Integrating socio-hydrological and climate models for improved water management under climate change

Amelie Schmitt, Peter Greve

Climate Service Center Germany (GERICS), Helmholtz-Zentrum Hereon

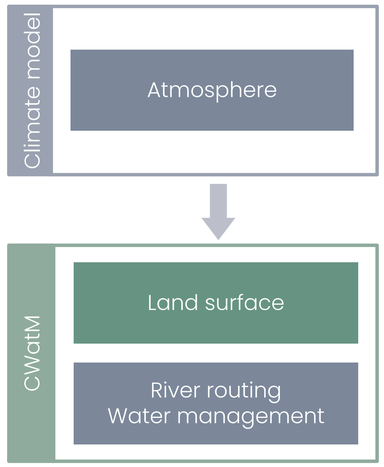
Background

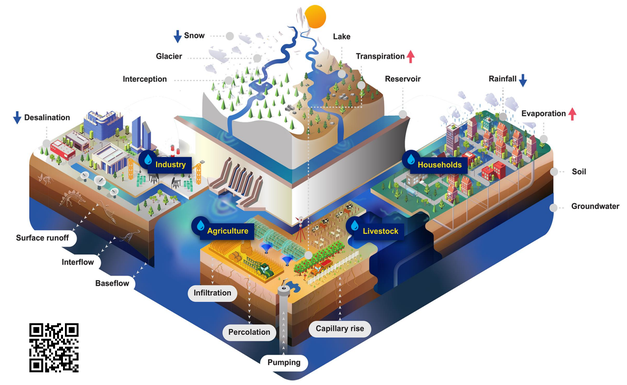
A growing world population and the associated social and economic developments are leading to a steadily **increasing demand for water**. Assessing **current and future water resources availability** must consider the complex interplay between **climate and socio-economic change.**

- Large-scale water resources and water management assessments are currently carried out using socio-hydrological models - leading to **biases in offline simulations**.
- Large-scale water management affects regional precipitation patterns, monsoon dynamics, and local temperatures – such impacts are **not routinely considered in climate models.**
- We argue that **climate models must consider water management practices**
  1. to provide better estimates of water resource availability
  2. to represent climate impacts arising from extensive water use

CWatM

The Community Water Model (CWatM) is a large-scale rainfall runoff and channel routing water resources model.

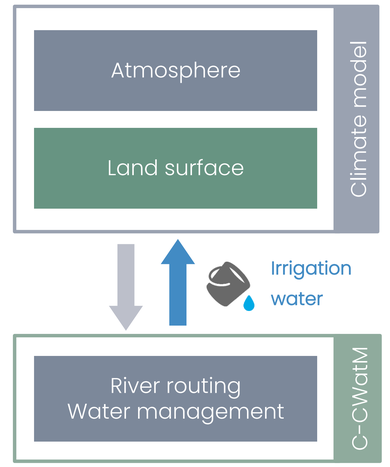




This graphic has been designed using images from Flaticon.com

Climate-CWatM

C-CWatM is a novel modelling tool based on CWatM to enable full coupling to regional/global climate models.



A Coupled Water Modelling Tool

We develop Climate-CWatM (C-CWatM), a socio-hydrological modelling tool that

- can be easily linked with regional or global climate models
- simulates hydrological quantities, sectoral water use, and water storage to estimate water resource availability

C-CWatM can be coupled with a climate model or used in offline mode. The required forcing data are:

- runoff
- groundwater recharge / percolation
- soil water content
- evaporation over water surfaces

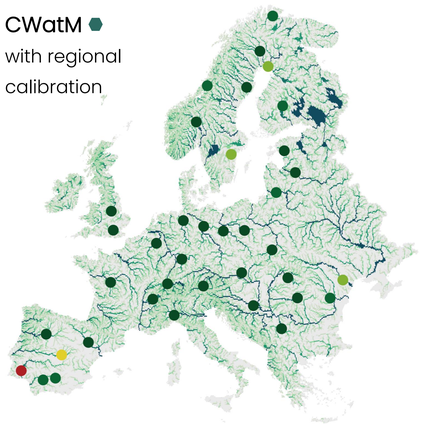
A coupler allows easy integration of C-CWatM into existing modeling systems. The implementation of **OASIS3-MCT** is currently underway.

A preliminary model version can be accessed at:

github.com/UWaRes/c-cwatm

First Simulation Results

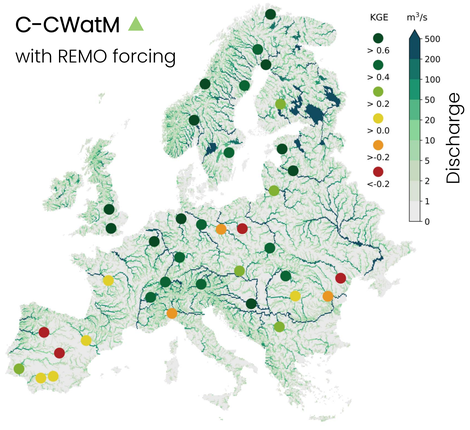
CWatM with regional calibration



CWatM forced with bias-corrected meteorological data fromm MSWX[1] (Multi-Source Weather).

1: Beck et al., 2022

C-CWatM with REMO forcing



C-CWatM forced with land surface data from the regional climate model REMO (forced with ERA5). REMO runoff was bias-corrected using a quantile mapping.

Figure 1: Average daily discharge from 1990 to 2009 modelled with CWatM (left) and C-CWatM (right). The points indicate the Kling-Gupta efficiency (KGE) for selected river basins.

- A **regional calibration** for CWatM results in good agreement between measured and modelled discharge.
- C-CWatM results improve when a **bias-correction** is applied to the runoff from the regional climate model used as forcing.

➡ Future improvements by using regional calibration also for C-CWatM

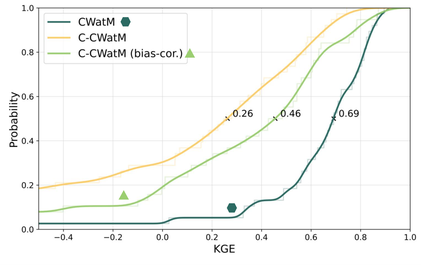


Figure 2: Cumulative distribution functions (CDF) of the Kling-Gupta efficiency (KGE) for the same river basins as in Fig. 1. The yellow line indicates results from C-CWatM forced with REMO data without bias-correction.

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Sharing is encouraged

Climate Service Center Germany (GERICS) • Helmholtz-Zentrum Hereon • Fischertwiete 1 • 20095 Hamburg • Germany

Amelie Schmitt • Email: amelie.schmitt@hereon.de • Peter Greve • Email: peter.greve@hereon.de • www.climate-service-center.de