Space Weather Workshop

Millennium Hotel – Boulder, CO
April 13 - 17, 2015

Poster Abstracts

Atulkar, Roshni (National Institute of Technical Teachers' Training and Research, India)

Poster Number: I2

Poster - Impact of Geomagnetic disturbances on Ionospheric critical frequency (foF2)

Authors: Roshni Atulkar , Shivangi Bhardwaj, Prakash Khatarkar, Purushottam Bhawre, P. K. Purohit

Abstract: A geomagnetic storm is a major disturbance of Earth's magnetosphere that occurs when there is a very efficient exchange of energy from the solar wind into the space environment surrounding Earth. During solar and geomagnetic activities, critical frequency of F2 layer (foF2) varies in a great extent. In this Study, our main aim is to examine the effect of solar and geomagnetic activities on the critical frequency (foF2) during January 2014 to April 2014 respectively. One magnetic intense storm occurred on 19 February with (Dst -112) and other moderate storm occurred on 12 April 2014 with (Dst -80). In our study, we have analyzed these effects on critical frequency of F2 layer for ionospheric monitoring. We have used ionospheric data at Low, mid and high latitude station. The absorption and ionization of the ionospheric medium depends on solar activity. The value of foF2 increased from their normal value at all the three latitudes. This is due to geomagnetic storms that occurred around the same time. A very interesting feature that can be seen in the figures is that the increase of foF2 at Low latitude is much more intense as compare to high and mid latitude. Comparison among all the latitudes shows that the values of foF2 at high latitude are quite less as compared to low and mid-latitude. We have found that the effect of solar and geomagnetic storm disturbances is strongest at the low latitude and weakest at the high latitude during the geomagnetic storm time.

Azeem, Irfan (ASTRA)

Poster Number: I9

Poster - Ground-Based GPS TEC Measurements of Traveling Ionospheric Disturbances Produced by Tropospheric Weather and Seismic Phenomena

Authors: Irfan Azeem, Geoff Crowley, Tim Duly, and Adam Reynolds

Abstract: Traveling Ionospheric Disturbances (TIDs) are gravity wave (GW) signatures in the ionosphere. These GWs are generated by numerous lower atmospheric processes, such as storms, orography, and jet stream dynamics, as well as by auroral processes in the ionosphere. At ionospheric heights, the GW-induced motion of the neutral gas sets the ionosphere into motion; displacing the isoionic contours and establishing a travelling ionospheric disturbance (TID). Despite the frequent occurrence and long-lived nature of mid-latitude TIDs, no studies have tracked them from their source regions in the lower atmosphere, through the middle atmosphere, and ultimately to the upper atmosphere regions where they deposit their energy. In this paper we use an array of GPS receivers throughout the continental United States to present recent observations of TIDs in Total Electron Content (TEC) from several events. We will describe the propagation characteristics of the TID observed over the continental Unites States shortly after the 11 March 2011 Tohoku Earthquake. We will also present observations of a concentric GW event in ionospheric TEC over the South-Central United States associated with a convective source region in the troposphere over North Texas on April 4, 2014. The network of GPS receivers used in this study provides a 2D spatial maps of TEC perturbations, which are used to calculate TID parameters, including horizontal wavelength, speed, and period. Examples of GPS receiver data containing ionospheric space weather

signatures generated by Pacific Rim earthquakes will be also presented. The work presented in this paper will enhance our understanding of upward coupling caused by all gravity wave sources in the lower atmosphere (not just tsunamis) and how this coupling can generate ionospheric perturbations that affect navigation, communications and surveillance systems.

Azeem, Irfan (ASTRA)

Poster Number: I10

Poster - Recent Results of Phase Scintillation and TEC from a Latitude Chain of GPS Receivers in Alaska

Authors: Irfan Azeem, Geoff Crowley, Adam Reynolds, and Patrick McBride

Abstract: In this paper, we present recent results from a latitudinally extended array of GPS receivers measuring ionospheric scintillation in Alaska. The receivers were deployed at sites in Kaktovik (70.1° N, 143.6° W), Toolik (68.6° N, 149.6° W), Fort Yukon (66.6° N, 145.2° W), Poker Flat (65.1° N, 147.4° W), Eagle (64.8° N, 141.2° W), and Gakona (62.4° N, 145.2° W). The phase scintillation database analyzed covers November 9, 2012 to Jan 31, 2015. We present comparisons of phase scintillation measurements from the GPS array and auroral emissions from an All-Sky Imager (ASI) and a Meridian Spectrograph at Poker Flat to characterize the correspondence between scintillation and auroral features. Results from November 13, 2012 and November 20, 2012 show a strong correlation with 630.0 nm auroral emissions indicating F-region irregularities may be a source of scintillations. Utilizing the ASI data, we also demonstrate the localized nature of the night-time phase scintillation. In this paper we demonstrate our ability to map scintillation in real-time, and to provide space weather services to GPS users. We present results from a statistical analysis of multi-year phase scintillation data from the chain and show that the severity of phase scintillation decreases with decreasing latitude, and the largest phase scintillations occur near magnetic midnight. We also present the scintillation frequency distribution statistics from the GPS chain in Alaska to highlight the differences in temporal variations of low, moderate, and severe scintillation events. The results show that weak scintillation events show a diurnal variation with a well-defined minimum near 0000 MLT while moderate and strong scintillations both have Gaussian distributions with peaks near the midnight sector.

Berdermann, Jens (German Aerospace Center)

Poster Number: I1

Poster - Provision of value added services within the ESPAS system

Authors: http://www.espas-fp7.eu/trac/wiki/PublicPages/ESPASConsortium

Abstract: A Near-Earth Space Data Infrastructure for e-Science (ESPAS) is under development in the frame of the European Commission FP7 program with the aim to provide observation data from Earth's atmosphere up to the inner magnetosphere for the scientific community and interested users. The core functionality of ESPAS is to ensure an easy and fast access to a broad range of data from a multitude of different observation instruments by use of an advanced search ontology. Although the access to more than 40 data repositories containing heterogeneous data from ground and space, in situ and remote sensed observations is a unique characteristic in itself, some efforts are put in the investigation and development of value added services (VAS) to provide the user with higher order information and special services. The VAS can be derived from the underlying metadata or via access to the real observation data. In the following we will present an existing VAS demonstrator focusing on its benefit for the user.

Biesecker, Douglas (NOAA)

Poster Number: S17

Poster - How DSCOVR Will Perform During Extreme Space Weather

Authors: Ruth Skoug, Michael Stevens, Ruth Skoug, Justin Kasper, Adam Szabo

Abstract: The NOAA/DSCOVR satellite launched February 11, 2015 and will replace the NASA/ACE satellite as the L1 Sentinel in mid-Summer, 2015. Having relied on ACE to provide critical warnings of geomagnetic storms since 1998, it is important for the space weather community to understand how DSCOVR will perform relative to ACE in real-time operations. The WIND/SWE instrument is sufficiently similar to the DSCOVR Faraday Cup that it can be used as a proxy for DSCOVR, with some caveats. We compare the ACE/SWEPAM and WIND/SWE observations for all geomagnetic storm events meeting the criteria of severe or extreme. We also examine time periods where ACE data were compromised by solar energetic particles. We find that DSCOVR will provide a more robust data stream than was provided by ACE during solar cycle 23. We also demonstrate that lead time for geomagnetic storm notifications to customers far exceeds the L1 to Earth delay time.

Bisi, Mario (RAL Space, Science & Technology Facilities Council)

Poster Number: S21

Poster - Ongoing Faraday Rotation (FR) and Interplanetary Scintillation (IPS) Case-Study Analyses Using the LOw Frequency AReay (LOFAR)

Authors: M.M. Bisi (1), R.A. Fallows (2), C. Sobey (2), T. Eftekhari (2,3), E.A. Jensen (4), B.V. Jackson (5), H.-S. Yu (5), D.J. Gershman (6,7), J.M. Raines (7) and Dusan Odstrcil (6,8).

(1) RAL Space, Science and Technology Facilities Council, Rutherford Appleton Laboratory
(2) ASTRON, the Netherlands Institute for Radio Astronomy
(3) University of New Mexico
(4) Planetary Science Institute
(5) Center for Astrophysics and Space Science, University of California, San Diego
(6) NASA Goddard Space Flight Center
(7) Department of Atmospheric, Oceanic and Space Sciences, University of Michigan Ann Arbor
(8) School of Physics, Astronomy, and Computational Sciences, George Mason University

Abstract: Here we provide the latest update on progress using the LOw Frequency ARray (LOFAR) next-generation radio telescope for space-weather related activities. These include observations of interplanetary scintillation (IPS) and the first tests of observing heliospheric Faraday rotation (FR) in the inner heliosphere. IPS has been used for over half a century for the study of interplanetary solar-wind structures and transients throughout the inner heliosphere. Much progress has been made in recent years for using IPS in space weather science and forecasting. We use FR, typically an astrophysical technique that uses pulsars and extragalactic radio sources to study the galactic magnetic field, as a pathfinder for possible space-weather and heliospheric studies of the inner heliosphere. The determination of heliospheric FR, combined with observations of IPS, can provide essential information on the Sun's extended magnetic-field structure out into the inner heliosphere, especially when also combined with other forms of remote-sensing/heliospheric imaging data, and *in-situ* measurements. We present recent observations of IPS using LOFAR and a preliminary analysis of heliospheric FR observations, and investigate pathways for determining B_z from, and an overview of the potential of, such observations. LOFAR is an interferometric phased-array radio telescope that can be used to observe between 10 MHz (depending on ionospheric conditions) and 240 MHz, and consists of many relatively-low-cost antennas. These antennas are organized into 'stations' located in an area of ~100km diameter in The Netherlands. Additional "international" stations are spread across central and Western Europe (Germany, France, Sweden, and the UK) with several more in the planning stages (Poland, Germany, Ireland, and possibly the UK).

Cade, Trey (Baylor University)

Poster Number: G4

Poster - The Origin of "Space Weather"

Authors: Trey Cade, Christina Chan-Park

Abstract: Although “Space Weather” is a fairly recent term, there is a rich history of similar terms such as “Solar Meteorology,”, “Magnetic Weather,” and “Cosmic Meteorology.” We will explore "space weather" terminology that can be traced back to the mid-19th century and then present the earliest known usages of the exact term “space weather” from the 1950’s.

Cash, Michele (University of Colorado)

Poster Number: S18

Poster - Development of an Operational L1 to Earth Delay Time Product

Authors: M.D. Cash, D.A. Biesecker, A.A. Reinard, C.A. deKoning, and D.R. Weimer

Abstract: We present a report on the development of an operational space weather tool for use with the upcoming DSCOVR spacecraft to forecast the delay time between L1 and Earth using the Weimer and King [2008] tilted phase front technique. The present technique for propagating the solar wind from L1 to Earth currently used by NOAA Space Weather Prediction Center (SWPC) assumes that all observed solar wind discontinuities, such as interplanetary shocks and interplanetary coronal mass ejection (ICME) boundaries, are in a flat plane perpendicular to the Sun-Earth line traveling in the GSE X direction at the solar wind velocity. In reality, these phase plane fronts can have significantly tilted orientations, and by relying on a ballistic propagation method, delay time errors of ±15 minutes are common. The L1 to Earth delay time product presented here is designed to more accurately predict the delay time from L1 to Earth by taking into account these tilted phase plane fronts. This algorithm is based on the work of Weimer and King [2008] and is currently running in real-time in test mode at SWPC as part of the SWPC Testbed. We discuss the current algorithm performance, observed improvements in space weather forecasting, as well as the limitations of this model. Both real-time and historic events will be presented.

Chen, Weihan (National Cheng Kung University)

Poster Number: I15

Poster - Global ionosphere monitoring and forecast using data assimilation of FORMOSAT-3/COSMIC and GPS data

Authors: Chia-Hung Chen, I-Te Lee, Tomoko Matsuo, Chien–Hung Lin, Chih-Ting Hsu, Jann-Yenq Liu, and Arthur D. Richmond

Abstract: Ionospheric space weather is barely difficult to be monitored and/or forecasted by particular observation or model, but could be resulted with ionospheric assimilation model. This study assimilate the ionospheric electron density profile which retrieved from FORMOSAT-3/COSMIC (F3/C) GPS Occultation experiment 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). The EnKF assimilation system employed in this study is Data assimilation Research Testbed which developed by National Center for Atmospheric Research . The root-mean-square error (RMSE) is used to evaluate the assimilate analysis accuracy and the forecasting abilities of Observing System Simulation Experiments (OSSEs). The result shows that RMSE of F3/C and GPS observations decreased to around 50% and 28% comparing with the control run during the

assimilation period, respectively. In forecasting period, the RMSE of F3/C and GPS observations back to around 90% and 70%. This study also assimilate the real F3/C and GPS observations during storm period to investigate the global TEC map comparing with Global Ionosphere Maps(GIM) form Center for Orbit Determination in Europe (CODE). More detail result will be discussed in this presentation.

Comberiate, Joseph (JHU/Applied Physics Laboratory)

Poster Number: I5

Poster - Three-Dimensional Ionosphere and Scintillation Data Products with DMSP/SSUSI

Authors: Joseph Comberiate, Robert Schaefer, Giuseppe Romeo, Larry Paxton Johns Hopkins University Applied Physics Laboratory Space Exploration Sector

Abstract: Improving our ability to predict and mitigate the impacts of ionospheric scintillation on satellite communication and navigation systems requires new observations of the global morphology and climatology of scintillation-causing irregularities. The SSUSI (Special Sensor Ultraviolet Spectrographic Imager) instrument on-board the DMSP F16-F19 satellites have extensive global observations of the ionosphere at 6:30 PM and 8 PM local time for the recent solar maximum. When we account for effects like mutual neutralization (O+ + O- -> 2 O + 135.6nm photon) and conjugate photoelectrons in near terminator orbits, we get a fairly accurate representation of nightside ionospheric electron densities from 135.6 nm images. SSUSI also orbits the Earth at a low enough altitude to get multiple lines of sight through the ionosphere, enabling a 3D tomographic reconstruction of electron density. We also have developed a technique that routinely detects and characterizes equatorial plasma bubbles in SSUSI data. Detecting these bubbles also identifies regions where radio scintillation is likely to occur. We will describe these data products and also discuss how SSUSI data can be combined with other data to make a more complete map of scintillation regions.

Corona-Romero, Pedro (SCiESMEX, Universidad Nacional Autonoma de Mexico)

Poster Number: S13

Poster - SCiESMEX, fast forecasting of space weather through modeling energetic solar storms

Authors: J.A. Gonzalez-Esparza; V. de-la-Luz; J.C. Mejia-Ambriz; L.X. Gonzaelz

Abstract: We present a methodology to estimate the arrival and in-situ transits of energetic solar storms. Our methodology assemble a number of analytic models that calculate the trajectories and properties of both, coronal mass ejections (CMEs) and associated shock waves. In order to calculate the evolution of CMEs and shocks, our methodology requires data from coronagraph images, X-ray flux registers and in-situ measurements of solar wind. Departing from these data collection, our methodology estimates: (1) the trajectories of CMEs and shocks from the Sun to Earth, as well (2) their properties during the in-situ transit through out Earth's neighborhood. Combining the results of our methodology, we are able to forecast: (1) CME and shocks trajectories, (2) CME and shock arrival speeds and transit times, as well (3) in-situ transits. This methodology has two free parameters, related with the initial mass and size of CMEs, respectively.

Dandenault, Patrick (JHU/Applied Physics Laboratory)

Poster Number: I6

Poster - Remote Sensing of the Ionosphere: Operational Space Weather from DMSP/SSUSI

Authors: Patrick Dandenault, Larry J. Paxton, Robert K. Schaefer, Gary Bust, Ethan Miller, Yongliang Zhang, Bernard S. Ogozalek, Brian Wolven, Giuseppe Romeo, Steve Osterman, Syau-Yun Hsieh, John Hicks

Abstract: Space is the figurative and literal high ground. Commanding this high ground requires the ability to execute the mission efficiently, reliably and cost-effectively. APL has developed a unique capability to provide space weather information. The Defense Meteorological Satellite Program (DMSP) satellite carries, along with other sensors, a hyperspectral, cross-tracking imaging spectrograph known as the Special Sensor Ultraviolet Spectrographic Imager (SSUSI). SSUSI has been part of the DMSP program since 1990. The first SSUSI was launched in 2003 and the most recent of the four, so far, was launched in April 2014. In this paper we present representative SSUSI data products and describe their utility. SSUSI provides all-weather, day and night coverage of the polar regions' space weather – particularly important as the tempo of Arctic operations increases. The constellation of SSUSI instruments provides coverage of key problem areas for models that provide a predictive capability – the dawn and dusk ionosphere and high latitude energy inputs. The challenge is to use these data in global assimilative models such as GAIM while still preserving the detailed understanding of the fine scale structure that affects the propagation of radio frequency transmissions. We describe our approach to addressing this need by introducing the use of an additional assimilative layer that adds value to the models currently used.

Darnel, Jonathan (CIRES)

Poster Number: S19

Poster - Demonstration of GOES-R Solar Imagery Products

Authors: Darnel, Jonathan., Denig, William., Hill, Steven

Abstract: The GOES-R Solar UltraViolet Imager (SUVI) is a normal incidence telescope designed to image the Sun in six narrowband Extreme Ultraviolet (EUV) channels. To address specific needs of the National Weather Service's Space Weather Prediction Center, GOES-R Risk Reduction funded the development of additional Level 2+ products in addition to the Level 1b product. These Level 2+ products have been designed to aid the Space Weather Prediction Center in their forecasting activities in order to predict periods of adverse space environment conditions due to solar activity or solar flare events.

De la Luz, Victor (UNAM Instituto de Geofisica)

Poster Number: G5

Poster - The Infrastructure of the Mexican Space Weather Service (SCiESMEX)

Authors: Americo Gonzalez, Pedro Corona, Julio Mejia, and Xavier Gonzalez

Abstract: We introduce our technological and human infrastructure evolved in the new Mexican Space Weather Service (SCiESMEX), located in the Geophysics Institute seat Morelia of the National University of Mexico (UNAM). We started operation the October 1st, 2014 becoming the first space weather service worldwide in Spanish language. The space weather instrumentation associated to SCiESMEX includes: the Mexican Array Telescope (MEXART), a Callisto radio telescope, a set of Schumann antennas, magnetometers, cosmic ray observatory, h-alpha telescope, and the GPS mexican network (Tlaloc). The laboratory of High Performance Computing started with a data center with a Storage Server and a SuperBlade computer. There are 4 scientist working full time in the project, 8 associated scientist, and 3 technicians.

Den, Mitsue (National Institute of Information and Communications Technology)

Poster Number: S11

Poster - REPPU (REProduce Plasma Universe) code for space weather simulators developed at NICT: 3-dimensional MHD simulation codes for the solar surface and global solar wind structure

Authors: Takashi Tanaka,Yuki Kubo, Shinichi Watari

Abstract: Three-dimensional MHD simulation code, REPPU (REProduce Plasma Universe) code, is developed as space weather simulators at NICT. We utilized this code for the solar surface and global solar wind structure. The distinguishing feature of this code is the 3-D grid system. There is no polar singularity though it is able to fit the spherical structure. This grid system makes it possible to set fine grids on the inner boundary which corresponds to 1 solar radius, the solar surface. Some complicated magnetic structures on the solar surface is closely related with the global solar wind structure. REPPU code achieved both the implementations for the fine grid structure on the inner boundary and for the wide range grids in global configuration. We extend the outer boundary to 400 solar radius, though the previous our model covered 200 solar radius. We split the simulation region at several 10 solar radius where the solar wind speed is super-sonic. The simulation model for the inner region is developed in a rotational frame and the observed magnetic field data are input on the solar surface as the inner boundary. The frame of the simulation model for the outer region is a fixed frame and simulation data in the inner region are set at the inner boundary of this code. We describe REPPU code and present several simulation results.

Deng, Yue (University of Texas at Arlington)

Poster Number: I3

Poster - Analysis of equatorial F-region vertical neutral winds from Brazil FPI observations

Authors: Yue Deng, Cheng Sheng, Jose De La Garza, Jonathan Makela, Daniel Fisher, John Meriwether and Rafael Mesquita

Abstract: An accurate description of vertical neutral winds in the thermosphere is essential to understand the upper atmosphere variations. Although the vertical winds are typically small, significantly smaller than typical zonal and meridional winds, they can be non-zero under certain conditions. Recent observation deployments now permit substantial progress on specifying this component of the neutral wind. In this paper, neutral vertical wind data from Brazil FPI observations at around 240-km altitude during 2009 to 2014 are used for a climatological study of the equatorial vertical wind, including the dependencies on seasonal, solar, and geomagnetic activities. First, the data have been binned according to the local time, and the seasonal dependence of the local time variation is analyzed. Second, the examination of vertical neutral wind dependency on solar and geomagnetic activity is performed and the correlation of vertical wind with F10.7, Kp and Dst has been studied. The results give us an unprecedented view of the nighttime vertical wind at low latitudes, which is critical to specify the dynamics of the upper atmosphere.

Engell, Alexander (Weather Analytics)

Poster Number: G7

Poster - Weather Analytics: Global & Space Weather Information Systems

Authors: Alexander Engell, Ellen Cousins, Wallace Hogsett, Nathan Fullerton, Kristen Jewett, Justin Bloom

Abstract: Weather Analytics answers global weather intelligence questions and provides solutions to businesses and organizations impacted by the state of the Earth's atmosphere and magnetosphere. Our Global Weather Information System (GWIS) provides the user with the ability to extract weather variables going back 35 years on a grid resolution of 35km x 35 km, globally. Weather Analytics will demo components of the GWIS system. We are currently in the process of building a Space Weather Information System (SWIS), which will include a large database of unified, space-weather related data. Through SWIS and its supported user-interface and API, data can be downloaded, visualized, and uploaded. The user will be able to upload, for instance, amps measured near a power transformer or times when a satellite underwent an operational intervention event and compare to other data sets such as coronal mass ejections or solar energetic particles. We will demo coronal mass ejection visualizations including estimating the helical evolution of CMEs in the Y-Z GSM coordinate plane. Weather Analytics will display components of SWIS for feedback. Because technologies such as communications are affected by both space weather (in the case of HF) and terrestrial weather (in the case of UHF), the GWIS and SWIS systems together are highly complementary. In the future Weather Analytics will build forecasting models for industry assets based on both space and terrestrial weather environments.

Fontenla, John (NorthWest Research Associates)

Poster Number: S20

Poster - Status and Latest Improvements to SERFS

Authors: John Fontenla

Abstract: The Solar EUV Radiation Forecast System has improved in several areas. One of these is its extension to longer wavelengths that are relevant to the Earth's middle and upper atmosphere, and upper stratosphere. Also, characterization of coronal holes and cool coronal jets is now implemented using AIA images and provides information about the source regions for fast solar wind.
This poster will show examples of these improvements and the current status of the effort on extended forecast of UV SSI for application to Earth and other planets.

Fox, Nicola (JHU/Applied Physics Laboratory)

Poster Number: M1

Poster - Space Weather with the Van Allen Probes

Authors: Mona Kessel, Sasha Ukhorskiy, Barry Mauk, Robin Barnes

Abstract: NASA's Van Allen Probes are broadcasting space weather data nearly continuously, data that is downloaded by partner ground stations and then made available through APL's science gateway. The Van Allen Probes mission targets one part of the space weather chain: the very high energy electrons and ions magnetically trapped within Earth's radiation belts. The understanding gained by the Van Allen Probes will enable us to better predict the response of the radiation belts to solar storms in the future, and thereby protect space assets in the near-Earth environment. This presentation details the Van Allen Probes capabilities for generating and broadcasting near real-time space weather data, discusses the data products, the ground stations collecting the data, and the users/models that incorporate the data into test-beds for radiation belt nowcasting and forecasting.

Gannon, Jennifer (Computational Physics Inc.)

Poster Number: M14

Poster - AVERT model for GIC Hazard Analysis

Authors: J. L. Gannon

Abstract: Geomagnetic disturbances can cause potentially damaging geomagnetically induced currents to flow through the long conducting lines of the United States bulk power system. This goal of the AVERT project is to provide tools that allow transformer operators a better understanding of the geophysical hazard due to GICs. This is done through the combination of publicly-available data, information specific to a utility's local area, and newly-developed models for electric field calculation. Public resources include data available through federal and academic magnetometers, and wide-area regional conductivity profiles of the physiographic regions of the US. Proprietary and regional resources are added to increase the accuracy of a local specification for an individual customer, and may include: local magnetic field information from measurements or models, locally-targeted conductivity estimates and measurements, and measured neutral currents from specific transformer assets. These data are incorporated into wavelet-based electric field estimation models using frequency-separated interpolation to produce accurate estimates of the geophysical hazard at locations distant from direct measurements. We present a near real time geo-electric field hazard map product and show preliminary validation work for the newly-developed wavelet-based techniques.

Gentile, Louise (Air Force Research Laboratory)

Poster Number: I4

Poster - C/NOFS Thermospheric Research and Reentry Experiment (T-RREX)

Authors: Louise C. Gentile, Cassandra G. Fesen, Rod A. Heelis, and Robert F. Pfaff

Abstract: The Air Force Research Laboratory is taking advantage of a unique opportunity with the Communication/Navigation Outage Forecasting System (C/NOFS) satellite to collect a comprehensive set of low-altitude measurements as the orbit continues to decay. C/NOFS is in a 13-degree elliptical orbit, with apogee currently below 540 km and perigee below 360 km. The primary goals for this last phase of the C/NOFS mission are to advance our understanding of topside/bottomside dynamics and to improve models currently used for trajectory propagation, orbital drag and uncontrolled reentry predictions.

Golightly, Michael (Assurance Technology Corp)

Poster Number: M6

Poster - Design, calibration and specifications of the Space Environment In-Situ Suite (SEISS) space weather instruments for the GOES-R program

Authors: B. K. Dichter, G. E. Galica, J. McGarity, S. Tsui, C. Lopate and J. J. Connell

Abstract: The next series of GOES spacecraft (GOES-R, S, T, U) will continue the long-term operational measurement of the charged particle environment in geosynchronous orbit with the Space Environment In-Situ Suite (SEISS) space environment monitors. The suite comprises five instruments that measure electrons and ions in multiple energy ranges and a data processing unit. Two of the instruments, MPS-LO and EHIS, provide new measurement capabilities compared with previous GOES environmental monitors. The MPS-LO is an electrostatic instrument that measures electrons and ions from 30 eV to 30 keV in 15 logarithmically spaced energy bins. Its twelve 15-degree x 5-degree angular channels provide a 180-degree FOV oriented north to south. The MPS-HI instrument, using solid state Si detector telescopes, covers the

energy range of 50 keV to 4 MeV in 10 logarithmically spaced differential energy channels for electrons and 80 keV to 10 MeV in 11 channels for protons. There is also an integral > 2 MeV electron channel. Electron and proton fluxes are each measured along five 15- degree half-angle look directions spaced 35-degrees apart. High-energy solar and galactic protons in the range of 1 to 500 MeV are measured by the SGPS, which also has an integral channel above 500 MeV. The total energy range is divided into three sub-ranges, 1-25, 25-80 and 80-500 MeV, each measured by a separate Si detector telescope. The opening half-angles of the telescopes are 30 degrees, 30 degrees and 45 degrees respectively. One SGPS unit measures particles arriving from the local east direction, the other from the west. Energetic heavy ions are detected by EHIS, utilizing solid state detectors, in thirty individual species from H to Ni and in five logarithmically spaced energy bands from 10 MeV/n to 200 MeV/n. The FOV is a 30-degree opening half-angle cone. Extensive calibrations at accelerator facilities have been performed to verify the 25% accuracy of each instrument's geometric factor. In addition, performances of the solid state detector instruments have been modeled using the GEANT (MPS-HI and SGPS) and FLUKA (EHIS) Monte Carlo codes and the results compared to calibration measurements. The instruments have been designed with overlapping energy regions in order to improve the quality and self-consistency of the data sets.

Gonzalez Esparza, J. Americo (Instituto de Geofisica, Univ. Nacional Autonoma de México)

Poster Number: G6

Poster - Mexican Space Weather Service (SCIESMEX)

Authors: Victor de la Luz, Pedro Corona-Romero, Julio Mejia-Ambriz

Abstract: Recent modifications of the Civil Protection Law in Mexico include now specific mentions to space hazards and space weather phenomena. During the last few years, the UN has promoted international cooperation on Space Weather awareness, studies and monitoring. These internal and external conditions impulsed the creation of a Space Weather Service in Mexico (SCIESMEX). The SCIESMEX (www.sciesmex.unam.mx) is operated by the Geophysics Institute at the National Autonomous University of Mexico (UNAM). The UNAM has the experience of operating several critical national services, including the National Seismological Service (SSN); besides that has a well established scientific group with expertise in space physics and solar-terretrial phenomena. The SCIESMEX is also related with the recent creation of the Mexican Space Agency (AEM). The project combines a network of different ground instruments covering solar, interplanetary, geomagnetic, and ionospheric observations. The SCIESMEX has already in operation computing infrastructure running the web application, a virtual observatory and a high performance computing server to run numerical models. The purpose of the SCIESMEX is to become a Regional Warning Center of the International Space Environment Services (ISES) and to participate in the Inter-progamme Coordination Team on Space Weather (ICTSW) of the Word Meteorological Organization (WMO).

Green, Janet (Space Hazards Applications)

Poster Number: M2

Poster - Testing Assumptions Underlying Radiation Belt Models

Authors: O'Brien, T.P.,Mulligan-Skov, T., Roeder, J., Fennell, J., Claudepierre, S.

Abstract: Most models of Earth's radiation belts rely on a common assumption that has not been validated. Our goal is to test this assumption and determine whether a new modeling paradigm is necessary for reliable predictions. Near Earth space is filled with intense particle radiation that poses a threat to the fleet of orbiting satellites. Physics based models have been developed that can predict the radiation environment and, in particular, large enhancements in an effort to mitigate that threat. These models assume that changes in the radial profile of the radiation can be described as a random diffusive process. The assumption drastically simplifies the computational challenge of modeling the belts and eliminates the need to track

interactions with individual particles. However, this assumption has not been tested. Here we use data from the GOES satellites to test whether impulsive injections and ULF wave oscillations are frequent enough to describe the particle motion using the diffusion approximation.

Guerra Aguilera, Jordan (The Catholic University of America)

Poster Number: S7

Poster - Ensemble Forecasting of Major Solar Flares

Authors: Guerra, J.A., Pulkkinen, A., Uritsky, V.M.

Abstract: We present the results from the first ensemble prediction model for major solar flares (M and X classes). Using the active-region probabilistic forecasts from three models hosted at the Community Coordinated Modeling Center (NASA-GSFC) and the NOAA forecasts, we developed an ensemble forecasting method by linearly combining the flaring probabilities from all four methods. The combination weights were calculated using a sample of 13 actives regions between 2012 and 2014, containing 3120 forecasts and 1728 events. We constructed several different ensemble models (based on the values of the combination weights used) and found the conditions for which the ensemble method performed the best. This linear combination led to improving both the probabilistic and categorial forecasts in terms of the attributes (accuracy and reliability) and the Heidke skill score (HSS), correspondingly. The results of our investigation can be used for improving forecasts in a real-time scenario and therefore helping forecasters during the decision-making process.

Henney, Carl (AFRL)

Poster Number: S9

Poster - Forecasting Solar UV & F10.7 with ADAPT

Authors: C. J. Henney, W. A. Toussaint, C. N. Arge, R. A. Hock, A. K. Schooley, K. Shurkin, and S. M. White

Abstract: A new method is presented here to forecast solar 10.7 cm (2.8 GHz) radio flux, abbreviated F10.7, and selected bands of solar ultraviolet (UV) and extreme UV irradiance, ranging from 0.1 to 175 nm, utilizing advanced predictions of the global solar magnetic field generated by the ADAPT (Air Force Data Assimilation Photospheric Flux Transport) model. Initial results reveal a good correlation between the absolute value of the observed photospheric magnetic field and the observed F10.7 and selected UV bands. In Henney et al (2012), the observed F10.7 signal is found to correlate strongly with strong magnetic field regions. In Henney et al. (2015), we found that the observed integrated full-disk solar UV signals are strongly correlated with weak field. By evolving solar magnetic maps forward 1 to 7 days with a flux transport model, this new method provides a realistic estimation of the Earth-side solar magnetic field distribution used to forecast both F10.7 and UV. The ADAPT model used in this work was developed with support by a grant from the AFOSR (Air Force Office of Scientific Research).

Hock-Mysliwiec, Rachel (Air Force Research Laboratory)

Poster Number: S8

Poster - Modeling the EUV Irradiance of Solar Flares

Authors: Rachel Hock-Mysliwiec

Abstract: We have developed a hybrid-physics model of solar flare irradiance based on the EBTEL model, developed by J. Klimchik (NASA/GSFC) to study the role of nanoflare heating in the corona. By

combining many EBTEL loops, we are able to reproduce EUV lightcurves at a range of coronal temperatures. Presently, we use two emission lines observed by SDO/EVE to constrain the model parameters, which allows us to calculate lightcurves for other EUV lines at different temperatures. Here, we present preliminary results on the robustness of this method and the comment on future feasibility to model EUV flare irradiance with limited observations.

Hong, Sunhak (Korean Space Weather Center, National Radio Research Agency)

Poster Number: S22

Poster – Automatic Solar Synoptic Analyzer and High Speed Solar Wind Prediction

Authors: Sunhak Hong, Kichang Yoon, Whansang Lee, Sungwon Park

Abstract: Automatic Solar Synoptic Analyzer (ASSA) is an automatic software system of identifying sunspot groups, coronal holes, and filament channels which are three major solar sources causing the space weather. Coronal holes, the sources of high speed solar wind stream, cause many of disturbances to the geomagnetic field. We have developed a solar wind effect prediction model using artificial neural network technique with the ASSA coronal hole data archive of the period of from 1997 to 2013. When the ASSA generated coronal hole data archive, images of SOHO EIT 195 and SDO AIA 193 were used for morphological identification and then SOHO MDI Magnetograms and SDO HMI Magnetograms were used for quantitative verification. In this report, we characterize coronal hole area and solar mean field variation over both the period of solar cycle 24 and the inclining phase of solar cycle 25 and present correlations among coronal hole data (area, location and polarity etc.); the corresponding solar wind velocity; and geomagnetic indices. Those study results were used when selecting training data sets into the artificial neural network. The high speed solar wind prediction model which was developed under this research can provide the predictions not only of solar wind speed at L1 orbit but also of Kp and Ap indices and 2 MeV electron flux at geosynchronous orbit as well with one to nine days lead-time. Correlation coefficient and Prediction Efficiency are used and compared with 1-day Persistence and 27-day Recurrence for model performance evaluation. The initial evaluation results of the model were good enough to be used for solar wind speed and 2 MeV electron flux forecast service. The high speed solar wind prediction model will be combined with the ASSA software and will be deployed at the Korean Space Weather Center for its forecast service.

Hsu, Chih-Ting (NOAA/NCU)

Poster Number: I14

Poster - Global ionospheric specification and forecasting by inferring unobserved thermospheric and ionospheric state variables via an Ensemble Kalman Filter

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

Abstract: This study demonstrates the significance of ion-neutral coupling to ionospheric data assimilation for ionospheric specification and forecast under different seasons and solar activities. Ensemble Kalman Filter (EnKF) is used to assimilate synthetic electron density profiles sampled according to the Formosa Satellite 3/Constellation Observing System for Meteorology, Ionosphere and Climate (FORMSAT-3/COSMIC) into the Thermosphere Ionosphere Electrodynamics General Circulation Model (TIEGCM). The combination of the EnKF and first-principles TIEGCM allows a self-consistent treatment of thermosphere and ionosphere coupling in the data assimilation and forecast. Because thermospheric variables affect ionospheric electron densities, different combinations of an observed ionospheric state variable (electron density) and unobserved ionospheric and thermospheric state variables (atomic oxygen ion density, neutral temperature, winds, and composition) are included as part of the EnKF state vector in experiments. Furthermore, these experiments are carried out under different solar activities (F10.7 are 190 and 69, respectively) and seasons (vernal equinox and summer solstice) to investigate the filter

performance under different conditions. In the EnKF, the unobserved state variables are estimated and made dynamically and chemically consistent with the observed state variable, thus improving the performance of the data assimilation system. The impact on ensemble forecast is further examined by initializing the TIEGCM with the assimilation analysis.

Jackson, Bernard (University of California, San Diego)

Poster Number: S10

Poster - A Determination of the North-South Heliospheric Magnetic-Field Component from Inner-Corona Closed-Loop Propagation

Authors: Hsiu-Shan Yu, P. Paul Hick, Andrew Buffington, Mario M. Bisi, Munetoshi Tokumaru, Jaehun Kim, Sunhak Hiong

Abstract: We find that a portion of the north-south interplanetary magnetic field measured in situ near Earth is present from a direct outward mapping of fields from the low solar corona. Using the Current-Sheet Source Surface (CSSS) model (Zhao & Hoeksema, 1995), these lower coronal fields are extrapolated upward from near the solar surface. Global velocities inferred from a combination of observations of interplanetary scintillation (IPS) matched to in-situ velocities and densities measured by spacecraft instrumentation provide further outward timing assuming conservation of mass and mass flux. The north-south field component at 1 AU is compared with the appropriate Advanced Composition Explorer (ACE) MAGnetometer (MAG) in-situ magnetic-field component – the Normal (RTN) Bn field coordinate – for three years throughout the Cycle 24 solar minimum. We find a significant positive correlation throughout this period between this method of determining the Bn field compared with in-situ measurements. This result, from a study during times when few CMEs are present, indicates that a small fraction of the low-coronal Bn component flux regularly escapes from closed-field regions. Since the Bn field provides the major portion of the Geocentric Solar Magnetospheric (GSM) Bz field component that couples most closely to the Earth's geomagnetic field, the prospects for its determination using this technique for space weather use are being actively developed by our groups.

Jonas, Seth (IDA)

Poster Number: G3

Poster - A History of Federal Involvement in Space Weather Forecasting

Authors: Eoin McCarron and Seth Jonas

Abstract: Throughout the past decade interest in and awareness of the potentially negative effects of Earth-directed space weather have expanded dramatically. Although this heightened level of attention is recent, there has been long-standing Federal involvement in operational space weather forecasting. Beginning during the Second World War, the Federal government developed monitoring, forecasts, and warnings for space weather phenomena and some of the associated effects on navigation, radio communication, and radar. This initial program expanded over the decades and was eventually housed in the Department of Commerce, where responsibilities related to operational space weather forecasting remain today. Through research into agency documents and other primary sources, this study seeks to chart the evolution and expansion of Federal involvement in space weather forecasting, stretching from the Second World War to the present.

Kilcommons, Liam (University of Colorado, Boulder)

Poster Number: I23

Poster - AtModExplorer: An open source tool for visually exploring (empirical) atmospheric models

Authors: Liam Kilcommons, Delores Knipp, Michael Wiltberger

Abstract: We have created a simple and user-friendly web application to visualize, compare and analyze output from various commonly-used empirical atmospheric models. The Atmospheric Model Explorer (AtModExplorer) gives users intuitive ways to specify the time and location arguments common to most atmospheric models, and displays the resulting output as: 1) a contour plot over a map projection, 2) a pseudocolor plot (heatmap) which allows visualization of a variable as a function of two spatial coordinates, or 3) a simple line plot of one spatial coordinate versus any number of desired model output variables. Model drivers that quantify activity (solar,geomagnetic,etc.) can be set manually or sourced from historical data for a chosen date. As a follow-on to activity-based laboratories for the CISM summer school (Gross et al., Eos, Vol. 90, No. 2, 13 January 2009) the application makes use of the rich ecosystem of scientific and web programming tools provided in the Python community and is available along with its source code from the Github distribution platform. In this presentation we demonstrate use of AtModExplorer with NRLMSIS00.

Knipp, Delores (University of Colorado, Boulder)

Poster Number: G1

Poster - Space Weather Journal

Authors: Delores Knipp, Dawit Tegbaru

Abstract: In this poster we highlight recent Space Weather Journal manuscripts. We provide the general length limits and scope for the types of articles solicited and accepted by Space Weather.

Kress, Brian (NOAA/NGDC)

Poster Number: M12

Poster - Geomagnetic cutoff response to variations in magnetospheric current systems

Authors: Kress, B. T. and J. V. Rodriguez

Abstract: Access of solar and galactic cosmic rays to the Earth's magnetosphere is quantified in terms of cutoff rigidity. Geomagnetic cutoffs are sensitive to moderate geomagnetic activity and undergo daily variations due to the day–night asymmetry of the magnetosphere. The purpose of this study is to identify the storm-time current systems that physically affect solar proton access to the inner magnetosphere. By computing geomagnetic cutoffs in the Tsyganenko and Sitnov [2005] geomagnetic field model, we show how solar proton access to the magnetosphere is modified by changes in individual magnetospheric current systems.

Lee, Kangjin (Kyung Hee University)

Poster Number: S5

Poster - Probabilistic Forecast Models of Solar Flares and CMEs

Authors: Yong-Jae Moon, Jin-Yi Lee, Hyeonock Na, and Jongyeob Park

Abstract: We investigate the occurrence rates of solar flares and CMEs and their daily probabilities depending on McIntosh sunspot class and its area change. For this we use the Solar Region Summary(SRS) from NOAA, NGDC flare catalog, and SOHO/LASCO CME catalog for 18 years (from January 1996 to December 2013). We classify each sunspot class into two sub-groups: "Large" and "Small". In addition, for each class, we classify it into three sub-groups according to sunspot class area change: "Decrease", "Steady", and "Increase". In terms of sunspot class area, the solar flare and CME occurrence probabilities noticeably increase at compact and large sunspot groups (e.g., 'Fkc'). In terms of sunspot area change, solar flare and CME occurrence probabilities for the "Increase" sub-groups are noticeably higher than those for the other sub-groups. These results demonstrate statistically that magnetic flux and its emergence enhance solar flare and CME occurrence, especially for compact and large sunspot groups. For verification, we compare several statistical parameters of our flare forecast model with those of the NOAA/SWPC model. We also discuss the solar cycle phase dependences of our flare and CME forecast models.

Leka, KD (NWRA)

Poster Number: S6

Poster - The NWRA Discriminant Analysis Flare Forecasting System (DAFFS)

Authors: K D Leka, G Barnes, E W Wagner

Abstract: The Discriminant Analysis Flare Forecasting System (DAFFS) is being developed to prototype at NWRA under a NOAA/SBIR Phase-II contract, and in this poster we describe its salient features. The goal is a self-contained automated near-real-time forecasting tool that will supplement the NOAA/SWPC system, matching the NOAA forecast products at the outset (1-, 2-, and 3- day forecasts for standard C, M, and X thresholds). The analysis is based on solar magnetic field data and prior flaring history of a target active region, results of which are fed into a Discriminant Analysis statistical package developed at NWRA. Benchmarks show that DAFFS out-performs the present NOAA forecasts when judged by Brier and similar skill scores, especially for longer-range periods and larger events. DAFFS will include numerous customizable features; a prototype is expected in mid-2016.

Funding for this work is acknowledged from NOAA/SBIR contracts WC-133R-13-CN-0079 and WC-133R-14-CN-0103. Leka, Barnes and Wagner acknowledge additional support from NASA NNH09CE72C, NNH12CG10C.

Maruyama, Naomi (NOAA/NWS)

Poster Number: I13

Poster - Ionosphere Plasmasphere Electrodynamics (IPE) model development for space weather application

Authors: P.G. Richards, Y.-Y. Sun, J. Middlecoff, T.-W. Fang, T.J. Fuller-Rowell, A. Richmond, A. Maute, R. Akmaev, J.-Y. Liu, C. Valladares

Abstract: IPE model has been developed at NOAA SWPC, in order to improve our specification of ionosphere and plasmasphere in response to external forcing from both above and below, and to be coupled to whole atmosphere models for understanding an impact of the terrestrial weather to space weather. The model describes the time dependent, three-dimensional, global density of nine ion species, electron density, temperatures of electron and ions in the ionosphere and plasmasphere. The parallel plasma transport is based on Field Line Interhemispheric Plasma (FLIP) Model [Richards et al., 1990]. A realistic model of Earth's magnetic field is implemented by using the APEX coordinate system [Richmond, 1995]. Global, seamless plasma transport perpendicular to the magnetic field has been included all the way from the

equator to the poles. The electrodynamics solver is based on the TIEGCM [Richmond and Maute 2013]. It self-consistently calculates the electric field as one of the main driver for the Ionosphere-Plasmasphere module. The code has been parallelized using MPI/Scalable Modeling System (SMS) [Govett et al., 2003], in order to speed up the code to meet so that its run speed will be comparable to that of the whole atmosphere model. The code scales reasonably well, and runs up to 640 processors, by decomposing both latitude and longitude direction in a flexible manner determined at run time. The recent developments will be updated in this presentation.

Matsuo, Tomoko (NOAA/NWS)

Poster Number: I16

Poster - Predictability and Ensemble Modeling of the Space-Atmosphere Interaction Region

Authors: Tomko Matsuo, Tim Fuller-Rowell, Tzu-Wei Fang, Valery Yudin, Kayo Ide, Daryl Kleist, Adam Kubaryk, Xinan Yue, Chih-Ting Hsu, Rashid Akmaev, Houjun Wang, Mihail Codrescu, Rodney Viereck, Jeffrey Whitaker, Arthur Richmond, Tom Woods, Thomas Immel, Brian Anderson, Larry Paxton, and Jann-Yeng Liu

Abstract: The Space-Atmosphere Interaction Region (SAIR), encompassing the mesosphere, thermosphere and ionosphere, is an intersection between geospace and the Earth's atmosphere, and is exposed to vacillating conditions of both space and terrestrial weather. Recent observational and modeling studies have revealed clear reaches of terrestrial weather far beyond the mesosphere lower-thermosphere region into the topside ionosphere. At the same time, the region lends itself to forcing originating from the Sun and solar-wind magnetosphere interactions. The predictability of the SAIR is a fundamental question in Heliophysics, and calls for a paradigm shift from a deterministic to a probabilistic modeling framework. To meet with this contemporary modeling and simulation challenge, we will systematically compare and combine ensemble simulations of a comprehensive whole atmosphere model, coupled with an ionosphere and plasmasphere model called the Integrated Dynamics in Earth's Atmosphere (IDEA) with global Earth and geospace observations. Building on the National Weather Service's operational ensemble forecasting and data assimilation systems as well as our earlier efforts, we will construct an ensemble forecasting and data assimilation system that will ultimately be capable of assimilating observations from the ground to SAIR. We will present the project overview along with some initial results from our new interdisciplinary initiatives.

Matthiä, Daniel (German Aerospace Center (DLR))

Poster Number: M9

Poster - PANDOCA - Professional AviatioN DOse CAlculator

Authors: Daniel Matthiä, Matthias M. Meier, and Günther Reitz

Abstract: The PANDOCA (Professional Aviation Dose Calculator) software was developed at the German Aerospace Center (DLR) for the calculation of route doses in aviation. The calculations are based on galactic cosmic ray spectra taking into account primary nuclei from hydrogen to iron by direct transport calculations of hydrogen and helium nuclei and approximating heavier nuclei by the number of protons equalling the corresponding atomic number. A comparison to experimental data recorded on several flights with a tissue equivalent proportional counter shows very good agreement between model calculations and measurements.

In addition to the calculation of the radiation exposure from galactic cosmic rays, the PANDOCA model can also be used for an assessment of the contribution of solar events producing highly energetic particles which may have the potential to increase the dose rate at aviation altitudes. The expected increase in dose

rates during such events can be estimated using neutron monitor and satellite measurements. Potential mitigation measures can be evaluated based on their effect and cost.

McGranaghan, Ryan (University of Colorado, Boulder)

Poster Number: I20

Poster - A fast, parameterized model of the upper atmospheric ionization, densities, and conductivity.

Authors: Delores J. Knipp, Stanley C. Solomon, Xiaohua Fang

Abstract: Rapid specification of ionization in the upper atmosphere is essential when many evaluations of the atmospheric state must be performed, as in global studies or analyses of on-orbit satellite data. Though many models of the upper atmosphere perform the necessary specification, none provide the flexibility of computational efficiency, high accuracy, and complete specification. We introduce a parameterized, updated, and extended version of the GLobal AirglOW (GLOW) model, called GLOWfast, that significantly reduces computation time and provides comparable accuracy in upper atmospheric ionization, densities, and conductivity. We extend GLOW capabilities by: 1) implementing the nitric oxide empirical model; 2) providing a new model component to calculate height-dependent conductivity profiles from first principles for the 80-200 km region; and 3) reducing computation time. The computational improvement is achieved by replacing the full, two-stream electron transport algorithm with two parameterizations: 1) photoionization (QRJ from Solomon and Qian [2005] and 2) electron impact ionization (F0810 from Fang et al. [2008, 2010]). We find that GLOWfast accurately reproduces ionization rates, ion and electron densities, and Pedersen and Hall conductivities independent of the background atmospheric state and input solar and auroral activity. Our results suggest that GLOWfast may be even more accurate for low characteristic energy auroral conditions. We demonstrate in a suite of 3028 case studies that GLOWfast can be used to rapidly calculate the state of the upper atmosphere with few limitations on background and input conditions.

We anticipate GLOWfast becoming a useful tool for the space weather modeling community. Specifically, the robust calculations of Hall and Pedersen conductivities, uncertain parameters in the specification of ionospheric electrodynamics, in the model address an area of need in space weather modeling.

McIntosh, Scott (National Center for Atmospheric Research)

Poster Number: S1

Poster - On The Seasons Of Space Weather

Authors: Scott W. McIntosh

Abstract: Abstract: Solar magnetism displays a host of variational timescales of which the enigmatic 11-year sunspot cycle is most prominent. Recent work has demonstrated that the sunspot cycle can be explained in terms of the intra- and extra-hemispheric interaction between the overlapping activity bands of the 22-year magnetic polarity cycle. Those activity bands appear to be driven by the rotation of the Sun's deep interior. Here we deduce that activity band interaction can qualitatively explain the "Gnevyshev Gap" – a well-established feature of flare and sunspot occurrence. Strong quasi-annual variability in the number of flares, coronal mass ejections, the radiative and particulate environment of the heliosphere is also observed. We infer that this secondary variability is driven by surges of magnetism from the activity bands. Understanding the formation, interaction and instability of these activity bands will considerably improve forecast capability in space weather and solar activity over a range of timescales.

Meehan, Jennifer (Utah State University)

Poster Number: I17

Poster - Ionospheric Scale Height and its Relationship to Upper Atmospheric Neutral and Plasma Temperatures

Authors: Jennifer Meehan, Jan J Sojka, 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 well known but the topside ionosphere and the uncertain contribution from the plasmasphere are still poorly modeled. We attempt to find out what new information can be extracted from measured, ground-based total electron content (TEC) from GPS satellites and bottomside ionosonde data and compare it to a range of data collected and analyzed from Millstone Hill's incoherent scatter radar (ISR). The plasma scale height derived from ISR data is compared to the approximated exponential function of the Chapman derived scale height by linearly fitting the electron density profiles. The ratio of TEC to the F-region peak electron density provides the slab thickness parameter, which we will use to gain new, fundamental information about the topside thermal conditions, electron and ion temperatures, by a detailed analysis of the scale height under different solar zenith angles.

Meier, Matthias (German Aerospace Center)

Poster Number: M8

Poster - A space weather index for the radiation field at aviation altitudes

Authors: Matthias M. Meier and Daniel Matthiä

Abstract: The additional dose contribution to the radiation exposure at aviation altitudes during Solar Particle Events (SPEs) has been a matter of concern for many years. After the Halloween storms in 2003 several airlines began to implement mitigation measures such as rerouting and lowering flight altitudes in response to alerts on the NOAA S-scale regarding solar radiation storms. These alerts are based on the integral proton flux above 10 MeV measured aboard the corresponding GOES-satellite which is operated outside the Earth's atmosphere in a geosynchronous orbit. This integral proton flux has, however, been proved to be an insufficient parameter to apply to the radiation field at aviation altitudes without an accompanying analysis of the shape of the energy spectrum. Consequently, false alarms and corresponding disproportionate reactions ensued. Since mitigating measures can be quite cost-intensive, there has been a demand for appropriate space weather information among responsible airline managers for about a decade. Against this background, we propose the introduction of a new Space Weather index D, based on dose rates at aviation altitudes produced by solar protons during solar radiation storms, as the relevant parameter for the assessment of corresponding radiation exposure. The Space Weather index D is a natural number given by a graduated table of ranges of dose rates in ascending order which is derived by an equation depending on the dose rate of solar protons.

Murphy, Matthew (RIT)

Poster Number: S14

Poster - Statistical Study of Interplanetary Coronal Mass Ejctions with Strong Magnetic Fields

Authors: Matthew Murphy, Dr Roger Dube, Dr Yihua Zheng

Abstract: The magnetic field strength of a CME is linked to the strength of a geomagnetic storm on Earth, particularly when the magnetic field is predominantly southward for a long duration. CMEs with strong magnetic fields are typically associated with significant solar energetic particle (SEP) and solar flare events. The correlations between strong magnetic field coronal mass ejections from the entire sun (especially from the far side or non-Earth facing side of the sun) to SEP and flare events, solar source regions and other relevant solar variables are not well known. CME events with magnetic field strength readings over 30 nT from January 2010 to October 17, 2014 will be studied to see what correlations there are between these other solar storm variables. The STEREO spacecraft (launched in 2006) combined with the ACE and SOHO spacecraft near the first Lagrangian point (L1) provide a 360-degree view of the sun. The magnetic field strength measurements originate from magnetometer sensors on the ACE and STEREO spacecraft. On STEREO A and B the instrument is know as the n-situ Measurements of Particles and CME Transients (IMPACT). This IMPACT instrument also monitors SEP levels. Also onboard the STEREO spacecraft is the Sun Earth Connection Coronal and Heliospheric Investigation (SECCHI) instrumentation. SECCHI has coronagraph cameras and extreme ultraviolet light cameras. These cameras give the ability to monitor CMEs from the solar source. This imagery will be studied to provide information about the CME source region, speed, direction and etc. The combined capabilities of the ACE and SOHO spacecraft at L1 match the aforementioned capabilities of the STEREO A and B spacecraft.

Nagatsuma, Tsutomu (National Institute of Information and Communications Technology)

Poster Number: M5

Poster - Initial Observations of Space Environment Data Acquisition Monitor (SEDA) on Board Himawari-8

Authors: Tsutomu Nagatsuma, Kaori Sakaguchi and Yuki Kubo

Abstract: New Japanese meteorological satellite, Himawari-8, was successfully launched on October 7, 2014. Space environment data acquisition monitor (SEDA) is on board Himawari-8, as one of the housekeeping information for satellite operation. SEDA consists two sensors. One is proton sensor, which has 8 separate diode detectors. The energy range of the proton detectors are from 20 MeV to 100 MeV. The other is electron sensor, which measures internal charging currents caused by energetic electrons. There are eight sensor plates arranged in a stack and each plate responds to a different energy range. As a result, energetic electrons whose energy range between 0.2 to 4.5 MeV can be measured by the electron sensors. The time resolution of each sensors is 10 sec. The field of view of SEDA is eastward. Thus, the specification of SEDA is suitable for monitoring the energetic electrons and protons above Japanese meridian of Geostationary orbit.

Himawari-8/SEDA has been operating since November 3, 2014. Based on the agreement between Japanese Meteorological Agency (JMA) and NICT, JMA is providing Himawari/SEDA data in near-real time since January 21. 2015. Currently we are checking the quality of Himawari-8/SEDA data. Results of initial observation by Himawari-8/SEDA will be introduced in our presentation.

Nagatsuma, Tsutomu (National Institute of Information and Communications Technology)

Poster Number: M4

Poster - Development of NICT's MeV electron forecast model through the outer radiation belt

Authors: Kaori Sakaguchi, Tsutomu Nagatsuma, Harlan E. Spence, and Geoff Reeves

Abstract: The radiation belts consist of relativistic energy electrons in MeV range. The electron flux in the outer belt is highly variable depending on both solar wind and magnetospheric conditions. Enhanced fluxes sometimes cause deep dielectric charging on spacecraft and anomalies happen after discharge. Prediction of the electron flux is important for safety operation of the satellite in the near Earth's orbit, but the physical processes of relativistic electrons acceleration, loss, and transport are not fully understood, so far. Japanese space weather information center at NICT has developed a multivariate autoregressive (AR) model for the prediction of electron flux at geostationary orbit. The model can estimates future flux variations by a few days lagging response of solar wind parameter changes [Sakaguchi et al., 2013]. In this poster, we show the prediction models for each of the L-value location from 3 to 6, and GEO. Data from GOES at geostationary orbit and Van Allen Probes in the outer radiation belt were used for predictor time series. We estimated the best combination of explanation variate among geomagnetic indices (AE, KP, Dst) and solar wind parameters for each L model, respectively. The forecast validations are estimated by latest 1-year data in 2014.

Nikolic, Ljubomir (Natural Resources Canada)

Poster Number: S12

Poster - Development of a solar wind forecast model

Authors: Ljubomir Nikolic

Abstract: Forecasting solar wind parameters is one of the main space weather research and operational efforts. A well-known approach to the background solar wind forecast exploits correlations between solar wind speed and properties of open coronal magnetic field lines. The models based on this approach, such as Wang-Sheeley-Arge (WSA), have shown some success in forecasting the solar wind speed and magnetic field polarity. A WSA-like solar wind model has been developed to forecast solar wind speed and to explore further improvements. To derive the global coronal magnetic field, GONG magnetograms are used as input to a potential field source surface model. Performance of the solar wind forecast model is examined. In particular the forecast performance for cases of centrally located coronal holes is discussed.

Park, Eunsu (Kyung Hee University)

Poster Number: M13

Poster - Observational test of magnetopause location models and nowcast of geosynchronous magnetopause crossings

Authors: Yong-Jae Moon

Abstract: A geosynchronous magnetopause crossing is a phenomenon that magnetopause boundary moves into the geosynchronous orbit by solar wind pressure and interplanetary magnetic field, which can cause damage, anomaly, and loss of geosynchronous satellite. In this study we investigate two major studies about geosynchronous magnet opause crossing. We investigate an observational test of magnetopause location models using GOES satellite observation data from 1996 to 2010. For this, we consider three representative magnetopause location models : Petrinec and Russell (1996), Shue et al. (1997), and Shue et al. (1998). Geosynchronous magnetopause boundary crossings are identified as follows : (1) The standard deviation of the 3 min magnetosheath magnetic field is greater than 4.5 nT. (2) The standard deviation of magnetosheath magnetic field is 2.5 times larger than that of magnetospheric magnetic field. As a result, we identify 563 geosynchronous magnetopause crossings. For the evaluation of the models, we calculate Probability of Detection (PoD) and Critical Success Index (CSI) as a function of year. Major results from this study are as follows. First, PoD and CSI depend on solar cycle phase and have the highest values in the decaying phase around 2004. Second, Shue et al. (1998) has the best CSI and PoD in solar cycle 23. Third, Shue et al. (1997, 1998) have similar values of average of PoD in solar cycle 23. In addition, we are looking for a good nowcasting proxy to indicate magnetopause crossings of geosynchronous satellites:

whether the satellites are in the magnetosphere or solar wind. We will compare the performance of several proxies using typical examples of magnetopause crossing events.

Parker, Linda (Jacobs Technology)

Poster Number: S15

Poster - The Advanced Composition Explorer Shock Database and Application to Particle Acceleration Theory

Authors: L. Neergaard Parker and G. P. Zank

Abstract: The theory of particle acceleration via diffusive shock acceleration (DSA) has been studied in depth by Gosling et al. (1981), van Nes et al. (1984), Mason (2000), Desai et al. (2003), Zank et al. (2006), among many others. Recently, Parker and Zank (2012, 2014) and Parker et al. (2014) using the Advanced Composition Explorer (ACE) shock database at 1 AU explored two questions: does the upstream distribution alone have enough particles to account for the accelerated downstream distribution and can the slope of the downstream accelerated spectrum be explained using DSA? As was shown in this research, diffusive shock acceleration can account for a large population of the shocks. However, Parker and Zank (2012, 2014) and Parker et al. (2014) used a subset of the larger ACE database. Recently, work has successfully been completed that allows for the entire ACE database to be considered in a larger statistical analysis. We explain DSA as it applies to single and multiple shocks and the shock criteria used in this statistical analysis. We calculate the expected injection energy via diffusive shock acceleration given upstream parameters defined from the ACE Solar Wind Electron, Proton, and Alpha Monitor (SWEPAM) data to construct the theoretical upstream distribution. We show the comparison of shock strength derived from diffusive shock acceleration theory to observations in the 50 keV to 5 MeV range from an instrument on ACE. Parameters such as shock velocity, shock obliquity, particle number, and time between shocks are considered. This study is further divided into single and multiple shock categories, with an additional emphasis on forward-forward multiple shock pairs. Finally with regard to forward-forward shock pairs, results comparing injection energies of the first shock, second shock, and second shock with previous energetic population will be given.

Phillips, Tony (spaceweather.com)

Poster Number: M10

Poster - Rads on a Plane

Authors: Tony Phillips (Spaceweather.com), Olivia Grah, Joey Harvey, Jordan Herbst, Rachel Molina, Sam Omondi, Carson Reid, Jamie Schultz, Amelia Yarborough (Earth to Sky Calculus)

Abstract: Using the same radiation sensors that they routinely fly to the stratosphere onboard research balloons, Spaceweather.com and the students of Earth to Sky Calculus have been investigating cosmic rays on commercial air flights. Preliminary results suggest a more dynamic radiation environment than is commonly supposed. Examples will be presented from commercial flights in late 2014-early 2015, including travel to the Space Weather Workshop.

Pilinski, Marcin (ASTRA)

Poster Number: I13

Poster - Ensemble Assimilation Using First-Principles Models as a Tool for Three-Day Space Weather Forecasts

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

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 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 neutral density, winds, temperature, composition, and satellite drag. This modeling tool will be called the Atmospheric Density Assimilation Model (ADAM). ADAM will be based on three state-of-the-art coupled models of the thermosphere-ionosphere running in real-time, using assimilative techniques to produce a thermospheric nowcast. It 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. We will review the requirements for this system, a feasibility study showing the performance of first-principles models as it pertains to satellite-drag operational needs, and review challenges in designing an assimilative space-weather prediction model.

Rigler, Josh (USGS)

Poster Number: M15

Poster - Dynamic geomagnetic hazard maps in space weather operations

Authors: Rigler, E. Joshua – USGS Geomagnetism Program
Pulkkinen, Antti A. – NASA-CCMC
Wiltberger, Michael – NCAR-HAO
Balch, Chris – NOAA-SWPC

Abstract: Traditionally, the use of geomagnetic data in space weather operations has been limited to specific geographic coordinates (i.e., magnetic observatories), or to global indices that, at best, averaged longitudinally distributed magnetic measurements into latitudinal bands of relatively general space weather interest (e.g., Dst, Kp, AE). Modern technological systems are beginning to require information about ground magnetic variations that is more tailored to their specific locale. One solution is to simply install many new magnetic observatories, but his is both economically and operationally impractical. We have chosen instead to adopt a physics-inspired optimal interpolation/extrapolation technique to fill in the gaps between/beyond magnetic observatories. This planned operational space weather product is still under development, but is mature enough to undergo systematic validation. We present results from the first stage of this validation effort, based primarily on synthetic data generated by a first-principles global geospace model

Rowland, William (CIRES/NGDC)

Poster Number: S16

Poster - DSCOVR Archive and Retrospective User Access

Authors: William Rowland, Paul Loto'aniu, Heather McCullough, William Denig, Robert Redmon, Stefan Codrescu, Margaret Tilton, Dominic Fuller-Rowell

Abstract: We discuss NOAA's archive of and user access options for long term (retrospective) Solar Wind measurements from NOAA's Deep Space Climate Observatory (DSCOVR) satellite. We will demonstrate the National Geophysical Data Center's existing asynchronous access portal as well as a prototype for our synchronous access portal.

DSCOVR is NOAA's newest environmental satellite. It will monitor the interplanetary solar wind and provide space weather operations with advanced warnings of adverse space weather. DSCOVR launched aboard a SpaceX Falcon 9 rocket on 11 February 2015 from the Kennedy Space Center. It is currently in transit towards its operational location near the sun-earth Lagrange point (L1) located some 240 earth radii in the upstream direction. Near term measurements of the solar wind density, velocity and composition and of the Interplanetary Magnetic Field (IMF) will be available to real-time users via the Space Weather Prediction Center, while retrospective users will have access to the complete time history of these data via the National Geophysical Data Center.

Schaefer, Robert (JHU/Applied Physics Laboratory)

Poster Number: I8

Poster - UV Imaging of Space Weather

Authors: Robert Schaefer, Larry J. Paxton, Robert K. Schaefer, Gary Bust, Ethan Miller, Yongliang Zhang, Bernard S. Ogozalek, Brian Wolven, Giuseppe Romeo, Steve Osterman, Patrick Dandenault, Syau-Yun Hsieh, John Hicks

Abstract: Four hyperspectral imagers on currently on-orbit and providing data that has been been made widely available to the community. These sensors, the Special Sensor Ultraviolet Spectrographic Imager or SSUSI, have been tremendously successful and productive. Five SSUSI instruments were built by APL and delivered, calibrated and ready for flight between 1994 and 1996. The Global Ultraviolet Imager (GUVI) on TIMED was actually the 7th wide field of regard instrument built by APL. For those familiar with GUVI, SSUSI is very nearly identical. The first SSUSI flight was in 2003 on the DMSP F16 spacecraft. Two others have flown since then on DMSP F17, F18 and F19. One more awaits flight, with the launch possibly in 2016. Looking toward the future, the SSUSI-Lite instrument has been developed to be smaller and power efficient so it can be used on smaller platforms and hosted payloads.

Schrijver, Karel (Lockheed Martin Advanced Technology Center)

Poster Number: G2

Poster - Understanding space weather to shield society: A global road map for 2015-2025 commissioned by COSPAR and ILWS

Authors: Karel Schrijver, Kirsti Kauristie, Alan D. Aylward, Clezio M. Denardini, Sarah E. Gibson, Alexi Glover, Nat Gopalswamy, Manuel Grande, Mike Hapgood, Daniel Heynderickx, Norbert Jakowski, Vladimir V. Kalegaev, Giovanni Lapenta, Jon A. Linker, Siqing Liu, Cristina H. Mandrini, Ian R. Mann, Tsutomu Nagatsuma, Dibyendu Nandi, Takahiro Obara, T. Paul O'Brien, Terrance Onsager, Hermann J. Opgenoorth, Michael Terkildsen, Cesar E. Valladares, Nicole Vilmer

Abstract: There is a growing appreciation that the environmental conditions that we call space weather impact the technological infrastructure that powers the coupled economies around the world. With that comes the need to better shield society against space weather by improving forecasts, environmental specifications, and infrastructure design. Advanced understanding of space weather requires a coordinated international approach to effectively provide awareness of the processes within the Sun-Earth system through observation-driven models. This roadmap prioritizes the scientific focus areas and research infrastructure that are needed to significantly advance our understanding of space weather of all intensities and of its implications for society. Advancement of the existing system observatory through

the addition of small to moderate state-of-the-art capabilities designed to fill observational gaps will enable significant advances. Such a strategy requires urgent action: key instrumentation needs to be sustained, and action needs to be taken before core capabilities are lost in the aging ensemble. We recommend advances through priority focus (1) on observation-based modeling throughout the Sun-Earth system, (2) on forecasts more than 12 hrs ahead of the magnetic structure of incoming coronal mass ejections, (3) on understanding the geospace response to variable solar-wind stresses that lead to intense geomagnetically-induced currents and ionospheric and radiation storms, and (4) on developing a comprehensive specification of space climate, including the characterization of extreme space storms to guide resilient and robust engineering of technological infrastructures. The roadmap clusters its implementation recommendations by formulating three action pathways, and outlines needed instrumentation and research programs and infrastructure for each of these.

Shibata, Kazunari (Kyoto University)

Poster Number: S2

Poster - Superflares on Solar type Stars and Their Implications on the Possibility of Superflares on the Sun

Authors: Kazunari Shibata, Hiroaki Isobe, Takuya Takahashi

Abstract: Using Kepler data, Maehara et al. (2012) have discovered 365 superflares (10^34-10^36 erg) on 148 solar type stars (G type dwarfs). They revealed that the occurrence frequency of superflares of 10^34 erg is once in 800 years, and that of 10^35 erg is once in 5000 years on Sun-like stars whose surface temperature and rotation are similar to those of the Sun. It was also found that these superflare stars show quasi-periodic brightness variation, which can be interpreted as a result of rotation of stars with large star spots (Notsu Y. et al. 2013). This interpretation is consistent with standard theory of solar flares and dynamo (Shibata et al. 2013), and has partly been confirmed by spectroscopic observations of some of these stars using Subaru telescope (Notsu S. et al., 2013; Nogami et al. 2014). Furthermore, there were no evidence of hot Jupiters around these superflare stars, suggesting the possibility that superflares may occur on the Sun (Nogami et al. 2014). Shibayama et al. (2013) extended Maehara et al.'s work to find 1547 superflares on 279 solar type stars from 500 days Kepler data. They basically confirmed the results of Maehara et al., but found that in some Sun-like stars the occurrence rate of superflares was very high, 5 superflares in 500 days (i.e., once in 100 days). We shall discuss what would happen on the civilization and environment of the Earth if such superflares would occur on the Sun.

References
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Notsu, Y. et al. (2013) ApJ 771, 127
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Shim, Ja Soon (CUA/NASA GSFC)

Poster Number: I19

Poster - Modeling and validation of neutral density in higher altitude regions

Authors: Ja Soon Shim (CUA/NASA GSFC), Tim Fuller-Rowell (CIRES SWPC), Lutz Rastaetter (NASA/GSFC), Bruce R Bowman (Space Environment Technologies), and Maria M Kuznetsova (NASA/GSFC)

Abstract: There has been a growing concern about orbital collisions that will occur more frequently. One of the main sources of errors in orbit determination is uncertainty in the atmospheric density. As a result, accurate specification and prediction of neutral density is crucial to avoid potential disasters both in LEO and higher altitude regions. In this paper, we focus on modeling of neutral density in altitude regions higher than the upper limit of most physics-based atmosphere models, which are limited to a top pressure level of about 10 -7 Pa where the fluid approximation becomes no longer valid. To model neutral density at the altitude higher than 600 km, we introduce a simplified algorithm to extrapolate neutral density to greater altitudes. Using the extrapolation formula and thermospheric outputs obtained from a physic-based model, CTIPe (Coupled Thermosphere Ionosphere Plasmasphere Electrodynamics), we calculate neutral density along the satellite track such as Calsphere 02826 (near 800 km orbit) during quiet periods in 2003 and 2004 and geomagnetic storms as well. We will present preliminary results of the study and compare CTIPe orbital averaged neutral density values with HASDM (High Accuracy Satellite Drag Model) data, the JB2008 and NRLMSISE-00 model values.

Stohl, Emily (University of Colorado, Boulder)

Poster Number: I22

Poster - Global Scale Views of Upper Atmosphere Power Input and Output

Authors: Emily Stohl, Delores Knipp, Liam Kilcommons, Ryan McGranaghan, Linda Hunt, Kent Tobiska, and Martin Mlynczak

Abstract: We show observation and model-based views of upper atmosphere global power deposition and emissions for multiple solar cycles. Using revised estimates of extreme ultraviolet solar input for the Solar Irradiance Platform program, kinetic particle power for low Earth orbiting satellites, and a Joule heating proxy for 1948 to 2014, we improve the empirical energy deposition relationship from Knipp et al. [2004]. We compare these data with measurements of outgoing upper atmosphere infrared radiation from carbon dioxide and nitric oxide measured by the Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) instrument onboard the Thermosphere Ionosphere Mesosphere Energetics Dynamics) satellite for the years 2002-2013. Additionally, we compare the inputs and outputs to models driven by upstream solar wind data, such as the Weimer 2005 Joule heat model and the OvationPrime model from Newell et al. We find clear evidence of solar cycle modulation and response to specific events.

Tobiska, W. Kent (Space Environment Technologies)

Poster Number: M11

Poster - Operational advances for atmospheric radiation dose rate specification

Authors: Tobiska, W.K., D. Bouwer, J.J. Bailey, L.V. Didkovsky, K. Judge, H.B. Garrett, W. Atwell, B. Gersey, R. Wilkins, D. Rice, R.W Schunk, D. Bell, C.J. Mertens, X. Xu, G. Crowley, I. Azeem, A. Reynolds, M.J. Wiltberger, S. Wiley, S. Bacon, E. Teets, A. Sim, L. Dominik, B. Jones, and the ARMAS Science Team

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 developed innovative, new space weather observations that will become part of the toolset that is transitioned into operational use. One prototype operational system for providing timely information about the effects of space weather is SET's Automated Radiation Measurements for Aerospace Safety (ARMAS) system. ARMAS will provide the "weather" of the radiation environment to improve aircraft crew and passenger safety. Through several dozen flights the ARMAS project has 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 and Solar Energetic Particles. The real-time radiation exposure is computed as an effective dose rate (body-averaged over the radiative-sensitive organs and tissues in units of microsieverts per hour); total ionizing dose is captured on the aircraft, downlinked in real-time via Iridium satellites, 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 via the web and smart phone apps. We are extending the dose measurement domain above commercial aviation altitudes into the stratosphere with a collaborative project organized by NASA's Armstrong Flight Research Center (AFRC) called Upper-atmospheric Space and Earth Weather eXperiment (USEWX). In USEWX we will be flying on the ER-2 high altitude aircraft a micro dosimeter for effective dose rate measurements and a thermal neutron monitor to characterize Single Event Effects (SEEs) in avionics. In this presentation we describe recent ARMAS and USEWX advances that will ultimately provide operational users with real-time dose and dose rate data for human tissue and avionics exposure risk mitigation.

Wang, Houjun (University of Colorado, Boulder)

Poster Number: I12

Poster - Ionospheric Forecast during Sudden Stratospheric Warming Using the IDEA Model

Authors: Houjun Wang, Rashid Akmaev, Tim Fuller-Rowell1, Tzu-Wei Fang, and Jun Wang

Abstract: During sudden stratospheric warming (SSW), the large-scale atmospheric circulation in the stratosphere undergoes dramatic changes, which in turn affect the ionosphere through changes in tidal and other atmospheric waves, and possibly other mechanisms. Recent progress in coupled whole-atmosphere/ionosphere modeling has just enabled forecasting of the coupled system from first principles. In this talk, we present some results of the coupled atmosphere-ionosphere prediction during several recent SSW events. The purpose of this study is to demonstrate the feasibility for the coupled atmosphere-ionosphere prediction using a prototype IDEA model, i.e., the whole atmosphere model (WAM) coupled with an ionospheric model, in conjunction with the WAM data assimilation system (WDAS). The coupled IDEA model has been recently updated to a new version of the WAM model and data assimilation system.

The IDEA model has produced a successful medium-range prediction of the January 2009 SSW during solar minimum and quiet geomagnetic conditions. Recent SSWs in January 2012 and January 2013 occurred during different levels of solar activity and geomagnetic conditions. This study tests the predictive capability of the coupled system for different SSWs and during different solar and geomagnetic conditions.

Watari, Shinichi (National Institute of Information and Communications Technology)

Poster Number: S3

Poster - Statistics of events defined by UGEOA code and NOAA space weather scales

Authors: Shinichi Watari and Kazunori Yamamoto

Abstract: The Regional Warning Centers (RWCs) of the International Space Environment Service (ISES) have exchanged their data and information using the URSIgram codes. The URSIgram codes were originally developed to quickly exchange information among RWCs by using telex and have been used now. The UGEOA code is one of the URSIgram codes describing daily forecasts on solar flares, geomagnetic activities, and solar energetic particle events so called "proton events". The definitions of the forecasts of the UGEOA code were updated in April, 1992. For example, solar flare forecast becomes to

use GOES X-ray flare class instead of optical flare class by this update. The NOAA space weather scales was determined by the NOAA/SWPC in April, 2011. The scales describe solar flares, geomagnetic activities, and proton events as five categories, respectively. Definitions of events are slightly different between the UGEOA code and the NOAA space weather scales. Hence, we make a statistical analysis of events defined by using the UGEOA code and the NOAA space weather scales. We also calculate the hit rates of forecasts by the persistence method, which use condition of previous day as today's forecast. Those hit rates give us one measure of hit rates for forecasts made by the RWCs.

References
URSIgram code: http://ises-spaceweather.org/ISES/code/code.html
UGEOA code: http://ises-spaceweather.org/ISES/code/aaf/ugeoa.html
NOAA space weather scale: http://www.swpc.noaa.gov/noaa-scales-explanation

Winter, Lisa (AER)

Poster Number: S4

Poster - Developing an Empirical Model for Predicting Solar Energetic Particle Events

Authors: Lisa M. Winter (AER), R. Quinn (AER)

Abstract: Solar energetic particle (SEP) events are powerful enhancements in the particle flux received at Earth. These events, often related to coronal mass ejections, can be disruptive to ionospheric communications, destructive to satellites, and pose a health risk to astronauts. To develop a useful forecast for the peak of SEP events, we examined the radio burst and proton properties associated with the SEPs. Our goal is to use multiple observations from operational facilities to create an improved SEP forecast model that predicts both the time and energy spectral shape of impending SEP events. We present results on a detailed analysis of the Wind/WAVES type II and type III radio burst and GOES integral proton properties of SEPs from the current solar maximum. Additionally, we also explore the use of the proton background level in forecasting through an analysis of the GOES differential flux measurements over the past two and a half solar cycles.

Woodroffe, Jesse (Los Alamos National Laboratory)

Poster Number: M3

Poster - The LANL SHIELDS Project

Authors: Jesse R. Woodroffe, Vania K. Jordanova, Gian Luca Delzanno

Abstract: Due to the complex multi-scale nature of the magnetosphere, predicting space weather hazards remains one of the greatest challenges in space physics. This project, recently funded through the Los Alamos National Laboratory (LANL) Directed Research and Development (LDRD) program, will develop the SHIELDS framework, a new capability to understand, model, and predict Space Hazards Induced near Earth by Large Dynamic Storms. This challenging problem will be addressed by cross-Laboratory team of scientists using LANL's state-of-the-art models and computational facilities. Unlike other modeling efforts, SHIELDS will describe the dynamics of hot particles on both macro- and micro-scale, introducing new models for large-scale particle transport and a novel means of integrating the effects of local wave-particle interactions. In addition to physics-based models, we are developing new data assimilation techniques to dynamically incorporate data from LANL instruments on Van Allen Probes and geosynchronous satellites. SHIELDS will enhance our understanding of key radiation belt drivers and will improve our overall predictive capabilities in the near-Earth space environment where operational satellites reside.

Wu, Qian (National Center for Atmospheric Research)

Poster Number: I21

Poster - Thermospheric Wind Observation and Space Weather Research at NCAR

Authors: Qian Wu

Abstract: Thermospheric wind is a key parameter for understanding the ionosphere from high to low latitudes. NCAR has a long history of performing thermospheric wind observations from high to mid latitudes. With support from the National Science Foundation and Air Force Office of Scientific Research, NCAR is enhancing the observational capability in the polar regions and expanding into the equatorial region. The high latitude Fabry-Perot interferometer (FPI) at Resolute Canada (75N, 95W, 83 MLAT) has been upgraded and augmented by another FPI at Eureka (80N, 86W, 88 MLAT). In the mid latitudes, NCAR operates an FPI at Boulder (40N, 105W, 48 MLAT) and deployed one at Palmer station Antarctica (64S, 64W, 54 MLAT, to be funded). Soon NCAR will deploy two FPIs in Cape Verde (15N, 23W, 21 MLAT) and Ivory Coast (9.4N, 5.6W, 13 MLAT). These instruments will provide invaluable information for model development and space weather research related to the ionosphere. The high latitude observations help to validate a new ion convection model based on the SuperDARN observations for the NCAR TIEGCM. In the lower latitude, TIEGCM model simulation will be validated by new observations in Africa.

Yi, Kangwoo (Kyung Hee University)

Poster Number: M7

Poster - Dependence of spacecraft anomalies at different orbits on electron/proton particle flux

Authors: Yong-Jae Moon

Abstract: In this paper we investigate 198 spacecraft anomalies from 1994 to 2014. We use the anomaly data from Satellite News Digest (SND) and classify these data according to types of anomaly and spacecraft orbit. We examine the association between these anomaly data and 2-day particle (electron and proton) flux data from GOES as well as their occurrence rates. For the association, we use two criteria. The higher criteria are >10,000pfu for electron, >1,000pfu for proton, and >7 for Kp index. The lower criteria are >1,000pfu for electron, >100pfu for proton and >6 for Kp index. Main Results from this study are as flows. First, the control system and contact failure are dominant over the other ones. Second, the anomalies are much more associated with electron flux enhancements than the other ones. Third, the association between the anomalies and Kp index is not high. Fourth, the higher criteria seems to be better than the lower criteria since the former gives much higher occurrence rates than the latter. Fifth, there are 56 multiple events, which are more likely associated with space weather effects. In addition, we discuss the dependence of our results on the types of orbits : LH (Low altitude and High inclination) and HL (High altitude and Low inclination).

Young, Shawn (AFRL)

Poster Number: M17

Poster - Initial Analysis of an Energetic Proton Capability

Authors: Wm Robert (Bob) Johnston, Brian Kress, James McCollough

Abstract: Current environmental specifications for the energetic proton hazard focus on the South Atlantic Anomaly and the hazard at geosynchronous orbit, giving little or no quantitative information on the hazard for other orbits. Here we present a simple global model of the hazard and provide initial characterization of

its accuracy by comparing it to CRRES PROTEL (PROton TELescope) data. The CRRES satellite flew July 1990 to October 1991, during solar cycle 22 maximum, in a geo- transfer orbit that allowed it to observe energetic protons from LEO to GEO. During this period the PROTEL instrument observed several solar energetic proton events with a range of magnitudes. In this study we compare the model results to observations during several of these events.

Yudin, Valery (University of Colorado)

Poster Number: I18

Poster - Designing OSSE in the Whole Atmosphere Models: Analysis of GOLD and ICON Observations for Near Real Time Space Weather Predictions

Authors: Valery Yudin, Scott England, Stanley Solomon, Tomoko Matsuo, Michail Codrescu, Thomas Immel, Richard Eastes, Rashid Akmaev, Timothy Fuller-Rowell, Daryl Kleist, Larisa Goncharenko and Qian Wu

Abstract: The primary goal of Observing System Simulation Experiments (OSSEs) is to maximize and optimize the uses of current and future global observations to improve numerical weather prediction skills of operational forecast models. To help NOAA and NASA space-borne thermosphere –ionosphere teams to prioritize operational goals of forthcoming missions and their data products for space weather forecasts we discuss the first design of OSSEs in the whole atmosphere models. Performance of OSSEs in the whole atmosphere models with coupling of the ionosphere-thermosphere state will determine the complimentary impacts of new NASA Explores missions, such as GOLD and ICON, planned for launches in 2017. The aim of this poster is to discuss strategies to enable the assimilation of the thermosphere-ionosphere observations of GOLD and ICON into Whole Atmosphere Model (WAM) that represents the forecast component of the NOAA next generation global prediction system. We review and discuss the existing capability of adapted configurations of global community (WACCM-X and TIME-GCM) and planned-operational NEMS-WAM global models to support initial designs of OSSE for ICON and GOLD missions along with the assimilation of new types of data coming from observations of the thermospheric airglow emissions. Performing data denial OSSE studies that assimilate synthetic GOLD and ICON observations of the neutral temperature and composition drawn from a realistic Nature Runs stipulated to represent the "true" whole atmosphere, we examine the first opportunity to perform the near-real time space weather forecasts in the physics-based models constrained by observations of thermospheric emissions. A realism of OSSE Nature Runs represented by whole atmosphere models is evaluated by existing data collected during recent sudden and extreme terrestrial and space weather events.

Zanetti, Lawrence (JHU/Applied Physics Laboratory)

Poster Number: M16

Poster - Geomagnetic Disturbances – Prediction and Verification

Authors: L.J. Zanetti, B.J. Anderson, H. Korth, G. Ho, A. Vourlidas

Abstract: Aging research platforms angled into operational use, begs for a requirements and systems approach for space weather observational capability and to incorporate the measurements into operational prediction models, to the eventual goal of assilimation. Concept studies for upstream solar wind monitoring and CME observations from L1 as well as off-angle to L5 platforms will be discussed. This capability combined with modeling would be vital to understanding the cause and effect with AMPERE and AMPERE/Next as the ground truth.

Space weather impacts to the US power grid during even not-so-extreme events have been identified in multiple recent reports conducted by the National Academy of Sciences, Department of Homeland Security, stakeholder agencies and organizations, and insurance companies. Risk to the electric power grid

is but one example of space weather consequences and the dire need for increased capability with regard to prediction, assessment, and accuracy of our space weather intelligence system. The AMPERE/Iridium system of identifying the ionospheric source current systems, which are responsible for geomagnetic induced currents (GICs) will be highlighted.

Zhang, Yongliang (JHU/Applied Physics Laboratory)

Poster Number: I7

Poster - Real-time identification of radar auroral clutter using SSUSI data

Authors: Yongliang Zhang, Larry J. Paxton, Robert Schaefer, and Hyosub Kil

Abstract: We have developed and tested an algorithm to determine radar auroral clutter using auroral images from satellite instrument used to produce operational space weather products. SSUSI (the Special Sensor Ultraviolet Spectrographic Imager on DMSP F16, 17, 18 and 19 satellites) provides auroral images in near real time from each of these currently operating spacecraft. Energetic particle precipitation in the auroral region produces far ultraviolet emissions that are mapped by these sensors. These same energetic particles also create enhanced ionization and high electron densities in the polar ionosphere. These enhanced electron densities can scatter radio waves. The scattered radio waves form "auroral clutter" on a radar map. Since there are four SSUSIs in orbit we get updates of the aurora about every ~25 minutes. By combining SSUSI auroral images and an auroral forecast model, we can actually image auroral clutter regions in real time and even predict it a few hours ahead of time. The algorithm has been tested with radar measurements.