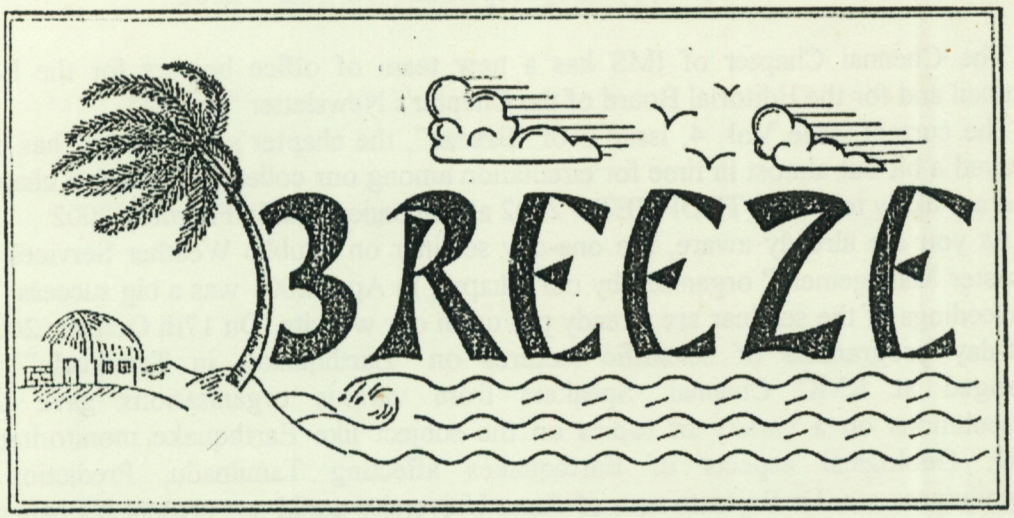

The newsletter of Indian Meteorological Society, Chennai chapter

Vol 4 Issue 2 July - December 2001

Contents

Editorial

Dear Member,

I wish you all a very happy and prosperous New Year – 2002.

The Chennai Chapter of IMS has a new team of office bearers for the Local Council and for the Editorial Board of the Chapter's Newsletter "Breeze".

The current issue Vol 4, issue 2 of "Breeze", the chapter's Newsletter, has been delayed a bit but almost in time for circulation among our colleagues of other chapters who are likely to attend TROPMET – 2002 at Bhubaneshwar in February 2002.

As you are already aware, the one-day seminar on "Public Weather Services and Disaster Management" organised by our Chapter in April 2001 was a big success. The proceedings of the seminar are already put up in our website. On 17th October 2001 a half-day programme of scientific lectures on "Earthquakes in Tamilnadu" was arranged at RMC Chennai. Speakers from various organisations gave their presentations on a variety of topics on the subject like Earthquake monitoring by IMD, Geological aspects of Earthquakes affecting Tamilnadu, Prediction & preparedness etc. Dr Rajarathinam of Anna University could not present his paper on "Seismicity of Tamilnadu". However, the same is included in this issue of Breeze. Another inclusion is the paper on "Observations of Marine Atmosphere from Indian Oceansat – 1" by Dr M.S.Narayanan, of SAC, Ahmedabad who addressed the members of our Chapter on 29 August 2001 on this topic.

I am happy to inform you that IMS Chennai Chapter has started a new homepage through VSNL, which can be accessed at **http://education.vsnl.com/imschennai**. Suggestions for improvement of this site are most welcome.

I cannot conclude this note without making a reference to the sad and sudden demise of one of our members of the Local Council, Sri J. Shanmugasundaram of SERC-Chennai, who passed away on 22 September 2001. IMS Chennai Chapter will forever cherish the memories of the selfless support and active involvement of Sri J.S. in various activities of our Chapter. May His vision lead the Society from strength to strength!

S.K.Subramanian
Chennai dated 4 January 2002

The Editor and the IMS-Chennai Chapter are not responsible for the views expressed by the authors.

Membership details of IMS-Chennai Chapter as on 1 January 2002

Life Members: 59 **Ordinary Members: 85** **Total : 144**

IPCC - Third Assessment Report 2001 and some comments

S. Raghavan

Members of IMS- Chennai Chapter had the benefit of a talk in January 2001 by Dr. Narasimhan Sundararaman, Secretary, Intergovernmental Panel on Climate Change (IPCC), Geneva. A summary of his talk was included in the last issue of Breeze. The third assessment report of IPCC's Working Group One on the science of climate change was released in January, at Shanghai, China.

In this report the IPCC updates its 1995 Second Assessment Report (SAR). The full report can be seen on their website www.ipcc.ch . Here are some salient features and comments regarding the Report collected from BBC website.

The Report says its confidence in the ability of models to project future climates has increased, with the greatest uncertainty still arising from the effects on climate of clouds. The report notes: "The observed changes in climate over time have been documented extensively by a variety of techniques. Many of these trends are now established with high confidence; others are far less certain."

It gives details of several trends, for example:

- the global-average surface air temperature has increased since the mid-19th century
- in the last four decades, temperatures have risen in the lowest few kilometers of the atmosphere
- snow cover and ice extent have decreased
- global average sea level has risen, and ocean heat content has increased
- Some important aspects of the global climate appear unchanged. No significant trends of Antarctic sea-ice extent are apparent over the last 30 years, and there are no clear long-term trends discernible in the intensity and frequency of tropical storms.

Under a variety of scenarios it has prepared, the IPCC says temperature and sea level are projected to rise. The range for globally-averaged surface air temperature increase by 2100 ranges from about 1.4 degrees Celsius to 5.8 degrees, an increase, the report notes, "would be without precedent during the last 10,000 years". The projected sea level rise by 2100 is between 0.09 and 0.88 metres. But the report does say that there are still many gaps in information and understanding. One priority, it says, is to "arrest the decline of observational networks in many parts of the world".

The report says that emissions of greenhouse gases continue to warm the Earth's surface, and that emission of some types of aerosols help to cool it. It is clear that both are caused by human activities, although the report notes that natural factors, such as changes in solar output or volcanic eruptions, can also have an effect. It estimates the warming caused by changes in solar energy since 1950 at about one-fifth of that attributable to carbon dioxide (CO2), and concludes that "natural agents have contributed small amounts" to warming over the last century. The report quantifies the build-up of CO2 in the atmosphere. The concentration now is one-third more than in 1750, it says. "The present CO2 concentration has not been exceeded during the past 420,000 years and likely not during the past 20 million years. The rate of increase is unprecedented during at least the past 20,000 years". "Over two-thirds of the increase in atmospheric CO2 during the past 20 years is due to fossil fuel burning. The rest is due to land-use change, especially deforestation, and, to a lesser

extent, cement production." Methane concentrations have increased by a factor of 2.5 since 1750, and those of nitrous oxide by 16%.

The SAR concluded in 1995: "The balance of evidence suggests a discernible human influence on global climate." This report says there is now stronger evidence for a human influence on global climate. It concludes: "It is likely that increasing concentrations of anthropogenic greenhouse gases have contributed substantially to the observed warming over the last 50 years."

Comments of Sir John Houghton

Asked whether as a scientist he had been taken aback by any of the report's findings, Sir John Houghton, the former UK Met Office chief who co-chaired the Shanghai meeting, said in one respect he had. "I'm surprised at how little it turns out we need to do to the climate to produce a substantial change," he said. "To see the signal of human activity emerge above the noise of natural climate change is in a way a scientific surprise."

And he had some advice for those who still remained sceptical about the phenomenon. "They should look at the evidence which has been collected by some of the world's leading scientists," he said. "I think there are very few scientists who'd disagree with the IPCC. And most of those who do disagree have not published much". "I'm sure climate change is the biggest environmental threat that faces the world, and it's linked to so many others. When some of the impacts begin to bite, they'll worsen the poverty in which so many people are already existing. The evidence is certainly sufficiently strong for countries to take action based on what we've said."

Critics

But several scientists outside the IPCC criticised what they described as the "arrogance" of the UN body, insisting that the evidence for global warming was still far from certain. Some believe indirect solar activity has a bigger impact than the IPCC will concede.

The prominent global warming sceptic Professor Philip Stott, from the University of London, said recent research had damaged the credibility of the IPCC and its climate predictions. "In the last month alone, serious scientific studies have undermined the whole basis of these predictions, with the temperature over the oceans seen as exaggerated by up to 40% and the very relationship between carbon dioxide and temperature questioned". He added: "The IPCC models and correlations are not new; they are re-cycled 'old hat'. It is essentially a political response to the collapse of The Hague climate talks." Professor Stott said computer models presented various "stories" or scenarios and people should not see them as outcomes that were bound to happen. "There are over 40 such stories; inevitably, of course, the media selects the very worst storyline," he said. His concerns were echoed by Professor David Unwin, an environmental scientist at Birkbeck College, London. He said the IPCC was guilty of glossing over many of the uncertainties in climate science. "These uncertainties are never really made explicit," he said. "The IPCC will give you error bars but there are huge uncertainties to do with the science that goes into the computer models that predict the future". He said the models had progressively drawn back from the real doomsday scenarios of a few years ago as climate processes had become better

understood and incorporated into calculations. "And in my view, and in the view of many other scientists, this refinement has a long way to go."

Professor Unwin said the IPCC, in becoming "fixated on the control of carbon dioxide as a measure to tackle global warming", had allowed other issues such as energy conservation and cleaner air to slip off the agenda. "And it has made light of all the other levers that society could pull to aid and adapt its way out of the problem that we may or may not have". All the social science evidence on weather hazards shows that, by and large, trying to modify the hazard isn't a strategy that works. There is a lobby which makes money out of global warming promotion and research, and governments around the world collect taxes on the back of it all

Piers Corbyn, weather forecaster of Weather Action, a company that provides long-term forecasts to UK industry, said "I would like the IPCC to stress the steps that society could take to adapt better to the consequences of global warming - and that includes managed retreat from the shoreline, not building on flood plains, care with water conservation and scheduling, and so on." He claimed the IPCC had quite simply got it wrong. Corbyn, like a large group of solar scientists, believes the UN body has underestimated some of the indirect effects of the Sun on the Earth's climate. "Particles and magnetic effects from the Sun are the decisive influence that controls world temperatures," he said. "The evidence can be seen in the graphic representation of geomagnetic activity plotted alongside world temperatures. The two correlate very closely". "I think there is a political agenda here. There is a lobby which makes money out of global warming promotion and research, and governments around the world collect taxes on the back of it all. If governments are serious, they should support research into solar effects."

OBSERVATIONS OF MARINE ATMOSPHERE FROM INDIAN OCEANSAT-1

M S Narayanan

(Meteorology and Oceanography Group, Space Applications Centre, Ahmedabad)

A Multichannel Scanning Microwave Radiometer (MSMR) has been in operation onboard the first Indian Oceansat, launched on May 26, 1999 by the Indian Polar Satellite Launch Vehicle (PSLV). This four frequency (6.6, 10.6, 18 and 21 GHz) dual-polarized instrument is operationally providing data of total precipitable water, cloud liquid water, sea surface temperature and sea surface winds over the global marine atmosphere once in two days from an altitude of about 720 km. MSMR is the first satellite instrument since Scanning Multichannel Microwave Radiometer (SMMR) of Nimbus-7 in 1987 with a 6.6 GHz channel capable of providing surface parameters like Sea Surface Temperature (SST), soil moisture etc.

Though MSMR radiometer systems are similar to SMMR, MSMR data are being processed over much larger swath (~1360 km). These necessitated special numerical approaches beyond 45° scan angles, which are affected by 'singularities' in the computation of polarized radiation.

Operational parameters derived from MSMR are described in Table 1. Several other parameters are also being retrieved on research mode from the brightness temperature measurements from MSMR. These parameters are Antarctic sea ice extent and boundaries, rainfall rate over oceans and large area soil moisture.

Table 1 - Geophysical Parameters from MSMR

Parameters	Channels (GHz)	Grids (km)	Range	Accuracy
Total Water Vapour	21, 18, 10	50	0.2 to 7.5 g/cm^2	0.3 g/cm^2
Sea Surface Wind	10, 6, 18, 21	75	2-2.4 m/s	1.5 m/s
Sea Surface Temperature	6, 10, 18, 21	150	273 -303 ° K	1.5° K
Cloud Liquid Water	21, 18, 10	50	0-80 mg/cm^2	-

Validation

The MSMR geophysical products have been validated using three different approaches: in situ, intersatellite and model-analysed fields. Each has its own merits (and limitations), considering the spatial and temporal resolutions, decorrelation lengths and the interconsistency of different atmospheric parameters from the modeling point of view Seven Special Ship cruises were organised to collect concurrent in situ observations. The Root Mean Square Error (RMSE) of some of these comparisons are summarised in Table-2. Validation with further data is in progress.

Table 2: SUMMARY OF COMPARISON (RMSE)

SOURCE	SST (°K)	Wind Speed (m/s)	Water Vapour (g/cm^2)
In situ	1.3	1.8	0.4
NCMRWF	-	2.0	0.6
NCEP	0.9	2.1	0.6
SSM/I	-	2.4	0.5
TMI	1.5	2.0	0.4

{NCMRWF: National Centre for Medium Range Weather Forecasting, NCEP: National Centre for Environmental Prediction, SSM/I: Special Sensor Microwave / Imager, TMI: TRMM Microwave Imager}

The information on moisture field (total water vapour content) and wind field (surface winds) as observed by MSMR during monsoon season is being routinely processed by India Meteorological Department in close collaboration with Space Applications Centre (ISRO) for monitoring the onset and progress of Monsoon. The time series analysis of wind speed data clearly brings out the series of monsoon surges and alongwith water vapour data indicate the regions of moisture convergence, with

potentiality of heavy rainfall. Intra seasonal oscillation of these parameters in the content of 30-50 day mode has also been studied.

MSMR-derived SST, surface winds and integrated water vapour fields were zonally averaged for characterization of large scale features. MSMR could capture the large scale oceanographic and meteorological features like east-west gradient in the Pacific ocean SST, large temperature gradients towards the north western pacific associated with Kuroshio current, cooler temperatures over Peru coast due to upwelling, high amount of Total Water Vapour (TWV) over the ITCZ etc. The latitudinal distribution of zonally averaged SST and TWV show large values in the tropical region with a small low in SST near the equator influenced by the equatorial upwelling. Similar results were obtained using 90 day (11th July to 10 Oct 1978) averaged Seasat SMMR observations.

Retrieval of instantaneous rainfall directly from brightness temperatures has yielded a correlation coefficient of 0.8 with Tropical Rainfall Measuring Mission (TRMM) TMI derived rainfall over global oceans. Similar attempts to compute instantaneous latent heat flux over oceans have been found to improve the accuracy significantly. MSMR brightness temperatures also reveal distinct signatures of ice covered sea and open water in the Antarctica. This is useful in monitoring the seasonal variations in the areal extent of ice covers in the polar continent.

Estimation of 'Large Area-Averaged Soil Moisture' and its use in seasonal (or longer scale) atmospheric predictions has been demonstrated. The lowest frequency (6.6 GHz) brightness temperature, by virtue of emissivity dependence on soil wetness, is shown to be a reasonably good indicator of soil moisture in the top layer in its footprint.

MSMR data assimilation exercise in Global Data Assimilation System in General Circulation Model (GCM) has opened up new applications in the country viz. Ocean State Forecast. Analysed and Forecast Winds are utilized in Ocean Wave and Oceanic Mixed Layer Models to generate Wave and Mixing Layer Depth (MLD) forecasts.

MSMR along with similar contemporary international missions like TRMM and SSMI has been providing unprecedented data coverage in space and time for studies on marine atmosphere and global oceans' exchange processes. The experience gained through these studies will enable a better definition of MADRAS (Megha Tropiques), the Indo-French Science mission slated for 2006. In a way, Megha Tropiques is likely to provide some sort of continuity of data of MSMR.

SEASONAL FORECASTING

----- Collected from the Internet by S. Raghavan

October in Canada: The (Red) Indians asked their Chief if the coming winter was going to be cold or not. Not really knowing the answer, the chief replied that the winter would be cold and that the members of the village should collect wood to be prepared.

Being a good leader, he then went to a phone booth, called the National Weather Service and asked, "Is this winter going to be cold?"

The man on the phone responded, "This winter is indeed going to be very cold." So the Chief went back to encourage his people to collect even more wood to be

prepared.
A week later he called the National Weather Service again, and asked again, "Is it going to be a very cold winter?"
"Yes," the man replied, "it's going to be a very cold winter."
The Chief went back to his people and ordered them to go out and bring back every scrap of wood they could find.
Two weeks later he called the National Weather Service again. "Are you absolutely sure that this winter is going to be very cold?"
"Absolutely" the man replies, "the Indians are collecting wood like crazy!"

Water-starved Chennai city - Is there a solution?

Y.E.A.RAJ and B.AMUDHA

Regional Meteorological Centre, Chennai

During the year 2001 Chennai city had been experiencing severe water shortage till the month of September. Water trains fetching water from far-off Neyveli and Mettur to the city, water tankers - heavily loaded, spilling and wasting substantial amount of water - dangerously speeding on the road, people queuing up in front of tanker lorries for a pot of water, putting on a brave fight and trying to somehow get one or two more pots of water extra, the cyclist in precarious balance with 6-8 pots of water on his fragile vehicle, have become familiar sights which a Chennai resident sees everyday as normal happenings in his daily life.

This not-so-inspiring scenario is in stark contrast to the several other developments that have recently taken place in the city, viz., glitzy shopping malls, newly built flyovers, internet kiosks everywhere, the city registering rapid growth in information technology, etc. The question that is raised naturally is whether in this 21st century a metropolis like Chennai should be so hopelessly dependent on primitive water supply mechanisms. What has gone wrong in the long term planning process in providing for such a basic necessity of the people is another question that gets raised by the media and the general public.

In this backdrop, an attempt has been made in this article to discuss the arithmetic of water requirements of Chennai city.

Chennai city has an area of 174 sq.km. The population of Chennai as per 1981 and 1991 census was around 32.8 lakhs and 38 lakhs respectively. The expected population in the year 2001 is around 45 lakhs, which translates into a population density of 25,862 persons per sq km. The city's population has been increasing at the rate of 15-20% adding 6-8 lakh people every decade while the quantum of rainfall received remains more or less the same at an average of nearly 127 cm of annual rainfall, the bulk of which is received during the northeast monsoon season of October-December.

However some amount of rainfall received is expected to be returned to the atmosphere due to *evaporation* and *evapotranspiration*. *Evapotranspiration* is the process whereby plants draw water from the soil and transpire it back to the atmosphere. The normal value of lake evaporation for Chennai is 5.7 mm per day or

208 cm for the whole year. The actual evaporation would be less than the above value but difficult to obtain or measure directly. After giving due consideration to all the attendant factors, we have taken that 30% of the annual rainfall of Chennai city gets evaporated or is lost as run-off into sea and only the balance is available for percolation into the earth. The figure of 30% or 38 cm annual actual evaporation, evapotranspiration and run-off into sea would, if at all, be an underestimation only and definitely not an overestimation. This leaves only 89 cm for eventual percolation into the ground, which contributes to the ground water storage.

The optimal water requirement for a person is 135 litres per day for hygienic living in accordance with the norms laid down by National Building Code and Indian Standards Institution. For a net rainfall of 89 cm per annum, Chennai receives 89 x 10^7 litres of water per sq.km, which translates into 24747 litres per person per annum, or 94 litres of water per person per day. In addition we have to consider the requirements of several other major consumers of water such as industries, service agencies like railways, transportation sector etc and water used for gardening to arrive at a realistic figure of per capita water availability. Such a figure would be much less than the 94 litres as derived above. Thus it is very clear that even if all the rain water received were to be conserved say by Rain Water Harvesting (RWH) it could meet only a portion of the requirements of the residents of Chennai city.

In other metropolitan cities such as Calcutta or Delhi, plenty of water is available from perennial rivers and in Mumbai the copious southwest monsoon rainfall is collected in several dams built on the slopes of Western Ghats nearby. But Chennai does not have either of the above topographical features of nature and so is solely dependent on rainwater collected in a few shallow dams/reservoirs such as Red Hills, Poondi and Chembarambakkam tanks located west or northwards of the city. These dams get filled up to capacity only during years registering substantially excess rainfall. The surrounding areas of Chennai city should naturally be the feeder sources augmenting its water resources. However the pace of urban development is such that the suburbs of Chennai are growing faster than the main city and the residents of suburbs themselves have become major users of its water resources. The lakes of Chennai and its suburbs, which were once responsible for maintaining the water table, have turned into concrete jungles with several multistoried apartments dotting the skyline, Madipakkam and Muggapair areas being poignant examples.

Further, a noteworthy reality in Chennai vis-à-vis other major cities is that the consumer (say, an apartment complex) receives, if at all, water supply from the official machinery only for drinking and cooking purposes, which amounts to a meagre 5-8 litres (or roughly 5% of the total requirements) per person per day only. For all other requirements (amounting to the remaining 95%) the consumers have to make their own arrangements! This situation has led to indiscriminate digging of deep borewells everywhere and pumping of ground water leading to intrusion of sea water under ground in several areas. Further the quality of such water drawn from borewells varies considerably from being potable in certain areas to salty/brackish/reddish in other areas. This situation is in stark contrast to that prevailing in other metros where the official machinery, by and large, meets the complete water requirements of all sections of the population including apartment complexes, industries etc by supplying treated and potable water.

Table 1 presents the mean annual rainfall of Chennai Nungambakkam and Meenambakkam observatories for the decade 1991-2000. It can be noted that annual rainfall higher than 100 cm has been registered in all the years. The mean annual rainfall during 1991-2000 was 146 cm, higher than the long-term normal by 15 %. The rainfall in the year 2000 was 115 cm, deficient by 12 cm or 10%. Now the rainfall in the year 2001 upto 30 September is 58 cm, which is higher than normal by 7 cm or by 14 %.

That Chennai has been receiving its share of rainfall fairly consistently in the last decade is thus evident. But public and media perceptions do not apparently concur with such a statistics-based reality. The city receiving normal or near normal rainfall is often described as *`drought'* or *`severe drought'* by media.

TABLE 1: Rainfall of Chennai (Mean of Nungambakkam and Meenambakkam)

{Mean (1991-2000) = 146 cm; Long term normal = 127 cm}

Year	1991	92	93	94	95	96	97	98	99	2000
Rainfall (cm)	137	113	141	156	158	225	191	110	112	115

Public memory is short but the highest annual rainfall recorded in Chennai Nungambakkam (244 cm) was realised in 1996. In spite of receiving normal or near normal rainfall the city has been experiencing severe water shortage. The coefficient of variation of annual rainfall of Chennai city is close to 30 %. Thus a deficiency of 30 % (37 cm) or more, when the annual rainfall realised would be less than 90 cm is likely in 1 out of 6 years. The scenario as regards water availability in such a year of *actual deficiency* could be left to anybody's guess.

At present, RWH is vigourously promoted by the development agencies as a solution for the perennial water shortage plaguing the city. The effectiveness of RWH in fulfilling the water requirements of the occupants of an apartment complex, using this technique for replenishing its borewells or shallow wells, can be lucidly understood from the following simple exercise.

In a four ground plot (1 ground = 2400 sq.ft) a builder can build an area of upto 14,400 sq.ft according to development rules. Suppose sixteen flats are constructed each with an area of 900 sq.ft, with the apartment complex occupied by 80 persons. Now, even if all the rainwater (realised from net rainfall of 89 cm after subtracting the evaporation/run off of 38 cm from the normal annual rainfall of 127 cm) falling on roof- top and sides of the building are routed to the percolation pits for conservation, it works out to only 27 litres of water per person per day and would meet only 20% of the requirement of the residents of the apartments. The situation would be different if, only four families comprising of around 20 persons lived in the four ground plot, which used to be the case once upon a time when people lived in independent houses and multi-storied apartments were not in vogue. Thus it is quite evident that RWH can only supplement and cannot provide a complete solution to the water-starved Chennai.

One particular strategy which was under serious consideration one or two decades ago was to construct more dams in the vicinity of Chennai (say, within 50-75 km from the core of the city) to store the excess rainwater. It may not be possible to

implement this plan in the current scenario of overcrowded areas surrounding Chennai (beyond the urban agglomeration) and the near impossibility of resettlement of those evacuated from the proposed dam site. Another dimension is added to this when the environment related issues in association with the construction of a dam inevitably crop up.

It is strange but true that whereas Chennai city has been receiving consistently good rainfall, the actual experience of the common man is that of standing in long queues awaiting the arrival of water tankers at any time (day or night) and an optimistic look into the future hoping that the reservoirs feeding water to the city will get filled to its capacity.

Then, what could possibly be the solution to the water shortage of Chennai?

Whereas no long term solutions are in sight, some of the short term solutions could be: (i) Augmenting the water sources (Krishna water/Veeranam project) (ii) RWH (iii) Recycling of used water (iv) Treatment of salty/hard water drawn from shallow / bore wells (v) Conversion of sea water into fresh water. (vi) Preventing pollution of the existing water bodies by industrial effluents and (vii) Conservation of water / thrifty use of water. Besides, the public and media should be correctly informed so as not to expect the impossible event of getting excess rainfall every year, which is completely against the laws of nature. Apart from India Meteorological Department (IMD), Indian Meteorological Society (IMS) could also play a role in this endeavour.

My experience as Duty Officer in Airport

P.V.Sankaran

Having served in IMD HQ office New Delhi for nearly 15 years mainly in administrative sections, I came on transfer to Chennai citing my "aged parents and ailing wife" as reasons. Equipped as I was with a thorough knowledge of Fundamental Rules & Supplementary Rules popularly known as FR & SR I thought of getting a posting to some administrative section where I can show my skills. But the office thought otherwise. They wanted me to work in aviation forecasting and I was posted to Airport Meteorological Office, (MO) Chennai as Duty Officer.

Talking of administration skills, I remember a humourous incident which happened in the office. An observer working at an outstation requested a cycle to commute to the telegraphic office to send weather telegrams. The office, having gone through all the rules and regulations, wrote back that as the telegraphic office is just 2 km from the observatory (as the crow flies) he is not entitled for a cycle. The observer shot back saying , "I am neither a crow nor I can fly; Please sanction a bicycle to our observatory". The request was immediately agreed to.

I joined duty as Duty Officer in MO Chennai. I settled down to work after performing parallel duties under a senior for 10 days. I was really wondering how such a big aircraft carrying a heavy load of people and cargo flies with the guidance given in a small Met.T3 or T4 form. (Chart Form of Documentation was not in vogue then).

One of the main functions of the Duty Officer in MO Chennai is to verify and issue a METAR, a Current Weather Observation issued every half an hour in airports for the safety of aircraft operations. METAR Assistant who sits in the Tower has to study the sky conditions, present weather, wind direction and speed with the help of aviation instruments and issue the METAR after getting the approval of the Duty Officer.

When the weather condition is bad, i.e., possibility of occurrence of thunderstorm, reduction in visibility etc. occurs, a SPECI (Special weather report) is issued in consultation with the Duty Officer from the time of occurrence of the bad weather phenomena. Copies of the report are then sent to various user-offices locally and outside.

I was in the evening duty one day. The Metar Assistant who was also quite new to the seat called me over phone and read out the current weather report. It was a SPECI for dry thunderstorm (coded as 17 TS). I was really taken aback because the Duty Officer is supposed to issue a thunderstorm warning for a four hour period well in advance for the safety of aircraft operations. I had not come across any Cb cells while observing the sky a few minutes before that. The sky had some Sc and Cu cells only whereas thunderstorm is generated by Cb clouds. On verifying with the Metar Assistant and cross-checking he was very firm that he did hear a distant thunder and was very sure that it was a dry thunderstorm which necessitated issue of a SPECI.

I got a little worried because there is a forecast verification cell which does verification of the aviation forecast issued and points out the mistakes, if any, of the duty forecasting officers. I went upstairs to the tower, came to the terrace alongwith the Metar Assistant. I was in search of a Cb cell which can produce thunder but except for small Sc and Cu nothing was to be seen. But the Metar Assistant put his foot down and asserted that he heard thunder and remarked that the Cb cell might be hidden behind the Pallavaram hills. I was really amazed how a small hill can conceal a Cb which grows into a few kms height.

This reminded me of an incident in Mahabharata where Lord Krishna hides the sun with the Sudershan chakra to enable Arjuna to fulfill his oath to kill Jarasandha before sunset. I too heard a big noise from the Pallavaram hill and a lot of dust and smoke coming up. My God! What's happening? It is nothing but the quarry people blasting the rocks with dynamite, the blast being interpreted by the Metar Assistant as dry thunder. I could not suppress my laughter and came down giving instructions to give the correct current weather report.

Integrated approach of RS, GIS and Meteorology for in-depth Urban Heat Island study

O.M.Murali, WTI Advanced Technology Ltd, Chennai

Feeling irritated because of the scorching sun combined with high humidity making you unbearable and uncomfortable? Not only this, according to a report, the prevalence of asthma and other respiratory diseases, particularly among children and the elderly is expected to increase due to smog caused by warmer temperatures. The World Meteorological Organisation (WMO) reports that in 2000 there were 1500

more deaths during heat waves in the United States (US) than there were in 1990. WMO projects that by the year 2020 this will increase to three to four thousand deaths per year just in US alone. But the reason for this is related to the human-induced factors – the so called "Urban Heat Island" which has been studied extensively in western countries. Such studies have also been conducted in a very few Indian cities including Chennai, where its present rate of growth in all dimensions have resulted in rapid and irrecoverable landscape changes at the expense of existing natural resources. This reminds us of the need for a fresh analysis in much more detailed fashion by integrating other available technologies like Remote Sensing (RS) and Geographic Information System (GIS). The Urban Heat Island is nothing but the increased surface temperature in some pockets of the city due to changing microclimate induced by concentrated human activities.

This Urban Heat Island study was carried out in Pune, Mumbai, Kolkata, Delhi, Visakhapatnam, Bhopal and in 1987 in Chennai by a team from Regional Meteorological Centre, Chennai. The temperature high, characteristic of Heat Island, was found to be varying from a maximum of 10 °C in Mumbai to a minimum of 0.6 °C in Visakhapatnam. In Chennai and Kolkata it was found to be around 4 °C

Everyday, the city weather report gives the maximum and minimum temperatures recorded at two places in Chennai namely Nungambakkam and Meenambakkam (airport). This will not be the same throughout the city because the former comes under the urban category and the latter, far removed from the human intervention is of suburban type. Also the temperature tends to vary across the whole city with pockets of hot and cool air at various locations. Urban Heat Island study is a purely meteorological study where data on temperature, humidity, wind speed etc. are collected at various spots across the city to identify areas of warm and relatively cooler areas. Normally in the city, the Central Business Districts (CBD) or the core area will experience the highest temperature. This is because of the uninterrupted and dense concrete structures with increased glass usage, emission from the ever-increasing vehicles, less or no tree cover etc. All these factors contribute to the unhygienic and unhealthy microclimatic conditions.

Most of the man-made structures like concrete, asphalt etc. will be heated up very fast in response to the solar radiation and release the stored heat energy very slowly, sometimes the duration of release extends well into the night. Because of this, the daily minimum temperature would tend to be higher than otherwise giving pleasant warmth during winter in regions of cold climate but quite uncomfortable in tropical cities like Chennai.

This Urban Heat Island has been widely studied in many US and the European cities. The huge size of the city and the mammoth man-made structures give the ideal environment to study such a microclimatic effect in greater depth. As far as Chennai is concerned, this study was undertaken 14 years ago. The level of urbanization is tremendous with the emergence of massive structures grown haphazardly without any land use plan, ruthless cutting of trees etc... A fresh study is now very much essential to understand the temperature changes that have taken place in different areas across the city. Chennai experiences a tropical climate and so the building design and type should be such as to allow for sufficient ventilation and enough spacing between the buildings to let the accumulated heat escape into the atmosphere. The present rate of growth would have generated some more "heat islands" with increased temperature in other parts of the city as well which would be known only from a fresh study integrating scientific and technological tools like RS, GIS. As a supplementary to the

meteorological data, RS satellite imagery give the latest land use/ land cover pattern of Chennai and with the temperature data combined in GIS environment, it is possible to map the hot and cool areas across the city. Once mapped, the following things will be known which is not possible with the conventional meteorological data alone.

- The direction of unplanned growth (urban sprawl) across various parts of the city
- Areas requiring proper land use plan
- Future vulnerable areas for higher temperature
- Areas devoid of natural vegetation, parks and water bodies which reduce the microclimate

This would be quite helpful to the architects, government departments and planners to take better decisions to improve the changing land use pattern.

Depending upon the size of the city, urban complexity and activities will vary with respect to the nature of industries and due to several geographical factors such as topography, latitude, proximity to water bodies, time of the day, season of the year and existing weather conditions. Actually, tall buildings, concrete and asphalt of the city absorb and store greater quantities of solar radiation than do the vegetation and soil typical of rural areas. Further, the city surface is impermeable and so the run-off of water following a rain is rapid, resulting in a severe reduction in the evaporation rate. This helps to increase the surface temperature further.

Furthermore, tall buildings also alter the flow of air. Because of the greater surface roughness, wind speeds within an urban area are reduced. The lower wind speeds decrease the city's ventilation by inhibiting the movement of cooler air from outside that, if allowed to penetrate, would reduce the higher temperatures of the city centre.

The "blanket" of pollutants over a city which include particulate matter and greenhouse gases like carbon dioxide, water vapour etc. contribute to the heat island by absorbing a portion of the upward directed long wave radiation (earth's radiation) emitted at the surface and reemitting some of it back to the ground thus increasing the temperature. As per the 1987 study across Chennai city and suburbs, it was found that the urban heat island (hot pockets) were found at Mambalam, Vepery and Ennore industrial areas and the cooler areas were in and around Raj Bjhavan and Guindy because of the vegetative cover and enough spacing between the buildings and also partially due to suburban characteristics.

This kind of a study is essential and needed now and the integrated approach of satellite imagery and GIS with meteorological data will help to know how the microclimatic has changed over the years because of human activities. It will help to initiate preventive steps for minimising ecological imbalances. This kind of an integrated scientific and technological study would be beneficial to implement for effective land use plan. That is why meteorology must be used in conjunction with the latest technologies like RS and GIS.

SEISMICITY OF TAMILNADU

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Earthquakes do not kill people but it is in fact the buildings that collapse and kill people.
Construct earthquake resistant houses and be safe.

INTRODUCTION

Peninsular India is a shield region, which has maintained its continental structure since the Precambrian age (3500 million years). An earthquake is not supposed to be a well-known phenomenon in a shield area. However, the earthquake of Villupuram (1867), Ooty (1882), Coimbatore (1900,1972), and Pondicherry off-coast (2001) in Tamil Nadu as well as in Latur (1993) of Maharashtra and Bhadrachalam (1969) in Andhra Pradesh with the magnitude of 5 to 6.3 in the Richter Scale have exploded the myth that Tamil Nadu, Andhra Pradesh, Maharashtra and other States in Peninsular India are earthquake-free. With reference to the Tamil Nadu, which has been experiencing several earthquakes with the magnitude of 2.5 to 5.6 on the Richter scale and the reason for these earthquakes/earth tremors, is the reactivation of faults under the earth's surface.

Earthquake disaster is extreme event that cause significant disruption to the normal life and damage to the property besides causing untold misery to the people. These dramatic events with catastrophic impact often test the outer limits of disaster mitigation and management apparatus of a country. The crisis situation gets created, whenever vulnerability overshadows preparation levels. This was amply demonstrated when the recent devastating earthquake in Bhuj, rocked the State of Gujarat shaking it to the very foundation.

METHODOLOGY

Tamil Nadu, which represents a shield in the inland, and the basement of the Cauvery basin in the east coast of Tamil Nadu, form the subject of discussion. The Indian Resources Satellite (IRS) imagery of Band 6 of 1:500,000 scale covering Tamil Nadu were studied and Interpreted for lineaments in the Archaean terrain of the study area. A map showing the major and minor lineaments was prepared for the study area (Fig. 1). The Common Depth Point (CDP) sound reflection and gravity geophysical data were utilized for delineating the subsurface major fault system in the basement of the Cauvery basin in Tamil Nadu coast where deep-seated fault systems remain concealed by the sedimentary formations and they are not manifested on the surface in any form. They do not get picked up in the satellite imagery.

INTERPRETATION

The data involved for the interpretation to identify the seismic-prone fractures in Tamil Nadu are structures and epicentres of earthquakes.

STRUCTURES

The shield area of Tamil Nadu consists of charnockite and gneisses with intrusive complexes. The intrusive complexes include anorthosite, ultrabasic complexes, carbonatite, dolerite, syenite and granite. The Cauvery basin has thick successions of sedimentary formations of Mesozoic to Cenozoic eras. The basin came into being in the above region as a pull-apart basin following the rift along the eastern continental margin of the Indian subcontinent in the early Mesozoic era.

Based on the distribution of lineation, Tamil Nadu has been broadly classified into North Block and South Block in the inland area and Coastal Block in the coast. The Cauvery-Moyar river course is the boundary in the inland area between the North and South Block (Fig.1). The lineaments in the North Block have NW-SE, N-S, NE-SW and E-W trends, which are the major ones. The NW-SE and NE-SW trends lineaments have high frequency distribution followed by E-W and N-S trends. The NE-SW lineaments are longer in length compared to those with other trends.

The major trends and pattern of lineaments in the South Block are NW-SE and NE-SW as in the case of the North Block, but the density of distribution of lineaments is lower.

In the Coastal Block, the basement of the Cauvery basin has the alternating horsts and grabens to form the ridges and depressions. The various tectonic features which have been recognized are Ariyalur - Pondicherry depression, Kumbakonam ridge, Thanjavur depression, Tranquebar depression, Devakottai Manargudi ridge, Nagapattinam depression, Ramnad Palk Bay depression, Manner Depression and Mandapam ridge (Fig.1). The depressions are broad and occupy large areas compared to the ridges which are in narrow zones. Most of these tectonic features are extending into the offshore areas. The sediment thickness in the depressions varies from 4000 to 7000 metres. The ridges have sediments in the range of 1000 to 2000 metres. The maximum thickness of 7000 metres is in the Ariyalur-Pondicherry depression.

HISTORY OF EARTHQUAKES

The information on past earthquakes gives an idea of the seismic status of a place or region. The study requires a variety of geological and seismological information such as details of epicentres origin time, focus depth and magnitude; the various fault systems along which earthquakes has occurred as well as those which are currently active.

To know about the seismicity of Tamil Nadu, apart from past earthquakes, micro-earthquake epicentres data were also collected for a period of 12 years (1977 to 1988) from the seismic array of Gauribidanur, Karnataka State. There are earthquakes with intensity of 3 to 5 on the Richter Scale (Table 1).

The available seismic data were plotted over such a lineament and geotectonic elements, map (Fig.1), the major percentage of the data are aligned along the NE-SW and NW-SE trend of fractures. A few of them fall on the E-W and N-S trend of fractures. The seismic-prone fractures as well as the fractures are shown in Fig.1.

DISCUSSION

The epicentres of earthquakes are related to the fault system in a region. From his study, the possibility of correlation between the epicentres of earthquakes to the fault systems have been explored to distinguish between the seismic prone and non-seismic prone crustal fractures.

The epicentres of earthquakes on fractures map (Fig.1) reveal that the major percentage of the seismic data align along NE-SW crustal fractures followed by NW-SE and a few fall along the E-W and N-S trends in the North Block. . Also intersections of all above fractures, east of Tirunelveli (Fig.1) and the E-W with NW-SE trends south of Coimbatore. The crustal fractures with more epicentres reveal the frequent reactivation than the other fractures.

It is interesting to note that the earthquakes with a maximum known intensity of 4 to 5.6 on the Richter Scale, are aligned in the intersection of NE-SW and N-S trend of fractures in Tiruppattur, as well as in the ocean area, east of Pondicherry. In the Tiruppattur area, the occurrence of minor earthquakes between the period of 27th November and 3rd December, 1984 with the intensity of more than 3 on the Richter-Scale (Table 1) suggests that reactivation of the fault is in the minor scale in recent years.

The Coimbatore earthquake in 1990 had the intensity of 6 to 7 on the Richter Scale in the South Block and was aligned along the E-W trends of fracture in south-west of Coimbatore (Fig.1). This fracture is the southern boundary of Palghat Pass or Gap. The change in trends of foliation and the presence of fault scarps in the field indicate two E-W faults, one on the north and other on the south of the Pass. The southern one continues towards the east, along the northern slope of Palani hills. This is evident that adjustment is occurring on a larger scale in the E-W trends crustal fracture, south of Palghat Pass. Further, it is supported by the occurrence of recent minor earthquakes with intensity less then 3 on the Richter Scale.

The study reveals that there is no uniformity in epicentres distribution with respect to the trends of fractures. For example, not all but some of the fractures of the NE-SW and NW-SE zone are seismic-prone. It indicates that the reactivation is not uniform in all the fractures. This may also indicate the different depth nature of fractures.

In the Cauvery basin, the plots of the epicentres of earthquakes fall along the NE-SW faults which form the upper boundaries of the Ariyalur-Pondicherry, Tranquebar and Nagapattinam depressions. Also the epicentres of earthquakes are in Kumbakonam ridge. The upper boundary fault of the Ariyalur-Pondicherry depression is the boundary fault between the Archaean shield and sedimentary deposit in the Cauvery basin. This fault has 5 epicentres of the earthquakes one of which have the magnitude to the level of 3 to 4. Within the Ariyalur-Pondicherry depression, there are epicentres of earthquakes which possibly relate to the basement faults within the depression. In the case of Kumbakonam ridge zone, it is prone to

seismicity as is evident from the presence of earthquakes with the maximum magnitude of 4 to 5.6 on the Richter Scale. The two other minor earthquakes in the offshore are also possibly aligned with the extension of the inland ridge.

The different thickness of sediments in the different depressions of the Cauvery basin and also the ridge portion indicate that there have been differential movements or reactivation of the boundary fault systems of these depressions and ridges during the Cretaceous and Tertiary. Such reactivation has let the subsidence of the basin give rise to the highest thickness of sediments in the Ariyalur-Pondicherry depression. The epicentres of recent earthquakes are also located in the northeastern part of this depression and they reveal that there is adjustment or subsidence taking place on a minor scale, with reference to the boundary faults.

Views on Pondicherry Earthquake of 25th September 2001

Pondicherry off-shore moderate earthquake on 25.9.2001 at 8.27 pm was from the Cauvery Basin. Time to time the Cauvery basin experiences mild to moderate earthquake and the details are in Table 2 and Fig 2.

The Table 2 and Figure 2 reveal that the Cauvery basin basement reactivated faults are the source of causing the minor earthquakes /tremors in the past. The reactivated faults are northern fault of Ariyalur depression, Kumbakonam ridge faults, Devakottai-Mannargudi ridge fault and to some extends northern fault of Tranquebar depression.

Epicentres of the present 25th September 2001 Pondicherry off-shore earthquake is located south-east of Pondicherry (40 km). This epicentre falls in the vicinity of major basement fault, forming the boundary between Ariyalur Pondicherry depression and Kumbakonam ridge of the Cauvery Main Basin. It is essential to state that this basement fault is reactivated in the past also, as evident from historical epicentres on the Kumbakonam ridge. This fault trends NE-SW direction, traceable from east of Trichy in the southwest through Kumbakonam, and enters into the sea north of Chidambaram and continues beyond in the ocean. This basement fracture found in the hard rock is covered by few thousands of sediments below the land and sea.

The present Pondicherry moderate earthquake has been caused by the reactivation of the existing basement fault. The intensity of vibration was reduced to the mild impact in Chennai, which is located 150km away from epicentres compared to the magnitude 5.6 of this earthquake. This is due to thick sediments of more than 7000m and also the a large column of water in the epicentre point of this earthquake

SEISMOLOGICAL OBSERVATORIES

Earthquake risk assessment is all the more difficult in Tamil Nadu because of the lack of seismic instrumentation (seismograph) in large parts of the State. Presently, Tamil Nadu has only three such observatories in the places viz. Chennai, Salem and Kodaikkanal. However, Indian Meteorological Department (IMD) will create an optimum Network of Seismological Observatories in Tamil Nadu by installations at Kavalur, Kiranur, Trichy and Ramanathapuram under Government of India Programme – Level I. Under the Government of India Programme – Level II,

another 9 observatories, are suggested for this networking. After completion of the Level II programme, Tamil Nadu can do monitor the earthquakes with higher confidence.

CONCLUSION

25th September 2001 Pondicherry off-coast earthquake was felt by everyone in Chennai and environs. It is also to be noted that Chennai and environs are being upgraded to Zone III in the revised Seismic-Zonation Map of India (2000). In view of these developments, it is essential to review the seismic proneness of the various districts of Tamil Nadu for evolving appropriate preparedness measures and mitigation strategies to reduce the impact of the earthquake disaster in future.

Centre for Disaster Mitigation and Management (CDMM), Anna University, Chennai has carried out a preliminary study of epicentres of earthquakes in Tamil Nadu. The location of epicentres falls in inland, coastal areas and off-coast of Tamil Nadu. The major portion of the epicentres of the earth tremor/earthquake in Tamil Nadu, are in northern part of Tamil Nadu i.e. north of Cauvery River. Chennai, Thiruvallur, Chengalpattu, Dharmapuri, Salem, Erode, Namakkal, Vellore, Thiruvannamalai, Nilgiri, Villupuram and Cuddalore districts are the areas, which were struck by earth-tremors/earthquakes with magnitude in the range of 3 to 5.7 of Richter Scale. In the southern part of Tamil Nadu, the districts experiencing earth tremors/earthquakes magnitude in the range of 3 to 6 are Trichy, Coimbatore, Dindigul and Tirunelveli. A details study needs to be carried out by using remote sensing data with required level of ground-truths to arrive at an effective seismotectonic map of Tamil Nadu in a reasonable scale of 1 : 250,000.

The Disaster Management Plan for State and District Levels are essential for proper planning and implementation of management strategy in Tamil Nadu.

Table-1

Earthquakes of Tamil Nadu with magnitude of more than 3 on the Richter scale.

	Magnitude	Location
1900 02 8	6.0	Coimbatore
1966	5.4	Pondicherry off-coast
1979 06 9	3.2	Krishnagiri
1983 07 5	3.2	Pondicherry
1984 03 20	4.4	Tiruppattur, Vellore district
1984 11 27	4.1	Tiruppattur
1984 11 28	3.3	Tiruppattur
1984 12 3	4.3	Tiruppattur
1984 12 3	3.3	Tiruppattur
1984 12 3	3.5	Tiruppattur
1985 09 22	3.3	Attur
1988 05 19	3.8	Tiruvannamalai
1988 06 8	3.5	Tirunelveli
1998 08 25	3.9	Dharmapuri
1998 11 25	3.5	Sangagiri (Salem)
2001 09 25	5.6	Pondicherry off- coast

{Note: No micro-earthquake data was available to the author from 1901 to 1965 and 1988 to 1997}

Table 2. Epicentres of earthquakes /earth tremors in Cauvery Basin

Date	Origin Time IST			Magnitude
	Hr.	Min.	Sec.	
1966	-	-	-	5.2
13.10.1982	07	51	35	2.7
05.07.1983	22	57	59	3.2
02.04.1994	07	09	27	2.5
22.09.1985	07	20	52	3.3
06.10.1985	08	42	19	2.8
21.05.1987	06	54	06	2.7
07.04.1988	06	58	04	2.6
02.05.1988	07	03	59	2.5
19.05.1988	14	58	27	3.8
20.11.1988	06	44	21	2.5
25.09.2001	20	27	00	5.6

{Note: No micro-earthquake data were available to the author for the period of 1965 to 1976 and December 1988 to August 2001}

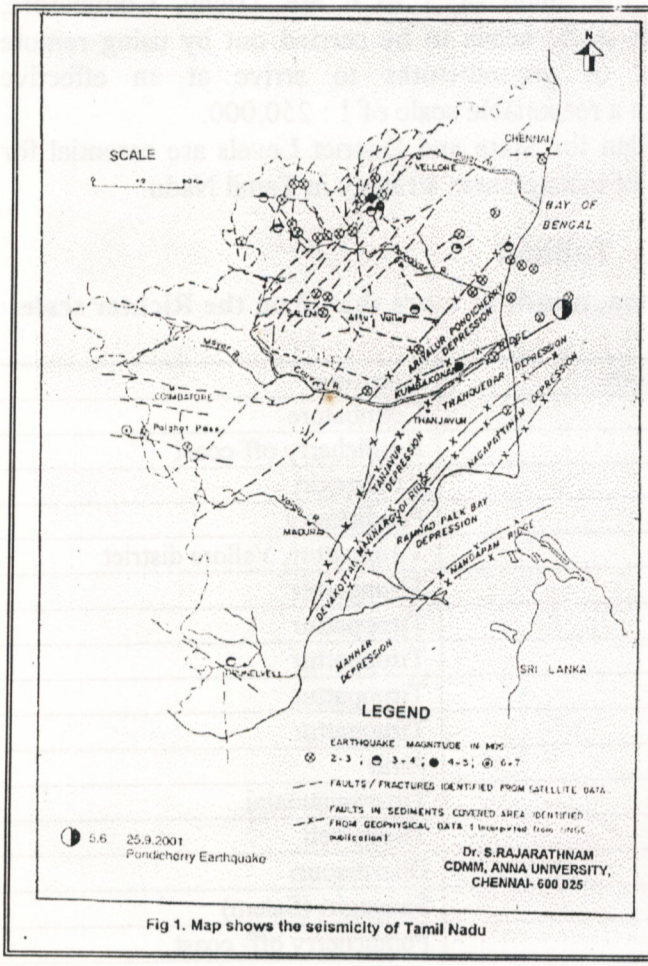

Fig 1. Map shows the seismicity of Tamil Nadu

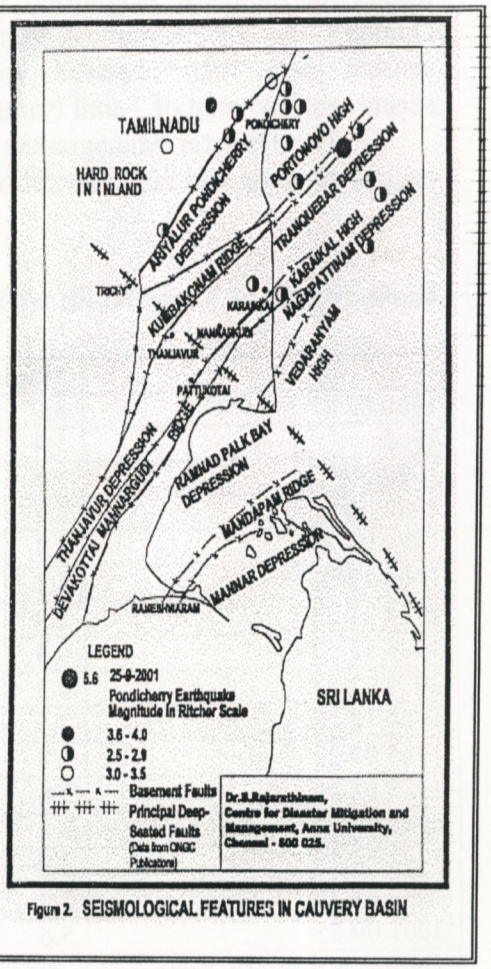

Figure 2. SEISMOLOGICAL FEATURES IN CAUVERY BASIN

Obituary

Shri.J.Shanmugasundaram
(1945-2001)
SERC Madras, Chennai.

Shri. J.Shanmugasundaram, a life member of IMS and member of the Local Council of Chennai Chapter, passed away suddenly on 22 September 2001 at Chennai following a heart attack. Born on 18 December 1945 in Madurai, Tamil Nadu, Shri. J.Shanmugasundaram graduated in Civil Engineering from Madras University in 1970 and took his postgraduate degree from Madurai University in 1973. He joined Structural Engineering Research Centre, Madras in 1975 and rose to become its Deputy Director in the cadre of Scientist-F in 1998.

One of his major areas of interests was Cyclone Disaster Mitigation, which included post-cyclone damage surveys and design of structures in cyclone prone areas. He received the best technical paper award from the Institution of Engineers (India) thrice. He is the author of two patents and has published more than 75 technical papers in journals of repute.

Shri. Shanmugasundaram joined IMS in 1999 and was a member of the Local Organising Committee of the IMS National symposium, TROPMET-99 held at Chennai in February 1999. He also served as a member of the Editorial Committee that brought out the Proceedings of TROPMET-99. His participation and involvement in these activities was one of complete devotion and dedication. In the year 2000 he was again actively associated with the one day seminar on Public Weather Services organised by IMS in April 2000. IMS Chennai Chapter will miss him and his services.

Shri. Shanmugasundaram is survived by his wife, son and a daughter.

CHAPTER NEWS

A one-day seminar on "**Public Weather Services and Disaster Management**" was held at Regional Met Centre, Chennai on 17 April 2001. It was organised by IMS-Chennai Chapter in collaboration with RMC Chennai, SERC Chennai and Centre for Disaster Mitigation and Management, Anna University and was sponsored by ISRO - Bangalore, Tamilnadu State Council for Science and Technology - Chennai, SERC - Chennai, ONGC Ltd - Chennai and India Cements Ltd – Chennai. More than 60 delegates representing 31 user organisations participated in the seminar. It turned out to be a good show.

The Annual General Body meeting of IMS-Chennai Chapter was held on 22 May 2001 to elect the new office bearers for the local Council for a 2-year term 2001-2003. The new office bearers are

Sri A.K.Bhatnagar	Chairman
Sri S.Raghavan	Immediate Past-Chairman
Sri S.K.Subramanian	Secretary
Sri P.V.Revikumar	Joint-Secretary
Sri E.R.Sukumar	Treasurer
Sri G.S. Ganesan	Member
Dr Y.E.A. Raj	Member
Sri J. Shanmugasundaram	Member
Prof. N. Sivagnanam	Member
Dr. S. Sivarajasingham	Member
Kum S. Stella	Member
Dr. N. Jayanthi	Ex-Officio Member
Dr R. Suresh	Ex-Officio Member

Subsequently the Local Council approved induction of Sri K. Premkumar of NIOT, Chennai and Prof T.N.Balasubramanian of TNAU, Coimbatore as co-opted members.

The Editorial Board of Chapter's Newsletter "Breeze" was also re-constituted with Sri S.K.Subramanian as Editor and Sri S.Raghavan, Sri G.S.Ganesan and Dr S.Rajarathinam as members.

Scientific Lectures

1. Dr G.Latha, Scientist from NIOT – Chennai spoke on " Storm Surge prediction and estimation of coastal inundation" on 27 June 2001.
2. Kum S.Stella, Meteorologist, MO Chennai spoke on " An expedition to Antarctica in the new millennium" on 26 July 2001.
3. Dr M.S.Narayanan, Group Director, Meteorology & Oceanography group, SAC Ahmedabad spoke on "Marine atmospheric observations from Oceansat – 1" on 29 August 2001.

A half-day session of scientific talks on "**Earthquakes in Tamilnadu**" was arranged on 17 October 2001. The following speakers delivered lectures

1. Sri P.C.S.Rao, Asst Meteorologist on "Earthquake monitoring by IMD".
2. Dr L.S.Suryanarayanan, Director, GSI Chennai on "Earthquakes – Geological aspects"
3. Prof Krishan Kant Sharma, Professor, Department of Applied Geology, University of Madras on "Earthquake prediction and preparedness".