Geophysical Research Abstracts
Vol. 12, EGU2010-13778, 2010
EGU General Assembly 2010

Grid-based Meteorological and Crisis Applications

Ladislav Hluchy (1), Juraj Bartok (2), Viet Tran (1), Andrej Lucny (2), and Martin Gazak (2)

(1) Institute of Informatics, SAS, Department of Parallel and Distributed Computing, Bratislava, Slovakia (viet.ui@savba.sk), (2) Microstep-MIS, Bratislava, Slovakia

We present several applications from domain of meteorology and crisis management we developed and/or plan to develop. Particularly, we present 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 requirements on computational means and our experiences how to meet them by grid computing.

The process of a pollution assessment and prediction of the consequences in case of radiological emergence results in complex data-flows and work-flows among databases, models and simulation tools (geographical databases, meteorological and dispersion models, etc.).

A pollution assessment and prediction requires running of 3D meteorological model (4 nests with resolution from 50 km to 1.8 km centered on nuclear power plant site, 38 vertical levels) as well as 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 particular situation (e.g. doses calculation).

Another example is a forecasting of fog as one of the meteorological phenomena hazardous to the aviation as well as road traffic. It requires complicated physical model and high resolution meteorological modeling due to its dependence on local conditions (precise topography, shorelines and land use classes). An installed fog modeling system requires a 4 time nested parallelized 3D meteorological model with 1.8 km horizontal resolution and 42 levels vertically (approx. 1 million points in 3D space) to be run four times daily. The 3D model outputs and multitude of local measurements are utilized by SPMD-parallelized 1D fog model run every hour.
The fog forecast model is a subject of the parameterization and parameter optimization before its real deployment. The parameter optimization requires tens of evaluations of the parameterized model accuracy and each evaluation of the model parameters requires re-running of the hundreds of meteorological situations collected over the years and comparison of the model output with the observed data.

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 we participated or participate in cooperation with academic sphere, namely int.eu.grid (dispersion model deployed as a pilot application to an interactive grid), SEMCO-WS (semantic composition of the 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. Having taken into account that the simulations are used for the aviation, road traffic

and crisis management, even small improvement in accuracy of predictions may result in significant improvement of safety as well as cost reduction.

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 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.