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Scientific Theme: Atmospheric Dynamics/Climate Change

The remarkable 2003–2004 winter and other recent warm winters in the Arctic stratosphere since the late 1990s, G. L. Manney, K. Krüger, J. L. Sabutis, S. A. Sena, and S. Pawson, *J. Geophys. Res.*, **110**, D04107, doi:10.1029/2004JD005367, 25 February 2005.
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Summary

The temperatures and dynamical evolution of the Arctic winter stratosphere in 2003-2004 were studied in the context of interannual variability. The 2003-2004 Arctic winter was unique in that the stratospheric polar vortex broke down in a "major stratospheric warming" for a period of nearly two months in January and February (stratospheric midwinter warmings more typically last a few days to a week). Comparison to the few past prolonged stratospheric warming periods on record highlights other unique characteristics of the 2003-2004 winter. Examination of interannual variability in the past 26 years shows that six of the past seven winters have been unusually warm, with little or no potential for Arctic chemical ozone loss. This period of unusually warm winters, immediately following a period of several unusually cold winters, has important implications for detection and attribution of stratosphere trends in temperature and ozone, and for possible changes in climate.

Understanding interannual variability in the Arctic stratosphere and the dynamical mechanisms underlying that variability are critical to detection and attribution of trends in atmospheric circulation, temperature, and ozone. This research thus benefits society by improving our understanding of stratospheric variability and hence our ability to detect and understand climate change. Educational benefits include involvement of an undergraduate student at New Mexico Highlands University (coauthor S. A. Sena) in analysis and visualization of the data presented here, thus contributing to improving knowledge of stratospheric processes and their relation to climate change.

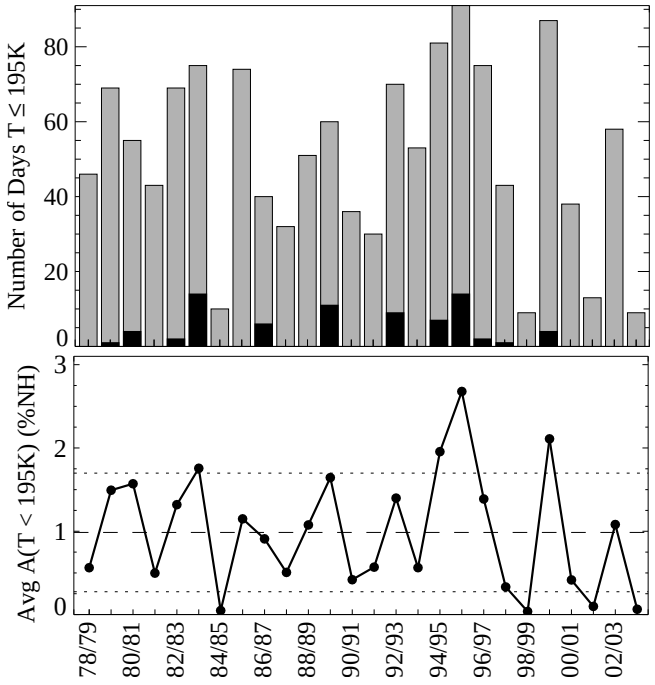

Figure 10. (Top) Number of days with temperatures less than the formation threshold for nitric-acid-containing (grey) and ice (black) polar stratospheric clouds (which activate the chlorine that destroys ozone) at 50 hPa (∼20 km) during the past 26 Arctic winters. (Bottom) Average area where nitric-acid-containing PSCs could form over December through March. Thin dashed line in lower panel shows average for all years, and thin dotted lines the one standard deviation envelope. The pattern of six out of the last seven years with much lower than average potential for PSC formation and hence ozone loss would be expected to occur randomly once every 850 years.