

Combination of GRACE monthly gravity field solutions with different weighting schemes

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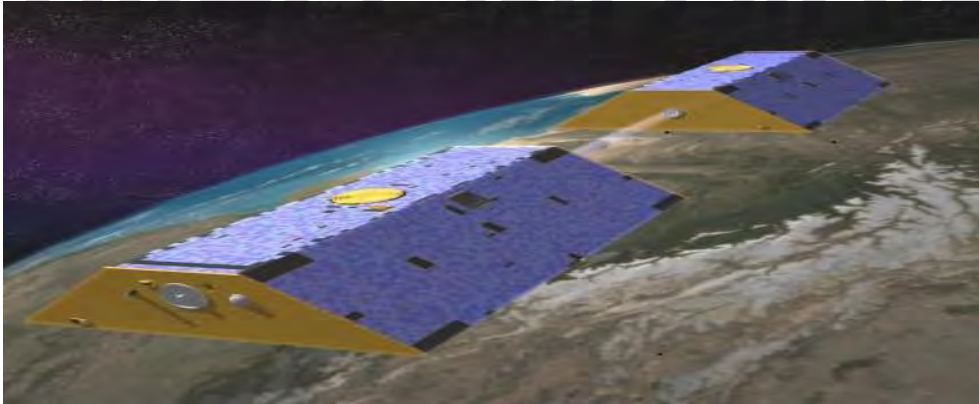
Astronomical Institute
University of Bern



Geodätische Woche 2015
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GRACE Monthly Gravity Field Solutions

GRACE MISSION



AIUB solution
Delft solution
GRGS solution
ITSG solution (GRAZ)
Tongji U. solution

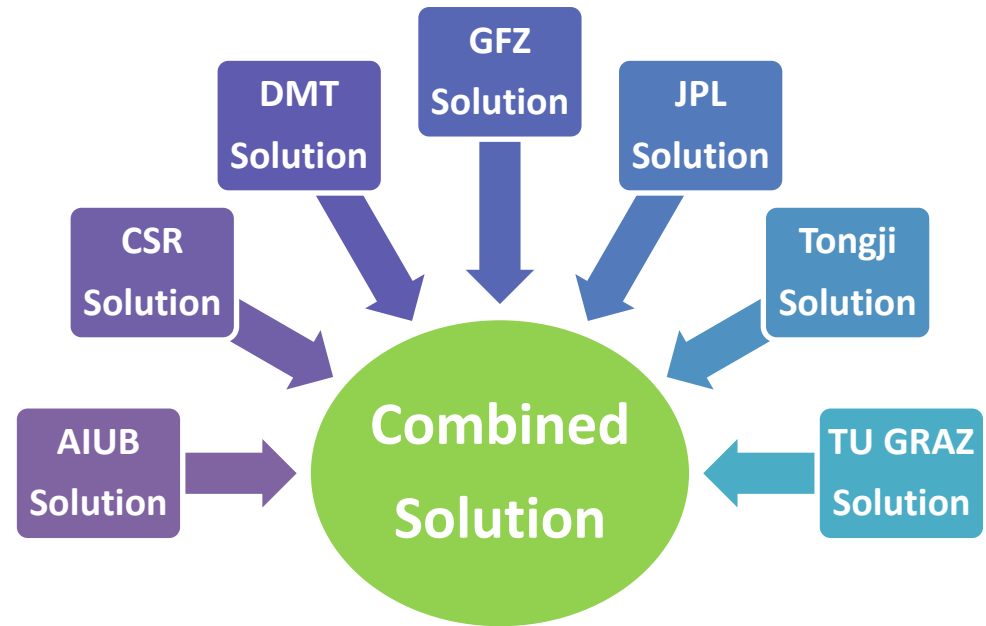
GFZ solution

CSR solution

JPL solution

Combination of Individual 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  European Gravity Service for Improved Emergency Management

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* AUB02_G090**	AIUB Release 2	AIUB	60 90	Celestial Mechanics Approach
CSR05_G060* CSR05_G096**	UTCSR Release 5	CSR	60 96	Direct approach
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* GRZ00_G090** GRZ00_G120	ITSG 2014	ITSG, TU Graz	60 90 120	Short arc approach (stochastic covariances)
JPL05_G060 JPL05_G090**	JPL Release 5	JPL	60 90	Direct approach
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

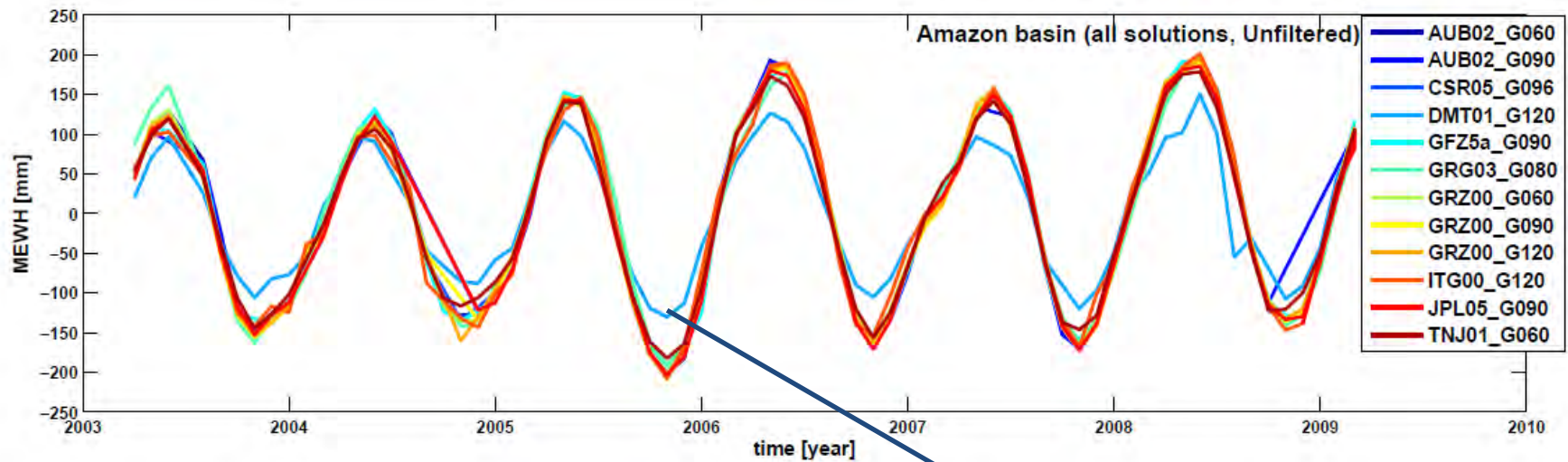
Comparison: Signal (MEWH)

- Mean Equivalent Water Height

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

θ : colatitude

MEWH of Amazon River Basin (degree 60)



DMT solution:
Damped Signal
due to pre-filtering

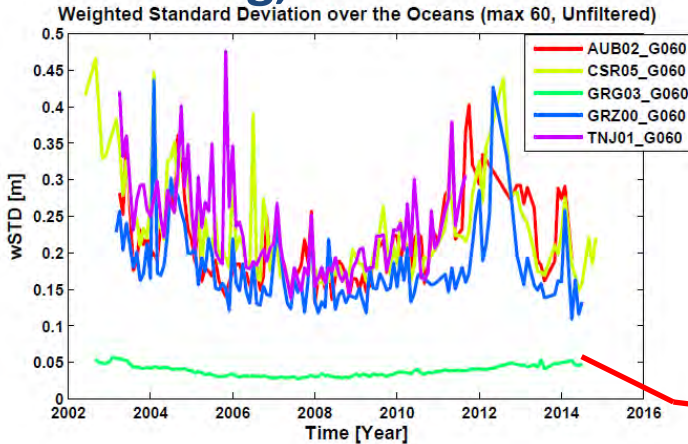
Comparison: Variability (wSTD over the Oceans)

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

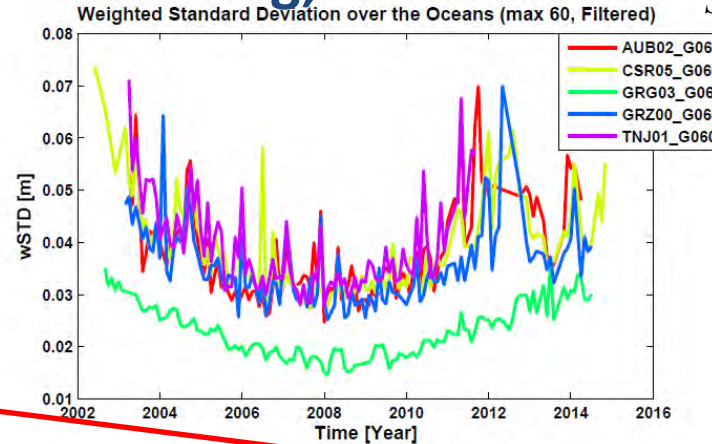
θ : colatitude

STD: Standard Deviation

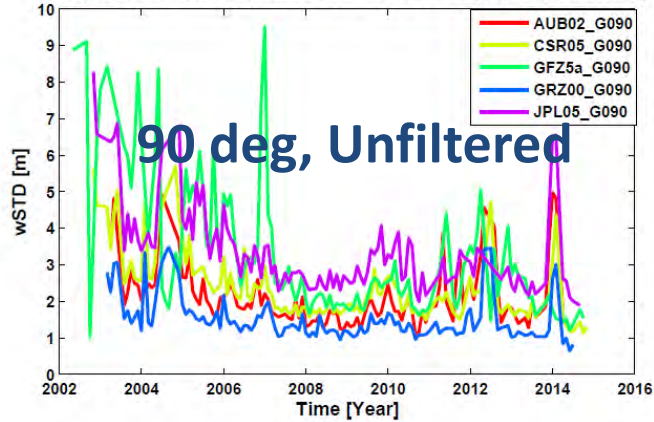
60 deg, Unfiltered



60 deg, Filtered

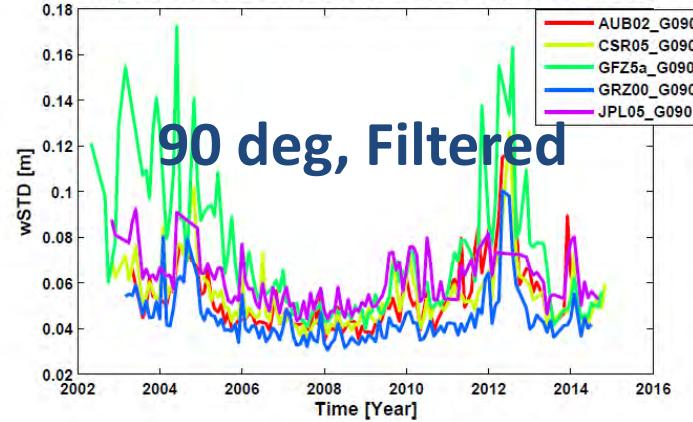


Weighted Standard Deviation over the Oceans (max 90, Unfiltered)



90 deg, Unfiltered

Weighted Standard Deviation over the Oceans (max 90, Filtered)



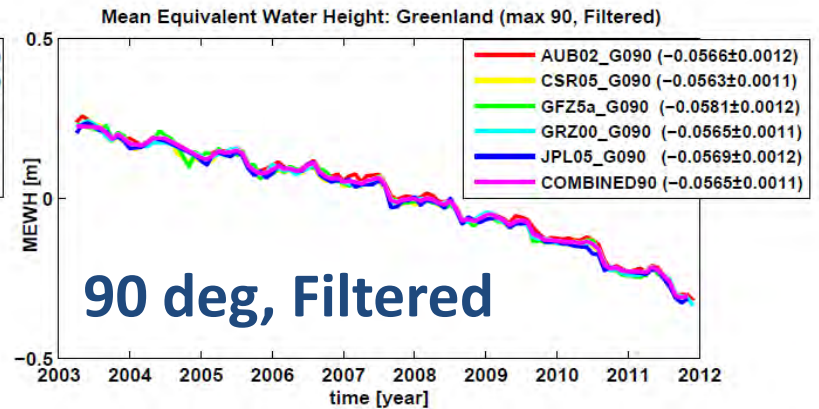
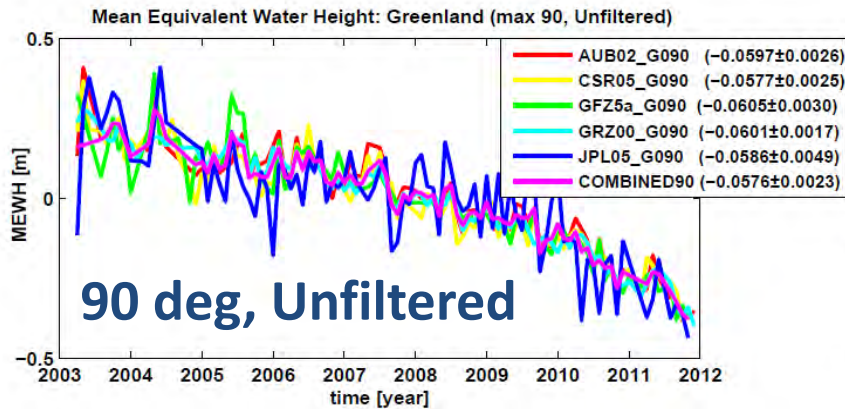
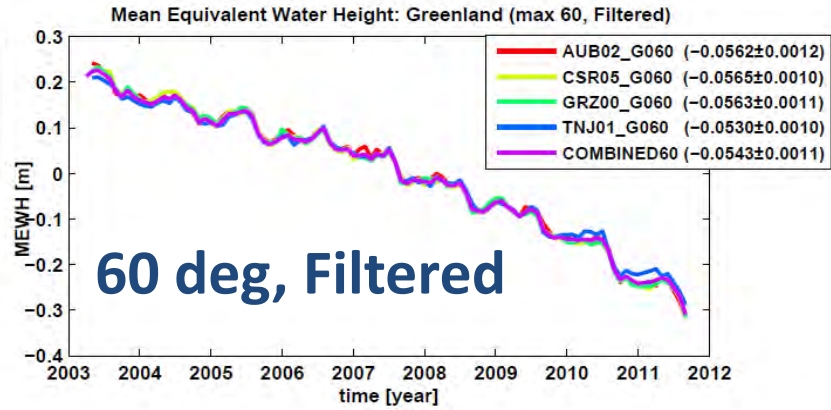
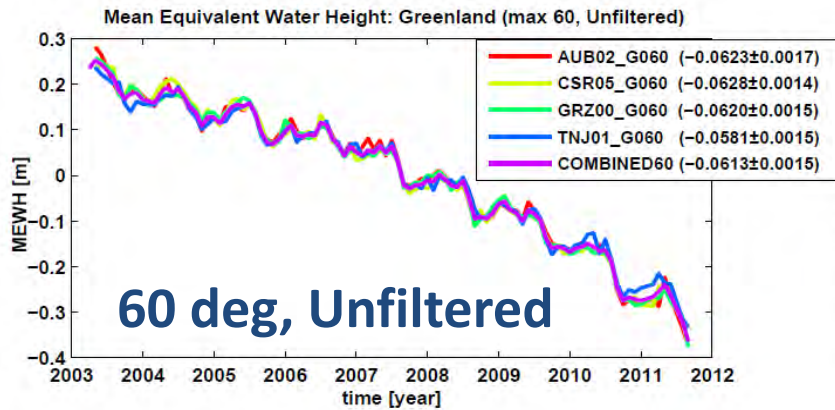
90 deg, Filtered

Different level of Noise in GRGS solution

Y. Jean et al.: Combination of GRACE monthly gravity field solutions with different weighting schemes
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Combination

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



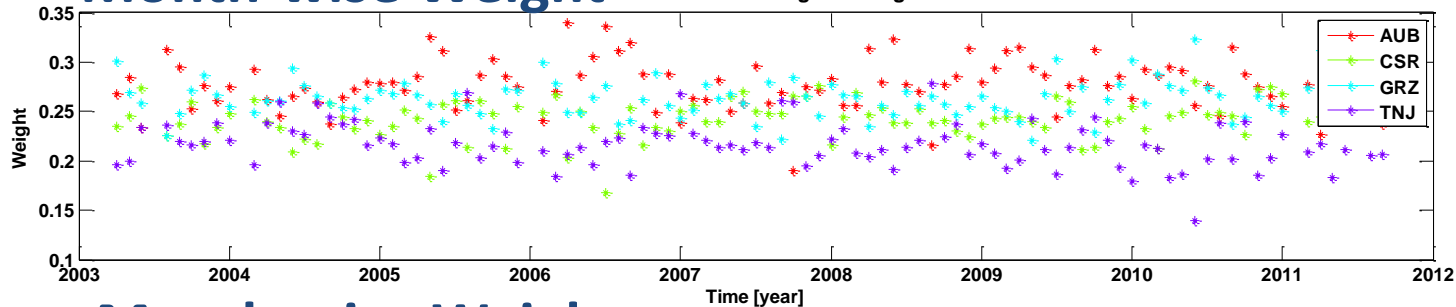
Combination: Weighting Schemes

Different Combined Solutions:

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

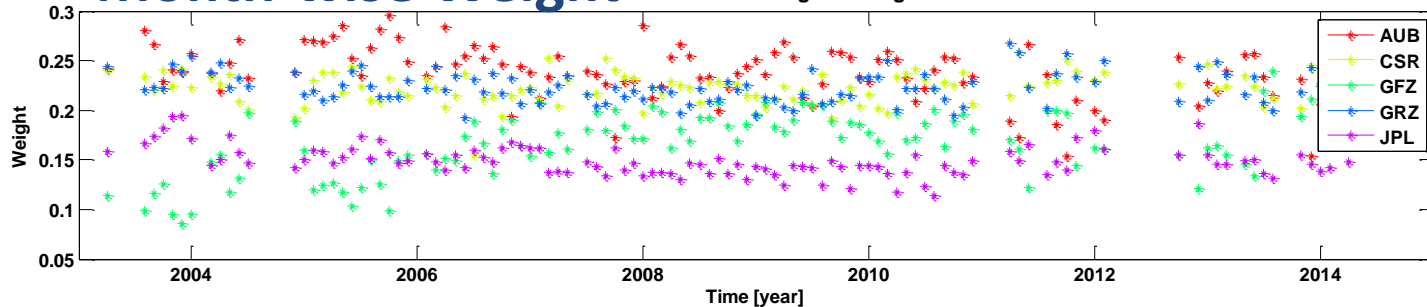
	Label	Type of Combined Solution	Weight
1	CMB00	Simple Arithmetic Mean	Identical weights
2	CMB02	Coefficient-wise Weighted Mean	Each L and each M in each Month
3	CMB03	Order-wise Weighted Mean	Each M in each Month
4	CMB05	Month-wise Weighted Mean	Each Month

Month-wise Weight



Degree 60

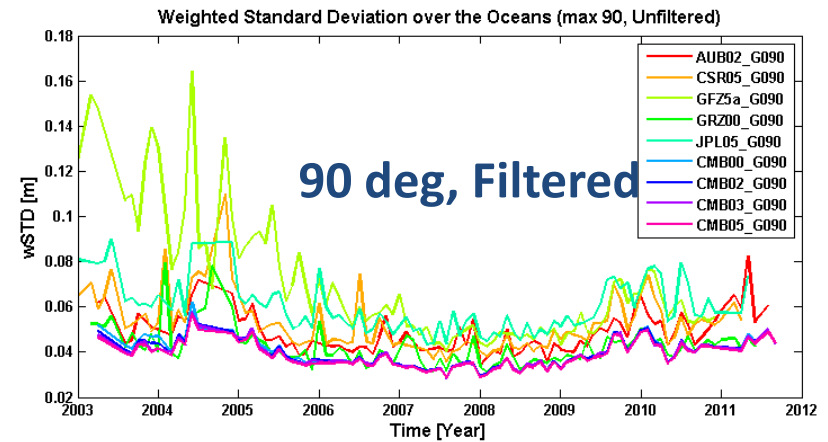
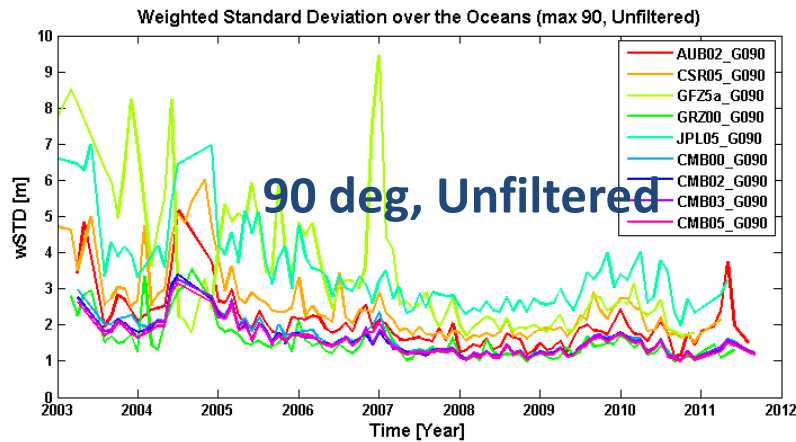
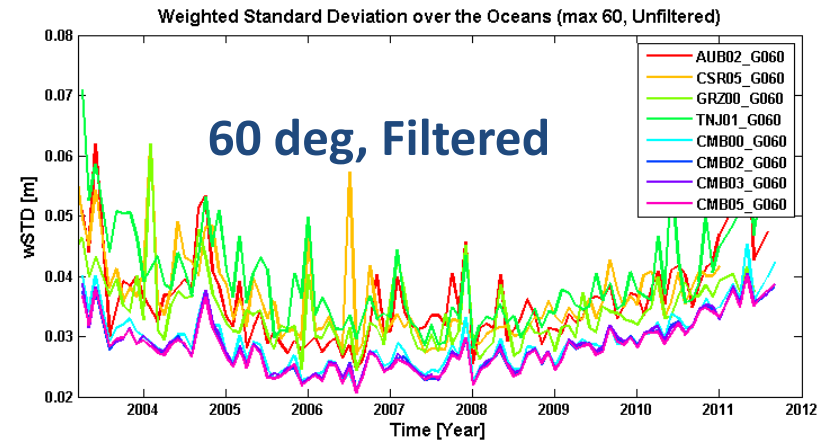
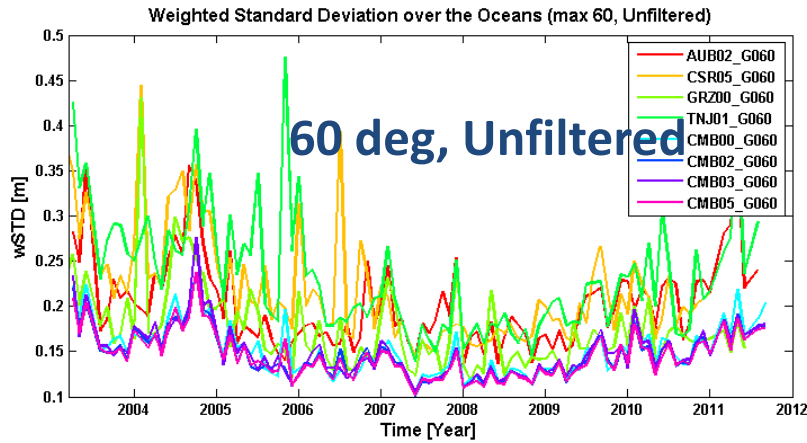
Month-wise Weight



Degree 90

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 comparable 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: on normal equation level