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Study of aerosol and cloud interactions over North Eastern China

C. Zhao

Department of Atmospheric Science, School of Physics, Peking University, Beijing, China (zcs@pku.edu.cn Phone:+86-10-62754684)

In this work aerosol and cloud interactions over North Eastern China are studied using aircraft data, satellite data and numerical modeling. Analysis of observed precipitation, MODIS data and meteorological sounding data over eastern central China shows that the precipitation in this region is significantly reduced during the last 40 years and this reduction of precipitation is strongly correlated to the high concentrations of aerosols. Meteorological sounding data indicates that the atmospheric stability in the troposphere has been increasing during the last 17 years. It is speculated that the aerosol layer in the lower troposphere affects the radiative processes, which lead to changes in atmospheric stability. The enhancement in the atmospheric stability tends to depress upward motion and precipitation in this region. Using a large amount of aircraft measurements of cloud droplet size distributions, the relationship between cloud spectral relative dispersion and cloud droplet number concentration is studied. The results indicate that the value of cloud spectral relative dispersion varies between 0.2 to 0.8 when the cloud droplet number concentration is low (about 50 cm^{-3}), and converges towards a narrow range of 0.4 to 0.5 when the cloud number concentration is higher. Because the distribution of the cloud droplet size is an important parameter in estimating the first indirect radiative effect of aerosols on the climate system, the uncertainty in the corresponding radiative forcing can be reduced by 10-40% under high aerosol loading.