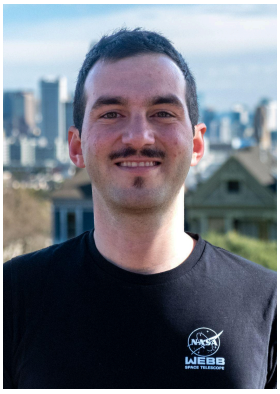
SPD Thomas Metcalf Travel Award Report

SEP Monitoring and Forecasting Workshop

Georgia State University, October 16-19, 2024

Spyros Kasapis was born and raised in Thessaloniki, Greece. He moved to the US when he was 17 and completed his Aerospace Engineering Bachelor's and Master's degrees in Worcester Polytechnic Institute where he focused on controls and autonomous aircraft path planning. He moved to Ann Arbor for his second Master's degree in Naval Architecture and Marine Engineering and his PhD which was focused on Machine Learning applications in visual recognition. He has worked as an intern at the NASA Goddard Space Flight Center, where he helped characterizing the Van Allen radiation belt using the SDO satellite data while also being a member of the NASA JPL 2022 Planetary Science Summer School cohort where he worked on the Gelatto asteroid sample return mission proposal. He is currently a Postdoctoral Fellow at the NASA Ames Research Center. His research interests include the use of Machine Learning for Detection of Solar Active Region Emergence and SEP Prediction.



Forecasting SEP Events During Solar Cycles 23 and 24 Using Machine Learning

Spiridon Kasapis, Irina Kitiashvili, Paul Kosovich, Alexander Kosovichev, Viacheslav Sadykov, Patrick O'Keefe, Vincent Wang

This work, recently published in *The Astrophysical Journal* (Kasapis et al. 2024), explores the use of interpretable machine learning techniques for predicting SEP events. Our model uses Solar Dynamics Observatory (SDO) and Solar and Heliospheric Observatory (SoHO) data from Solar Cycle 23 and 24 to demonstrate how magnetic field features related to solar flares can be used to forecast SEP events with improved accuracy. I discussed the use of machine learning models such as Support Vector Machines (SVMs) and regression-based approaches in my presentation, comparing their performance to existing studies.

The Q&A session following my presentation sparked insightful discussions, particularly about the challenge of selecting the appropriate lead time for SEP predictions and the limitations of using accuracy as a metric for evaluating machine learning models. There was interest in exploring higher-dimensional data and incorporating additional physical information about active regions to improve model performance. Additionally, participants highlighted the need to study the connection between solar flares, CMEs, and SEP events in greater detail, as the direct link between flares and SEPs remains complex. The conversation underscored the value of exploring new approaches, such as convolutional neural networks (CNNs), to capture the spatial dynamics of active regions more effectively.

Overall, the workshop provided an excellent platform to exchange ideas with fellow researchers, receive constructive feedback, and stay updated on the latest developments in the field. The discussions and networking opportunities will undoubtedly influence the future direction of my research on SEP forecasting and space weather prediction.