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# Experiences on porting and running a Climate - Air Quality Modeling System on the Grid

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We present results of regional climate-air quality simulations performed over Europe for the future decade 2091-2100 and the control decade 1991-2000 and briefly discuss the impact of climate change on air quality metrics over Europe throughout the 21st century. In order to meet the increased demands on computational resources the high resolution simulations were performed on the EGEE Grid. Special tools to allow for easy coupling of RegCM3 and CAMx on the underlying resources have been developed and we briefly discuss the benefits and drawbacks of using the Grid for such simulation campaigns.

## Detailed analysis

The RegCM3 regional climate model has been applied for the climate simulations whereas the air quality simulations have been performed using the CAMx model. CAMx has been coupled to RegCM with a FORTRAN-based code interface, which reads the basic meteorological parameters from RegCM and converts them into the format that is expected by CAMx. The spatial resolution was set to 50km x 50km. The vertical profile of CAMx was split into 12 layers of varying thickness extending to almost 6.5km with the lower layer being 36m deep and the uppermost layer 1.2km thick. To execute our simulations on the Grid, we have implemented a DAG job. With respect to the two application models themselves, we have used their parallel versions in order to leverage the distributed resources of the Grid infrastructure. RegCM3 was compiled and linked against the MPI library, while CAMx was compiled with OpenMP. In order to facilitate the execution of the OpenMP enabled CAMx model on the Grid, we have developed a modified version of the GRAM module, which has been installed on the CE at the GR-01-AUTH cluster and which allows the scheduler to properly allocate resources for shared memory parallel applications.

## Conclusions and Future Work

Our model simulations yielded average decadal changes of tropospheric ozone up to 1.5 ppb for the mid decade of the century and higher ozone increase (1-5 ppb) in the 2090s. The response of ozone to climate change varied in magnitude depending on season the and the geographical location. Future work includes application of newly developed online coupled climate-chemistry models, which are more suitable for the study of the complicated particle interactions. One of the technical challenges is the production of large datasets, which can be efficiently managed with tools, such as AMGA and GrelC.

## Impact

The result of our work is a database of air quality data corresponding to two different time slices: a present decade 1991-2000 and a future decade (2091-2100). The air quality information concerns concentrations of gaseous species and particulate matter (O3, NOx, CO, SO2, PM10) for the present time and provides an estimation of how anthropogenic climate change may affect these concentrations at the end of the century.
This information is of great importance to the atmospheric science community and, more specifically, to the researchers involved in climate change studies and the impact on air quality metrics on regional scale.

Most of the climate change studies available in the literature focus on a global scale, where the model resolution is too coarse to resolve atmospheric phenomena over a complex terrain such as the European. In this work, we introduce regional models in the study of climate change, and work with a resolution of 50 km, which can be easily further downscaled to even finer spatial resolutions, enabling us to simulate climate-air quality phenomena on a national level.

## Keywords

Atmospheric Science, MPI, OpenMP

## URL for further information

http://www.cecilia-eu.org/meetings.htm

## Justification for delivering demo and/or technical requirements (for demos)

N/A

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