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Supplement of

Calibration approaches for distributed hydrologic models in poorly gaged basins: implication for streamflow projections under climate change

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Supplementary materials

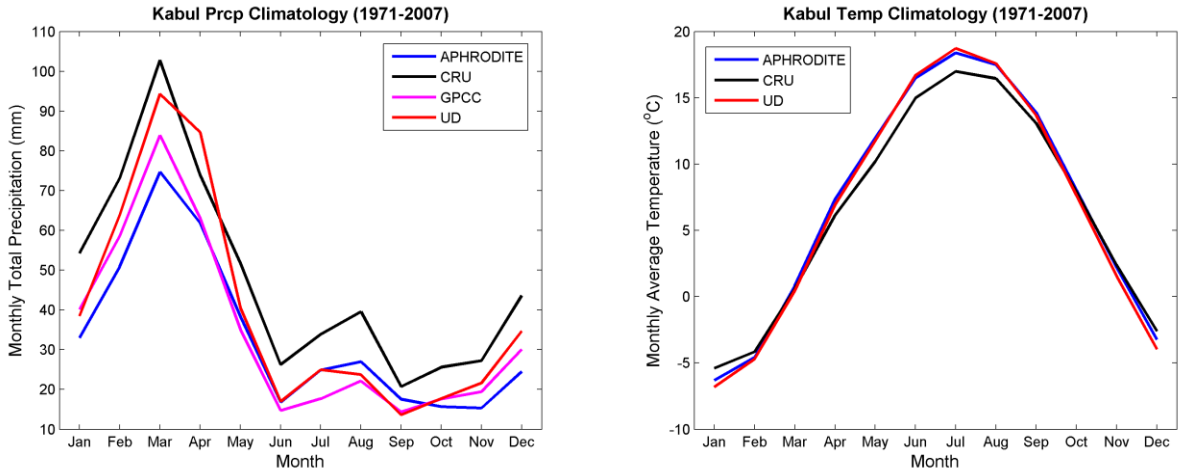


Figure S1. Comparison of basin-wise average monthly precipitation and temperature for the Kabul River basin. Sources of data sets: APHRODITE (Asian Precipitation High-Resolved Observational Data Integration Towards Evaluation), CRU (Climatic Research Unit), GPCC (Global Precipitation Climatology Centre), UD (University of Delaware).

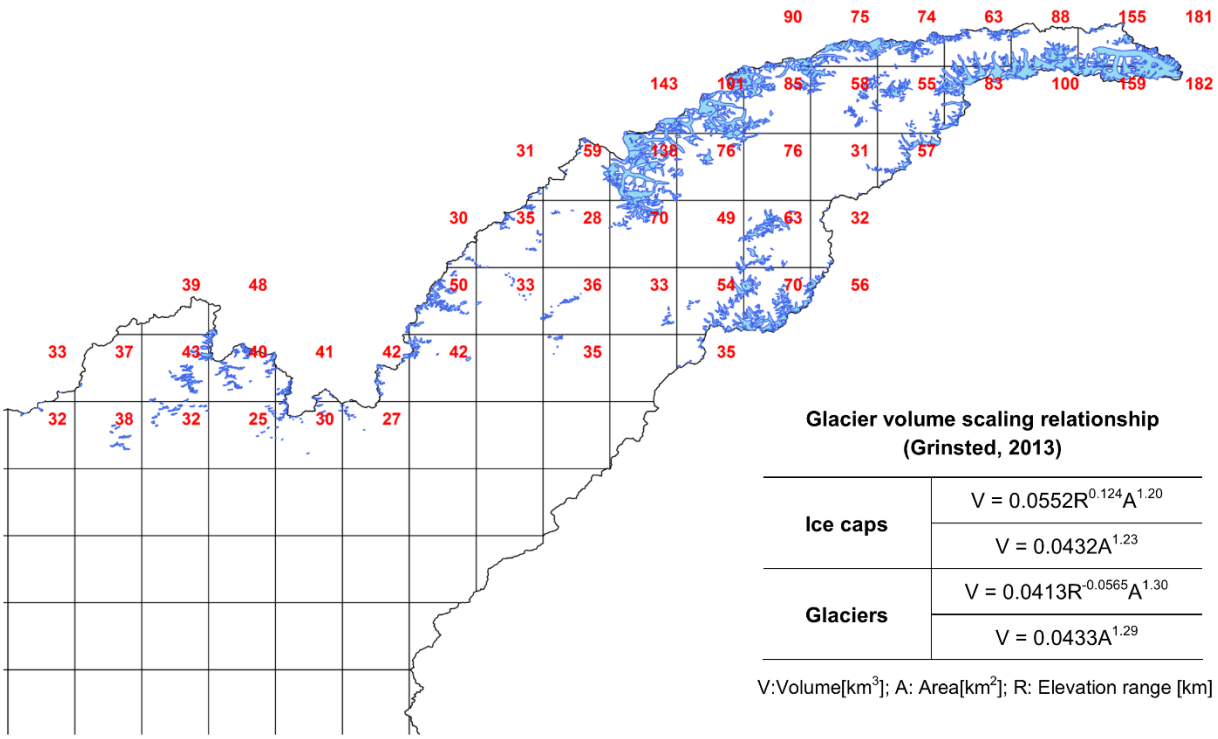


Figure S2. Glacial coverage in the Kabul River basin based on the Randolph Glacier Inventory version 3.2. Glacier volume scaling relationship proposed by Grinsted (2013) is applied to derive glacier volume. Numbers in red represent glacier depths in meter of water for grid cells containing glaciers.

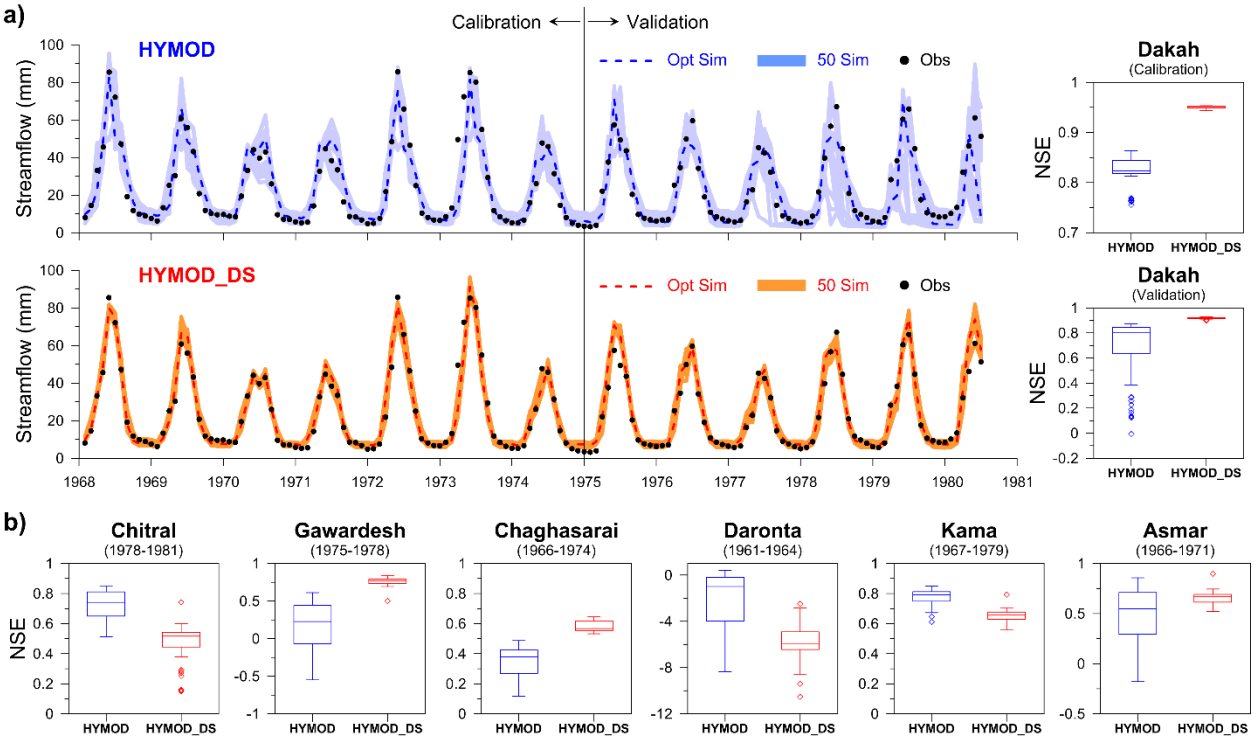


Figure S3. (a) Basin outlet (Dakah) simulations of HYMOD and MYMOD_DS (with the lumped parameterization) from 50 trials of calibration. The Box plots provide the performance evaluation on 50 simulations of both models for both calibration and validation periods. (b) Performances of the models at the interior points of the watershed are assessed.

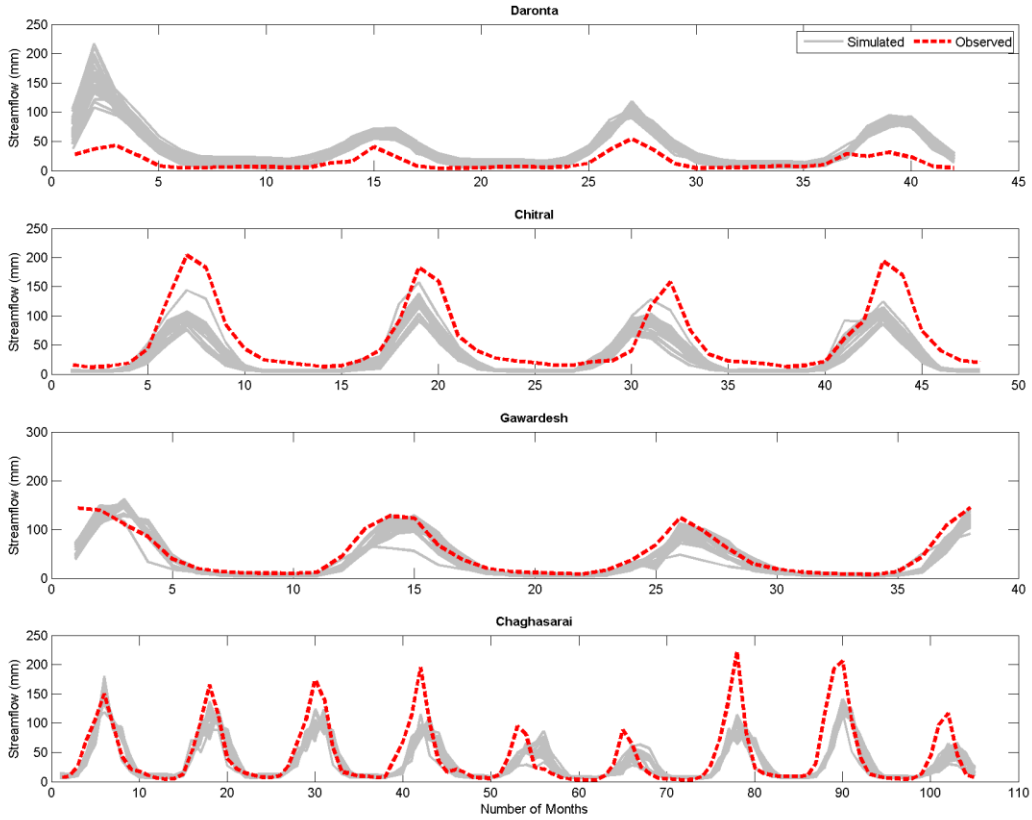
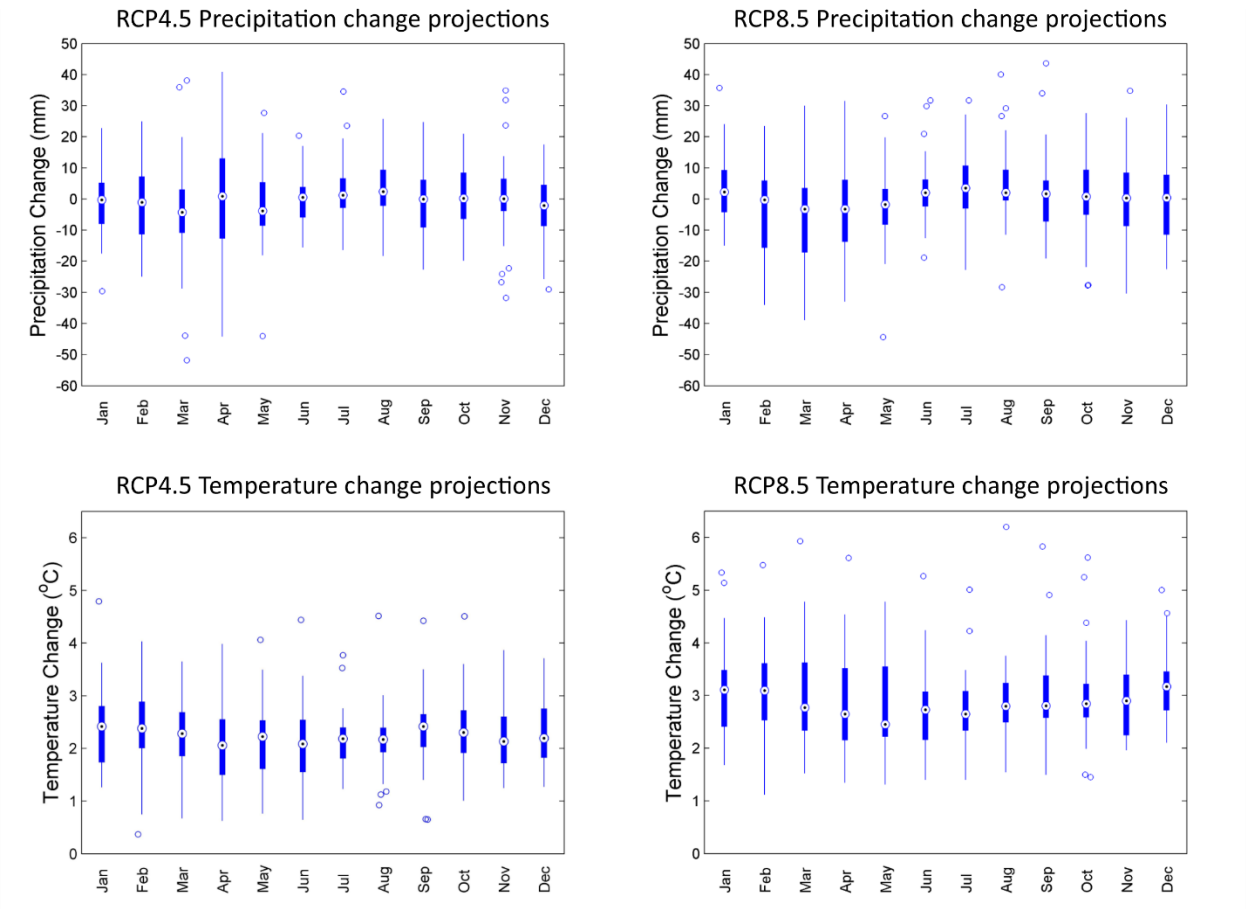


Figure S4. HYMOD_DS streamflow simulations at sub-basins from 50 trials of the basin outlet calibration under the lumped parameterization.



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27 Figure S5. CMIP5 climate change projections of precipitation and temperature for the Kabul basin.
28 The changes in average monthly total precipitation and mean temperature for the future period
29 2050s (2036-2065) were calculated from the comparison with the historical period (1976-2005).
30 36 GCMs were employed in this analysis.

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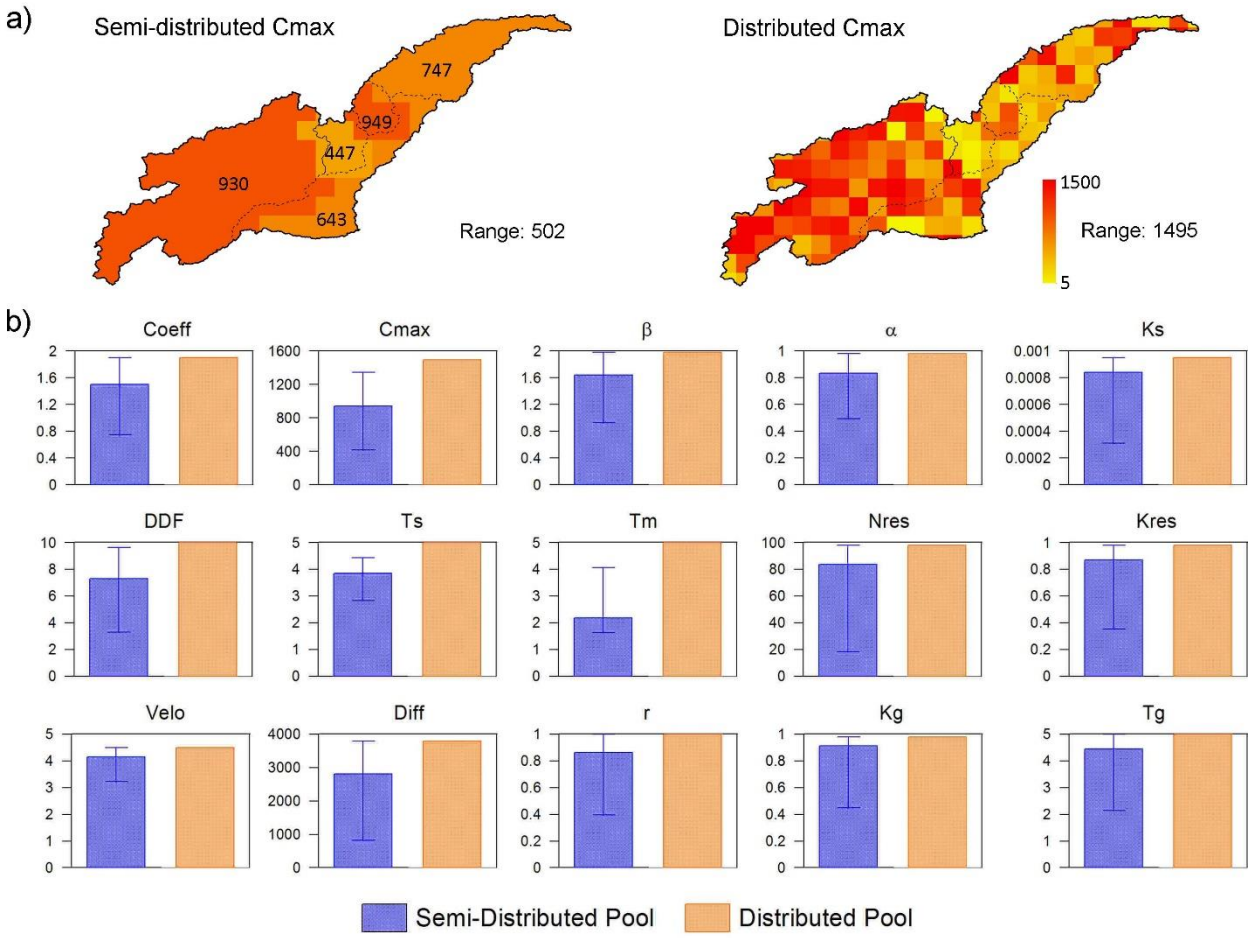

Figure S6. Spatial variability of the HYMOD_DS parameters. a) An example with C_{max} showing parameter ranges resulting from the single trail of Semi-Pooled and Dist-Pooled. b) Average spatial variability across 50 trials of calibration for all 15 parameters. Error bar in b) represents the range of parameter spatial variability from the 50 trails.

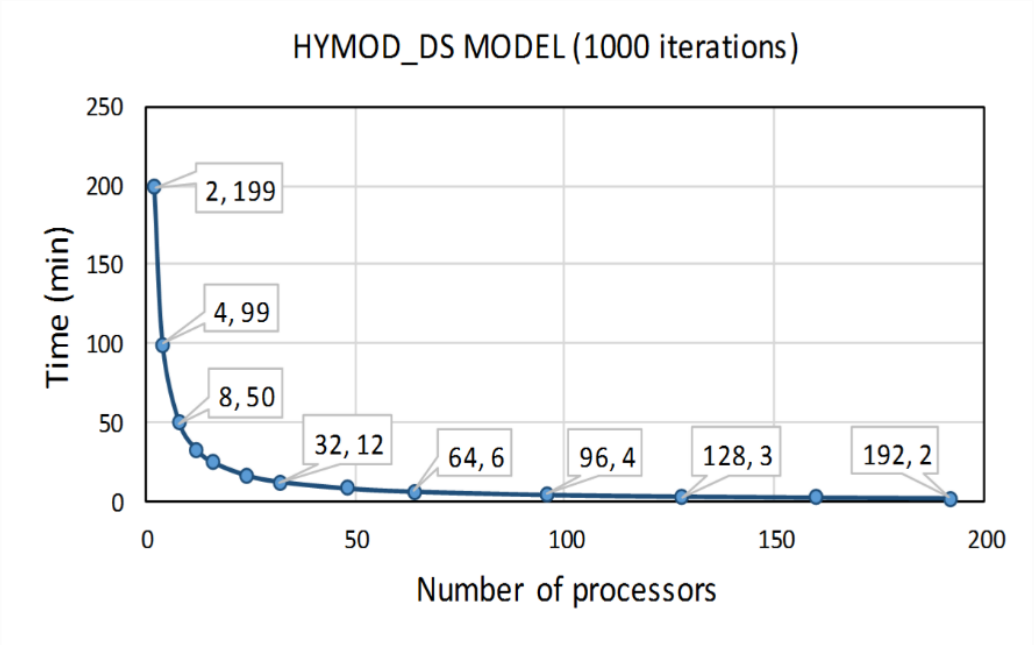

Figure S7. HYMOD_DS run time on parallel computing system.