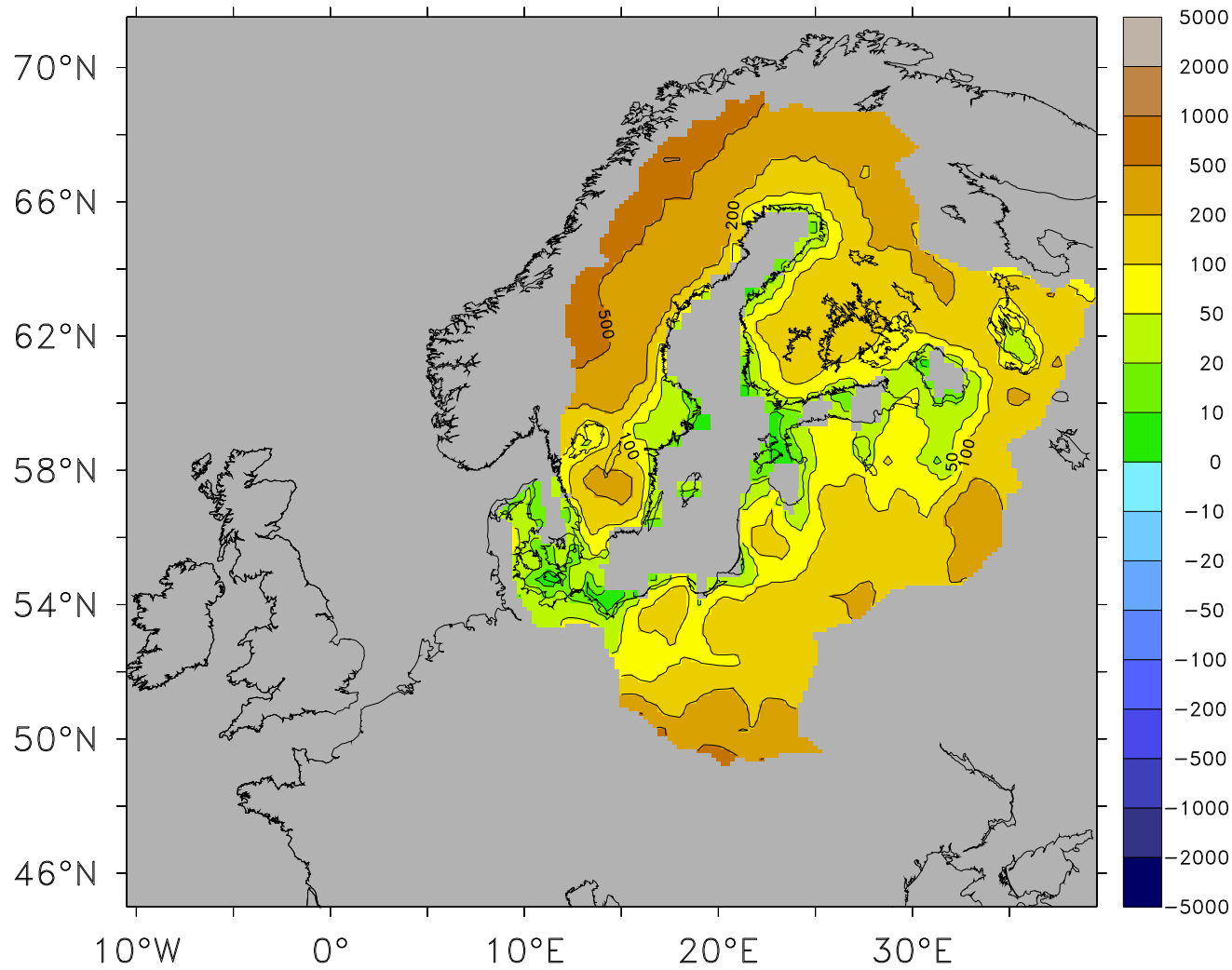


Freshwater Budget for the Baltic Sea Drainage Basin in an E-HYPE-ERA-interim hindcast

Baltic Sea Model Intercomparison Project

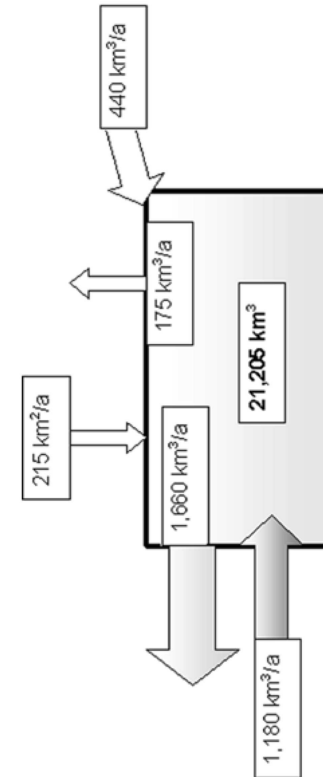
22. November 2018

Baltic Sea Drainage Basin



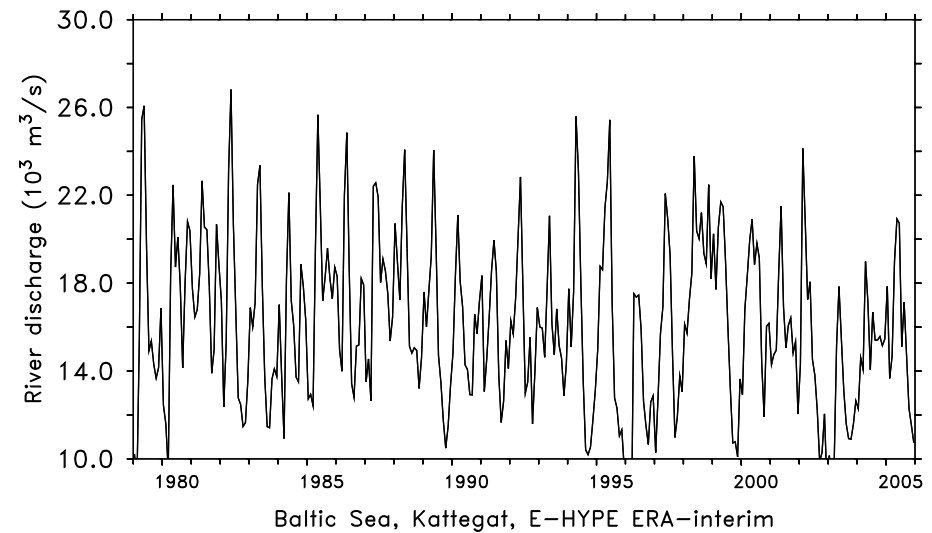
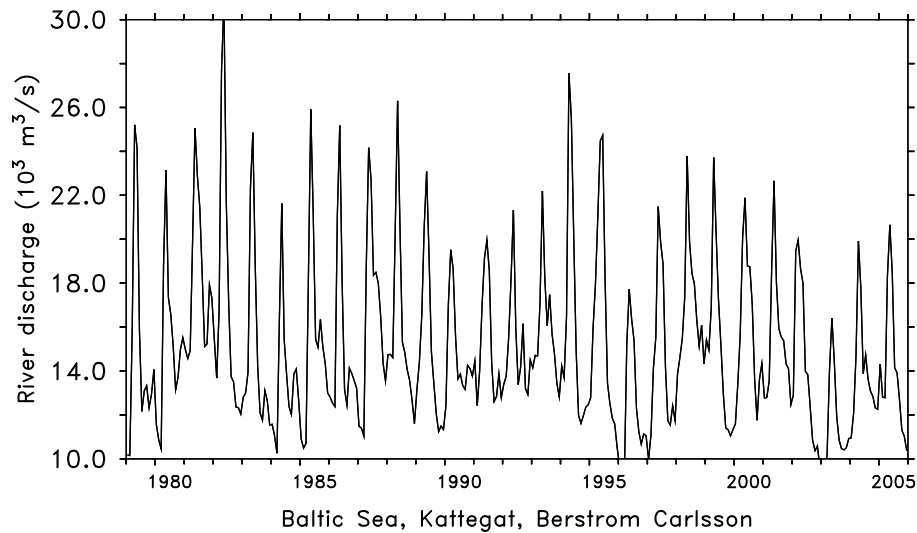
Elevation (m), RCA4 CORDEX Med-Res-Europe

Figure 4.1. The annual Baltic Sea water balance. The Baltic Sea is shown as a box with water exchange with the North Sea at the left, atmospheric exchange of freshwater on the top, and river discharge on the right.



Lepparanta & Myrberg

Bergström & Carlsson compared to E-HYPE ERA-interim



- Bergström & Carlsson, Discharge
- available: 1903 to 2005
- climatological mean (1979 to 2005): $15.22 \cdot 10^3 \text{ m}^3/\text{s}$
- Monthly resolution, 30 rivers
- E-HYPE ERA-interim, Discharge
- available: 1979 to 2012 (June)
- climatological mean (1979 to 2005): $16.15 \cdot 10^3 \text{ m}^3/\text{s}$
- Daily resolution, 275 rivers

E-HYPE model domain

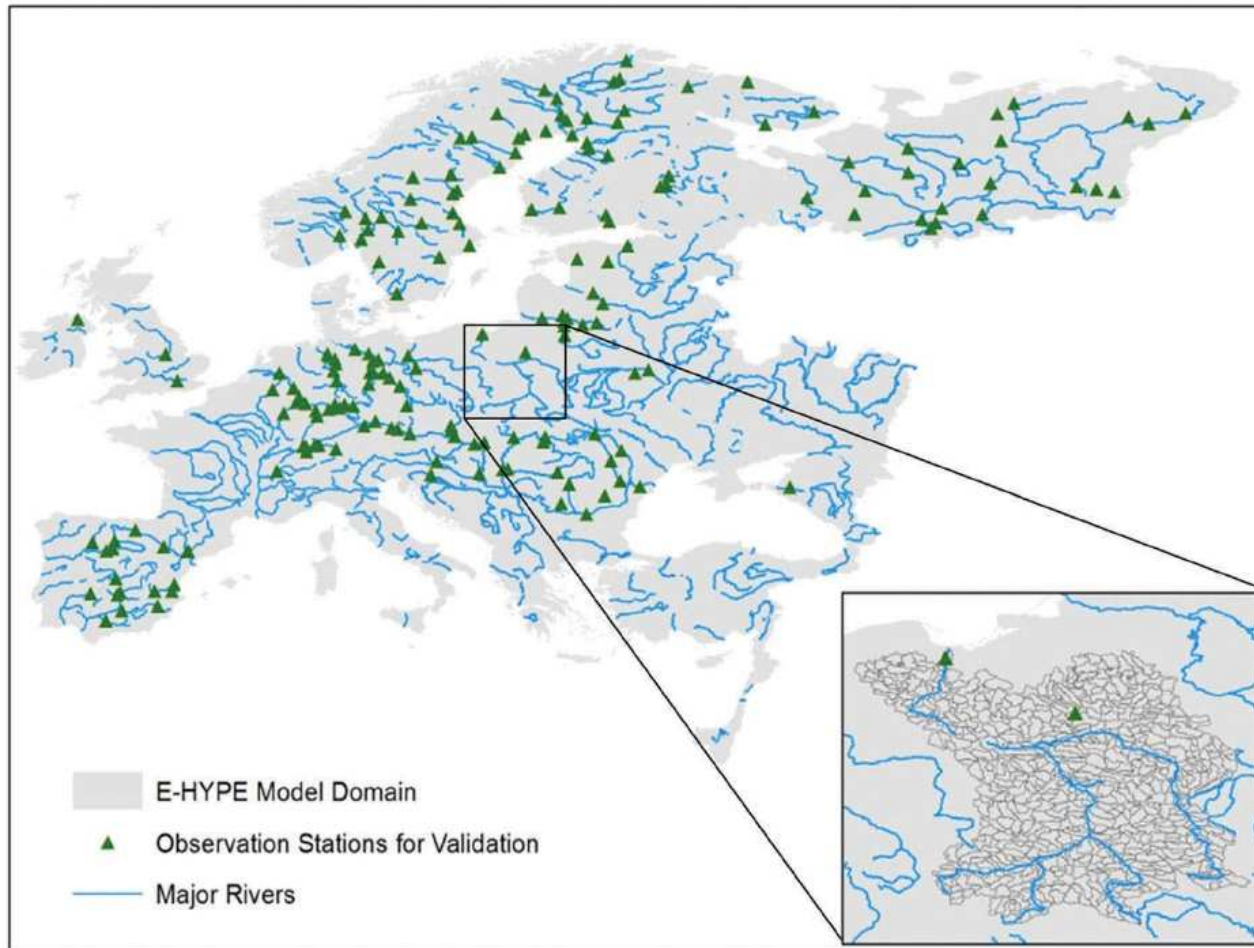
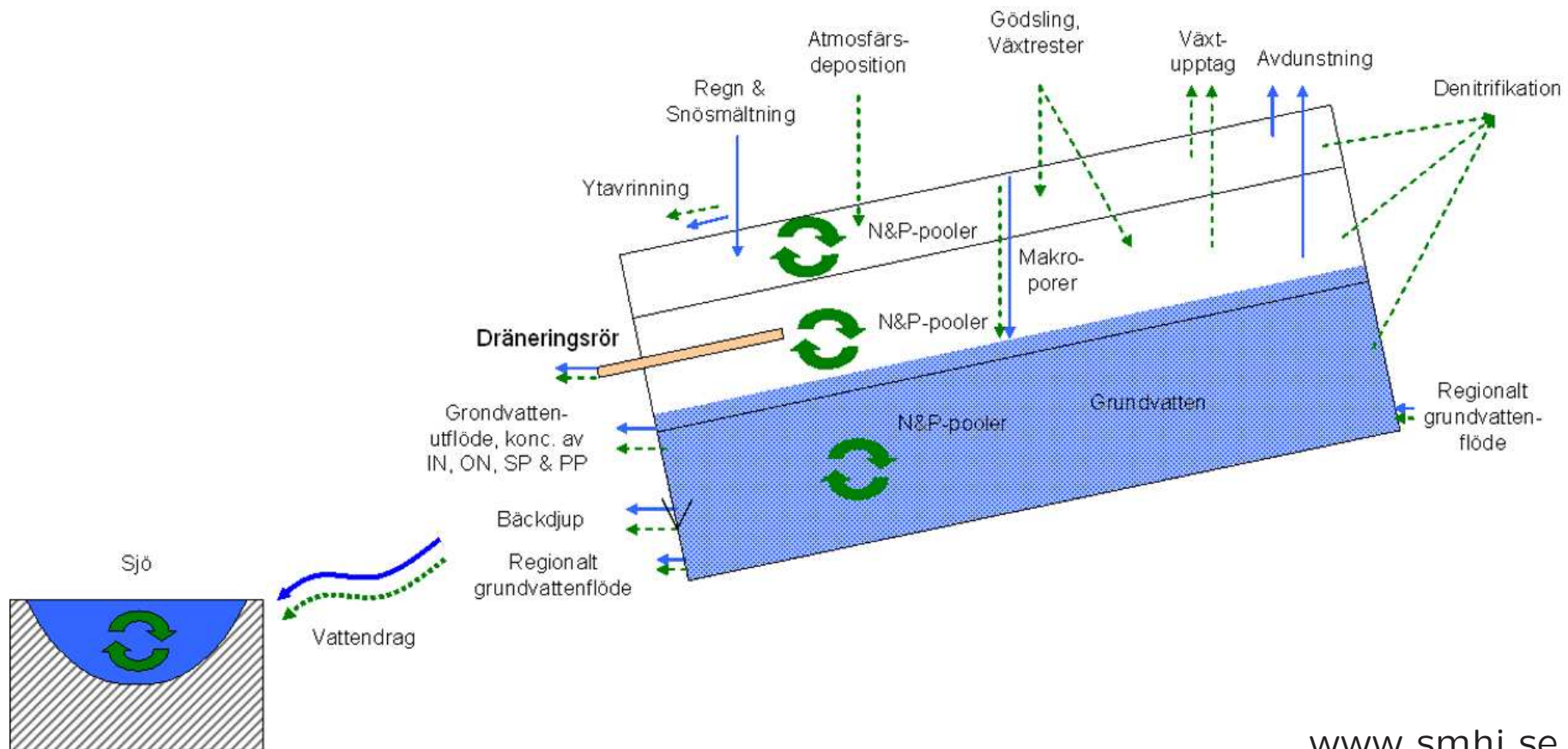


Figure 2. Domain of continental Europe, major rivers and gauges used in the study. The inset illustrates the resolution of sub-basins for the Vistula River (bottom right).

Donnelly et al., 2015

HYPE schematic



E-HYPE as boundary conditions

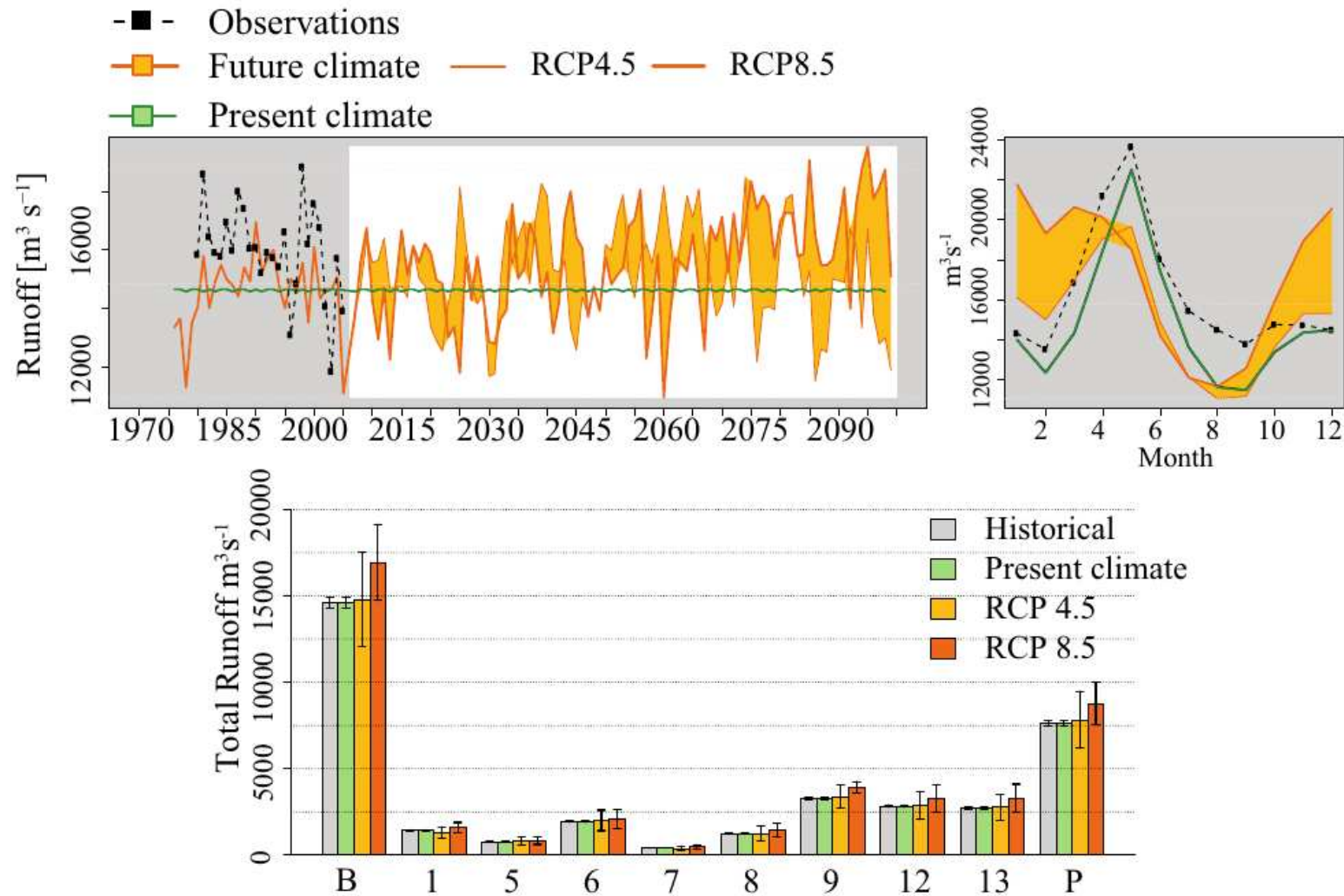


Fig. 3 Runoff projections to the Baltic Sea for 1975–2100 (upper left panel), mean seasonal cycle (upper right panel) and annual mean runoff in various sub-basins in present (1976–2005) and future climates (lower panel)

Available E-HYPE data

- ERA-interim hindcast, RCP scenarios, operational forecast
- volume flow, temperature, nutrients, ...

- operational forecast uses precipitation and temperature
 - 1978 to 2012: WFDEI (ERA-interim)
 - 2013 to 2014: ECMWF forecast
 - 2014 to yesterday: SMHI MESAN (EURO4M)
- operational forecast not completely consistent
- operational forecast still the most accurate?

Closed Freshwater Cycle in RCA4-NEMO

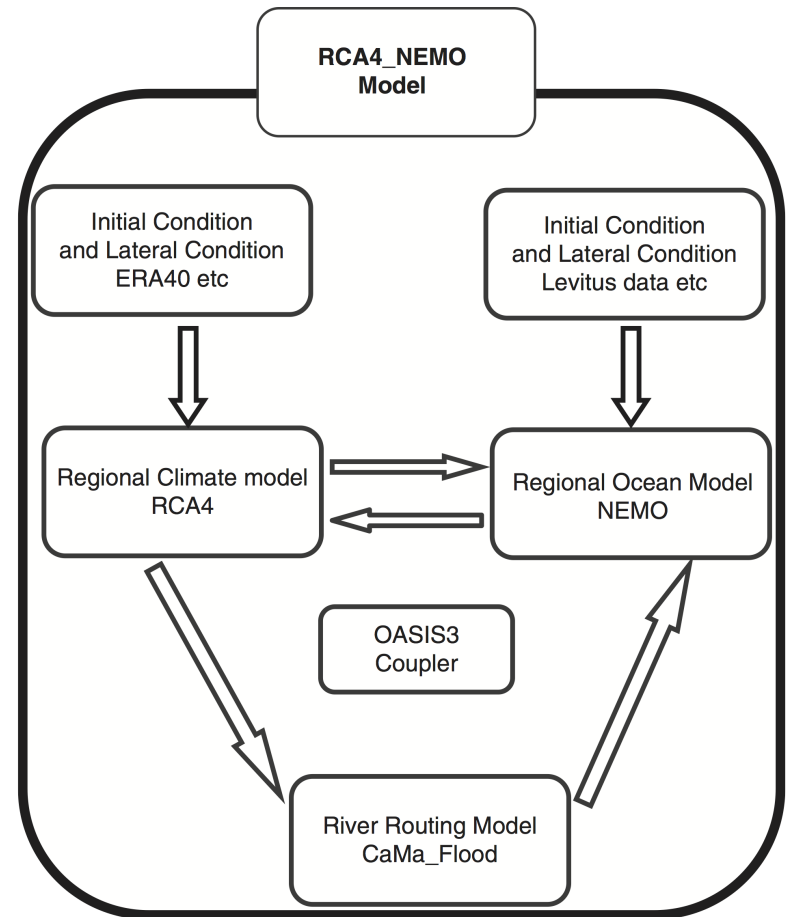
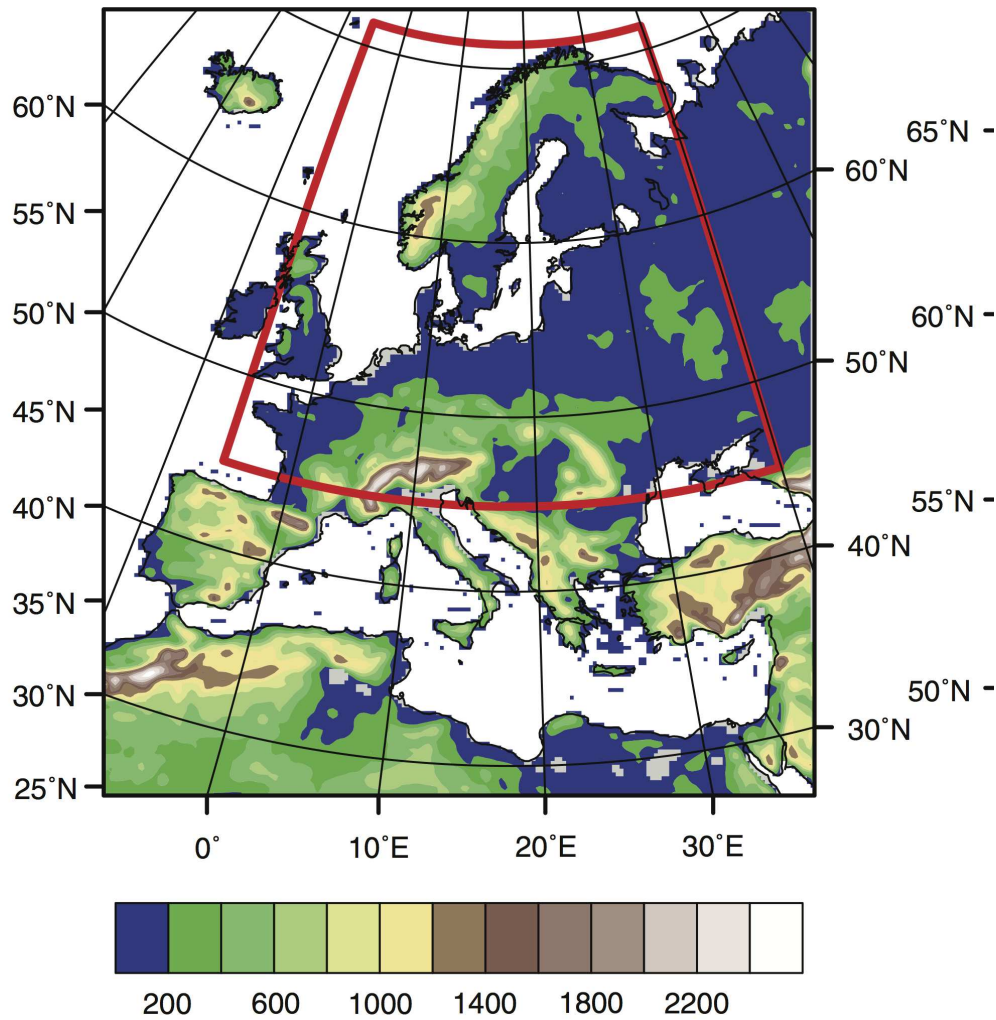
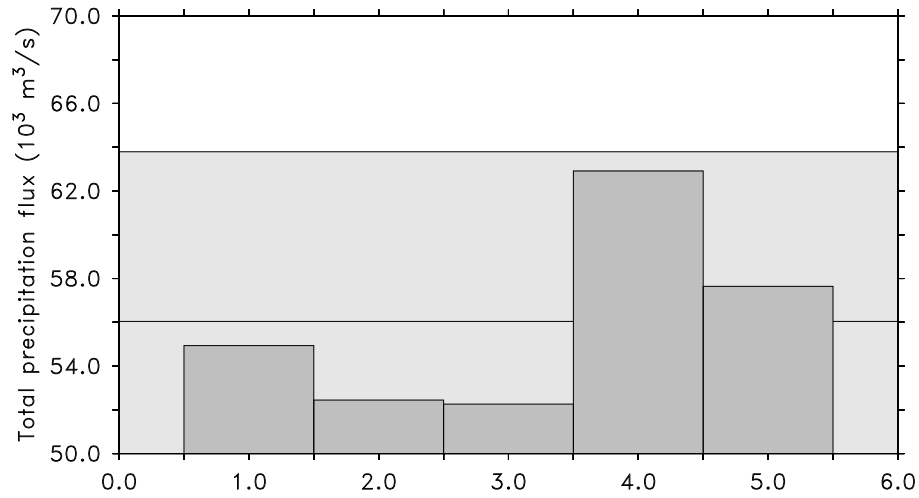


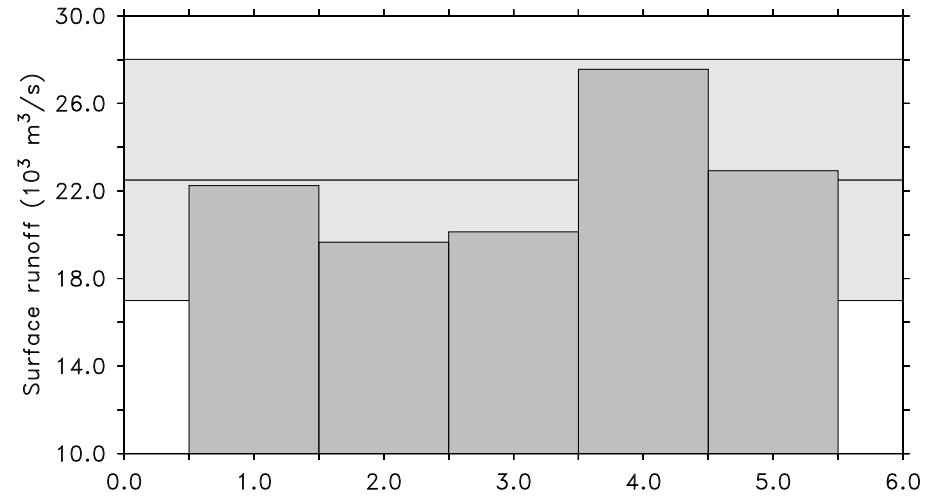
Fig. 2. Schematic diagram of the coupled model system (The sea ice model LIM3 is part of NEMO and not coupled via OASIS3).

Fig. 1. RCA4 domain and topography (the red square is the domain of the river routing model CaMa-Flood) (left) and the ocean model domain and bathymetry (right) (unit: meter).

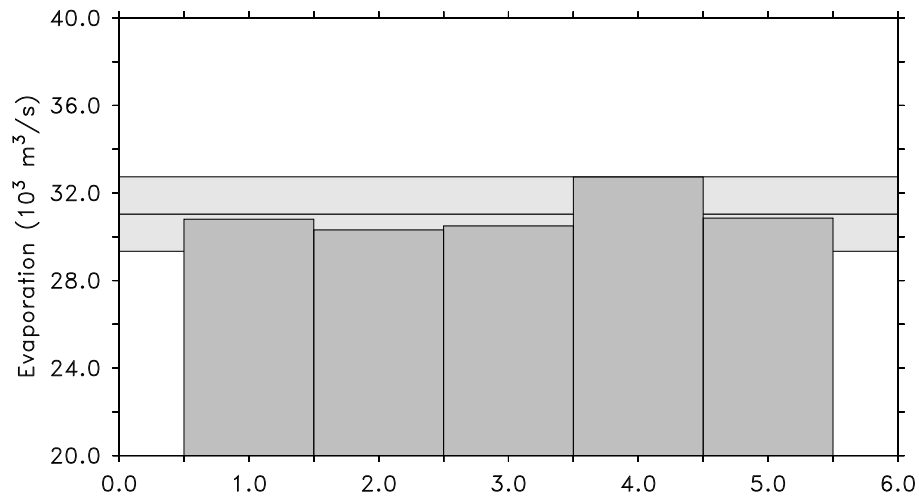
Interannual Variability



Baltic Sea drainage basin, RCA4 ERA40



Baltic Sea drainage basin, RCA4 ERA40

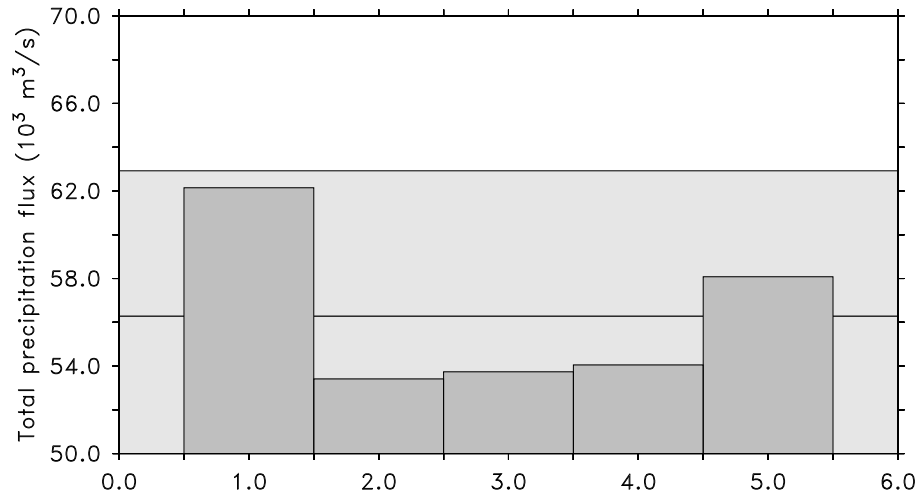


Baltic Sea drainage basin, RCA4 ERA40

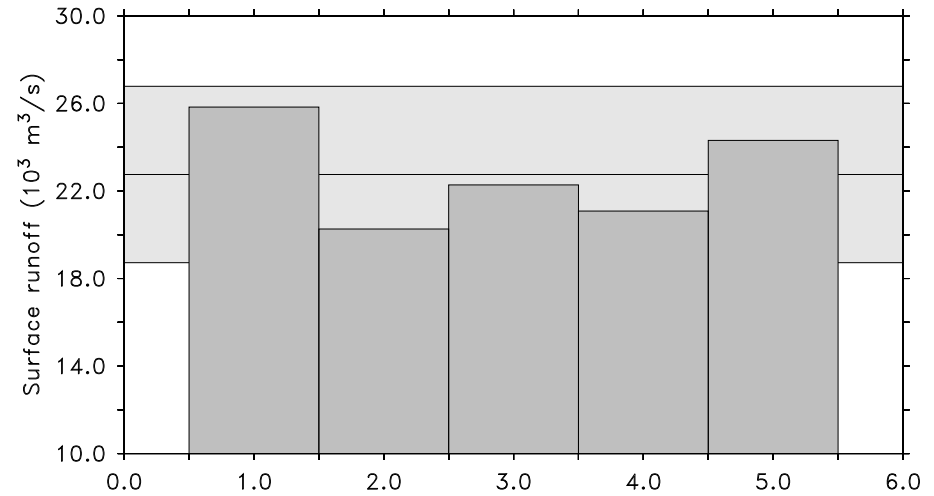
1. 1995
2. 1996
3. 1997
4. 1998
5. 1999

RCA4-0.22, ERA40

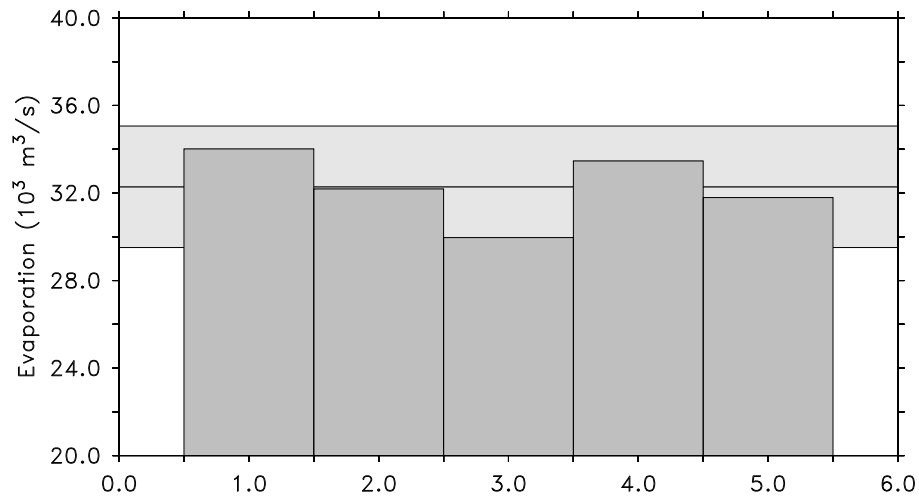
Sensitivity against different GCMs



Baltic Sea drainage basin, RCA4-NEMO HISTORICAL



Baltic Sea drainage basin, RCA4-NEMO HISTORICAL



Baltic Sea drainage basin, RCA4-NEMO HISTORICAL

1. MPI-ESM-LR
2. EC-EARTH
3. GFDL-ESM2M
4. HadGEM2-ES
5. IPSL-CM5A-MR

RCA4-NEMO, RCA4-0.22, ERA40