

DORIS / Cryosat-2 Now in Flight



- Cryosat mission
- DORIS Instrument Health status
- Performances
- Data availability

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- **ESA mission supported by CNES for DORIS system aspects, POD and Long term Archive**
- **Marine and continental ice monitoring**
- **3 years**
- **Orbit**
 - ◆ Altitude 717 Km
 - ◆ Not sun synchronous
 - ◆ Cycle: 369 days – sub cycle: 30 days
 - ◆ Inclination: 92°
- **Launched by Dniepr on April 8th 2010**



- **Spacecraft**
 - ◆ Manufactured by EADS-Astrium GmbH
 - ◆ 4,60 m x 2,34 m x 2,20 m
 - ◆ Mass: \approx 720 Kg
- **Payload**
 - ◆ SIRAL Altimeter (Thales Alenia Space)
 - ◆ DORIS (Thales Airborne Systems)
 - ◆ Laser Reflector Array

■ Real time products

- ◆ Inertial Navigation for S/C AOCS
- ◆ TAI time tagging

■ POD for altimeter data processing

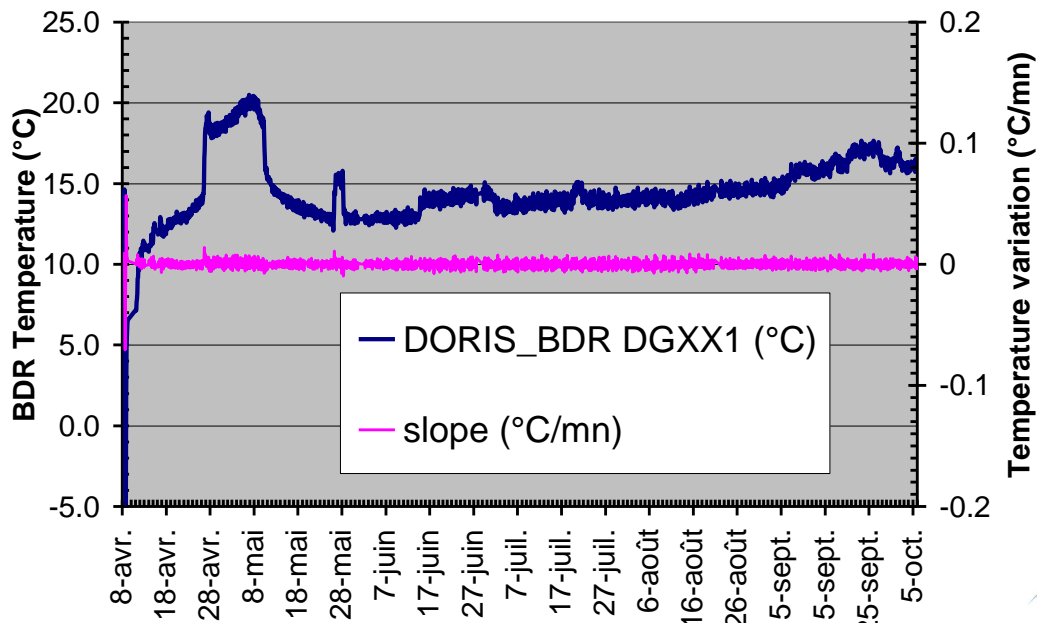
■ IDS

- ◆ DORIS data available for IDS

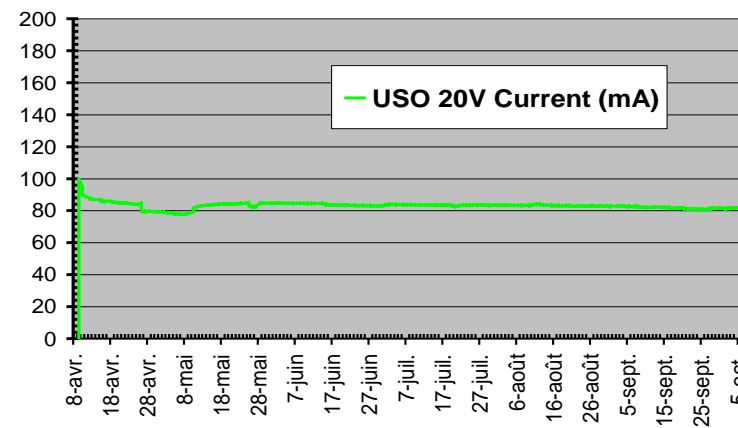
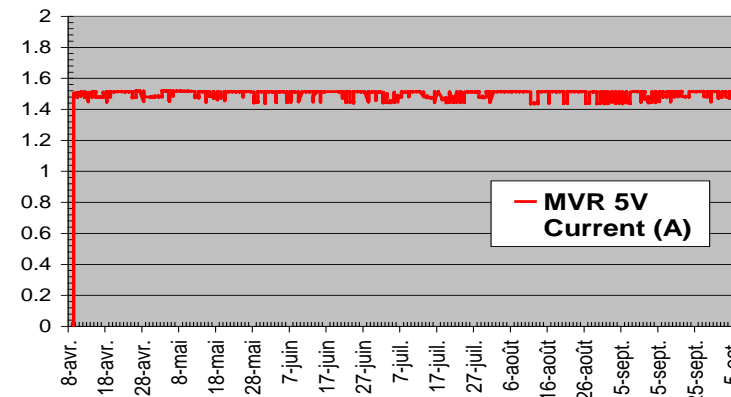
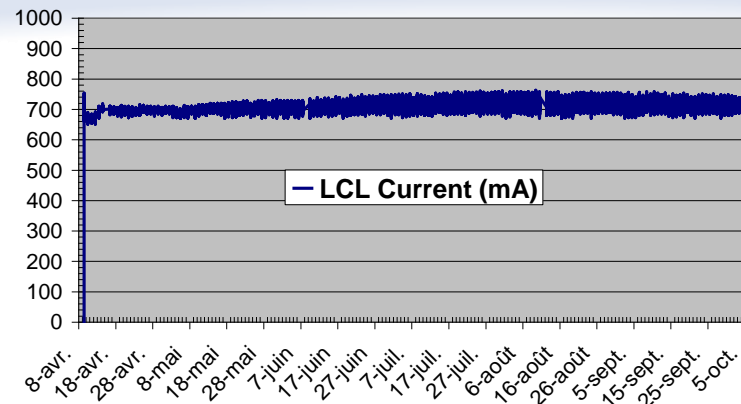


■ All parameters stable and in well in specified ranges

- ◆ LCL (primary) Current
- ◆ MVR 5V (CPU) Current
- ◆ USO 20V Current
- ◆ BDR temperature



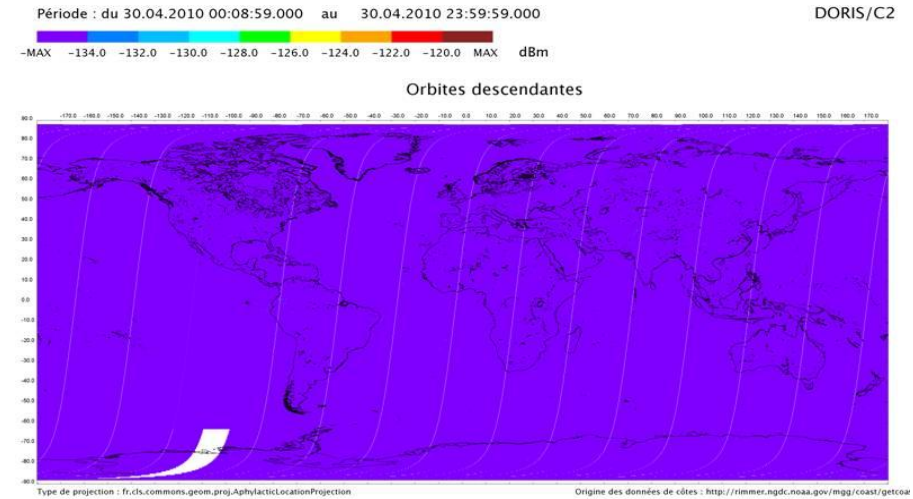
AA - IDS 2010



- **Satellite emission : none**
- **Ground emission :**
 - ◆ **2GHz : none**
 - ◆ **400MHz :**
 - Western Europe (already observed since 1990)
 - North East Asia
 - Some spots over Central America (already observed since 1990)
 - Discrete jammer in Antarctica
- **No major impact on the mission performance**
 - ◆ **Main channel is 2GHz**
 - ◆ **Doris system works since 1990 with the observed jammers in 400MHz channel.**

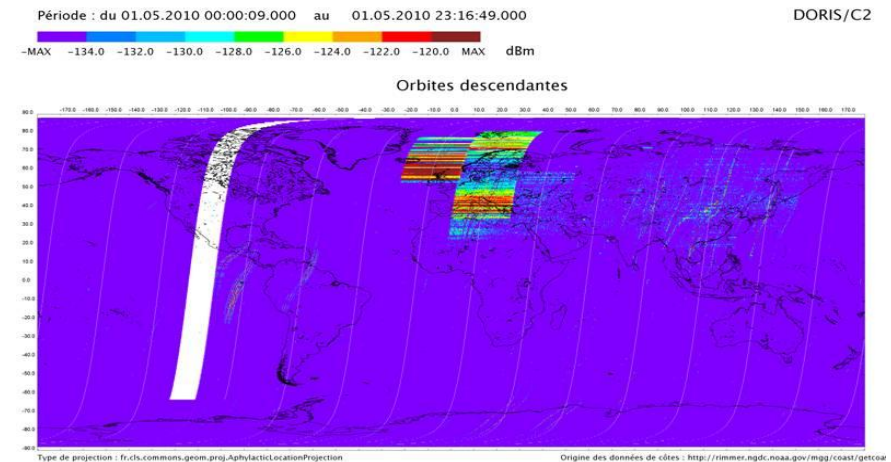
CARTE DE BROUILLAGE EN ORBITE

Spectres extraits 2036.25 MHz



CARTE DE BROUILLAGE EN ORBITE

Spectres extraits 401.25 MHz



CARTE DE BROUILLAGE EN ORBITE

Spectres extraits 401.25 MHz

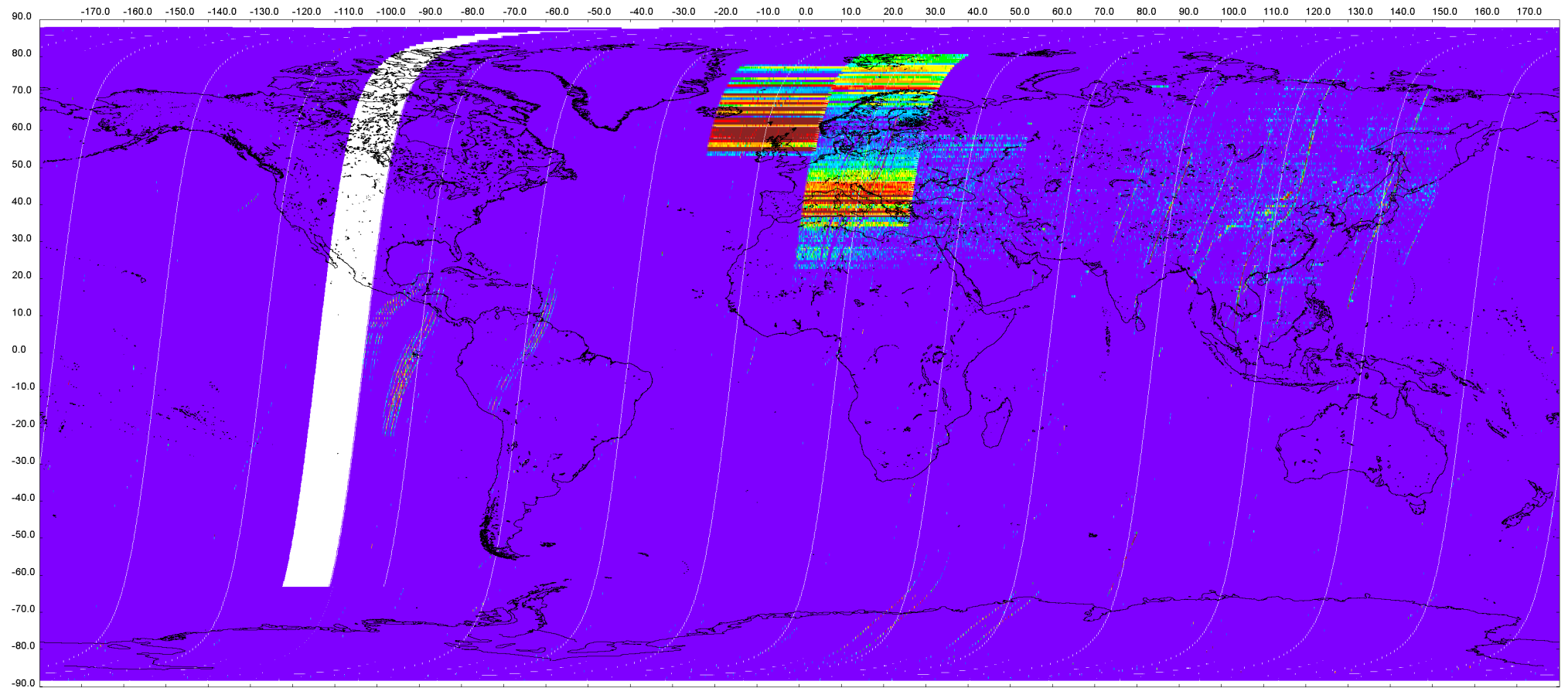
Période : du 01.05.2010 00:00:09.000 au 01.05.2010 23:16:49.000

DORIS/C2



-MAX -134.0 -132.0 -130.0 -128.0 -126.0 -124.0 -122.0 -120.0 MAX dBm

Orbites descendantes

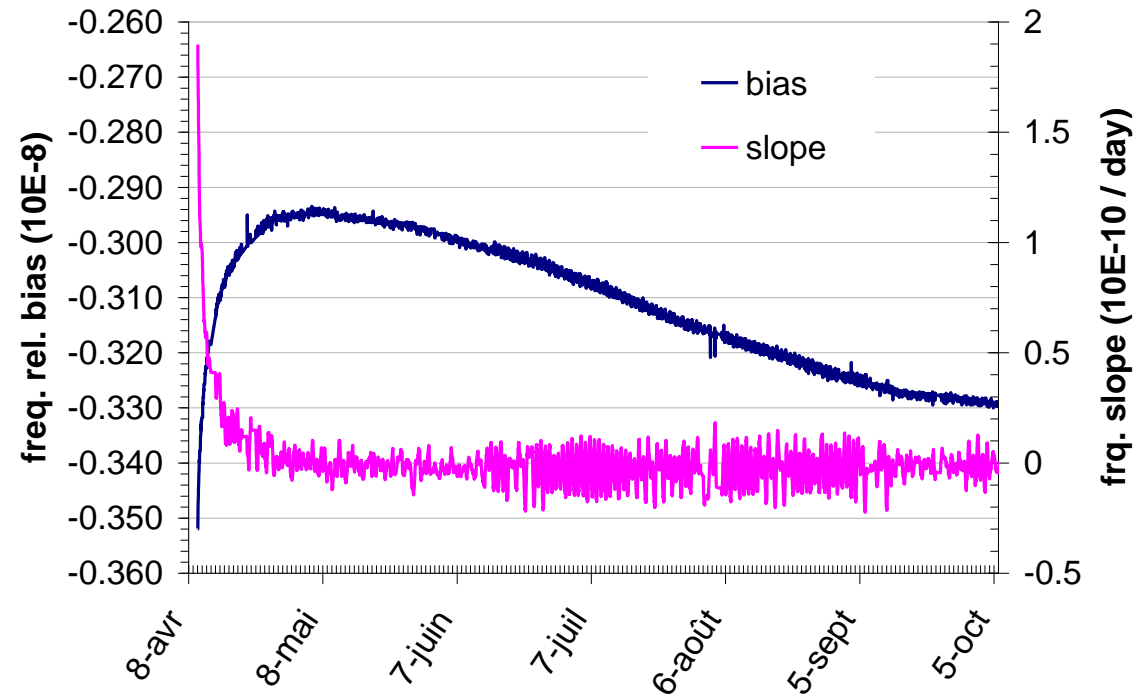


■ FREQUENCY BIAS :

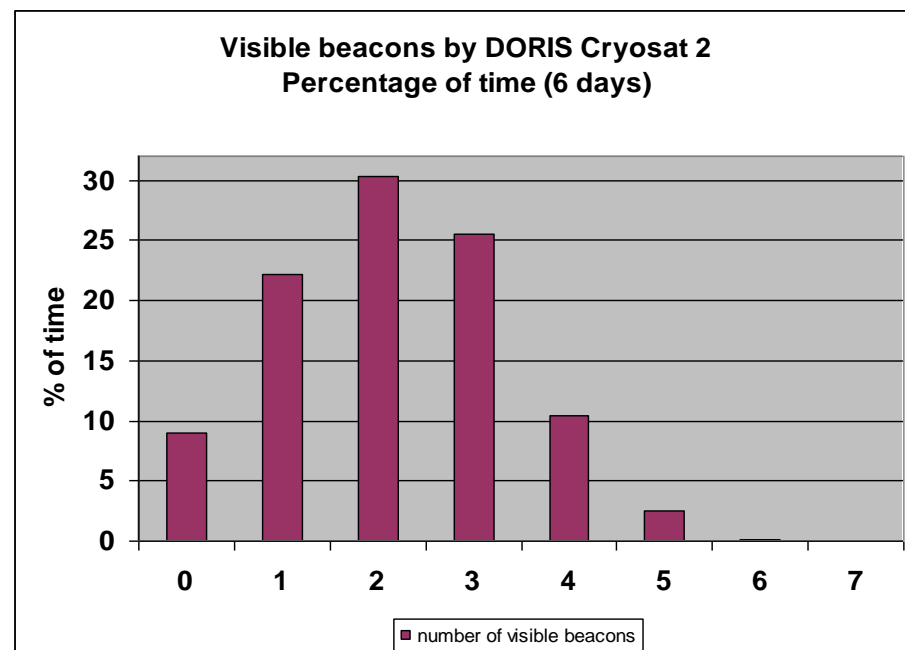
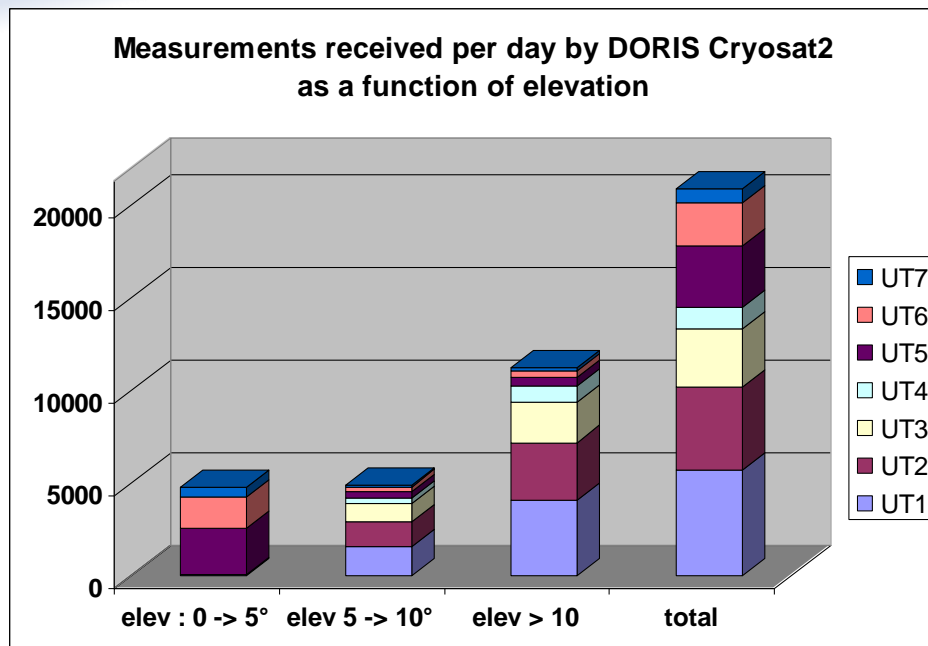
- ◆ Req : $< +/- 2.10^{E-7}$
- ◆ Value : around -3.10^{E-9}
- ◆ Typical « log » shape

■ FREQUENCY DRIFT :

- ◆ Req. (consistent with POD full performance) : $< +/- 1.10^{E-10}/\text{day}$
- ◆ Current value : $\sim -1.50^{E-14} / \text{d}$

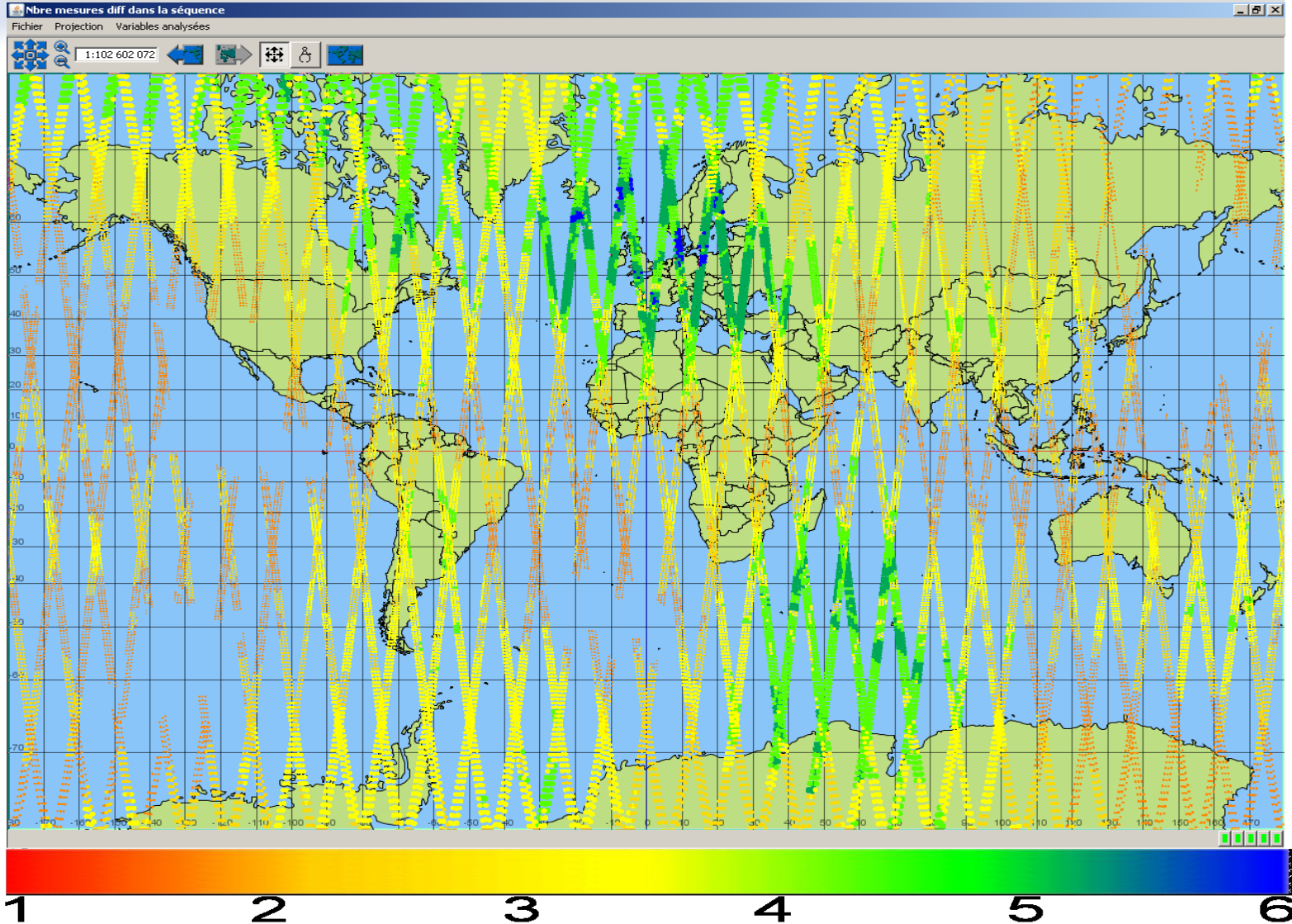


NB: noise is not representative of the USO frequency behaviour as it is due to estimation process ($\sim 10^{E-11}$)

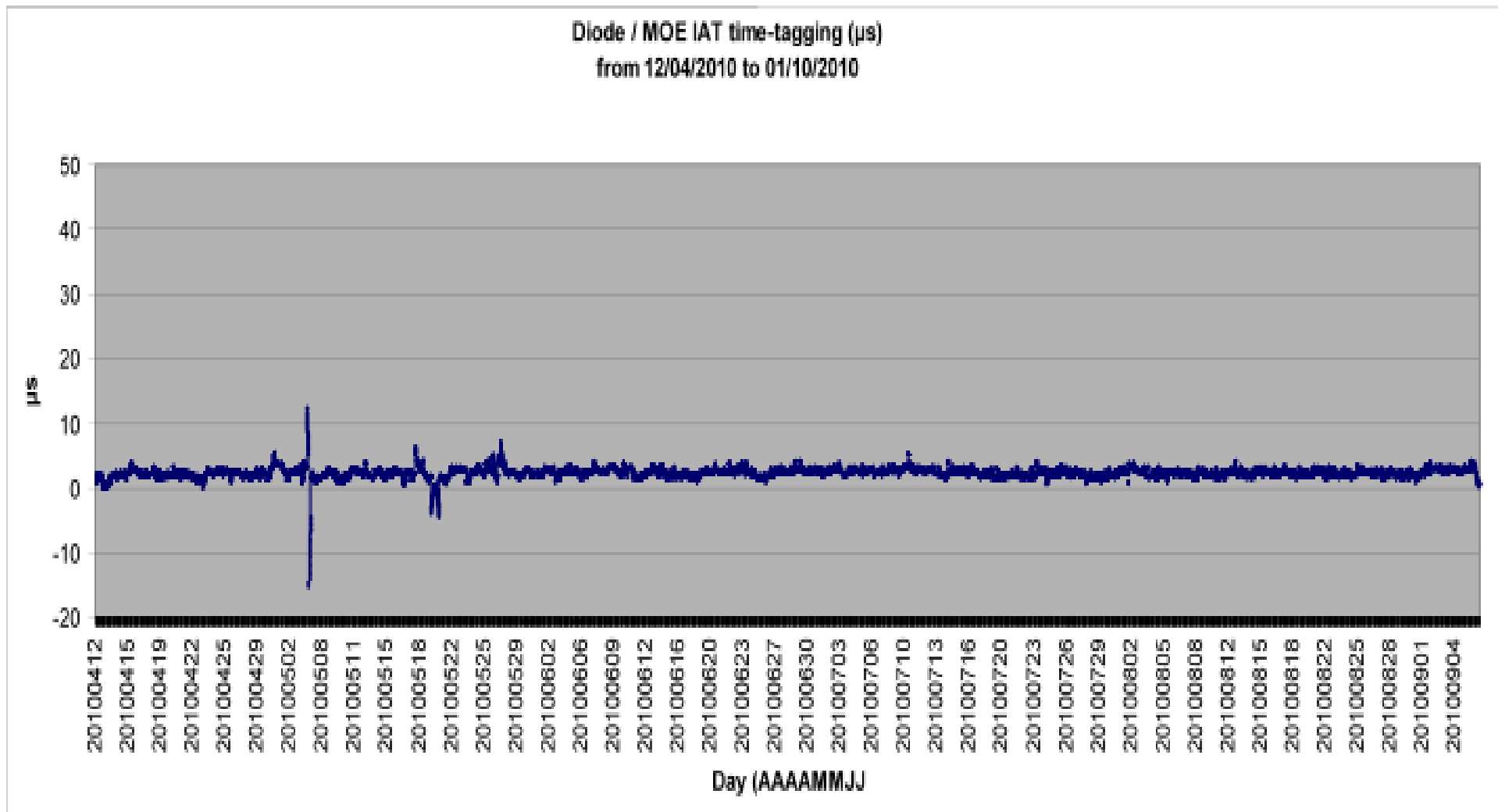


- **UT measurement modes :**
 - UT1 to UT4 : DIODE (helped by navigation)
 - UT5 to UT6 : DAS (Spectrum Analysis)

Number of Beacons simultaneously tracked by DORIS Cryosat 2

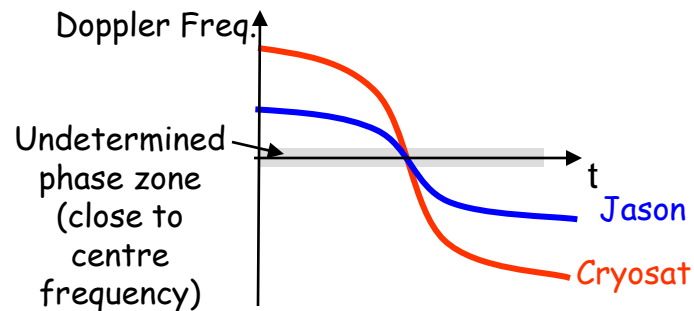


Comparison between MOE and DIODE TAI time tagging

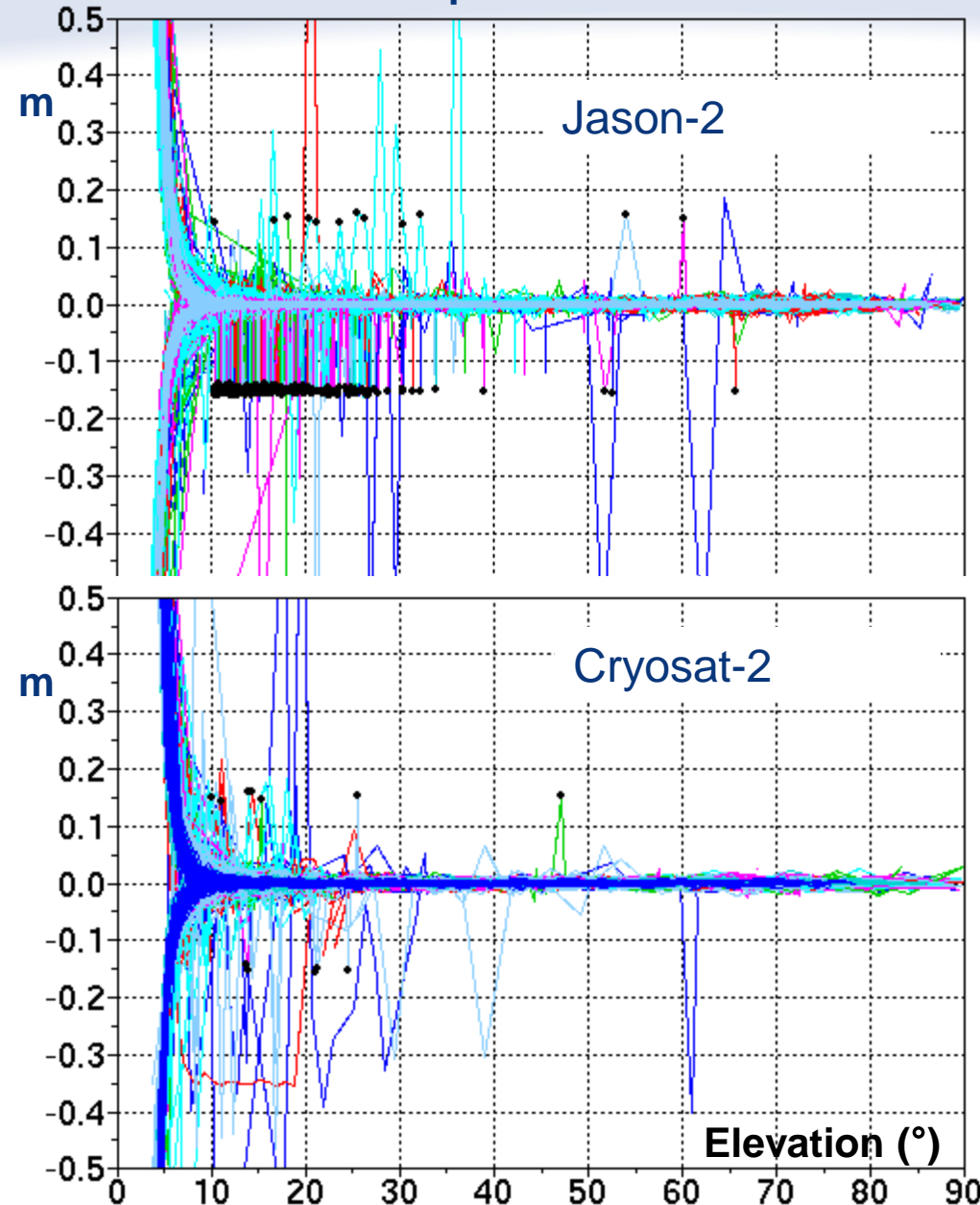


DORIS Residuals

- For a given elevation angle (below 30°), much fewer 1-cycle slips for Cryosat-2 than Jason-2
 - ◆ Due to lower altitude the “Doppler signature” of the received signal is stronger leading in a better efficiency of the phase loop.



Iono-free delta-phase residuals

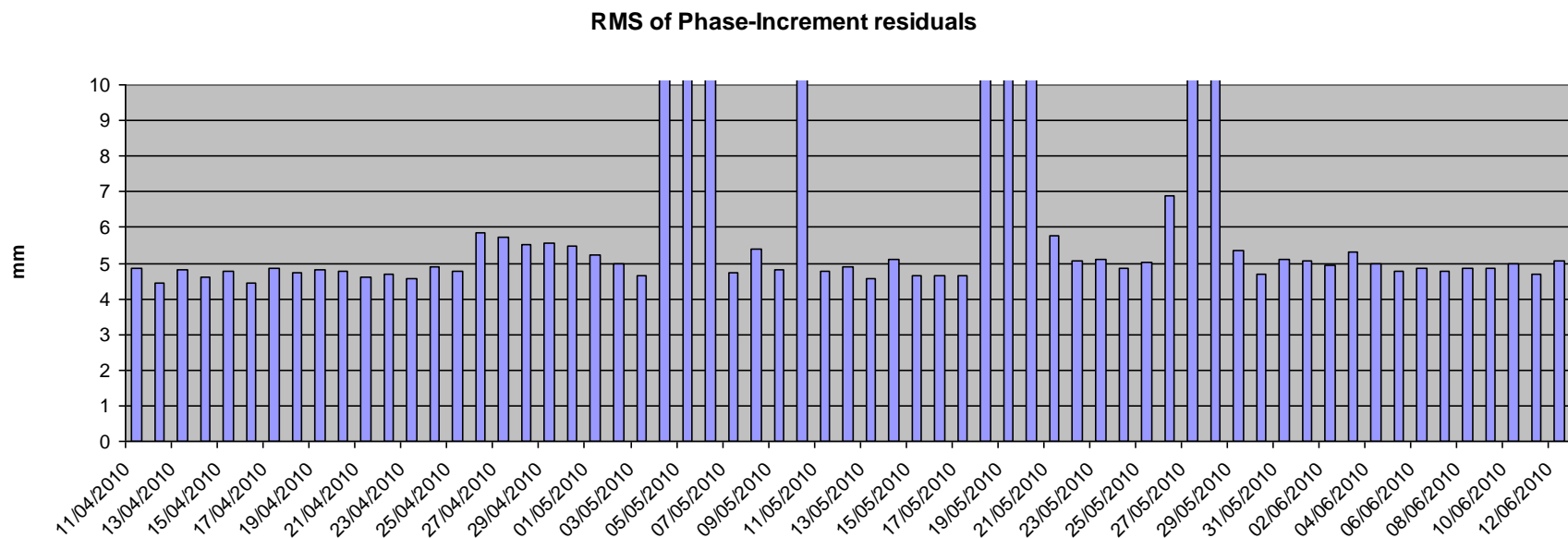


DORIS Tracking Availability

- about 8800 non-edited meas./day

- ◆ ~9200 meas./day for Envisat, ~17000 meas./day for Jason-2 (higher altitude)

- RMS of delta-phase residuals is stable (between 4 and 5 mm at 10 s count interval, outside maneuver periods), slightly higher than Jason-2

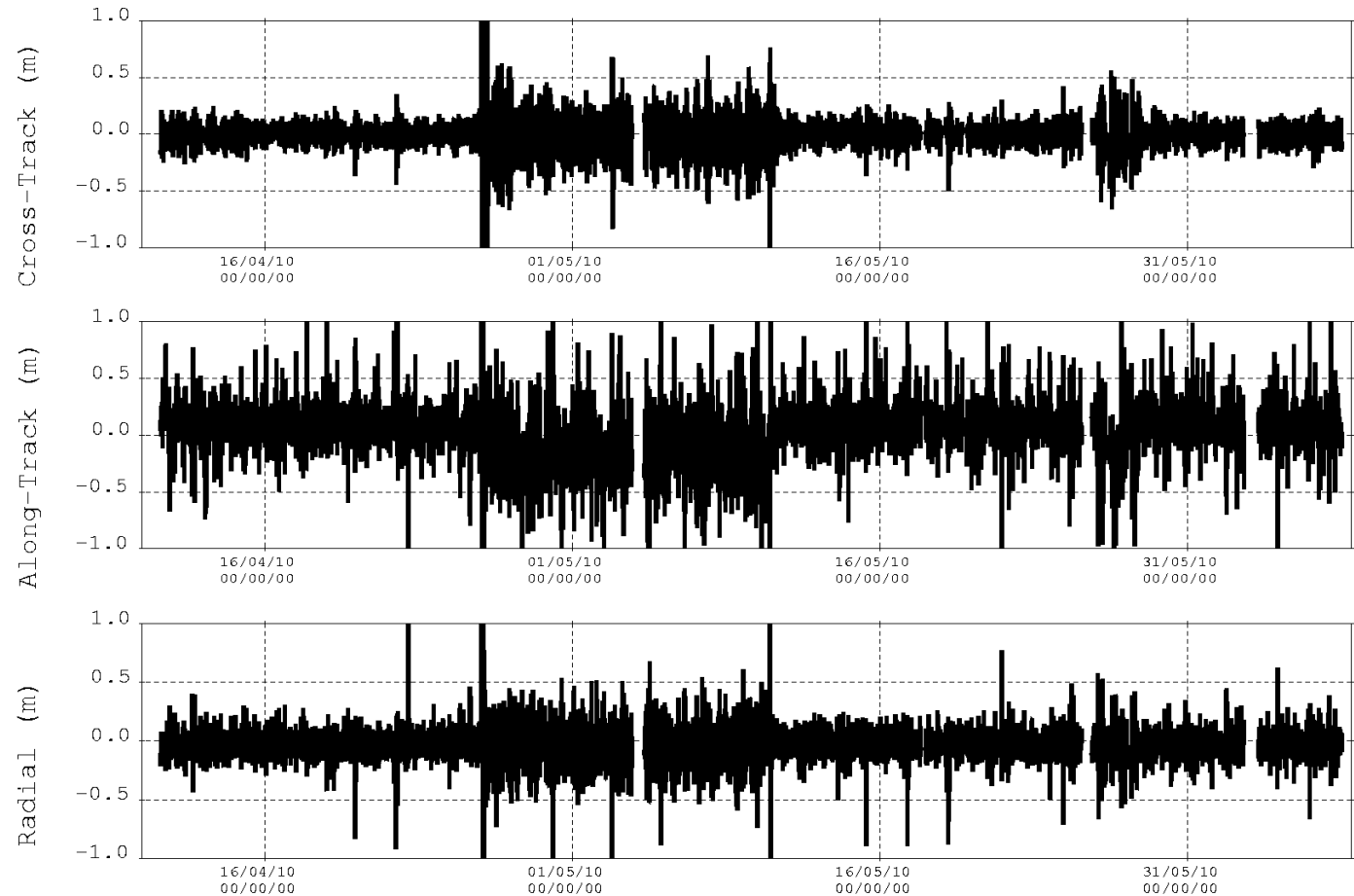


ITRF Real Time Navigation performance (DIODE) w.r.t. MOE

When attitude is « frontside », radial RMS DIODE vs
MOE = between 7 and 9 cm

Sometimes strong perturbations during Yaw Flips

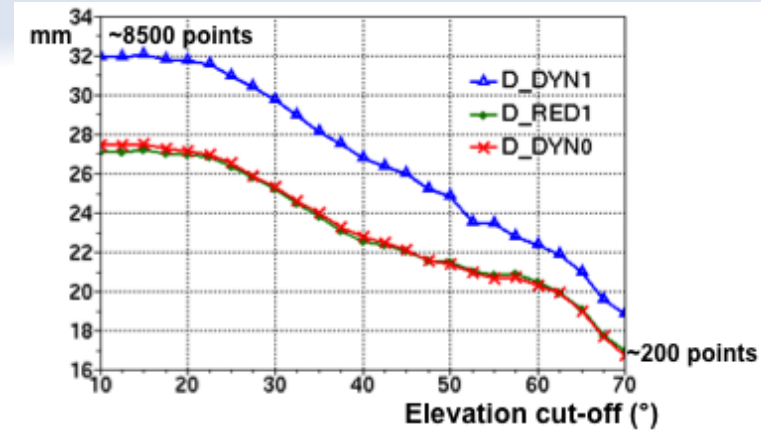
Metric perturbations during « backwards » flight (reference point, surface forces)



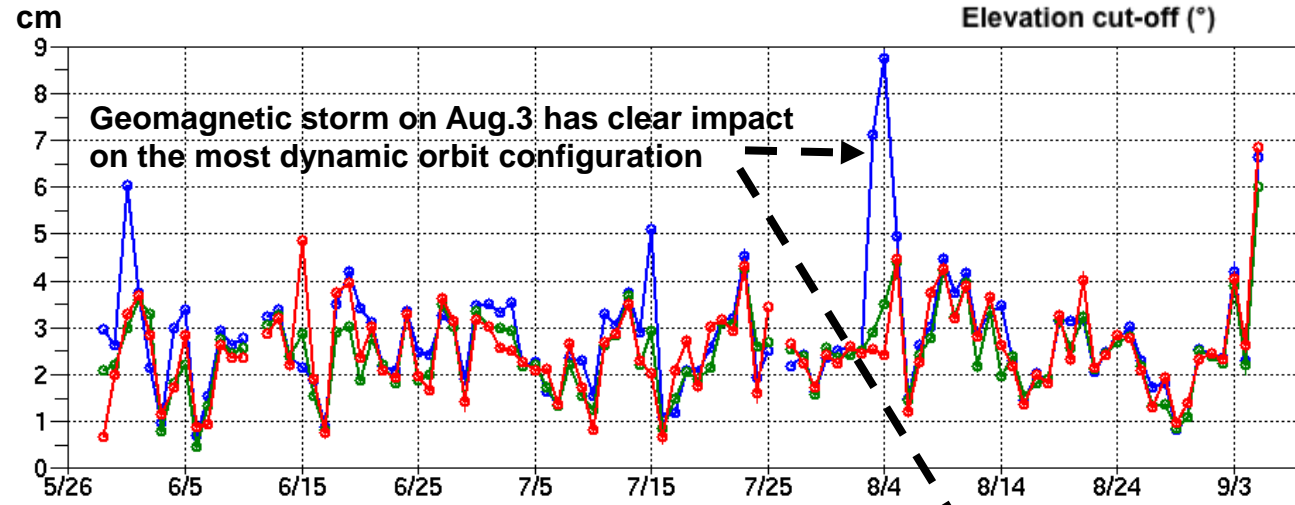
(with a more recent version of DIODE, performances are slightly better, between 5 and 8 cm RMS)

POE performance : below 2 cm

- High elevation SLR residuals indicate that the doris-only orbit radial accuracy is below 2 cm (similar results are obtained on Envisat Doris-only orbits)

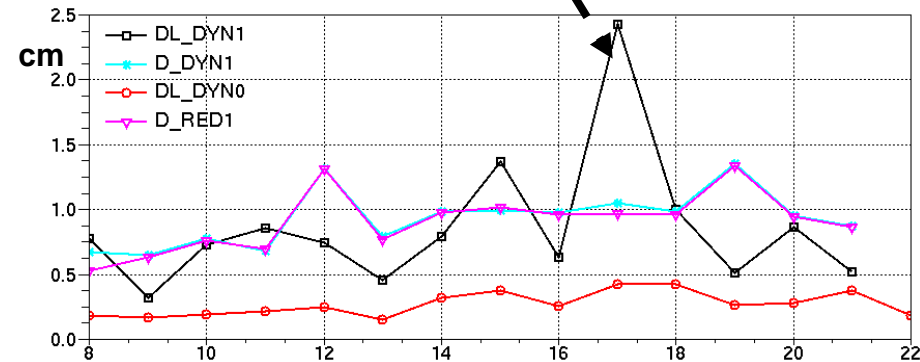


Residuals over arcs 008-022 from YARR_L7090, WASH_L7105, MONU_L7110, GRAZ_L7839, FORT_L7080, HERS_L7840, ZIMM_L7810



- Comparison of different internal solutions to POE at the 1-cm level

- POE: Dynamic step (1 drag / 3 revs + 1/revs every 24 h) + stochastic constant along-track
- DYN0: POE Dynamic step
- DYN1: 1 constant along track every 8 hours + 1/revs every 24 h
- RED1: DYN1 + stoch. constant al.track, stoch. 1/rev al.track



- Inaccurate injection by the launcher => lot of compensation manoeuvres (over 10 weeks)

- DORIS RINEX data available from July 18th
 - ◆ on board TAI time tagging corrupted (jumps)
 - + 10s on June 30th (Yellowknife Station default),
 - About 40 microseconds Sept 7th (Maser clock issue in Terre Adélie station)

- The DORIS DGXX instrument (identical to DORIS / Jason-2) performs very well on board Cryosat-2
- First results are very satisfactory
- data (RINEX files) are available since July 18th

