Combination of GRACE monthly gravity field solutions with different weighting schemes

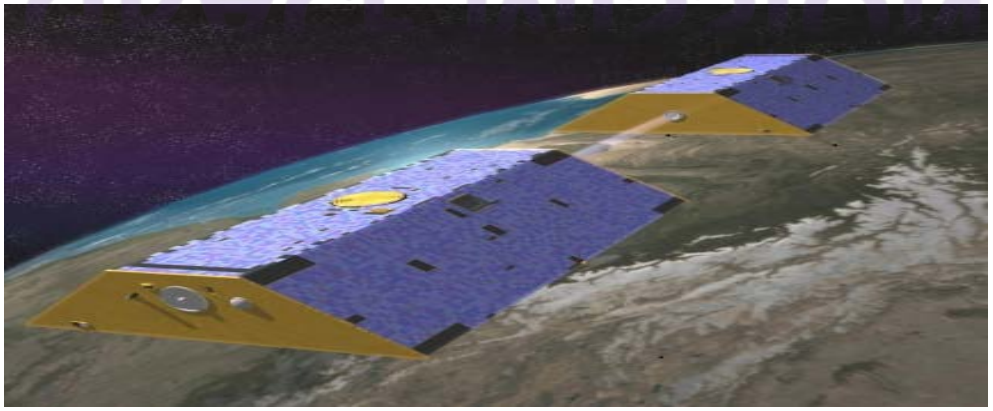
Yoomin Jean, Ulrich Meyer, Adrian Jäggi

Astronomical Institute
University of Bern

Geodätische Woche 2015
15-17 September, 2015
Stuttgart, Germany

GRACE Monthly Gravity Field Solutions

GRACE MISSION



AIUB solution

Delft solution

GRGS solution

ITSG solution (GRAZ)

Tongji U. solution

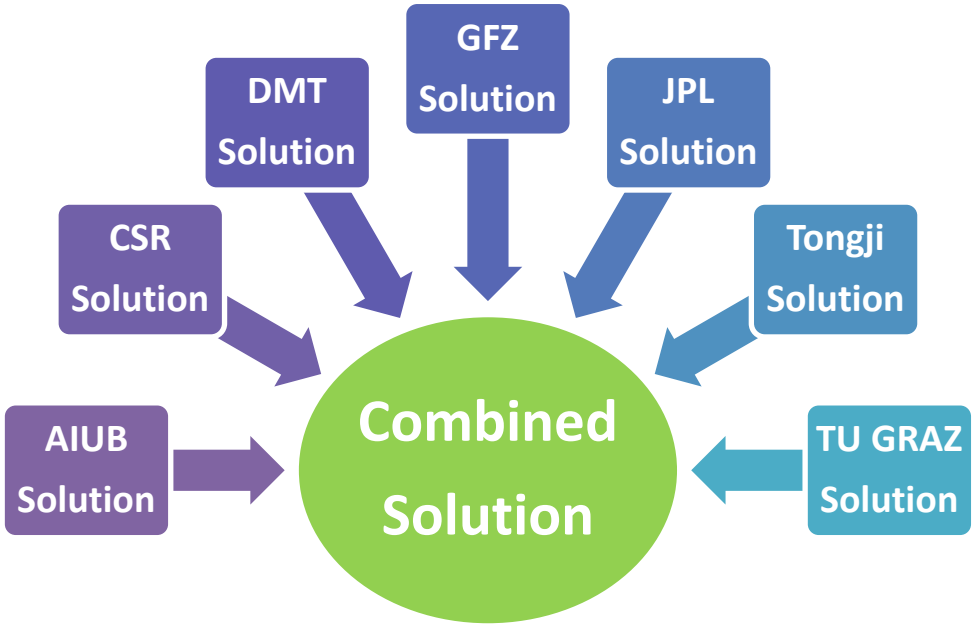
GFZ solution

CSR solution

JPL solution

Combination of Invidual Solutions

- To make use of the solutions from different processing strategies together



- Reduced systematic errors specific for certain processing centers
- Reliable and consistent solutions
- Benefits for users of GRACE gravity solutions without advanced knowledge or preference
- Project EOSIEM **E**uropean **G**ravity **S**ervice for **I**mproved **E**mergency **M**anagement

Available GRACE Monthly Gravity Solutions

The official **GRACE monthly gravity solutions**
available at the ICGEM website (`http://icgem.gfz-potsdam.de/ICGEM`):

Label	Solution Name	Institution	Max.deg.	Note
AUB02_G060*	AIUB Release 2	AIUB	60	Celestial Mechanics Approach
AUB02_G090**			90	
CSR05_G060*	UTCSR Release 5	CSR	60	Direct approach
CSR05_G096**			96	
DMT01_G120	DMT–1	TU Delft	120	Acceleration approach (pre-filtered)
GFZ5a_G090**	GFZ Release 5	GFZ	90	Direct approach
GRG03_G080	GRGS Release 3	GRGS	80	Direct approach (regularized)
GRZ00_G060*	ITSG 2014	ITSG, TU Graz	60	Short arc approach (stochastic covariances)
GRZ00_G090**			90	
GRZ00_G120			120	
JPL05_G060	JPL Release 5	JPL	60	Direct approach
JPL05_G090**			90	
TNJ01_G060*	Tongji Release 1	Tongji Univ.	60	Modified short arc approach

*: included in the combined solution of maximum degree 60
**: included in the combined solution of maximum degree 90

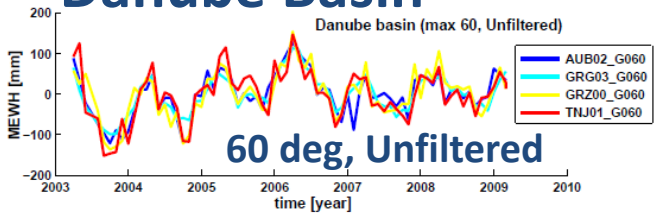
Comparison: Signal (MEWH)

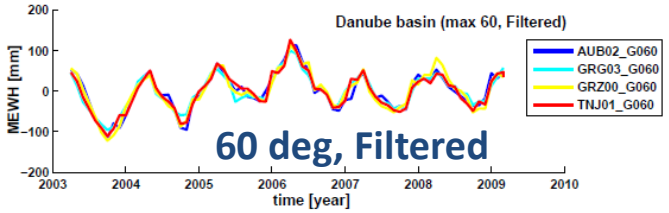
- Mean Equivalent Water Height

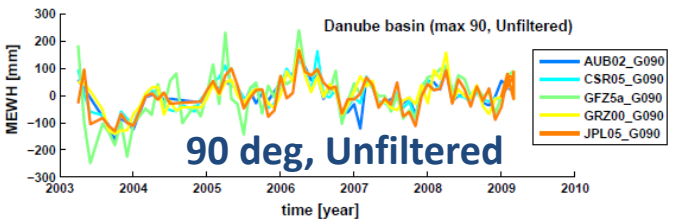
$$MEWH = \frac{\sum EWH * \sin\theta}{\sum \sin\theta}$$

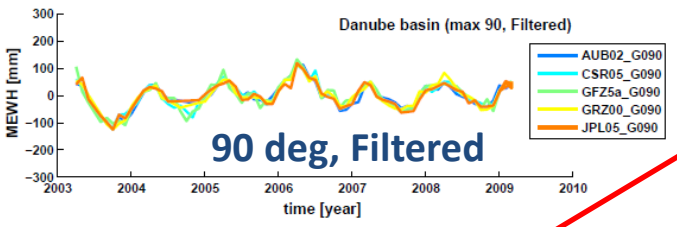
θ: colatitude

Danube Basin

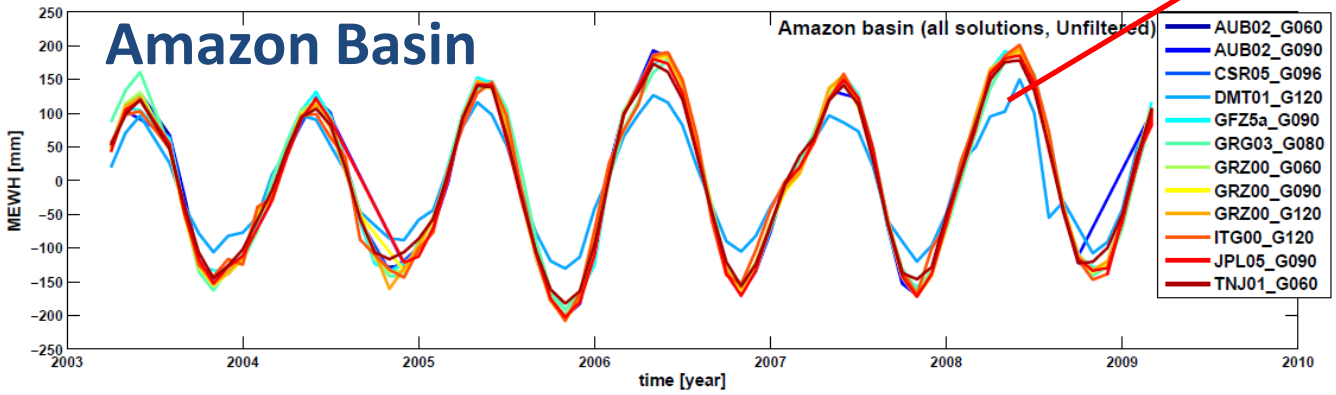








Amazon Basin



DMT solution: Dampened Signal due to pre-filtering

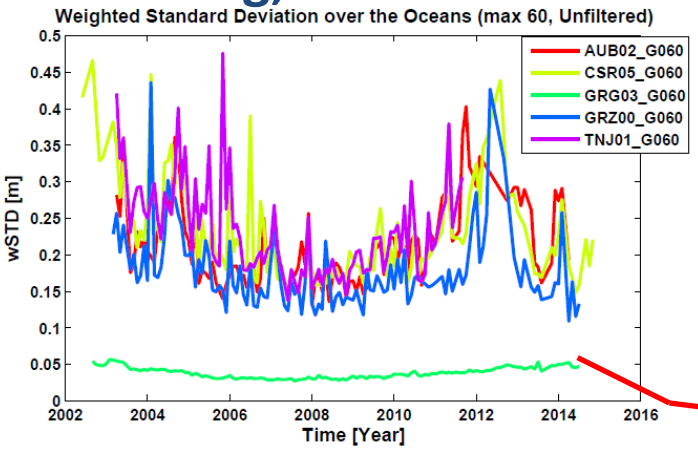
Comparison: Variability (wSTD over the Oceans)

$$wSTD = STD \cdot \sin\theta$$

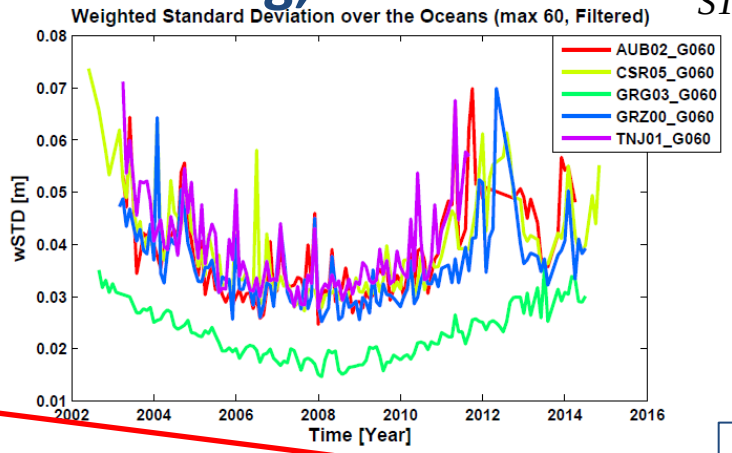
θ: colatitude

STD: Standard Deviation

60 deg, Unfiltered

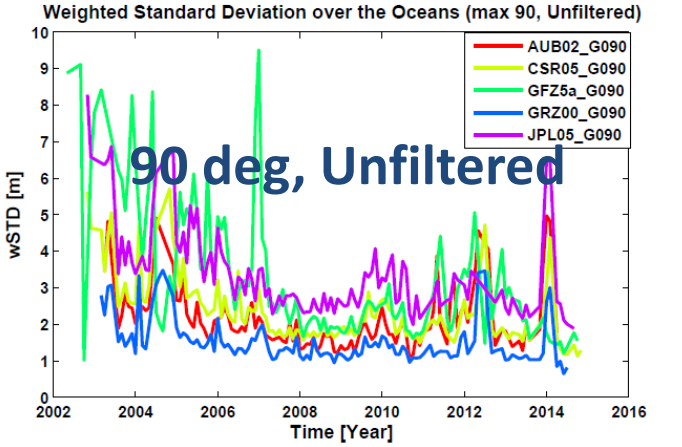


60 deg, Filtered

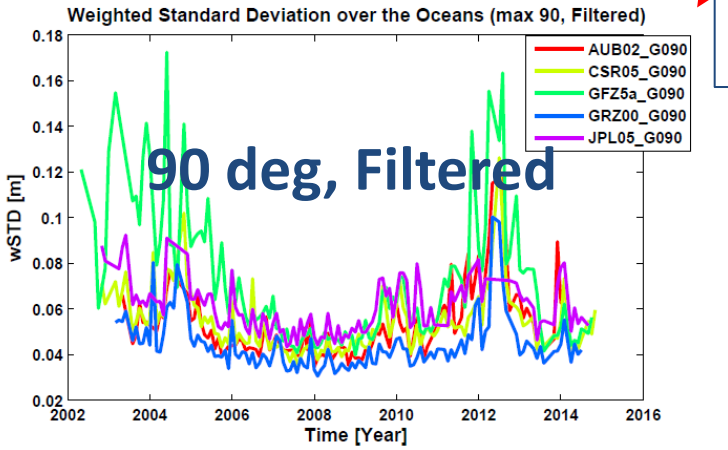


Different level of Noise in GRGS solution

90 deg, Unfiltered

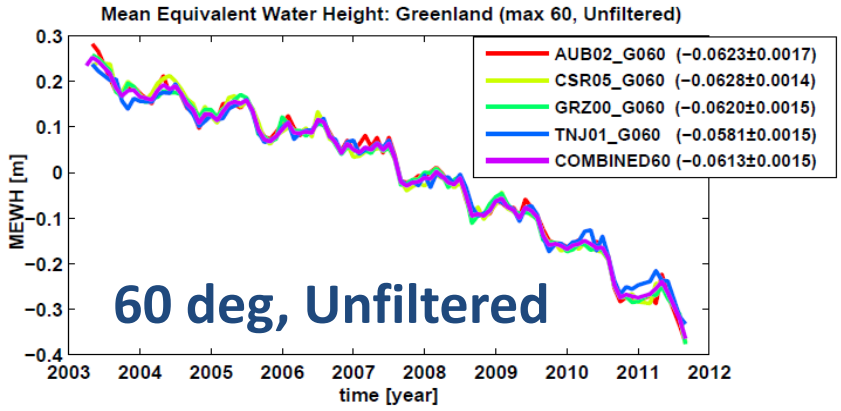


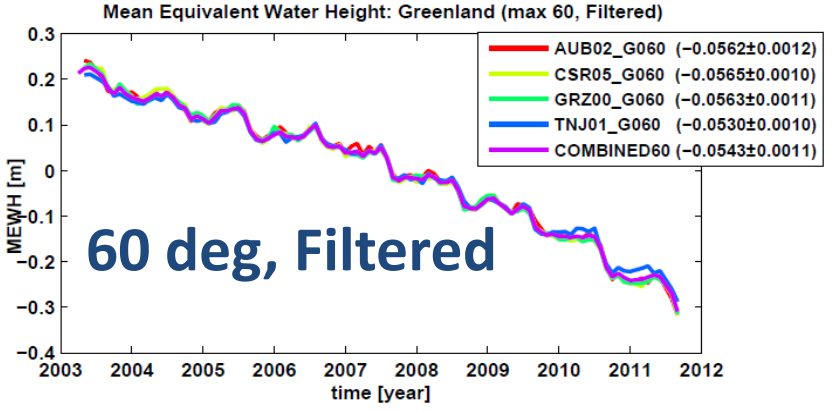
90 deg, Filtered

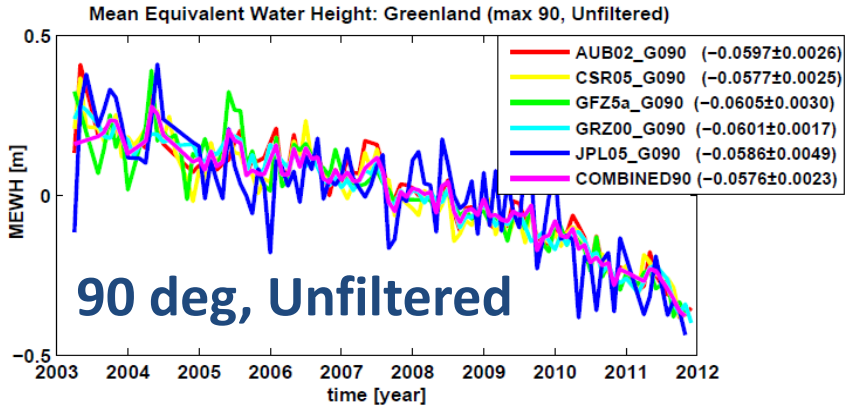


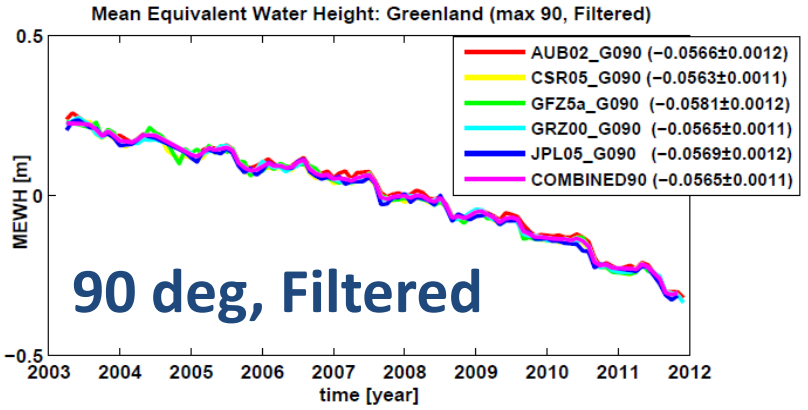
Combination

Combined Solution (Max. Deg.)	Involved Individual Solutions
Combined Solution (60)	AUB02, CSR05, GRZ00, TNJ01
Combined Solution (90)	AUB02, CSR05, GFZ5a, GRZ00, JPL05







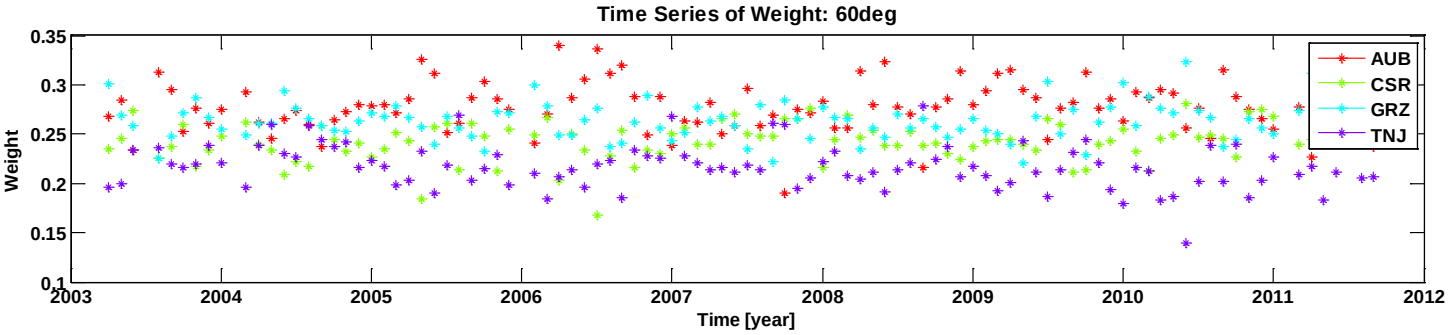


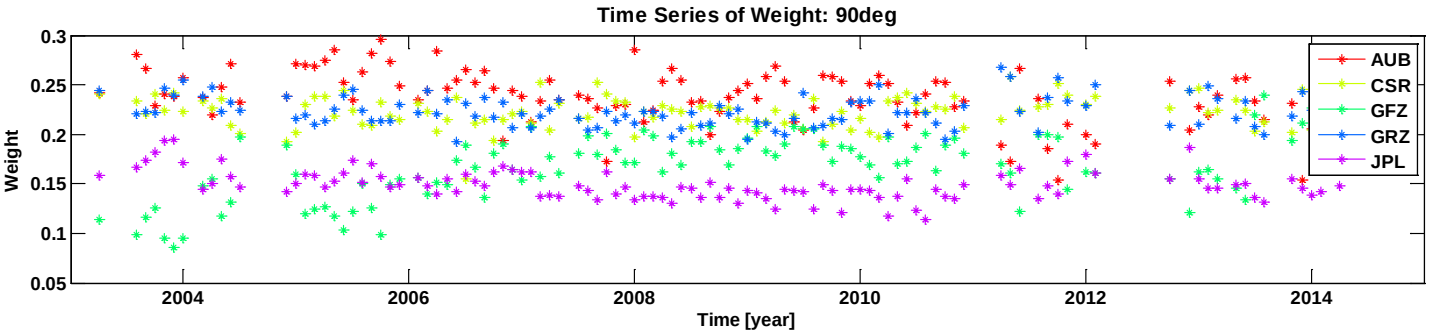
Combination: Weighting Schemes

Different Combined Solutions:

Weights are based on
(Individual Solution – Arithmetic Mean)$^{-2}$

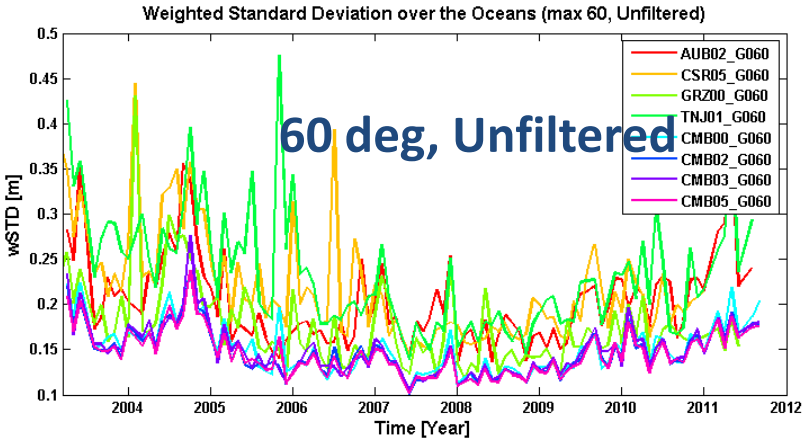
	Label	Type of Combined Solution	Weight
1	**CMB00**	**Simple Arithmetic Mean**	Identical weights
2	**CMB02**	Coefficient–wise **Weighted Mean**	Each **L** and each **M** in each **Month**
3	**CMB03**	Order–wise **Weighted Mean**	Each **M** in each **Month**
4	**CMB05**	Month–wise **Weighted Mean**	Each **Month**

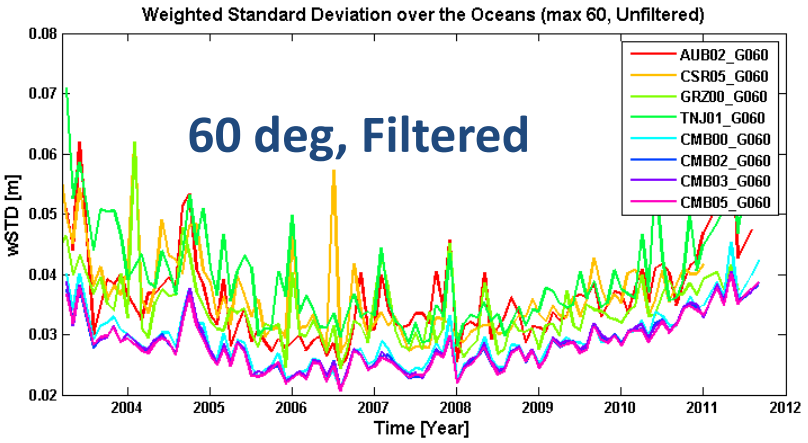


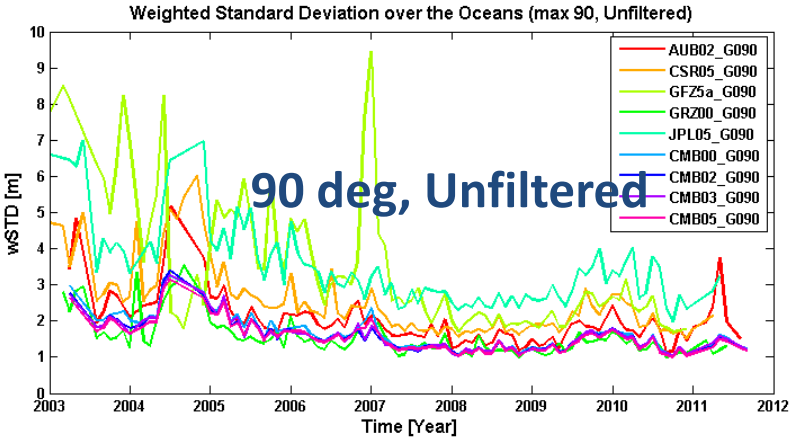


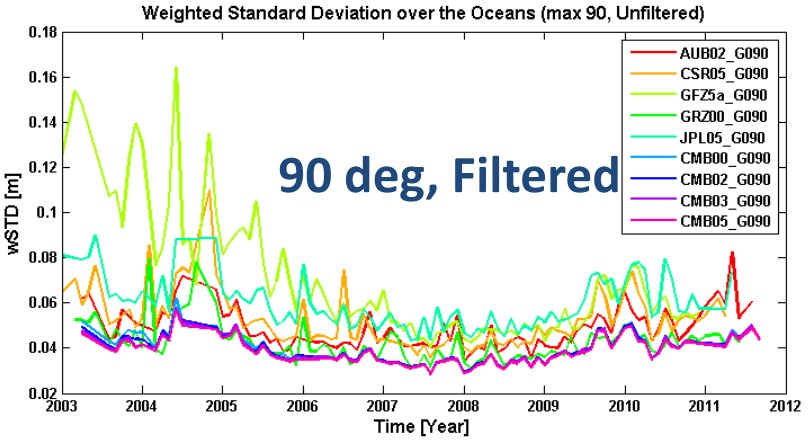
Combined Solutions with different weights

- wSTD over the oceans









Summary and Conclusions

- GRACE Monthly gravity field solutions from different processing centers
- Comparison: AIUB, CSR, GFZ, TU Graz, JPL, Tongji solutions are in similar levels in terms of MEWH and wSTD over the oceans
- Combination: Combined solutions are less-scattered especially unfiltered degree 90 case.
- Weighting Schemes: Simple monthly weighted average
- Further experiments: in normal equation level