Supplement

"Quantification of Drainable Water Storage Volumes in Catchments *and* in River Networks on Global Scales using the GRACE and / or River Runoff"

Description of the EXCEL workbook

The workbook contains all calculations and data presented in the paper including the diagrams and the table.

It consists of the following spreadsheets and provides :

1. "Synthetic": Calculations of the Cascaded Storage approach based on synthetic recharge data
2. "Graph Synthetic":Figures 2-7
3. "Results Sythetic": data base for Figures 2-7 incl. the empirical fits
4. "Amazon": Calculations of the Cascaded Storage approach applied to the Amazon Catchment
5. "Graphs Amazon": Figures 1, 8-12
6. "Table 1"

The calculation spreadsheets are analogous for the synthetic case and the Amazon application:

- The notation of the columns is the same as in the paper noting the respective equation number
- Parameter cells used for optimization are marked in yellow
- Optimization objectives in red
- Statistical characteristics for each run in green
- Recharge parameters in grey

The "Synthetic" spreadsheet is designed for the determination of the approach properties and the test of the optimization performance. It contains:

- Calculations of the masses and runoffs for given time constants τ_C, τ_R (columns A-O) for the description of the properties and as basis for optimizations
- Proof of consistency in mass balance (columns Q, R)
- Determination of phasing w.r.t. MCm, MRm, MTm (columns T, U)
- Fitting of the given time series with the same approach (columns W-AK)
- Direct phase adaption of total mass deviation dMTm to. river runoff RRm

The "Amazon" spreadsheet contains the observation data for GRACE, runoff from HYBAM, flood areas from GIEMS and recharge data (columns A-F) and the calculation of the Cascaded Storage approach

- Recharge can be chosen from moisture flux divergence (“0” in A2) or from water balance with GRACE (“1” in A2)
- Proof of consistency in mass balance (columns AA, AB)
- Optimization of τ_C, τ_R (B2, C2) versus observed runoff or GRACE based on RMSE values (L2, M2)
- Statistical results and optimization performance on the top
- Direct phase adaption of GRACE mass to measured runoff in (AD, AE)