Detection of mineral dust over the North Atlantic Ocean and Africa with the Nimbus 7 TOMS

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Abstract. It has recently been found that the ultraviolet measurements obtained with the Nimbus 7 total ozone mapping spectrometer (TOMS) instrument can be used to retrieve information on the distribution of aerosols over oceanic and continental surfaces. Here we examine the use of the derived TOMS aerosol index (AI) for the detection of absorbing aerosol in terms of mineral dust aerosol over the North Atlantic Ocean and North Africa. Specifically, we compare the TOMS AI with the time series of daily aerosol measurements made in the boundary layer at Sal Island (Cape Verde), Barbados, and Miami and in the free troposphere on Tenerife (Canary Islands); these sites are frequently impacted by African dust events. At Tenerife, over the time period 1988-1992, TOMS detected 80% of the African dust events that yielded daily average dust concentrations greater than 20 µg m⁻³; at Barbados and Miami, TOMS detected 65% and 44% respectively of the events over the period 1979-1992. If we exclude events during which some of the TOMS data are missing and also short (1-day) dust events, TOMS detected 99% of the events at Tenerife, 97% at Barbados, and 81% at Miami. TOMS was also successful in detecting the "low altitude" African dust events recorded at Sal during the winter season. Over Africa we compare the TOMS AI data with ground-based measurements of aerosol optical thickness (AOT) obtained during field experiments in Senegal and Niger; these yield a nearly linear relationship between the TOMS AI and the AOT. Discrepancies between ground-based measurements (in terms of dust concentrations or AOT) and TOMS AI can be attributed to a number of factors: variations in the physical properties of the aerosol; the sensitivity of the TOMS response to the altitude of the aerosol layer; or the coarse spatial resolution of the TOMS pixel. Nonetheless, our results clearly show that the TOMS AI provides a remarkably accurate picture of mineral dust distributions in the atmosphere over both continental and oceanic regions.

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