Space Weather Workshop

Omni Interlocken Hotel – Broomfield, CO
April 26 – 29, 2016

Poster Abstracts

Aa, Ercha (National Space Science Center, Chinese Academy of Sciences)

Poster Number: I5

Poster - Regional 3D Ionospheric Electron Density Specification on the Basis of Data Assimilation

Authors: Ercha Aa, Siqing Liu, Wengeng Huang

Abstract: In this paper, a regional 3D ionospheric electron density specification over China and adjacent areas (70E-140E in longitude, 15N-55N in latitude, and 100-900 km in altitude) is developed on the basis of data assimilation technique. The International Reference Ionosphere (IRI) is used as a background model, and a three-dimensional variational (3DVAR) technique is used to assimilate both the ground-based Global Navigation Satellite System (GNSS) observations from the Crustal Movement Observation Network of China (CMONOC) and International GNSS Service (IGS) and the ionospheric radio occultation (RO) data from FORMOSAT-3/COSMIC (F3/C) satellites. The regional 3D gridded ionospheric electron densities can be generated with temporal resolution of 5 min in universal time, horizontal resolution of 2*2 in latitude and longitude, and vertical resolution of 20 km between 100-500 km and 50 km between 500-900 km. The data assimilation results are validated through comparisons with ionospheric total electron content (TEC) from GNSS measurements, the Abel-retrieved F3/C electron density profiles (EDPs), ionosonde foF2 and bottom-side EDPs, as well as Utah State University Global Assimilation of Ionospheric Measurements (USU-GAIM) under both geomagnetic quiet and disturbed conditions. The comparisons show that the data assimilation performs better than the climatological IRI model and USU-GAIM model in specifying regional ionospheric morphology, which demonstrates the effectiveness of this data assimilation technique in bringing considerable systematic improvements.

Alonso Castro, Cata (Earth to Sky Calculus)

Poster Number: M11

Poster - Space Weather Ballooning in the South Atlantic Anomaly

Authors: Mia Yarborough, Jordan Herbst, Tony Phillips

Abstract: As the Solar Cycle moves toward a new minimum, decreasing levels of solar activity are allowing cosmic rays to penetrate the inner solar system. This change has already been observed in the atmosphere over the USA. How is it playing out in the South Atlantic Anomaly? Soon, the students of Earth to Sky Calculus plan to launch a pair of balloons to the stratosphere—one from California and another from Chile beneath the South Atlantic Anomaly. This will be the first-ever simultaneous flight of space weather balloons from multiple continents, and it will reveal radiation levels at altitudes of interest to aviation and space tourism. It will also establish a baseline for monitoring the South Atlantic Anomaly as it changes in response to the approaching Solar Minimum.

Bamba, Yumi (Japan Aerospace Exploration Agency)

Poster Number: S5

Poster - A Flare Trigger Model Based On Satellite Observations

Authors: Yumi Bamba, Kanya Kusano

Abstract: Solar Flares are explosive phenomena driven by magnetic energy stored in the solar corona, and interplanetary disturbances associated with solar flares sometimes impact terrestrial environments and our high-technology. However, predictability of flare occurrence remains limited because underlying physical mechanism of flare onset remains elusive.

We analyzed several major flare events which were observed by the Hinode and the SDO satellites, in order to elucidate flare-trigger mechanism. We investigated the spatial and temporal correlation between the detailed magnetic field structures and the pre-flare brightenings in the chromosphere for several hours prior to the onset of flares. As a result, we found that the magnetic shear angle in the flaring regions exceeded 70 degrees, as well as that characteristic structures of magnetic disturbances at the centers of flaring regions were developed in the pre-flare phase. These magnetic disturbances could be classified into two groups depending on the morphology of their magnetic polarity inversion lines; so-called "Opposite-Polarity (OP)" and "Reversed-Shear (RS)" magnetic field, as recently proposed by Kusano et al. (2012). The result suggests that some major flares were triggered by rather small magnetic disturbances. We further studied how small magnetic field can work for triggering flares. The results indicate that the critical magnetic flux, which the flare-trigger field has to contain, depends on the magnetic connectivity in the flaring site, and it varies even within an active region.

We believe that the flare trigger model of Kusano et al. (2012) can basically explain physical process in flare triggering. We also that the suitable combinations of the parameter depicted by the model will be applicable for the solar flare forecast.

Bisi, Mario (Science & Technology Facilities Council – Rutherford Appleton Laboratory)

Poster Number: S19

Poster - Preliminary Observations of Heliospheric Faraday Rotation of a CME Using LOFAR

Authors: Elizabeth A. Jensen, Charlotte Sobey, Richard A. Fallows, Bernard V. Jackson, David Barnes, Alessandra Giunta, P. Paul L. Hick, Tarraneh Eftekhari, Hsiu-Shan Yu, Dusan Odstrcil, and Munetoshi Tokumaru.

Abstract: Observations of Faraday rotation (FR) can be used as a remote-sensing method of determining magnetic fields. FR from the corona, ionosphere, and interstellar medium via observations of polarised radio sources are well documented. Measurements of the inner corona of the Sun in FR have been shown from both spacecraft beacons as well as some natural radio sources, but only at relatively-high radio frequencies. Here we show some initial results of heliospheric FR using the Low Frequency Array (LOFAR) below 200 MHz to investigate the passage of a coronal mass ejection (CME) across the line of sight. We demonstrate this through the analysis of observations of pulsar J1022+1001, which commenced on 13 August 2014 at 13:00UT and spanned over 150 minutes. We also show comparisons to the FR results via modelling techniques and additional context information to piece together the structure of the inner heliosphere being detected. This observation could pave the way to a set of observations and modelling techniques that might be implemented for space-weather purposes and eventually a near-global method for determining the magnetic field throughout the inner heliosphere. The most-intense space weather at Earth is that of geomagnetic storms which are driven by the speed, density, and magnetic-field of the incoming plasma. The most-important determining factor of the intensity of geomagnetic storms is that of the North-

South component of magnetic field (Bz in Geocentric Solar Magnetic - GSM - coordinates). Currently, there is no reliable prediction of this magnetic-field component until the incoming plasma from the Sun has reached in-situ monitors at the L1 point and this provides only 15-60 minutes advanced warning.

Boudouridis, Athanasios (University of Colorado Boulder)

Poster Number: M23

Poster - Comparison of Matrix Inversion and Bow-tie Techniques in the Calibration of the GOES-R SEISS MPS-HI Electron Channels

Authors: Juan V. Rodriguez, Brian Kress

Abstract: The Space Environment In-Situ Suite (SEISS) on GOES-R includes a new instrument for measuring radiation belt electrons and protons, the Magnetospheric Particle Sensor – High Energy (MPS-HI). The baseline calibration algorithm for the conversion of raw MPS-HI electron telescope counts to fluxes is based on the inversion of the geometric factor matrix that relates raw counts to electron fluxes, C=Rij F. This matrix is derived from the Geant4 simulation results of electron transport through the telescope solid state detectors, scaled and shifted based on measurements in electron beams. The inverse matrix, R-1ij, provides the electron fluxes from the measured counts and has no constraints placed on the inversion in order to ensure a realistic result. The baseline algorithm exhibits substantial errors in the electron flux determination, especially for the high energy (E7-E10) differential channels, and the integral E10A channel. Our first approach to mitigating the problem is to apply instead a diagonal array produced by the so-called Bow-tie technique for the characterization of a particle sensor instrument response. The purpose of the Bow-tie analysis is to calculate for each energy channel an energy/geometric factor pair applicable to a wide range of energy spectra, and for which the geometric factor error is minimized. Previous applications of the technique have used analytical families of energy spectra. For the first time we use proxy energy spectra observed by the CRRES satellite MEA and HEEF instruments in the period 1990-1991. A number of randomly selected CRRES spectra from a subset of the data is used to perform the Bow-tie analysis and determine the channel energy/geometric factor characteristics. The remaining CRRES spectra are first converted to counts using the Geant4 simulation results, and then inverted back to fluxes using both the baseline matrix inversion and the Bow-tie technique inversion. The retrieved electron spectra from the two methods are then compared to the original CRRES proxy spectra. We conduct both case study and statistical error analysis of the two inversion techniques to show that the diagonal Bow-tie array performs better than the baseline matrix inversion for the high energy (E7-E10) differential channels, and the integral E10A channel. We repeat our study for different Bow-tie analysis samples and CRRES proxy data sets, and compare the results.

Cameron, Taylor (University of Calgary)

Poster Number: S36

Poster - Determining Uncertainty In Solar Wind Timeshifting Methods

Authors: Taylor Cameron, Brian Jackel

Abstract: We present a large scale statistical test of various solar wind time shifting algorithms using ten years of solar wind data correlated with magnetospheric Bz. These tests allow us to present the average uncertainty in a given time shifting method. We show that the modified minimum variance scheme used by Weimer et al. (2003) performs better than all other methods tested, being on average a minute more accurate than a flat time shift. We also investigate the performance of these methods under different solar wind conditions. We find that all time shifting algorithms perform significantly worse when the solar wind magnetic field is aligned with the Earth-Sun line.

Carlton, Ashley (Massachusetts Institute of Technology)

Poster Number: M12

Poster - Telemetry Event Identification Algorithms for Space Environment Sensing

Authors: Kerri Cahoy

Abstract: New constellations of hundreds of low-Earth orbiting small satellites are currently being designed and built. They plan to provide data and media distribution services as well as imaging and weather observations. As our society increases its dependence on satellite services for communication and navigation, there is a growing need for efficient systems monitoring and space situational awareness to avoid service interruptions due to hazards such as space weather. Particularly for large constellations, satellites need greater autonomy to improve responsivity and reduce the load on human operators.
We have developed algorithms that find any unusual behavior in satellite health telemetry. Once these events have been identified, we collect and analyze them, along with assessing space weather observations and operational environment factors. Our approach uses transient detection and change-point detection techniques, and statistically evaluates the telemetry stream compared to a local norm. This approach allows us to apply our algorithms to any spacecraft platform, since there is no reliance on satellite- or component-specific parameters, and it does not require a priori knowledge about the data distribution.

We apply these techniques to individual telemetry data streams on a GEO ComSat, and show results, a compiled list of unusual events for each satellite. Preliminary results include being able to identify events that affect many telemetry streams at once, indicative of a system-level event. With data from multiple satellites, we can use these methods to better identify external factors. We compare event dates to known operational activities and to known space weather events to validate the use of event detection algorithms for spacecraft monitoring and for environmental sensing.

Cilliers, Pierre (South African National Space Agency)

Poster Number: M7

Poster - Telemetry Event Identification Algorithms for Space Environment Sensing

Authors: Pierre Cilliers, Christopher Balch, Alan Thomson, Ari Viljanen, Trevor Gaunt, Stefan Lotz

Abstract: The objective of the climatological E-field study is to find an improved indicator or proxy for geomagnetic induced current (GIC) activity. Currently the geomagnetic indicator most commonly used by NOAA SWPC and by power utilities for expressing the intensity of geomagnetic storms their and potential impact on power distribution systems is the NOAA G-scale which is directly linked to the 3-hourly global Kp-index. There is a need for an index or proxy for GIC intensity which has a closer link to GIC than the magnitude of the geomagnetic field and which has a better time resolution than the 3-hourly Kp-index or the hourly range indices analysed by Ngwira (2007). A 30 minute index is proposed.

The geo-electric field is generally taken as the driver of GIC. The proposed proxies of the GIC are based on measured values of the B-field and compared to two parameters derived from the E-field data, namely the peak value of the horizontal component of the E-field within a 30 minute time window and the average value of the E-field computed over non-overlapping 30 minute time windows. The peak E-field is often associated with events that are driven by a CME shock arrival at the Earth which produces a sudden impulse or sudden storm commencement, but may also characterize the inductive risk of an ongoing geomagnetic storm. The average E-field characterizes the inductive risk of sustained induced currents over time, typically associated with transformer heating.

The E-field time series data is computed from the horizontal components of the B-field and the local surface impedance using the assumption that the B-field may be locally regarded as a vertically incident

plane wave which has an evanescent decay with depth into the Earth [Cagniard 1953]. The frequency dependent surface impedance is derived from a 1D ground conductivity model derived for Quebec [Boteler 1998].

In order to compare results from different latitudes, geomagnetic data recorded at 1-minute intervals by four INTERMAGNET observatories with more than 30 years of continuous recording will be part of the final study, see below. There are many spikes in the data from early years, which were removed by a novel spike detection algorithm.

Chang, Oyuki (UNAM)

Poster Number: S20

Poster - Initial Assessment of MEXART Single-Site IPS Power Spectra Analysis for Space-Weather Products

Authors: Mario M. Bisi, Ernesto Aguilar-Rodriguez, J. Americo Gonzalez-Esparza, Richard A. Fallows, Igor Chashey, Sergey Tyul'Bashev, and Munetoshi Tokumaru

Abstract: Interplanetary scintillation (IPS) manifests itself as a variation in the radio signal received from a distant, point-like radio source on the sky as the radio waves traverse the interplanetary medium due to density inhomogeneities in the outflowing plasma. IPS allows us to infer the speed and density of the outflowing plasma. Forming a Cross Correlation Function (CCF) of two time series of the amplitude scintillation (Stokes I) for simultaneous observations of IPS from well-separated stations, and investigating the resulting shapes in each CCF, we find information/insight on the phenomena crossing the lines of sight. This information/insight is a priori and cannot necessarily be gleaned from individual power spectra alone. However, utilizing the shape of a CCF, it could be possible to ascertain distinct-enough patterns in individual single-station IPS spectra to improve fitted-parameter results for IPS-dedicated instruments such as MEXART, and isolate such a priori information, based on features in different parts of the power spectrum. Old EISCAT IPS data having well-known results and multiple fits (using more-detailed spectral-fitting routines) may disclose some features of parameters that could be implemented with MEXART fitting routines. This work seeks to obtain such improved parameter fits in the single-station analysis of individual spectra. This can then be applied to obtain improved results with IPS data from MEXART and also perhaps applying the same routines to IPS observations taken from Pushchino. This investigation seeks to understand the limits and capabilities of the single- site analysis, and improvements that may load to better IPS space-weather data products.

Chen, Chia-Hung (National Cheng Kung University)

Poster Number: I14

Poster - Ionospheric Data Assimilation with TIE-GCM and GPS-TEC During Geomagnetic Storm Conditions

Authors: Charels Lin, W. H. Chen, I. T. Lee, T. Matsuo, J. Y. Liu, and C. T. Hsu

Abstract: The main purpose of this paper is to investigate the effects of rapid assimilation-forecast cycling in ionospheric data assimilation during geomagnetic storm conditions. An Ensemble Kalman Filter (EnKF) software developed by National Center for Atmospheric Research (NCAR), called Data Assimilation Research Testbed (DART), is applied to assimilate ground-based GPS total electron content (TEC) observations into a theoretical numerical model of the thermosphere and ionosphere (Thermosphere-Ionosphere-Electrodynamics General Circulation Model, TIE-GCM) during the 26 September 2011 geomagnetic storm period. Effects of various assimilation-forecast cycles, 60-, 30-, and 10-minutes, on the ionospheric forecast are examined by using the global root-mean-square observation-minus-forecast (OmF) TEC residuals during the entire storm period. Substantial reduction in the global OmF for the 10 minutes

assimilation cycle suggests that rapid cycling ionospheric data assimilation system can greatly improve its quality of the model forecast during geomagnetic storm conditions. Further examination shows that updating the neutral state variables in the forecast model in the assimilation step is an important factor to alter the trajectory of model forecasting. The shorter assimilation cycle (10-minute in this paper) helps restrain a realistic model error growth during the forecast step due to unbalance among forecast model state variables resulting from an inadequate neutral state update and provides a higher forecast accuracy during geomagnetic storm conditions.

Chen, Wei-Han (NCKU)

Poster Number: I15

Poster - Ionospheric TEC Variations During the 2009 Sudden Stratosphere Warming by Assimilating F3/C RO and Ground-based GPSTEC

Authors: Chia-Hung Chen, Charles Lin, and Jia-Ting Lin

Abstract: The exact mechanisms of ionosphere variability during the 2009 sudden stratosphere warming (SSW) are generally accepted that the modification of atmospheric tides is the primary mechanism for coupling between SSWs and ionosphere. Especially the modification of semi-diurnal migrating tide (SW2) in MLT region, it has been reported the amplitude and phase of SW2 reveal notable changes in several whole atmospheric models that can significantly impact the ionosphere electrodynamics. This study assimilates the ionospheric electron density profile which retrieved from FORMOSAT-3/COSMIC (F3/C) GPS Radio Occultation observations and ground-based GPS total electron content (TEC) into a numerical simulation model called Thermosphere Ionosphere Electrodynamics General Circulation Model (TIE-GCM) by using ensemble Kalman filter (EnKF) during the 2009 SSW event. The EnKF assimilation system employed in this study is Data Assimilation Research Testbed (DART) which developed by National Center for Atmospheric Research (NCAR). To investigate the tide effects on the ionospheric variability during the 2009 SSW, the SW2 tidal forcing applies in the TIE-GCM on the lower boundary is shifted by 2-hours earlier. The assimilation result shows that the appearance time of TEC peak is earlier than 14LT and its amplitude is also decreased during the SSW period. More detail result will be discussed in the presentation.

Cherkos, Alemayehu (Addis Ababa University)

Poster Number: S29

Poster - Effect of Viscosity on Propagation of MHD Waves in Astrophysical Plasma

Authors: Alemayehu Mengesha Cherkos and S. B. Tessema

Abstract: We determine the general dispersion relation for the propagation of magnetohydrodynamic (MHD) waves in an astrophysical plasma by considering the effect of viscosity with an anisotropic pressure tensor. Basic MHD equations have been derived and linearized by the method of perturbation to develop the general form of the dispersion relation equation. Our result indicates that an astrophysical plasma with an anisotropic pressure tensor is stable in the presence of viscosity and a strong magnetic field at considerable wavelength.

Codrescu, Stefan (CU/CIRES, NOAA/NCEI)

Poster Number: S35

Poster - DSCOVR Space Weather Product Archive and Access at NCEI

Authors: Rowland, W.F., Codrescu, S.M., Tilton, M., Cartwright, J., McCullough, H., Redmon, R.J., Loto'aniu, P.T.M. and Denig, W.F.

Abstract: NOAA's National Centers for Environmental Information (NCEI) is introducing space-weather forecasters, researchers, and the general science community to a new era of solar wind measurements from DSCOVR through a newly developed web based search and retrieval interface. We illustrate our portal's functionality, including visualization and preliminary analysis in the browser as well as the ability to immediately retrieve the relevant files. The new on-line approach complements our existing email delivery based access to off-line archived products.

Cook, Michael (University of North Dakota)

Poster Number: M14

Poster - Extreme Poytning Flux Over the Polar Cap Region

Authors: Delores Knipp. Liam Kilcommons

Abstract: I investigated several intervals of prolonged intervals of northward Interplanetary Magnetic Field (IMF) to describe the correlation between strong Poynting flux and northward IMF. We primarily focused on Summer events in each hemisphere when the polar regions are sunlit. During northward IMF the magnetic reconnection regions can form tailward of the magnetic cusp, while during southward IMF they form near the sub solar point. Using data from the Defense Meteorological Satellite Program (DMSP) F13, F15 and F16 spacecraft we looked for areas of strong Poynting flux over the magnetic polar cap regions. Values ranging from 20 mW/m 2 to 140 mW/m 2 were measured in narrow channels, showing there can be significant energy transport to small concentrated region near the magnetic pole. These areas are generally thought of as quiet but our result says quite the opposite under specific conditions.

Copeland, Kyle (FAA Civil Aerospace Medical Institute)

Poster Number: S15

Poster - CARI-7: Extending CARI to Higher Altitudes

Authors: Kyle Copeland

Abstract: Aircrew members are exposed to unusually high doses of galactic cosmic radiation (GCR). Among the particles present in the primary GCR spectrum are heavy ions; nuclei of lithium and heavier elements traveling at relativistic speeds. These ions have very high radiation weighting factors and can contribute significantly to the effective dose at altitudes above the Pfotzer maximum. This report describes the latest version of the U.S. Federal Aviation Administration's GCR flight dose calculation software, CARI-7. Unlike its predecessor, CARI-6, CARI-7 directly includes heavy ion transport, using MCNPX 2.7.0. Calculations are found to compare well with measurements aboard commercial passenger and high altitude research aircraft.

Costa, Joaquim (INPE-National Institute for Space Research)

Poster Number: G1

Poster - The New Portal for Free Space Weather Data Distribution of the Embrace/INPE's Program.

Authors: J.E.R. Costa, C.M. Denardin, M.B. Pádua and Embrace Team.

Abstract: The Embrace/INPE launched its new web portal for free space weather data distribution. The portal allows registered users to access data by searching the archive, making data requests for specific location, resolution, cadence, different data formats, images, etc. The beta version is already running with data acquired by Embrace/INPE all over South America using magnetometers, ionosondes, GPS - TEC and Scintillation, solar spectrometer and all-sky imagers (for further details, please, visit the http://www2.inpe.br/climaespacial/SWMonitorUser/). In its current version, users will find products derived from a network of over 150 GNSS' monitors (sixteen of them measuring scintillations), which covers most of the South American territory; digisonde network that monitors the radio blackout in seven locations in Brazil; several radio telescopes to monitor solar activity; a network of magnetometers in ten locations in South America, and a physical model to predict the global ionosphere 24 hours ahead. Besides the space weather data, most of the parameters on space weather (including a newsletter) is published daily, in the Embrace/INPE web portal. The Goes X-ray flux and Ksa index (equivalent of Kp, but for South America) generate alerts that may be automatically sent to users registered in the data portal, upon request. Registering information of the users are required to account for the access to the data which will be used in administrative reports to match the Brazilian governmental policies. The plan of Embrace/INPE program is to make available the access of all instruments and products under its operation, including alerts.

Cress, Ryan (United States Air Force Academy)

Poster Number: M15

Poster - High Energy Dosimetry

Authors: Geoff McHarg, Mario Serna, Scott Alsid, and James Heitmann

Abstract: Manned and unmanned missions in space require an understanding of the space environment and its effects. Geosynchronous plasma density, temperature, and spacecraft charging will be measured on FalconSat-7 using the improved Miniature Electrostatic Analyzer (iMESA). This instrument also contains a micro-dosimeter to measure total dose and dose rate. To ensure accurate sampling of the space environment, the micro-dosimeter was calibrated to include the effects of the iMESA housing and spacecraft bus materials. As a capstone research project, two 1st class cadets at the United States Air Force Academy used Monte Carlo N-Particle Transport Code (MCNP) to simulate the detector. The final results of 14±3 μRad/digital step are consistent with the manufacturer's supplied calibration data.

Cress, Ryan (United States Air Force Academy)

Poster Number: M16

Poster - Falcon Solid-state Energetic Electron Detector (FalconSEED)

Authors: Robert Olesen, M. Geoff McHarg, Ryan Cress, Kirk Brown, Tim Goorley

Abstract: The Falcon Solid-state Energetic Electron Detector (FalconSEED) is a prototype detector designed to monitor beta radiation in geosynchronous orbit. FalconSEED will provide beta particle energy readings in order to monitor spacecraft charging with the hopes of reducing adverse effects to the spacecraft. The design limits indirect radiation incident on the detector using a series of tungsten baffles designed to reduce backscattering events. Theoretical geometric factor calculations were performed using the Monte Carlo N-Particle (MCNP) code. A maximum geometric factor of 12 cm^2 was calculated under nominal conditions for radiation directly incident on the detector. A more realistic geometric factor of 1.7 cm^2 was calculated after allowing electrons to interact with the optics of the detector. A comparison of readings from the prototype and the theoretical calculations will be discussed.

Danskin, Donald (Natural Resources Canada)

Poster Number: I1

Poster - Solar X-rays Effects on the Ionosphere

Authors: D.W. Danskin

Abstract: Using the Canadian Riometer Array, ionospheric absorption event during Space Weather events has been monitored by a large number of passive devices. During solar X-ray flares, a rapid response of the ionosphere is measured with a small time delay. The results of the research indicate that different events have different effects.

De la Luz, Victor (National University of Mexico)

Poster Number: G2

Poster - Observations of Space Weather on Mexico

Authors: Americo Gonzalez-Esparza, Blanca Mendoza, Ernesto Aguilar, Julio Mejia-Ambriz, Xavier Gonzalez-Mendez, Pedro Corona, Maria Sergeeva, Esmeralda Romero, Christian Mointset, Gerardo Cifuentes, Ernesto Andrade, Pablo Sierra, Pablo Villanueva, and Elizandro Huipe-Domratcheva, and Carlos Miranda-Salcido

Abstract: In this work, we presented preliminary results of the records from the instrumentation related with the Space Weather on Mexico. The network of instrumentation of Space Weather includes: MEXART radiotelescope, callisto MEXART, Schumann antennas, Cosmic Ray Observatory in Mexico City, tlaloc-net GPS network, SSN GPS network, and the Mexican Magnetic Service. We found that the instrumentation recorded at least 6 events of Space Weather.

DeLuca, Edward (Harvard-Smithsonian Center for Astrophysics)

Poster Number: S17

Poster - An EUV Wide-Field Imager and Spectrometer for the ISS

Authors: Leon Golub, Sabrina Savage

Abstract: The EUV Coronagraph and Spectrometer, ECS, selectably combines a wide-field solar coronal EUV imager (EUVC) and an on-disk EUV imaging spectrometer (EUVS). Located on the ISS, the goal of the mission is enhance our understanding of the dynamics of the Transition Corona, and to provide improved detection and tracking of solar eruptive events for space weather forecasting.

Ebrahimi, Hamideh (University of Central Florida)

Poster Number: I2

Poster - Remote Sensing of the Upper Atmosphere and Space Weather

Authors: Hamideh Ebrahimi, Linwood Jones

Abstract: The science learned from remote sensing observations is critical to improving our capabilities of space weather forecasting. We are investigating the use of a constellation of Ionospheric Sounder CubeSats in addition to use of instruments on geostationary satellite to study the earth's thermosphere and ionosphere. Also we investigate the uses of CubeSats to explore the impact of high energy particles, and plasma on spacecraft.

Engell, Alec (NextGen Federal Systems)

Poster Number: G5

Poster - Open-source Software and Operational Terrestrial and Space Weather Products

Authors: Alec Engell, Dave Bissett, and Erik Babyak

Abstract: In the past five years there has been an explosion in available open-source analytical and visualization technologies. These technologies offer an arsenal of abilities to deliver web-based, big-data analytics with intuitive user interfaces. Many industries are taking advantage of these tools to quickly and cost effectively deliver end-user solutions. We introduce some of these software capabilities and how they are being applied to terrestrial and space weather products. Using Python and associated libraries, we demonstrate new abilities to scour terrestrial and space weather data to help find new connections and interdependencies in their respective non-linear systems. Products include automated event detections, time-dynamic visualizations, and automatically calculated helicity of CMEs by ACE measurements. Mapping and interrogating thousands of grid-points of weather data with seamless streaming via web browser is possible though WebGL technologies. Furthermore, we provide a unified space-weather global operational display system using Analytical Graphic's open-source Cesium 4D visualization technology. Cesium, also a WebGL-based technology, visualizes hundreds of thousands of data points, 3-D physics-based models, ground and space-based assets (e.g., satellites) with integrated customizable forecast and trending tools. The system is browser delivered, an increasingly preferred product delivery platform, and can stream data via open internet, on secure networks, or run in a locally hosted environment.

Fang, Tzu-Wei (CU/CIRES)

Poster Number: I19

Poster - Impact of Lower Atmosphere on the Low-Latitude Ionosphere Electrodynamics

Authors: Tzu-Wei Fang, Naomi Maruyama, Tim Fuller-Rowell, Rashid Akmaev, Art Richmond, and Houjun Wang

Abstract: Recent studies have shown that the lower atmosphere has strong impact on the day-to-day variation of the upper atmosphere and ionosphere. To capture all the spectrums and waves from the lower atmosphere, the whole atmosphere model (WAM) has been developed through the vertical extension of the Global Forecast System. To estimate the impact of the lower atmosphere, solar and geomagnetic activities on the ionosphere, the new generation ionosphere-plasmasphere model with electrodynamics (IPE) has been developed and will be fully coupled with the WAM to produce the prediction of thermosphere and ionosphere conditions. The coupled version of these two models will become operational in NOAA Space Weather Prediction Center in the near future. In this study, we use the empirical horizontal wind model (HWM) or WAM to drive the IPE using the one-way coupled scheme to demonstrate the impact of lower atmosphere on the equatorial ionosphere and electrodynamics. Specifically, we will show the results of equatorial vertical drifts from the electrodynamic solver under the geomagnetic quiet conditions and will investigate the responses of electrodynamics during the major sudden stratospheric warming (SSW) event in 2009 using the WAM neutral atmosphere with data assimilation. The results from the quiet conditions will also be compared with observations and simulations from other community models.

Fernandez-Gomez, Isabel (German Aerospace Center (DLR))

Poster Number: I13

Poster - Coupled Thermosphere Ionosphere Plasmasphere Electrodynamics (CTIPe) Physics Based Model During the Extreme Geomagnetic Storm on the 20th November of 2003

Authors: Claudia Borries, Mihail V. Codrescu

Abstract: Significant perturbations were produced in the thermosphere-ionosphere-magnetosphere system during the geomagnetic storm of the 20th November of 2003, one of the largest ever recorded. Under these extreme conditions, modelling the ionosphere will be a challenging task due to energy flow uncertainties. This work addresses the ionospheric perturbations over Europe, reproduced by the Coupled Thermosphere Ionosphere Plasmasphere electrodynamics (CTIPe) physic based numerical code and compared with observations of the Total Electron Content (TEC) derived from Global Navigation Satellite System (GNSS) measurements and ionosonde measurements.

Travelling Ionsopheric Disturbances (TIDs) are the signatures of atmospheric surges causing neutral composition changes, and are associated with strong TEC enhancement as the one observed during the 20th November 2003 storm. CTIPe reproduce the strong perturbations in Joule heating and neutral winds over Europe, located at exactly the location of the source region of TIDs. Even the signatures of atmospheric surges with similar characteristics of the observed TIDs are reproduced by CTIPe. Joule heating initiated meridional winds and the associated storm-time neutral circulation seem to be the main driver of the ionospheric perturbations observed over Europe. However, comparisons with GNSS measurements show that the TEC enhancement and TEC rate over Europe are underestimated by the CTIPe model.

Nevertheless, the results provide valuable information on the physics of the processes that operate in the ionosphere/thermosphere during this extreme geomagnetic storm, and they may be improved by using better estimates of the thermosphere/ionosphere forcing during the storm.

Fink, Jessica (Millersville University)

Poster Number: S31

Poster - Comparison of the GOES X-ray data with EUVI of the Source Regions of the CME

Authors: Jessica Fink, Kara Piarulli, Christina Prestine, and Curtis Silverwood

Abstract: The strongest geomagnetic storms are caused when a CME's magnetic field distorts our planetary magnetosphere. CME's are often associated with flares. In this presentation, we will present a comparison of the integrated brightness of the source region of CME's with the X-ray data of solar flares. The Xray data are derived from the 5 second data averaged over 5 minutes. In this study we will use the Helioxm model to calculate the initial energy of the flux rope structure of CME's.

Fontenla, John (NorthWest Research Associates (NWRA))

Poster Number: S26

Poster - SERFS Status and Prospects

Authors: J.M. Fontenla, M. Codrescu, M. Fedrizzi, T. Fuller-Rowel, F. Hill, E. Landi, and T. Woods

Abstract: The Solar EUV Radiation Forecast System has accomplish several steps that include the full comparison of the results over the 5 years of SDO/AIA data and comparison with available well calibrated SDO/EVE data. The addition to coronal holes, which showed interesting trends over these years, and cool

coronal jets that provide information about the source regions for fast solar wind. The nowcast system has been delivered to AFRL last year and the forecast software is now being developed.

Now the STEREO images are now used as a source of far-side data because STEREO has been and still is in near opposition. The Helioseismic far-side data is now in the process of being cross-calibrated against the STEREO solar disk features masks that SERFS uses.

This poster will show examples of the effort on extended forecast of UV SSI for application to Earth and other planets in the Heliospheric Environment Solar Spectral Radiation (HESSR).

Gentile, Louise (Air Force Research Laboratory)

Poster Number: I20

Poster – The Final Phase of the C/NOFS Mission

Authors: L. C. Gentile, C. G. Fesen, R. A. Heelis, R. F. Pfaff

Abstract: The Air Force Research Laboratory leveraged an extraordinary opportunity with the Communication/Navigation Outage Forecasting System (C/NOFS) satellite to collect a comprehensive set of low-altitude measurements as the orbit decayed and the satellite reentered. The C/NOFS mission began on 16 April 2008 when the spacecraft was launched into a 13° elliptical orbit, with initial apogee of 857 km and perigee of 401 km. In its early years on orbit, C/NOFS provided a wealth of information about ionospheric irregularities that disrupt communication and navigation capabilities. As the final phase of the mission began on October 2014, apogee was below 500 km and perigee below 360 km. For several months, the C/NOFS apogee was slightly above and perigee slightly below the peak of the F-layer, providing measurements to advance our understanding of the dynamics of the topside and bottomside of the ionosphere. As its orbit decayed, C/NOFS collected the first long-term data set of neutral pressures and number densities in the equatorial region along a low-inclination orbit and observed a wide variety of plasma density structures that are associated with a local reversal of the zonal drift velocities below the peak of the F-layer. In its final weeks, the precise positioning data and the measurements of the neutral atmosphere provided unprecedented observations to improve models currently used for trajectory propagation, orbital drag, and uncontrolled reentry predictions. C/NOFS reentry occurred on 28 November 2015 after a highly successful mission of more than seven and a half years.

Gerrard, Andrew (New Jersey Institute of Technology)

Poster Number: M20

Poster - Interior Spacecraft Charging of the Van Allen Probes

Authors: Andrew Gerrard, Louis Lanzerotti

Abstract: Spacecraft in orbit within Earth's radiation belts are subject to hazardous MeV-level particles that can detrimentally impact a variety of subsystems. It is well recognized that the amount of interior spacecraft charging induced within the inner magnetosphere during nominal operation, as well as during geomagnetic storms produced by transient solar-generated interplanetary structures (e.g., coronal mass ejections (CMEs) or corotating interaction regions (CIRs)), is an important engineering topic and of interest to successful spacecraft operations. In this study we show charging measurements interior to the twin Van Allen Probes spacecraft using data from the Environmental Radiation Monitors (ERM) that is powered and operated through the RBSPICE instrument. The measurements reported here were made from RBSPICE conditioning (October 2012) through 2015. The spacecraft precessed through all local times during this more than 3-year interval. We provide charging occurrence and probability of occurrence as a function of geomagnetic L-shell over this more than 3-year period. We also show examples of explicit charging from

CIRs and CMEs. The measurements and results demonstrate that (1) relatively economical ERM instrumentation can provide synoptic interior charging data useful for the next generation of predictive spacecraft charging models, and (2) the appearance of event specific L-shells, below which enhanced charging is not observed. A pathway in the development of the next generation of synoptic radiation charging models, which utilizes these and future ERM data, is demonstrated.

Goyal, Ravinder (Indian Institute of Technology Delhi)

Poster Number: S28

Poster - Temporal evolution of Linear Kinetic Alfvén Waves in Inhomogeneous Plasmas and Effects of Landau Damping

Authors: Ravinder Goyal, R. P. Sharma and R. Uma

Abstract: The coronal ion heating in the Sun is primarily considered due to Alfvén wave dissipation. The Hinode data which has provided strong evidence for the presence of Alfvén waves in the corona and in coronal loops, has lead laboratory investigations and numerical simulations of Alfvén wave propagation and damping. The inhomogeneous plasmas with steep density gradients can be employed to study such phenomenon in relatively shorter systems. This article presents a model for the propagation of Kinetic Alfvén waves (KAWs) in inhomogeneous plasma when the inhomogeneity is in transverse and parallel directions relative to the background magnetic field. The turbulent spectrum of kinetic Alfvén waves in inhomogeneous plasma is investigated in the presence of Landau damping. The semi-analytical technique and numerical simulations have been performed to study the KAW dynamics when plasma inhomogeneity is incorporated in the dynamics. The model equations are solved in order to study the localization of KAW and their magnetic power spectrum which indicates the direct transfer of energy from lower to higher wave numbers as well as frequencies. The inhomogeneity scale lengths in both directions may control the nature of fluctuations and localization of the waves and play a very important role in the turbulence generation and its level. Numerical solutions of the equations governing kinetic Alfvén waves in the linear regime are obtained while retaining the effects of Landau damping, which have a significant impact on the frequency spectrum generated by propagating kinetic Alfvén waves. We present a theoretical study of the localization of KAWs, variations in magnetic field amplitude in time, and variation in the frequency spectra arising from inhomogeneities. The relevance of the model to space and laboratory observations is discussed.

Green, Matthew (Millersville University of Pennsylvania)

Poster Number: S30

Poster - Dependency of Magnetic Field of the CME on Other Physical Quantities on the Sun

Authors: Natalie Midzak, Kristen Pozsonyi, Megan McAuliffe, and Melinda R Hatt

Abstract: An interesting question of scientific and practical importance is what physical quantities are most important in determining the magnetic field of the CME ejecta at 1 AU. For this presentation we will show dependency of magnetic field on other physical quantities on the Sun for an initial flux rope CME. In this study we will use the Helioxm model. In this model of solar CMEs, the flux rope is characterized as a partial torus with a uniform major radius between the two footpoints. Once the initial flux rope geometry is given, the initial magnetic field is calculated by requiring d2Z/dt2 = 0 and d2a/dt2 = 0, balancing the Lorentz force, pressure, and gravity. CME magnetic field (B), temperature (T) , pressure (P), density (n), major radius (R), minor radius (a) will be calculated by using the Helioxm model. The physical measurement on the Sun will be the distance of footpoint separation of the CME.

Groves, Keith (Boston College)

Poster Number: I7

Poster - A Comprehensive Approach to Real-time Scintillation Specification

Authors: Charles Carrano, Christopher Bridgwood, and Ronald Caton

Abstract: Ionospheric scintillation represents a significant space weather phenomenon impacting satellite communications, global navigation satellite systems (GNSS), and other technologies employing radio waves traversing near-earth space. The scintillations result from electron density irregularities associated with various instability processes that are difficult to forecast for a variety of reasons, most notably the paucity of data needed to adequately specify the state of the upper atmosphere. The potential capability to specify and nowcast scintillation activity, however, has never been greater. By fusing traditional ground-based scintillation measurement methods, such as geostationary beacon and GPS observations, with emerging techniques such as multi-frequency low earth orbiting beacons and GNSS radio occultations (RO), one can achieve a higher fidelity specification of ionospheric density irregularities than has been possible previously. Moreover, the existence of a legacy ground-based network and the near-term launch of a constellation of RO and beacon-equipped spacecraft suggests that an approach to routinely obtain accurate scintillation specification on a global basis can be practically implemented at both low risk and low cost in the near future. The presentation will review the current status of scintillation nowcasting and discuss the technology development required to reach this goal, from the development of new beacon and RO techniques, to the deployment of ground-receivers, to changes in the paradigm for scintillation specification to support legacy narrowband channels, new GNSS signals and emerging systems employing sophisticated wideband waveforms. This comprehensive approach fuses information from both ground- and space-based systems to provide a single fused scintillation activity specification capable of supporting current and future space-interactive radio frequency systems.

Haiducek, John (University of Michigan)

Poster Number: M6

Poster - Magnetospheric Substorms using MHD and PIC

Authors: John Haiducek, Dan Welling, Lars Daldorff, Steve Morley, Natasha Ganjushkina, Gabor Toth, and Doga Ozturk

Abstract: Magnetohydrodynamic (MHD) models have long been seen to produce substorms, but their ability to reproduce observed substorms has not been examined except for a few case studies covering small numbers of individual events. We present a longer term study which covers the entire month of January 2005. The model consists of the BATS-R-US (Block Adaptive Tree Solver, Roe-type Upwind Scheme) MHD solver, driven by solar wind observations and coupled to the Ridley Ionosphere Model and the Rice Convection Model (RCM) through the Space Weather Modeling Framework (SWMF). We identify substorms in the model output using synthesized magnetic field values from various locations on the Earth's surface and in space, and make direct comparisons with observational magnetometer data where it is available.

One of the challenges with studying substorms is in identifying what signatures do and don't indicate the occurrence of a substorm. We address this issue by looking at several different signatures, including auroral envelope (AE) intensifications, midlatitude positive bay, and dipolarization signatures observable from spacecraft. We then calculate metrics of the model's performance relative to observations using each signature, including Heidke skill score, and distributions of inter-substorm timing and timing error. This will help us identify which signatures are most reliable for identifying substorms, as well as provide a picture of the model's performance and biases.

Harvey, Joey (Earth to Sky Calculus)

Poster Number: G6

Poster - Crowd-funding Space Weather Research

Authors: Joey Harvey (BUHS) and Tony Phillips (SpaceWeather.com)

Abstract: For the past three years, the students of Earth to Sky Calculus have conducted one of the world's most active upper atmospheric research programs, launching more than 150 "space weather balloons" to the stratosphere. They've done this with no regular support from the NSF, NASA, NOAA or other government organizations. Instead, the crowd has funded the cost of the program—more than $80,000 since 2012. In this poster, we'll reveal how we attract crowdfunding for curiosity-driven research, and how our methods could be adapted to other forms of space weather research.

Hatt, Melinda (Millersville University of Pennsylvania)

Poster Number: S30

Poster - Dependency of Magnetic Field of the CME on Other Physical Quantities on the Sun

Authors: Matthew Green, Natalie Midzak, Kristen Pozsonyi, Melinda Hatt, and Megan McAuliffe

Abstract: An interesting question of scientific and practical importance is what physical quantities are most important in determining the magnetic field of the CME ejecta at 1 AU. For this presentation we will show dependency of magnetic field on other physical quantities on the Sun for a initial flux rope CME. In this study we will use the Helioxm model. In this model of solar CMEs, the flux rope is characterized as a partial torus with a uniform major radius between the two footpoints. Once the initial flux rope geometry is given, the initial magnetic field is calculated by requiring d2Z/dt2 = 0 and d2a/dt2 = 0, balancing the Lorentz force, pressure, and gravity. CME magnetic field (B), temperature (T) , pressure (P), density (n), major radius (R), minor radius (a) will be calculated by using the Helioxm model. The physical measurement on the Sun will be the distance of footpoints separation of the CME.

Henderson, Michael (Los Alamos National Laboratory)

Poster Number: M24

Poster - The Geosynchronous Energetic Particle Environment During the Galaxy 15 Spacecraft Anomaly: LANL/GEO Observations

Authors: Michael G Henderson

Abstract: On April 5, 2010 the Galaxy 15 geosynchronous spacecraft suffered an anomaly that rendered it unresponsive to commanding from the ground. Although a number of studies have been conducted over the years since the anomaly, none of these include the extensive LANL geosynchronous particle datasets. Here, we present these data for the first time, showing the particle conditions from a few eV to several MeV at 5 additional locations around geosynchronous orbit.

Hsu, Chih-Ting (National Cental University of Taiwan)

Poster Number: I17

Poster - Seasonal and Solar Cycle Dependence on Coupled Thermosphere-Ionosphere Ensemble Data Assimilation System for Ionospheric Forecast: FORMOSAT-3/COSMIC Observing System Simulation Experiments

Authors: Chih-Ting Hsu, Tomoko Matsuo, Wenbin Wang, Xinan Yue and Jann-Yenq Liu

Abstract: Data assimilation is an important part of numerical ionospheric weather prediction. The objective of this study is to investigate how a coupled thermosphere-ionosphere model can be used in the ensemble data assimilation and forecast system to extend its ionospheric forecast ability. Synthetic electron density profiles, generated according to assimilate Formosa Satellite 3/Constellation Observing System for Meteorology, Ionosphere and Climate (FORMOSAT-3/COSMIC) radio occultation experiments, are assimilated into Thermosphere-Ionosphere-Electrodynamics General Circulation Model (TIEGCM) under four different geophysical conditions, including equinox and solstice high and low solar activities. Ensemble data assimilation and forecast results from observing system simulation experiments (OSSEs) indicate that major neutral compositions are key state variables that need to be updated (estimated by assimilation) for long-term (over 24 hours) ionospheric forecast under all geophysical conditions. While initialization of neutral winds by FORMOSAT-3/COSMIC data assimilation impact ionospheric forecast only for a short period of time (under 24 hours). The neutral temperature initialization can enhance the ionospheric forecast ability of the coupled thermosphere-ionosphere model under low solar activity conditions. Estimating the neutral temperature from the FORMOSAT-3/COSMIC data by ensemble data assimilation does not necessarily positively impact ionospheric forecast under high solar activity conditions. This negative impact might be caused by an inadequately estimated sample correlation from a limited number of the ensemble model forecasts and/or the inconsistency between and thermospheric temperature state variable that is estimated and heating sources prescribed in the model.

Huang, Chaosong (Air Force Research Laboratory)

Poster Number: I8

Poster - Empirical Models of Occurrence and Drift of Equatorial Plasma Irregularities and Scintillation

Authors: Chaosong Huang

Abstract: Equatorial plasma bubbles are the most significant disturbances in the nighttime low-latitude ionosphere and cause radio scintillation. The prereversal enhancement of the vertical plasma drift in the postsunset sector is an important factor that controls the generation of equatorial plasma bubbles. The zonal drift determines the location of plasma bubbles after they are generated and is the key factor for accurately predicting where scintillation will occur at a later time. In this study, we use measurements of the Communication/Navigation Outage Forecasting System (C/NOFS) satellite to identify the global occurrence of plasma bubbles and measurements of the COSMIC F3 satellite to identify the global occurrence of scintillation. The dependence of plasma bubble occurrence on the postsunset ion vertical drift is derived. We have also created a model of the zonal drift of plasma bubbles and irregularities on the basis of measurements of Jicamarca radar and the C/NOFS satellite. The model provides the local time distribution of the zonal drift when the input parameters (solar radio flux, day of year, longitude, and latitude) are given.

Jackel, Brian (University of Calgary)

Poster Number: M10

Poster - Predicting Lognormal Distributions of Geomagnetic Time Derivatives

Authors: Brian Jackel, Martin Connors, Muriel Singleton, and Kyle Reiter

Abstract: Nearly two decades of auroral zone magnetometer observations are used to develop statistical predictions of geomagnetic time derivatives.

Distributions of differences between successive 5~second vector field measurements are approximately lognormal, motivating a parametrization in terms of the first and second log-moments which are nearly uncorrelated and exhibit very different properties. Log-mean ranges over several orders of magnitude, with autocorrelation time scales longer than 30 minutes. Log-variance correlation time is typically less than 5 minutes, with small amplitude noise-like fluctuations. Both log-moments are dependent on local time and magnetic latitude, but these factors predict less than 10\% of observed variance. Simple combinations of solar wind parameters predict nearly 50\% of log-mean but almost none of log-variance.
Including information about recent local activity in addition to solar wind parameters significantly improves log-mean predictability to 70\% but only accounts for 10\% of log-variance.
Empirical models for these two parameters based on L1 solar wind data provide lognormal distribution forecasts which can be used to obtain point and range estimates of upcoming activity levels.
Prediction accuracy is highest during the day and lowest before midnight.
Hourly predictions of typical (median) and active (90th percentile) events are unbiased, with roughly 90\% of cases falling between half and twice the predicted value.
Extreme (99th percentile) event magnitudes are consistently 20\% lower than predicted, possibly due to deviations from lognormality in the tail of the observed distribution.

Jackson, Bernard (University of California, San Diego)

Poster Number: S21

Poster - Space Weather Forecasting Using Remotely-sensed Heliospheric IPS Data Sets From Around the World – an Inclusion of MEXART and BSA Pushchino Data into the UCSD STELab IPS Tomography

Authors: Bernard Jackson, Hsiu-Shan Yu, Paul Hick, Andrew Buffington, Oyuki Chang, Munetoshi Tokumaru, Americo Gonzalez-Esparza, Julio Mejia-Ambriz, Mario Bisi, Jaehun Kim, Sunhak Hong, Bowon Lee, Jonghyuk Yi and Jongyeon Yun

Abstract: The UCSD time-dependent iterative kinematic reconstruction technique has been used and expanded upon for over two decades; it provides some of the most accurate predictions and 3D reconstructions of heliospheric solar-wind parameters presently available, using interplanetary scintillation (IPS) data to do this. The parameters include velocity, density, and magnetic fields. Magnetic fields are mapped-outward from the solar surface using the Current-Sheet Source Surface model. From the inner boundary IPS source surface, these fields are then propagated outward using IPS-derived velocities. Precise time-dependent results are currently obtained at any solar distance in the inner heliosphere using ISEE (formerly STELab), Japan, IPS data sets, but the modeling input can also incorporate other IPS systems from around the world, most easily using data provided in the "standard" IPS format. When employing a global network of IPS data systems, not only can IPS predictions be made without observation dead times due to poor longitude coverage or system outages, but the program can itself be used to standardize IPS observations. Here we show preliminary work to incorporate IPS data from both the MEXican Array Radio Telescope (MEXART), and the Big Scanning Array (BSA) in Pushchino, Russia, into the ISEE data set.

Johnson, Jeff (NOAA/NWS)

Poster Number: S34

Poster - DSCOVR Real-Time Solar Wind and Tracking Data Plots

Authors: Michael Burek, Jeff Johnson

Abstract: The SWPC Real-Time Solar Wind (RTSW) web plots provide a convenient tool for displaying and analyzing operational DSCOVR data as it arrives. Unlike the previous web display which consisted solely of static images, the new web plots are interactive. Hovering over the plot provides a readout of the

selected values, and the user can zoom in for more detail. The primary controls are the timespan selection (from 2 hours to 7 days back from the present) and the plots to be displayed (Magnetometer, Solar Wind, or a combination of the two). The user can save the data for the currently visible or zoomed timespan to a text file or PNG image with a single click. There are user preference options for choosing either a white or black background color, and for rendering the data as either markers or lines.

The tracking plot provides real-time awareness of the data that is being received from the RTSW stations. Improvements from previous tracking plots from ACE include the capability of showing reception from more than one tracking station simultaneously, comparing the received telemetry to the telemetry expected from the tracking schedule, and notation of data outages. Simultaneous tracking of multiple stations can allow a station that is not providing telemetry to be identified and resolved early, while there is still redundancy with other stations. Station schedule is derived from inp2 files received from MMFD, giving a first pass schedule early. The schedule can be edited at the SWPC forecast center to fine tune later in case of schedule outages or addition of new tracking assets to cover outages. The display allows the user to display 1, 3 or 7 days of tracking information.

Joshi, Dev (Institute for Scientific Research, Boston College)

Poster Number: I9

Poster - Investigation of the Precursor Conditions of Equatorial Plasma Bubble Irregularities with Oblique HF links

Authors: Keith Groves

Abstract: Data from the Metal Oxide Space Cloud (MOSC) experiment in April-May 2013 conducted by the Air Force Research Laboratory with support of the NASA sounding rocket team are analyzed to understand the factors influencing the growth rate of Gravitational Rayleigh Taylor Instability (GRTI) believed to be the main cause of equatorial plasma irregularities generally known as spread F. Data from oblique HF radio links, ALTAIR incoherent scatter radar and VHF radar are analyzed to understand the various precursor conditions of the pre-reversal vertical drift, F-layer bottomside density gradient correlating to the scintillation activity in the equatorial ionosphere. We analyzed nights with and without spread F and found that plasma drift velocity $\geq$ 20 m/sec was necessary condition for spread F instability initiation, similar to results found in previous studies. However, we also examine other parameters influencing the GRTI growth rate, such as the vertical density gradient and the ion-neutral collision frequency to develop a more complete description of the formation of irregularities in the equatorial environment. Moreover, ALTAIR incoherent scatter radar scans are used to provide ground truth so that the exact state of the ionosphere can be determined for comparison with the oblique HF links. The findings suggest that oblique HF links may be exploited for short-term forecasts of low-latitude scintillation activity. The scintillations are significant because they affect radio wave propagation and may impact the performance of satellite communications and navigation links.

Kellerman, Adam (UCLA)

Poster Number: M25

Poster - Forecasting the Earth's Radiation Environment Using Physics-based Modeling and Data Assimilation

Authors: Yuri Shprits, Tatiana Podladchikova, Dmitri Kondrashov, and Alexander Drozdov

Abstract: Presented is the data-assimilative VERB code, which is currently used for operational forecasts of the Earth's radiation belt environment. An overview of the performance of the model is presented for a test period during 2012-2013, and for a real-time forecast analysis during 2015-2016, using different

empirical magnetic field models. It is demonstrated that the model may be used currently to provide a realistic forecast of the radiation environment up to 2 days into the future.

Kim, Kyung-Im (Kyung Hee University)

Poster Number: M4

Poster - Application of HD/MHD Numerical Modelling in Space Weather Issues

Authors: Dong-Hun Lee, Jaehun Kim, KiChang Yoon, and Young Yun Kim

Abstract: Time-dependent simulations in hydrodynamic and/or magnetohydrodynamic numerical models are often used to study space weather phenomena of relatively long time period and large size space, which include many examples from the solar origin to the Earth impact in the heliosphere. There have been rising questions on whether many different numerical codes are consistent with each other and how we can confirm the validity of simulation results for a given event. In this study, we propose a self-consistent method, which can provide solutions in practical models. By adopting a class of exact analytic solutions of HD/MHD when the boundary is driven by certain impulsive impacts, we test and compare numerical models with these exact full MHD solutions to check whether the simulations are sufficiently accurate under given parameters. Our results show that numerical errors are very significant in the problems of HD/MHD disturbance propagation. In fact, typical spatial and temporal resolutions, which are widely used in numerical modelling, are found to easily produce serious numerical errors in both of arrival timing and time-dependent profile at the near-Earth space. In addition, we suggest how we can avoid serious errors by optimizing the model parameters in advance.

Kim, Tae (University of Alabama in Huntsville)

Poster Number: S23

Poster - Solar Wind Modeling with Multi-Scale Fluid-Kinetic Simulation Suite

Authors: T. K. Kim, N. V. Pogorelov, S. N. Borovikov, M. C. Bedford, I. A. Kryukov, C. N. Arge, P. K. Manoharan, H. A. Elliott, D. J. McComas, and G. P. Zank

Abstract: The solar wind is a turbulent medium with physical properties fluctuating on multiple scales. We model three-dimensional solar wind plasma flow using our own software Multi-Scale Fluid-Kinetic Simulation Suite, which, in addition to the thermal solar wind plasma, takes into account charge exchange of solar wind protons with interstellar neutral atoms and treats nonthermal ions (i.e., pickup ions) born during this process as a separate fluid. Additionally, our model includes a description of turbulence generated by pickup ions. Using adaptive mesh refinement, we can efficiently model propagation of sophisticated structures such as coronal mass ejections at high resolution. Currently, we focus on data-driven modeling with realistic time-dependent boundary conditions derived from remote-sensing observations (e.g., interplanetary scintillation) as part of our effort to create a time-dependent solar wind model capable of reproducing the plasma flow, magnetic field, and turbulence throughout the heliosphere. Furthermore, we run our model using plasma and turbulence parameters from OMNI data as time-dependent boundary conditions at 1 AU for the Reynolds-averaged MHD equations and investigate the evolution of plasma and turbulent fluctuations along the trajectory of the New Horizons spacecraft, which recently passed Pluto at ~33 AU. The simulation results agree reasonably with in situ measurements made by New Horizons between 11 and 33 AU. We plan to provide modeling support for the New Horizons mission as the spacecraft continues to explore the outer reaches of the heliosphere.

Kim, Yeon-Han (Korea Astronomy and Space Science Institute (KASI))

Poster Number: S18

Poster - A Prestudy for the Development of a Compact Coronagraph

Authors: Su-Chan Bong, Heesu Yang, Kyuhyoun Cho, Bi-Ho Jang, Seonghwan Choi, Eun-Kyung Lim, Yeon-Han Kim, Young-Deuk Park, Jaejin Lee, and Jongchul Chae

Abstract: We are conducting a prestudy for the development of a compact coronagraph. The coronagraph is comprised of the external occulter, lens, filter, and the CCD. We focus on the performance of the external occulter, and the measurement of the coronal temperature and velocity using a set of filters. We have tested the diffraction pattern and strength of a few occulters using artificial light source. We also have calculated the Thomson scattering of the K corona to form coronal spectra in various temperature and velocity conditions. We found the optimized wavelength set for temperature and velocity measurement. We are making a prototype coronagraph and plan to test during the total eclipse in near future without the occulter.

Kitiashvili, Irina (NASA ARC/BAERI)

Poster Number: S1

Poster - Data Assimilation Approach to the Solar Cycle Prediction

Authors: Iriana Kitiashvili

Abstract: Prediction of the solar cycles is one of most interesting problems closely linked to dynamo processes on the Sun. Numerous attempts to predict future solar cycles are mostly based on empirical relations derived from observations of previous cycles, and provide a wide range of predicted strength and duration of the cycles. The current dynamo models also have not been able to make reliable predictions. The origin of these uncertainties is in limitations of the observational data, and also in our insufficient understanding of the complex turbulent dynamics of the solar interior. Data assimilation is a relatively new approach to develop physics-based predictions and estimate their uncertainties in the situations when physical properties of a system are not well-known, and when the available observational data are uncertain, and do not constrain the model parameters. I will present an application of an Ensemble Kalman Filter approach for modeling and prediction of the solar cycles. Despite the successful prediction of Cycle 24 further development is needed. Remaining problems that needs to be resolved, and prospects for prediction of Cycle 25 will be discussed.

Knipp, Delores (University of Colorado Boulder)

Poster Number: M2

Poster - The May 23-26 1967 Great Storm and Radio Disruption Event: Extreme Space Weather and Extraordinary Responses

Authors: A. Ramsay, E. Beard, A. Boright, T. Cade, I. Hewins, W. Denig, M. Shea and D. Smart

Abstract: When space weather enthusiasts discuss superstorms, they usually call out the Carrington Event of 1859, the Railroad Storm of 1921, and the 1989 HydroQuebec Blackout Storm. These storms had broad and visible societal impact, interfering with telegraph communications, railway and transoceanic cable operations, and regional power grids, respectively. Although listed as one of the significant storms of the last 80 years, the space weather storm of late May 1967 has been of mostly fading academic interest. Here we tell a more compelling story of this radio disruption event: How the May 1967 space storm was nearly one with ultimate societal impact, were it not for the nascent efforts of the US Air Force in expanding its terrestrial weather forecasting efforts into the realm of space weather forecasting. The primary impact of the event was severe disruption of radio systems. A signficant outcome of this storm was the formalization

of US Department of Defense support for what is today called space weather forecasting. We argue the circumstances surround this event makes this one of the "Great Storms" of the 20th century.

Kosovichev, Alexander (New Jersey Institute of Technolgoy)

Poster Number: S2

Poster - Solar-Cycle Evolution of Subsurface Flows and Magnetic Fields

Authors: Alexander Kosovichev and Junwei Zhao

Abstract: Local helioseismology and magnetic field measurements from the HMI instrument on SDO provide unique high-resolution data that allow us to investigate detailed dynamics of the upper convection zone and its relation to the magnetic field evolution during the first five years of the current solar cycle. This study is focused on the understanding the role of the near-surface shear layer (NSSL) in the dynamo process, generation, emergence and transport of the solar magnetic flux. The helioseismology data represent 3D flow maps in the depth range of 0-20 Mm, obtained uninterruptedly every 8 hours for almost the whole solar disk with the spatial sampling of two arcsec. We calculate the flow characteristics (such as divergence, vorticity and kinetic helicity) on different spatio-temporal scales from supergranulation to global-scale zonal and meridional flows. We investigate the multi-scale organization of the subsurface flows, including the inflows into active regions, the hemispheric `flip-flop' asymmetry of variations of the meridional flows, the structure and dynamics of torsional oscillations, and compare the flow behavior with the evolution of the observed magnetic activity. We discuss implications of helioseismology data for predictions of solar activity.

Kubo, Yuki (National Institute of Information and Communicatons Technology)

Poster Number: S6

Poster - Verification of Operational Solar Flare Forecast in RWC Japan

Authors: Yuki Kubo

Abstract: Forecast verification has been recognized as one of the most important topic in meteorological forecast research. In the field of space weather forecast, however, a forecast verification study is still incipient. Recently, some regional warning centers (RWCs) belonging to the International Space Environment Service (ISES) started to verify their operational forecasts. After their initiatives, a forecast verification study has come to be noticed as one of the important research topic in the operational space weather forecasting community. RWC Japan have performed verification study of operational solar flare forecast. In this presentation, we introduce preliminary results for the verification study of operational solar flare forecast in RWC Japan.

Lamb, Aaron (Earth to Sky Maritime)

Poster Number: G7

Poster - Applying Maritime Skills to the Space Weather Industry

Authors: Ulises Garibay

Abstract: Earth to Sky Maritime adds an extra dimension to space weather research, allowing for payloads to be both launched and recovered from the water.

Lee, I-Te (Central Weather Bureau)

Poster Number: I18

Poster - Role of Data Assimilation with a Ionosphere-thermosphere Coupled Model

Authors: T. Matsuo, C. T. Hsu, W. H. Chen, C. H. Chen, C. H. Lin, and J. Y. Liu

Abstract: The Earth's ionosphere and thermosphere conditions can be affected by the solar, interplanetary, magnetosphere, and mesosphere, stratosphere, troposphere, and even lithosphere processes. These conditions like neutral and ion density distribution, neutral composition ration, and neutral and ion temperature could cause variations in minutes to weeks which are called space weather. The severe space weather would influence radio communication, satellite navigation and position, and so on. Recently, many of ionospheric observations are used to reconstruct the Earth ionosphere for monitoring the space weather. However, a system could produce nowcasting and forecasting of space weather is desirable in this age of modern technology. Therefore, to assimilate worldwide and denser radio occultation (RO) observations in to an ionosphere-thermosphere coupled model with the ensemble Kalman filter (EnKF) will lead a new way for future space weather forecasting operation. According to the EnKF assimilation schema, model state variables of the ionosphere are advanced based on the observation information. Within the coupled model, the neutral dynamics and interaction with ion are considered. The selected neutral state variable can be adjusted during the procedure to improve the result and extend effectively forecasting period. In this study, information of this data assimilation system structure, ensemble generation strategy, system performance, and brief results are presented.

Leka, KD (NorthWest Research Associates (NWRA))

Poster Number: S7

Poster - The Discriminant Analysis Flare Forecasting System (DAFFS)

Authors: KD Leka, Graham Barnes, Eric Wagner (NorthWest Research Associates);
Frank Hill, and Andrew R. Marble (National Solar Observatory)

Abstract: The Discriminant Analysis Flare Forecasting System (DAFFS) has been developed under NOAA/Small Business Innovative Research funds to quantitatively improve upon the NOAA/SWPC flare prediction. In the Phase-I of this project, it was demonstrated that DAFFS could indeed improve by the requested 25% most of the standard flare prediction data products from NOAA/SWPC. In the Phase-II of this project, a prototype has been developed and is presently running autonomously at NWRA. DAFFS uses near-real-time data from NOAA/GOES, SDO/HMI, and the NSO/GONG network to issue both region- and full-disk forecasts of solar flares, based on multi-variable non-parametric Discriminant Analysis. Presently, DAFFS provides forecasts which match those provided by NOAA/SWPC in terms of thresholds and validity periods (including 1-, 2-, and 3- day forecasts), although issued twice daily. Of particular note regarding DAFFS capabilities are the redundant system design, automatically-generated validation statistics and the large range of customizable options available. As part of this poster, a description of the data used, algorithm, performance and customizable options will be presented, as well as a demonstration of the DAFFS prototype.

DAFFS development at NWRA is supported by NOAA/SBIR contracts WC-133R-13-CN-0079 and WC-133R-14-CN-0103, with additional support from NASA contract NNH12CG10C, plus acknowledgment to the SDO/HMI and NSO/GONG facilities and NOAA/SWPC personnel for data products, support, and feedback. DAFFS is presently ready for Phase-III opportunities.

Lindsey, Charles (NorthWest Research Associates)

Poster Number: S25

Poster - Seismic Mapping of the Sun's Far Hemisphere for Applications in Space-Weather Forecasting

Authors: Charles Lindsey, Joseph Werne, and Frank Hill

Abstract: Magnetic regions in the Sun's near hemisphere exert a major impact on space weather at Earth. Magnetic regions in the far hemisphere appear to exert relatively little immediate impact, but, because the Sun rotates, these regions cross into the near hemisphere somewhat suddenly and without warning---except for our ability to monitor the Sun's far hemisphere. Monitoring of the Sun's far hemisphere therefore becomes crucial to space-weather forecasting on time scales ranging from a few days to a few weeks. For the past several years, this need has been well served by NASA's twin STEREO spacecraft, which, since 2011, have been in positions to view the entirety of the Sun's far hemisphere directly. Beginning in about 2019, STEREO coverage of the far hemisphere will begin to diminish, as both of the STEREO spacecraft drift back to Earth's side of the solar system. For most of the succeeding decade, solar seismology will be the only means of detecting and accurately locating large, newly emerging active regions that covers the entirety of the Sun's far hemisphere. We will review the development of seismology of the Sun's far hemisphere from the 1990s to present. We will summarize recent developments in seismic sensing of the Sun's far hemisphere, describing its basic capabilities and limitations as a tool for detecting and locating new emerging magnetic flux in the Sun's far hemisphere and forecasting its subsequent transit across the Sun's eastern limb. We will also offer projections on coming improvements in far-side solar seismology of likely value to space-weather forecasters.

Mabie, Justin (CIRES)

Poster Number: I4

Poster - A Research Ionosonde in Antarctica

Authors: Terry Bullett

Abstract: The CIRES ionosonde group has successfully installed and tested a research grade ionosonde at Jang Bogo Station in Antarctica. Observations are presented with results that promise a future instrument on the Antarctic ice sheet can be installed with a greater observation capability at a reduced cost. The proposed future instrument will provide detailed and continuous observations of the Ionosphere, make high quality observations of a wide range of disturbances, and support LIDAR, SuperDARN and magnetometer operations in Antarctica.

MacDonald, Gordon (New Mexico State University)

Poster Number: S24

Poster - The Sensitivity of Coronal Structure to Changes in the Flux Distribution in Active Regions

Authors: G.A. MacDonald, C. Downs, J.A. Linker, C.N. Arge, C.J. Henney, and R.T.J. McAteer

Abstract: We present ongoing work to determine the sensitivity of coronal structure to changes in the distribution of magnetic flux in active regions. Coronal structure is important in shaping the solar wind outflow which we model using an advanced magnetohydrodynamic (MHD) model of the inner-heliosphere, CORHEL. The Air Force Data Assimilative Photospheric flux Transport (ADAPT) model is a global flux transport model that uses data assimilation techniques to produce an ensemble of realizations for the distribution of magnetic flux in the photosphere. ADAPT synchronic maps are used as an input to CORHEL. The MHD solution is Forward-modeled using SolarSoft's FORWARD module to simulate the white light emission from the corona. The model emission is checked against observed emission measured with the HAO/Mk4 coronameter. Our dataset contains three MHD solutions produced with CORHEL, each

using a different ADAPT map as input: 1) a baseline run with a far-side active region excluded from the ADAPT map, 2) the far-side active region present with the correct polarity, and 3) the far-side active region present but with opposite polarity. The correlation coefficients between the Mk4 image and the three simulations are computed. We find that the simulation with the far-side active region included with the correct polarity is most strongly correlated with the Mk4 image. Future work will involve comparing the positions and widths of the streamers found in these data and observations.

Maruyama, Naomi (NOAA)

Poster Number: I16

Poster - Ionosphere-Plasmasphere-Electrodynamics (IPE) Model and its Coupling to Whole Atmosphere Model (WAM) Toward Transitioning to Operational Space Weather Forecasting

Authors: Naomi Maruyama, Phil Richards, Mariangel Fedrizzi, Tzu-Wei Fang, Tim Fuller-Rowell, Mihail Codrescu, Peggy Li, Gerhard Teurich, Robert Oehmke, Cecelia DeLuca, Art Richmond, Jacques Middlecoff, Rashid Akmaev, Houjun Wang, and Valery Yudin

Abstract: The Ionosphere-Plasmasphere-Electrodynamics (IPE) model is a new, time dependent, three-dimensional model of ionosphere and plasmasphere recently developed through collaboration between University of Colorado, George Mason University, NOAA Space Weather Prediction Center (SWPC), NOAA Global Systems Division (GSD), NCAR HAO and NESII. It provides time dependent, global, three-dimensional plasma densities for nine ion species, electron and ion temperatures, and both parallel and perpendicular velocities of the ionosphere and plasmasphere. IPE reproduces not only the climatology of global TEC observations, but the model has also been applied to Space Weather events, such as Sudden Stratospheric Warmings (SSW) and geomagnetic storms. The model follows the storm time redistribution of the plasma density in the ionosphere and plasmasphere, including the dynamic evolution of the Storm Enhanced Densities (SEDs). While the standalone IPE continues to be improved, IPE has been coupled to Whole Atmosphere Model (WAM), a special configuration of the Global Forecast System(GFS), in order to respond to terrestrial weather. IPE has been included as a component of the NOAA Environmental Modeling System (NEMS) coupled system using the Earth System Modeling Framework (ESMF) and National Unified Operational Prediction Capability (NUOPC) layer. In this presentation, an overview of the IPE model development and current status is presented. Furthermore, the preliminary results from the coupled WAM-IPE model is shown to demonstrate the impact of meteorological perturbations on the ionosphere. The presentation is summarized by the discussions on the challenges in the coupling effort toward the ultimate goal of transitioning to operations.

Maute, Astrid (NCAR)

Poster Number: I11

Poster - A New Model of the Three-dimensional Ionospheric Current System

Authors: Astrid Maute and Art D. Richmond

Abstract: Ionospheric electric fields and currents are driven by collisional interaction between thermospheric winds and ions, by magnetospherically driven ion convection and field-aligned currents at high latitudes, by gravitational and pressure-gradient forces on the ionospheric plasma, and by weak currents from the lower atmosphere. For simulating the electric field due to these different drivers we assume that the electric potential is nearly constant along geomagnetic-field lines, and therefore the electric field variations can be expressed in two dimensions. The current density, however, depends also on the conductivity distribution, and consequently varies in all three dimensions. We have developed a model

of ionospheric electrodynamics that takes into account the wind dynamo, the magnetospheric field-aligned current, and gravitational and pressure gradient forces to calculate the three-dimensional (3D) structure of currents. From the currents we calculate the magnetic perturbation fields at the Earth's surface and at Low Earth Orbit (LEO) satellite altitudes. We will use this model to examine the effects of the different sources on the 3D currents and their associated magnetic perturbations. An accurate description of the 3D ionospheric currents is critically important to interpreting satellite observations at LEO height as they are affected by the various atmospheric forces all together. In this presentation we will introduce the new capabilities of calculating the 3D ionospheric current and associated magnetic perturbations. With selected examples we will illustrate the complex 3D current system and the magnetic perturbations produced by the neutral wind and by gravity and plasma pressure-gradient forces on the plasma. We will discuss further improvements in the modelling and applications.

McAuliffe, Megan (Millersville University)

Poster Number: S30

Poster - Dependency of Magnetic Field of the CME on Other Physical Quantities on the Sun

Authors: Natalie Midzak, Kristen N Pozsonyi, Melinda R Hatt, Megan I McAuliffe

Abstract: An interesting question of scientific and practical importance is what physical quantities are most important in determining the magnetic field of the CME ejecta at 1 AU. For this presentation we will show dependency of magnetic field on other physical quantities on the Sun for an initial flux rope CME. In this study we will use the Helioxm model. In this model of solar CMEs, the flux rope is characterized as a partial torus with a uniform major radius between the two footpoints. Once the initial flux rope geometry is given, the initial magnetic field is calculated by requiring d2Z/dt2 = 0 and d2a/dt2 = 0, balancing the Lorentz force, pressure, and gravity. CME magnetic field (B), temperature (T) , pressure (P), density (n), major radius (R), minor radius (a) will be calculated by using the Helioxm model. The physical measurement on the Sun will be the distance of footpoint separation of the CME.

McCollough, James (Air Force Research Laboratory)

Poster Number: M5

Poster - Dynamic Modeling of EMIC Wave Activity in a Realistic Magnetosphere

Authors: James P. McCollough, Scot R. Elkington, Maria E. Usanova, and Jacob Bortnik

Abstract: On 14-16 December 2006, A geomagnetic storm was observed accompanied by electromagnetic ion-cyclotron (EMIC) wave activity. We use a 3D test particle simulation in a realistic magnetosphere from the global Lyon-Fedder-Mobarry (LFM) MHD code to compute the phase space density dynamics of warm electrons responsible for chorus wave growth. We use these results to compute the temperature anisotropy and density for input into a linear convective wave growth rate for EMIC waves. We then follow Bortnik et al. [2010] to compute EMIC saturation amplitudes to provide a global dynamical picture of EMIC wave activity for this event. We will perform a data-model comparison of the modeled wave amplitudes with the observed wave activity, aiding in understanding the spatio-temporal and spectral response of EMIC wave activity to geomagnetic disturbances.

McFadden, Robert (Boston College)

Poster Number: S3

Poster - Preserving a Unique Archive for Long-Term Solar Variability Studies

Authors: Ian Hewins, Robert McFadden, Barbara Emery, Sarah Gibson, David Webb, and William Denig

Abstract: In 1964 (solar cycle 20) Patrick McIntosh began creating hand-drawn synoptic maps of solar activity, based on Hydrogen alpha (Hα) imaging measurements. These synoptic maps were unique because they traced the polarity inversion lines (PILs), connecting widely separated filaments, fibril patterns and plage corridors to reveal the large-scale organization of the solar magnetic field. He and his assistants later included coronal hole (CH) boundaries to the maps, usually from ground-based He-I 10830 images. They continued making these maps until 2010 (the start of solar cycle 24), yielding more than 40 years (540 Carrington rotations) or nearly four complete solar cycles (SCs) of synoptic maps. The McIntosh collection of maps forms a unique and consistent set of global solar magnetic field data, and are unique tools for studying the structure and evolution of the large-scale solar fields and polarity boundaries, because: 1) they have excellent spatial resolution for defining polarity boundaries, 2) the organization of the fields into long-lived, coherent features is clear, and 3) the data are relatively homogeneous over four solar cycles. After digitization and archiving, these maps -- along with computer codes permitting efficient searches of the map arrays -- will be made publicly available at NOAA's National Centers for Environmental Information (NCEI) in their final, searchable form. This poster is a progress report of the project so far and some suggested scientific applications.

McGranaghan, Ryan (University of Colorado Boulder)

Poster Number: I12

Poster - Determining Global Ionospheric Conductivity in the Satellite and Assimilation Age and Assessing its Influence on the Magnetosphere-Ionosphere-Thermosphere System

Authors: Ryan M. McGranaghan, Delores J. Knipp, Tomoko Matsuo, Ellen Cousins, and Stanley C. Solomon

Abstract: Energy redistribution in the magnetosphere-ionosphere-thermosphere (MIT) system is largely controlled by a complex system of field-aligned, Hall, and Pedersen currents, and the electrodynamics underlying their distributions. Application of Ohm's law to the auroral zone requires knowledge of the ionospheric conductivity, whose estimation has often been simplified by invoking Maxwellian behavior of the impacting particles and height independent conductance. Though these assumptions have allowed us to study height-integrated conductivities (conductances), they have also limited our ability to understand how the MIT system operates as a whole. We are now in a position to address conductivity variations, and thus energy redistribution, in three dimensions.

We present the first objective analysis of the fully three-dimensional (3-D) ionospheric Hall and Pedersen auroral conductivities, and demonstrate the method for the November 30, 2011 coronal mass ejection event. We show: 1) a fundamental picture of ionospheric conductivity variability organized into empirical orthogonal functions (EOFs) [McGranaghan et al., 2015] and 2) an event reconstruction of the ionospheric conductivities. Our reconstruction relies on a data assimilation scheme that optimally combines Defense Meteorological Satellite Program (DMSP) satellite observations and their errors with a background model and its error covariance (modeled with the EOFs). We find significant 3-D structure in the ionospheric conductivities that can drastically modify the E- and lower F-region behavior. Quantitatively and qualitatively this new technique provides better ionospheric conductivity specification than past statistical models, especially during heightened geomagnetic activity. Finally, we suggest an exciting opportunity to extend these analyses to other data sets, such as the Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC).

McMichael, Elizabeth (NOAA/NESDIS/GOES-R)

Poster Number: M22

Poster - Preparing for GOES-R: Post-Launch Testing

Authors: Elizabeth J. McMichael, Jon P. Fulbright, William F. Denig, and William F. Rowland

Abstract: GOES-R will provide marked improvements in Space Weather monitoring, including:
- Improved detection of coronal holes, solar flares, and coronal mass ejection source regions,
- More accurate monitoring of energetic particles responsible for radiation hazards,
- Improved power blackout forecasts,
- Increased warning of communications, and navigation disruptions.

Upon deployment of a new system and new capabilities, user readiness becomes an increasingly important activity. The GOES-R Product Readiness and Operations (PRO) team is tasked with working with calibration/validation (cal/val) groups within the Satellite and Information Service (NESDIS) to ensure all Level 1b (L1b) space weather data products are ready for operations, and the user community is ready to receive and disseminate the various products to serve their needs and requirements.

In anticipation of the GOES-R satellite launch, the GOES-R PRO team has been working with cal/val partners to develop comprehensive readiness, implementation, and management plans in preparation for Post-Launch Testing (PLT), including Post-Launch Product Testing (PLPT), of all space weather L1b products. PLT includes many validations events for each space weather instrument. These tests require coordination between science teams and instrument vendors in order to execute the tests. This poster will discuss the preparation for and activities associated with PLT and PLPT for all the GOES-R space weather instruments' L1b cal/val teams.

Meehan, Jennifer (Utah State University)

Poster Number: I3

Poster - How to Utilize Scale Heights to Infer Information about the Topside Ionosphere

Authors: Jennifer Meehan, Jan J Sojka, and Michael David

Abstract: Ionospheric scale height is a measure of the topside altitude dependence of electron density and is a key ionospheric parameter due to its intrinsic connection to ionospheric dynamics, plasma temperature and composition. Knowledge of the distribution of electron density and its altitude dependence is important for ionospheric empirical modeling and ionospheric studies, and for practical applications such as time delay correction of radio wave propagation through the ionosphere. A longtime problem has been that information on the bottomside ionospheric profile is readily available but the observation of the topside ionosphere is still challenging. Over the years, researchers have gathered information and developed several different methods to analyze the topside ionosphere, including: coherent scatter radar observations of underdense electron density irregularities, incoherent scatter radar (ISR) probing, topside sounders onboard satellites, in situ rocket and satellite observations such as Global Positioning System (GPS) and occultation measurements. However, despite numerous data techniques to characterize the topside ionosphere the knowledge of the behavior of the topside ionosphere and its subsequent scale heights remains insufficient. In a simple model, the electron density in the F-region topside decreases exponentially with height. This exponential decay is mainly driven by thermal diffusive equilibrium. But also dependent on the dominate ion species as well as other drivers during non-diffusive conditions. A scale height based on observations of the temperature can generate topside electron density profiles. While a measure of the electron density profile enables a scale height to be inferred hence yielding temperature information. In the event that neither temperature nor electron density are measured can topside information be gained by an analysis of GPS TEC and bottomside electron density profiles observed by ionosondes? A studying using one month of Millstone Hill ISR observations is planned out to address this question.

Miao, Juan (National Space Science Center, Chinese Academy of Sciences)

Poster Number: S4

Poster - New Sunspot Number Series and the Prediction of Solar Cycle 25

Authors: Liu Siqing, Gong Jiancun

Abstract: On July 1st 2015, the World Data Center SILSO laid an unprecedented milestone in the long history of the sunspot number. Since July 1st, the original sunspot number data are replaced by a new revised data series. This paper will show the prominent changes for values and solar cycles. Most of the previous equations and predictions will be not consistent with the new values. Based on correlation between cycle parameters, the preliminary maximum amplitude of cycle 25 is predicted.

Midzak, Natalie (Millersville University)

Poster Number: S30

Poster - Dependency of Magnetic Field of the CME on Other Physical Quantities on the Sun

Authors: Kristen Pozsonyi, Matthew Green, Megan McAuliffe, and Melinda Hatt

Abstract: An interesting question of scientific and practical importance is what physical quantities are most important in determining the magnetic field of the CME ejecta at 1 AU. For this presentation we will show dependency of magnetic field on other physical quantities on the Sun for an initial flux rope CME. In this study we will use the Helioxm model. In this model of solar CMEs, the flux rope is characterized as a partial torus with a uniform major radius between the two footpoints. Once the initial flux rope geometry is given, the initial magnetic field is calculated by requiring d2Z/dt2 = 0 and d2a/dt2 = 0, balancing the Lorentz force, pressure, and gravity. CME magnetic field (B), temperature (T) , pressure (P), density (n), major radius (R), minor radius (a) will be calculated by using the Helioxm model. The physical measurement on the Sun will be the distance of footpoint separation of the CME.

Molina, Ferris (Earth to Sky Calculus)

Poster Number: S12

Poster - The Transcontinental Space Weather Balloon Experiment

Authors: Carson Reid (BUHS), Amelia Yarborough (BUHS), Jamie Shultz (BUHS), Joey Harvey (BUHS), Duncan Reid (BUHS), Tony Phillips (SpaceWeather.com)

Abstract: In July 2015, the students of Earth to Sky Calculus joined forces with researchers at the University of New Hampshire Dept. of Physics to launch balloons simultaneously from opposite sides of the USA—California and New Hampshire. The balloons carried radiation sensors to the stratosphere and measured the Pfotzer maximum over both coasts. Radiation levels over New Hampshire were substantially higher than over central California. In November 2015, we repeated the experiment and measured even bigger differences between the two launch sites. The differences in radiation, New Hampshire vs. California, set important boundary conditions on geomagnetic cutoff rigidity for atmospheric radiation models.

Morley, Steven (Los Alamos National Laboratory)

Poster Number: M21

Poster - The Global Positioning System Constellation as a Space Weather Monitor

Authors: Steven K. Morley, John P. Sullivan, Michael G. Henderson, J. Bernard Blake, and Daniel N. Baker

Abstract: The Global Positioning System satellites are distributed across six orbital planes and follow near-circular orbits, with a 12 hour period, at an altitude of approximately 20200 km. The six orbital planes are distributed around the Earth and are nominally inclined at 55 degrees. Energetic particle detectors have been flown on the GPS constellation for more than two decades; by August 2015 there were 21 GPS satellites equipped with energetic particle instrumentation. We will describe the physical and temporal coverage of the GPS constellation from the perspective of its use as a monitor for space weather. We will briefly introduce the energetic particle sensors, review some of the key scientific results enabled by these instruments and show some recent observations from the constellation. We will also present a comparison of the GPS data with measurements from the Van Allen Probes to demonstrate the quality and utility of these data.

Ngwira, Chigomezyo (The Catholic University of America)

Poster Number: M1

Poster - Extreme Space Weather Events and their Implication for Geomagnetically Induced Currents

Authors: Chigomezyo M. Ngwira and Antti Pulkkinen

Abstract: Extreme space weather events challenge our understanding of the solar wind-magnetosphere-ionosphere interaction because the occurrence of such events is infrequent. In the last two decades, three-dimensional (3-D) global magnetohydrodynamics (MHD) models have played a critical role in advancing our understanding of space weather. However, the modeling of extreme space weather events is still a major challenge even for existing global MHD models. In this paper, we use a state-of-the-art physics model to acquire information about possible theoretical space weather extremes. We present simulation results of two extreme events and discuss their implication for geomagnetically induced currents.

Nita, Gelu (New Jersey Institute of Technology)

Poster Number: S8

Poster - Real-Time Detection of Solar Transient Events Using Higher Order Statistical Estimators

Authors: Gelu M. Nita

Abstract: Efficient real-time detection of transient events is a key ingredient of any Space Weather monitoring and short-term forecasting system. Many algorithms employed for this purpose involve triggers based on time-series analysis, which in most of the cases rely on arbitrarily defined thresholds relative to a short-time averaged signal. As an alternative to using such rather empirical methods, this study investigates the feasibility of employing higher order statistical estimators such as the Sample to Model Ratio (Nita et al. 2014, ApJ, 789 (2), 152) and the Generalized Spectral Kurtosis (Nita and Gary 2010, MNRAS, 406(1), L60-L64), for which detection thresholds having user-defined probabilities of false alarm can be analytically defined. X-ray time series provided by GOES satellites and multi-frequency microwave time series provided by the Owens Valley Radio Observatory are used to demonstrate the real-time flare detection performance of such statistical estimators.

Orehek, Ashley (Millersville University)

Poster Number: S31

Poster - Comparison of the GOES X-ray Data with EUVI Brightness of the Source Regions of the CME

Authors: Jessica Fink, Kara Piarulli, Christina Prestine, and Curtis Silverwood

Abstract: The strongest geomagnetic storms are caused when a CME's magnetic field distorts our planetary magnetosphere. The CMEs often are associated with flares. In this presentation we will present a comparison of the integrated brightness of the source region of CME with the X-ray data of solar flares. The X-ray data are derived from the 5-sec data averaged over 5 minutes. In this study we will use the Helioxm model to calculate the initial energy of flux rope structure of CME.

Pathak, Neha (IIT, Delhi)

Poster Number: M9

Poster - Whistler Wave Interaction with Magnetic Islands and Electron Scale Structure Formation

Authors: Neha Pathak, Nitin Yadav and R. P. Sharma

Abstract: The present paper aims to investigate the role of whistler waves in facilitating reconnection and to explore relationship between magnetic reconnection and turbulence. Reconnection is the key driver of many important aspects of space weather both on the solar side and on Earth's side.The key role of the whistler waves in the formation of coherent structures during their propagation in the pre-existing fully developed chain of magnetic islands has been investigated. For this scenario, the dynamical equation of whistler wave has been derived in the presence of magnetic islands and has been solved semi-analytically as well as numerically. Due to pre-existing magnetic islands, background field gets perturbed and localization of the whistler waves and formation of current sheets of electron scale takes place, contributing to the generation of magnetic turbulence. In this way whistler wave propagating through fully developed magnetic islands may provide a physical mechanism underlying the formation of electron scale current sheet.

Perez, Ginger (Earth to Sky Calculus)

Poster Number: G9

Poster - Earth to Sky

Authors: Ginger Perez

Abstract: Earth to sky is a student research group orchestrated by Dr. Tony Phillips that frequently launches weather balloons into the atmospere.

Pettit, Joshua (University of Colorado Boulder)

Poster Number: M13

Poster - Comparison of Two MEPED Electron Data Sets with Proton Contamination Corrections

Authors: Josh Pettit, Cora Randall, Craig Rodger, Ethan Peck, and Xiaoua Fang

Abstract: During periods of high geomagnetic activity, significant electron precipitation into the atmosphere can occur from the radiation belts. These electrons can have large impacts on the chemistry in

the middle and upper atmosphere, particularly odd nitrogen, odd hydrogen, and subsequently ozone. Precipitating electrons have a wide spectrum of energies. Low energy electrons that are responsible for the Aurora Borealis/Australis are highly correlated with geomagnetic indices such as the Kp-index. This makes geomagnetic indices a good proxy for low energy electron precipitation. Medium and higher energy electrons have more variability than low energy electrons and can penetrate deeper into the atmosphere, making them potentially more important for chemistry effects. Unfortunately, the MEPED instruments generally used to quantify higher energy electron precipitation suffer from proton contamination. Several attempts have been made to improve the data through proton removal algorithms. Two data sets that have used such correction algorithms are compared in this investigation. The data sets are described Rodger et al. [2013] and Peck et al. [2015].

Piarulli, Kara (Millersville University)

Poster Number: S31

Poster - Comparison of the GOES X-ray Data with EUVI Brightness of the Source Regions of the CME

Authors: Ashley Orehek, Jessica Fink, Kara Piarulli, Christina Prestine, and Curtis Silverwood

Abstract:
The strongest geomagnetic storms are caused when a CME's magnetic field distorts our planetary magnetosphere. The CMEs often are associated with flares. In this presentation we will present a comparison of the integrated brightness of the source region of CME with the X-ray data of solar flares. The X-ray data are derived from the 5-sec data averaged over 5 minutes. In this study we will use the Helioxm model to calculate the initial energy of flux rope structure of CME.

Pilinski, Marcin (ASTRA LLC.)

Poster Number: I25

Poster - Improved Orbit Determination and Forecasts with an Assimilative Tool for Satellite Drag Specification

Authors: M. Pilinski, G. Crowley, M. Codrescu, T. Fuller-Rowell, T. Matsuo, M. Fedrizzi, S. Solomon, L. Qian, and J. Thayer

Abstract: Much as aircraft are affected by the prevailing winds and weather conditions in which they fly, satellites are affected by the variability in density and motion of the near earth space environment. Drastic changes in the neutral density of the thermosphere, caused by geomagnetic storms or other phenomena, result in perturbations of LEO satellite motions through drag on the satellite surfaces. This can lead to difficulties in locating important satellites, temporarily losing track of satellites, and errors when predicting collisions in space. As the population of satellites in Earth orbit grows, higher space-weather prediction accuracy is required for critical missions, such as accurate catalog maintenance, collision avoidance for manned and unmanned space flight, reentry prediction, satellite lifetime prediction, defining on-board fuel requirements, and satellite attitude dynamics.

We describe ongoing work to build a comprehensive nowcast and forecast system for specifying the neutral atmospheric state related to orbital drag conditions. The system outputs include neutral density, winds, temperature, composition, and the satellite drag derived from these parameters. This modeling tool is based on several state-of-the-art coupled models of the thermosphere-ionosphere as well as several empirical models running in real-time and uses assimilative techniques to produce a thermospheric nowcast. This software will also produce 72 hour predictions of the global thermosphere-ionosphere system using the nowcast as the initial condition and using near real-time and predicted space weather data and indices as the inputs. Features of this technique include:

• Satellite drag specifications with errors lower than current models
• Altitude coverage up to 1000km
• Background state representation using both first principles and empirical models
• Assimilation of satellite drag and other datatypes
• Real time capability
• Ability to produce 72-hour forecasts of the atmospheric state

In this paper, we will review the driving requirements for our model, summarize the model design and assimilative architecture, and present preliminary validation results. Validation results will be presented in the context of satellite orbit errors and compared with several leading atmospheric models. As part of the analysis, we compare the drag observed by a variety of satellites which were not used as part of the assimilation-dataset and whose perigee altitudes span a range from 200 km to 700 km.

Plunkett, Simon (Naval Research Laboratory)

Poster Number: S22

Poster - Capabilities of a Global 3D MHD Model for Monitoring Extremely Fast CMEs

Authors: Chin-Chun Wu, Dennis Socker, Yi-Ming Wang (Naval Research Laboratory), Kan Liou (JHU/APL), Shi-Tsan Wu (University of Alabama), and Murray Dryer (NOAA/SWPC, Emeritus)

Abstract: Since the start of the space era, spacecraft have recorded many extremely fast coronal mass ejections (CMEs) that have resulted in severe geomagnetic storms. Accurate and timely forecasting of the space weather effects of these events is important for protecting expensive space assets and astronauts and avoiding communications interruptions. Here, we will introduce a newly developed global, three-dimensional (3D) magnetohydrodynamic (MHD) model (G3DMHD) of the heliosphere. The model takes the solar magnetic field maps at 2.5 solar radii (Rs) and interpolates the solar wind plasma and field out to 18 Rs using the algorithm of Wang and Sheeley (1990, JGR). The output is used as the inner boundary condition for a 3D MHD model. The G3DMHD model is capable of simulating (i) ambient solar wind conditions in the absence of eruptive events; (ii) extremely fast CME events with propagation speeds faster than 2500 km/s; and (iii) multiple CME events in sequence or simultaneously. We will demonstrate the simulation results (and comparison with in-situ observation) for the fastest CME on record on 23 July 2012 and for the Halloween Epoch in 2003 (multiple CME events during October 28 – November 4, 2003). In addition, we will also present simulation results for a modest single CME event on April 3, 2010.

Pothier, Nicole (Electro Magnetic Applications, Inc.)

Poster Number: M19

Poster - A Spacecraft Charging Application of the AE9 Model Framework

Authors: Nicole Pothier, Bryon Neufeld, Timothy McDonald

Abstract: Spacecraft traveling through the Van Allen Radiation Belts are exposed to energetic particles that may present dangerous charging on a spacecraft's surface and internal dielectrics. Common issues include electrostatic discharging (ESD) that can damage sensitive electronics, surface charging, and internal charging leading to local dielectric breakdown. Space weather adds dynamic variability that is difficult to accurately capture, making charging models difficult. The AE9/AP9 environment model is a new and highly improved framework that more accurately captures the electron, proton and plasma environments throughout the radiation belt region, and includes variability due to space weather at high confidence. We characterize such environments using the AE9 framework for use in quantifying risk of damage to dielectrics due to spacecraft charging. The spacecraft charging evaluation presented includes

peak electron flux at dielectrics, charging rate at dielectrics, maximum embedded charge density within outer mold line, and electric fields within dielectrics. Results for a fictitious sample mission will be presented.

Pozsonyi, Kristen (Millersville University)

Poster Number: S30

Poster - Dependency of Magnetic Field of the CME on Other Physical Quantities on the Sun

Authors: Matthew Green, Melinda Hatt, Megan McAuliffe, Natalie Midzak, and Kristen Pozsonyi

Abstract: An interesting question of scientific and practical importance is what physical quantities are most important in determining the magnetic field of the CME ejecta at 1 AU. For this presentation we will show dependency of magnetic field on other physical quantities on the Sun for an initial flux rope CME. In this study we will use the Helioxm model. In this model of solar CMEs, the flux rope is characterized as a partial torus with a uniform major radius between the two footpoints. Once the initial flux rope geometry is given, the initial magnetic field is calculated by requiring d2Z/dt2 = 0 and d2a/dt2 = 0, balancing the Lorentz force, pressure, and gravity. CME magnetic field (B), temperature (T) , pressure (P), density (n), major radius (R), minor radius (a) will be calculated by using the Helioxm model. The physical measurement on the Sun will be the distance of footpoint separation of the CME.

Prestine, Christina (Millersville University)

Poster Number: S31

Poster - Comparison of the GOES X-ray Data with EUVI of the Source Regions of the CME

Authors: Jessica Fink, Ashley Orehek, Kara Piarulli, Christina Prestine, and Curtis Silverwood

Abstract: The strongest geomagnetic storms are caused when a CME's magnetic field distorts our planetary magnetosphere. The CMEs often are associated with flares. In this presentation we will present a comparison of the integrated brightness of the source region of CME with the X-ray data of solar flares. The X-ray data are derived from the 5-sec data averaged over 5 minutes. In this study we will use the Helioxm model to calculate the initial energy of flux rope structure of CME.

Reinard, Alysha (NOAA/SWPC)

Poster Number: S37

Poster - Transitioning GONG data processing to NOAA SWPC operations

Authors: Thomas Berger, Frank Hill, Andrew Marble, Alysha Reinard

Abstract: The NOAA Space Weather Prediction Center (SWPC) is the nation's official source of space weather watches, warnings, and alerts, providing 24x7 forecasting and support to critical infrastructure operators around the world. Observations of the conditions on the Sun are crucial for determining when and if a warning is needed. The Global Oscillation Network Group (GONG) operated by the National Solar Observatory (NSO) consists of six ground stations, allowing continuous observations of the Sun. Of particular interest for space weather purposes are the H-alpha images and magnetograms. The H-alpha data are used to identify filaments and their eruptions, to assess active region evolution and plage extent, and to help localize flare locations. The magnetograms are used to identify neutral lines, to examine potential

shearing areas and to characterize the magnetic structure of active regions. GONG magnetograms also provide the initial condition for models of solar wind expansion through the heliosphere such as the WSA-Enlil model. Although beyond the scope of current space weather applications, GONG helioseismology products can be used to assess active region emergence on the far side of the Sun and to indicate the flaring potential of a front-side active region. These products are being examined as future tools in flare prediction.

NSO has operated GONG as a science facility since 1995 and has provided processed space weather data products to NOAA via public internet connections for the past several years. In 2014 the White House Office of Management and Budget (OMB) requested that NOAA transition the GONG network to an operational space weather asset in order to ensure the continued flow of critical magnetogram data for solar wind models. NSO will continue to operate and manage the instruments and sites, but the H-alpha images and 10 minute averaged magnetogram data will be sent directly to SWPC for processing and use in space weather modeling. SWPC will make these data available to NSO and the public via the new NOAA Integrated Dissemination Program (IDP) network. We discuss the progress and details of this change.

Sadykov, Viacheslav (New Jersey Institute of Technology)

Poster Number: S9

Poster - Interactive Multi-Instrument Database for Studying Solar Flares

Authors: Viacheslav Sadykov, Rishabh Gupta, Alexander Kosovichev, Gelu Nita, and Vincent Oria

Abstract: Solar flares are the most powerful events in the Heliosphere. High-energy radiation and particles generated during the flares affect the Earth's space environment, technological and biological systems. The radiation from the solar flares cover the whole range of electromagnetic spectrum, from radio- to gamma-rays, opening a broad observational opportunities for the space missions and ground-based observatories. We develop a multi-instrument database of solar flares. Our database integrates flare reports from various sources (e.g. GOES event list, RHESSI event list, SDO/HEK flares) and allows to group (match) the reports physically representing the same flare events based on their time and position on the solar disc. For the interaction with users, we have developed a web-based interface allowing the users to search events based on their physical characteristics (e.g. the flare duration, X-ray class temperature and emission measure etc.), browse them and identify the corresponding data products (GOES and SDO/EVE light curves, SDO images etc.). The database provides an important tool for studying the physics of solar flares and developing physics-based flare forecasts.

Schultz, Jamie (Earth to Sky Calculus)

Poster Number: S13

Poster - Using Microbes as Biological Radiation Sensors

Authors: Jamie Shultz (BUHS), Joey Harvey (BUHS) and Tony Phillips (SpaceWeather.com)

Abstract: For the past year, the students of Earth to Sky Calculus have been flying live yeast to the stratosphere to discover whether this common microbe can act as a biological radiation sensor. We will present survival and mutation rates for three strains of yeast which suggest that the microbe can be used to assay cosmic rays and solar energetic particles (SEPs). The results could be of interest to human travelers in airplanes and spaceships. Yeast and people have a lot in common. About 1/3rd of our DNA is the same. Indeed, the DNA of yeast is so similar to that of humans, yeast can actually live with human genes spliced into their genetic code. The enzymes yeast use to repair radiation damage to DNA are similar to the corresponding enzymes in humans. Understanding how yeast respond to cosmic rays and SEPs could tell us how human cells respond as well.

Seaton, Daniel (CIRES/CU and NOAA NCEI)

Poster Number: G3

Poster - NOAA's GOES-R Mission: Space Weather Instruments & Cal/Val Efforts

Authors: Daniel B. Seaton, A. Boudouridis, J. Darnel, W.F. Denig, B. Kress, P.T.M. Loto'aniu, J. Machol, D. Nietfeld, R. Redmon, J. V. Rodriguez, W. Rowland, and M. Tilton

Abstract: Since their inception in the 1970s, the GOES satellites have monitored the sources of space weather on the Sun and the effects of space weather at Earth. The space weather instruments on GOES-R will provide images of the extreme-ultraviolet solar corona and monitor solar X-ray and UV irradiance, solar energetic particles, magnetospheric energetic particles, galactic cosmic rays, and Earth's magnetic field for some 20 years to come. These measurements are important for providing alerts and warnings to many customers, including satellite operators, the power utilities, and NASA's human and robotic spaceflight programs. Here we review the capabilities of the GOES-R space weather instruments, discuss the calibration and validation effort for space weather products, and present some of the data products that are being developed for the GOES-R era. New and continuing data products that are well calibrated and validated will be an integral part of NOAA space weather operations.

Sergeeva, Maria (Instituto de Geofisica, Unidad Michoacan, Universidad Nacional Autonoma de Mexico)

Poster Number: I6

Poster - Estimates of Ionospheric Conditions over Mexico Based on TEC Behaviour

Authors: Sergeeva M.A.*, Maltseva O.A.**, Gonzalez-Esparza J.-A.**SCiESMEX, Instituto de Geofisica, Unidad Michoacan, Universidad Nacional Autonoma de Mexico, Morelia, Mexico
**Institute of Physics, Southern Federal University, Rostov-on-Don, Russia

Abstract: Development of navigation satellites systems as GPS, GLONASS and others as well as extensive networks of their signal receivers all over the world provided the opportunity of continuous monitoring of Total Electron Content (TEC). The last is one of the key parameters of the terrestrial ionosphere along with the critical frequency of the ionospheric F2 layer, foF2. The possibility of monitoring of Space Weather conditions and their impact on the ionosphere state in Mexican region based on TEC behaviour is discussed in the present study. The work is focused on estimating the state of the ionosphere with use of global TEC maps (JPL, CODE, UPS, ESA, IGS) as well as with use of data obtained from local GPS receivers. It would be of interest to compare TEC results with foF2 local values. However, at the present moment there is no ionosondes in the considered region. That is why, the results of TEC calculation in Mexico were compared to the results for adjacent regions having ionosondes in Eglin and Puerto Rico as well as with the satellite data from CHAMP and DMSP. The Space Weather effects are most prominent during the geomagnetic disturbances. Therefore, cases of different geomagnetic storm events were considered. Example given, two recent disturbances of April 11-14, 2014 (min Dst= - 80 nT) and of March 16-20, 2015 (min Dst = - 223 nT). The TEC response to these disturbances was the same, although the intensities of these disturbances differed twice. It was revealed that TEC behavior was almost at its "classical" nature: positive phase was preceded by negative phase. The ionosphere over Puerto-Rico demonstrated the positive and negative phases in TEC, with the response in Puerto Rico having been stronger than in Mexico, but foF2 in Puerto Rico did not have the positive phase. Another task was to reveal the relationship between the ionosphere response and the Dst-index. For instance, the character of parameters variations in March, 2004 was similar in Puerto-Rico and in Mexico, though the maximum deviations were lower in Mexico. Since in Ruerto-Rico the δfoF2 variations were identical to the δTEC variations, it could be expected that for the Mexico station they would be identical as well. However, even these first comparisons reveal the complicity of interpretation of disturbances without engaging additional

data. The example of the beginning of March, 2004 illustrates that, when the Dst-index was quiet, the behaviour of the foF2 and TEC manifested the prominent negative disturbances, which can not be explained by the relationship between the ionospheric parameters and the F10.7 index of solar activity. This behaviour is confirmed by the plasma frequency values fne, measured at CHAMP and DSMP satellites. This goes to prove that TEC is a good indicator of the state of the ionosphere over Mexico: when F10.7 and Dst indexes do not show any disturbance, TEC can manifest its strong variations of ionospheric conditions as its corelation with fne(sat) exists.

Sharma, Swati (Indian Institue of Technology Delhi)

Poster Number: S27

Poster - Localization of Dispersive Alfvén Wave in Solar Wind Plasmas and Turbulent Spectrum

Authors: Swati Sharma, R.P. Sharma

Abstract: Alfvén cascade. The inertial range of Solar wind turbulence can be described by a magnetohydrodynamic model. But at small scales the MHD description is not valid. At scales of the order of proton inertial length, Alfvén cascade excites kinetic Alfvén wave or fast wave or whistler wave that carries wave energy to smaller scales. On the other hand, parallel propagating right(R) and left(L) circularly polarized Alfvén/ ion cyclotron wave in the framework of Hall MHD are also thought to be essential ingredients of the solar wind turbulence. Recently, He et.al[1] have used the magnetic field data from the STEREO spacecraft to calculate the magnetic helicities in the solar wind turbulence and reported the possible existence of Alfvén -cyclotron waves and their coexistence with the right handed polarized fluctuations. In the present article we intend to study the right circularly polarized dispersive Alfvén wave (DAW) and their role in the solar wind turbulence. The inclusion of the Hall term causes the dispersion of the AW which, in the present study, is considered on account of the finite frequency (frequency comparable to ion gyro frequency) of the pump wave. Filamentation instability has been reported to occur for the case of circularly polarized dispersive Alfvén wave (DAW) propagating parallel to ambient magnetic field. In the present study, the instability arises on account of the transverse density perturbations of the acoustic wave that may couple nonlinearly with the Alfvén wave and the driven ponderomotive force sequentially leads to growth of density perturbations. Numerical simulation involves finite difference method for the time domain and pseudo spectral method for the spatial domain. The power spectrum is investigated which shows a steepening for scales larger than the proton inertial length. These findings have been reported by Alexandrova et al. [2], using the data obtained from the CLUSTER spacecraft.
References :
[1] J. He, E. Marsch, C. Tu, S. Yao and H. Tian, Astrophysical Journal, 731, 85 (2011)
[2] O. Alexandrova, V. Carbone, P. Veltri and L. Sorriso-Valvo, Astrophys. J., 674, 1157 (2008)

Silverwood, Curtis (Millersville University)

Poster Number: G8

Poster - Spaced Out – A Monthly Online Program that Communicates Space Weather Events to the Public

Authors: Curtis Silverwood

Abstract: Space Weather is a topic not fully understood by the general public. Millersville Meteorology has taken strides in utilizing their weather entertainment show MU Weather Watch to develop a program called Spaced Out. Since its inception in spring of 2015, the program has improved the public's understanding of space weather by summarizing major events that occur each month. Spaced Out introduces images from our earth-sun environment through a visually appealing program with quick and well written scripts to inform the general public. One of the program's main goals is to help the public

understand the science behind space weather events. Spaced Out creates a dialogue for space weather events. The importance of communication in the field of space weather helps the public understand the in adverse effects and potential impacts of living with a star. This presentation will showcase episodes produced over the past year.

Tate, Jacob (United State Air Force Academy)

Poster Number: M17

Poster - Comparing Methods of Measuring Space Weather Parameters

Authors: J. Tate, M. McHarg, R. Balthazor, G. Wilson and L. Paxton

Abstract: Two satellite-based instruments, one an electrostatic analyzer (ESA) and one a remote spectrographic imager are compared to test the consistency of derived ion density data between the in situ and remote sensing methods. To compare data, areas of orbital overlap are found with a focus on the relatively few data-rich areas covered by the integrated miniaturized electrostatic analyzer (iMESA). The overlaps depend on the various orbital elements and the areas where the ion density is above the minimum sensitivity threshold of iMESA. Proper fitting of a shifted Maxwellian to the ion count data is also discussed.

Thiemann, Edward (Laboratory for Atmospheric and Space Physics)

Poster Number: S10

Poster - A Lumped Element Thermal Model for Solar Flare Light Curves in the EUV

Authors: Edward M.B Thiemann, Francis G. Eparvier

Abstract: Solar flares are the result of magnetic reconnection in the solar corona which converts magnetic energy into kinetic energy resulting in the rapid heating of solar plasma. As this plasma cools, it emits radiation at different EUV wavelengths when the dropping temperature passes a line's characteristic temperatures of formation. This results in a delay in the emissions from cooler EUV lines relative to hotter EUV lines. Therefore, characterizing how this hot plasma cools is important for understanding how the corresponding geo-effective extreme ultraviolet (EUV) irradiance evolves in time. I present a simple new framework in which to study flare cooling by using a Lumped Element Thermal Model (LETM). LETM is frequently used in science and engineering to simplify a complex multi-dimensional thermal system by reducing it to a 0-D thermal circuit. For example, a structure that conducts heat out of a system is simplified with a resistive element and a structure that allows a system to store heat is simplified with a capacitive element. A major advantage of LETM is that the specific geometry of a system can be ignored, allowing for an intuitive analysis of the major thermal processes. I show that LETM is able to accurately reproduce the temporal evolution of cooler flare emission lines based on hotter emission line evolution. In particular, it can be used to predict the evolution of EUV flare light curves using the NOAA X-Ray Sensor (XRS).

Tilton, Margaret (NOAA/CIRES)

Poster Number: G4

Poster - GOES-R Space Weather Data: Promoting Access and Usability

Authors: W. Rowland, D. Wilkinson, W. Denig, J. Darnel, B. Kress, P. Loto'aniu, J. Machol, R. Redmon, and J. Rodriguez

Abstract: The upcoming Geostationary Operational Environmental Satellite series, GOES-R, will provide critical data for space weather forecasting. These data are used to prevent power and communication outages, to mitigate the damage solar weather causes to satellites, and to reduce astronaut radiation exposure. The space weather instruments aboard GOES-R will deliver an operational dataset of unprecedented breadth. However, NOAA's National Centers for Environmental Information (NCEI)—the organization that provides access to archived GOES data—has faced several challenges in providing these data to customers in usable form. For instance, the GOES-R ground system was contracted to develop higher-level data products for terrestrial data but not space-weather data. Variations in GOES-R data file formats and archive locations have also threatened to create an inconsistent user experience. NCEI is taking several steps to make GOES-R space weather data more accessible and actionable for customers. These include developing high-level data products to meet the requirements of the Space Weather Prediction Center and other customers; storing popular data products on spinning disk rather than tape so as to allow for instantaneous downloads; and aggregating granular files for user convenience. This poster presentation will cover NCEI's efforts to improve the accessibility and usability of GOES-R space weather data.

Tobiska, W. Kent (Space Environment Technologies)

Poster Number: S14

Poster - Results from Measuring Atmospheric Radiation on Aircraft

Authors: W. Kent Tobiska, D. Bouwer, J. Bailey, Leonid Didkovsky, Kevin Judge, Seth Wieman, William Atwell, Brad Gersey, Richard Wilkins, Don Rice, Bob Schunk, Duane Bell, Chris Mertens, Xiaojing Xu, Michael Wiltberger, Scott Wiley, and Ed Teets

Abstract: Space weather's effects upon the near-Earth environment are due to dynamic changes in the energy transfer processes from the Sun's photons, particles, and fields. Of the domains that are affected by space weather, the coupling between the solar and galactic high-energy particles, the magnetosphere, and atmospheric regions can significantly affect humans and our technology as a result of radiation exposure. Space Environment Technologies (SET) has been conducting space weather observations of the atmospheric radiation environment at aviation altitudes that will eventually be transitioned into air traffic management operations. The Automated Radiation Measurements for Aerospace Safety (ARMAS) system and Upper-atmospheric Space and Earth Weather eXperiment (USEWX) both are providing dose rate measurements. Both activities are under the ARMAS goal of providing the "weather" of the radiation environment to improve aircraft crew and passenger safety. Over 120 ARMAS and USEWX flights have successfully demonstrated the operation of a micro dosimeter on commercial aviation altitude aircraft that captures the real-time radiation environment resulting from Galactic Cosmic Rays. The real-time radiation exposure is computed as an dose equivalent rate, .i.e,, Si absorbed dose multiplied by quality factor for reporting dose relevant to radiative-sensitive organs and tissues in units of microsieverts per hour. ARMAS total ionizing dose is captured on the aircraft, downlinked in real-time, processed on the ground into effective dose rates, compared with NASA's Langley Research Center (LaRC) most recent Nowcast of Atmospheric Ionizing Radiation System (NAIRAS) global radiation climatology model runs, and then made available to end users. Dose equivalent rates from flight altitudes up to 55,000 ft. are shown for flights throughout the western hemisphere.

Wilson, Gabriel (United States Air Force Academy)

Poster Number: M18

Poster - Integrated Miniaturized Electro Static Analyzer (iMESA)

Authors: G Wilson, M G McHarg, R Balthazor

Abstract: The Space Physics and Atmospheric Research Center (SPARC) at the US Air Force Academy (USAFA) has flown a number of Electro Static Analyzers (ESA). The purpose of the iMESA instrument is to gather in-situ measurements of the thermal plasma environment. For a ram facing ESA, the measured ion distribution function can be interpreted to give space craft charging, ion temperature and ion density. The most recent ESA is the iMESA instrument on the Space Test Program's Satellite 3 (STPSat-3), which has been operational since late November, 2013. SPARC has recently designed and built an improved iMESA instrument. We will fly four of these new generation iMESA instruments on small satellites sponsored by the Department of Defense Space Test Program. The new sensors include a miniaturized dosimeter providing total dose and dose rate information as well as improved ESA geometries when compared to the STPSat-3 iMESA. I will review on-orbit results from the STPSat-3 iMESA, and discuss the design and engineering upgrades made to the new iMESA instruments.

Woodroffe, Jesse (Los Alamos National Laboratory)

Poster Number: M3

Poster - The Latitidinal Variation of Geoelectromagnetic Disturbances During Large Geomagnetic Storms

Authors: Jesse R. Woodroffe, Steven K. Morley, Vania K. Jordanova, Michael G. Henderson, Misa M. Cowee, Michael K. Rivera, and Jesper W. Gjerloev

Abstract: Using a comprehensive 30-year data set, have obtained estimates of 100- and 200-year GMD levels during large (Dst < -100 nT) storms as a function of magnetic latitude and Dst. We have found that, over a sufficiently large period of time, large peak geoelectromagnetic disturbances (GMDs) are equally likely to occur during any level of storm strength with Dst being primarily responsible for determining the size and latitudinal distribution of "typical" GMD amplitudes. We have also used this data set to develop a relatively simple analytical model of the latitudinal distribution of GMD amplitudes that incorporates Dst-dependent parameters and providing a better description than existing parameterizations (while being only mildly more complex).

Yadav, Nitin (Indian Institue of Technology Delhi)

Poster Number: I26

Poster - Turbulence and Particle Acceleration by Inertial Alfvén Waves in Auroral Ionosphere

Authors: Nitin Yadav , R. P. Sharma and R. Uma

Abstract: Using pseudospectral method based simulation and fluid model of plasma; we investigate the nonlinear interaction of three dimensionally propagating inertial Alfven wave and parallel propagating ion acoustic wave. The nonlinear evolution of inertial Alfven wave in the presence of ion acoustic wave undergoes filamentation instability and results in magnetic field intensity localization. These localized intense magnetic filaments may play a very crucial role in charged particle acceleration. The presented model is also intended to explore about the observed magnetic field turbulence in auroral ionosphere.

Turbulence provides unstable conditions and the amplitude of low frequency inertial Alfven waves keeps growing and eventually cascades to smaller wavenumber modes resulting in turbulent spectrum. Thus the presented coupling also suggests a mechanism of energy transfer from lager length-scales to smaller length-scales. To get the physical insight of this proposed interaction, a simplified semi-analytical model based on paraxial approximation is also developed. The relevance of present investigation with recent spacecraft observations is also pointed out.

Yarborough, Amelia (Earth to Sky Calculus)

Poster Number: S11

Poster - Rads on a Plane

Authors: Amelia Yarborough (Cerro Coso), Joey Harvey (BUHS), Aaron Lamb (Cal-Maritime), Carson Reid (BUHS) and Tony Phillips (SpaceWeather.com)

Abstract: A longstanding topic of discussion at NOAA's Space Weather Workshop is radiation at aviation altitudes—both cosmic rays and solar energetic particles. Lately, the background level of cosmic rays has been increasing as solar activity ebbs. Forecasters believe cosmic rays could reach Space Age highs in the years ahead as the solar cycle plunges toward another deep solar minimum. How does this affect air travelers? We have just completed a one-year survey of aviation radiation over the continental United States. Our study includes dozens of commercial airplane flights covering a wide range of magnetic latitude and solar conditions. The results provide a baseline for evaluating changes to aviation radiation in response to declining levels of solar activity.

Young, Shawn (AFRL/RVBXR)

Poster Number: S16

Poster - Comparison of Solar Energetic Particle Flux Mapping Models

Authors: C. Roth, W. R. Johnston, S. Huston, J. P. McCollough, C. Brodowski

Abstract: Current energetic proton hazard specifications focus on the LEO and GEO environments and while an "All Clear" for these regions indicates an "All Clear" throughout geospace, elevated flux levels at GEO and in regions of LEO do not mean that the flux is elevated for every orbit. In an effort to provide actionable information to satellite operators with satellites operating outside LEO and GEO we are developing methods to map observed fluxes to other regions of geospace. Here we compare the specifications along the Van Allen Probes orbit of multiple mapping models to observations made by the REPT instrument on-board the Probes.

Yudin, Valery (University of Colorado)

Poster Number: I21

Poster - Drivers of Space Weather Events from Below: Tides and Wave Dynamics of Whole Atmosphere Models and Data Analysis

Authors: Yudin V.A., L.P. Goncharenko, R.A. Akmaev, T. J. Fuller-Rowell, T. Matsuo, N. Maruyama, D.A. Ortland, A. Maute, H-L Liu, A.K. Smith, S. Solomon, and Q. Wu

Abstract: At present several research groups using the middle and whole atmosphere models attempted to perform the coupled ionosphere-thermosphere predictions to interpret the "unexpected" day-to-day variable anomalies in the electron content, ions and plasma drifts observed during the recent stratospheric warming events. The recent whole atmosphere inter-comparison case studies also displayed striking differences in simulations of prevailing flows, planetary waves and tides when even the lower atmosphere domain of those models were constrained by similar meteorological analyses. We will present the possible reasons of such differences between the data-constrained whole atmosphere simulations when the 6-hour separated analyses are used and discuss the potential model-data and model-model differences above the stratopause. The possible shortcomings of the whole atmosphere simulations associated with model physics, dynamical cores and resolutions will be discussed. Several success stories on the middle and whole atmosphere simulations coupled with the ionosphere models will be highlighted, and future perspectives for links of the

space and terrestrial weather predictions constrained by the current and scheduled ionosphere-thermosphere-mesosphere satellite missions will be presented.

Zhang, Yongliang (Johns Hopkins University, Applied Physics Laboratory)

Poster Number: M8

Poster - Polar Rain Energy Dispersion and Magnetotail Reconnection Location

Authors: Yongliang Zhang, Simon Wing, Larry J. Paxton, and Hyosub Kil

Abstract: The energy dispersion in the polar rain electrons near the poleward edge of nightside auroral oval carries the information of magnetic field line length between the magnetotail reconnection location (X-line) and the polar ionosphere. Methods have been developed to estimate the X-line location using observed polar rain spectra. Recent particle tracing simulations using APLOPM model indicate that the current method underestimates the path length by an average of 40%. This is due to different paths taken by polar rain electrons with different energies. A parameter (energy adjustment) is introduced in the improved algorithm to minimize the errors caused by the different paths. The improved algorithm has been validated using the APLOPM simulation results. By applying the new algorithm to two real events measured by DMSP satellites, we found the polar rain electron path lengths of 67 and 114 RE, (X-lines estimated at X = -54 and -91 RE) under IMF Bz 1 and -11 nT conditions, respectively. This is consistent with the stretched magnetotail configuration under a strongly southward IMF.

Fedrizzi, Mariangel (Universtiy of Colorado/CIRES and NOSS/SWPC)

Poster Number: I22

Poster - On the Validation of the Ionosphere-Plasmasphere-Electrodynamics (IPE) Model

Authors: M. Fedrizzi, N. Maruyama, T. Fuller-Rowell, P. Richards, T-W. Fang, M. Codrescu

Abstract: The recently developed Ionosphere-Plasmasphere-Electrodynamics (IPE) model provides time dependent, global, three dimensional plasma densities for nine ion species, electron and ion temperatures, parallel and perpendicular velocities of ionosphere and plasmasphere. The geomagnetic storm high latitude drivers rely on the empirical models of the time-dependent Weimer magnetospheric convection and TIROS/NOAA auroral precipitation patterns. The neutral atmosphere composition and winds come from either empirical the MSIS and HWM models, or the Coupled model of the Thermosphere, Ionosphere, Plasmasphere and electrodynamics (CTIPe). In this study, the March 17th, 2013 geomagnetic storm event is simulated by the IPE model. Results from this simulation are used to evaluate the relative importance between electric field, neutral wind and neutral composition in reproducing the Storm-enhanced densities (SEDs). Furthermore, observations from ground and space are used to validate the model results.

Fedrizzi, Mariangel (University of Colorado/CIRES and NOAA/SWPC))

Poster Number: I23

Poster - Physical Modeling of Neutral Density for Satellite Drag

Authors: M. Fedrizzi, T. Fuller-Rowell, M. Codrescu, V. Yudin, E. Doornbos, S. Bruinsma, and E. Sutton

Abstract: The largest uncertainty in determining orbits for satellites operating in low Earth orbit is the atmospheric drag. Drag is the most difficult force to model mainly because of the complexity of neutral atmosphere variations driven by solar radiative power, magnetospheric energy inputs, and the propagation

from below of lower atmosphere waves. Neutral density models used routinely in orbit determination applications are mainly empirical. These models are based on a database of historical observations, to which parametric equations have been fitted, representing the known thermospheric variations with local time, latitude, season, solar and geomagnetic activity. Changes in solar and geomagnetic activity are represented by their proxies F10.7 or extreme (EUV) and far (FUV) ultraviolet solar indices, and geomagnetic indices Ap, Kp, or Dst with model specific combination of lag-times, interpolation and smoothing applied. Upper atmospheric neutral density estimates with accuracies below the 15% barrier of traditional empirical models have been recently obtained through correction parameters determined from assimilated daily drag data. However, these data assimilation systems have been limited by the empirical model description of the upper atmospheric nonlinear dynamics and the scalar index description of the varied forcing. Empirical models cannot completely describe the complex chain of events that connect the heating and the complex atmospheric response, especially during long duration geomagnetic storms. Furthermore, the use of scalar geomagnetic indices to describe the greatly varying heating distributions is insufficient. Small inconsistencies in the heating location and magnitude can lead to vastly different conclusions since the upper atmosphere is strongly externally driven. Physical models are valuable tools in the task to understand and forecast complex non-linear systems. They have reached a level of maturity such that many of the physical processes controlling the neutral and ionized upper atmosphere's structure are included. In this work, results from a self-consistent physics-based coupled model of the thermosphere, ionosphere, plasmasphere and electrodynamics (CTIPe) are used along with Challenging Minisa-tellite Payload (CHAMP), Gravity Recovery And Climate Experiment (GRACE) and Gravity field and steady-state Ocean Circulation Explorer (GOCE) neutral density observations to show how the model captures the daily space weather and the year-long climatology not only in a qualitative but in a quantitative way. The assessment of CTIPe model capabilities in simulating the upper atmosphere's climatology, day-to-day-variability, and weather, as well as the identification of areas that need to be improved in the model, are a necessary step towards a deeper understanding of the internal and external physical processes driving neutral density variability, which can help improving the specification and prediction of drag forces on satellites.

Thompson, Barbara (NASA GSFC)

Poster Number: S33

Poster - CCMC and SWRC Space weather Forecasting Services for NASA Robotic Mission Operators

Authors: Antti Pulkkinen, Maria Kuznetsova, Yihua Zheng, Barbara J. Thompson, and the CCMC/SWRC Team

Abstract: Community Coordinated Modeling Center (CCMC) located at NASA GSFC has been one of the core US space weather activities for more than a decade. While the primary CCMC goals are to facilitate community space weather research and usage of state-of-the-art models as well as research to operations (and operations to research) activities, the more recent Space Weather Research Center (SWRC) activity linked to CCMC is dedicated for providing space weather services for NASA's robotic mission operators. SWRC together with JSC Space Radiation Analysis Group are NASA's space weather services providers for robotic and human exploration, respectively.

In this paper we will review the latest CCMC and SWRC forecasting services that allow addressing NASA's spacecraft operators' needs. The new forecasting tools include space weather databases such as Scoreboard, DONKI (Space Weather Database Of Notifications, Knowledge, Information) and novel forecasting capacity such as ensemble CME and flare prediction systems that have been implemented at CCMC. We will also discuss our work on developing future forecasting capacity that includes higher level of tailoring of services for individual NASA missions.

Thompson, Barbara (NASA GSFC)

Poster Number: S32

Poster - Deriving Kinematic Properties of Asymmetric CMEs

Authors: Barbara J. Thompson, Ryun Young Kwon, Christina D. Kay, Paulett Liewer, and Ian G. Richardson

Abstract: An improved understanding of the kinematic properties of CMEs and CME-associated phenomena has several impacts: 1) a less ambiguous method of mapping propagating structures into their inner coronal manifestations, 2) a clearer view of the relationship between the "main" CME and CME-associated brightenings, and 3) an improved connection to the heliospheric sources of shocks, Type II bursts, and SEPs. However, there are several challenges in characterizing the kinematic properties of CMEs. Most rapidly-evolving eruptions are accompanied by changes in the surrounding corona. The larger the impact on the surrounding corona, the more difficult it is to separate the "main" CME from the CME-associated brightenings. Complicating the issue is the range of observed propagation properties: super-radial expansion, asymmetric expansion, non-radial propagation, and alterations in the direction of propagation. These properties can be a function of both the internal magnetic structure of the CME and the structure of the corona through which the CME is propagating. While the relative contribution of internal/external factors can be difficult to assess, it is of fundamental importance because it not only reveals the nature of CMEs but also CME-associated phenomena such as EUV waves, Type II radio bursts, shocks, and SEPs. Most halo CMEs are a combination of both the "main" CME and the CME-associated brightenings, but new diagnostic methods such as time convolution mapping can help separate the CME mass from the impacted corona. Additionally, while most CME-fitting methods assume symmetry about the radial direction, adaptive methods allow us to study highly asymmetric CME expansion and take into account the fundamentally different natures of the CME and the shocked/deflected corona. Several methods will be examined, and each has their respective strengths and weaknesses; for example, the difference between the direction of a highly non-radial CME and a sun-centered model's orientation can exceed 45 degrees, which impacts our ability to correctly assess changes in propagation direction and the causes of these changes. We examine the assumptions inherent in these methods and how they may produce artifacts that can influence conclusions about CME kinematics.

Wu, Qian (NCAR)

Poster Number: I24

Poster - What is Missing in the High Latitude Thermospheric Wind Simulations?

Authors: Qian Wu, W. Ward, and G. Jee

Abstract: Polar cap is the source region of geomagnetic activities, which have a great impact on the ionospheric response to the substorms. For that reason, the high latitude thermospheric winds are of great importance to the space weather forecast. Since forecast requires model simulation, it is imperative to have an ionosphere and thermosphere model that can capture the underlying physics of the thermospheric dynamics inside the polar cap. In this report, we examine the NCAR Thermosphere Ionosphere Electrodynamics General Circulation Model (TIEGCM) simulation of the polar cap thermospheric winds using Weimer ion convection model. We also compare the simulation with observations from three polar cap stations using Fabry-Perot interferometer thermospheric wind data In general the simulation performs very well. However, there are still some discrepancies between the simulation and observations. The TIEGCM tends to overestimate the thermospheric winds, we believe that the model probably is missing sufficient diffused aurora, which would produce larger ion drag to reduce the wind speed.

Wu, Qian (NCAR)

Poster Number: I10

Poster - TIEGCM Simulation of Equatorial Rayleigh-Taylor Instability

Authors: Qian Wu

Abstract: Understanding the R-T instability will lead to more insight about the occurrence of the plasma bubble. In recent years, the NCAR-TIEGCM is used to calculate the R-T growth rate. The NCAR-TIEGCM can be used to evaluate R-T growth rate dependence on lower atmosphere input and solar effect because it has inputs from the mesosphere at the lower boundary and solar UV (F10.7 as a proxy) inputs to the ionosphere and high latitude convection. TIEGCM simulation of the R-T growth rate under solar minimum and maximum years to study the solar effect on the R-T growth rate are presented. Field line integrated R-T growth rate seasonal and longitudinal variations will be calculated and to be compared with occurrence of the plasma bubbles. This kind of effort can lay the foundation for future development of forecast capability of plasma bubble. Because plasma bubbles have a great impact on the navigation and communication systems, it is important to understand the R-T growth rate in the equatorial region.