Evaluation of three global gradient-based groundwater models in the Mediterranean region

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Motivation: Application of global groundwater models for water table depth estimation in the Mediterranean

Groundwater modelling has moved from local to regional/global scale, offering insights into the status of data-scarce regions, such as the Mediterranean which is recognized as one of the most sensitive regions in the world to water scarcity, due to both climate change and consistently increasing anthropogenic pressures.

Objective
This study aims to compare and evaluate the performance of three groundwater models to represent the steady-state groundwater levels in the Mediterranean region. Thus, the groundwater models of Reinecke et al. (2019), de Graaf et al. (2017) and Fan et al. (2013) will be utilized in this study.
Methodology

Table 1: Comparison of the global (steady-state) models (modified from Reinecke et al. 2020)

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<thead>
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<tbody>
<tr>
<td>Spatial resolution</td>
<td>30° (~900 m)</td>
<td>5° (~9 km)</td>
<td>6° (~10 km)</td>
</tr>
<tr>
<td>Surface elevation</td>
<td>30° DEM</td>
<td>Avg. of 30° DEM</td>
<td>Avg. of 30° DEM</td>
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<tr>
<td>River elevation</td>
<td>-</td>
<td>P_{30} of 30° DEM</td>
<td>calculation based on bankfull flow and naturalized river discharge</td>
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<tr>
<td>Conductivity data</td>
<td>Global lithology</td>
<td>GLHYMPS 2.0 (Huscroft et al. 2018)</td>
<td>GLHYMPS 1.0 (Gleeson et al. 2014)</td>
</tr>
<tr>
<td>Aquifer thickness Layers</td>
<td>Infinite</td>
<td>200 m</td>
<td>calibrated</td>
</tr>
<tr>
<td>Calibrated</td>
<td>Manual</td>
<td>No</td>
<td>Manual</td>
</tr>
</tbody>
</table>

Figure 1: High-resolution satellite image of the Mediterranean region (EOMAP)

References
- Reinecke, R. et al. Challenges in developing a global gradient-based groundwater model (G3M v1.0) for the integration into a global hydrological model. Geosci. Model Dev 12, 2401-2418 (2019).
Preleminary results

- A comparison of the distribution of the water table depth for the three models is given in Figs 2-5.
- Results showed that de Graaf model presents a deeper water table than Reineche and Fan models.
- We observe that there is a greater variability for de Graaf model compared to other models.
Preliminary results

Figure 6: Histograms of the three models.
There is a discrepancy between the three compared models outputs.

The mean water table depth for de Graaf model (134.16 m) is almost four times higher than Reinecke (35.03 m) and Fan (38.8 m) models.

The model of de Graaf seems to overestimate the predicted water table depth by the two other models in the Mediterranean region.

Comparison between the models results and in-situ data is needed to evaluate the models' performances better.

Detailed investigation on water table depth patterns in the Mediterranean region is required using the process-based model. Further investigation on the prediction of groundwater level at transient regime will be carried out.