



香港天文台

HONG KONG OBSERVATORY

2nd Asia/Oceania Metsat Users' Conference

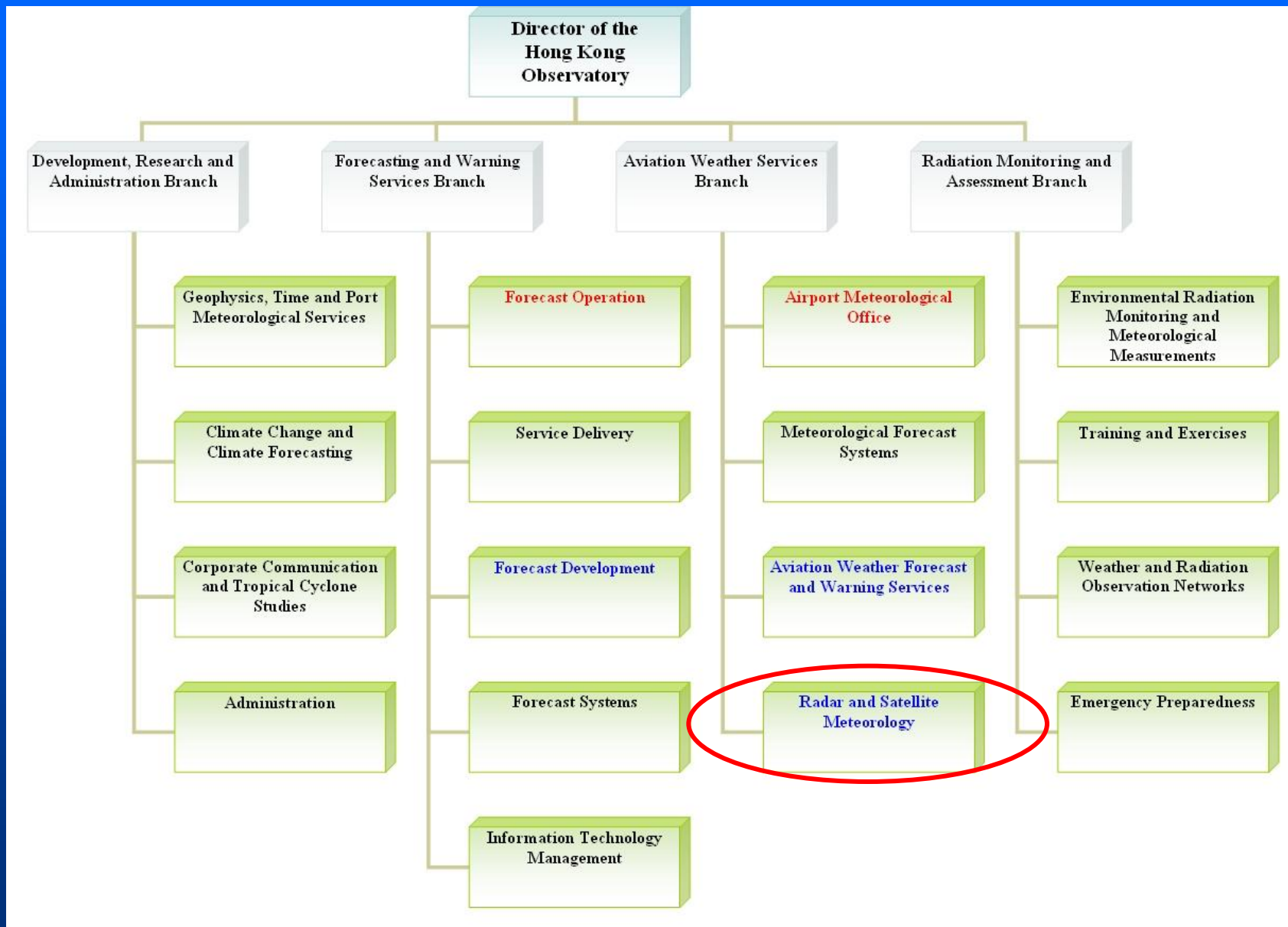
Utilization of Meteorological Satellite Data and
Products to support
Weather Forecasting and Warning Services
in Hong Kong

Chi Kuen SO
Hong Kong Observatory

Outline

- Brief Introduction of HKO
- Satellite Ground Reception Systems
- Application of Satellite Data
- Studies and Use of Satellite Data on Numerical Models
- Enhancement in Public Information and Education
- Looking ahead

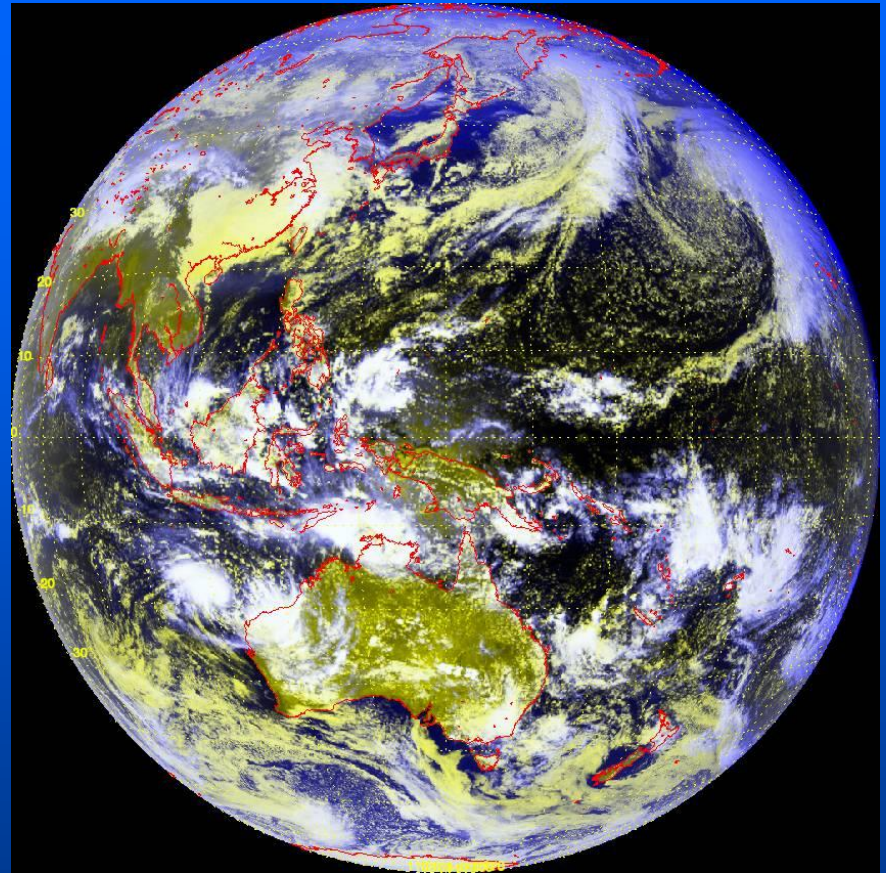
Hong Kong Observatory Organization Chart



MTSAT Ground Reception System

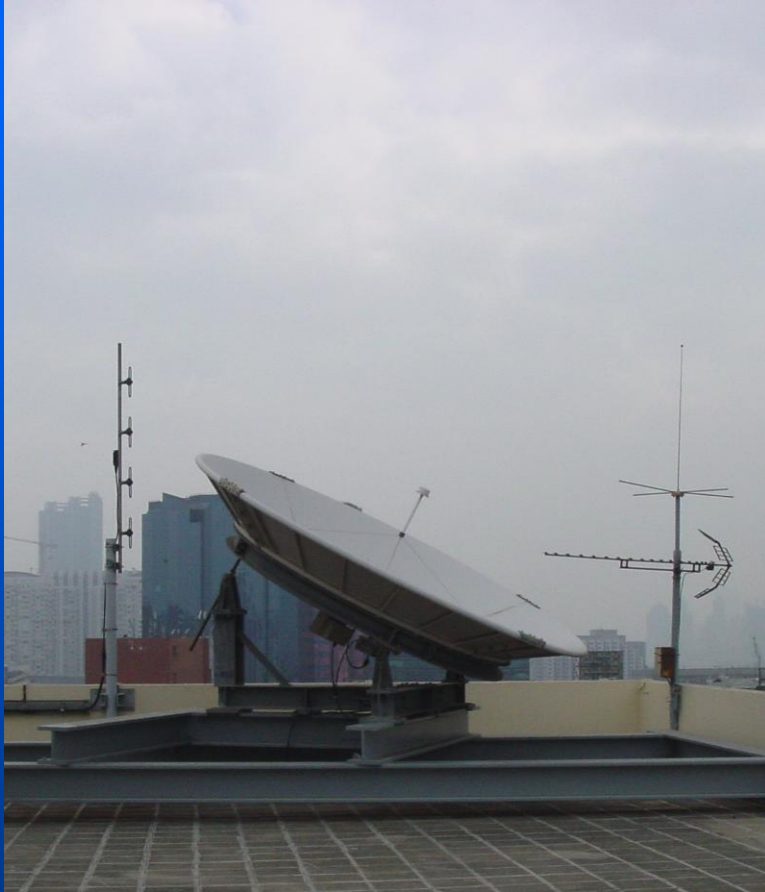


**MTSAT antenna at the
HKOHQ**

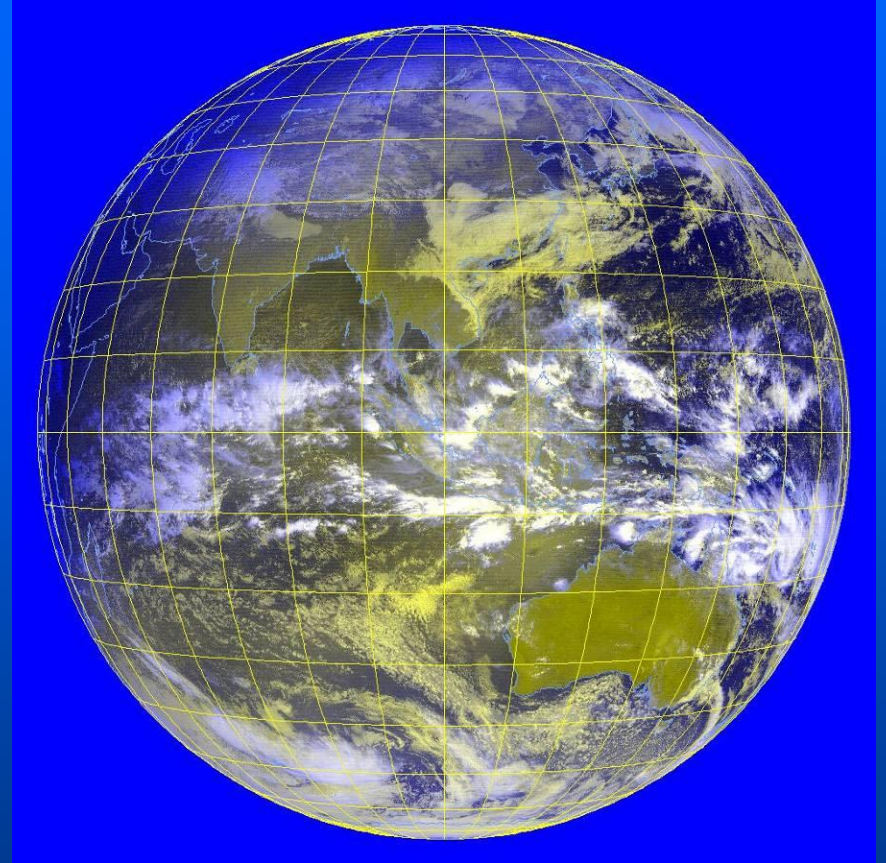


MTSAT-2 image

FY-2 Ground Reception System



FY-2 antenna at the HKOHQ

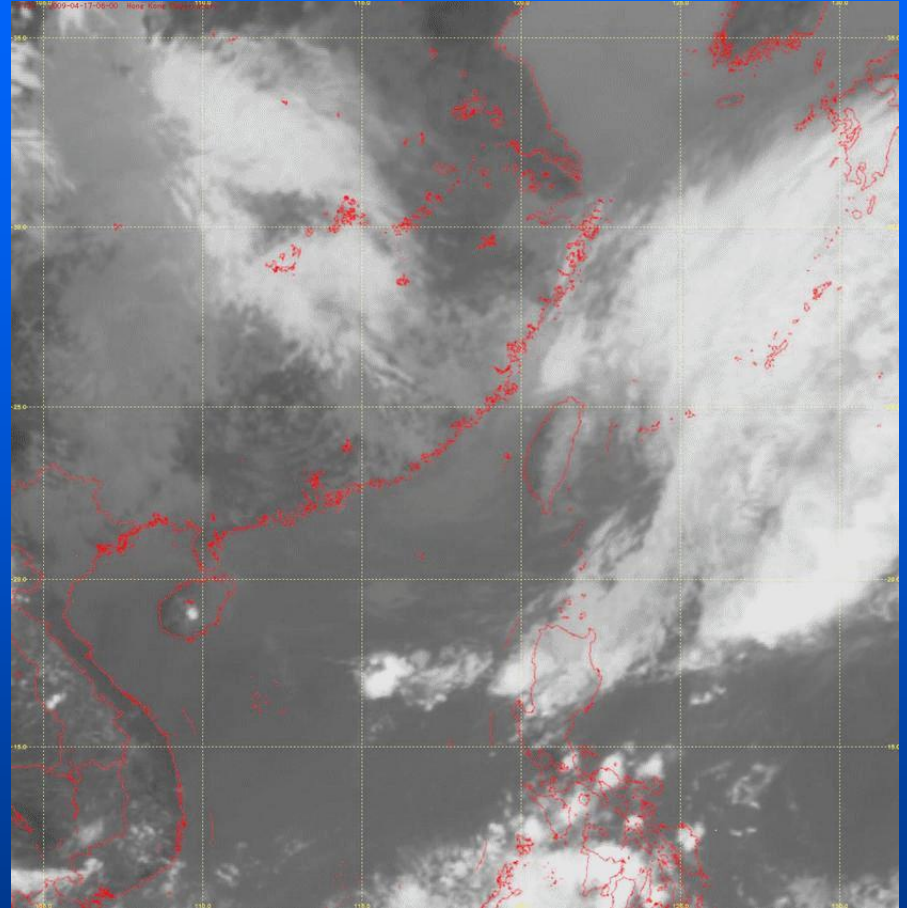


First FY-2B Image received
by HKO on 20 January 1999

FenyunCast Reception System



Reception antenna at
HKO Headquarters

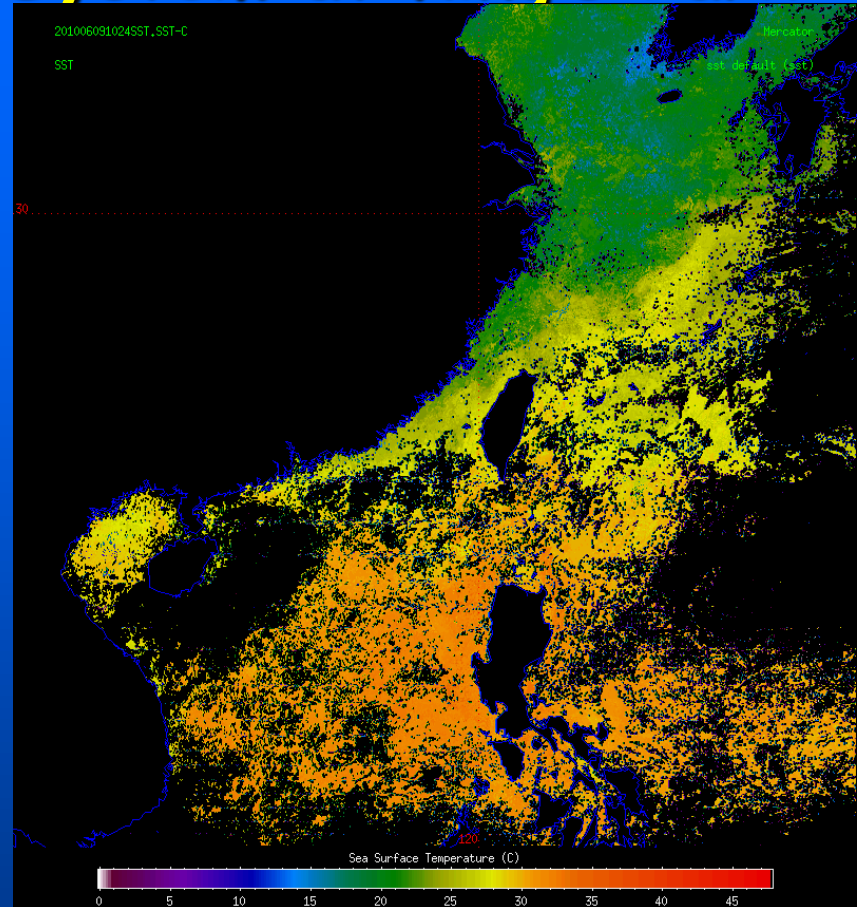


FYCast Combined Imagery

NOAA/FY-1/MTSAT (backup) Ground Reception System at King's Park



Tracking antenna at King's
Park Meteorological
Station

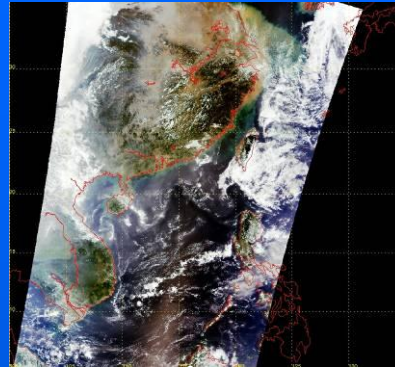


Sea surface temperature
(derived from NOAA satellites)

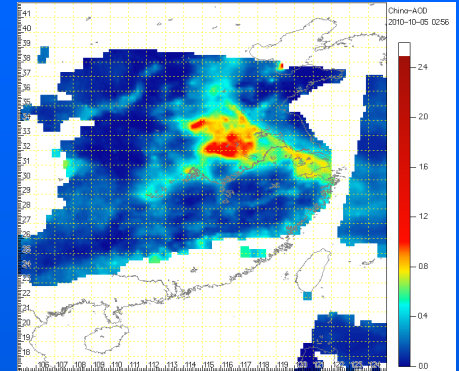
Earth Observing Satellite Reception System at King's Park



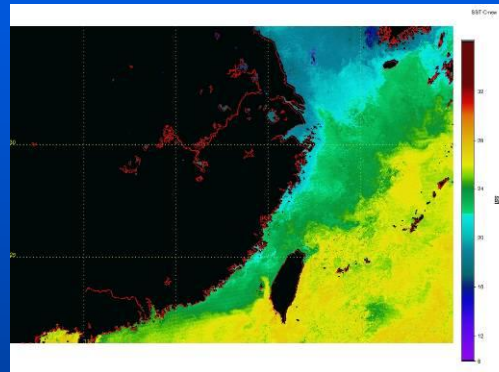
Reception antenna



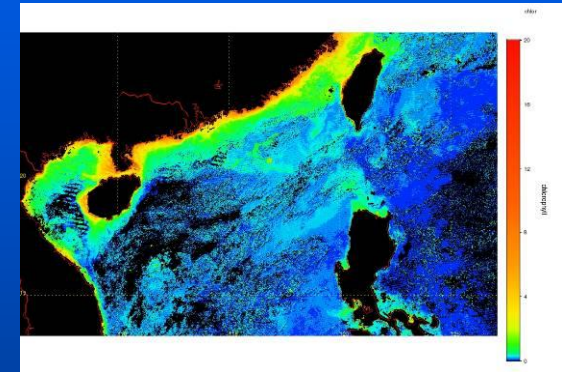
True colour Image



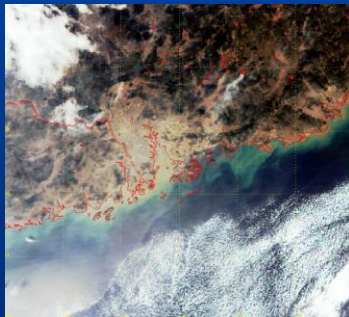
AOD Image



SST Image



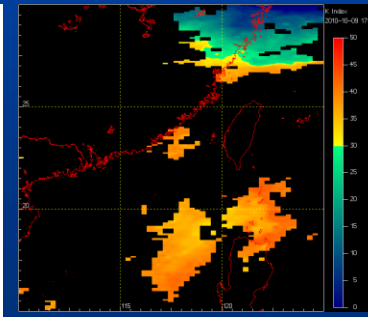
Chlorophyll Image



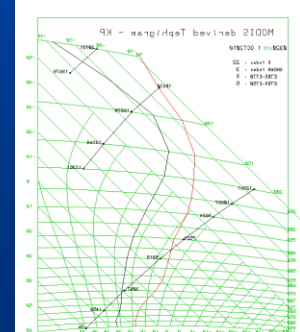
Fire product



Vegetation index

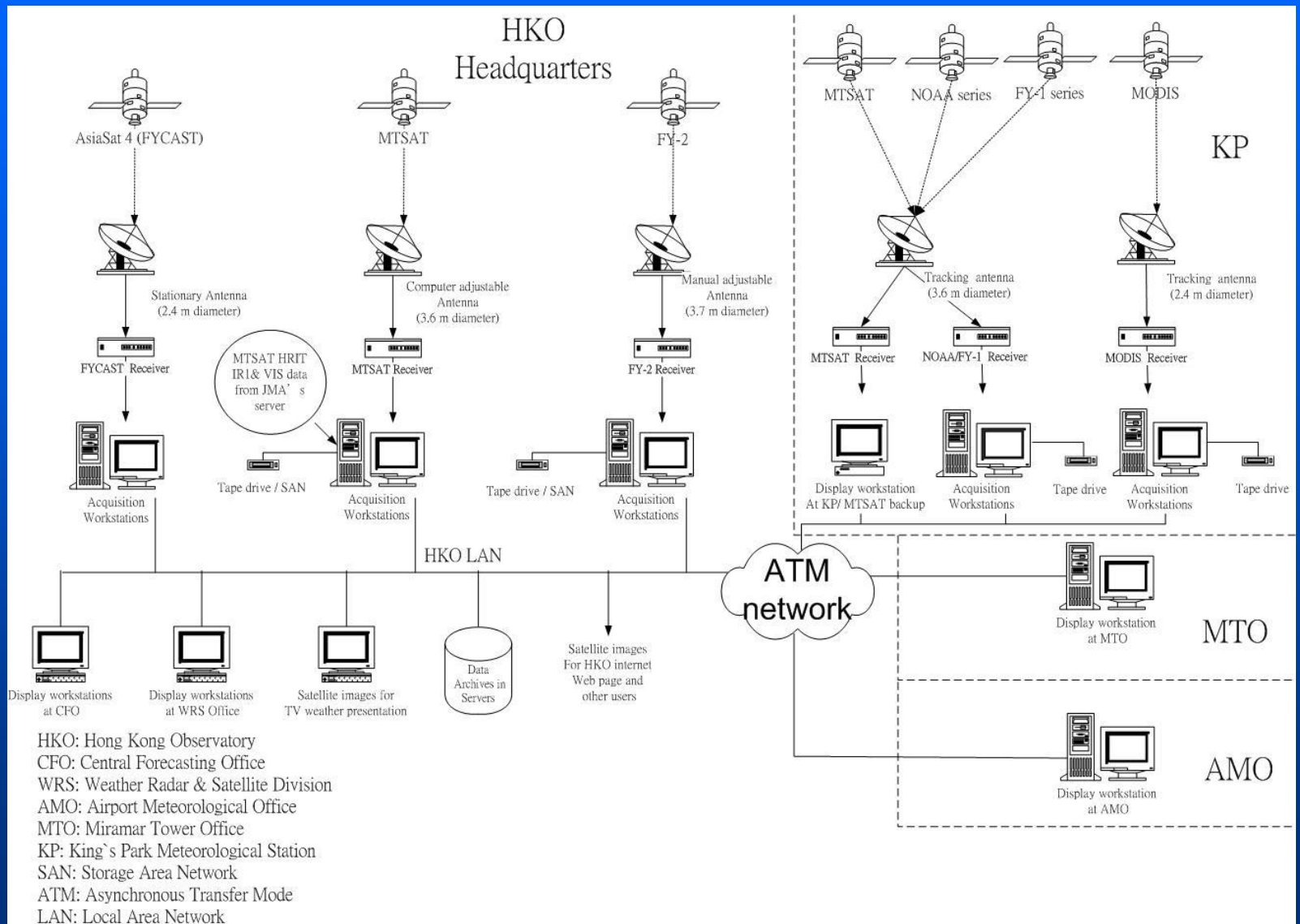


Stability index



Derived Tephigram

Satellite Ground Reception Systems



Satellite Ground Reception Systems

- Huayun Reception System (1998)
 - VISSR data from FY-2D/2E
- POES Reception System (starting 2002)
 - NOAA + FY-1 data
- MODIS Reception System (2004)
 - AQUA and TERRA
- MTSAT Reception System (2007)
 - HRID, HRIT data from MTSAT
 - VISSR data from FY-2E
 - HRIT download from JMA server as backup
- FYCast Reception System (2008)
 - re-broadcast satellite data from AsiaSat4, including FY2D/2E, FY3A (sectorized), NOAA-series, MODIS

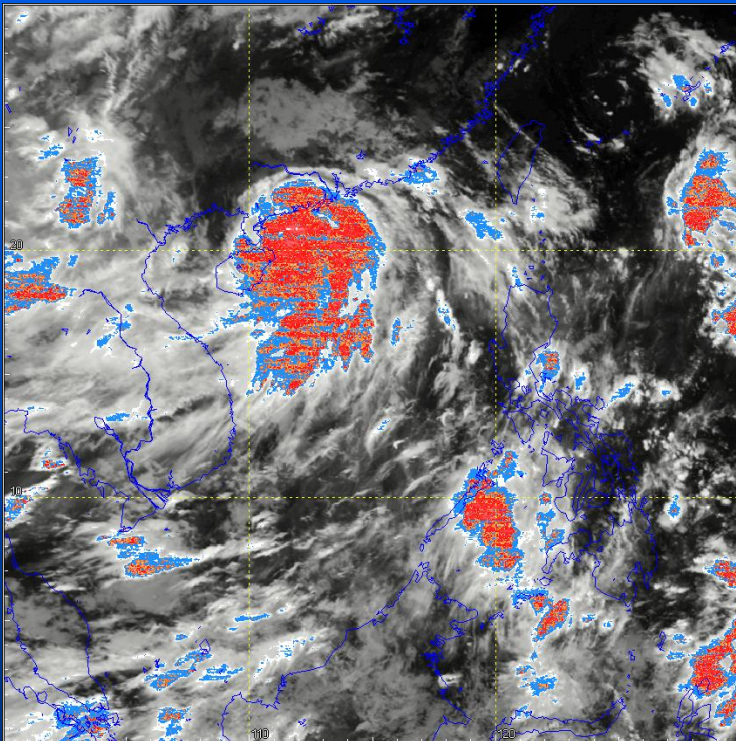
Application of Satellite Data

- Apart from using real-time satellite imagery for monitoring of severe weather, HKO develops some applications to support weather forecast and severe weather monitoring
- A few examples ...

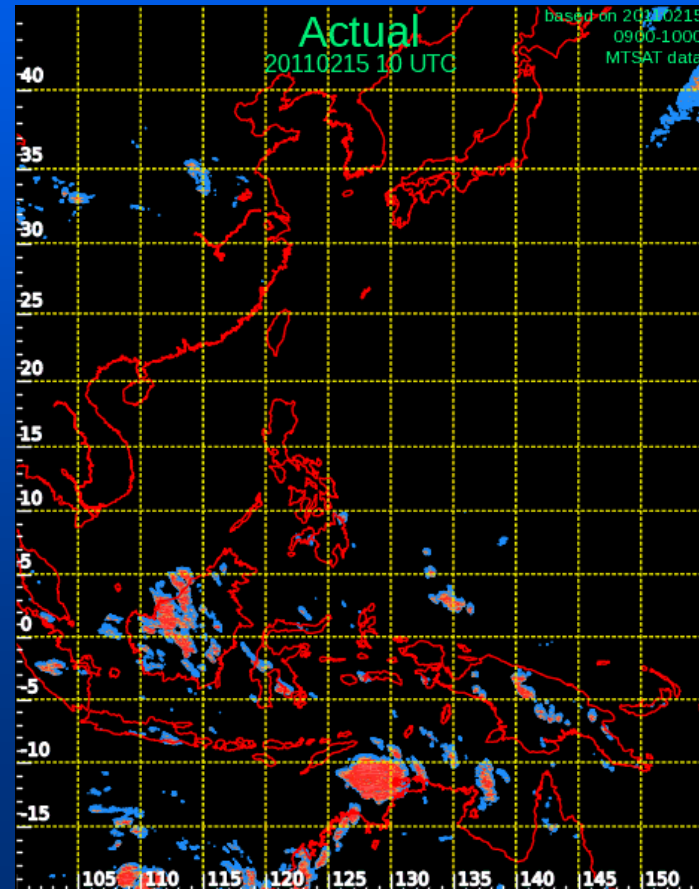
Application of Satellite Data

Deep convection monitoring and forecast

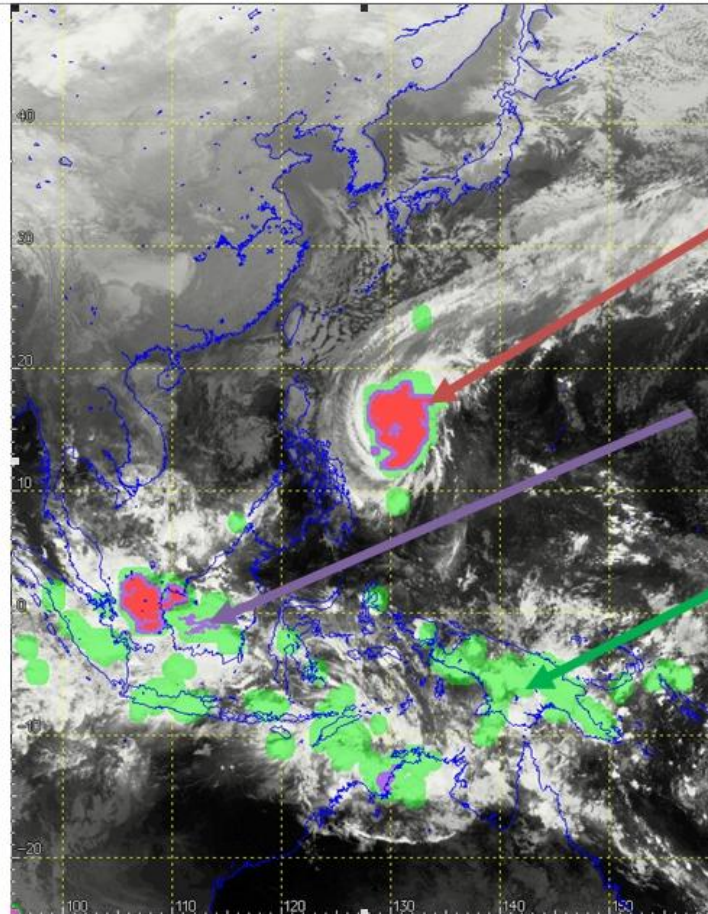
Infrared satellite image with highlighted areas of deep convection.



Based on Full Multi-grid Optical Flow algorithm, deep convection development forecast for 1-6hr



Deep Convection Classification



FRQ

OCN

ISOL



deep convection classification

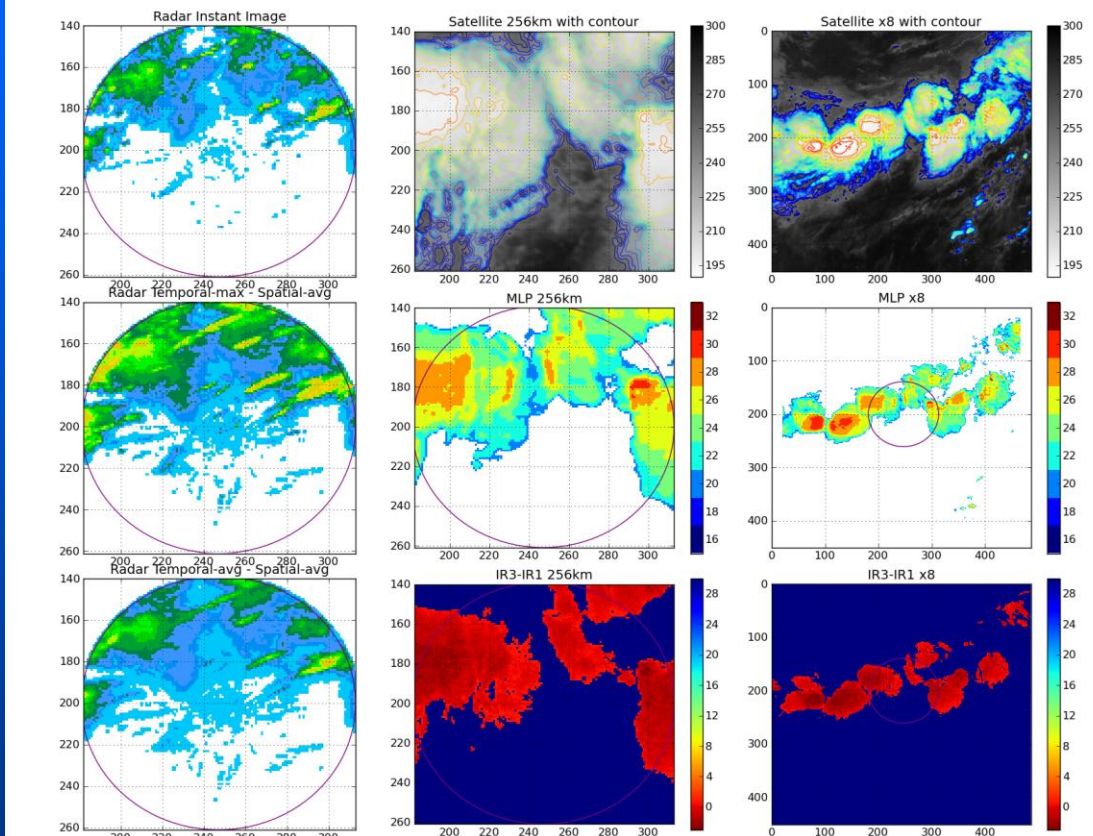
SIGWX Prognostic chart
for FL250-630

Based on ICAO definitions for deep convection classification

Satellite-based Convective System Identification using Multilayer Perceptron (MLP)

(supervised artificial neural network algorithm, non-linear regression model)

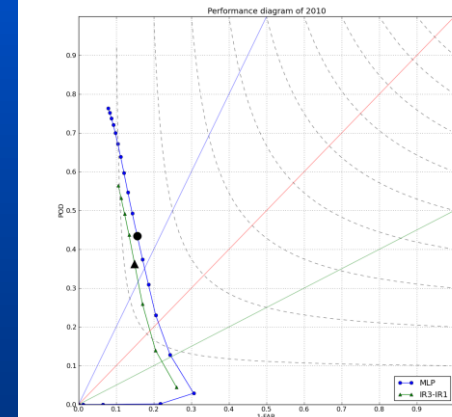
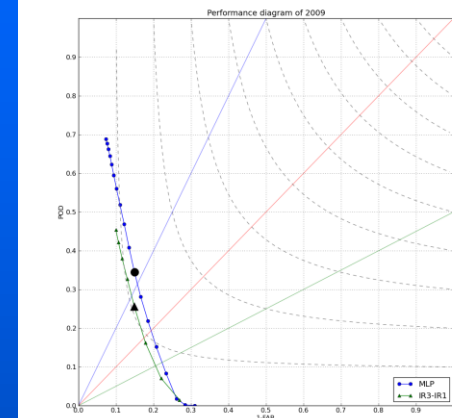
2010062423



MTSAT data (IR1, IR2, IR3)
as a source of training data



dBZ from radar as
target of regression

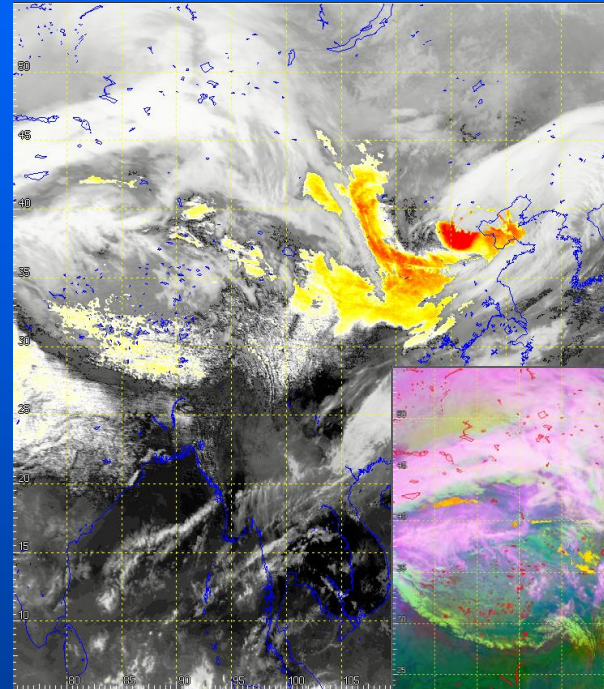


MLP outperforms IR3-IR1,
describing better to distribution
of heavy rain areas

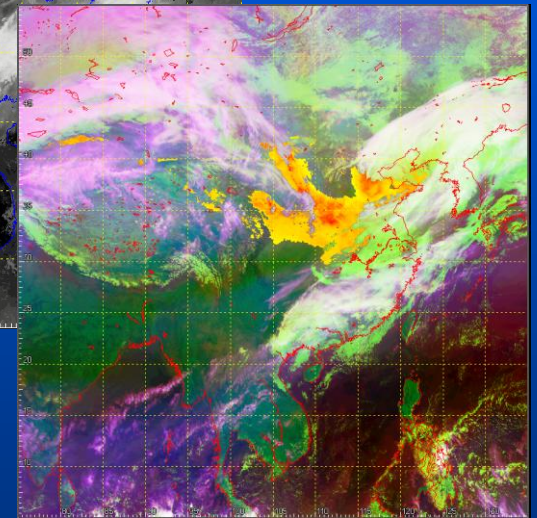
Dust/ Sand/ Ash Monitoring

20100320_0157 MTSAT image

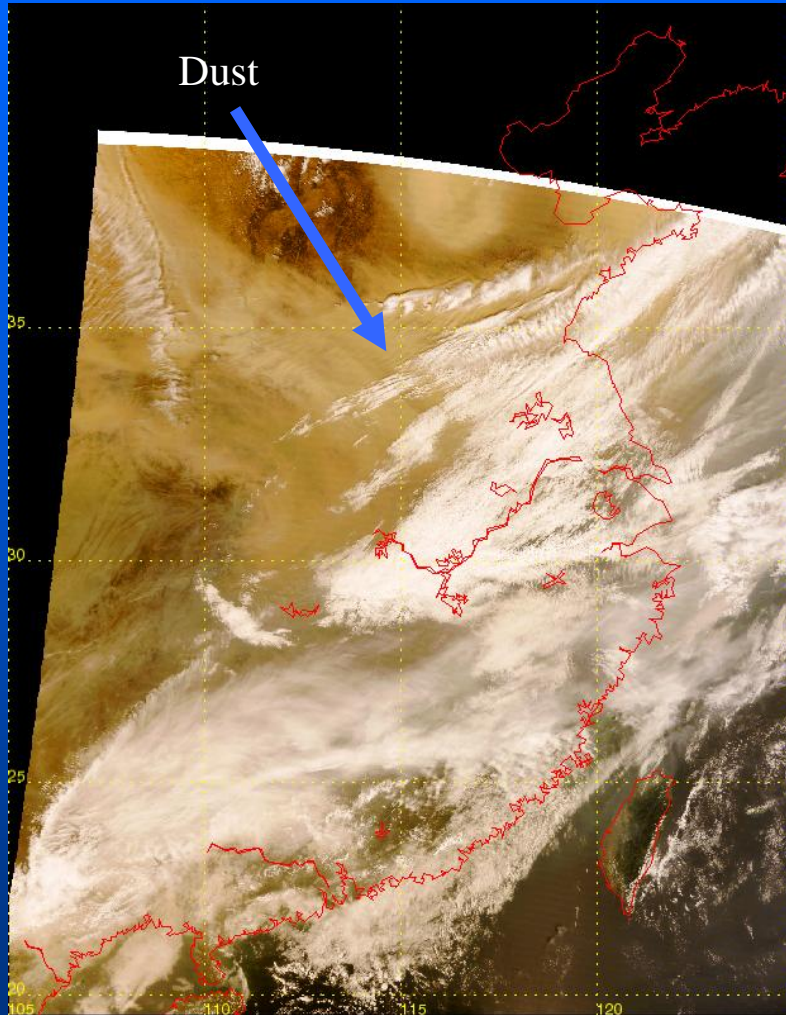
(IR2-IR1) image



IDDI image



overlay on
Infrared satellite image with
highlighted areas of sand, dust
and ash

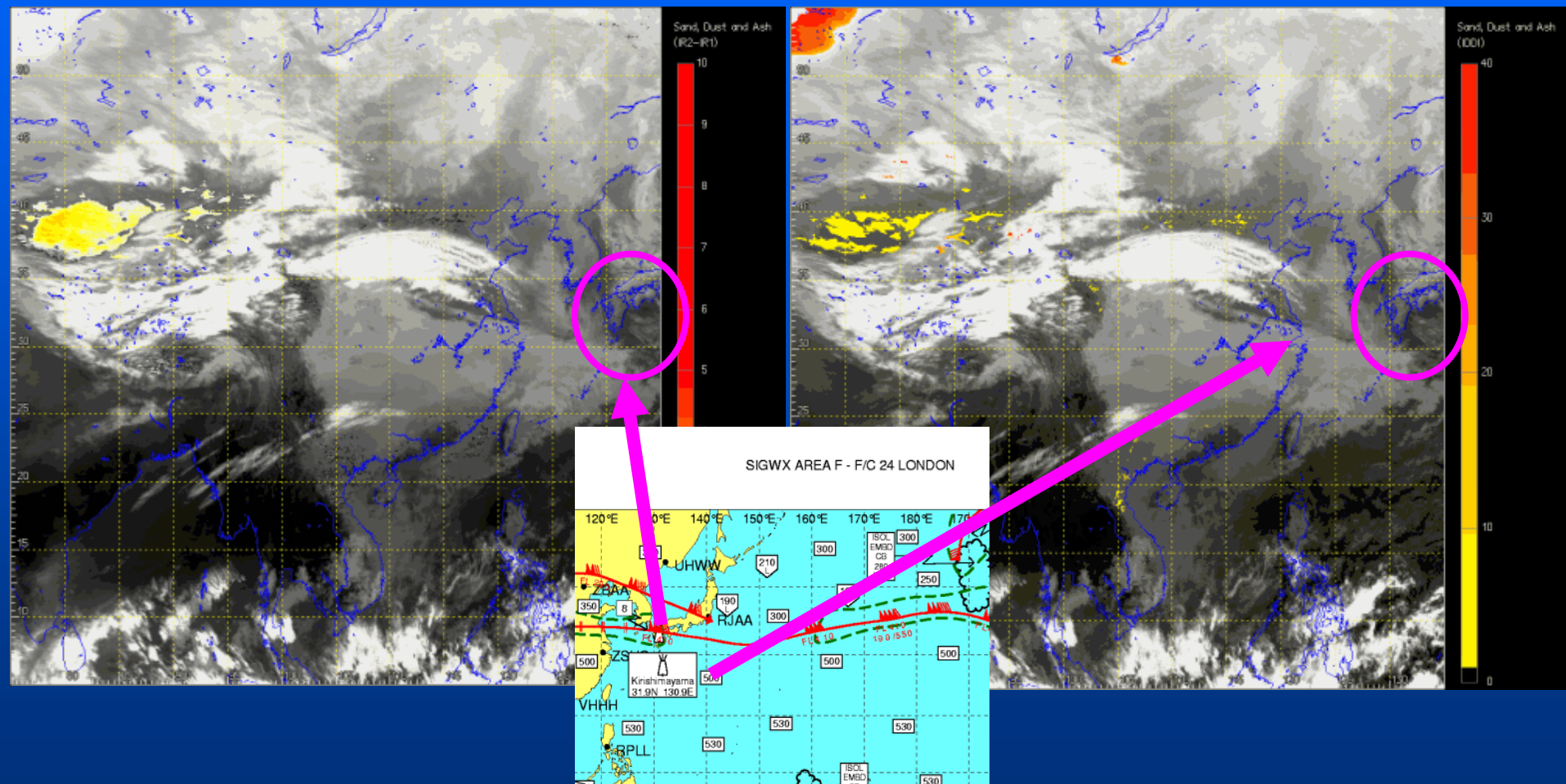


20100320_0250_terra_true

Observation of Volcanic Ash

(IR2-IR1) image

IDDI Product

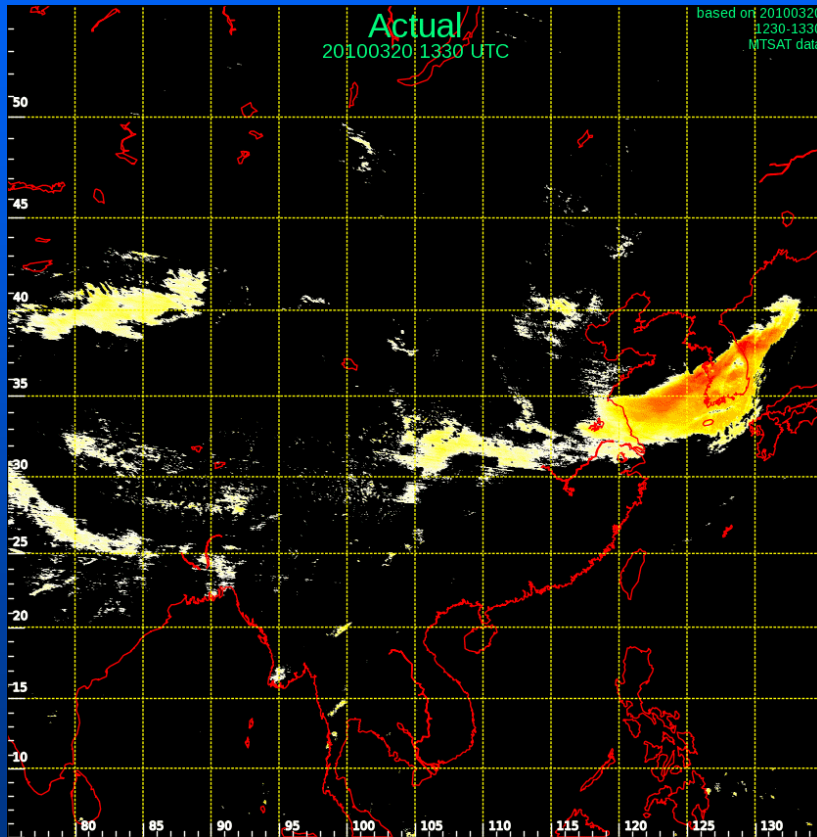


20110126_0632-1132Z

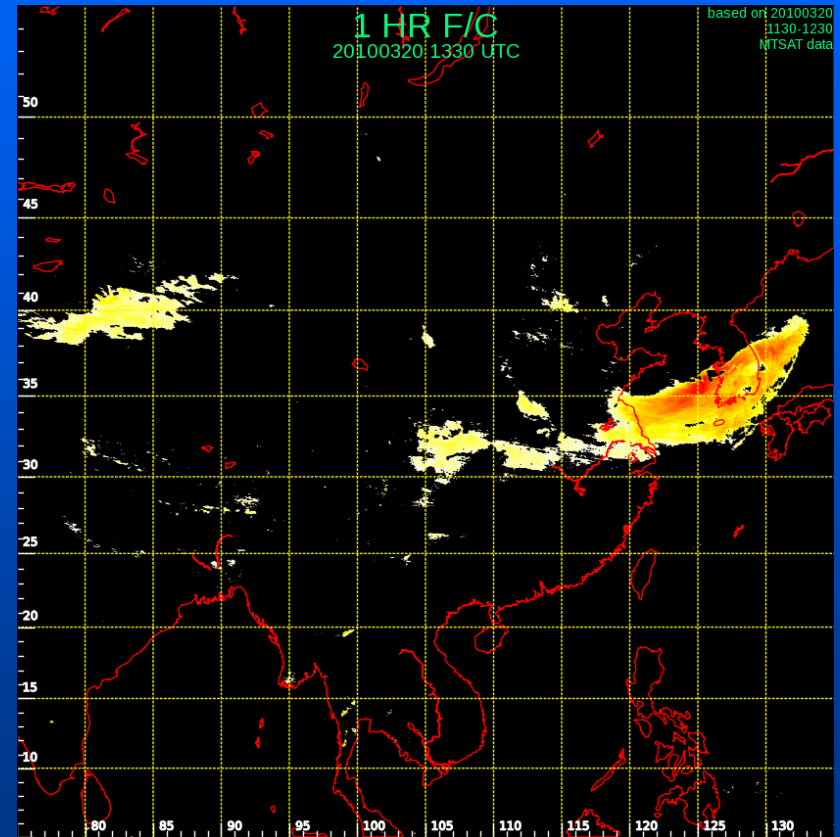
20110126_0632-0832Z

Sand, Dust, Ash (SDA) monitoring and forecast

SDA Actual Obs



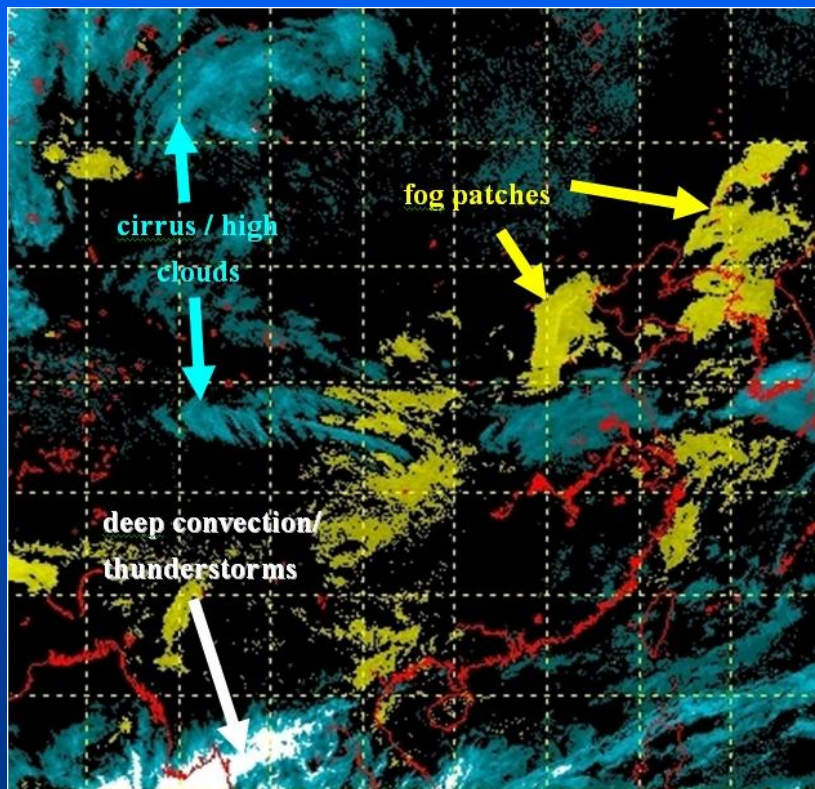
SDA development forecast



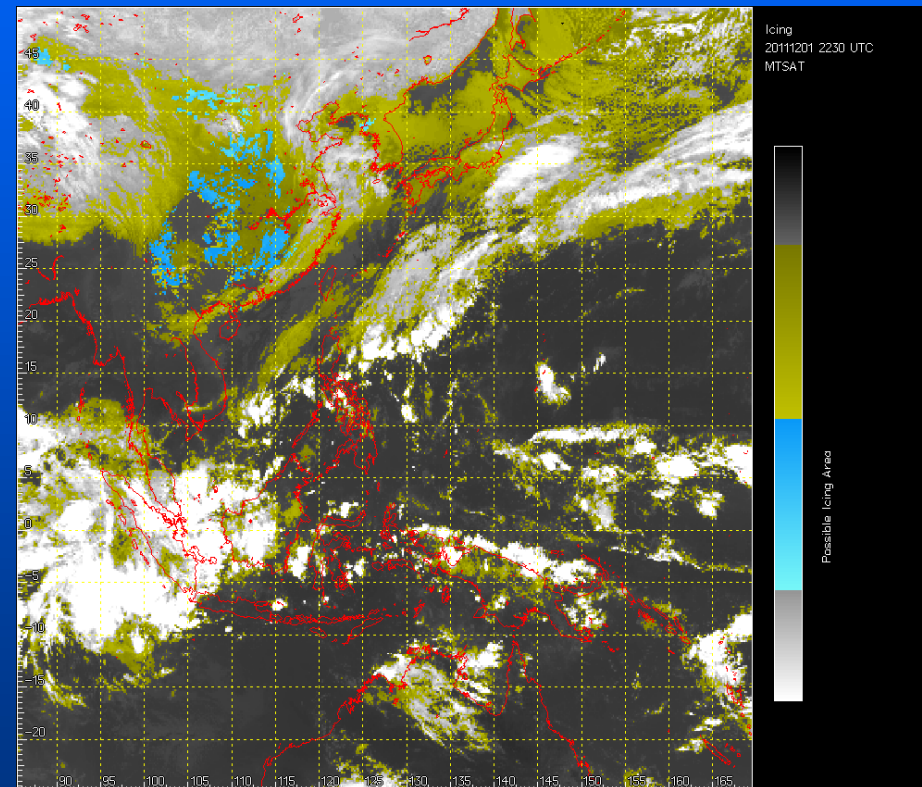
Based on split window (IR1-IR2) and Full Multi-grid Optical Flow Algorithm

Application of satellite data

Night time fog



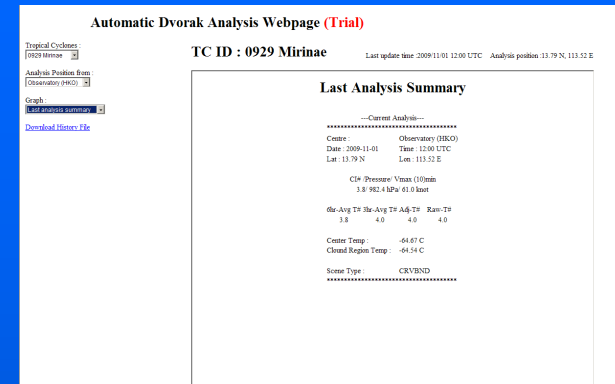
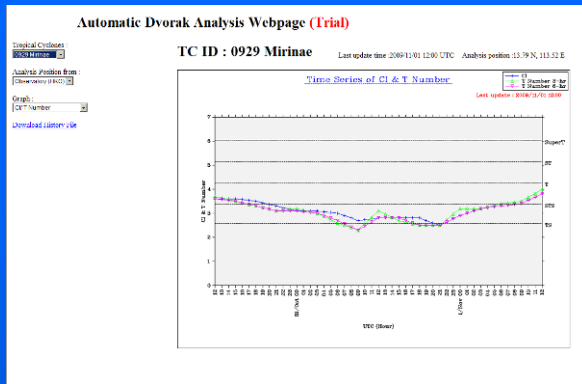
Icing



Automatic Dvorak Products for TC monitoring

CI / T/ No.

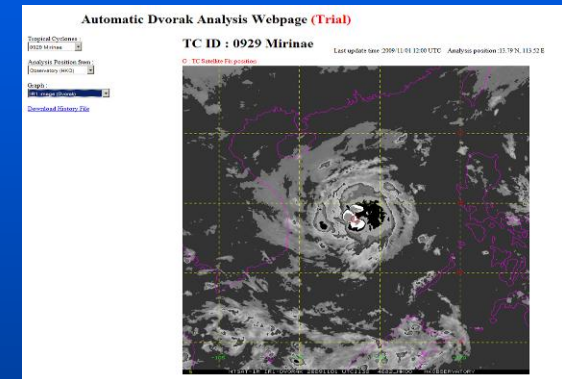
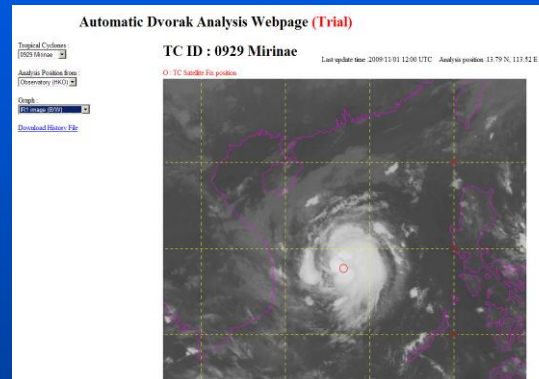
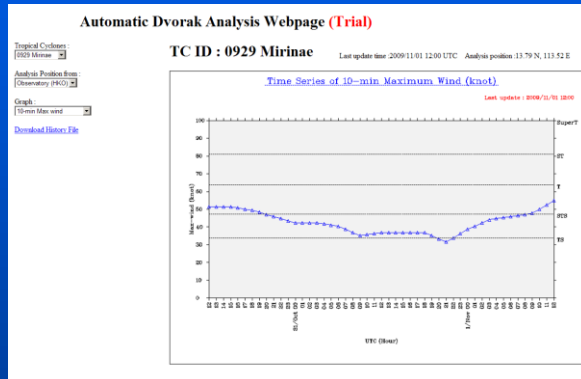
Analysis Table



Max 10-min winds

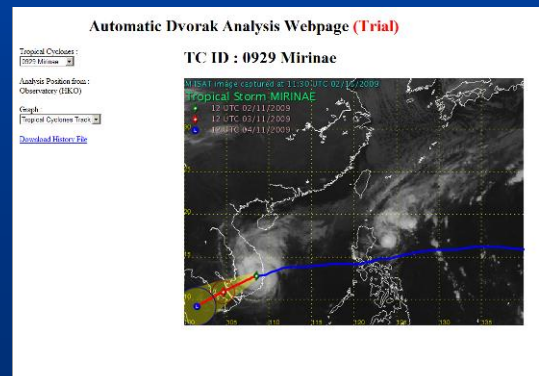
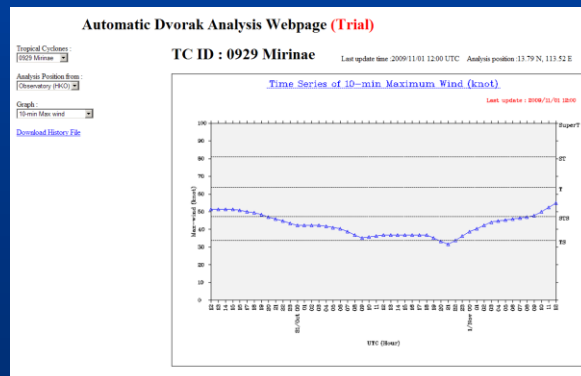
IR image

Dvorak Image



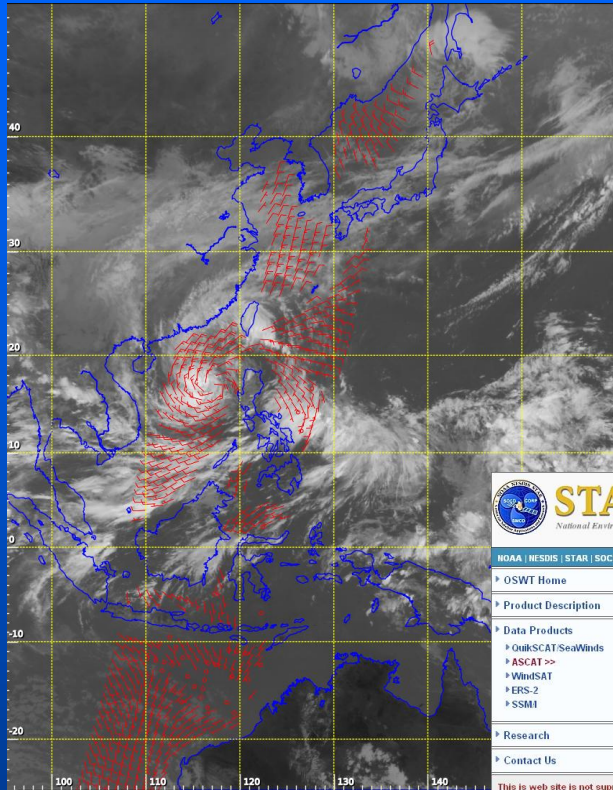
Min Pressure

Track overlay



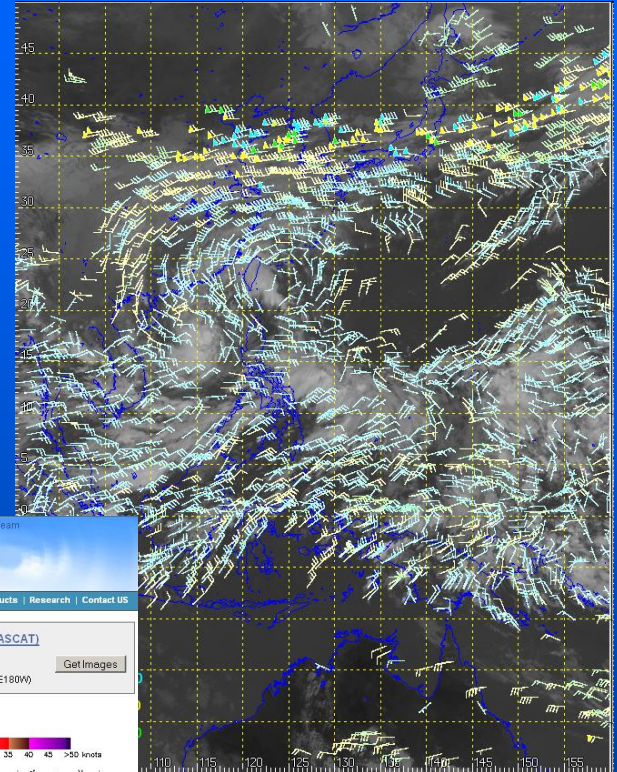
..Download of
history file

Satellite Winds for monitoring of tropical cyclones

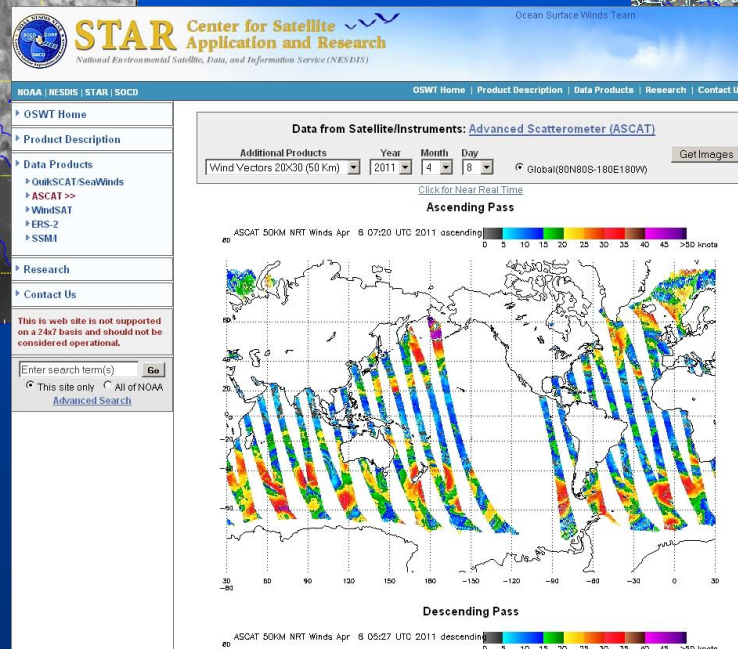


OceanSat-2

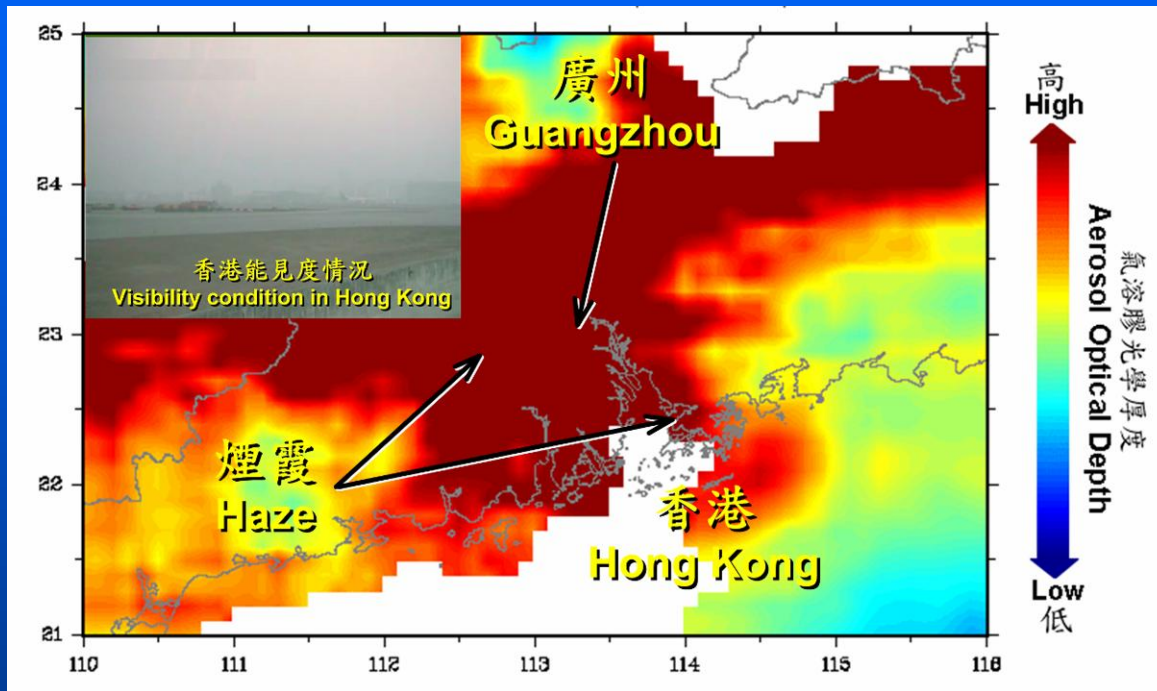
ASCAT



MTSAT
Sat Wind



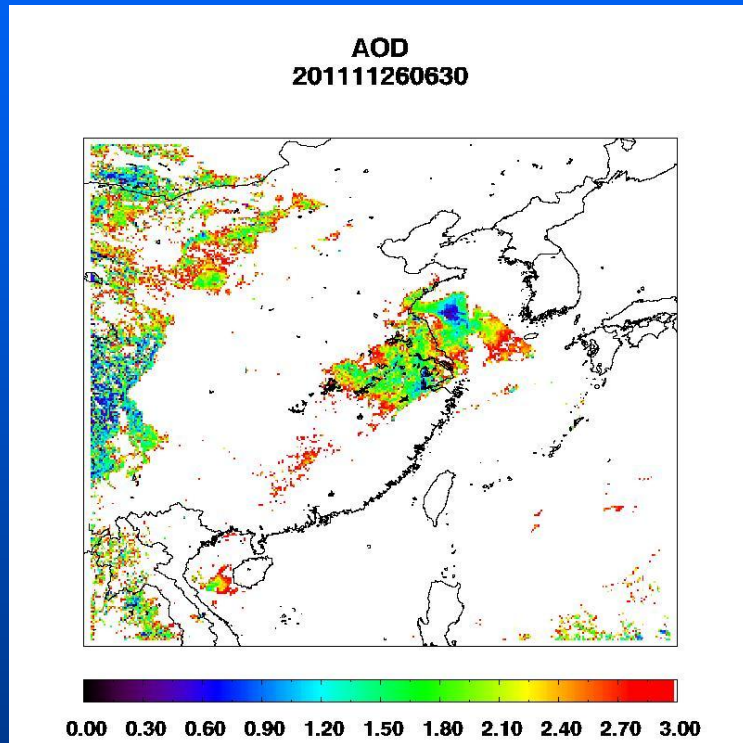
Aerosol / Haze monitoring



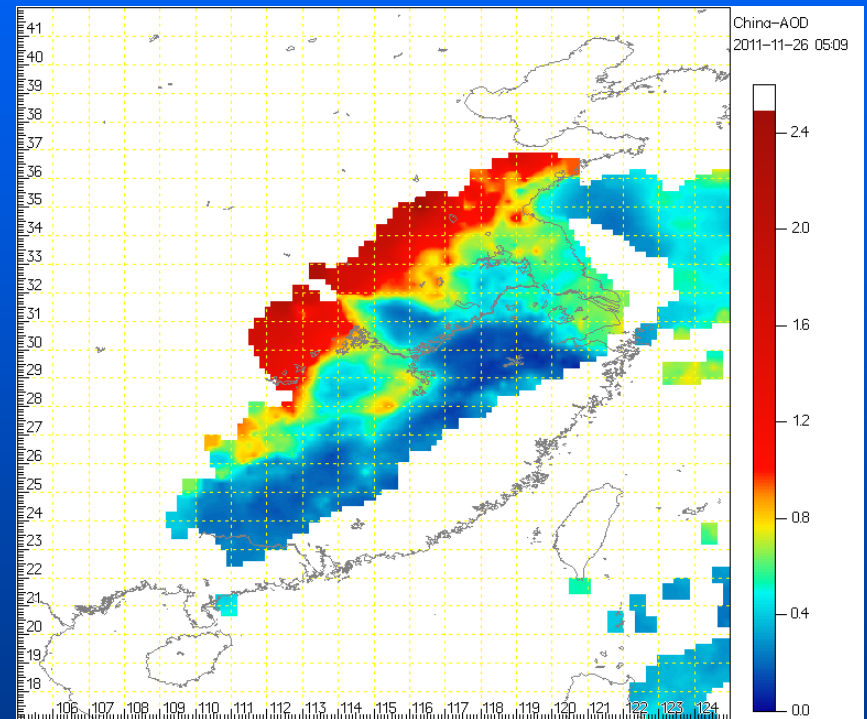
Aerosol optical depth image from EOS/MODIS is useful for monitoring of haze.

MTSAT derived Aerosol

MTSAT derived AOD




MODIS AOD




Collaboration with
Yonsei Univ., Republic of Korea

Satellite images and products in Aviation Information Dissemination System for aviation community



香港天文台
HONG KONG OBSERVATORY

AVIATION METEOROLOGICAL
INFORMATION DISSEMINATION SYSTEM



What's New

Announcement


References

HKIA Climatology


Usage Notes

HKO Web Site


International Projects


Warnings in force


- HKO Warnings
- Strong Monsoon Signal
- Information on Volcanic Eruption / Ash Cloud


What's New


- Airport Thunderstorm and Lightning Alerting System (ATLAS)
- HKIA Aerodrome Warnings
- Alternate Aerodrome Landing Minima (AMO)
- Hong Kong SIGMET
- Hong Kong TC SIGMET (Graphical)
- Information on Volcanic Eruption / Ash Cloud
- Real-time SIGMET Monitoring
- Volcanic Ash Monitoring Tools (Beta Version)
- Volcanic Ash Advisory Information in Graphical Format (Beta Version)
- Tropical Cyclone Advisory Information in Graphical Format (Beta Version)


Tropical Cyclone Information


- HKO TC Information
- TC Warnings from Other Centres
- General Information on TC
- WMO CAEM Aviation-weather Disaster Risk Reduction (ADRR) website [Beta Version]
- Probabilistic forecasts for HKIA [Beta Version]
- Probabilistic forecasts for HKIA [Beta Version] (AMO)


HKIA Weather


- Significant Convection Monitoring and Forecast (trial)
- Weather Summary for HKIA
- Aviation Thunderstorm Nowcasting System (Internet access required)
- Latest AMOS Data
- Winds Around HKIA
- Lightning Around HKIA
- Rainfall at HKIA
- Runway Winds (more...)
- Wind Profiler Data (AMO)
- Winds At Sha Chau
- Lightning Around Sha Chau


General and Local Aviation Weather


- MET page | MET page (ATMD)
- Local Routine Report / Special Report: 07L/25R/07R/25L
- Local Routine Report for AIDB
- HKIA Report/Forecast (more...)
- Latest ATIS
- TerMet/Extended-take-off Forecast
- Cloud Condition at CLK
- Local Aviation Forecast
- Local Weather Forecast
- 7-day Weather Forecast
- Winds around Hong Kong
- Visibility Readings in Hong Kong Waters
- Hong Kong Tephigram
- Hong Kong Weather Photos
- Upper wind and temperature information over South China Sea
- Significant Weather for Neighbouring Aerodromes
- QNH over Hong Kong


Enroute and Destination weather


- Standard Flight Document Package (high temporal resolution)
- Brief Flight Information Package (high temporal resolution)
- Customize Information (high temporal resolution)
- Select / Print Flight Document (high temporal resolution)
- Wind / Temp Chart (high temporal resolution)
- Standard Flight Document Package (old)
- Customize Information (old)
- Customize Landing Minima
- Destination Weather Report & Forecast
- Latest Visibility Reports
- Latest Cloud Base Reports
- Latest Significant Weather Reports METAR/SPECI/TAF/SIGMET/AIREP (more...)


Select / Print Flight Document (old)

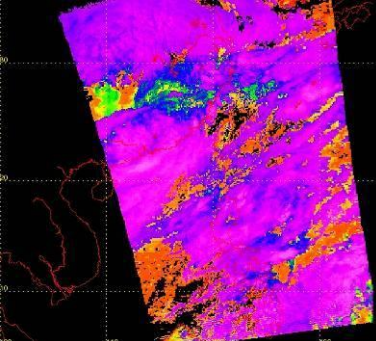
- Wind / Temp Chart (old)
- Temperature Chart
- Prognostic Significant Weather Charts
- Enroute and Surface Charts (more...)
- Aerodromes below Landing Minima
- WAFS Gridded Forecasts of Icing, Turbulence and Cumulonimbus Clouds [Beta Version]



Satellite and Radar Images

- METEOSAT - 9
- METEOSAT - 7
- Kalpana-1
- FY - 2E
- MTSAT-2
- EOS
- NOAA & FY - 1
- GOES - 11
- GOES - 12
- Lightning Events with Satellite Image
- Hong Kong Weather Radar
- China Composite Radar



HONG KONG
The information available on ANID should carefully note the time of the assistance.




 Internet

available due to technical or other problems. Users (hours) or aao@hko.gov.hk if you require further

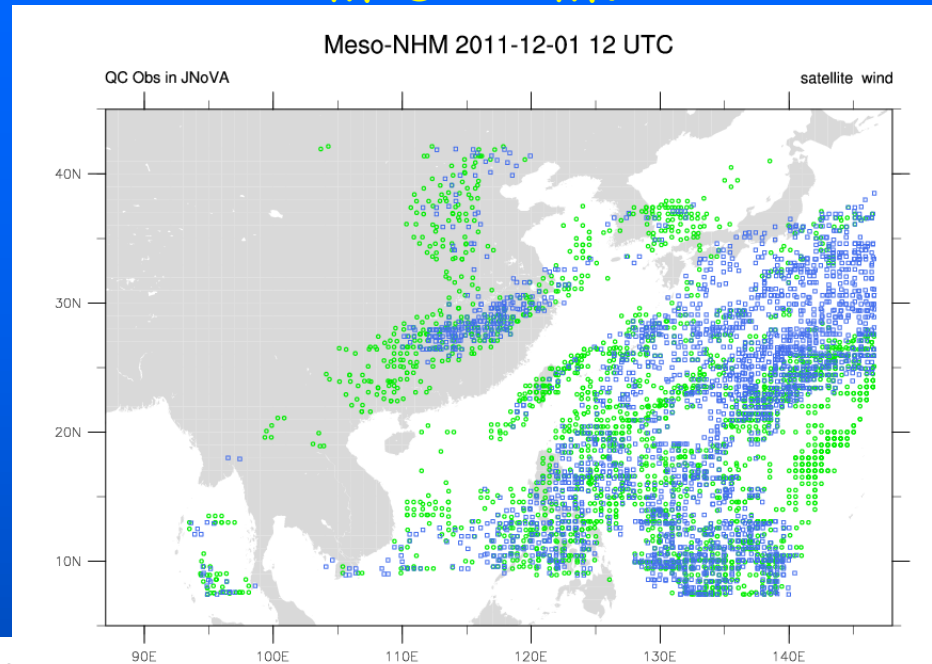
2011-02-13 02:24 UTC

Studies and Use of Satellite Data on Numerical Models

MTSAT AMV

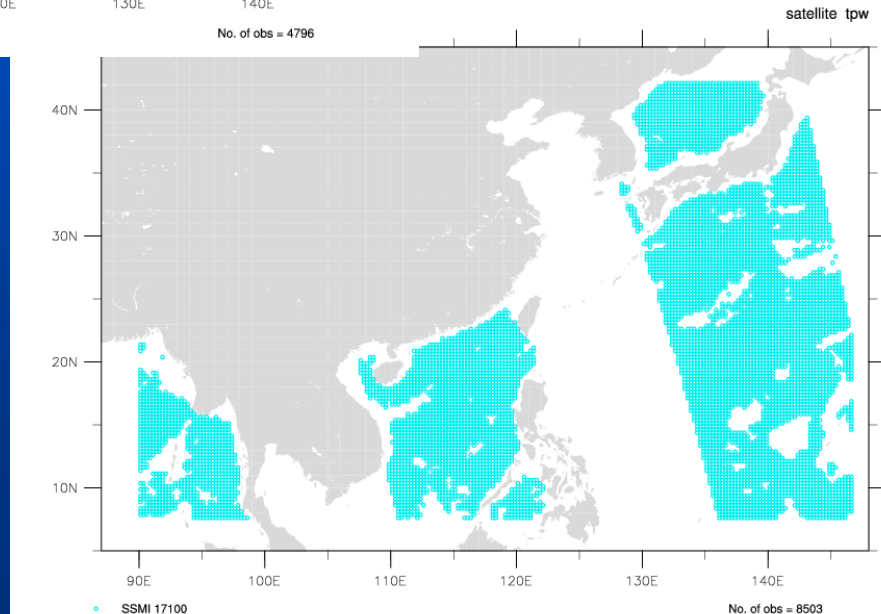
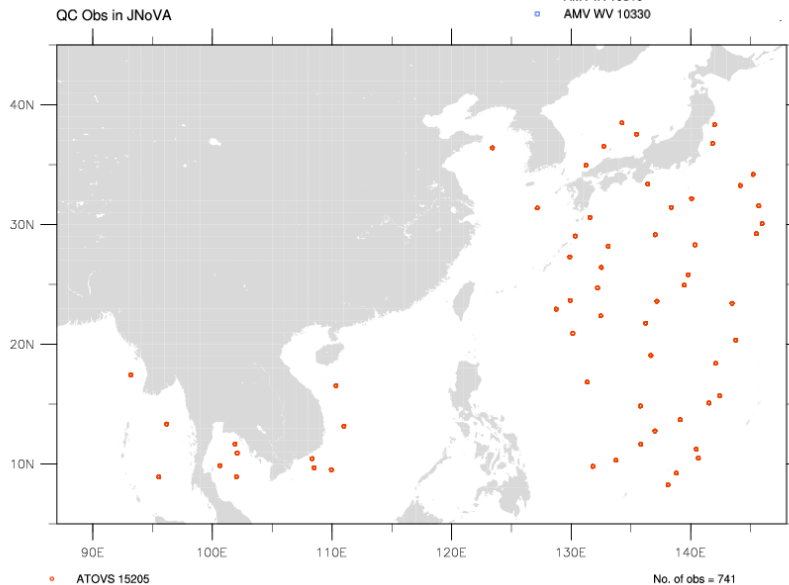
ATOVS T profiles

Total precipitable
water vapour



M 2011-12-01 12 UTC

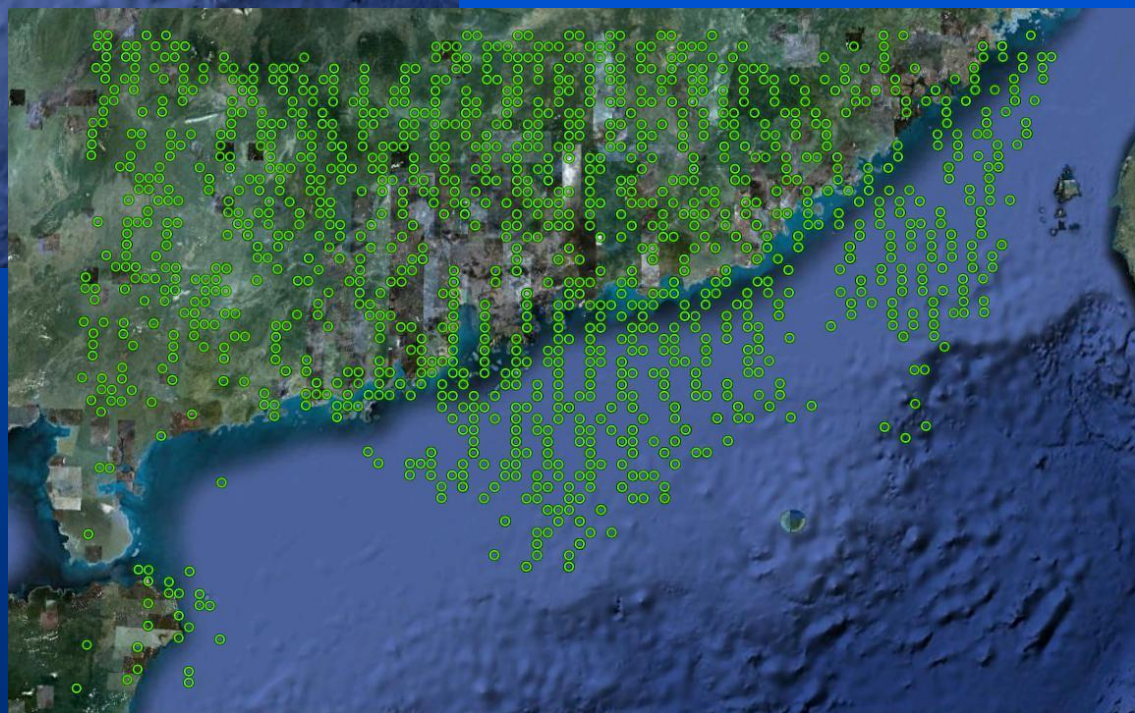
Meso-NHM 2009-C



Ingestion of MODIS data to NHM model

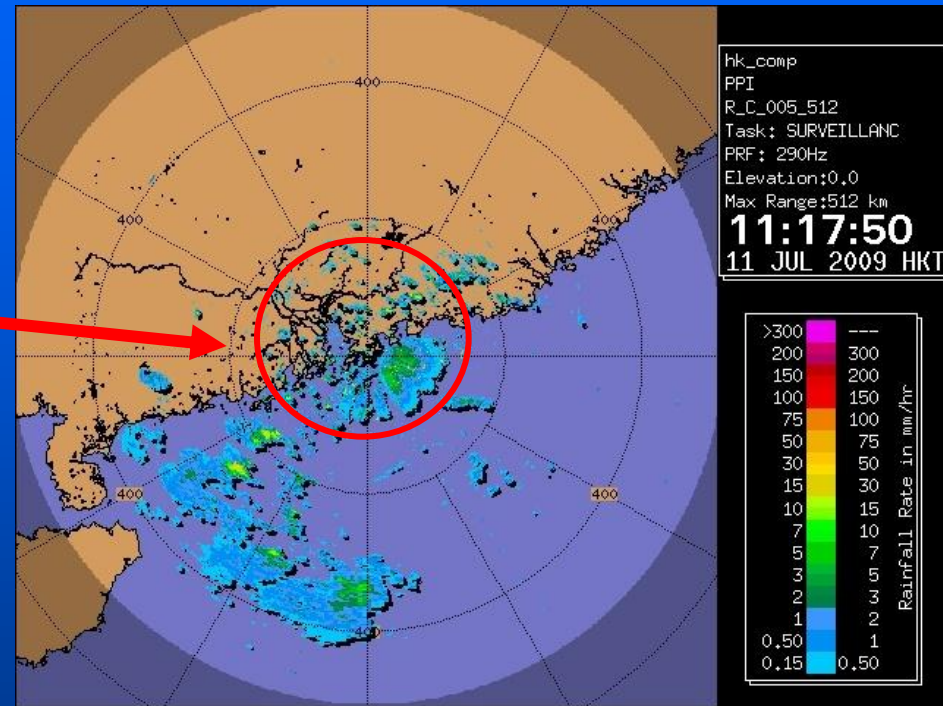
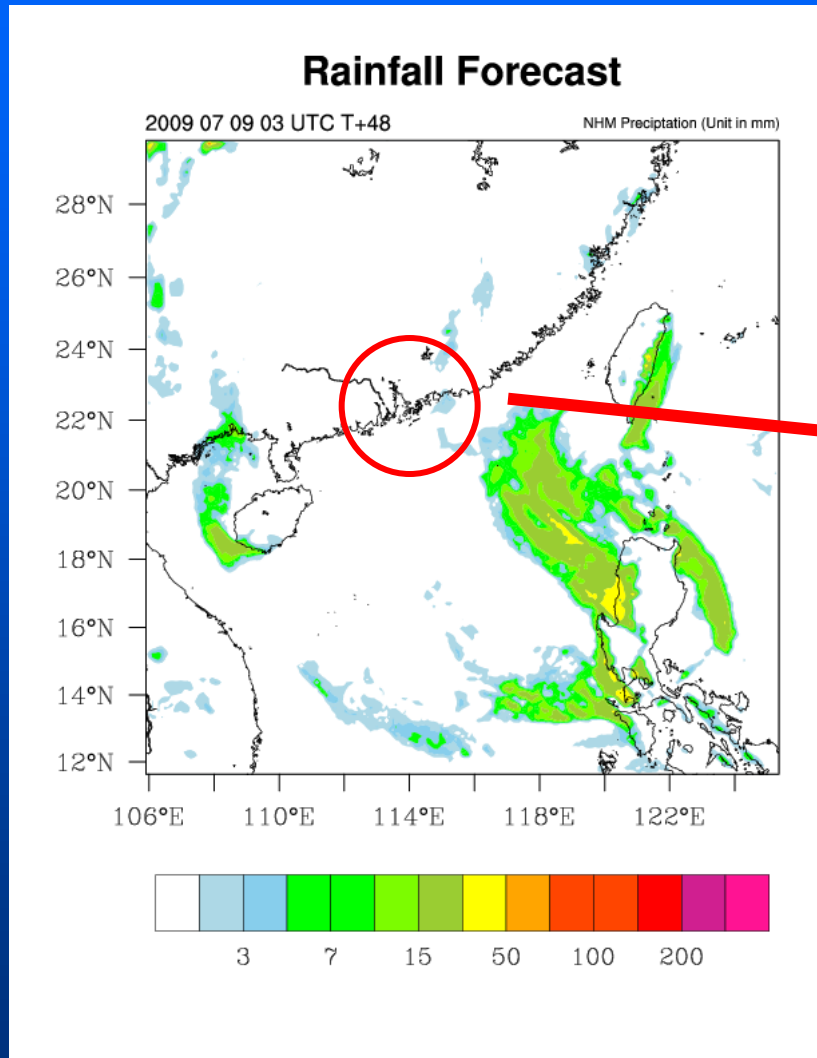


Full distribution of
MODIS profiles



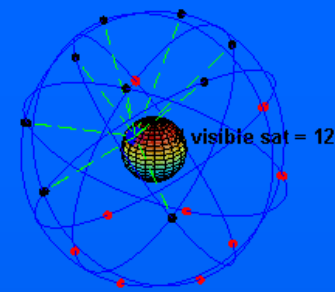
Thinned MODIS

Positive impact to NHM



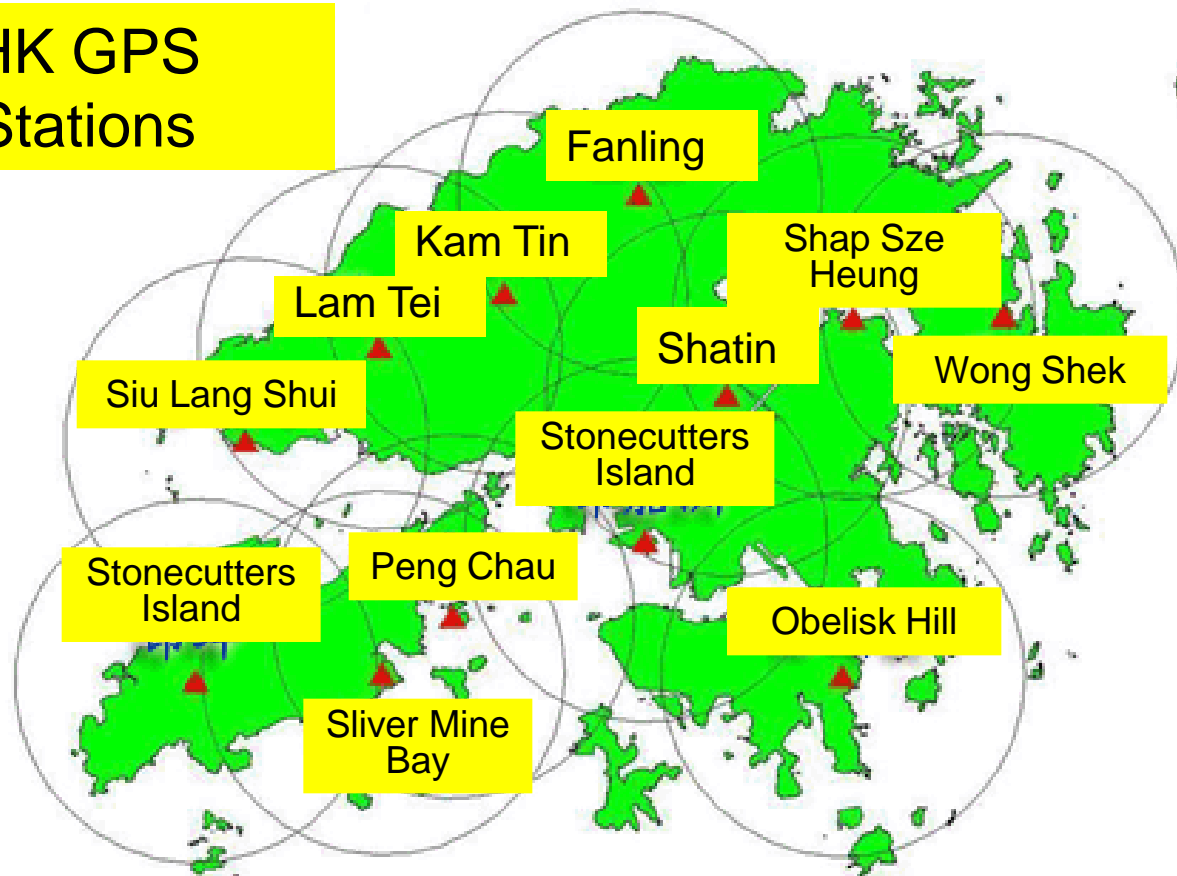
Predict more accurately the rainfall distribution After ingestion of MODIS data

GPS-PWV station network



- operated by the HK Lands Department

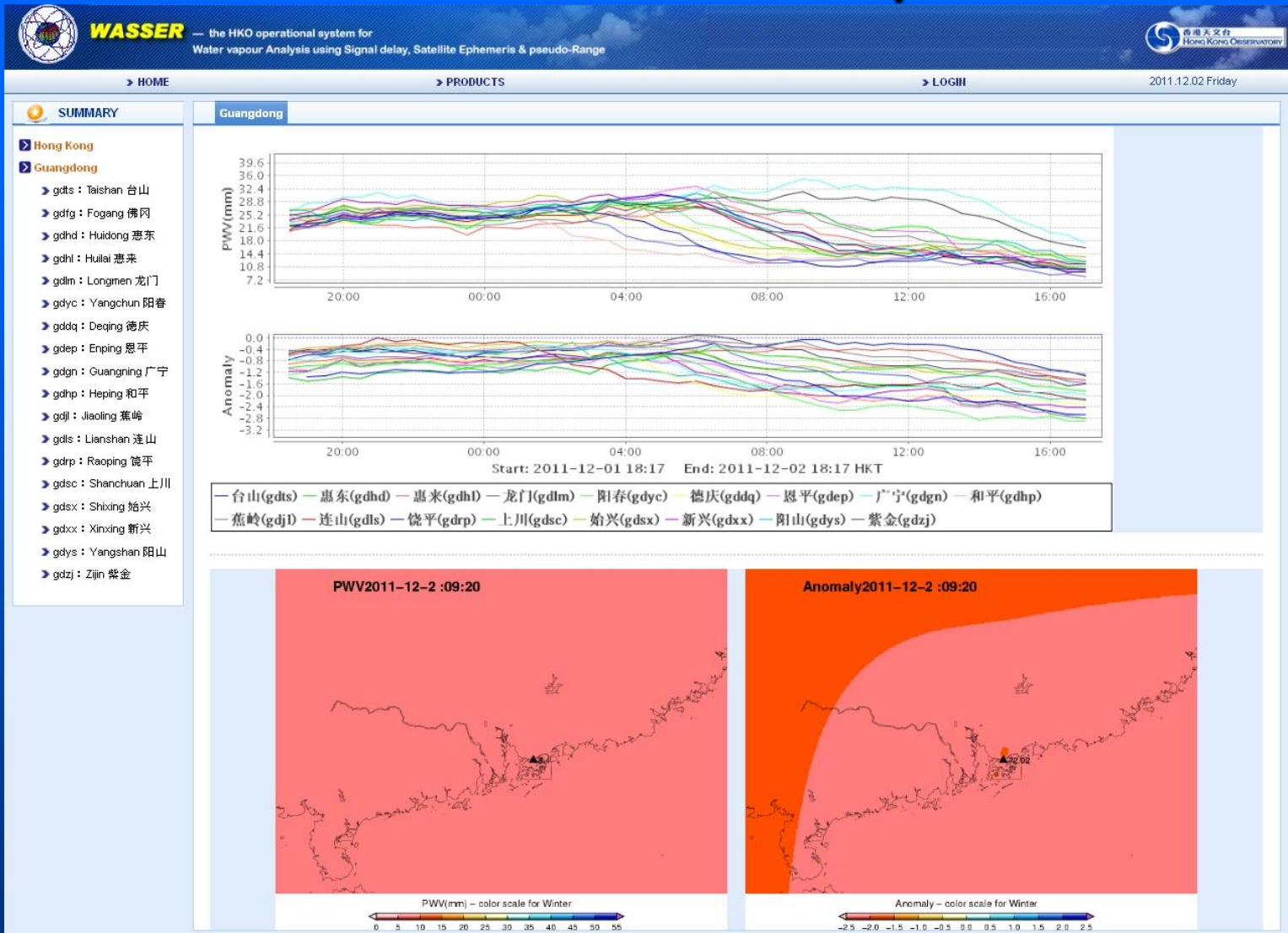
HK GPS Stations



0 5 10 公里

▲ 衛星定位參考站

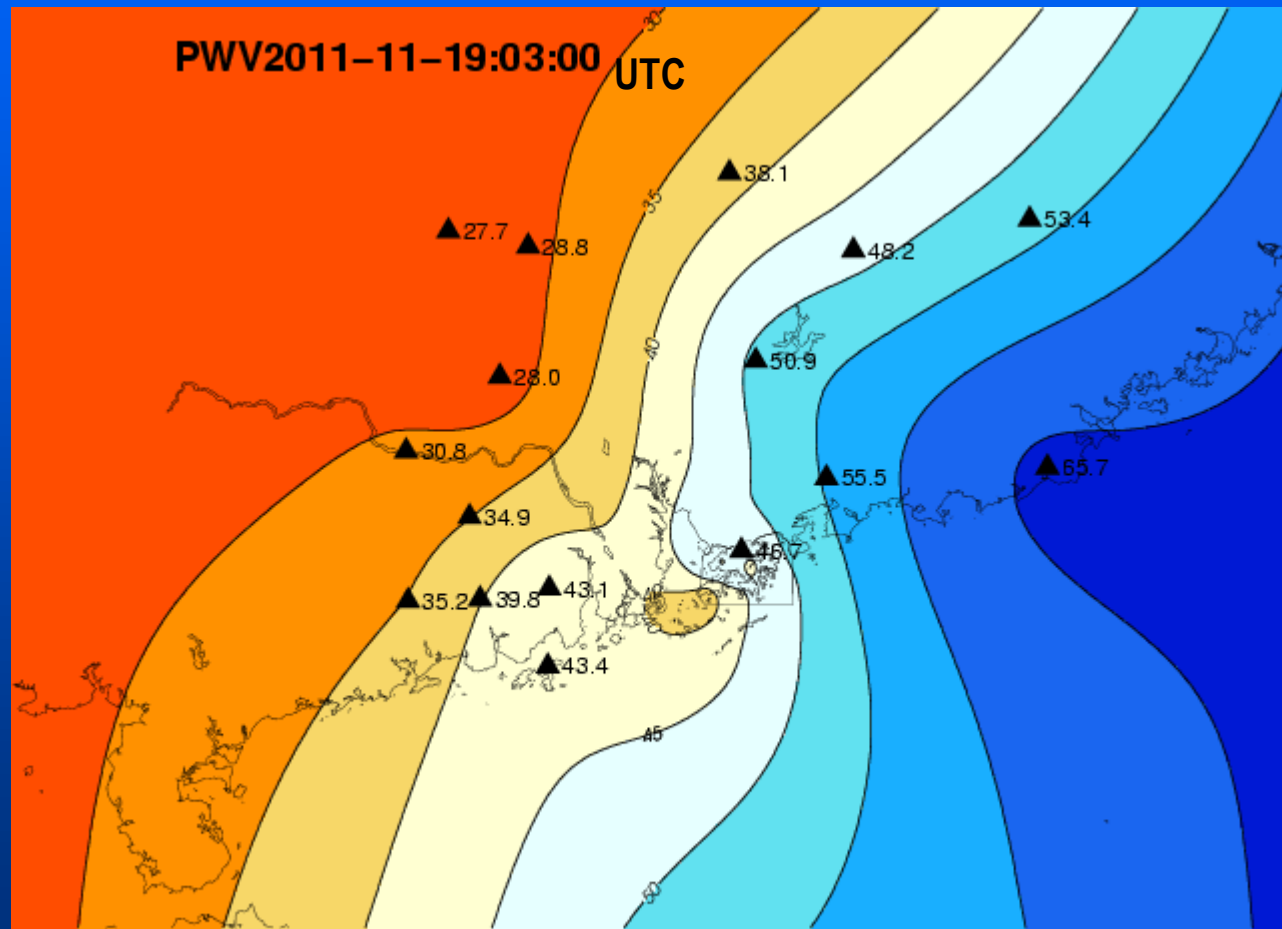
GPS-PWV Analysis



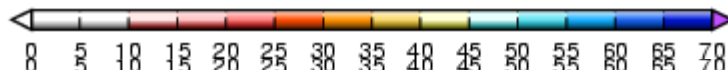
- 18 GPS stations in Guangdong, updated in 30 min

Combined PWV Analysis using GPS data from Hong Kong & Guangdong

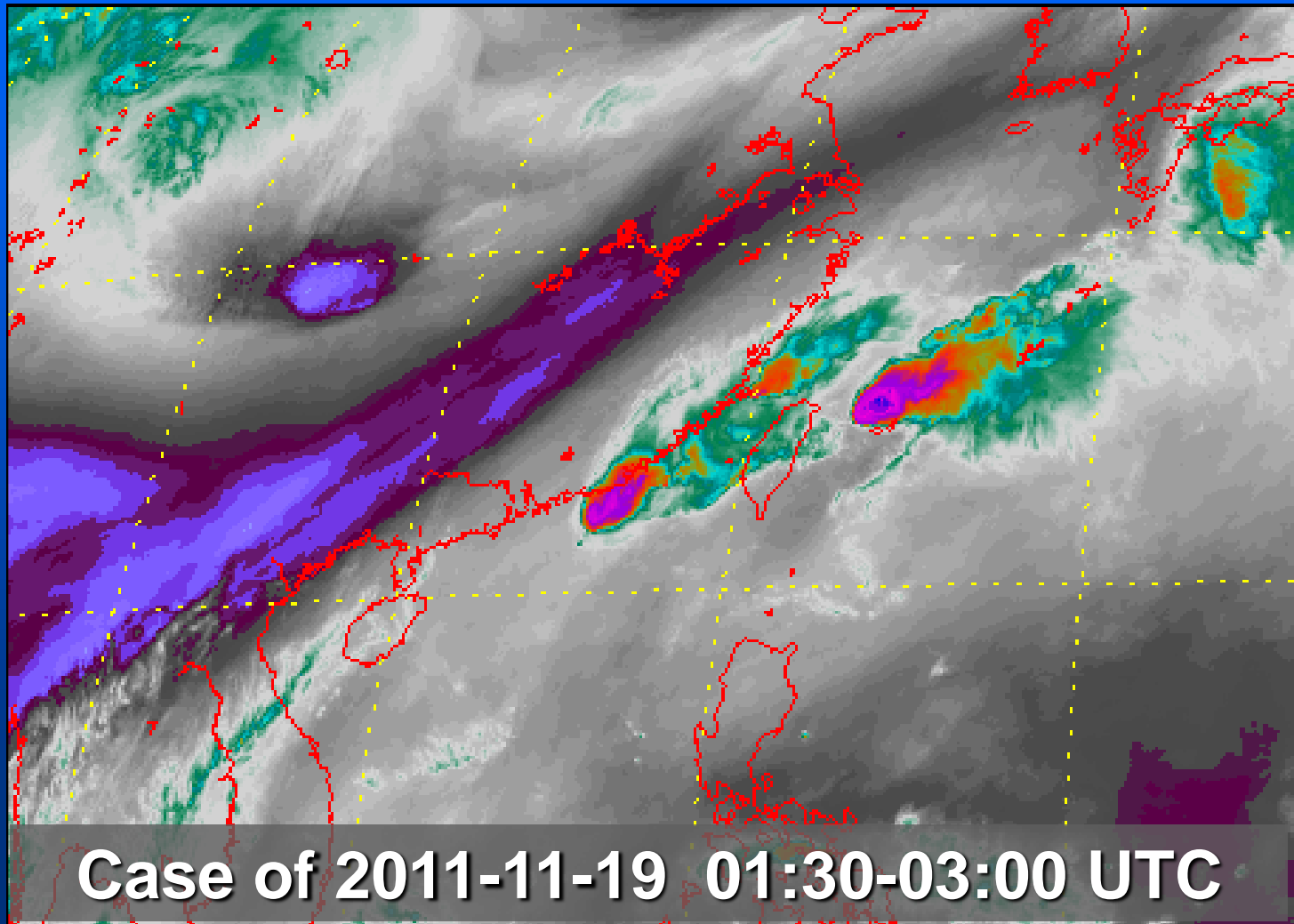
Case of 2011-11-19 01:30-03:00 UTC



PWV(mm) – color scale for Autumn



Comparison with Satellite WV Imageries

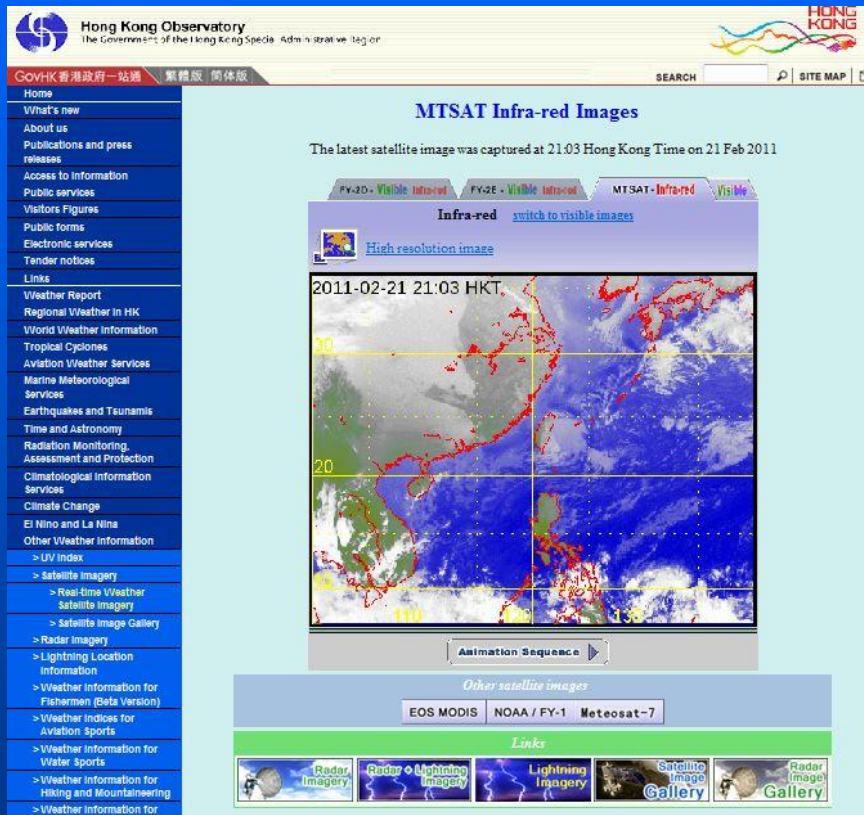


Studies and Use of Satellite Data on Numerical Models

- Geostationary
 - (MTSAT AMV BUFR data via GTS) to NHM
- Polar-orbiting
 - NOAA ATOVS temperature retrieval
 - SSM/I and AMSR-E total precipitable water vapour
 - MODIS temperature and humidity profiles (e.g Collection-5 retrieval algorithm)
 - ASCAT and OceanSat-2 ocean surface wind
- Ground based GPS network
 - GPS-PWV processing system for station within HK and from Guangdong

Enhancement in Public Information and Education

Internet webpage



Apps on mobile devices





Over 400 government officers, teachers and members of the public have been trained since 2003.

Enhancement in Public Information and Education

- Satellite image gallery
(http://www.weather.gov.hk/wxinfo/intersat/satellite_gallery/index_e.htm)
- Real-time satellite image
(http://www.hko.gov.hk/wxinfo/intersat/mtsatsatpic_s.shtml)
- Realtime FY-1 and NOAA images
(http://www.weather.gov.hk/wxinfo/intersat/satpic_s.shtml)
- EOS MODIS images
(<http://www.hko.gov.hk/wxinfo/intersat/modis/sat.html>)
- Meteosat-7 Infra-red Images
(<http://www.hko.gov.hk/wxinfo/intersat/meteosat/sat.shtml>)
- Training courses on interpretation of radar and satellite images for government officers and the public
- TV weather presentation

Looking Ahead

- Implement CMACast Reception System
- Reception of new generation of satellites, e.g. MetOP, NPP, COMS, and others.
- Develop more products based on user requirements
- Carry out more experiments and works on ingesting data from different variety of satellites for improving model forecasts
- Enhance HKO web site
- Conduct more training courses on satellite remote sensing and related subjects

THANK YOU