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

Background :

The ionosphere in the magnetic low-latitude and the magnetic equator region is observed to be highly unstable due to unique disturbance events, resulting degradation in performances of communication and navigation. Therefore, ionospheric irregularities in this region need to be analyzed or forecasted based on the collected data including GNSS and other related data from the station networks in the region. Based on them, data products and predictions models can be implemented for positioning, navigation, communications, aviation, especially in this magnetic low-latitude region. Phase I of ASEAN IVO project (2018-2020) was successfully accomplished to expend GNSS and ionospheric monitoring system and to implement data products and prediction models for disaster prevention and aviation in magnetic low-latitude regions.

Targets:

1. To expand GNSS and ionospheric monitoring system into Cambodia.
2. To upgrade data products and disturbance prediction models for disaster prevention and aviation developed in Phase I
3. To develop a low-cost real-time kinematics (RTK) receiver system and test its performance during Plasma Bubble using the data collected from newly installed stations in Phase I.
4. To continue the recently established GNSS and SW Excellence Center at KMITL and conduct capacity building for domestic network and partnered institutions on GNSS technology, ionosphere, basic Space Weather parameter understanding.

Speaker: Asst. Prof. Dr. Lin Min Min Myint, KMITL, Thailand

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

Project Members :

Party	Name		
NICT, Japan	TSUGAWA Takuya	CMU, Thailand	Tharadol Komolmis
	HOZUMI Kornyanat	GISTDA, Thailand	Sittiporn Channums
KMITL, Thailand	Pornchai Supnithi	NUOL, Lao	Donekeo Lakanchan
	Watid Phakphisut		Phutsavanh Thogphanh
	Punyawi Jamjareegulgarn		Khampaserth Xaphakdy
	Prasert Kenpankho	CADT, Cambodia	Khema Van
	Amornchai Chaichana		Vannak Chin
6 Associate Project Members.			

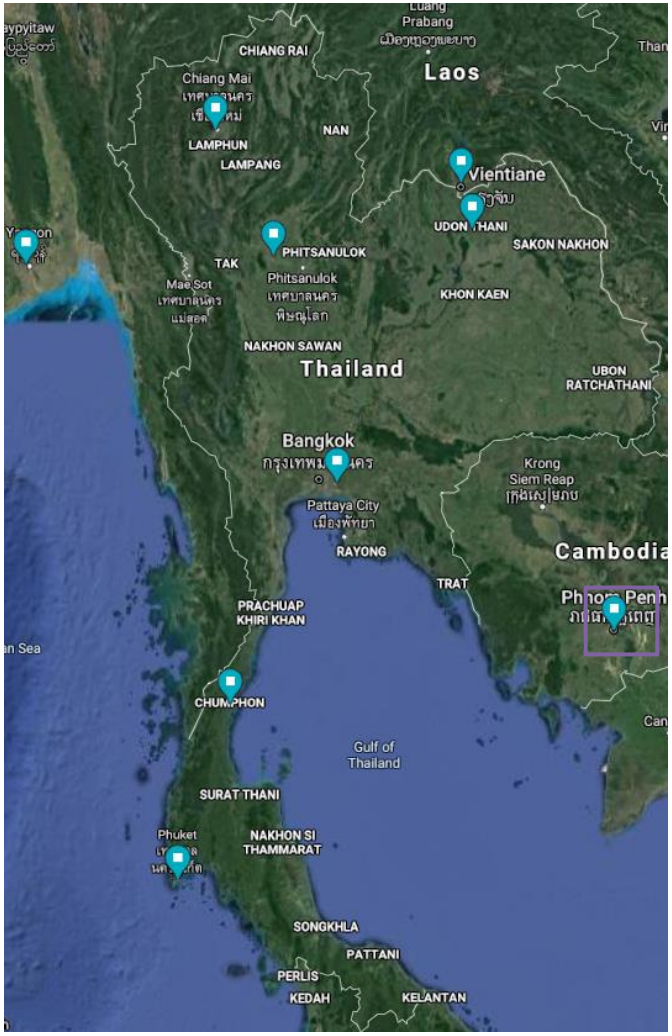
Project Duration :

April 1st, 2021 - March 31st, 2023 (24 Months)

Project Budget:

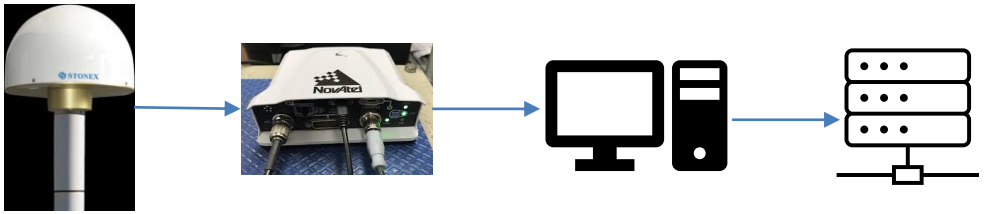
First year (April 1st, 2021 – March 31st, 2022) : 39,880 USD
Second year (April 1st, 2022 – March 31st, 2023) : 39,980 USD

Expanding GNSS and Ionospheric Monitoring System into Cambodia



Methods

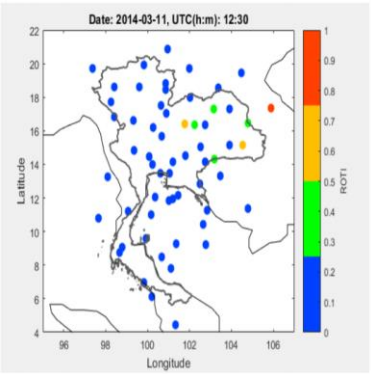
- ✓ Install additional new dual-frequency GNSS receiver station at Cambodia Academy of Digital Technology, Phnom Penh, Cambodia.
- ✓ Collect the GNSS data from the stations in the network in daily or near real-time and then share to them to NICT and other partnered institutes for academic research.



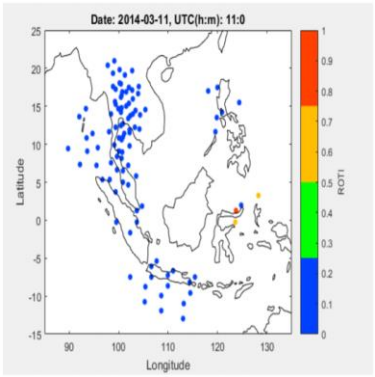
Upgrading Data Products and Prediction Models for Disaster Prevention and Aviation

Methods

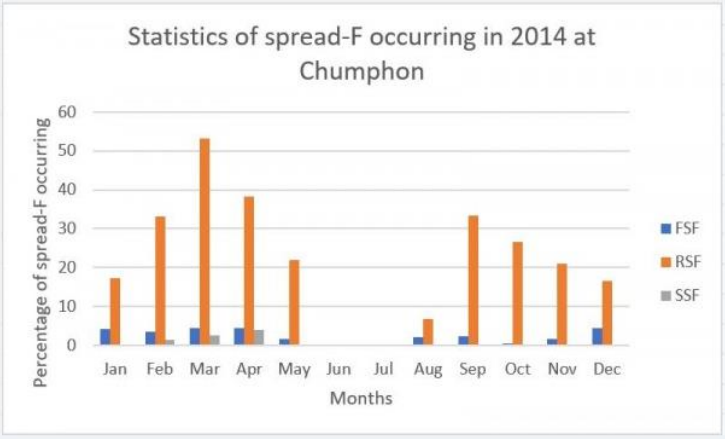
- ✓ Upgrade near real-time TEC and ROTI maps for communication and aviation applications by integrating the collected from the newly installed stations.
- ✓ Perform the multi-sensor data analysis based on the collected data over the networks.
- ✓ Improve the ionospheric data products and disturbance prediction model developed in Phase I with the help of AI and Machine Learning algorithms.



Thailand



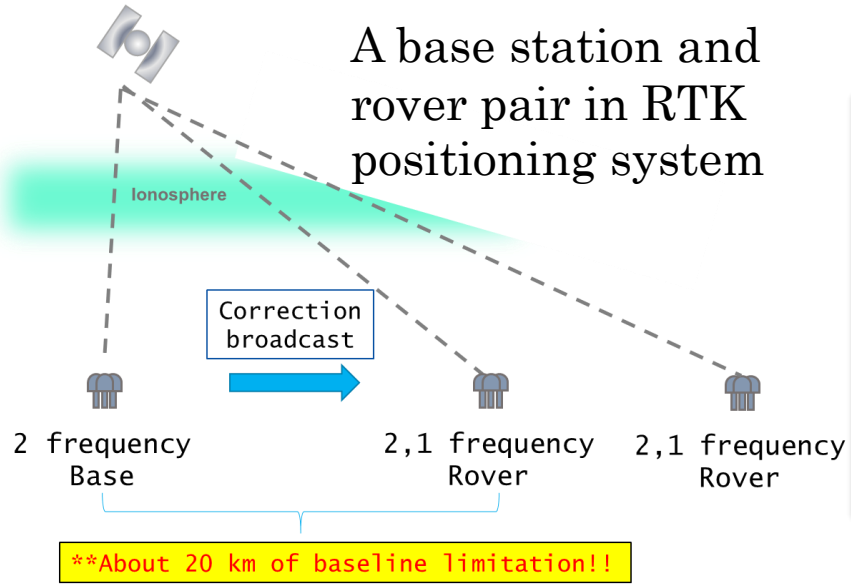
ASEAN



http://iono-gnss.kmitl.ac.th/?page_id=3306

Real-Time Kinematics (RTK) Receiver System

- RTK positioning is a carrier-based positioning technique in which the precision of position is improved using the real-time corrections information transmitted through the radio or internet channels from a reference/base station.
- The RTK positioning aims to achieve up to centimeter-level accuracy in the applications such as land survey, agriculture, constructions, unmanned vehicle navigation etc.



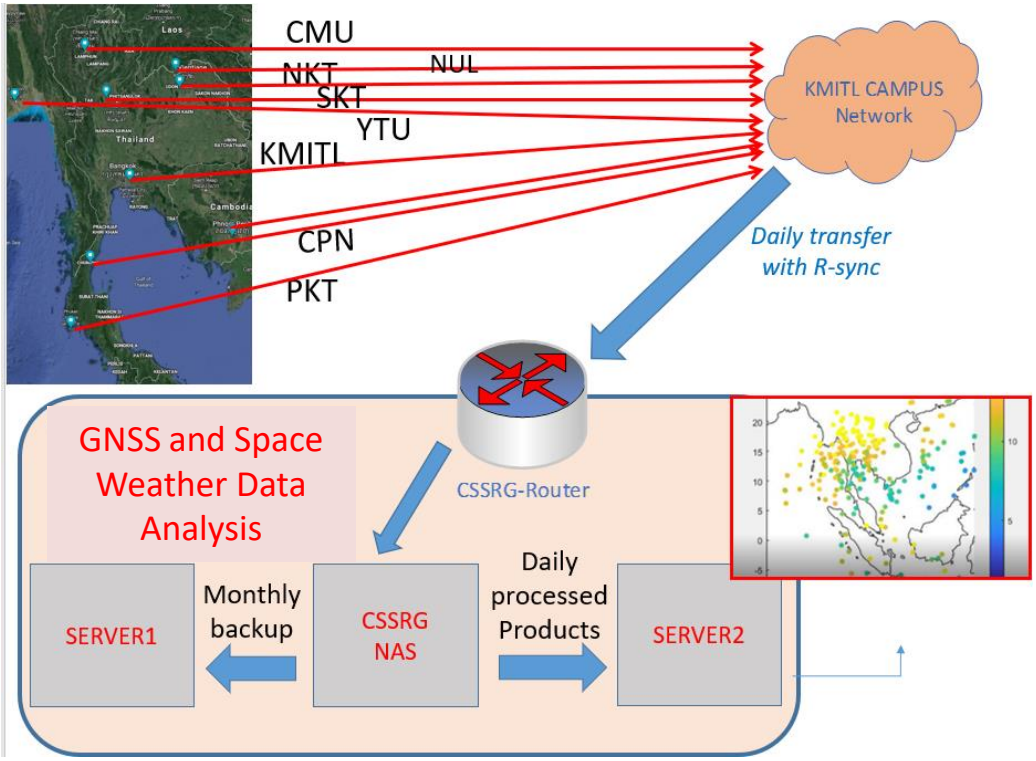
A base station and rover pair in RTK positioning system

Methods

- ✓ Implement a low-cost RTK receiver system.
- ✓ Test the system using the collected data from our station networks, particularly newly installed in Phase I.

GNSS and SW Excellence Center at KMITL

The objective of the Excellence Center is to provide not only the data from our observation networks, but also disseminate the knowledge and research information on GNSS, Ionosphere and Space Weather Effects through various media and channels such as seminars, trainings, online materials etc. to academic institutes and industries in Thailand and the neighboring ASEAN countries.



Methods

- ✓ Organize capacity building for domestic network and partnered institutions.
- ✓ Conduct high-quality research works in this area collaboratively with partnered institutions.

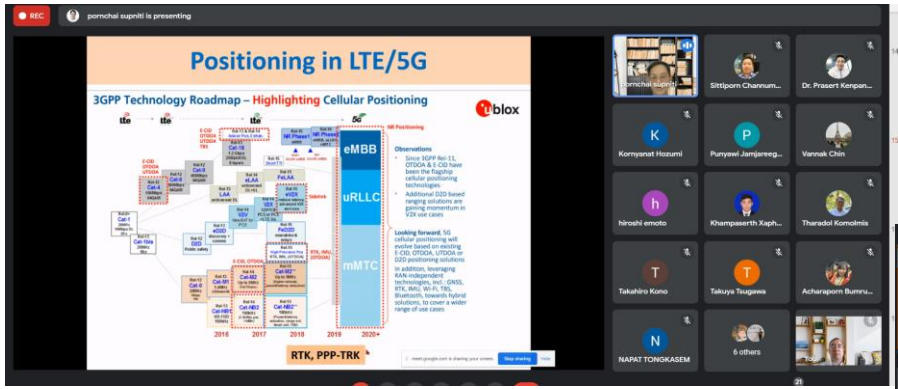
http://iono-gnss.kmitl.ac.th/

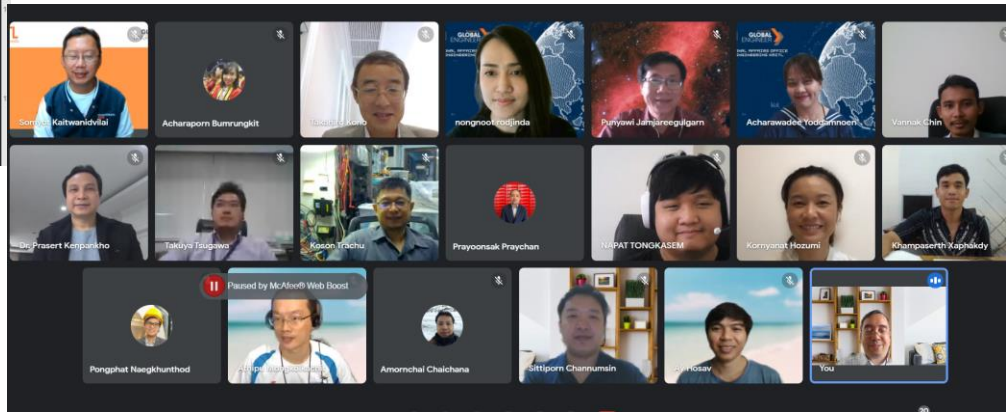
Online Project Kick-Off Meeting and Technical Workshop #1

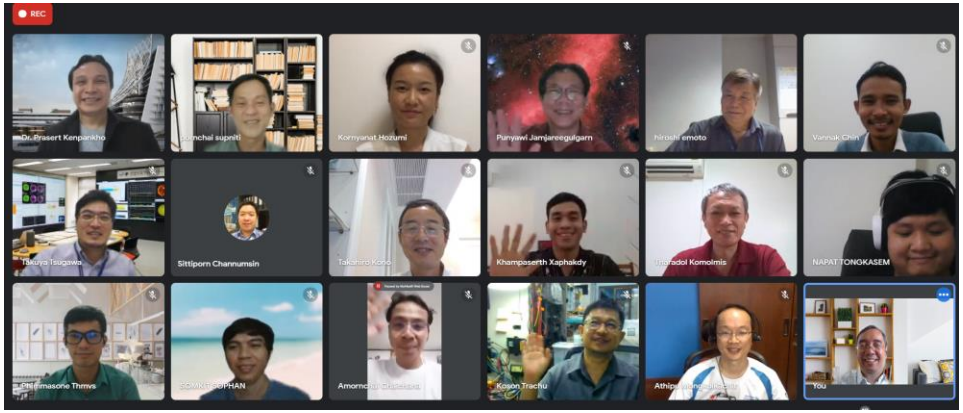
The online project kick-off meeting and technical workshop was organized on Thursday, July 29th, 2021.
All project members attended and discussed project's plan during kick-off meeting.
The following project members presented their ongoing researches related to Ionospheric weather and GNSS.

1. Dr. TSUGAWA Takuya and Dr. HOZUMI Kornyanat, NICT, Japan.
2. Prof. Pronchai Supnithi KMITL and Assoc. Prof. Dr. Prasert Kenpankho, KMITL, Thailand
3. Assoc. Prof. Dr. Punyawi Jamjareegulgarn, KMITL Chumphon campus, Thailand
4. Dr. Sittiporn Channumsin, GISTDA, Thailand
5. Dr. Khampaserth Xaphakdy, NUOL, Laos
6. Dr. Vannak Chin, CADT, Cambodia

Online Project Kick-Off Meeting and Workshop







Project Plan Year 1

Research Plan	Month (1-3)	Month (4-6)	Month (7-9)	Month (10-12)
1. Install a dual-frequency GNSS receiver in Cambodia		X	X	
2. Upgrade daily GNSS data and SW products for disaster and Aviation • **Modify daily GNSS data such as 2-D TEC maps, ROTI data products including the data from Laos**	X	X	X	
3. Develop AI and Machine learning model the applications of GNSS and Aviation	X	X	X	X
4. Capacity building for domestic network and partnered institutions on GNSS technology, ionosphere, basic space weather parameter understanding (I)				X

Project Plan Year 2

Research Plan	Month (1-3)	Month (4-6)	Month (7-9)	Month (10-12)
1. Develop and test a real-time kinematics positioning system using the post-processed data from our newly GNSS station at Laos.	X	X	X	X
2. Upgrade daily ionospheric data products for Communication and aviation • Improve prediction model for spread F events using more inputs from upgraded foF2, MUF and Spread F data products		X	X	X
3. Create online learning materials on the information of GNSS, ionosphere and SW.	X	X	X	X
4. Capacity building for domestic network and partnered institutions on GNSS technology, ionosphere, basic space weather parameter understanding (II)				X

Societal Impact:

- In the phase II, we will analyze the heterogeneous data in order to understand a more complete picture and understanding of disturbance events and develop more data products such as local K-index and near real-time TEC maps and analyze them together with other parameters to understand the dynamics of ionosphere.
- The results will be useful for forecasting the geomagnetic storm and other disturbances in GNSS and radio communications.
- The knowledge from the proposed data analysis and data products are useful for ionospheric disturbance detection for aviation and HF communications, prevalent, in aviation and communications, especially along the coastal areas as well as to other low-latitude regions in the world and essential to global model improvement (such as IRI model and IGS model).
- The project will encourage and support the researchers from the partnered institutes in Cambodia and Laos to work on joint research with the data collected. The research outputs from this project will be presented in international conferences and published in the academic journals.