Characterisation of Equatorial Ionospheric Anomaly in African/Asian region

EquatoRial Ionosphere Characterization in Asia (ERICA)

Executive Summary

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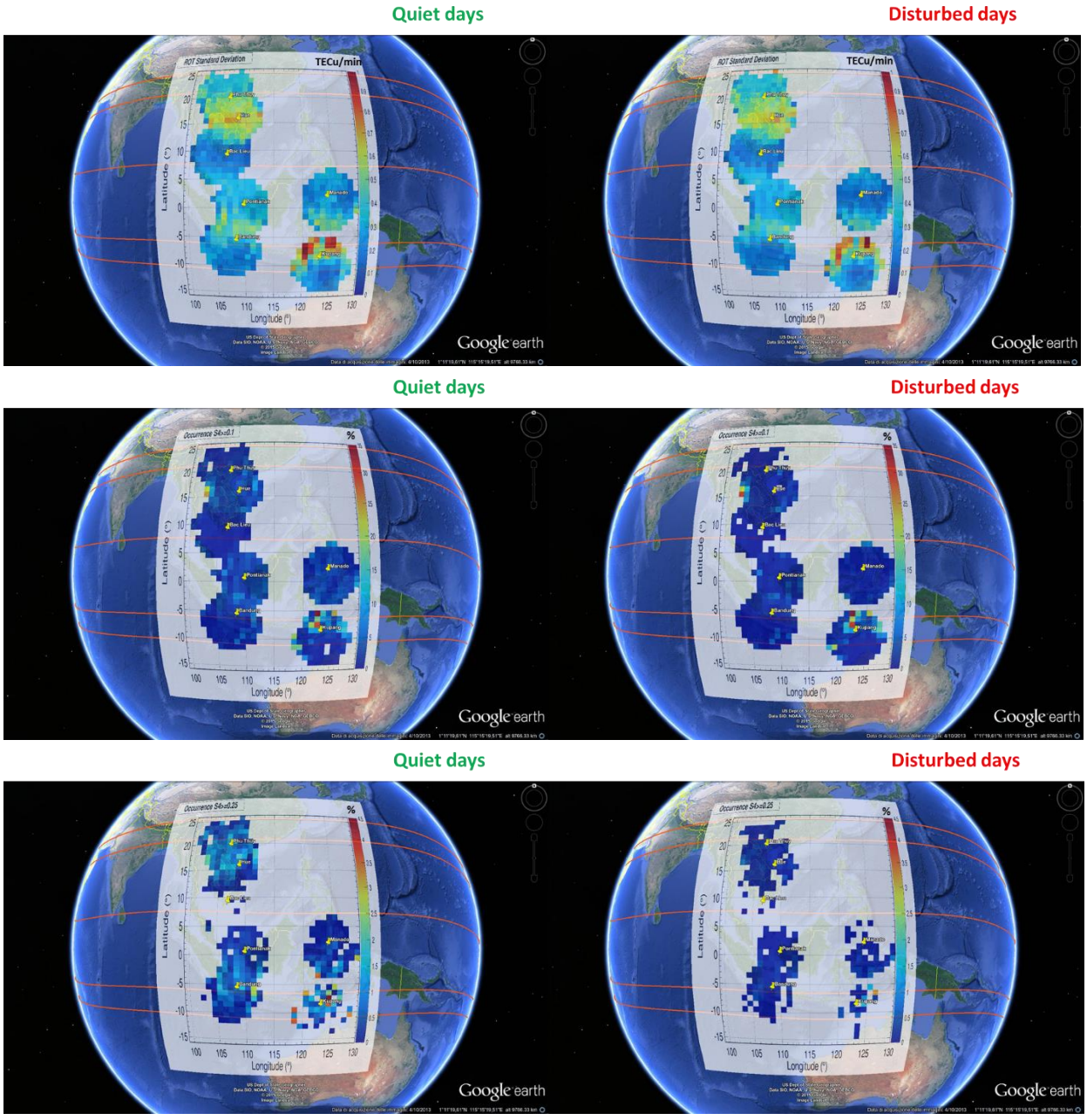
Alcantara Study Reference No.: 14-P53

Study Type: Study

Contract Number:4000112416/14/F/MOS

Picture:



Representation of the Ground Based Scintillation Climatology over the Google Earth ™ maps (orange curves are the dip equator line and the ± 15°-20° magnetic parallels from IGRF 2010)

Motivation:

Scope of the study was to characterize the ionospheric variability of the Equatorial Ionospheric Anomaly (EIA) in South East Asia (SEA), in particular the variation of plasma electron density in EIA southern and northern crests and over the dip equator identified by the Equatorial Ionospheric Trough (EIT).

Methodology:

The ERICA team set up an ad-hoc measurement campaign (March-October 2015) carried on with contribution of local experts in Indonesia and Vietnam, who conducted the data collection with ground-based instruments deployed in the footprints of EIA and EIT. The set of instruments included scintillation and Total Electron Content (TEC) monitors, magnetometers, and ionosondes. Collected data comprehend raw and processed data from GNSS scintillation monitors and variation of the components of the geomagnetic field. To support the assessment of the ionospheric electron density distribution, data from International GNSS Service receivers in the area were also used. Raw GNSS datasets were collected with a custom front-end deployed at the NAVIS Centre in Hanoi. The collected data were used to assess the ionospheric features that characterize the upper atmosphere over Vietnam and Indonesia. The adopted approach was twofold: an overall climatology of the ionosphere in the considered region and an in-depth analysis of specific weather events.

Results:

- The main achievement of the ERICA study is the contribution to the understanding of not completely resolved and/or open issues of the ionosphere over SEA. Among these, the inhibition of the formation of the two crests of the EIA, the corresponding inhibition of the scintillation on L-band signals and the asymmetry of the scintillation patterns between the northern crest of the EIA and the southern one.
- The study has highlighted the crucial importance of accessing regional data to properly characterise the ionospheric environment for both climatological and space weather assessment. In fact, the ionospheric climatology provides a realistic picture of the upper atmosphere environment that serves as a background to investigate more deeply the ionospheric perturbations caused by geospatial events. The twofold approach has proved to be effective in providing the knowledge tools to understand the local features of the ionosphere. This is even more important in SEA regions that are unevenly covered by ionospheric and geomagnetic measurements.
- A data base of all data collected during the measurement campaign is available on a server in ISMB premises and open to interested researchers with not-for-profit purposes.
- The collaboration with SEA institutions established during the project has been fundamental to achieve interesting results during both the conduction of the measurement campaign and the data analysis. In this frame, the study was the opportunity to combine the strong expertise of the European team with the specific knowledge of the Asian researchers. This is indeed the most valuable legacy left by ERICA, which will hopefully result in future collaborations.

Publications:

- G.Povero, M. Pini, L.Alfonsi, L. Spogli, D. Di Mauro, F. Dovis, R. Romero, M. Le Huy, P. Abadi, V. La The, N. Floury, "Ionosphere Monitoring in South East Asia: activities in GINESTRA and ERICA projects", in the *Proceedings of the 2015 International Association of Institutes of Navigation World Congress*, Prague, Czech Republic, October 20-23, 2015, DOI 10.1109/IAIN.2015.7352230 IEEE Conference Publications
- G.Povero, P. Abadi, L. Alfonsi, D. Di Mauro, F. Dovis, V. La The, M. Le Huy, M. Pini, R. Romero, L. Spogli, "The Saint Patrick geomagnetic storm monitored by the ERICA project", *12th European Space Weather Week*, Ostend, Belgium, November 23-27, 2015
- L. Alfonsi, L. Spogli, D. Di Mauro, M.Pezzopane, C. Cesaroni, G.Povero, M. Pini, F. Dovis, R. Romero, N. Linty, P. Abadi, F. Nuraeni, A. Husin, M. Le Huy, V. La The, V. Pillat, N. Floury, "The ionospheric response to the Saint Patrick storm over South East Asia", *2015 AGU Fall Meeting*, San Francisco, California, December 15-19, 2015
- G.Povero, L. Alfonsi, L. Spogli, D. Di Mauro, C. Cesaroni, F. Dovis, R. Romero, M. Le Huy, P. Abadi, V. La The, N. Floury, "Ionospheric Monitoring in South East Asia in the ERICA study", in the *Proceedings of International Technical Meeting of the Institute of Navigation (ION-ITM) 2016*, Monterey, California, January 26-28, 2016, 556-563
- L. Alfonsi, L. Spogli, C. Cesaroni, R. Romero, F. Dovis, G. Povero, "Characterization of Equatorial Ionosphere in South East Asia in the ERICA Project: a case study", submitted to *2016 Beacon Satellite Symposium*, Trieste, Italy, June 27–July 1, 2016

Highlights:

The data availability and the synergy between the European and the Asian institutions involved in the study has resulted in an unprecedented description of regional ionospheric plasma. The ERICA results will hopefully contribute to the advancement of the current scientific understanding of the SEA ionosphere in view of future space weather services in the area. It is however recommended to foresee resources to support the local institutions in training the next generation of scientists to strengthen links between Europe and SEA.