Project: **892** Project title: **Mid-to-late Holocene Climate-Vegetation Simulations over central Europe** Project lead: **Emmanuele Russo** Report period: **1.1.2014 - 31.12.2015** 

We performed a set of different regional climate simulations with the COSMO-CLM version 4.8\_19 in order to study climatic changes in response to changes in the external forcings at different time periods of mid-to-late Holocene, from 6000 years before present to pre-industrial times. We focused our attention on climatic changes over Europe during this time for different reasons, including the importance of the area from an historical point of view for the development of present days cultures and the availibility of a high number of proxy data that would allow the comparison, validation and evaluation of model's results and performances for the past, with consewuent improvements of present and future predictions.

We performed in total 7 simulations at a resolution of 0.44 lon degrees over 30 years periods, for a total amount of 210 years. For each simulation we employed 8 nodes with 8 CPUs each, after having tested the best possible configuration.

For our simulations and some additional tests we employed, over two years, a total amount of 60822 computational hours, plus 11360 hours considered as expired resources.

For the year 2014 we have been granted with 57960 CPUh of which we only consumed, including expired resources, 53577 CPUh. For the year 2015 we have been granted with 14490 CPUh but we employed extra resources for a total of 19605 CPUh.

The results of the simulations are being used in different cooperations within the excellence cluster TOPOI of the FU-Berlin, for a PhD thesis at the instutute of meteorology of the FU-Berlin and for two scientific papers on peer-reviewed journals that are in process.

The relevance of the project is to be seen on the fact that, despite numerous studies for this area and period of time have been conducted, a regional climate model has never been used and important advantages are expected from the comparison of its results with proxy data and for the study of specific regions.

The results attained show important evidences.

First of all the implemention of changes to the code required for paleoclimate studies have been tested for present day conditions. In this way we are able to provide a reference for other paleoclimate studies with the COSMO-CLM.

Then we analyzed the answer of the model to changes in the external forcings. The values of simulated surface variables are compared with a set of proxy reconstructions with the final aim to investigate the physical processes driving these results. Additionally the results are used to compare the performances of the regional climate model with the ones of global climate models and to estimate the added value of regional climate models for paleoclimate studies.

What arises from the results is that the model does not perform particularly well duirng summer over southern Europe for both temperature and precipitations. From previous research during present day conditions and from the analysis of soil variables we conclude that the problem is due to the incorrect reproduction of heat fluxes and wrong soil water storage capacities and suggest that improvement of soil features for this area should be considered.

During winter the possible effect of changes in atmospheric circulation are investigated. Their effects seem to be underestimated by the model. This could be due to the fact that no significant changes in atmospherical patterns are evident and the consideration of additional time slices should provide more informations.

The results as said are also used in support of different archaeological studies.

Between these investigations are being conducted in order to study the changes in textile production over the pannonian peninsula for the mid-Holocene, for studies regarding the changes in subsistence strategies of non-sedentary communities for the area of the Black sea during the same period of time, and for the cultural, historical and social development of the area of the Göte Stepp in Turkey.

Here below are shown some of the most significant results obtained:







Figure 6: Mid-to-Late Holocene Anomalies of the CCLM outputs and data derived from a pollen dataset