

# ***CORDEX.be: COmbining Regional climate Downscaling EXpertise in Belgium***



***P. Termonia  
ICRC, 17 May 2016, Stockholm***

# A Belgian network



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<sup>b,c</sup>KU LEUVEN



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<sup>e</sup>Ulg



<sup>f</sup>VITO



<sup>g</sup>BISA



<sup>h</sup>RBINS



<sup>i</sup>ROB



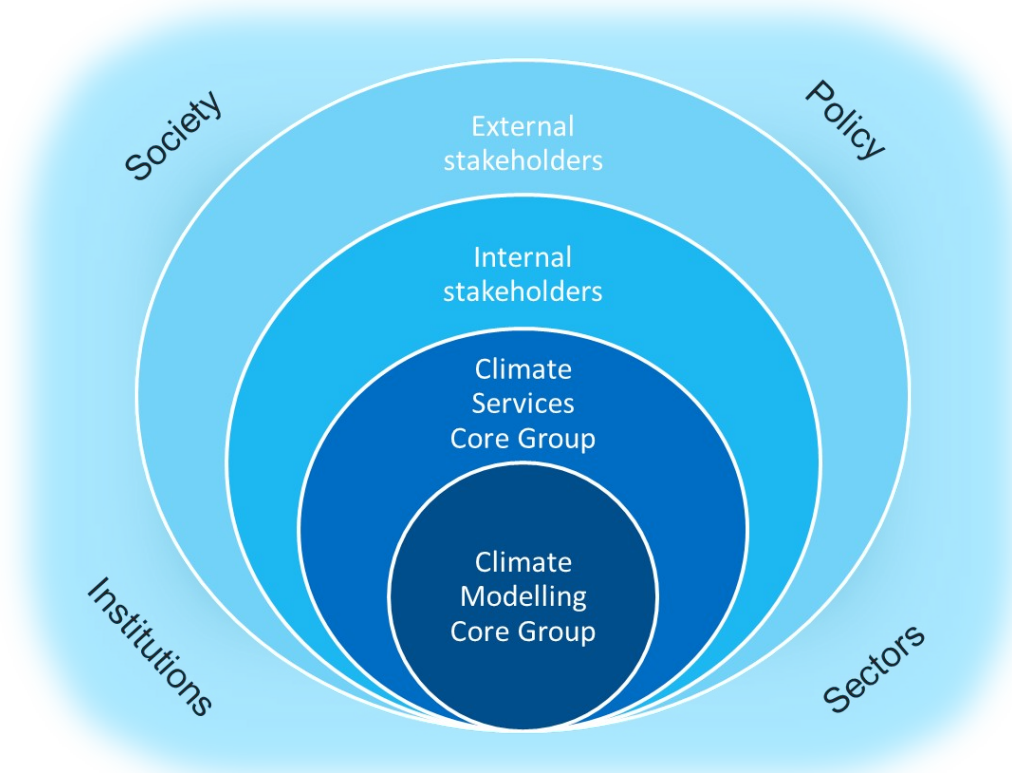
# Scope



- CORDEX.be is **NOT** a project to provide enough resources for 9 partners for computing ensembles of regional climate runs,
- **BUT** CORDEX.be provides a frame to combine existing, **ongoing efforts** in the Belgian climate community, to optimally bring CORDEX scale information to the Belgian local scales in a coherent way: *a stakeholder should get the same information from any of the 9 partners.*
- Period: 2 years, March 2015 – March 2017.
- Cost: ~ 1M Euro, funded by the Belgian Science Policy (BELSPO)

# Challenge

- How to deal with a twofold challenge:
  - each partner has strong links with its Belgian stakeholders; this includes tailor-made modeling activities that go beyond what CORDEX can deliver, but
  - each partner and, in fact, the Belgian community is too small to capture the uncertainties?
- Solution:
  - situate each contribution within the spread of the CORDEX ensemble;
  - combine the available expertise to get coherent Belgian climate information;
  - infer uncertainties from CORDEX to the Belgian scale.



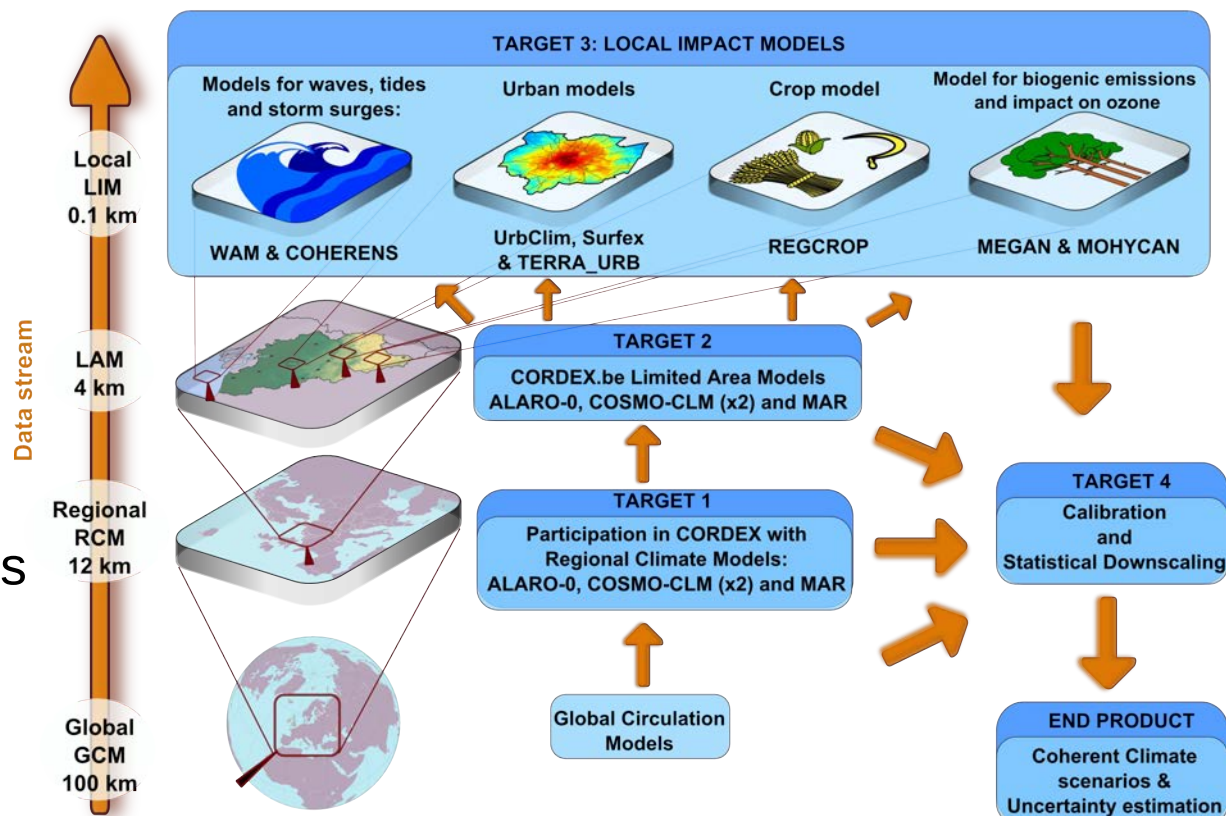


# *The approach is bottom-up:*



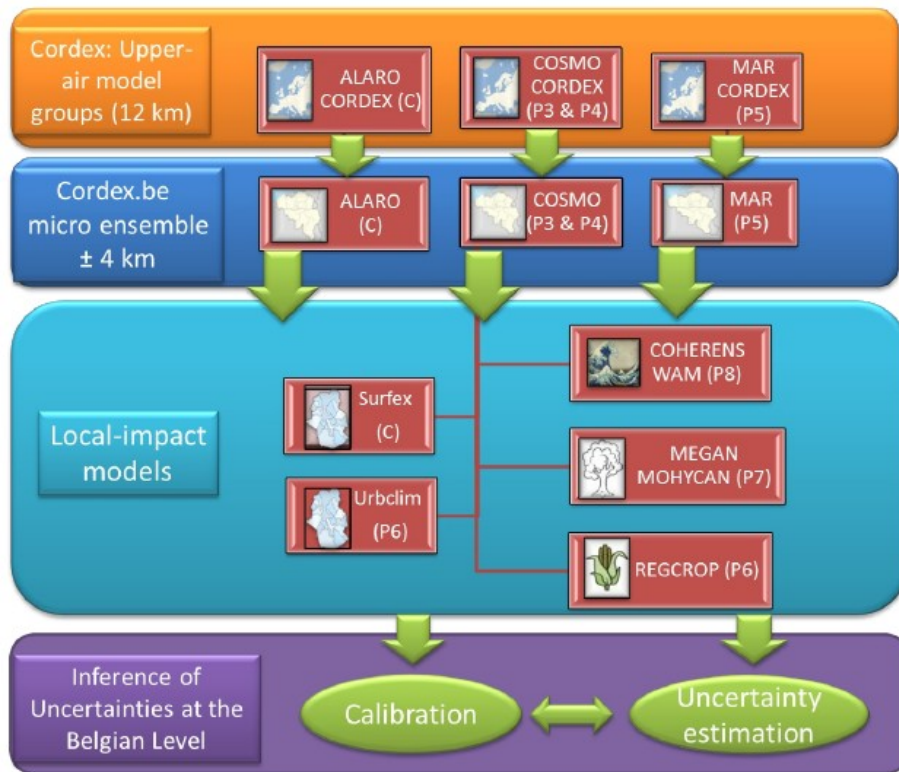
## Objectives:

1. Contribution to the CORDEX project
2. Beyond CORDEX: high-resolution runs
3. Beyond CORDEX: local-impact models
4. Inferring the climate uncertainties to the Belgian level

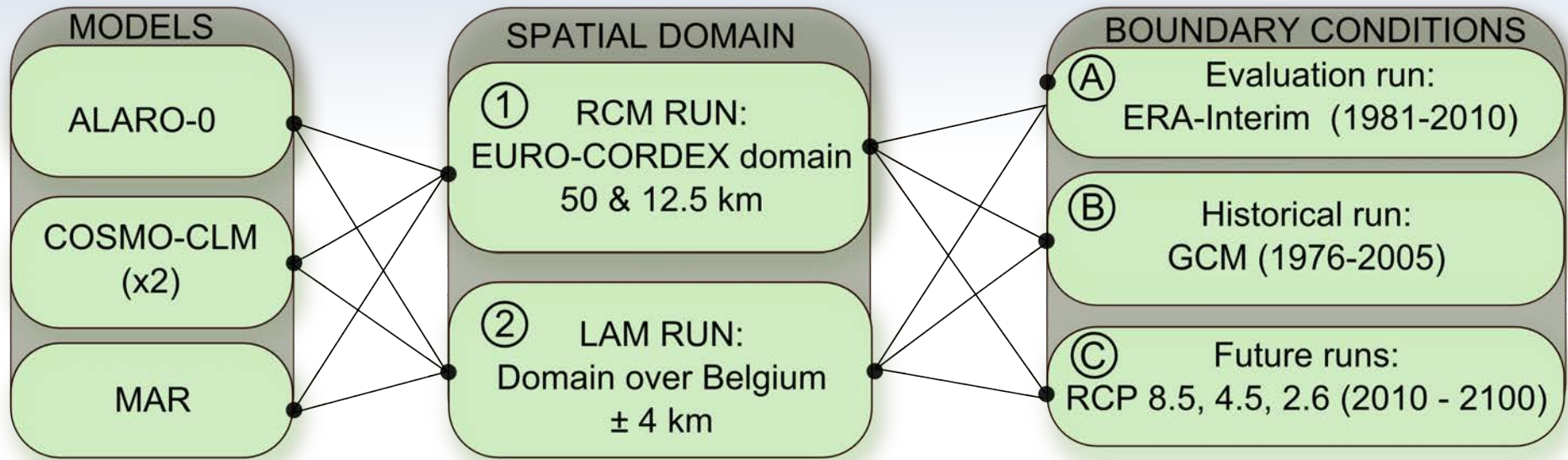


# *The methodology for Combining climate efforts*

- Coordinate the planning:
  - which models,
  - which couplings,
  - which scenario's.
- Technically coordinate the couplings (green arrows):
  - agreement on the variables,
  - the file formats.
- Inference of uncertainties from CORDEX (second year) (green ovals)



# Models and runs



## ALARO-0 (RMI):

- De Troch et al. 2013: Multiscale performance of the ALARO-0 model for simulating extreme summer precipitation climatology in Belgium, J. Climate, 26, 8895-8915.
- Giot et al. (2016), Validation of the ALARO-0 model within EURO-CORDEX framework, Geosc. Mod. Dev., 9, 1143
- Posters ICRC: De Troch et al, Berckmans et al., Van Schaeybroeck et al.

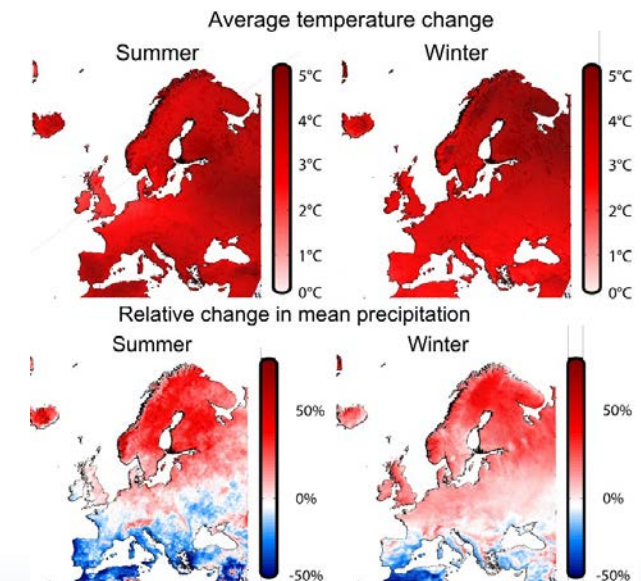
## COSMO5.0-CLM6 (KUL, UCL)

- This version is extensively evaluated for Europe during the COPAT experiment last year (Anders et al.) in the CCLM-EVAL group.
- Accepted as the default model version by the the CLM-Community last september

## MAR (ULg):

- Historically developed at UCL. Now maintained and developed at ULg, validation is being done.

## ALARO-0, 12.5-km, RCP 8.5



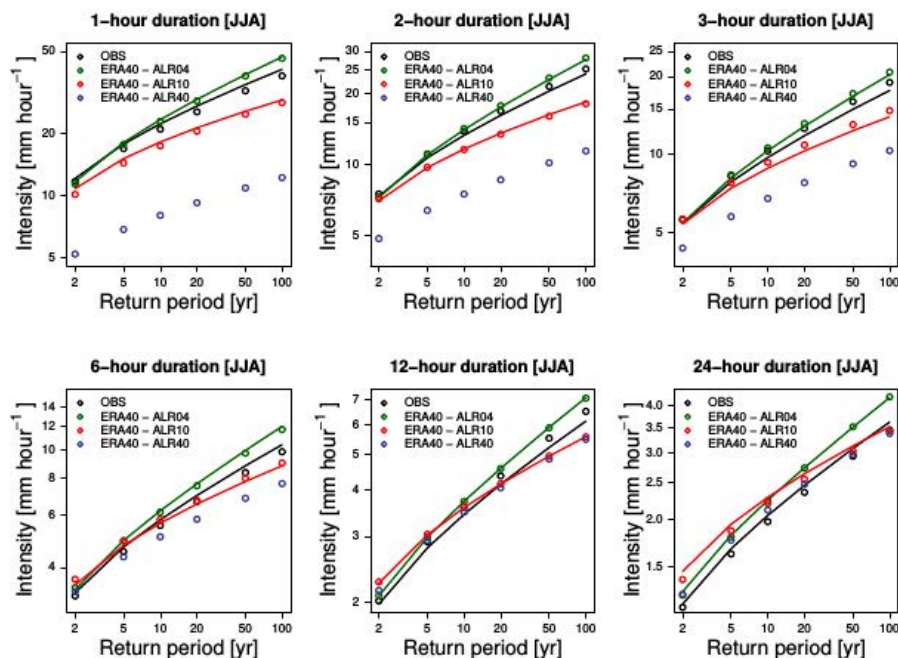
Currently we store more data than the ones requested by the CORDEX guidelines



# .beyond CORDEX: Hres runs and added value

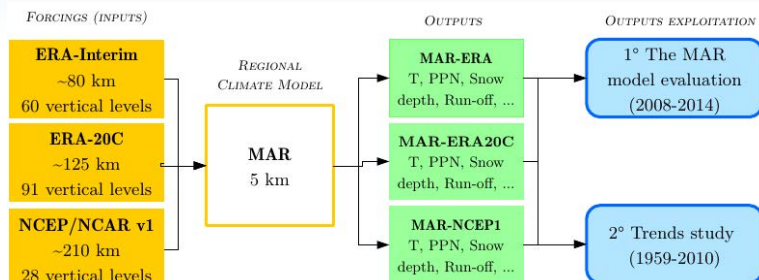
## ALARO-0 runs validated at sub-daily scale: added value

IDF relationship based upon power law



See also poster R. De Troch, ICRC

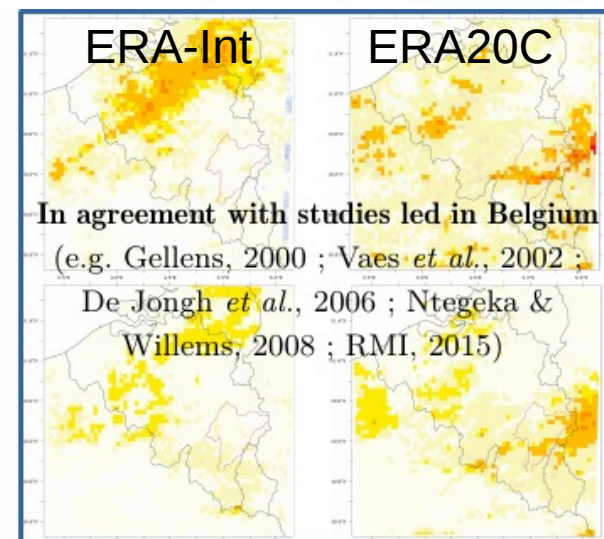
## Validation of MAR 5-km runs:



Extreme precipitation events frequency trend (events/52 winters)

Extreme precipitation events intensity trend (mmWE/52 winters)

Coraline WYARD



In agreement with studies led in Belgium (e.g. Gellens, 2000 ; Vaes *et al.*, 2002 ; De Jongh *et al.*, 2006 ; Ntegeka & Willems, 2008 ; RMI, 2015)

planned in 2<sup>nd</sup> year:

## GNSS-based Verification Scheme for CORDEX.be:

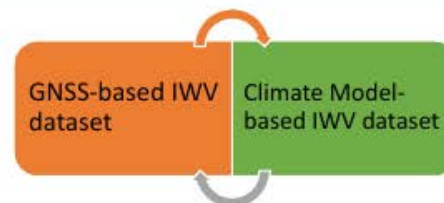
### 1 GNSS Reprocessing Activity

- ROB will perform an homogeneous re-analyse with latest state-of-the-art processing techniques.
- Set of GNSS stations suitable for climate.
- Period : 2000-2010 (hindcast period).

Eric Pottiaux and Carine Bruyninx, Royal Observatory of Belgium (ROB)



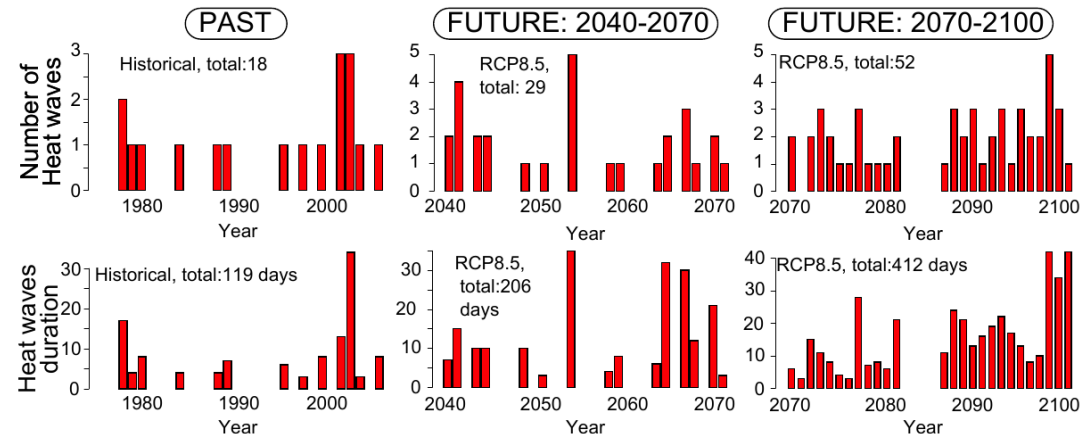
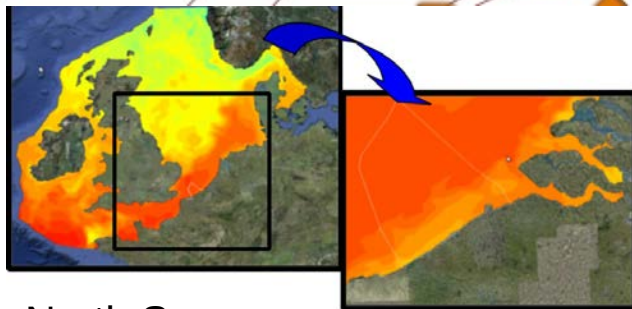
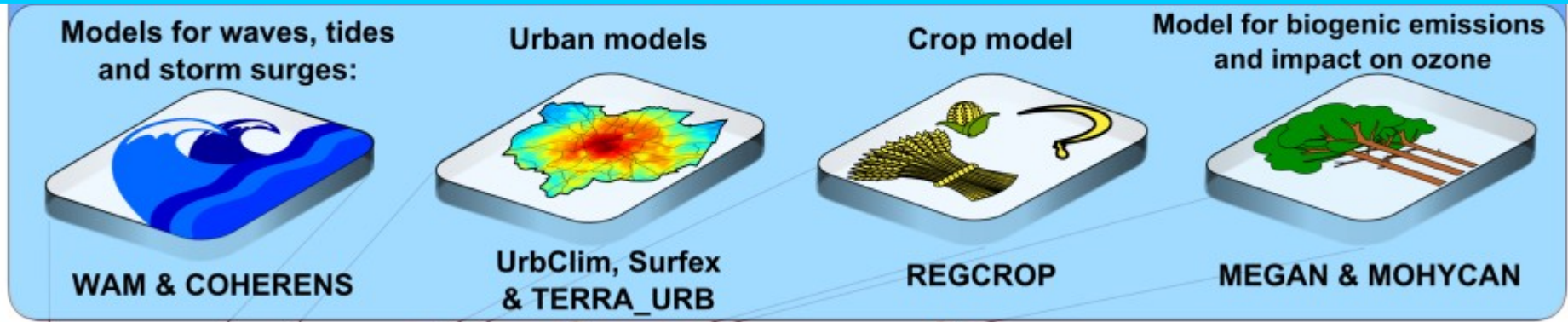
### 2 Verification Activity



Royal Meteorological Institute (RMI)



# Local-Impact modeling (2<sup>nd</sup> year)



ALARO-0 runs with SURFEX. First example: change in heat wave duration and frequencies. See Talk R. Hamdi in this ICRC, see also,

- Hamdi, *et al.* 2014: International Journal of Climatology, 34, 978-999. doi: 10.1002/joc.3734
- Hamdi, *et al.* , 2014: Geosci. Model Dev., 7, 23-39, doi:10.5194/gmd-7-23-2014, 2014.
- Hamdi, *et al.* , 2015: Future climate of Brussels and Paris for the 2050s under the A1B scenario. Urban Climate, 12, 160-182.

Planned climate scenarios with CORDEX and CORDEX.be databases:

- SSH and storm surges with the COHERENS model:
- Impact on waves with the WAM model.

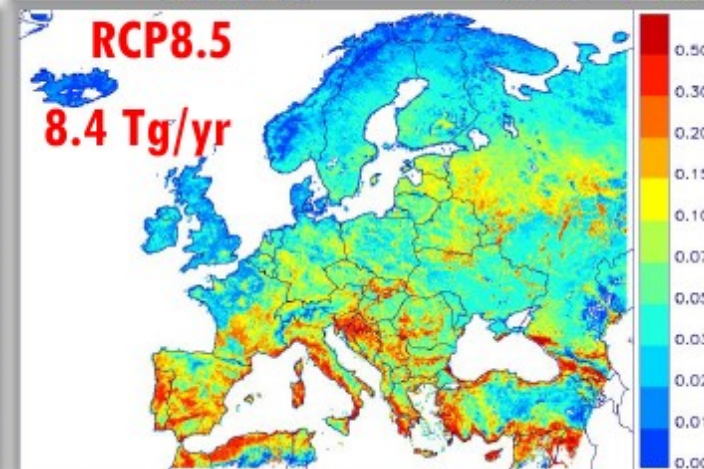
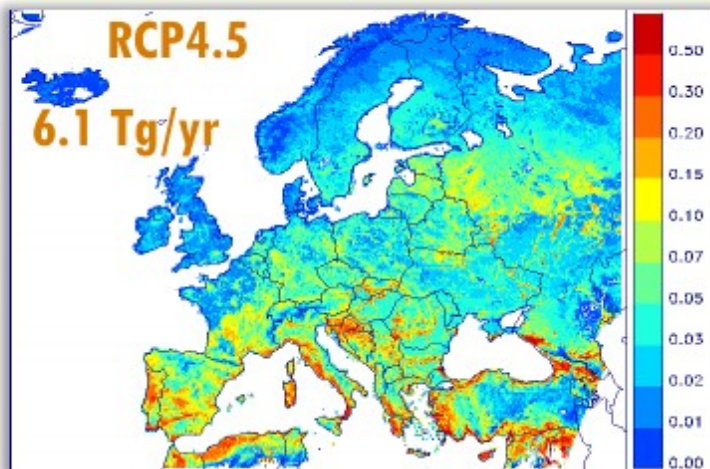
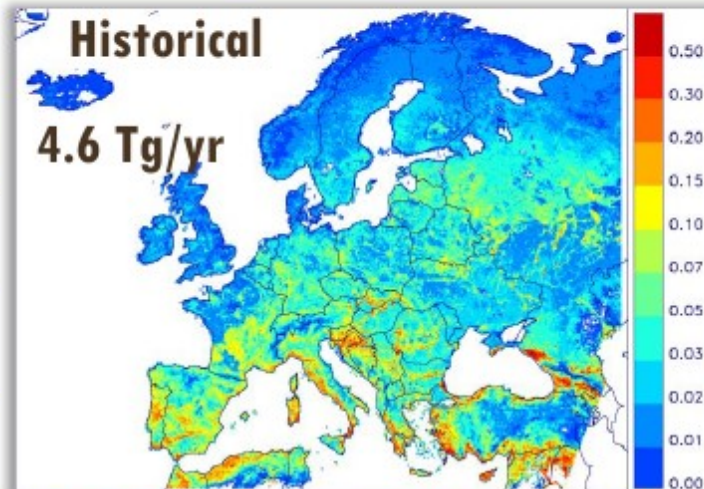
Expected output: wave heights, extreme water heights during storms, frequency of extreme events (storm surges and waves)



## Use of a biogenic emission model to estimate high resolution isoprene emissions over Europe in past and future climate

MEGAN-MOHYCAN using  
ALARO-0 meteorology

Historical	1976-2005
Future RCP4.5	2071-2099
Future RCP8.5	2071-2099

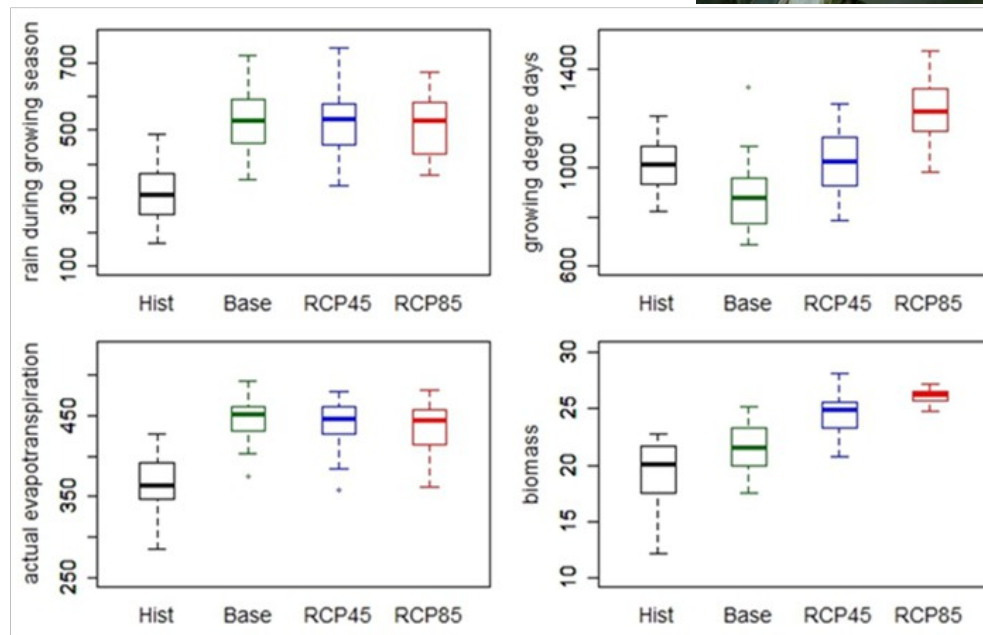
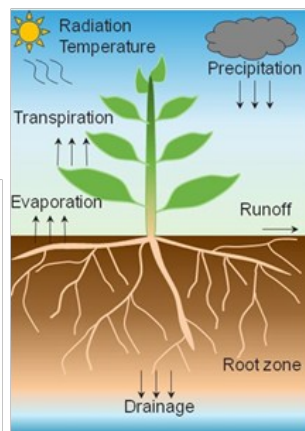
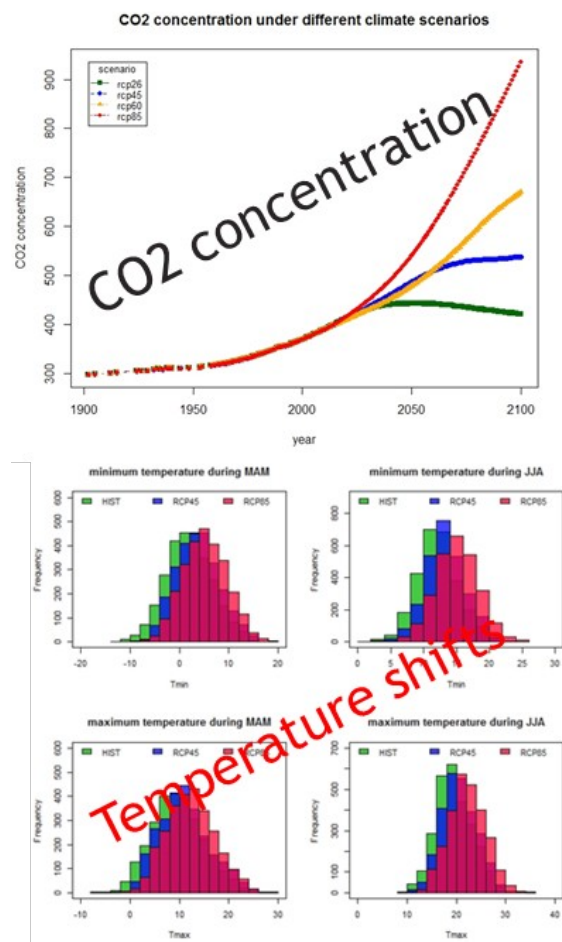


- Account for effects of **CO<sub>2</sub> inhibition** and **CO<sub>2</sub> fertilization** in future projections of isoprene emissions

- Warming climate leads to strong isoprene flux increases
- Higher isoprene over polluted regions leads to enhanced ozone abundances in summer → direct adverse health effects

# IMPACT ON AGRICULTURAL CROPS

Projected shifts in **maize** productivity for observed weather 1960-1990 (*Hist*), GCM 1976-2005 (*Base*), and 2070-2100 (*RCP45*, *RCP85*).



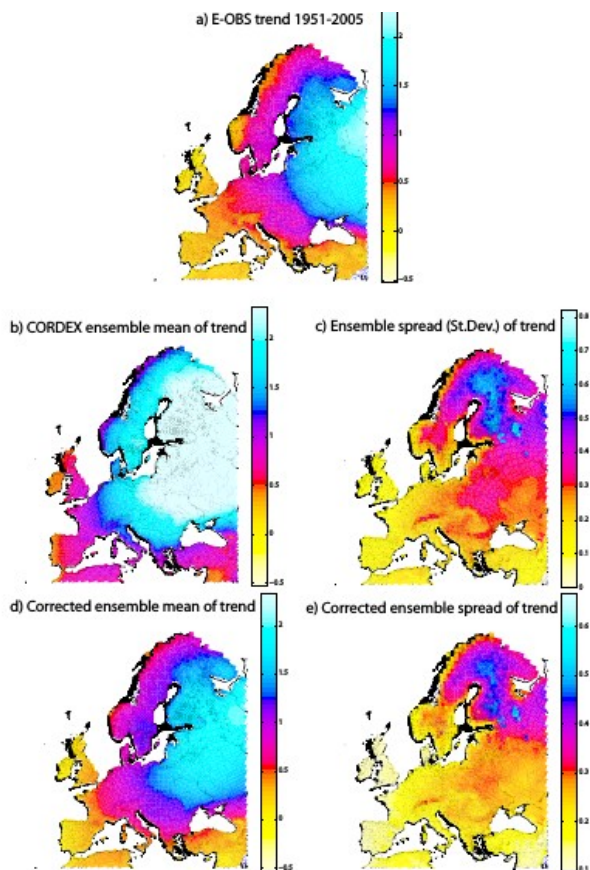
Future work necessitates finetuning and conversion of:

- Precipitation fluxes to daily precipitation
- Potential evapotranspiration fluxes to daily reference evapotranspiration

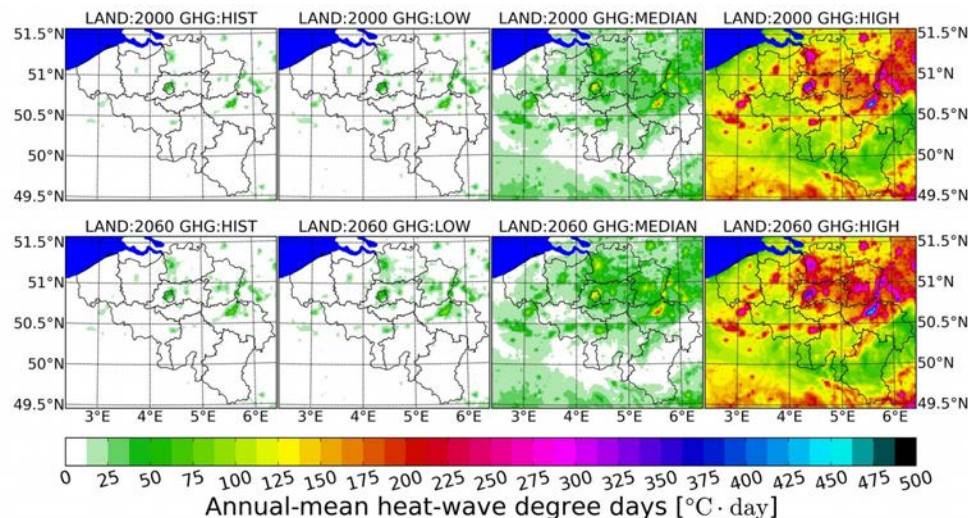


# Inference of climate uncertainties from CORDEX to CORDEX.be: to be started (year 2); already a few examples:

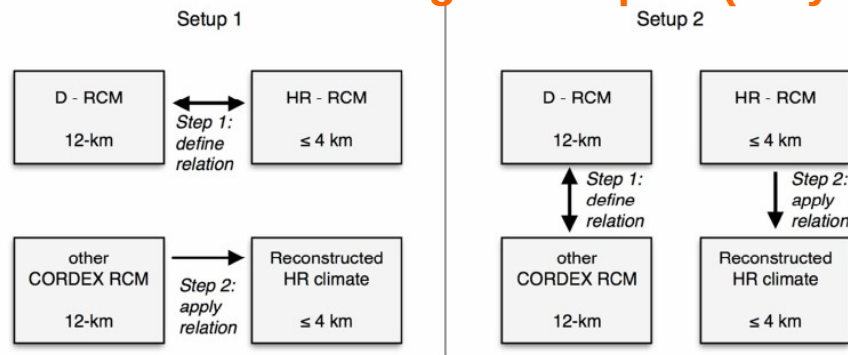
## Bias correction by minimizing CRPS



## Heat wave stress with uncertainty estimation (KUL) for Belgium, IPCC style presentation



## Uncertainty inference based on statistical downscaling techniques (2<sup>nd</sup> year)



Van Schaeybroeck, poster ICRC

# Concluding remarks

- CORDEX runs are either finished or ongoing.
- First use of data in local-impact models has been done (urban, REGCROP, MEGAN-MOHYCAN). More are planned (wave model).
- Inference of uncertainties will start (2<sup>nd</sup> year).
- Currently we store more data than the ones requested by the CORDEX guidelines. e.g. vertical profiles (for air pollution studies). They can be used for “fine tuning” (see example of REGCROP)
- We plan validation against GNSS data (2<sup>nd</sup> year).
- Two case studies are planned in the future:
  - study of spread of invasive species,
  - climate a vulnerability map (request of the Flemish VMM).

**Thank you for your attention.**