Ecology & Hydrology
NATURAL ENVIRONMENT RESEARCH COUNCIL

water cycle. Experimental setup and first results.

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The Water Model Intercomparison Project (WaterMIP) aims to compare a variety of models of the terrestrial hydrological cycle, and to produce multi-model ensemble estimates of the state of the world's water resources for the 20th and 21st centuries. WaterMIP is a joint activity between the EU Water and Global Change (WATCH) FP6 project and the Global Water System Project (GWSP).

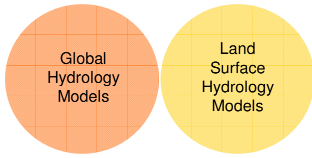
1. Aims of WaterMIP

- To understand the differences between models and between broad groups of models
- To improve models by exchanging ideas and parameterisations, particularly between traditionally separate communities, guided by analysis of WaterMIP simulations. The main focus is on improved representation of human activities (e.g. irrigation, dams). These improvements in the hydrology models used in climate models will mean feedback processes will be better represented in climate change simulations.
- To gain improved estimation and understanding of the impacts of Global Change on the global hydrological cycle and water resources, including uncertainties. In part this will be achieved through analysis of a multi-model ensemble simulation.

2. Two types of model

Traditionally there have been two separate groups of models:

Global Hydrology Models (GHMs)
used for water resource studies, consider many human impacts, such as extraction of water for irrigation, domestic use and manufacturing.



Land Surface Hydrology Models (LSHMs)
used in climate models, tend to have simpler hydrology schemes and ignore most or all human interventions, but pay more attention to details of surface energy balance and state.

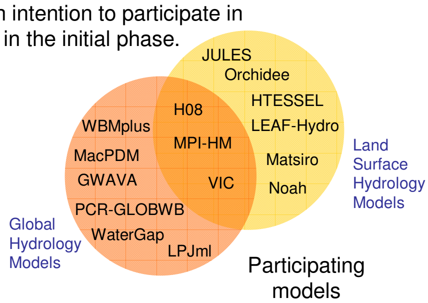
These have largely been used in different research communities, but both types can be used to quantify the world's water resources.

Global Hydrology Models (GHMs)	Analysis of global water resources. Daily or monthly timestep.	Typical processes and stores: Evaporation Soil moisture River flow Irrigation demands Reservoir operation Water extractions – e.g. for domestic use
Land Surface Hydrology Models (LSHMs)	Land surface component in a climate model. Timestep ~1 hour.	Typical processes and stores: Surface energy balance Photosynthesis and carbon fluxes Soil temperature and moisture River flow

3. Models and experiment

Fifteen models have expressed an intention to participate in WaterMIP. Of these, ten took part in the initial phase.

For the intercomparison, all models are driven by standard sets of meteorological data at 0.5ºx0.5º resolution, use a common land/sea mask and a common river channel network. Each model is free to choose a data source for all other inputs, e.g. vegetation map.



WaterMIP will proceed in stages (see table):

Stage 1 considers "Natural" conditions, meaning without reservoirs, irrigation and other explicit human interventions.

Each model will include a representation of some or all these effects in later stages.

This design will allow climate-drive changes to be separated from societal changes (e.g. population growth).

	Time period	Human interventions?
Stage 1	1985-1999	No
Stage 2	1985-1999	Yes
Stage 3	2085-2099	No
Stage 4	2085-2099	Yes

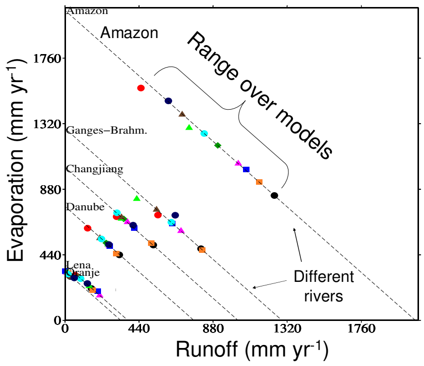
Historical runs will be forced by the WATCH forcing data (see poster by G.Weedon in this session), based on CRU monthly observations with variability on shorter timescales derived from the ERA40 reanalyses.

Runs for the 21st century will use bias-corrected data from GCM simulations.

4. Initial results

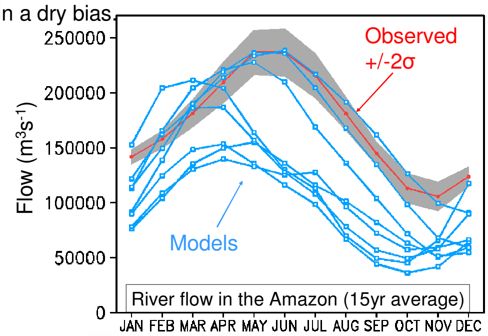
Thus far, there has been a preliminary round of integrations involving 10 models, which has allowed participants to adapt their model codes to use the modelling protocol. (Note that these runs used an alternative source of driving data.)

The figure shows modelled evaporation and runoff for several large river basins. There is large variation between the models, and also between how a given model compares (relative to the ensemble mean) between different basins.



Modelled riverflow in the Amazon is shown compared with observed values (15 year averages). Again, there is large variation between the models. All models are on average drier than observed. Although model deficiencies most likely account for most of the discrepancy, the best-estimate "observed" precipitation might also contain a dry bias.

The components of evaporation over the Amazon also vary greatly between models (not shown) and this has been identified as an important factor in explaining model spread. Local observations of evaporation can be used to identify outlier models. There are also suggestions that the method used to calculate evaporation in some GHMs can be related to model behaviour.



5. Conclusions

So far there appears to be little systematic difference between the results from the two main groups of models (GHMs and LSHMs) for naturalised runs. However, features of individual models can be related to differences in behaviour. Further analysis and comparison with observations will be used to identify models and processes that are unrealistic in any given area. Upcoming runs will consider human interventions (e.g. irrigation) and scenarios for the 21st century.

WATCH Water and Global Change
GWSP Global Water System Project
NVE
WAGENINGEN UR For quality of life
CESR Center for Environmental Systems Research

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