Project Details

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Project Title:
Impacts of Stratospheric dynamics on atmospheric behavior from the ground to space under solar minimum and solar maximum conditions

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Summary:
Dynamical response to solar radiative forcing is a crucial and poorly understood mechanisms. We propose to study the impacts of large dynamical events on both the troposphere and the thermosphere during different phases of the solar cycle. The scientific objectives of this proposed research are intimately connected with the integrated response of the whole atmosphere to solar variability. In particular we compute and analyze the solar-induced variations of the following: (1) the penetration into the thermosphere of wave dynamics associated with disturbed events in the stratosphere; and (2) the influence of the stratosphere on the tropospheric climate during different phases of the solar cycle. In addition, a third objective of our research plan is to provide a fiducial simulation of the whole atmosphere up to 500 km which will allow the community to investigate in detail the sources and mechanisms that generate seasonal variations in the thermosphere (annual and semiannual variations). For this purpose, we will exercise the newly developed and updated extension of the Whole Atmosphere Community Climate Model (WACCM-X) to 500 km which provides the most comprehensive ground-to-thermosphere modeling capacity to date. To specify the stratospheric dynamical events as realistically as possible, the meteorology of the atmosphere below 90 km is constrained to the observed state using data assimilation products from the Naval Research Laboratory Atmospheric Variational Data Assimilation System (NAVDAS) or from the NASA Modern Era Retrospect Analysis for Research and Applications (MERRA). The quality of the model simulations (thus constrained) in the thermosphere will be assessed by comparing to the globally averaged mass density dataset developed at Naval Research Laboratory that covers the last 40 years and, where available, to composition, temperature and density profiles from the Global Ultraviolet Imager (GUVI) onboard of the NASA/TIMED satellite.

Publication References:

Summary: no summary

Reference: Pedatella, N. M.; Liu, H.-L.; Sassi, F.; Lei, J.; Chau, J. L.; Zhang, X.; (2014), Ionosphere variability during the 2009 SSW: Influence of the lunar semidiurnal tide and mechanisms producing electron density variability, Journal of Geophysical Research: Space Physics, Volume 119, Issue 5, pp. 3828-3843, doi: 10.1002/2014JA019849

Summary: no summary

Reference: Sassi, Fabrizio; Liu, Han-Li; (2014), Westward traveling planetary wave events in the lower thermosphere during solar minimum conditions simulated by SD-WACCM-X, Journal of Atmospheric and Solar-Terrestrial Physics, Volume 119, p. 11-26, doi: 10.1016/j.jastp.2014.06.009

Summary: no summary

Reference: Lean, J. L.; Meier, R. R.; Picone, J. M.; Sassi, F.; Emmert, J. T.; Richards, P. G.; (2016), Ionospheric total electron content: Spatial patterns of variability, Journal of Geophysical Research: Space Physics, Volume 121, Issue 10, pp. 10,367-10,402, doi: 10.1002/2016JA023210