



Institute for Space Weather Sciences Colloquium

Thursday, 7th of March 2024, 1pm ET

ECE 202 & via njit.webex.com, meeting ID: 2621 447 3191, password: isws

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Prediction of Solar Energetic Events Directly from Solar Sources: Progress, Challenges, Expectations

Solar weather, the solar end of space weather, is responsible for a dominant majority of concerning – quite often hazardous – radiation and particulate conditions in the near- Earth, cislunar and deep space. Predicting these instabilities all the way from Sun to Earth to mitigate their effects implies tackling an 8-order-of-magnitude dynamical range in space and time, and we are clearly not there yet. On the other hand, relying on inner- heliospheric conditions far from the Sun to forecast the impact of propagating particles and transients may have some accuracy but leads to impractically short advance warning times. With our reliance on space technology and exploration increasing, we make a case that, no matter how hard the problem is, prediction of solar flares, coronal mass ejections (CMEs) and solar energetic particle (SEP) events should start from their host locations in the low solar atmosphere. We briefly review the physical rationale, methodologies, and key results of these methodologies, ways to verify and comparatively validate their performance, as well as critical data gaps that inhibit predictions. We further discuss the attention we should be paying to potentially cutting- edge AI technologies, as they have already outnumbered conventional methods in flare prediction. The potential role of AI can be transformative beyond prediction efforts if they can be used as ultrafast solvers of fundamental equations of magnetohydrodynamics to provide routine and realistic magnetic field configurations in the solar corona, where routine magnetographic measurements are intractable.

This seminar draws significantly from a just-accepted review and roadmap paper in the framework of COSPAR's Panel on Space Weather / International Space Weather Action Teams. The paper can be found here: <https://doi.org/10.1016/j.asr.2024.02.030>



Dr. Manolis K. Georgoulis is a Senior Professional Staff Scientist at Johns Hopkins APL and a Research Director (on leave of absence) at the Research Center for Astronomy and Applied Mathematics of the Academy of Athens, Greece. He is also a Scientific Editor for the American Astronomical Society Journals, the President of Commission E2 on Solar Activity of the International Astronomical Union, and a Corresponding Member of the International Academy of Astronautics. B.Sc. (Physics; 1993) and PhD (Solar Plasma Physics; 2000) from the Aristotle University of Thessaloniki, Greece, specializing in heliophysics, with emphasis on solar magnetism and the initiation of solar eruptions. Extensive work in solar flare prediction and space weather forecasting. A science team member for the Modeling and Data Analysis Working Group of the Solar Orbiter and PROBA-3 missions (ESA) and of the proposed Firefly Constellation mission concept (NASA). Project Coordinator of the FLARECAST EU Consortium and Project Manager of the ESA/SSA/SWE A-EFFort Service. Former Deputy Project Scientist of the Parker Solar Probe mission and Visiting Professor at the Georgia State University. Former National Delegate of Greece in ESA's Science Programme Committee and President of the European Solar Physics Division of the European Physical Society. Author or co-author of 100+ refereed papers, including invited book chapters and monographs. Editor in seven fully refereed topical issues and books in solar physics and space weather. The latest book he edited is an interdisciplinary treatise on helicity, entitled "Helicities in Astrophysics, Geophysics and Beyond" (AGU Geophysical Monograph Series, Wiley, 2023, ISBN: 978-1-119-84168-5).