AQUACLEW case study progress report

Future Biodiversity Changes in Sweden

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Water management issue

Jönköping county administration works as a policy maker of environmental protection. With the responsibility to detect changes in ecosystems, to describe them as well to decide for new regulations to protect environment in a changing climate there is a need for information on different climate indicators to be easily accessible and comparable with other data sources. There are many species that contribute to biodiversity that may be negatively or positively impacted by climate changes, for example, increased temperatures extending breeding seasons.

Use of Climate Data

Jönköping länstyrelsen use climate data within the following sectors of work: environmental monitoring, city-community planning, climate adaptation measures (e.g. solar panels, drinking water planning), and ecological restoration.

- Currently use Sweden's länsanalyser (climate service) regularly in different departments
- Climate data is used for many different decisions, such as …. The main focus at the moment is on biodiversity. It has been attempted to use climate data within resource consent processes, however it was not successful due to uncertainties and legal complications.
- There has been no official training in using climate services at Länstyrelsen.

Preliminary Workflow Results

The existing methods are to use S-HYPE (catchment-based, average size of about 25 km^2) as the hydrological impact model, and the 'new' method is to use E-HYPE, which has an average catchment size of 216 km^2.

Workflow Steps:

Step 1 Collect and downscale EuroCORDEX 11km-scenarier with PTHBV for S-HYPE with Midas method

Step 2 Run S-HYPE with input data from Step 1 and E-HYPE with input data from European analysis for climate scenarios (listed below) and calculate "index"/"parameters":

- MPI-M-MPI-ESM-LR-r1i1p1-SMHI-RCA4_v1a
- ICHEC-EC-EARTH-r12i1p1-DMI-HIRHAM5_v1
- ICHEC-EC-EARTH-r12i1p1-SMHI-RCA4_v1
- MOHC-HadGEM2-ES-r1i1p1-SMHI-RCA4_v1

Step 3 Calculate climate indicators based on Jönköpings need for ecological indicators for S-HYPE and E-HYPE respectively (Step 1 – 2).

Step 4 Analysis of reasons for differences and similarities in climate indicators from E-HYPE and S-HYPE and discussion about what this means for decisions made by Jönköpings län.

Step 1

EuroCORDEX 11km-scenaries have been down scaled and bias corrected using a new method developed at SMHI called the Midas method. The bias correction has been done for temperature and precipitation using the observation data sets:

- The Swedish 4x4 km data set PTHBV (used for the S-HYPE calculations) [Data available from 1961]
- The European 5x5 km data set EFAS-Meteo (used for the E-HYPE calculations) [Data available from 1990]

The climate scenarios used are RCP 8,5 of:

- MPI-M-MPI-ESM-LR-r1i1p1-SMHI-RCA4_v1a
- ICHEC-EC-EARTH-r3i1p1-DMI-HIRHAM5_v1
- ICHEC-EC-EARTH-r12i1p1-SMHI-RCA4_v1
- MOHC-HadGEM2-ES-r1i1p1-SMHI-RCA4_v1

Step 2

Results from Step 1 have been transformed from grid to catchments, to fit the hydrological models S-HYPE and E-HYPE. S-HYPE has been calibrated to PTHBV and E-HYPE to EFAS METEO. Thereafter the hydrological models have been run using both the observation data sets and the climate scenarios.

Output variables describing precipitation, air and water temperature, runoff, snow, ice and ground water have been stored for calculations in Step 3.

For the S-HYPE results, some comparisons have been done for the reference period between results based on the climate models and the observation data set. In general the results are consistent, giving us confidence in the climate calculations (see Figure 1). But for snow there is a distinct deviation such that the climate model calculation has too little snow, with the largest relative deviations in southern Sweden (see Figure 1 and Figure 2). However, the absolute deviation is smallest in southern Sweden due to thinner snow pack (see Figure 2). Similar results have been seen in earlier studies at SMHI. Also for ice thickness there is some deviation, but much less than for snow pack. Moreover, neither snow pack or ice thickness is a prioritised climate indicator for the Jönköping county government.

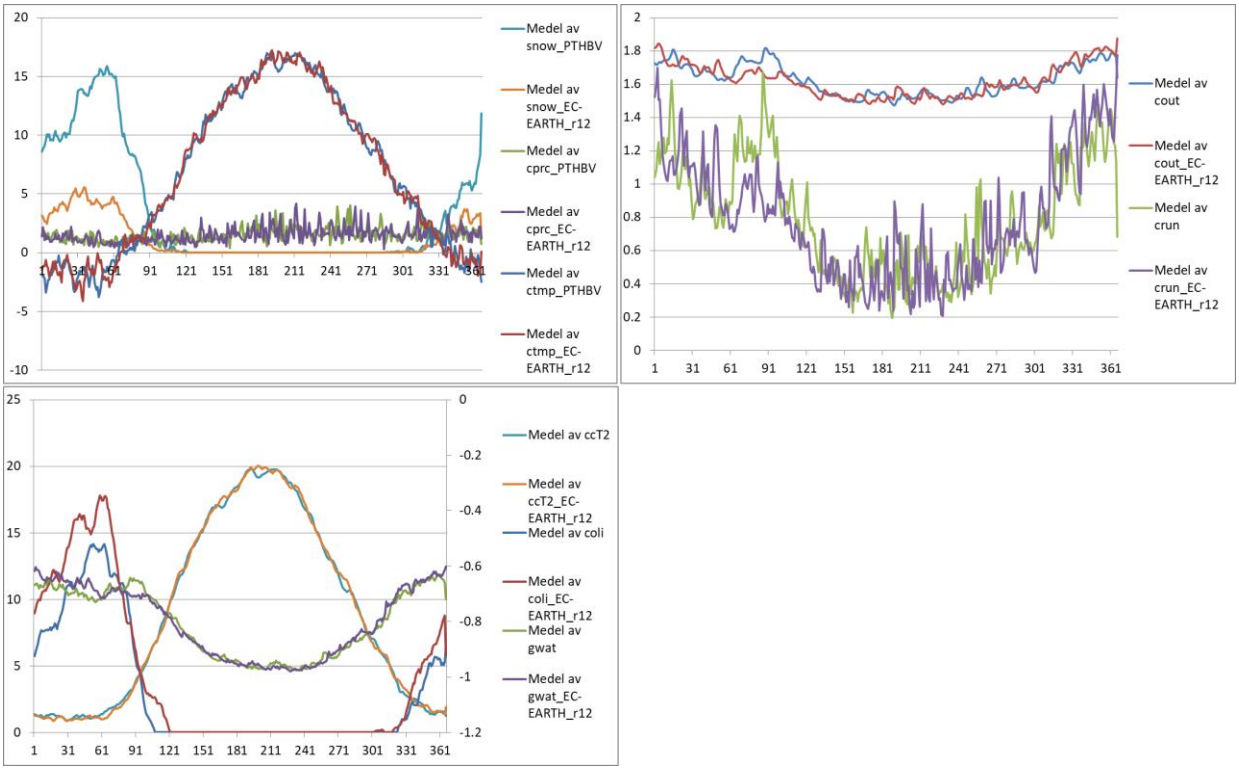

Figure 1 Comparison between S-HYPE results for the reference period (1971-2000) based on PTHBV and EC-EARTH_r12 respectively. The plots show mean values over one year (day number on the x-axis) for the Jönköping area. The results are generally consistent. A large deviation can be seen for snow pack ("snow") and there is also some deviation for ice thickness ("coli").

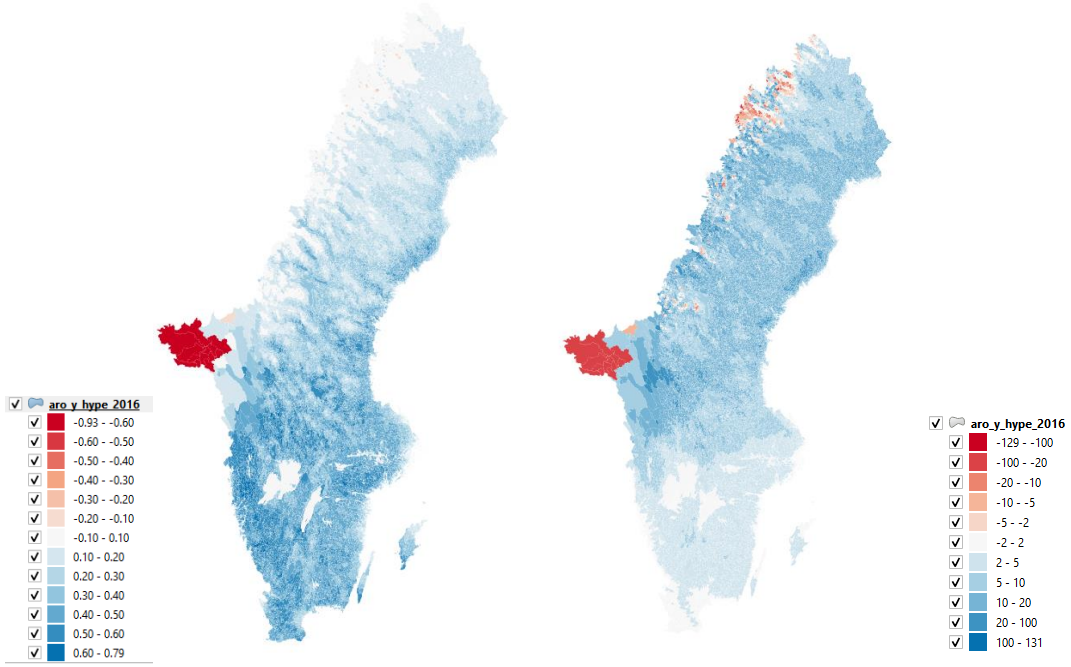

Figure 2 Left: Relative difference between snow pack calculated from PTHBV and EC-EARTH-r12. Right: Absolute difference between snow pack calculated from PTHBV and EC-EARTH-r12. (The red area in Norway can be ignored!)

Preliminary studies indicate that the reason for this deviation is a lack of precipitation on days with negative temperature (Celcius) in the climate models (see Table 1). This indicates that the snow results must be presented as changes over time and also further analysed.

Table 1 Number of days within the reference period (1971-2000) with temperature < 0°C and precipitation. Calculations are done for the Jönköping area on data from PTHBV and EC-EARTH-r12.

	PTHBV	EC-EARTH_r12
Temperature < 0°C	2109	2032
Temperature < 0°C and precipitation > 1mm	461	256
Temperature < 0°C and precipitation > 5mm	92	30

Step 3

Ecological indicators will be calculated from the S-HYPE and E-HYPE results, based on the needs defined by Jönköping. The indicators calculated from the S-HYPE results so far are:

Temperature
- Mean air temperature
- Number of days with air temperature <0°C
- Number of days with air temperature >22°C
- Mean water temperature

Precipitation
- Longest period with precipitation <1mm
- Longest period with precipitation >10mm
- Number of days with precipitation <1mm
- Number of days with precipitation >10mm
- Largest precipitation over one day

Snow and Ice cover
- Number of days with snow cover
- Number of days with ice cover

Step 4

Not yet started.

Client perspective

Jönköping Länstyrelsen has asked for a system that can quickly provide an overview of different indicators for climate in the region. These indicators should be divided into different areas within the region, so that any possible differences between high/low altitude or ecosyste m type can be identified. We will provide the indicators for the different regions as figures in a report, with possibly adding different threshold values, dependent on availability of such data.