Expeditions to Antarctica

1481. SHRI K. R. ARJUNAN: Will the Minister of EARTH SCIENCES be pleased to state:

(a) whether it is a fact that annual missions to maintain three Indian bases in Antarctica will continue;

(b) whether it is also a fact that there will be more expeditions and research focus on the other poles; and

(c) if so, the details thereof?

THE MINISTER OF EARTH SCIENCES (DR. HARSH VARDHAN): (a) Yes, Sir. Annual expedition to Antarctica to maintain India's two stations *viz* Maitri and Bharati is continuing. India's first station "Dakshin Gangotri" was decommissioned in 1990.

(b) Yes, Sir.

(c) India commenced its dedicated Arctic research in 2007 and later established its Arctic research base 'Himadri' in 2008. India continues to send expeditions to Arctic each year since 2008 in the Norwegian Arctic, Svalbard. India's Arctic research includes atmospheric, biological, marine and earth sciences and glaciological studies. Ministry of Earth Sciences has also established a high-altitude research station in Himalaya called "HIMANSH", at a height of 13,500 feet (4000 m), at a remote region in Lahaul-Spiti, Himachal Pradesh to study and quantify the Himalayan Glacier response to climate change.

Cyclone forecasting system

1482. SHRI G. C. CHANDRASHEKHAR: Will the Minister of EARTH SCIENCES be pleased to state:

(a) whether cyclone 'Titli' and 'Gaja' wrecked havoc across various States resulting in loss of lives and properties, if so, the details thereof;

(b) whether Government has taken any new initiatives to bring in technological advancement in cyclone forecasting system and if so, the details thereof including international cooperation/agreement; and

(c) other steps taken by Government to develop cyclone forecasting and management system in the country?

THE MINISTER OF EARTH SCIENCES (DR. HARSH VARDHAN): (a) Yes,

Sir. Authentic details of death and damage caused by cyclones Titli and Gaja not available with IMD.

(b) One of the most important initiatives has been to improve the weather modelling capability for forecasting cyclones. In addition to in-house efforts, collaborative efforts with Academic and R&D Institutes to improve early warning services have been taken up. A few notable initiatives taken up in recent years are as follows:

- Bilateral agreement with NOAA, USA and UK Met. Office for improvement in numerical weather prediction (NWP) modelling w.r.t. Global Forecast System and Unified Model (UM) respectively. This collaboration has led to implementation of the deterministic and ensemble prediction systems (EPS) for probabilistic forecast based on Global Ensemble Forecasting System (GEFS) and UM-EPS.
- A bilateral collaboration between India and United States involving National Centre for Environment Prediction (NCEP), USA, IMD, Indian National Centre for Ocean Information Services (INCOIS), Indian Institute of Technology (IIT) Bhubaneswar has resulted in experimental implementation of high resolution of Ocean Atmosphere Coupled Model *viz*. Hurricane Weather Research and Forecast (HWRF) Model for north Indian Ocean with a resolution of 2,6,18 km.
- IMD and ISRO continuously collaborate to develop various satellite based observational products to improve the early warning services of cyclones. It includes development of cyclone specific images and products, analytical tools like Advanced Dvorak Technique and RAPID software.
- The Monsoon Mission Project of the Ministry is a multi-institutional initiative involving many academic and R&D institutes nationally and internationally to improve monsoon forecast in various space and time scales.
- Round the clock Forecast Demonstration Project (FDP) is taken up to improve forecast and warning services with respect to Cyclones during Oct.-Dec.

(c) IMD has one of the best forecasting systems for predicting tropical cyclones using high resolution advanced mathematical models and a suite of quality observations from Satellites and Radars. IMD utilises an array of high resolution advanced mathematical models (including global, regional and cyclone specific models) and a

suite of quality observations from Satellites, Radars and conventional and automatic weather stations for monitoring and predicting tropical cyclones crossing both west and east coast of India. IMD has a very effective Decision Support System for generating track of cyclones and analysing various observations at a single platform. IMD has defined Standard Operating Procedure for monitoring and forecasting the cyclones and issue of warning services.

IMD continuously expands its infrastructure for meteorological observations, data exchange, monitoring and analysis, forecasting and weather services. IMD has always used contemporary technology and is in process of further expanding it's observational network and computational abilities.

Methods of rainfall forecast by IMD

1483. SHRI PARIMAL NATHWANI: Will the Minister of EARTH SCIENCES be pleased to state:

(a) the current methods of rainfall forecast being followed by the India Meteorological Department;

(b) whether there are any defects that affect the current methods and if so, the details thereof;

(c) whether the said defects have caused inaccuracies in this year's rain forecast for areas that were affected by excessive rainfall and were not prepared for it and if so, the details thereof; and

(d) whether Government is looking at alternative methods for rainfall calibration and if so, details thereof and if not, the measures taken for accurate rain forecast?

THE MINISTER OF EARTH SCIENCES (DR. HARSH VARDHAN): (a) India Meteorological Department (IMD) issues three types of forecasts *i.e.*, seasonal forecast (for the whole season), extended range forecast (10- 30 days), short-medium range forecast (0-10 days). These forecasts are generated using dynamical prediction models. Under the National Monsoon Mission, MoES has implemented two state-of-the-art dynamical prediction systems for short range to medium, extended range and seasonal forecasts. All these initiatives have helped to improve the skill of monsoon forecasts over the country.

(b) No, sir. The Ministry is continuously working to improve the dynamical prediction systems for the prediction of rainfall.

(c) Does not arise.