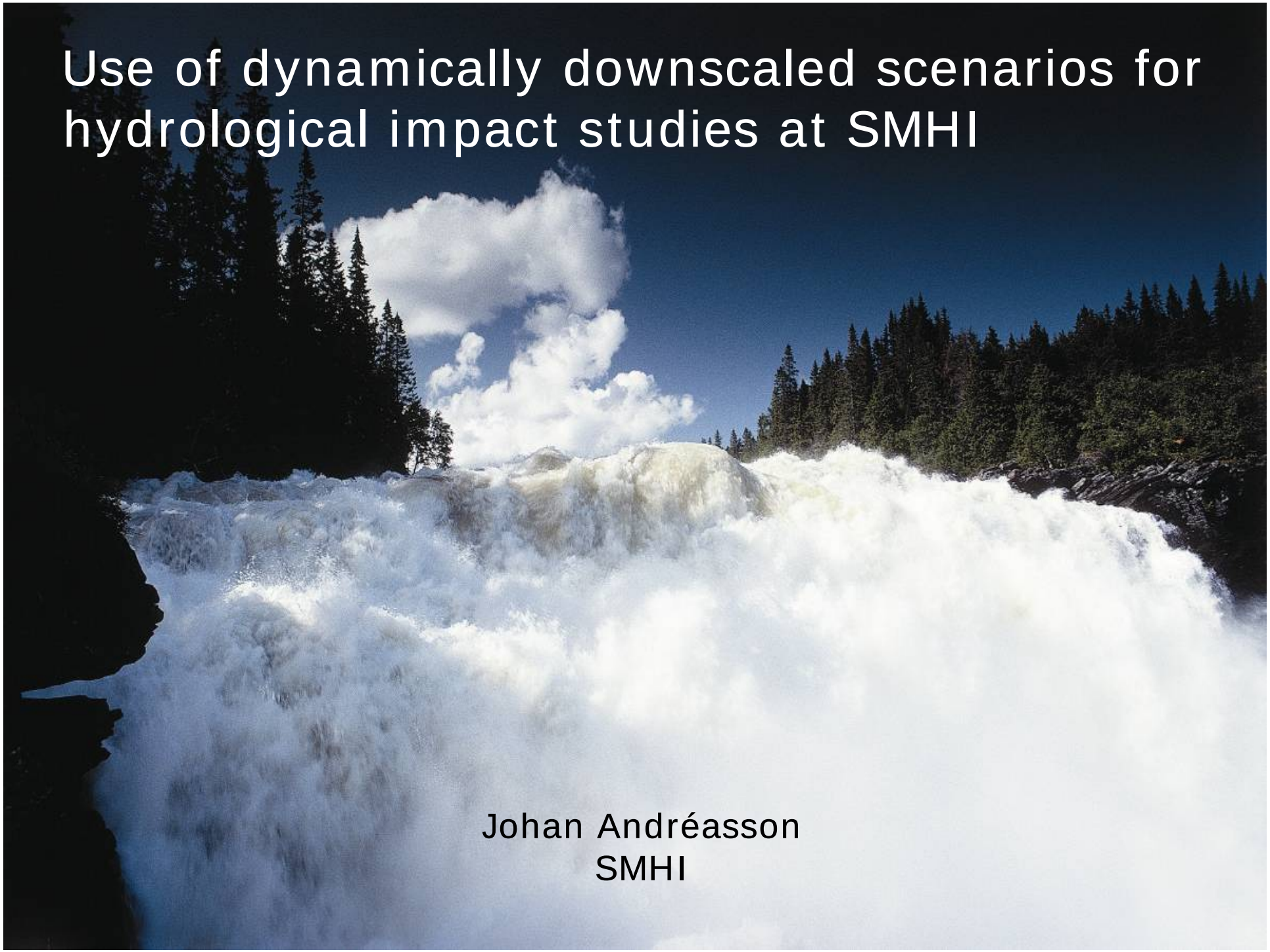
Use of dynamically downscaled scenarios for hydrological impact studies at SMHI



Johan Andréasson
SMHI

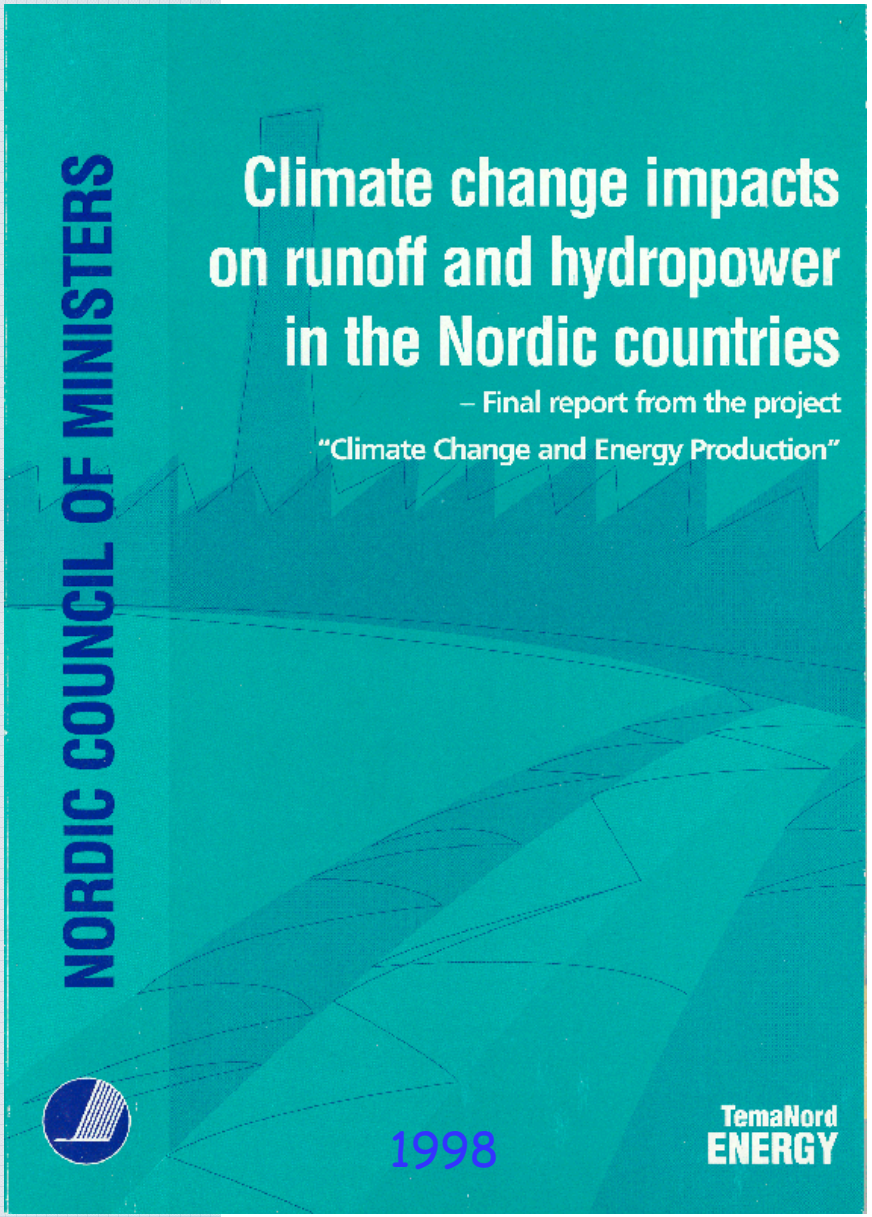
SMHI

Outline

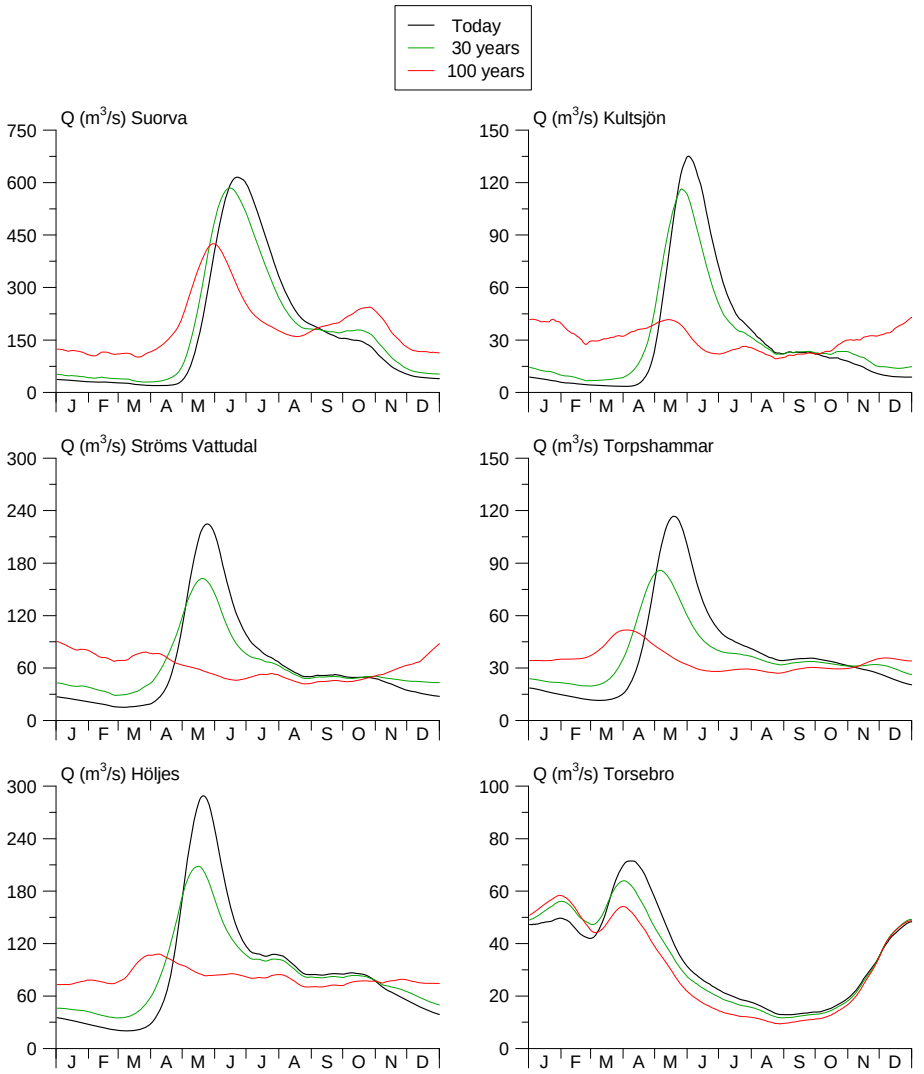
- Background/Intro
- Some examples of results
- Current development
- The near future

SMHI

Nordic Project 1991-1996



0, 30 and 100 years from today



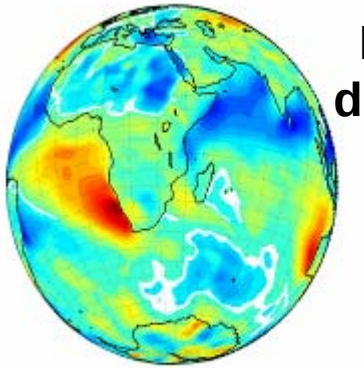
Example of present day questions

How will the conditons change for:

- Hydropower production?
- Dam safety and discharge needs?
- Flooding?
- Urban systems?
- Inflow to the Baltic Sea?
- Risk for landslides?
- Nutrient transport / eutrophication?
- Water availability in Southern Africa and South America?

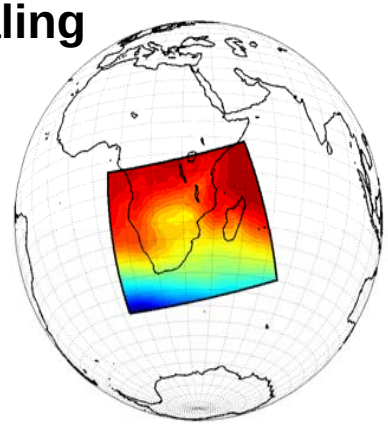
SMHI

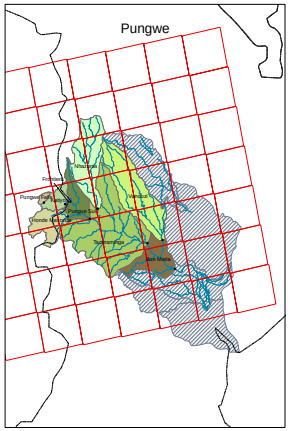
GCM



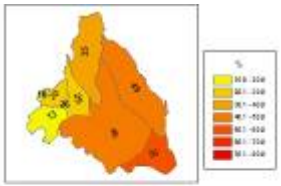
Dynamical downscaling

RCM

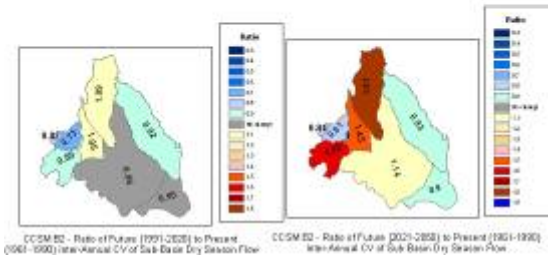




Statistical downscaling



Hydrological modelling

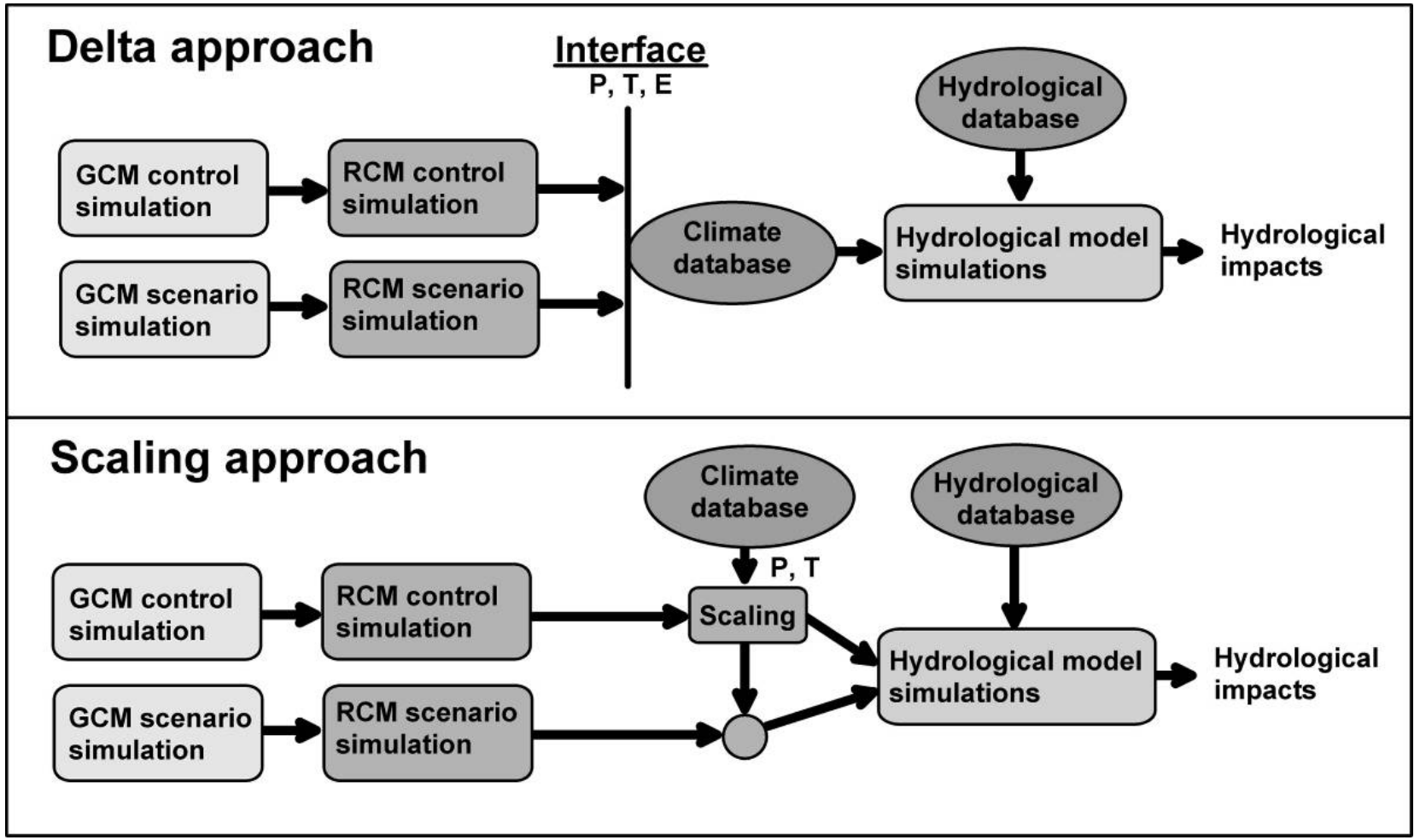


Adjustment of RCM data (Interface)

- Delta method
- Scaling method
- Statistical downscaling

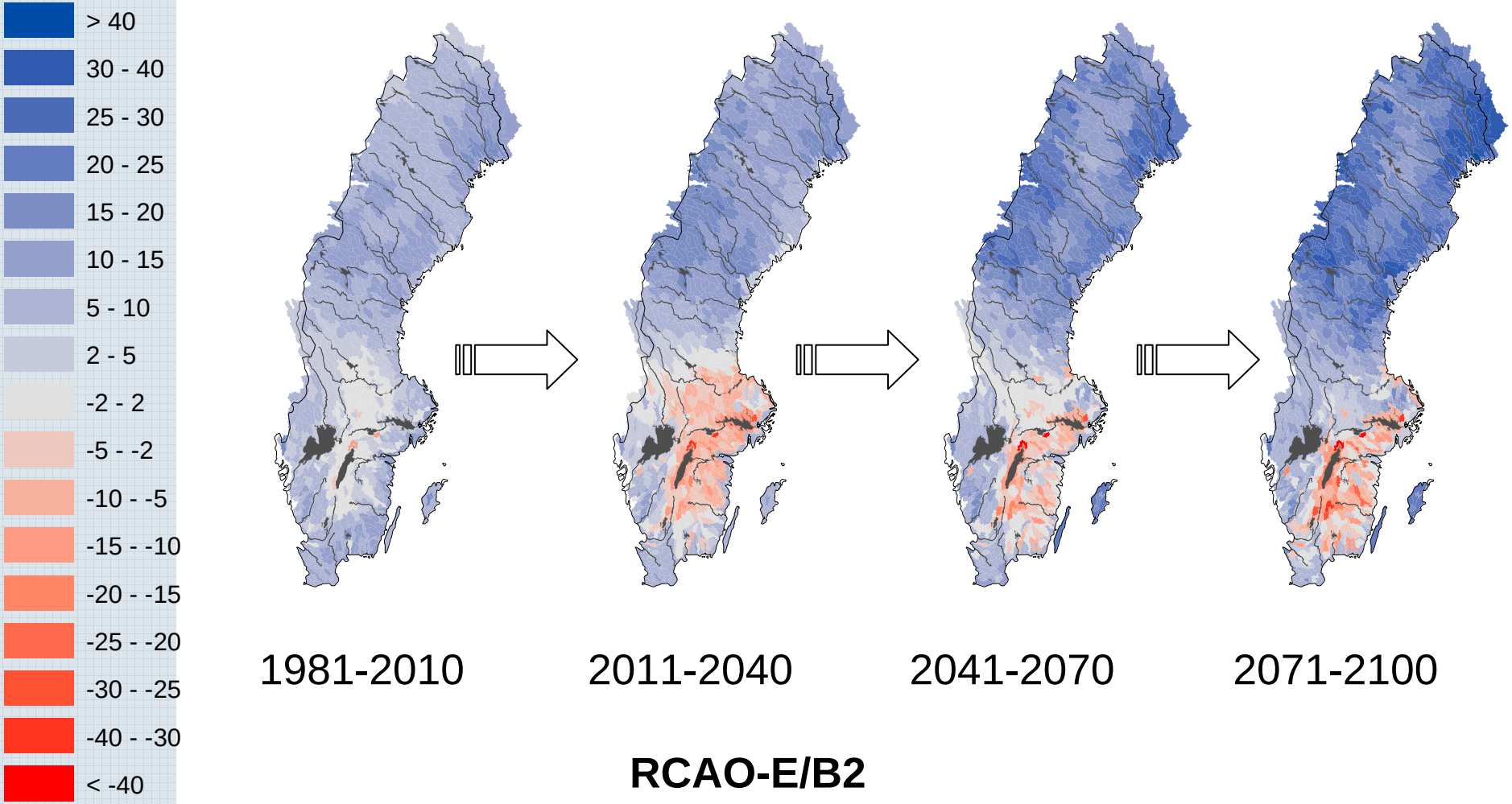
SMHI

Two different approaches



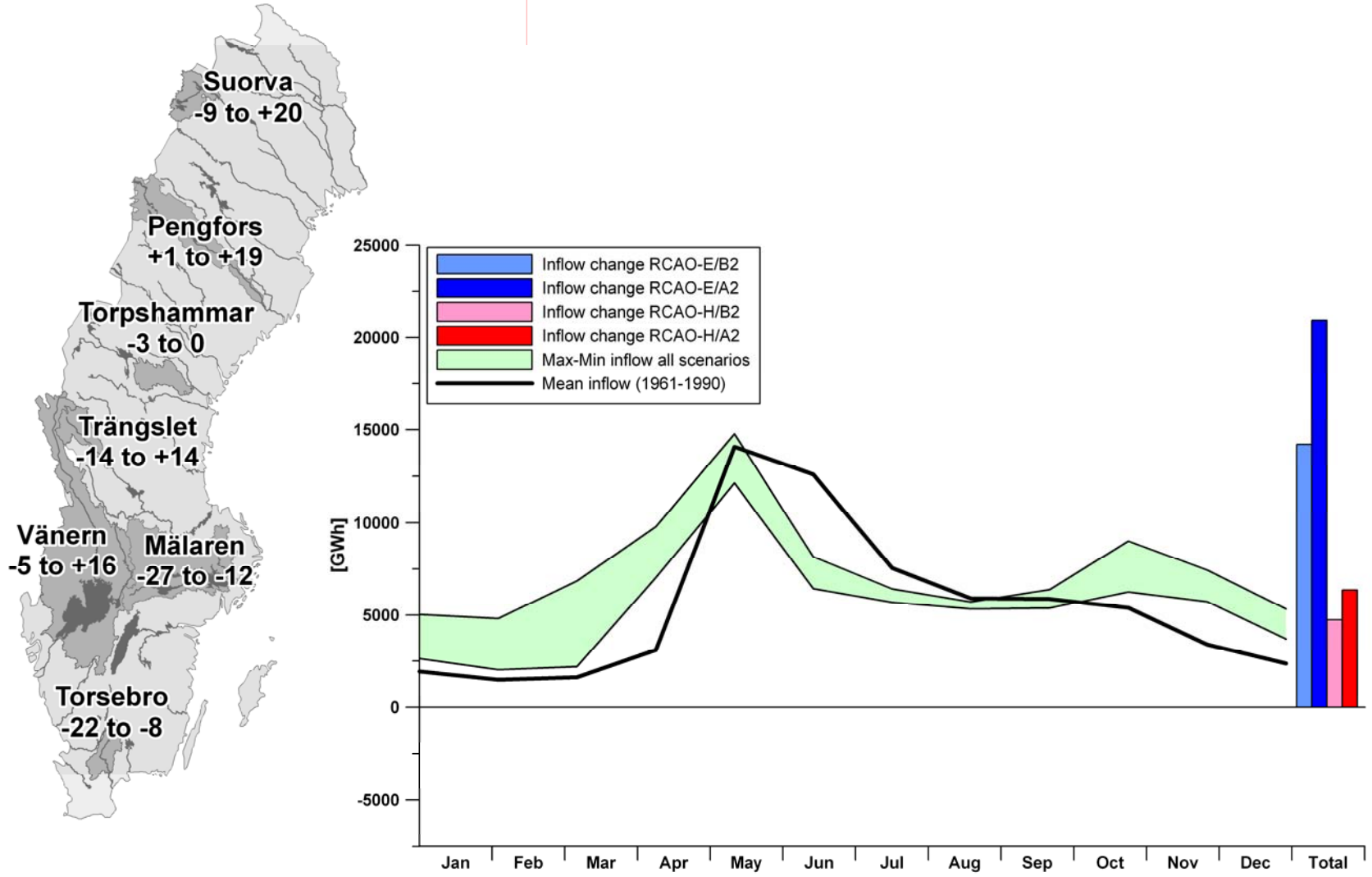
Maps of future water availability

Change in mean annual runoff (%) compared to 1961-1990

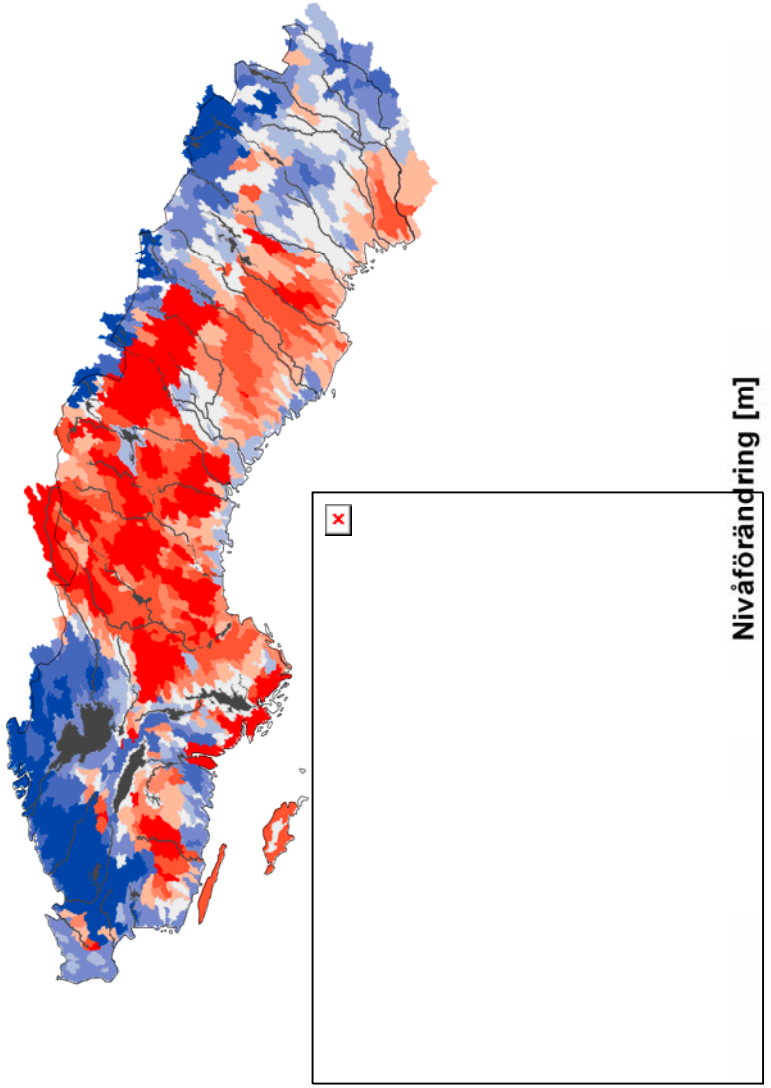


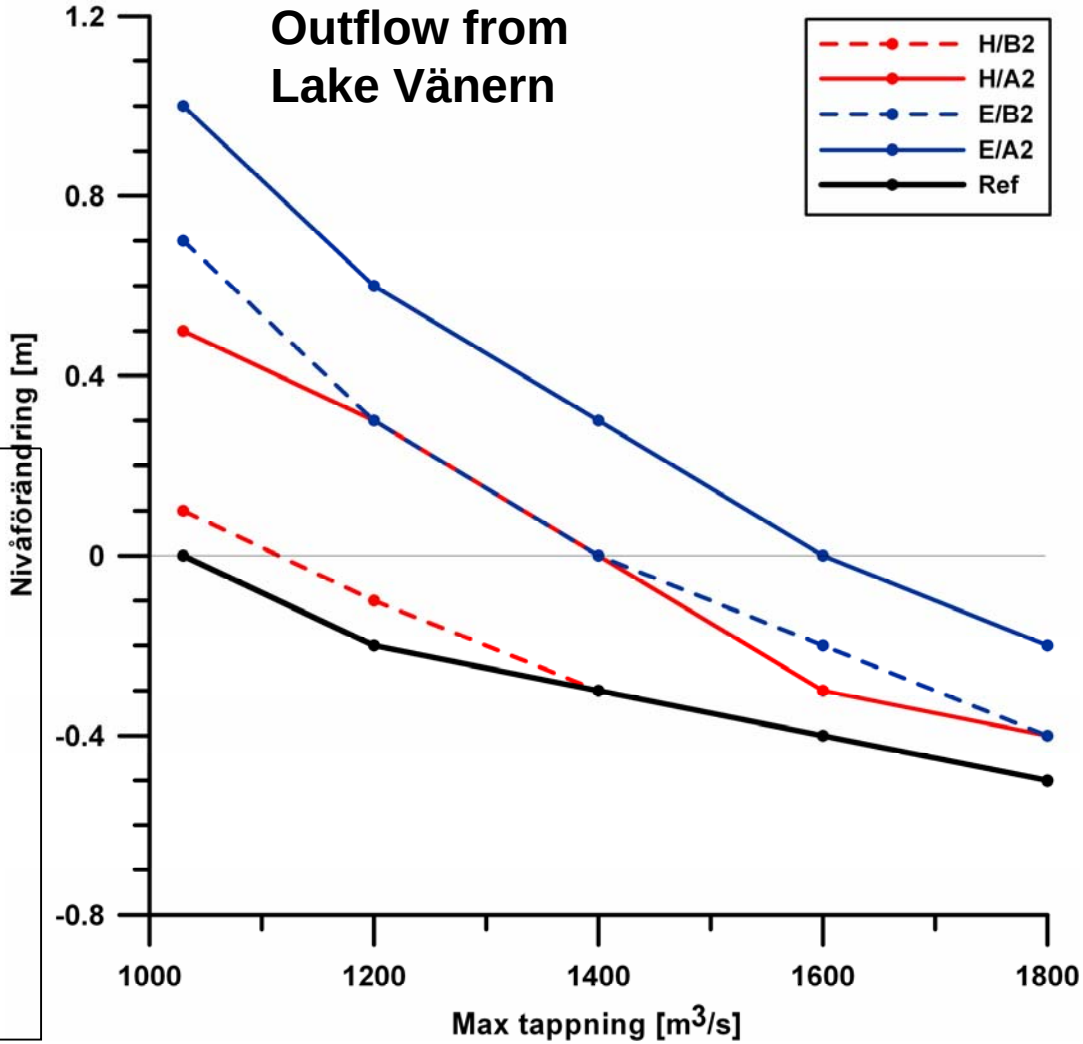
RCAO-E/B2

Swedish hydropower – dam safety & production



Flooding in a future climate - Example

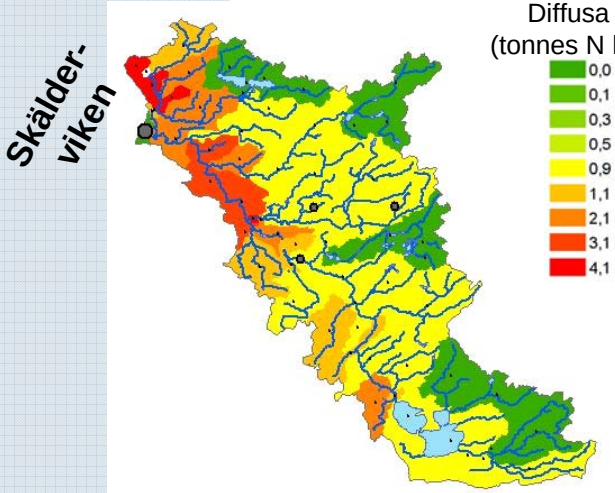




Changes in water quality – Some examples

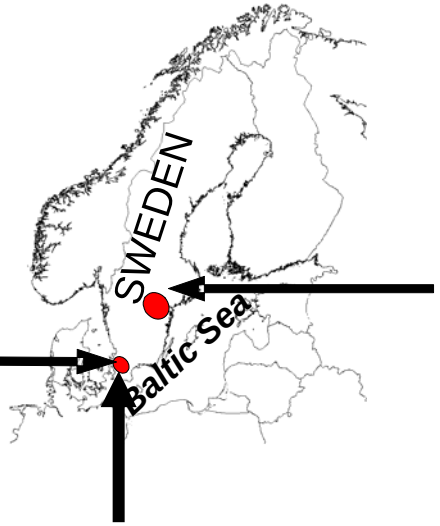
Nitrogen sources to Skälderviken (Rönne å)

2071-2100

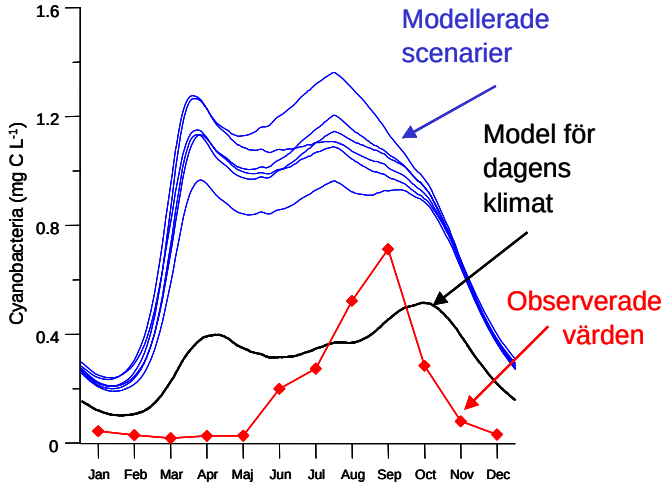


Diffusa källor
(tonnes N km^{-2} yr^{-1})

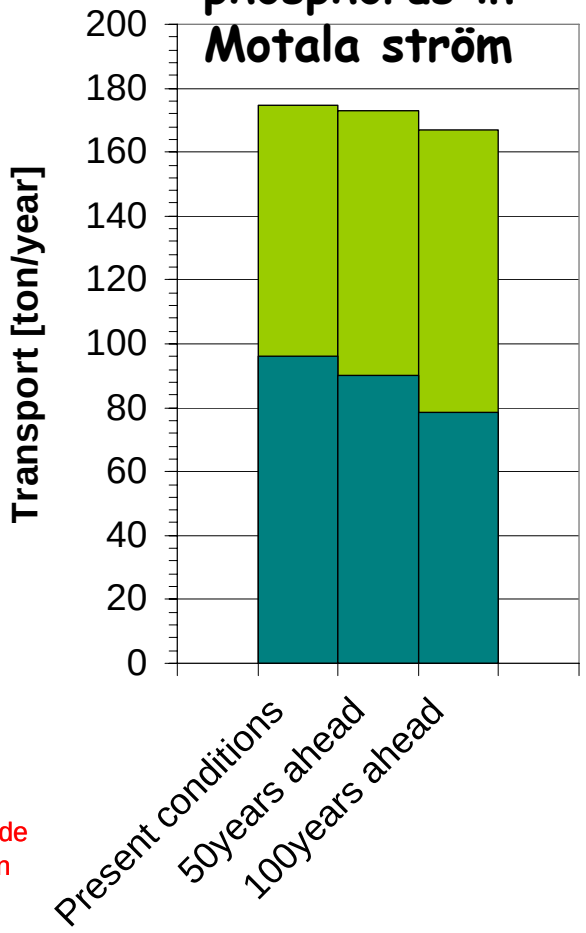
- 0,0
- 0,1 - 0,2
- 0,3 - 0,4
- 0,5 - 0,8
- 0,9 - 1,0
- 1,1 - 2,0
- 2,1 - 3,0
- 3,1 - 4,0
- 4,1 - 5,0



Cyanobacterias in Ringsjön



Transport of phosphorus in Motala ström



SMHI

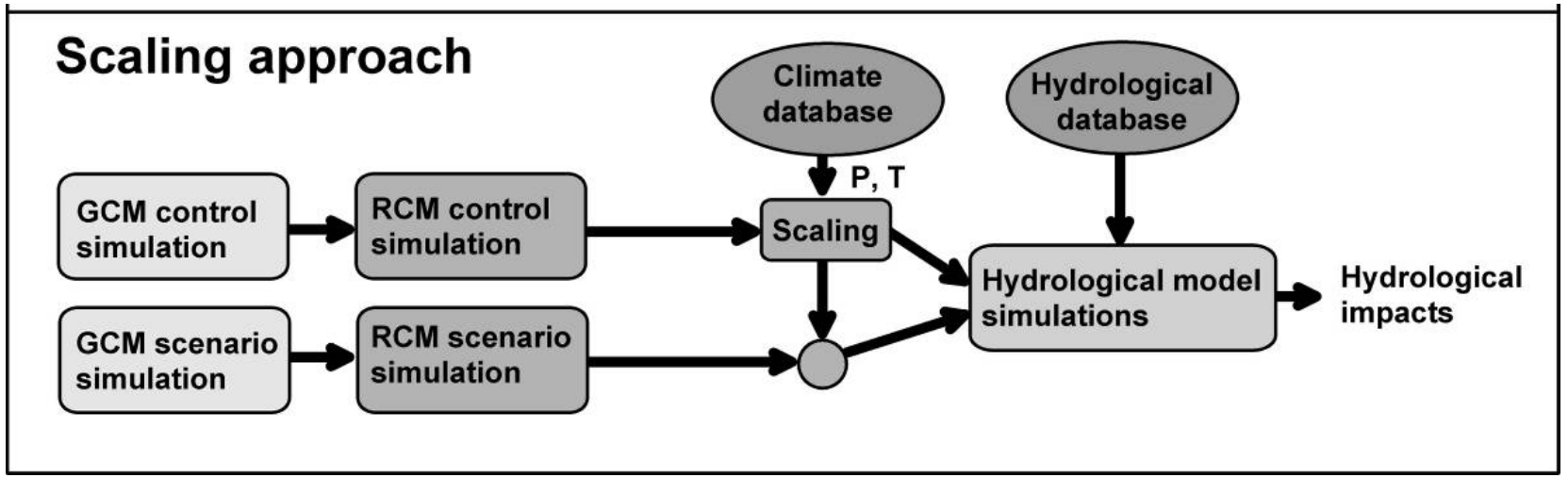
Development goal 2007

- Develop a method that in a credible way transforms climate model output into HBV input

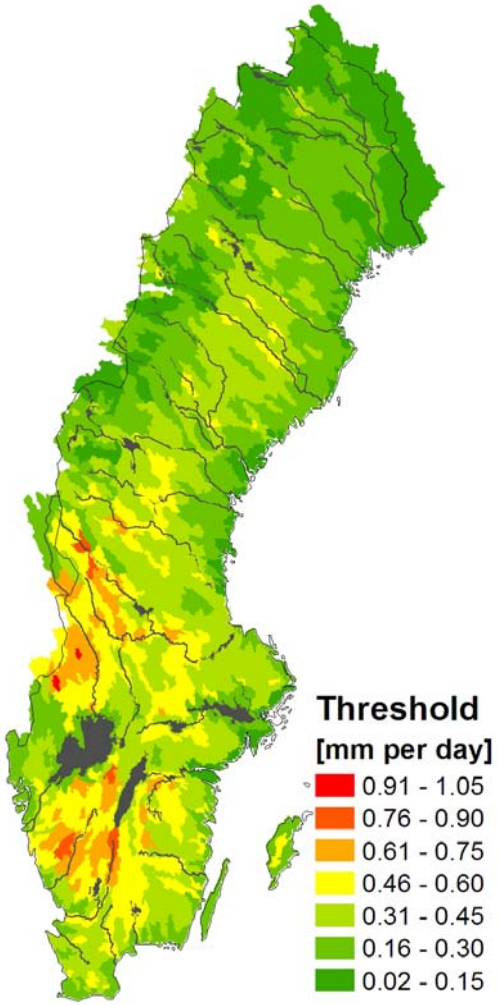
- The method should be stable also when the output is used in hydrological design calculations

SMHI

The starting point



The gamma-method for precipitation (Scaling ver2)
1st Step : Identify a threshold value



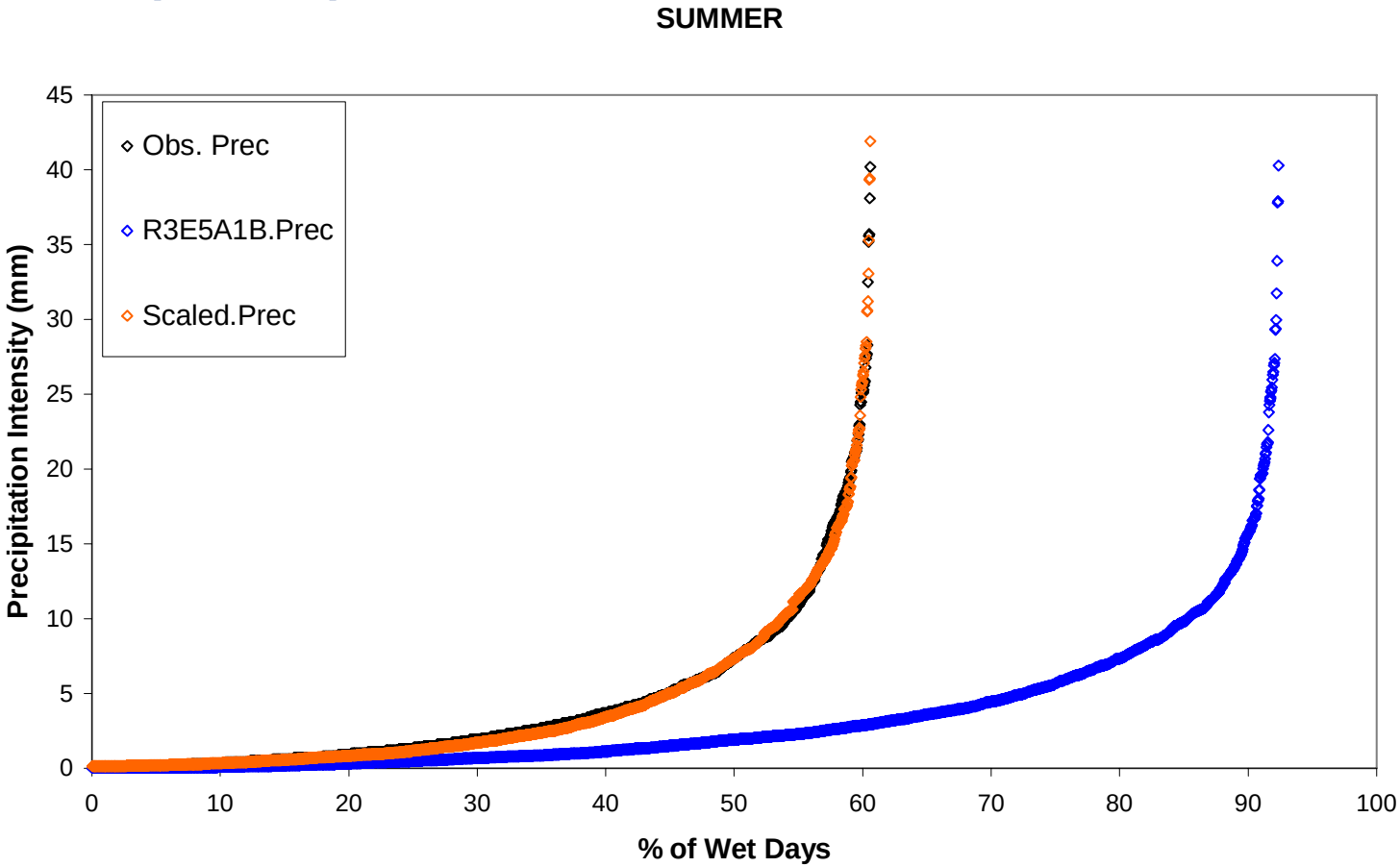
2nd Step : Parameter Estimation

- Distribution well suited for precipitation
- 2 parameters (shape and scale)
  - 2 distributions, above and under 90th percentile
- Parameters are estimated for both observations and RCM-control (4 seasons)

  ⇒ Scaling factors

The gamma-method for precipitation (Scaling ver2)

Analysis: CDF of obs., raw RCA and scaled RCA precipitation



SMHI

Scaling Method for Daily Temperature

1st Step: Parameter Estimation

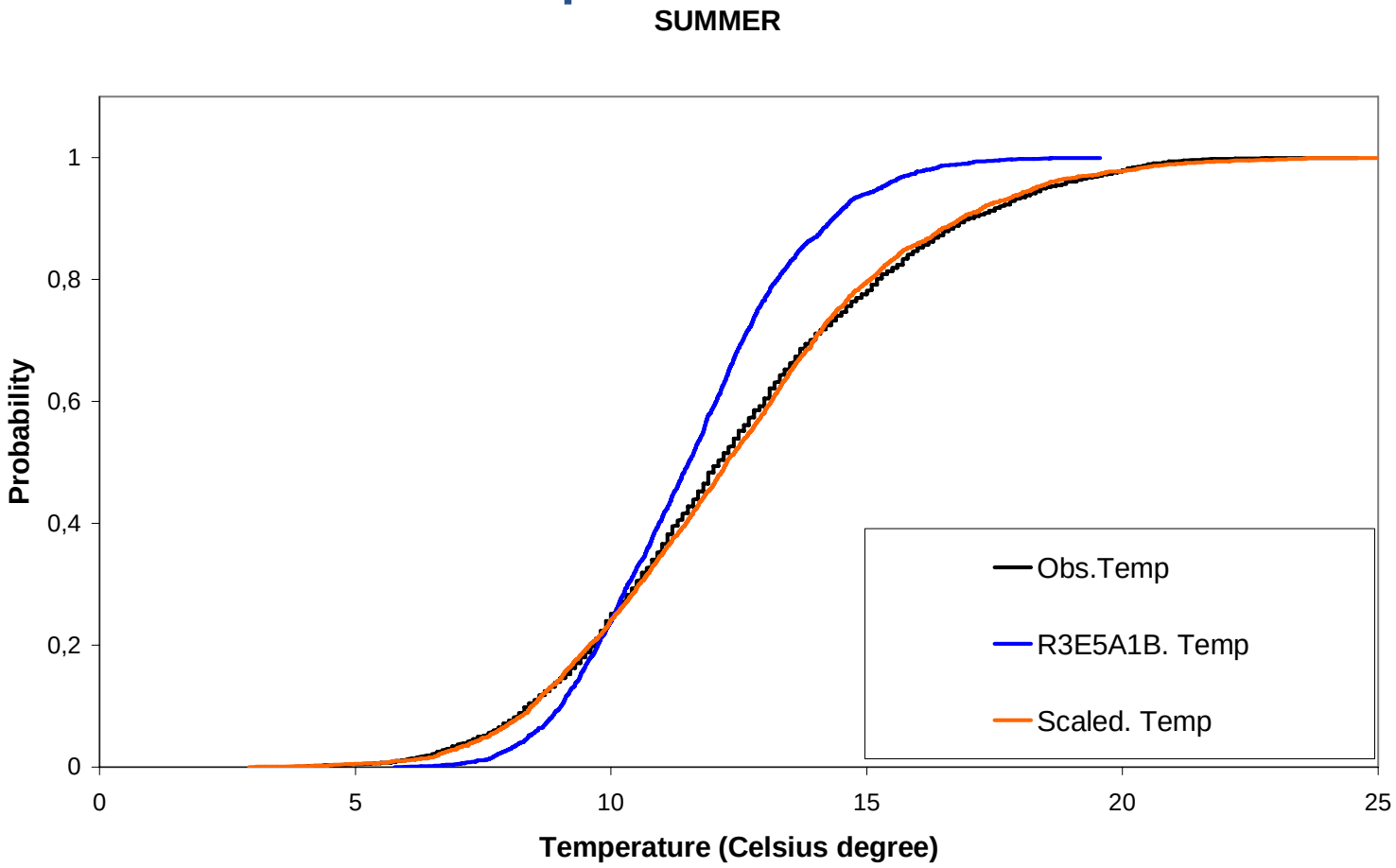
Calculate mean and standard deviation of daily temperature collected from observation, modelled with RCA control run and RCA scenarios for dry and wet days

2nd Step : Scale daily temperature

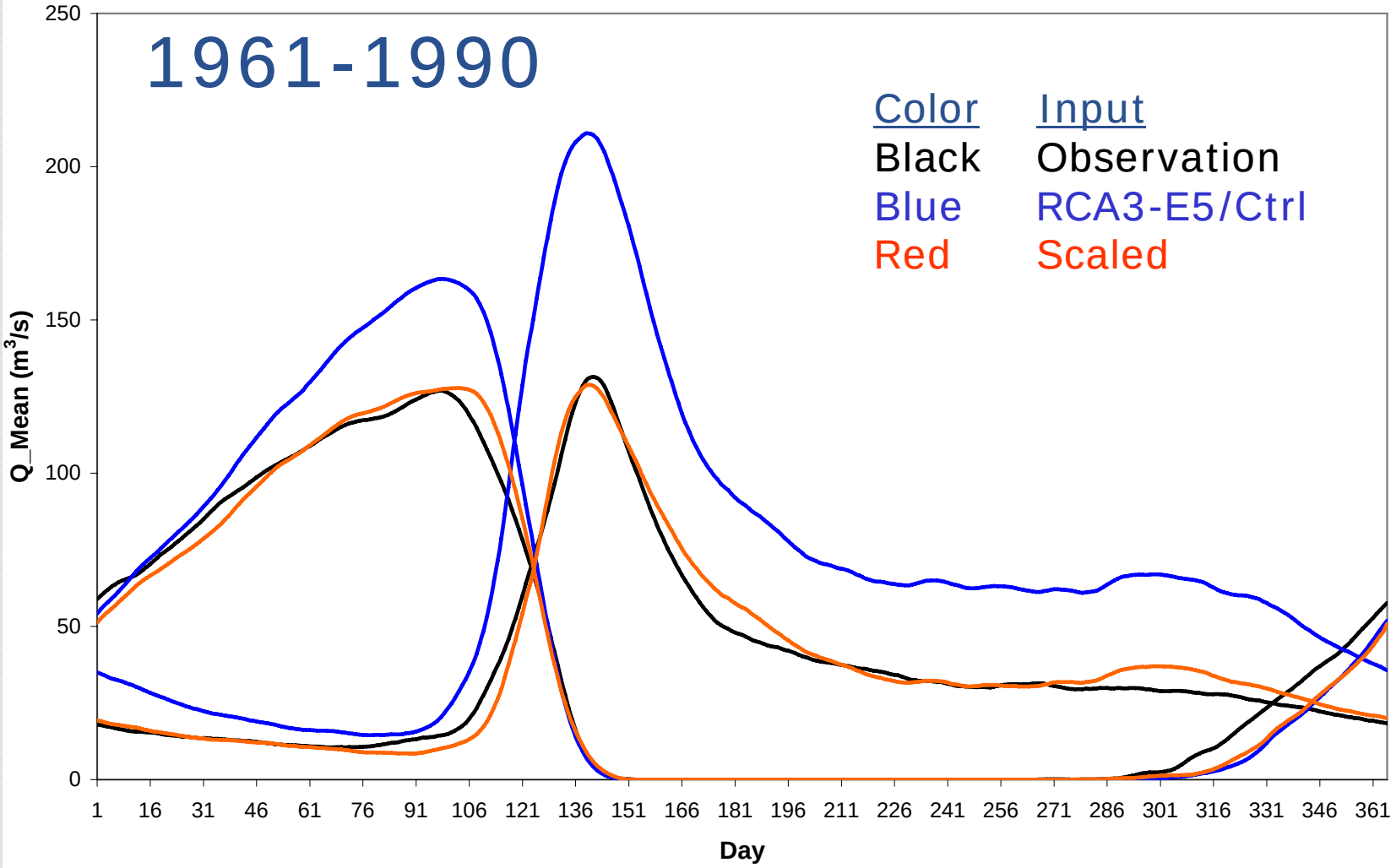
Scaling is applied on both standard deviation and mean temperature separately for dry and wet days

Scaling Method for Daily Temperature

Analysis: CDF of obs., raw RCA and scaled RCA temperature



HBV run with scaled precipitation and temperature



SMHI

Near future

- Construction of databases on operational formats for precipitation and temperature from ENSEMBLES scenarios
- Impact simulations
- Method development (Swecia)
- CLIMODUSE – a project that will make it easier to do impact studies
  - Adjust and store RCM output (also other variables) on operational database formats


Thank you for
your attention!