Application of Dynamic and Thermal Parameters from FengYun Meteorological Satellites in Tropical Cyclone Monitoring and Early Warning

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Status of FengYun satellites and typhoon targeted observation

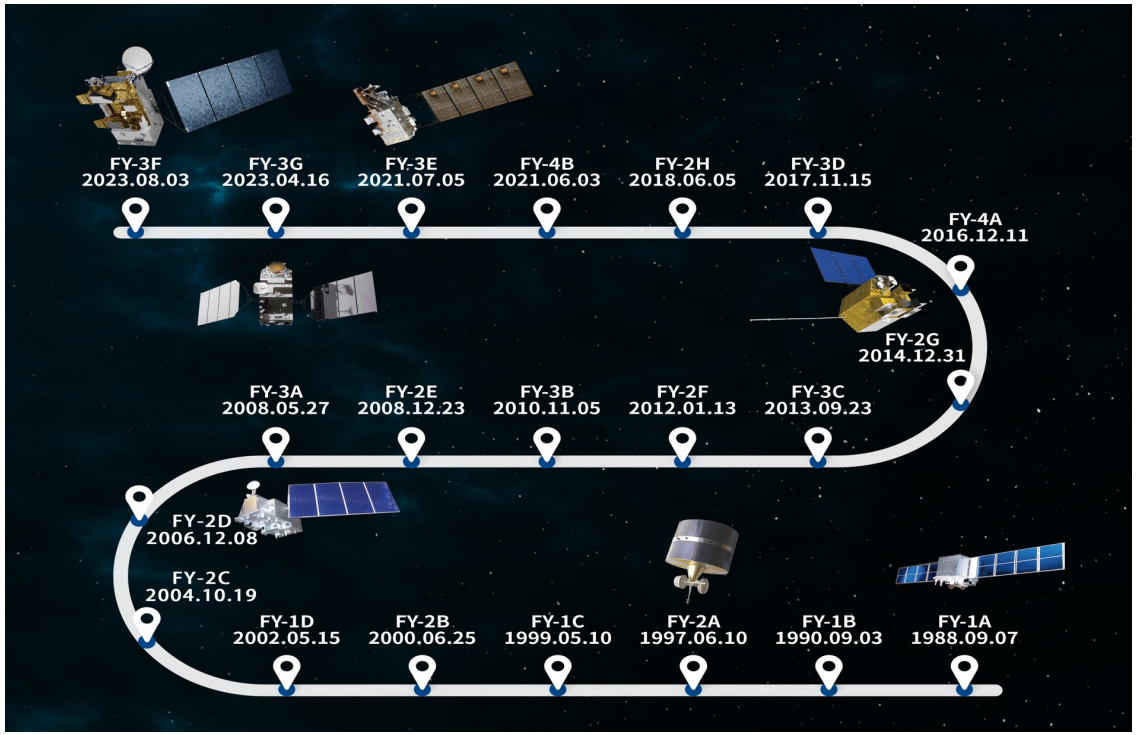
Status of FengYun satellites and typhoon targeted observation

➢ Status of FengYun Satellite

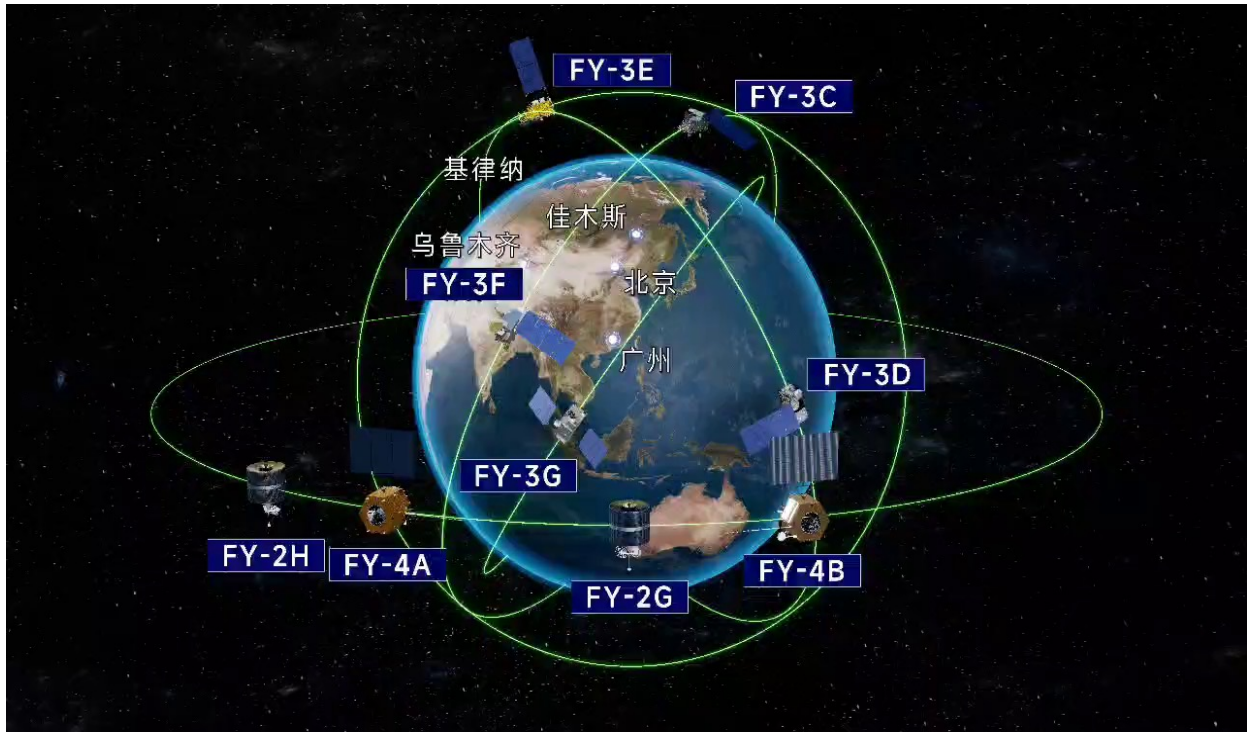
Constellation: 9 Satellites in orbit

- **4 GEO:FY-2G(99.2ºE),FY-2H(79ºE),FY-4A(86.5ºE),FY-4B(105ºE)**
- **5 LEO:FY-3C,FY-3D,FY-3E,FY-3G,FY-3F**

The collaborative observation of GEO and LEO meteorological satellites can provide three-dimensional and high-resolution observations



21 satellites, Two generations and Four types



9 FengYun satellites on duty

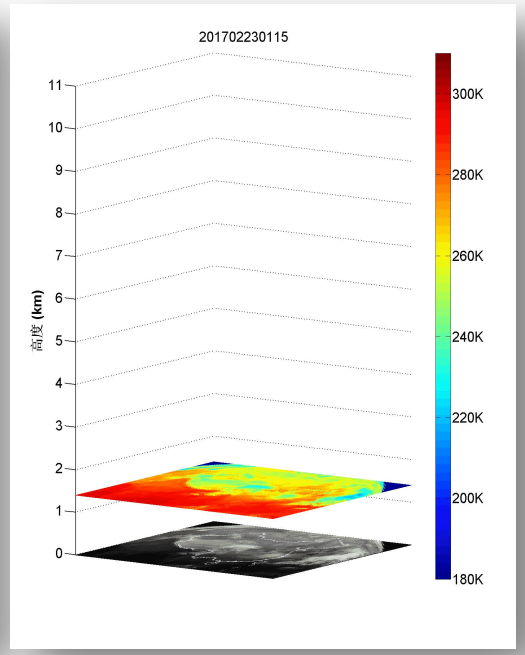
Status of FengYun satellites and typhoon targeted observation

GEO

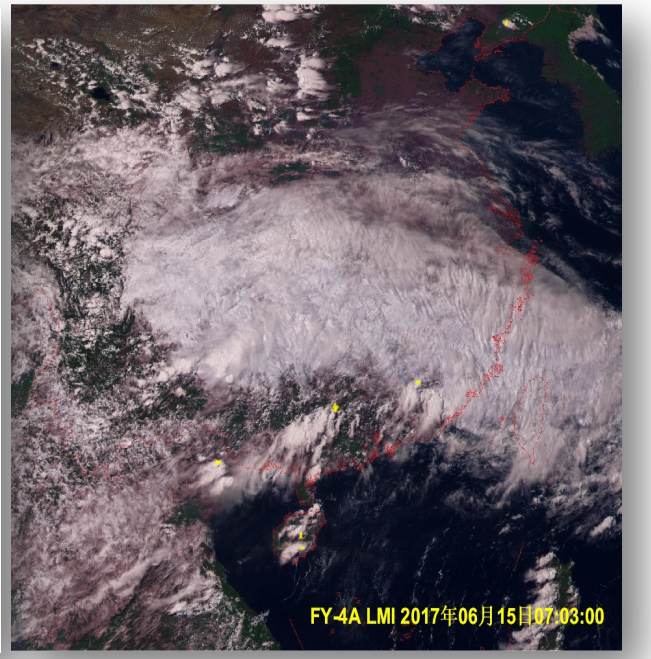
FY-4A/4B instruments on board

FY-4A/4B AGRI

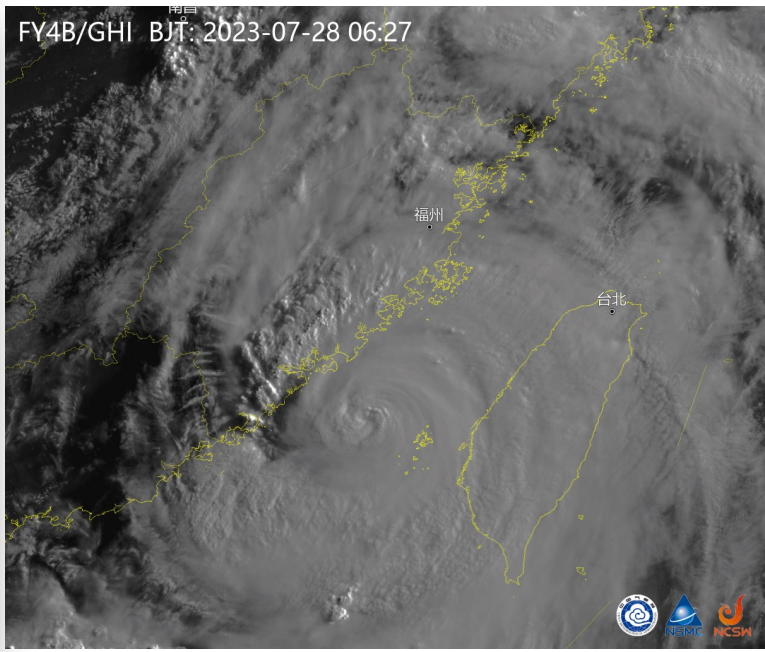
FY-4A/4B GIIRS



FY-4A LMI



FY-4B GHI



AGRI

Advanced Geo. Radiation Imager

GHI

Geo High-speed Imager

GIIRS

Geo. Interferometric Infrared Sounder

LMI

Lightning Mapping Imager

Status of FengYun satellites and typhoon targeted observation

LEO

FY-3D : afternoon satellite

FY-3E : early morning satellite
launched in 2021

FY-3F: morning satellite
launched in 2023

FY-3G : precipitation satellite
(precipitation measurement radar : PMR)
launched in 2023

Three dimensional atmospheric vertical detection capability,
FY-3D/E/F can provide 6 times global observations per day.

FY-3E Payloads

- ✓ 11 instruments on board
- ✓ More than 7000 bands

Acronym	Full name
GNOS-2	GNSS Radio Occultation Sounder -2
HIRAS-2	Hyper-spectral Infrared Atmospheric Sounder -2
MERSI-II	Medium Resolution Spectral Imager -II
MWHS-2	Micro-Wave Humidity Sounder -2
MWTS-3	Micro-Wave Temperature Sounder -3
SIM-2	Solar Irradiance Monitor - 2
SSIM	Solar Spectral Irradiance Monitor
SWS/Tri-IPM	SWS / Triple-angle Ionospheric PhotoMeter
SES/SEM	SES / SEM(FY-3E)
WindRAD	Wind Radar
XEUVI	Solar X-ray and Extreme Ultraviolet Imager

Status of FengYun satellites and typhoon targeted observation

FengYun satellite L2 products

Product List:

Atmosphere(33)

Cloud & Radiation(17)

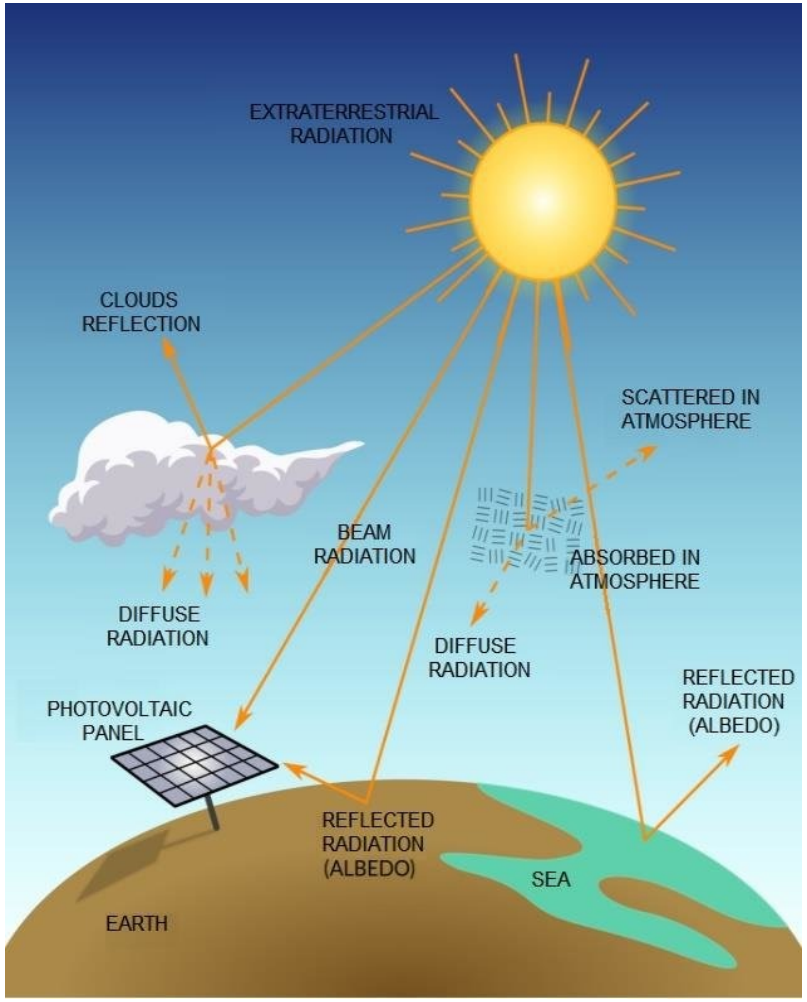
Land(12)

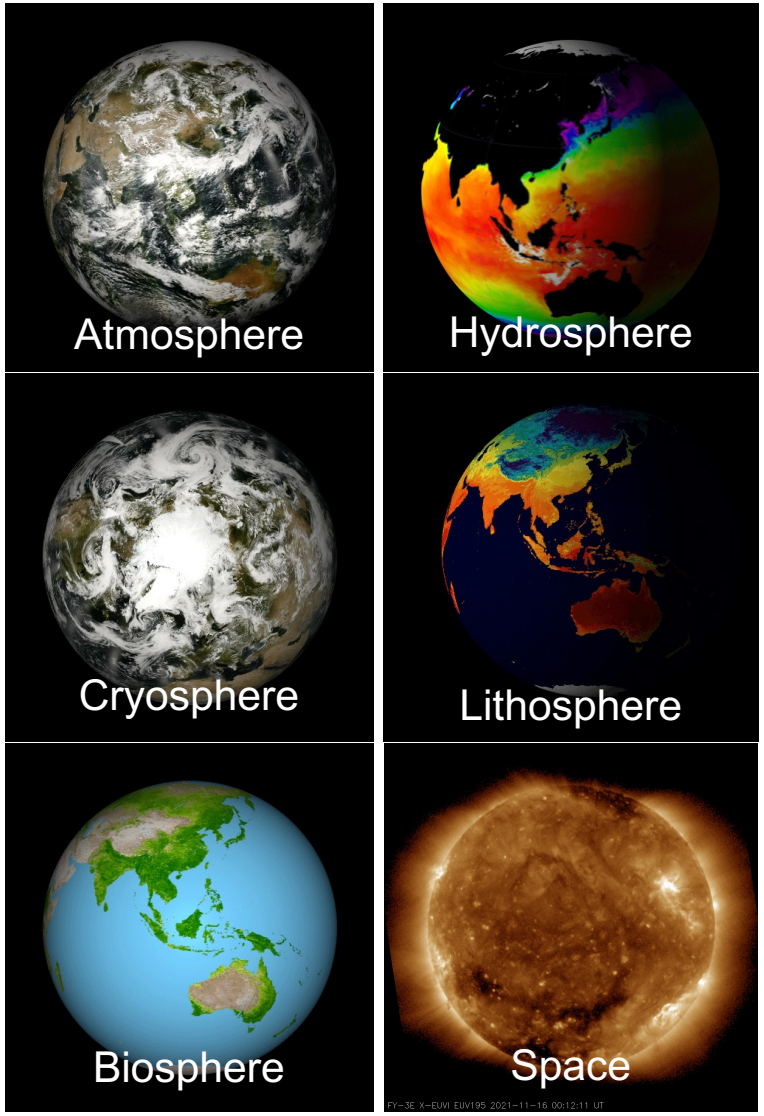
Ocean(7)

Ice&Snow(4)

Biology(4)

Space Weather(13)





Status of FengYun satellites and typhoon targeted observation

GEO: List of FY-4 L2 products

Cloud and radiation (20)	Cloud detection	**Atmospheric parameters (21)**	TBB
	Cloud type、cloud phase		AMVs
	Cloud properties（CTH、CTT、CTP)		Precipitable Water Vapor
	Microphysical characteristics of daytime clouds		QPE
	Microphysical characteristics of nighttime clouds		CI
	Cloud cover		Tropopause Folding Turbulence
	Atmospheric top reflection shortwave radiation		Temperature profile（clear sky、cloudy sky)
	Upward longwave radiation on the surface		Humidity profile（clear sky、cloudy sky)
	Downward longwave radiation on the earth's surface		Atmosphere instability index
	OLR		GIIRS humidity
	Surface Shortwave Radiation		Lightning
Ocean and land surface (7)	Fog detection	**Atmospheric environment (4)**	Aerosol optical properties
	LST		Dust detection
	Land Surface Albedo		Ozone (Ozone profile 、ozone amount)
	Land surface emissivity	**Assimilation support（1)**	Clear Sky Radiation
	Snow cover	**RGB composite (14)**	Day convection storm, True color, Dust, Natural color RGB, et al.
	SST		
	Fire		

Status of FengYun satellites and typhoon targeted observation

➢ Status of FengYun Satellite

List of FY-3F Level 2 products

- The FY-3F product covers **7 categories**: **cloud radiation, land surface, ocean, atmospheric parameters, atmospheric composition, and space weather, with a total of 72 main parameters;**

- Newly added products for pollutants such as sulfur dioxide (SO2), nitrogen dioxide(NO2), ozone(O3), etc. obtained through UV hyperspectral inversion;

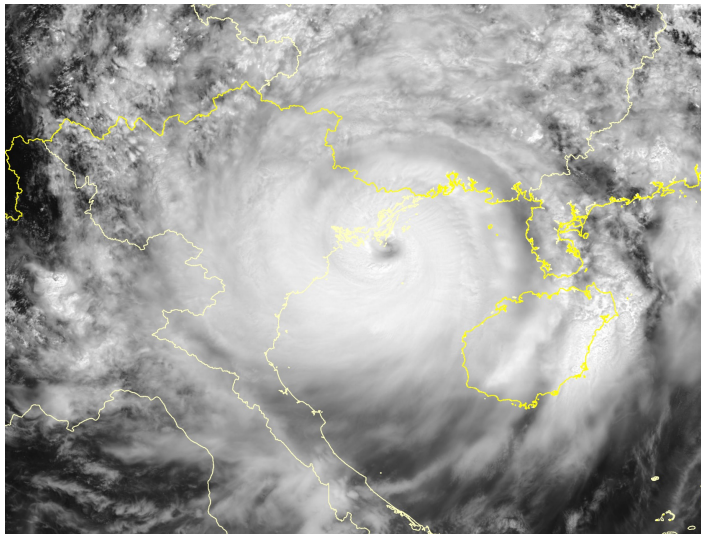
- Newly added products for kilometer level land surface parameters such as global ice and snow, soil moisture, soil freeze-thaw, and surface temperature based on super-resolution reconstruction technology.

Instruments	L2 Products
MWRI	super-resolution reconstruction product
	surface rain rate
	cloud water
	total precipitable water over sea
	temperature profile
	snow depth/snow water equivalent
	surface temperature
	soil moisture
	soil freezing and thawing
HIRAS/MWHS/MWTS	temperature/moisture profile
HIRAS	ozone profile
OMS-N/L	SO2 amount
	NO2 amount
	ozone amount and profile (nadir)
	ozone profile (limb)
	aerosol optical depth
	aerosol index
GNOS-II	GNOS bending angles
	atmospheric refractivity
	atmospheric density
	atmospheric temperature/moisture profile
	electron density profile
	sea surface wind
	soil moisture
MERSI	cloud detection
	cloud amount
	Cloud optical thickness
	cloud phase
	cloud properties
	precipitable water
	polar AMV
	aerosol optical depth
	dust detection
	surface skin temperature
	surface reflectance
	BRDF/albedo
	land cover
	Photosynthetic effective radiation
	NDVI
	LAI
	net primary productivity (NPP)
	snow cover
ERM-II/SIM-II	solar irradiance

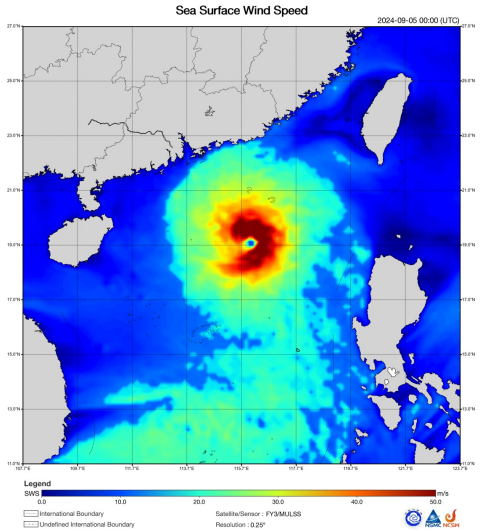
Status of FengYun satellites and typhoon targeted observation

Some examples of FengYun satellite products used in typhoon monitoring.

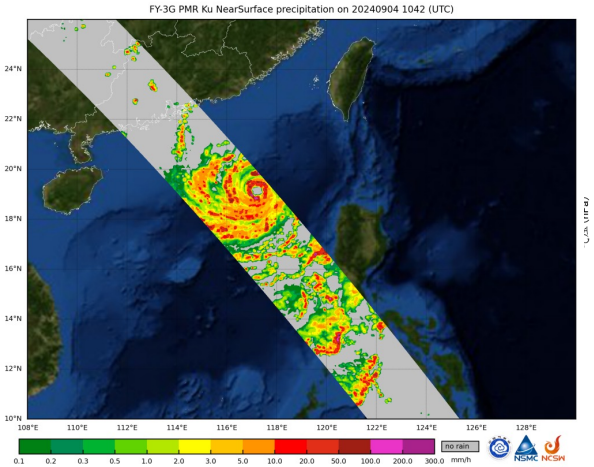
FY-4B/GHI cloud imagery



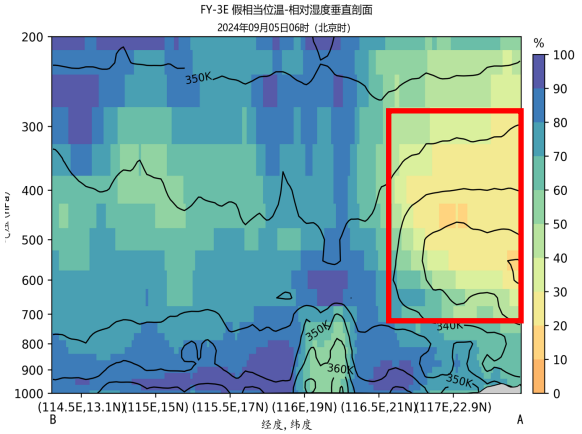
Sea Surface Wind



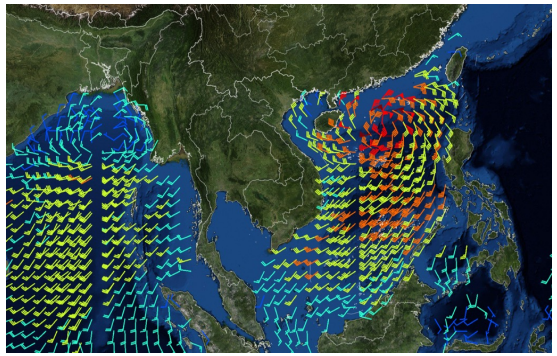
Precipitation



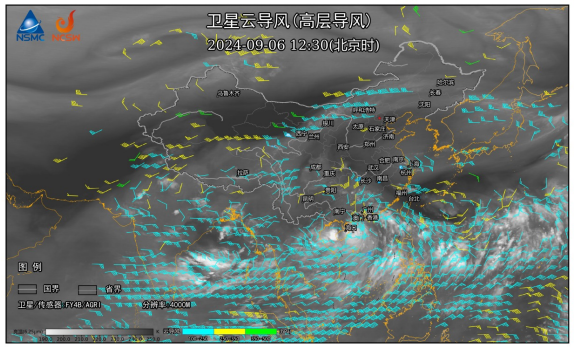
Temperature and Humidity



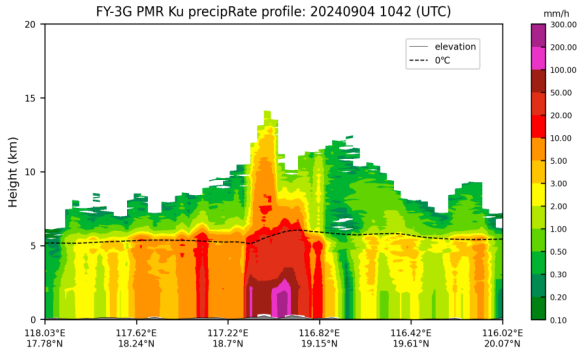
Sea Surface Wind

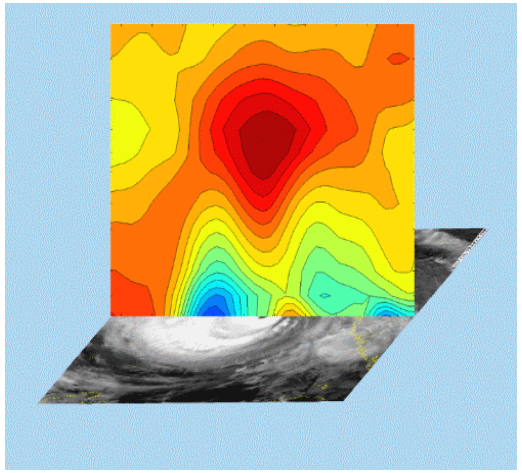


AMV



Precipitation





Status of FengYun satellites and typhoon targeted observation

Example

- Experiment of a multi-platform collaborative observation of Typhoon Yagi in the South China Sea in 2024.

The collaborative observation program combines conventional observation methods such as FengYun satellites, Beidou sounding, S-band and X-band weather radar, and mobile observations such aircraft, to carry out observation, data collection, numerical modeling, forecasting, and services.

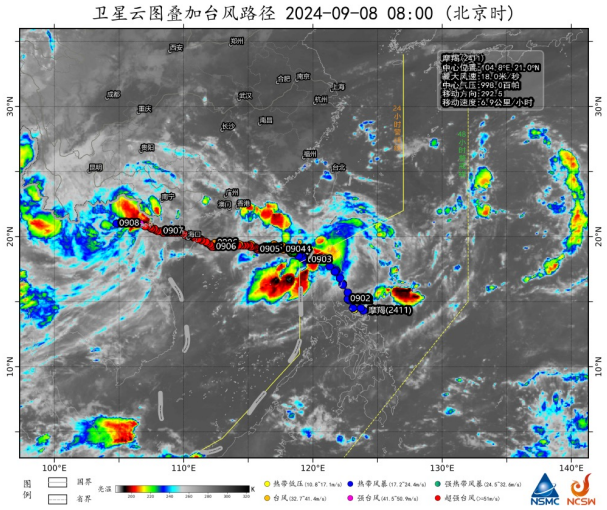
FengYun satellites

- ✓ **FY-4B/GHI** is activated to initiate highly frequent observation of a given area (2000km × 2000km) at an interval of up to 1 minute and 250 meters resolution.
- ✓ **FY-4B/GIIRS** is activated to initiate highly frequent observation of typhoon regional observation at 15 min interval, obtaining three-dimensional vertical temperature and humidity profiles in the typhoon area.
- ✓ **FY-3G/PMR** conducted mobile observations observation and successfully captured the three-dimensional structure of the precipitation of typhoon “Yagi”.

2411 Super Typhoon “Yagi”

- ✓ The strongest typhoon to land in China in autumn since 1949. The intensity is second only to 201409 super typhoon “Rammasun” .
- ✓ Characteristics: Long impact time, long duration of super typhoon (64 hours), severe disaster losses which far exceeding typhoon “Rammasun” .
- ✓ It has landed four times (in Philippines, Hainan Province, Guangdong Province, and Vietnam).

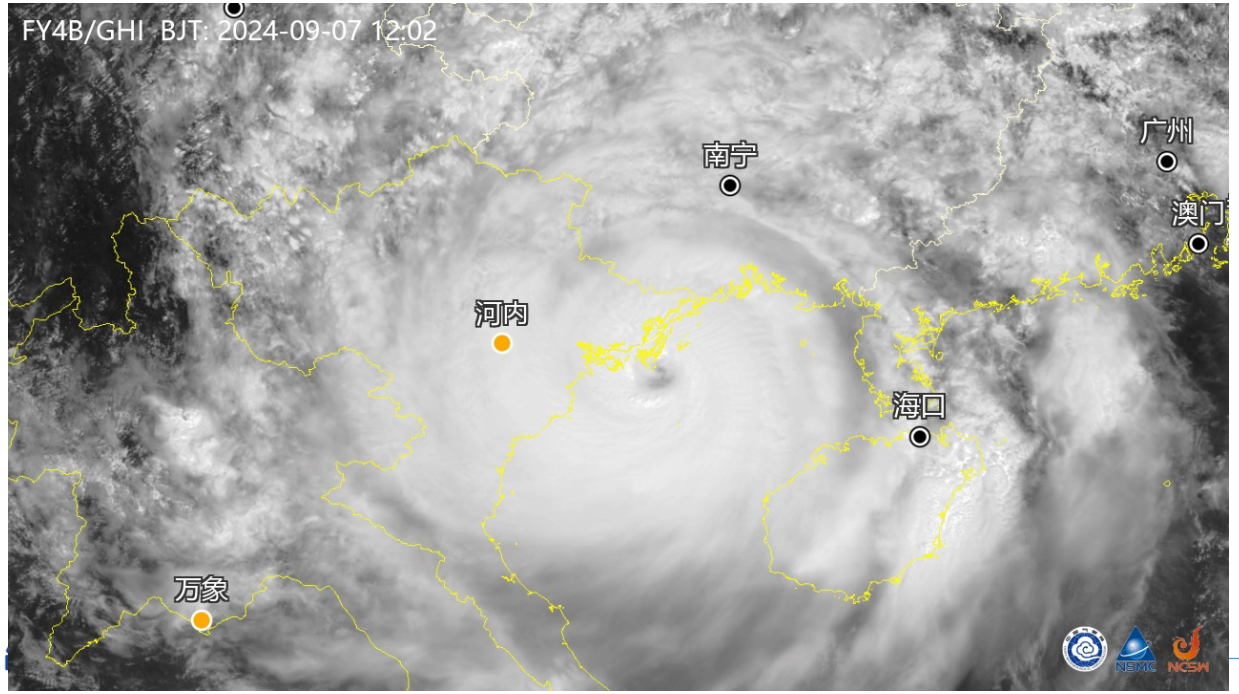
Typhoon “Yagi” track



Typhoon “Yagi” targeted observations using FengYun meteorological satellites.

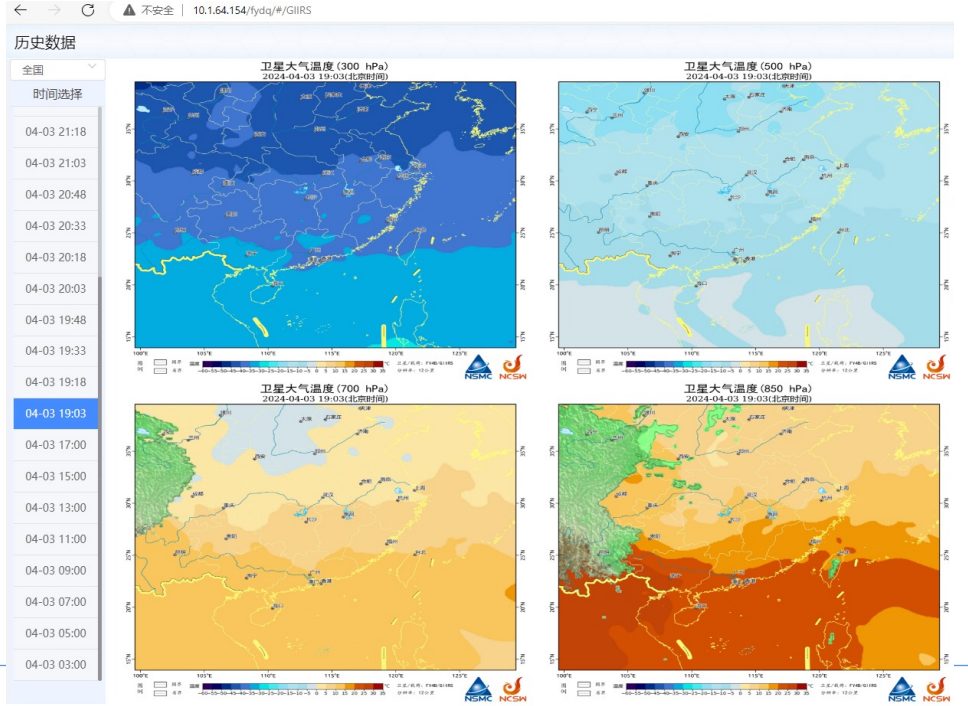
FY-4B/GHI (1 min interval)

FY-4B/GHI cloud image animation during “Yagi” landfall Vietnam.



FY-4B/GIIRS (15 min interval)

Temperature and humidity profiles

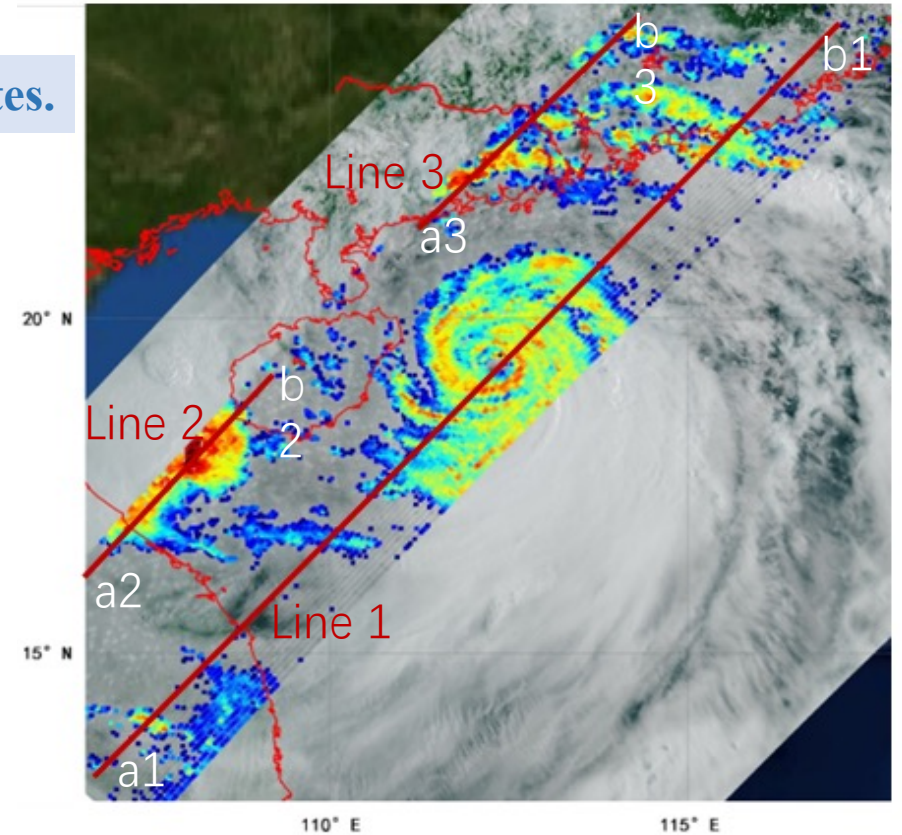


202411 Super Typhoon “Yagi”

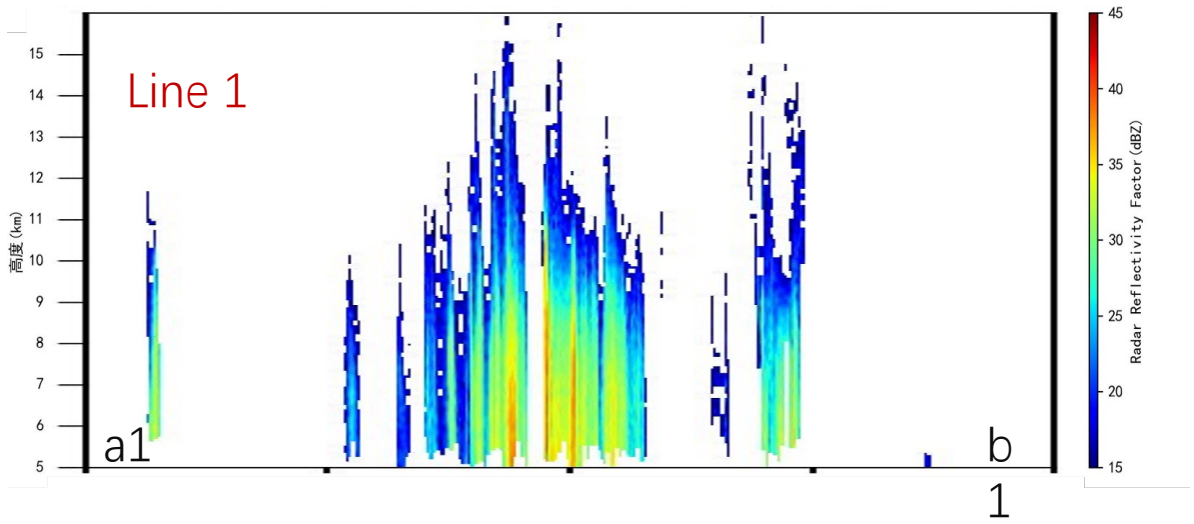
Typhoon “Yagi” targeted observations using FengYun meteorological satellites.

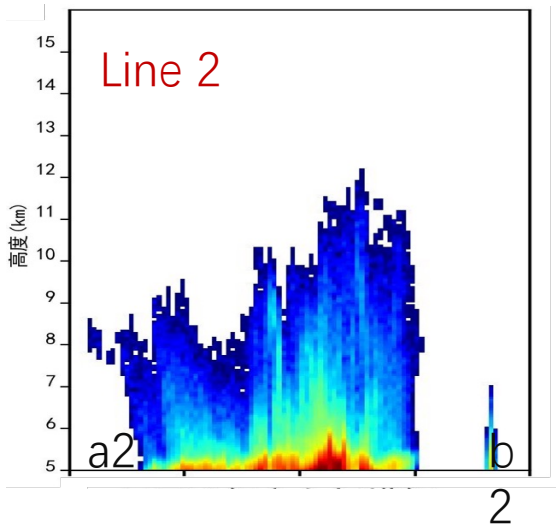
FY-3G/PMR (Precipitation Measurement Radar)

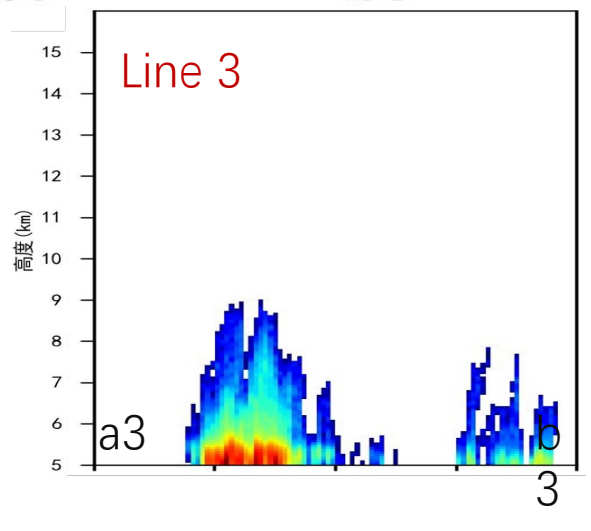
- ✓ At 1:04 (UTC) on 6 September 2024, FY-3G satellite conducted mobile observations in orbit and successfully captured the three-dimensional structure of the precipitation of typhoon “Yagi”.
- ✓ FY-3G/PMR captured the typhoon rainfall belt before its landfall in Hainan Province, with a clear spiral structure. The strong radar reflectivity factor exceeds 40 dBZ (Ku band), and the precipitation development height exceeded 15 km .



Vertical cross-section of FY-3G/PMR reflectivity factor







Dynamic and thermal parameters from FY satellites and their application in TC monitoring

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

☐ Atmospheric dynamic parameters :

FY-4/AGRI AMV , FY-3E/WindRad OWV, FY-3/MWRI sea wind speed

☐ Atmospheric thermal parameters :

FY-4/GIIRS and FY-3/VASS temperature and humidity profiles

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

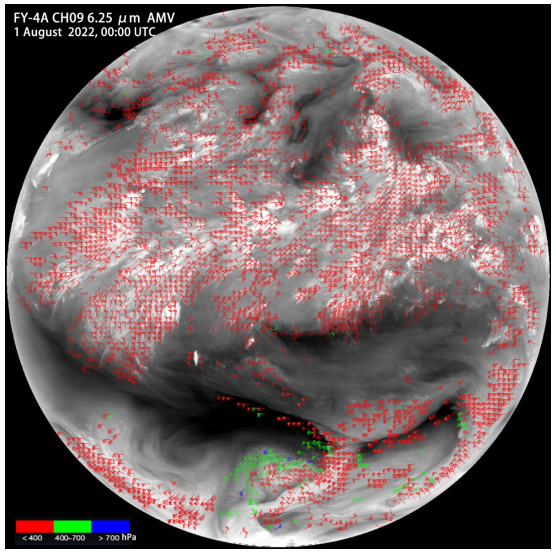
☐ Atmospheric dynamic parameters :

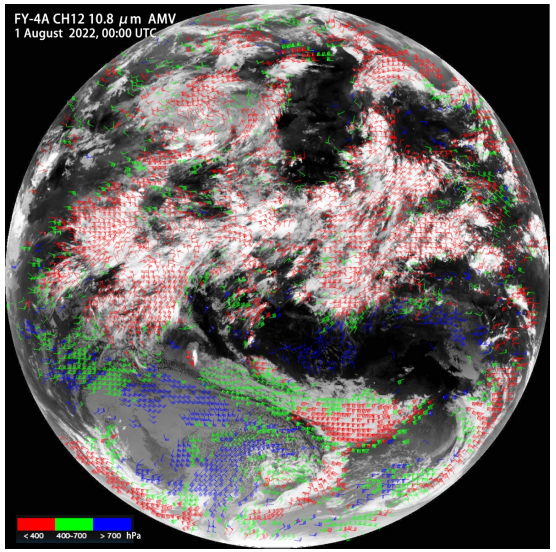
Atmospheric Motion Vectors (FY-4/AMV)

Mid-upper troposphere winds

FY-4A:3h

FY-4B:15 min

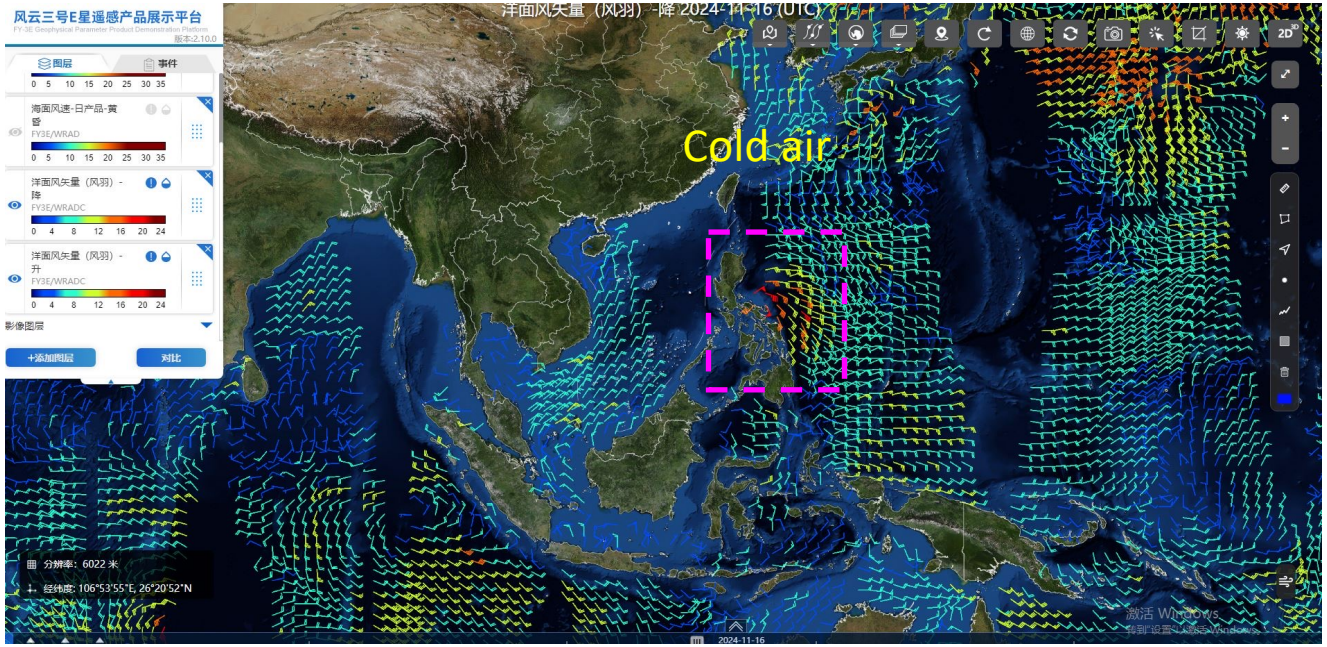




6.25μm water vapor channel and 10.8μm far-infrared channel red, green and blue vectors are for winds upper than 400 hPa, between 400 hPa and 700 hPa, and lower than 700 hPa.

Ocean Wind Vectors (FY-3E/WindRAD OWV)

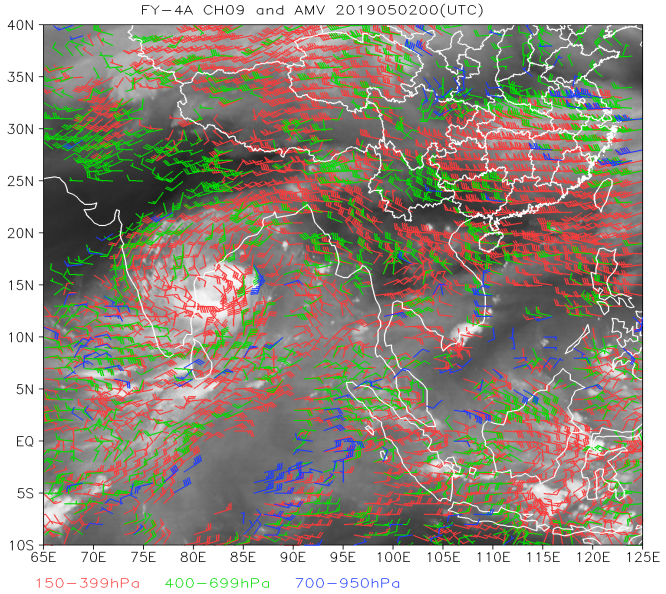
Lower troposphere winds



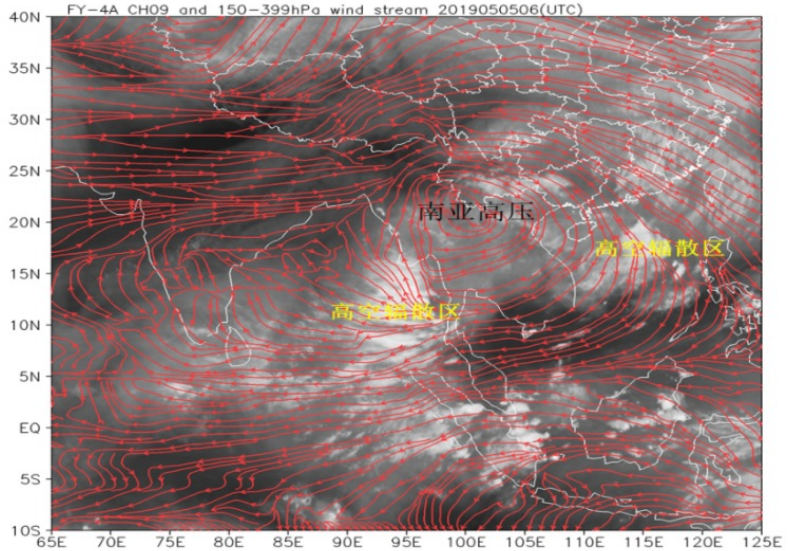
On16 Nov 2024, Super Typhoon 2424 Man-yi

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

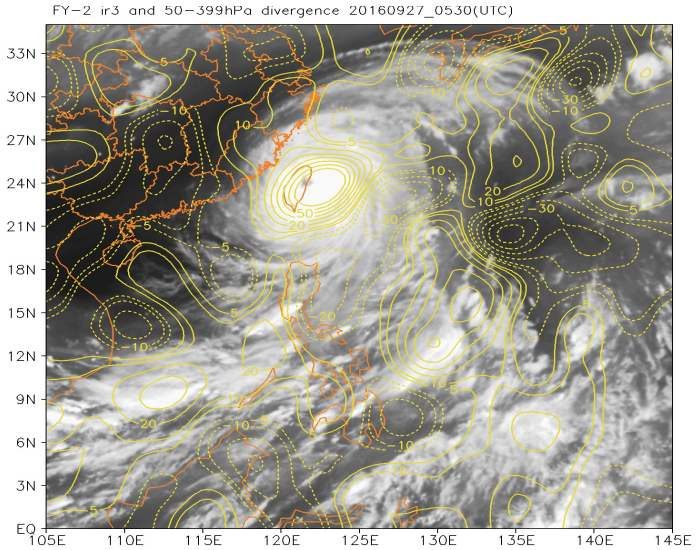
☐ Atmospheric dynamic parameters :



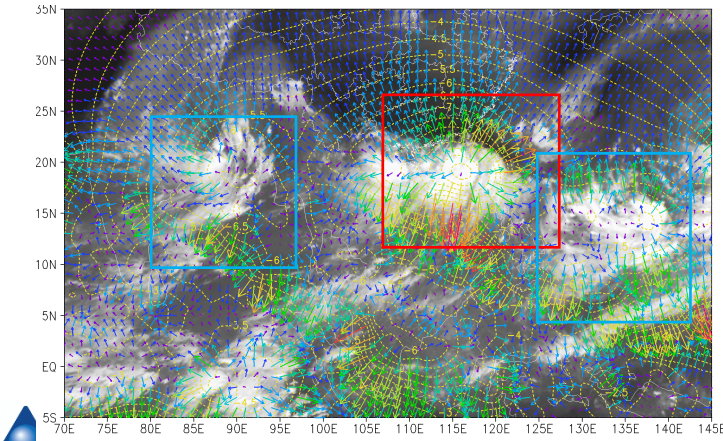
Upper troposphere wind stream



Upper troposphere divergence



AMV velocity potential and divergence wind



FY-4/AMV

Using the satellite derived wind data upper tropospheric wind stream, divergence, potential function and divergence winds products are calculated.

There is a velocity potential φ if the motion is irrotational, the velocity in different direction is the differential of the velocity potential φ. That is

$$W_\varphi = \frac{\partial \varphi}{\partial Z} \quad x_\varphi = \frac{\partial \varphi}{\partial \ell}$$

$$D = \frac{\partial u_\varphi}{\partial x} + \frac{\partial v_\varphi}{\partial y} = \left(\frac{\partial^2 \varphi}{\partial x^2} + \frac{\partial^2 \varphi}{\partial y^2}\right)$$

Divergence is the second-order differential of velocity potential φ

FY-4/AMV

potential function and divergence winds

$$D = \frac{\partial u_\varphi}{\partial x} + \frac{\partial v_\varphi}{\partial y} = \left(\frac{\partial^2 \varphi}{\partial x^2} + \frac{\partial^2 \varphi}{\partial y^2}\right)$$

$$w_\varphi = \frac{\partial \varphi}{\partial z} \qquad x_\varphi = \frac{\partial \varphi}{\partial \zeta}$$

Advantage:

potential function: potential function is the second-order integration of the divergence, Larger scale convergence and divergence information can be obtained

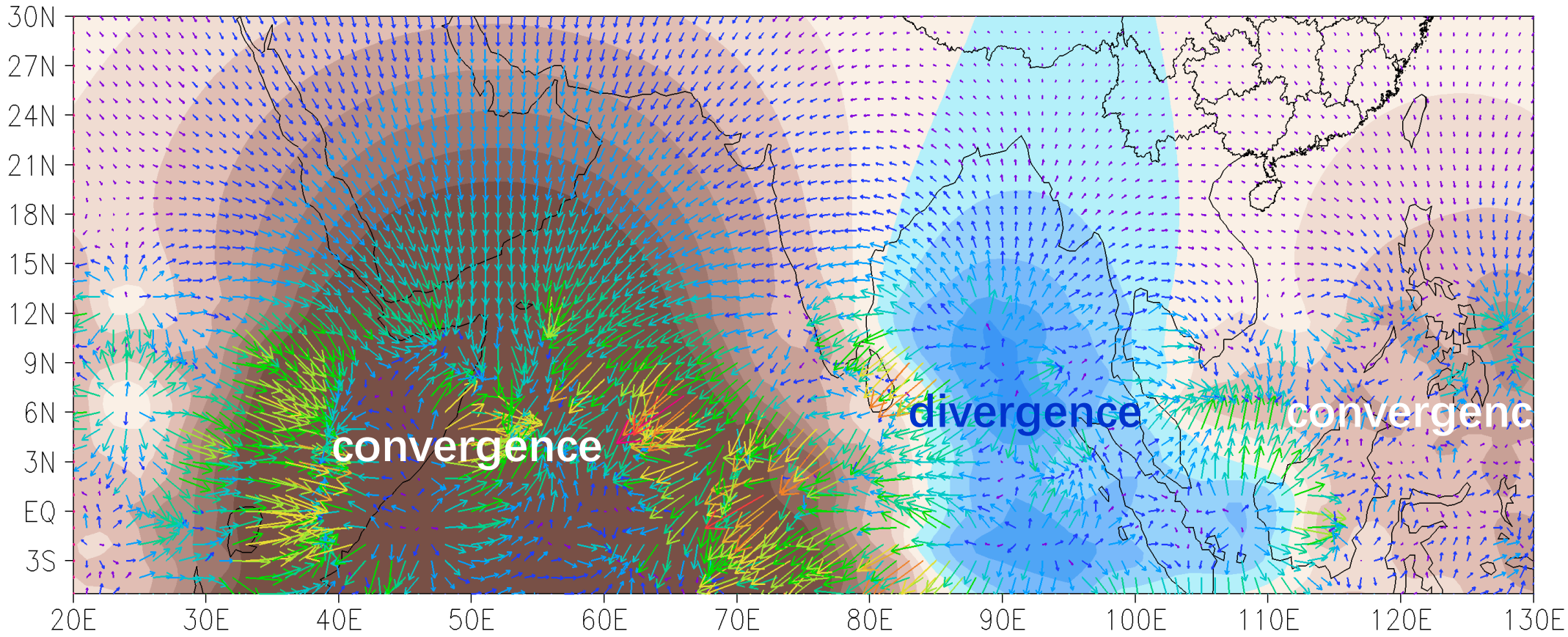
divergence winds： remove the rotating component of the wind. It can more clearly show the intensity and center position of the outflow from the upper troposphere, which is suitable for tropical and subtropical areas.

AMVs

Application: Satellite derived wind products can be used to monitor the planetary scale system **South Asian High**, the rain belt of the **Meiyu front** in summer, the **summer monsoon** in the South China Sea, the high-level outflow flow, the Intertropical Convergence Zone **(ITCZ).**

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

AMV application in monitoring the upper troposphere divergence in tropical and subtropical areas



potential function and divergence winds in tropical and subtropical areas

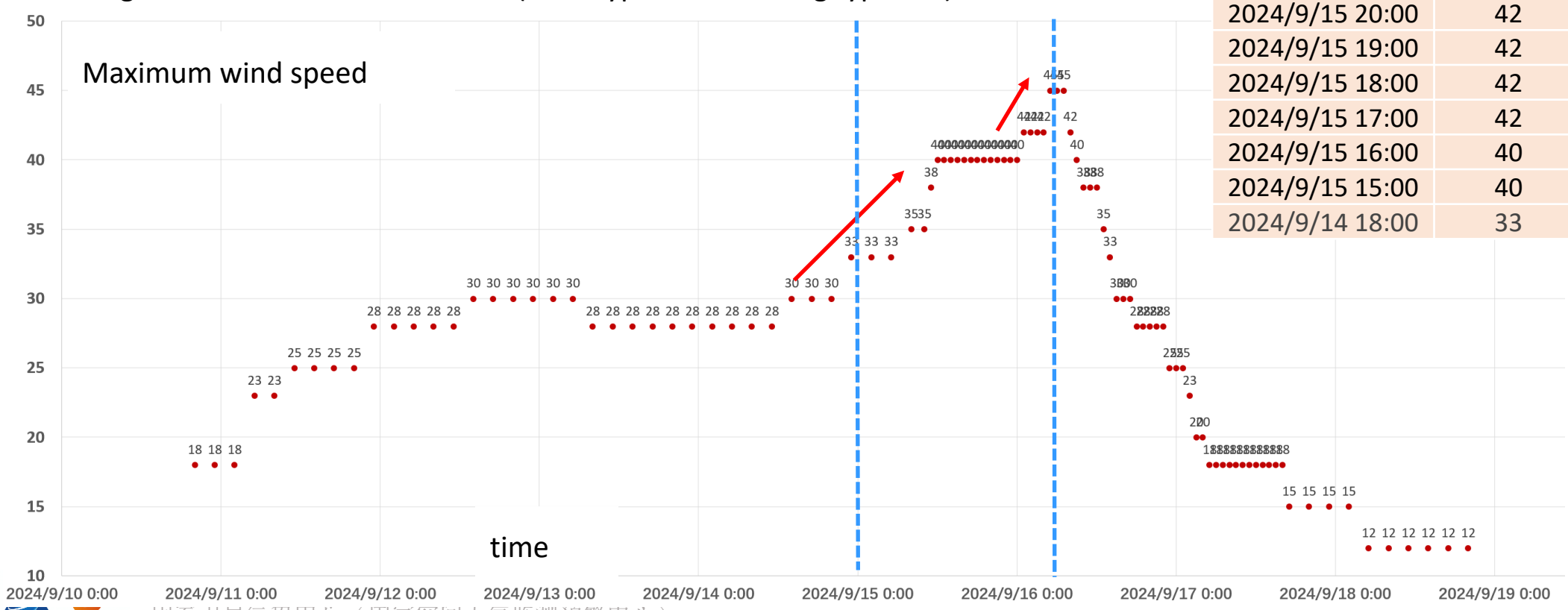
FY-4/AMV

Example 2: AMV products application in typhoon monitoring

The rapidly increasing intensity of typhoon 2413 Bebinca

From 18:00(UTC) on September 14th to 2200(UTC) on September 15th, it strengthened from 33m/s to 45m/s (form typhoon to strong typhoon)

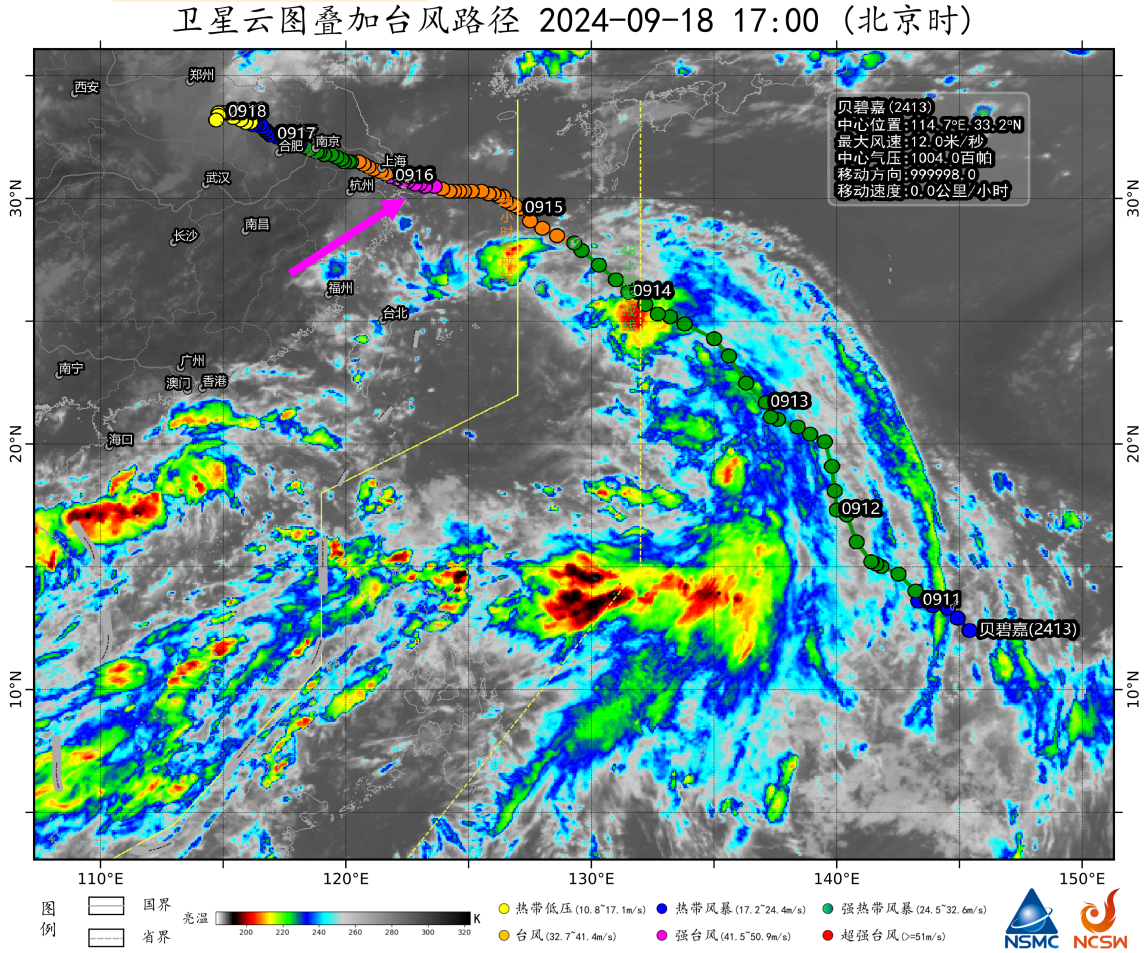
TIME（UTC）	Maximum windspeed	Intensity
2024/9/16 02:00	38m/s	TY
2024/9/16 01:00	40	TY
2024/9/16 00:00	42	STY
2024/9/15 23:00	45	STY
2024/9/15 22:00	45	STY
2024/9/15 21:00	45	STY
2024/9/15 20:00	42	STY
2024/9/15 19:00	42	STY
2024/9/15 18:00	42	STY
2024/9/15 17:00	42	STY
2024/9/15 16:00	40	TY
2024/9/15 15:00	40	TY
2024/9/14 18:00	33	TY



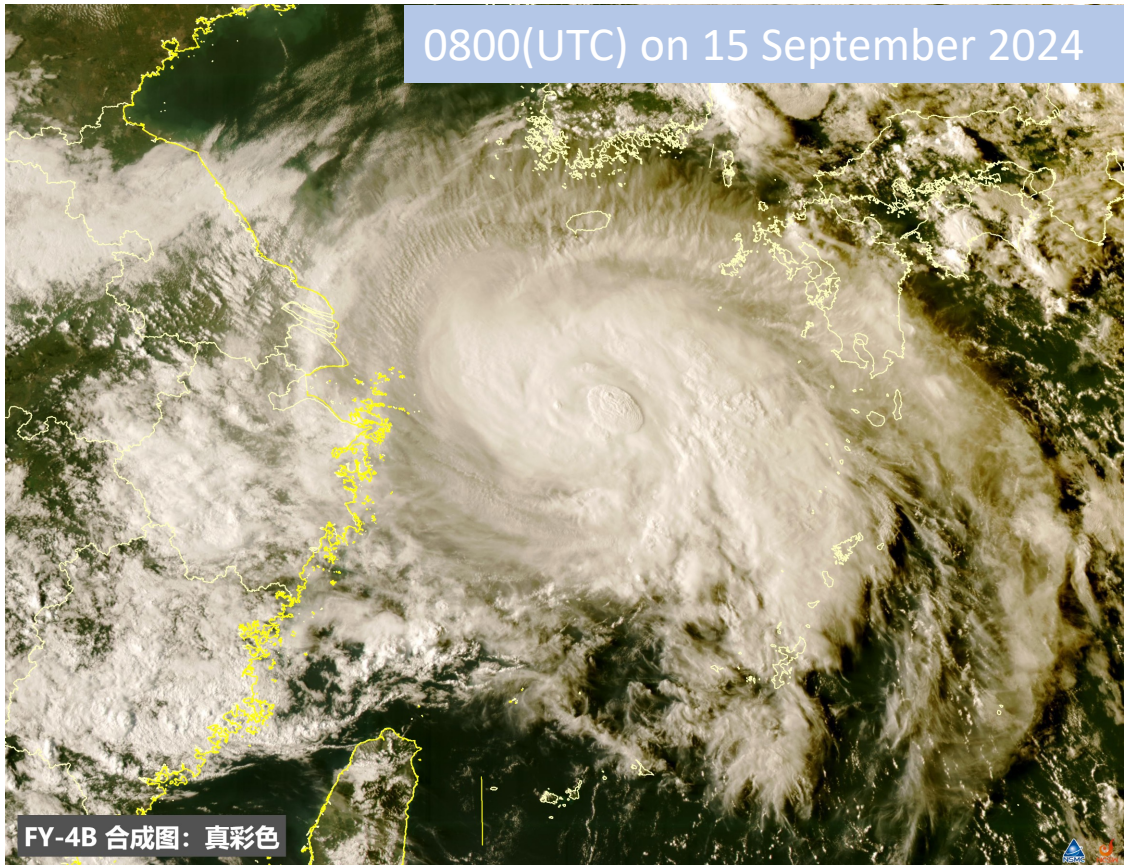
Dynamic and thermal parameters from FY satellites and their application in TC monitoring

Atmospheric dynamic parameters :

FY-4/AMV



From 18:00(UTC) on September 14th to 2200(UTC) on September 15th, it strengthened from 33m/s to 45m/s (form typhoon to strong typhoon)

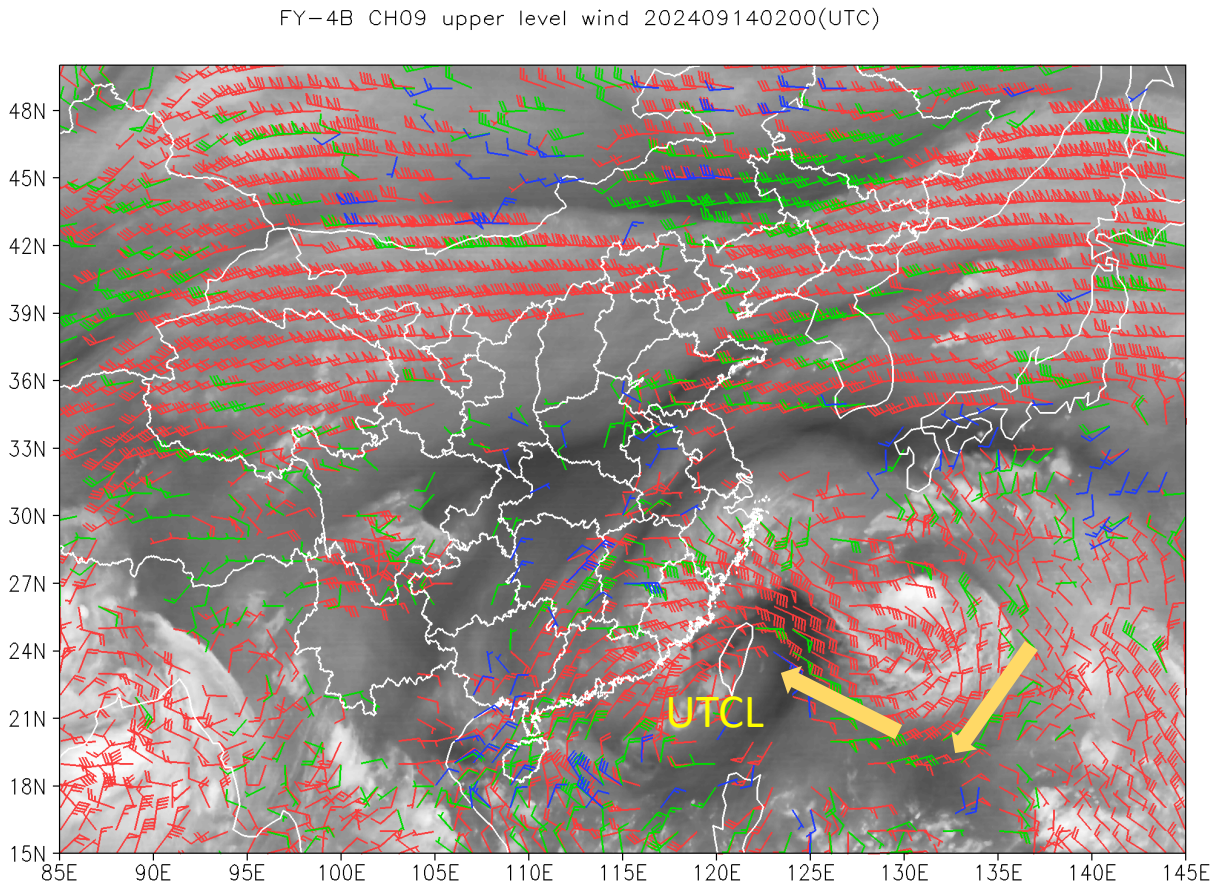


Dynamic and thermal parameters from FY satellites and their application in TC monitoring

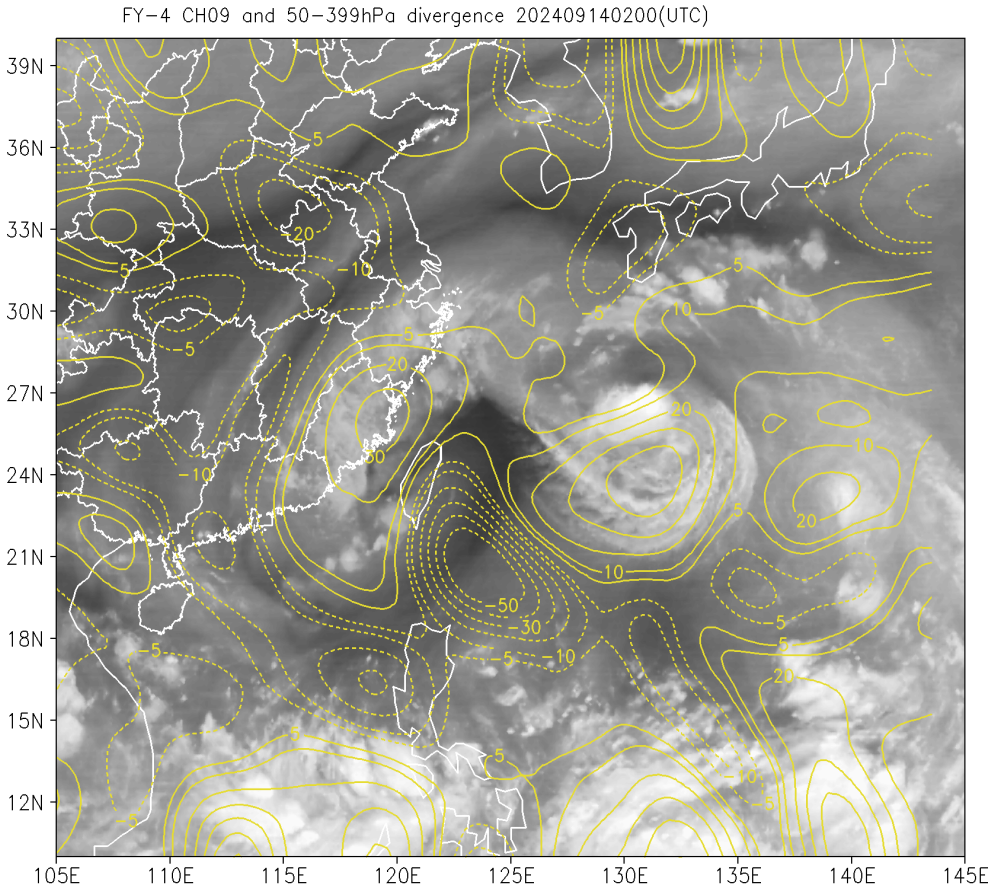
Atmospheric dynamic parameters :

At 0200(UTC), 14 Sep 2024

Upper troposphere AMV



Upper troposphere divergence from AMV



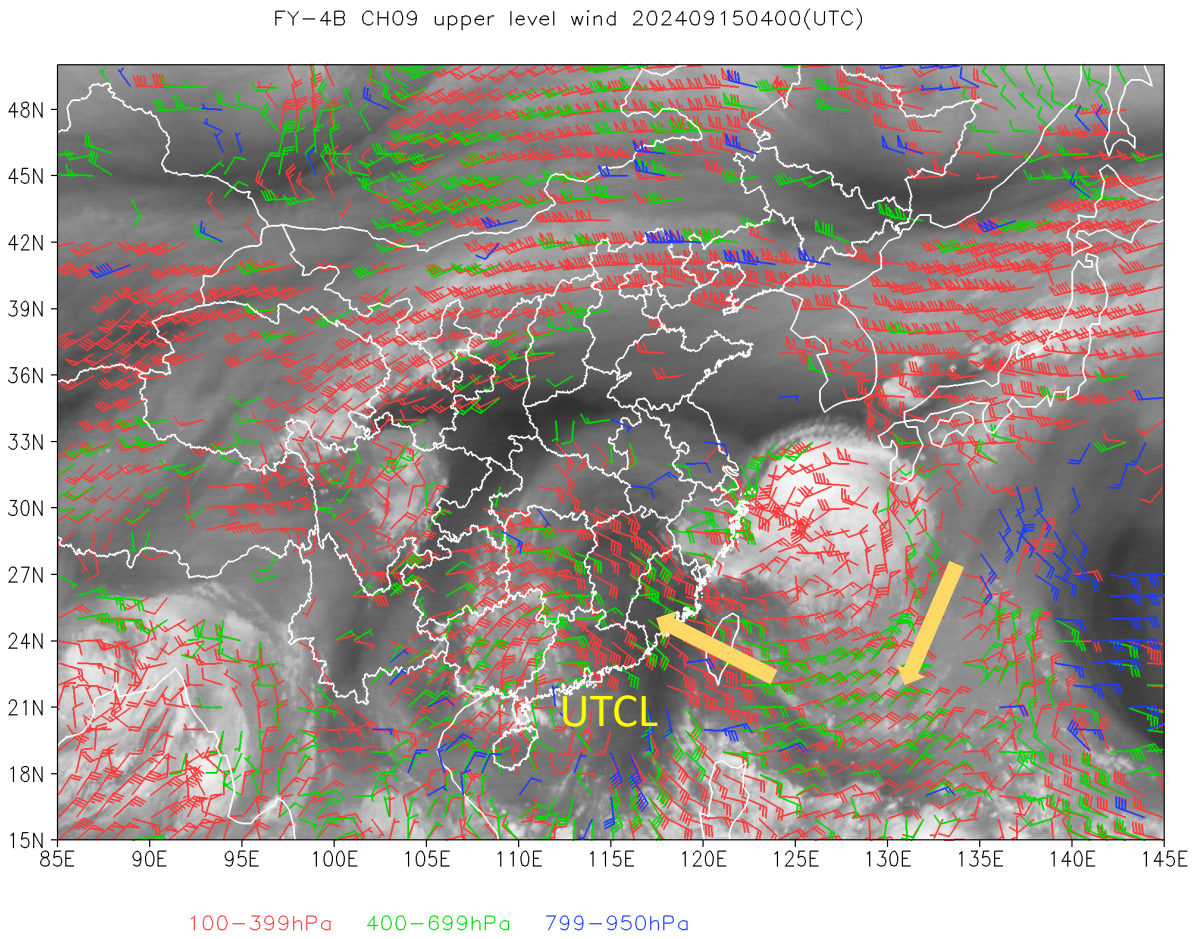
Upper-Tropospheric Cold Low (UTCL)

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

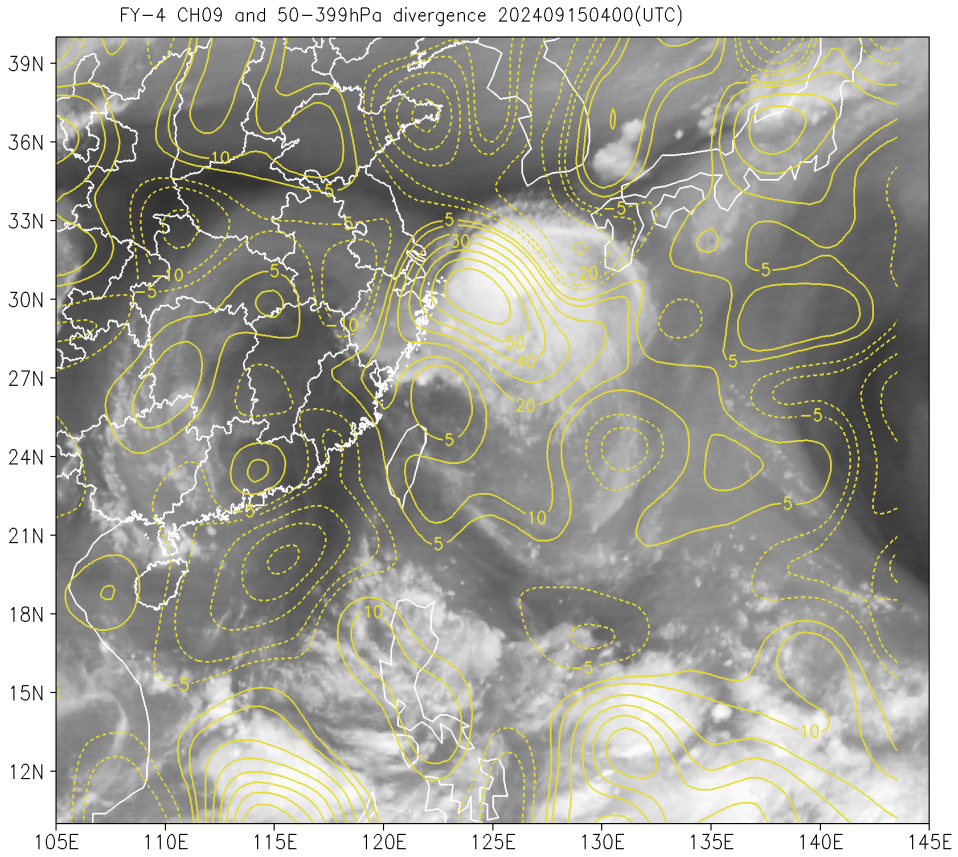
☐ Atmospheric dynamic parameters :

At 0400(UTC), 15 Sep 2024

Upper troposphere AMV



Upper troposphere divergence from AMV

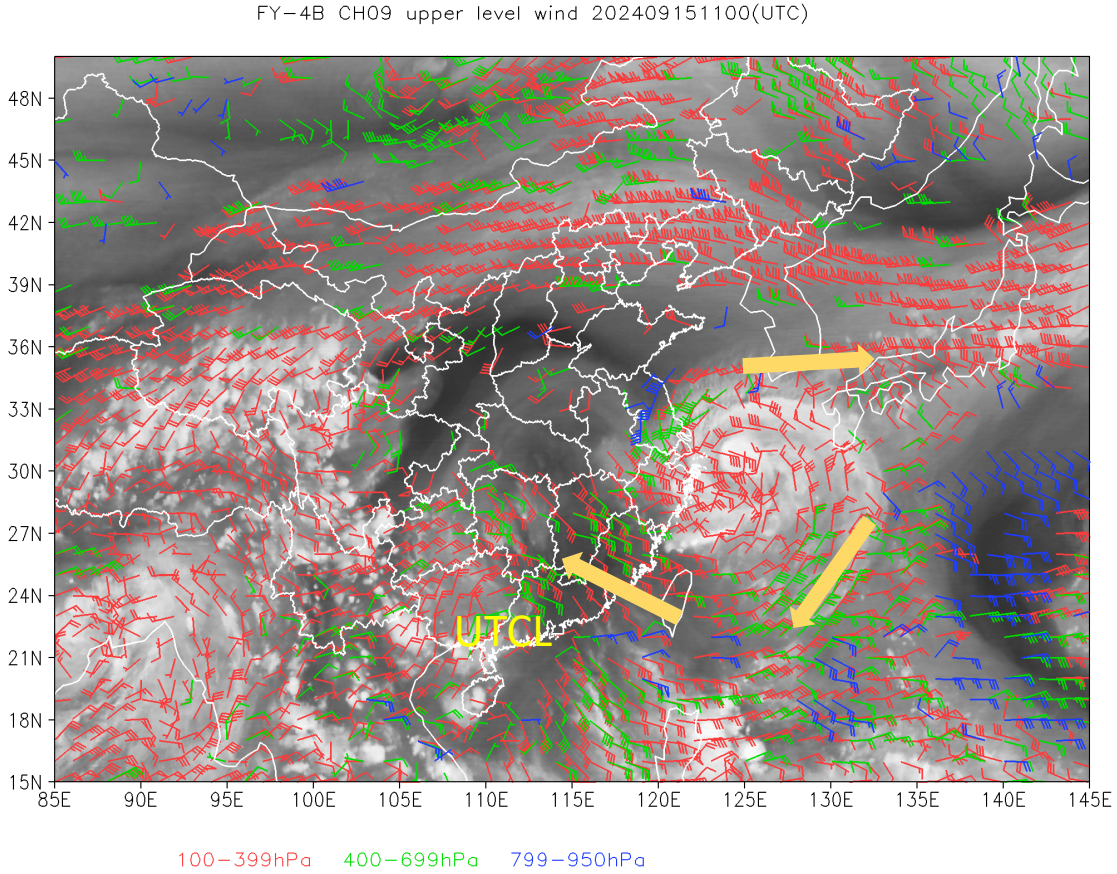


Dynamic and thermal parameters from FY satellites and their application in TC monitoring

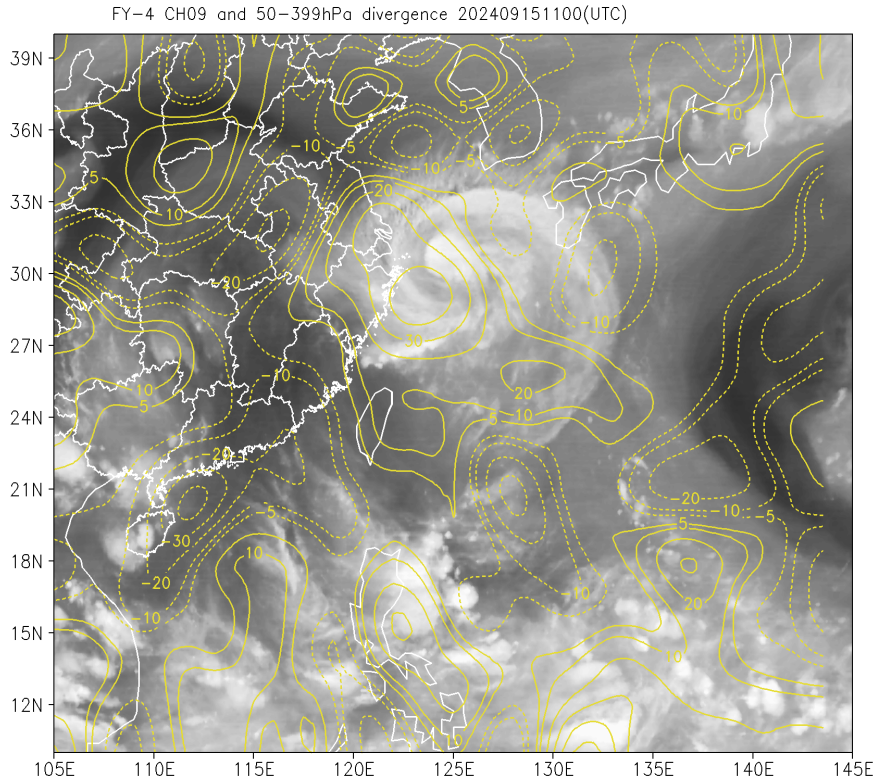
Atmospheric dynamic parameters :

At 1100(UTC), 15 Sep 2024

Upper troposphere AMV



Upper troposphere divergence from AMV



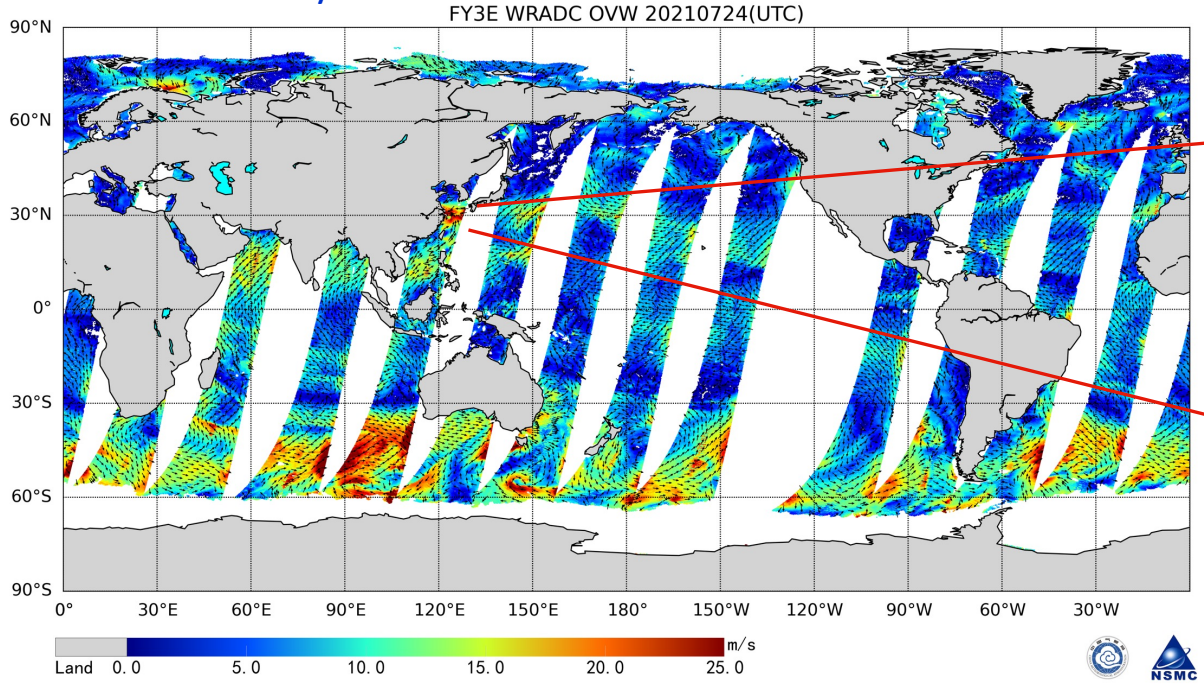
What is the impact of the cut off **Upper-Tropospheric Cold Low (UTCL)** in the tropical Upper Tropospheric Trough (TUTT) on typhoons?
The UTCL with wide and deep cyclonic circulation may be favorable for upper outflow of TC Bebinca.

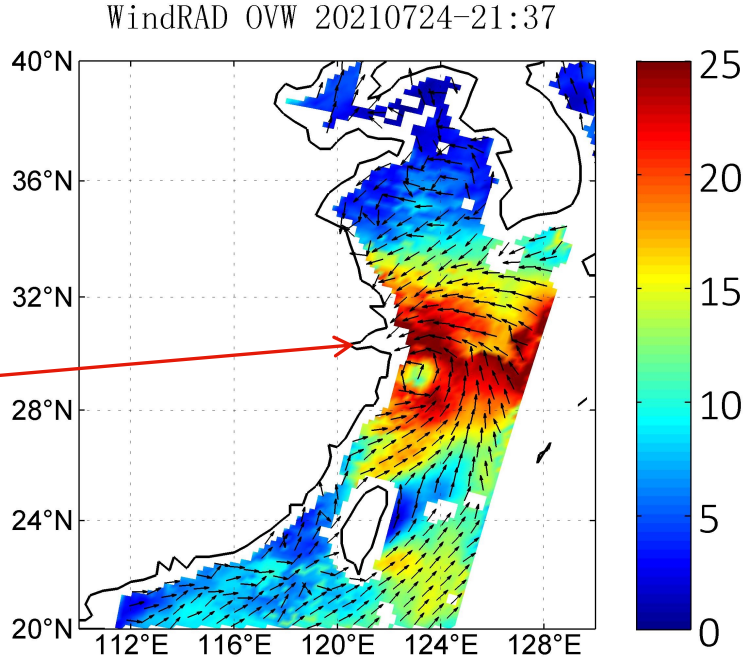
Dynamic and thermal parameters from FY satellites and their application in TC monitoring

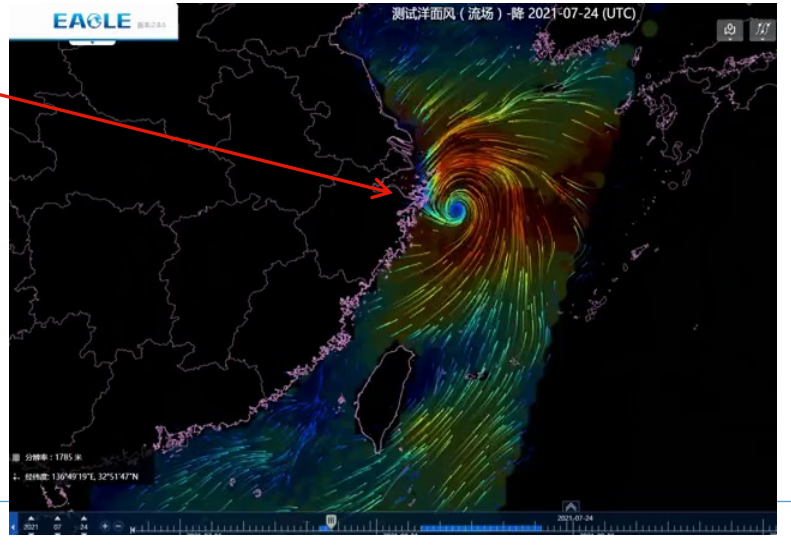
☐ Atmospheric dynamic parameters : FY-3E/WindRAD OWV

FY-3E OVW twice a day

It can be directly used in the monitoring of offshore strong winds, cold air-mass , typhoons, and the southwest airflow over the ocean caused by Asian summer monsoon activity.





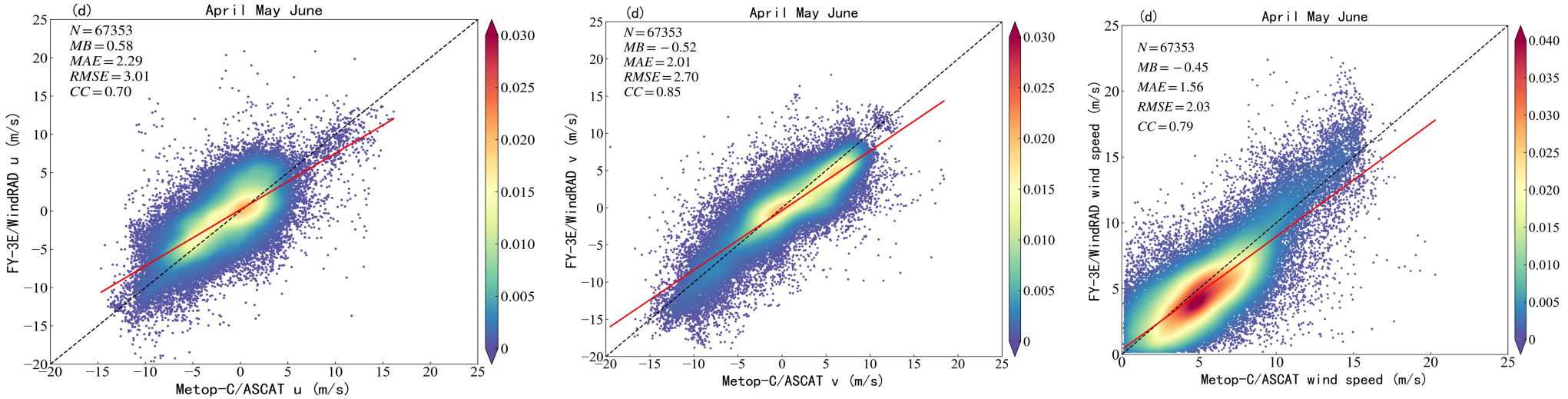


The ocean wind vectors from FY-3E includes the wind speed and wind direction. This is an example super typhoon “In-Fa” monitoring on July 24, 2021. The low-level circulation of the typhoon is strong, and the wind speed on the north and east sides of the center is more larger.

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

Atmospheric dynamic parameters :

Consistency comparison of Ocean Wind Vector consistency between FY-3E/WindRAD and MetOp-C/ASCAT over the South China Sea in summer



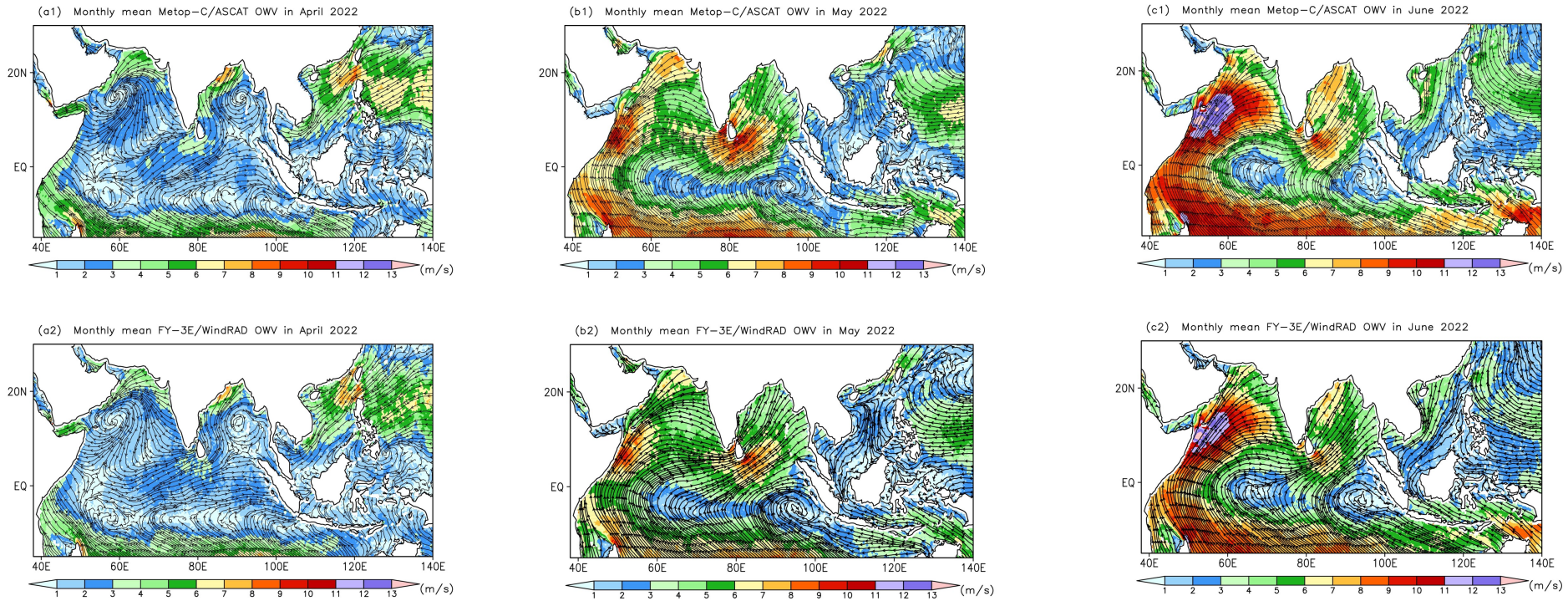
FY-3E/WindRAD and MetOp-C/ASCAT ocean surface wind scatter plots (U,V, Winds)

- U MB=0.58m/s, MAE=2.29m/s, RMSE=3.01m/s, CC=0.70
- V MB=-0.52m/s, MAE=2.01m/s, RMSE=2.70m/s, CC=0.85
- Winds MB=-0.45m/s, MAE=1.56m/s, RMSE=2.03m/s, CC=0.79

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

FY-3E/WindRAD and MetOp-C/ASCAT **monthly mean** Ocean Wind Vectors and wind speed in 2022

April | May | June



MetOp-C/ASCAT

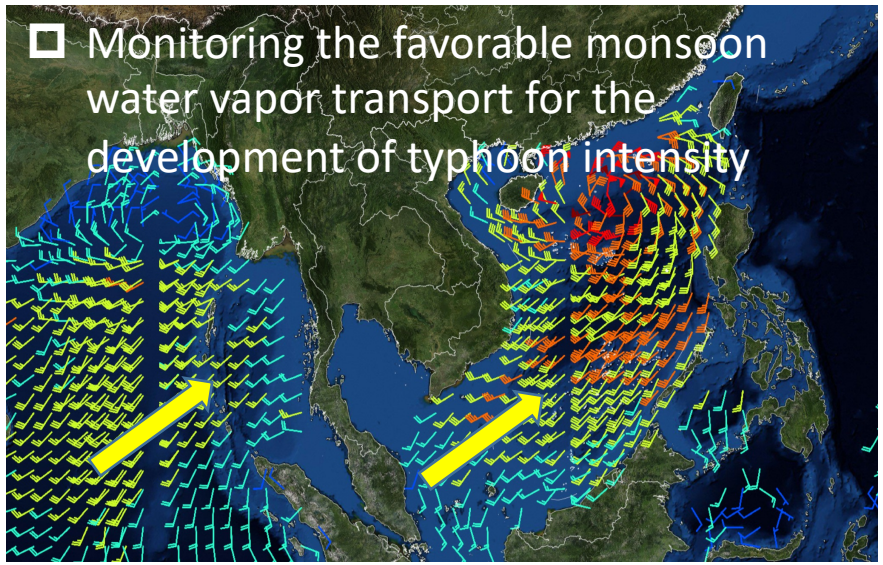
FY-3E/WindRAD

The distribution of OWV from FY-3E/WindRAD and MetOp-C/ASCAT is consistent, with similar locations and intensities

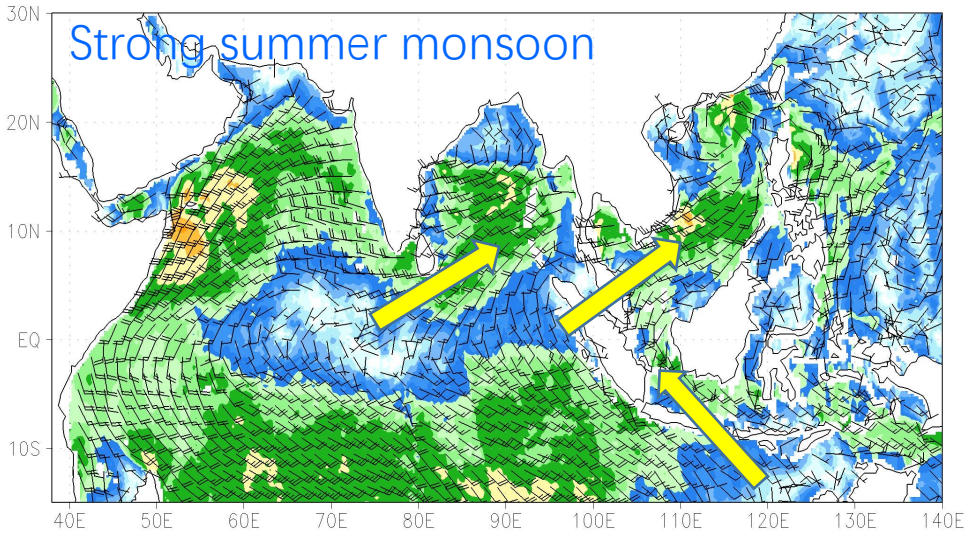
- In April, the South China Sea summer monsoon region is characterized by northeast winds.
- In May, as the Asian summer monsoon onset, the equatorial airflow over the East African Ocean became stronger.
- In June, the cross equatorial airflow further strengthened, and the Asian tropical summer monsoon region was controlled by westerly and southwest winds.

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

FY-3E OWV at 21:54UTC on 5 September 2024



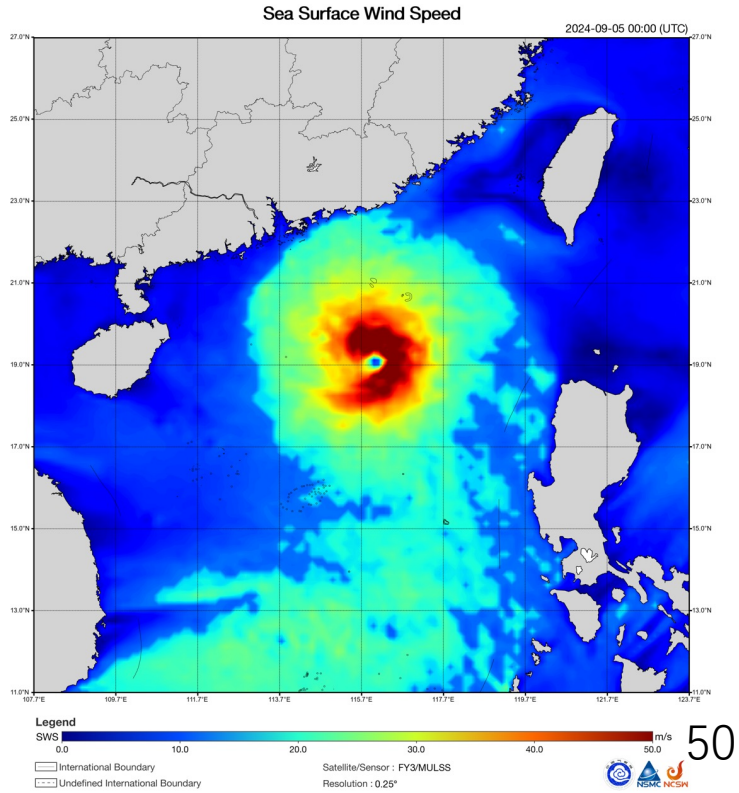
Average FY-3E OWV in past 5 days



Example 01:Super Typhoon “Yagi” (2411)

Dynamic field, ocean surface wind fields

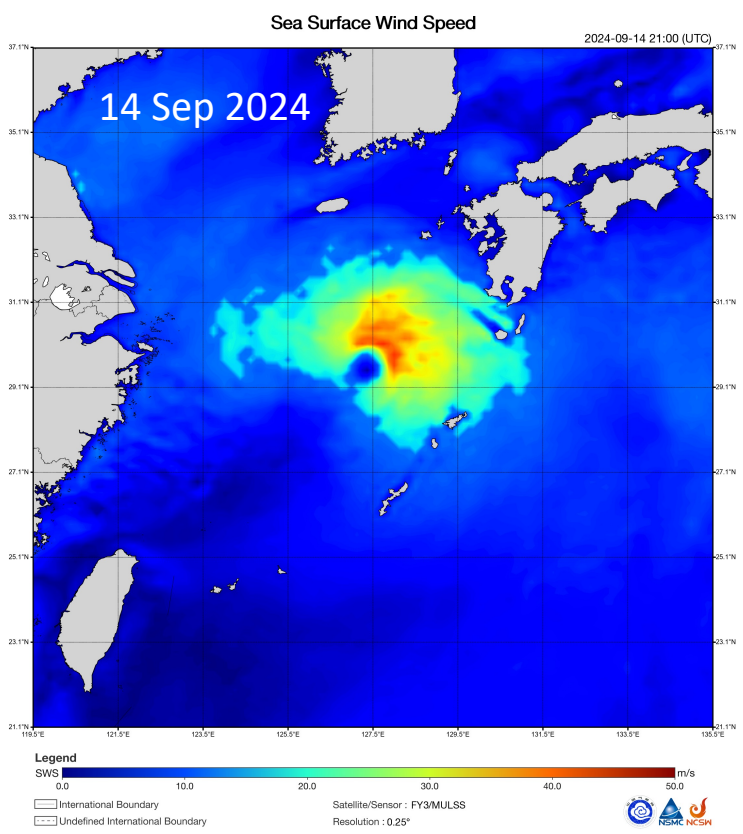
- Based on FY-3E/WindRad OWV and FY-3/MWRI sea wind speed， the **multi source data fusion wind-speed product** can be used in **monitoring the maximum wind speed** of typhoons.

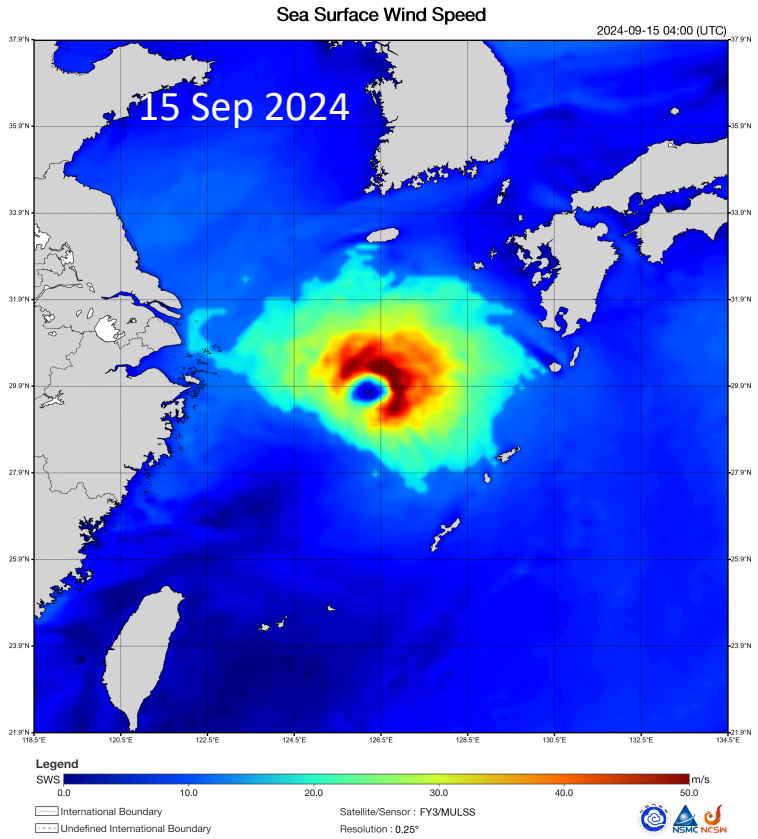


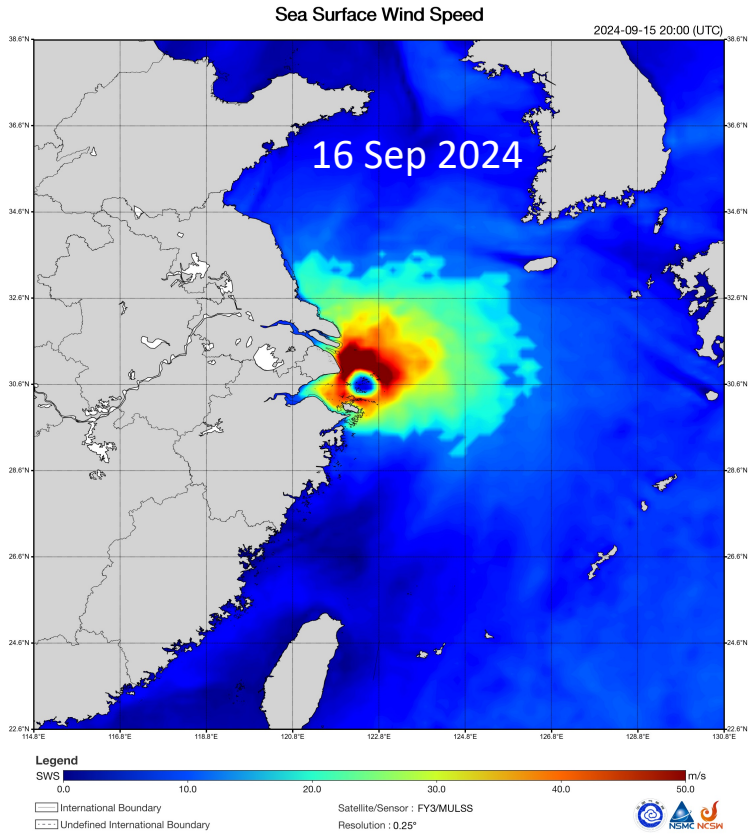
50m/s

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

Example 02:Super Typhoon “Bebinca” (2413)







FY-3 satellite fusion ocean surface wind speed:

- The wind speed is higher in the northeast and east near the center.
- The maximum wind speed is increasing from 14 to 16 September 2024 before its landing.

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

- **Atmospheric thermal parameters :** FY-3/VASS and FY-4/GIIRS temperature and humidity profiles

LEO:FY-3D/3E/3F (microwave and infrared)

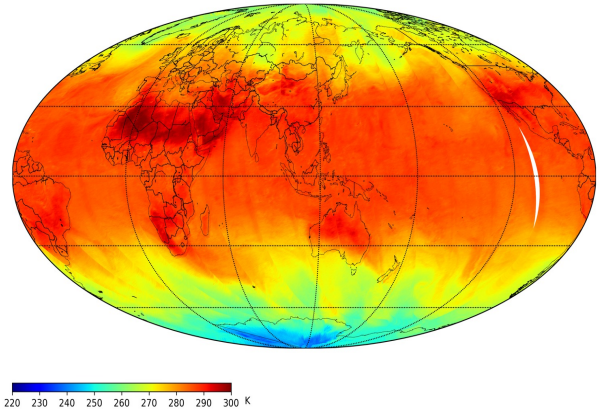
VASS product :

- Global 3-D observation of atmospheric temperature and humidity under all-weather conditions
- Twice a day for each satellite

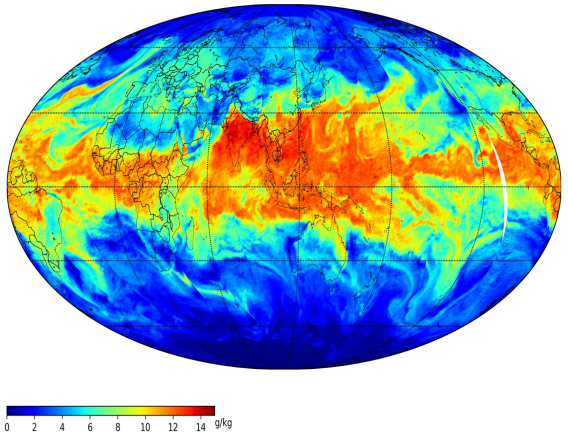
GEO: FY-4A/4B

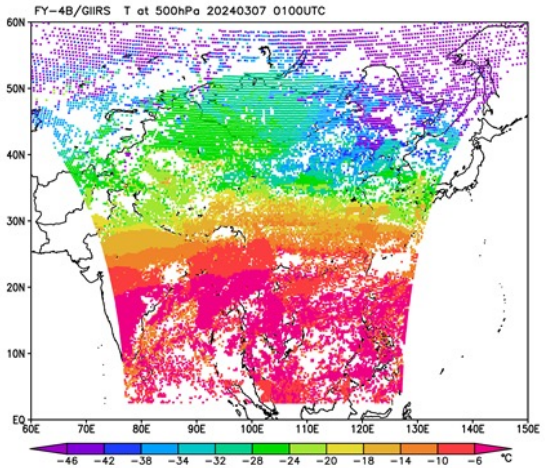
- Observation of regional three dimensional atmospheric temperature and humidity under clear sky or low cloud conditions
- 2-hour observation frequency (with relatively high time resolution)

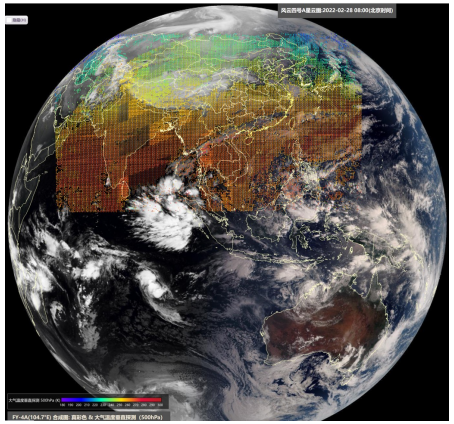
FY-3E/VASS temperature at 850hPa



FY-3E/VASS specific humidity at 850hPa







Vertical Atmospheric Sounding System instrument group (VASS)

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

Atmospheric thermal parameters

Study on the **accuracy of temperature profile** retrieved from **FY-4/GIIRS** over the East and South China Sea during Typhoon activity season.

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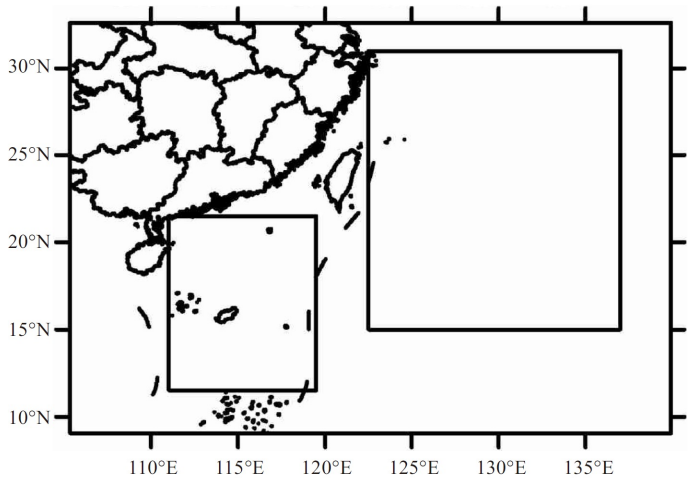
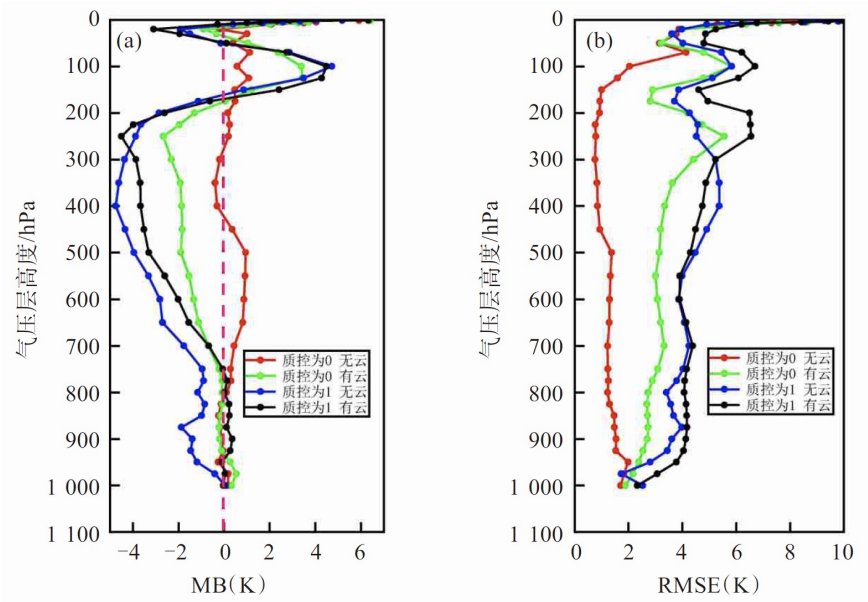
A STUDY ON THE ACCURACY OF TEMPERATURE PROFILE RETRIEVED FROM GIIRS/FY-4A OVER THE EAST AND SOUTH CHINA SEA

HUANG Yi-wei[1], CHEN Shu-yi[4], HE Min[2], ZHANG Lei[3], ZHAO Bing-ke[3], LIU Qiong[1], CHEN Yong-hang[1], WU Xian-wen[1]

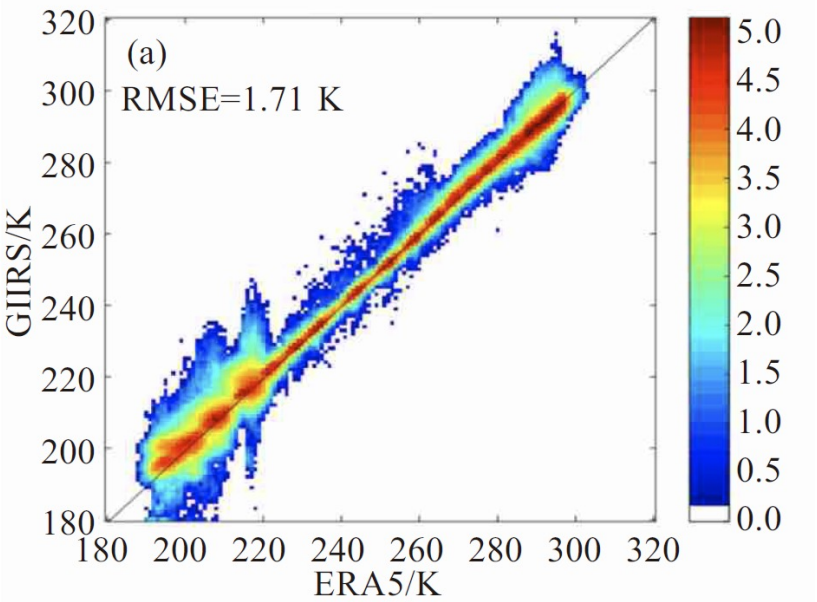




Vertical distribution of MB and RMSE for different quality control number (0,1) under clear sky or cloudy sky.

Quality control number 0 under clear sky

Quality control number 0 under cloudy sky



Scatter plot:

Quality control number 0

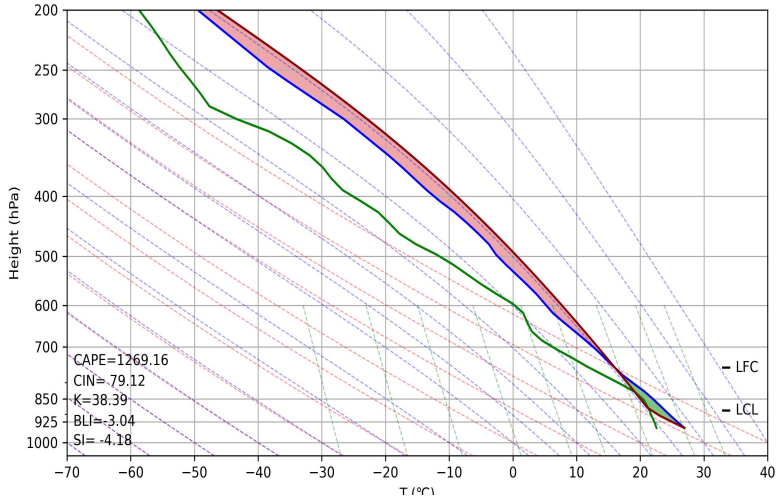
Clear sky

Dynamic and thermal parameters from FY satellites and their application in TC monitoring

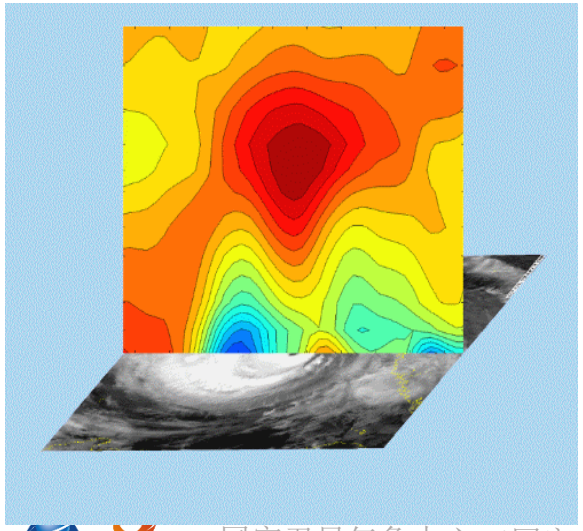
Atmospheric thermal parameters

- ✓ Monitoring the typhoon 3-D structures.
- ✓ Monitoring the atmospheric environment field of typhoon activity including instability energy, water vapor distribution, and atmospheric stratification.

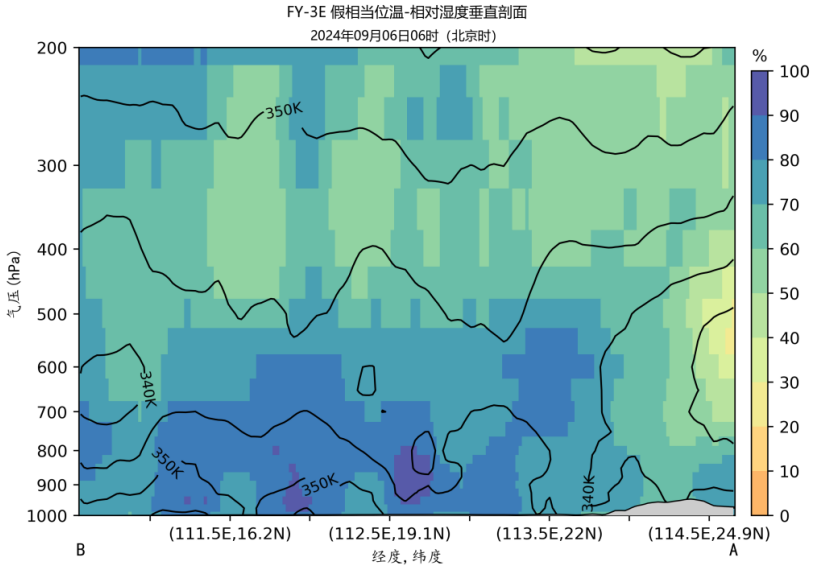
T-lnP: atmospheric stratification



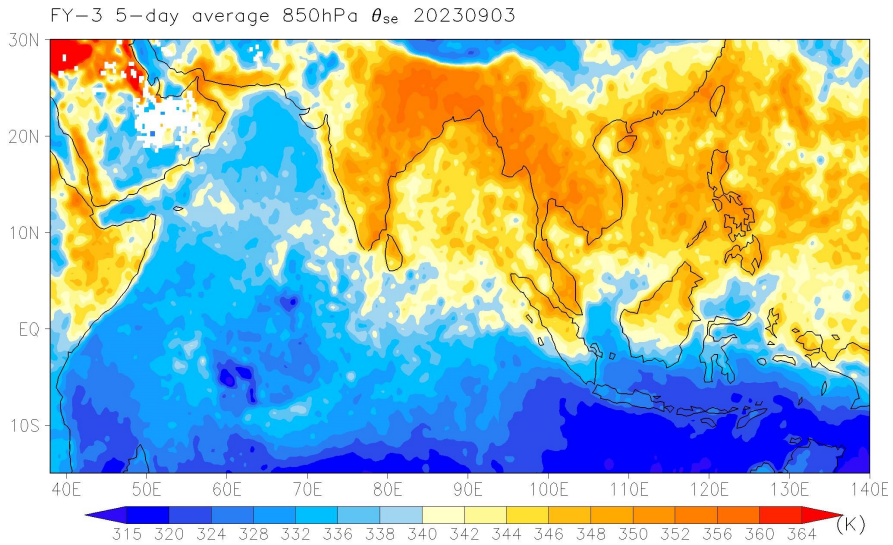
3-D structures: temperature (warm core)



Humidity: vertical profile of relative humidity of TC



Energy: pseudo-equivalent potential temperature

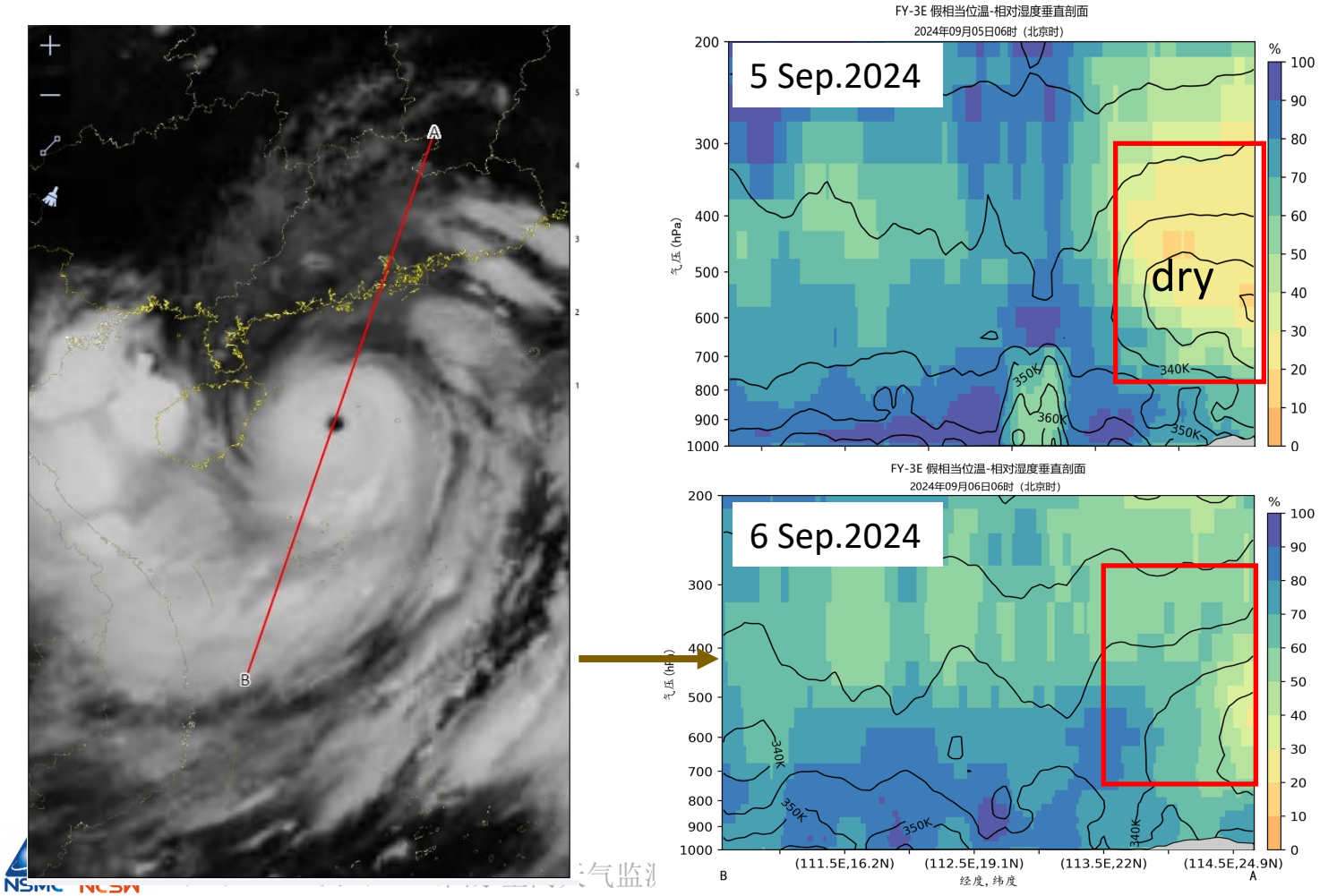


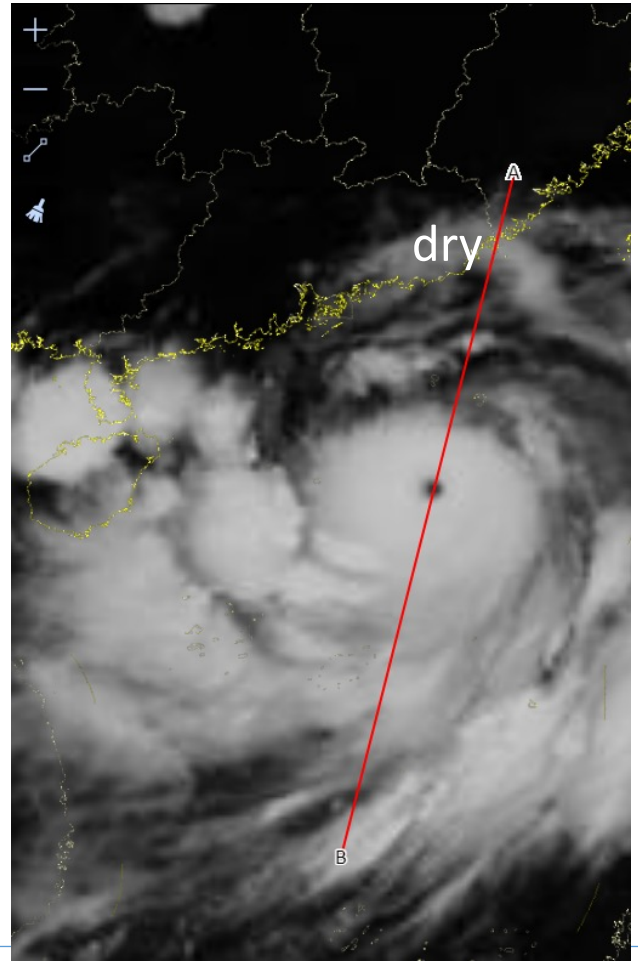
Dynamic and thermal parameters from FY satellites and their application in TC monitoring

☐ Atmospheric thermal parameters

Example: Super Typhoon “Yagi” (202411)

The humidity conditions above 700hPa on the north side of the typhoon have improved on 6 September compared to that on 5 September 2024.





Dynamic and thermal parameters from FY satellites and their application in TC monitoring

Typhoon activity is closely related to the summer monsoon

Comprehensive summer monsoon monitoring from satellite data

South China Sea Summer Monsoon index from Fengyun satellite L2 products

Region: (110-120° E;10-20° N)

FY-4 L2: AMV and TBB

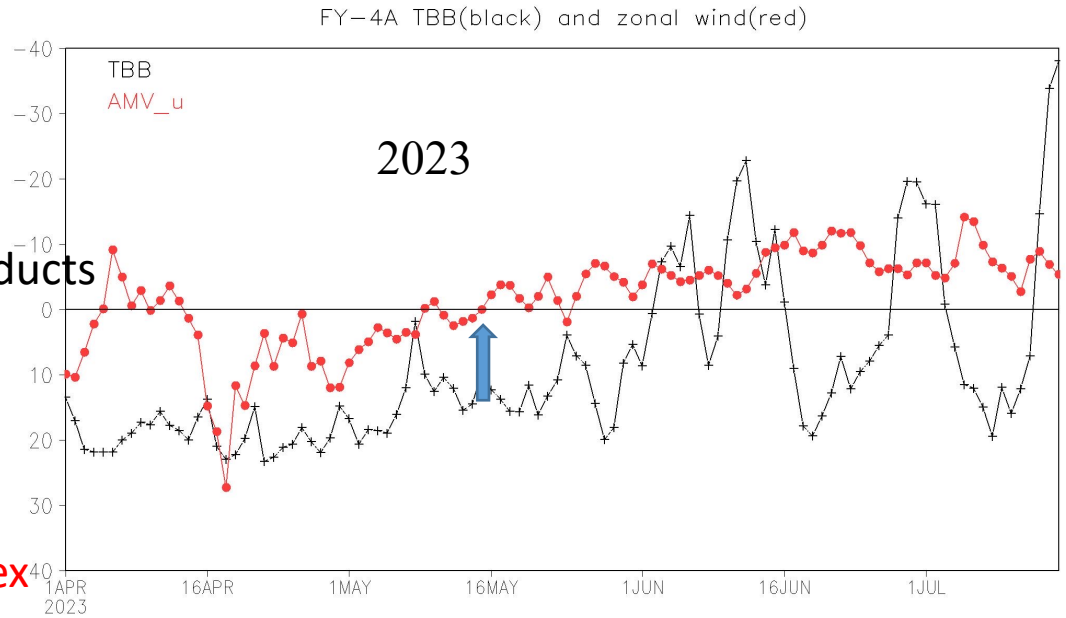
Region average mid-upper troposphere AMV ：upper level dynamic index

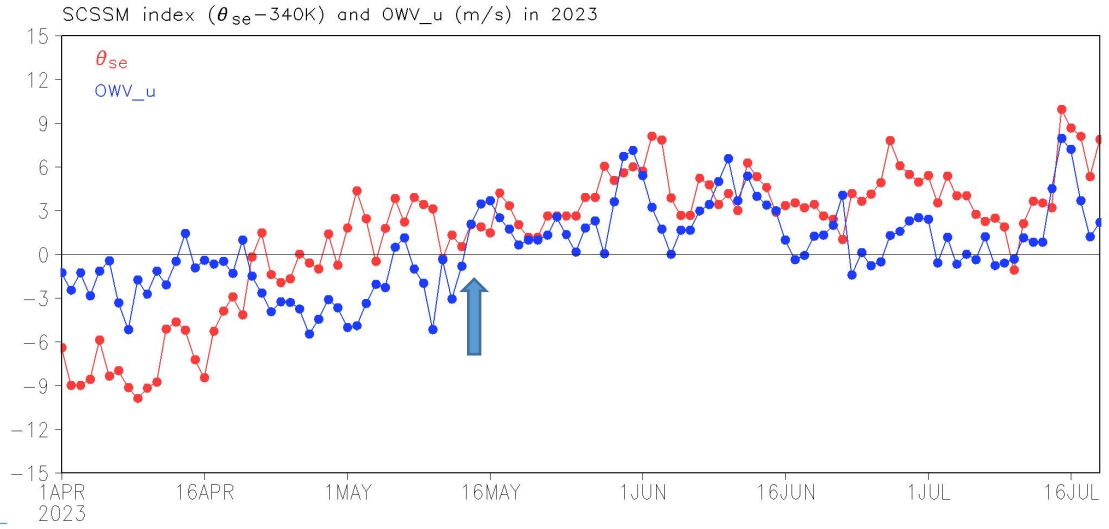
Region average TBB: convection index

FY-3 L2： OWV and T & SH

Region average ocean surface zonal wind: low level dynamic index

Region average pseudo-equivalent potential temperature: thermal index



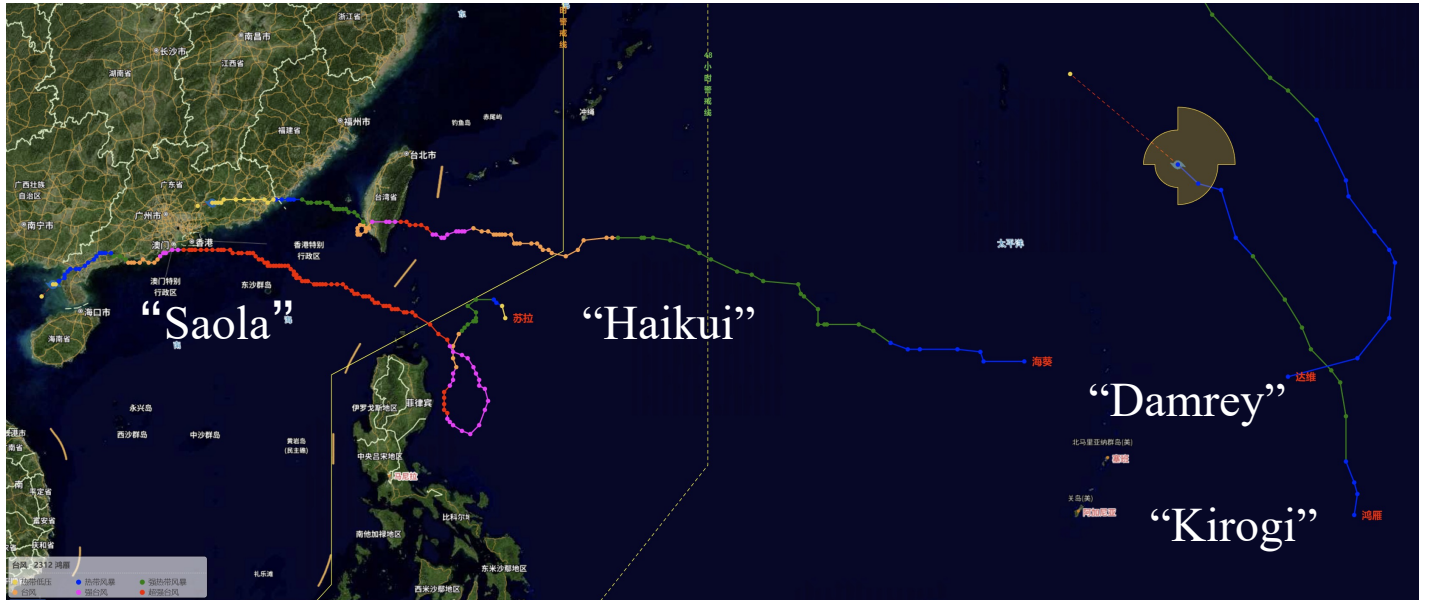


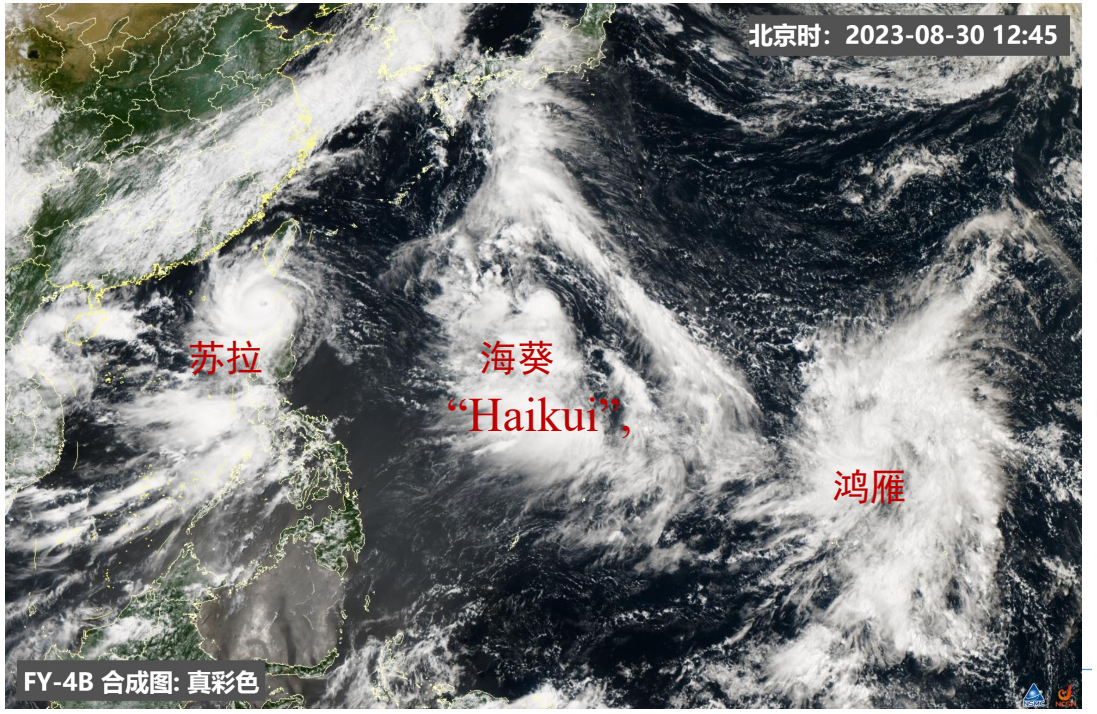
Dynamic and thermal parameters from FY satellites and their application in TC monitoring

Example: Application of Summer Monsoon product in typhoon “Haikui” (2311) monitoring

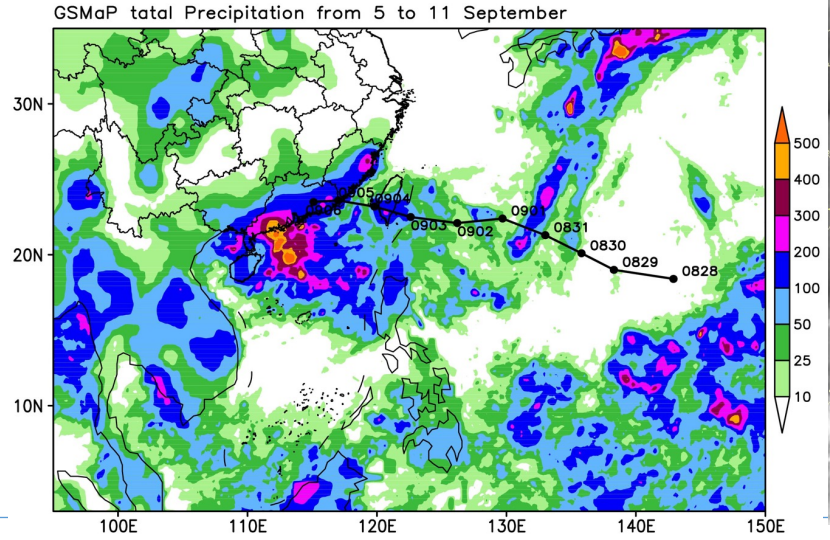
Three typhoons: “Haikui”, “ Saola”, and “Kirogi” in late August and early September,2023

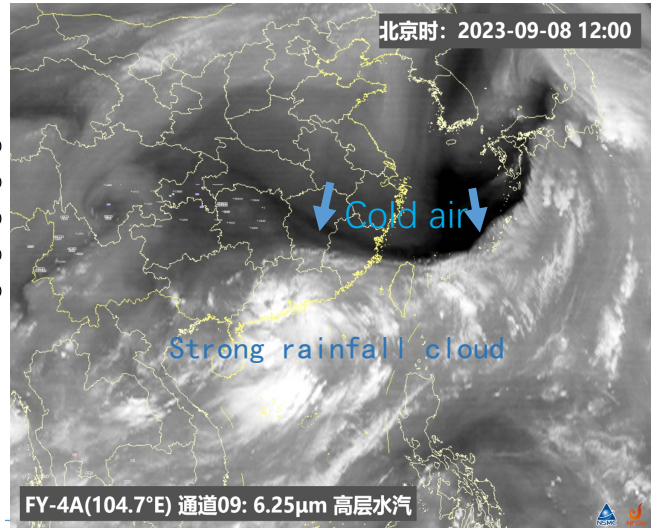
Typhoon "Haikui" has caused serious disasters in many places in southeast China, leading to record breaking extreme rainstorm in Fujian, Guangdong, Hong Kong and other places, among which the precipitation in Fuzhou broke the record set by its predecessor "Dragon King" in 2005





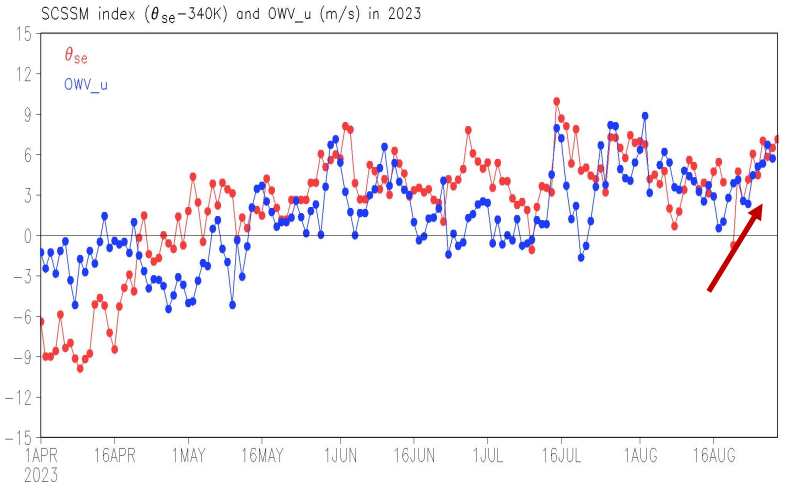
Total precipitation from 5 to 11 September 2023



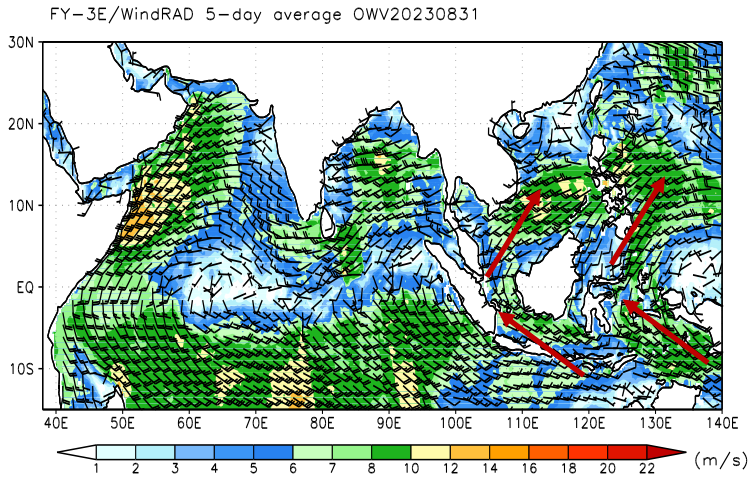


Dynamic and thermal parameters from FY satellites and their application in TC monitoring

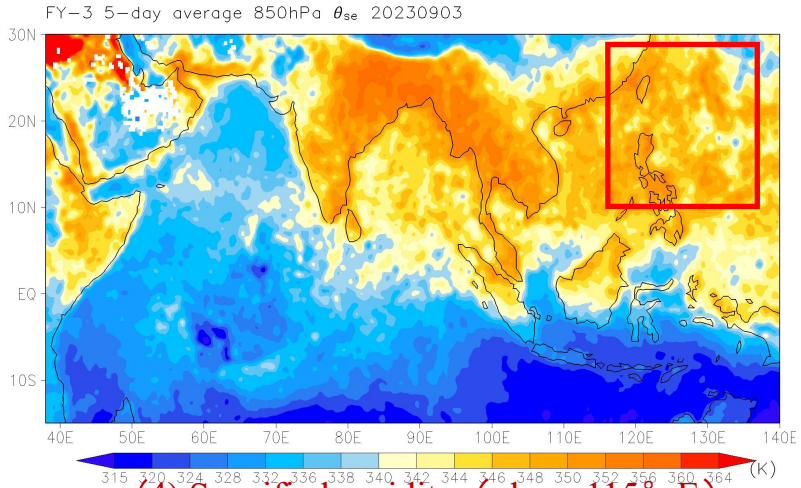
(1) The SCS summer monsoon increase during the typhoon development



(2) 5 day average OWV on 31 August 2023



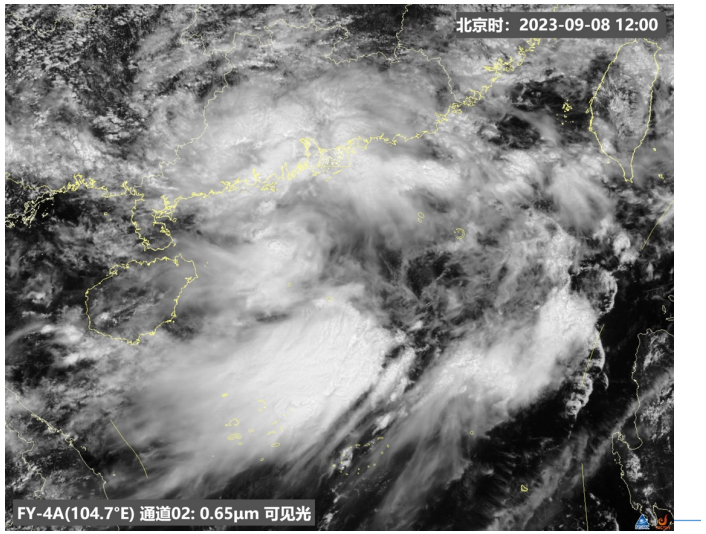
(3) 5 day average θse at 850hPa on 3 September 2023

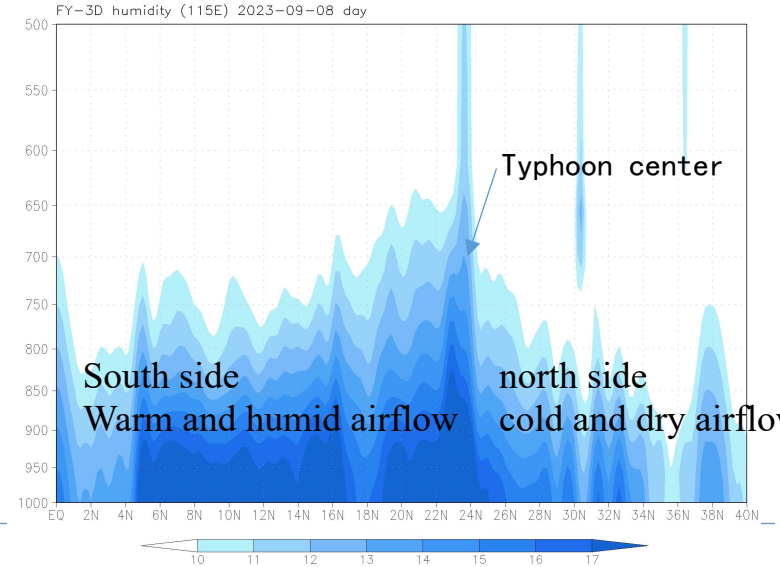


(4) Specific humidity（along 115° E）on 8 Sep 2023 from FY-3

（1）The low-level convergence formed by the southwest monsoon and the easterly wind at the edge of the subtropical high pressure is conducive to the generation of typhoons. During typhoon activity, the strong southwest monsoon airflow in the South China Sea region and near the Philippines causes high-temperature and high humidity air masses to be transported to the typhoon, which is conducive to the rapid development of typhoon "Haikui" strength on September 3。

（2）After the typhoon made landfall and weakened, the heavy precipitation caused by the low-pressure circulation was also related to the water vapor transport of the southwest summer monsoon in the South China Sea. At the same time, the southward movement of cold air in mid latitude areas also further enhanced convective precipitation.



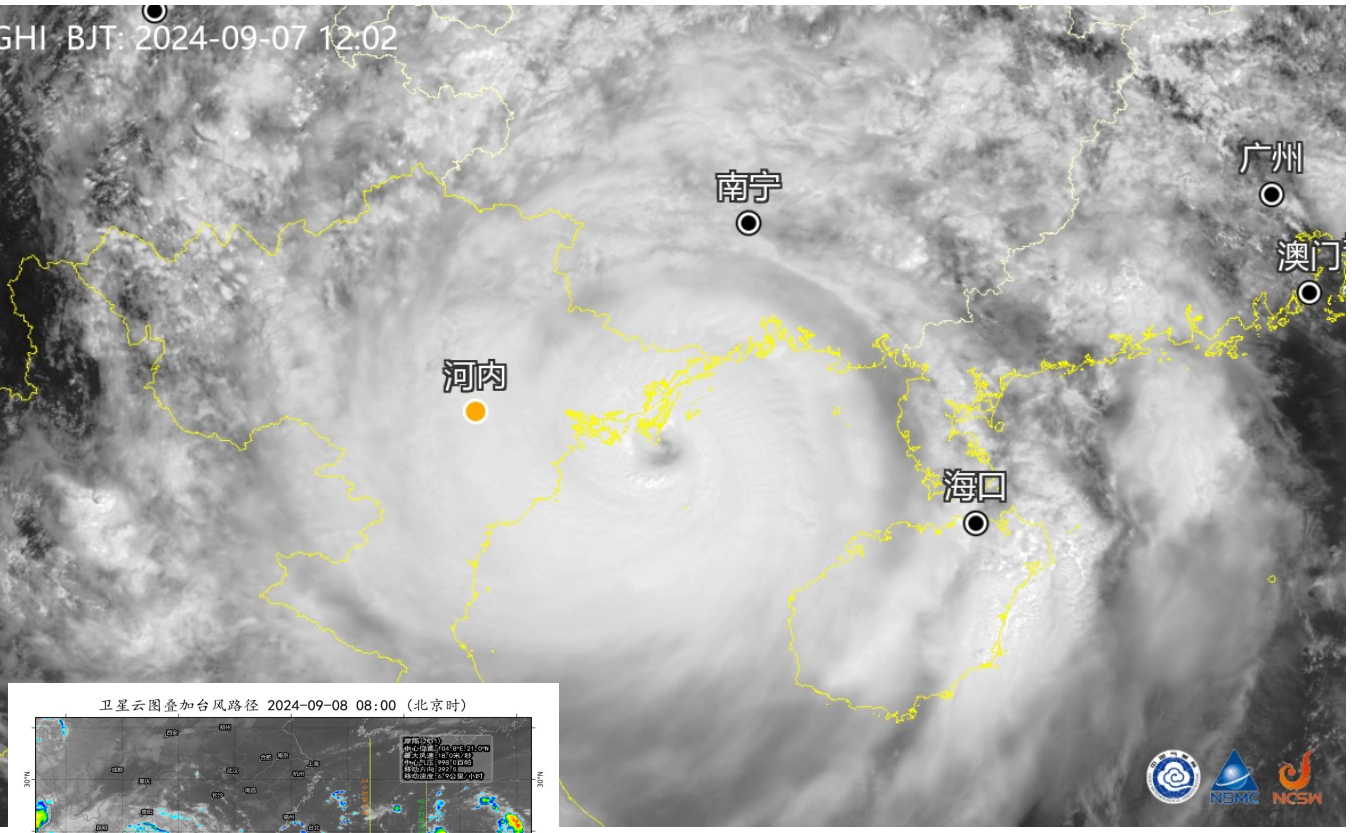


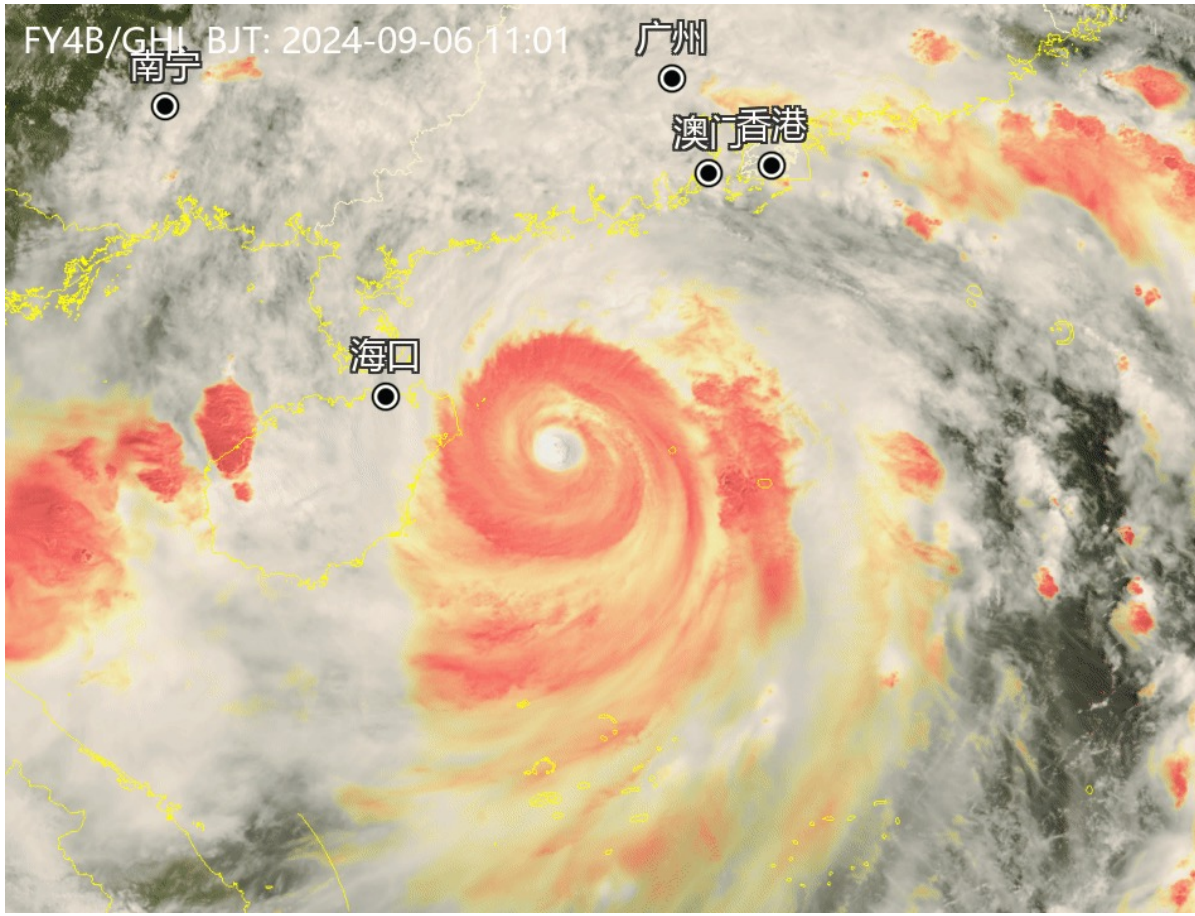
Overview of FY satellite data application in 2411 super typhoon “Yagi”

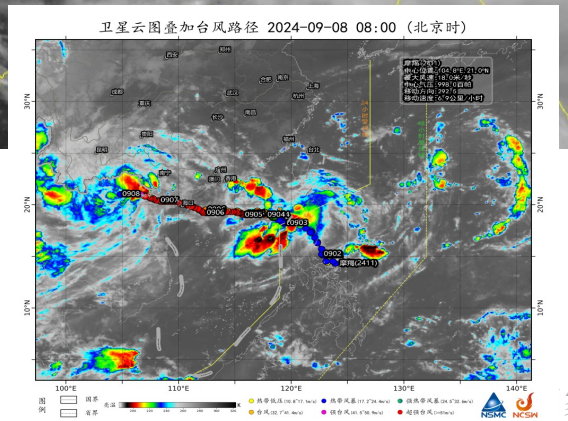
Super typhoon “Yagi” (2411)

✓ 01 FY-4B/GHI cloud images to analysis cloud evolution

Index using the difference of reflectivity between 1.3um and 1.6um to reflect the intensity of the convection.







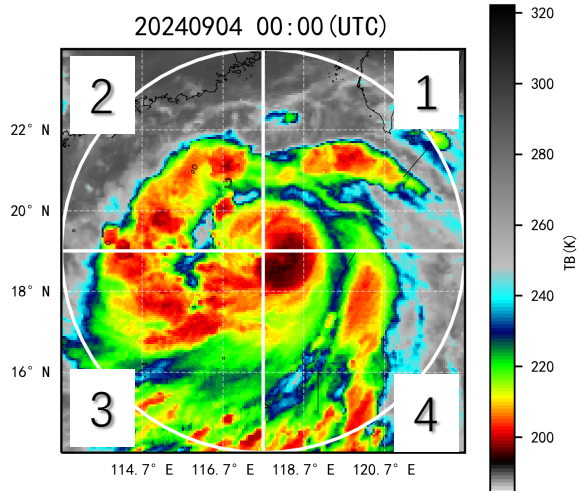
✓The 1.6um band has a lower reflectivity due to the strong absorption effect of ice crystal particles.

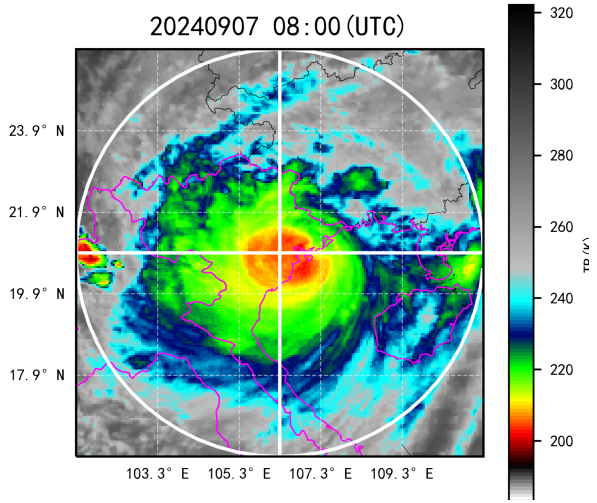
✓The 1.3um band has a higher reflectivity due to lower water vapor absorption.

Super typhoon “Yagi” (2411)

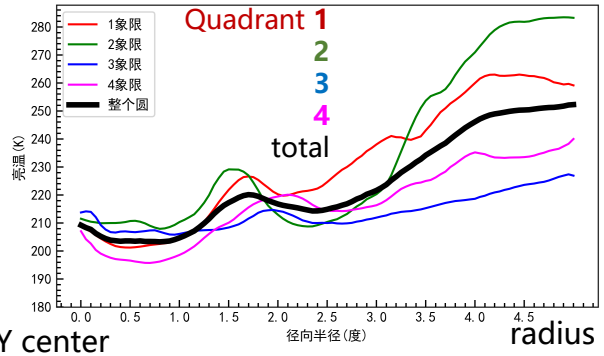
✓ 02. Quantitative analysis of typhoon structure using infrared channel brightness temperature

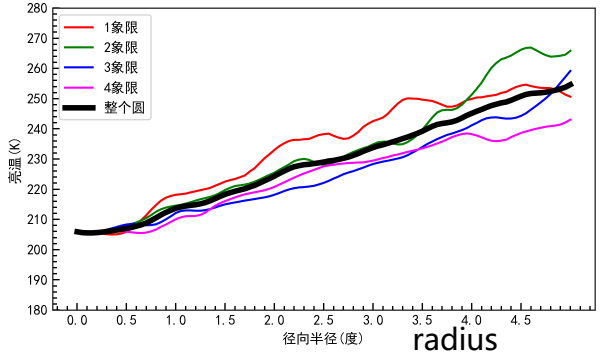
Quantitative analysis of typhoon structure



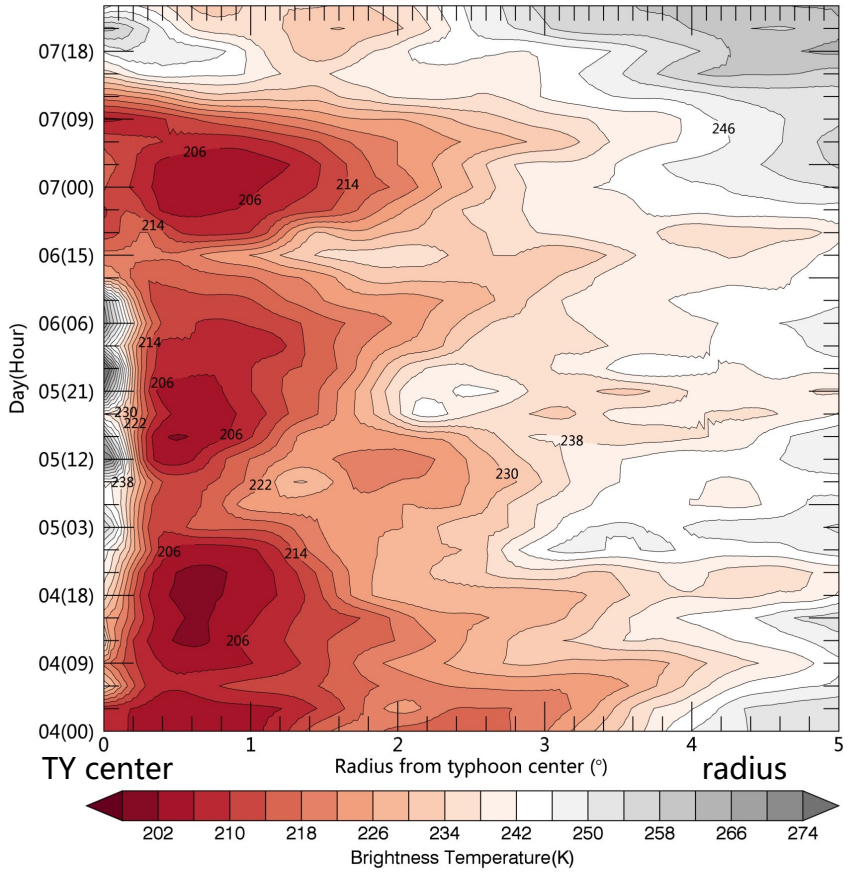


Radial average brightness temperature



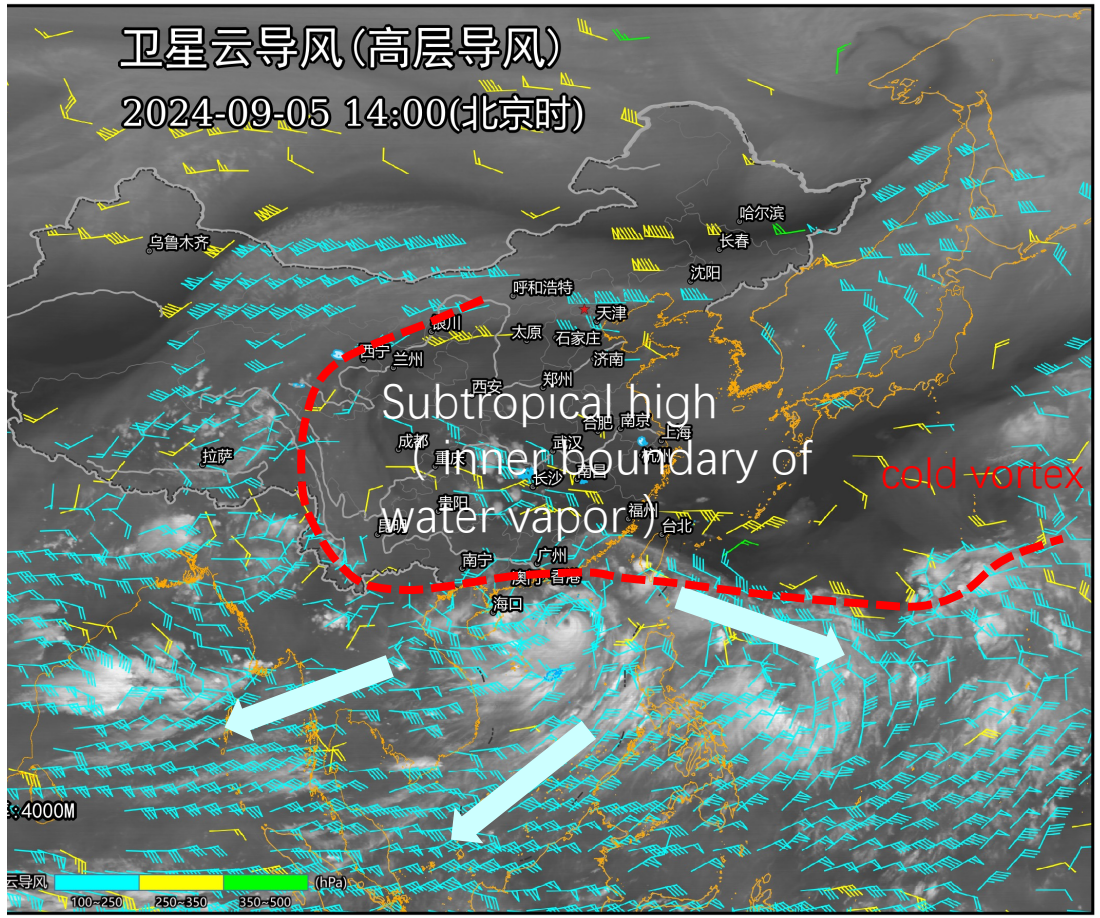


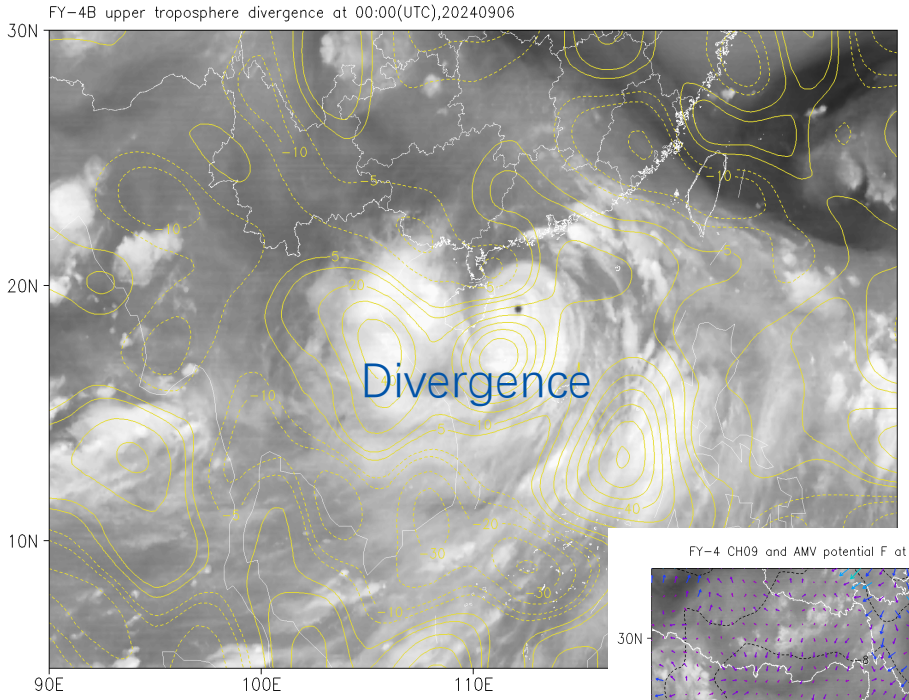
Radial average brightness temperature of quadrant all

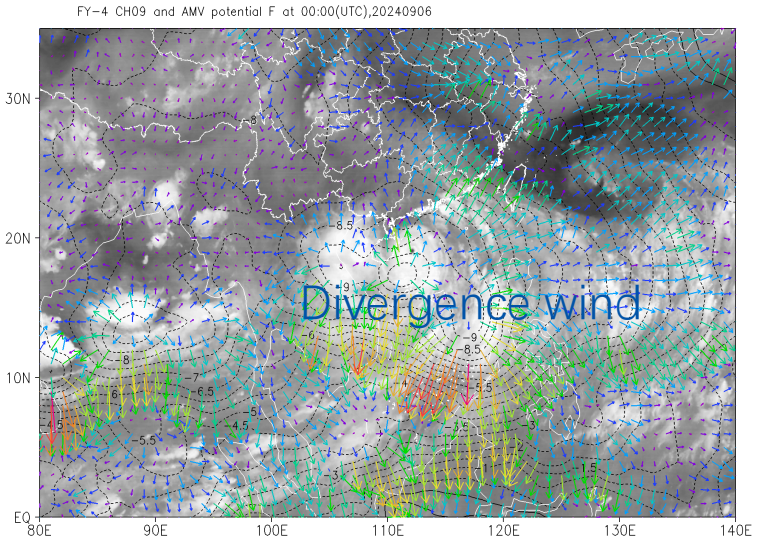


Super typhoon “Yagi” (2411)

✓ 03. Upper troposphere outflow and divergence: typhoon intensity and moving direction



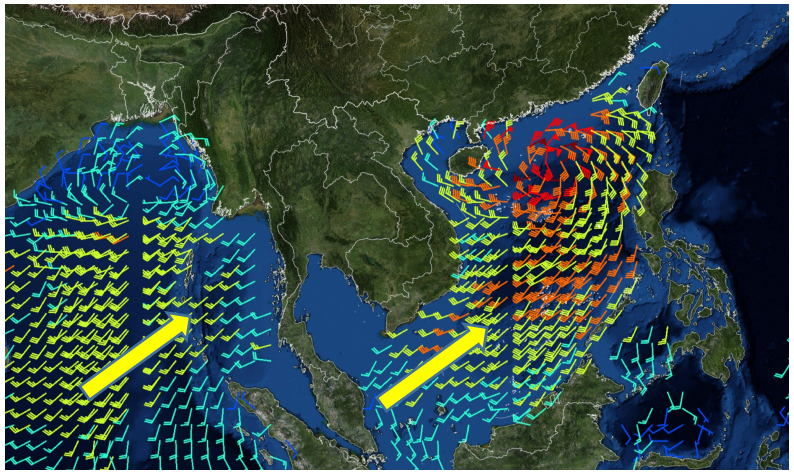




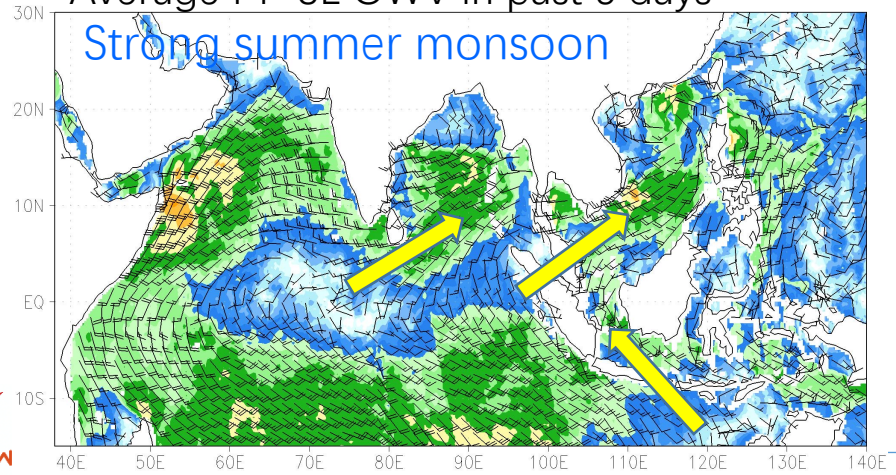
Super typhoon “Yagi” (2411)

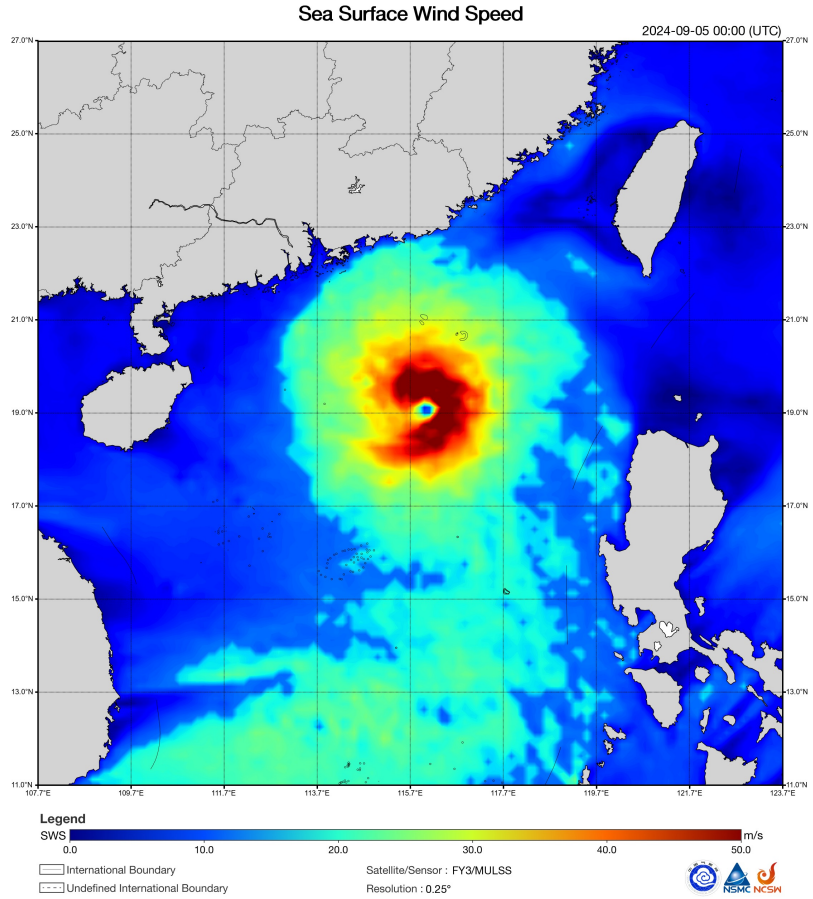
✓ 04. Low troposphere wind field: typhoon intensity and related rainstorm

FY-3E OWV on 5 September 2024



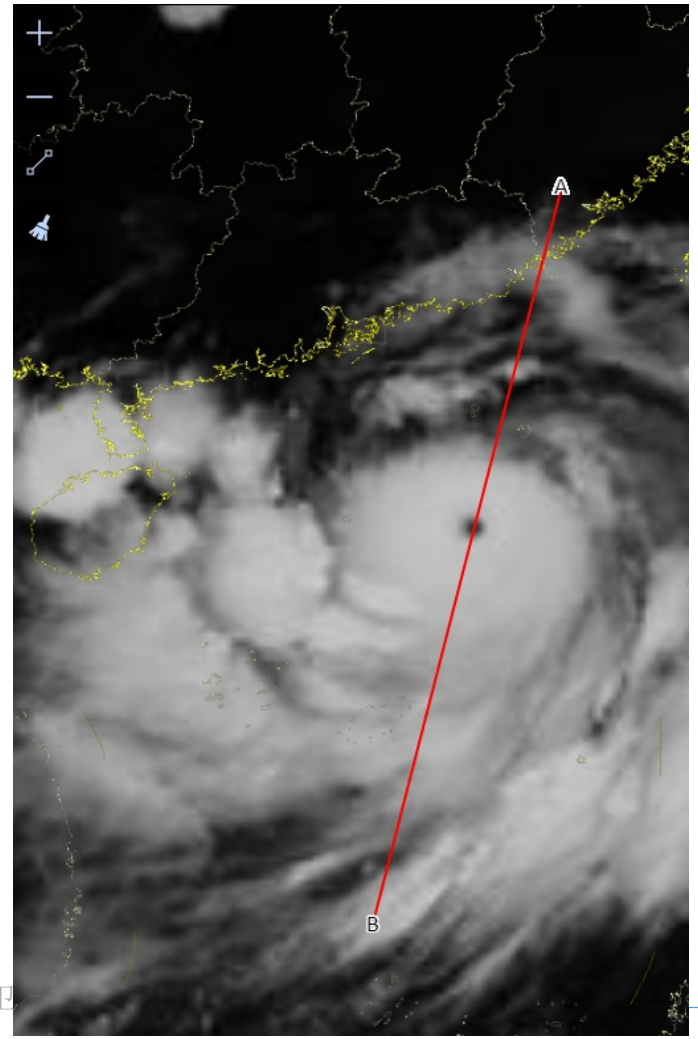
Average FY-3E OWV in past 5 days

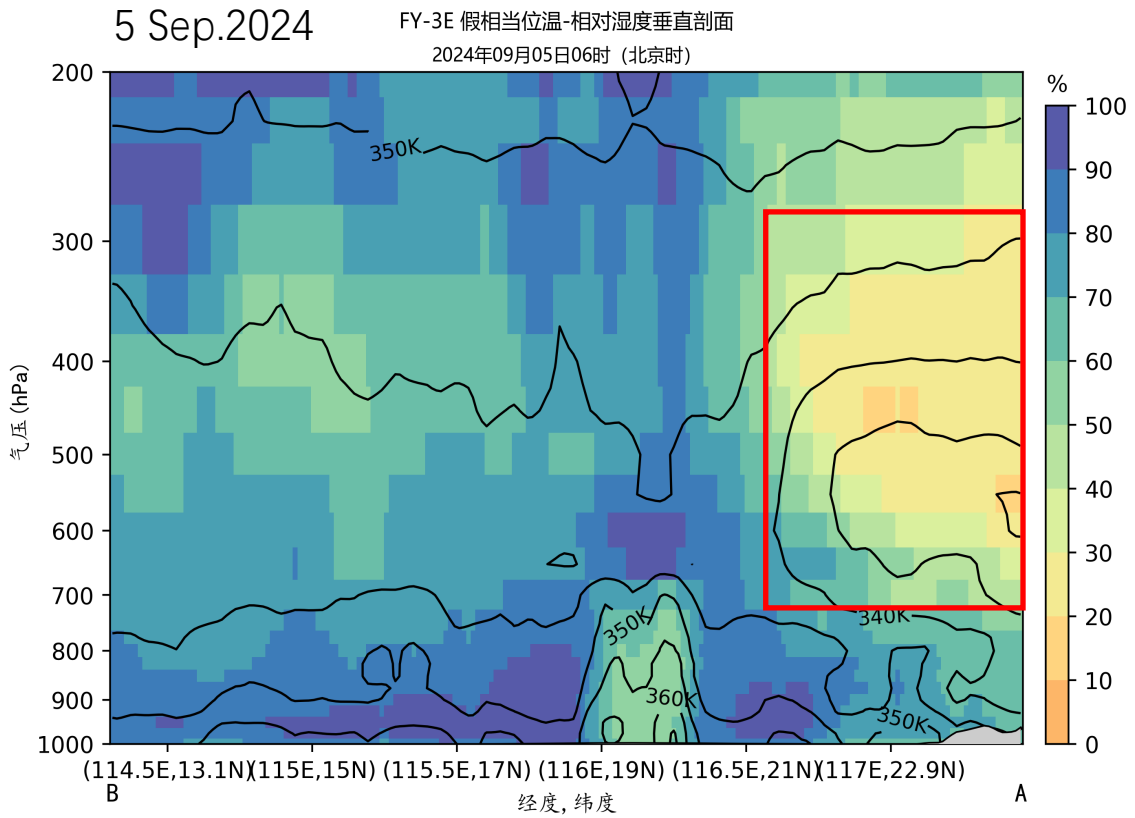




Super typhoon “Yagi” (2411)

✓ 04. Thermal fields temperature and humidity: typhoon intensity, related rainstorm and structure



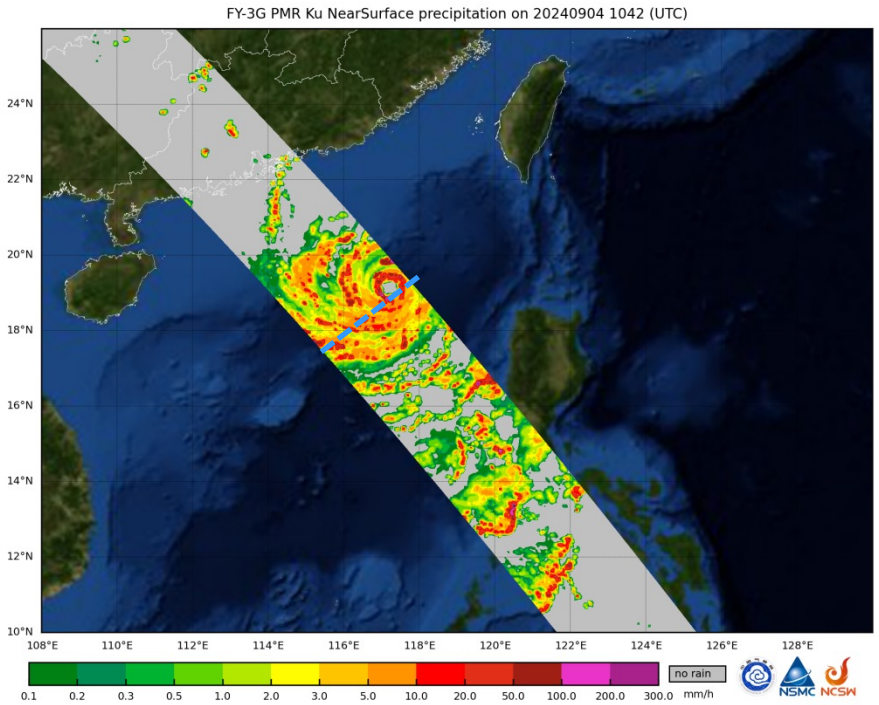


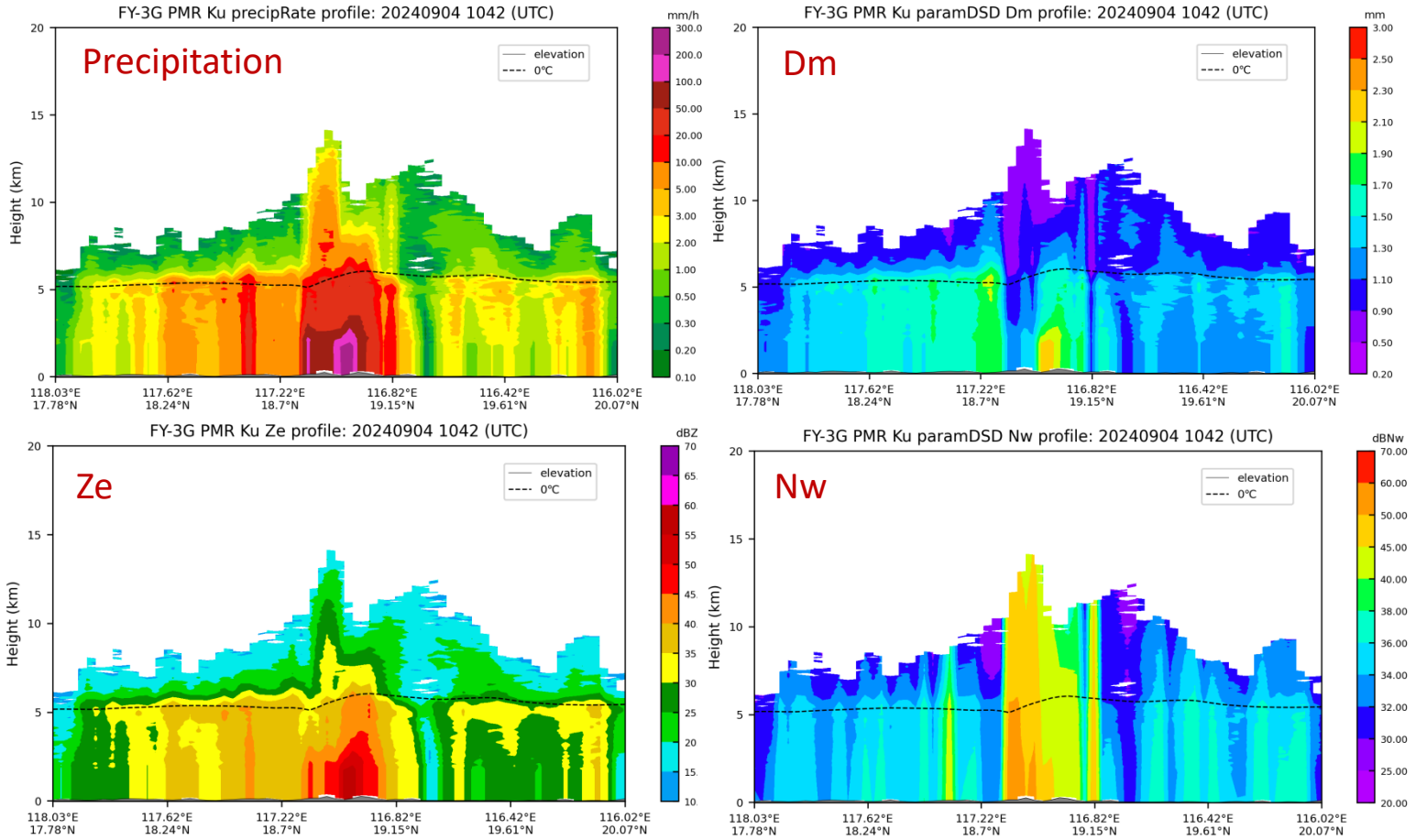
Super typhoon “Yagi” (2411)

✓ 05. FY-3G/PMR precipitation: three dimensional structure of cloud and precipitation of typhoon

At 10:40UTC on 4 September 2024

Near surface precipitation rate



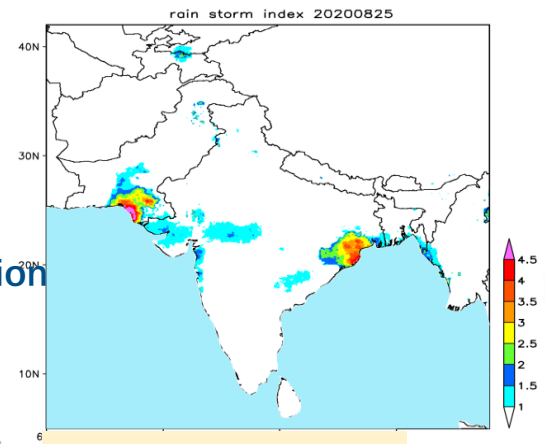


The maximum precipitation rate near the Yagi center is greater than 100mm/h, with a zero temperature layer height of around 5km. The vertical height at which the precipitation rate reaches 50mm/h is below 3km.

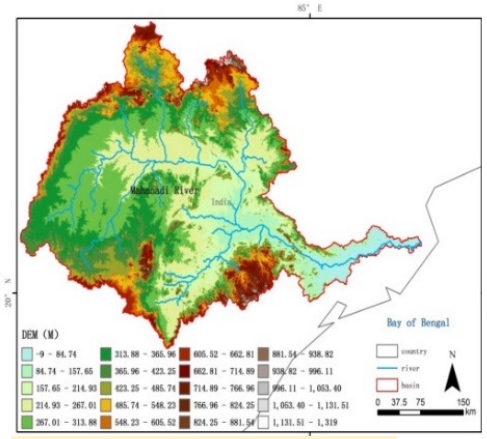
Summary

- FengYun satellites (LEO and GEO) can **support the multi-platform collaborative observation** experiments for typhoon and can provide high frequency observations of many parameters.
- The **three dimensional sounding(microwave and infrared) observations of atmospheric dynamics and thermal field** application capabilities in typhoon monitoring and early warning.
- The **active observations from spaceborne radar (WindRAD and PMR)** can be used in typhoon structure, intensity monitoring.
- FengYun satellites have great potential in **typhoon related rainstorm and flood monitoring** and early warning.

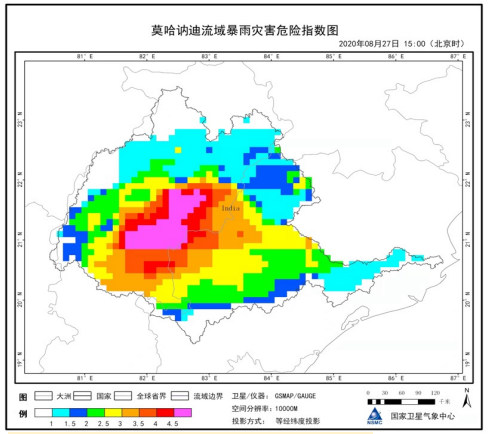
- ✓ Satellite QPE
- ✓ River and terrain
- ✓ Economy and Population



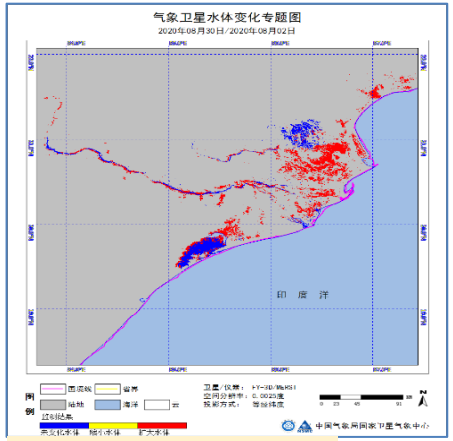
Rainstorm risk index



Mahanadi River Basin



Rainstorm risk index



Flood monitoring


Thank you!