

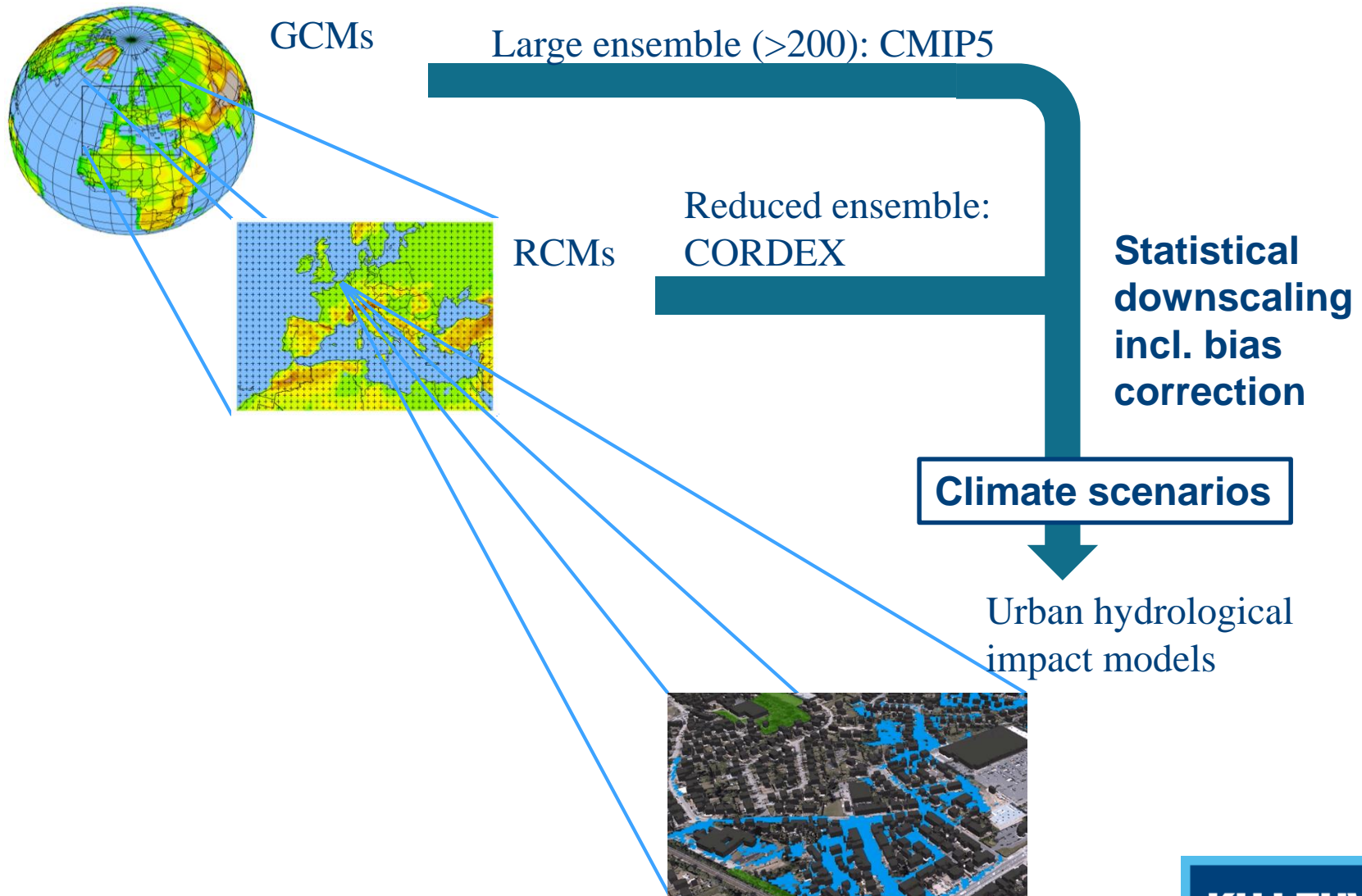


Climate change scenarios for hydrological impact analysis (floods, droughts)

*Parisa Hosseinzadehtalaei, Hossein Tabari,
Els Van Uytven, Patrick Willems*

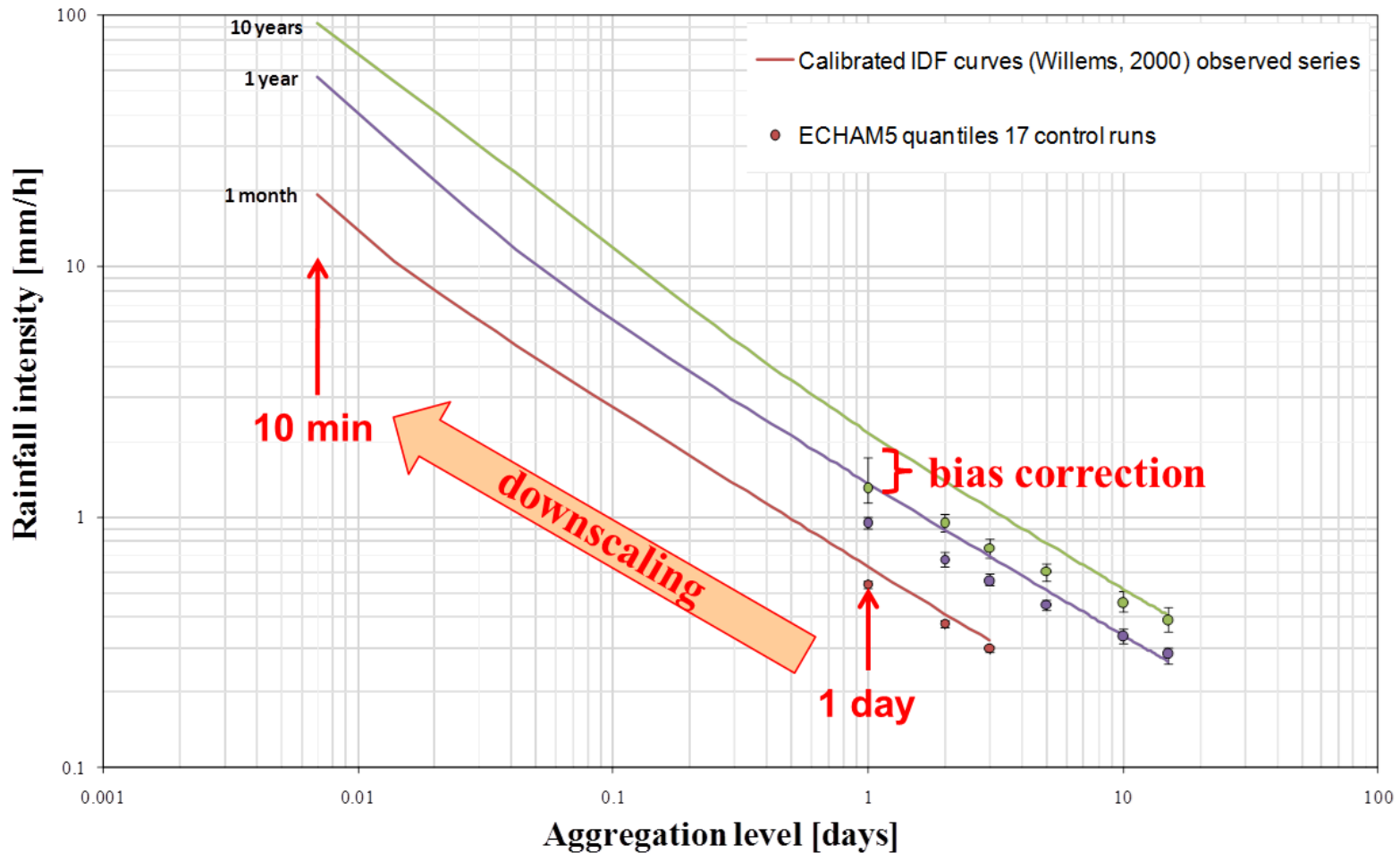
KU Leuven - Hydraulics Section

Climate change impact analysis

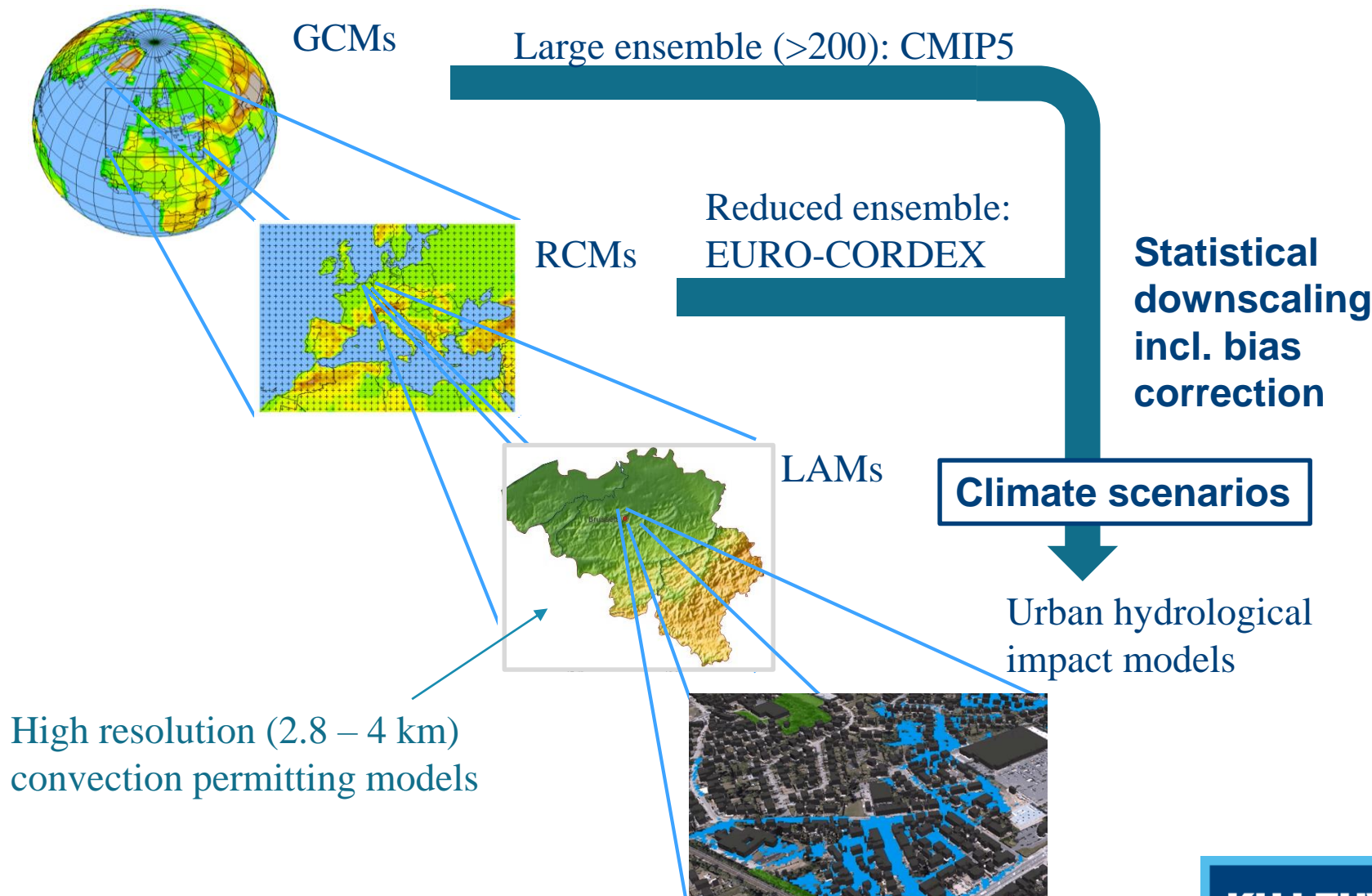


Coarse resolution climate models

-> need for downscaling + bias correction



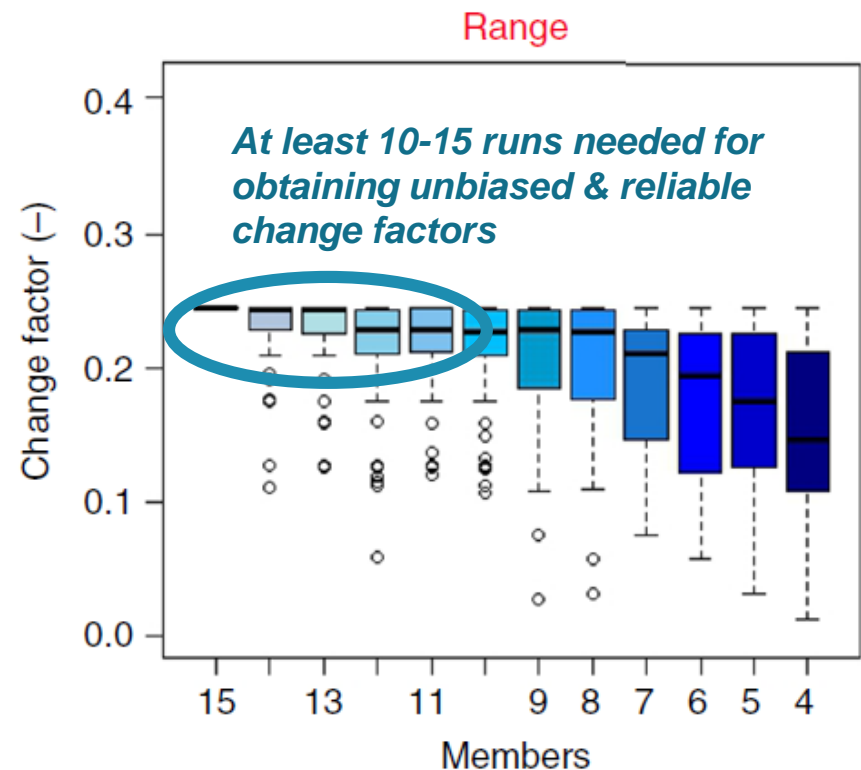
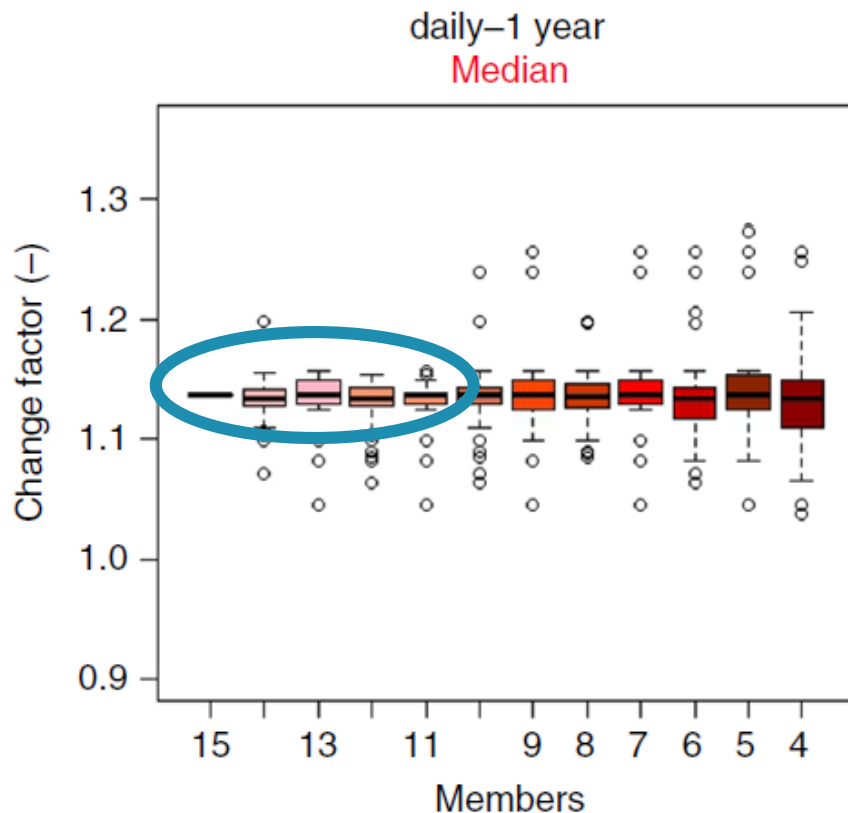
Thanks to CORDEX.be ...



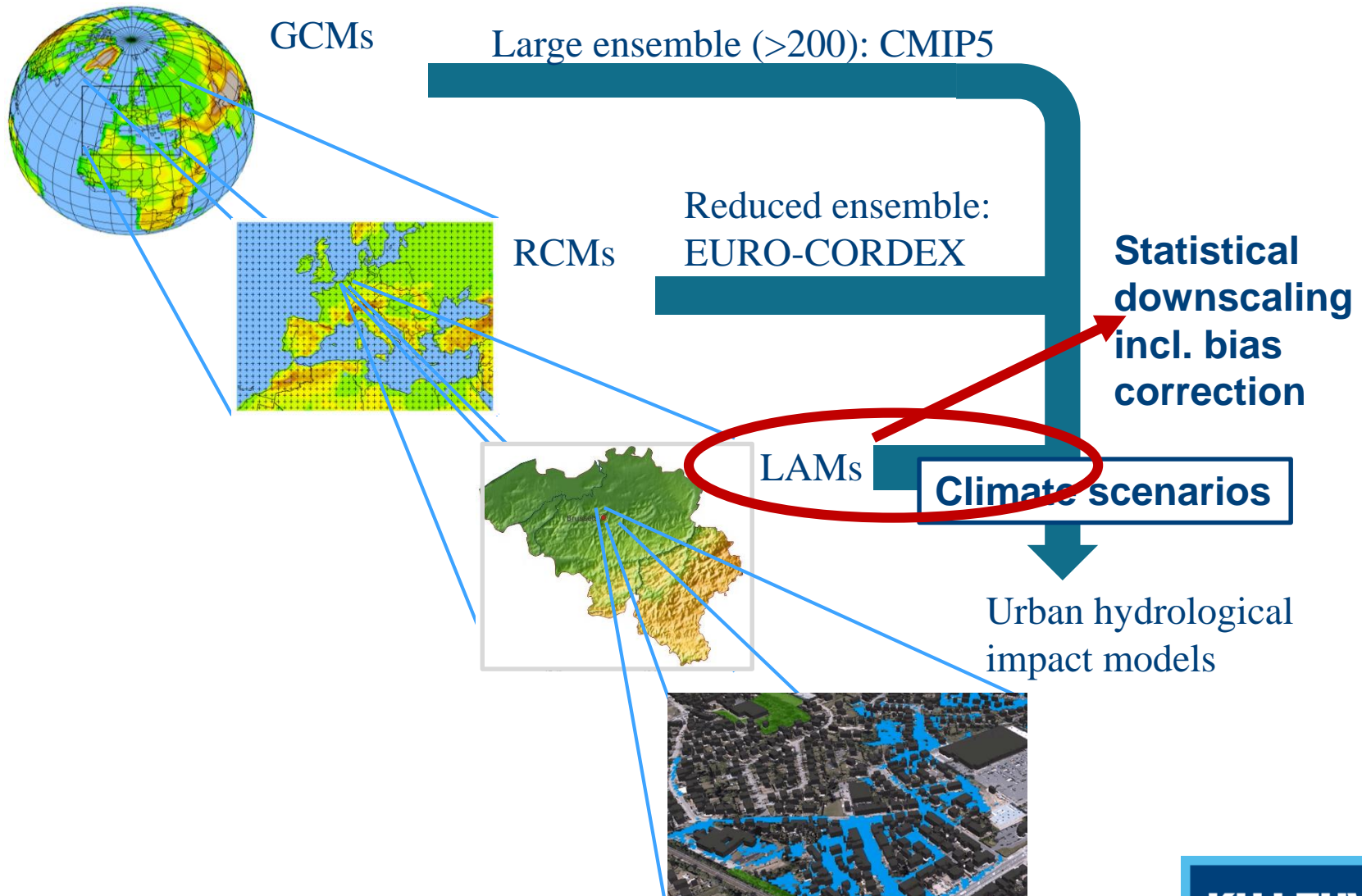
Changes in precipitation extremes

Influence of number of model runs?

Climate model based variance analysis for extreme precipitation:

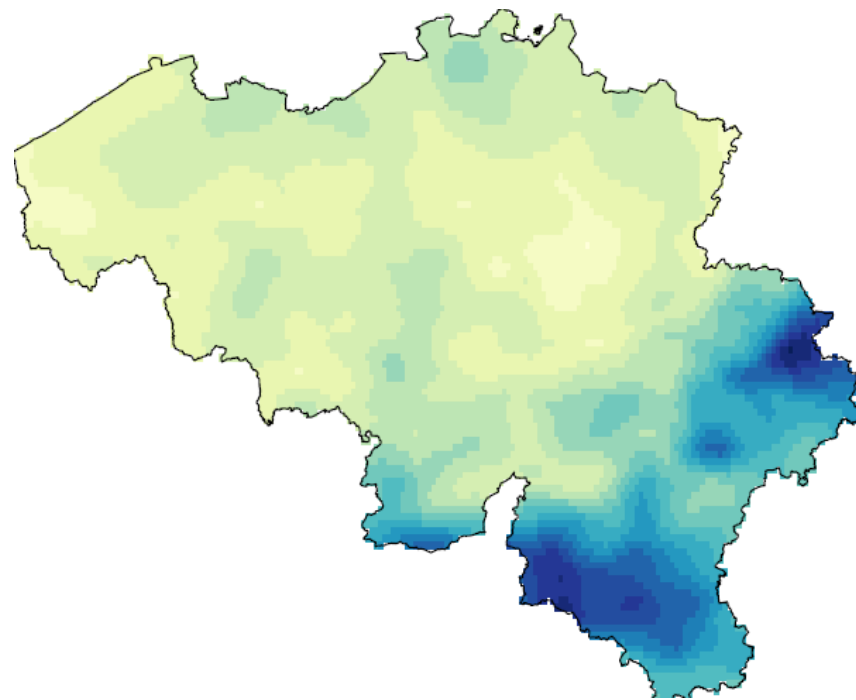
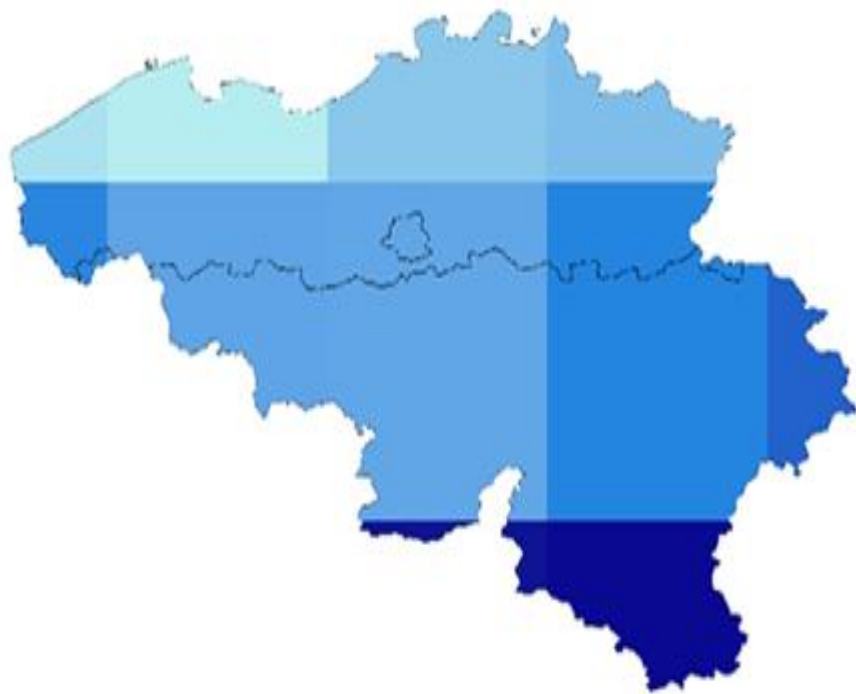


Climate scenarios



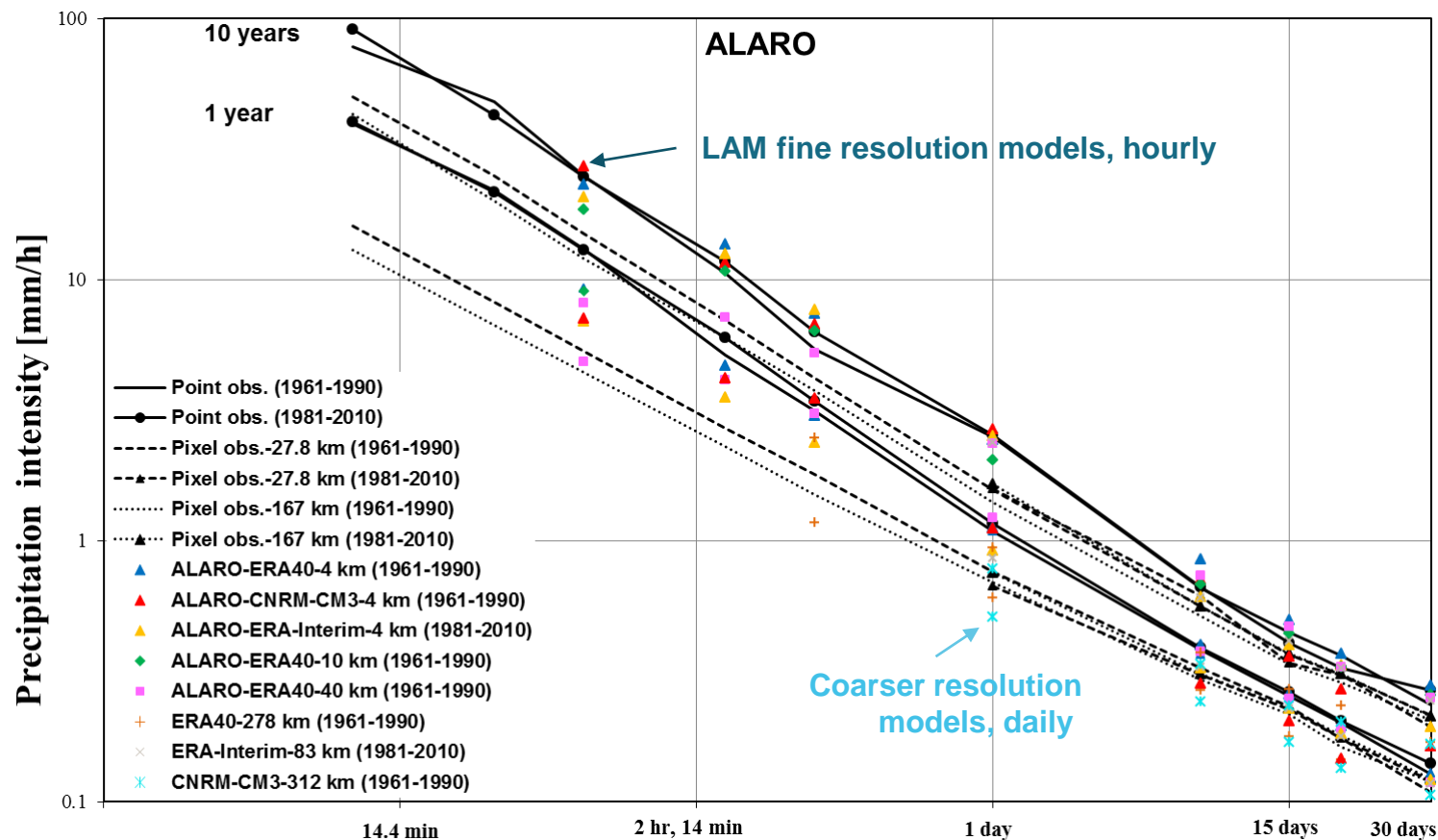
CORDEX.be runs

-> downscaling



CORDEX.be runs

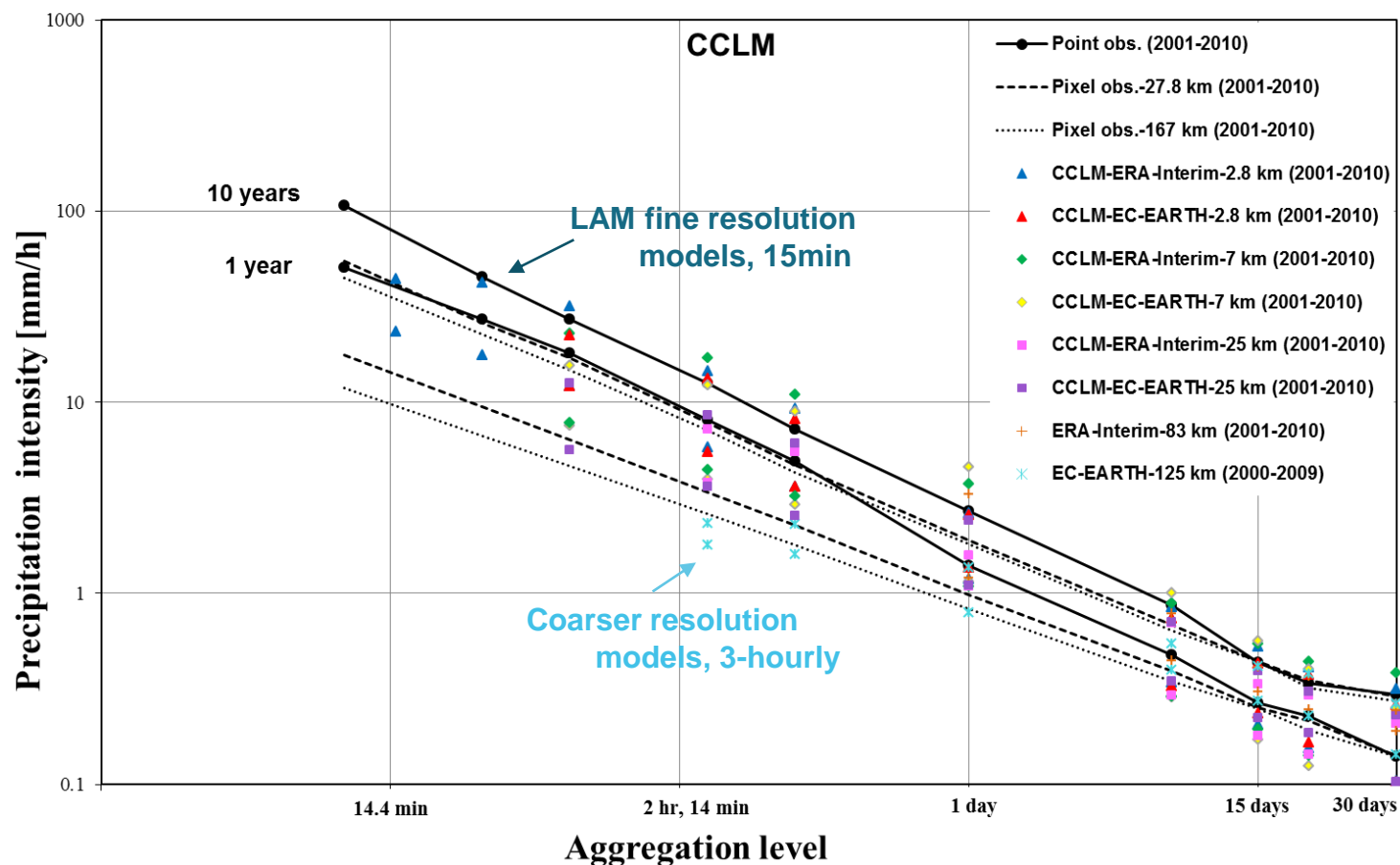
-> downscaling + lower bias for precipitation extremes



Tabari H, De Troch R, Giot O, Hamdi R, Termonia P, Saeed S, Brisson E, Van Lipzig N, Willems P (2016) Local impact analysis of climate change on precipitation extremes: are high-resolution climate models needed for realistic simulations? *Hydrology and Earth System Sciences* 20: 3843-3857

CORDEX.be runs

-> downscaling + lower bias for precipitation extremes

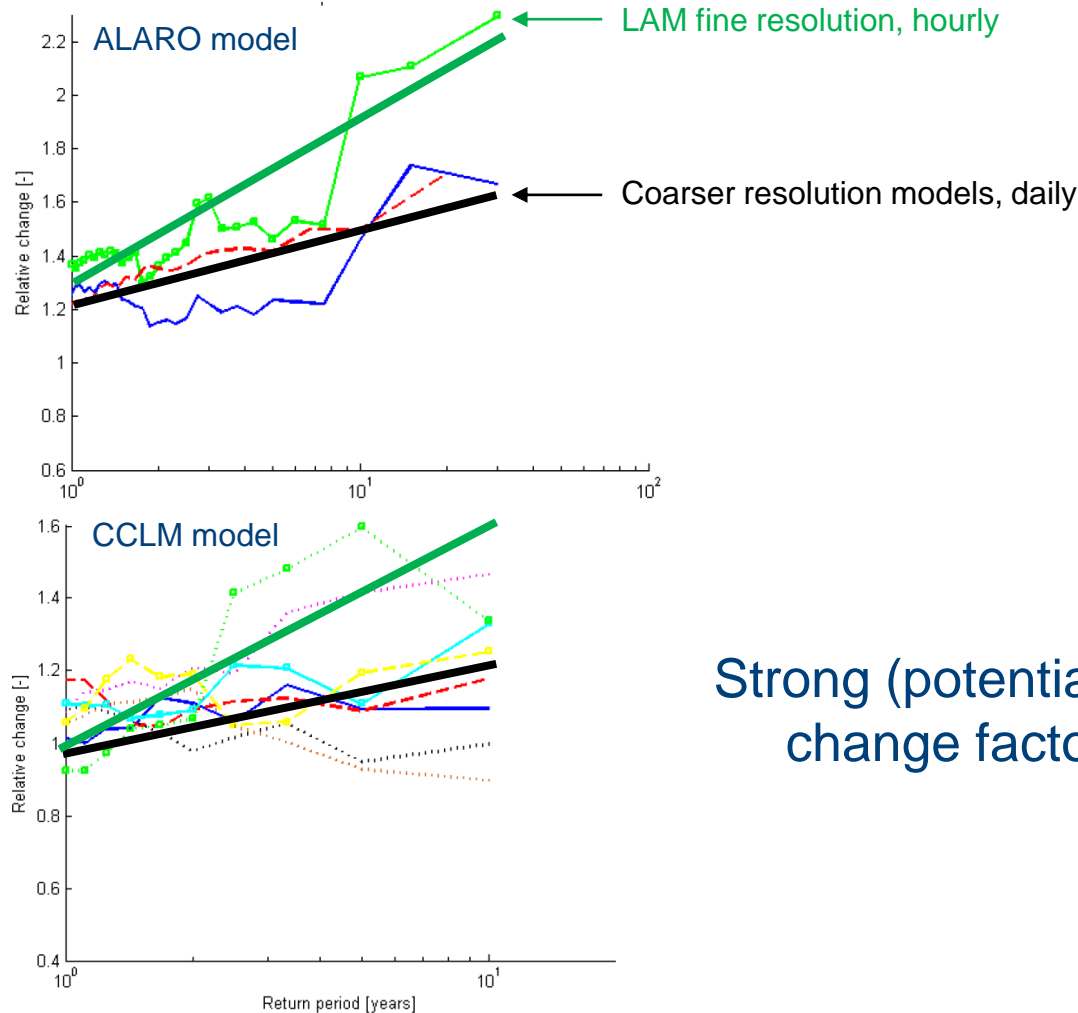


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Changes in precipitation extremes

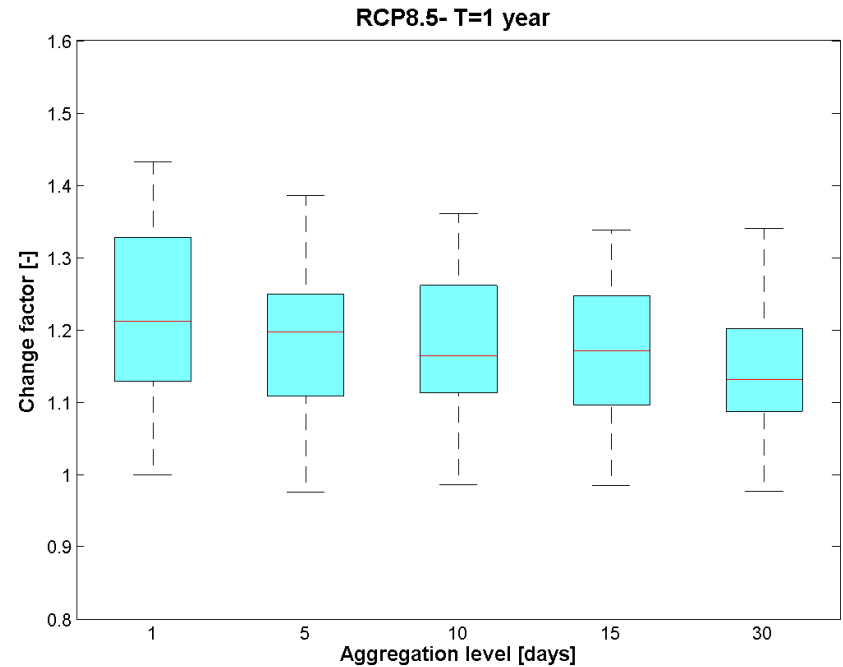
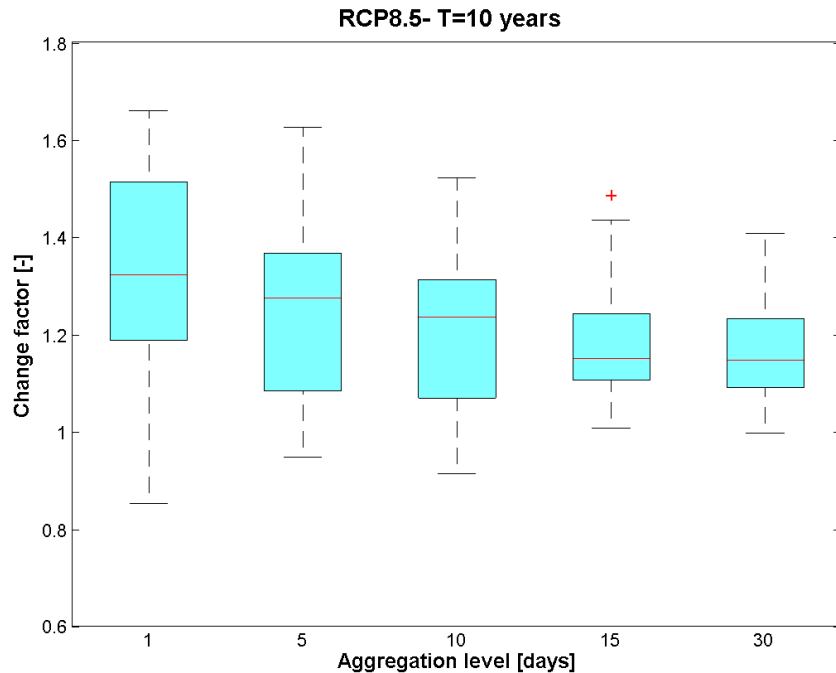
Relative changes till 2071-2100:



Strong (potential) dependency of climate change factor on time & spatial scale

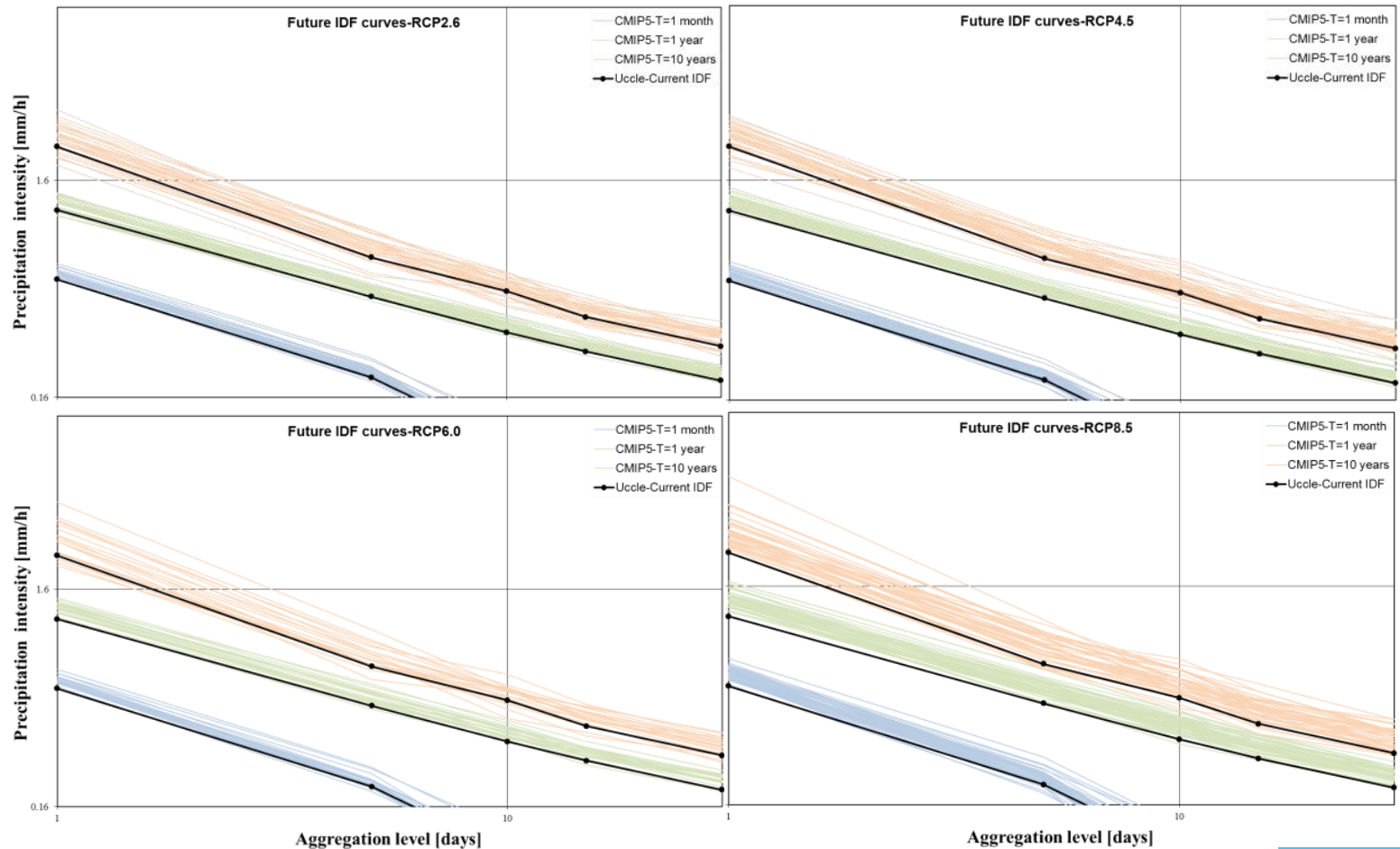
Changes in precipitation extremes

Higher changes for higher return periods & shorter durations:



Changes in precipitation extremes

Higher changes for higher greenhouse gas concentrations:



Conclusions

Because at least 10 to 15 different models should be considered for obtaining reliable climate change factors

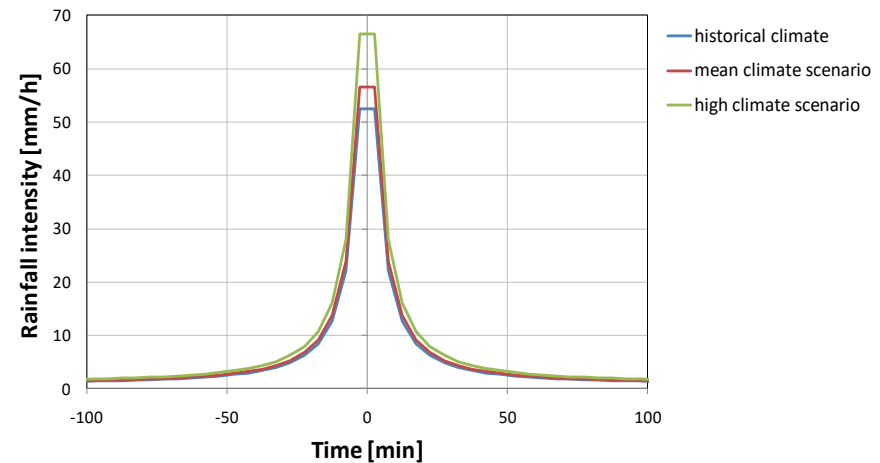
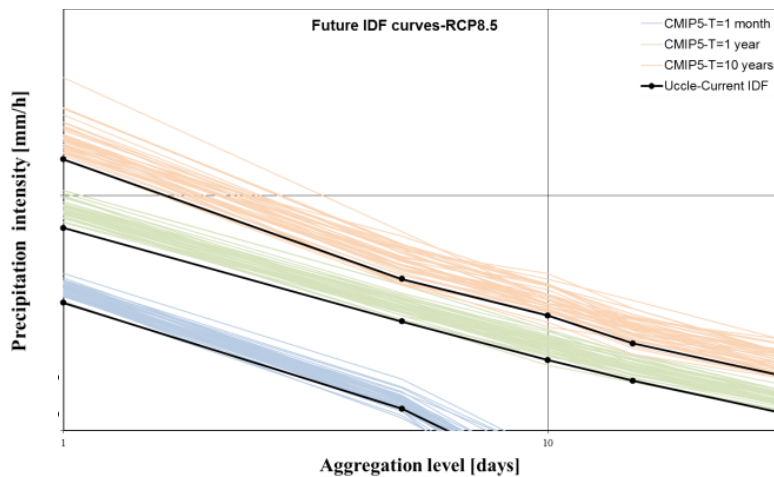
& no large ensemble of super resolution climate model runs available yet:

hydrological impact modellers have to rely on:

- **combining available climate change projections** from:
 - GCMs (large ensemble available; CMIP5)
 - RCMs (smaller ensemble available; EURO-CORDEX)
 - LAMs (few models and runs available; CORDEX.be)
- **to be further downscaled applying statistical methods**
- **where statistical downscaling assumptions have to be applied with caution and validated as much as possible**

Applications

- Changes in precipitation extremes -> Changes to design storms (design of urban drainage systems):

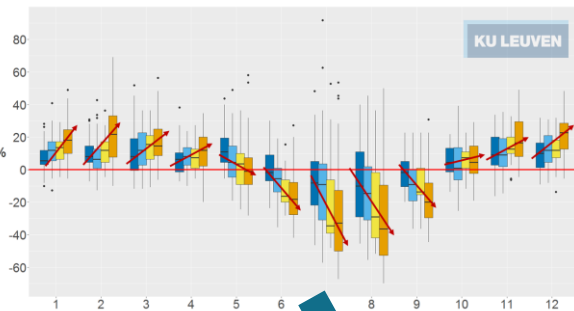


Applications

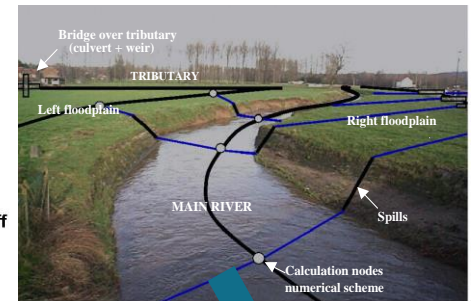
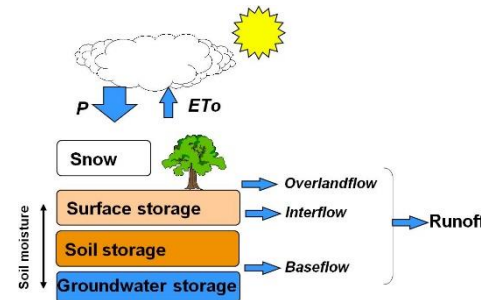
- Changes in precipitation, temperature, ETo statistics -> Perturbed historical time series (river catchment hydrological impact analysis: floods, droughts, ...):

Climatic change signals:

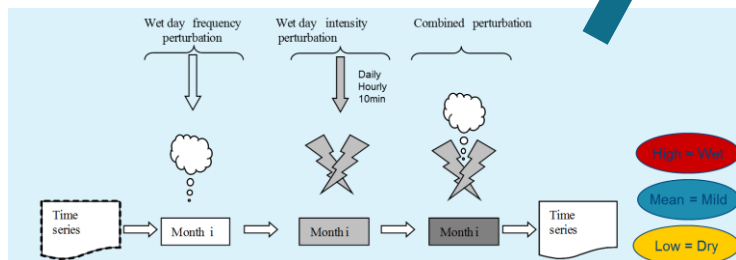
■ RCP 2.6 ■ RCP 4.5 ■ RCP 6.0 ■ RCP 8.5



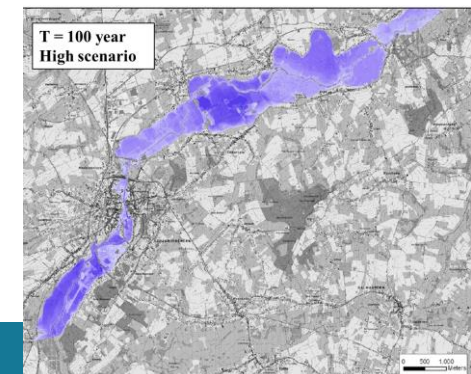
Hydrological & hydraulic impact models:



Climatic Perturbation Tool:



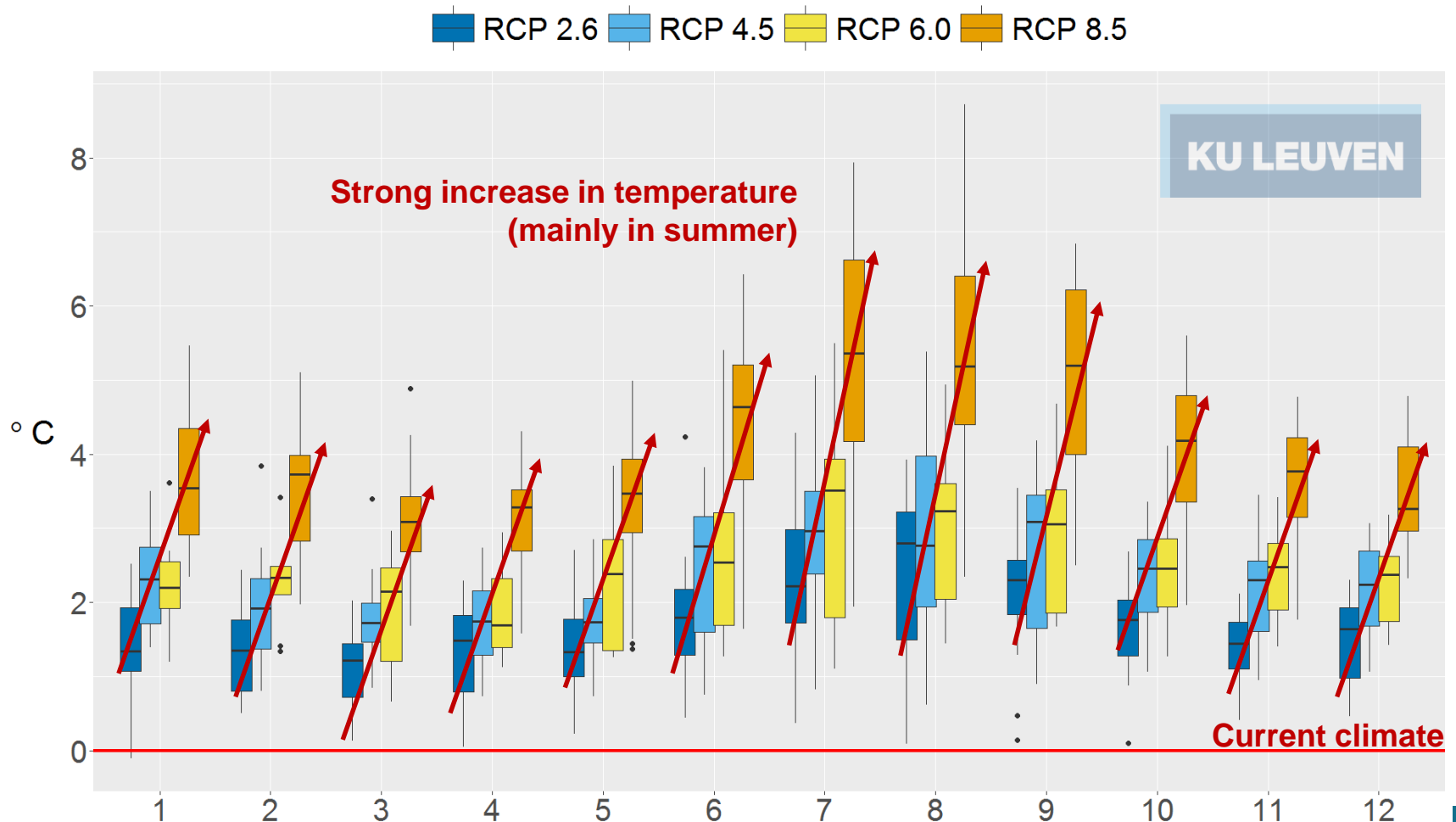
Impact results:



Climate scenarios

>200 GCMs CMIP5 (RCP based) for Uccle: change for 100 years (2000 -> 2100):

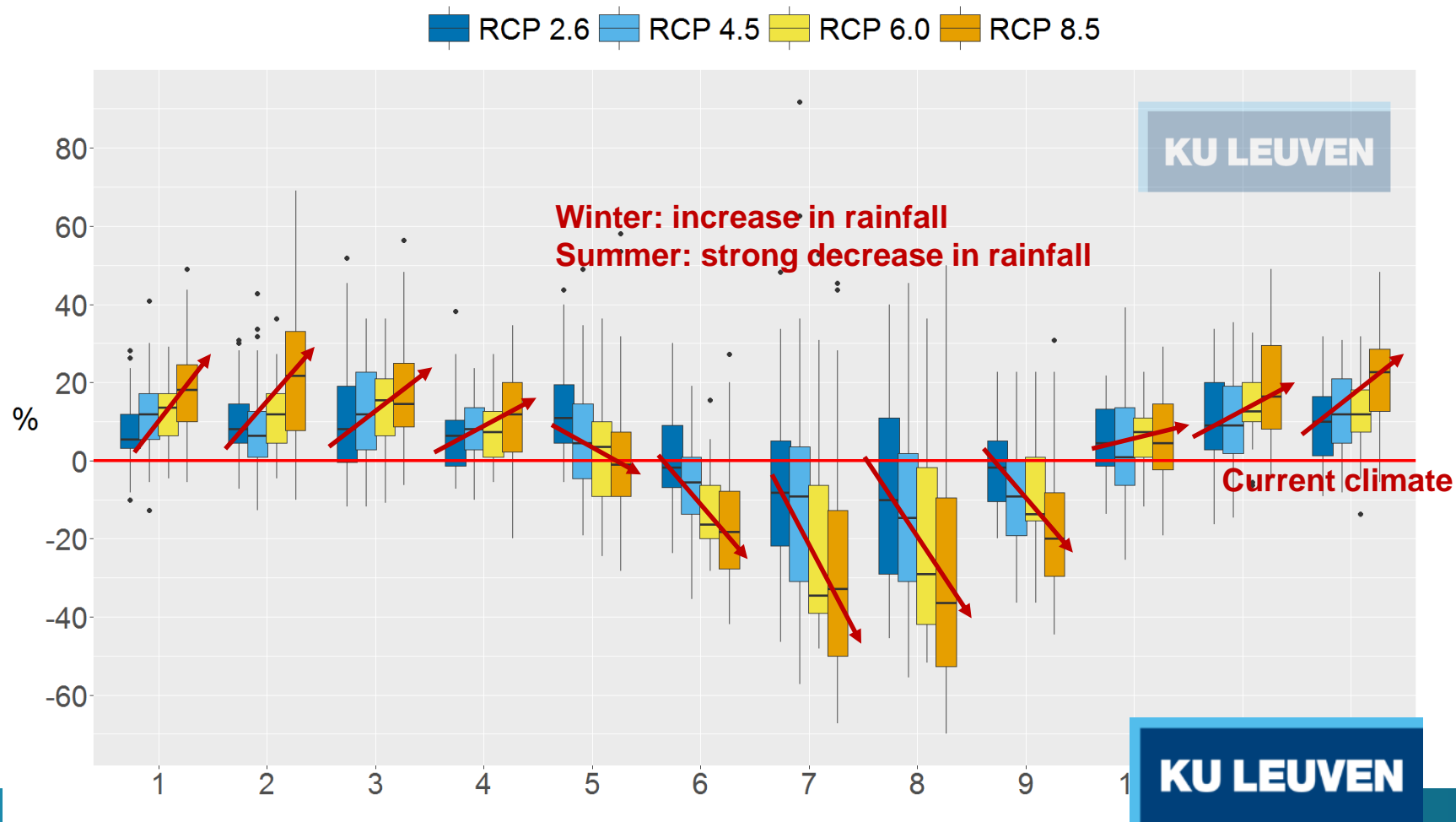
Change in mean monthly temperature:



Climate scenarios

>200 GCMs CMIP5 (RCP based) for Uccle: change for 100 years (2000 -> 2100):

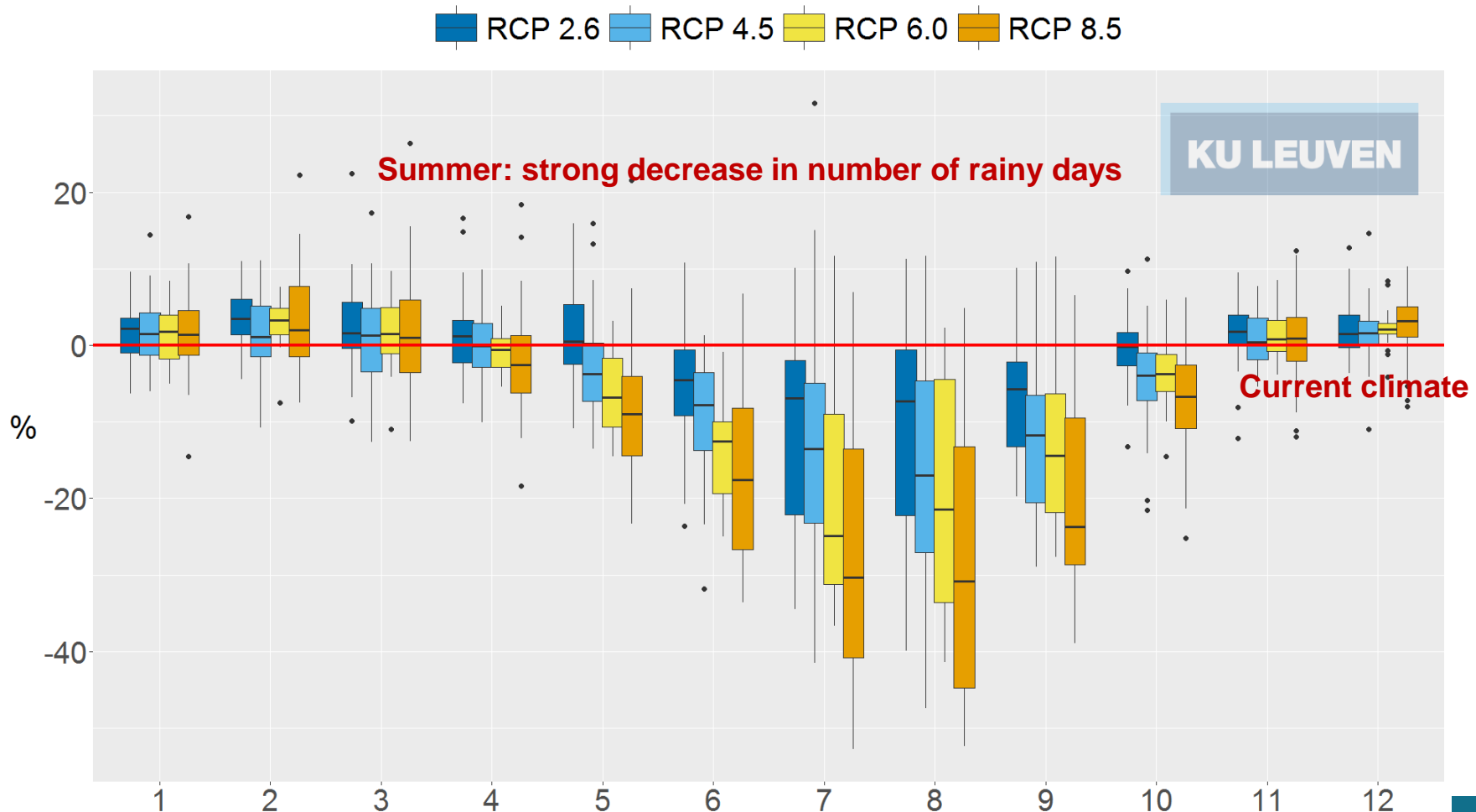
Change in mean monthly rainfall:



Climate scenarios

>200 GCMs CMIP5 (RCP based) for Uccle: change for 100 years (2000 -> 2100):

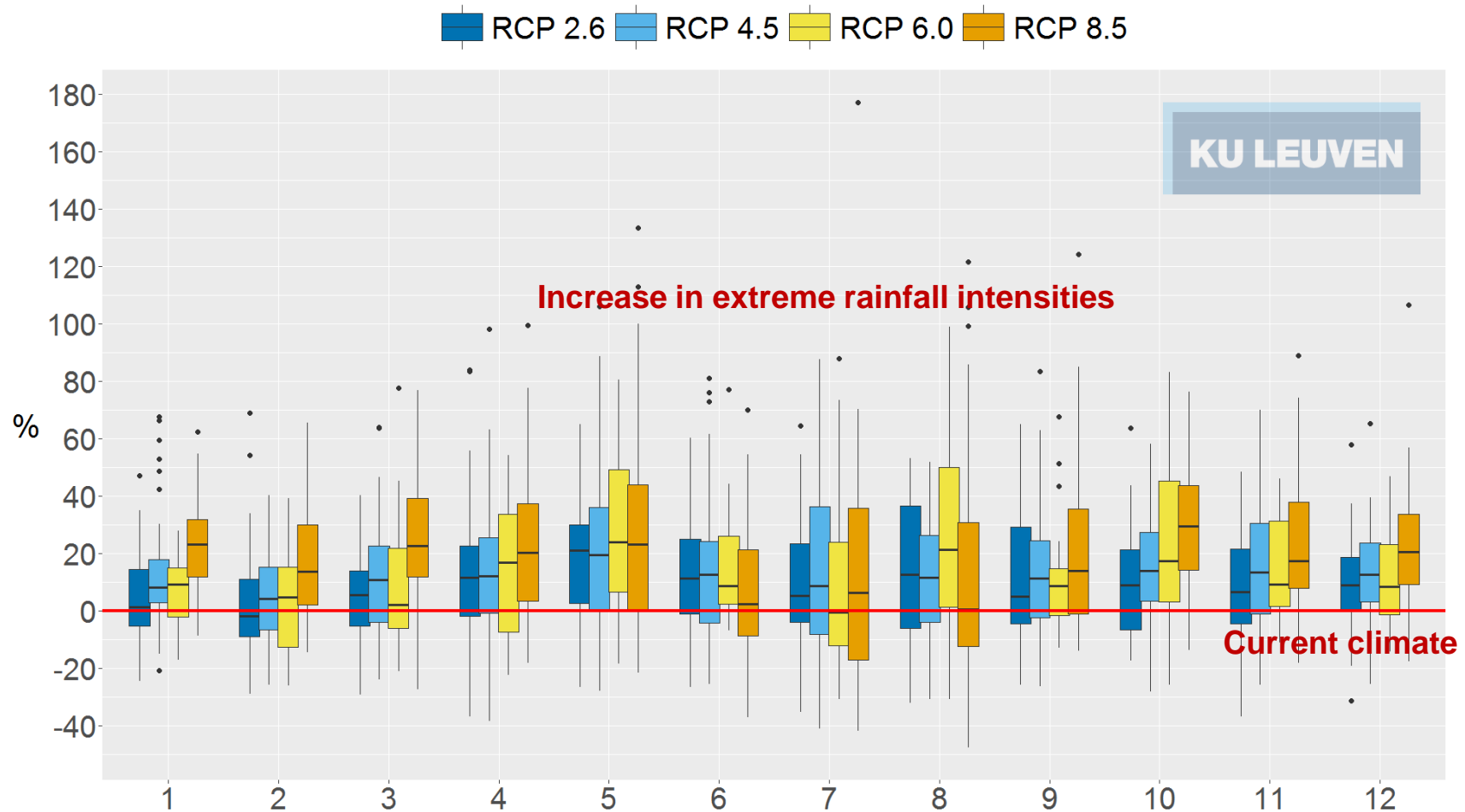
Change in number of wet days:



Climate scenarios

>200 GCMs CMIP5 (RCP based) for Uccle: change for 100 years (2000 -> 2100):

Change in rainfall intensity for 20-year storm:



Applications

- Changes in precipitation, temperature, ETo, ... statistics:
Climate Perturbation Tool

Perturbs historical series to high/mean/low climate scenarios

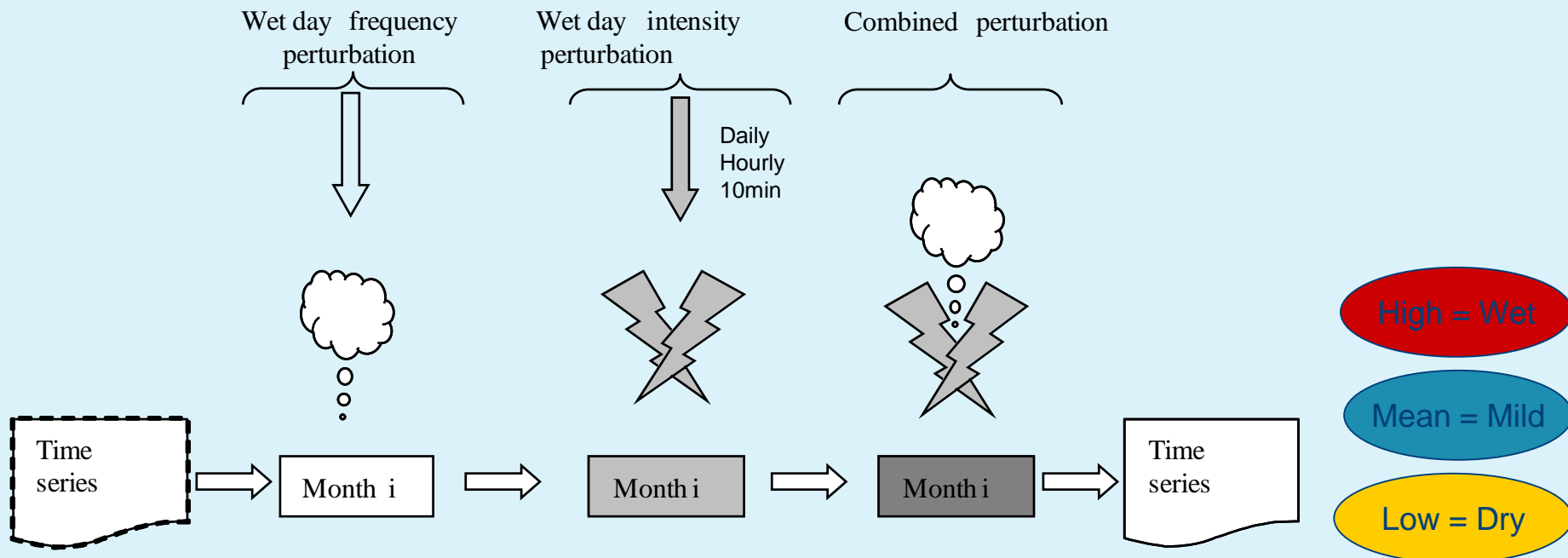
Time scales: daily, hourly, 10-minutes

Based on quantile perturbations:

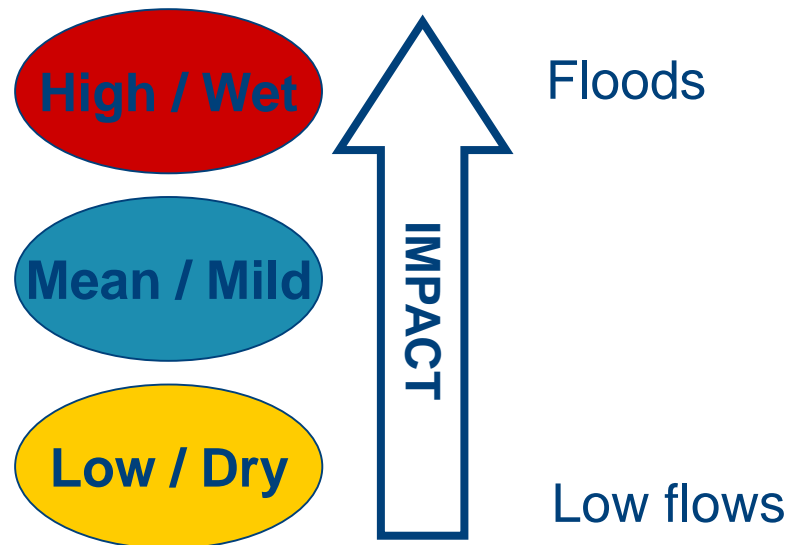
change in rain storm frequency and rain storm intensity

dependent on return period and season

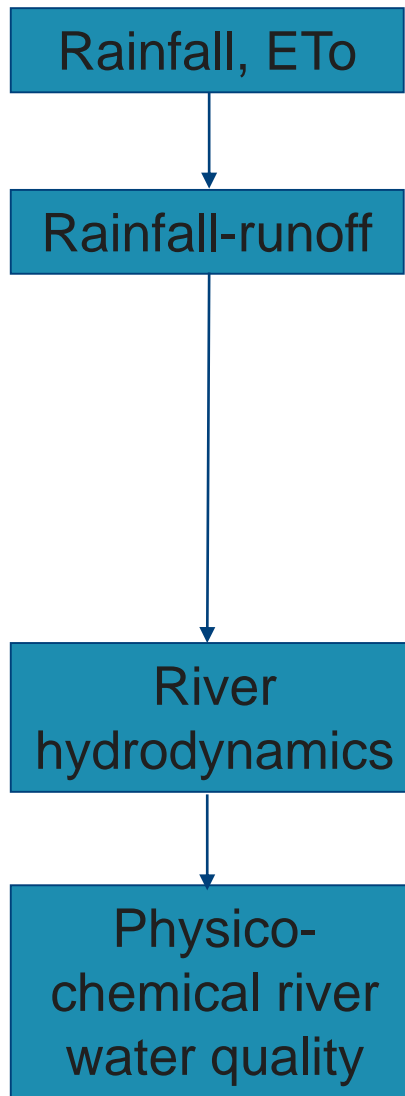
Time horizons till 2030, 2050, ..., 2100



High/mean/low climate scenarios, tailored for hydrological climate change impact analysis



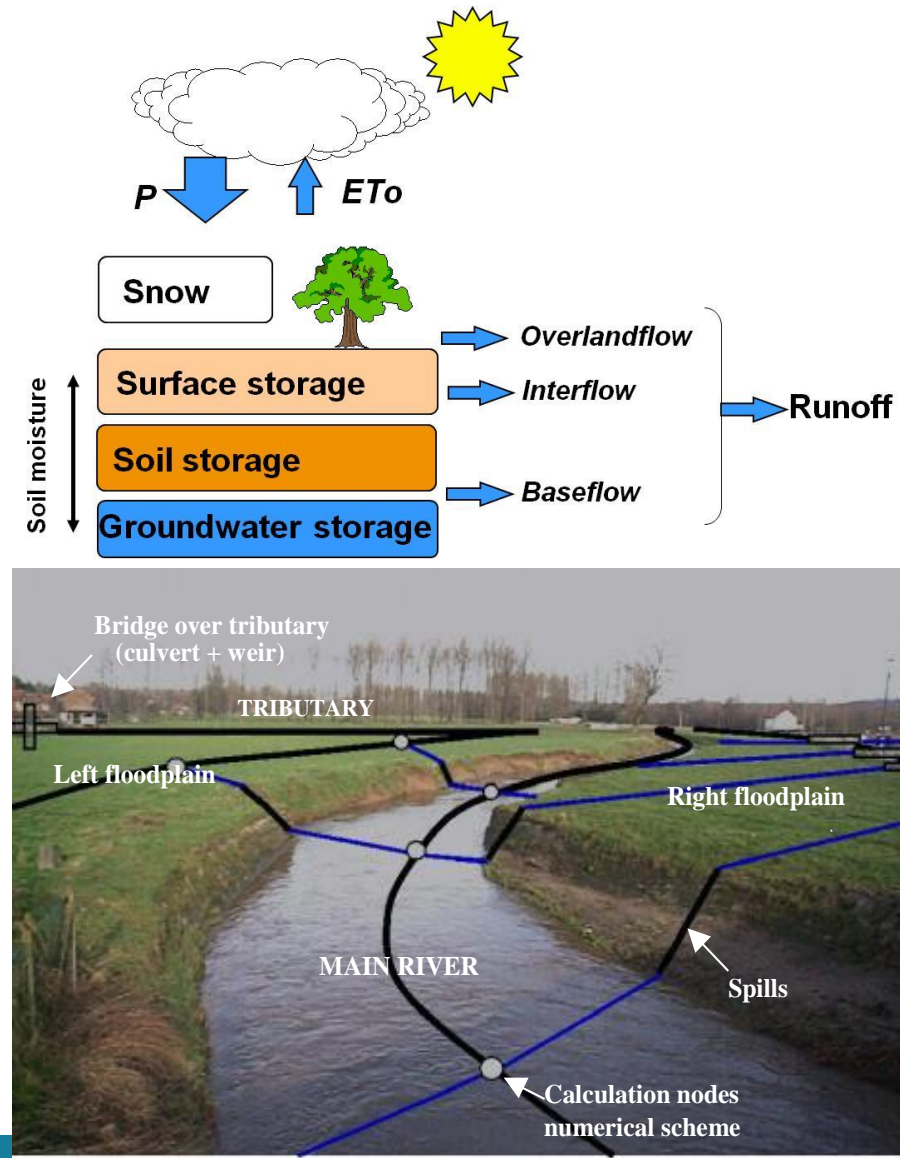
Hydrological impact analysis



PDM, NAM, VHM:
conceptual

Spatially distributed:
MIKE-SHE
WetSpa
Modflow
...

InfoWorks (RS, ICM)
MIKE11
+ floodplains





Our recent CORDEX.be papers on the topic:

Tabari H, De Troch R, Giot O, Hamdi R, Termonia P, Saeed S, Brisson E, Van Lipzig N, Willems P (2016) Local impact analysis of climate change on precipitation extremes: are high-resolution climate models needed for realistic simulations? *Hydrology and Earth System Sciences* 20: 3843-3857

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Hosseinzadehtalaei P, Tabari H, Willems P (2017) Uncertainty assessment for climate change impact on intense precipitation: How many model runs do we need? *International Journal of Climatology* 37(S1): 1105-1117

Hosseinzadehtalaei P, Tabari H, Willems P (2017) Precipitation intensity–duration–frequency curves for central Belgium with an ensemble of EURO-CORDEX simulations, and associated uncertainties. *Atmospheric Research* 200: 1-12; doi:10.1016/j.atmosres.2017.09.015

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