FengYun 2C and It's Application

Celebration of CIMSS's Silver Anniversary

- Review of over 25 years' bilateral cooperation
- Products from FY2C Meteorological Satellite

P. Zhang on behalf of Xu Jianmin

CIMSS

NSMC

Visitors from NSMC to CIMSS

- **1980s: Fengxian Zhou, Xia-Lin Ma, Zonghao Wang, Yanni Qu**
  - McIDAS was introduced and used on NSMC
  - ITPP PC version was generated and distributed
- **1990s: Jun Li, Wenjian Zhang**
  - ITPP improved version was generated and distributed
  - IAPP was generated and distributed
- **2000s: Zhongdong Yang, Xuebao Wu, Peng Zhang, Feng Lu**
  - IMAPP algorithm and software development
  - GOES calibration

CIMSS

NSMC

Other short visitors

- Academician: Jianmin Xu
- Academician: Bolin Zhao
- Former NSMC director: Chaohua Dong
- Prof. Yuanjing Zhu

Staff here from NSMC

- Xuanji Wang
- Hong Zhang

CIMSS

NSMC

CIMSS visitors to NSMC

Tom Achtor,
Chris Velden,
Hank Revercomb,
Jun Li,
Allen Huang,
Paul Menzel,
Liam Gumley,
Hal Woolf,
Steve Ackerman ……

CIMSS

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WMO - OMM

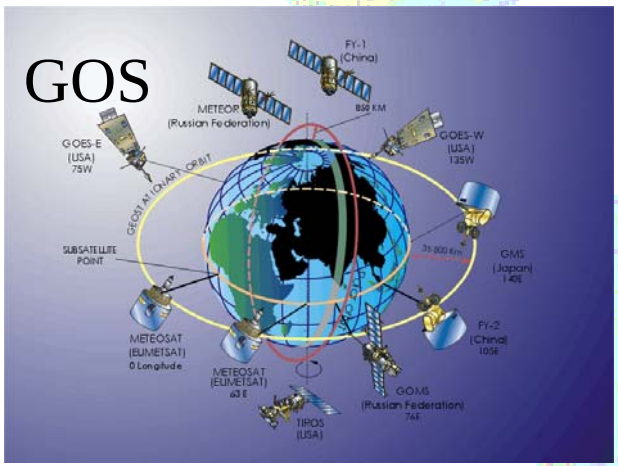
NSMC and NESDIS/ORA

* Working together on WMO Expert Team that is influencing vision of Global Observing System of 2015

* Sharing DB Processing Packages for FY2 plus MODIS & AIRS

* Conducting remote sensing seminars in real and virtual labs

GOS



X-band Antenna

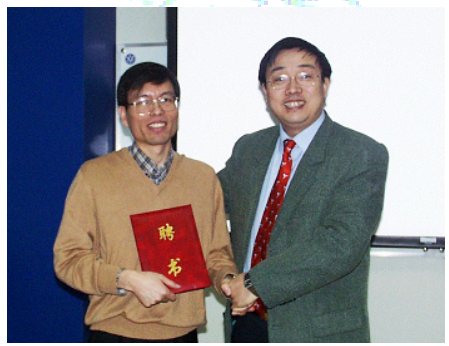
Classroom in China

NSMC

Dr Jun Li of NESDIS/CIMSS awarded title “guest chief scientist’ by NSMC in March 2003

Dear Paul, Hank, Steve, and Tom,

I am pleased to inform you that Dr. Jun Li, a scientist at your center, has been awarded the title of "guest chief scientist" on satellite atmospheric sounding by National Satellite Meteorological Center (NSMC) of China in March. He is the first scientist out of NSMC who has received this title. A certificate (Chinese version) has been given to him. From our point of view, Dr. Jun Li's research work, talent, and publications on atmospheric remote sounding during the past 10 years are highly recognized at NSMC. In addition, he has not only made great achievements in research, but also made great contribution in promoting the cooperative research work between NSMC and CIMSS on processing and applying data from both U.S. and Chinese weather satellites. ……

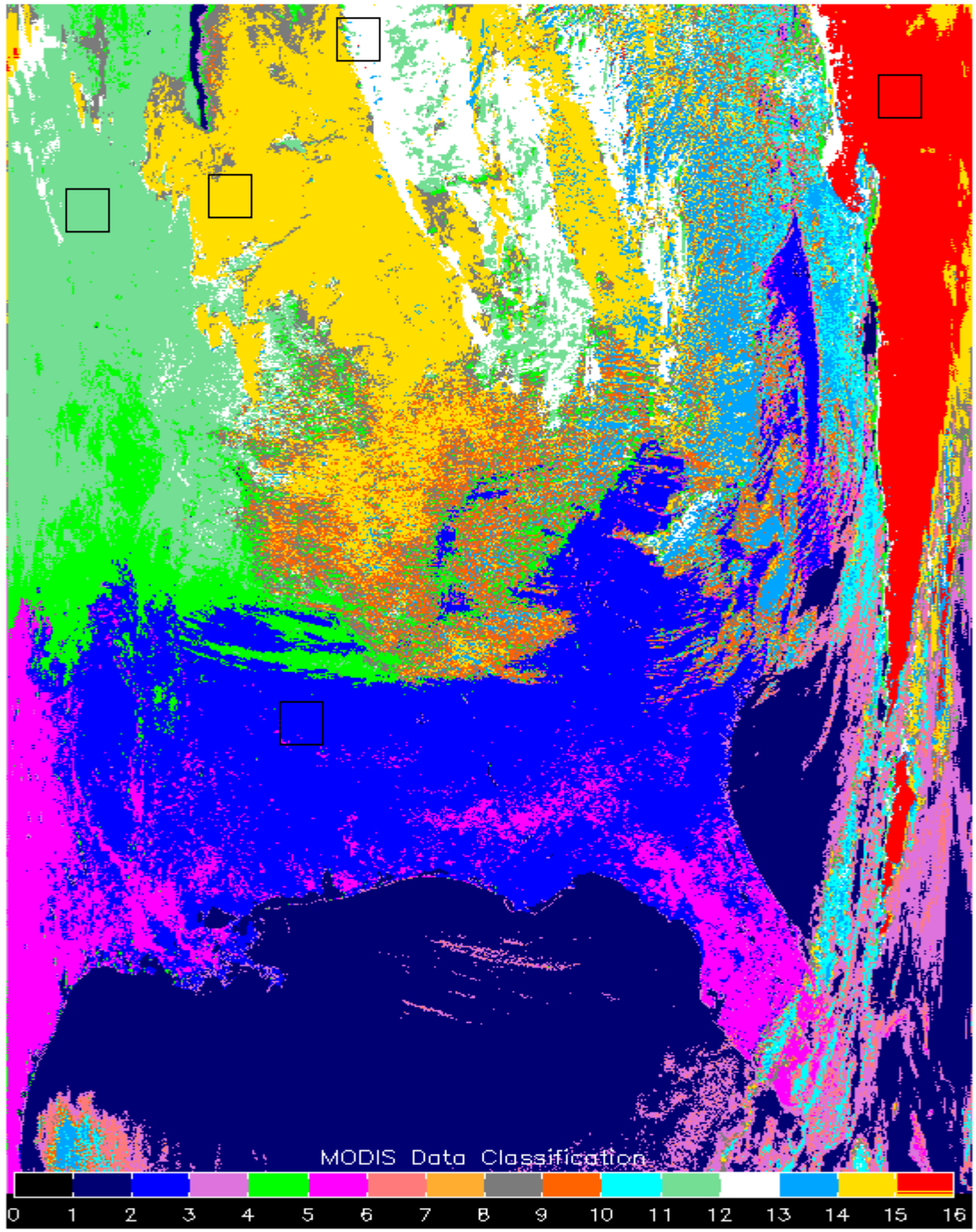


Sincerely,

Wenjian Zhang
Director General National Satellite Meteorological Center(NSMC) of China

MODIS identifies cloud Classes

By Zhongdong Yang



Hi cld

Mid cld

Lo cld

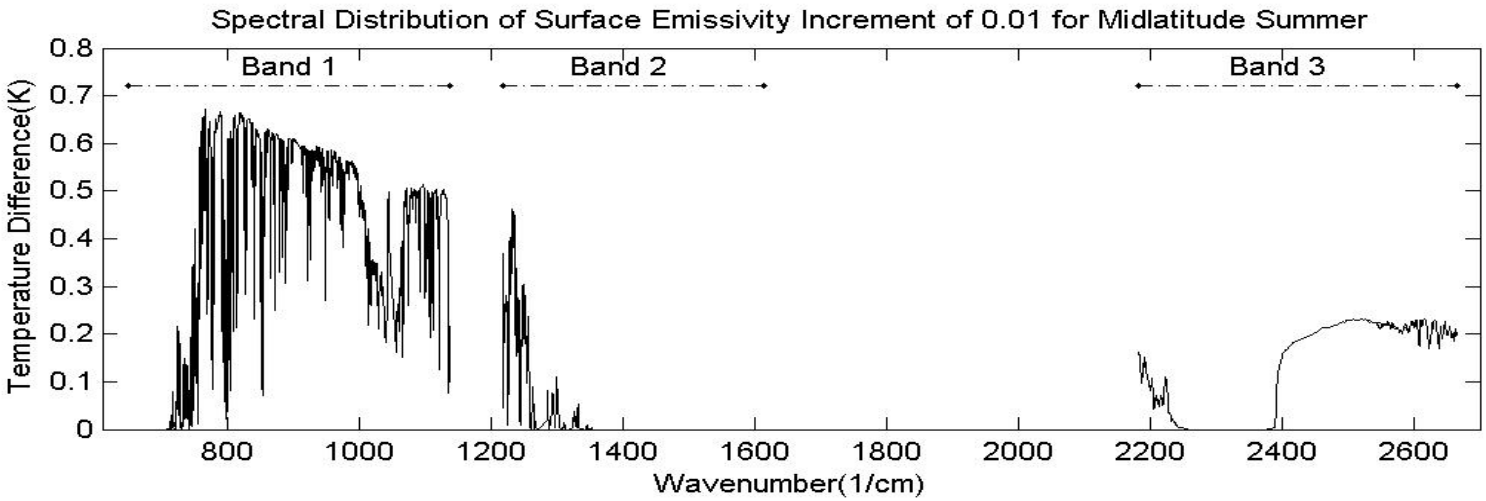
Snow

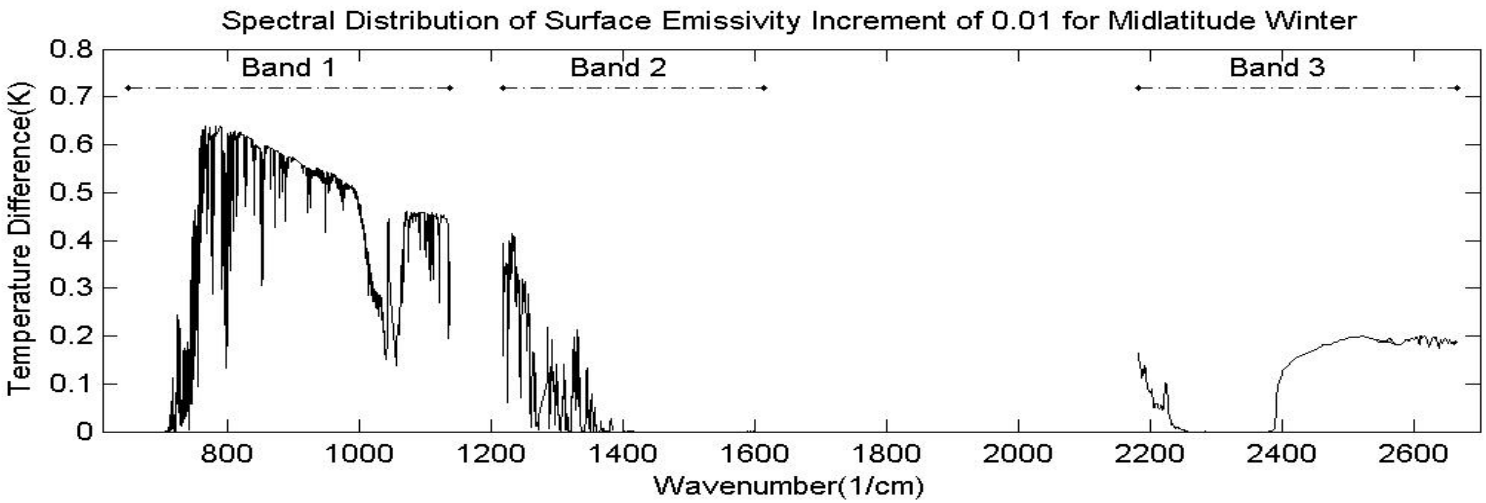
clr

CIMSS

NSMC

Sensitivity Study for Land Surface Emissivity by Xuebao Wu





PhD work with Prof Zhu Yuanjing

with guidance from Paul Menzel (NESDIS) and Zhang Wenjian (NSMC)

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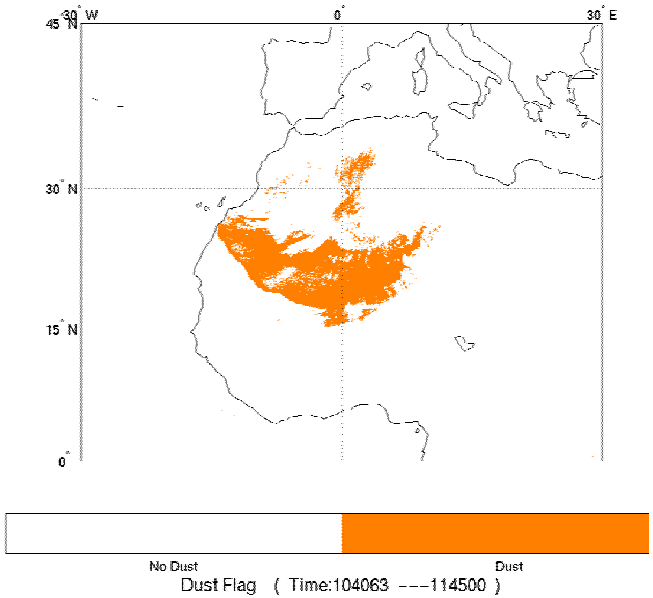
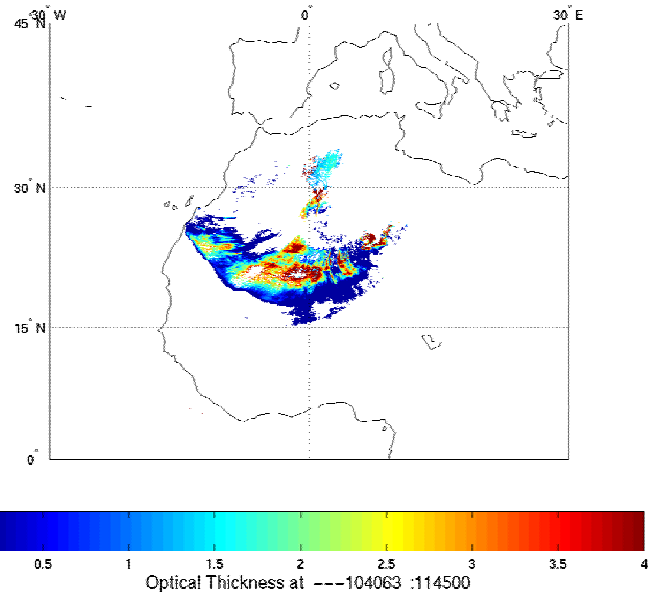
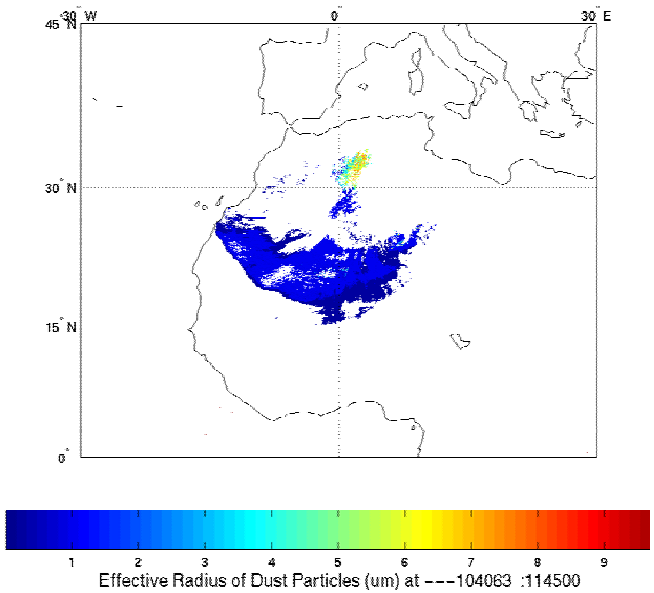
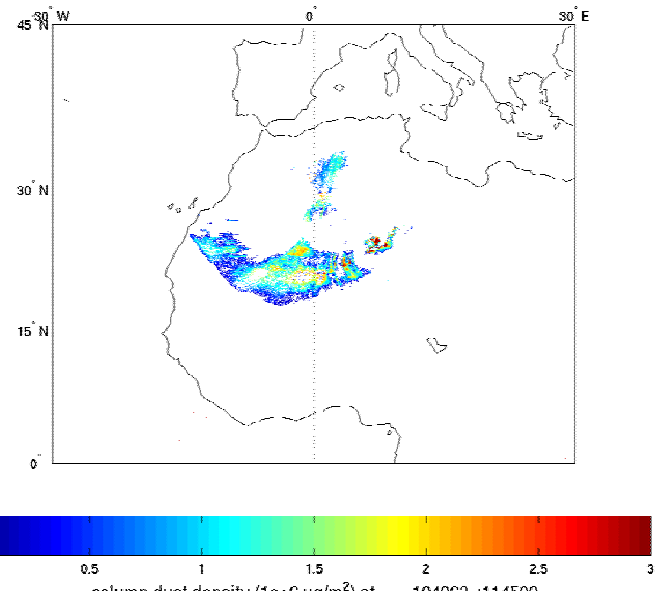
Dust Storm Remote Sensing with 3 TIR channels

By Peng Zhang



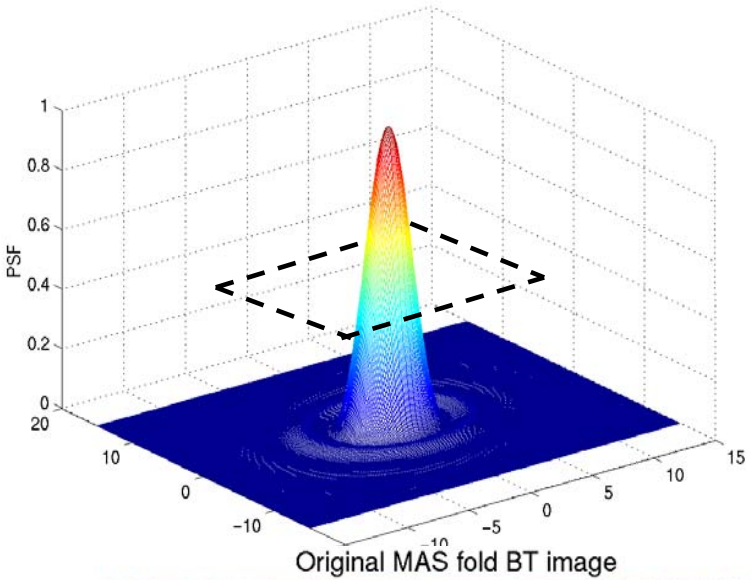


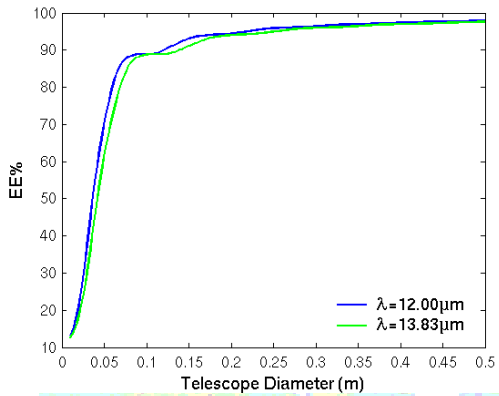


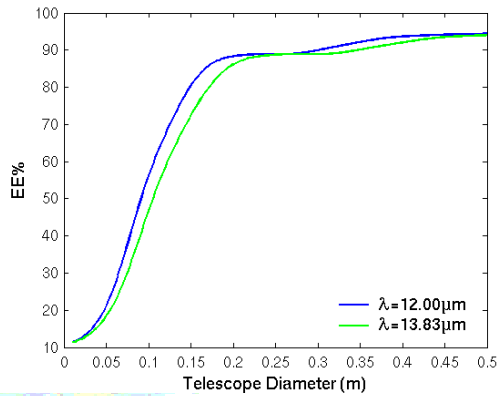


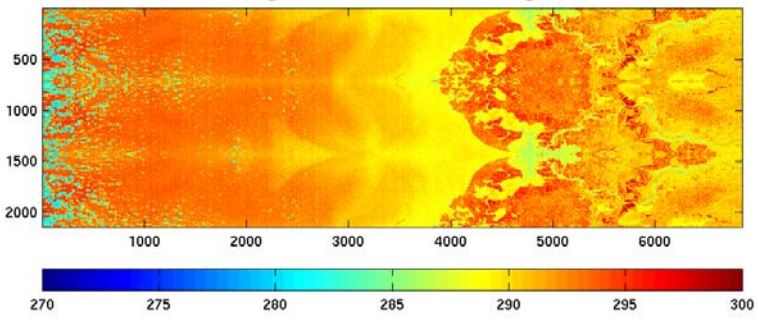
EE Effects on GOES-R HES Simulated from MAS data

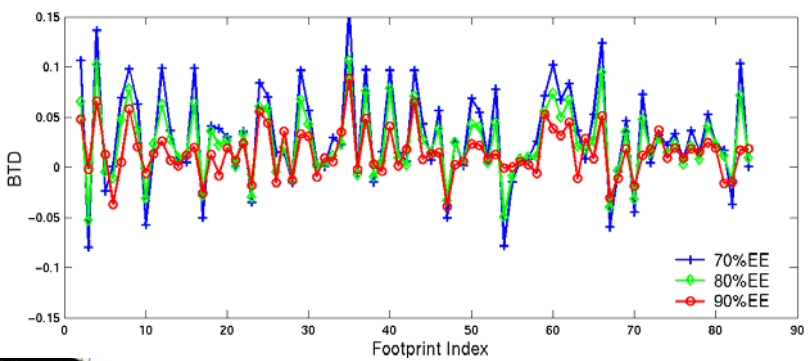
By Peng Zhang

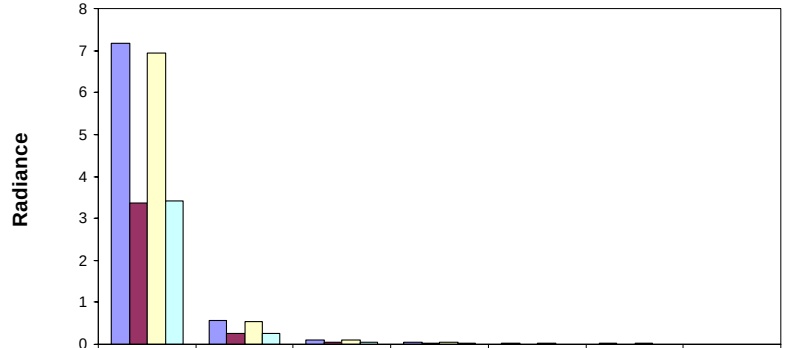












	FOV	1st nbr	2nd nbr	3rd nbr	4th nbr	5th nbr	others
clear 12.00	7.1592	0.5653	0.1135	0.0503	0.027	0.0176	0.0121
clear 13.83	3.3778	0.266	0.0537	0.0238	0.0128	0.0084	0.0057
cloudy 12.00	6.9406	0.5472	0.1098	0.0487	0.0261	0.017	0.0117
cloudy 13.83	3.423	0.2696	0.0544	0.0241	0.0129	0.0085	0.0058

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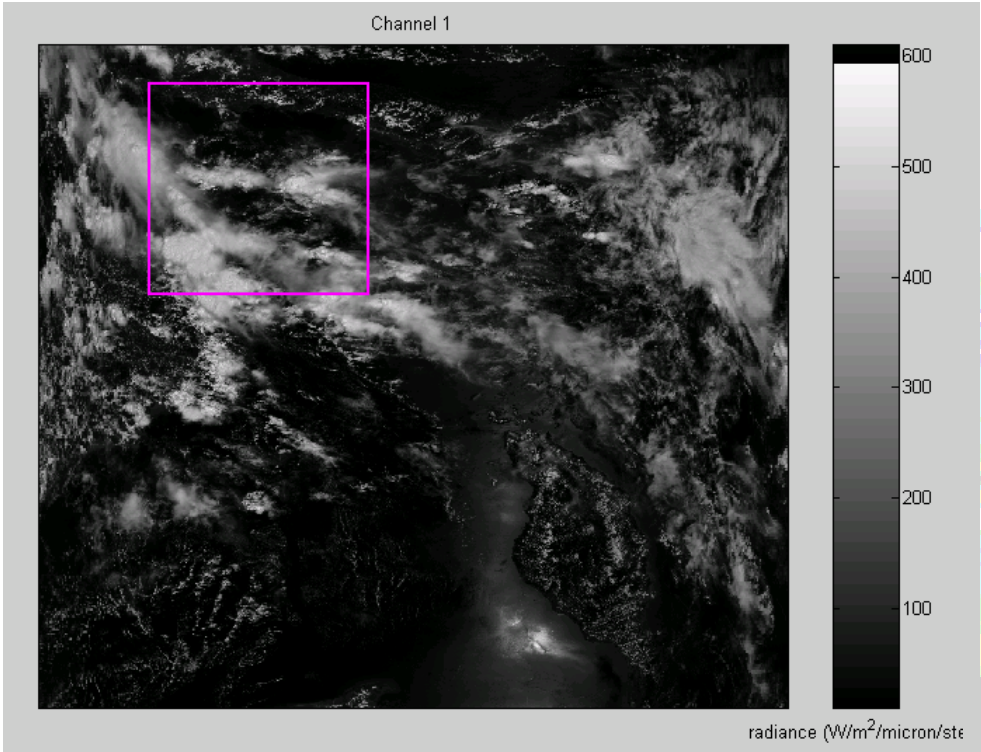
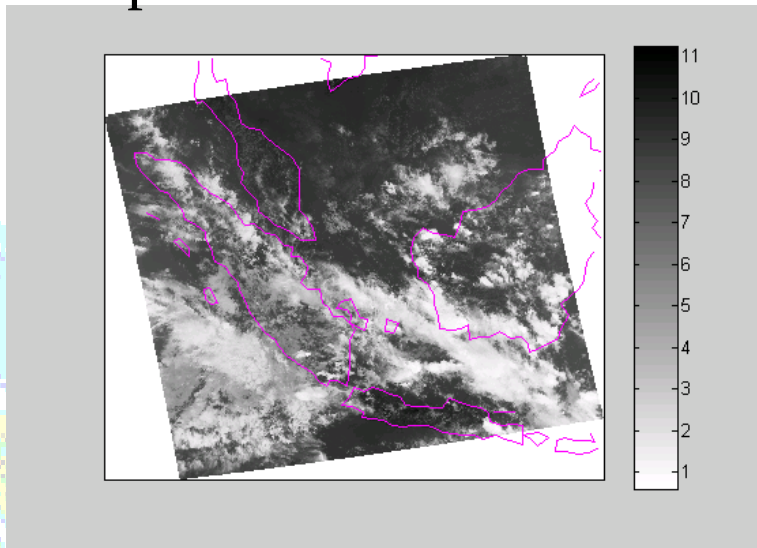
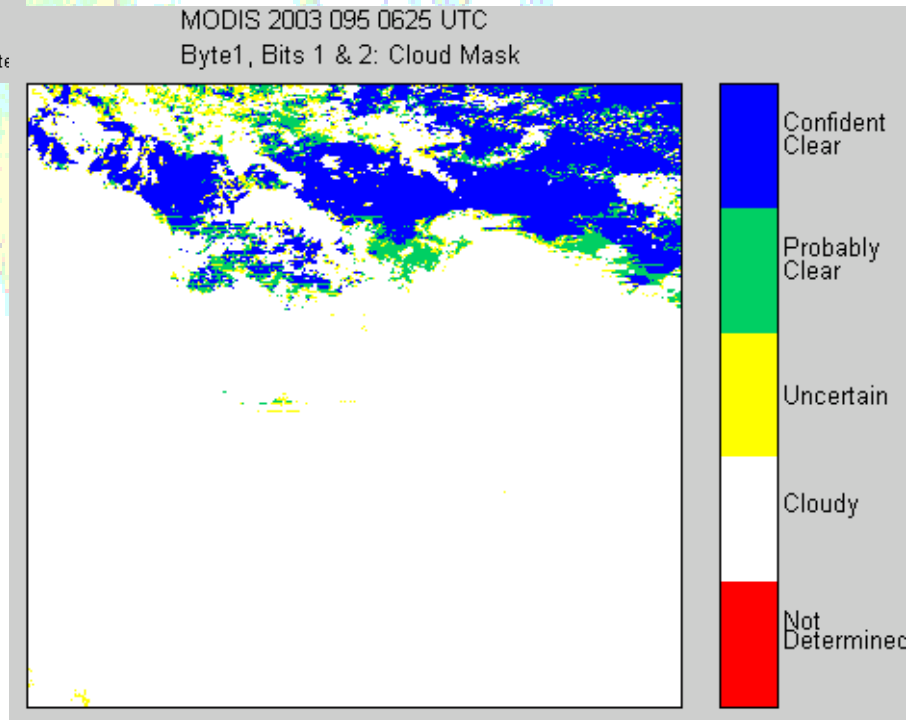


Example over Indonesian Seas



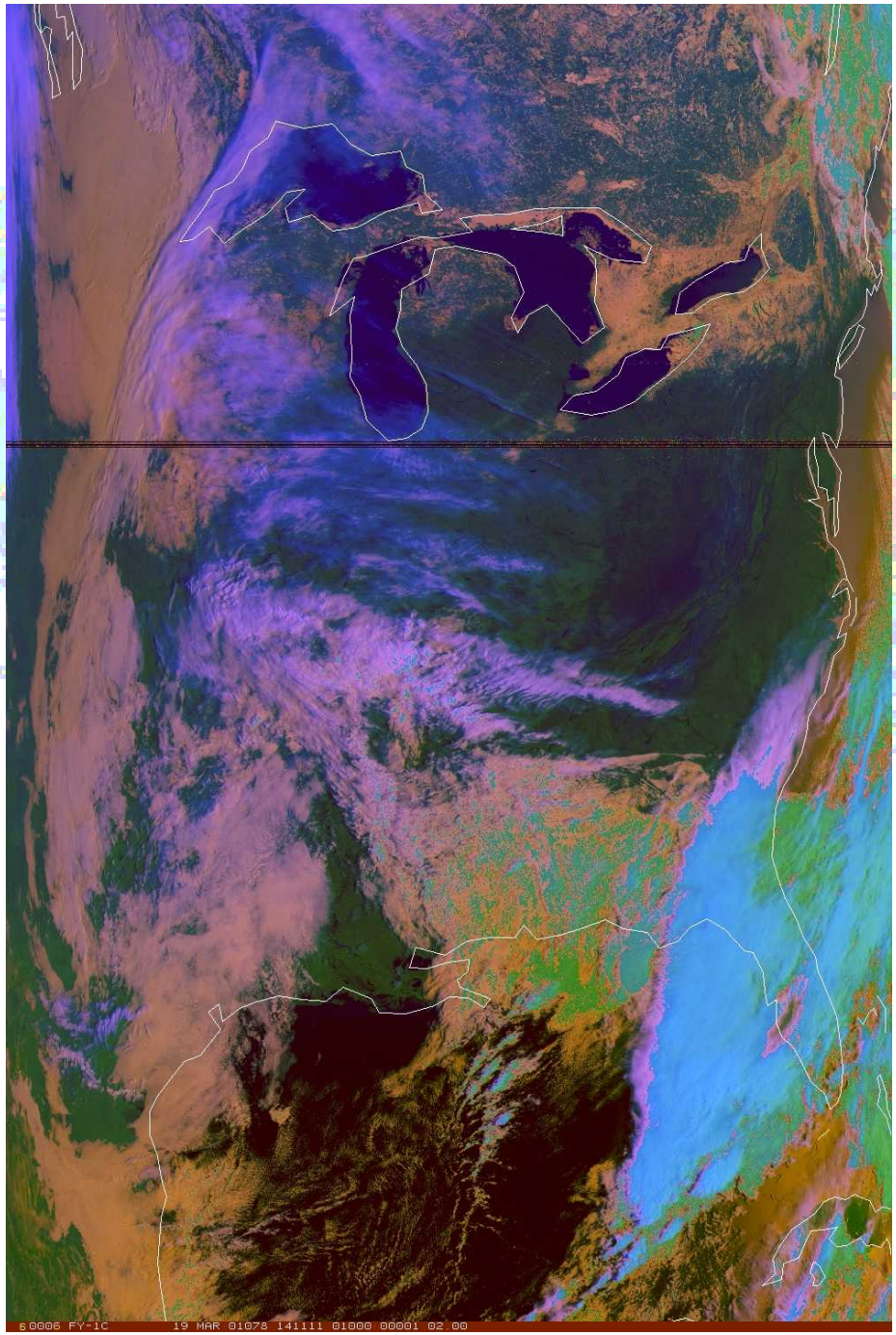


MODIS direct reception software developed at NESDIS/CIMSS and implemented at NSMC added generation of cloud mask & level 2 cloud and clear sky products

CIMSS


MODIS sees fires in China

FY1C sees clouds over CONUS



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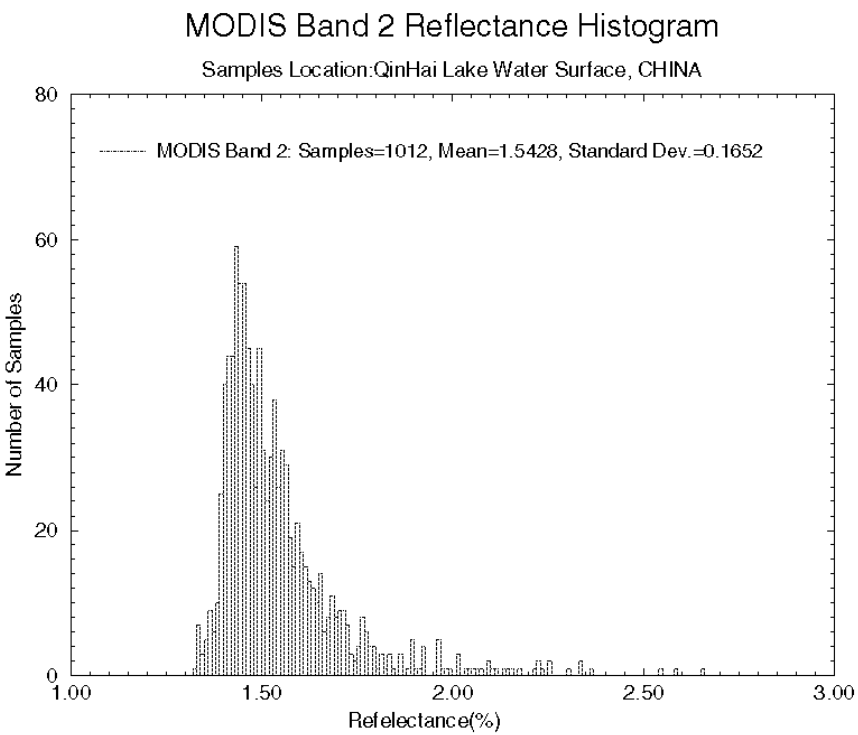
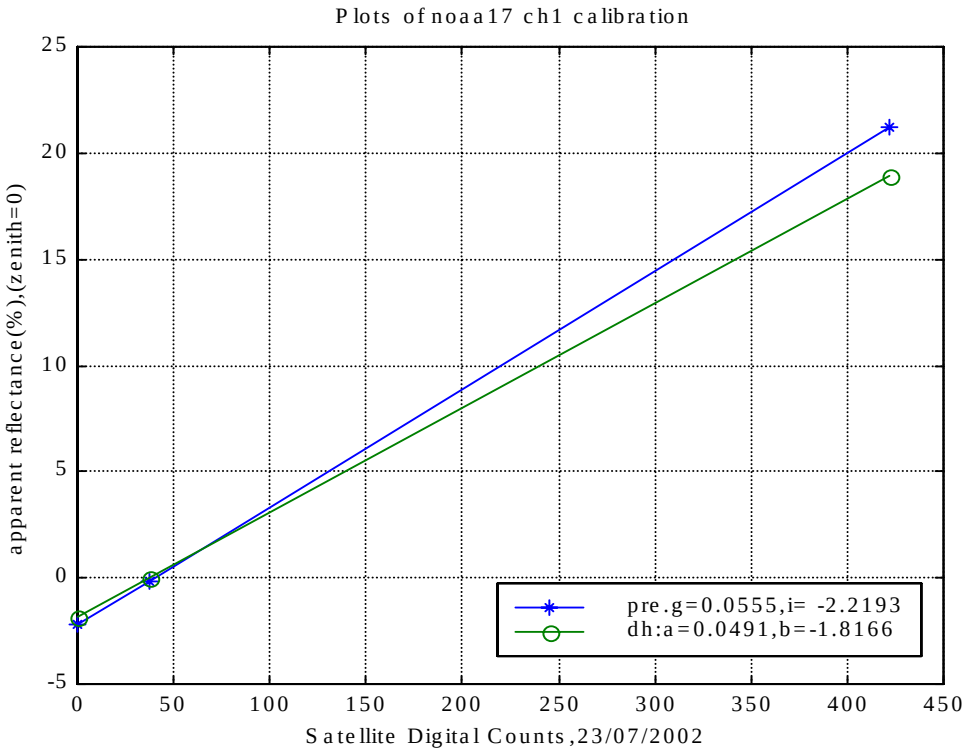
Continuing Collaboration on Cal/Val on Remote Sensing Instruments using instrumented ground sites



Calibra
Band
1.5%

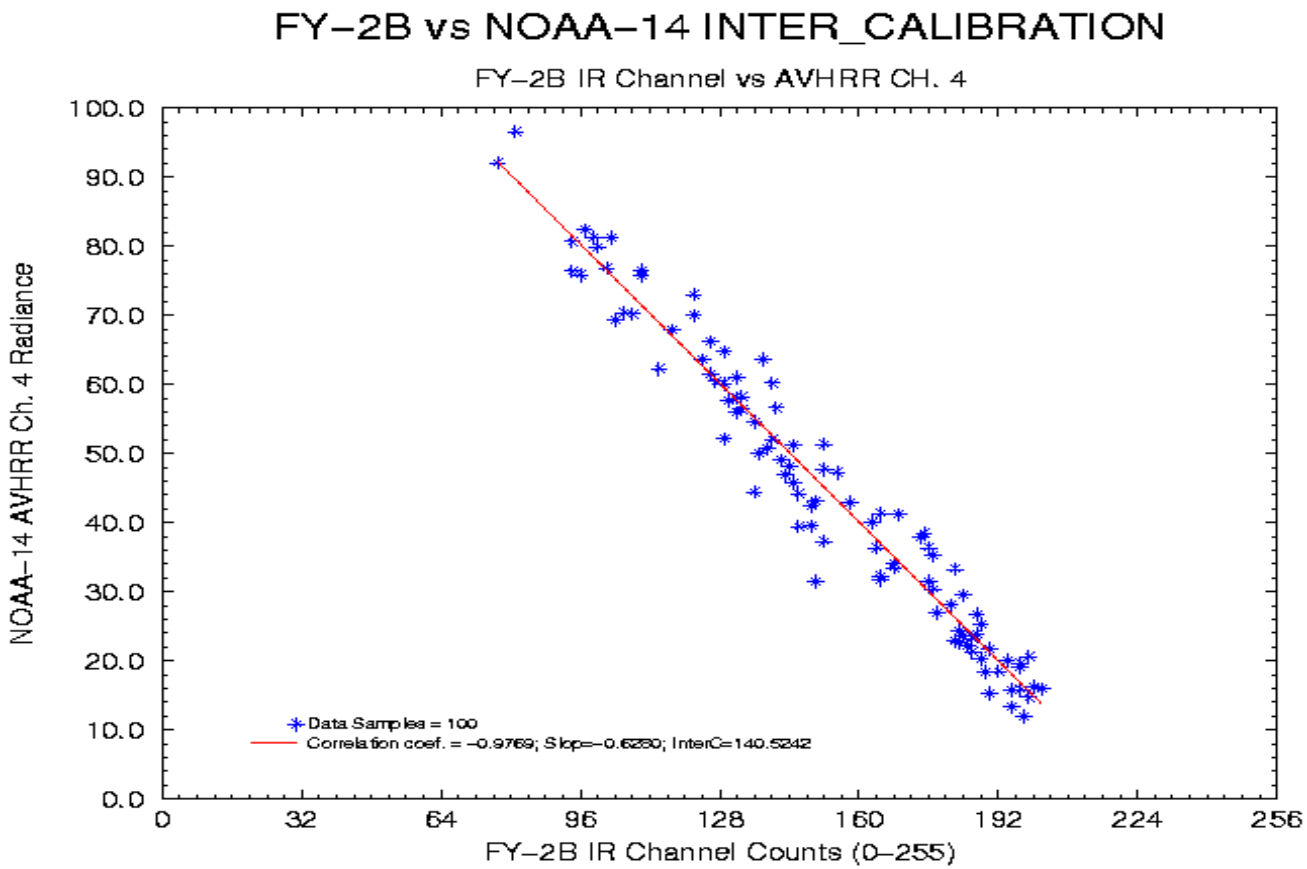


Calibration of NOAA 17 AVHRR ch1 pre and post launch comparison

ZhangYuxiang, Rongzhiguo, HuXiuqing, Zhanglijun, Qiukangmu, Xu Jiamin and students

CIMSS

Intercalibration of geostationary FY2B and polar orbiting NOAA AVHRR & HIRS demonstrated



It remains to be done routinely

CIMSS

NSMC

Impact of Cooperation between CIMSS and NSMC

- Benefit to CIMSS
  - Visitors helps to finish CIMSS projects
  - Visitors help to develop software packages for communities
    - ITPP, IAPP, IMAPP
- Benefit to NSMC
  - Satellite data processing software was used for processing FY data
  - The first DB ground station for EOS data in China by Paul and Liam
  - Visitors play key role in China (e.g.)
    - Wenjian Zhang: Director of NSMC
    - Zhongdong Yang: Chief Engineer of NSMC
    - ……

CIMSS

NSMC

As far as the overarching issue of the importance of the **U.S.-PRC Atmosphere Protocol**, there are a number of issues of note:

• **Data Access**: China currently has a free and open data access policy and plans to continue this policy in the future.

• **Future Satellite Coordination**: NSMC has indicated a willingness to fly their next generation polar satellites to enhance the NPOESS-Metop constellation by filling potential gaps with its AMSU-like instrument as well as its future ocean color instruments.

• **Added Expertise**: Bilateral cooperation has opened doors for several Chinese scientists to work in NOAA labs and to contribute to the research programs and to return to China with added expertise for Chinese utilization of the Global Observing System.

• **Virtual Lab**: US-PRC cooperation has generated interrogation tools for the web based Virtual Lab, which is used for international training exercises by the WMO.

• **DB Data and Software**: Cooperation with China has enabled reception of DB data from FY1B and 1C at several NOAA offices, most notably at the Fairbanks NWS Field Office.

• **RAMSDIS**: While serving as a visiting scientist to CIRA, NSMC's General Director Yang Jun 's expertise was critical to the development of RAMSDIS. RAMSDIS proved a big asset to NOAA/ NWS. Also, RAMSDIS made possible the virtual laboratory for satellite data utilization.

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Products from FY2C Meteorological Satellite

Leading Scientist: Xu Jianmin

FY2C Data Processing Team

Fang Xiang, Fan Changyao, Gao Yun, Hu xiuqing, Li Sanmei, Li Yajun, Liu Cheng, Liu Jian, Lu Feng, Lu Naimeng, Luo Jingning, Rong Zhiguo, Shi Chunxiang, Xian di, You ran, Yuan wanping, Wang Baohua, Wang Sujuan, Wang Weihe, Wu Xiao, Wu Xiaojing, Xu Jianmin , Zhang Huayi, Zhang Qisong, Zhang Yuxiang, Zhang Xiaohu, Zhao Hongmiao, Zheng Zhaojun, Zhu Xiaoxiang

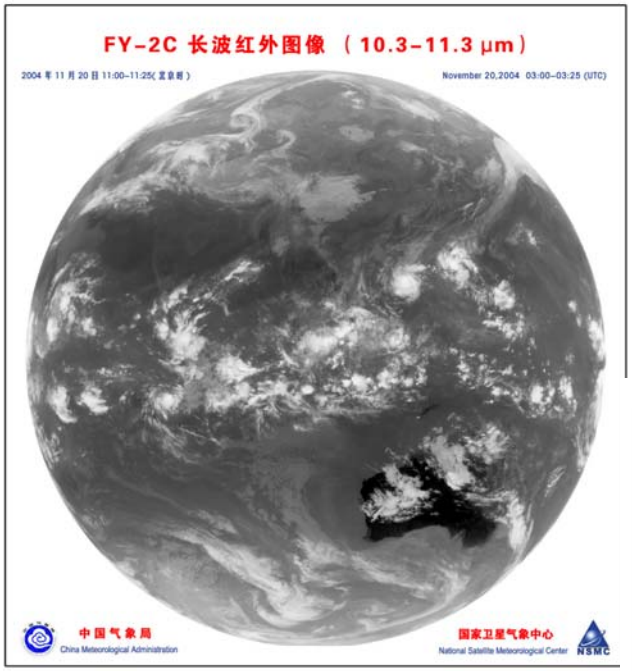
Content

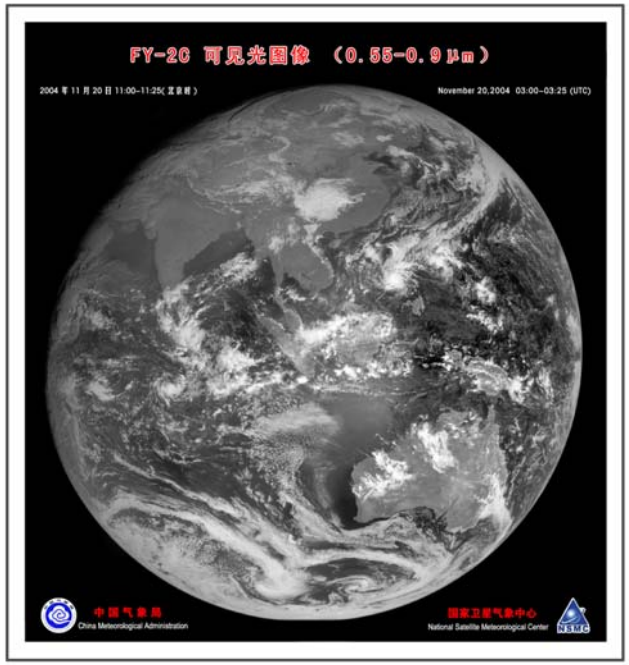
- General introduction to FY2C
- FY2C image registration, **navigation**, calibration status
- Products from FY2C

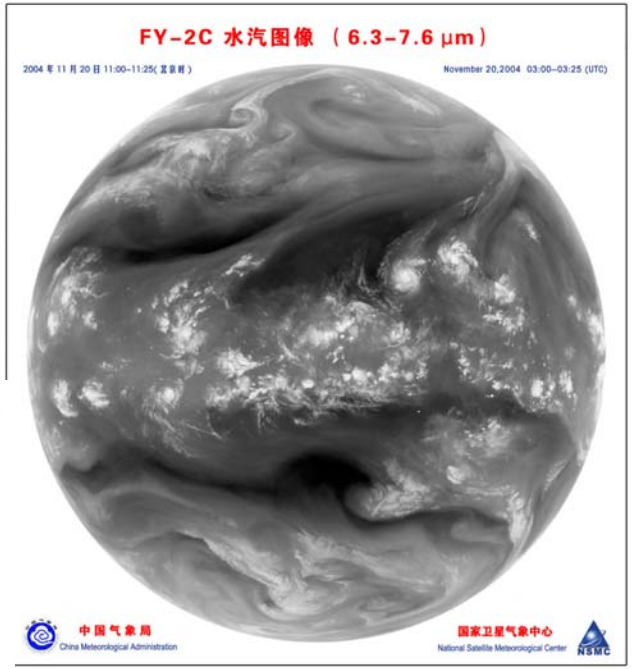
FY2 Meteorological Satellite

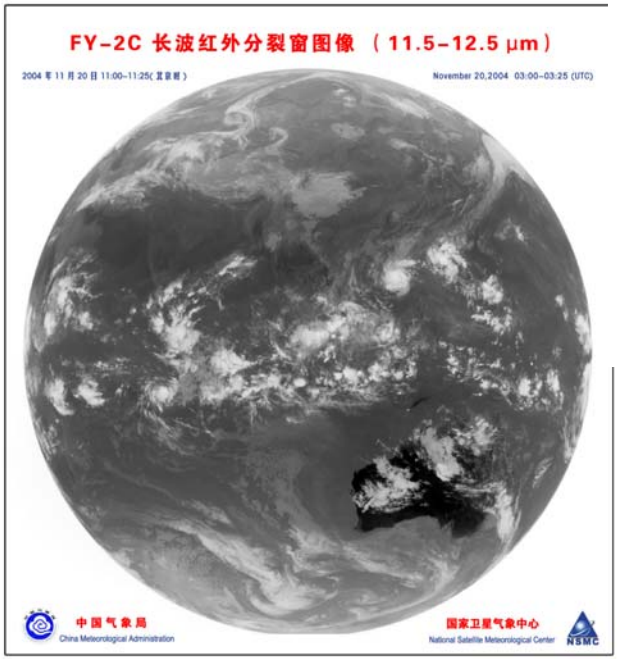
FY-2C 5 Channel Radiometer

Channel	Wavelength (μm)	Quantification Level
VIS	0.55 0.90	6 bits
IR1	10.3 11.3	10bits
IR2	11.5 12.5	10bits
IR3	6.3 7.6	10bits
IR4	3.5 4.0	10bits


FY-2C 长波红外图像 （10.3-11.3 μm）
2004 年 11 月 20 日 11:00-11:25(北京时)
November 20,2004 03:00-03:25 (UTC)
中国气象局
China Meteorological Administration
国家卫星气象中心
National Satellite Meteorological Center
NSMC


FY-2C 可见光图像 （0.55-0.9 μm）
2004 年 11 月 20 日 11:00-11:25(北京时)
November 20,2004 03:00-03:25 (UTC)
中国气象局
China Meteorological Administration
国家卫星气象中心
National Satellite Meteorological Center
NSMC


FY-2C 水汽图像 （6.3-7.6 μm）
2004 年 11 月 20 日 11:00-11:25(北京时)
November 20,2004 03:00-03:25 (UTC)
中国气象局
China Meteorological Administration
国家卫星气象中心
National Satellite Meteorological Center
NSMC


FY-2C 长波红外分裂窗图像 （11.5-12.5 μm）
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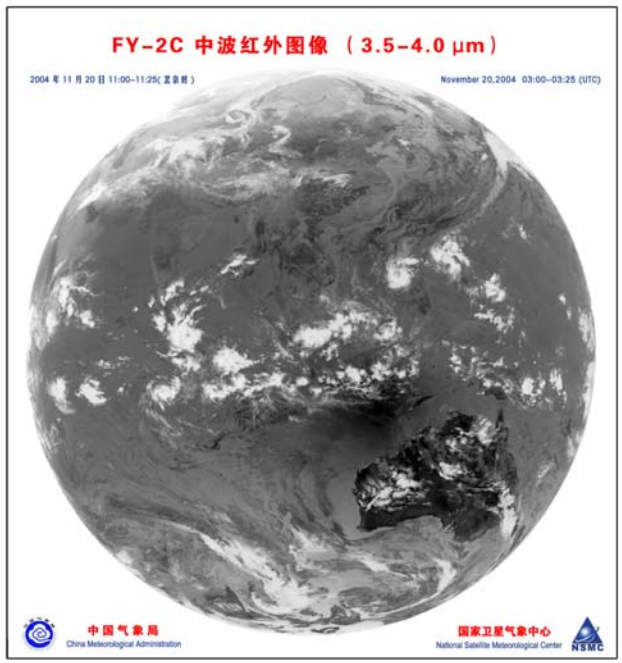
November 20,2004 03:00-03:25 (UTC)
中国气象局
China Meteorological Administration
国家卫星气象中心
National Satellite Meteorological Center
NSMC

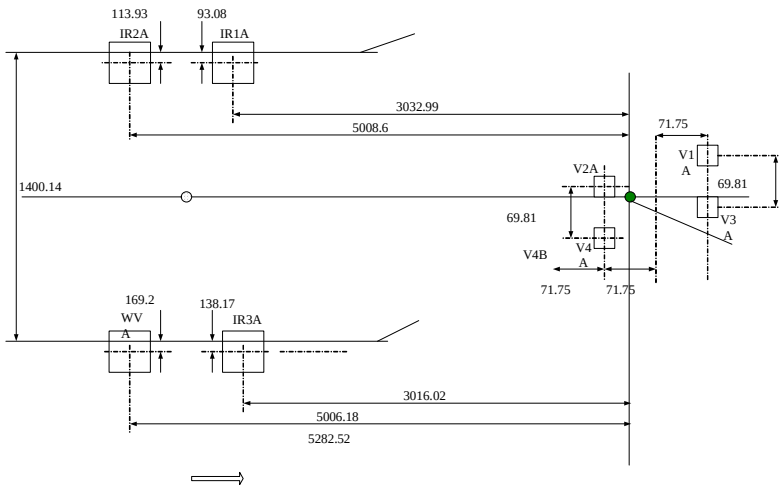

FY-2C 中波红外图像 （3.5-4.0 μm）
2004 年 11 月 20 日 11:00-11:25(北京时)
November 20,2004 03:00-03:25 (UTC)
中国气象局
China Meteorological Administration
国家卫星气象中心
National Satellite Meteorological Center
NSMC

PREPROCESSING

Status on Image Registration
Navigation and Calibration

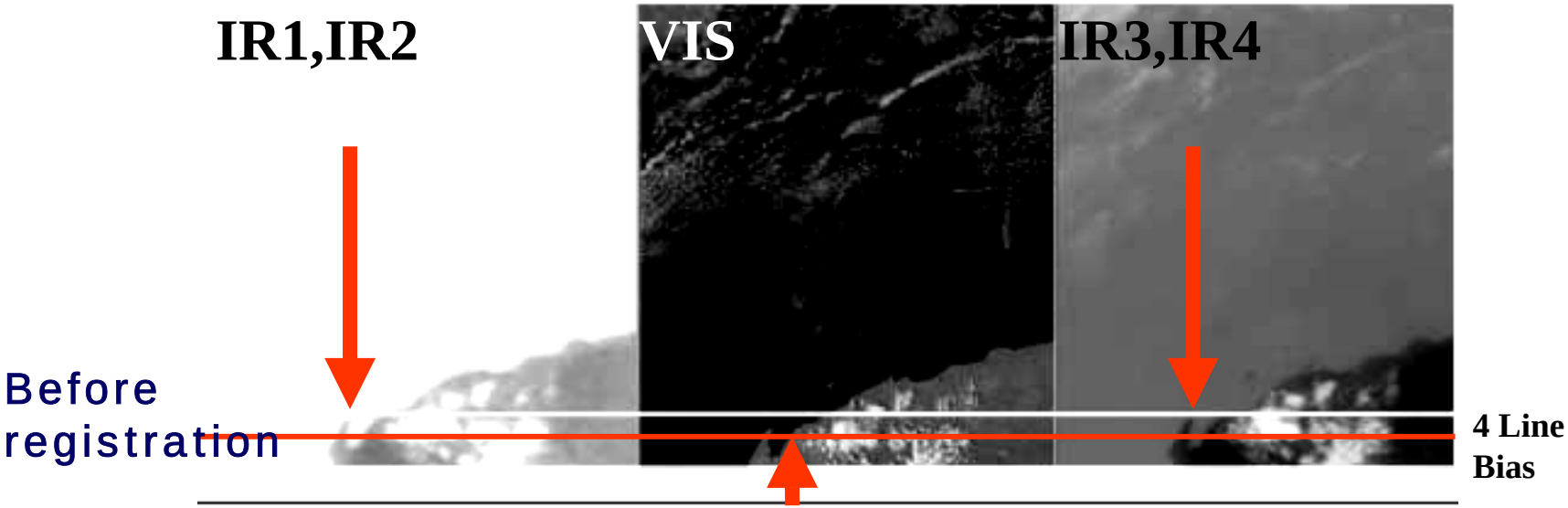
Image Registration

- Inter-channel
- channel
- Inter-detector for Visible channel

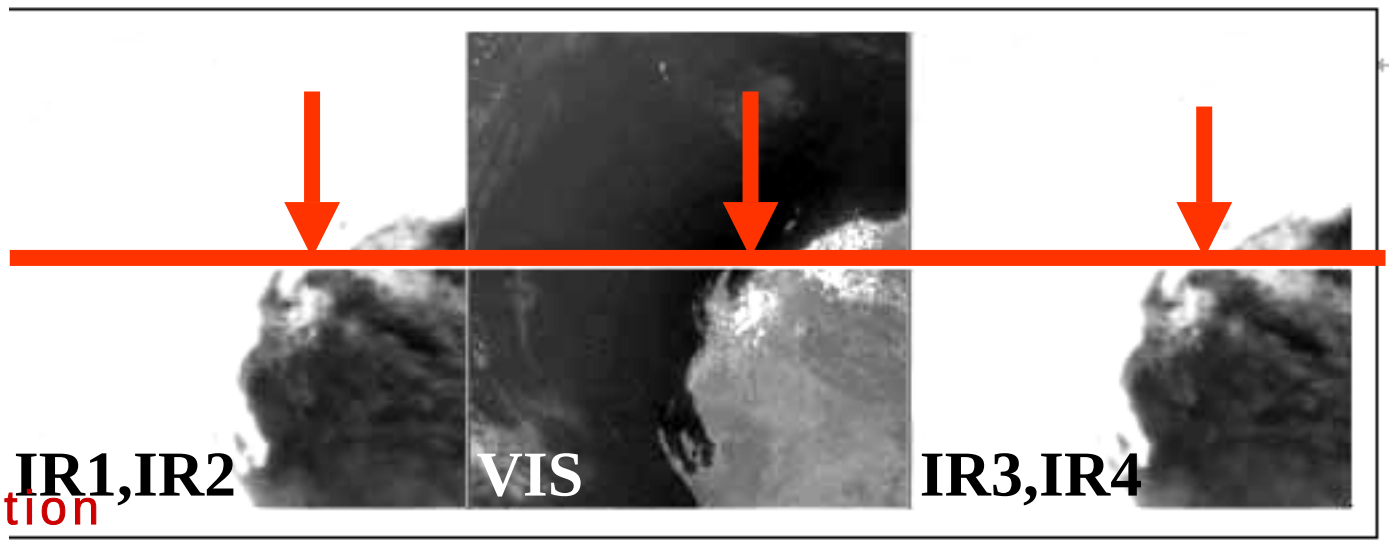


For FY2C Satellite, multi channel observation is such realized:

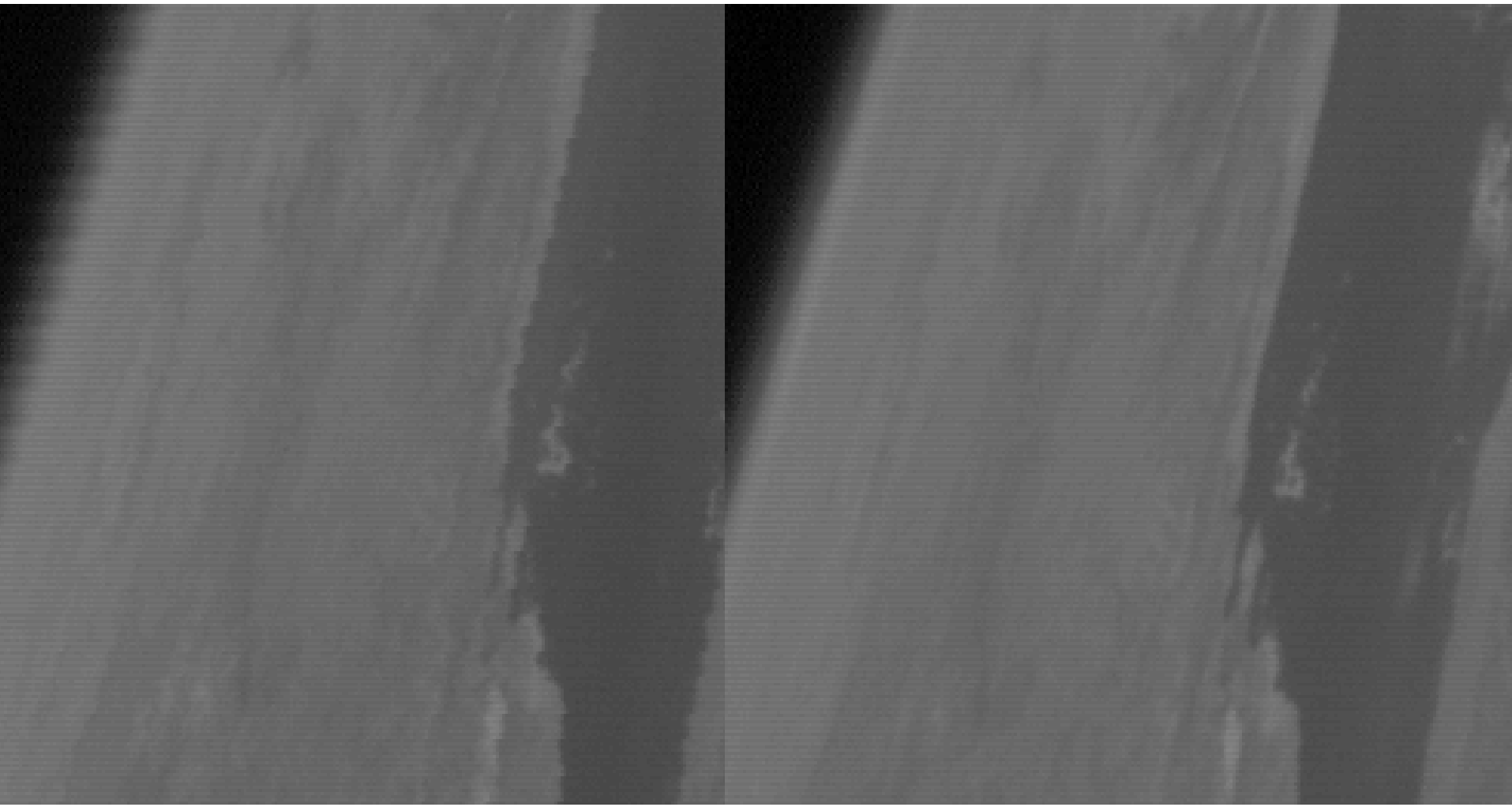
- Sensors of different channels are located at difference places of the focus plane.
- Image registration is performed at ground.



Inter-Channel Registration



Channel Registration



Visible Channel Multi-detectors Registration

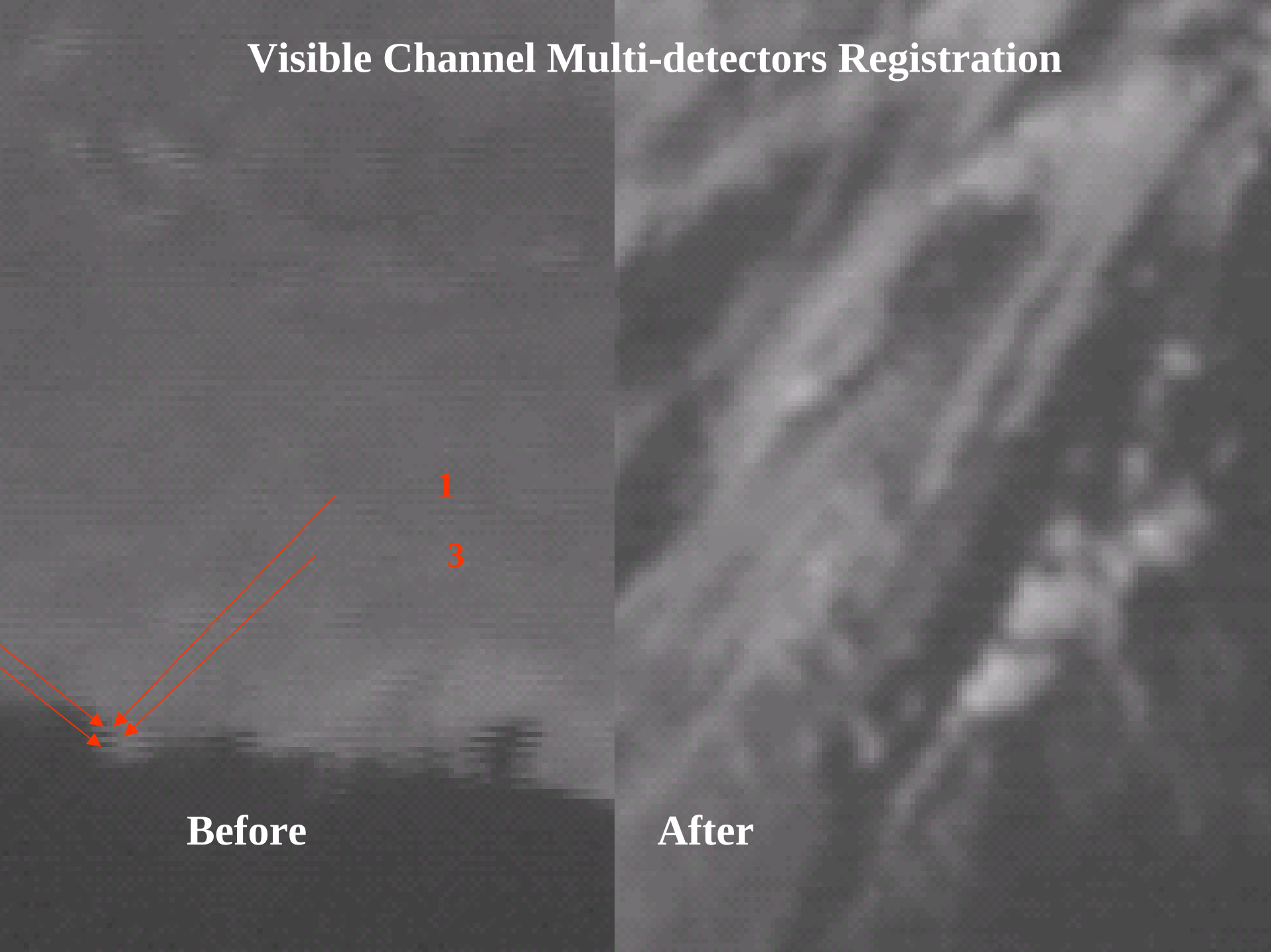
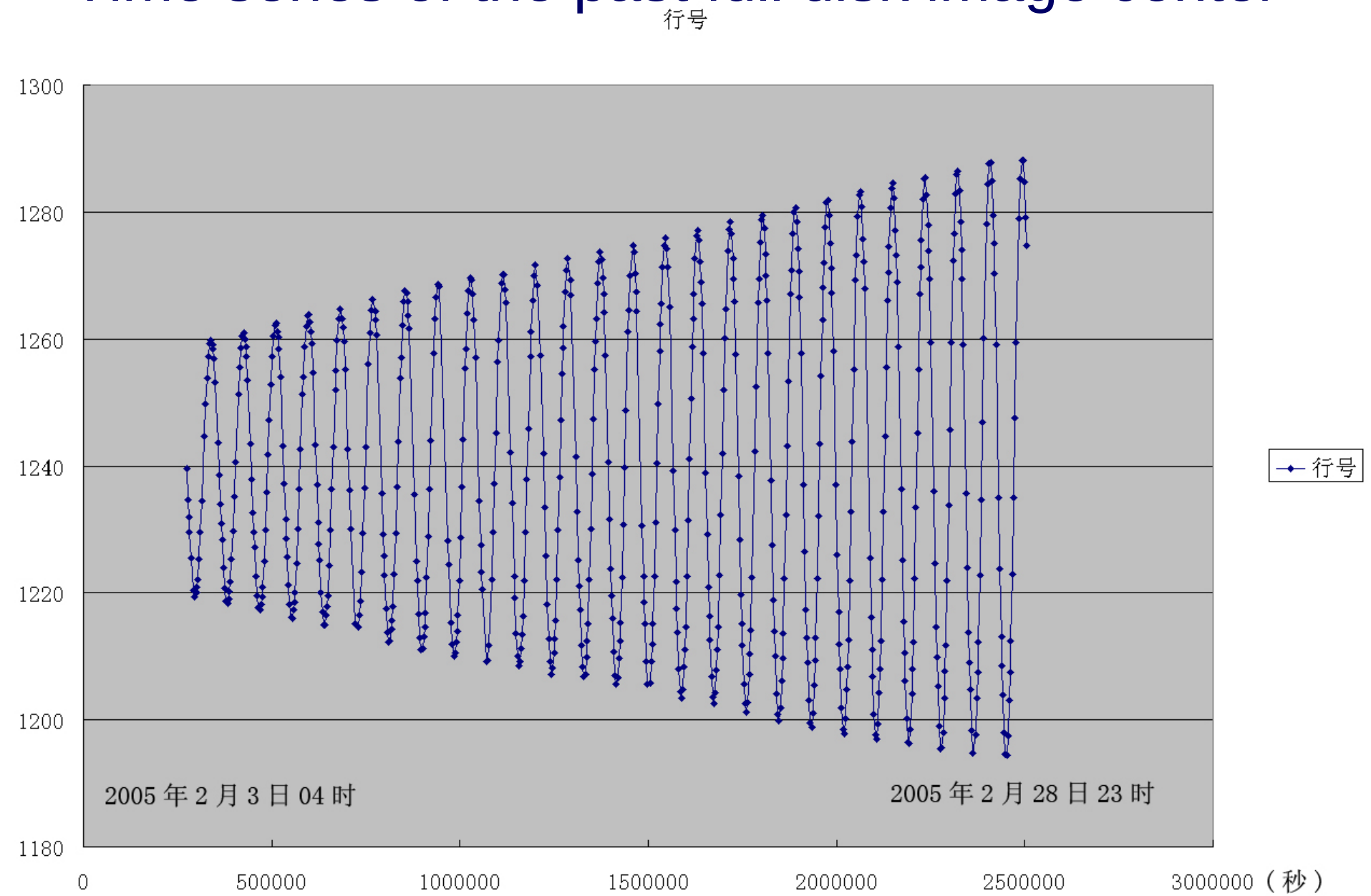


Image Navigation

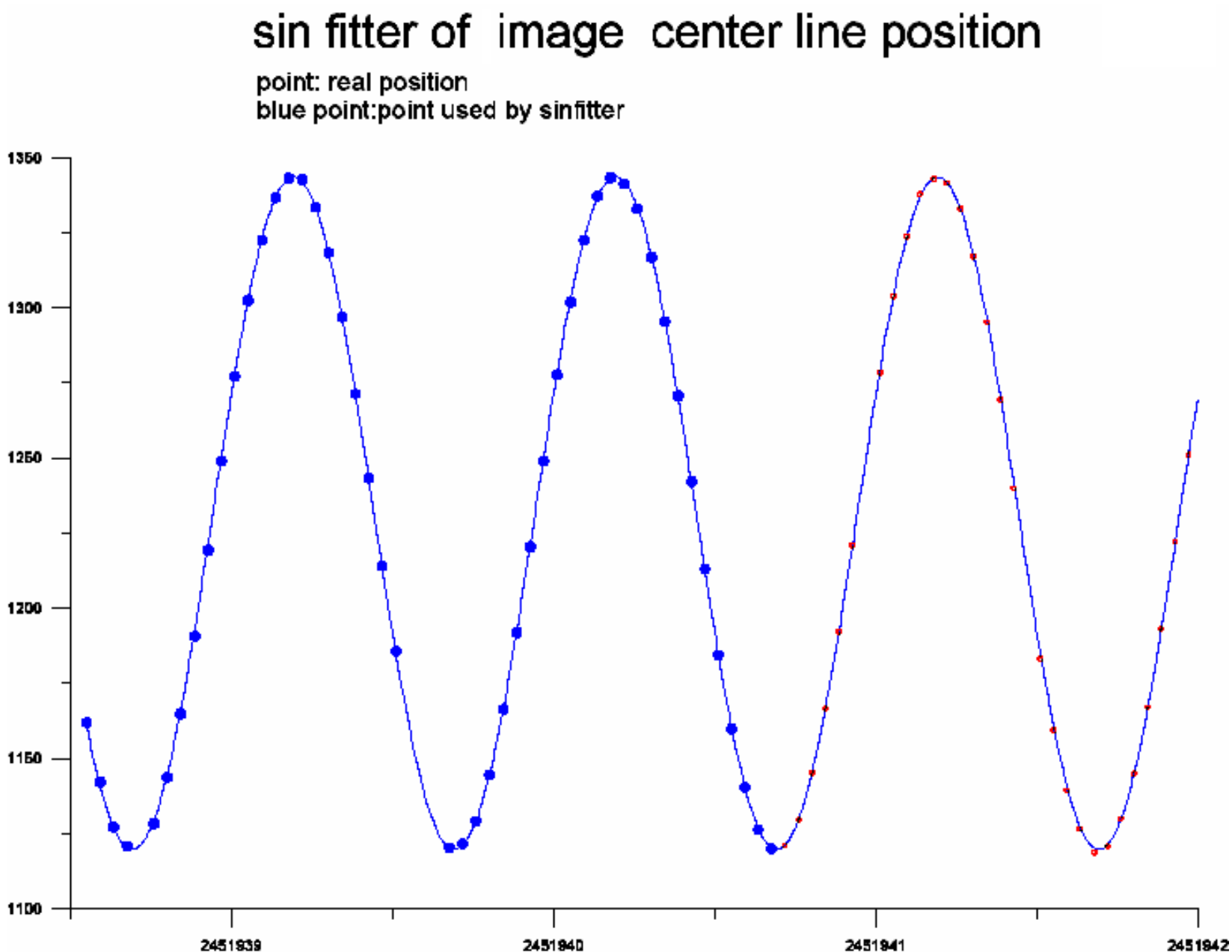
Speciality: We developed the unique technique to navigate the FY2C image. It doesn't use landmark but full disk image center for the Image Navigation.

- Time series of the past full disk image center and the satellite position are known data for the model.
- FY2C image navigation grid is gained by the solution of a mathematical model.
- 13 parameters for image navigation are gained. 12 of them can be treated as constant in 24 hours.
- All navigation process is done automatically. No any land mark registration or manual operation is performed.
- Except 1or 2 days after orbital and attitude control, the accuracy of prediction grid is IR pixel level.

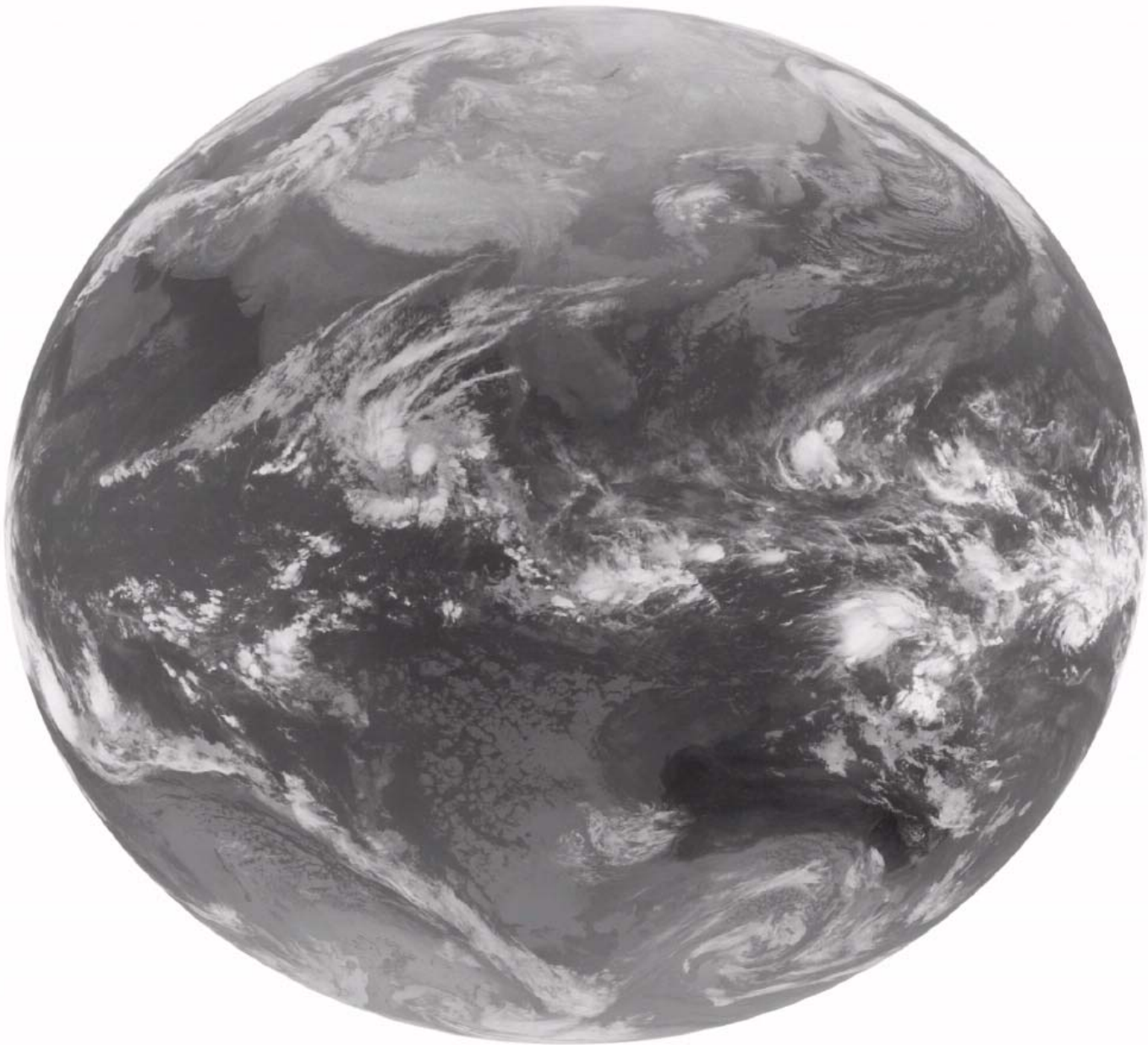
Time series of the past full disk image center



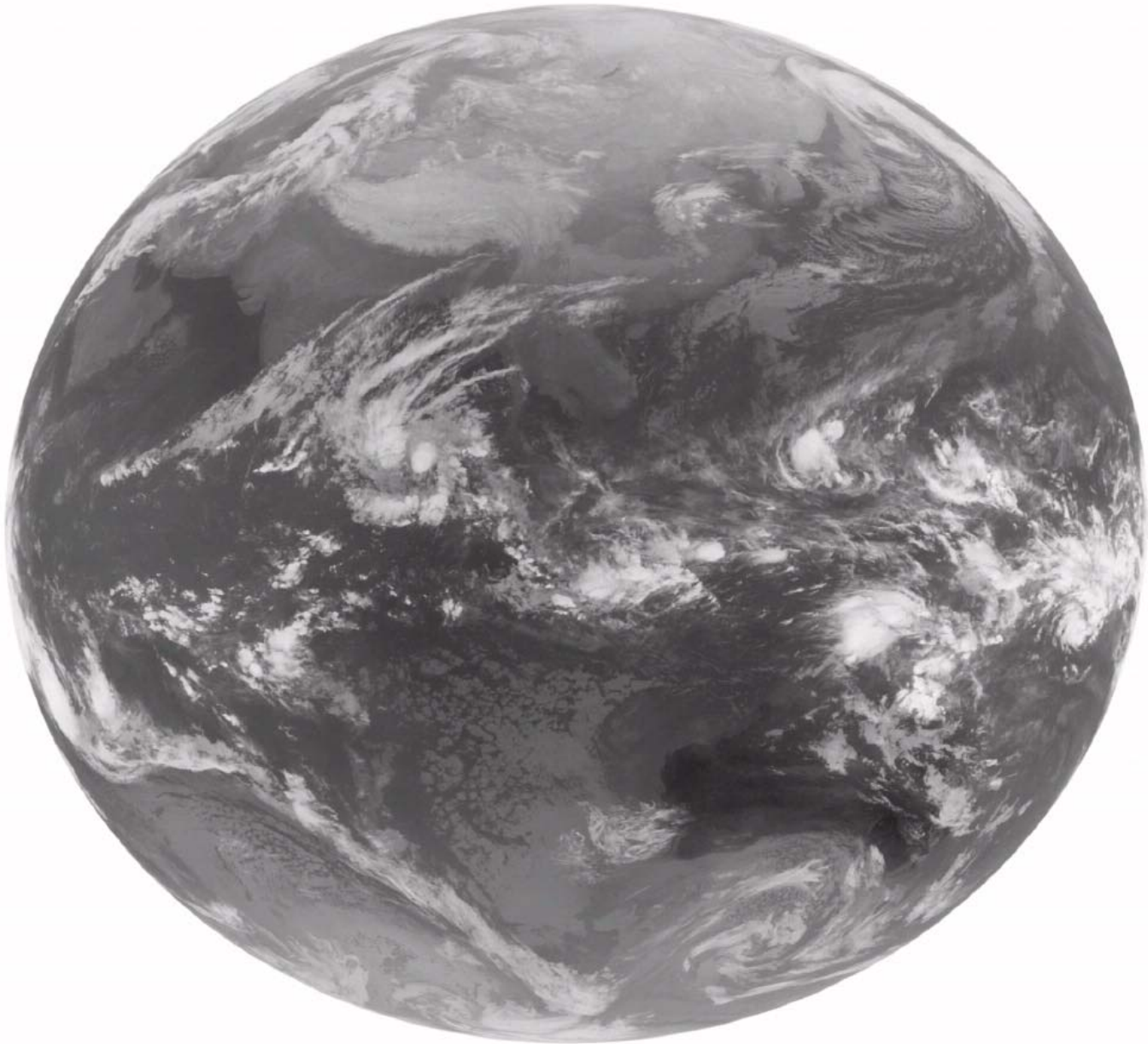
Full disk image center is predictable



Time series of the past full disk image center, notice the vertical movement of the image

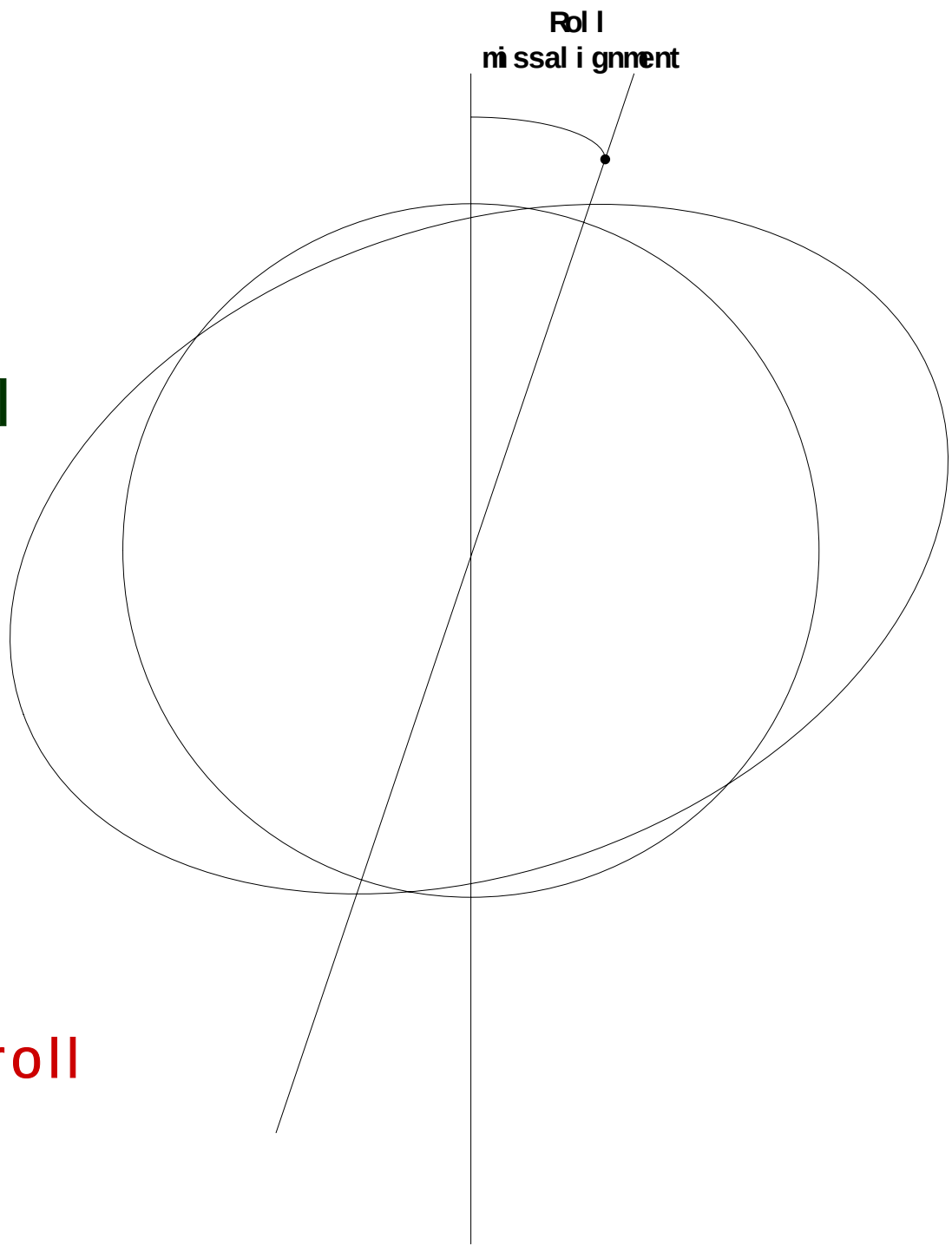


Put Earth center at the origin, there is a tendency of turning motion

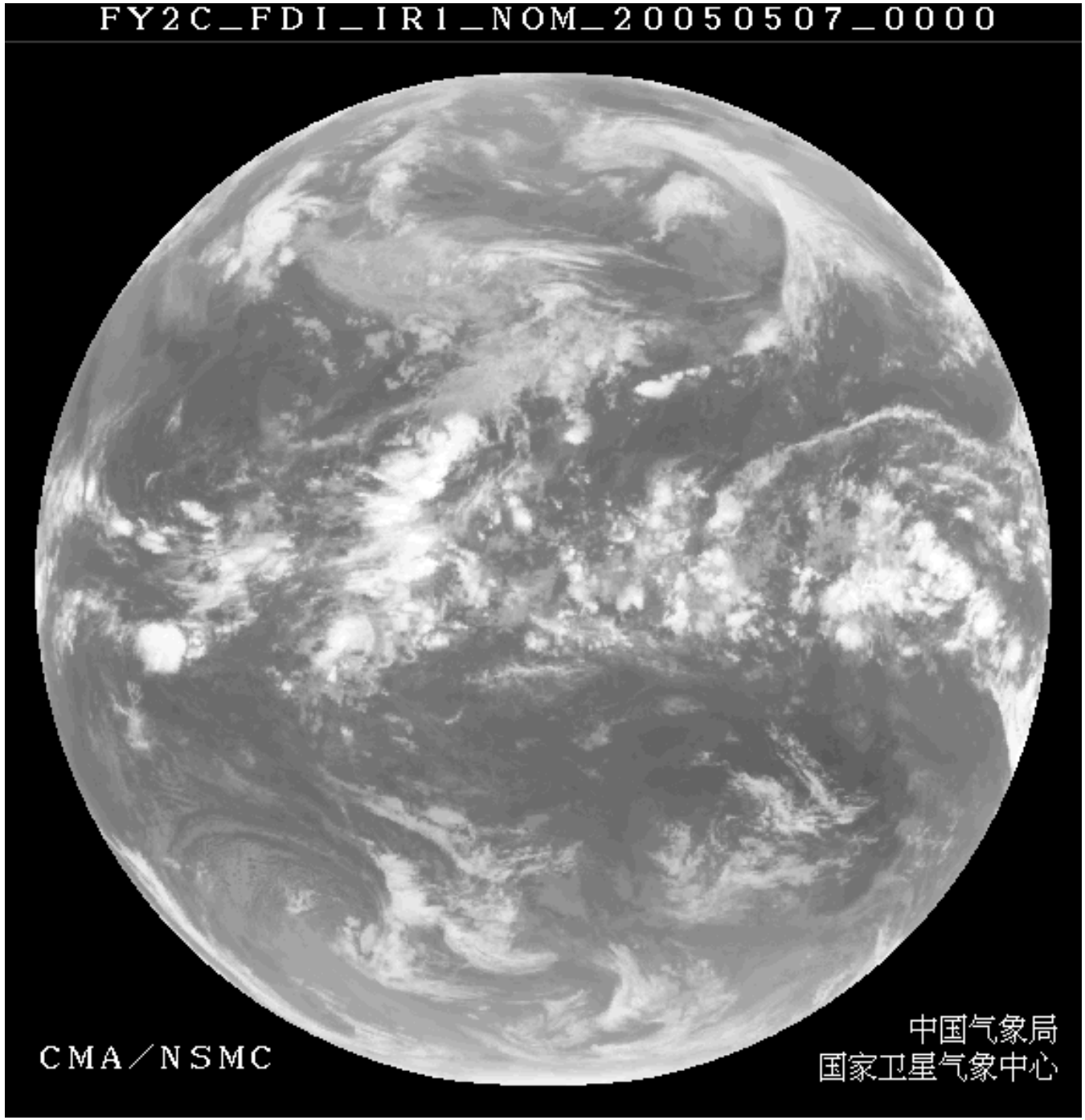


Three components of misalignment

Pitch, Yaw, Roll



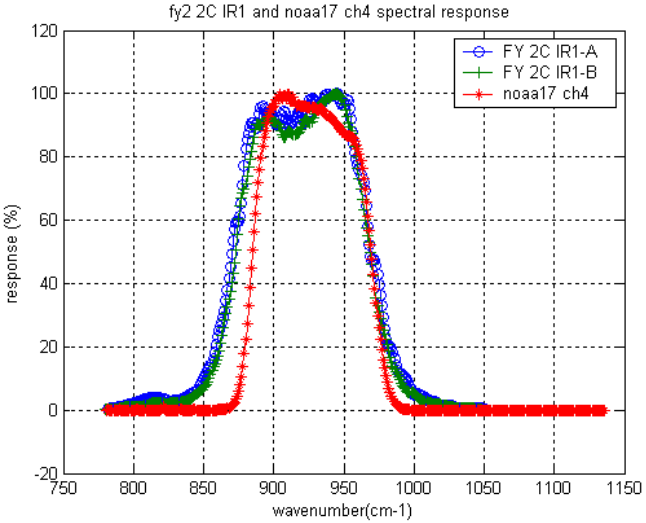
GOES-7 and before did not define the roll misalignment

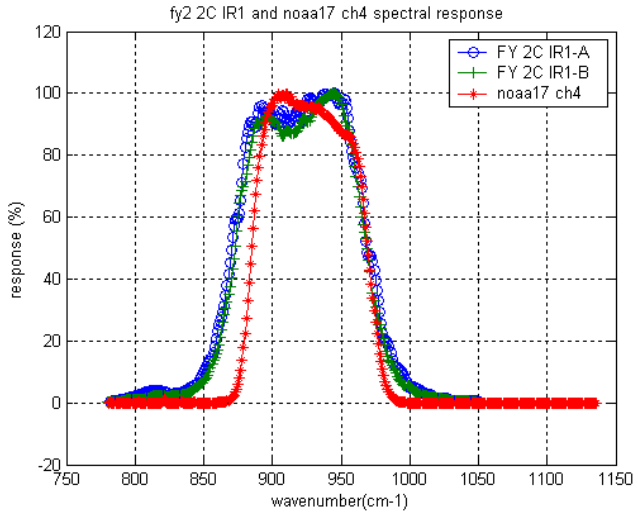

FY2C_FDI_IRI_NOM_20050507_0000
CMA／NSMC
中国气象局
国家卫星气象中心

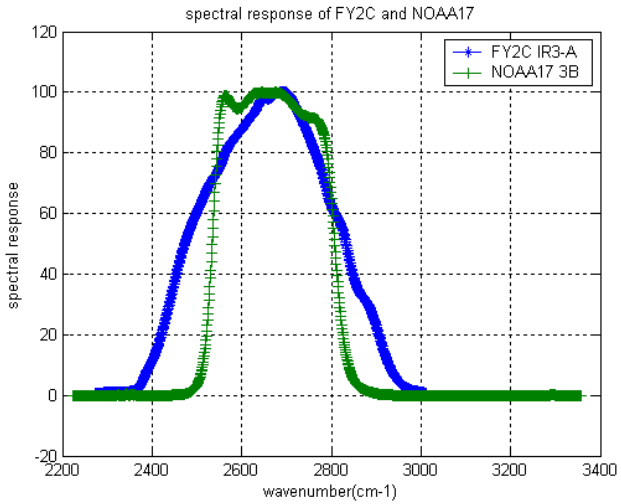
FY-2B Animation

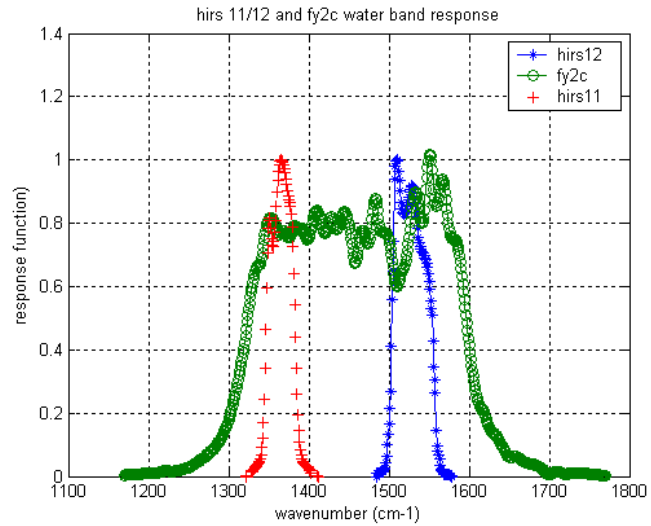
6/21/2002 -8/29/2002

Calibration with NOAA

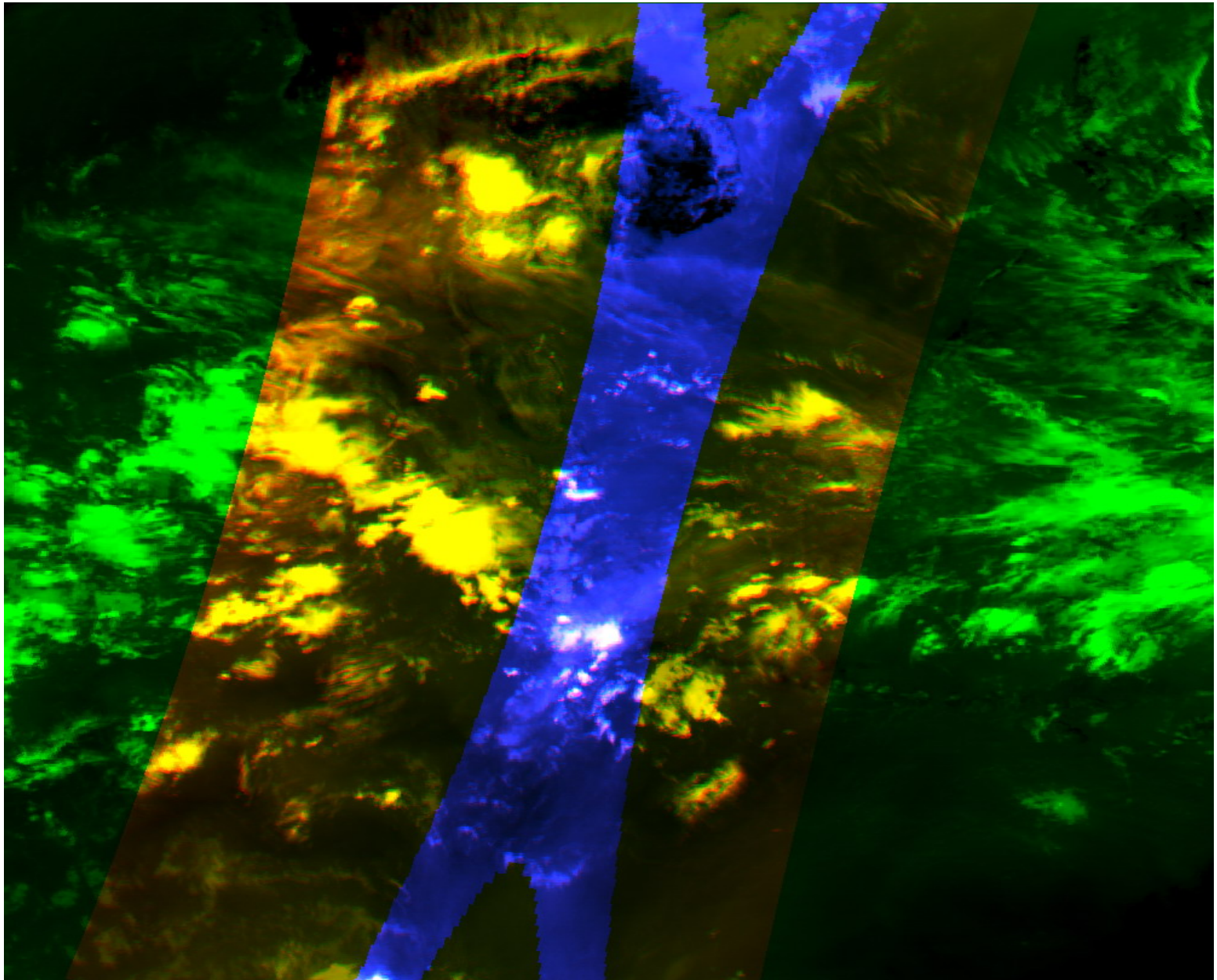




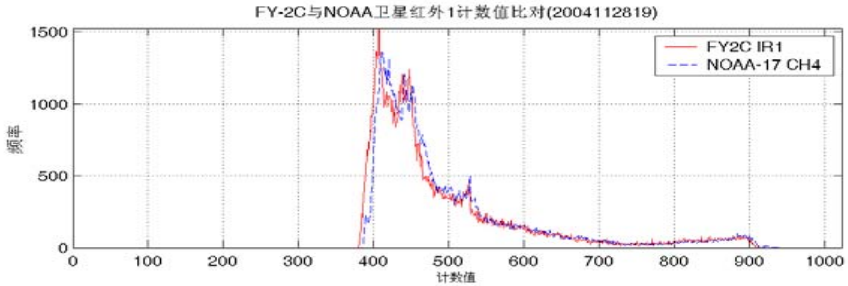


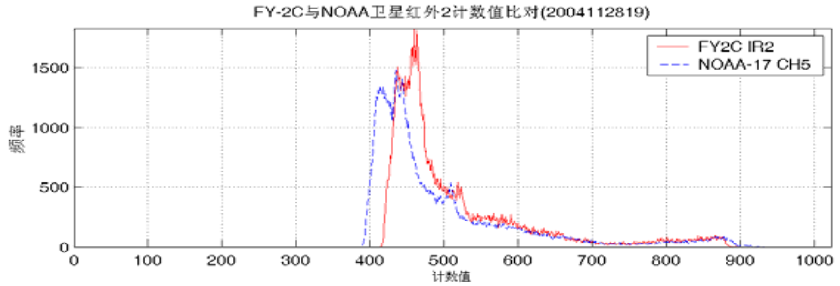


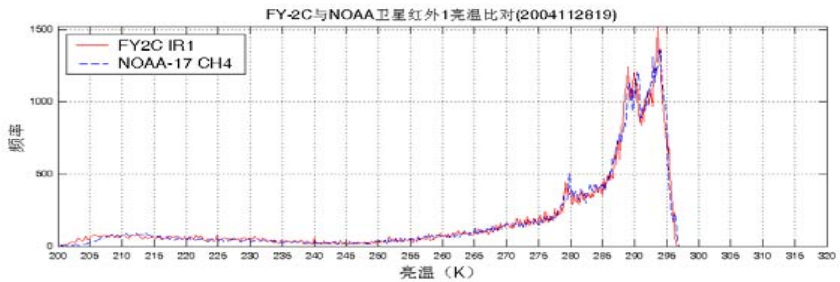
Geographic registration

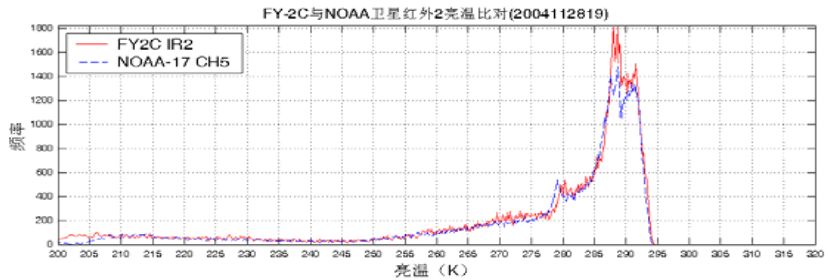


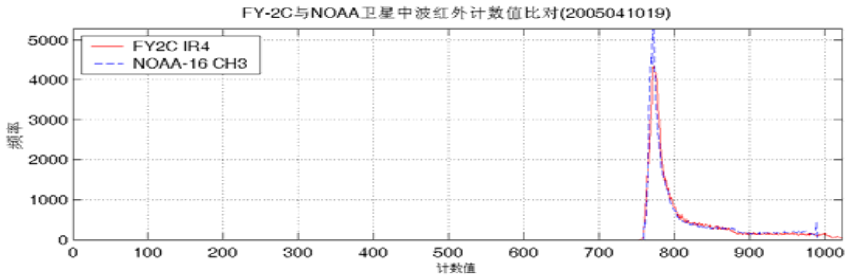
FY-2C IR measurements and BT compared with NOAA

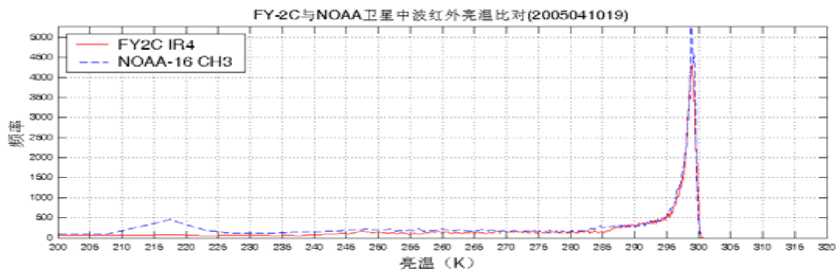


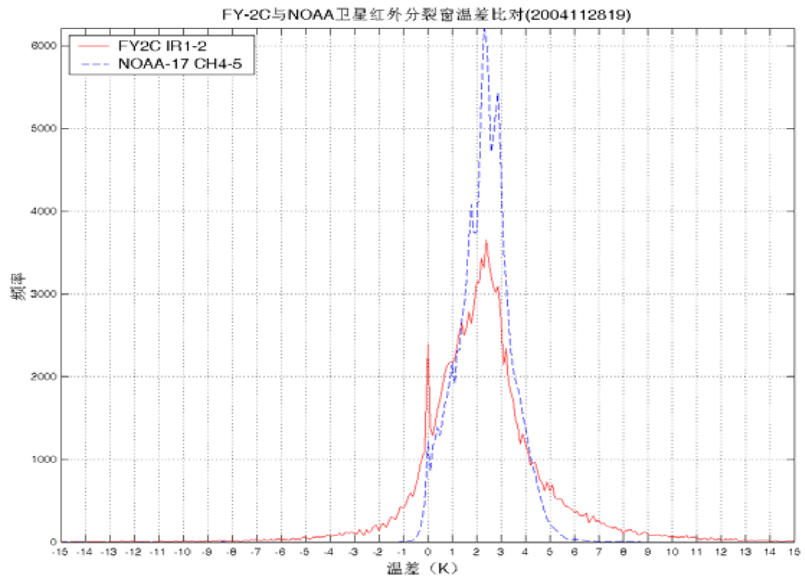




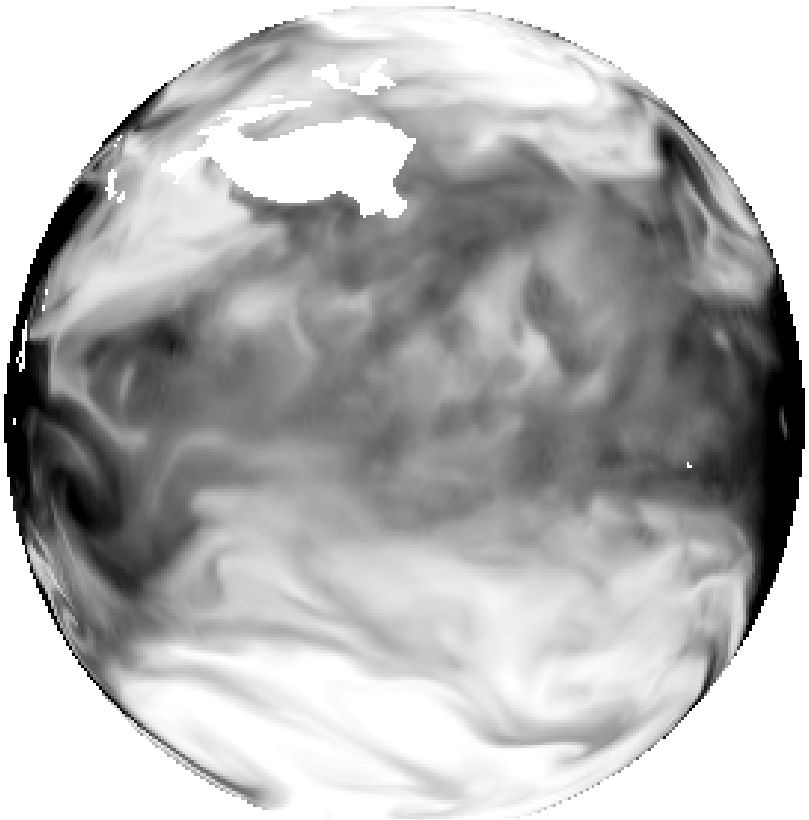




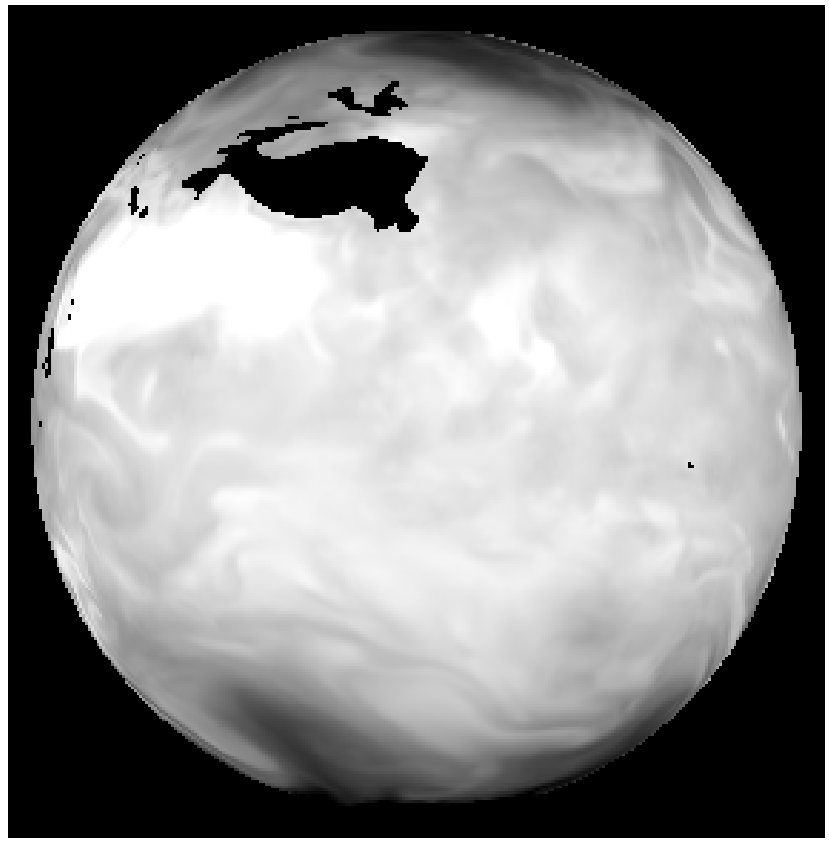




PRODUCT PROCESSING



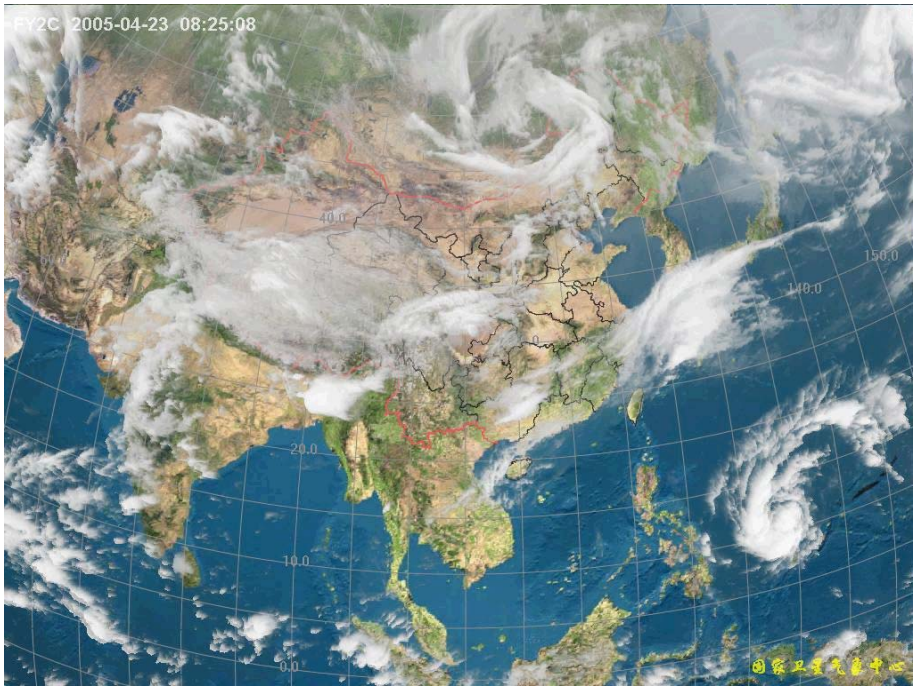
Layer 05 800hPa
Atmosphere Reduction
Example

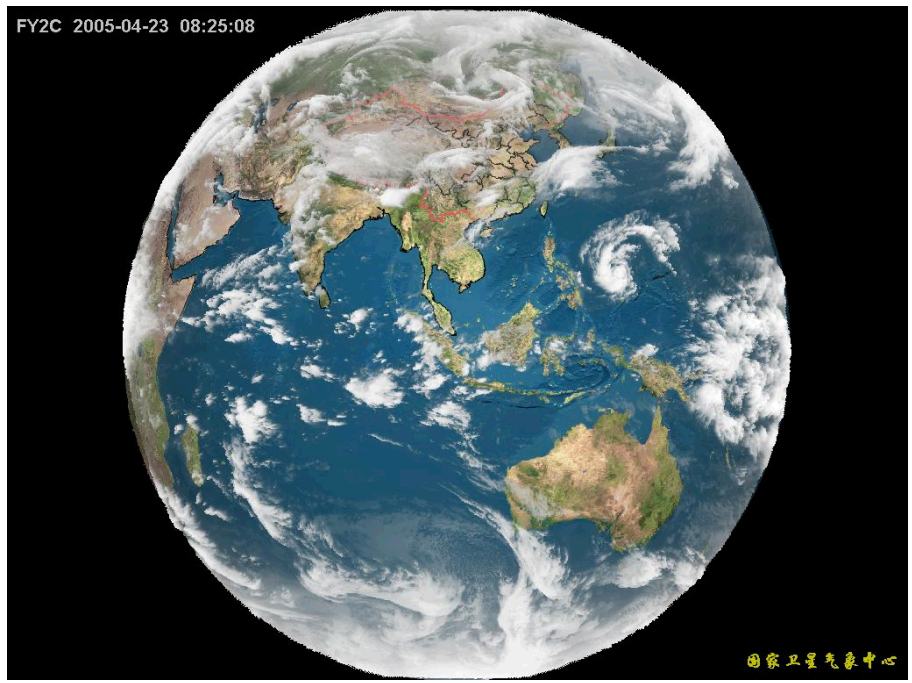


Layer 05 800hPa Incident
Radiation

IR Atmosphere Reduction

FY2C Image Broadcasted by TV



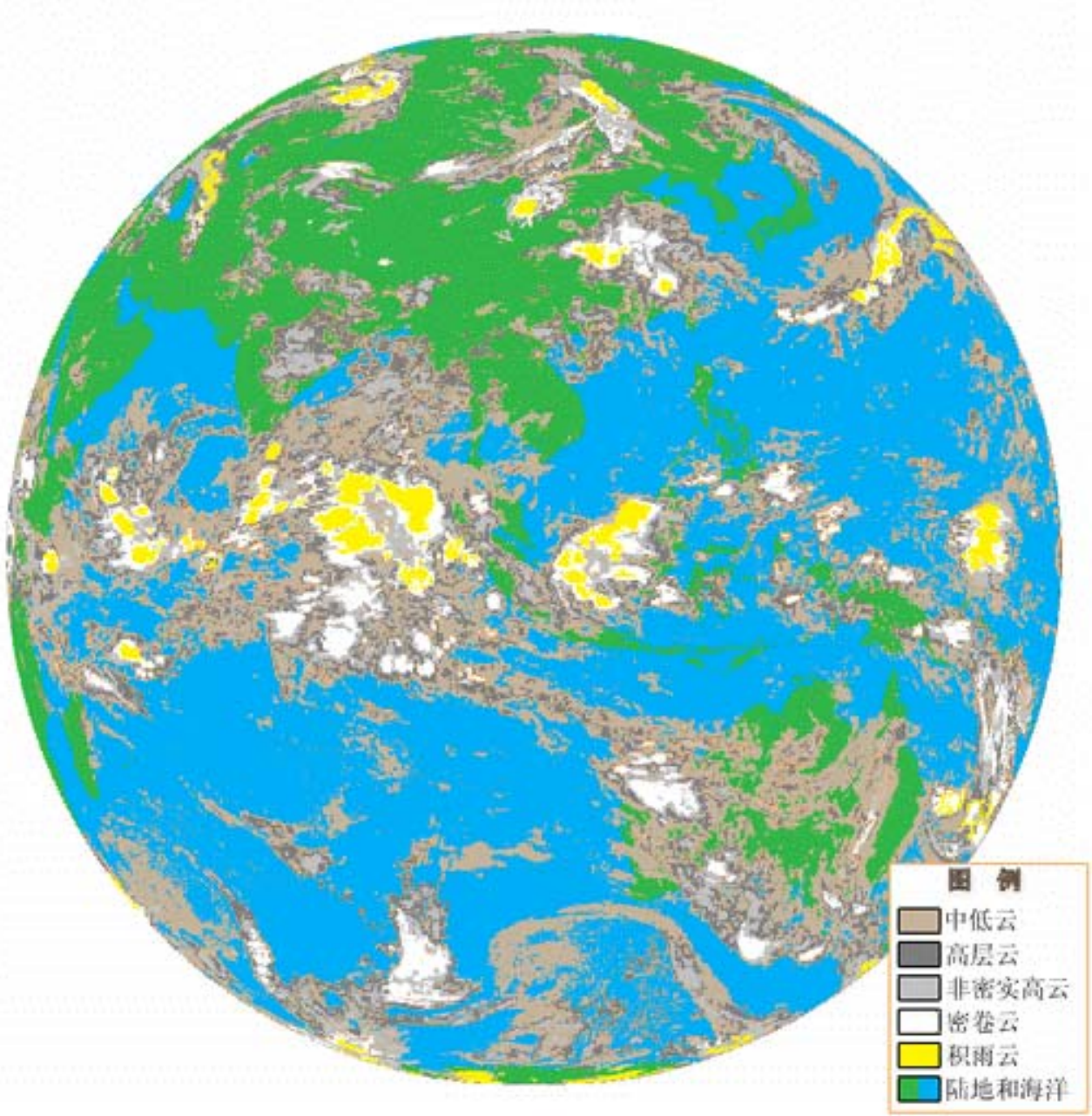


Products from FY2C

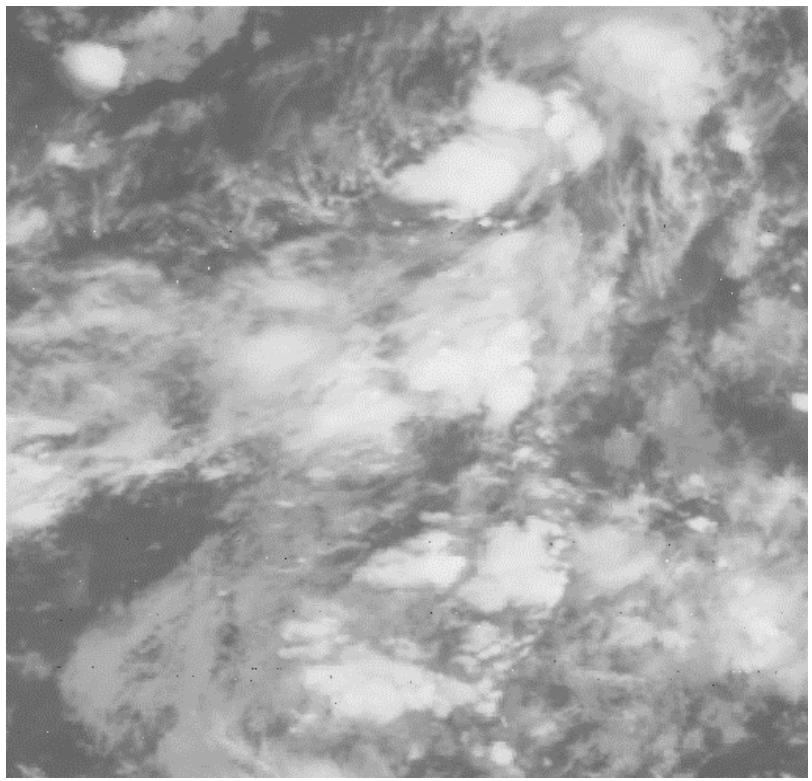
Name of Product	Coverage	Time/Day
Wind	50°N-50°S 55°E-155°E	4
SST	60°N-60°S 45°E-165°E	8
Upper Troposphere Humidity	60°N-60°S 45°E-165°E	8
ISCCP Data set	60°N-60°S 45°E-165°E	8
Precipitation Index	60°N-60°S 45°E-165°E	8
Precipitation Estimation	60°N-60°S 45°E-165°E	4
Cloud Classification	60°N-60°S 45°E-165°E	8
Cloud Amount	60°N-60°S 45°E-165°E	8
Humidity Profile from Cloud	50°N-50°S 55°E-155°E	8
Perceptible Water in Clear Sky Region	60°N-60°S 45°E-165°E	8
Outgoing Long wave Radiation	60°N-60°S 45°E-165°E	8
Solar Irradiance	60°N-60°S 45°E-165°E	1
Snow Cover	60°N-60°S 45°E-165°E	1
Sea Ice	60°N-60°S 45°E-165°E	1
Flood Monitoring	China	1
Soil Moisture	60°N-60°S 45°E-165°E	1
Fire Monitoring	China	24
Tropical Cyclone Position and Intensity	Western Pacific and India Ocean	24
Sand Storm Monitoring	China and Mongolia	8
Fog	China	24
TBB	60°N-60°S 45°E-165°E	8

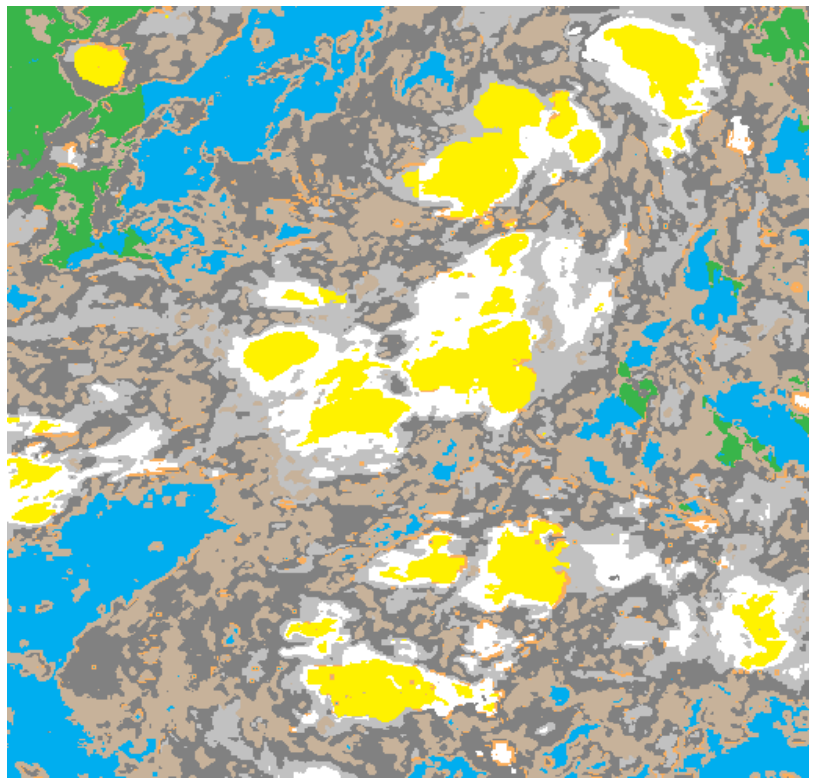
Cloud Classification

Cloud is defined with topography so that the cloud detection can work for Tibetan Plateau

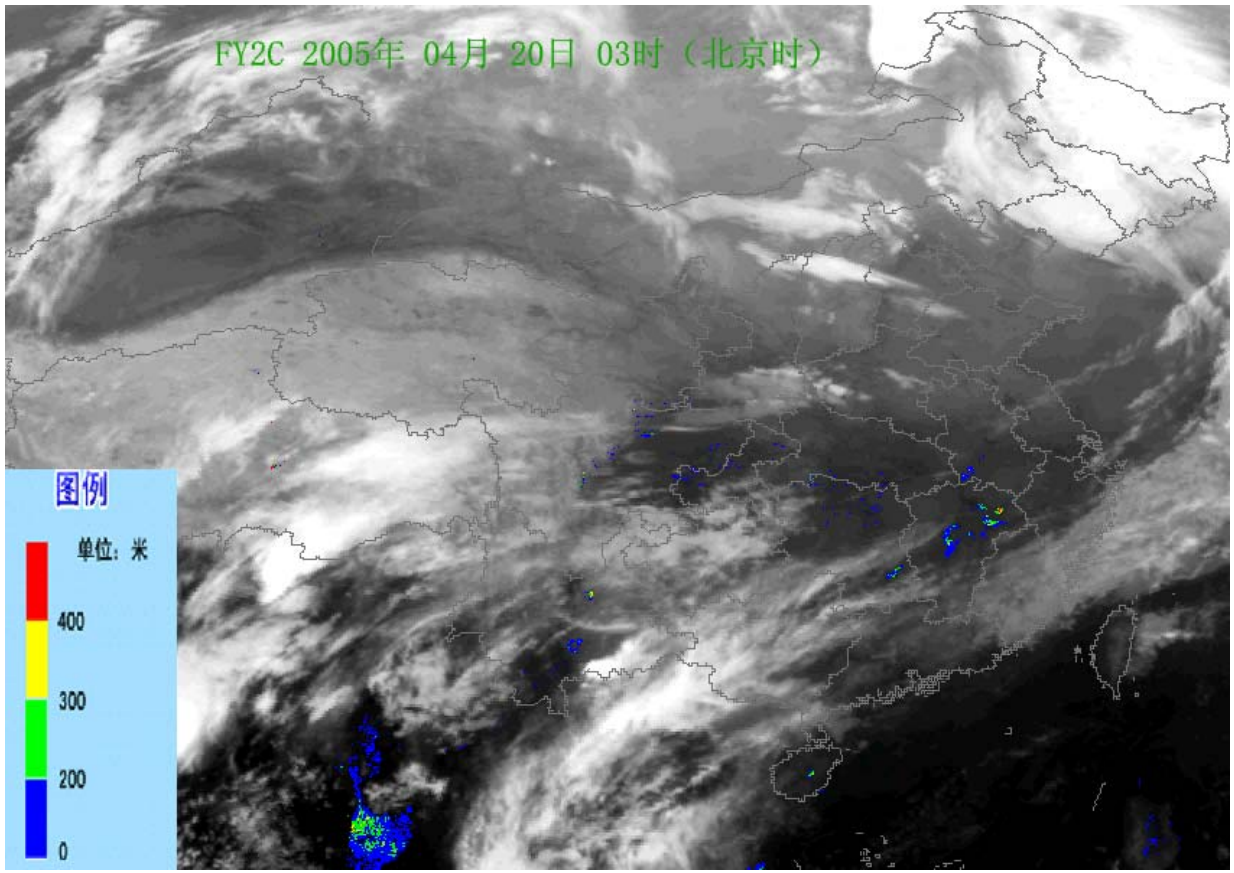


IR image and cloud classification

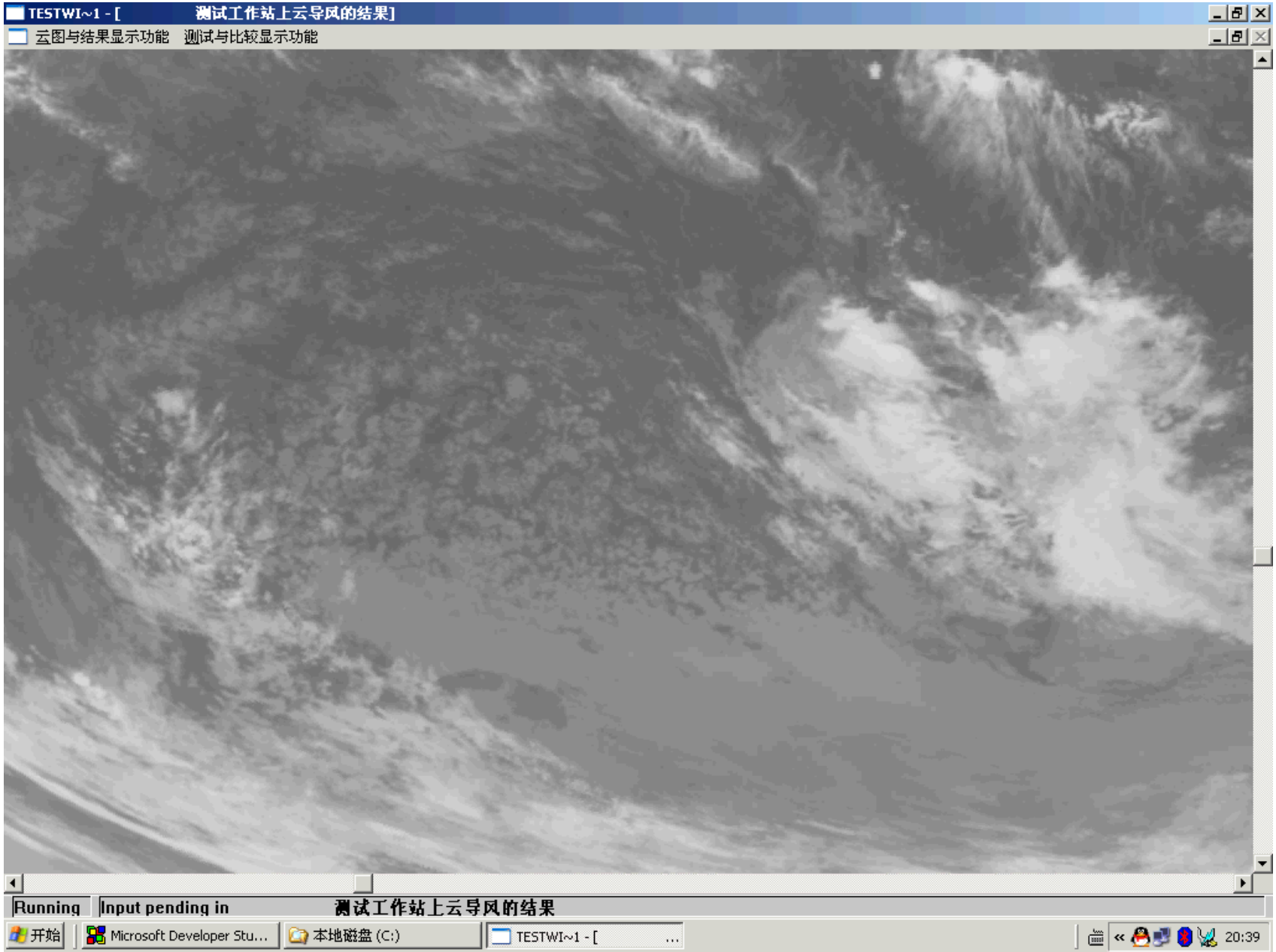


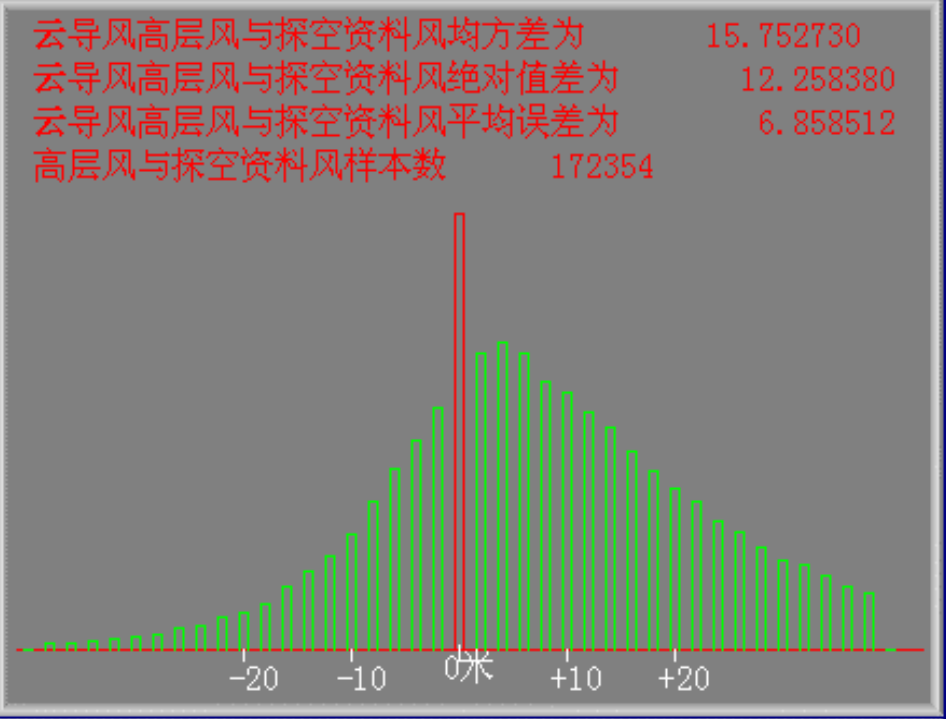


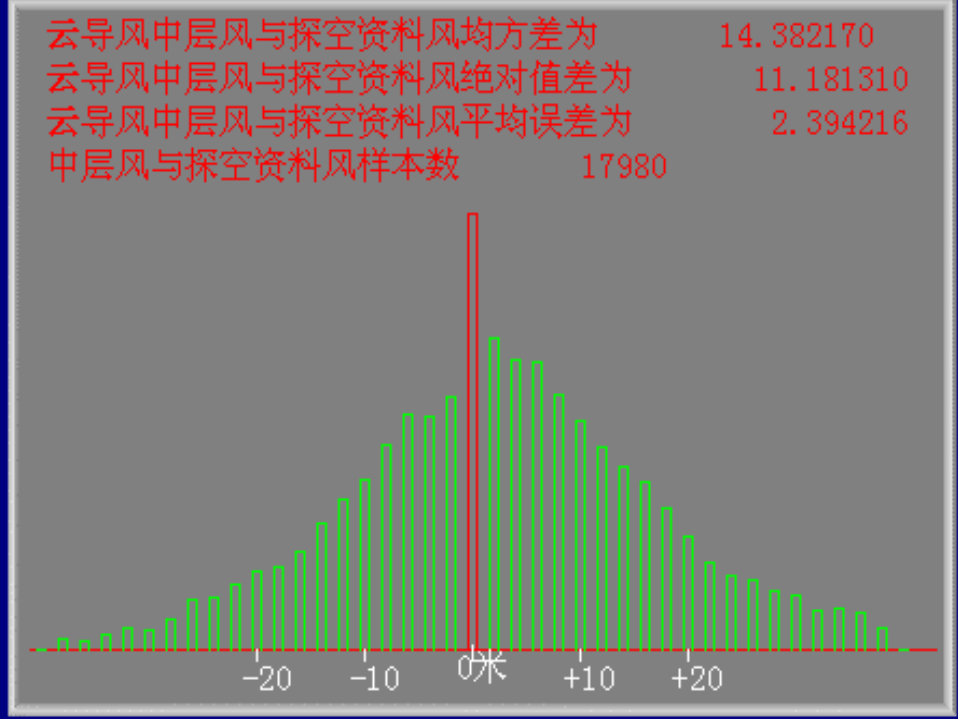
FY2C Fog

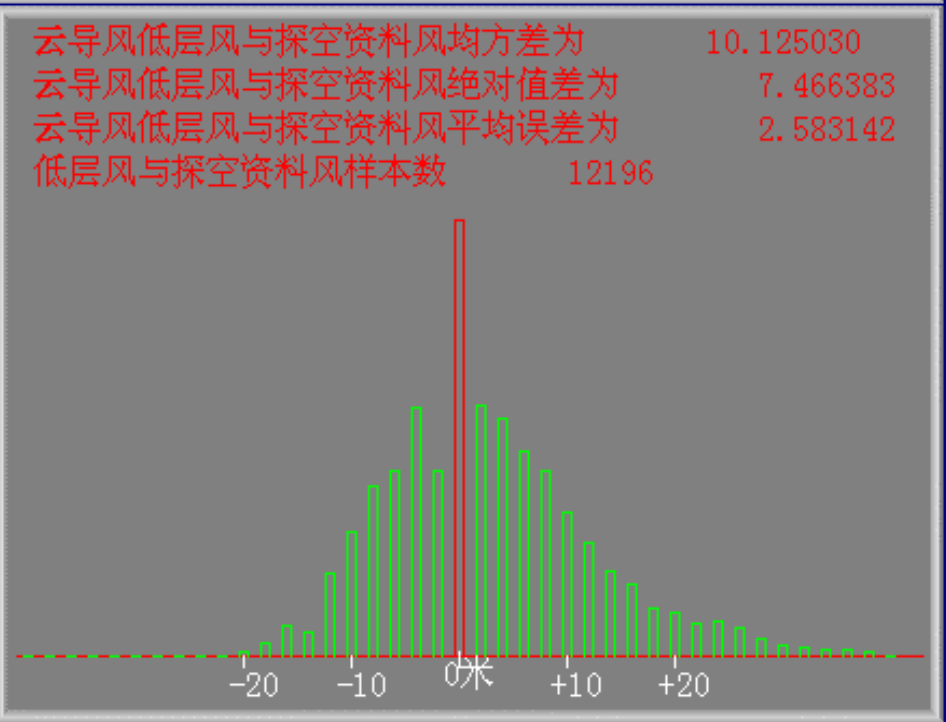


Atmospheric motion vectors





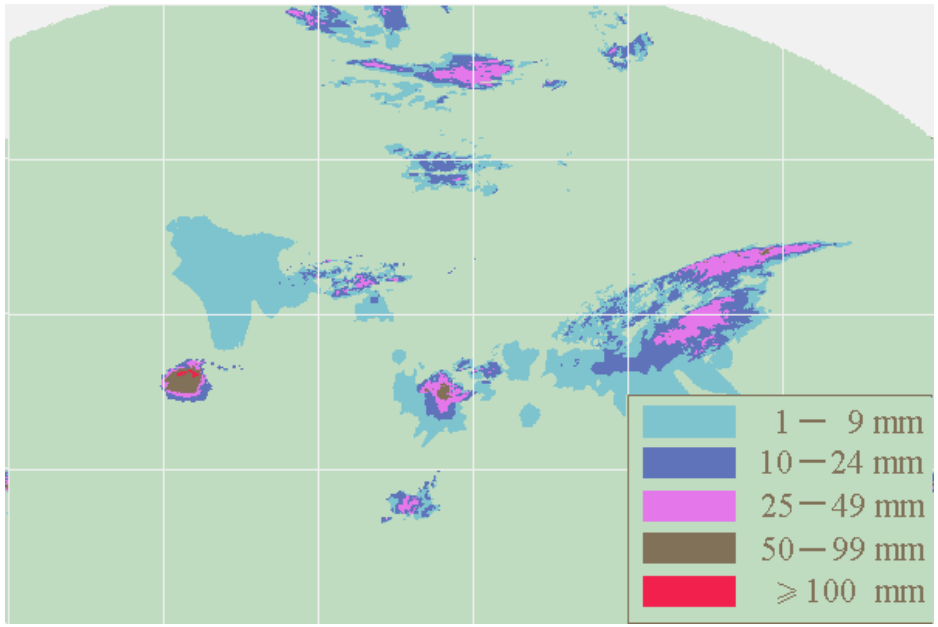


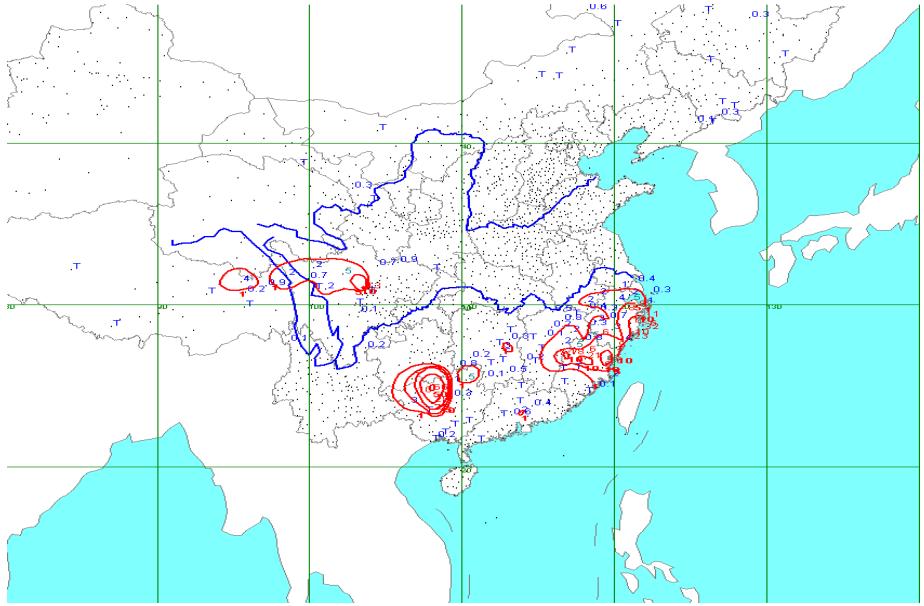


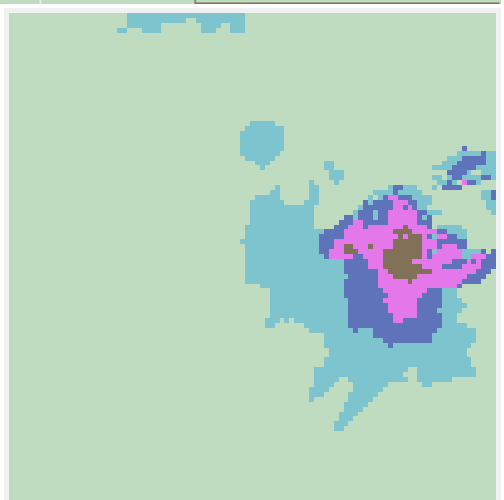
Motion vectors is comparable with sonde data

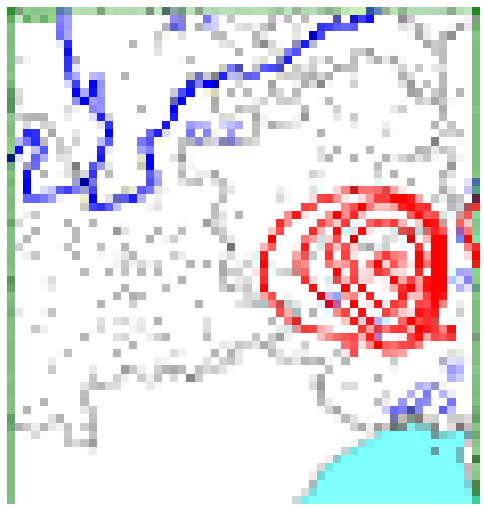
Precipitation Estimation

6 hourly precipitation 2005.04.22.18 04.23.00



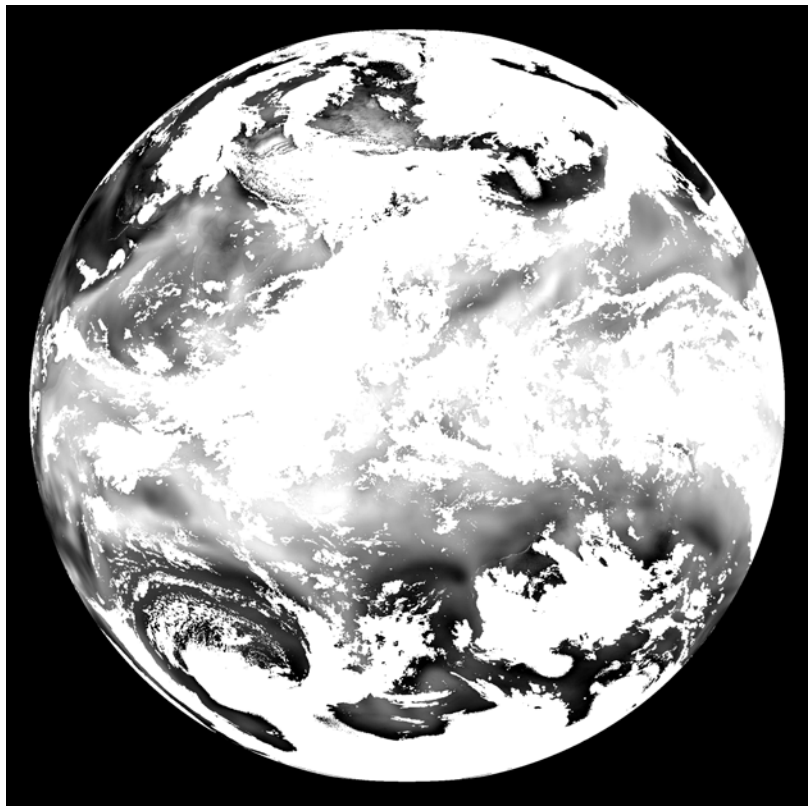






FY2C total precipitable water

FY2C_TPW_MLT_NOM_2
0050507_0600_a.bmp



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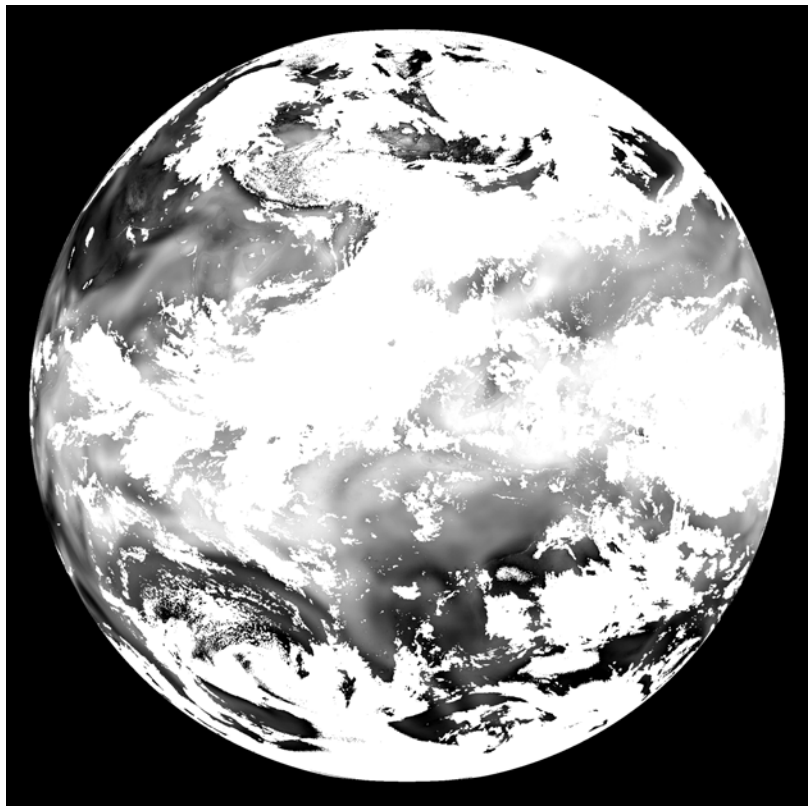
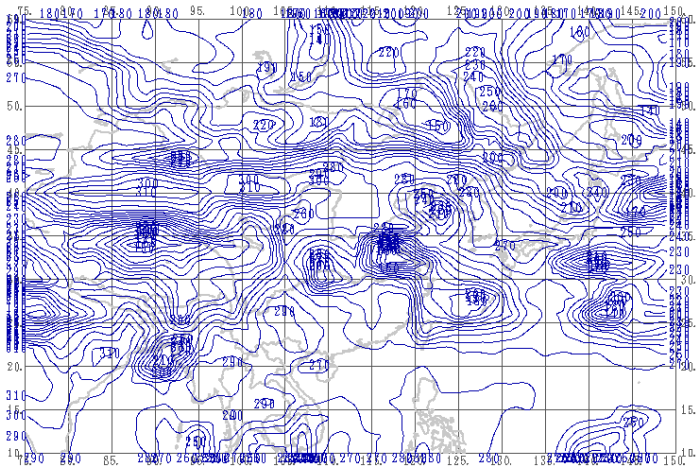
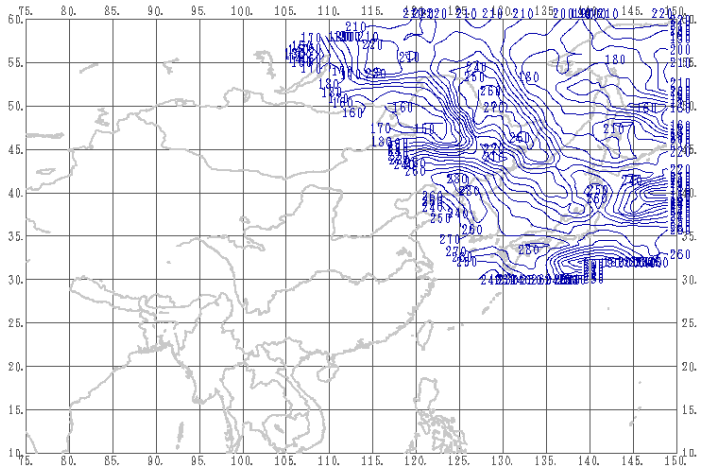


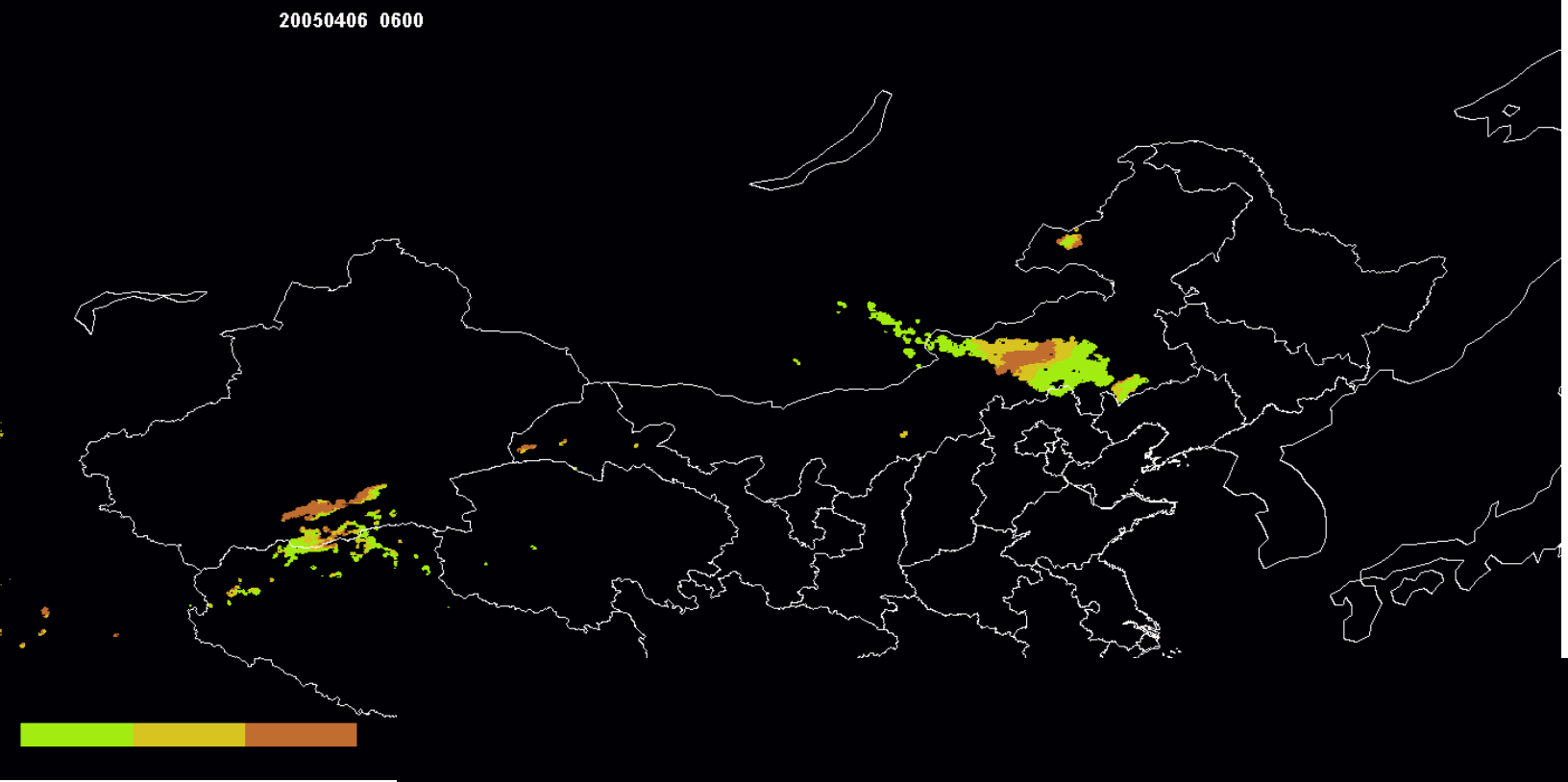
FY2C/NOAA OLR comparison



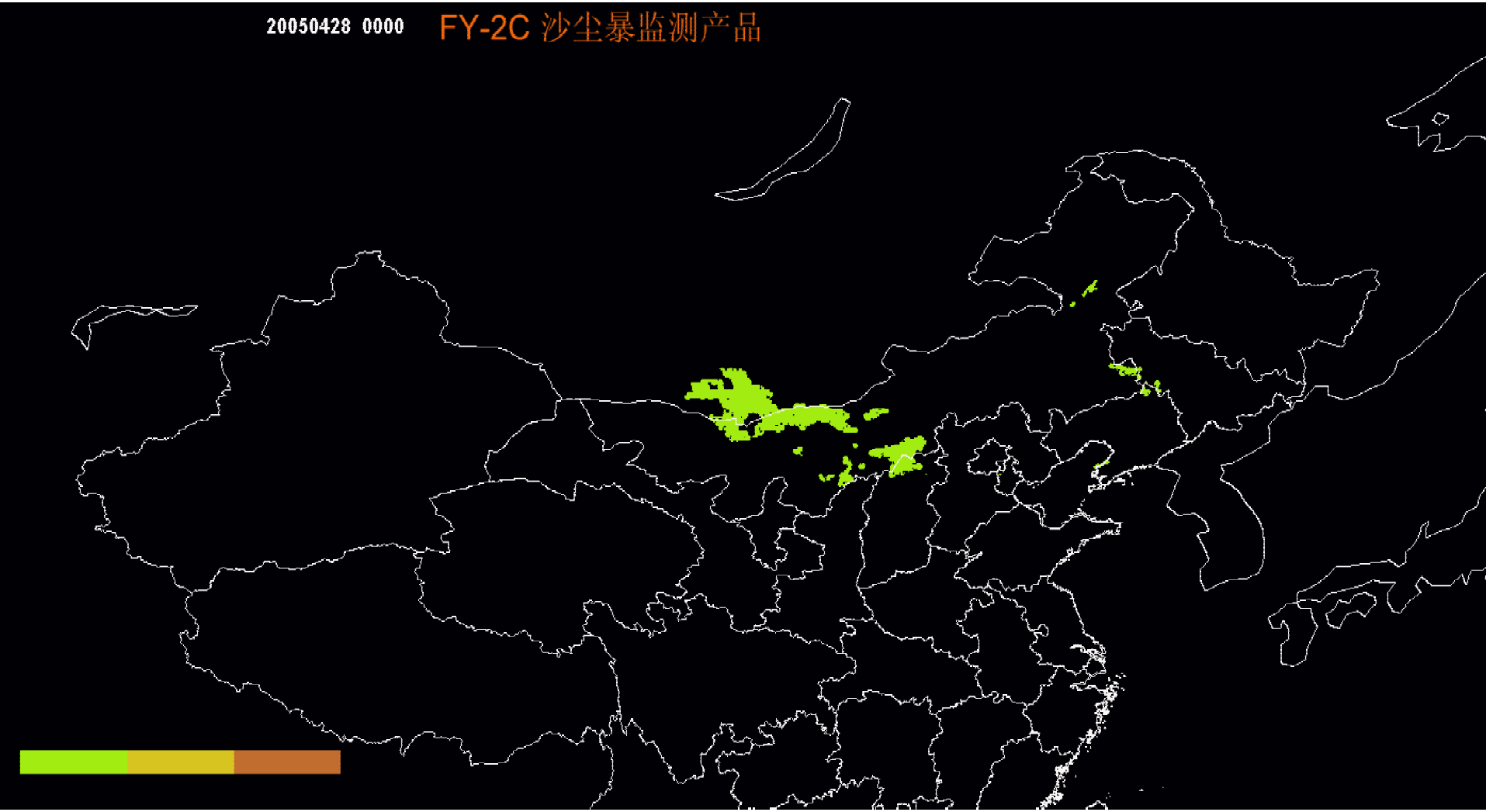
FY-2C实时OLR产品等值线图（2005年4月29日04时56分
局部，单位：瓦/米**2）



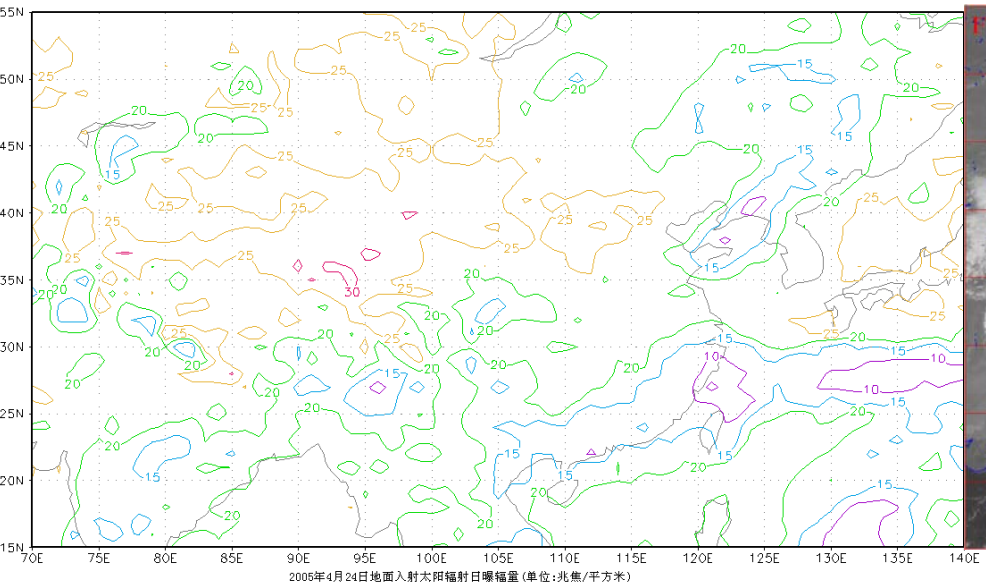
NOAA-16实时OLR产品等值线图（2005年4月29日04时44分
，单位：瓦/米**2）

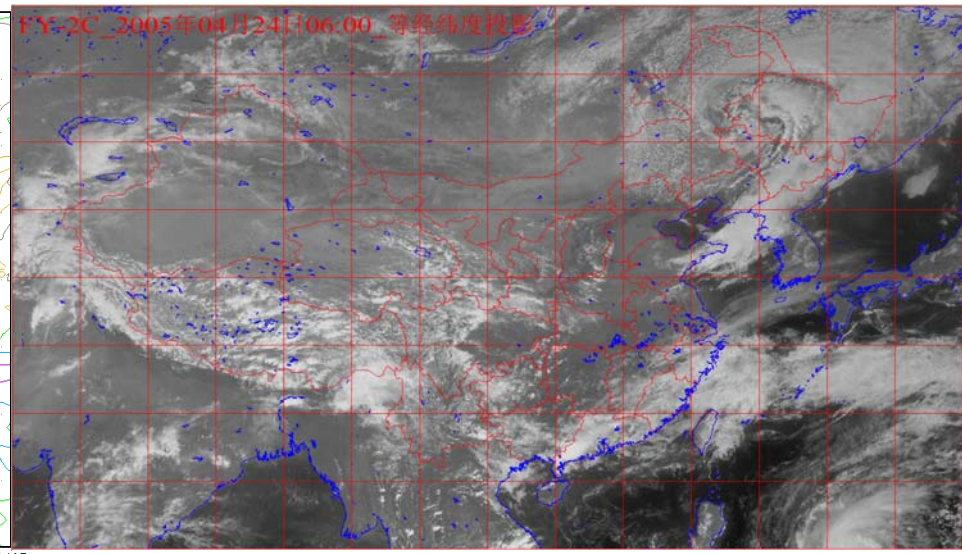


Sand Storm


20050428 0000
FY-2C 沙尘暴监测产品

Solar irradiance for China region at 24 April 2005/06Z



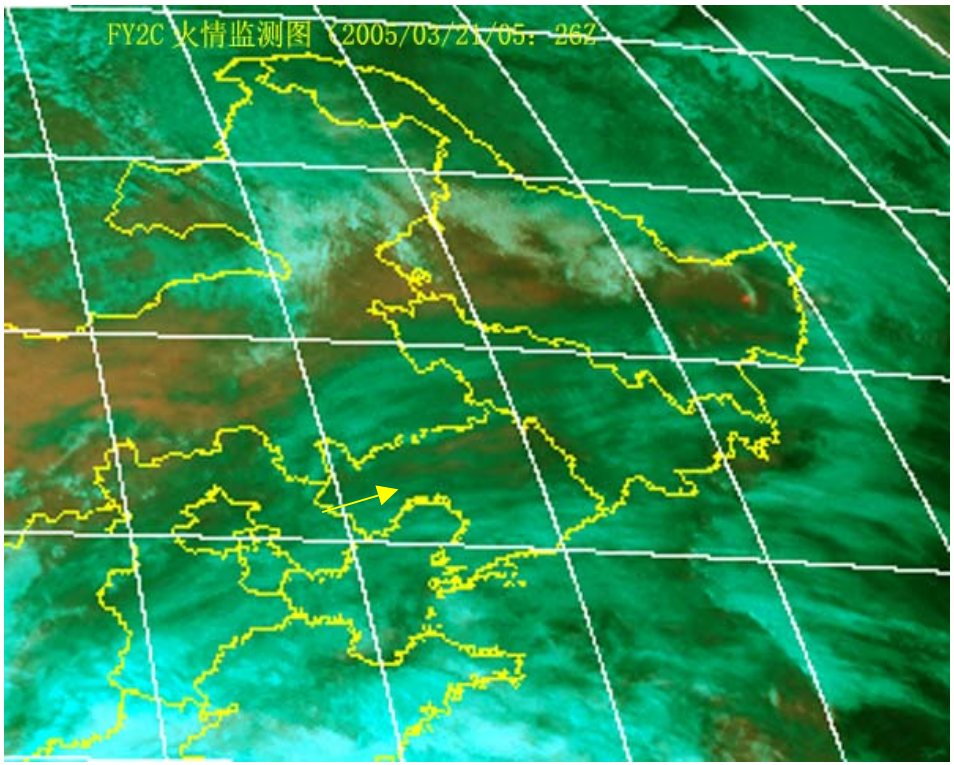


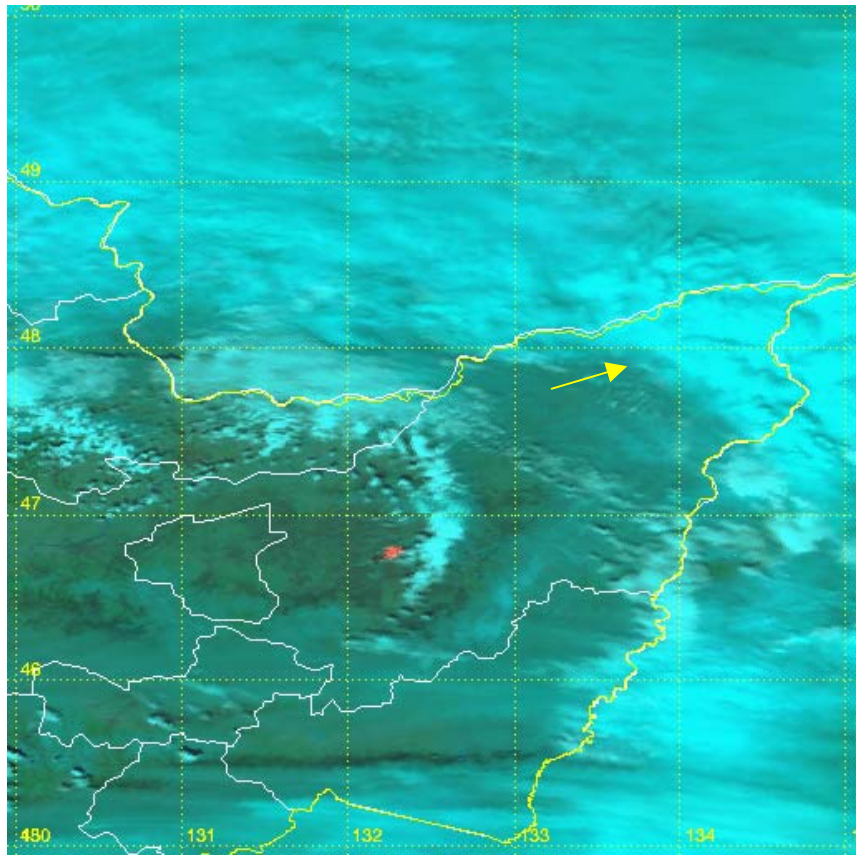
Sloar irradiance

VIS image

FY2C fire monitoring

Comparable with NOAA-16





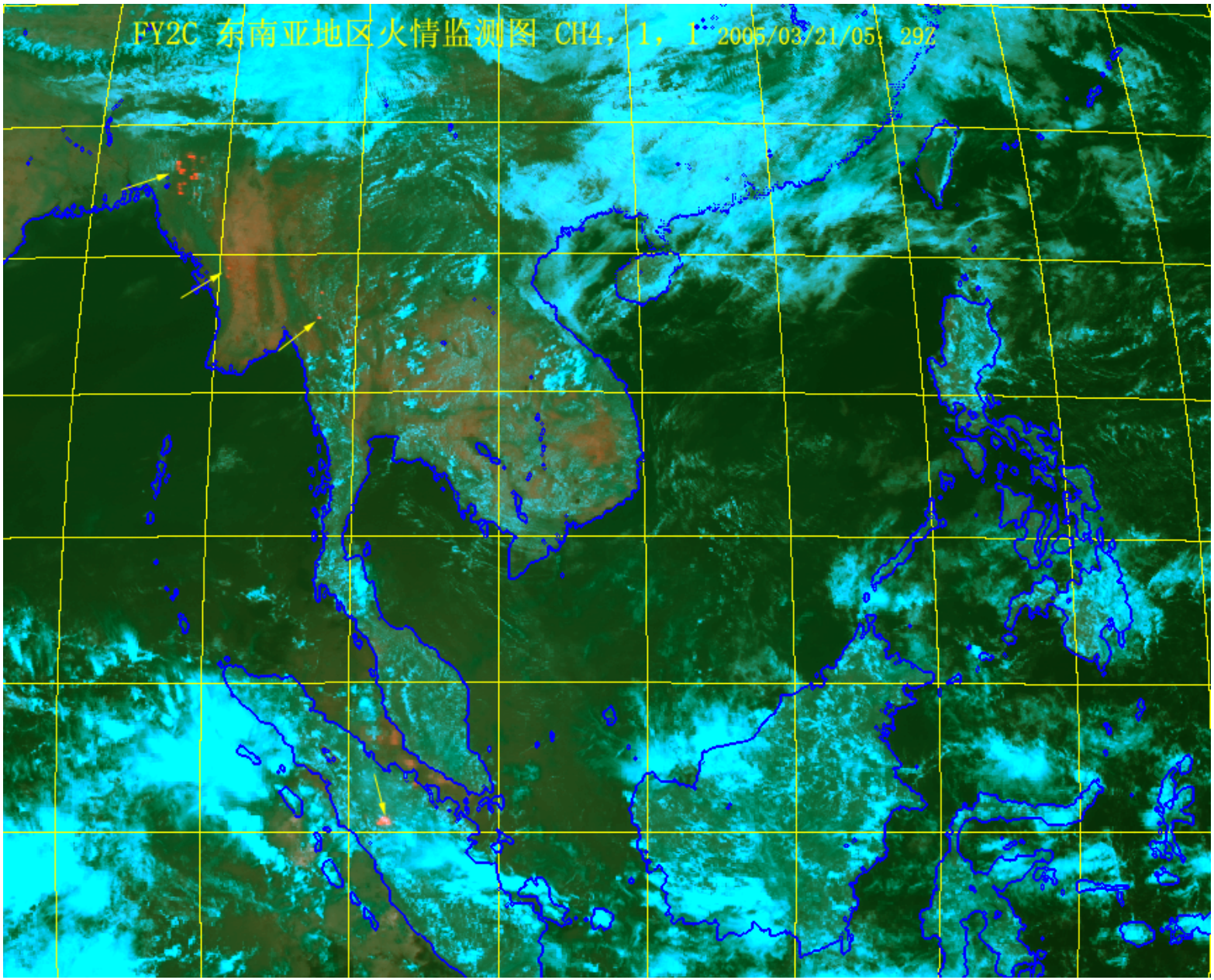
FY2C fire monitoring

2005/03/21/05 26z

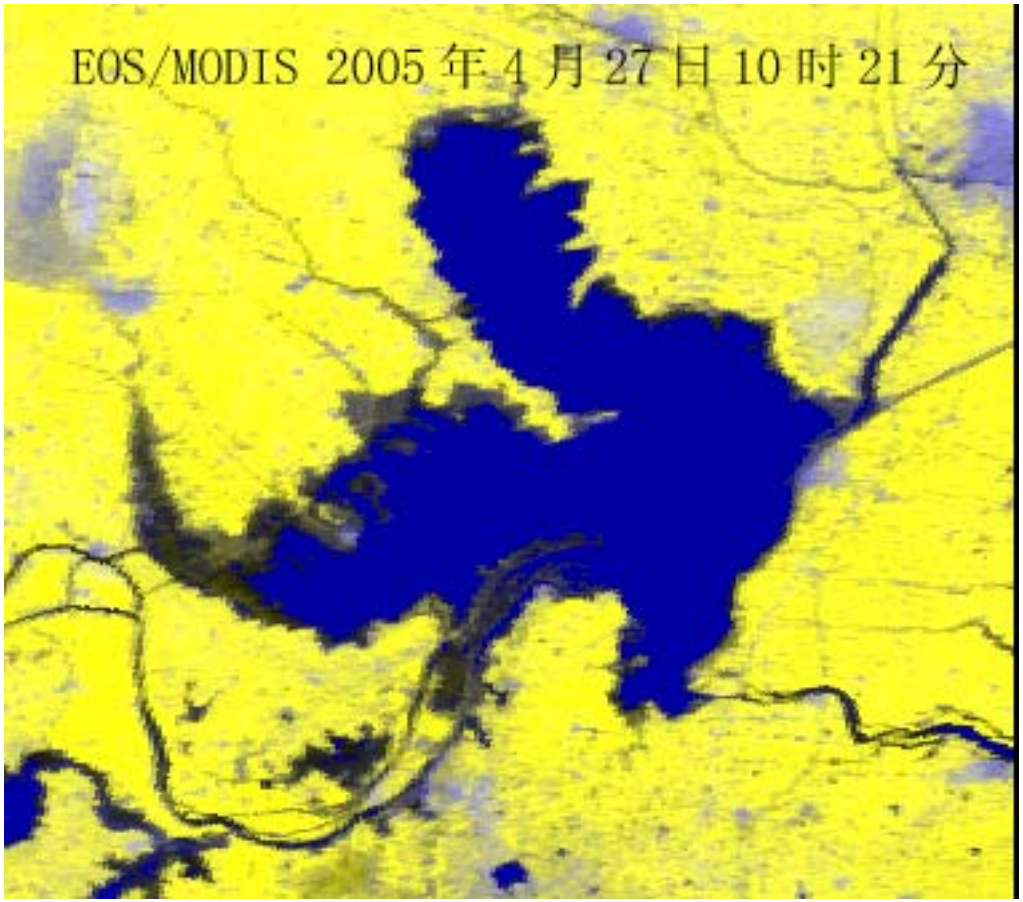
NOAA-16 fire monitoring

2005/03/21/05 26Z

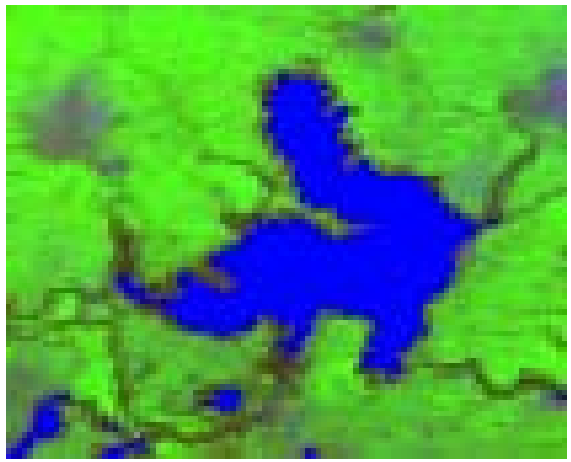
FY2C fire monitoring in south east Asia March 21 2005 0529Z



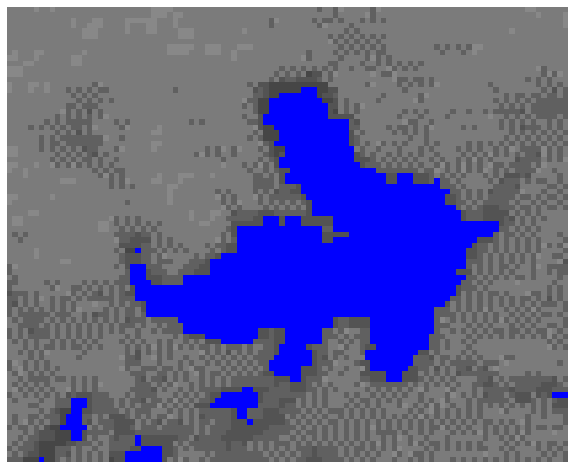
FY2C Flood Monitoring



EOS/MODIS 200504271021

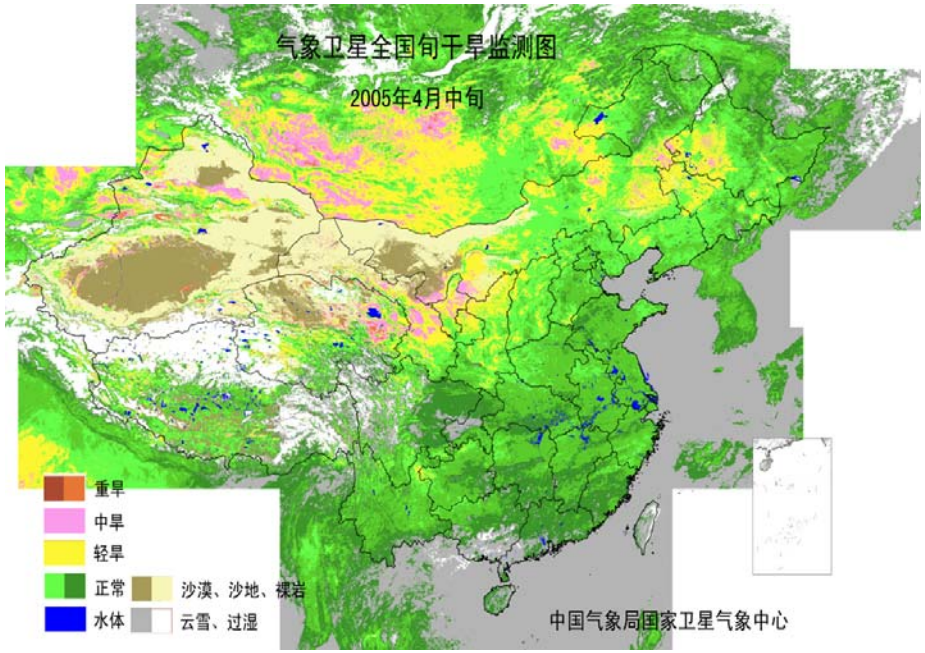


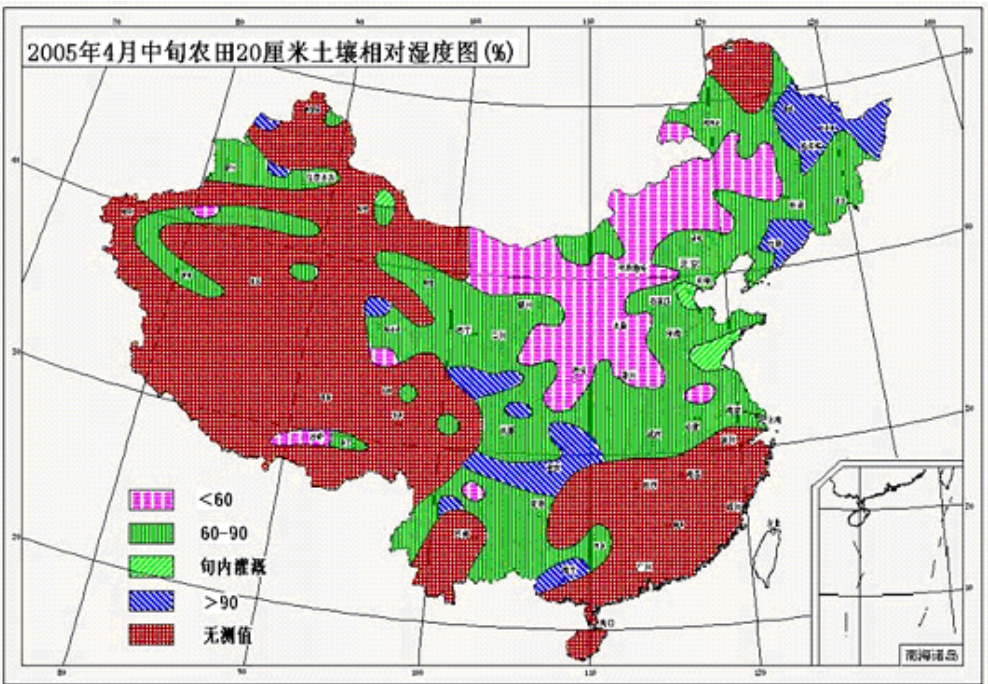
NOAA-16 200504271441

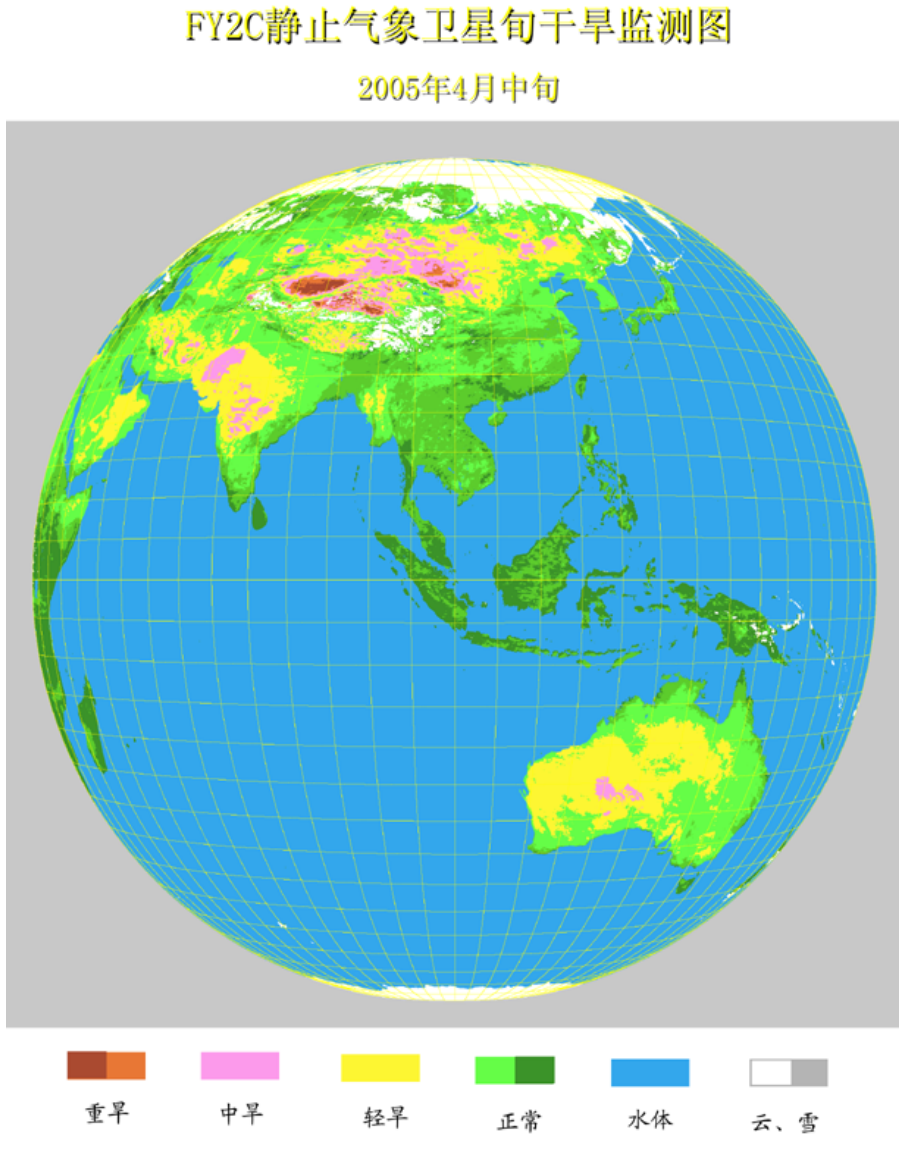


FY-2C 200504271100

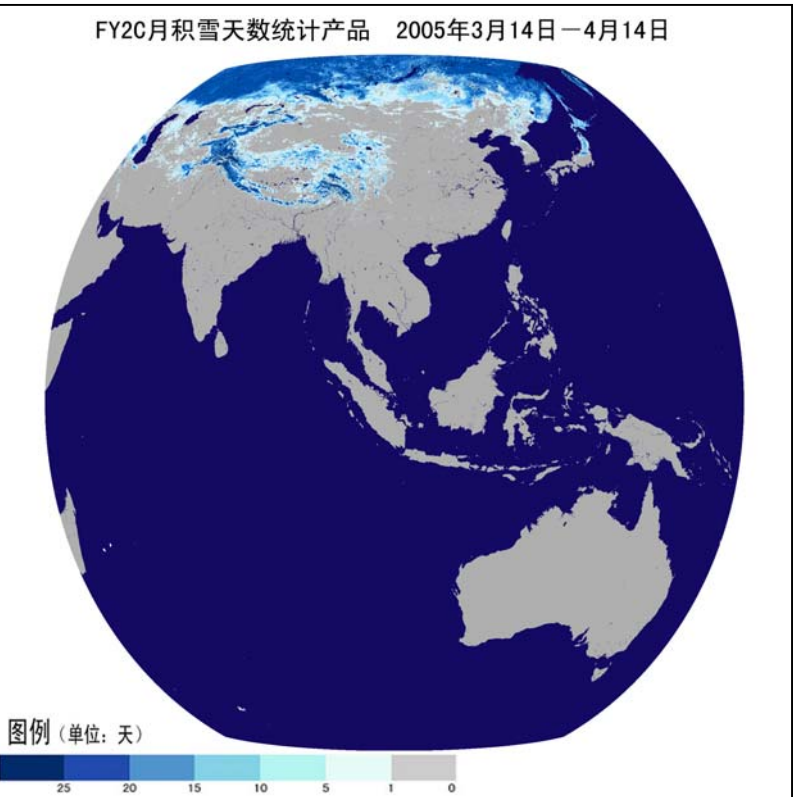
Soil moisture estimated with ground temperature tendency





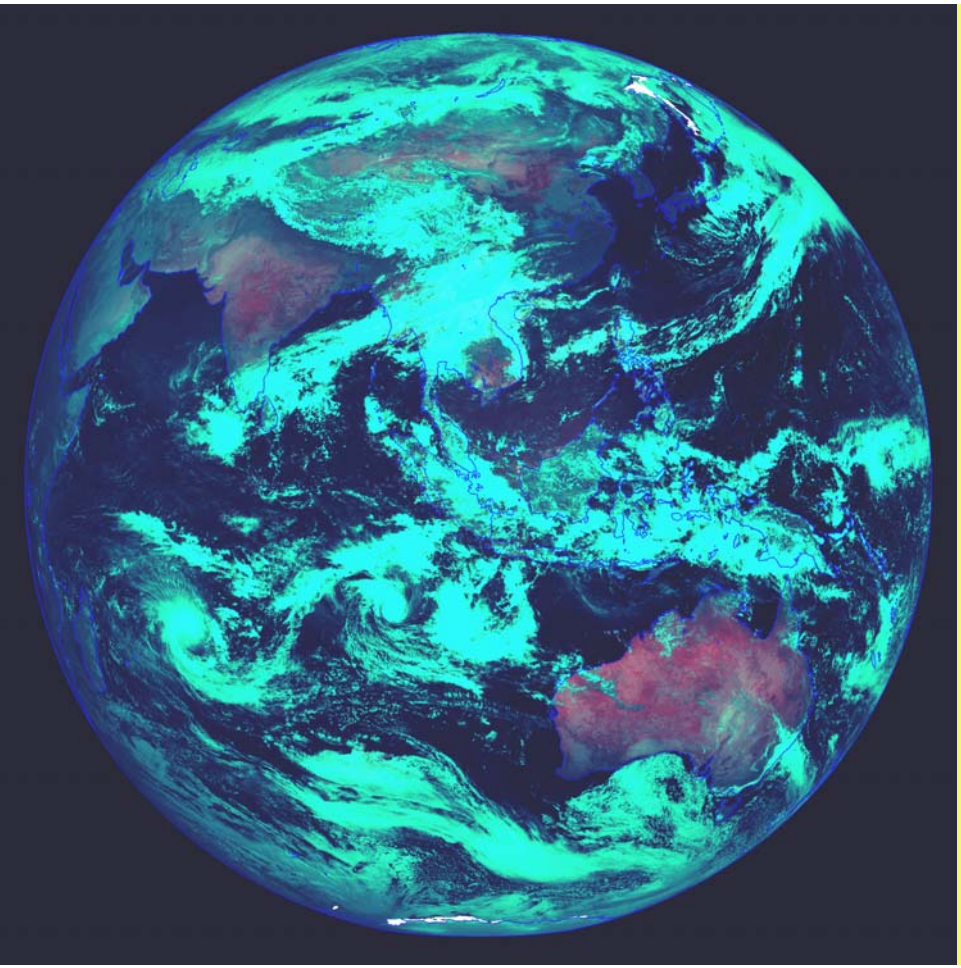


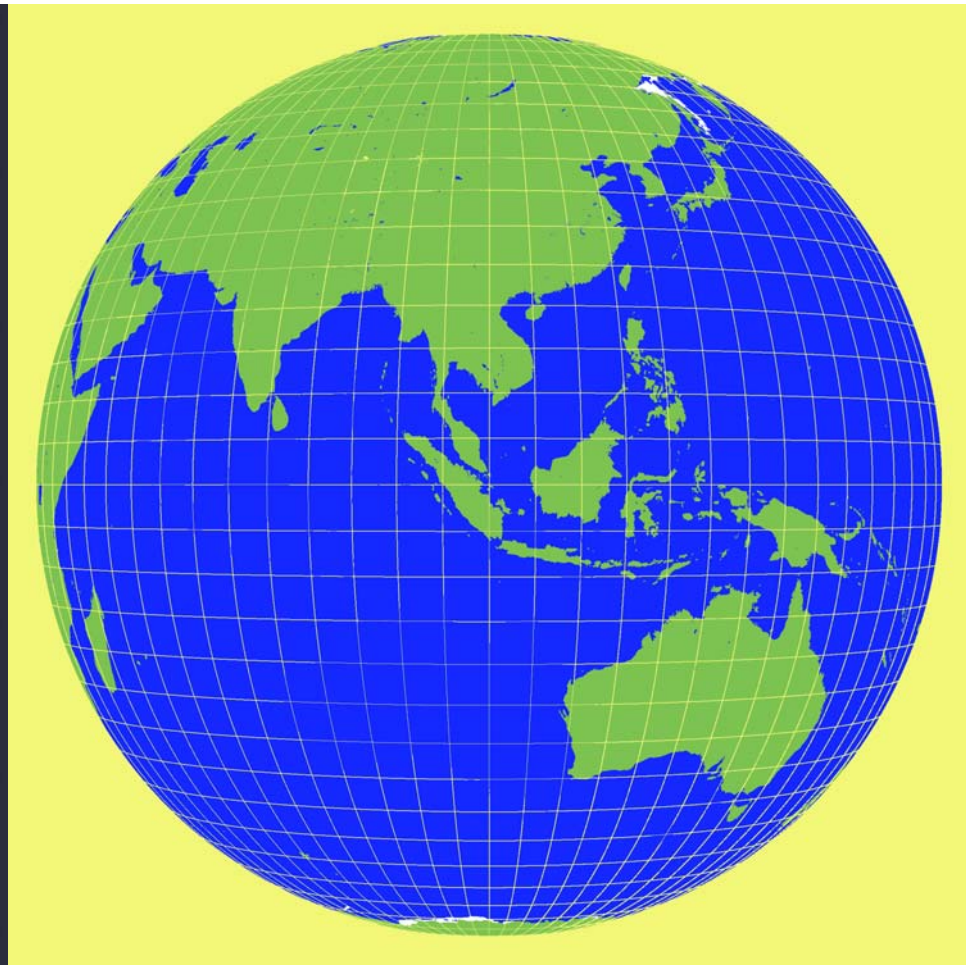
FY2C
snow cover



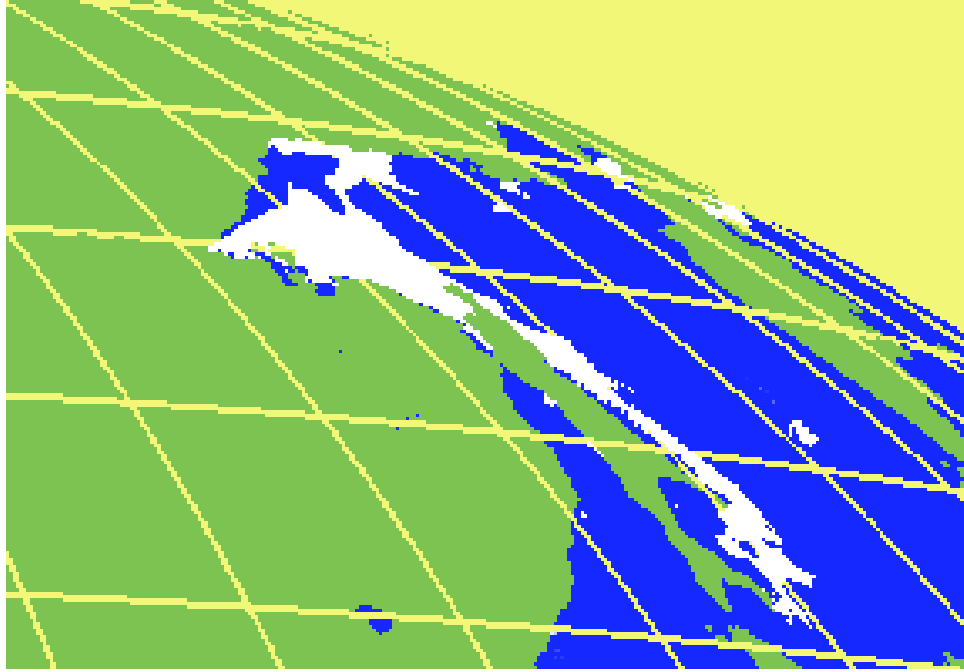
Snowy days in the month

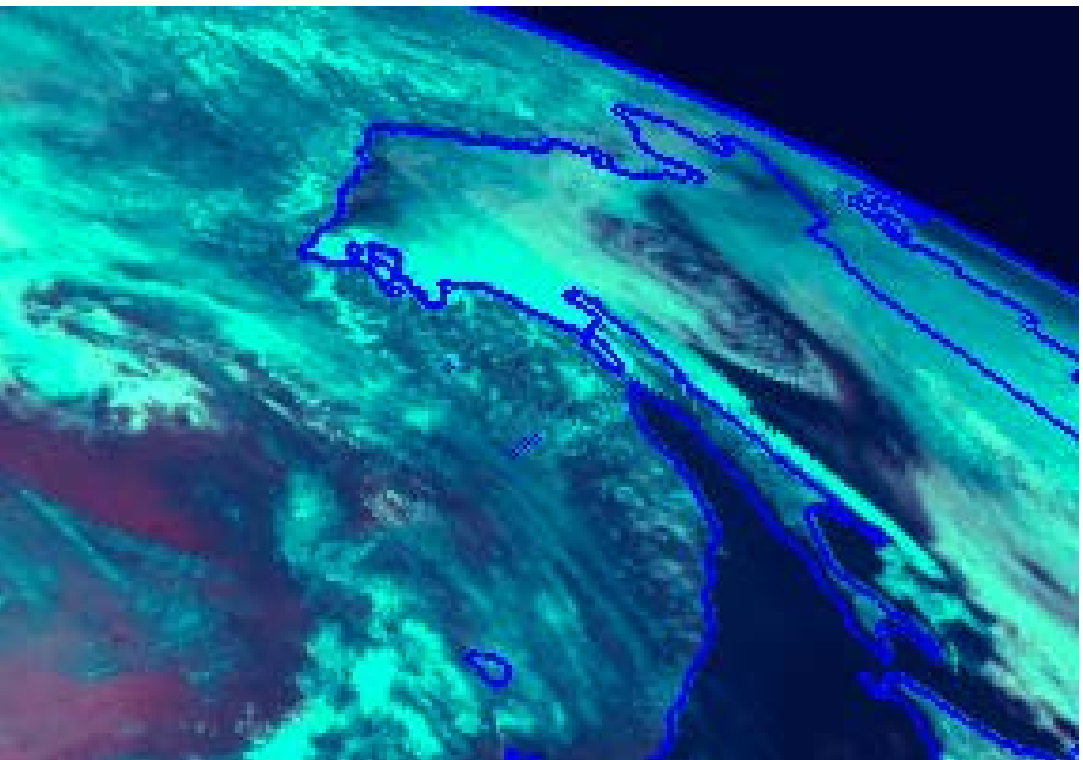
FY2C Sea Ice

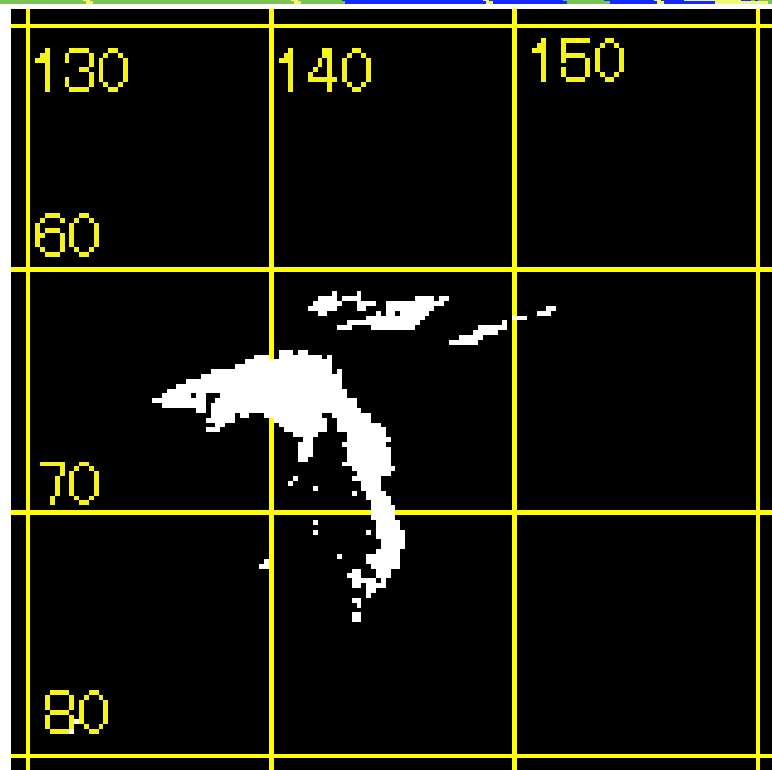




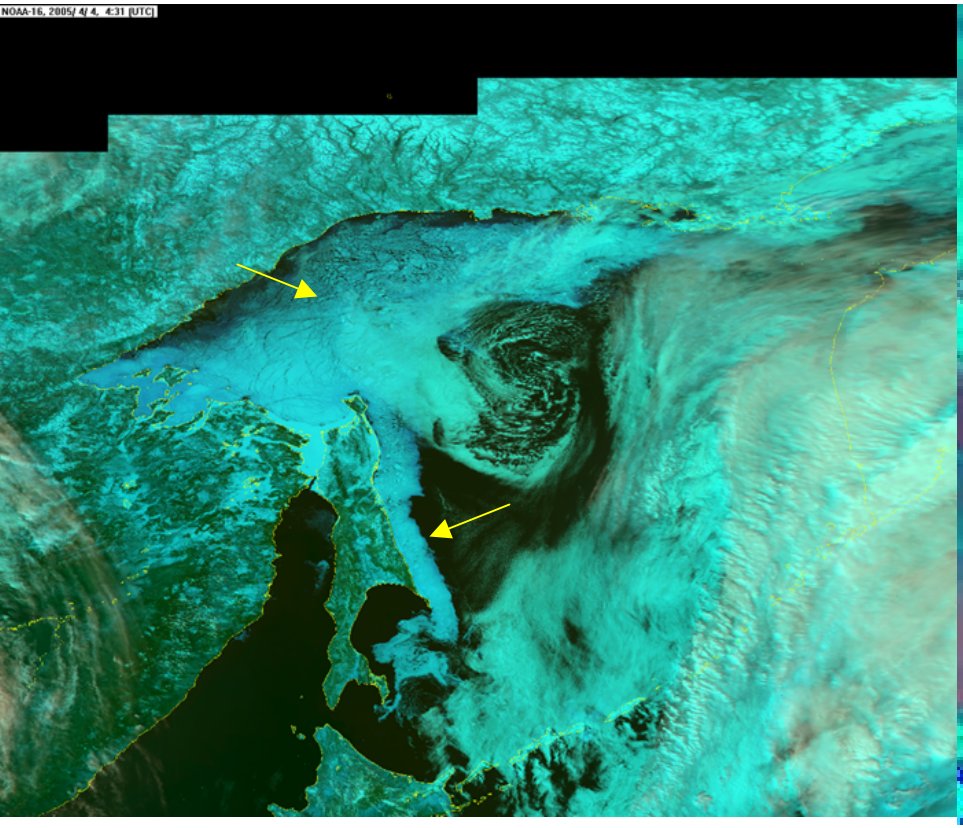
Regional Sea Ice

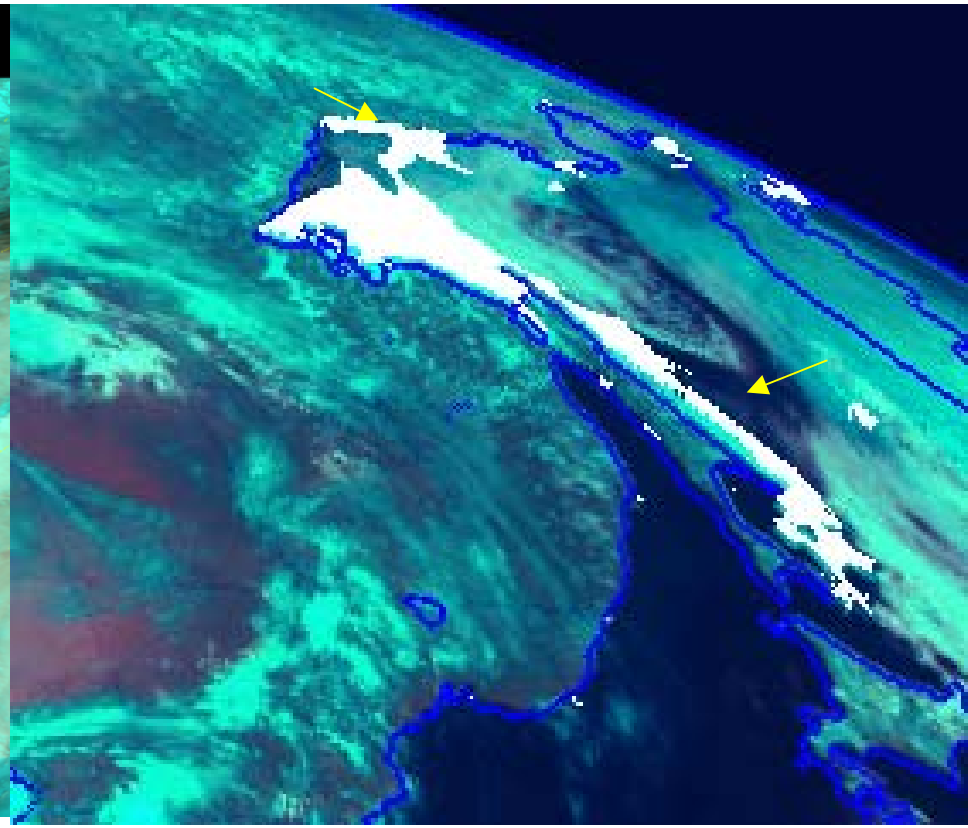






Sea ice compared with NOAA





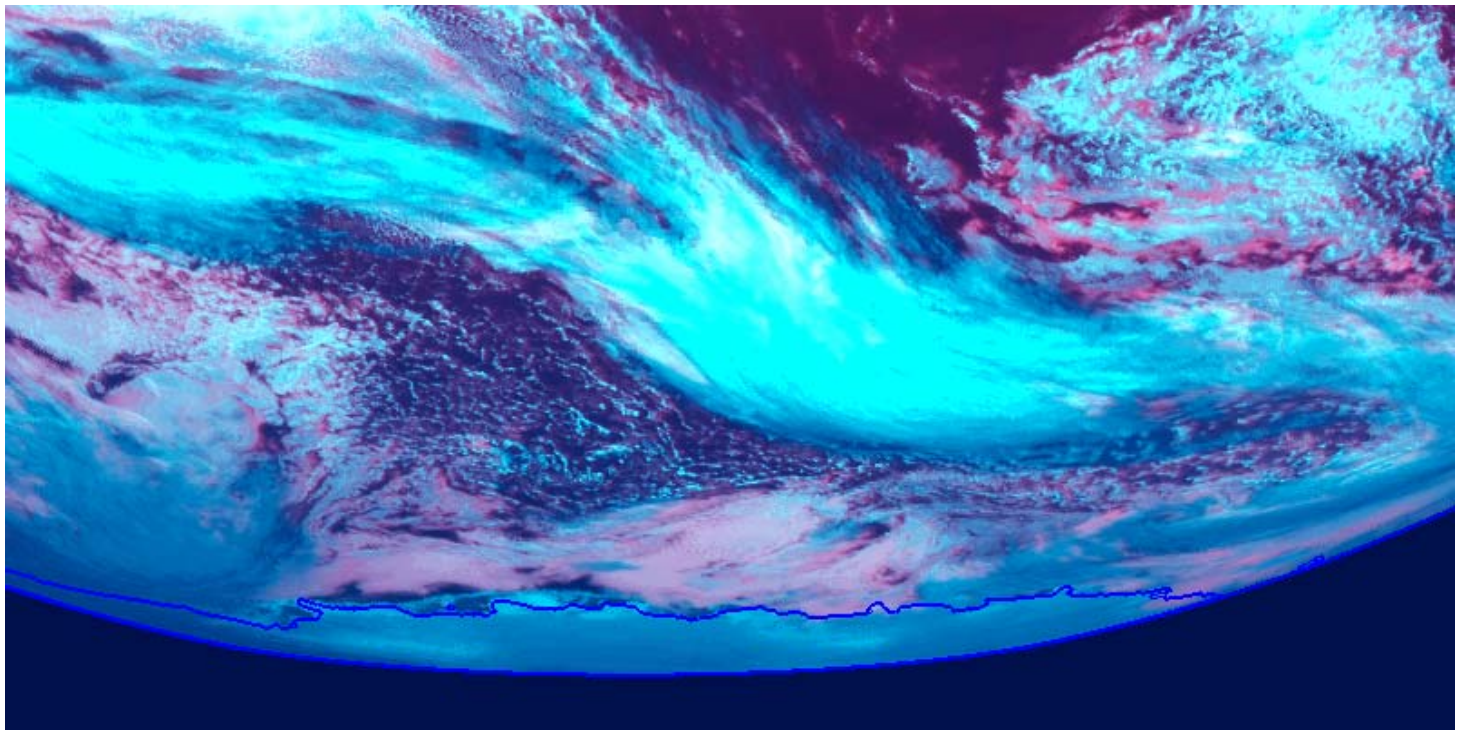
NOAA-16 Sea ice

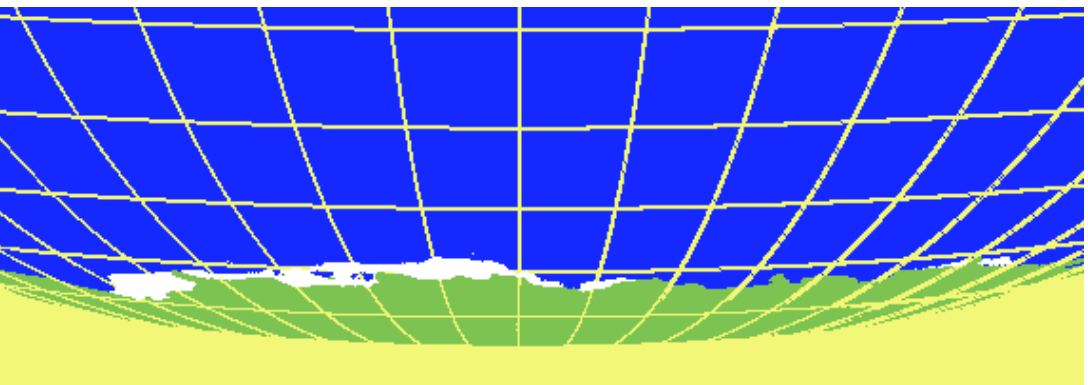
2005/04/04/04 31Z

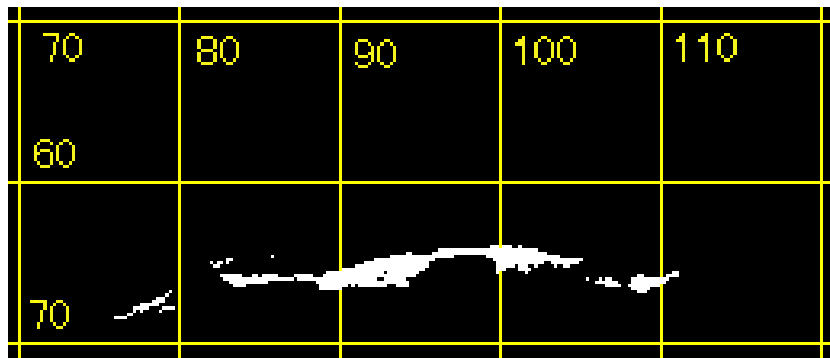
FY2C Sea ice

2005/04/04/04 00Z

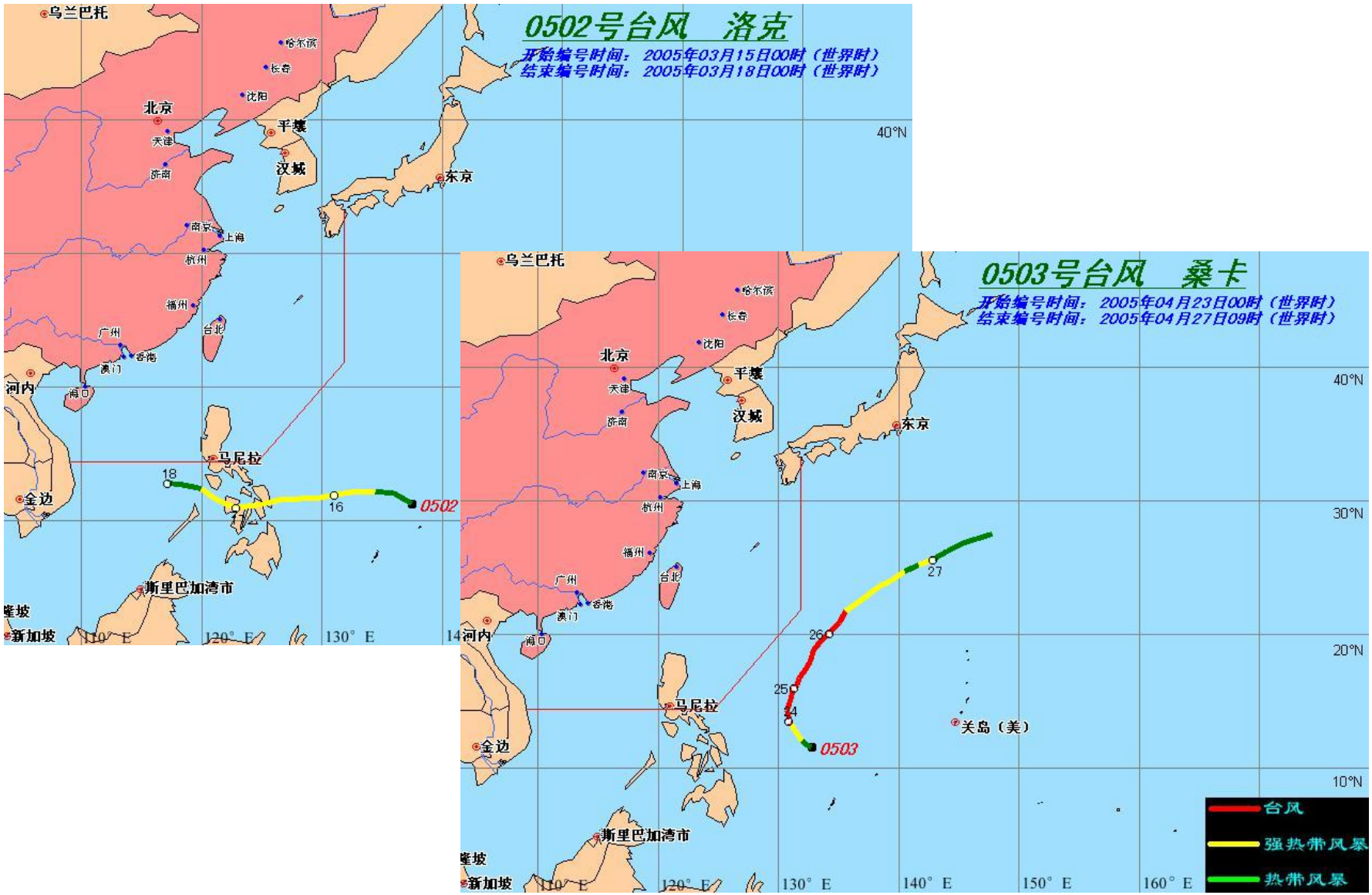
Regional Sea Ice Antarctic



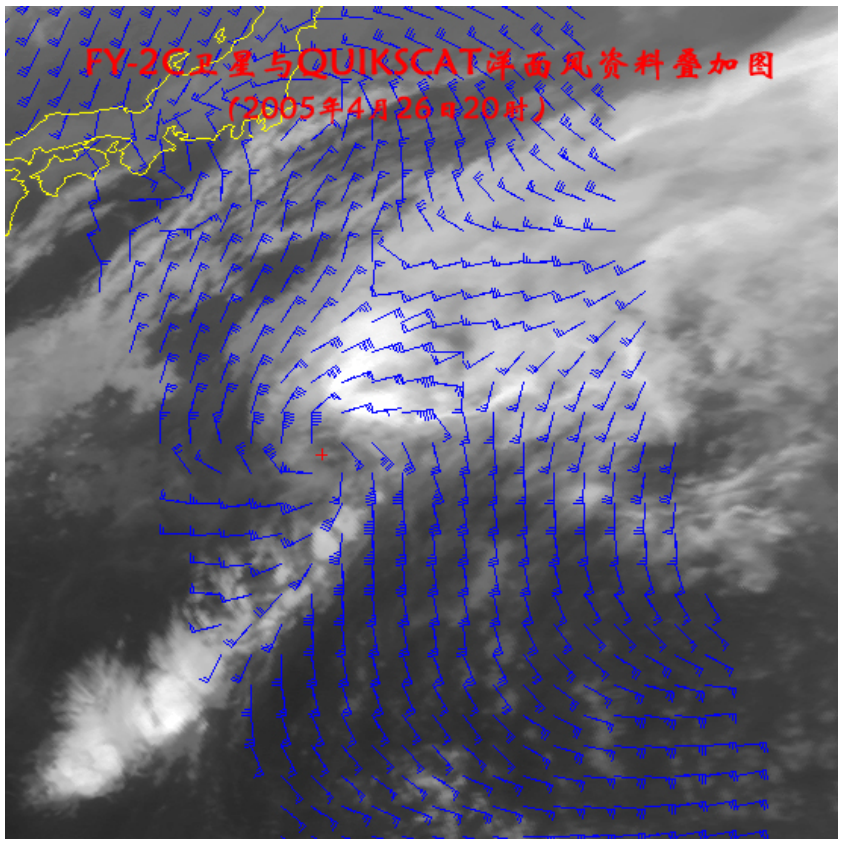


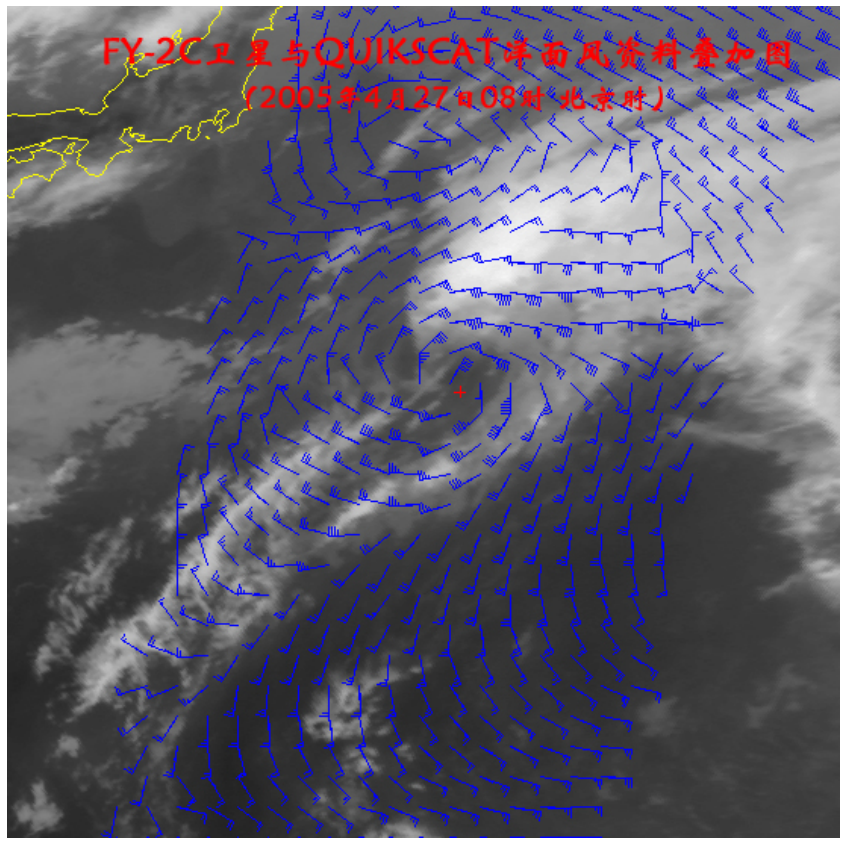


Tropical Cyclone



Tropical Cyclone position compared with QUIKSCAT



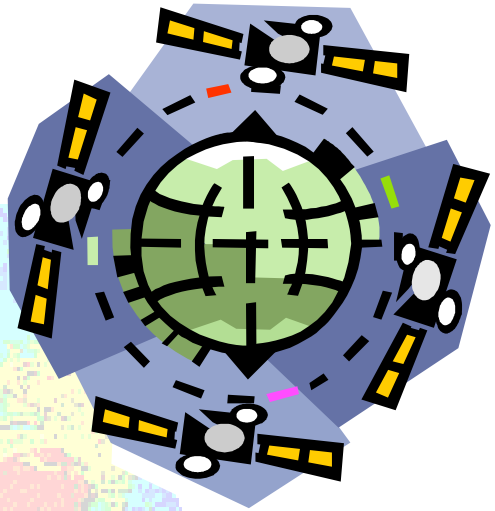


With the bilateral Cooperation

- **More CIMSS experts' research can be applied to FY2C data processing to bloom the FY2C's application;**
- **FY2C data can be easy to access for CIMSS's Experts;**
- **Experience in FY2C data processing can be shared with CIMSS's experts to improve the US. Geostationary satellite;**
- **Celebrating CIMSS's silver anniversary and cheers for 25 years' relationship between CIMSS and NSMC**

CIMSS

NSMC



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CIMSS

NSMC