International Collaboration on Space Weather Forecast

S1-8
Space Weather Activity at KMITL and Its Research Networks in Thailand

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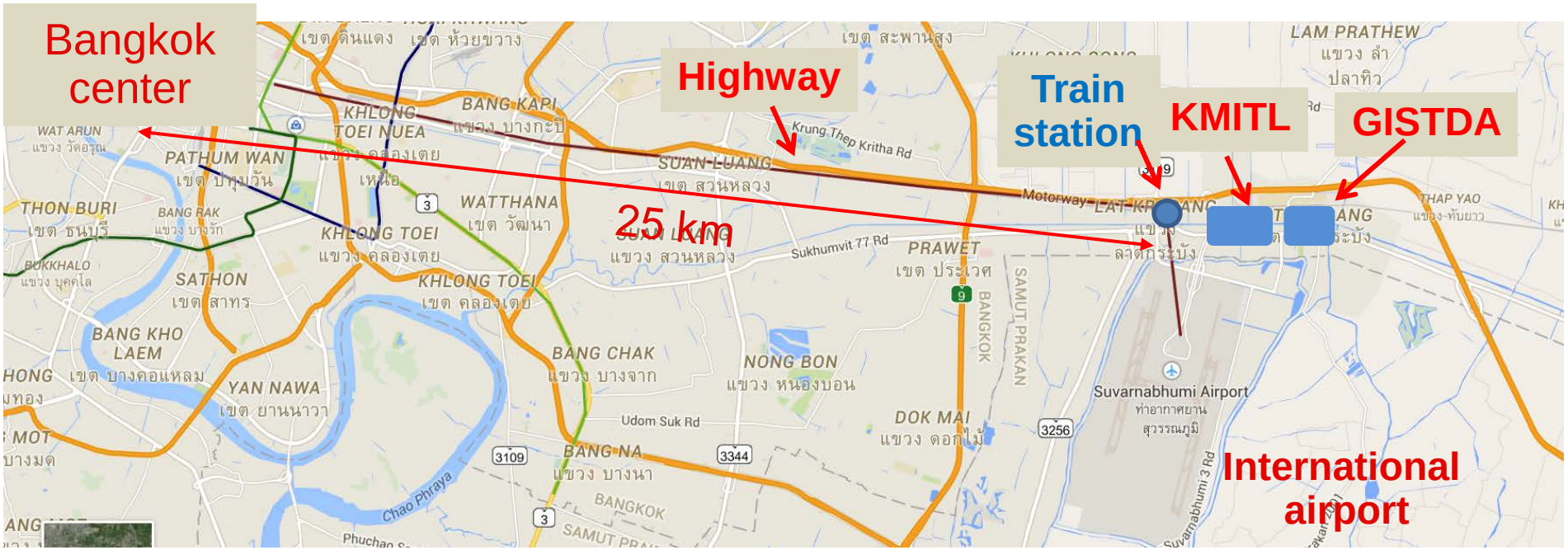
Chiangmai University, Thailand

[3]National Institute of Information and Communication Technology (NICT), Japan

Overview

- Founded in 1961
- Faculty members: ~1,000
- Student body: ~24,000
- Research university in Thailand
- Emphasis: Science, Engineering, ICT, Education and Architecture

Location


Bangkok center
Highway
Train station
KMITL
GISTDA
25 km
International airport
Krung Thep Kritha Rd
Motorway
Sukhumvit 77 Rd
Udom Suk Rd
Suvarnabhumi Airport
KHLONG TOEI NUEA
BANG KAPI
PATHUM WAN
SUAN LUANG
WATTHANA
THON BURI
KHLONG TOEI
SATHON
BANG KHO LAEM
YAN NAWA
BANG CHAK
NONG BON
PRAWET
DOK MAI
BANG NA
LAM PRATHEW
THAP YAO
SAMUT PRAKAN
BANGKOK

Space and Atmospheric Communication and Informatics Research Group

Members: 5

Students: 7

Assoc. Prof.
Pornchai Supnithi

Asst. Prof.
Prasert Kenpankho

Asst. Prof.
Tulaya Limpiti

Assoc. Prof. Punyawee

Surachai
Pimsalee

Current Research Activities

Main theme	Ionospheric and GNSS Data Center	Ionospheric Study in the Equatorial Region
Research Targets	Monitoring	foF2, h'F, foE, Spread F Sporadic E, etc.
	2-D map Thailand, ASEAN	TEC analysis
	SHM model NN model	Scintillation
	Monitoring	Plasma Bubble study
		Slant Delay gradient analysis
Applications	Improved IRI model	Disaster
	Prediction model	Satellite Communication
	Capacity-Building	Aeronautical Navigation

Near-Future Research Targets in SW

Main theme	Ionospheric and GNSS Data Center	Ionospheric Study in the Equatorial Region
Research Activity	Set up stations in Laos/Cambodia	foF2, h'F, foE, Spread F Sporadic E, etc.
	Link more stations	TEC analysis using Beidou data
	2-D map Thailand, ASEAN	Scintillation
	SHM model NN model	Plasma Bubble study
		Slant Delay gradient analysis
Applications	CubeSat Project	Capacity-Building
	Ionospheric signature related to plasma bubble, ionospheric storm, earthqueake	GBAS experiments for Aeronautical Navigation

What kinds of data do you want? Which area? How often? For what?

- GNSS data (1-sec)
  - equatorial and low-latitude stations
  - Arctic or Antartica stations
- Ionosonde/Digisonde data
  - equatorial and low-latitude stations
  - Arctic or Antartica stations
- Scintillation data

data name	Observing Period （start to end）	Object	Instrument	Location of instrument	project name	temp resol ution	frequency of data
GPS			Novatel	Bangkok	KMITL		
Magnetometer	2012DEC-2013MAR		gsm19fd (Canada)	Phuket	SEALION		5 sec
ionogram/image data	2003-2014	ionosphere	ionosphere	Chumphon	SEALION		5 min
ionogram/image data	2004-2014	ionosphere	ionosphere	Chiangmai	SEALION		5 min
GPS (Nongkhai)	2008-	ionosphere	Trimble	Nongkhai	CU, Kyto		1 sec
GPS(Sukhothai)	2009-	ionosphere	Trimble	Sukhothai	CU, Kyoto		1 sec
GPS(Phimai)	2003-	ionosphere	Topcon	Phimai	CU, Kyoto		1 sec
GPS data	2008-	ionosphere	Topcon	Bangkok	SEALION		1 sec
GPS data	2004-	ionosphere	Topcon	Chumphon	SEALION		1 sec
GPS data	2004-	ionosphere	Topcon	Phuket	SEALION		1 sec
GPS data	2004-	ionosphere	Topcon	Chiangmai	SEALION		1 sec
GPS data	2009-	ionosphere	Novatel	Bangkok	ENRI		1 sec
foE data (CPN)	2004-2012	ionosphere	FM/CW ionosonde	Chumphon	SEALION		1 hour
foEs data (CPN)	2004-2012	ionosphere	FM/CW ionosonde	Chumphon	SEALION		1 hour
foF2 data (CPN)	2004-2010	ionosphere	FM/CW ionosonde	Chumphon	SEALION		obtained = 5 min, created = 15 min
foF2 data (CMG)	2004-2010	ionosphere	FM/CW ionosonde	Chiangmai	SEALION		obtained = 5 min, created = 15 min
MUF data (CPN)	2004-2010	ionosphere	FM/CW ionosonde	Chumphon	SEALION		obtained = 5 min, created = 15 min
MUF data(CMG)	2004-2010	ionosphere	FM/CW ionosonde	Chiangmai	SEALION		obtained = 5 min, created = 15 min
h'F data (CPN)	2004-2010	ionosphere	FM/CW ionosonde	Chumphon	SEALION		obtained = 5 min, created = 15 min
h'F data (CMG)	2004-2010	ionosphere	FM/CW ionosonde	Chiangmai	SEALION		obtained = 5 min, created = 15 min
Spread F data (CPN)	2004SEP-2005AUG 2008SEP-2009APR MAR&APR2006-2013	ionosphere	FM/CW ionosonde	Chumphon	SEALION		obtained = 5 min, created = 15 min
Spread F data (CMG)	2004SEP-2005AUG 2008SEP-2009APR MAR&APR2006-2013	ionosphere	FM/CW ionosonde	Chiangmai	SEALION		obtained = 5 min, created = 15 min

What kinds of technique do you want to learn?

- 3-D mapping
- Satellite data analysis (COSMIC, etc.)
- Incoherent scatter radar analysis
- TEC analysis related to earthquake
- Cloud computing/Data Analytics
- Space Weather Operation Center Management

Current Partners

- Japan: Nagoya University, Kyoto university
- Japan: NICT, ENRI, JAXA
- Thailand: AIT, Chulalongkorn University, Chiangmai Unviersity, Mahidol University, Khon Kaen University
- Thailand: National Science and Technology Development Agency (NSTDA), Geo-Informatic and Space Technology Development Agency (GISTDA), Ministry of Digital Economy, Aeronautical Radio of Thailand (AeroThai), ThaiCom

Which countries/institutes do you want to collaborate with?

- CAS, China
- APSCO, AOSWA, IRI Working Group
- ASEAN countries
- India
- Institute with facilities at Arctic/Antartica areas
- Peru, Brazil, Argentina
- All countries

Chumphon Ionosphere Station

เครื่องส่งและเครื่องรับรุ่น SKH-96092 FM/CW Radar

สายอากาศ GNSS

อุปกรณ์แยกสัญญาณ (Splitter)

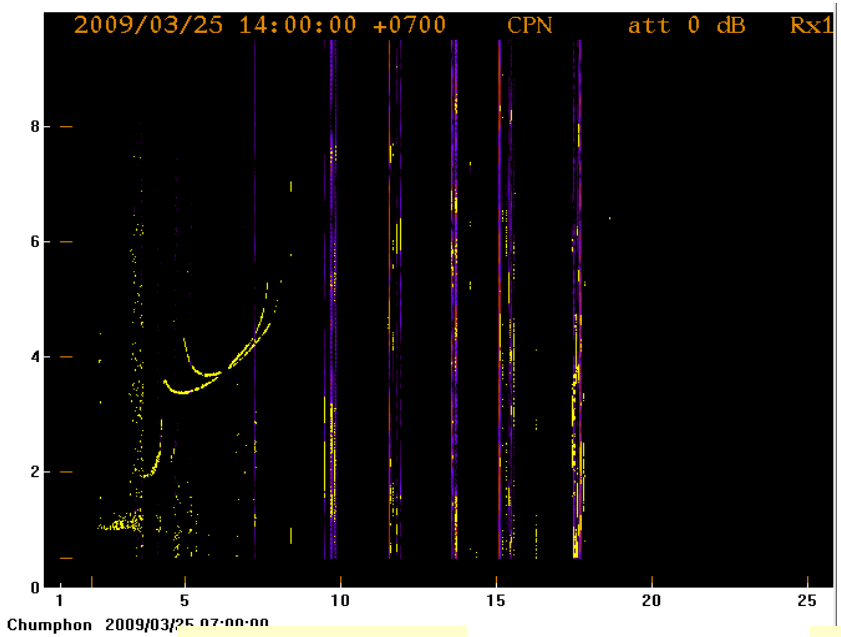
เครื่องรับ GPS

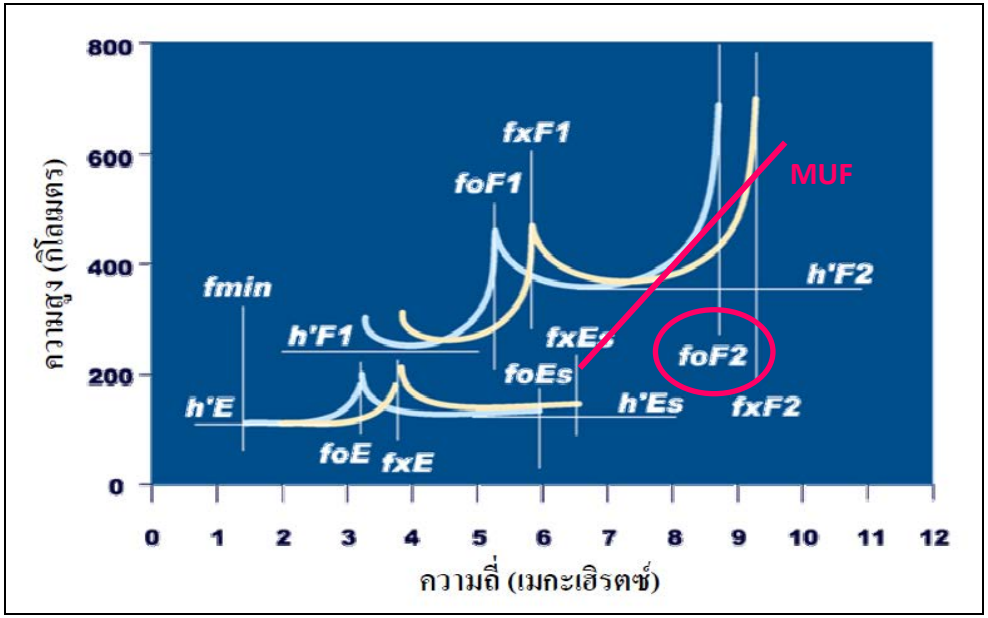
GNSS antenna

Splitter

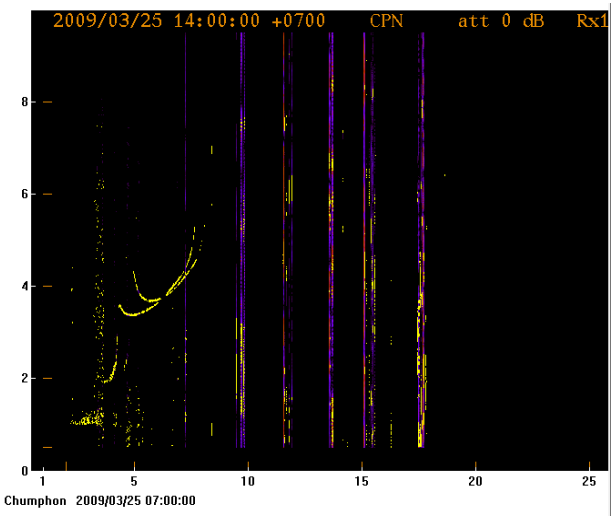
2 TOPCON GPS receive

Ionogram

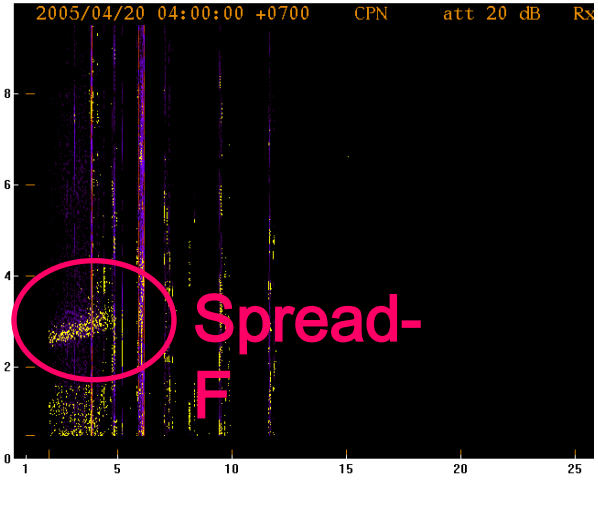




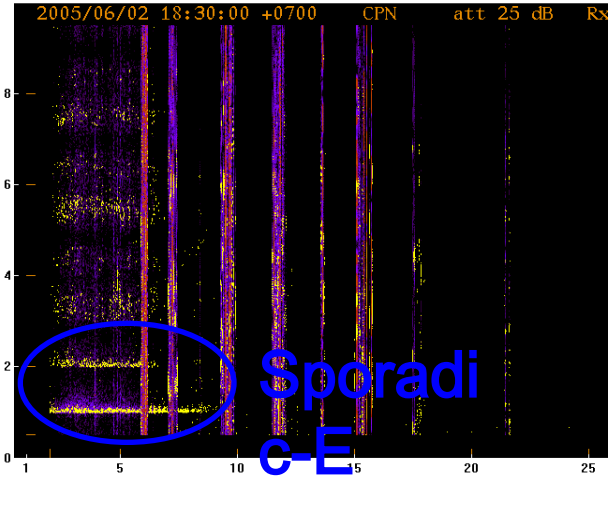
No Spread-F



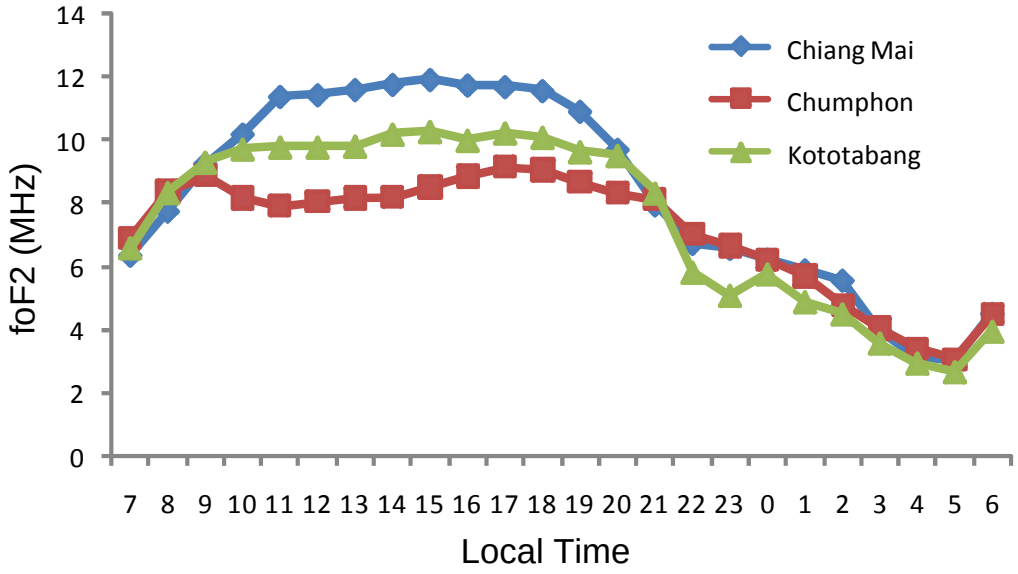
With Spread-F



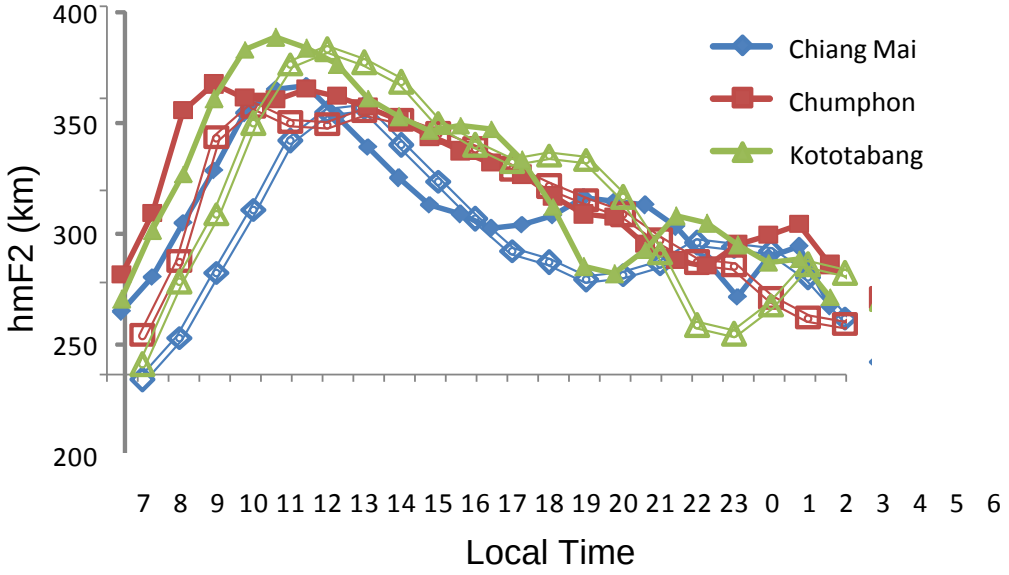
With Sporadic-E



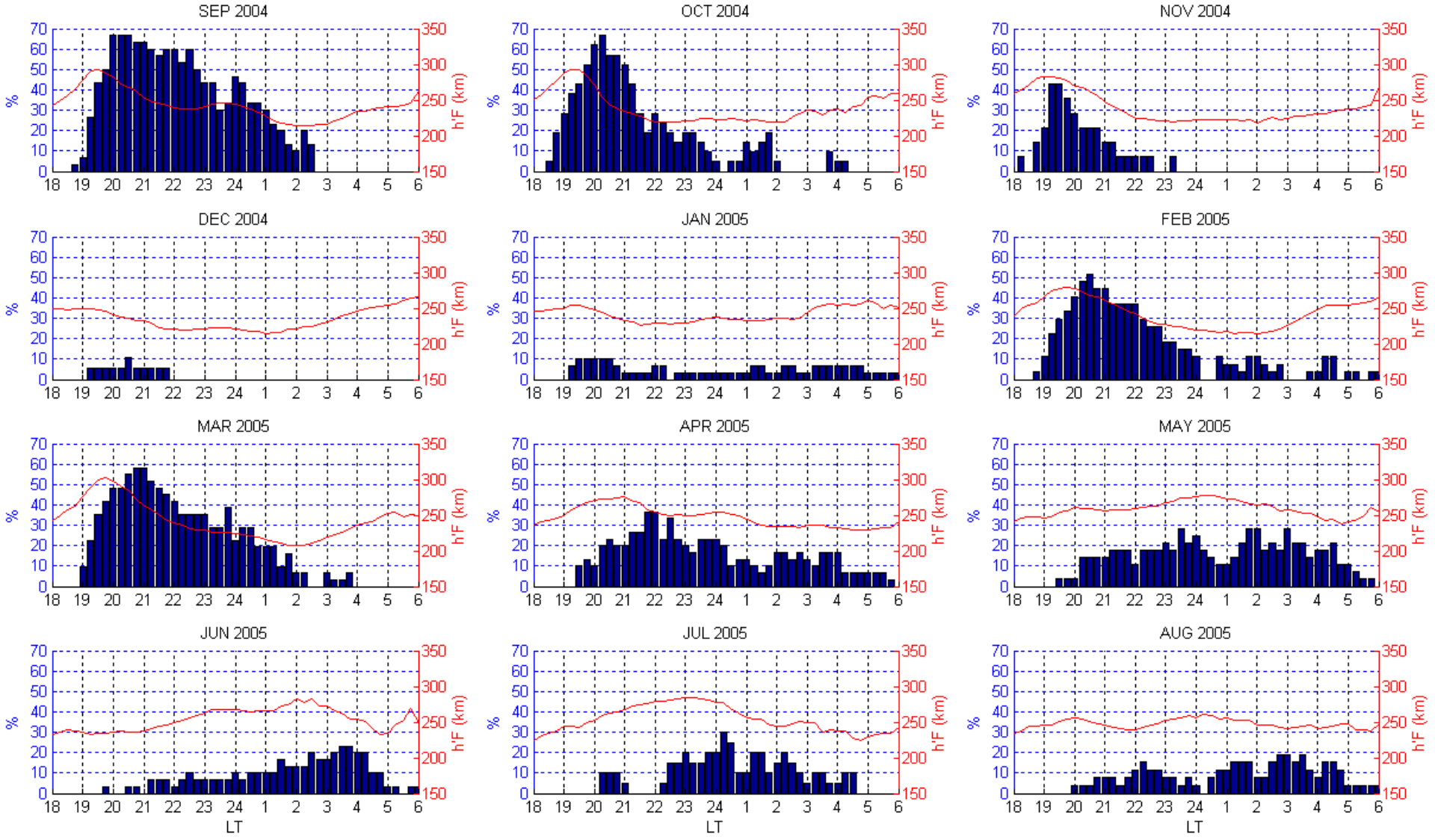
foF2


foF2 (MHz)
0
2
4
6
8
10
12
14
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 0 1 2 3 4 5 6
Local Time
Chiang Mai
Chumphon
Kototabang

hmF2


hmF2 (km)
200
250
300
350
400
7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 0 1 2 3 4 5 6
Local Time
Chiang Mai
Chumphon
Kototabang

RSF Occurrence Rate (CPN Station)

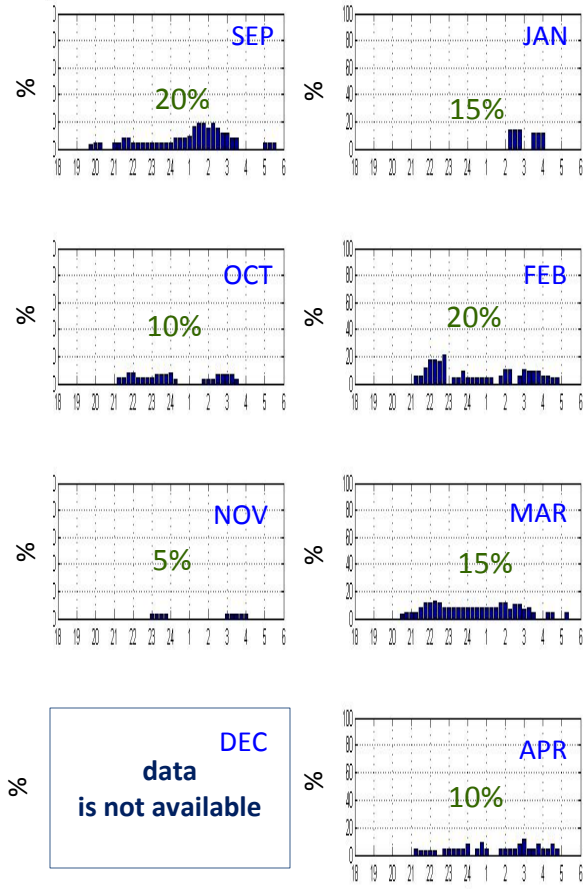


In general, %RSF occurrence at CPN is higher than KTB and CMU

This confirms that the plasma bubble is generated around the magnetic equator and then expand to the higher latitude area.

Chiangmai (CMU)

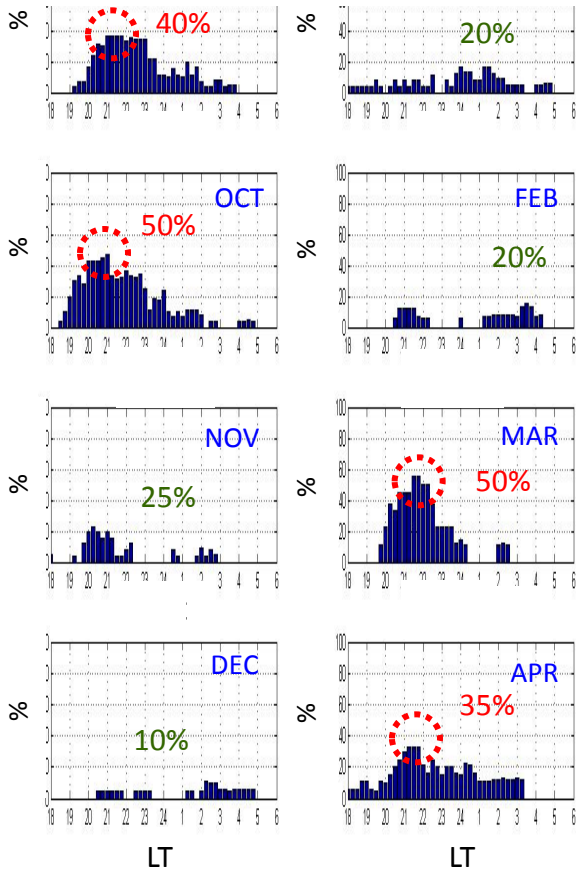
The %RSF occurrence at CMU is not over 20% in average.



Chumphon (CPN)

The %RSF is not over 20% in average at CPN in NOV, DEC, JAN and FEB

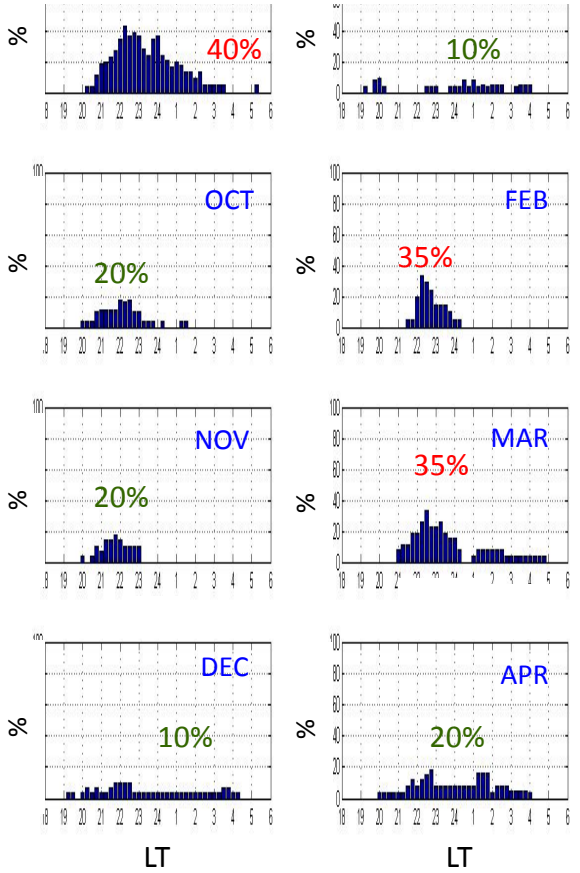
The higher rate mostly occurs during the equinoctial months



Kototabang (KTB)

The %RSF is not over 20% in average at KTB from OCT to JAN and APR

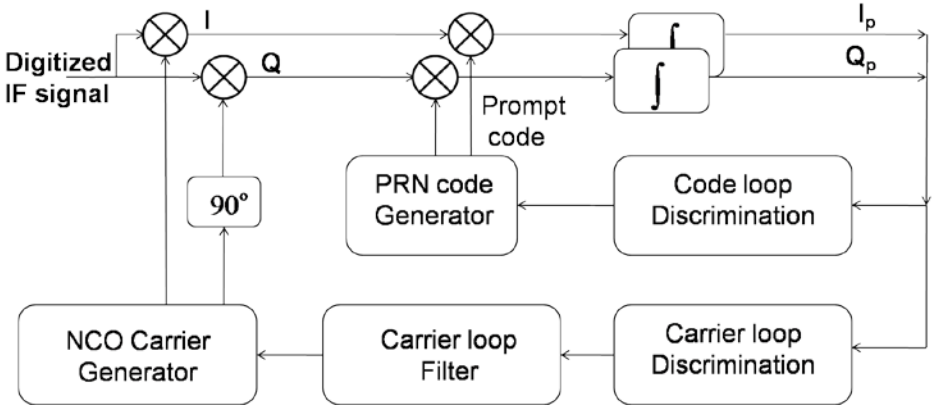
The higher rate occurs in SEP, FEB and MAR



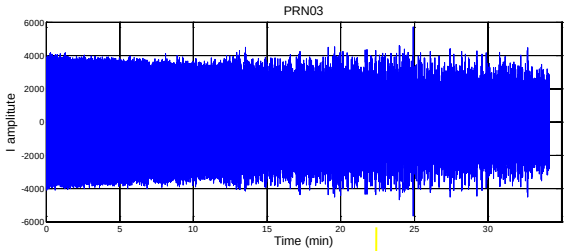
Scintillation Experiment

DIF

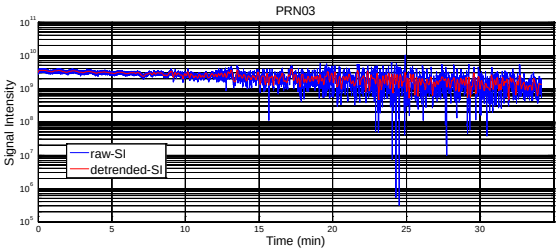
Acquisition → Tracking Loop → • Navigation data • Scintillation



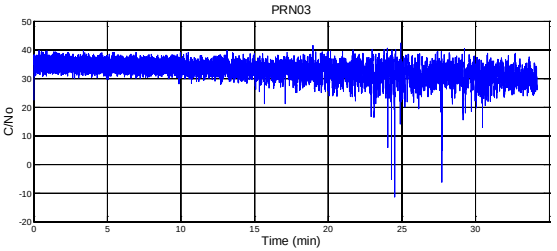
Results



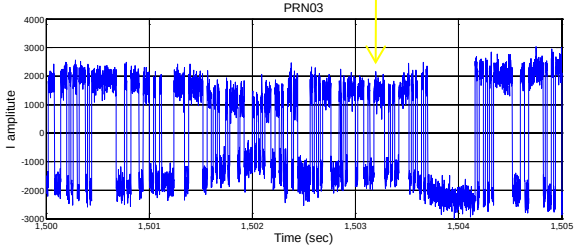
I-channel amplitude

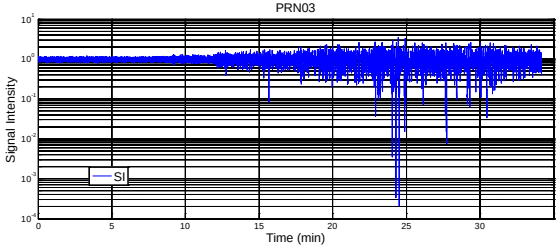


The intensity of raw signal and detrended signal

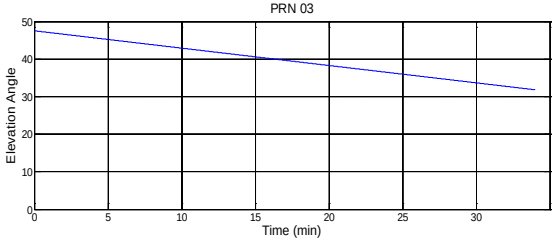


The C/No estimation

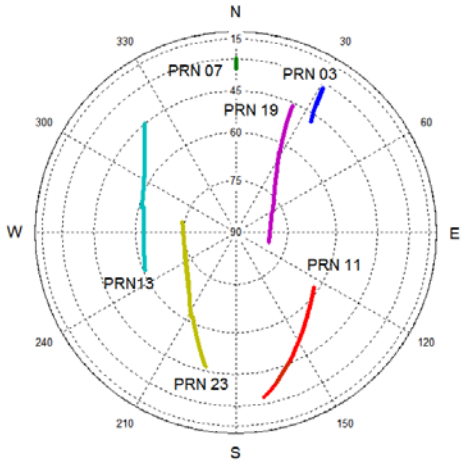


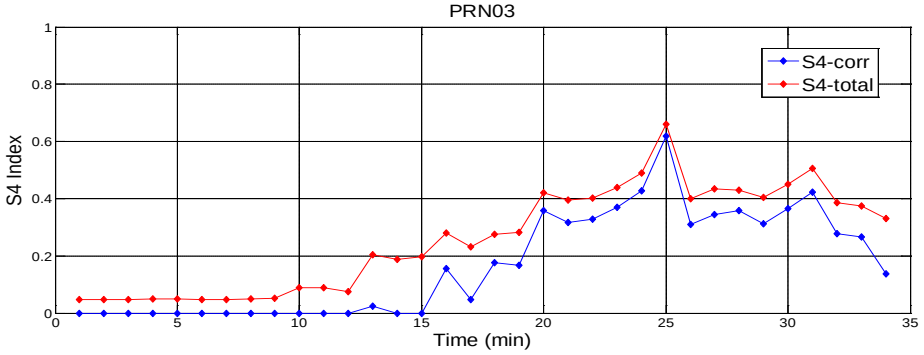


The final signal intensity

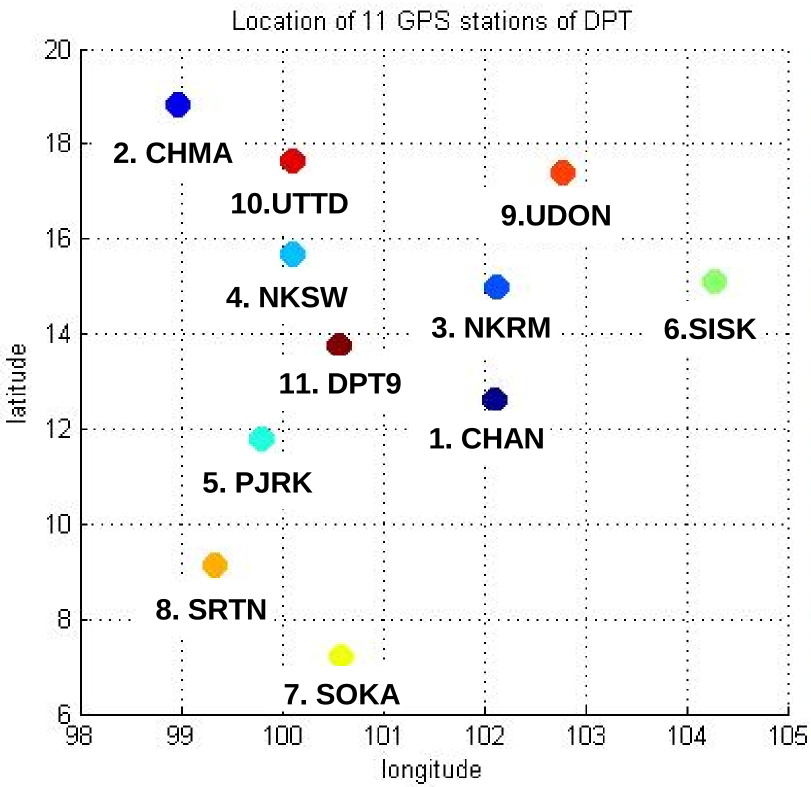


The elevation angle





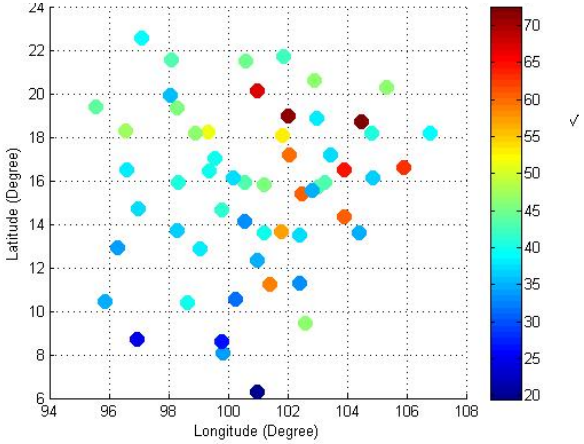
Location of DPT stations



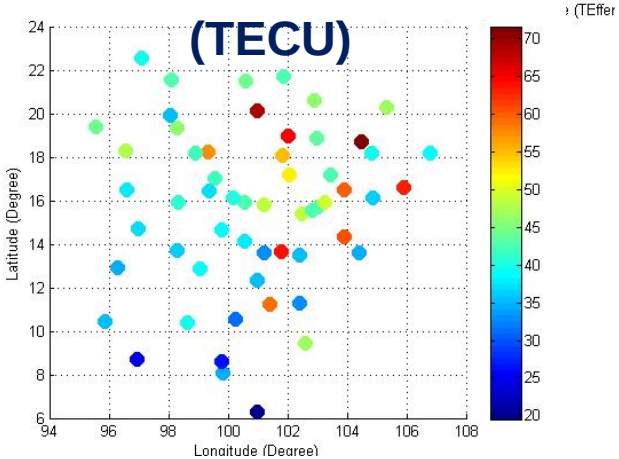
No	[illegible]	GPS Base Stations	Station
1	จันทบุรี	Chanthaburi	CHAN
2	เชียงใหม่	Chiang Mai	CHMA
3	นครราชสีมา	Nakhon Ratchasima	NKRM
4	นครสวรรค์	Nakhon Sawan	NKSW
5	ประจวบคีรีขันธ์	Prachuap Khiri Khan	PJRK
6	ศรีสะเกษ	Si Sa Ket	SISK
7	สงขลา	Song Khla	SOKA
8	สุราษฎร์ธานี	Surat Thani	SRTN
9	อุดรธานี	Udon Thani	UDON
10	อุตรดิตถ์	Uttaradit	UTTD
11	กรุงเทพฯ	DPT9	DPT9

VTEC on 08JUL12 at 09:43:21UT at 11 GPS stations of DPT Estimated by ASHM and LS Maximum SH Degree : N = 15

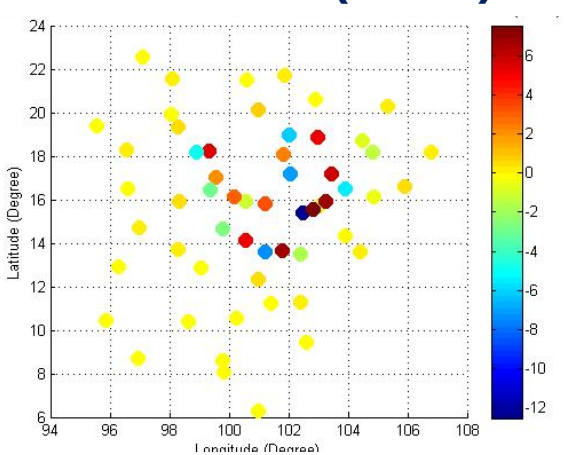
Observed VTEC : T (TECU)



Estimated VTEC : Te (TECU)



dT = Te – T (TECU)



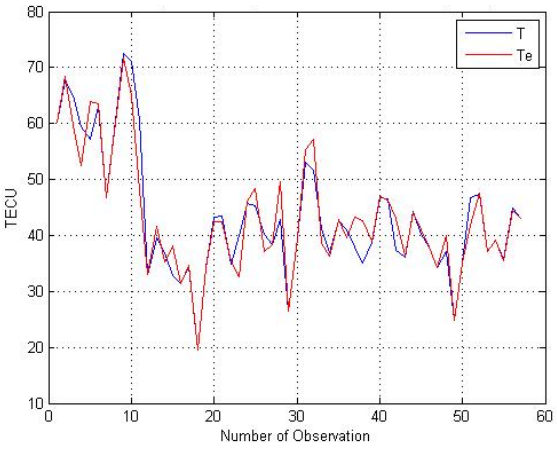
Number of observation :

p = 57

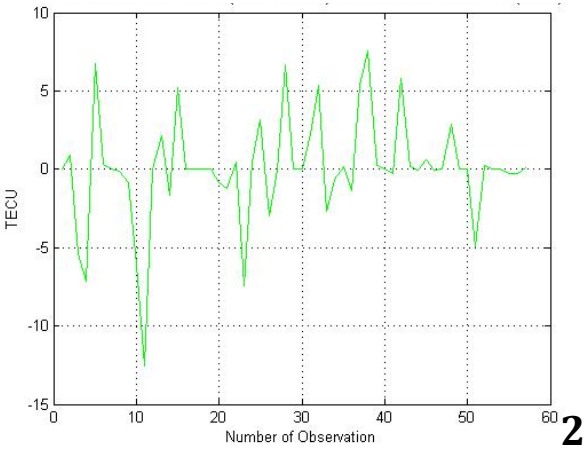
Number of SH coefficients :

$q = (N+1)^2 = 256$

T vs. Te (TECU)



dT = Te – T (TECU)



iono-gnss.kmitl.ac.th

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HOME | DATA | PARTNER | KNOWLEDGE | LINKS | ABOUT US | GALLERY

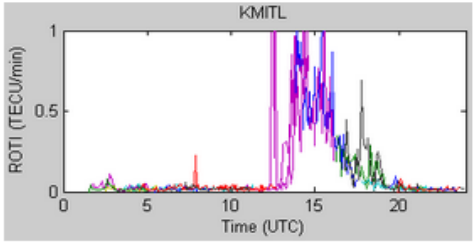
Ionospheric and GNSS Data Center

Home

Welcome to the Thailand GNSS and ionospheric data center hosted at King Mongkut's Institute of Technology Ladkrabang (KMITL).

This project presents the current status of GNSS and ionospheric monitoring networks and he efforts to create a GNSS and ionospheric database in Thailand. These data are important for the study of the Ionosphere, Troposphere, GPS/GNSS Technology, Geodsy and applications on the aeronautical navigation, satellite communication, earthquake study among others. At present, KMITL, Chulalongkorn University, Chiangmai University, NICT as well as Kyoto University, Japan have cooperated to install a number of ionospheric monitoring equipment such as ionosondes, all-sky imager, magnetometer as well as GNSS receivers in various locations of Thailand such as Chiangmai, Chumphon, Bangkok and Phuket. Other GPS networks and ionosonde stations exist, whereby each network is owned and operated independently. For example, the Department of Land has 11 stations, the Royal Thai Navy owns three ionosonde stations, the Thai Meteorological Department houses 5-7 GPS receivers and the Aeronautical Radio of Thailand owns 3-4 GPS receivers. We aim to create the database of GPS data and ionospheric parameters in the Thailand location. In our plan, the data center with collaboration among various universities and agencies is being foreseen. At present, Thailand GNSS and Ionospheric Data Center is collecting the data from each GPS receiver as well as the ionosonde stations by using the script at each station to send the raw data through the internet to the server at KMITL. The database is useful for the determination of TEC and enhances the study of the ionosphere.

Should you need these data for research purpose, please contact the website admin directly.



Example of ROTI (Rate of TEC Index) Oct 11, 2011

Navigation

- Chaos Tools AJAX Demo
- Forums

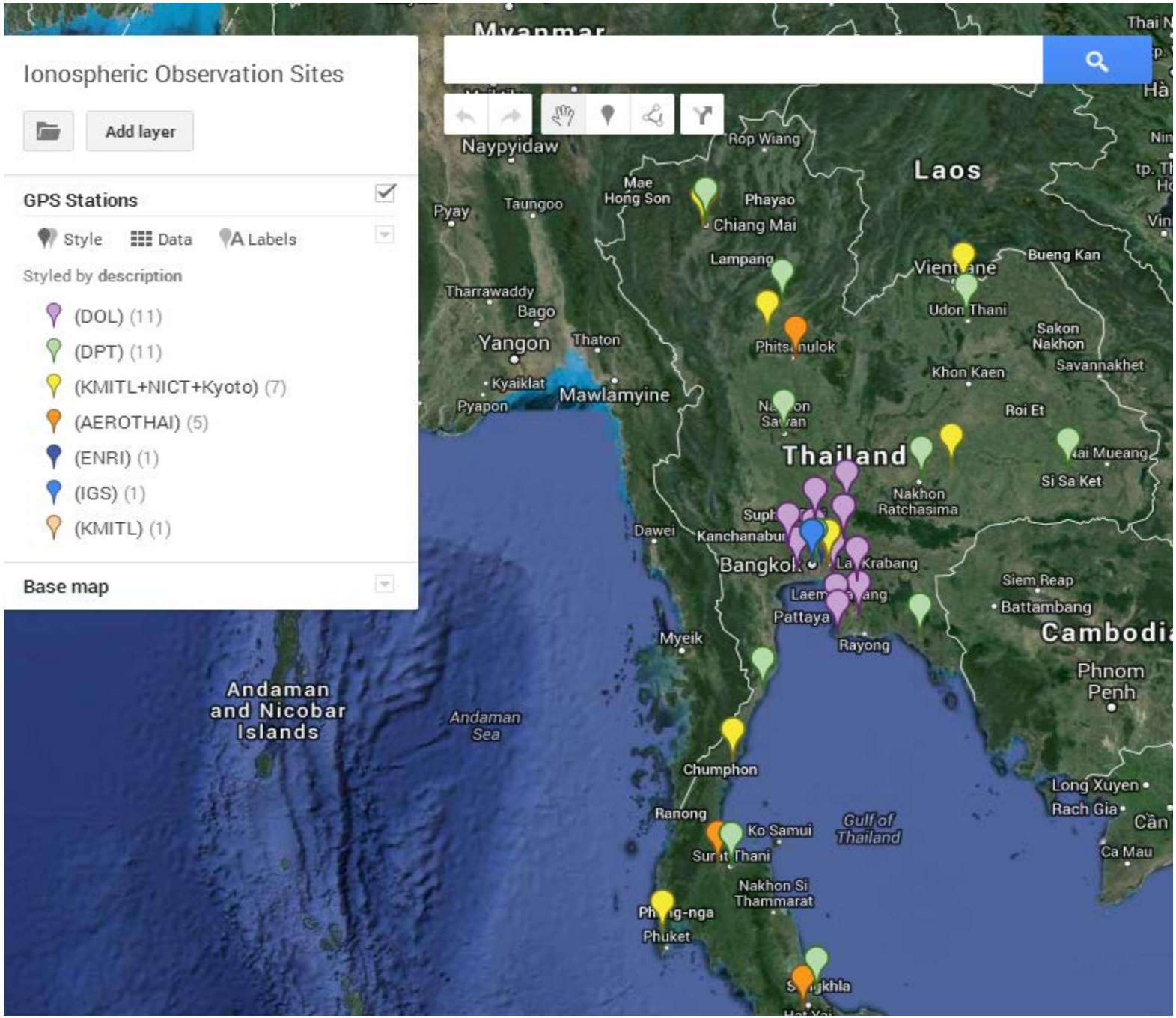
USER LOGIN

USERNAME *

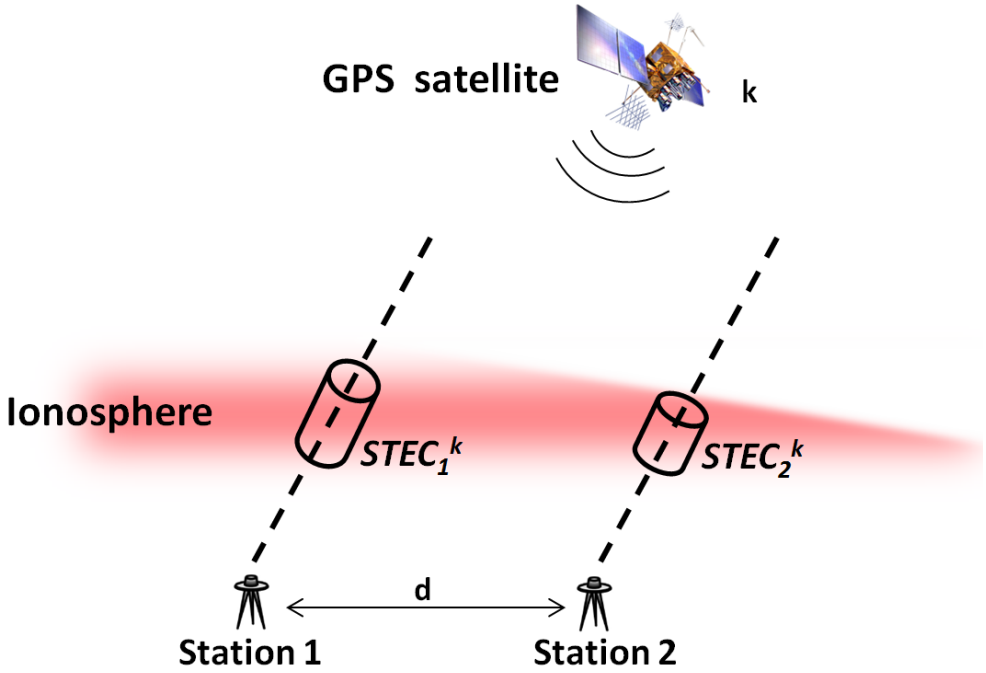
PASSWORD *

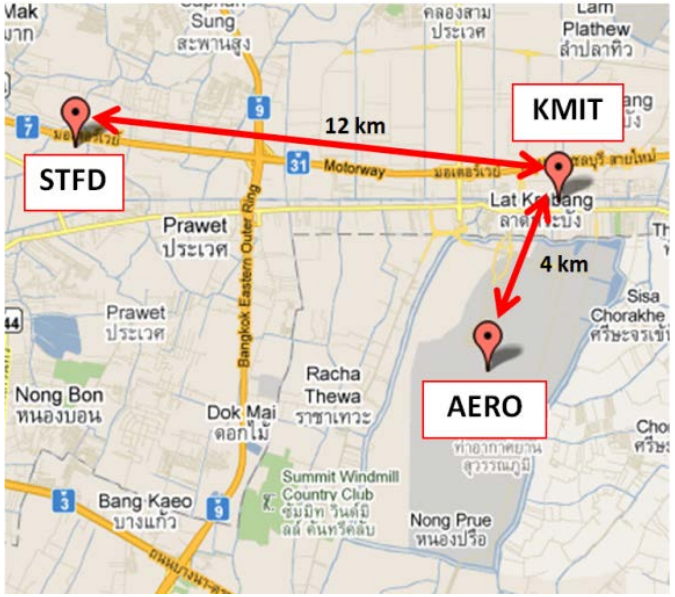
- Create new account
- Request new password

Log in


Ionospheric Observation Sites
Add layer
GPS Stations
Style
Data
Labels
Styled by description
(DOL) (11)
(DPT) (11)
(KMITL+NICT+Kyoto) (7)
(AEROTHAI) (5)
(ENRI) (1)
(IGS) (1)
(KMITL) (1)
Base map
Myanmar
Naypyidaw
Laos
Thailand
Cambodia
Yangon
Mawlamyine
Bangkok
Chiang Mai
Phayao
Mae Hong Son
Taungoo
Pyay
Lampang
Udon Thani
Khon Kaen
Nakhon Ratchasima
Si Sa Ket
Roi Et
Sakon Nakhon
Savannakhet
Bueng Kan
Pattaya
Rayong
Chumphon
Ranong
Ko Samui
Nakhon Si Thammarat
Phuket
Myeik
Dawei
Kanchanaburi
Andaman and Nicobar Islands
Andaman Sea
Gulf of Thailand
Phnom Penh
Siem Reap
Battambang
Long Xuyen
Rach Gia
Ca Mau

Ionospheric delay gradient



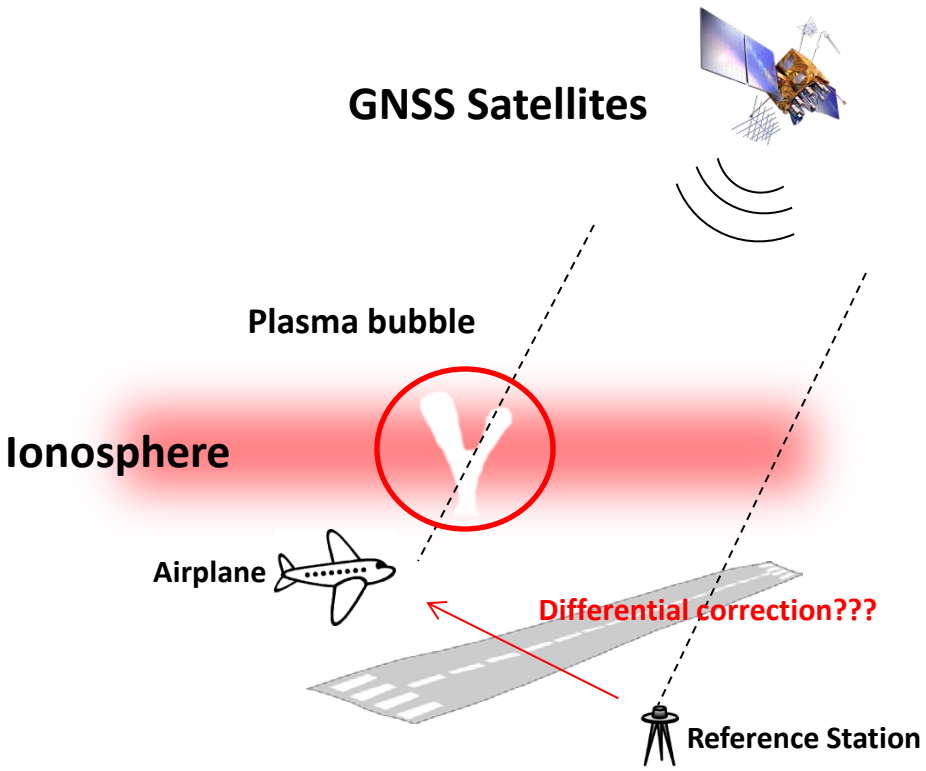


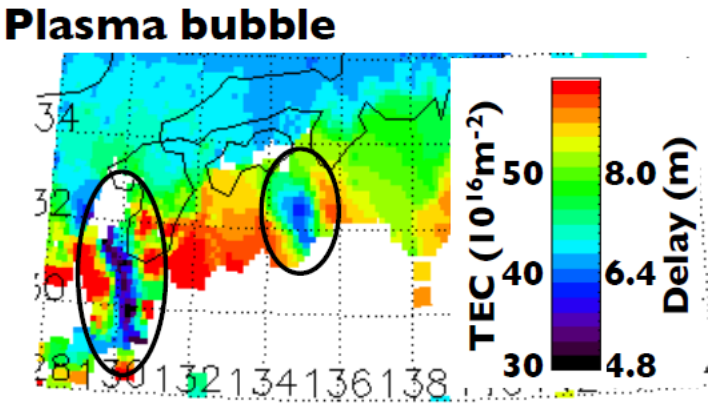
$$dSTEC^k = (STEC_1^k - STEC_2^k) + (B_{R1} - B_{R2})$$

$$\nabla I(t) = \frac{40.3}{f^2}\left(\frac{STEC_1^k(t) - STEC_2^k(t)}{d}\right)$$

Ionospheric delay gradient (mm/km)

Ionospheric effects to GBAS





S. Saito 2011.

- Plasma bubble frequently occurs in low-latitude region after sunset , and more occurrence during high solar activity period..

- This phenomena can cause ionospheric delay gradient and also scintillation, which degrades the GBAS performance.

The ICAO has recently realized the impact of this issue and recommended each country to investigate ionospheric delay gradient in that region.

THANK YOU

Q&A