The role of spatial and temporal model resolution in a flood event storyline approach in Western Norway

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Motivation

• A physical climate storyline approach is applied to an autumn flood event in the West Coast of Norway caused by an atmospheric river

• Event of interest: October 2014 floods

• Demonstrate the value and challenges of higher spatial and temporal resolution in simulating flood impacts
Operational modelling chain

ECMWF (global model) → AROME MetCoOp (regional model) → Observations

State Meteorologists

National flood warning

Commercial Partners like renewable energies

Data dissemination server

Courtesy of Malte Müller
Storyline modelling chain

• Global high-resolution (~25km) atmosphere-only simulations:
  – 6 ensemble members 2002-2006 (obs SST)
  – 6 ensemble members 2094-2098 (RCP 4.5, ΔSST from SRESA1B)

EC–EARTH (global model)
Storyline modelling chain

- Global high-resolution (~25km) atmosphere-only simulations:
  - 6 ensemble members 2002-2006 (obs SST)
  - 6 ensemble members 2094-2098 (RCP 4.5, ΔSST from SRESA1B)
- Select most extreme event in October for West Coast, for PRESENT and FUTURE
- 2 events x 10 initial condition perturbations = 20 simulations at ~25km resolution with EC-EARTH
Storyline modelling chain

- Boundary conditions from EC-EARTH to run AROME-MetCoOP (2.5km)
Storyline modelling chain

- EC–EARTH (global model)
- AROME MetCoOp (regional model)
- HBV distributed / lumped

- HBVlump as used by stakeholder NVE to assess effect of higher spatial resolution
- HBVdist to assess effect of higher temporal resolution
Results

- Cumulative precipitation in West Coast region in EC-Earth and AROME
Results

• Precipitation change FUTURE-PRESENT
Results: HBVlump (effect of spatial resolution)

- Streamflows generally higher in AROME compared to EC-Earth
- Future event streamflows higher for Røykenes but not for Flåm
Results: HBVdist (effect of temporal resolution)

- Peak streamflows more realistic with hourly vs daily input (both AROME)
Conclusions

- EC-Earth & AROME simulate extreme precipitation event caused by AR realistically.
- In AROME simulations, precipitation occurs more localised than in coarser EC-Earth simulations: some catchements are not hit, but those that are experience larger precipitation amounts.
- Peak streamflows therefore higher when using AROME input in HBV model.
- Hourly input further produces higher streamflows compared to daily input.
- Streamflow peaks on average higher in a future climate BUT not every future event hits every catchment.
Lukas Brunner

«Investigating the impact of atmospheric blocking on temperature extremes across Europe using an objective metric»

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Atmospheric rivers detection

Atmospheric river: long narrow and transient corridor of anomalously strong horizontal water vapor transport

Topography

Oct-Nov-Dec 99th percentile daily precipitation

°CICERO