Project Details

ROSES ID: NNH09ZDA001N
Selection Year: 2010
Program Element: Sun Climate

Project Title:
Global and regional climate sensitivity to solar forcing in an integrated chemistry-climate atmosphere-ocean model driven by SORCE observations

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Summary:
We propose to examine the impact of solar irradiance variations on the Earth s atmosphere and climate at multiple timescales. Using a state-of-the-art climate model driven by spectrally discriminated variations in solar output observed by satellite we will investigate the changes induced in atmospheric composition, circulation, and surface climate and compare against available observations. The model includes fully interactive chemistry operating seamlessly from the surface through the mesosphere in the new IPCC AR5 version of the GISS climate model (modelE). The flexible architecture of modelE allows us to easily run the identical atmospheric model with or without chemistry, and coupled to either a fully dynamic ocean, a slab ocean or using prescribed sea surface temperatures (SSTs). We propose to use this model to examine the climate response to solar variations on decadal to millennial timescales.

We will include extensive comparisons between observations and the simulated solar cycle response (with both a slab ocean and fixed SSTs) in the model driven by recent observations of solar irradiance variations as a function of wavelength from the SIM instrument on SORCE. Results to date indicate that modelE captures many aspects of the observed ozone response (including in the lower stratosphere), the poleward and downward propagation of zonal wind anomalies, and the spatial structure of long-term solar-induced surface climate changes. Sensitivity studies will test the importance of various processes, e.g. the tropospheric and stratospheric chemistry, or the model s vertical extent, in the cascade of solar effects from the upper atmosphere down to the surface. The simulations will also allow separation of the so-called top-down and bottom-up mechanisms of solar-climate interactions. The climate response will be compared with that reported in several observational analyses. Subsequently, we will use the evaluated model incorporating only those processes which are critical based on the solar cycle tests to simulate century-scale transients (e.g. to Maunder Minimum-type conditions) including a coupled ocean and compare with global and regional historical reconstructions. These latter simulations will be closely linked with GISS participation in the PMIP (Paleoclimate Model Intercomparison Project) simulations of the past millennium, but will add a distinct solar-climate analyses to that project which otherwise includes multiple forcings.

The proposal is highly relevant to the Sun-Climate Theme 1.2.2 of the solicitation and will address many of the potential research questions outlined in that section of the proposal call.

Publication References:

Summary: no summary

Reference:
Gray, L. J.; Beer, J.; Geller, M.; Haigh, J. D.; Lockwood, M.; Matthes, K.; Cubasch, U.; Fleitmann, D.; Harrison, G.; Hood, L.; Lut erbacher, J.; Meehl, G. A.; Shindell, D.; van Geel, B.; White, W.; (2010), Solar Influences on Climate, Reviews of Geophysics, Volume 48, Issue 4, CiteID RG4001m, doi: 10.1029/2009RG000282

Summary: no summary

Reference:
Gray, L. J.; Beer, J.; Geller, M.; Haigh, J. D.; Lockwood, M.; Matthes, K.; Cubasch, U.; Fleitmann, D.; Harrison, G.; Hood, L.; Lut

erbacher, J.; Meehl, G. A.; Shindell, D.; van Geel, B.; White, W.; (2012), Correction to “Solar influences on climate”, Reviews of Geophysics, Volume 50, Issue 1, CiteID RG1006