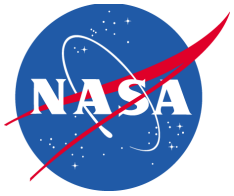


Towards Models and Standards for the Next ITRF

F.G. Lemoine

IDS Analysis Working Group Meeting

Prague, Czech Republic

May 31 – June 1, 2012

New standards & data

Improvements based on experience with ITRF2008

1. Update to Radiation pressure modelling, macromodels (SRP …).
2. Parameterization for Atmospheric drag.
3. Update to Troposphere modelling; GMF/GPT or VMF1.
4. Application of Atmospheric gravity in forward-modelling.

Force & measurement model improvements

1. New static geopotential model based on GRACE+GOCE?
2. Time-varying geopotential?
3. Ocean Tides (also Ocean Loading).
4. DPOD2008 – with fixes for problems identified in operational combination.
5. IERS2010 standards.

Data

1. New satellite data (Jason-2, Cryosat2).
2. New Envisat data, (6/2002 – 5/2007) (DORISMAIL 0823, May 16-2012)
3. How to handle SPOT-5/SAA issue?
4. More rigorous attention to *a priori* deletes (e.g. DPOD2008).

AC Modelling summary, ITRF2008

AC	Gravity	Atmos. Gravity	Ocean Tides	Troposphere + Met Data + Mapping Function	Elev. Cutoff (Deg)
ESOC	EIGEN-GL05C (120x120)	NCEP	FES2004	GMF+GPT + GMF	10°
GAU	GGM02C	NCEP	GOT4.7	Hopfield + GPT+ Niell	12°
GOP	EIGEN-GL04S (100x100)	ECMWF	CSR3	GMF+ GPT + GMF	10°
GSC	EIGEN-GL04S1 (120x120)	ECMWF	GOT4.7	Hopfield + GPT+ Niell	10°
IGN	GGM03S (120x120)	-	FES2004	GMF+ formula +GMF	10°
INA	GGM01C (120x120)	-	CSR3	Lanyi+ formula+ Lanyi	15°
LCA	EIGEN-GL04S	ECMWF	FES2004	(1)	12°

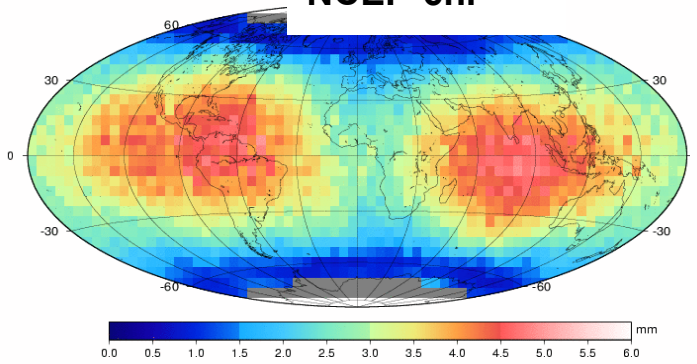
(1) After 2002. Dry and Wet Interpolated from ECMWF grids; Before 2002, use DORIS Met. Data. Mapping function Guo and Langley (2003).

IGN, INA: Apply Atmospheric Gravity.

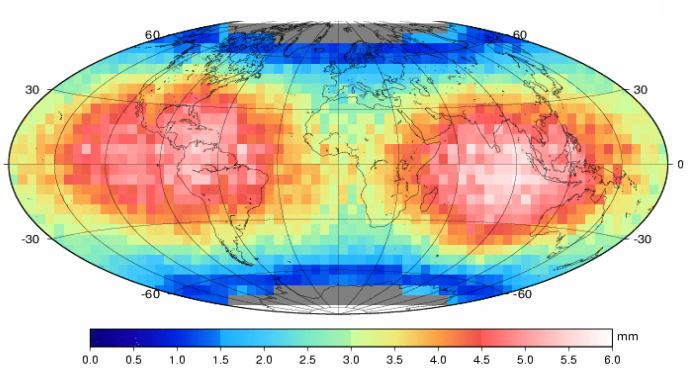
GSC, GAU: Update Troposphere mapping Function.

Radial Annual Signal, Jason Orbit

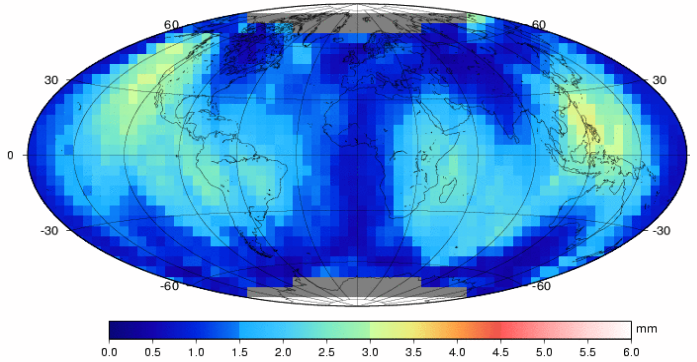
NCEP-6hr



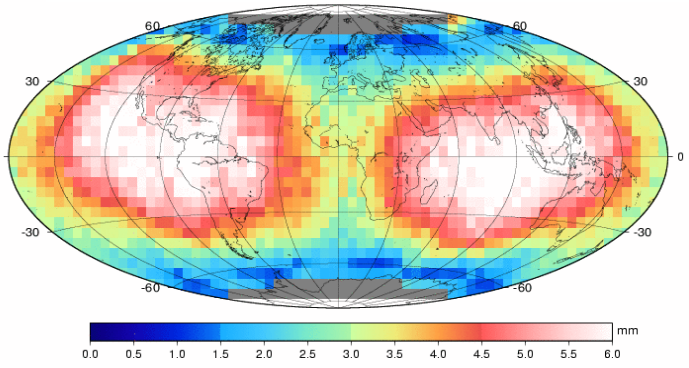
ECMWF-3hr + (T-UGO)



Hydrology (GLDAS)



ECMWF-3hr+ (T-UGO) +GLDAS



Ocean Tide Modelling

For dynamical application & ocean loading.

New Tide Models since ITRF2008.

- GOT4.8 (Corrects minor S2 error in GOT4.7)
- EOT11a
- TPX07.2, TPX07.2Atlas.
- FESXXXX?

Site of Duncan Agnew, SPOTL -> software to compute ocean loading parameters by station.

New Geopotential Models

Complicated – because one has to select a static model (e.g. GRACE + GOCE+others) and a time-variable gravity parameterization that will work 1993-2012.

ICGEM (Potsdam)
URL: http://icgem.gfz-potsdam.de

New Geopotential Models

Recent Geopotential Models (examples)

- GOCO2S. (Goce, Grace, Lageos, Champ, 2011)

- EIGEN6S (Goce, Grace, Lageos, 2011)
  - Secular, Annual, Semi-annual terms to 50x50 – Rate terms do not project well beyond period over which they are determine – not just C20.

- GO_CONS_GCF_2_DIR_R3 (Goce, Grace, Lageos, 2011)

AC Modelling summary, ITRF2008. (2)

AC	Solar Radiation Pressure Modelling	Atmosphere Density Model	Drag Coefficient Estimation	Planetary Radiation Pressure
ESOC	Envisat : ANGARA Doornbos et al. (2002) T/P & SPOT's : Box-wing	MSIS90	Cd/2.4 hrs	Knocke et al. (1988)
GAU	T/P, SP2, SP3 : GSFC(1) box-wing (untuned) SP4, SP5, Envisat : CNES box-wing (untuned) (2)	MSIS86	SPOT's & Envisat : Cd/6 hrs T/P : Cd/8hrs	Knocke et al. (1988)
GOP	N/A (3)	N/A (3)	(3)	N/A (3)
GSC	T/P, SP2, SP3 : GSFC (tuned) (1) SP4, SP5 : CNES (tuned) (2) Envisat : UCL, Sibthorpe (2006)	MSIS86	SPOT's & Envisat : Cd/2hrs. Cd/1hr 2001-2002 T/P : Cd/8 hrs	Knocke et al. (1988)
IGN	CNES box-wing (tuned) Gobinddass et al. (2009)	DTM94	SPOT's & Envisat : Cd/1hr T/P :Cd/day	Knocke et al. (1988)
INA	CNES box-wing (untuned) (2)	DTM94	SPOT's & Envisat : Cd/6hrs T/P : Cd/day	Not Applied
LCA	CNES box-wing (untuned) (2)	DTM94	T/P: Cd/12 hrs SPOT's & Envisat: Cd/4 hrs Cd/1 hr 2001-2002	Albedo & IR values from 6-hr ECMWF grids

(1). See Le Bail et al. (2010) for GSFC macromodel summaries.
(2). CNES macromodels available from the IDS data centers.
(3). No exact models for non-conservative forces. Empirical constant and harmonic parameters in Sun and y-directions ; Stochastic parameters along-track every 15 minutes (Stepanek et al., 2006)

Table 3b, Valette et al., 2010.

Nonconservative Force Modelling

• ACs who did not adopt/use tuned macromodels, in ITRF2008 should update models – especially if the OPR amplitudes are high wrt other ACs. (INA, GAU).

• Drag Parameterization:

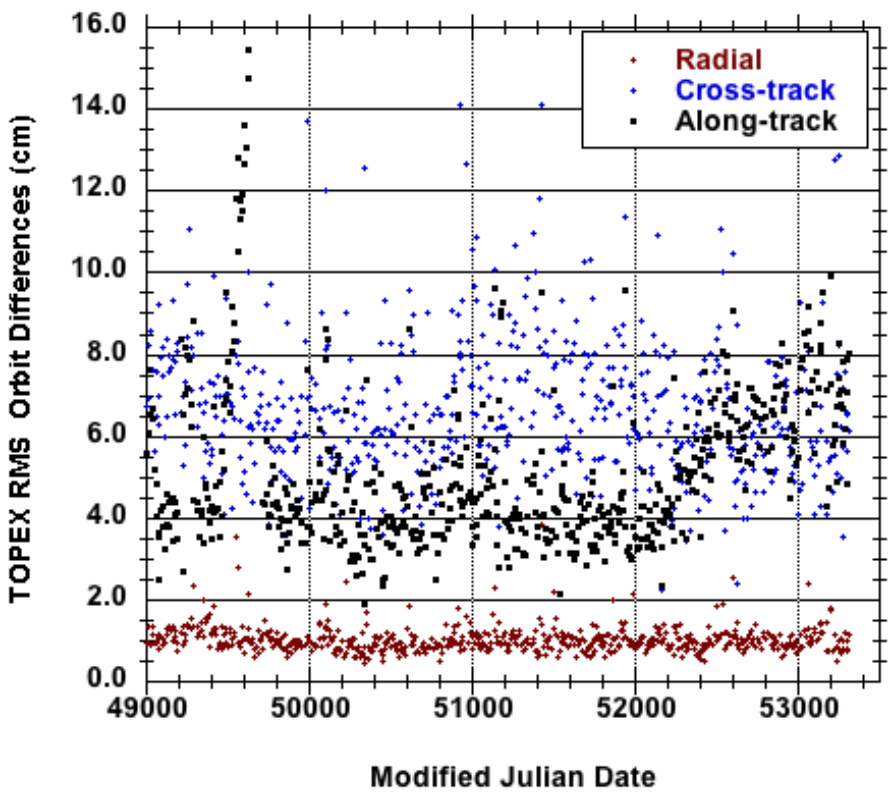
For ~800 km satellites (SPOTs, Envisat)

cd 2-4 hrs (low F10.7)

cd 1-2 hrs (high F10.7, near solar maximum)

DORIS System Time Bias

- Origin – is that DORIS time system is offset from SLR produces along –track bias (e.g. Zelensky et al., JoG 2006).
- Discernible on all satellites with SLR+DORIS.
- Use SLR+DORIS derived time biases at least for TOPEX;

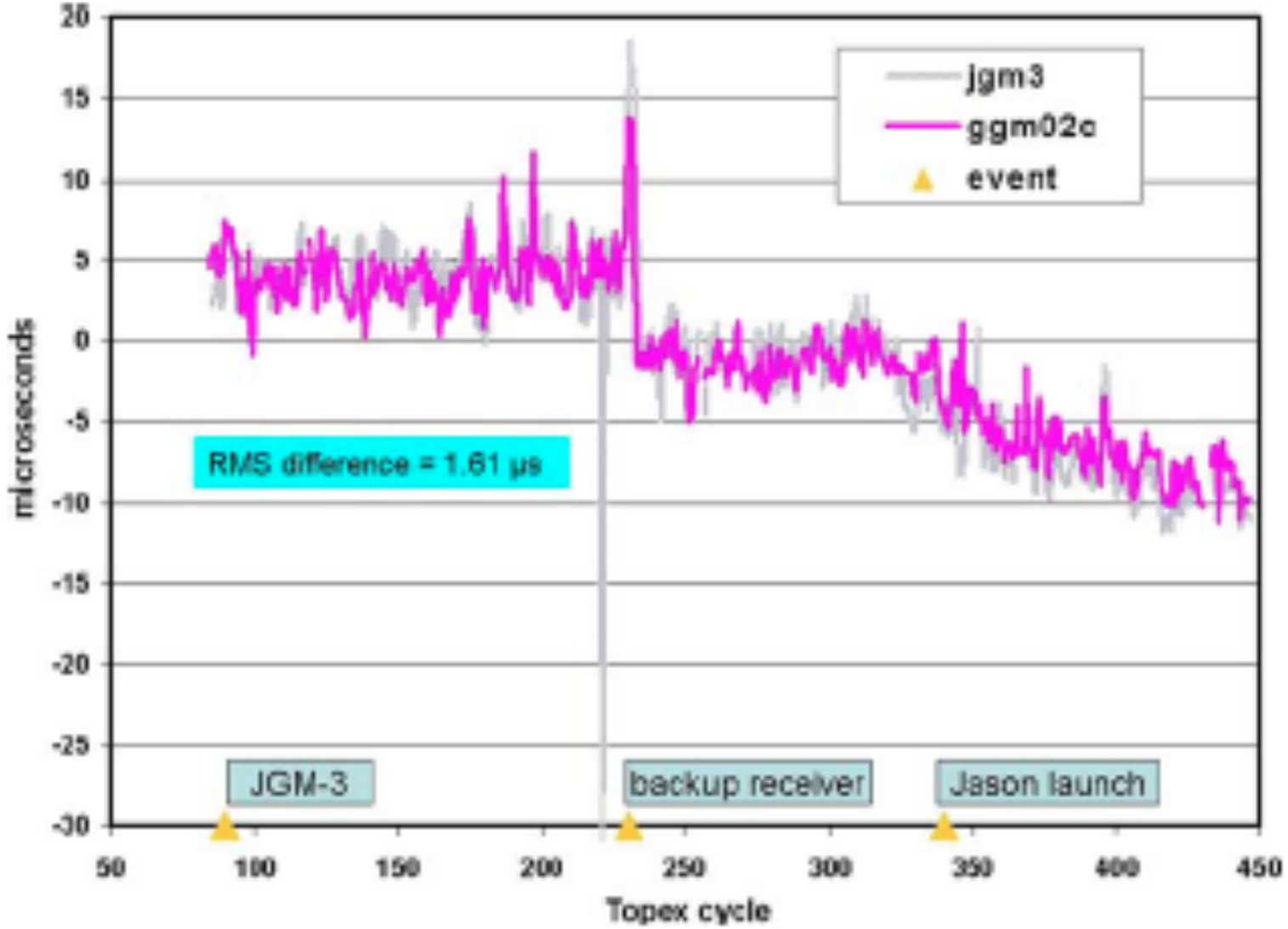


SLR/DORIS vs DORIS-only Orbit Differences

TOPEX

Le Bail et al.., 2010

DORIS System Time Bias (TOPEX)



DORIS System Time Biases (2011)