From Jason2 to Jason3

DIODE enhancements

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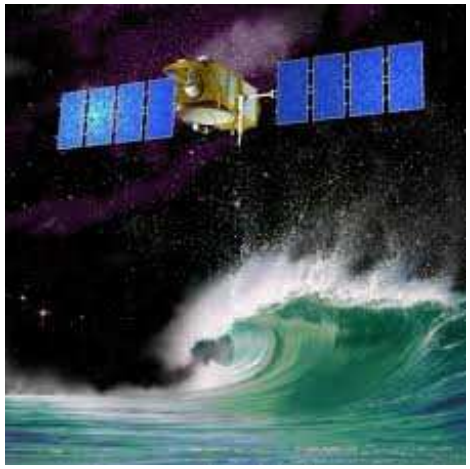
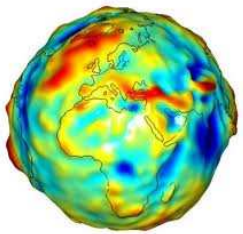
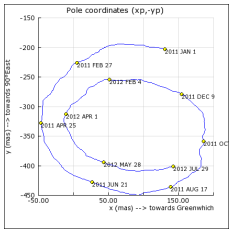
Summary

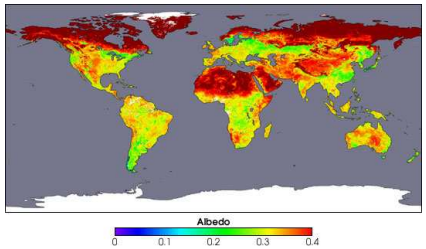
- **DIODE DGXX versions on Jason2**
  - ✦V3.06, V4.02(LV8), V4.05(LV11)
  - ✦Performances



- **Evolutions towards DIODE DGXX-S for Jason3**
  - ✦Focus on a few improvements





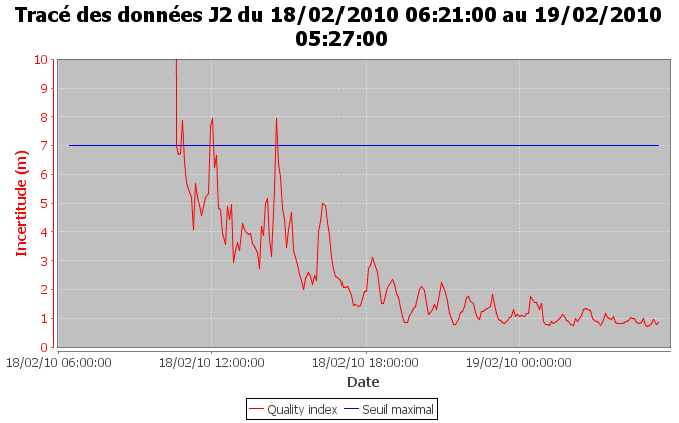


- **Expected performances on-board Jason3**

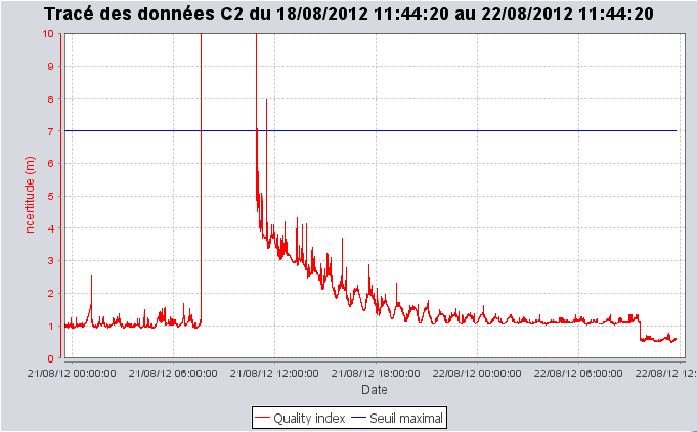
DIODE DGXX Versions

- **Launched in 2008 : version V3.06**

- **On-board now : V4.02(LV8)**
  - ✦Correction of radiation pressure model
  - ✦Uploaded on Feb 18, 2010
    - ➔Re-convergence in a few hours
    - ➔No discontinuity since that time



- **DIODE DGXX V4.05(LV11) available**
  - ✦Empirical forces added in the along-track direction
    - ➔Absorption of mismodelling at the orbital period
  - ✦Uploaded on-board Cryosat2 on August 28, 2012
    - ➔Re-convergence in a few hours
  - ✦Should be uploaded on Jason2 soon
  - ✦Also integrated on AltiKa



Comparison DIODE / POE on Jasons2

DIODE V4.02 on-board (19/02/2010 – 25/08/2010)

	NB POINTS	MINIMUM	MAXIMUM	MOYENNE	ECART TYPE	RMS
Radial	262379	-0.154137	0.167234	0.004240	0.033353	0.033621
Tangentiel	262379	-0.863369	0.625138	0.005866	0.077669	0.077890
Normal	262379	-0.536943	0.519837	-0.000574	0.090467	0.090469
Distance	262379	0.001082	0.903077	0.109701	0.057858	0.124024
Vit rdle	262379	-0.000558	0.000753	-0.000006	0.000064	0.000064
Vit tgtle	262379	-0.000146	0.000125	-0.000016	0.000033	0.000037
Vit nrmle	262379	-0.000492	0.000419	0.000002	0.000094	0.000094
Norme vit	262379	0.000000	0.000757	0.000105	0.000056	0.000119

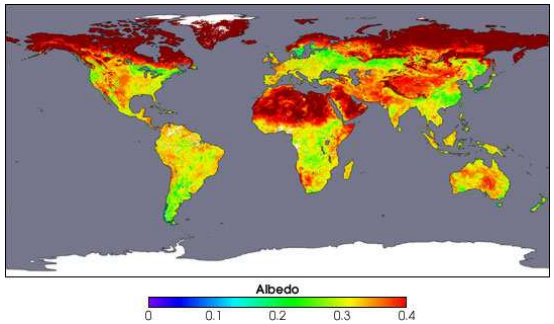
DIODE V4.05 (ground retrieval)

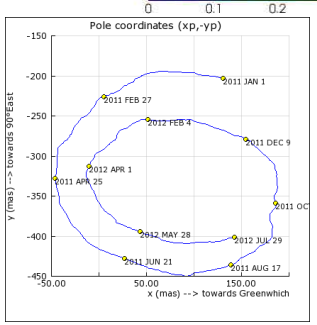
	NB POINTS	MINIMUM	MAXIMUM	MOYENNE	ECART TYPE	RMS
Radial	262379	-0.190617	0.219343	-0.001000	0.027175	0.027193
Tangentiel	262379	-0.681318	0.737505	-0.000927	0.066379	0.066385
Normal	262379	-0.291969	0.287919	-0.000894	0.063802	0.063808
Distance	262379	0.000927	0.759530	0.084654	0.045295	0.096010
Vit rdle	262379	-0.000641	0.000610	0.000001	0.000059	0.000059
Vit tgtle	262379	-0.000144	0.000110	-0.000022	0.000028	0.000035
Vit nrmle	262379	-0.000325	0.000305	0.000002	0.000071	0.000071
Norme vit	262379	0.000001	0.000658	0.000088	0.000045	0.000099

Evolutions towards DIODE DGXX-S

- **A new processor : ERC32 => LEON2**
  - Faster processing : 12 MHz => 36 MHz
  - Allow use of new or more complex models

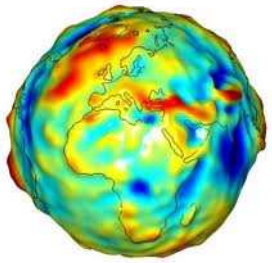
- **New models**
  - Empirical Hill forces in along track direction
  - Albedo + Infra-Red rediffused radiation pressure
  - Oceanic tidal acceleration
  - Ionospheric correction for the datation
  - Rejection of stereo measurements
  - Estimation of pole drift
  - Estimation of on-board frequency drift
  - Estimation of beacons frequency drift





Evolutions towards DIODE DGXX-S

- **Improvement of models already present in DIODE**
  - Relativistic acceleration (2nd order)
  - Luni-solar acceleration (2nd order)
  - Terrestrial tidal acceleration (3rd order)
  - Earth potential : up-to-date model
  - Meeus models for Moon and Sun positions
  - Precession and nutation : up-to-date models

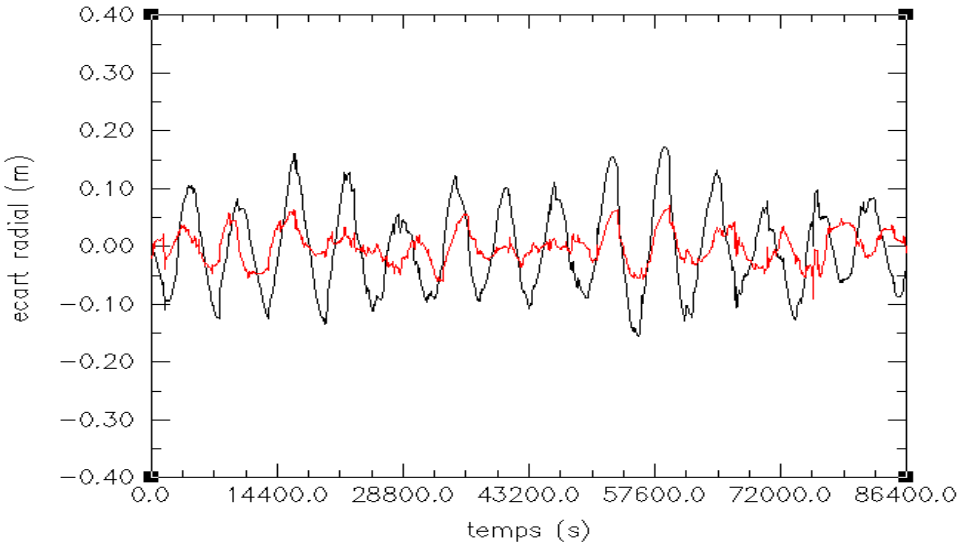


- **Specific evolutions**
  - Use of TC for solar array orientation on Jason3
  - Parametrisation
  - Sentinel3 attitude model

- **Also evolutions without direct effect on the navigation**
  - Organisation of the source code, monitoring, optimisation, …

Focus on a few improvements (1/3)

- **Along-track empirical forces**



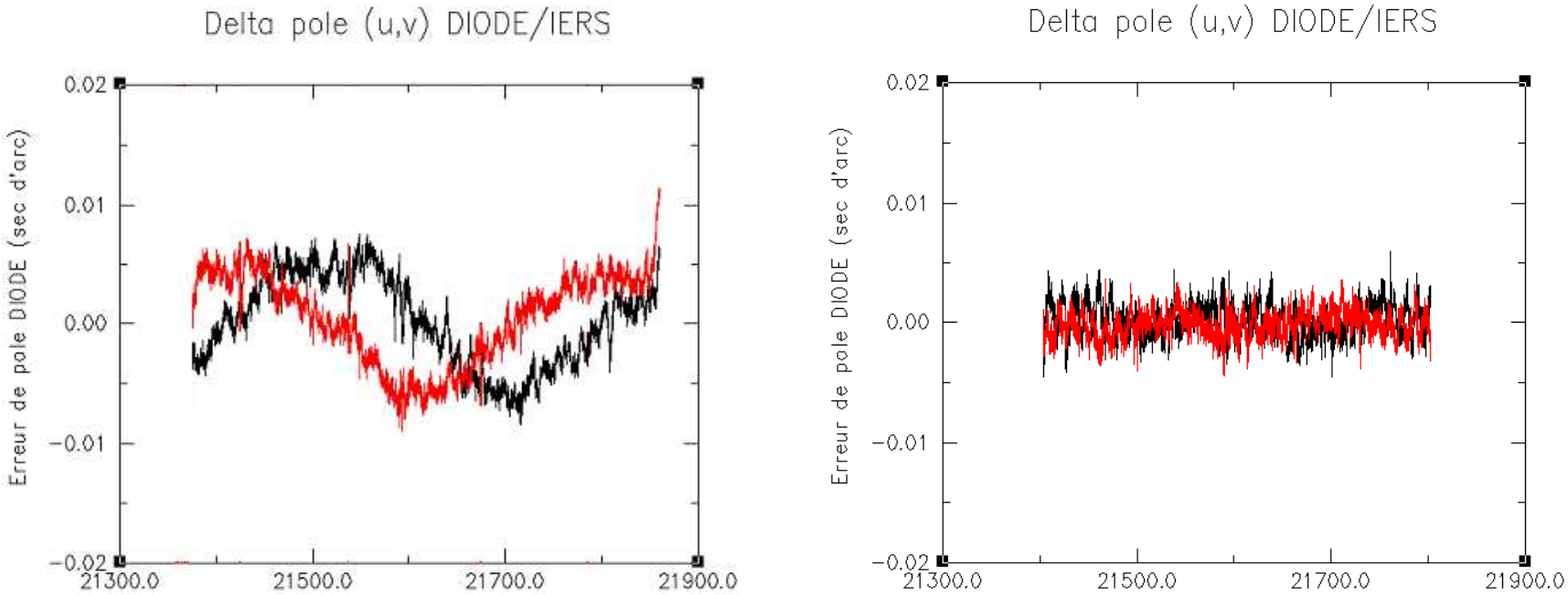
	RMS	RMS
	**********	**********
Radial	0.080230	0.031467
Tangentie	0.137860	0.085896
Normal	0.096922	0.091486
Distance	0.186644	0.129375
Vit rdle	0.000135	0.000087
Vit tgtle	0.000079	0.000032
Vit nrmle	0.000102	0.000097
Norme vit	0.000187	0.000134

Cryosat2 : comparison w.r.t. POE for the radial component with (red) and without (black) empirical forces

Imperfection in the satellite model can be absorbed by empirical forces

Focus on a few improvements (2/3)

- **Pole drift estimation for pole prediction**



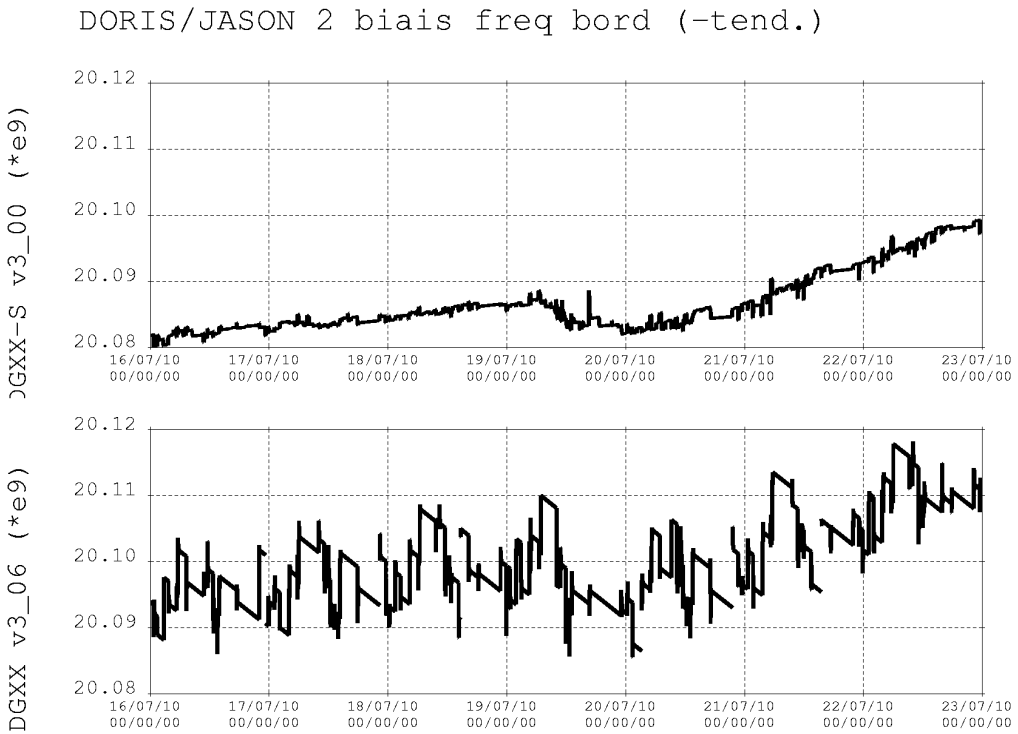
Jason2 : comparison of DIODE pole coordinates w.r.t. IERS (400 days) without (left) and with (right) pole prediction

Precision = ~1mas rms

Focus on a few improvements (3/3)

Frequency drift estimation for frequency prediction

- On-board frequency bias



- Accuracy = ~10^{-12} (delta f/f)
  (improvement : X 10)
- For on-board and beacons USO
- ***Allow detection of events*** on USO (beacons network survey from space)
- and ***prevent navigation from perturbations*** due to these events

(improvement driven by Doris Performance Group)

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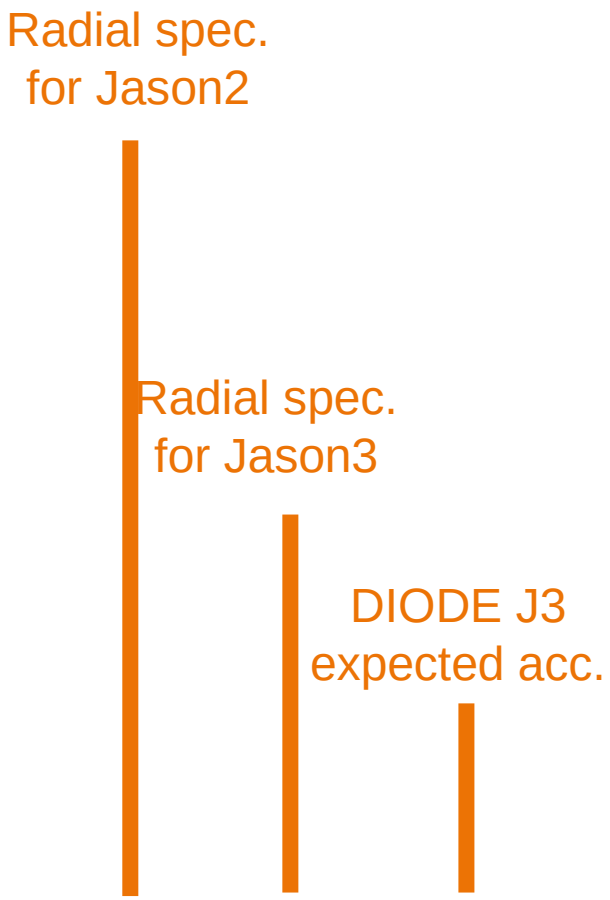
DIODE DGXX-S current version (ground retrieval)

	NB POINTS	MINIMUM	MAXIMUM	MOYENNE	ECART TYPE	RMS
Radial	262379	-0.150069	0.223386	-0.001171	0.025216	0.025243
Tangentiel	262379	-0.842104	0.613508	-0.000485	0.062689	0.062690
Normal	262379	-0.281760	0.291711	-0.000865	0.057965	0.057972
Distance	262379	0.000735	0.858537	0.078313	0.042369	0.089039
Vit rdle	262379	-0.000544	0.000684	-0.000000	0.000056	0.000056
Vit tgtle	262379	-0.000156	0.000118	-0.000022	0.000026	0.000034
Vit nrmle	262379	-0.000290	0.000273	0.000001	0.000067	0.000067
Norme vit	262379	0.000001	0.000714	0.000084	0.000042	0.000094

Conclusion

- **A new and faster processor for DORIS**
- **New and more complex models for DIODE**
  - ✦Performances :
    - ➔Better than 5cm RMS on the radial component
    - ➔Better than 10cm on 3D
    - ➔~1µs in datation
  - ✦Robustness :
    - ➔Validated by ground retrieval over very long periods



THANK YOU!

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