Project Title: Research and development for precise positioning with Artificial Intelligence (AI) during ionospheric disturbances in low-latitude region in ASEAN

Background :

Ionospheric irregularities such as equatorial plasma bubbles (EPB) in low-latitude regions in ASEAN countries often lead to degradation in precise positioning and navigation. To detect irregularity various sensors and data are typically utilized such as ionosonde, GNSS receivers, VHF (Very High Frequency) radar and LEO (Low Earth Orbit) satellite data. In addition, forecasting and mitigation of EPB effects on modern technology is needed for society at large. Importantly, as Solar cycle 25 is ongoing and will reach the solar maximum in 2024 or 2025, it is imperative to acquire more data and develop the warning capability.

Target :

1. To analyze the EPB statistics during the solar maximum and mitigate the EPB effects
2. To develop forecasting models for EPB occurrences
3. To demo RTK technology at local stations and utilize for various applications

Speaker: Prof. Pornchai Supnithi, KMITL, Thailand

Project Title: Research and development for precise positioning with Artificial Intelligence (AI) during ionospheric disturbances in low-latitude region in ASEAN

Project Members :

(KMITL, Thailand) Pornchai Supnithi, Punyawi Jamjureegulgarn, Presert Kenpankho, Kasemsuk Sepsirisuk , Lin Min Min Myint, Jirapoom Budho, Somkit Sophan, Thananphat Thankulketsarat
(CMU, Thailand) Tharadol Komolmis, Witsarut Achariyaviriya, Prayoonsak Praychan
(KMUTT, Thailand) Alisa Kongthon
(NUOLS, Laos) Phosy Phanthongsy, Phimmasone Thammavongsy, Tick Sengthipphany, Phouthong Southisombath
(IG, Vietnam) Le Truong Thanh, Dung Nguyen Thanh
(LQDTU, Vietnam) Hoang Van Phuc, Nguyen Van Trung
(ITC, Cambodia) Sainglong Kaing
(CADT, Cambodia) Phutphalla Kong, Soklay Heng
(NICT, Japan) Michi Nishioka, Takuya Tsugawa, Septi Perwitasari

Project Duration : 24 months

Project Budget: (Year 1) $39,700 (Year 2) $39,700

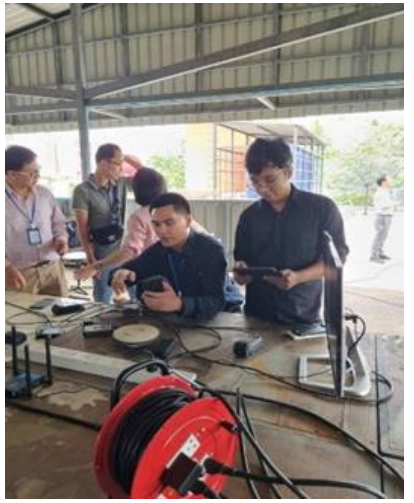
Project Activities: **The Kick-off meeting**

August 3-4, 2023 KMITL, Bangkok, Thailand

Day 1

Kick-off Meetings

Training on RTK service



Day 2

Training on TEC computation

Project Activities: **AOSWA 2023 Workshop**

October 9-11, 2023 Kuala Lumpur, Malaysia

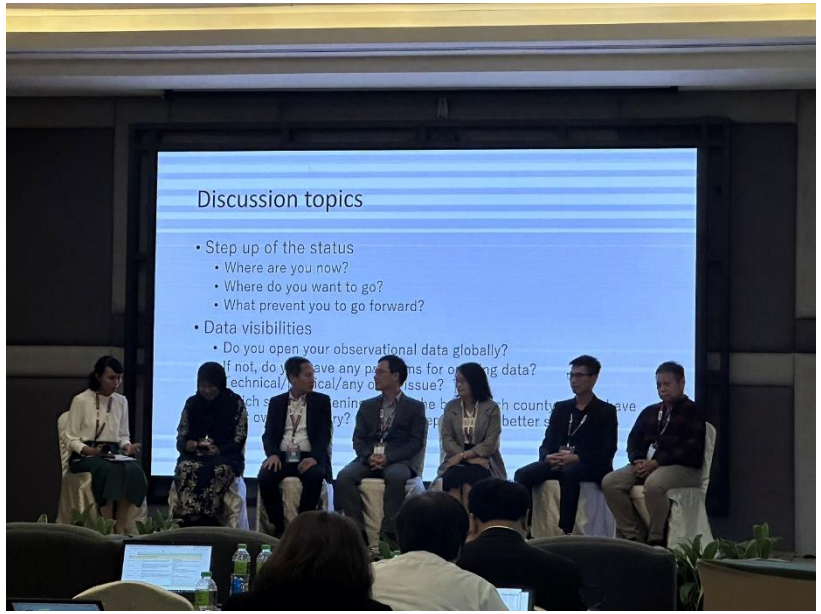
ASEAN IVO Members

(KMITL, Thailand) P. Supnithi, L. M.M.Myint, J.Budho, P. Jamjareegulgarn, P.Kenpankho

(CADT, Cambodia)

(IGP, Vietnam)

(NICT, Japan) S. Perwitasari, T. Tsugawa



R&D results: Proposed location for GNSS installation

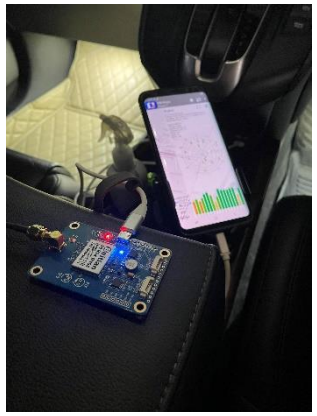
Mr. Sainglong Kaing (ITC, Cambodia)

- surveyed the site installation for a new GNSS receiver

R&D results: Survey on the low-cost RTK receivers

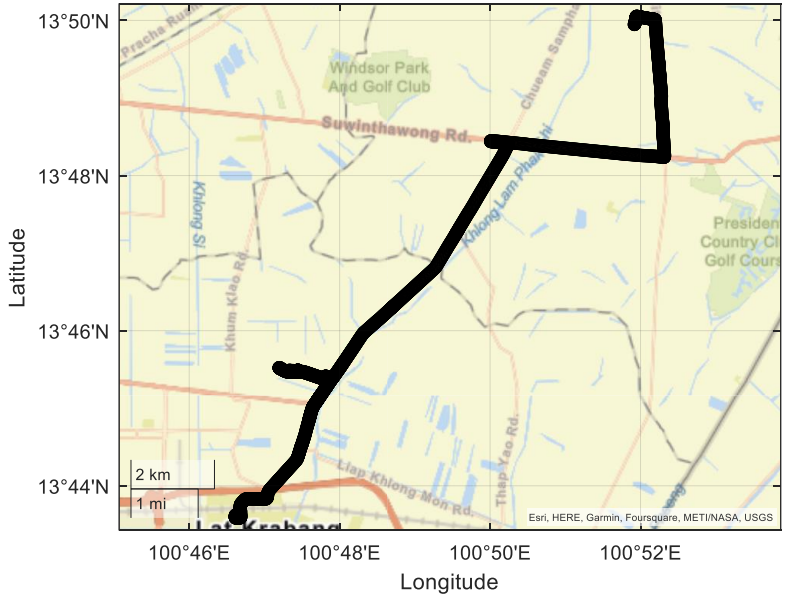
Dr. Jirapoom Budho (KMITL, Thailand)
Dr. Lin MM Myint

- tests the RTK performance and signal quality of the units



RTK setup:

1. Base: KMI6 station (NovAtel Propak 6)
2. Rover: Ublox F9P
3. GNSS Correction: NTRIP
4. RTK Processor: Build-in RTK ship (in Ublox F9P)
5. Logging equipment: Mobile (SW Map software

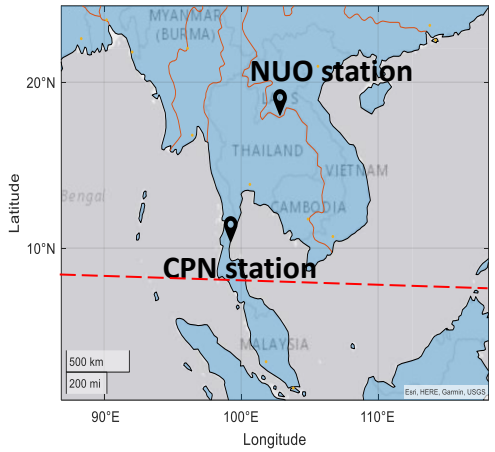


Source: https://www.minew.com/

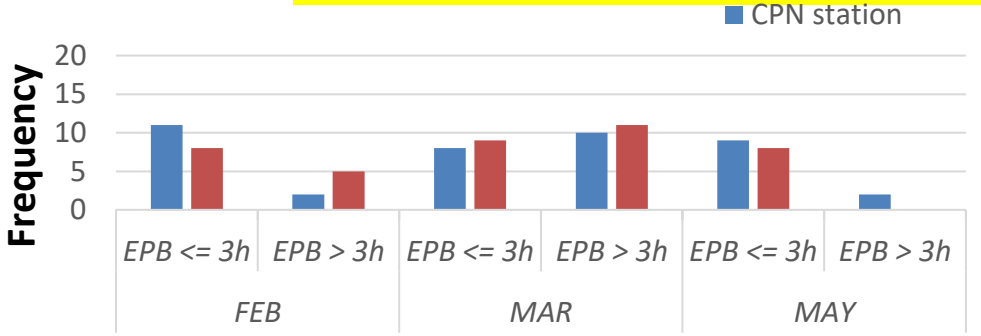
R&D results: Comparison of Spread F and ROTI at CPN, NUOL stations

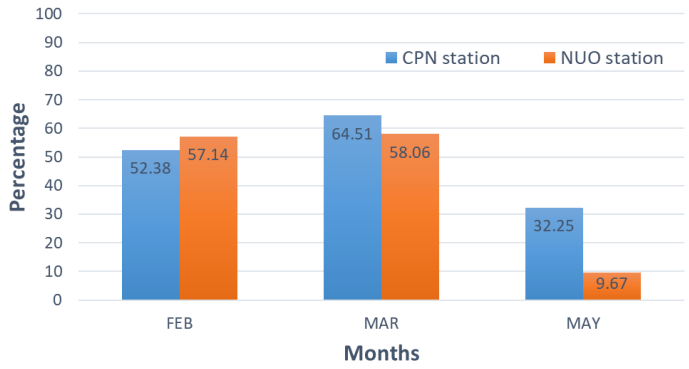
Mr. Phimmasone (NUOLS)

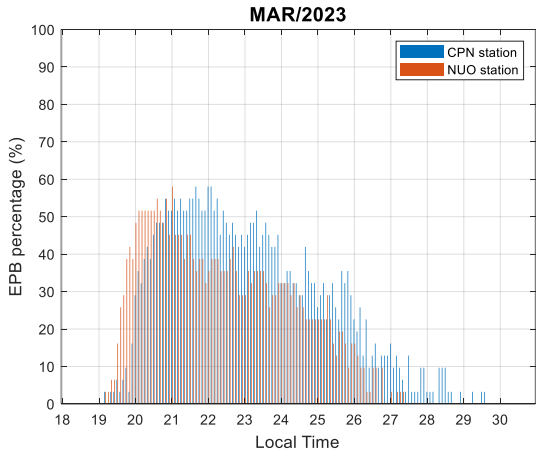
- to observe statistical characteristics of the Equatorial Plasma bubbles (EPBs) at Chumphon (CPN) station, Thailand and NUOL station, Laos



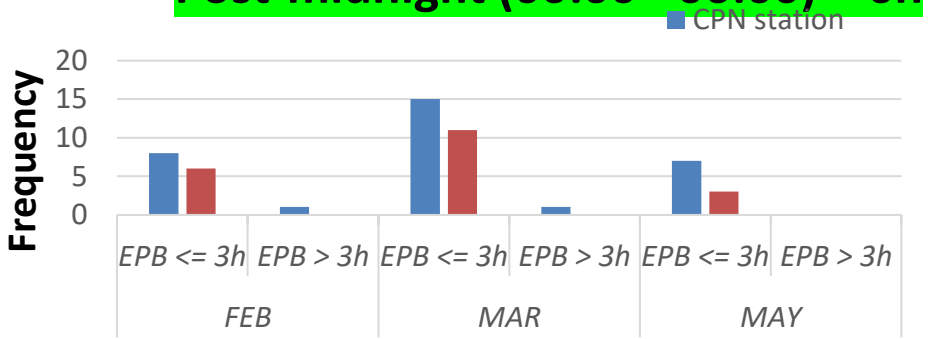
Post-sunset (18:00 - 23:55) – 6h







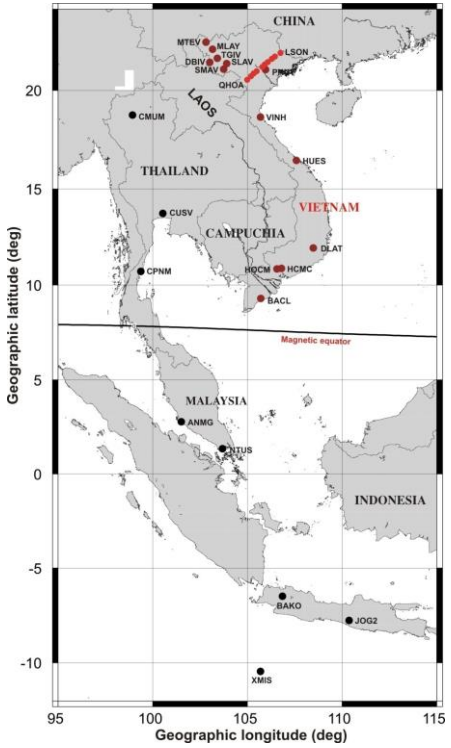
Post-midnight (00:00 - 06:00) – 6h

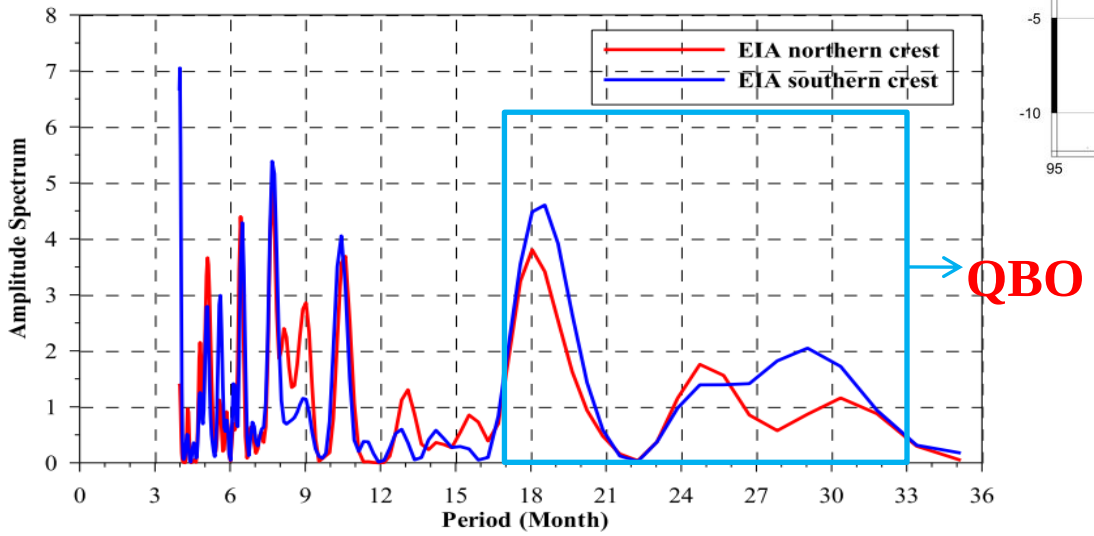


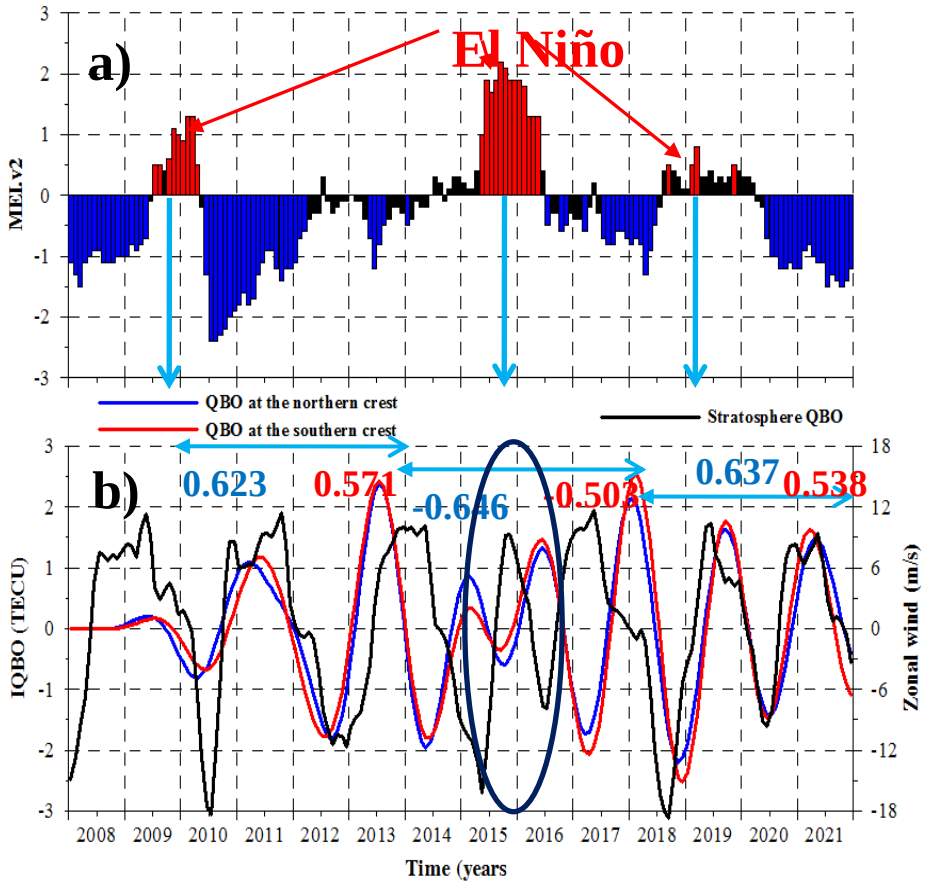
R&D results: ionospheric quasi-biennial oscillation (QBO) of TEC amplitude of equatorial ionization anomaly (EIA) crest

Dung Nguyen Thanh (Institute of Geophysics, Vietnam)

Analyze the ionosphere QBO of TEC amplitude of EIA crests over the Southeast-Asian region







Scientific Contribution:

Presentations at International Conferences:

No:	Paper title:	Author names	Affiliation	Conference name:	The date of the conference	The venue of the conference
1	Statistics of the Equatorial Plasma Bubbles in February, March and May 2023 at CPN station, Thailand, and NUO station, Laos	P. Thammvongsy, P. Supnithi, L. M.M. Myint, D. Larkanchanh, P. Phanthongsy, P. Soutthisombath and M. Nishioka	NUOLS (Laos), KMITL (Thailand), NICT(Japan)	AOSWA 2023 Workshop	9-11/10/2023	Kuala Lumpur, Malaysia
2	The network of continuous GPS observation in Vietnam and adjacent region and evaluation of the ionospheric quasi-biennial oscillation (QBO) of TEC amplitude of equatorial ionization anomaly (EIA)	Dung Nguyen Thanh	IGP (Vietnam)	AOSWA 2023 Workshop	9-11/10/2023	Kuala Lumpur, Malaysia

Societal Impact:

- The total electron content (TEC) data are shared among countries from 2-D TEC map
- The RINEX file format is modified to GTEC and ScinTEX formats for ease of scientific sharing
- Equatorial plasma bubble detection and warning capability
- Low-cost RTK receivers and applications in robotics, space weather, etc.

Conclusion:

- Prof. Pornchai, Dr. Lin Myint, Dr. Jirapoom, organized a Kick-off meeting in August, 2023
- Many members attended the AOSWA 2023 Worskshop from 9-11 October, 2023.
- Mr. Phimmasone (NUOLS, Laos) analyzed the statistical characteristics of the Equatorial Plasma bubbles (EPBs) at Chumphon (CPN) station, Thailand and NUOL station, Laos
- Dr. Dung Nguyen Thanh (ITC, Cambodia) analyzed the ionosphere QBO of TEC amplitude of EIA crests over the Southeast-Asian region
- Dr. Sainglong Kaing surveyed installation site for GNSS receiver

Future Works:

- KMITL team will test the low-cost RTK receivers for sending to all members
- All members will analyze the TEC maps during EPB events from many countries in the project
- Mr. Phimmasone (NUOLS, Laos) will develop AI techniques for Spread F prediction
- Dr. Sainglong Kaing (ITC, Cambodia) and KMITL team will aid installation site for GNSS receiver
- All members will implement low-cost RTK receivers