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The Formation and Behaviour of a large Saharan Haboob

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One of the major mechanisms for dust uplift in the Sahara, the world's largest source of atmospheric soil dust, is the "Haboob" dust storm. Haboobs are produced along the turbulent leading edge of evaporatively cooled air flowing away from deep convective storm systems. Often gust fronts produced by convective storms are short-lived, limiting Haboob size and duration to a scale similar to the storm system that initiated them. However, some Haboobs reach much larger sizes, occasionally spanning over 1000 km and propagating across huge distances.

To illustrate possible factors that influence the generation of very large Haboobs in the Sahara, a case that occurred between 8th - 10th June 2010 has been investigated. The Haboob was produced by a large meso-scale convective system initiated over the Aïr Mountains in northern Niger. The resulting dust cloud eventually covered parts of Algeria, Mali and Mauritania. The study is based on standard surface observations, reanalysis products, Meteosat dust images, Tropical Rainfall Measuring Mission (TRMM) rainfall estimates, Cloud Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) and other satellite products. The case is also simulated using the Weather Research and Forecasting (WRF) model.

Results show that the generation of the event is heavily influenced by both the large-scale and meso-scale meteorology. The former include: (1) effects of a mid-latitude low-pressure system over the Iberian Peninsula on West Africa, (2) a Rossby wave on the subtropical jet that supports convection by fostering upper-level convergence and (3) enhanced northward moisture transport into the desert due to a re-arrangement of surface pressure over West Africa. The latter is associated with a tropical plume, where precipitating clouds formed along the northward limb of the subtropical Rossby wave, leading to a weakening and splitting of the Saharan Heat Low. The meso-scale influences identified include: (1) previous convective storms that provide favourable conditions for initiation by providing elevated moisture levels and near-surface convergence, (2) triggering by mountainous terrains (specifically the Aïr Mountains) through forced ascent, convergence between mountain ranges and lee-side convergence of air deflected around obstacles and (3) the repeated initiation of storm systems to the west of older cells producing a rapidly moving squall-line system with a cold pool continuously emanating from its northern edge into the Sahara.

In the future this work will be extended to more cases to investigate to what extent the track of a convective systems affects its likelihood to produce a large Haboob. This will include running sensitivity simulations with WRF on a subset of these cases.