

SYSTEM ASPECTS OF THE
OPERATIONAL MULTI-SCALE ENVIRONMENT MODEL WITH GRID ADAPTIVITY

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1. INTRODUCTION

In order to improve the fidelity of hazardous transport models, it is essential that the meteorological forecast itself be improved. This is because the modeling of atmospheric dispersion involves virtually all scales of atmospheric motion from microscale turbulence to planetary scale waves. The current operational atmospheric simulation systems are scale specific and cannot resolve the full spectrum required for the accurate forecast of local scale phenomena. Even with recent advances in computational power, the current architecture and physics of today's generation of atmospheric models cannot fully simulate the scale interaction of the atmosphere. Recently, several groups have started the development of non-hydrostatic, nested (multiply nested in some cases) atmospheric models, however these represent an incremental evolutionary path in atmospheric simulation.

OMEGA, with its embedded Atmospheric Dispersion Model (ADM) was conceived to advance the state-of-the-art in predicting the transport and diffusion of hazardous releases. The bulk of hazardous releases occur near the surface, are dispersed primarily in the PBL, and are strongly influenced by surface features. These hazardous releases often require emergency response. Effective emergency response, in turn, requires the highest possible resolution of both the atmospheric state as well as the aerosol concentration. The grid structure, numerical basis, and physical models encapsulated by OMEGA have been discussed elsewhere (Bacon *et al.*, 1993, 1996), this paper is intended to discuss the system aspects of OMEGA that play an important role in providing its utility as a hazard response system.

2. BASIC PHILOSOPHY

The basic philosophy of the OMEGA/ADM model development has been the creation of an operational tool for real-time hazard prediction. The model development has been guided by two basic

design considerations in order to meet the operational requirements: (1) the application of an unstructured mesh numerical technique to atmospheric simulation; and (2) the use of an embedded atmospheric dispersion algorithm. The goal of an operational tool, however, provided the impetus for the creation of two important parts of the OMEGA system: OMEGA_X, the graphical user interface (GUI) for the OMEGA system, and XGRID, the OMEGA graphics post-processor. In addition, in order to meet the requirement of worldwide applicability, it was necessary to develop worldwide terrain and surface datasets and the ability to import a wide variety of meteorological data.

3. OMEGA_X, THE OMEGA GUI

In order to rapidly re-configure the OMEGA model for any part of the globe, SAIC developed OMEGA_X, an X-windows based GUI (Figure 1).

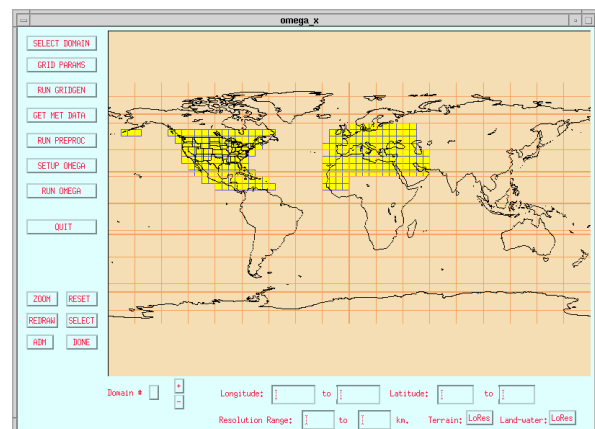


Figure 1. The OMEGA GUI Browse Map.

Starting from a browse map of the world, the user can zoom in on any part of the globe, see if the high resolution terrain data is available, select the model domain and set the resolution. OMEGA_X permits the specification of the model domain, resolution, data ingest sources, forecast period, and output frequency in a natural manner. In addition, OMEGA_X will execute the automated OMEGA grid generator (Figure 2), retrieve the required meteorological data over the

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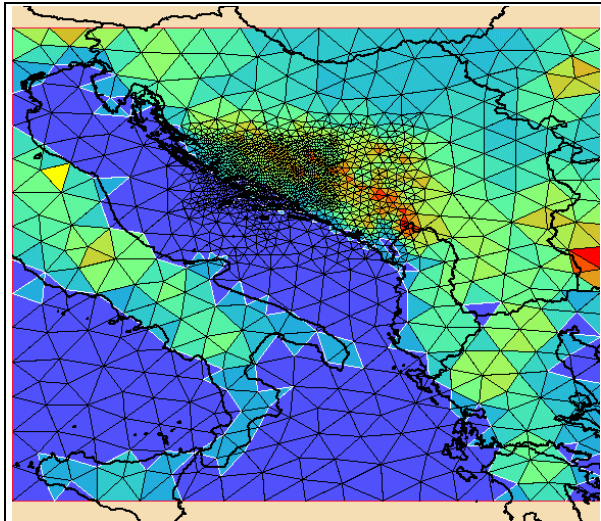


Figure 2. OMEGA grid for Bosnia - Herzegovina.

Internet (from an archival site), run the OMEGA pre-processor, and execute the model itself.

3. SURFACE DATASETS

OMEGA was designed from the beginning as an operational system. For that reason it was necessary to develop an entire suite of datasets to support the model. An elevation data was built using a multi-variate krigging procedure from a wide variety of source data. The elevation data was built into two datasets: low-resolution (5 arc-minutes) and high-resolution (30 arc seconds). A land/water fraction dataset was derived at the same resolutions from the Digital Chart of the World and the World Vector Shoreline products of the US Defense Mapping Agency.

In addition to elevation and land/water fraction, OMEGA needs information on the sea surface temperature, soil type, soil temperature and moisture, land use, and vegetation.

4. WEATHER DATA INGEST

In order to meet the variety of missions that OMEGA is intended to serve, we have developed a meteorological data ingest system capable of using surface and rawinsonde observations as well as gridded fields. The OMEGA preprocessor can ingest archived Global Optimal Interpolation (GOI) data, Medium Range Forecast (MRF), Nested Grid Model (NGM), or ETA model gridded analyses and forecasts, and surface and rawinsonde observations obtained from a variety of data sources over the Internet.

The OMEGA preprocessor was derived from the MASS preprocessor (Manobianco *et al.*, 1996), and performs three functions: (1) the data ingest and translation; (2) quality control of the input data; and

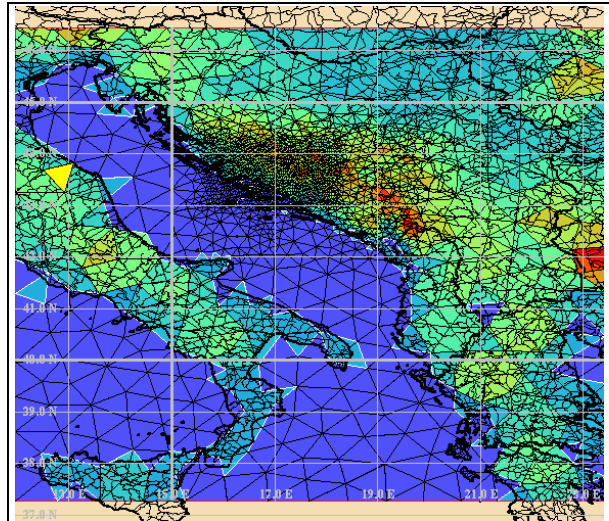


Figure 3. OMEGA grid with roads overlaid.

(3) an optimal interpolation of the ingested data to create physically consistent three-dimensional initialization fields and the time dependent lateral boundary conditions for the model.

5. XGRID, AN OMEGA POST-PROCESSOR

Once the OMEGA simulation has completed, the OMEGA graphics post-processor, XGRID, is used to view the results. Using XGRID, the OMEGA results can be explored as horizontal or vertical fields. In addition, XGRID is capable of displaying the results with overlaid mapping information from the Digital Chart of the World (Figure 3). XGRID also permits the examination of any point in the OMEGA domain at either the cell or column level.

6. ACKNOWLEDGMENTS

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7. REFERENCES

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