

**GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
LOK SABHA
UNSTARRED QUESTION NO. 3461
TO BE ANSWERED ON WEDNESDAY, 22ND MARCH, 2023**

ACCURATE WEATHER FORECASTS

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DR. BHARATIBEN DHIRUBHAI SHIYAL:
SHRI RAMESH CHANDER KAUSHIK:

Will the Minister of EARTH SCIENCES be pleased to state:

- (a) whether any agreement has been signed by the Government with a foreign country for accurate weather forecasting;
- (b) if so, the salient features of the said agreement in view of the rapidly changing nature of weather and natural calamities in the past year;
- (c) the steps being taken/proposed to be taken by the Government for accurate weather and climate forecasting;
- (d) the details of the systems and softwares being developed to improve weather forecasts and weather alerts; and
- (e) the details and types of technologies on which the country is dependent on foreign institutions for weather forecasting?

ANSWER

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

- (a)-(b) Yes Sir. The details of collaboration in various fields of Meteorological and Climatological Services and the MoU signed by Govt. of India with other countries and foreign government agencies are provided in Annexure-I.
- (c) India Meteorological Department (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 daily four times 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 1089 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.

- (d) The details of systems/software developed to provide above forecasts and warnings are provided below:
1. Developed a dynamical prediction system for seamless prediction of weather, extreme events from seasonal scale to short-range scale.
 2. Thirty seven Doppler Weather Radars 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 for augmentation of satellite derived products.
 4. 4940 rain gauge stations have been installed for District-wise Rainfall Monitoring.
 5. Location specific forecast for 7 days and nowcast for next 3 hours have been extended to 1164 cities and 1089 stations respectively covering 739 districts in the country.
 6. Six Global and regional Numerical Weather Prediction (NWP) models are run by MoES daily twice to provide forecast upto seven days (short to medium range) to provide the forecast and warning at station, Block, district and meteorological sub-divisions levels. Sector specific modelling is also carried out for forecasting with respect to agriculture, cyclone, riverine flood, flash flood and urban flood, thunderstorm/lightning etc.

7. The 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. Operationalization of Flash Flood Guidance system, generation and issue of Flash Flood Guidance for all watersheds of 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.
12. A very high-resolution (400 m) operational air quality prediction system has been developed to forecast air pollution events in Delhi and issue timely warnings to take necessary steps as per the newly designed Graded Response Action Plan (GRAP) of the Government of India.
13. Heat Action Plans developed in collaboration with NDMA and state governments to reduce heat-related mortality and morbidity in the country.
14. A network of lightning detection sensors has been established over India for monitoring and now-casting of lightning occurrences.
15. India's first Earth System Model (IITM-ESM) contributed to global and regional climate change assessments of the Intergovernmental Panel on Climate Change Sixth Assessment Report (IPCC AR6) and participated in the Coupled Model Intercomparison Project – Phase 6 (CMIP6).
16. The National Climate Change Assessment report documenting the regional climate change projections, released to benefit students, researchers, and policymakers.

IMD has taken various initiatives in recent years for improvement in dissemination of weather forecast and warning services based on latest tools and technologies. IMD has launched seven of its services (Current Weather, Nowcast, City Forecast, Rainfall Information, Tourism Forecast, Warnings and Cyclone) with 'UMANG' mobile App for use by public. Moreover, IMD had developed mobile App 'MAUSAM' for weather forecasting, 'Meghdoot' for Agromet advisory dissemination and 'Damini' for lightning alert.

- (e) Though we are not dependent entirely on any foreign entity for weather forecasting, the bilateral and multilateral international agreements with various Government agencies in the field of Earth system science, helps the Ministry to support research proposals, joint observational campaigns, joint development work, exchange of resource personnel and training abroad etc.

Details of various collaborations/MoU with other countries

1. The MoU for Technical Cooperation in Earth Observations and Earth Sciences between the National Oceanic and Atmospheric Administration (NOAA), USA and MoES.

- (i) Under this collaboration, systems have been set up for seasonal, extended-range and short-range dynamical predictions using coupled and atmosphere only models with specific emphasis on monsoons and its variability. A modified version of the same modeling system is also used for climate change studies and this formed the basis for an Indian entry in the CMIP6 inter-comparison.
- (ii) The Hurricane Weather Forecast (HWRF) model of NOAA has been customized and implemented for real time tropical cyclone forecast (Track, intensity, wind & Rainfall). This model is used along with other models to provide cyclone forecasting and warnings. It is needless to mention successful early warning of recent cyclones like, Phalin, Hudhud, Fani, Amphan, Nisarg, Tauktae & Yaas by IMD. This enabled disaster managers to minimize the losses of life being limited to less than 100 due to any cyclone hitting the coastal region.

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 which commenced from monsoon season of 2020. It helped to issue impact based forecast and risk based warning during monsoonal flood situations like heavy rainfall.

- (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.

- (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 provides 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.

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 Fusion Service (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.

4. Developments under Monsoon Mission Project

The Ministry of Earth Sciences (MoES), Government of India, launched the National Monsoon Mission (NMM) in 2012 (now referred as Monsoon Mission, MM), with a vision to develop a state-of-the-art dynamical prediction system for Indian monsoon rainfall on different time scales. MoES bestowed the responsibility of execution and coordination of this mission to the Indian Institute of Tropical Meteorology (IITM), Pune in collaboration with the National Centre for Environmental Prediction (NCEP), USA, other MoES organizations (NCMRWF, IMD & INCOIS) and various national and international academic institutions and organizations.

5. MoU on cooperation in Weather and Climate Sciences with the Met office, UK

(i) Under this collaboration, a science plan consisting of 3 work packages has been finalized with a focus on enhancing our capabilities in modelling high impact weather and inform services that help reduce exposure to damaging weather and climate impacts like the flooding during the South Asian summer monsoon, lightning and landslides; tropical cyclones bringing heavy rains, storm surges/flooding and strong winds; drought; hail and dust storms.

(ii) Consortium Agreement on Unified Model Earth System Modelling Software.

The agreement enables scientific and technical collaboration on a shared modelling system, across a range of modelling and science issues relevant for weather and climate prediction