

The 2015–2016 Arctic winter: Perspectives on extremes in polar processing and meteorological variability from the 12-year record of Aura Microwave Limb Sounder measurements

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In the last decade, the Arctic lower stratosphere has seen some of the most dynamically disturbed winters, with stratospheric sudden warmings that curtailed polar processing early in the season and limited chemical ozone loss, as well as several winters marked by exceptionally cold conditions and severe chemical ozone loss. The occurrence in recent winters of different combinations of extreme meteorological conditions, and their impact on polar chemical processes, has underscored the Arctic stratosphere's sensitivity to a spectrum of dynamical variability. Launched as part of NASA's Aura satellite in July 2004, the Microwave Limb Sounder (MLS) provides a suite of measurements enabling quantification of polar processing and chemical ozone loss. Here we use MLS observations in conjunction with meteorological analyses for a comprehensive examination of lower stratospheric polar processing during the Arctic winter of 2015–2016. An atypically large volume of persistently low temperatures through much of the winter led to extensive polar stratospheric cloud formation, which in turn brought about an unprecedented (for the Arctic) degree of denitrification and dehydration. As a consequence of early-winter processing and an unusually large and elongated vortex with significant portions exposed to sunlight, substantial chlorine activation (enhanced abundances of ClO, depressed abundances of HCl) was evident earlier than is typical in Arctic winter. Polar processing then continued unabated until being terminated by a major final stratospheric sudden warming in early March. In this talk we will use a Lagrangian “Match”-based approach to quantify the amount of denitrification, dehydration, and chemical ozone destruction in the 2015–2016 winter, and we will place the extent of polar processing in this winter in the context of the previous 11 Arctic winters observed by Aura MLS.