DORIS / Cryosat-2
Now in Flight

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

- 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: ≈ 720 Kg

- Payload
  - SIRAL Altimeter (Thales Alenia Space)
  - DORIS (Thales Airborne Systems)
  - Laser Reflector Array
The DORIS Mission on board Cryosat-2

- **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
RF environment checking

- 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 401.25 MHz

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

Orbites descendantes

Type de projection : fr.cls.commons.geom.proj.AphylacticLocationProjection
Origine des données de côtes : http://rimmer.ngdc.noaa.gov/mgg/coast/getcoas
**USO behaviour**

- **FREQUENCY BIAS:**
  - Req.: \( < +/- 2.10^{-7} \)
  - Value: around \(-3.10^{-9}\)
  - Typical « log » shape

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

**NB:** Noise is not representative of the USO frequency behaviour as it is due to estimation process (~10\(^{-11}\))
• **UT measurement modes:**
  - UT1 to UT4: DIODE (helped by navigation)
  - UT5 to UT6: DAS (Spectrum Analysis)
Measurements coverage (2)

Number of Beacons simultaneously tracked by DORIS Cryosat 2
DORIS time tagging monitoring

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.
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
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)

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

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

Geomagnetic storm on Aug.3 has clear impact on the most dynamic orbit configuration.
Data availability

- 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