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Analysis of De-correlation Filters Performance For Estimating Temporal Mass Variations Determined From GRACE-Based GGMs Over Konya Basin

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Content

1. Introduction
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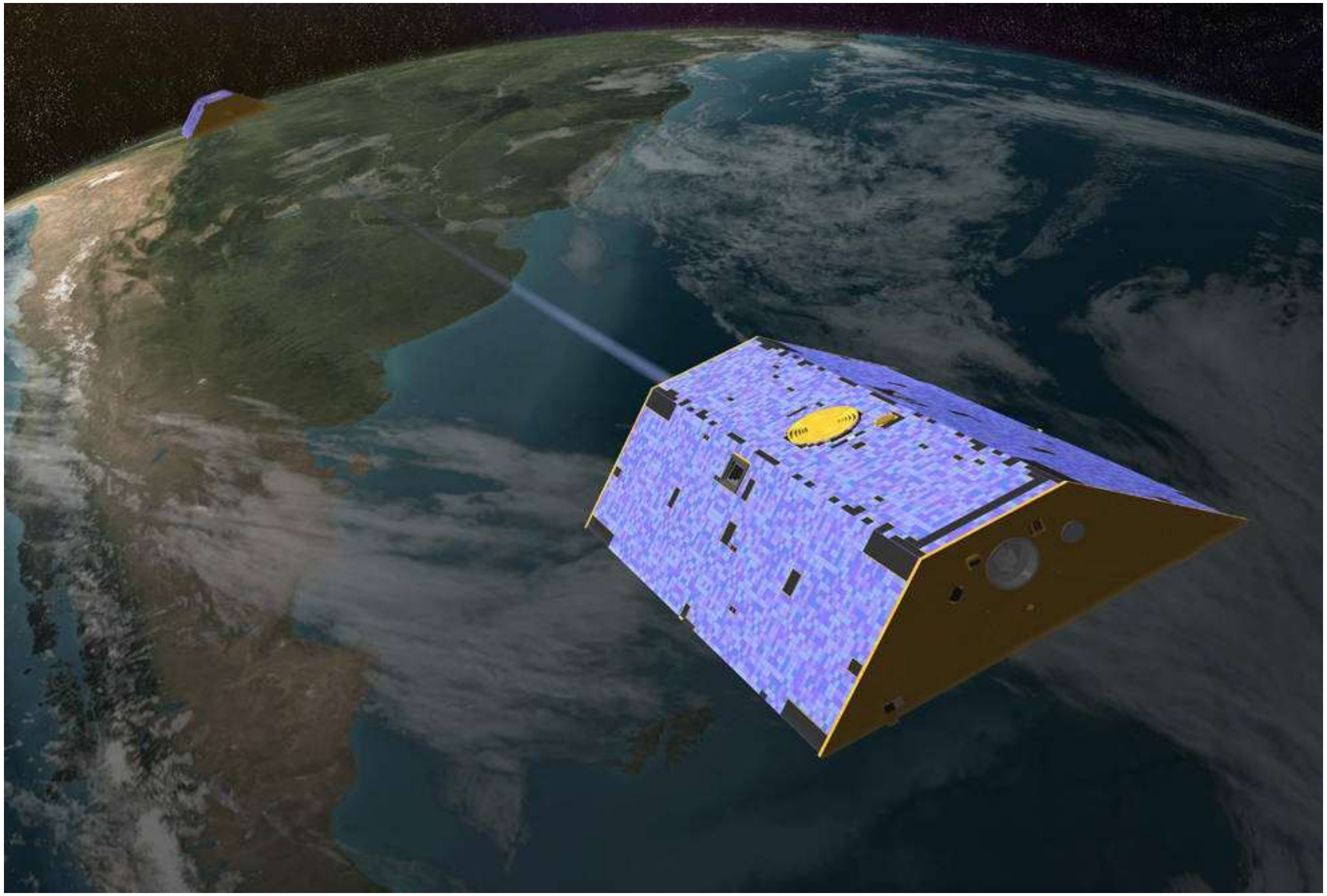
1 Introduction

- GRACE Mission (March 2002- October 2017)



- GRACE Follow-On (ca. May 2018 – ca. May 2023)

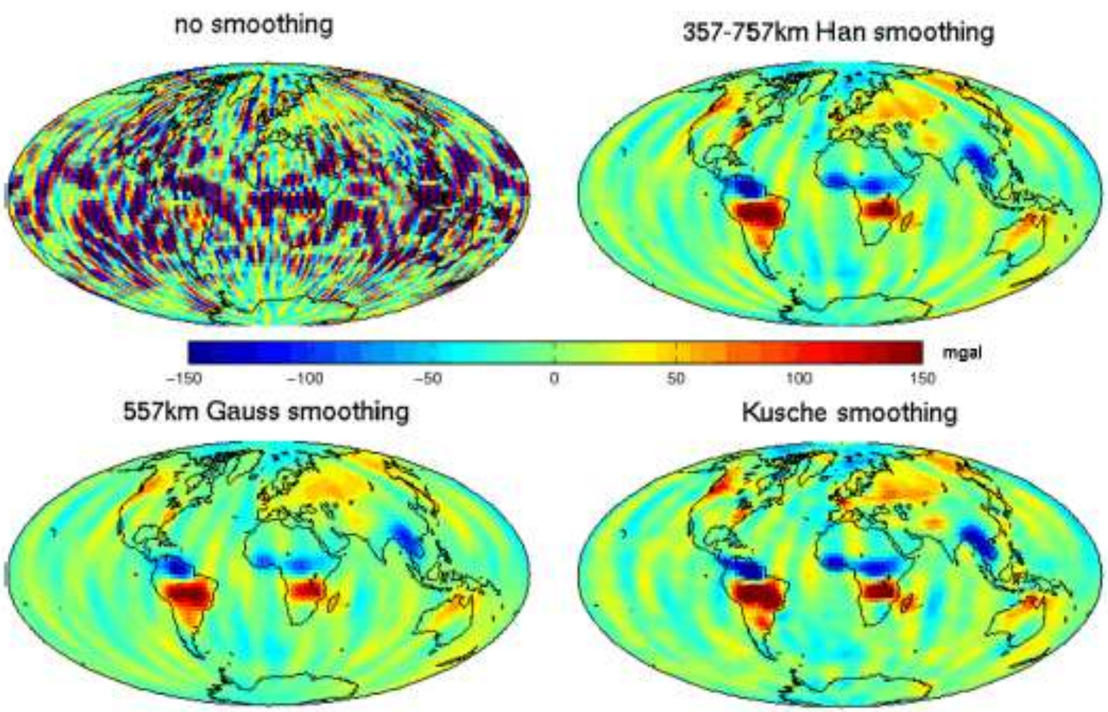
1 Introduction

- Tectonic motions (e.g. Mikhailov et al., 2004; Choi et al., 2006; Han and Simons 2008)
- Ocean mass variations (e.g. Chambers, 2009)
- Glacier melting (e.g. Slobbe et al., 2009)
- Level changes in groundwater sources (e.g. Swenson and Wahr 2003; Schmidt et al., 2006; Chen et al., 2008; Cazenave and Chen, 2010)

GRACE gravitational field solutions are often used to estimate the equivalent water thickness (*EWT*) because of their high sensitivity to hydrological changes at the global and regional scales.

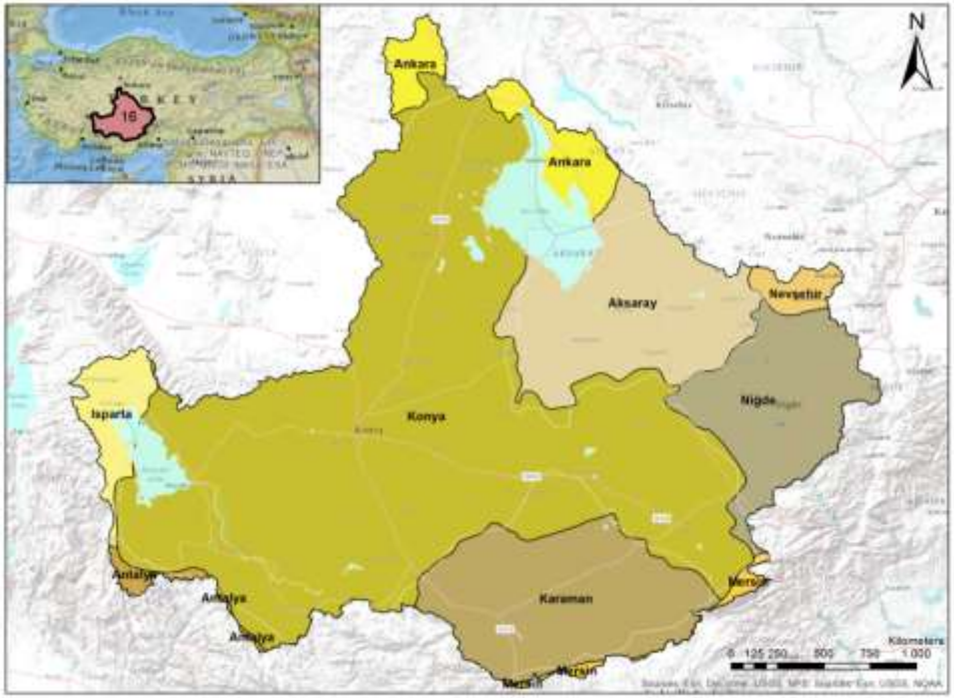
1 Introduction

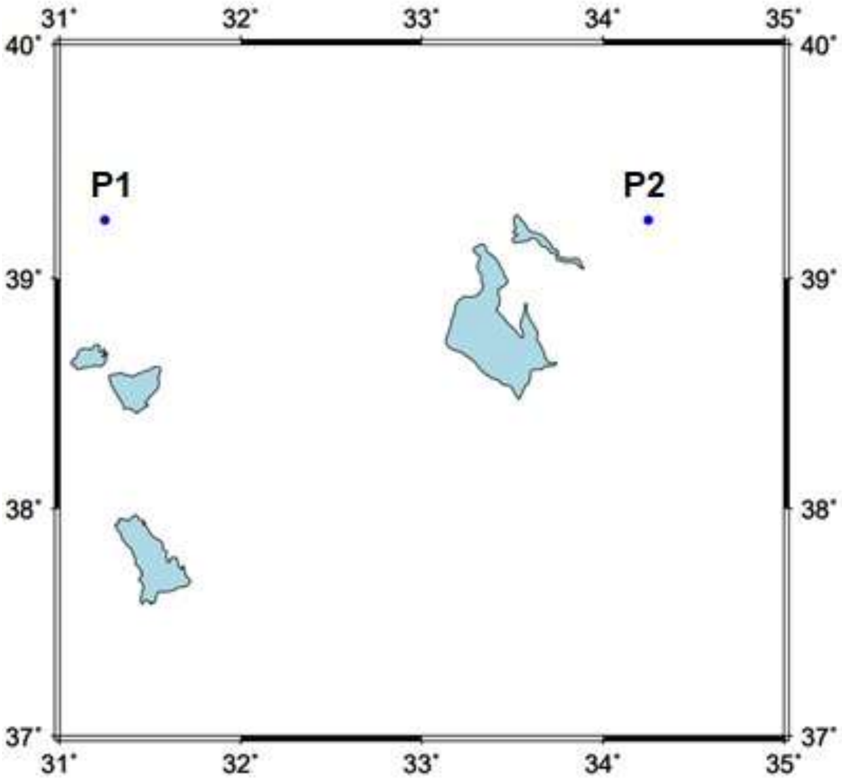
- Release 1
- Release 2
- Release 3
- Release 4
- Release 5 (RL05)



- **Gaussian Filtering Method**
- **De-correlation Filtering Method**

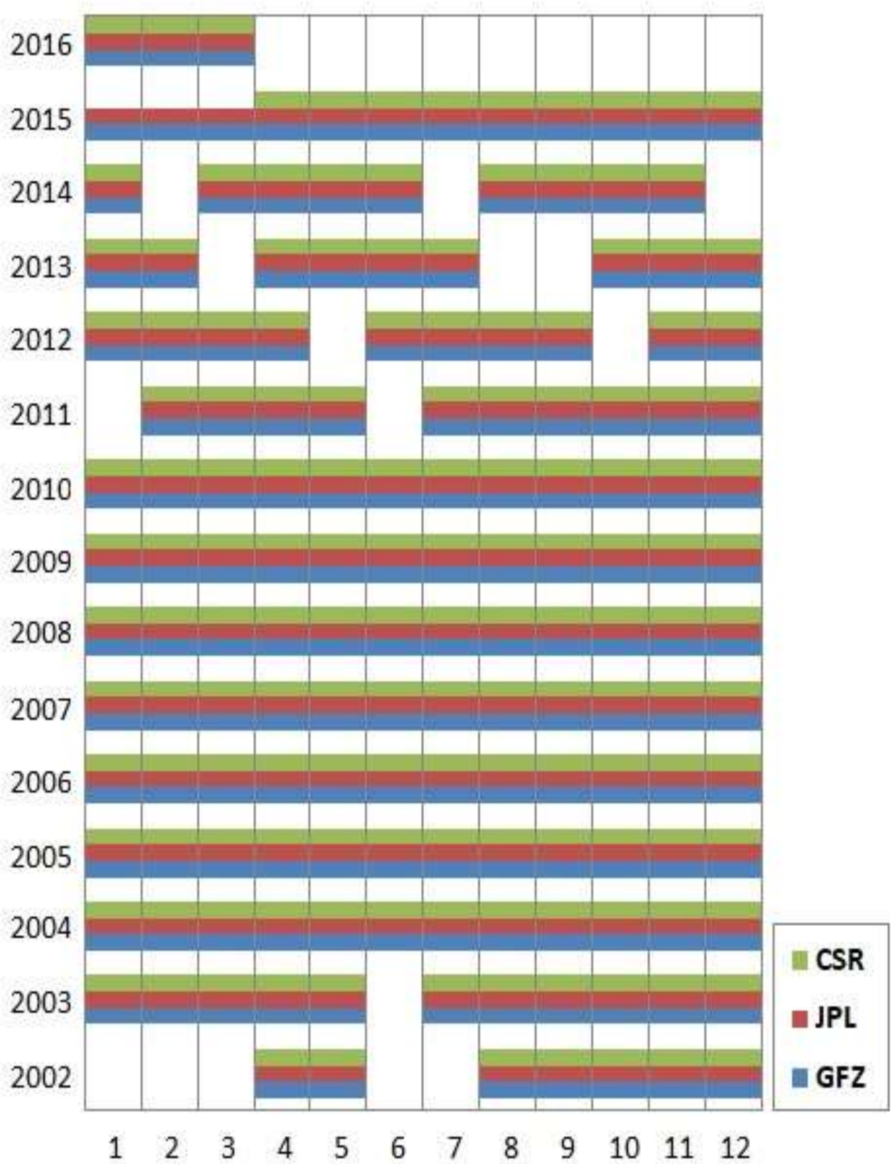
2 Data Used and Study Area





The basin spreads over an area of almost 5 million hectares, is one of the regions where mass variations are most intense.

2 Data Used and Study Area



- GFZ
- JPL
- CSR centers

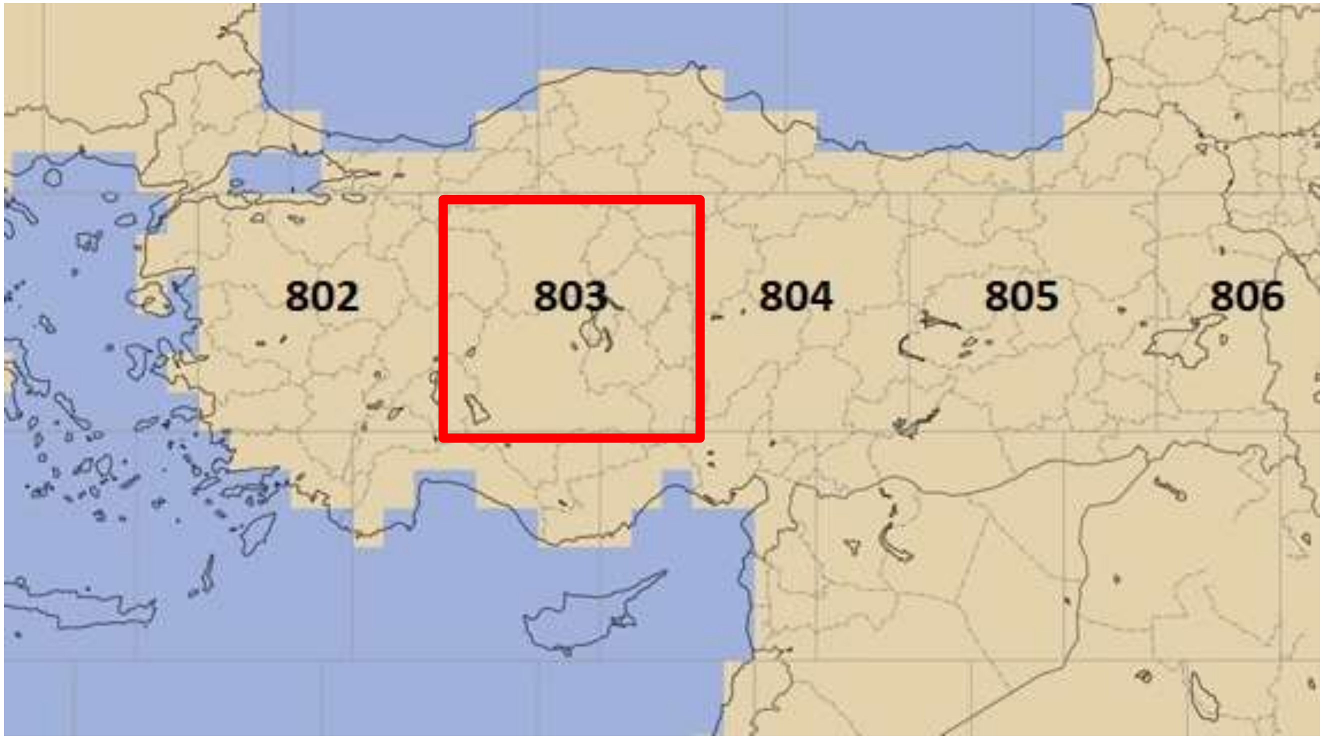
(filtered with DDK1, DDK2, DDK3, DDK4, DDK5, DDK6, DDK7, DDK8)

- ➢ The GGMs are released on the ICGEM website (http://icgem.gfz-potsdam.de/home)
- ➢ The coefficients of all data centers were cut at 60 d/o.

2 Data Used and Study Area

- WaterGAP (Water Global Assesment and Prognosis) Global Hydrological Model (WGHM) was used to compare GRACE-based GGMs in the study. WGHM, produced at 0.5° × 0.5° spatial resolution and monthly runoff and river discharge, is based on meteorological and hydrological datasets.

- In addition to WGHM data, Mascon (mass concentration) solutions produced by the JPL were used as second evaluation data.



FORMULAE

$$EWT^{(GRACE)} = \frac{R \cdot \rho_{av}}{3} \sum_{n=0}^{N_{max}} \left(\frac{2n+1}{1+k_n} \right) \sum_{m=0}^{n} \overline{Y}_{nm}(\varphi, \lambda)$$

$$\Delta EWT_i^{(GRACE)} = EWT_i^{(GRACE)} - EWT^{(GRACE)}_{mean}$$

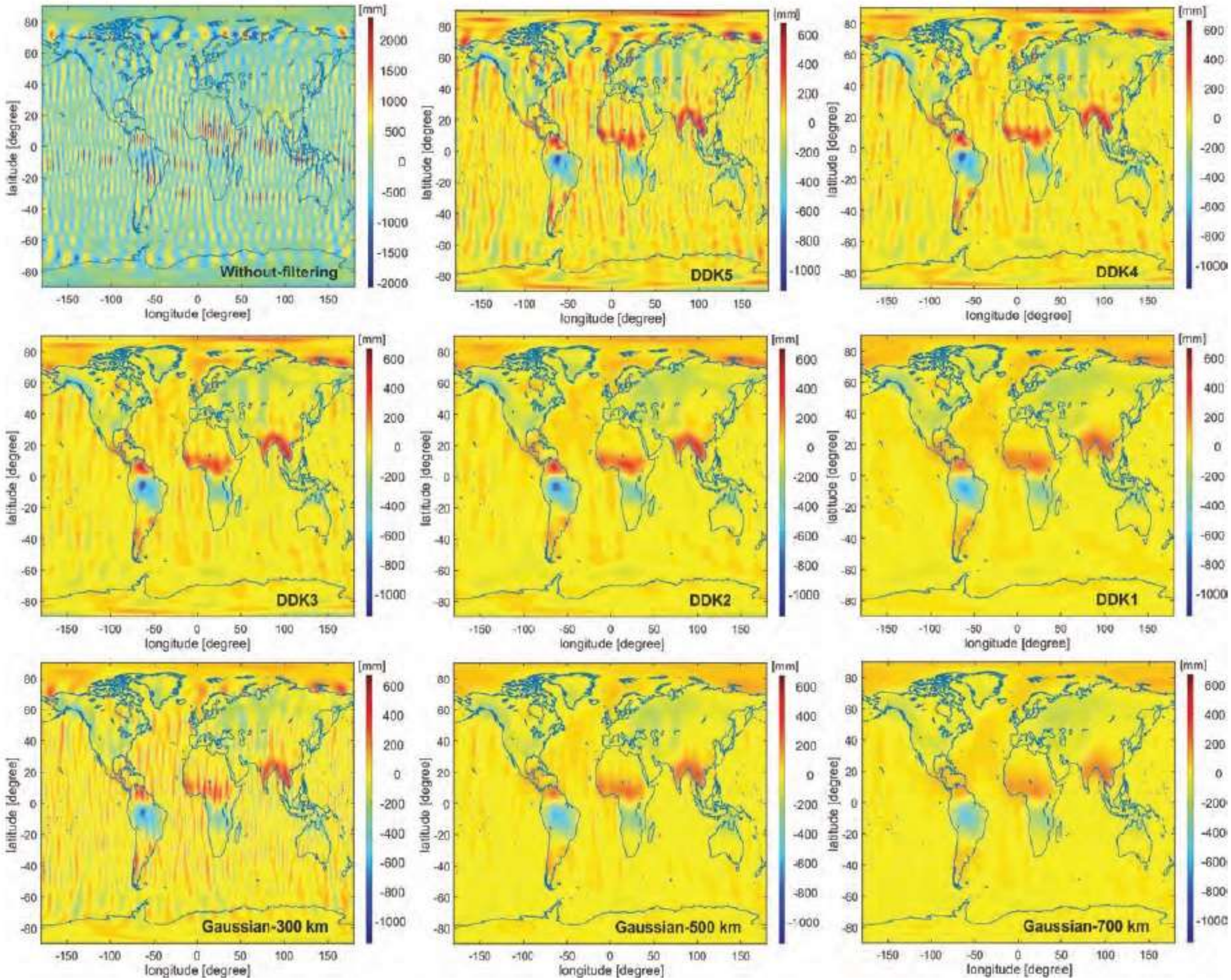
$$\Delta EWT_i^{(WGHM)} = EWT_i^{(WGHM)} - EWT^{(WGHM)}_{mean}$$

$$d\Delta EWT_i = \Delta EWT_i^{(WGHM)} - \Delta EWT_i^{(GRACE)}$$

Statistics of the differences between $\Delta EWT^{(WGHM)}$ and $\Delta EWT^{(GRACE)}$ obtained from GFZ

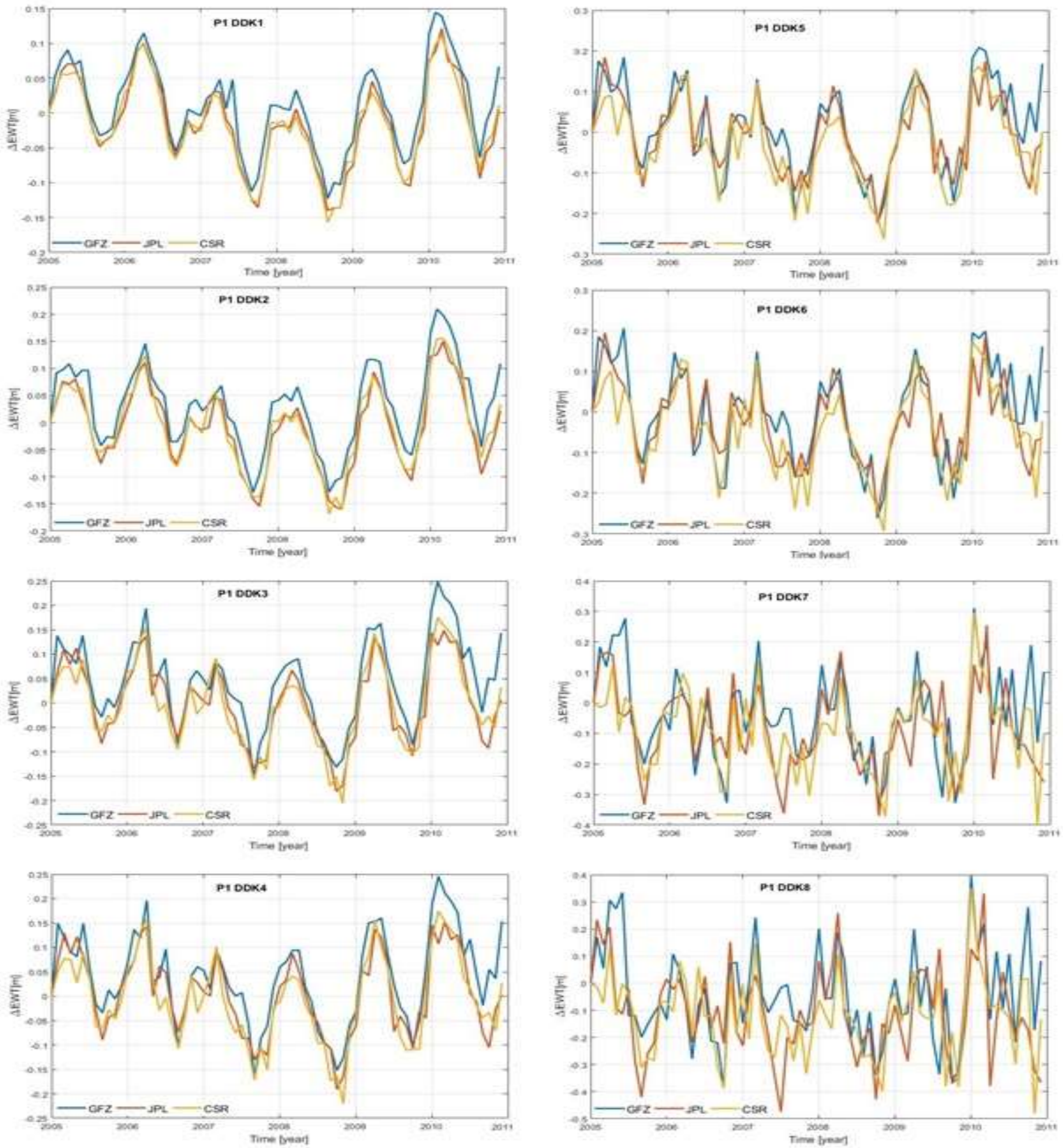
Statistics[m] (P_1)	Min	Max	Mean	Std	Max-min
DDK1	-0.097	0.098	-0.004	**0.045**	**0.194**
DDK2	-0.139	0.081	-0.025	0.051	0.220
DDK3	-0.162	0.098	-0.037	0.061	0.260
DDK4	-0.165	0.118	-0.033	0.065	0.283
DDK5	-0.200	0.190	-0.009	0.079	0.390
DDK6	-0.221	0.227	0.006	0.089	0.448
DDK7	-0.293	0.299	0.045	0.130	0.592
DDK8	-0.350	0.358	0.047	0.157	0.708
(P_2)	Min	Max	Mean	Std	Max-min
DDK1	-0.123	0.125	0.004	**0.054**	**0.248**
DDK2	-0.093	0.164	0.032	0.055	0.257
DDK3	-0.092	0.210	0.049	0.063	0.302
DDK4	-0.096	0.207	0.049	0.066	0.303
DDK5	-0.097	0.274	0.059	0.077	0.371
DDK6	-0.114	0.337	0.077	0.085	0.451
DDK7	-0.177	0.507	0.133	0.128	0.684
DDK8	-0.228	0.556	0.145	0.162	0.784

4 Results

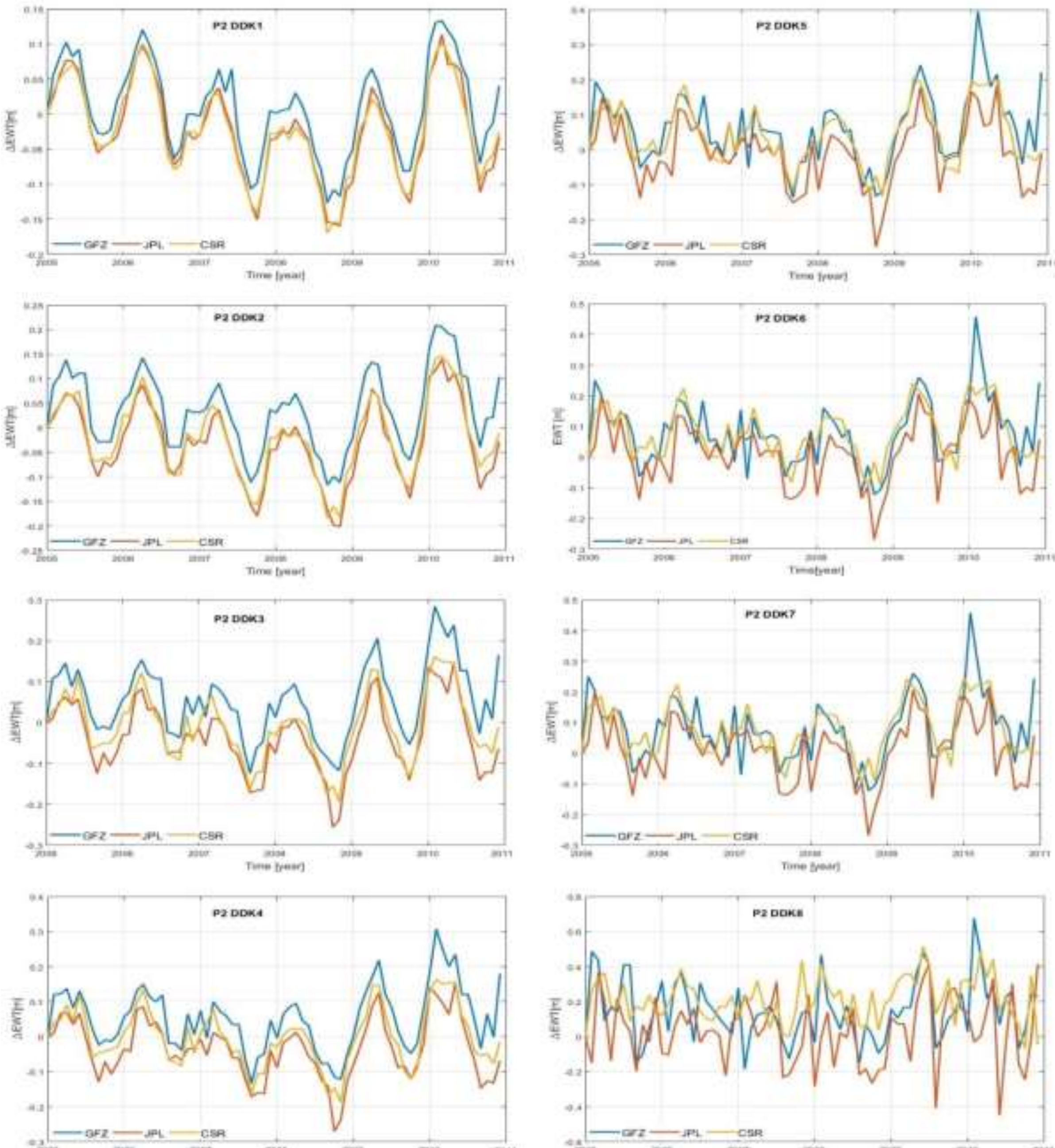


Without-filtering
DDK5
DDK4
DDK3
DDK2
DDK1
Gaussian-300 km
Gaussian-500 km
Gaussian-700 km
latitude [degree]
longitude [degree]
[mm]

4 Results

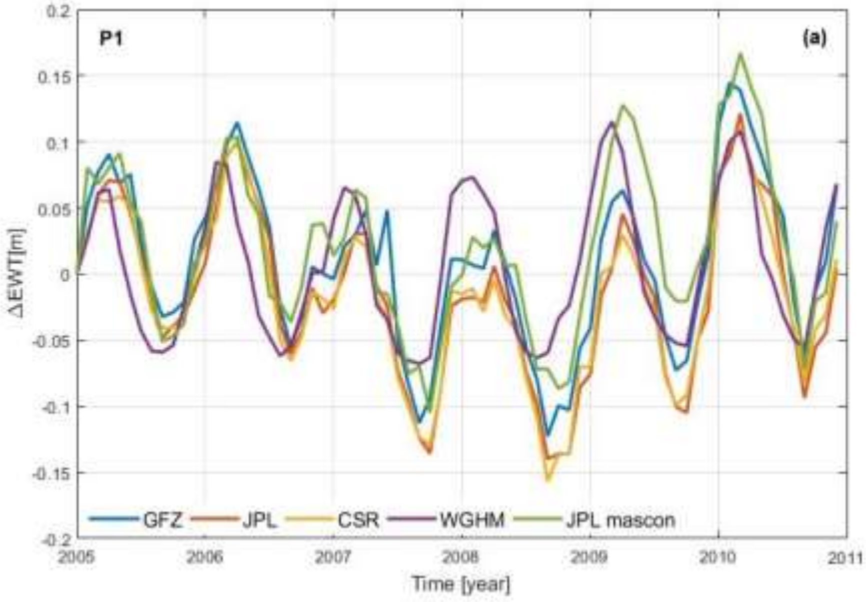

P1 DDK1
P1 DDK5
P1 DDK2
P1 DDK6
P1 DDK3
P1 DDK7
P1 DDK4
P1 DDK8
GFZ
JPL
CSR
Time [year]
ΔEWT[m]

4 Results

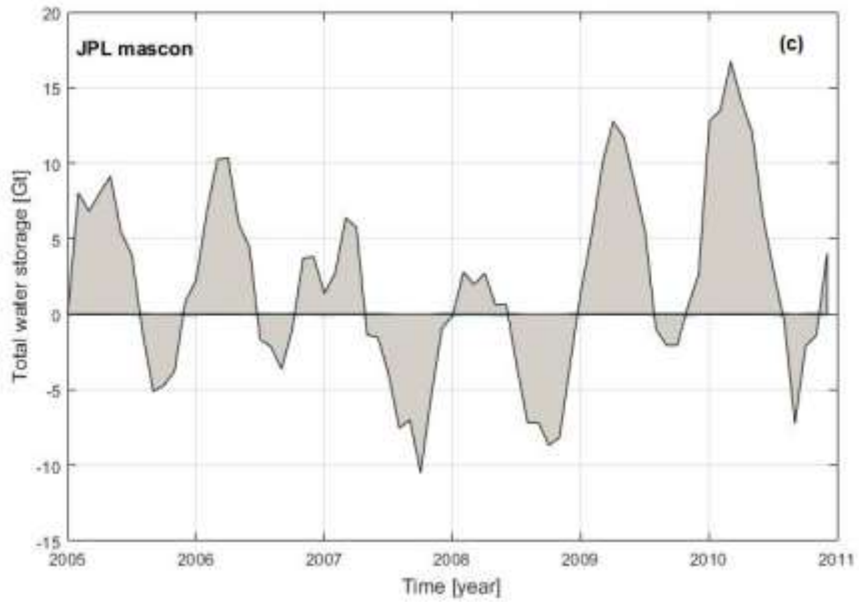


P2 DDK1
GFZ JPL CSR
Time [year]
P2 DDK5
GFZ JPL CSR
Time [year]
P2 DDK2
GFZ JPL CSR
Time [year]
P2 DDK6
P2 DDK3
GFZ JPL CSR
Time [year]
P2 DDK7
GFZ JPL CSR
Time [year]
P2 DDK4
GFZ JPL CSR
P2 DDK8
GFZ JPL CSR

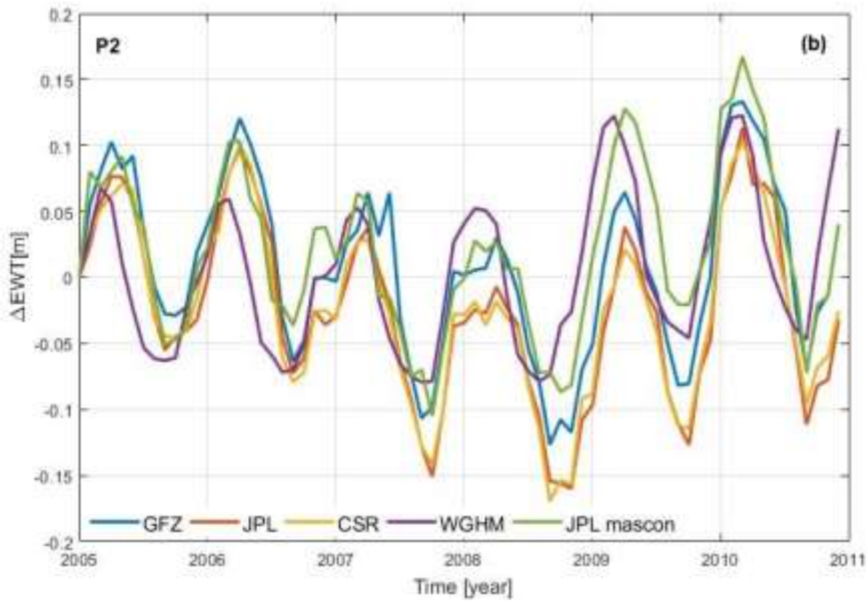
4 Results



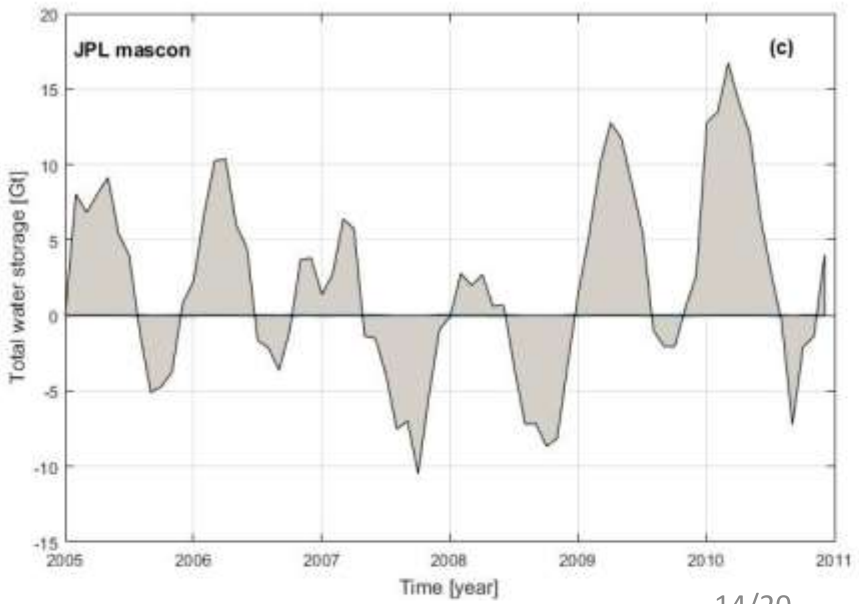
P1
(a)
GFZ
JPL
CSR
WGHM
JPL mascon
ΔEWT[m]
Time [year]



JPL mascon
(c)
Total water storage [Gt]
Time [year]



P2
(b)
GFZ
JPL
CSR
WGHM
JPL mascon
ΔEWT[m]
Time [year]



JPL mascon
(c)
Total water storage [Gt]
Time [year]

4 Results

Statistics of the differences between $\Delta EWT^{(WGHM)}$ and $\Delta EWT^{(GRACE)}$

Statistics[m]		Min	Max	Mean	Std	Max-min
P_1	CSR	-0.127	0.079	-0.022	0.047	0.206
	GFZ	-0.098	0.097	0.004	**0.045**	**0.194**
	JPL	-0.132	0.084	-0.021	0.050	0.216
P_2	CSR	-0.160	0.100	-0.028	0.057	0.260
	GFZ	-0.123	0.125	0.004	**0.054**	**0.248**
	JPL	-0.169	0.104	-0.028	0.061	0.273

5 Conclusions and recommendations

- ✓ In this study, the performance of **De-correlation filters** for estimating temporal mass variations determined from GRACE-based GGMs over Konya basin is investigated

- ✓ **DDK1 and DDK2 filters** are more suitable to reduce noise contained in RL05 GRACE-based GGMs, when estimating mass variations in the Earth system over Konya basin.

- ✓ It can be highly recommended to use RL05 GRACE-based GGMs developed by **GFZ center** in order to determine the mass changes in Konya basin.

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