Project Details

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Program Element: Strategic Capability

Project Title:
Physical modeling of the radiative Sun-Earth connection

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Summary:
We propose a strategic capability that produces and evaluates physics-based models of the causes and effects of solar radiation-driven processes occurring on the Earth s atmosphere, including all layers from troposphere to thermosphere, and time-scales from days to centuries. The research will produce and validate methods and physical models against current and future observations, will feed into Earth s atmospheric and climate research, and will gauge the effects of solar processes on aeronomy and climate modeling.

The final product will be quantitative understanding and modeling of how solar processes affect the Earth climate and atmosphere through the Solar Spectral Irradiance (SSI) variations they introduce, i.e. the Sun-climate relationship will be fully characterized from the point of view of the radiative coupling. In addition, the updated computing tools developed will be made available to the community for further testing and evaluating models as newer observations and theoretical results become available in the coming years.

Our proposal addresses the goal 1.3 Strategic Goal: Solar Spectral Irradiance Models on Multiple Time Scales for Coupling to Atmospheric/Climate Models .
In one stage we will use and further develop the existing Solar Radiation Physical Modeling (SRPM) tools and semi-empirical physical models of the solar atmosphere to address the entire spectral range from 1 nm to 5 m, and complete their coronal components that are essential for the 1 nm to 40 nm range. This system will deliver very detailed SSI computations of high-resolution full-spectra, and intensities over bands, that can be directly compared with current observations and input into climate modeling systems. The tools developed in this stage will permit our team and other researchers to: 1) Study the climate and atmospheric models sensitivity to physically plausible variations of irradiance at various wavelengths. These variations include the produced by features on the solar disk (usually magnetic field related), global changes of the solar atmosphere, and historical reconstructions of any combination of these. 2) Further develop the physical models of the solar atmosphere and the image analysis already built into SRPM, and to develop their own physical models or image analysis by comparing with spectral observations of irradiance and radiance (e.g. existing and future SORCE and SDO observations).

As a result of these studies we will also characterize the redundancy in the wavelength spectrum and quantitatively understand the relationship between various wavelengths SSI and design optimal observational schemes.

In another stage the already existing and further developed methods and data SRPM infrastructure will be used to define the key aspects, solar processes, and mechanisms that affect different layers and time-scales of the Earth atmosphere and climate. Our team will analyze the effects on Earth of SSI variations driven by existing solar features data, possible global solar changes, and reconstructions of both of these. For this SRPM system output will be used as input to numerical simulations of GCM and other tools. We expect to further our collaborations with other researchers in the country and abroad for discussing and elaborating the results. After our research all the tools and models will be made available to the whole community through the CCMC and other interfaces.

Publication References:

no references