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Statistical evaluation on upper mesospheric temperature effects caused by energetic particle precipitation using NOAA and TIMED

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The upper mesosphere and lower thermosphere is perhaps one of the least known regions in our atmosphere when considering the energy budget. A large number of parameters, such as electromagnetic radiation from the sun, particle precipitation, Joule heating, atmospheric waves, winds, turbulence, chemical reactions, infrared cooling, photoelectrons, and heat conduction do all influence the heating and cooling processes. The complexity of the energy budget makes it more or less impossible to determine the influence from just a single parameter in a case study. A large number of measurements on the other hand, might average out the effects from some of the parameters, making it easier to see if there are any significant effects from e.g. energetic particle precipitation.

The SABER instrument onboard the TIMED satellite has measured the neutral gas temperatures in the upper mesosphere since January 2002. In this period NOAA 15, 16, and 17 have been orbiting the Earth in polar, sun-synchronous orbits with periods of approximately 100 minutes and at different local times. The NOAA satellites carry two types of particle detectors, TED and MEPED, which provide measurements of energetic electrons and protons. The particle measurements are projected down to about 100 km where they are sorted into a geomagnetic grid. A global distribution of the precipitating energetic particles is then obtained by interpolating between the passes of the different satellites. Using large data sets, sorted by season, local time, and latitude, we investigate if there are significant temperature effects in the upper mesosphere associated with the energetic particle precipitation.