

Project Details

ROSES ID: NNH09ZDA001N

Selection Year: 2010

Program Element: Sun Climate

Project Title:

Solar UV-Induced Responses of Stratospheric Ozone, Temperature, and Circulation on Decadal Time Scales

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Project Member(s):

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Summary:

Objective: The objective of the proposed work is to more completely determine and interpret the observed solar cycle change in stratospheric ozone, temperature, and circulation as a function of altitude, latitude, longitude, season, and QBO phase.

Methods/Techniques: We will apply an improved multiple regression statistical model to evaluate the 11-year solar induced stratospheric response using a series of complementary and independent data sets. A primary initial task will be to evaluate whether the observed 11-year responses of ozone and temperature in the low-latitude lower stratosphere may be caused mainly by the troposphere-ocean amplification mechanism investigated recently by Meehl et al. [2009]. We will do this by determining more completely the dependence on latitude, longitude, season, and QBO phase of the lower stratospheric ozone and temperature responses and then evaluating whether these responses correlate significantly with observationally estimated and model-predicted sea surface temperature solar cycle variations in the Pacific sector. Second, we will analyze statistically a series of reanalysis and direct satellite remote sensing data sets for the purpose of determining more completely the zonal mean temperature, zonal wind, and planetary wave flux responses to 11-year solar forcing. Solar regression coefficients will be calculated in monthly and, in some cases, 10-day increments to allow detailed comparisons with recent model simulations. Third, we will evaluate the relative contributions of particle precipitation-induced odd nitrogen variability and solar UV variability in producing interannual ozone variations in the polar stratosphere as a function of altitude, season, and QBO phase.

Significance: As stated in the LWS TR&T Summary (Appendix B.6 of the ROSES-2009 NRA), "NASA through the TR&T program and Earth Science Division in conjunction with other national agencies such as NOAA and NSF needs to deliver the understanding of how and to what degree variations in the solar radiative and particulate output contribute to changes in global and regional climate ..." The observed solar cycle variation of the stratosphere is a fundamental constraint on chemistry climate models that include stratospheric effects of solar ultraviolet and energetic particle inputs. The proposed work is intended to determine (to the extent allowed by the length and calibration of existing satellite data sets) the characteristics of the observed solar cycle variation so that current models can be quantitatively tested.

Publication References:

no references