

New frontiers of altimetry

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Doris ground network performance and monitoring

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OUTLINE

- Reminder about DORIS system
- Quality parameters and usage
 - Orientation for interventions
 - Global quality monitoring
- Examples
- Installation requirements and compliance matrix

Introduction / reminder

- DORIS system is based on Doppler shift measurement of RF signals

DORIS system, it is :

A ground network

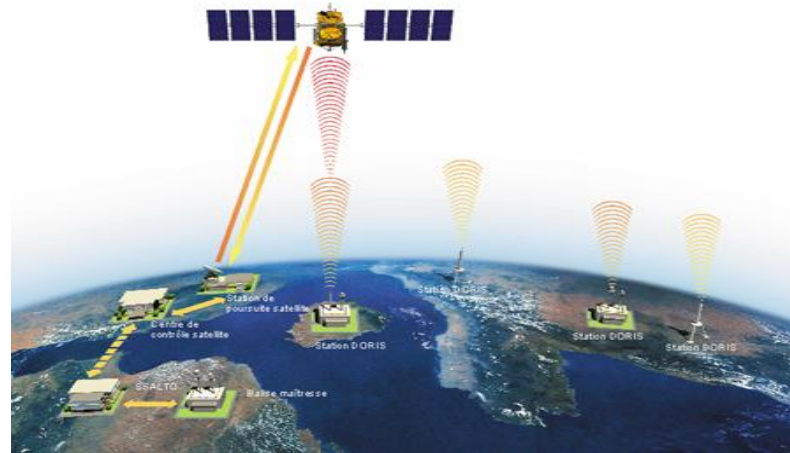


Several on-board instruments



For one given DORIS mission

The network is as important as the instrument



SALP mission

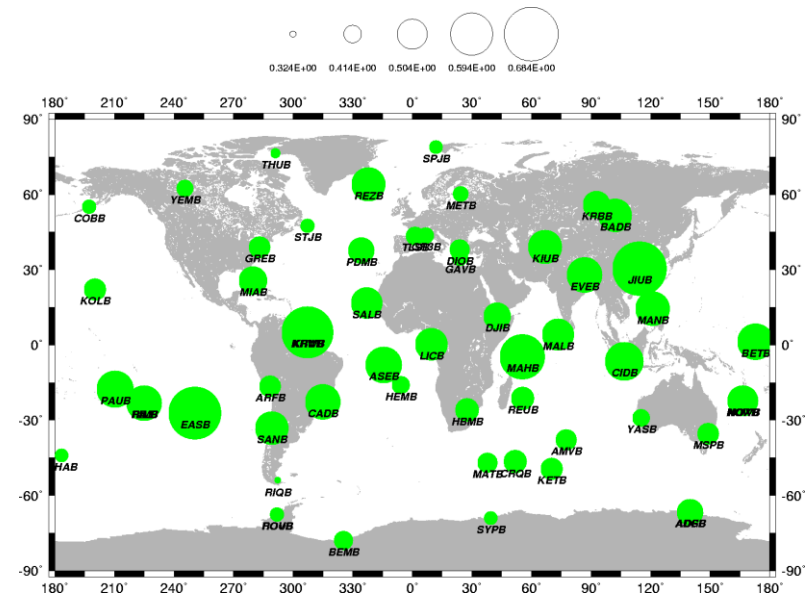
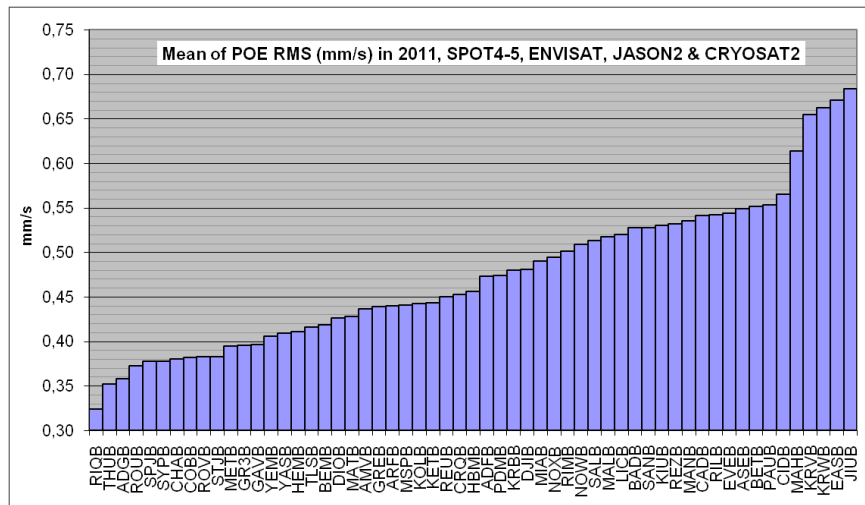
- **One of the SALP project missions is to maintain the DORIS network**
- **This means :**
 - **Maintain a high level of availability**
 - Monitor DORIS stations transmissions
 - Fix or replace material in case of failure
 - Prevent failure by identifying default and corrective actions.
 - Work preformed routinely (availability over 85% since 2006)
 - **Guaranty and improve the network quality as much as possible**
 - Define parameters relevant of station quality
 - Monitor those parameters,
 - Define action plan to improve quality when possible.
 - Mid/long term work based on :
analysis of :
 - RF signal transmission
 - Ground treatment outputs**improvement of installation**
 - REX assimilation in specifications
 - New specifications for new objectives

Quality parameters and usage

- **Quality is checked at several levels**
 - **Observation on the signal received on board**
 - Power level
 - **Ground treatments outputs**
 - Residuals from precise orbit processing
 - Residuals from precise localization processing
- **Those parameters can be used in different ways :**
 - **To establish a relative ranking of site quality**
 - **To observe the evolution :**
 - of each site quality
 - of the global network quality
 - **To characterize the quality of one site and determine possible improvements**

Network sites relative quality

- **Every year an assessment is performed on POE residuals for all DORIS sites**
 - The mean of POE residuals is determined for all stations over the full year,
 - It allows to distinguish sites where improvement can be made,
 - Two ways of looking at it :



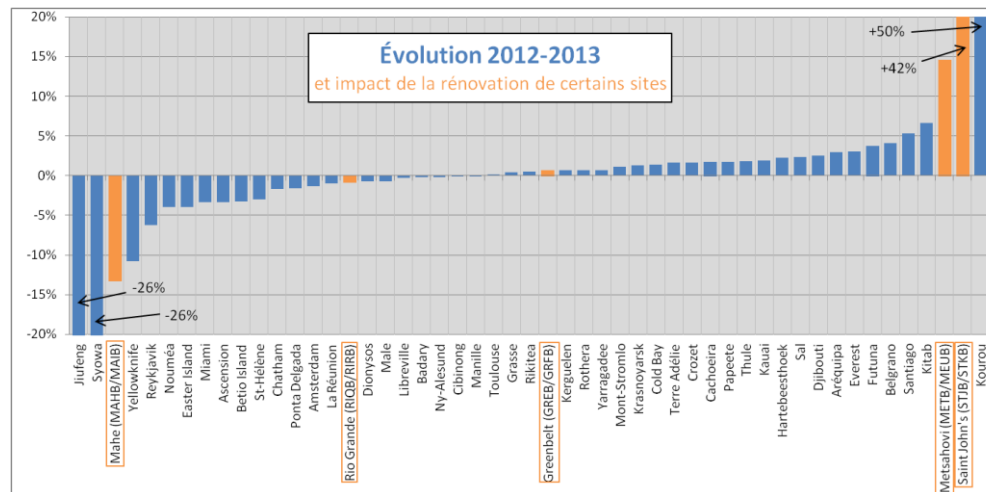
- **There is a latitude effect that must be taken into account :**
 - Sites at high latitudes have more measurements and consequently more weight in solutions
- **The map helps to distinguish real problematic sites**
 - The latitude effect is easily visible

Sites quality evolution

DORIS stations are not transmitting in a fixed environment

DORIS stations elements can present degradations that do not impact network availability but decrease stations performance (USO ageing...)

=> Every year a comparison of residuals with those of previous one is performed



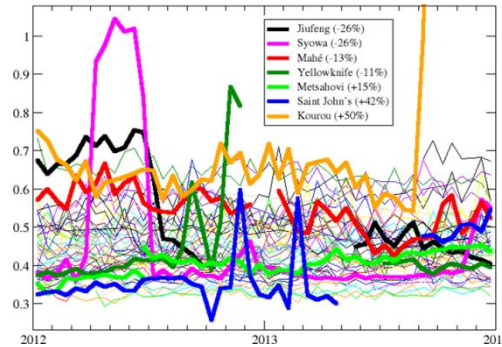
- This evolution (given in percentage) allows :
 - to identify sites with abnormal degradation
 - Investigation are meant to determine degradation origin
 - to measure the impact of station renovations

Use of indicators

Those metrics are used to analyze sites needing improvement:

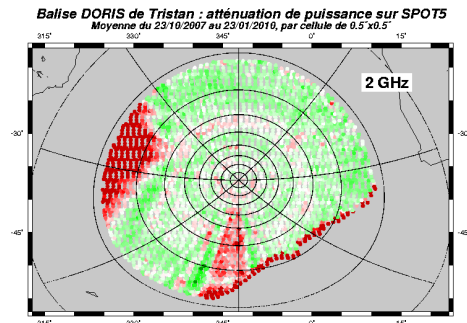
- **Specific investigations :**

- Temporal analysis

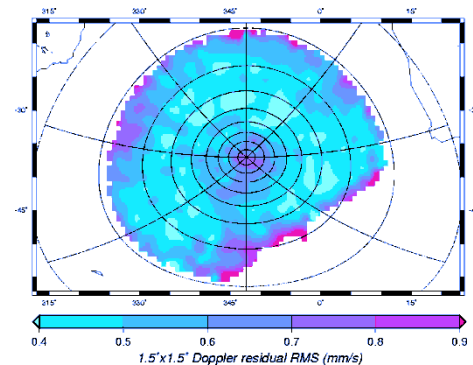


- Geometric analysis

- signal power level received



Residuals

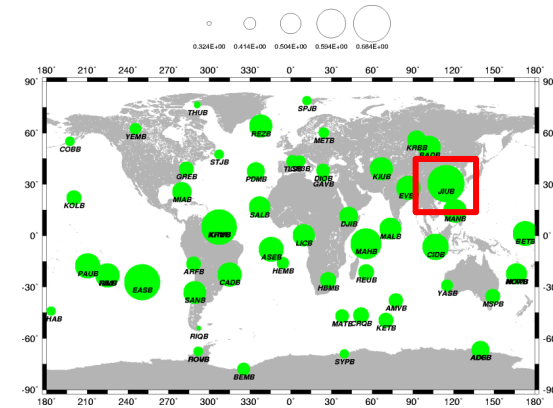
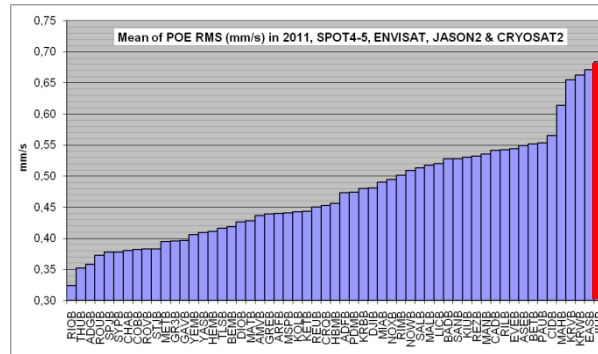
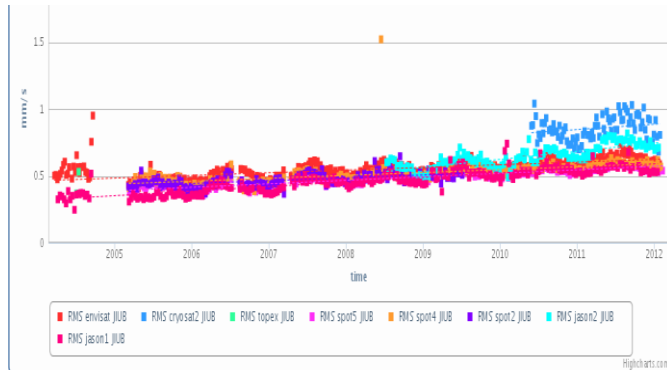


- **Corrective actions**

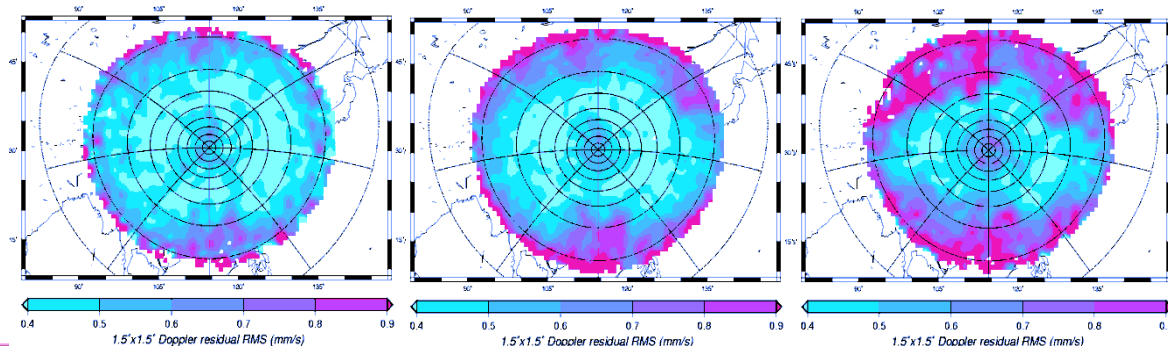
- Material change
- Environment modification
- Antenna re-location

Examples : Jiufeng (1/2)

- **Progressive increase or RMS**
 - Jiufeng station strongly degraded performance

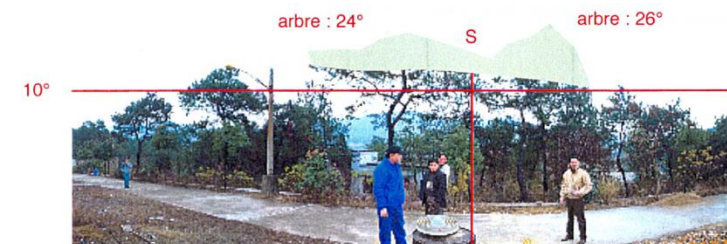


- **Investigation**
 - The evolution of RMS is progressive and constant
 - Localized on North and South of the visibility circle



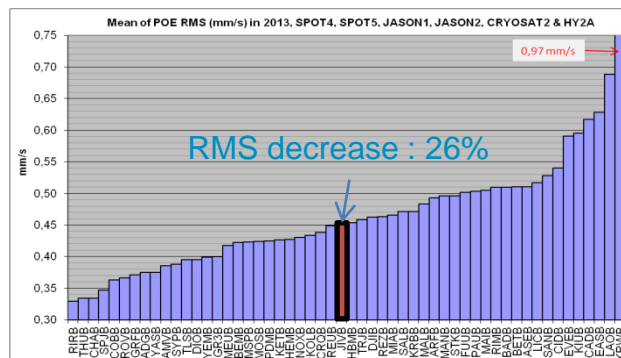
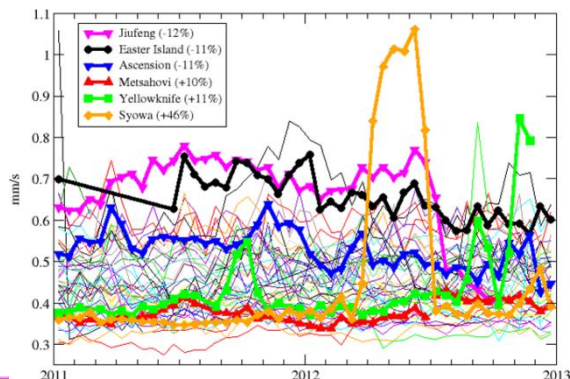
Examples : Jiufeng (2/2)

- **Site observation :**
 - **Vegetation height strongly increased**
 - Match with quality degradations observed.



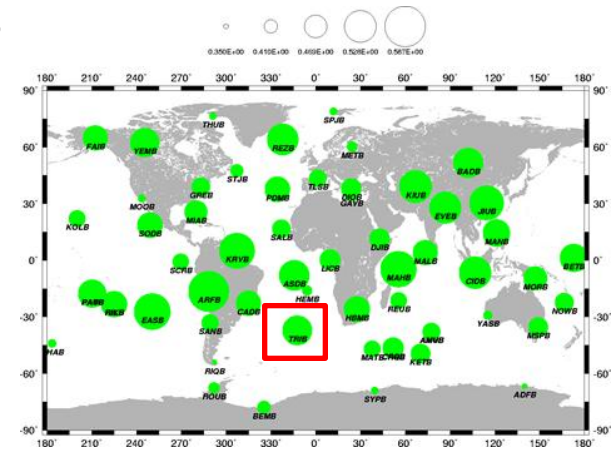
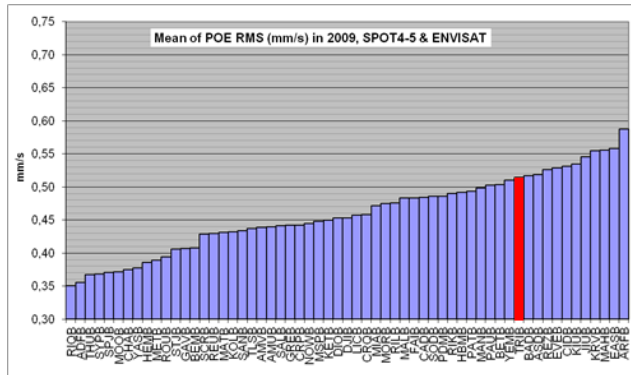
- **Several options considered :**
 - **Antenna raising**
 - **Station re-location**
 - **Cutting back Vegetation**
- **simplest : vegetation pruning**
=>request to the host agency => OK

- **Results after the pruning of trees:**



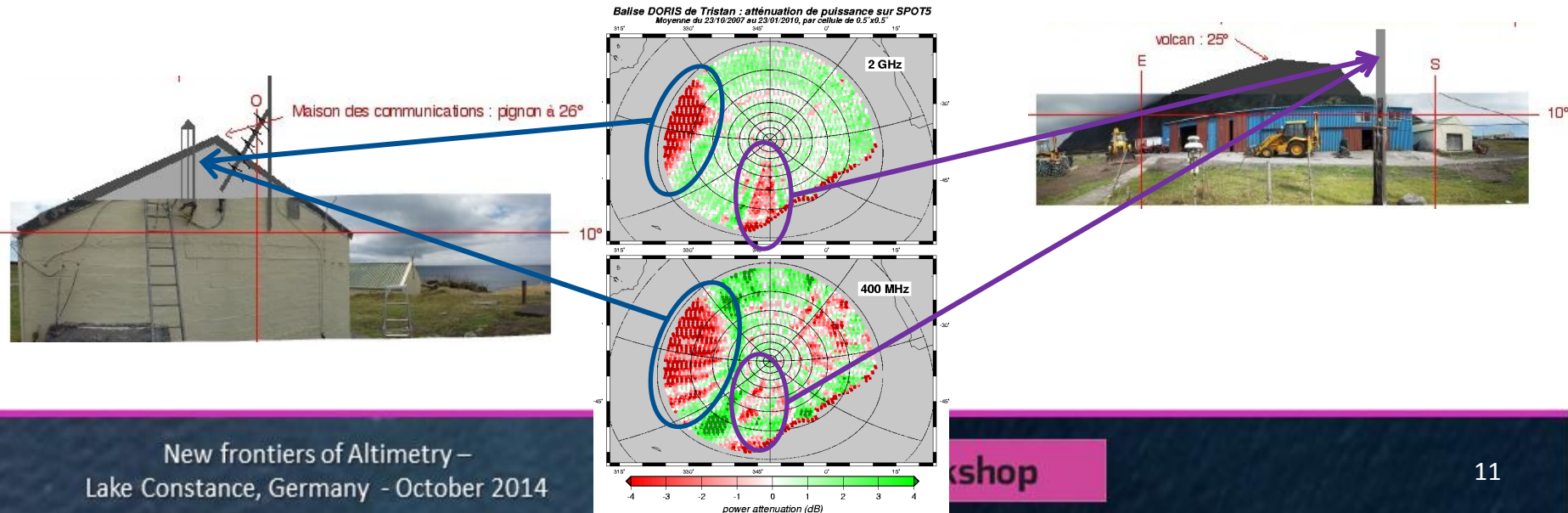
Examples : Tristan Da Cunha (1/2)

- Tristan Da Cunha station among the lowest performers



- Investigation

=> important masks degrades the signal



Examples : Tristan Da Cunha (2/2)

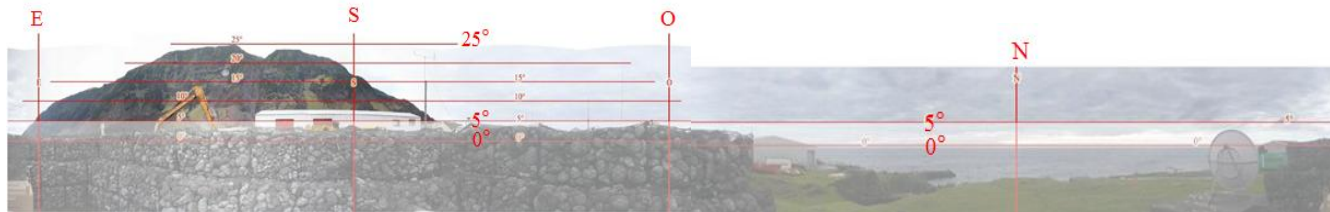
- **Options possible:**

- Antenna raising => not possible, would need to raise too high
- Pylon and building removal => impossible, used by host agency
- Station displacement => OK

- **New station location on the same Island found by IGN**

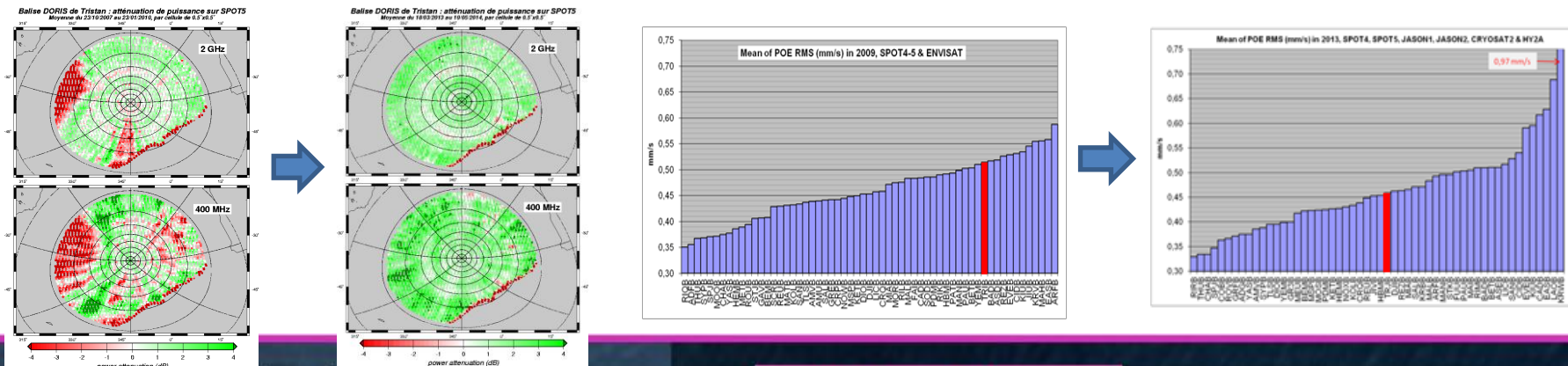
- **Station re-located and installed by IGN**

- Except the volcano (impossible to avoid on the island), no mask above 5° elevation.



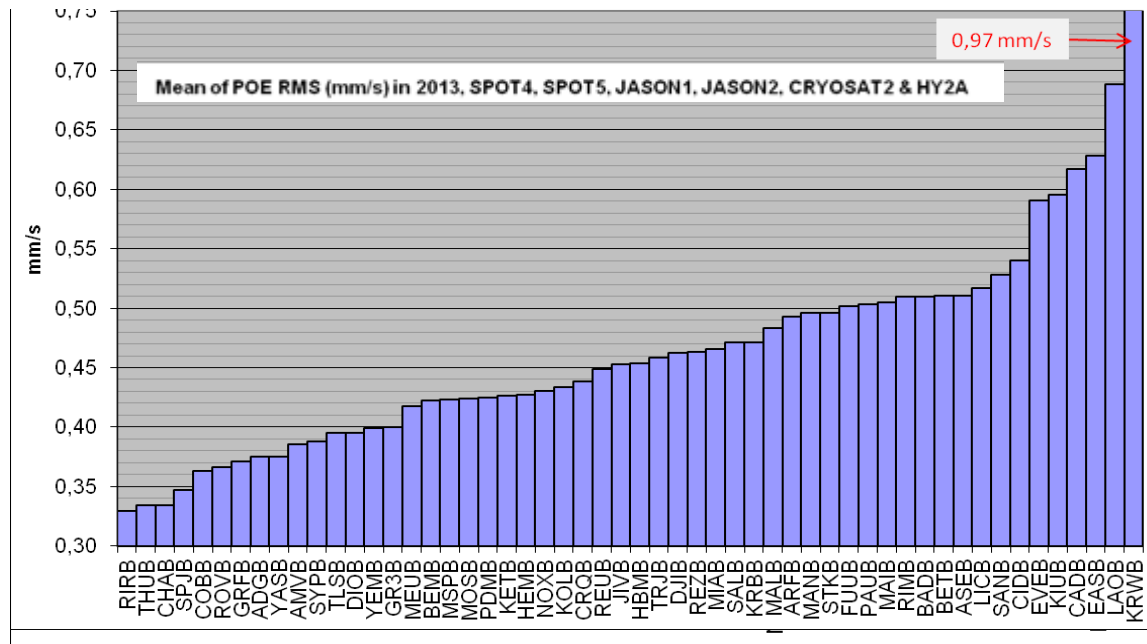
- **Results after re-location:**

- Significant improvement in the site quality



Global network quality evolution (1/2)

- To get an idea of the evolution of the global network quality
- Inter annual POE RMS evolution observation



- **Analysis results to be taken with care**
 - Would be relevant with a consistent constellation over time
 - The constellation change over time (instruments loss, new generation instruments...)**=> this gives an indication, not an absolute metric**

Global network quality evolution (2/2)

- **POE RMS is relevant of :**
 - **DORIS system noise : estimated at a level of 0,3mm/s**
 - Instrumental modeling accuracy
 - Dynamic models accuracy
 - **All disturbances that can be encountered on site:**
 - RF environment
 - masks,
 - reflecting surfaces
 - Other RF systems
 - Ionosphere disturbances (scintillations)
 - ...
- **The permanent DORIS network is composed of 56 sites**
 - **This means 56 different environments with specific characteristics**
 - **RF environment and impact on DORIS signal is a wide subject**
 - **We can not treat and characterize all DORIS sites**
- **However**
 - **Degraded sites are analyzed and treated when possible**
 - **In order to prevent, as far as possible, form disturbances**
 - Installation requirements have been improved
 - IGN contributes to the installation requirements evolution and works on site to:
 - select the best suitable site and location compliant with the installation requirement
 - Collect site specificities and examine the compliance with those requirements

Installations requirements (1/2)

Installation requirements were written in 2007 by CNES and IGN

- To specify selection criteria for new DORIS sites
- To define standards for DORIS stations installations
- Available on IDS web site :
 - ftp://ftp.ids-doris.org/pub/ids/stations/System_Requirements_For_Management_Of_The_DORIS_Station_Network.pdf

2 main levels of requirements:

- Operational requirements
 - Guaranty the stations availability
 - Power, beacon hosting building, accessibility...
- Performance oriented requirements
 - RF environment : visibility cone, envelope volume
 - Geodetic requirement : short/mid/long term stability

Installations requirements (2/2)

To keep information about compliance to requirements,

- A compliance matrix is filled in for each new site
 - It indicates for each requirement if the site is compliant or if a derogation is allowed
 - Main site specificities are given
- This matrix is also filled in for old sites during a visit,
- It allows :
 - To choose the best location on a site when several options are possible, based on objective criteria
 - To eliminate, as far as possible, disturbances by respecting the most requirements for new sites
 - to identify more easily degradation sources on old sites
 - to assess the network quality

THANK YOU