The Programs of China Ocean Observation Satellites and Applications

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SOA, Feb. 26, 2008

1、The Objectives of Ocean Observation Program of China

2、The Program before 2020

3、The Achievement of China Ocean Satellites and Applications

1 The Objectives of Ocean Observation

- Three series of Ocean Observation satellites and their application systems have been planed before 2020.
  - Ocean Color & Sea Surface Temperature (**HY-1** Series),
  - Ocean Dynamics (**HY-2** Series)
  - Marine Monitoring Satellite (**HY-3** Series).
- Objective 1: To establish China Ocean Observation System mainly based on the three satellite series
- Objective 2: To Improve the precision and time efficiency of ocean disaster monitoring and forecast.
- Objective 3: To provide services for the management of coastal zone integrate, exploitation of ocean resources and protection of ocean environment.
- Objective 4: Safeguard the maritime rights and interests of the nation.

2 The Program of China Ocean Observation Satellites before 2020

2.1 HY-1 Series

- The main task of HY-1 is ocean color & SST
  - Chlorophyll, suspended sediment, and dissolved organic matter, pollutants, as well as sea surface temperature.
  - HY-1A, launched on 15 May,2002.
  - HY-1B, launched on 11 April, 2007.
  - HY1-A/B is power limited, only downloading in China
- HY-1C/D, will be launched ~2010.
  - 1C is AM and 1D PM.
- AM/PM satellites will be launched every 3 years
  - 2010, 2013, 2016, 2019.

HY-1B Satellite and orbit characteristics

Orbit type	**Near Circular ,near sun-synchronous**
Equator crossing local time	**10:30±30 min (descending node)**
Altitude	**798km**
Inclination	**98.8 deg**
Period	**100.8 minute**
Repeat observation period	**1days for COCTS, 7days for CZI**
Mass	**<400kg**
Payload	**COCTS and CZI**
Attitude control	**3 axis stabilized**
Downlink frequency	**X-band**
TT&C link	**S-band**
Designed life time	**3 years**
Platform	**CAST968 small satellite**

HY-1B COCTS Specifications

Nadir Resolution: 1100m		**Pixels per line: 1664**
Field-Of-View: ±55^0		**Digitization: 10 bits**
Accuracy Goal: VNIR-10%, TIR:1K		
BandNo.	**Wavelength(μm)**	VNIR Polarization: ~7%
1	**0.402～0.422**	Gains: 1
2	**0.433～0.453**	4-detecotors
3	**0.480～0.500**	45^0 Scan-mirror & K-mirror
4	**0.510～0.530**	Sterling Cooler
5	**0.555～0.575**	
6	**0.660～0.680**	
7	**0.740～0.760**	**B 9: 10.30～11.40 μm**
8	**0.845～0.885**	**B10: 11.40～12.50 μm**

HY-1A CZI bands & detecting objectives

Band (micro m)	*Main detecting object*
0.42-0.50	*Ocean color，pollutant，sea ice*
0.52-0.60	*Sediment，Pollutant，sea ice*
0.61-0.69	*Sediment，Vegetation，Soil、*
0.76-0.89	*Soil，Vegetation，Atmospheric correction，land/ocean/cloud boundary*

Resolution: 240m

Pixels per line: 2048

HY-1B CZI bands

Band	Detecting objects
443±10nm	Chl-a，pollutant
565±10nm	Sediment，Chl-a, Pollutant
665±10nm	Flouroscence, Sediment
685±10nm	Flouroscence, Sediment

Its atmospheric correction depends on COCTS !

2 The Programming of China Ocean Observation Satellite before 2020

2.2 HY-2 Satellite Series

- The Object of HY-2 series satellite:
  - Global Ocean Wind Field
  - Global Ocean Topography, Sea Level and Gravity Field.
  - Wave Field.
  - All weather Sea Surface monitor and forecast
  - Sea Ice monitor

- Will be launched in 2009, 2012,2015,2019.

HY-2 series satellite Monitor Parameter

Payload	Monitor Parameter
Scatterometer	***Main Parameter：*** Sea Surface Wind Field
Altimeter	Sea Surface height, Significant wave height, Gravity field and Ocean Circumfluence
Radiometer	Sea Surface Temperature Wind Speed Sea Ice and Vapor content

HY-2 Series Satellite Orbit Select

- Monitor Global Wind: Cover more than 90% in 1 day.
- Regress Period are of two cycles: one is 14days and the other is 168days.

HY-2 Satellite Characteristics

- Point precision: pitching ,roll and yawing<0.1°
- Measure precision: pitching ,roll and yawing< 0.05°
- Three axis pose stability <0.001° /s
- Repeat Cycle: two phases（14days and 168days）
- Life: more 3years。

Payload user requirment

（1）SCAT

wind speed range: 2-24m/s

wind direction precision: ±20°

wind speed: 2m/s or 10%

（2）ALT

Sea Surface precision: <5-8cm

SWH range： 0.5-20m

SWH precision: <10% or 0.5m(greater)

Payload user requirment (con.)

（3）RAD

wind speed：

range：7-50m/s

precision：2m/s or 10%(greater)

SST：

range：100-300K

precision：1.0K

Vapor:

precision：10%

Payload Specifications

- **Scatterometer**
  - frequency： 13.2515GHz
  - polarizae: HH, VV
  - scan coverage：>1300KM
  - ground resolution：50km
  - backscatter coefficient precision：<0.5dB
  - backscatter range：-40~20dB
  - dynamics range： AGC 60dB

- Altimeter

- frequency： 13.58 and 5.25 GHz
- compress ratio： 33000
- pulse repeat frequency： 1~4KHz
- ground resolution： 16km
- SSH precision： ＜4.0cm
- backscatter precision： 0.5dB

Radiometer

freq.(GHz)	6.6	10.7	18.7	23.8	37
Bandwidth(MHz)	350	250	250	400	1000
Polarize	VH	VH	VH	V	VH
Swath	1600km				
Resolution	100	62	36	30	18
Sensitive	0.5	0.5	0.5	0.5	0.8
range	3-350K				
Precise	1K （180-320K）				
Linearity	>0.999				

HY-2 Satellite Precision Orbit Determine requirement

Satellite radius vector direction precision: 10cm

POD system is composed of :
DORIS+laser system +GPS (Double frequency)

The SSH Accuracy Goal: 4~5cm

2 The Programming of China Ocean Observation Satellite before 2020

2.3 The HY-3 series satellite:

- **HY-3 Mission Objectives:**

  (1) To obtain high resolution data of ocean **targets, waves, oil spills, winds, currents, coastal engineering, coastal zone resources**.

  (2)To provide services for safeguard the state's **maritime rights** and interests, marine **law enforcement**, rapid response to national security, marine **environmental protection**, monitoring of **marine pollution**, exploitation of marine resources, **Coastal zones survey**, management of marine resources, polar study and research, etc.

- HY-3 Payload

SAR

2 The Programming of China Ocean Observation Satellite before 2020

The HY-3 series satellite:

- HY-3 Satellite Project schedule:
  2005 － 2006： User requirements analysis
  2007 － 2008： Key techniques research
  2009 － 2011： Sensor & Satellite manufacture
  2012： launch
  - We will launch one HY-3 satellite every 5 years
  - 2012,2017, 2022

WSAR parameters

basic parameters	Frequency	X	
	Polarization	HH VV	
	incidence angle	15^0-60^0	
	NE σ^0	<-20db	
swath	Precise model	resolution	1m*1m
		swath	20－40km
	Strip model	resolution	5m*5m
		60－80km	
	ScanSAR	resolution	10m*10m
		120－150km	
Image quality	azimuth ambiguous	<-20db	
	Range ambiguous	<-20db	
	dynamic range	>30db	
	Precision	1db(1scene)1.5db(1orbit)	

Platform features

Technical parameters name	Parameter values
Attitude control mode	Three-axis stably
Pointing accuracy	pitch、roll、yaw 〈0.1°
Measurement accuracy	pitch、roll、yaw 〈0.05°
Attitude stability	〈0.001° /s
Life time	Not less than 3 years
Data transmission	X-band, QPSK/UQPSK, Realtime or delay
Data storage	400GB
Instrument operation requirements	>30 minutes each orbit
orbit	Sun-synchronous

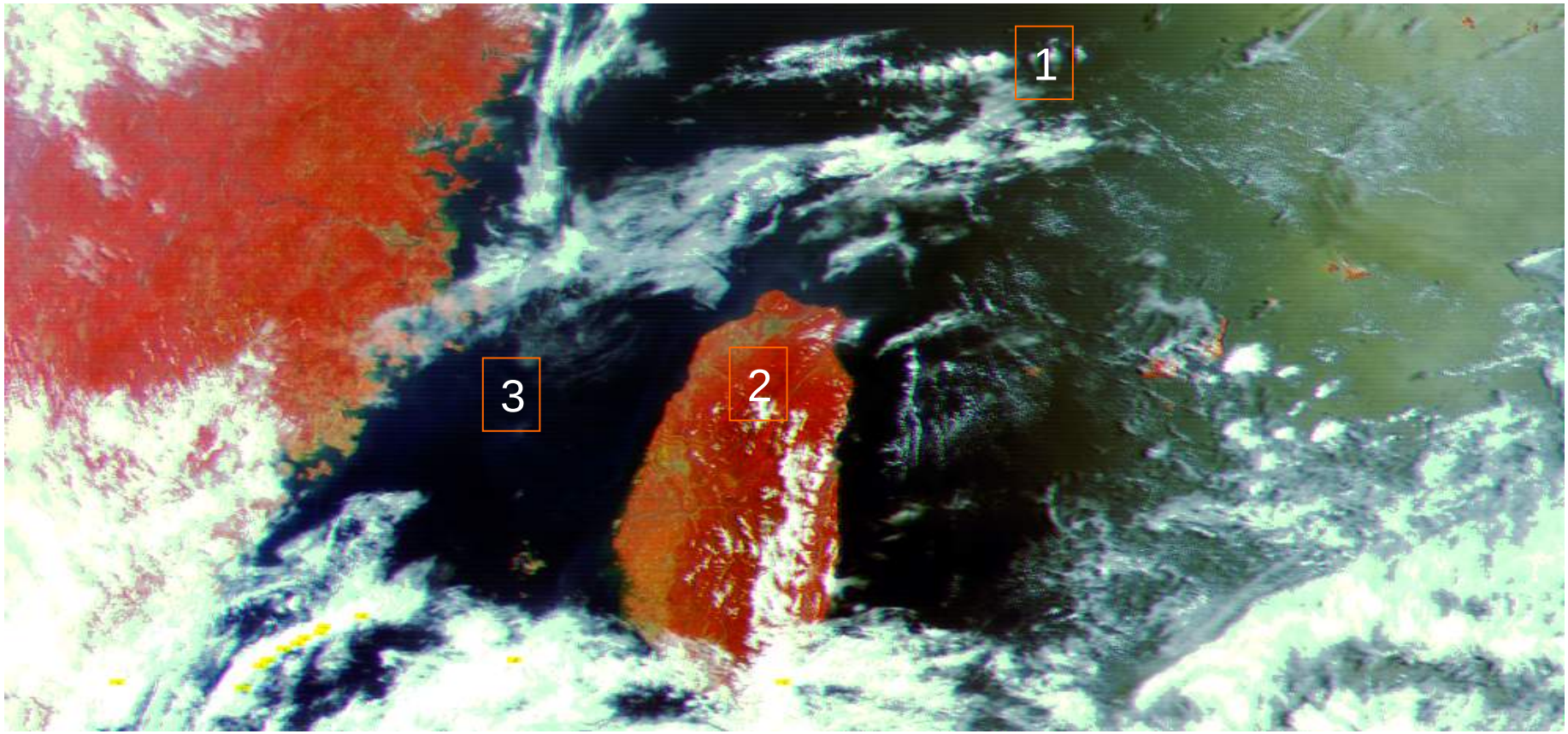
HY-3 Applications

- Ship activities, oil platform operations;
- The changes of coastal line, islands and reefs etc;
- Information services for EEZ management and monitoring;
- Monitor ocean waves, oil spills, sea ice, bathymetry, internal waves, fronts and eddies, coastal zones, ocean disaster prevention and relief.

The Schedule of China Ocean Satellites

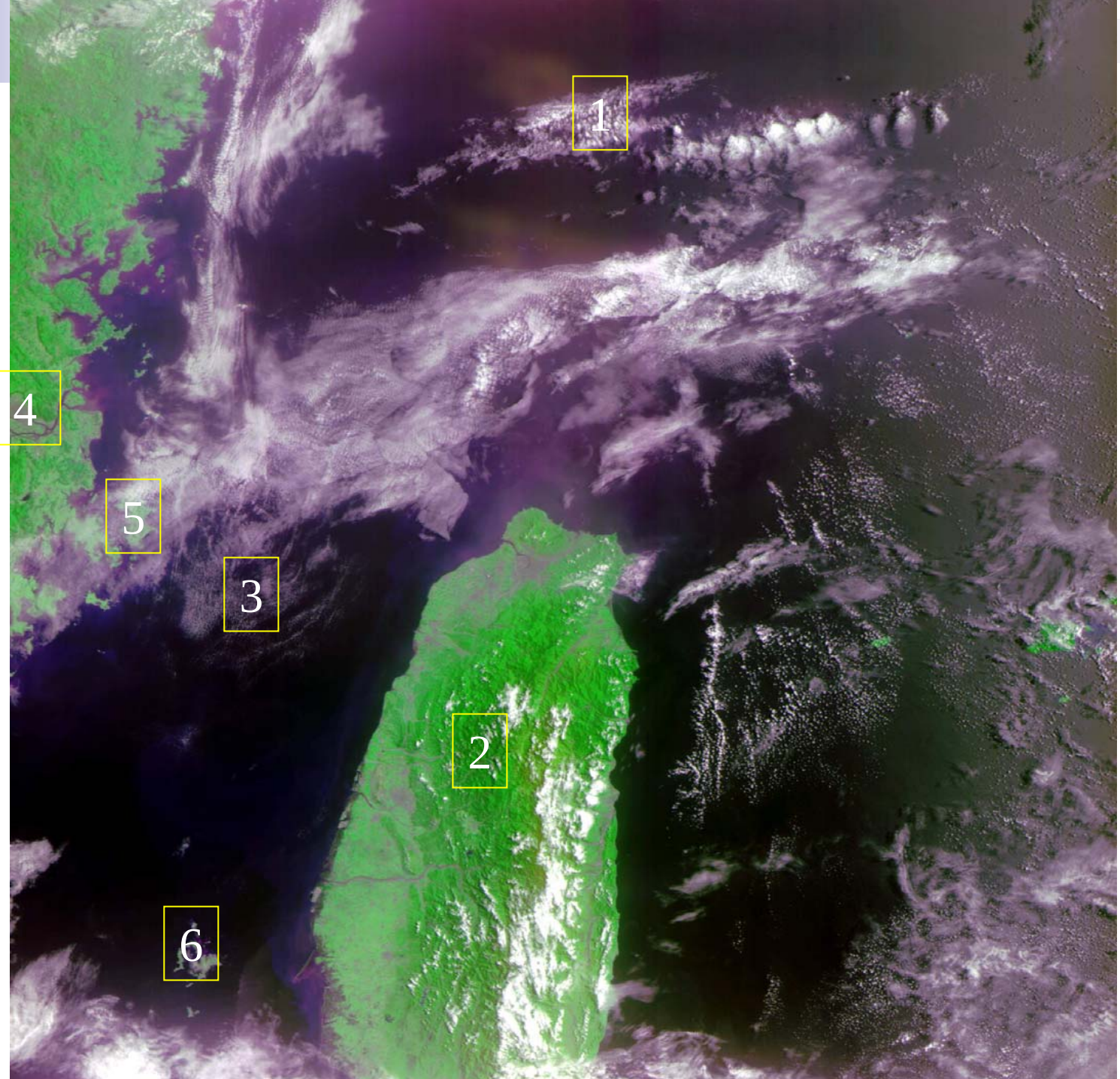
	2002	2007	2010	2012	2013	2016	2017	2019
HY-1	**1A**	**1B**	**1C/1D**		**1E/1F**	**1G/1H**		**1I/1J**
HY-2			**2A**		**2B**	**2C**		**2D**
HY-3				**3A**			**3B**	

3 The Achievements of China Ocean Satellites and Applications



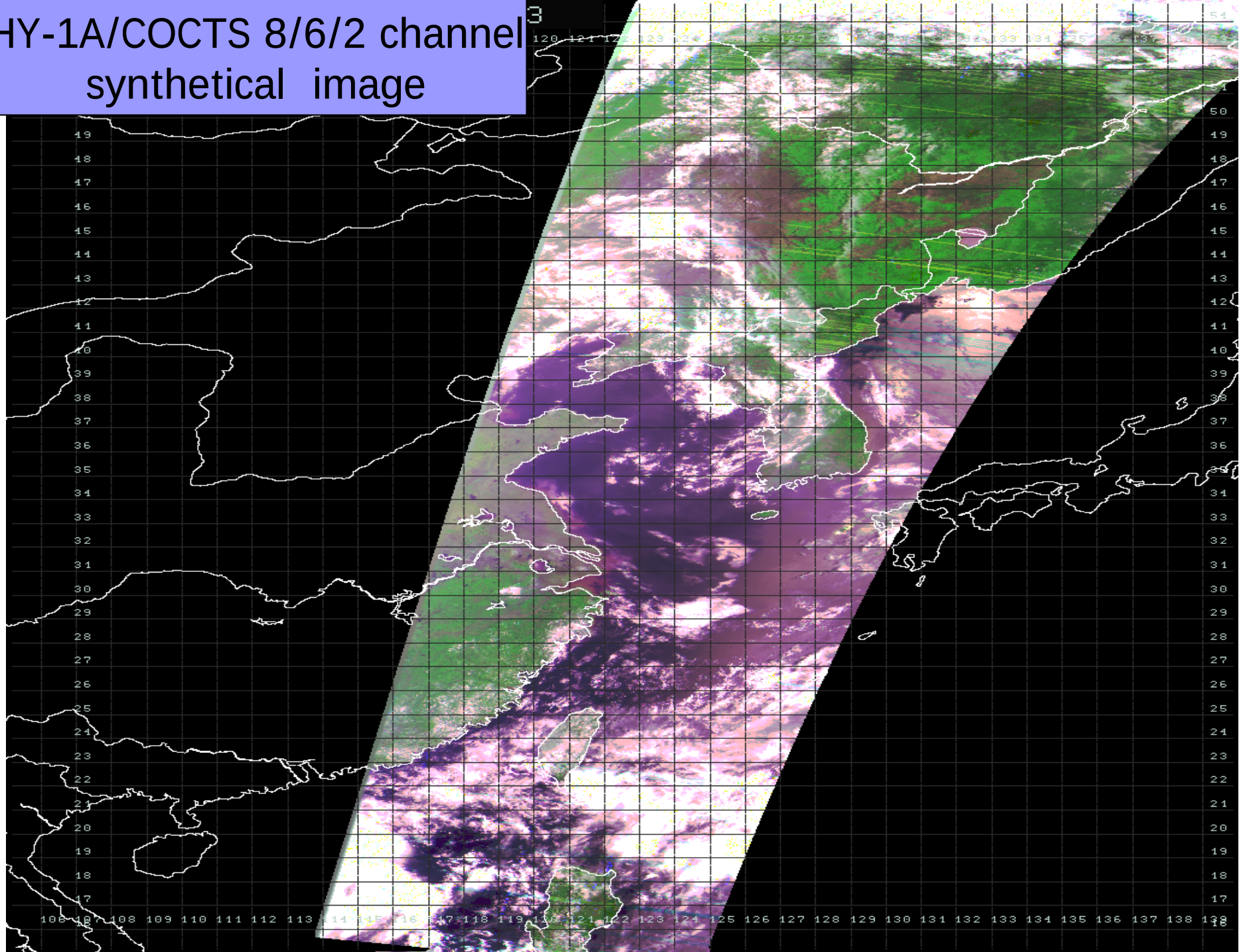
（BJT 2002.5.29 9:07　865/670/443）

HY-1A First COCTS Image in Real Time

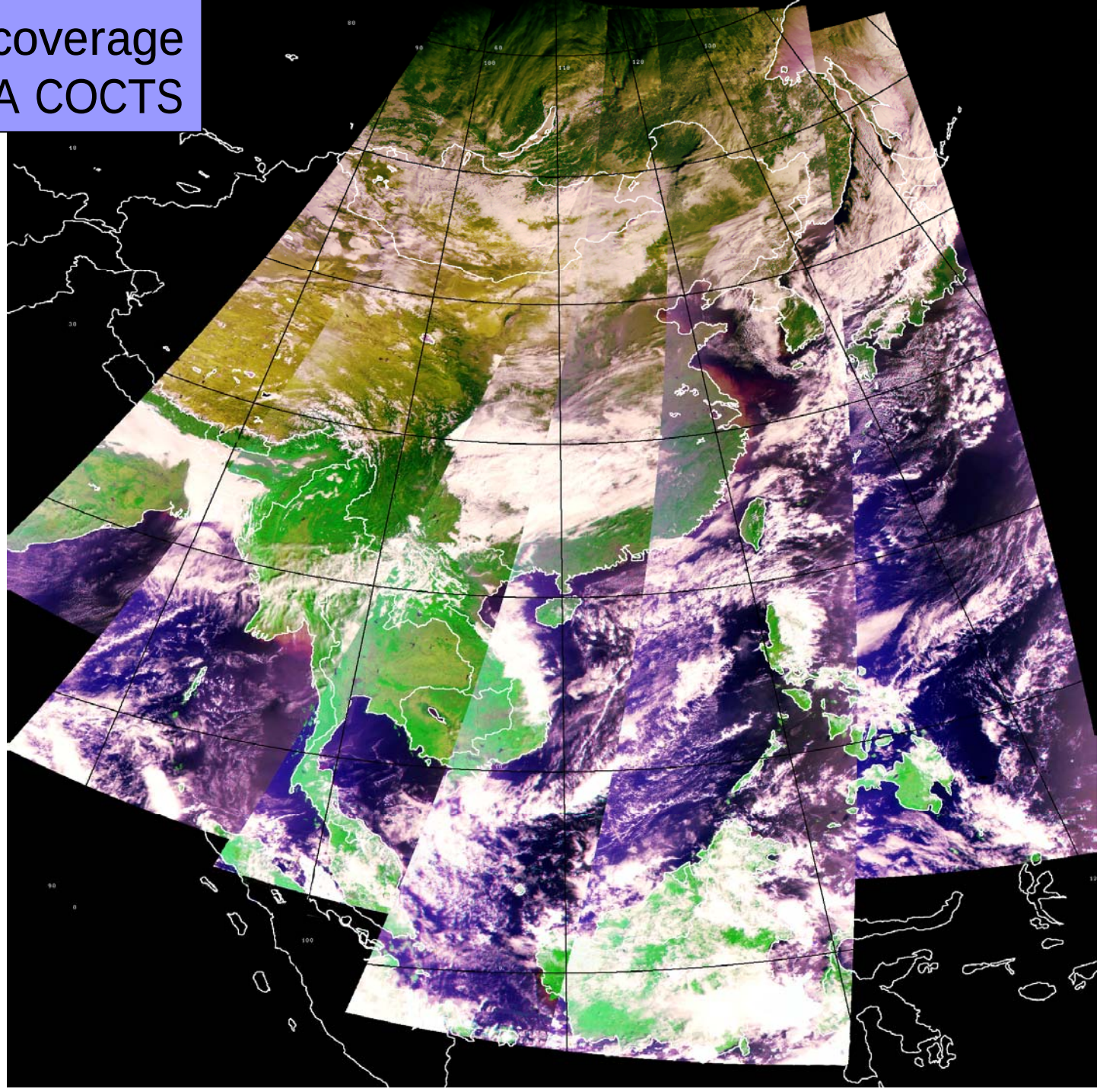


HY-1A First CZI Image
2002.5.29 9:07

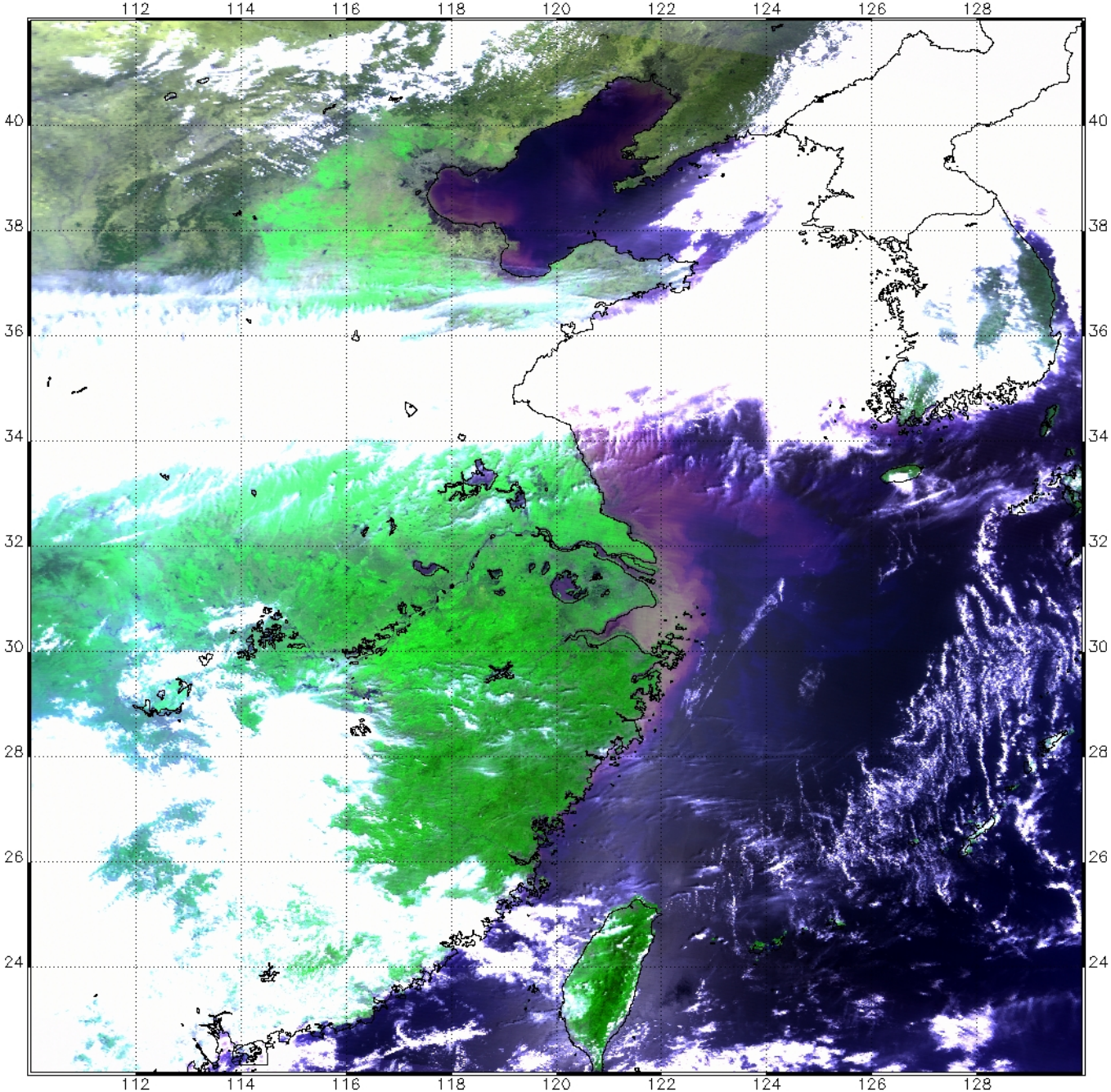
HY-1A/COCTS 8/6/2 channel synthetical image



3 Days coverage of HY-1A COCTS



mosaic

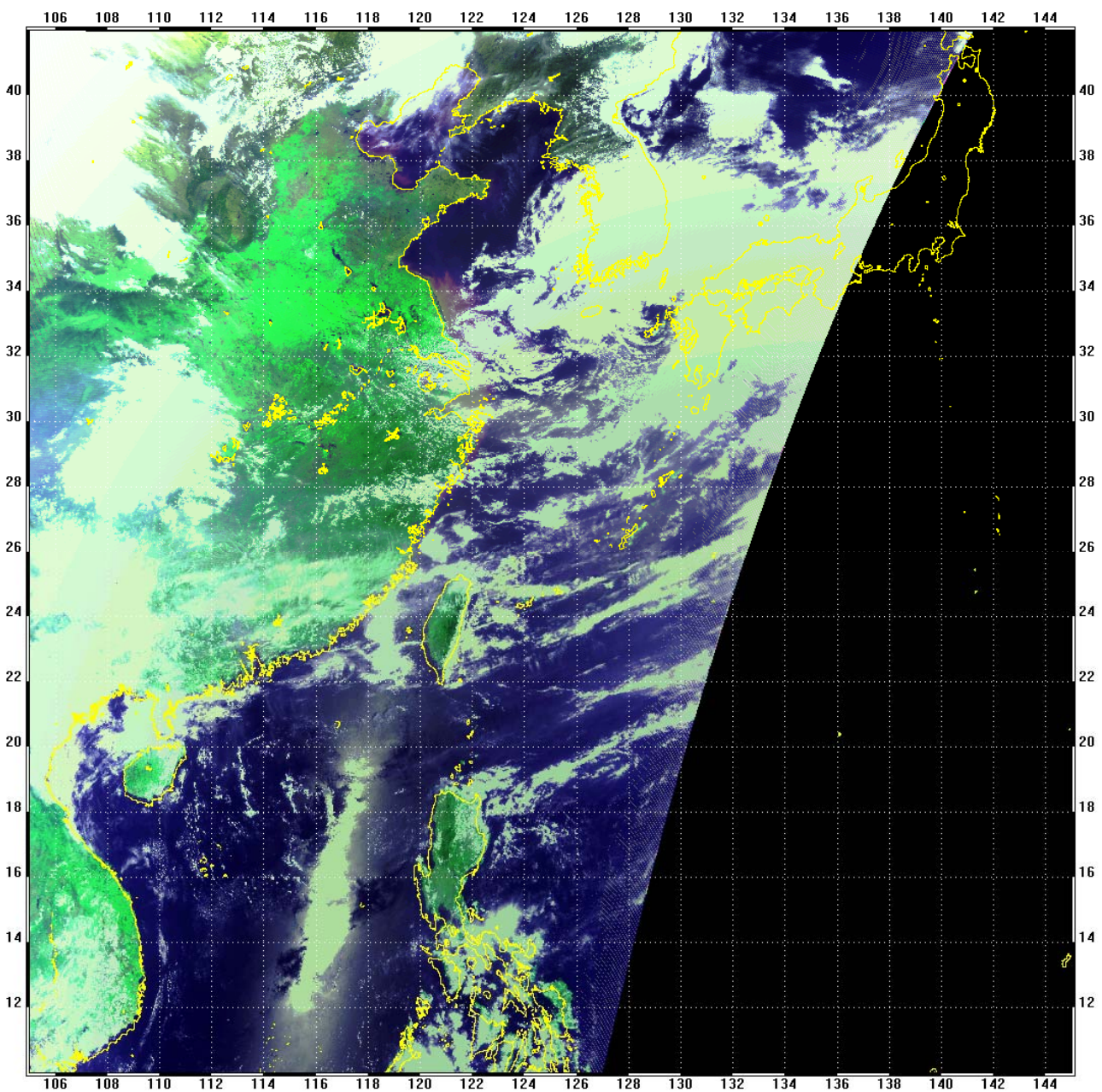


HY-1B
20 April
First
COCTS Image

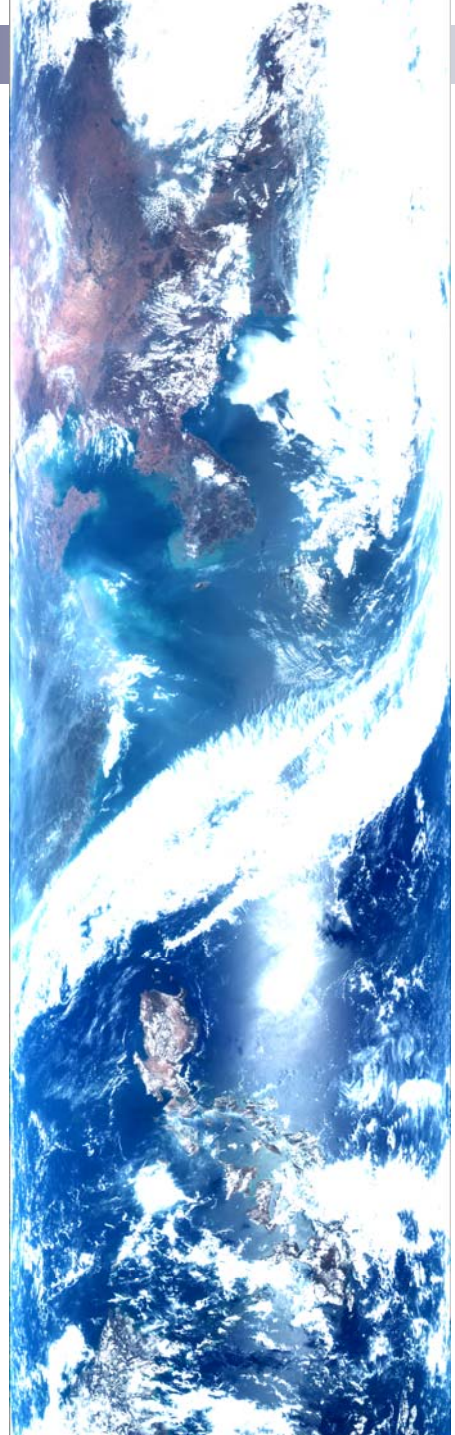
海洋一号 B 卫星第一轨遥感影像图
（CZI B4/B2/B1）

国　家　海　洋　局
国家卫星海洋应用中心

HY-1B
20 April
First
CZI Image

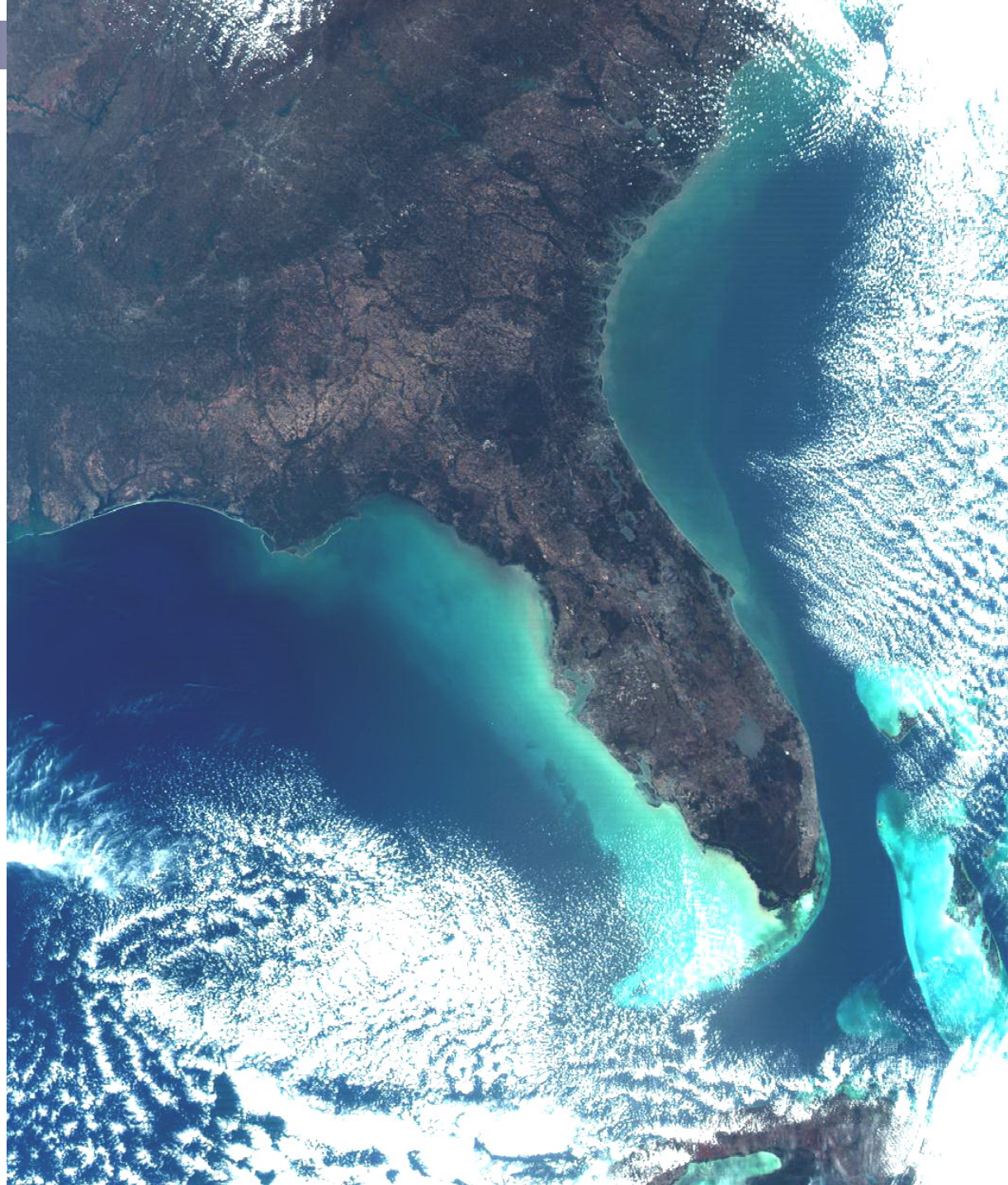


HY-1B Projection Image (located) COCTS
24 April COCTS

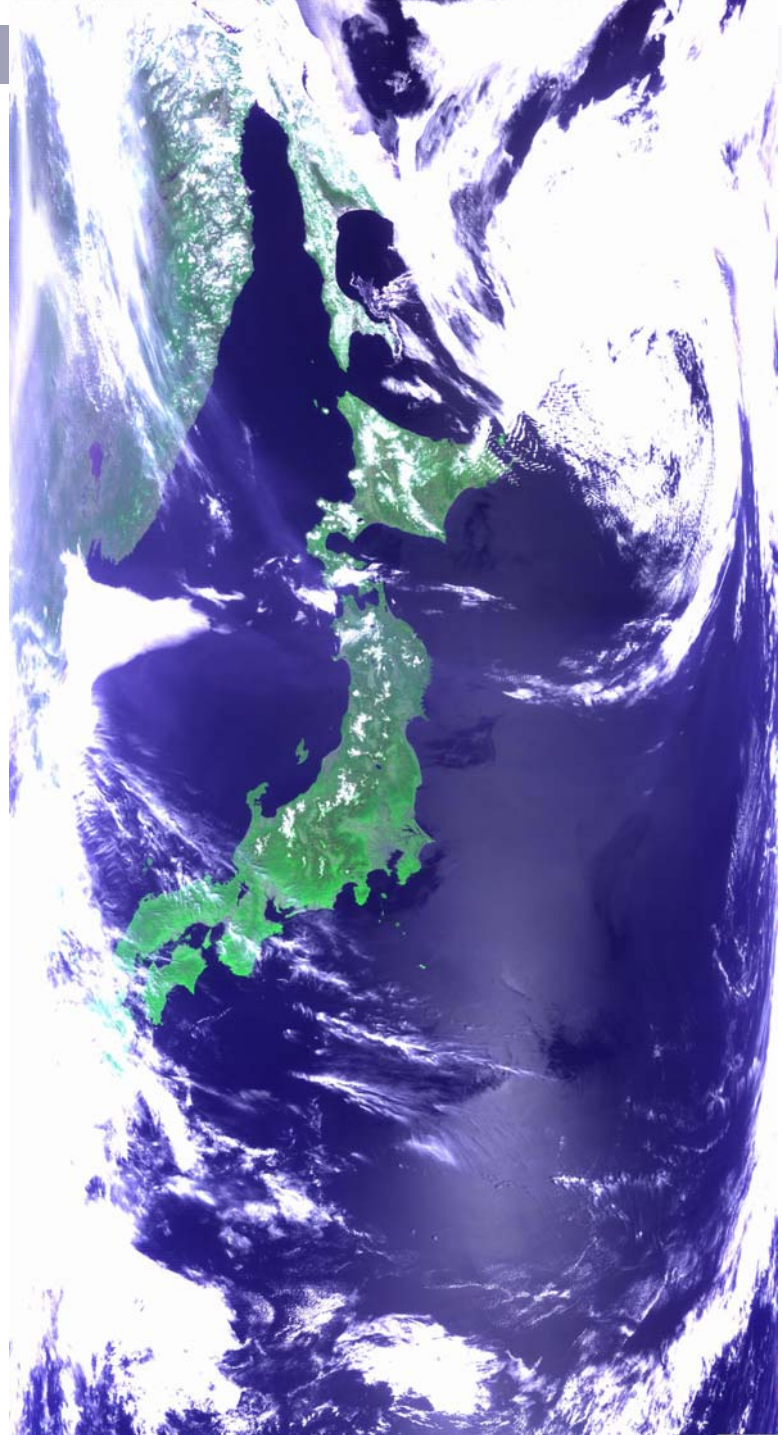


Part of HY-1B COCTS one orbit image

HY-1B CZI Image

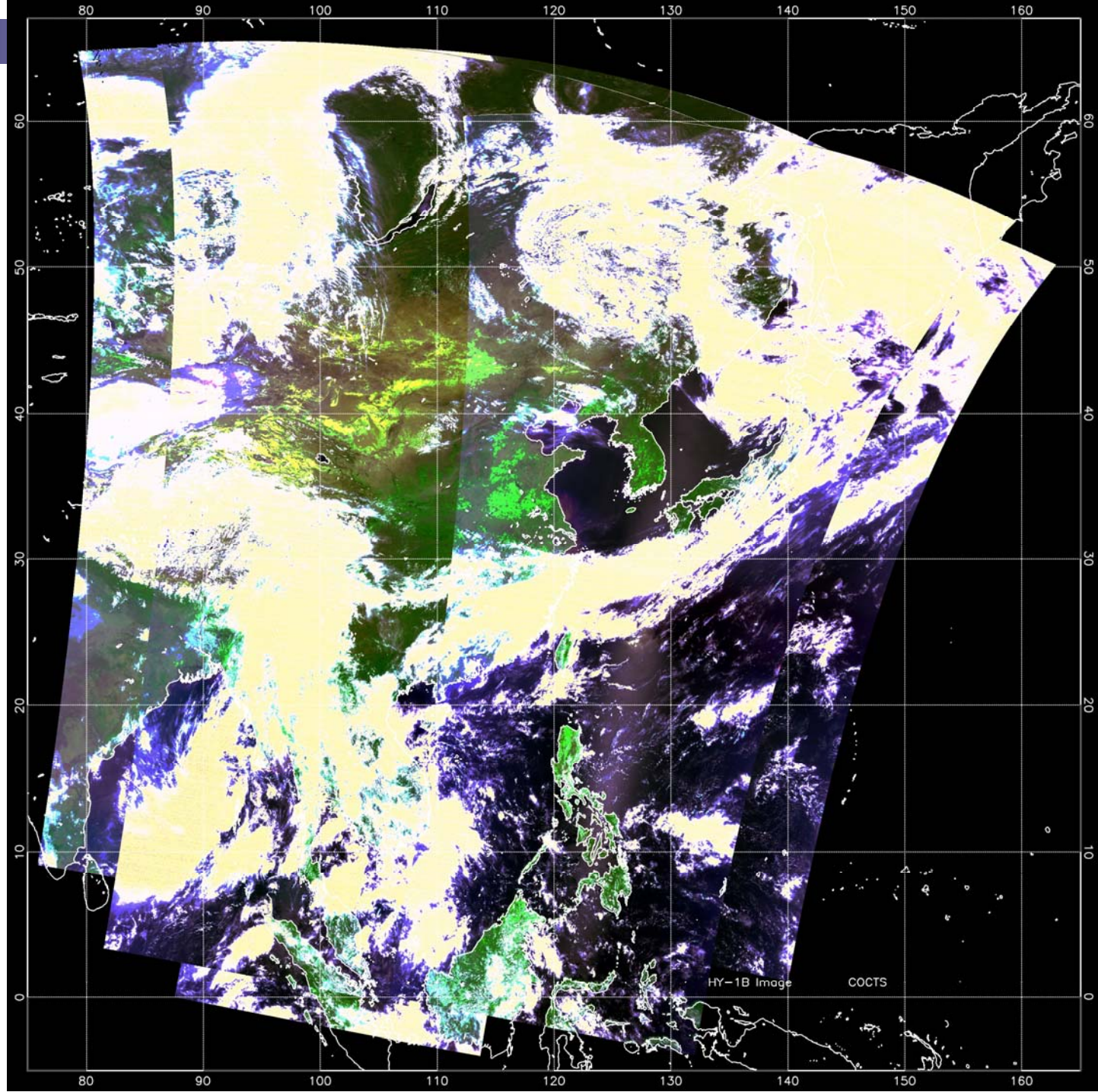


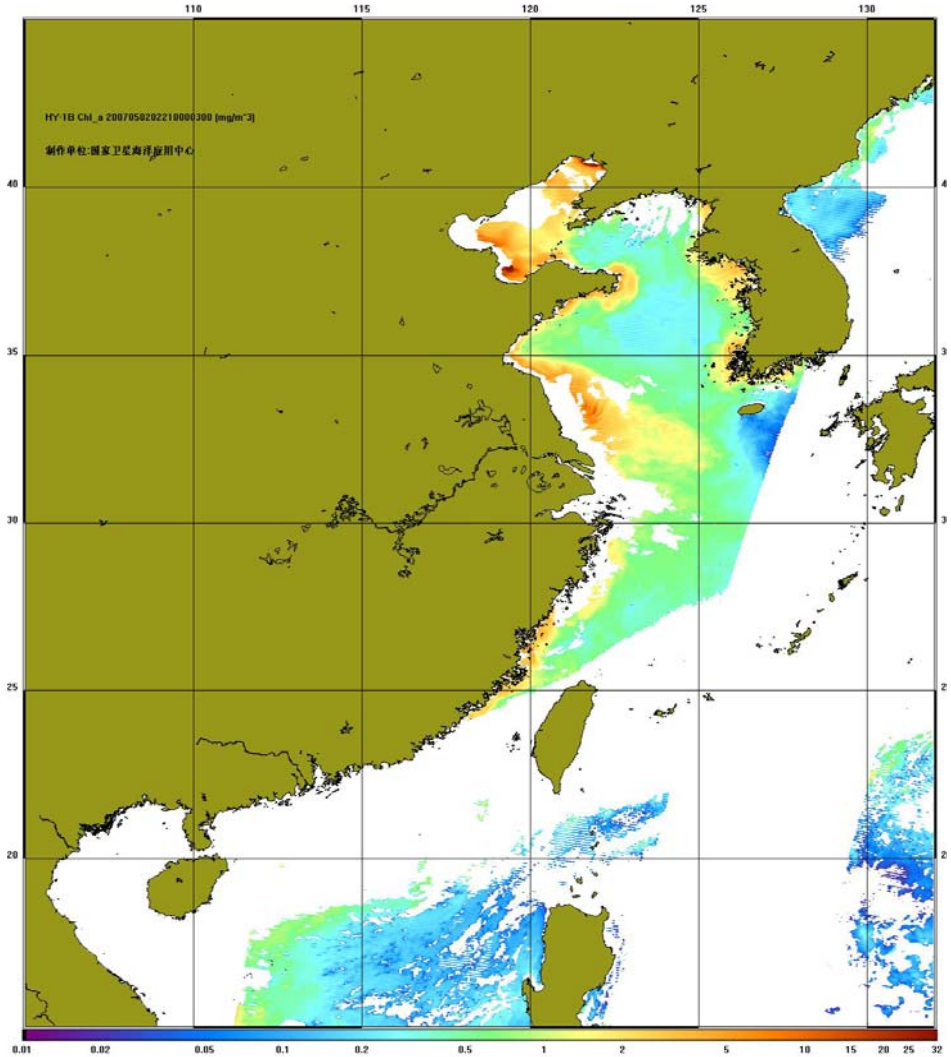
HY-1B CZI Image

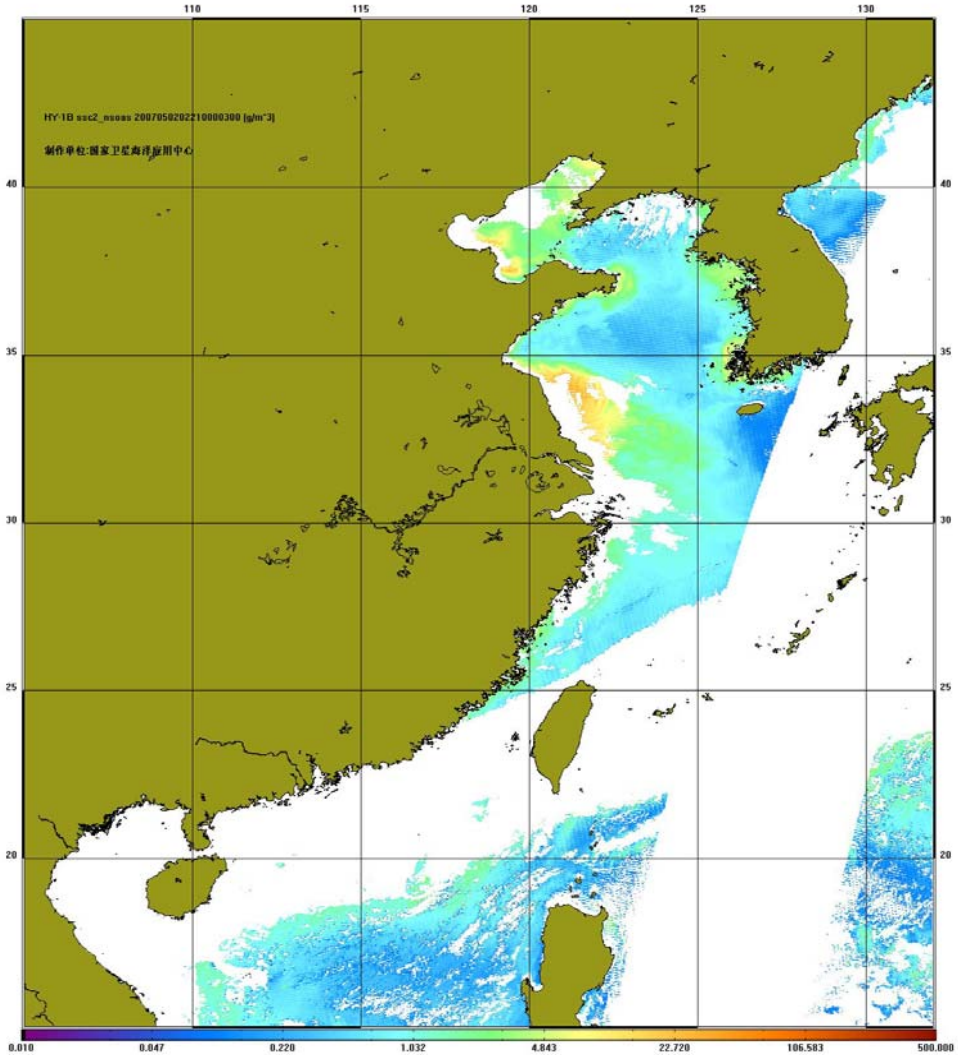


HY-1B COCTS

2 station
3 days
coverage



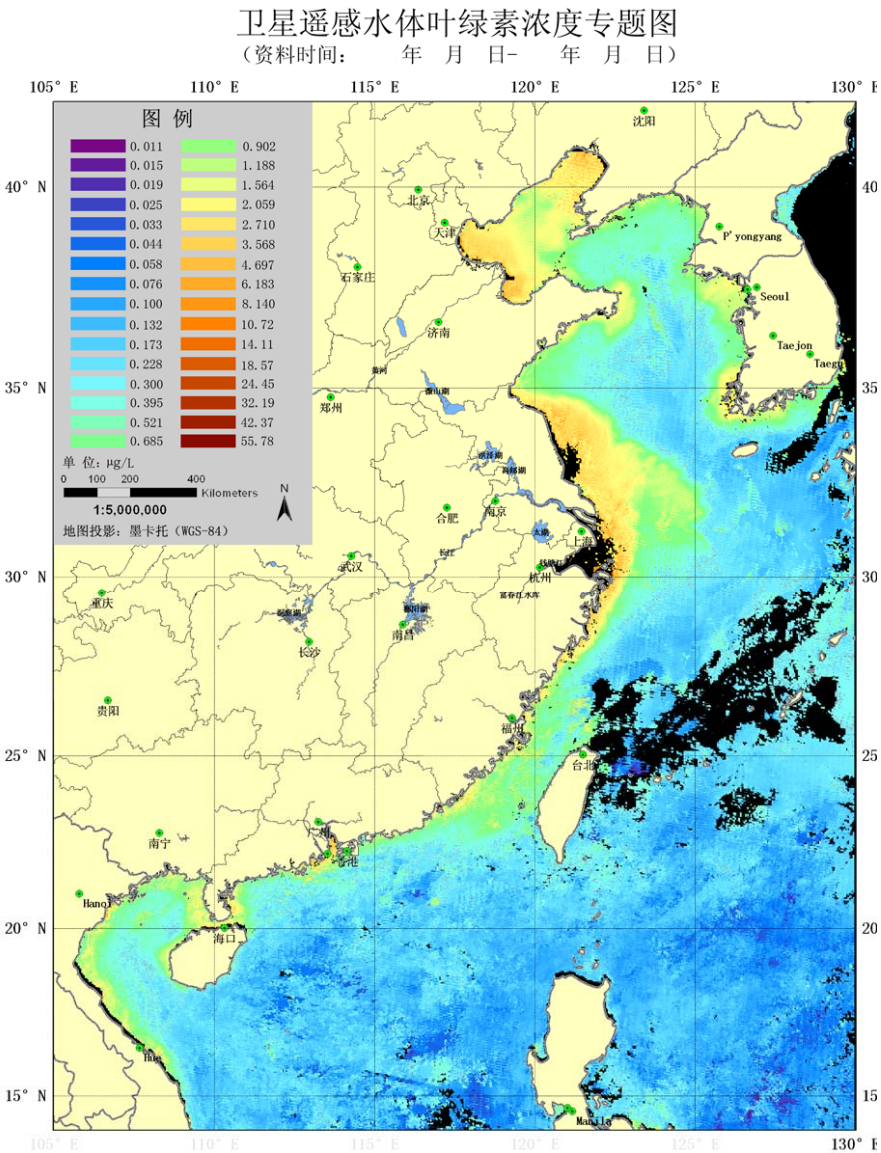




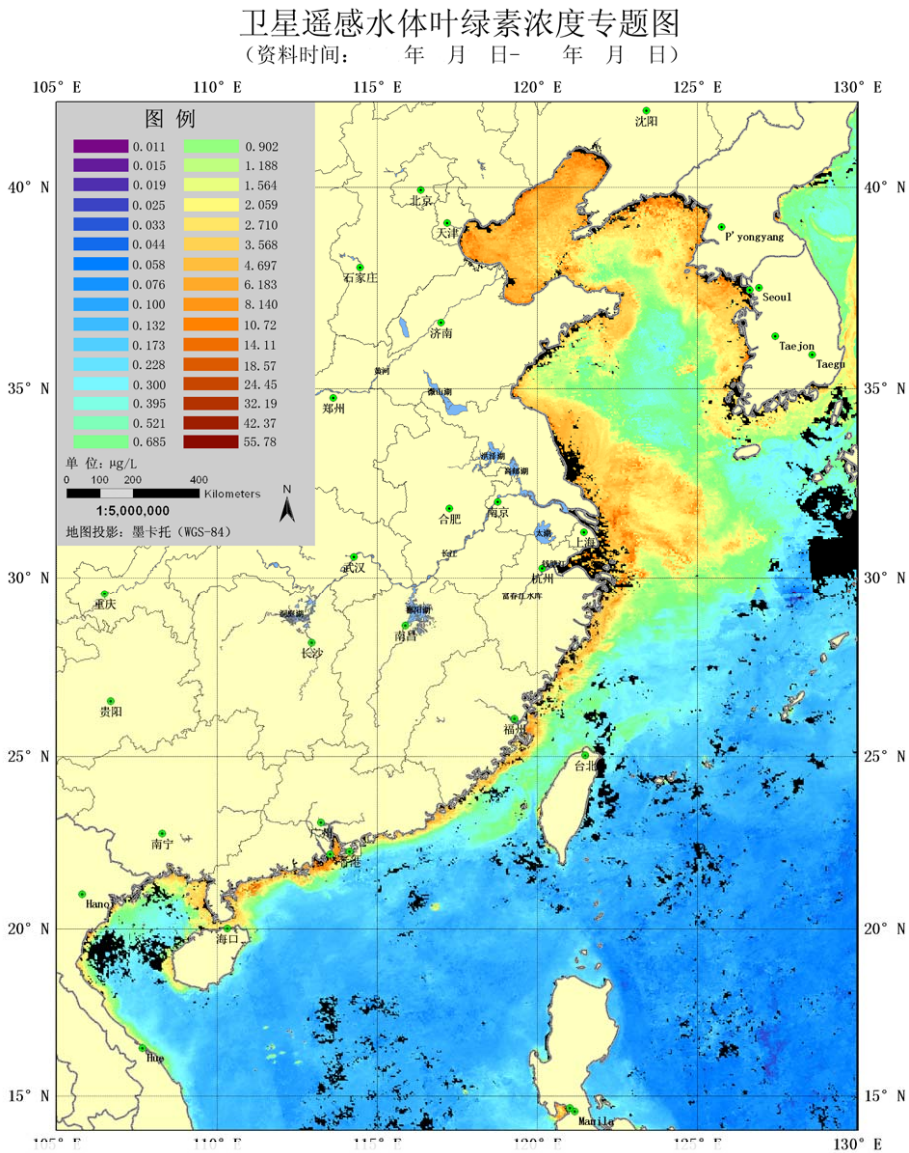
Chl-a Sediment

2008.5. 2 HY-1B/COCTS results

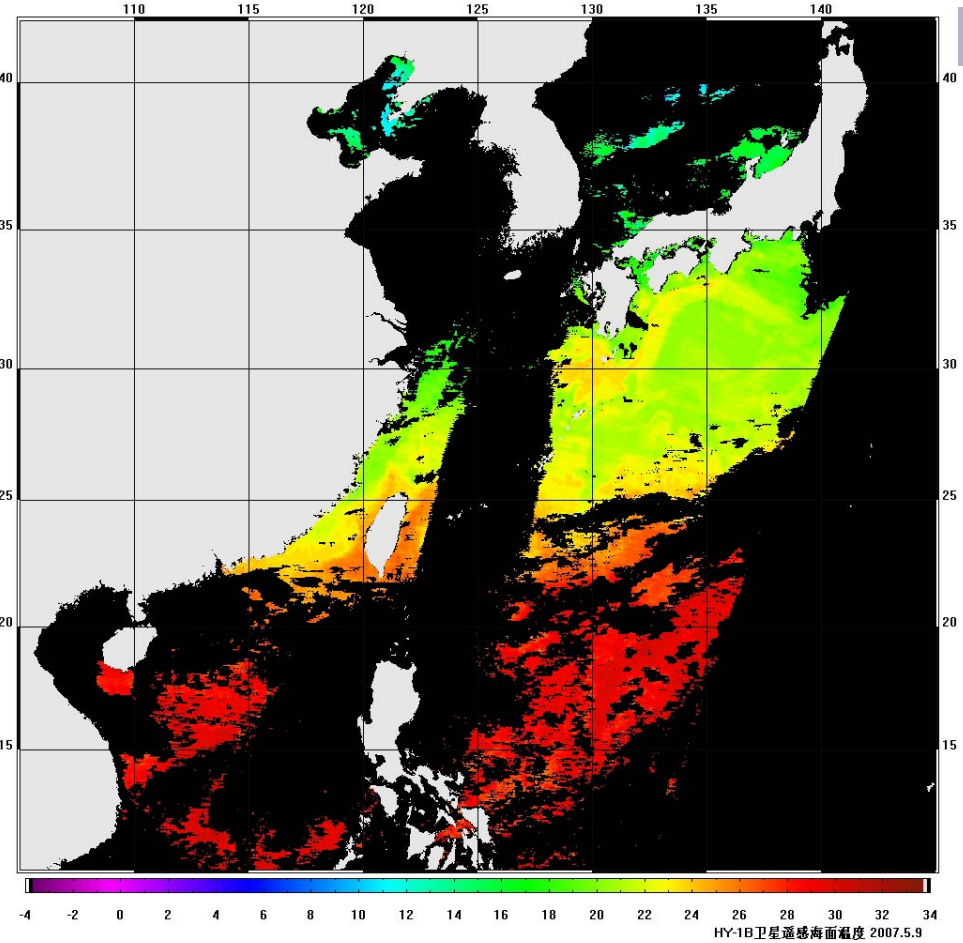
HY-1B/COCTS & Aqua/MODIS (Chl-a)

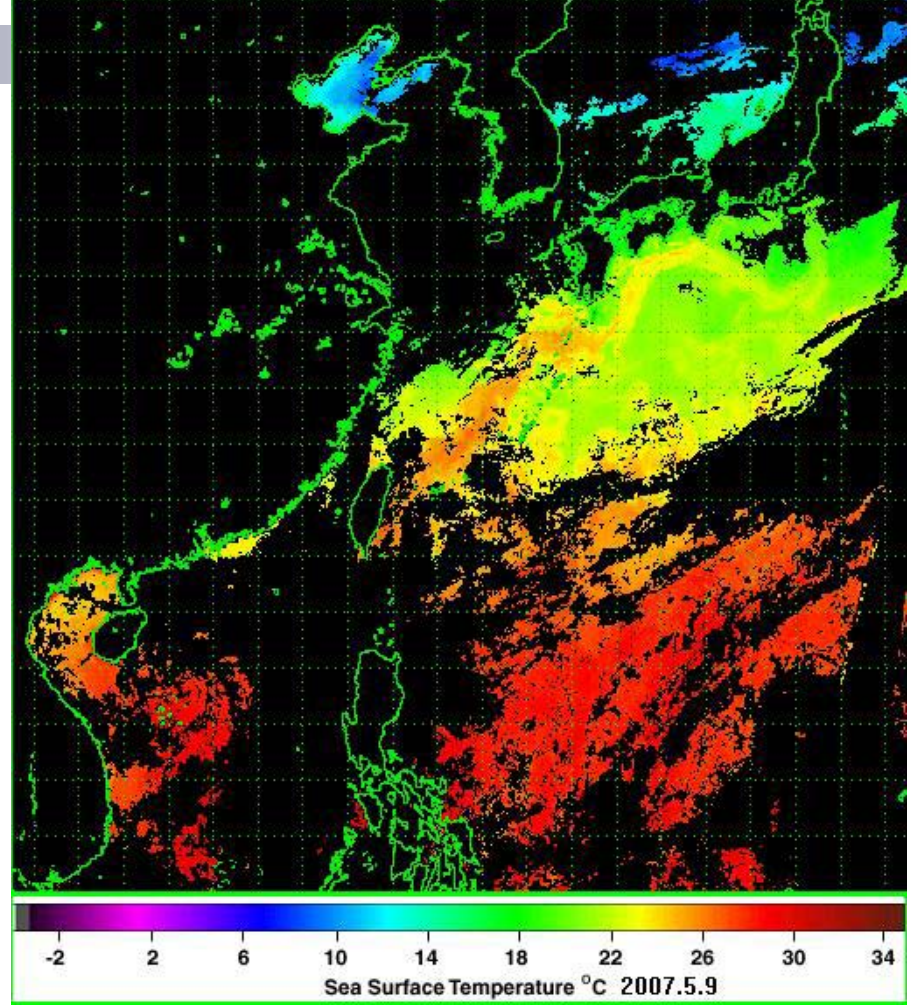


5月份,HY-1B



5月份,MODIS



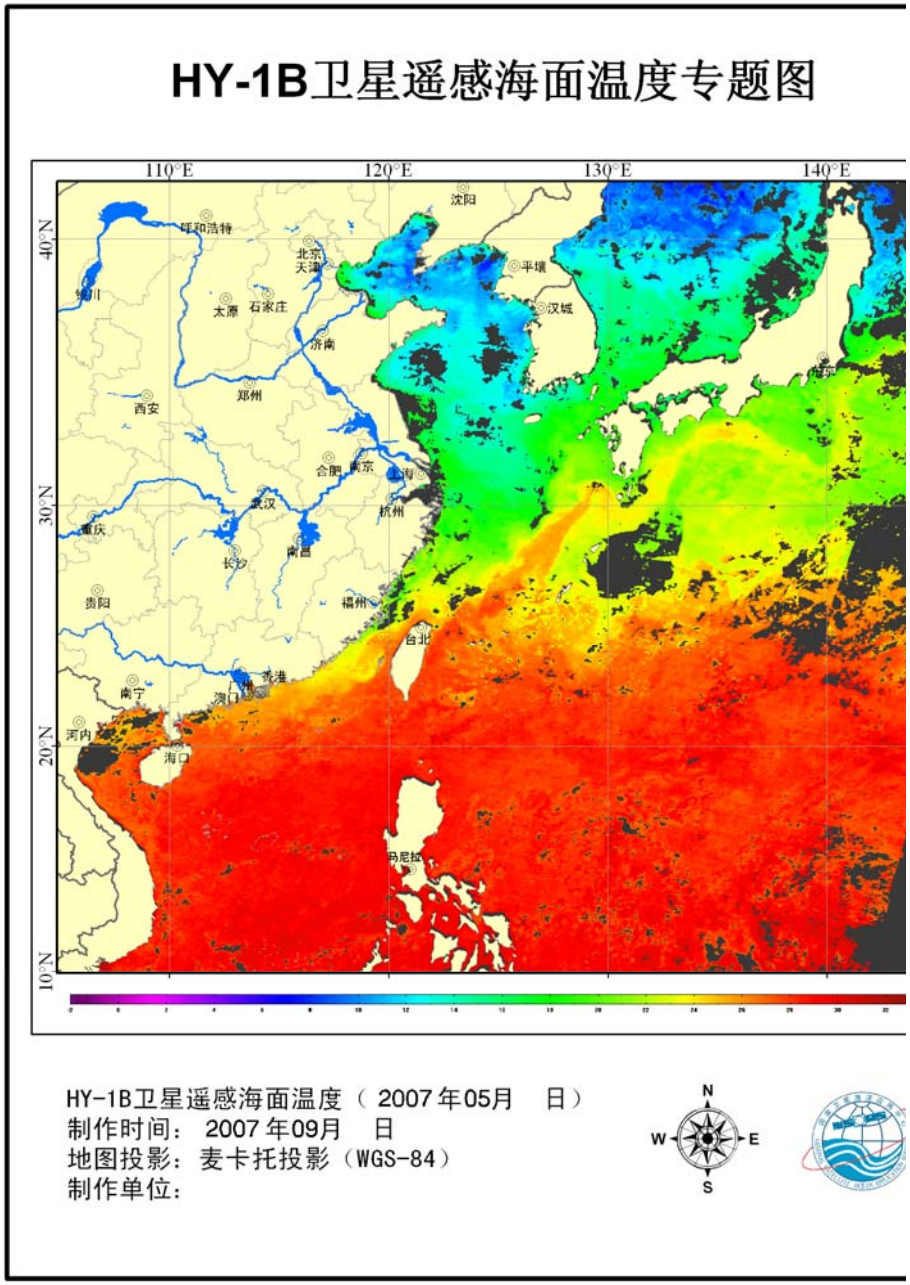


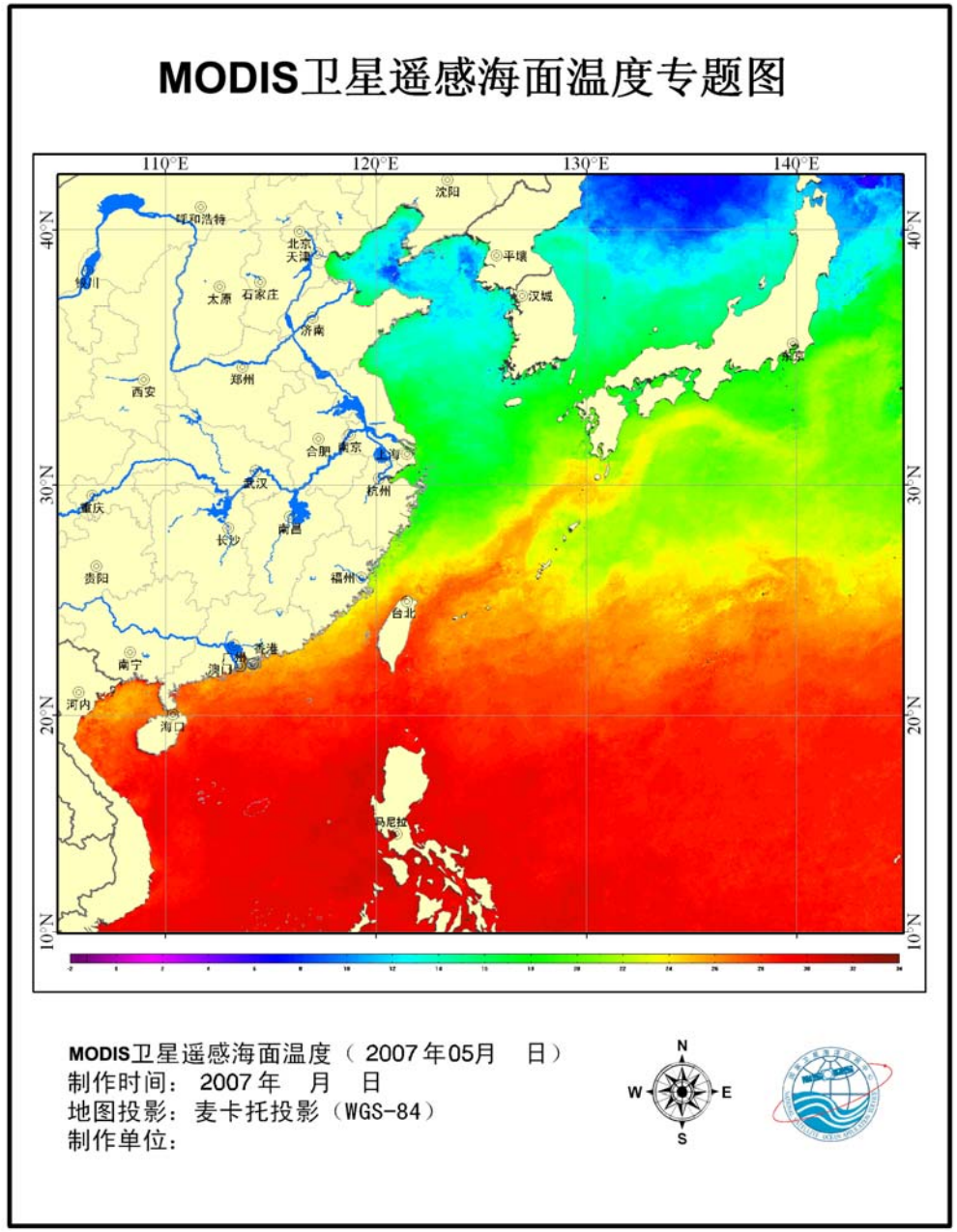
2007.5.9

HY-1B/COCTS SST

2007.5.9

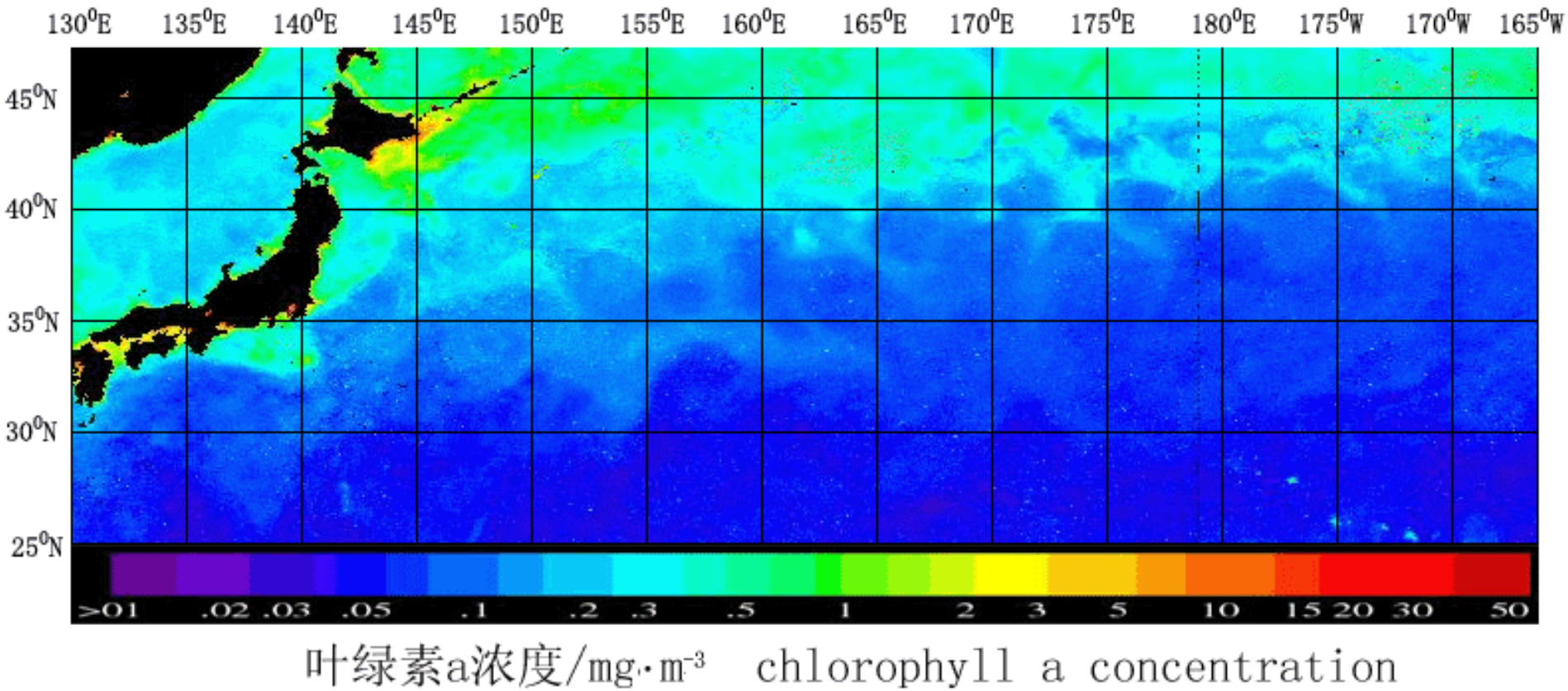
MODIS SST





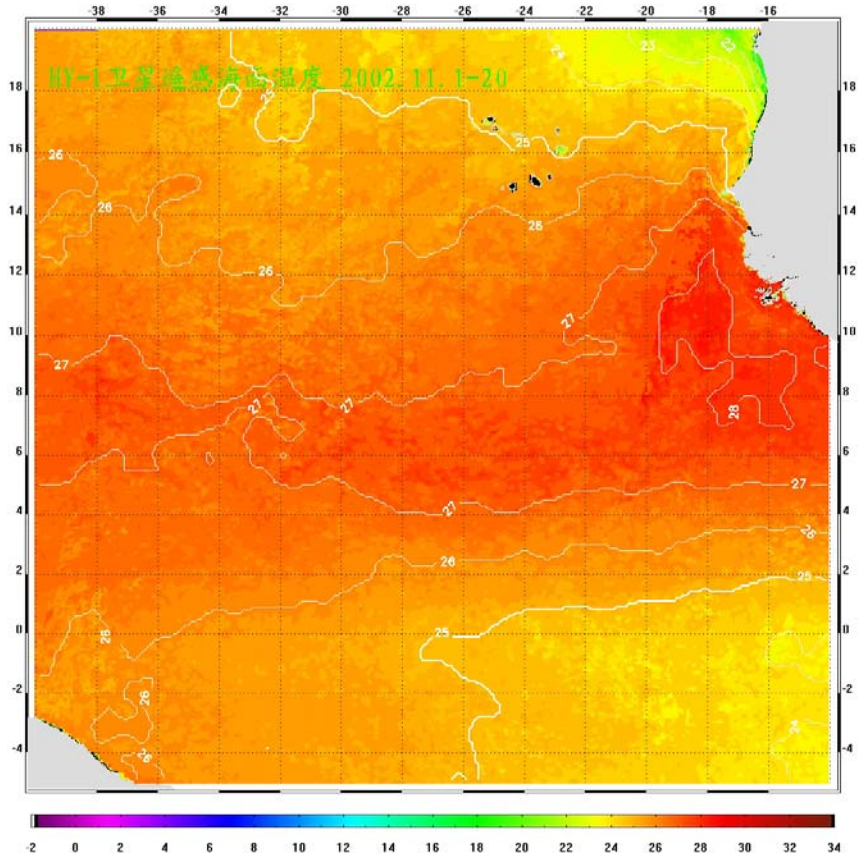
COCTS SST

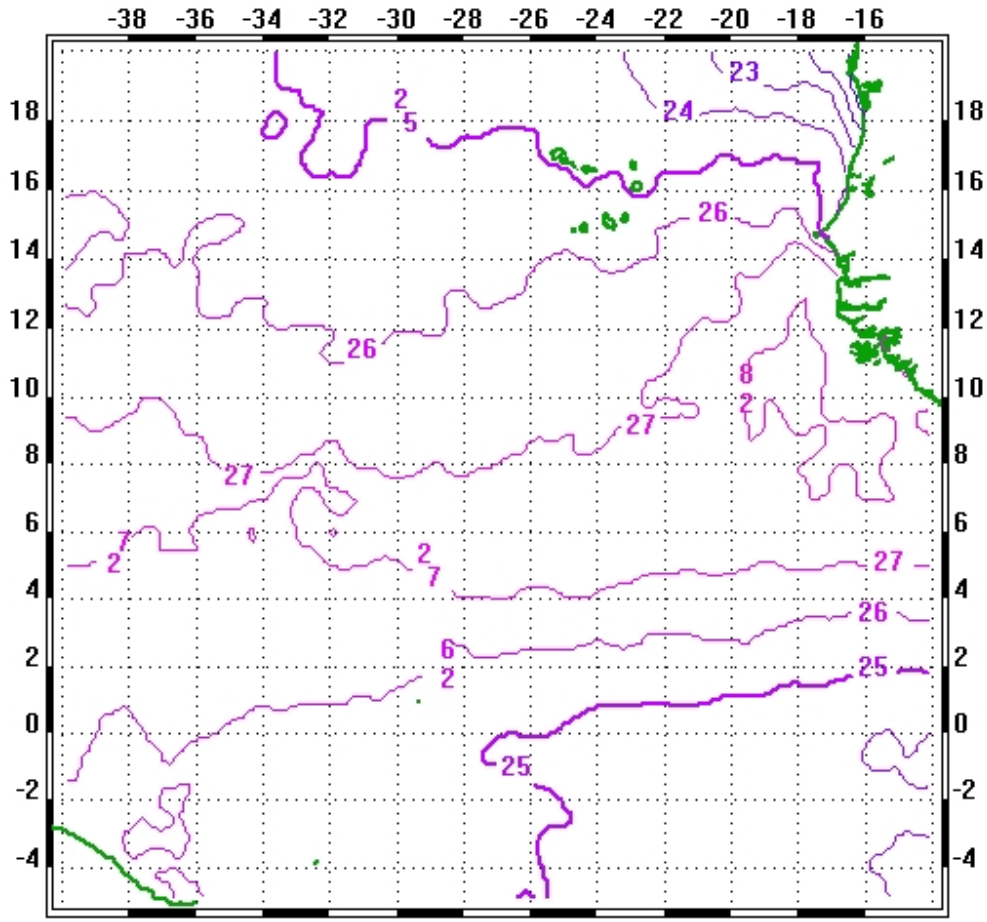
MODIS SST



Tuna fishery field Chlorophyl distribute, HY-1A**(week average)**

The SST from HY-1A satellite in tuna field （2002.11.1-11.20）

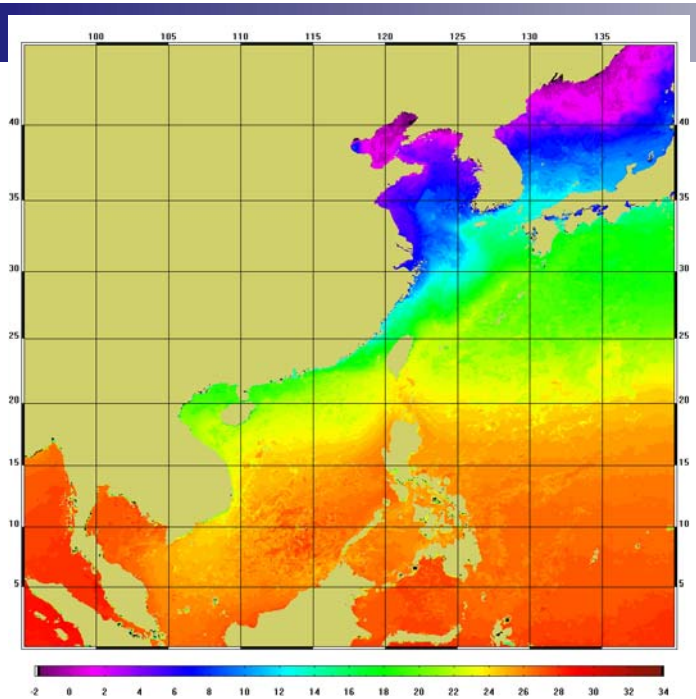




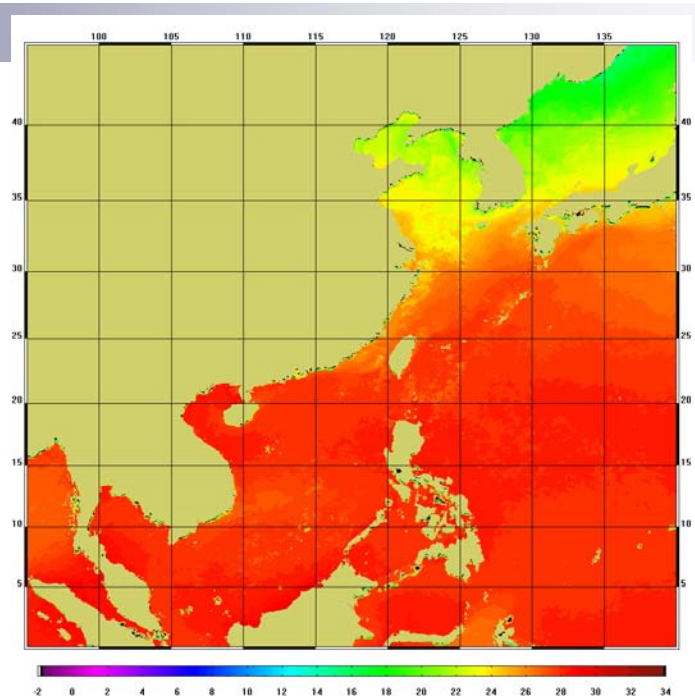
Sea surface temperature contour (2002.11.1-20)

The SST contoue map from HY-1A satellite in tuna field （2002.11.1-11.20）

1-3



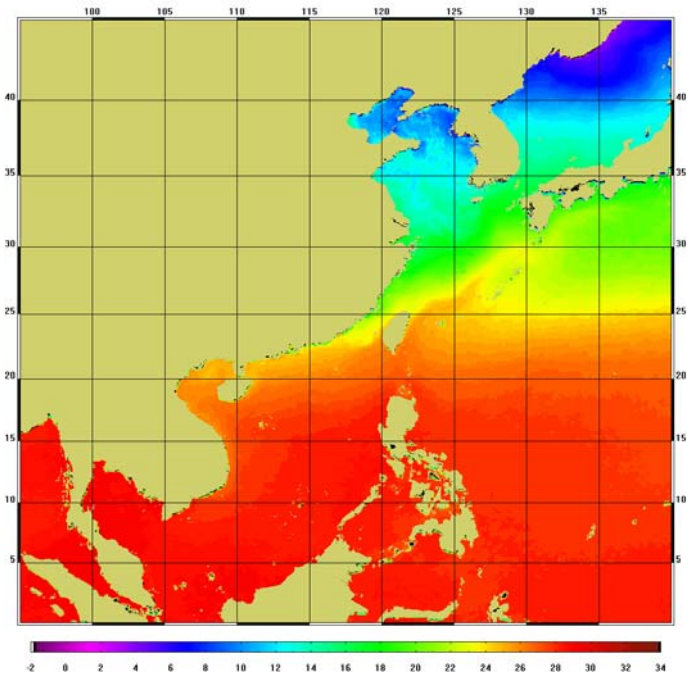
4-6



SST

Seasonal change

7-9



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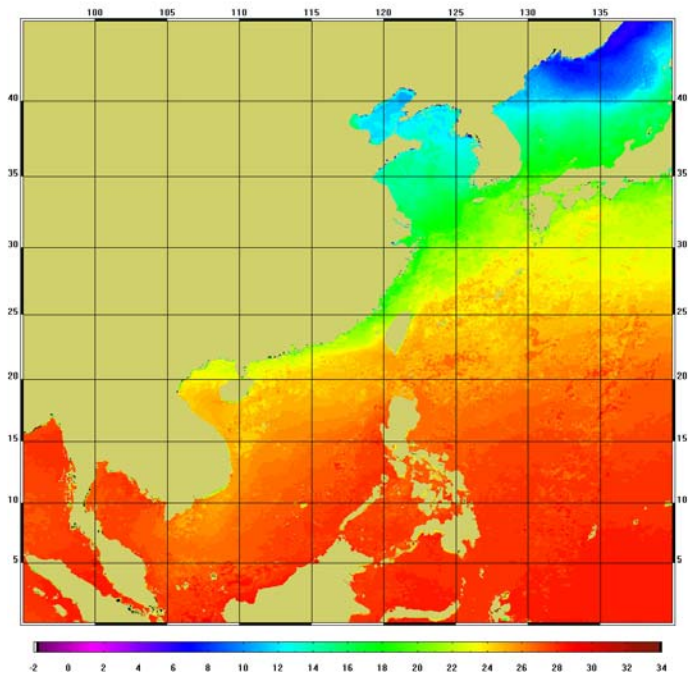


Monitor the marine disaster

- Red-tide and pollution monitor

Red-tide

Red tide

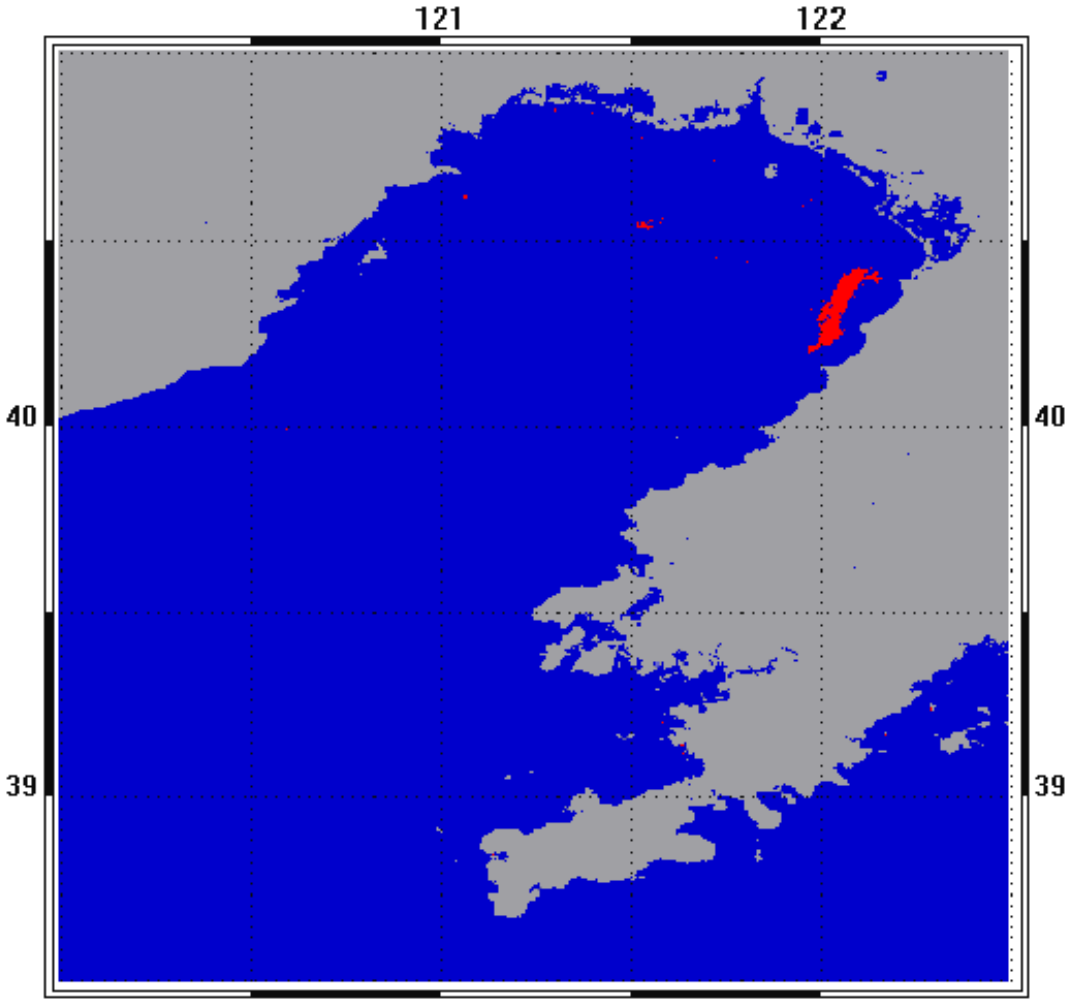
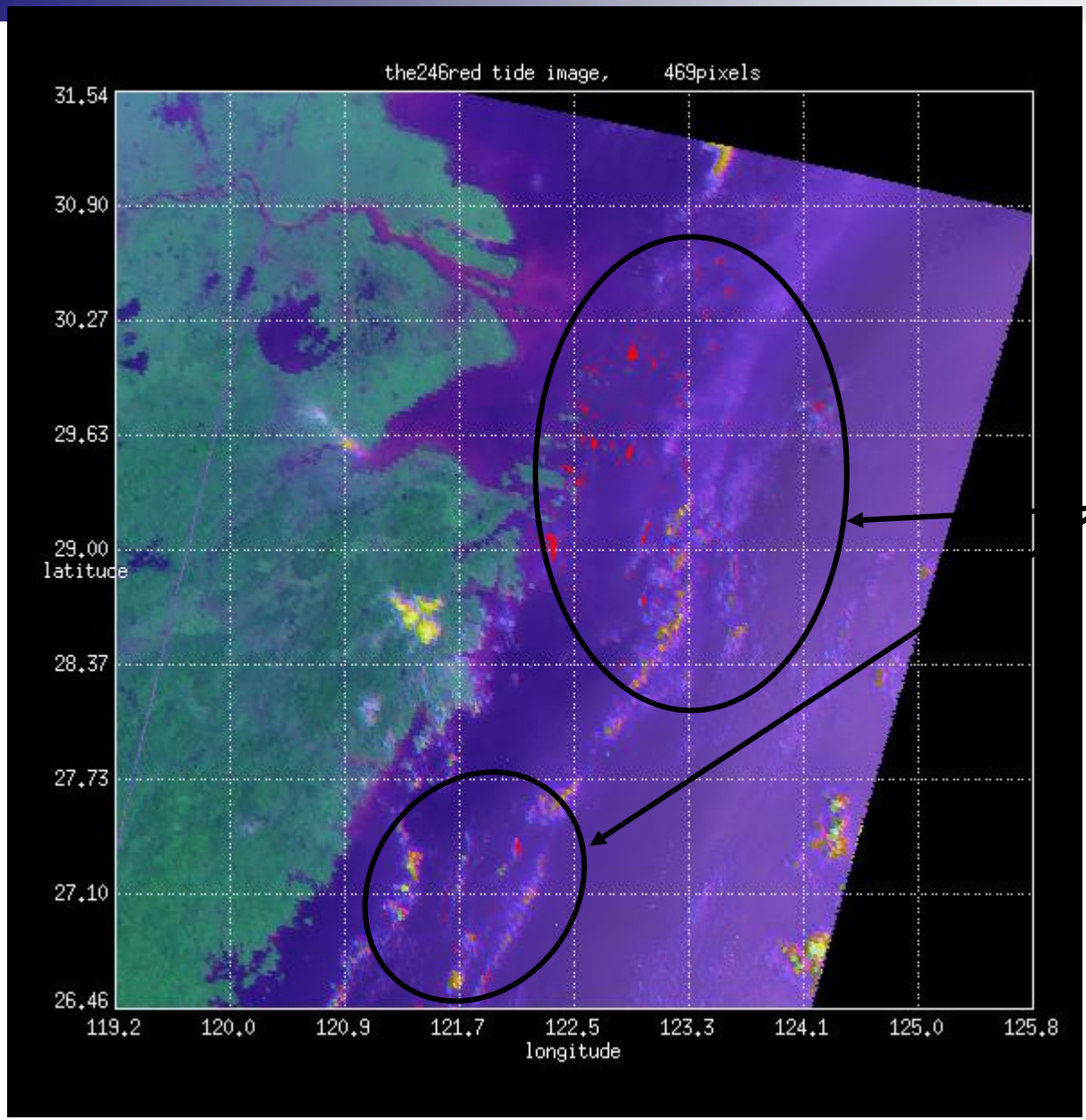


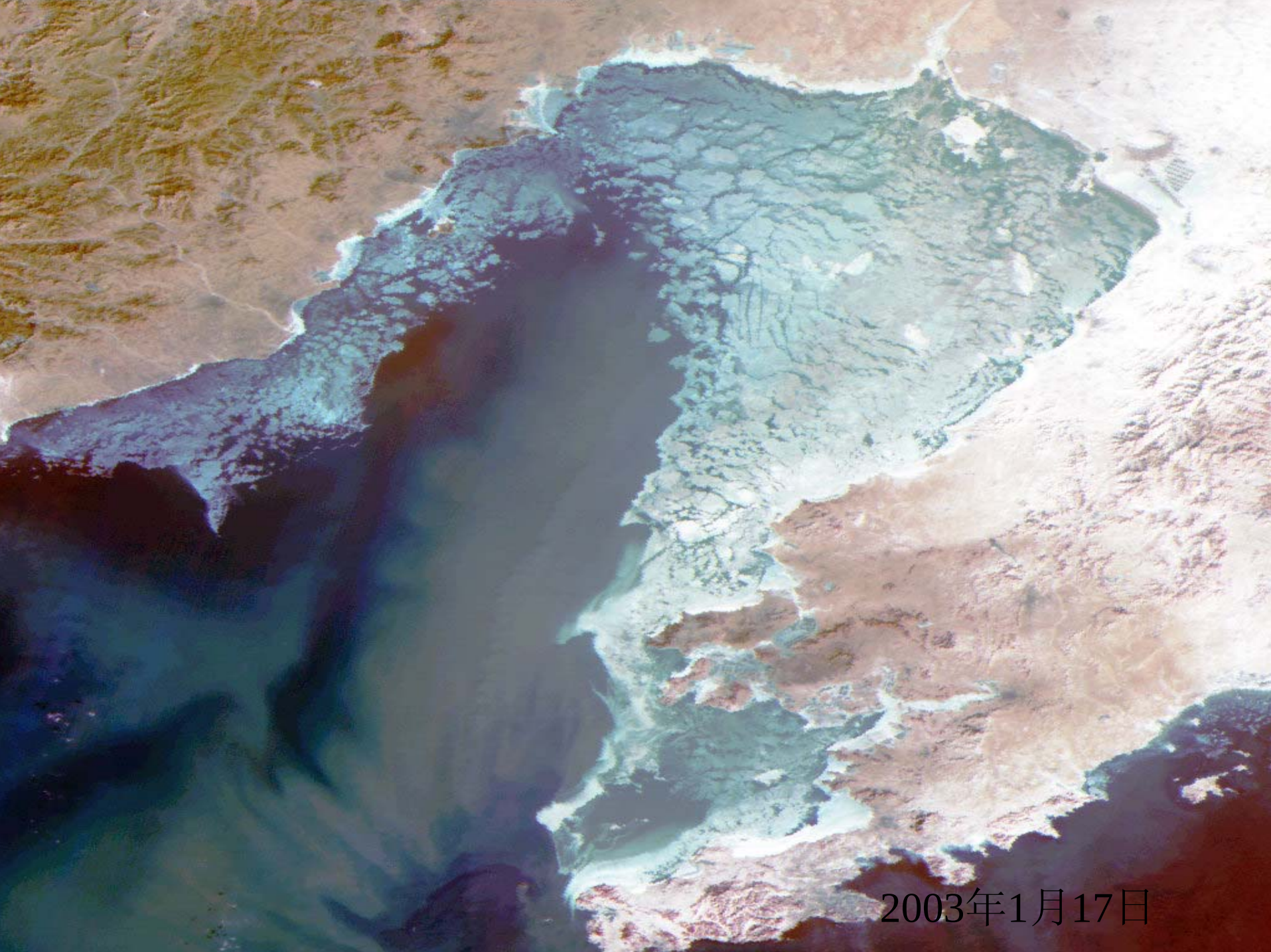
Fig.5 The red tide information monitor by HY-1/CCD in 15 Jun, 2002

国家卫星海洋应用中心

Red-tide



2002年9月3日发现了东海海域赤潮。


2003年1月17日

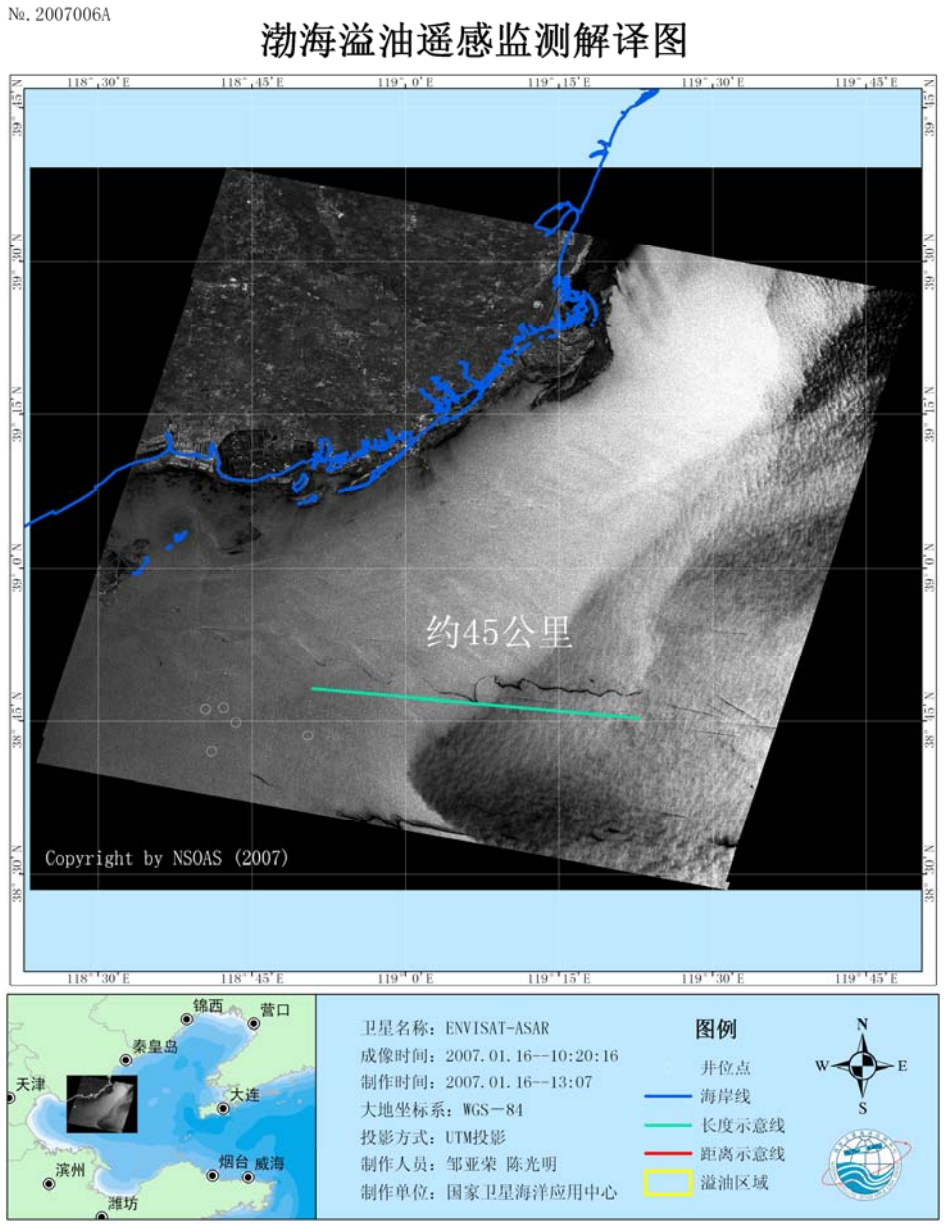
4 Other Application

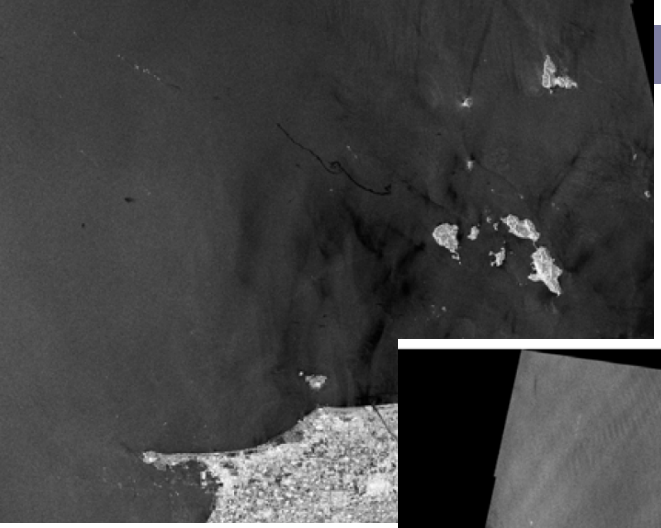
- Oil monitor by SAR,NDVI Vegetation general investigation using CZI, major lake water environment monitor, forest fire monitor and polar monitor.

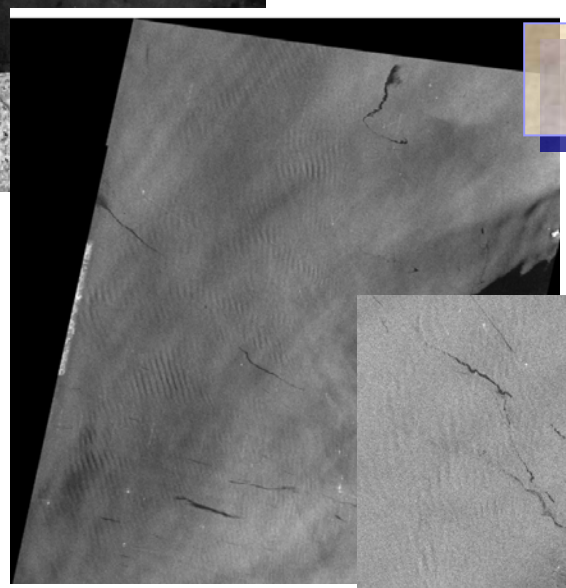
Oil spill,2007-1-16

45km

Cao Feidian




May 10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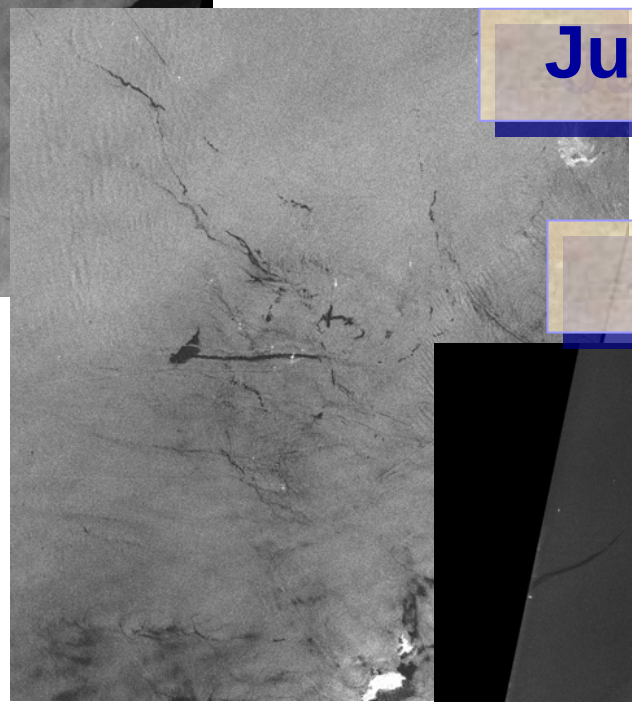
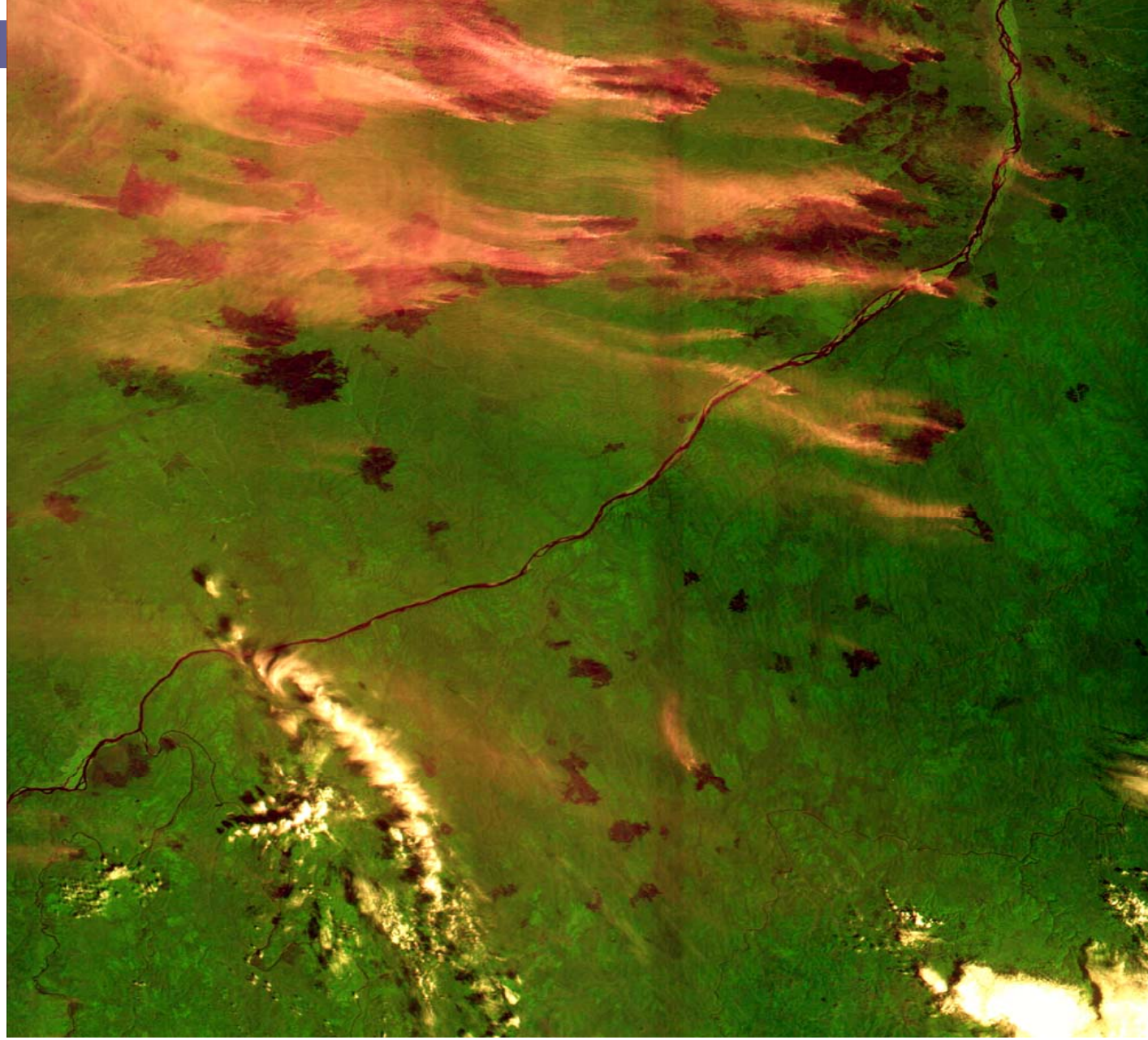
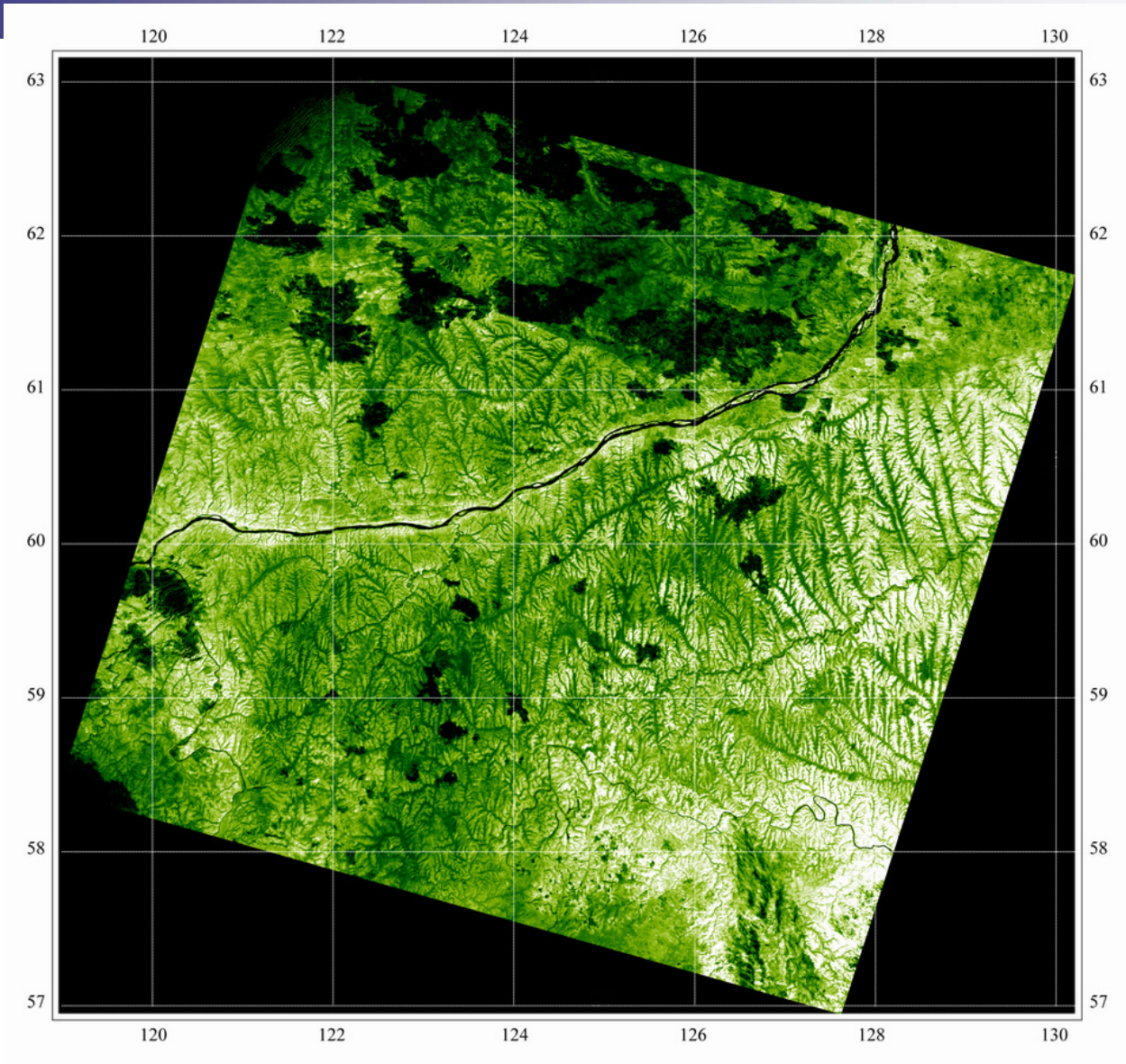

June 13

July 14

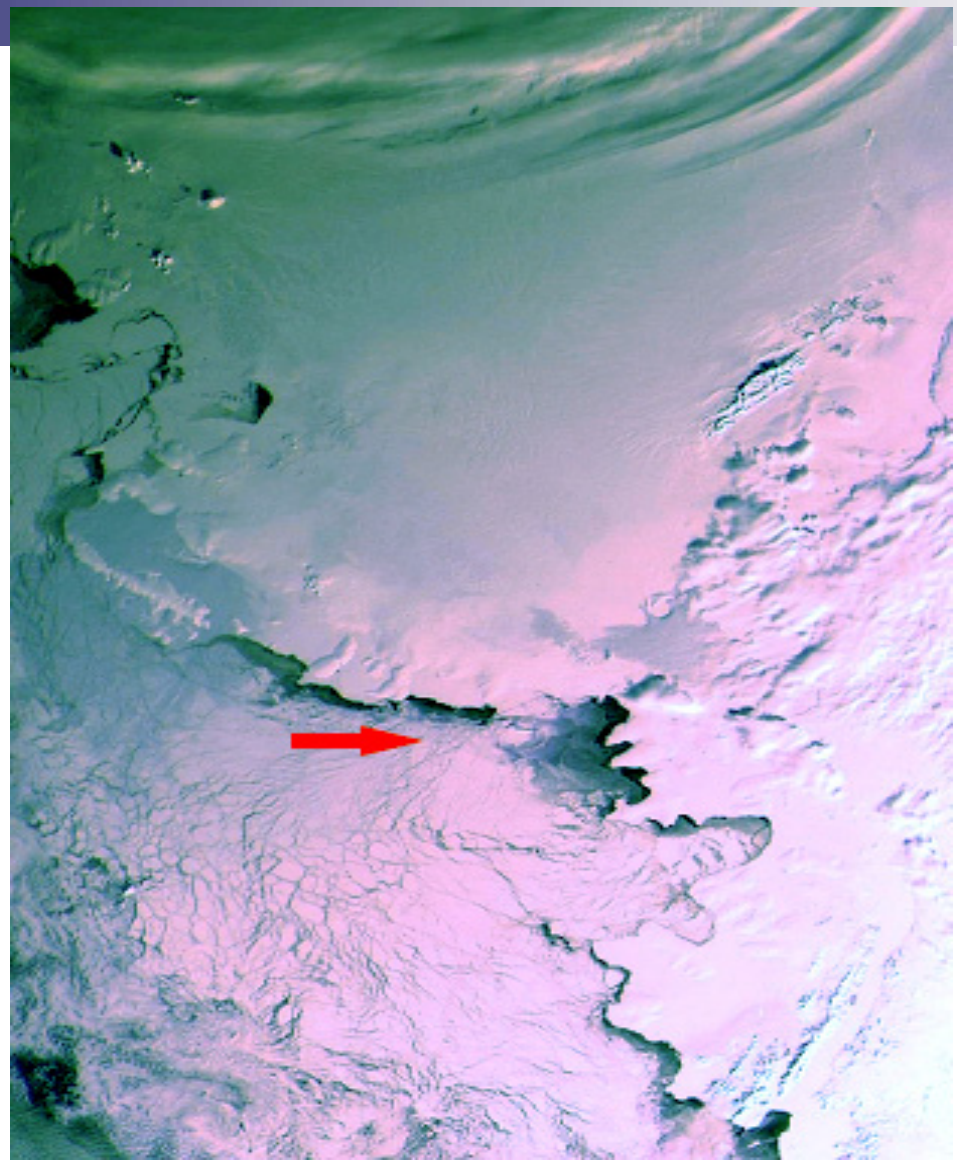
HY-1A CZI

Russia Lena River forest fire

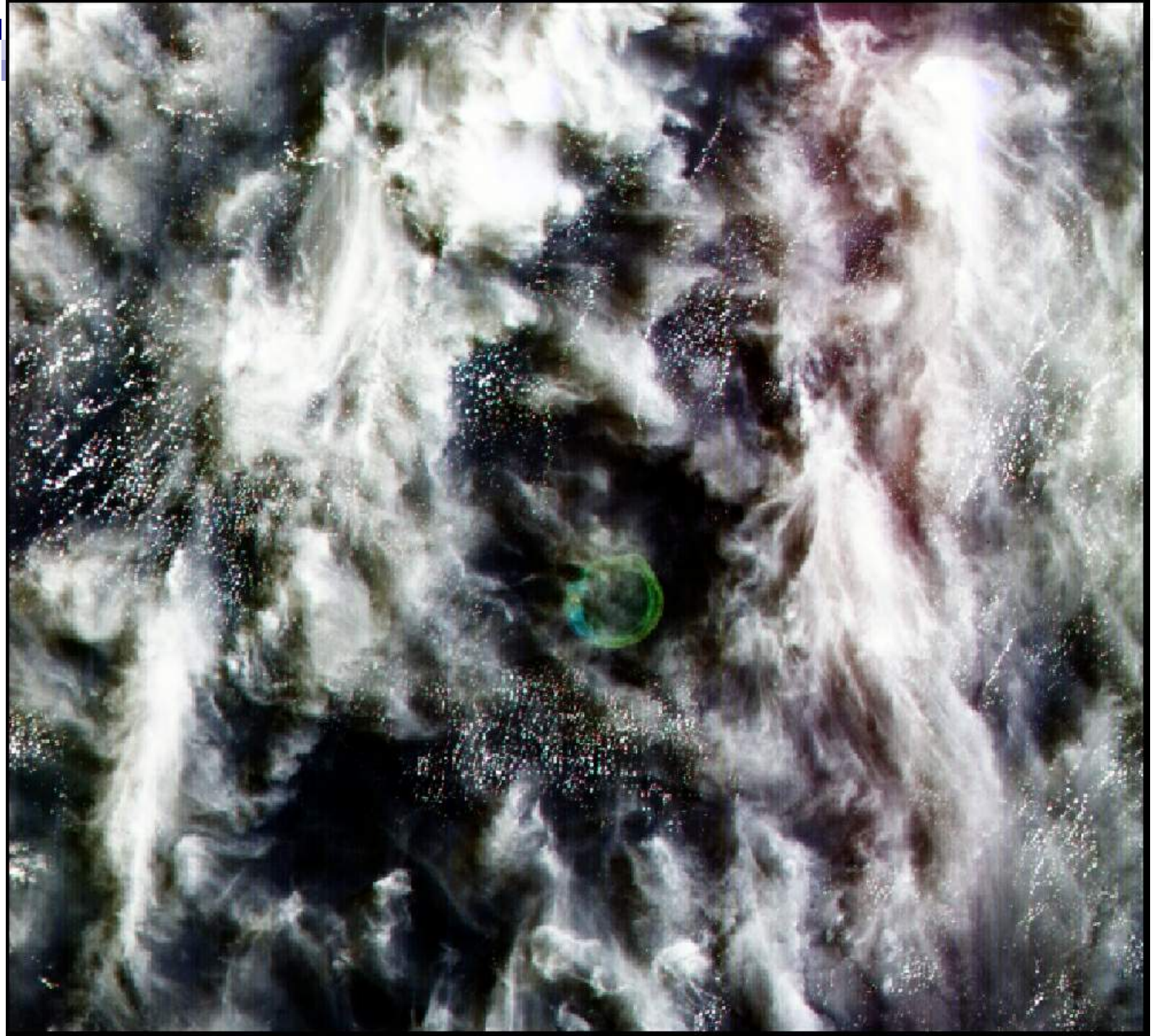




The NDVI after the fired from HY-1A



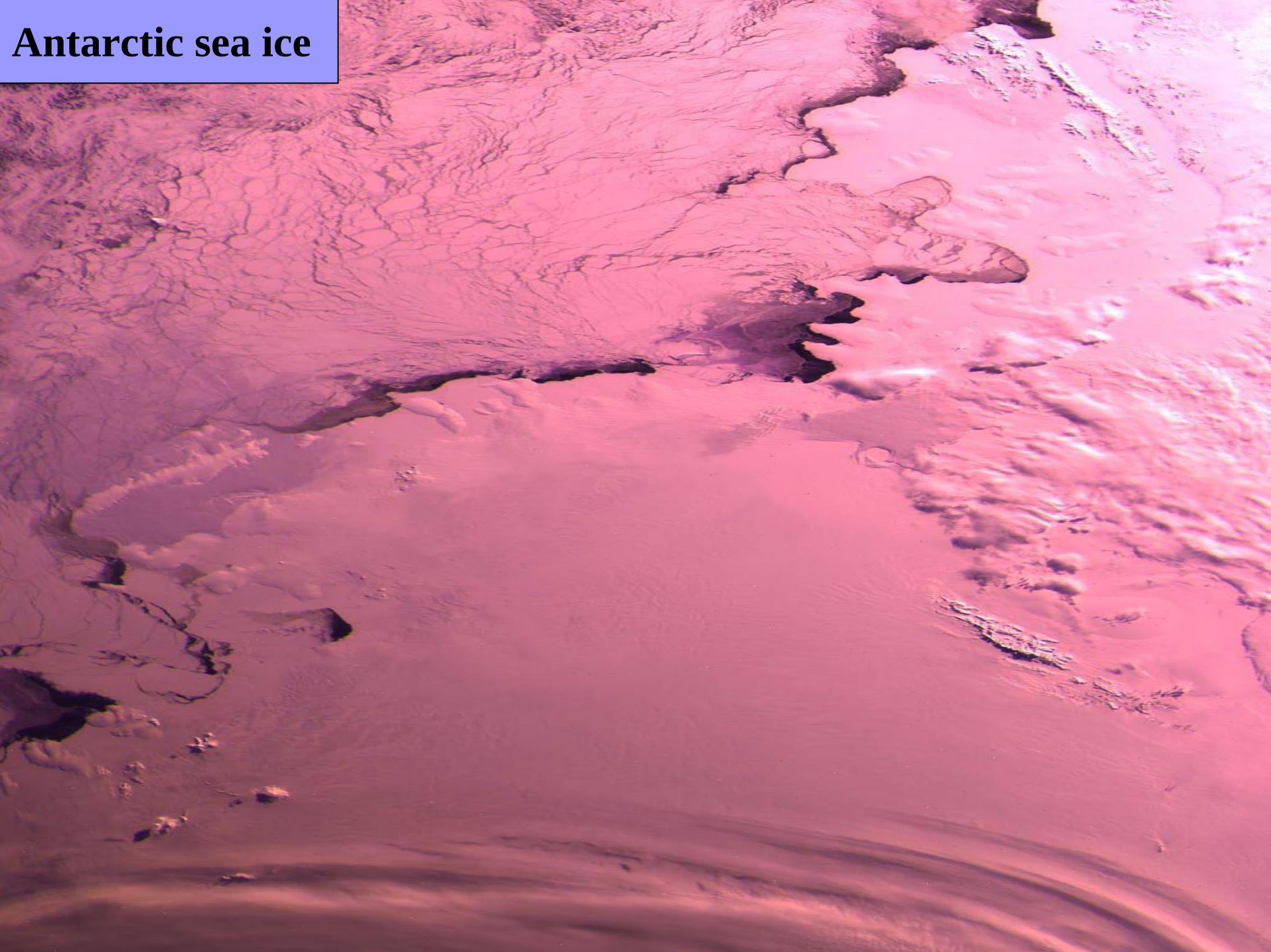
The HY-1A COCTS south pole Icecap map in Oct,19,2002

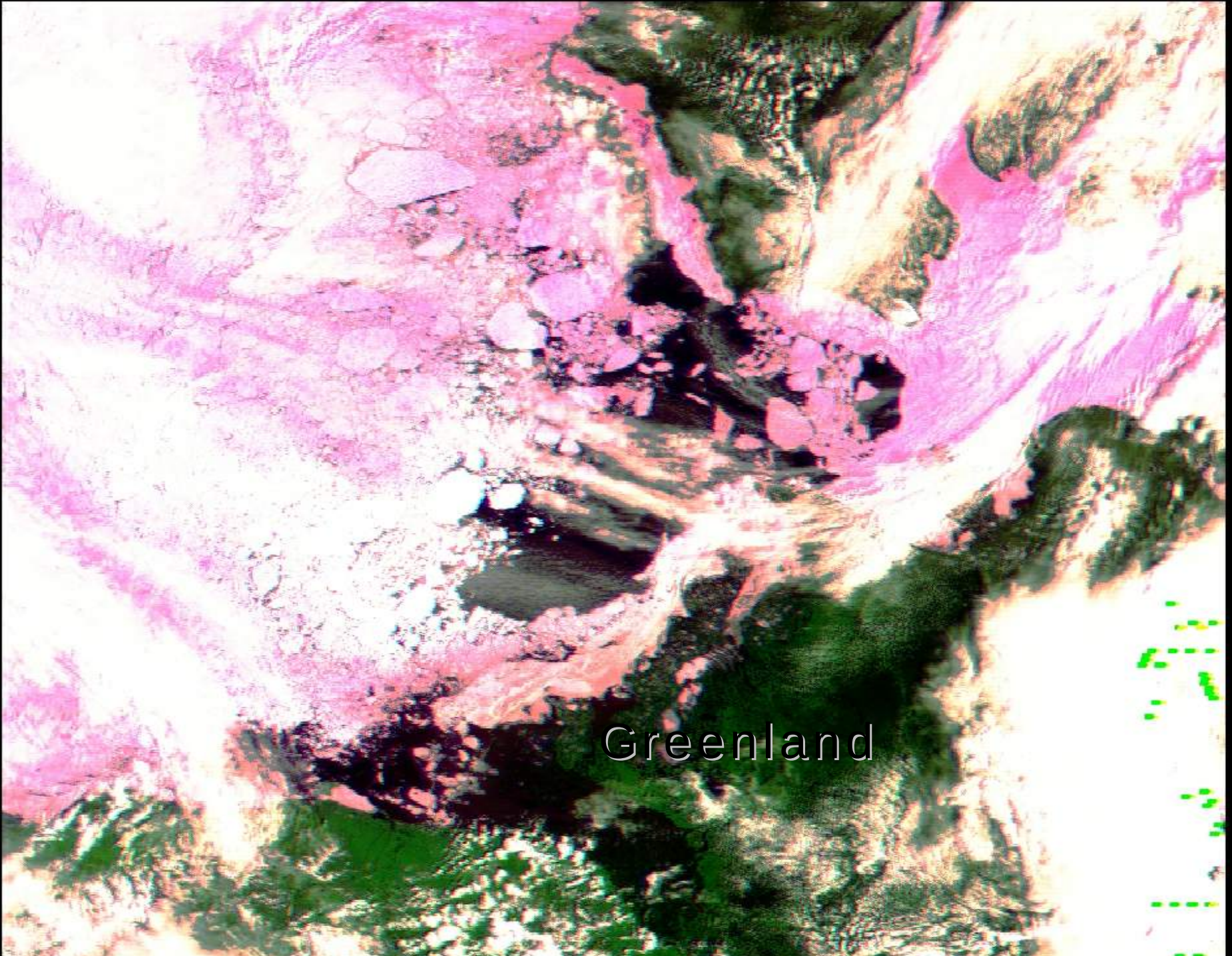


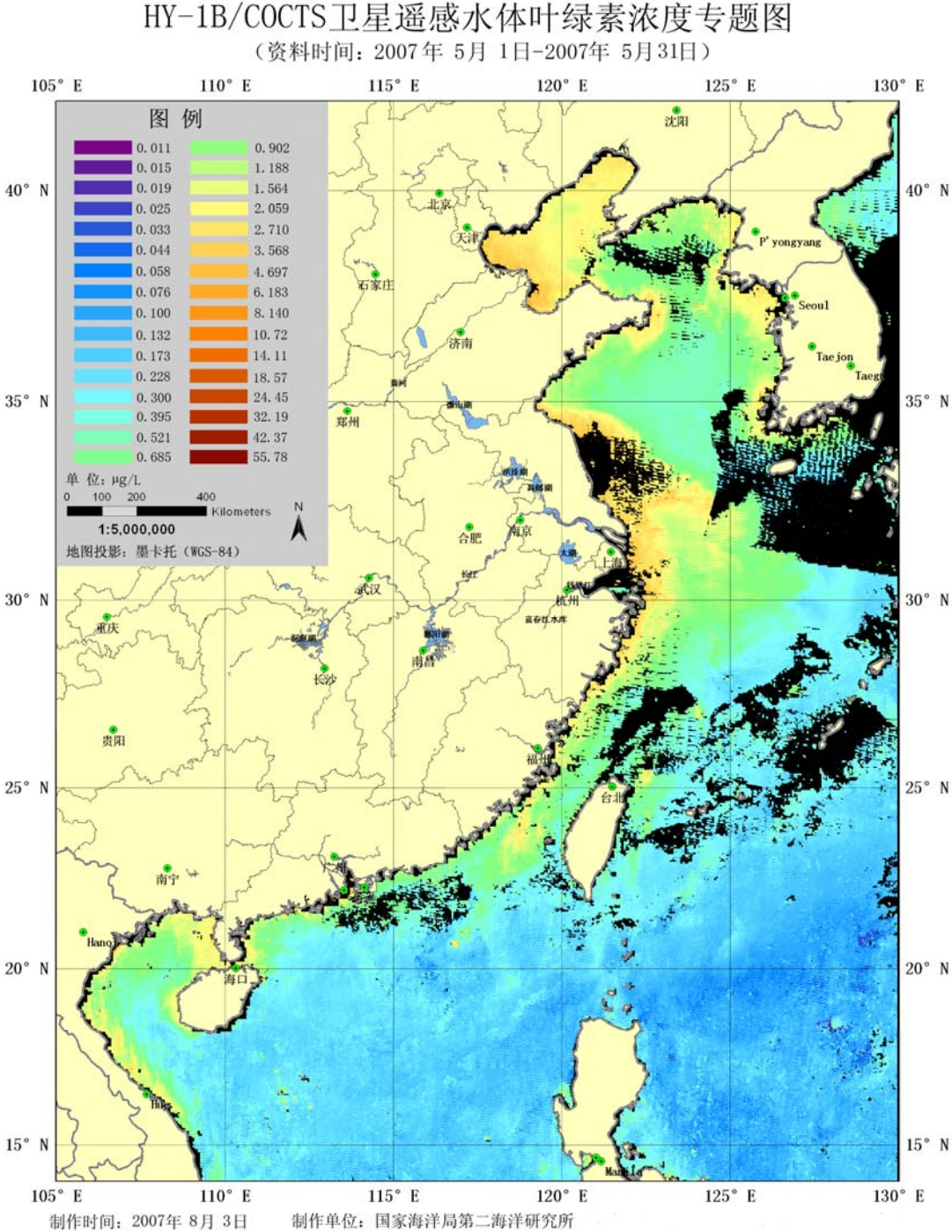
南海
东沙珊
瑚礁

Coral
Reef
In South
China
Sea

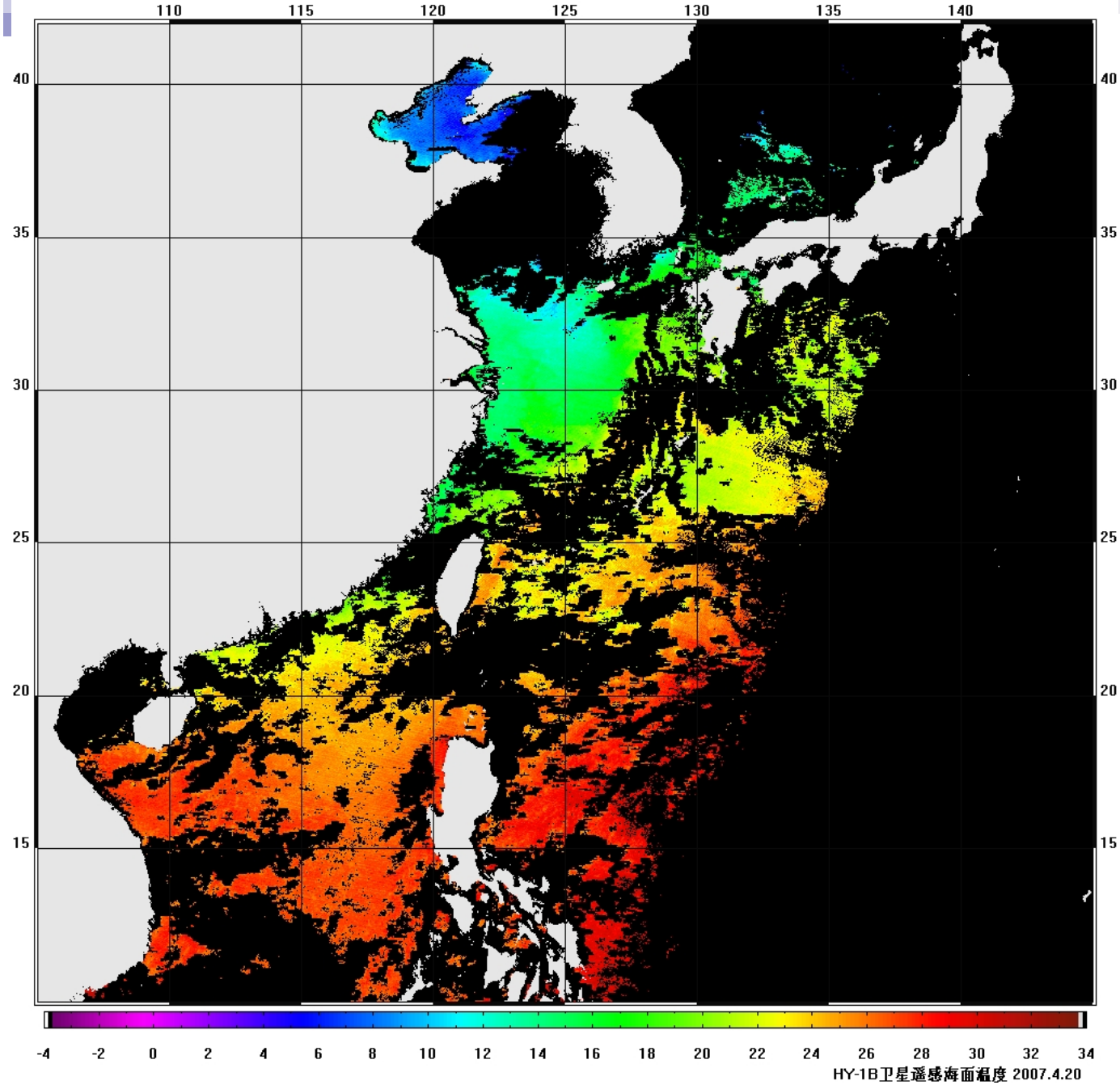
Antarctic sea ice




Greenland



The Monthly Average Chlorophyl from 1B/COCTS


110
115
120
125
130
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140
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35
30
25
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15
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-2
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2
4
6
8
10
12
14
16
18
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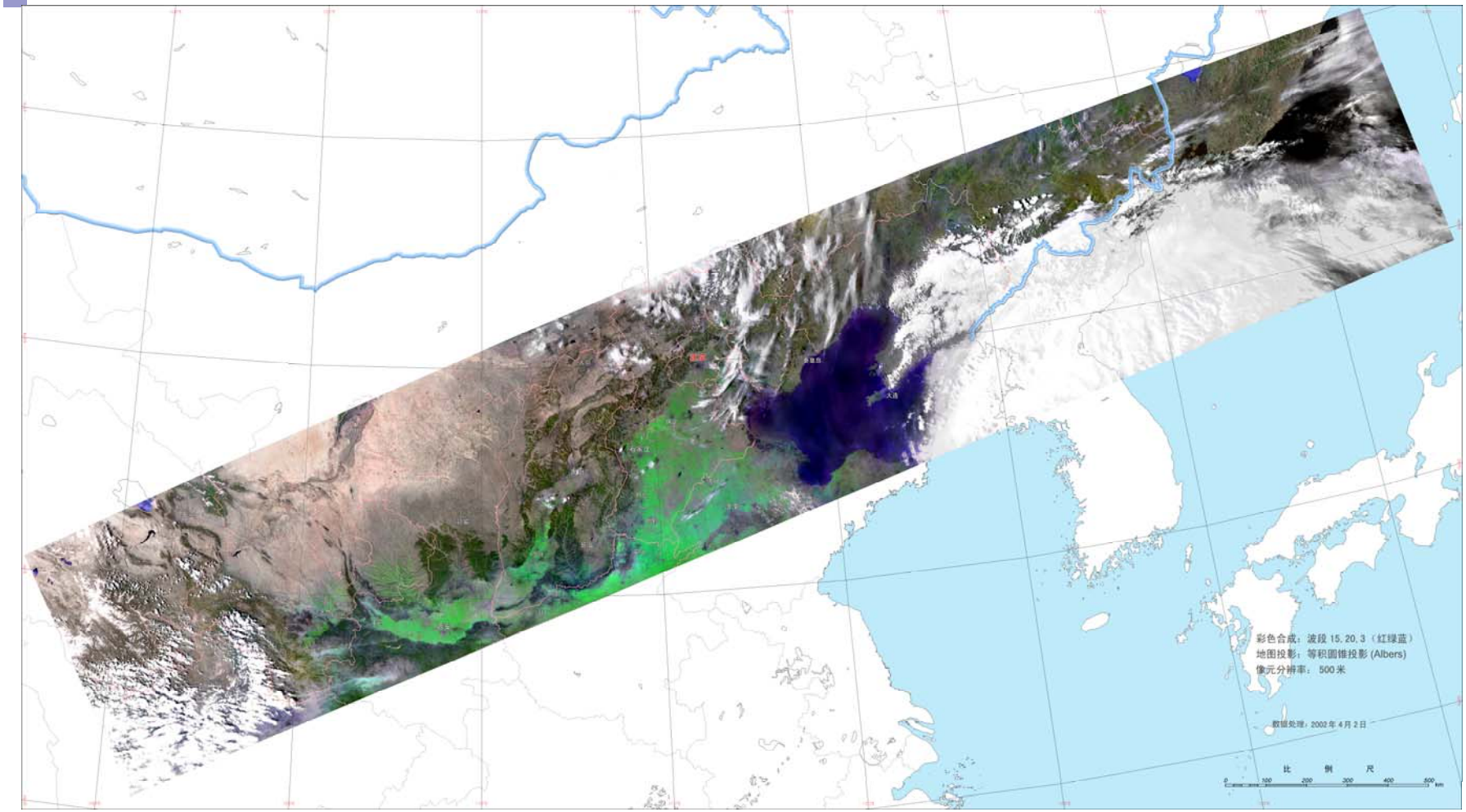
26
28
30
32
34
HY-1B卫星遥感海面温度 2007.4.20

HY-1B
SST



CMODIS image

谢　谢！

Thanks!