Impacts of Stratospheric Ozone Extremes on Arctic High Cloud

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Stratospheric ozone depletion in the Antarctic is well known to cause changes in Southern Hemisphere tropospheric climate; however, because of its smaller magnitude in the Arctic, the effects of stratospheric ozone depletion on Northern Hemisphere tropospheric climate are not as obvious or well understood. Recent research using both global climate models and observational data has determined that the impact of ozone depletion on ozone extremes can affect interannual variability in tropospheric circulation in the Northern Hemisphere in spring. To further this work, we use a coupled chemistry–climate model to examine the difference in high cloud between years with anomalously low and high Arctic stratospheric ozone concentrations. We find that low ozone extremes during the late twentieth century, when ozone-depleting substances (ODS) emissions are higher, are related to a decrease in upper tropospheric stability and an increase in high cloud fraction, which may contribute to enhanced Arctic surface warming in spring through a positive longwave cloud radiative effect. A better understanding of how Arctic climate is affected by ODS emissions, ozone depletion, and ozone extremes will lead to improved predictions of Arctic climate and its associated feedbacks with atmospheric fields as ozone levels recover.