Sensitivity of COSMO-CLM Regional Climate Model to the domain selection

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September 9, 2016

List of Acronyms

CCLM COSMO-CLM

RCM Regional Climate Model

T2M 2 meter Temperature

RMSE Root Mean Square Error

Abstract

This is a report on how domain selection of COSMO-CLM (CCLM) Regional Climate Model (RCM) will alter the forecast estimate. Also the sensitivity of the model to the buffer zone is investigated.

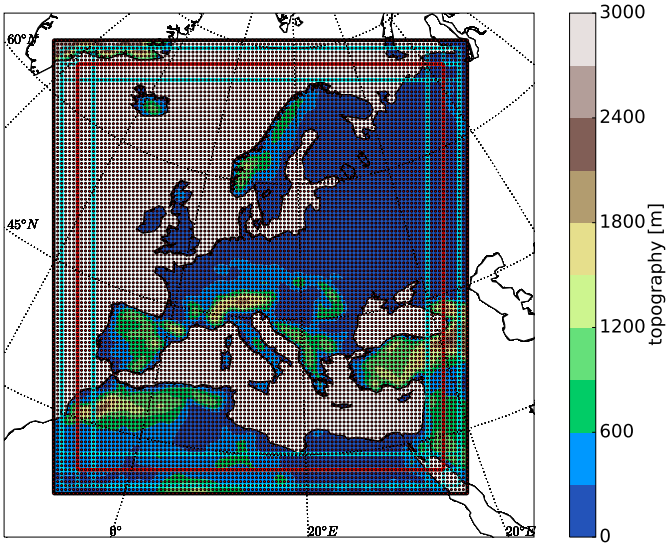

Figure 1: Model topography and domains. Red box shows the default domain. Black solid box indicates the int2lm domain and the cyan boxes the shifted domains.

0.1 Experiment Set-up

In order to investigate the domain selection impact on the model results, I designed the following procedure:

i) Set-up the **Default** run of CCLM over Europe (CCLM domain 4 grid points smaller than int2lm domain).

ii) Set-up 8 similar runs with the Default run but shifted 4 grid points to different directions(1. East, 2. North-East, 3. North, 4. North-West, 5. West, 6. South-West, 7. South, 8. South-East) with the $nboundlines = 3$.

The model is set up using the default namelist from CLM community. The model is integrated for a 6 year period 1990-1996. The monthly mean values of 2 meter Temperature (T2M) for the last year (12 months) are used for analysis (first 5 years are considered as spin-up). The code contains the CCLM5.0_clm8 and INT2LM2.0_clm4 version.

Figure 1 shows the default domain along with the 8 different shifted domains. To evaluate the differences in model output on T2M, I have used the Root Mean Square Error (RMSE) as a metric. Results show that shifting in Northwest direction produces the greatest RMSE values (Figure 2). Therefore, in the next step only this direction will be considered for further investigation.

The distance between the shifted domain (red dashed box in Figure 2) and the int2lm domain is 2 grid points ($2 \times 0.44^{\circ}$). In the next step this distance will be increased. To achieve this goal I have decreased the CCLM domain size

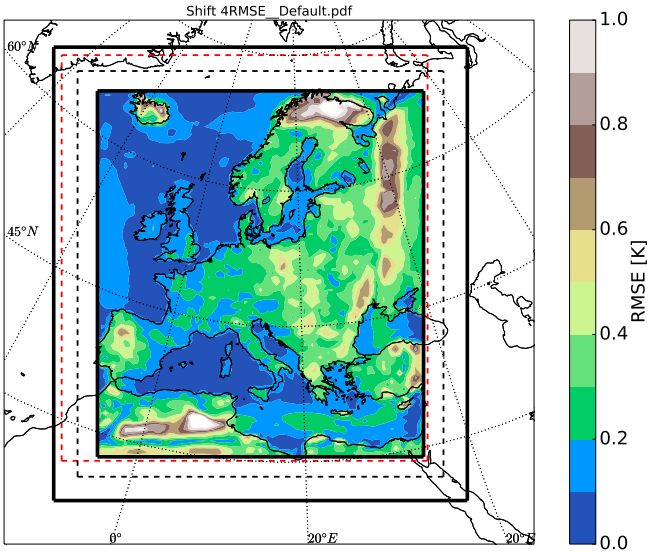

Figure 2: RMSE of T2M [K] between the shifted domain in the Northwest direction (dashed red box) and the default domain (dashed black box). The int2lm domain is the solid black box.

so that it is 20 grid points smaller than the int2lm domain. Figure 3 shows the RMSE of the new set-up. The RMSE pattern remains very similar to the previous setting with minor reduction on Southwest of domain.

In the next step the the offset position of lateral physical boundary from the outer boundaries (nboundlines in the CCLM namelist) is set to 4, 6 and 9 instead of 3. According to the COSMO user guide: "All grid points interior to the physical boundary constitute the computational (or model interior) domain, where the model equations are integrated numerically. The extra points outside the interior domain constitute the computational boundaries. At these points, all model variables are defined and set to specified boundary values, but no dynamical computations are done. " Figures 4, 5 and 6 show the changes in RMSE by increasing the nboundlines, respectively.

0.2 New model set-up after discussions at CLM Community

The previous discussions can be found here. The external parameter using the WebPEP are extracted with the parameters shown in Table 0.2 .

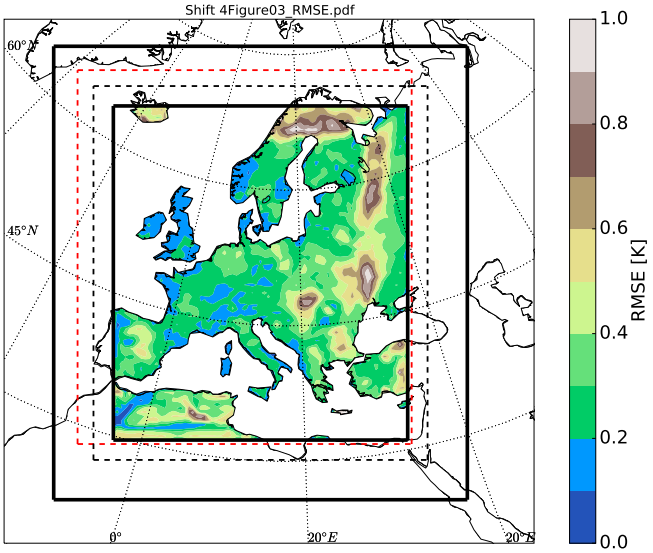

Figure 3: RMSE of T2M [K] between the shifted domain in the Northwest direction (dashed red box) and the default domain (dashed black box). The int2lm domain is the solid black box.

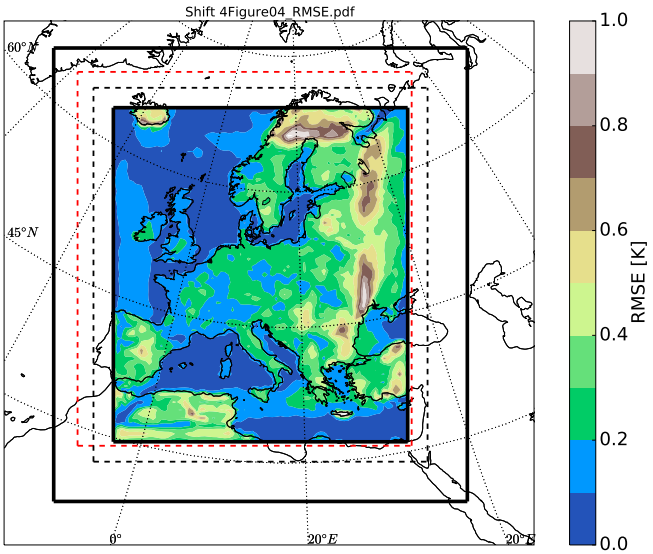

Figure 4: RMSE of T2M [K] between the shifted domain in the Northwest direction (dashed red box) and the default domain (dashed black box) with the nboundlines parameter set to **4**. The int2lm domain is the solid black box.

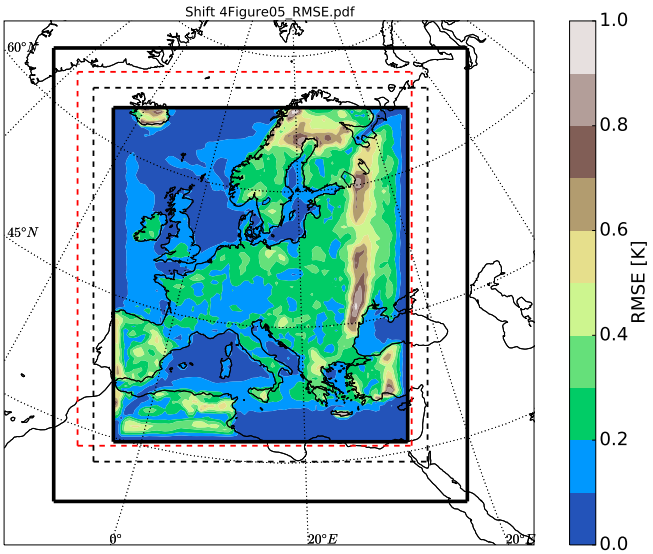

Figure 5: RMSE of T2M [K] between the shifted domain in the Northwest direction (dashed red box) and the default domain (dashed black box) with the nboundlines parameter set to **6**. The int2lm domain is the solid black box.

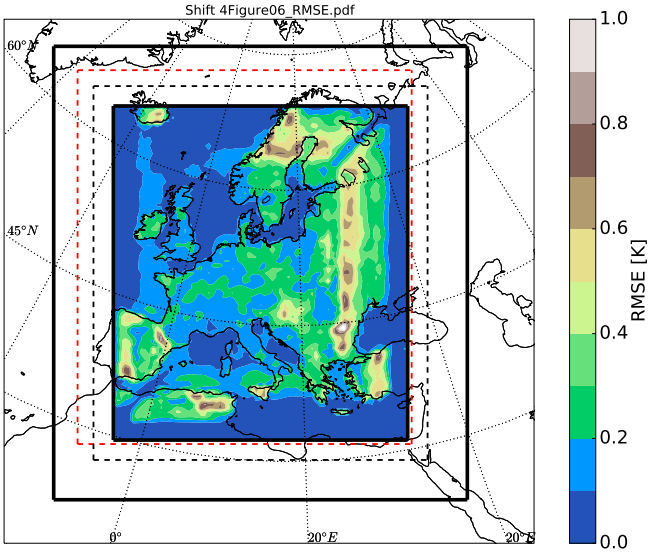

Figure 6: RMSE of T2M [K] between the shifted domain in the Northwest direction (dashed red box) and the default domain (dashed black box) with the nboundlines parameter set to **9**. The int2lm domain is the solid black box.

External Data	
Parameter	Value
Model version	EXTPAR-3.0
pollon	-165
pollat	46
polgam	0
ie_tot	155
je_tot	150
startlon_tot	-34
startlat_tot	-30
dlon	0.44
dlat	0.44
oro	1
orofilter	1
landuse	2
soil	1
tcl	1
aot	1
albedo	2
urban	0