Investigating Aerosol-Cloud-Precipitation Relationships in South Atlantic Stratocumulus Clouds Using Modern and Long-Term Historical Satellite Data Sets

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Using satellite observations of the Earth scientists have determined that, on average, 50-70% of the globe is covered with visible clouds at any given. Of all clouds, stratocumulus clouds cover more area than any other type making them critically important for the movement of energy, primarily through reflection of solar radiation back to space, and the transport of moisture, through drizzle/precipitation processes. Stratocumulus clouds are notably sensitive to changes in aerosol (i.e. dust, smoke, and anthropogenic emissions) through which reflectivity and precipitation are altered (Wood, 2012). These clouds dominate off the western coasts of continents with large decks found off California in North America, Chile in South America and the Namibia-Angola South Atlantic coast in Africa. The focus of this study is the South Atlantic stratocumulus deck. This region is complex with a variety of aerosol sources from dust, biomass burning and industrial processes which alter cloud properties and precipitation formation.

Here we investigate current and historical relationships between and trends in cloud properties (cloud fraction, cloud thickness, effective radius), precipitation (drizzle) and aerosol (type and altitude) over the African Stratocumulus Cloud deck region. We present detailed analysis of NASA A-train data sets (MODIS, CloudSat, CALIPSO, OMI) and long-term historical data sets including TOMS (Nimbus 7 and Earth Probe), AVHRR, ISCCP cloud products, GPCP precipitation and TRMM. Additional meteorological information is obtained through the use of NCEP/NCAR and MERRA reanalysis data sets. Statistical analysis and multi-variate composite analysis of these data sets are used to examine the spatial and temporal correlations and relationships between the described data sets.