

Toward a Release-06 GRACE Atmosphere and Ocean De-Aliasing Level-1B (AOD1B) Product

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(1) 1.2 Global Geomonitoring and Gravity Field

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Outline

- ECMWF Operational and Re-analysis
- Explaining the “jumps”
- Towards a Release-06: an improved algorithm
- Conclusions

Operational vs. Re-Analysis

Resolution increase at ECMWF

- Main changes in **Operational**:

before	-> N256 ($\sim 0.351^\circ$) + L60
01.02.2006	-> N400 ($\sim 0.225^\circ$) + L91
12.12.2006	GPS radio occultation from CHAMP, GRACE, and COSMIC
26.01.2010	-> N640 ($\sim 0.141^\circ$) + L91
25.06.2013	-> L137

- **Re-analyses:**

- ERA-40 (1957-2002), 3D-VAR, **N80** ($\sim 1.125^\circ$) + **L60**
- ERA-INTERIM (1979-present), 4D-VAR, **N128** ($\sim 0.7^\circ$) + **L60**

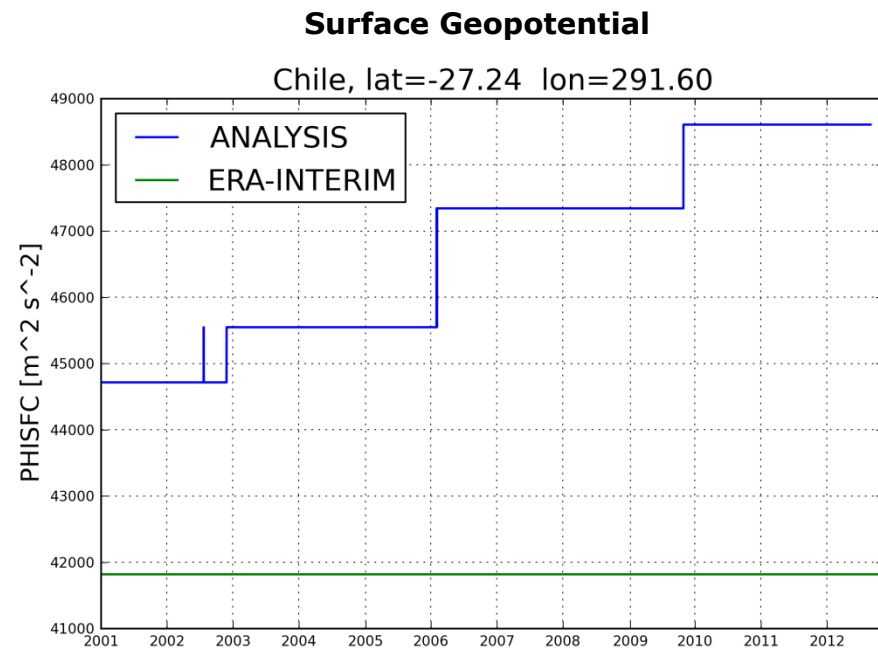
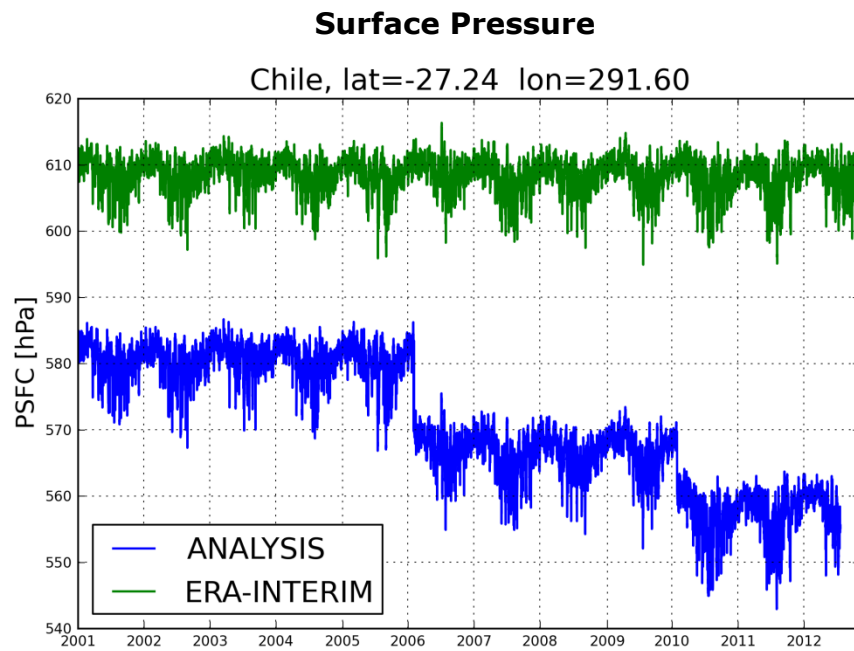
ca. 3 Months latency

http://www.ecmwf.int/products/data/operational_system/evolution/

Explaining the “jumps”

Jumps

Chile

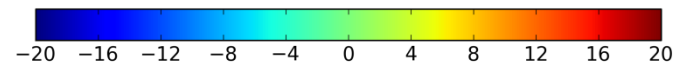
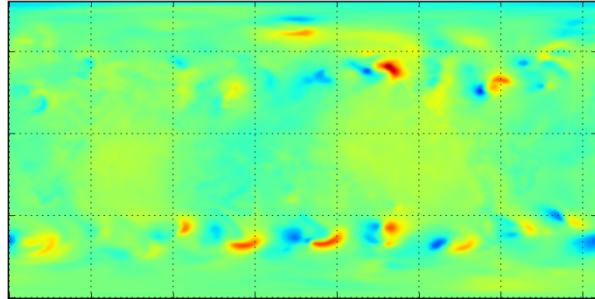


Associated with horizontal resolution increase: 01.02.2006 and 26.01.2010

Jumps Global

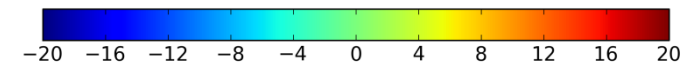
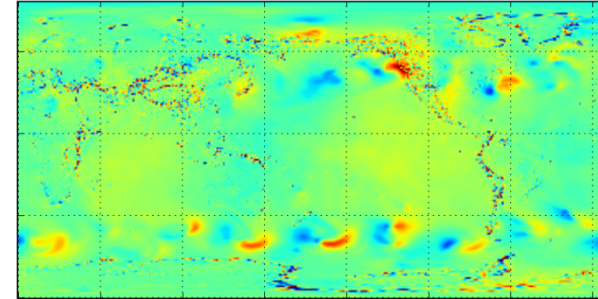
Pressure changes in re-analysis

EI PSFC diff(20060131,20060201)

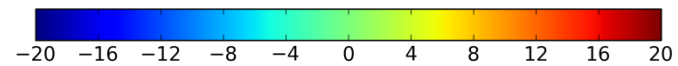
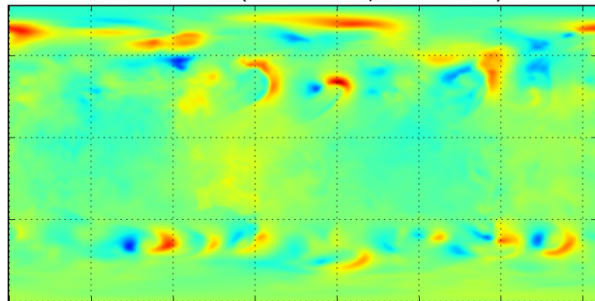


Pressure changes in operational

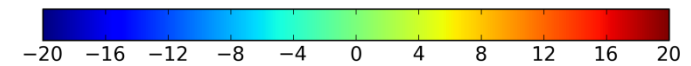
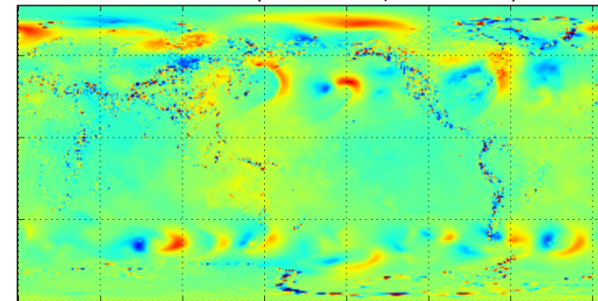
OP PSFC diff(20060131,20060201)



EI PSFC diff(20100125,20100126)

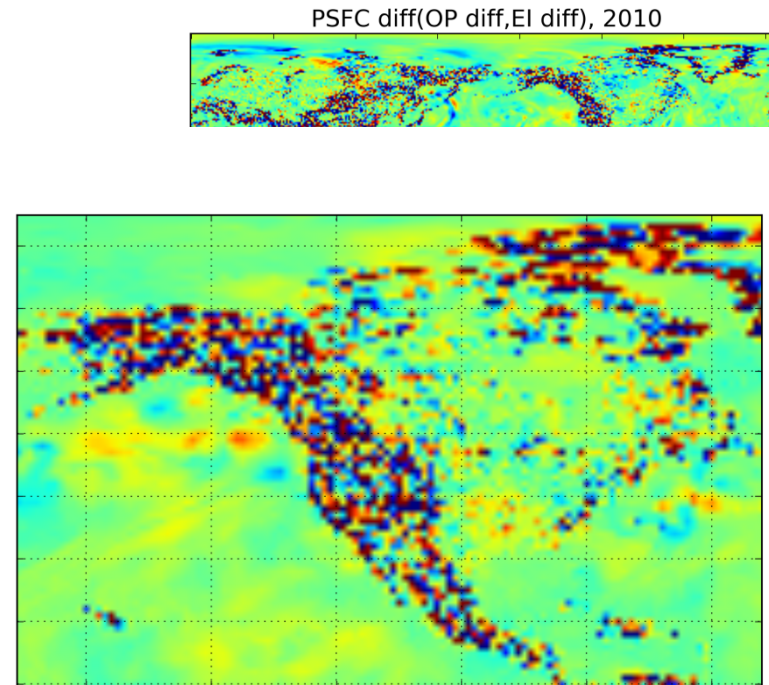
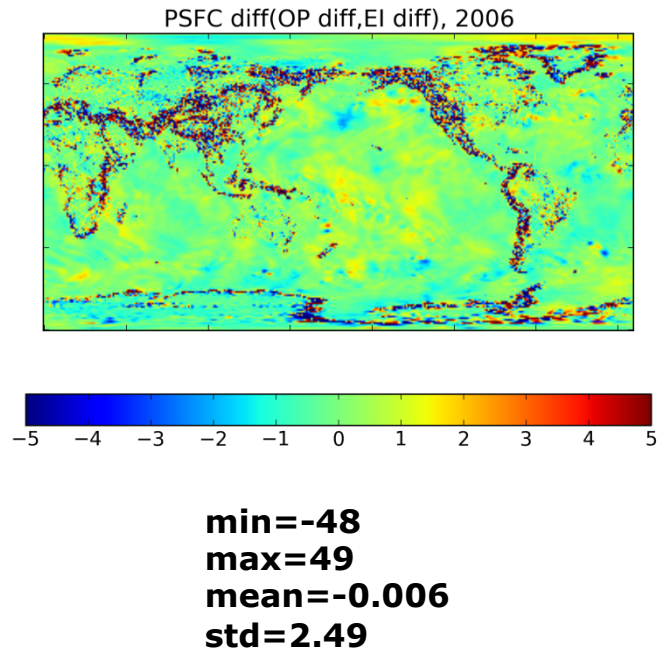


OP PSFC diff(20100125,20100126)



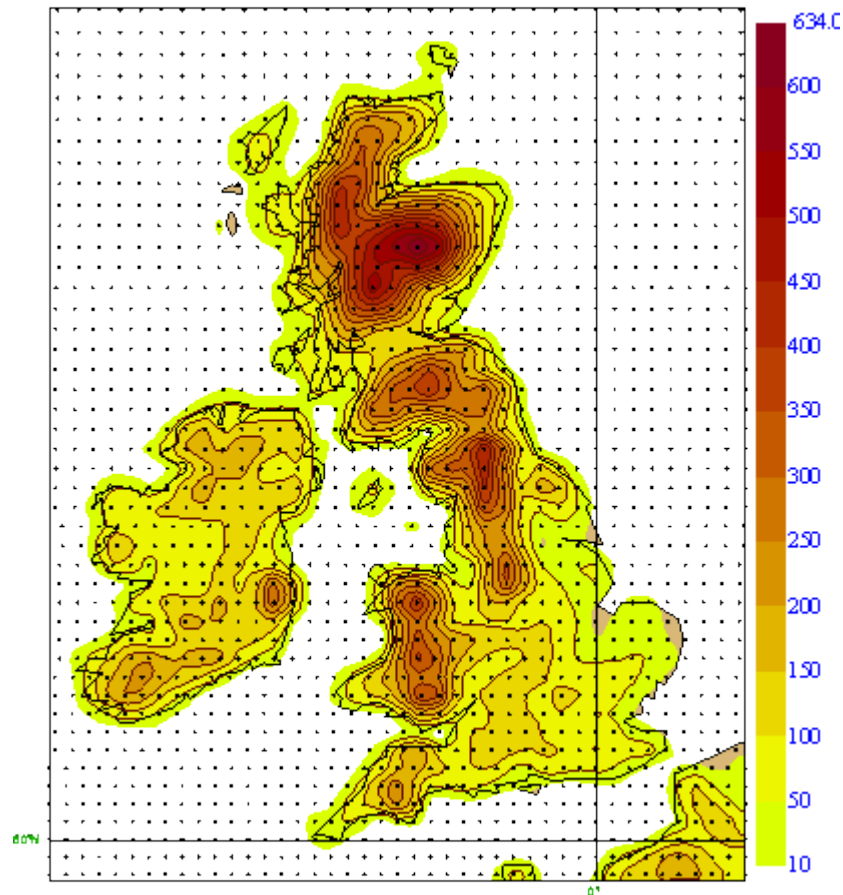
Jumps Global

Operational vs. Re-analysis [hPa]

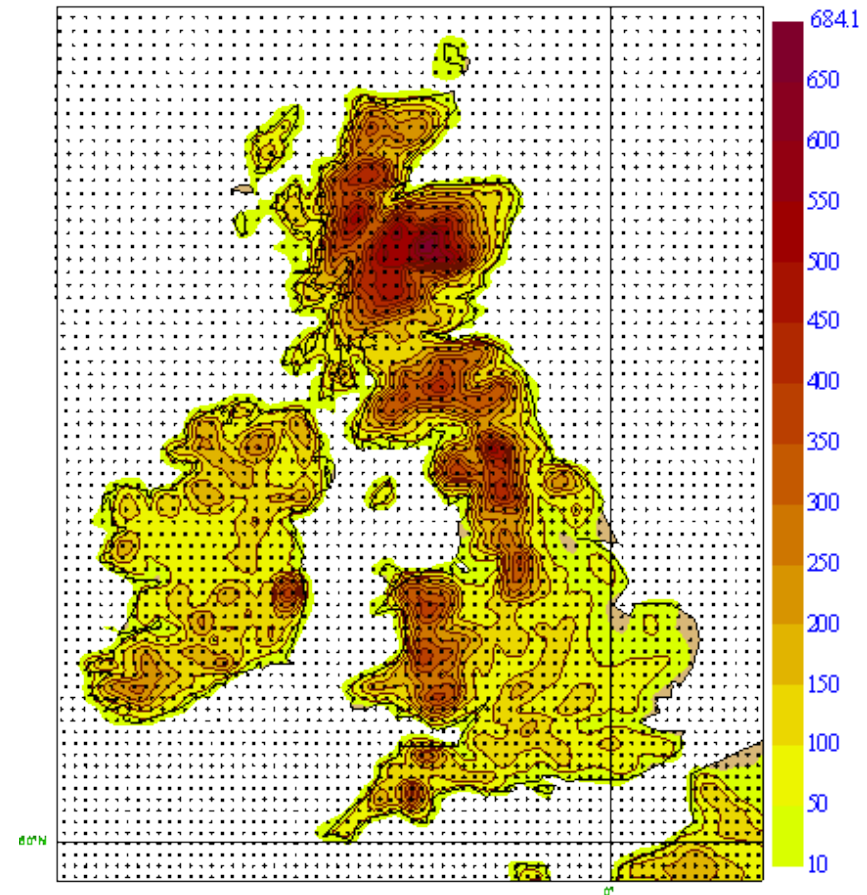


Main effect over steep orography.
Dipole patterns: upslope / downslope

Horizontal Resolution

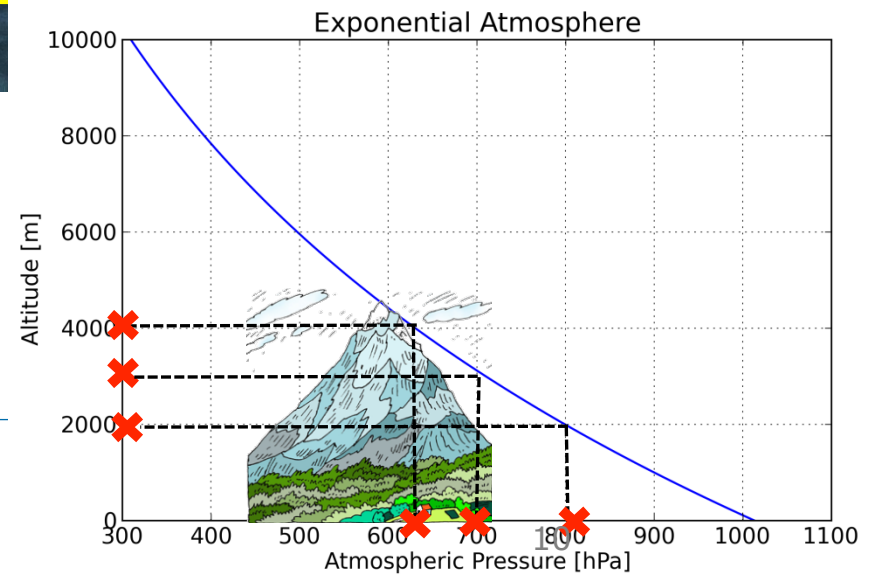
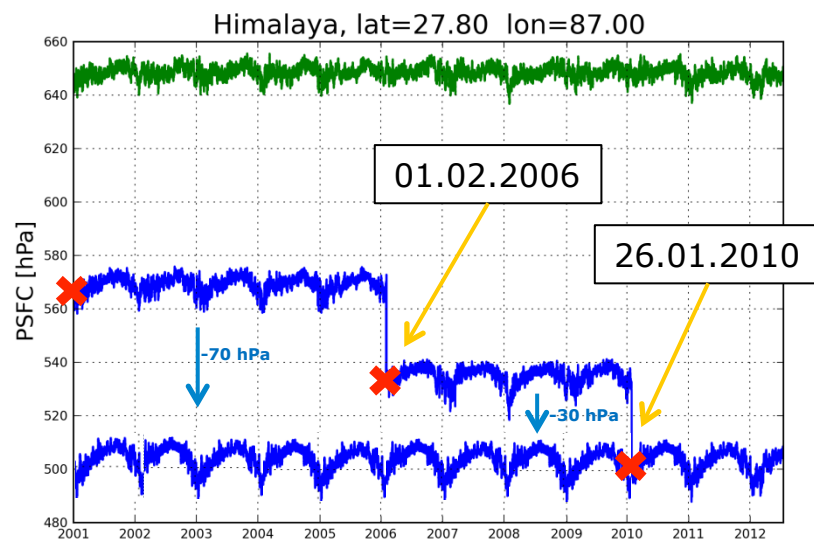
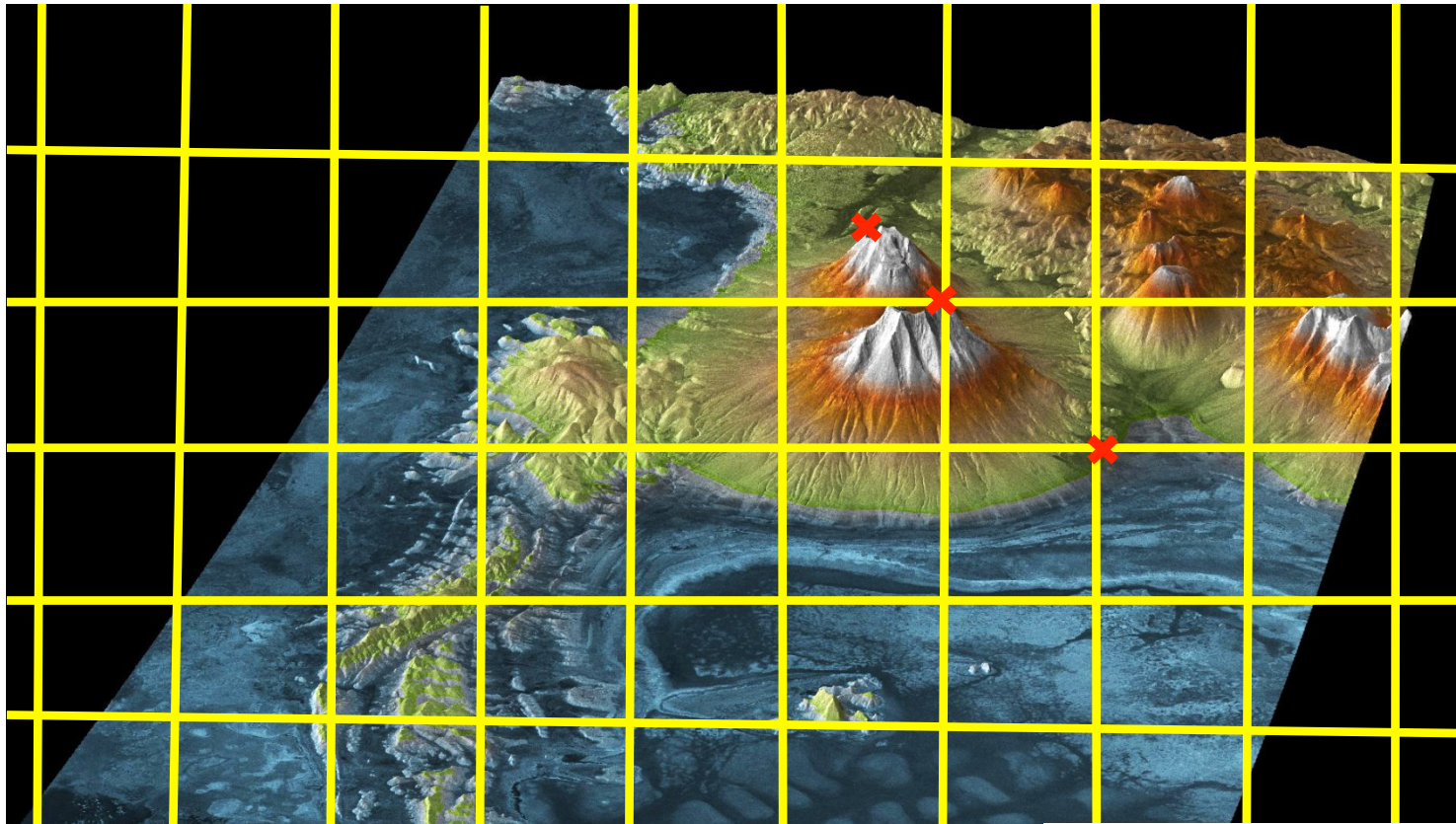


**N400 (T799) 25km grid spacing
(843490 grid points)**



**N640 (T1279) 16km grid spacing
(2140704 grid points)**

http://www.ecmwf.int/products/changes/horizontal_resolution_2009/



Jumps estimate and correction (1/2)

Assumptions:

We stay with the 2001+2002 Mean (consistency to all previous releases)

J_1 : date of 1st jump (e.g. 01 Feb 2006)

J_2 : date of 2nd jump (e.g. 26 Jan 2010)

Corrections for jumps:

For data before J_1 :

- Do nothing.

For data after J_1 and before J_2 :

- calculate grid difference btw. 6h variations (before and after J_1) from 0.5° Operational and ERA-Interim data;
- convert to SHS up to degree 100 (SHS_J1);
- provide this as GAA_J1 and GAC_J1 product to users;
- user has to add these to his analysis between J_1 and J_2 .

Jumps estimate and correction (2/2)

For data after J_2 :

- calculate grid difference btw. 6h variations (before and after J_2) from 0.5° Operational and ERA-Interim data;
- convert to SHS up to degree 100 (SHS_J2);
- add SHS_J2 to SHS_J1 = final SHS_J2;
- provide this as GAA_J2 and GAC_J2 product to users;
- user has to add these to his analysis after J_2 .

Correction products will be provided for testing purposes within the end of 2013.

Toward a Release-06

Toward a Release-06

New in vertical integration of atmospheric column:

- **Latitude- and altitude-dependent gravity** [Heiskanen and Moritz 1967];
- **Ellipsoidal radius** [Heiskanen and Moritz 1967].

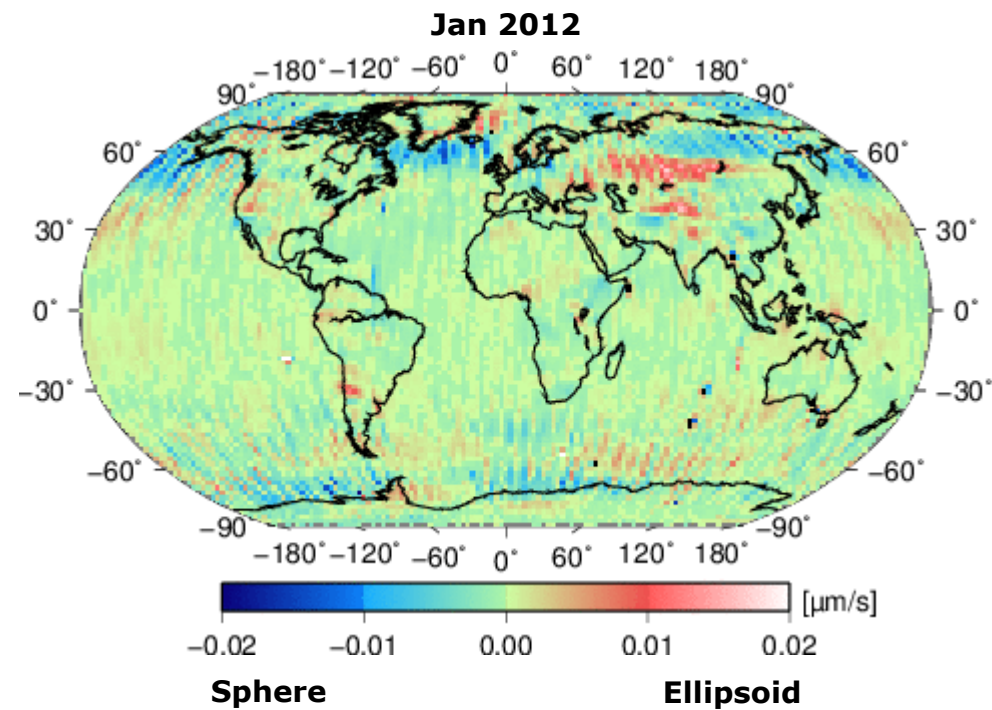
as suggested by Shengjie (2006) and Forootan et al. (2013).

Tested:

- **ECMWF ERA-INTERIM** (re-analysis) input data;
- Different time-span for the subtracted **mean field**;
- **Corrected operational** data.

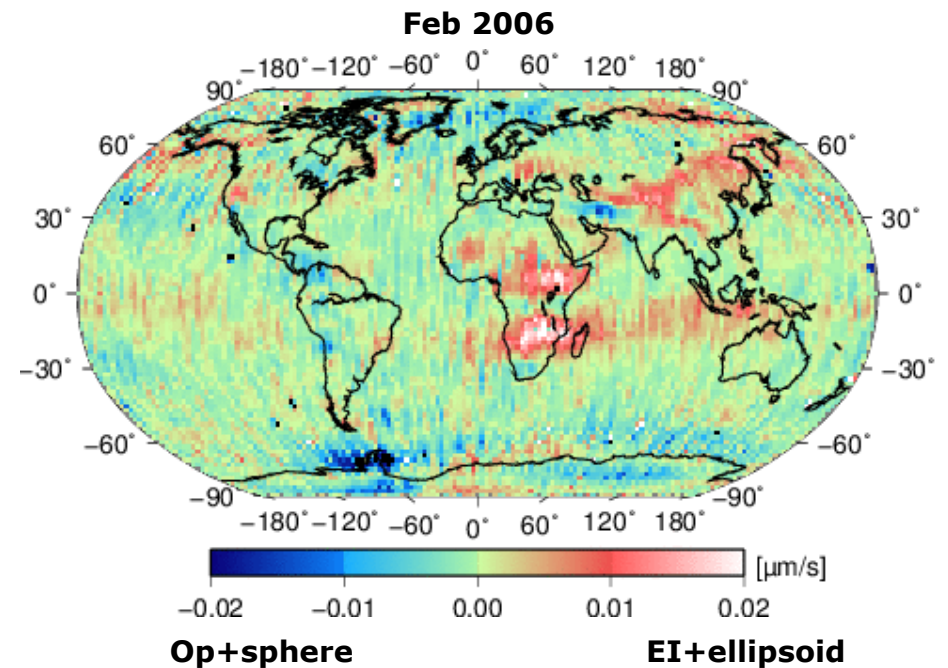
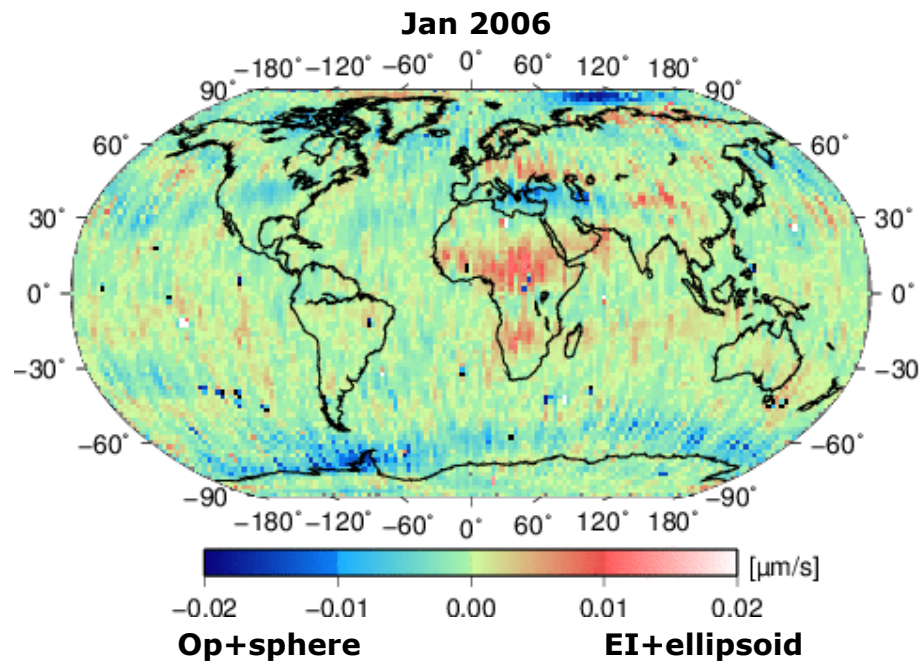
KBRR Residuals

Effect of improved algorithm



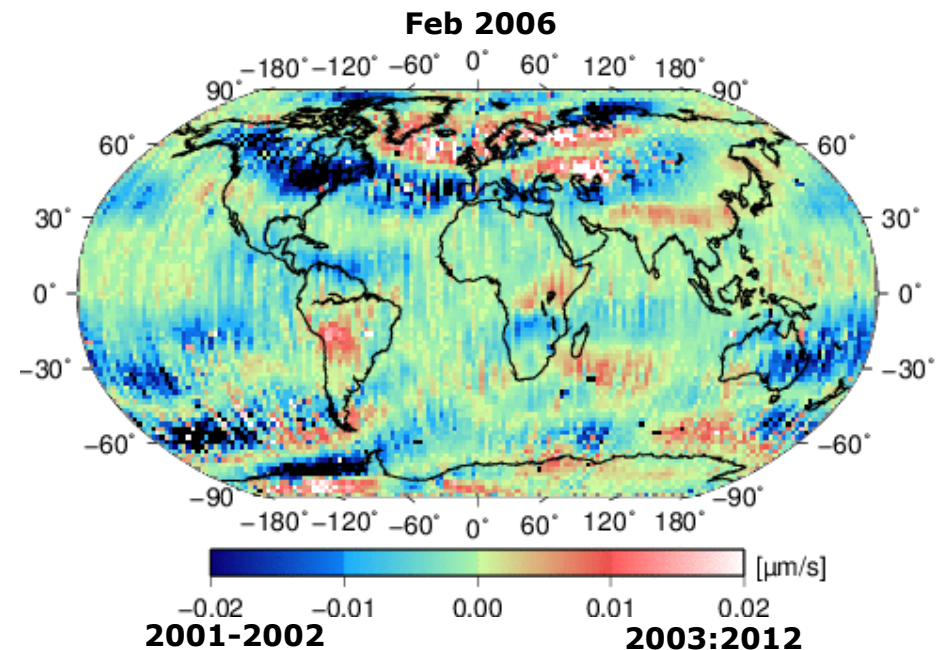
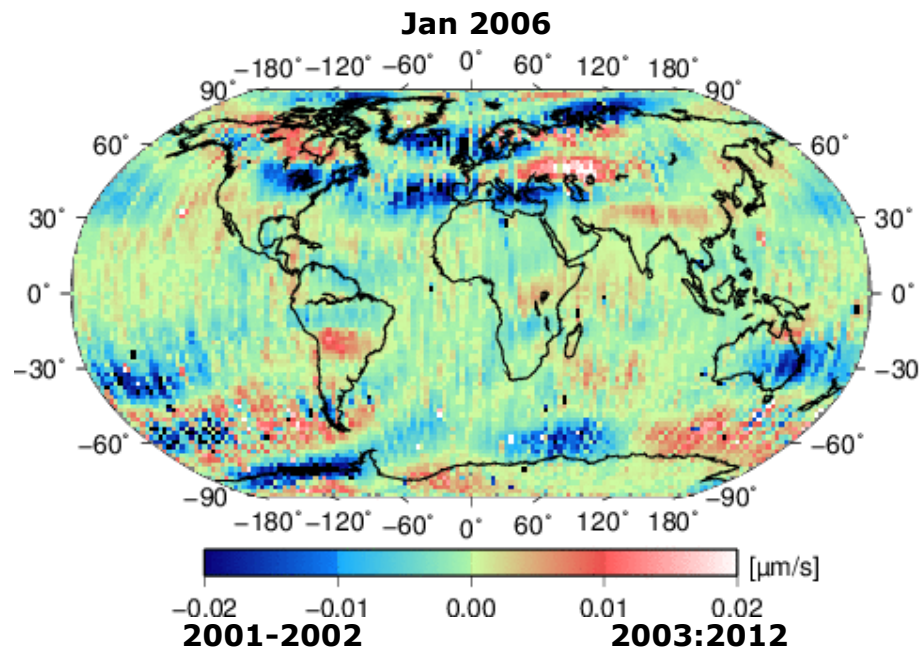
KBRR Residuals

Effect of ERA-INTERIM and improved algorithm



KBRR Residuals

Effect of different time-span for the subtracted mean



Conclusions

- Operational data advantages: short latency and high resolution.
- Disadvantage: discontinuity in time -> wrong trends.
- Re-analysis data advantage: stability.
- Disadvantages: longer latency and low resolution.
- Jumps can be explained and corrected.
- Ellipsoidal radius and gravity latitude-altitude dependent will be definitely introduced in a future release.
- Still to be understood: the effect of different time-span of the subtracted mean field.
- Improved OMCT ocean simulations: increased resolution; explicit consideration of self-attraction and loading of the water masses on the ocean dynamics; the use of updated bathymetry information in various coastal regions including the Arctic; consistency with the atmospheric part (e.g. input data, mean).