Geophysical Research Abstracts,
Vol. 10, EGU2008-A-07991, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-07991
EGU General Assembly 2008

Investigation on the aerosol transport mechanisms over Athens, Greece combining satellite data and back-trajectory analysis

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The present study analyzes the main pathways and transport mechanisms of specific aerosol types over Athens, Greece. Based on aerosol optical depth at 550 nm (AOD550) and fine mode (FM) values from a long-term (2000-2005) Terra-MODIS dataset three main aerosol types are identified (urban/industrial, UI; clean maritime, CM; and desert dust, DD), each one to correspond to different optical characteristics and source regions. Therefore, the UI aerosols are assumed to be associated with polluted air masses from Europe, the CM conditions correspond to clean Atlantic air masses and the DD aerosols to air masses from North African arid regions carrying significant amount of dust on certain cases. The comparison of the three specific aerosol types with the air-mass trajectories derived from HYSPLIT model constitutes a first “quick-validation” of the identification scheme. The results show a good agreement between each aerosol type occurrence and the respective source of its originality. Therefore, 81% of the UI aerosols are associated with air masses from Europe and 73% of the CM conditions correspond to Atlantic clean air. On the other hand, the 50% of the coarse-mode aerosols, characterized as DD, correspond to Saharan air masses.

Further analyzing the air-mass trajectories at three altitudes the transport mechanisms of the aerosol types are identified. The results clearly show that the UI aerosols are mainly transported within the boundary layer, while the CM conditions are associated with Atlantic air masses at the higher altitudes. Moreover, the DD aerosols are transported either in the upper atmosphere or in the whole atmospheric column. The frequency of occurrence of each aerosol type and transport mechanism is seasonally investigated, since large differences can be revealed mainly driven by local and synoptic meteorological patterns.