



**Asia-Pacific  
Economic Cooperation**

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**2017/SOM1/EPWG/018**

Agenda Item: 7.1.2

## **National Disaster Risk in Viet Nam in the Period 2006 – 2016 and Forecasting and Warning System**

Purpose: Information  
Submitted by: Viet Nam



**11<sup>th</sup> Emergency Preparedness Working Group  
Meeting  
Nha Trang, Viet Nam  
18-19 February 2017**



**THE 11<sup>st</sup> EMERGENCY PREPAREDNESS WORKING GROUP MEETING**  
Feb 18-19, 2017, Nha Trang- VIETNAM.

**NATIONAL DISASTER RISK IN VIETNAM  
IN THE PERIOD 2006-2016  
AND FORECASTING AND WARNING SYSTEM**

National Center for Hydro-Meteorological Forecasting  
– Ministry of Natural Resources and Environment , VIETNAM

*National Disaster Risk in Vietnam in  
2006-2016*

## *Disaster and Climate change in Vietnam*

### 1. Natural Disaster:

1. Natural disasters in Vietnam have been increasingly severe in terms of magnitude, frequency and volatility
2. Natural disasters such as typhoons, floods and droughts have caused significant losses, and asset damage equivalent to 1.5% of GDP

### 2. Climate change:

1. Vietnam is one of the 5 countries worst affected by climate change. Climate change will worsen natural disasters
2. If the sea level rises by 1 meter, 90% of the Mekong River Delta area will be flooded during the flood season, and 71% will be salted during the dry season, and about 20 million people will be affected in terms of housing

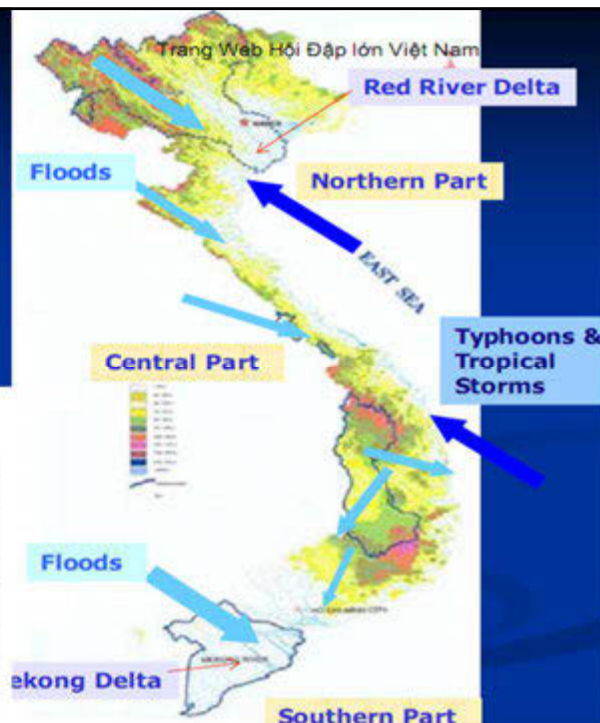
**Vietnam is one of the most natural disaster-prone countries :**

**typhoons, floods, tropical storms, drought, seawater intrusion, landslides, forest fires, occasionally earthquakes.**

**Disasters triggered by typhoons and floods : most frequent and severe !!**

Table I. Disaster relative frequency in Vietnam can be classified as follows:

High	Medium	Low
Flood, Inundation	Hail rain	Earthquake
Typhoon, tropical depression	Landslide	Accident (technology)
Flash flood	Forest fire	Frost
Tornado	Salt water intrusion	
Drought		



## Disaster and Climate change in Vietnam

**Table 2. Assessment of Disaster Severity in Different Geographic Areas and in the Coastal Economic Zone of Vietnam**

Disaster	Geographic Areas and Economic Zones							
	North east and north west	Red River Delta	North central coast	South central coast	Central highlands	North east south	Mekong River Delta	Coastal Economic Zone
Storm	+++	++++	++++	++++	++	+++	+++	++++
Flood	-	++++	++++	+++	+++	+++	++++	++++
Flashflood	+++	-	+++	+++	+++	+++	+	+++
Whirlwind	++	++	++	++	+	++	++	++
Drought	+++	+	++	+++	++	+++	+	+++
Desertification	-	-	+	++	++	++	+	++
Saline intrusion	-	+	++	++	+	++	+++	++
Inundation	-	+++	++	++	-	++	+++	+++
Landslide	++	++	++	++	+	++	+++	++
Storm surge	-	++	++	++	++	++	+++	++
Fire	++	+	++	+++	-	+++	+++	+++
Industrial and environmental hazard	-	++	++	++	+++	+++	++	+++

*Map of hazard zones in Vietnam*



## SERIOUS NATURAL DISASTERS FROM 2006 - 2016

Number of Natural Disasters in Vietnam for the period 2006 to 2016

Year	Storm	Tropical depression	Cold air	Rét đậm, rét hại	Heat	Heavy rain	Flood	Flash flood landslide
2006	10	6	25	5	15	24	34	4
2007	7	3	28	3	16	23	56	7
2008	10	5	28	3	12	28	50	3
2009	11	3	28	3	12	20	35	3
2010	6	5	29	4	17	18	47	2
2011	7	7	38	6	6	18	53	16
2012	10	2	31	6	18	17	30	8
2013	31	5	28	4	19	31	60	11
2014	5	3	25	5	17	31	23	30
2015	27	1	24	5	17	23	23	8
2016	5	1	22	3	17	23	16	7

Top 10 Natural Disasters in Vietnam for the period 2006 to 2016 sorted by economic damage costs

Type	Date	Total damage ('000 US\$)
Storm	28-09-2009	785000
Storm	11/11/2013	734000
Storm	30-09-2013	663230
Storm	27-09-2006	624000
Drought	00-12-2015	613000
Flood	27-10-2008	479000
Storm	30-11-2006	456000
Flood	10/11/2007	350000
Storm	28-10-2012	336000
Flood	28-10-2007	300000

## **SERIOUS NATURAL DISASTERS FROM 2006 - 2016**

Top 12 Natural Disasters in Vietnam for the period 2006 to 2016 sorted by numbers of total deaths people

Type	Date	Totals deaths
Storm	17-05-2006	204
Storm	28-09-2009	182
Storm	8/8/2008	162
Storm	2/11/2009	124
Flood	27-10-2008	99
Storm	29-09-2007	96
Storm	30-11-2006	95
Flood	00-09-2011	85
Flood	1/10/2010	84
Flood	28-10-2007	83
Storm	12/2006	70
Storm	10/2006	70

Top 10 Natural Disasters in Vietnam for the period 2006 to 2016 sorted by numbers of total affected people

Type	Date	Total affected
Storm	28-09-2009	2477315
Flood	14-11-2013	2130001
Storm	30-09-2013	1835585
Drought	00-12-2015	1750000
Storm	27-09-2006	1467925
Storm	30-11-2006	1226360
Flood	14-10-2010	761000
Flood	3/7/2009	700000
Storm	29-09-2007	685430
Flood	1/10/2010	679825

### **Typhoon and Tropical storm**

In more than 60 years (1954-2016), more than 550 typhoons and tropical depressions in Vietnam.

- 31% hit the North, 36% to the Central Region and 33% to the southern central and the southern regions
- In past 10 years (2006- 2016): 138 typhoons and tropical depressions in Vietnam
- Typhoons' landfalls usually accompany strong winds and heavy torrential rains, high tides, thus resulting in heavy and long rains and floods.
- It is estimated that up to 80 -90% of Vietnam's population are affected by typhoons.

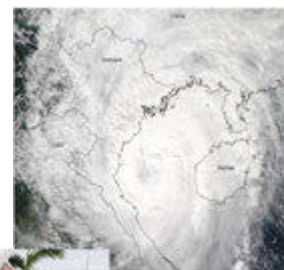


Track of typhoons and TD in 2009 in Vietnam



## Typhoon Son Tinh – October 28<sup>th</sup>, 2012

- At noon on October 25, 2012 , Sontinh entered the Bien Dong Sea (BDS)
- Made landfall over Nam Định – Thái Bình Province at night on October 28 , 2012
- Extreme strong wind and heavy rains for the areas of Northeast part of Tonkin, Thanh Hóa to Quảng Ngãi Province.
- Caused on average rainfall of 50-100mm in Northern and Northern central provinces, some places had Quảng Hà (Quảng Ninh Province) 375 mm, Cửa Cấm (Hải Phòng City) 334 mm and Thái Bình City 404mm.
- A total of 11 people were killed or are missing as a result of the typhoon; a further 90 people were injured; 55,680 houses were damaged; more than 95,000ha of paddy rice and cash crops were damaged. An initial estimate of total damage is nearly US\$2 billion



## Flood and Inundation

- Among the disasters, flood is ranked first in terms of affected areas, severity, frequency and losses it causes to society
- Floods occur in the rainy season influenced by the tropical monsoons, and also during the typhoon season in the northern and central part areas where typhoons land
- High flood and inundation about 2-3 days in the Central Viet Nam, 3-7 days in the North Viet Nam, and 3-4 months in the Mekong River delta
- For the last 10 years (2006-2016) there have been more than 400 flood events



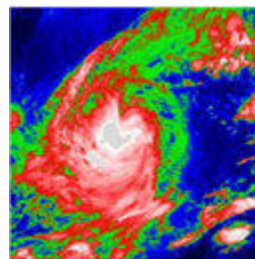
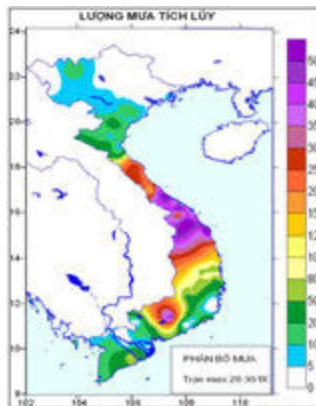


Some images about flood and inundation



**Typical Flood event in September 2009**

- Causing by the Tropical Storm Kesana landed in Quang Nam
- Heavy rains, over 600 millimetres was recorded
- The rain in some places was very heavy and higher than 600mm such as Nam Dong: 884 mm, Tra Bong: 914 mm.
- Heavy rainfalls mainly concentrated on 29 September with daily rainfall from 200 to 450 mm.
- The peak floods exceeded the alarm level 3 from 1.0 m to 4.0 m and got over the historical value in Vu Gia river.
- The heavy rainfall and extreme flood led very serious large, deep inundation about 1,0-4,5m during 3 - 7 days in the province.



Quang Nam in 30/09/2009



## Flash flood and landslide

- Distributed in mountainous areas where there are steep slopes, intense rainfall without or with limited drains and in the sedimentary rock area.
- Triggered by the heavy rain during a typhoon or tropical storm
- Occur within the limited geographical areas, but very intense and often cause serious loss of life and property
- Last 10 years (2006-2016) there have been 101 flash floods uncounted landslide
- The risk of Flash flood and landslide rises as climate change causes growth in the number and strength of typhoons and heavy rainfall.
- The frequency of landslides, number of deaths and economic losses are ranked third in ASEAN.



## Inundation on November, 2008 in HaNoi with total rainfall 500-600mm in Hanoi





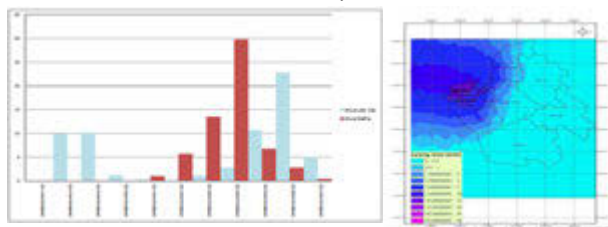
### Flash flood and landslide in Lao Cai province during 4<sup>th</sup> to 5<sup>th</sup> August, 2016

Causing by heavy rainfall of Tropical Storm NIDA  
 Daily rainfall distribution during NIDA storm occurrence at stations in Lao Cai province from 130 – 260mm



Tên Trạm	Ngày	27/7	28/7	29/7	30/7	31/7	01/8	02/8	03/8	04/8	Tổng
KT Lao Cai		6.8	17.6	36.5	28.5	0.0	0.0	1.2	9.1	55.3	155.0
KT SaPa		2.7	68.3	72.1	48.4	16.3	0.0	1.6	10.9	34.0	254.3
Mưa Bat Xat		2.0	10.0	11.0	39.0	0.0	0.0	3.0	5.0	60.0	130.0
Mưa O Quy Ho		0.0	75.7	77.8	32	0.0	0.0	23.0	19.3	39.4	267.2

hourly rainfall



**Loss and damage information**

- + Death and missing: 10 people (Bat Xat district: 9; Sa Pa: 1);
- + Damage Houses: 795 houses collapsed and destroyed;
- + 400 hectares rice and vegetable damaged;
- + Landslide of many parts of 4D main road; 5 bridges washed away; 30 irrigation construction as dams, reservoirs, spillway and 3 electric hydro- powers destroyed;
- + Estimate losing cost: more than 200 billion VND

**Some images about flash flood and landslide**



Flooding in Ngoi Dum basin affected to Lao Cai city



Broken 4D main road.



Main road in Bat Xat district after flash flood



A bridge at Sung Hoang village



Rice field at Quang Kim commune after flood



Ngoi San hydro-power after Flash flood

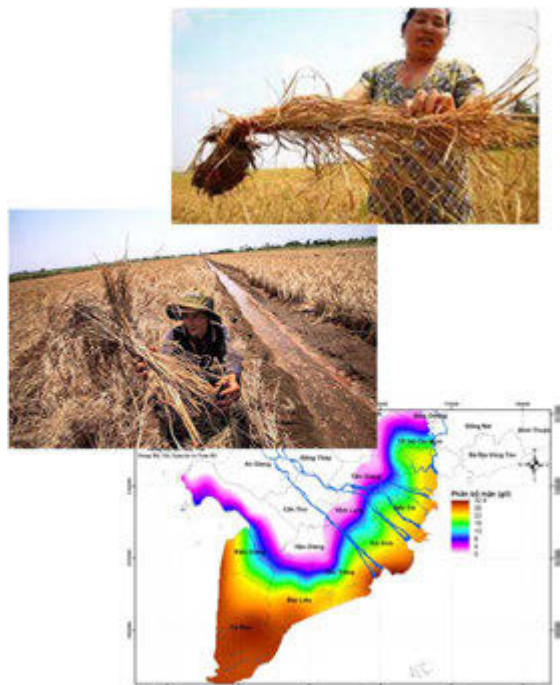
## Drought and desertification:

- In recent years, droughts and desertification occur in all parts of the country.
- Drought has reduced from 20 to 30% yields, reduced food production, causing serious effects on livestock and subsistence of the people.
- Prolonged drought will lead to the risk of desertification in some regions, especially the South Central region, coastal and and slopes of the midland.
- The last major drought occurred in 2015, 2016 and affected 3 million people especially in the agriculture, forestry and industrial farming.
- Droughts might increase in number and severity in the near future



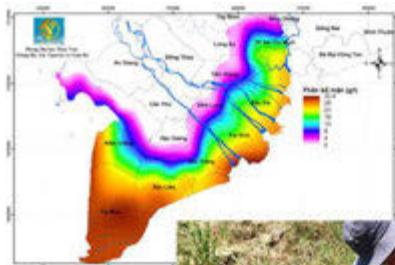
## Salinity

- Salinity occurs along the coast with different levels.
- The South West coastal provinces are those of most affected area of serious salinization with 1.77 million hectares, accounting for 45% of the land area.
- Cost of construction of the salinity intrusion, keeping fresh water is very expensive.
- There was a lack of rainfall and very high evaporation rates and salt water intrusion increased rapidly in the Mekong Delta.



## Drought and Salinity in 2015-2016

- 2015-2016, the worst drought the country has seen in 90 years has been attributed to the El Niño weather event
- River water levels : 15-35% lower than average in the Mekong Delta; 20-60% lower than average in the Central Highlands and 70% lower than average in the South-Central region
- Saltwater intrusion has extended up to 90 km inland in some coastal areas,
- 52 out of 63 provinces having been affected by drought; 18 provinces were declared states of emergencies
- 2 million people affected, some 500,000 live in the drought-affected South Central and Central Highlands Regions, and 1.5 million live in the Mekong Delta
- The total costed recovery needs is estimated at VND 27,241.2 billion (equivalent to US\$1,221 million).



## Other natural disasters

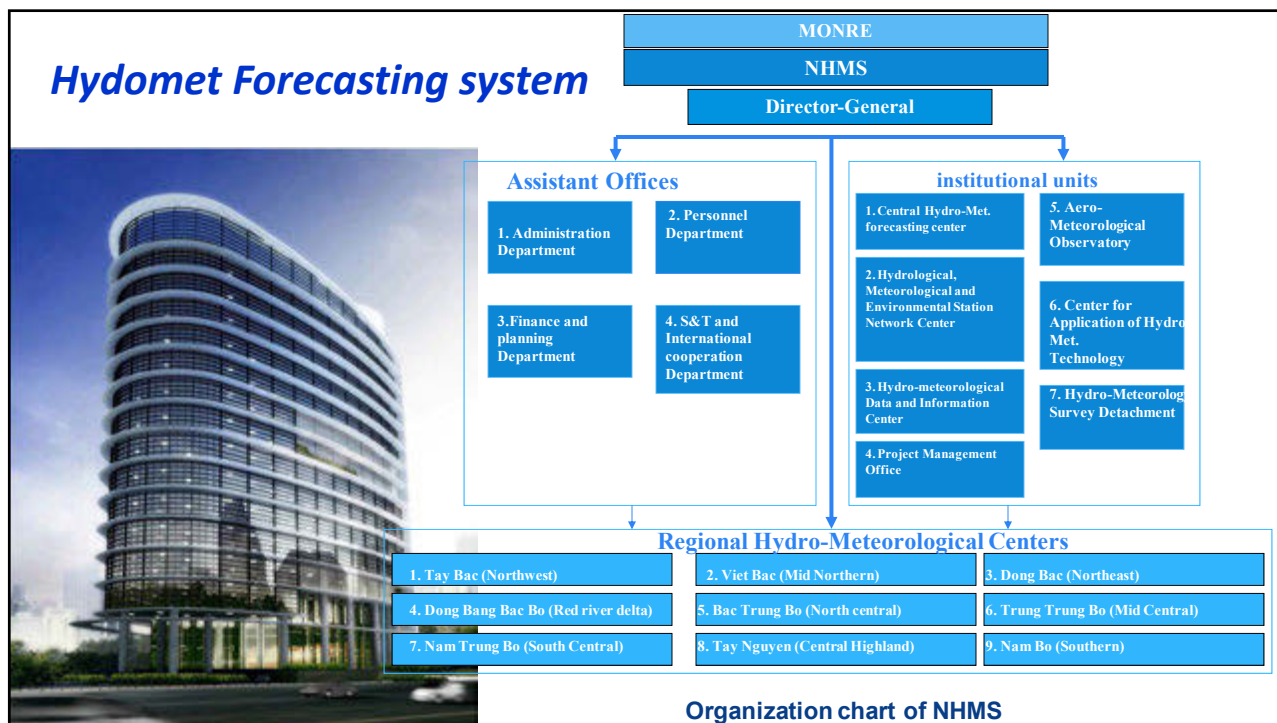


- Whirlwind: usually occurs suddenly, often occur every year in Vietnam. In recent years the number of whirlwind increases.
- Earthquakes have occurred in Vietnam, but only at low levels
- Sea level rise: the phenomenon of annual average sea level in recent years, higher than average sea many years due to the effects of global climate change
- Due to its location, it is difficult for the Vietnamese coast to be affected by destructive tsunamis.



## Natural disaster Forecasting system

### Hydromet Forecasting system





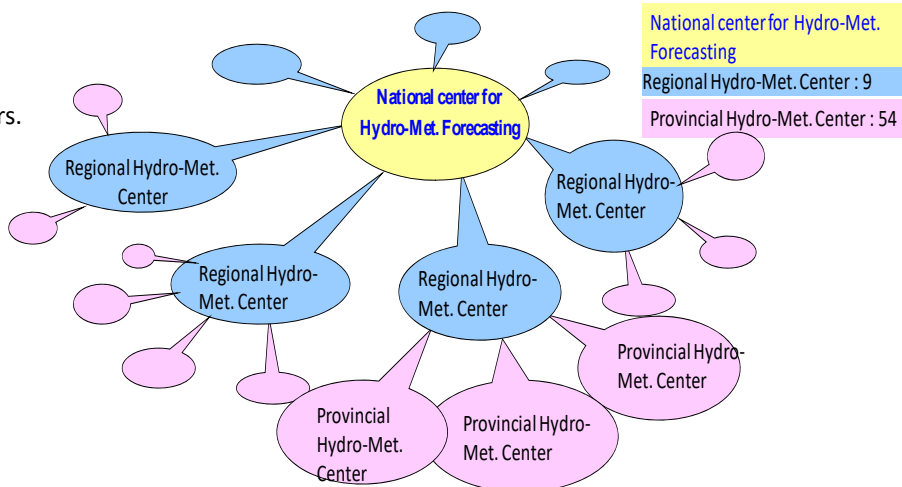
## Hydromet Forecasting system

**Human resources in the forecast:**

-National Centre for Hydromet Forecasting:  
 126 Forecasters.  
 19 main Forecasters,  
 107 staffs as forecasters.  
 6 Doctors,  
 38 Masters,  
 University: 82.

-Regional, provincial Hydromet Centers:  
 - About 3-7 Forecasters/each unit.  
 -Mostly are university levels.

The system of hydro-meteorological forecasts includes three levels



## Hydromet Forecasting system

The system of hydro-meteorological forecasts includes three levels

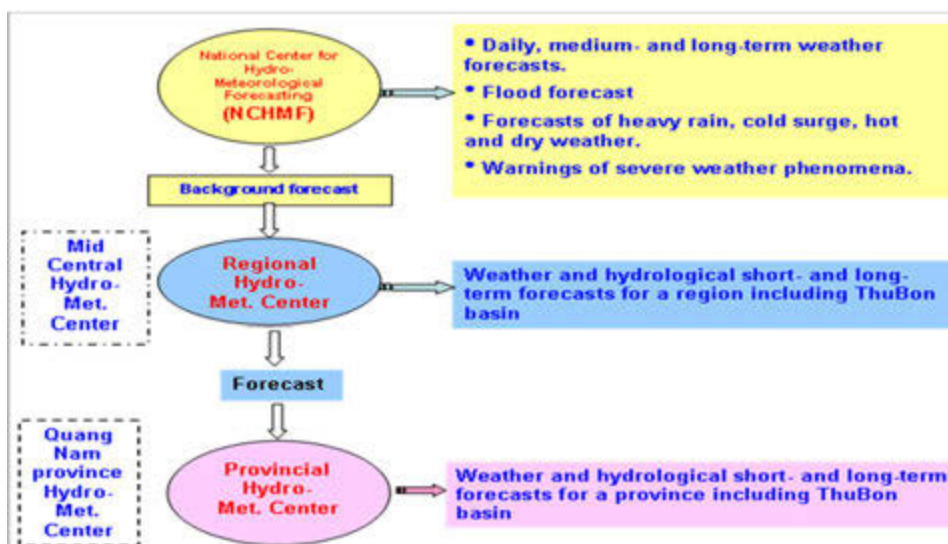
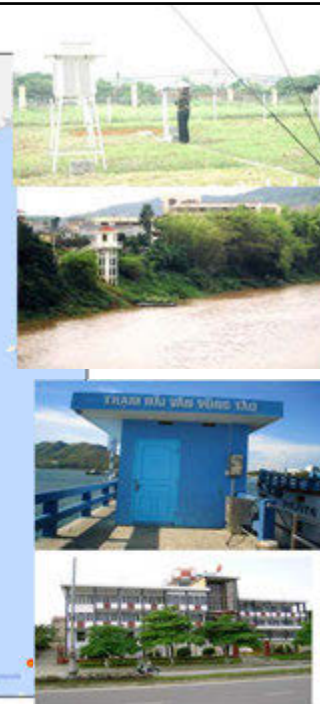
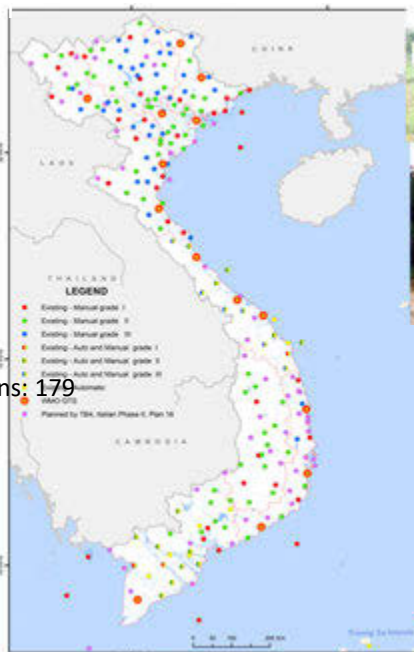


Figure 10: Functions of each forecasting level

### Hydro-meteorological data collection

- \* Surface Meteo. Stations: 186
- \* Raingauge sites : 889 (414+475)
- \* Radiation: 14
- \* Hydrological Stations: 232
- \* Marine Met. Stations: 23
- \* Aero- Meteorological Observation
  - \* Radiosonde stations: 6
  - \* Wind-gauge by theodolite: 8
  - \* Ozone and UV : 3
  - \* Weather radars: 7
- \* Air and water environment observation stations: 179
  - \* Automatic stations: 10
  - \* Dust/rain water quality : 16
  - \* River Water Quality : 51
  - \* Reservoir water quality : 4
  - \* Coastal water quality : 6
  - \* Salinity : 91
  - \* Climate Change Monitoring Station: 1



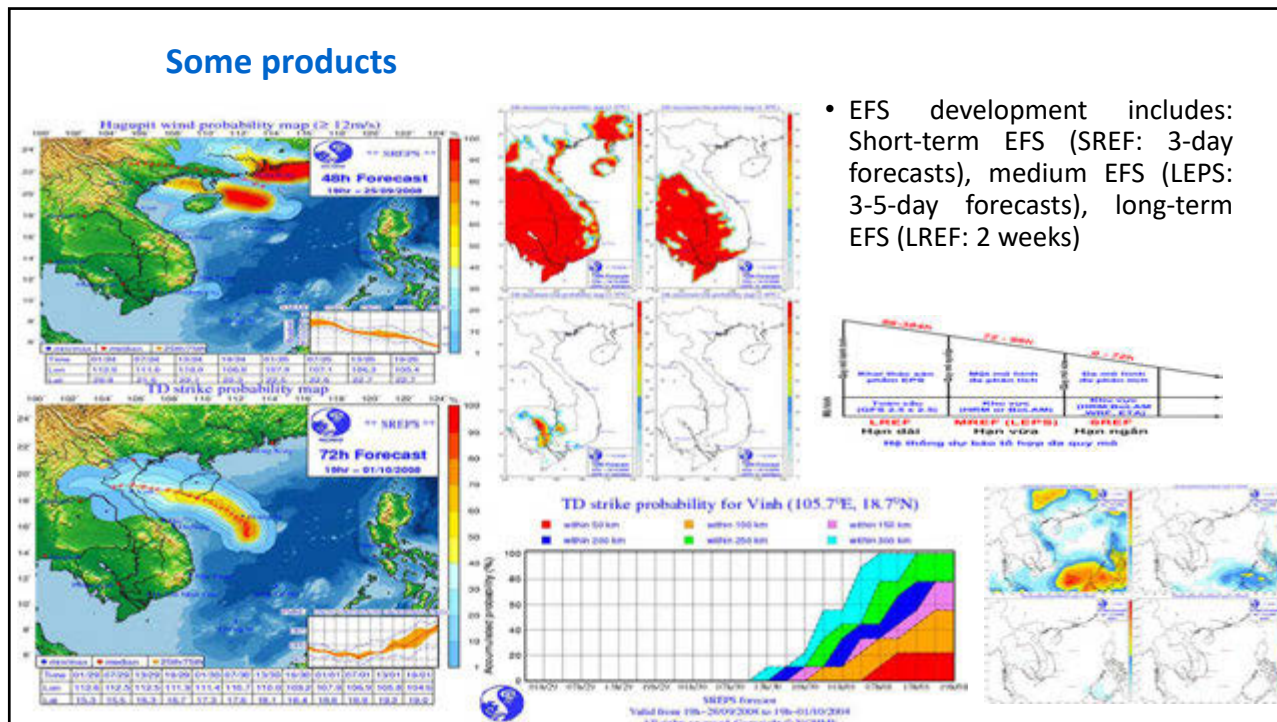
## Forecasting technology and products

### ❖ Meteorology

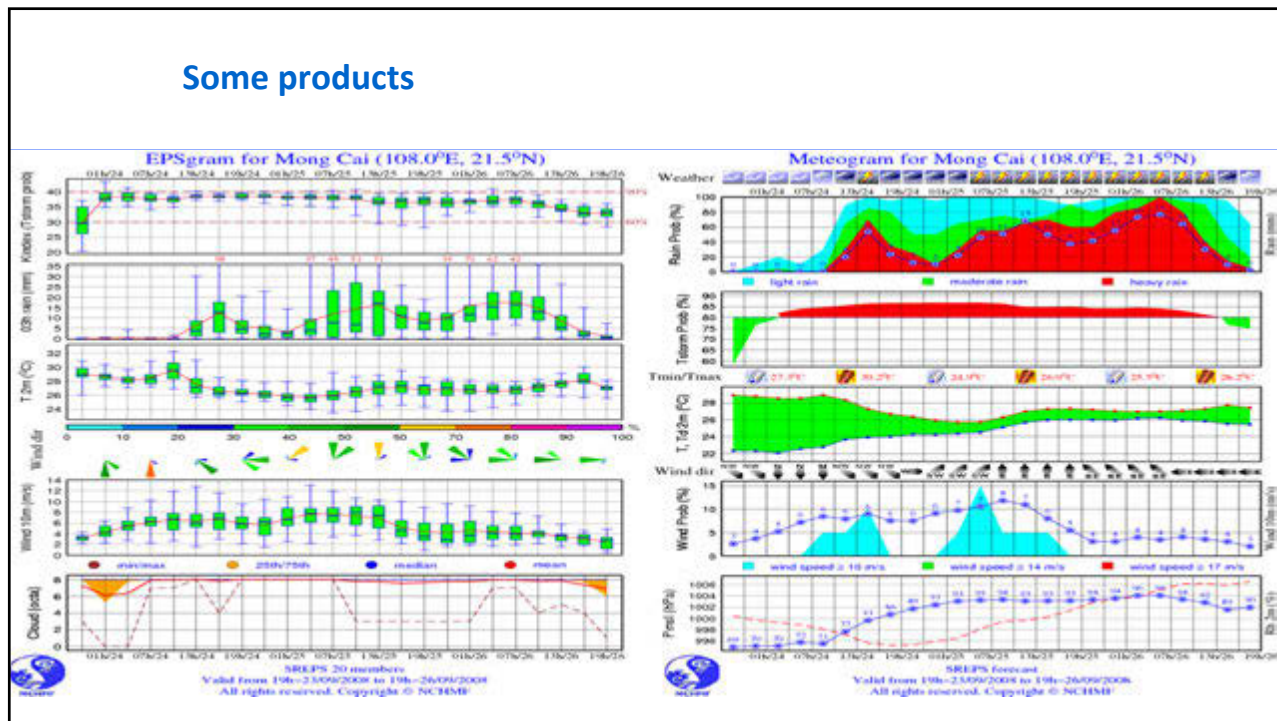
- Short-term weather forecast
- forecasts and warnings of severe weather phenomena causing natural disaster (storm, drought, heat ...)
- Medium weather forecast bulletins (3-10 days), monthly and seasonal forecasts.
- Warning of thunderstorm, lightning and severe weather phenomena on a small
- The weather forecast bulletins are transferred to agencies, departments, media to post on the Centre's Website, at: <http://www.nchmf.gov.vn> or <http://kttv.gov.vn>.
- Regional and provincial Hydromet Centers' bulletins provide agencies and local media.

### Data collection and use

- Domestic and international survey network data,
- weather radar images.
- Forecasting products of digital models from the Hydrometeorological Centres on the world and from professional models at NCHMF.
- Geostationary satellite cloud images (MTSAT, FY-2C), polar orbits (NOAA, FY-1D, FY-1C, FY-1E)
- Orbit forecasting products and storm magnitudes of Japan Meteorological Agency (JMA), Hong Kong Observatory (HK Observatory), American Joint Typhoon Warning Center (JTWC), China Meteorological Administration (CMA), Korea Meteorological Administration (KMA)
- Products of storm trajectory and magnitude extracted directly from global and regional models.

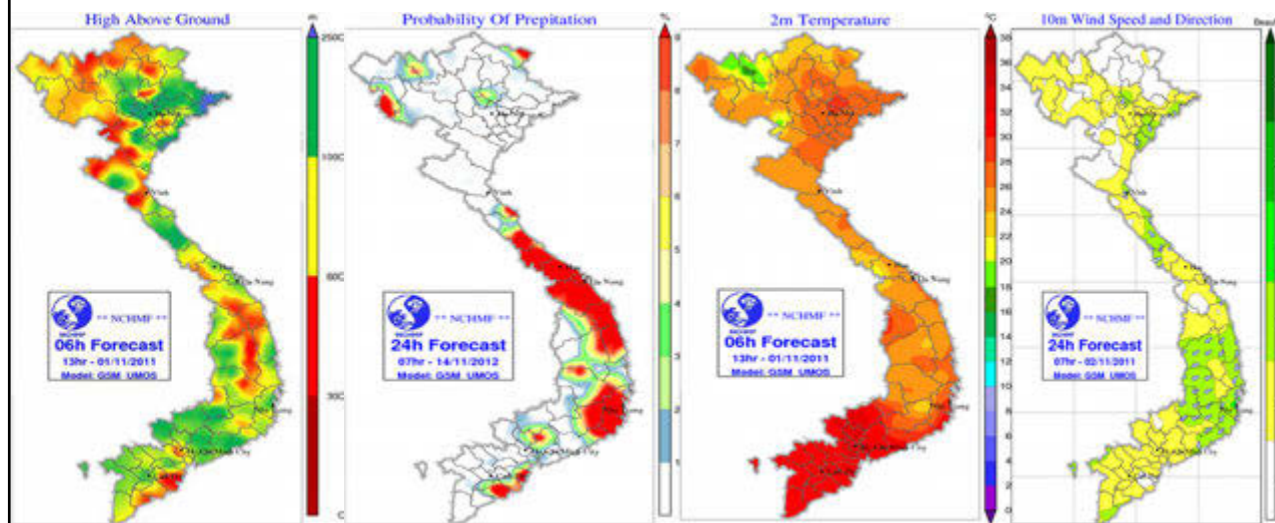


- EFS development includes: Short-term EFS (SREF: 3-day forecasts), medium EFS (LEPS: 3-5-day forecasts), long-term EFS (LREF: 2 weeks)



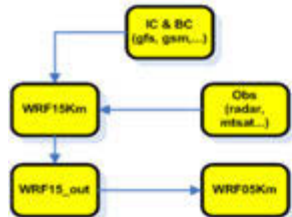
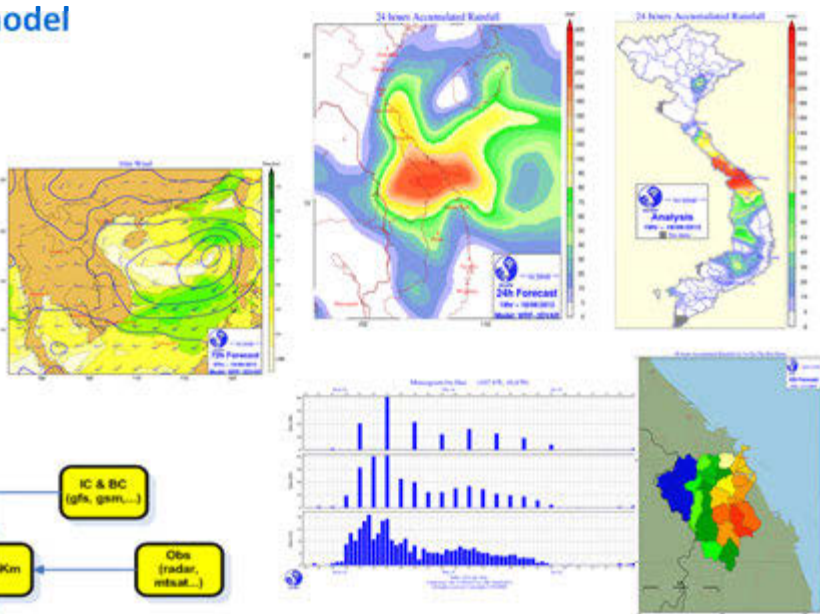


### Some products



### High resolution model

- **High resolution model system:**
- Running WRF model 15km with GFS input radar data assimilation, then downscaling to 5km.
- Forecast limit 72h
- Interval: 06h
- Base time: 12Z
- **Purpose:** capture the extremes, phenomena on local scale (heavy rains, tropical cyclones,...)



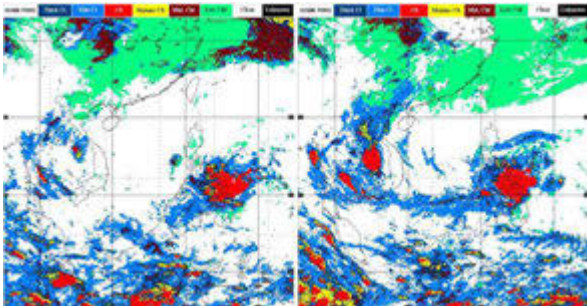


## Some satellite products

Satellite receiving and processing station

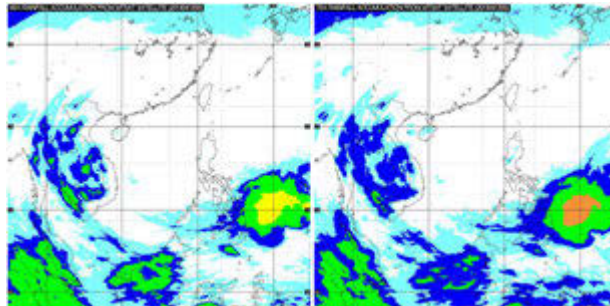
Data available:

- Geostationary satellite (48sets/day): MTSAT-1R, COMCAST,
- Polar-orbiting satellite: NOAA series and FY-1D, Himawari 8.
- Microwave: Internet



Cloud classification map from the satellite at 03z on the 13<sup>th</sup> of April and 14<sup>th</sup> of April 2014

- i. Realtime satellite mapping of precipitation (every 30 minutes); accumulated precipitation from 03 to 72 hours (every 03 hours).
- ii. Daytime cloud analysis map
- iii. Classification map of some types of cloud



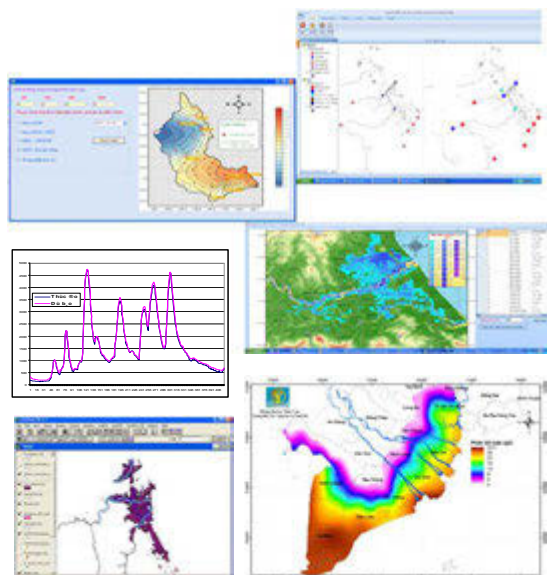
Estimated precipitation from the satellite in 48 hours and 72 hours at 00z on the 12<sup>th</sup> of April 2014 (unit: mm)

## Forecasting technology and products

### ❖ Hydrology

+ Existing products

- Short-term, med-term and long-term hydrological forecasts;
- Flooding season, water sources and flood flow identification forecasts;
- Flood, flash flood, land slide, land subsidence and inundation warning forecasts for natural disaster protection;
- Flood and emergent flood forecasts for natural disaster management;
- Reservoir management advisory forecasts for flood protection for works, downstream flood control and regulation of power generation as well as reservoir water supply;
- Hydrological forecasts for the construction of hydropower facilities, waterway and water supply for irrigation.

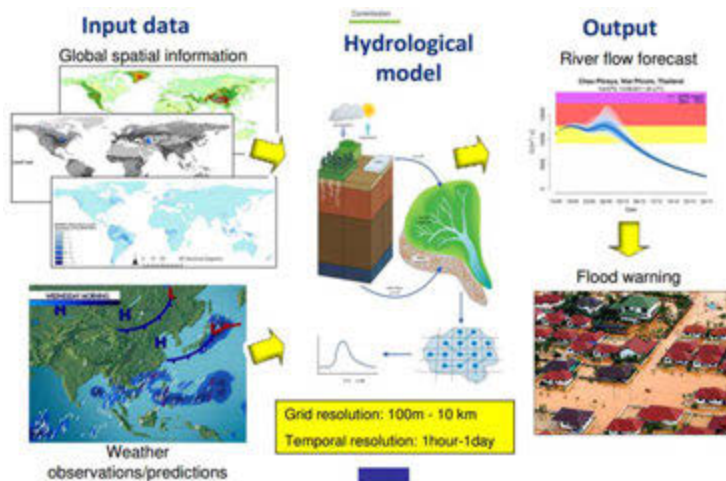


## Forecasting technology and products

### ❖ Hydrology

+ Existing forecast technologies

- The statistical models (multivariate regression, correlation, etc);
- Hydrological models including lumped parameter model and distributed parameter model with GIS connection;
- Hydrological and hydraulic models are used for the forecast at forecasting points on main rivers;
- Hydraulic models are mostly used at stations from North-Central Region to the Southern Region at some river basins.



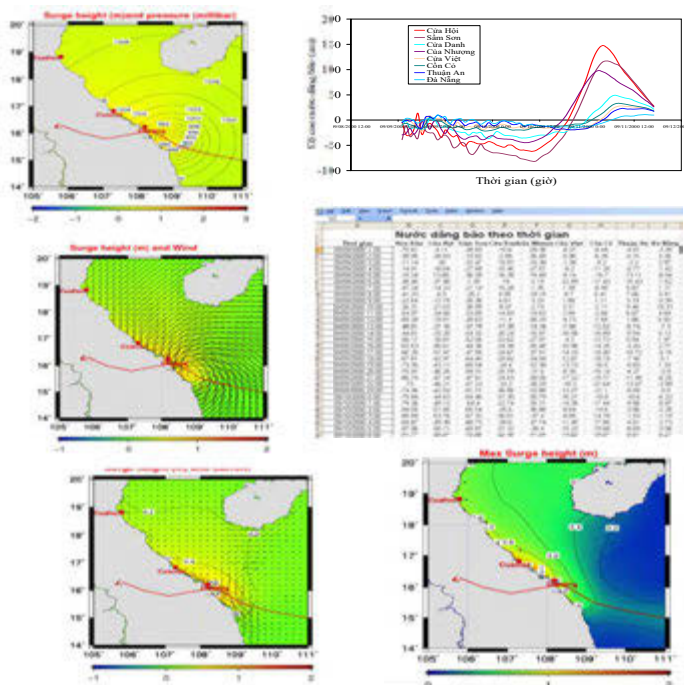
### ❖ Oceanography

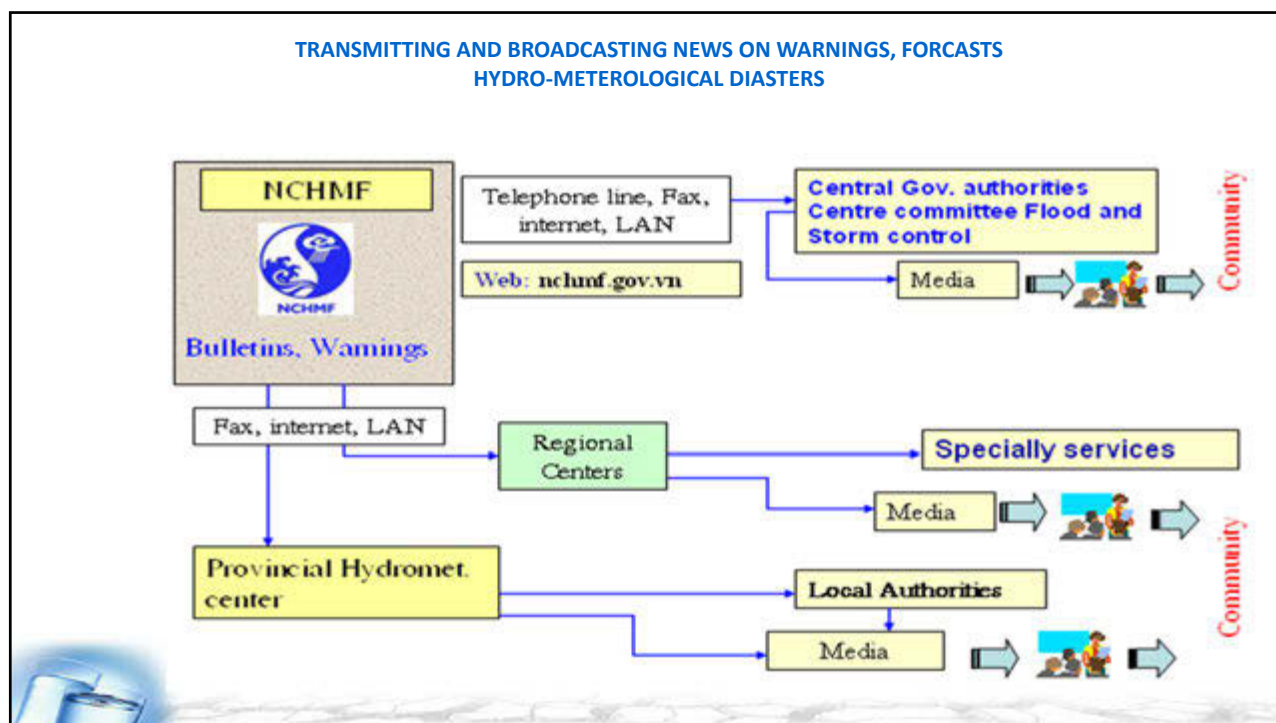
+ Existing products

- Current oceanographically forecast bases mainly on results from numerical models and are implemented for only 2 factors including waves and storm surges; forecast period is 12-24h.

+ Existing technologies

- bases on 3 major methods:  
Synop,  
statistical  
dynamic models.





## Natural disaster forecasting in the future

*Development orientation :*

*Enrichment of data sources (quantity, quality, in time) for weather, hydrological forecasts and warnings*

- Consolidating and upgrading observation network to meet requirement of storm and flood forecasting and warning activities;
- Updating observation technology;
- Strengthening hydro-met. survey capabilities

*Development of hydro-meteorological forecasting system*

- Developing telecommunication system and material-technical base for forecasting activities;
- Developing forecasting technologies;
- Improving forecast system

## Natural disaster forecasting in the future

*Improvement of meteorological, hydrological, environment data collection, processing, archives and service system*

*Research and Development will be focusing on:*

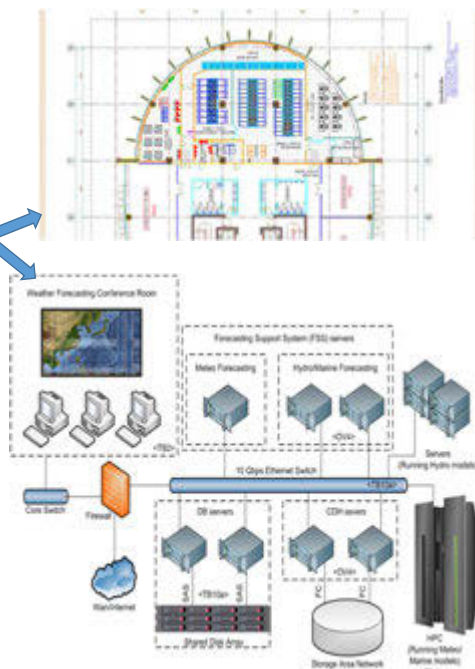
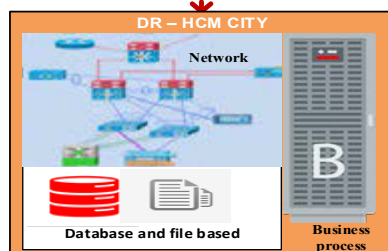
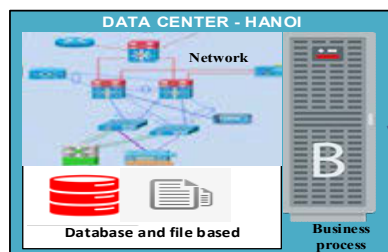
- ❖ Improvement of forecast capabilities
- ❖ Improvement of telecommunication facilities
- ❖ Interpretation of satellite and radar images
- ❖ Familiarizing and mastering new observation equipment and technologies

### Near Future Infrastructure development

Developing our station network (2016-2025):

- Surface Meteo. Stations: 454
- Raingauge: 755
- Radiation: 18
- Hydrological Stations: 640
- Marine Met. Stations: 77
- Aero- Meteorological Observation Radiosonde stations: 11
- Wind-gauge by theodolite: 14
- Ozone and UV : 4
- Weather radars: 21

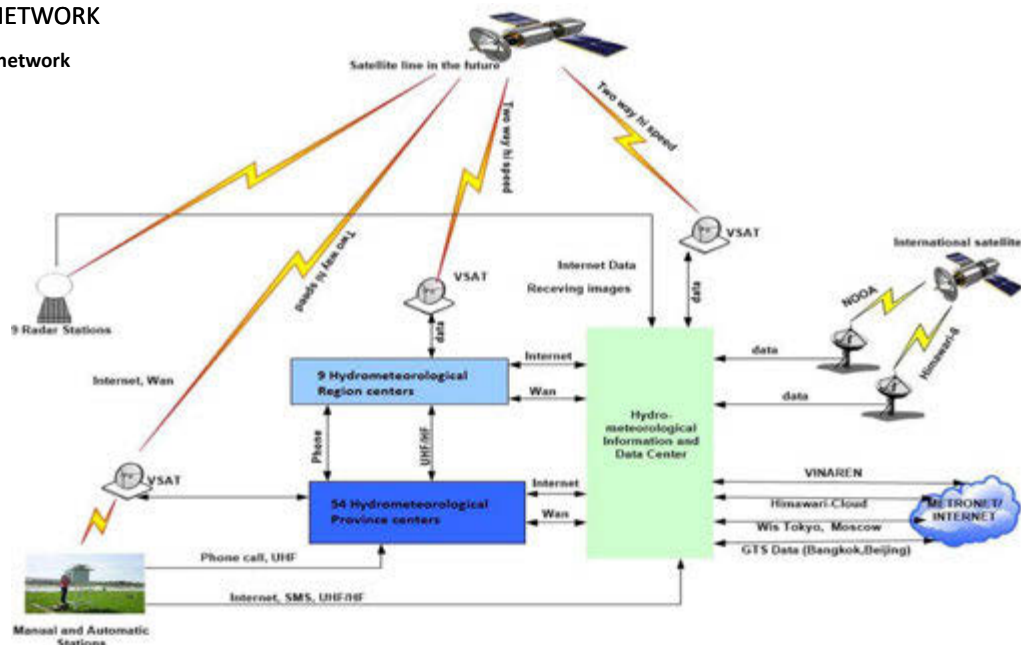
Building a centralized database system





### OUR FUTURE NETWORK

Desired network



Thank you for attention