DEPARTMENT OF **EARTH AND ENVIRONMENTAL SCIENCES**
KU Leuven - BELGIUM

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To provide a high-quality convection-permitting ensemble member for the Belgian climate change with the COSMO-CLM model

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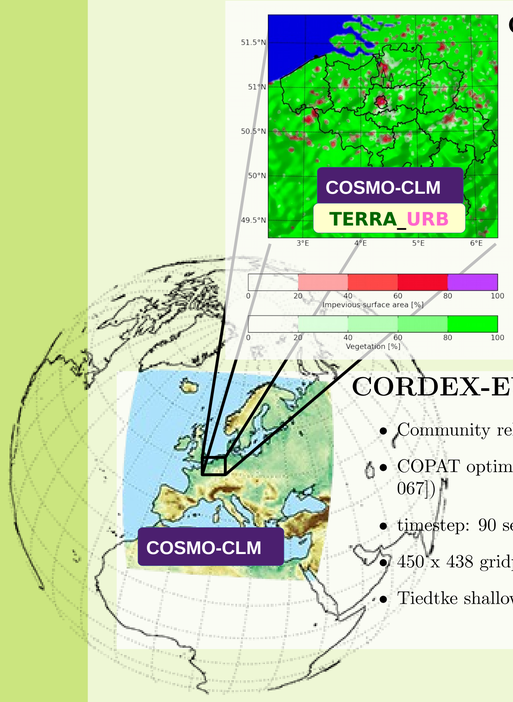
Model setup



CORDEX.be(∗) 0.025°

- COSMO5.0-CLM6 with TERRA_URB v.2 (Wouters et al., [Poster P17 S10-078])
- CRCS optimal configuration (Brisson et al., 2016,2015; Prein et al., 2015)
- Timestep: 20 seconds
- 192 x 175 gridpoints and 40 vertical layers
- Deep convection is resolved; only shallow convection parametrization

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- Community release COSMO5.0-CLM6
- COPAT optimal configuration (see poster Anders et al., [Poster P29 S07-067])
- timestep: 90 seconds
- 450 x 438 gridpoints and 40 layers
- Tiedtke shallow and deep convection parametrization.

Scenarios

Downscaling ERA-INTERIM

EXP-ID	Model setup	period	urbanisation
ERA_EUR	CORDE.EU	1979 → 2014	-
└ ERA_BEL_URB2000	CORDEX.be	1979 → 2014	ref. year 2000
└ ERA_BEL_URB2060	CORDEX.be	1979 → 2014	ref. year 2060
└ ERA_BEL_VEGSCEN	CORDEX.be	1979 → 2014	vegetation scenario

[*example application on right panel*]

Downscaling RCP8.5 member EC-EARTH KNMI '14

EXP-ID	Model setup	time frame	urbanisation
ECE_EUR_CTRL	CORDE.EU	Control / 1975 → 2005	-
└ ECE_CTRL_BEL_URB2000	CORDEX.be	Control / 1975 → 2005	ref. year 2000
└ ECE_CTRL_BEL_URB2060	CORDEX.be	Control / 1975 → 2005	ref. year 2060
ECE_FUT1_EUR	CORDE.EU	RCP8.5 / 2040 → 2070	-
└ ECE_FUT1_BEL_URB2000	CORDEX.be	RCP8.5 / 2040 → 2070	ref. year 2000
└ ECE_FUT1_BEL_URB2060	CORDEX.be	RCP8.5 / 2040 → 2070	ref. year 2060
ECE_FUT2_EUR	CORDE.EU	RCP8.5 / 2070 → 2100	-
└ ECE_FUT2_BEL_URB2000	CORDEX.be	RCP8.5 / 2070 → 2100	ref. year 2000

Ensemble median member selection

Given the field variables X_v of interest (eg., averaged summer temperature, total winter precipitation...), the i-th GCM ensemble member is selected for which the following metric is minimal (G_v are the user-preferred variable weight-factors):

$$\sum_v G_v \frac{\left|\Delta X_{v,i} - \left(\sum_j \Delta X_{v,j}\right)/n\right|}{\left(\sum_j |\Delta X_{v,j}|\right)/n}$$

Research questions

- How do climate-change statistics for Belgium modify when going from coarse resolution modelling to high-resolution modelling in terms of extreme precipitation and heat waves?
  1. What is the role of resolving deep convection and urbanization?
  2. Does there exist a robust translation between the course and high-resolution signal?
- What is the relative impact and synergy between the urban expansion and increased green-house gases on the differen climate-change statistics?
  → Can these impacts be included in the coarse-to-high resolution translation?

(∗)

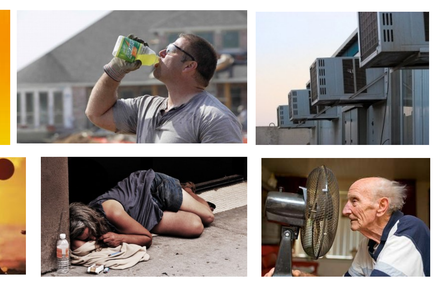
CORDEX.be — *"Coherent and detailed information about climate change statistics, uncertainty and impacts for Belgium with a micro-ensemble of regional climate models and local impact models"* — *for stakeholders*

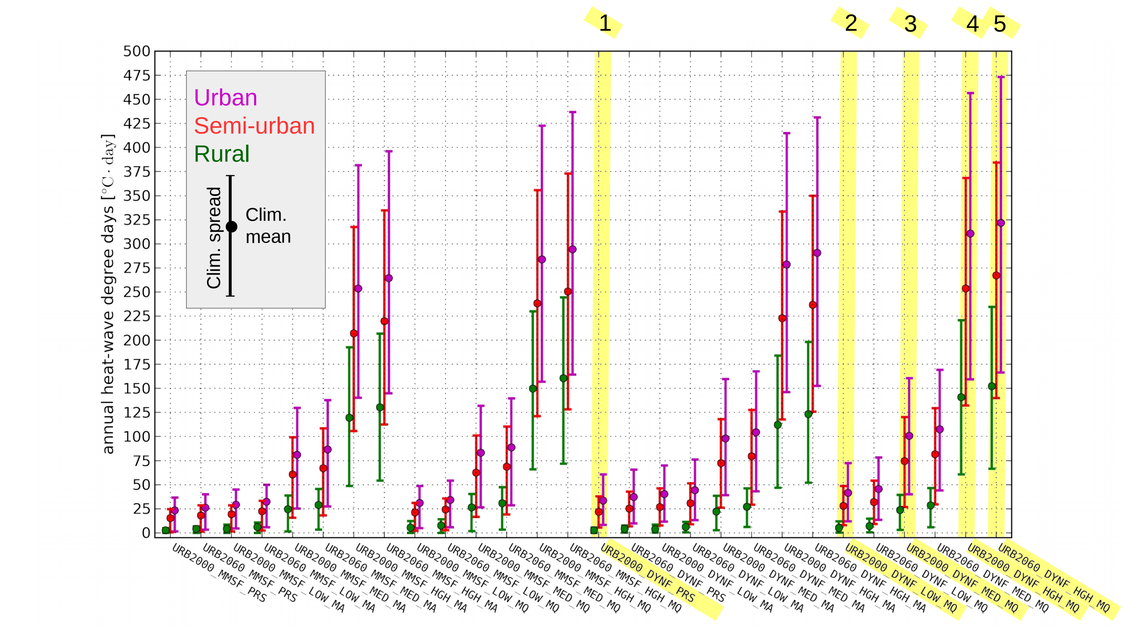
Example application: fine-meshed heat stress reconstruction and scenarios for Belgian cities

Heat wave degree days

$$\sum_i \left[(T_{\min,i} - 18.2)^+ + (T_{\max,i} - 29.6)^+\right] h_i$$

with the sum over the heat-wave days (where $h_i = 1$)





urban scenario

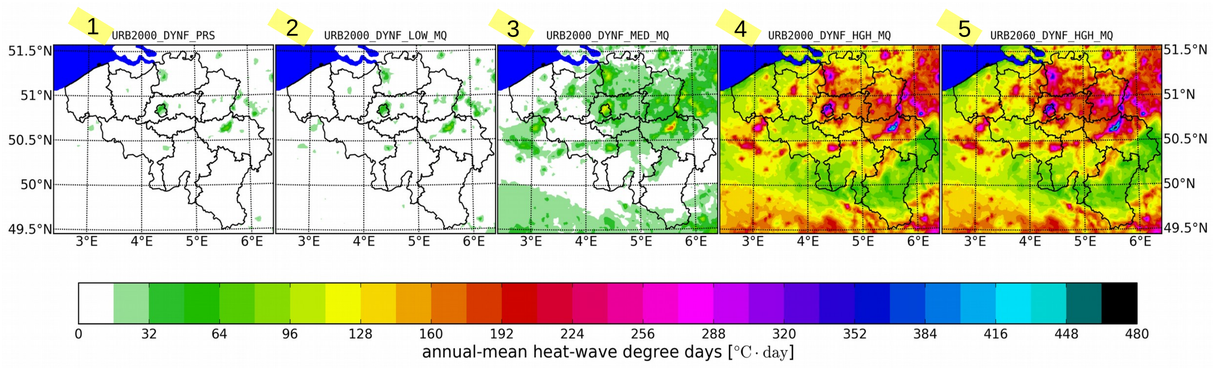
ID	description
URB2000	present-day urbanisation; reference year 2000
URB2060	future urbanisation; reference year 2060

time dependence of downscaling

ID	description
DYNF	DYNamic Field from baseline
MMSF	Monthly-Mean Static Field

60-year climate 'delta-change' (Tabari et al., 2014) greenhouse-gas scenarios

ID	description	ensemble change basis for T_{min} and T_{max}
PRS	present-day scenarios: composite of E-OBS and ERA-INTERIM-driven COSMO-CLM model output (ERA_BEL_URB20XX)	-
LOW_MA	GCM ensemble LOW scenario (∼ RCP2.6)	Monthly Average
MED_MA	GCM ensemble MED scenario (∼ RCP4.5)	idem
HGH_MA	GCM ensemble HiGH scenario (∼ RCP8.5)	idem
LOW_MQ	GCM ensemble LOW scenario (∼ RCP2.6)	Monthly Quantiles average
MED_MQ	GCM ensemble MEDium scenario (∼ RCP4.5)	idem
HGH_MQ	GCM ensemble HiGH scenario (∼ RCP8.5)	idem



Key points

- Belgian cities are hotspots of climate change
- Largest future excess in urban heat stress stems from averaged temperature increase due to greenhouse-gas change
- Additonal heat excess results from:
  1. Excess GHG temperature increase for the heat waves
  2. Coincidence of heat islands and heat waves
  3. Urban expansion
- Urban heat stress largely depends on the regional context:
  1. Small versus large cities
  2. Coastal versus inland cities

Wouters, H., N. P. M. van Lipzig, S. Vanden Broucke, L. Poelmans, P. H. Talaee, H., Tabari, J. Brouwers, K. De Ridder, D. Lauwaet, B. Maiheu, M. Demuzere: Impact assessment of green-house gas change and urban land-use change on heat-stress in Belgium for regional mitigation and adaptation support. *[in preparation]*