



# Weathering Heights

Predicted or confronting you out of the blues, bad weather can give anybody the jitters, especially when each of your business moves, right from the stage of planning to that of execution, will have to be weighed against the vagaries of weather and climatic changes. Not surprisingly, demand for intelligent, location-specific weather data and reports has been on the rise. The Indian Meteorological Department is leaving no space for risk, as it plans to bring in new technology that will facilitate the generation of such reports, writes **Sheetal Vyas**



**W**eather, a variable atmospheric condition, has had its characteristics often compared to those of a mischievous child, who is known to play up unexpectedly and settle down just as abruptly. Defined by paradoxes, it can be tame and cantankerous at the same time. Legends have been woven around it and stories made up

to relate totally disconnected events with the kind of weather a particular region experiences. Such is the power weather wields that it can stop or trigger wars, cause accidents, change the course of rivers or even flatten or submerge entire cities.

Humanity has constantly waged a losing war against weather, for not only does it control our food

production, navigation, transport and business sectors, but also dictates the way we live, dress and eat. It is also true that we have turned in technology's pockets every possible way, just to check if we can have a little more control over weather and climate. Much to our disappointment, it continues to strengthen and is polishing its unpredictability with global warming, which again to our misfortune, has been a result of our own actions. The result, flash floods, extreme weather conditions, unusual rainfall patterns, destructive cyclones, severe temperature fluctuations, devastating category 5 hurricanes, year-long draughts and constant uncertainty. Such events force us to consider the possibility of a scientist developing a remote controlled machine to control the weather, a *la Prima*, described by Sidney Sheldon in his bestseller, *Are you Afraid of the Dark?*

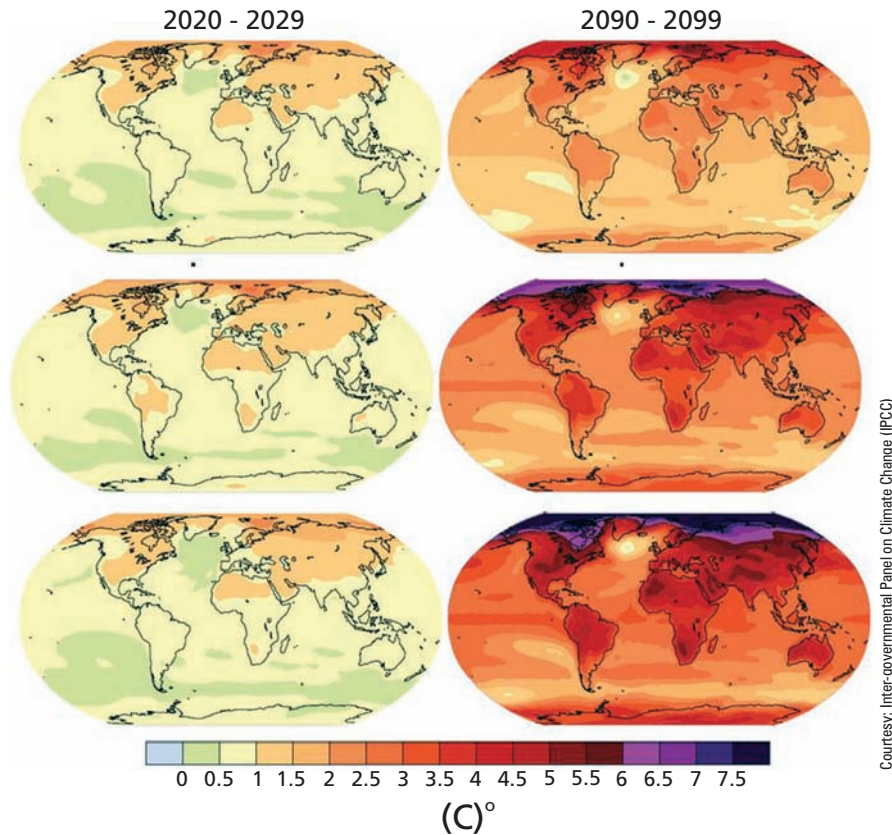
The recent years have unveiled an even greater rise in instances that have resulted in severe loss of property, life and economy because of the damage unleashed by weather, and environmentalists, scientists, climate experts and disaster management organisations have screamed for more diligently accrued weather data and a little more precision in weather prediction. While weather data collection and warning systems have improved to a large extent, new and specialised demand for explicit weather details continues to pour in.

Consider the case of Sanchita Tiwari, who owns a floral farm in the outskirts of Bangalore. She often needs to refer to the weather report and monitor some of the exotic flower varieties she grows, because of the sensitivity of these flowers to the changing weather. Some of them have to be planted under special conditions and protected from severe weather. However, she is at a loss of preventive steps because of the unavailability of exclusive weather data. "Last October I had a tough time managing the farm because there were sudden downpours in

October-November, which was not very common and I had to fight root rot due to excessive water logging," she laments. She is not the only one; there are several others who wish they could have detailed weather reports at their disposal to help them plan their moves – all the more reason why weather data should now move out of the 'condensed' mode to the 'precise' and commercialised one.

India, we could say is blessed with a unique weather system, which takes turns showering us with rains, scorching us with unbearable heat and freezing us with menacingly cold weather. While they have their own specific seasons, they often shift and intermingle, giving us some very tense moments.

Besides the effects of global warming, what is it about the weather conditions in India that makes it difficult to predict weather precisely? Atmosphere and weather experts are of the opinion that it's the tropics and the distribution of rainfall which makes all the difference to weather patterns in India. "I believe that we have very good observation stations and have been improving at a very steady rate. However, what we need to realise is that tropical weather, such as we experience, is difficult to follow and predict and we have a lot of convective instability. In the middle latitudes, the variables are large and there is a day-to-day



These maps illustrate the surface temperature in the years to come and also project how the global temperatures are likely to rise in the next century. The inter-governmental panel on climate change predicts that temperatures will probably rise by 1.8° C to 4° C by 2100.

fluctuation unlike in the tropics where there are small variables in the weather. Though I would want clear weather data to be made available, I know that predictions cannot be perfect. This is the case the world over because the

atmosphere is constantly changing. We are all considering probabilities here," says professor B N Goswami, director, Indian Institute of Tropical Meteorology, Pune.

One of the more critical aspects of weather data collection is the study of cloud formations, for they give an indication of when and where rainfall is expected. It is necessary to know how clouds formulate because the data has to be fed into the model. You even need to tell the system the type of clouds that have for every 10 km stretch. "It also requires details such as whether the clouds are deep or shallow. We have been predicting accurately two to three days in advance. However, every scale has different predictability and add to it the local weather instability," Dr Goswami points out.

It is interesting to note that there has been a significant increase in the mean temperatures in the last 100

## Weather risk weapons

**WeatherData Services:** It is an AccuWeather company, which specialises in weather-risk management consulting and state-of-the-art weather forecasting and services to utility, transportation, manufacturing, educational and governmental clients, has developed solutions that help manage weather data and send out risk and warning signals.

**SkyGuard:** A proactive weather risk management solution, it is believed to have saved dozens of lives on February 5, 2008 during the worst tornado outbreak in 20 years. It helps organisations in improving safety, protect property and reduce costs associated with interruptions in operations, customer service and supply chain. Warnings are issued by the system only when specific locations are at risk, which saves money by keeping facilities running. Customisable warnings based on an organisation's requirements include: tornado, high wind, lightning, flash flooding, hail, extreme temperature, rain and hurricane.

**SmartRAD:** It is a weather information and monitoring system which delivers weather information in real time. Data is collected and compiled from national and international sources and presented through an intuitive, graphical interface. Clients can quickly see the big picture and analyse the current weather at each facility, rail or highway mile that is pertinent to their business operations and supply chain.

**SelectWarn:** It is described as an intelligent command centre by the developers and is an early warning system that is able to selectively activate only those sirens within the path of a storm, rather than all sirens within the county, for a more reliable emergency warning system.

years. There may not have been a change in the amount of rainfall we receive, but the distribution patterns have definitely changed. Normally, we have two monsoons – southwest and northeast, with two intermittent cyclone seasons – April-May and October-November. Within the seasons, some parts of the country may be flooded while others may reel under severe drought. There is wide variability within the seasons, which makes it all the more challenging for any meteorological community to forecast. In addition to variability in seasons; we also have belt divisions based on the tropics and sub-tropics.

According to Dr Krishna Kumar, a senior scientist at IITM, fluctuations happen on a yearly basis and there will be a marked deflection of one week every 50 years. Giving the example of Karnataka, he says, “Karnataka is one region which has

## Weather dominated headlines

- Greatest rainfall in a day** : 73.62 inches (Indian Ocean; March 15, 1952)
- Greatest rainfall in a year** : 1,041 inches (Assam, India; August 1880-1881)
- World’s one minute rainfall record** : July 4, 1956, 1.23 inches of rain in Unionville, MD.
- Rainiest place in a rainy country** : Manchester, England, has the reputation of being one of the rainiest places in a rainy country. Its average annual rainfall of 32.3 inches (819 mm) is only a shade more than Venice, with 30.3 inches (770 mm) and less than Rome, with 36.0 inches (915 mm)

noticed a marked shift in the rainy season. June usually is the sowing time for the farmers in this region, if for some reason climate jumps, the dependable rain comes either a week in advance or a week later, which again jeopardises the farmers crop.”

Till recently, it was only the farmers who sought detailed weather data to plan their crop, but the last five years have witnessed a significant increase in the numbers spanning sectors

from oil refineries, especially those situated near the sea, spice traders, transport and shipping companies, banks and the aviation sector. There is no dearth of solutions to ensure that such information reaches the end users, however, applicability needs to be worked upon. “People are becoming increasingly conscious of the factors that affect their business. Our solutions have a considerable demand from the business community, especially those

## INTERVIEW



**Dr Ajit Tyagi,**  
Director General, IMD

## IMD’s current focus: User-driven weather data

The Indian Meteorological Department is upbeat about the changes it plans to introduce in the weather observatories and is confident that the model shifts would enhance data collection and make it available to various sectors. **Ramprasad** chats up Air Vice Marshal **Dr Ajit Tyagi**, director general, IMD

**Q: Around the world climate change is a concern today. What are the changing trends you have noticed in climate data collection on the international front?**

**A:** If you consider the longer timescale, climate does change over a period of time, which we usually refer to as natural variability. However, what’s disturbing is the rate at which climate has changed during the last 500 years. This is primarily because of human intervention. We have recorded observations spanning 150 years around the globe. If you look at temperatures in the last century there has been a rise of 0.7 degrees centigrade. The data

whose output is weather dependent like the transport companies and traders. We even have event planners approaching us for weather data around a particular event that's being planned so as to avoid any hiccups arising out of it. Even couples send their wedding planners to check if we can provide them with specific weather data. We depend on the Indian Meteorological Department for our weather data. While it is detailed to a large extent, it could be more comprehensive at the area level," Vipin Gandhi, managing director for SGS Weather and Environmental Systems, a Delhi-based firm offering weather related solutions said. There are many other organisations like Weather Risk Management Services Ltd., AccuWeather and WeatherData Services that have developed specialised technological solutions that send out early warning to

Tropical weather, such as we experience, is difficult to follow and predict and we have a lot of convective instability. In the middle latitudes, the variables are large and there is a day-to-day fluctuation unlike in the tropics where there are small variables in the weather. Though I would want clear weather data to be made available, I know that predictions cannot be perfect.

- professor **B N Goswami**,  
director, IITM, Pune.

specific or multiple locations based on client requirements.

Banks and insurance companies too have read into this demand and are offering new products and schemes including weather insurance for farmers. ICICI Lombard General Insurance Company is one such company. Pranav Prashad, head of Rural and Agriculture Business Group elaborates, "Weather insurance covers the weather related risks faced by crops or by any other economic activity and promises immediate redressal based on objective data. During 2008, we have insured over 250,000 farmers and 325,000 acres of land for wheat, paddy, oranges, cotton, coriander, grapes, cumin, fenugreek, kinnu, castor and soybean across 165 locations in the states of Andhra Pradesh, Rajasthan, Tamil Nadu, Punjab, Haryana, Maharashtra,

clearly shows that climate is changing at a much faster rate. It is not just temperature, but aspects that are influenced by it, such as the warming of oceans, sea-level rise and the melting of glaciers and ice sheets are also showing greater variations. The major cause for concern is the rising greenhouse gases levels, with CO<sub>2</sub> levels rising to between 378 and 379 ppm in the last 150 years. If things move at this rate some of the changes will become irreversible. In India too temperatures on an average have risen. We realise that the impact of climate change cannot be uniform. So it will not help to study and consider generalised scenarios. What we need to understand is how such changes affect India and choose solutions accordingly. Through our data we are trying to analyse what have been the past trends and rainfall variations. Orissa and its adjoining states for instance have witnessed a decrease in rainfall, while areas along the western part of the country have been receiving excess rainfall. To understand and analyse these variations, a lot of research is required which is being addressed. We have set up a Centre for Climate Change Studies in Pune to look into the long-term effects of climate change in south Asia.

**Q: In India, with floods and cyclones getting more rigorous and unpredictable, the importance of weather data and prediction is growing. How is it being made available to people?**

**A:** Our country is a subcontinent. We have a variety of weather patterns. Weather is mostly of convective nature and develops locally. However, one can never be sure of how and when it develops because it happens randomly. Therefore, predicting precisely is a big challenge. We are trying to address these problems on three fronts. One is through having a better observation system. Each weather development should be monitored right from when it starts and how it proceeds to its culmination point. People should be alerted immediately because weather conditions are so random and unpredictable that they don't generally give you time to warn. The second approach is to use this multi-sensor data which is generated and assimilate it through state-of-the-art models that are available now. Third is the area of basic



Doppler weather radar installation at Visakhapatnam

which are covered under this project."

The company has also partnered with PepsiCo International to offer weather insurance for farmers, supplying potatoes to PepsiCo's potato chips. The scheme protects these farmers against the vagaries of weather that affect their crop resulting in losses and also provides them with detailed weather data. Similar cover has also been provided to mustard growers.

HDFC-Chubb General Insurance too has tied up with Weather Risk Management Services, a provider of weather data solutions to provide weather insurance to farmers.

Considering the increasing demand for authentic and exclusive weather data, the Indian Meteorological Department is planning to introduce

Weather insurance covers the weather related risks faced by crops or by any other economic activity and promises immediate redressal based on objective data. During 2008, we have insured over 250,000 farmers and 325,000 acres of land for wheat, paddy, oranges, cotton, coriander, grapes, cumin, fenugreek, kinnu, castor and soybean across 165 locations in various states.

- **Pranav Prashad**  
ICICI Lombard  
General Insurance

several changes, which will aid them in providing such information to individuals, businessmen and farmers. According to IMD, improvements will be made to the upper air observing capability through radio sound data. The launch of INSAT-CD towards the tail end of 2009 will further enhance IMD's observational capabilities and offer new generation of sensors. So far the sensors are providing visible, infrared, water vapour presence details and give imagery data. "We do not get the vertical sounding of the atmosphere. ISRO, which has been doing a lot of work in this area, will be putting a sounder in the satellite. It would be an excellent means to collect uniform data and structure of the data over oceans, mountains which we do not get normally. That data will be useful in our numerical models. We have also acquired high power computing

research, which again requires some good quality data. A number of multi-institutional, multi-disciplinary field experiments have been planned over the next 2-3 years. We'll be studying the cyclones in the Bay of Bengal. We are initiating a forecast demonstration project, which will have intensive observations being made and attempts will be made to collect as much data as possible. Though we have a fairly good number of observatories, all the districts are not covered. Our first phase plan is to provide each of the districts with an automatic weather station and rain gauges. These will provide us real-time access to data. This kind of data will also be required for crop insurance. Presently we are unable to provide such data. We are also installing a mosaic of Doppler weather radars throughout the country. Not only will they help study cyclones along the coastline but also monitor areas where heavy rainfall, thunderstorm and hailstorm are expected. The information will be made available through our website and through television channels on partnership mode. Things will fall into perspective once INSAT-CD becomes operational by the end of this year.

**Q: The agriculture sector is in need of such information. Have any specific changes been initiated to ensure this?**

A: We are planning to generate multi-lingual graphic products. Through strategic tie-ups with institutions like the ICAR and Ministry of Agriculture we are reaching the Krish Vigyan Kendras. We are providing a five-day

forecast which goes through the Agriculture University which in turn does the value addition depending on the local crop conditions. Then advisories are made and transmitted back to media and farmers through Krish Vigyan Kendras.

**Q: IMD has recently invested in a lot of technological upgrades and state-of-the-art equipment. How does it contribute to the efficiency and capability of the department?**

A: Modernisation or upgradation is an ongoing process. This time it is user driven. Observations are becoming sector-specific. We are also planning to procure some unmanned air vehicles and cyclone-probing aircraft.

**Q: Accurate weather prediction is based on proper choice of model. Do we have the right kind of models that are suitable for our country?**

A: Basic structure of the modelling is common to every country. The problem remains in the specific physical processes like types of clouds and cloud formation. This is one part on which research is required and it is a continuous process. Models usually have equations that can predict the future state based on the initial state information fed to them. If the initial state is not rightly picked, the results are prone to butterfly effect and may give totally different solutions. One of the problems in

## Weather wise

**Thermometer:** Measures the air temperature. These are closed glass tubes containing liquids such as alcohol or mercury. When air around the tube heats the liquid, the liquid expands and moves up the tube.

**Barometer:** It measures the air pressure and tells you whether or not the pressure is rising or falling. A rising barometer means fair, sunny and dry weather, while a falling barometer indicates rain and stormy winds.

**Sling psychrometer:** It is used to measure relative humidity, using the cooling effect of evaporation. Two thermometers are used in a sling psychrometer. Wet the cloth of one of the thermometers and swing the psychrometer around a few times. Water evaporates from the cloth, causing the temperatures on that thermometer to be lower than the other.

**Rain gauge:** Measures the amount of rain that has fallen over a specific time period.

**Wind vane:** Determines the direction from which the wind is blowing.

**Anemometer:** Is applied to measure wind speed. The cups catch the wind, turning a dial attached to the instrument. The dial shows the wind speed.

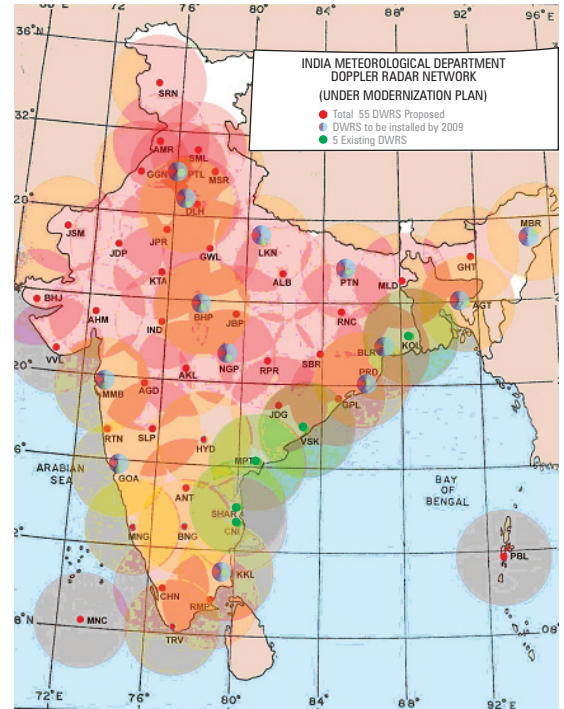
**Weather maps:** Indicate atmospheric conditions above a large portion of the Earth's surface. Meteorologists use weather maps to forecast the weather.

**Hygrometer:** Measures the water vapour content of air or the humidity.

**Weather balloon:** Measures weather conditions higher up in the atmosphere.

**Weather satellites:** Are used to track large-scale air movements. The collected data is fed into computers to analyse weather.

**Eyes:** The best ways to help determine weather. Keep them on the sky to read into the weather for the day.



Location map of the present and proposed radar installations in India

tropics, where data is sparse is that we cannot give the precise data of the initial state. Since a lot of data is being generated now, we are confident of feeding the right data into these models.

The next task would be to add local data into these models and the National Centre for Medium Range Weather Forecast (NCMRWF) has been given the responsibility to do research on these aspects. We are also encouraging the various universities to take up research and improve the models. With better data and adequate research support, we should be able to predict better.

In addition, we have also started collecting output from some of the best models established in different countries. We'll check how they perform in the Indian scenario. Based on the observations, we will develop a multimodal forecast for the districts.

**Q: Commercialisation of weather data can happen with lot of businesses looking for informed decisions. Can we look at public private participation in weather data?**

**A:** We are open to all types of approaches as long as weather data can be used for the benefit of the larger society. Our major focus is common man.

If the state or private partners come forward to collaborate, we are open. We already have started

discussions with the aviation sector. We cannot provide service beyond a point and we realise our limitations. If there's somebody who wants to take our data and add value to it, we are more than willing to cooperate with them. The sector promises huge opportunities. Presently, the data is being provided free to the common man. But if it is to be specialised and commercialised, we will have to place a price tag on it. This will also help us improve the quality of our data. We should encourage the use of weather data in as many sectors as possible so that we improve the productivity.

**Q: Can you tell us about the international collaboration in weather data dissemination?**

**A:** The meteorological community is fortunate because weather knows no boundaries. Right from the beginning international cooperation has been excellent. WMO which is a strong body with 188 nations as members is doing a wonderful job. We get to share data within less than half-an-hour, irrespective of from which part of the world the data was collected.

India is an important member in this organisation and also an executive member in many committees. In fact, our early warning of Nargese cyclone was appreciated by WMO. We had also sent digital data to Nepal, Sri Lanka and the Maldives.

visible, infrared, water vapour presence details and give imagery data. "We do not get the vertical sounding of the atmosphere. ISRO, which has been doing a lot of work in this area, will be putting a sounder in the satellite. It would be an excellent means to collect uniform data and structure of the data over oceans, mountains which we do not get normally. That data will be useful in our numerical models. We have also acquired high power computing systems to analyse the data," informs Air Vice Marshal Dr Ajit Tyagi, director general, IMD.

Admitting to the lacuna in elaborated weather data and elucidating IMD's other plans, Dr Tyagi says that the common user will have to be given a lot of priority and provided with authentic weather information so that he can plan the day's business or bring in preventive measures. "Once he starts getting the right kind of information he starts factoring it. For example, if FM radio starts giving you the weather data of the city that you are in you will start getting interested. We soon plan to put up forecasts at the airports for all the destinations people travel to, even if it's an international destination. Then we move on to railway stations. This will prove to be dually beneficial, we will be able to collect observations from every station and also pass analytical information to these places," he explains.

Plans to launch a weather channel are also in the pipeline, which will have a 24-hour dedicated channel offering hourly weather reports. Global warming induced extreme weather conditions, is another cause for concern and environmental events arising out of it have been giving disaster management firms sleepless nights and exclusive weather data will act as ready reference for them, increasing

## Knowledge of monsoon doesn't imply ability to predict

The global nature of meteorology has always been recognised. Till the 19th century, the collection of meteorological data remained a personal effort. It was only later that it became the responsibility of designated organisations, which preserved data like libraries or museums do with historical treasures. So, the concept of free exchange of meteorological data among national meteorological services was introduced in the 1970s.

Also, archival and supply of meteorological data became easier as manuscripts were replaced by punched cards, magnetic tapes and successions of electronic storage media. This led to an increase in demand for data and opened issues like ownership, access and pricing. Of late, for public awareness, meteorological forecasts are now being generated by many centres. However, in the information age, when the world is connected via mobiles, I feel that the GTS is becoming redundant.

The national meteorological services, researchers and the public have the right to meteorological data. As far as the sectors are concerned, they include aviation, shipping, tourism, defence, disaster mitigation, farmers, research, technology, insurance, structural safety, media, industries involved in off-shore drilling, wind energy, solar energy, health and insurance.

For meteorological purposes, India has been divided into 36 meteorological

sub-divisions, which are regions that are homogeneous in terms of weather and climate and are of comparable size. Ideally, they should have been delineated on the basis of natural factors. However, for practical convenience, compilation of statistics or issue of warnings, they have been made to conform to state or district boundaries.

Now, with our satellites, models, computers and field experiments, we know much more about the monsoon than ever before. The paradox, however, is that our knowledge or appreciation of the monsoon does not necessarily imply our ability to predict it. While it is true that we have a few inherent limitations of science, monsoon prediction is a worthwhile scientific effort that needs to be pursued.

*Professor R R Kelkar was the former director general of meteorology, Indian Meteorological Department. He was also the ISRO Space chair professor, Department of Atmospheric and Space Sciences, University of Pune. He was one of the first meteorologists who proved, through NWP modelling, that the presence of Himalayan Tibetan Plateau was responsible for the monsoons in India and the neighbouring countries of Southeast Asia.*



the probability of early warnings being issued in the event of a natural, weather disaster. To that end, India's 72-hour and 48-hour predictions are accurate and the warnings issued by IMD during cyclone Nargese helped save a number of lives and preventive measures were taken in advance. Commenting on the trends in the collection of such data, Dr Krishna Kumar says, "Temperature fluctuations in peninsular India have increased to a great extent, while rainfall, which was sufficient until a few years back in the eastern region, has decreased significantly. But we need to analyse what is causing it so that corrective measures can be taken. There are inherent internal variabilities in the Eurasian lands and a detailed study of global climate models goes a long way in avoiding such catastrophes. While there's been an increase in the frequency of such events, there is no spatial uniformity. However, we need to be prepared and work on active and break forecast on a fortnightly basis."

An increasing number of businessmen are seeking intelligent weather data so that their best laid business plans can be altered or executed according to the indications, thus enhancing their profits. Businesses; big or small, agriculturists, shipping companies, aviation firms and event managers, everybody prays for fair weather and all that they seek is a warning in advance so that they can delay the departure of the goods truck expected to reach Shimla from Nagpur, or anchor ships at a safe distance depending on the tidal force, dress according to how hot/cold the day will turn out to be, or whether to accessorise ourselves with umbrellas. With the planned changes, it is unlikely that their prayers will go unanswered. 🌍