DORIS / Cryosat-2 Now in Flight

Cryosat mission
DORIS Instrument Health status
Performances
Data availability

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COES 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 × 2,34 m × 2,20 m
 - Mass: ≈ 720 Kg
- Payload
 - SIRAL Altimeter (Thales Alenia Space)
 - DORIS (Thales Airborne Systems)
 - Laser Reflector Array



COES The DORIS Mission on board Cryosat-2

Real time products

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

POD for altimeter data processing

• DORIS data available for IDS



cnes **DORIS Instrument health status** 1000

All parameters stable and in well in specified ranges

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



400 300

200 100

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- LCL Current (mA)

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RF environment checking

CARTE DE BROUILLAGE EN ORBITE

Spectres extraits 2036.25 MHz

dBm

Période : du 30.04.2010 00:08:59.000 au 30.04.2010 23:59:59.000 -134.0 -132.0 -130.0 -128.0 -126.0 -124.0 -122.0 -120.0 MAX

DORIS/C2

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

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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

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

Orbites descendantes



Type de projection : fr.cls.commons.geom.proj.AphylacticLocationProjection

Origine des données de côtes : http://rimmer.ngdc.noaa.gov/mgg/coast/getcoas

DORIS/C2

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USO behaviour

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}/day
- Current value : ~ -1.50^{E-14} / d

NB: noise is not representative of the USO frequency behaviour as it is due to estimation process (~10^{E-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



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CORIS time tagging monitoring

Comparison between MOE and DIODE TAI time tagging



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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



RMS of Phase-Increment residuals



Commissioning DORIS / Cryosat-2

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

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





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

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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,

D_RED1 28 + D_DYN0 26 24 22 20 18 -200 points 16₊ 20 30 50 60 Elevation cut-off (°) cm Geomagnetic storm on Aug.3 has clear impact on the most dynamic orbit configuration 6 5 4 3 2 0+ 5/26 8/4 6/5 6/15 6/25 7/5 7/15 7/25 8/14 8/24 9/3 2.5 - DL DYN1 cm D DYN1 2.0 D RED1 1.5 1.0 0.5 0.0-12 14 16 18 20

~8500 points

D_DYN1

DORIS 14

mm

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

ZIMM L7810

- DYN1: 1 constant along track every 8 hours + 1/revs every 24 h
- RED1: DYN1 + stoch. constant al.track, mshorkshopey, abtra of tober 21-22, 2010



- 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)





CONCLUSION

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



