

The Process and Value of Reprogramming a Legacy Global Hydrological Model

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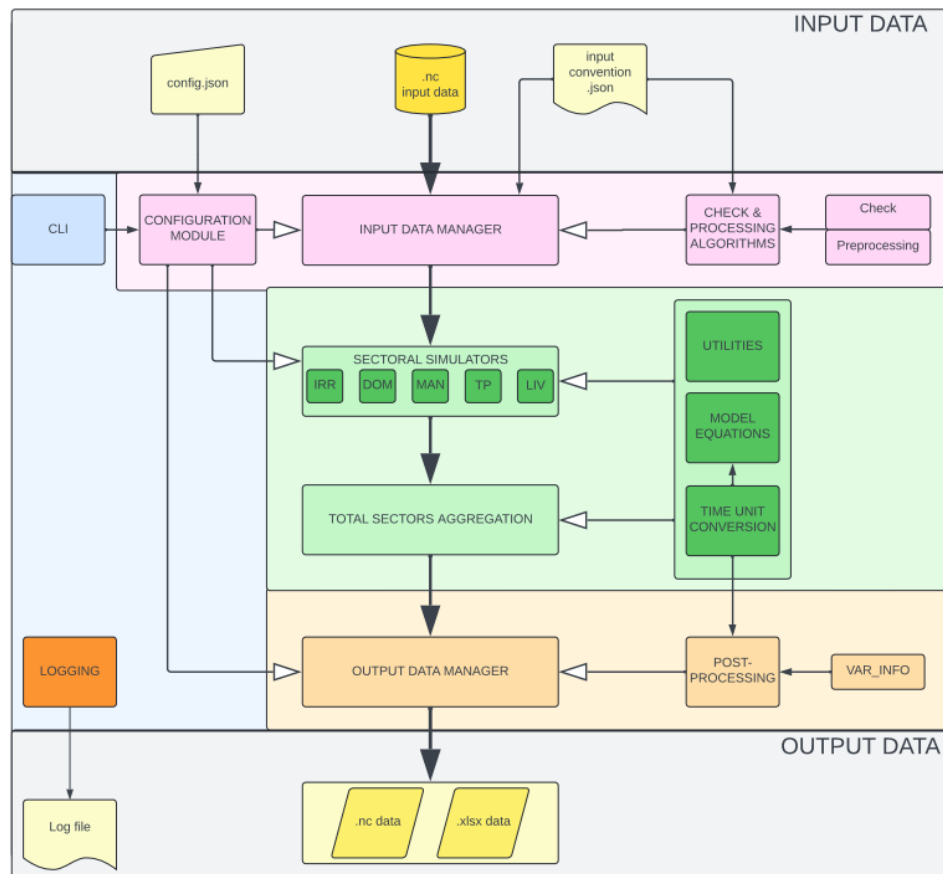


Figure S1: Model-View-Controller architectural pattern of the reprogrammed GWSWUSE software. The Controller package (pink) manages the configuration and input data (e.g., sectoral water use data), the Model package (green) contains core hydrological processes and the View package (light orange) handles the saving and presentation of model outputs in NetCDF format.

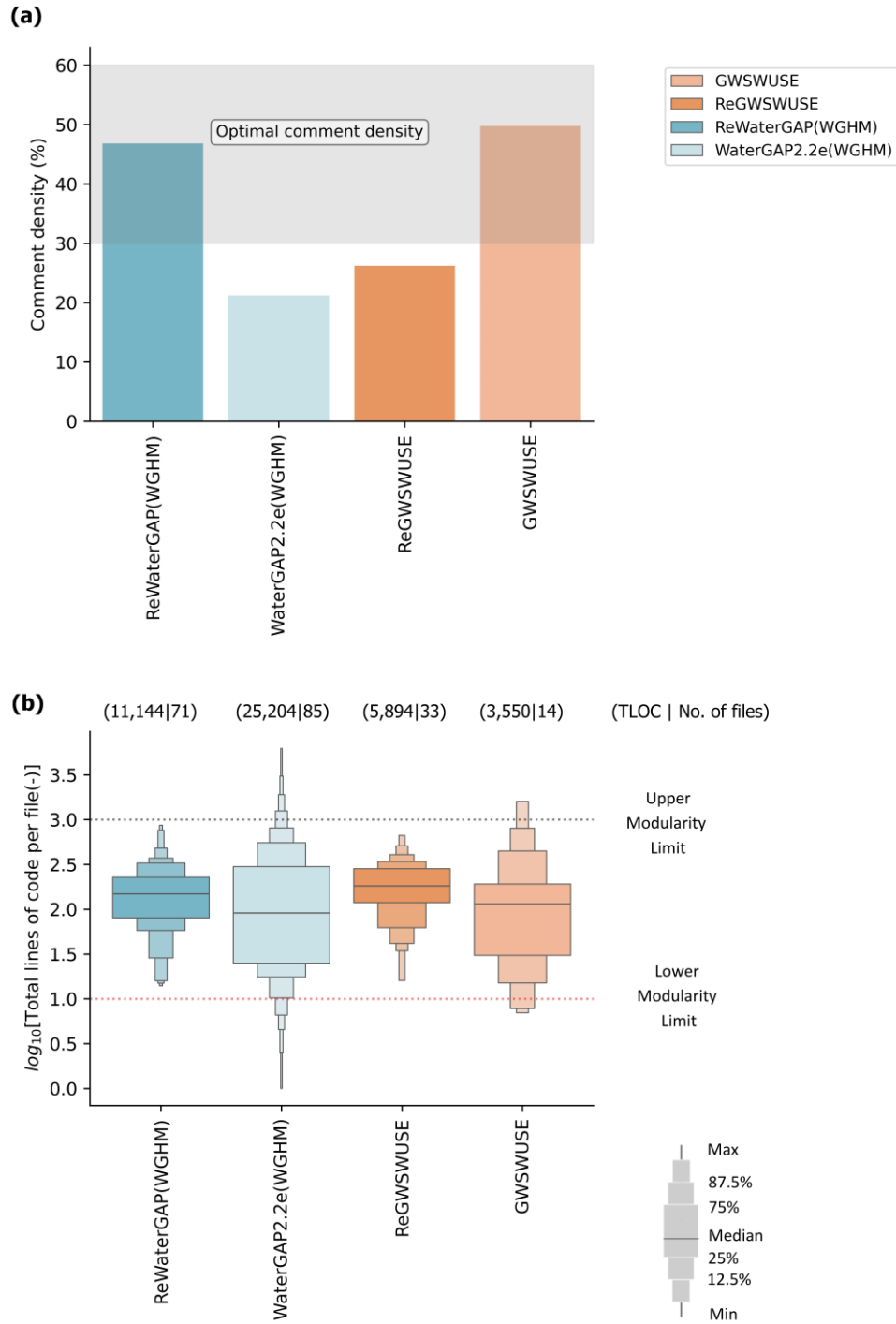


Figure S3: Modularity and commenting practice of two legacy and reprogrammed software. (a) Comment density per model. The grey zone in Fig. S3a denotes the optimal comment density, (b) Letter value plot of the total lines of code per file (logarithmic scale) of each model. The dotted black (red) line shows the upper (lower) modularity limit defined as the maximum of 1,000 (minimum of 10) total lines of code per file. The values (x | y) shown in the upper section of Fig. S3b correspond to the TLOC and number of files per model.

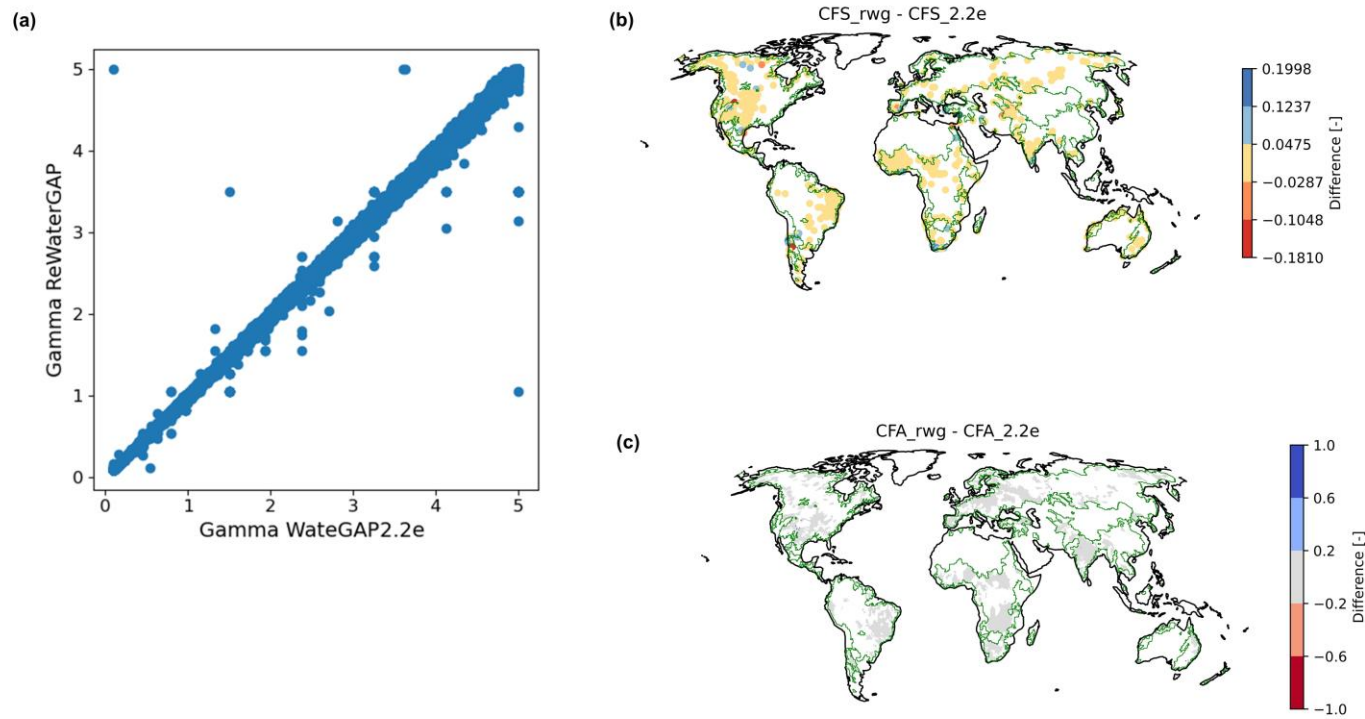


Figure S4: Difference in calibration parameters between the reprogrammed and legacy WGHM (Müller Schmied et al., 2024). (a) Gamma (runoff coefficient), (b) absolute change in areal correction factor (CFA) and (c) absolute change in station correction factor (CFS). The CFA (with range 0.5-1.5) adjusts runoff and actual evapotranspiration at the grid-cell level to maintain mass balance, while the CFS (unconstrained) corrects streamflow at gauging stations to prevent error propagation downstream (Müller Schmied et al., 2024). (b)-(c) Green outlines indicate the boundaries of the calibration basins. Outside these boundaries, Gamma is regionalized (Müller Schmied et al., 2021). (b)-(c) White represents cases where the difference is 0, except for Greenland.

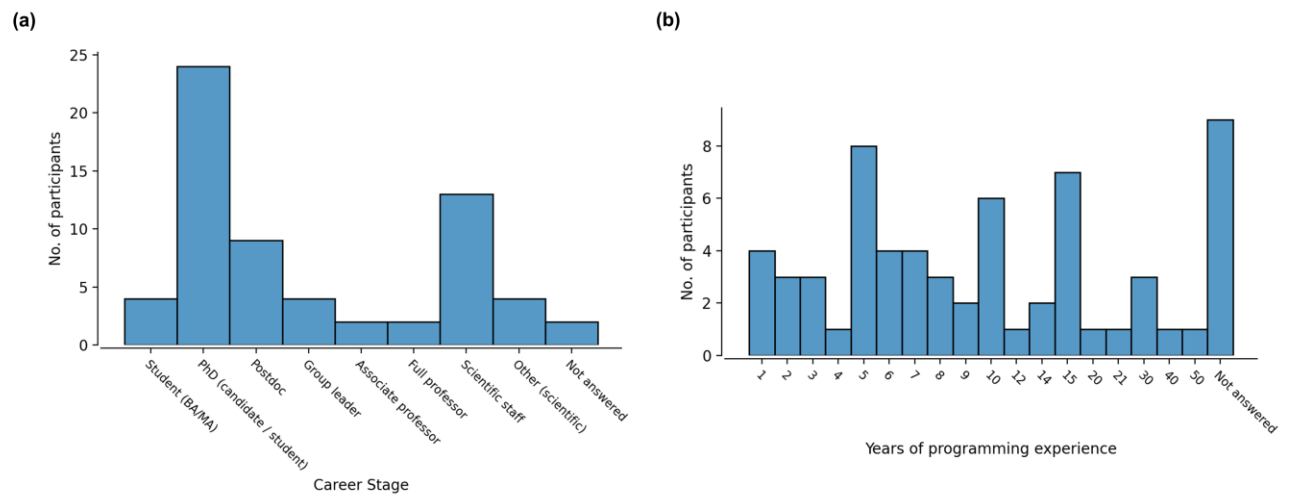


Figure S5: Career stage (a) and years of programming experience (b) for the 64 survey participants.

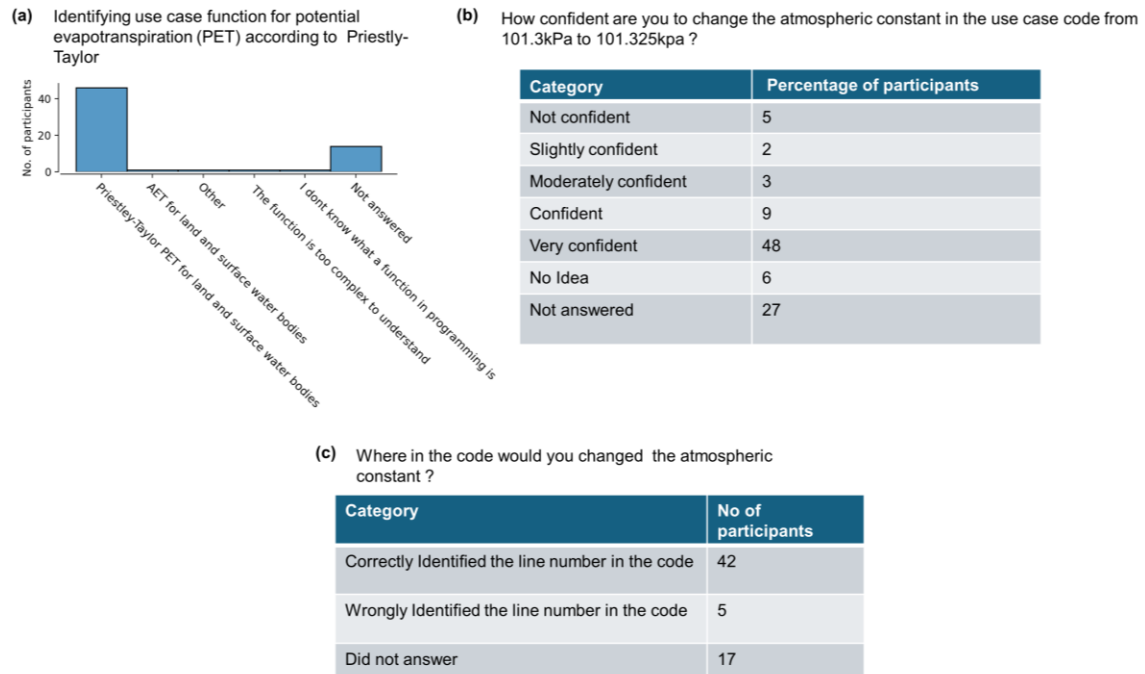


Figure S6: Survey results for the 64 participants on code readability, comprehension and ease of modification of the Priestley-Taylor potential evapotranspiration (PET) code snippet.

References

Müller Schmied, H., Cáceres, D., Eisner, S., Flörke, M., Herbert, C., Niemann, C., Peiris, T. A., Popat, E., Portmann, F. T., Reinecke, R., Schumacher, M., Shadkam, S., Telteu, C.-E., Trautmann, T., and Döll, P.: The global water resources and use model WaterGAP v2.2d: model description and evaluation, *Geoscientific Model Development*, 14, 1037–1079, <https://doi.org/10.5194/gmd-14-1037-2021>, 2021.

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