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The Saharan Aerosol Long-range Transport and Aerosol-Cloud-Interaction Experiment (SALTRACE) took place at Barbados from June 10 to July 15 2013. During this period, dust was frequently transported from Africa across the Atlantic Ocean toward the Caribbean. In this study, we investigate the atmospheric aging of the dust aerosol based on its hygroscopicity. Aerosol samples were collected ground-based at Ragged Point (13°9'54.4"N, 59°25'55.7"W) with a single round jet cascade impactor on nickel-substrates. The particles from the stage with a 50% efficiency cutoff size of 1 μm were analyzed with an Environmental Scanning Electron Microscope (ESEM) equipped with an energy-dispersive X-ray detector (EDX) and a cooling stage. In an initial automated run, information on particle size and chemical composition for elements heavier than carbon were gathered. Afterwards, electron microscope images of the same sample areas as before were taken during a stepwise increase of relative humidities (between 50 % and 92%), so that the hygroscopic growth of the droplets could be directly observed. The observed hygroscopic growth can be correlated to the chemical composition of the respective particles. For the automated analysis of several hundred images of droplets an image processing algorithm in Python was developed. The algorithm is based on histogram equalization and watershed segmentation. Since SEM images can only deliver two-dimensional information, but the hygroscopic growth factor usually refers to the volume of a drop, Atomic Force Microscopy (AFM) was used to derive an empirical function for the drop volume depending on the apparent drop diameter in the electron images. Aside from the mineral dust, composed of mostly silicates and Fe-rich particles, sea-salt and soluble sulfate particles were abundant in our samples. Also, mixtures of the former were found. A chlorine-sulfur index (S/(Cl+S), based on atom%) was used to determine different grades of sea-salt aging. Growth factors are in general the highest for sea-salt particles. Within the sea-salt particle type, sea-salt with a Cl-S index between 0.05 and 0.1 has the highest growth factor. Second highest is the sea salt group with almost un-aged sea-salt (Cl-S index < 0.05). Soluble sulfate particles come right after the sea-salt group in terms of the growth factor. Even lower hygroscopic growth show the sea-salt-silicate mixtures and the silicates. Interestingly, the few silicates showing considerable hygroscopic growth (only at high RH) have a slightly higher growth factor than the silicate mixtures with sea-salt. The latter, however, have a lower deliquescence relative humidity, most likely due to the internal mixture with sea-salt.