



# User-oriented Satellite Application Platforms ----SWAP & SMART



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# Outline

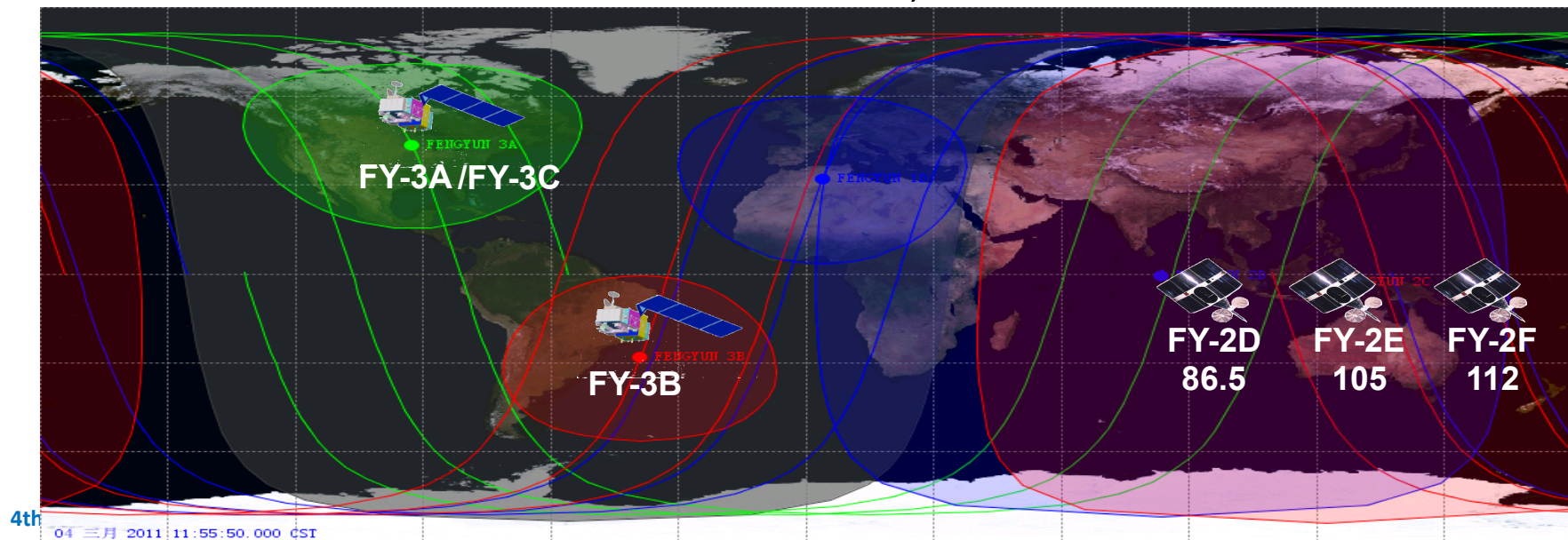
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1. Background
2. Satellite Weather Application Platform (SWAP)
3. Satellite Monitoring Analysis Remote-sensing Toolkit (SMART)
4. Summery

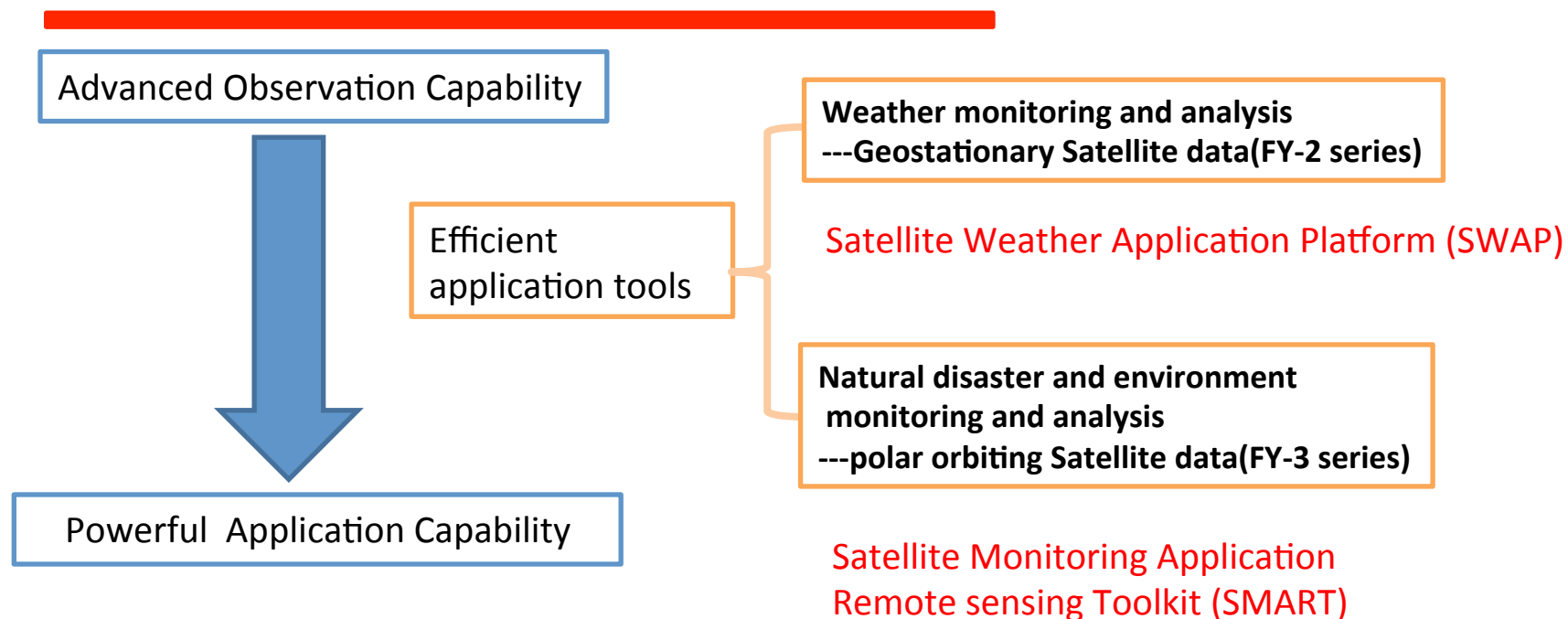


# The Observation and Data service Of FY Satellllites

- Global observation---FY-3 series
- High frequency and Specific regional rapid scan mode- ---FY-2 series
- Real-time data dissemination via CMACast ,Website ....



# How to promote the application of FY satellite data



Domestic training activities have been organized and SWAP & SMART have been applied in operation all around China.

# Satellite Weather Application Platform(SWAP)

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**Users:** Weather Forecasters

**Purpose :** A highly efficient tool for cloud image displaying and analyzing

**Special Features:**

- Powerful ability of data processing
- Flexible software architecture
- Specialized analysis tools for TC and convective system

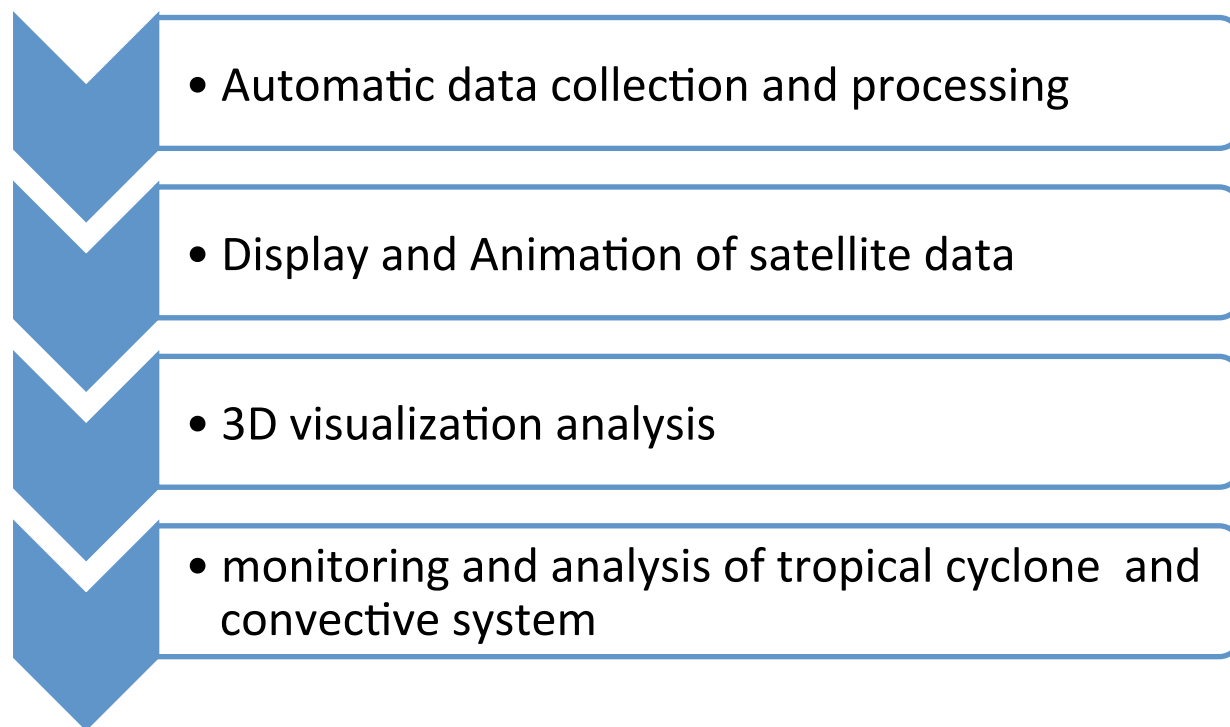
# Performance Analysis of SWAP

Test environment: PC, 4 cores 2.6GHz, 8G memory;

| Function Operation                                         | Response time<br>(unit: second) | Increased memory occupation<br>(unit: MB) |
|------------------------------------------------------------|---------------------------------|-------------------------------------------|
| Open a single standard projection image                    | 0.036                           | 10.03                                     |
| Open 12 pieces of image animation                          | 0.086                           | 34.42                                     |
| Geographic projection conversion from standard projection  | 0.056                           | 16.31                                     |
| Enhancement display of single image                        | 0.008                           | 0.53                                      |
| Switch channels of 12 times images                         | 0.068                           | 16.22                                     |
| Convective cloud detection and track of 12 times animation | 0.266                           | 28.63                                     |

# Functions of SWAP

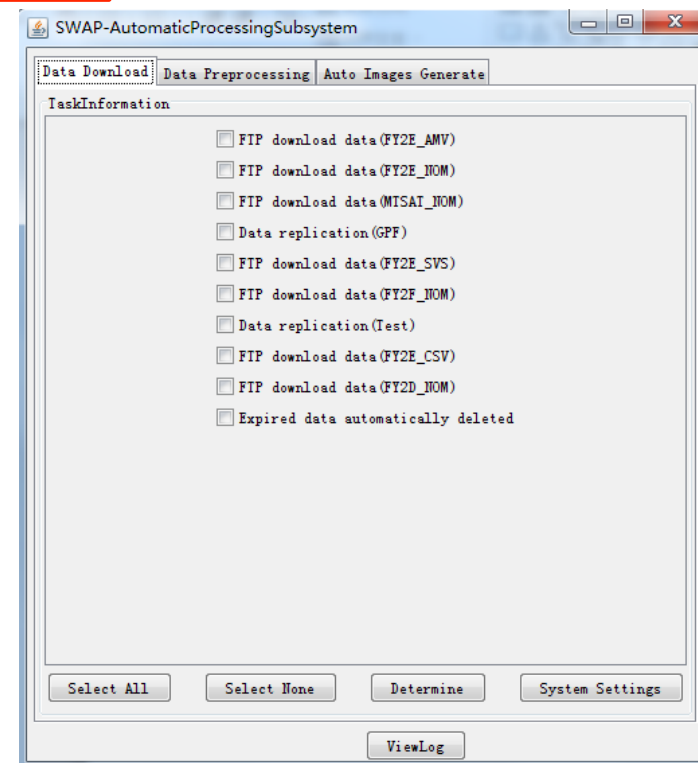
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# Automatic data collection and processing

## Data collection and pre-processing

- Download satellite data automatically
- Delete overdue data automatically
- Customize data source(FTP, automatic copy of local data )
- Output Real-time log about data downloading

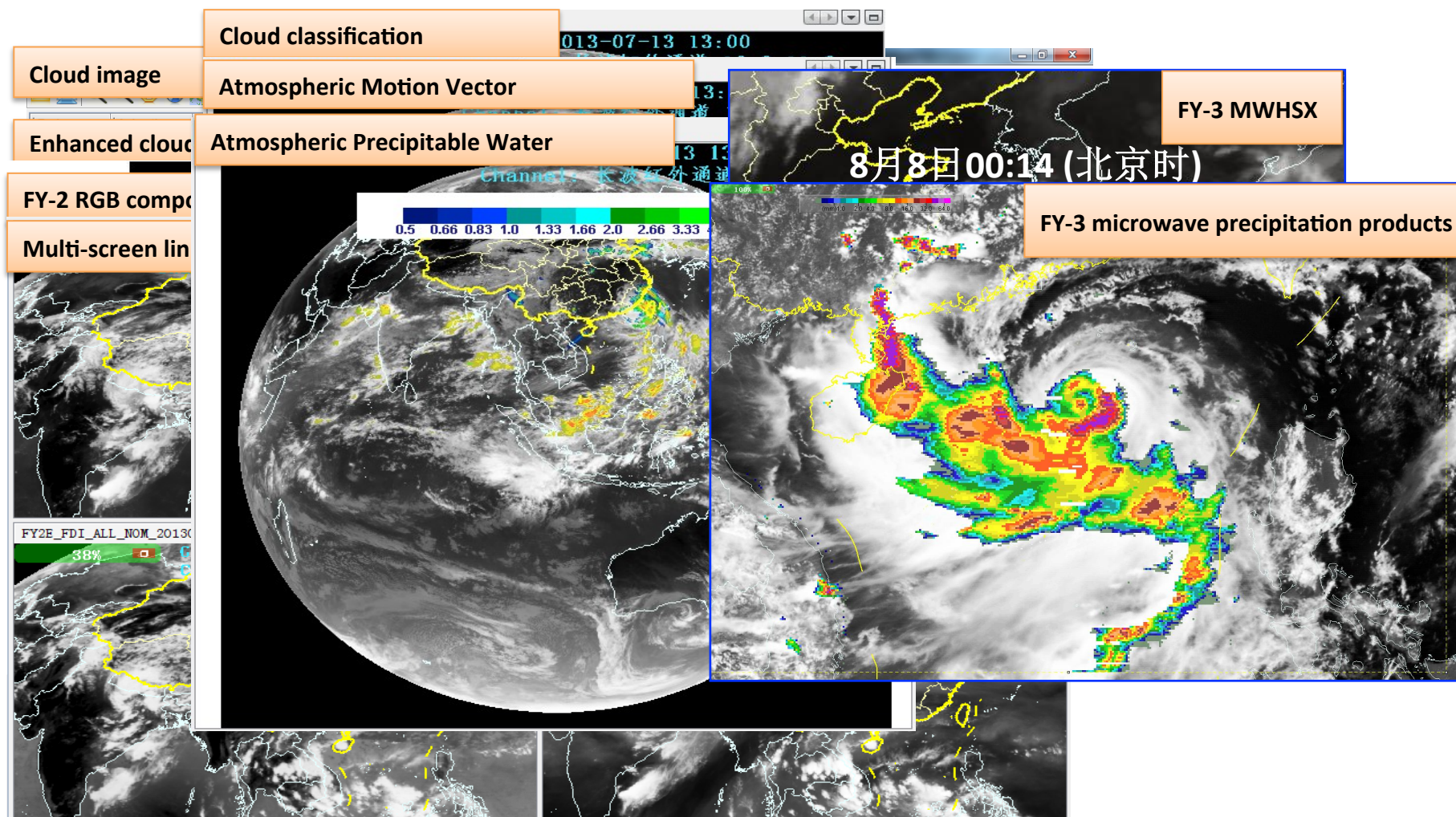


# Display Function

- Overlapping display of multi-source data
- Automatically time matching of the different data.
- Multi-screen linkage analysis
- RGB composite tools

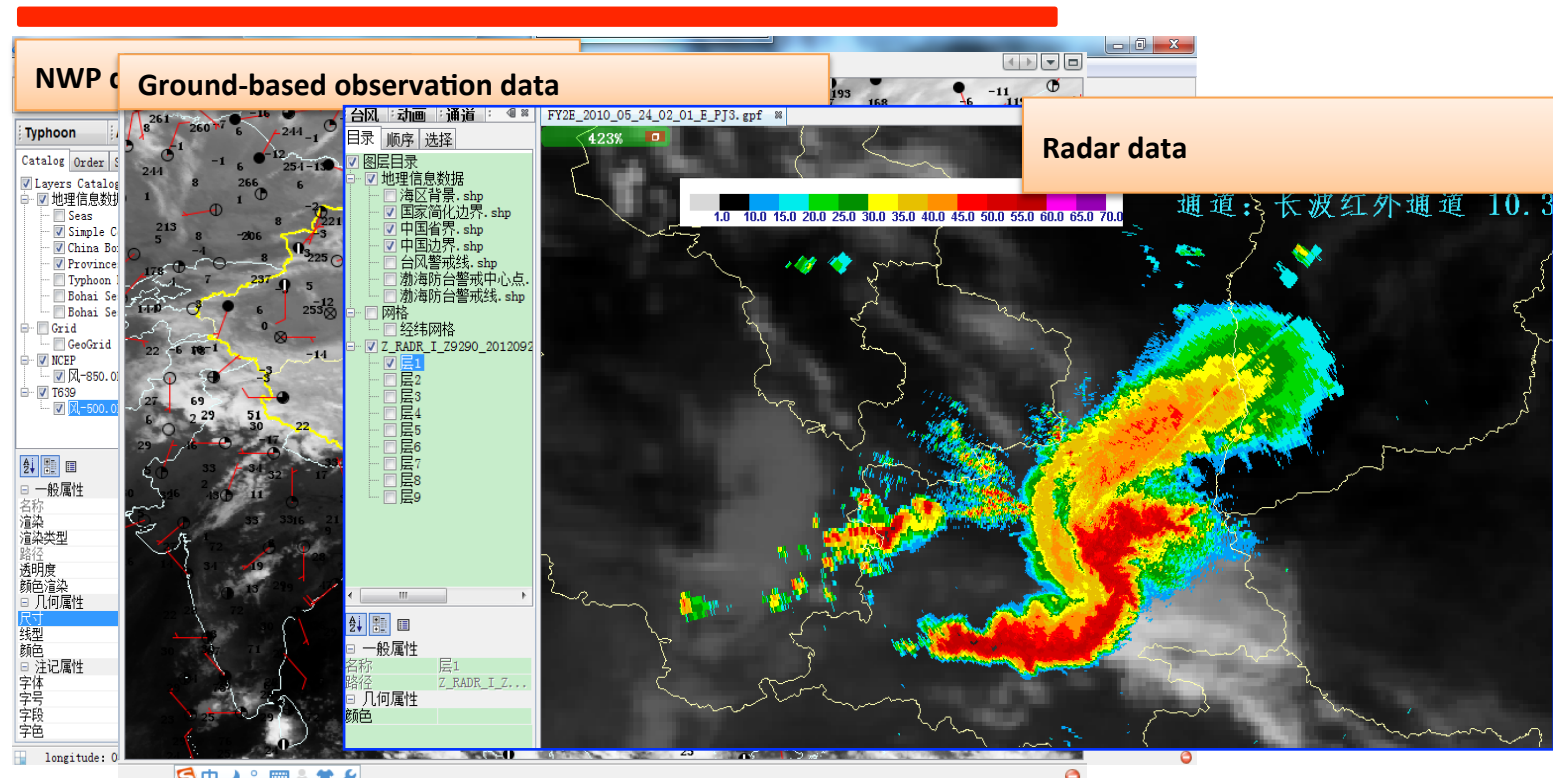
| Data classification        | Name                                                        |
|----------------------------|-------------------------------------------------------------|
| Satellite data and product | FY-2C/D/E/F<br>(AMV/CLC/TBB/OLR/PRE)<br>MTSAT               |
|                            | FY-3A/B/C                                                   |
| Observation Data           | Ground-based observation and<br>Sounding Data<br>Radar Data |
| NWP                        | T639, Grapes, NCEP, ECWMF                                   |





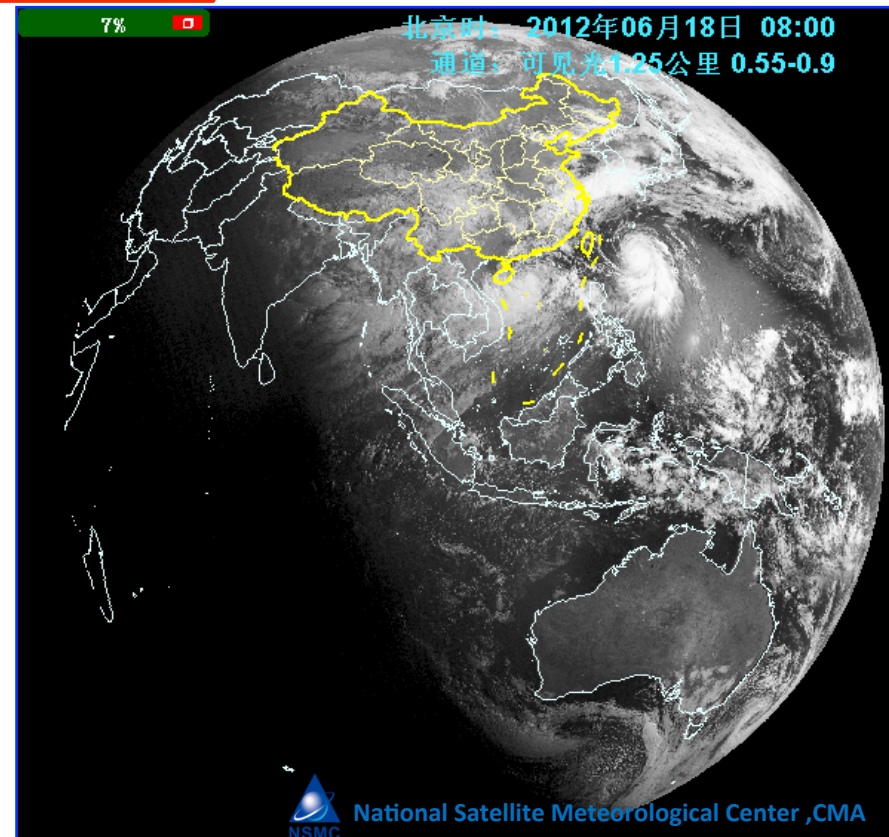


# Overlapping cloud image with other data

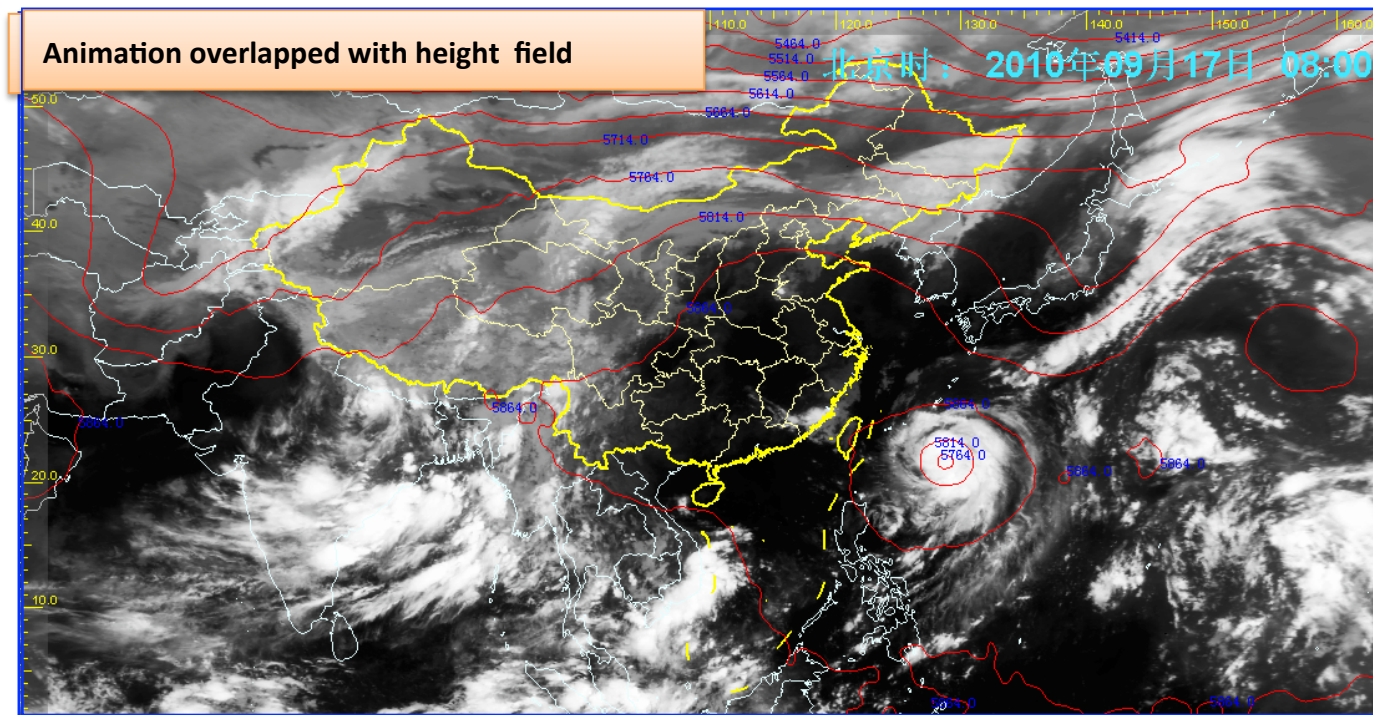


# Animation Function

- Dynamically load to support a large amount of data animation
- Customizing animation of specific region
- Overlapping animation of multi-source data

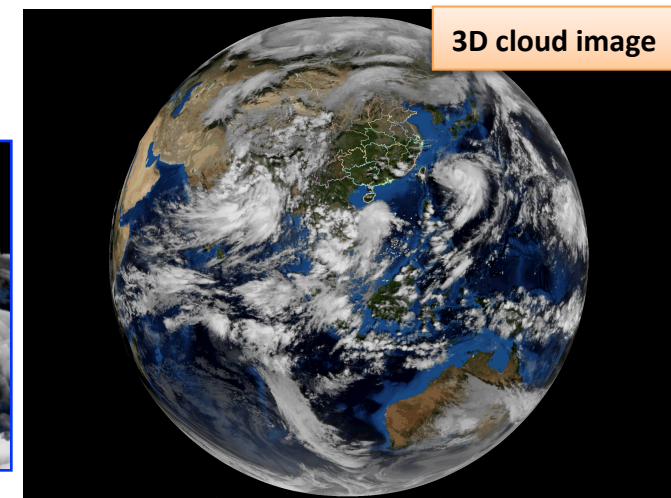
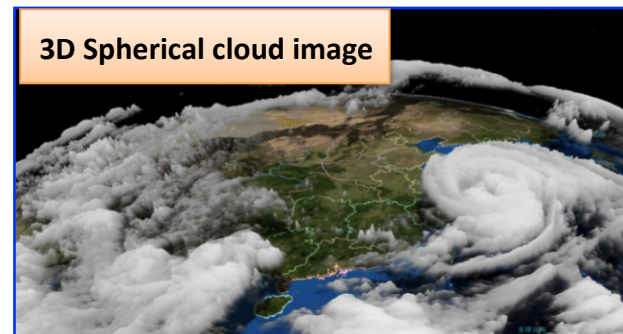
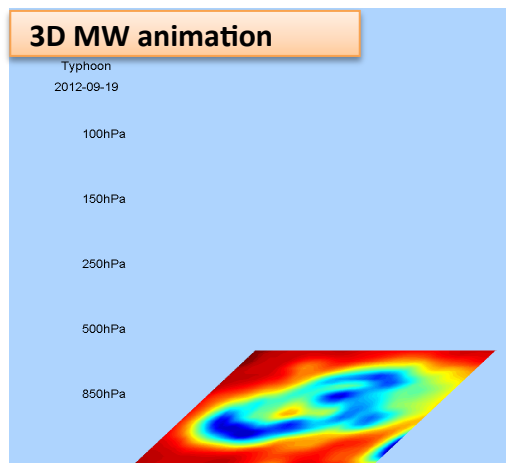


# Animation demo of satellite data



# 3D Visualization

- Adaptive cloud detection
- 3D display of cloud image
- 3D animation of Microwave data



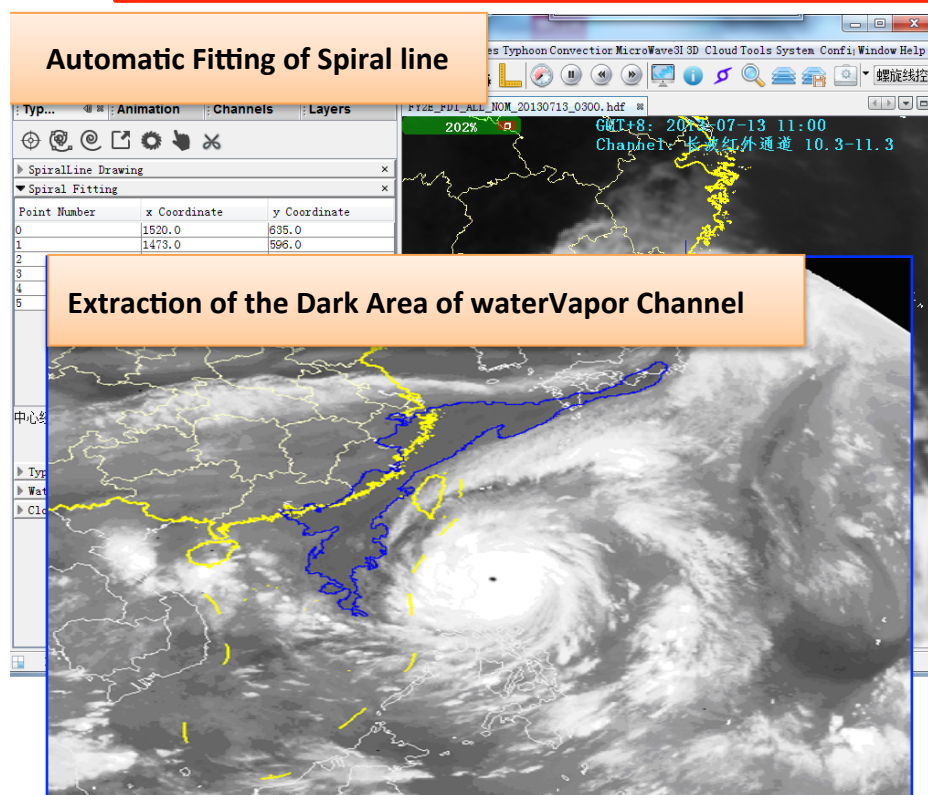
# Monitoring and Analysis of TC & Convective System

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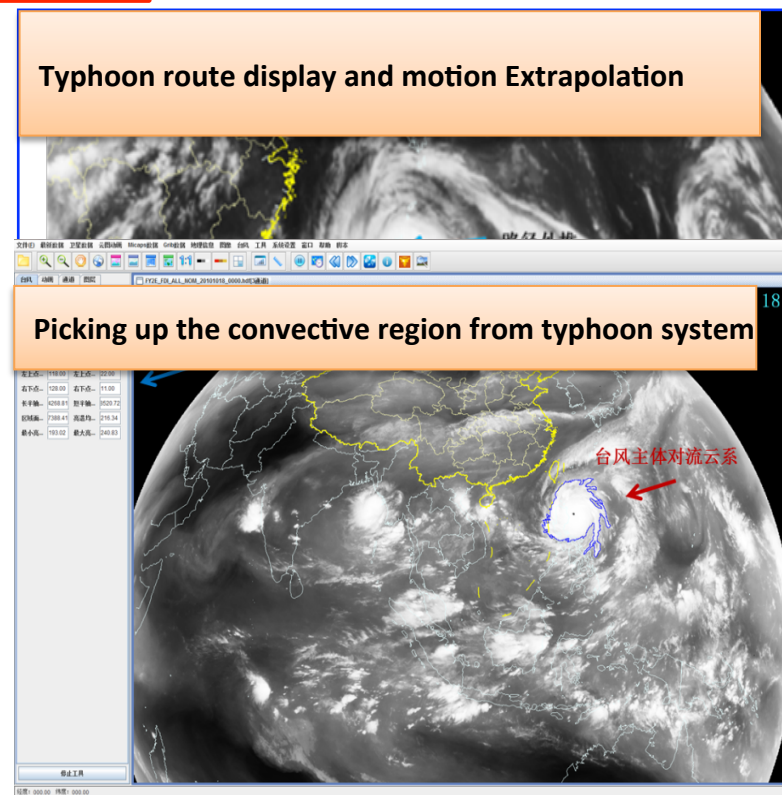
- Center location and intensity estimation
- Route analysis and motion extrapolation
- Convective cloud detection and tracing
- Convective cloud parameters extraction
- Precipitation Analysis



# Monitoring and analysis of tropical cyclone

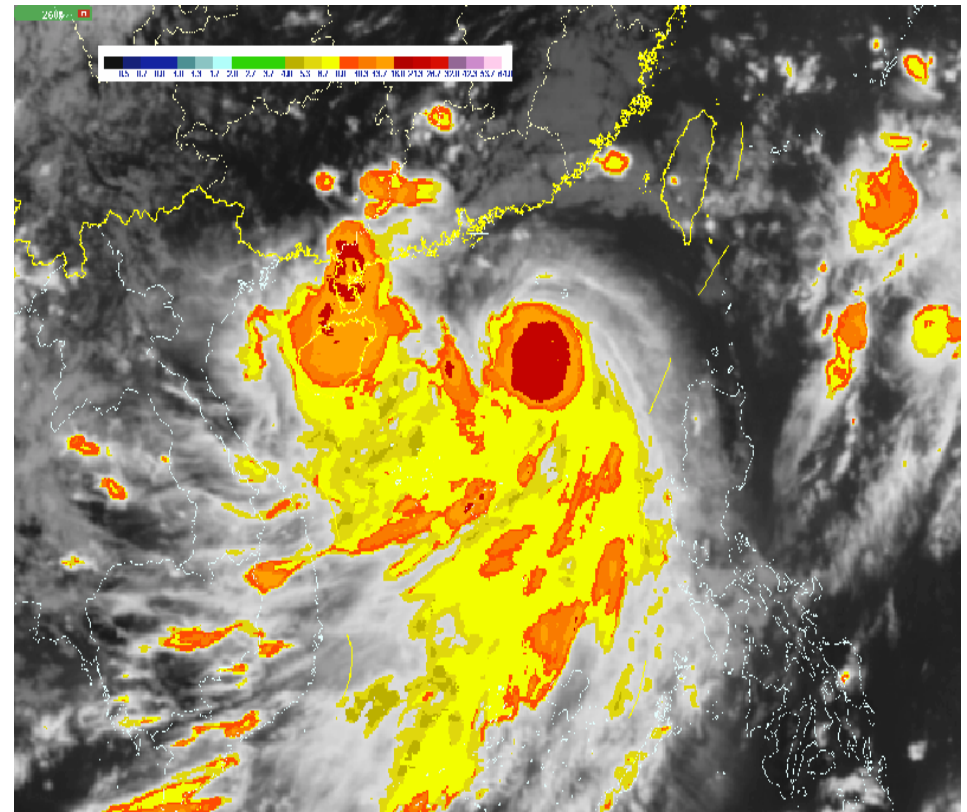
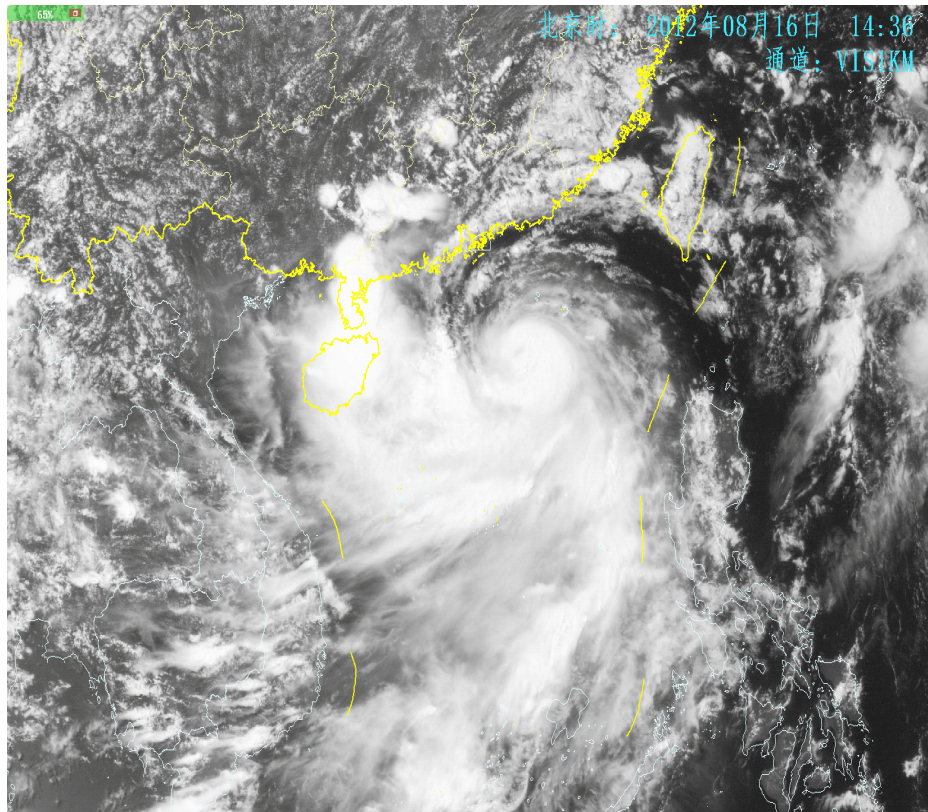


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NSMC National Satellite Meteorological Center ,CMA

## ***Tropical Cyclone Kai-tak (201213)***



Using FY-2F data, 6 min interval



# Monitoring and analysis of tropical cyclone

$$\Delta T_i = T_i - \bar{T}_i \text{ (MV+IR)}$$

NOSD

SKWJJF

20123020

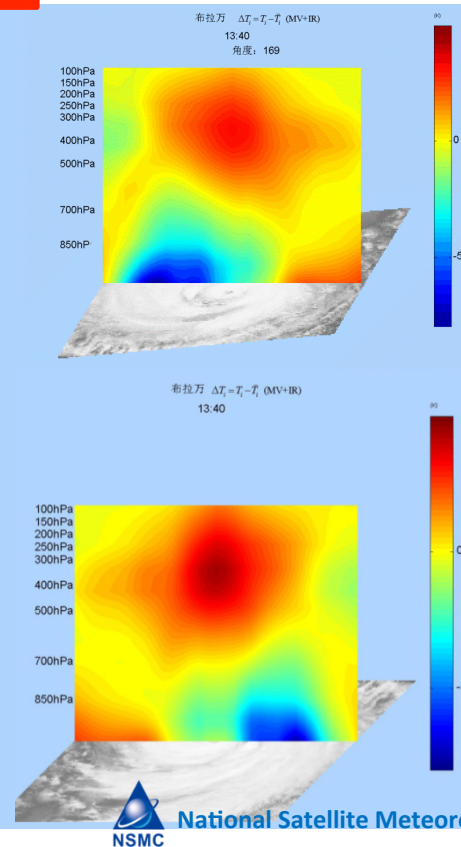
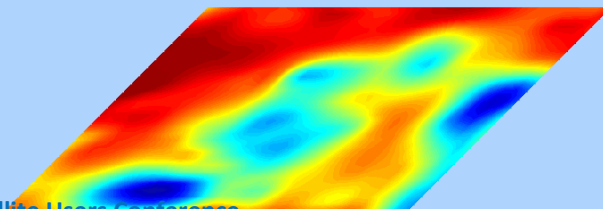
100hPa

150hPa

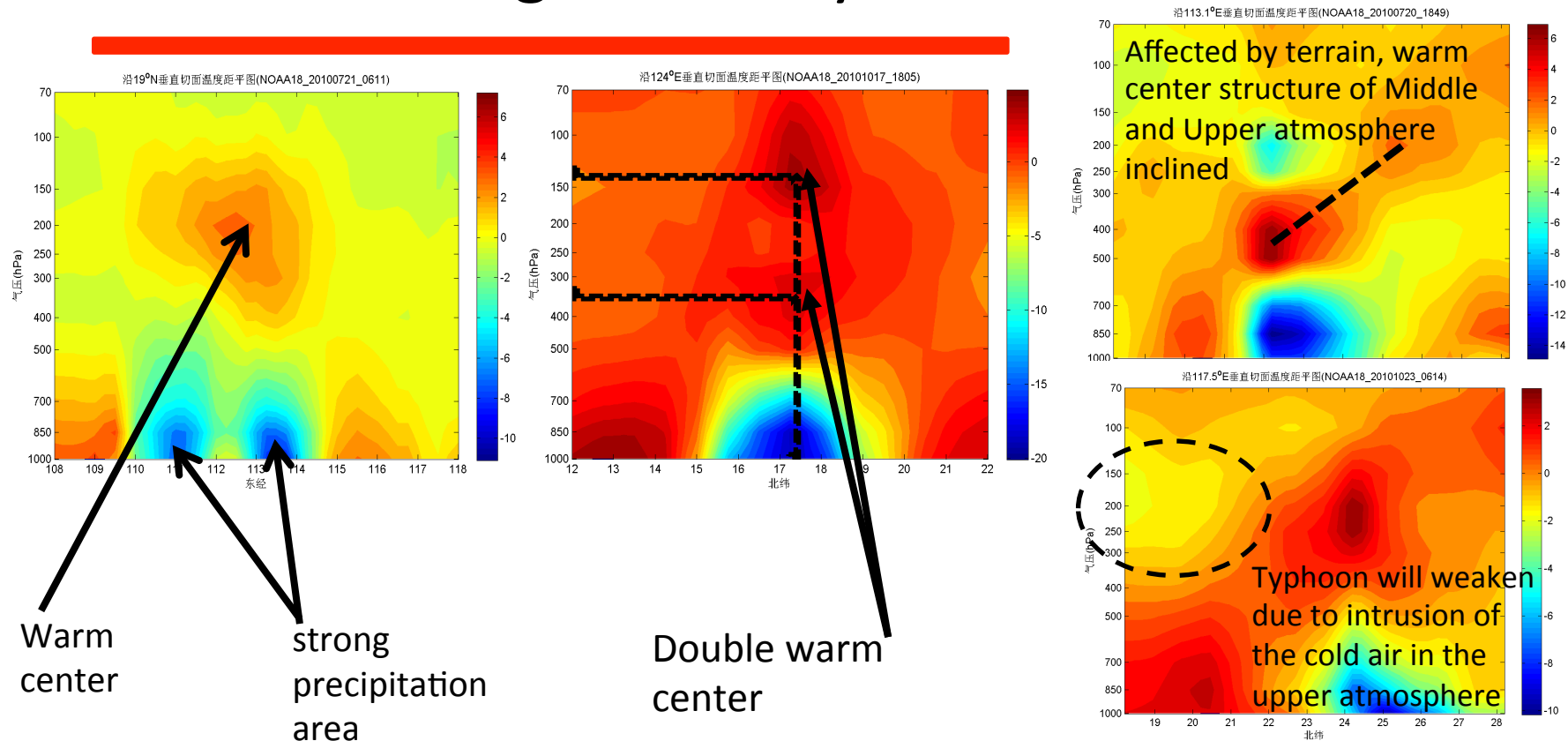
250hPa

500hPa

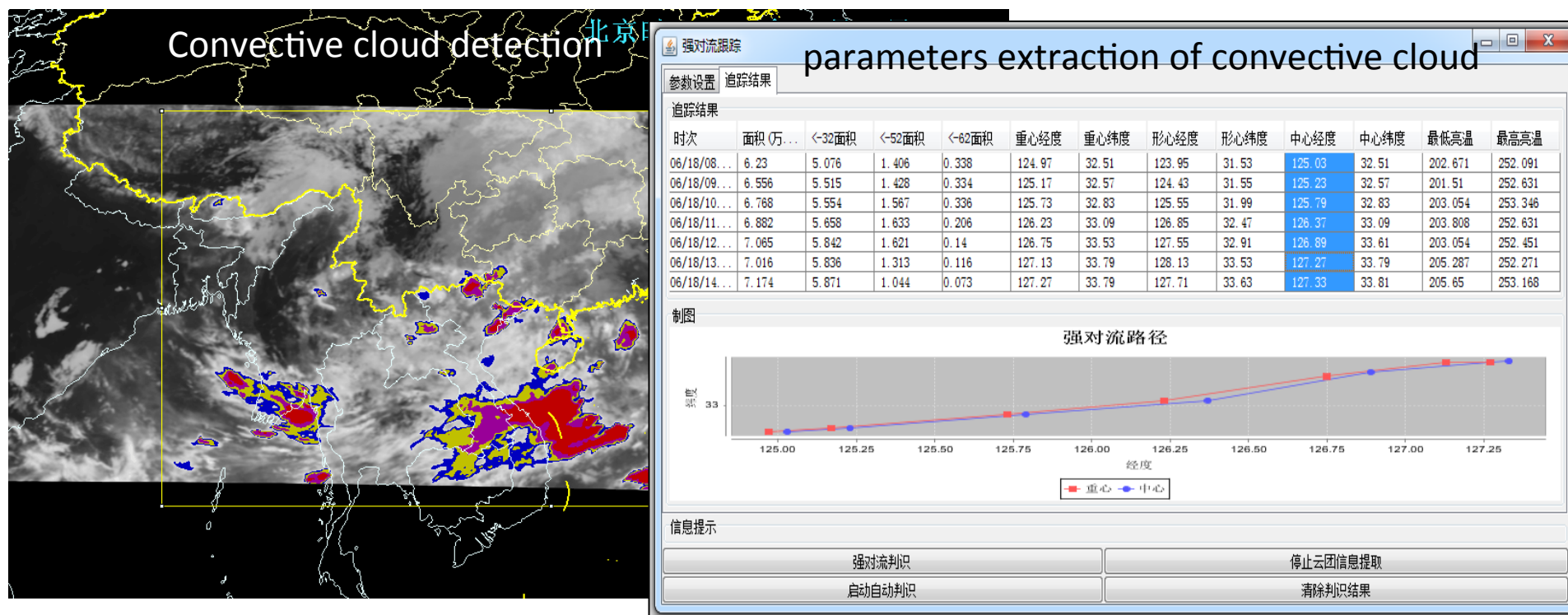
850hPa



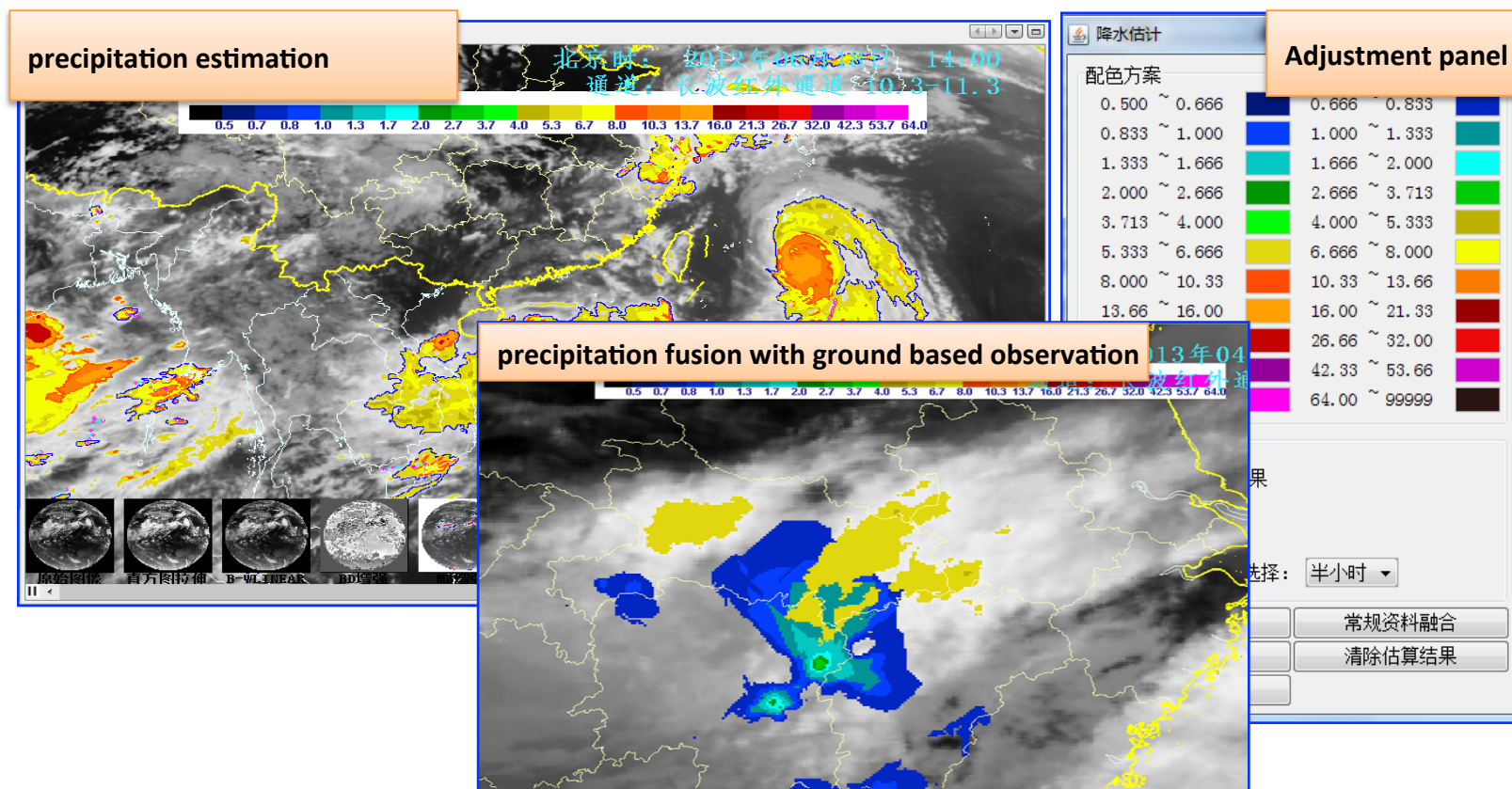
# Monitoring and analysis of tropical cyclone



# Monitoring and analysis of convective system

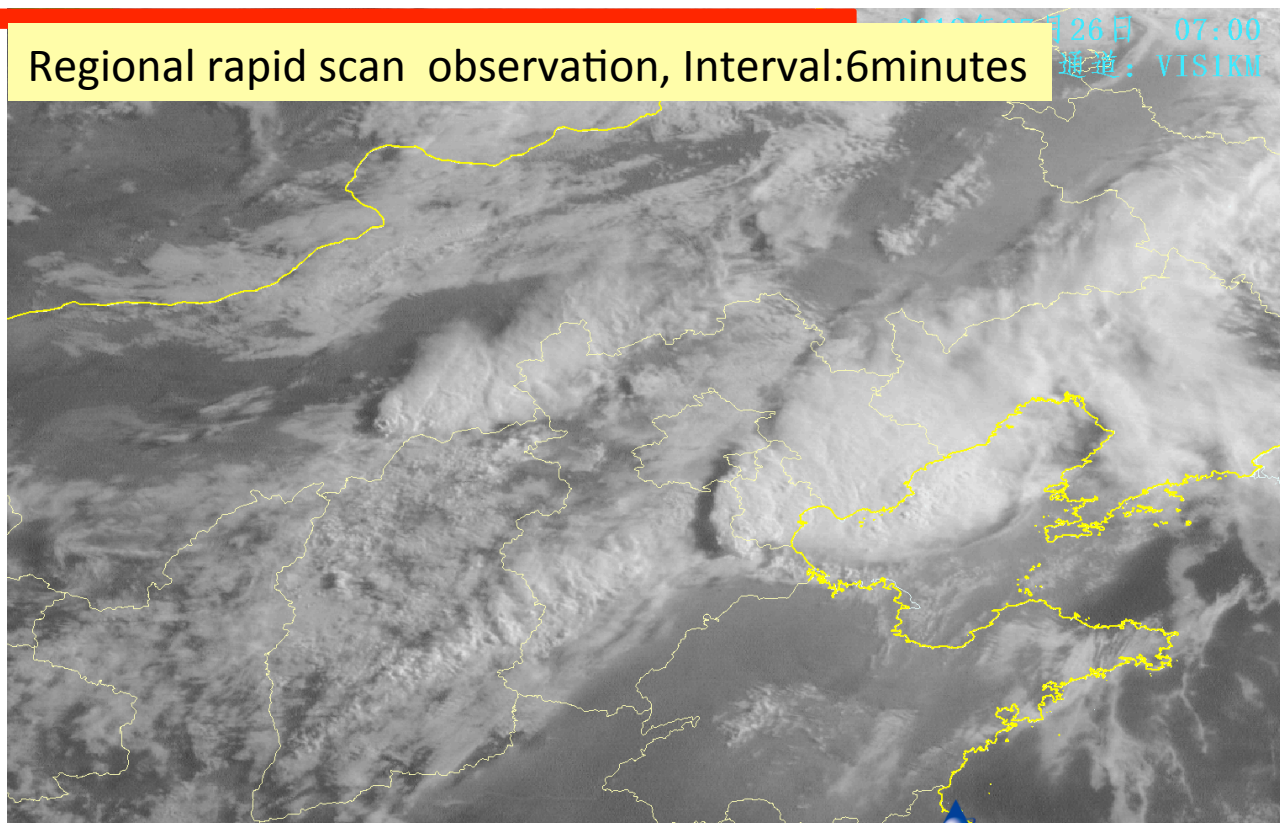


# Monitoring and analysis of convective system



# Monitoring and analysis of convective system

Regional rapid scan observation, Interval:6minutes





# Satellite Monitoring Analysis Remote-sensing Toolkit (SMART)

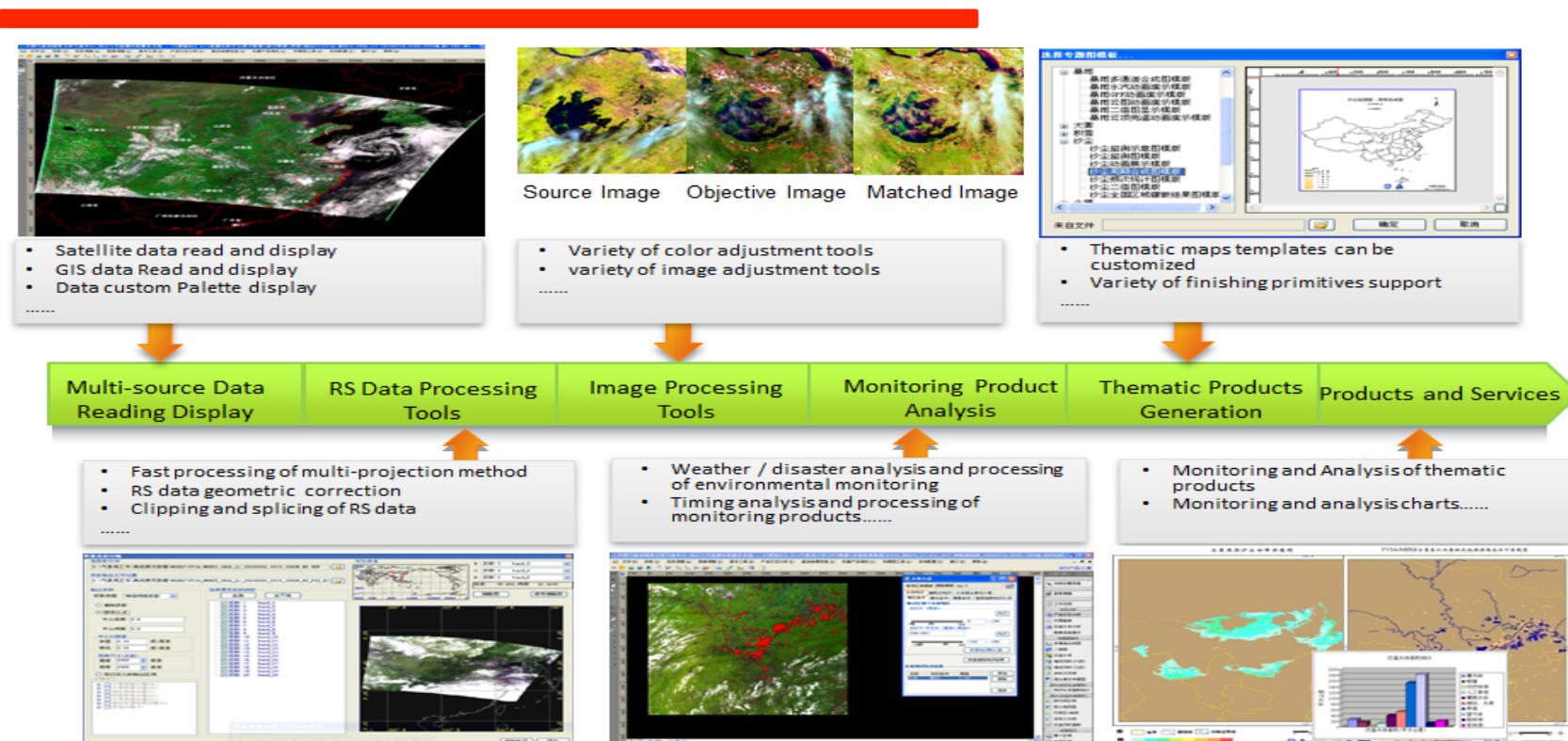
**Users:** Operators and researchers of disaster and environment monitoring

**Purpose:** Comprehensive application platform of FY-3 and other polar orbit meteorological satellite data

**Special Features:**

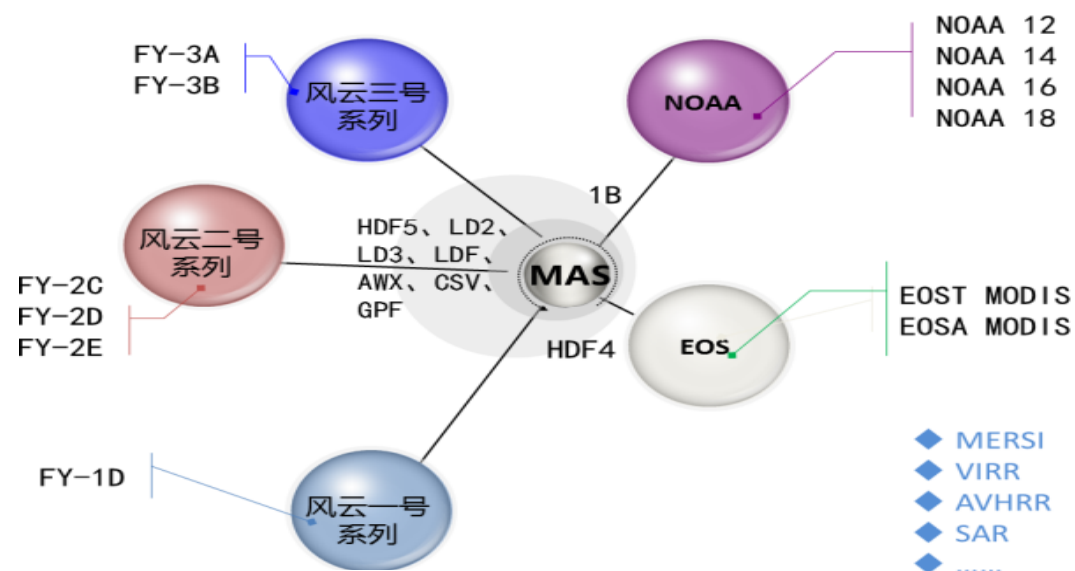
- Standard operation flow
- Professional monitoring models
- Powerful image processing tools

# The operational flow of SMART



# Multi-source data display

- ◆ Support for Multi-satellite, Multi-Sensor, Multi-Format data

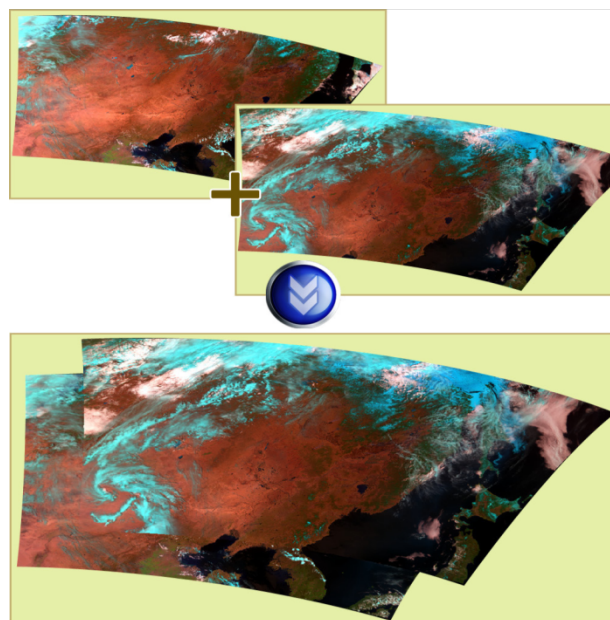


# RS Data Processing Tools

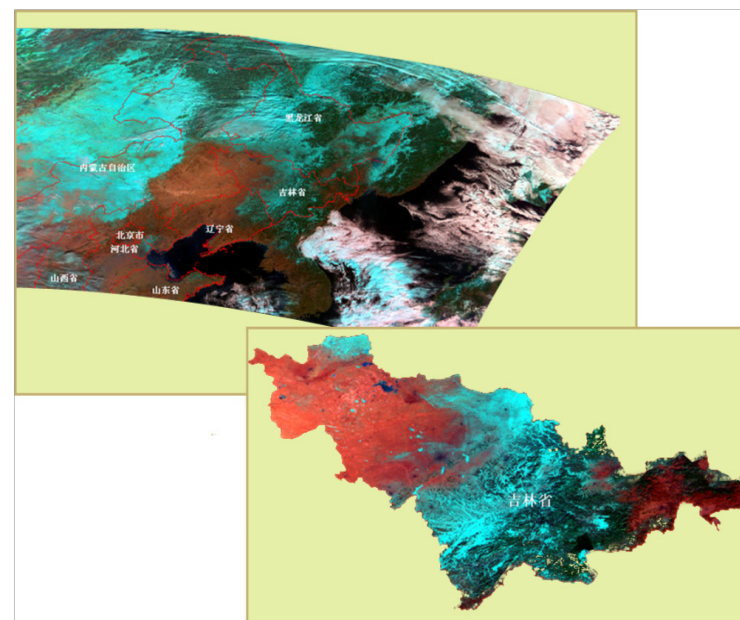
Mosaic

- radiometric correction
- geometric correction
- projection and coordinate system conversion
- Resize and cut
- mosaic and clipping

.....

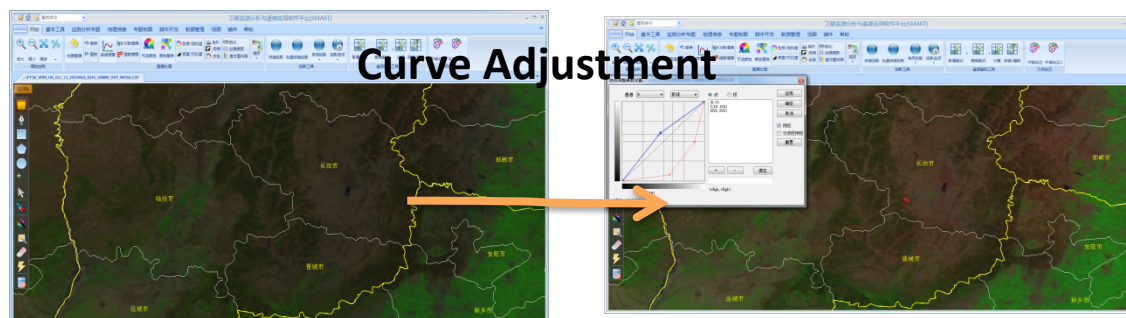
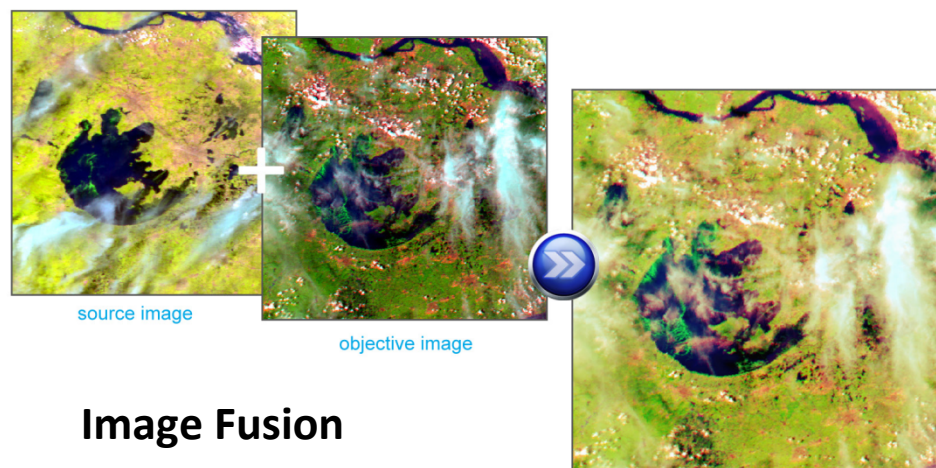


Clipping



# Image Processing Tools

- image enhancement
- image filter
- image classification
- Image fusion
- .....





# Monitoring & Analysis Thematic Products

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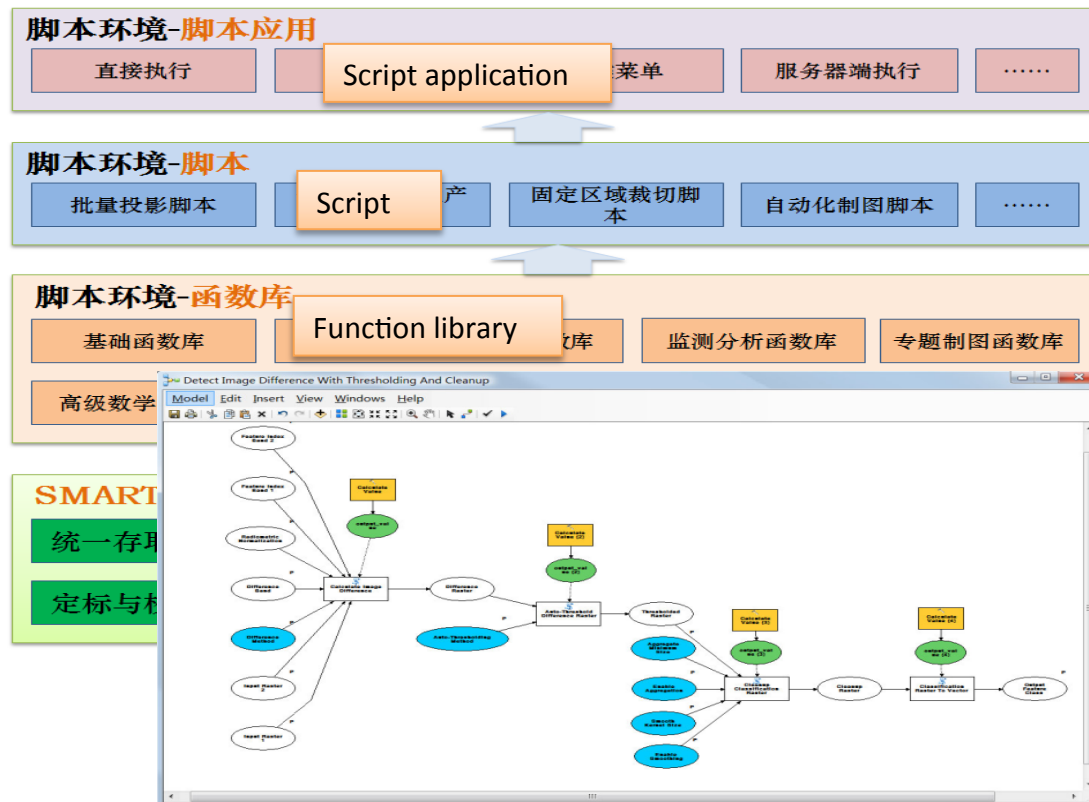
- Dust
- Fog
- Fire
- Water
- Snow
- Sea ice

- Cyanophyta
- Vegetation
- Drought
- Land surface temperature
- Urban Heat Island
- Extension of new production

Monitoring analysis content:

- Time
- Location
- Area
- Degree
- Frequency
- Changes
- .....

# Customized Development



4th Asia-Oceania Meteorological Satellite Users Conference

## ◆Primary user

Customizing interface and operational process Through XML setting.

## ◆Intermediate user

Designing operational process by basic function library .

## ◆Advanced User

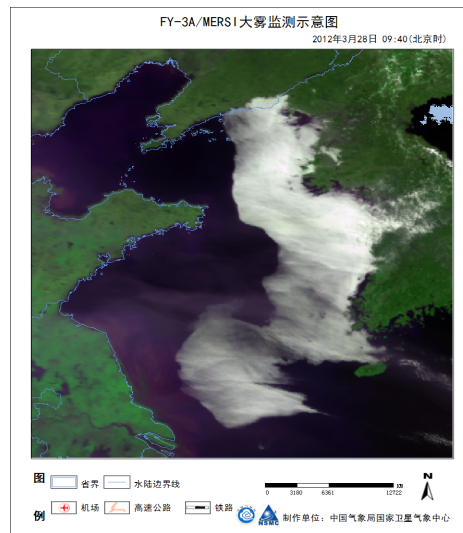
Developing specific application system by complete SDK (Software Development Kit)。



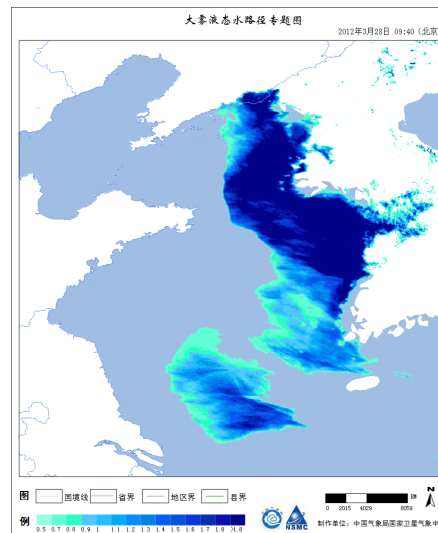
National Satellite Meteorological Center ,CMA

# Application Examples

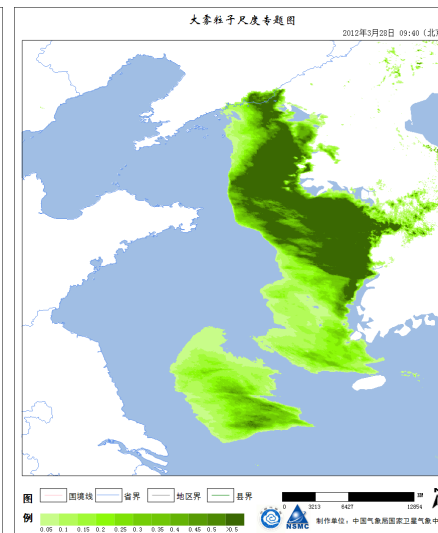
## Fog monitoring



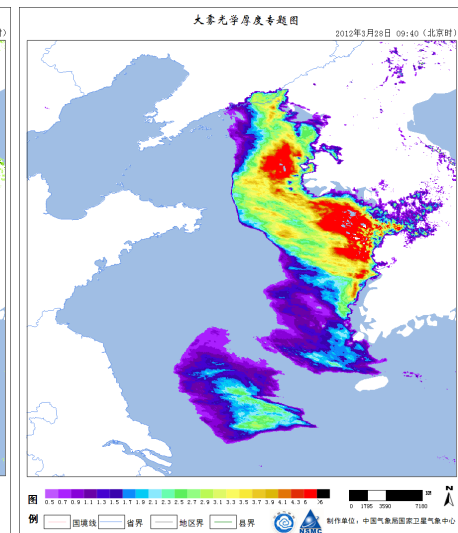
Fog RS Image



Liquid Water Path Map



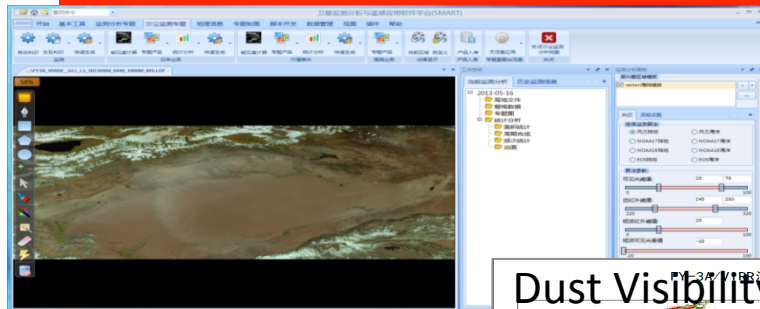
Fog Droplet Scale Map



Fog Optical Depth Map

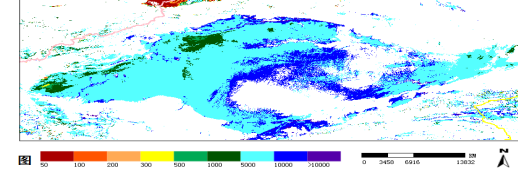
# Application Examples

## Dust monitoring

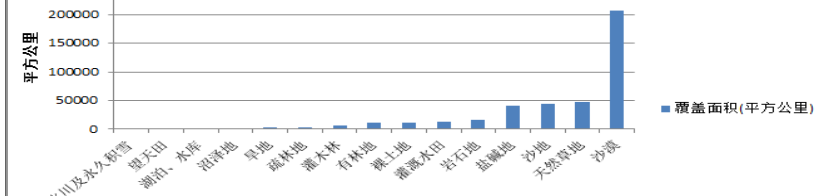


Dust RS Image

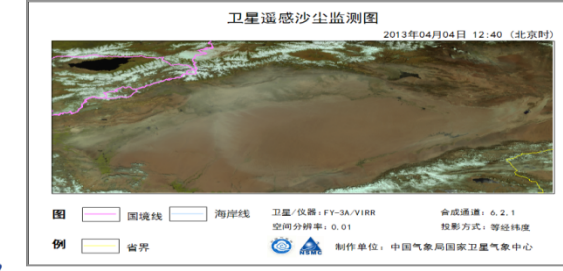
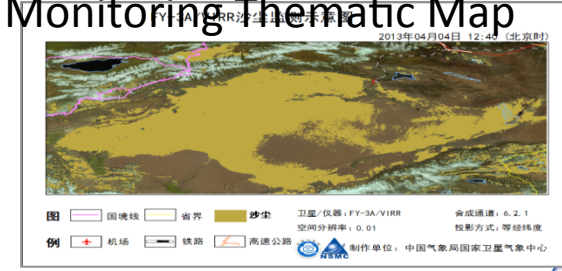
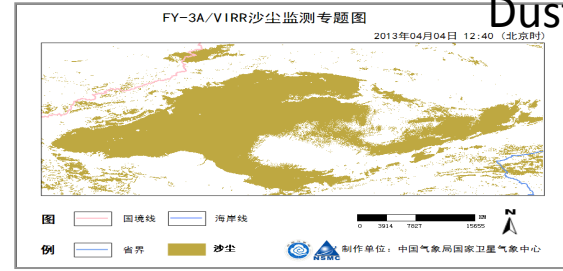
Dust Visibility Thematic Map



Dust Area Statistics Chart



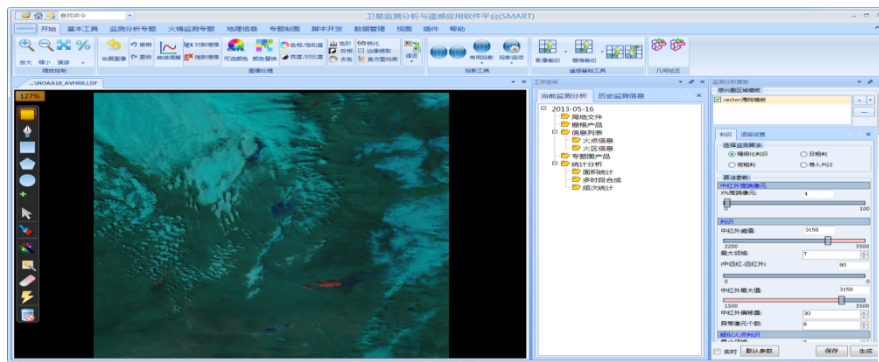
Dust Monitoring Thematic Map



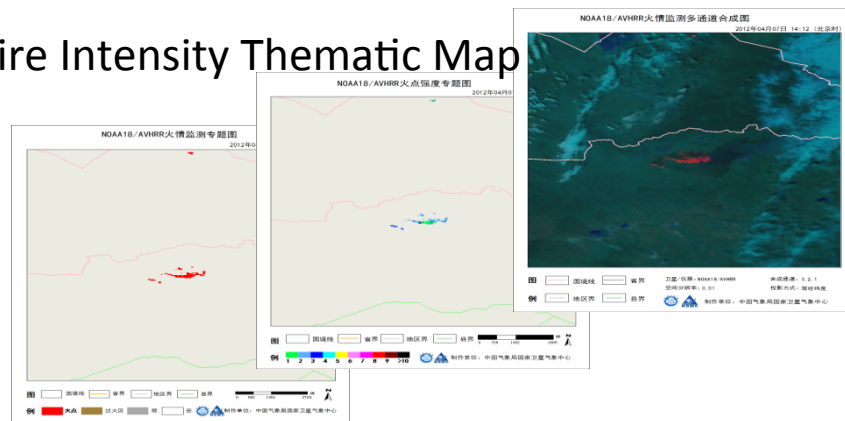
# Application Examples

## Fire monitoring

Fire RS IMAGE



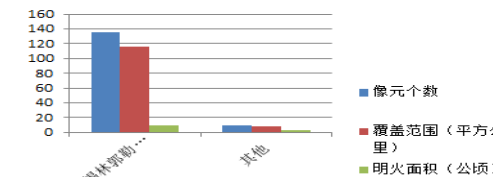
## Fire Intensity Thematic Map



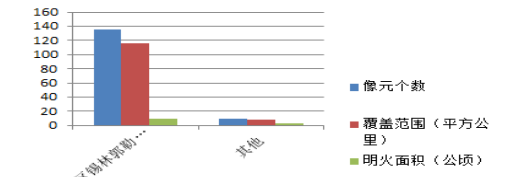
| 火情省市县面积统计       |       |        |            |            |
|-----------------|-------|--------|------------|------------|
| 统计日期: 2013/5/16 |       |        |            |            |
| 省/直辖市           | 市/区   | 县      | 覆盖面积(平方公里) | 累计面积(平方公里) |
| 内蒙古自治区          |       |        | 113.41     | 113.41     |
|                 | 锡林郭勒盟 |        | 113.41     | 113.41     |
|                 |       | 东乌珠穆沁旗 | 113.41     | 113.41     |

## Fire Area Statistics

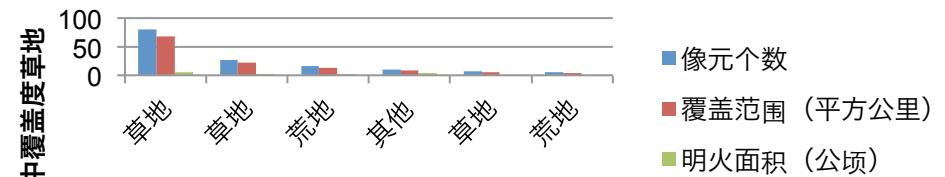
火情按分级行政区划面积统计



火情按分级行政区划面积统计



## 火情按土地利用类型面积统计

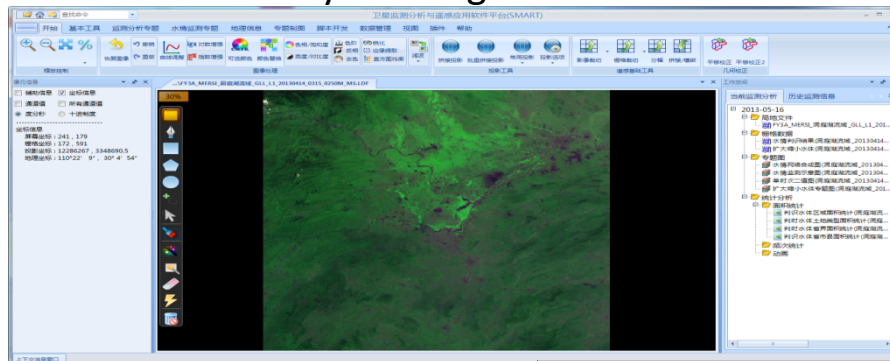




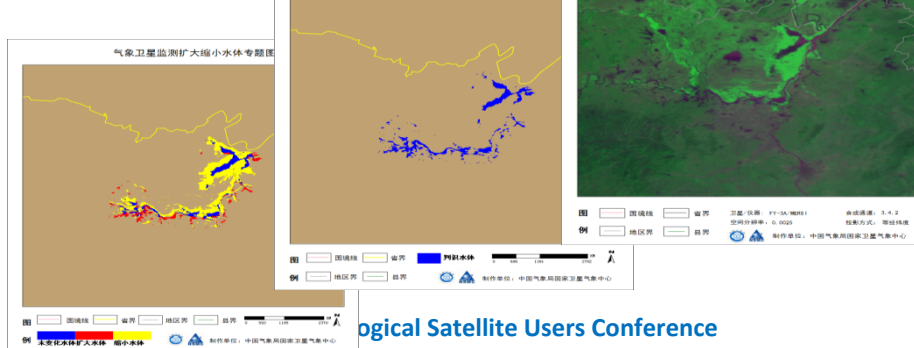
# Application Examples

## Water body monitoring

### Water Body RS Image

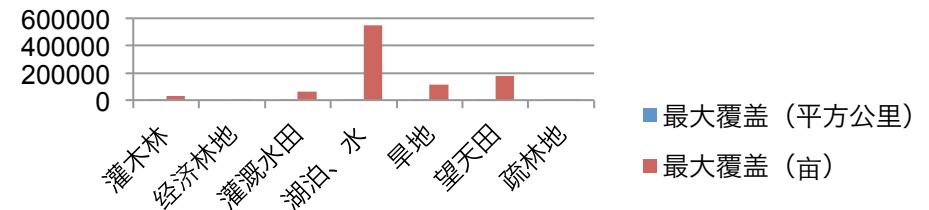


### Water Monitoring Thematic Map



| 水 情 省 市 县 面 积 统 计 |     |     |            |            |
|-------------------|-----|-----|------------|------------|
| 统计日期: 2013/5/16   |     |     |            |            |
| 省/直辖市             | 市/区 | 县   | 覆盖面积(平方公里) | 累计面积(平方公里) |
| 湖南省               | 岳阳市 |     | 661.8      | 661.8      |
|                   |     | 市辖区 | 415.24     | 415.24     |
|                   |     | 岳阳县 | 120.44     | 120.44     |
|                   |     | 华容县 | 149.77     | 149.77     |
|                   |     | 湘阴县 | 1.83       | 1.83       |
|                   | 常德市 | 汨罗市 | 116.17     | 116.17     |
|                   |     |     | 27.03      | 27.03      |
| 益阳地区              | 汉寿县 |     | 59.61      | 59.61      |
|                   |     |     | 59.61      | 59.61      |
|                   |     |     | 186.96     | 186.96     |
|                   |     | 沅江市 | 176.59     | 176.59     |
|                   | 益阳县 |     | 9.62       | 9.62       |
|                   |     | 南县  | 0.75       | 0.75       |

### Flood Area Statistics 水情按土地利用类型面积统计

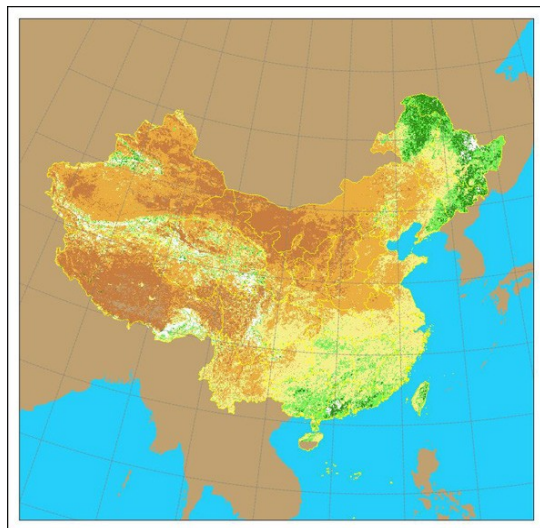


National Satellite Meteorological Center ,CMA

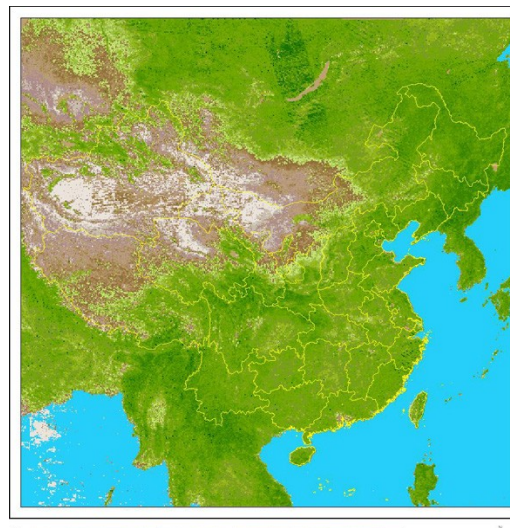
ological Satellite Users Conference

# Application Examples

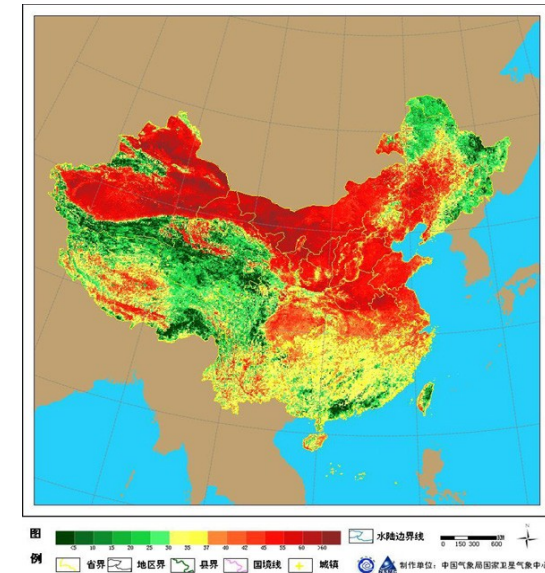
## Vegetation & Drought monitoring



Land Surface Temperature Map



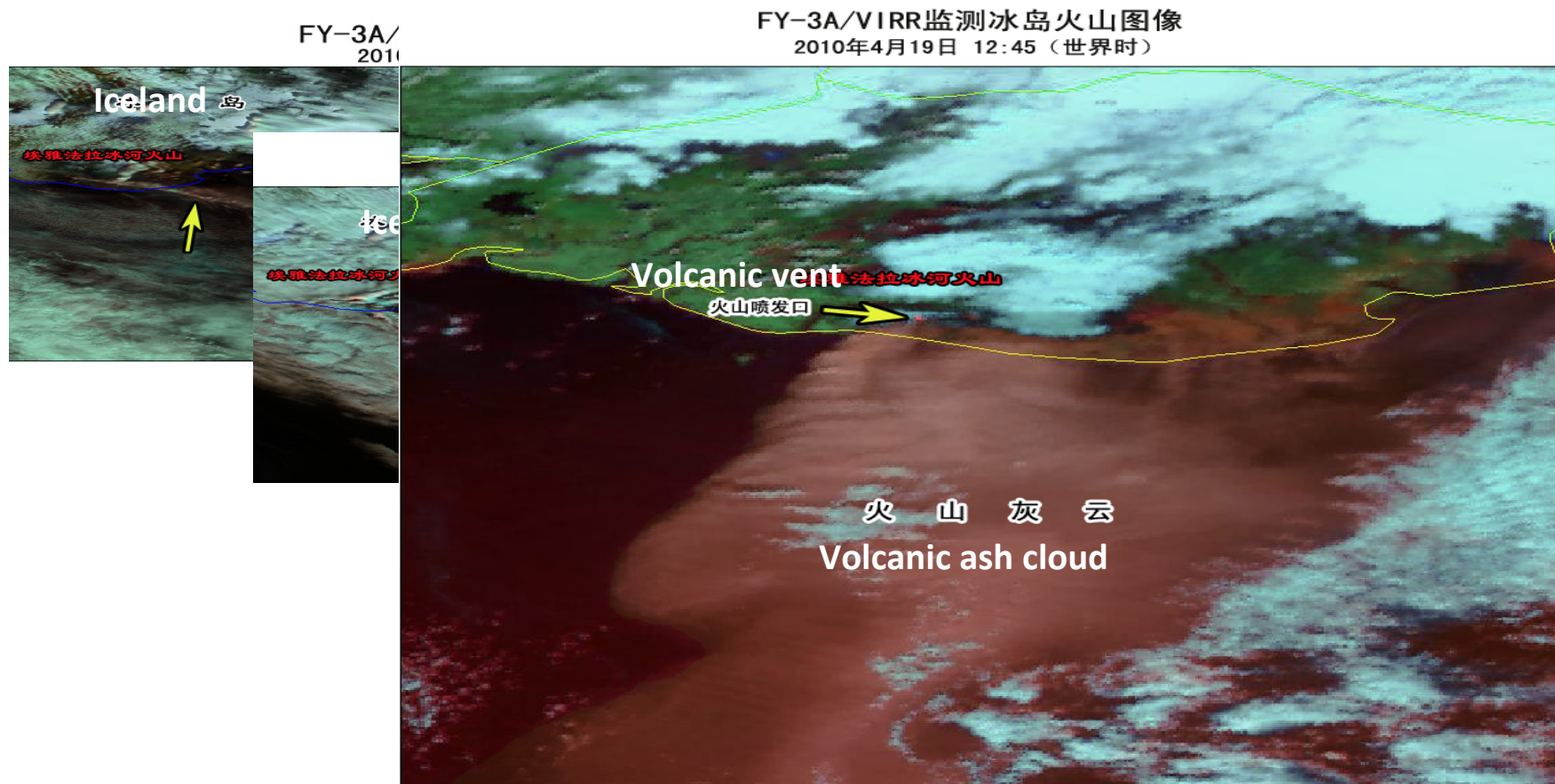
Vegetation Index Map



Drought Index Map

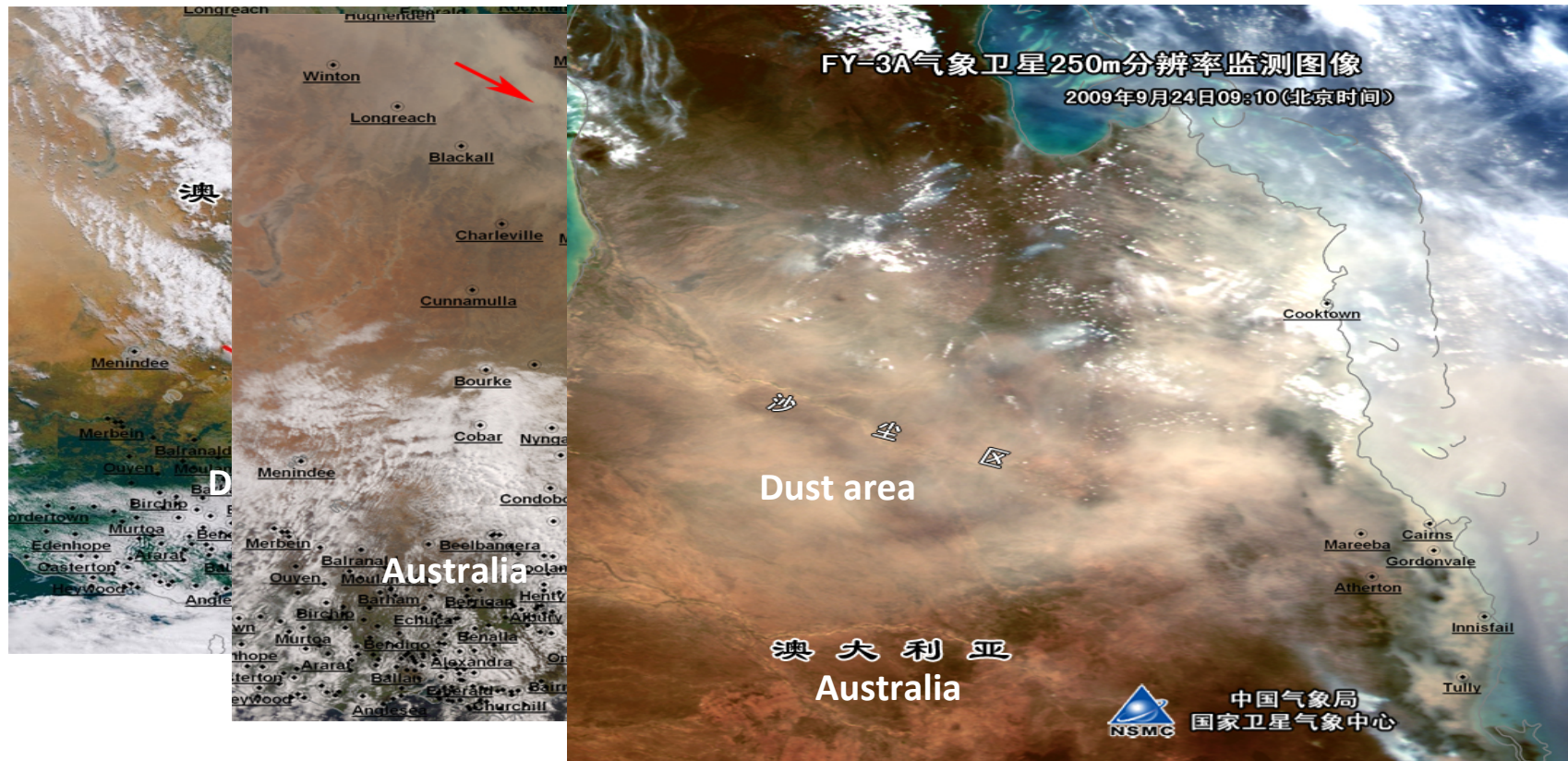
# Application Examples

## Volcanic ash in Iceland





# Dust Storm in Australia



# Application Examples

## Fire in Indonesia

FY3A/MERSI 真彩色



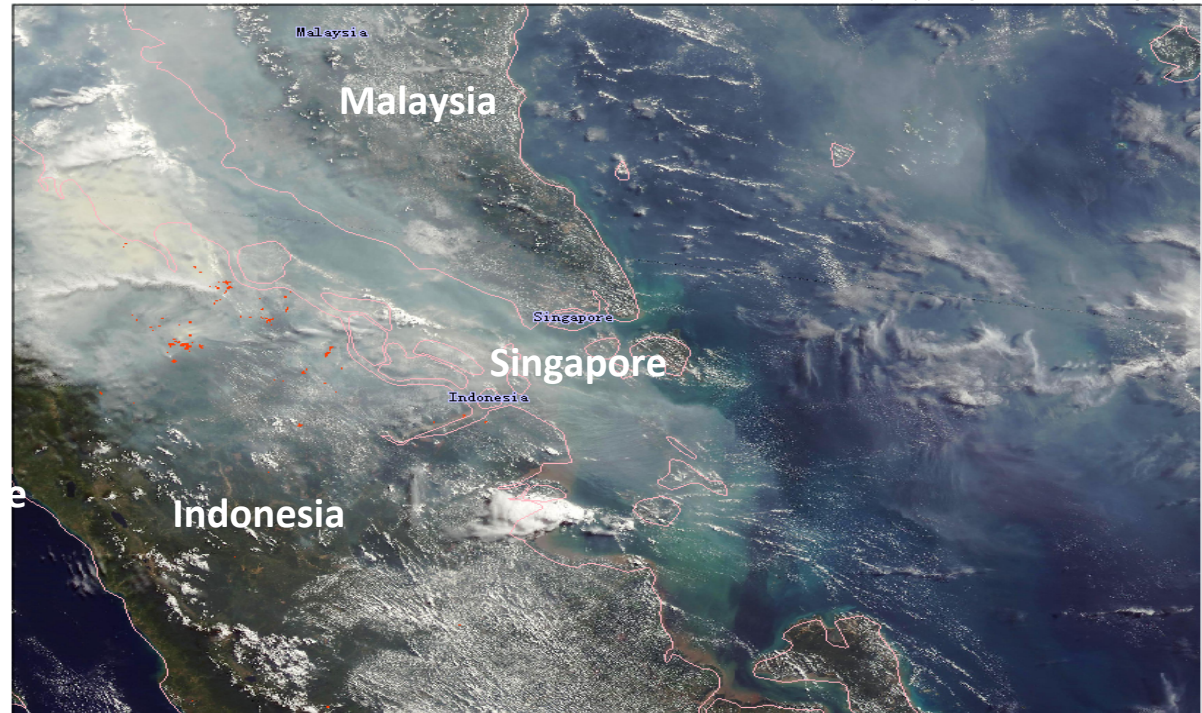
图

国境线 火点

例

FY-3A/MERSI 真彩色合成图与火点信息叠加

2013年06月25日 10:50 (北京时间)



图

国境线 省界

例

地区界 县界

卫星/仪器: FY-3A/MERSI

空间分辨率: 0.0025



制作单位: 中国科学院空间与地球信息研究所

合成通道: 3, 2, 1

投影方式: 等经纬度



# Application Examples

## Flood in India

FY-3A/MERSI 印度北部洪涝监测专

2013

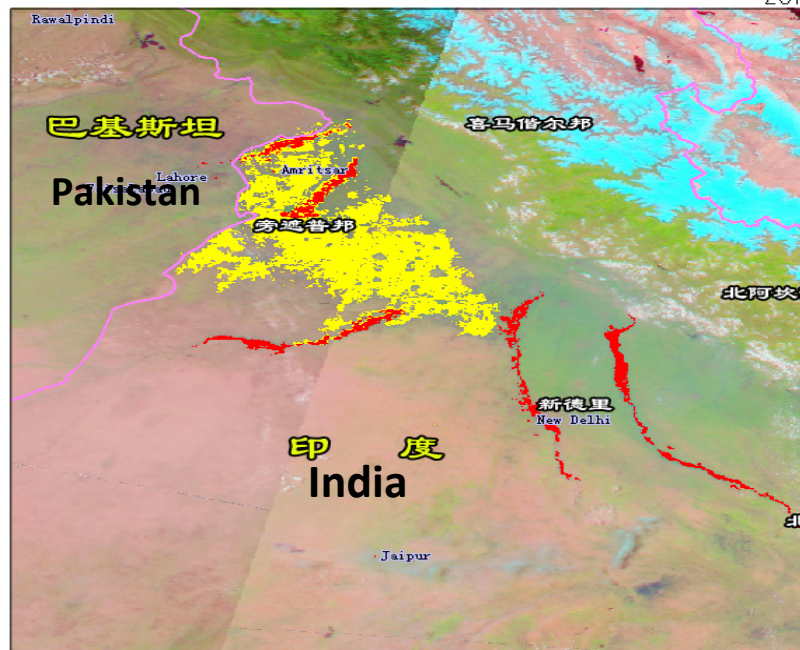


图 国境线

例 Waterlogging water Flood water

卫星/仪器: FY-3A/MERSI

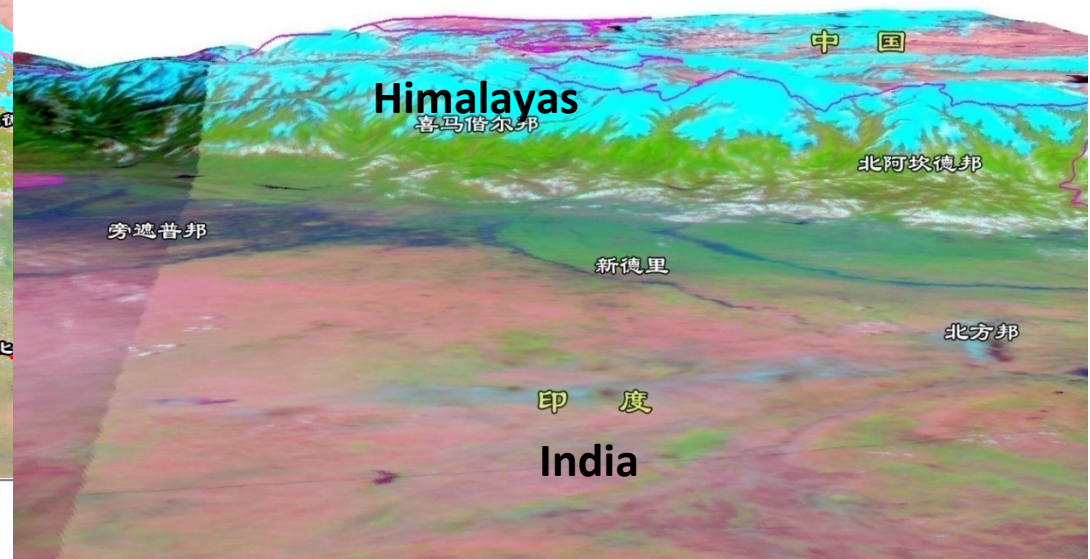
空间分辨率: 0.0025



制作单位: 中

FY-3A/MERSI 印度北部水体监测3D图

2013年06月20日 13:30 (北京时间)



中国气象局  
国家卫星气

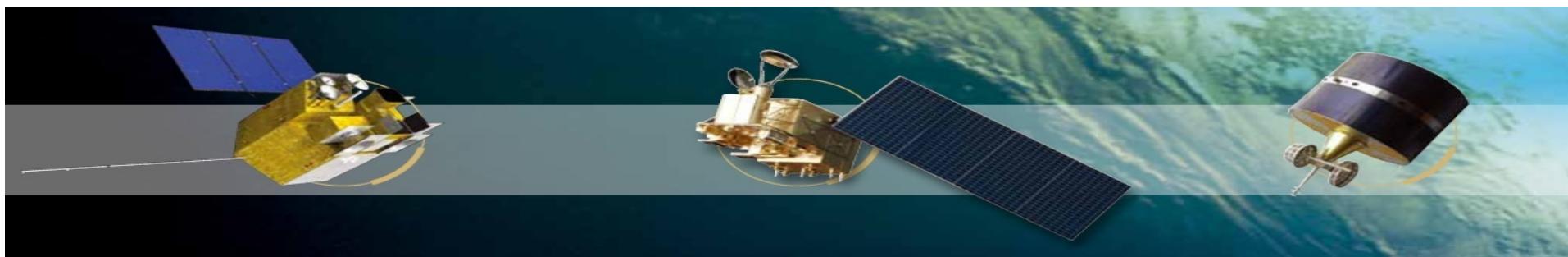


# Summary

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## SWAP and SMART

- ❑ **Powerful capability of data processing**
- ❑ **Support multi-source Data**
- ❑ **Capability of customized development**
  - Flexible software architecture
  - Component-based Develop Building block Deployment
  - Providing APIs and Standard Programming Environment
- ❑ **Collect data via CMACast ,Website**
- ❑ **The English version is now designed and provided soon**



***Thank you for your kindly attention!***

