

## Project Details

**ROSES ID:** NRA-02-OSS-01

**Selection Year:** 2003

**Program Element:** Independent Investigation: LWS

**Project Title:**

Stratospheric Modulation of Terrestrial Climate during the Solar Cycle

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**Project Member(s):**

- Melaugh, Marita ; Authorizing Official; Georgia Tech Research Corporation

**Summary:**

We propose a diagnostic investigation of the physical mechanisms linking the solar cycle to terrestrial climate variability. It is well known that UV variations associated with the solar cycle modulate the upper stratospheric circulation. The solar cycle is also observed to be related to annular atmospheric variability in the lower stratosphere and troposphere. The physical mechanisms for the latter linkages remain elusive, however. Recent studies postulate both indirect and direct dynamical mechanisms in which the stratosphere can modulate tropospheric climate (Shindell et al. 1999, Black 2002). We hypothesize that the stratosphere provides the "missing" dynamic link between the solar cycle and terrestrial climate variability. The modulation of terrestrial climate by the solar cycle will be examined by comparatively testing the ideas put forward in the two studies mentioned above. Our primary objectives include (1) characterizing the typical stratospheric and tropospheric dynamic structures associated with the solar cycle and (2) diagnosing the mechanistic interaction among these structures, focusing particularly on the downward influence of stratospheric circulation anomalies. These objectives will be pursued with a combination of (a) quantitative diagnostic analyses of space-based and ground-based observations of the Earth System and NASA/GISS GCM output and (b) diagnostic modeling analyses. The indirect mechanism will be tested by assessing Eliassen-Palm fluxes, refractive indices, and forcings of the Transformed Eulerian-mean circulation. The direct mechanism will be studied by applying potential vorticity inversion methods and diagnostic downward control principles. The proposed research is aimed to provide an improved scientific understanding of the physical mechanisms linking the Sun-Earth system. In doing so, the project will address some of the primary research objectives of NASA, the Space Science and Earth Science Enterprises, the OSS Sun-Earth Connection Theme, and the Living With a Star Research Program. The results will likely provide useful information for assessing the potential for future predictive efforts and helping focus the needs of future NASA space missions. Black, R.X., 2002: Stratospheric forcing of surface climate in the Arctic Oscillation. *J. Climate*, 15, 268-277. Shindell, D. T., D. Rind, N. Balachandran, J. Lean, and P. Lonergan, 1999: Solar cycle variability, ozone, and climate. *Science*, 284, 305-308.

## Publication References:

**Summary:** "

**Reference:** Black, Robert GIT - Stratospheric Modulation of Terrestrial Climate during the Solar Cycle

**Summary:** no summary

**Reference:** Wills-Davey, M. J.; DeForest, C. E.; Stenflo, J. O.; (2007), Are ``EIT Waves" Fast-Mode MHD Waves?, *The Astrophysical Journal*, Volume 664, Issue 1, pp. 556-562, doi: 10.1086/519013