4.254 Dust storms in the Middle East: An observational and modeling study of two events using in-situ and remotely sensed measurements and WRF-Chem-RTFDDA.

Presenting Author:
Yongxin Zhang, NCAR/RAL, Boulder, CO, USA, yongxin.fred@gmail.com

Co-Authors:
Dorita Rostkier-Edelstein, IIBR, Dept. Applied Mathematics, Ness-Zyiona, Israel
Gregory Roux, NCAR/RAL, Boulder, CO, USA
Pavel Kunin, Tel-Aviv University, Tel-Aviv, Israel
Rong-Shyang Sheu, NCAR/RAL, Boulder, CO, USA
Yubao Liu, NCAR/RAL, Boulder, CO, USA
Linlin Pan, NCAR/RAL, Boulder, CO, USA

Abstract:

The combination of WRF-Chem and RTFDDA (Real-Time Four Dimensional Data Assimilation), WRF-Chem-RTFDDA, provides an ideal modeling system for simulating and forecasting dust storms in the Middle East due to (a) WRF-Chem's capability of simulating the emission, transport, mixing, and chemical transformation of trace gases and aerosols simultaneously with the meteorology, and (b) RTFDDA's capability of continuously assimilating both conventional and nonconventional observations and thus providing improved initial conditions for dust analyses and forecasts. In this talk, we will present a study of two dust storms in the Middle East using WRF-Chem-RTFDDA and in-situ (AERONET and surface stations) and remote sensing observations (MODIS and SMAP imaging, and profiles retrieved from the CALIPSO mission). WRF-Chem-RTFDDA was run including mineral dust only without the inclusion of anthropogenic aerosols and chemical reactions.

The synoptic conditions for the two dust storm cases are characterized by a cold front at the low level and an upper-level low-pressure system over the Western Mediterranean. Strong westerly and southwesterly winds associated with the cold fronts and the low-pressure systems are behind the development and evolution of the dust storms. WRF-Chem-RTFDDA simulated synoptic weather conditions out to 48-h forecasts are largely consistent with the GFS analyses though some discrepancies in the system locations and intensities are noted. Simulated surface variables, wind speed, wind direction, temperature and relative humidity generally show small biases at all station locations. WRF-Chem-RTFDDA demonstrates its capacity in resolving the generation and evolution of the dust storms; however, model deficiencies are noted especially over the Saudi Arabia where the model fails to simulate the observed dust in the first period of one of the cases. We investigate various factors that may be responsible for the deficiencies, with too moist soil conditions in GFS, and subsequently WRF-Chem-RTFDDA, appearing to be the main one.