Title: Simulated river flow and temperature in regulated river systems in the southeastern United States

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Description:
Streamflow and stream temperature are important water resources variables, and regional-scale simulations are essential for water resources management and multi-sector assessment for large regions, e.g., regional ecological assessment and power system planning. In large-scale stream temperature modeling practices, reservoir thermal stratification is mostly ignored. We have synthesized a process-based modeling approach, consisting of a series of established models, to simulate streamflow and stream temperature for a complicated river-reservoir system, which explicitly considers thermal stratification. This approach consists of a large-scale, spatially-distributed hydrological model (Variable Infiltration Capacity or VIC; Liang et al., 1994; Hamman et al., 2018), a river routing model (Model for Scale Adaptive River Transport or MOSART; Li et al., 2013), coupled to a spatially-distributed water management model (WM; Voisin et al., 2013, 2017), and a stream temperature model (River Basin Model or RBM; Yearsley, 2009; 2012) that includes a two-layer reservoir thermal stratification module (2L; Niemeyer et al., 2018). To generate this dataset, we applied this modeling approach at a temporal resolution of 1 day and a spatial resolution of 1/8º to river systems in the southeastern United States that include 271 major reservoirs. We used an ensemble of downscaled meteorological forcing data from 20 global climate models (GCM) based on RCP8.5 to simulate potential climate change impacts. This dataset includes simulated river flow and temperatures for both historical (1980-2009; 1980s) and future periods (2070-2099; 2080s). The simulations for the 1980s are based on the gridMet data set (Abatzoglou, 2013), which also forms the basis for the statistical downscaling that is applied to each of the climate models. All simulations for the 2080s are based on downscaled climate model outputs. This dataset includes streamflow and stream temperature using both unregulated and regulated model setups to quantify the impacts of reservoir regulations. The unregulated setup does not account for withdrawals and impoundments in the river system. The stream temperature in the unregulated model setups is constant in each river cross section. In the regulated setup, we explicitly considered reservoir regulation, thermal stratification, and water withdrawal. For a more detailed description of the model configuration and a discussion of the results see Cheng et al. (2020).

Directory structure and filenames:
The archive includes two directories, named “streamflow/” and “stream_temperature/”, which contain model output for streamflow and stream temperature, respectively. Within each directory, subdirectories named “regulated/” and “unregulated/” contain model output for the regulated and unregulated model setups, respectively. All data files are in netCDF format and provide model outputs at a temporal resolution of 1 day and a spatial resolution of 1/8º. The unit for streamflow is m^3/s and the unit for stream temperature is °C.

File names are constructed according to the following template:
SERC.<climate simulation>.RCP85.<model setup>.<variable>.nc

where

- <climate simulation> is either 'historical' for the simulation that represents the 1980s or an abbreviation that indicates the climate model for the simulations that represent the 2080s. The abbreviations for the climate models are shown in column 1 in the Table below.
- <model setup> is either 'regulated' or 'unregulated' for the regulated and unregulated model setups, respectively.
- <variable> is either 'streamflow' or 'stream_temperature' for streamflow and stream temperature, respectively.

Table: List of Global Climate Models (GCMs) used in this study.

Global Climate Models	**Modeling Center (Country)**
bcc-csm1-1	Beijing Climate Center, China Meteorological Administration (**China**)
bcc-csm1-1-m	
BNU-ESM	College of Global Change and Earth System Science, Beijing Normal University (**China**)
CanESM2	Canadian Centre for Climate Modelling and Analysis (**Canada**)
CCSM4	National Center for Atmospheric Research (**United States**)
CNRM-CM5	Centre National de Recherches Météorologiques / Centre Européen de Recherche et Formation Avancée en Calcul Scientifique (**France**)
CSIRO-Mk3-6-0	Commonwealth Scientific and Industrial Research Organization in collaboration with Queensland Climate Change Centre of Excellence (**Australia**)
GFDL-ESM2G	NOAA Geophysical Fluid Dynamics Laboratory (**United States)**
GFDL-ESM2M	
HadGEM2-CC365	Met Office Hadley Centre (additional HadGEM2-ES realizations contributed by Instituto Nacional de Pesquisas Espaciais) (**United Kingdom**)
HadGEM2-ES365	
inmcm4	Institute for Numerical Mathematics (**Russia**)
IPSL-CM5A-LR	Institut Pierre-Simon Laplace (**France**)
IPSL-CM5A-MR	
IPSL-CM5B-LR	
MIROC5	Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology (**Japan**)
MIROC-ESM	Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies (**Japan**)
MIROC-ESM-CHEM	
MRI-CGCM3	Meteorological Research Institute (**Japan**)
NorESM1-M	Norwegian Climate Centre (**Norway**)

Data structure of each file:
Streamflow values vary along three dimensions, including two spatial dimensions (latitude and longitude), with dimension names 'lat' and 'lon', respectively, and one temporal dimension, with the dimension name 'time'. The variable name is 'streamflow'.

Stream temperature values vary along one additional dimension named 'no_seg'. In the stream temperature model, RBM, the river reach in each 1/8º model grid cell was divided into multiple segments of equal length. The 'no_seg' dimension indicates this subdivision. We divided the river reaches into multiple segments for two main reasons. First, to ensure numerical stability in the semi-Lagrangian approach, which RBM uses to solve the energy balance equations; and second to produce a higher-resolution river temperature. For consistency between different model grid cells, we only output the temperature for the middle (no_seg=1) and the most downstream river segments (no_seg=2) within each grid cell. The variable name is 'stream_temperature'.

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