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Observational evidence of polar mesospheric ozone loss following substorm events

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Ozone in the polar middle atmosphere is known to be affected by charged energetic particles precipitating into the atmosphere from the magnetosphere. In recent years there has been increased interest in the sources and consequences of electron precipitation into the atmosphere. Substorms are an important source of electron precipitation. They occur hundreds of times a year and drive processes which cause electrons to be lost into our atmosphere. The electrons ionise neutrals in the atmosphere resulting in the production of HO_x and NO_x , which catalytically destroy ozone. Simulations have examined substorm driven ozone loss and shown it is likely to be significant. However, this has not previously been verified from observations. Here we use polar mesospheric ozone observations from the Global Ozone Monitoring by Occultation of Stars (GOMOS) and Microwave Limb Sounder (MLS) instruments to investigate the impact of substorms. Using the superposed epoch technique we find consistent 10-20% reduction in mesospheric ozone in both data sets. This provides the first observational evidence that substorms are important to the ozone balance within the atmosphere.