Project Details

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Project Title:
A Troposphere-Stratosphere-Mesosphere General Circulation Model Study of the Effects of Electron Precipitation on Atmospheric Chemical Composition and the Tropospheric Weather/Climate System

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Summary:
The global climate/weather system can be affected by solar variability directly via the changes of insolation or through numerous indirect mechanisms that can change the chemical composition, temperature and circulation in the middle atmosphere, as well as by changes in cloud formation, the atmospheric electrical-circuit system and biospheric processes. Using statistical methods, Labitzke and Van Loon (1988, 1989, 1990) found a high correlation between solar activity indices and temperature and pressure fields in the troposphere and stratosphere. One proposed mechanism which may explain this correlation has been described by Hines (1974). He suggested that the solar-induced temperature and wind changes in the upper and middle atmosphere may result in changes in the phase and amplitude of planetary waves in the troposphere which, in turn, modify the weather/climate system. However, in recent experiments with 3-D models by Haigh (1996) and Shindell et al.(1999), it was shown that the variation of UV flux during the 11-year solar cycle could only produce an atmospheric response which is much smaller than the reported observations. There are other natural phenomena related to the 11-year solar cycle, however, which may affect stratospheric ozone. Callis et al. (1991, 1996, 1998) showed that the fluctuation of high-speed solar wind streams during the 11-year solar cycle would modulate the continuous precipitation of energetic electrons (E > 5-10 keV) into the lower thermosphere and mesosphere. They also showed that such energetic electron precipitation (EEP) events can lead to significant increases in NOy in the middle atmosphere, that NOy formed by such events is transported into the stratosphere, and that stratospheric reactive nitrogen oxides and ozone concentrations may be affected on a significant scale. It is potentially very useful to estimate the influence of the thermal and wind changes of this coupling on the climate/weather system. Accordingly, we propose to study the effects of the variations of EEP events during the 11-year solar cycle on the ionization events in the middle atmosphere, the resultant NOy production, and the weather/climate system

Publication References:

Summary: no summary

Reference: Rozanov, E.; Callis, L.; Schlesinger, M.; Yang, F.; Andronova, N.; Zubov, V.; (2005), Atmospheric response to NOy source due to energetic electron precipitation, Geophysical Research Letters, Volume 32, Issue 14, CiteID L14811, doi: 10.1029/2005GL023041

Summary: no summary

Reference:
Phillips, G. W.; Share, G. H.; King, S. E.; August, R. A.; Tylka, A. J.; Adams, J. H., Jr.; Panasyuk, M. I.; Nymmik, R. A.; Kuzhevskij, B. M.; Kulikauskas, V. S.; Zhuravlev, D. A.; Smith, A. R.; Hurley, D. L.; McDonald, R. J.; (2001), Correlation of upper-atmospheric 7Be with solar energetic particle events, Geophysical Research Letters, Volume 28, Issue 5, p. 939-942, doi: 10.1029/2000GL012518