M. Weigelt, A. Jäggi, L. Prange, W. Keller, N. Sneeuw

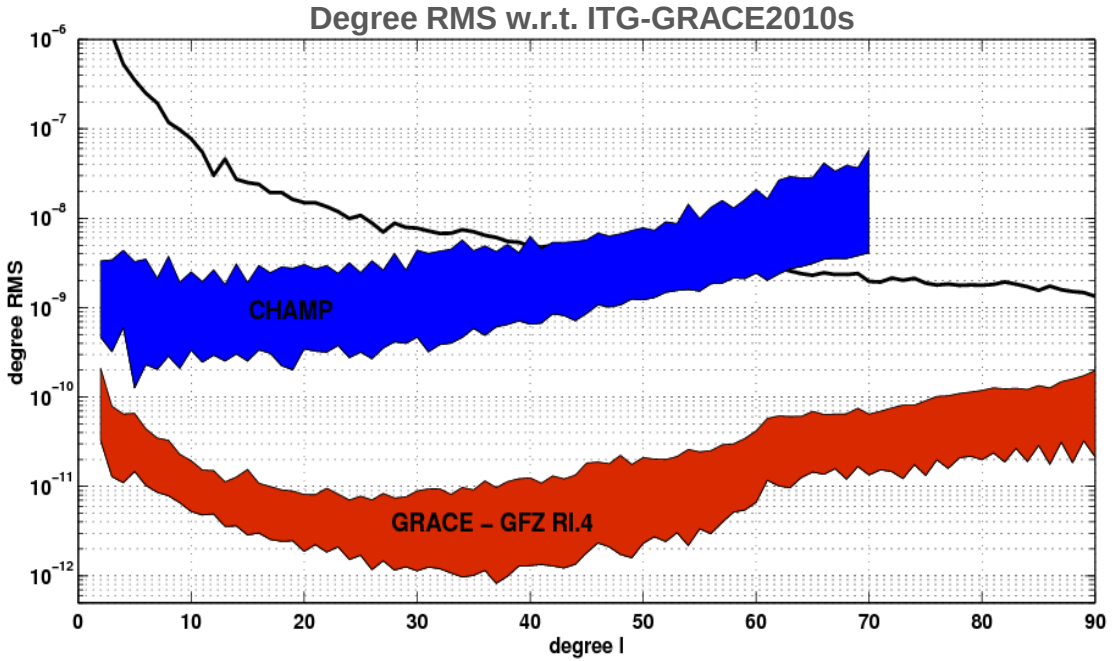
TOWARDS THE TIME-VARIABLE GRAVITY FIELD FROM CHAMP

Questions

- Did we get everything out of the CHAMP data?
- Is the time variable gravity field really out of reach?
- What do we learn for future satellite missions?

Previous studies & limitations

- based on the energy balance approach
- two years of GPS-data with 30 s sampling
- no dealiasing products
- no covariance information



Processing refinements

Refinements

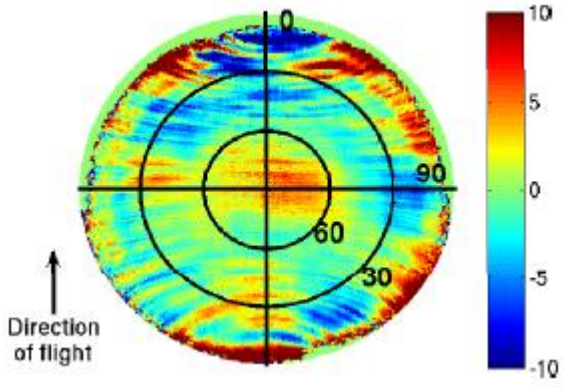
Acceleration approach:

$$\nabla V = \ddot{x} - f^{\mathrm{3rdBody}} - f^{\mathrm{Tides}} - f^{\mathrm{Rel}} - f^{\mathrm{Grav}}$$

- three times the number of observations
- three dimensional observations

Improved GPS positioning:

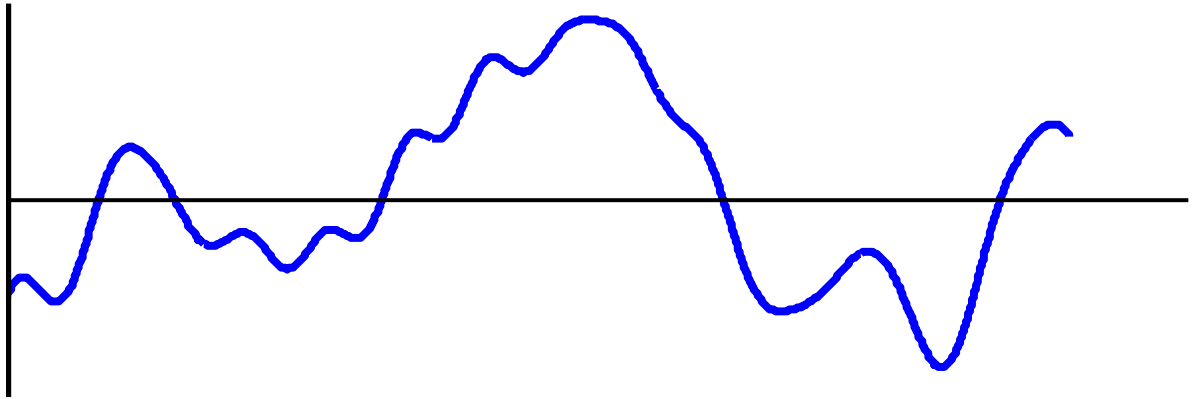
- 10 s sampling
- estimated absolute antenna phase center model
- new IGS standards
- …



Prange 2010

Outliers vs. poor observations

- Typically threshold based outlier detection based on residuals:



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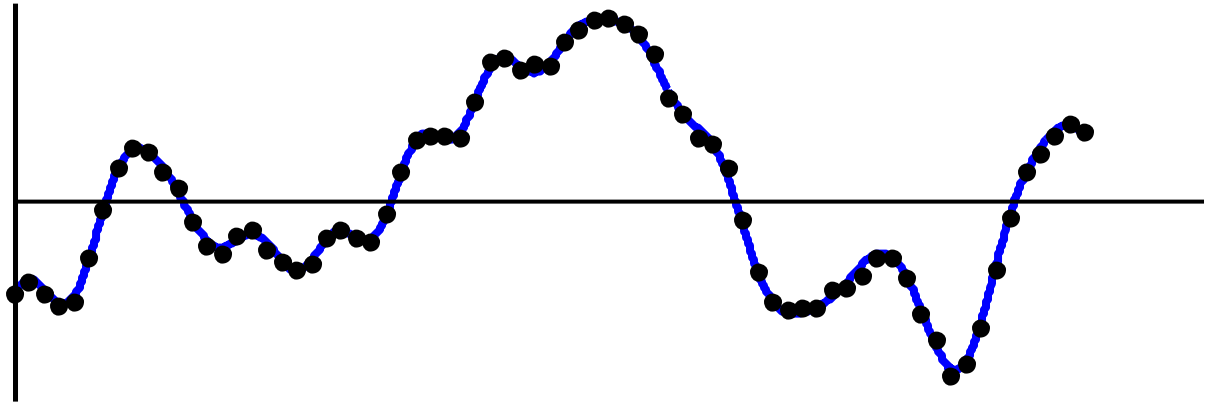

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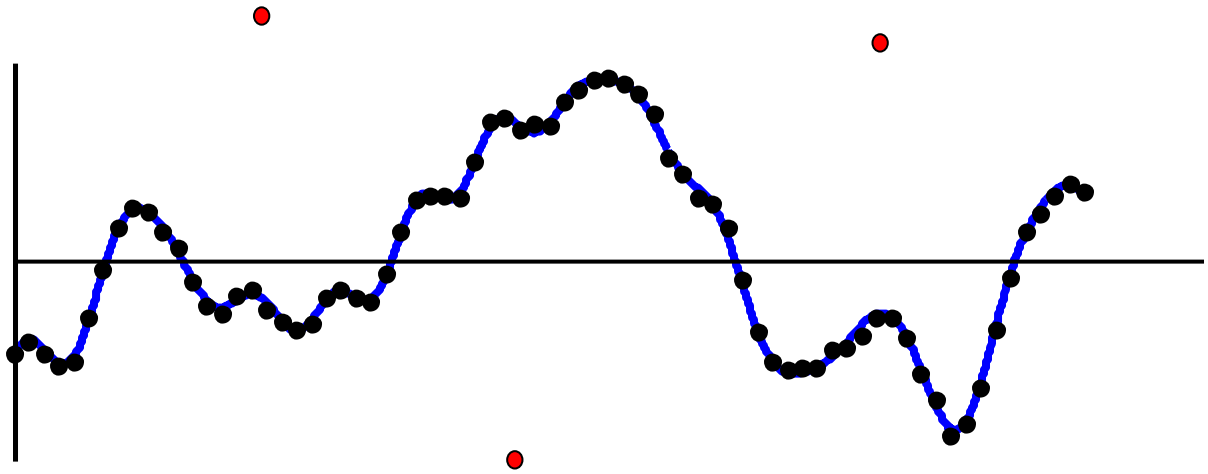

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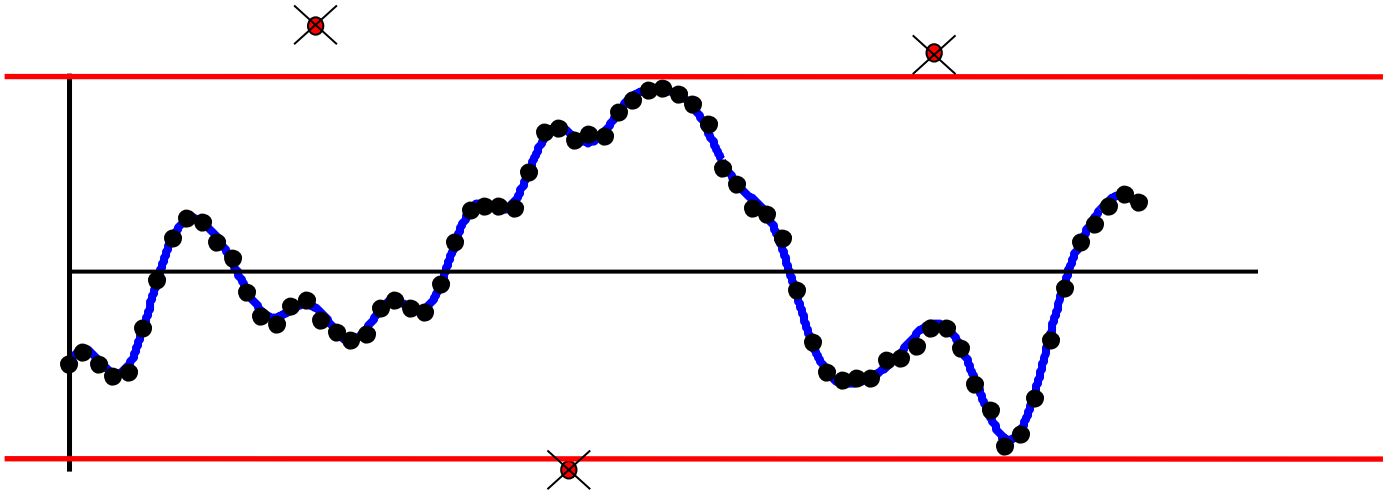

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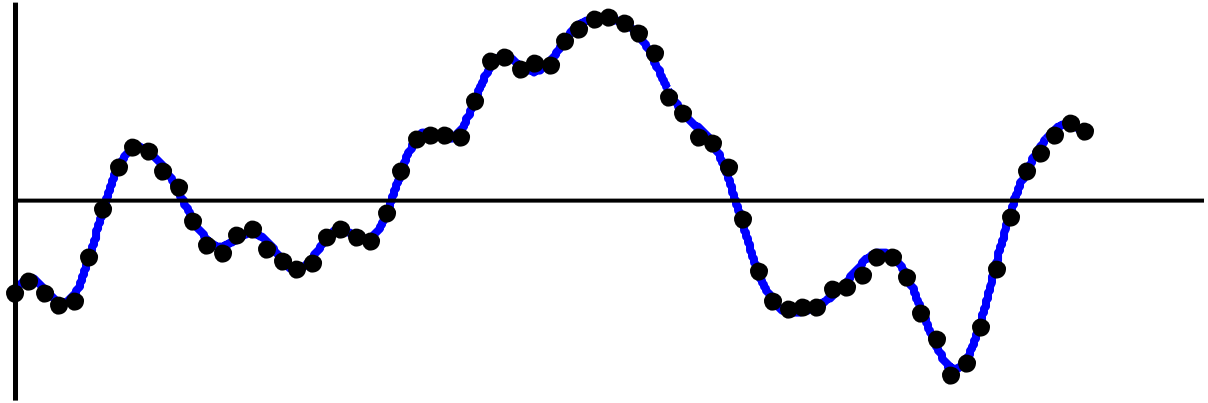

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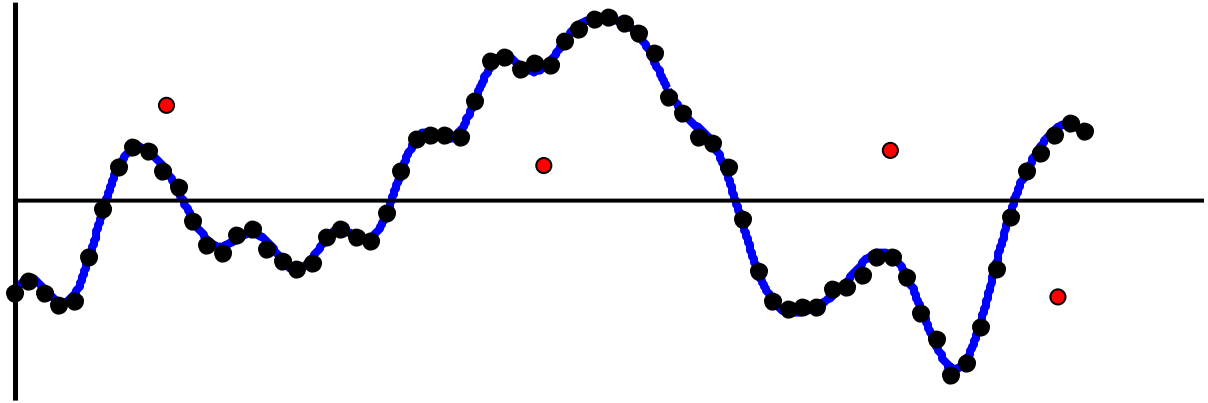

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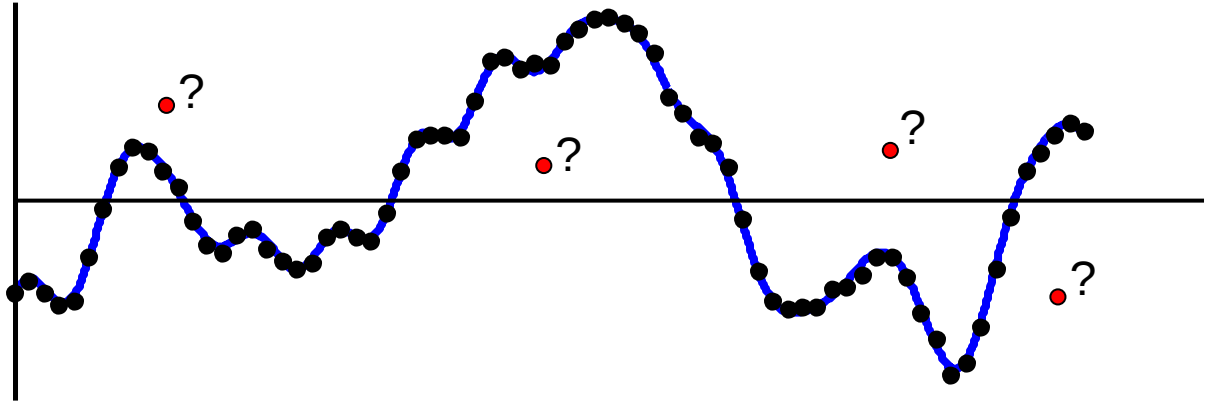

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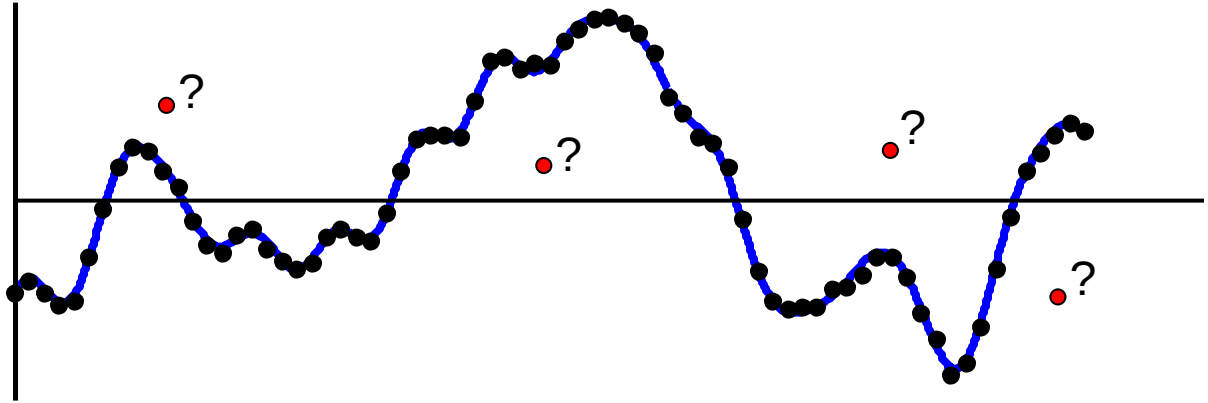

- Localizing outlier detection necessary

Outliers vs. poor observations

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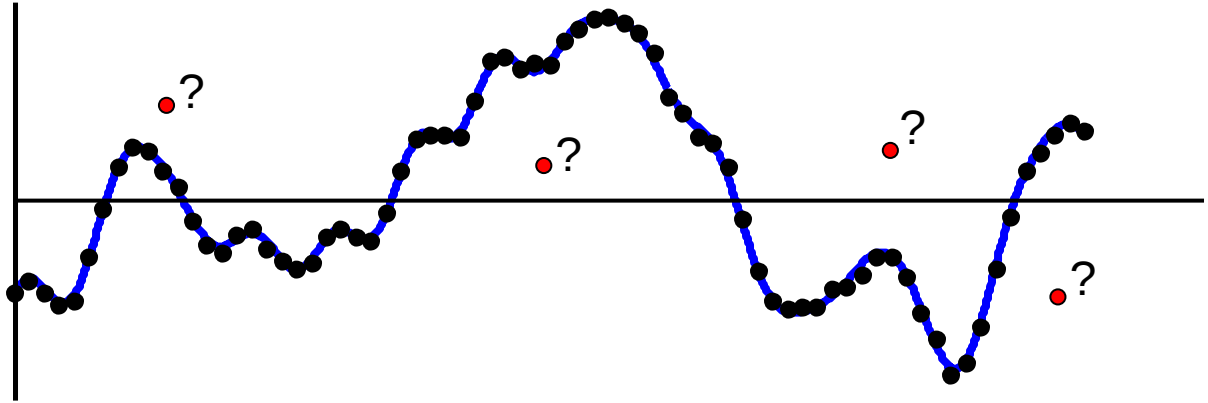
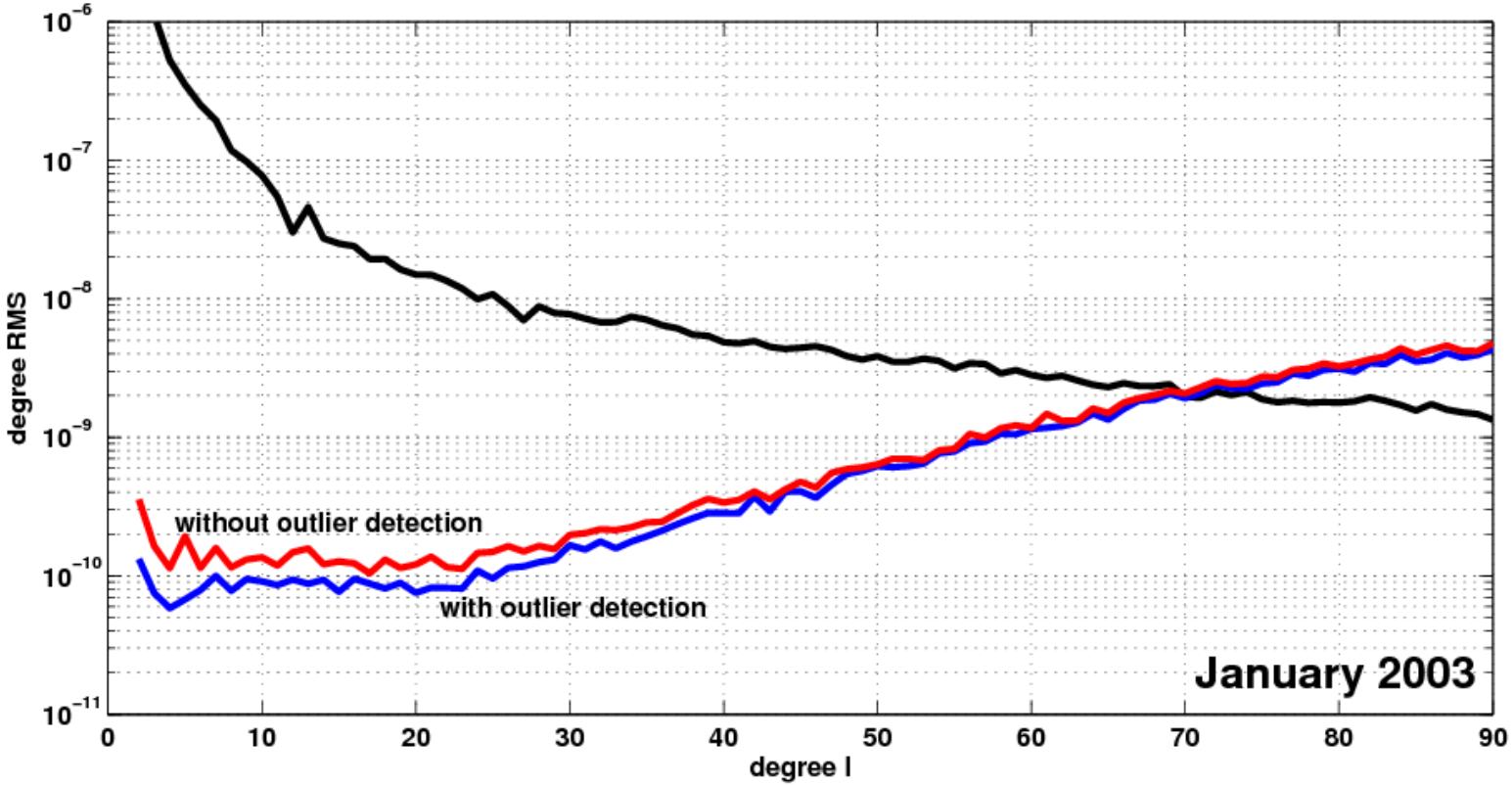
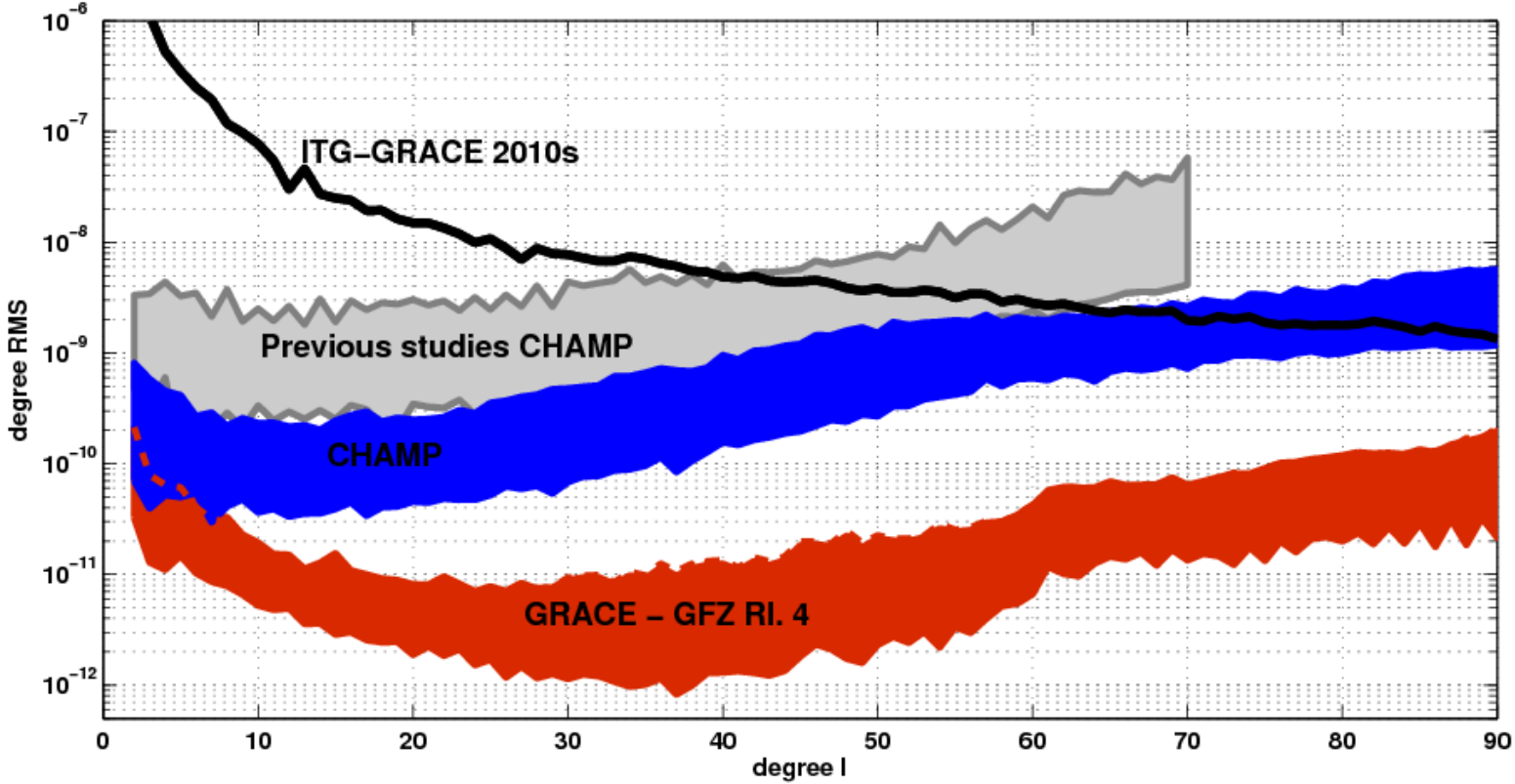


- Localizing outlier detection necessary
- Consider (synthetical) covariance information

Results using outlier detection

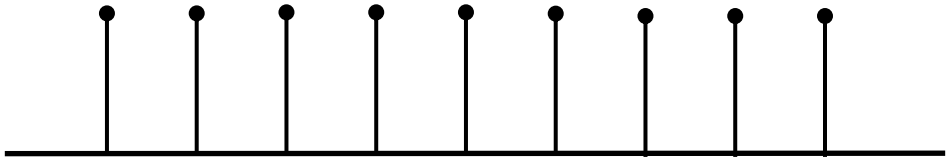


CHAMP vs. GRACE monthly solutions



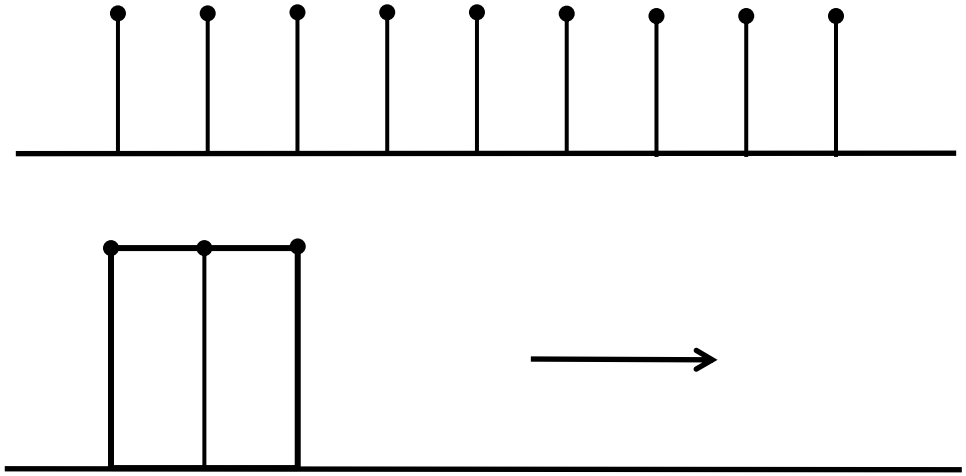
Monthly solutions

Pushing the limits – combination strategies



Standard case:
single month solution

Pushing the limits – combination strategies



Standard case:
single month solution

Combining n-month
with unit weight

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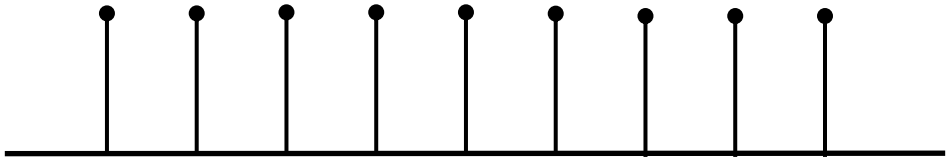

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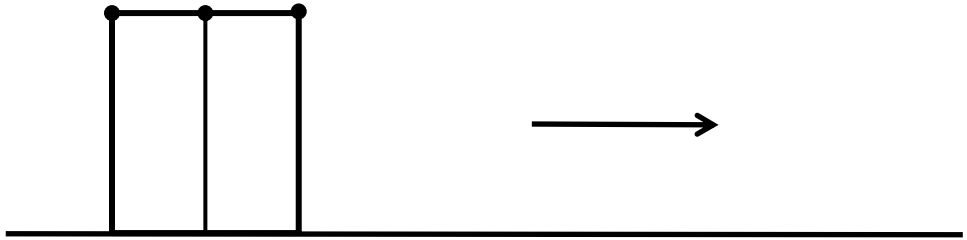

Combining n-month
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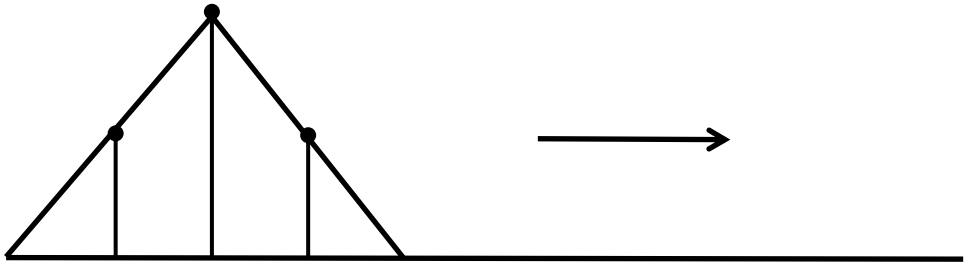
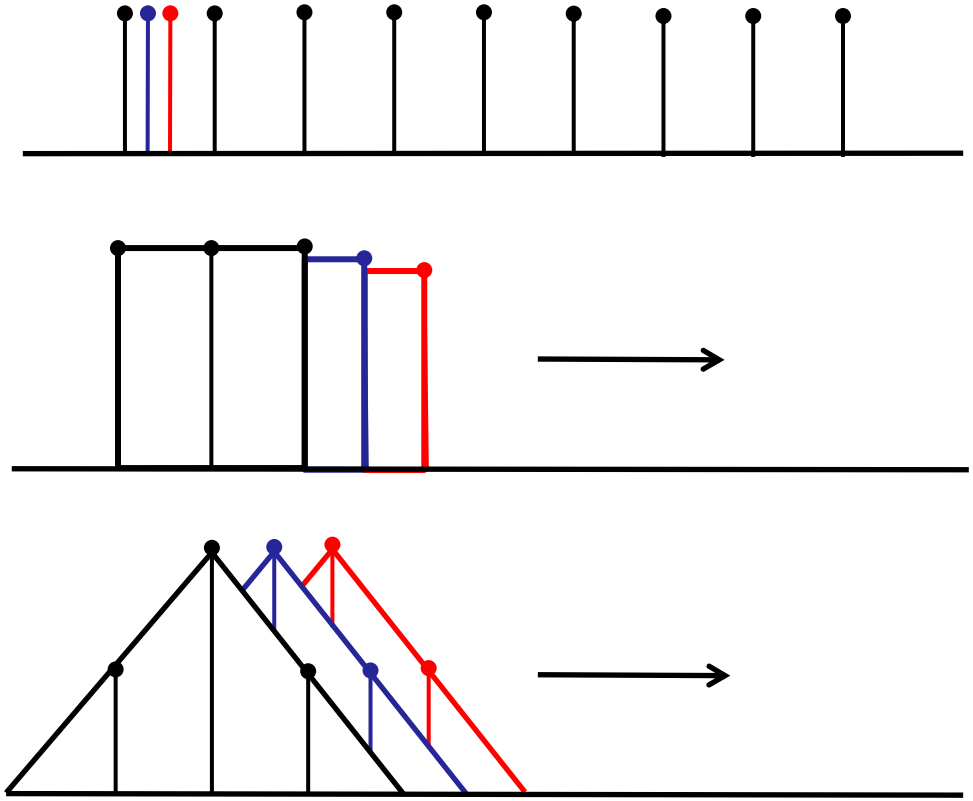


Combining n-month
with Bartlett weight

Pushing the limits – combination strategies



Standard case:
single month solution

+ **Grace A** and **Grace B**

Combining n-month
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Combining n-month
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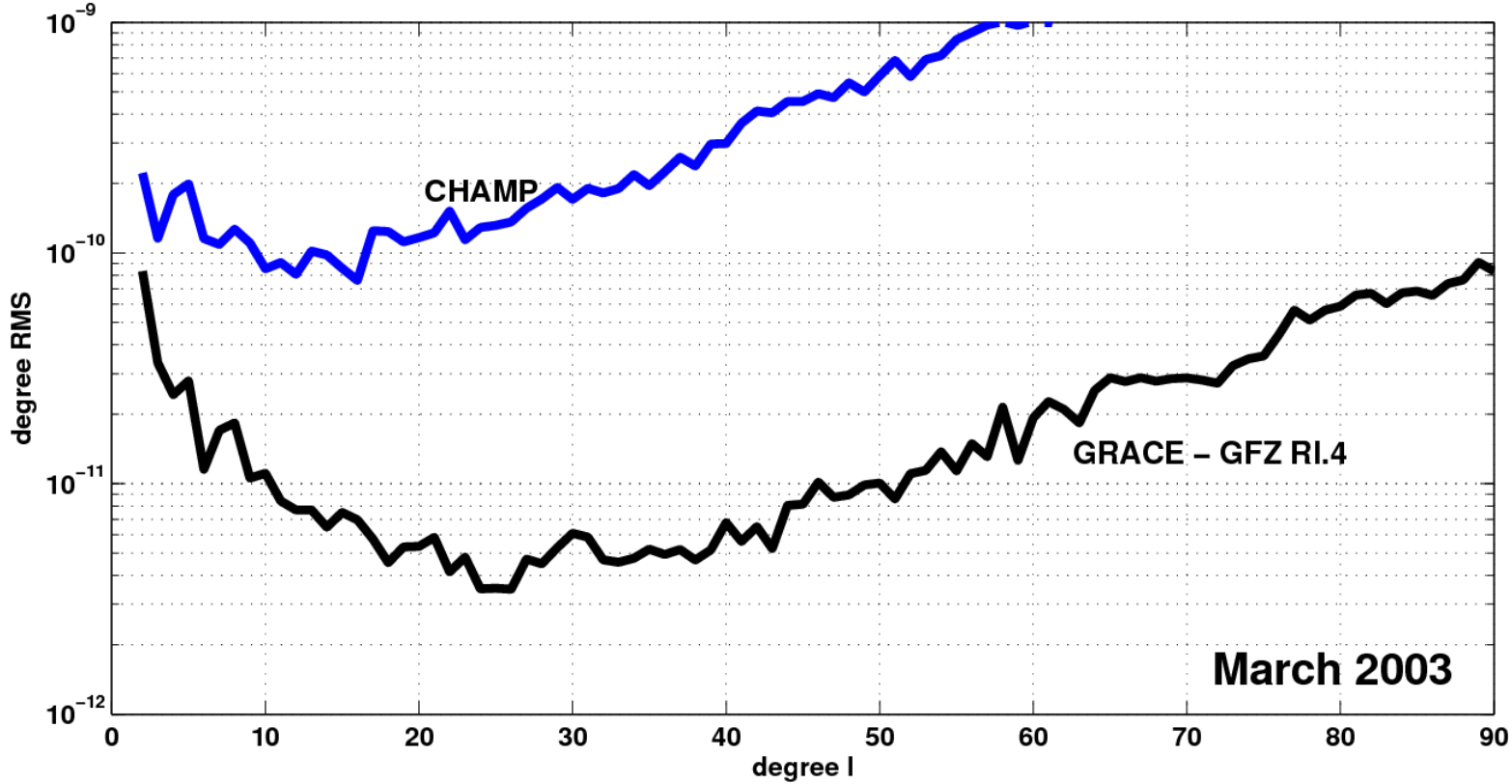
+ **Grace A** and **Grace B**

Comparison of combination strategies



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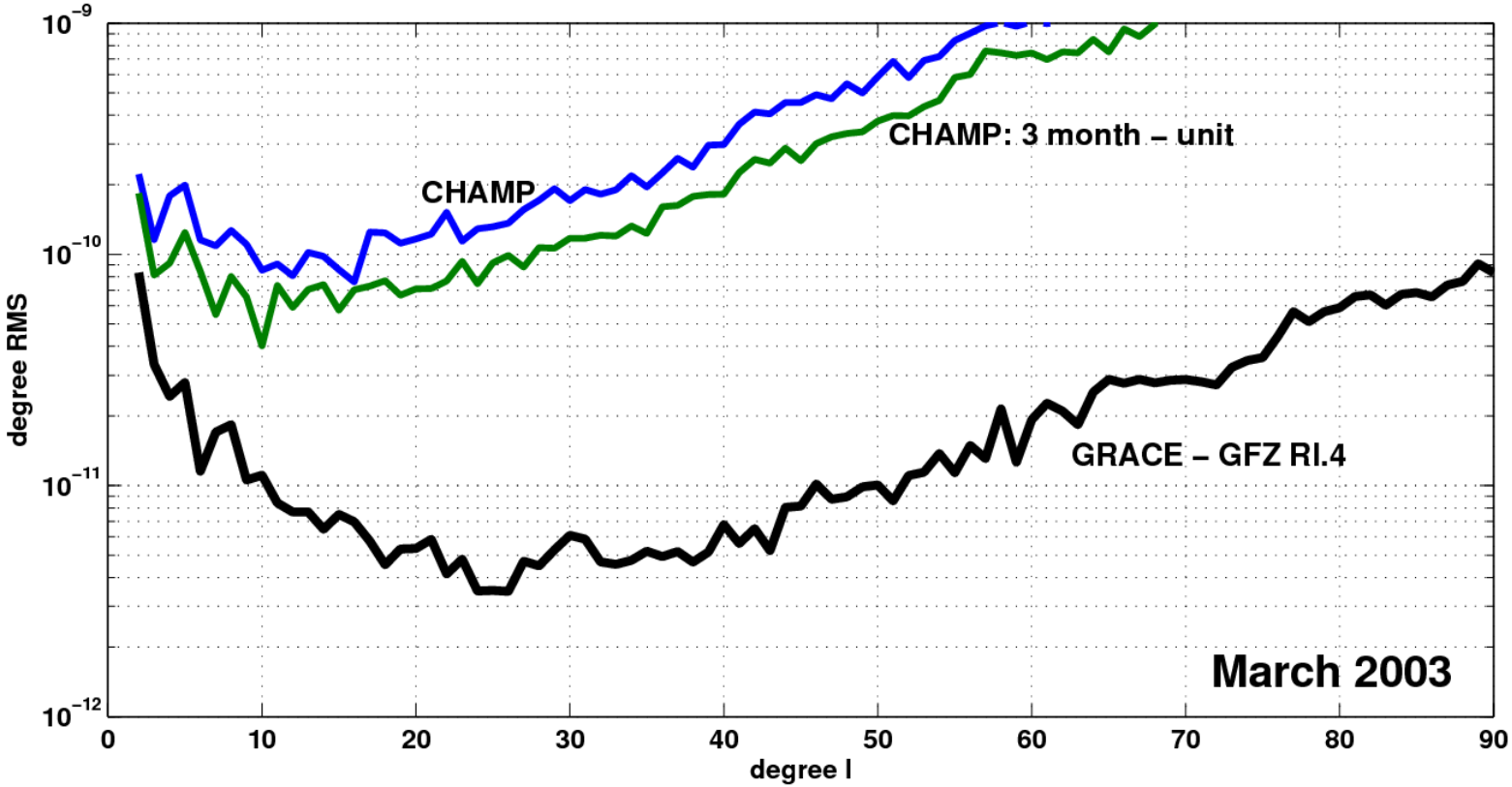

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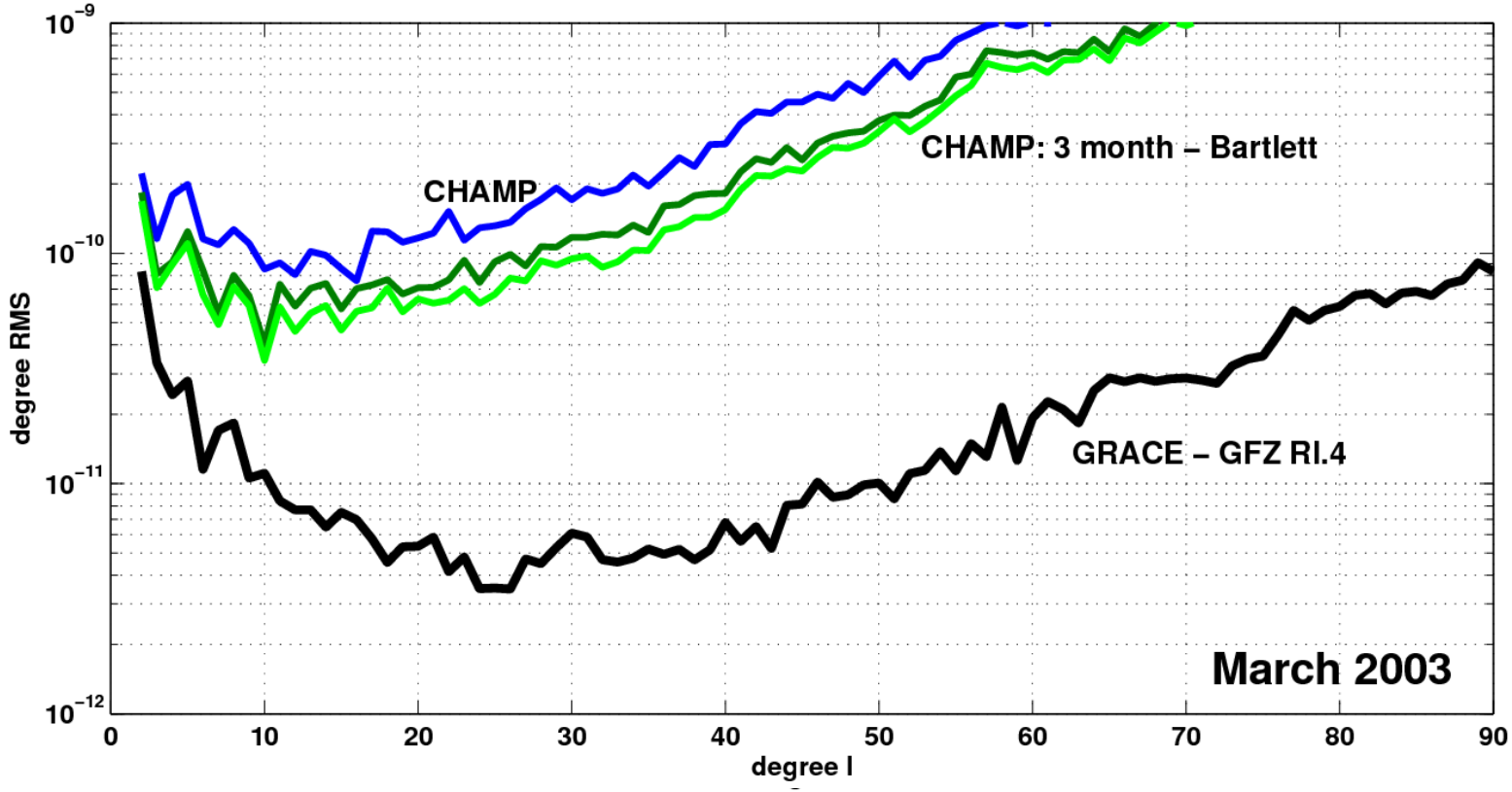
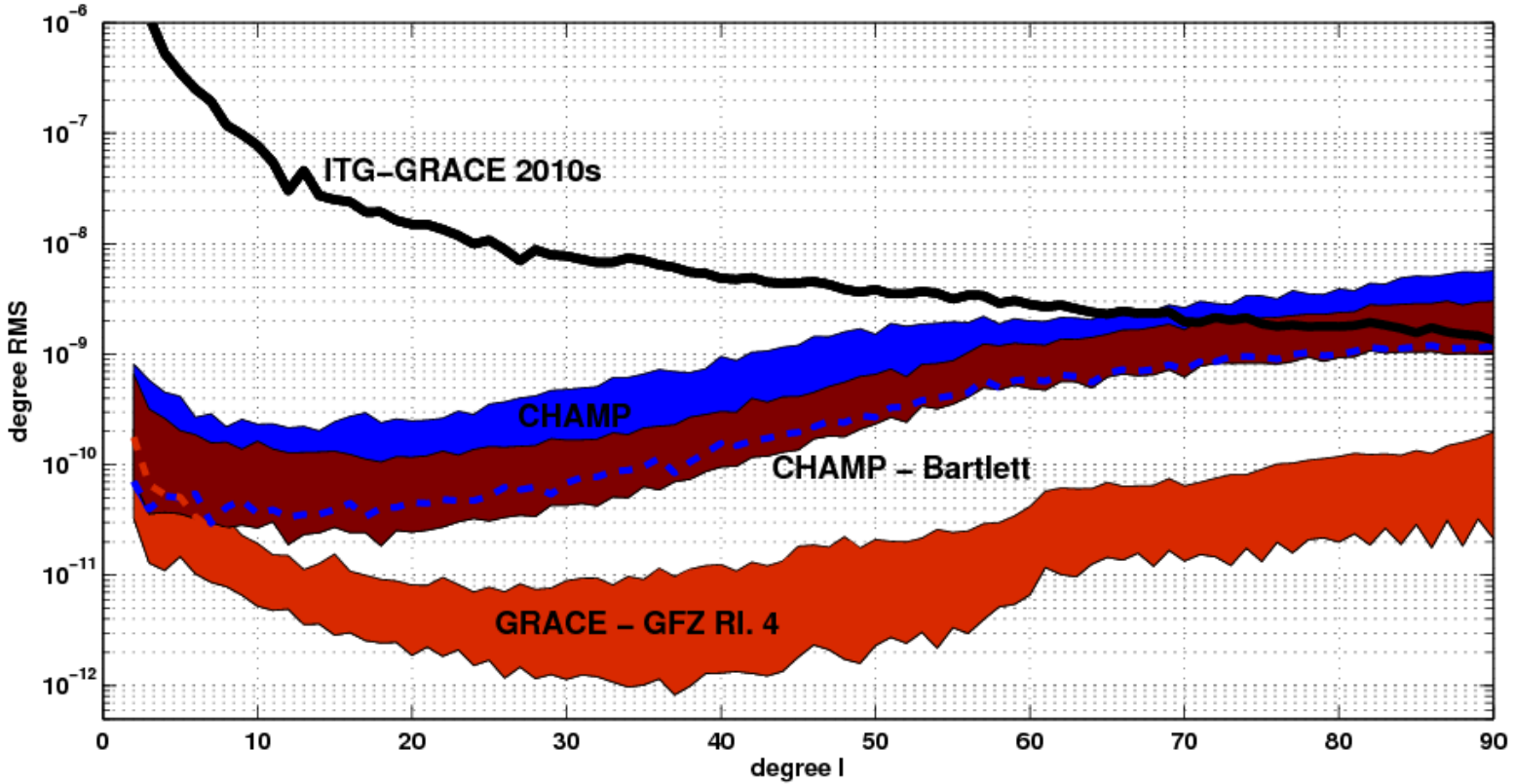
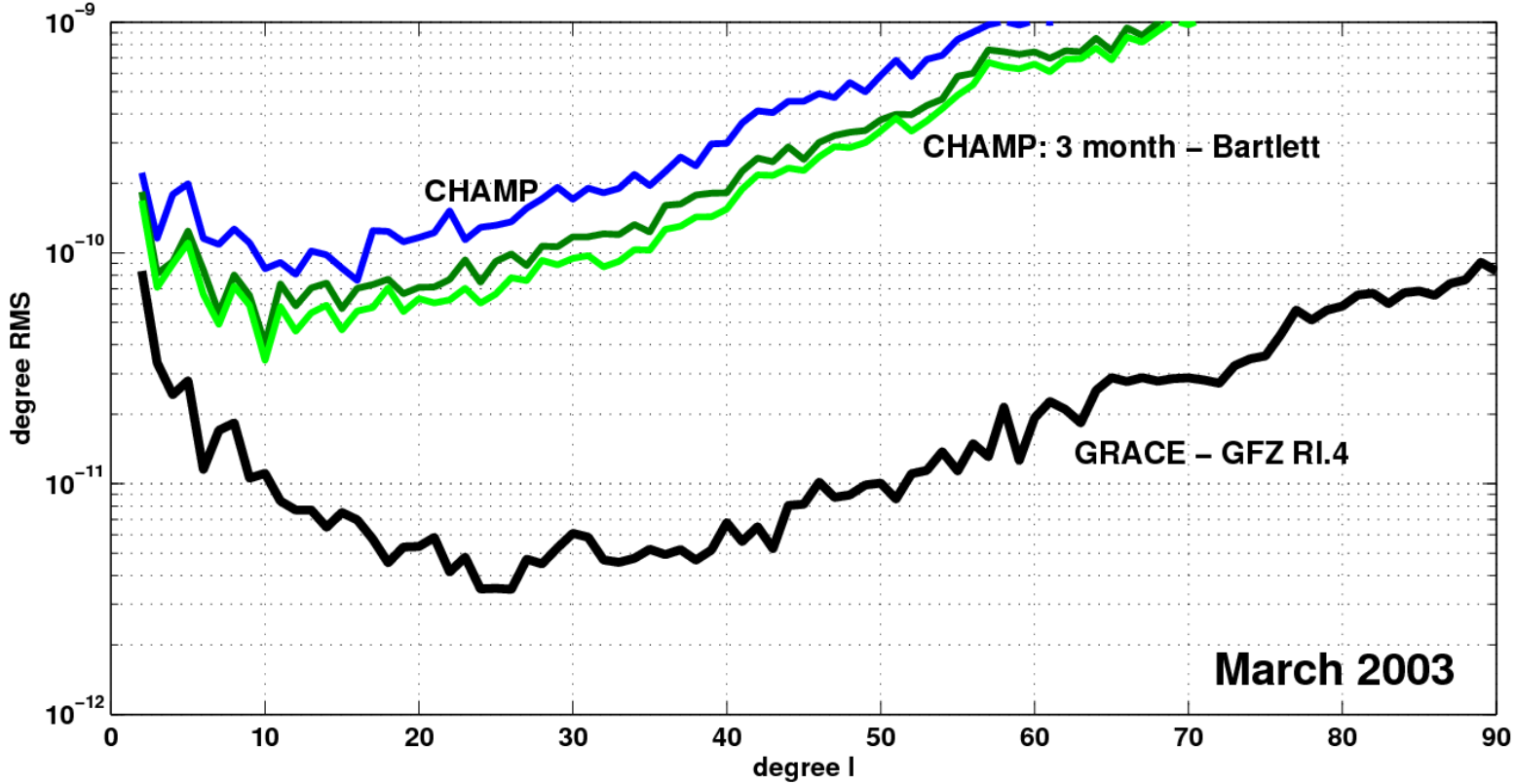


CHAMP-only solution with Bartlett option



Adding GRACE …



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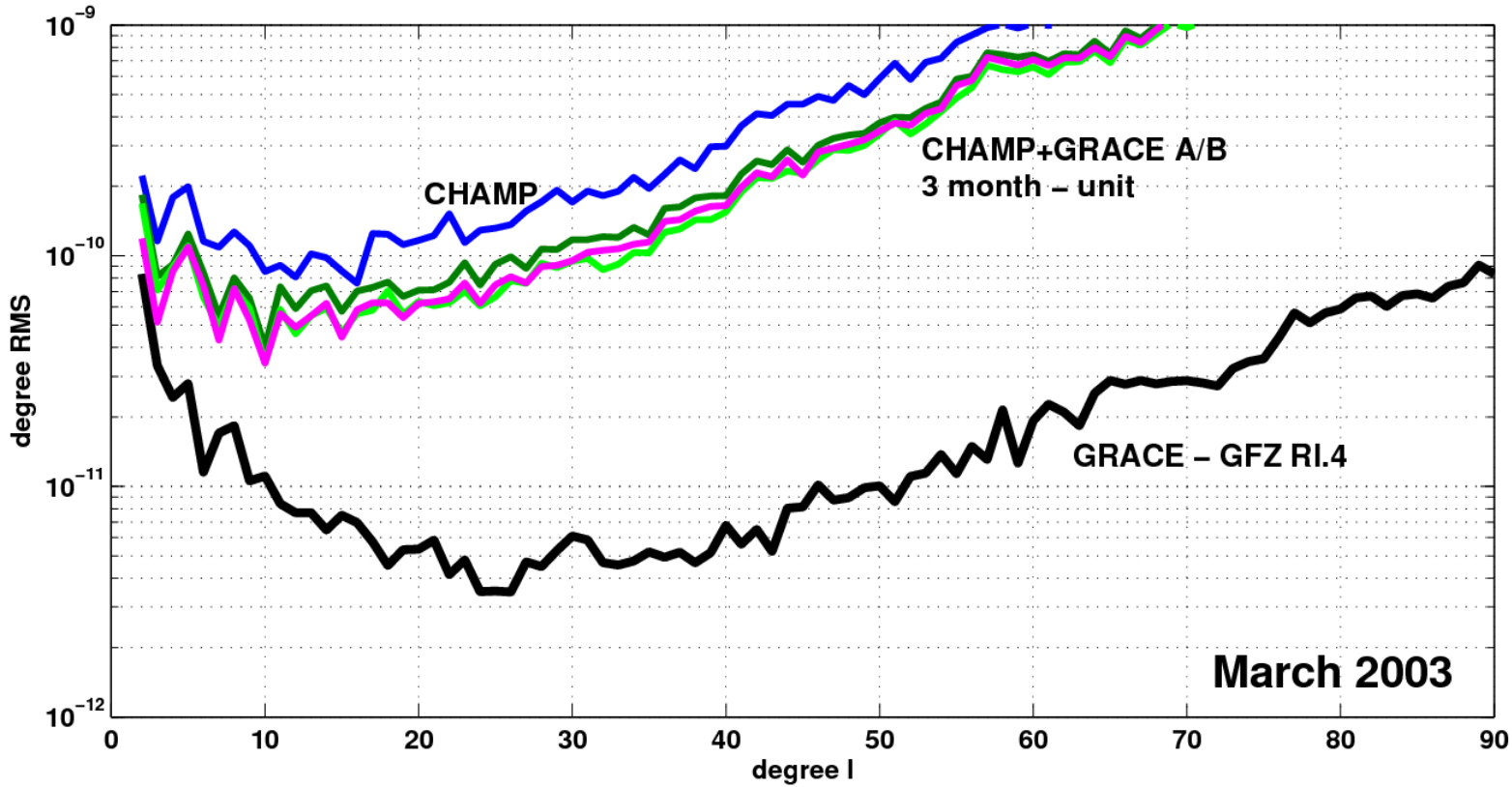

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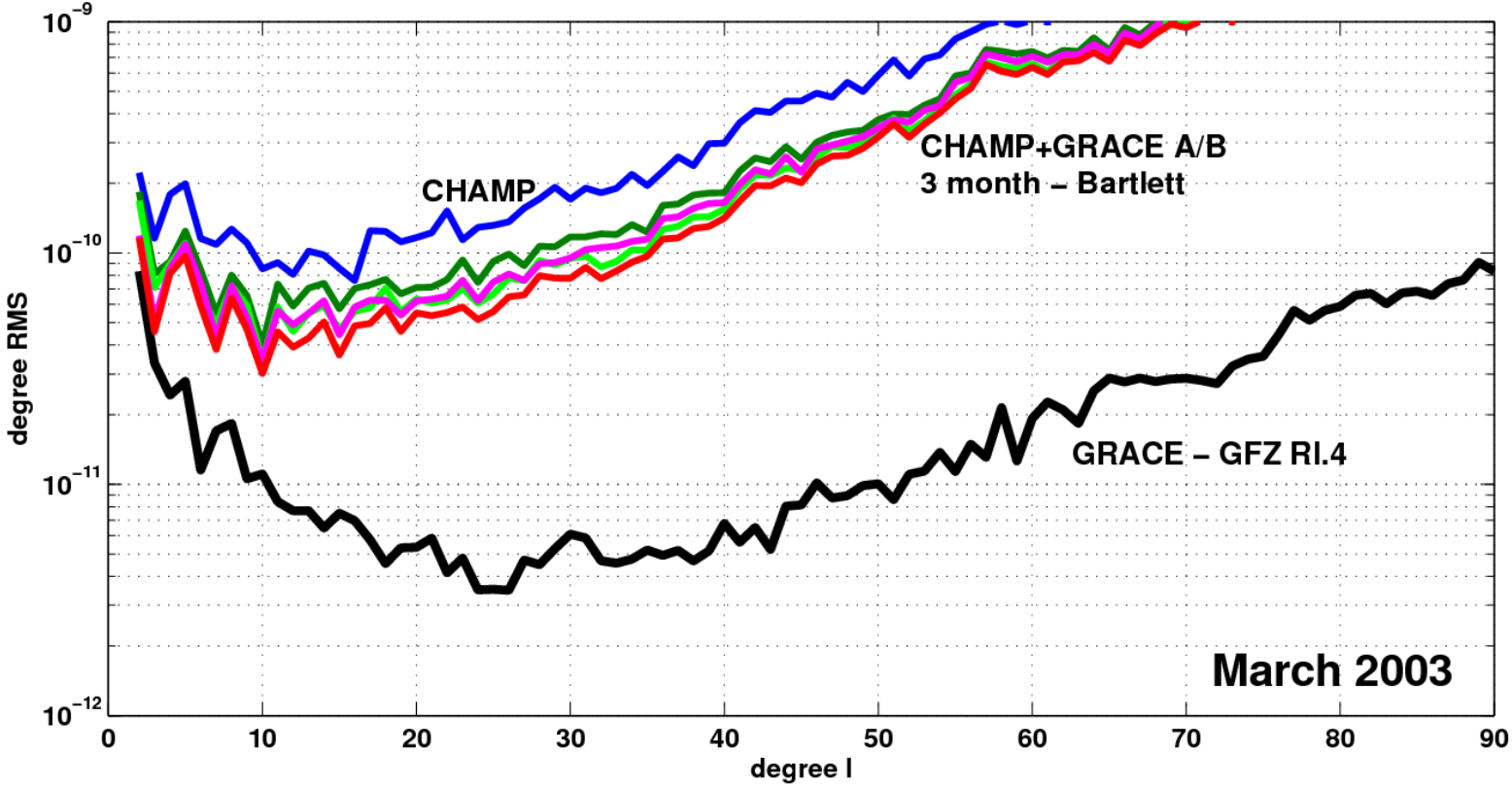

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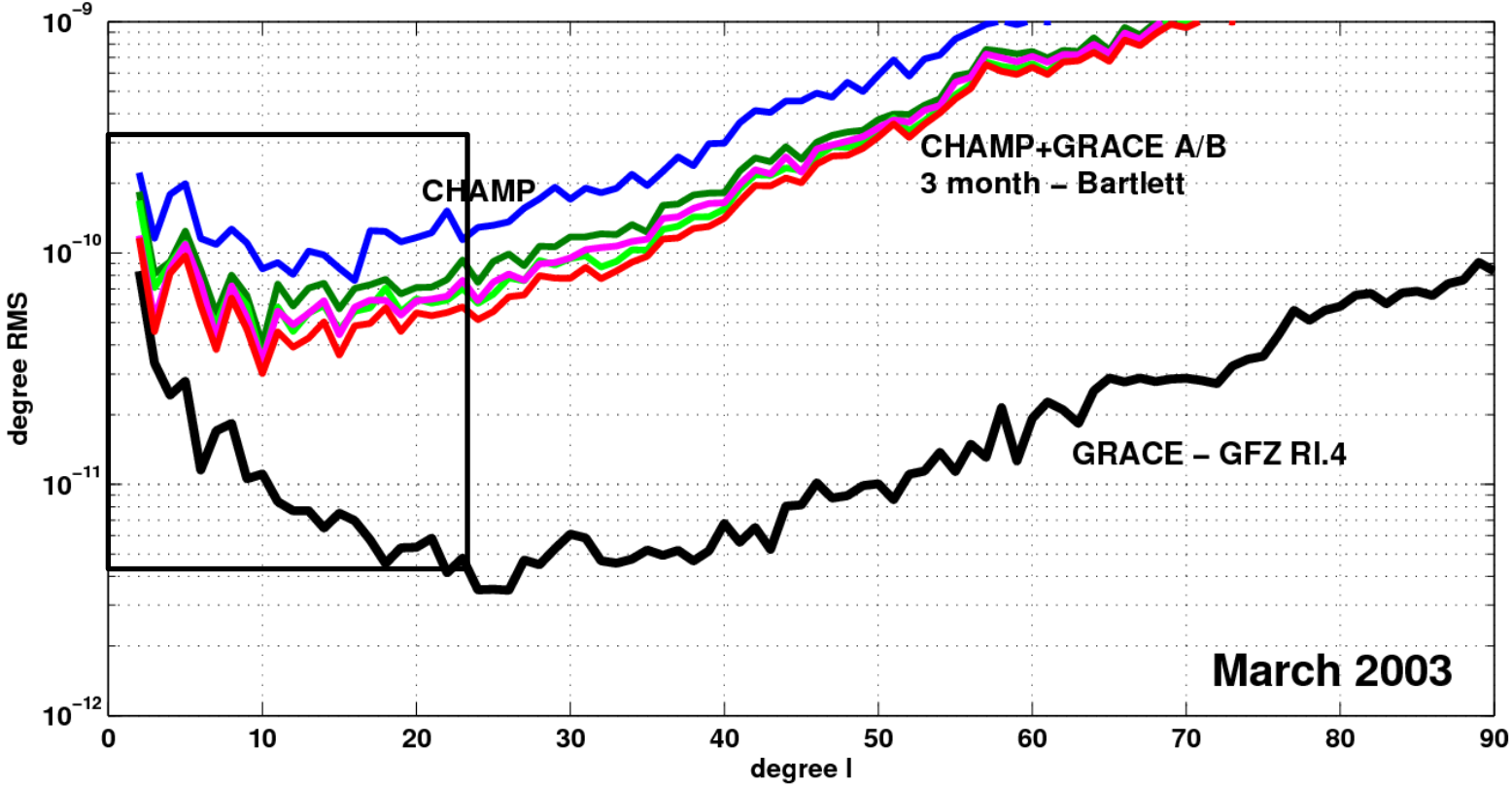

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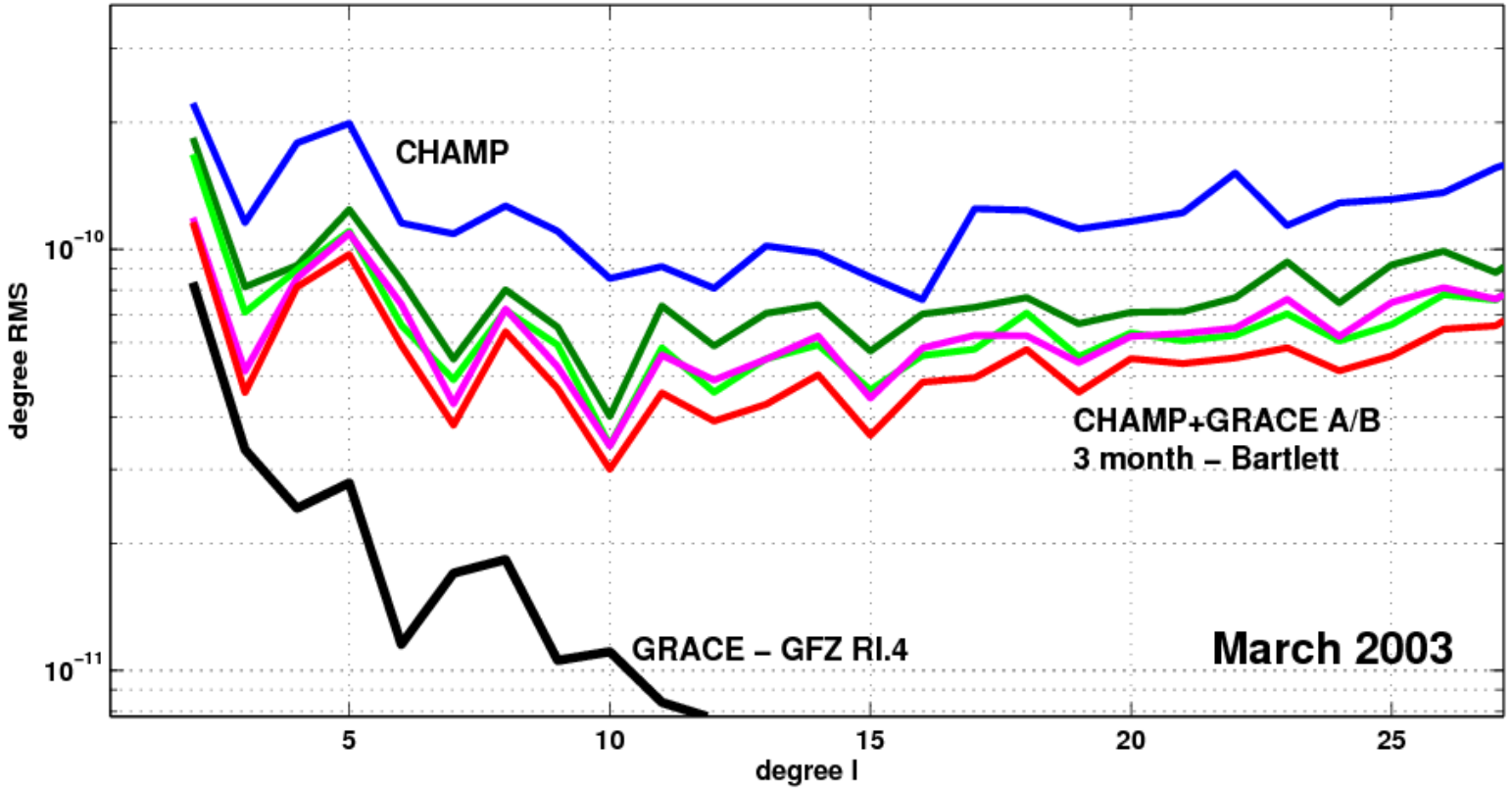
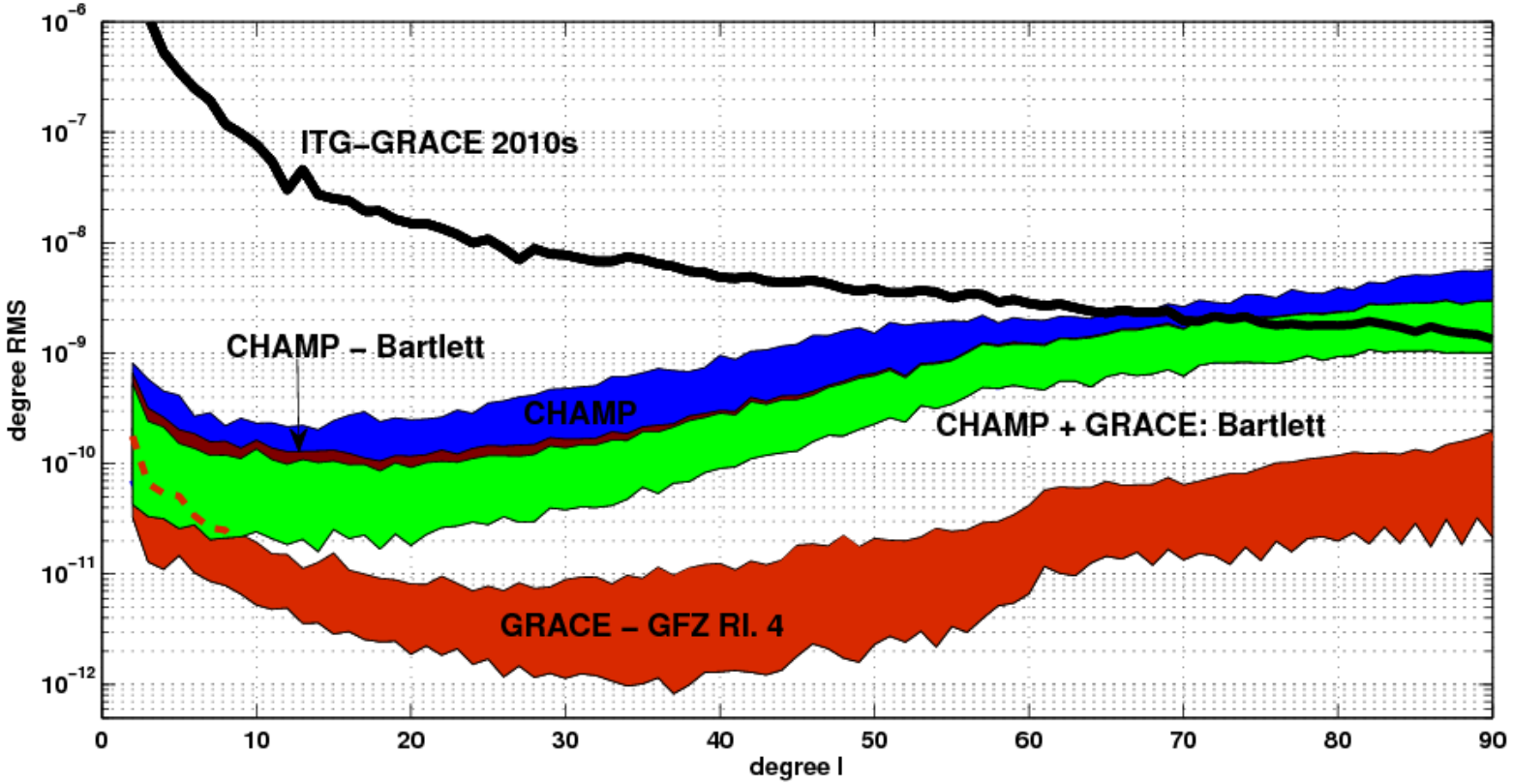
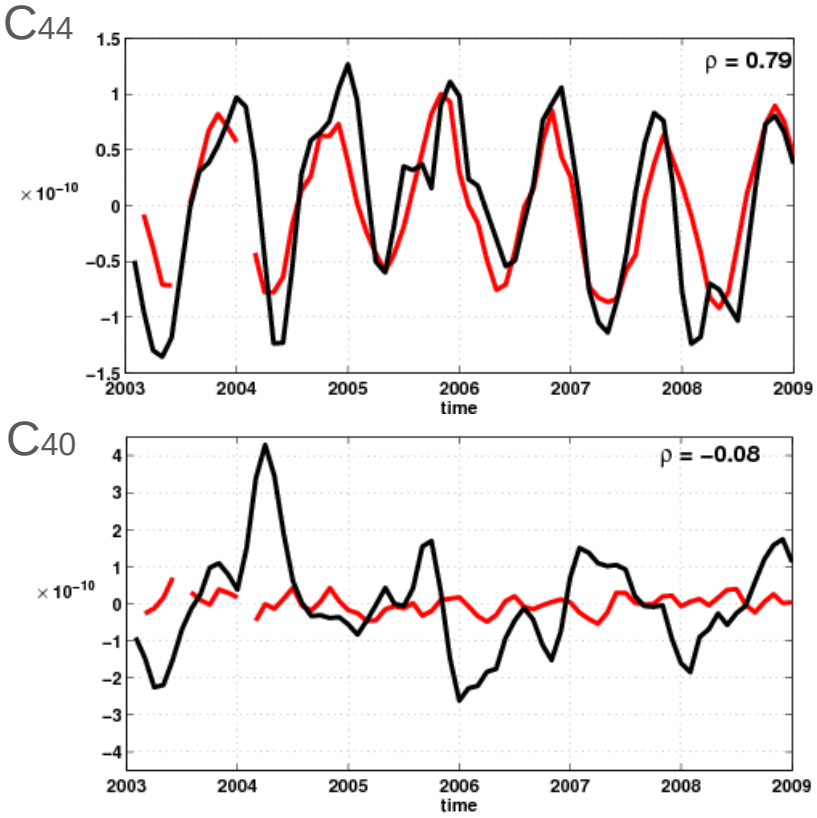
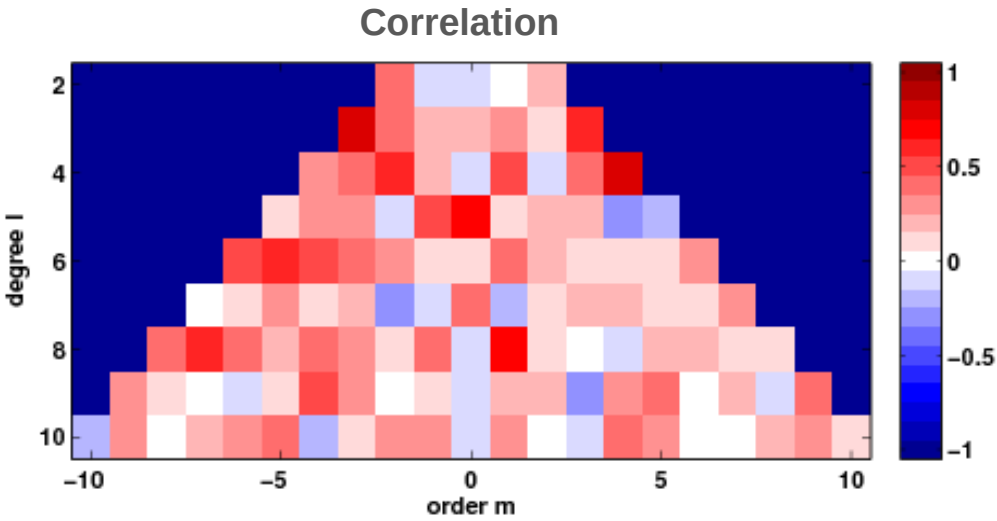


Results for CHAMP + GRACE



Time series of coefficients





GRACE – GFZ RL. 4

CHAMP + GRACE

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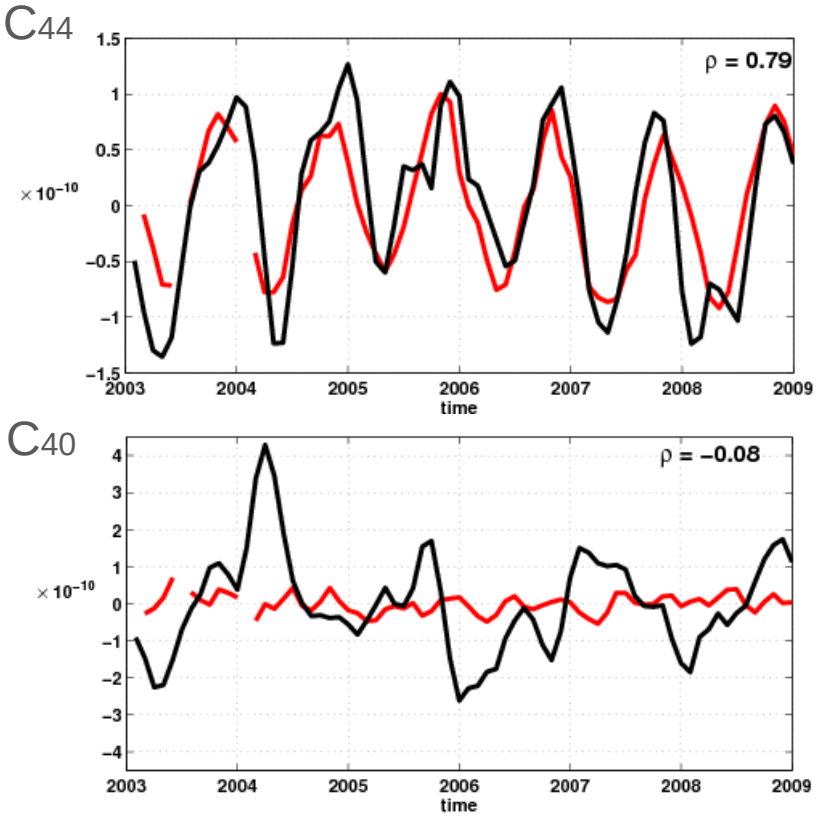
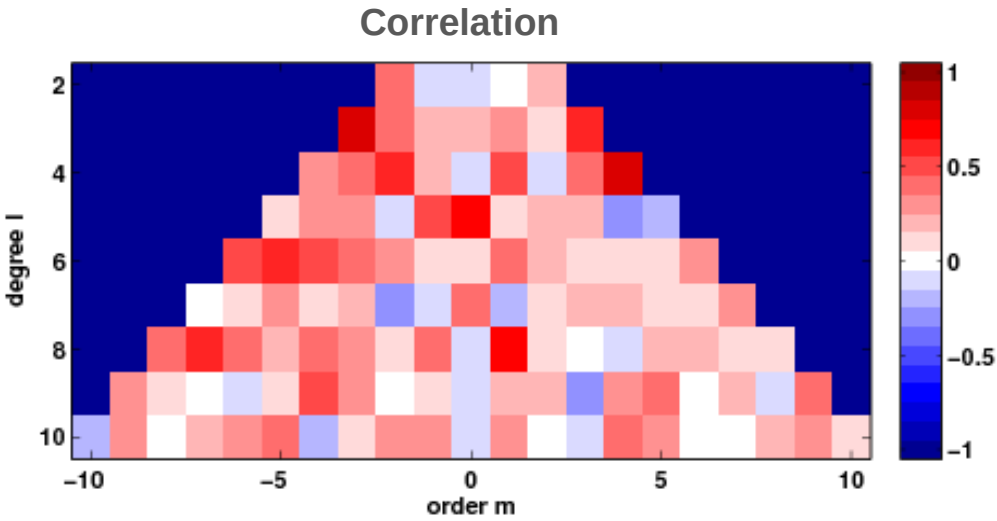




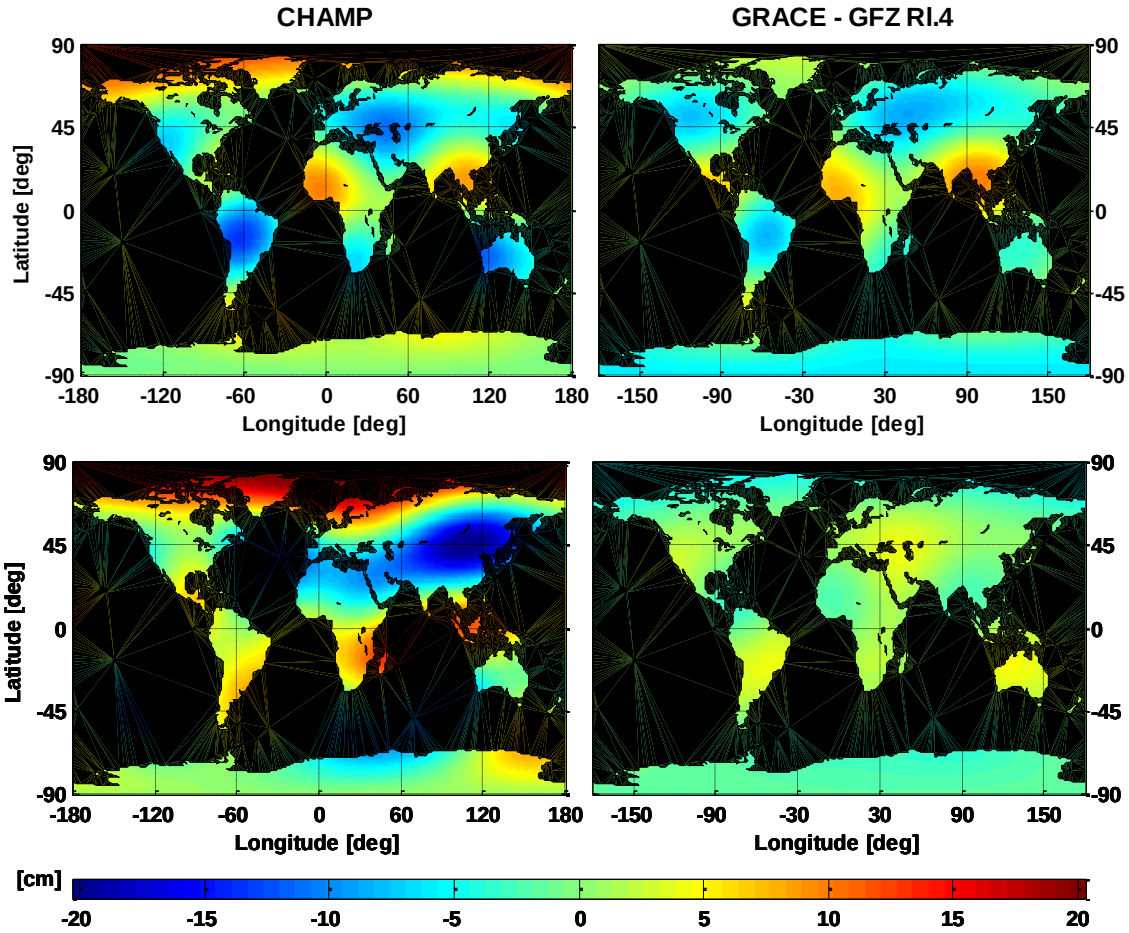
Single coefficients

comparison capability

Spatial pattern

October 2003:

February 2004:



Conclusion

- Did we get everything out of the data of CHAMP?
- Is the time variable gravity field really out of reach?
- What do we learn for future satellite missions?

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  CHAMP still offers a wealth of information

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  “Real” covariance information needed

  Increase the number of observations

THANK YOU

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Appendix

Time variable signal?