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

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1. Introduction
2. Data Used and Study Area
3. Method
4. Results
5. Conclusions and recommendations
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
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](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 Assessment 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.
3 Method

**FORMULAE**

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

\[
\Delta EWT_i^{(GRACE)} = EWT_i^{(GRACE)} - EWT^{(GRACE)}_{\text{mean}}
\]

\[
\Delta EWT_i^{(WGHM)} = EWT_i^{(WGHM)} - EWT^{(WGHM)}_{\text{mean}}
\]

\[
d \Delta EWT_i = \Delta EWT_i^{(WGHM)} - \Delta EWT_i^{(GRACE)}
\]
Statistics of the differences between $\Delta EWT^{(WGHM)}$ and $\Delta EWT^{(GRACE)}$ obtained from GFZ

<table>
<thead>
<tr>
<th>Statistics[m] (P₁)</th>
<th>Min</th>
<th>Max</th>
<th>Mean</th>
<th>Std</th>
<th>Max-min</th>
</tr>
</thead>
<tbody>
<tr>
<td>DDK1</td>
<td>-0.097</td>
<td>0.098</td>
<td>-0.004</td>
<td>0.045</td>
<td>0.194</td>
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<tr>
<td>DDK2</td>
<td>-0.139</td>
<td>0.081</td>
<td>-0.025</td>
<td>0.051</td>
<td>0.220</td>
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<td>DDK3</td>
<td>-0.162</td>
<td>0.098</td>
<td>-0.037</td>
<td>0.061</td>
<td>0.260</td>
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<tr>
<td>DDK4</td>
<td>-0.165</td>
<td>0.118</td>
<td>-0.033</td>
<td>0.065</td>
<td>0.283</td>
</tr>
<tr>
<td>DDK5</td>
<td>-0.200</td>
<td>0.190</td>
<td>-0.009</td>
<td>0.079</td>
<td>0.390</td>
</tr>
<tr>
<td>DDK6</td>
<td>-0.221</td>
<td>0.227</td>
<td>0.006</td>
<td>0.089</td>
<td>0.448</td>
</tr>
<tr>
<td>DDK7</td>
<td>-0.293</td>
<td>0.299</td>
<td>0.045</td>
<td>0.130</td>
<td>0.592</td>
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<tr>
<td>DDK8</td>
<td>-0.350</td>
<td>0.358</td>
<td>0.047</td>
<td>0.157</td>
<td>0.708</td>
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</table>

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<tr>
<th>Statistics[m] (P₂)</th>
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<th>Mean</th>
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</tr>
</thead>
<tbody>
<tr>
<td>DDK1</td>
<td>-0.123</td>
<td>0.125</td>
<td>0.004</td>
<td>0.054</td>
<td>0.248</td>
</tr>
<tr>
<td>DDK2</td>
<td>-0.093</td>
<td>0.164</td>
<td>0.032</td>
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<td>0.257</td>
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<tr>
<td>DDK3</td>
<td>-0.092</td>
<td>0.210</td>
<td>0.049</td>
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<td>0.302</td>
</tr>
<tr>
<td>DDK4</td>
<td>-0.096</td>
<td>0.207</td>
<td>0.049</td>
<td>0.066</td>
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<tr>
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<tr>
<td>DDK7</td>
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<tr>
<td>DDK8</td>
<td>-0.228</td>
<td>0.556</td>
<td>0.145</td>
<td>0.162</td>
<td>0.784</td>
</tr>
</tbody>
</table>
4 Results

Without-filtering

DDK5

DDK4

DDK3

DDK2

DDK1

Gaussian-300 km

Gaussian-500 km

Gaussian-700 km
4 Results
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### 4 Results

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

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<thead>
<tr>
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<td>$P_1$ CSR</td>
<td>-0.127</td>
<td>0.079</td>
<td>-0.022</td>
<td>0.047</td>
<td>0.206</td>
</tr>
<tr>
<td>CSR</td>
<td>-0.098</td>
<td>0.097</td>
<td>0.004</td>
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<td><strong>0.194</strong></td>
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<td>GFZ</td>
<td>-0.132</td>
<td>0.084</td>
<td>-0.021</td>
<td>0.050</td>
<td>0.216</td>
</tr>
<tr>
<td>$P_2$ CSR</td>
<td>-0.160</td>
<td>0.100</td>
<td>-0.028</td>
<td>0.057</td>
<td>0.260</td>
</tr>
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<td>-0.123</td>
<td>0.125</td>
<td>0.004</td>
<td><strong>0.054</strong></td>
<td><strong>0.248</strong></td>
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<td>GFZ</td>
<td>-0.169</td>
<td>0.104</td>
<td>-0.028</td>
<td>0.061</td>
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</tr>
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<td>JPL</td>
<td>-0.127</td>
<td>0.079</td>
<td>-0.022</td>
<td>0.047</td>
<td>0.206</td>
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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.
Thanks!
Bettadpur S., (2012), UTCSR Level-2 Processing Standards Document for Level-2 Product Release 0005, GRACE 327–742, CSR Publ. GR-12- xx, Rev. 4.0, pp. 16, University of Texas at Austin.


References


• Kusche J., (2007), Approximate decorrelation and non-isotropic smoothing of time variable GRACEtype gravity field models, J. Geod. 81(11), pp. 733–749.


References


