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# Computational Requirement of Meteorological and Crisis Applications

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We present several applications from the domain of meteorology and crisis management that we developed and/or plan to develop. In particular, we present the IMS Model Suite - a complex software system designed to address the needs of accurate forecast of weather and hazardous weather phenomena, environmental pollution assessment, prediction of consequences of nuclear accident and radiological emergency. We discuss the computational requirements and our experiences on how to meet them by grid computing.

## Detailed analysis

A pollution assessment and prediction requiresthe running of 3D meteorological model (4 nests with resolution from 50 km to 1.8 km, 38 vertical levels) as well as the running of the dispersion model performing the simulation of the release transport and deposition of the pollutant with respect to the numeric weather prediction data, released material description, topography, land use description and user defined simulation scenario. Several post-processing options can be selected according to the particular situation.
Another application is the forecasting of fog as one of the meteorological phenomena hazardous to aviation and road traffic. It requires complicated physical model and high resolution meteorological modeling. An installed fog modeling system requires a 4 time nested parallelized 3D meteorological model to be run four times daily. The 3D model outputs and a multitude of local measurements are utilized by the SPMD-parallelized 1D fog model run every hour.
The fog forecast model is a subject of parameter calibration before its real deployment. For each parameter, it requires re-running of the hundreds of historical situations and comparison with the observed data.

## Conclusions and Future Work

We found grid computing useful for our applications. We are satisfied with this technology and our experience encourages us to extend its use.

Within an ongoing project (DMM) we plan to include the processing of satellite images which extends our requirement on computation very rapidly. We believe that thanks to grid computing we are able to handle the job almost in real time.

## Impact

The architecture and inherent heterogeneity of both examples, and their computational complexity and their interfaces to other systems and services, make them well suited for decomposition into a set of web and grid services.
Such decomposition has been performed within several projects in which we have participated in cooperation with the academic sphere, namely int.eu.grid (dispersion model deployed as a pilot application), SEMCO-WS (semantic composition of web and grid services) DMM (development of a significant meteorological phenomena prediction system based on the data mining), VEGA 2009-2011 and EGEE III.
We present useful and practical applications of technologies of high performance computing. The use of grid

technology provides access to much higher computation power not only for modeling and simulation, but also for the model parameterization and validation. This results in the model parameters optimization and more accurate simulation outputs. Since the simulations are used for the aviation, road traffic and crisis management, even a small improvement in the accuracy of predictions may result in a significant improvement of safety as well as a cost reduction.

## Keywords

High performance computing, meteorological model, hazardous phenomena, fog, environmental modeling

## URL for further information

http://www.microstep-mis.com, http://www.i2g.eu/, http://semco-ws.ui.sav.sk/

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