Training on Climate Impact and Adaptation for Thailand

TMD Data Portal

Boonlert Archevarahuprok

31 May 2016, Pattaya Marriott Resort and Spa, Thailand

Overlay of Data Types

- Data Types
  - Historical Data
    - Real-time Data
      - Future Data
        - Nowcast
        - Short-Range Forecast
        - Long-Range Forecast
        - Short-term Climate Prediction
        - Climate Scenario

Past

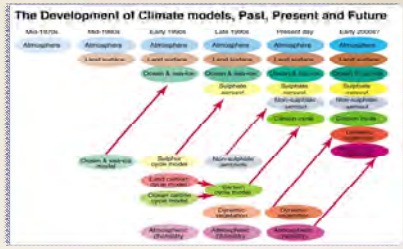
- Conventional
- Automatic
- In-Stu

Current

- Conventional
- AWS
- In-Stu

Future

- Nowcast
- SRF, MRF, LRF, ERF
- Scenario



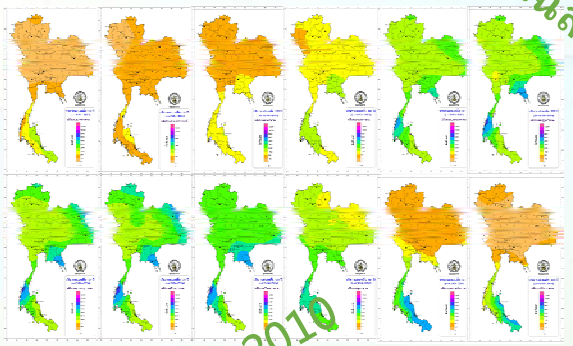
Data Source

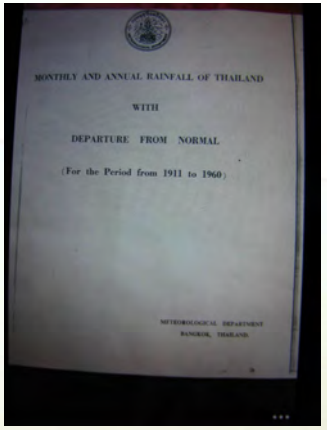
Observation Data: 1) Synoptic data
2) Radar data; 2 km composite
3) Satellite Data; FY2G, HIMAWARI
CMACAST, HIMAWARICAST
4) Automatic Weather Station (AWS)
5) Telemetry

Modeling Data: 1) Short Range; UM, WRF
2) Long Range, Global-WRF, GSM
3) Climate Projection; PRECIS (Providing REgional Climates for Impact Studies)
4) Climate Projection; CSIRO CCAM (Cubic Conformal Amostpheric Model)

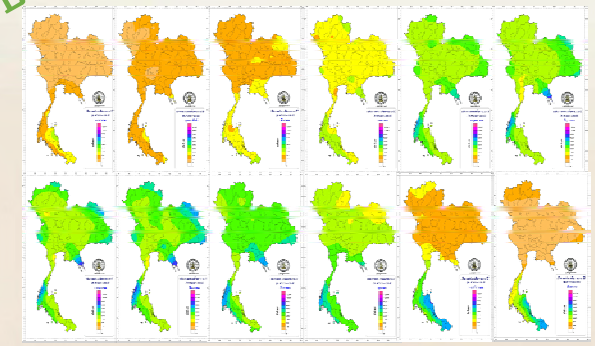
Historical Data (Recorded Data)

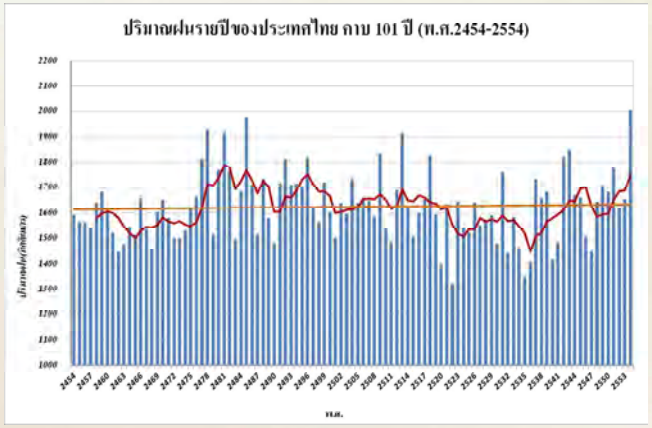
ค่าเฉลี่ย 101 ปี





ฝนค่าปกติ 1981-2010

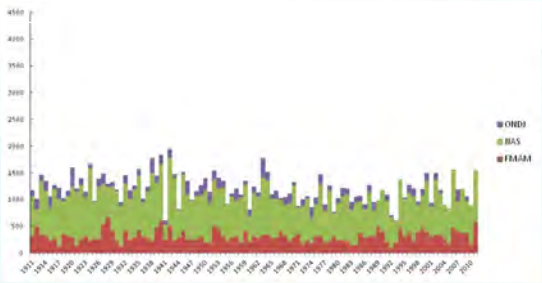




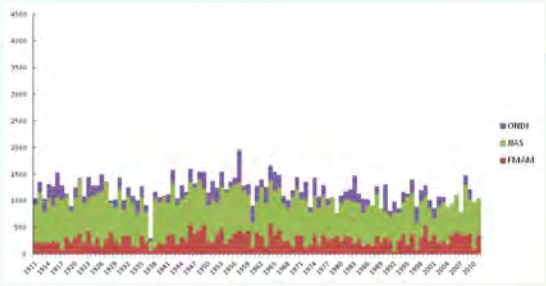
Seasonal variability

The four-month seasonal rainfall
(JJAS) June to September,
(ONDJ) October to January
(FMAM) February to May

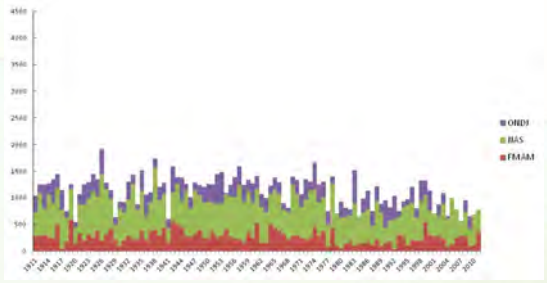
(a) Phetchabun



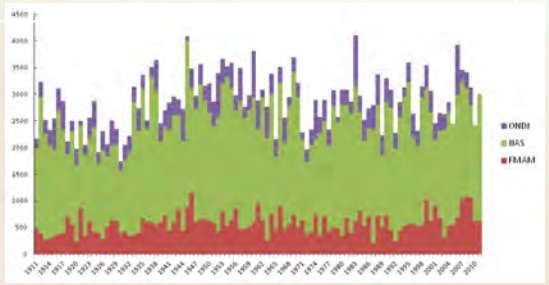
(b) Lop Buri



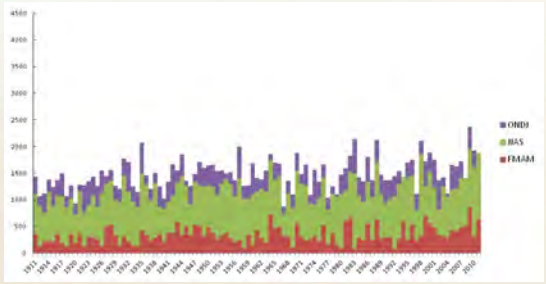
(c) Suphan Buri



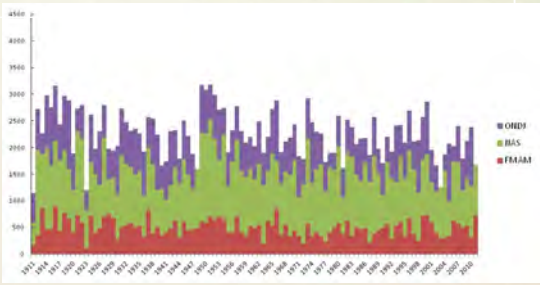
(d) Chantha Buri



(e) Bangkok Metropolitan

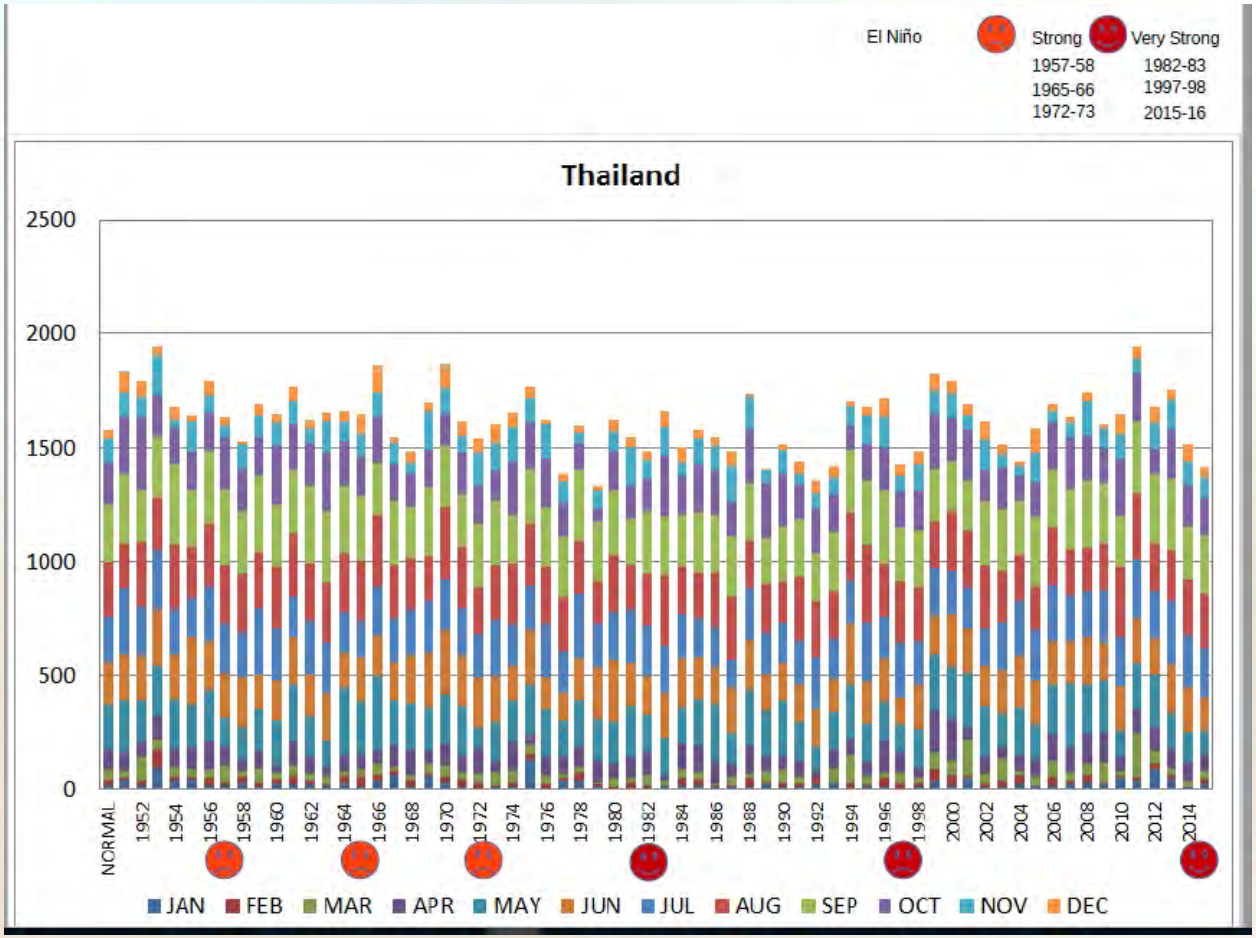


(f) Trang



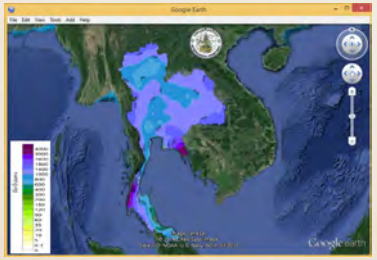
A trend of rainfall pattern is different for each station for a short duration showers in the early season (FMAM) to longer (JJAS) and short in the later season (ONDJ). Maximum rainfall on JJAS period

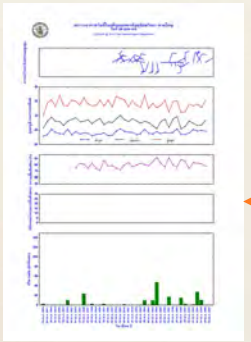
Yearly Rainfall (1951-2015)

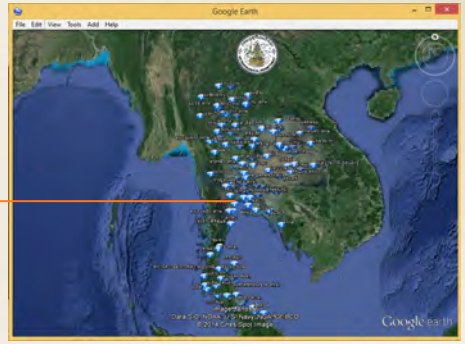


climate.tmd.go.th

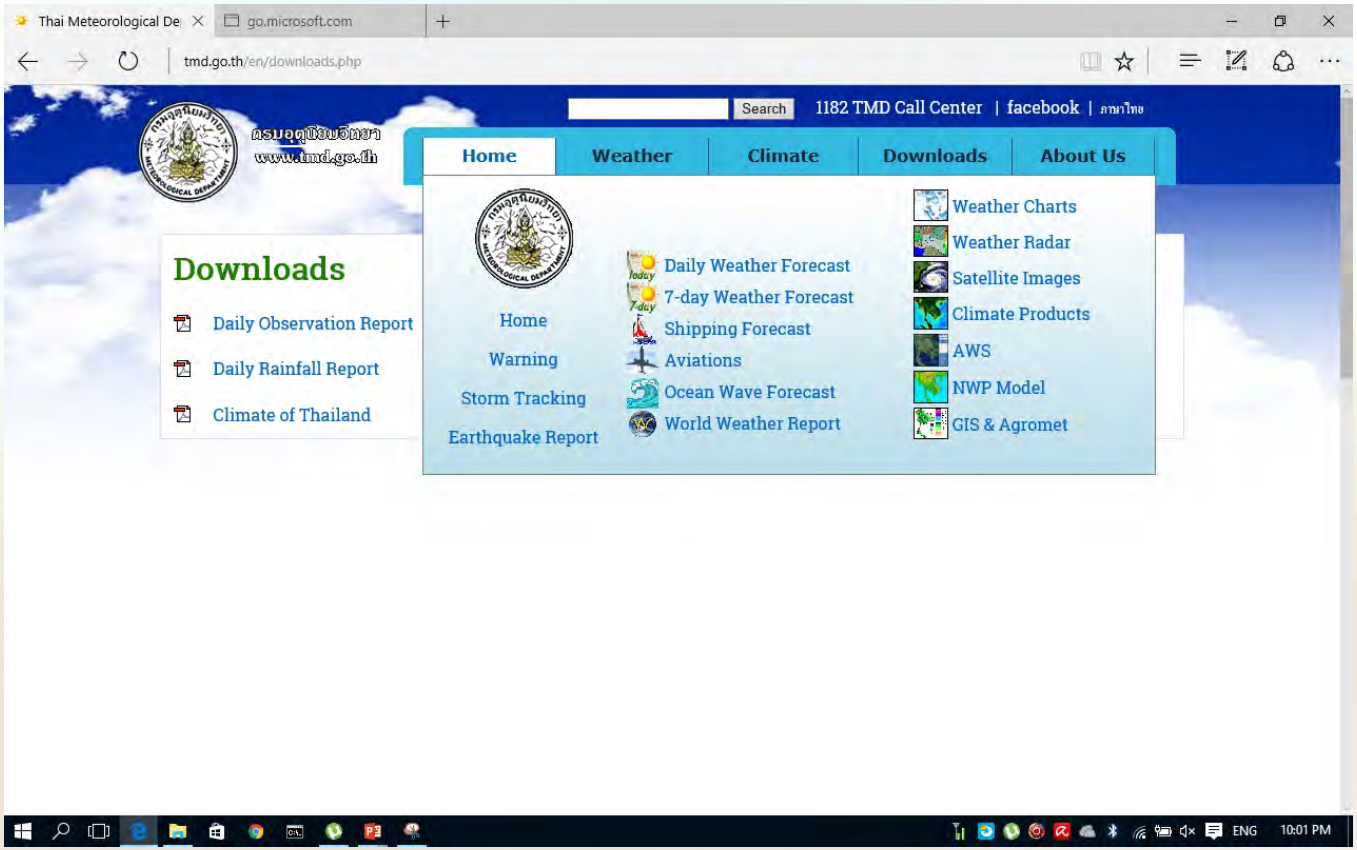
climate.tmd.go.th/gge



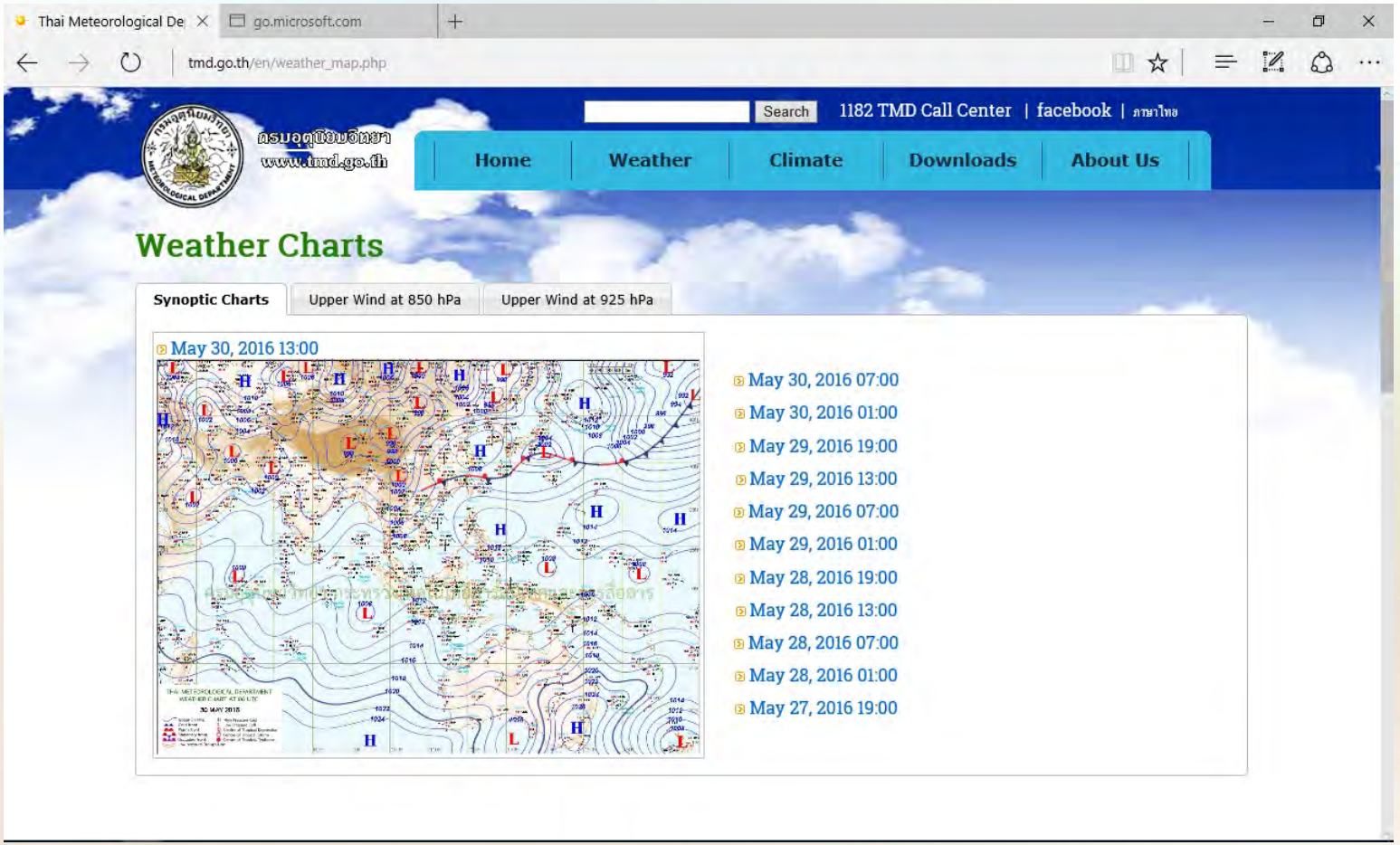




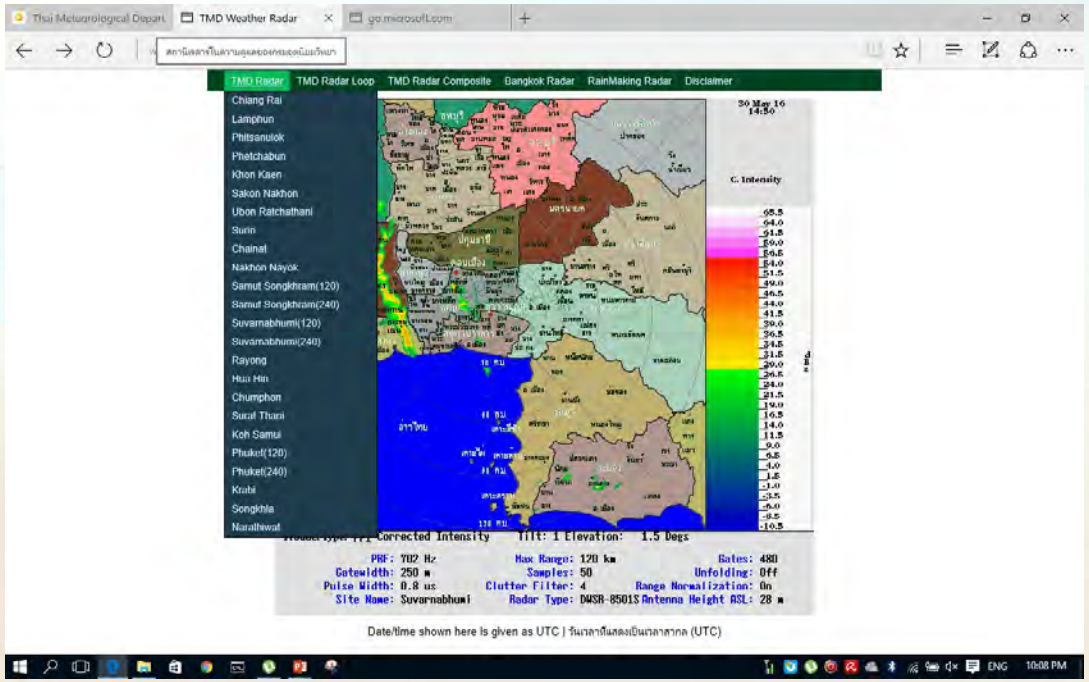
Real-time Data

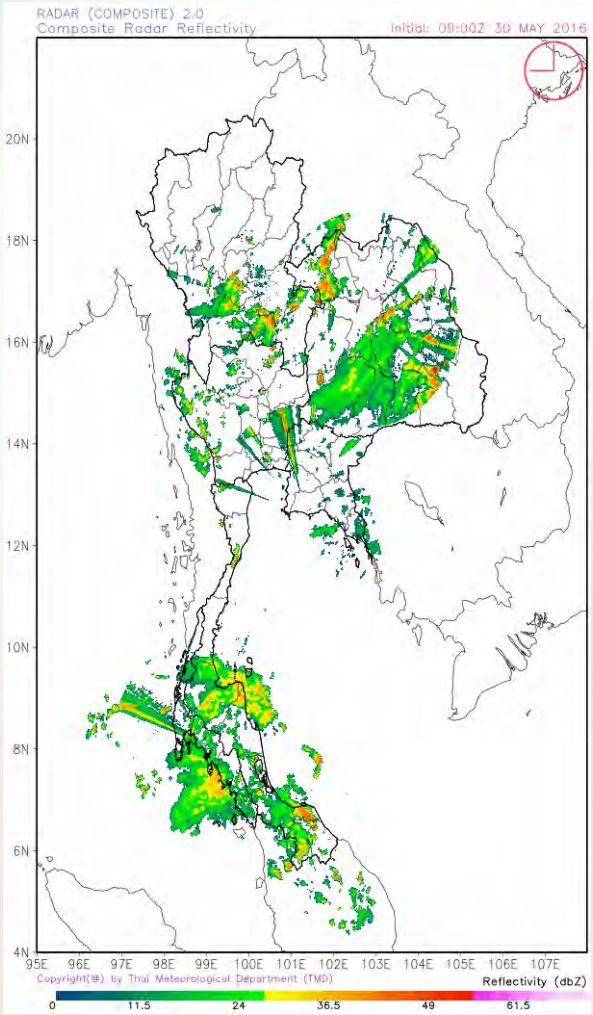


Weather Charts

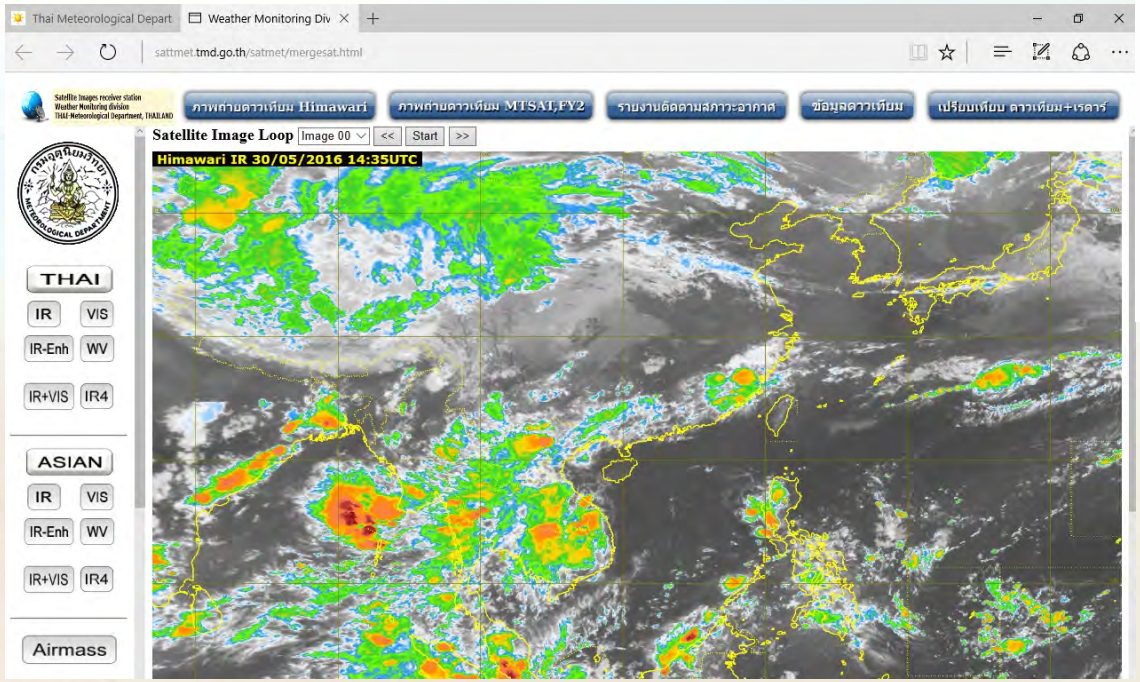


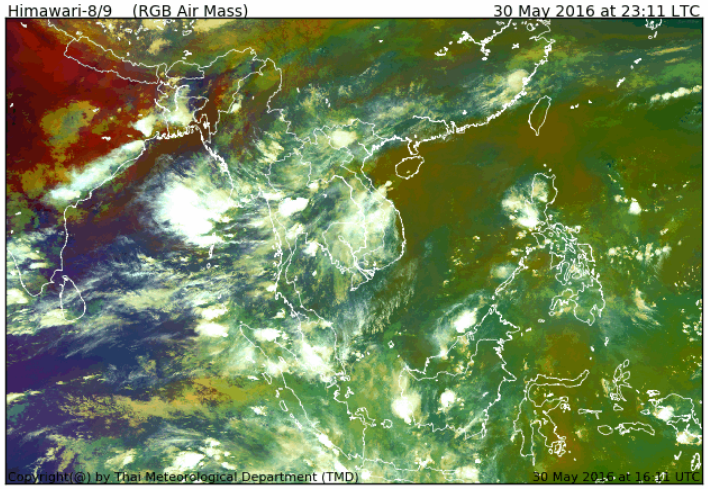
Weather Radar

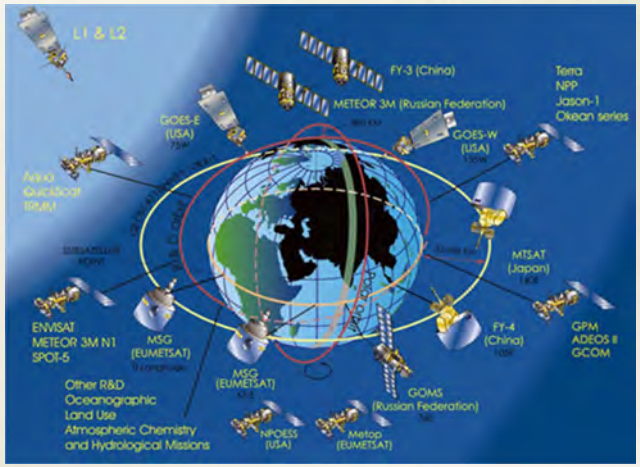




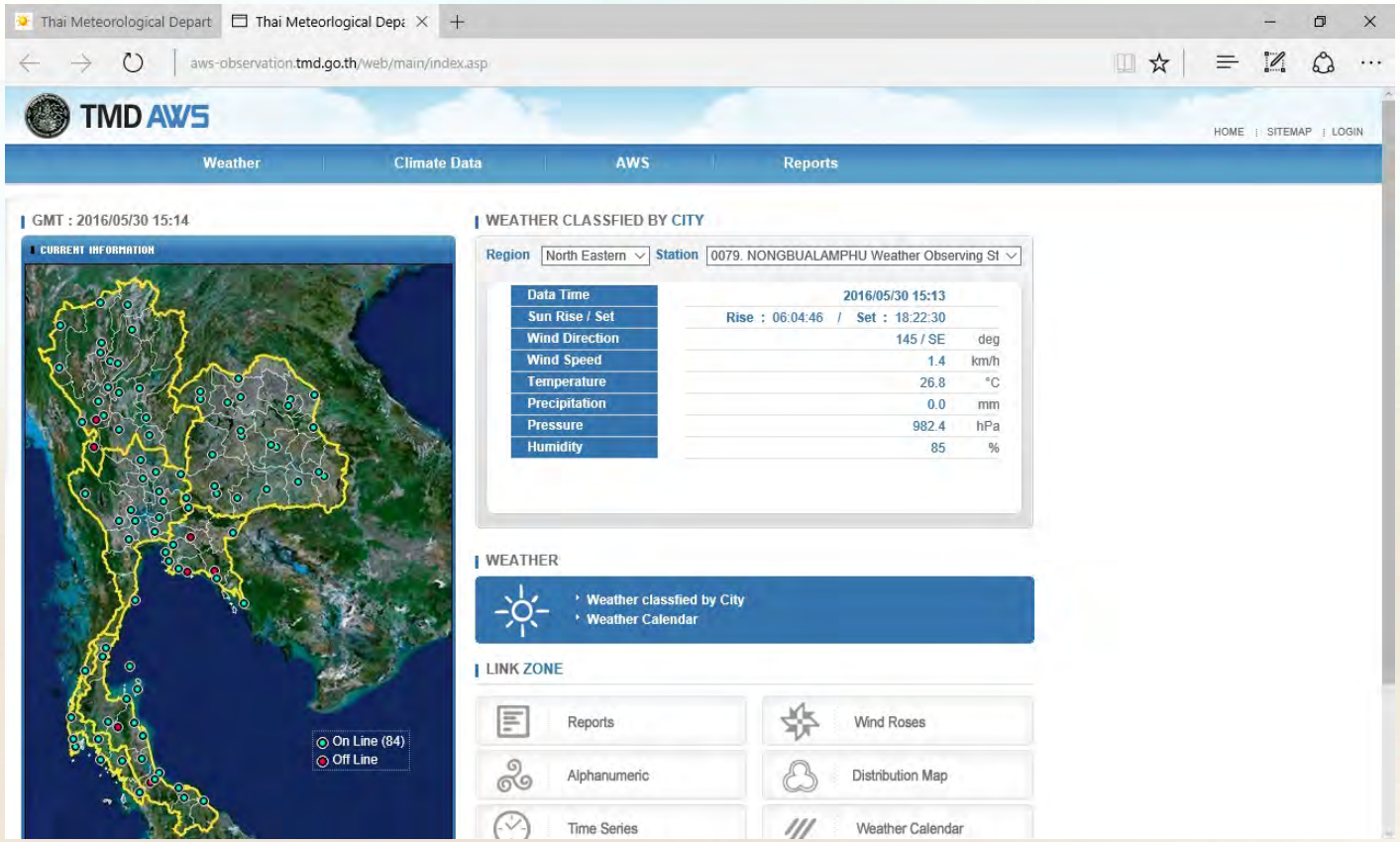
Satellite Images



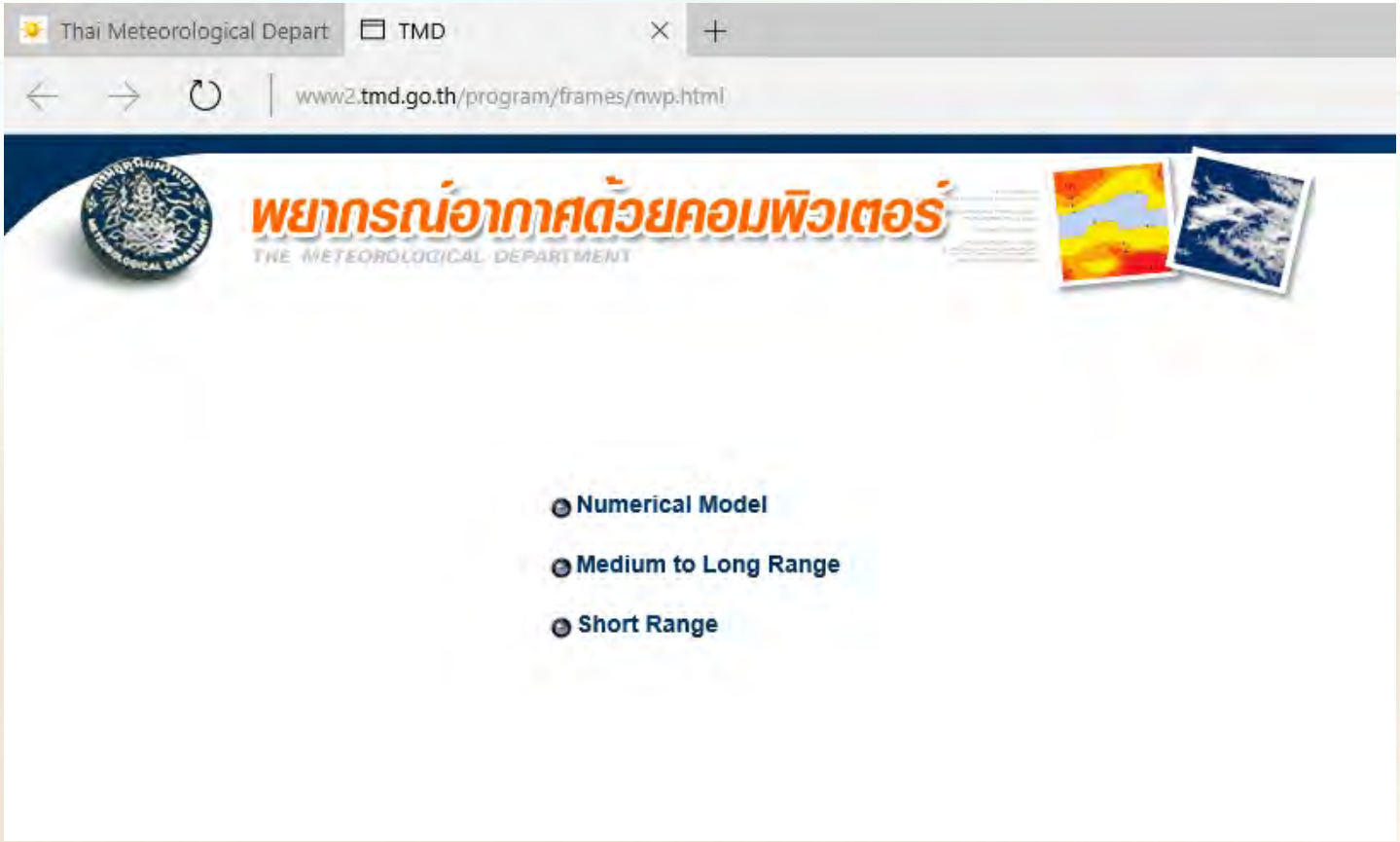




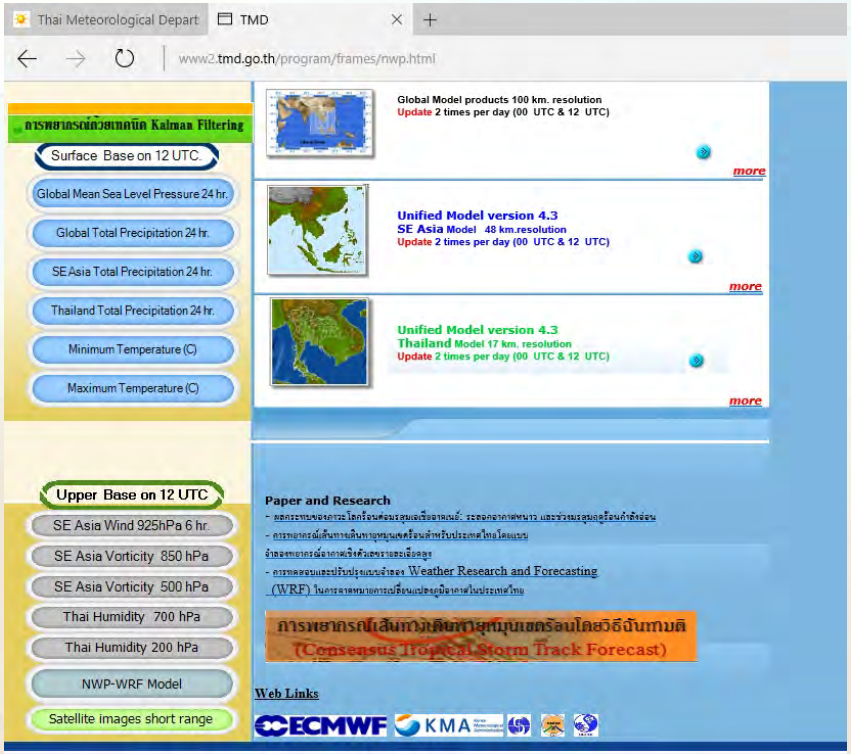
AWS


Thai Meteorological Depart
Thai Meteorlogical Depa
aws-observation.tmd.go.th/web/main/index.asp
TMD AWS
HOME | SITEMAP | LOGIN
Weather
Climate Data
AWS
Reports
GMT : 2016/05/30 15:14
CURRENT INFORMATION
On Line (84)
Off Line
WEATHER CLASSFIED BY CITY
Region North Eastern
Station 0079. NONGBUALAMPHU Weather Observing St
Data Time 2016/05/30 15:13
Sun Rise / Set Rise : 06:04:46 / Set : 18:22:30
Wind Direction 145 / SE deg
Wind Speed 1.4 km/h
Temperature 26.8 °C
Precipitation 0.0 mm
Pressure 982.4 hPa
Humidity 85 %
WEATHER
Weather classfied by City
Weather Calendar
LINK ZONE
Reports
Wind Roses
Alphanumeric
Distribution Map
Time Series
Weather Calendar

Future Data (SRF, MRF)

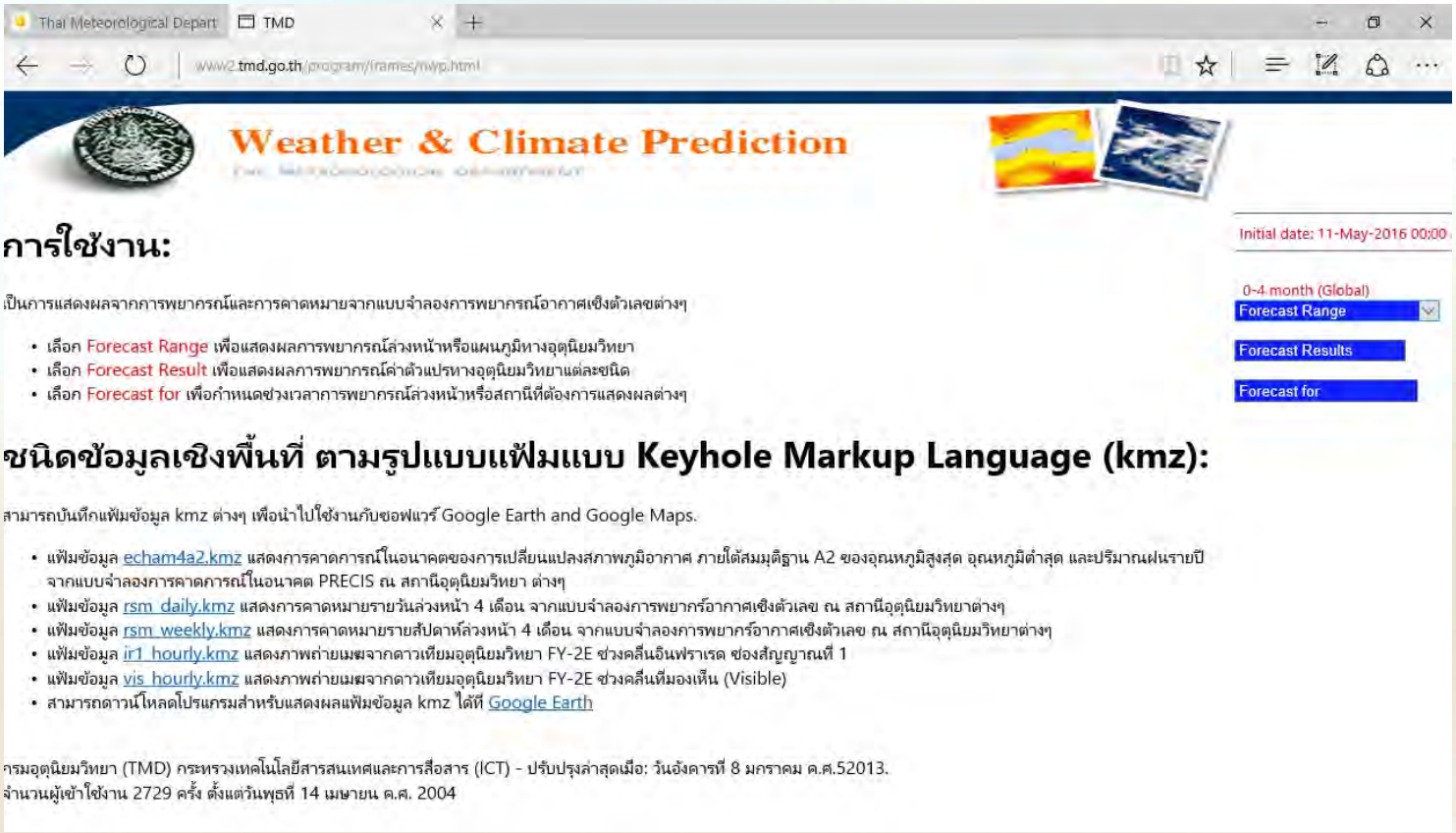


SRF


Thai Meteorological Depart
TMD
www2.tmd.go.th/program/frames/nwp.html
การพยากรณ์ด้วยเทคนิค Kalman Filtering
Surface Base on 12 UTC
Global Mean Sea Level Pressure 24 hr.
Global Total Precipitation 24 hr.
SE Asia Total Precipitation 24 hr.
Thailand Total Precipitation 24 hr.
Minimum Temperature (C)
Maximum Temperature (C)
Upper Base on 12 UTC
SE Asia Wind 925hPa 6 hr.
SE Asia Vorticity 850 hPa
SE Asia Vorticity 500 hPa
Thai Humidity 700 hPa
Thai Humidity 200 hPa
NWP-WRF Model
Satellite images short range
Global Model products 100 km. resolution
Update 2 times per day (00 UTC & 12 UTC)
more
Unified Model version 4.3
SE Asia Model 48 km.resolution
Update 2 times per day (00 UTC & 12 UTC)
more
Unified Model version 4.3
Thailand Model 17 km. resolution
Update 2 times per day (00 UTC & 12 UTC)
more
Paper and Research
Weather Research and Forecasting
(WRF)
การพยากรณ์เส้นทางเคลื่อนที่ของพายุหมุนเขตร้อนโดยวิธีฉันทามติ
(Consensus Tropical Storm Track Forecast)
Web Links
ECMWF
KMA


NWP OUTPUT
mean sea level pressure
wind 10 meters(kts)
wind 925 hPa(kts)
wind 850 hPa(kts)
wind 700 hPa(kts)
wind 500 hPa(kts)
wind 200 hPa(kts)
precipitation 3 hr(mm.)
surface temperature
Vorticity 850 hPa
CAPE (Thailand)
Cross-section E-W
Cross-section N-S
K-Index (Thailand)
TTI (Thailand)
CIN (Thailand)
Minimum temperature (c)
Mean sea level pressure (hPa)
พยากรณ์ฝนรวม 24 ชั่วโมง 7 วันล่วงหน้า
รายละเอียดระดับโลก (GCM)
ข้อมูลจาก NCEP
(0.5 degree resolution)
Domian2 30 km.
Domain3- 10 km.
Skew-T Meteogram
BKK 3x3 km.
Forecast
12UTC & 00UTC
Domain run WRF Model
Severe Weather Forecast
จากแบบจำลอง WRF-3DVAR
การพยากรณ์อากาศแบบ 3 มิติ

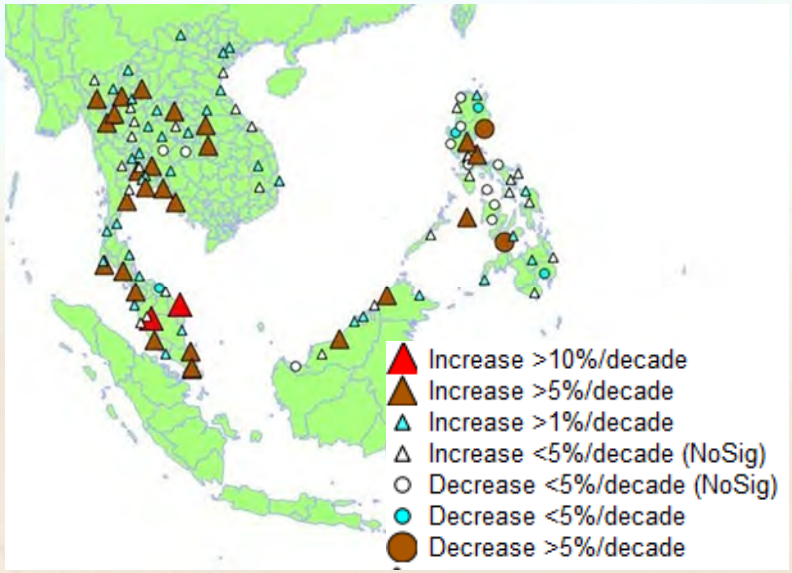
MRF


Thai Meteorological Depart
TMD
www2.tmd.go.th/program/iframes/nwp.html
Weather & Climate Prediction
Initial date: 11-May-2016 00:00
0-4 month (Global)
Forecast Range
Forecast Results
Forecast for
การใช้งาน:
เป็นการแสดงผลจากการพยากรณ์และการคาดหมายจากแบบจำลองการพยากรณ์อากาศเชิงตัวเลขต่างๆ
• เลือก Forecast Range เพื่อแสดงผลการพยากรณ์ล่วงหน้าหรือแผนภูมิทางอุตุนิยมวิทยา
• เลือก Forecast Result เพื่อแสดงผลการพยากรณ์ค่าตัวแปรทางอุตุนิยมวิทยาแต่ละชนิด
• เลือก Forecast for เพื่อกำหนดช่วงเวลาการพยากรณ์ล่วงหน้าหรือสถานีที่ต้องการแสดงผลต่างๆ
ชนิดข้อมูลเชิงพื้นที่ ตามรูปแบบแฟ้มแบบ Keyhole Markup Language (kmz):
สามารถบันทึกแฟ้มข้อมูล kmz ต่างๆ เพื่อนำไปใช้งานกับซอฟแวร์ Google Earth and Google Maps.
• แฟ้มข้อมูล echam4a2.kmz แสดงการคาดการณ์ในอนาคตของการเปลี่ยนแปลงสภาพภูมิอากาศ ภายใต้สมมุติฐาน A2 ของอุณหภูมิสูงสุด อุณหภูมิต่ำสุด และปริมาณฝนรายปี จากแบบจำลองการคาดการณ์ในอนาคต PRECIS ณ สถานีอุตุนิยมวิทยา ต่างๆ
• แฟ้มข้อมูล rsm_daily.kmz แสดงการคาดหมายรายวันล่วงหน้า 4 เดือน จากแบบจำลองการพยากร์อากาศเชิงตัวเลข ณ สถานีอุตุนิยมวิทยาต่างๆ
• แฟ้มข้อมูล rsm_weekly.kmz แสดงการคาดหมายรายสัปดาห์ล่วงหน้า 4 เดือน จากแบบจำลองการพยากร์อากาศเชิงตัวเลข ณ สถานีอุตุนิยมวิทยาต่างๆ
• แฟ้มข้อมูล ir1_hourly.kmz แสดงภาพถ่ายเมฆจากดาวเทียมอุตุนิยมวิทยา FY-2E ช่วงคลื่นอินฟราเรด ช่องสัญญาณที่ 1
• แฟ้มข้อมูล vis_hourly.kmz แสดงภาพถ่ายเมฆจากดาวเทียมอุตุนิยมวิทยา FY-2E ช่วงคลื่นที่มองเห็น (Visible)
• สามารถดาวน์โหลดโปรแกรมสำหรับแสดงผลแฟ้มข้อมูล kmz ได้ที่ Google Earth
กรมอุตุนิยมวิทยา (TMD) กระทรวงเทคโนโลยีสารสนเทศและการสื่อสาร (ICT) - ปรับปรุงล่าสุดเมื่อ: วันอังคารที่ 8 มกราคม ค.ศ.52013.
จำนวนผู้เข้าใช้งาน 2729 ครั้ง ตั้งแต่วันพุธที่ 14 เมษายน ค.ศ. 2004

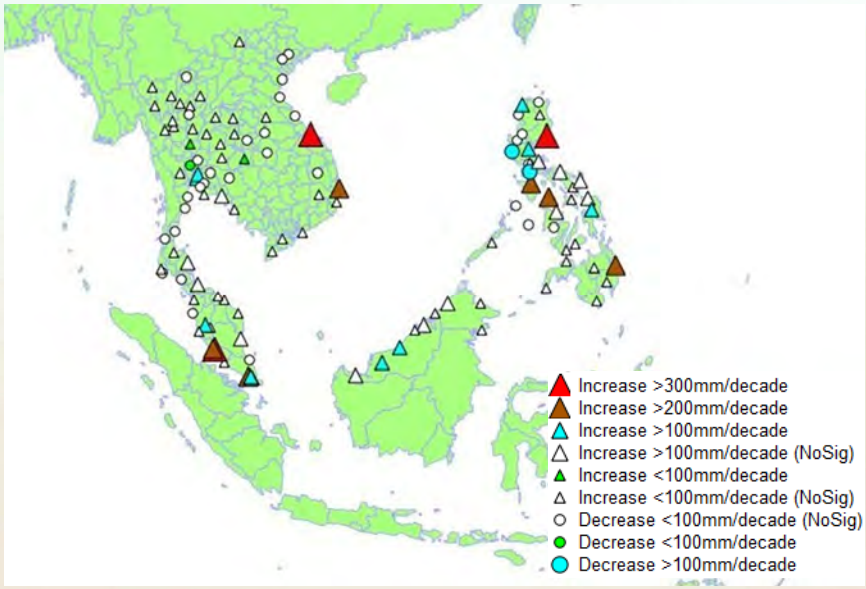
Future Climate Projection

South East Asia Climate Analysis & Modelling (SEACAM) project

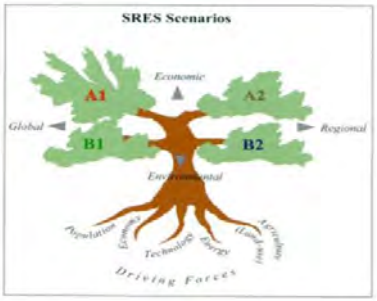
Station trends for percentage of warm days (TX90p); Period 1972-2010



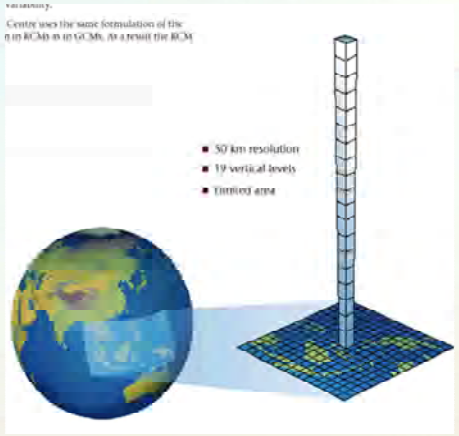
Station trends for Annual total wet-day precipitation (PRCPTOT); Period 1972-2010



A2/A1B



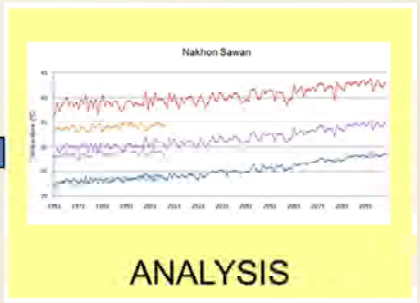
Dynamical Downscaling



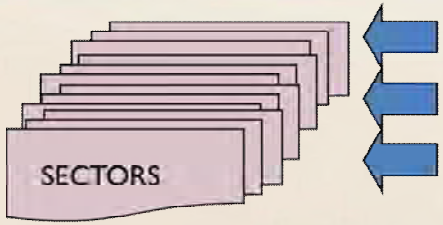
GLOBAL MODEL : ~ 300 km

~25/50Km

PRECIS REGIONAL MODEL



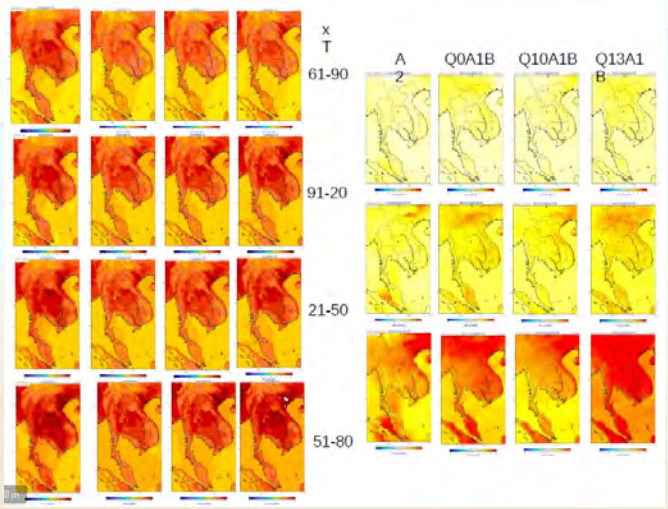
Scenarios Maps

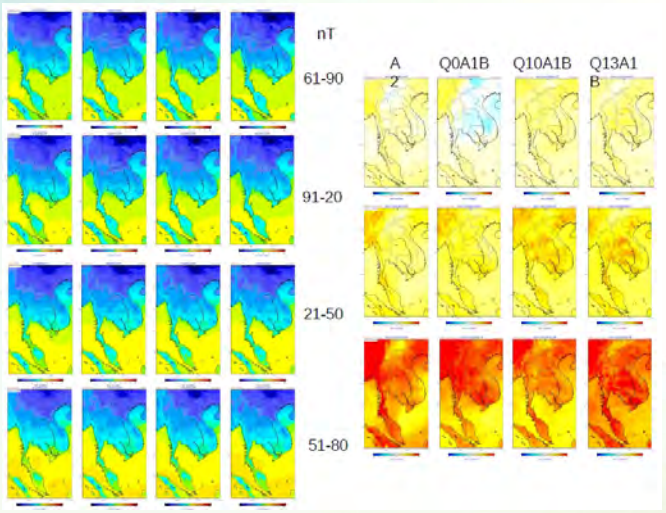


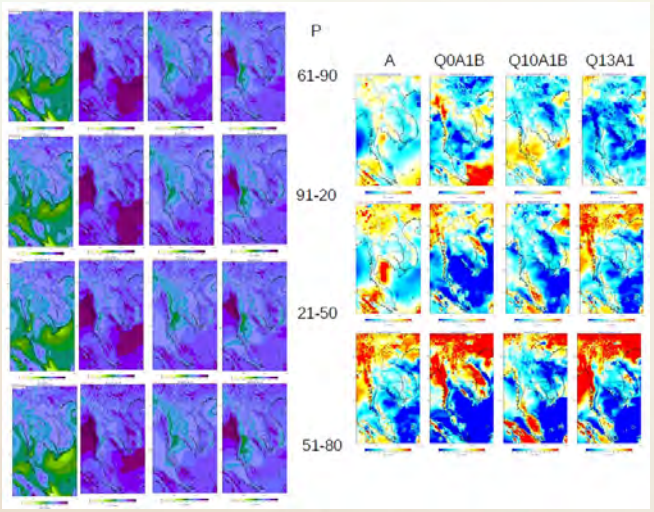
CMIP3 (PRECIS)

Model	Domain	Resolution	IC/BC	Results
PRECIS 1.4.7 2010		.44 deg (55 km)	ECHAM4 **A2**	Daily, Monthly 1951-2099
PRECIS 1.9.3 2012		.22 deg (25 km)	HadCM3Q0 **A1B**	Daily, Monthly 1950-2099
PRECIS 1.9.3 2013		.22 deg (25 km)	HadCM3Q10 **A1B**	Daily, Monthly 1950-2099
PRECIS 1.9.3 2013		.22 deg (25 km)	HadCM3Q13 **A1B**	Daily, Monthly 1950-2099

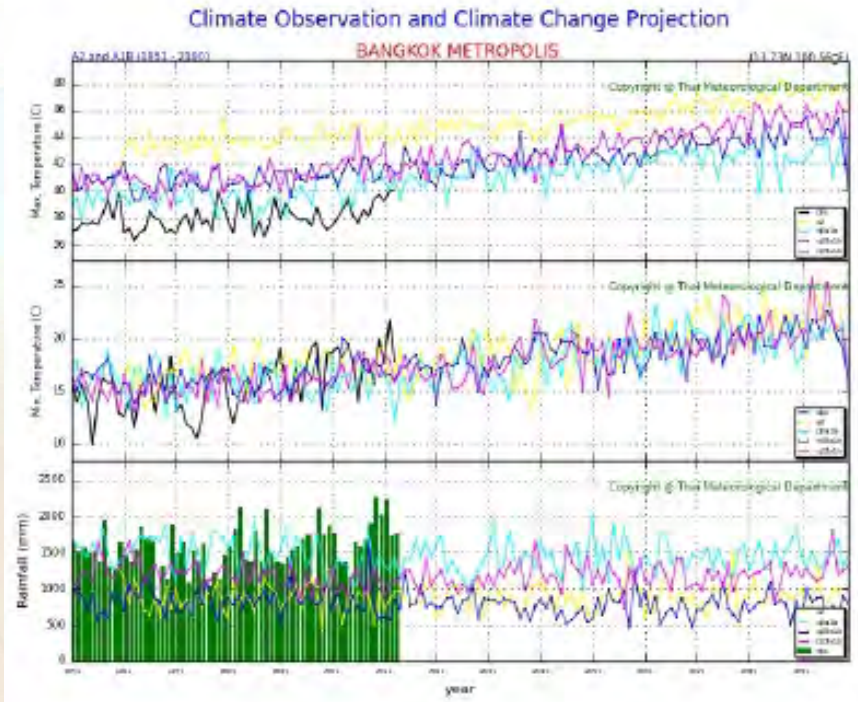
Temp, Precipitation

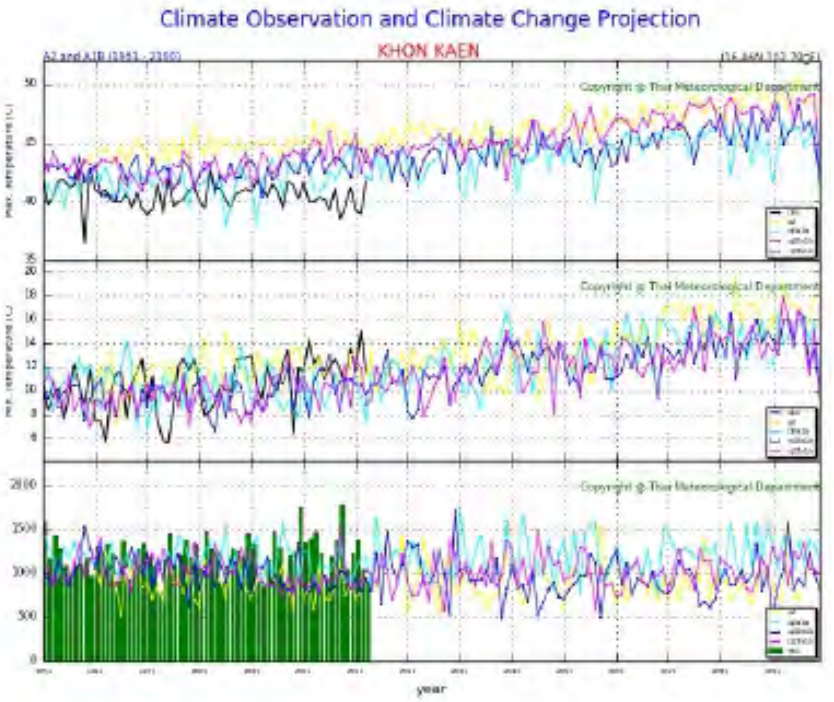




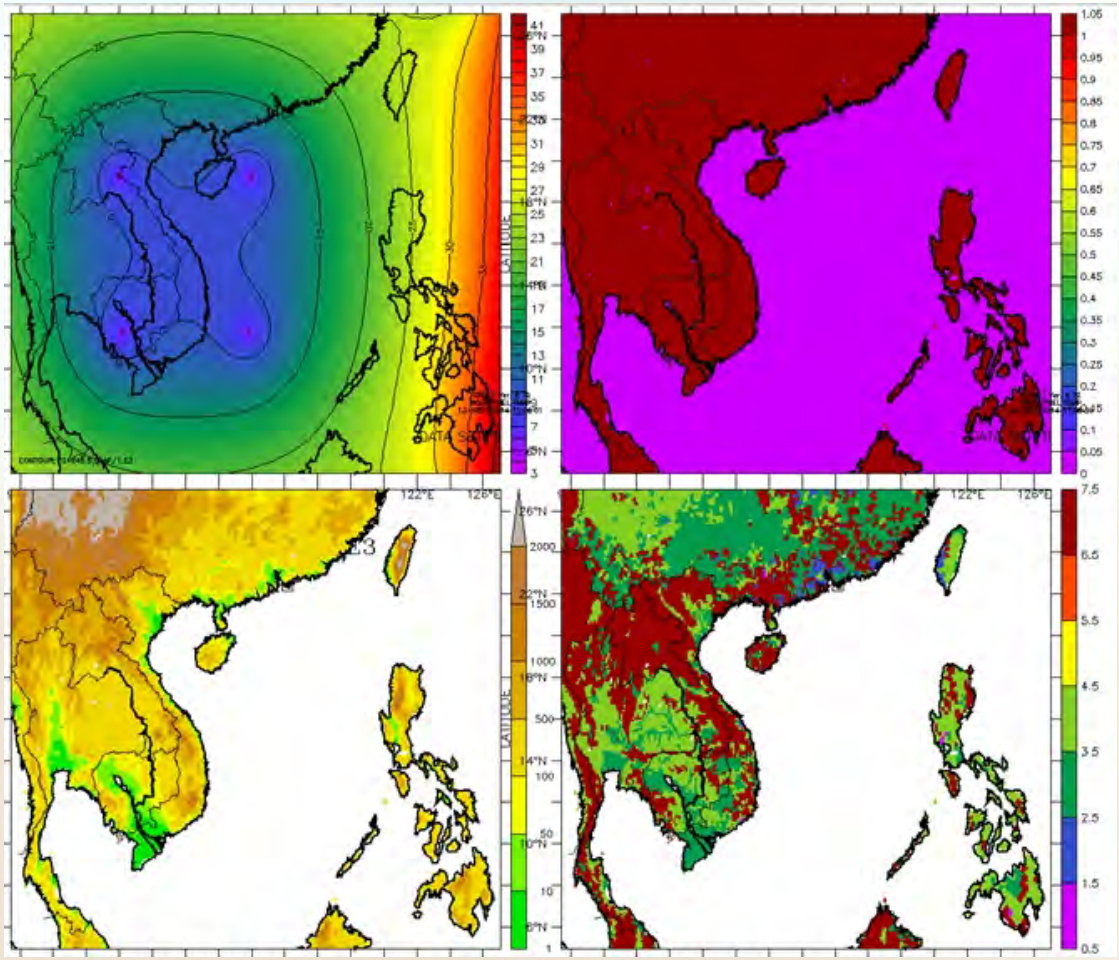


Station's Scenario





CMIP5 (CCAM)



Network common data form (NetCDF)

Thai Meteorological Department (TMD) is recoding data of real-time synoptic observation station on the Microsoft SQL server Relational Database Management System (RDBMS) and provided data and reports to internal and external user via web base system namely Climate Information System (CIS). The climatological center used SQL database language to retrieval daily data for analysis and monitoring in geographical information of Keyhole Markup Language (KML) that update products daily, weekly, monthly, seasonal and yearly on the webpage at http://climate.tmd.go.th. Before year 2006, the climate date of synoptic observation station are stored in the flat binary file format. The number of data elements to converted to RDMS system and some of data is error and missing, data rescue can recovery with logging recorded book are verified and fix some of them. The network common data form (NetCDF) is introduce to use for backup in case of system failure or emergency lost and this format accepted for various standard applications. Currently, the climate analysis usually are on the spreadsheet system. The new tool is considered for easy and flexible use when the urgent need of decision-maker. The climate data operators (CDO) which more than 400 operators and many climate index is used for climate data manipulation and analysis. Here to shown concept and provided some example results of the tool for rainfall distribution of Bangkok metropolitan during year 1951 to 2013

Station Data

```
netcdf \2016_81_5_580201 {
dimensions:
        time = UNLIMITED ; // (366 currently)
        obs = 1 ;
        strlenen = 15 ;
variables:
        double times(time) ;
                times:standard_name = "time" ;
                times:units = "minutes since 1900-01-01 00:00:00" ;
                times:calendar = "standard" ;
        float latitude(obs) ;
                latitude:standard_name = "latitude" ;
                latitude:long_name = "station latitude" ;
                latitude:units = "degree_north" ;
        float longitude(obs) ;
                longitude:standard_name = "longitude" ;
                longitude:long_name = "station longitude" ;
                longitude:units = "degree_east" ;
        float alt(obs) ;
                alt:standard_name = "height" ;
                alt:long_name = "vertical distance above the surface" ;
                alt:units = "" ;
                alt:positive = "up" ;
                alt:axis = "Z" ;
        char stationname(strlenen) ;
                stationname:long_name = "station name in English" ;
                stationname:long_name_Thai = "à¸›à¸±à¸à²à¸™à¸µ" ;
        int stationcode(obs) ;
                stationcode:long_name = "station code" ;
        int stationregion(obs) ;
                stationregion:long_name = "station region code" ;
        float E81(time) ;
                E81:standard_name = "Amount of Rainfall" ;
                E81:long_name = "NRAINFALL" ;
                E81:units = "mm" ;
                E81:missing_value = -9.e+33f ;

// global attributes:
                :Conventions = "CF-1.5" ;
                :title = "Timeseries of station data" ;
                :institution = "Climatological Center, Thai Meteorological Department (TMD) " ;
                :source = "SQLgetdata.py" ;
                :history = "Created 2016-4-12 12:17:17" ;
                :references = "Thailand Meteorological Data in NetCDF4 format" ;
                :comment = "pyTMD developer" ;
}
```

Climate Data Operators (CDO)

CDO are a collection of command line operators that were originally developed for processing and analysis of data produced by a variety of climate and numerical weather prediction models (e.g. for file operations, simple statistics, arithmetics, interpolation or the calculation of climate indices). Supported file formats are therefore the frequently used output formats of such models as GRIB, NetCDF and several binary formats.



The example of CDO operator

The example of CDO operator to created monthly, seasonal (DJF,MAM,JJA,SON), yearly and normal rainfall of station code 455201 (Bangkok Metropolitan) from year 1951 to 2013

EXAMPLE 1: TO MERGE YEARLY DATA TO A FILE

To concatenate rainfall of station code 455201 from yearly file of year 1951 to 2013 use:

```
cdo cat 81_455201_1951.nc . . . 81_455201_2013.nc 81_455201_1951_2013.nc
```

To print information and simple statistics for each field of a dataset use:

```
cdo info 81_455201_1951_2013.nc
```

EXAMPLE 2: TO ANALYSIS DATA OF MONTHLY, SEASONAL, YEARLY, AND STANDARD NORMAL

To summary monthly rainfall of station code 455201 for each year use:

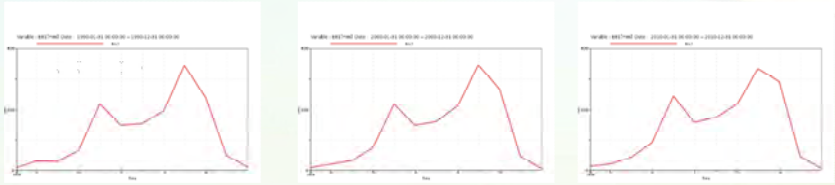
```
cdo mon[illegible]81_455201_1951_2013.nc 81_455201_1951_2013_monthly.nc
```

EXAMPLE 3: TO SHOW TIME SERIES OF DAILY, MONTHLY, AND YEARLY

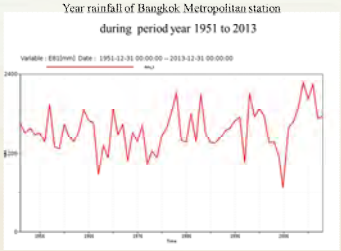
To plot graph for each field of a dataset and to store in png file format use:

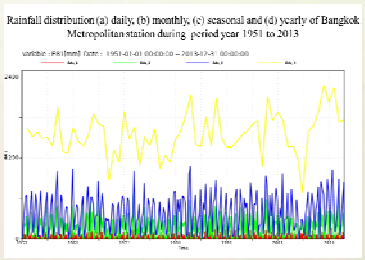
```
cdo graph,device="png" 81_455201_1951_2013.nc daily
cdo graph,device="png" 81_455201_1951_2013_monthly.nc monthly
cdo graph,device="png" 81_455201_1951_2013_seasonal.ncseasonal
cdo graph,device="png" 81_455201_1951_2013_yearly.nc yearly
cdo graph,device="png" 81_455201_1961_1990_month_normal.nc normal1990
cdo graph,device="png" 81_455201_1971_2000_month_normal.nc normal2000
cdo graph,device="png" 81_455201_1981_2010_month_normal.nc normal2010
```

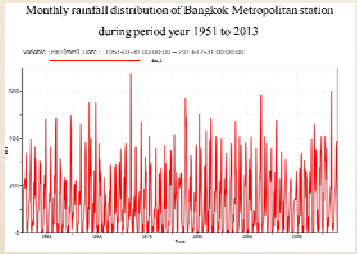
Normal rainfall distribution of Bangkok Metropolitan station in period (a) 1961-1990, (b) 1971-2000, and (c) 1981,2010)

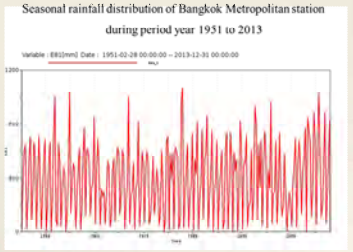


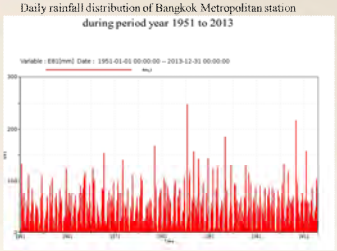
a b c





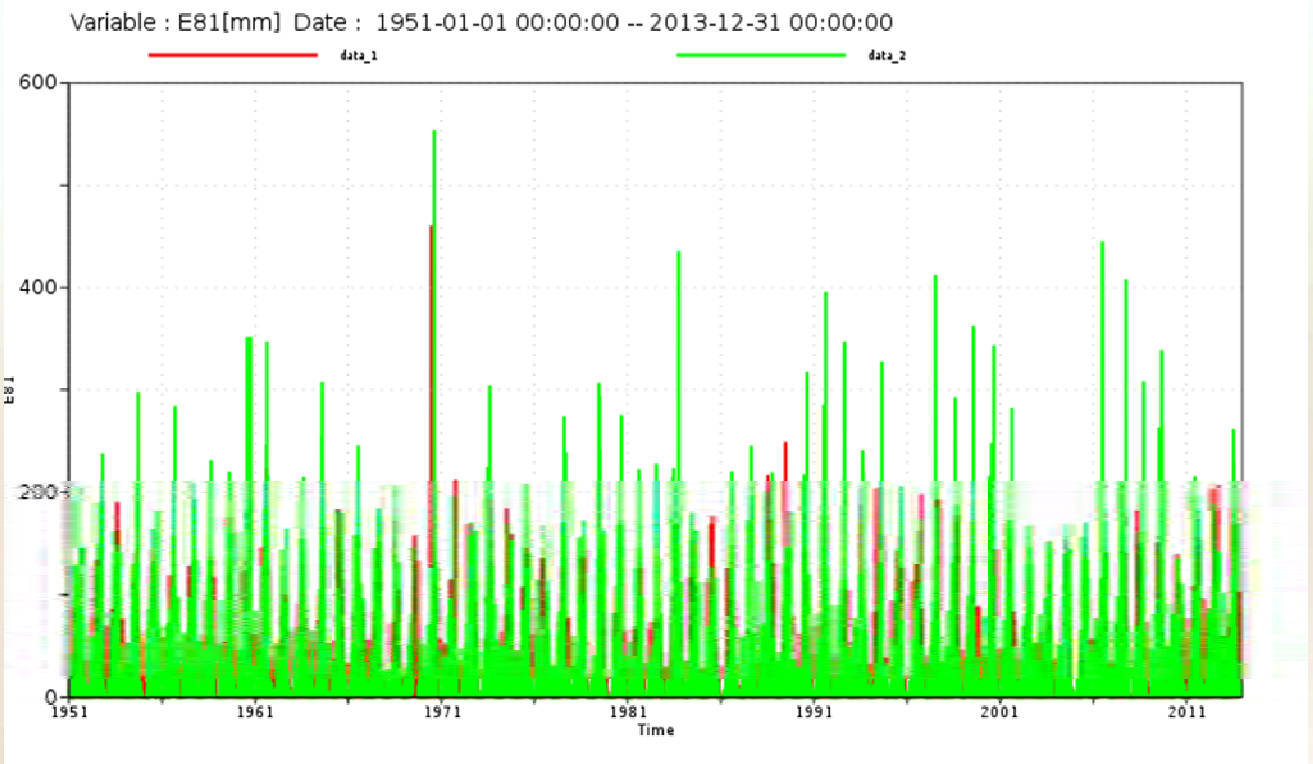






Extreme Rainfall Station

Daily Rainfall distribution of Ranong and Trad Station
(1951-2013)



Thank you for your Attention

Boonlert.arc@tmd.go.th