DORIS DAYS 2021

November 16,17 and 18

Network requirements

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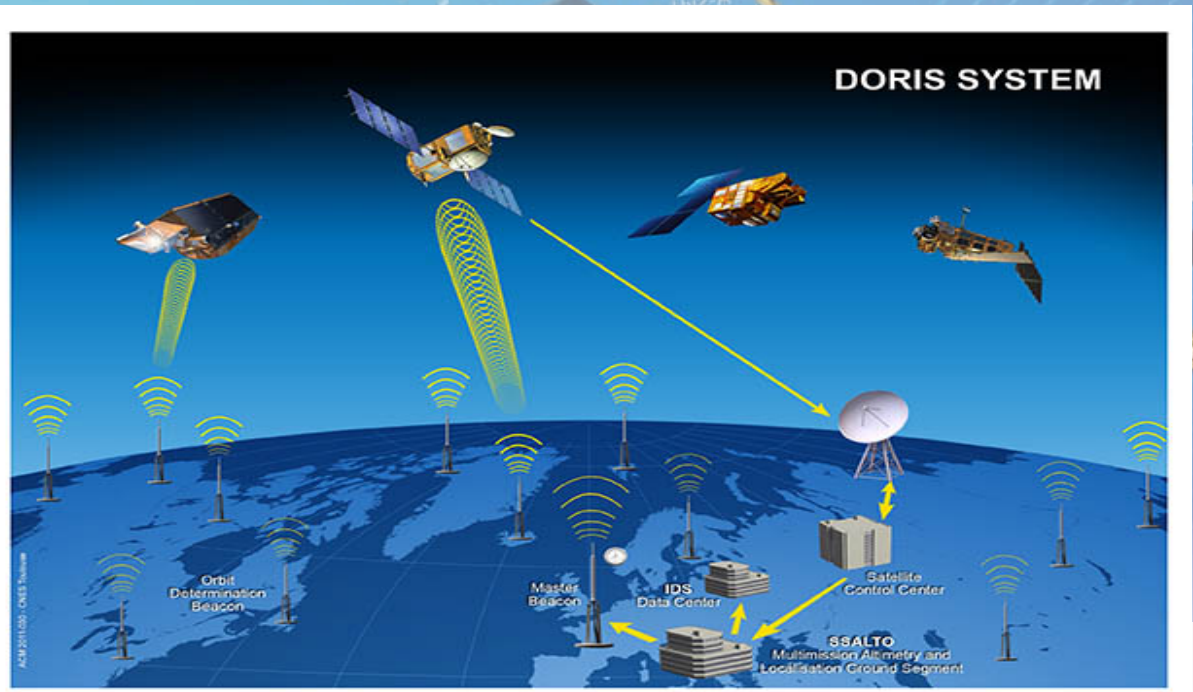
November 18

Session 3 – Presentation 3

Specificities of the system



1. Ascending system
   a. Manage Doppler collisions: avoid **internal jamming** between co-visible DORIS stations
   b. Control of network deployment: functional requirements, centralized maintenance

   => Unlike GNSS stations, you cannot set up DORIS stations wherever you want!

2. System mainly dedicated to satellite altimetry
   a. optimized for precise orbit determination => a **good geographical coverage** is required
   b. continuous service required => reinforcing the network in challenging areas: densification
   c. minimum rate of availability => monitoring and troubleshooting the stations

1a. Internal jamming

Network / EX.I_20: generate less than 10% of Doppler collisions with co-visible stations

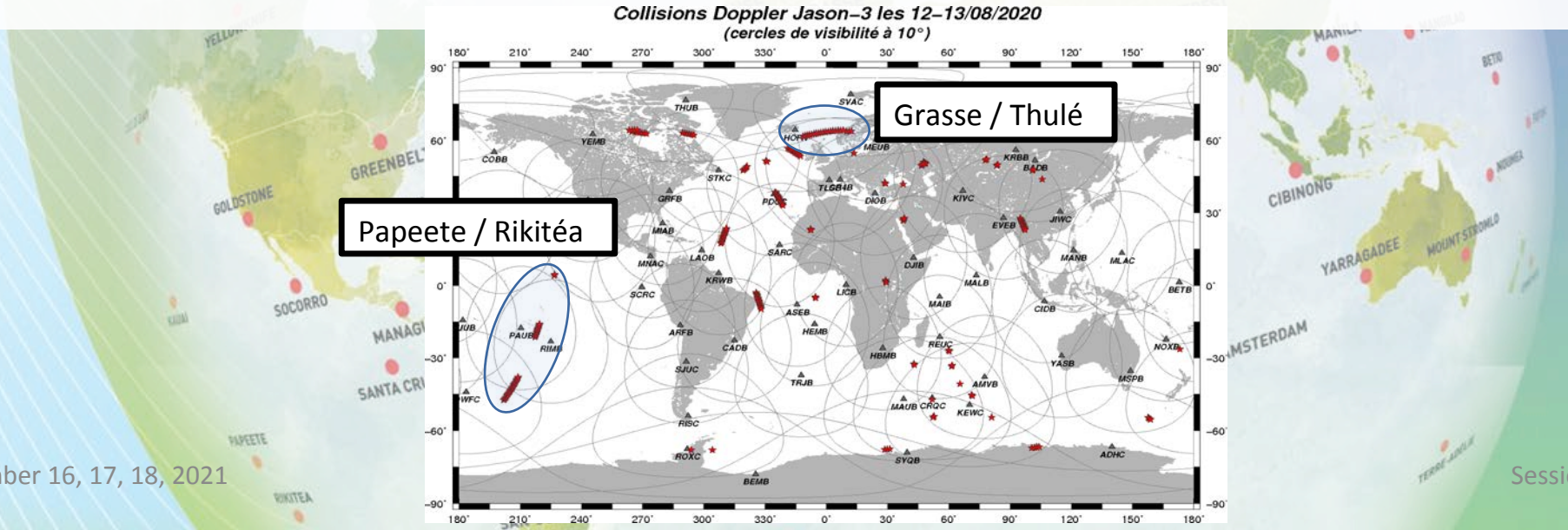
- The addition of all new site into the DORIS network is assessed through the CNES DORIS Simulation Software to analyze possible frequency conflict at the on-board receiving antenna when tracking several beacons simultaneously
- A way to reduce the number of Doppler crossings is to slightly shift a beacon frequency
- However, DGXX on-board receivers are able to track 7 beacons simultaneously at most

=> too many stations in the same area must be avoided

- See article in IDS Newsletter #9:

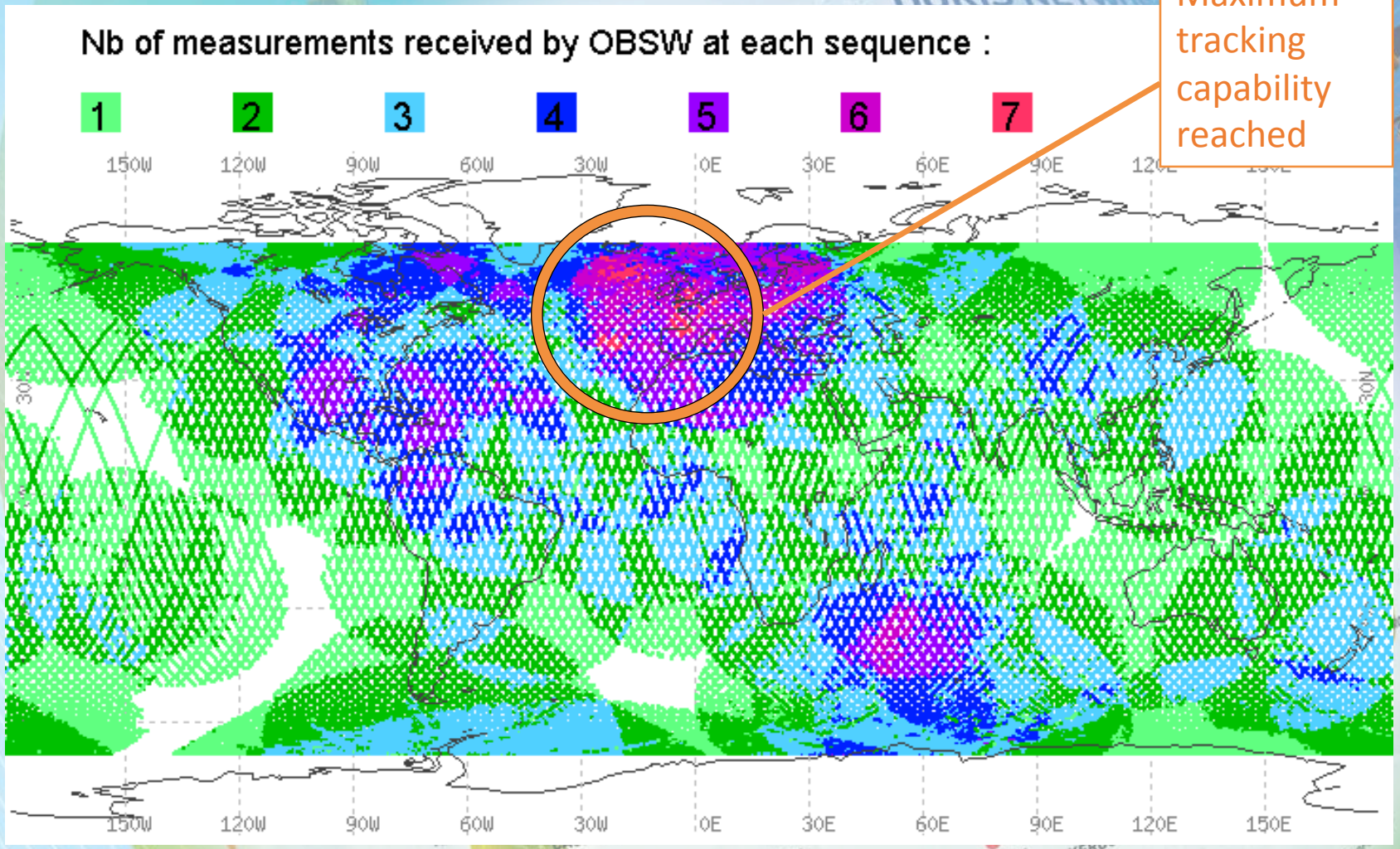
Doppler crossings on-board DORIS receiver carrier satellites by C. Jayles (CNES), J.P. Chauveau (CLS), P. Yaya (CLS)

=> https://ids-doris.org/images/documents/newsletters/IDS-Newsletter9.pdf



1a. Internal jamming

Beacons simultaneously tracking capability: 7-channels with DGXX DORIS on-board receiver



1b. Centralized control of the deployment

Functional requirements (operating configuration)

- Master beacons: providing an update of the network description and system synchronization
- Time Beacons: ensuring the on-board / ground time synchronization
- Orbitography beacons: about 50 stations providing continuous coverage of satellites path

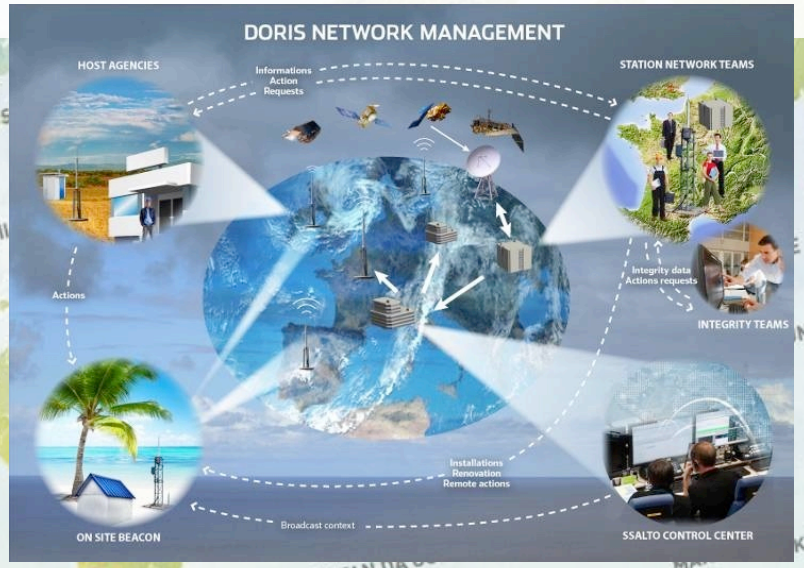
Radiofrequency interferences management

- Site reconnaissance and examination prior to installing a station

New sites are submitted to the approval of the “Groupe Mission DORIS”

- Decision-maker group comprised of CNES and IGN members (quarterly meetings)
- All new sites are added in the network monitoring and maintenance process

=> a DORIS station cannot operate independently



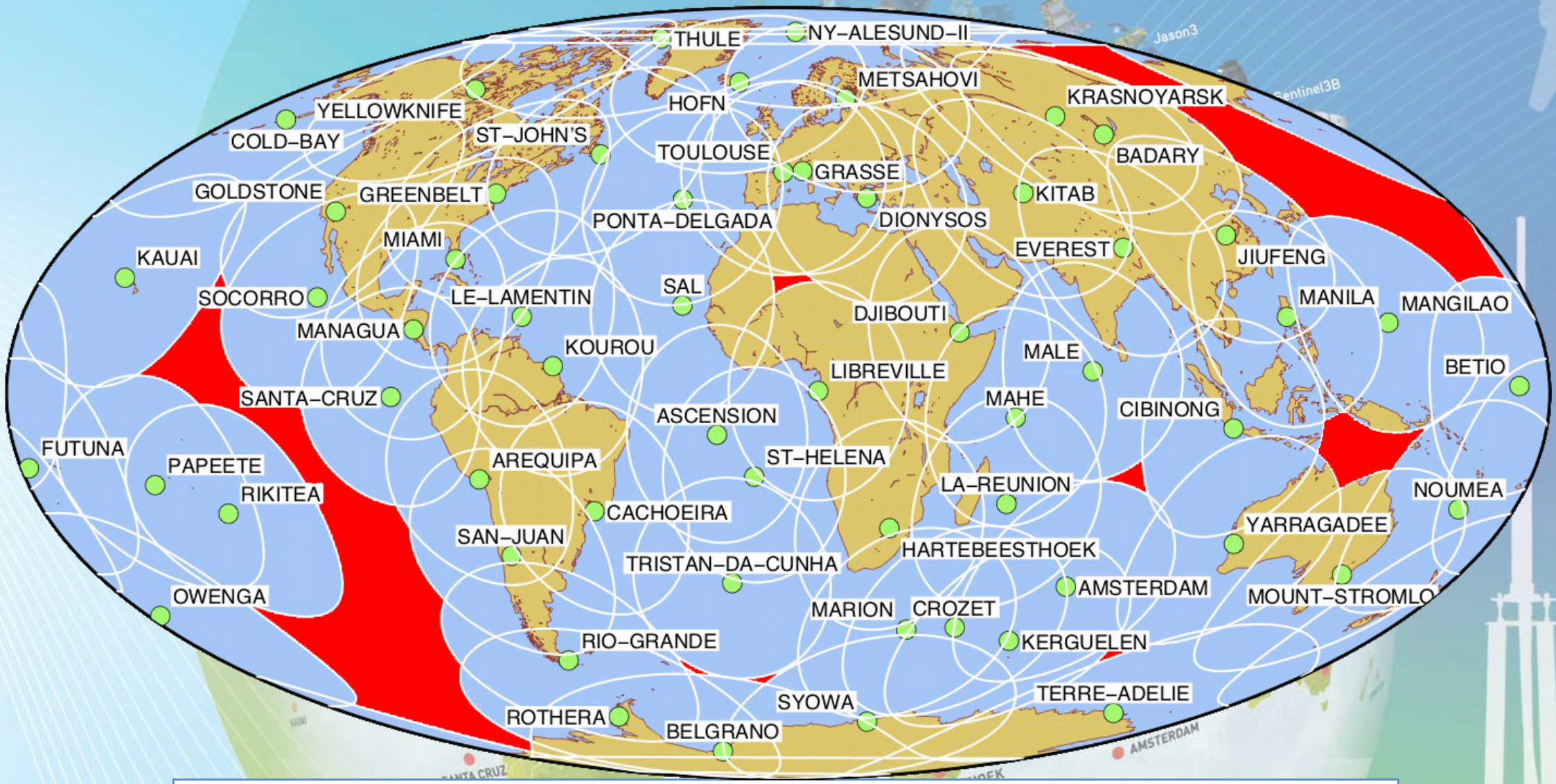
2a. Geographical coverage

Network / EX.I_10: Ensure the maximum percentage of visibility from the ground stations along satellites orbits over a full cycle

- Current global network coverage rate (theoretical) of Sentinel-3A orbit (altitude 800km): 85%
- Current global network coverage rate (theoretical) of Jason-3 orbit (altitude 1300km) : 95%

Contribution to geographical coverage for new site project in Russia

2a. Geographical coverage



Current coverage gaps (in red color) for LEO satellites (altitude: 800km; cut-off angle: 10°)

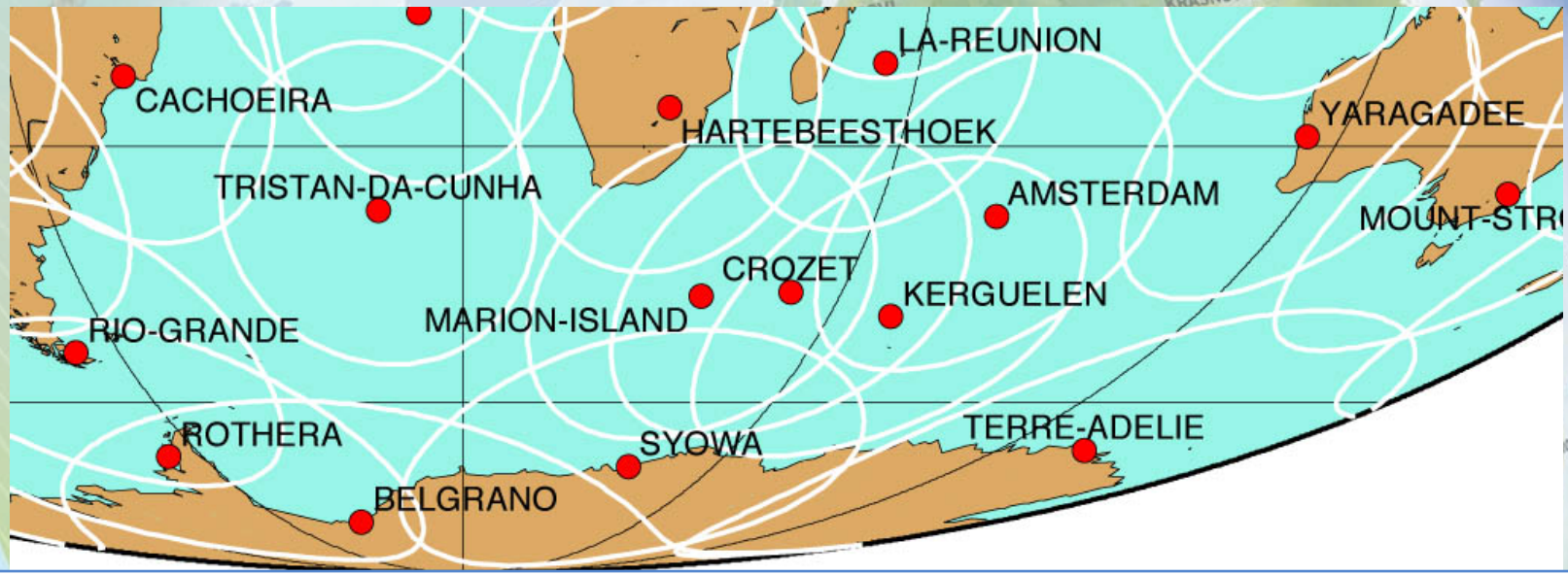
2b. Robustness

Densification in challenging areas

- Hard-to-access areas: Antarctica, Subantarctic Islands, North polar region, middle of Oceans…
- Countries with political and economic difficulties

Network / EX.I_275: guarantee the best possible coverage in case of stations failure

- Contribution to the network robustness is a selection criterion taken into account in the sites assessment



High density of stations in Sub Antarctic area: Marion, Crozet, Kerguelen, Amsterdam islands

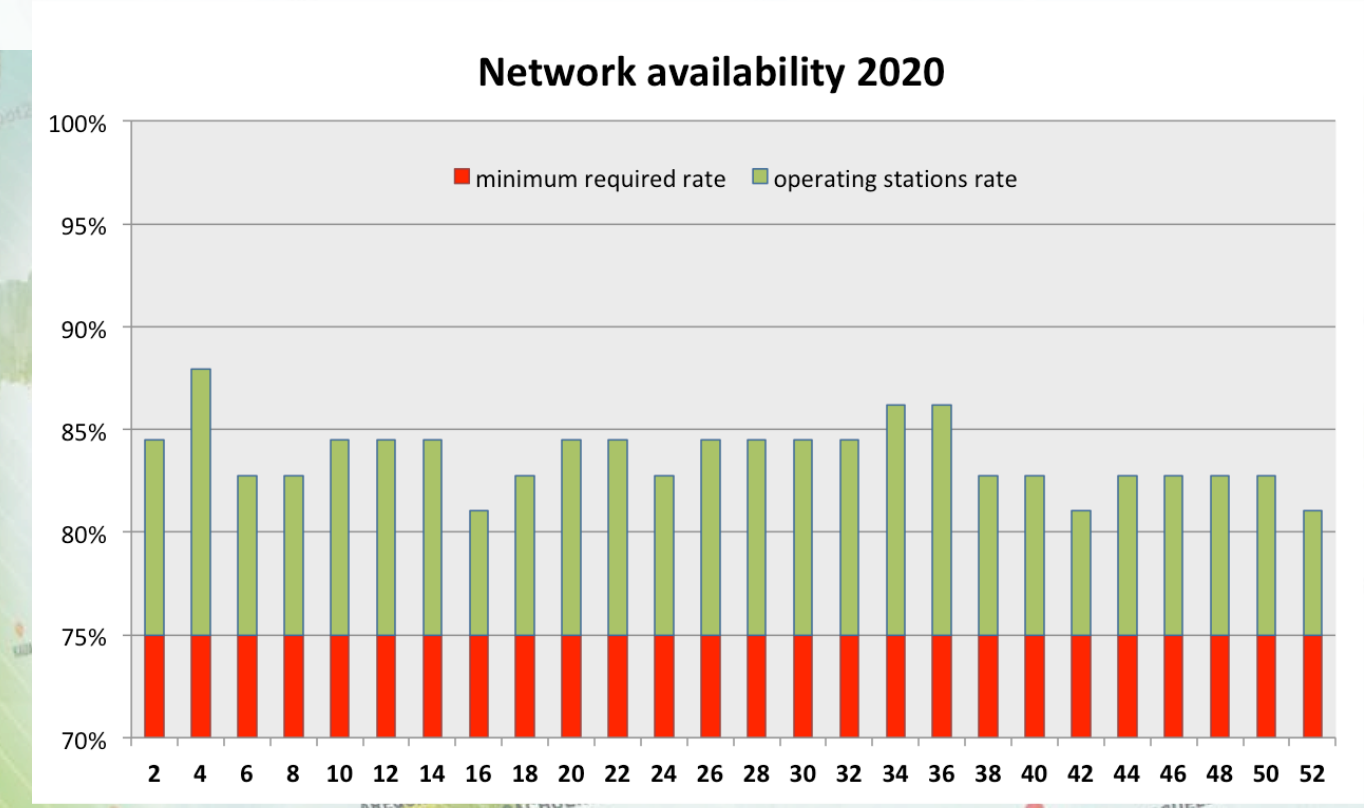
2c. Stations availability

Continuous service of the permanent tracking stations

- The quality of the precise orbit determination is strongly correlated to the number of operating stations and their geographical distribution

Minimum required rate of active sites

- The number of stations out of order must not exceed 25% (currently less than 15 stations)



Network requirements in summary

- Centralized control of the stations deployment and maintenance
- Any DORIS station is part of the DORIS system
- Internal interferences management
- Geographical coverage need for satellite altimetry
- Minimum rate of stations in operation: 75%