# Project Details

**ROSES ID:** NNH07ZDA001N
**Selection Year:** 2008
**Program Element:** Independent Investigation

**Project Title:**
Long-term Atmospheric Effects of Solar Proton Events and their Contribution to the Polar Solar Cycle Variations

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**Summary:**
This investigation will quantify the long-term (months to years) atmospheric impact of solar proton events (SPEs) using the Whole Atmosphere Community Climate Model (WACCM). The model domain extends from the ground to 140 km and includes the chemistry and physics of the troposphere, stratosphere, mesosphere, and lower thermosphere. In our past work we created a publicly available daily average ion pair production rates (http://strat-www.met.fu-berlin.de/~matthes/sparc/inputdata.html), computed from IMP and GOES proton flux data, which we used in some studies with SPEs in WACCM. This previous work with WACCM focused on the short- and medium-term (days to weeks) SPE influences and has shown reasonable agreement between WACCM predictions and satellite instrument measurements of polar middle atmospheric NOx (NO+NO2) increases and ozone decreases due to the four largest SPEs in the past 45 years. This satisfactory agreement provides the motivation for studying the longer-term SPE influences.

The long-term downward transport of the SPE perturbation to the lower stratosphere is an important component of our research and we will use WACCM in its full general circulation model mode to study ozone and dynamical changes. We will also compare the polar atmospheric effects of SPEs to other solar cycle-dependent particle precipitation phenomena including auroral electrons; medium and higher energy electrons; and galactic cosmic rays. We will also study stratospheric NOy (N, NO, NO2, NO3, N2O5, HNO3, HO2NO2, ClONO2, BrONO2) changes using WACCM's "specified dynamics" mode, which is currently being tested. This mode uses reanalysis winds in the troposphere and stratosphere from the European Center for Medium-range Weather Forecasting (ECMWF) or the Goddard Earth Observing System (GEOS-5). By reducing the ambiguity associated with interannual dynamical variability, simulations carried out with specified dynamics allow detailed comparisons against observations of the atmospheric effects of SPEs and other charged particle precipitation in specific years.

The proposed research is relevant to the NASA Strategic Sub-goal 3B: "Understand the Sun and its effects on Earth and the solar system" discussed in Table 1 of the ROSES-2007 NRA. In particular, we will address the NASA Science Question: "How do planetary systems respond?" and the NASA Research Objective: "3B.1 Understand the fundamental physical processes of the space environment from the Sun to Earth, to other planets, and beyond to the interstellar medium." We will be focusing on the long-term impact of solar proton events on the Earth s atmosphere and we will quantify the importance of SPEs relative to other solar cycle-dependent particle precipitation phenomena. We will also test our understanding of the impact of SPEs and other charged particle precipitation processes on atmospheric composition by comparing WACCM simulations against available satellite observations.

# Publication References:

no references