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The OH morphology during Solar Proton Events – footprints of the cutoff latitudes

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To accurately quantify the effect of Solar Proton Events (SPEs) on the atmosphere requires a good estimate of the particle energy deposition in the middle atmosphere (60-100 km) and how the energy is distributed globally. Protons in the energy range 1-20 MeV, depositing their energy in the middle atmosphere, are subject to more complex dynamics with strong day-night asymmetries compared to higher energy particles. By using measurements from the Medium Energy Proton and Electron Detector (MEPED) on all available Polar Orbit Environment Satellites (POES), we show that in the main phase of geomagnetic storms the dayside cutoff latitudes are pushed poleward, while the nightside cutoff latitudes have the opposite response, resulting in strong day-night asymmetries in the energy deposition.

In 2005 the polar orbiting sun-synchronous satellites, NOAA/POES-16 (N16) and Aura, covered approximately the same local times. In other words, the particle fluxes measured by MEPED/N16 deposited their energy close in both time and space to the OH and ozone measurements performed by MLS/Aura. The January 2005 SPE caused a clear increase in the OH density above 56o CGM latitude. We investigate to what extent the lower latitude boundary of the increased OH and ozone density fits the proton cutoff latitude.

Previous studies have investigated if OH can be used as an indicator of solar proton precipitation in the high latitude atmosphere. OH data were reduced to daily means and/or averaged over a latitude interval. In this study we take advantage of the fact that N16 and Aura are close in both time and space and evaluate the measurements on shorter time scales. We investigate the correlation and evaluate the production efficiency and lifetime of OH produced by energetic proton precipitation at different altitudes between 60 and 80 km.