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IMPROVEMENT OF AEROSOL REPRESENTATION IN A CHEMICAL-TRANSPORT MODEL : MODELLING AND DATA ASSIMILATION

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en salle de conférences Joël Noilhan

Résumé :

The improvement of the aerosol representation in a chemical transport model (CTM) permits better understanding of aerosol properties, forecasts, and their widespread effects. The main goal of this thesis is to improve the aerosol representation in the CTM MOCAGE. The work may be divided into two approaches to achieve the main goal: the direct improvement of aerosol physical schemes and parameterizations, and the development of a data assimilation system able to assimilate aerosol optical depth (AOD) and lidar profiles into the model.

On the modelling side, the processes that underwent the important improvements were sea salt, desert dust and volcanic aerosol emissions, wet deposition and sedimentation. The ambition is related to improve the model biases compared to observations, and to implement more physically detailed schemes in the model. We evaluated the impacts of these changes and compared the modelled fields to observations. The implemented updates significantly enhanced the model agreement with the observations and the inter-model comparison data. The results also confirmed that large uncertainties in models can come from the use of different parameterizations.

The aerosol data assimilation is implemented to further reduce the model uncertainties. The set of observation operators and their tangent linear and adjoint operators for AOD and lidar profile observations are developed to link the model and the observation space. Aerosol assimilation proved to be very efficient to reduce the differences between the model and the observations. AOD observations assimilated for the periods of the extensive field campaigns over the Mediterranean basin in 2012 and 2013 and the period of volcanic ash plume from the Eyjafjöll eruption in 2010 in Iceland showed that the AOD assimilation is able to significantly improve the model performance in terms of AOD, but also other aerosol parameters such as concentrations. Assimilation of different elastic backscatter lidar profile measurements, namely of the backscatter signal, the extinction coefficient and the backscatter coefficient, also showed an efficient influence on the modelled aerosol vertical profiles.

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