The radiative impact of airborne dust on the Saharan cyclone on February 2007.

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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 and ground based measurements. 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 cyclone provided a dynamical forcing that led to strong near-surface winds and produced a major dust storm over North Africa. Heavy dust load was seen along the cold front and the southeastern edge of the cyclone accompanied by a deep cloud band along its northwestern edge. The dust was transported all around the cyclone leaving a clear eye on its centre (Fig. 1). 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 (Fig. 1), becoming subject to long range transport.

The radiative forcing of dust and its feedback on the cyclone dynamics has been evaluated using a mesoscale model. The comparison between the simulations with and without dust has suggested that the radiative impact of dust represents important implications on the dynamics and the lifetime of the cyclone. A local heating of 3 K at 1 km was induced by the presence of the airborne dust in the atmosphere.

Key Words: Mediterranean cyclone, CloudSat, ECMWF, North Africa, Sharav cyclone, CALIPSO, MesoNH.

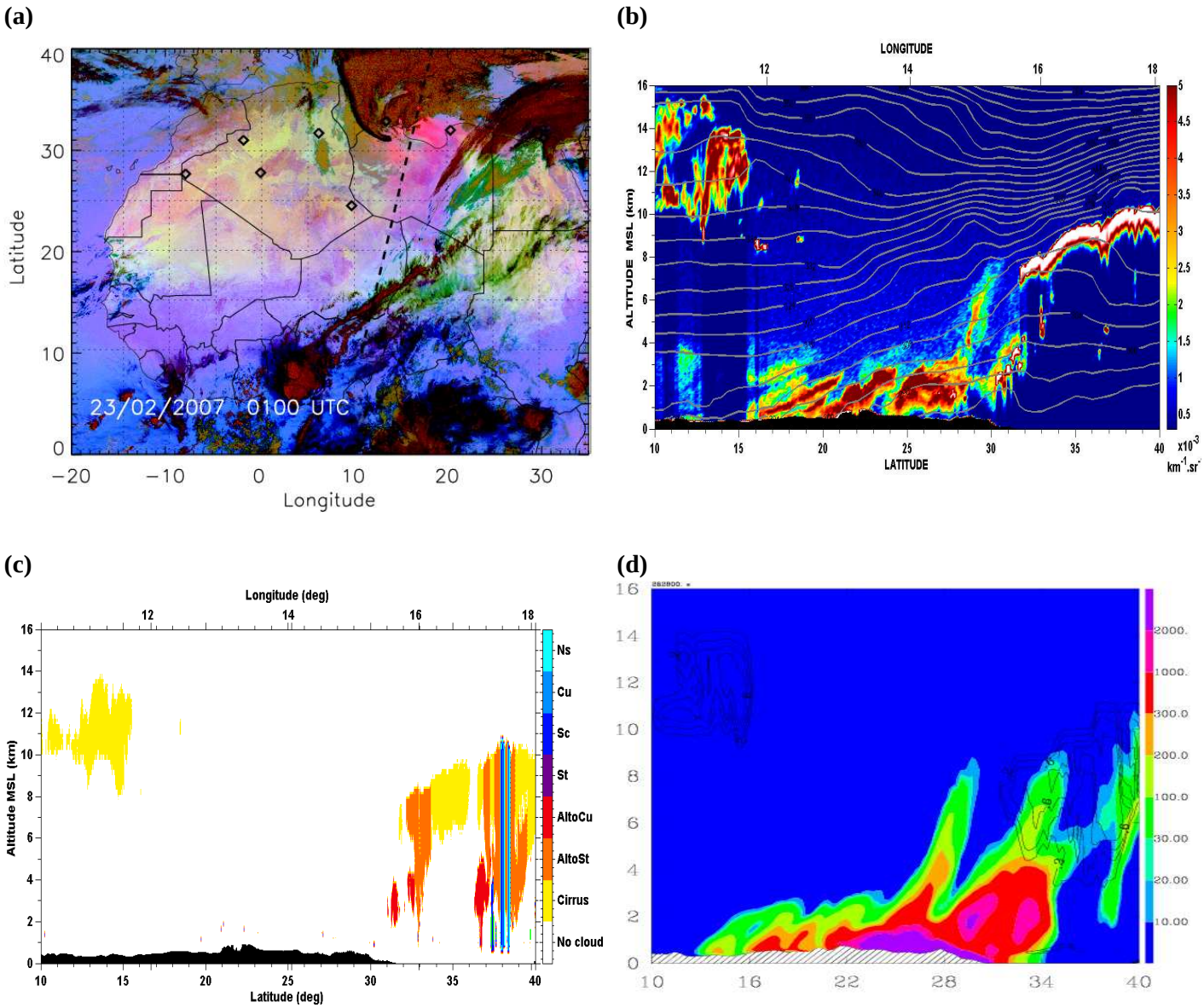

Figure 1: (a) SEVIRI-derived false color images over West Africa on 23 February 2007 at 0100 UTC. The dashed black line is the CALIPSO track and the black diamonds are the location of the ground stations. **(b)** CALIPSO lidar transect over West Africa on 23 February 2007 at 0103 UTC: attenuated backscatter coefficient profiles at 532 nm with a 60-m (12-km) resolution in the vertical (horizontal). The outline of the topography appears in black. Optical thick clouds appear in white, the low backscatter values below them being due to lidar signal extinction. Superimposed on the CALIPSO lidar data are 0000 UTC ECMWF analyses of potential temperature (dark gray plain contours). **(c)** CloudSat radar transect over West Africa on 23 February 2007 at 0103 UTC (co-aligned with CALIPSO lidar) of level 2 cloud type classification in colors (available at http://disc.sci.gsfc.nasa.gov/giovanni/). **(d)** Simulated dust concentrations (colors) and cloud fraction (isocontours) along CALIPSO track.