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Baltic - C

Participant 5, Uppsala University: Atmospheric forcing, air-sea interaction, atmospheric deposition of acidic components, climate scenarios

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Topic 4: Atmospheric forcing, air-sea interaction, atmospheric deposition of acidic components, climate scenarios

Today

- Climate scenarios

- Atmospheric deposition of acidic components (Björn Carlsson)

- Air-sea interaction

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- Emission scenarios

Emissions of green-house-gases, but also of aerosol emissions.

The scenarios give suggested global developments of ecomomy, population, energy sources and globalisation. This is done by defining ”storylines”.

We choose 2-3 different scenarios for a variety of possible developments.

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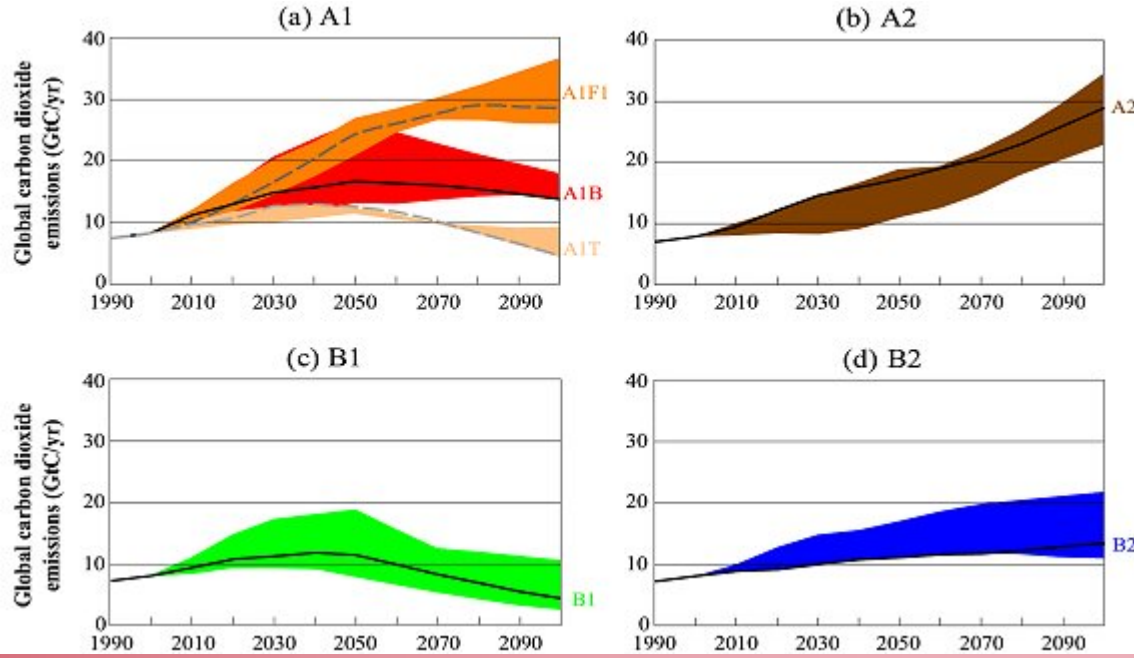
- Two (three) different scenarios: A1B, A2, B2

Storyline A1: Rapid economic growth, population peaks in mid-century, new technologies, reduction in regional differences. A1B-balance across energy sources.

Storyline A2: Heteorogeneous world, continously increasing populations, economic development is regionally oriented.

Storyline B2: Emphasis on local solutions and environmental sustainability. Continously growing population (at lower rate than A2)

Emission scenarios



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Global coupled atmosphere-ocean general circulation models (AOGCMs)

Emission scenarios are used in global climate models (GCM:s) during extended periods, we will use two different GCM:s.

• We will focus on the ECHAM4 model, and ECHAM5, which is an improved version of ECHAM5, developed at Max-Planck-Institute for meteorology. Based on ECMWF model, modified for climate. The model is a spectral transform model with 19 atmospheric layers and spatial resolution T42 (2.8º longitude/latitude resolution), ECHAM 5 is T63 (1.875º), time-step of the model is 24 minutes.

The ocean model is an updated version of the isopycnal model (OPYC3) developed by Josef Oberhuber. The name OPYC is derived from Ocean and isoPYCnal co-ordinates.

ECHAM5 – improved cloud parameterisation and land surface scheme, improved semi-lagrangian transport scheme

• The Community Climate System Model (CCSM) is a coupled climate model for simulating the earth's climate system developed at NCAR. Composed of four separate models simultaneously simulating the earth's atmosphere, ocean, land surface and sea-ice. CAM (Community Atmosphere Model) is the atmospheric component of the Community Climate System Model (CCSM).

Global coupled atmosphere-ocean general circulation models (AOGCMs), figure from Kjellström

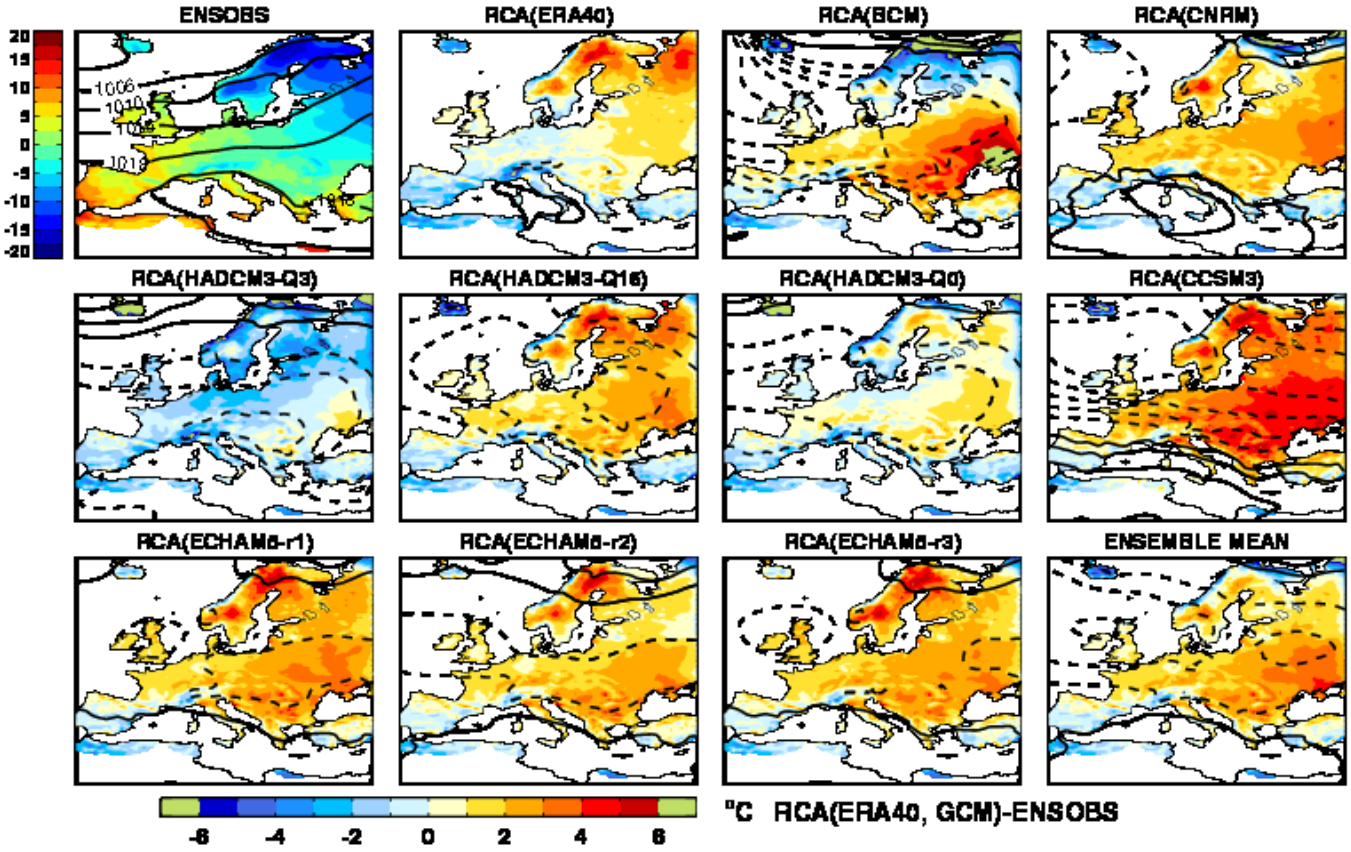

Figure 1. 2m-temperature and mean sea level pressure (contours) in winter (DJF) in the 1961-1990 period. The uppermost left panel shows the ENSEMBLES gridded observational 2m-temperatures (Haylock et al. 2008) and the ERA40 MSLP (Uppala et al. 2005). The one labeled RCA3(ERA40) shows biases compared to the uppermost left panel in an ERA40 downscaling simulation with RCA3. The other panels show biases from the individual 50km A1B-simulations listed in Table 1. The mean (lower right) is taken over the ensemble consisting of 5 simulations with different AOGCMs in the two rightmost columns. MSLP biases are shown for every 2 hPa except 0 (dashed for negative numbers).

Global coupled atmosphere-ocean general circulation models (AOGCMs), figure from Kjellström

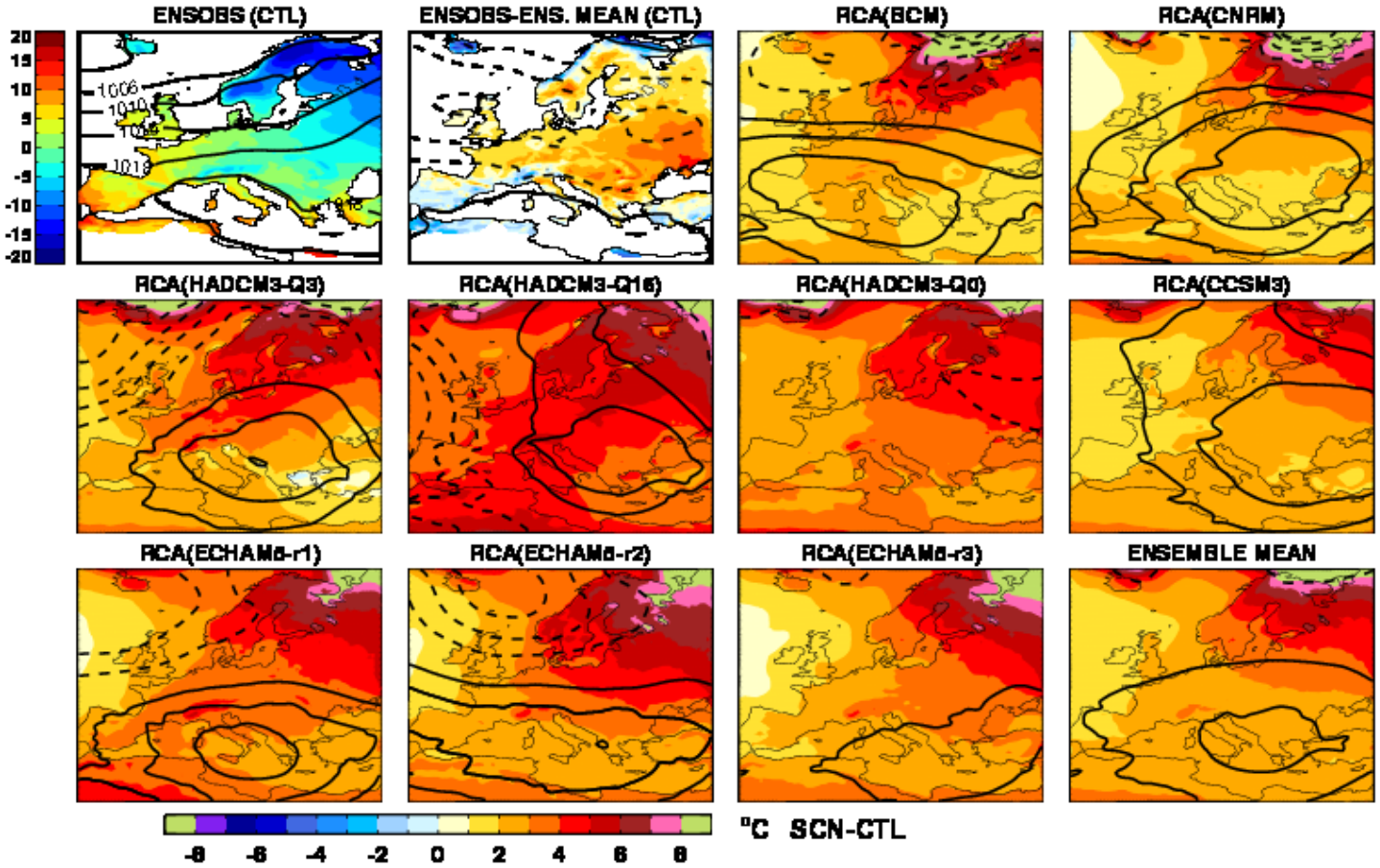

Figure 2. Change in 2m-temperature and mean sea level pressure (contours) between 2071-2100 compared to 1961-1990. The uppermost two panels to the left shows the ENSEMBLES project gridded observational 2m-temperatures (Haylock et al. 2008) and the ENSEMBLE mean bias from Figure 1. The other panels are results from the individual A1B-simulationsat 50km horixontal resolution listed in Table 1 The mean (lower right) is taken over the ensemble consisting of 5 simulations with different AOGCMs in the two rightmost columns. MSLP changes are shown for every 2 hPa (CTL) and every 1 hPa (SCN-CTL) except 0 (dashed for negative numbers).

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Regional climate model (RCM)

The GCM:s gives coarse information and for a smaller area like the Baltic Sea the simulation needs to be downscaled, we use dynamical downscaling with a RCM.

We will use one RCM and when looking at monthly mean values/seasonal variations the different RCM:s are relatively similar. RCM:s differ more in parameters with a larger variability (extreme precipitation, daily cycle etc).

We use the RCA3 RCM model, which is the Rossby Centre regional climate model (Kjellström et al, 2005), with/without the ocean component for the Baltic Sea (RCA/RCAO). Available from Ensembles/Prudence EU-projects.

Temperature errors within ±1degree (positive bias NE, negative bias in Mediterranean). Precipitation overestimated. There seems to be a problem with RCA3 10 m winds (too low), gustiness can be added.

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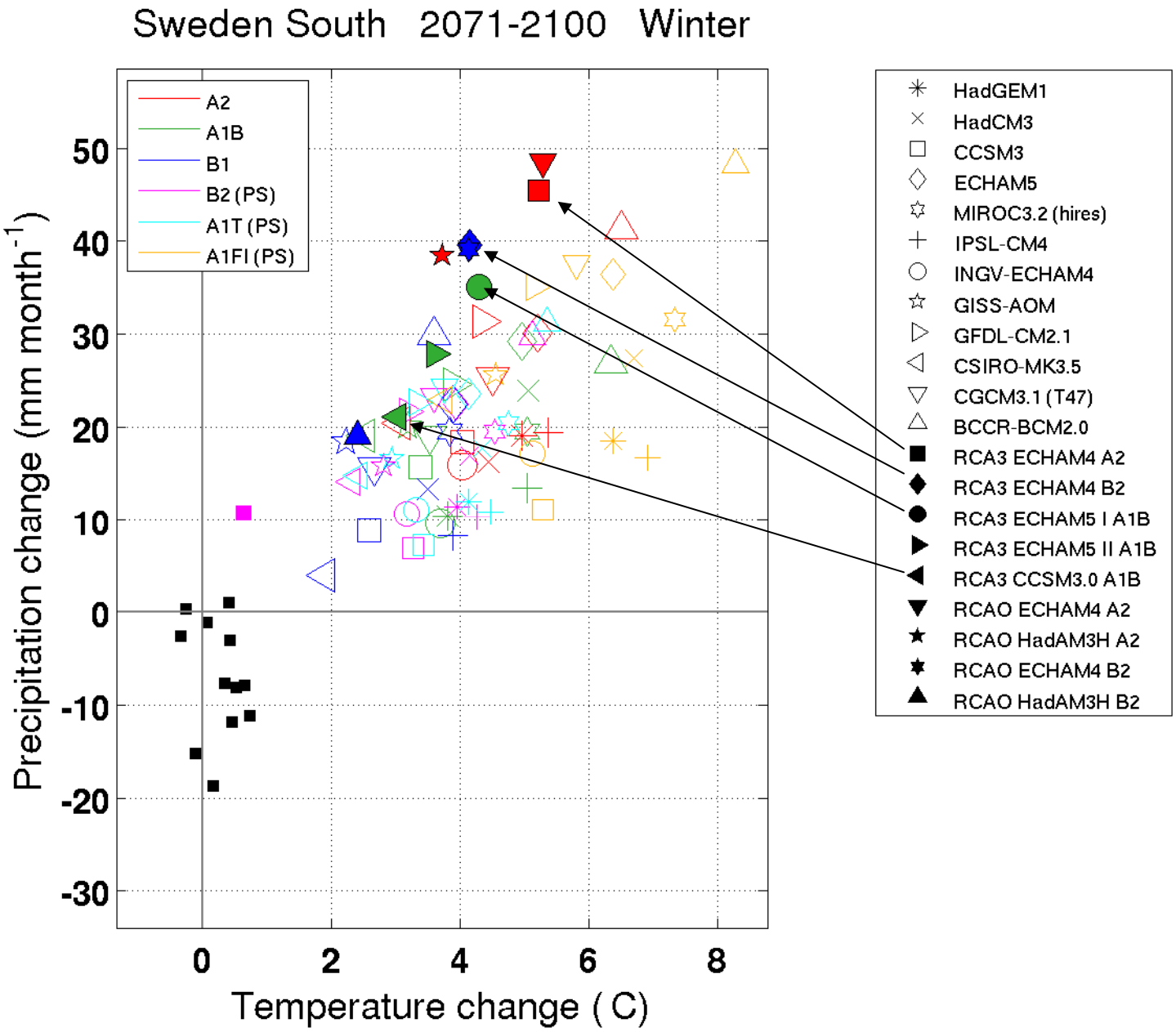
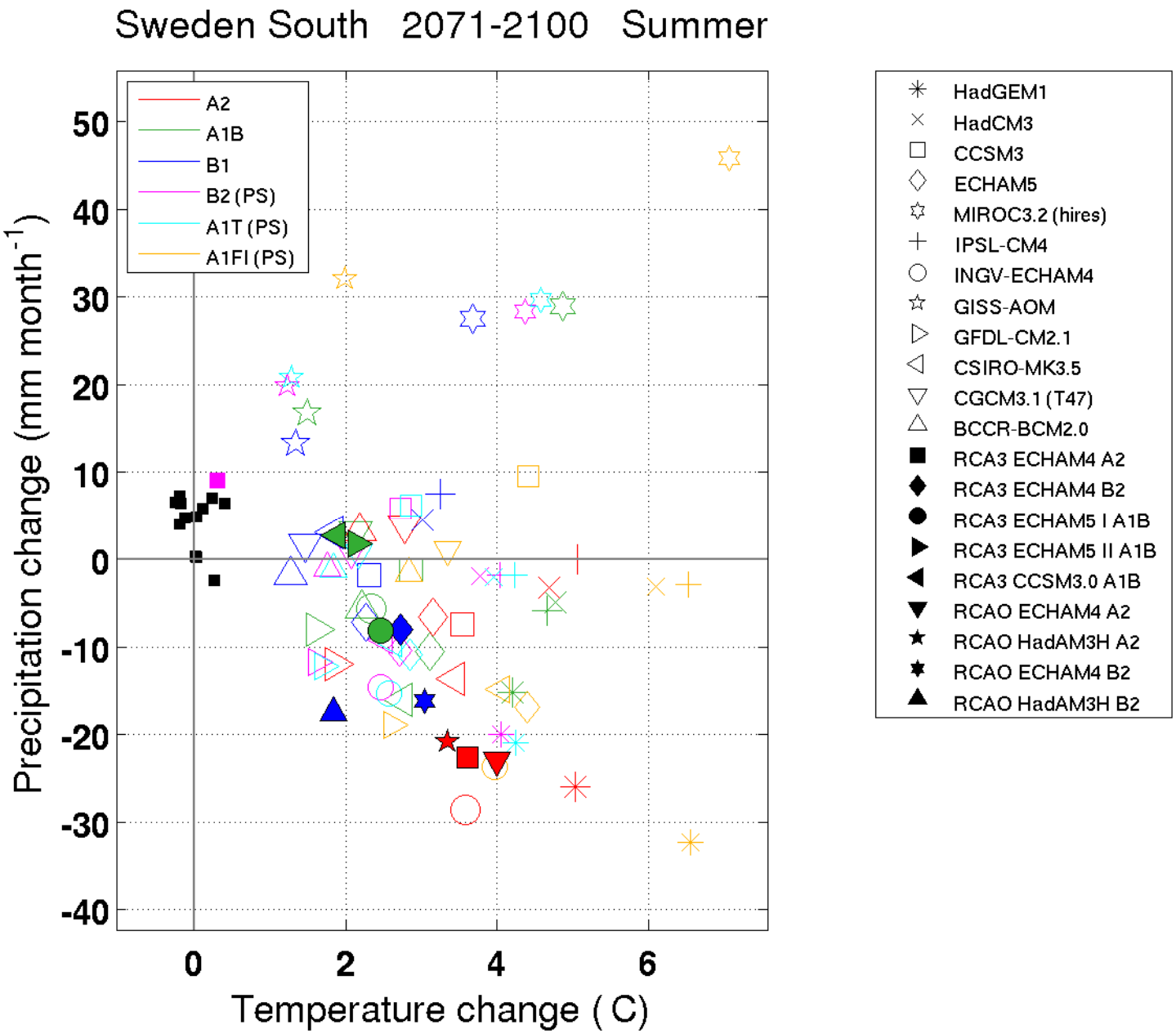


From Erik Kjellström



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Previously agreed on

Data sets and periods:

- Transient climate runs 1961-2100 based on two GCM's downscaled by one RCM, 3 emission scenarios with consistent land use changes, thus 6 different transient climate runs.

	GCM	RCM	Scen	Land use
1.	ECHAM4	RCA3	A2	1
2.	ECHAM4	RCA3	B2	2
3.	ECHAM5 I	RCA3	A1B	3
4.	CCSM3.0	RCA3	A1B	3

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Climate scenarios:

Over sea every 3H, derived at one point representing each basin:
Grid averaged temperature and relative humidity (2m)
Total cloudiness
Precipitation
Geostrophic wind (should be discussed)
Sea level pressure at Debilt and Oksoya

Land ecosystem modelling 24H averages (?), basin averages:
shortwave radiation
CO2 (local-global?)
Grid averaged 2m temperature
Precipitation

Land catchment modelling 3H or 24H averages (?), basin averages:
Grid averaged 2m temperature
Precipitation

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Climate scenarios of acid deposition:

A deliverable from the BONUS project ECOSUPPORT and can thus probably be available to us.

“Changing atmospheric deposition for NOx and SOx loads from IPCC and MATCH model simulations.”

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pCO_2 at Östergarnsholm: