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# A novel method to quantify the aerosol-cloud net synergy effect employing weather prediction model "errors"

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Aerosols have various effects on the atmosphere that are not generally incorporated in numerical weather predictions. Most of the operational models do not take realistic aerosol distributions into account in their radiation transfer, leading to model errors in temperature, cloudiness, precipitation, winds and other atmospheric variables.

In this study we investigate the impact of aerosols, clouds and their interaction on the atmosphere. Using a multilinear regression model to separate among predictor variables, we compare measurements of the MODIS/TERRA aerosol optical thickness (AOT) and MM5 model prediction output including errors in temperature, absolute humidity and horizontal wind and vertical temperature gradient over Central Israel.

Based on 2001-2005 model outputs for temperature, we found that the aerosols increase the air temperature in the low altitudes (1000-850hPa), whereas the interaction between aerosols and clouds, or net aerosol-cloud synergy, cools the air. At 950 hPa, for instance, the temperature increases by 1.193± 0.274K for each unit of AOT=1 and decreases by -1.285± 0.337K for each aerosol-cloud interaction unit, i.e., AOT*(cloud cover) =1. For wind, we found that at the 900 hPa level, aerosols increase the wind velocity by 1.564± 0.360m/s for each AOT=1 and the aerosol-cloud synergy reduces the wind velocity by -1.148±0.442m/s for each AOT*cloudiness=1.

Mineral dust particles constitute a major part of the aerosols in Israel. They heat the lower troposphere primarily due to extensive absorption of thermal ground infrared radiation, but reduce the solar radiation which reaches the ground due to increased cloudiness caused by aerosol-cloud interactions, thus cooling the lower troposphere. It is assumed that the reduction and increase in the lower atmospheric temperatures for different altitudes, causes a decline and intensification in the mixing layer kinetic energy and consequently in the wind velocity.