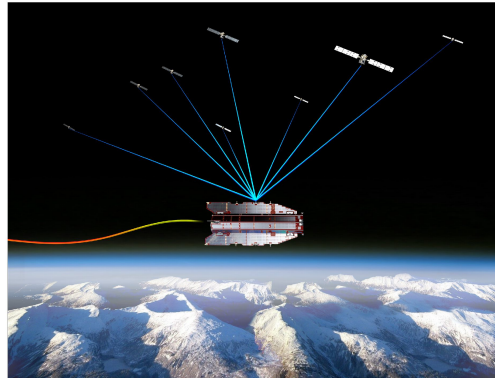


New approach to estimate time variable gravity fields from high-low satellite tracking data



Norbert Zehentner & Torsten Mayer-Gürr

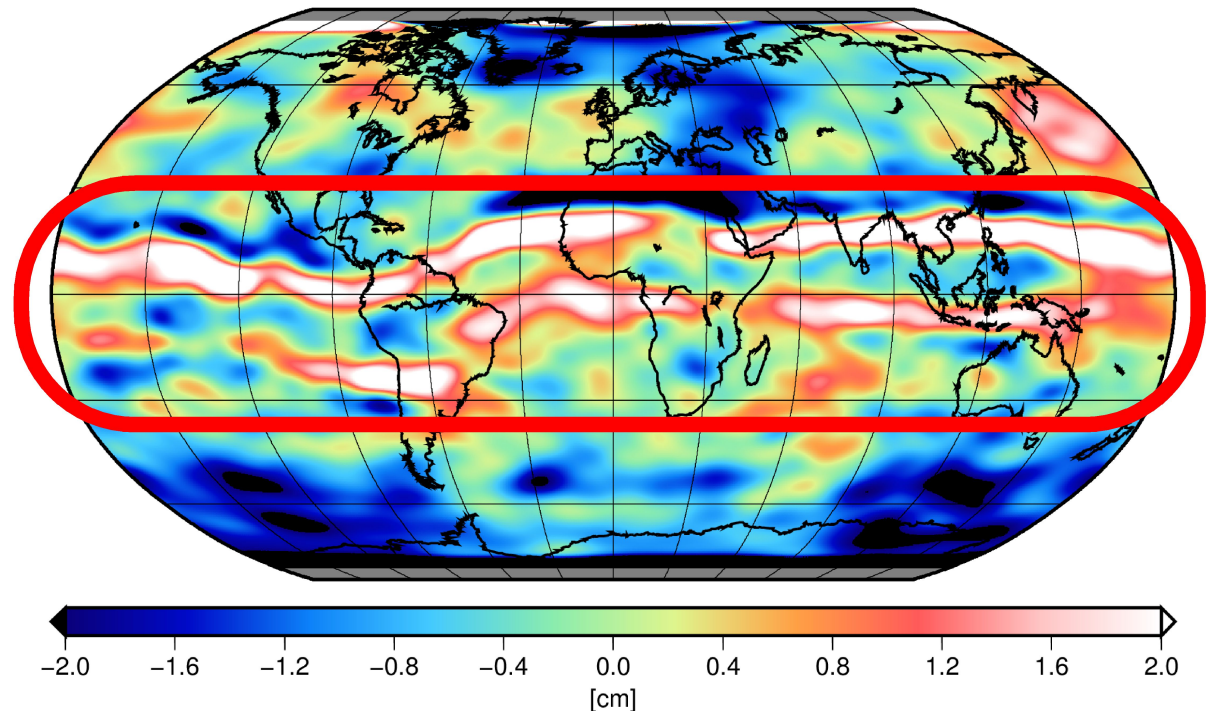
Institute of Theoretical Geodesy and Satellite Geodesy
Graz University of Technology

International Symposium on Gravity, Geoid and Height Systems 2012
Venice, Italy

GOCE monthly solution

- SST-hl only solution using the acceleration approach
- based on official orbit product
- 500 km Gaussian filter applied

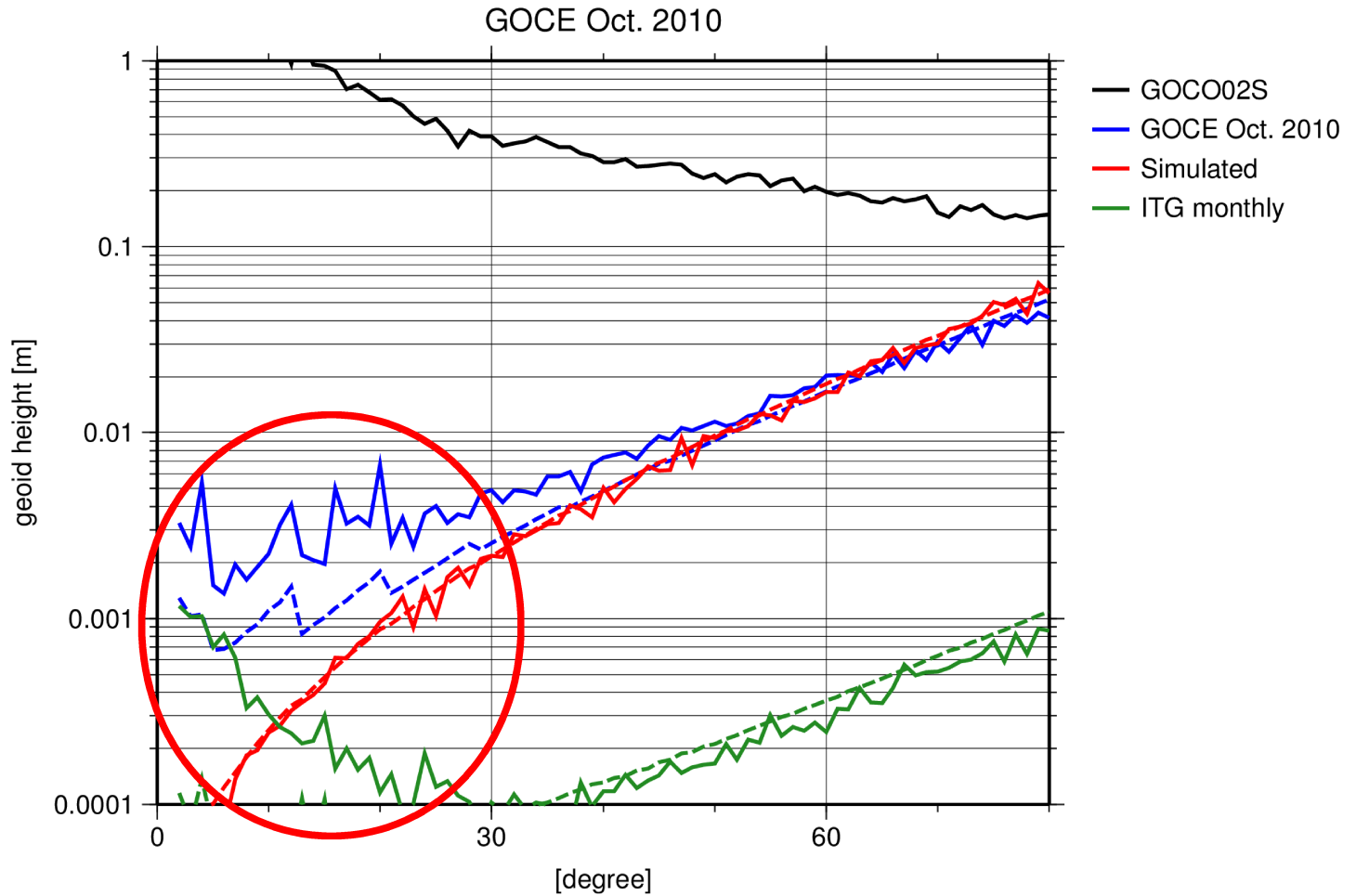
Difference to GOCO02S (Oct. 2010)



Problems

- Systematic deficiencies in current precise orbit products
 - Similar for CHAMP, GRACE and GOCE
- Mostly related to the earth's geomagnetic equator
 - Cause?
- Reduced systematic effects would enable estimation of time variable gravity fields

Degree variances



New approach to estimate kinematic orbits

Basic concept:

- Use of all available observations
 - *Code and Phase on all Frequencies*
- No formation
 - *of differences*
 - *of linear combinations (Ionosphere free, ...)*
- Accounting for all known influences
 - *Phase wind-up, relativistic effects, antenna offsets and attitude for receiver and transmitter, ...*
- Remaining influences included as additional parameters
 - *Ionosphere, antenna center variations, ...*

Observation equation

- Code observation

$$R = \rho + c \delta t + Iono + CCV_{Rec} + CCV^{Sat}$$

distance receiver clock error ionosphere

Antenna center variations

- Phase observation

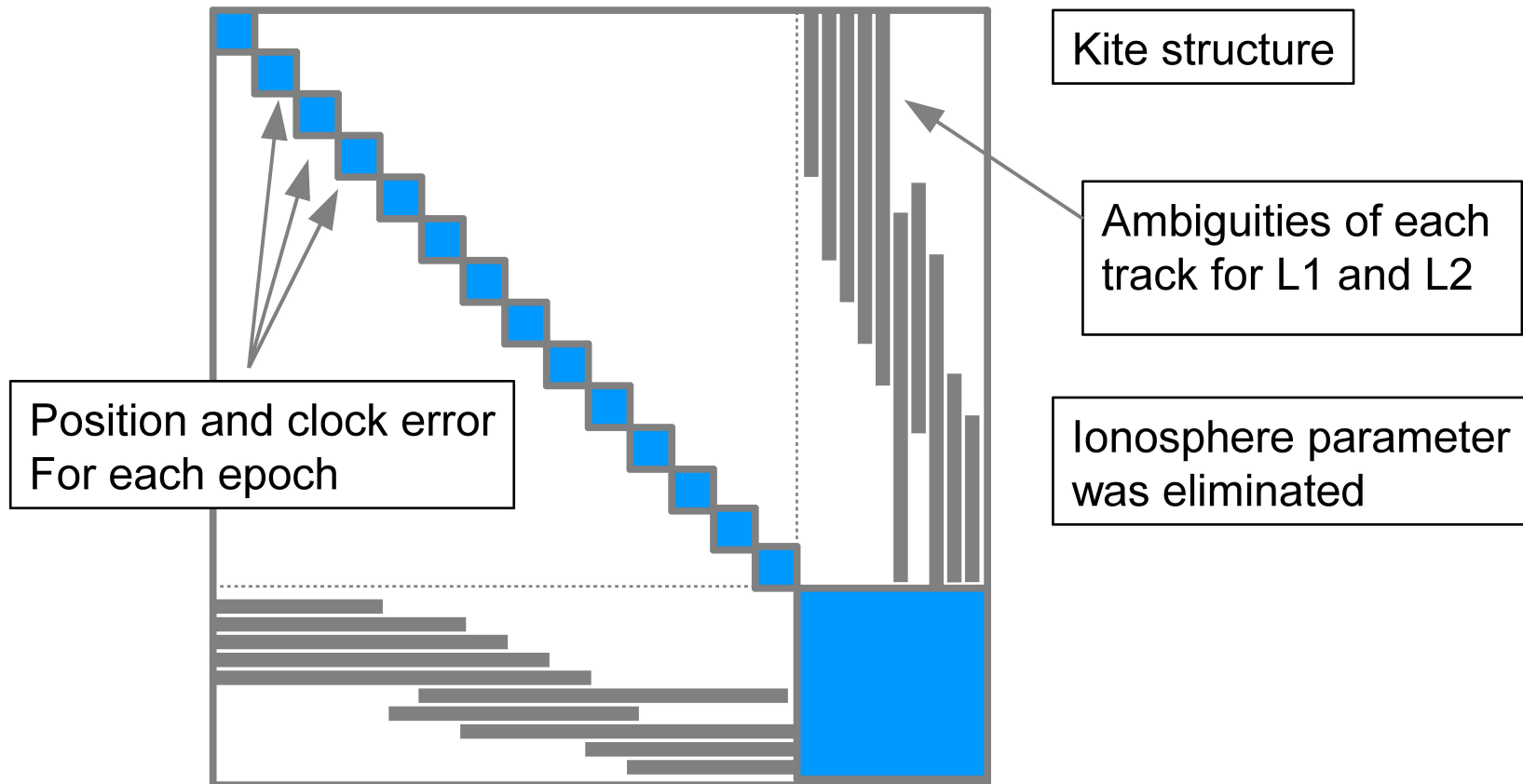
$$\Phi = \rho + c \delta t + Iono + \lambda n + PCV_{Rec} + PCV^{Sat}$$

ambiguity

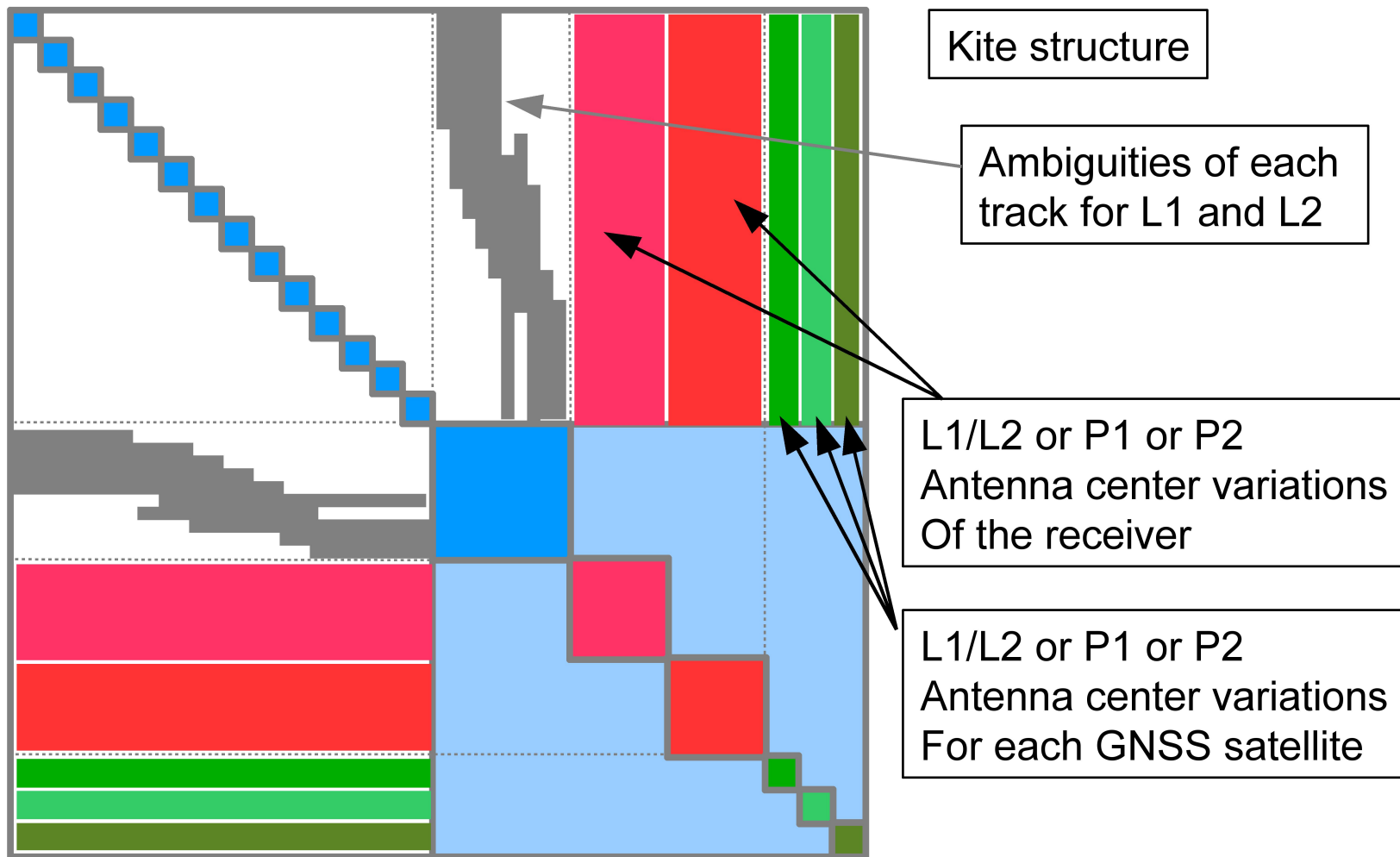
- All known Influences are corrected
- Remaining Parameters are estimated!

System of normal equations

- Assembling of observation equations features kite-structure



Extended normal equations



Extended normal equations



Additional parameters can be added easily

New observation types can be included easily
(GPS L5, GLONASS, GALILEO)

Extension to simultaneous processing
of several receivers

Kite structure

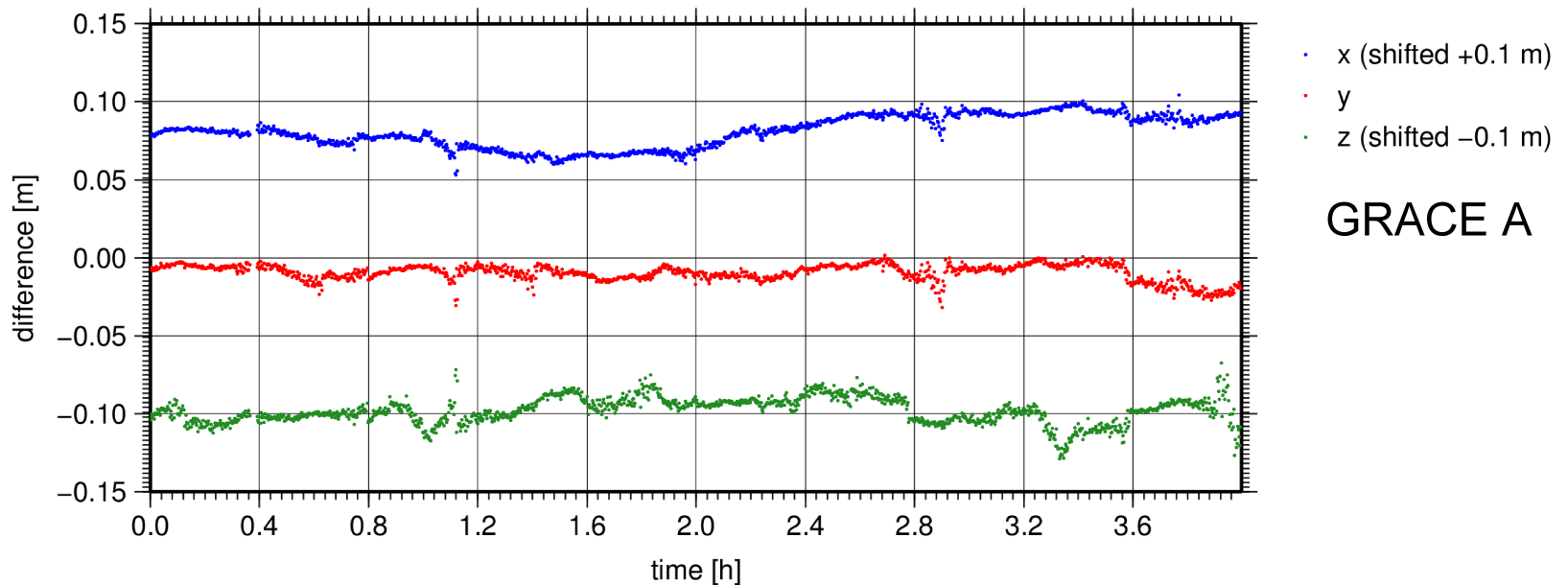
Ambiguities of each
track for L1 and L2

L1/L2 or P1 or P2
Antenna center variations
Of the receiver

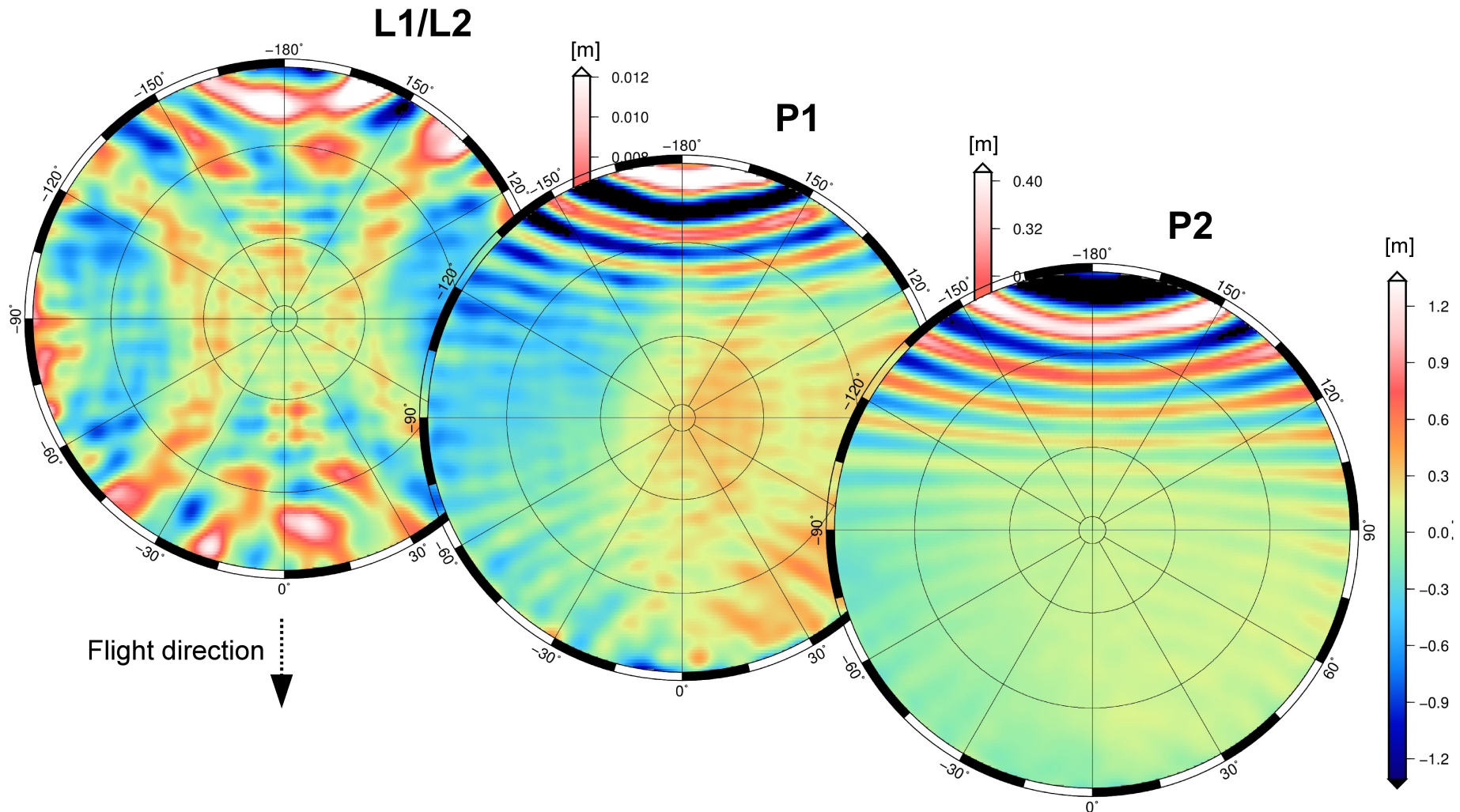
P1 or P2
Antenna center variations
For each GNSS satellite

First results

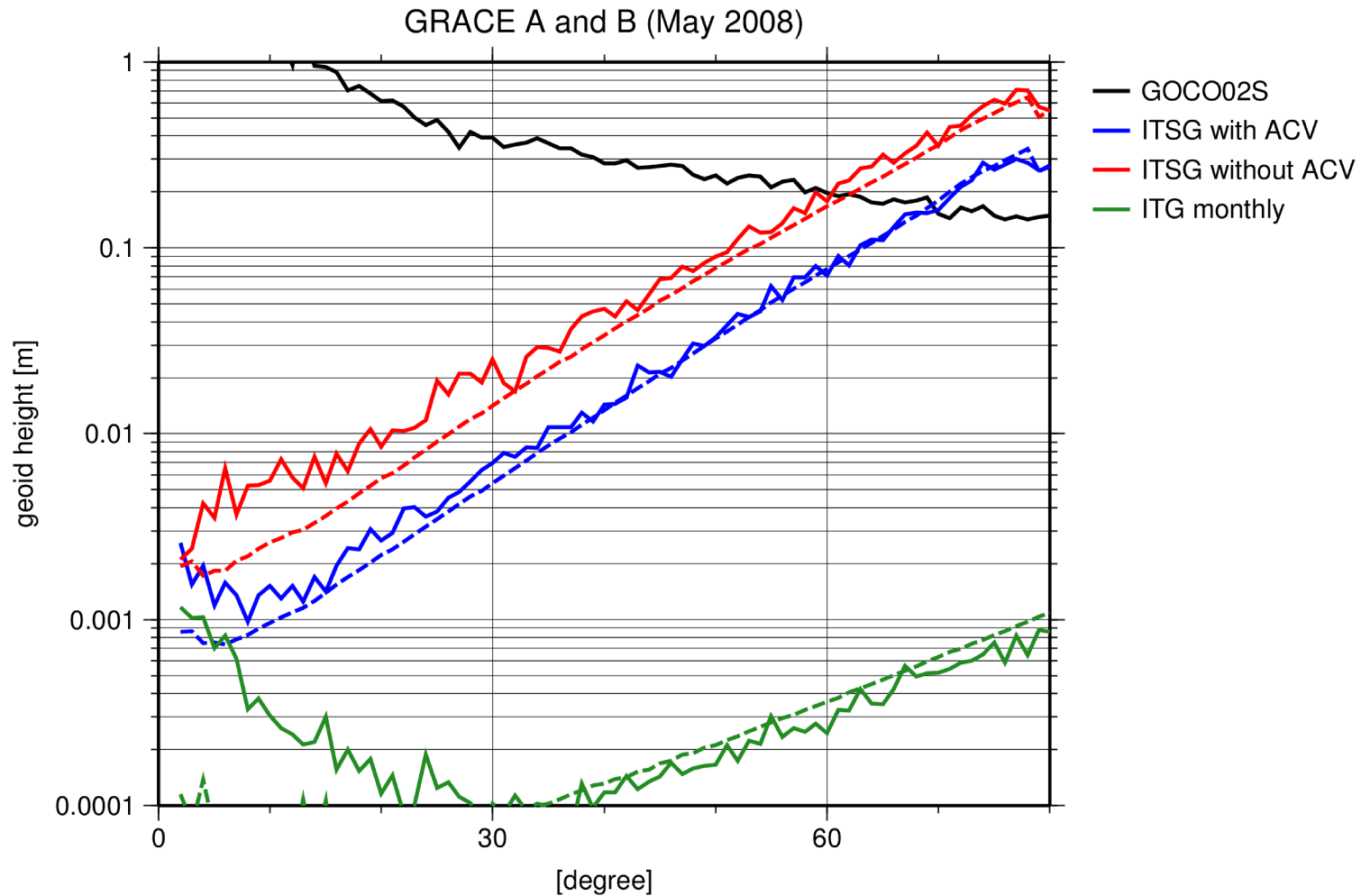
- Dataset: GRACE A and B
- Precise GPS orbit and clock information
 - orbit and 5 s clock corrections from CODE
- Difference to official orbit product (GNV1B)



Receiver antenna center variations GRACE A



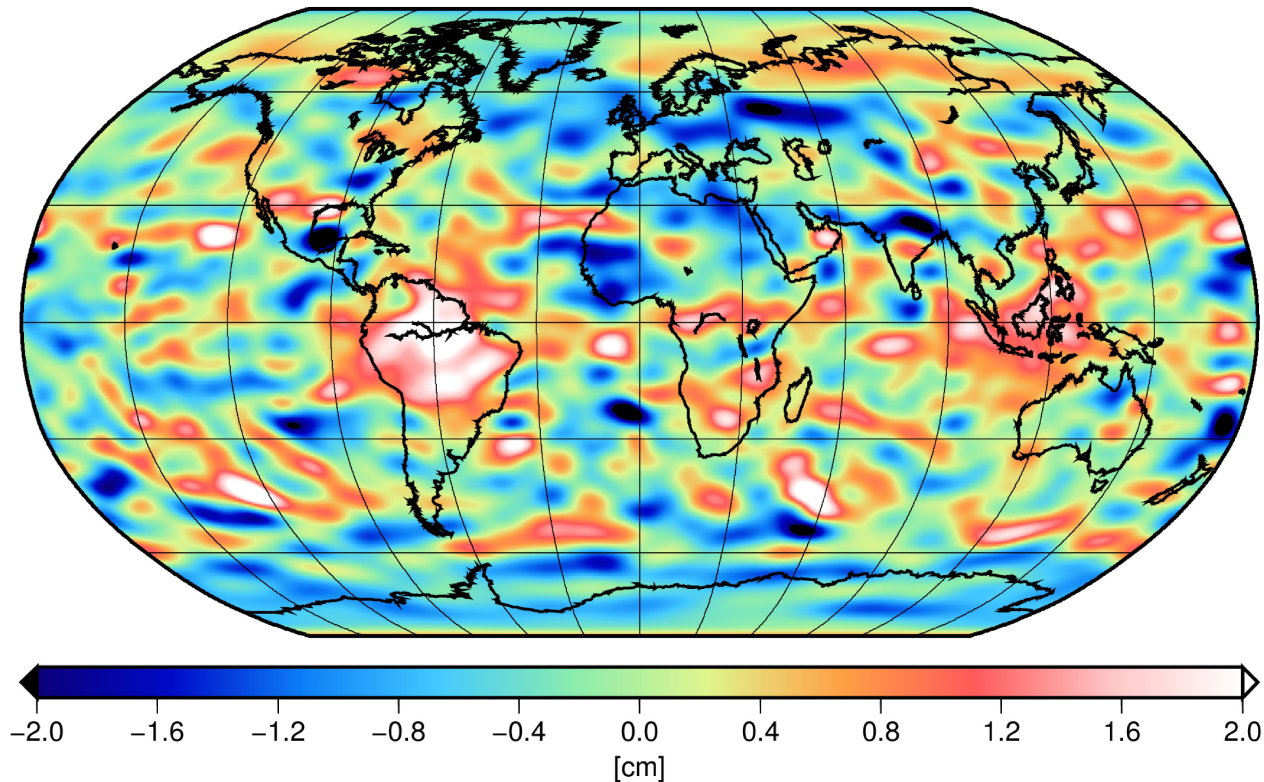
Example



Example

- Solution filtered with 500 km Gaussian filter

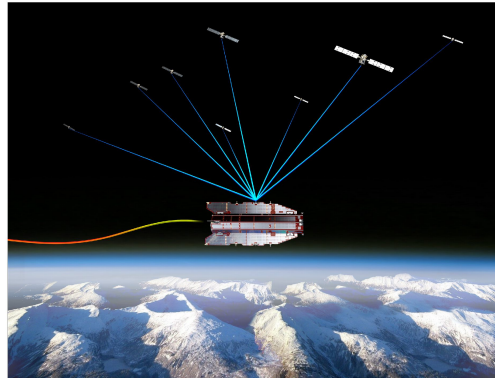
Difference to GOCO02S (May 2008)



Summary

- Systematic effects degrade actual gravity field solutions based on orbit positions (SST-hl)
- New approach for precise orbit determination
- Method works
- First results are encouraging
 - Still problems to be solved!
- Clustered processing of several satellites (CHAMP, GRACE, GOCE and others)
 - Could enable estimation of time variable gravity fields

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