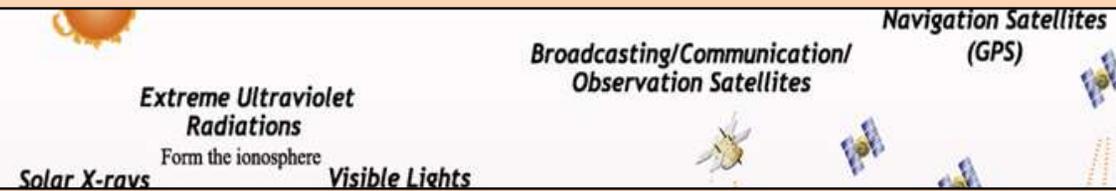


Effects of ionosphere

Background :

Ionospheric irregularity such as plasma bubble

- ➔ typically occurs after sunset due to the bottomside instability
- ➔ degrades HF communication, precise positioning and aeronautical navigation.



Targets:

1. Expand GNSS and ionospheric monitoring system in neighboring countries
2. Daily GNSS data products for disaster prevention and aviation
3. Ionospheric data products and disturbance prediction models for disaster prevention and aviation
4. Support the Installation of a new VHF radar station at Chumphon campus, Thailand

Disaster
Power plant



Speaker:

Prof. Dr. Pornchai Supnithi (Project Leader)



Project Title: GNSS and Ionospheric Data Products for Disaster Prevention and Aviation in Magnetic Low-Latitude Regions

Project Members :

Name	Institution	Country
Prof. Pornchai Supnithi	KMITL	Thailand
Dr. Win Zaw	YTU	Myanmar
Asst.Prof. Donekeo Lakanchan	NUOL	Laos
Assoc.Prof. Punyawit Jamjureekulkarn	KMITL (Chumphon)	Thailand
Asst.Prof. Watid Phakphisut	KMITL	Thailand
Assoc.Prof. Tharadol Komolmis	Chiangmai Univ.	Thailand
Dr. Takuya Tsugawa (NICT)	NICT (Space Environment Laboratory)	Japan
Dr. Kornyanat Hozumi	NICT (Space Environment Laboratory)	Japan

Possible added members from Cambodia, Vietnam

Project Duration : 2 Years

Project Budget: \$38,750 (first year)

Project Activities:

Project Activities		Responsible members
1. Install dual-frequency GNSS receiver at YTU (Myanmar) Collect observational data for further analysis	Expand GNSS stations	KMITL, YTU
2. Install dual-frequency GNSS receivers at NUOL (Laos) Collect observational data for further analysis		KMITL, NUOL
3. Develop daily GNSS data products for disaster and Aviation <ul style="list-style-type: none"> • Study the Space Weather (SW) Data Format for Aviation • 2-D TEC map, ROTI data products • Analyze the loss-of-lock statistics and scintillation • Prediction model for iono parameters, GNSS parameters 	Data products: TEC, ROTI, foF2, Spread F	KMITL, YTU, NUOL
4. Develop daily ionospheric data products: foF2, Spread F		KMITL, CMU
5. To support the new installation of VHF Radar Station at Chumphon, Thailand	VHF radar station	KMITL (Chumphon), NICT
6. Kick-off Meeting Workshop, GNSS station site visit - June 2019 ASEAN IVO Workshop on “GNSS and total electron content (TEC) analysis”		ALL
7. GNSS Positioning and Total Electron Content Analysis Workshop – January 2020		ALL
8. Research seminar on GNSS and Ionosphere: Trends and Challenges in Precise Positioning Technology – October 2020		ALL

Budget Spent:

No.	title	items	US\$
1	Kick-off Meeting (1)	meeting package (venue fee, accomodation, flight tickets, etc.)	\$3,932.02
2	Kick-off Meeting (2)	luncheon buffet, cofee break*2	\$527.02
3	Purchase of experimental equipment (Myanmar)	GNSS receiver, antenna, cable, etc. for YTU station (Myanmar)	\$21,843.61
4	GNSS Positioning and Total Electron Content Analysis Workshop (Chumphon, KMITL)	Meeting package, Travel expense, Accomodation Printing materials	\$5,043.12
5	Purchase of experimental equipment (Laos)	GNSS receiver, antenna, cable, etc. for NUOL station (Laos) (2,403,583 Yens)	\$23,216.2

Project Activities: GNSS Positioning and Total Electron Content Analysis Workshop, Chumphon, Thailand

17-19 January, 2020

17 Jan: VHF Radar site visit, research presentation

18 Jan: Hand-on session





Project Activities: Research Seminar on GNSS and Ionosphere

30th November, 2020
Auditorium#3, KMITL

Speakers English Presentation

- Prof. Pornchai Supnithi (KMITL)**
Professor, Telecommunications Engineering Department
"KMITL Research on GNSS and Equatorial Plasma Bubble Detection"
- Dr. Mamoru Ishii (NICT, Japan)**
Director, Space Environment Laboratory
"Space Weather Data Service at NICT"
- Dr. Sittiporn Channumsin (GISTDA)**
Researcher, Astro Lab
"Thai Space Weather Consortium Update"
- Prof. Chalermchon Satirapod (CU)**
Professor & Department Chair
Department of Survey Engineering
"Trends in RTK, PPP-RTK Technology"
- Mr. Wasit Wattanasap (AIS)**
Senior Vice President Nationwide Operations and Support, Advanced Wireless Network Co. Ltd.
"Positioning technology in 5G Service"
- Dr. Veerasak Kritsanapraphan (TRUE)**
Head of Technology Innovation,
True Digital Group Co. Ltd.
"Industrial Case Study in Positioning Technology"
- Dr. Ningbo Wang (CAS, China)**
Researcher, Aerospace Information Research Institute
"Real-time Ionospheric SSR Corrections in support of High Accuracy GNSS Applications"

FRIDAY, OCTOBER 30TH, 2020
AUDITORIUM ROOM #3, E12 BUILDING
FACULTY OF ENGINEERING, KMITL

**RESEARCH SEMINAR ON
GNSS & IONOSPHERE:
TRENDS AND CHALLENGES
FOR FUTURE PRECISE
POSITIONING**

Register at
<https://forms.gle/Ca9adUSZbaV7M9rf7>

Limited **40 seats** only (due to social distancing)
Maximum 2 persons/per organization only.
Breaks and Lunch will be provided.

We will confirm your registration via email.

This seminar is supported by NXPO, ASEAN IVO and The Program Management Unit for Human Resources & Institutional Development



R&D results (1): 1. Data network and Analysis

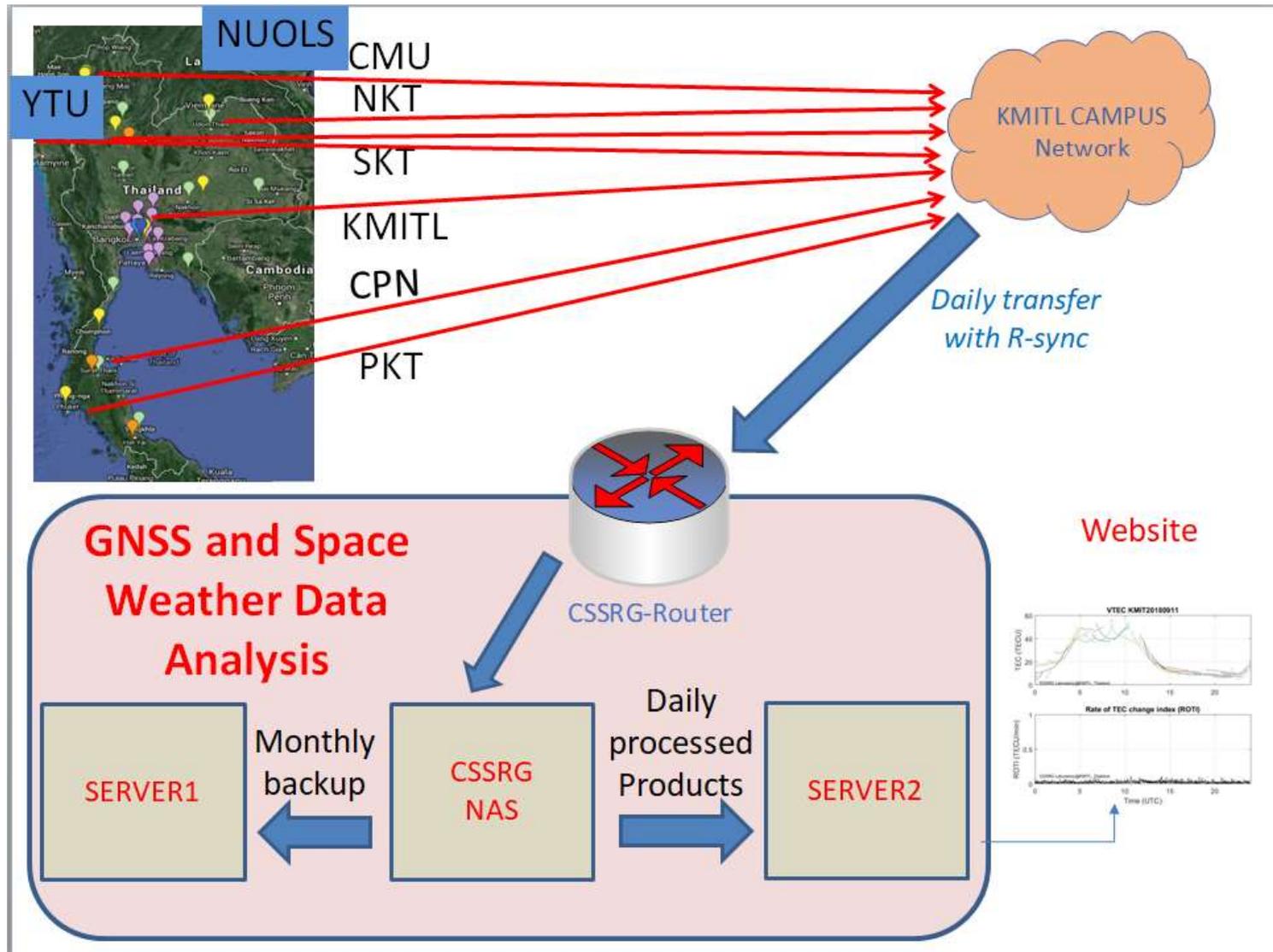
GNSS & space Weather Website: http://iono-gnss.kmitl.ac.th/?page_id=807



GNSS receiver



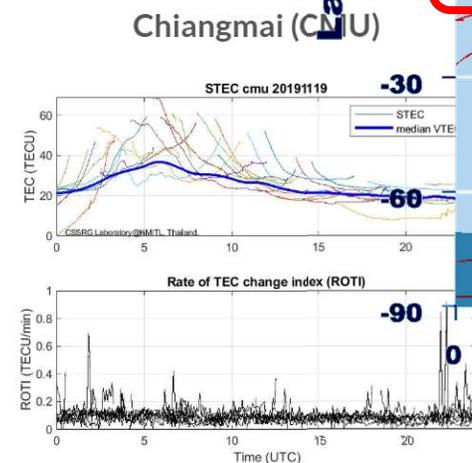
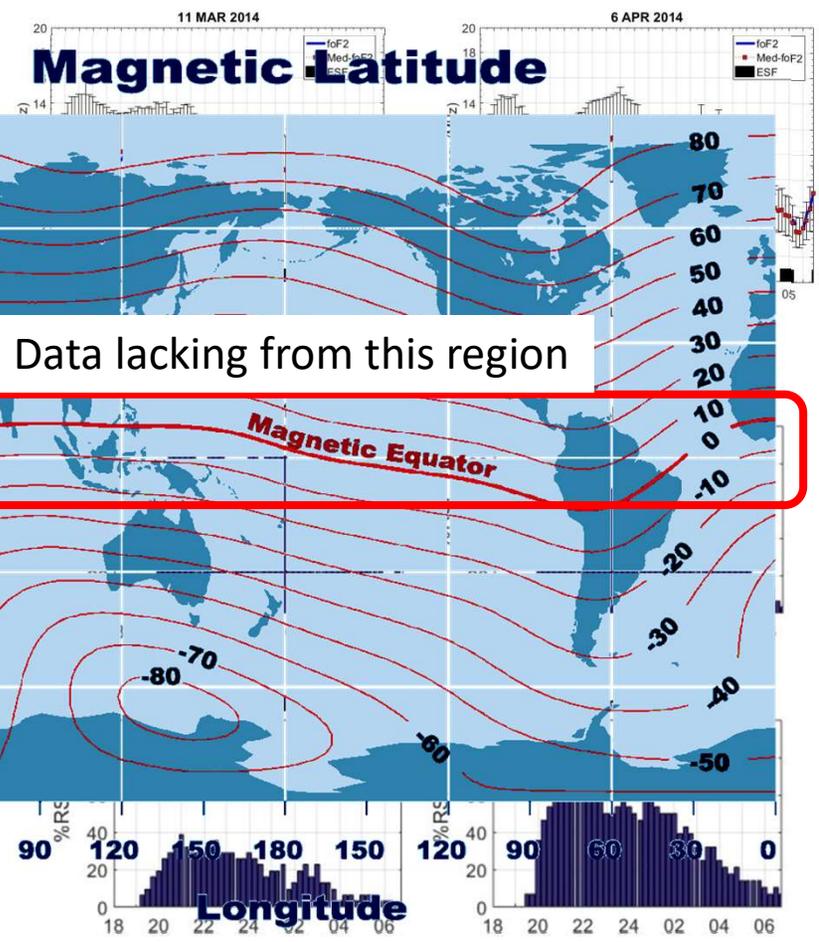
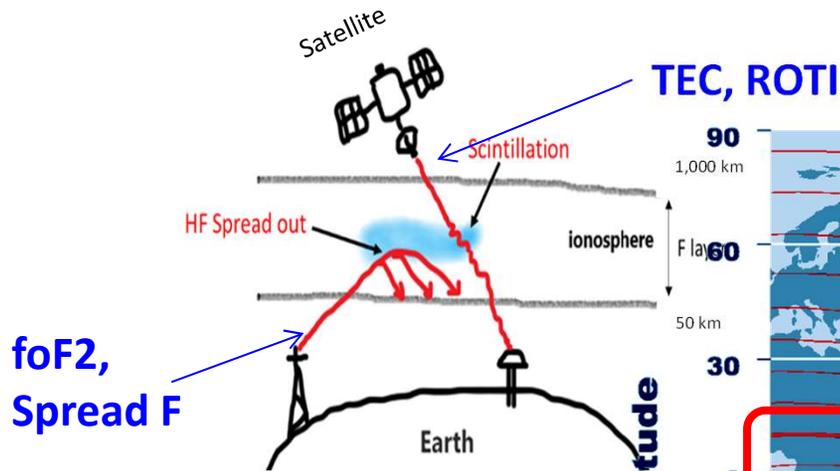
Ionosonde system



R&D results (2): 2. GNSS and Iono data analysis for disaster and aviation (KMITL, CMU)

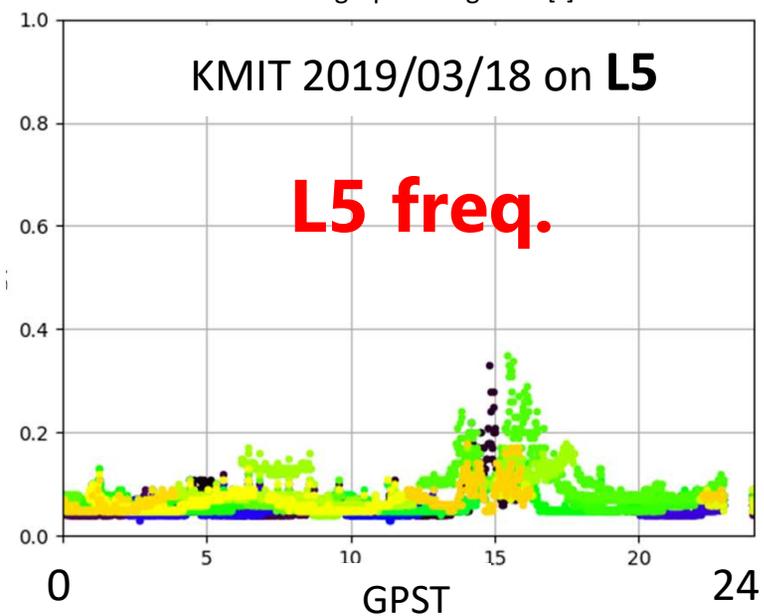
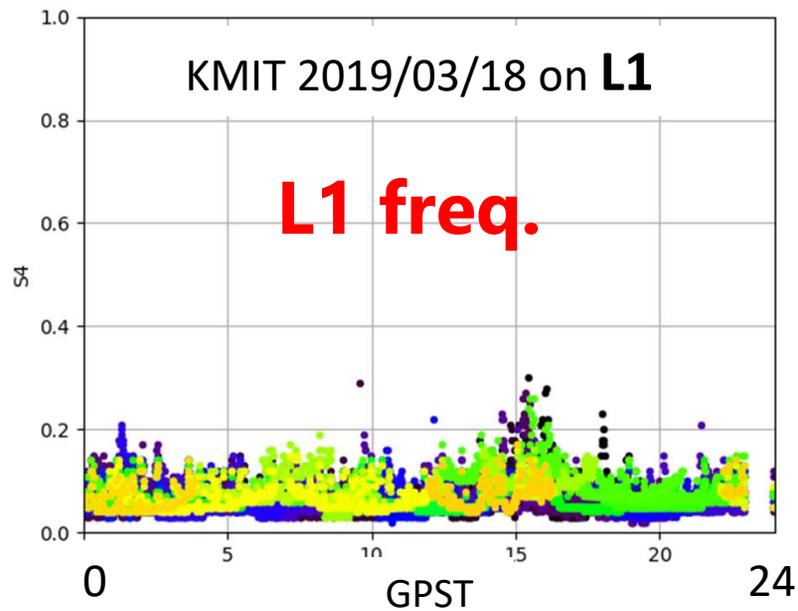
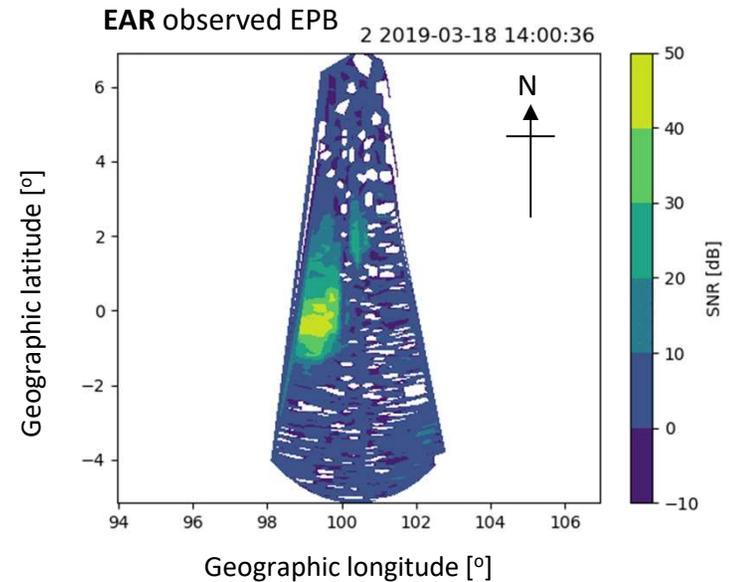
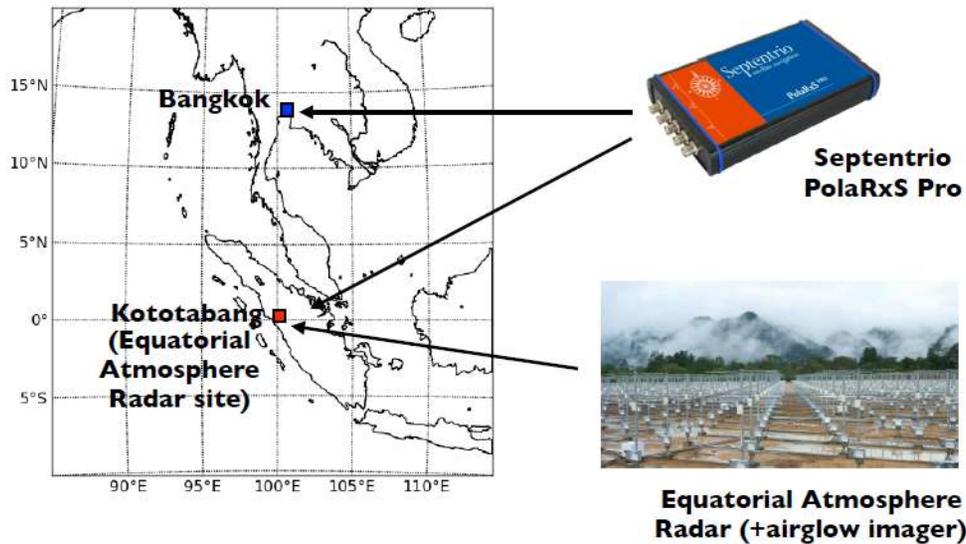
Equatorial Spread-F impacts on radio wave propagation at night-time

Critical frequency values (foF2)

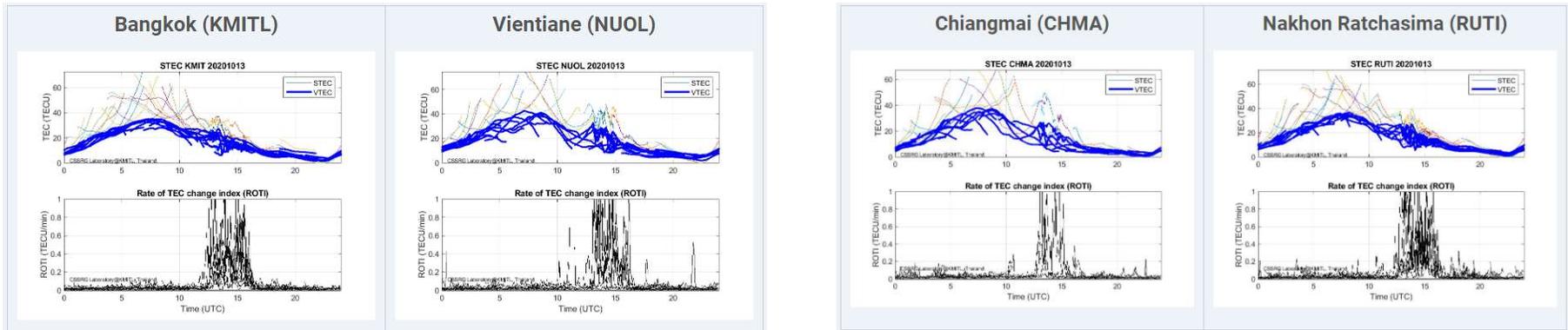


TEC

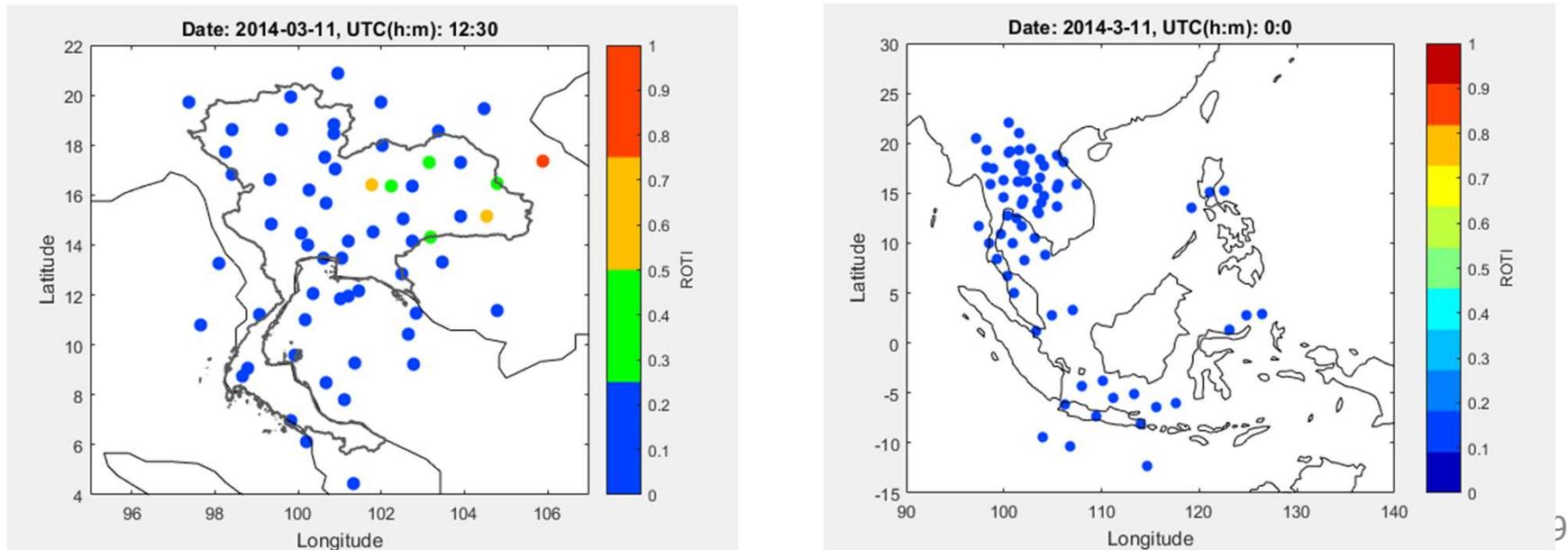
R&D results (3): 2. GNSS and Iono data analysis for disaster and aviation



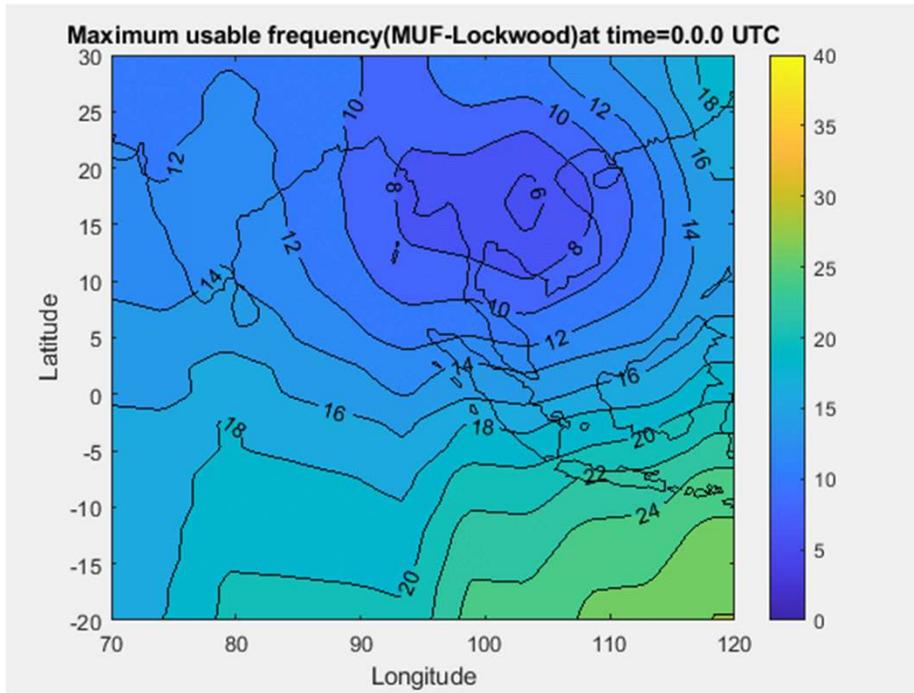
Daily TEC/ROTI Plots



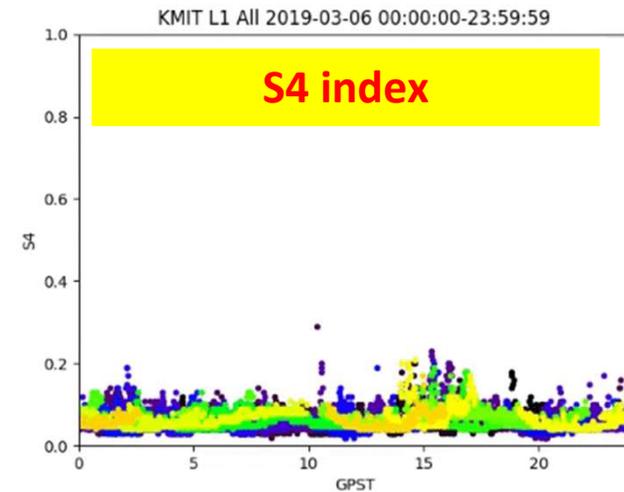
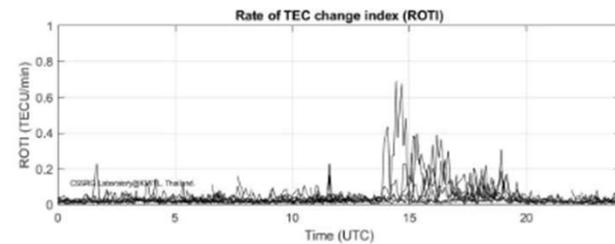
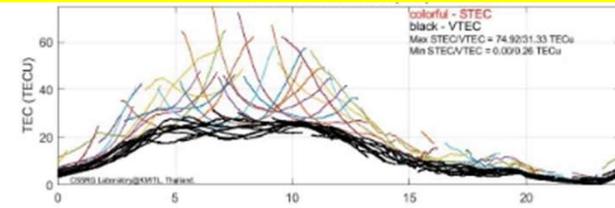
2-D ROTI Map



Maximum usable frequency (MUF) Map

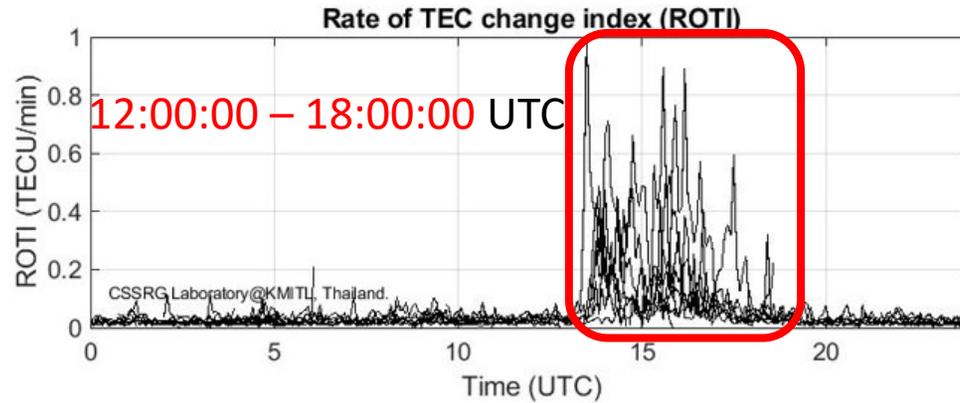


TEC / ROTI Plots

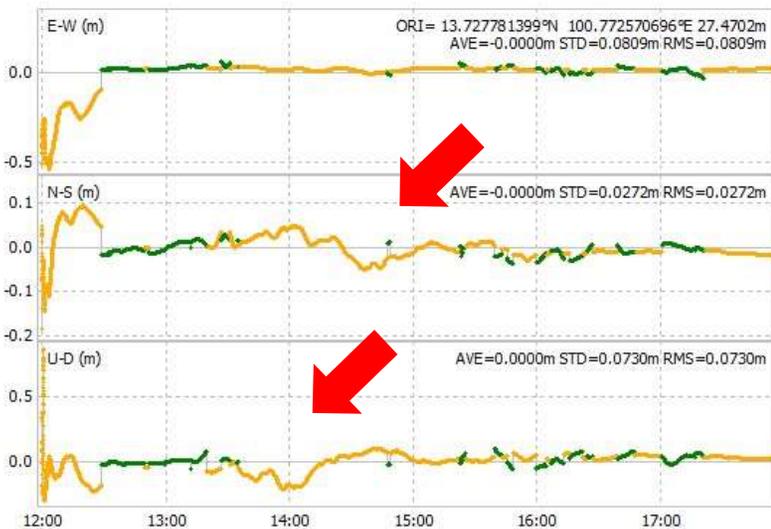


days with scintillation (2019) = 47 days

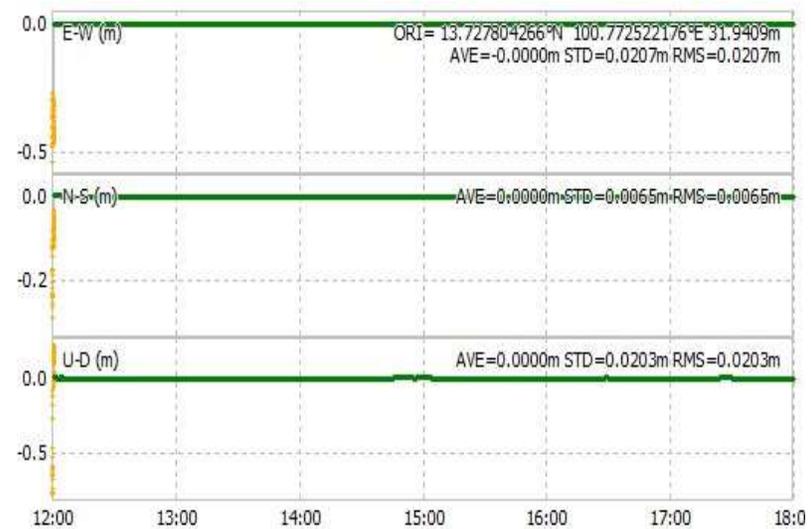
Low-cost RTK rover



DOY78,
2020



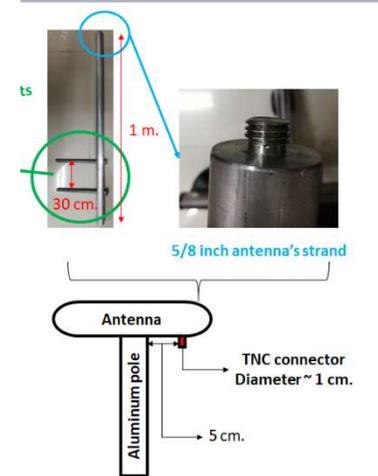
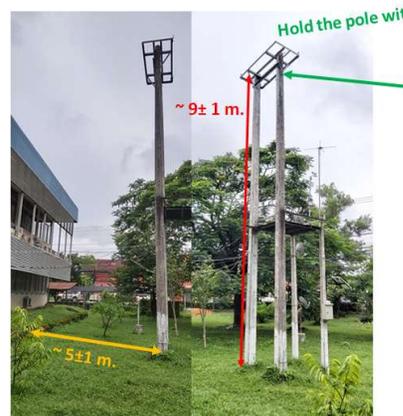
Positioning: Baseline 8 km.



Positioning: Baseline 22 m.

Expanded GNSS and ionospheric monitoring system (NUOL, YTU)

1. GNSS station at NUOL: Site survey → NUOL



2. GNSS station at YTU (Mynamar): Site survey → YTU



No	Paper title:	Author names	Affiliation	Name:	The date	Venue
1	Spread F Prediction Model for the Equatorial Chumphon Station, Thailand	P. Thammavongsy, P. Supnithi, W. Phakphisut, K. Hozumi, T. Tsugawa	KMITL, NICT	Journal of Advances in Space Research	Vol. 65, 2020, pp. 152-162	
Conferences						
1	Study of topside scale height based on NeQuick topside formulation and their comparison with ionogram-derived scale height in 2014 at Ascension Island	P. Jamjareegulgarn, P. Supnithi, T. Tsugawa, K. Hozumi	KMITL, NICT	IRI 2019 Workshop	9-13 Sept. 2019	Nicosia, Cyprus
2	Comparison of Spread-F probability and the IRI-2016 model during descending solar cycle in 2016 at the equatorial Chumphon station, Thailand	P. Thammavongsy, P. Supnithi, P. Kenpankho, K. Hozumi, T. Tsugawa	KMITL	IRI 2019 Workshop	9-13 Sept. 2019	Nicosia, Cyprus
3	The Statistics of Equatorial Spread-F and Effects on Critical Frequency at Chumphon, Thailand	P. Thammavongsy, P. Supnithi, W. Phakphisut, K. Hozumi, T. Tsugawa	NUOL, KMITL, NICT	(SICONIAN 2019)	15-16 Nov, 2019	Palembang, Indonesia
4	Performance os GAGAN Satellite-based Augmentation System in Thailand Region	S.Sophan, W.Phakphisut, L.Myint, P.Supntihi	KMITL	ITC-CSCC 2020	3-6 July, 2020	Nagoya, Japan (online)
5	Improvement of Kalman Filter for GNSS/IMU Data Fusion with Measurement Bias Compensation	N.Nilchan, P.Supntihi, W. Phakphisut	KMITL	ITC-CSCC 2020	3-6 July, 2020	Nagoya, Japan (online)
6	The disturbance effects on single-frequency GPS positioning at low-geomagnetic latitude stations in Thailand	N.Tongkasem, L. Myint, P. Supnithi, K.Hozumi	KMITL, NICT	ITC-CSCC 2020	3-6 July, 2020	
Exhibitions						
4	Space Weather Knowledge	National Science and	Technology Fair 2019			

Societal Impact:

- Enhance **better understanding of ionospheric disturbance in magnetic equator and low-latitude region**, particularly, ASEAN region.
- Useful ionospheric disturbance detection for **aviation and HF communications**, prevalent, in aviation and communications in disaster situation, especially, along the coastal areas.
- Better disturbance characterization is required to determine performance of **high-accuracy GNSS system** used in other industries such as **precisioned agriculture and autonomous driving**.
- **Regional data collection** is important for long-term study and useful to **global model improvement** (such as IRI model and IGS model).



Conclusion:

- We have prepared the additional GNSS station installation in Laos and Myanmar
 - ➔ Site surveys and equipment purchase/allocation are completed
- We have analyzed the iono disturbance based on Ionosonde station
 - ➔ foF2 statistics
 - ➔ Spread F statistics

HF Communication data products
- We have analyzed the iono disturbance and create the ROTI map
 - ➔ ROTI maps are accessible at <http://iono-gnss.kmitl.ac.th>

Aviation data products
- GNSS positioning analysis at Chumphon station, Chiangmai station
 - ➔ quiet days, disturbed days

Positioning, Navigation data products
- The new VHF radar station at Chumphon has been opened and operated.