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Strong aerosol effects on cloud amount based on long-term satellite observations over the East Coast of the United States

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Here we use 16-year satellite and reanalysis data in combination with a multivariate regression model to investigate how aerosols affect cloud fraction (CF) over the East Coast of the United States. Cloud droplet number concentrations (N_d), cloud geometrical thickness, lower tropospheric stability, and relative humidity at 950 hPa (RH_{950}) are identified as major cloud controlling parameters that explain 97% of the variability in CF. N_d is shown to play an important role in regulating the dependence of cloud fraction on RH_{950}. The observed annual-mean CF shows no significant trend due to the cancelation from the opposite trends in N_d and RH_{950}. The multivariate regression model revealed that the decline in N_d alone would lead to a about 20% relative decline in CF. Our results indicate the significant aerosol effects on CF and suggest the need to account for pollution-induced cloud changes in quantifying cloud feedback based on long-term observations.