POTSDAM INSTITUTE FOR CLIMATE IMPACT RESEARCH **PIK**
MEMBER OF THE LEIBNIZ ASSOCIATION

COUPLING OF CCLM, STAR AND SWIM TO STUDY HYDROMETEOROLOGICAL EXTREMES

There is a burning need for a better understanding of climate induced changes in hydro-meteorological extremes, especially generation of intense rain and flood events, probability of exceedance of thresholds (low flows, droughts) and feedbacks across hydrology-vegetation-climate. Aim of the study RECCWEX is to improve understanding and to reduce uncertainty.

PROBLEM:

Regional climate models are lacking a comprehensive formulation of hydrological processes (e.g. routing, retention, groundwater formation, wetland plant transpiration).

SOLUTION:

Intelligent combination and cross-pollination of climate (CCLM[1], STAR[2]) and hydrological (SWIM[3]) models. PIK is in the unique situation to have both the models and experts needed in house.
The basic idea is to use SWIM as the land surface model for CCLM and to implement the full hydrological cycle (e.g. by adding routing of runoff, groundwater) as well as SWIM's process descriptions for wetlands, riparian zones and vegetation into CCLM.

Figure 1:Havel river flood 2002

Figure 2: Elbe river drought 2003

APPROACH FOR DROUGHT DETECTION

Droughts are long lasting events, where the feedbacks climate-vegetation-water are extremely important. The idea here is to have better descriptions in the coupled model for:

- Evapotranspiration-heat-humidity feedbacks
- Groundwater supply into the root zone
- The role of wetlands and riparian zones
- Vegetation physiology and dynamics

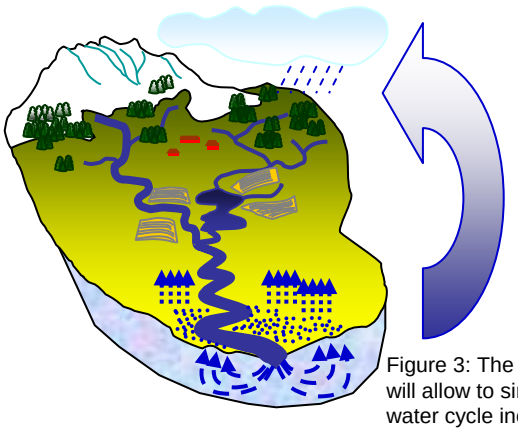
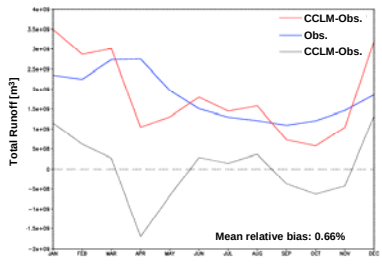


Figure 3: The coupled model will allow to simulate the entire water cycle including feedbacks.

APPROACH FOR FLOOD RISK:

Floods are short events, where precipitation intensity and soil infiltration processes are crucial. The idea here is to consider lateral and to improve vertical soil water transport process descriptions:

- Routing of runoff / freshwater inflow into oceans
- Retention / delay between runoff formation and river outflow
- Fast vertical transport by macro-pores
- Lateral soil moisture transport



Climatological monthly cycle runoff, Elbe river catchment, 1970-1999

Figure 4: CCLM well reproduces the climatological mean annual cycle of runoff but overestimates variability.

[1]The Regional Climate Model COSMO-CLM, Meteorologische Zeitschrift (2008) Volume 17/4 [2] B. Orlowski, F.-W. Gerstengarbe, P. C. Werner, Theor. Appl. Climatol. (2008) 92: 209-223 [3] F.F. Hattermann, M. Wattenbach, V. Krysanova, F. Wechsung, Hydrological Processes (2005) 19: 693-714

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RESEARCH DOMAIN II - CLIMATE IMPACTS AND VULNERABILITIES
REGIONAL IMPACTS AND STRATEGIES - RECCWEX
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