Project Details

ROSES ID: NNH22ZDA001N-LWS
Selection Year: 2022
Program Element: Focused Science Topic

Topic: FST #1: Beyond F10.7: Quantifying Solar EUV Flux and its Impact on the Ionosphere - Thermosphere - Mesosphere System

Project Title:
The Next Generation of Flare Irradiance Spectral Models: FISM-3 and FISM-AI

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Summary:
Version 2 of the Flare Irradiance Spectral Model (FISM2; Chamberlin et al., 2020) was released in Dec 2020, and has quickly replaced the original FISM model as the most accurate solar ultraviolet spectral irradiance model over all time scales from solar flares (seconds to hours), active region emergence (hours to days), solar rotation (days to weeks), and solar cycle (months to years). FISM's accuracy and cadence are attributed to moving beyond using solely the F10.7 cm radio flux to more representative proxies for each wavelength, such as the H I Lyman Alpha 121 nm, Mg II core-to-wing ratio (c/w), and He II 30.4 nm measurements. Additionally, including higher temporal cadence proxies, such as those from GOES-XRS, allows for significant improvements in FISM's ability to model variations due to solar flares. _x000D_
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Science Goal: Improve the accuracy of solar UV spectral irradiance modeling on all time scales from seconds to decades. Despite significant improvements from FISM to FISM2, discrepancies remain between FISM2 estimates and the measurements for which it is based. This proposal will add additional capabilities in the next versions, FISM-3 and FISM-AI. The specific objectives of this proposal for FISM-3 are to (1) incorporate the Lumped Element Thermal Model (LETM; Thiemann et al., 2017a) for the delay in flare peak emissions for different wavelengths, (2) incorporate new MinXSS-1/-2/DAXSS soft X-ray spectral measurements, (3) add the additional daily proxies of plasma Temperature and Emissions measures (Schwab, PhD thesis, 2022), (4) improve the center-to-limb variation correction, (5) incorporate the new routine proxies that are now available from the GOES/EUVS instrument and (6) incorporate the ADAPT full-Sun magnetic field model, as well as relations of the photospheric magnetic field to irradiance, to drive a 'daily average' forecast of the UV solar spectral irradiance. Furthermore, for Objective (7), FISM-AI will employ an artificial intelligence (AI) model to determine if this method can improve upon the accuracy of the traditional UV spectral irradiance empirical model results from FISM-3._x000D_
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Methodology: Objective (1) will use the approach described in Thiemann et al. (2017a), using available emissions to estimate the required cooling time constant. Objectives (2 and 4-6) will determine regression coefficients between irradiance measurements and proxies, detrended according to fundamental timescale (solar cycle, solar rotation, etc.), following the approach of Chamberlin (2007; 2008; 2020). Objective (3) will use OSPEX modeling software to calculate coronal plasma temperatures and emission measures and correlate these to GOES XRS irradiance as a proxy measurement. Objective (7) will employ state-of-the-art multi-dimensional time-series learning algorithms to develop an independent deep-learning powered empirical model._x000D_
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Relevance: This proposal is for the Beyond F10.7" Focused Science Team and the proposed significant improvements to FISM will directly address this FST Objective #1, identifying new and/or improved EUV indices for driving model predictions of ITM structure". We expect through collaboration with other teams, who will presumably bring a wealth of ITM expertise, these improved irradiances will be used to address the other two FST objectives.

Publication References:

no references