Project Details

ROSES ID: NRA-NNH04ZSS001N
Selection Year: 2005
Program Element: Focused Science Topic

Topic: To quantify the sensitivity of regional and global climate to solar forcing in the full context of the interactive climate system.

Project Title:
Modeling the Climate System's Response to the 11-Year Solar Cycle

PI Name: Terrence Nathan
PI Email: trnathan@ucdavis.edu
Affiliation: University of California Davis
Project Member(s):
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Summary:
Observational and global modeling evidence both point to the stratosphere as the intermediary for communicating variations in solar irradiance to the troposphere. The observational evidence indicates that interactions between the quasi-biennial oscillation (QBO) and stratospheric ozone may provide a pathway for linking the 11-year solar cycle to long-term climate variability; the global modeling evidence shows that the solar cycle signal may be amplified by stratospheric ozone to affect the extratropical planetary waves. How the solar cycle modulates the interactions between the QBO, stratospheric ozone, and extratropical planetary waves remains largely unknown. This is due in part to the inability of global climate models to produce a realistic QBO. In view of the importance of the QBO to the solar cycle problem and global climate, the proposed research will assimilate the QBO and its interactions with solar induced ozone perturbations into the Whole Atmosphere Community Climate Model (WACCM). This will permit us to address our central objective: to provide improved understanding and more accurate numerical simulations of atmospheric quasi-decadal variability associated with the 11-year solar cycle. In addressing this objective we shall employ a unified work flow that combines basic research, numerical modeling, and observational validation. The basic research will employ tropical and extratropical mechanistic models to help identify mechanisms that may provide a pathway for linking the solar cycle signal to variations in climate. Attention will be focused on developing a better understanding of how solar cycle induced variations in stratospheric ozone modulates the interactions between the QBO, stratospheric ozone and planetary waves. The numerical modeling will involve assimilating the QBO into the WACCM; the output will be analyzed with a suite of diagnostics; including Eliassen-Palm fluxes, refractive indices, and singular value decomposition. The modeling simulations will be validated by comparing the WACCM output with observations. The proposed research addresses the primary goal of NASA, the Office of Space Science, and the Living with a Star Program: to develop scientific understanding of the Sun-Earth system and its impact on terrestrial climate.

Publication References:

Summary: no summary

Reference: Cordero, Eugene C.; Nathan, Terrence R.; (2005), A new pathway for communicating the 11-year solar cycle signal to the QBO, Geophysical Research Letters, Volume 32, Issue 18, CiteID L18805