Hydro and Agro Informatics Institute

Ministry of Science and Technology

Thailand

Water resources and flood management in Thailand

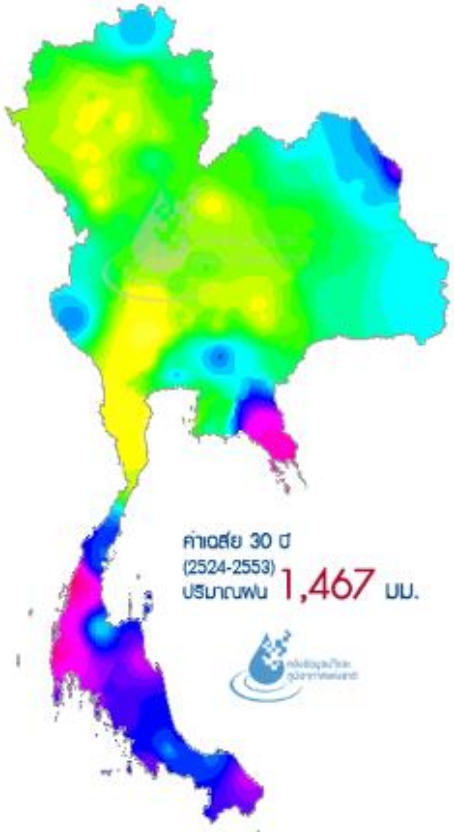
- past experiences and future challenges

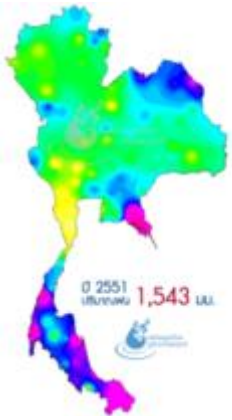
(Using the Flood and Drought Management Tools)

By Dr. Sutat Weesakul

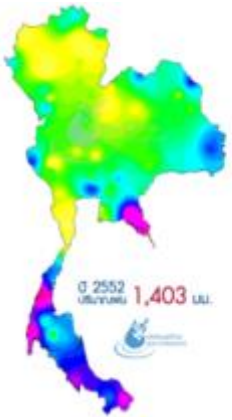
Director of Hydro and Agro Informatics Institute, Thailand

Rainfall Distribution (2008 – 2017)





2008

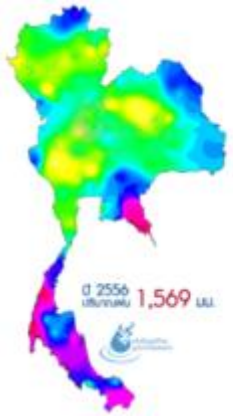


2009

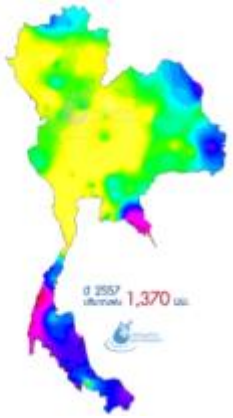
2010

2011

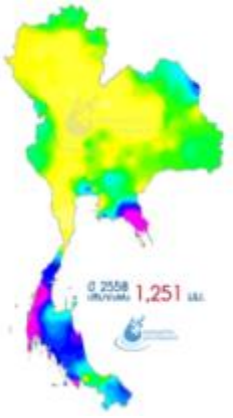
2012



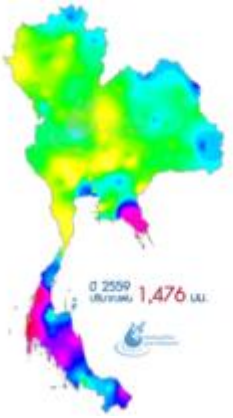
2013



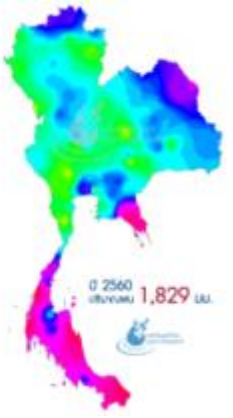
2014



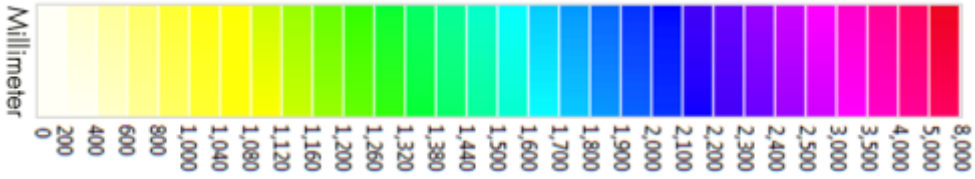
2015



2016



2017



Thailand 2011 Flood Leads to the Establishment of NHC

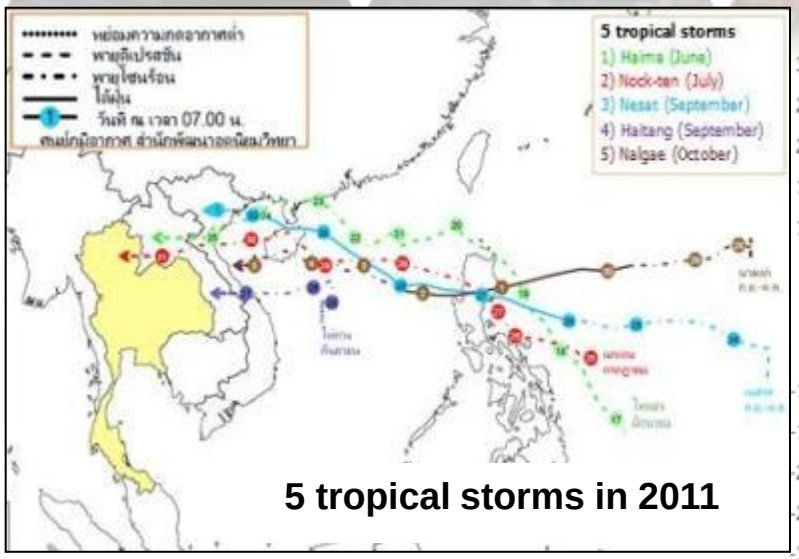
Early warning and real time decision making

Flood sensorweb	Forecast & modeling	Networking & cluster	Flash flood & landslide warning	Reservoir networking	Data warehouse

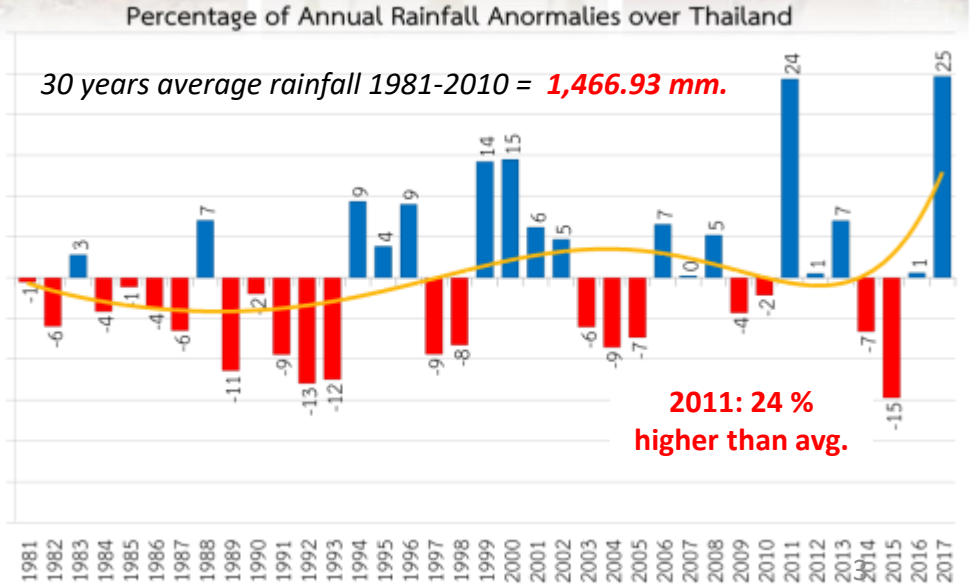
Integration of technology for data analysis and flood management





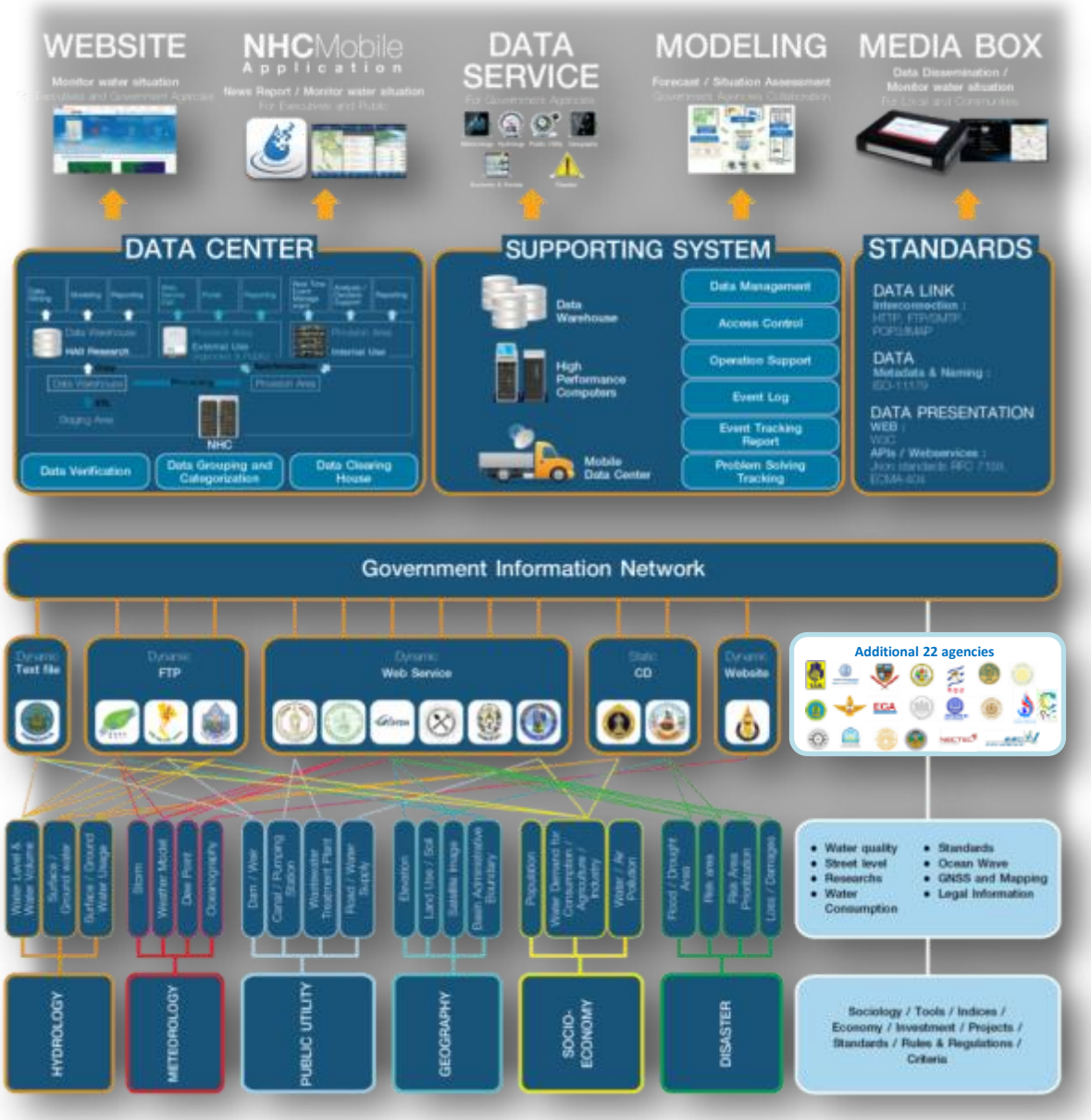


5 tropical storms in 2011



NHC = National Hydroinformatics and Climate Data Center

National Hydroinformatics and Climate Data Center (NHC)



NHC

- **Decision Support** Information System
- **Processing and analysis** of water management information
- **Data integration** and exchange among water related agencies
- **De Facto Standard** flexible data format for monitoring, analysis and forecast of water situation
- Unified water management system for both **normal and crisis situation**

The process and integrated function chart of NHC with the collaboration of the Government Operation Centers to support National Water Resources Management

Prime Minister Operation Center (PMOC)

Committee on The Integration of National Hydroinformatics and Climate Databases
Chairman: Minister, MOST
Secretariat: HAII, EGA

- Primary Data Acquisition and Analytical Reports
- Report 9 Aspects of Hydroinformatics for Water Resource Management

National Water Resources Committee

Office of the National Water Resources

Single Integrated Report

- Public Announcement
- Normal and Crisis Operation

Smart Water Operation Center (RID)

Data in Irrigation Area

35 Government Agencies

Distributed functions, Integrated use

NHC

- Data Warehouse
- Data Exchange and Improvement
- Develop and Utilize modelling

Pollution Control Department Operation Center

- Use data/model from NHC to develop waste water model

Water Quality Data
Discharge Data

Hydrodynamic model

Water related Disasters Data Operation Center (DDPM)

- Preparing data to be linked to Water-related disaster and E-stock management to NHC

Reservoir data

Improve reservoir inflow forecasting model

Rainfall data from Radar

Visualize spatial distribution and forecasting of rainfall

Electricity Generating Authority of Thailand (EGAT)

- Improve reservoir inflow and release forecasting

Department Operation Center, Royal Rainmaking Department (DOC)

Future Operation Centers

Water Resource Management Center

Regional Level

Provincial Level

On process

35 Government Agencies

BB: Bureau of the Budget

BMA: Department of Drainage and Sewerage.

DDPM: Department of Disaster Prevention and Mitigation

DGR: Department of Groundwater Resources

DIW: Department of industrial works

DMR: Department of Mineral Resources

DNP: Department of National Parks, Wildlife and Plant Conservation

DOH: Department of highways

DPT: Department of Public Works and Town & Country Planning

DRR: Department of Rural Roads

DRRAA: Department of Royal Rainmaking and Agricultural Aviation

DWR: Department of Water Resources

EGA: Electronic Government Agency

EGAT: Electricity Generating Authority of Thailand

FOREST: Royal forest department

GISTDA: Geo-Informatics and Space Technology Development Agency

HAII: Hydro and Agro Informatics Institute

IEAT: Industrial Estate Authority of Thailand

KRISDIKA: Office of the Council of State

LDD: Land Development Department

MD: Marine Department

MWA: Metropolitan Waterworks Authority

NDWC: National Disaster Warning Center

NECTEC: National Electronics and Computer Technology Center

NESDB: Office of the National Economic and Social

NRCT: National Research Council of Thailand

NSO: National Statistical Office

PCD: Pollution Control Department

PWA: Provincial Waterworks Authority

RID: Royal Irrigation Department

RTN: Hydrographic Department, Royal Thai navy

RTSD: Royal Thai Survey Department

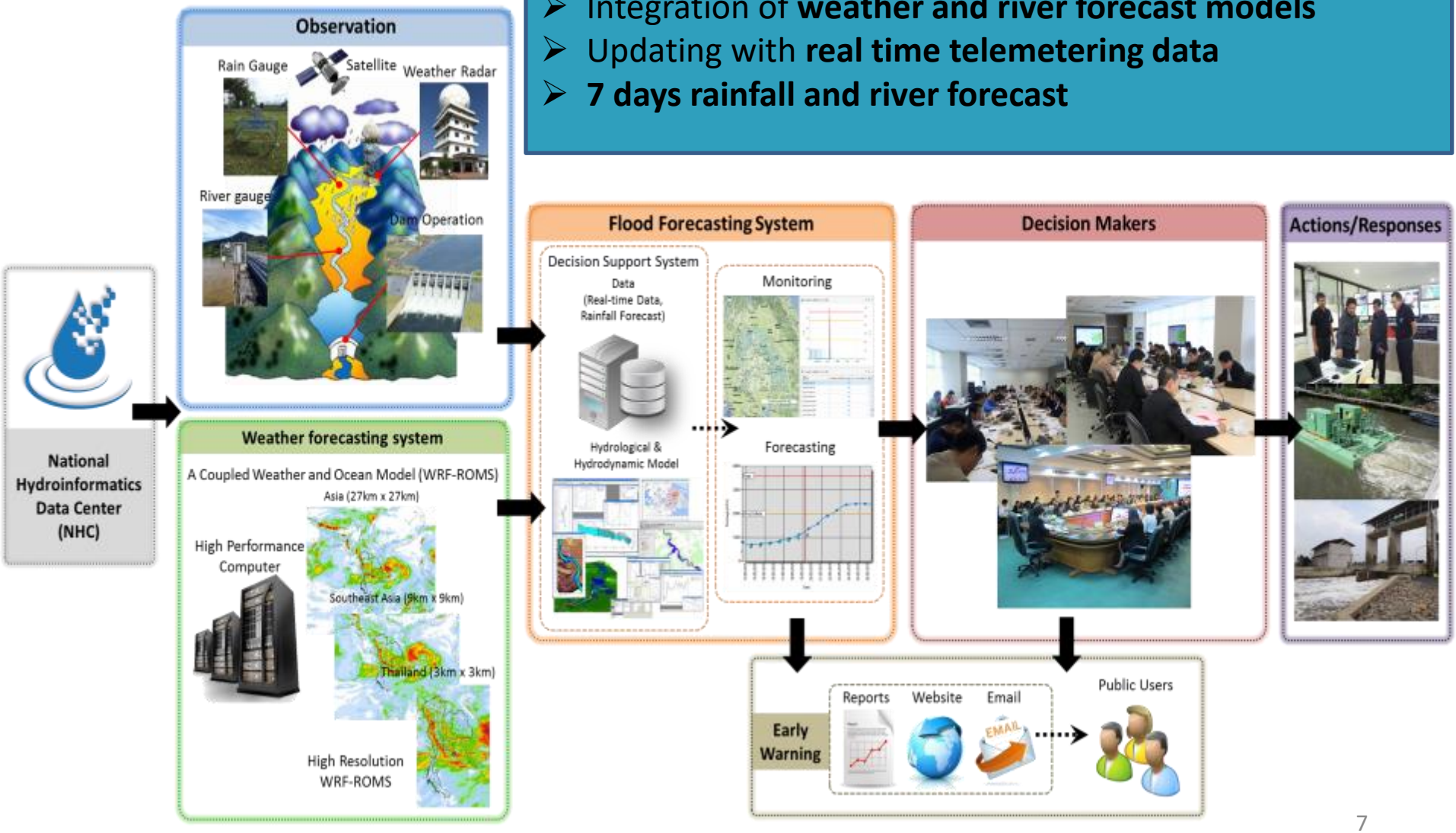
TGO: Thailand Greenhouse Gas Management Organization

TMD: Thai Meteorological Department

TRF: The Thailand Research Fund

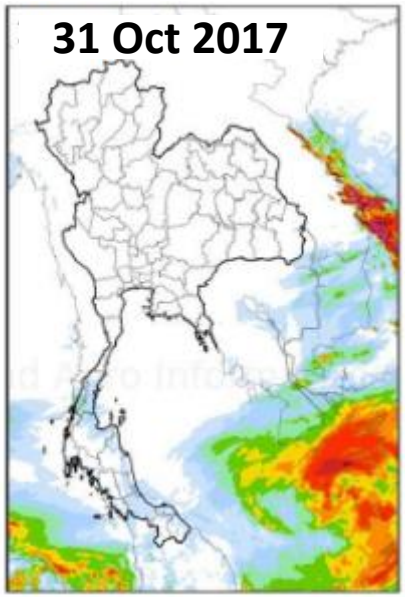
Flood Forecasting System

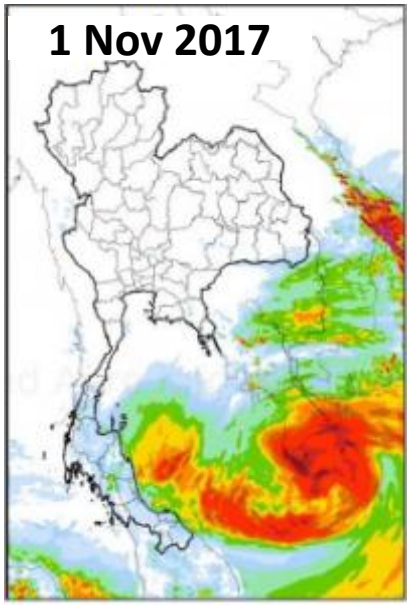
- Integration of **weather and river forecast models**
- Updating with **real time telemetering data**
- **7 days rainfall and river forecast**

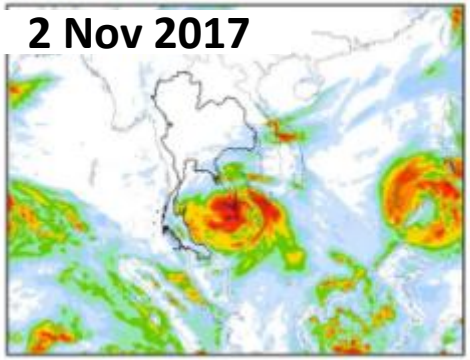


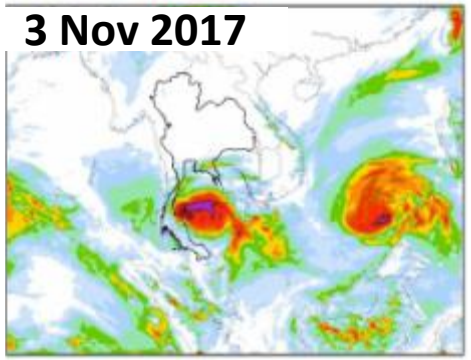
PAST EXPERIENCES OF FLOOD MANAGEMENT IN THAILAND

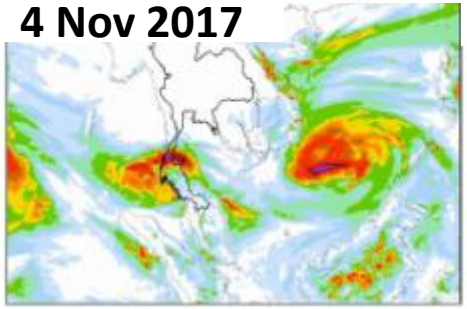
Rainfall Forecast: Detection of low pressure

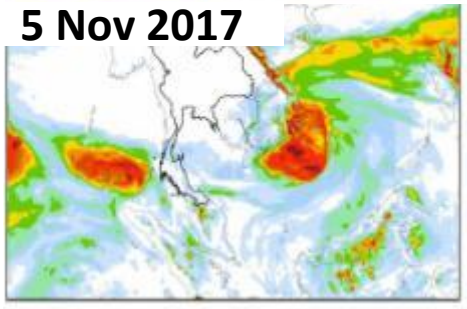












24 Oct 2017

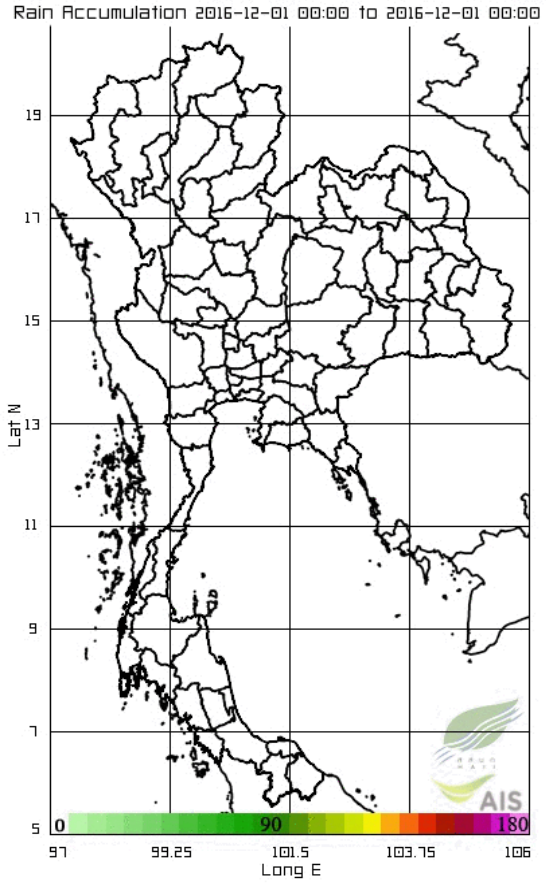
- Detect the formation of low pressure

30 Oct 2017

- Confirm the developing of Depression

3 Nov 2017

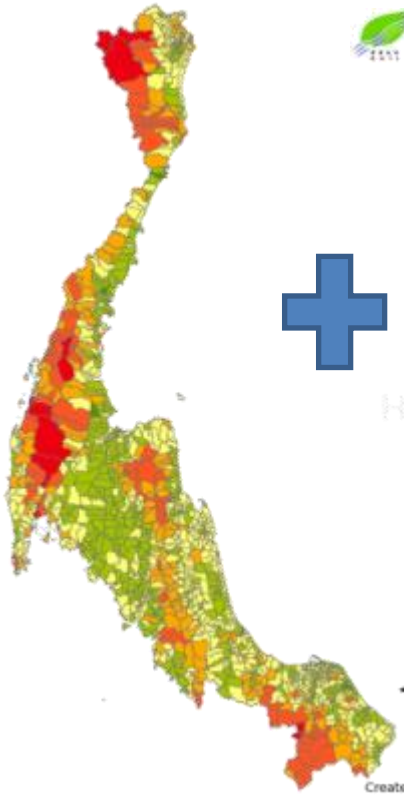
- Depression hit the Southern part of Thailand



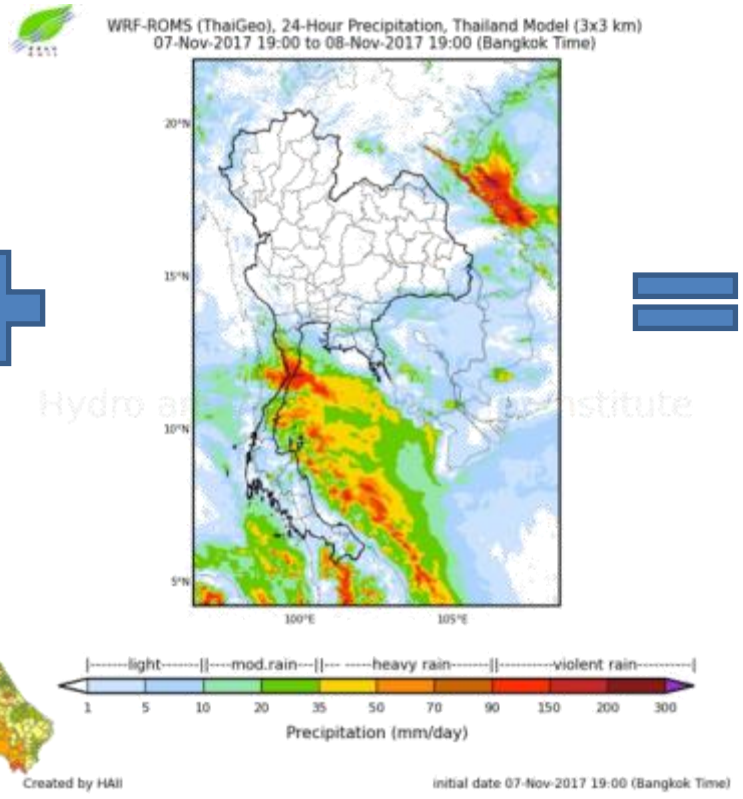
Accumulated Rainfall from 1 to 9 Dec 2017

Flashflood Forecast at Bangsaphan

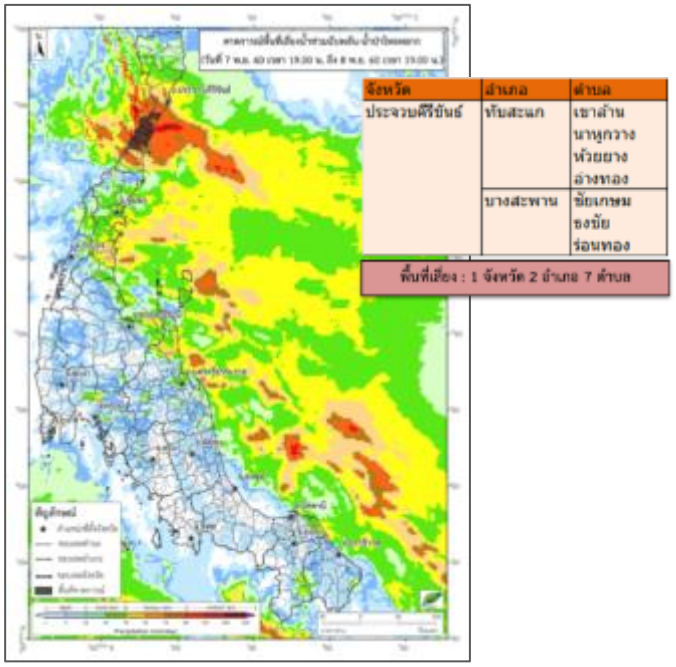
Flashflood potential index (FFPI)



Rainfall forecast



Flashflood Risk Area



8 November 2017 – Morning
Flashflood at Bang Saphan district

Data support to DDPM and local operation

Set up Local Monitoring System

Meeting & Teleconferencing with Authorized National and Local Government Agencies

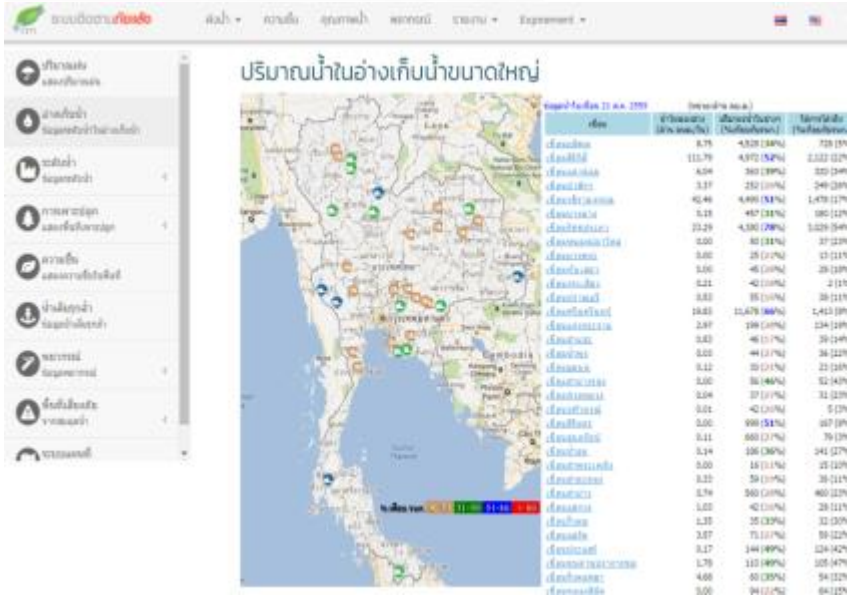
Prime Minister visited to the emergency operation center

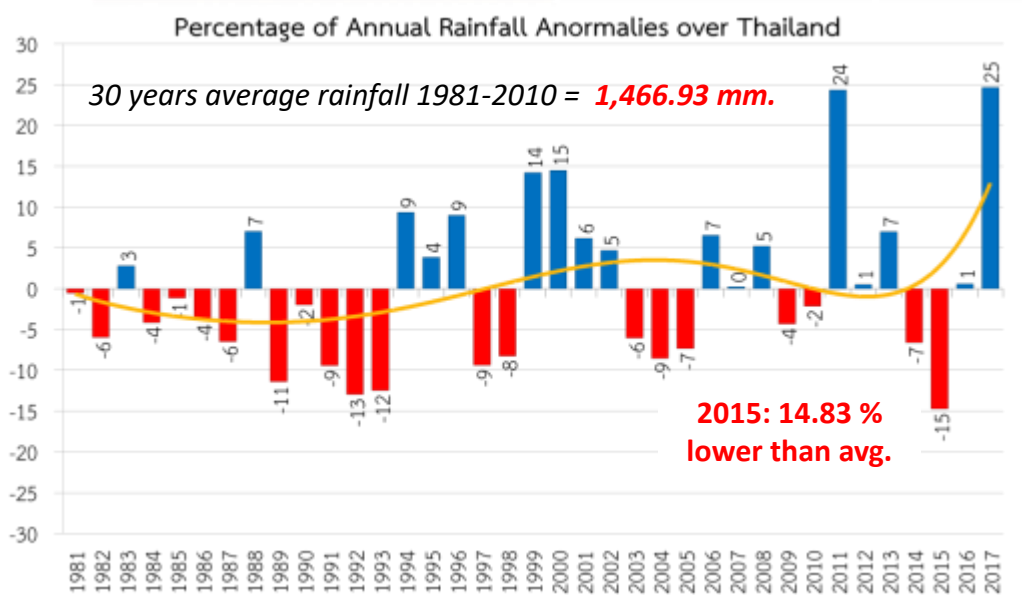
Providing scientific information about the weather condition to the public

Thailand's droughts in 2015

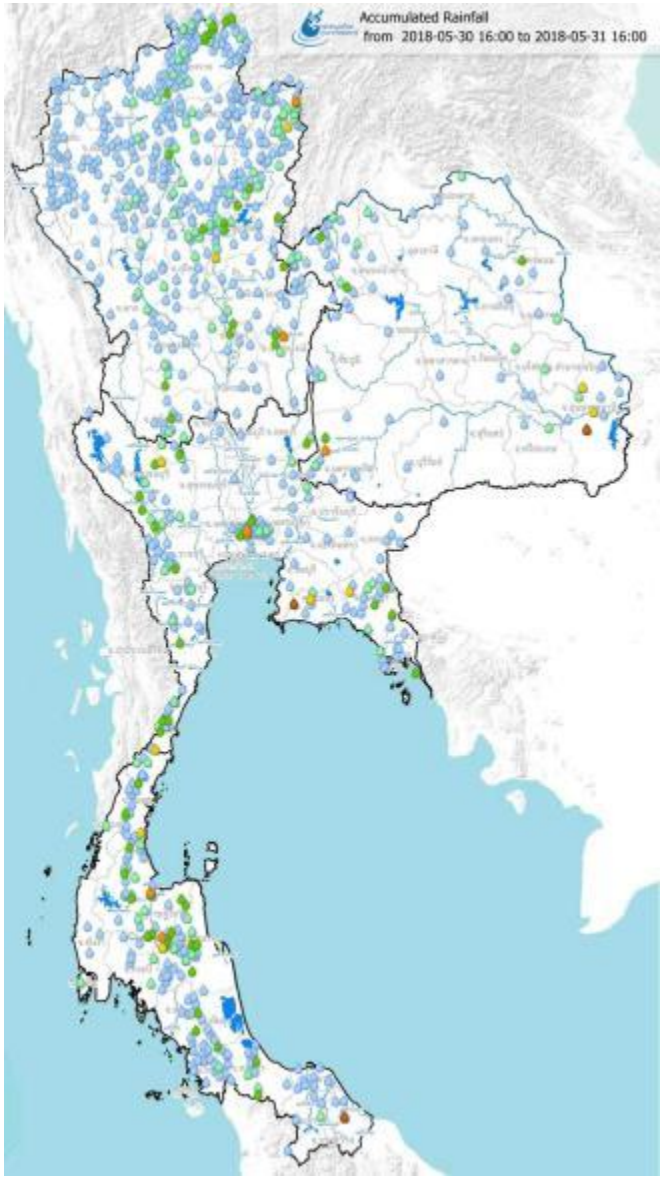
Severe droughts, particularly in the upper-middle part of the country

Ping River	Phayao Lake	Khwae Noi Bamrungdan Dam	Ubolratana Dam





Drought Monitoring and Definition in Thailand



Thailand's Rain Gauge Stations

Drought Monitoring

- **Drought monitoring** mainly refers to rainfall data from rain gauge stations

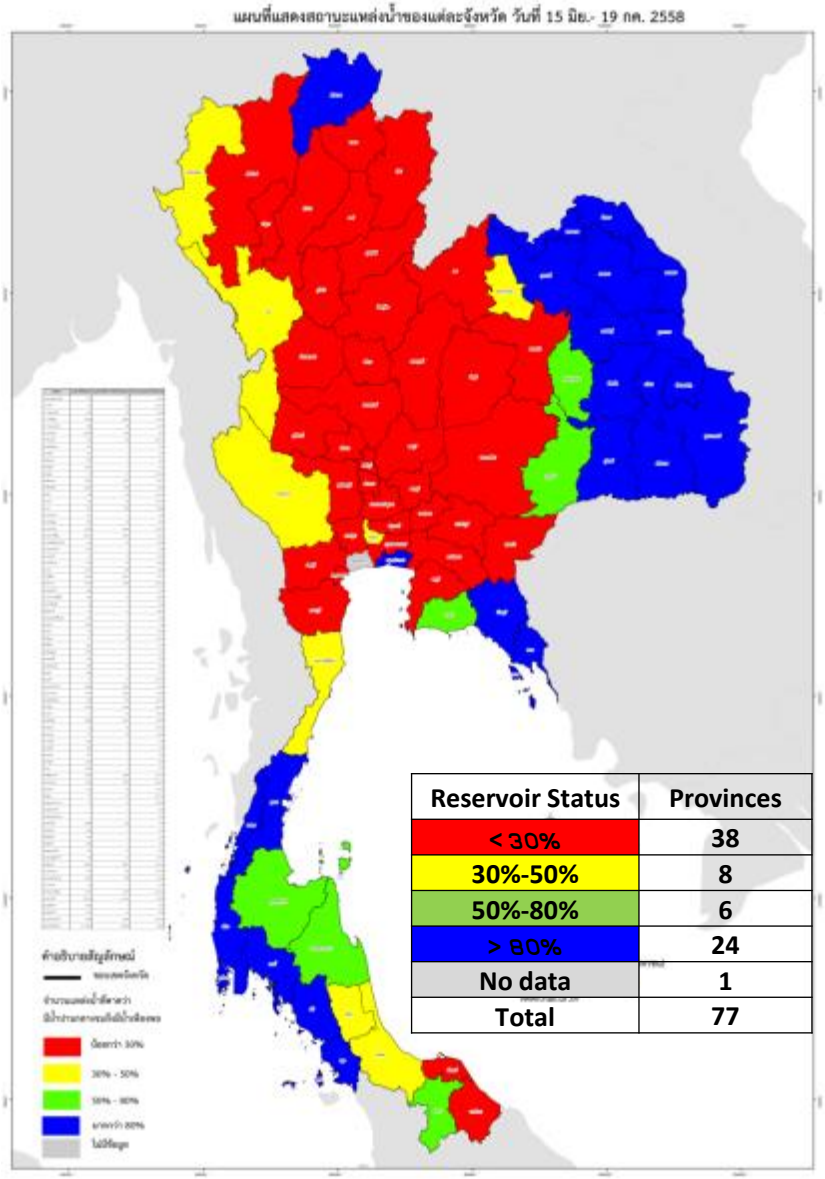
Drought Definition

- No continuous **rainfall** within 7-15 days and rainfall is less than 1 mm/day.
- Lack of **water supply and demand**.
- Effect of drought on **agricultural area and crop growth**.
- Effect of drought on **soil moisture status**.

Limitations of Drought Monitoring in Thailand

- Point monitoring based on rain gauges
- Using only rainfall data which does not cover or reflect other related drought problems
- HAII collaborates with IWA and DHI to **develop Flood and Drought Monitoring Tools**.
- **FDMT web portal** is an online tool that provides a series of web based technical tools and readily available satellite data which can be used individually or collectively to incorporate information about floods and droughts.

Reservoirs in Thailand



Reservoirs Status from 15 June to 19 July 2015

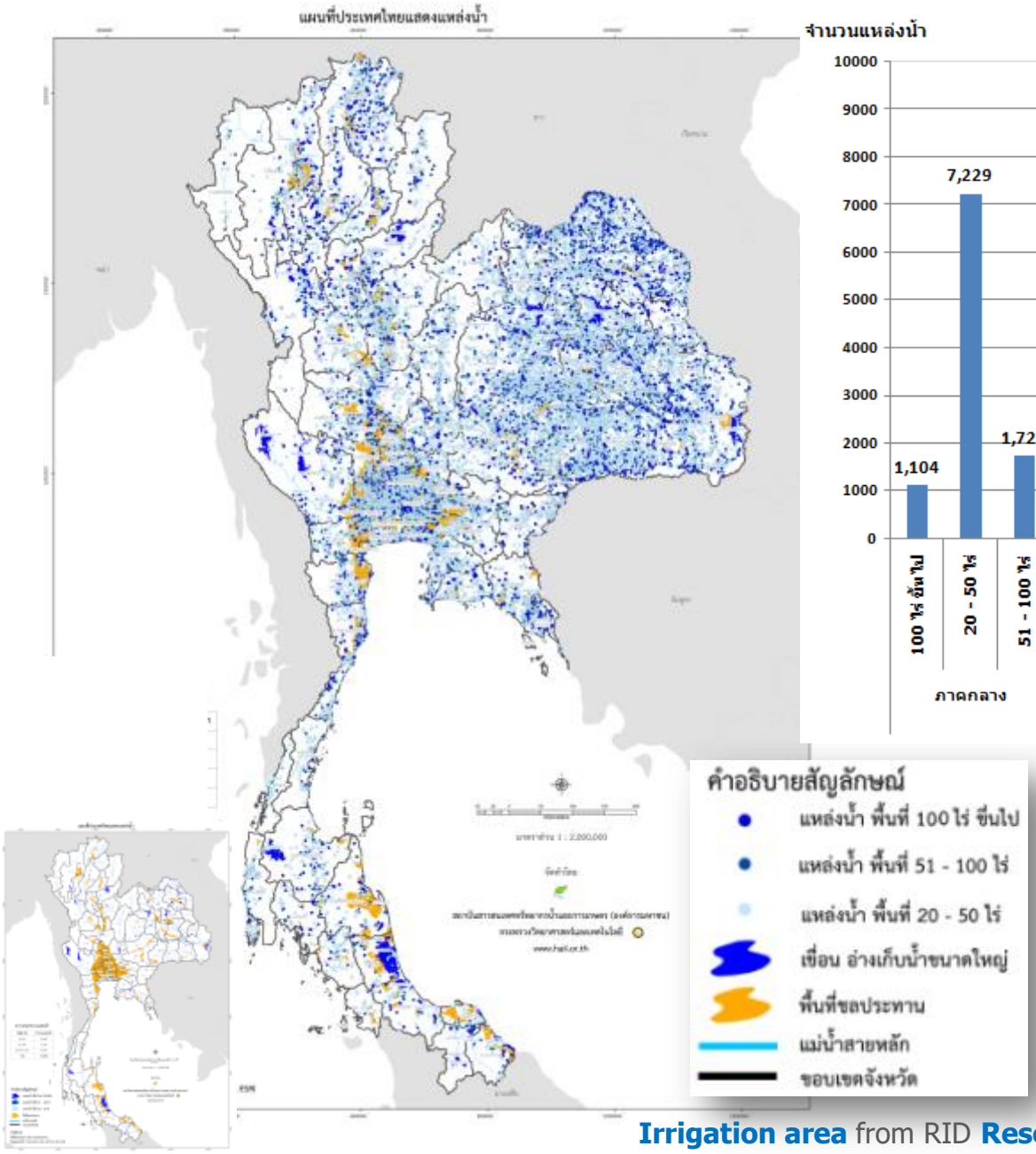
	Large Reservoirs	Capacity (MCM)
North	8	24,825
Northeast	12	8,368
Central	5	27,965
East	6	1,515
South	4	8,194
Total	35	70,867

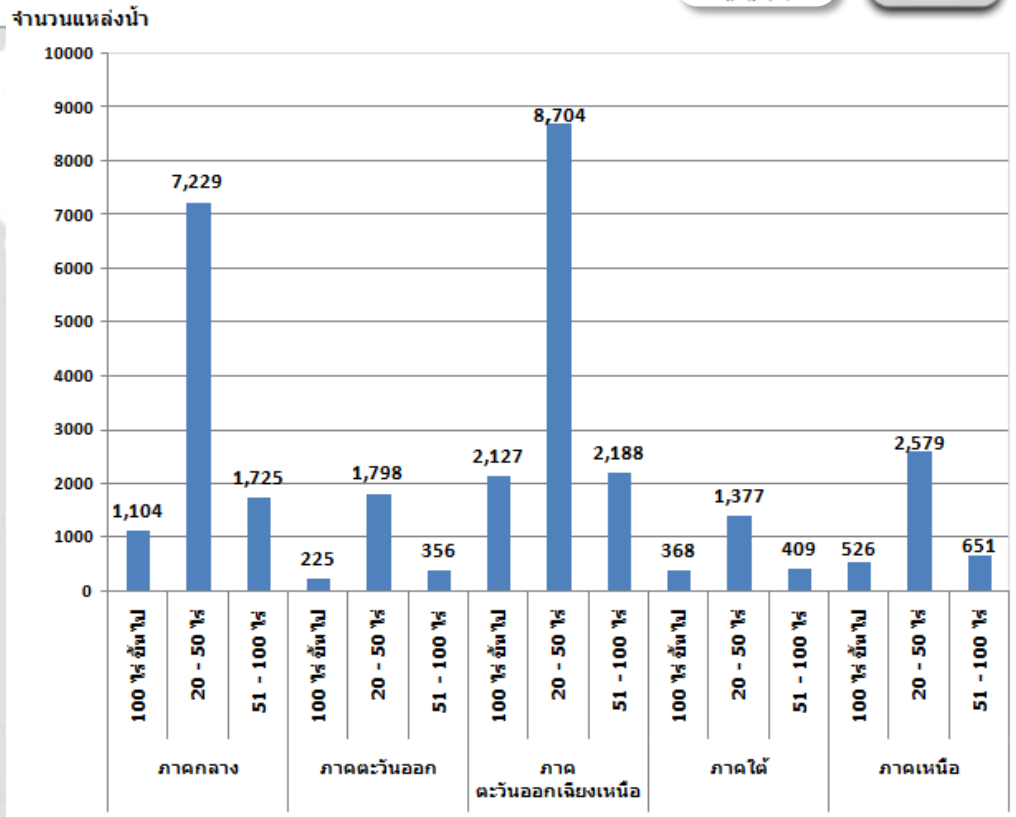
Reservoir status

- **16 EGAT** Reservoirs and the rest are under responsibility of **RID.**
- **35 Large reservoirs**
- **412 Medium reservoirs**

Reservoir's number from RID and EGAT

Water resources in Thailand

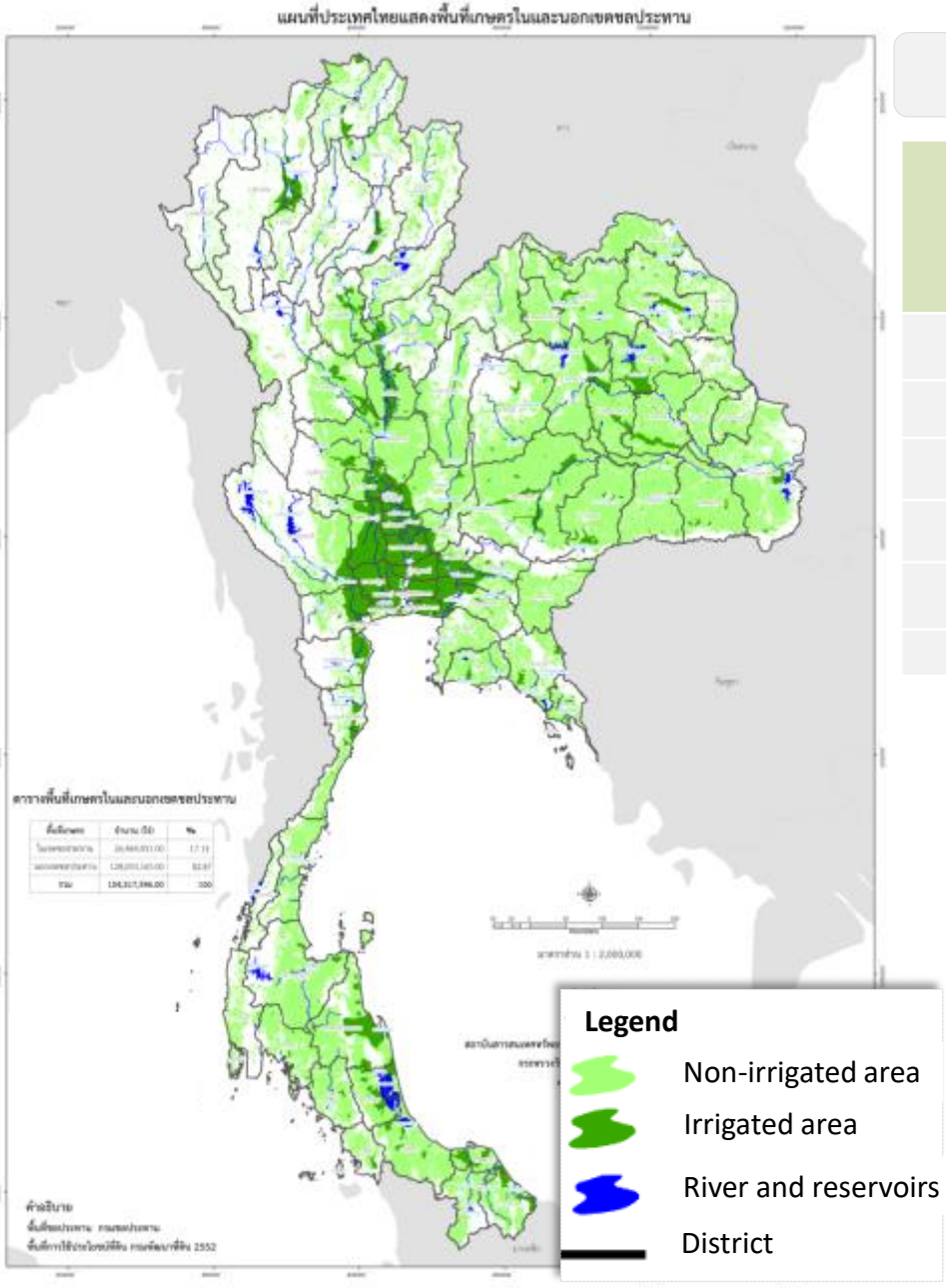




Area (Rai)	Reservoirs
20-50	21,687
51-100	5,329
> 100	4,349
Total	**31,365**

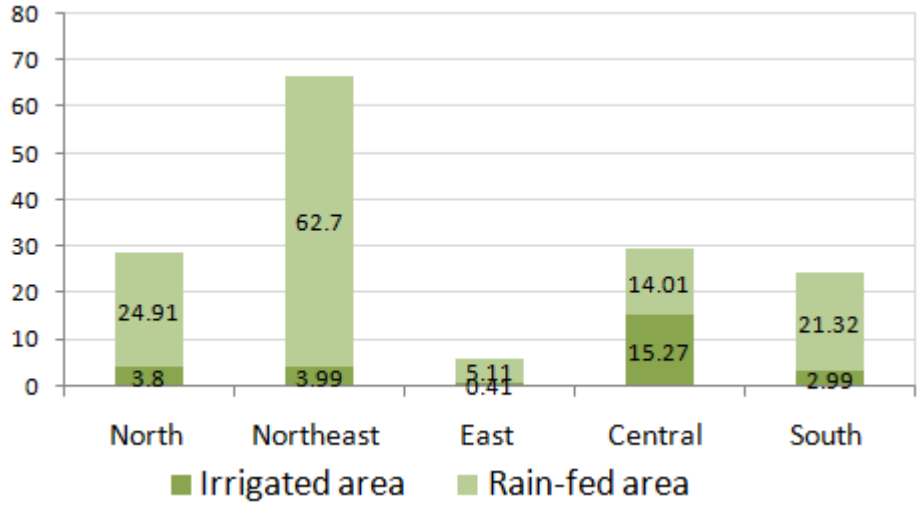
Irrigation area from RID **Reservoir information** from HAII, GISTDA, and ESRI

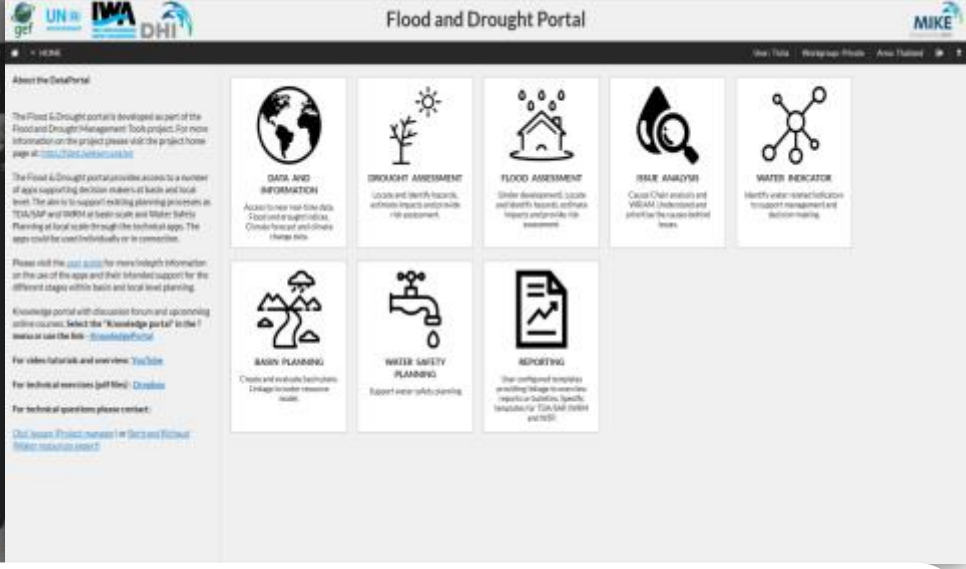
Agricultural Area (Irrigated vs Non-irrigated)



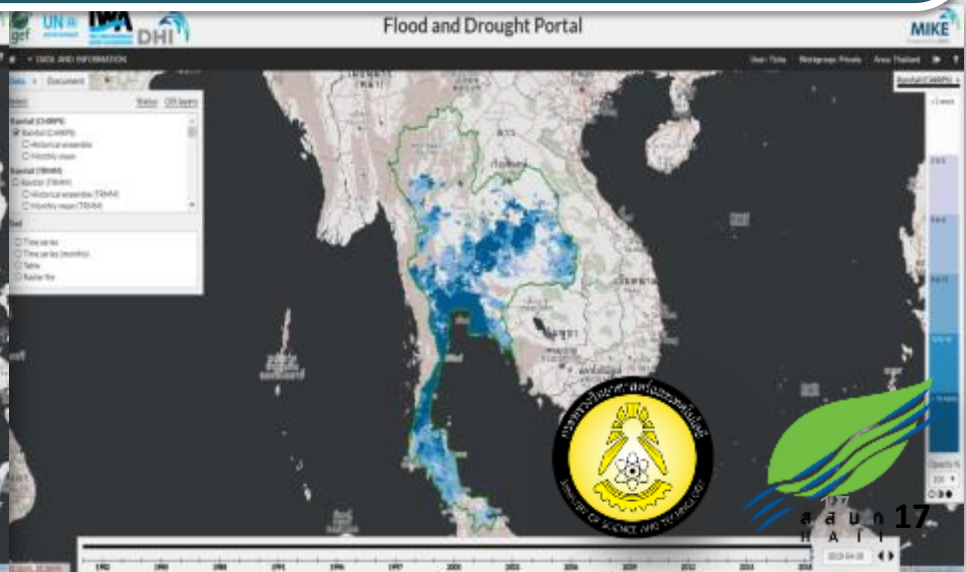
83% of agricultural area is in non-irrigated

	Agriculture area(Million Rai)			% Irrigated Area
	Total	Irrigated Area	Non-Irrigated Area	
North	28.71	3.80	24.91	13.2%
Northeast	66.69	3.99	62.70	6.0%
East	5.52	0.41	5.11	7.5%
Central	29.29	15.27	14.01	52.1%
South	24.31	2.99	21.32	12.3%
Total	**154.52**	**26.46**	**128.05**	**17.1%**



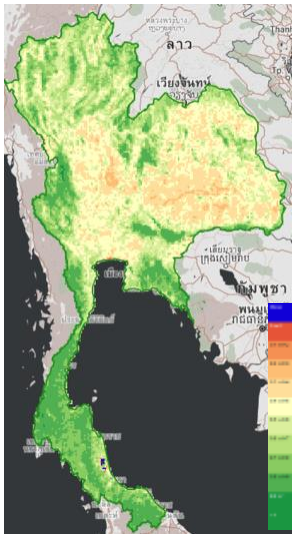


FLOOD & DROUGHT WEB PORTAL

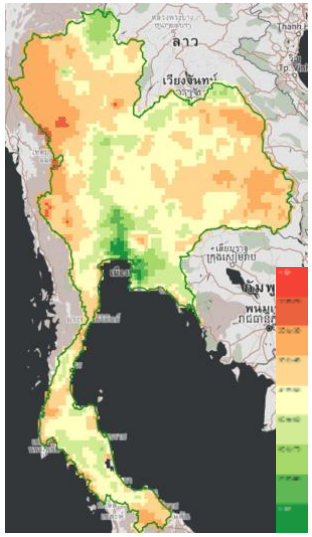


Flood and Drought web portal

Rainfall data



Vegetation index



Soil Water index

Access near real-time data

Flood and Drought Indices

Climate forecast and climate change data

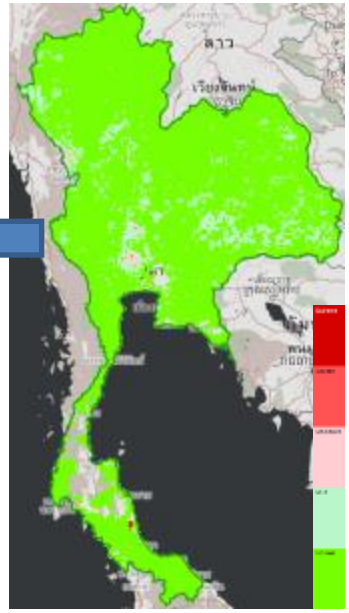
Satellite	Data	Spatial Resolution	Temporal Resolution	Period
CHIRPS	Rainfall	0.05 deg	daily	1981-present
GPM		0.1 deg	daily	2015-present
CRU		0.5 deg	monthly	1901-2013
PERSIAN		0.04 deg	daily	2000-present
TRMM		0.25 deg	daily	2000-present
MODIS	Temperature	5600 m (resampling from 250m	8 daily	2000-present
	NDVI	5600 m (resampling from 250m	16 days composite	2000-present
	Evapotranspiration	5000 m (resampling from 1000m)	8 day	2000-2014
MeTOP-ASCAT	SWI	0.1 deg	10 daily	2007-present

- **rainfall, temperature, vegetation index (NDVI), Evapotranspiration, and soil water index (SWI)** are provided in the portal.

Flood and Drought web portal

Indicate drought status from precipitation

SPI Index



Indicate dry status from vegetation health and ground condition

VHI Index

Access near real-time data

Flood and Drought Indices

Climate forecast and climate change data

Index	Input	Strengths	Weaknesses
SPI	Rainfall (TRMM)	➢ Calculate from long term mean precipitation ➢ Standard index ➢ Simplify and easy to understand ➢ Indicate status both of dry and wet in the same way	➢ Can not indicate ground condition ➢ Unstable with low precipitation region
EDI	Rainfall (TRMM)	➢ Calculate from daily precipitation ➢ Current status of drought	➢ Daily rainfall is unstable data
VHI	NDVI & Temperature	➢ Indicate ground condition status ➢ Monitor dry status and vegetation health	➢ Precipitation is not include

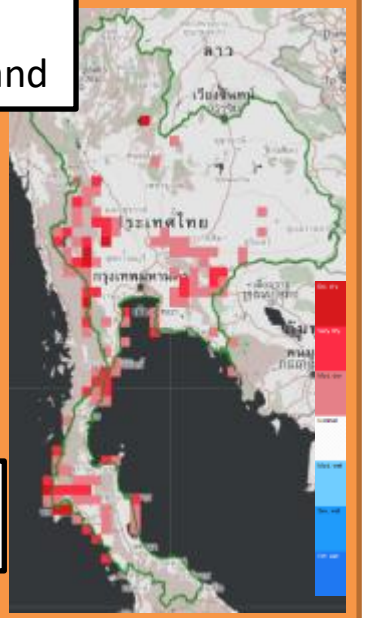
- Drought Indices are calculated from satellite data and can be used for **drought monitoring and planning** in Thailand.
- Many indices are suitable to difference drought types. For example
  - **SPI and EDI** indicate drought from **precipitation**.
  - **VHI** relate to drought in **agricultural** and crop area.
- **Total number** of index is **8** index both flood and drought

Flood and Drought web portal

Rainfall data cover entire Thailand

Is this hit a real situation?

Rainfall forecast at 06 June 2018



Seasonal drought outlook for Thailand

Will this hit a real situation?

SPI forecast 28 Feb 2019

Access near real-time data
Flood and Drought Indices
Climate forecast & Climate change data

Challenges in using Seasonal Forecast

- **For better planning and management** weather forecast provides location and intensity of future rainfall. it tells the tendency of **possible flood or drought.**
- **Accurate flood & drought risk assessment and mapping** with appropriate indicators and climate related data risk area can be identified and monitored in order to prepare **better measures or responses.**
- **Long-term prediction** under changing climate vs **adaptation technology.**
- The Climate Forecast System (CFS) is used for seasonal forecast and provides ensemble forecast with 9 months lead time.

Flood and Drought web portal: Drought Report

Example of Thailand Drought Report

Automatically send the report to all stakeholders

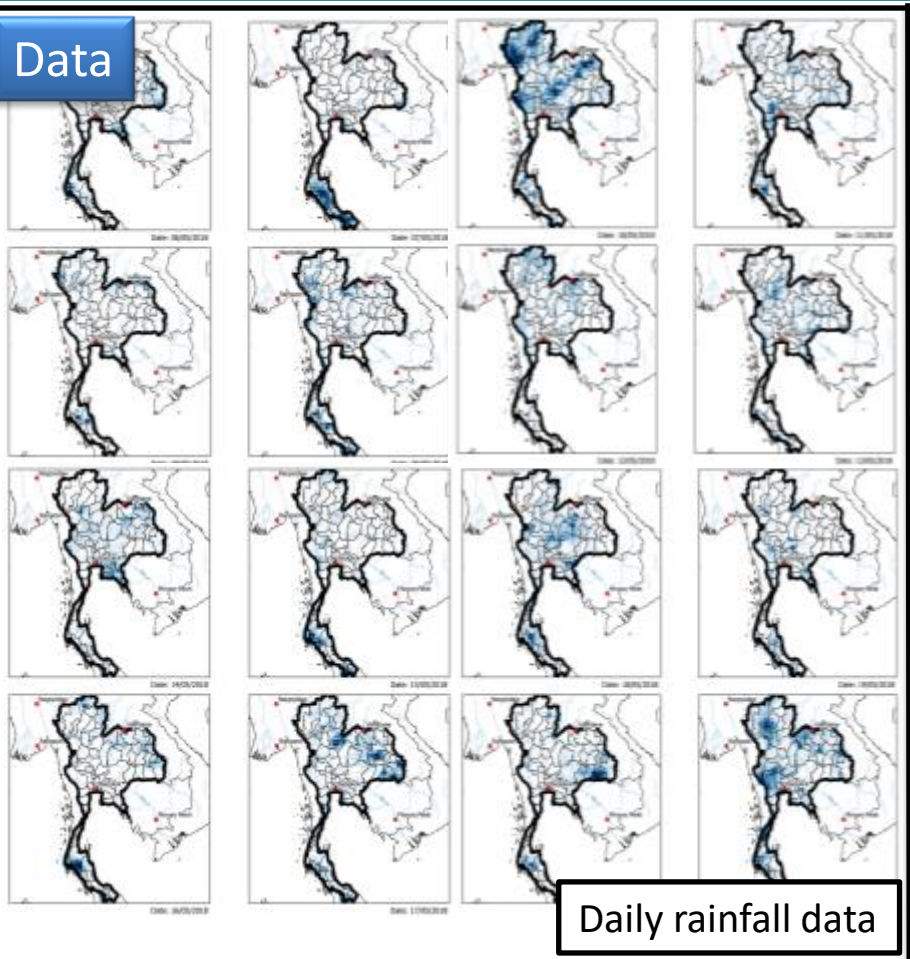
Overview of the report

- **Drought information** is provided in the report for all water management-related stakeholders.
- Drought related data is generated from the portal as a **map, table and graph**.

- **Advantages** of the report
  - ✓ Present **drought current status** of Thailand
  - ✓ Various water related satellite data are readily available such as **Precipitation, Vegetation, Soil Moisture, and combined indicators to generate drought indices**
  - ✓ **Easy to use, semi-automatic report generation tool**

Flood and Drought web portal: Selected data in Drought report

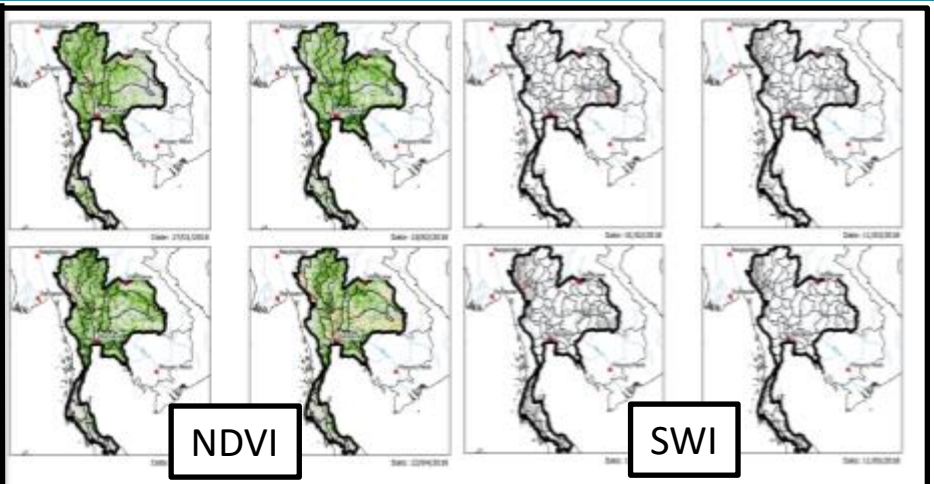
Data



Daily rainfall data

Daily Rainfall

- Monitoring of **spatial rainfall distribution**



NDVI

SWI

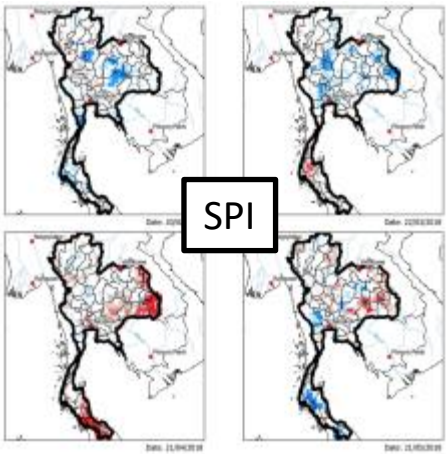
Computed Data

NDVI

- Monitor **health and density** status of agricultural area.

SWI

- Monitor **moisture and dry** status of soil.



SPI

Drought Index

SPI

- Monitor and indicate **risk area** of drought.

THANK YOU

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