DEVELOPER MANUAL

AIR POLLUTION APPLICATION

WP1.4.3

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1. INTRODUCTION

STEM-II is an Eulerian air quality model with simulates transport, chemical transformations, emissions and depositions in an integrated framework. It is used to know in advance how the meteorological conditions, obtained from a meteorological model (COAMPS, included in the project), will affect the emissions effects of As Pontes Power Plant (A Coruña, Spain).

The Air Pollution application is based on the MPI parallelization of the STEM-II model with the inclusion of an interactive GUI for representing the output.

The program is designed for the Power Plant technicians. Running this application they can see graphically and in real time, the pollution that a specific combustion generates. Experts can interact with the model choosing different species to be visualized at several high levels. With the help of this tool they can make decisions in order to fulfilling the EU directives about pollution.

The model is computationally intensive, thus, with the help of Grid Computing and the parallelization of the model, the users obtain results in a reasonably time.

Additionally to this document, there are available an installation guide and a developer manual.

1.1. ABBREVIATIONS AND ACRONYMS

STEM: Sulphur Transport Eulerian Model version 2

GUI: Graphical User Interface

MPI: Message Passing Interface

MD: Migrating Desktop

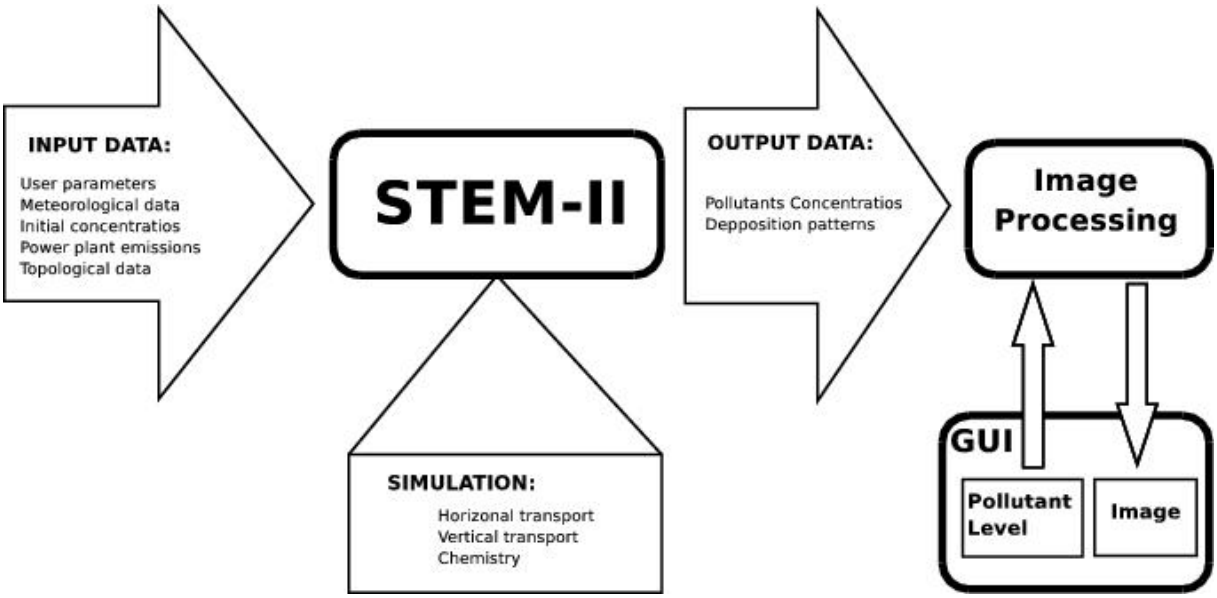
COAMPS: Coupled Ocean-Atmosphere Mesoscale Prediction System.

1.2. REFERENCES AND SOURCE CODE

The source code of this application and how to install it is fully described in the Installation Guide of the application.

2. IMPLEMENTATION STRUCTURE

There are two main components in this application: the STEM-II simulation model and the graphical user interface. The STEM-II model read the input data and simulates the dispersion and reactions of most than 28 species. The concentration of each pollutant in the simulated mesh is written into binary files. The final user chooses a pollutant to be visualized and a level of representation and a .bmp image is generated with these parameters from the output files.



2.1. PRODUCT USE CASES

The Air Pollution application is not Object Oriented, thus there are no UML diagrams. But the can describe the use cases for the application.

- **Assumption**: The system is used to check the predicted behavior of acid deposition in the neighborhood of a power plant. The user is a power plant engineer.
- **Step 1**: The user send the program to execution on the Grid, specifying the input parameters of the model, the date and hour of the simulation, the number of hours of simulation and some parameters about the existence or not of chemical phase. These decisions have influence on the performance of the parallel code, so the user must know the constrains,
- **Step 2**: The simulation starts and gets new meteorological data as soon as it is available. The output is shown to the user on the GUI.
- **Step 3**: The user can change the output parameters in order to change the pollutant to be visualized and the high level of this representation.
- **Step 4**. If some thresholds are not satisfied, the user can adopt some actions, like decreasing the production of the power plant, or change the mixture of coal, etc.

3. PRODUCT TESTING

The program has been exhaustively tested in several platforms and in the CrossGrid Testbed. The output of the program was tested by experts.

Since the beginning of the project, several tests have been performed. As results of these tests, several improvements to the code have been done.

Initially, the load balance between the processors was unbalanced and we have tried new data distributions in order to balance the computations. Some of these data distributions have been done with the information that the Performance Prediction Tool has provided. With the help of MARMOT, a tool included into the project, some bugs in the communications have been discovered and now the have been solved and the communications have been improved.

In a Grid platform, made up of a large number of nodes, the probability of fault in any part of the system is high. Thus, it would be advisable to endow the application with some kind of fault tolerance mechanism. We have studied several fault tolerance options for the Air Pollution application and we have a fault tolerance version of the application, but it is not the version treated in this document and available into the CrossGrid project.

Finally, numerical results of these tests are available in different internal documents of the project and in a set of published papers.

Some test for load balance, communications and performance prediction have been carried out.

4. CONTACT INFORMATION AND CREDITS

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