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# The WATCH project: the terrestrial water cycle: progress and challenges

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WATCH Water and Global Change

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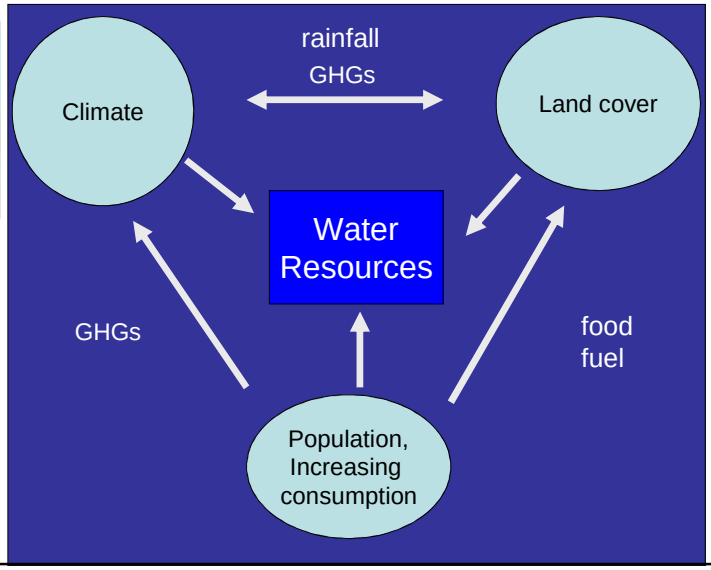
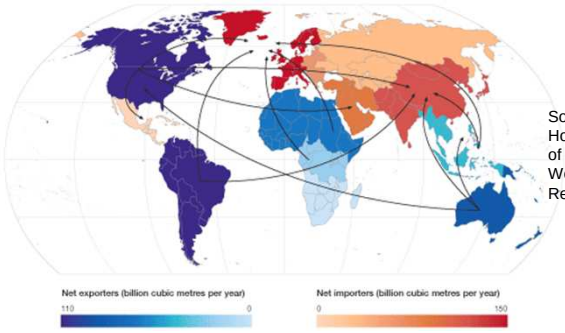
## Global Drivers of Change: interactions

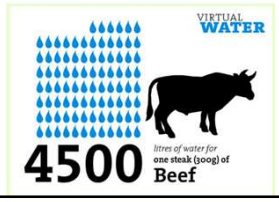



WATCH Water and Global Change

# Virtual water imports and exports around the world



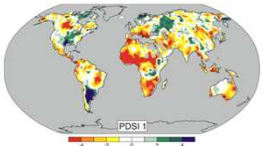

Source: Chapagain and Hoekstra, 2004 Water Footprints of Nations; UN/WWAP 2006, UN World Water Development Report

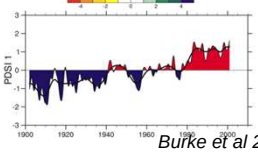




# Global Changes in Hydrology

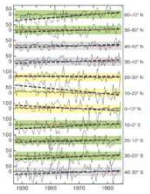
## Changing drought severity



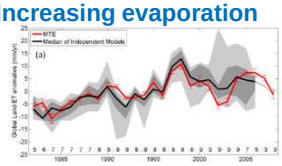

*Burke et al 2007*

## Changing zonal rainfall



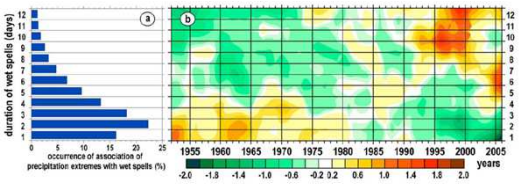
*Zhang et al 2008*

## Increasing evaporation



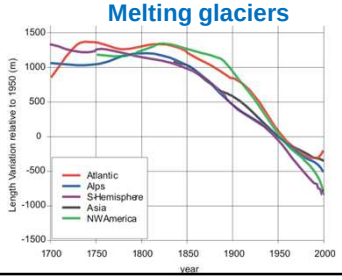

*Jung et al 2010*

## Increasing heavy rainfall




*Zolinia et al 2010*

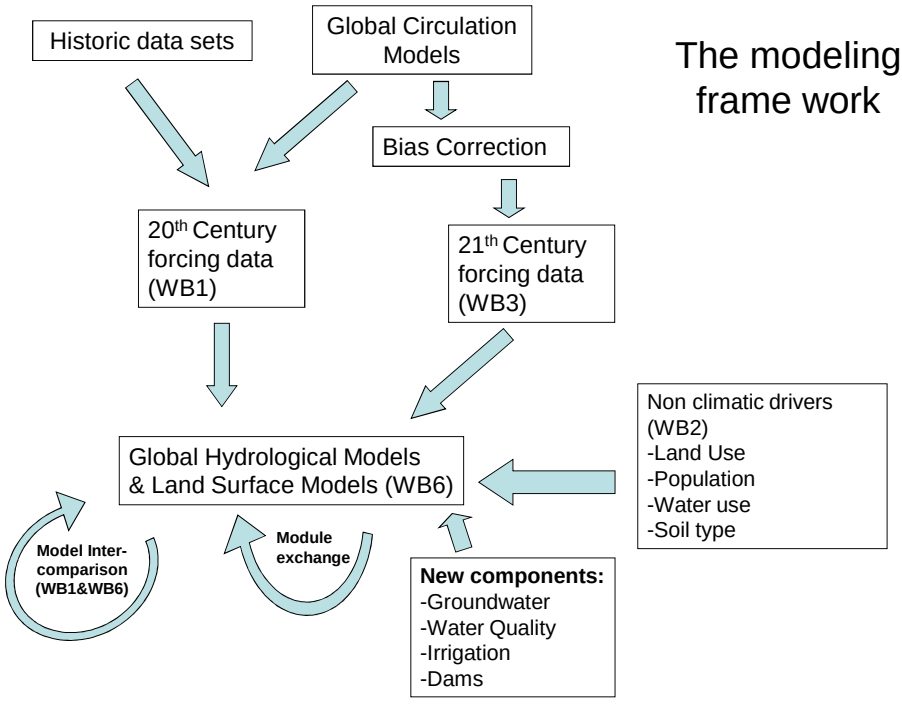
## Melting glaciers



WATCH is a integrated project bringing together the hydrological, water resources and climate communities to analyse, quantify and predict the components of the current (20th C) and future (21st C) global water cycle.

The project aims to evaluate the uncertainties of, and clarify the overall vulnerability of, global water resources related to the main societal and economic sectors

## The modeling frame work



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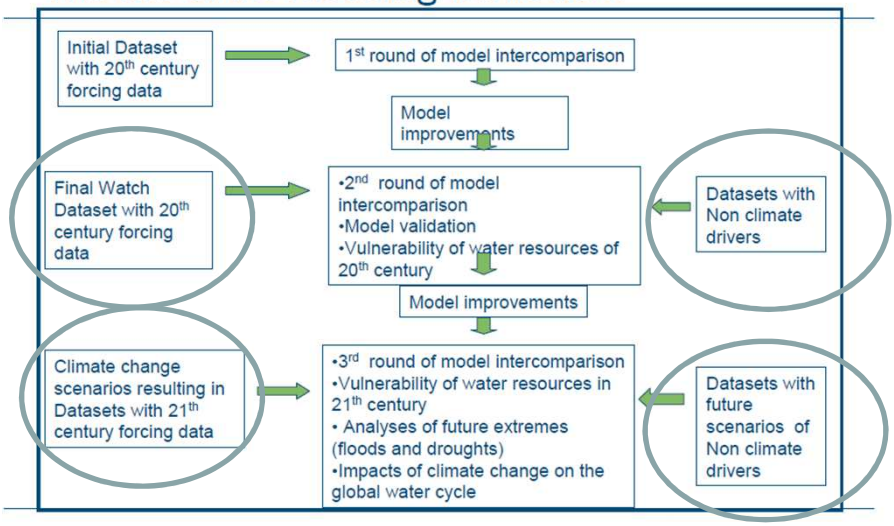
## The use of the modeling framework

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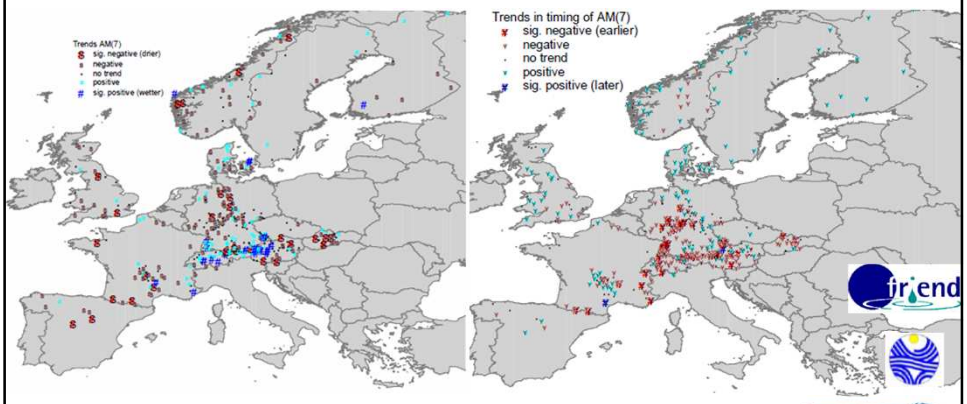
## WATCH WB4 Extremes: are extremes becoming more common?

Trends for 1962-2005

Magnitude of 7-day Annual minima

Timing of 7-day Annual minima




***Stahl et al, 2008, Trends in low flows from streamflow records of small headwater catchments across Europe, WATCH conf.***

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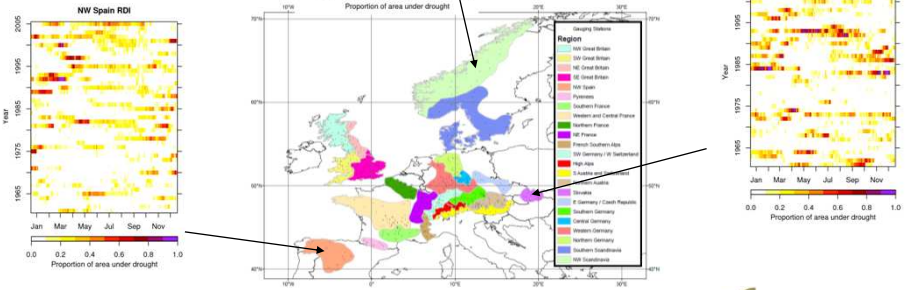
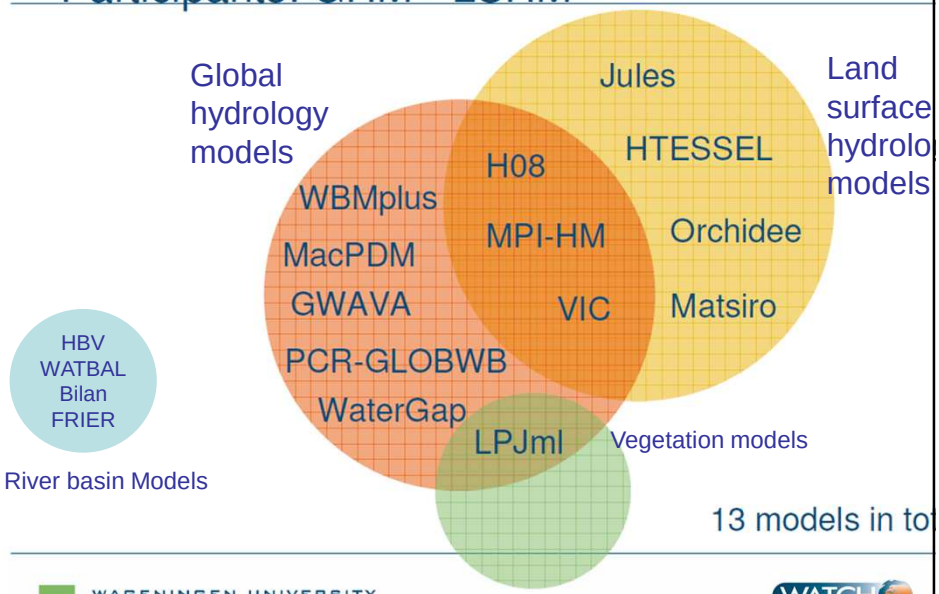
## 20th century drought catalogue


Norway, 2002

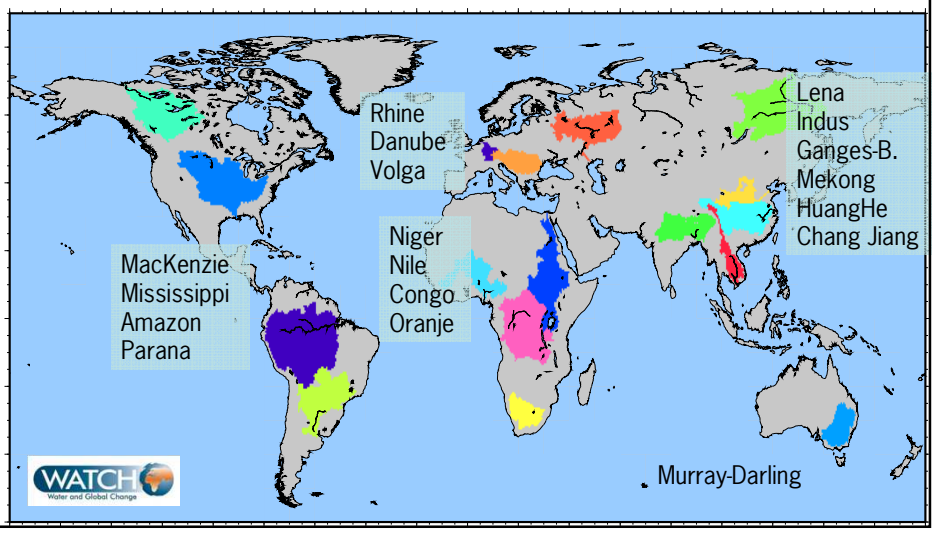



Hannaford et al., (in press) Hydrol. Process

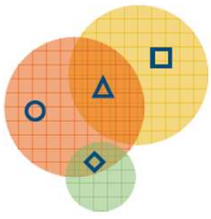
## Participants: GHM - LSHM

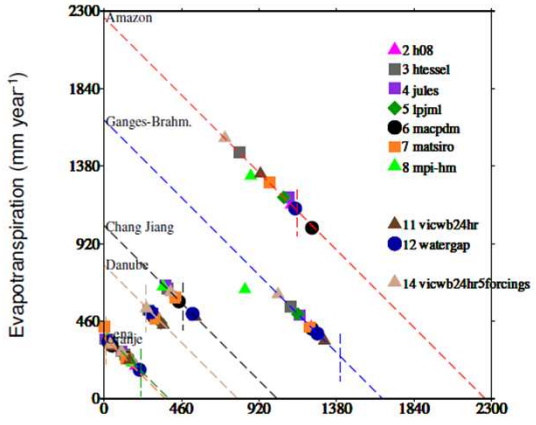


# River basins




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



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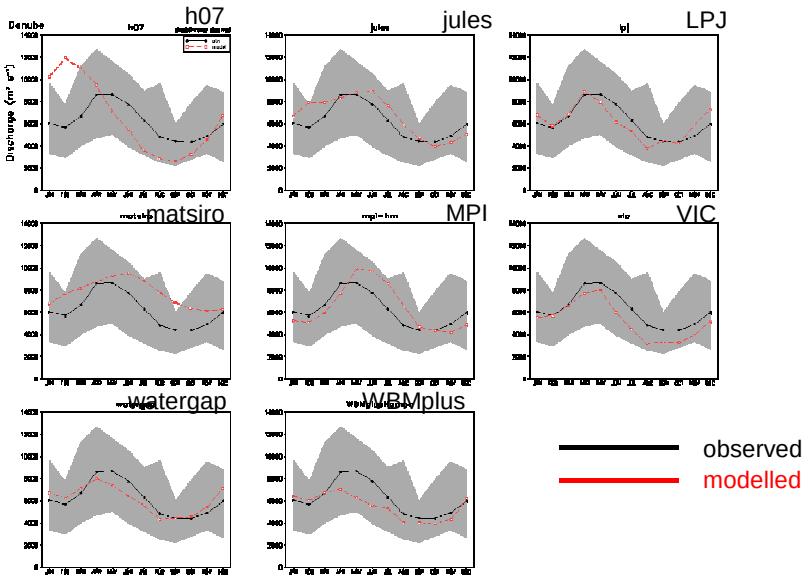
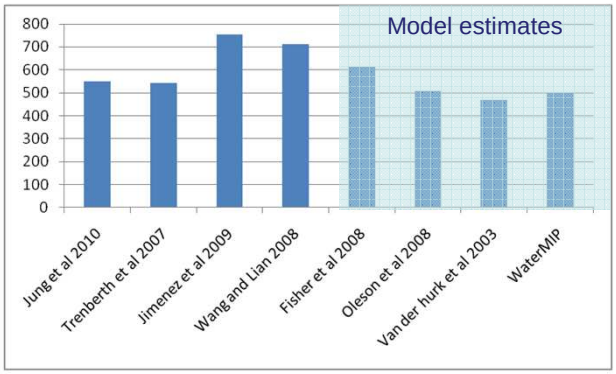
Danube at Ceatal Izmail, average monthly values




Global annual land evaporation derived from observations




| Reference | E(mm) | Method | Time period | Comment |
|---|---|---|---|---|
| Jung et al, 2010 | 549 | AI+FLUXNET+RS | 1982-2008 | vegetated |
| Trenberth et al, 2007 | 541 | P-Q | 1979-2000 | non-ice |
| Fisher et al. 2008 | 613 | modified PT + RS | 1986-1993 | |
| Jimenez et al, 2009 | 754 | RS calibrated on GSWP | 1992-1999 | |
| Wang and Lian, 2008 | 712 | Statistical correlation | 1986-1993 | |

## Global Extremes Analysis

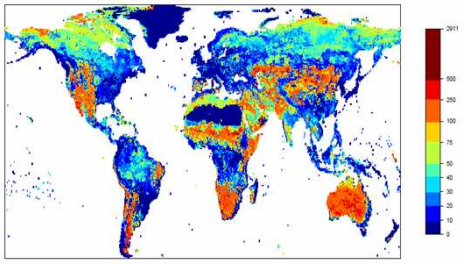
ERA40 → WATCH forcing data, 1958-2001

CRU → WATCH forcing data, 1958-2001

WATCH forcing data, 1958-2001 → Multi-model runoff series (daily)

Multi-model runoff series (daily) → Drought and flood analysis

**Runoff Drought:**
**Mean drought duration per cell (1963-2001)**

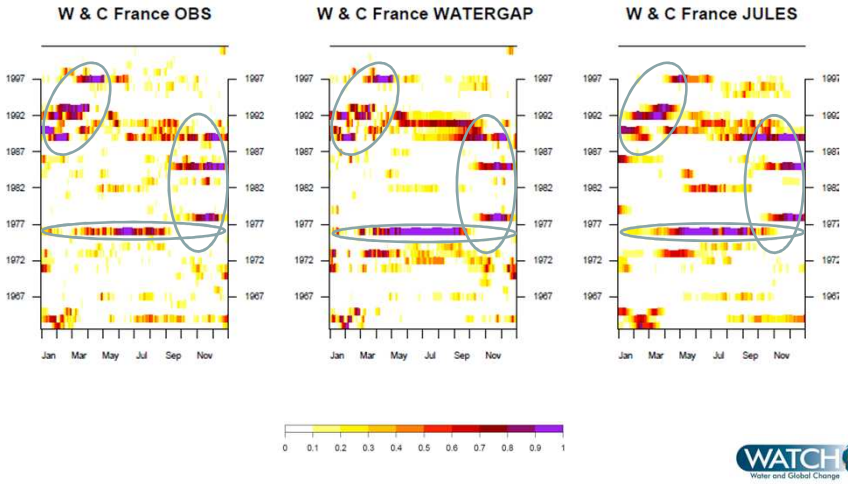


MPI-HM

Van Huijgevoort *et al.* (ongoing)

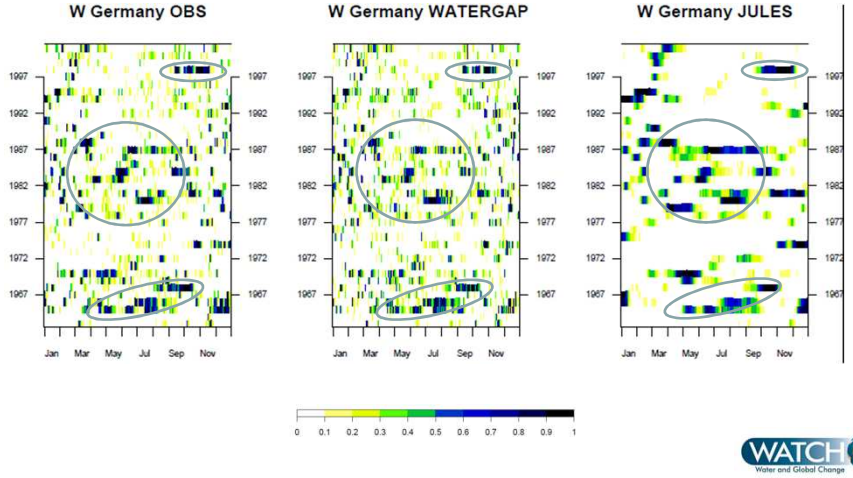
## Analysis of droughts

Good reproduction of major drought events



# Analysis of floods

Good reproduction of major high flows/flood events






**WATCH has (will) acheived:**

•Global data sets of 20th C driving data

•Bias corrected 21st C data

•Global data sets of land use, water use , soils etc

•Improved models

•a better understanding of regional and global patterns of evaporation (and its components),

•a better global analysis of extremes (floods and droughts) for the 20th and 21st centuries

•Assessment of human influence on the hydrological cycle with in Earth System Models

•Demonstrated the importance of multi-model ensembles for impact studies to better represent uncertainty in our predictions.

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# Thank you

http://www.eu-watch.org

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