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(Mínim 1 i màxim 4, podeu veure els codis a http://doctorat.upc.edu/gestio-academica/impresos/tesi-matricula-i-diposit/codis-unesco)

Resum de la tesi de 4000 caràcters màxim (si supera els 4000 es tallarà automàticament)

This PhD Thesis presents and discusses the developments of a hybrid sectional-bulk multicomponent aerosol module coupled with the multiscale chemical weather prediction system NMMB/BSC-CTM. The module is designed to provide short and medium range forecast of the atmospheric aerosols for a wide range of scales (from global to regional) and applications (from the simulation of the aerosol-radiation interaction to the study of air pollution). The module represents the processes controlling the life cycle of dust, sea-salt, black carbon, organic matter (both primary and secondary), and sulfate aerosols. The dust module was previously implemented in the model and it can be considered the starting point of this work. For the production of secondary organic aerosol, a 2-product scheme was implemented in the model. A simplified gas-aqueous-aerosol mechanism was introduced in the module to account for the sulfur chemistry. The module also accounts for the hydrophobic-to-hydrophilic conversion of carbonaceous aerosols.

In a first step, we implemented the sea-salt aerosol module and we compared global simulations using five state-of-the-art open-ocean emission schemes with AOD measurements from selected AERONET sun photometers, surface concentration measurements from the University of Miami's Ocean Aerosol Network, and measurements from two NOAA/PMEL cruises. The sea-salt global distribution was found to be highly sensitive to the introduction of SST-dependent emissions and to the accounting of spume particles production. Our results indicate that SST-dependent emission schemes improve the overall model performance in reproducing surface concentrations. On the other hand, they lead to an overestimation of the coarse AOD at tropical latitudes.

Since we found that our global simulations of the sea-salt distribution in orographic/coastal regions are affected by positive biases (regardless of the source function applied), we investigated the effect of high model resolution (0.1ºx0.1º vs 1ºx1.4º) upon sea-salt patterns in four stations from the University of Miami Network: Baring Head, Chatam Island, and Invercargill in New Zealand, and Marion Island in the sub-antarctic Indian Ocean. We found that normalized biases improved and correlation increased compared to the use of a lower resolution. In particular we found that the representation of sea/land interfaces, mesoscale circulations, and precipitation with the higher resolution model played a major role in the simulation of annual concentration trends. Our results recommend caution when comparing or constraining global models using surface concentration observations from coastal stations.

In a second step, we implemented carbonaceous and sulfate aerosols and we performed a benchmark experiment at global scale by applying emissions from the AEROCOM-ACCMIP dataset together with online biogenic emissions from the MEGAN model. The biomass-burning emissions were injected in the vertical model layers according to the satellite-derived climatologies of the IS4FIRES algorithm. The results were evaluated with observations from several networks, both for surface concentrations and optical depth (AERONET and satellites). We found that the model scores lie in the higher part of the range provided by the global models involved in the AEROCOM and ACCMIP studies. The main sources of uncertainty affecting our global results can be identified with the estimates of biomass-burning emissions and with the size distribution applied to the dust aerosol at the emission.

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