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P-4 Regional aerosol trends and potential impacts on clouds in the western North Atlantic Ocean

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Aerosols and clouds contribute to atmospheric variability and Earth's radiative balance. Changes in aerosol loading directly alter the radiative balance and indirectly via complex feedbacks with clouds. Changes in emissions, air quality policies, and socioeconomic factors ultimately lead to changes in aerosols, with cascading effects on clouds and the combined radiative effects.

Here an assessment of aerosol trends over the western North Atlantic Ocean during the period from 2000 to 2012 is presented. Monthly mean observational data from NASA's MODIS instruments is employed. Two aerosol models (GOCART and MERRAero) with the capability to model five individual aerosol species are used to separate anthropogenic from natural contributions to the total aerosol load and trend. Preliminary results show two distinct regions of opposite trend in the satellite aerosol optical depth (AOD) over the western North Atlantic with model analysis indicating their different origins: a negative AOD trend (-0.020 to -0.040 per decade) of anthropogenic origin is seen off the eastern coast of the U.S. while a positive AOD trend (0.015 to 0.030 per decade) of natural origin is seen in the south of the domain. Compelling evidence from ground-based observations (AERONET and EPA) corroborates the anthropogenic origin of the negative trend off the eastern U.S. coast. Finally, trends in the cloud effective radius are explored to examine the presence of the first indirect effect (Twomey effect). The analysis from Aqua appears stronger and more coherent, likely a testament to its calibration stability relative to Terra. Statistical significance tests are performed for the 90% and 95% levels using the Student's t-test. This research can not only provided information for modeling and validation studies of aerosol trends but also act as an initial study into the long-term impacts of air quality policies on the aerosol field, aerosol-cloud interactions, and the combined complex radiative effects.