GRACE gravity field determination with the Celestial Mechanics Approach at AIUB

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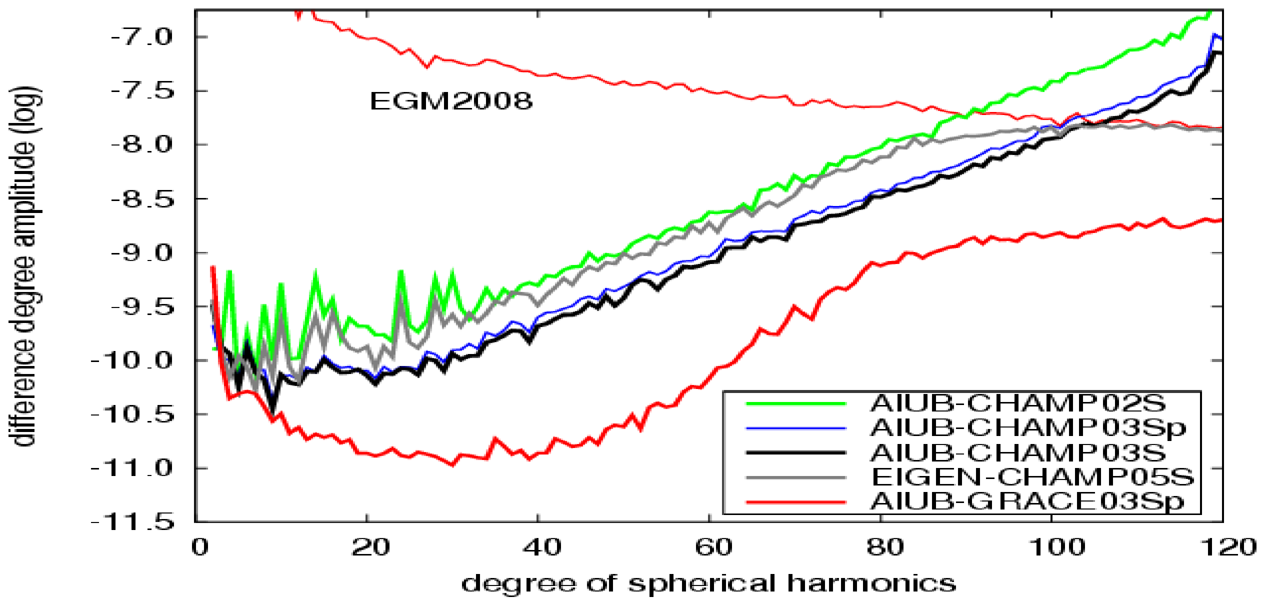
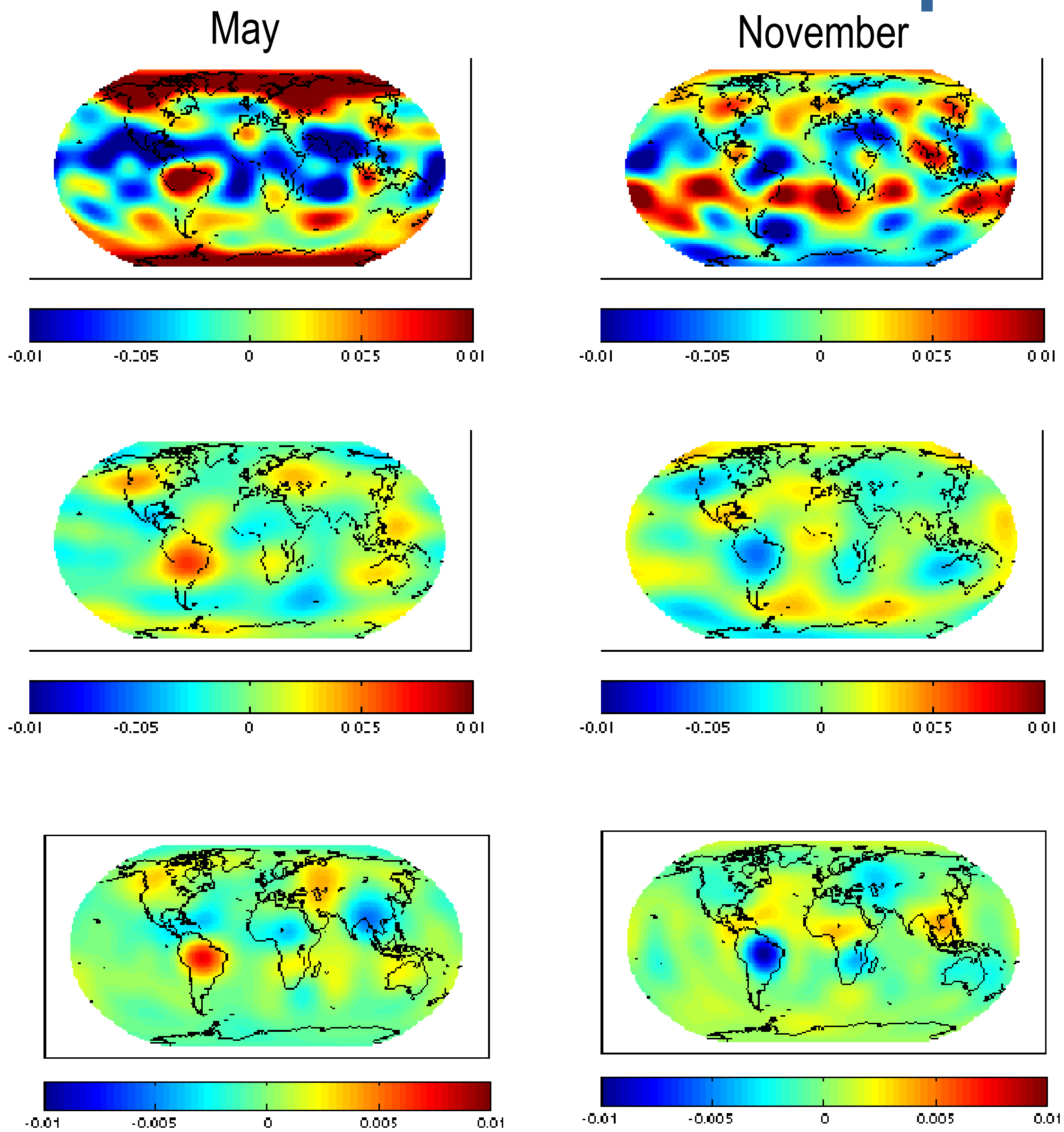
CHAMP: static 8y field AIUB-CHAMP03S



CHAMP: temporal variations

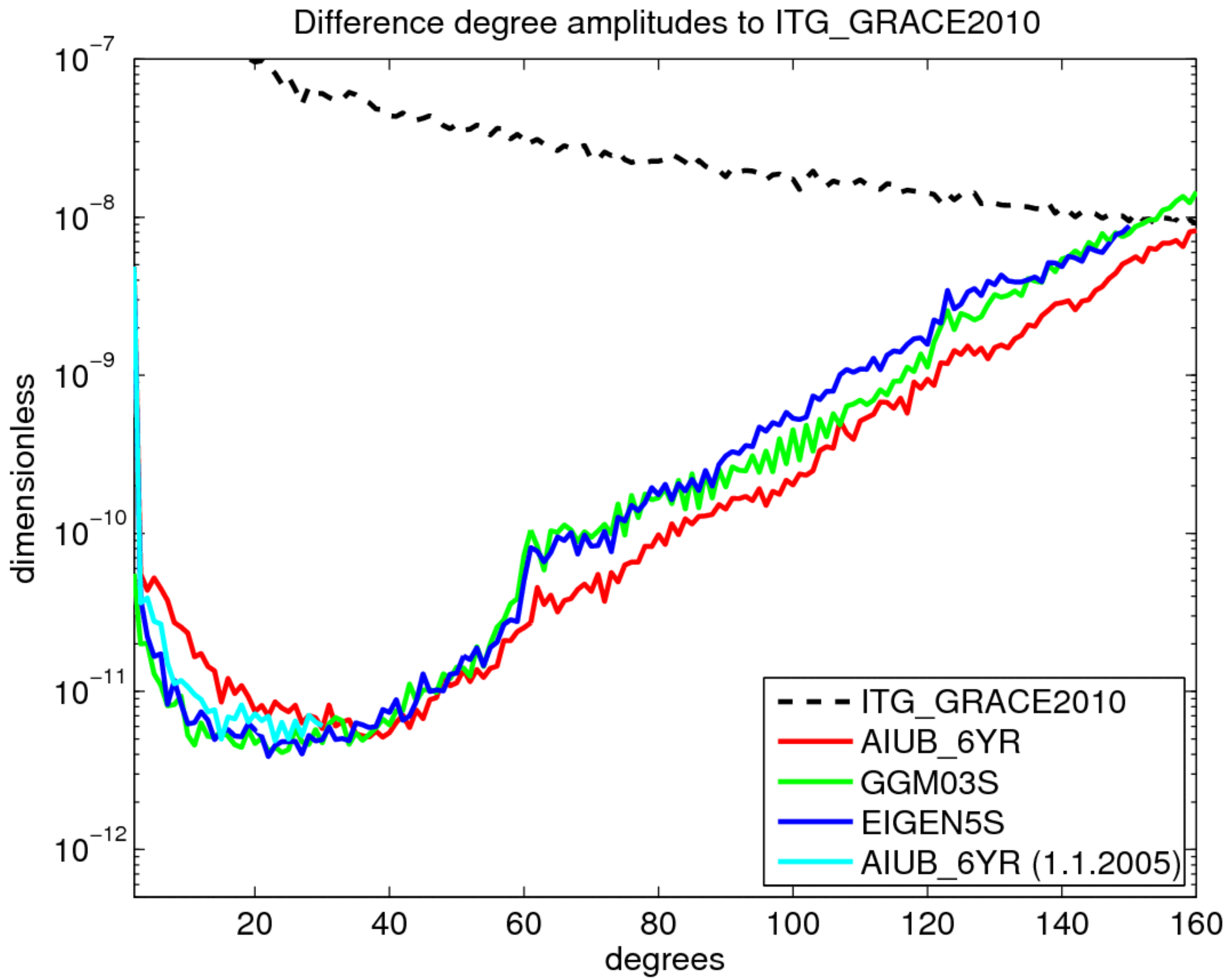


CHAMP: monthly solutions from 2007

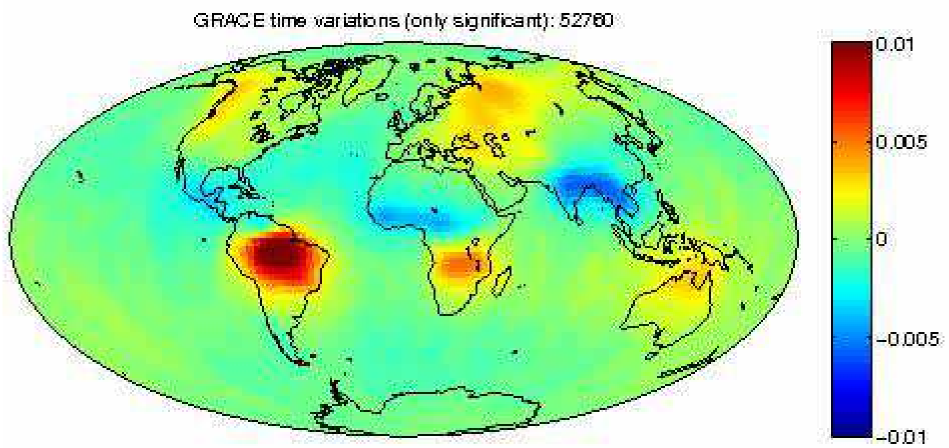
CHAMP: stacked solutions (8 years), only significant terms (Davis et al., 2008)

GRACE: corresponding monthly solutions (for reference)

GRACE: static 6y field AIUB_6YR



GRACE: periodic time variations



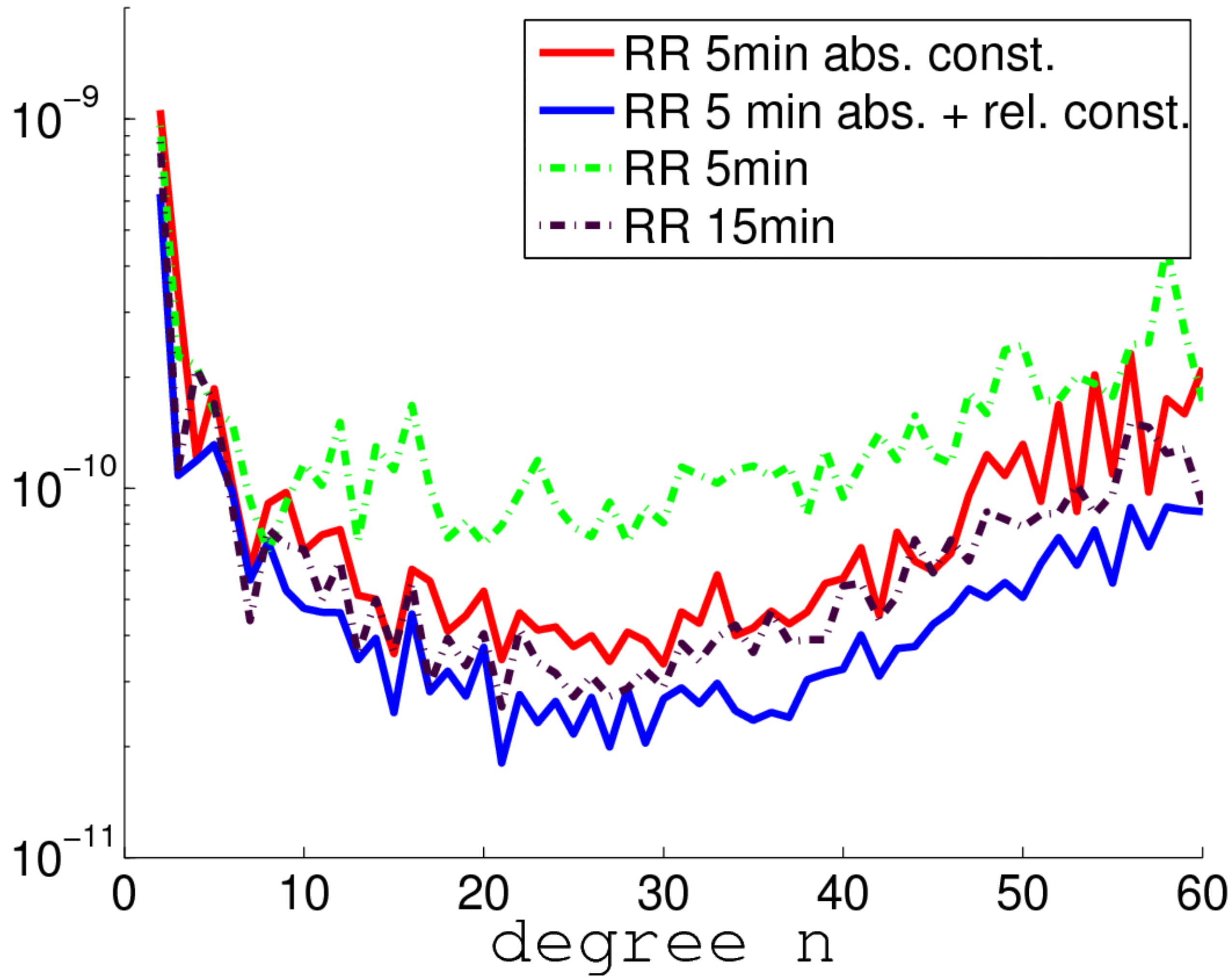
significant terms
(1-yearly, ½-yearly)

Celestial Mechanics Approach

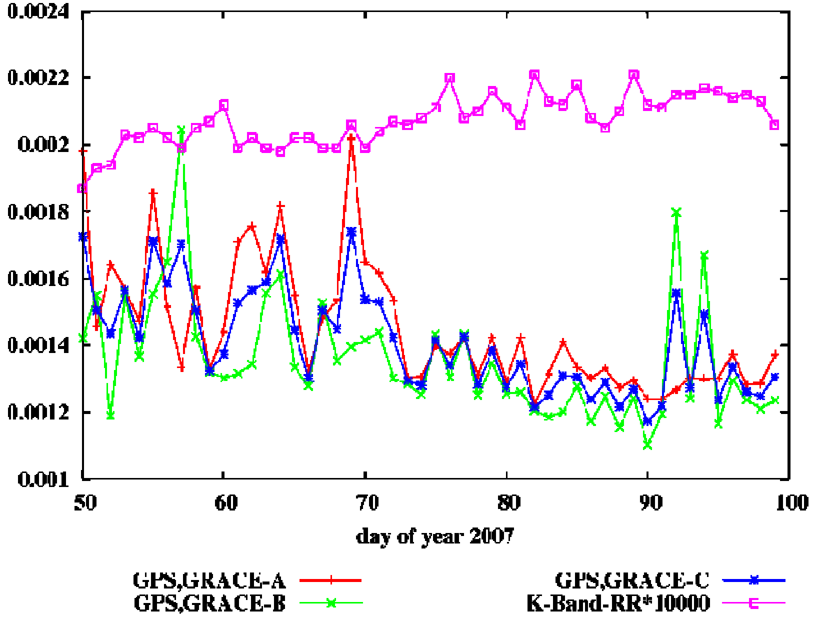
Key features:

- Kinematic orbits (from GPS) as pseudo-observations (efficiency)
- Reduced dynamic orbits (GPS & K-Band) with stochastic pulses (flexibility)
- Intelligent way to compute variational equations (efficiency)
- NEQ-manipulation: relative weighting in combination, parameter pre-elimination, accumulation (flexibility and efficiency)

Pulses: spacing and constraints



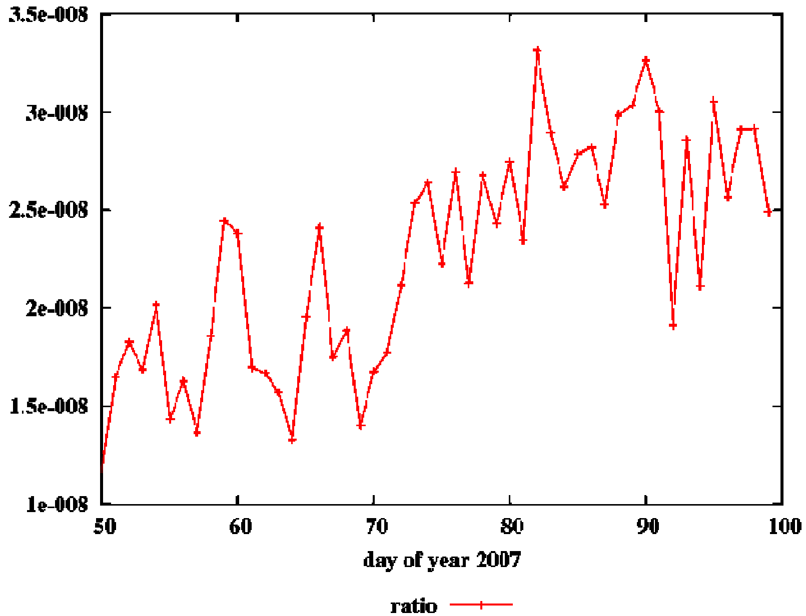
GPS via K-Band: RMS and rel. weighting



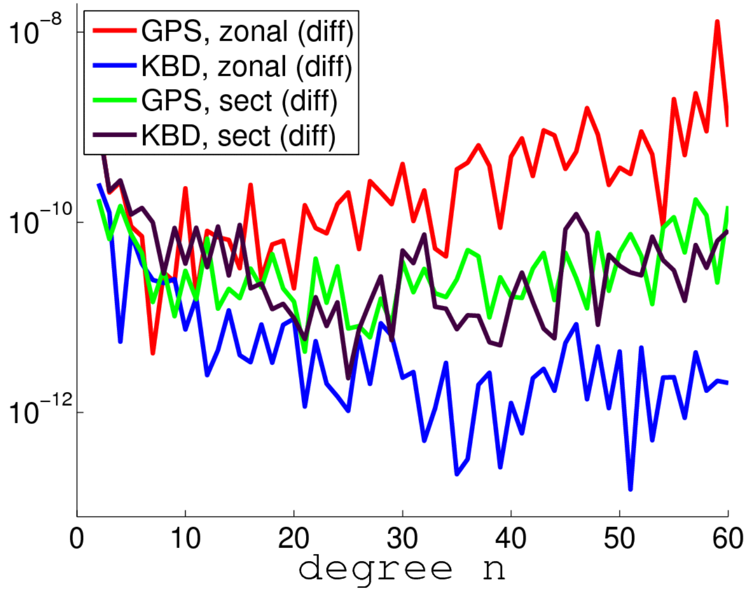
K-Band-only solution:

- solved for difference ½($\mathbf{r}_1$-$\mathbf{r}_2$)
- mean value ½($\mathbf{r}_1$+$\mathbf{r}_2$) slightly constrained to kin. positions (from GPS)

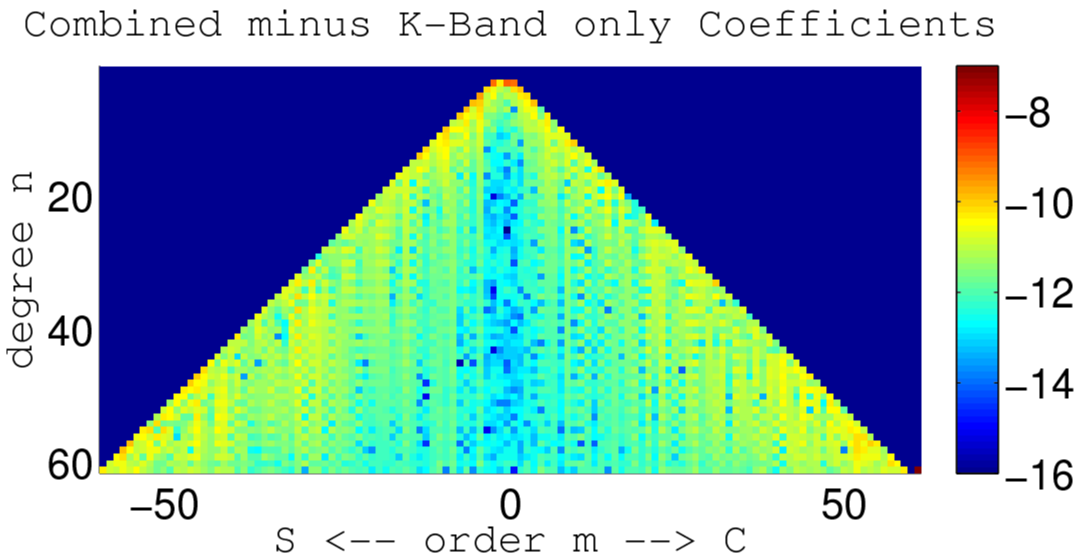
Theoretical weighting factor $\sigma_{KBD}^2/\sigma_{GPS}^2 = 2...3 * 10^{-8}\ s^{-2}$ (better agreement with other GRACE-fields is achieved using $1*10^{-10}\ s^{-2}$, i.e. down-weighting GPS)



Impact of GPS on combined solution



Impact of GPS mainly on very low degree and close to sectorial coefficients.



relative weighting:

$\sigma_{KBD}^2/\sigma_{GPS}^2 = 10^{-8}\ s^{-2}$

Range-Differences and Correlation

R	Range	**RC**	correlated
RR	Range-Rate	**RRC**	
RA	Range-Acceleration	RAC	
RD	Range-Difference	**RDC**	
DD	Double-Difference	DDC	

$$R \approx RC$$

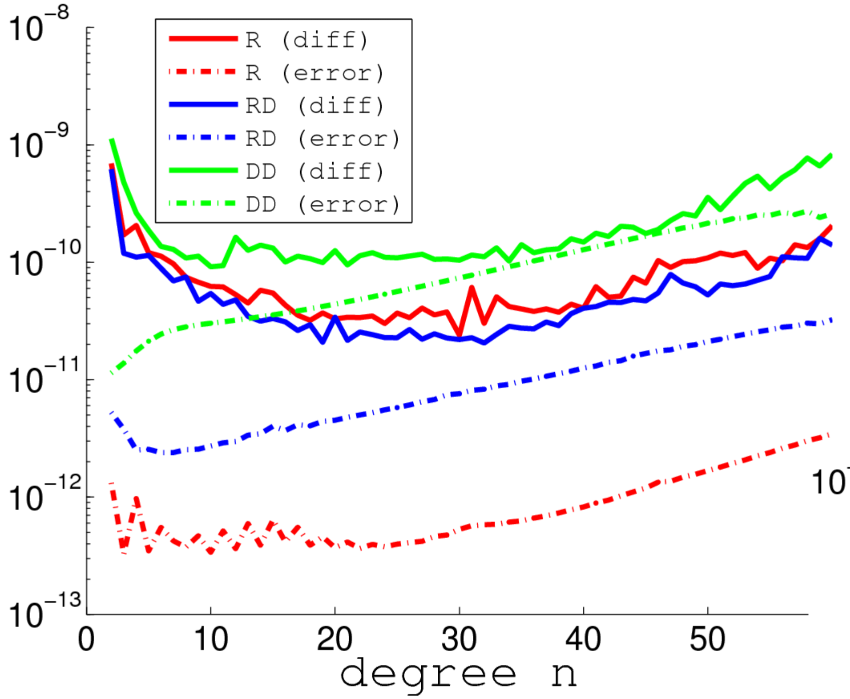
$$RR \approx RD = (R(t_2) - R(t_1)) / \Delta t$$

$$R = RDC \approx RRC$$

$$P_R = k * I$$

$$P_{RD} = ((\partial RD/\partial R)^T P_R \, \partial RD/\partial R)^{-1}$$

Range, Range-Diff., Double-Diff.



Uncorrelated RD-solution outperforms R-solution (contradictory to formal errors).

Introducing frequent (5 min.) constrained pulses results in a competitive R-solution.