Analysis of dynamically downscaled climate simulations over the Baltic Sea drainage basin

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Evaluation in present climate

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Uncertainties of scenario simulations, SMHI, 14 October 2010

Issues on the workshop

- http://www.baltex-research.eu/ecosupport/results.html#presentations
- Uncertainties in climate modelling
  - Emission scenarios: Future behaviour of mankind, uncertainty increases with time
  - Modelling uncertainty: Climate response to changes in atmospheric composition
  - Natural climate variability: Solar activity, volcanoes. Non-linear climate dynamics
- Temperature and precipitation uncertainty:
  - First natural variability, modelling and scenario uncertainty take over later
- Wind:
  - AOGCMs and natural variability are dominant sources of uncertainties
- Weighting based on different parameters like statistics and large scale circulation and weather regimes
- Problem: Precipitation (and temperature) from RCA over control period very different from actual. Can we use it?
  - Methods: Statistically downscaling, Delta-change (Rossby), Bias correction
- ECOSUPPORT: RCA scenario results should not be used as forcing for Baltic Sea models!!! The price of using RCAO: no large model ensemble available.
- Discussion for future projects, key questions
  - Time scale has to be long because of slow responses
  - Focus more on thresholds
  - Bayesian method and statistics
  - Include stakeholders from beginning

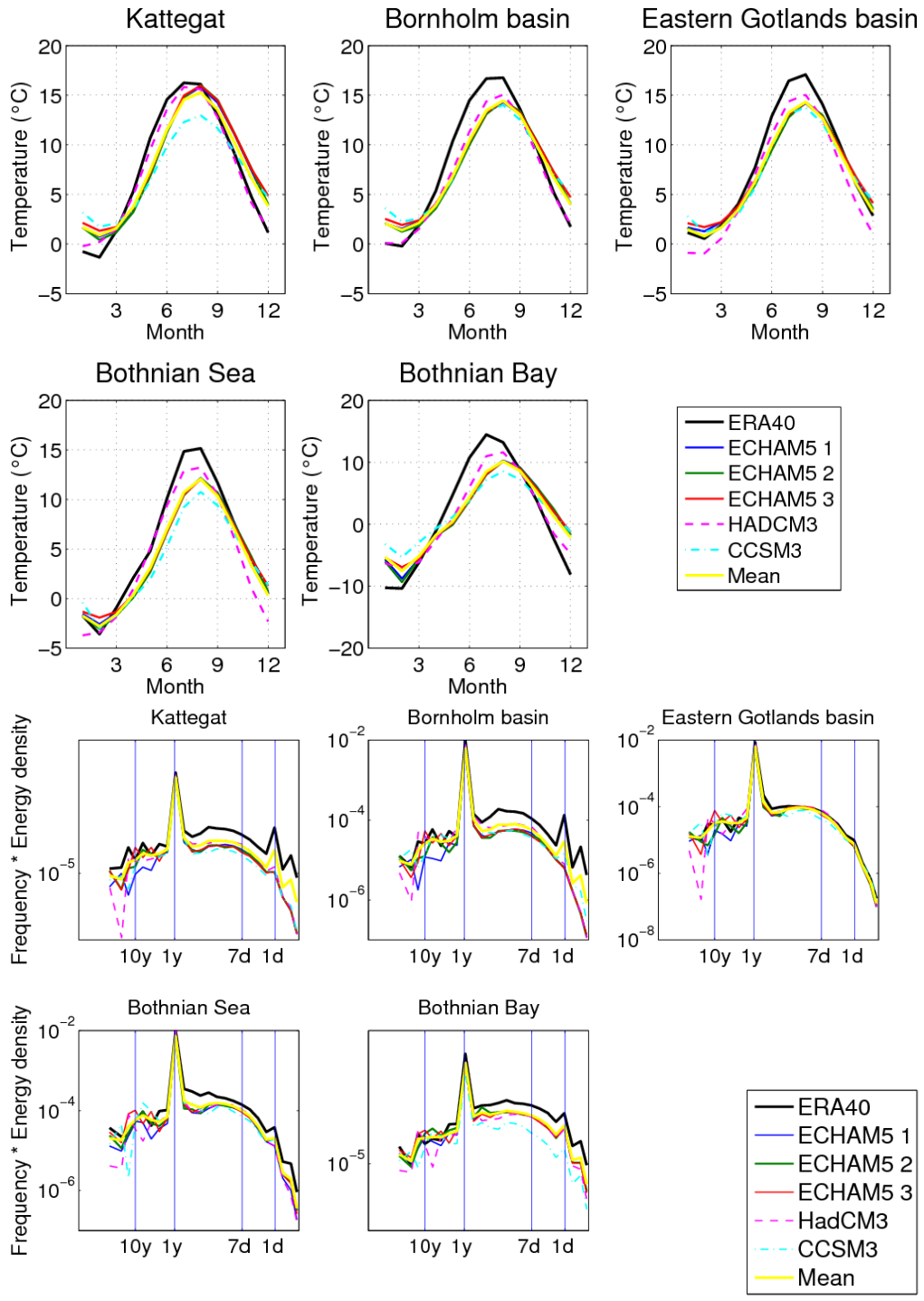
Our evaluation of control period 1961-2005

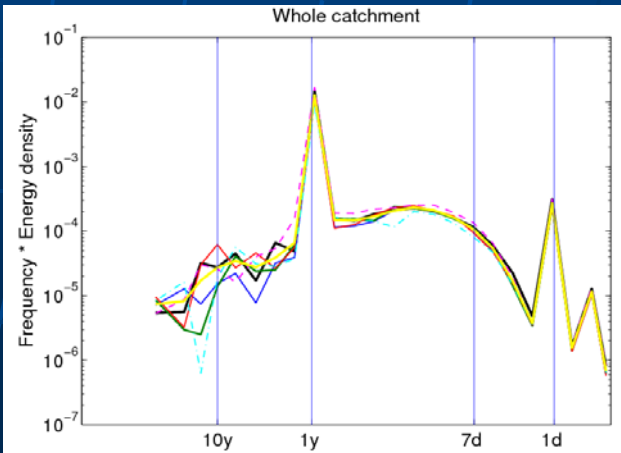
Used forcings from ENSEMBLES

- Dynamically downscaled AOGCMs with RCA3 (50x50km, no ocean component
  - ECHAM5, 1.875° : A1B (3 runs), A2, B1
    - Run 1 has same initialization as for other scenarios
  - HADCM3, 2.5° x 3.75° : A1B
  - CCSM3, 1.4° : A1B
- Present analysis
  - Performance in control period (1961–2005) compared to downscaled ERA-40.
- Future analysis
  - Model variation: A1B (3 models)
  - Scenario variation: ECHAM5 (3 scenarios)
  - Internal variation: ECHAM5 A1B (3 different initializations)

Temperature

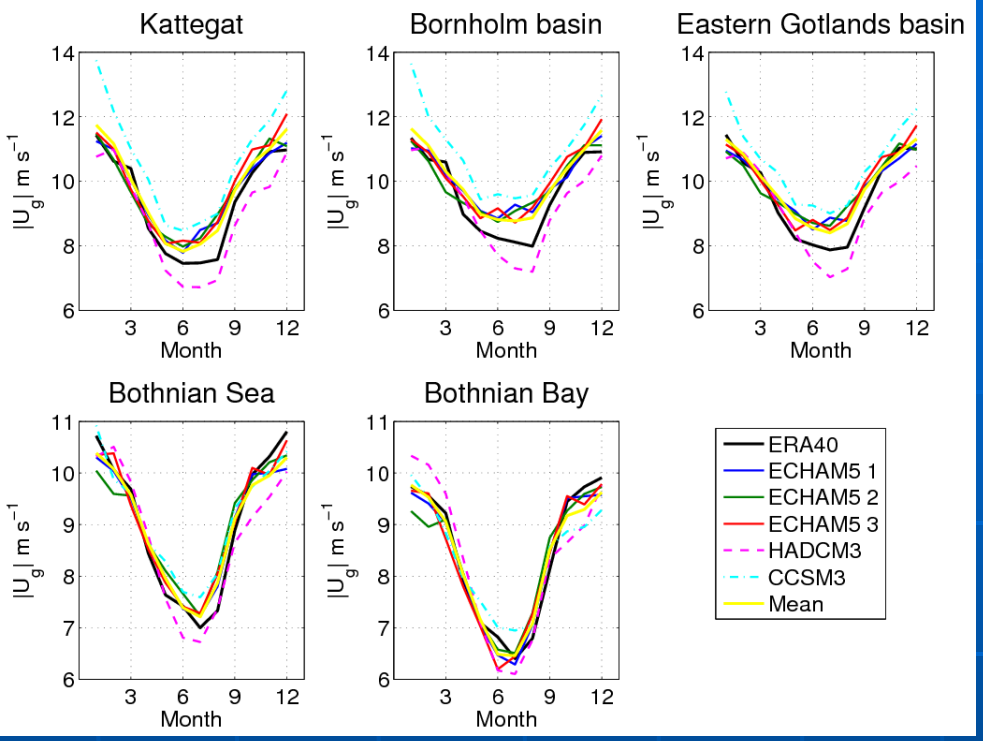
- Models are often colder than ERA-40 over the sea. (Due to lower SST, except for CCSM3).
- Meier: T2 very important for salinity, important for initialization and T2 bias probably increases in future.
- Seasonal variability under-estimated and time lag in small basins. (Due to land influence in ERA-40?)
- The model runs, except CCSM3 in Bothnian Bay, agree well on temperature variability on all scales.

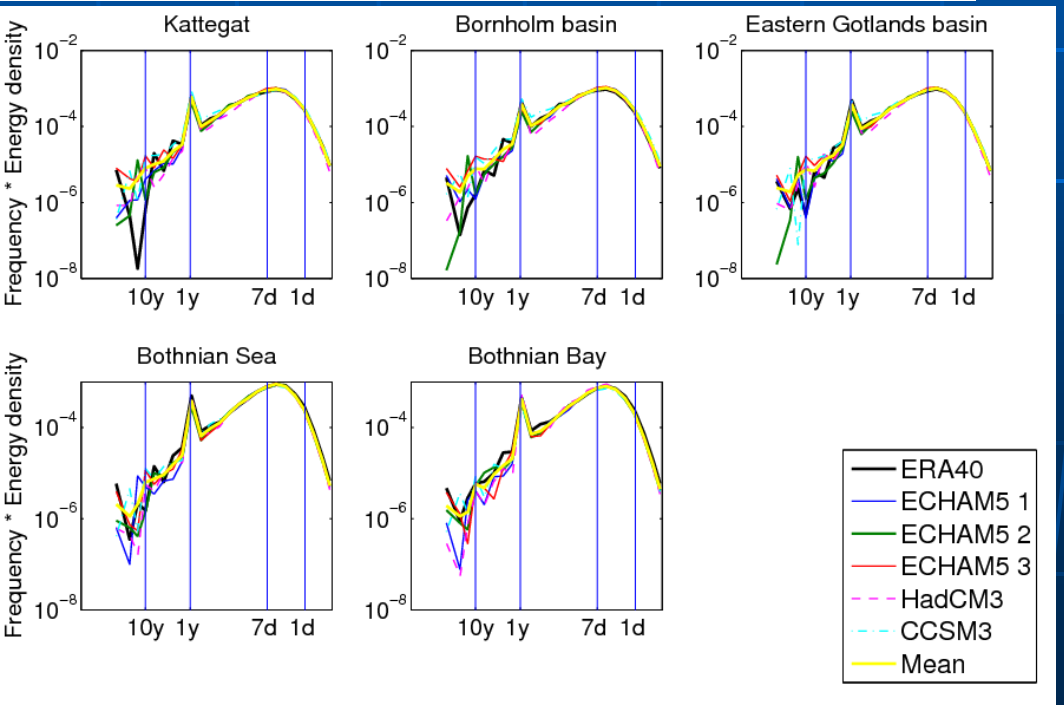


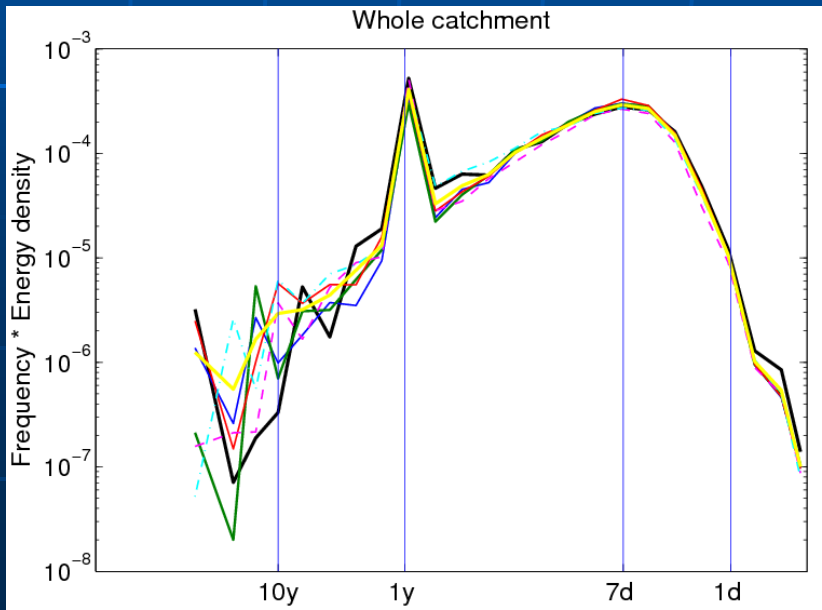


Geostrophic wind speed variations

- All models except HadCM3 over-estimate the geostrophic wind, especially in the south and summer.
- Variability good at all scales above land and sea

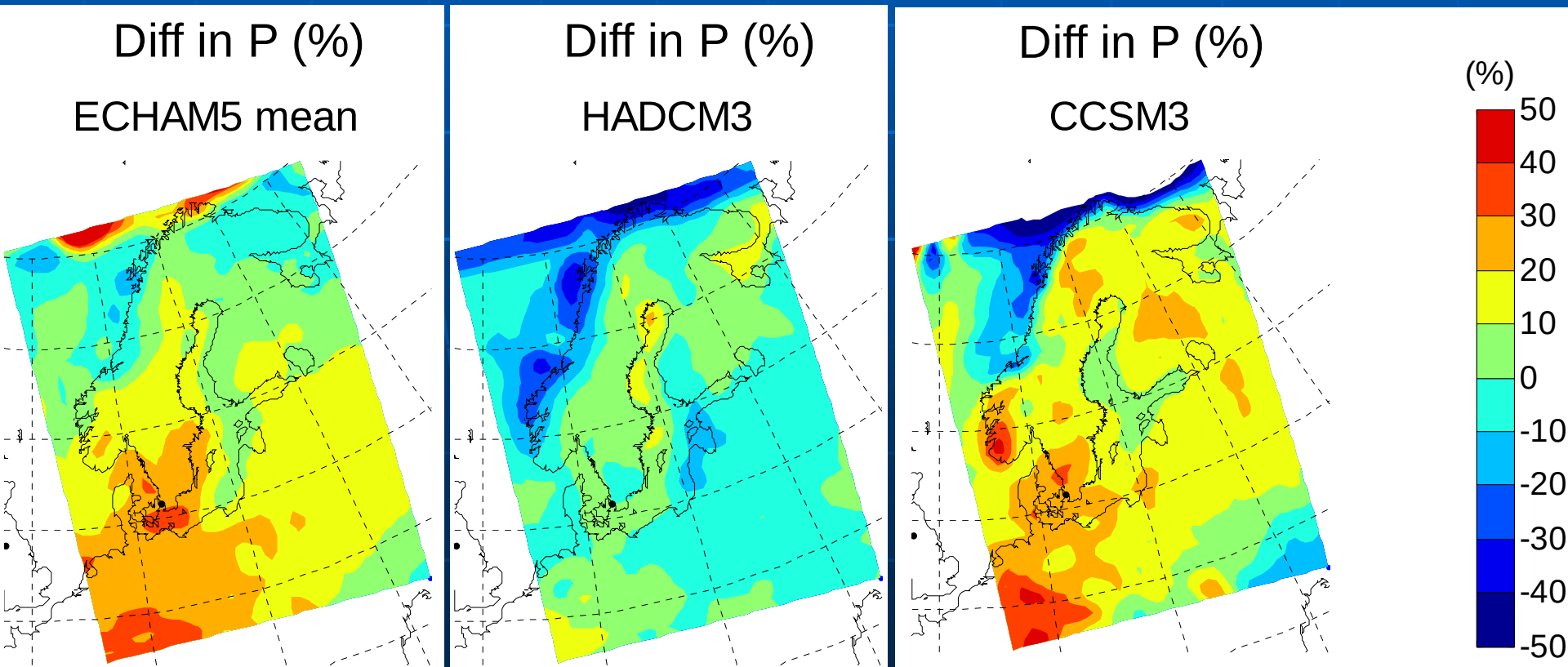






Yearly precipitation

- Problem: RCA3 increases precipitation from ERA-40.
- Models gives even higher precipitation but HadCM3 gives less in south-eastern part of the catchment.



Estimation of “score”

Based on the averages of 5 parameters in the catchment area

Model	T2 (C)	Cloudiness	RH2	UG (m/s)	Precipitation (mm)
ECHAM5 1	5.14 (-0.04°)	0.72 (+5%)	0.84 (+2%)	9.06 (+2%)	825 (+13%)
ECHAM5 2	5.02 (-0.16°)	0.72 (+5%)	0.84 (+2%)	9.05 (+2%)	816 (+12%)
ECHAM5 3	5.26 (+0.06°)	0.72 (+5%)	0.84 (+2%)	9.12 (+3%)	831 (+13%)
HadCM3	4.46 (-0.72°)	0.81 (+20%)	0.93 (+14%)	8.61 (-3%)	736 (+1%)
CCSM3	4.91 (-0.27°)	0.73 (+7%)	0.83 (+2%)	9.33 (+5%)	848 (+16%)
ERA40 downscaled	**5.18**	**0.68**	**0.82**	**8.85**	**732**

Conclusions - control period

- Natural variability is well simulated for all scales
- Some biases: clouds and precipitation overestimated, larger in basins
- Ensemble mean often better fits ERA-40 than individual runs
- "Best" model choices, based on means for the catchment area
  - SST / Geostrophic wind speed: ECHAM5 and HadCM3
  - T2 / RH2: ECHAM5 (for trends in E.Go basin ECHAM5r1 bad)
  - Total cloudiness: ECHAM5 and CCSM3
  - Precipitation: HadCM3
- Problem: Model sensitivity to greenhouse gases will change scores in future → present weighting not valid
- Small Baltic Sea basins are more influenced by land on T2 and RH2 for downscaled ERA-40 than AOGCMs.

- Use?
  - The output from you could be analyzed and evaluated in the perspective of the control period "score".
  - Different methods to look at the uncertainties

Additional work

- Control period
  - Geostrophic wind distributions
  - Variability in precipitation, return values, length of precipitation events
  - Percentiles
  - Compare temperature and precipitation over land with real gridded data (E-obs)
- Future climate
  - Significance in changes
  - The variability in the scenarios

U10 in Eastern Gotland basin (Sjöström, 2010)