#125 Received 01/21/2015

Coster, Anthea[1]; Pankratius, Victor[1]; Kingsbury, Ryan[2]; Kennedy, Andrew K.[2]; Frank Lind[1]; Phil Erickson[1]; John Noto[3]; Juanita Riccobono[3]
1. MIT Haystack Observatory
2. MIT
3. Scientific Solutions, Inc.

Monitoring Traveling Ionospheric Disturbances With a Global Mobile Device Network

Abstract:
Traveling ionospheric disturbances (TIDs) have been an area of increasing interest due to their potential relationship to tsunamis, meteors, nuclear detonations, and man-made disasters such as fires. In addition, TID's can seriously impact HF and VHF signal propagation.

Detecting TIDs requires continuous and high-resolution monitoring of the ionosphere, and this can be achieved by exploiting the already deployed Global Navigation Satellite System (GNSS) infrastructure. The signal delays measured by ground receivers are proportional to the global total electron content (TEC) along the line of sight to a particular satellite. Various "slices" can be collected to create a 2-dimensional maps of TEC and with further processing, maps of TIDs. For example, Japan's dense network of GNSS receivers has been repeatedly used to successfully observe TIDs with high resolution. However, in many areas of the globe, the practicality of deploying more and more ground sensors to enable the creation of accurate TID maps is prohibitively expensive.

To easily expand the collecting area, the NSF-supported Mahali project leverages mobile phones as low-cost relays in order to transport TEC data to a cloud computing environment that reconstructs and visualizes current ionospheric conditions. This contribution discusses an experiment planned for Spring 2015, when the Mahali project will deploy multiple GNSS receivers around the Haystack Observatory area in Westford, MA, to monitor traveling ionospheric disturbances (TIDs). Mahali offers the advantage that GNSS receivers with attached cell phones can be easily moved and configured to enable the collection and processing of data in near real-time.

Our proof of concept will serve as a starting point for an investigation of ionospheric structures at different scales. Initial TID results will be compared with optical images and incoherent scatter radar observations. As connectivity over cell phone networks and WiFi continues to improve across the world, scientific data collection will become possible in many places that were considered unreachable in the past. Mobile devices can also utilize local storage and programmatic intelligence to initiate data transfers when networks are within range.

Eventually our approach will enable scientists to follow the spirit of "Kila Mahali", which means "everywhere" in Swahili, and expand our knowledge horizon in exciting new ways.