WaterMIP

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Water Model Intercomparison Project

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(and many others)

Motivation

First International Workshop on
Computing the World Water Balance

University of Kassel, Kassel, Germany
25-26 April, 2007

Sponsored by
Global Water System Project
EU WATCH Project
Center for Environmental Systems Research, Uni-Kassel
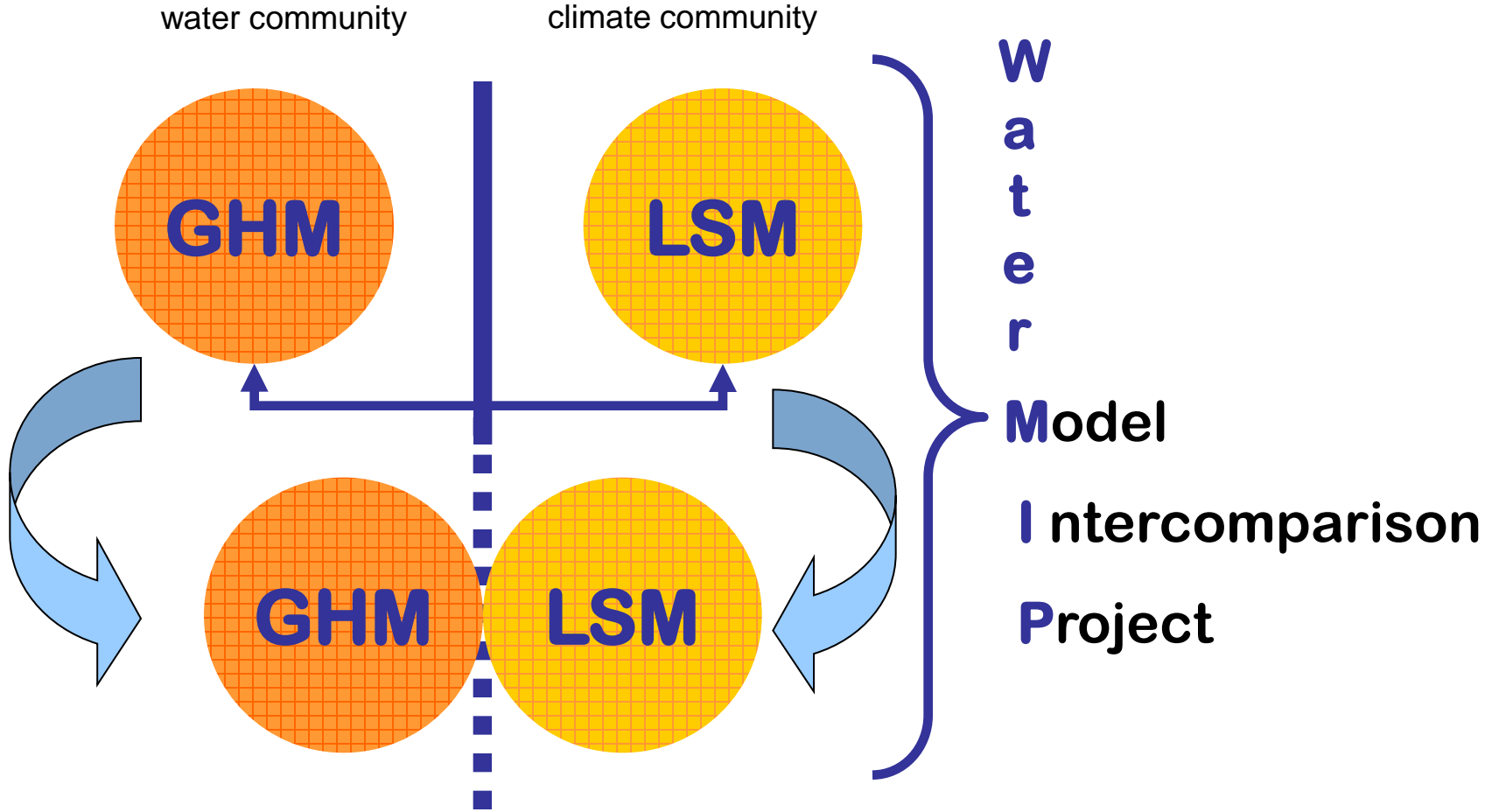
Motivation

Key Issues of the Model Intercomparison Exercise

- Model intercomparison is a joined **GWSP-WATCH** initiative

- Improved understanding of the **uncertainties** and the drivers of the current and future global water balance / water resources

- **Vulnerability** of global water resources

- Facilitate the design of a **modelling framework**

  - Intercomparison follows a strict and well defined **modelling protocol**

- Improving the **representation** of the global hydrological cycle in GCMs to improve the simulation of **feedbacks**

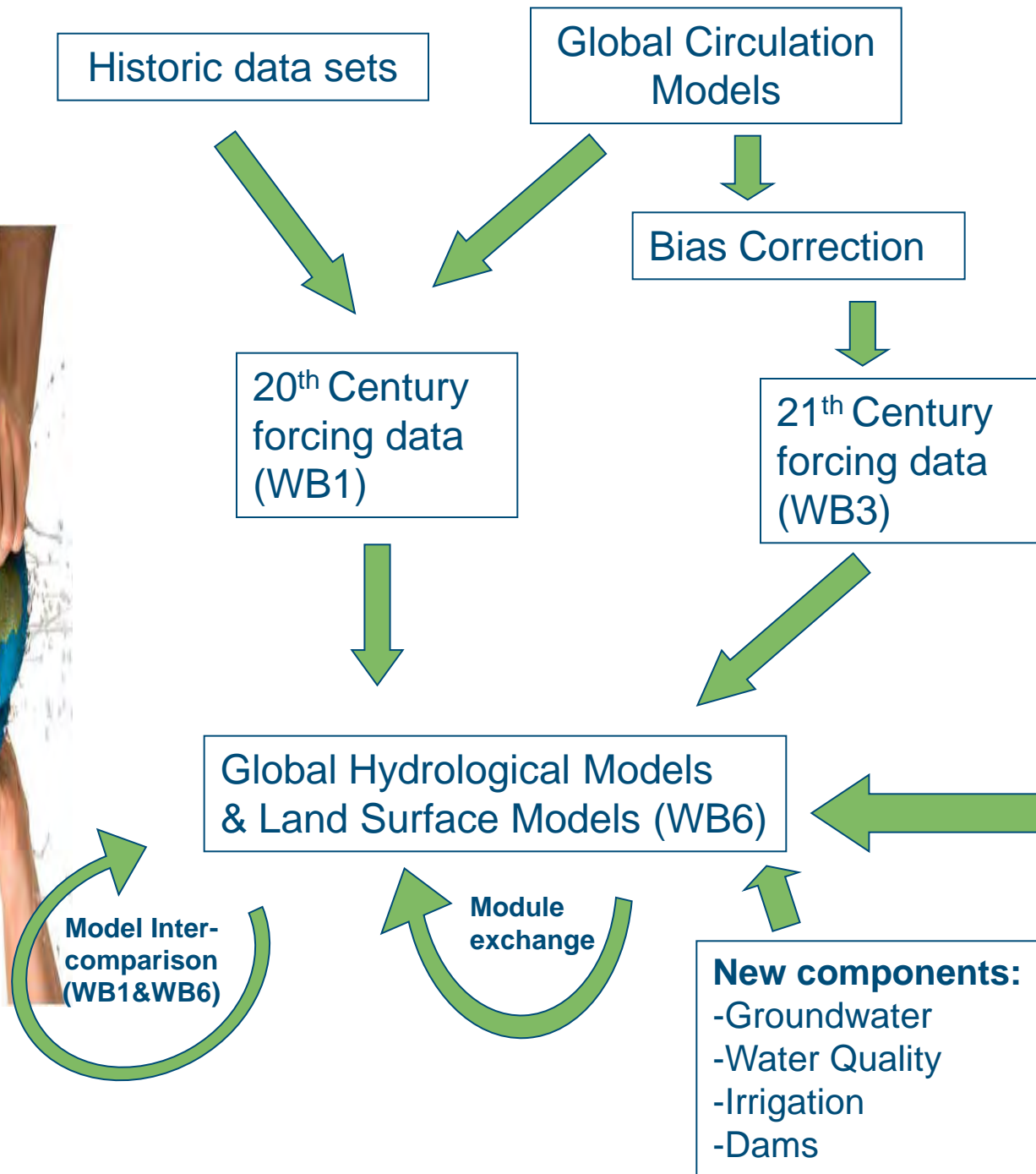 - Bring together different communities: LSMs - GHMs

Motivation

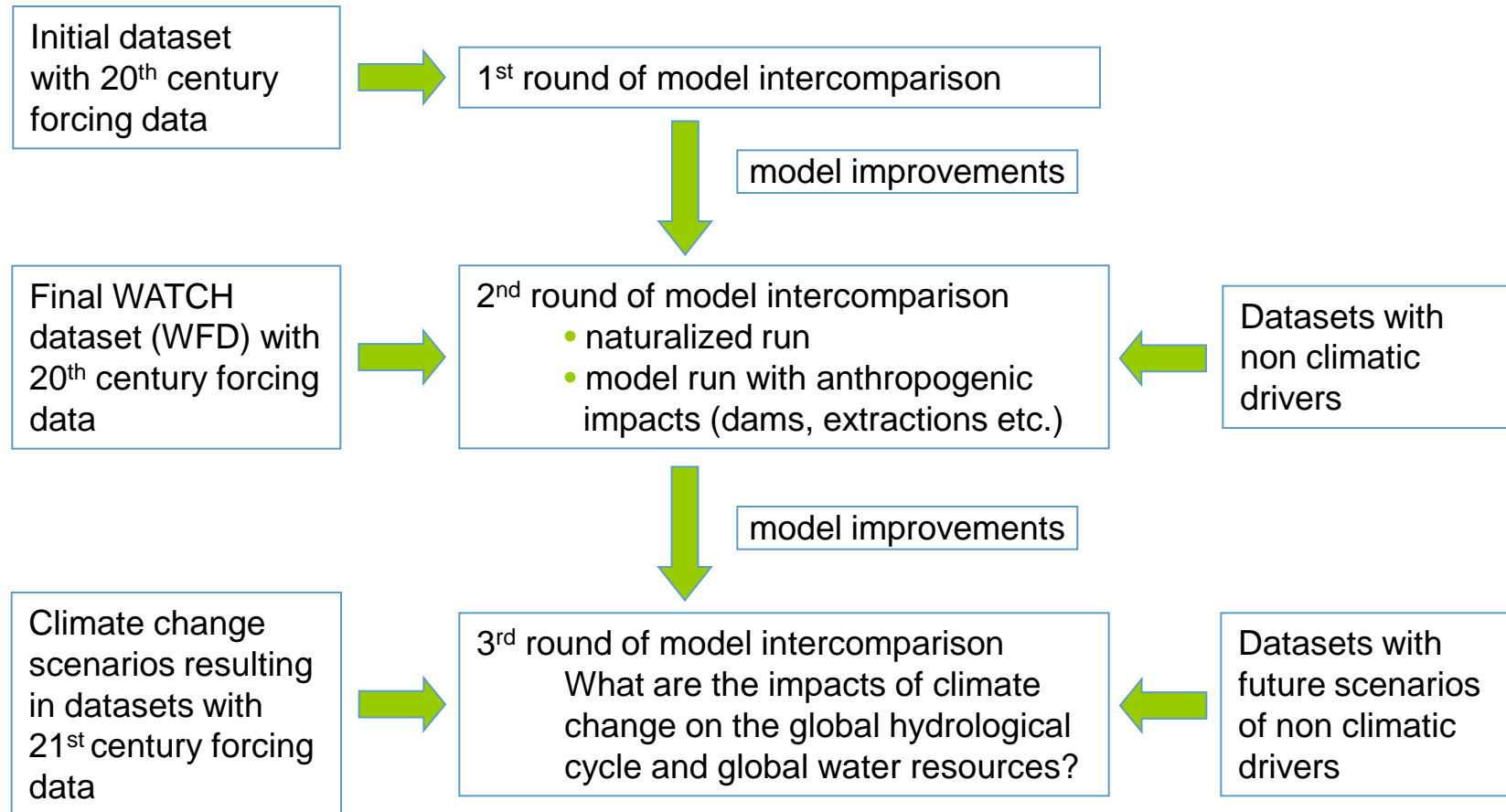Improvements

The modelling framework

Historic data sets

Global Circulation Models

Bias Correction

20th Century forcing data (WB1)

21th Century forcing data (WB3)

Global Hydrological Models & Land Surface Models (WB6)

Non climatic drivers (WB2)
-Land Use
-Population
-Water use
-Soil type

Model Inter-comparison (WB1&WB6)

Module exchange

New components:
-Groundwater
-Water Quality
-Irrigation
-Dams

# The modelling framework

Sets of Model Intercomparisons

Initial dataset with 20th century forcing data	→	1st round of model intercomparison

model improvements

Final WATCH dataset (WFD) with 20th century forcing data	→	2nd round of model intercomparison • naturalized run • model run with anthropogenic impacts (dams, extractions etc.)	←	Datasets with non climatic drivers

model improvements

Climate change scenarios resulting in datasets with 21st century forcing data	→	3rd round of model intercomparison What are the impacts of climate change on the global hydrological cycle and global water resources?	←	Datasets with future scenarios of non climatic drivers

WaterMIP Results

What have we accomplished so far

- **11** models have submitted **naturalized runs** using WATCH Forcing Data 1985-1999 – with a nice spread of Global Hydrological Models and Land Surface Schemes.

- "Tested" WATCH Forcing Data using many models

- **5** models have submitted **human impacts runs**

- A clear **protocol** for data submission and model runs – a great benefit for the rest of the WATCH project.

- First **paper** submitted

- **Many** model runs submitted for the **21st century** over the last few week

- Potentially the first global **multi climate** and **multi impact** model assessment

Global mean annual runoff and evaporation
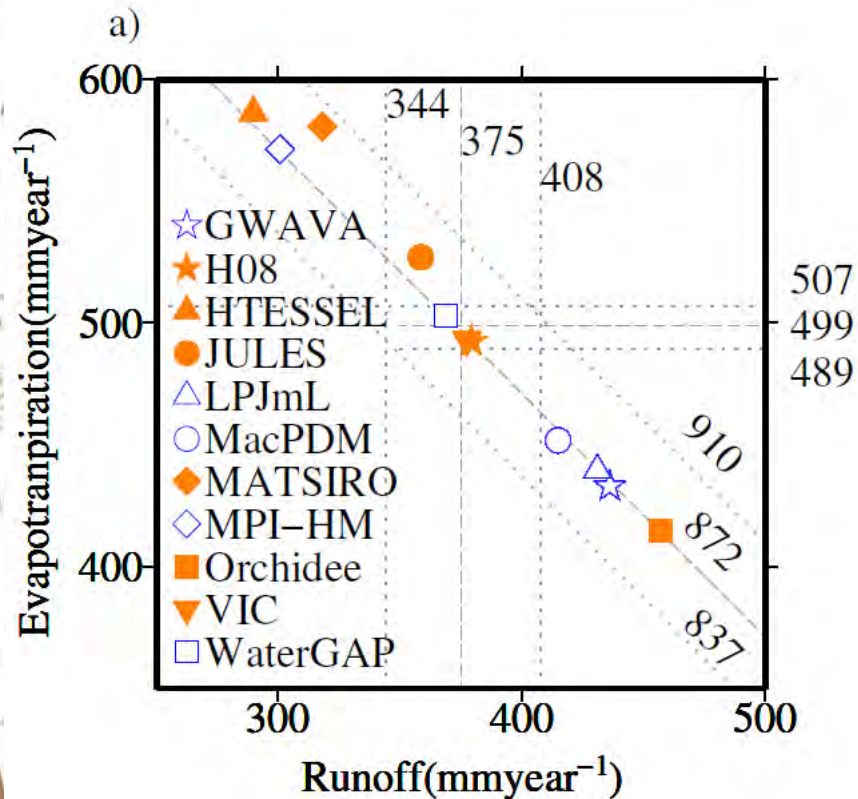
LSM

GHM
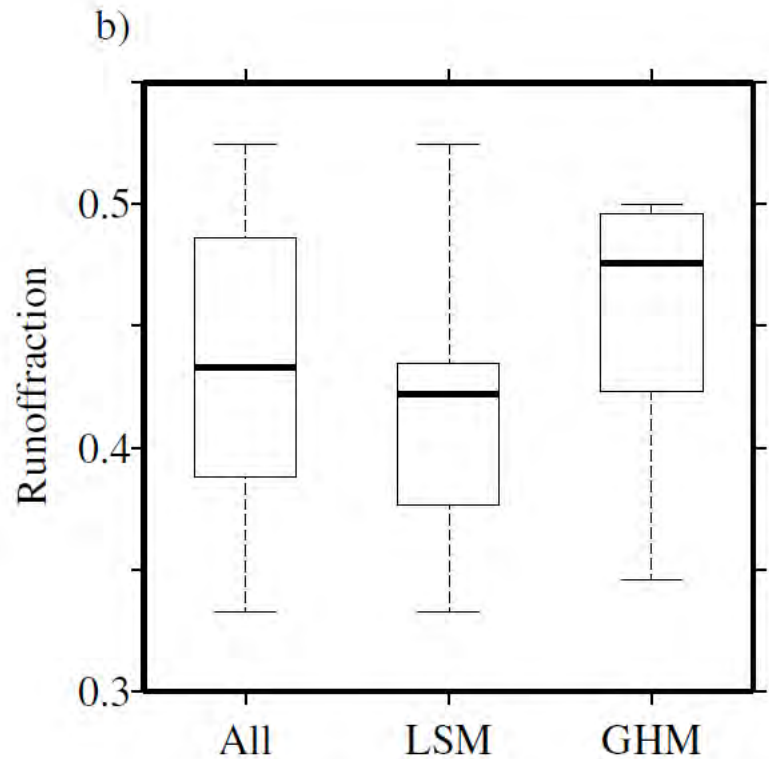
Haddeland et al 2010, *in review*

WaterMIP Results

Precipitation	Evaporation	Run-off Fraction
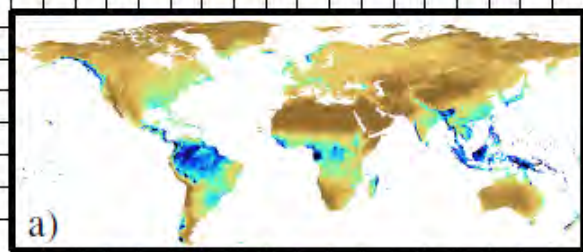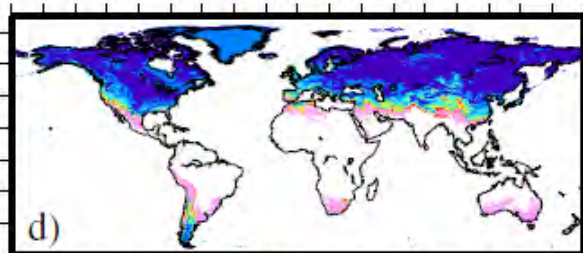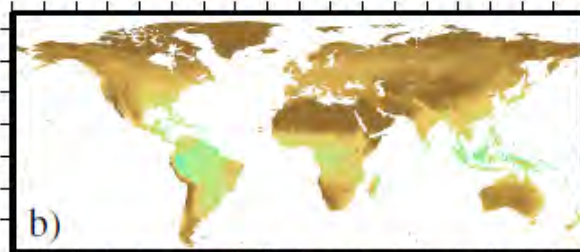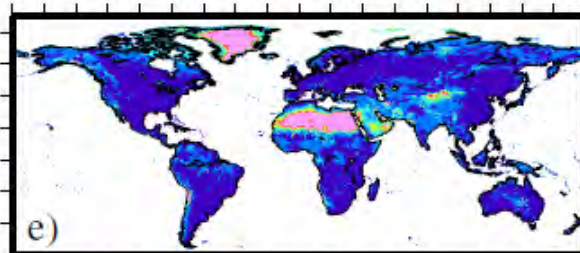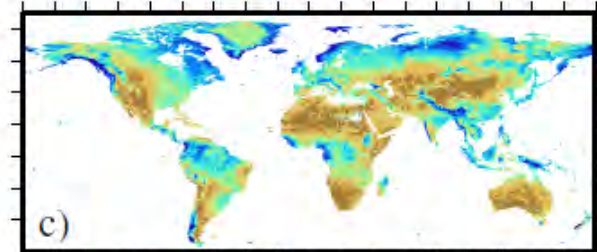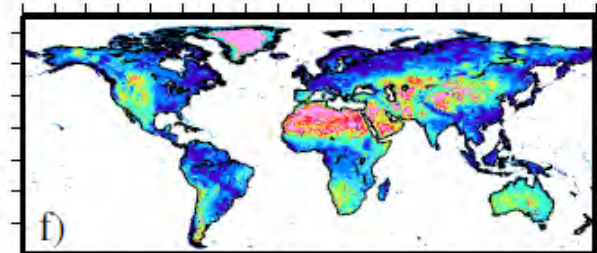
WaterMIP: **872 mm**	**415-586 mm**	**0.33 - 0.52**
GSWP2: **829 mm**	**272-442 mm**	**0.47 - 0.68**

Haddeland et al 2010, *in review*

WaterMIP - Results

Key findings for naturalized modeling results

- Considerable **spread** in model results (range in runoff is 25.000 km^3).

- Interannual **variation** in predicted global **runoff** is much larger than variation in **ET**.

- Global Hydrological Models show **higher average** and **median runoff** values than Land Surface Models. Partly due to a different **snow melt scheme**.

- **Energy balance** models in general predict **lower snow water equivalents** than models using a **degree day** approach.

- Calculating **ET** based on **temperature** solely can lead to significantly different results than using **radiation** and **humidity** in addition.

- **Reliable** conclusions for the impacts of climate change on water resources should **not** be based on the results of a **single** model.

Haddeland et al 2010, *in review*
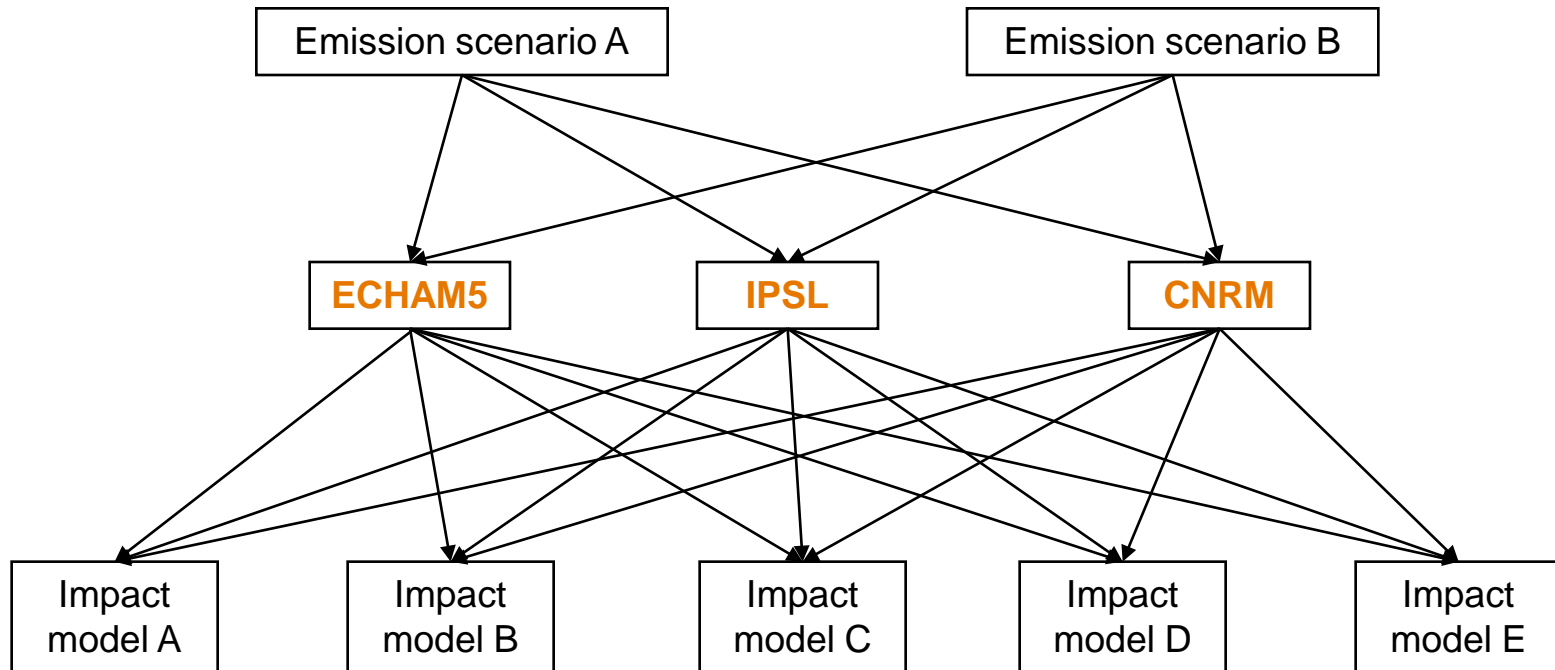
WaterMIP - Outlook

What's coming next?

No.

2

x

3

x

???

Emission scenario A   Emission scenario B

ECHAM5   IPSL   CNRM

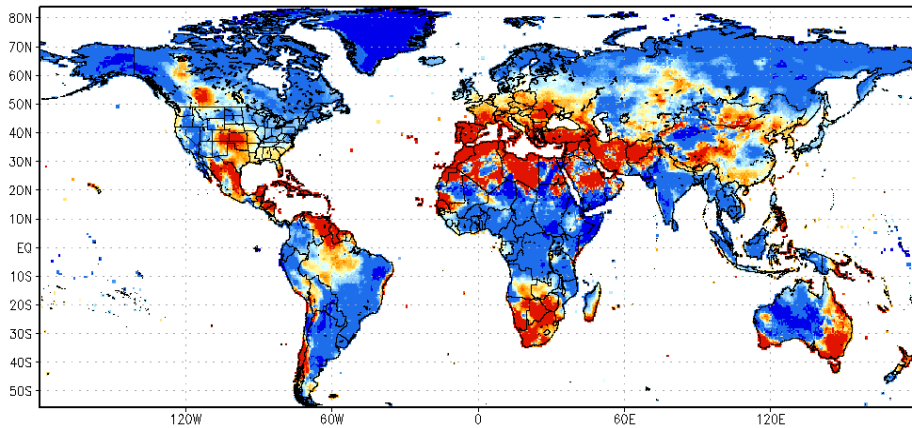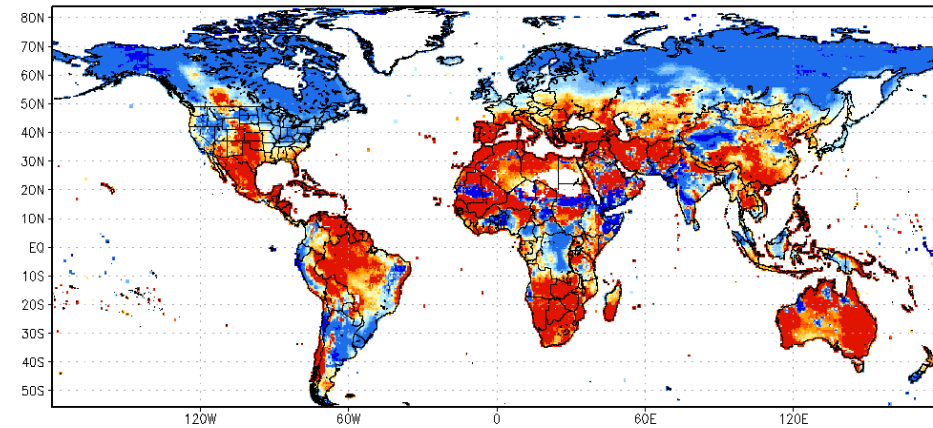Impact model A   Impact model B   Impact model C   Impact model D   Impact model E

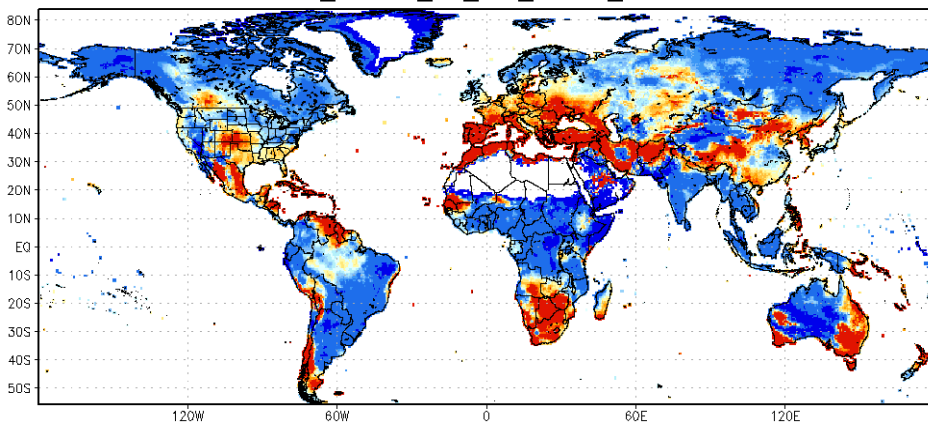# Change in runoff 1971-2000 vs 2071-2100
ECHAM5 A2

Diff: Control 1971-2000 vs. Scenario a2 2071-2100 [in %]
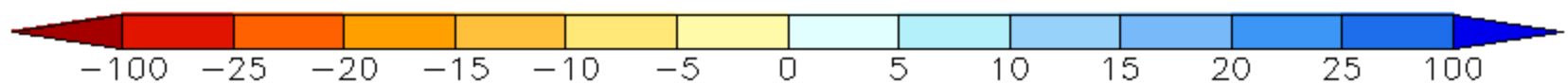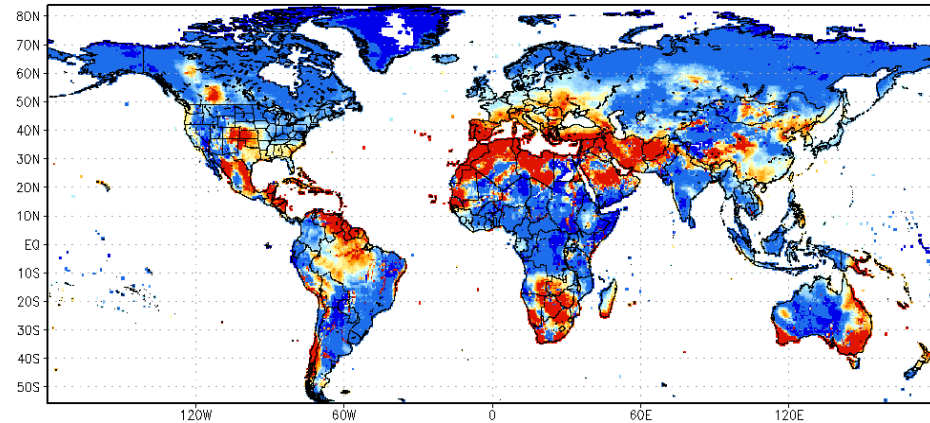MacPDM_echam_a2_nat_runoff_World

Diff: Control 1971-2000 vs. Scenario a2 2071-2100 [in %]
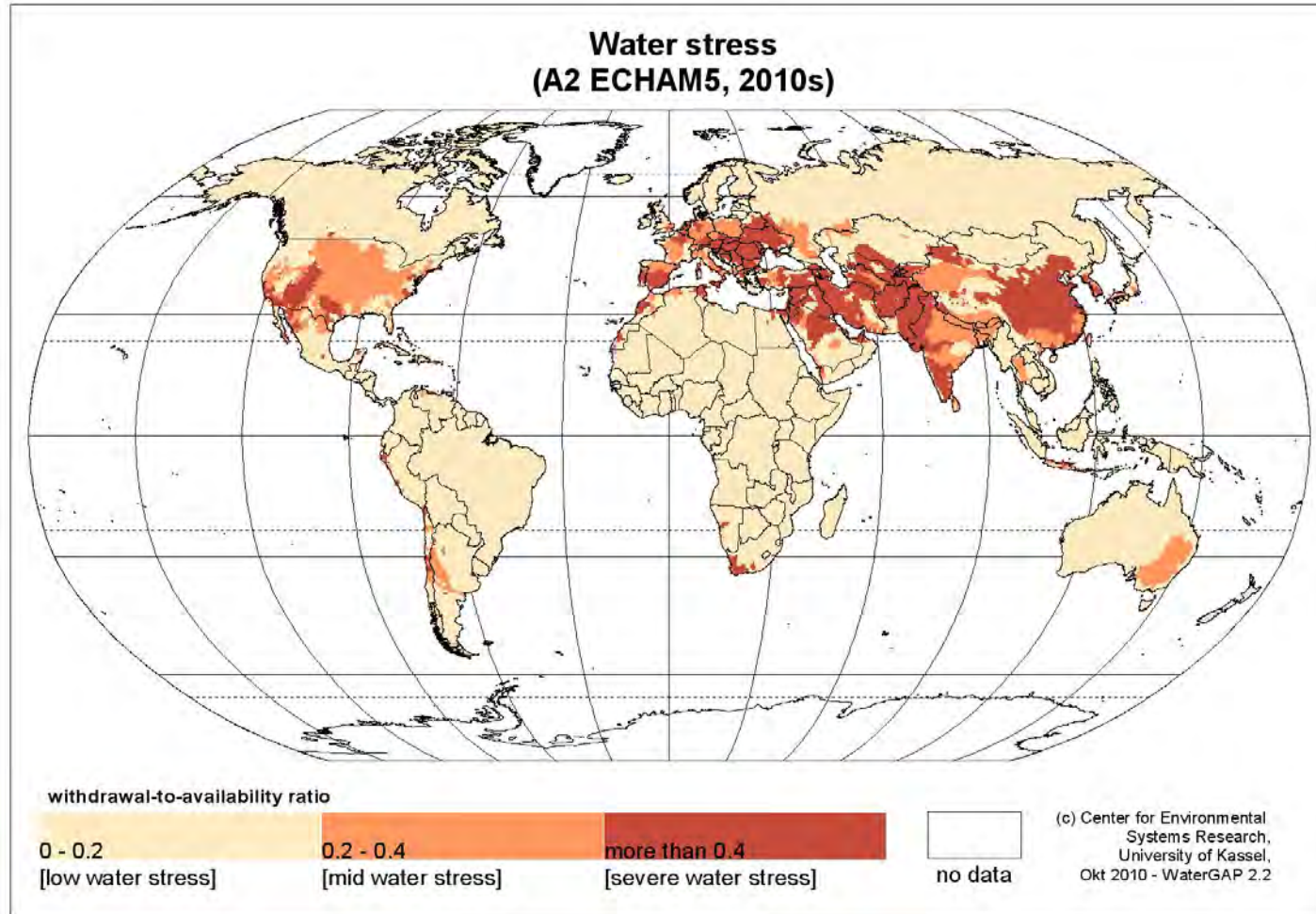mpihm_echam_a2_nat_runoff_World

Diff: Control 1971-2000 vs. Scenario a2 2071-2100 [in %]
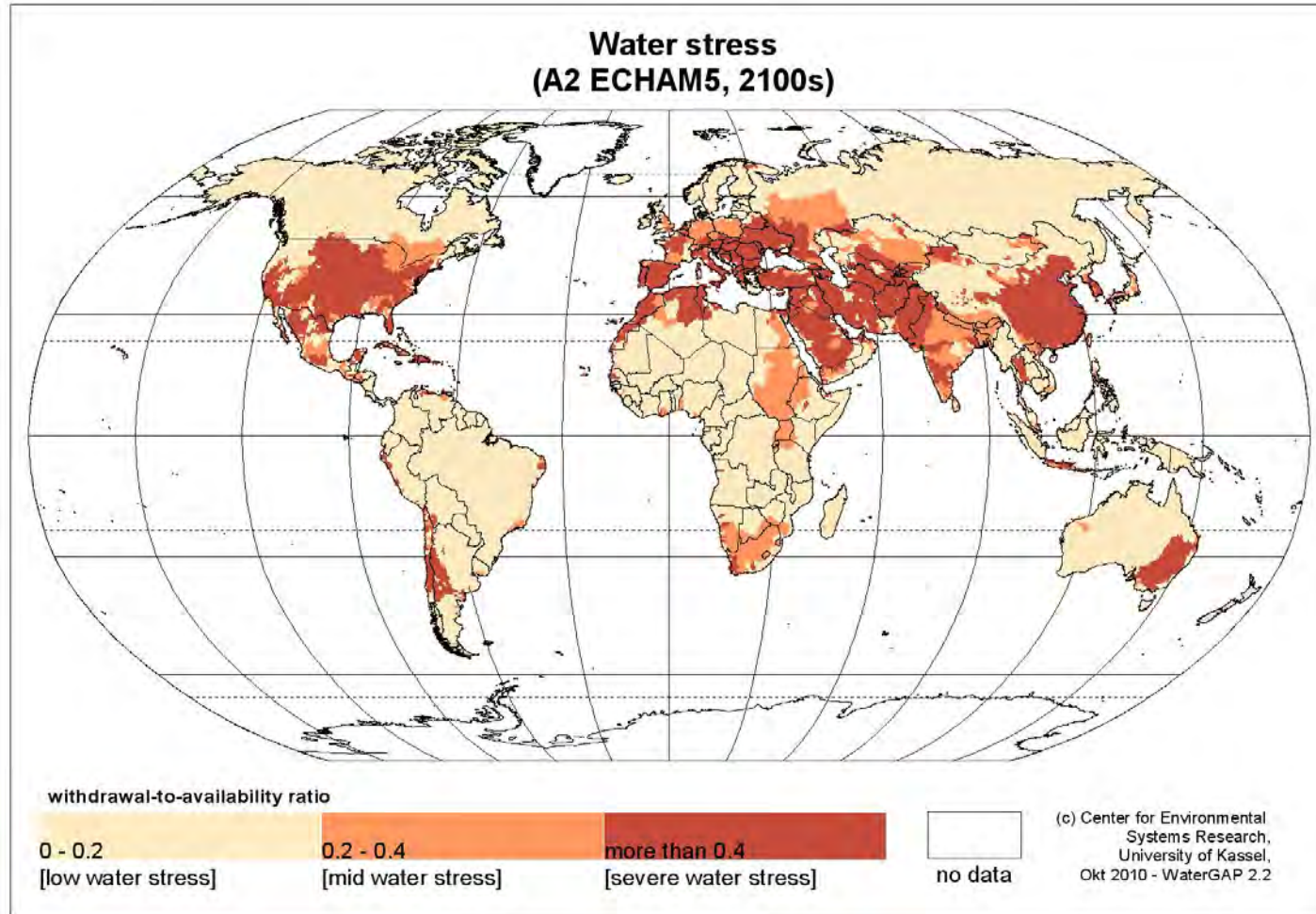VIC_echam_a2_nat_runoff_World

Diff: Control 1971-2000 vs. Scenario a2 2071-2100 [in %]
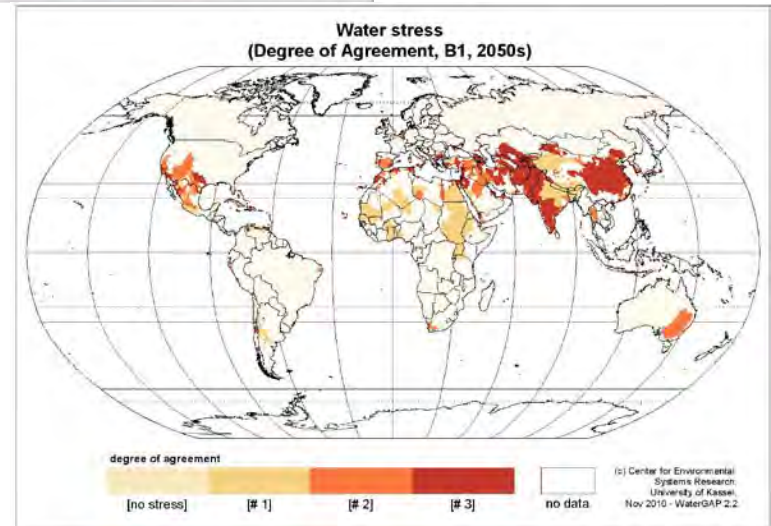WaterGap_echam_a2_nat_runoff_World

-100 -25 -20 -15 -10 -5 0 5 10 15 20 25 100

Multi Model Analysis on Water Scarcity

Water stress
(A2 ECHAM5, 2010s)

withdrawal-to-availability ratio

0 - 0.2 [low water stress]   0.2 - 0.4 [mid water stress]   more than 0.4 [severe water stress]   no data

(c) Center for Environmental Systems Research, University of Kassel, Okt 2010 - WaterGAP 2.2

Multi Model Analysis on Water Scarcity

Water stress
(A2 ECHAM5, 2100s)

withdrawal-to-availability ratio

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(c) Center for Environmental Systems Research, University of Kassel, Okt 2010 - WaterGAP 2.2

Water Scarcity

WaterMIP - Outlook

Data sets from WaterMIP (WATCH)

- WATCH Forcing Data – WFD (1901-2002)

- 100 years daily and monthly runoff data from several hydrological models

- bias corrected climate forcings from 3 GCM x 2 scenarios.

- 140 years daily and monthly runoff data from several hydrological models