Contribution ID: **12** Type: **poster**

A Grid application to ensemble ocean forecasting

Wednesday 9 May 2007 17:30 (20 minutes)

Describe the scientific/technical community and the scientific/technical activity using (planning to use) the EGEE infrastructure. A high-level description is needed (neither a detailed specialist report nor a list of references).

The Istituto Nazionale Geofisica e Vulcanologia runs an operational oceanographic system called Mediterranean Forecasting System. The long term goal of this project is to collect high quality data and provide reliable environmental predictions for the Mediterranean Sea. End user applications of ocean forecast span from contaminant drift predictions to search and rescue operations. An ensemble forecast system is currently under investigation to provide estimates of forecast uncertainties.

Report on the experience (or the proposed activity). It would be very important to mention key services which are essential for the success of your activity on the EGEE infrastructure.

Two techniques for generating an ocean ensembles were successfully tested on the Grid. The first approach is based on a random perturbation of the initial conditions of the ocean forecast. This is highly efficient because all the members are initialized using the same input files, only the seed numbers needed to be transferred to the Grid Working Nodes. The results show that a minimum number of 450 members were successfully accomplished in 5 hours. This result was achieved using 15 Computing Elements and imposing a simple requirement policy to the Grid software manager. The second approach relies on the perturbation of the wind forcing. All the ocean members start from the same initial condition but are driven by different wind realizations. This significantly increase the amount of data that must be transferred through the network. Preliminary results showed that the Grid system was able to sustain this working load for a 100 members ensemble set up.

With a forward look to future evolution, discuss the issues you have encoun-

tered (or that you expect) in using the EGEE infrastructure. Wherever possible, point out the experience limitations (both in terms of existing services or missing functionality)

So far every member of the ocean ensemble was run on a single Working Node. This
represents a limitation to the size of the problem that can be treated.
While a natural evolution to this problem will be apply a Message Passage Interface a
second strategy will also be tested. Since many events that would benefit from an
ocean ensemble forecast are localized in a small portions of the model domain, an
high-resolution limited-domain ocean model might be the best compromise for the Grid
environment.

Describe the added value of the Grid for the scientific/technical activity you (plan to) do on the Grid. This should include the scale of the activity and of the potential user community and the relevance for other scientific or business applications

The subject of this study is the understanding and the demonstration of the usage of
the Grid system in ensemble ocean forecasting.
Short term ocean forecast are externally driven by atmospheric forecasts. The MFS
system collects ECMWF atmospheric forecast daily. To be effective an ocean ensemble
forecast must be run within the time constraints imposed by the availability of the
ECMWF products. To test the potential of the Grid for this purpose, the time window
allowed for a 10 days ocean forecast with an ensemble of 1000 forecasts was set to 6
hours.
This experiment was run in collaboration with the Istituto Nazionale di Fisica
Nucleare on the INFN Grid. This work demonstrated that an extremely large ocean
ensemble forecast, that would be unfeasible on most of the other computer
infrastructures, could be run on a Grid system under operational forecasting working
conditions and normal Grid configuration.

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Session Classification: Poster and Demo Session