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 Eval": Calculations of the Cascaded Storage approach based on synthetic recharge
   Data and evaluation of fitting properties
2. "Synthetic Phase": Tests of the phasings and phase adaption, Evaluation of the simplified calculation of time series for storage and runoff from synthetic observations
3. "Graph Synthetic": Figures 2-7
4. "Results Synthetic": data base for Figures 2-7 incl. the empirical fits
5. "Amazon": Calculations of the Cascaded Storage approach applied to the Amazon Catchment (Obidos)
   Evaluation of the simplified calculations of time series for Drainable storage volumes and runoff from observations of the Amazon basin
6. "Graphs Amazon": Figures 1, 8-12
7. "Table 2"

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
- Simplified calculations in red

The "Synthetic Eval" 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)

The "Synthetic_Phase" spreadsheet is designed for the evaluation of the simplification approach It contains:

- Calculations of the masses and runoffs for given time constants τ_C, τ_R (columns A-O) as reference for the comparison
- Determination of phasing w.r.t. MRm, MTm (Eq.35), MCm, (Eq.36), (columns T, U, V)
- Simplified calculations RRsim (Eq.37), MTsim (Eq.38) from GRACE and Runoff (columns Z-AB)
- Accuracy by RMSE and Nash Suttcliffe for the signal

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

- Calculations of the masses and runoffs for given time constants τ_C, τ_R (columns A-AB) as reference for the comparison
- 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)
- Simplified calculation of MR_{sim}, MT_{sim} (Eq.35), MC_{sim} (Eq.36), based on τ_C, τ_R , GRACE and observed runoff (Columns AE, AF, AG)
- Simplified calculations RRsim (Eq.37),, MTsim (Eq.38), from GRACE and Runoff (columns AI-AK)
- Direct phase adaption of GRACE mass to measured runoff in (AM, AN)
- Statistical results and optimization performance on the top