DORIS /JASON STATUS

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Instrument health and operation status

Instrument command & control status

Measurements accuracy

DORIS orbits performances

Doris onboard instrument health status

- **Currents, tensions, temperatures MVR and USO :** **OK**
  - internal calibrations : stable
- **<u>Instrument operation</u>** **OK**
- **no transition in instrument « safe mode »**
- **high robustness towards SEU**
- **<u>DORIS software (including DIODE)</u> : very good functionning** **OK**
  - DIODE is the onboard real-time software dedicated to orbit & TAI time estimation, embedded in the DORIS instrument software
  - DIODE is in charge of the delivery of « DAT » and « NAV » packets used for OSDR production
  - **0 anomaly** observed over the CALVAL phase on both softwares
  - **availability** (DORIS measurement mode, DIODE real-time products) : **100 %**
  - a new software version is currently planned to be uploaded in November 2002
    - to have the benefit of what have been experienced during recent DORIS in-flight assessment phases (JASON, ENVISAT, SPOT5)
    - main improvements : self-programming on shifted frequency beacons, increased robustness of the self-initialization mode, simplification of ground operations for recovery in case of DORIS or DIODE outages.

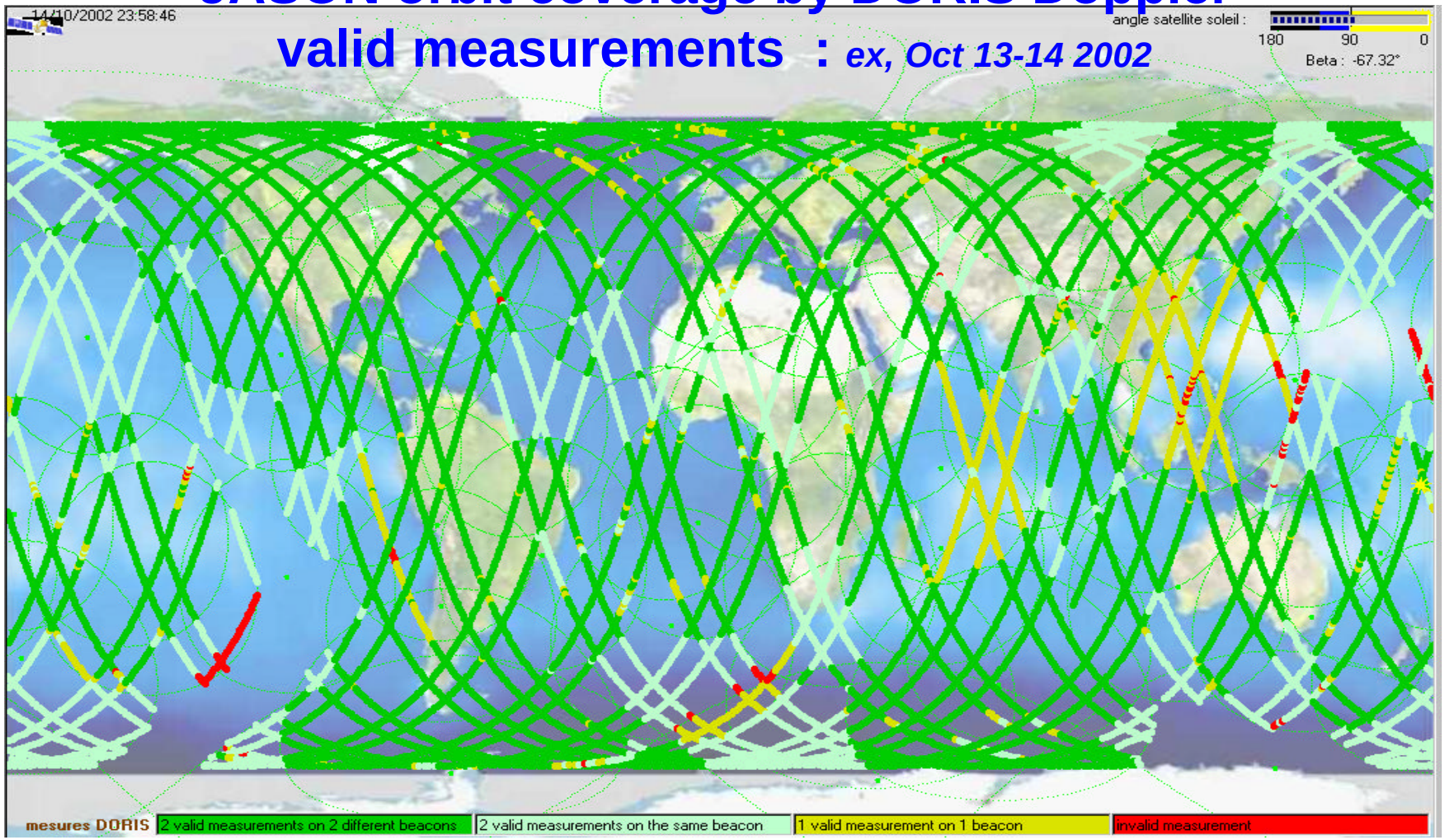
Doris measurement modes

- **The different measurement modes have been successfully tested during the in-flight assesment phase**
  - the capability of tracking simultaneously 2 beacons (*instead of 1 on DORIS T/P*) is used in an efficient way by the different measurement modes

- **CALVAL phase : only « self-programming » mode used**
  - nominal mode of operation
  - beacons RF signals acquisition is based on DIODE directives in terms of ground beacons selection and receiver phase loop pre-positionning (Doppler frequency)
    - *instead of ground computed uploaded programmations for T/P*
  - about **16 000 up to 17 000,** valid at instrument level, bi-frequency Doppler and mono-frequency pseudorange, measurements ***/ day***
    - *(DORIS T/P : about 8 000 up to 8 500 measurements / day)*
  - JASON orbit coverage by DORIS valid measurements
    - **> 90 %** with at least **1** beacon tracked
    - **> 60 %** with simultaneous measurements on **2** different beacons

JASON orbit coverage by DORIS Doppler

valid measurements : *ex, Oct 13-14 2002*



Orbit coverage with at least 1 beacon : 93.4 % ; with 2 different beacons : 62.9 %

A very good orbit coverage thanks also to DORIS beacons network global availability despite a few « meteorological outages » ……

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GUAM beacon antenna
after a typhoon

THULE beacon antenna
before and after a storm

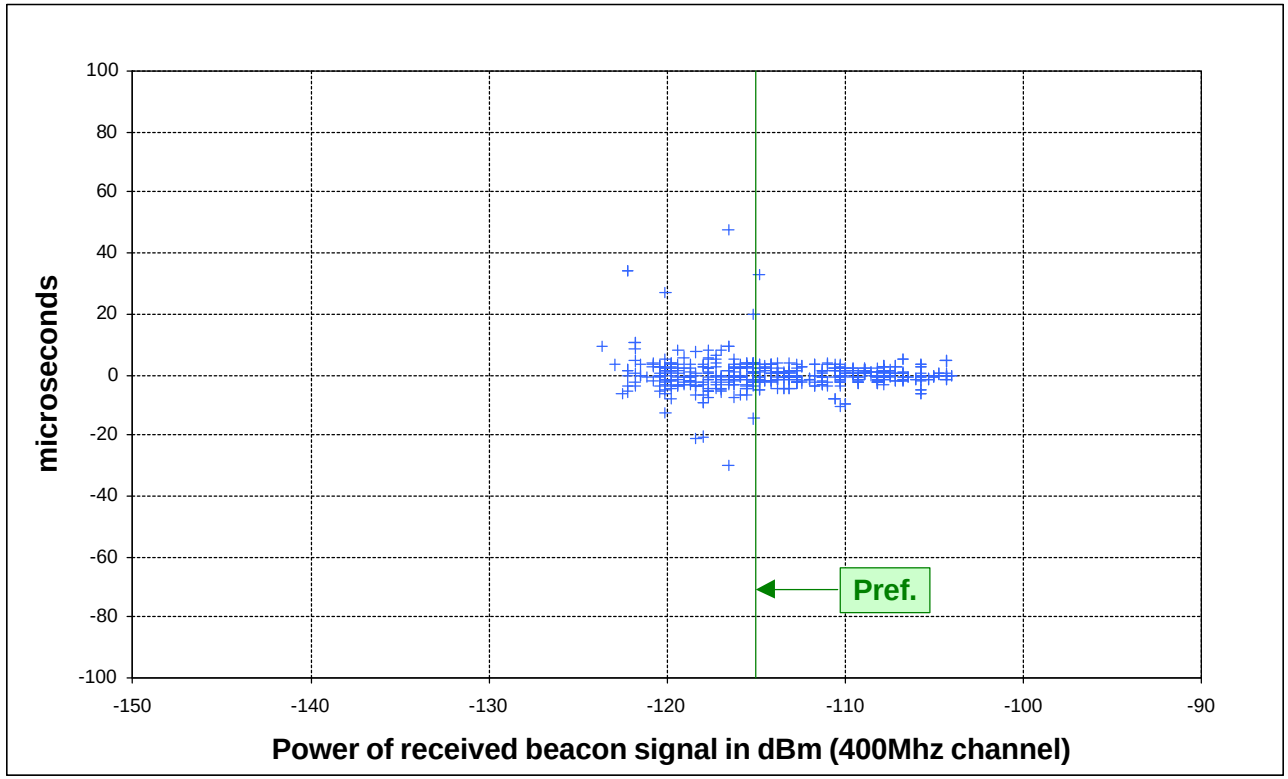
DORIS/JASON Command & Control

- **This function relies on several entities**
  - SSALTO : DORIS system ground segment
  - JTCCS and/or JCCC, TM/TC ground stations
  - satellite platform
  - onboard DORIS instrument
- **Commands :** generation, uploading and onboard processing **OK**
- **Telemetry :** generation, downloading and ground processing **OK**
  - about 99.8% of onboard instrument generated TM are available at ground segment level over the last 10 months
  - 99,998% available since June 2002
- **Instrument monitoring :** **OK**
- **additionnal specific SSALTO functions**
  - **1st level of processing and delivery of DORIS measurements** **OK**
  - **Control of DORIS ground beacons network :** **OK**
    - information related to beacons network (time parameters of Time reference beacons, current network status) are now permanently broadcast by Toulouse Master beacon
    - new generation beacon : 5 installed and fully operational; good performances

DORIS pseudorange measurements accuracy

- **requirement** : standard deviation of pseudorange error **< 7 µsec** for (C/No) > (C/No)ref.
- **in-orbit measured precision** : between **3** and **7 µsec**. (1σ) depending on beacon generation and location

Pseudorange errors on KOUROU (1st generation) beacon 1s = 3,1 microsecond



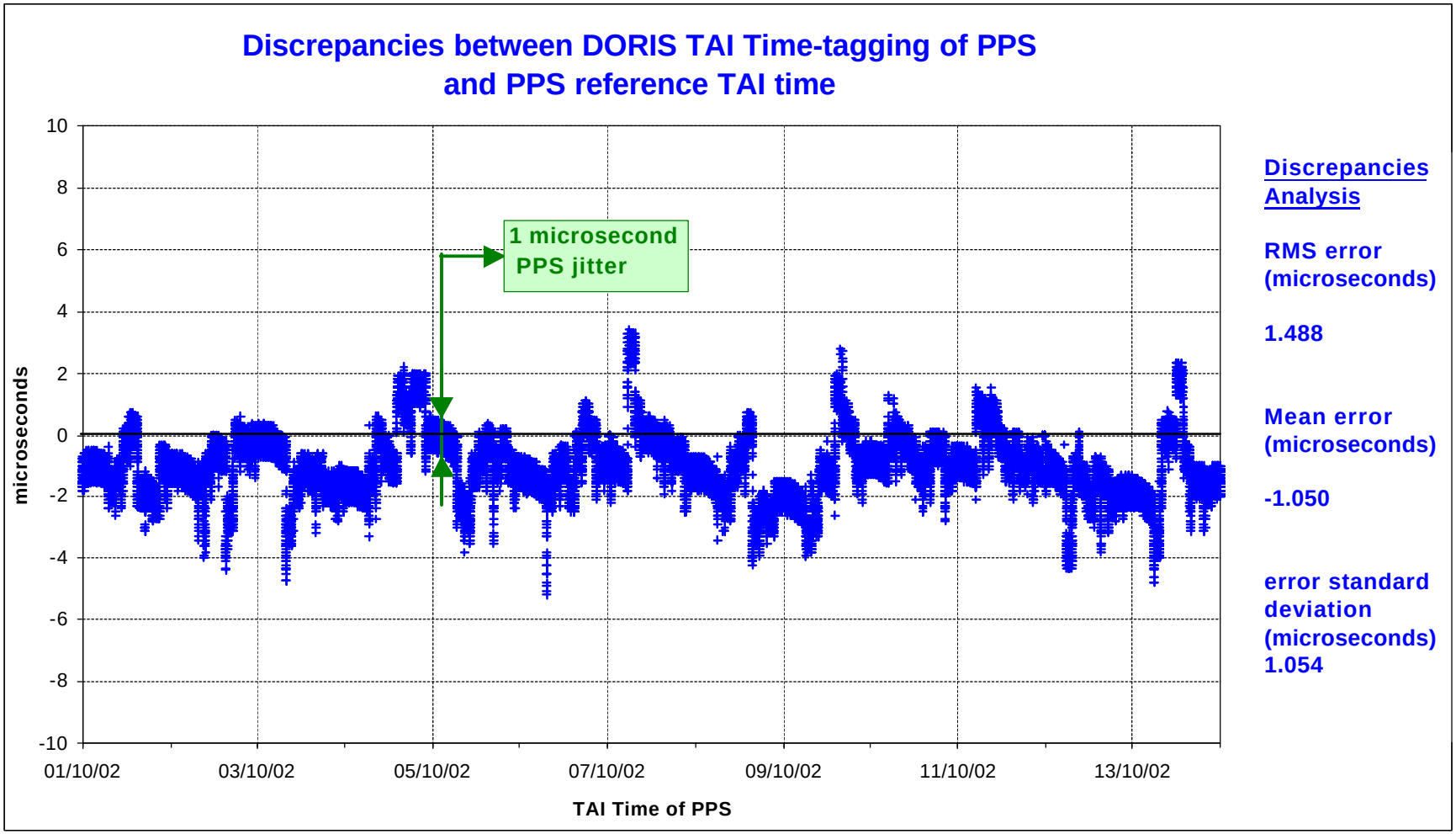
DORIS Doppler measurements accuracy

- **Issue of the Biarritz SWT POD session**
  - increase of rms Doppler residuals in DORIS/JASON MOEs or POEs
  - increasing errors in altitude and latitude in beacon positioning based on DORIS/JASON measurements (*J. Ries, P.Willis*)
    - 8 beacon sites concerned, located below the S.A.A. area
- **recent results of POD team show that (***J.P. Berthias, J.Ries, P.Willis***)**
  - for most of the beacons, the rms of DORIS/JASON Doppler residuals is better than the rms of DORIS T/P residuals : **0.30 / 0.35 mm/sec** compared to **0.35 / 0.40 mm/sec**
  - for about 10 beacons located in the S.A.A. region, rms of DORIS/JASON Doppler residuals are significantly larger than DORIS T/P residuals
- **CNES analyses (***Doris performances group- 10/02 2002***) indicate that these large Doppler residuals are due to onboard USO frequency variations which are strongly correlated to the variations in radiations (protons) dose received at USO level**
- **This current USO sensitivity to radiations does not seem to induce any degradation of JASON orbit quality (POE) or altimetry products (GDR)**
  - cf. POD session

DIODE TAI Time estimation accuracy

- **DIODE TAI estimation is based on the onboard processing of DORIS pseudorange (« IT3 ») measurements performed on Time reference beacons**
  - 2 Time reference beacons : Toulouse and Kourou
- **TAI estimation accuracy requirements (<= *OSDR*)**
  - **100 µsec** ; 10 µsec as a goal
  - DIODE TAI estimation is used to time-tag altimeter measurements
- **DIODE TAI estimation accuracy**
  - evaluation method :
    - use of the « pps » (*pulse per second*) generated by the JASON platform GPS receiver as an UTC (or TAI) second « marker »
  - results : **1, 5 µsec rms** (***bias : -1 µsec ; standard deviation : 1 µsec***)
    - no significant degradation of the TAI estimation accuracy in case of an outage of one or even both Time reference beacons during one day

Evaluation of DIODE TAI estimation accuracy



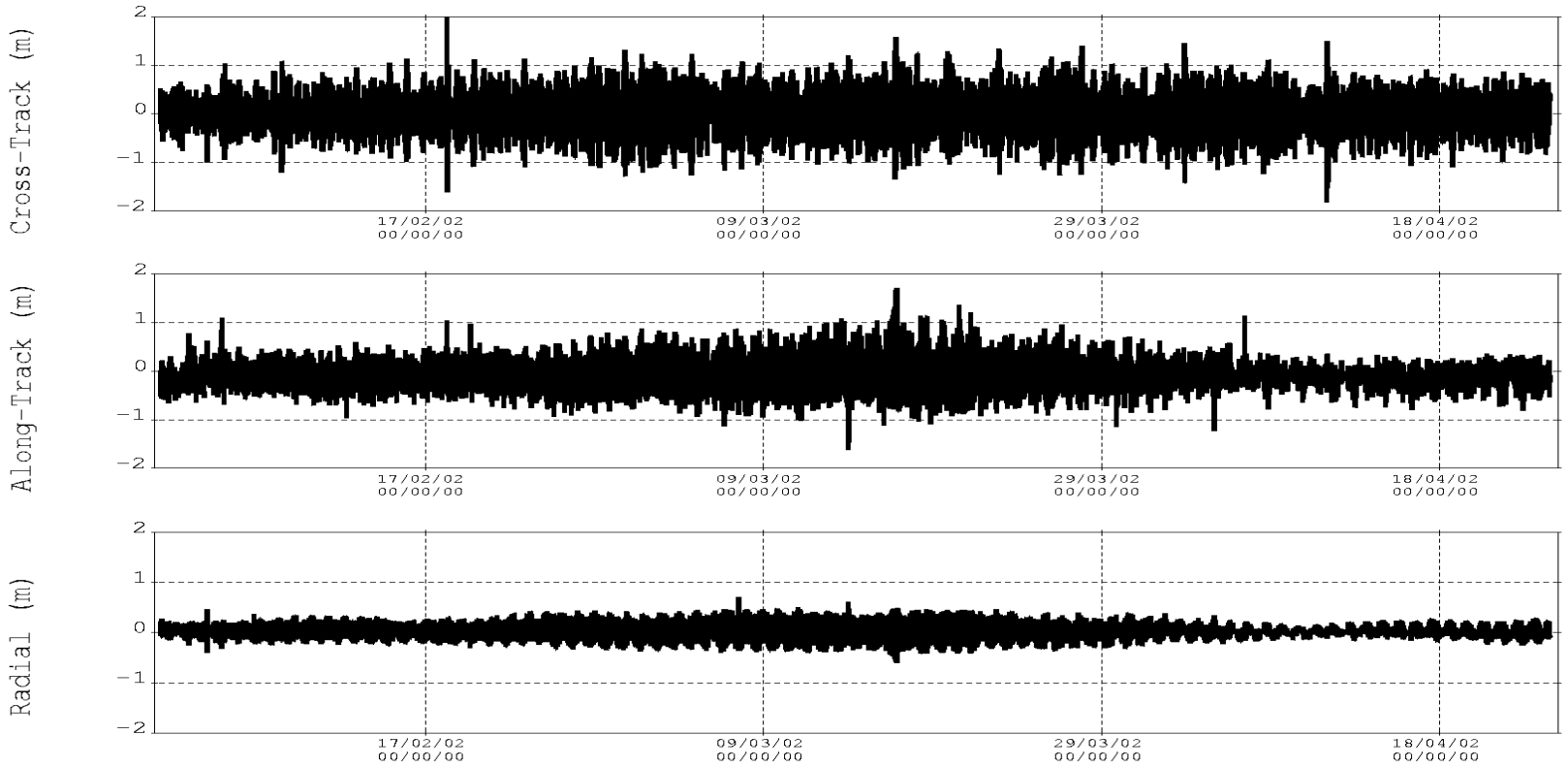
DORIS JASON orbits accuracy

- **Real-time orbit (<=> *OSDR*)**
  - DIODE orbit estimation is based on the onboard processing of DORIS bi-frequency Doppler measurements
    - TAI time-tagging of Doppler measurements is derived from the DIODE TAI estimation
  - requirements on the satellite position determination
    - **30 cm rms on the radial direction ; 1 m rms on 3-D position**
  - DIODE orbit estimation accuracy
    - evaluated by comparison with POE orbits for 3 months
    - accuracy on the radial direction : between **10cm and 25 cm rms**
    - 3-D accuracy : between **0.40 and 0.90 m rms**

DIODE JASON orbit estimation accuracy

Comparison DIODE estimated orbit / POE over 3 months

rms of radial error over 1 day : between 10 cm and 25 cm



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- **Daily DORIS orbit : MOE (<=> *IGDR*)**
  - requirement : **4 cm rms on the radial direction**
  - accuracy on radial direction : estimated to be between **3 and 5 cm rms**
    - J/J-1 overlaps, GPS /DORIS MOE comparison
- **DORIS POE (<=> *GDR*)**
  - requirement : **2.5 cm rms on the radial direction; *1 cm as a goal***
  - rms radial error is considered to be between **1.5 cm and 2 cm**