Geophysical Research Abstracts,
Vol. 10, EGU2008-A-06697, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-06697
EGU General Assembly 2008

Atlantic tropical cyclones and Saharan dust: a simulation study

S. Nickovic (1), C. Perez (2), O. Jorba (2), J.M. Baldasano (2,3)

(1) World Meteorological Organization (WMO), Geneva, Switzerland (snickovic@wmo.int), (2) Earth Sciences Department, Barcelona Supercomputing Center (BSC-CNS), Barcelona, Spain, (3) Environmental Modelling Lab., Technical University of Catalonia (UPC), Barcelona, Spain.

Through direct radiative forcing and indirect effects on cloud processes, interaction between the atmosphere and dust aerosol affects weather, climate and aerosol features. During major dust storm episodes, surface temperature may drop several degrees due to dust radiative forcing, accompanied with a negative feedback upon dust emission (Miller et al., 2004; Pérez et al., 2006). Indeed, Haywood et al. (2003) noticed an outgoing long-wave radiation anomaly in the UK operational model over the Sahara as a consequence of the non inclusion of radiative affects of dust in the model.

Dust originating from the Saharan desert and driven westward by trade winds forms a persistent dust load pattern over the North Atlantic. Several recent studies speculate on possible influence of dust aerosol on Atlantic tropical cyclones. Based on satellite evidence, Dunion and Velden (2004) suggested that the Saharan air layer could inhibit the formation or reduce the intensity of tropical cyclones in the North Atlantic, although a cause-effect relationship between tropical cyclone activity and dust transport is not demonstrated. Furthermore, Evan et al. (2006) reported a strong link between tropical cyclone activity and dust transport over the Tropical Atlantic.

In this study, the regional DREAM dust model with included on-line dust interactions with short- and long-wave radiation (Nickovic et al., 2004; Pérez et al., 2006) is implemented to explore relationships between tropical cyclones and dust. The tropical cyclone Isaac (September 2000) was selected for first model experiments.

Our study demonstrates that a tropical cyclone system performs the dust transport more efficiently than that through a trade wind advection. In its initial stage, the Isaac location (eastern Tropical Atlantic) coincided with high load of Saharan dust. Dust was sucked up by the cyclone in the lower atmosphere and lifted by the cyclone convection into the higher troposphere. Isaac moved westward towards the North American coast, continuously carrying out a portion of dust that was initially embedded into the cyclone structure.

Furthermore, we simulated Isaac with and without radiation-dust interaction in the sensitivity model experiments. In the test with the radiation-dust interaction, there was no significant deviation in cyclone paths due to direct radiation forcing by dust aerosol five days after the cyclone generation. However, after seven days the cyclone was dislocated several hundred km away from the cyclone position in the no radiation interaction test, thus indicating that dust impacts on tropical cyclones may be significant.

References

Nickovic, S., G. Pejanovic, E. Ozsoy, C. Pérez, and J. M. Baldasano (2004): Interactive radiation-dust model: A step to further improve weather forecasts. International Symposium on Sand and Dust Storm, World Meteorological Organization, Beijing, China.

Pérez, C., S. Nickovic, G. Pejanovic, J. M. Baldasano, and E. Ozsoy (2006): Interactive dust-radiation modeling: A step to improve weather forecasts, J. Geophys. Res., 111, D16206, doi:10.1029/2005JD006717.

Haywood, J. M., R. P. Allan, I. Culverwell, T. Slingo, S. Milton, J. Edwards, and N. Clerbaux (2005): Can desert dust explain the outgoing longwave radiation anomaly over the Sahara during July 2003?, J. Geophys. Res., 110, D05105, doi:10.1029/2004JD005232.

Miller, R. L., J. Perlwitz, and I. Tegen (2004): Feedback upon dust emission by dust radiative forcing through the planetary boundary layer, J. Geophys. Res., 109, D24209, doi:10.1029/2004JD004912.

Evan, A. T., J. Dunion, J. A. Foley, A. K. Heidinger, and C. S. Velden (2006): New evidence for a relationship between Atlantic tropical cyclone activity and African dust outbreaks, Geophys. Res. Lett., 33, L19813, doi:10.1029/2006GL026408.

Dunion, J.P., and C.S. Velden (2004): The impact of the Saharan air layer on Atlantic tropical cyclone activity. Bull. Amer. Met. Soc. DOI: 10.1175/BAMS-85-3-353