DORIS DAYS 2021

November 16,17 and 18

Impact of local antenna environment on data quality

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Session 3 – Presentation 8

Summary

- Interest for the analysis of the stations’ environment
- How to monitor the environment quality?
- Example of Reykjavik
- Example of Jiufeng

Why analysing the antenna environment?

A radio signal may be degraded or lost by:

- Plain masks (building, mountain,…): no data in its direction + degradation in its vicinity
- Translucent medium (vegetation): degradation (refraction)
- Reflection on the ground (multipaths)
- Radio-interference

Analysis necessary for:

- Evaluating a **new site**
- Evaluating a **renovation**
- Analyzing data when a **problem** is raised on a station
- Determining the **next renovation** to be conducted

 Need for a regular health check of the stations by analyzing:

- The signal **amplitude** (received power)
- The signal **phase** (residuals of CNES POD adjustment)

Values to be monitored

<u>Power attenuation</u> = {**measured** received power – **theoretical** received power} on both frequencies (400 MHz & 2GHz).

The theoretical power is given by:

$$P_{theo} = P_{tran} - l_{gr} + g_{gr}(\theta) - p_{path} + g_{boa}(\theta) - l_{boa}$$

gr = ground
boa = on-board
l = cable loss
g = antenna gain
θ = elevation
p_{path} = path loss

The <u>mean</u> of all values in a 0.5° x 0.5° square is computed. In order to eliminate the biases (cable length, etc.) we substracte the average on the whole geometry.

<u>POE residuals</u> : DORIS-only 2 GHz residuals from CNES POE (Precise Orbit Ephemeris)

The <u>RMS</u> of all values in a 0.5° x 0.5° square is computed.

The results are compared with the fisheye/panoramic views (360° views) from IGN if available, or other pictures of interest

Reykjavik: short history

- 1990: 1st Installation in Reykjavik (REYA, then REYB)

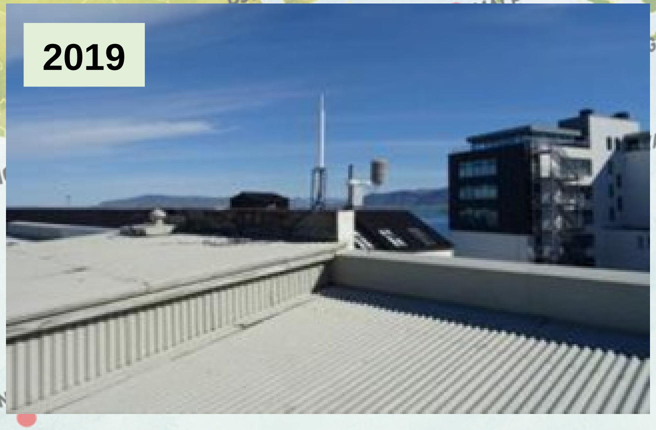
Problem: RF interference in the vicinity of the antenna

- 2004 : move on the roof of the Public Transport Admin. building (REZB)

Problems: Corrugated iron roof at the foot of the antenna + upcoming demolition of the building + new buildings around

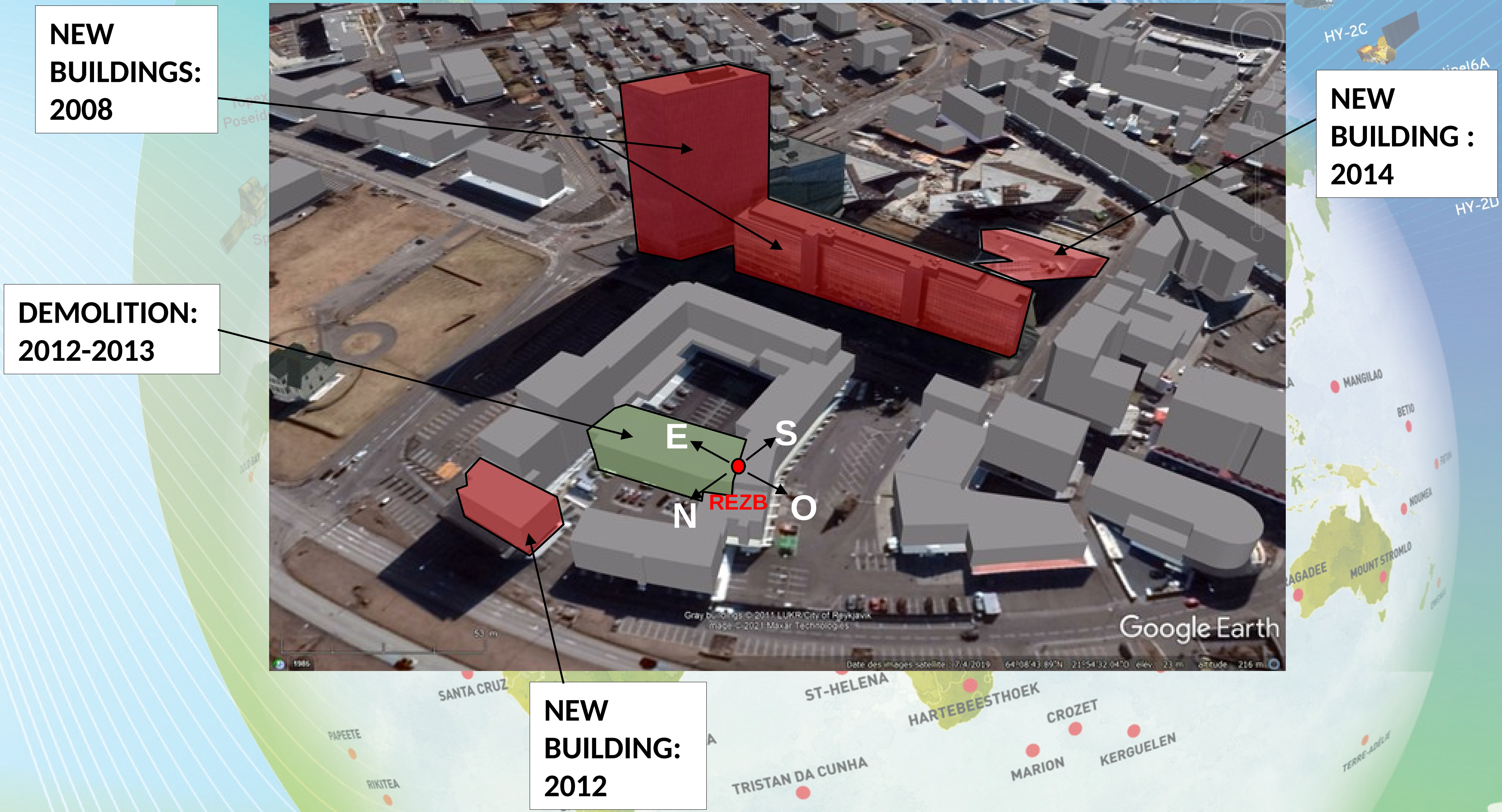
- 2020: move at Höfn (HOFC)

Many changes in Reykjavik environment, but the corrugated iron roofs are still present (images below)



Reykjavik: 3D view

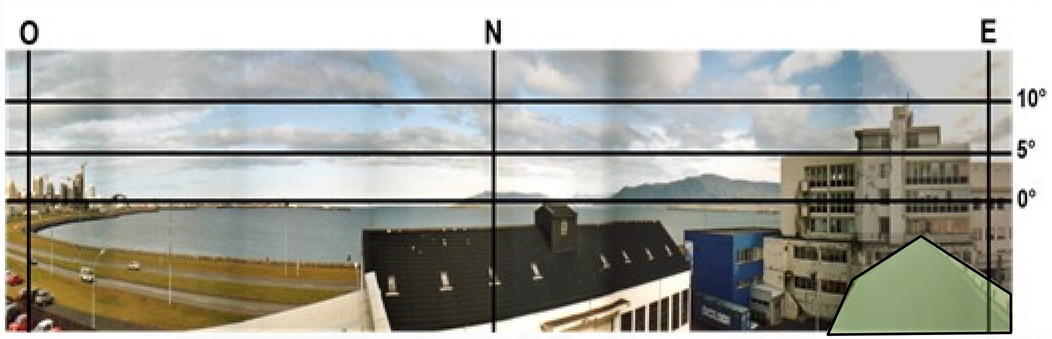
Significant changes in the close environment of REZB between 2004 and 2019

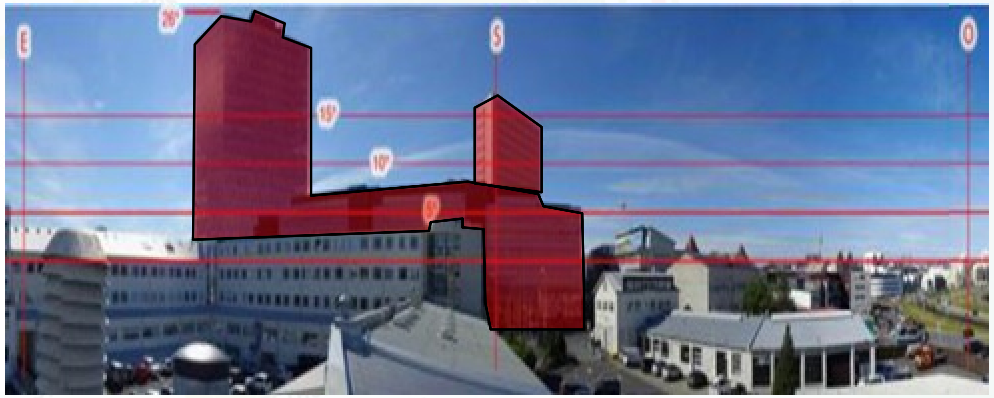


Reykjavik: evolution in the panoramic views

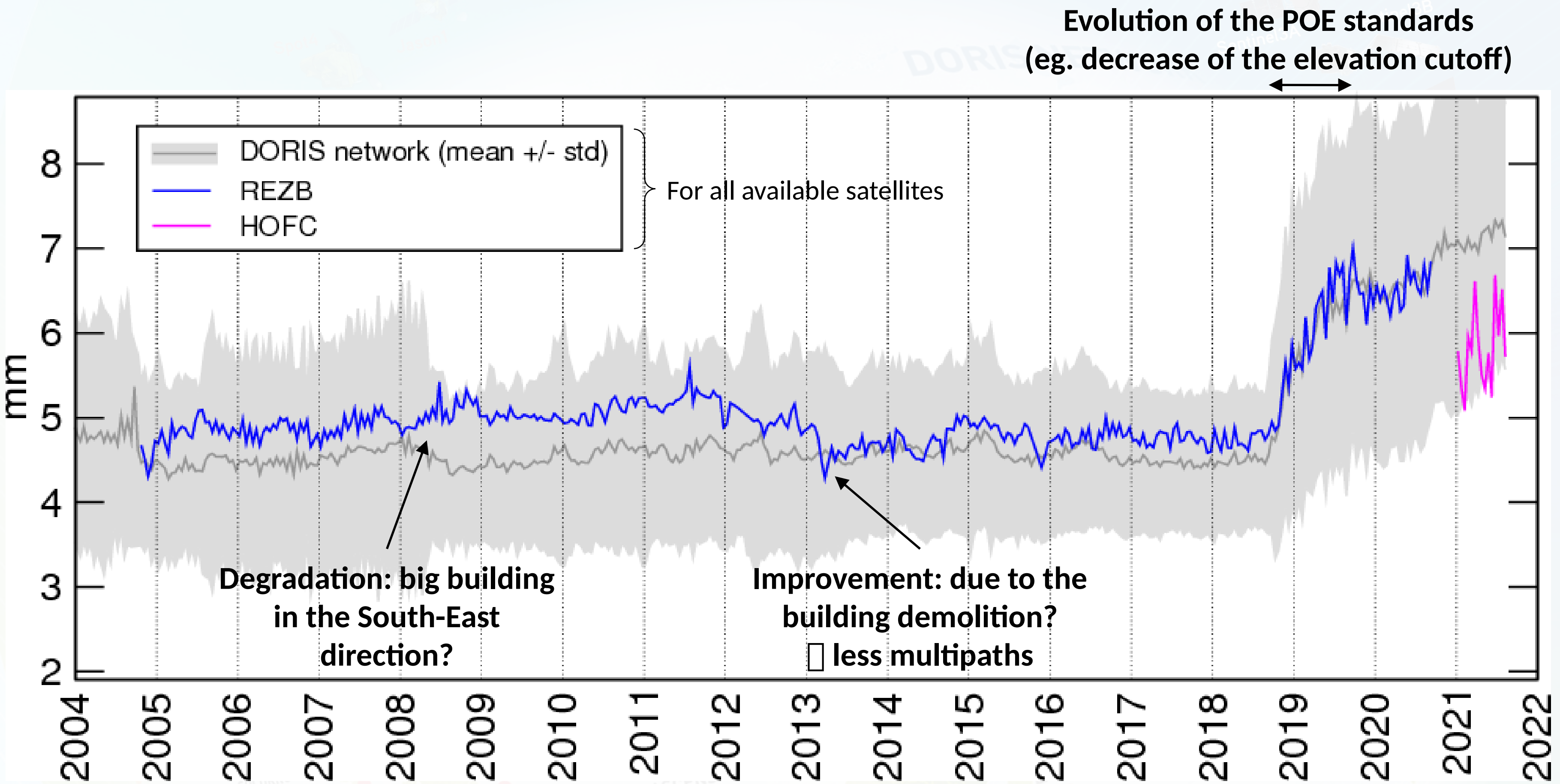
2004

2019





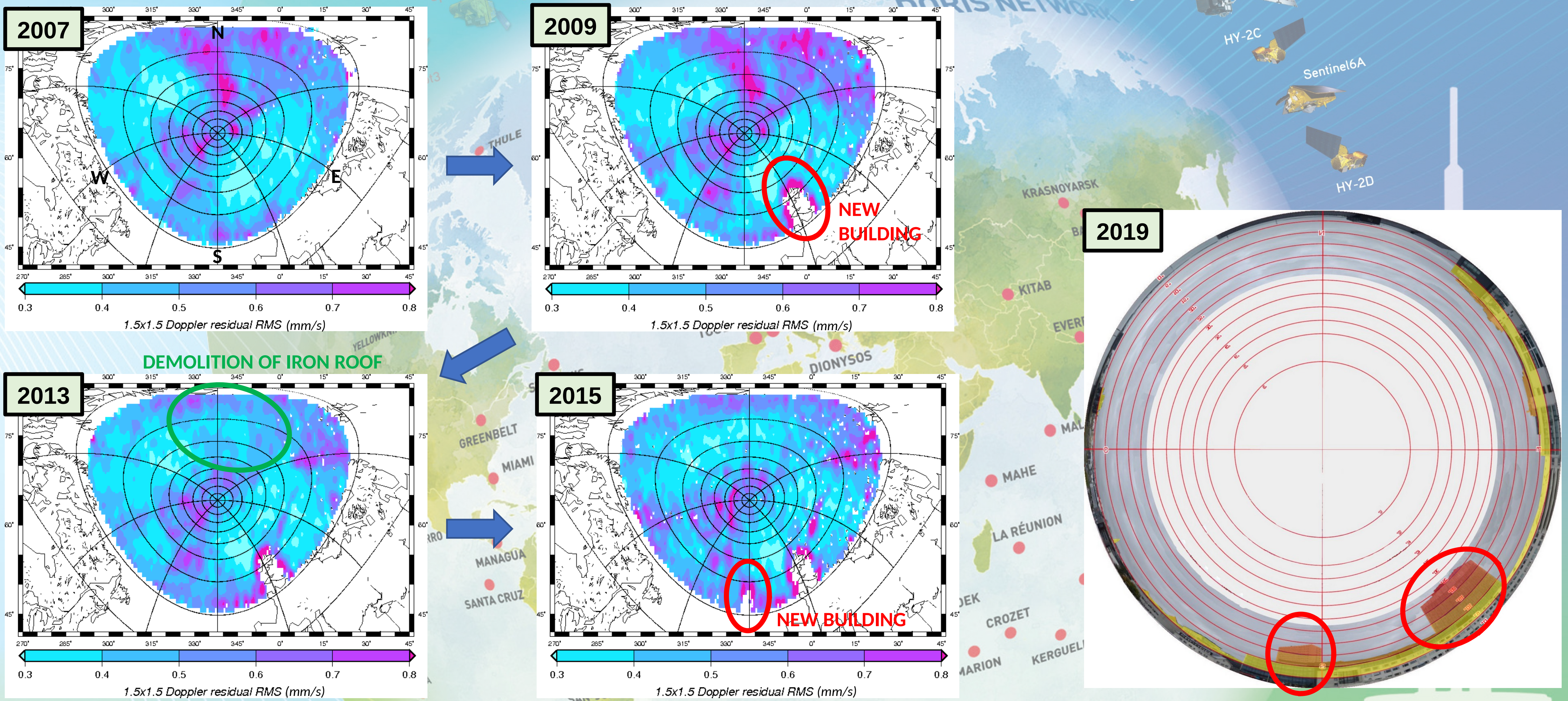
Reykjavik: POE RMS time series



POE ranking

51th 49th 51th 46th 44th 40th 31th 38th 38th 38th 39th 43th 35th 31th

Reykjavik: POE RMS maps (SPOT5)

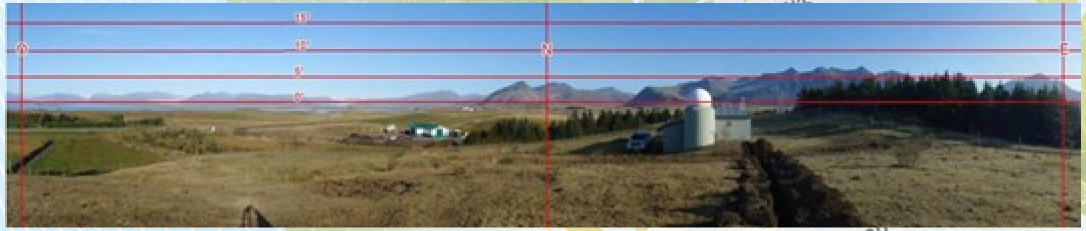


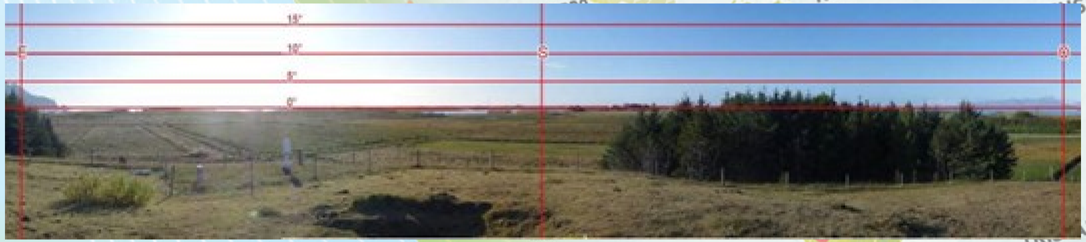
Reykjavik to Höfn

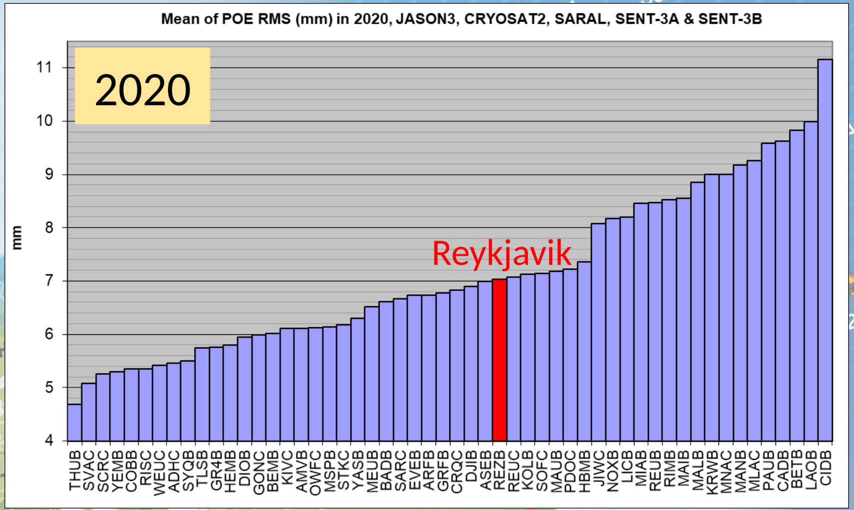
The new site in Höfn has an excellent clearance (no mask above 7°).

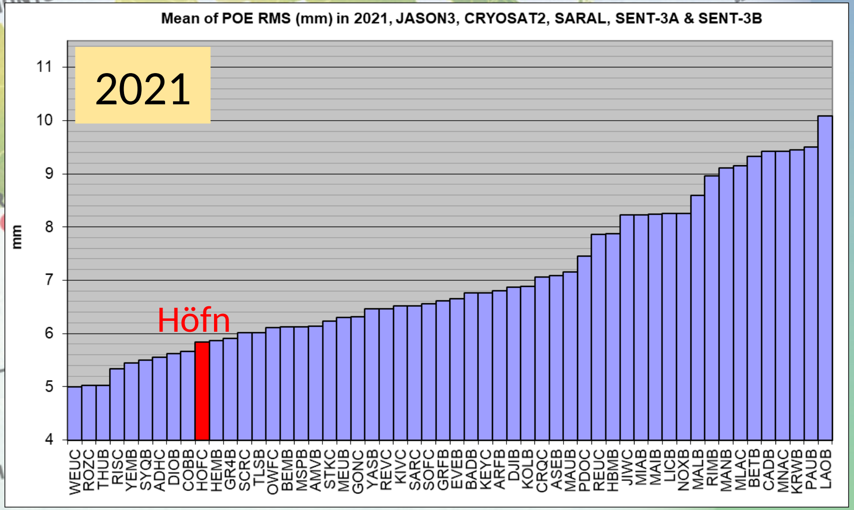
The short grass at the pillar foot is optimum to avoid multipaths

The Icelandic site is now in the top 10 sites for POE RMS.

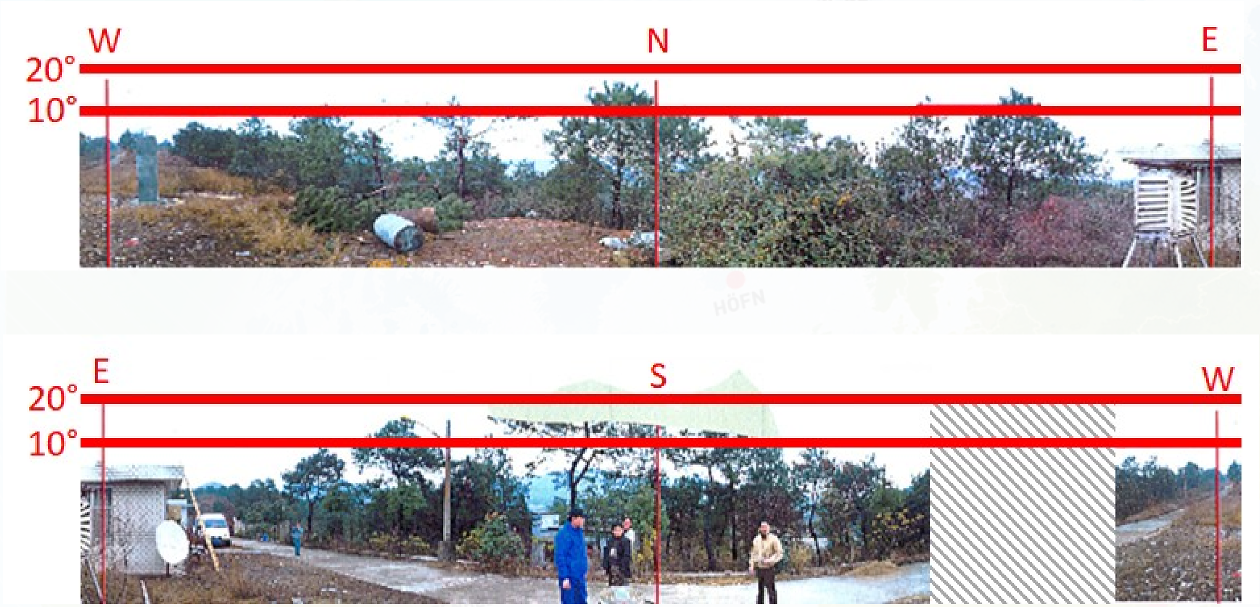








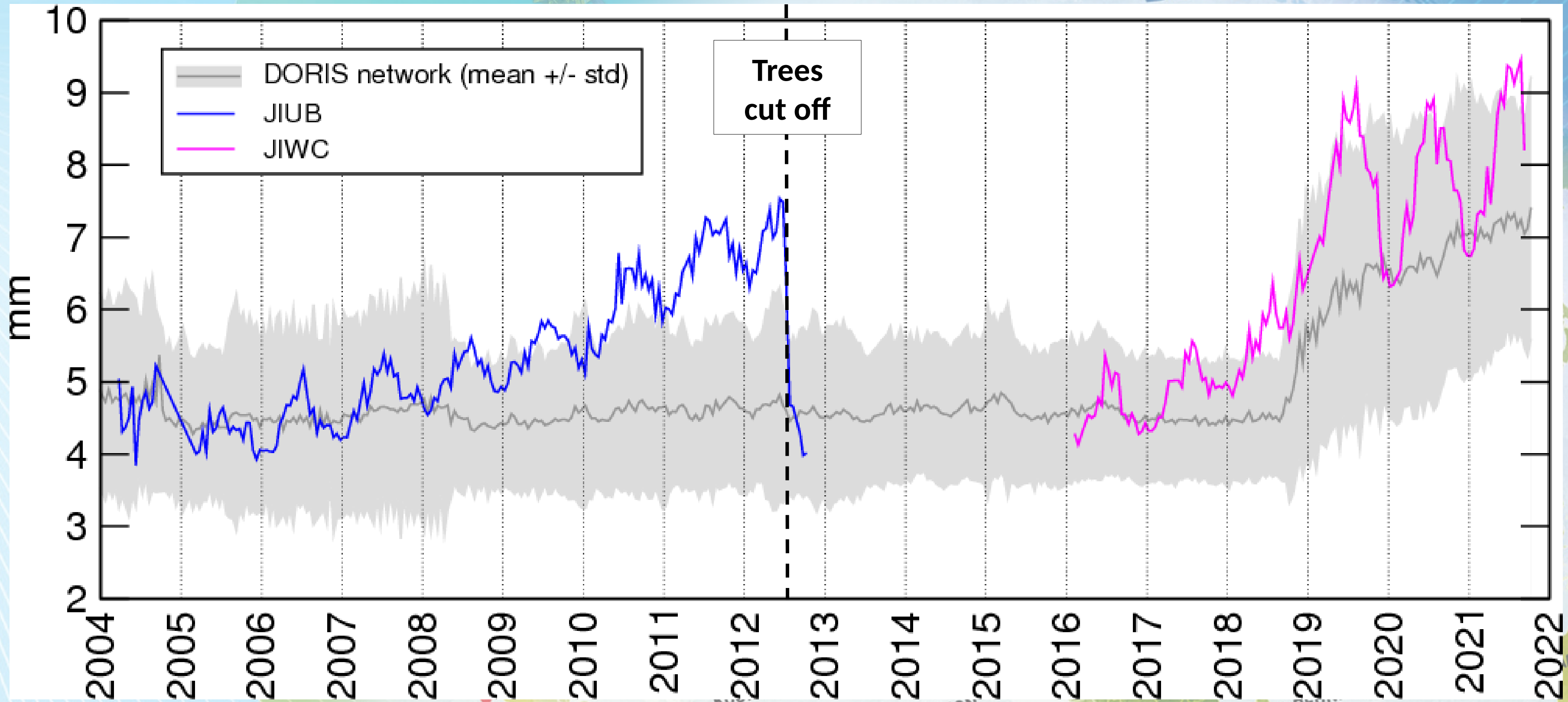
Jiufeng: on site panoramic views



Many trees all around the antenna, mainly in the south and north directions

Pictures taken in 2003, from *Report of the Doris Installation at Jiufeng, IGN, 2005*

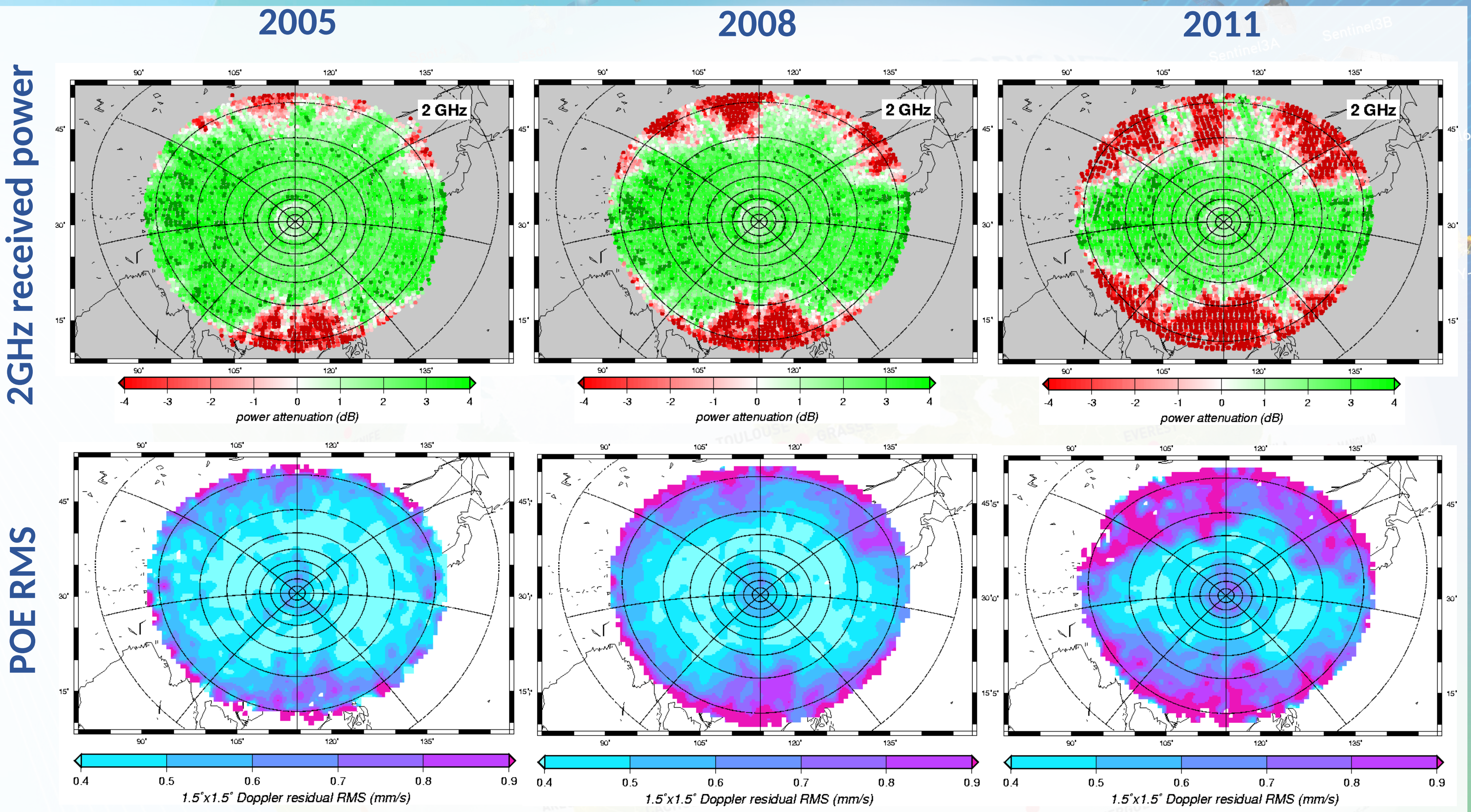
Jiufeng: POE RMS time series



Clear continuous degradation (mainly a power loss) due to the **vegetation growth**

Seasonal signal due to the **densification of the foliage** in summer.

Jiufeng: deterioration between 2005 and 2011



Jiufeng: trees cut off in 2012

Before

After

Conclusions

- The signal quality is highly dependent on the environment quality
- Reykjavik and Jiufeng give 2 typical examples:
    - ➢Masks (buildings) data loss
    - ➢Reflecting material (iron roof) multipaths
    - ➢Translucent medium (vegetation) degradation due to refraction

        + with an evolution of the vegetation: linear drift + seasonal variations