI 1.2)

Thank you!