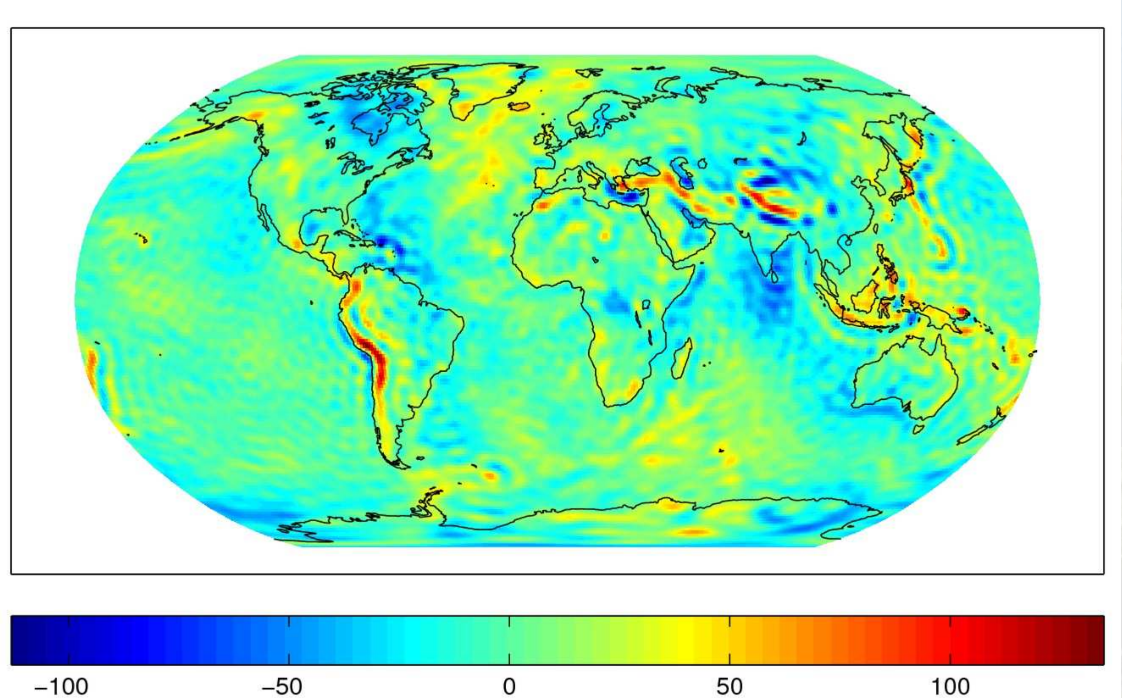
GNSS MODEL CHANGES AND THEIR INFLUENCE ON GRAVITY FIELD RECOVERY USING SPACEBORNE GPS



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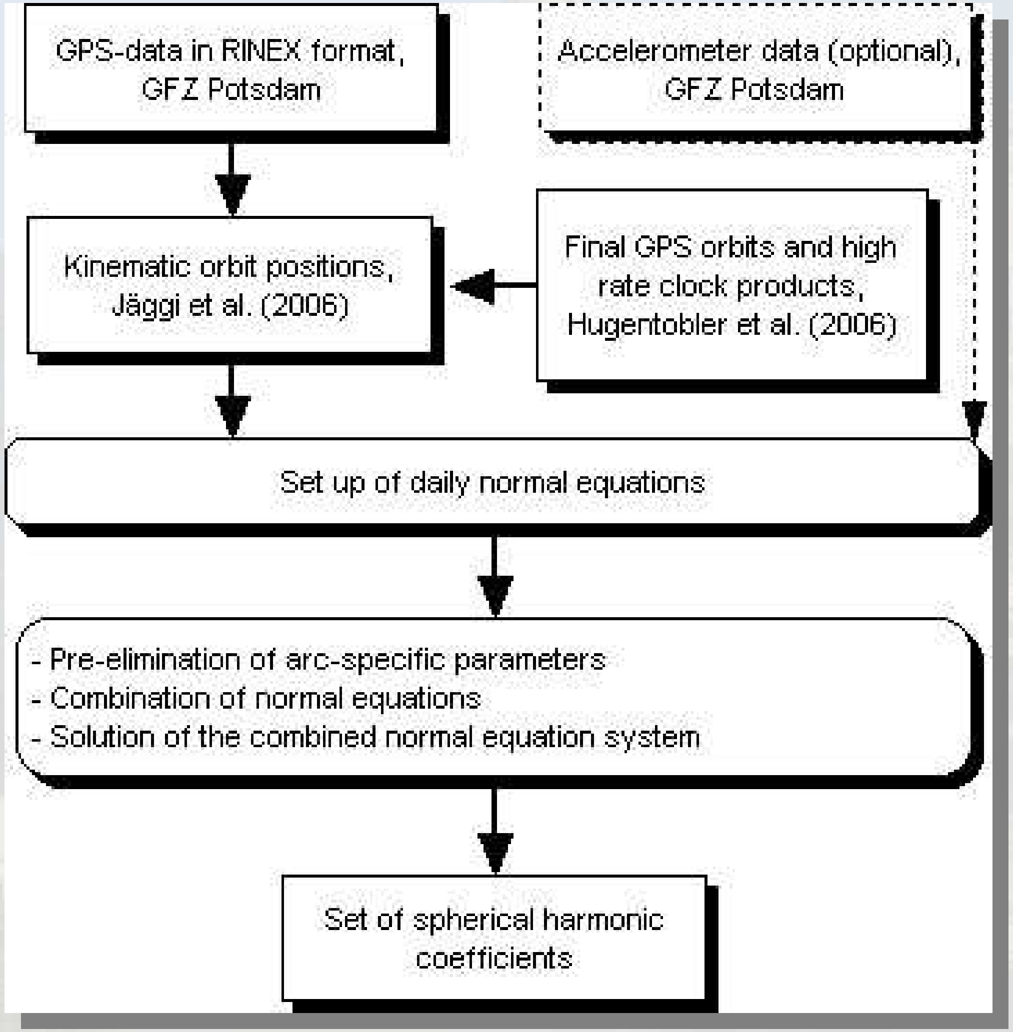
GPS based gravity field recovery at the AIUB

- Consistent GPS products available from CODE IGS data center located at the AIUB
- BERNESE GPS software
- Experience in LEO orbit processing
- Celestial Mechanics approach
- Work on real data started in 2006
- Reasons?:
  - Derive the best possible solutions from LEO GPS data
  - GPS data is also used for GRACE and GOCE models

GPS based gravity field recovery at the AIUB



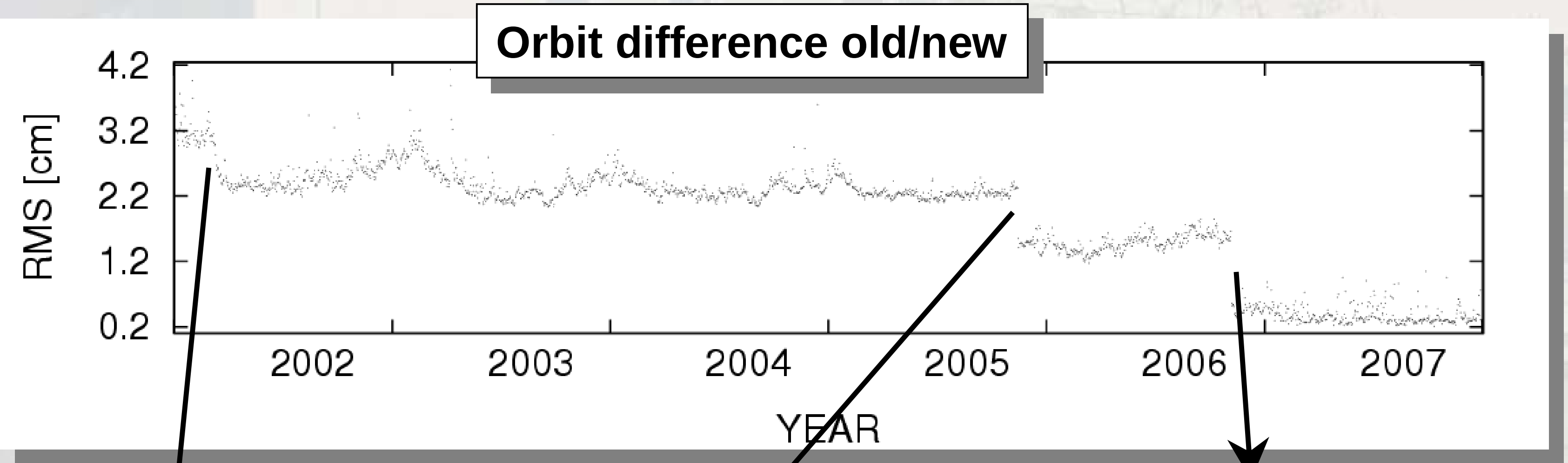
- Parameters: initial conditions, constant accelerations, coefficients of 1/rev. periodical functions, polynomial along-track, pulses every 5 min.
- Max degree: 90
- Arc length: 1 day
- Background: EIGEN2, CSR 3.0

GPS reprocessing

- Many model changes in the IGS data processing in the recent years
- Need for a consistent data set of homogeneous quality for the last years, benefiting from the latest IGS standards
- The most important improvements are:
  - Change from relative to absolute antenna pattern
  - Global mapping function in the troposphere modeling
  - Improved CODE radiation pressure model
  - Improved ambiguity resolution strategies
  - Hardisp and CMC correction applied for OTL model
  - IERS2003 mean-pole, IAU200 nutation model, phase wind-up
  - ITRF2000 to ITRF2005

GPS orbit reprocessing

- Estimation of new GPS orbits, ERP’s, IGS station coordinates and troposphere parameters
- Based on modified exerpt of CODE IGS routine



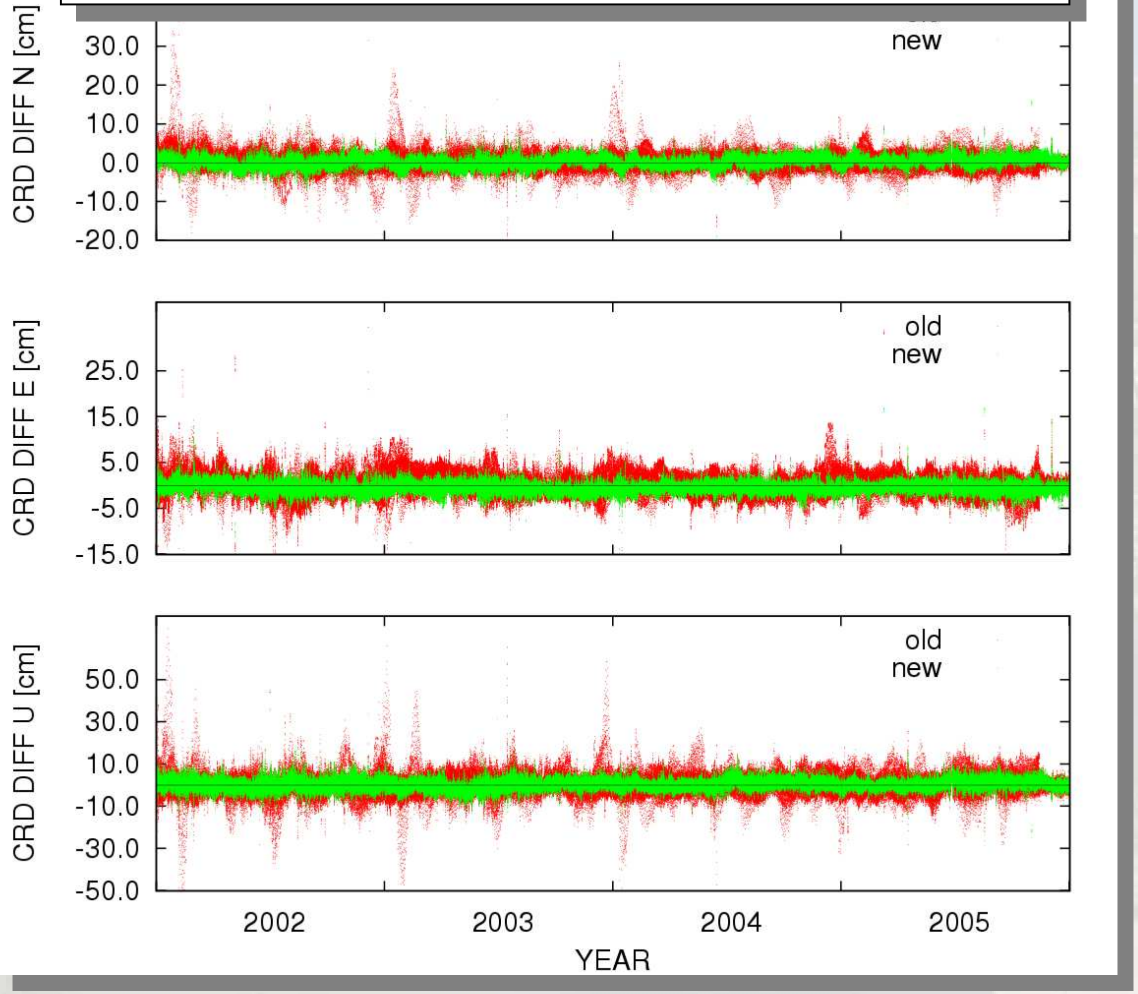
- Improved ambiguity resolution

- New nutation model
- Change in RPR model

- PCV model change
- GMF in troposphere model
- MP, CMC, hardisp, phase windup
- Change in RPR model

GPS clock reprocessing

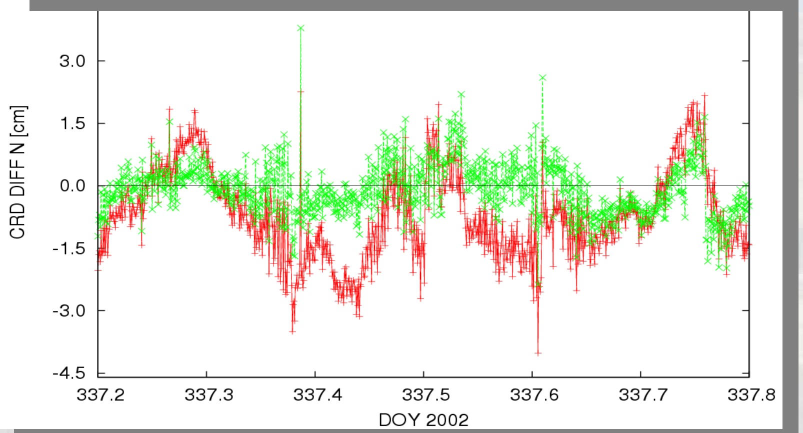
PPP residuals for IGS station Zimmerwald



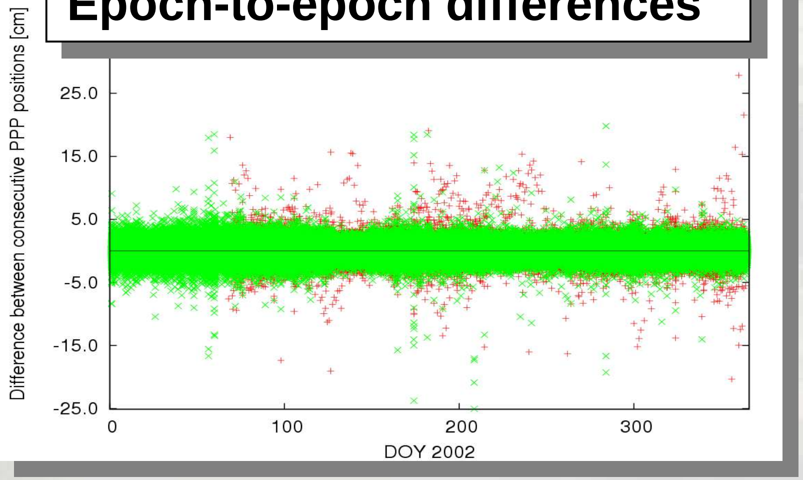
- Estimation of new 5 min and 30s GPS satellite clock corrections
- Based on modified CODE IGS clock processing
- Validation by PPP for different IGS stations

GPS clock reprocessing

PPP positions within one day



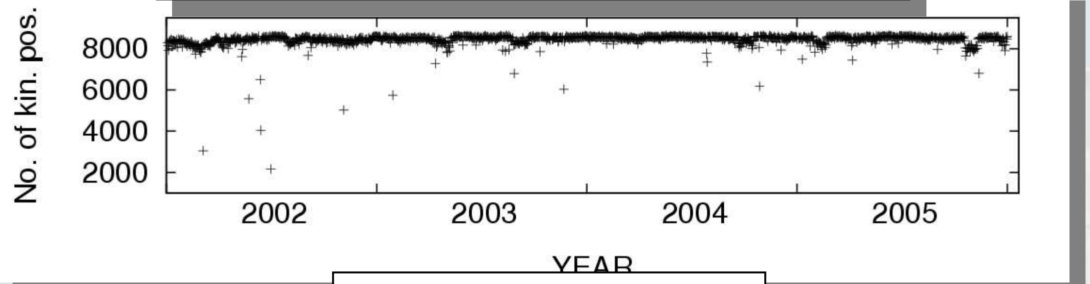
Epoch-to-epoch differences



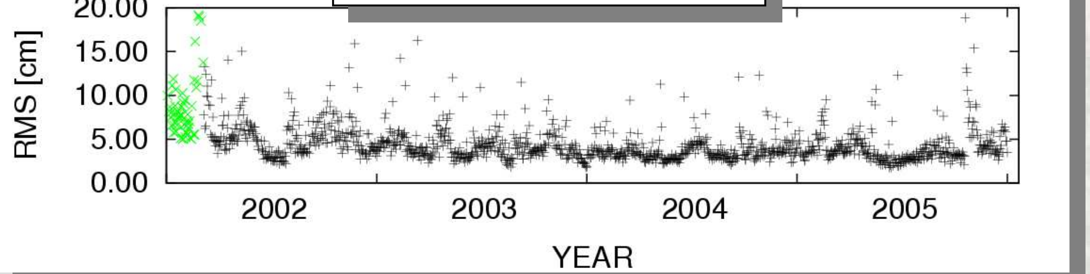
- Reduction of long wavelength noise
- Improvement of PPP for static stations
- No significant reduction of epoch-to-epoch noise

CHAMP orbit reprocessing

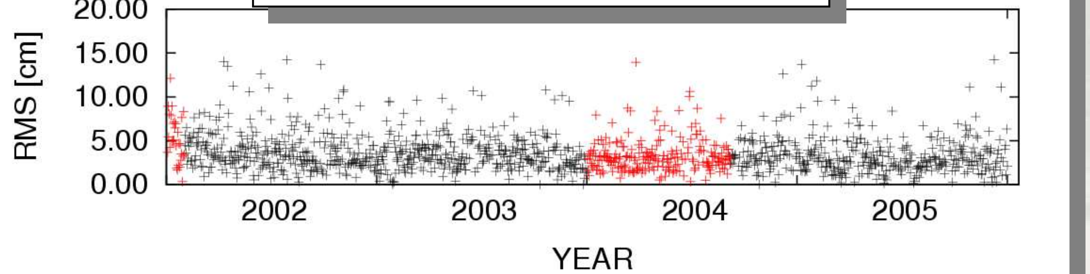
Amount of kinematic positions



Orbit differences



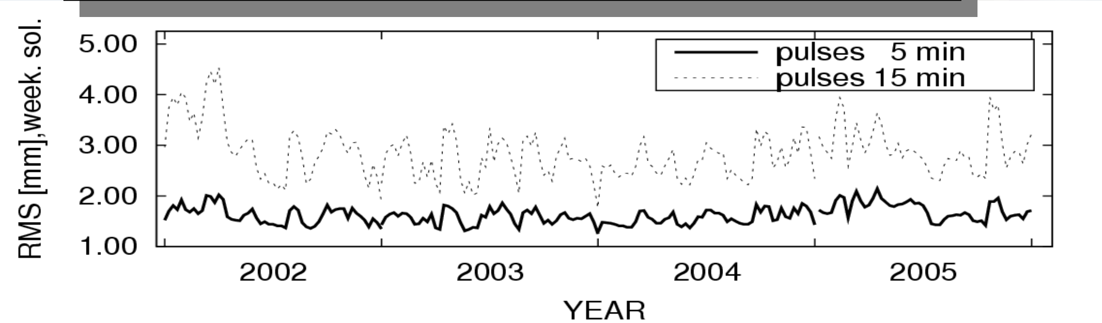
SLR-RMS of kin. orbits



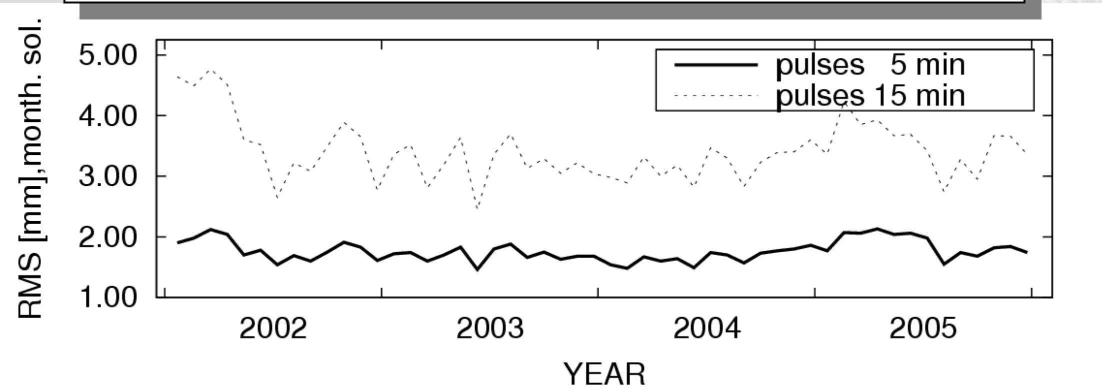
- Almost constant amount and accuracy of kinematic positions
- Reduced # of observations in early 2002 visible in kin. orbits
- Unavailability of attitude data not visible in quality of kinematic positions

Gravity field processing

RMS of weekly gravity field solutions



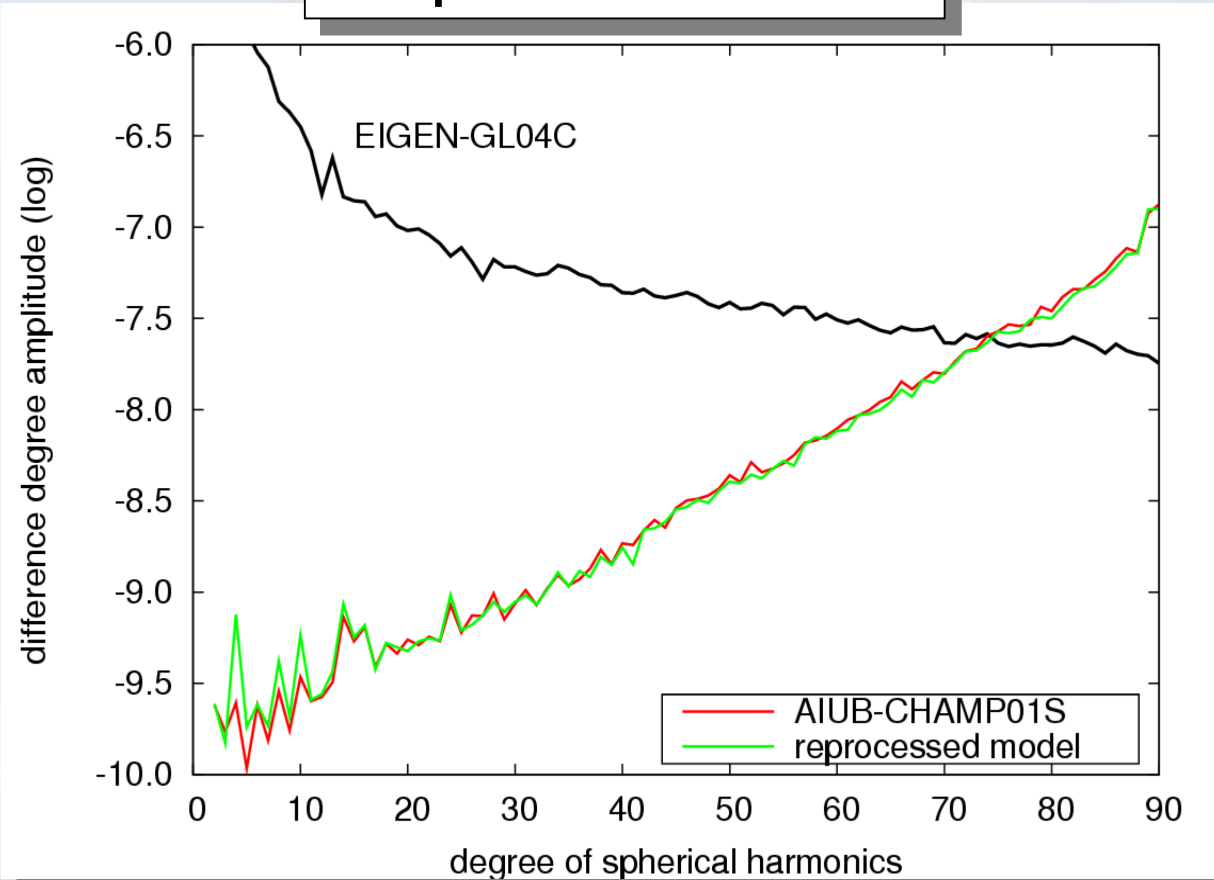
RMS of monthly gravity field solutions



- Relatively moderate fluctuations in the accuracy of orbit determination and computation of gravity field parameters for solutions with many parameters
- Unavailability of attitude data is also not visible in RMS of gravity field estimation

Gravity field processing

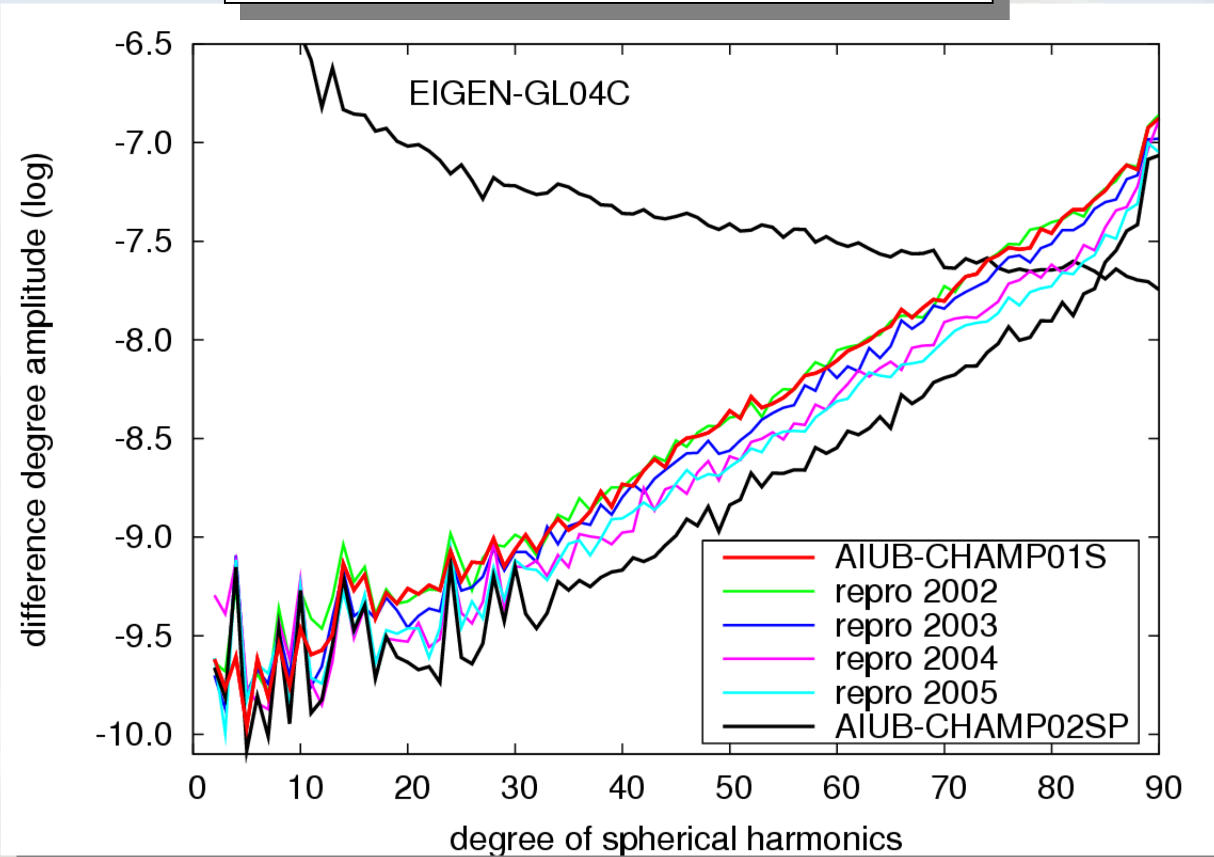
Comparison old vs. new



- Minor improvement in the higher degrees
- Degradation in the lower degrees not yet understood (inconsistency or incompatibility due to model and reference system changes?)

Gravity field processing

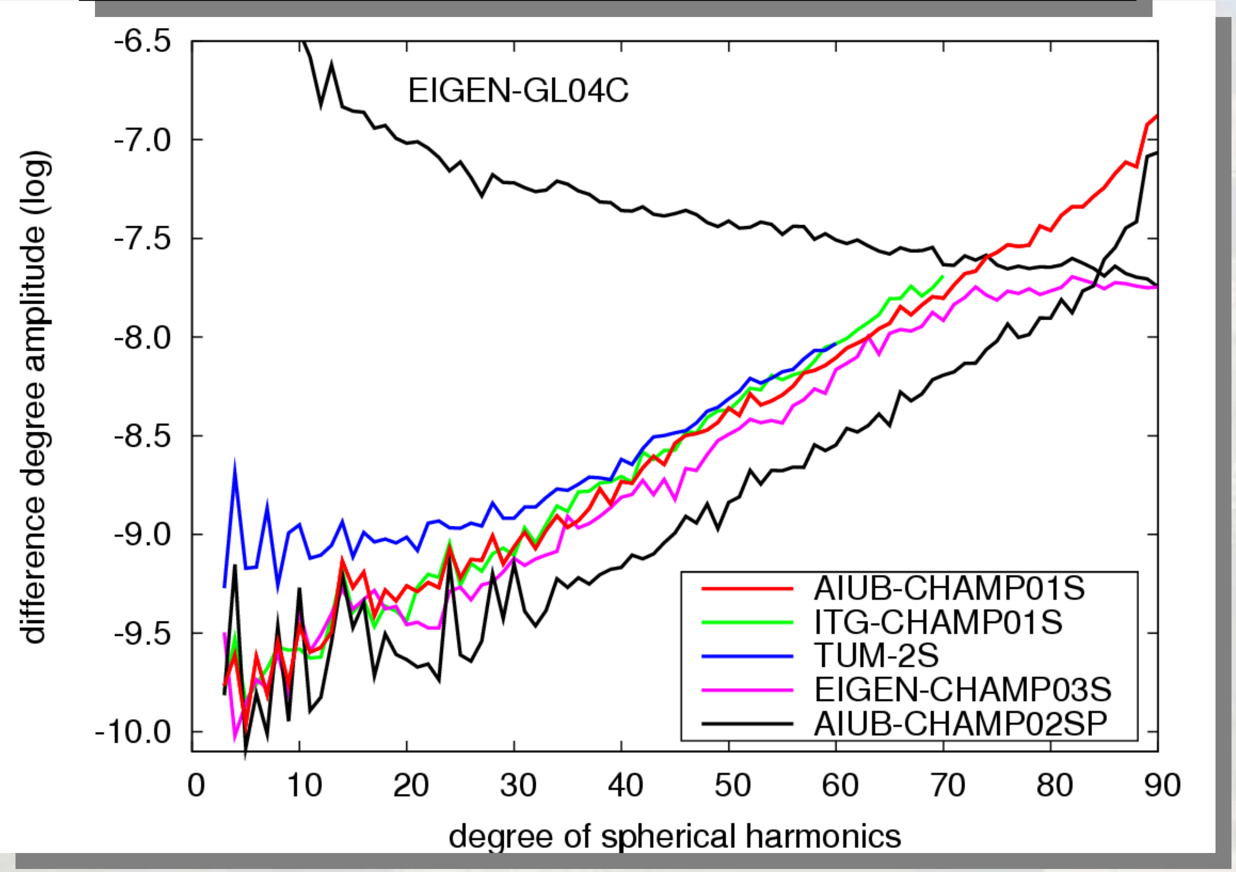
Yearly and combined solutions



- Solutions become better with time (orbit decay?)
- $\sqrt{n}$-law holds, except for low degrees
- Further improvements expected by solving up to higher degrees

Gravity field processing

Comparison with external CHAMP solutions



- 4-year solution seems to be of good quality compared to other CHAMP-only gravity field solutions

Gravity field processing

Geoid and gravity anomaly differences of chosen models to the EIGEN-GL04C model

Compared models	Type of comparison		Spectral range of SH coefficients 0-30	0-50	0-70
AIUB-CHAMP01S – EIGEN-GL04C	undulation [cm]:	RMS	1.4	5.2	22.2
		max.	7.7	30.5	137.6
		min.	-7.6	-32.9	-127.3
	anomaly [mGal]:	RMS	0.05	0.35	2.15
REPRO-1Y – EIGEN-GL04C	undulation [cm]:	RMS	1.5	5.0	21.0
		max.	6.9	31.9	128.7
		min.	-8.5	-25.5	-115.7
	anomaly [mGal]:	RMS	0.05	0.33	2.03
AIUB-CHAMP02SP – EIGEN-GL04C	undulation [cm]:	RMS	0.9	2.1	8.1
		max.	4.4	12.3	101.1
		min.	-4.6	-11.7	-53.0
	anomaly [mGal]:	RMS	0.03	0.13	0.78
EIGEN-CHAMP03S – EIGEN-GL04C	undulation [cm]:	RMS	1.1	3.8	17.8
		max.	6.4	23.1	141.0
		min.	-5.1	-19.5	-161.6
	anomaly [mGal]:	RMS	0.03	0.25	1.73

Conclusions

- Reprocessed set of GPS orbits, clock corrections and ERP's will soon be available for 2002 to 2007
- Improvement of PPP (especially for static stations)
- Computation of a consistent set of LEO-orbits and gravity field parameters from GPS observations for 2002 to 2007 (precondition for the estimation of multi-year gravity field solutions from LEO GPS data)
- But: no significant improvement of gravity field determination by using the new GPS products and models
- Open issues:
  - Degradation of low degree SH coefficients (real?)
  - Improvement of LEO orbit determination and data screening when using GPS data with 10s sampling is still necessary