# Combining the regional downscaling expertise in Belgium: CORDEX and beyond

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## Project Objectives

The main objective of the national project CORDEX.be, "COmbining Regional Downscaling EXpertise in Belgium: CORDEX and Beyond", is to gather existing and ongoing Belgian research activities in the domain of climate modelling to create a coherent, scientific basis for future climate services in Belgium. The project regroups 8 Belgian Institutes under a single Research program of the Belgian Science Policy (BelSPo).

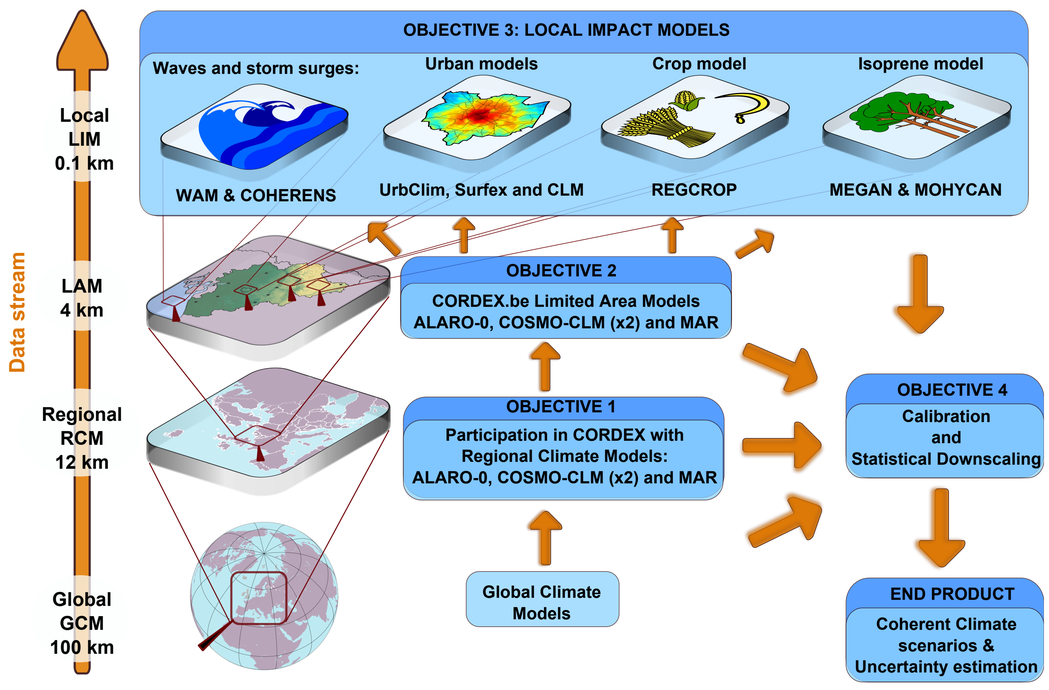


Figure 1 The CORDEX.be framework is naturally structured by the concept of dynamic downscaling. By successively nesting or coupling low-resolution model runs over large domains to high-resolution runs over small domains. This approach determines the data stream, the timing and the network structure of the Belgian research activities.

## Project Partners

[1]Belgian Royal Meteorological Institute (RMI); [2]Katholieke Universiteit Leuven (KU Leuven); [3]Université Catholique de Louvain (UCL); [4]Université de Liege (ULg); [5]Vlaamse Instelling voor Technologisch Onderzoek (VITO); [6]Belgian Institute for Space Aeronomy (BISA); [7]Royal Belgian Institute of Natural Sciences (RBINS); [8]Royal Observatory of Belgium (ROB)

## General framework of CORDEX.be

Climate services have to be based on the last outcomes of the First Working Group (WG I) of the Intergovernmental Panel on Climate Change in its Fifth Assessment Report (AR5). Today, the most important coordinated international effort to translate the AR5 outcomes to *regional* climate modelling is the so-called "COordinated Regional climate Downscaling EXperiment" (**CORDEX**).

In Belgium, the main **atmospheric modelling** groups already run their climate models *(ALARO, COSMO-CLM, and MAR)* with resolutions higher than the CORDEX resolutions of 12 km (typically these Belgian models run at 3 to 6 km). Within CORDEX.be, the Belgian modelling groups will produce altogether a set of comparable simulations that will enable to create very high resolution climate scenarios (regional downscaling focused on the Belgian area), with documented uncertainties.

These model outputs and climate scenarios will give detailed local climate information as input to so-called **local-impact models** that are used to study specific climate-impact phenomena (urban effects, storm surges and waves, impact on crop production and resulting changes in emissions from vegetation). The outcomes of this project will also be used to contribute at the European level to the CORDEX program.

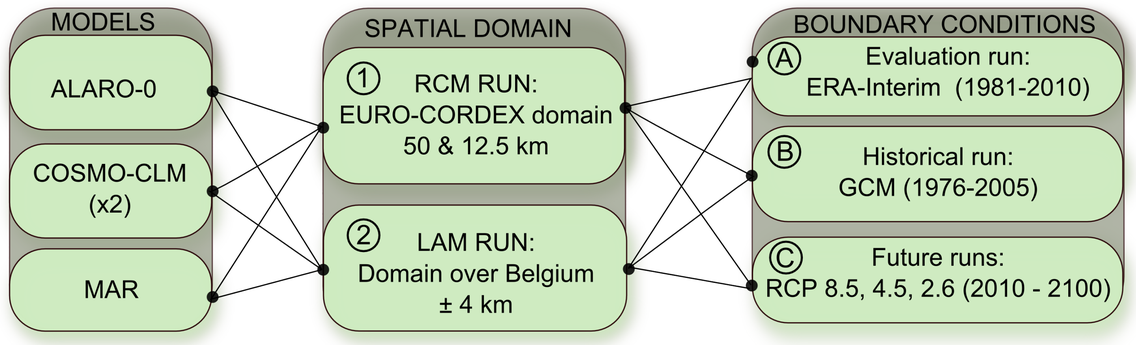


Figure 2 Table with the different combinations of planned runs for Objectives 1 & 2. A combination among each column item will be performed.

## Objectives and Organisation

- **OBJECTIVE 1: Contribute to the EURO-CORDEX Project**
  The purpose of CORDEX is to coordinate an international regional climate project using the technique of downscaling to provide ensembles of regional climate simulations with varying Global Climate Model (GCM) simulations, varying greenhouse gas (GHG) concentration scenarios, natural climate variability and different downscaling methods to sample the uncertainties in Regional Climate Change.
- **OBJECTIVE 2: High Resolutions Runs**
  Creating a small Belgian CORDEX ensemble (CORDEX.be) by using the model configurations used by the Belgian climate groups, but with a *higher resolution* than the CORDEX resolution of 12 km. These model runs are driven by ERA-Interim and different CMIP5 models using RCPs (Representative Concentration Pathways) 2.6, 4.5 and 8.5. The validation of the model runs will be done with respect to conventional observations and more sophisticated data such as radar data and GNSS products.
- **OBJECTIVE 3: Coupling to Local Impact Models** (see further for details)
  The model output of OBJECTIVE 2 will be used to drive the local-climate-impact models for urban effects, storm surges, ocean waves, vegetation emission and crop production.
- **OBJECTIVE 4: Inferring climate uncertainties to the Belgian level**
  The runs of the CORDEX.be micro-ensemble should be situated with respect to all runs in the CORDEX Archive. To this end some existing techniques from statistical downscaling and Model Output Statistics (MOS) will be used. They will be supplemented with existing expertise on MOS at the RMI. Besides using known techniques, some of the underlying assumptions in these techniques will be tested which may lead to scientific innovations.

## Objective 3: Local Impact Models

**SURFEX** or Surface Externalisée is a newly-developed surface scheme from Météo-France. Deliverables of these urban model runs will be time series of the Urban Heat-Island effect.
**UrbClim** is a three-dimensional urban climate model, developed at VITO. Deliverables will be time series of the Urban Heat-Island effect.
**REGCROP** is a regional dynamic agri-meteorological model geared towards modelling climate impact on biomass production of arable crops. Deliverables will be the impact of the different scenarios on different Belgian agro-ecological zones.
**COHERENS** is the model used to simulate tides and storm surges in the North Sea and Continental Shelf. Wave heights will be modelled with WAM. Deliverables will be past and future time series of storm surges and wave heights.
**MEGAN-MOHYCAN** model enables the calculation of fluxes emitted by the vegetation. It couples two submodels, namely the Model of Emissions of Gases and Aerosols from Nature (MEGAN), and the MOdel of HYdrocarbon Emissions from the CANopy (MOHYCAN). Deliverables of these model runs will be time series of the future "local ozone production" index.

## Objective 1: Early results

Preliminary results are presented in Figure 3, showing climate change of temperature in Belgium. Results from three combinations of future time periods and greenhouse gas scenarios are shown.

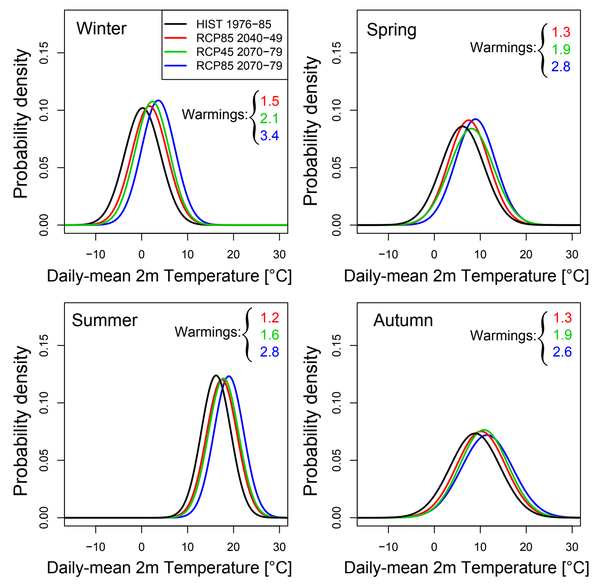


Figure 3 Distributions of 10-year daily-mean temperatures (normal fit based on mean and variance) at Uccle (Belgium), for the different seasons and different climate runs with the ALARO-0 model.

## Acknowledgements

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