

Microphysical effects of Saharan dusts on an orogenic thunderstorm

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Saharan dusts are usually transported into the Mediterranean by southerly wind associated with cyclones. They modulate radiative budget by the absorption and scattering of solar and thermal radiation. Another aspect of Saharan dust is its microphysical impact as cloud condensation nuclei and ice nuclei. It is known that the dry elevated mixed layer (ELM) from North Africa can cap the moist marine boundary layer, and set up “loaded-gun sounding” in the Mediterranean. The Saharan dust tends to be abundant in the EML. In addition, aerosols of salt particles from the Mediterranean Sea also are brought into the storms. The resulting mixture of mineral dust and sea salt has a strong impact on the precipitation process occurring in Mediterranean storms.

This study investigates the sensitivity of an orogenic thunderstorm modeled for the Genoa 1992 flood event to the concentration and solubility of nucleating aerosols. The relative roles of the heterogeneous freezing nucleation process, the deposition-condensation nucleation processes of ice particles, and the activation of liquid hydrometeors are evaluated through the explicit numerical simulation of the storm using the University of Wisconsin Nonhydrostatic Modeling System (UW-NMS) and the newly developed Advanced Microphysical Prediction System (AMPS). The AMPS features the Hashino and Tripoli (Hashino and Tripoli, JAS, 2007) Spectral Habit Ice Prediction System (SHIPS), which is the first microphysics model to explicitly simulate the growth of ice habit characteristics beginning with the nucleating aerosol. The system also features the Hashino and Tripoli (2007) Spectral Liquid Prediction System (SLIPS) which predicts the evolution of the liquid drop spectrum from aerosol origins. These models provide the first explicit multidimensional simulations of the precipitation formation process and the explicit chain of events set off by the interaction between evolving droplets containing immersed aerosols, aerosols in the air parcel and evolving crystals, some nucleated by aerosols directly having varying habits, sizes and origins.

This talk will feature a fascinating first look at these processes in the context of a complex dynamical storm and how they directly and indirectly affect the resultant precipitation produced. The results suggest a strong sensitivity of the precipitation process to the chemical properties of the aerosols involved.