Impact of climate change on regional flood hazard in Germany

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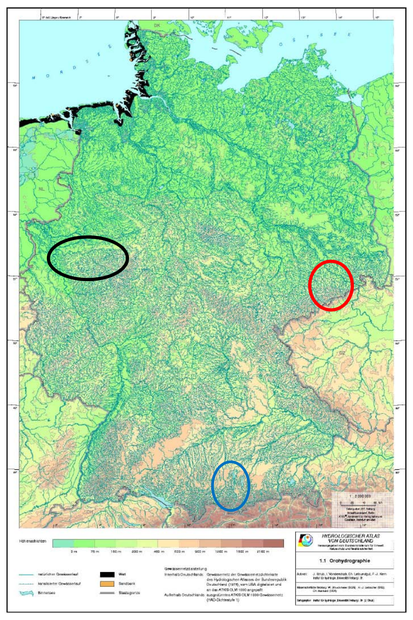
Introduction



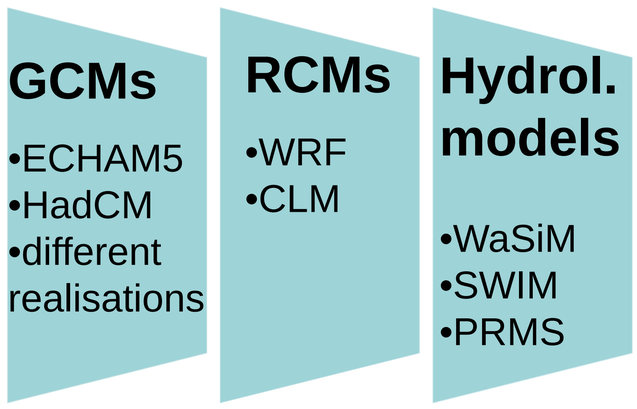
➢ Within CEDIM (Centre for Disaster Management and Risk Reduction Technology, http://www.cedim.de) the presented project investigates the **impact of climate change on the regional water balance in particular for extreme events.**

➢ For this purpose **ensembles of coupled climate-runoff simulations** below 10 km will be used which allows in addition to the prognosis of the changing flood hazard also the assessment of accuracy.

➢ **Research area:** Three representative river catchments of Germany are selected to analyze flood hazards as a result of changing climate:
- Ammer catchment (blue) for the alpine region,
- Freiberger Mulde (red) and Ruhr (black) for the central uplands in Germany.

➢ The regional scale of the analysis allows for addressing the following questions:
- How will the flood characteristics for small and medium catchment alter in a changing climate within the next decades?
- What uncertainties can be expected?

Methodology



Ensembles of coupled climate-runoff simulations

➢ High resolution regional climate simulations up to **7 km spatial & 1 hour temporal resolution** are performed with the regional meteorological model WRF (Weather Research & Forecasting Model).

➢ WRF is twice nested in the general circulation model (GCM) ECHAM5 for an evaluation period between **1971 and 2000** as well as a future scenario period between **2021 and 2050**.

➢ These simulation results are applied as meteorological input for the hydrological models.

➢ Together with project partners from KIT (Karlsruhe Institute for Technology) and GFZ Helmholtz Zentrum Potsdam **ensembles of coupled climate-runoff simulations** using a set of general and regional circulation models as well as hydrological models will be investigated.

Preliminary results

➢ WRF simulations driven by i) reanalysis data (NCEP and ERA40) to find best setup for research area and ii) ECHAM5

i) reanalysis data

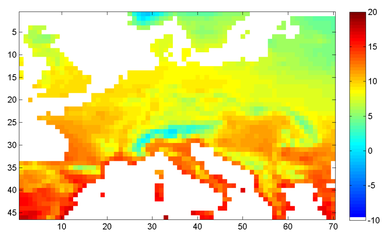
WRF setup using

➢ NCEP & ERA40 data

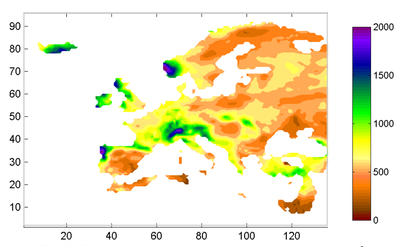
➢ Validation with E-OBS dataset from the EU-FP6 project ENSEMBLES: 1968-1975 (here: 1968 only)

➢ Domains: horizontal (42 & 7 km) and vertical (42 layers up to 20 hPa) resolution coordinated with CLM

➢ Model physic: so far
- microphysics (WRF Single-Moment 3-class (WSM3) and Eta Grid-Scale Cloud and Precipition (Eta))
- cumulus parameterization

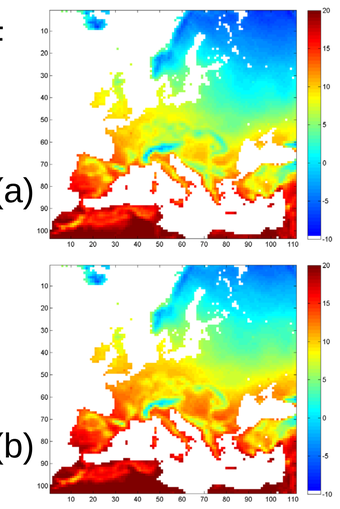


E-OBS mean annual temperature [°C]

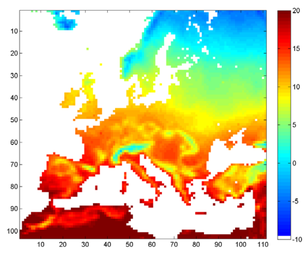


E-OBS mean annual precipitation [mm]

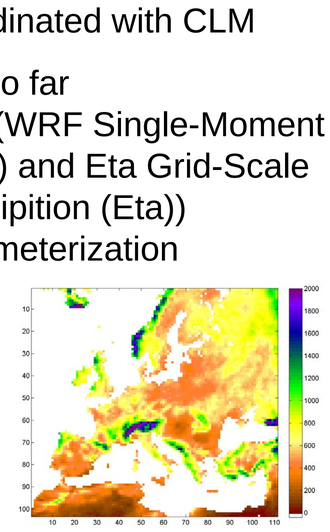
WRF D1



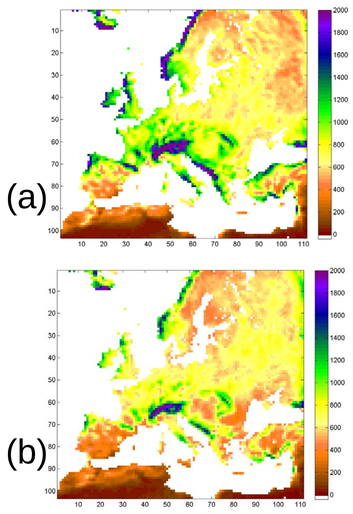
Mean annual temperature [°C] using NCEP data and WSM3 (a) or Eta (b) microphysic



Mean annual temperature [°C] using ERA40 data and Eta microphysic

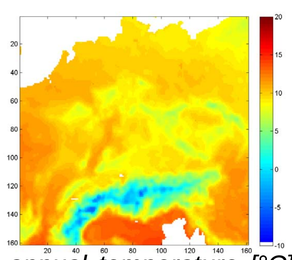


Mean annual precipitation [mm] using ERA40 data and Eta microphysic

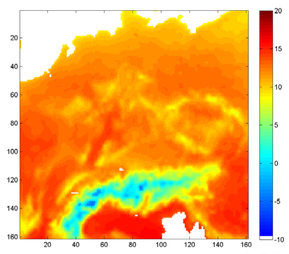


Mean annual precipitation [mm] using NCEP data and WSM3 (a) or Eta (b) microphysic

WRF D2



Mean annual temperature [°C] using NCEP data and Eta microphysic



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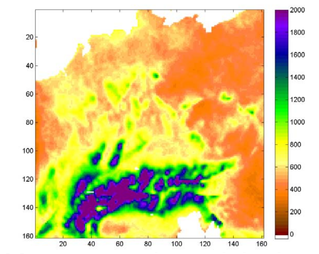
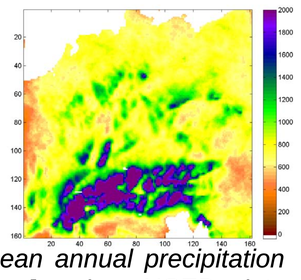


Mean annual precipitation [mm] using ERA40 data and Eta microphysic

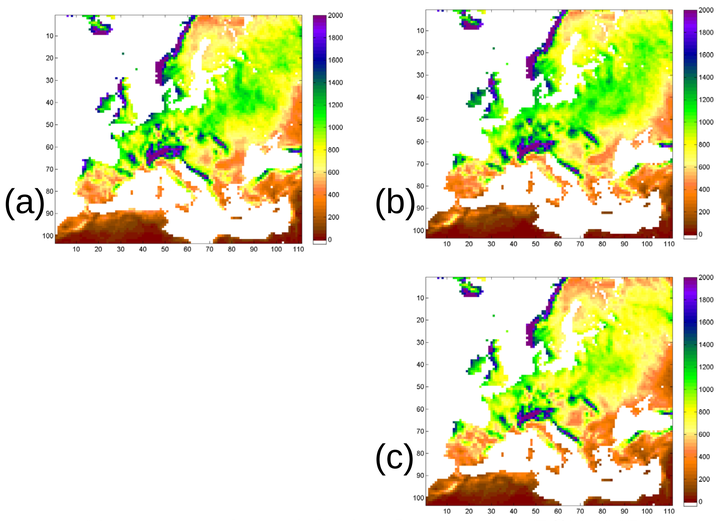


Mean annual precipitation [mm] using NCEP data and Eta microphysic

ii) ECHAM5

WRF setup using

➢ in addition to the applied options in i) different cumulus options for D1 are performed



Mean annual precipitation [mm] using ECHAM5 data, WSM3 microphysic and Kain-Fritsch (a), Betts-Miller-Janjic (b), or Grell-Devenyi (c) cumulus parametrization scheme

References:
Skamarock, W.C., Klemp, J.B., Dudhia, J., Gill, D.O., Barker, D.M., Duda, M., Huang, X., Wang, W.: *A Description of the Advanced Research WRF Version 3*, NCAR TECHNICAL NOTE, 2008
Haylock, M.R., N. Hofstra, A.M.G. Klein Tank, E.J. Klok, P.D. Jones, M. New: *A European daily high-resolution gridded dataset of surface temperature and precipitation,* J. Geophys. Res (Atmospheres), 2008, **113**, D20119, doi:10.1029/2008JD10201

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