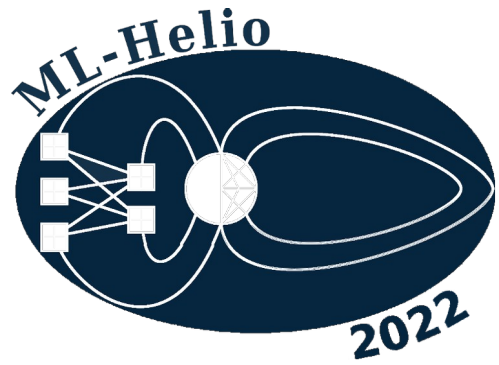


**2nd Machine Learning in Heliophysics
Boulder, 21 – 25 March 2022**



Monday 21st March

8:30 – 9:30 Registration and coffee
9:30 – 10:00 Introductory Remarks

Session 1 – Chairs:

10:00 – 10:30 (Invited) **Rafal Angryk**
 TBD

11:00 – 11:20 **Cedric Huwyler** (University of Applied Sciences and Arts Northwestern, CH)
 Using Multiple Instance Learning for Explainable Flare Prediction

11:20 – 11:40 **Kiera van der Sande** (University of Colorado)
 Comparing Solar Flare Irradiance in GOES X-ray and SDO/AIA EUV Data via Machine Learning Regression

11:40 – 12:00 **Jonathan Donzallaz** (Haute Ecole d'Ingénierie et d'Architecture Fribourg, CH)
 SolarNet: Solar Flares Prediction with Self-Supervised Learning

12:00 – 12:20 **Dattaraj B Dhuri** (NYU Abu Dhabi)
 Deep learning reconstruction of sunspot vector magnetic fields for forecasting solar storms

12:20 – 14:00 Lunch

Session 2 – Chairs:

14:00 – 14:30 (Invited) **Eunsu Park**
 Application of image translation methods based on deep learning to solar data

14:30 – 14:50 **Elena G Broock** (Instituto Astrofísico de Canarias)
 Farnet-II: application of Convolutional LSTM and attention mechanisms to solar far-side activity detection

14:50 – 15:10 **Allison Liu** (University of Colorado)
 Data Augmentation of Magnetograms for Solar Flare Prediction using GANs

15:10 – 16:00 Coffee Break

16:00 – 16:30 (Invited) **Andres Munoz-Jaramillo**
 TBD

16:30 – 16:50	Robert Jarolim (Graz University) <i>Probing the coronal magnetic field with physics informed neural networks</i>
16:50 – 17:10	Oleg Stepanyuk (Bulgarian Academy of Sciences) <i>Advanced Image Preprocessing and Feature Tracking for Remote CME Characterization with Deep Learning</i>
17:10 – 17:30	Benoit Tremblay (University of Colorado) <i>Emulation of MHD simulations to Infer Flows in Granulation, Sunspots, and Active Regions</i>
18:30 – 20:00	Reception

Tuesday 22nd March

8:00 – 9:30	(demo) Hannah Marlowe (Amazon AWS)
9:30 – 10:00	Coffee break
10:00 – 11:30	Wendy Carande (LASP, University of Colorado) <i>Tutorial on ML, part 1</i>
11:30 – 12:30	Poster Session A (<i>mostly virtual</i>)
12:30 – 14:00	Lunch

Session 3 – Chairs:

14:00 – 14:30	(Invited) Katariina Nykyri (Embry-Riddle Aeronautical University) <i>Information Theory and Machine Learning Applications to Solar Wind Magnetosphere Interactions</i>
14:30 – 14:50	Sahib Julka (University of Passau) <i>An active learning approach for automatic detection of bow shock and magnetopause crossing signatures in Mercury's magnetosphere using MESSENGER magnetometer observations.</i>
14:50 – 15:10	Simon Wing (Johns Hopkins Applied Physics Lab) <i>Modeling radiation belt electrons with information theory informed neural networks</i>
15:10 – 15:30	Georgios Balasis (National Observatory of Athens) <i>Machine Learning Techniques for Automated ULF Wave Recognition in Swarm Time Series</i>
15:30 – 15:50	Michael S. Kirk (ASTRA) <i>The Center for HelioAnalytics</i>
15:50 – 18:00	Poster Session A (<i>mostly in-person</i>) – including coffee and refreshments

Wednesday 23rd March

8:30 – 10:30 **Enrico Camporeale** *Tutorial on ML, part 2:*

- *Gaussian Process Regression*

10:30 – 11:00 Coffee Break

Session 4 – Chairs:

11:00 – 11:20 **Ramiz A. Qudsi** (Boston University)
Algorithm Development for Magnetic Field topology Reconstruction in a 3-D Simulation Box Using Machine Learning

11:20 – 11:40 **Brecht Laperre** (KU Leuven)
Identification of closure terms from fully kinetic plasma simulations using machine learning

11:40 – 12:00 **Mikhail Sitnov** (Johns Hopkins Applied Physics Lab)
Resolving the geomagnetic tail current sheet structure with data mining

12:00 – 12:20 **Sigiava AminaIragia-Giamini** (SPARC)
Radiation belt model including semi-annual variation and Solar driving (SENTINEL)

12:20 – 12:40 **Sergio Vidal-Luengo** (University of Colorado)
Whistler-mode Waves and Relativistic Precipitation Event Detection by Employing Self-Organizing-Maps

12:40 – 14:00 Lunch

Session 5 – Chairs:

14:00 – 14:30 (invited) **Jay Johnson** (Andrews University)
Information Horizon of Flares and Magnetic Active Regions

14:30 – 14:50 **Marius Giger** (University of Applied Sciences and Arts Northwestern, CH)
Unsupervised event detection in heliophysics

14:50 – 15:10 **Sophie Teichmann** (Georg-August-Universität Göttingen)
Influence of solar wind parameters on unsupervised solar wind classification

15:10 – 15:30 **Talwinder Singh** (University of Alabama)
Improving the Arrival Time Prediction of Coronal Mass Ejections using Magnetohydrodynamic Ensemble Modeling, Heliospheric Imager data and Machine Learning

15:30 – 16:00 (invited) **Gary Doran** (JPL)
Responsive Onboard Science for Europa Clipper

16:00 – 16:30	Coffee
16:30 – 17:00	(invited) Maria Elena Innocenti (Ruhr University Bochum) <i>A versatile technique for unsupervised classification and preliminary analysis of simulation results</i>
17:00 – 17:20	Hannah Marlowe (Amazon) <i>An unsupervised learning approach to superstorm signature identification in precipitating particle data</i>
17:20 – 17:40	Andong Hu (University of Colorado) <i>Innovative Dst predictions using neural networks</i>
17:40 – 18:00	Kiley Yeakel (Johns Hopkins Applied Physics Lab) <i>Automated algorithm for the detection of dispersionless electron injection events in Earth's magnetotail</i>

Thursday 24th March

Session 6 – Chairs:

8:30 – 9:00	(invited) Maziar Raissi (University of Colorado) <i>Data-Efficient Deep Learning using Physics-Informed Neural Networks</i>
9:00 – 9:20	Xiaoyue Li (Zhejiang University) <i>Transfer-Solar-GAN: Generation of Input Sources for Solar Wind Models with Deep Learning</i>
9:20 – 9:40	Panagiotis Tigas (Oxford University) <i>Global geomagnetic perturbation forecasting using deep learning</i>
9:40 – 10:00	Mohamed Nedal (Bulgarian Academy of Sciences) <i>Forecasting the Solar Energetic Protons Integral Flux using the Bi-Directional Long Short-Term Memory Neural Network</i>
10:00 – 10:20	Andrew Smith (University College London) <i>Producing ML-driven Real-Time Forecasts of the Probability of Large Rates of Change of the Surface Magnetic Field in the UK</i>
10:20 – 11:00	Coffee Break
11:00 – 11:30	(invited) Alan Kaptanoglu (University of Washington) <i>Machine Learning for discovering sparse models of fluids, plasmas, and much more</i>
11:30 – 12:30	Poster Session B (mostly virtual)
12:30 – 14:00	Lunch

14:00 – 14:20	Sai Gowtam Valluri (University of Alaska) <i>An Artificial Neural Network-based global three-dimensional ionospheric electron density model: present state, challenges, and future directions</i>
14:20 – 14:40	Vivian Otugo (Rivers State University) <i>Estimation of ionospheric critical plasma frequencies from GNSS-TEC measurements using artificial neural networks</i>
14:40 – 15:00	Jhassmin A Aricoché (Universidad Nacional del Callao) Modeling ionograms with deep neural networks: Contrasting models
15:00 – 15:30	Brianna Maze and Alec Engell (NextGen) <i>The Weather Machine Learning Platform and the Space Radiation Intelligence System</i>
15:30 – 17:30	Poster Session B (mostly in-person) – including coffee and refreshments
19:30	Social Dinner

Friday 25th March

Session 7 – Chairs:

8:30 – 9:00	Early career awards
9:00 – 9:30	(invited) Maria J. Molina (NCAR, Boulder, Colorado) <i>Machine Learning for the Geosciences</i>
9:30 – 9:50	Simon Mackovjak (Slovak Academy of Sciences) <i>Towards explanation of airglow variation by ML techniques</i>
9:50 – 10:10	Shanshan Bao (Rice University) <i>A gray-box approach in modeling atmospheric precipitation in global geospace models</i>
10:10 – 10:30	Daniel I Okoh (Centre for Atmospheric Research) <i>Results from a 3-D electron density model developed from COSMIC radio occultation data using artificial neural networks</i>
10:30 – 11:00	Coffee
11:00 – 11:20	Delores J Knipp (University of Colorado) <i>Geophysical interpretations from machine learning superstorm signature identification in satellite precipitating particle data</i>
11:20 – 11:40	Ekaterina Verner (NASA)
11:40 – 13:00	Open discussion

List of posters

(Poster sessions will be assigned once we have numbers on virtual and in-person attendees)

Carlos J Diaz Baso	<i>Bayesian Stokes inversion with Normalizing flows</i>
Spiridon Kasapis	<i>Machine Learning-Based Forecasting of SEP Events Using the Recently Published MDI Data</i>
Linnea Wolniewicz	<i>SEARCH: SEgmentation of Active Regions and Coronal Holes</i>
Pete Riley	<i>What Machine Learning Algorithms Teach us about Which Explanatory Variables Matter Most in Predicting Bz within Coronal Mass Ejections</i>
Yong Ji	<i>Composite model for predicting sym-H index</i>
Egor Illarionov	<i>Machine learning for digitization of historical records of solar activity</i>
Zeyu Sun	<i>Predicting Solar Flares Using CNN and LSTM on Two Solar Cycles of Active Region Data</i>
Shan Jiahui	<i>Transfer learning for the three-dimensional reconstruction of CMEs</i>
Xiukuan Zhao	<i>Ionospheric scintillation prediction using gradient boosting algorithm</i>
Matthew G Lennard	<i>Machine Learning in Heliophysics</i>
Anna L Morozova	<i>Comparison of the performance of PCA-NN models for daily mean TEC over the Iberian Peninsula: performance of different neural networks configuration</i>
Kevin D Smith	<i>Machine Learning Classification of Mercury Magnetospheric Boundary Crossings</i>
Daniel T S Wrench	<i>Exploring the potential of neural networks to predict statistics of solar wind turbulence</i>
Rukundo Wellen	<i>Forecasting of ionospheric electron content (TEC) using a time series neural network</i>
Emmanuel De Leon	<i>Automatic detection of the electron density from the WHISPER instrument onboard CLUSTER</i>
Drew L Turner	<i>Unsupervised clustering employed to identify different drivers of relativistic electron enhancement events in Earth's magnetotail</i>
Xiangning Chu	<i>Relativistic Electron Model in the Outer Radiation Belt Using a Neural Network Approach</i>
Kimberly D Moreland	<i>A machine-learning oriented remote and in-situ database for forecasting SEP occurrence and properties</i>

Amy Keesee	<i>Methods to improve magnitude accuracy for machine learning predictions of ground magnetic field perturbations</i>
Hannah T Rüdissler	<i>Automatic Detection of Interplanetary Coronal Mass Ejections</i>
Luisa Capannolo	<i>Investigating the Relativistic Electron Precipitation using Deep Learning Techniques</i>
Raman Mukundan	<i>Optimizing a Neural Network for Regional Forecasting of Ground Magnetic Perturbations Using Spherical Elementary Current Systems</i>
Alexander Boyd	<i>SHELLS Model: Specifying High-altitude Electrons using Low-altitude LEO Systems</i>
Michael K Coughlan	<i>Using a Convolutional Neural Network with Uncertainty to Forecast GIC Risk of Occurrence at Mid-Latitudes.</i>
Victor A Pinto	<i>Developing near real-time ground magnetic field perturbations predictions with machine learning models</i>
Xudong Sun	<i>SpIn4D: Spectropolarimetric Inversion in Four Dimensions with Deep Learning</i>
Rong Lin	<i>Predicting Ambient Solar Wind Speed at L1-point based on Convolutional Neural Network and PFSS Magnetogram</i>
Stefan Lotz	<i>Solar flare forecast and feature attribution with simple deep neural networks</i>
Mario Cobos Maestre	<i>Stability of loss functions for solar wind forecasting using Deep Learning</i>
Armando Collado-Villaverde	<i>Deep Neural Networks With Convolutional and LSTM Layers for SYM-H and ASY-H Forecasting.</i>
Suvadip Sinha	<i>A comparative study of supervised machine learning algorithms to forecast solar flares</i>
Tommaso Alberti	<i>Chaos and spontaneous stochasticity: two sides of (un)predictability</i>
Luiz F Guedes dos Santos	<i>Exploring the ability of Convolutional Neural Networks to predict Solar wind quantities at 1 AU</i>
Seray Sahin	<i>Spatial and Temporal Analysis of Quiescent Coronal Rain over an Active Region</i>
Luiz F Guedes dos Santos	<i>Forecasting flux rope's orientation using CNNs</i>
Peter Wintoft	<i>Solar wind to ground magnetic field proxies studied with GRU networks: predictability with respect to physical phenomena</i>
Kamen Kozarev	<i>Towards Lucky Imaging for Quiet-Time Low-Frequency Radio Solar Observations</i>
Verena Heidrich-Meisner	<i>Neural network reconstruction of in-situ solar wind parameters</i>
Ute V Amerstorfer	<i>Machine Learning Solutions for Data Analysis and Exploitation in Planetary Science - A Work Package in Europlanet 2024 Research Infrastructure</i>

Ajay Kumar Tiwari	<i>CME-learn: An interactive playground to benchmark CME databases for the time of arrival (ToA) prediction for using machine learning methods</i>
Elizabeth P O'Dwyer	<i>Machine Learning for the Classification of Low Frequency Extensions of Saturn Kilometric Radiation</i>
Harry Arnold	<i>Using Effective Resistivity Maps Derived From Data Mining for Global MHD Simulations of the Magnetosphere</i>
Ajay Kumar Tiwari	<i>Predicting Arrival Time and Arrival Speed for CMEs: Machine Learning and Ensemble Methods</i>
Laura Simms	<i>A comparison of ARMAX (autoregressive moving average transfer function) and RNN (recurrent neural network) models to predict geostationary keV electrons</i>
Luigi Palladino	<i>Application of diverse explainable DL architectures for sunspot groups detection and classification</i>
Dogacan S Ozturk	<i>A predictive model for the high-latitude ionospheric convection</i>
Aliaa A. M. Afify	<i>Development of a forecasting technique for ionospheric plasma irregularities by applying a supervised machine learning regression technique to spaceborne GPS measurements</i>
Matthew Blandin	<i>Predicting Geomagnetically Induced Currents across Alaska utilizing Multi-Variate LSTM models</i>
Chris Green	<i>Solar flare predictions with mixed data neural network</i>
Reynaldo O Rojas Zelaya	<i>Forecasting Spread F at Jicamarca</i>
Adam T Michael	<i>Radiation Belt Variability due to Wave-Particle Interactions: A Multiscale Modeling Approach</i>
Kendra Bergstedt	<i>Machine Learning Algorithms for the Detection of Plasmoids in Multiple-X-Line Collisionless Reconnection Regions</i>
Yigit Aytac	<i>A Computer Vision Approach for Real-time Solar Event Detection</i>
Andong Hu	<i>A Multi-Hour-Ahead global geospace model using Gated Recurrent Unit (GRU) networks and SuperMAG data</i>
Sevag Derghazarian	<i>Neural Network Based ISR Estimates</i>
Jasmine R Kobayashi	<i>Machine Learning Models as an Alternative to Standard Interpolation Techniques for Estimating Gaps in OMNI Data</i>
Robert Jarolim	<i>ITI for the Sun: Improved intercalibration of multi-instrument heliophysics data series with Instrument-To-Instrument translation</i>
Paul J Wright	<i>SDOVIS: A Vision Transformer Model for Solar Dynamics Observatory (SDO) Data</i>
Laura Simms	<i>The use of differencing to remove spurious correlations in models of geostationary 2 MeV electron flux</i>
Naoto Nishizuka	<i>Reliable Probability Forecast of Solar Flares using Deep Neural Networks</i>

Juliana Vievering	<i>Real-Time Solar Flare Predictions using Machine Learning</i>
Constantinos Papadimitriou	<i>Application of information theoretical measures for improved machine learning modelling of the electron radiation belt</i>
Hemapriya Raju	<i>Deep learning analysis on CMEs associated with flares and filaments</i>
Ryan McGranaghan	<i>A Next Generation Space Weather Particle Precipitation Model: Mature machine learning approaches, multiscale mesoscale prediction, and an open science framework for machine learning</i>
Dattaraj B Dhuri	<i>A deep learning model of proton auroras on Mars</i>
Henrik Eklund	<i>Image refinement and estimation of intensity contrast degradation at small scales events of Solar observations.</i>
Sumanth A.T. Rotti	<i>Machine Learning Dataset of SEP Events from Solar Cycles 22, 23 and 24.</i>
Yana Shtyk	<i>Solar flare prediction using a multi-channel model</i>
Pavithra G Srinivas	<i>Development Of An Onboard Space Weather Module For Satellite Operations</i>
Grant K Stephens	<i>Global structure of magnetotail reconnection unveiled by mining spaceborne magnetometer data</i>
Gonzalo A Cucho-Padin	<i>A machine learning framework for the reconstruction of the 3-D ion density distributions and energetic fluxes in the Earth's cusp</i>
Andrea Diercke	<i>Automatic Extraction of Solar Filaments Using Machine Learning Techniques</i>
Vanessa M Mercea	<i>Detection of sunquakes in Egression Power Maps using Deep Autoencoders</i>
Anthony Sciola	<i>Ring current plasma pressure reconstructed from empirical magnetic field distributions embedded within a global MHD model</i>
Varad Deshmukh	<i>Decreasing False Alarm Rates in ML-based Solar Flare Prediction using SDO/HMI Data</i>
Talha Siddique	<i>A Bayesian Ensemble Machine Learning Approach For Prediction of Geomagnetically Induced Currents (GICs) With Uncertainty Quantification</i>
Victor M Velasco Herrera	<i>Are Ground Level Enhancement events really the result of a random process?</i>
Sachin A Reddy	<i>Predicting Equatorial Plasma Bubbles with Machine Learning and CubeSats</i>
Edward J E Brown	<i>Attention-based machine vision models and techniques for solar wind speed forecasting using solar EUV images</i>
Stefano Bianco	<i>A neural network model of the plasmasphere dynamics</i>
Michele Piana	<i>The STIX imaging problem</i>

Denny Oliveira	<i>Perspectives on the use of data assimilation for improving thermospheric empirical models: Focus on extreme magnetic storms</i>
Ravindra T Desai	<i>Using a neural network to model ultra-relativistic charged particles and exploit sparse datasets</i>
Harim Lee	<i>Generation of Modern Satellite Data from Galileo Sunspot Drawings by Deep Learning</i>
Charles Topliff	<i>A domain transfer approach to forecasting the Solar Wind at L1</i>
Shah Mohammad Bahauddin	<i>Unboxing the Black Box: Learning to identify acoustic wave sources on the Sun from Deep Learning</i>
Daniel E da Silva	<i>Semi-Empirical Data Compression for Heliophysics Space Mission Data</i>

Sponsors

