Annual Report of RWC Korea 2013-2014

Korean Space Weather Center of National Radio Research Agency

The Korean Space Weather Center (KSWC) of the National Radio Research Agency (RRA) is a government agency which is the official source of space weather information for Korean Government and the primary action agency of emergency measure to severe space weather condition.

KSWC's main role is providing alerts, watches, and forecasts in order to minimize the space weather impacts on both of public and commercial sectors of satellites, aviation, communications, navigations, power grids, and etc. KSWC is also in charge of monitoring the space weather condition and conducting research and development for its main role of space weather operation in Korea.

Recent Accomplishments

1) New ISES website and forecaster discussion tools

KSWC had developed a new ISES website and hosted it since August 1st, 2013. The ISES website can be accessed through two URLs of http://www.spaceweather.org and http://ises-spaceweather.go.kr. The new website contains new functionalities of showing current space weather condition and latest forecast of regional warning centers.

It also has special tools of sharing information and helping real-time discussion among ISES members. The space weather discussion tool provides a social network service based upon a bulletin board to discuss specific topics for space weather condition among ISES members. The Enlil discussion tool gives results of the Enlil model and analysis of the results from RWC USA, RWC Australia and RWC Korea.

The new ISES website also gives help in sharing information and making a coordinated forecast among ISES members. However, the project of forecaster discussion tools is not completed yet. We need more inputs of idea and efforts to facilitate the live discussion on it.

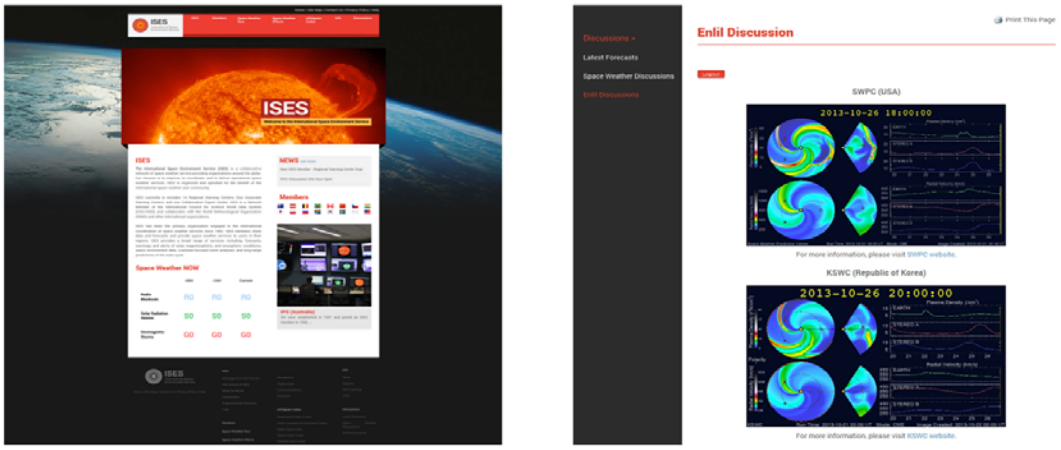

Figure 1. New ISES website and a discussion tool

2) Automatic Solar Synoptic Analyzer and Solar Activity Forecast

KSWC has developed a software system, named as Automatic Solar Synoptic Analyzer (ASSA). From solar images of SDO and SOHO satellites, the ASSA automatically identifies sunspot groups, coronal holes, and filament channels, which are three major solar sources causing changes in the space weather. It also provides sunspot classifications according to both of McIntoshi and Mt. Wilson Magnetic Classification Rules and flare probabilities based on the statics of ASSA Sunspot Catalog which is generated with SOHO MDI Continuum and Magnetogram images from September 1996 to January 2011. The whole procedures are automatically and periodically performed in one-hour cadence.

The ASSA is a fruit of international collaborations between KSWC and NOAA Space Weather Prediction Center (SWPC). We got the basic idea of analysis with solar imaginaries from SWPC's Solar Synoptic Drawings. SWPC forecasters produce the Solar Synoptic Drawings as a daily basis to predict solar activities, i.e., solar flares, filament eruptions, high speed solar wind streams, and co-rotating interaction regions as well as their possible effects to the Earth. As an attempt to emulate this process with a fully automated and consistent way, we developed the ASSA. We also borrowed their knowledge and experiences on sunspot classification and flare predictions, and transcribed the heritages into automated software system.

The ASSA has been served KSWC customers and international partners since December 2012. The latest resultant images and text data can be accessed at http://www.spaceweather.go.kr/assa. Additionally, a standalone IDL application program for public, called as ASSA GUC is being distributed, with users can use the ASSA software on their own computers. KSWC provided the ASSA software system to NASA Coordinated Community Modeling Center (CCMC) and it has been

operated onsite at the CCMC from November 2013.

We are conducting a couple of research projects to upgrade the performance of the ASSA's solar activity forecast and develop additional functions on it, such as solar wind predictions based on the ASSA's coronal holes identification results, and tracking variations of each active region's classification and morphological parameters of area, length of magnetic inversion line, and etc.

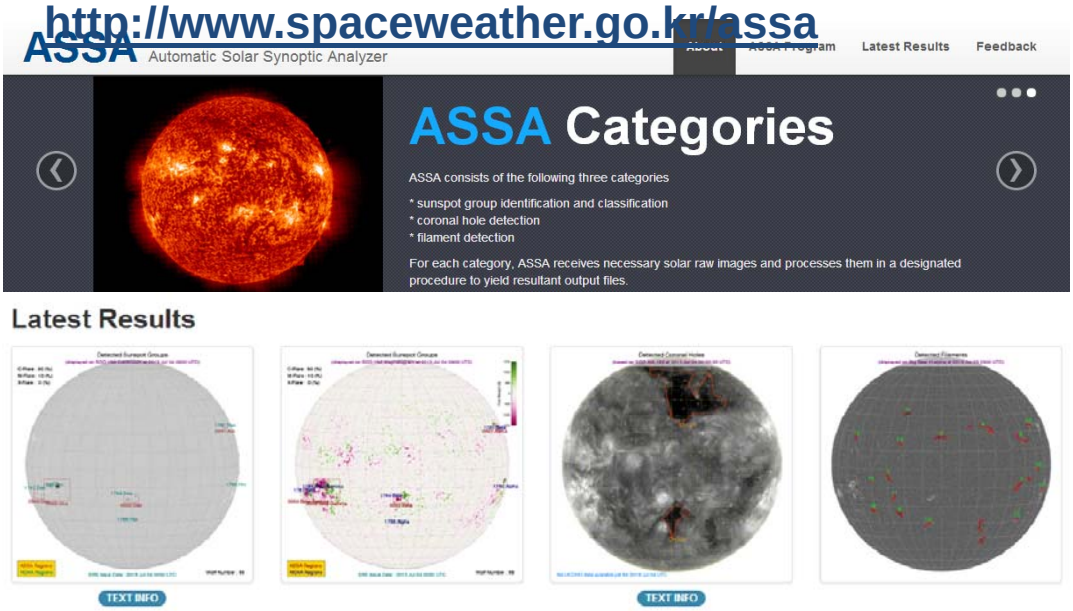

Figure 2. KSWC's ASSA website

3) IPS-Driven Enlil Model

KSWC is funding Dr. Bernard Jackson's group of the University of California, San Diego (UCSD) and Dr. Dusan Odstrcil group of George Mason University (GMU) to perform so called IPS-Driven Enlil Model study. Both of UCSD IPS tomography model and WSA-Enlil+CONE model has been operated at KSWC since March 2013 and December 2012, respectively. The goal of first year project for FY2014 is making the IPS-driven boundary condition at 21.5 Rs for Enlil model input. It is expected that the model helps in predict CME arrival when no STEREO nor SOHO coronagraph data available in the future. For the specific applications, it is best to certify that there are high-quality data (both remotely-sensed and in situ) available, especially when using these analyses as a lower boundary for 3D-MHD forward-modeling techniques. The Enlil model simulation results using IPS boundaries as input are verified fairly well with in situ measurements. The real-time IPS boundary data for driving Enlil model are now available and Enlil has been run successfully using these inputs.

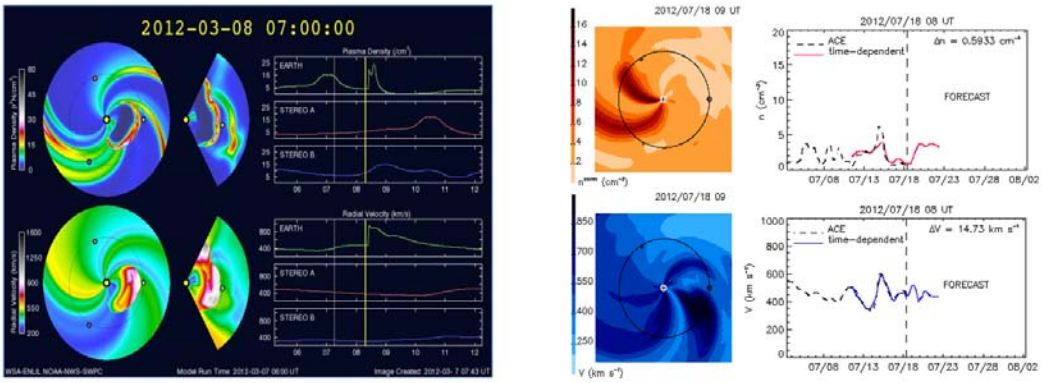

Figure 3. KSWC's WSA-Enlil+CONE and IPS tomography model

4) Efforts on Space Weather Monitoring and Prediction for Aviation Sector

KSWC has developed a space weather monitoring software system to support local airlines for their polar route flights. It serves the Korean Airline and Asiana Airline and provides a tailor-made system including near real-time flight position tracking, radiation dose rate and cumulative radiation dose for each flight number.

KSWC participates in NASA's Automated Radiation Measurement for Aviation Safety (ARMAS) project. KSWC-owned two measuring systems will be mounted at the flights of NOAA and NCAR within 2014, and the measured data will be gathered in real-time and compared with NASA's radiation model of Nowcast of Atmospheric Ionizing RAdiation System (NAIRAS).

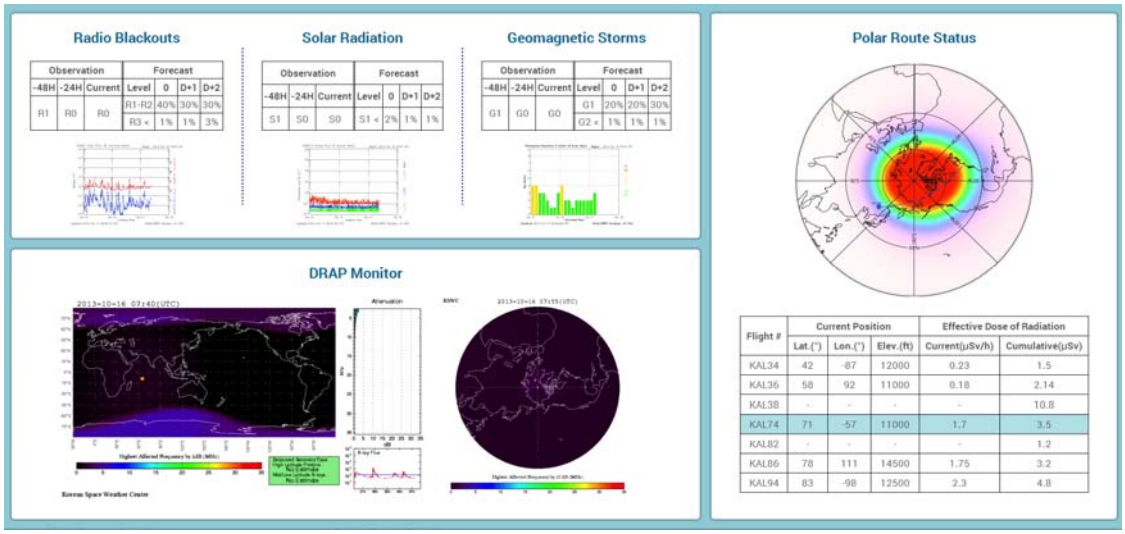

Figure 4. KSWC's Polar Route Space Weather Monitor

High Priority Product Goals

In order to support customer groups better, KSWC has adopted two solar wind models, NOAA's WSA-Enlil+Cone model and UCSD's IPS tomography model, and continues to develop new prediction models and services. Among the new models, the ASSA is the one in the limelight. The ASSA is a fully automated software system of near real-time monitoring and identification of key solar phenomena such as sunspot groups, coronal holes and filaments, and provides flare probability prediction with an hour cadence. The latest results and information can be accessed at http://www.spaceweather.go.kr/assa and they are also available through the NASA Community Coordinated Modeling Center's website of http://ccmc.gsfc.nasa.gov.

High Priority Data Needs

KSWC has three local observatories in Jeju, Icheon, and Gangnung and operates full sets of ground based observation systems. Two ionosondes, and two TEC/scintillation monitors are located in Icheon, and Jeju. Three magnetometers are located in Icheon, Jeju, and Gangnung. A Solar Radio Spectrograph Radiometer and a F10.7 solar flux meter are located in Icheon. An Interplanetary Scintillation monitor, a solar radio interference measurement system, and a 13-meter parabolic antenna for ACE tracking are located in Jeju. KSWC also operates GIC monitors along the 765 KV and 154 KV power transmission lines of Korea Electric Power Cooperation. KSWC will build another 13-meter satellite receiver antenna by the end of 2014. It has dual RF of X band and S band plays a role of triple receiver for tracking STEREO, ACE, and DSCOVR satellites.

Forecast Verification

KSWC conducted its forecast verification and validation study. An example of comparison of forecast reliability between 2013 and 2014 is shown in Figure 5.

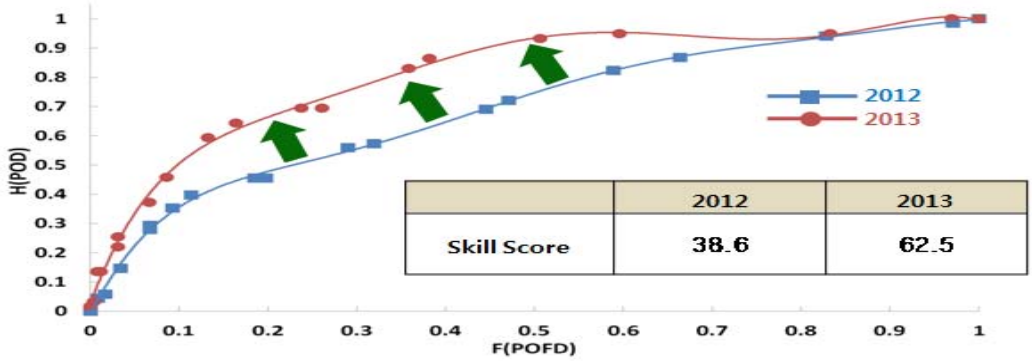

Figure 5. KSWC's forecast reliability, 2013-2014