

# Combination of the Latest Releases of GRACE Monthly Gravity Field Solutions

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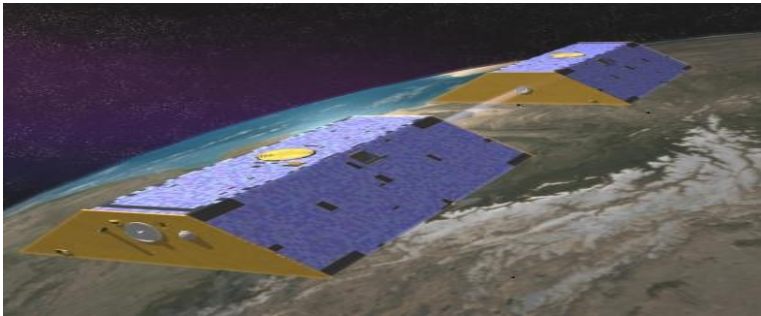
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# Combination of GRACE Monthly Gravity Solutions

## GRACE MISSION



- To make use of the solutions from different processing strategies
- **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  **EGSIEM** European Gravity Service for Improved Emergency Management

# Available GRACE Monthly Gravity Solutions

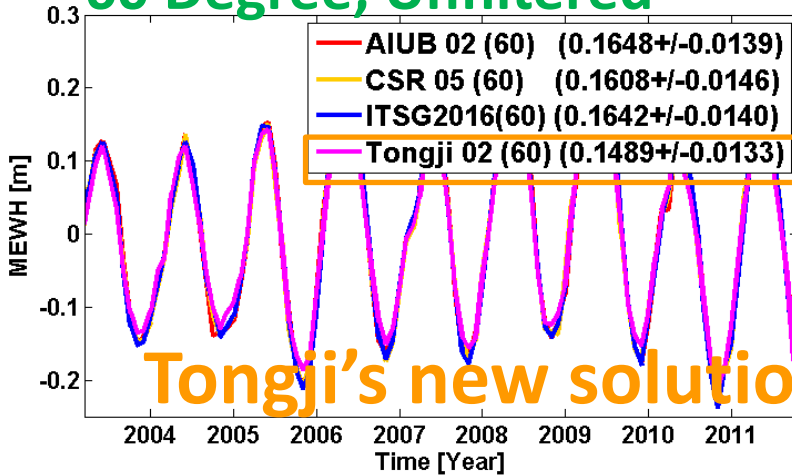
## The official **GRACE** monthly gravity solutions

available at the ICGEM website (<http://icgem.gfz-potsdam.de/ICGEM>):

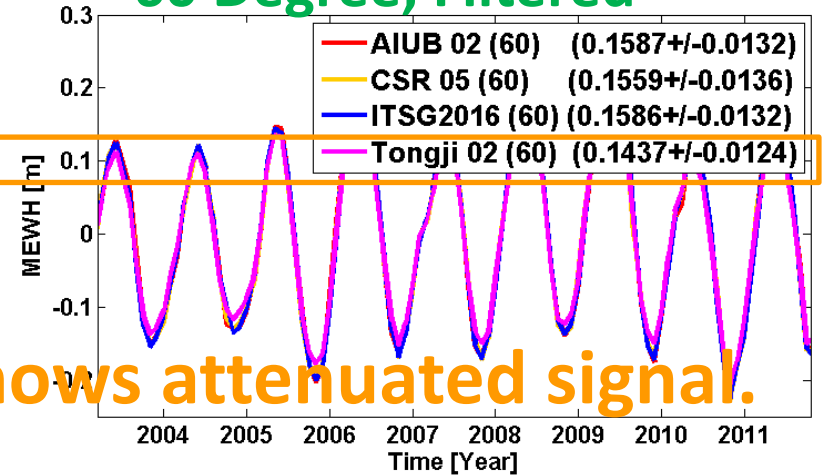
Processing Center	Maximum Degree	Release #	New Release in 2016	In the Combination
AIUB	60,90	RL02	-	Included
CSR	60,96	RL05	-	Included
GFZ	90	RL05	-	Included
ITSG	60,90,120	2014	2016 (60,90,120)	Included
JPL	60,90	RL05	-	Included
Tongji Univ.	60	RL01	RL02 (60)	Included
DMT	120	RL01	-	Not Included (: Pre-filtered)
GRGS	80	RL03	-	Not Included (: Pre-filtered)

# Comparison: Signal (MEWH)

## 60 Degree, Unfiltered

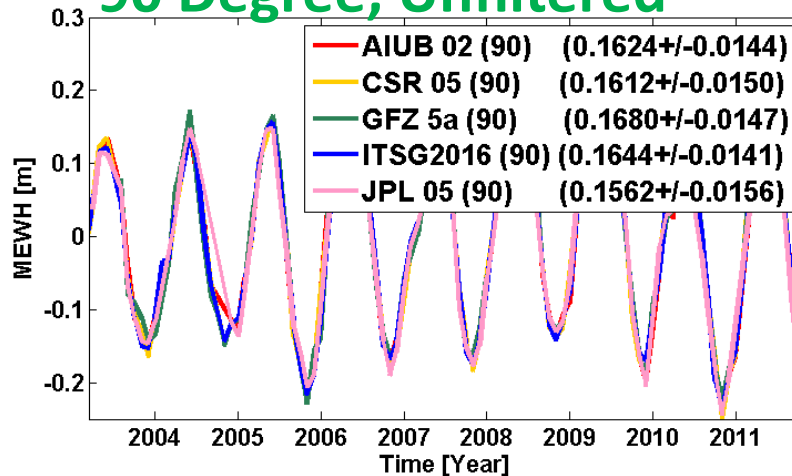


## 60 Degree, Filtered

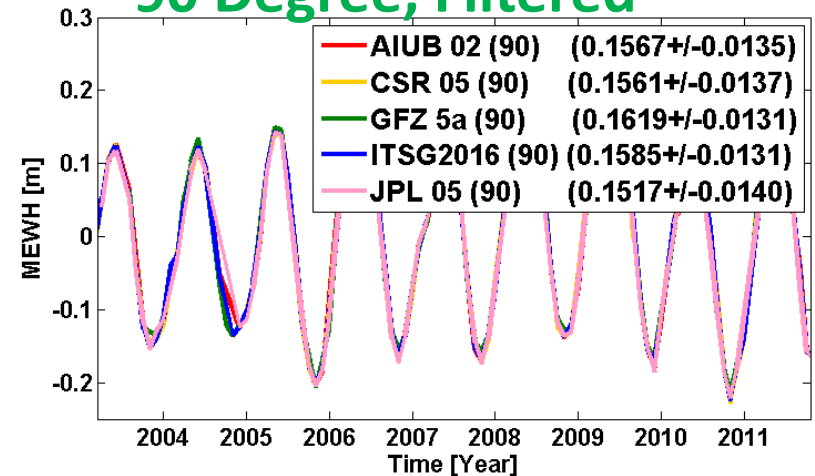


**Tongji's new solution shows attenuated signal.**

## 90 Degree, Unfiltered

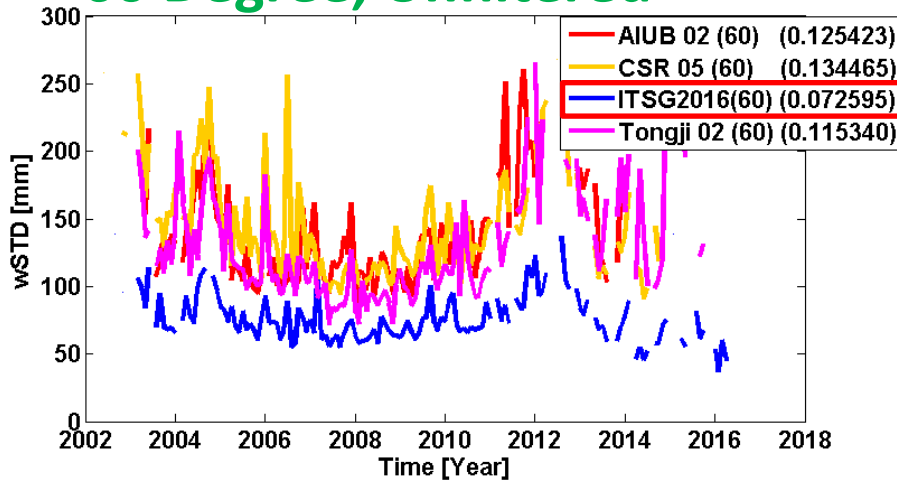


## 90 Degree, Filtered

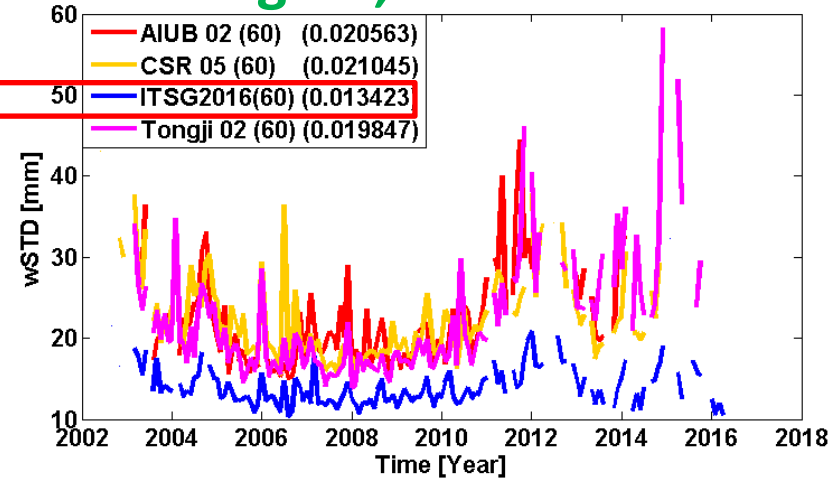


# Comparison: Variability (wSTD over Oceans)

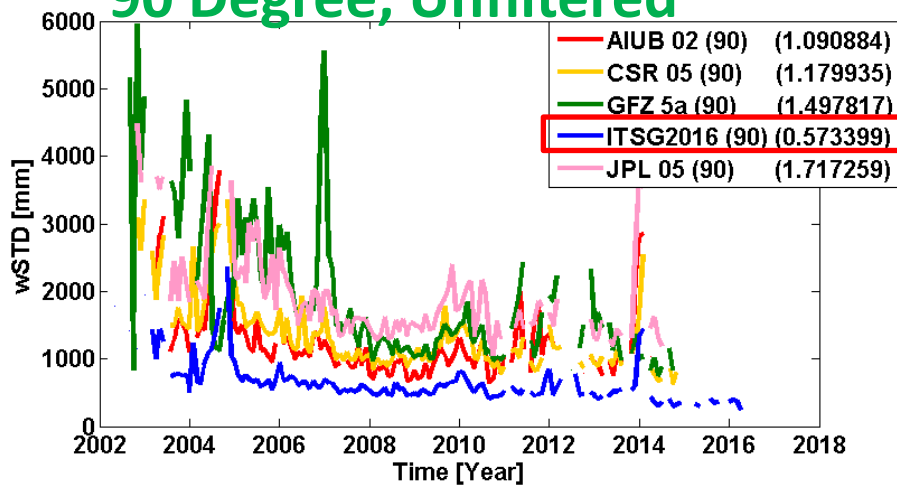
## 60 Degree, Unfiltered



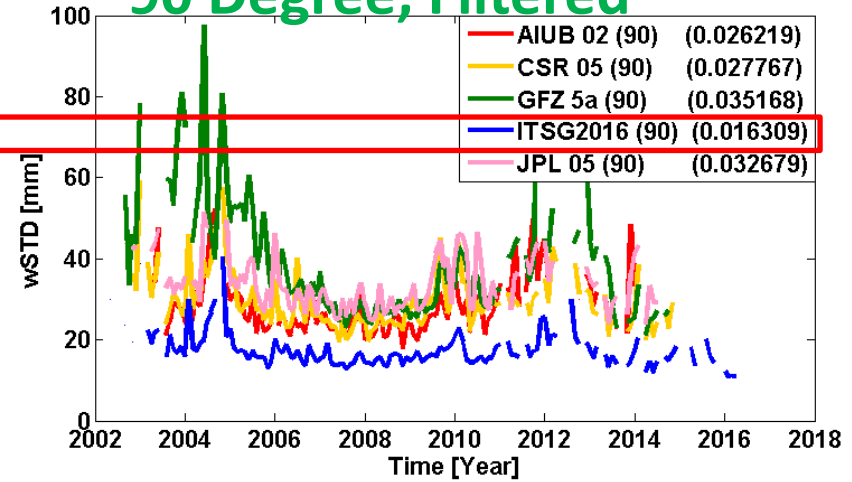
## 60 Degree, Filtered



## 90 Degree, Unfiltered



## 90 Degree, Filtered



# Combination: Weighting Schemes

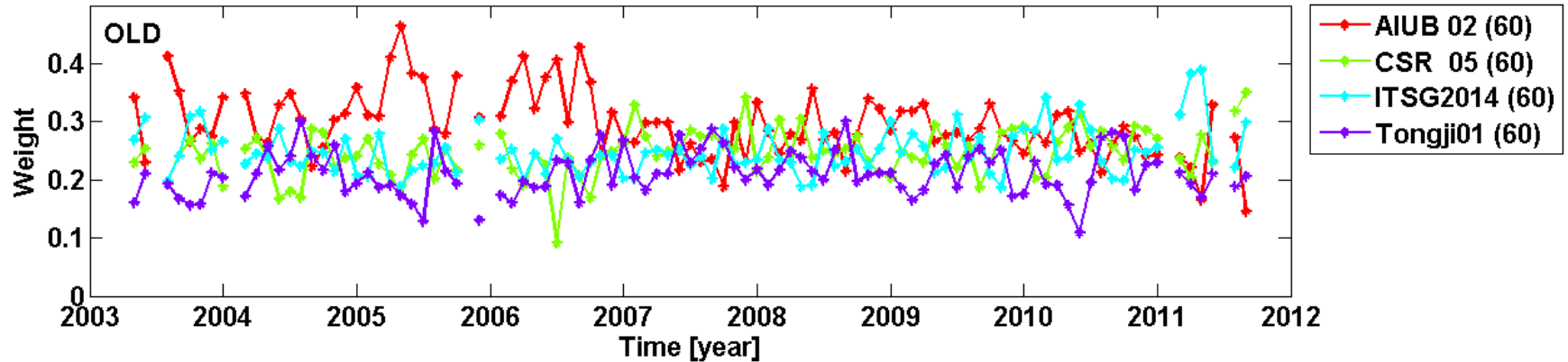
Combined Solution (Max. Deg.)	Involved Individual Solutions
Combined Solution (60)	AIUB 02, CSR 05, <b>ITSG2016</b> , <b>Tongji 02</b>
Combined Solution (90)	AIUB 02, CSR 05, GFZ 5a, <b>ITSG2016</b> , JPL 05

- **Equal weight:** (arithmetic mean)
- **Field-wise Single weight:** using  $(\text{Individual} - \text{Arithmetic Mean})^{-2}$
- **Weights using VCE** (Variance Component Estimation):
  - Iterative process
  - Weights and wMean are updated in each iteration step

# Field-wise Weights: Degree 60

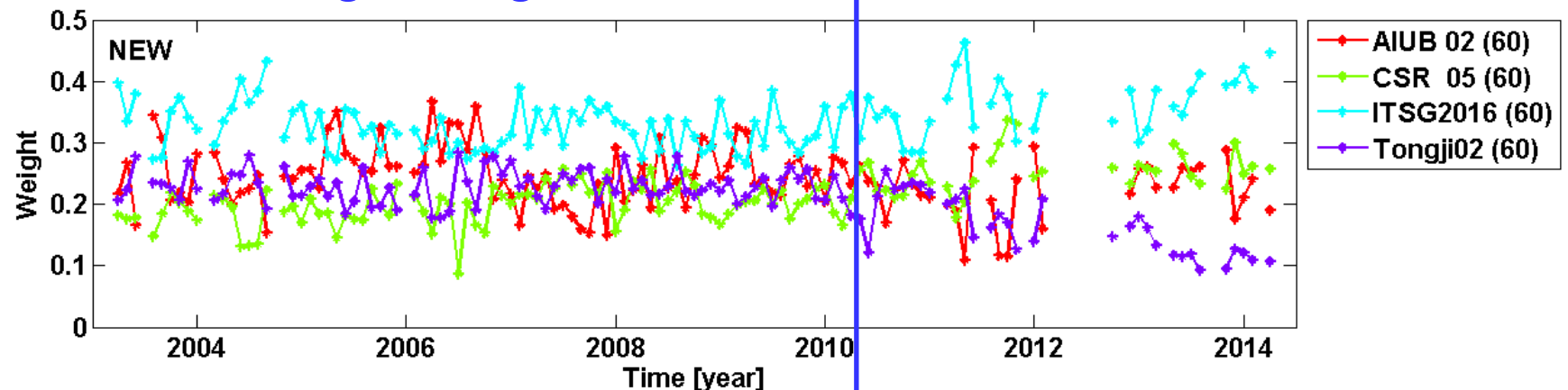
OLD

(without C20)



NEW

Higher weights on ITSG solution

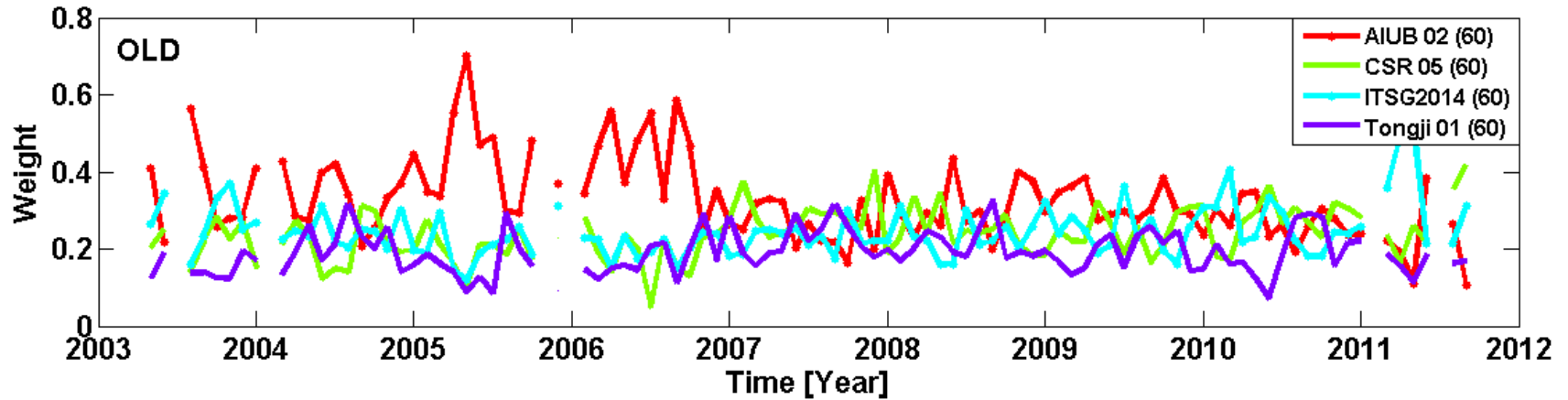


Difference in Tongji Solution: higher weights until 2010

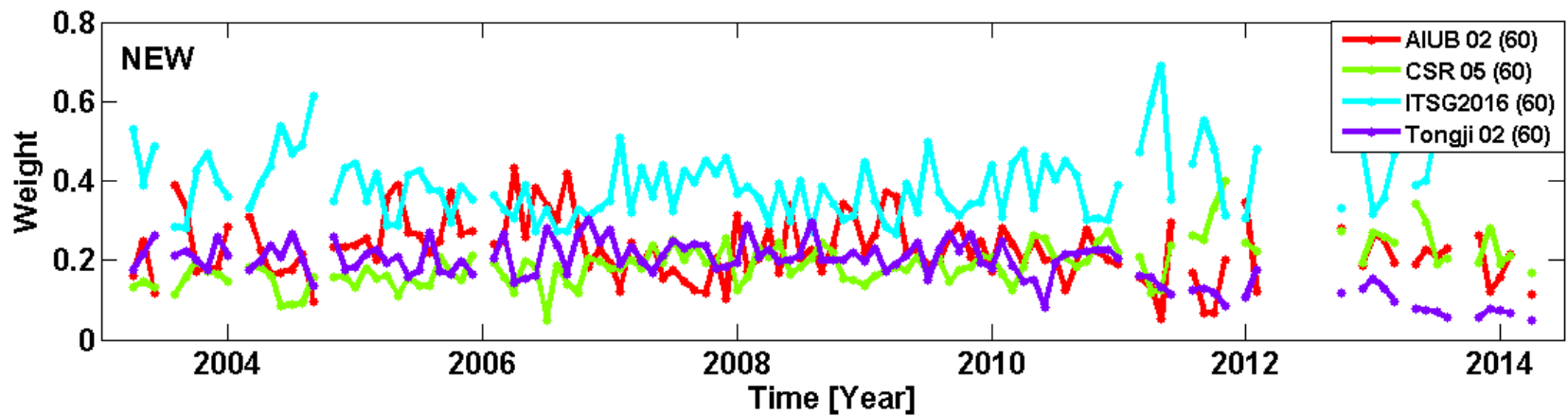
# Weights from VCE method: Degree 60

OLD

(without C20)



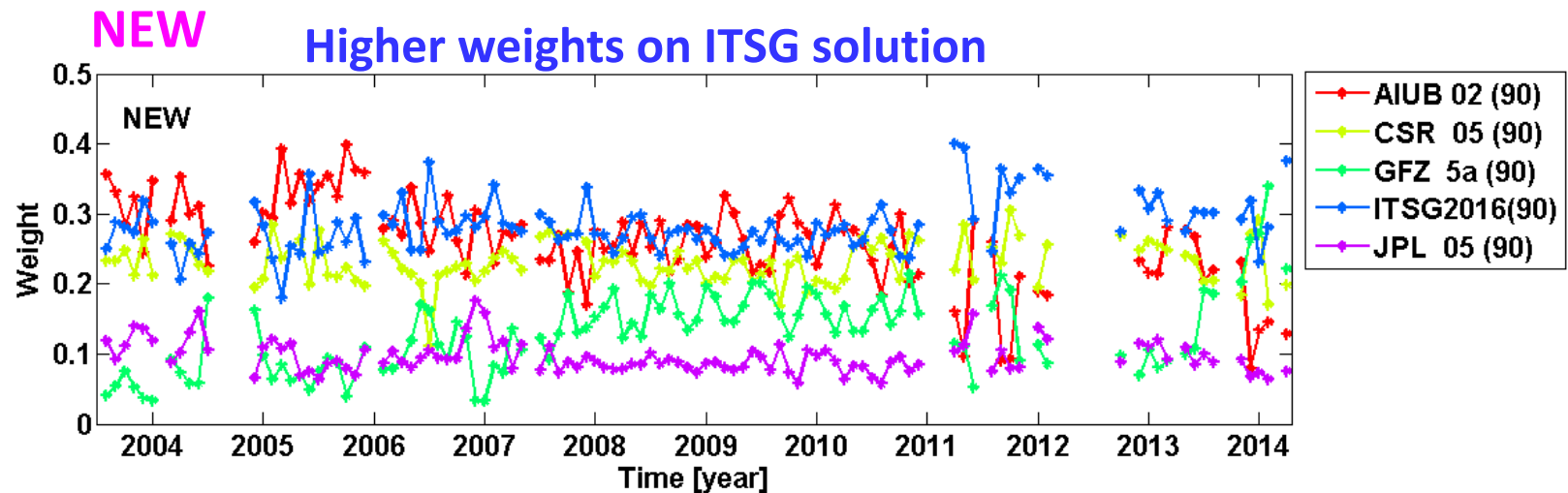
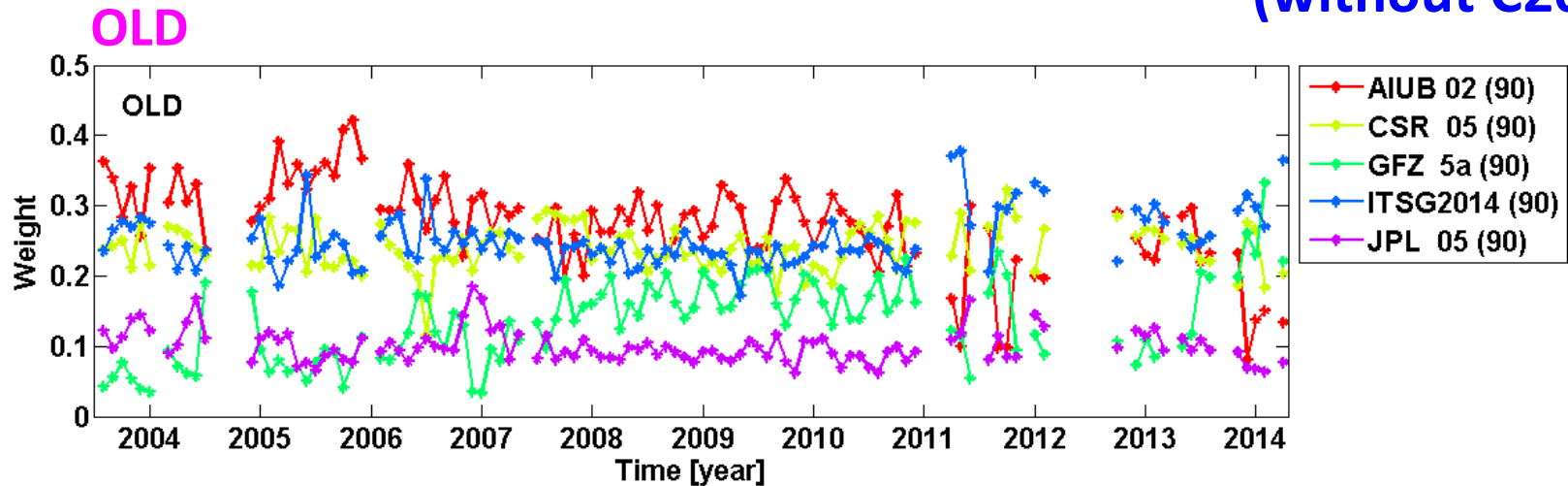
NEW





# Field-wise Weights: Degree 90

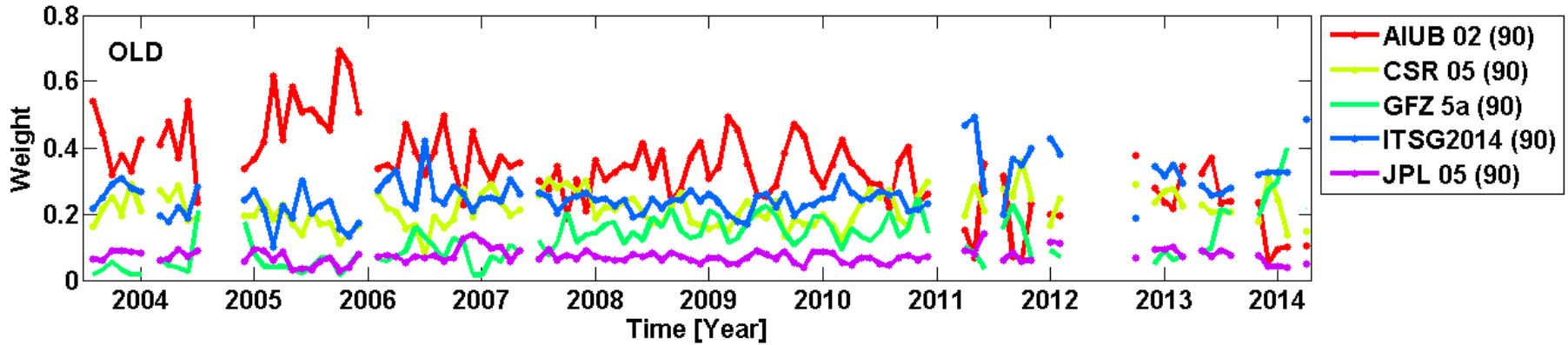
(without C20)



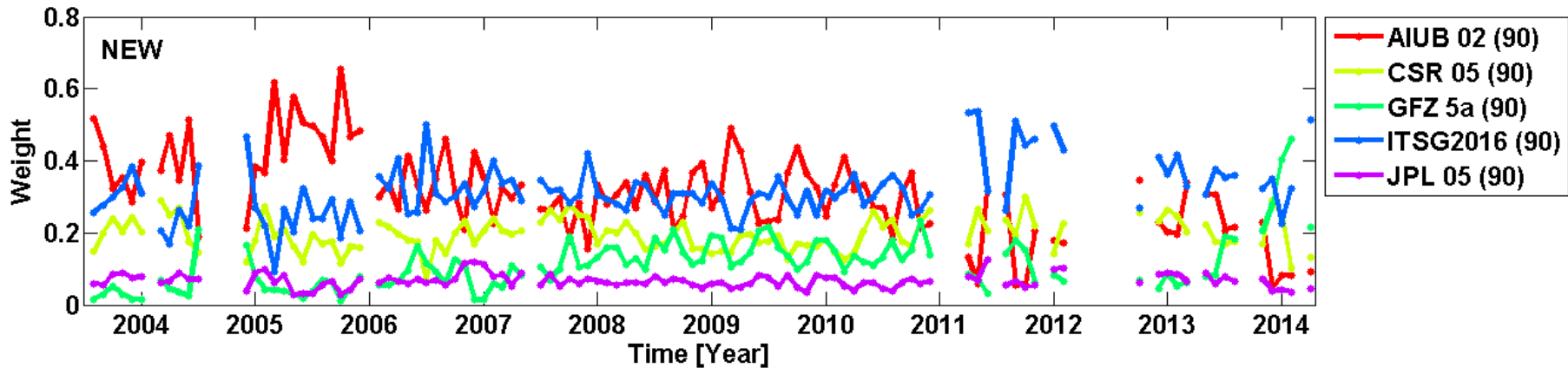
# Weights from VCE method: Degree 90

OLD

(without C20)

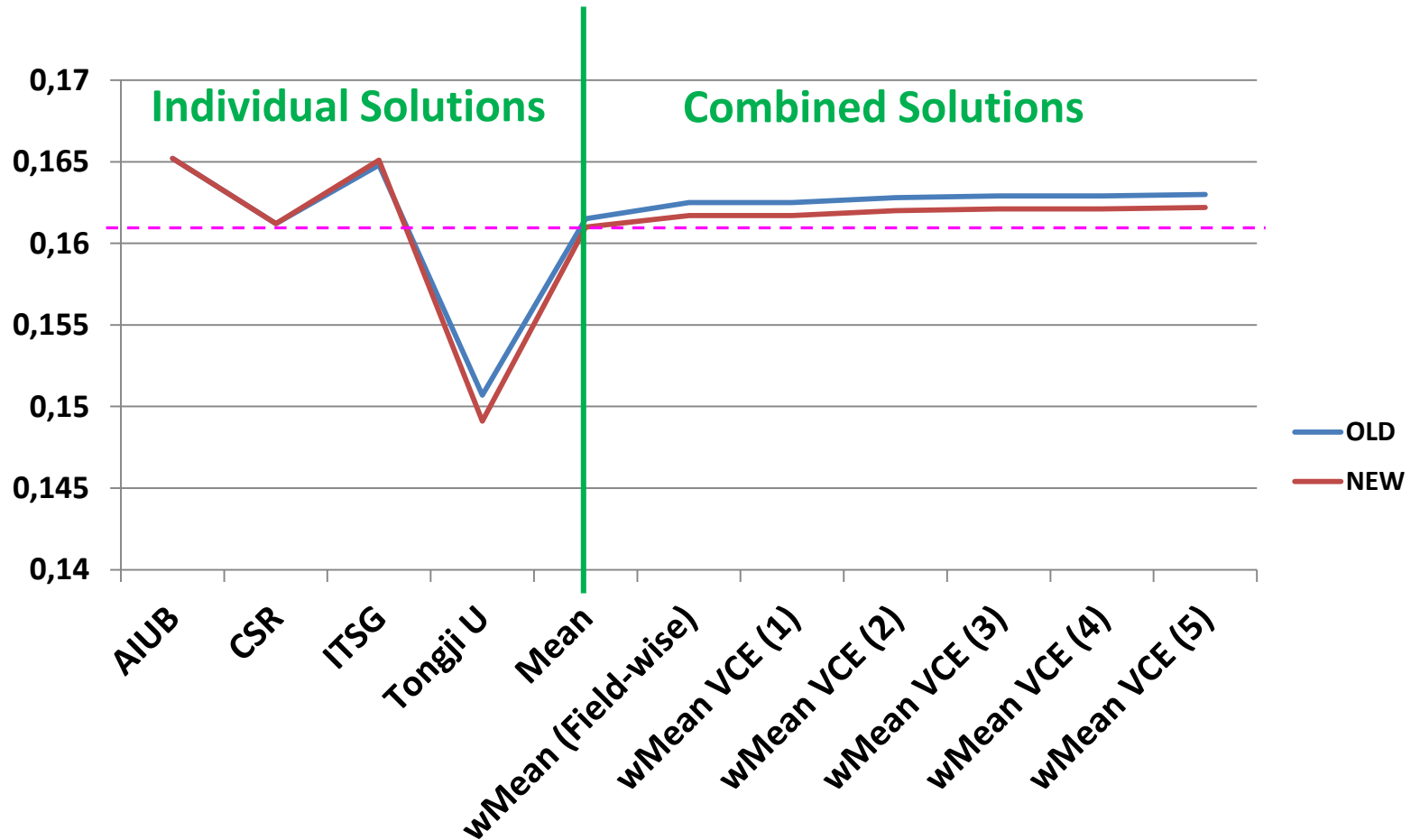


NEW



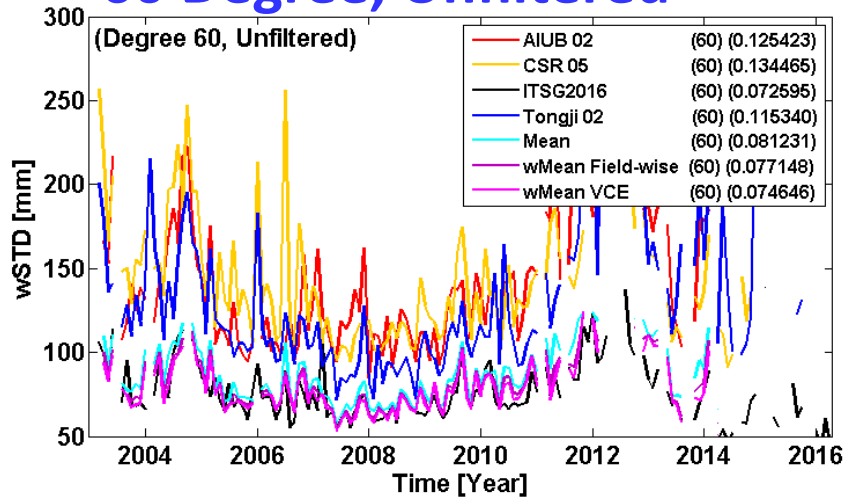
# Amplitude of Annual Signal

## in MEWH of Amazon River Basin (60 Degree, Unfiltered)

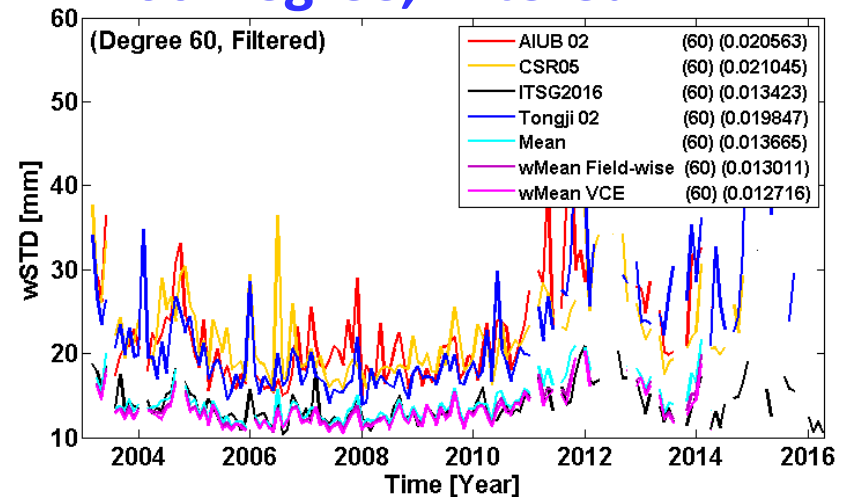


# Variability: wSTD over Oceans

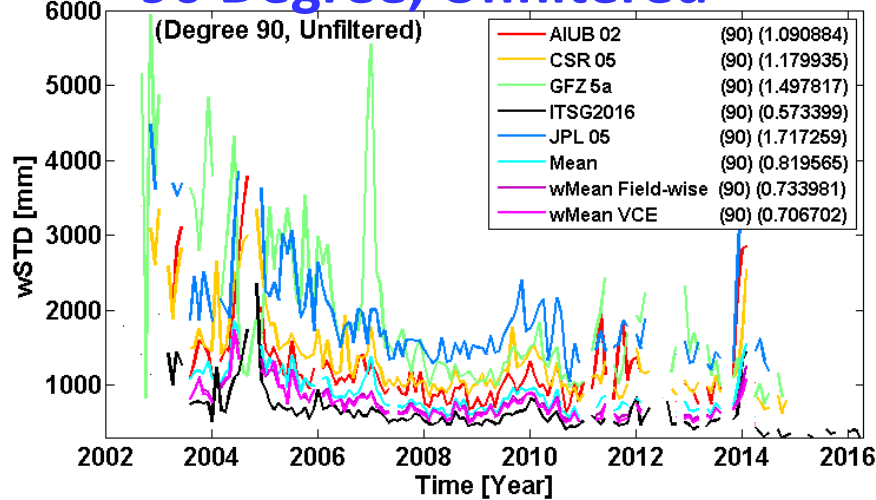
## 60 Degree, Unfiltered



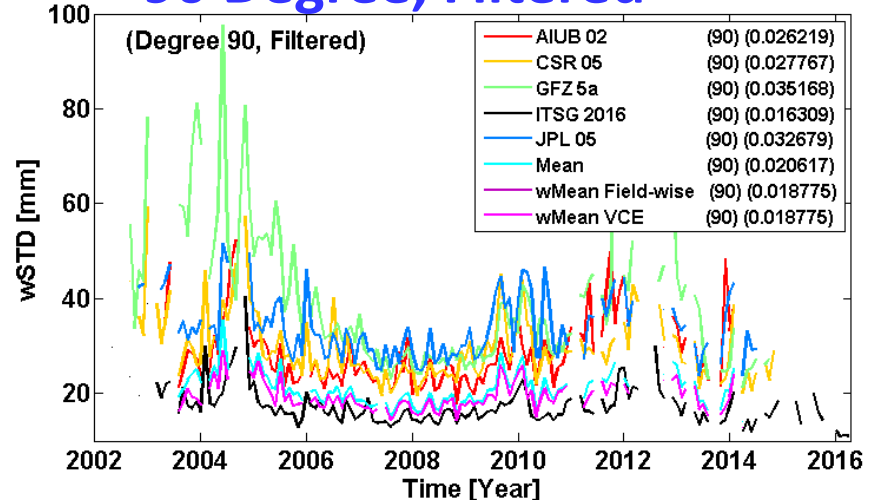
## 60 Degree, Filtered



## 90 Degree, Unfiltered

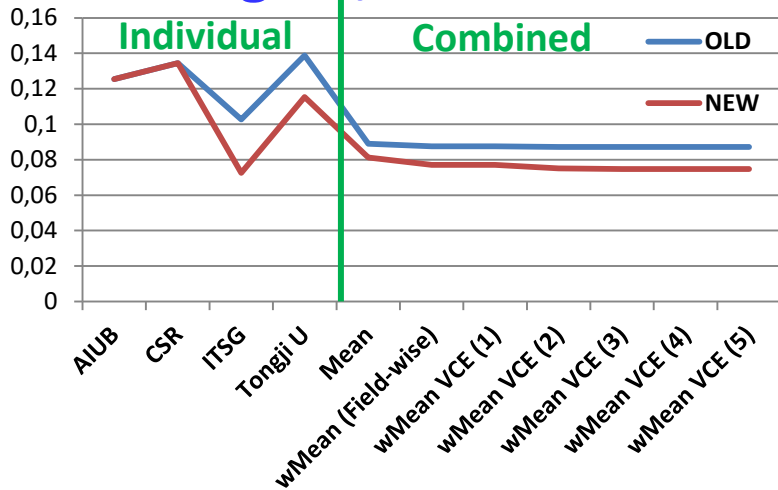


## 90 Degree, Filtered

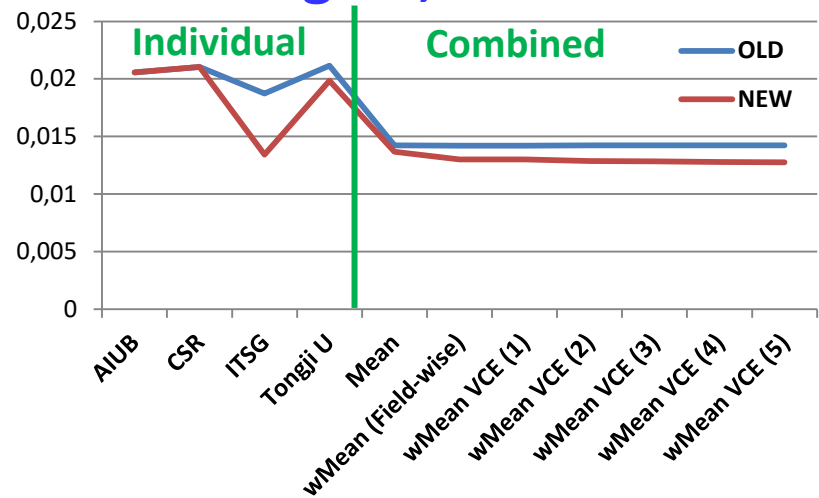


# Variability: wSTD over Oceans

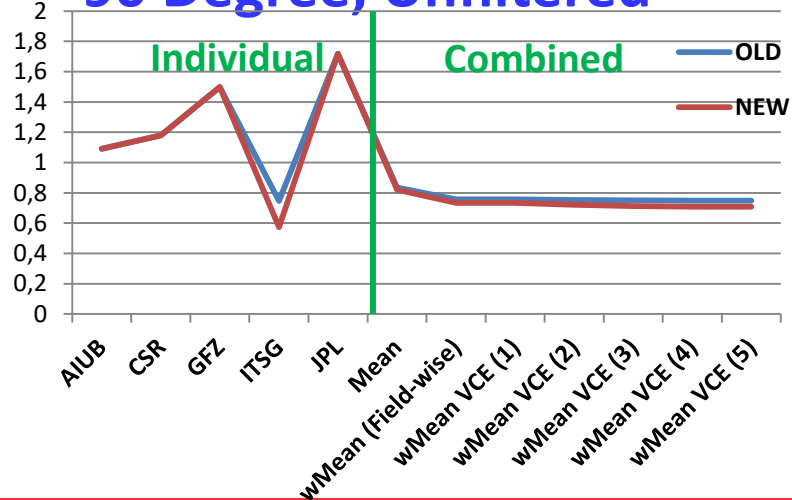
## 60 Degree, Unfiltered



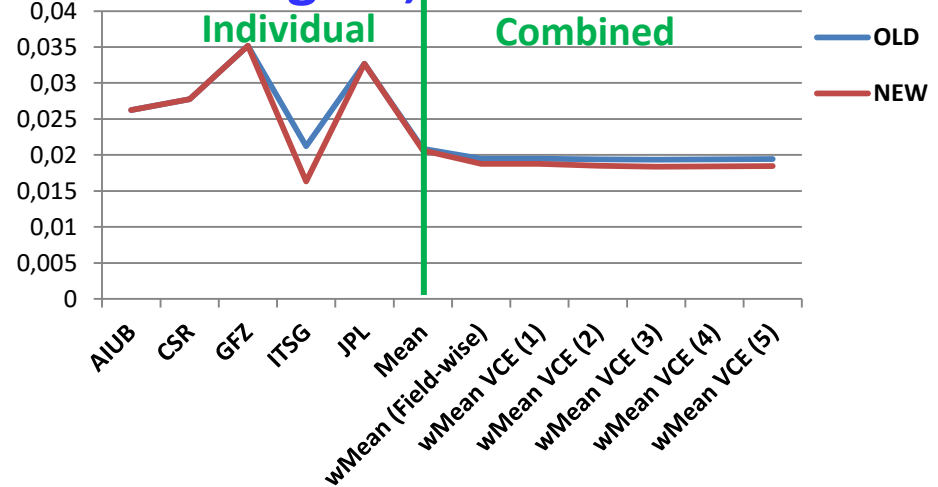
## 60 Degree, Filtered



## 90 Degree, Unfiltered



## 90 Degree, Filtered



# Summary and Conclusions

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- **GRACE Monthly gravity field solutions**  
*New release in 2016*: ITSG2016 (60,90,120), Tongji U (60)
- **Comparison** (signal and variability)
  - Both ITSG and Tongji solutions are **improved** in the new releases.
  - **Tongji solution** shows **slightly attenuated signal**.
- **Combination** including the *newly released solutions*:
  - Weighting schemes: equal weights, Field-wise weights, and weights from **VCE** method
  - Involved individual solutions have different levels of variability  
→ Combined solutions are not stronger in terms of variability
  - Better combined solutions are expected if the other processing centers also improve their solutions in the next releases.