Towards a Roadmap for Future Satellite Gravity Missions

Session B3
Data Processing, Modeling & Interpretation

Co-Chairs
Srinivas Bettadpur (UTCSR Austin, Texas)
Frank Flechtner (Helmholtz-Centre Potsdam, German Research Centre for Geosciences (GFZ))

Session Background

Future Satellite Gravity Missions (FSGM) are based on technological improvements and mission requirements and designs, different to GRACE (will be covered in other breakout sessions).

This session focuses on anticipated challenges in the improved analysis and use of data from FSGM.

The context includes use of data from

- GRACE-like low-low satellite tracking (LL-SST) missions
- GOCE-like satellite gravity gradiometer (SGG) missions
- Low-Earth orbiters (LEO) using GNSS, satellite laser ranging (SLR) or radiometric (DORIS) tracking from ground or space and
- any combinations thereof.

Within this context, we focus on three important topics:

GFZ
Helmholtz Centre
POTSDAM

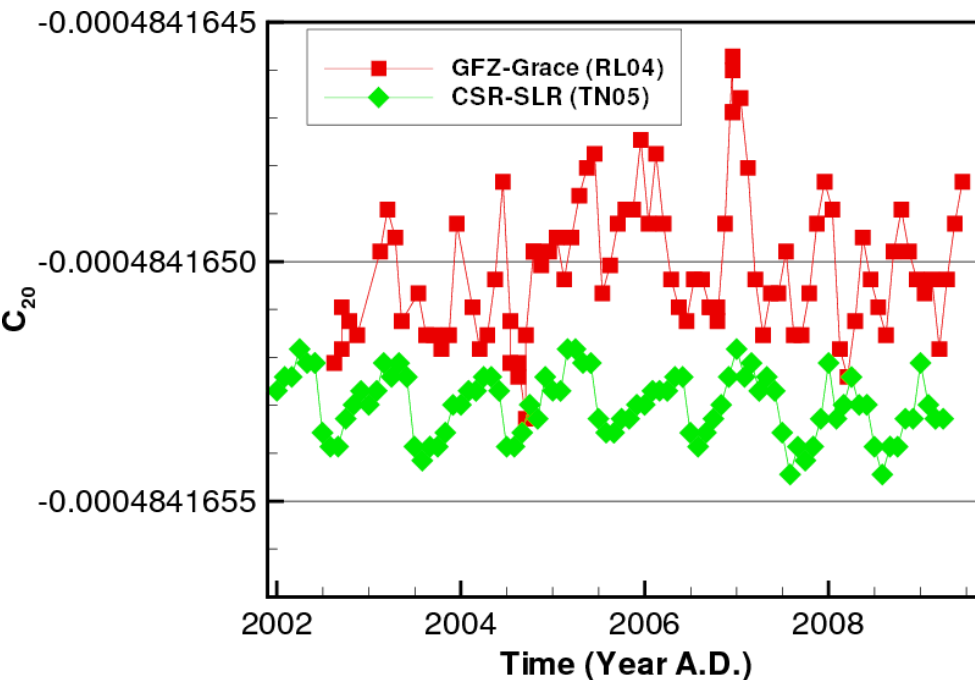HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE
FOR GEOSCIENCES

Topic 1: Useability

For a diverse variety of users, as evidenced by the work of the existing satellite gravity community, how can we make the satellite gravity measurements as well as data products more useable? For example, specific questions include:

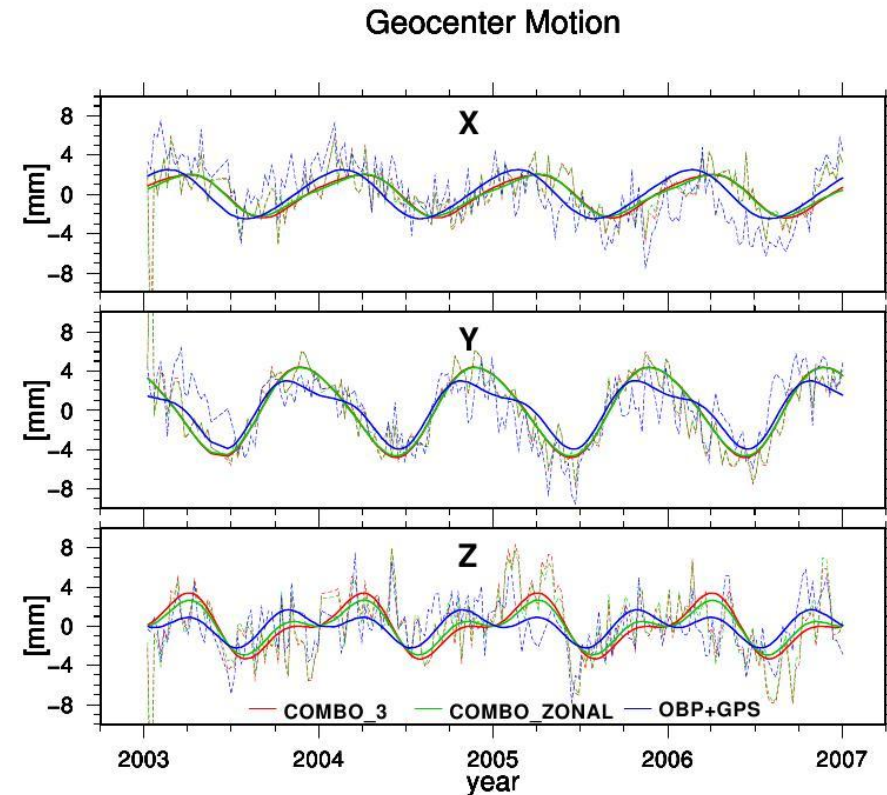• Do we need additional L1A/L1B , L2 products or even L3 products?

• What ancillary satellite data is necessary for Level-1 and Level-2 analysis/interpretation?

• Role of "ground-truth" or "a priori" knowledge of the structure of the process being observed. What information is necessary for Level-1 and Level-2 analysis? And is it available in a simple-to-use form?

• Enforcing mutual consistency in the combination of multi-technique products e.g. GOCE+GRACE; or degree-1 harmonics; or GRACE+SLR; etc.

ancillary satellite data

mutual consistency in the combination
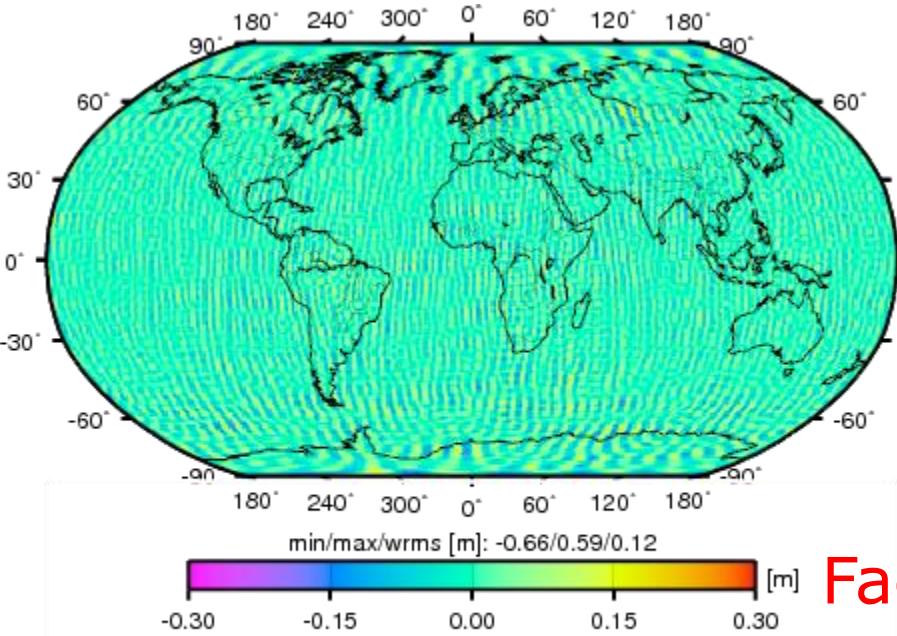

From Rietbroek et al., 2009

GFZ
Helmholtz Centre
POTSDAM

HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE
FOR GEOSCIENCES

min/max/wrms [m]: -0.66/0.59/0.12

Factor 30

min/max/wrms [cm]: -0.92/1.13/0.22
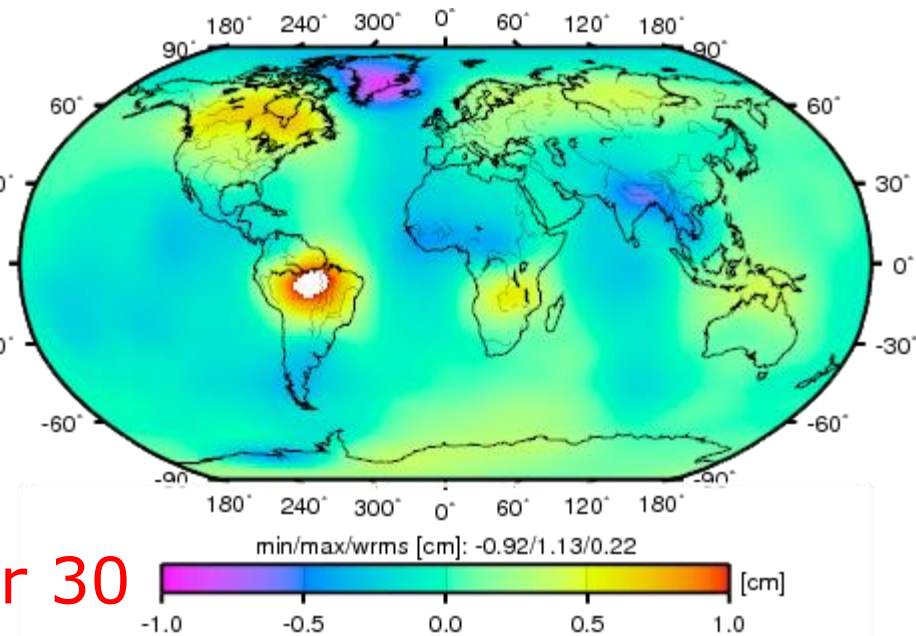
GFZ RL04
4/2008 – EIGEN-GL04C
no filter

GFZ RL04
4/2008 – EIGEN-GL04C
Kusche filter (400 km)

• A-posteriori filtering necessary or use GRACE-TELLUS products
• new SDS L3 products (constrained/Masscons) for RL05?

GFZ
Helmholtz Centre
POTSDAM

HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE
FOR GEOSCIENCES

Topic 2: Algorithms

Analyses of the data from the ongoing satellite gravity missions are helping us identify deficiencies in the conventional satellite geodetic methods (dynamic approach (SDS, GRGS), mass con solutions (GSFC, JPL), boundary problem (Bonn), …)

What are the future directions for algorithmic improvements? Topics include

• numerical,
• computational,
• parameterization, and
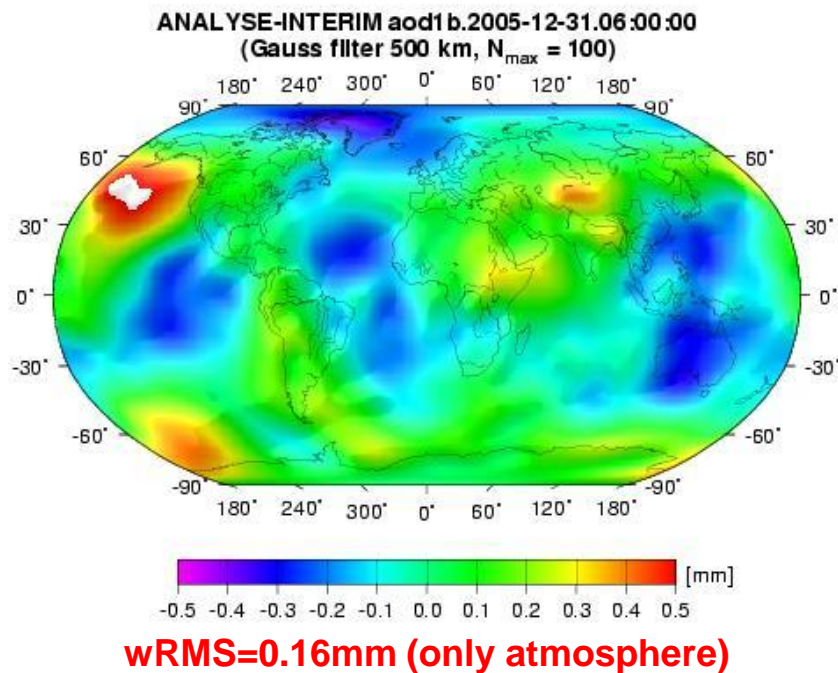• modeling

aspects of the satellite geodetic methodology.

Topic 3: De-Aliasing

This refers to the use of a priori gravity field models to remove the contributions to the measurements from short-period geophysical variability, before estimates of the lower-frequency variability are extracted. Interesting questions include:
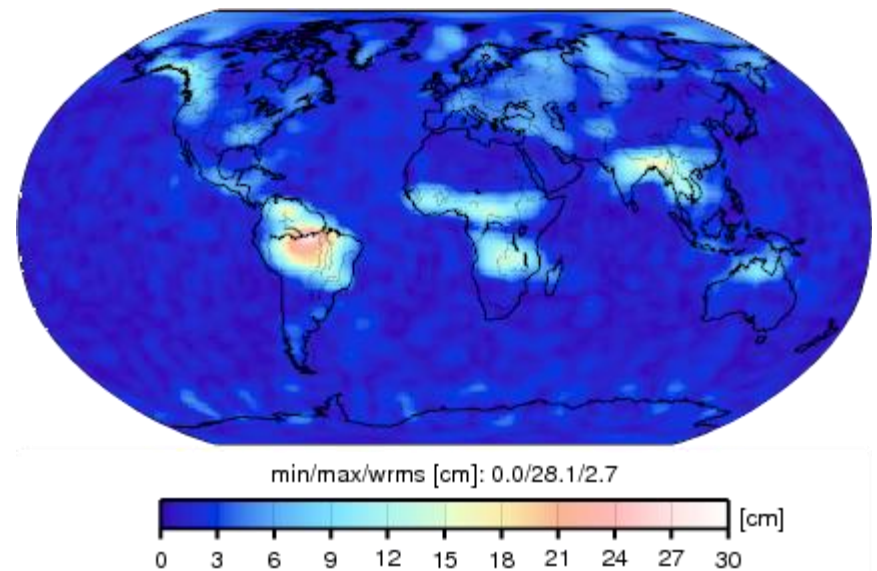
• To what extent do we have to improve the background models for future gravity missions?

• Is it necessary to improve these independently from the gravity missions? Or can we simultaneously solve for some components of the background models?

• Can we use assimilation/modeling methods to eliminate the need for de-aliasing?

GFZ
Helmholtz Centre
POTSDAM

HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE
FOR GEOSCIENCES

Topic 3: De-Aliasing (Examples)

- Atmosphere, non-tidal oceans and hydrology models are represented in empirical time series
- Models are the result of non-geodetic actvities: not safe in continuity, uniformity of standards, long-term trends

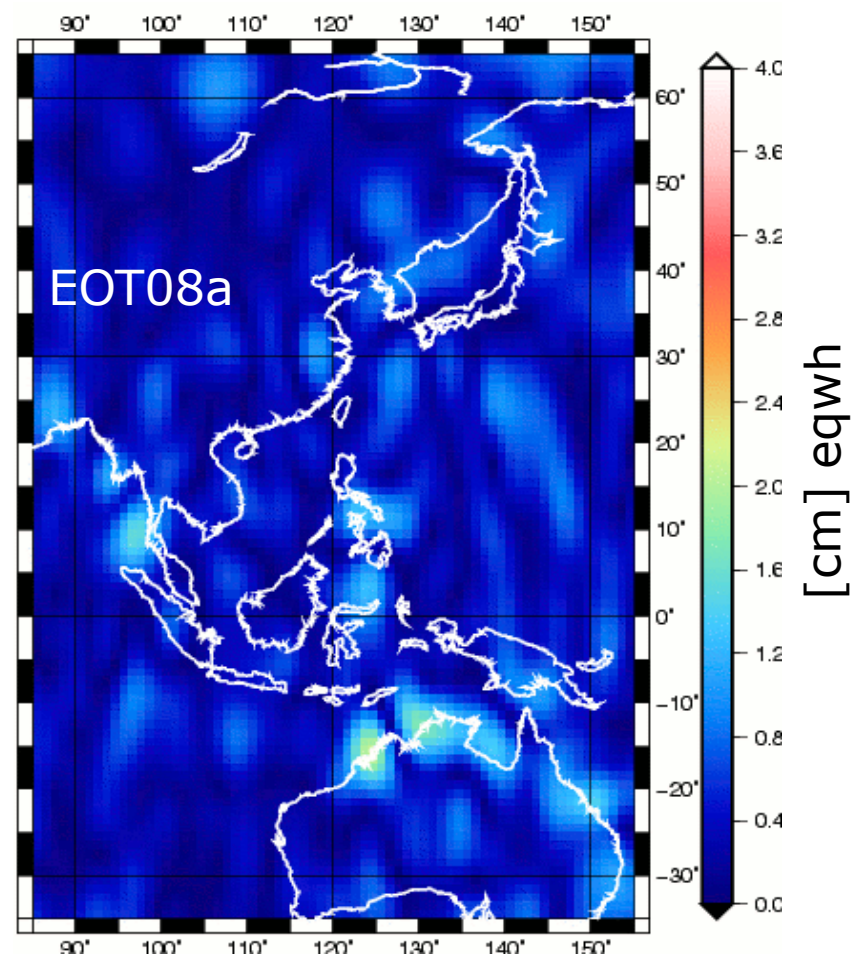ANALYSE-INTERIM aod1b.2005-12-31.06:00:00
(Gauss filter 500 km, N_max = 100)

wRMS=0.16mm (only atmosphere)

Annual Hydrology from GFZ RL04

min/max/wrms [cm]: 0.0/28.1/2.7

GFZ
Helmholtz Centre
POTSDAM

HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE
FOR GEOSCIENCES
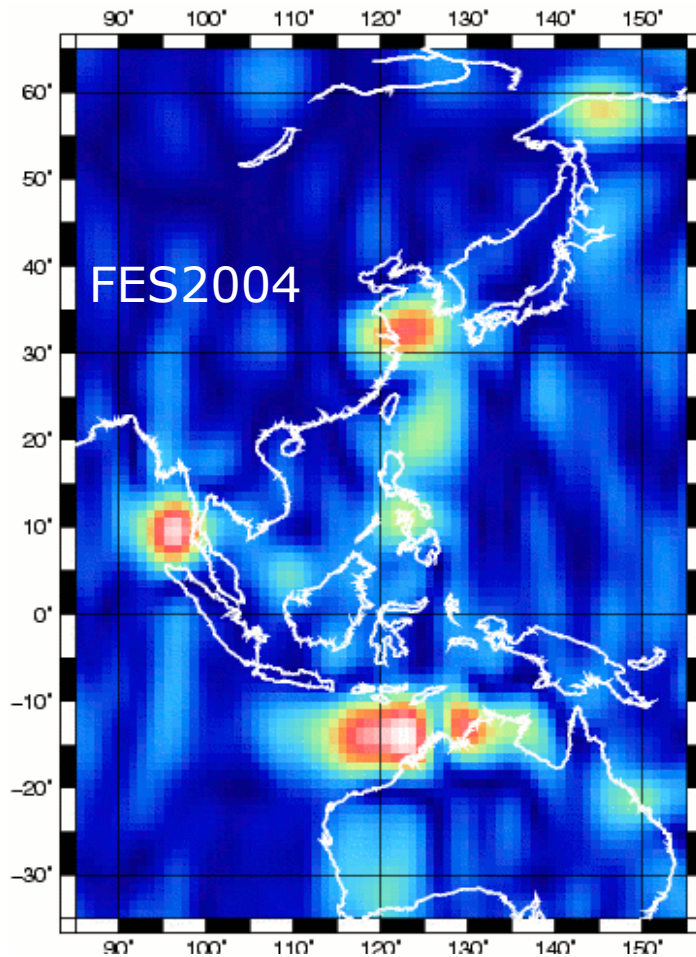
Topic 3: De-Aliasing (Examples)

S2 (161d) signal in GFZ RL04 (FES2004) and with EOT08a (EOT10ag planned)

From Bosch et al., 2009

GFZ
Helmholtz Centre
POTSDAM

HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE
FOR GEOSCIENCES

from Mike Watkins :
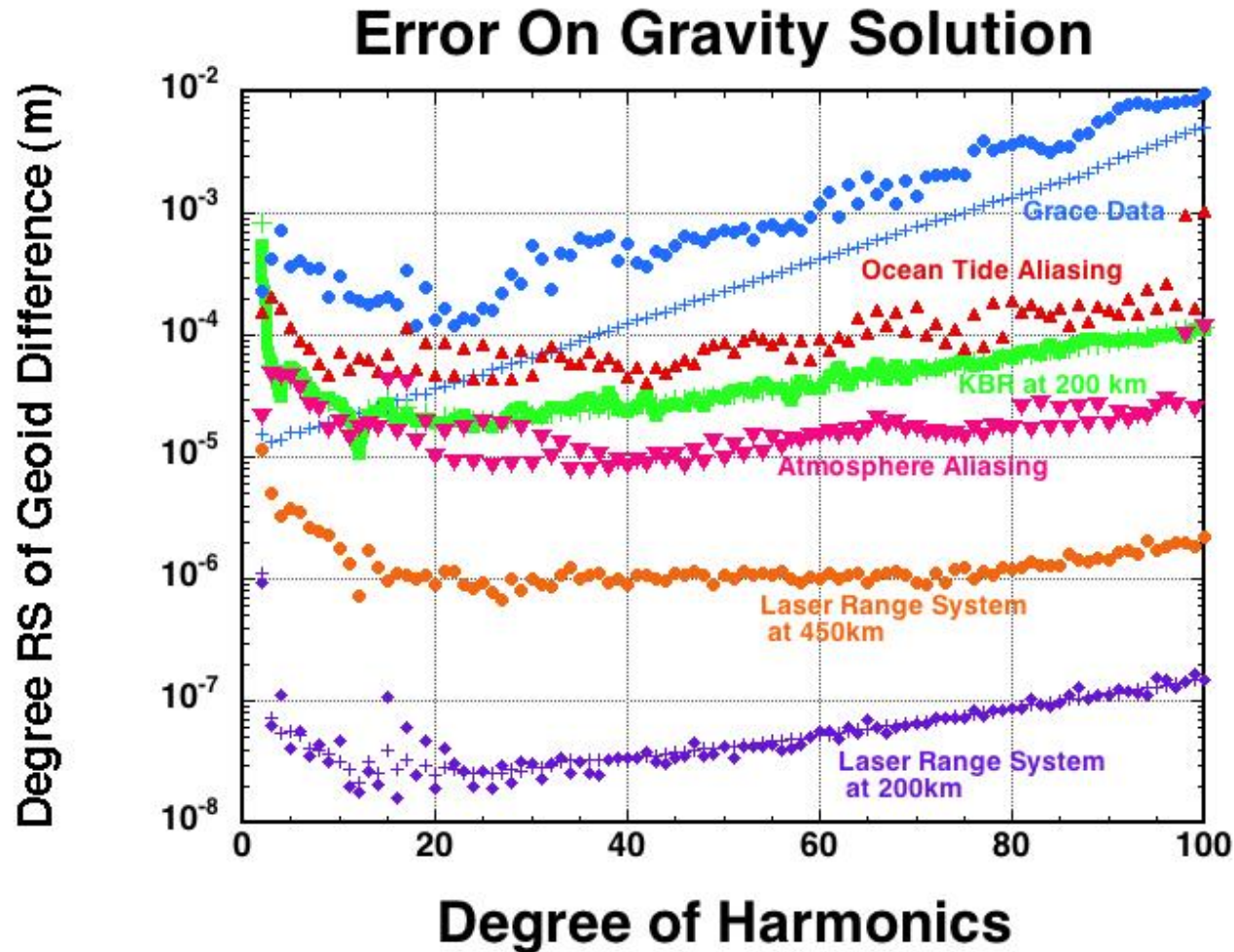
Session Outline: Block 1 (1:20)

➢ Introduction (10')

➢ 4 invited speakers (15'):
- ~~Frank Lemoine (GSFC): "The Role of Ground-truth Information"~~ ~~(stabilization incl. taxonomy, ground truth data, a-priori knowledge, …)~~
- Jürgen Kusche (U Bonn): "Methodological aspects related to gravity analysis from future missions"
- Tonie van Dam (U Lux): "Can geodetic Data be used as a Complement to Satellite Gravity Data in the Future"
- Pascal Gegout (DTP/GS): „Background Models used in geodetic Data Processing"
- ~~Frank Lemoine (GSFC): Ocean Tide Issues (from R. Ray)~~

➢ Each speaker was requested to summarize a list of "key questions" or "challenges": Consolidation (10')

GFZ Helmholtz Centre POTSDAM

HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE FOR GEOSCIENCES

Session Outline: Block 2 (1:40)

- ➢ Contributed abstract by Bender et al. "Local Analysis Approach for Short-wavelength Variations in the Geopotential" (15', now end of block 1)

- ➢ Discussions of key questions / challenges and their answers (all)

- ➢ Prepare recommendations for the roadmap (all)

GFZ
Helmholtz Centre
POTSDAM

HELMHOLTZ CENTRE POTSDAM
GFZ GERMAN RESEARCH CENTRE
FOR GEOSCIENCES