

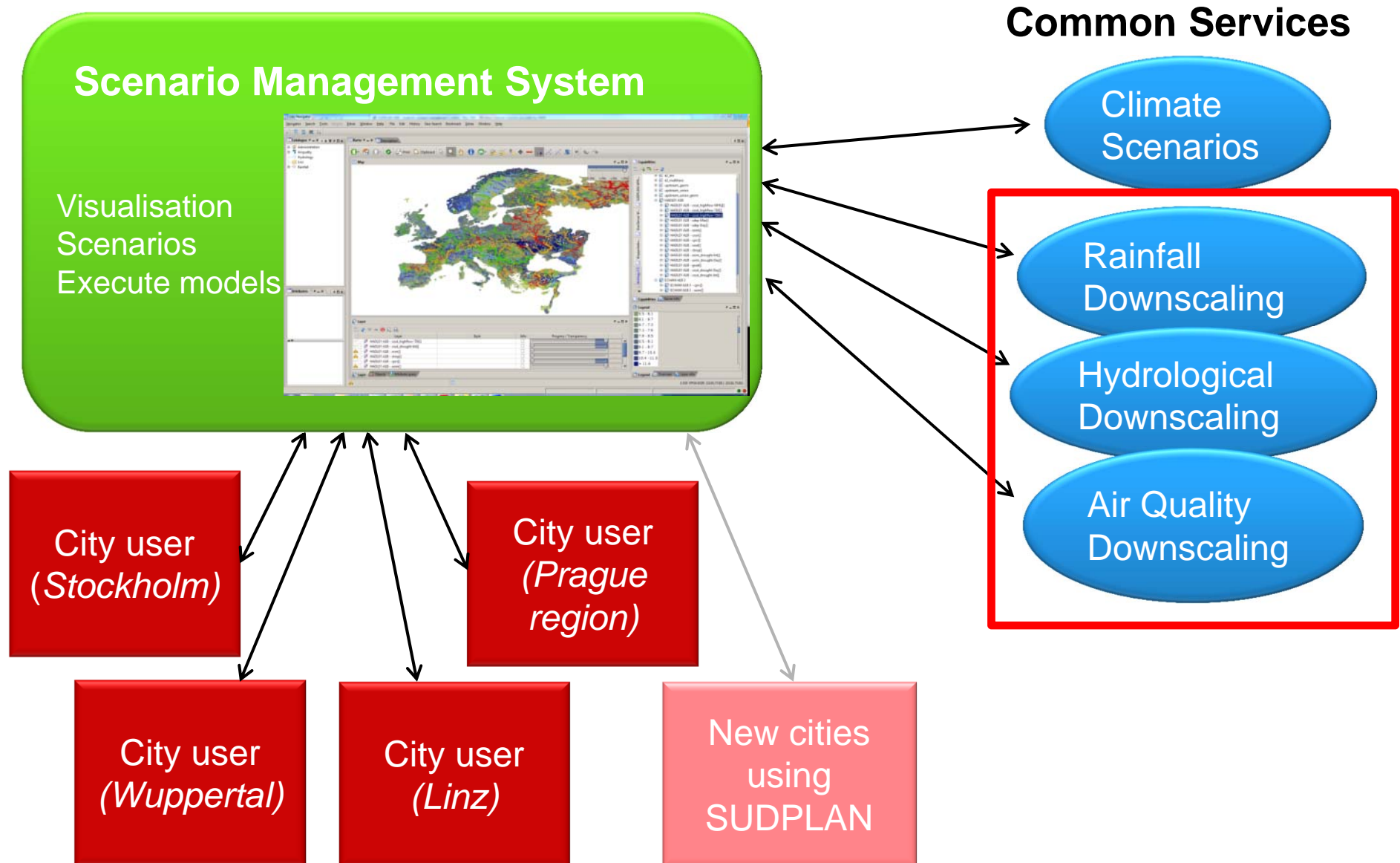
Environmental models used in Common Services



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SUDPLAN system overview

SUDPLAN

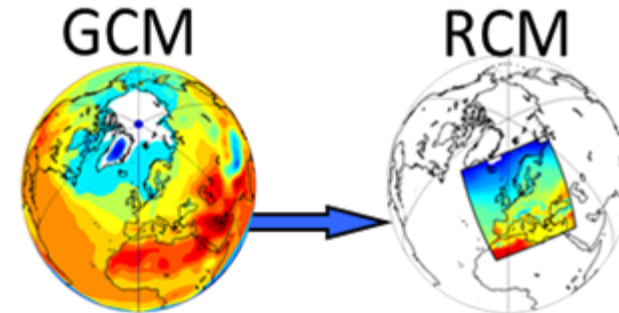


Local downscaling

- Based on meteorological variables as simulated in Regional Climate Model (RCM) scenarios for present and future climate in Europe:

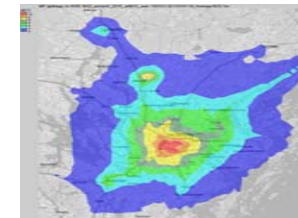
(*Global Climate Model GCM*, *IPCC Emission Scenario*)

- ECHAM5 (DE), A1B (middle)
- ECHAM5 (DE), A2 (high)
- HADCM3 (UK), A1B (middle)
- CCSM3 (US), A1B (middle)
- CNRM (FR), A1B (middle)



- Common Services: further downscaling by statistical and dynamical modelling to estimate the local impacts on environmental processes

- Short-term rainfall (high intensities)
- Hydrology (discharge, soil moisture, etc.)
- Air quality (chemical substances)



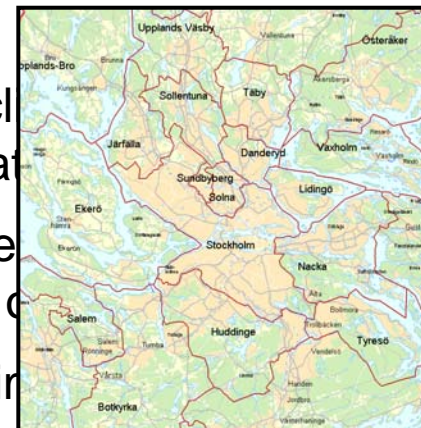
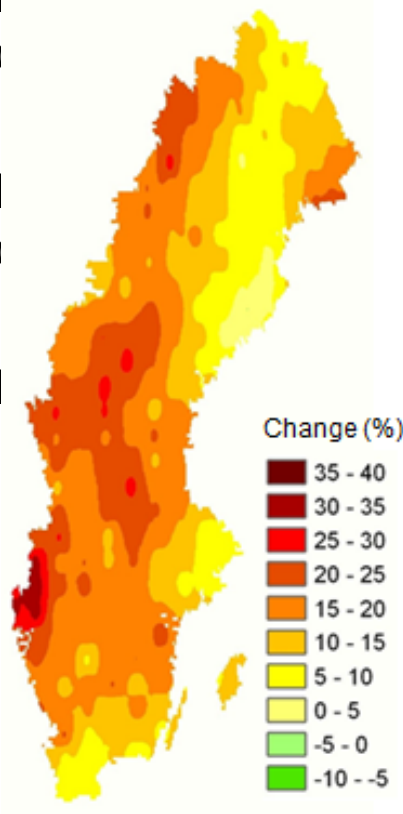
- Local data (rainfall, discharge, emissions) is used to assure that the downscaled results represent the local processes at the proper temporal and spatial scales

- Background: climate change is expected to intensify short-term rainfall → increased risk of urban flooding and sewer overflow

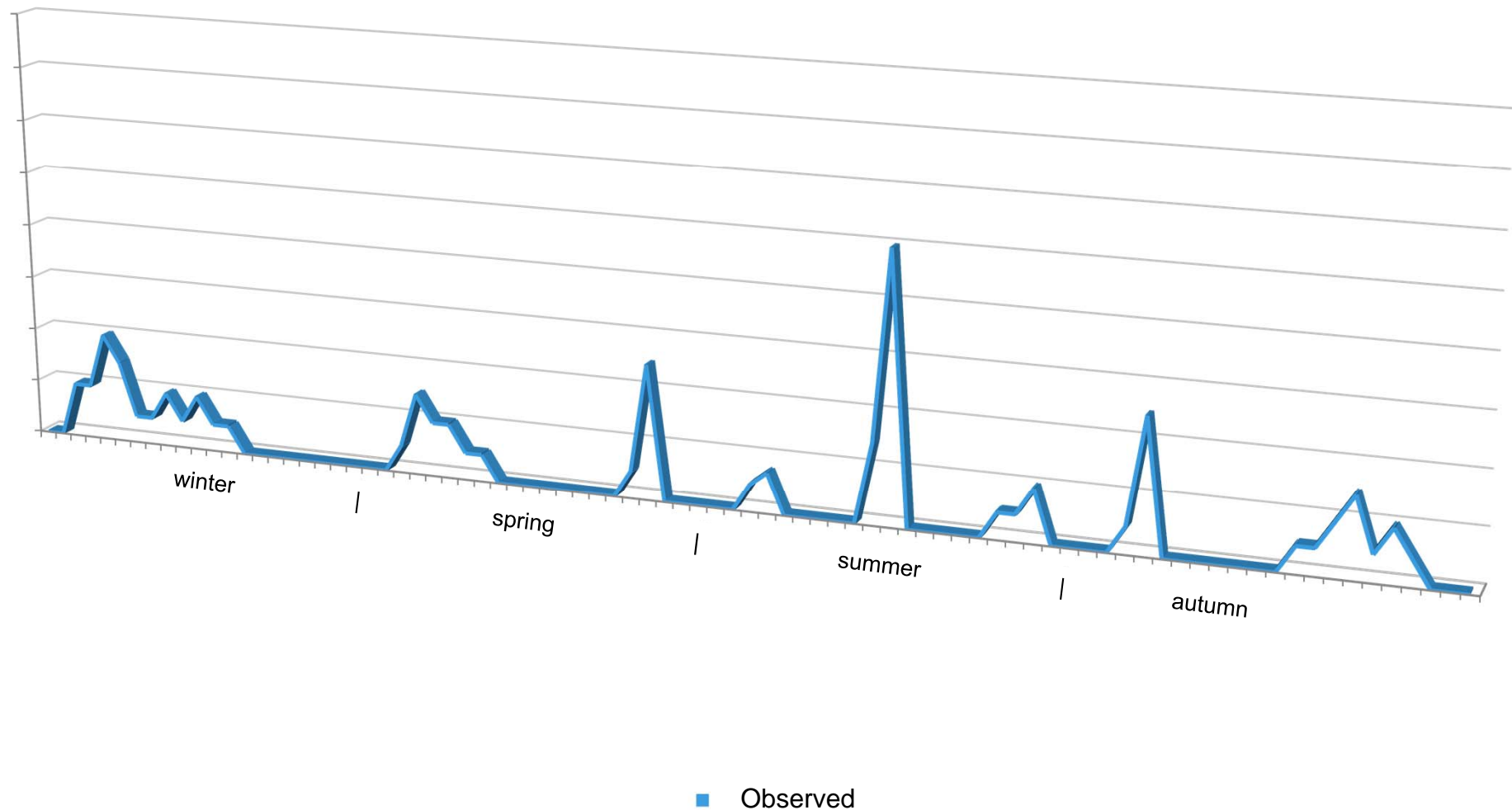
- 30-min rainfall by 2050 assessment and design of adaptive measures, input logic and hydraulic models are needed

- and climate model results are on fundamentally downscaling is required

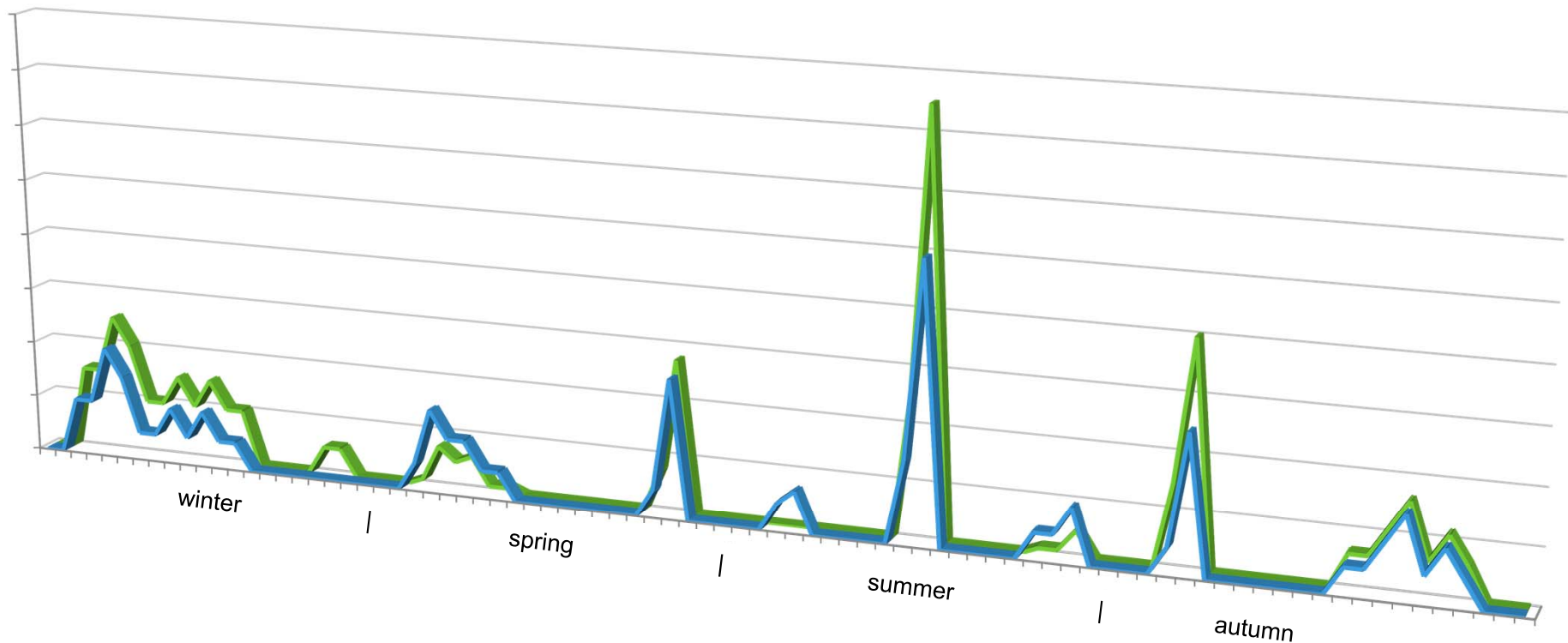
- Change (DC): changes at climate changes at temperature change the change of continuous time forms



Historical time series, uploaded by the user



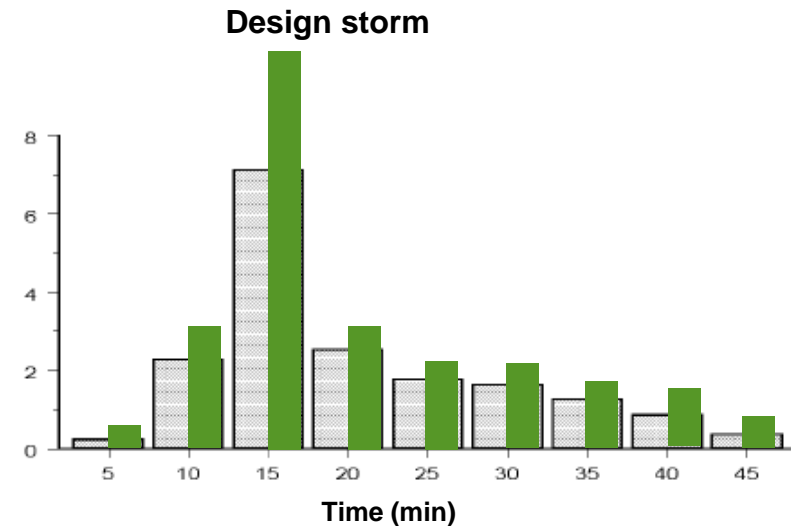
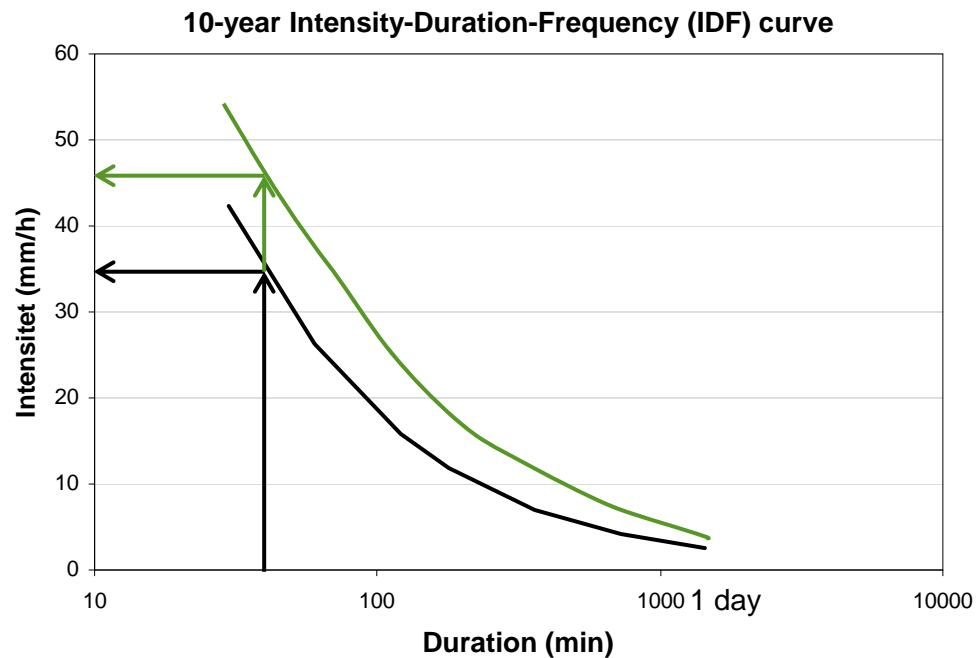
Downscaling by statistical analysis of short-term rainfall in climate scenario



Changes related to *season*, *intensity* and *frequency* are taken into account

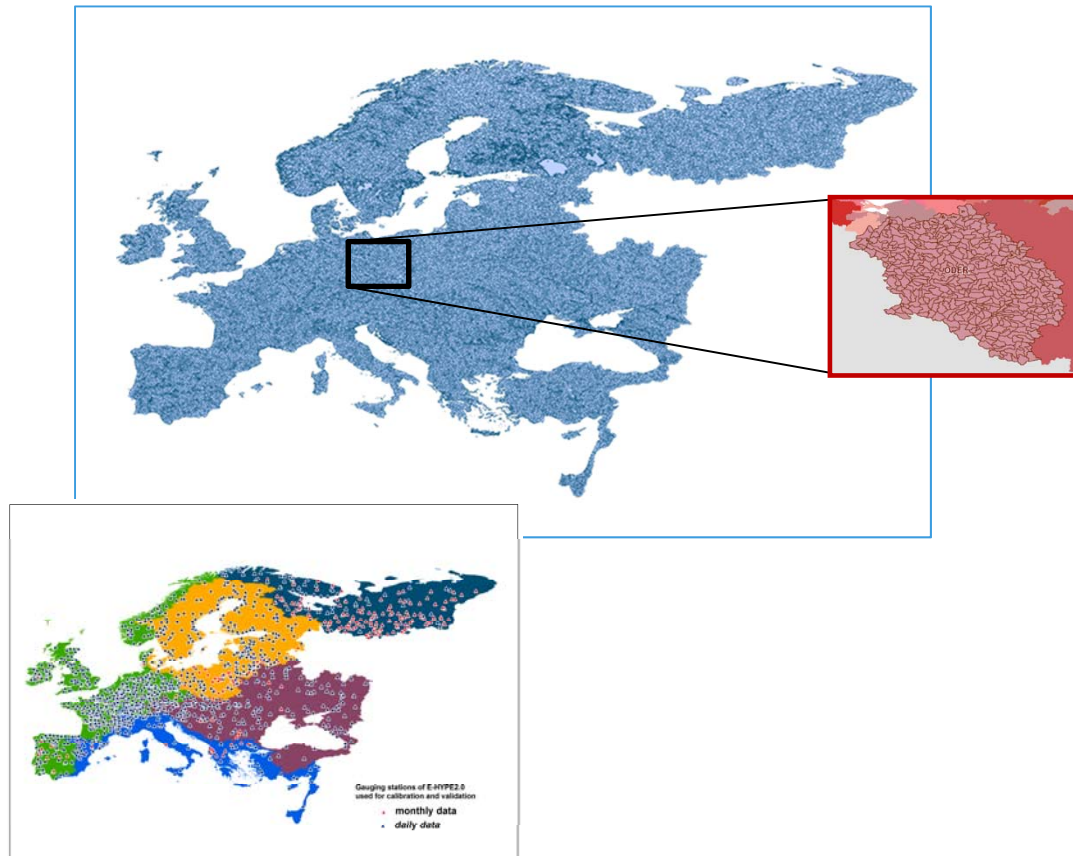
■ Observed ■ Downscaled

Downscaling by extreme value analysis of short-term rainfall in climate scenario



Downscaled time series, IDF-curves and design storms are input to urban hydrological modelling and analysis

Pan European hydrological model

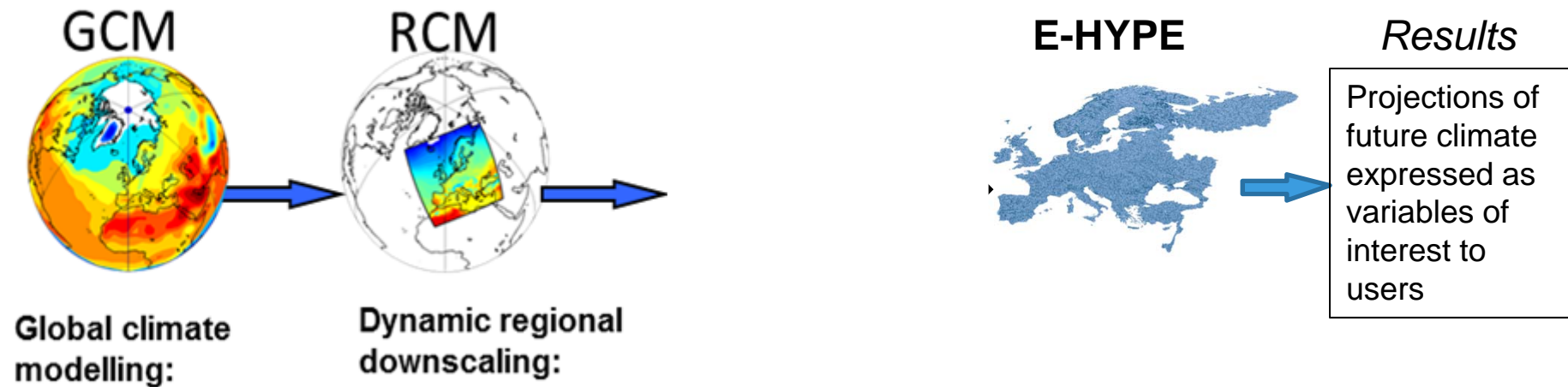


- 35000 subbasins
- Median size 215 km²
- Delivers discharge (Q) and water quality (WQ)
- Used in many FP7 projects
- Used for hindcasting, operational forecasting and future climate predictions
- Under constant development

>1000 stations for calibration/validation

- Selected from GRDC, EWA and Baltex
- Allows for validation of catchment sizes from 200 km² to 800 000 km²

Making climate predictions with E-HYPE

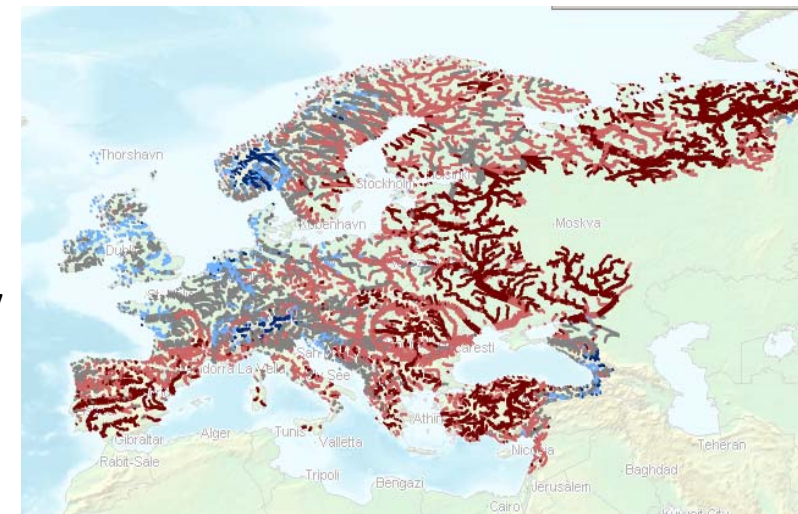
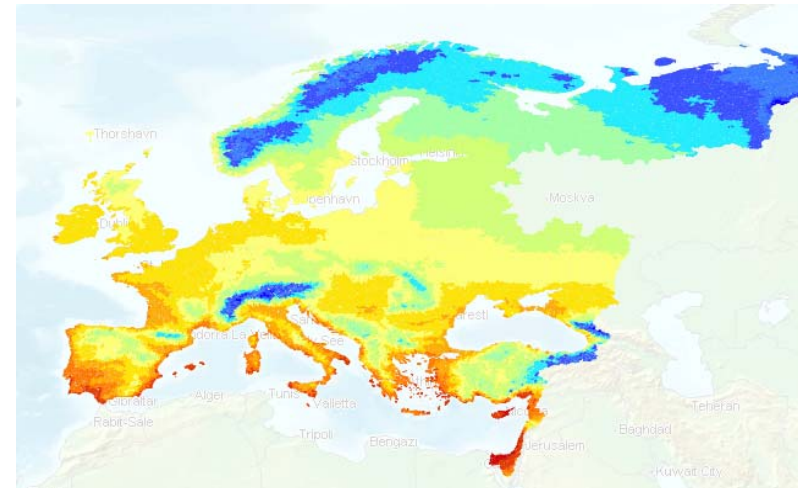


Yang et al. 2010, Hydrol. Res.

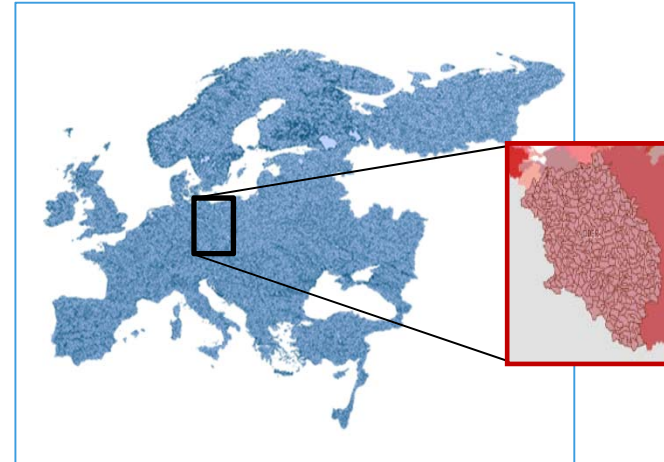


Pan-European climate predictions for:

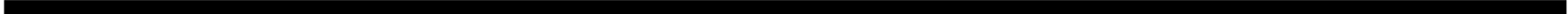
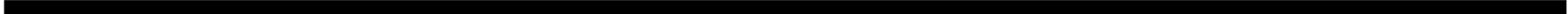
- DBS corrected temperature
- DBS corrected precipitation
- Mean Q
- Mean specific runoff
- Soil Moisture Deficit
- Relative groundwater level
- 1 in 10 year and 1 in 50 year Flow
- Mean High Flow
- Mean Low Flow
- Hydrological drought, nr of days and intensity
- Agricultural drought nr of days and intensity
- Snow days and snow depth max

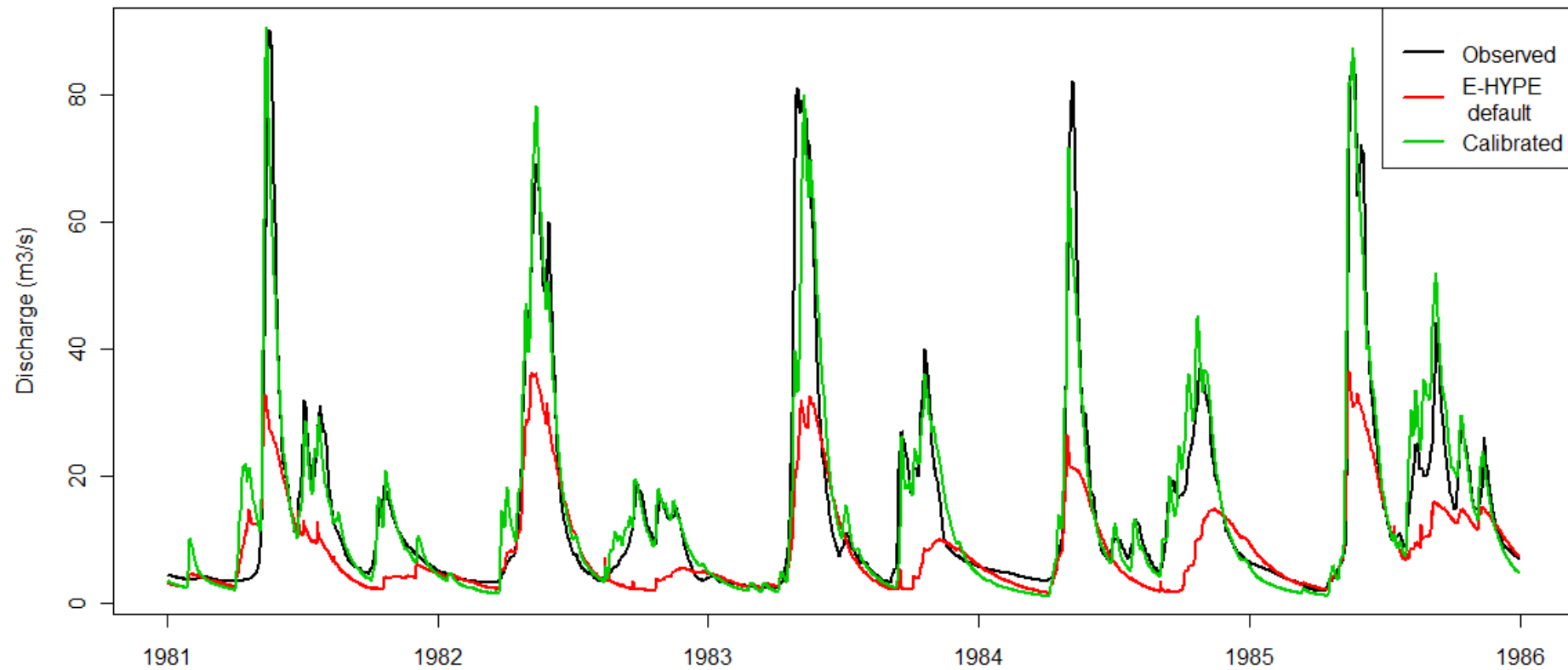


- E-Hype delivers high quality for catchments $> 5000 \text{ km}^2$
- Need: Local model optimized for a specific area of interest
- Benefit:
 - More trustworthy model for the area
 - Better results regarding e.g. climate change impact studies

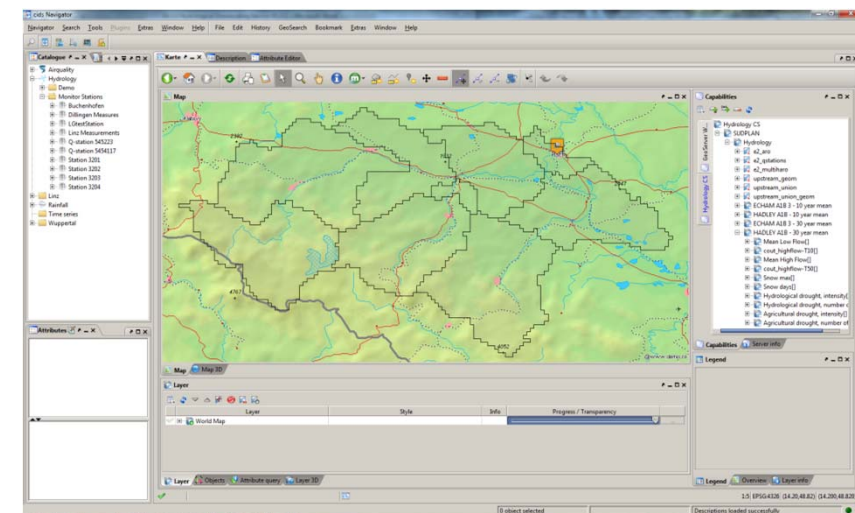
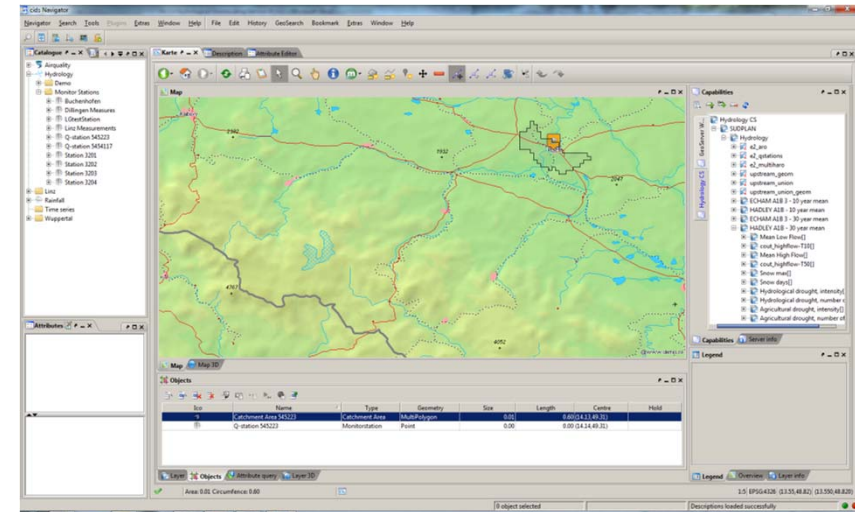


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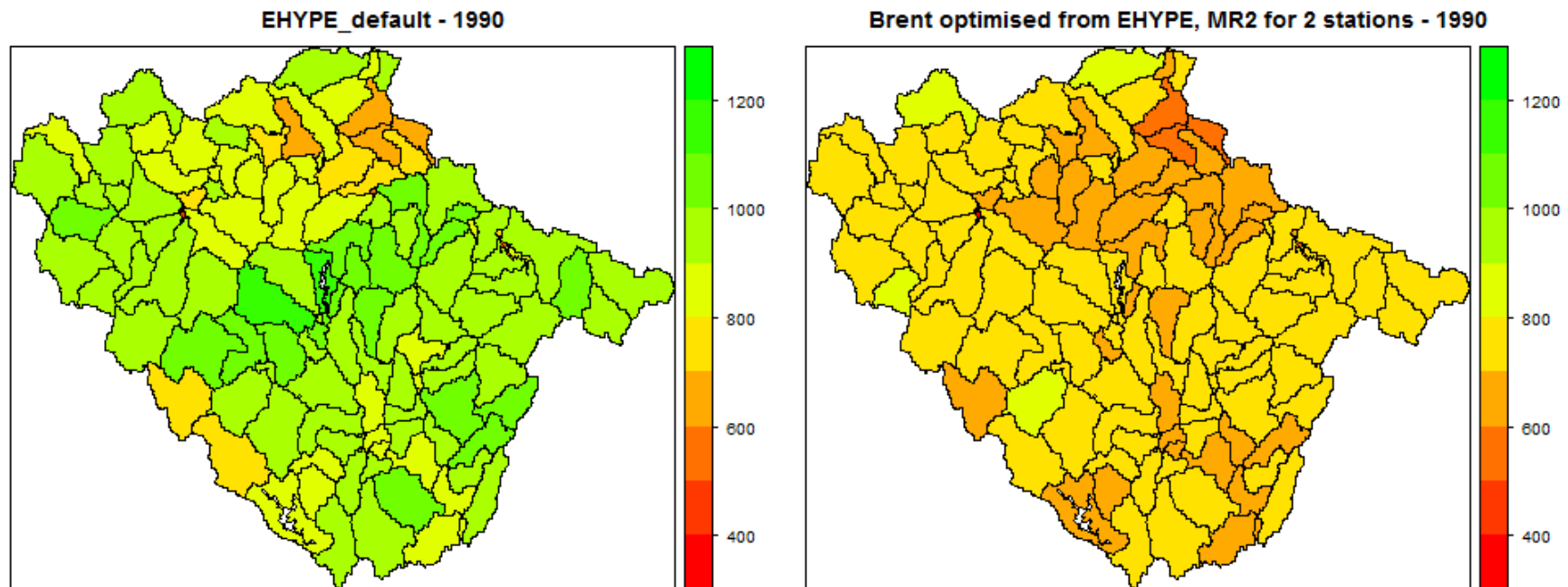




- Input: Local daily observations from Q-station.
- Create local model:
 - Select point of interest
 - Add observations
 - Calibrate
- Use the local model for climate predictions choosing
 - Scenario
 - Period



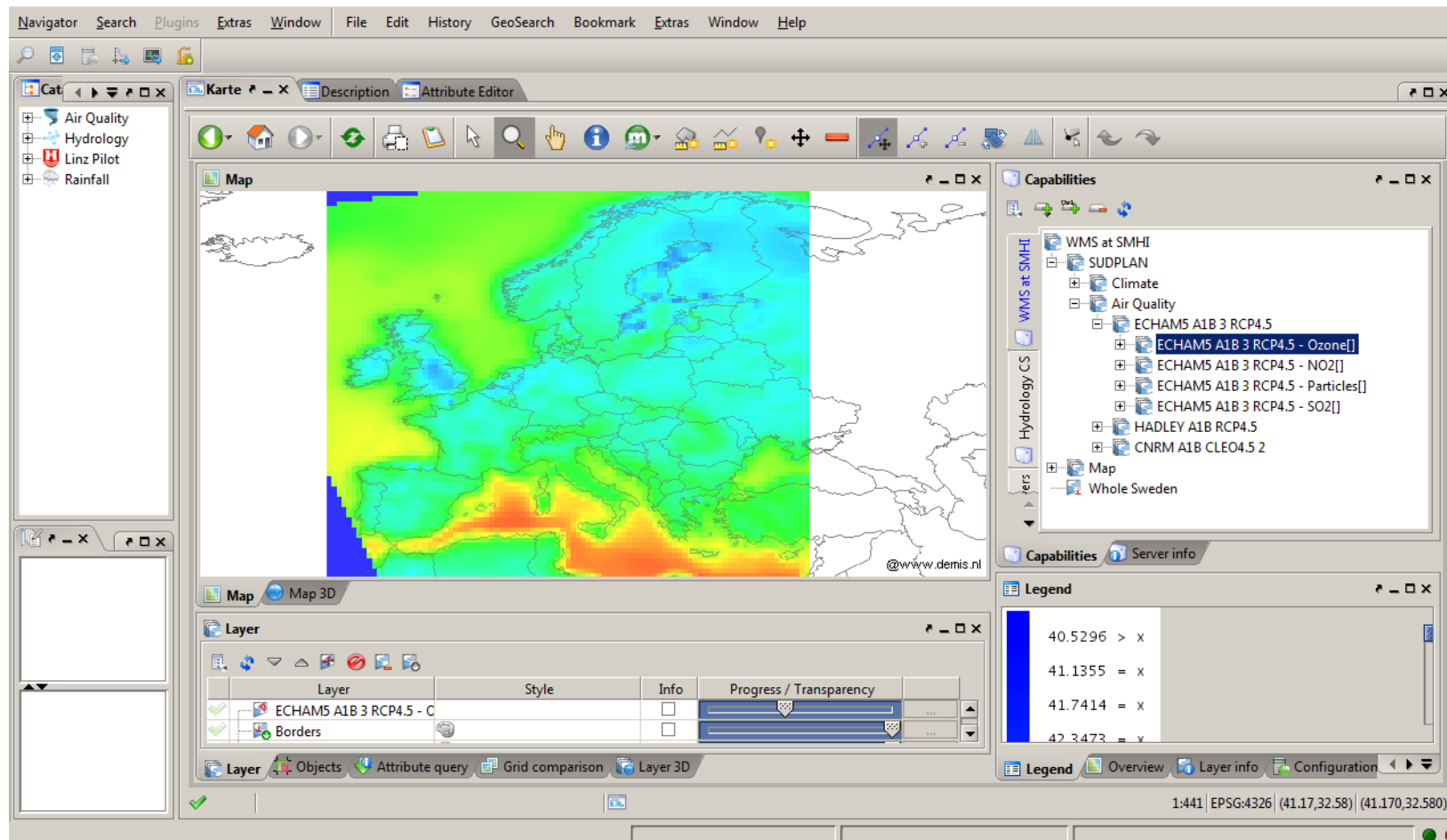
This matters for the results



Annual average soil moisture storage (mm)
Averaged for all classes, soil layers, and timesteps

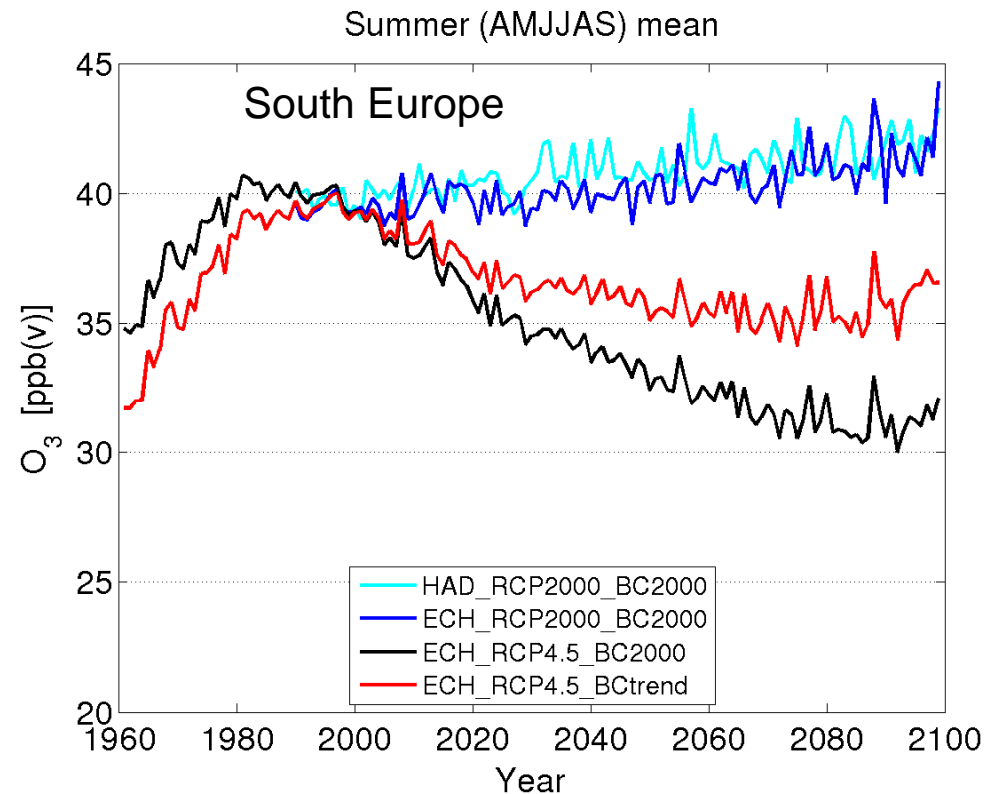
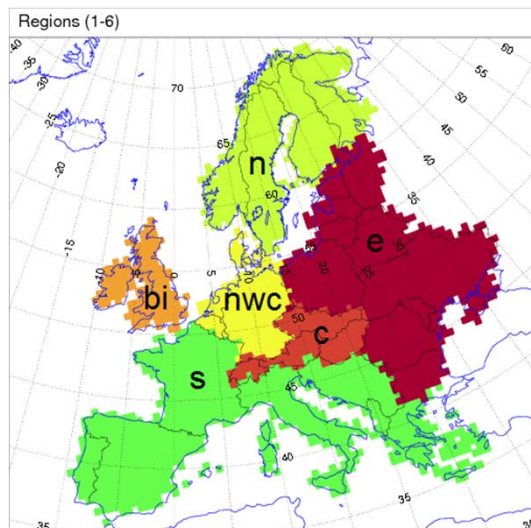
Complement to the pan-European air quality scenario information:

- 140 year simulations using meteorology from climate scenarios and air pollution emissions from RCP4.5
- Presently 3 scenarios available: ECHAM5_A1B, HADLEY A1B and CNRM A1B



Factors determining future pollution levels in Europe

- Climate change
 - higher temp → photochemistry
 - more rain → more deposition
- Emission changes
- Changes in hemispheric background concentrations

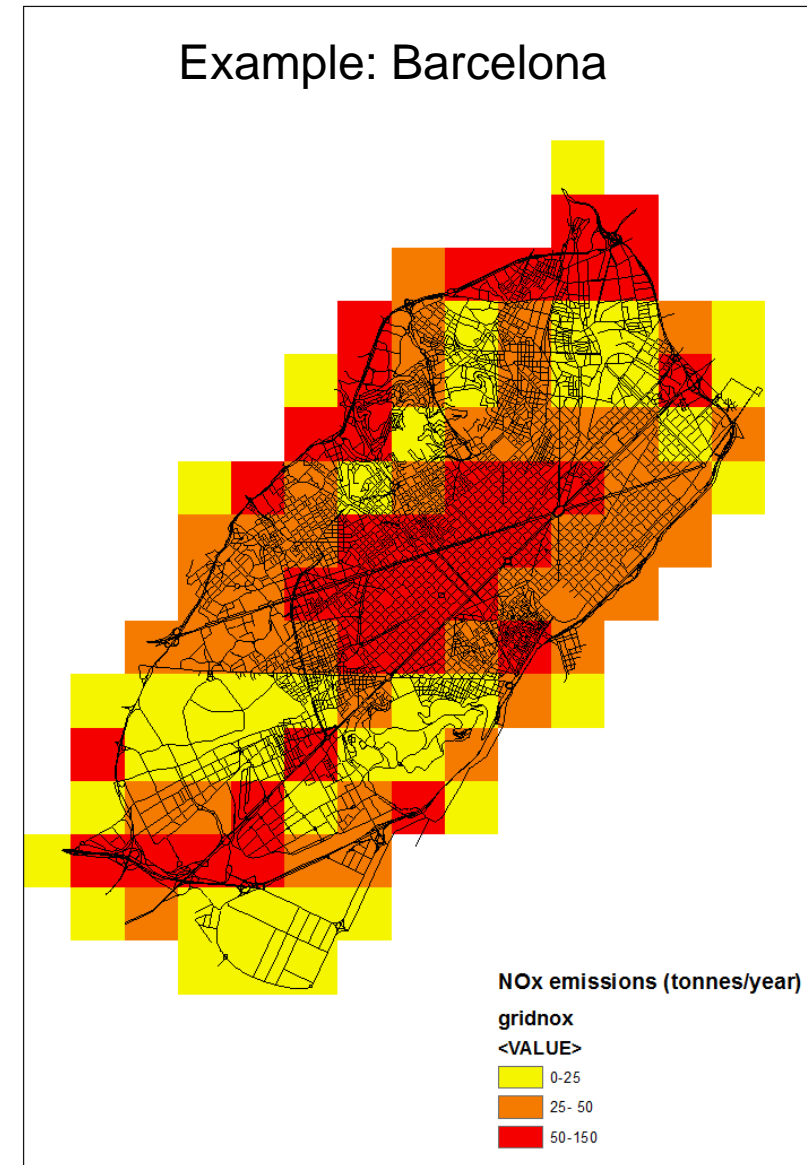


Air Quality urban downscaling: emission input required **SUDPLAN**

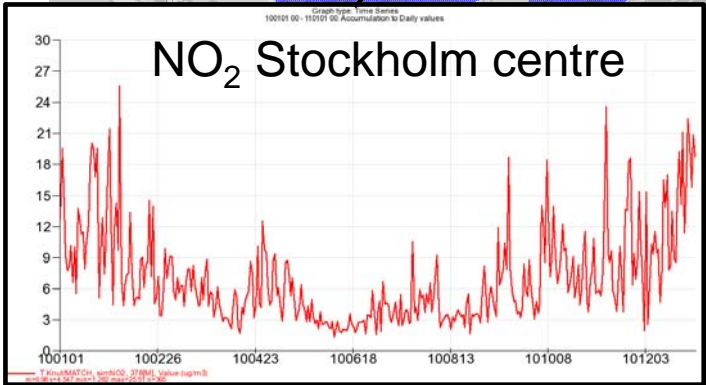
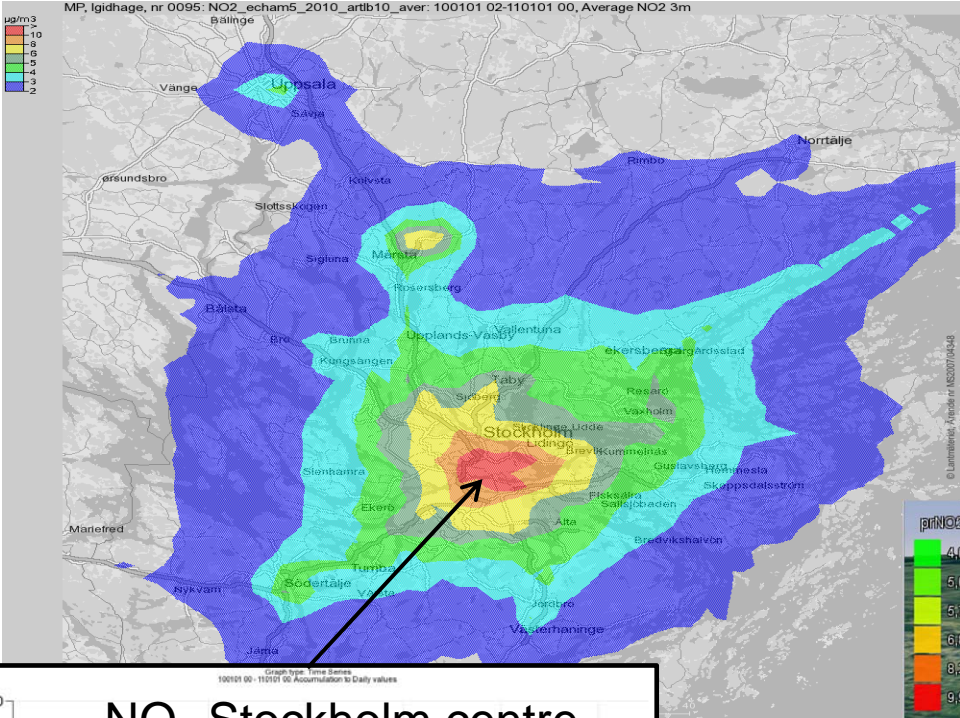
Gridded emissions (approx. 1x1 km², annual averages)

- NO_x
- VOC
- CO
- NH₃
- SO₂
- PM

Meteorological data and boundary concentrations available in SUDPLAN
–select when initiating the urban downscaling



1. *Journal of Management Studies*, 1997, 34, 1, 1-14.



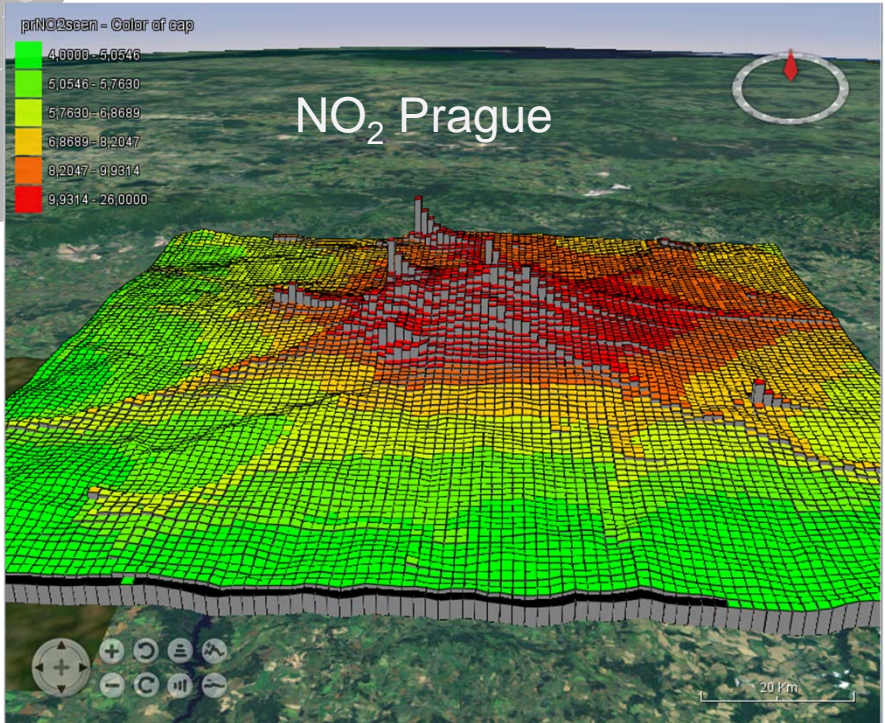
- NO_2 & NO_x

- O_3

- PM10

- SO_2

(hourly/daily/monthly/annual
grids at ground level)



- Assessment of local climate change impacts require further downscaling of results from Regional Climate Models
- In SUDPLAN, local downscaling is achieved by statistical and dynamical modelling governed by local observations
- Three Common Services are available for all European cities
 - Rainfall
 - Hydrology
 - Air quality
- The services have been applied and evaluated in four SUDPLAN pilots