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Relationship between PSC types and ozone destruction quantified from CALIPSO and MLS data

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The stratospheric ozone destruction in the Arctic has been smaller than that of Antarctic for years. The main cause of this can be attributed to its higher winter minimum temperature of ∼10-20 K than that of Antarctic stratosphere owing to topography. The average winter minimum stratospheric temperature in the Arctic is just around the threshold temperature of polar stratospheric cloud (PSC) formation. This results in the appearance of intermittent PSC formation, which is the key factor of severe ozone depletion.

Several types of PSCs are reported. The major ones are nitric acid trihydrate (NAT), supercooled ternary solution (STS), and water ice. However, it still remains unknown whether different types of PSCs have different ability of chlorine activation and ozone destruction efficiency or not. In order to clarify the above question, we made satellite match analysis using CALIPSO and MLS data.

Pitts et al. [2009] and [2011] developed a method to categorize the PSC types from 532 nm backscatter ratio and depolarization data from CALIPSO data. They categorized the PSC types into 6 types; i.e. Mix1, Mix2, Mix2-enhanced, Ice, Wave-ice, and STS. Mix denotes the mixture of NAT and STS. We made satellite match analysis from the location of certain type of PSC categorized by CALIPSO. On the forward and backward trajectories, MLS measurement locations were searched within 150 km and +/- 3 hours difference. As a result, ozone destruction rate was estimated in terms of sunlit hours on the trajectory. We analyzed Antarctic winter/spring in 2007, and Arctic winter/spring in 2010 and 2011. Difference in ozone destruction efficiency was found for both Antarctic and Arctic cases.

Reference:
Pitts, M. C., et al., [2009], Atmos. Chem. Phys., 9, 7577-7589.
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