Arctic Warming Associated with Aerosol Indirect Effects

CHUANFENG ZHAO[1] AND TIMOTHY GARRETT[2]

[1]GCESS, Beijing Normal University, Beijing, China
[2]ASD, University of Utah, Salt Lake City, UT, USA

There is consensus among climate models that Arctic climate is particularly sensitive to anthropogenic greenhouse gases and that, over the next century, Arctic surface temperatures are projected to rise at a rate about twice the global mean1. The response of Arctic surface temperatures to greenhouse gas thermal emission is modified by Northern Hemisphere synoptic meteorology and local radiative processes. Aerosols may play a contributing factor through changes to cloud radiative properties. Here we study the contribution of anthropogenic aerosols to cloud emission and surface temperatures in the Arctic. Using four years of ground-based aerosol and radiation measurements obtained near Barrow, Alaska, we show that, where thin water clouds and pollution are coincident, there is an increase in cloud longwave emissivity resulting from elevated haze levels. This results in an estimated surface warming under cloudy skies of between 3.3 and 5.2Wm-2 or 1 and 1.6 ºC. Arctic climate is closely tied to cloud longwave emission, but feedback mechanisms in the system are complex and the actual climate response to the described sensitivity remains to be evaluated. A statistical study about the relationship between aerosols and radiation has also been investigated.