# A statistical analysis of ozone depletion in the polar mesosphere caused by solar proton precipitation

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It is known that energetic particle precipitation (EPP) into the polar mesosphere induces production of $NO_x$ and $HO_x$ due to dissociation and/or ionization of nitrogen and oxygen molecules, leading ozone ($O_3$) depletion in the upper stratosphere and mesosphere. In particular, $O_3$ depletion in the stratosphere and mesosphere was reported at the large solar proton events (SPEs) that the energetic protons from the sun precipitate into the atmosphere (e.g. Jackman et al. 2005). However, the response of the stratospheric and mesospheric $O_3$ at the SPEs with the medium and the small proton flux is not revealed. To understand relationship between the $O_3$ depletion and SPEs in the upper stratosphere and mesosphere, we investigated changes of mesospheric $O_3$ mixing ratio before and after the SPEs that the maximum of the proton flux over 10 MeV exceeds 100 pfu during a period in 2004-2017 which are listed by NOAA SPACE ENVIRONMENT SERVICES CENTER, by using the $O_3$ dataset observed with Aura/MLS (version 4.0 and 4.2). We examined the temporal change of the zonal average of the $O_3$ mixing ratio at an altitude of 60 km every 3 degrees from 50 to 80 degrees in geomagnetic latitude for 24 SPEs which maximum of the proton flux measured by GOES satellite is over 100 pfu. We estimate the $O_3$ depletion rate and time at which the $O_3$ mixing ratio at 60 km shows the minimum value from the average before the event with the geomagnetic latitude every 3 degrees, and find the relationship between the maximum proton flux and the maximum $O_3$ depletion rate regardless of the Arctic or Antarctic side. In the presentation, we report on the details of these features as well as the feature of the $O_3$ depletion at other altitudes. In addition, difference in time of the maximum $O_3$ depletion in both the polar areas is discussed.

**References**

Jackman, C. H., M. T. DeLand, G. J. Labow, E. L. Fleming, D. K. Weisenstein, M. K. W. Ko, M. Sinnhuber, and J. M. Russell, Neutral atmospheric influences of the solar proton events in October–November 2003, J. Geophys. Res., 110, A09S27, doi: 10.1029/2004JA010888, 2005.