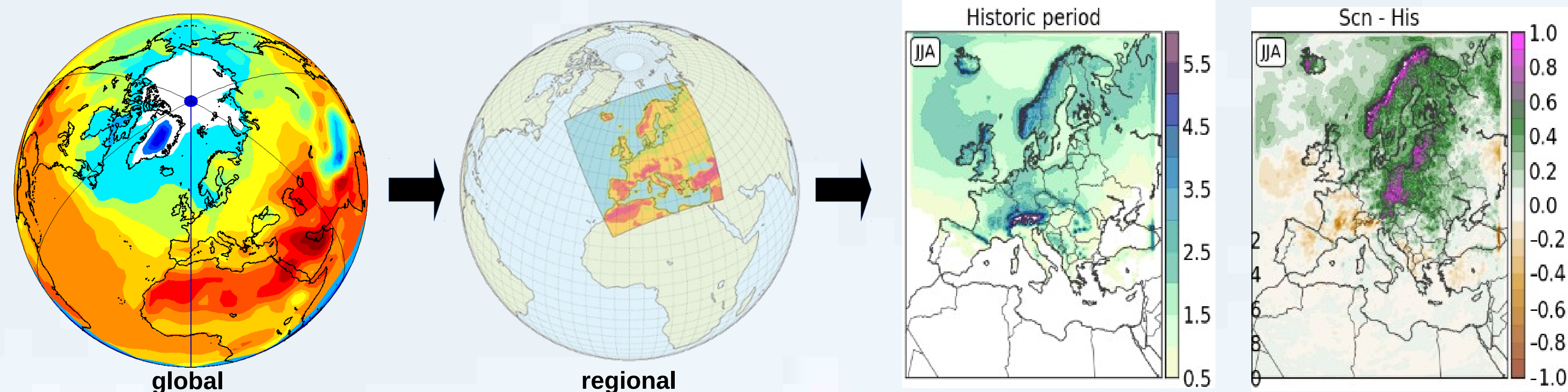


Regional projections of global climate change for local adaptation response

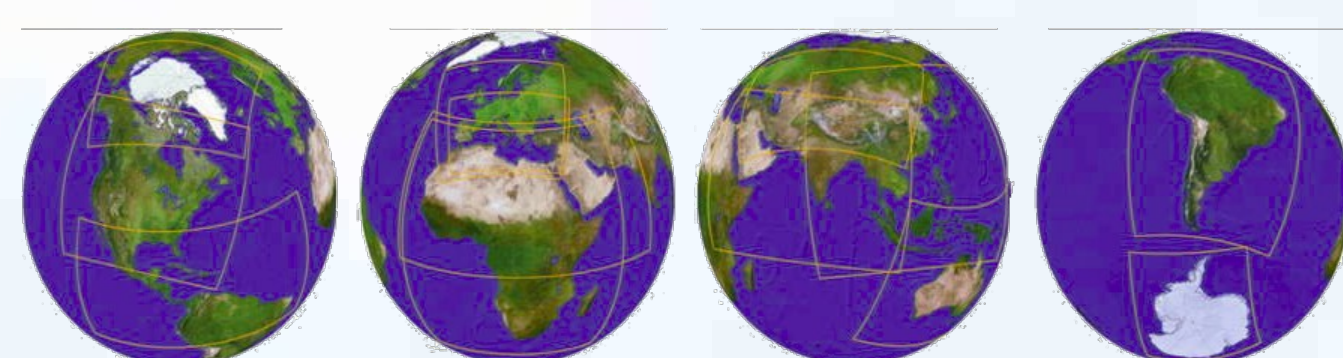
Resolution in climate models matters

Ralf Döscher, SMHI, Sweden



The value chain from global climate model, via regional model to impact studies

Improving regional climate models will be essential for regional-local climate information, adaptation planning and climate services in the next 20 years.



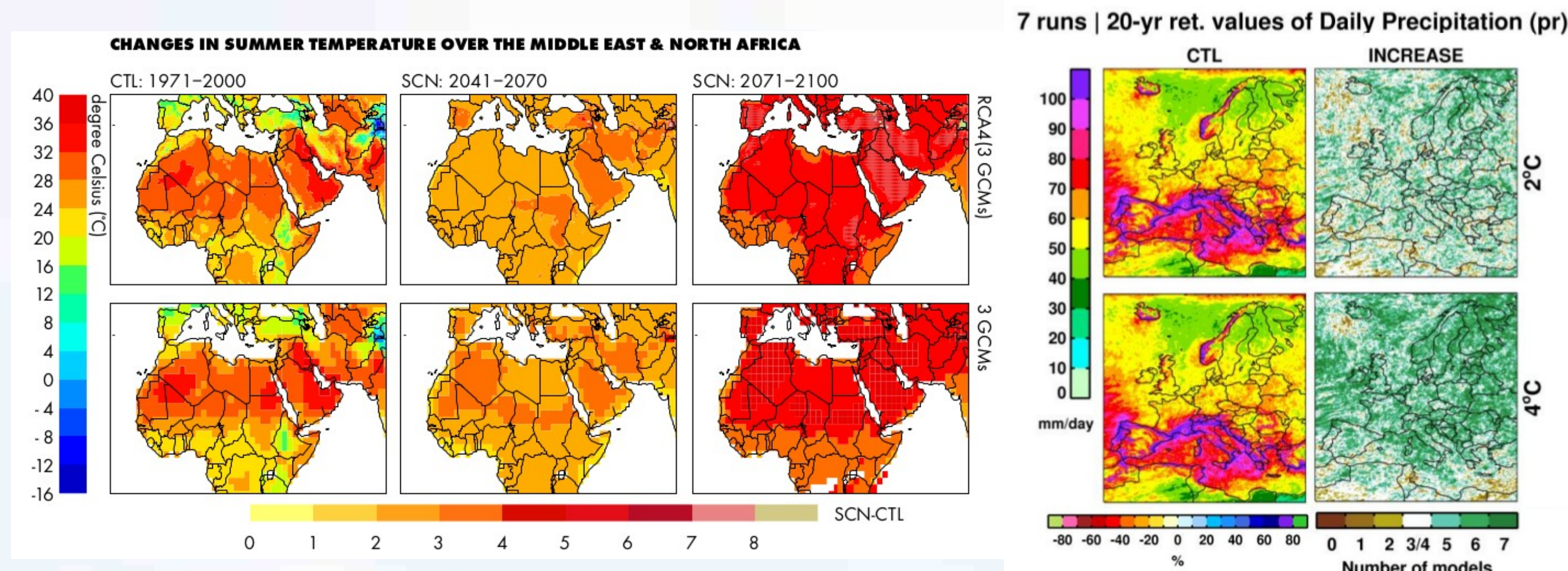
The CORDEX community is providing coordinated sets of regional downscaled climate projections that clearly add value to the underlying global climate projections. Downscaling is a critical component, will be the primary source for climate services on regional and local level, even in coming decades,

Challenges are better and more complex process descriptions at high and very high resolution, as well as distillation of user-relevant information.

Added benefits

Added value of regional high resolution climate models

Global climate models (GCMs) and Earth System Models (ESMs) provide the large-scale picture of the climate and the climate change signal as well as interactions between the components of the global earth system. Robust assessment of that signal is necessary at regional to local scales where the impact is felt and adaptation needs exist. This requires higher spatial resolution than global models can provide. Regional features such as steep orography, varying soil and vegetation properties, and small-scale landscape heterogeneities are strongly shaping the climate signal, including climate events and probabilities of short-term extremes. Regional climate models (RCMs), climate models in spatially limited domains, are applied downstream of the GCMs with enhanced grid resolution that allows for a more realistic regional climate response.



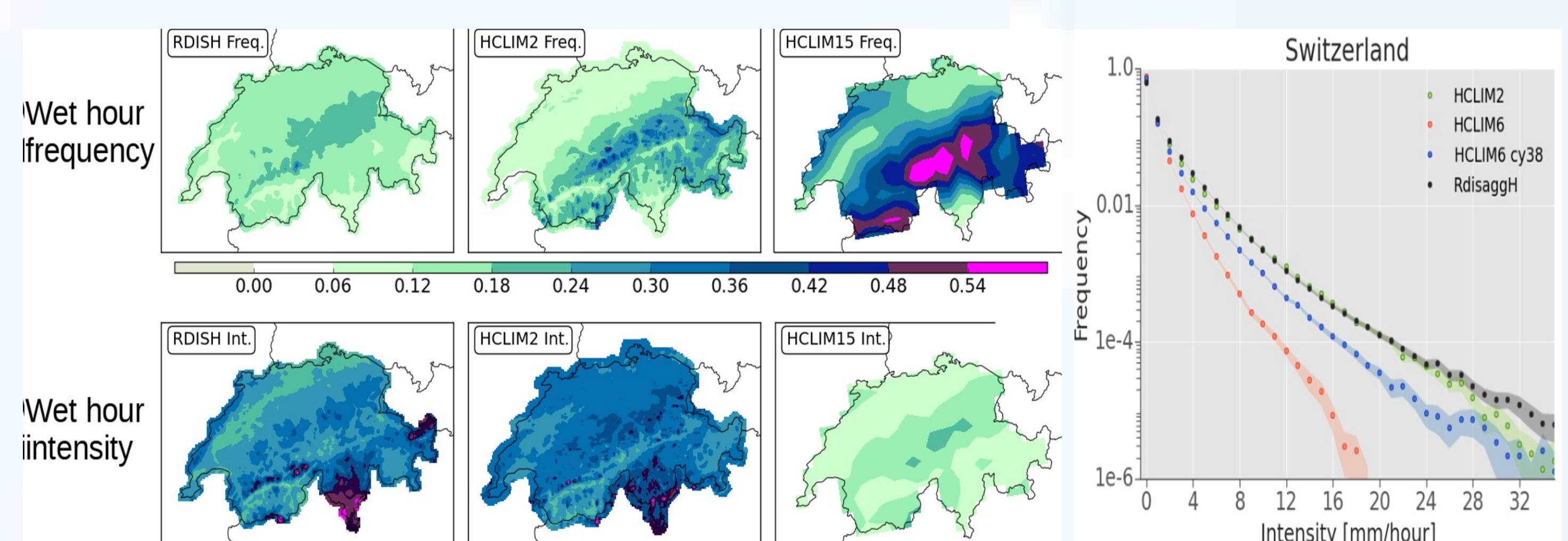
Summer temperature change in high emission scenario RCP8.5, for regional downscaling. Nikulin, 2015, SMHI

20-year return value of maximum daily precipitation (left) and the number of RCM simulations that indicate an increase (right). High emission scenario RCP8.5, Kjellström et al, 2016, SMHI

Scientific Challenges

Upcoming scientific challenges are

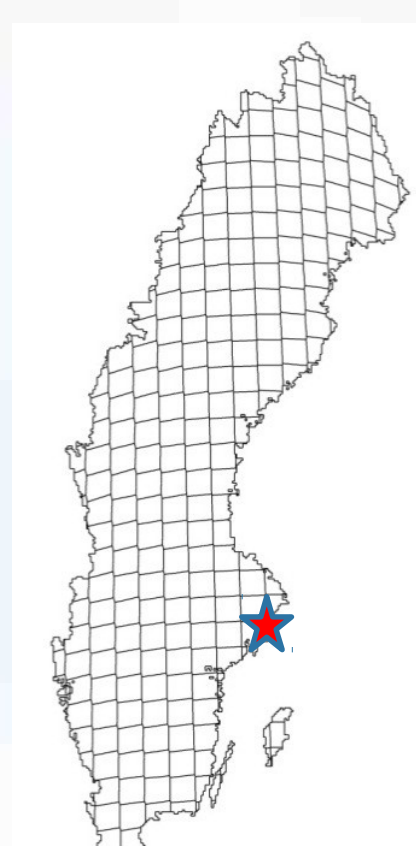
- further improved climate models at high resolution, related to better processes descriptions.
- regional Earth System Models, involving local feedbacks relevant for impact questions.
- km scale and higher resolution in regional-local domains for better synchronization with impact scales, e.g. for urban areas.
- Model evaluation on the km scale to support the development of 2030's GCMs by transferring knowledge gains in km-scale climate modelling from RCMs.
- Distillation of actionable information from multiple sources of downscaled projections



Precipitation statistics over Switzerland. (left)-(right) observation, HCLIM2 and HCLIM15 using the following statistics: (top) wet hour frequency (fraction), (middle) mean wet hour intensity (mm/h). Lind et al. 2016, SMHI

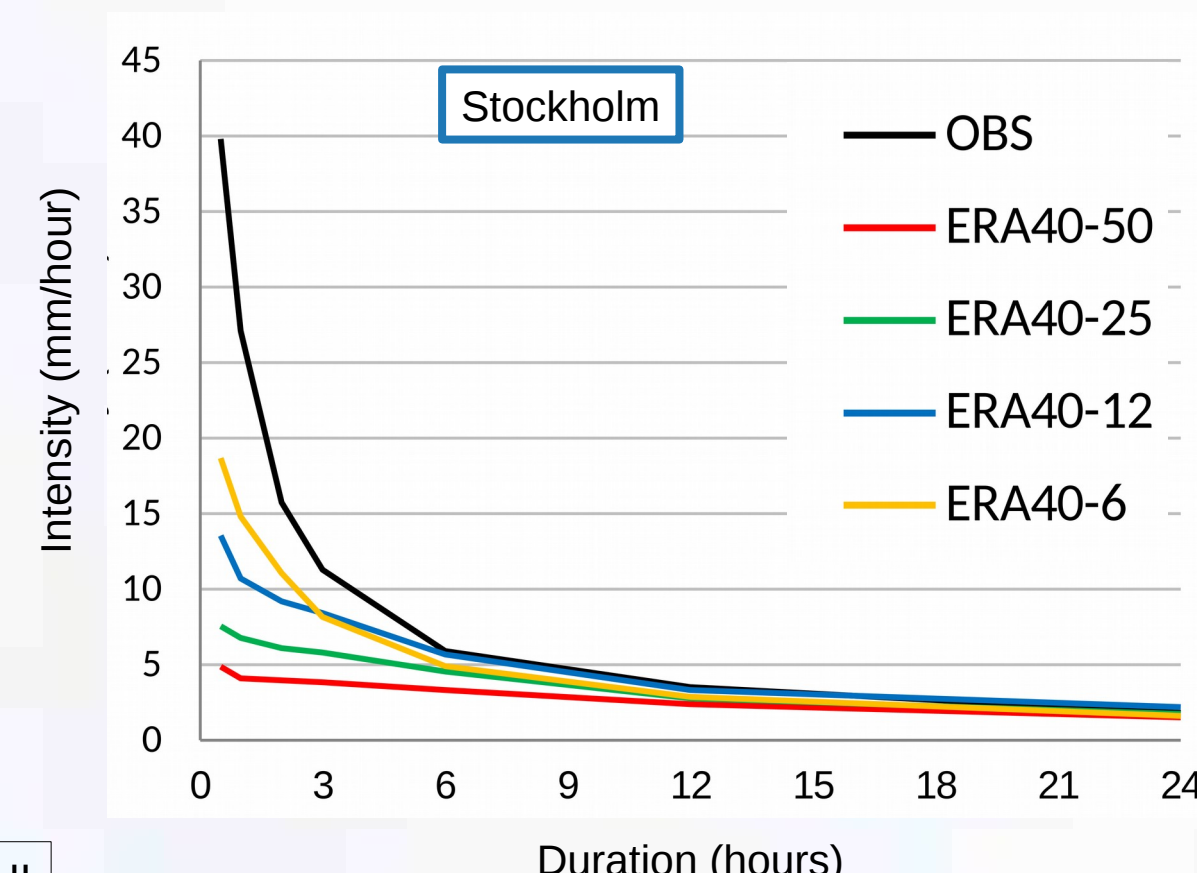
Distribution of precipitation at 2 km (green), model cycle 37 in 6 km (orange) and model cycle 38 in 6 km (blue)

Intensity and duration of precipitation



1995-2010

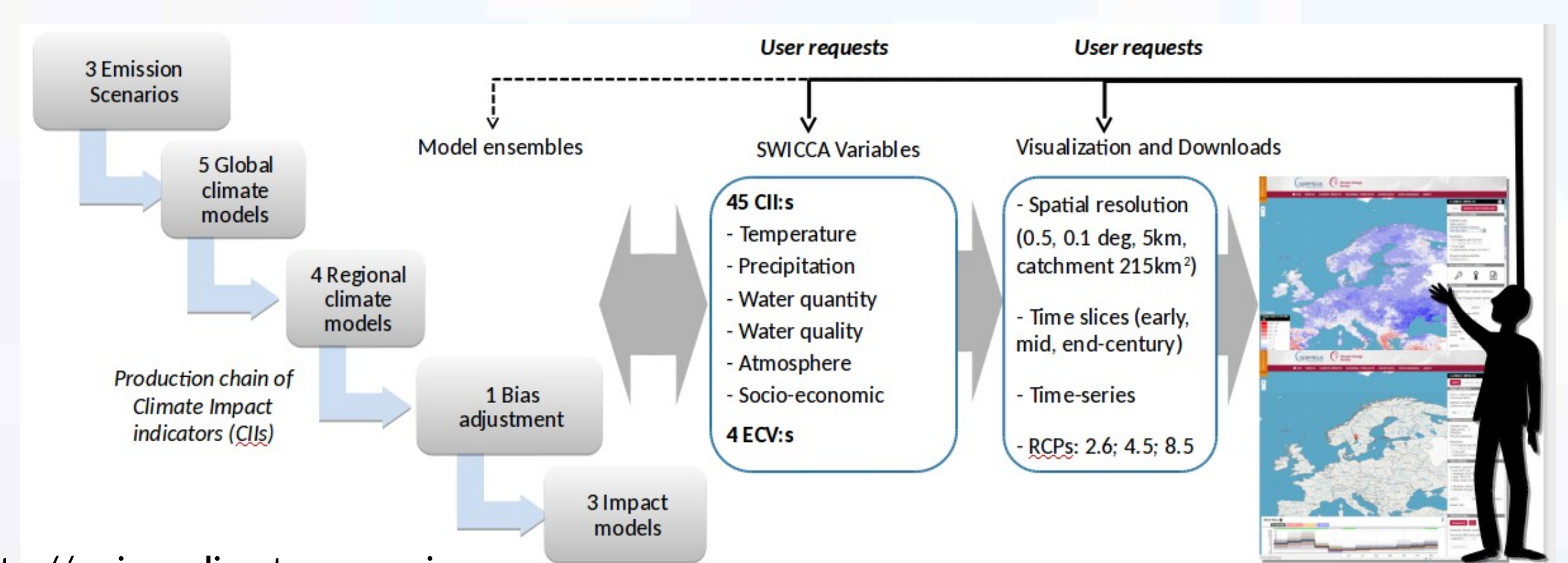
Jonas Olsson, SMHI



RCM data: - 30-min precipitation from RCA model with ERA40 boundary - resolutions 50, 25, 12.5, 6.25 km - 3x3 grid boxes

Climate Services

Demands for local climate information in support of climate impact assessments and the development of regional to local-scale adaptation strategies has grown quickly. In particular, interest is high for small-scale extreme events such as local floods connected to heavy precipitation. Regional signals can only be captured by climate models with high (10-25 km) or very high (1-10 km) spatial resolutions. "Convection-permitting" resolutions of 3 km and finer are required when events involve deep convection, or feel the impact of local complex or steep topography. The value of downscaling for impact applications generally increases with resolution. Global climate models are developed towards higher resolution but will not be able to provide operational km-scale resolution for decades.



<http://swicca.climate.copernicus.eu>

From emission scenario to climate services: SWICCA, a proof-of-concept web service under Copernicus Climate Change Services for adaptation of water management