

# Comparison and combination of CHAMP and GRACE data for gravity field analysis

M. Weigelt<sup>1</sup>, M.M. El-Habiby<sup>1</sup>, M.G. Sideris<sup>1</sup>, N. Sneeuw<sup>2</sup>

<sup>1</sup> Geomatics Engineering, University of Calgary

<sup>2</sup> Geodätisches Institut, Universität Stuttgart


*mlbweige@ucalgary.ca*



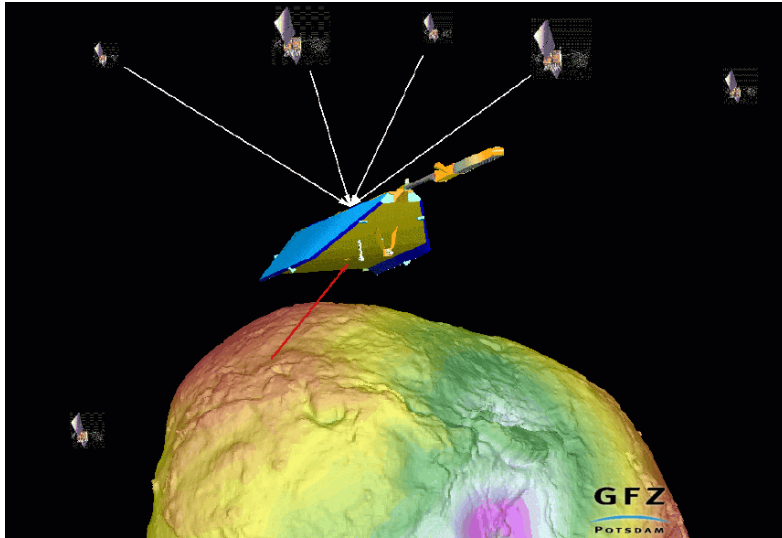
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# Outline

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- A faint, stylized world map is visible in the background of the slide, showing the outlines of continents and oceans in a light, multi-colored palette.
- **Review and open issues**
  - **Methodology and combination techniques**
  - **Results**
  - **Conclusion**

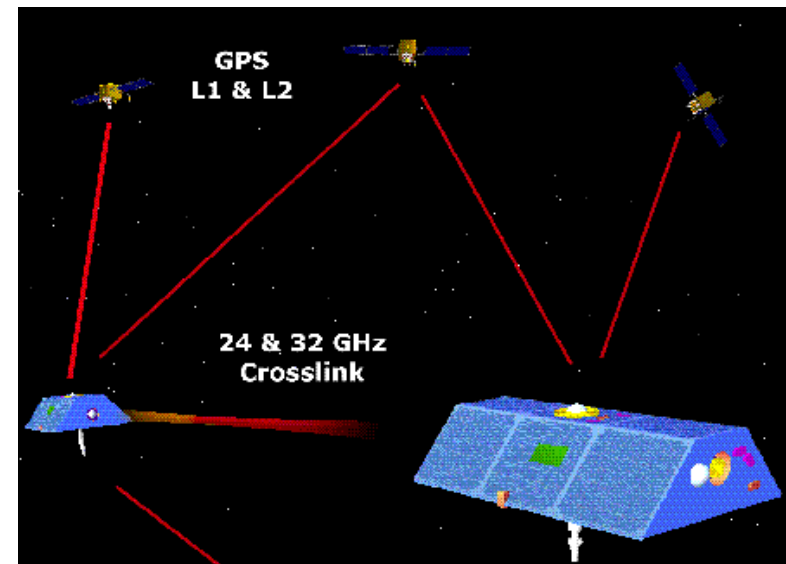
# Satellite systems: CHAMP + GRACE



source: GFZ-Potsdam

- orbit height: ~ 485 km
- inclination: ~ 89°
- principle of low-low SST
- mission duration: 5+ years
- time variable gravity field

- orbit height: ~ 400 km
- inclination: ~ 87°
- principle of high-low SST measurement
- mission duration: 7+ years

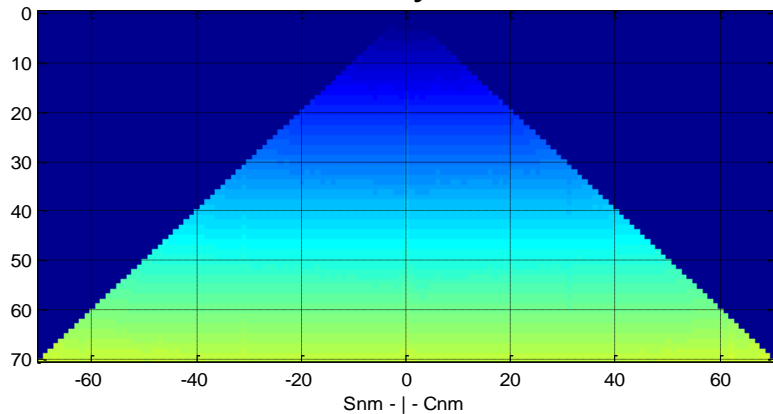


source: GFZ-Potsdam

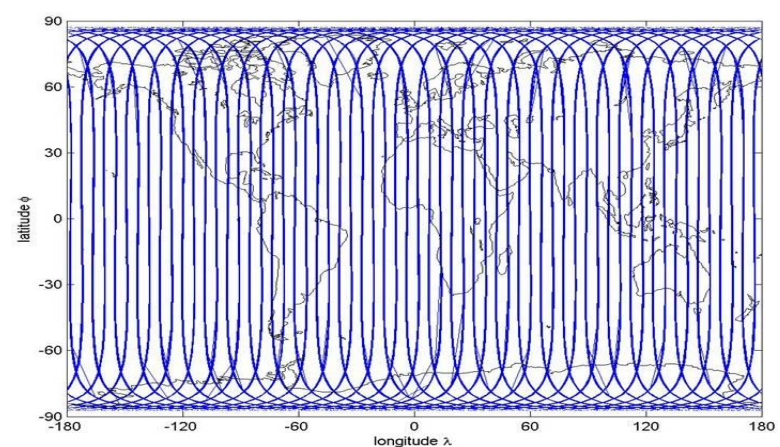
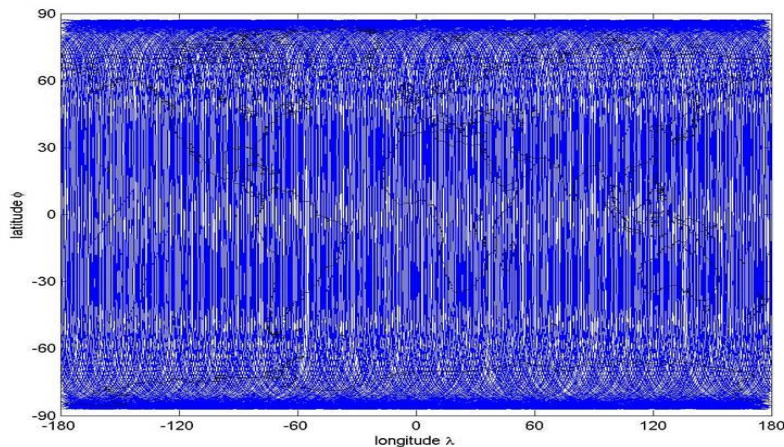
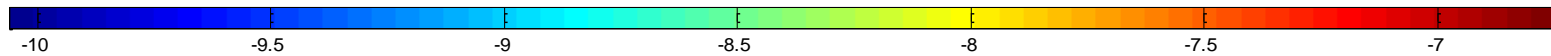
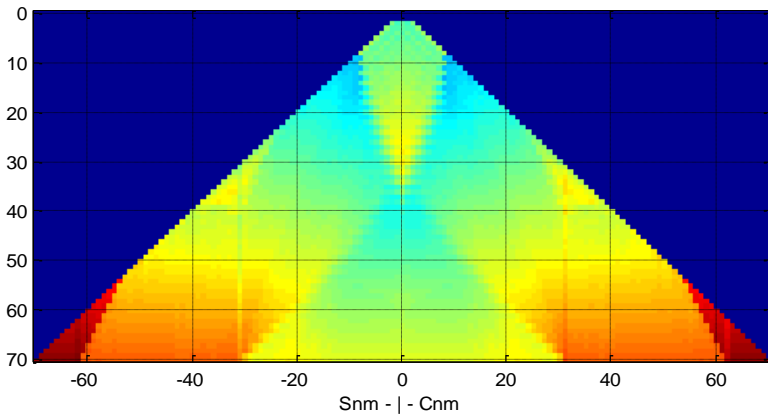
# Open issues

- Recovery of a time variable gravity field from an time variable ground track pattern

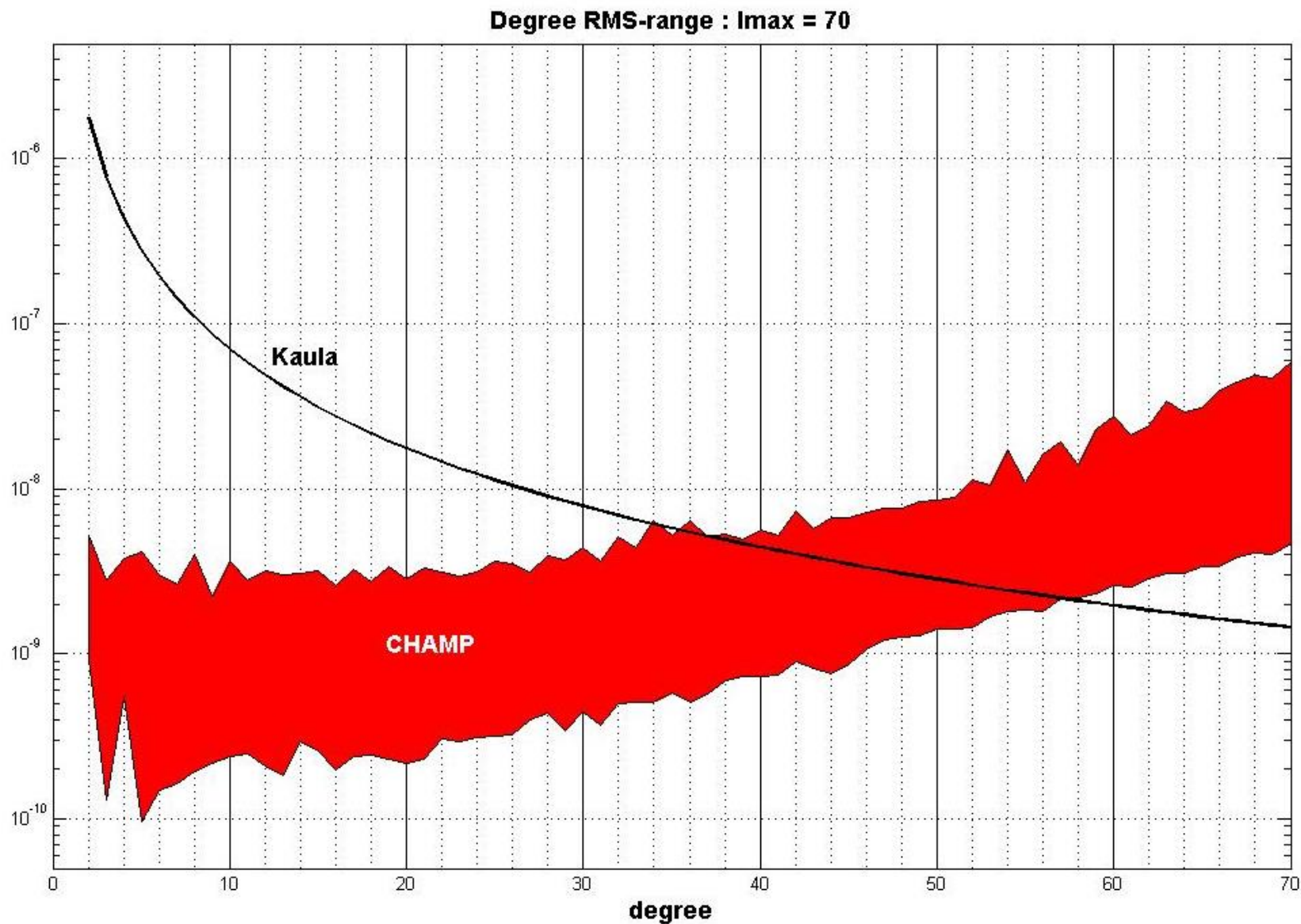
January 2003



June 2003

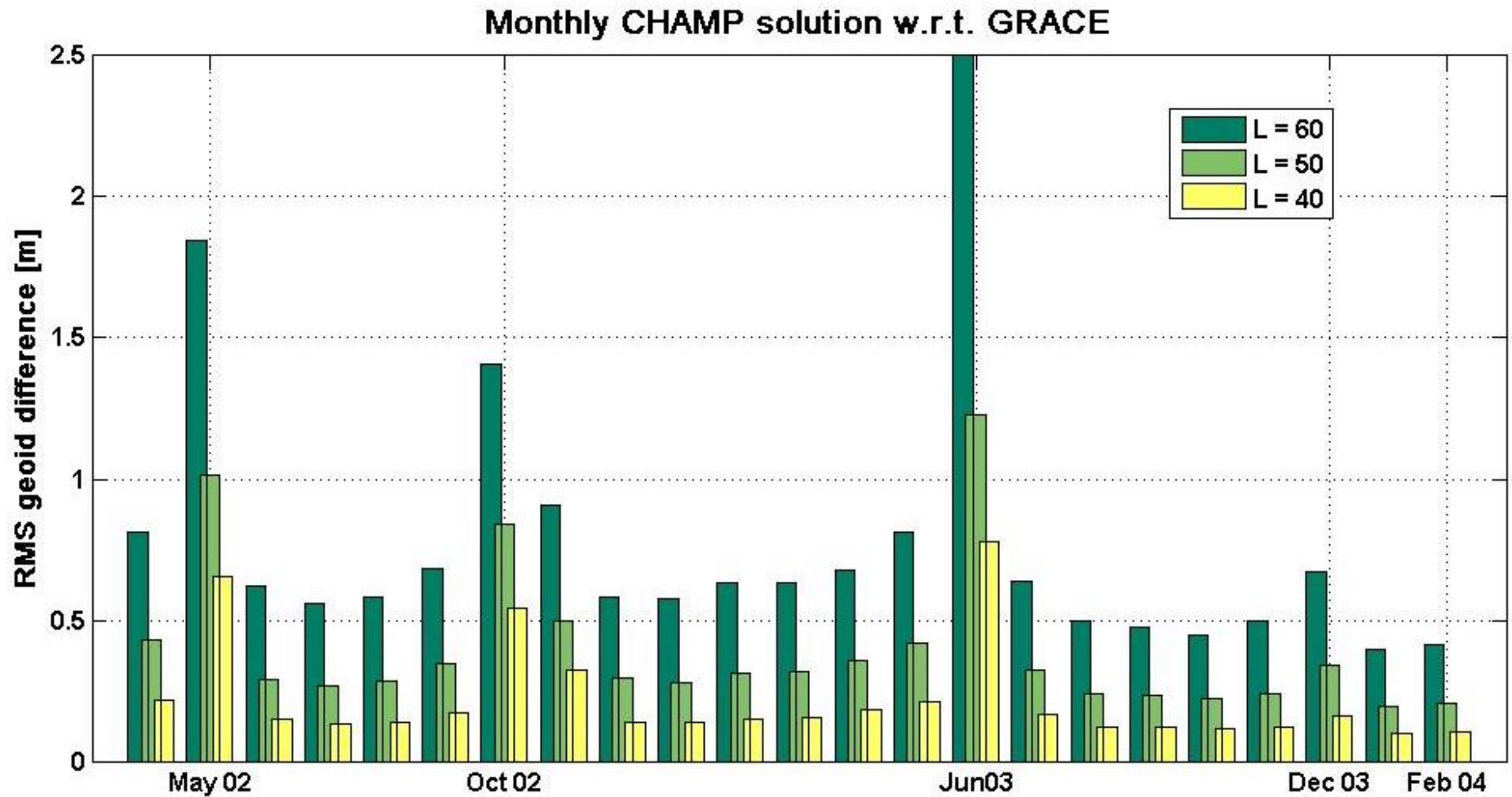


# Variability of monthly CHAMP solution





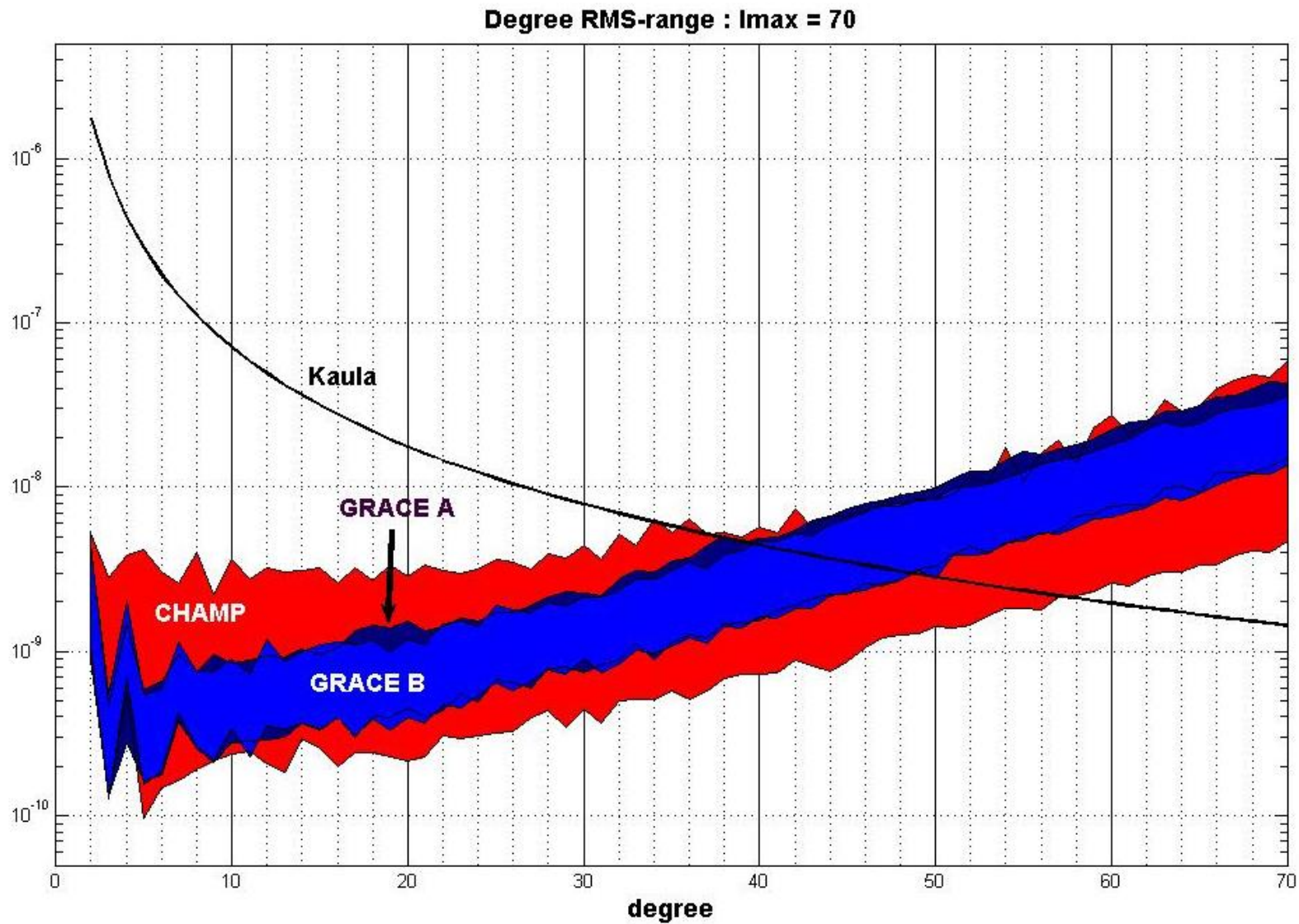
# Variability of monthly CHAMP solution



# Approach

- Problem:
  - satellite in resonance with gravity field
  - aliasing caused by data distribution
- Possible Solutions:
  - de-aliasing filter (e.g. spherical cap averages)
  - introduction of additional data in order to improve the data distribution
- Approach: each GRACE satellite is a CHAMP-like single satellite mission
  - Benefits:
    - 3 times data availability: 4.2 million measurements for 2 years
    - combination techniques can be studied
    - effect of downward continuation can be studied
  - Drawback:
    - currently no K-band measurements used → poorer overall performance

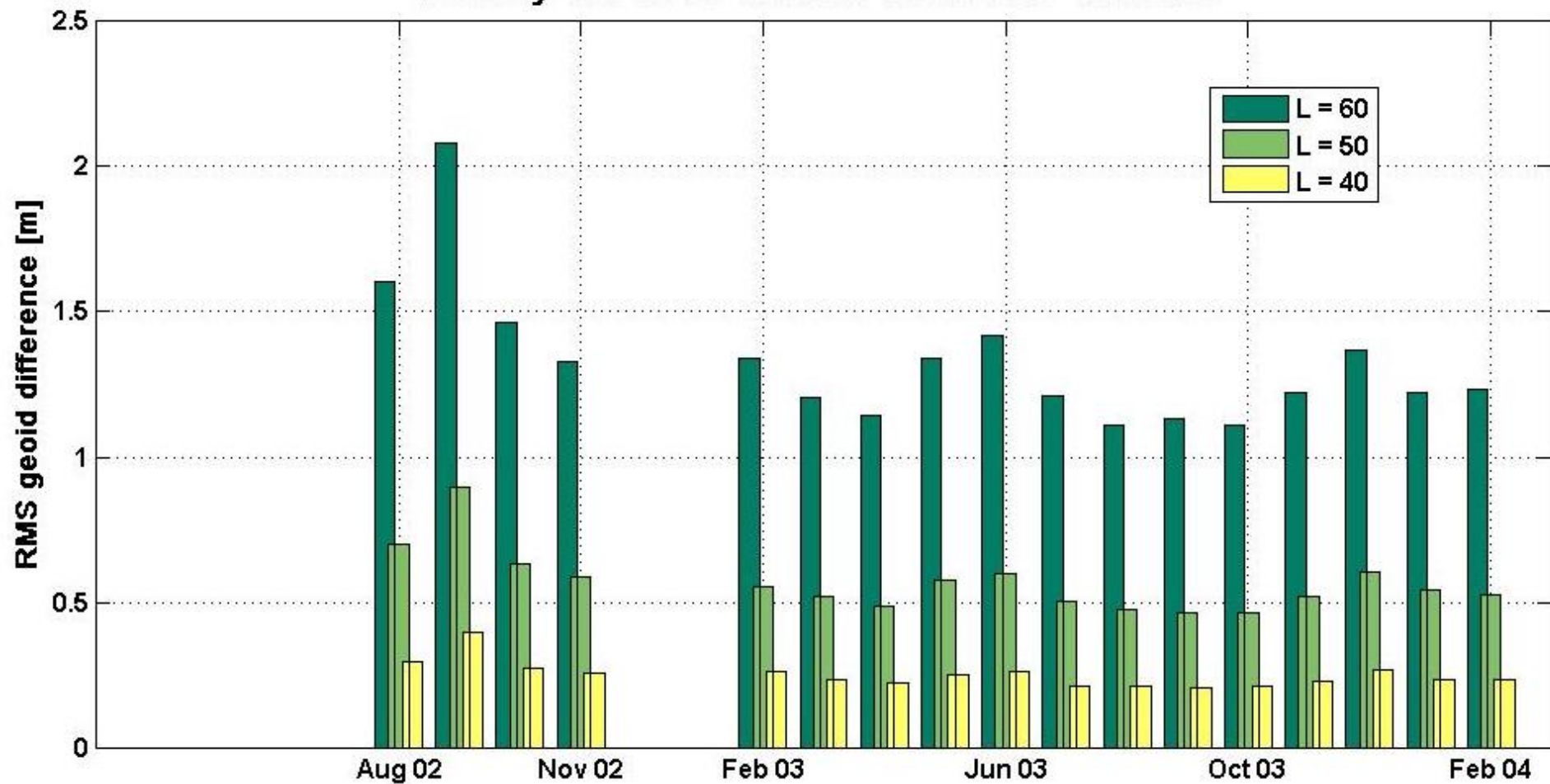
# Variability of CHAMP and GRACE



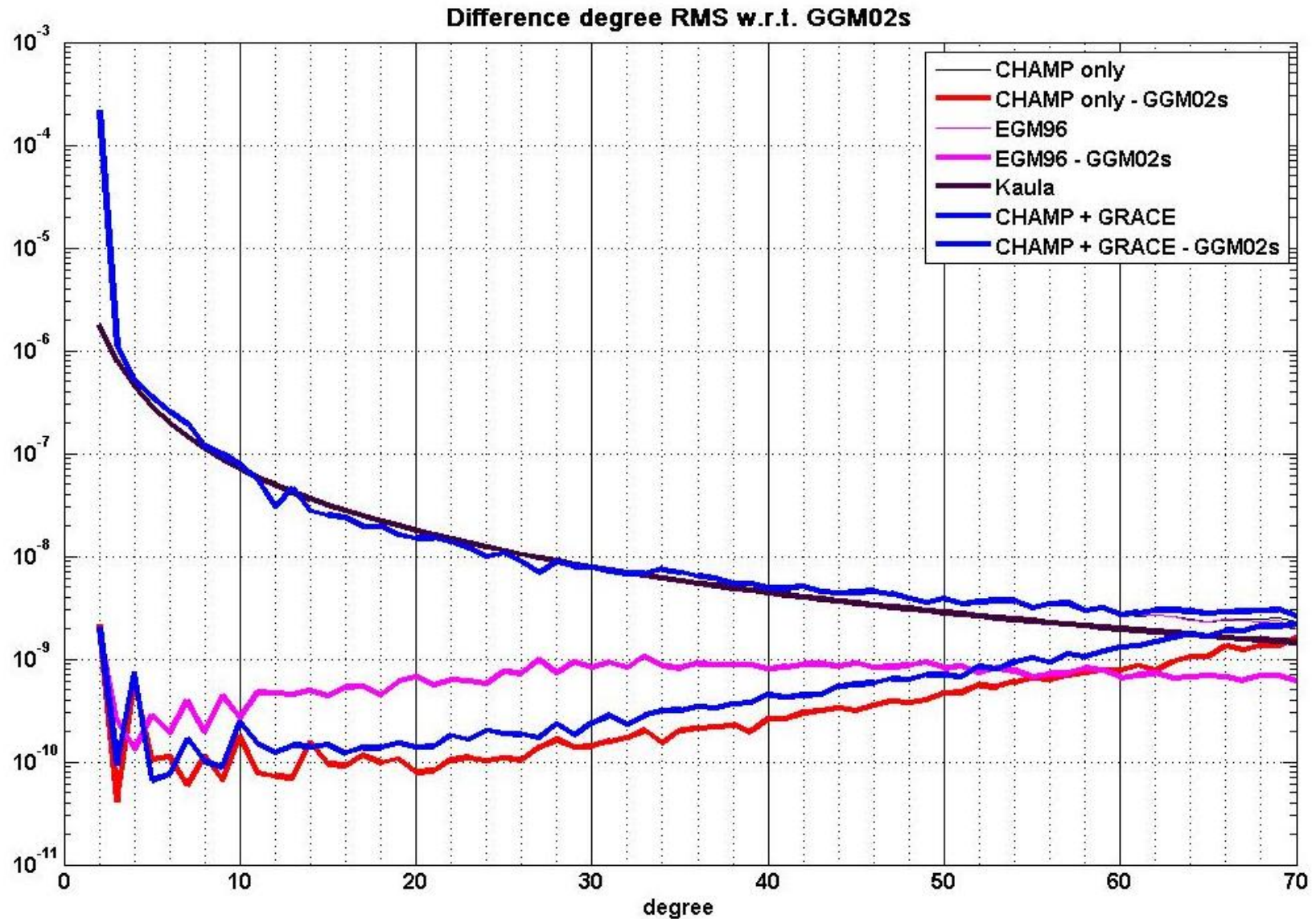


# Variability of monthly GRACE solution

Monthly GRACE A solution vs. GRACE GGM02s



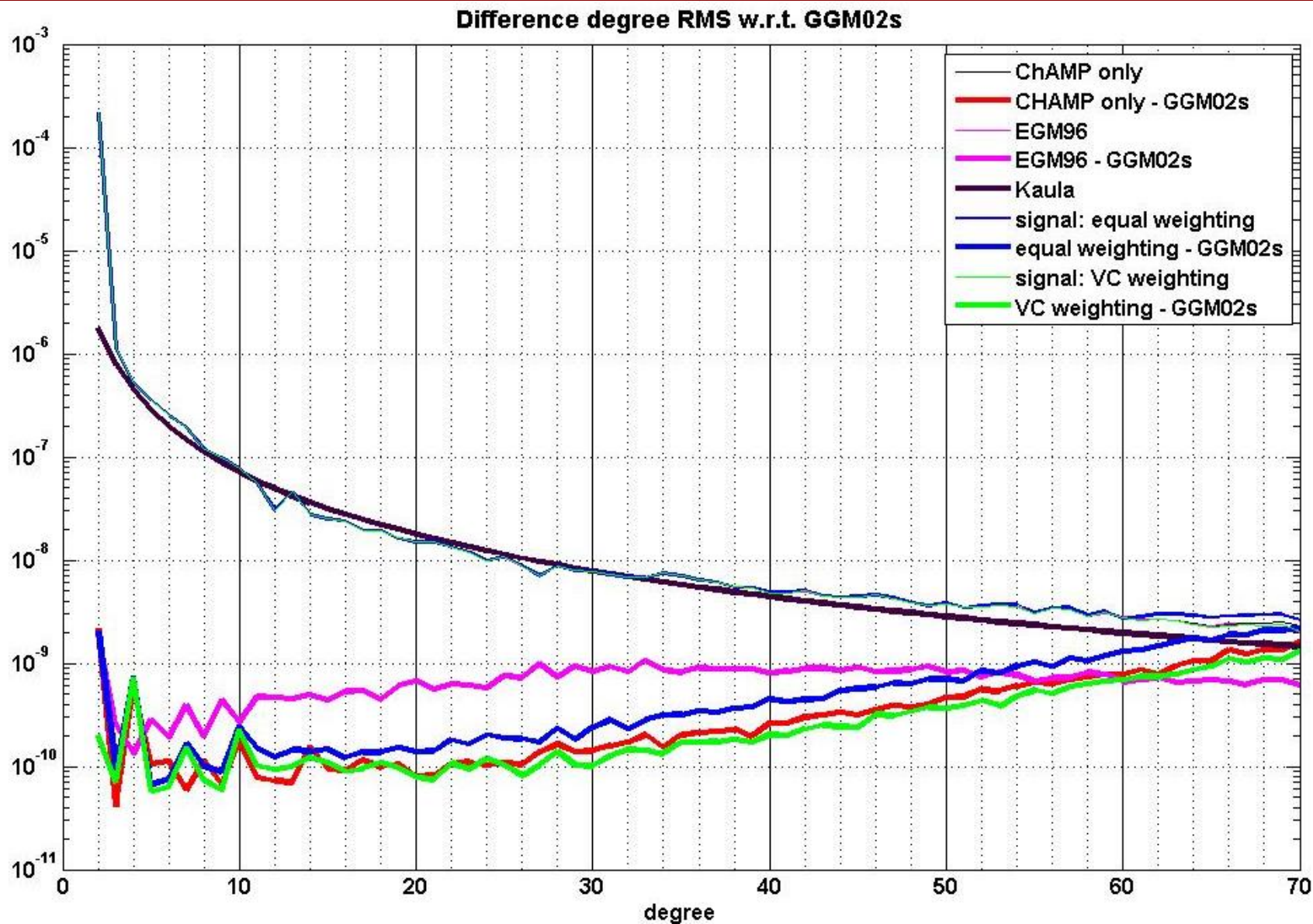
# Equal weighted CHAMP+GRACE solution



# Combination Approach

- **Optimal data weighting (Lerch, 1991):**
  - Influence of subset of solutions is determined
  - can handle biases in the data
  - no convergence reached
- **Variance component estimation (Koch & Kusche, 2002):**
  - variance component for each month
  - regularization possible
  - convergence reached after 3 – 5 iterations
- **Spectral approach (Kern et. al, 2003)**

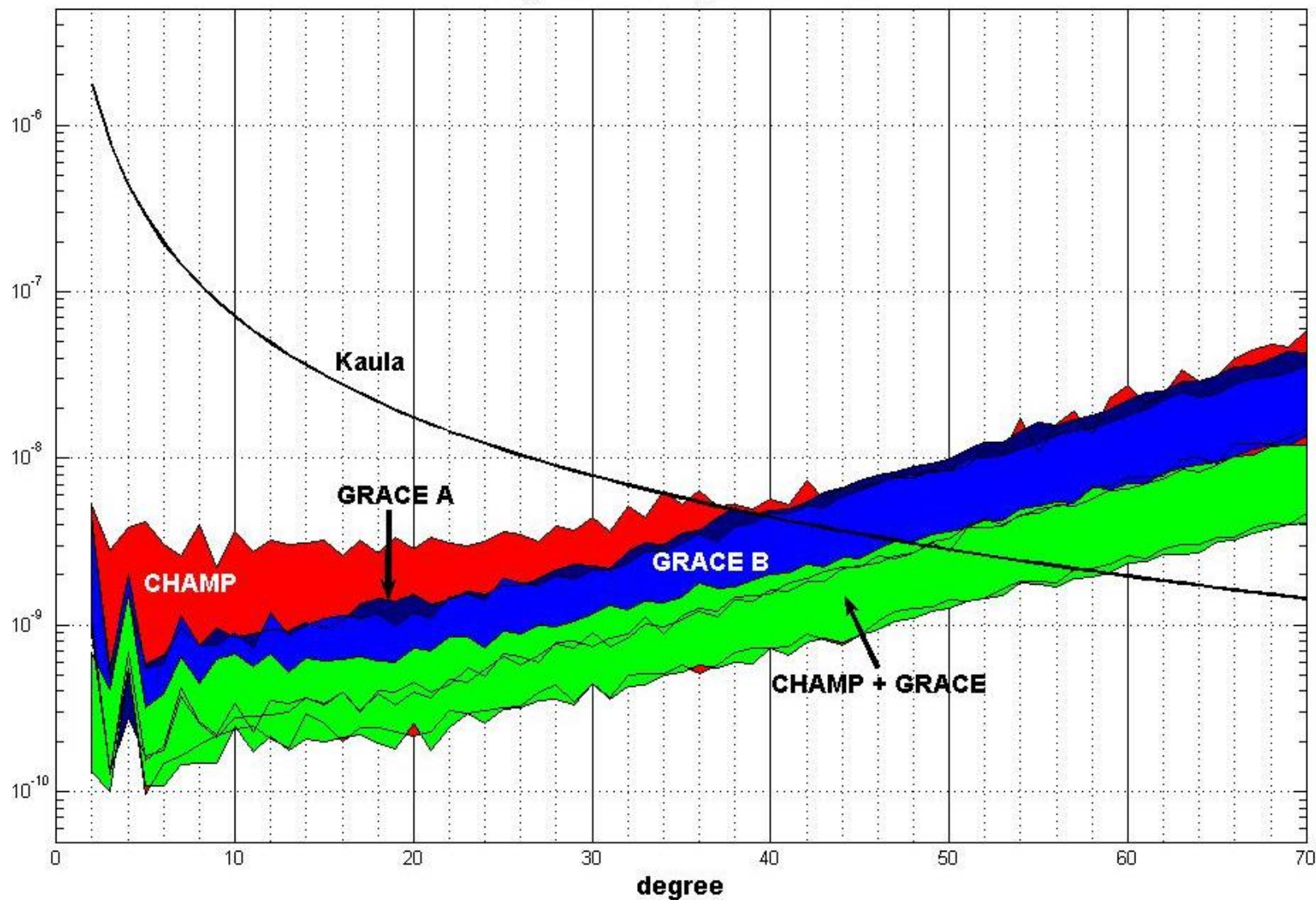
# Variance-Component estimation





# Degree RMS-range of combined months

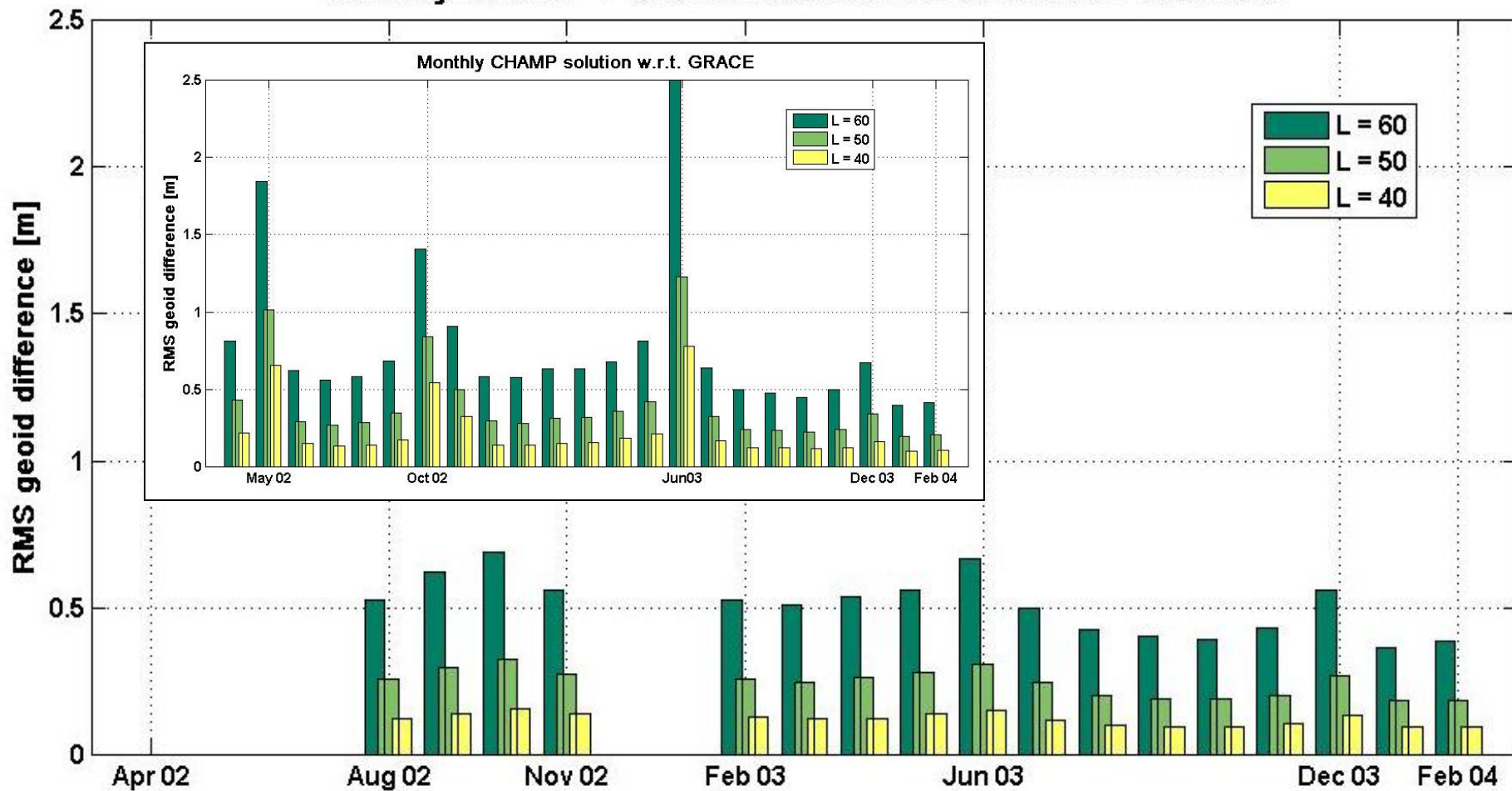
Degree RMS-range :  $l_{max} = 70$





# Variability of combined monthly solutions

Monthly CHAMP + GRACE solution w.r.t. GRACE GGM02s



# Conclusions and Future Work

## ● Conclusions:

- improvement of solutions of months with poor ground track using additional data
- proper data weighting method necessary
- 2-year-solution is limited by measurement errors
- improvement and homogenization of monthly solution

## ● Future Work:

- incorporation of K-band measurement
- spectral combination techniques

# Questions ?

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