Real-Time Solar Flare Predictions for Improved Flare Observations. J. T. Vievering¹, P. S. Athiray², J. C. Buitrago-Casas³, P. Chamberlin⁴, L. Glesener⁴, L. Golub⁵, V. Knoer⁶, S. Krucker³, J. Machol⁴, A. Pantazides⁴, C. Peck⁷, K. Reeves⁶, S. Savage⁶, D. Schmit³, B. Smith¹, G. Vigil⁸, A. Winebarger⁶; ¹Johns Hopkins Applied Physics Laboratory (Juliana.Vievering@jhuapl.edu), ²University of Alabama Huntsville, ³Space Sciences Laboratory at the University of California Berkeley, ⁴Laboratory for Space and Atmospheric Physics at the University of Colorado Boulder, ⁵University of Minnesota Twin Cities, ⁶Harvard-Smithsonian Center for Astrophysics, ⁷CIRES at the University of Colorado Boulder, ⁸NASA Marshall Space Flight Center

Introduction: Understanding when and where solar flares and eruptive events will occur continues to be an important goal for the heliophysics community, from both fundamental science and space weather perspectives. Improvements in near-term flare predictions are particularly important for observatories targeting flare physics that are restricted in field of view (FOV) and/or observing time. To enable triggered observations of solar transients, we need to invest in the development of flare predictions that are more actionable than long-term (e.g., 24-hour) forecasts and provide earlier notice than current flare alerts.

Science motivation: Solar flares are some of the most energetic events in the solar system, producing bursts of radiation across the electromagnetic spectrum and often resulting in significant space weather hazards at Earth. Answering key questions in the next decade about how energy is released and transferred during these extreme events requires both improvements in instrumentation (e.g., finer spatial/temporal resolution, greater sensitivity) and observational coverage across the electromagnetic spectrum throughout the duration of the events.

Real-time solar flare predictions: To support improved coverage of flaring events, we propose developing a tool that rapidly aggregates near-real-time signatures of flare onset to provide early prediction of the magnitude and duration of ensuing solar eruptive events. Multiple near-real-time data sets are publicly available which provide measurements of early flare signatures, including solar irradiance (e.g., GOES/XRS, GOES/EUVS, SDO/EVE) and imaging (e.g., GOES/SUVI, SDO/AIA) data. Using these data sets and machine learning techniques, we aim to identify the strongest predictors of flaring activity and how these predictors relate to the resulting flare magnitude and duration. With these flare predictions, any instrument with the capability for real-time pointing adjustment will be able to point to the flare in its early stages, greatly increasing multiwavelength coverage of each event.

Measurements/missions that will benefit: A tool for real-time solar flare predictions will maximize the science return for a wide variety of missions targeting solar flares, including instruments with a limited FOV, instruments with different operational modes for flares, and missions with a limited life span (e.g., CubeSats). Additionally, such a tool will allow for optimizing use of astrophysical observatories (i.e., limited time on solar targets) for solar flare observations. Real-time predictions will also support future solar sounding rocket flare campaigns, which seek to perform a triggered launch to observe a large solar flare with novel flare-optimized instrumentation. In addition to the benefits for flare physics and solar instrumentation development, this tool could feasibly be leveraged for space weather applications.