

GOVERNMENT OF INDIA
MINISTRY OF EARTH SCIENCES
RAJYA SABHA
UNSTARRED QUESTION NO-3072
ANSWERED ON - 23/03/2021

ACROSS SCHEME

3072. SHRI AYODHYA RAMI REDDY:

Will the Minister of EARTH SCIENCES be pleased to state:

- (a) the details of features of Atmosphere & Climate Research-Modelling Observing Systems & Services (ACROSS) scheme which aims to provide for a reliable weather and climate forecast;
- (b) the progress made under the scheme;
- (c) the intended impact of the scheme; and
- (d) the details of other measures being taken to improve upon climate forecasting?

ANSWER

**MINISTER FOR MINISTRY OF SCIENCE AND TECHNOLOGY
AND MINISTRY OF EARTH SCIENCES
(DR. HARSH VARDHAN)**

- (a) Atmosphere & Climate Research-Modeling Observing Systems & Services (ACROSS) umbrella scheme pertains to the atmospheric science programs of Ministry of Earth Sciences (MoES). The entire gamut of weather/climate prediction involves assimilation of meteorological observations, understanding the processes, research and development of dynamical models and providing the forecast services. Each of these aspects is incorporated as sub-scheme under the umbrella scheme ACROSS and is implemented by four different institutions under MoES namely: India Meteorological Department (IMD), National Centre for Medium Range Weather Forecasting (NCMRWF), Indian Institute of Tropical Meteorology (IITM) and Indian National Centre for Ocean Information Services (INCOIS) which implements a small part of one of the sub-schemes.

The ACROSS umbrella scheme has eight (08) sub-schemes and all sub-schemes are Central Sector Scheme fully funded by the Central Govt.

Sl. No.	Sub-Scheme	Implementing Institution
1	Commissioning of Polarimetric Doppler Weather Radars (PDWR)	IMD

2	Commissioning of Polarimetric Doppler Weather Radars (PDWR)	IMD
3	Weather and Climate Services (WCS)	IMD
4	Atmospheric Observations Network (AON)	IMD
5	Numerical Modelling of Weather and Climate (NMWC)	NCMRWF
6	Monsoon Mission -III	IITM
7	Monsoon Convection, Clouds and Climate Change (MC4)	IITM
8	High Performance Computing System	IITM

Objectives of the each of the sub-schemes are given in Annexure-I.

(b) The progress made under the ACROSS scheme are listed below:

- (i) Development of global advanced weather prediction models and Ensemble Prediction System to generate deterministic and probabilistic forecasts at a high horizontal resolution of 12 km. In addition regional models with higher resolution also have been developed.
- (ii) For past few years, skill of IMD's weather forecasts and warnings, especially cyclone prediction has improved substantially.
- (iii) A first of its kind high-resolution Air Quality Early Warning System for Delhi has been developed to predict extreme air pollution events in Delhi. A very high-resolution (400 meters) model for operational air quality forecasts using both satellite and surface chemical data assimilation has been developed.
- (iv) Procurement of 10 Petaflop High Performance Computer (HPC) in 2017 (which is now fourth best among weather prediction centres) for modelling efforts.
- (v) X-Band Doppler Weather Radars (DWR) under Integrated Himalayan Meteorological Programme have been installed and commissioned at Mukteshwar (Uttarakhand), Kufri (Himachal Pradesh) and Sonmarg (J&K).
- (vi) A Multi-Mission Meteorological Data Receiving & Processing System (MMDRPS) has been established. The system has three dedicated earth station and data receiving system to receive the data from currently operational Geostationary satellites INSAT-3D, INSAT-3DR and INSAT-3DS to be launched in year the 2021-22.
- (vii) Seventeen (17) High Wind Speed Recorders (HWSR) were installed at Vishakapatnam, Machilipatnam, Chennai, Goa, Cuddalore, Bhubaneshwar,

Kakinada, Puri, Ongole, Digha, Kavali, Haldia, Pamban, Gopalpur, Kanyakumari, Veraval and Bhuj.

- (viii) Integrated Flood Warning System for Mumbai (IFLOWS-Mumbai) was launched on 12th June, 2020
- (ix) Meteorological Observatory (MO) Leh was upgraded into full-fledged Meteorological Centre (MC) to cater to the needs of Ladakh region.
- (x) Establishment of 189 new Agro-Meteorological Field Units (AMFUs) for rendering Agromet Advisories in addition to already existing 130 AMFUs. Furthermore, there has been a remarkable increase in the dissemination of these advisories to farmers and at present approximately 43 million farming households against 22.7 million during 2016.
- (xi) IMD provides agrometeorological advisories twice in a week in collaboration with Indian Council for Agricultural Research (ICAR). A recent assessment report published by the National Council of Applied Economic Research (NCAER) concluded that investments made by the Government to enhance weather and forecasting services are yielding great economic benefits to farmers, livestock rearers and fisherfolk. India's investment of nearly 1,000 crores through Monsoon Mission and High Performance Computers yielded benefits worth rupees 50 thousand crores to ~10.7 million below poverty line (BPL) agricultural households and 0.53 million BPL fisherfolk households in the country over a period of five years. Therefore, investments by Government have yielded fifty-fold gains to agricultural farmers, livestock rearers, and fisherfolk of India.
- (xii) A Lightning Location Network with sensors at 83 locations across the country has been put in place. The DAMINI LIGHTNING ALERT Mobile App has been developed and released in May 2020.
- (xiii) Thunderstorm warning for 832 stations covered all over the country as nowcast basis (3hrs forecast).
- (xiv) The Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEEX) observational campaign, was conducted during 2018-19 and 2019-20 for understanding cloud and rainfall processes in natural and seeded clouds over the rain shadow region, and resulted in 240 hours of observations.
- (xv) The Indian Institute of Tropical Meteorology (IITM) has developed an Earth System Model (ESM) for the first time. The IITM-ESM will be the first climate model from India that will be participating in the Coupled Modeling Intercomparison Project-Phase 6 (CMIP6) experiments required for the Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report.
- (xvi) A new open access book on **Assessment of Climate Change over the Indian Region** has been published in June 2020. This is the first climate change report for the Indian region from the Ministry of Earth Sciences, and discusses the influence of human-induced global climate change over the Indian subcontinent, the adjoining Indian Ocean, the Himalayas and on the regional monsoon.
- (xvii) State wise reports have been prepared on rainfall changes/trends and its variability based on the recent 30 years of data (1989-2018).

(xviii) **Upgradation of the forecast dissemination strategy.** MoES has made a drastic improvement in the dissemination of weather-related information to all stakeholders, including the public.

(c) The scheme aims to continuously improve the skill of weather forecasts in all temporal and spatial scales to provide near accurate forecasts for all weather events including extreme weather events and disaster related events to various user communities like farmers, fishermen, general public, state and public authorities etc.

(a) An Earth System Model has been developed at the Centre for Climate Change Research (CCCR), IITM, Pune (IITM –ESM) for giving long-term climate change projections. The IITM-ESM is the first of its kind from India and this is the first climate model from India that participated in the Coupled Modeling Intercomparison Project- Phase 6 (CMIP6) experiments required for the Intergovernmental Panel on Climate Change (IPCC) 6th Assessment Report. The IITM-ESM projections are also feeding into the IPCC Sixth Assessment Report (AR6), which will be released later in 2021. Efforts are on to continuously improve climate forecasting by developing the next-generation IITM-ESM in the next few years.

Annexure-I

The eight (08) sub-schemes under the ACROSS umbrella scheme and their objectives are as follows:

SNo	Name of the sub-scheme	Objectives
1	Commissioning of Polarimetric Doppler Weather Radars (PDWR)	Installation & commissioning of C-Band Polarimetric Doppler Weather Radars at various locations across the country is the major objective of the sub-scheme PDWR. Implementation of this plan of action shall directly or indirectly result into several benefits such as effective nowcasting of severe weather events, improved data collection, better monitoring and tracking of tropical cyclones etc.
2.	Upgradation of Forecast System (UFS)	<ul style="list-style-type: none">• Augmentation and sustenance of Communication Systems including upgradation of decision support systems.• Development of an advanced Operational Forecast System (including Monsoon Mission-IMD), Multi-Hazard Early Warning System, Automation of Nowcast, Thunderstorm Testbed, Urban Meteorological Services and Positional Astronomy services• Upgradation of Hydrometeorological Services, Tourism Forecast Services & development of Mobile/web based applications for customized weather and climatic advisories.• Integrated Himalayan Meteorological Programme for Western & Central Himalayas (IHMP).
3.	Weather and Climate Services (WCS)	<ul style="list-style-type: none">• Setting up of District Agro-Met Units (DAMUs) at all the districts complementarily with existing AMFUs in the country for extension of Agromet Advisory Services (AAS).• To expand the outreach of weather based Agromet advisories to the farmers through multiple means of communication, collection of feedback and impact assessment of AAS.

		<ul style="list-style-type: none"> • Major upgradation of Meteorological facilities at all airports through commissioning of State-of-art Integrated Aviation Weather Observing Systems. • Setting up of automated Heliport Weather Observing & Transmitting System (HAWOS) at Heliports, Landing ground, and other strategic locations to support the helicopter and low level flight operation of IAF, Indian Army and CPMF and also at important tourist and pilgrimage locations. • 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. • Contributions among WMO/RIMES/ESCAP/Global Framework for Climate Services (GFCS) in South Asia etc.
4	Atmospheric Observations Network (AON)	<ul style="list-style-type: none"> • Integrated Meteorological Services for the North-East (NE) region through commissioning of DWRs, AWOS/ HAWOS, AWSs/ARGs/ SGs, Microwave Radiometers, Wind LiDARsetc, and establishment/ upgradation of Meteorological Centres aimed at improving weather and climate services over the region. • Metro Air Quality and Weather Service (MAQWS) through establishment of Air pollution prediction and monitoring systems in the country –SAFAR (System of Air Quality and Weather Forecasting and Research). • Sustenance and Augmentation of observational networks comprising of Doppler Weather Radars (DWRs), Automatic Rain Gauges (ARGs), Automatic Weather systems (AWSs), Upper Air (RS/RW and PB), Surface, Environmental and Polar Observatories etc. • Establishment/ upgradation and maintenance of Multi processing, computing and communication facilities for Satellite Meteorological Applications comprising of Multi Mission Data Reception and

		Processing System (MMDRPS), Polar Orbit Direct Receiving systems etc.
5.	Numerical Modelling of Weather and Climate (NMWC)	<ul style="list-style-type: none"> • Improvement of seamless weather and climate prediction system with high reliability over India and neighbouring regions • Development of novel applications based on dynamical model outputs for various sectors (viz. Defence, Energy, Water Resource, Transport, Geo-Hazards etc.) • Establishment, maintenance and enhancement of physical, computational and associated infrastructure for carrying out research and development activities
6.	Monsoon Mission -III	<ul style="list-style-type: none"> • Development of Next Generation seamless prediction system for short, medium, extended and long-range predictions including improved assimilation systems with improved lead times for better decision making in applications in the various climate sensitive sectors. • Development of climate applications in Agriculture, hydrology, energy and Health sectors • Use of AI/ML and Physics Guided Data Mining in improving forecasts at shorter spatial scales and long leads including development of better parametrization.
7	Monsoon Convection, Clouds and Climate Change (MC4)	<p>This scheme has five targeted project components focusing on the scientific deliverables, and also allowing for cross-fertilization of innovative research ideas through interconnections among the individual project components. The five sub-components are (a) Centre for Climate Change Research (CCCR) (b) Physics & Dynamics of Tropical Clouds (PDTC) (c) Atmospheric Research Testbeds (ARTs) (d) Metro Air Quality and Weather Service (MAQWS) (e) Climate Variability and decadal Prediction (CVP). All the sub-components of MC4 are interlinked, however each has a specific objective aimed at achieving the larger objective of MC4.</p>

CCCR

- Modelling of global and regional climate variability and change using Earth System Models and High Resolution (27 km grid) Climate Models.
- Conduct ground based measurements of greenhouse gas (GHG) concentrations and fluxes, chemical trace gases, meteorological & land surface parameters. Reconstruct past variations in the South Asian monsoon extending back to several thousands of years using climate proxies (*eg., tree-rings, speleothems, corals, etc*) based on field campaigns, laboratory measurements and climate model investigations.

PDTC

- Conduct scientific investigations of aerosol-cloud-precipitation interactions in warm and mixed phase clouds, characterize cloud condensation nuclei and ice nuclei particles, physical and dynamical processes leading to extreme precipitation, winter fog experiment, urban air quality and atmospheric chemistry.
- Develop weather modification research strategies on artificial rainmaking, hail suppression, fog dispersal and reduction of air pollution.
- Conduct field experiments (campaign mode) at various stations, laboratory and simulation experiments to understand the effects of electrical forces, different environmental conditions including aerosols on initiation and intensification of thunderstorms.

ART

- To establish an Atmospheric Research Testbed in Central India for better understanding on processes governing monsoon convection including its diurnal variation and land-atmosphere interactions in core monsoon zone with state of the art instrumentation and UAVs.
- To establish a small radar network in the Mumbai metropolitan region to provide high-resolution rainfall (both temporal and spatial) flood warning

		<p>and nowcasting. Utilize radar data sets to better understand heavy precipitation processes and to validate and improve satellite retrievals.</p> <ul style="list-style-type: none"> • Continue high-altitude cloud physics laboratory for cloud, aerosol, rain microphysics using in-situ and radars over Western Ghats to better understand orographic convection and precipitation processes; aerosol-cloud-precipitation interaction processes. <p><u>MAQWS</u></p> <ul style="list-style-type: none"> • Research on science of air pollution and forecasting, relevant atmospheric chemistry processes and impact assessment on health and ecosystem through observational campaigns and modelling. <p><u>CVP</u></p> <ul style="list-style-type: none"> • To develop a decadal prediction system based on the in-house Earth System Model for enabling the capability to predict the Indian monsoon and Indian Ocean temperature, sea level etc. about 1-10 years ahead of time.
8.	High Performance Computing System	<ul style="list-style-type: none"> • Establishing a multi-petaflops scale computing facility for the MoES institutes to meet requirement of numerical modelling for weather and climate forecasting, basic research, and observations. • To make available computational resources to the academic and other R&D community to work on the operational forecasting system and to improve forecast skill. • To establish and maintain a MoES Atmospheric Research Data Center, and provide researchers with easy access to data. • Promote research on weather/climate applications and AI/ML
