Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05620, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05620
EGU General Assembly 2008

Recent SKIRON dust model development and future plans

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Desert dust is a major source of PM in the atmosphere. The impacts of dust in the atmosphere are many and of course the feedbacks are considerable. The impacts are ranging from air quality and health, to radiation, clouds and precipitation. There are considerable impacts also in marine ecosystems. In the Mediterranean there is Saharan dust transported almost every day but the severe episodes is something that needs special attention because of their implications.

A dust transport prediction system was subject of well known research projects namely SKIRON, MEDUSE and ADIOS. A combined effort was devoted at the UOA/AM&WFG to the development of an analysis and forecasting tool that will provide early warning of Saharan dust outbreaks. The developed tool is the SKIRON limited-area forecasting system. It is based on the Eta limited area modeling system with embedded algorithms describing the dust cycle (DREAM module). The first version of the system only one particle size was considered. On 2000, a new version had been developed with many new capabilities like the non-hydrostatic consideration and new schemes concerning production in four particle size bins. This version was in operational use until September 2007 over a large area covering North Africa, Mediterranean and Europe with forecasting horizon of three days. High resolution SST was updated every day. The model outputs are widely used by several oceanographic, air quality and ecosystems management Institutes and Agencies from several countries. The web page http://forecast.uoa.gr has 6,000-10,000 visitors per day.

Continuous development of the entire system led to a model version where inaccuracies have been reduced and extra features have been added. Some of these are eight-size particle bins, calculation of Aerosol Optical Depth (AOD), radiative transfer corrections by utilizing look up tables, new dust source identification and utilization of rocky soil characterization, replacement of the dry and wet deposition schemes with more accurate ones, in cloud scavenging, etc. The new model version replaced the previous four-size bins system in the operations of the University of Athens.

Since SKIRON does not include an explicit cloud microphysical parameterization, the dust cycle modules have been implemented in RAMS atmospheric modeling system. The purpose of this development is to study gas and aqueous phase chemistry and three generations of particle formation. The new model development will have CCN and IN particle concentration as prognostic parameters directly coupled with the explicit cloud microphysical scheme existing in RAMS. The new model development will be used for studying feedbacks between air pollution and climate.

In this presentation we discuss the major characteristics of the developed (and under development) modeling systems. We will discuss also the characteristics of the Saharan dust outbreaks, the spatiotemporal distribution of the transported dust amounts, the co-existence with air pollutants of anthropogenic origin and its potential implications on air quality (frequent violations of the imposed air quality standards) , radiative transfer (warming of mid-tropospheric layers and cooling of the surface), water cycle (disturbances on precipitation mechanisms) and ecosystems (nutrient for some marine organisms).