

# Combination of GRACE monthly gravity field solutions with different weighting schemes

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**Geodätische Woche 2015**

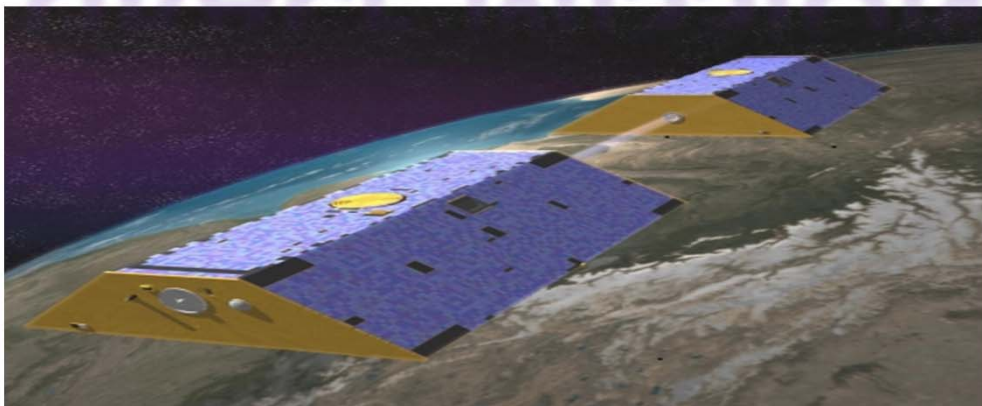
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# GRACE Monthly Gravity Field Solutions

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## GRACE MISSION



AIUB solution

Delft solution

GRGS solution

ITSG solution (GRAZ)

Tongji U. solution

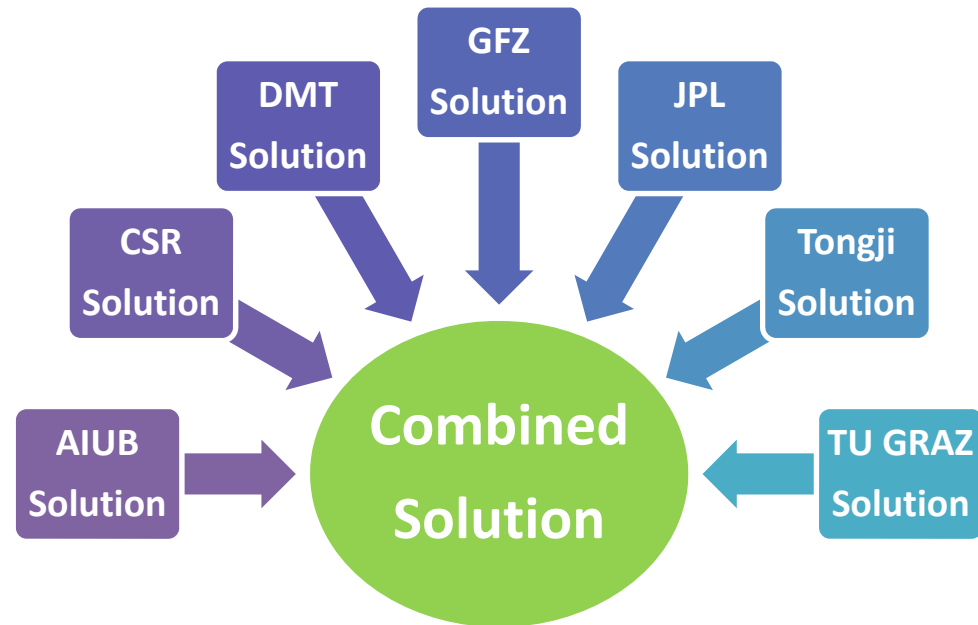
GFZ solution

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

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

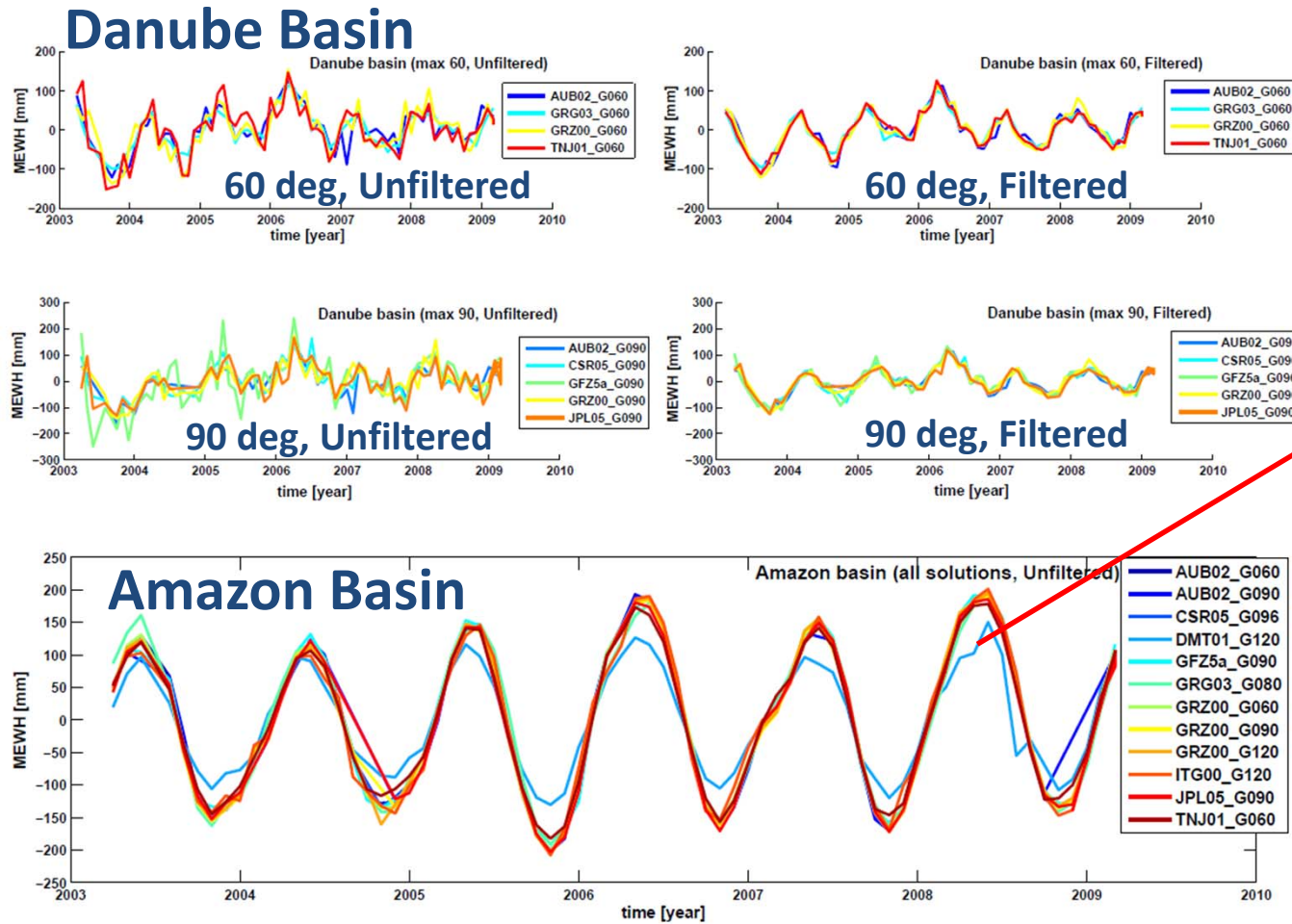
\*\* : included in the combined solution of maximum degree 90

# Comparison: Signal (MEWH)

- Mean Equivalent Water Height

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

$\theta$ : colatitude



DMT solution:  
Damped Signal  
due to pre-filtering



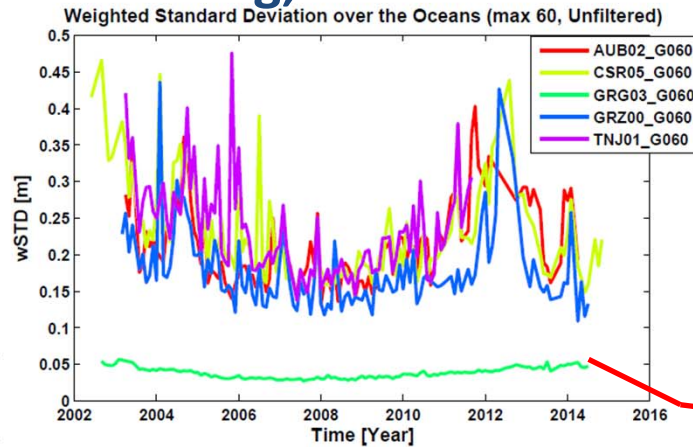
# Comparison: Variability (wSTD over the Oceans)

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

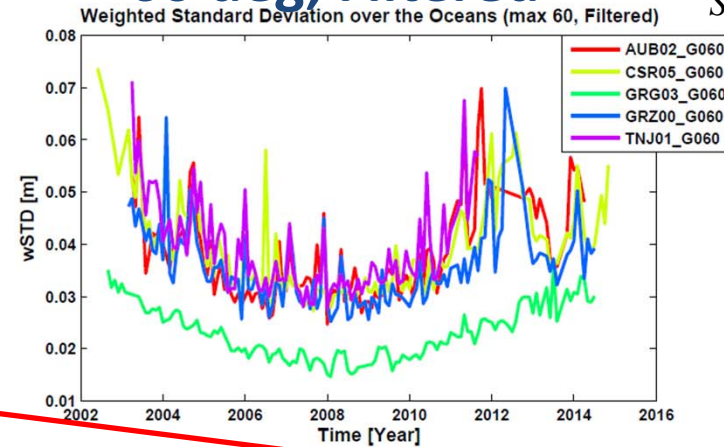
$\theta$ : colatitude

STD: Standard Deviation

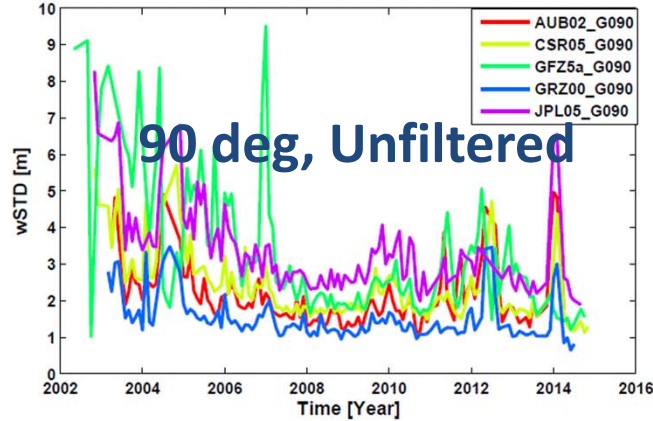
## 60 deg, Unfiltered



## 60 deg, Filtered

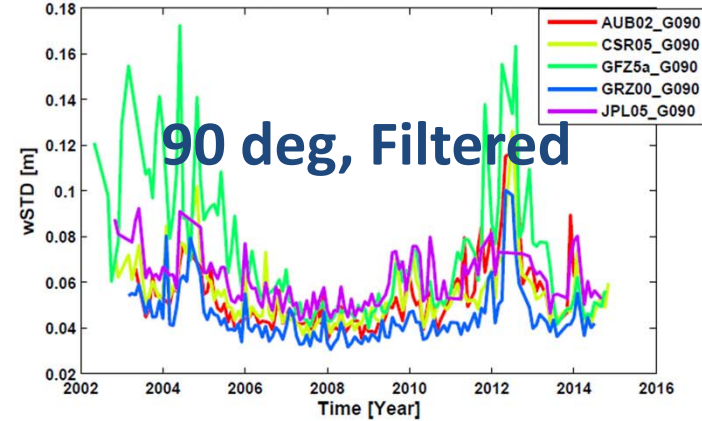


Weighted Standard Deviation over the Oceans (max 90, Unfiltered)



## 90 deg, Unfiltered

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



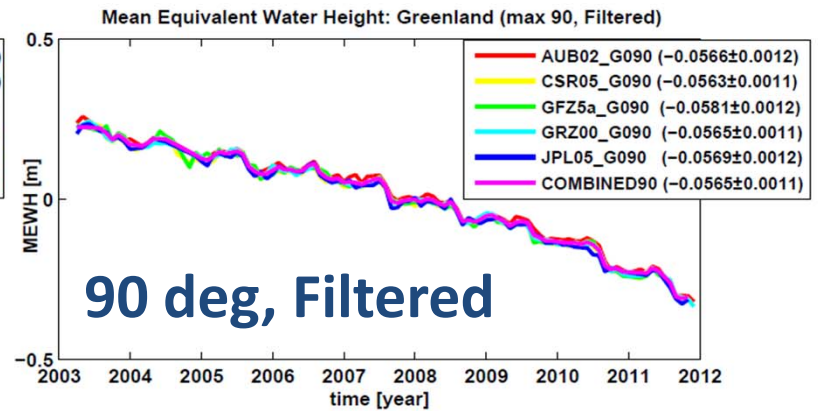
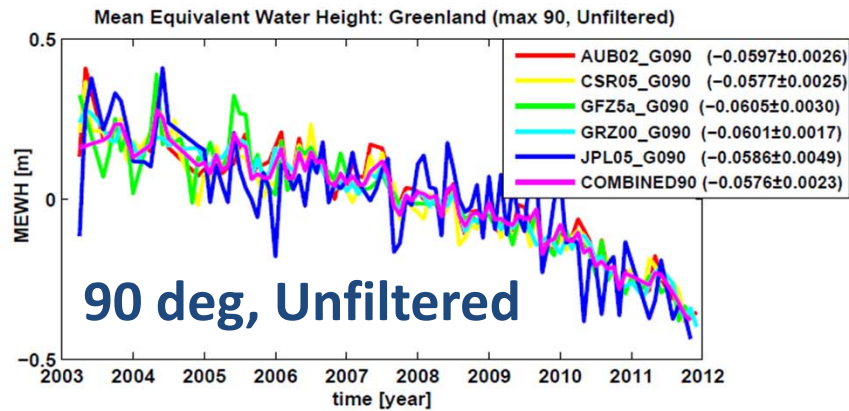
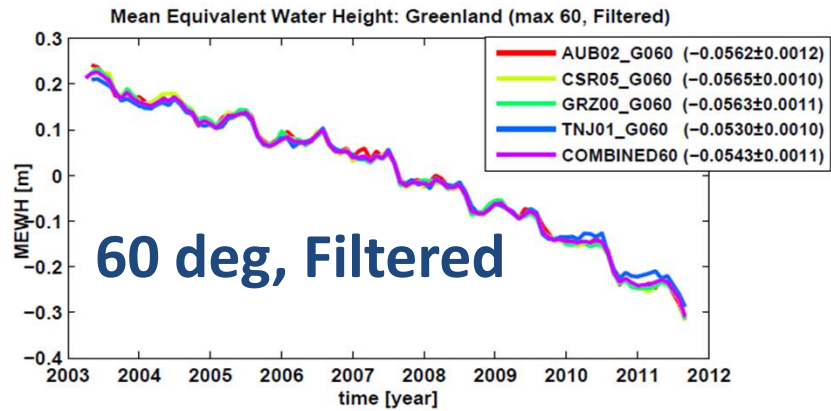
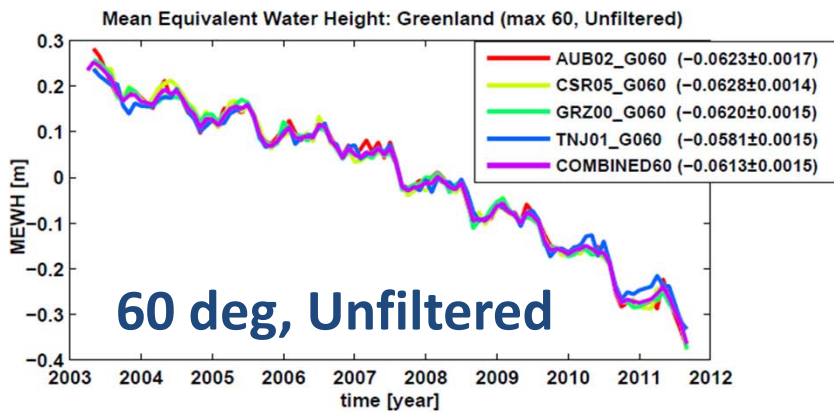
## 90 deg, Filtered

Different level of Noise in GRGS solution

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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



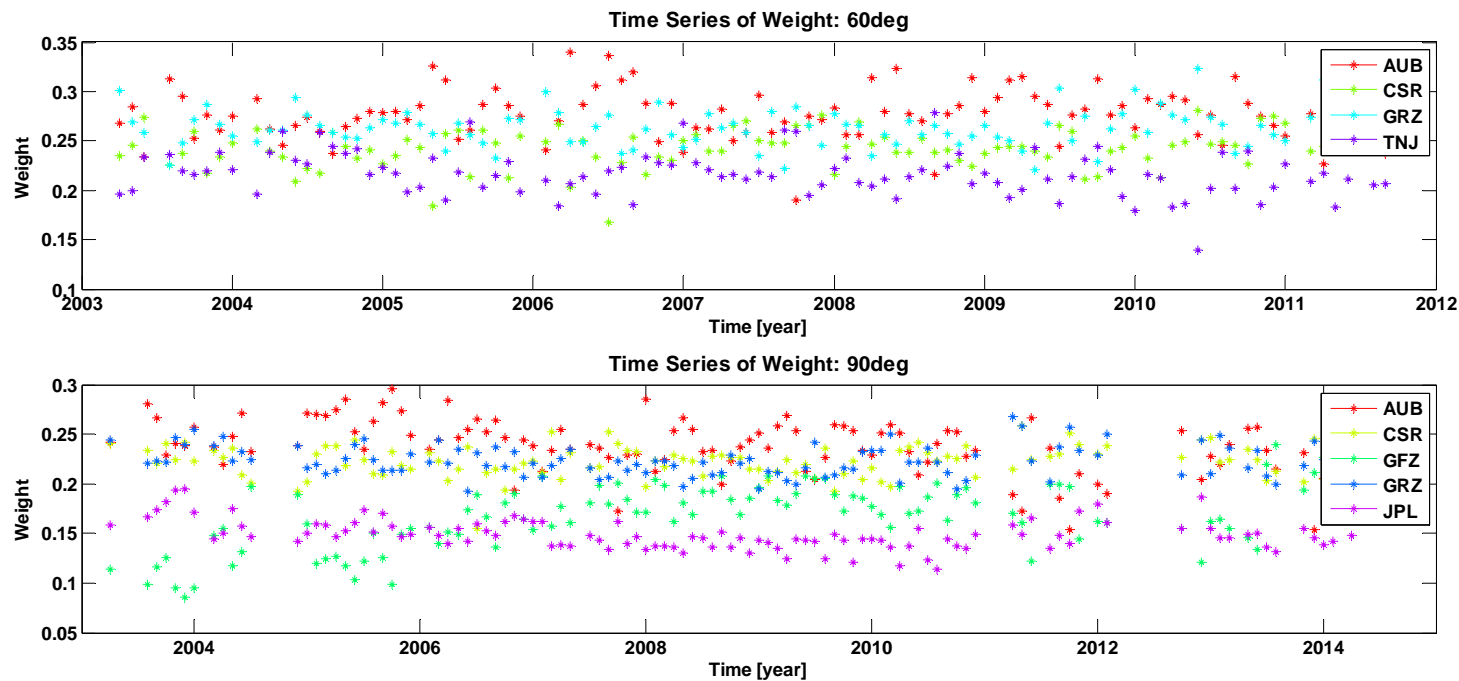
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# Combination: Weighting Schemes

## 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 <b>Weighted Mean</b>	Each <b>L</b> and each <b>M</b> in each <b>Month</b>
3	CMB03	Order-wise <b>Weighted Mean</b>	Each <b>M</b> in each <b>Month</b>
4	CMB05	Month-wise <b>Weighted Mean</b>	Each <b>Month</b>

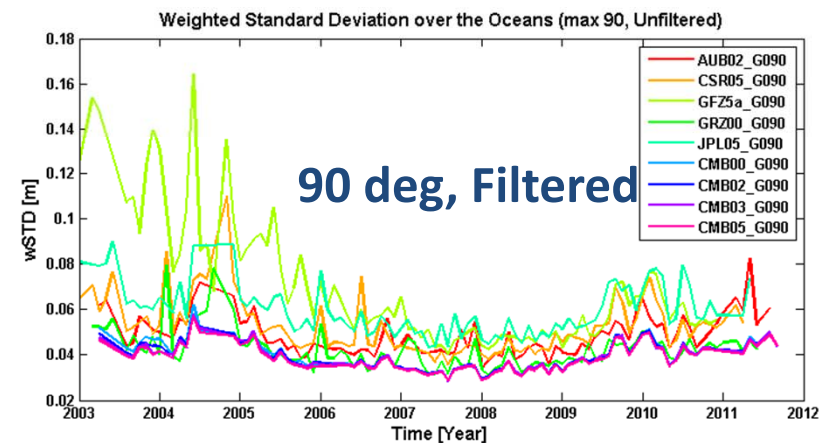
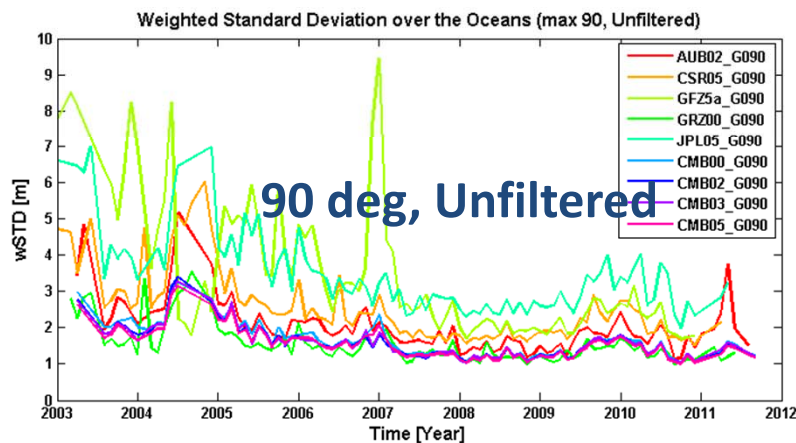
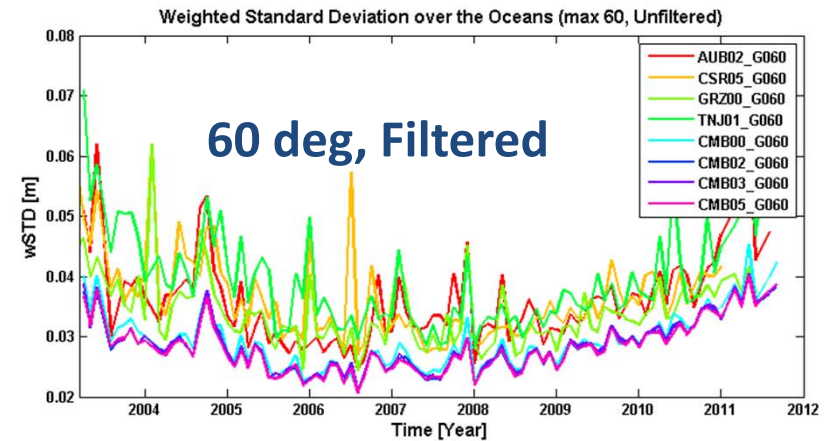
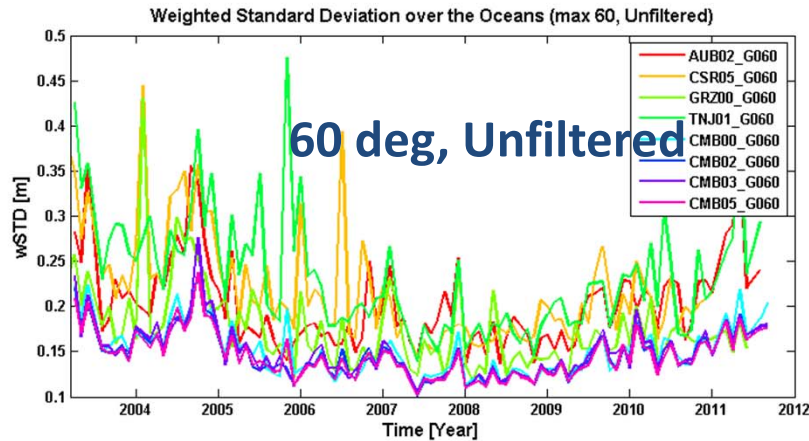


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# Combined Solutions with different weights

- wSTD over the oceans



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# Summary and Conclusions

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- 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