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Dust emission and transport associated with a Saharan depression: The February 2007 case

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The dust activity over North Africa associated with the Saharan depression event in February 2007 is investigated by mean of spaceborne observations, ground based measurements and mesoscale simulation with Meso-NH. The main characteristics of the cyclone as well as the meteorological conditions during this event are described using the European Centre for Medium-range Weather Forecasts (ECMWF). The dust storm and cloud cover over North Africa is thoroughly described combining for the first time Spinning Enhanced Visible and Infra-Red Imager (SEVIRI) images for the spatio-temporal evolution and Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and CloudSat observations for the vertical distribution.

The Saharan depression formed over Algeria in the lee of the Atlas Mountain on the afternoon of February 20 in response to midlatitude trough intrusion. It migrated eastward with a speed of 11 m s-1 and reached Libya on February 22 before exiting the African continent toward the Mediterranean Sea on February 23. The horizontal scale of the cyclone at the surface varied between 800 km and 1000 km during its lifetime. On the vertical the cyclone extended over 8 km and a potential vorticity of 2 PVU was reported on its centre at 3 km in altitude. The cyclone was characterised by a surface pressure anomaly of about 9 hPa with respect to the environment, a warm front typified at the surface by an increase in surface temperature of 5°C, and a sharp cold front characterized by a drop in surface temperature of 8°C and an increase in 10 m wind speed of 15 m s-1.

The cyclone provided a dynamical forcing that led to strong near-surface winds and produced a major dust storm over North Africa. The dust was transported all around the cyclone leaving a clear eye on its centre and was accompanied by a deep cloud band along the northwestern edge of the cyclone. On the vertical, slanted dust layers were consistently observed during the event over North Africa. Furthermore, the dust was lofted to altitudes as high as 7 km, becoming subject to long range transport. The model was able to reproduce reasonably the structure, the lifetime and the trajectory of the cyclone. Also comparison with MODIS deep blue AODs and CALIPSO/CloudSat observations suggests that the model can be used reliably to quantify the dust emissions associated with this event. The mean daily dust loads over the area influenced by the cyclone were simulated to range between 2 and 8 Tg during the lifetime of the Sharav cyclone (i.e. 5 days). This study suggests that dust emissions linked with Saharan cyclones may contribute significantly to the total dust load over West and North Africa observed annually.