WFD Lille 2010

Evaluation of the global water cycle's response to current and future drivers of climate change

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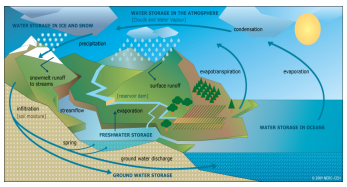
Outline

- Background Science
- Watch project
  - Water Model Intercomparison Project
  - Regional Test Basins
- Outcomes
- Future results

Global Water Cycle

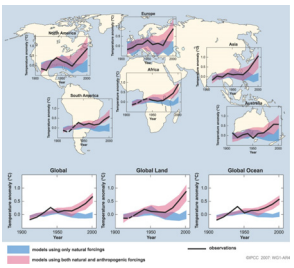
- Availability of water is impacted by:
  - increasing temperature
  - increasing carbon dioxide
- Consequences of a warming world are numerous
- local events have global Consequences



- Holistic approach to tackling problem is needed
- must be based on a sound global understanding of the problem

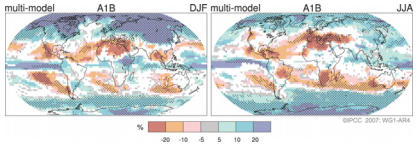
Warming is unequivocal

- Temperatures are forecast to rise
- Water cycle key component of Climate system
- 85% of Europeans believe water resources will be impacted by climate change



Changes in Rainfall Regionally

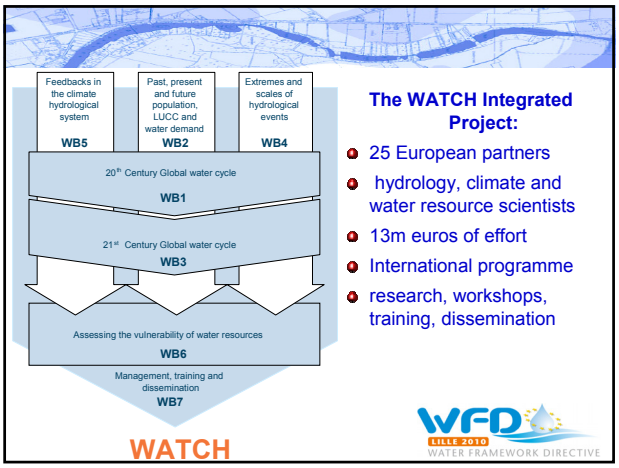
- multi-model averages of relative changes in precipitation
- Regional changes of up to 20% in average rainfall
- Less than 66% of models agree on the sign of change for white areas
- More than 90% of models agree on the sign of the change in stippled areas

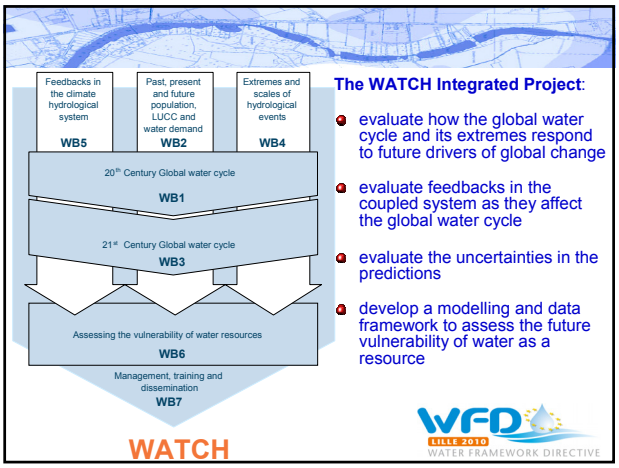


Projected changes to precipitation for the period 2090–2099, relative to1980–1999

WATCH: A Global Project

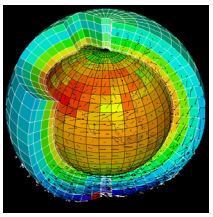
- Brings together the hydrological, water resources and climate communities
- To integrate modelling of the water cycle into global and regional climate models
- To provide policy makers with a coherent assessment of flows, floods and droughts for the present and in the future.





Model Intercomparison

- many models used to provide future scenarios estimates
- previous studies have differed in use of driving data and interpretation of changes in resource availability.
- comparison of 13 models, assessing the uncertainties in estimating the world water balance.
- **All models use the same WATCH Forcing Data**
- Data sets are an essential step to estimating the land surface water budget



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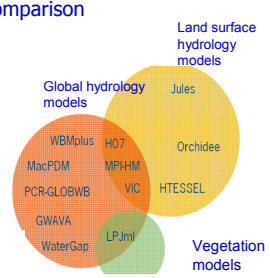
WaterMIP: Land Surface Hydrology Model/ Global Hydrology Model Intercomparison

- Highlight differences in model physics
- Improve understanding of uncertainties and drivers of global water balance
- Improved estimates of global change impacts on global hydrological cycle and water resources
- lead to improved rep global hydrological c LSHMs and GHMs, i impacts



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WaterMIP outputs

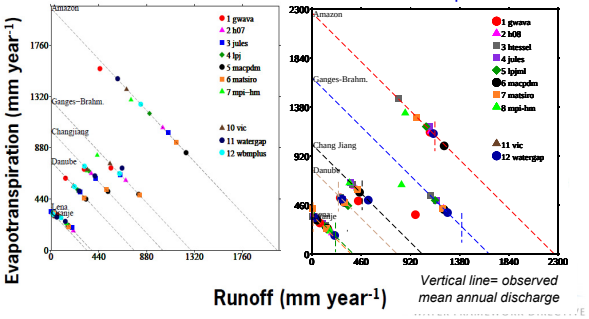
- study vulnerability of global water resources for 20th and 21st century
- Focus on the impacts of climate change on future water resources.
- Allow attribution assessment to human influence and/or climate system changes

WATER FRAMEWORK DIRECTIVE

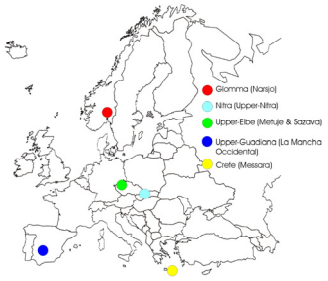
Comparing model outputs driven with 2 different datasets

Mean annual water fluxes (mm year^{-1})

WATCH input Data



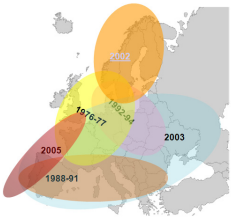
WATCH Test Basins



- Finer scale (12km) climate data sets for two regions - Europe and India
- 5 test basins in Europe selected
- experience different climate and catchment control

Recent severe events globally and in Europe pose questions

- **Are we seeing an increase in the frequency and severity of drought?**
- **If so, can it be attributed to:**
  - natural long-term variability
  - climate change
  - anthropogenic causes like abstraction, landuse change
  - Mismanagement
- **What about the future?**



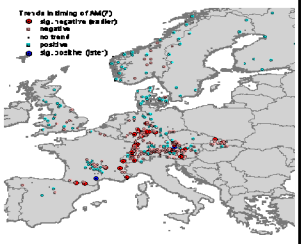
Recent major events:
- 2003
- 2005
- 2006
- 2007

Tallaksen & van Lanen

Regional Testing

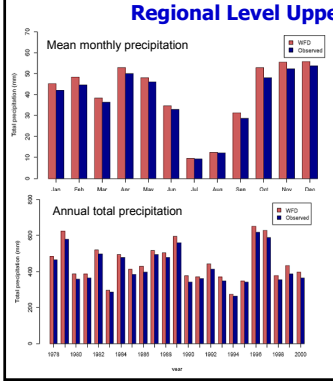
- The WATCH Forcing Data and the outcomes from large scale models will be tested at the regional basin scale of these 5 catchments for current climate (20th C) and future climate.

Timing of minimum flows for period 1962-2004: Droughts are happening earlier, one month earlier in certain locaitons



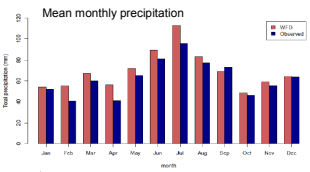
From: Stahl, Hisdal, Tallaksen, van Lanen, Hannaford, Sauquet & Demuth (2008)

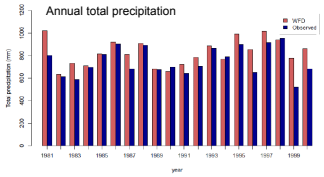
Regional Level Upper-Guadiana, Spain



- **comparison of Precipitation**
- **WATCH Forcing Data vs. Local Observed Data**
- **WATCH Forcing Data overestimates total precipitation but shows similar annual pattern**

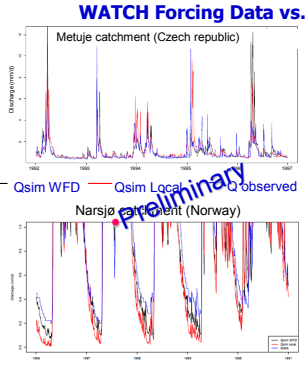
Regional Level Metuje Catchment, Czech republic





From: van Huijgevoort, Horacek, Machlica, Horvat, Haddeland, Aris Koutroulis et al. (2009)

Stream Flow comparison WATCH Forcing Data vs. Local Observed Data

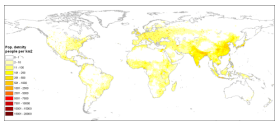


- drought characteristics from River Basin Hydrological Models (RBHM)
- very similar to those derived from RBHMs forced with local data
- Small basins useful to validate spatial and temporal aspects of simulated drought

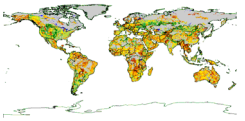
From: van Huijgevoort, Horacek, Machlica, Horvat, Haddeland, Aris Koutroulis et al. (2009)

New data products (to enable the full range of hydrological models to be run and evaluated):

- Global forcing data – half degree forcing data, daily and sub-daily for 20th C
- 21st C bias corrected forcing data
- Regional forcing data sets 0.1°
- Land cover for 20th and 21st C
- Population and water use for 20th and 21st C



Future Population (1990-2100)



Harmonized World Soil Database

FUTURE WORK:

- Integrated model intercomparisons and evaluations, WaterMIP models will improve parameterisation of physical processes.
- Consistent global analyses (@50km) of rainfall, runoff, soil moisture, flood indices etc for 20th and 21st C
- Evaluate the uncertainties in the predictions
- Improved prediction of extreme events – flood / drought – magnitude, duration, spatial extent
- Develop a modelling and data framework to assess the future vulnerability of water as a resource

WATCH
Water and Global Change

' The Integrated Project (WATCH) which will bring together the hydrological, water resources and climate communities to analyse, quantify and predict the components of the current and future global water cycles and related water resources states, evaluate their uncertainties and clarify the overall vulnerability of global water resources related to the main societal and economic sectors.'

What new scientific findings and experiences can facilitate RBMP implementation & revision?

- Developing a consistent modelling framework to assess future vulnerability of water as a resource
- WATCH Forcing Data was successfully applied at the river basin scale
- drought characteristics derived from River Basin Hydrological Models (RBHM) using WATCH Forcing Data are very similar to RBHMs forced with local data
- Improved prediction of extreme events – flood / drought – magnitude, duration, spatial extent