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A dusty gust front of synoptic scale initiated and maintained by moist convection over the Sahara desert

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In this study we document the evolution, the synoptic trigger and the characteristics of an intense dust event which occurred over the Sahara desert on August 3-5, 2006. The motivation for this study is to highlight the large scale dust production over the Sahara associated with gust fronts of squall lines. The dust emission during this event was initiated by a large-scale cold pool emanated from a squall line that developed over Niger and Mali on August 3. We examine the development of this squall line and its subsequent dust lifting using high temporal resolution false color dust product images from the Meteosat Second Generation Spinning Enhanced Visible and Infrared Imager (MSG-SEVIRI). Observations from Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) are used to characterize the vertical structure of the dust plume as it spreads over the Sahara and near the Atlantic coast line.
The European Centre for Medium-Range Weather Forecasting African Monsoon Multidisciplinary Analysis (ECMWF-AMMA) special reanalysis was used to provide the synoptic-scale conditions that favored the occurrence of this event. Particular attention was paid to the intrusion of a mid-level extratropical streamer of potential vorticity that interacts with an African Easterly Wave (AEW) and favored the growth of a low-level cyclonic circulation along the intertropical discontinuity zone over the course of the event. The subsequent coupling of the ITD low-level circulation to an AEW aided both on the formation of the squall line and on the pronounced northward transport of the uplifted dust over the Sahara. The dusty cold pool extended over 2-3 km in altitude and exhibited an aerosol optical depth on the order of 1.5 and a dust load of about 1 Tg on average. Large amount of the dust produced during this event was subject to westward transport over the Atlantic Ocean after being mixed up by the diurnal heating over the Sahara to altitudes as high as 5 km. The pump of moisture by the cold pool into the dry desert favored the development of new convection over the Sahara which resulted on weak precipitation of about 3 mm per hour.