Project Title

Integration of new methodologies for environmental management

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Reference

CTM2014-55014-C3-1-R

Title of the subproject

Integration of new methodologies in simulation of wind fields, solar radiation and air quality

Reference

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website

http://www.dca.iusiani.ulpgc.es/proyecto2015-2017/html/index.html

Introduction and project objectives

Today numerical modeling has become an essential tool for analyzing and predicting many physical phenomena. Numerical modeling includes the mathematical formulation of the problem and the numerical solution of mathematical problems involved. This sub-project focuses on three phenomena simulation environment: (1) wind fields, (2) air quality and (3) solar radiation. Although different problems, there are many commonalities between them. They are defined in similar types of domains and therefore can be used the same quantization techniques. The results of the models of wind critically affect the simulation of air pollution. Thus, the first problem is essential to the achievement of other simulations. In addition, wind

modeling has its own applications (wind maps). Air pollution is associated with unstable propagation problems that can be described mathematically by an equation of convection-diffusion-reaction and therefore solved using numerical techniques similar. Modeling of solar radiation is also an environmental problem which is mainly geometrical nature. Finally, the phenomena studied have clear technical applications. Among them, we include: the construction of wind maps, the study and control and prediction of pollutant immissions, and construction of solar radiation maps. For this reason, we propose a joint treatment of problems in the context of this coordinated project. The main objectives of the coordinated project are:

• Development and implementation of environments for the prediction of the phenomena of the wind field, the quality of air and sunlight. Development of specific mesh generator developed environments.

•Development of advanced numerical algorithms for the simulation of phenomena
• Adjustment and validation of the models that govern phenomena.

Adaptation of the project to research challenge "Action on climate change and efficient use of resources and raw materials"

The environmental problems of this proposal (wind fields, air pollution, solar radiation) have great social, economic and scientific impact. Today, it is considering climate change as one of the most important problems of our planet. Therefore, the efficient use of renewable energies (wind and solar) is increasing exponentially. Moreover, the reduction of pollution is needed to maintain the quality of the human environment and ecosystems. The scientific objectives proposed in this project are clear, accessible and appropriate. We do not try to reproduce the tools that already exist, but we want to solve problems that can not be solved by the known standard codes. Our wind model is able to build a wind field from a few experimental measurements. This is important for the diagnosis or evaluation of wind energy in an area. However, companies are also interested in the prediction of renewable energy to optimize the grid. To do this, our local adaptation models (with a resolution of a few meters) should be connected with meso-scale models of prediction (with a resolution of kilometers). To do this, we have focused on the HARMONIE code.

In the context of air pollution, the objectives are similar, our code will extract the weather and air quality from the MM5-CMAQ code information. The solar radiation model will be designed both for diagnosis and for the prediction. All this justifies the appropriateness of our proposal to call.

Specific objectives of the subproject

The objectives of this subproject are:

1. Adaptivity of the mesh to the solution of the wind field and air quality. Study of estimators / indicators error and refinement / coarsening of the mesh.

2. Improvements in physical models. More sophisticated models that add the effect of turbulence for wind shear and the freeboard pen contaminants introduced. In the field of solar radiation locating enhance shadows.

3. Improved integration with regional models. Assimilation model parameters between local and regional wind HARMONIE model will improve, as well as between local air quality model and the CMAQ. Genetic algorithms used for estimating the parameters will be improved. In the field of solar radiation a method for obtaining clarity index is proposed from the information provided by HARMONIE cloudiness.

4. Methods "ensemble". One "ensemble" model to predict wind fields, air quality and solar radiation is developed.

5. Wind Model for urban environments. Wind models for specific fields of wind and air quality in urban environments will be studied.

6. In the field of solar radiation estimation, clarity rates for each time step will be integrated into the model using artificial neural networks (ANN). Another objective is to predict the solar generation of electricity for solar power plants based on models of electric power production of photovoltaic and solar thermal generation connecting with solar radiation maps and predictive values ; all this with the aim of improving the management of electrical power systems.