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Long-range Transport of Dust and Smoke towards Barbados during Summer and Winter Season Measured with Three-Wavelength Polarization Lidar during SALTRACE-1, 2 and 3

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The annual cycle of the north-south movement of the intertropical convergence zone has an impact on the sources and mixture of the dust transported to the Caribbean. In summer, pure Saharan dust from northern Africa dominates, while in winter the dust originates from southern West Africa and is mixed with biomass burning smoke. The island of Barbados (13°N, 59°W) is an ideal site to investigate the long-range transport of Saharan dust because it is advected more than 5000 km across the Atlantic Ocean without any disturbance by anthropogenic aerosol sources. To investigate these seasonal changes in dust transport we extended the Saharan Aerosol Long-Range Transport and Aerosol-Cloud Interaction Experiment (SALTRACE) in June-July 2013 by further two campaigns in February-March 2014 (SALTRACE-2) and June-July 2014 (SALTRACE-3). Additionally a ship cruise with a Raman polarization lidar on board from the Caribbean to the Cape Verde islands was performed in April-May 2013. Dual-polar sun photometer observations were performed continuously from June 2013 to July 2014 (see AERONET Barbados_SALTRACE site). For SALTRACE, we used a complex lidar system equipped with two Raman channels and a 532 nm high spectral resolution lidar (HSRL) channel to obtain daytime (HSRL) and nighttime (Raman) extinction profiles. For the first time the dust linear depolarization ratios at 355, 532 and 1064 nm were measured simultaneously. The linear depolarization ratio provides information about the presence and amount of dust. The spectrum yields information about the dust size distribution. Combined with the extinction-to-backscatter ratio (lidar ratio) a separation of mineral dust (fine-mode and coarse-mode fractions), biomass burning smoke and maritime aerosols is possible. The measurements are presently used for understanding of long-range transported dust and provide insight into the aerosol composition over the western Atlantic. The classification of different aerosol types will be presented on the basis of selected case studies from the summer and winter SALTRACE campaigns and will be set in the context of the whole campaign. Dust outbreaks are quite frequent in summer while in winter pure marine conditions or dust-smoke mixtures are detected. Additionally the results of the SALTRACE analysis will be compared with dust transport model calculations.