



Geospatial and Space Based Solutions on Environmental Issues

The Extreme Weather Events and Climate Change

UN-SPIDER International Workshop

Space-based Technologies for Disaster Risk Reduction -
Assessing the Unseen Risks

Bangkok, UN-ESCAP Conference Centre

December 7, 2022

Outline

Introduction

The rise/role of Space and GI Technology
Extreme Weather Events

Flood & Drought

Recent critical hydro-meteorological disasters in Thailand
Current state of space and geo-informatics technology for extreme disaster monitoring and impact

PM2.5

Space-Based PM2.5 Monitoring System and Geographic Information

Introduction

AM Session 1: Understanding and assessing unseen risks

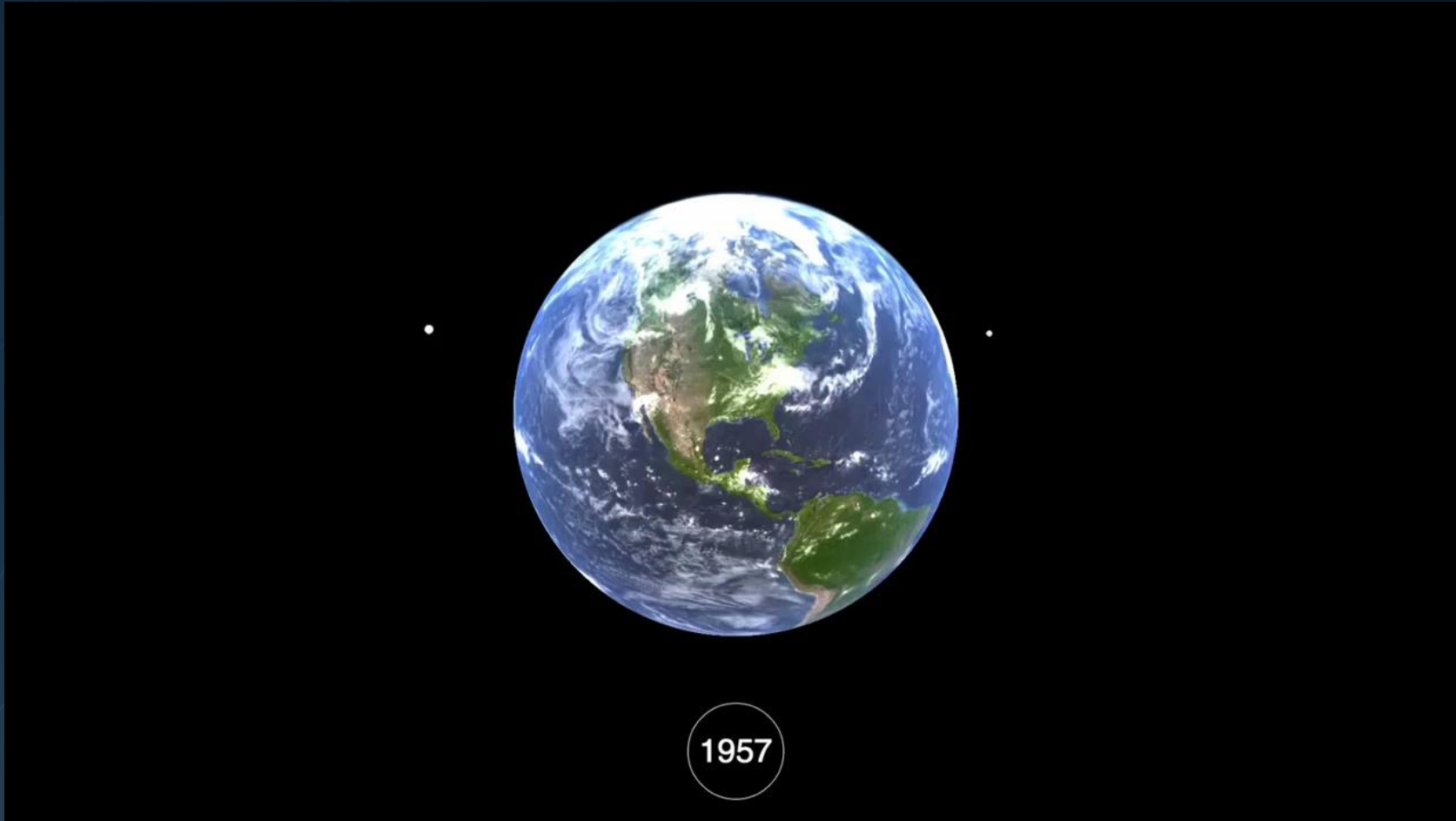
Remote Sensing Technology

The term "remote sensing" is commonly used to describe the science and art of identifying, observing, and measuring an object without coming into direct contact with it



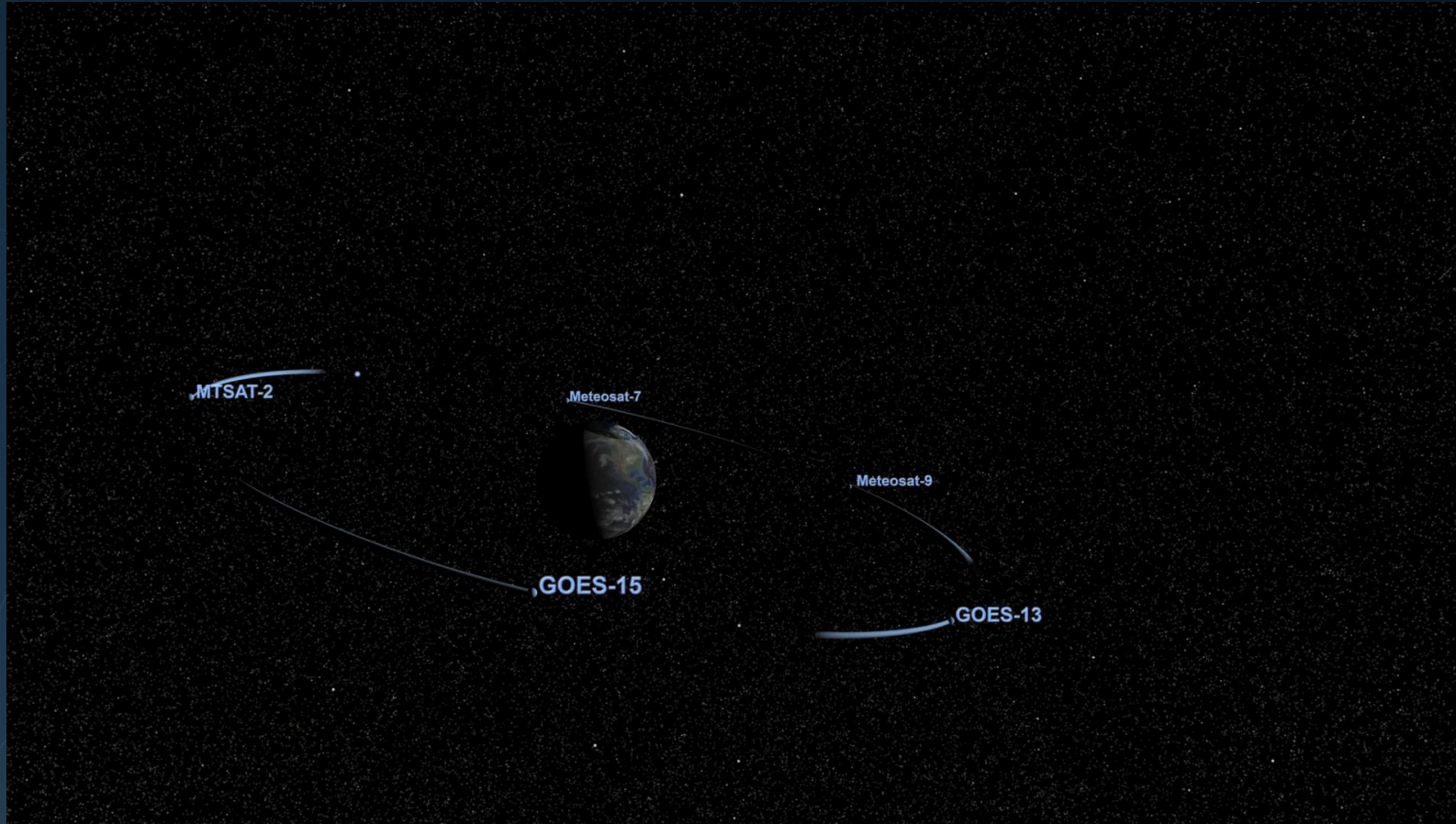
AM Session 1: Understanding and assessing unseen risks

Satellites/ Space technology



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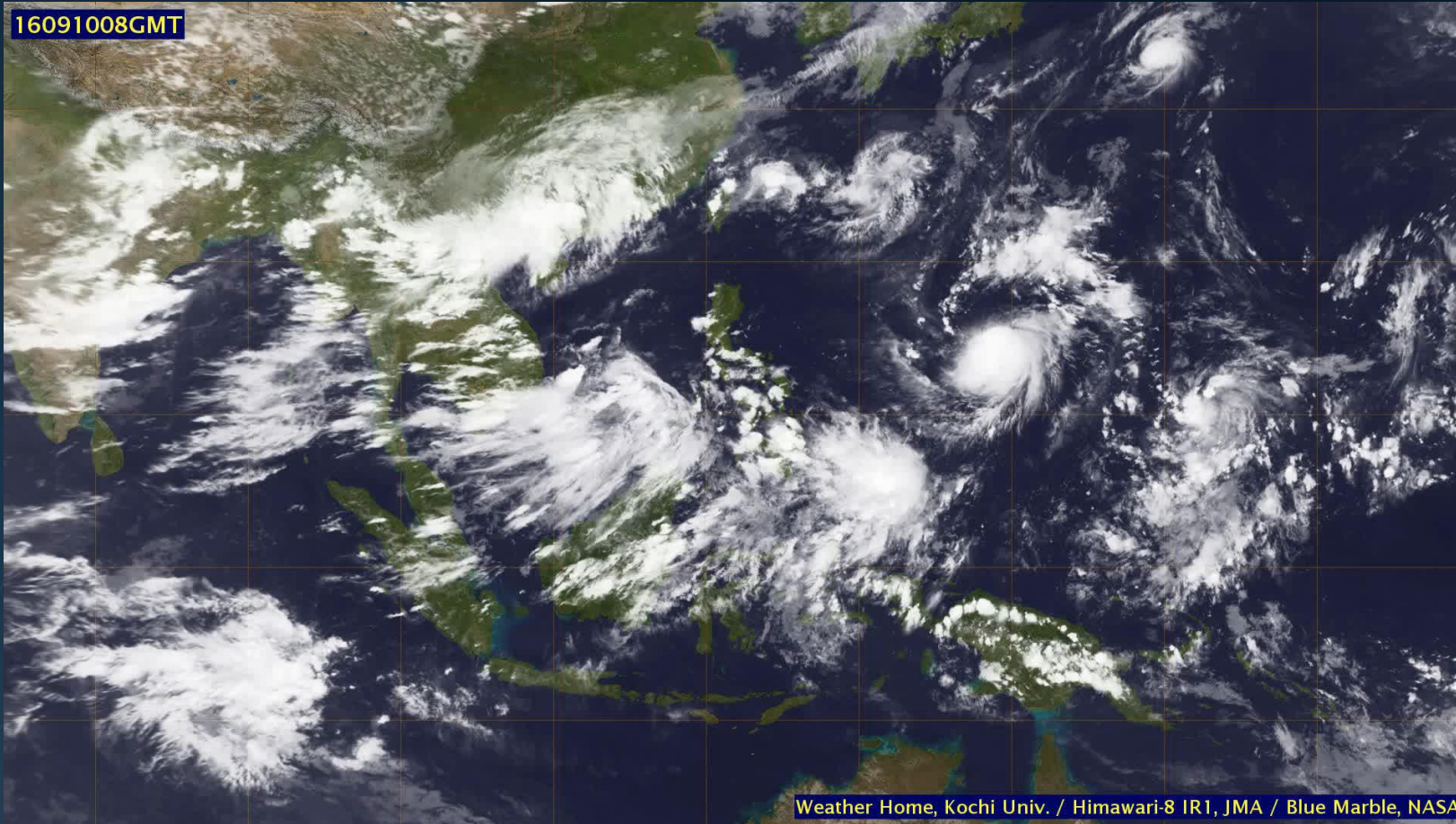
Geostationary



NASA/GSFC

Geostationary

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Climate Change

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A-Train Satellites

- Aura (ozone layer, air quality, climate)
- GCOM-W1 (water vapor, aerosol)
- OCO2 (CO2 concentrations)
- OCO3 on board ISS
- PARASOL (radiative and microphysical properties of clouds and aerosols)
- Aqua (MODIS, MISR)

C-Train Satellites

- CloudSat (Altitude and properties of clouds)
- CALIPSO (Cloud and aerosol)

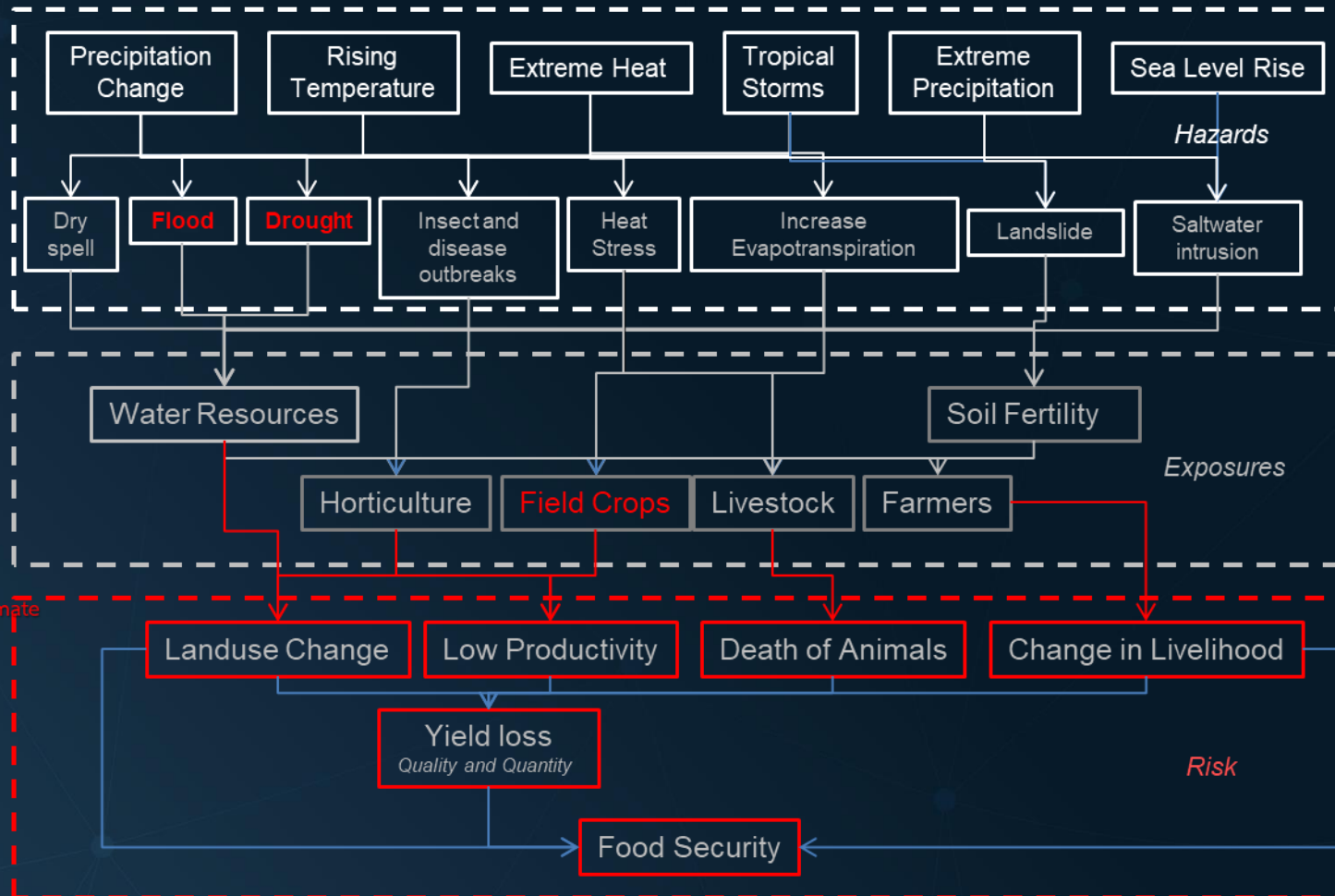
GCOM-C

Global Change Observation Mission - Climate

TERRA (MODIS, MOPIT)

METOP

COMS
Himawari
GOCI

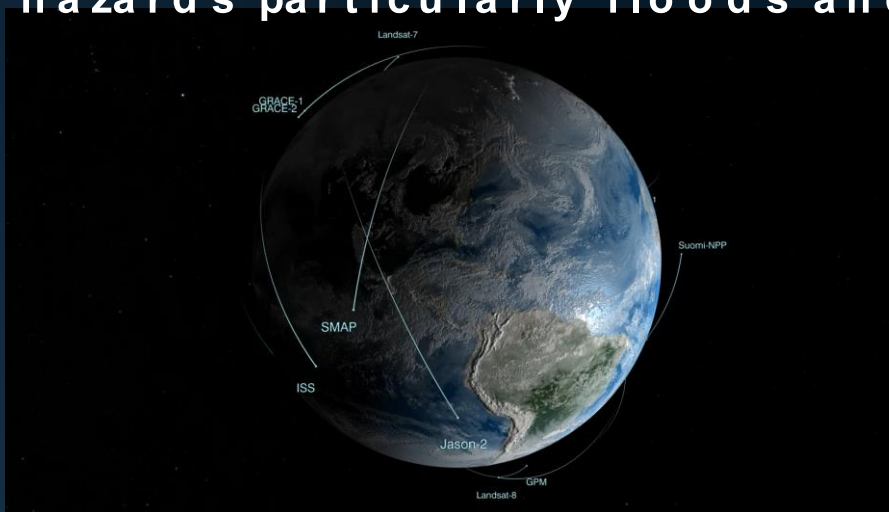


Flood & Drought

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Flood and Drought Disaster

Thailand, an agricultural country and one of the top rice exporters in the world, has been extremely exposed and vulnerable to natural disasters caused by hydro-meteorological hazards particularly floods and droughts

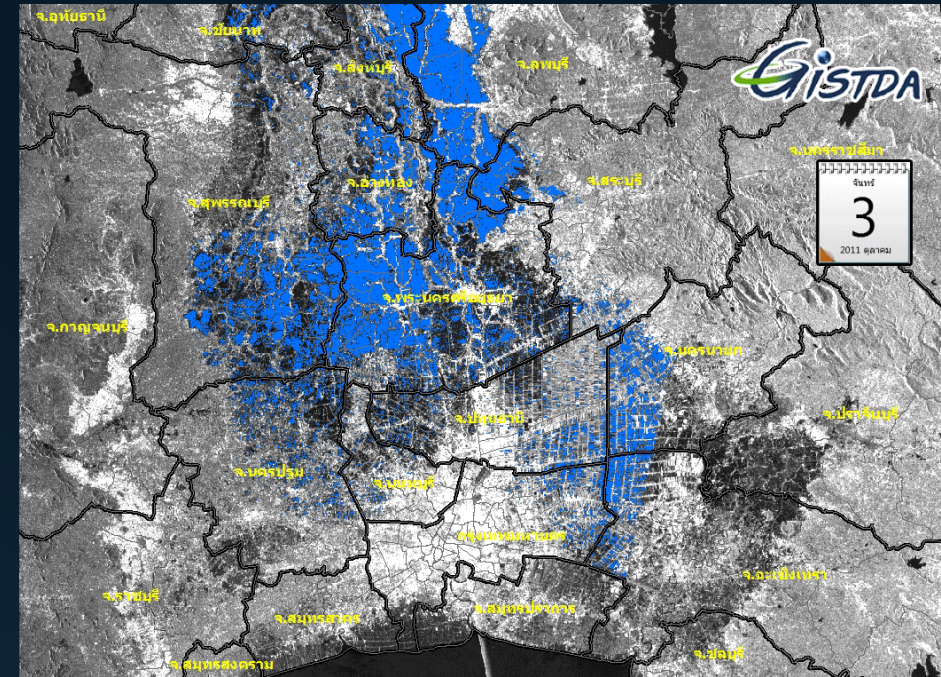
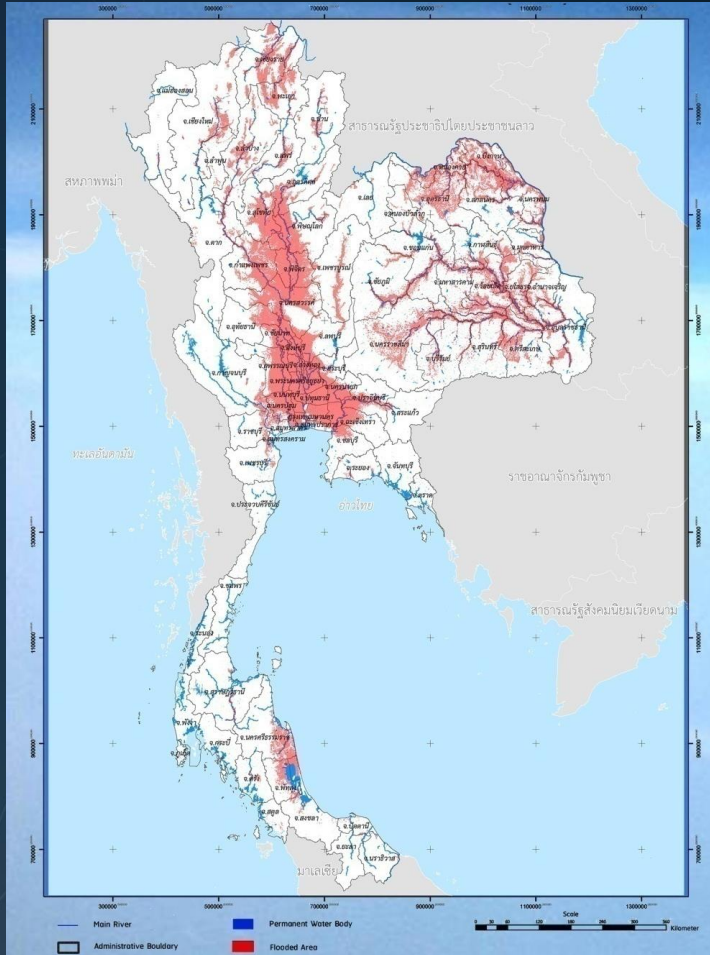


The amount of satellite missions carrying sensors that can be applied for flood and drought management has increased considerably and there is now a general consensus among space agencies and scientists to strengthen the



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Thailand Great Flood of 2011

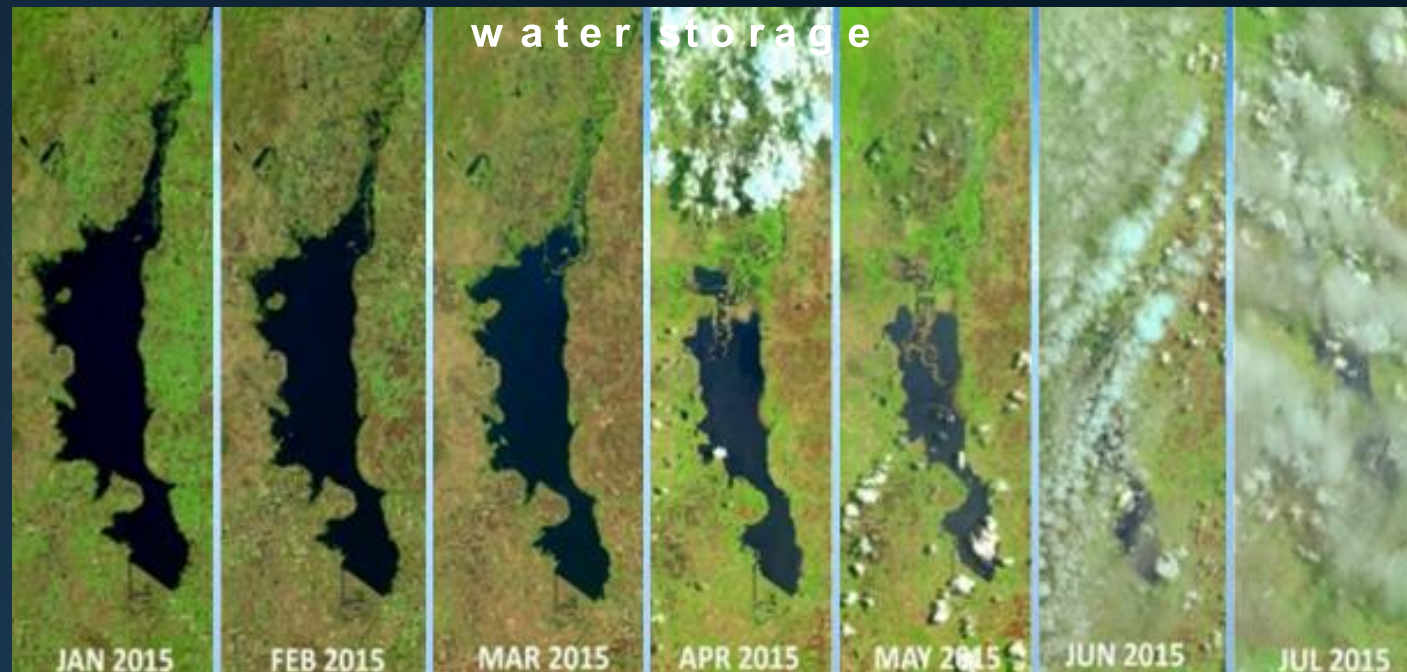


64 out of its 77 Provinces including Bangkok were flooded

www.gistda.or.th

Drought

El Niño phenomenon leads to severe drought conditions in many parts of the country 14 of Thailand's reservoirs had very small quantities (1% - 20%) of usable

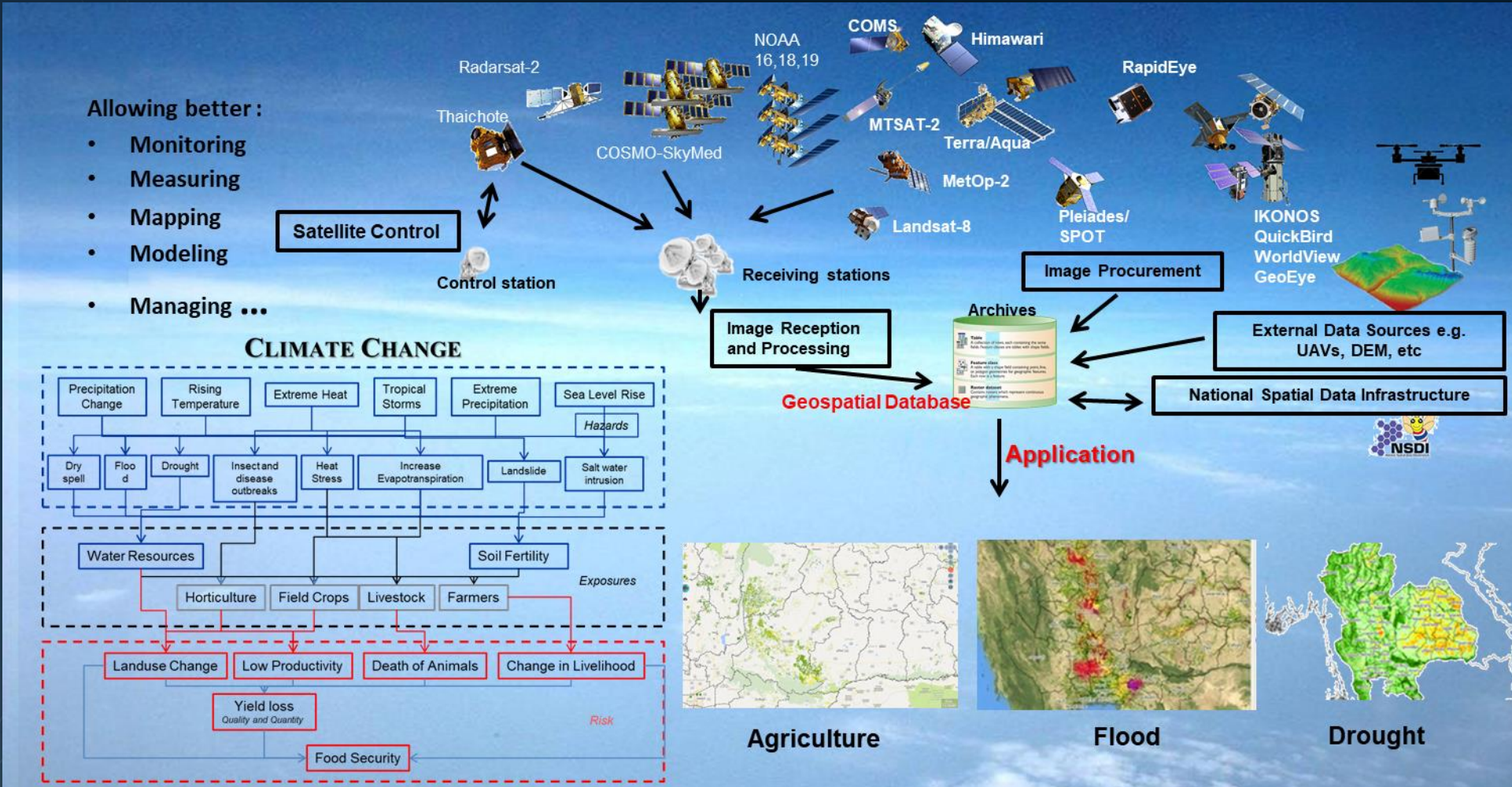


Critical low water levels prevailed throughout the country, with most of the affected provinces located in the northern and northeastern regions of the country. Approximately 160,000 hectares of

rice paddies were affected, which were about 1.30 percent of Thailand's total rice farmland

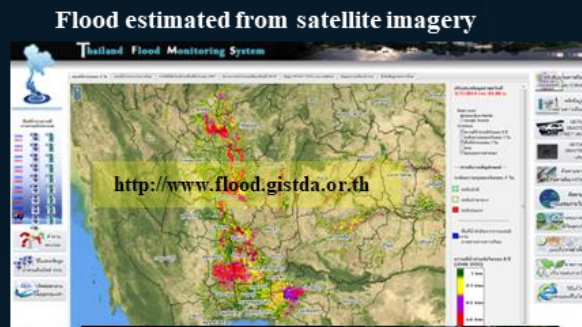
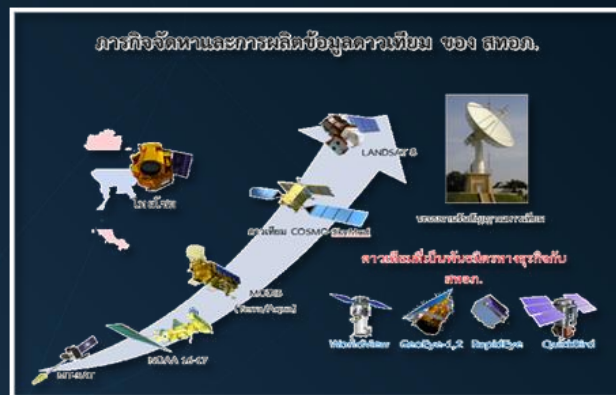
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The rise/role of Remote Sensing



Flood Monitoring

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<http://lidarem.gistda.or.th>

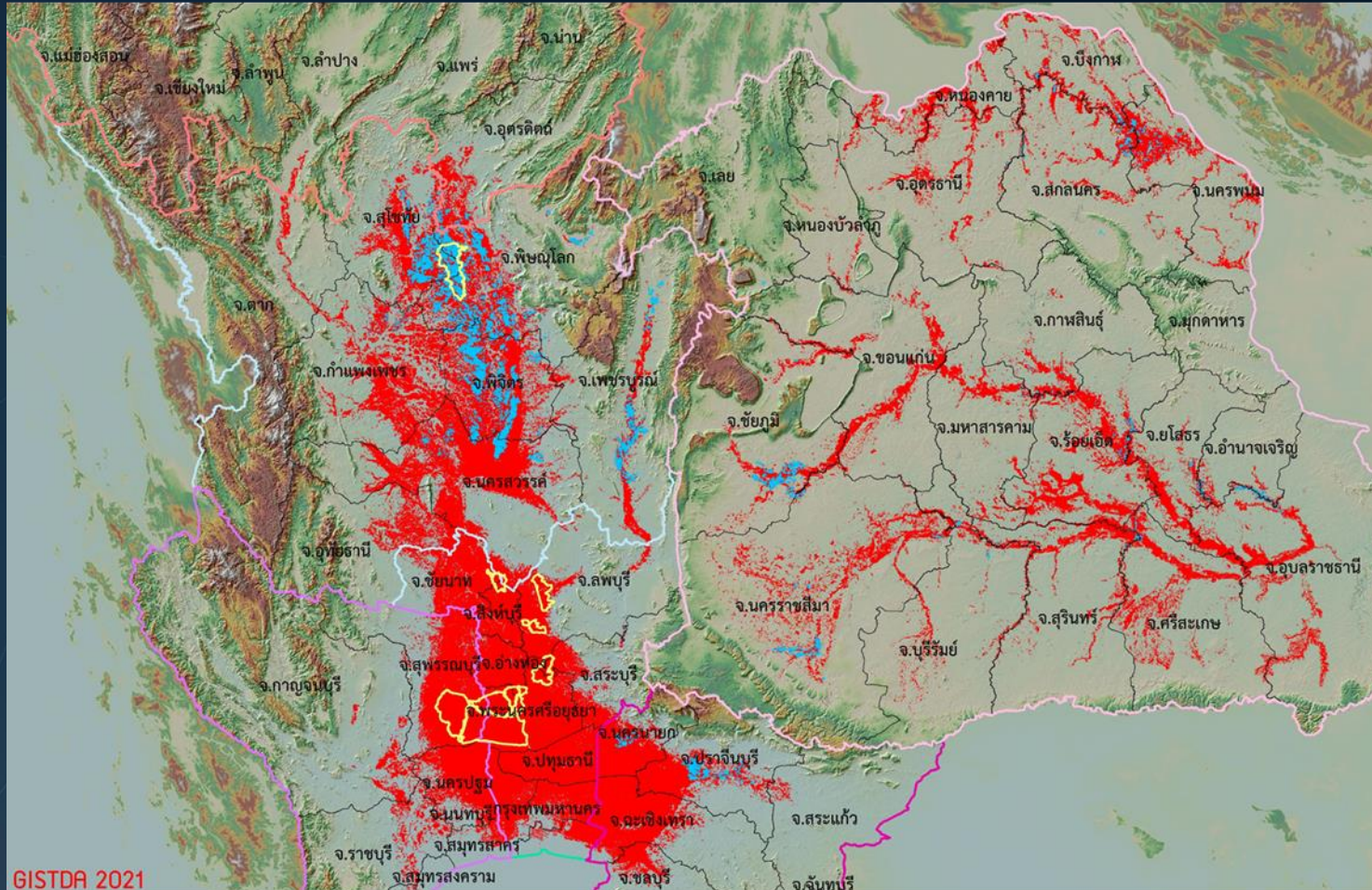
Ground Survey Monitoring System

Weather Station



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Flood of 2011 and 2021



พื้นที่น้ำท่วม จำแนกรายภาค	
เหนือตอนบน	
2554	427,714
2564	17,459
เหนือตอนล่าง	
2554	7,491,525
2564	851,924
ภาคตะวันออกเฉียงเหนือ	
2554	5,713,591
2464	13,4321
ภาคตะวันออก	
2554	2,555,756
2564	69,211

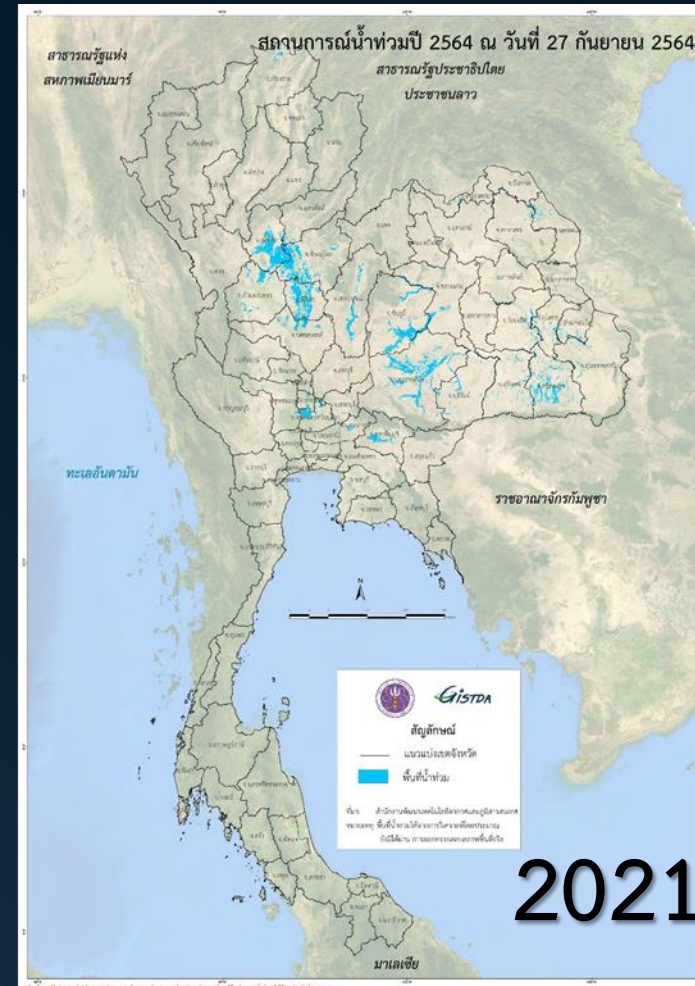
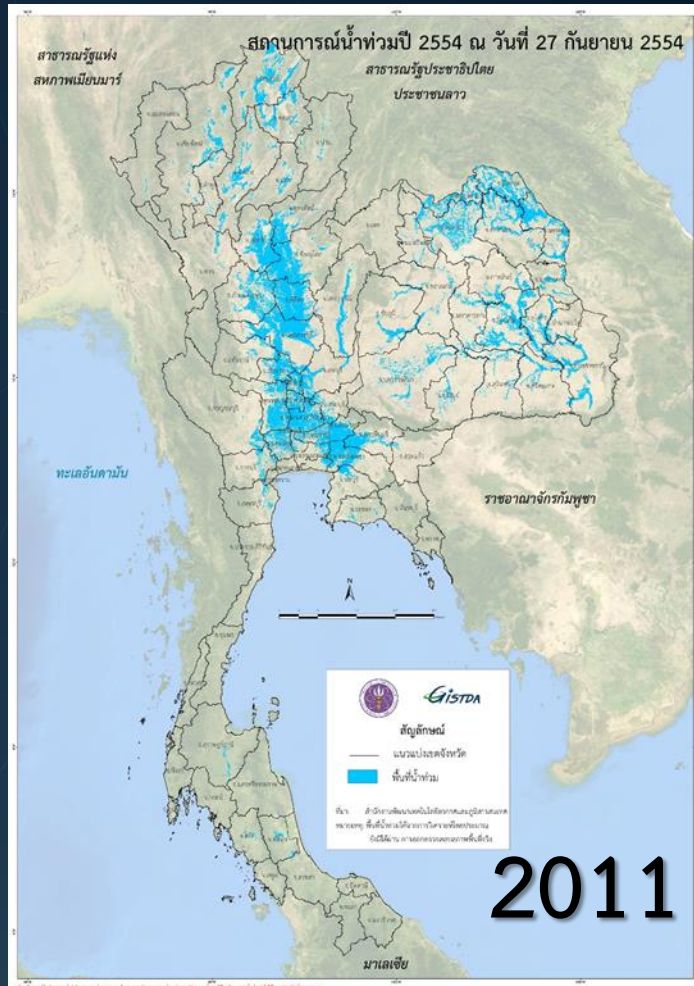
GISTDA 2021

www.gistda.or.th



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Flood of 2011 and 2021

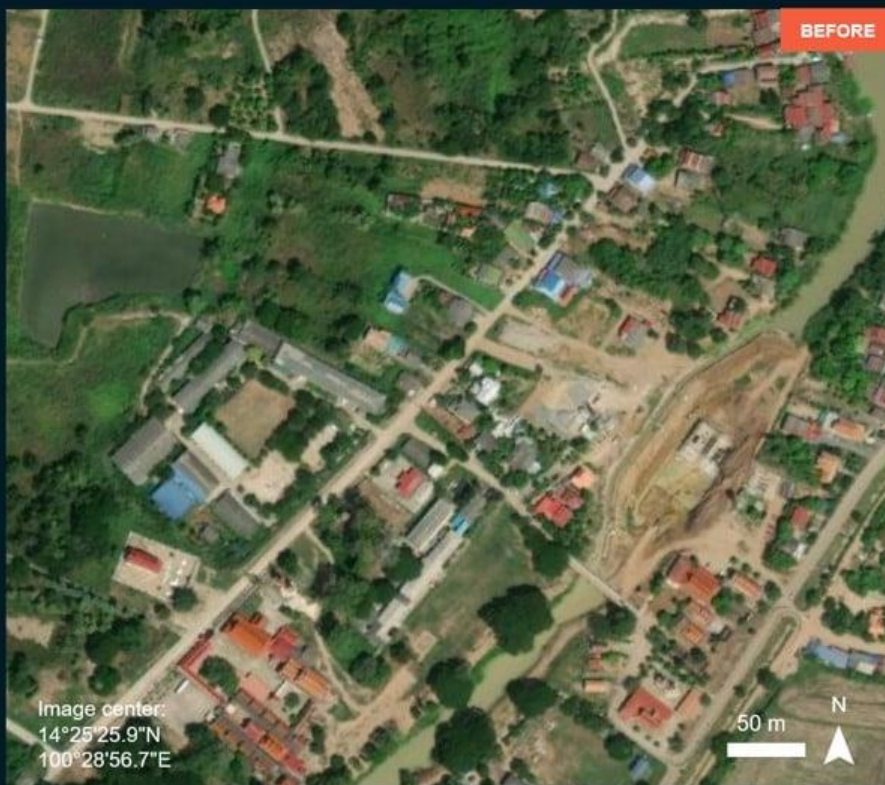


Flood of 2011 and 2021

BANG BAN DISTRICT, AYUTTHAYA PROVINCE

อำเภอบางบาล จังหวัดพระนครศรีอยุธยา

Ayutthaya
อยุธยา



ESRI Basemap



Pleiades / 30 Sep 2021



Flood Monitoring

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Thailand flood monitoring (<http://www.flood.gistda.or.th>) tracks, monitors and archives flood events and makes data available to the public in various formats including graphics, spreadsheets and geographic information systems (GIS) maps.

Thailand Flood Monitoring System

แผนที่น้ำท่วมรอบ 7 วัน สถานการณ์น้ำท่วมบริเวณเขื่อนบีบี 49-64 ส่งรับสัญญาณดาวเทียม ดาวินโหลดข้อมูลย้อนหลัง

ปรับปรุงข้อมูลน้ำท่วมล่าสุด วันที่ 8 ตุลาคม 2564

ข้อมูลน้ำท่วม คำอธิบายสัญลักษณ์

แผนที่ฐาน

- ภาพถ่ายดาวเทียมไทยโชด
- ภาพถ่ายดาวเทียม Nasa Blue Marble
- ชั้นข้อมูลเวกเตอร์
- ขอบเขตการปกครอง
- ความถี่น้ำท่วมซึ่งในรอบ 11 ปี
- ตำแหน่งหลังคาเรือน (มาตราส่วน 1 : 25000)

ข้อมูลสถานการณ์ปัจจุบัน

- ระดับความรุนแรงรายค่าบลในรอบ 7 วัน
- พื้นที่น้ำท่วมรอบ 7 วัน
- ข้าว (มาตราส่วน 1 : 25000)
- ข้าวโพด (มาตราส่วน 1 : 25000)
- มันสำปะหลัง (มาตราส่วน 1 : 25000)
- อ้อย (มาตราส่วน 1 : 25000)

ดาวินโหลดข้อมูลน้ำท่วมรอบ 7 วัน

1.ข้อมูลพื้นที่เสียหาย

การติดตามสถานการณ์ฝนรายวัน จากข้อมูลดาวเทียมในระบบ GSMaP

Drought Monitoring

Types of Drought

- 1) meteorological drought,
- 2) hydrological drought,
- 3) agricultural drought,
- 4) socioeconomic drought.

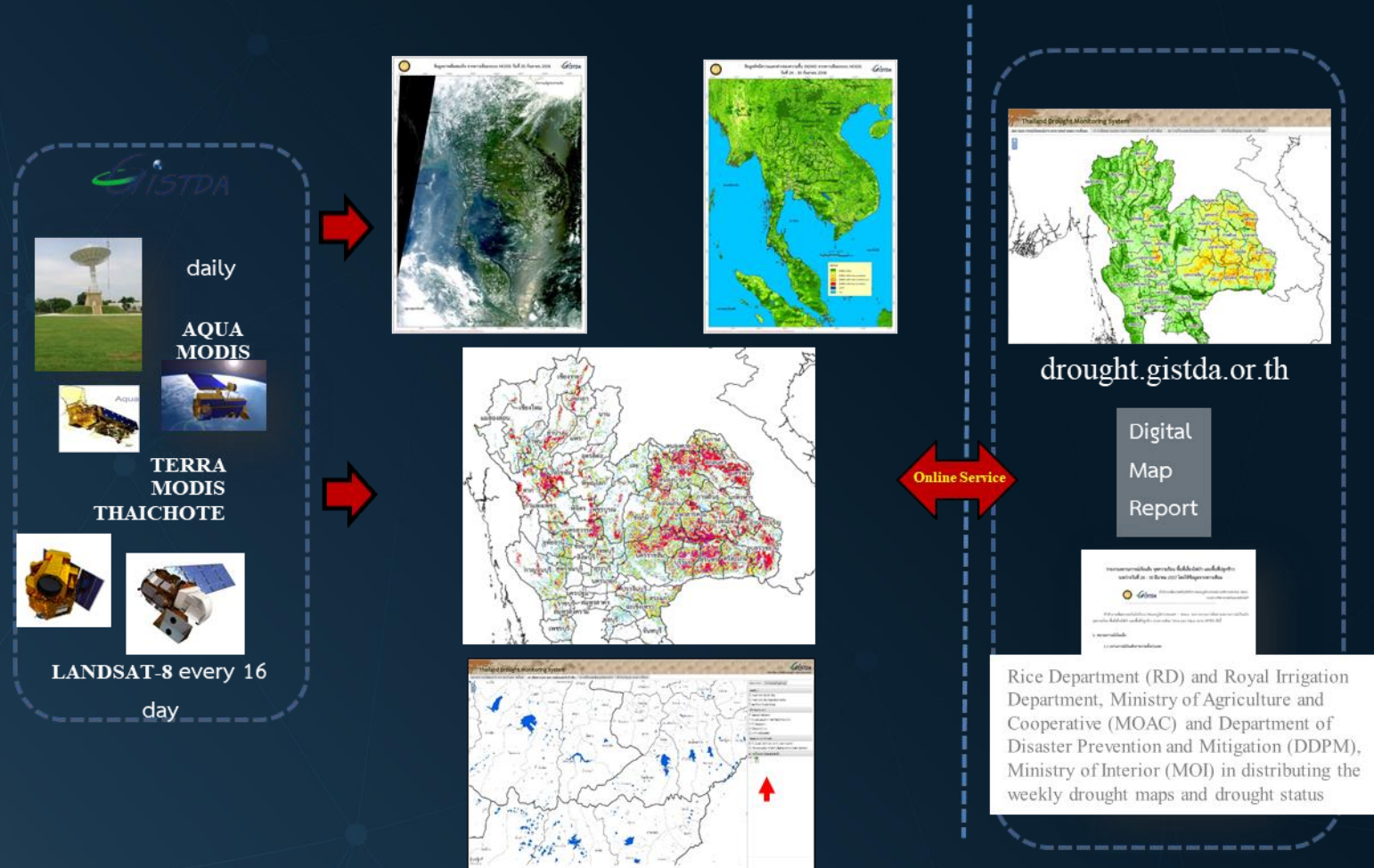


There are three main methods for monitoring drought and guiding early warning and assessment:

1. Using a single indicator or index
2. Using multiple indicators or indices
3. Using composite or hybrid indicators

Drought Monitoring

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drought.gistda.or.th

Digital Map Report



Rice Department (RD) and Royal Irrigation Department, Ministry of Agriculture and Cooperative (MOAC) and Department of Disaster Prevention and Mitigation (DDPM), Ministry of Interior (MOI) in distributing the weekly drought maps and drought status

Drought Monitoring

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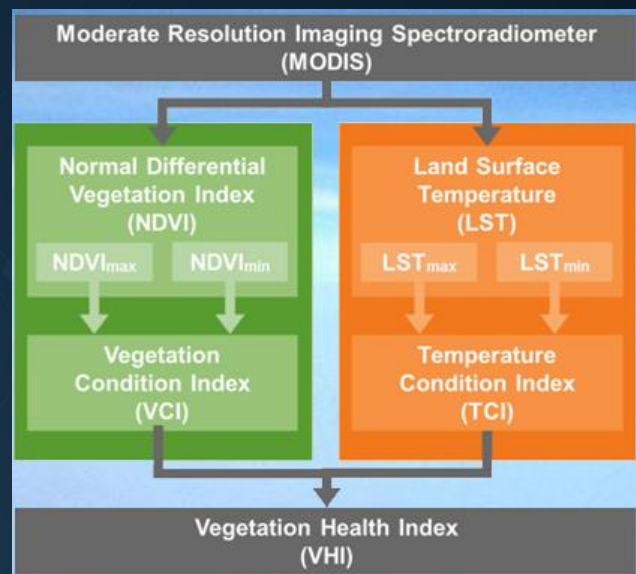
Meteorology	Soil moisture	Hydrology	Composite or modelled
Remote sensing	Ease of use	Input parameters	Additional information
Enhanced Vegetation Index (EVI)	Green	Sat	Does not separate drought stress from other stress
Evaporative Stress Index (ESI)	Green	Sat, PET	Does not have a long history as an operational product
Normalized Difference Vegetation Index (NDVI)	Green	Sat	Calculated for most locations
Temperature Condition Index (TCI)	Green	Sat	Usually found along with NDVI calculations
Vegetation Condition Index (VCI)	Green	Sat	Usually found along with NDVI calculations
Vegetation Drought Response Index (VegDRI)	Green	Sat, P, T, AWC, LC, ER	Takes into account many variables to separate drought stress from other vegetation stress
Vegetation Health Index (VHI)	Green	Sat	One of the first attempts to monitor drought using remotely sensed data
Water Requirement Satisfaction Index (WRSI and Geo-spatial WRSI)	Green	Sat, Mod, CC	Operational for many locations
Normalized Difference Water Index (NDWI) and Land Surface Water Index (LSWI)	Green	Sat	Produced operationally using Moderate Resolution Imaging Spectroradiometer data
Soil Adjusted Vegetation Index (SAVI)	Red	Sat	Not produced operationally

REMOTE SENSING

AWC = available water content,
 CC = crop coefficient,
 ER = ecoregion,
 ET = evapotranspiration,
 GW = groundwater,
 LC = land cover,
 Mod = modelled,
 P = precipitation,
 PET = potential evapotranspiration,
 Sat = satellite,

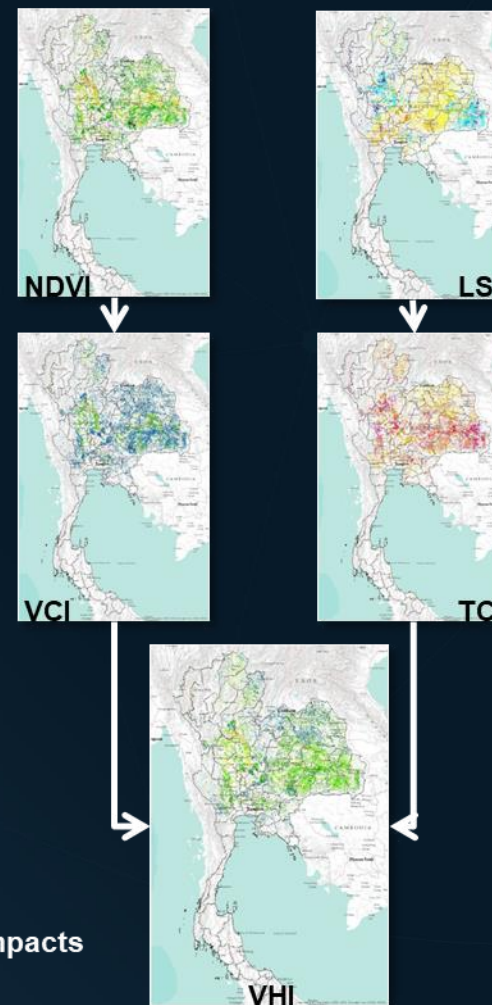
Drought Monitoring

EARLY DETECTION OF REGIONAL DROUGHT, BEFORE IT DEVELOPS INTO A DISASTER, IS VERY IMPORTANT



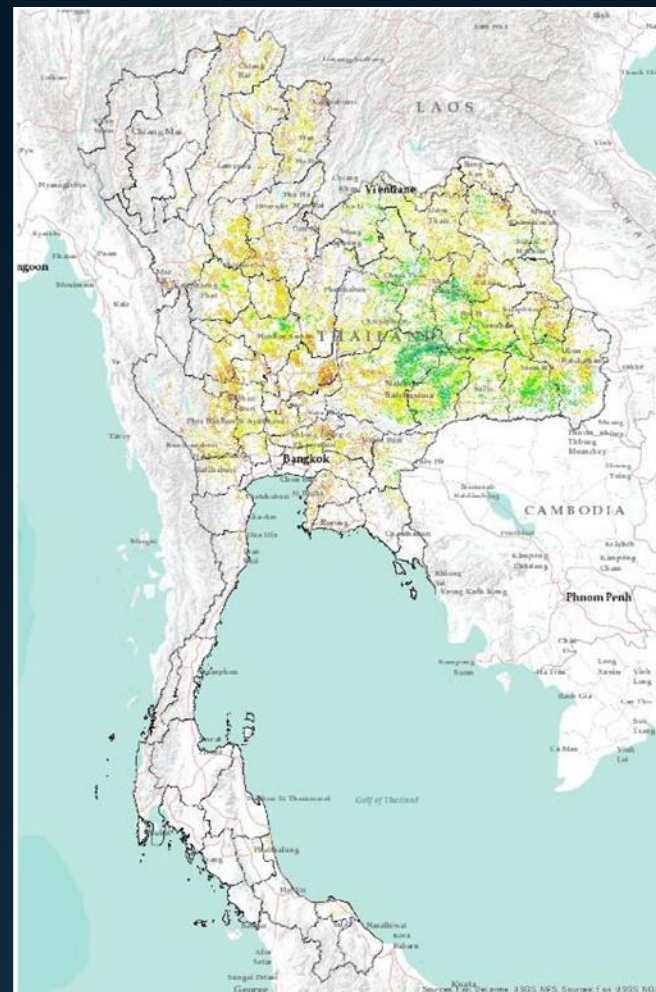
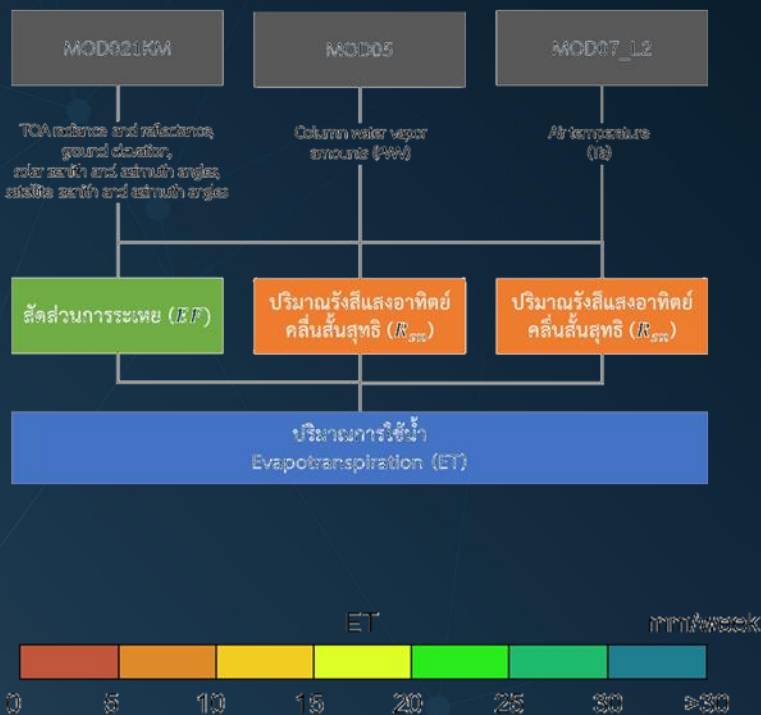
NDVI, VCI, and TCI are used to estimate the VHI. The VHI and all indices are calculated during the dry season on a weekly basis

The VHI monitors and identify drought-related agricultural impacts



Drought Monitoring

EVAPOTRANSPIRATION

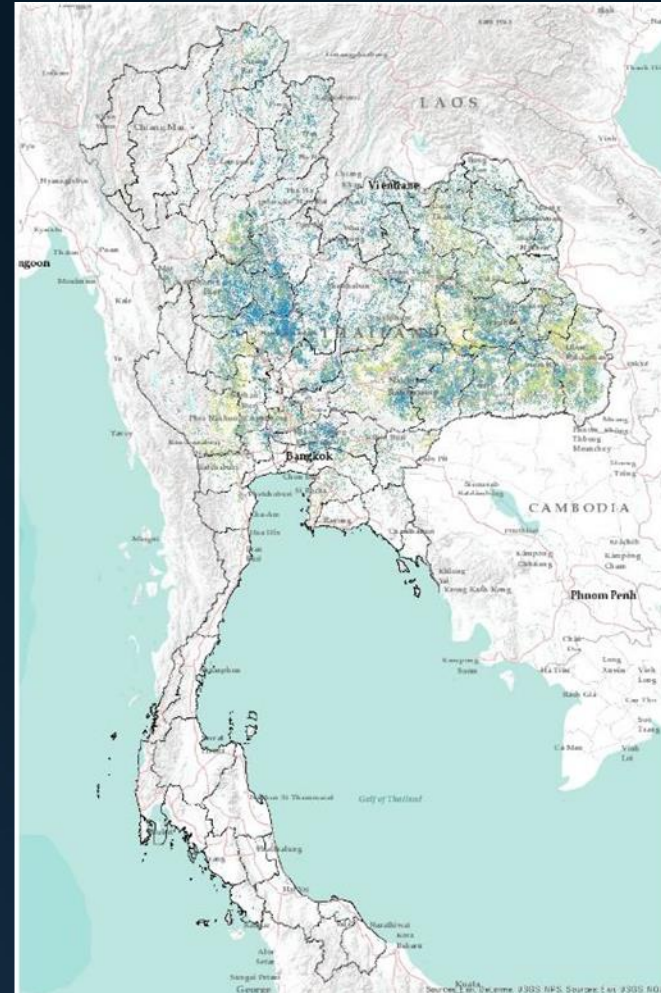
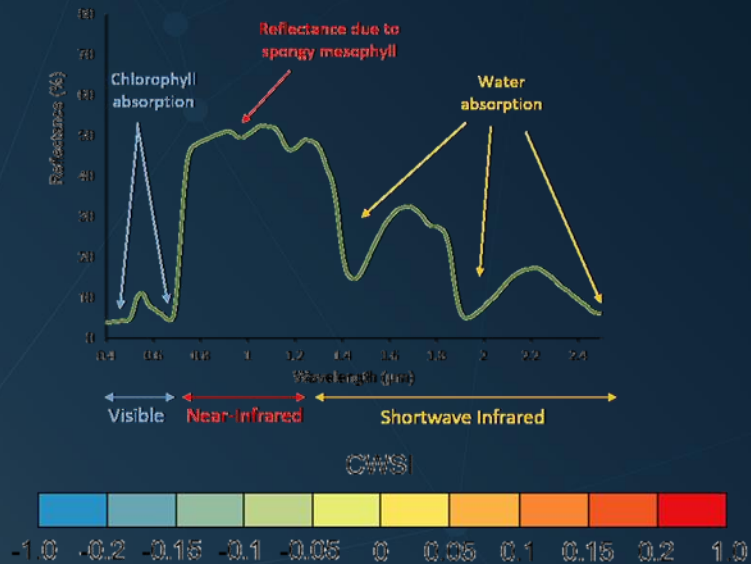


Drought Monitoring

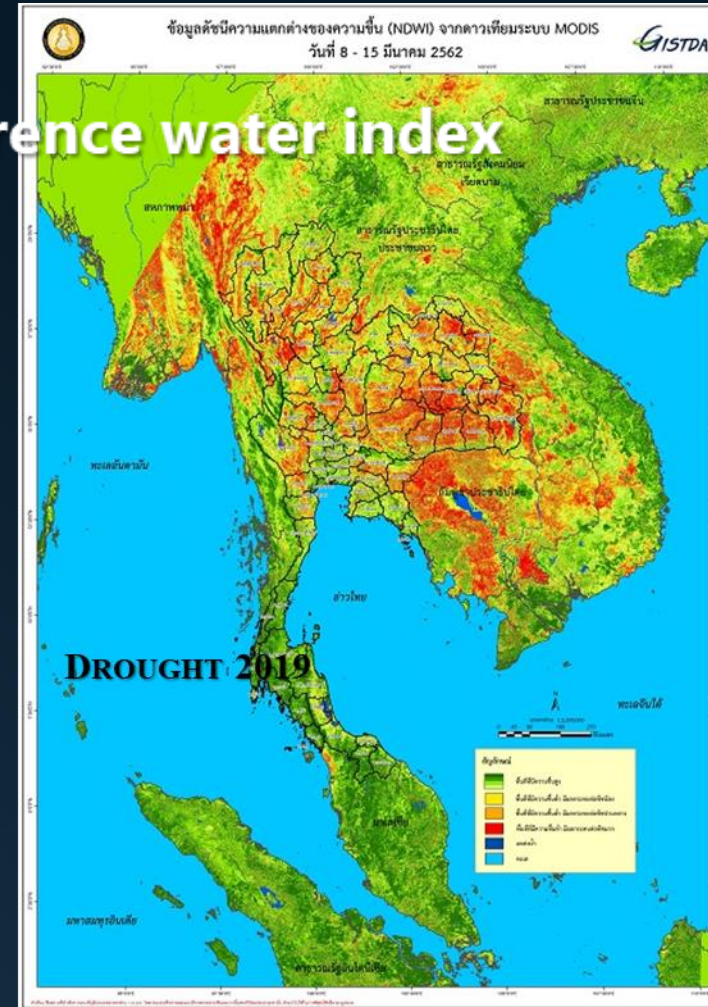
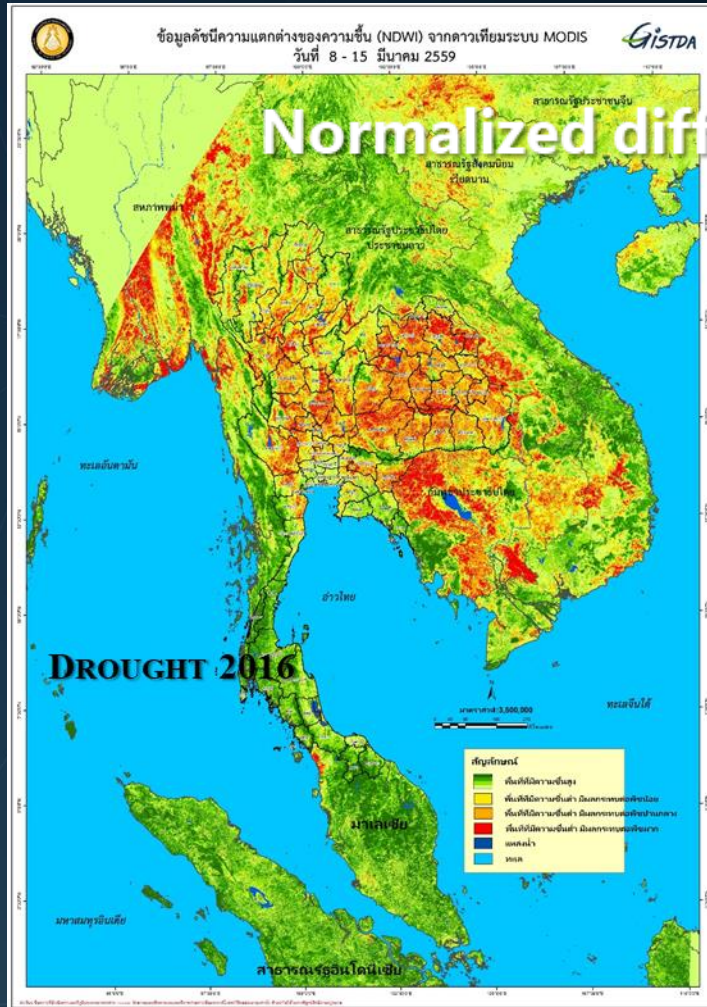
CROP WATER STRESS

Crop Water Stress Index (CWSI) has also been used for monitoring crop water stress.

$$CWSI = \frac{(\rho_{SWIR} - \rho_{NIR})}{(\rho_{SWIR} + \rho_{NIR})}$$

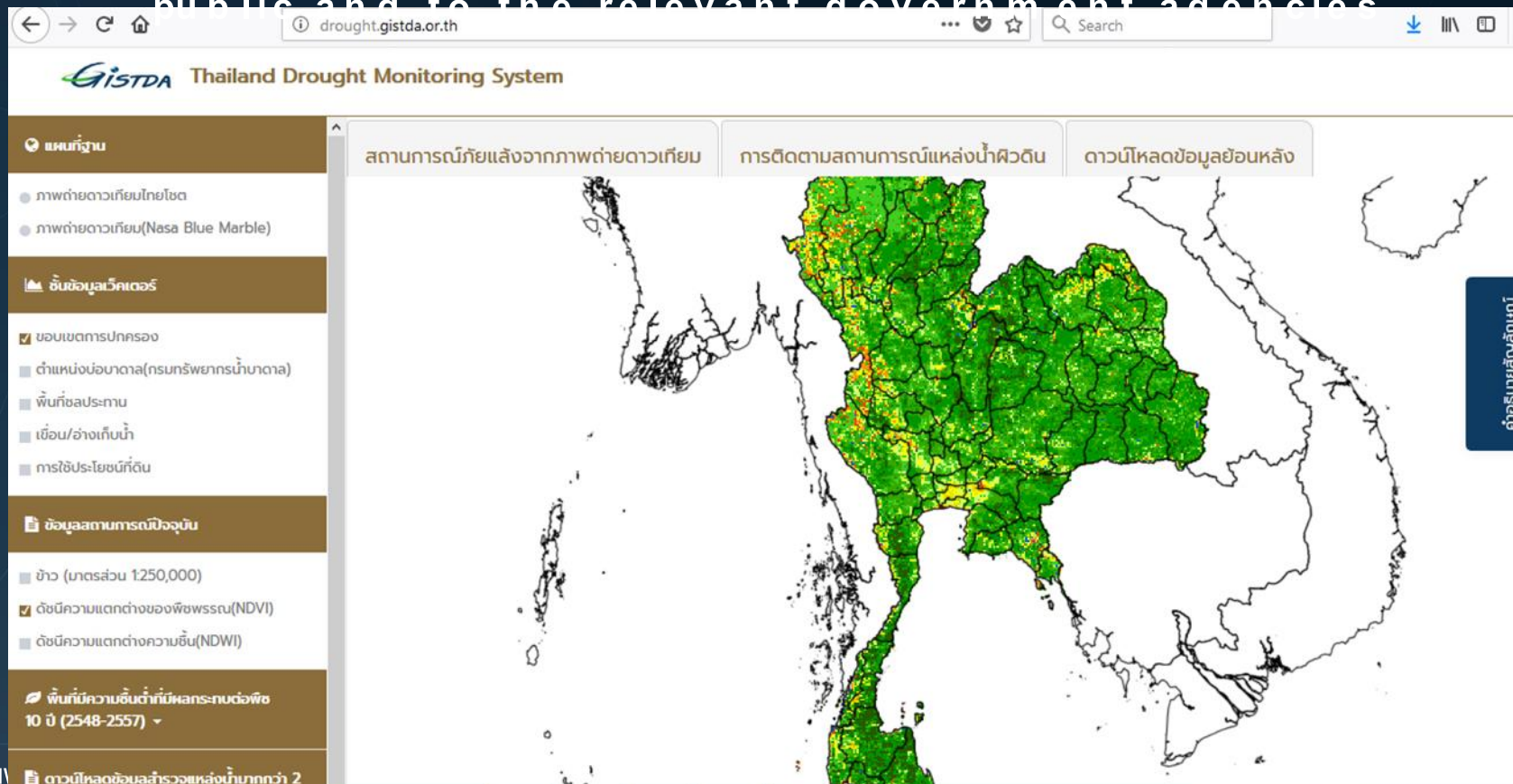


Drought Monitoring



Drought Monitoring

The TMS drought monitoring (<http://www.drought.gistda.or.th>) analyzes the data and the information to detect and monitor drought events and makes data available to the public and to the relevant government agencies



PM2.5

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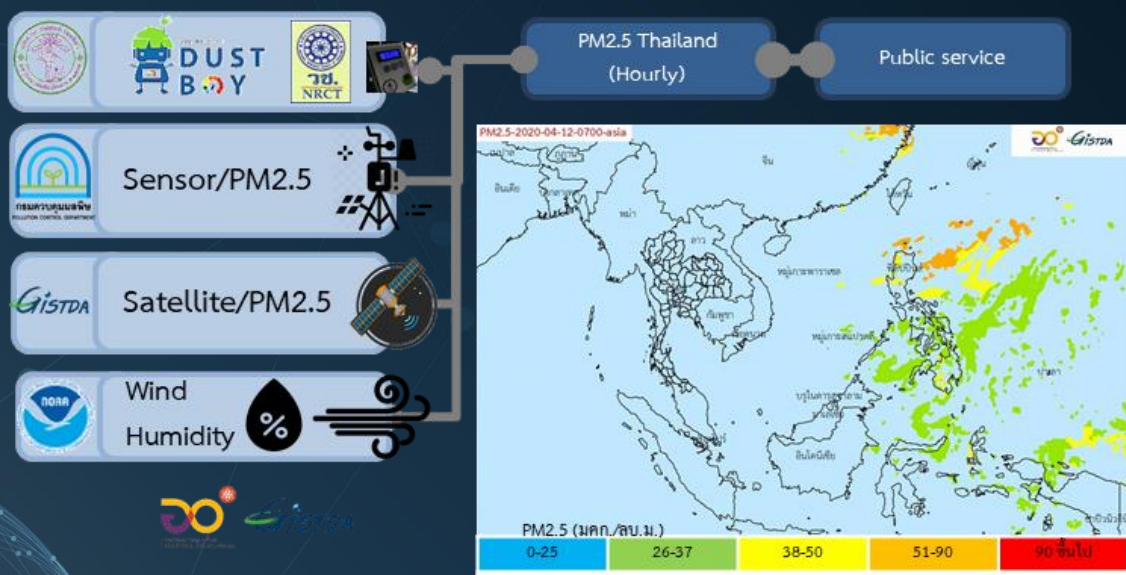
Satellite-Based Estimation of PM2.5 Concentrations



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Satellite-Based Estimation of PM2.5 Concentrations

Satellite-Based Estimation of Hourly PM2.5 Concentrations



Color Description

Very Good (0-25)	Good (25-37)	Moderate (37-50)	Sensitive Groups (50-90)	Unhealth (+90)
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PM2.5 Statistics:

Data Fusion: Himawari, PM2.5, Wind Speed, Pressure, Relative Humidity, NDVI, and DEM

Display: Satellite Image (selected), Thematic Map, Stations

DateTime: Tuesday, January 26, 2021 5:00 PM

Report: District Average PM2.5 (Ranking)

No.	District	Province	PM2.5 (avg. µg)
1	Chiang Klang	Nan	59
2	Pua	Nan	58
3	Thung Chang	Nan	58
4	Chaloem Phra Kiat	Nan	57
5	Tha Wang Pha	Nan	57
6	Bo Kluea	Nan	56
7	Mueang Nan	Nan	56
8	Phu Phiang	Nan	56
9	Santi Suk	Nan	56

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Satellite-Based Estimation of PM2.5 Concentrations

ระบบติดตาม PM2.5 จากเทคโนโลยีดาวเทียม

คำอธิบายความหมาย

- ดีมาก: 0 - 25
- ดี: 25 - 37
- ปานกลาง: 37 - 50
- เริ่มมีผลกระทบต่อสุขภาพ: 50 - 90
- มีผลกระทบต่อสุขภาพ: > 90

สรุปข้อมูล PM2.5

รวบรวมข้อมูล : Himawari, Wind Speed, Pressure, Relative Humidity, NDVI, and DEM

แสดงชั้นข้อมูล : ชั้นข้อมูล

วันเวลา : Thursday, November 11, 2021 1:00 PM

รายงาน : เฉลี่ยปริมาณ PM2.5 รายอำเภอ (จัดลำดับ)

No.	District	Province	PM2.5 (avg. µg)
1	Ban Chang	Rayong	21
2	Bang Na	Bangkok	21
3	Chai Badan	Lop Buri	21
4	Mueang Rayong	Rayong	21
5	Mueang Saraburi	Saraburi	21
6	Nikhom Phatthana	Rayong	21
7	Nong Saeng	Saraburi	21
8	Prawet	Bangkok	21

SATELLITE-BASED ESTIMATION OF PM2.5 CONCENTRATIONS

ผู้เสนอ PM2.5 จากดาวเทียม

19
มคก./ลบ.ม.

วันพฤหัสบดีที่ 11 พฤศจิกายน 2021 เวลา 13:00

แขวงทุ่งสองห้อง เขตหลักสี่ จังหวัดกรุงเทพมหานคร

Lat : 13.8820 , Long : 100.5645

อากาศ: ต่ำมาก

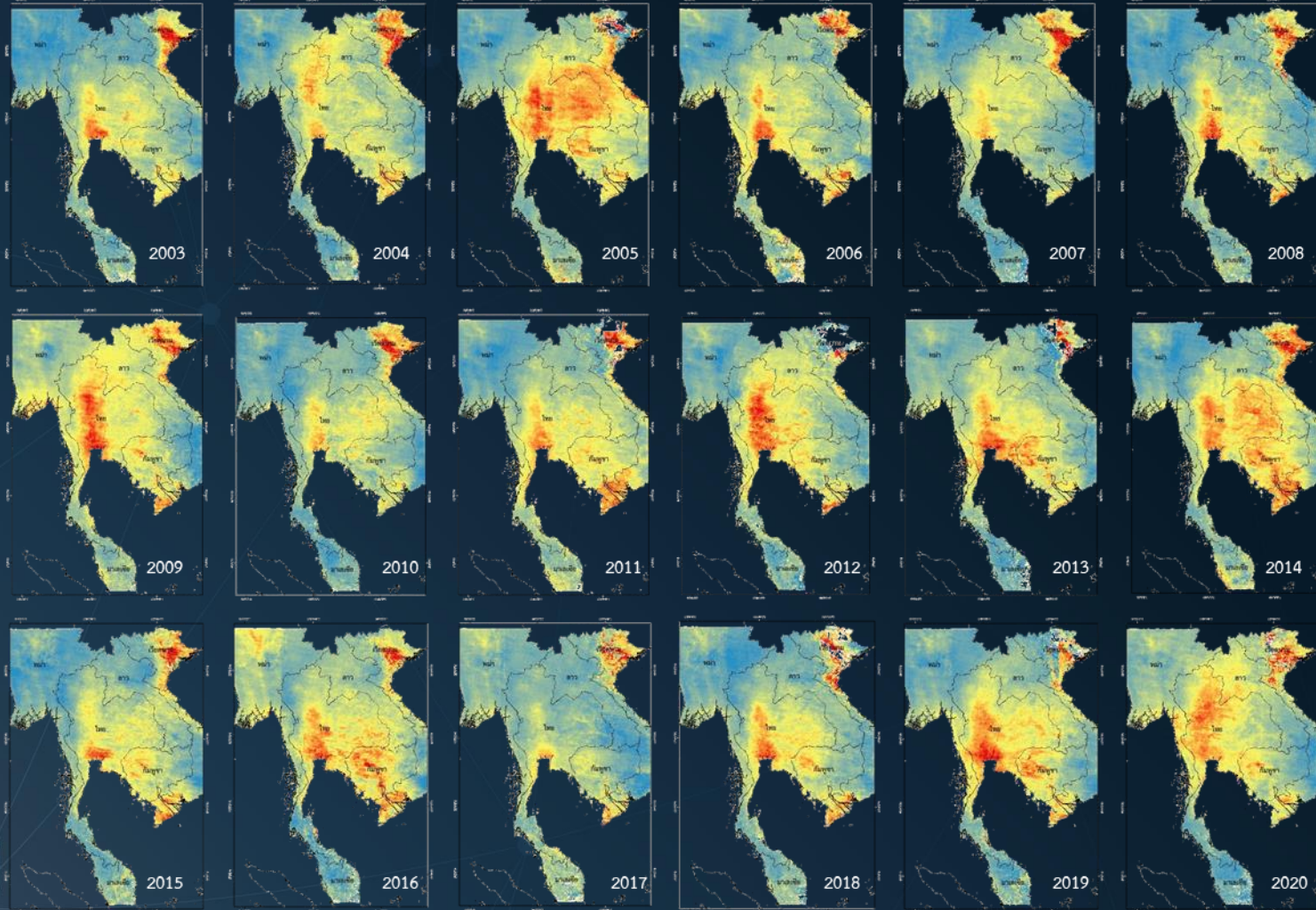
ปริมาณฝุ่นย้อนหลัง 24 ชม.

LAT : 13.8820 , LONG : 100.5645

www.gistda.or.th

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Satellite-Based Estimation of PM2.5 Concentrations

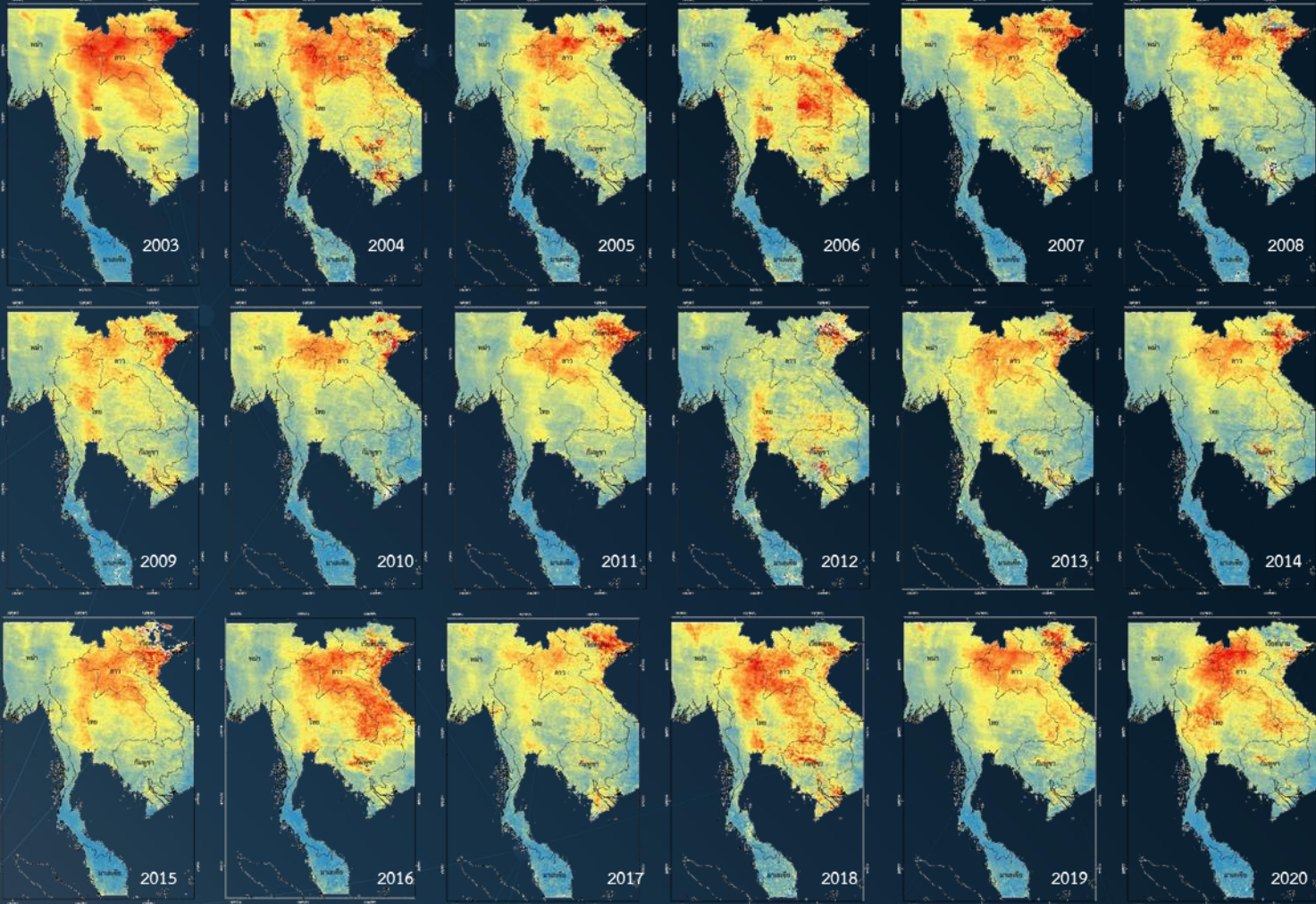


PM 2.5
of JAN - FEB
for the period
2003 - 2020

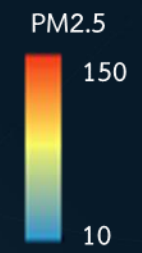


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Satellite-Based Estimation of PM2.5 Concentrations

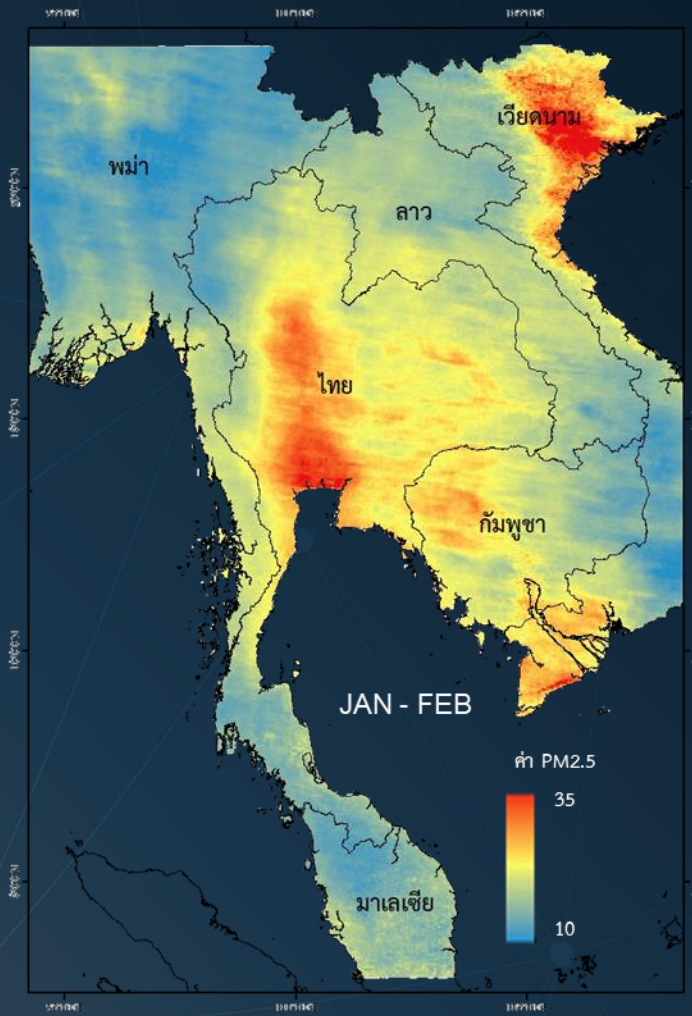


PM 2.5
of MAR - APR
for the period
2003 - 2020

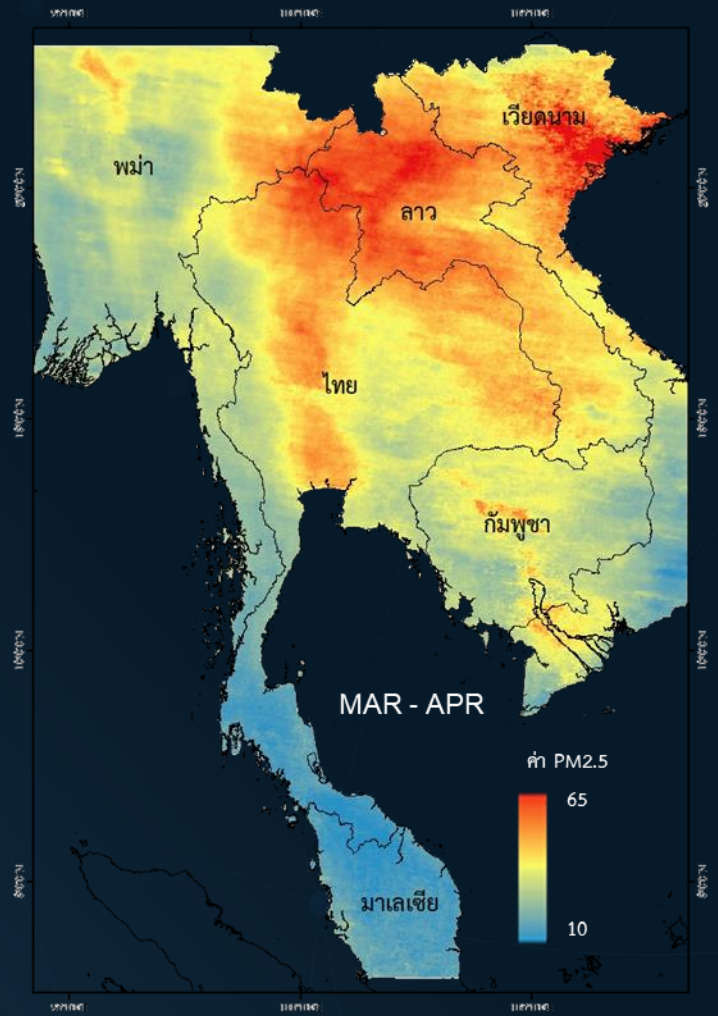


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Satellite-Based Estimation of PM2.5 Concentrations

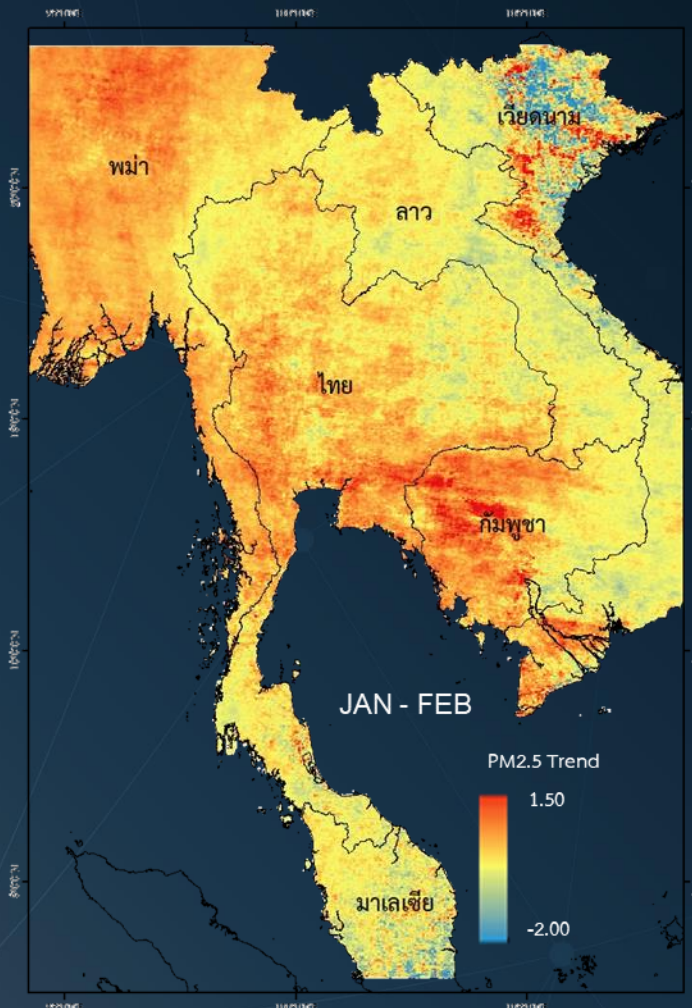


Mean PM 2.5
for the period
2003 - 2020

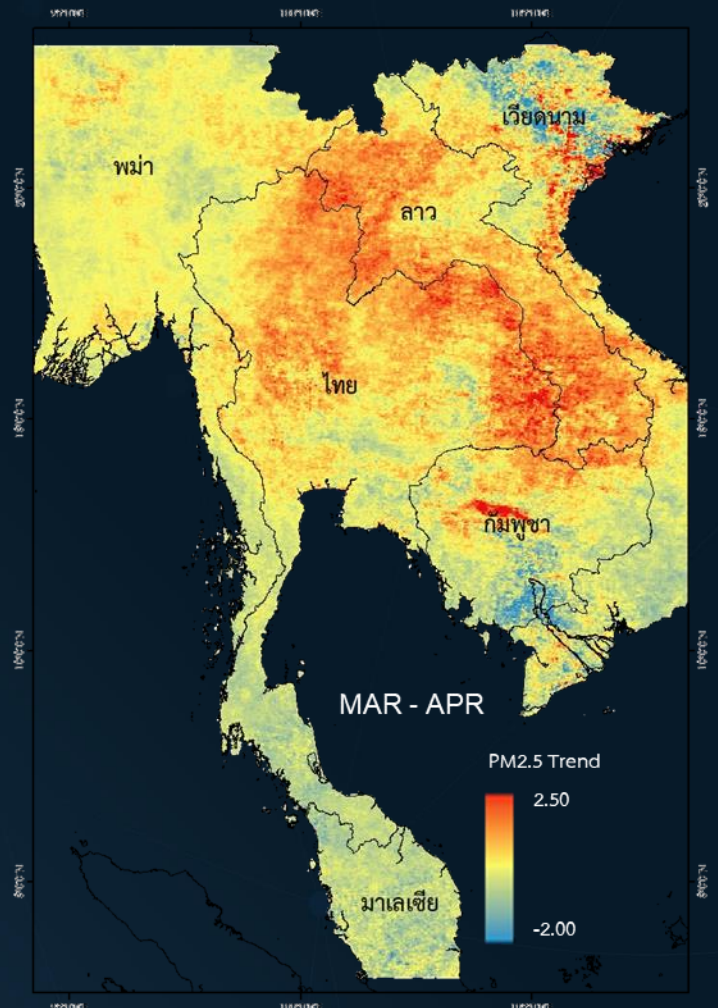


AM Session 1: Understanding and assessing unseen risks

Satellite-Based Estimation of PM2.5 Concentrations



PM 2.5 Trends for the period 2003 - 2020



THANK YOU



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