Project No. 037005

CECILIA

Central and Eastern Europe Climate Change Impact and Vulnerability Assessment

Specific targeted research project

1.1.6.3.I.3.2: Climate change impacts in central-eastern Europe

D2.2: forcing files from ARPEGE for the different versions of ALADIN

Due date of deliverable: 1st January 2007
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Lead contractor for this deliverable: CNRM

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination Level		
PU	Public	X
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

ARPEGE simulation

In deliverable D1-3, a 151-year simulation has been produced with the global model ARPEGE. This model has a variable resolution of 50 km over southern Europe, decreasing to 300 km at the antipodes. The version used was version 4. This simulation covers the 1950-2100 period. Beyond 2000, the SRES-A1B radiative forcing were used. The model uses sea surface temperature (SST) from a CNRM ocean-atmosphere coupled version at lower resolution (uniform 300 km). The monthly mean SST are corrected for each calendar month by subtracting the mean error over the 1958-1999 period.

ALADIN forcing files

ALADIN is nothing more than an ARPEGE version on a torus rather than on a sphere. ARPEGE covers the globe with a spectral representation of altitude fields in spherical harmonics. ALADIN covers a rectangle extracted from a Lambert projection of the globe with a spectral representation of altitude fields in bidimensional Fourier fonction. The double peridicity is ensured not too be detrimental by inclusion of a non-geographic transition area at the North and the East of the domain (so-called extension zone). ARPEGE and ALADIN use the same executable (same dynamical core, same physical parameterizations) and differ only by the spectral-to grid point transforms and inverse transforms. Indeed most calculations are performed on series of grid points, the spectral representation being used for horizontal derivatives and horizontal diffusion only.
The ARPEGE-ALADIN software inculdes a very powerful tool which transforms a file with prognostic variables from one geometry to another one. The interpolation takes care of surface elevation, land-sea mask and vertical structure of the planetary boundary layer. With such a tool an ARPEGE file can be transformed into an ALADIN file, or an ALADIN file over one domain can be transformed into an ALADIN file over another domain, provided that the latter is included in the former. In ALADIN lateral boundary forcing files are simply files containing all prognostic variables over the whole domain (including the extension zone). They can be used to restart the model as well, and are produced from ARPEGE or bigger ALADIN files with the above described software.
In CECILIA, we want to study two periods: the 2021-2050 and the 2071-2100 period. The latter period is useful because the signal (global warming) to noise (natural variability) is greater than in the former period. The former period corresponds to a frequent request of end-users about a possible future they want to manage. It is therefore necessary to create lateral boundary every six hours for the whole periods. In addition, we need a couple of months in the preceding year to allow a proper stabilization of soil variables with long memory like deep soil moisture or snow cover; we chose to start during winters 2019-2020 and 2069-2070.
In CECILIA three different domains are considered: Czech Republic, Hungary and Bulgaria. We need to create lateral boundary forcing files for each domain.

Practical aspects

The above described transform software is time consuming (one real day to create one year of lateral boundary forcing files), and the output is huge because the ALADIN versions are high resolution. So, producing 3 sets of boundary condition at CNRM should have been a no-return process forbiding any change on the domain once the files are created. Since CECILIA is a brand new approach for modelling partners, nobody had an accurate view on the best domain to balance the computation costs and the level of realisms. It was thus proposed that CNRM produces ALADIN files on a pan-CECILIA domain at 50 km resolution (which is the one of ARPEGE), each ALADIN partner being in charge of the transform between this domain and they own domain. This has two advantages:

- the whole forcing files fit in a 500 GB usb-disk and can be easily exchanged among partners
- each partner is free to test different domains and customize his integration area, the transfom between two ALADIN domains being less costly than between a global and a regional domain

The constraint is that the pan CECILIA domain must be large enough to anticipate the requirements of the ALADIN partners. After some discussions, we agreed upon the domain shown in Figure 1.

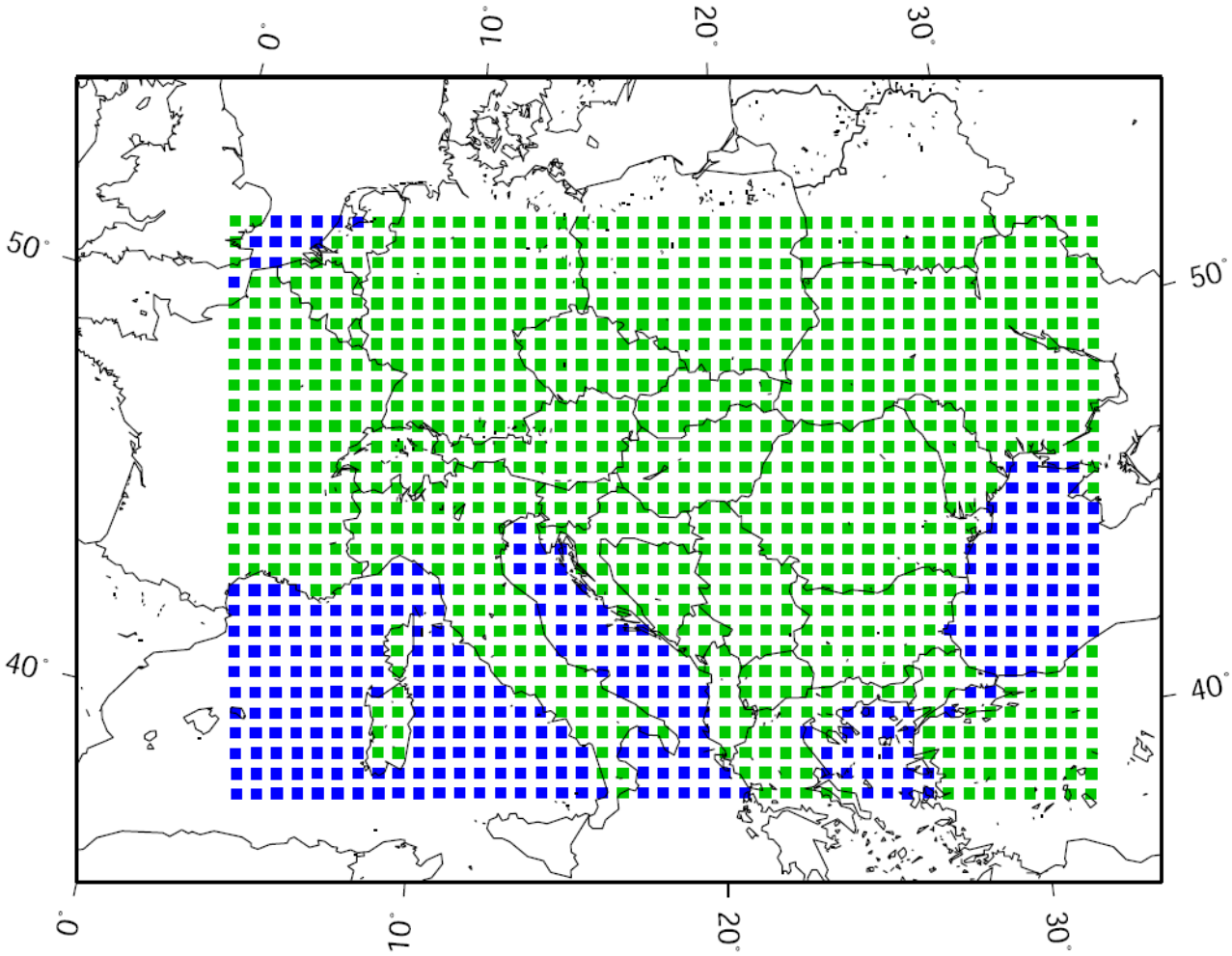

Figure 1: Domain extracted from the ARPEGE global grid used as an intermediate step before creating 10 km-resolution smaller area domains; green (resp. blue) squares correspond to land (resp. sea) grid points