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Inter-comparison and evaluation of dust prediction models in the Sahel region

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Airborne dust forecasts are currently available from a number of operational and research centres around the world. In the present work, dust surface concentration and dust optical depth at 550 nm provided by seven models (BSC-DREAM8b, MACC, DREAM8-NMME-MACC, NMMB/BSC-Dust, GEOS-5, NGAC and MetUM) in the framework of the WMO Sand and Dust Storm Warning Advisory and Assessment System are evaluated for two years (2013-2014) with observations recorded in the Sahelian region. A multi-model median computed from them is also included in the evaluation. Three-hourly forecasts with lead times from 3 to 24 hours bi-linearly interpolated to the observing sites are considered.

The first problem to address the model evaluation is the scarcity of suitable routine observations. In Northern Africa, the world's largest source of mineral dust, the only reliable background information of aerosol surface concentration is that provided by three monitoring stations deployed in the Sahel in the frame of the African Monsoon Multidisciplinary Analysis project. Tapered Element Oscillating Microbalance monitors continuously record particulate mater with aerodynamic diameter less than 10 μm (PM10) in M'Bour, Senegal; Cinzana, Mali and Banizoumbou, Niger. Although mineral dust is the dominant aerosol type in the region, incursions of the monsoon flow eventually allow transport of biomass burning aerosol from southern sources. Thus, a wind-based filter is introduced to remove these cases from the model evaluation.

Information on surface concentration is complemented with columnar data provided by three collocated AERONET stations. Sun-photometric retrievals of aerosol optical depth are compared with dust optical depth simulated by the models. As with surface concentration, a filter has been set to remove those cases with suspected significant presence of other aerosol types: threshold discrimination is made by discarding observations with an Ångström exponent higher than 0.6.