GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION NO. - 498
ANSWERED ON – 02/12/2021

NEW TECHNIQUES OF FORECASTING WEATHER

498   Shri Brijlal

Will the Minister of EARTH SCIENCES be pleased to state:

(a)   the new technologies being used by Government for exact forecast of weather in view of the rapidly changing nature of weather and natural calamities during previous years;

(b)   the details of plan under consideration for using some other new technology in future and the details thereof; and

(c)   the types of technologies of weather forecast for which the country is dependent on foreign institutions and the details thereof?

ANSWER
THE MINISTER OF STATE (INDEPENDENT CHARGE) FOR
MINISTRY OF SCIENCE AND TECHNOLOGY
AND EARTH SCIENCES
(DR. JITENDRA SINGH)

(a)   Yes Sir. India Meteorological Department (IMD) issue various outlook/forecast/warning for Public as well as Disaster Management Authorities for the preparedness and for mitigation measures related to extreme weather events based on latest and new technologies as mentioned below.

IMD follows a seamless forecasting strategy. The long-range forecasts (for the whole season) issued are being followed with extended range forecast issued on every Thursday with a validity period of four weeks. To follow up the extended range forecast, IMD issues short to medium range forecast and warnings at 36 meteorological sub-divisions levels fdaily four times by the National Weather Forecasting Centre (NWFC), New Delhi valid up to next five days with an outlook for subsequent two days. The short to medium range forecast and warning at district and station level are issued by state level Meteorological Centres (MCs)/Regional Meteorological Centres (RMCs) with a validity of next five days and are updated twice a day. The short to medium range forecast is followed by very short range forecast of severe weather up to three hours (nowcast) for all the districts and 1085 cities and towns. These nowcasts are updated every three hours.

While issuing the warning suitable colour code is used to bring out the impact of the severe weather expected and to signal the disaster management authorities about the course of action to be taken with respect to impending disaster weather event. Green color corresponds to no warning hence no action is needed, yellow color corresponds to be watchful and get updated information, orange color to be alert and be prepared to take action whereas red color signals to take action.

IMD is issuing Impact Based Forecast (IBF) which give details of what the weather will do rather than what the weather will be. It contains the details of impacts expected from the severe weather elements and guidelines to general public about do's and don'ts while getting exposed to severe weather. These guidelines are finalised in collaboration with National Disaster Management Authority (NDMA) and is already implemented successfully for cyclone, heat wave, thunderstorm and heavy rainfall. Work is in progress to implement the same for other severe weather elements.

Technologies used to provide above forecasts and warnings are as follows.

1. The observational network of the department is enhanced with installation of more number of Automatic Weather Stations (AWSs) and Automatic Raingauges (ARGs) across the country.

2. 29 Doppler Weather Radars (DWR) are operational across the country to provide adequate warning in the event of approach of Cyclonic Storms, Monsoon Depressions, Thunderstorms etc. DWR network also provides vital information for nowcasting purposes on mesoscale convective weather developments anywhere in the country.

3. Multi-Mission Meteorological Data Receiving & Processing System has been established and dedicated to the nation for augmentation of satellite derived products.

4. 203 new raingauge stations have been added in the District-wise Rainfall Monitoring Scheme taking the total number of stations to 4940.

5. Location specific forecast for 7 days within the capital cities and nowcast for next 3 hours have been extended to 526 and 1084 stations, respectively covering 739 districts in the country.

6. Six Global and regional numerical weather prediction (NWP) models are run daily twice to provide forecast and warnings upto seven days (short to medium range) at station, block, district and meteorological sub-divisions levels. Sector specific modelling is also carried out to issue forecast in respect of agriculture, cyclone, riverine flood, flash flood and urban flood, thunderstorm/lightning etc.

7. The Numerical Weather Prediction (NWP)model based gridded rainfall data are provided to Central Water Commission for their flood forecasting model for all 153 river catchments and Extended Range model products for 10 river basins.

8. With operationalization of Flash Flood Guidance system, generation and issue of Flash Flood Guidance has commenced for all watersheds in the country.

9. Urban flood warning system has been developed for Mumbai and Chennai.

10. Common Alert Protocol (CAP) has been implemented as per WMO standard for severe weather warning. It is being utilized for Global Multi-Hazard Alert System of WMO.

11. The multi-model ensemble (MME) based Extended range prediction system and long range forecasting system have been developed and implemented in IMD.

(b)   For modernization, expansion and improvement in Weather & Climate services, various plans are underway in IMD under the Central Sector umbrella Scheme Atmosphere & Climate Research-Modelling Observing Systems & Services (ACROSS). There are 4 sub-schemes of IMD under ACROSS namely, Atmospheric Observation Network (AON), Upgradation of Forecast System (UFS), Weather & Climate Services (WCS) and Commissioning of Polarimetric Doppler Weather Radars (PDWR). Main activities of these sub-schemes undertaken during 2017-21 are as follows:

Atmospheric Observations Network (AON)

- Sustenance and Augmentation of observational networks comprising of Doppler Weather Radars (DWRs), Automatic Rain Gauges (ARGs), Automatic Weather Stations (AWSs), Upper Air, Surface and Environmental Observatories etc. Improve upon the spatial and temporal density of Radar observational network, particularly over the regions with large data gaps in the country.
- To improve and upgrade weather and climate services over north-eastern region by establishing additional state of art surface and upper air observatories for real time observations.
- Sustenance & Establishment of Multi processing, computing and communication facilities for Satellite Meteorological Applications.

Upgradation of Forecast System (UFS)

- Upgradation and sustenance of Communication Systems for Data and Product transmission.
- Development of an advanced Operational Forecast System, Delivery System for Forecast and other services.
- Conduct of special campaign for improving Cyclone, Thunderstorm and Fog forecasting through Aircraft reconnaissance and provision of additional observations.
- Integrated Himalayan Meteorological Programme for Western & Central Himalayas.
- Capacity Building, Outreach, Planning and sustenance of specific process related observing systems over India.

Weather & Climate Services (WCS)

- Setting up of District Agro-Met Units (DAMUs) at all the districts complimentarily with existing AMFUs in the country for extension of Agromet Advisory Services (AAS).
- Major upgradation of Meteorological facilities at all airports through commissioning of State-of-art Integrated Aviation Weather Observing Systems (AWOS), HAWOS, Microwave Radiometers, Doppler LIDARs, Wind Profilers etc to support Aeronautical MET Services.
- Establishment of a state-of the-art Climate Data Centre with integrated advanced Climate Data Services portal for rendering national and regional climate services.
- To upgrade the training infrastructure and facilities to enhance the capacity of the training establishment.

Commissioning of Polarimetric Doppler Weather Radars (PDWR)

The scheme "Commissioning of Polarimetric Doppler Weather Radars (DWRs)" is aimed at augmenting the DWR network over the country to facilitate plugging the existing gaps in the meteorological observational network of radars for most parts of the country, through installation of eleven C-Band dual polarized DWRs.

(c)   The details of collaboration in various fields and the MoU signed by Govt. of India with other countries and foreign government agencies are as follow;

1. The MoU for Technical Cooperation in Earth Observations and Earth Sciences between the National Oceanic and Atmospheric Administration (NOAA), USA and MoES. There are 5 active implementation agreements and IMD is responsible for Tropical cyclone activity part.

   - The Hurricane Weather Forecast (HWRF) model of NOAA has been customized and implemented for real time tropical cyclone forecast (Track, intensity, wind & Rainfall).
   - Customization of tailor made real time weather forecast products of extreme rainfall and impact based forecast.
   - This model has reasonable skill and is used along with other models to improve cyclone forecasting and warnings. It is needless to mention successful early warning of recent cyclones like, Phailin, Hudhud, Fani, Amphan, Nisarga, Tauktae&Yaas. This enabled disaster managers to minimize the losses of life being limited to less than 100.

2. Cooperation with World Meteorological Organisation (WMO):

   (i)   South Asia Flash Flood Guidance System (SAsiaFFGS)

   Collaboration with WMO has helped in technology transfer from Hydrologic Research Centre (HRC), USA to India for South Asia Flash Flood Guidance System commencing from monsoon season 2020 and will continue further.

   -Further integration in SAsiaFFGS model at IMD Delhi with configuration through use of local observational data like, rain-gauges &radar based rainfall data are in progress.

   - Implementation of MoES, Numerical Weather Prediction (NWP) model and development of SAsiaFFG for India, Nepal, Bhutan, Bangladesh and Sri -Lanka (4 times daily and valid up to next 12 hours) are in progress.

   -It helped to issue impact based forecast and risk based warning during monsoonal flood situations like heavy rainfall over Mumbai, Heavy rainfall over Dwarka and Heavy rainfall over Bhopal as few examples.

(ii) In coming 2-3 years collaboration with WMO will help in capacity building of the forecasters through training and augmentation of NWP guidance like probabilistic/ensemble forecast of cyclone and other severe weather events with the help of THORPEX Interactive Grand Global Ensemble (TIGGE) programme of WMO.

(iii) WMO Severe Weather Forecast Demonstration Programme (SWFP):

This collaboration in supporting India to be recognised as a regional leader to provide severe weather guidance to the member countries India, Bangladesh, Myanmar, Thailand, Bhutan, Nepal, Pakistan, Sri-Lanka and Maldives). In return, India got access to high resolution NWP model and location specific forecast products from European Centre for Medium Range Weather Forecasts (ECMWF), National Centre for Environmental Prediction (NCEP), UK Met Office (UKMO), Japan Meteorological Agency (JMA), Korean Meteorological Agency (KMA), China Meteorological Administration (CMA). Also satellite based nowcast (very short range forecast of convective activity like thunderstorm rainfall) was made available for use in the region. It also helps in capacity building through training of forecasters from different countries since June 2016.

(iv) Regional Climate Centre (RCC), Pune:

IMD Pune is WMO recognized Regional Climate Centre (RCC) for Regional Association (RA)-II region of WMO (May-2017). This center support to provide Gridded Rainfall data sets created for South Asia Region and the same is using for SASCOF outlooks. SASCOF outlooks issued by RCC Pune twice in a year along with Climatological model forecast which is updated every month for South Asia region. This centre also provides outlook for rainfall and temperature for next few months since monsoon 2010.

The collaboration with WMO helped RCC Pune for capacity building in South Asia region. In the Year 2016, 8 trainees trained for Pre-Climate Outlook Forum Training (Bangladesh, Bhutan, India, Maldives, Myanmar and Sri Lanka). Similarly, training were done during 2017, 2018, 2019, 2020 & 2021. RCC Pune centre in coming years will generate more user specific products in national as well as international level.

3. Project Mode Co-Operation Agreement between IMD& FMI for Air quality:

Collaborative agreement between IMD and Finish Meteorological Institute (FMI) helps in customizing the Air Quality Forecasting Model System for Integrated Modeling of Atmospheric Composition (SILAM) at 3.0 km resolution & City scale air quality forecasting model FMI-IMD ENFUSER ENvironmental information FUsionSERvice (customized for Delhi NCR and operationalized). This collaboration helps in providing realistic air quality forecast since 2020 and has improved further in air quality early warning system through customization of models like SILAM and ENFUSER. This coordination will further enhance the air quality forecast with sufficient lead time in a smaller domain.

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