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Doris System : the new age

DGXX generation instrument on board Jason2

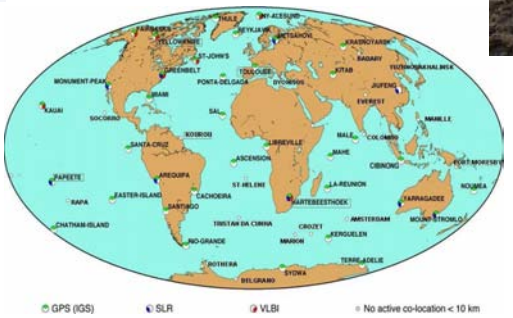
- contribution of the 7 channels
- In orbit RF environment

- Hardened USO
- new features of the DIODE Navigation sw

Ground segment improvements

- RINEX formats

- Beacons Network
- Signal integrity monitoring



A. Auriol ; C.Tourain ; B.Besson

OSTM JASON-2

doris

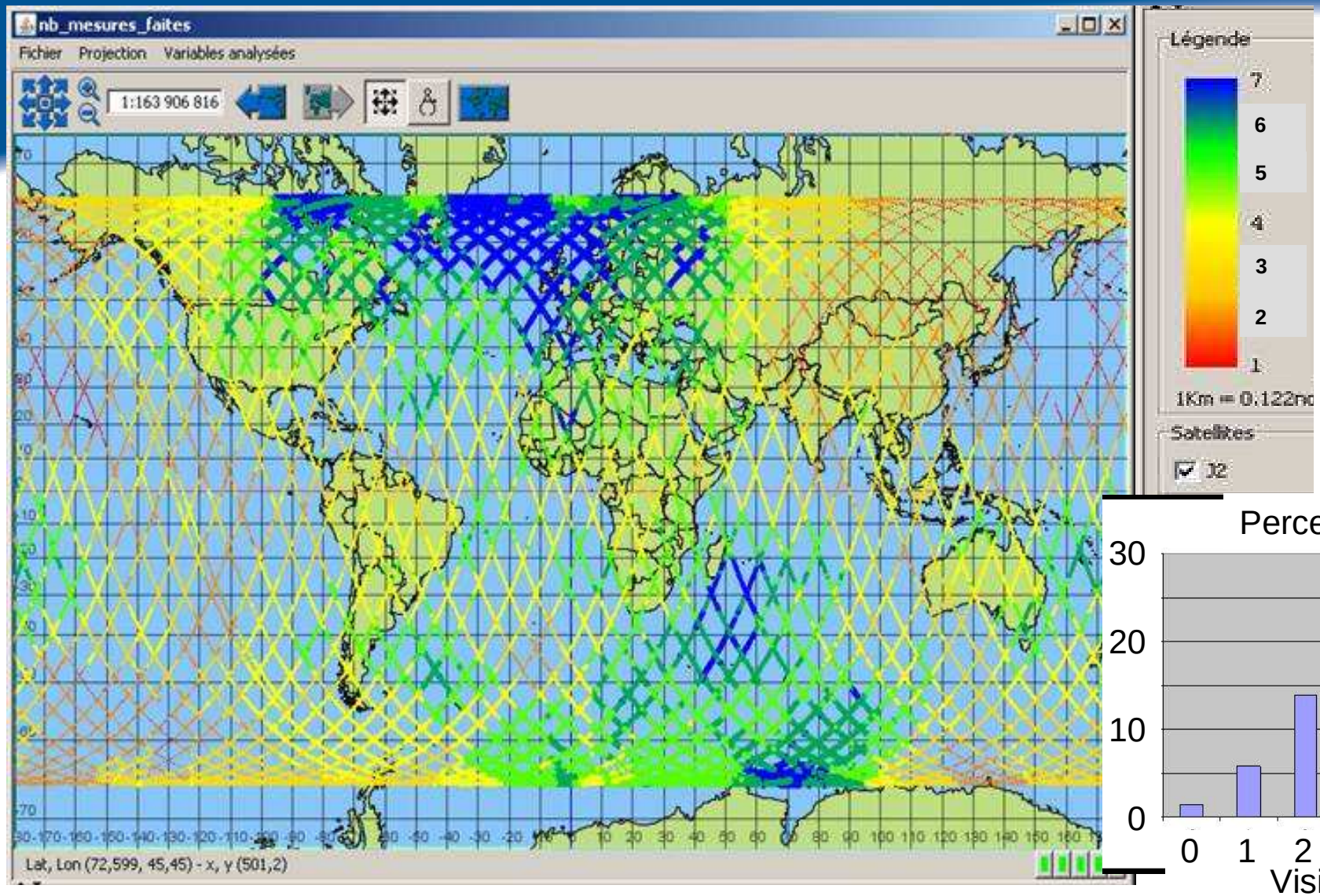
The DORIS DGXX Instrument

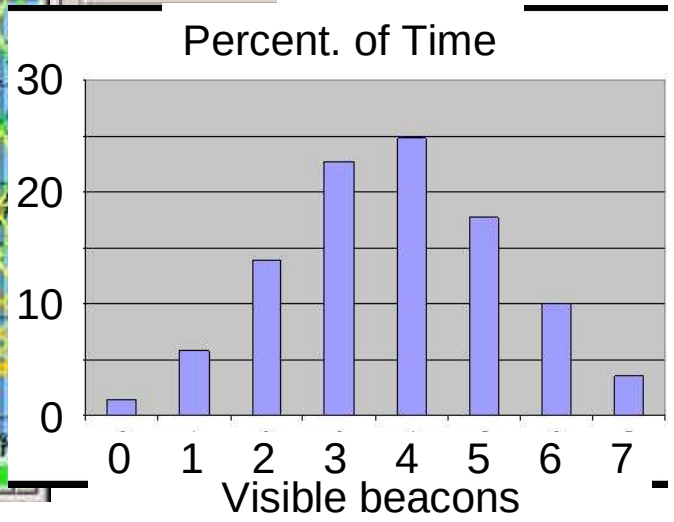
- 7 Dual frequency Channels
  - capacity to track up to 7 beacons simultaneously
    - Increases data quantity
    - Makes available low elevation measurements
    - Improves passes distribution

- Hardened USO
  - Better Frequency stability while crossing SAA
    - better quality of MOE
    - Jason 2 useful for beacons location

- New DIODE Navigation sw
  - No more numerical limitation thanks to ERC32 processor
  - improved accuracy (see C. Jayles presentation)
    - better quality of NRT products (OGDR)
  - geodesic bulletin for altimeter tracking
    - Access to new zones of interest for altimetry

Doris / Jason2 coverage





DORIS / Jason2 Measurement Channels designation strategy

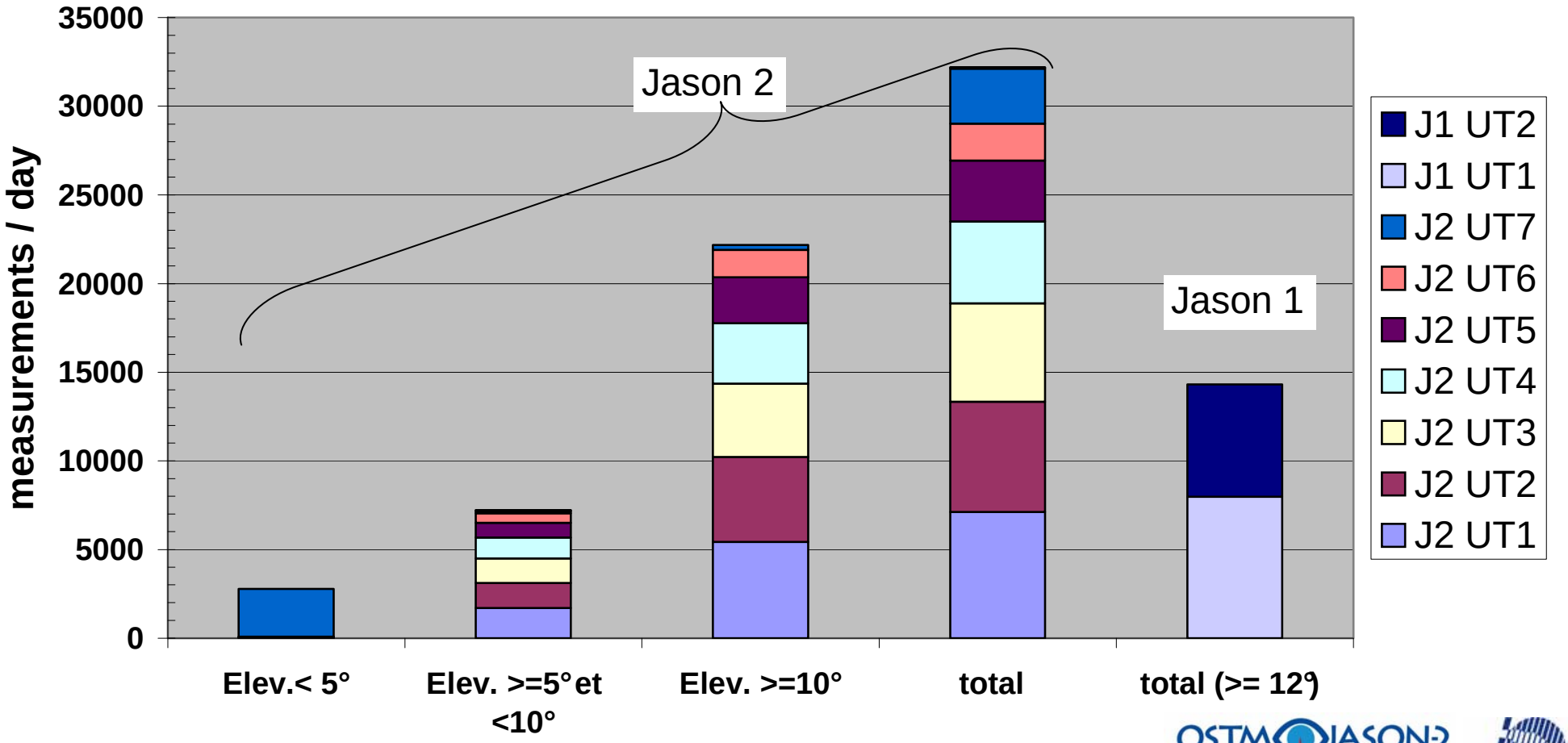
- Channels 1 to 6 : Beacons selected by DIODE Navigation sw
  - the beacon is tracked
    - if its identification and coordinates have been uploaded on board (permanent stations, orbitography network)
    - as soon as it is visible with an elevation > 5 °

- Channel 7 : Beacons selected by Spectrum Analysis
  - the beacon is tracked as soon as it is visible over the noise floor
    - temporary stations (IDS)
    - low elevation measurements on permanent beacons (0° to 5°)
      - this may have an impact on phase reconstruction over the passes (see F. Mercier, L. Cerri pres.)
      - May be affected by masks or multi path effects (station field of view requirement limit is 5°)

- May be changed depending on users recommendations

DORIS / Jason2 Measurements quantity

Data quantity
comparison Jason 2 / Jason 1
Jason 2 distribution / elevation



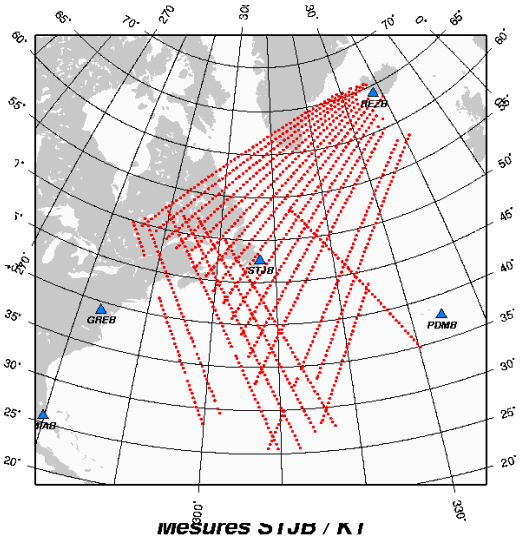
Passes distribution

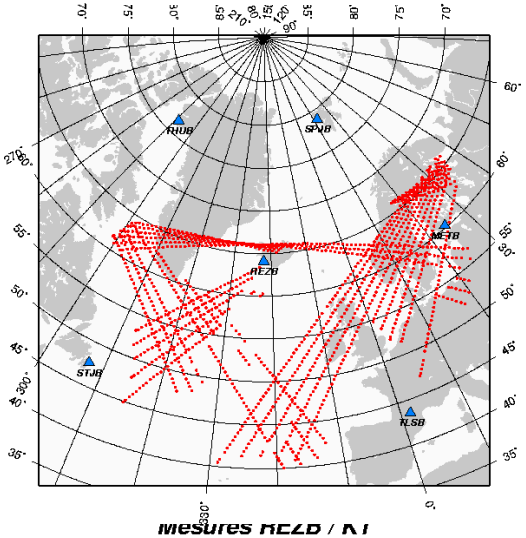
Saint-John's

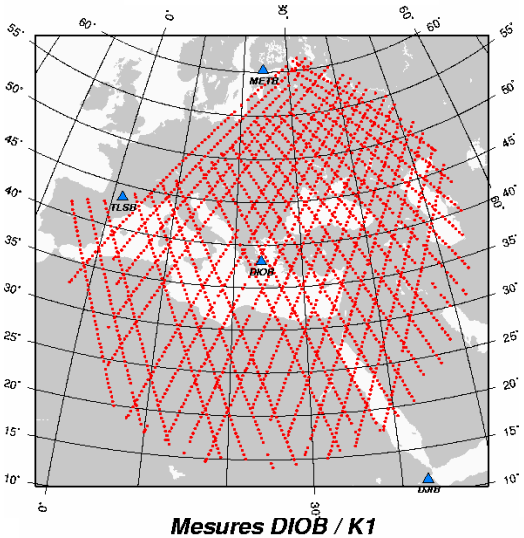
Reyjavik

Dionysos

Jason 1
(10 day cycle)







Mesures DIOB / K1

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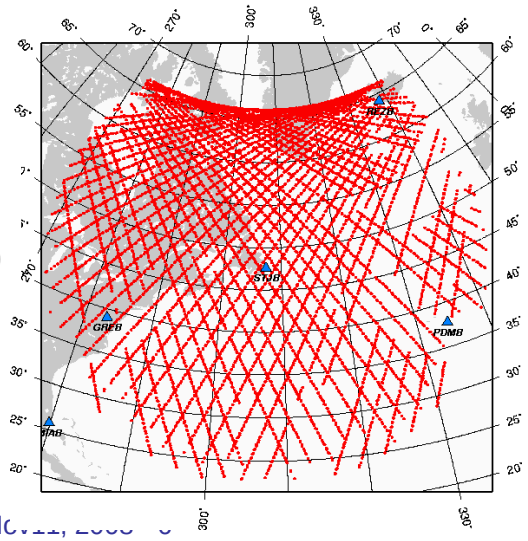
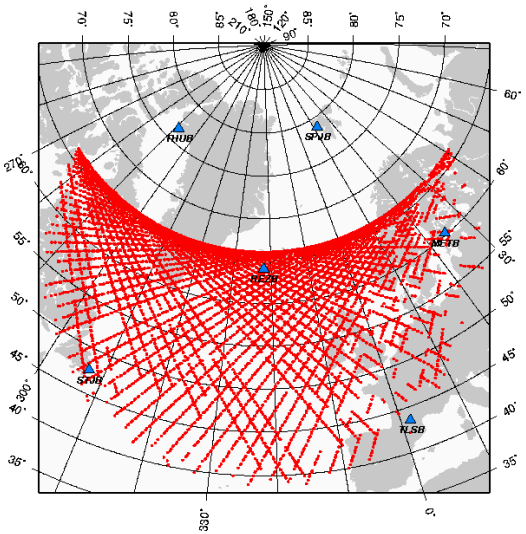
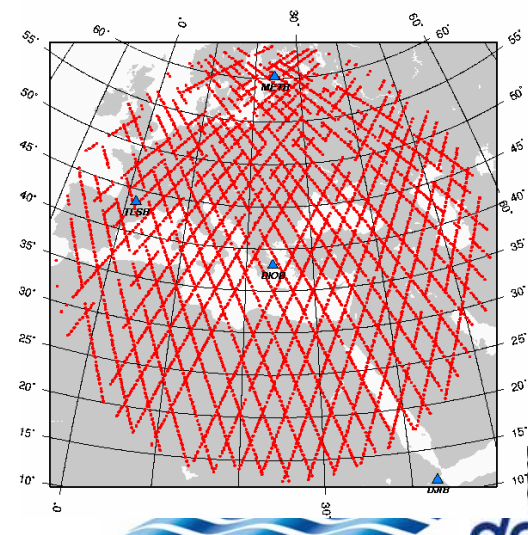
Jason 2
(10 day cycle)

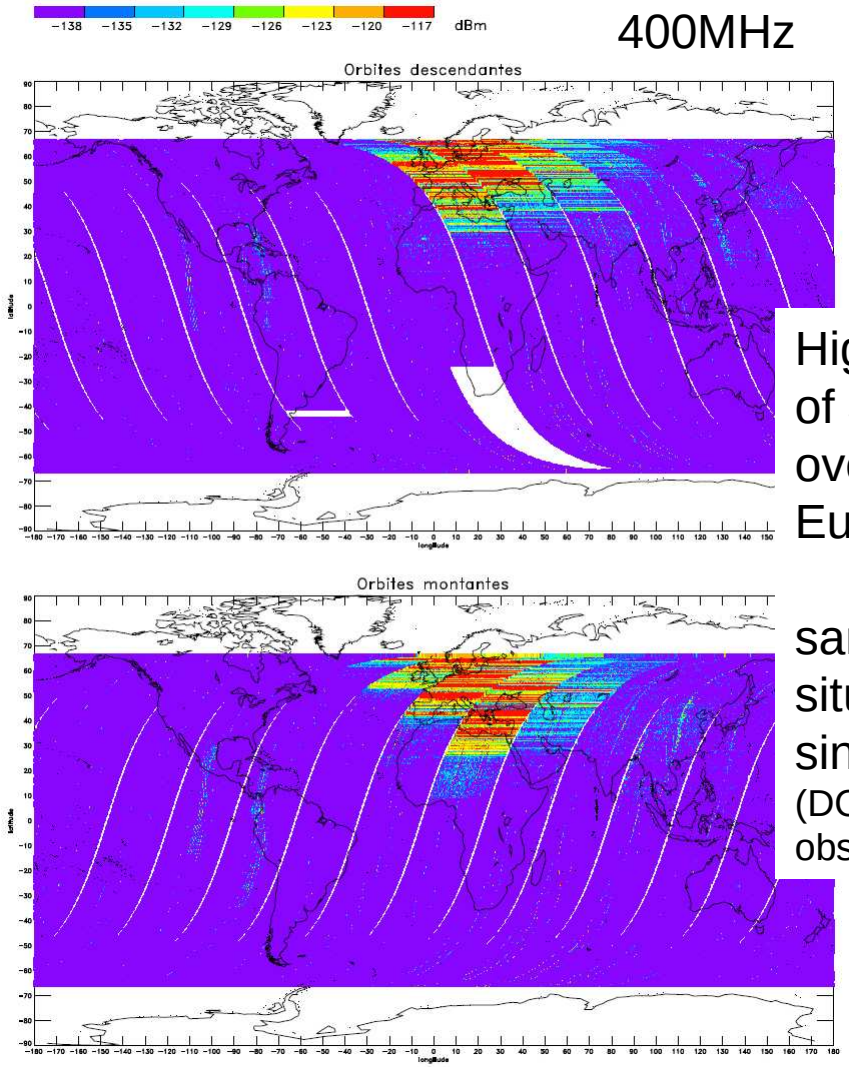






DORIS Jason 2 Jamming measurements (June 2008)

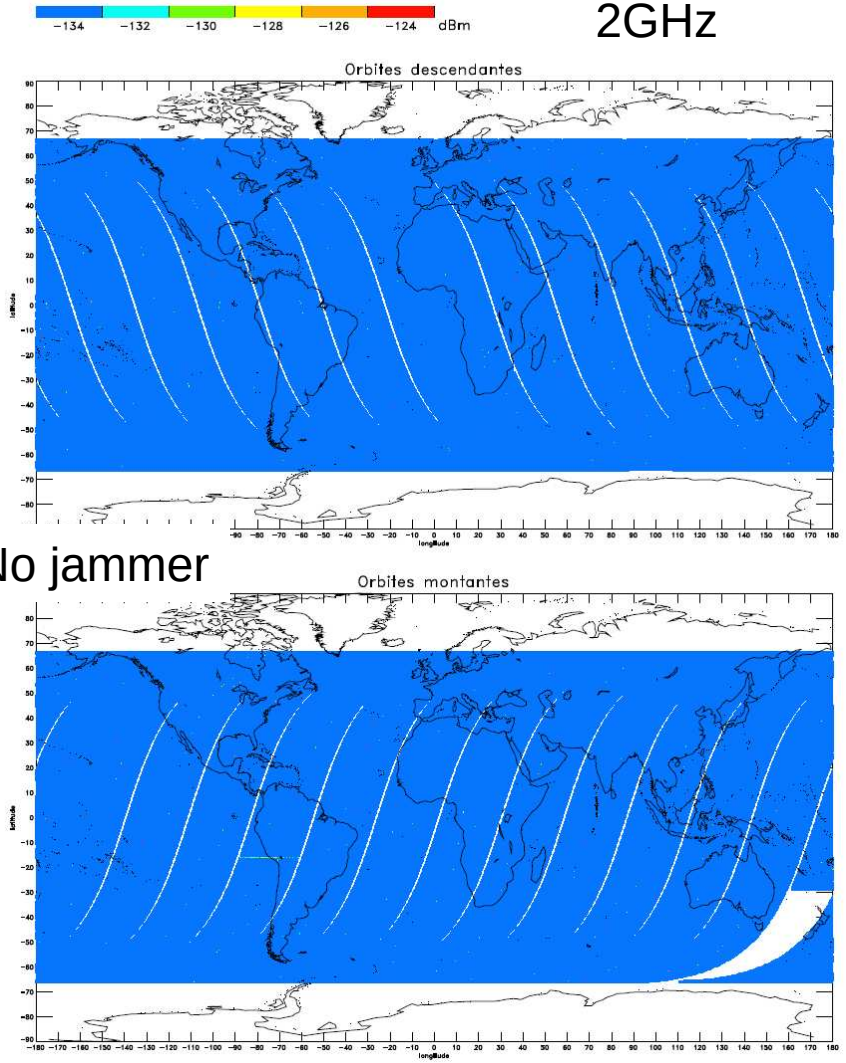
400MHz



High density of Jammers over Western Europe

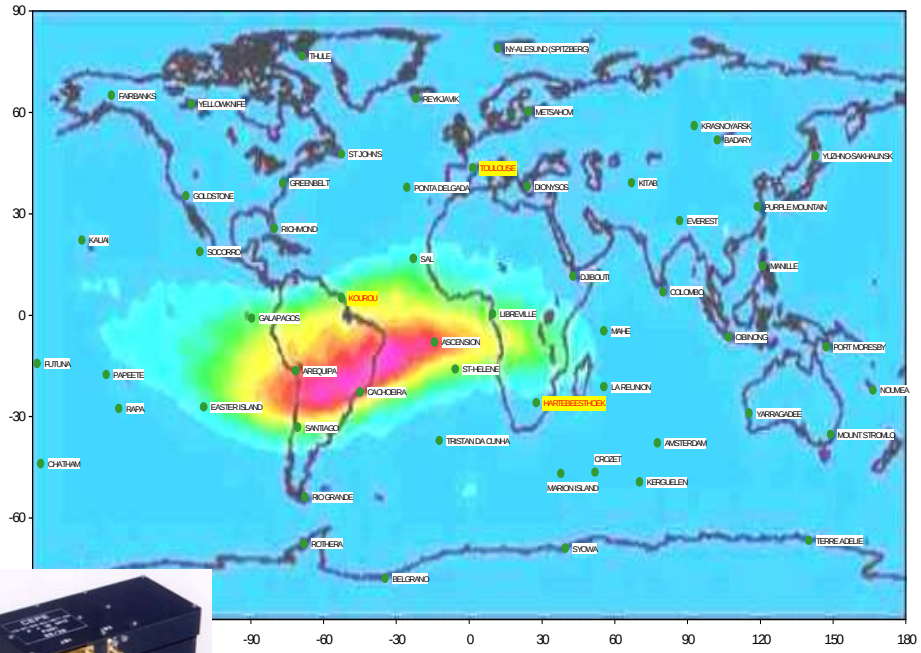
same situation since 1990 (DORIS/SPOT2 observation)

2GHz

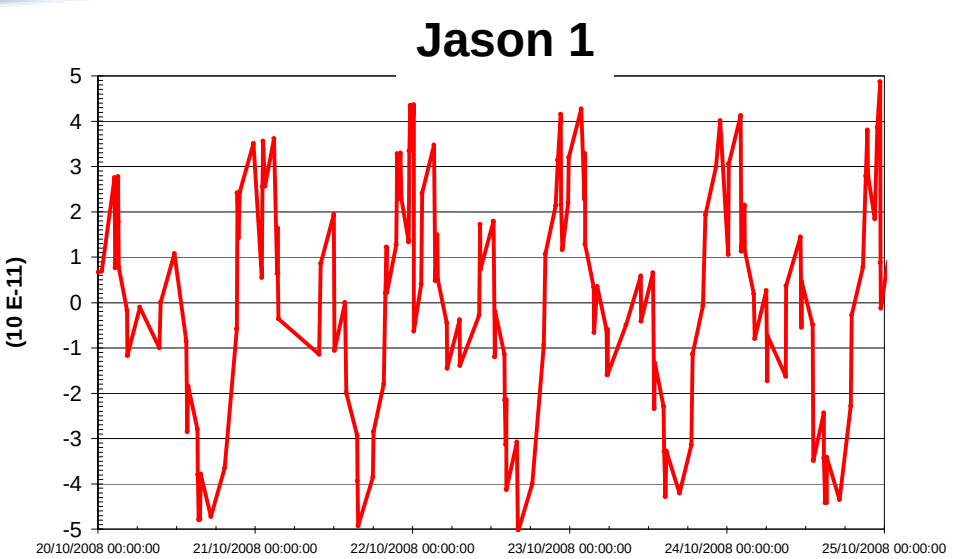


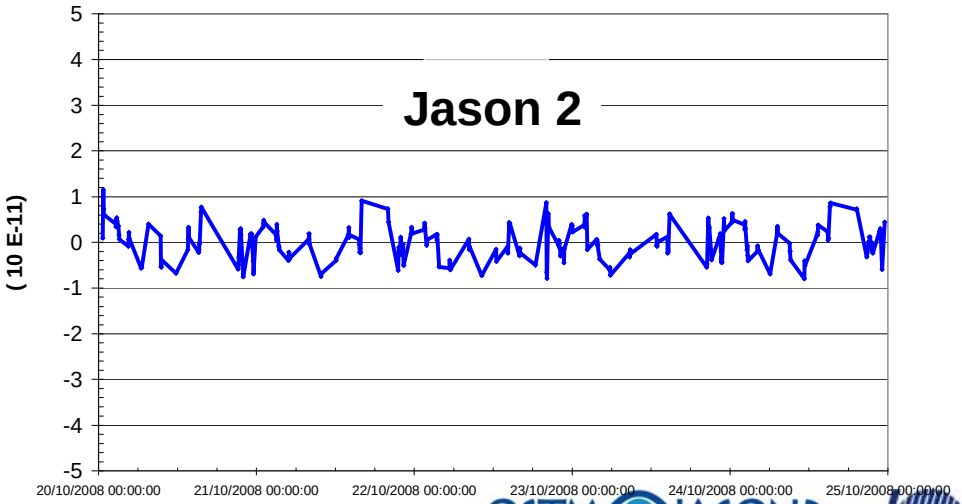
No jammer

USO behavior while crossing SAA



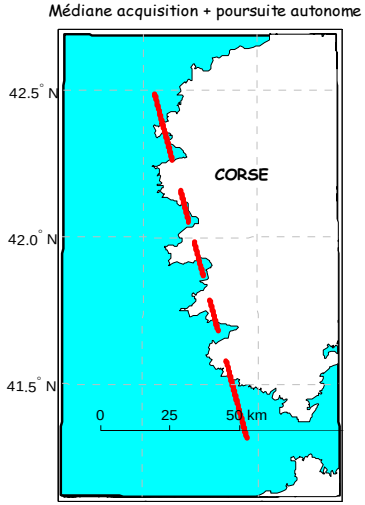
The DORIS/Jason2 USO has been successfully hardened against radiation





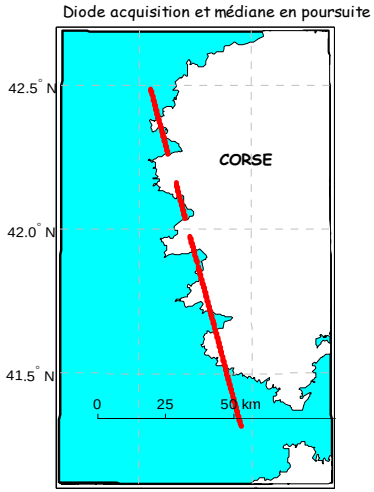
New features of the DORIS-DIODE Navigation sw

- **Provision of real time precise "geodesic" ephemeris helping the altimeter tracking**



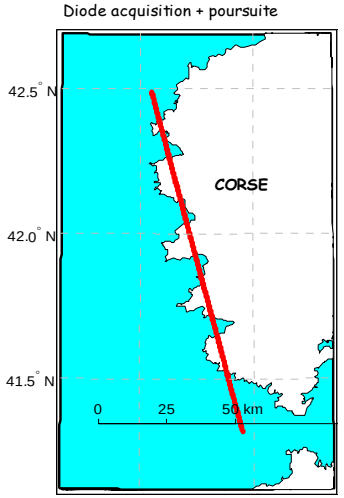
Altimeter "traditional" Mode closed loop (Jason1)

- Measurement on coasts lost due to acquisition delay
- No Measurement on Land



Acquisition helped by DIODE; closed loop

- gain in acquisition delay > 1s (~ 7km)
- Acces to coastal zones

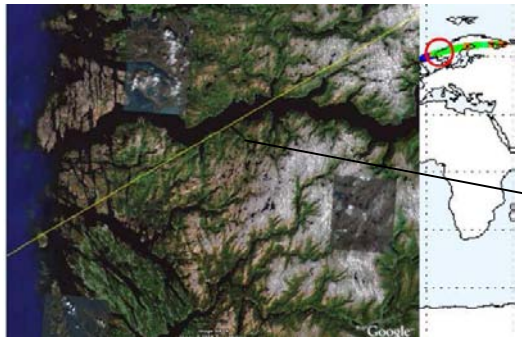


Tracking driven by DIODE ; open loop

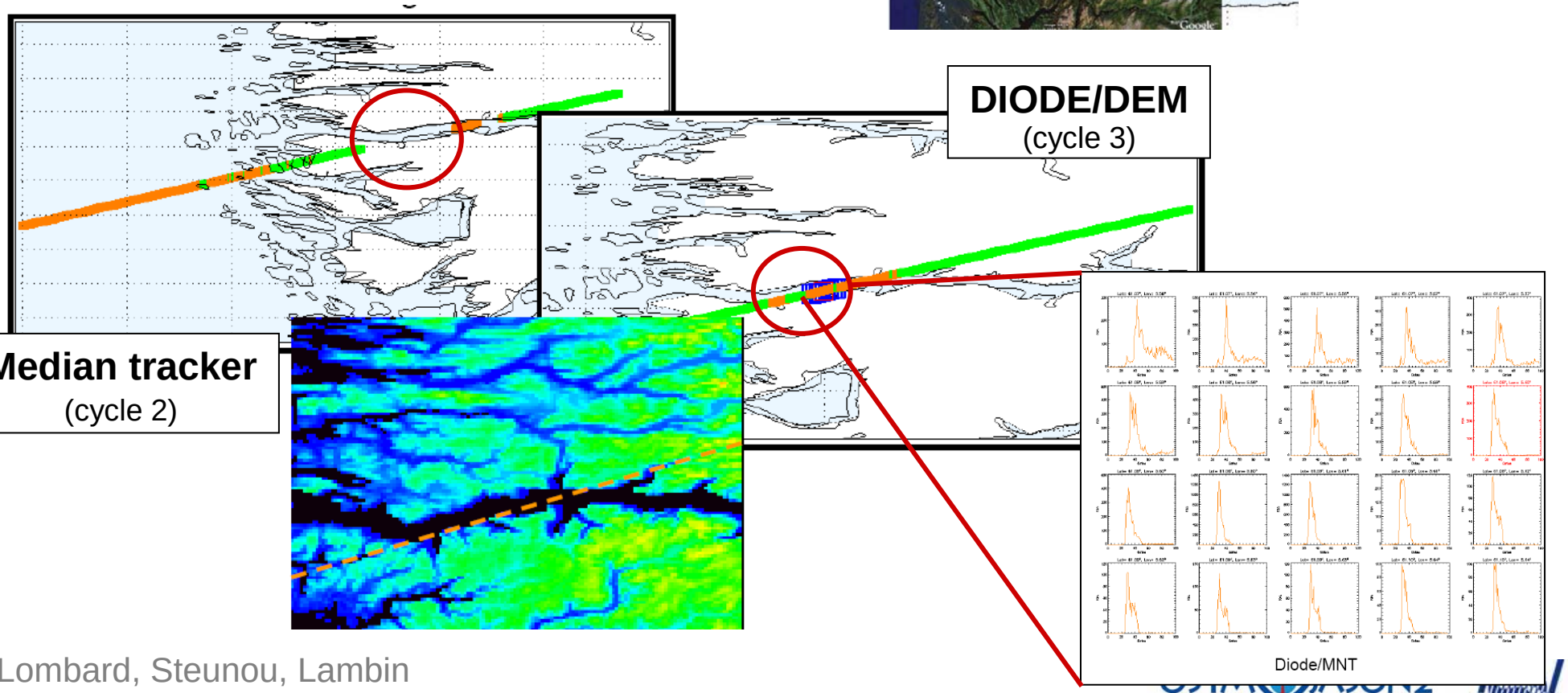
- Acces to water surfaces in strong relief
- Focus on zones of interest selected in the DEM
- Acces to off Nadir targets (appropriate tayloring of DEM)

Jason-2 In-Flight validation of DIODE+DEM mode

Coastal zone : example in **Norway (fjords)**



Strong relief region



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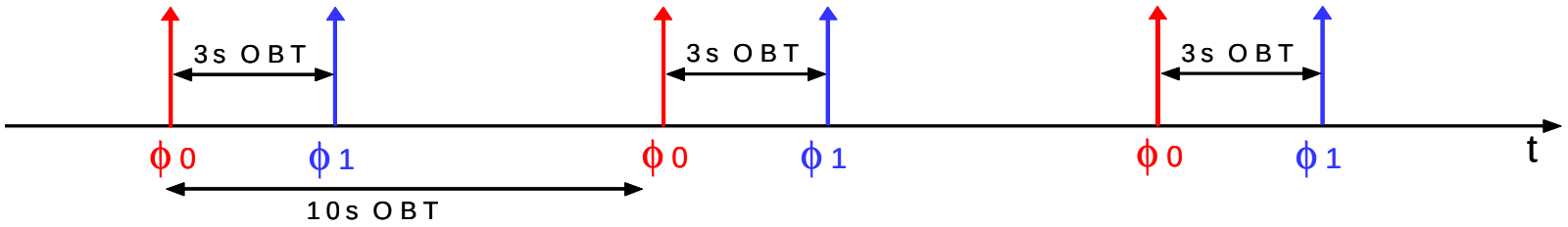
RINEX Formats (1/2)

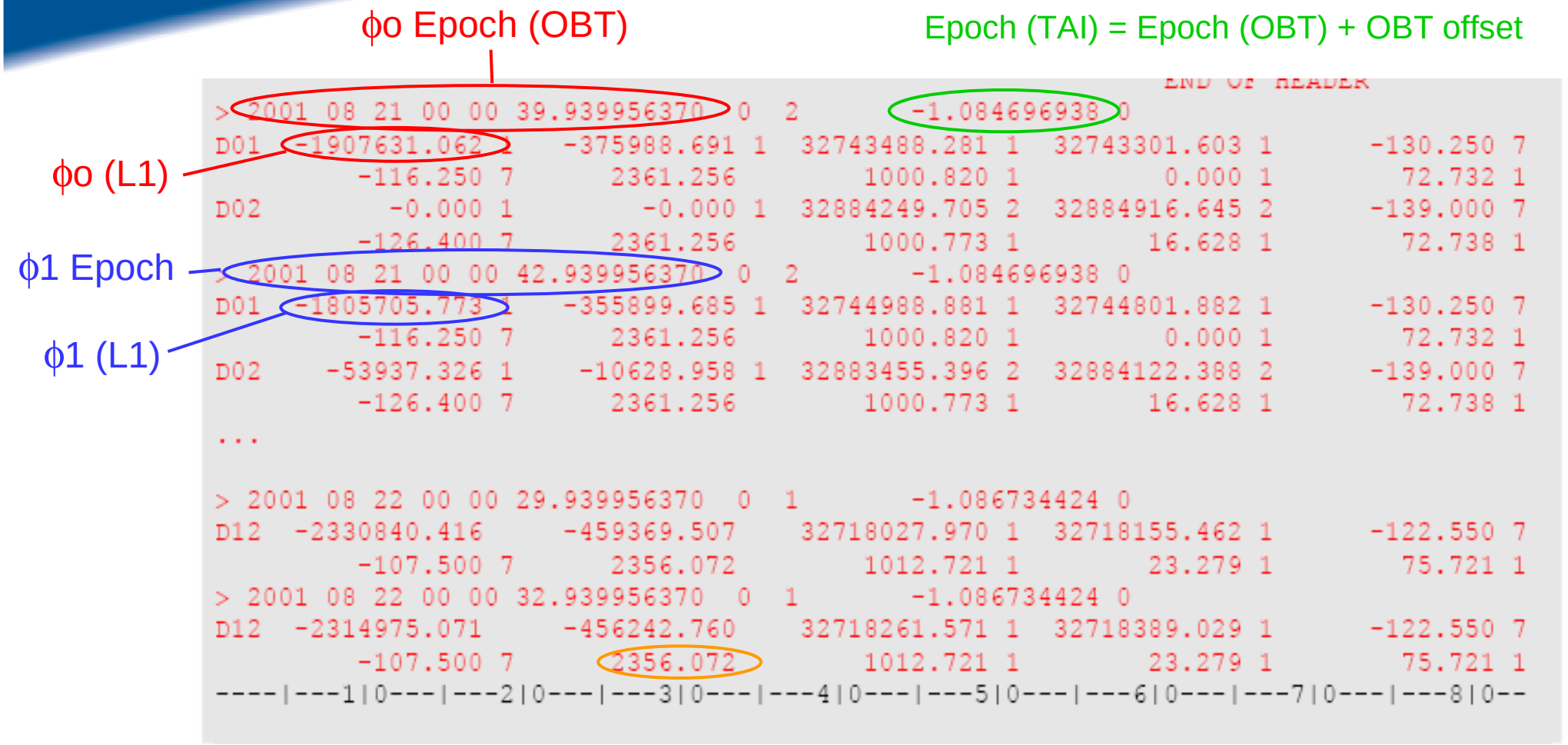
- DORIS Measurements now available daily in Receiver Independent "GPS like format"
  - Documentation on RINEX files is available on IDS site
- Measurements are dated (event : signal arrival at antenna phase centre) in two ways :
  - In On Board Time
    - Pseudo range measurements on Time Beacons may be used for all measurements redatation
  - In International Atomic Time scale
    - By means of the OBT offset field
    - Time correspondence is currently estimated by the OBSW (DIODE) with an accuracy of few microseconds
    - Improvement currently under study towards an accuracy of less than 1 microsecond
- Available received power on both channels may be used for data weighting purpose
- On board clock (USO) frequency is also available as per OBSW (DIODE) estimation
- Two sets of phase measurements "ϕ0" and "ϕ1" are available :



RINEX Formats (1/2)

OBT offset

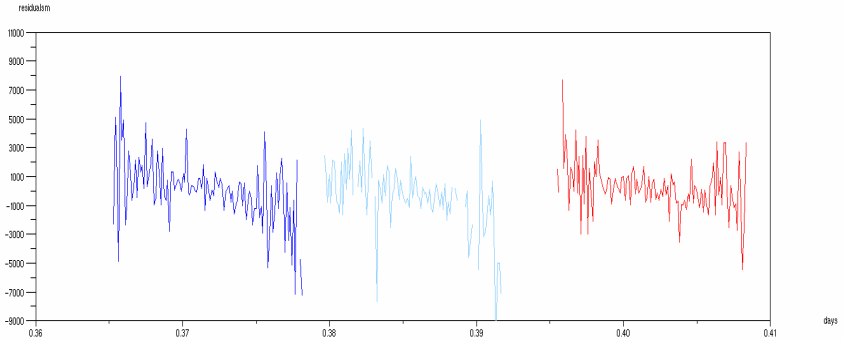
Epoch (TAI) = Epoch (OBT) + OBT offset



On Board Frequency estimation

RINEX Formats (2/2)

- Anomalies detected :
  - Sensitivity of pseudo range to Doppler variation not taken into account :
    - Pseudo Range Curves over a beacon pass are slant but centred on zero (no impact on datation assuming passes are balanced)
    - update of configuration file currently in progress



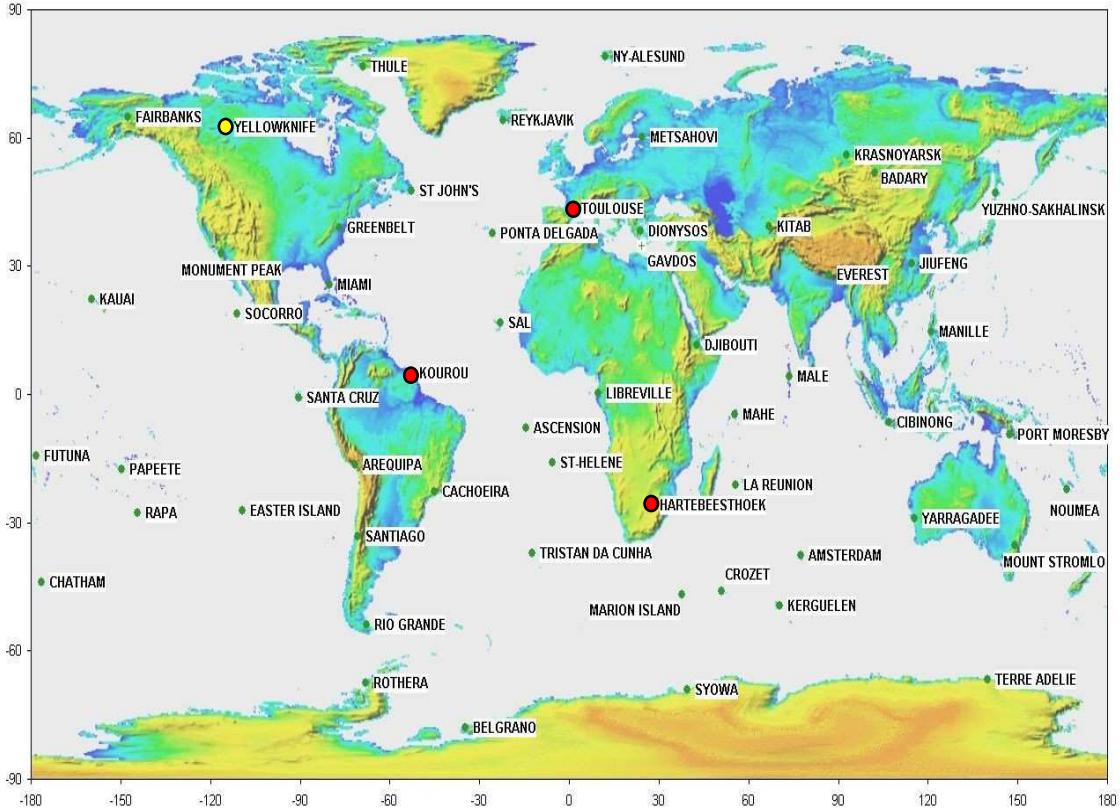
  - Bias of 51.83 microseconds in [TAI – OBT] field :
    - Leads in an error of 35 cm on along track position when TAI datation is used
    - Correction planed mid November
  - Bad interpretation of meteo parameters
    - Correction planed mid November
- Reprocessing planed in early December

Beacons Network
3rd generation beacons deployment

93% of the DORIS stations already equipped with 3rd Generation beacons

Beacons Network
Time / Master Beacons

- 4 Time Beacons currently operating :
  - Toulouse (Master Beacon, USO + Cs)
  - Kourou (Master Beacon, USO + Cs)
  - Hartebeestoek (Master Beacon, USO + Cs)
  - Yellowknife (HMaser)
    - These 4 beacons all driven by an atomic clock may be used for datation purpose
- 1 more MB still planed to be installed in South Pacific



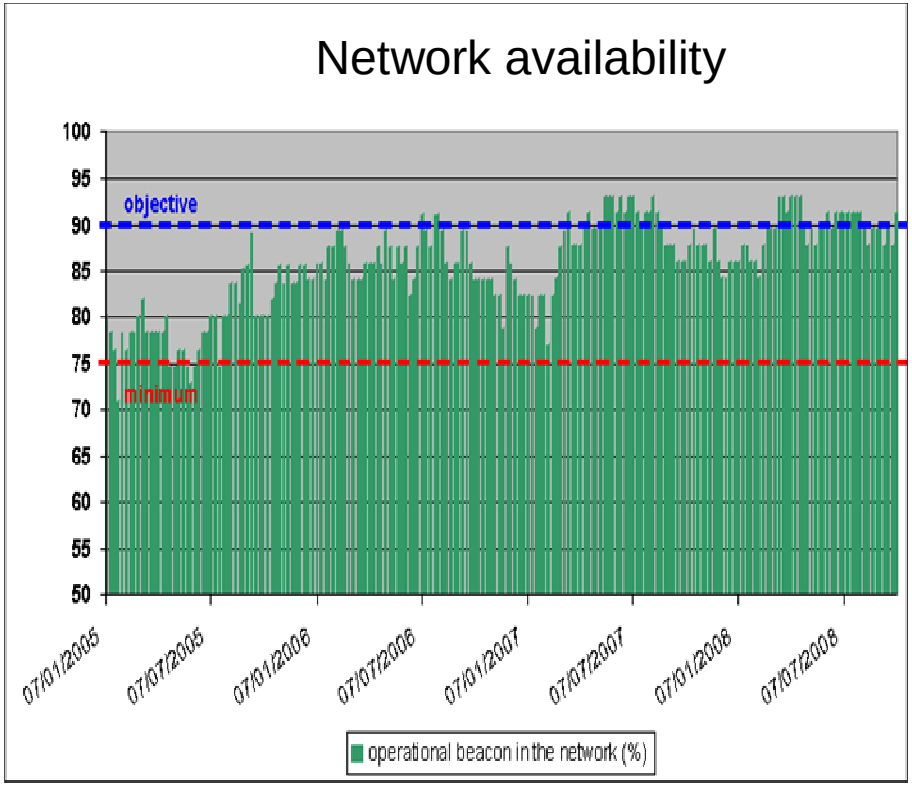
Beacons Network stations improvement

- DORIS stations are currently revisited
  - to renew ageing beacons,
  - To improve the Radio-Frequency environment (masks, multi path)
  - To ensure electrical power availability
  - To improve the antenna stability.

- See detailed presentation by H. Fagard

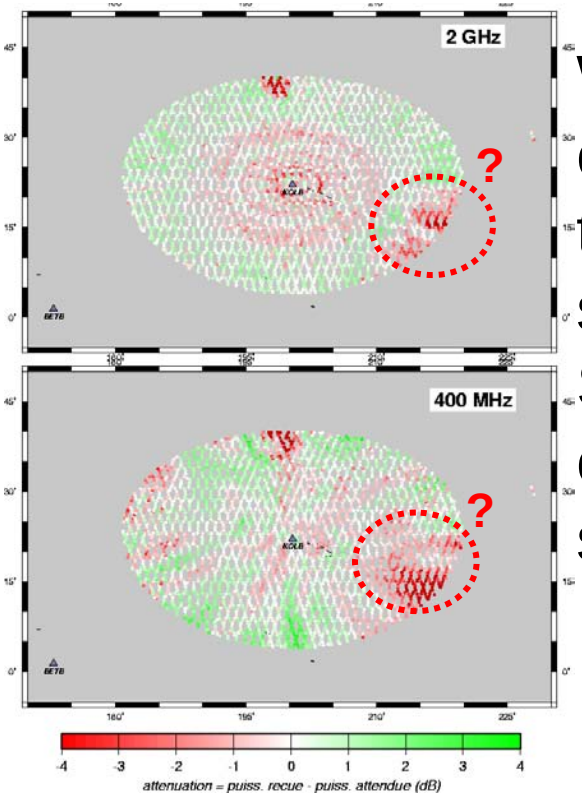
Signal Integrity monitoring

- DORIS Integrity Team set up end 2004-beginning 2005
  - to monitor permanently the DORIS signal transmitted in space, control its characteristics, investigate non nominal situations and take corrective actions if needed
  - By systematic analysis of
    - RF levels received by all contributing instruments in operations and comparison with theoretical expected levels
    - Orbit or positioning processing residuals
    - On board and beacons USOs frequencies
    - Datation performance on board Jason1 & Jason2
    - Navigation quality indexes on board Envisat, Jason1 & Jason2
    - Sw reports of Jason 2



Signal Integrity monitoring example of action

Analysis of power received from Kauai station



What is corrupting the DORIS signal in the South East of Kauai station ?

The sight was free when the station was installed

But a metallic tower has grown since !

Corrective action taken : last floor of the tower has been removed

Doris System : the new age

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Thank you for attention

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