Assessment of experimental EGSIEM series

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Introduction

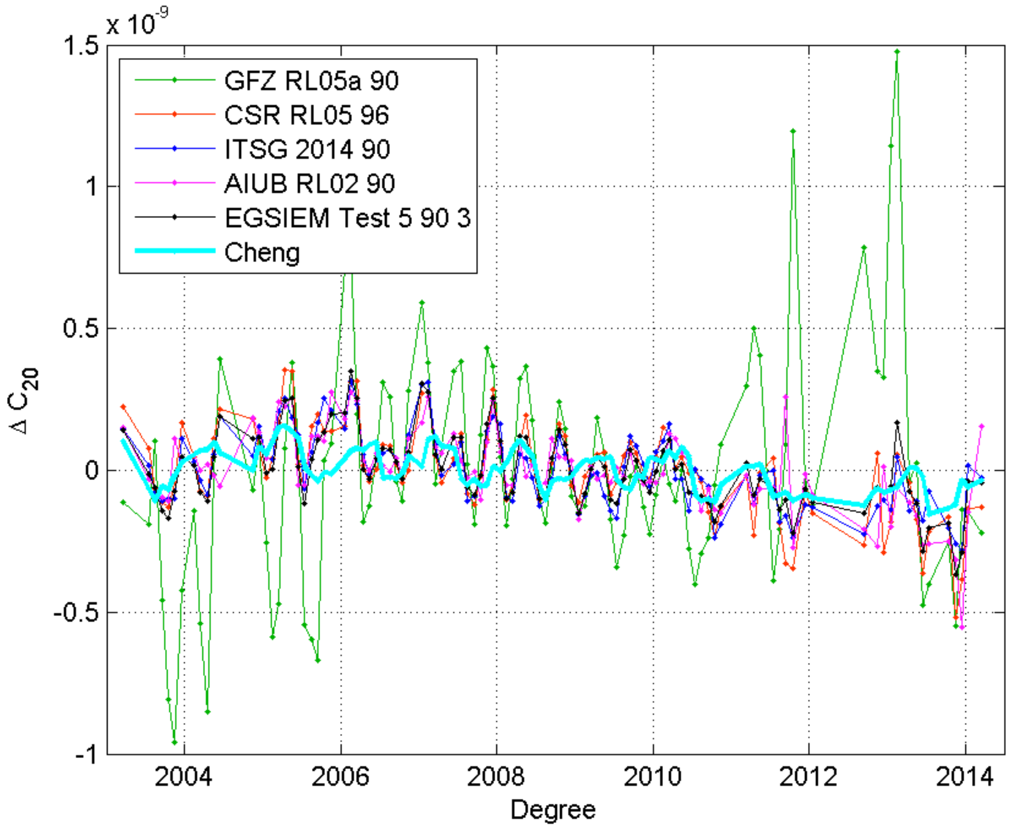
Comparison of the following time series:

- CSR (96), truncated to degree 90
- GFZ RL05a (90)
- ITSG 2014 (90)
- AIUB RL2 (90)
- EGSIEM (90), test combination

Only months that are common to all series were used.

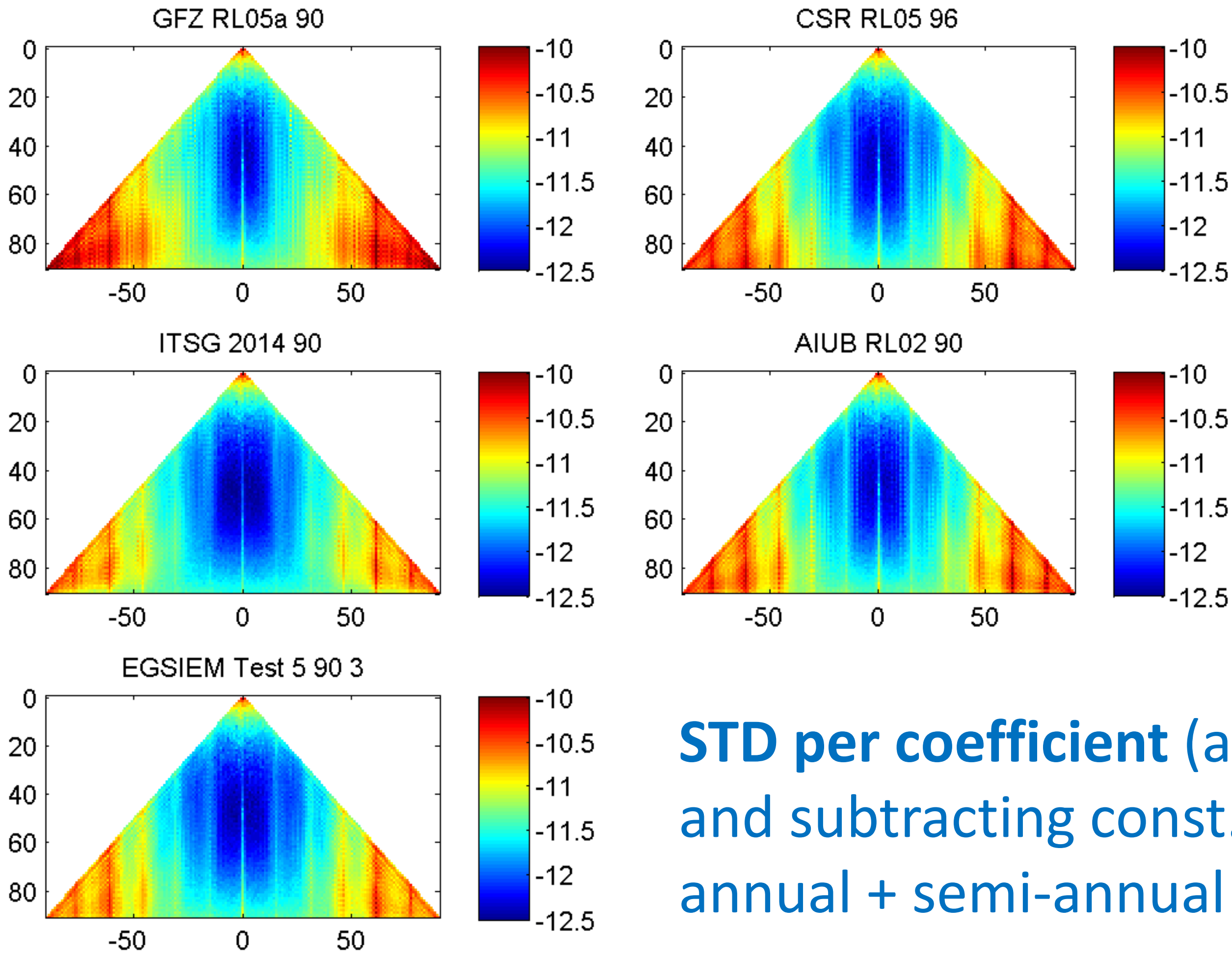
1. **In the Spherical harmonic domain**
2. **In the Spatial Domain**
3. **Mass Changes in Antarctic Drainage Basins**

C_{20}



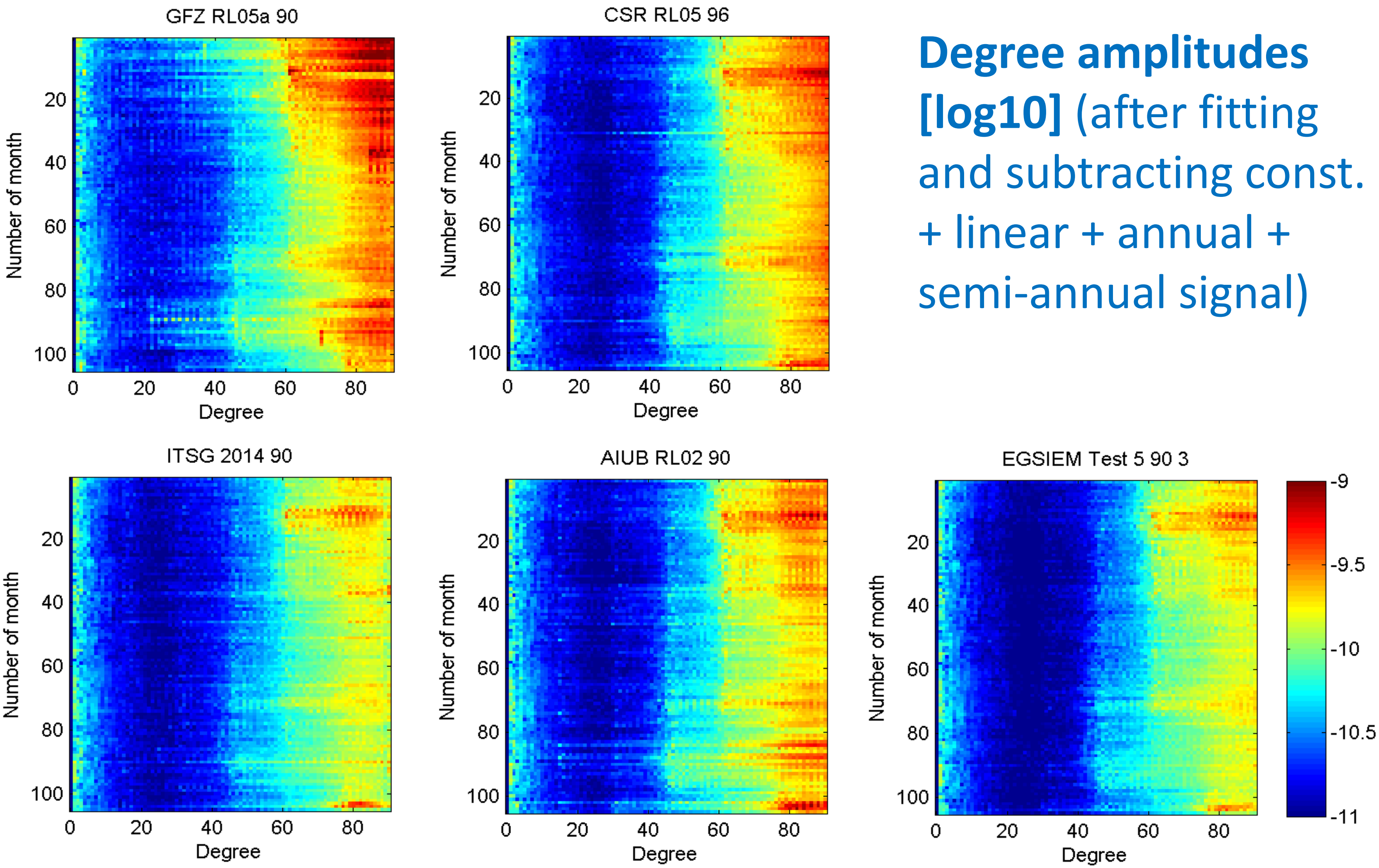
C_{20} is replaced by values from SLR (Cheng et al. CSR series) and degree-1 terms are added (Swenson, Chamber, Wahr series) to make the Antarctic mass balance results consistent.

Analyses in the Spherical harmonic domain (1/3).



STD per coefficient (after fitting and subtracting const. + linear + annual + semi-annual signal)

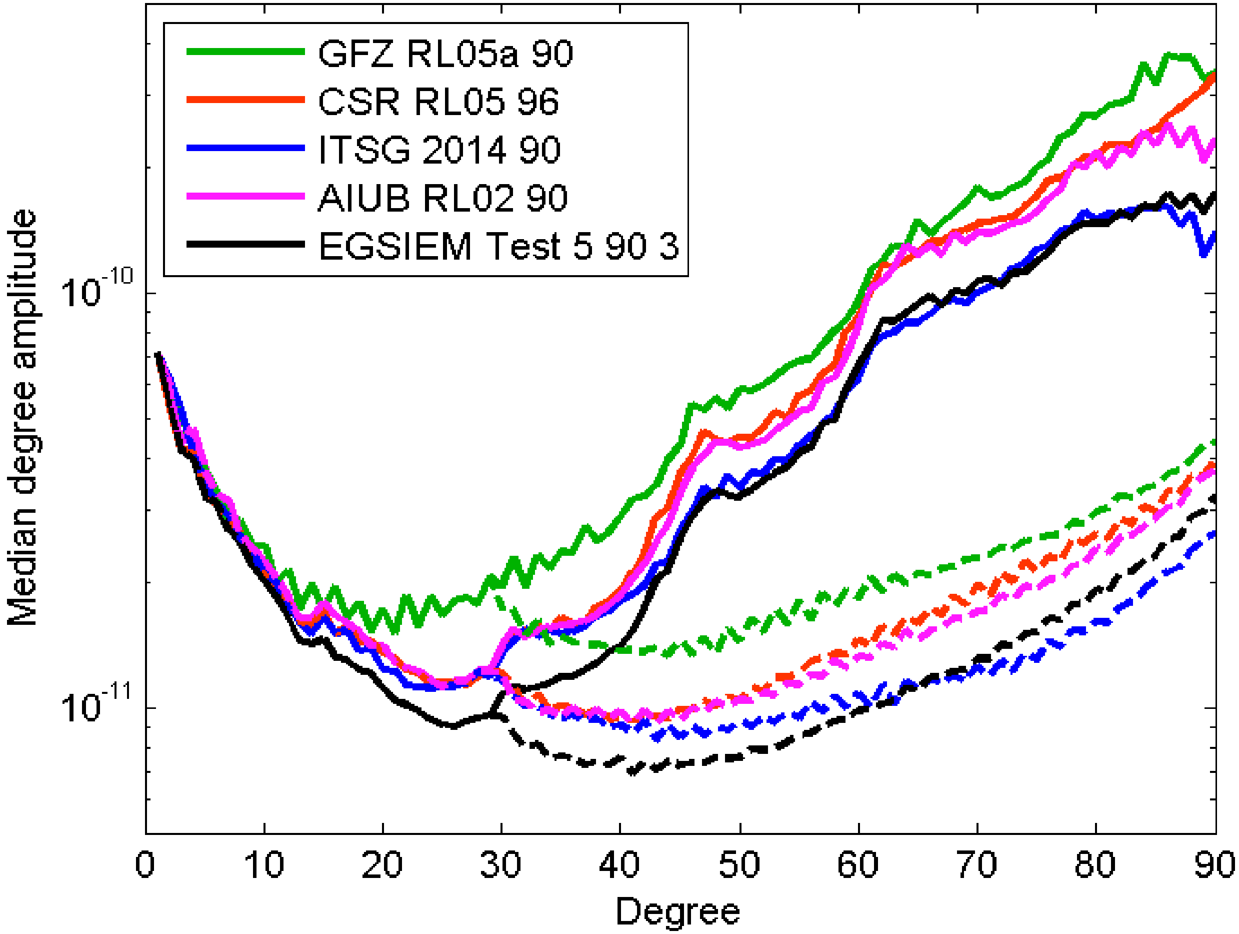
Analyses in the Spherical harmonic domain (2/3).



Degree amplitudes [log10] (after fitting and subtracting const. + linear + annual + semi-annual signal)

Analyses in the Spherical harmonic domain (3/3).

Median degree amplitudes



Dashed: Median degree amplitudes calculated for orders m = 0 … 29 only (these orders are most important for polar signals).

Analyses in the Spherical harmonic domain: conclusion

- From looking at the ascending (error-dominated) part of the degree amplitude curves, **ITSG** and **EGSIEM** show the **lowest noise levels**.

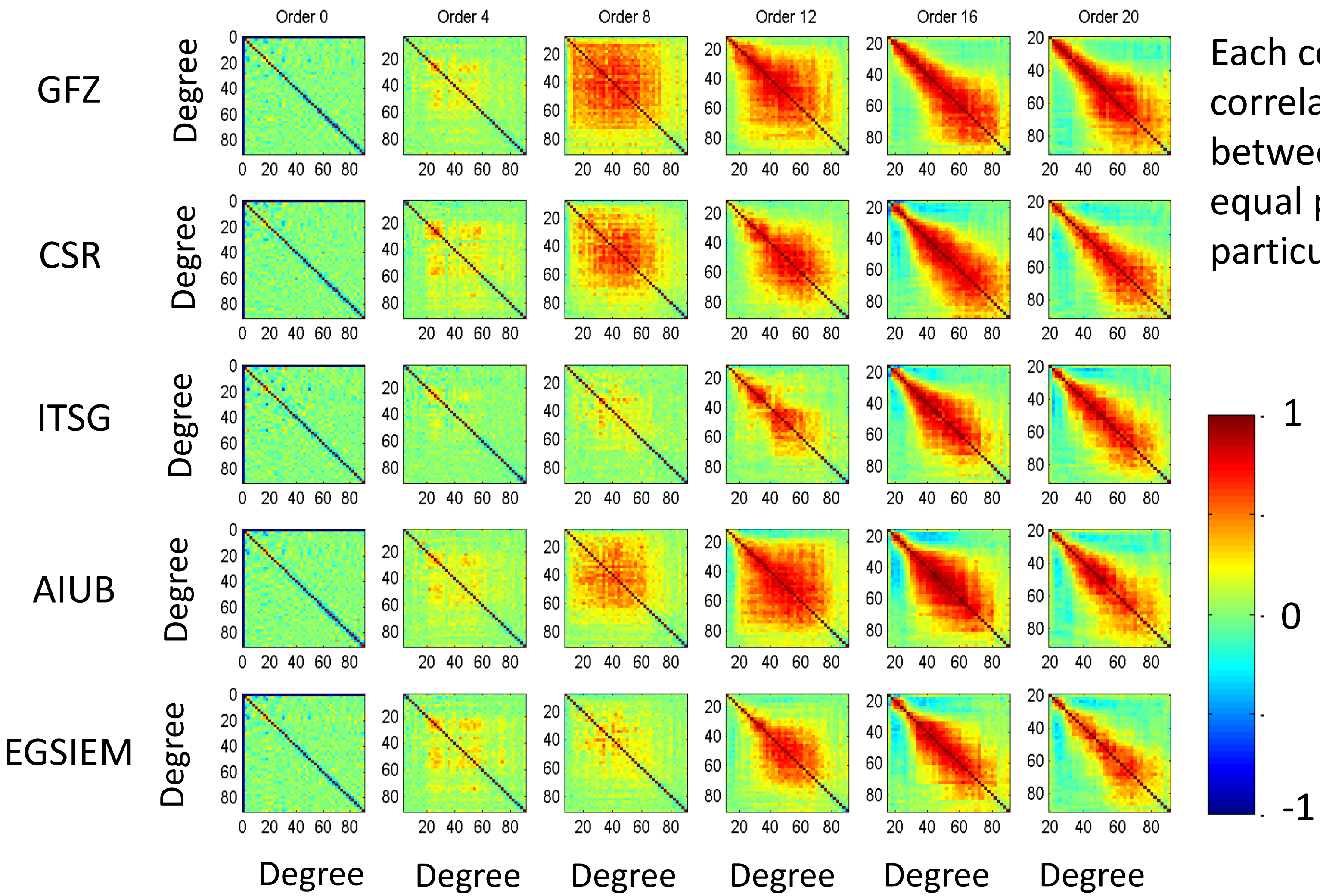
- **For n>60**, **ITSG** noise level is lower than EGSIEM noise level. This is particularly pronounced for the **near-zonals**, which are most important for polar signals.

- **For n<60**, **EGSIEM** has the lowest level of variability. This is visible even in the very low degrees. Later we will see that this is not related to signal attenuation.

Empirical Correlations

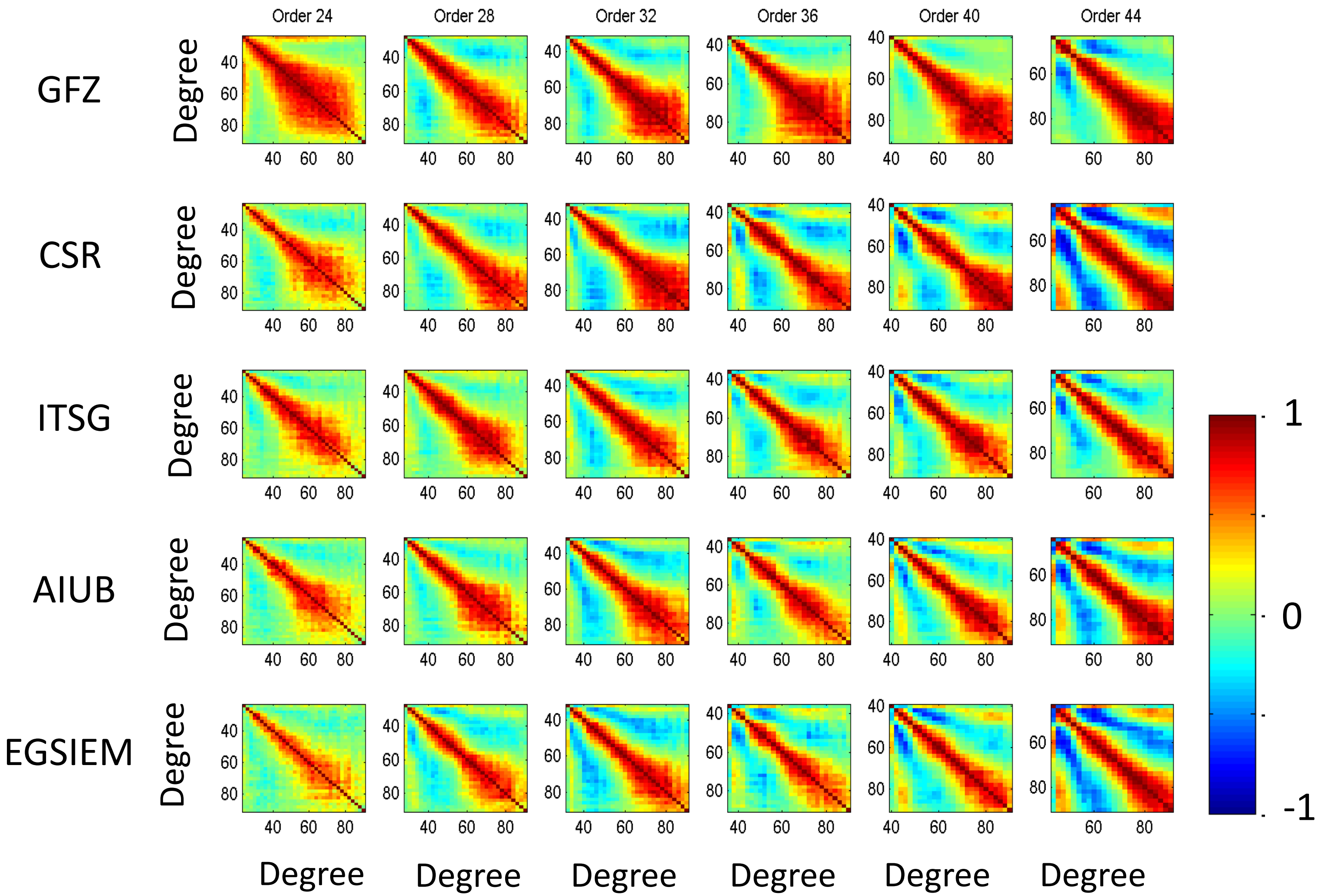
- **EWH anomalies** = EWH coefficients – model (bias + trend + annual + semi-annual variation)
- **Empirical correlation matrices** between EWH anomaly coefficients of the same order and even (odd) degrees.
- Starting from order 8 or so we see the typical "**striping**" correlations.
- **ITSG** series shows **weaker correlations** than the other series.

Empirical correlations (1/2)



Each column shows correlation matrices between degrees of equal parity for a particular order.

Empirical correlations (2/2)

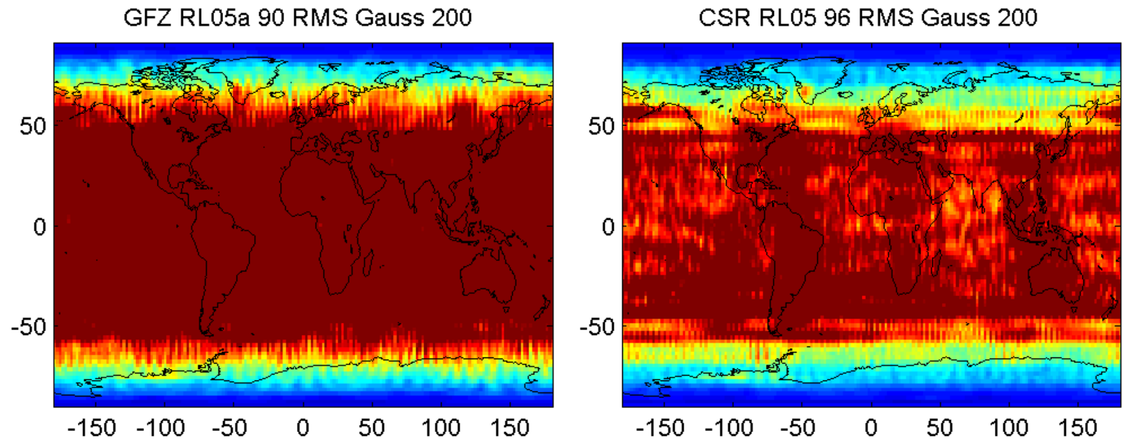


Analyses in the spatial domain

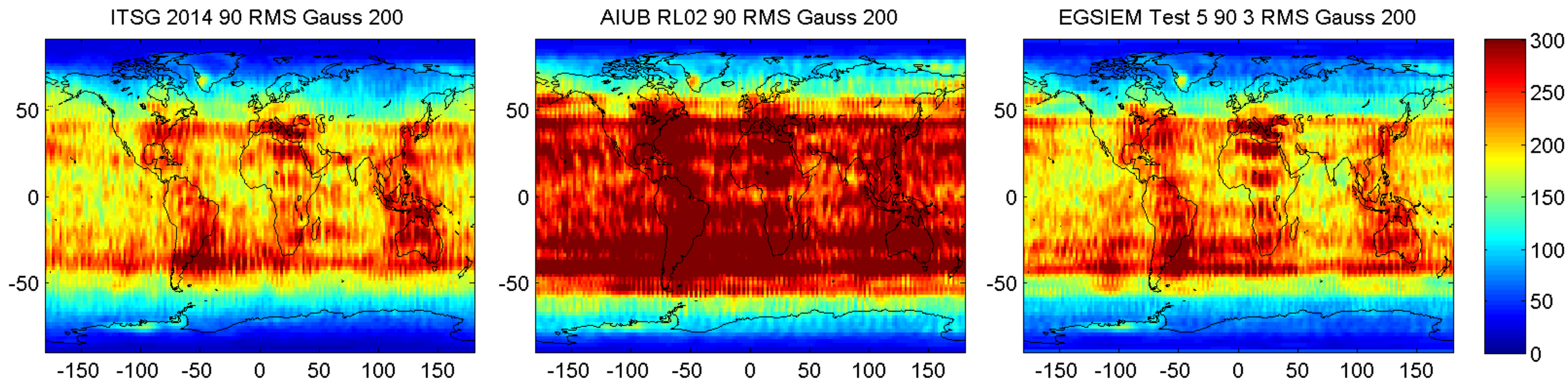
1. Fit and removal of Bias + Trend + annual + semi-annual signal,
2. filtering in the spectral domain: destriping, 200/400 km Gauss,
3. monthly maps of EWH-anomalies,
4. standard deviation or median of absolute temporal variability.

Noise is assessed over regions of low signal: oceans, inner Antarctica.

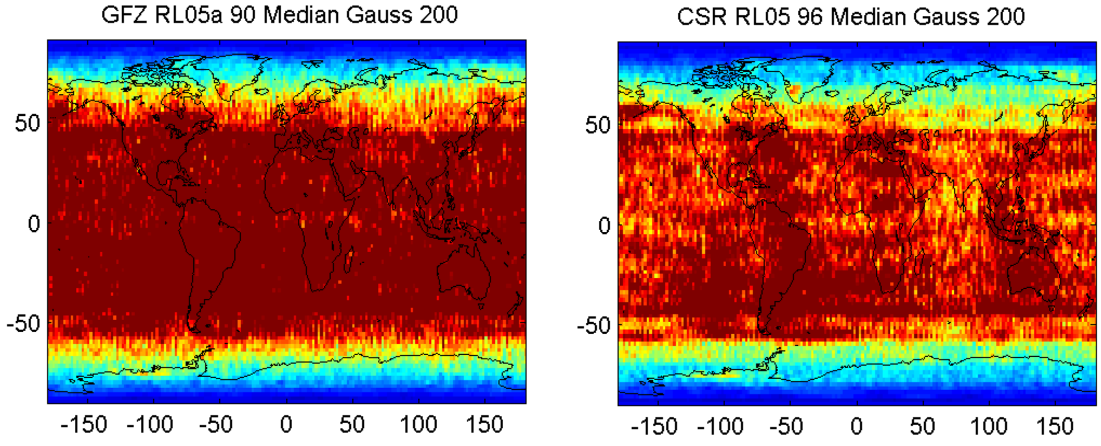
Analyses in the spatial domain (1/12)



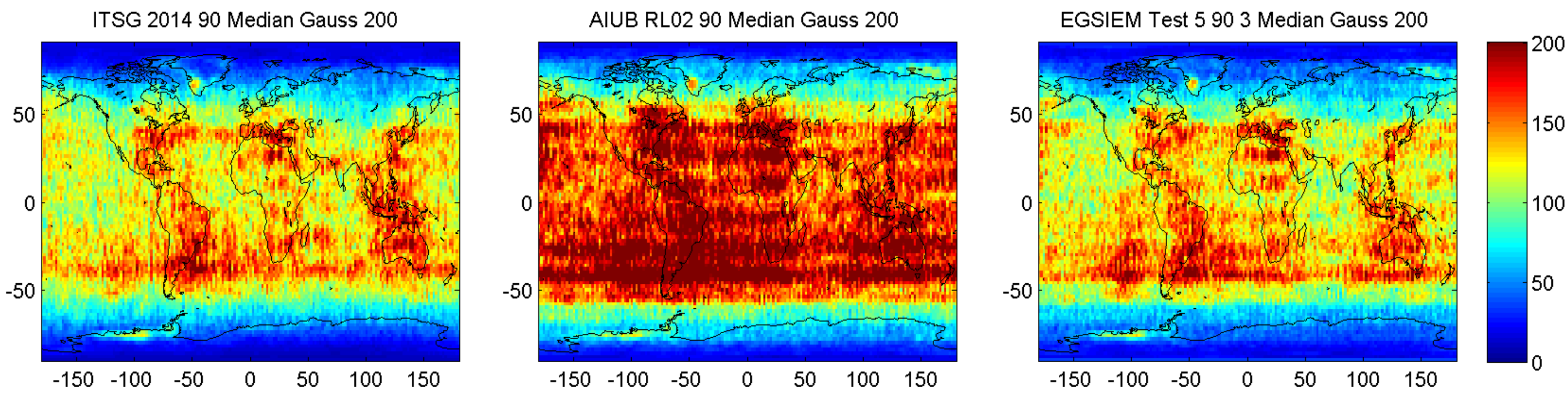
RMS of EWH variability: 200 km Gaussian filtering



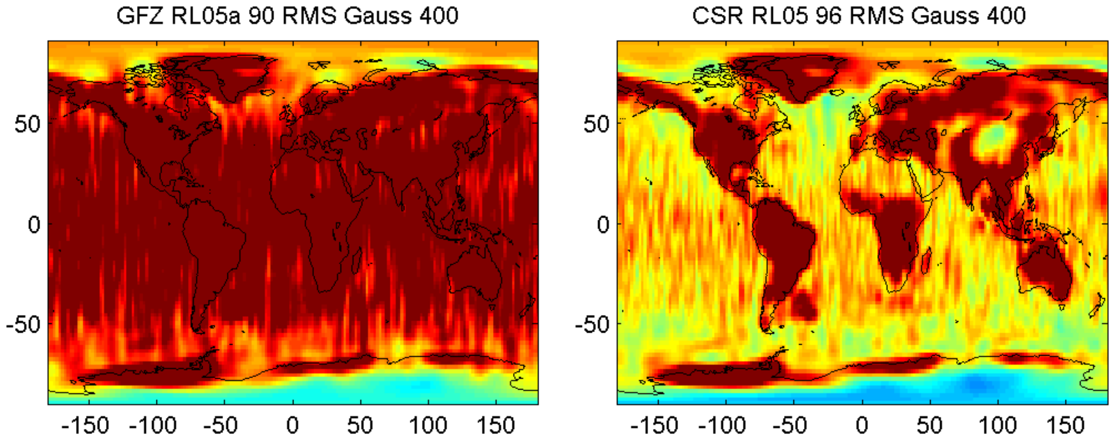
Analyses in the spatial domain (2/12)



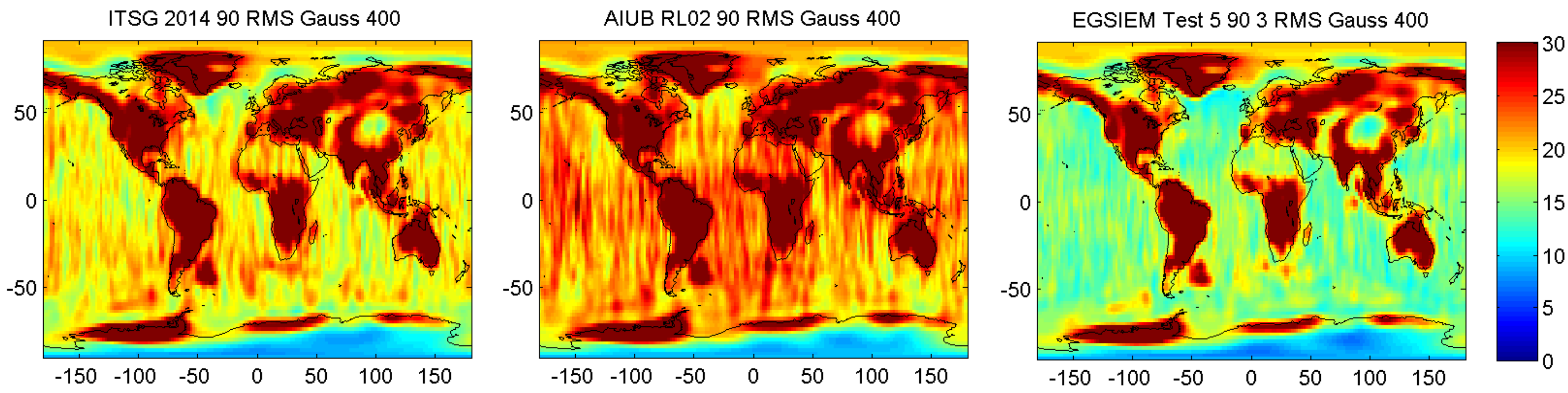
Median of EWH variability:
200 km Gaussian filtering



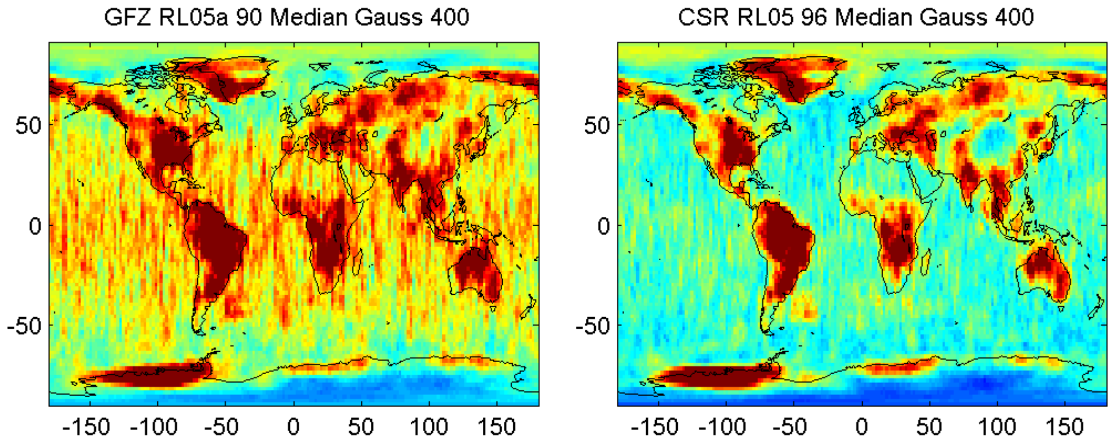
Analyses in the spatial domain (3/12)



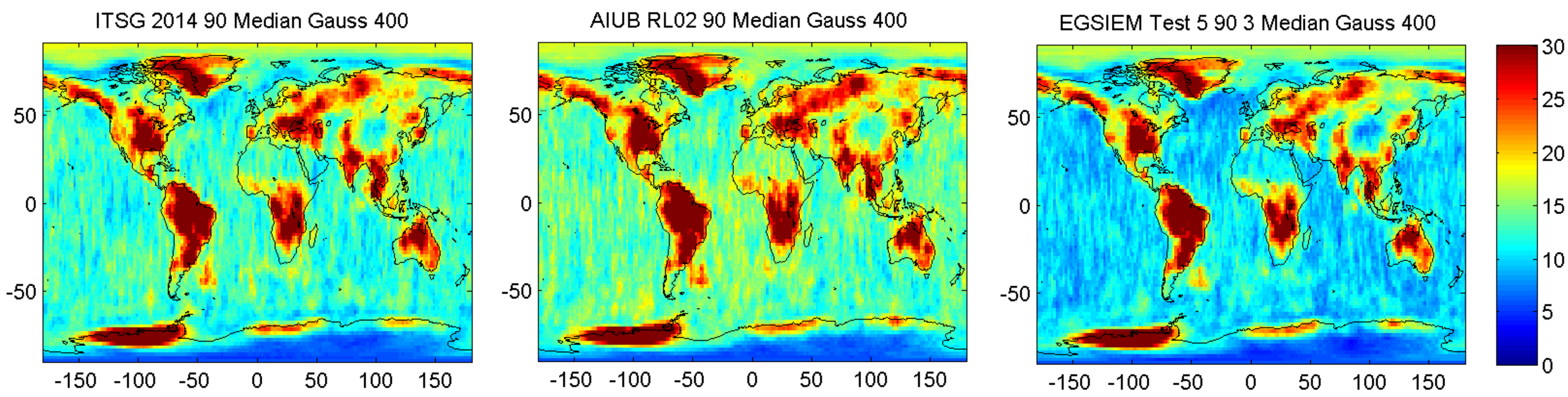
RMS of EWH variability:
400 km Gaussian filtering



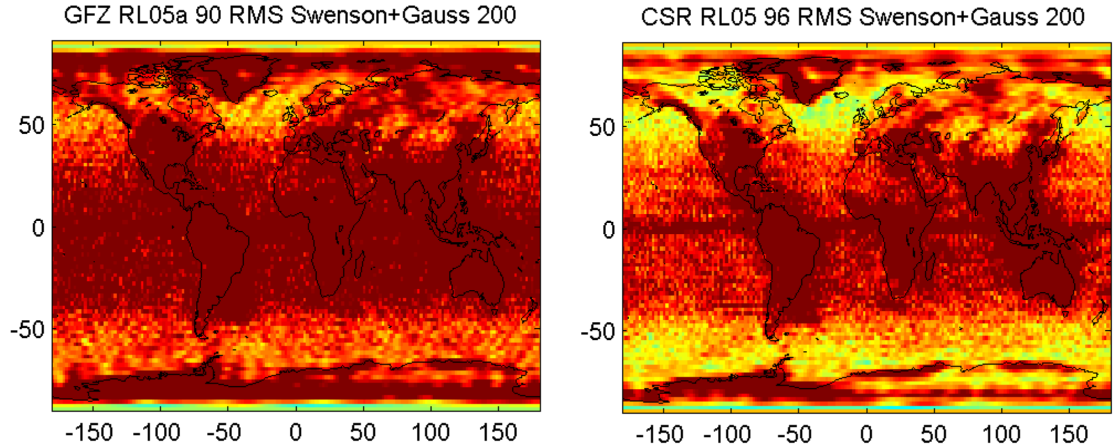
Analyses in the spatial domain (4/12)



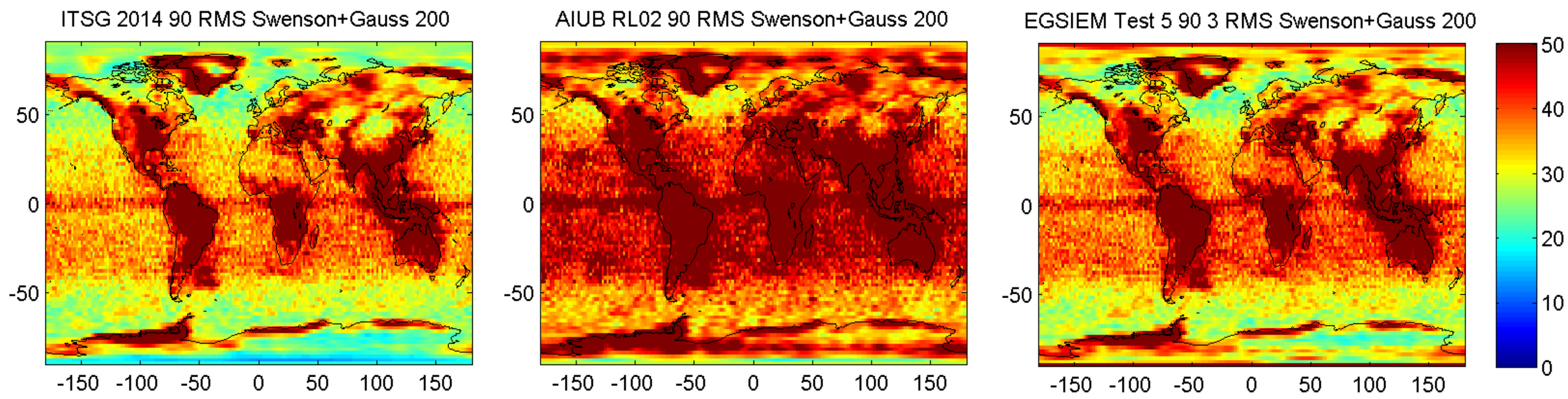
Median of EWH variability: 400 km Gaussian filtering



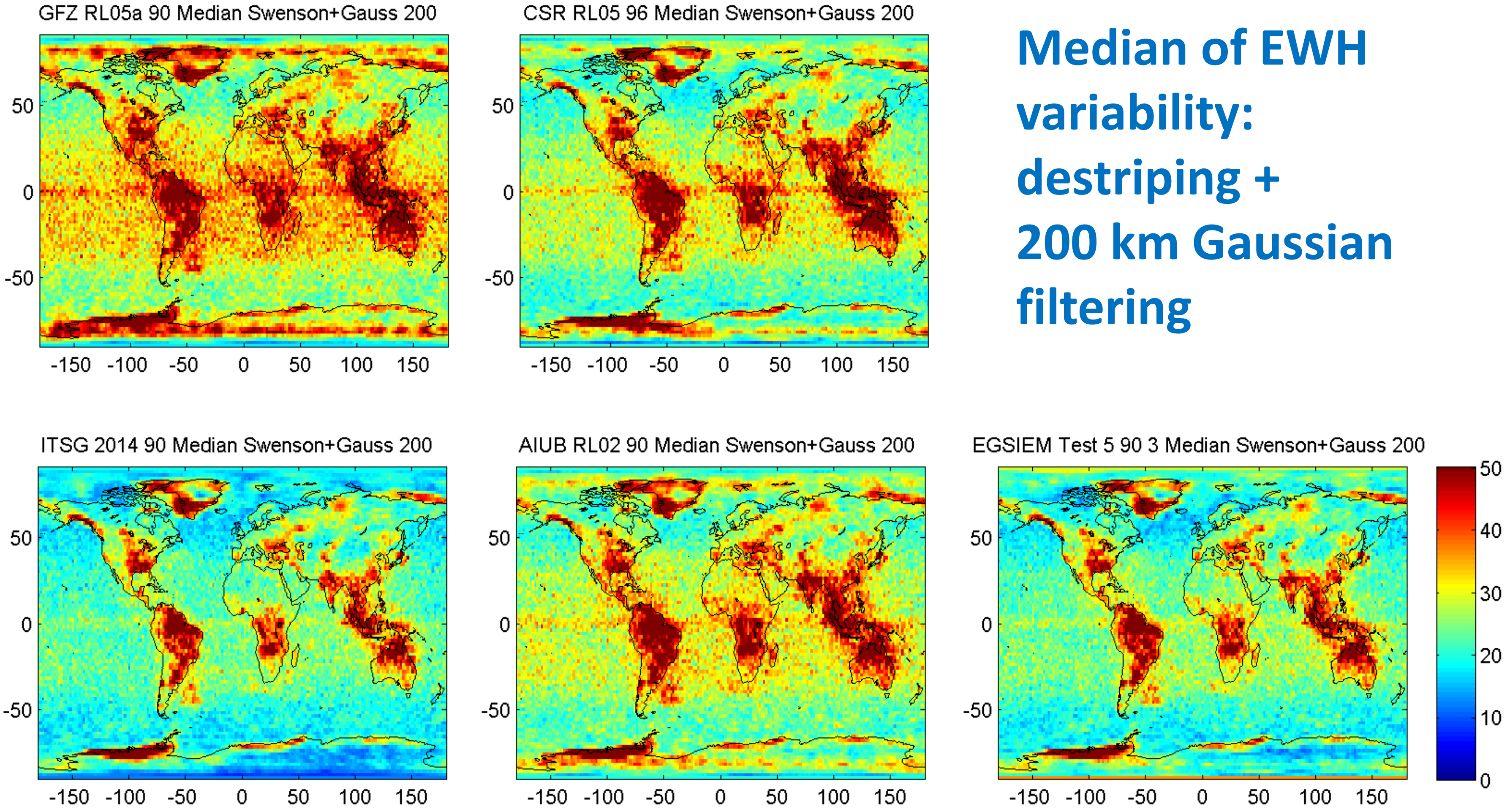
Analyses in the spatial domain (5/12)



RMS of EWH variability: destriping + 200 km Gaussian filtering

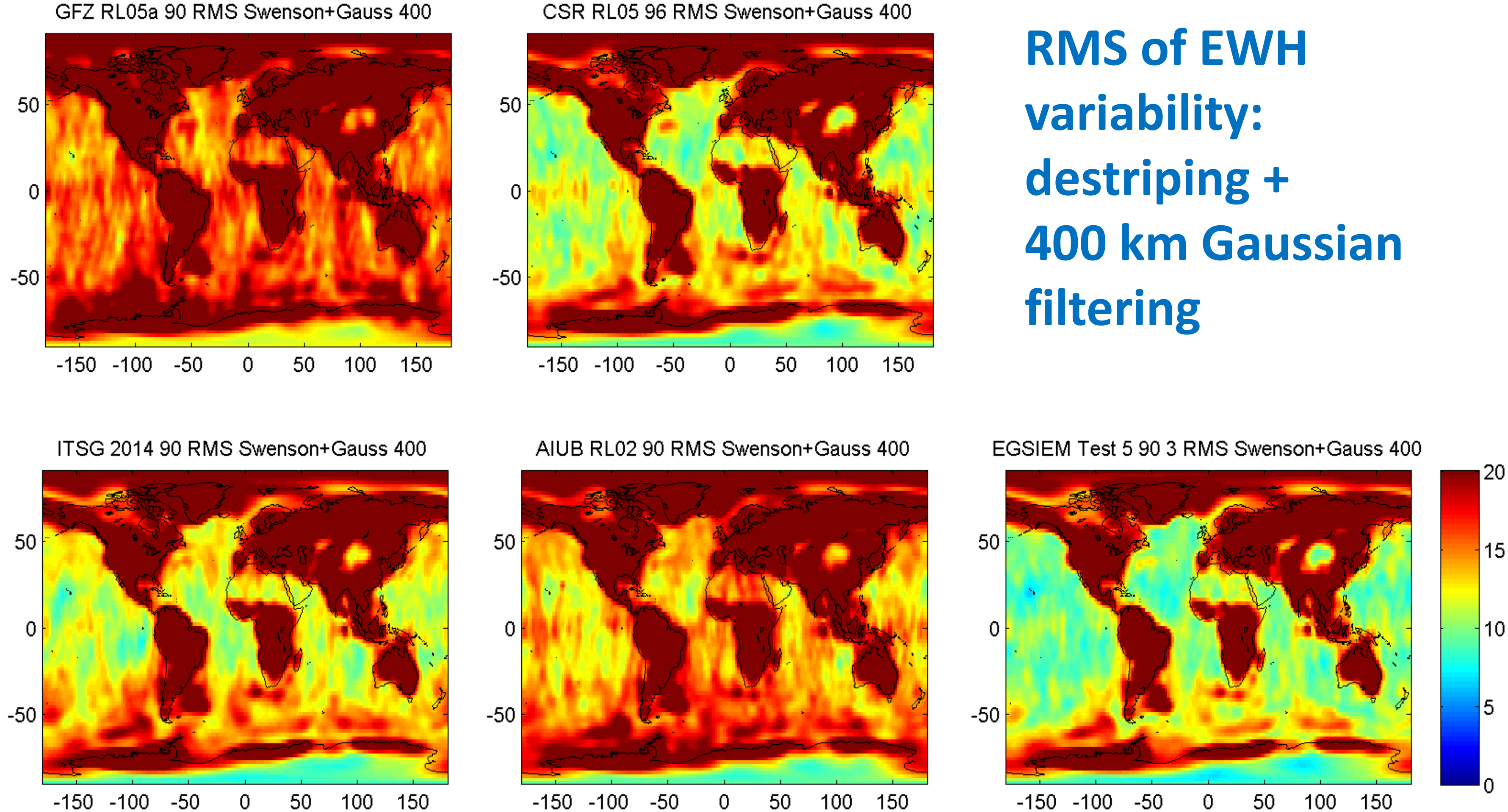


Analyses in the spatial domain (6/12)



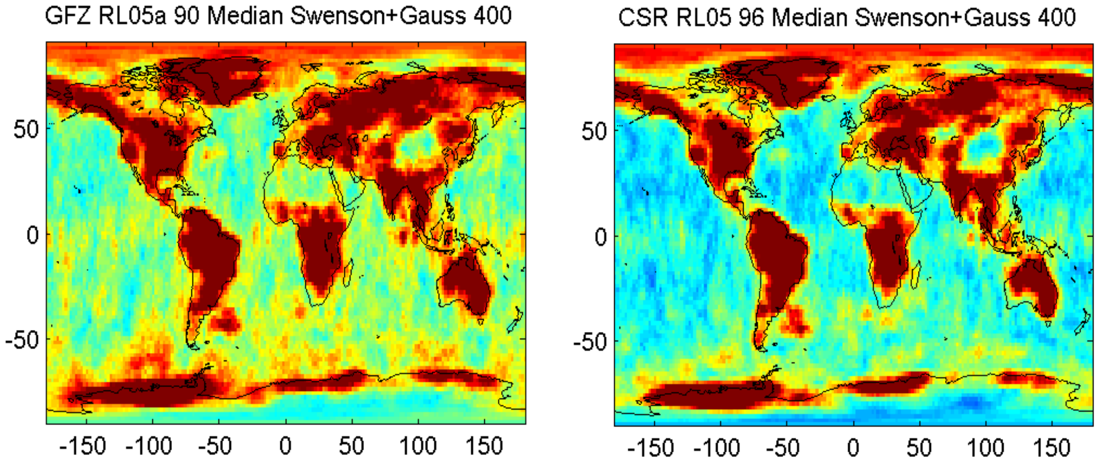
Median of EWH variability: destriping + 200 km Gaussian filtering

Analyses in the spatial domain (7/12)

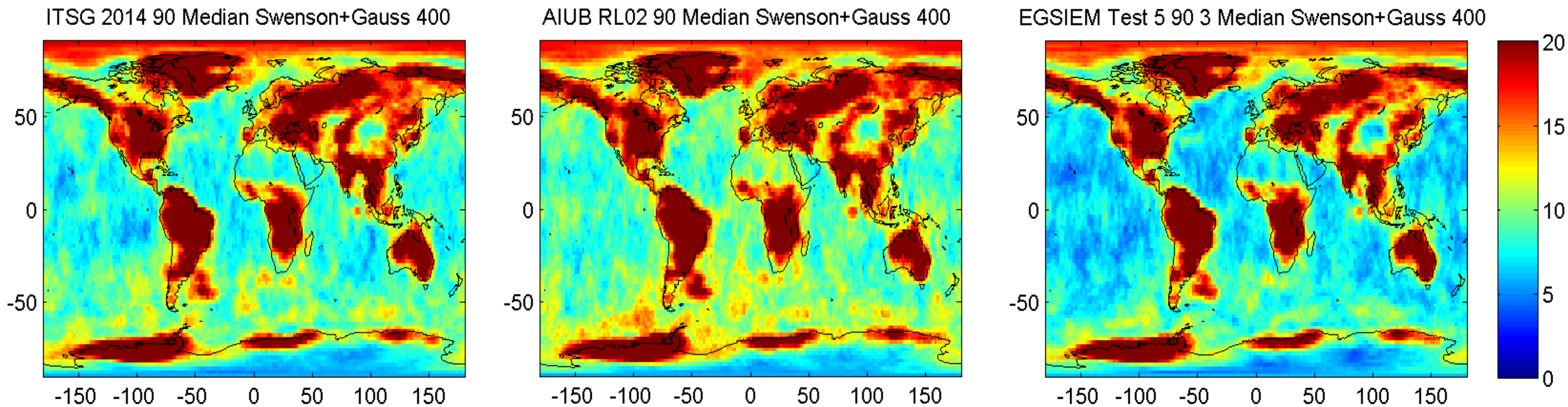


RMS of EWH variability: destriping + 400 km Gaussian filtering

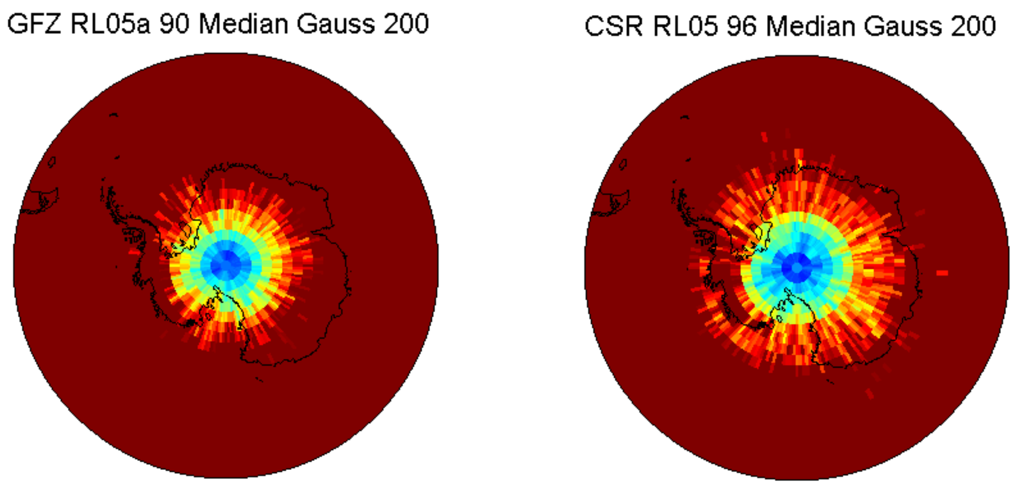
Analyses in the spatial domain (8/12)



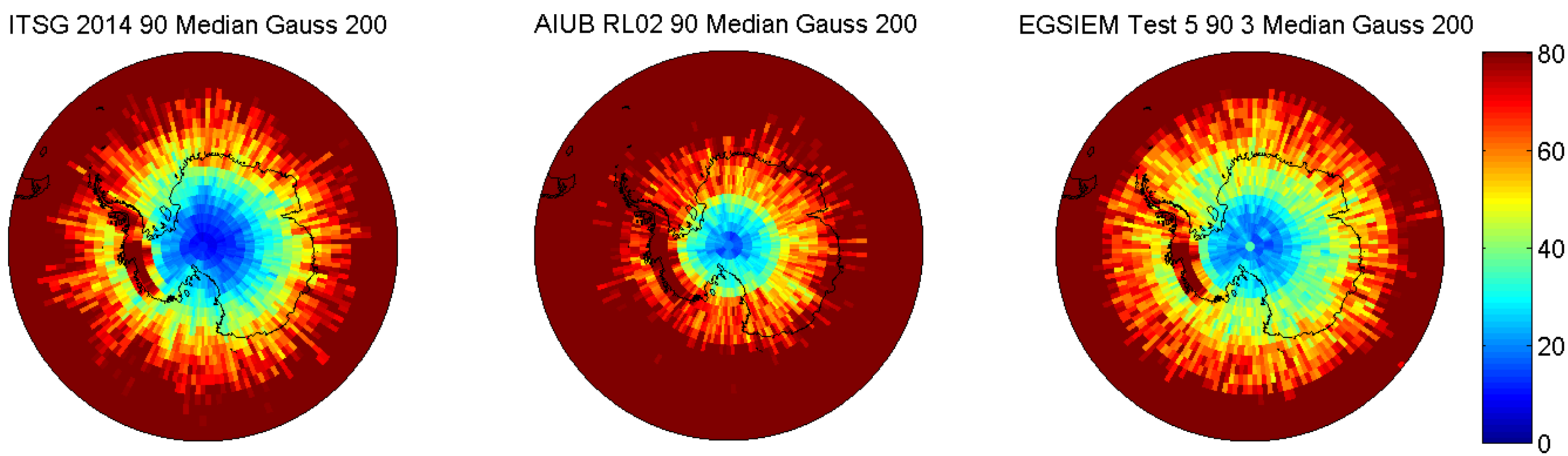
Median of EWH variability: destriping + 400 km Gaussian filtering



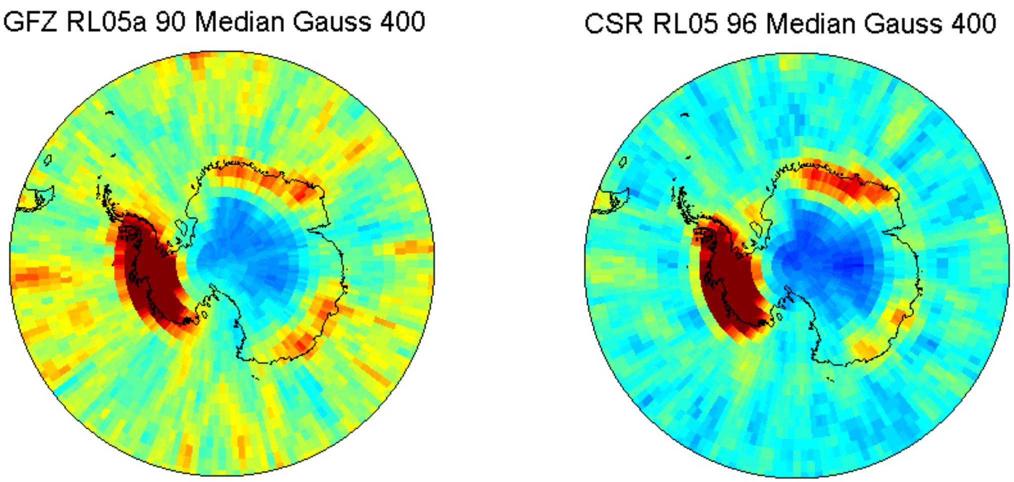
Analyses in the spatial domain (9/12)



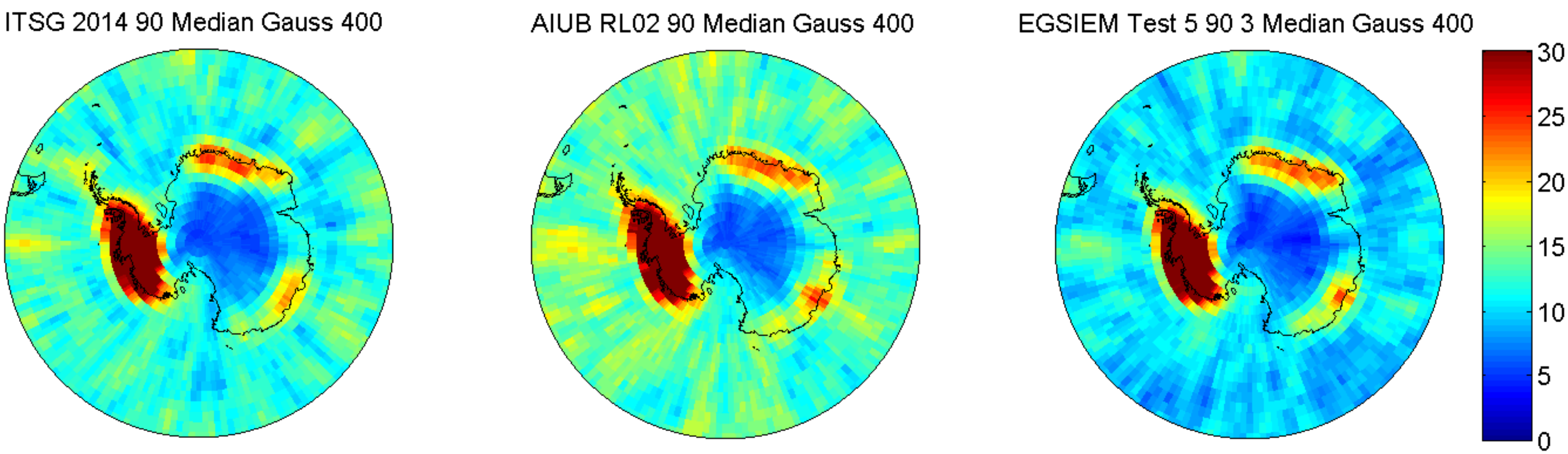
Median of EWH variability:
200 km Gaussian filtering



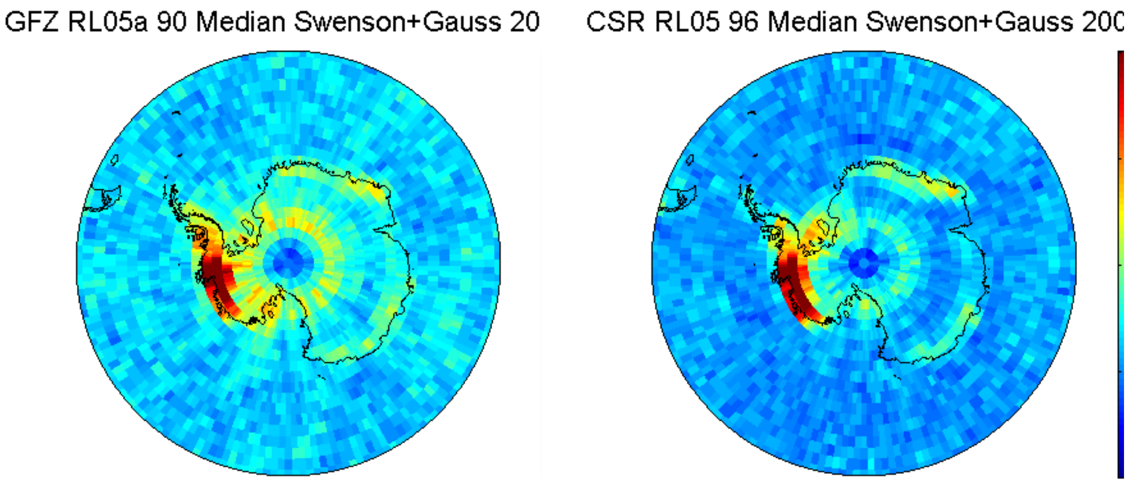
Analyses in the spatial domain (10/12)



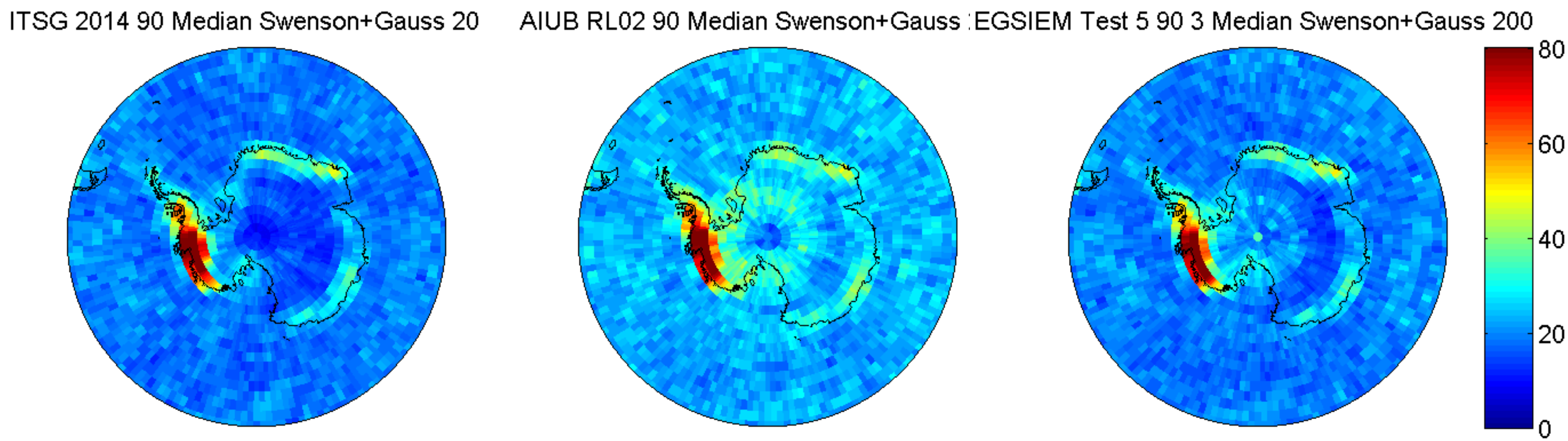
Median of EWH variability:
400 km Gaussian filtering



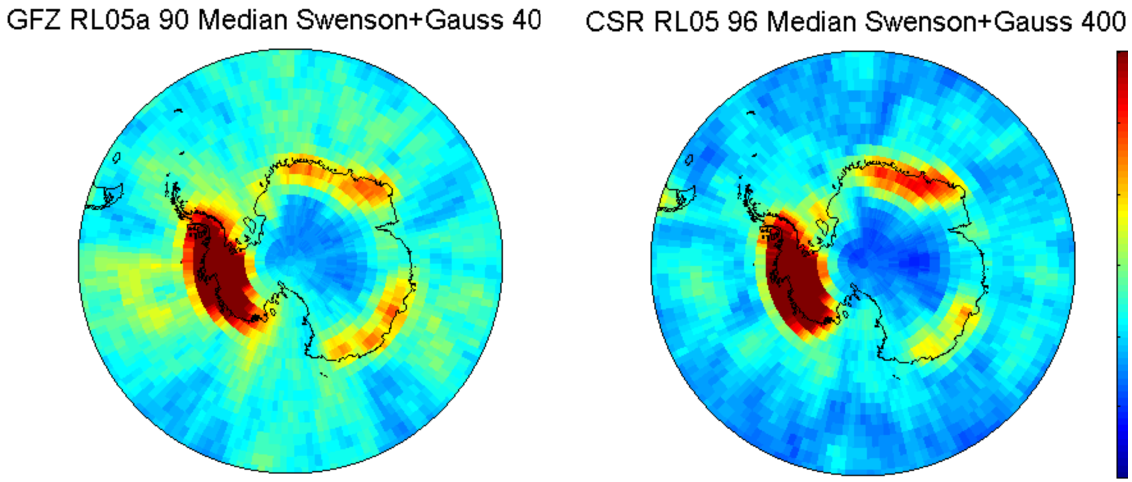
Analyses in the spatial domain (11/12)



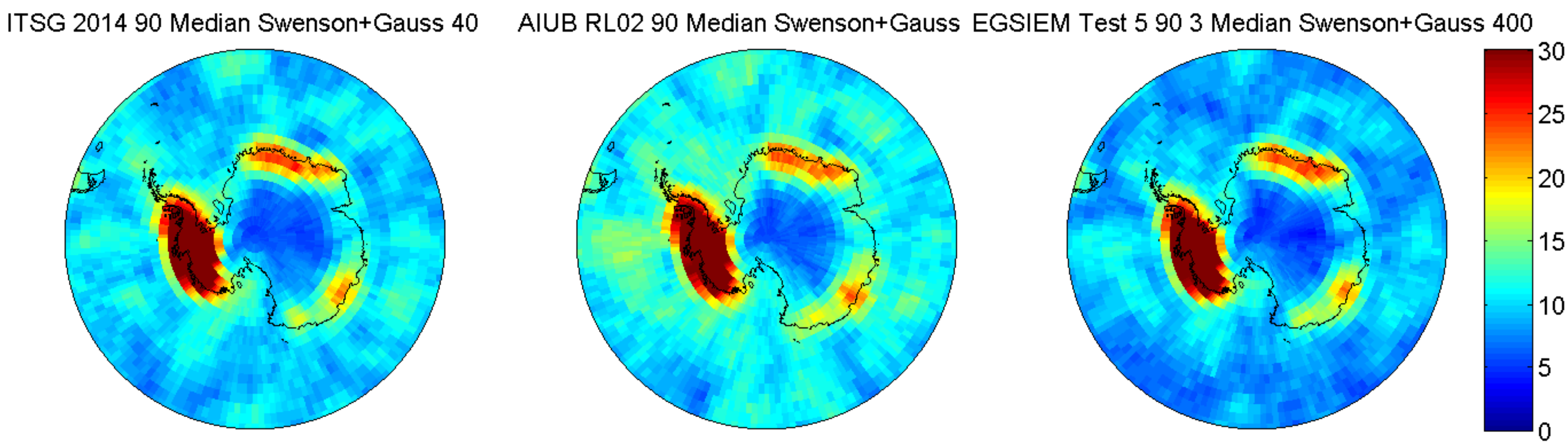
Median of EWH variability: destriping + 200 km Gaussian filtering



Analyses in the spatial domain (12/12)



Median of EWH variability: destriping + 400 km Gaussian filtering



Analyses in the spatial domain: conclusion

200 km Gaussian filter:

- **ITSG** and **EGSIEM** show the lowest noise levels.
- **ITSG** noise level < **EGSIEM** noise level.

This is **consistent with the assessment in the spectral domain**, where **ITSG** has the lowest noise level in the high degrees

400 km Gaussian filter:

- **EGSIEM**, **ITSG** and **CSR** show the lowest noise levels.
- **EGSIEM** noise level < **ITSG, CSR** noise level.

The relative differences between releases remain the same irrespective of STD or Median and destriping or not.

Mass changes of Antarctic drainage basins

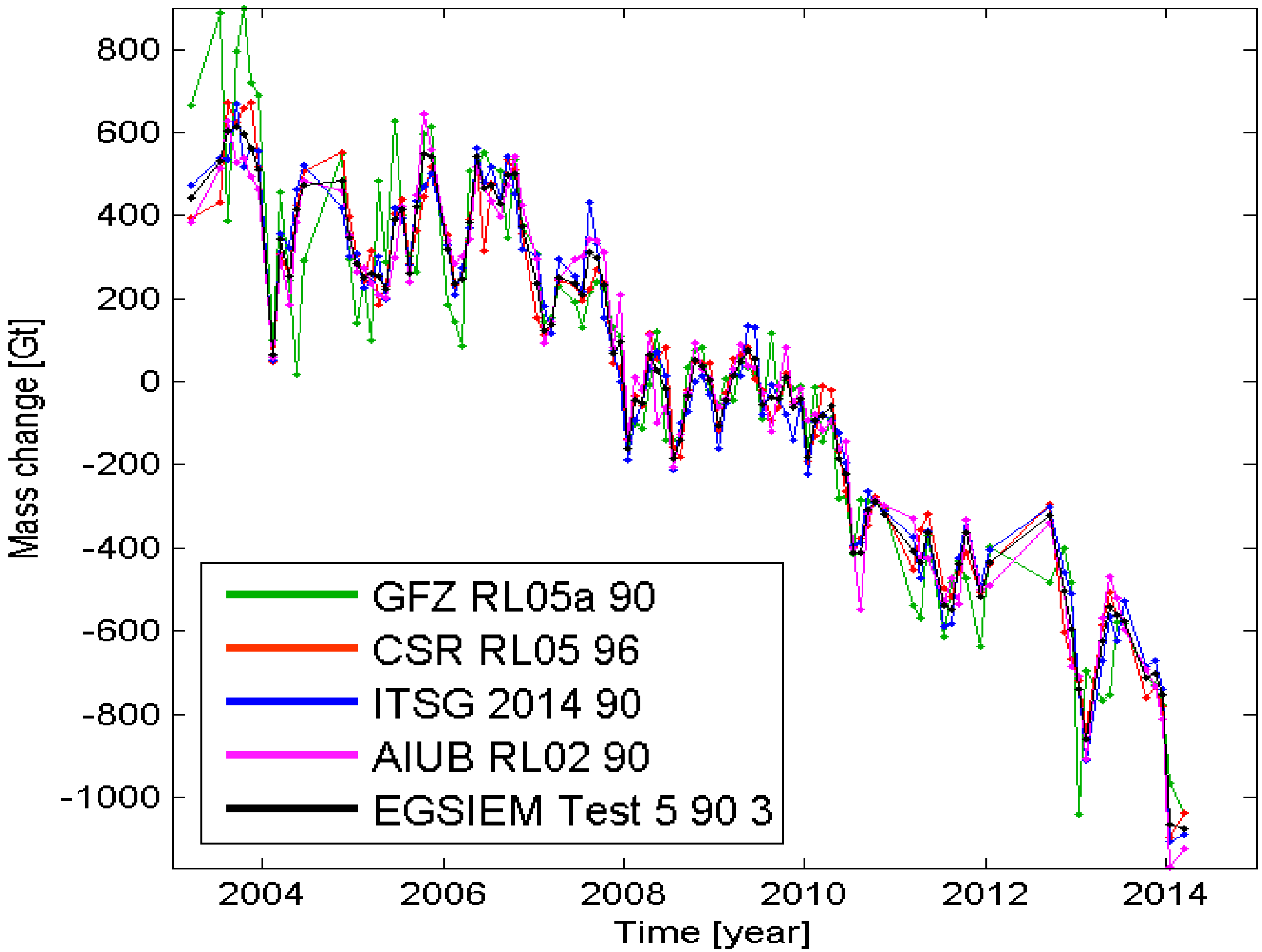
Basin masses are computed using an **integration kernel** (in the spectral domain) which is designed to attain a compromise between leakage errors and propagated GRACE errors.

The kernel design depends on empirical GRACE error covariances that are specific for each series. To achieve comparable results kernels were derived for all series and then averaged.

GIA models as in Shepherd et al. (2012).

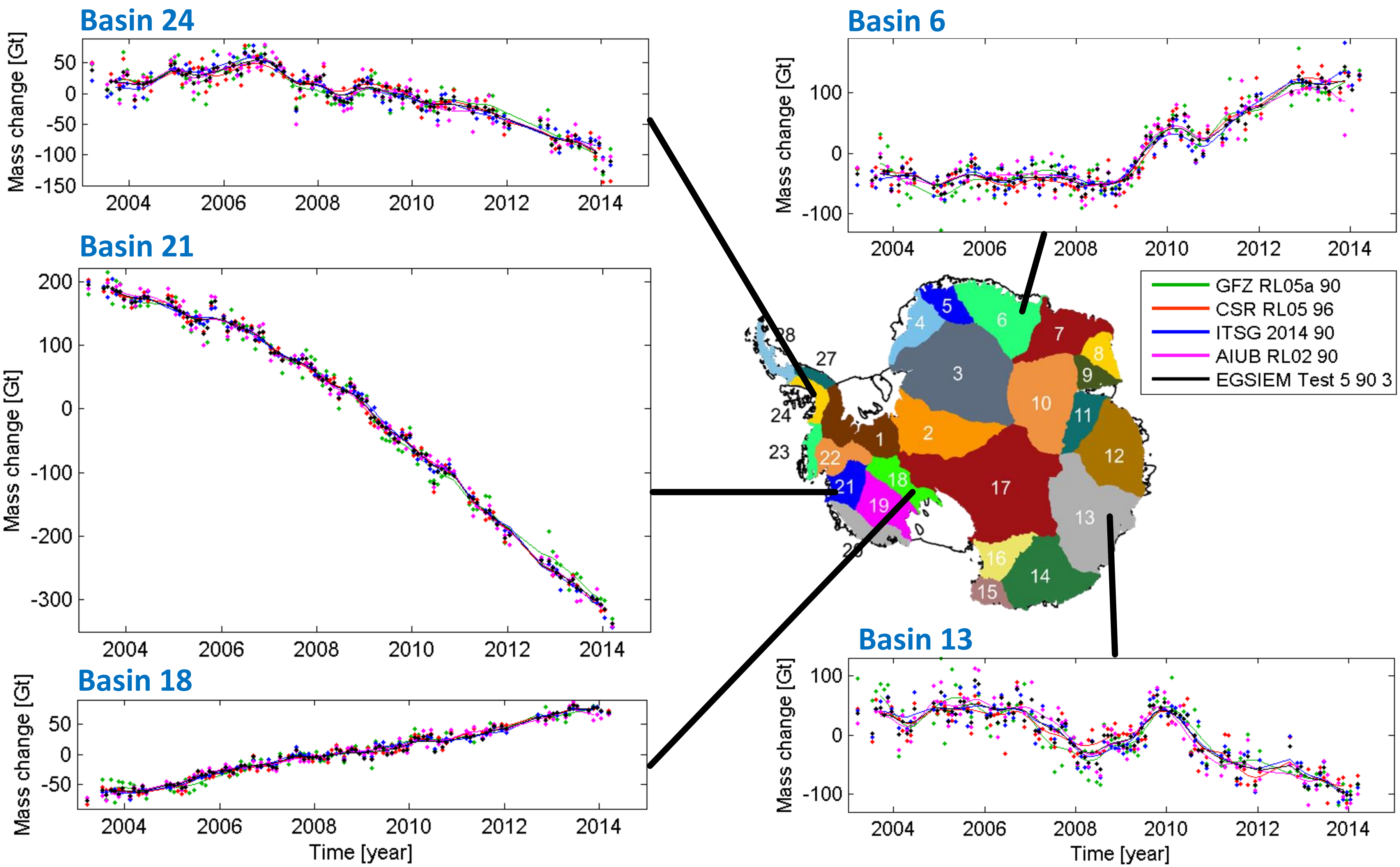
Mass changes of Antarctic drainage basins (1/4)

Entire Antarctica



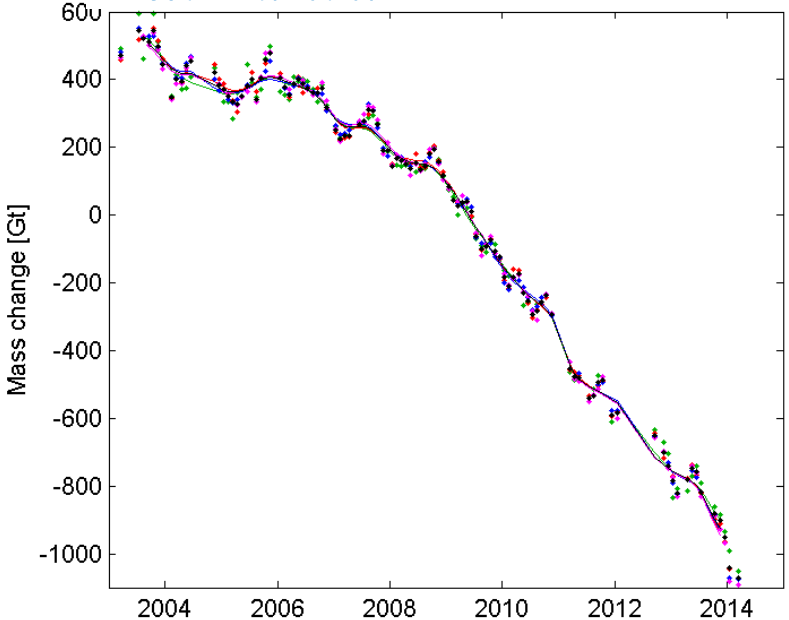
- **No signal attenuation!**
- **Different noise levels.**

Mass changes of Antarctic drainage basins (2/4)

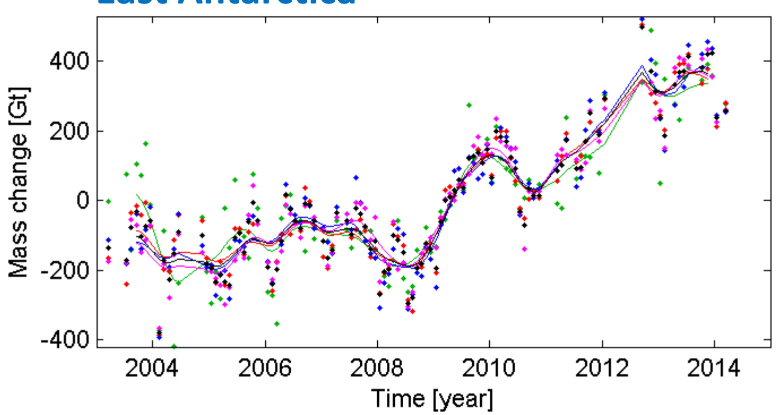


Mass changes of Antarctic drainage basins (3/4)

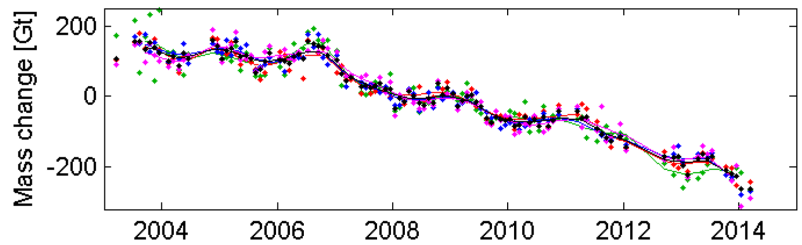
West Antarctica



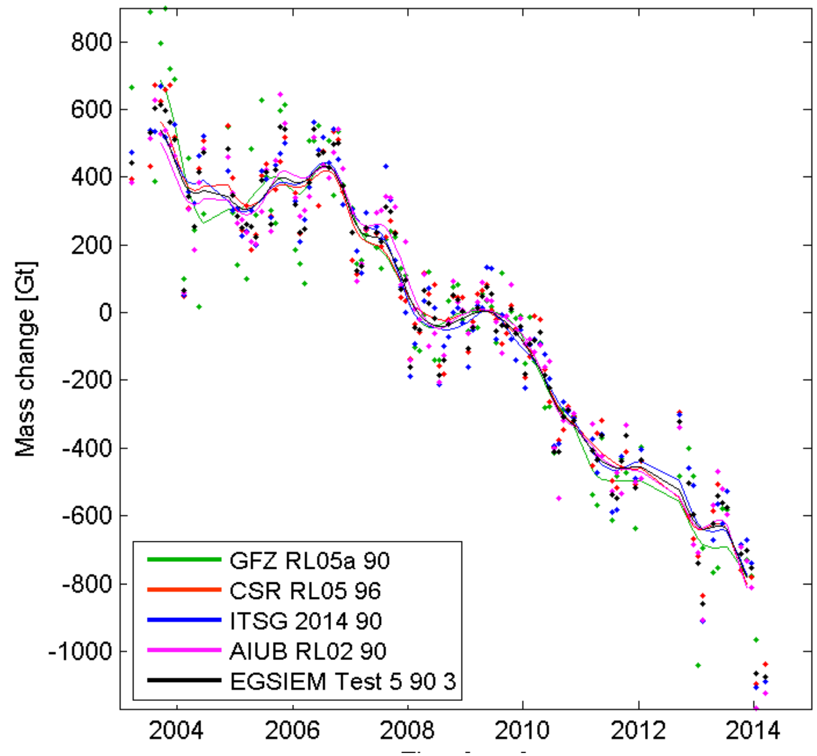
East Antarctica



Antarctic Peninsula



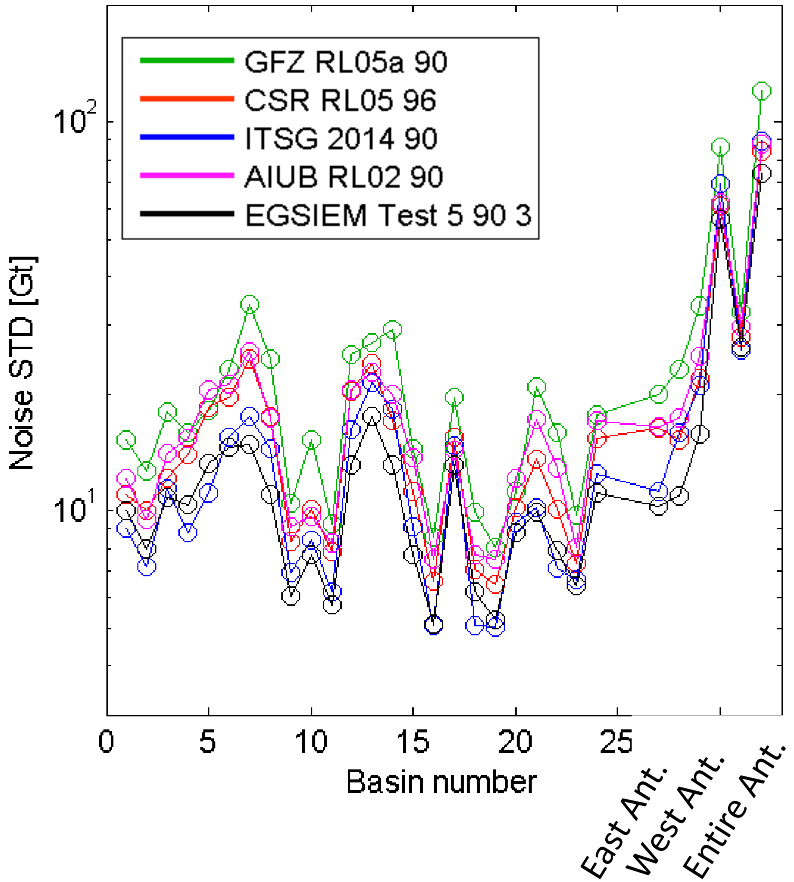
Entire Antarctica



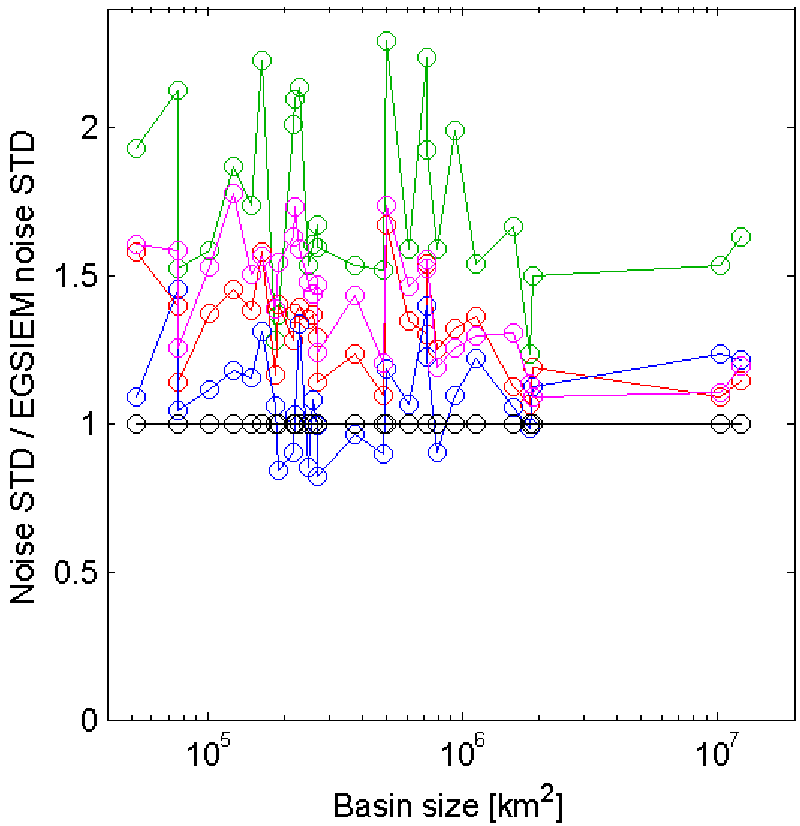
Mass changes of Antarctic drainage basins (4/4)

The uncorrelated (white) noise content was assessed based on the STD of high-pass filtered time series.

Noise levels per basin



Noise levels relative to EGSIEM



Mass changes of Antarctic drainage basins: conclusion

- Differences in noise STD between the series are on the order of 10% to 50%

- For most basins (including the large aggregations), **EGSIEM has the lowest noise level** (dependent on attenuation of high-degree noise by integration kernel; ITSG may benefit from less aggressive dampening).