RWC Brazil 2014 Annual Report

1. Recent Accomplishments

1.1 Magnetometer Network in South America

Embrace program has start setting a magnetometer network over South America, mainly in the eastern portion, to monitor the Earth's magnetic fields variations along the eastern portion of the American sector to provide a toll to:

1. estimate the electric fields at E and/or F regions heights;
2. provide the ground induced effect of the EEJ (or CEJ);
3. provide the time derivative of the field (dB/dt);
4. monitor the disturbance level based on the Ksa-index, and
5. monitor the disturbance level based on the Dst Proxy.

In the Figure 1, we present the network station locations in which the green label means that the stations are operational, the yellow label indicates the magnetometers for those particular stations are passing through the calibration process or standing by to be calibrated; and the red label indicated that the magnetometers for those particular stations are being bought.

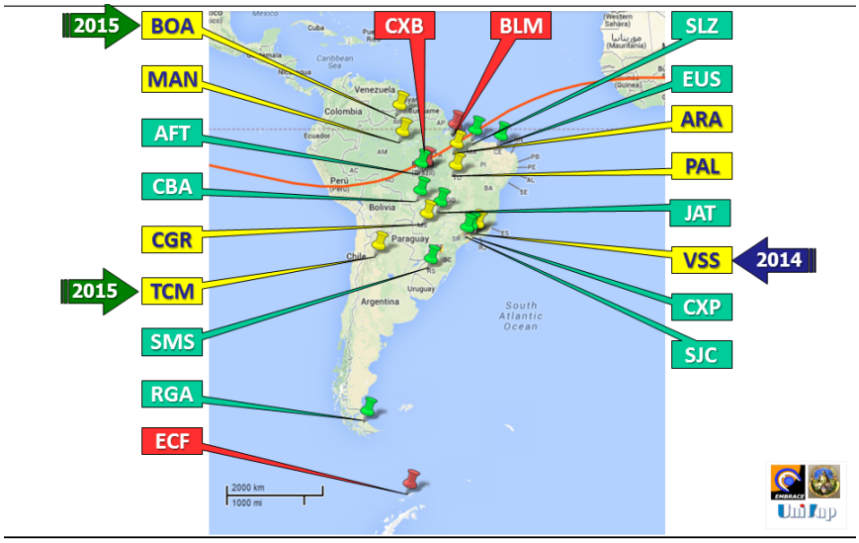

FIGURE 1. Locations of the Embrace Magnetometer Network in South America.

The data from these stations is routinely collected every five minutes and automatic processed to derive: (a) each individual station delta H (horizontal component); (b) the time derivative of each individual station delta H; (c) the station K index; (d) the network averaged delta H named Dst Proxy; (e) the network averaged derivative of delta H named GIC proxy; and (f) the South American K index named Ksa.

1.2 TEC Maps over South America

Embrace program has provide some improvements to the TEC map obtained from more than 150 GNSS receivers spread over South America to monitor the ionized atmospheric environment aiming to provide a toll to:

1. provide a reliable GNSS data processor for the community,
2. provide the current TEC over the South America;
3. estimate the vertical error [m] over the South America; and
4. estimate the horizontal error [m] over the South America.

In the Figure 2, we present the network station locations in which the green label means that the last data from that particular stations arrived inside the 10 minutes window, the yellow label indicates that the last data from that particular stations arrived between the 10 and 30 minutes window; and the red label reveals that the last data from that particular stations arrived more than 30 minutes ago. Also, the filled symbol inside the icon indicated the owner of that particular station listed in the right bottom corner of the figure.

FIGURE 2. Locations of the GNSS Networks in South America from which the Embrace process the data.

The data from these stations is routinely collected every 10 minutes and automatic processed to derive: (a) the South American TEC map; (b) the South American vertically integrated error estimate (in meters); and (c) the South American water vapor vertically integrated map (*currently under validation process*). Also, one day after the data being collected all the maps are reprocessed for including extra data arrived within the last 24 hours.

1.2 Space Weather User Workshop

The second Workshop of the Embrace Space Weather Program with its users was held on October 11th 2013 at the National Institute for Space Research, which included training, visit to the Embrace Space Weather facilities and workshop discussion with spread groups (satellite-

based positioning/locating industry, telecommunication industry, power grid and pipe lines operators, satellite operators, and academy).

As a result from the user requests, Embrace has provided two alert systems, one based on the GOES X-Ray monitor, another in the Ksa magnetic index. Also, the South American water vapor vertically integrated map is to be public released before the end of this year and the Embrace platform for user registration, data exchange and data access is planned to be developed soon.

1.3 Discussion on Ionospheric Scales

Together with representatives from North America, Europe, and Australia, some Embrace members attended a meeting held on 7 April, 2014 in association with the Space Weather Workshop in Boulder, Colorado to discuss the possibility of developing an ionospheric scale or index. The discussion was attended by representatives from North America, South America, Europe, and Australia.

It was generally agreed that more than one scale is needed to target all the different user groups impacted by ionospheric disturbances, and that the initial focus should be on addressing the navigation, positioning and satellite communication users. It was agreed that both regional and global scales are needed, with a global scale serving as a “heads-up” that will direct customers to the next level. It was recommended that interested collaborators work together on a regional basis, utilizing GNSS phase or code data to explore techniques to quantify ionospheric disturbances. The goal is to catalogue times of departure of TEC from “normal”, or when steep spatial gradients or rapid temporal changes occur. The occurrences are to be binned by their degree of departure from a 10-day running mean.

As a result, the Embrace program developed its web service for TEC maps data exchange to allow the beginning of the scientific analysis to develop the ionospheric scales.

2. High Priority Product Goals

2.1 Regional Disturbance Products

Embrace has made an effort to develop and provided two alert systems, one based on the GOES X-Ray monitor, and another in the Ksa magnetic index. Both system automatic analyze the received data from magnetometers and X-Ray flux, and release alerts in both media twitter and email, when some threshold level is achieved depending on the scale. Depending on the alert and the media which it is sending to, some additional information is add to the alert, like the time of start, severity and consequences for the community (*available only for the email version*).

FIGURE 3. Sample email with a R3 radio alert released on 11 June 2014.

So far, the email alerts are sent to the Embrace program member only. However, Embrace is currently developing a platform where user can register and select products and alert they want to receive in their email boxes.

2.2 Modeling Capability

Embrace is also making an effort to create a new computational capability to run space weather related models for both operational and scientific purpose. The system is tough to be a balanced

mirror of computer processor. In one side of the system the space science modelers community may research new method and test new space weather related models. Once the model is fully operational it may easy be transferred to the operational side of the system to start its routine runs according to the Embrace needs.

3. High Priority Data Needs

3.1 Solar Radio Images

Embrace is devoting efforts to develop a radio observatory with capability for obtaining radio images from the Sun similar to those obtained with the Noboyama Radio Observatory in Japan. However, contrary to the Noboyama Radio Observatory, Embrace opted by a radio interferometer with a relatively large spectrum coverages in a long baseline. Its integration is made with fiber optics in order to avoid cables-related problems. Besides monitor the sunspot number, size, complexity and time evolution, the purpose of such solar radio observation is to monitor the locus of development of magnetic loops to start developing tool to prevent solar burts.

3.2 Low Cost Solar Burst Monitor

Embrace has developed and tested a low cost ground based solar burst monitor to identify and locate active solar region (solar latitude and longitude). The prototype was developed, testes and provided good results. The equipment in now in phase of first version manufacturing and is planned to be released to the community in a two year time frame. The main objective of such monitor is to provide a very fast solar burst region detector that can provide accurate solar coordinates to the big and oversized solar observatories antennas, reducing the tracking time.

4. Forecast Verification

Embrace is developing a IT platform, integrated to its data banks for maintaining the data and metadata verification/validation. Also, Embrace continues to maintain its weekly forecasters group meeting activities for proving a forum to discuss and to weld the lessons learned from the daily activities.