Agro-met Monitoring Methods and Implementation (Hands-on training of JASMIN)

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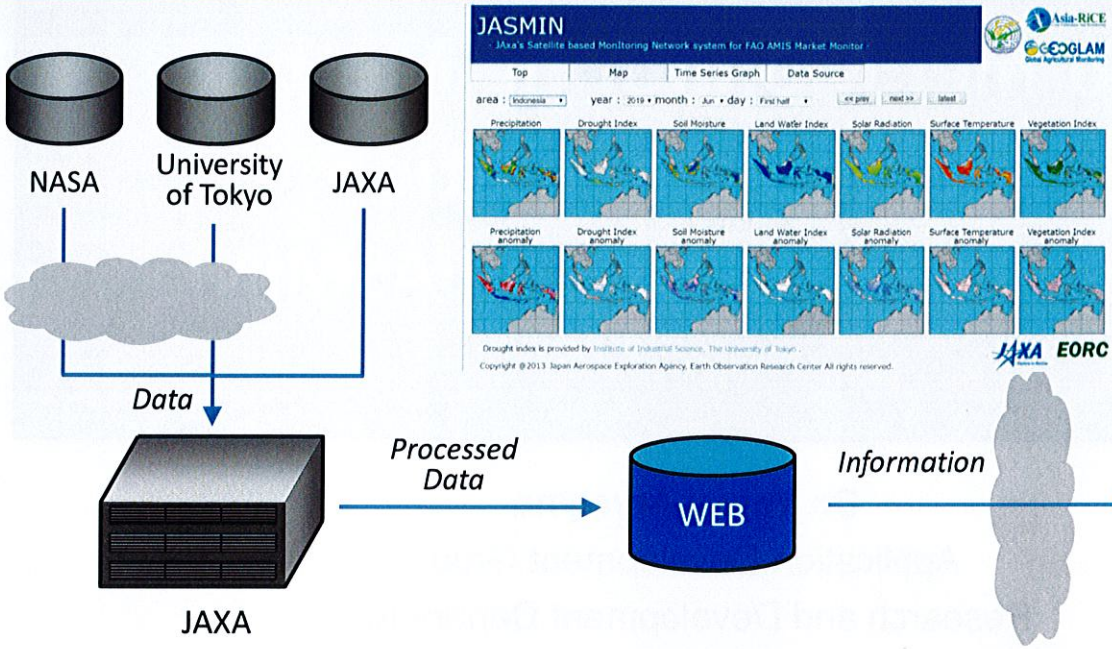
Hands-on training menu (JASMIN)

JASMIN =
JAxa's Satellite based MonItoring Network system for FAO AMIS Market Monitor

- ✓ Download JASMIN data of the province where you are now living and check which parameter are higher or lower this year.

Architecture of the system



- Data Collection
- Data Processing
- Image Generation

https://suzaku.eorc.jaxa.jp/JASMIN/index.html

at Tsukuba, Japan

End Users

Outline

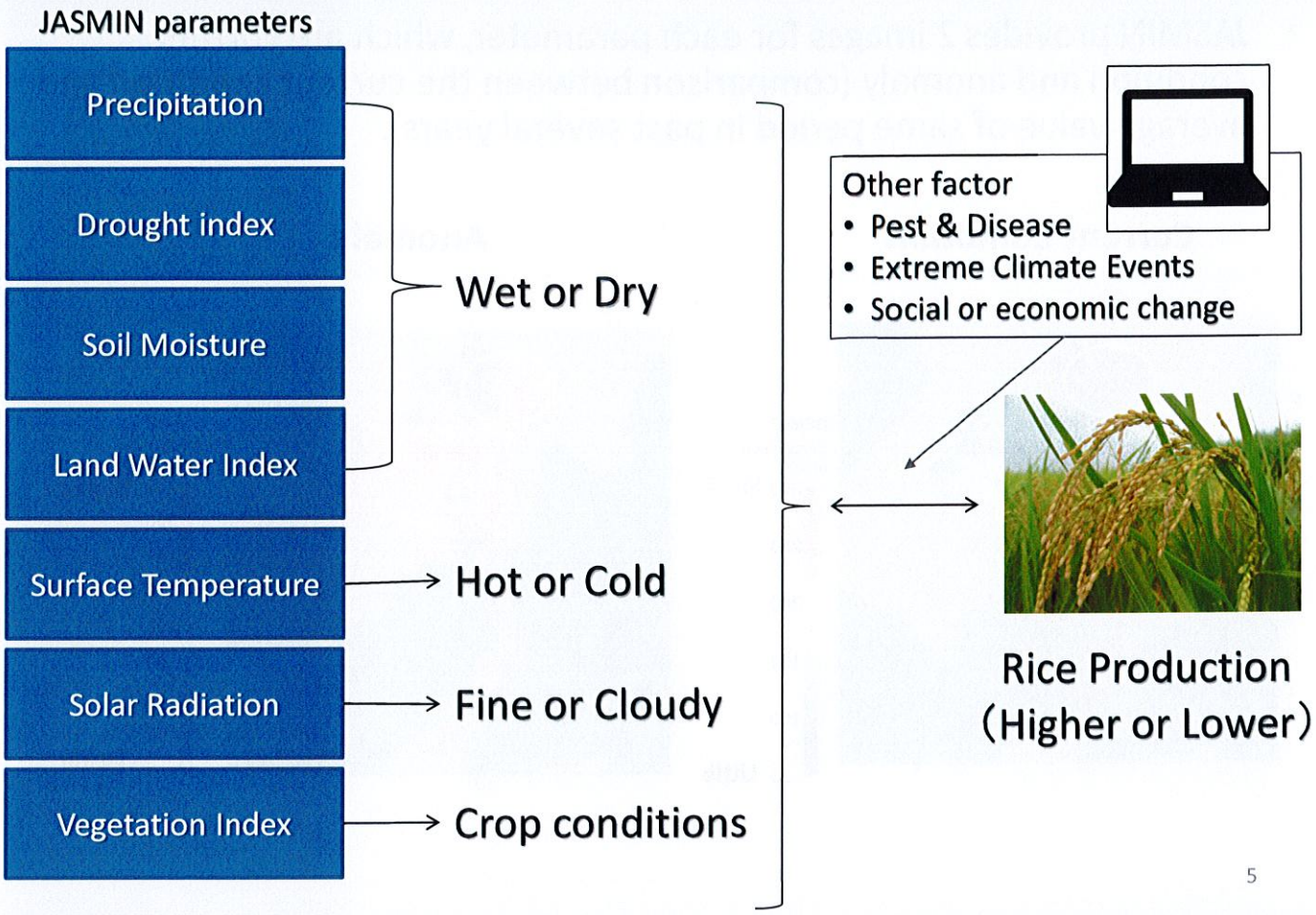
JASMIN parameters

- Precipitation
- Drought index
- Soil Moisture
- Land Water Index

→ Wet or Dry

- Surface Temperature → Hot or Cold
- Solar Radiation → Fine or Cloudy
- Vegetation Index → Crop conditions

Outline



Data Source and Spatial Resolution

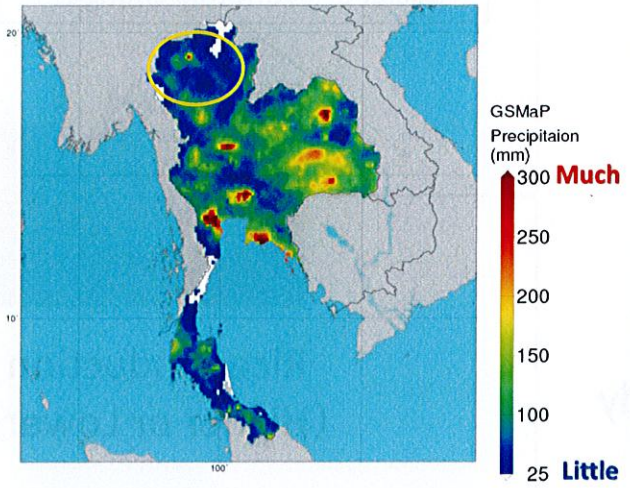
Product	Units	Spatial Resolution	Satellite Data(Product)
Precipitation	mm	10km	GCOM-W,GPM,Himawari etc. (GSMaP Ver.5)
Drought Index	unitless	10km	MTSAT, GCOM-W, GPM etc. (KBDI by IIS,U.Tokyo)
Soil Moisture	%vol	30km	AMSR-E,AMSR2
Land Water Index	unitless	10km	AMSR-E,AMSR2
Solar Radiation	W/m²	5km	MODIS (JASMES)
Surface Temperature	degrees Celcius	5km	MODIS (MOD11C1/MYD11C1)
Vegetation Index	unitless	5km	MODIS (JASMES)

* GSMap: Global Satellite Mapping of Precipitation

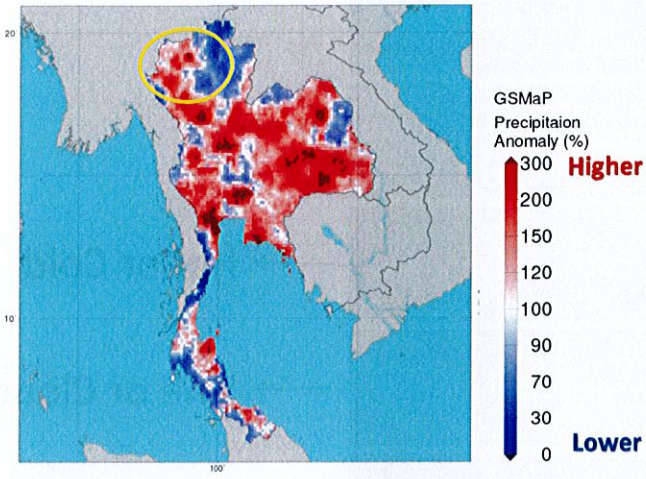
What information can I get?

- JASMIN provides 2 images for each parameter, which are current condition and anomaly (comparison between the current condition and average value of same period in past several years).

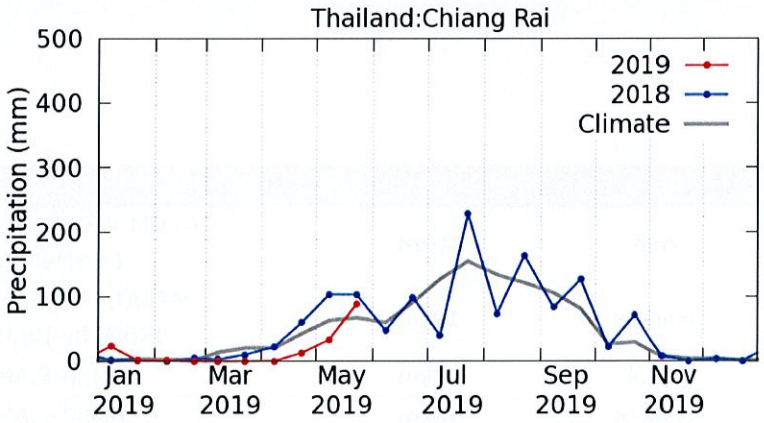
Current Condition



Anomaly



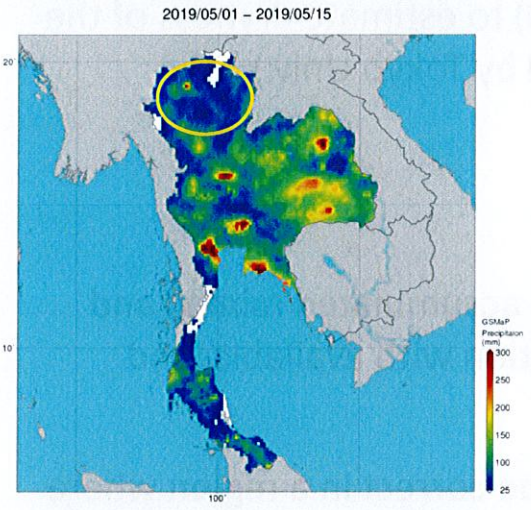
What information can I get?



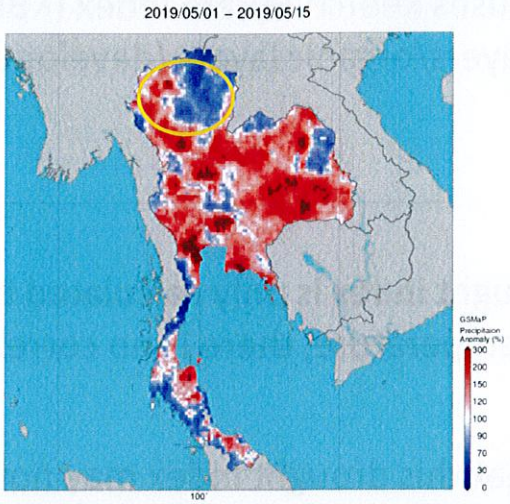
- Averaged value of the parameters within the specific province selected by user are provided as time series graph.
- Red line and dots are time series of target year.
- Blue line and dots are time series of previous year.
- Grey line are time series of climate value (average value of same period information in several years).

Precipitation

Current Condition



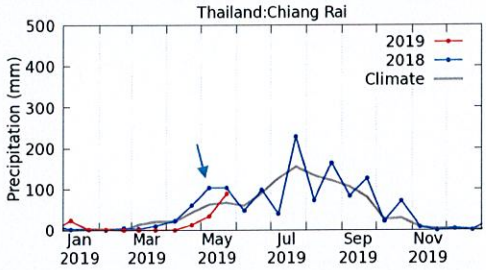
Anomaly



Much

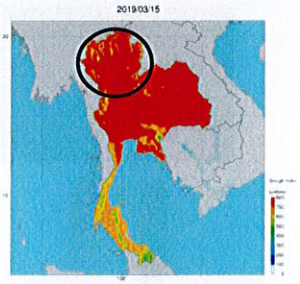
Little

- System provides 15-days accumulated precipitation
- Spatial resolution : 10 km
- Too little precipitation can result in dry soil, and too much rain at once can lead to flooding

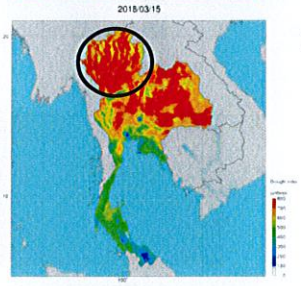


Drought Index

Current Condition

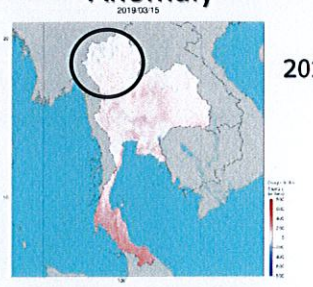


2019/3/15



2018/3/15

Anomaly



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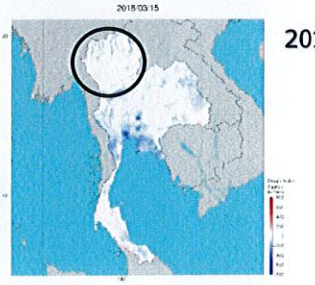
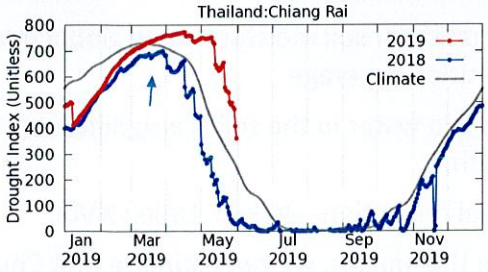


2018/3/15

Dry

Wet

- System provides daily data most close to the end of the period of half month.
- Spatial resolution : 10 km.
- From daily time-series graph and images, we can estimate that Chiang Rai Province was in dry condition on March, 2019 and drier than in 2018.



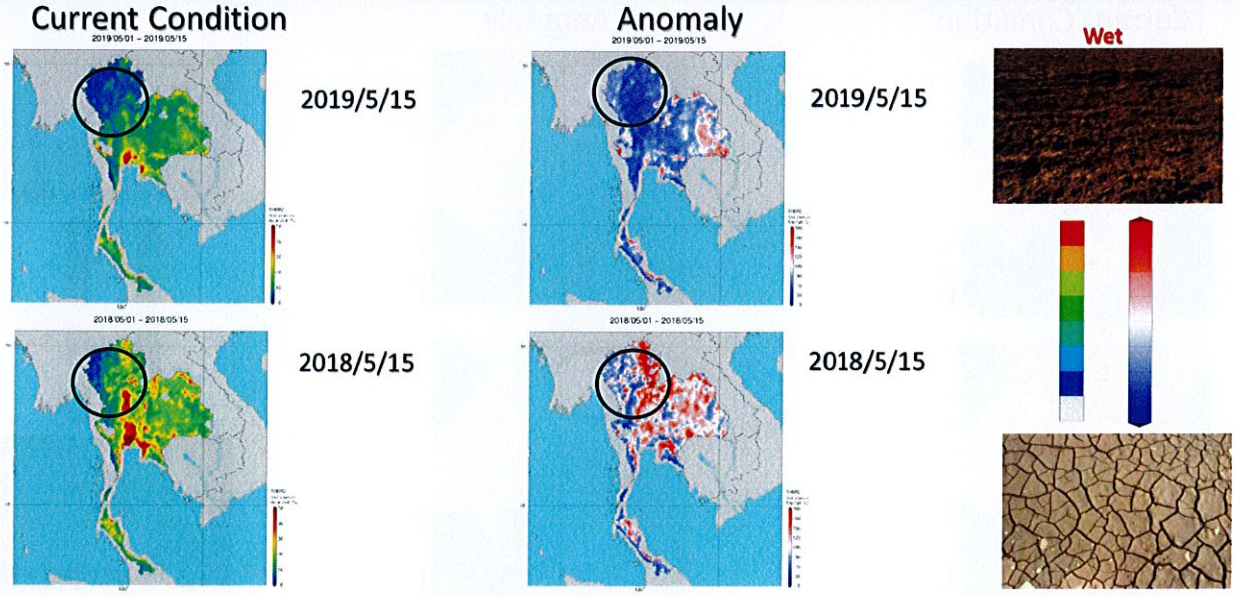
Drought Index Data Info

- Drought data uses Keetch-Byram Index (KBDI) to estimate dryness of the soil and duff layers/organic layers (developed by Tokyo Univ.)

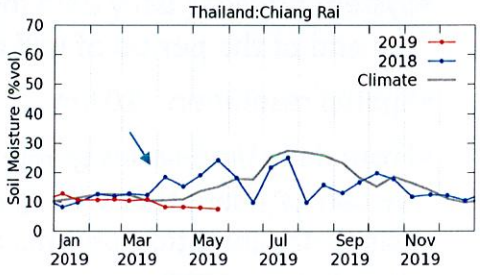
Limitation:

- Since this drought index is only calculated by accumulated rainfall and land surface temperature, there is no correlation with available land water.
- This means that this drought index may not be correct in a region where there is irrigated area with enough available water for rice crop growing.

Soil Moisture

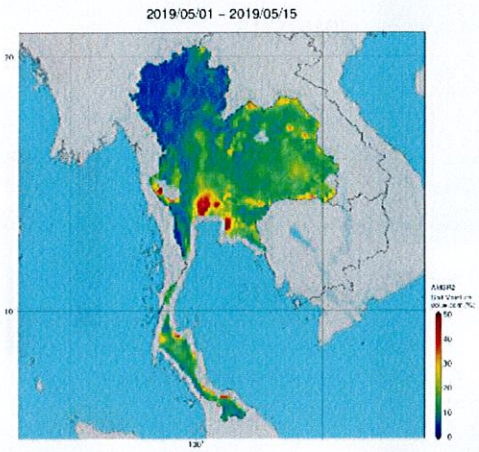


- Satellite data (product): AMSR-E & AMSR2.
- Estimation of soil moisture using global fractional vegetation coverage.
- Available water in the soil is a significant factor for rice growth.
- Spatial resolution : 30 km. Units: %Vol.
- From the images, we can estimate that Chiang Rai Province was in dry condition in May 2019 and drier than in 2018.



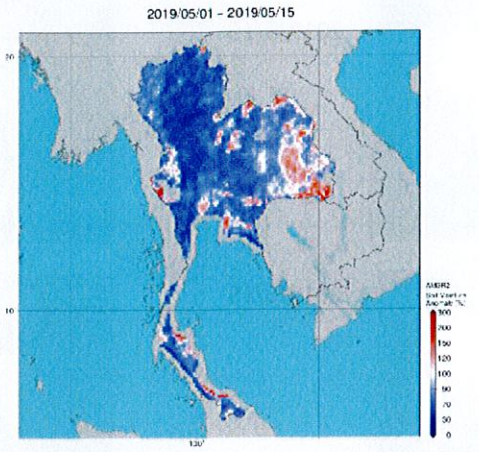
Limitation of Soil Moisture Data

Current Condition



2019/5/15

Anomaly

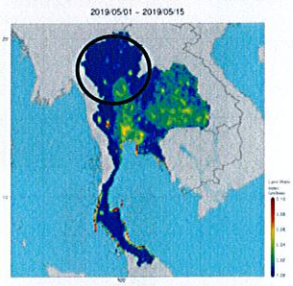


2019/5/15

- Soil moisture value are too high around water area and too low in the forest, mountain and heavy precipitation area. So, we can not use soil moisture information in those area.
- In addition, satellite based soil moisture values in rice paddy field area during planting season may be also too high since paddy field are flooded and soil moisture value in that area may not be useful.

Land Water Index

Current Condition



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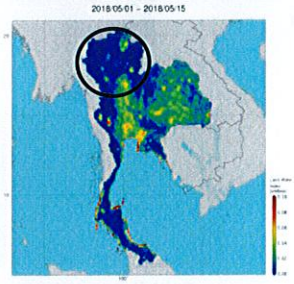
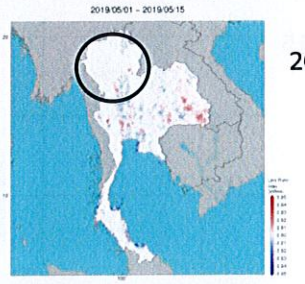


2018/5/15

Anomaly



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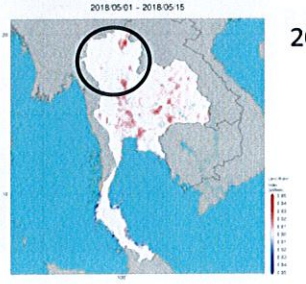
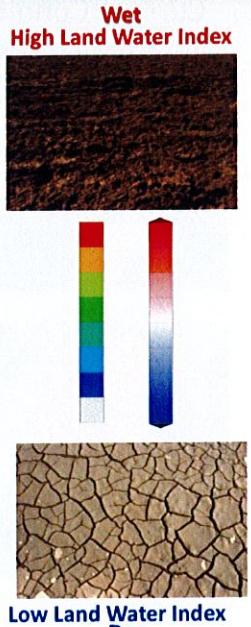
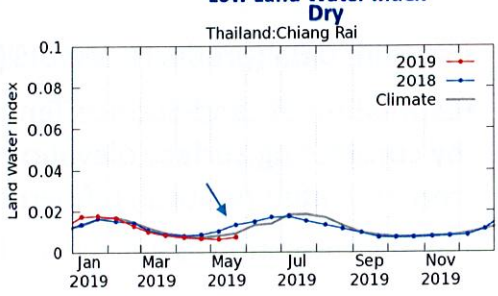


2018/5/15

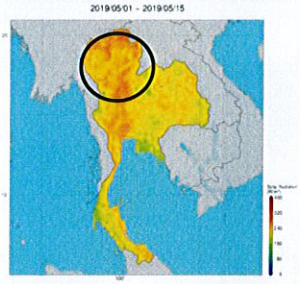


- Satellite data (product): AMSR-E & AMSR2.
- Estimation of Land Water Index using microwave sensitivity of surface water fraction (i.e. smaller value vs land).
- Spatial resolution : 10 km. Units: Unitless (Index).
- From the images, we can estimate that Chiang Rai Province in May 2019 was drier than in May 2018.

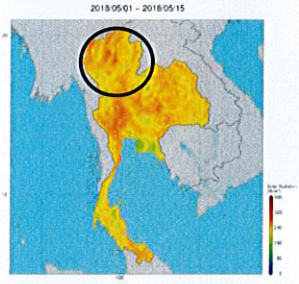


Solar Radiation

Current Condition

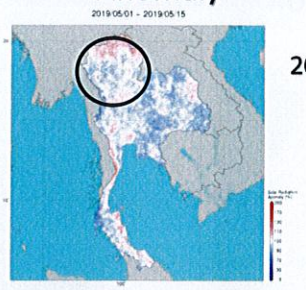


2019/5/15

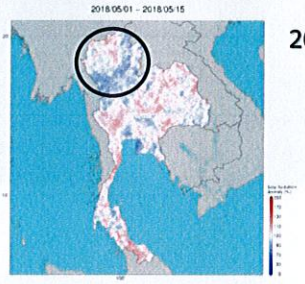


2018/5/15

Anomaly



2019/5/15

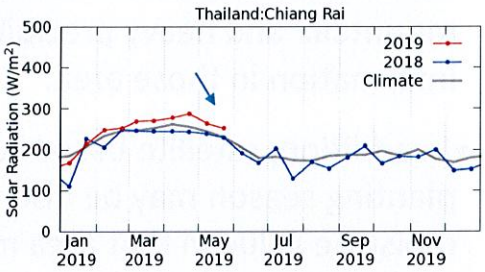


2018/5/15

High Solar Radiation: Clear

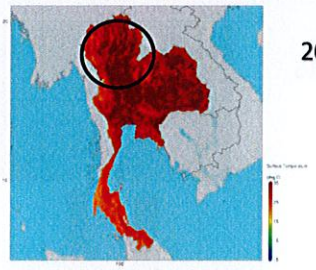
Low Solar Radiation: Cloudy

- Satellite data (product): MODIS (JASMES).
- Estimation of Photoshynthetically Available Radiation (PAR) at the ocean surface from Global Imager (GLI) Data.
- Sunshine intensity and duration are key factor for rice growth.
- Spatial resolution: 5 km. Units: W/m2.
- From the images, we can estimate that solar radiation over Chiang Rai Province in May 2019 was higher than normal value and data in May 2018.



Surface Temperature

Current Condition



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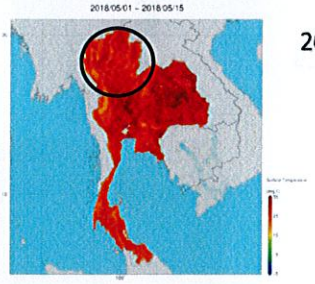
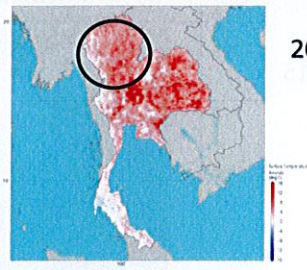
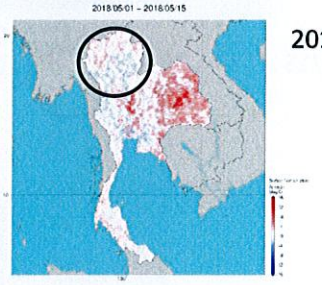


2018/5/15

Anomaly



2019/5/15

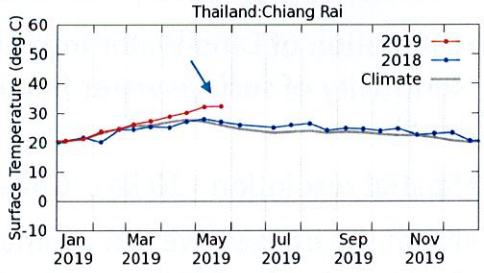


2018/5/15

Hot Temperature

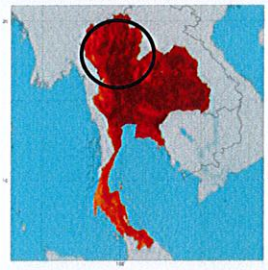
Cold Temperature

- Satellite data (product): MODIS (MOD11C1/MYD11C1).
- Estimation of Land-Surface Temperature/Emissivity (LST) by considering surface elevation on cloudmask, cloud contaminated removal, refinement of algorithm, etc.
- Spatial resolution: 5 km. Units: Degrees Celcius.

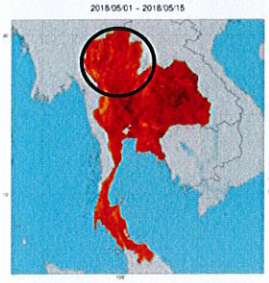


Surface Temperature

Current Condition



2019/5/15



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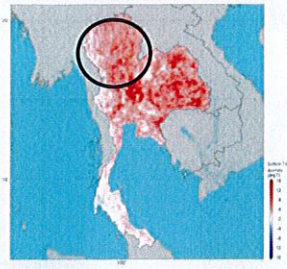
Anomaly



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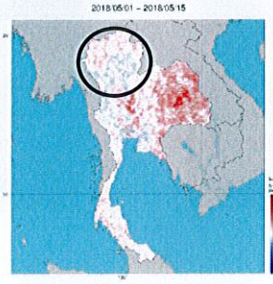
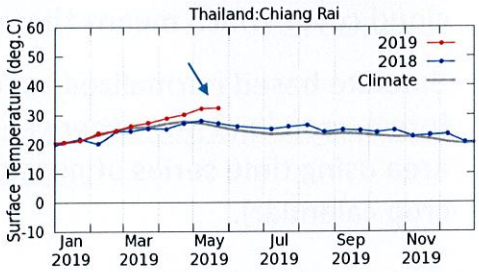


2018/5/15

Hot Temperature

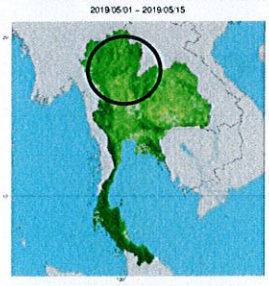
Warm Temperature

- Temperature (T) is one of the most important factors to govern crop growth.
- Too high T decreases soil moisture & dry out vegetation.
- Too low T disturbs vegetation growth.
- From the images, the surface temperature over Chiang Rai Province in May 2019 > May 2018.



Vegetation Index

Current Condition



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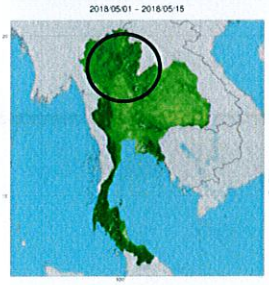
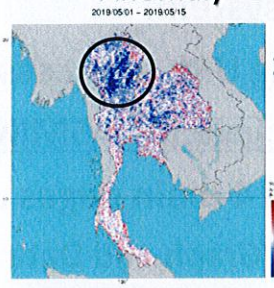
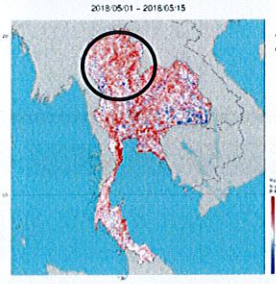


2018/5/15

Anomaly

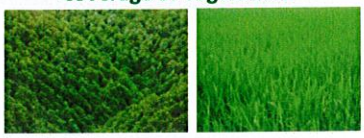


2019/5/15



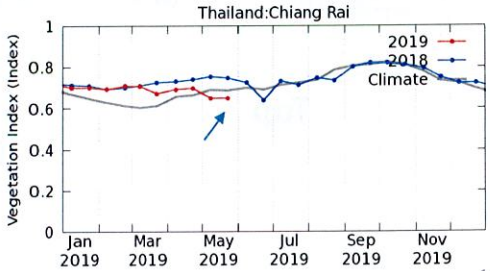
2018/5/15

High Density and Coverage of Vegetation



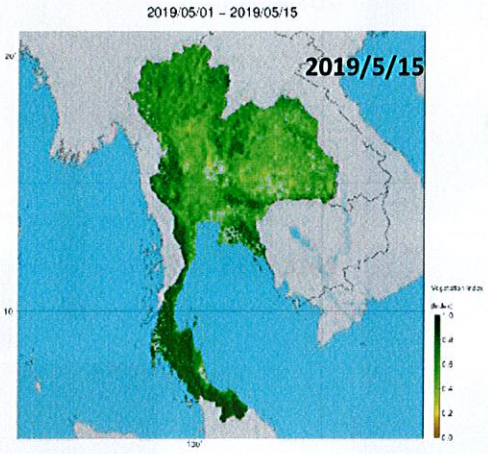
Low Density and Coverage of Vegetation

- Satellite data (product): MODIS (JASMES).
- Vegetation Index is useful to estimate rice growth condition.
- Spatial resolution: 5 km. Data period: 15-days.
- From the images, we can estimate that vegetation index over Chiang Rai Province in May 2018 was higher than normal value and data in May 2019.

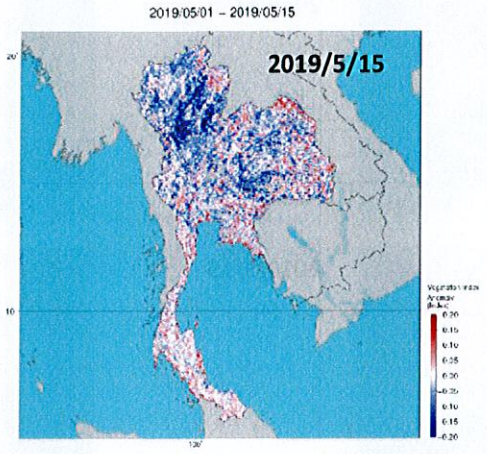


Limitation of the land surface temperature and vegetation index data

Current Condition



Anomaly



- Land surface temperature and vegetation index sometimes have missing data due to cloud cover which means there are no observation during the target period.
- Satellite based normalized vegetation index only identify vegetation activity including forest, crop land and other vegetative area and it is necessary to identify paddy field area using time series of normalized vegetation index with rice crop phenology (rice crop calendar).

How can we use it ?

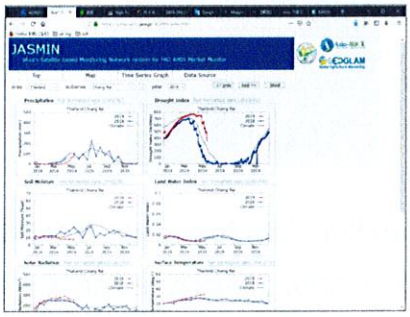
- JASMIN is a web based system.
- Just type in the following URL to access JASMIN from PC.
  - https://suzaku.eorc.jaxa.jp/JASMIN/index.html

The system is consist of 4 main pages .

- Top, Map, Time Series Graph and Data Source.

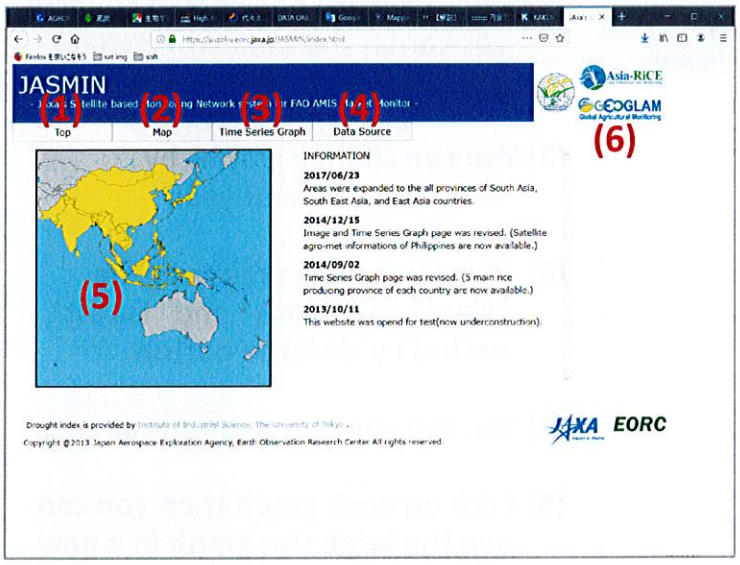
Top

Map
(Example, Area: Thailand, Year: 2019; Month: May; Day: Second Half)



Time Series Graph
(Example, Area: Thailand; Subarea: Chiang Rai, Year: 2019)

Top page



(1) Click the "Top" menu then you can return to the Top page.

(2) Click the "Map" menu then you can jump to the Map page.

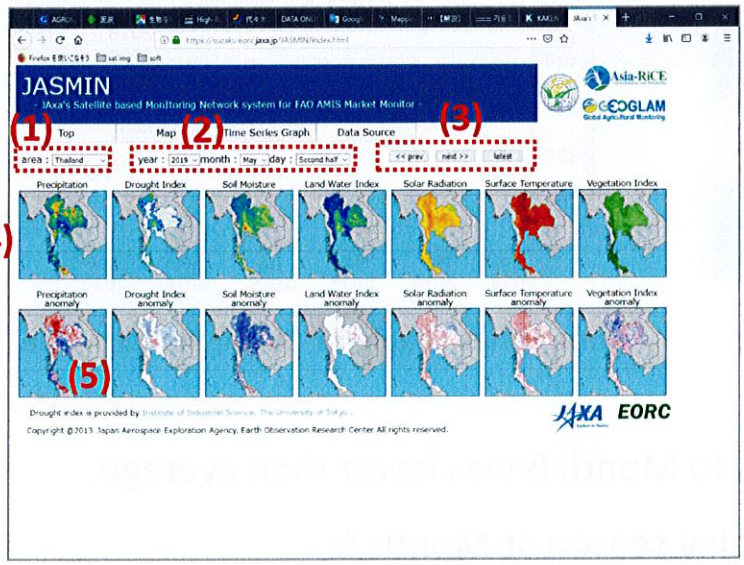
(3) Click the "Time Series Graph" menu then you can jump to the Time Series page.

(4) Click the "Data Source" menu then you can jump to the Data Source page.

(5) Click any country in the map, then you can jump to the Image page of the selected country.

(6) INFORMATION will be updated after any change in the system.

Map page



(1) Select the country.

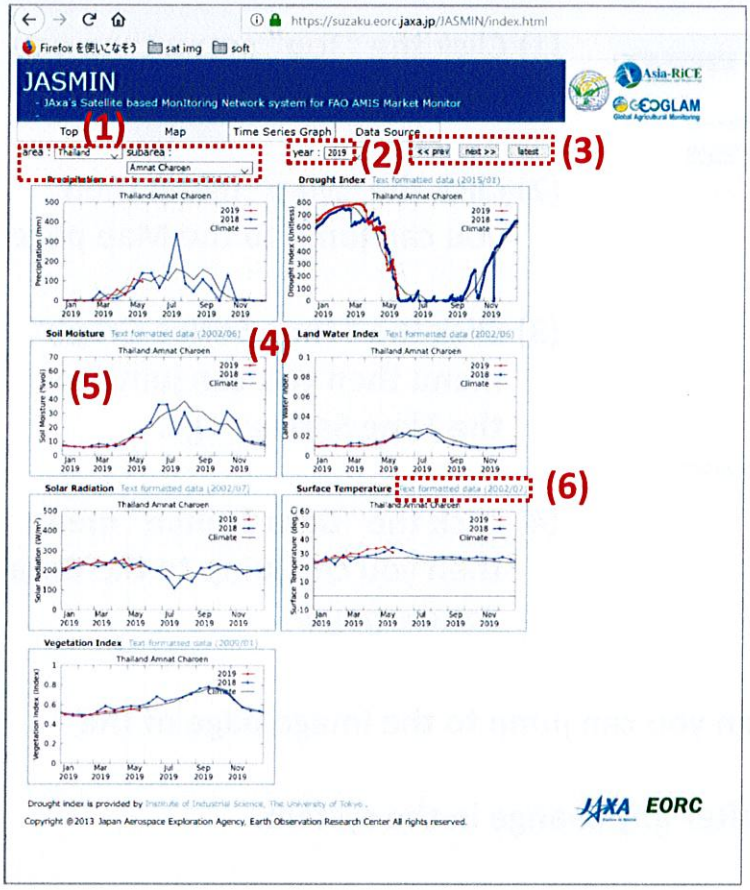
(2) Select the period (Two periods in every month: First half / Second half).

(3) You can also see maps of the "Next", "Previous" and "Latest" period by click the button.

(4) Upper maps are "Current Condition" and lower maps are "Anomaly" of each data.

(5) Click each map (thumbnail) then you can see the large size map in a new tab or window of the web browser.

Time Series Graph page



(1) Subarea icons of selected country appear on the map when check box is on.

(2) You can change graphs by selecting area and year.

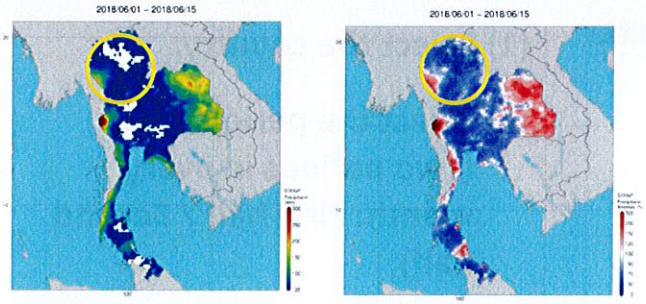
(3) You can switch graphs to the "Next", "Previous" and "Latest" period by click the button.

(4) You can see seven graphs at once.

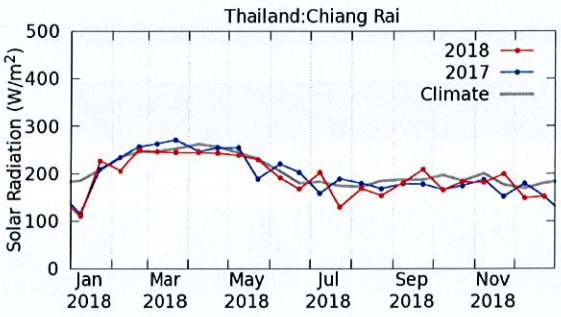
(5) Click on each graph then you can see the large size graph in a new tab or window of the web browser.

(6) Click "Text formatted data" then you can get the CSV of the data.

Example



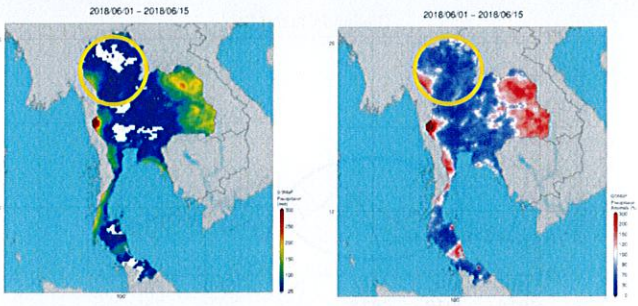
Precipitation and Anomaly image of 1st half of June, 2018.



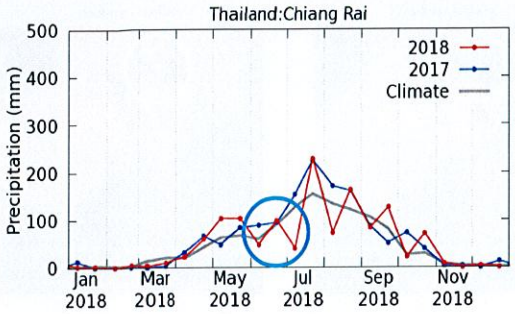
Time Series Graph for Chiang Rai province.

- Precipitation between Month A to Month B was lower than average.
- Soil moisture was low during rainy season at Month A.
- LST (Land Surface Temp) was lower than average in summer, but higher in winter.
- Vegetation index reached peak in Month C about average value.
- Solar radiation was almost the same as average value.

Example: Precipitation Data Analysis



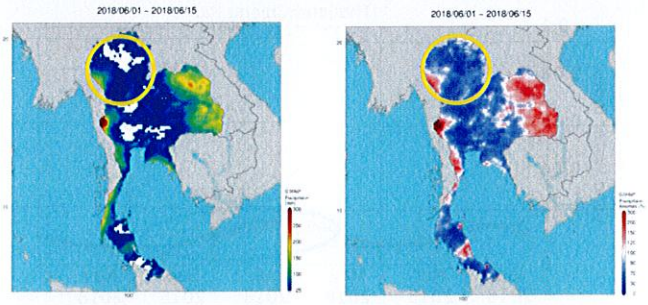
Precipitation and Anomaly image of 1st half of June, 2018.



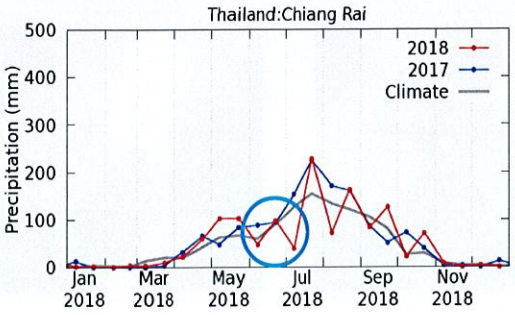
Precipitation Graph for Chiang Rai Province, Thailand, 2017 -2018

- Distribution maps of Land Surface Water Trend from microwave sensor on satellite (e.g. GCOM-W1-AMSR2) and its ratio to normal year.
- Indicate a trend of area ratio of land water surface (e.g. flooding area, lake, paddy field) .
- Red = possible area of water surface in compare with no water surface in ordinary year

Example: Precipitation Data Analysis



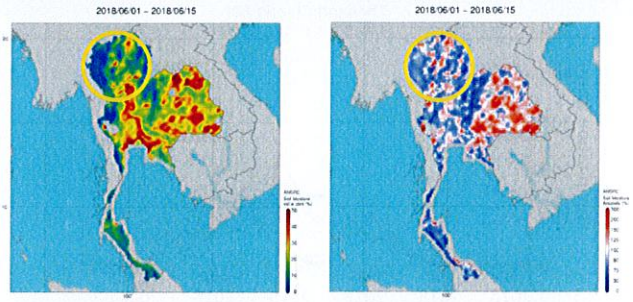
Precipitation and Anomaly image of 1st half of June, 2018.



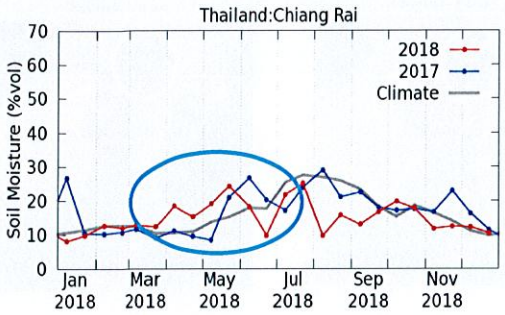
Precipitation Graph for Chiang Rai Province, Thailand, 2017 -2018

- Precipitation and Anomaly image of 1st half of June 2018 show low precipitation data (blue) in the north, central and south areas and higher precipitation (yellow to red) in the west and east of Thailand.
- In detail, precipitation graph of Chiang Rai Province in 2017 shows higher precipitation than average between June to August (SW Monsoon/Rain Season).
- In 2018, precipitation data between June to July, in August and October were lower than average.
- In general, precipitation data in 2017 is slightly larger than in 2018.

Example : Soil Moisture Data Analysis



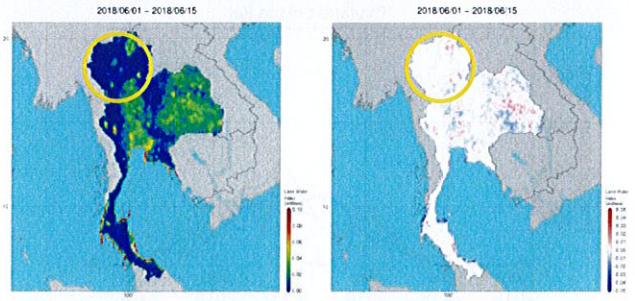
Soil Moisture and Anomaly image of 1st half of June, 2018.



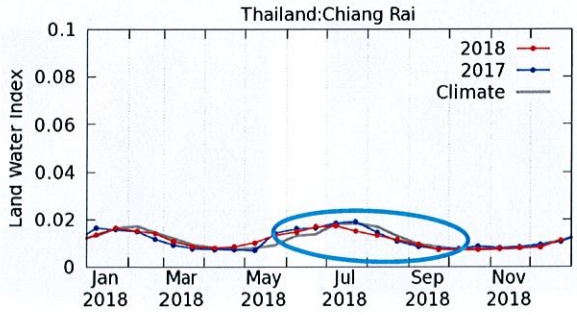
Soil Moisture Graph for Chiang Rai Province, Thailand, 2017 -2018

- Soil Moisture and Anomaly image of 1st half of June 2018 show low precipitation data (blue) in the northwest and west areas and higher precipitation (yellow to red) in the south areas of Thailand.
- Soil Moisture graph of Chiang Rai Province in 2017 shows lower soil moisture data than average in between February to May (Pre Monsoon/Hot Season).
- In the same period of 2018, the values were higher than average but drastically lower in June.
- In general, soil moisture data during rain season of 2018 is lower than average.

Example : Land Water Index



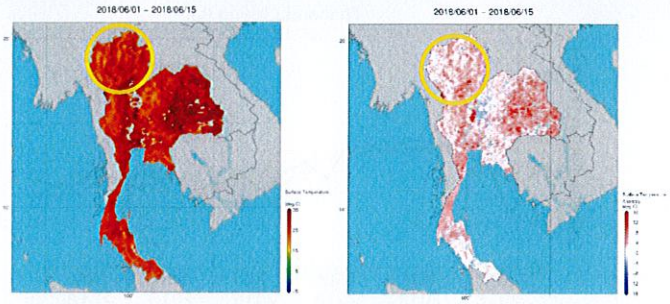
Land Water Index and Anomaly image of 1st half of June, 2018.



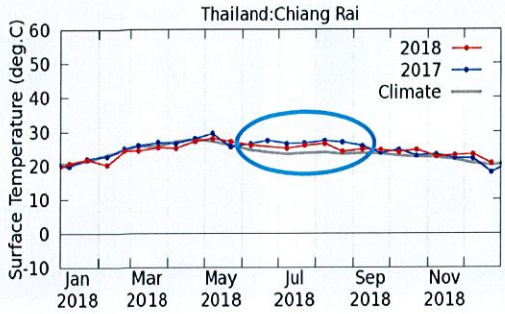
Land Water Index Graph for Chiang Rai Province, Thailand, 2017 -2018

- Land Water Index (LWI) and Anomaly image of 1st half of June 2018 show low surface water content (blue) in the northwest into the south and the central areas and higher value (yellow-red) in the east and along the coastline areas.
- LWI graph of Chiang Rai Province during rain season in 2018 shows low surface water content than average in July and in between August to September, which possibly remarks dry event.
- In the same period of 2017, the values were slightly higher than in 2018 but still under average value (in August – September).

Surface Temperature Data Analysis



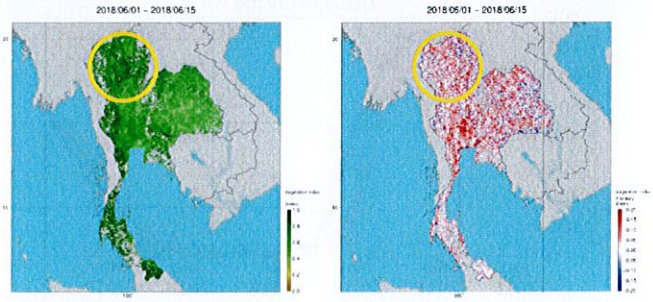
Surface Temperature and Anomaly image of 1st half of June, 2018.



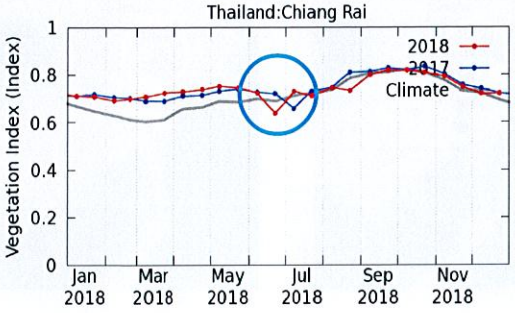
Surface Temperature Graph for Chiang Rai Province, Thailand, 2017 -2018

- Surface Temperature and Anomaly image of 1st half of June 2018 show mostly high temperature data (red) in the whole area of Thailand.
- Surface Temperature graph of Chiang Rai Province in 2017 shows higher temperature data than average in June to August (SW Monsoon/Rain Season).
- In the same period of 2018, the value were lower than in 2017.
- In general, surface temperature data in 2017 is higher than average.

Example : Vegetation Index Analysis



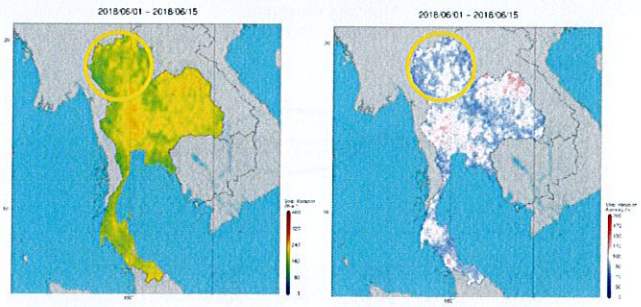
Vegetation Index and Anomaly image of 1st half of June, 2018.



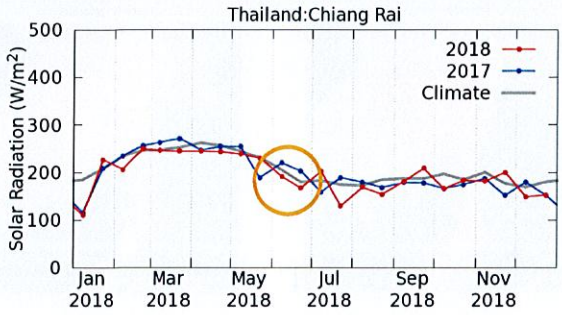
Vegetation Index Graph for Chiang Rai Province, Thailand, 2017 -2018

- Vegetation Index and Anomaly image of 1st half of June 2018 show medium to high value (light green to dark green) in the north and mostly medium value in the central areas of Thailand.
- In June 2018 (SW Monsoon/Rain Season), vegetation index in Chiang Rai Province shows lower value than average.
- In the same period of 2017, the values were higher than average.
- In general, vegetation index data during rain season of 2018 is lower than average.

Example : Solar Radiation Data Analysis



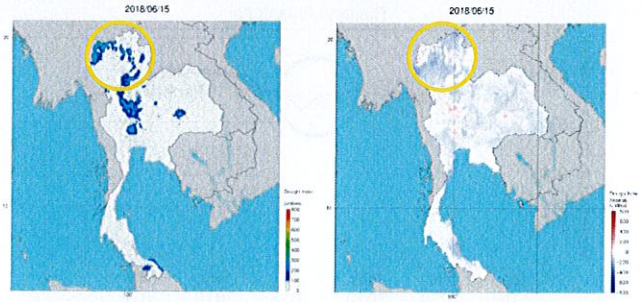
Solar Radiation and Anomaly image of 1st half of June, 2018.



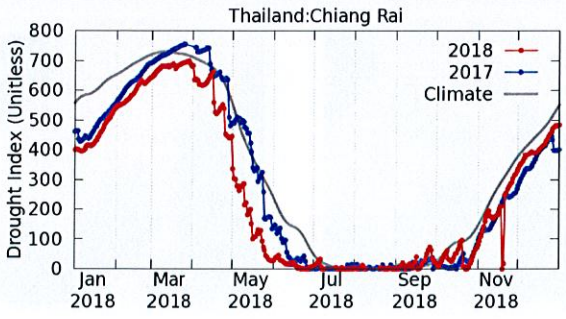
Solar Radiation Graph for Chiang Rai Province, Thailand, 2017 -2018

- Solar Radiation and Anomaly image of 1st half of June 2018 show medium value (yellow to orange) in the north and the central areas of Thailand.
- In June 2018 (SW Monsoon/Rain Season), Solar Radiation data in Chiang Rai Province shows lower value than average.
- In the same period of 2017, the values were higher than average.
- In general, Solar Radiation index data during rain season in 2018 is lower than average.

Example : Drought Index Analysis



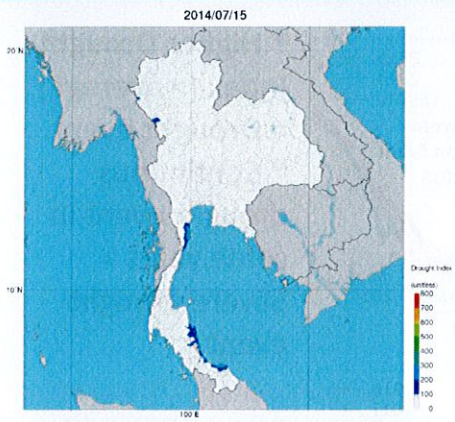
Drought Index and Anomaly image of 1st half of June, 2018.

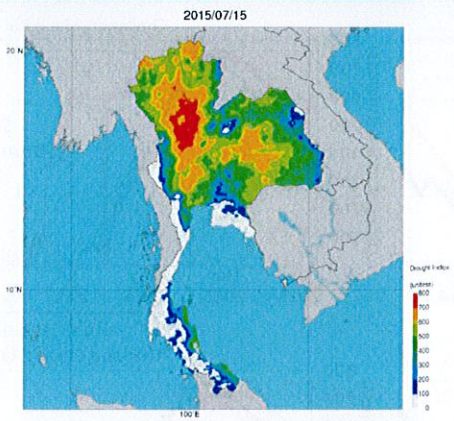


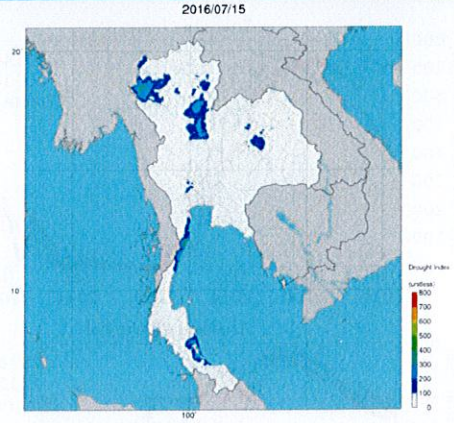
Drought Index Graph for Chiang Rai Province, Thailand, 2017 -2018

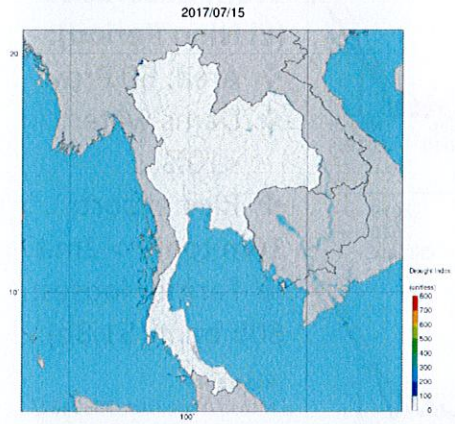
- Drought Index image of 1st half of June 2018 show medium value (blue) in the north and in the central areas of Thailand.
- These areas have medium value (light red) on Anomaly image.
- In Chiang Rai Province, drought index in July-September (Rain Season) 2018 is slightly higher than average and in 2017, which possibly remark dry event.

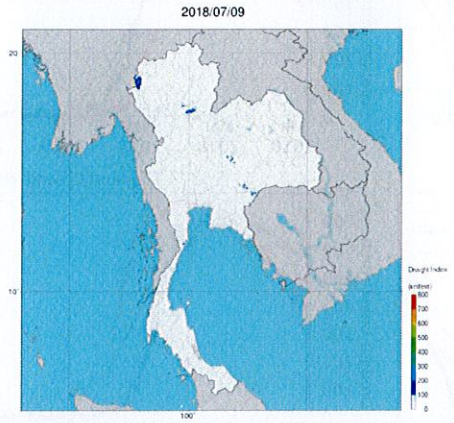
Drought Index Analysis in Thailand (2014-2018)





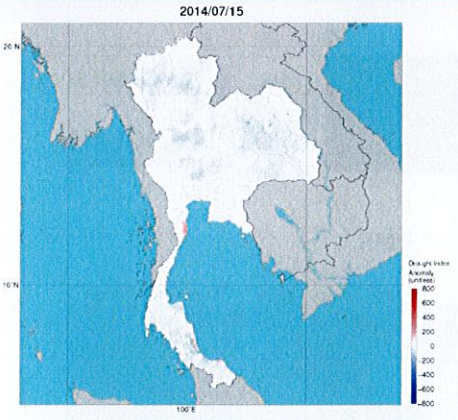


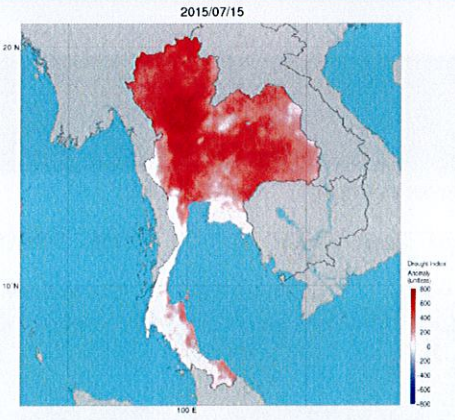


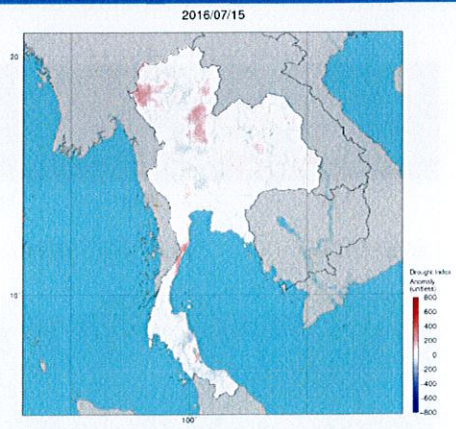


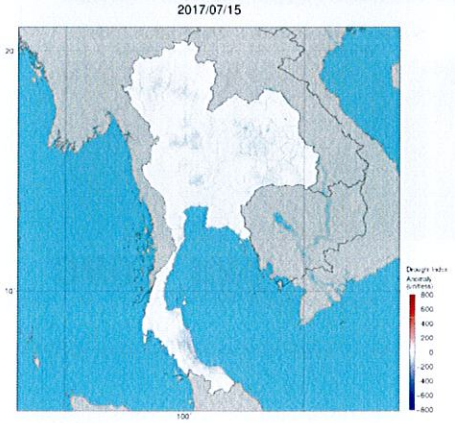
- July is in rain season but has high Drought Index value.
- Highest Drought Index value in 2015.
- High Drought Index value in 2016.
- Area: North, Central and West of Southern of Thailand.

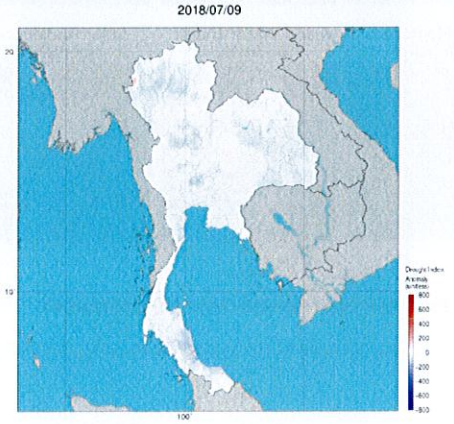
Drought Index Anomaly Analysis (2014-2018)





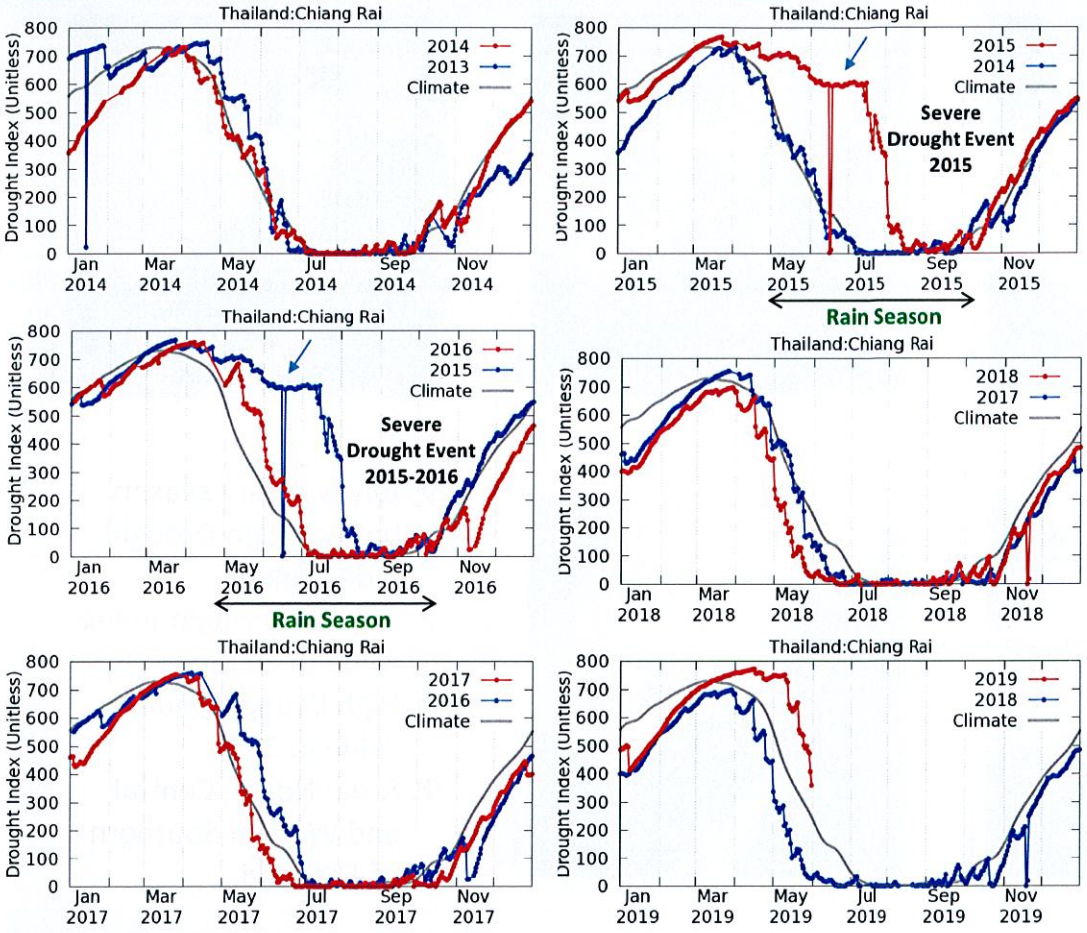






- July is in rain season but has high Drought Index Anomaly.
- Highest Drought Index Anomaly in 2015.
- High Drought Index Anomaly in 2016.
- Area: North, Central and West of Southern of Thailand.

Drought Index Analysis in Thailand (2014-2019)



*** Higher Drought Index (> average) = Drought event.**

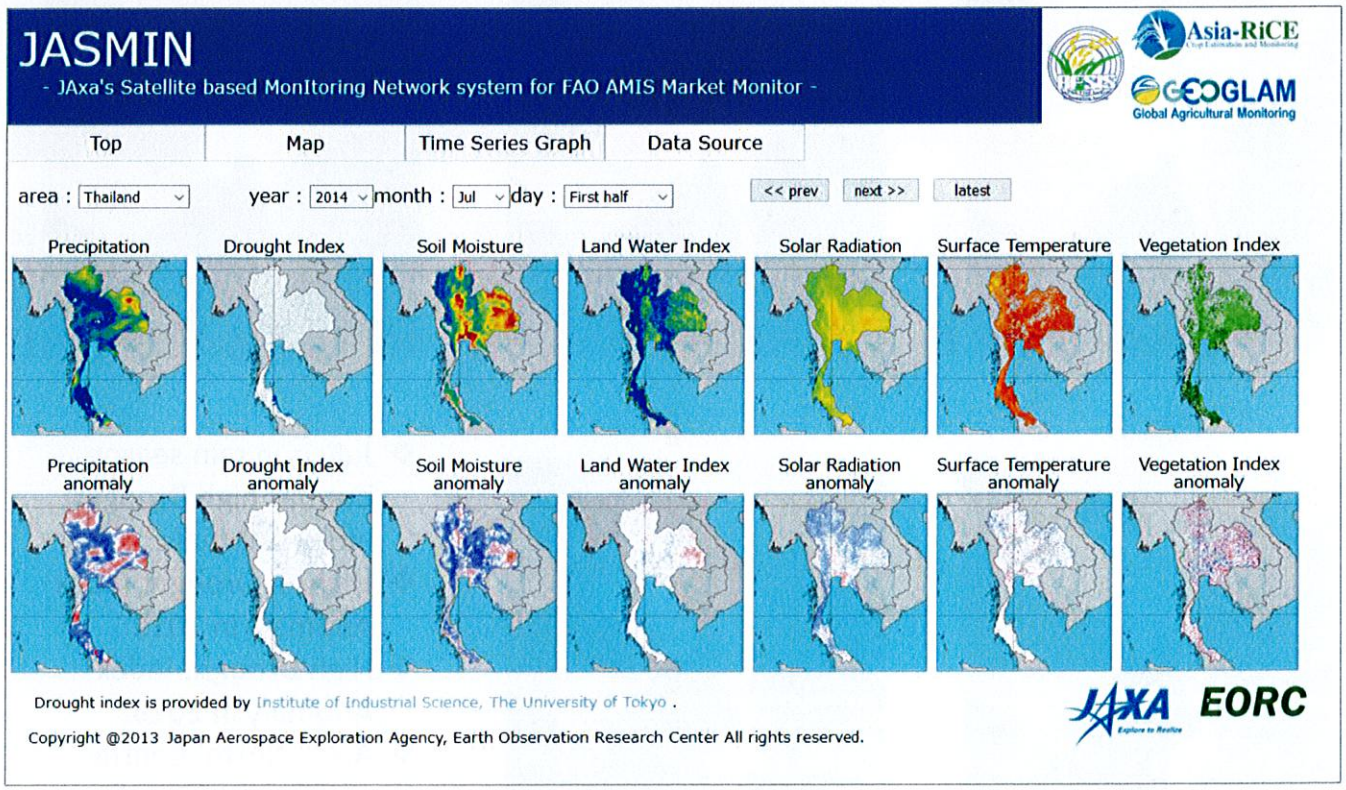
*** Continuous drought event in some years = Severe drought event!**

Severe Drought Event 2015-2016 (El Nino Period):

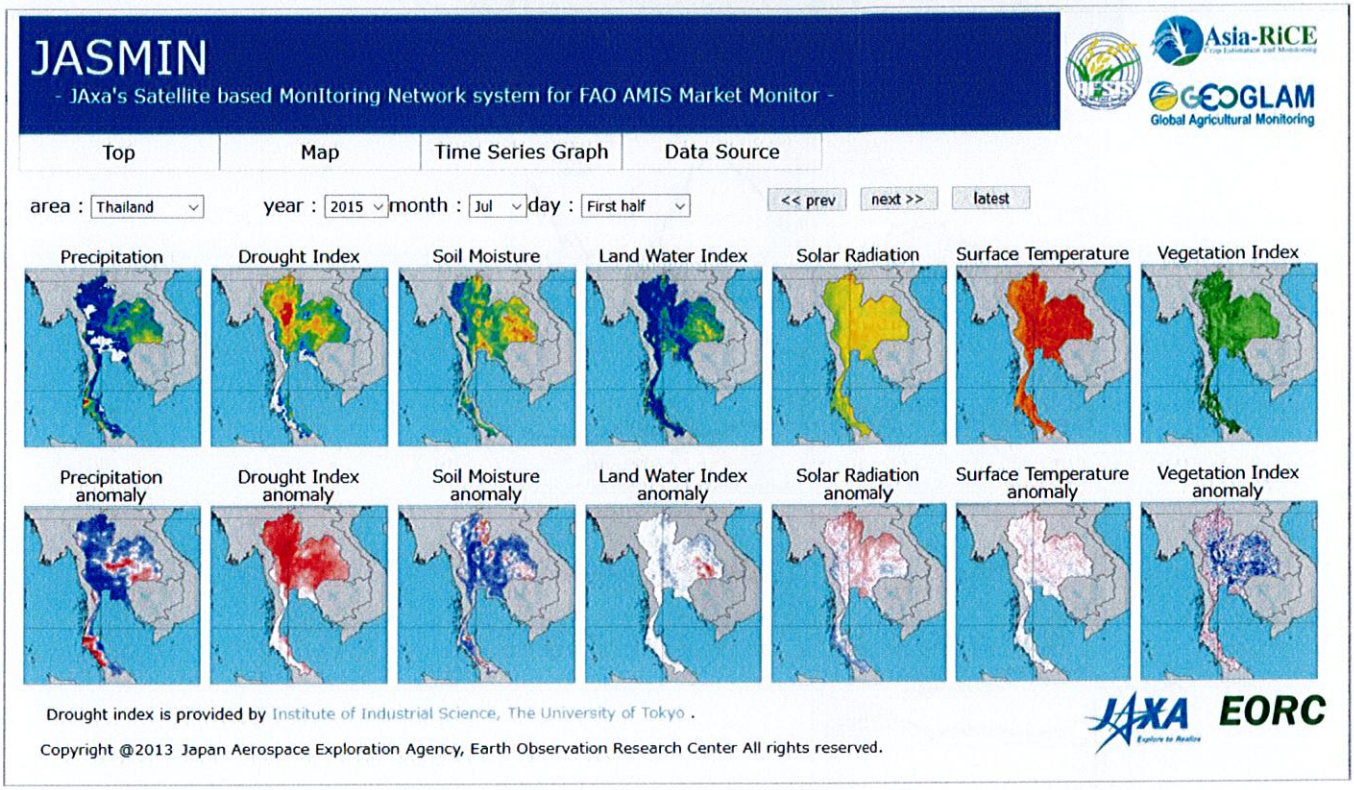
- Area: 60 Prov.
- Dams water <10%.
- Rice export: 10m ton/y > 2m.t
- Farmer looses: 60b baht ($1.8b).

Reference:
https://time.com/3960462/thailand-drought/

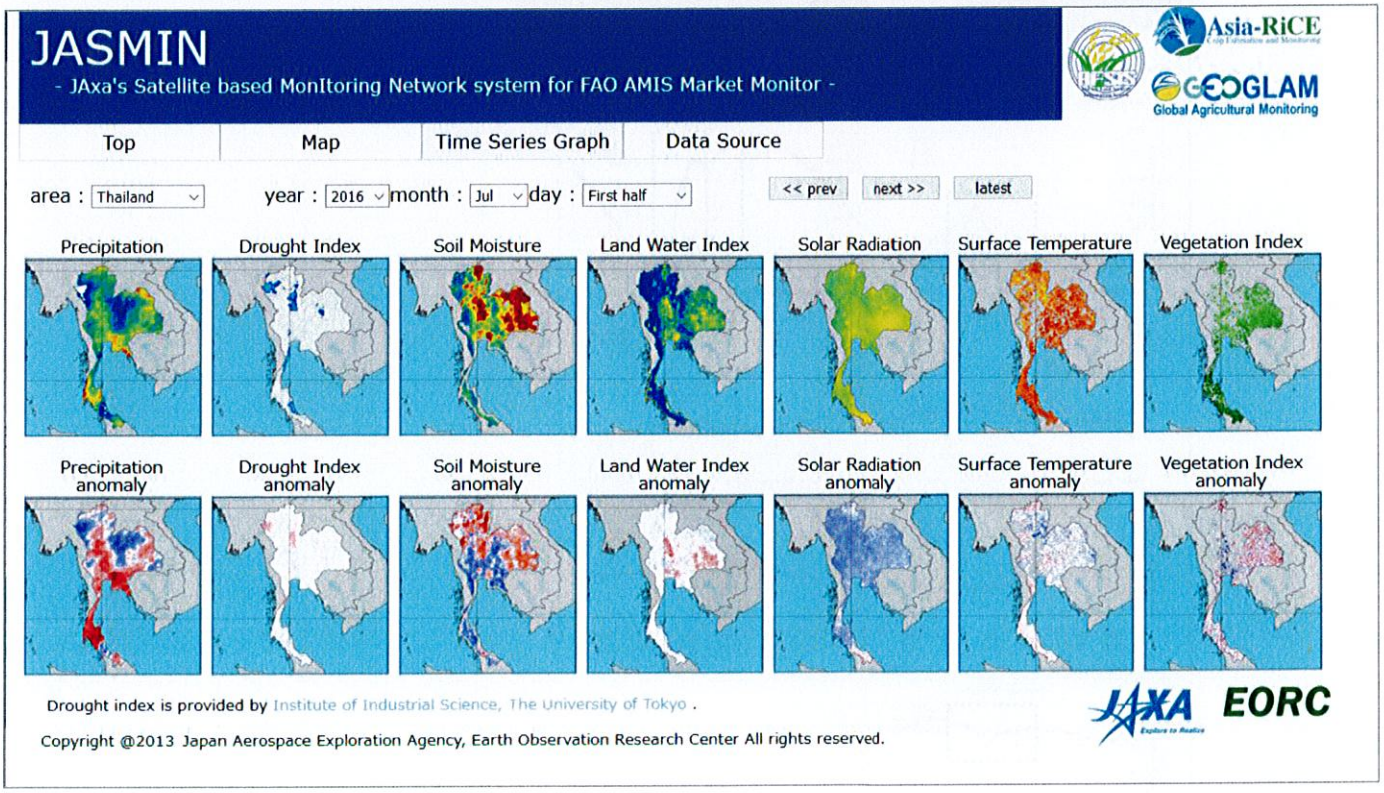
Drought Analysis in Thailand (2014)



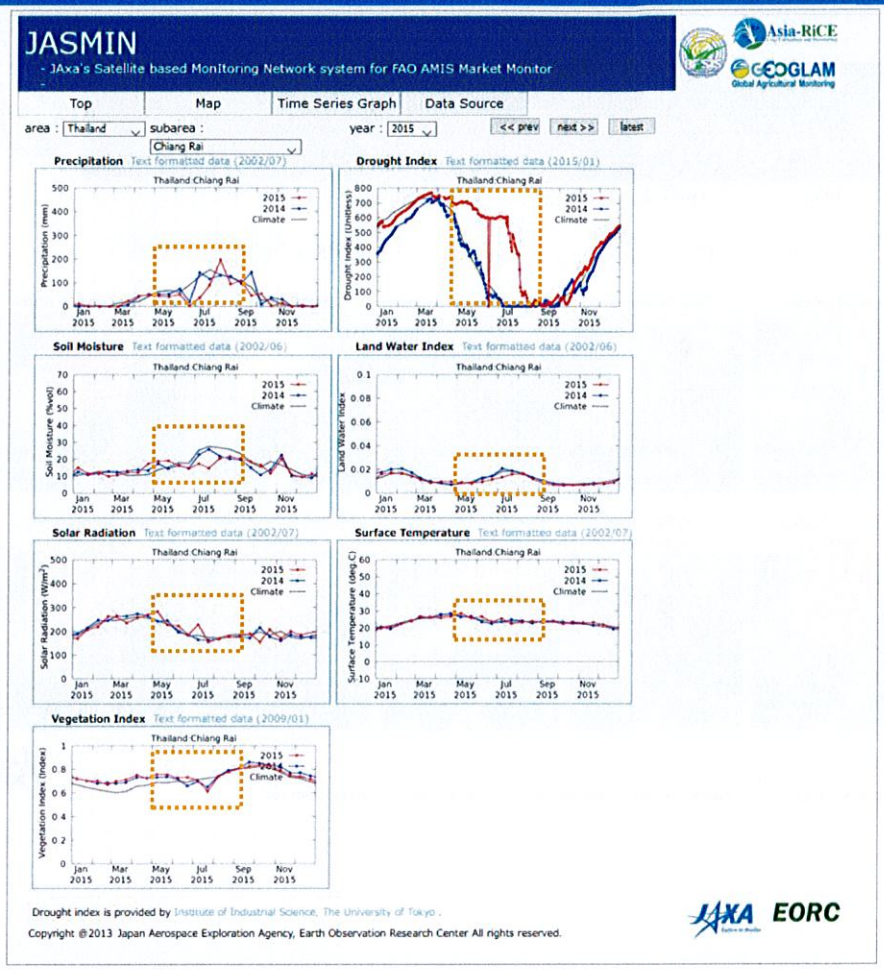
Drought Analysis in Thailand (2015)



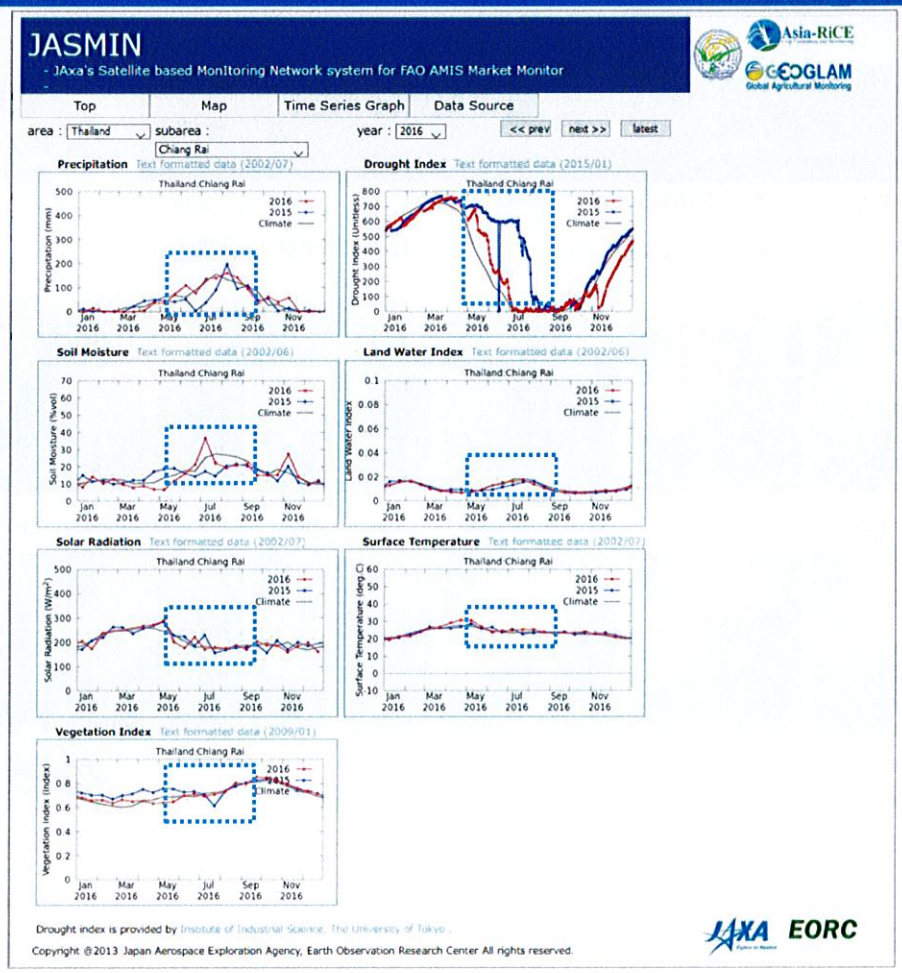
Drought Analysis in Thailand (2016)



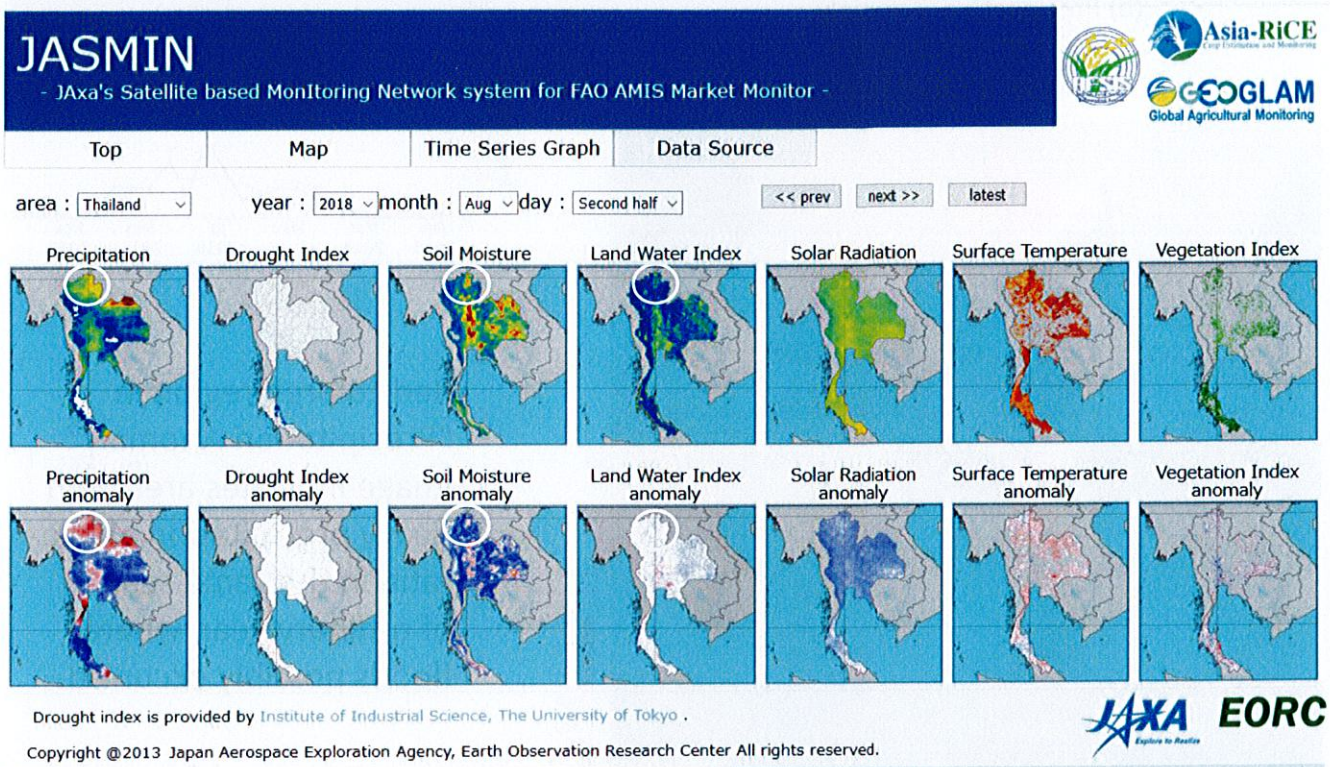
Drought Analysis in Thailand (2014-2015)



Drought Analysis in Thailand (2015-2016)



Heavy Precipitation and Flood Analysis in Thailand (2018)



Tropical Storm Bebinca (2018/8/17): Floods & landslides that affected 130,000 ppl in SE Asia.

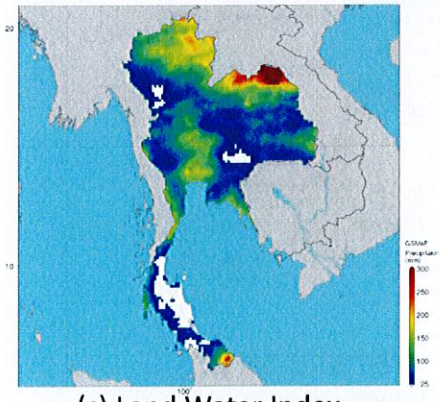
Floods in Thailand (2018/8/18): Nan Province, 1000 homes, 44,000 ppl.

http://floodlist.com/asia/thailand-vietnam-laos-storm-bebinca-august-2018

Heavy Precipitation and Flood Analysis in Nan Province Thailand (2018)

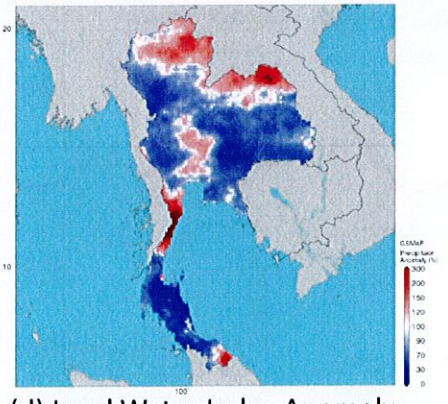
(a) Precipitation

2018/08/16 – 2018/08/31



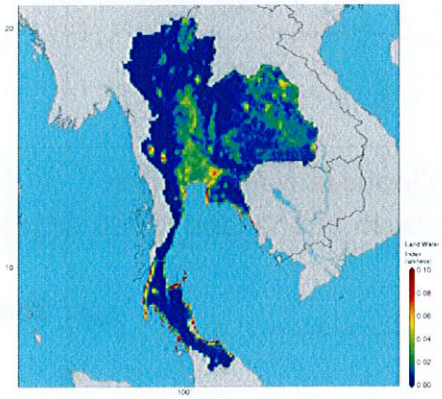
(b) Precipitation Anomaly (Ratio to normal year)

2018/08/16 – 2018/08/31



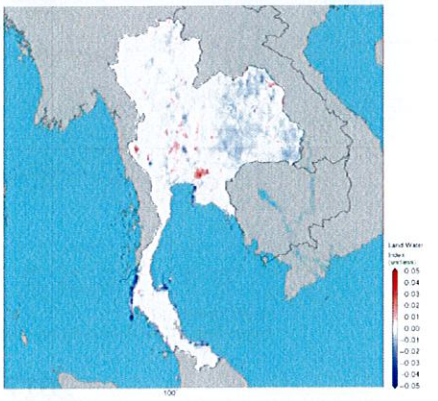
(c) Land Water Index

2018/08/16 – 2018/08/31



(d) Land Water Index Anomaly

2018/08/16 – 2018/08/31



Tropical Storm Bebinca (2018/8/17):

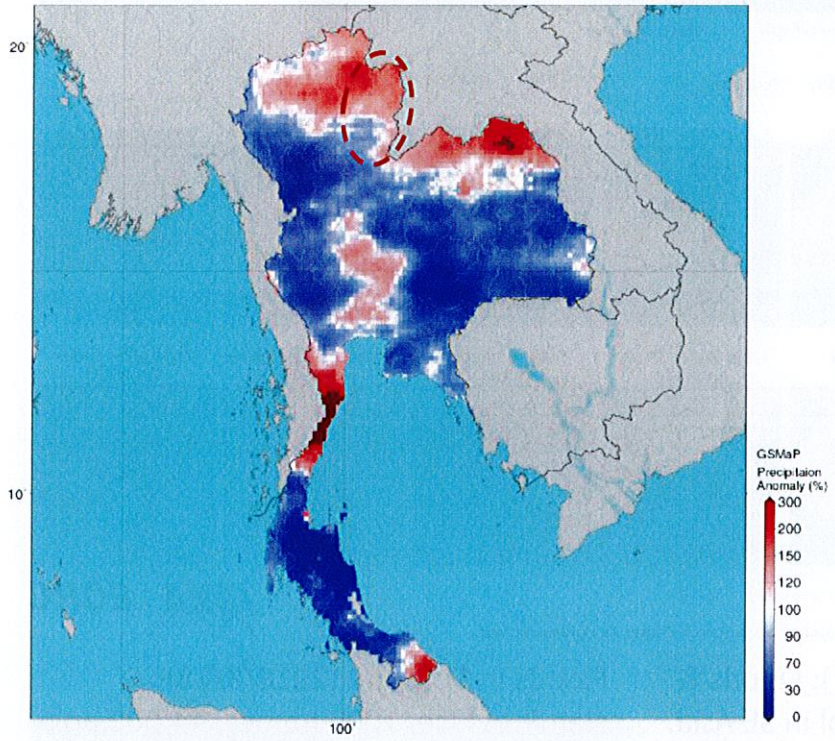
Floods were reported in Nan Province on 18 August 2018, after heavy rain caused the Nan River and its tributaries burst their banks. More than 1,000 homes were flooded in the seven districts of Chiang Klang, Pua, Tha Wang Pha, Mae Charim, Santisuk, Phu Phiang, and Muang. Around 44,000 people were affected. The water levels at the Nan River kept stood at 8.30 metres at Kadlaeng as of 18 August.

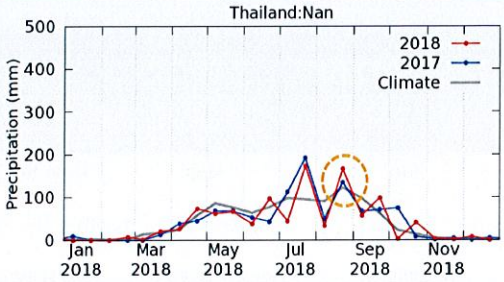
http://floodlist.com/asia/thailand-vietnam-laos-storm-bebinca-august-2018

Heavy Precipitation and Flood Analysis in Nan Province Thailand (2018)

(b) Precipitation Anomaly
(Ratio to normal year)

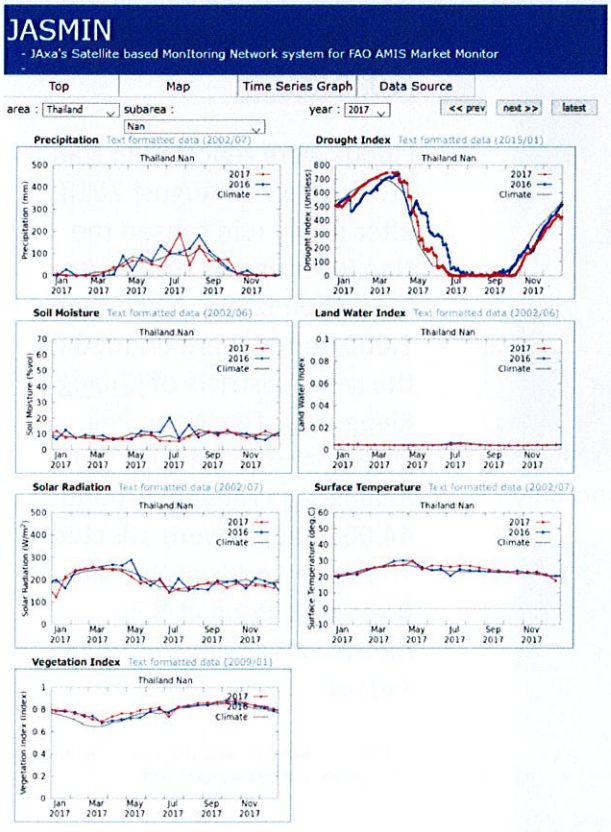
2018/08/16 – 2018/08/31

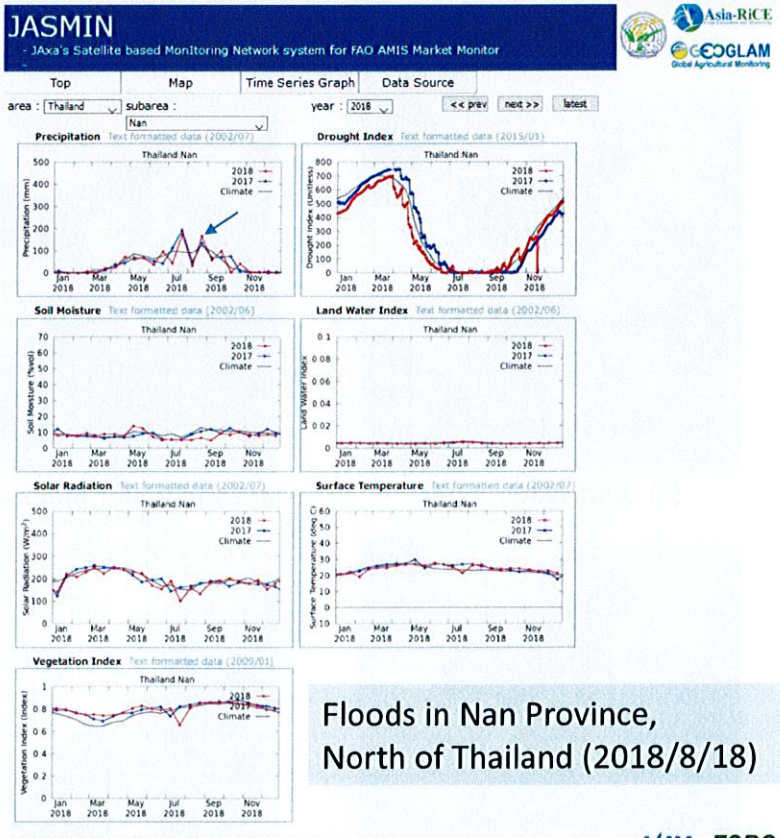




Red colored region in "Precipitation Anomaly" image indicates area with heavy precipitation above ratio in the same season of ordinary year, where floods possibly occurred.

Heavy Precipitation and Flood Analysis in Thailand (2018)





Floods in Nan Province, North of Thailand (2018/8/18)

2016-2017

2017-2018

Thank you for your attention!