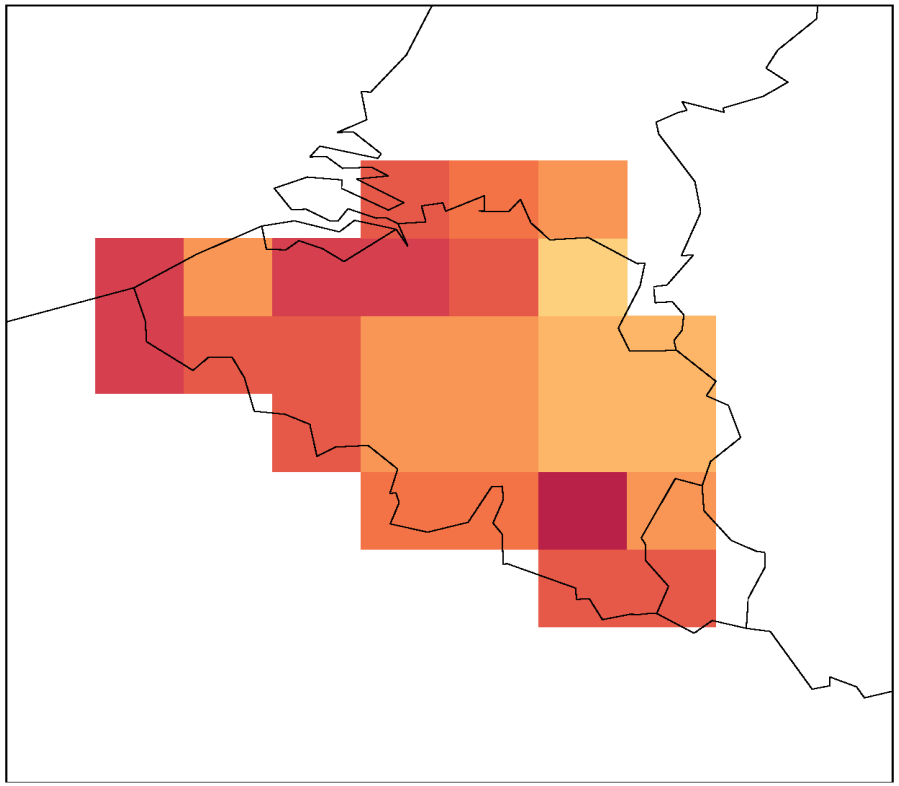
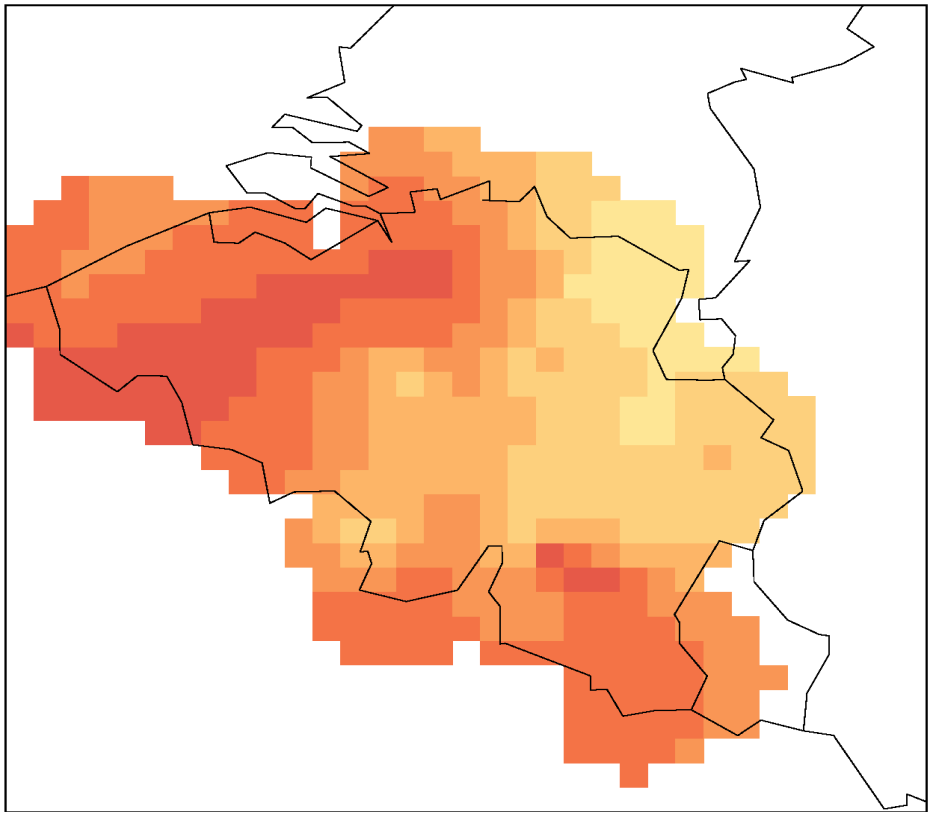
Température maximale en été

a) ALD40, 50 stations mean= 2.18 °C

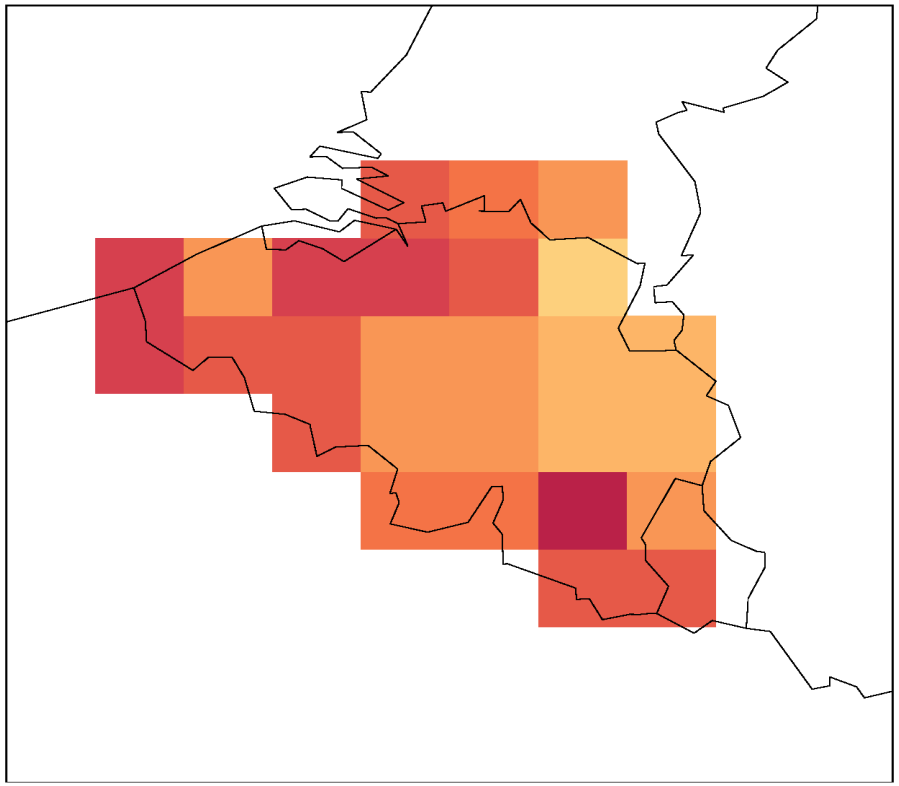


b) ALD10, 50 stations mean= 1.68 °C

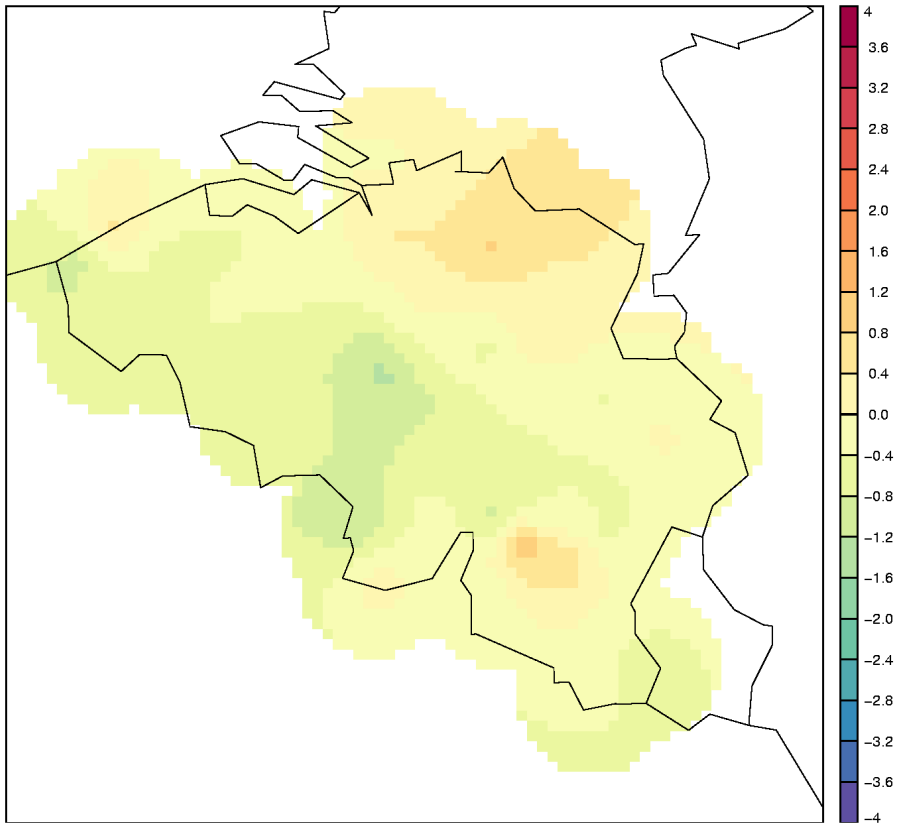


Température maximale en été

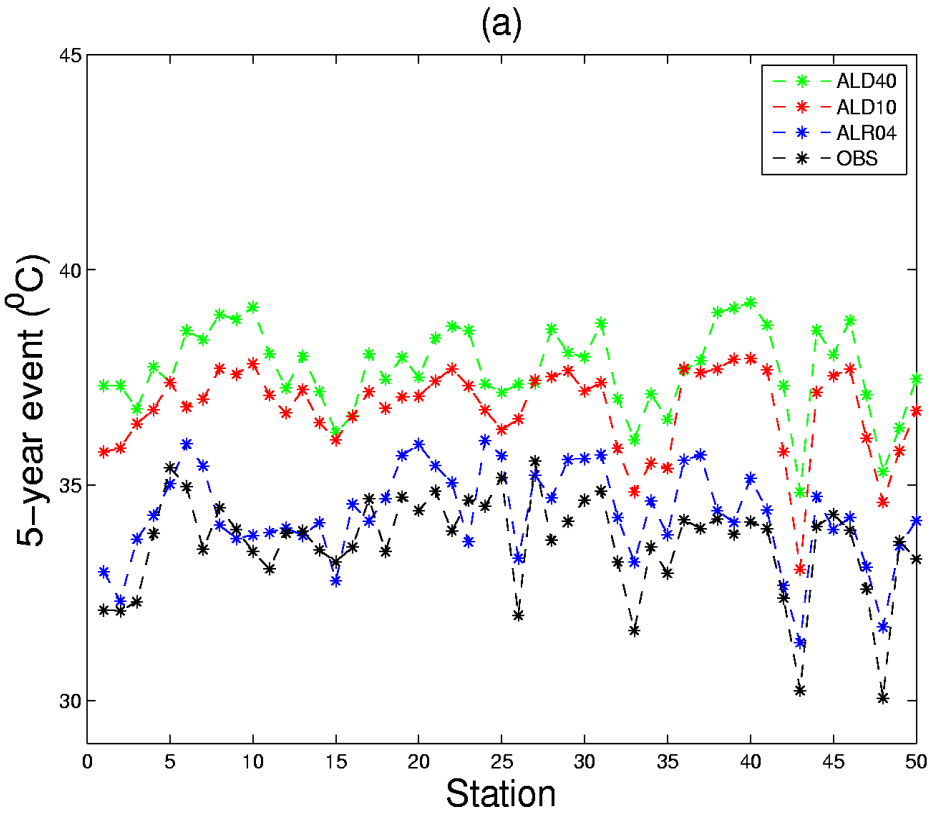
a) ALD40, 50 stations mean= 2.18 °C

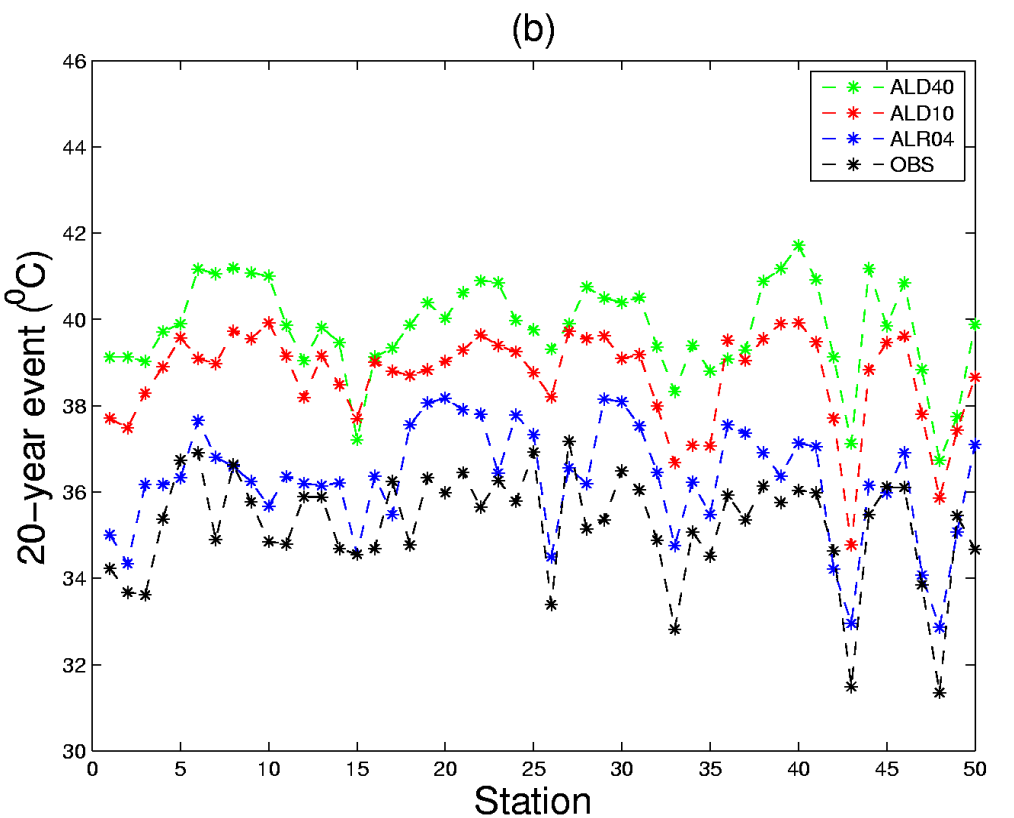


c) ALR04, 50 stations mean= –0.22 °C



Extreme Value Analysis with the Peak-Over-Threshold methods





Un downscaling dynamique à haute résolution en utilisant une nouvelle paramétrisation des nuages et de la microphysique : Application aux températures maximales estivales en Belgique

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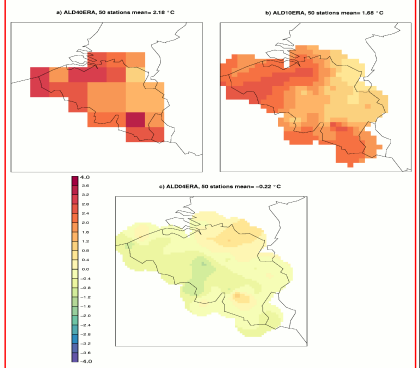
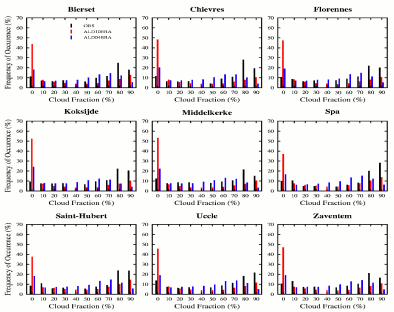
Maximum Temperature



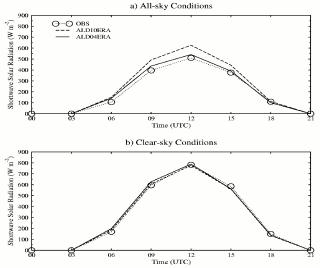
Spatial distribution of 30-years average summer biases (model minus observed) of the daily maximum temperature obtained with ALD40 (a), ALD10 (b), and ALR04 (c). The mean bias over the 50 climatological stations is indicated at the top of each sub figures.

Cloud Fraction



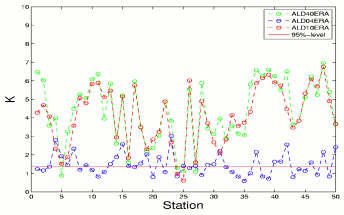
Frequency of occurrence of 3-hourly mean cloud fraction for the 9 stations belonging to the synoptic network of the Royal Meteorological Institute of Belgium.

Surface Solar Radiation



30-years mean diurnal cycle of 3-hourly mean shortwave solar radiation observed at Uccle and simulated with ALD10 and ALR04, (a) for all-sky conditions and (b) for clear-sky conditions.

Extreme Value Analysis with the Peak-Over-Threshold methods



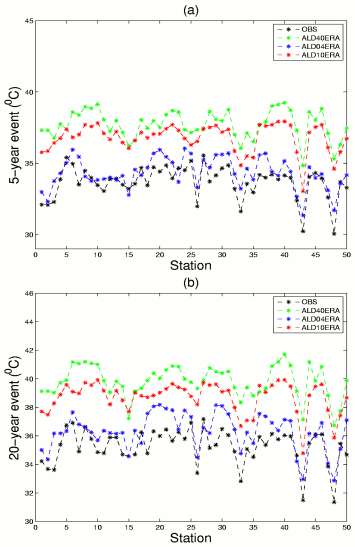
ALD10, and ALR04. The threshold value for each dataset is chosen in such a way that there are, on average, $\lambda = 5$ excesses per year. We have used the classical two-sample Kolmogorov–Smirnov test to investigate whether the underlying probability distribution of the POT events of the observations and a model mutually differs. The test statistic is $D_{n_1,n_2} = Max|F_{n_1}(x) - F_{n_2}(x)|$.

Where $F_{n_1}(x)$ and $F_{n_2}(x)$ are the empirical distribution functions of the observations and the model respectively, and n_i refers to number of samples. The null hypothesis is rejected at level α if

$$K = \sqrt{\frac{n_1 n_2}{n_1 + n_2}} D_{n_1,n_2} > K_\alpha \qquad (14)$$

where K_α is the critical α-level of the Kolmogorov distribution:

$$\Pr(K \leq K_\alpha) = 1 - \alpha. \qquad (15)$$



Estimation of 5-year (a) and 20-year (b) events in every location from observations and model runs (ALD40, ALD10, and ALR04).

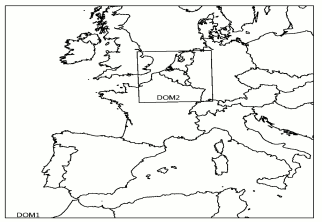
Heat Wave

Here we use the definition of heat waves proposed by Huth et al. (2000) and employed in recent European studies. Two thresholds, T1 and T2 are applied: a heat wave is defined as a continuous period of at least 5 days during which:

(1) TMAX is higher than T1 in at least 3 days,
(2) mean TMAX over the whole period is higher than T1 , and
(3) TMAX does not drop below T2 .
The threshold values were set to T1 = 30 ° C and T2 = 25 ° C,

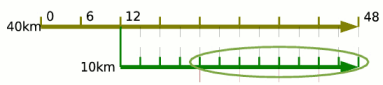
The number of heat wave events observed at the Uccle station, is 8 events between 1961 and 1990. While the ALR04 simulation reproduces exactly the same number, the ALD10 and ALD40 values are much higher, 29 and 41, respectively.
To characterize heat wave intensity, we calculate the 5-day cumulative TMAX excess above 30 ° C. The ALR04 value is very close to the observed one, 110 and 111 ° C, respectively, while the ALD10 value is exacerbated 350 ° C.
All indicate that ALR04 results are much more realistic than ALD10 in simulating the number and intensity of heat wave events and thus considered also to be more credible for projecting future climate change.

Model Configuration



Domains for ALADIN simulations, DOM1 represents the 40 km horizontal resolution whereases DOM2 represent the nested domain with 10 km and 4 km horizontal resolution.

Simulation Set-up



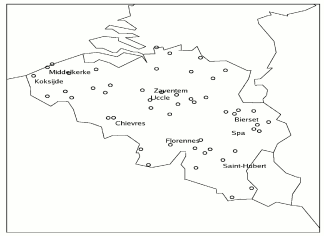
Our procedure is to interpolate ERA40 to 40 km resolution. These 6-h files serve as initial and boundary conditions for a 48 h ALADIN run at 40 km resolution (ALD40). These are started at 00 UTC every day.

The (3-h) output from this first run serves as input for the high-resolution 10 km run (ALD10) and also for the very high-resolution 4 km run (ALR04).

However, to avoid spin-up problems, the first 12 h are not taken into account. So we have 36 h of data left for the 4 and 10 km runs (which thus start at 12 UTC).

Finally, we again dismiss the first 12 h of the runs, to arrive at 24 h of (3 h) output at 4 km and 10 km resolution, and then integrate/re-initialize over each subsequent 24 h period during the summer period of June–July–August, 1961–1990.

Station Data



The station data used in this study has been retrieved from the climatological network of the RMI. It is based on the daily maximum temperature (TMAX) over the period of 1961–1990.
However, in order to have a homogeneous network without substantial interruptions, 50 stations were selected.

A further dataset used in this study is the ground-based measurement of solar radiation in Uccle 1961-1990.

References:

ALADIN international team. 1997. *The ALADIN project: Mesoscale modelling seen as a basic tool for weather forecasting and atmospheric research.* ***WMO Bull. 46: 317-324.***

Gerard L, Piriou JM, Brozková R, Geleyn JF, Banciu D. 2009. *Cloud and Precipitation parameterization in a Meso-Gamma-Scale operational weather prediction model.* ***Monthly Weather Review 137: 3960-3977.***

Hamdi R., H. Van de Vyver, P. Termonia. *Regional climate of summer maximum surface air temperature over Belgium through high-resolution dynamical downscaling.* ***International Journal of Climatology, DOI: 10.1002/joc.2409, 2011.***