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MICROWAVE OBSERVATIONS OF MESOSPHERIC OZONE LOSS OVER ANTARCTICA ASSOCIATED WITH PARTICLE PRECIPITATION

Abstract

Mesospheric research is critical to understanding the coupling of the near-Earth space environment and atmosphere. Although ozone is a trace gas its role in the atmospheric heat budget is significant. Determining the extent of ozone response to solar forcing is imperative to improve current climate models. Geomagnetic activity is thought to play a role in the ozone cycle, but observational evidence over long time-scales are lacking and the response is poorly constrained. This study, as part of a master's thesis, aims to further knowledge in this field.

Two distinct ozone layers have been known since the beginning of the 20th century. The stratospheric primary ozone layer, responsible for protecting biological life from harmful radiation, and the upper mesospheric secondary layer. Due to its elusive nature, a third middle mesospheric layer was only quite recently discovered. The tertiary ozone maximum is highly variable and only exists during winter months in polar regions. At times the layer is absent, leaving a deep ozone minimum between the primary and secondary layers, before reappearing over the course of a few days. These gaps may be linked to solar energetic particle precipitation.

A two-year data set (2008-2009) with hourly ozone profiles from the British Antarctic Survey's radiometer at Troll Station was combined with profiles from NASA's EOS Aura satellite's Microwave Limb Sounder instrument (MLS). Time series of total ozone column content was calculated for the tertiary maximum to assess climatology and the seasonal cycle. Geomagnetic indices Dst and AE were used to identify times of enhanced geomagnetic activity. Key times were sorted into four storm categories according to peak strength. Each category was subject to superposed epoch analysis to resolve and enhance the particle precipitation induced ozone loss from background noise and natural variability.

Preliminary results indicate that ozone column density of the tertiary maximum will decline after a geomagnetic storm stronger than 800 on the AE scale, or -40 on Dst. Any storm weaker than these limits appear to have no significant impact on mesospheric ozone content. These results show that it is possible to constrain ozone response by the strength of common geomagnetic indices.