Groundwater modelling challenge

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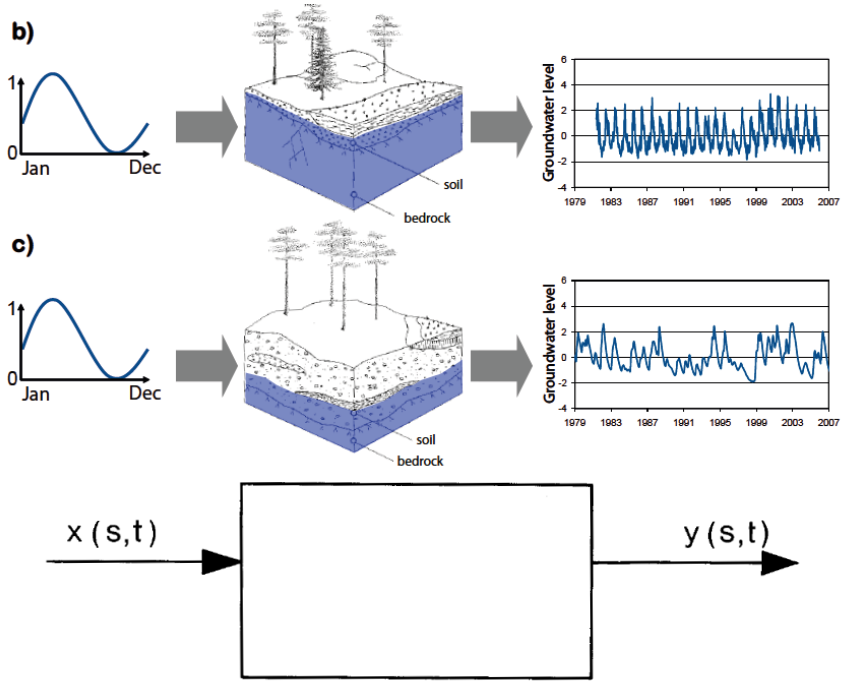
Background & objective

- Large number of different models to model groundwater level time series
- Traditionally process-based models dominant
- Grey- and black-box models gaining in importance
- GWM challenge: show diversity and systematically show performance & differences



Haaf, 2020

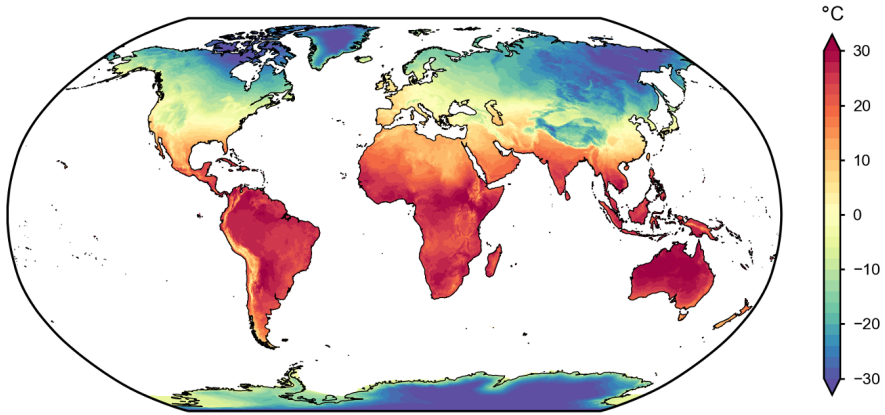
The challenge (1)

- Modelling of five gw level time series datasets
  - Netherlands: sedimentary rock, impacted data
  - Sweden: glacial deposit, snow-melt influenced
  - Germany: karstic rock
  - Usa: tba
  - Australia: tba
- Time series data
  - 15 years calibration data given, 5 years target
  - Daily or weekly data
- Groundwater level may not be model input

https://ggis.un-igrac.org/view/ggmn

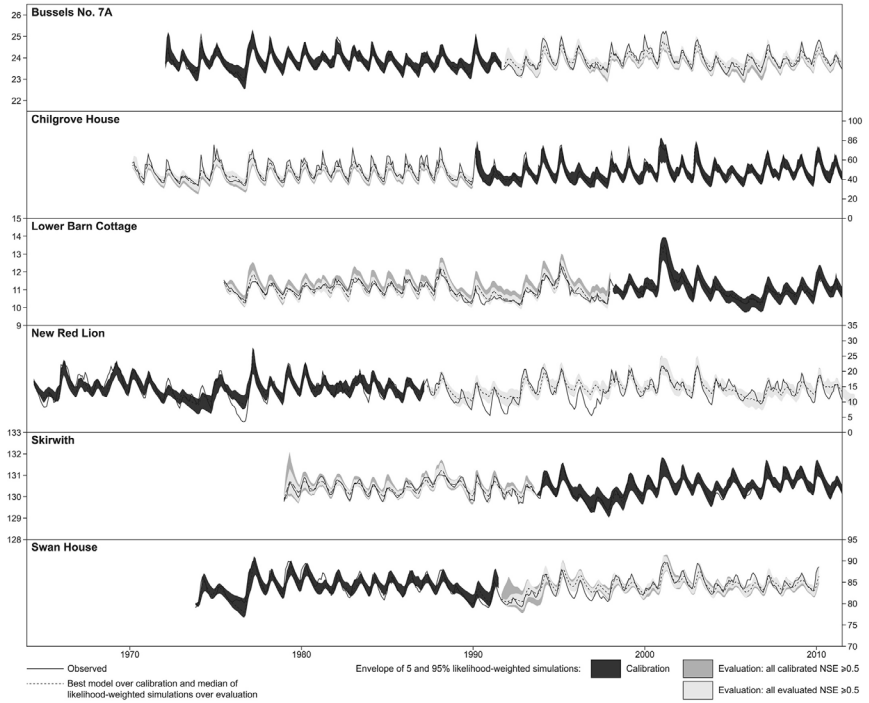
The challenge (2)

- Forcing data provided for each location
  ERA5 reanalysis data
- Other publicly available data allowed
  (Exception: alternative forcing data!)
- Any model goes



Deliverables

- Daily groundwater level time series 20 years (15 years calibrated + 5 years predicted)
- 95% prediction interval
- Reproducible workflow, scripts or comprehensive description
- List (and data file) of supplementary data
- Estimation of effort



Jackson et al., 2016

Model evaluation

- Goodness of fit metrics
- Hydrogeological signatures
- Effort

Metric Name	Equation
MAE (mean absolute error)	$\sum_{i=1}^{N} w_i' \mid x_i - y_i \mid$
RMSE (root mean squared error)	$\sqrt{\sum_{i=1}^{N} w_i'(n_i - \overline{\mu}_n)^2}$
r (Pearson correlation coefficient)	$\frac{\sum_{i=1}^{N} w_i'(x_i - \overline{\mu}_x)(y_i - \overline{\mu}_y)}{\sqrt{\sum_{i=1}^{N} w_i'(x_i - \overline{\mu}_x)^2 \sum_{i=1}^{N} w_i'(y_i - \overline{\mu}_y)^2}}$
R^2 (coefficient of determination)	$1 - \frac{\sum_{i=1}^{N} w_i' n_i^2}{\sum_{i=1}^{N} w_i'(x - \overline{\mu}_x)^2}$
EVP (explained variance percentage)	$\frac{\overline{\sigma}_x^2 - \overline{\sigma}_n^2}{\overline{\sigma}_x^2} \cdot 100\%$
KGE (Kling-Gupta efficiency)	$1 - \sqrt{(r-1)^2 + (\beta - 1)^2 - (\gamma - 1)^2}$ where $\beta = \overline{\mu}_x / \overline{\mu}_y$ and $\gamma = \frac{\overline{\sigma}_x / \overline{\mu}_x}{\overline{\sigma}_y / \overline{\mu}_y}$

Collenteur, 2021

Groundwater Regime

Structure	Distribution	Shape
Magnitude	Density	Slope
Timing	Modality	Scale
Inter annual variability	Boundness	
Flashiness		

Haaf, 2020

Other info

- Data out in Mid June
- Statement of interest to: ezra@chalmers.se and raoul.collenteur@uni-graz.at
- Submit as pull request to: https://github.com/gwmodeling/challenge
  (add folder)
- Deadline 31/12/2022 → Results presented at EGU 2023
- Write a paper with all submitting authors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