

# The design of the CORDEX.be II ensemble: selecting CMIP6 GCMs to downscale based on their spread of extreme weather at future warming levels.



Kobe Vandelanotte<sup>1,2</sup>, Fien Serras<sup>3</sup>, Josip Brajkovic<sup>4</sup>, Wout Dewettinck<sup>1</sup>, Bert Van Schaeybroeck<sup>1,2</sup>, Dirk Lauwaet<sup>5</sup>, Rozemien De Troch<sup>6</sup>, Xavier Fettweis<sup>4</sup>, Steven Caluwaerts<sup>1,2</sup>, Nicole Van Lipzig<sup>3</sup>, and Piet Termonia<sup>1,2</sup>

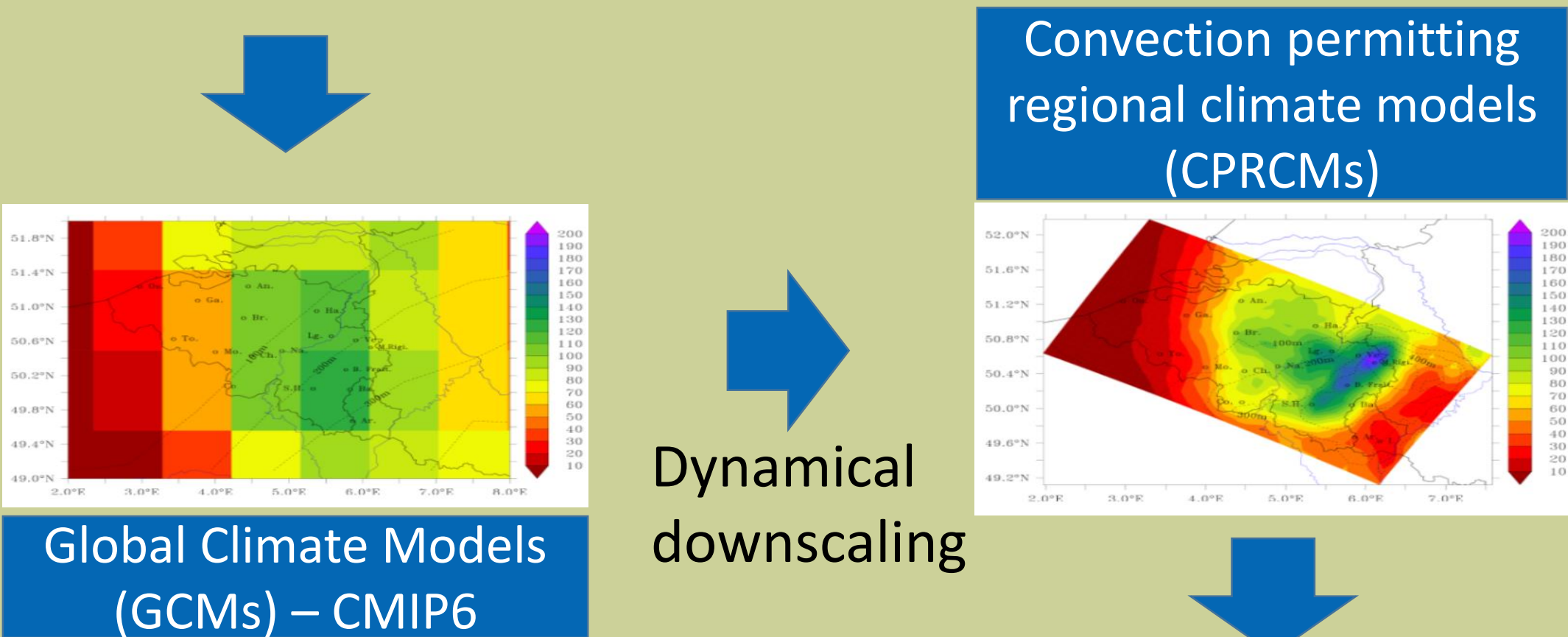
**What?** 4 year project 2023-2026  
**Goal** Close the gap between regional climate information and local impacts.  
**Focus** Extreme precipitation and heat waves.  
**How?** 1) Create a convection permitting model ensemble over Belgium.  
 2) Do impact modelling.  
 3) Have recurring stakeholder interactions.

## The CORDEX.be II ensemble

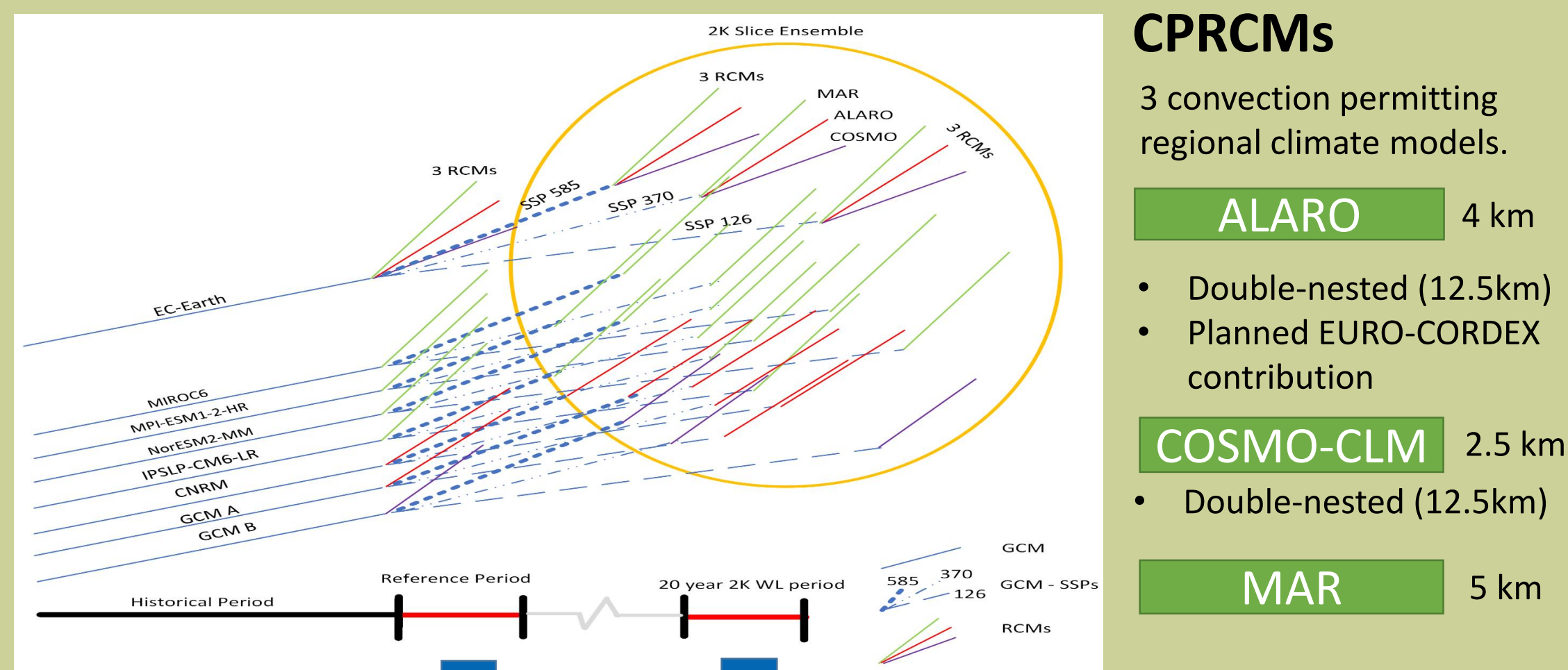
**Ensemble Design**

- 3 CPMs - ALARO, COSMO-CLM, MAR
- 3 Scenarios - SSP1-2.6, SSP3-7.0, SSP5-8.5
- 20 year time slices - 2°C & 4°C global warming level (GWL)
- **GCM-SSP selection** - Selecting *multiple* GCM-SSP pairs

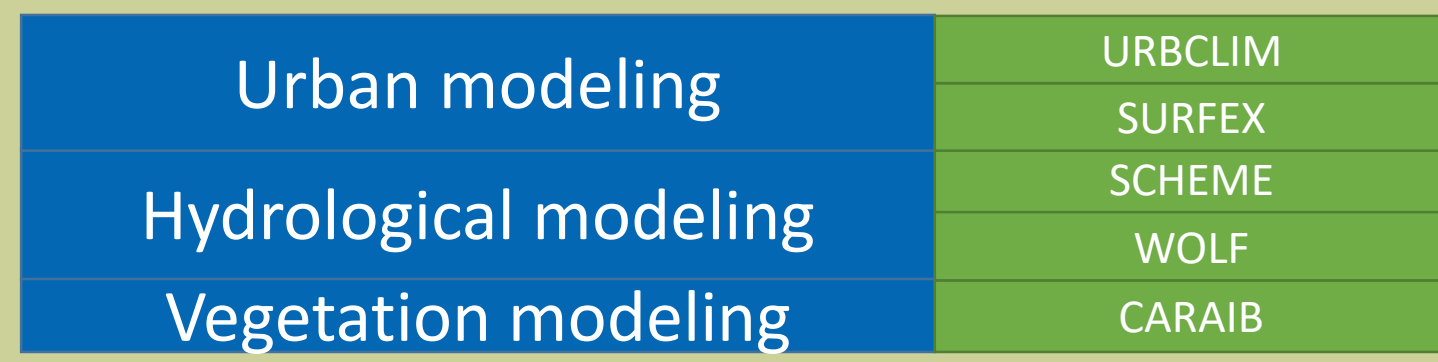
**Dynamical Downscaling**



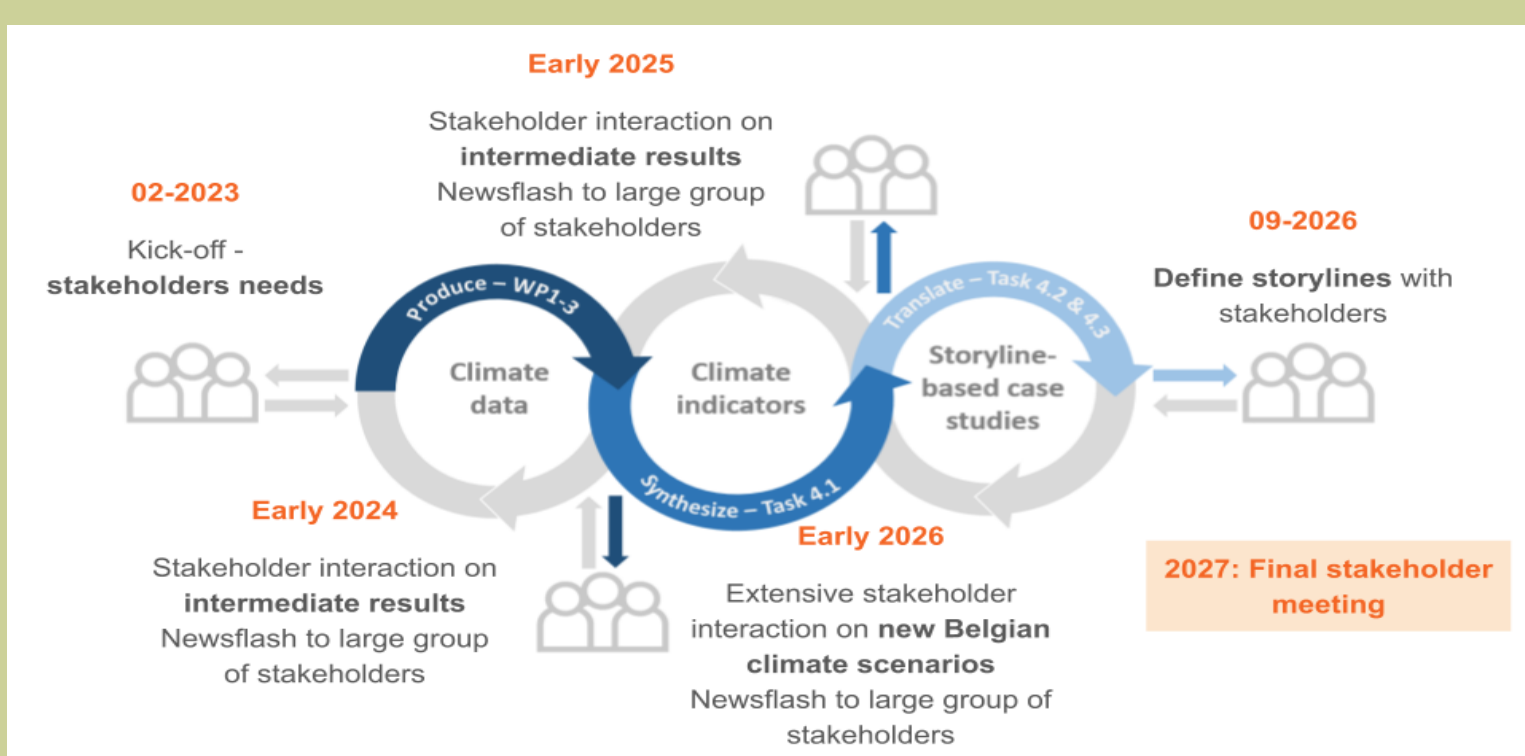
**CPM Ensemble**



**Impact models**



## Output, Timeline & Stakeholder interaction



- Stakeholders**
- National Crisis Center
  - Federal public services - Department of Climate Change
  - Flanders Environment Agency
  - Walloon public services - Hydrological department
  - Air & Climate Agency
  - City of Ghent

## GCM-SSP (CMIP6) Selection

**Goal**

Select GCM-SSP pairs that will allow us to explore and downscale future low-likelihood high impact extreme precipitation events.

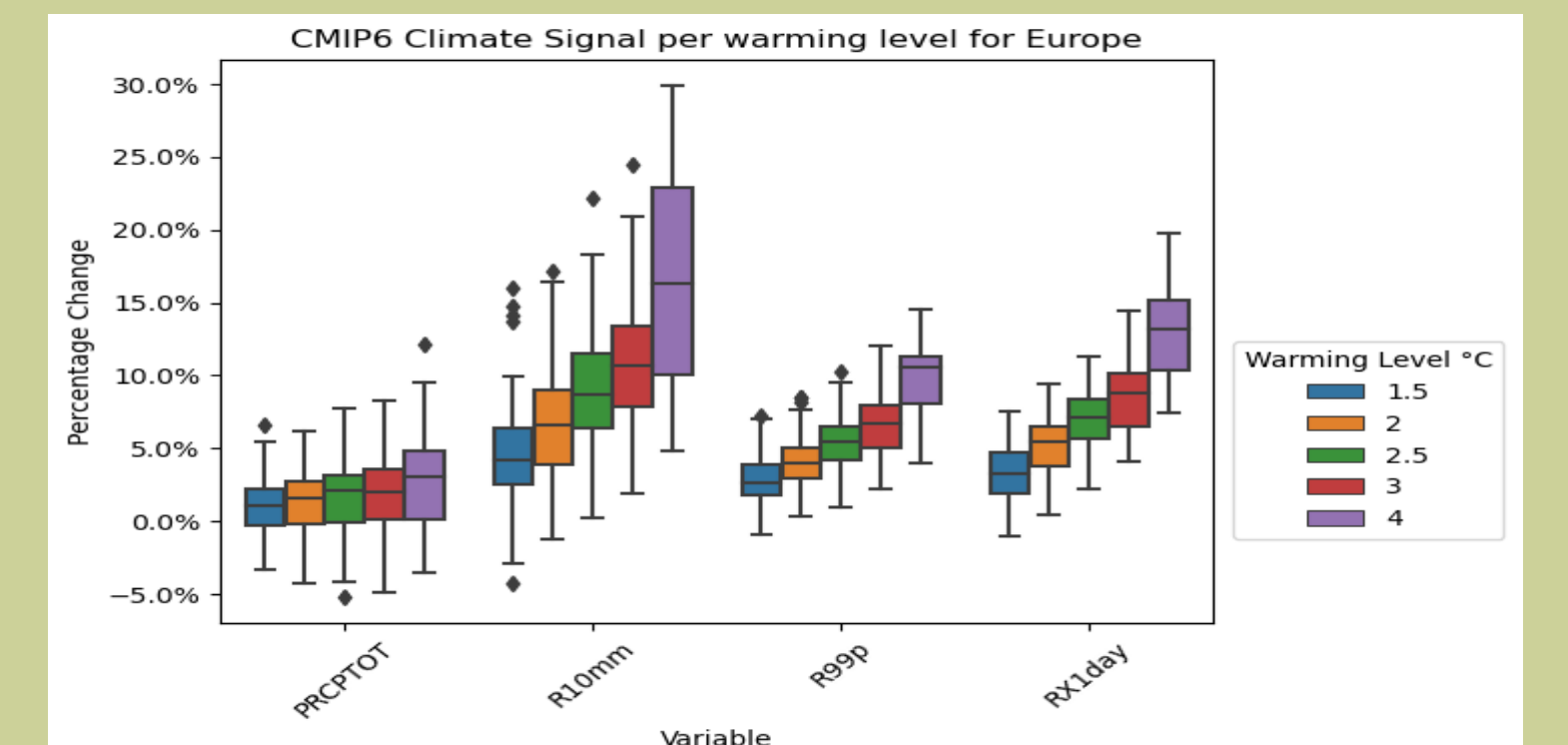
**Procedure**

- Procedure** - Based on the GCM selection whitepaper [1]
- 1) Data availability
  - 2) GCM plausibility - (see poster Fien Serras)
  - 3) Future climate change spread
  - 4) GCM independence

## 3) CMIP6 GWL future spread analysis

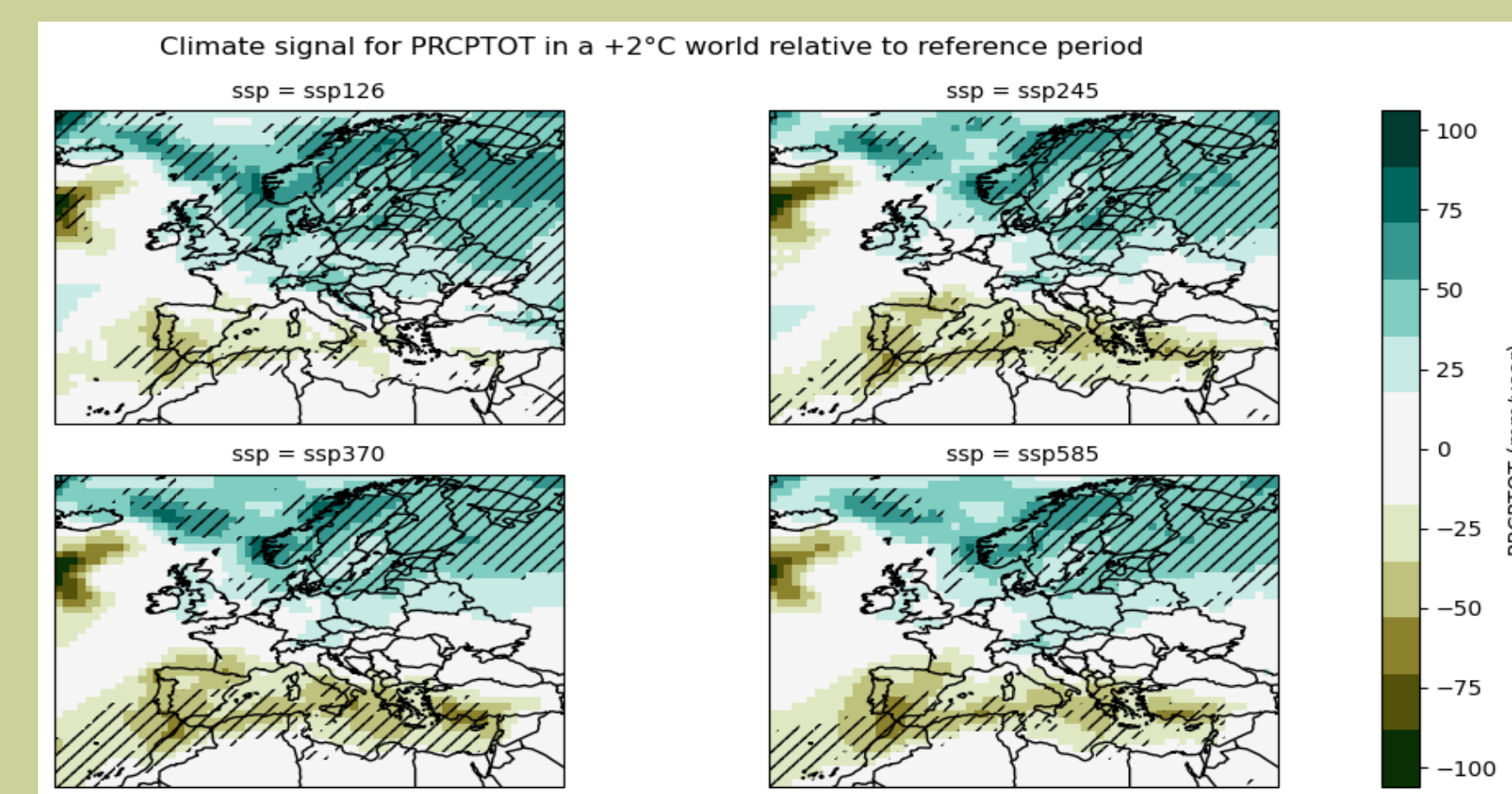
**Variables**

- PRCTOT - Annual total precipitation
- R10mm - Annual count where precipitation ≥ 10mm
- R99p - The 99<sup>th</sup> annual percentile of daily precipitation
- Rx1day - The annual one day maximum precipitation
- Tas - Daily avg. temperature at the surface

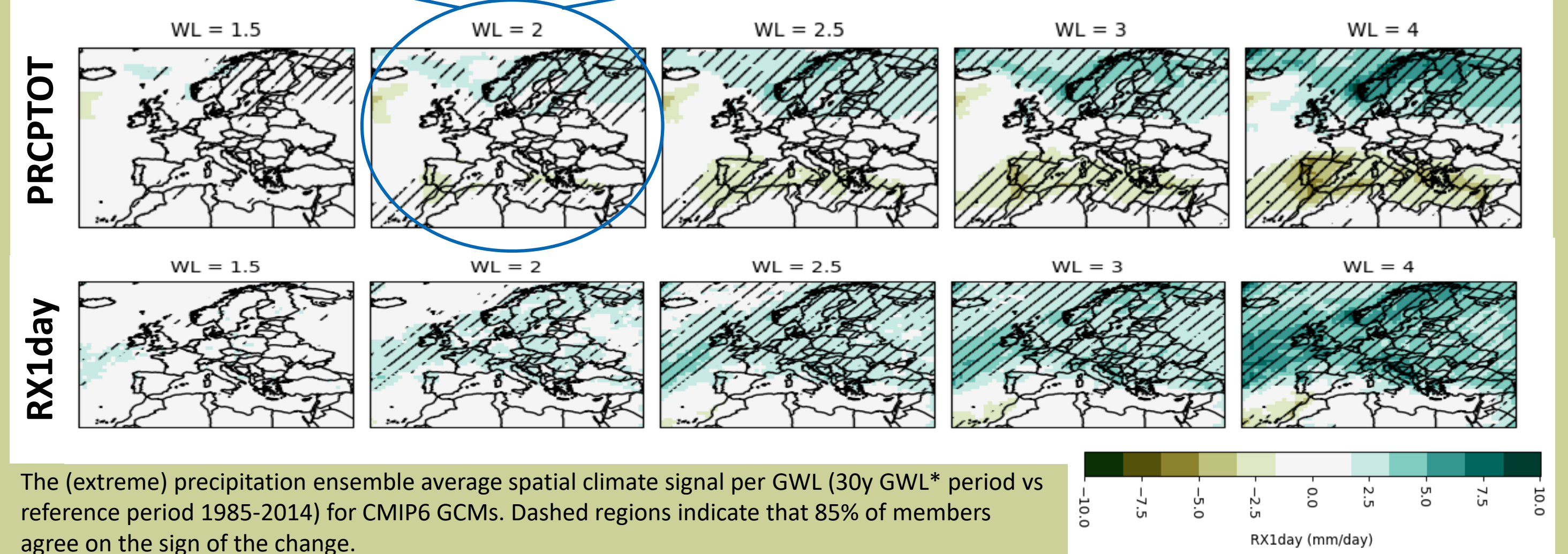


The (extreme) precipitation climate signals per GWL (30y GWL\* period vs reference period 1985-2014) for CMIP6 GCMs. The box plots consist of the spatially averaged signal of each member (GCM-SSP pair) that reaches the GWL.

Extreme precipitation indices increase across GWLs but total precipitation change remains uncertain.



Within a given GWL the scenario has little impact on the climate signal for (extreme) precipitation.



The (extreme) precipitation ensemble average spatial climate signal per GWL (30y GWL\* period vs reference period 1985-2014) for CMIP6 GCMs. Dashed regions indicate that 85% of members agree on the sign of the change.

- Across GWLs the CMIP6 signal strength increases.
- Over Belgium, extreme precipitation has a clearer increase compared to total precipitation.

## Ongoing work

- **Investigating GCM-RCM agreement.** Does coupling to the wettest GCM also result in the wettest RCM?
- **CMIP6 dynamics and non-precipitation variables** Which CMIP6 variables are predictive for local (Belgian) extreme precipitation change?

## Conclusion

- **CORDEX.be II** is a Belgian 4-year project studying extreme precipitation and heat stress over Belgium in warmer futures using a CPM ensemble.
- **The CORDEX.be II ensemble** is designed to optimize the projects effectiveness given the computational constraints while considering the stakeholders needs.

Within a GWL the SSP scenarios (shapes) are clustered per model (colors).



The temperature and (extreme) precipitation spatially averaged climate signals (2°C GWL\* vs reference period 1985-2014) for CMIP6 GCMs.

\*The GWL is defined as the first 30y period with an average global temperature increase of 2°C above the pre-industrial period 1850-1900

[1] Sobolowski, Stefan, Samuel Somot, Jesus Fernandez, Guillaume Evin, Douglas Maraun, Sven Kotlarski, Martin Jury, et al. "EURO-CORDEX CMIP6 GCM Selection & Ensemble Design: Best Practices and Recommendations." Zenodo, February 24, 2023. <https://doi.org/10.5281/zenodo.7673400>.



## Contact

Kobe Vandelanotte  
[kobe.vandelanotte@meteo.be](mailto:kobe.vandelanotte@meteo.be)  
[linkedin.com/in/kobevandelanotte](https://www.linkedin.com/in/kobevandelanotte)

