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

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Objectives of this Project

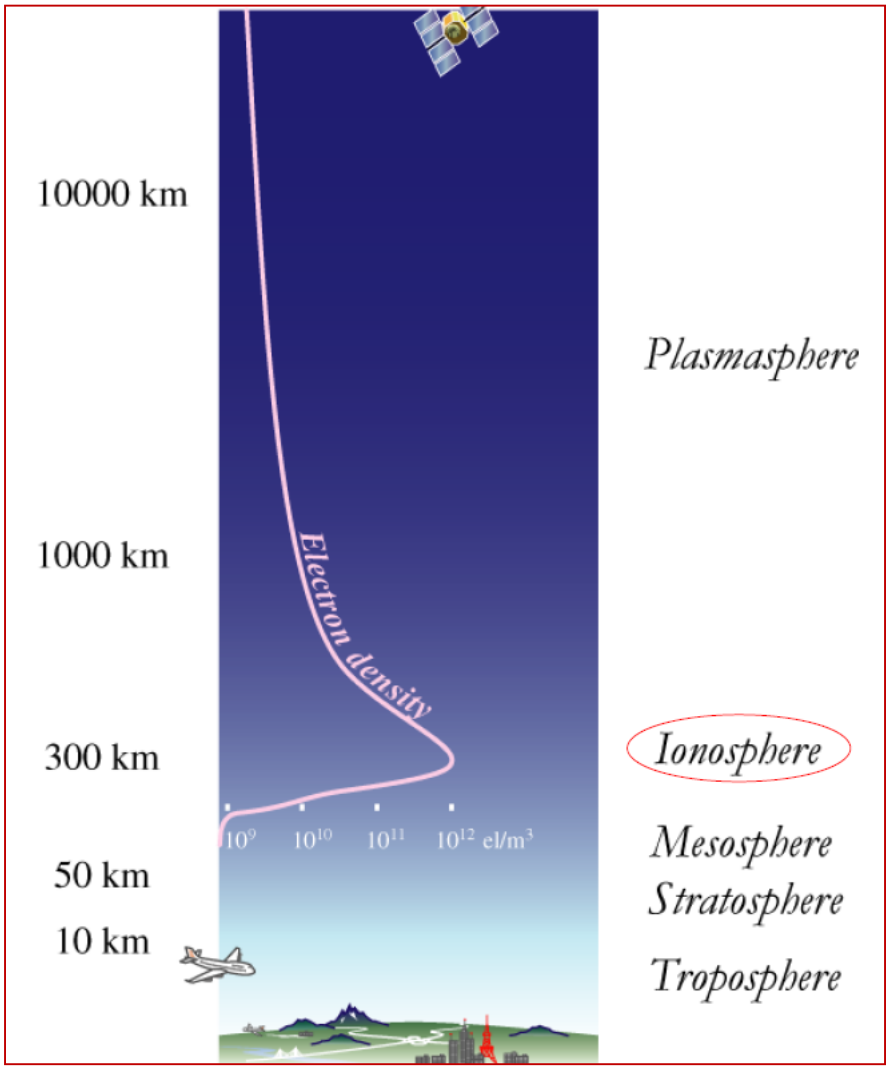
To expand GNSS and ionospheric monitoring system in Thailand and neighboring countries

To develop daily GNSS data products for disaster prevention and aviation

To develop daily ionospheric data products for disaster prevention and aviation

To support the new installation of VHF Radar station at Chumphon campus

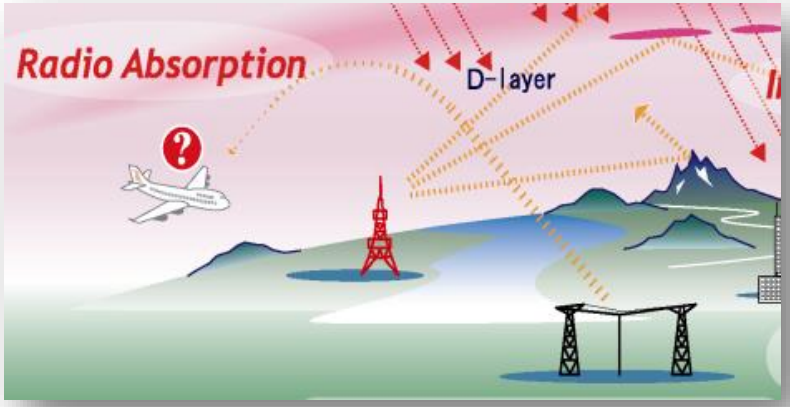
What is the ionosphere?

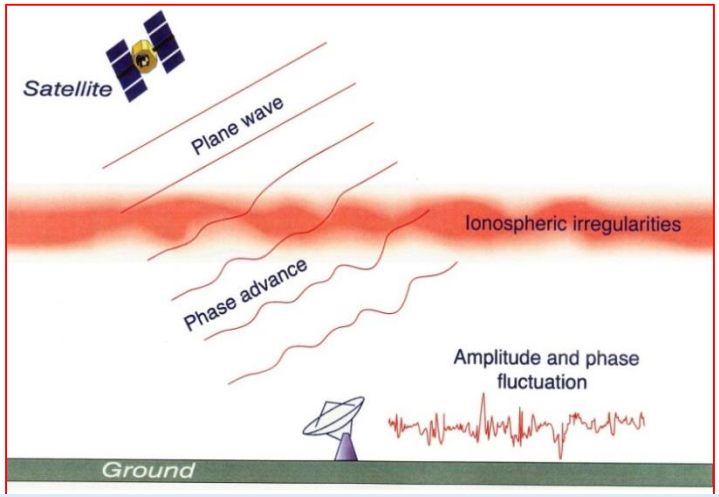


- The electron density also varies with time, location and solar activity.
- 50-1500 km height from the earth surface
- Ionized (electrons + ions) region which enhances the HF radio propagation (HF Band : 3-30 MHz)
- Free electrons and ions are due to extreme ultra violet (EUV) and X-ray

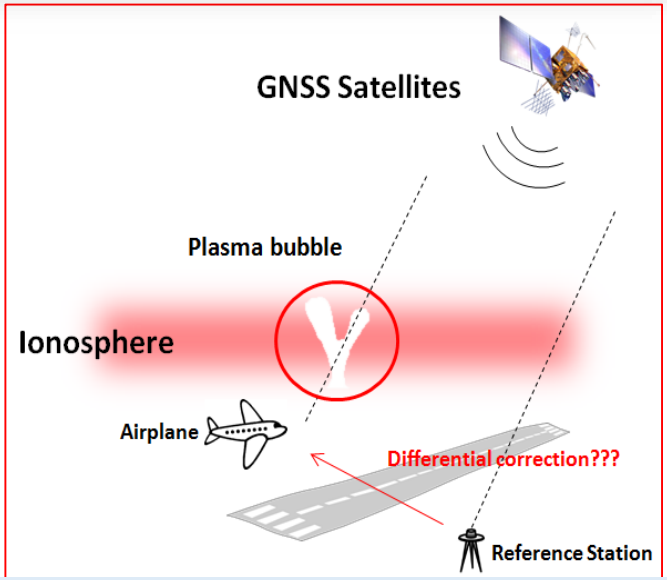
Iono Disturbance Effects & Monitoring

HF Communications in aircrafts, ships (commercial, military)
➔ Ionosonde, GNSS





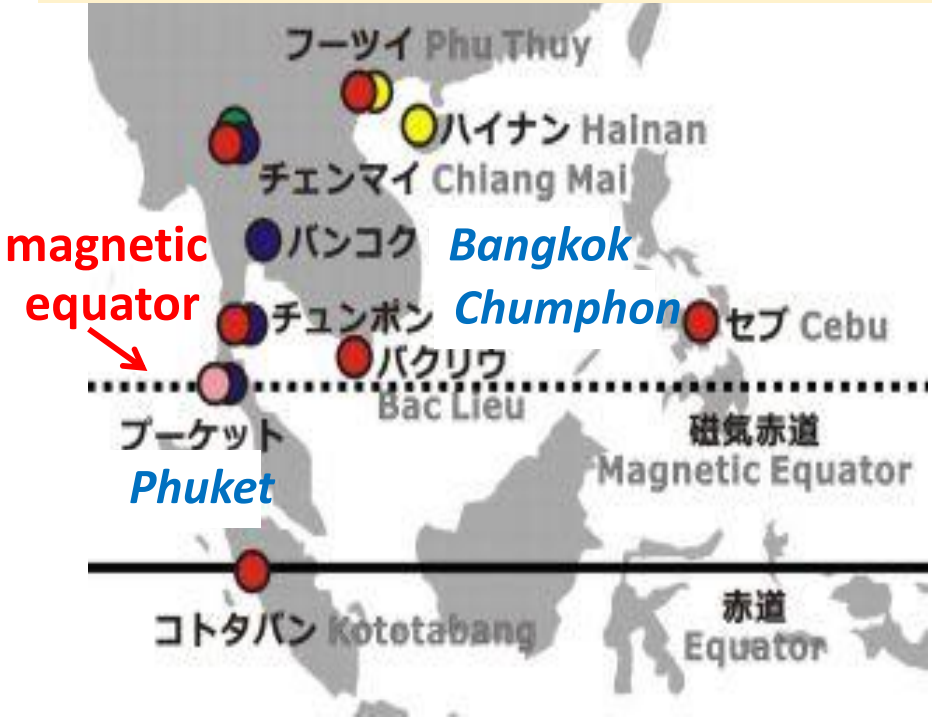
Scintillations, Loss-of-lock in GNSS signals
➔ GNSS, Beacon

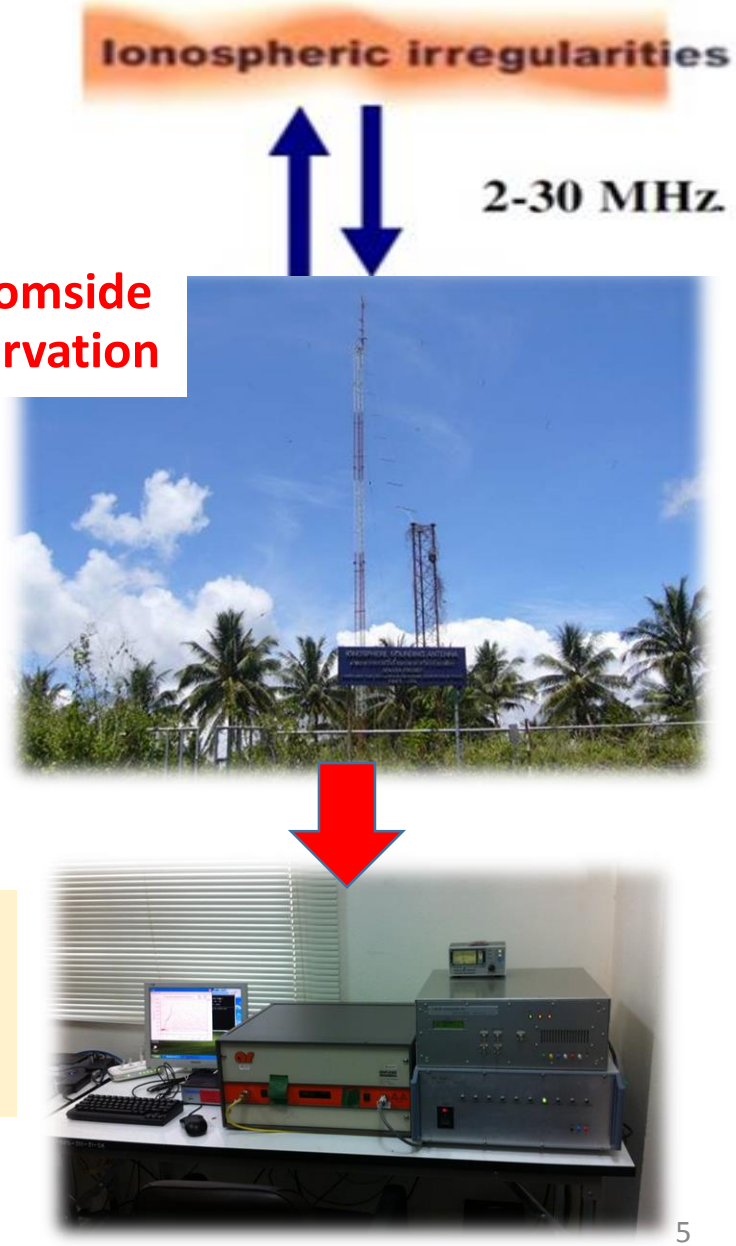


Navigation, Positioning
➔ GNSS, VHF Radar

Chumphon station (Ionosonde station)

South-East Asia Low-latitude Ionospheric Network (SEALION) project

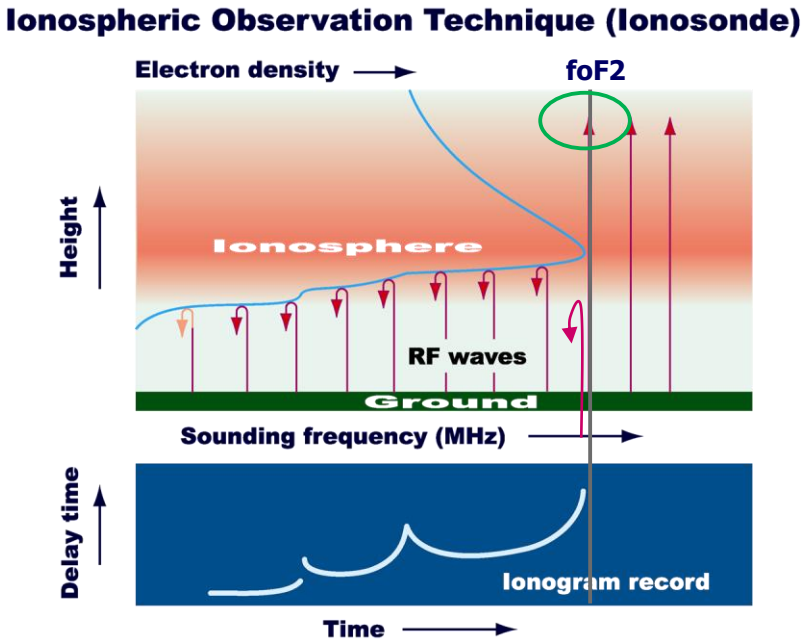


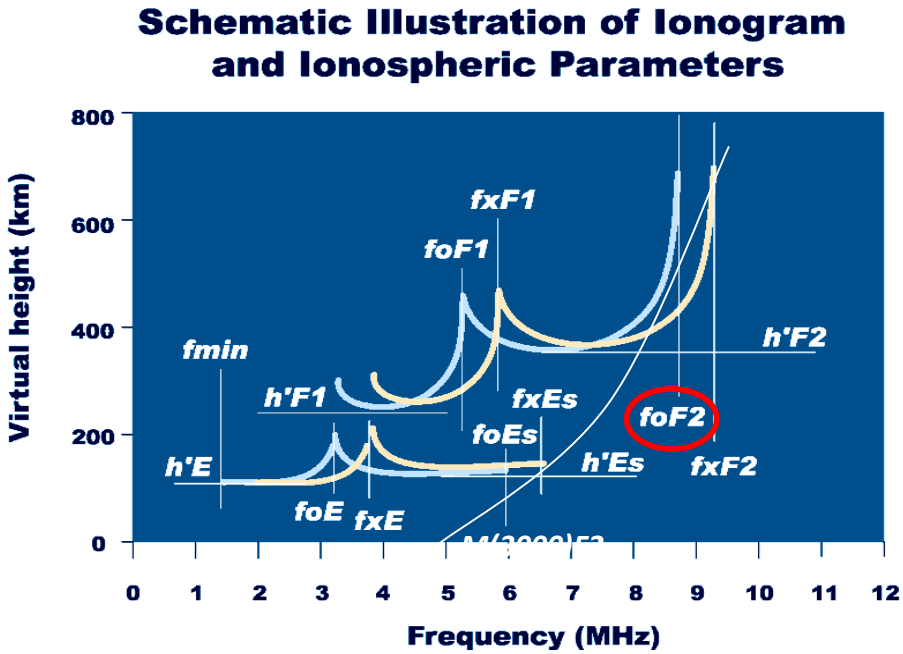


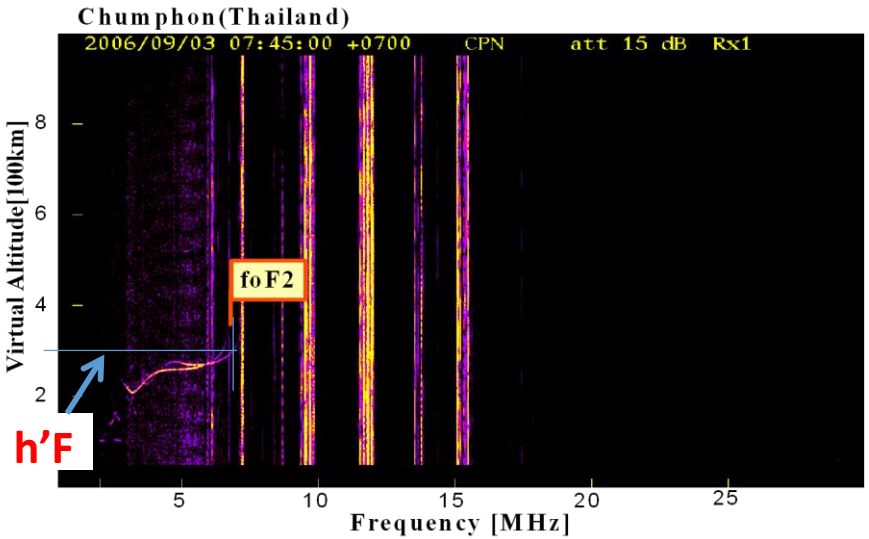
Purpose: monitor and forecast equatorial ionospheric disturbances, especially plasma bubbles.

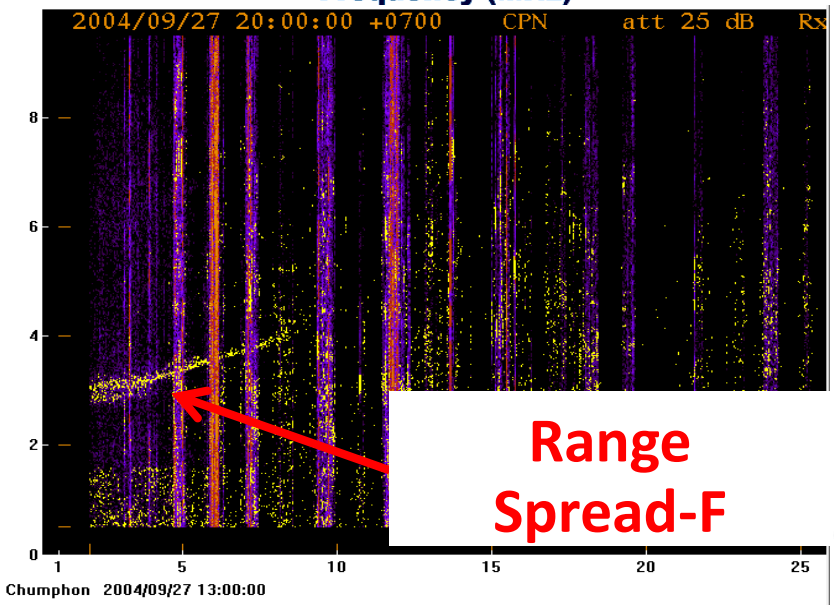
Source: http://seg-web.nict.go.jp/sealion/

Principles of Ionosonde & Ionograms





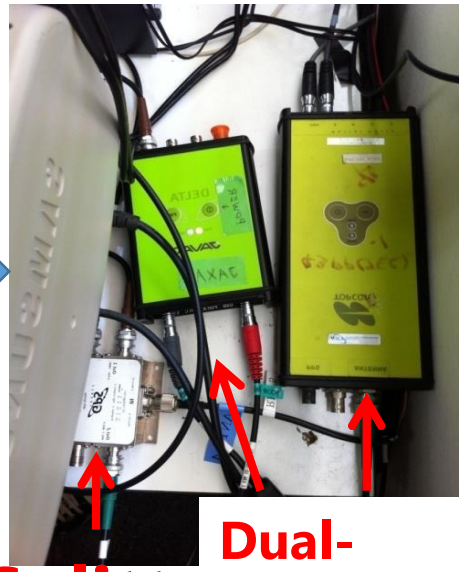




Chumphon station

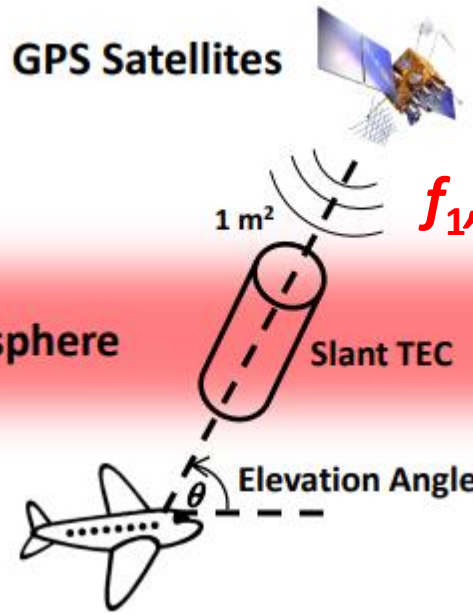
GNSS station

GNSS Antenna

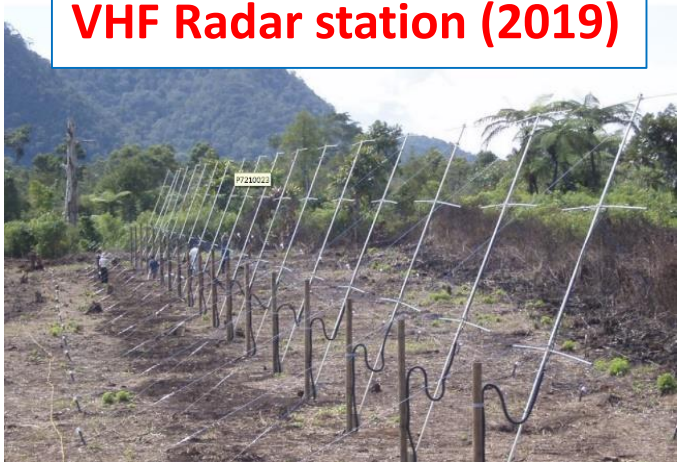


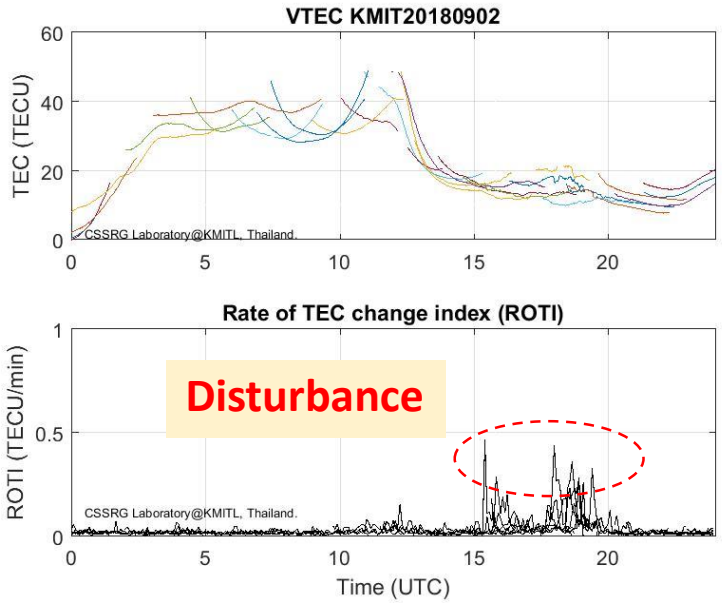
Splitter

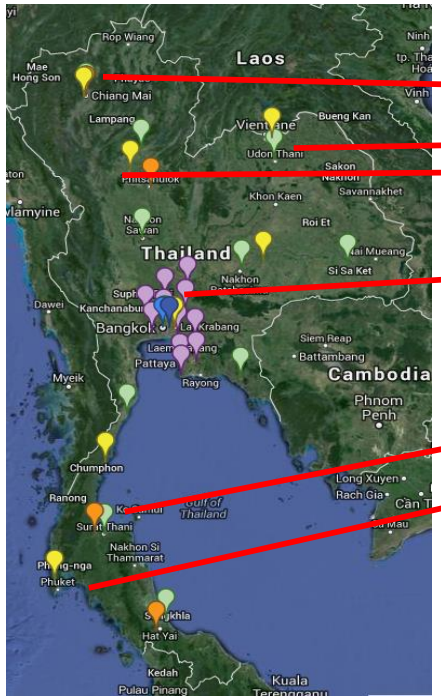
Dual-frequency GNSS Receiver



VHF Radar station (2019)







CMU

NKT

SKT

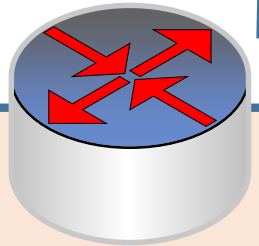
KMITL

CPN

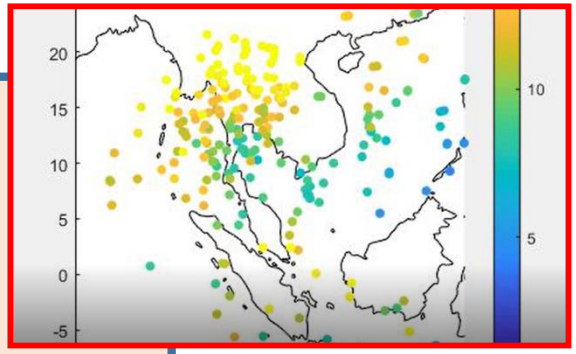
PKT

KMITL CAMPUS Network

Daily transfer with R-sync



CSSRG-Router



CSSRG Network

SERVER1

Monthly backup

CSSRG NAS

Daily processed Products

SERVER2

Space Weather Products for Aviation

Guidance on Criteria for SW Providers

3-Technical Criteria

a) Ability to provide the space weather information service, both near real-time and forecast information, as defined in the draft SARPs for Amendment 78 of ICAO Annex 3 Meteorological Service for International Air Navigation.

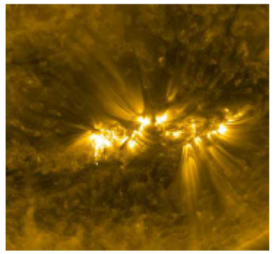
b) Ability to access observations (own observations and received from other space weather providers) of:
- Coronal mass ejections and high-speed streams
- Geomagnetic storms
- Solar radiation storms
- Solar flares
- Solar radio bursts
- Ionospheric activity

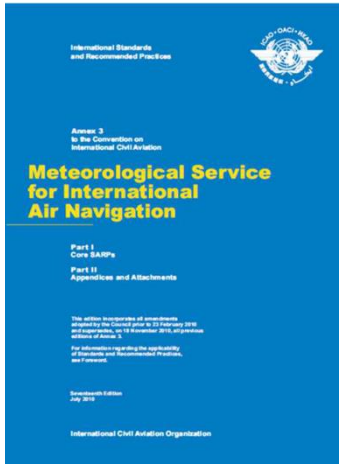
c) Ability to produce near real-time and forecast information regarding the potential impacts of space weather using numerical models capable of ingesting observation data from multiple sources.

d) Ability to produce near real-time and forecast information that meets the proposed functional and performance requirements.

e) Ability to coordinate and harmonize information with the space weather information providers for adjacent areas of responsibility, as necessary.

f) Ability to conduct forecast verification





End of 2018 Early 2019	Commence production and dissemination of space weather information.

R. Romero, "Establishment of Space Weather Information Service for International Air Navigation," ***UN/USA Workshop on the International Space Weather Initiative, Boston, 31 July- 4 August 2017****.*

Research Plan

Research Plan	Month (1-3)	Month (4-6)	Month (7-9)	Month (10-12)
1. Install a dual-frequency GNSS receiver in Myanmar or Laos	X	X		
2. Develop daily GNSS data products for disaster and Aviation • Study the Space Weather (SW) Data Format for Aviation • Develop daily SW data with emphasis on GNSS data such as 2-D TEC map, ROTI data products • Analyze the loss-of-lock statistics and scintillation at various GNSS stations	X	X	X	X
3. Develop daily ionospheric data products for Communication and aviation		X	X	X
4. To support the new installation of VHF Radar Station at Chumphon, Thailand	X	X	X	X
5. Capacity building for domestic network and Partnered Institution on GNSS technology, Ionosphere, Basic Space Weather parameter Understanding				X

BACK UP

Budgets

Category	Details	Amount ($US)
Personnel	1. Research Assistant at KMITL	5,000.00
Materials	1. Computer and electronic parts 2. Office supplies	1,500.00 500.00
Operational costs	1. Installation cost of a new GNSS station (Myanmar or Laos) 2. Installation support for VHF Radar station at Chumphon, Thailand 3. Travel expense to various stations (2 trips to Myanmar and Laos, 3 persons each, 3 days) 4. Travel expense and allowances for Myanmar and Laos researchers to KMITL (4 persons x 5 days) 5. Maintenance fees, Electricity and Internet connection at a new GNSS station 6. Travel expense for training at NICT, Japan (2 persons, 3 weeks) or inviting NICT researcher to train at KMITL 7. Capacity-building session for domestic Users on GNSS and Ionospheric products (30 people x 3 days)	1,000.00 5,000.00 (or more) 2,000.00 4,000.00 3,000.00 12,000.00 3,000.00
Hardware	1. Two sets of GNSS receiver and antenna	30,000.00
Miscellaneous	1. Miscellaneous (shipping, etc.) 2. University administrative fee (10%)	1,000.00 7,445.00
Total		74,445.00