IBISCO

IONOSPHERIC ENVIRONMENT CHARACTERIZATION FOR BIOMASS CALIBRATION OVER SOUTH EAST ASIA

IBISCO team

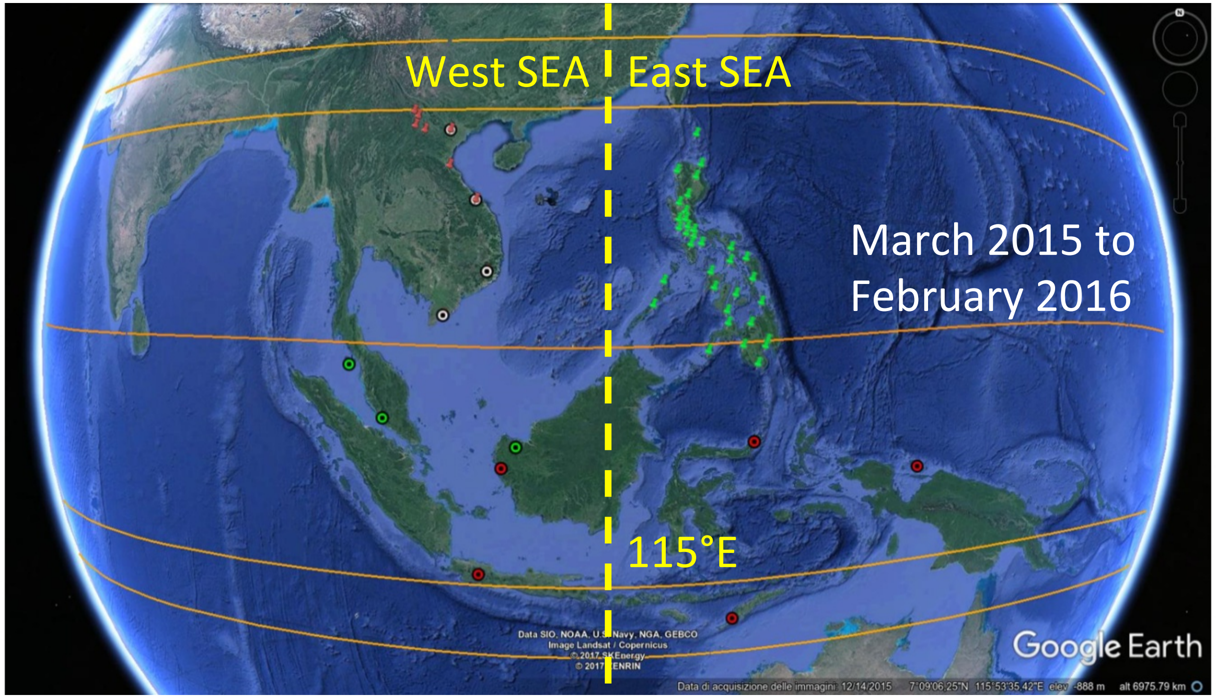
Gabriella Povero, Marco Pini,
Luca Spogli, Claudio Cesaroni, Giorgiana De Franceschi,
Michael Pezzopane, Alessandra Giuntini,
Biagio Forte, Cathryn N. Mitchell,
La The Vinh, Ta Hai Tung, Asnawi Husin, Sri Ekawati

Final Review – 7 December 2017

methodology

- limatology (1 year) of the ionosphere in the two quietest days of each month in the considered period over South East SIA (SEA)
- pecial focus is given to the times of the foreseen Biomass orbital passes, i.e. 06 AM and 06 PM
- ariation of TEC (including its spatial and temporal variation) and amplitude scintillations (S_4)
- he sensitivity of TEC and TEC gradients mapping has been tested to assess the actual reliability of the method
- ase events and climatology from ionosonde data

network of GNSS receivers*



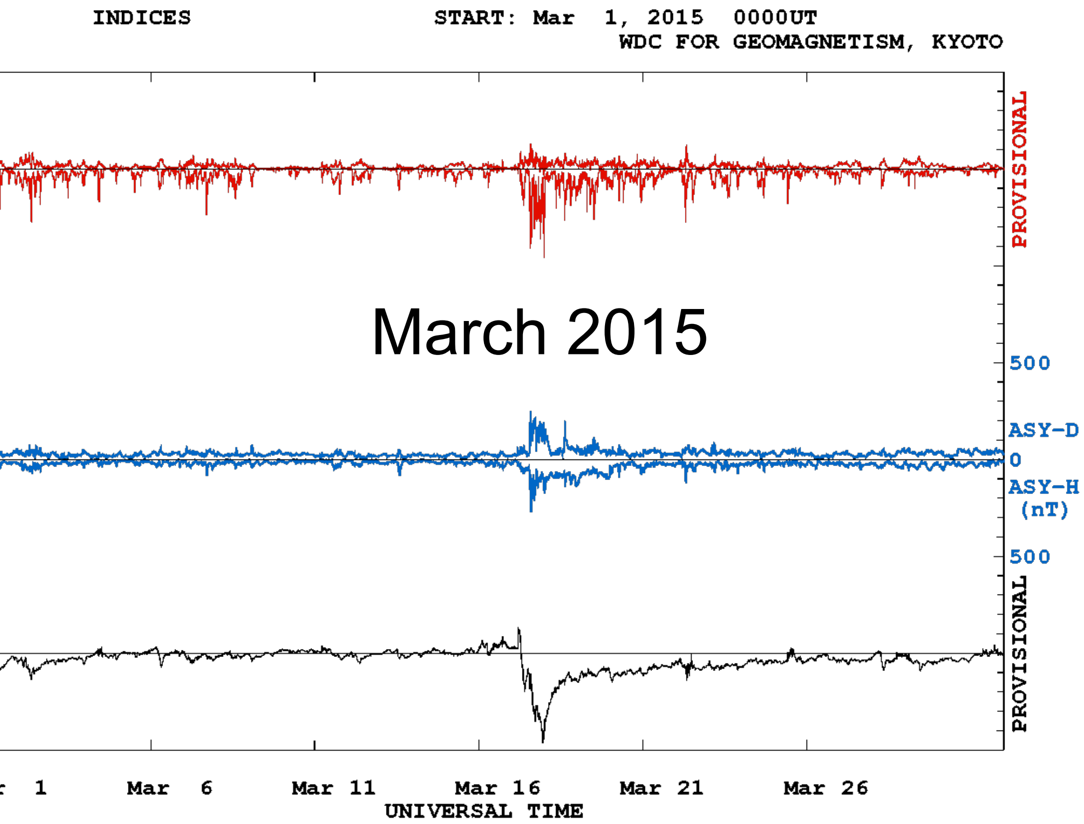
Pins: geodetic receivers
(1 Hz – TEC measurement)

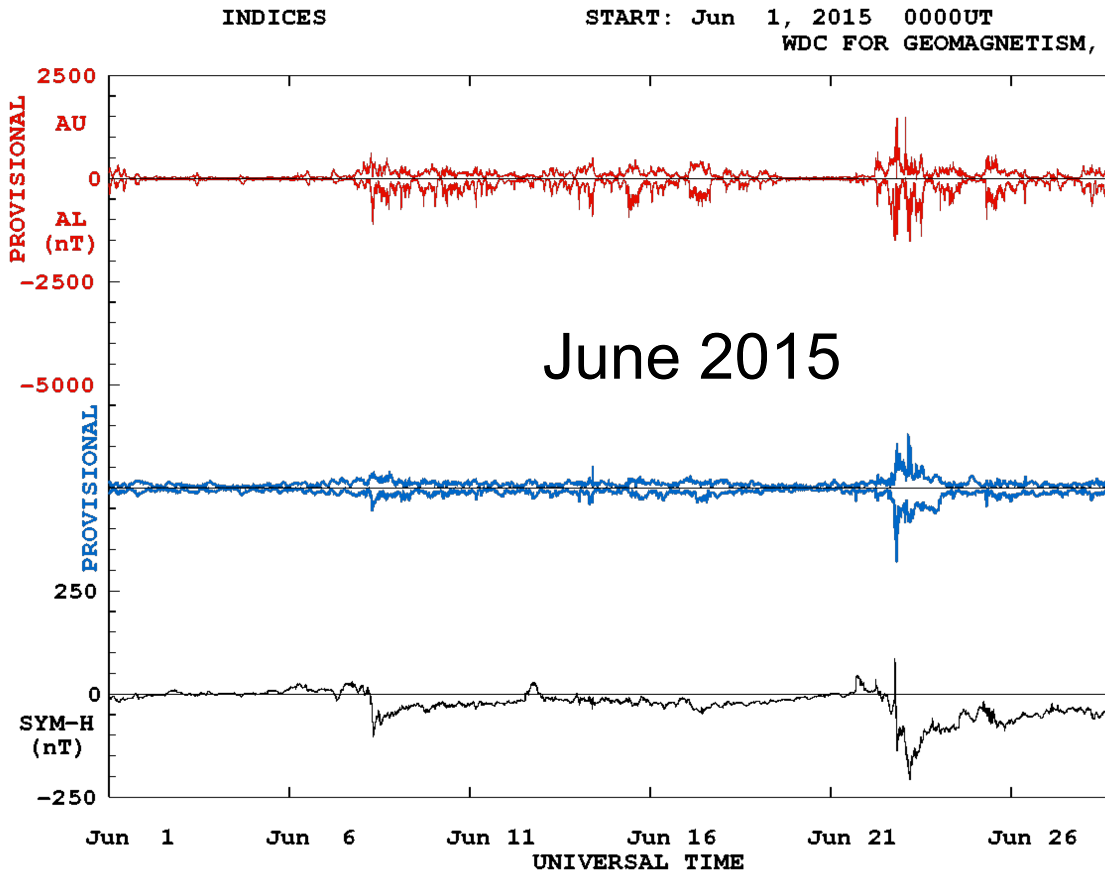
Circles: scintillation receivers
(50 Hz – S4 and TEC measurement)

*from partners + addition

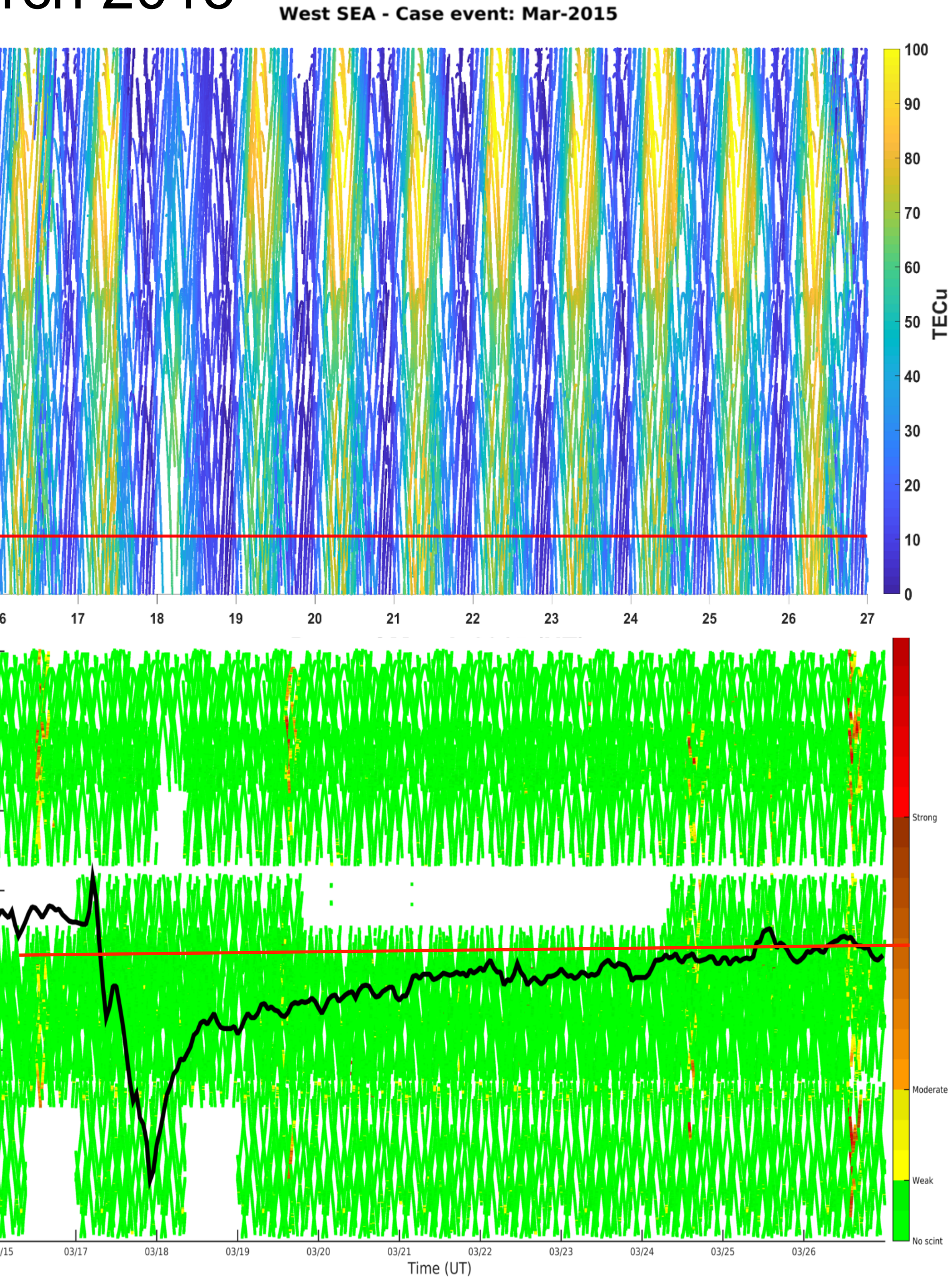
ighlights of the scientific results:

pplications to ionospheric science

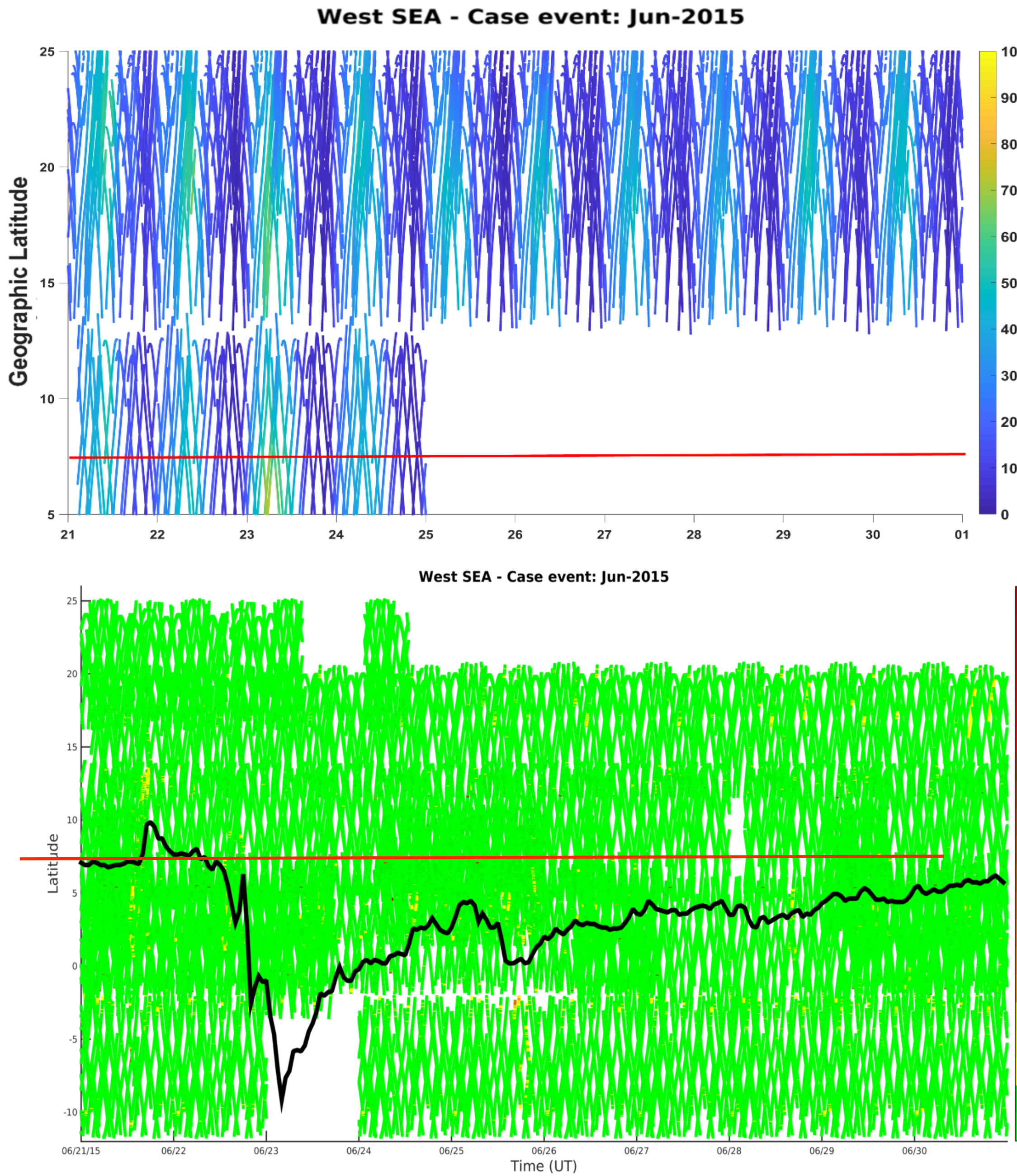




rch 2015



June 2015



Lessons learnt from the case studies

The two storms of **March and June 2015** were investigated by analysing the **TEC** and **S_4** variations.

The comparison between the geomagnetic indices variations in the two case studies reveals a quite **diffe configuration of the magnetosphere-ionosphere coupling**. The event happened in March is characterized by a recovery phase, but the SYM-H assumes higher values soon after the peak. At the storm onset the auroral regions s high level of the electrojet with impulsive substorm signatures.

Although the average TEC level was significantly larger in March, the ionospheric irregularities were suppres mainly in June. That storm, in fact, induced an almost complete inhibition of scintillations over all the SEA investig areas. Such effect is well explained looking at the TEC variability, that is quite smooth in June, testifying a signif modification of the EIA.

The **lower level of scintillation found for the June 2015 storm with respect to the March 2015** one is some expected. In fact, solsticial months are characterized by a lower occurrence of scintillation with respect to equinoctial c Thus, in the case of the June 2015 storm the lack of strong scintillation levels is due to the interplay between the re seasonality of the equatorial ionosphere and the inhibition of the ionospheric irregularities formation due to the pr penetration of electric fields from the auroral latitudes and to the disturbance dynamo.

As stressed by several authors (e.g., Alfonsi et al., 2011; Ray et al., 2006; Anderson et al., 2004; Spogli et al., 2016**), not yet clear whether an enhancement in upward ExB drift is necessary and sufficient or simply necessar creating the conditions driving to scintillation occurrence**. Certainly, the upward **ExB** drift is a key driver for develo scintillation models at low latitudes.

ighlights of the scientific results:

pplications to Biomass external calibration

xisting Facilities in SEA have been used to characterize West/East regions in SEA

he analysis of the GNSS data has produced the following outputs:

- TEC temporal gradients derived from meridional chains of receivers;
- TEC spatial gradients;
- Scintillation occurrence.

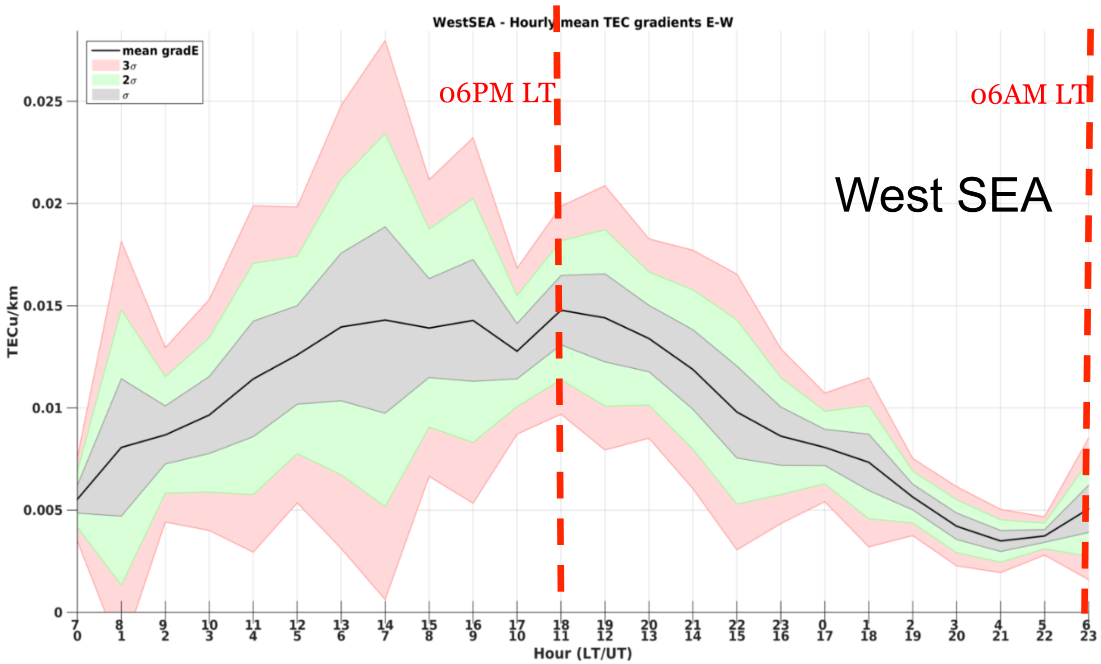
ompanion data analysis: ionosondes

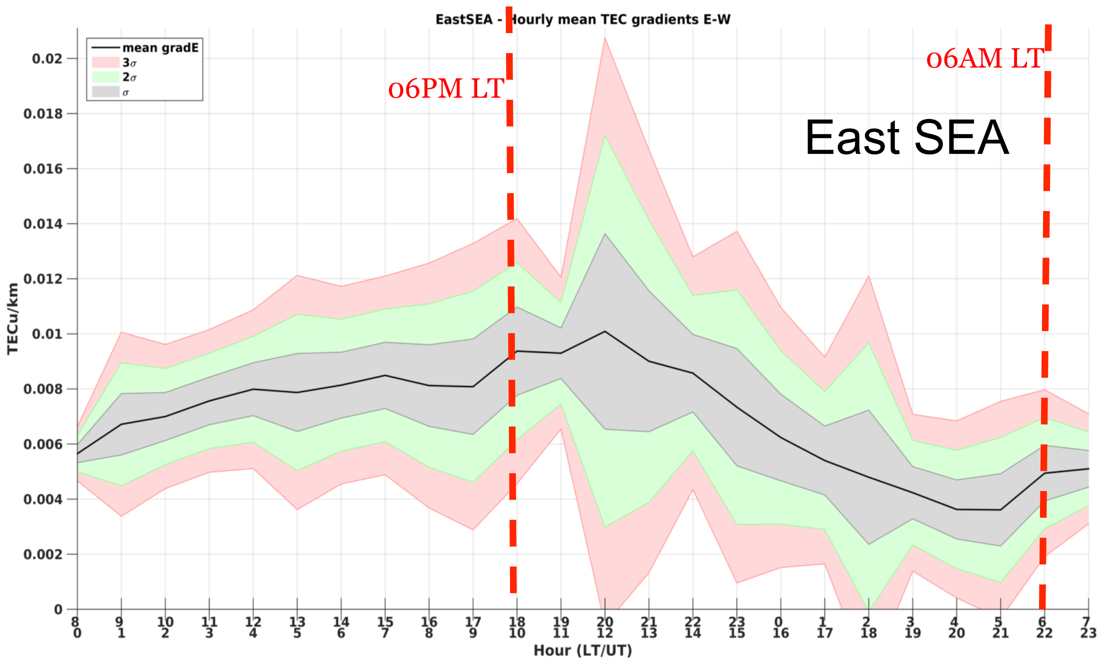
- foF2

ata refers to the 2 quietest days of:

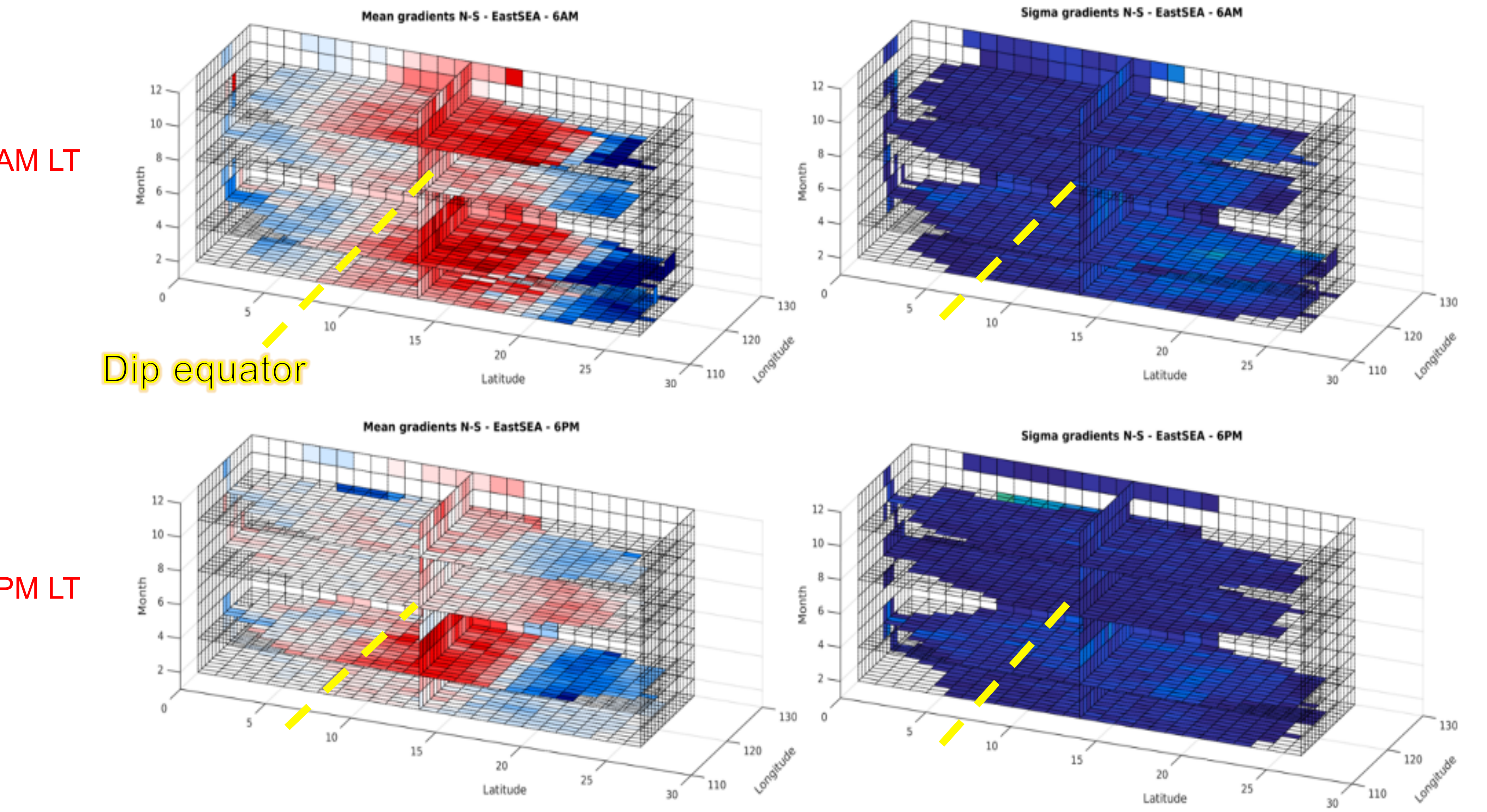
- March 2015-February 2016

TEC spatial gradients (E-W): daily variation





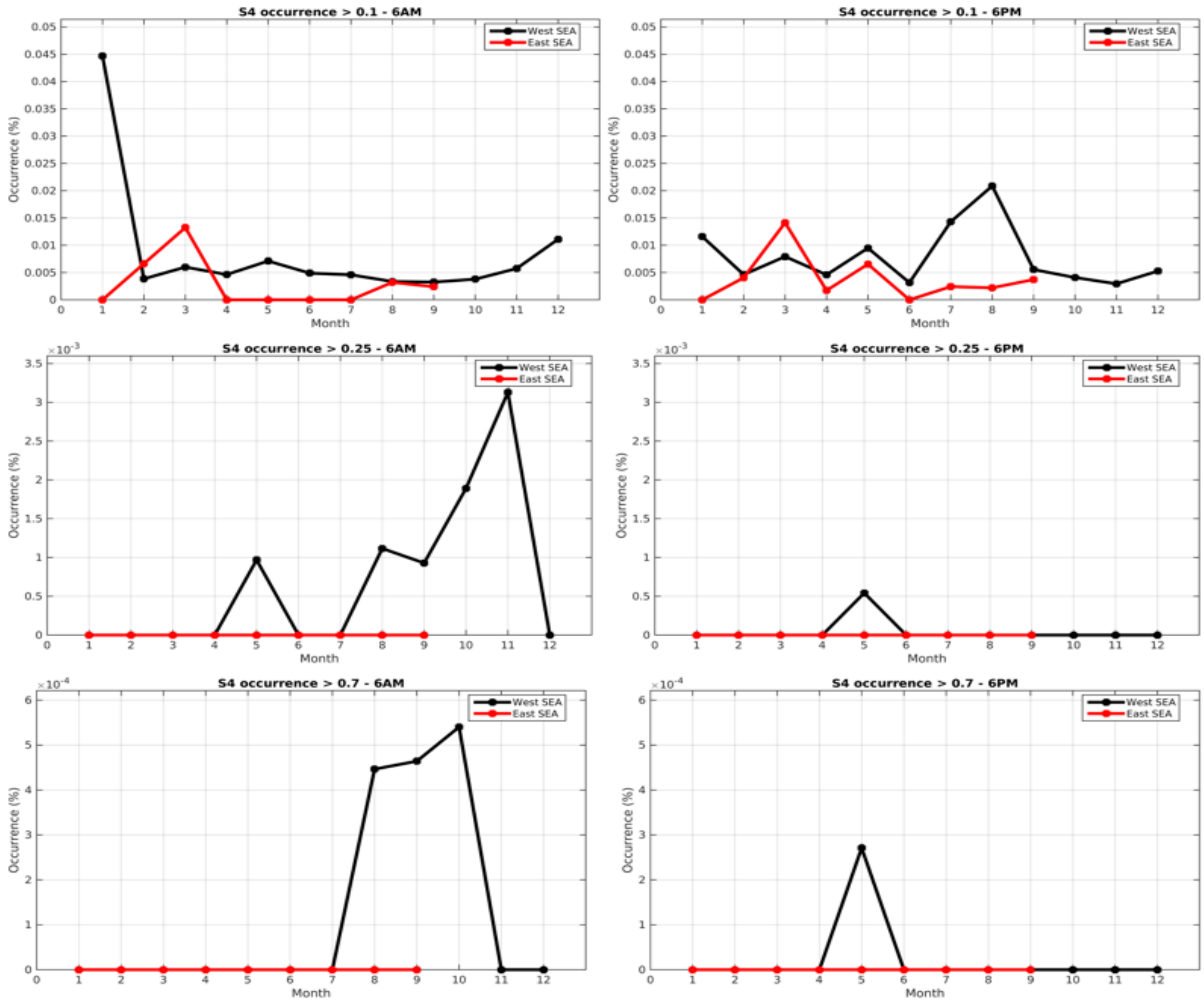
TEC spatial gradients (N-S): monthly variation over SEA



Scintillation occurrence (S4>0.1, 0.25, 0.7): monthly variation

AM LT

06PM LT



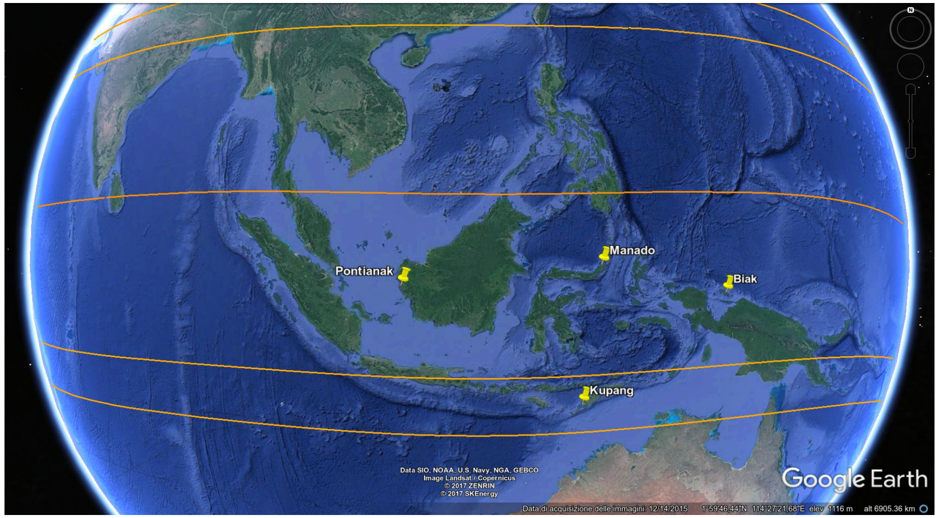
st SEA

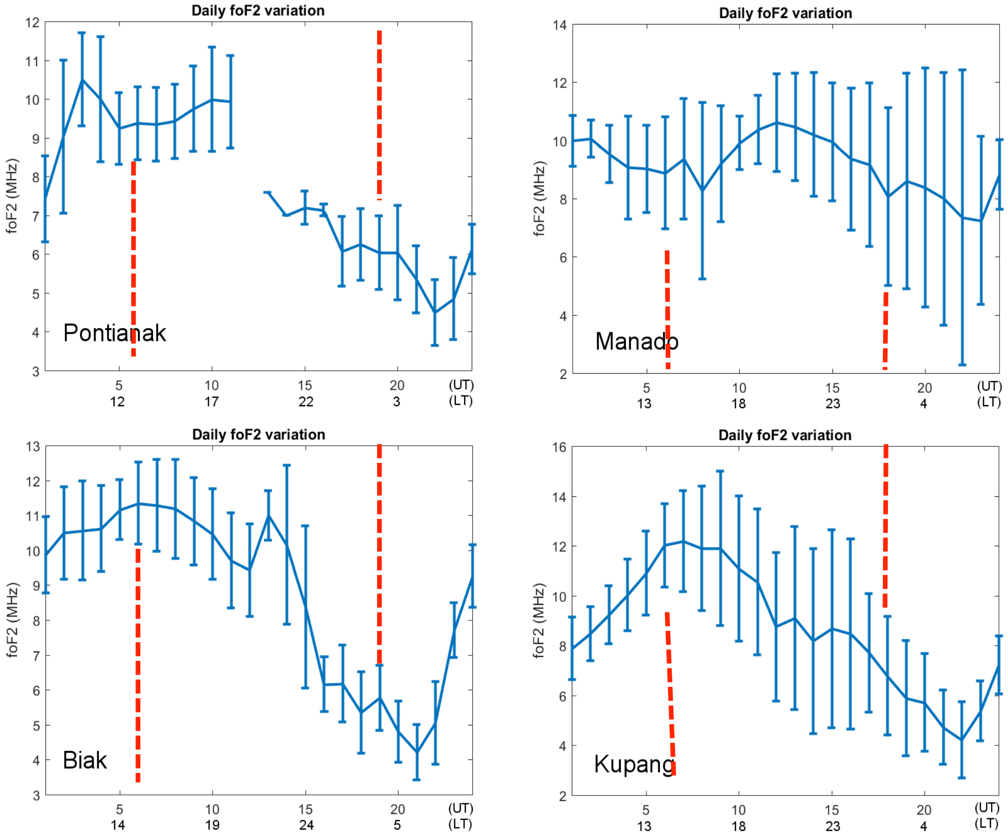
est SEA

Table of requirements from SoW

tity onitor	Temporal scale	Spatial Domain (Lx,Ly)	Spatial resolution (Dx,Dy)	Accu
	30 s	West SEA: (4°;25°) lat, (100;115°) lon East SEA: (3°;26°) lat, (115°;130°) lon	West SEA: 1° lat x 1° lon East SEA: 1° lat x 1° lon	1 TEC
lation cteristics	50 Hz data providing 1 minute indices	West SEA: (-12°;26°) lat, (94°;118°) lon East SEA: (-15°;7°) lat, (118°;141°) lon	West SEA: 1° lat x 1° lon East SEA: 1° lat x 1° lon	0.05 (

Ionosonde data analysis





Climatological behaviour of the critical frequency (*foF2*) of the F2 layer

Ionospheric impact on Biomass ESA mission

Lucilla Alfonsi*[1], Gabriella Povero[2], Luca Spogli[1,3], Claudio Cesaroni[1], Biagio Forte[4], Cathryn N.Mitchell[4], Robert Burston[4], Sreeja Veettil[5], Marcio Aquino[5], Virginia Klausner[6], Marcio Muella[6], Michael Pezzopane[1], Alessandra Giuntini [1], Ingrid Hunstad [1], Giorgiana De Franceschi [1], Elvira Musicò [1,13], Marco Pini [2], La The Vinh[7], Ta Hai Tung[7], Asnawi Husin[8], Sri Ekawati[8], Charisma Victoria de la Cruz-Cayapan [9] , Mardina Abdullah[10], Noridawaty Mat Daud[10], Minh Le Huy[11], Nicolas Floury[12]

[1] Istituto Nazionale di Geofisica e Vulcanologia, Italy

[2] Istituto Superiore Mario Boella, Italy

[3] SpacEarth Technology, Italy

[4] University of Bath, UK

[5] University of Nottingham, UK

[6] Universidade do Vale do Paraíba (UNIVAP), Brazil

[7] Hanoi University of Science and Technology, Vietnam

[8] National Institute of Aeronautics and Space (LAPAN), Indonesia

[9] National Mapping and Resource Information Authority (NAMRIA), The Philippines

[10] Universiti Kebangsaan Malaysia (UKM), Malaysia

[11] Institute of Geophysics, Vietnam Academy of Science and Technology, Vietnam

[12] European Space Agency

[13] University “Sapienza” of Rome, Italy

Paper ready to be submitted to

Journal of Space Weater and Space Climate

Infrastructures to support Biomass

uth East Asia

isCo study, data were from the following
rks:

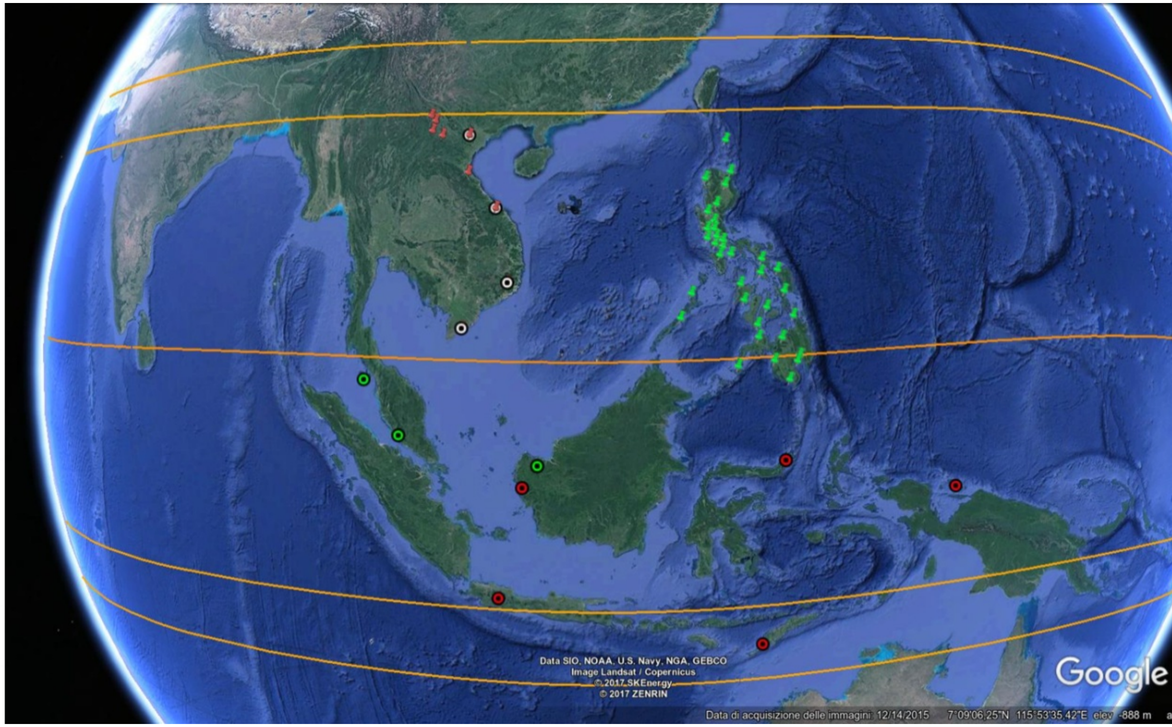
e geodetic network managed by VAST-IGP,
etnam

e CORS network of the Philippines National
apping and Resource Information Authority

oand scintillation monitor receiver network of
e Universiti Kebangsaan Malaysia

nosondes and GPS Scintillation Receivers
anaged by LAPAN in Indonesia

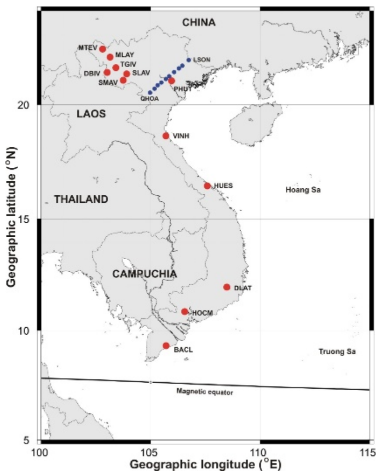
Owner	Region	Receiver type	Note
VAST	Vietnam (West SEA)	Scintillation (GSV4004) and geodetic	White circles (scint) and p pins (geodetic)
UKM	Malaysia (West SEA)	Scintillation (GSV4004)	Green circles
NAMRIA	Philippines (East SEA)	Geodetic	Yellow pins
LAPAN	Indonesia (West and East SEA)	Scintillation (GSV4004 and Station6)	Red circles



Infrastructures to support Biomass

uth East Asia

- itional data could come from other agencies, but
nission takes time to be obtained:
- ndonesia – GNSS receiver network (about 120 station
ver Indonesia region , most in Java island) managed
y BIG (Indonesian Geospatial Information Agency)
- lalaysia – Data from MyRTKnet available after
greement with Department of Geospatial Information
- ietnam - CORS network under deployment (10
dditional stations in October)
- hilippine - additional ionospheric
nonitoring stations



- Fragmented situation, different from country to country
- Involved institutions have general willingness to cooperate, install, run, and monitor instruments and signals
- No P-band instruments already deployed
- Support needed to cover the costs of new installations
- Endorsement by ESA needed to establish agreements with specific Ministries and Departments
- IBisCo team available to support ESA with established local contacts

emarks

The statistical analysis of the **TEC temporal gradients reveals a highly skewed distribution**, where the extreme cases in its tail ne to be taken into account.

- **Temporal gradients are generally larger in SEA** than in Brazil (up to 1 TECu/min)
- Over **SEA**, **TEC temporal gradients** are found to be **larger in the East SEA sector** than in the West one.
- Over **Brazil**, **TEC temporal gradients** are found to be **larger over the crests** than over the dip equator.

The statistical analysis of the TEC spatial gradients reveals important **differentiation of the meridional variation with respect to t zonal variation.**

- **E-W gradient** is generally **larger than N-S** (less evident over SEA)
- **Over both SEA sectors the equinoxes results into largely variable meridional TEC gradients**, even if in the West SEA also t winter months show a significant excursion.
- The **largest concentration and variability of meridional TEC gradients** is in the afternoon/evening hours, mainly **in the po sunset, and around midnight.**
- **Method sensitivity: few tenths of receivers can be sufficient** to efficiently cover regions like the one here considered.

The statistical analysis of GNSS scintillations results in a clear definition of **the role of EIA crests in hosting the ionosphe irregularities**, mainly in the local post-sunset hours.

- **Strong scintillation events are not negligible over West SEA**, even with a low probability, at the time of the Biomass passes

The analysis based on ***foF2*** data showed that:

- the climatological behaviour of the ionospheric plasma in the **Brazilian sector is the one expected at low latitudes**.
- the climatological behaviour of the ionospheric plasma in SEA has a **strong dependence on the longitude**.
- **Noontime bite out observed in Brazil and in West SEA, but not in East SEA.**

Over Brazil LSTIDs were not detected on any of the analysed days; **MSTIDs** were detected on 3 days, **1 day over the anomaly cre and on 2 days over the equatorial region.**

<u>**Paper is ready to be submitted to JSWSC**</u>

Infrastructures availability for Biomass operation is discussed

ISCO – Contribution of the external partners

me	Institution	Role in the study	Contribution to the study
awi Husin	LAPAN	External Researcher	• Coordination of data providers in Indonesia • Survey of the current and foreseen infrastructures • Participation to training in Europe • Training of Indonesian researchers on TEC calibration • Contribution to TEC calibration
Ekawati	LAPAN	External Junior Researcher	• Contribution to the TEC calibration
The Vinh	HUST	External Researcher	• Contribution to data collection and links with data providers in Vietnam
risma apan	NAMRIA	External Reseacher	• Coordination of data providers in the Philippines • Survey of the current and foreseen infrastructures
dina Abdullah	UKM	External Resercher	• Coordination of data providers in Malaysia • Survey of the current and foreseen infrastructures
dawaty Mat d	UKM	External Junior Researcher	• Contribution to data calibration