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Impacts of anthropogenic aerosols on extreme high temperatures in eastern China : A model simulation

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Extreme temperatures have severe impacts on environment and human health. An extreme temperature is in general defined as a rare temperature record related to a statistical model characterized by the mean and variability of temperature distribution. Changes in the distribution can be attributed to natural fluctuations of atmospheric circulation or external radiative forcing by human activities. Global warming has been projected to lead to more frequent and intense extreme high temperatures in the future. This work investigates the impacts of aerosol direct radiative forcing on extreme high temperatures in eastern China during 1951-2000 using the GISS GCM II' with coupled chemistry and aerosols. Impacts of anthropogenic aerosols, including sulfate, nitrate, black carbon (BC), and organic carbon aerosols, on warm days are simulated and compared with the effect of greenhouse gases (GHGs). Our model results show that the change in mean temperature is the major factor that contributes to the extreme high temperatures. With the presence of GHG forcing, the warm days are predicted to generally increase over the continents but are overestimated in China in the past decades. The radiative forcing by BC slightly increases the regional warm days with an effect much smaller than that of GHGs. The forcing by scattering aerosols is predicted to significantly reduce warm days. The predicted changes in warm days in the presence of radiative forcings of both GHGs and all anthropogenic aerosols agree closer with the observations than those simulated with GHGs alone. The maximum effect of aerosols on extreme temperature is found in winter. After removing the linear trend in surface air temperatures during the past decades, the residual representing the interannaul variability is found to be increased by aerosols. It suggests that aerosols have a potential of increasing extreme high temperature events, which is further confirmed by that the predicted pattern of the changes in intensity of warm days in the presence of BC agrees closely with the observations in the winter.