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Influence of aerosols on weather conditions

Iuliia Palamarchuk (1), Sergiy Stepanenko (2), Sergiy Ivanov (2), Igor Ruban (2), and Hanna Pavlova (2)
(1) HMC BAS, Odessa, Ukraine (j_pal@ukr.net), (2) OSENU, Odessa, Ukraine (svvivo@te.net.ua)

The accurate numerical weather prediction demands the better understanding and detailed representation of aerosol effects in the atmosphere. The presence of various types of aerosols as well as other chemical components in the atmosphere causes different effects on weather, climate and still keeps many unresolved aspects. Non-linear interactions between weather phenomena, in particular, precipitation and aerosols need to be additionally highlighted.
To investigate features of the atmosphere sensitivity to aerosols the high resolution limited area model Harmonie (Hirlam Aladin Regional/Meso-scale Operational NWP In Europe) was used. The Harmonie is extensively developing weather forecast modeling system, in which the convection-permitting physics substantially promotes to the near-realistic representation of the aerosol effects complexity. Numerical experiments with modifications in aerosol concentrations were performed over the Finland domain.
The direct effect of aerosols associates with changes in both radiation processes and precipitation formation. The presence of aerosols increases cloud drop concentration and reduces the effective drop size. A high density of nuclei population initializes coalescence growth, accelerates precipitation formation, increases cloud lifetime and lags precipitation. Since aerosols disperse and absorb the radiation they have a direct effect on the albedo, which depends on the aerosol type. The land aerosols increase the albedo mainly in the lower atmospheric layers. Higher up, the effect of land aerosols on the shortwave radiation coming down toward the surface is diminished in comparison with aerosols of the marine origin. The high concentrations of continental aerosols lead to changes in the precipitation rate, while sea aerosols mainly cause the displacement in time of the precipitation event.