Indian Meteorological Society, Chennai Chapter

NEWSLETTER
Vol. No.21, Issue No.2, Dec 2021
Vol. No.22, Issue No.1, June 2022

Editorial Board

Editor : R. Nallaswamy

Members : Dr. Y.E.A. Raj, Dr.B. Geetha and Dr. K.V. Balasubramanian

Contents :

Message from the Chairman.,

I am happy to see that the issues Dec 2021and June 2022 of Breeze are being released. The articles of these two issues written by the scientists and academicians of various organizations and I thank them very much on behalf of IMS Chennai Chapter for their valuable contribution. I wish this cooperation extends that will help the IMS to move forward in reaching the more people.

I also take this opportunity to welcome the new council of IMS Chennai Chapter.

I am sure that the articles published in these two issues will be useful in understanding the meteorology and its allied areas.

I congratulate the editorial team of Breeze for their efforts in bringing out these two issues.
I request all the IMS members and readers of the Breeze newsletter to write their views and suggestions to us for further improvement.

Thank you very much,

Yours sincerely,

T. V. Lakshmi Kumar

Dr. T.V. Lakshmi Kumar
Associate Professor
SRM Institute of Science and Technology, Kattankulathur

Editor's Desk :

Dear Members Greeting to you all.

As mentioned in the Charirman's Page The News Letter Breeze Vol 21 Issue 2 Dec 2021 and Vol 22 Issue 1 June 2022 of IMS Chennai Chapter are being released as a combined one. It is being uploaded in the IMD Chennai Website with link to IMS Chennai imdchennai.gov.in with link to IMS Chennai. I am exfreamly thankful to Chairman and Editorial board members for their guidance and help in preparing the Breeze. Thanks are also due to Mr. M. Ashok Williams and Mr. Bharath J of SRM for their help

Since the new council took over in May 2022 and had the first meeting in June the releasing of Breeze was given priority.

The first Scientific lecture is proposed in August 4th week. The next issue will be released in Dec 2022 . Articles related to Meteorology and allied fields may be sent by email to ims.chennai6@gmail.com or rns115@gmail.com.

Members are requested brief their colleagues friends faculties Students and all who are interested willing to acquire additional knowledge to become life members by paying the fees fixed.

Indian Meteorological Society has headquaters at Mausam Bhavan New Delhi and having 29 local chapters all over India with over 3000 members

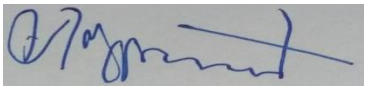
Once one becomes a life member that Membership will continue in the new place if shifted.

Chennai Chapter with 155 members is functioning at C/O Regional Meteotological Centre

No 6(Old no 5) College Road Chennai 600006.The Chapter is arranging periodical Scientific lectures and Seminars firvthe benifit of members and to reach out to all and spread the Science of Meteorology.

Those who are interested to become member may down load membership Form from the website of IMS Chennai Chapter .The Editor and IMSCC are not responsible for the views of the authors of the articles of Breeze.

With best wishes.



R.Nallaswamy, Editor,

August 2022

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2022 -2024

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Salient Features of Southwest Monsoon 2021 over the Southern Region

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- All India southwest monsoon (SWM) seasonal rainfall during Jun-Sep, 2021 was normal (87.0 cm against Long Period Average (LPA) of 88.0 cm)
- Onset on monsoon over Kerala took place on 03rd June 2021 against the normal date of 01st June.
- South Peninsular region recorded above normal rainfall of (111% of LPA). Seasonal rainfall received over various subdivisions in the southern region is as follows

SUB-DIVISION	Actual rainfall (mm)	Normal rainfall (mm)	PDN (%)
COASTAL ANDHRA PRADESH (CAP)	704.0	586.9	20
TELANGANA (TEL)	1044.7	751.9	39
RAYALASEEMA (RYS)	488.2	411.6	19
TAMIL NADU & PUDUCHERRY (TN)	393.4	336.1	17
COASTAL KARNATAKA (CK)	2795.6	3095.1	-10
NORTH INTERIOR KARNATAKA (NIK)	603.1	497.1	21
SOUTH INTERIOR KARNATAKA (SIK)	701.7	681.8	3
KERALA (KER)	1718.8	2049.2	-16
LAKSHADWEEP (LAK)	790.9	1013.1	-22

- Excepting Lakshadweep, all other subdivisions in the region [Coastal Andhra Pradesh (CAP), Telangana (TEL), Rayalaseema (RYS), Tamilnadu-Puducherry-Karaikal (TN), Coastal Karnataka (CK), North Interior Karnataka (NIK), South Interior Karnataka (SIK) & Kerala (KER)] received *normal to excess* rainfall during the SWM season.
- There were *isolated heavy* rainfall activity on 73 days over TN, 69 days over SIK, 67 days over TEL, 56 days over CK ,53 days over KER, 49 days over CAP, 32 days over NIK, 30 days over RYS & 2 days over LAK area.
- TEL & SIK experienced 5 & 4 days respectively of *isolated extremely heavy* rainfall during the season.

- Cyclonic storm '**Gulaab**' formed over Bay of Bengal on 24th September, crossed north Andhra Pradesh coast and caused heavy to very heavy rainfall with isolated extremely heavy falls over north coastal Andhra Pradesh and Telangana on 27th-28th Sep 2021.
- Wankdi (Kumaram Bheem district) in Telangana recorded the highest rainfall amount of 387.2 mm over the southern region on 23rd July 2021.
- The SWM withdrew from the entire country on 25th October 2021

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Summary of Northeast Monsoon 2021

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During the year 2021, the southwest monsoon withdrew from the Indian region on 25th October and simultaneously, the Northeast monsoon (NEM) of 2021 commenced over the southeastern parts of peninsular India on 25th October against the normal date of 20th October.

Excepting Coastal Andhra Pradesh (CAP) that received normal rainfall during the season, the other four sub divisions benefitted by the NEM [Tamil Nadu (TN (including Puducherry & Karaikal), Kerala (KER), Rayalaseema (RYS) and South Interior Karanataka (SIK)] received excess to large excess rainfall during the NEM season (Oct-Dec) with KER, SIK, RYS recording more than 100% excess (large excess) rainfall.

Subdivisional Seasonal rainfall during Oct-Dec 2021

Sub division	Actual (mm)	Normal (mm)	PDN (%)
TN	714.3	449.7	**+59**
CAP	360.6	338.1	**+7**
RYS	469.7	223.3	**+110**
KER	1026.3	491.6	**+109**
SIK	500.8	204.1	**+145**

- There were 30 days of active to vigorous monsoon conditions over TN & KER during the season.
- There were 65 days of isolated heavy rainfall activity with 33 days of isolated very heavy rain including 09 days of isolated extremely heavy rainfall activity over TN.
- Two depressions that formed over the North Indian Ocean during November contributed significantly to NEM rainfall over the peninsular India.

- Cyclonic Storm (CS) Jawad over Bay of Bengal (BOB) during 02-06 December tracked northwards towards West Bengal-Bangladesh coasts and did not contribute towards NEM rainfall.
- There were two days of extremely heavy rainfall activity over Chennai (i) 06th November night & (ii) 30th December 2021.
- Recurrent heavy rainfall over the coastal and adjoining districts from last week of October to November, led to filling up of water bodies. Inland and riverine flooding occurred over several areas of TN and RYS.
- NEM 2021 extended into January 2022 and cessation of NEM-2021 rainfall over peninsular India occurred on 22.01.2022.

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Flood Vulnerability of the Adayar River – Present and the Future

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The only source of flooding of the Adayar River is the release of excess water from the Chembarambakkam Lake. Ever since the onset of northeast monsoon in 2015 and other historic years like 2005 and 2008, rainfall has been consistent, copious, intense and widespread. This has resulted in the rapid rise of the water in the catchments of the Chembarambakkam Lake.

One of the places the researcher visited was Shanti Nagar and other neighbourhoods along the river course at Anakaputhur, southern suburban of Chennai. Also, it acts as the major entry point of the river in Chennai Metropolitan. Adayar River has two arms – western arm where the Chembarambakkam lake is connected to the river and the southern arm where it gets water from in and around the lakes of Tambaram, Mudichur, Guduvanchery and Perungalathur. Both these arms meet at Tiruneermalai and from where the Adayar river gains width to be called as a river. Another interesting feature of the river here is that from Anakaputhur, the river course from its earlier south-north direction changes to west-east thus aligning her to move towards the Bay of Bengal in perpendicular direction to the coast. This particular winding shape of the river doubly impacted the Anakaputhur communities living along this neighbourhood with extensive damage on 2-3 December 2015.

Fig.1. Completely flooded suburban of Chennai with overflowing Adayar River at the backdrop on 18 November 2015 – Photo by author

For the first release of 18,000 cusecs of water on 17 November 2015, Shanti Nagar was completely inundated and on 2 December 2015, flood inundation was close to 500 m from the river bank, especially on the eastern side towards Anakaputhur with nearly 10 feet height of flood water near the bank. In other parts of the city, canals linked to the Adayar River did the reversal of water against gravity like it happened when Tsunami (sea water) was actually moving upstream from the sea to Chennai water courses like Adayar, Cooum and Buckingham canal. This act of the Adayar River has literally submerged areas which do not have direct impact of the river in several parts of the Chennai city. This has resulted in the flooding of houses along the water courses to over 3 km. During this period, there were houses flooded completely and there were houses not much inundated within Chennai Metropolitan. Here, we must go beyond urban flooding and require understanding of the entire river system or river basin or its sub-basin with its physical characteristics (rainfall, watershed, slope, soil and land use) from origin till its final destination to sea or nearby lake. Only such comprehensive approach on the entire river course (river basin) will help to first understand the flood and evolve long term strategies in flood mitigation.

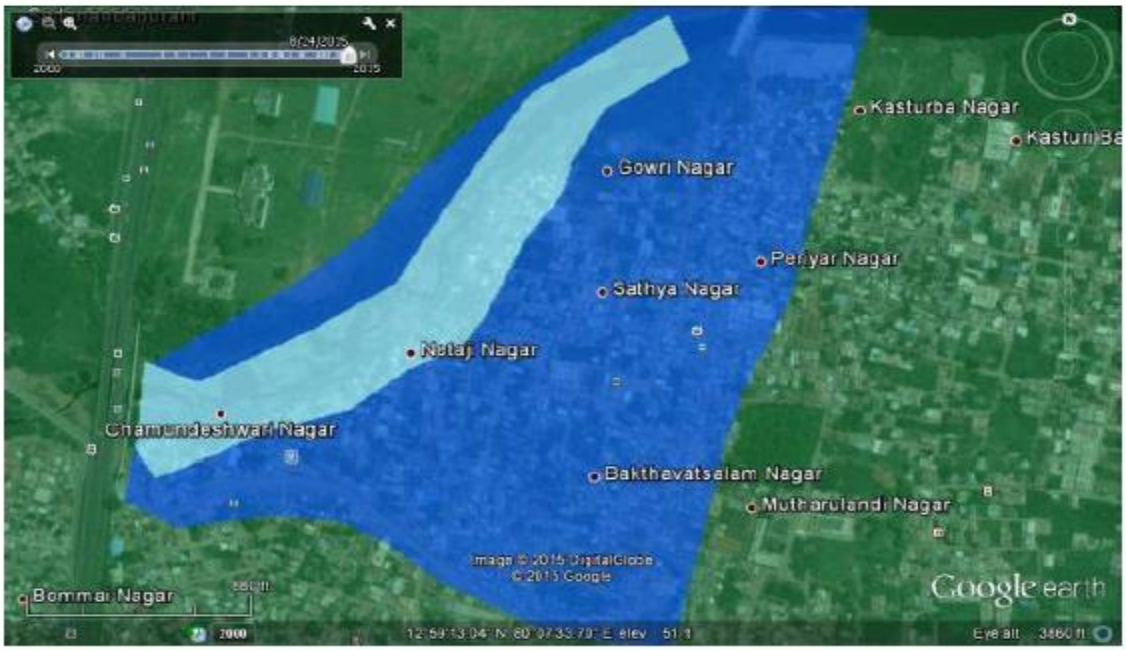

Fig.2. Extent of Adayar River Flood at Anakaputhur in Chennai – (Cyan - 18 November 2015 and Blue – 2 December 2015)

Knowing the flood hazard of an area helps the local government to identify and understand the vulnerable locations and the likely risk to living communities. Once it is in place,

it helps the government to prepare the strategies towards flood risk reduction and management, initiate sustainable land use practices, and bring in structural and non-structural measures towards disaster reduction.

Adayar sub-basin covers partially three administrative divisions namely Kancheepuram, Thiruvallur districts and Chennai Corporation. In this, it covers 112 out of 166 villages in Kancheepuram district and 18 out of 166 villages in Thiruvallur district. In Chennai Corporation, the sub basin covers 36 out of 155 wards of the earlier Chennai Corporation limit. In Chennai Corporation, the zones covered include Kodambakkam, Saidapet, Nungambakkam, Mylapore and Ice-house. Of the total 166 administrative divisions covering three districts, nearly 90 divisions are vulnerable and inundated in 2015.

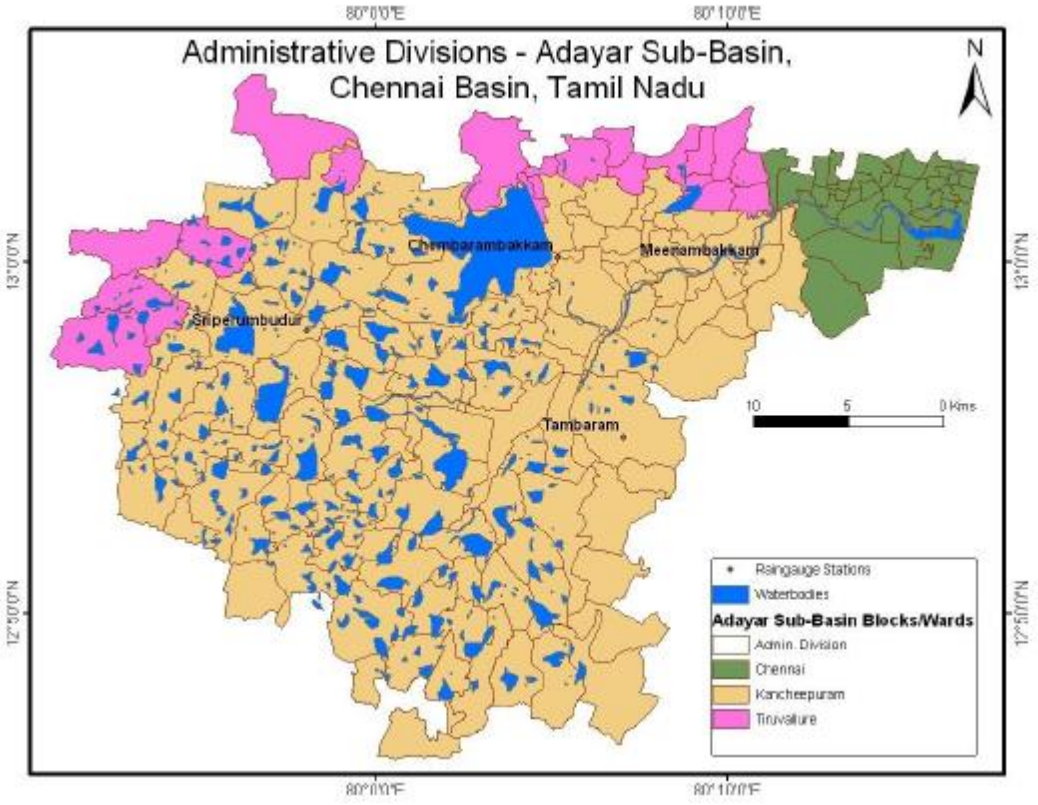

Fig.3. Administrative Division of Adayar Sub-basin – Map compiled by the author

Nearly 40 percent of the Adayar sub-basin is vulnerable to floods, especially in areas which are under the direct influence of the growth of Chennai Metropolitan in Kancheepuram district where majority of the sub-basin is found. High vulnerability to flood near Tambaram is attributed to the presence of numerous lakes and land use changes due to rapid urban expansion. On the other hand, areas falling within the Chennai Corporation are exposed to high flood

frequency due to factors such as high population density, flat terrain, and large number of populations living along the river banks.

Need of the hour – To understand the flood potential of the Chennai Metropolitan, entire Chennai Basin needs to be studied on its physical vulnerability. Because Adayar sub-basin is part of the Chennai basin which consists of Gummidipundi, Araniyar, Kosasthalaiyar, Cooum, Kovalum, Nagari Ar, Nandhi Ar. and Adayar.

Additionally, preparation of flood extent using Global Positioning System (GPS) or using freely available Google Earth Engine and web applications can quickly aid in understanding the extent of flood inundation and deploy human resources for rescue, relief and rehabilitation to safer locations.

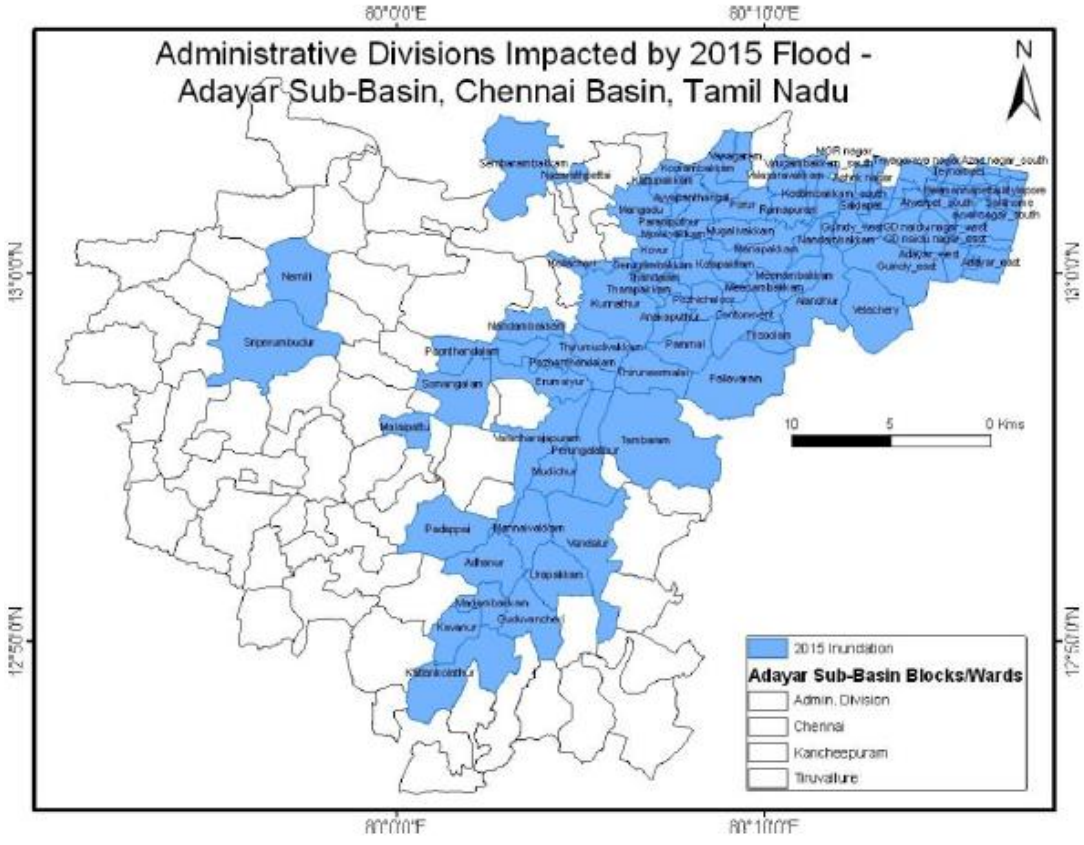

Fig.4. 2015 rainfall impacted administrative divisions of the Adayar sub-basin – Map compiled by the author

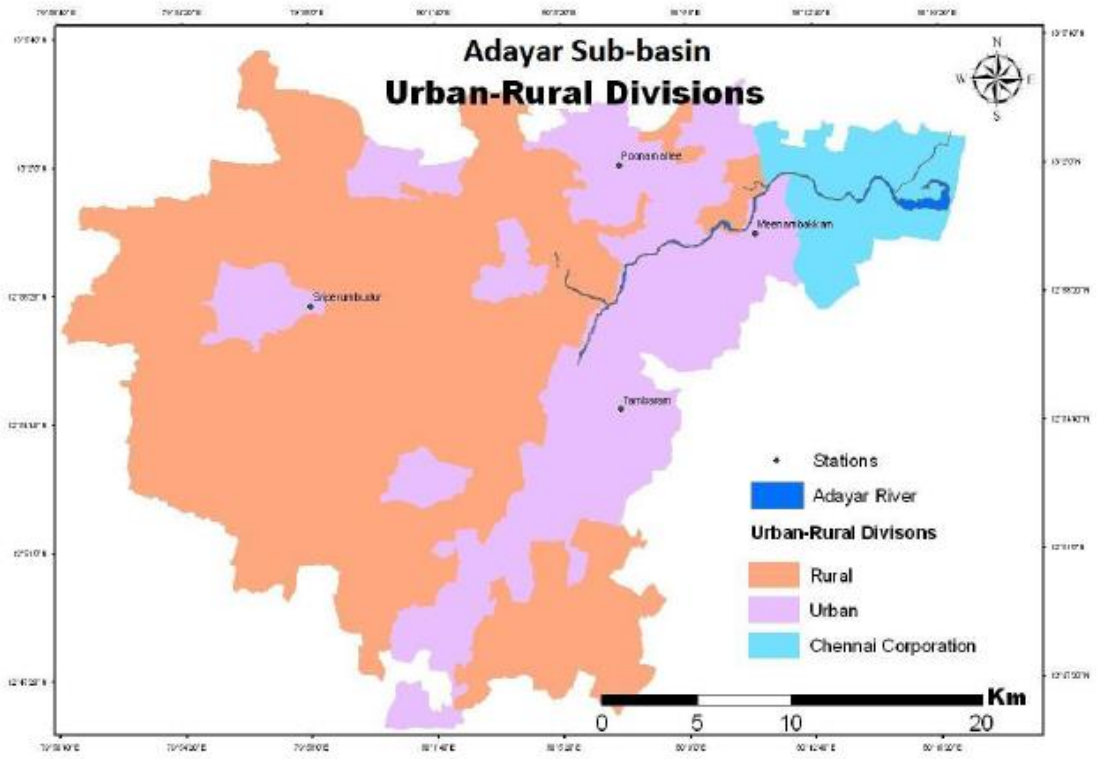

Fig.5. Adayar sub-basin with catchments predominantly rural and its final course passes through urban division – Map compiled by the author

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Ensemble prediction system (EPS) and communicating forecast uncertainties

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In a county fair in England a century ago, few hundred fair-goers entered a contest to guess the weight of an ox. Estimates of some of them were wildly off the mark, but the average guess was extremely close to the true weight of the beast! In addition, the average guess was closer than the separate estimates made by cattle experts. A statistician of that time, Sir Francis Galton, made the observation that the 'wisdom of the crowd' was more powerful than any individual member within it.

Now a days, weather forecasting also employs this technique, by using a group (or *ensemble*) of weather models to predict the state of the atmosphere. The *average* outcome of the ensemble group often validates well, even when the model is run for three or four weeks. If a group of weather models are run, they all *initialise* (capture the current weather) slightly differently. Some of them will underestimate, some overestimate – rather like the fair-goers guessing at the weight of the ox. Overall, as a *group*, ensemble forecasts show skill (accuracy) beyond a week. Ensemble forecasting provides human forecasters with a range of possible solutions, whose average is generally more accurate than the single deterministic forecast, and whose spread gives information about the forecast errors. It also provides a quantitative basis for probabilistic forecasting.

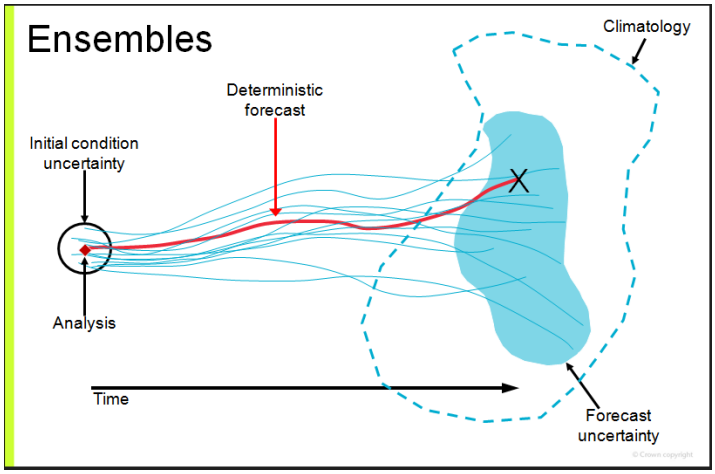

Image credit: UK Met Office

Ensemble Prediction Systems (EPS) are Numerical Weather Prediction (NWP) systems that allow us to estimate the uncertainty in a weather forecast as well as the most likely outcome. In EPS, instead of running the NWP model only once (a deterministic forecast), the model is run many times from very slightly different initial conditions.

The atmosphere is a chaotic system. This means that it is sensitively dependent on initial conditions. In a chaotic system, a slight change in the input conditions can lead to a significant change in the output forecast. Hence, it is important in weather forecasting to investigate how sensitive the atmosphere is to initial conditions at any stage. Ensemble forecasting does this by looking at the spread of possible outcomes.

Due to:

(i) inadequate observations,

(ii) our limited understanding of the physical processes of the atmosphere, and

(iii) the chaotic nature of the atmospheric flow,

Uncertainties always exist in both initial conditions and numerical models. The deterministic method is still widely employed today and generates a single model forecast. The problem with deterministic forecasts, however, is that they provide no information on the confidence or uncertainty in a forecast. Sometimes, for example, a forecast can go badly wrong very quickly and the forecaster or the user has no warning of this.

An EPS, in contrast, runs the model many times instead of just once. Each forecast within an ensemble is referred to as an ensemble member, and the members are initiated from very slightly different versions of the analysis. If all the members evolve similarly, this provides high confidence in the forecast. If, however, the various members diverge from each other, this indicates less confidence in the forecast, with the ensemble providing an estimate of the probabilities of different outcomes. The smaller the range of predicted outcomes, the ‘sharper’ the forecast is said to be. EPSs are therefore generally used to provide probabilistic forecasts and to support risk-based forecasts and warnings. EPSs have become a powerful tool for forecasting weather and its uncertainty across the globe.

Uncertainty is an inherent ingredient in the meteorological forecasting process. Sometimes the available computer models or other guidance are consistent in their predictions and the forecaster is confident of the outcome. At other times, the models may differ greatly or

the weather parameter may be intrinsically difficult to forecast. Nevertheless, a forecast must be made, even when the confidence is low. Communicating the uncertainty of the forecast to the users is vital to them. The ultimate purpose of communicating uncertainty is to enable users to make better decisions in the face of uncertainty.

There are several reasons for communicating the forecast uncertainty, because it is useful to both the users of the forecast and also to the forecasters.

Benefits of communicating uncertainty for improved decision making.

Communicating uncertainty helps manage user expectations.

Communicating uncertainty promotes user confidence.

Forecast uncertainty reflects the state of the science.

In general, it is strongly recommended by the World Meteorological Organisation that uncertainties should be communicated as part of every forecast.

In 2018, the Ministry of Earth Sciences (MoES) has commissioned two very high resolution (12 km grid scale) state-of-the-art global Ensemble Prediction Systems (EPS) for generating operational 10-days probabilistic forecasts of weather.

The EPS has shown improved performance in forecasting tropical cyclones (TC) over the North Indian Ocean (NIO). The regional ensemble prediction system (NEPS-R) has 4 km horizontal resolution. The forecasting of peak TC intensity is better in NEPS-R. It could also predict the rapid intensifications of the Tropical Cyclones 'Fani' (2019) and 'Amphan' (2020).

As computational power has dramatically increased, the ensemble approach has also been applied to short-range forecasting.

Multi-model ensemble forecasts are another tool that meteorologists consult to gain insight into future tracks of tropical cyclones and to help them establish the cone of uncertainty (figures attached below).

Excerpts from "Uncertainty in weather and climate prediction" By JULIA SLINGO, Met Office, Exeter, UK, and TIM PALMER, European Centre for Medium-Range Weather Forecasting, Reading, Berkshire, UK and Department of Physics, University of Oxford, Oxford, UK is furnished below:

Quote. "The advantages of ensemble forecasting became readily apparent in the case of the October 1987 storm when Michael Fish, a British Broadcasting Corporation (BBC) weather

forecaster, was famously quoted as saying '…….a woman rang the BBC and said she had heard that there was a hurricane on the way. Well, if you are watching, don't worry there isn't'. He had access to only a single deterministic forecast, which gave no clues as to what might happen. If he had had access to a fully probabilistic system, then he might well have decided to issue a warning of severe weather". Unquote.

The forecast probabilities allow the users to decide on the level of risk they are prepared to take depending on their vulnerabilities, and to take appropriate action within a proper understanding of the uncertainties.

The future is more likely to see new applications of ensembles. Their reliability and accuracy will further improve thanks to advances in model design, data assimilation methods, and in the schemes used to simulate the initial and model uncertainties. Resolution will be increased, to improve large-scale predictions and to start resolving finer, relevant scales.

Ensembles of analyses and forecasts will be more closely linked together, to improve their performance. Physical processes that are not yet included in the models but are relevant for weather prediction will be included, to make the forecasts more and more realistic.

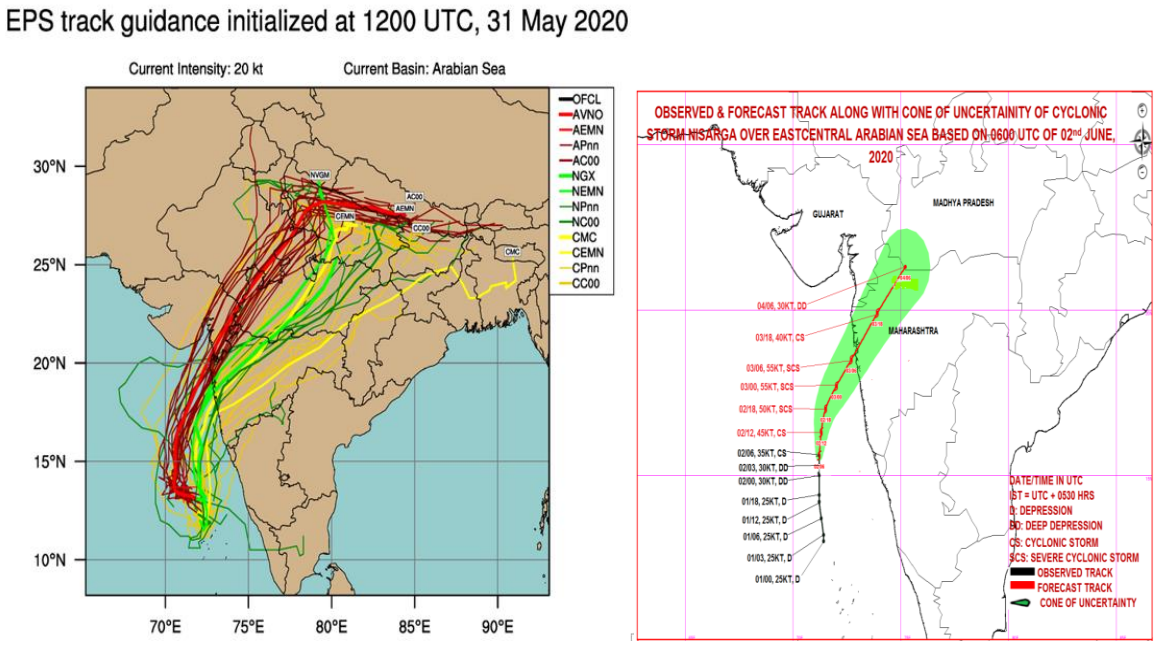

Image credit: University Corporation for Atmospheric Research (UCAR)

Impact of elevated tropospheric ozone on crop growth and yield

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Introduction

Environmental concerns became very serious for the survival and wellbeing of society. The alarming pace of increase in air pollution concentrations is one of the most significant environmental issues of the modern era. The issue of tropospheric ozone (O_3) as an air contaminant has multiplied and gained international attention over the last few decades. The O_3 is one of the most significant secondary air pollutant possess negative an impact on crop growth and yield in the world, which poses a serious danger to the world's ability to feed its expanding population. The concentrations of O_3 at ground level have dramatically increased as a consequence of rising emissions of nitrogen oxide and reactive hydrocarbons in metropolitan areas. Anthropogenic activities have led to increase in the level of tropospheric ozone beyond the critical limit throughout the world. Ozone is formed in the troposphere, when sunlight causes complex photochemical reactions involving oxides of nitrogen (NOx), volatile organic hydrocarbons (VOC) and carbon monoxide that originate chiefly from gasoline engines and burning of other fossil fuels. Woody vegetation is another major source of VOCs. NOx and VOCs can be transported long distances by regional weather patterns before they react to create ozone in the atmosphere, where it can persist for several weeks.

Tropospheric Ozone formation

O_3 is generated in the stratosphere as a result of the photolysis of O_2 via UV radiation into atomic oxygen. However, in the troposphere, NO2 is photolysis to generate O_3 as a result. Methane, carbon monoxide (CO), and non-methane organic molecules react with NOx in the free troposphere to create O_3. Temperature and sunlight play a major role in regulating these processes.

Ozone formation from NOx

$$NO_2 + hv \rightarrow NO + O$$

$$O + 02 \rightarrow O_2$$

Ozone formation from carbon monoxide

$$CO + 2O_2 + hv \rightarrow CO_2 + O_3$$

Ozone formation from methane

$$CH_4 + 4O_2 + 2hv \rightarrow HCHO + H_2\,O + 2O_3$$

Tropospheric Ozone Concentration and it impact

Ozone concentrations are increasing rapidly in developing countries and are predicted to continue to increase in coming decades unless suitably ambitious measures are taken to cut precursor emissions. Tropospheric (or ground-level) concentrations of ozone, are already high in many crop growing areas of the world, e.g. in North America, Europe, and South and East Asia (Cooper et al., 2014). Surface level ozone concentration is increasing in Asia and decreasing or stagnating in Europe and North America, which possess great threats to food production and food quality in Asia (Feng et al., 2021). The tropospheric ozone level is higher during winter season in India and the transport vehicle sectors followed by residential sectors are more important sources. The northern parts of India is contributing more compare to southern parts of India (Gao et al., 2019).

Ozone's phytotoxic effects are influenced by ambient exposure patterns, how much of it diffuses into leaves before dissolving into liquid inside cells, and how reactive it is with cellular components. The stomatal aperture and conductance to gas diffusion govern the main uptake pathway, which is through the leaves (Long and Naidu, 2002). Ozone can also harm cuticles, however most damage happens once it enters through the stomata. O3 is absorbed as a result of a chemical potential gradient between the environment and the site of deposition, which might be either on the foliar surface or on the cells within the core of the leaf. Wind speed, leaf orientation, and leaf morphology (size, shape, epidermal features, etc.) all influence boundary layer resistance.

Formation of Reactive Oxygen Species (ROS) within the Plants

In order to sense and adapt to environmental changes, including the increasing O3 levels, plants have developed mechanisms. After uptake in plants, interactions under gas and liquid phases lead to the harmful effects of O3. Ozone reactions with ethylene emissions from plants, known as ozonolysis, result in the production of hydrogen peroxide (H2O2) and aldehydes in the

gaseous phase. Due to the generation of H2O2, the by-products of ozonolysis may potentially affect plant metabolism.

The ozonolysis reaction is given below

$$O_3 + ethylene \rightarrow Aldehydes + biradical$$

$$Biradical + H_2O \rightarrow Hydroxymethyl\ hydroperoxide$$

$$Hydroxymethyl\ peroxide + H_2O \rightarrow Hydroxyhydro\ peroxide$$

$$Hydroxyhydro\ peroxide + H_2O \rightarrow Aldehyde + H_2O_2$$

Impact of tropospheric ozone on crop yield

Tropospheric ozone is a powerful oxidant by causing damage to mucus and respiratory tissues in animals and also tissues in plants, above concentrations of 100 ppb, which makes ozone a potent respiratory hazard and pollutant near ground level (Bell et al., 2005). Low level ozone is not only a secondary air pollutant but also a greenhouse gas, next to CO_2 and methane affects the growth and yield of agricultural and horticultural crops (Table 1.) in most parts of the world (IPCC, 2001). Near surface ozone is a pollutant of important concern due to its adverse effects of agricultural productivity is now a major environmental concern in many regions of the world (Mills *et al.,* 2007).

Table 1. Impact of elevated tropospheric ozone on crop yield

S.No.	Crops	Yield loss (%)	References
	Radish	25	Hassan, 2006
	Turnip	20	
	Soybean	8.5-14	Avnery *et al.*, 2011
	Wheat	3.9-15	
	Maize	2.2-5.5	
	Potato	4.56-25.5	Suganthy and Udayasoorian, 2016
	Rice	11-13	Feng *et al.,* 2019
	Wheat	6-8	
	Spring Wheat	10-26	Hansen *et al.,* 2019
	Maize	9.8-16.2	Singh *et al.,* 2018
	Mung bean	9.8-15.4	Chaudhary and Agrawal, 2015
	Maize	3.6±1.1	Tai *et al.,* 2021

	Rice	2.6±0.8	
	Soybean	6.7±4.1	
	Wheat	7.2±7.3	

Summary and Conclusion

Since, IPCC has identified that the tropospheric ozone is not only the important greenhouse gas, it is also a harmful gas, which would affect all living organisms in the earth. Furthermore, it is evident that tropospheric ozone has detrimental effect on growth, physiology, development and yield of crop plants all around the globe. Further the identification of ozone protectants to nullify the tropospheric ozone effect on growth, physiology, development and yield of plants need to be done. Since, the tropospheric ozone has identified as potential air pollutant by IPCC recently, the future research may be focused to study the tropospheric ozone impact studies on different crops and identify the best ozone protectants to nullify the tropospheric ozone impact for sustainable agriculture and ensure food security for growing population with shrinking land and water resources along with changing climate.

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Rainfall Estimates from SPACE : INSAT to GPM Case for a Passive Microwave Imaging Satellite

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Accurate measurements of precipitation and their variability are important for our country, not only for management of water resources, but also to understand the coupling of Earth's water, energy, and bio - geochemical cycles. Variability of Monsoon rainfall, both in intraseasonal and interannual scales plays important role in our economy. The increasing incidents of heavy rainfall / flash floods / associate landslides etc in the context of Global warming have posed increased need for more frequent and high resolution observations.

With the availability of many geostationary meteorological satellites around the globe since 1970s, including our own INSAT series from 1984, equipped with Very High Resolution Radiometer (VHRR) visible and infrared sensors, rainfall estimation (albeit indirectly from cloud tops) has become possible particularly over the oceans – but with huge uncertainties.

Thus, to ameliorate this issue to some extent, it is important that a low orbiting, low inclination microwave imaging satellite is launched by India, similar to the GPM microwave imager (GMI), to improve the rainfall estimation over India and adjoining oceans. Towards this, the journey of rainfall estimation in India from 1979 till date is described, and the lacunae have been brought out.

The earliest attempt at quantitative precipitation estimates from satellites over Indian land mass and adjoining oceanic regions, can be traced to a small joint pilot experiment initiated by scientists of Space Applications Centre (SAC / ISRO), Indian Meteorological Department (IMD) and Space Science and Engineering Centre (SSEC), University of Wisconsin / USA) during MONEX / FGGE programme of 1979. Shifting of GOES (East), one of USA's two geostationary

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satellites, equipped with visible – infrared imaging (VHRR)instrument, over the Indian Ocean for an year, was taken advantage of. Simultaneous observations from visible and infrared hourly images from GOES - VHRR over three continuous days of a northeast monsoon depression

system (12 – 14 November1979) and a newly established S - band radar (manually operated) at Cyclone Warning Centre, IMD, Chennai were collected. A new methodology, just then developed at Space Science and Engineering Centre (SSEC), was employed to estimate hourly and 48 - hour accumulated rainfall from GOES (E), using their Man computer Interactive Data Access System (McIDAS). This collaborative work initiated in 1979, fructified under the Indo US Monsoon Exchange Programme (1985).

The first successful Indian geostationary satellite, INSAT 1 – B with a VHRR instrument (with visible and infrared sensors), was launched in 1984. Quantitative Precipitation Estimates (QPE) on 2.5° x 2.5° daily spatio - temporal grids over the Indian land mass were made and compared with ground rain gauges with reasonable success. INSAT – 1B was followed by successful launches of INSAT – 2D, INSAT - 3E and Kalpana VHRRs on geostationary satellite platforms for meteorological imaging, 2 – level wind determination, SST, rainfall estimation, etc. The rainfall estimation was made operational by IMD – SAC team by 2010 at 1° x 1° spatial and hourly scale.

Later, INSAT - 3 D and - 3 DR carried also a 19 - channel infrared sounder for estimation of atmospheric temperature profiles. .All the above satellite payloads were designed and built at the Space Applications Centre (ISRO). The rainfall products from INSAT (besides half hourly images, atmospheric winds, temperature –humidity profile, total ozone etc) are available in MOSDAC website for registered users.

In a major effort, India launched in 1999 a low orbiting sun - synchronous, Oceansat – 1 satellite, with a passive Multi - channel Scanning Microwave Radiometer (MSMR) - which was operated for two years for estimation of precipitation and many other key oceanic parameters over global oceans (total precipitable and liquid water, ocean surface winds, etc.), besides soil moisture over land, albeit at low spatial resolution of around 75 km x 75 km.

Since about the beginning of this century, the emphasis of rainfall estimation from space has been shifting from infrared to passive microwave instruments. The microwaves emanating from various depths of the cloud, depending on the microwave frequency penetrate through the upper layers of the cloud to reach the satellite sensor. Thus the sensors receive signals directly from the rain drops of the clouds (thus making the rainfall measurements more direct) in contrast to empirical estimates from infrared signals from geostationary satellites, which see only the top of the cloud.

A few orbiting satellites (at ~ 800 km) equipped with passive microwave sensors, are providing direct precipitation estimates since 1980s, though at relatively poorer spatio - temporal resolutions (initially at 50 x 50 km) over oceans and even over inaccessible land areas. With technological advancements, the spatial resolution of microwave channels have now improved significantly to nearly 10 x 10 km. The global precipitation products, based on measurements from satellite platforms, are freely available at many websites almost in near real time since the launch of Tropical Rainfall Monitoring Mission (TRMM) satellite in late 1997, which flew with the microwave imager and the first active radar for direct observation of raindrops .

Twelve major International and National programmes have been conducted / participated by India since 1964, for studying various aspects of Indian Summer Monsoon. The most important among them being the International Indian Ocean Experiment (IIOE 1964), MONsoon EXperiment (MONEX 1979) and INDian Ocean Experiment (INDOEX 1999).

However, none of these twelve programmes addressed the precipitation aspect – in an exclusive or exhaustive manner. Megha Tropiques satellite, a major Indo – French effort (which was a follow - on of MSMR on Indian Oceansat – 1 launched in 1999) and a part of Global Precipitation Mission (GPM), would have partly . ameliorated this lacuna. But its rainfall measuring instrument, MADRAS (Microwave Analysis and Detection of Rain and Atmospheric Structure), with a five-frequency i. e. 18, 23, 36, 89 and 157 GHz (9 channels with both Horizontal (H) and Vertical (V) polarizations) passive microwave radiometer worked only for about one and half years (from Oct 2011 to Jan 2013). However, the other microwave instrument on Megha - Tropiques, SAPHIR (for water vapour profiling operating at 183 GHz), is still being utilised in rain estimation, both by GPM Precipitation Processing System (PPS) and by INSAT rain estimating algorithms.

Merged Precipitation Products

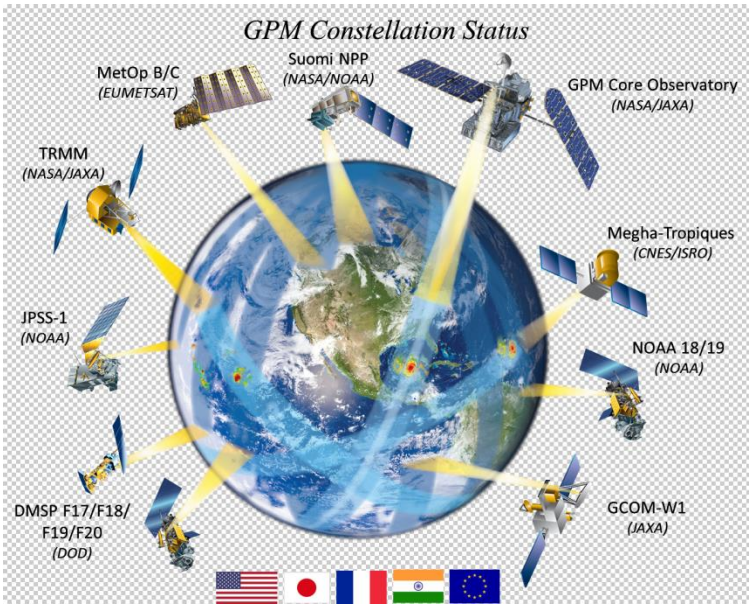
Tropical Rainfall Monitoring Mission (TRMM) and Global Precipitation Mission (GPM) became the buzz word by the end of last century in the context of rainfall estimates around the globe. Besides a 9 – channel [10.7 (H/V), 19.3(H/V), 21.3(V), 37.0(H/V), 85.5(H/V) in GHz] passive microwave radiometer, the TRMM satellite, launched in late 1997, was equipped also with an active radar operating at 13.8 GHz. Thus, TRMM got the distinction of being known as the first Raingauge in Space ! The high temporal resolution (4 x 4 km), but indirectly estimated rainfall estimates from cloud tops by the VHRR - IR sensors onboard the five Geostationary satellites around the globe, along with TRMM active and passive microwave instruments (and a few other microwave imaging sensors onboard orbiting meteorological satellites though with poorer spatio – temporal resolution, but with capability of direct sensing of raindrops), were combined judiciously to generate merged global rainfall product - TRMM Multi satellite Precipitation Algorithm (TMPA) - at 0.25° x 0.25° spatial and 3 - hourly temporal scales. TRMM satellite, which was designed to work only for 3 years, was orbit - raised from 350 to 405 km after five years, and this enabled it to function for a total of 15 years (1998 – 2013) producing very valuable global precipitation data. SAC and IMD scientists in 2004 reported the first comparisons of TMPA data over Indian land mass with the newly produced IMD all India daily 1° x 1° gridded rain products from ground raingauges

GPM (core) satellite was launched in 2014, with a 13 – channel [10 to 183 GHz, optimized 9 channel TMI frequencies along with 4 additional channels from 166 to 183 GHz to detect light precipitation and snowfall) and a Dual Precipitation Radar (DPR), operating at 13.6 and 35.5 GHz, to provide continuity of the TRMM service with better accuracy and more geographical coverage..

The estimates of rainfall from the GPM microwave instruments, and from nine other orbiting satellites with microwave imagers onboard, are used since 2014 to estimate rainfall, greatly dispensing off the VHRR infrared rainfall estimates. Many improvements in newer versions of algorithms (e.g. Kalman filter morphing technique) are continually taking place in the GPM rain estimation, as shown through various versions of the products. The GPM rainfall products are now operationally available at 0.1° x 0.1° spatial grids and at 30 min temporal intervals from 2014 to date in real time for operational and also in delayed mode as research products.

Integrated Multi satellitE Retrieval of GPM (IMERG) products

There are presently ten microwave imaging satellites in the GPM constellation, which are used to generate the high resolution Integrated Multi satellitE Retrieval of GPM (IMERG) data. These include AMSR2, GMI, ATMS, SSMIS-F16, SSMIS-F17, SSMIS-F18, MHS-MetOpA,



MHS - MetOpB, MHS-NOAA18, and MHS-NOAA19. IMERG system utilizes besides GPM (core), all other microwave imaging and microwave water vapour sounding satellite instruments around the globe. GPM's higher frequency (153 – 182 GHz) channels enable better estimation of light rain and snow. IMERG achieves its half-hourly temporal resolution following the Kalman Filter morphing approach.

Many scientific groups in India are using the IMERG data to validate them over Indian land mass and applications – the chief among them being various centres of ISRO, MOES, IISc, SRM I&ST and many Institutions / Universities. All studies have shown that the correspondence between full-resolution IMERG products and surface raingauges are presently modest at best at daily all India scale. At this scale the Intraseasonal Oscillations (of 10 – 20 day and 50 – 60 days) and their power are well picked up.

The GPM products have become very popular among the scientific community, because of their high user - friendly nature and easy accessibility Presently Version 6 of the IMERG data are available in public domain. For their use and updating of retrieval algorithms / software in operational scenario and research purposes, these products are being continually validated by

many groups across different regions of the globe, as also in India for scientific and various applications. .

Need of a low inclination Microwave Imaging satellite for India

In the Indian context, the deficiencies encountered with GPM products, is in their applicability over smaller regions and smaller time scales, where the errors are large. The standard deviation of even all India seasonal rainfall is ~ 150 mm as seen from 23 years of data and the monsoonal IAV is ~ 90 mm. Thus, signal is submerged in noise.

Over large rainfall regions / occasions, there is qualitative agreement with the INSAT / radar imageries. As has already been pointed out earlier - if the number of microwave imaging satellites is increased steadily over a period of time, the accuracies can be improved as also the revisit time of a microwave observation over a particular region (particularly useful for short duration heavy rainfalls). This will be helpful during disasters like flash floods etc. We can hope for the day, when a geostationary passive imaging microwave satellite is placed over India longitude, providing direct rainfall estimate every quarter or half hour of the day !

India last launched a microwave imaging instrument, the MSMR onboard Oceansat – 1, twenty five years ago in 1999. It had poor ground resolution of ~ 60 km. It was more a proof of concept technological mission. Megha Tropiques, the Indo French joint venture, which was to be a part of the GPM constellation with the rainfall instrument MADRAS with much higher resolution ~ 10 km, unfortunately did not last much.

In the true spirit of International cooperation and for our own needs, it is important that India adds one state - of - art microwave imaging satellite to improve the morphing technique associated with GPM retrievals. It could be in lower inclination orbit (~ 30 deg) for more repeated coverage of tropical regions. VHRR – IR technique for rainfall estimation is fast becoming obsolete, and are to be used mainly for cloud monitoring, wind and SST retrievals.

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A few facts and thoughts on the sources of energy for the humankind in past present and future scenarios

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The air we breathe, the water we drink and the food we eat – these are perhaps the three most important ingredients without which not just humans but also all the other living things in the world cannot survive. Another important parameter which has played a very important role in the evolution of human civilisation is energy. In the past and present scenarios humans have substantially relied upon the various forms of energy to attain higher standard of living and to sustain the same. But these have all come up at a stiff cost in the form of global warming and the consequent climate change and its ill effects on our planet. In this article we briefly discuss certain specific aspects of the energy scenario as to how it evolved, developed, the present and the likely future scenario in the world, in India and in the State of Tamil Nadu, all in a brief fashion.

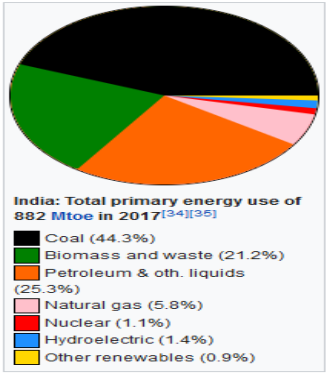
If we flash back to say 17-18th century ships sailed over the oceans with the help of wind energy, people used horses, horse /cattle drawn carriages for movement over the land. Firewood was used for cooking food and oil lamps lighted up the night. Coal was used around the year 1700. The power of steam and the steam engine were invented in the 18-th century. One of the most important discoveries of human kind, the rail engine was discovered in England in 1814. The rail network with traction by steam engines powered by coal was subsequently built in several countries and was capable of moving people and goods over long distances in relatively short time. The industrial revolution started in England in the 19-th century and spread to several other countries of the world. Petroleum was mined in large quantities and its derived products such as petrol, diesel, aviation fuel etc revolutionised travel. The motor car was developed and the invention of aircraft in the early 1900 was another major path breaking invention. That of electricity in the year 1752 in its basic form was another path breaking finding and its usage in all walks of life in subsequent centuries played an important role in the life of humans.

The population of world rapidly increased in the 20-th century. Countries attained higher standard of living by burning coal to generate electricity, burnt fuel to drive automobiles and the aircrafts flew in the sky moving people from one continent to another seamlessly. Greenhouse

gases such as CO2 and Methane were released into the atmosphere day after day for several years almost all over the world, which resulted in the warming of the earth with its devastating effects and consequences. Now can the world find a replacement for coal and petroleum?

The sources of energy can be divided into Renewable and Non Renewable energy. Wind, Solar, Hydro power, Geo thermal and Biomass are some of the important sources of the former. Oil, Coal, Nuclear and Natural Gas are sources of the later. Fig.1 presents these facts in a pictorial format.

Fig.1



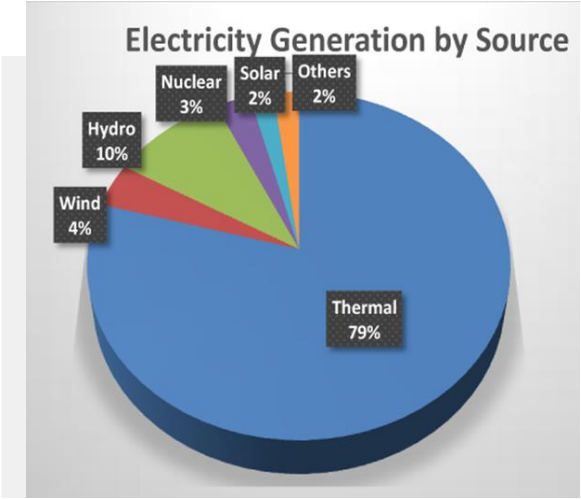
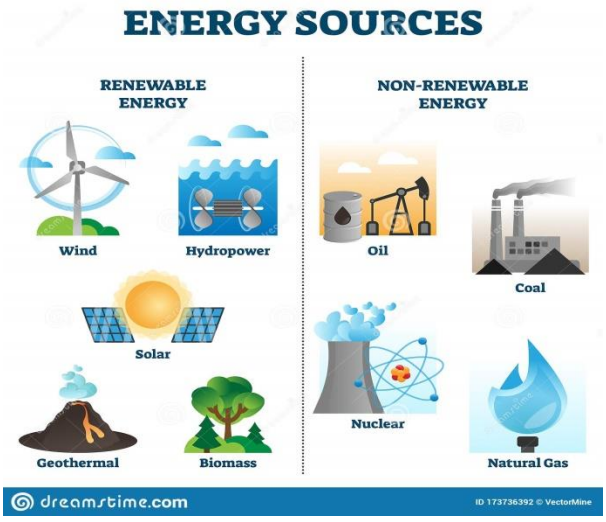


Fig.2

Fig.3



Coming to the Indian context Fig.2 presents the breakup of energy generation in India. As shown India consumed 882 mtoe (million or mega tons of oil equivalent) in 2017. The break up is coal- 44.3%, Biomass and waste 21.2%, Petroleum 21.2%, Natural gas 5.8%, Nuclear power 1.1% and hydroelectric 1.4%. Fig 3 presents the electricity generation by source in India. Thermal (coal) accounts for 79%. The dependence on coal by India is obvious. India produced 77.7 crore tons of coal in 2021-22 and imported 21.2 crore tons. Gas production in India and its import are 2.89 and 328.6 crores cubic

metres respectively. India imported 23.9 crores tons of crude oil in 2020-21 which is 84% of its total consumption. The above figures show the dependence of India on hydrocarbon products for its energy needs. Coal accounts for 75% of India's electricity generation which is given as 1383.5 Twh (trillion watts for one hour) in the year 2019-20. In Tamil Nadu the power consumption per day (24 hrs) is around 17000 MW in April 2022. (Mw – Mega watts, 1 Mw= 1000 kw = 10 lakh watts).

We now briefly discuss the renewable energy sources, some of which can be termed unconventional.

Wind: Wind power or wind energy is the energy generated from wind. Historically, wind power has been used in sails, windmills and wind pumps. Wind power is a popular, sustainable, renewable energy source that has a much smaller impact on the environment than burning fossil fuels. Wind farms consist of many individual wind turbines, which are connected to the electric power transmission network. The total power from wind is related to the cube of the wind speed and so when wind speed doubles, theoretically the power from wind goes up 8 times.

The Muppandhal wind farm situated in the southernmost Kanyakumari district of Tamil Nadu is the largest wind farm in the country with capacity of 1500 MW per day. Fig.4 presents an image of this farm and also the design of the wind turbines. For TN the installed capacity of wind power is 7633 MW per day but only 15% of this is realised. In India Gujarat State had an installed capacity of 8562 MW in 2019-20.

The building of large wind farms may not be without environmental costs. They foul the landscape when installed in mountain slopes or near sea coast. They also pose some threat to the birds. Another issue is the disposal of old wind turbines and blades.

Fig.4. Muppandhal wind farm

Solar power: Solar power is the conversion of energy from sunlight into electricity using photovoltaic cells. Solar constant is 2.0 cal/sq cm/sec or Langley or 1361 watts per sq metre. To quote a specific example, in Chennai the uninterrupted short wave solar radiation for 24 hrs is 695Langley in 23 Dec and 953 in the middle of May. But the atmosphere absorbs nearly 50% of this radiation. The clouds also absorb radiation or reflect back to sky depending on the type of cloud.

Solar power capacity installed in TN is 4894 MW. The biggest solar farm in TN is at Kamuthi spread over 2500 acres. It can generate 648 MW of power per day. Kochi Airport has a solar power plant farm spread over nearly 100 acre. It generates 40 MW per day. Figs. 5&6 present the images of solar plants at Kamudhi and Kochi airport. In Fig.7 is depicted a solar power plant installed on the terrace of one of the blocks of the housing complex where the author lives. The electricity thus generated is used to power the water pumps of the complex. It has been working very well for the last 4 years or so since its installation.

Fig.5. Solar plant at Kamudhi

Fig.6 Solar plant at Kochi

Fig.7. Micro Solar panel installed in a housing colony

Bio fuels: These are plant based fuels. Oil derived from plants can be used as fuel for automobiles and rail engines. It can also be mixed with petroleum based fuel. Biodiesel can be made from oils which have been extracted from plants such as palm, soybean, oilseed rape, or sunflower. This is renewable energy but can not be considered as environment friendly as CO2 is substantially emitted in the burning of bio fuels. Further if used in large scale all over the world whether the earth can support large scale cultivation of such plants without affecting food production is not clear. To quote an example a person's need of oil for cooking is just about 50ml per day, i.e. one litre lasts for 20 days. But he/she uses biofuel to drive a car daily say 50 km nearly 4 litre per day or nearly 120 litres needed every month. Coming to India it imports 60% of its cooking oil or base ingredients from other countries. Obviously India can not sustain growing of biofuel plants in large scale.

Power from oceans: Power can be generated from oceans also from wave tides and the ocean thermal gradient. Ocean power is still to be harnessed fully. In India which has a 7000 km long coast line the potential for generating power from Oceans is very much there.

Hydrogen: Finally we briefly touch upon a most promising (atleast conceptually) renewable energy source. This is Hydrogen or H2, which we all know is contained in water. It is fully renewable as H2 can be produced from water which is available aplenty. However the catch is that H2 can be separated from water only through a process called electrolysis which needs power. Another major issue is that H2 has to be maintained in the liquid state in cryogenic temperatures (-253.8^{o} C) which is a technologically challenging task. If the power generated from coal, gas, or petroleum products is used to generate H2 which is then used as a fuel it is known as Blue Hydrogen. Instead if energy from clean sources such as wind, solar etc is used in generating H2 it is called Green Hydrogen. The technology of deriving power from H2 is named as fuel cell technology.

The advantage of liquid H2 as fuel is that it can be stored, moved easily and filled up in tanks in the same way as we fill a car with petrol. Dis-advantage is that it needs power for its production and has to be maintained at very low temperatures. If wind and solar power could be fully harnessed (when they are available) H2 can be generated from such sources, transported and used anytime anywhere which is not always the case with wind and solar based power. Let us visualise a ship sailing in the ocean with a H2 based engine. If the ship has the provision to harness wind power (which is plenty in ocean), wave power (again plenty) and solar power (during the day), the power thus generated could be used to produce H2 from water and used as engine fuel which could be a perfect replacement for petroleum based shipping fuels. Let us hope that such a scenario could become a reality soon.

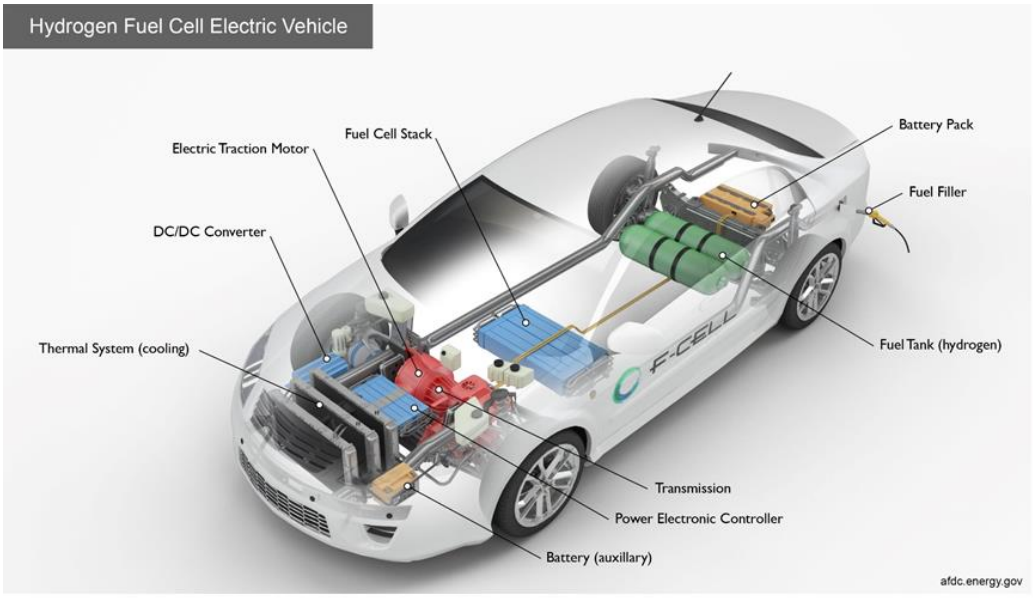


Fig.8

Fig.9 (Toyota Mirai)

Fig.10 (Hyundai Nexo)

H2 can be (conceptually) used as fuel for propulsion in cars, aeroplanes and ships but there are several issues technical and logistical still to be resolved. A design of a car with H2 as the fuel is depicted in Fig.8. As on date two models of H2 powered car Toyota Mirai and Hyundai Nexo are available in the International market. Mirai (fig.9) costs around USD 50k, 18k cars have been sold so far. Nexo (Fig.10) is priced around 50-60k and nearly 10-15k cars are on the

roads. Nearly 1000 H2 powered cars are running in Germany in 2021. Provision of sufficient number of refuelling locations of liquid H2 is another issue which has to be addressed and resolved, before the users could be convinced on the switch over from conventional petrol / diesel fuel cars to H2 based cars.

Hydrocarbon based fuels have definitely played a very important role in the past 100-150 years in human kind achieving a very high standard of living. But eventually they will run out of stock some day and further they come at a terrible cost to the environment. Though varied alternative options for partial replacement are available most of them still can not provide the functionality of petroleum based fuels as on date. Coming to electricity generation in India coal is the base fuel for 75% of the electricity generated. India has committed doing away with coal in the year 2070. There is pessimism about whether coal based power can be fully replaced by wind and solar based power based in India based on existing technology. Nuclear power is non polluting but the issues involved in nuclear power generation are varied some of them controversial. We can only hope that in future, appropriate technology will develop to fill the gap and an environment friendly fully renewable fuel or fuels which are economic as well functional will be available to the world community. As of now H2 produced from power derived from wind and solar appears to be the most promising option. ■

(The above lecture was delivered online on 22.5.2022 by the author to a group called 'Friends On Same Wave Length' (FOSWL) based in Anna Nagar, Chennai. Statistics, pictures and other info used in this article have been taken from the various websites and the same is acknowledged with thanks)

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" Varun & Weather "..

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MAS

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Quite a warm and humid day..An unusual late October evening...

Varun gingerly walks into his home bit shaken, fearing what his parents would say..Three long hours of cricket with his colony friends has left him drained, exasperated to the core. Huge sigh of relief as he finds his parents not there... With just his sister to give him company ,Varun narrates his exploits in the cricket field to her with great interest....

After a quick bite of rusk tosted in milk Varun heads to main hall, searches for the Television remote for quite some time to finally find it in a remote place near the verandah...

The brand new Panasonic LCD Television is almost blarring like a roadside loudspeaker with the latest Tamizh hits . Varun takes control of the remote, keeps swapping channels and to his surprise and unbound joy finds Ramanan Sir on the screen..eye's lit up gets closer to the tely box and his all glued to it now.. Yes.. that's the piece of info Varun, an avid rain lover was so eager to listen..It was music to ears for him to listen Ramanan Sir explaining the possible development of a depression, deep depression and the resultant torrential downpour that would ensure a stretch of break from from school activities..

Varun, understandably over the moon , on cloud nine, calls up his class mates to share what he has just heard ...

Nothing short of few rain holidays would satisfy him..The excitement reaches feverish pitch as the D day arrives..Yes it's 26 October and Varun is all set to embrace the heavenly downpour that has been forecast..It's well past midnight and the heavens open up with a huge thunder clap that could be heard far and wide..Weary eyed Varun is still awake peeping thru the wooden window as the monsoon depression lets loose with some mind boggling intensity..The street lights go off and its pitch dark now..What could be heard is the loud roar emanating from the relentless spell that's unleashed with all its fury.

Varun, totally engrossed, eyes and ears glued to to the sight and sound of the monsoon music that's in no mood to relent even a bit..

His eyes relents though after all the adrenaline rush, a well deserved sleep that follows immediately after..

Its day break, varun gets up in a jiffy to check if the show is still on..finds there's a break of sorts though he's shell shocked to find a river flow in front of his home..The power hasn't come to switch on the Television, check the latest update on the deep depression that has flooded the streets of the city.....

The manic rains has left an indelible mark on the way he would observe, enjoy it...The quest for learning, understanding weather begins in all earnest..How did this event happen, why such abrupt change in the weather pattern...plenty of questions flood his inquisitive mind...

A fresh new flower blooms here...a brand new approach to the way he would see things..heads to the internet world, the library near by to seek answers..Meteorology is indeed the new subject of interest for him..

Amidst the knowledge search via the computer finds a weather blog to his surprise...Couldn't believe his eyes as he finds few enthusiastic bloggers chatting about weather events and the monsoon rains..

Slowly but surely gets addicted to the discussions as he finds some answers to his million questions..From being a passive observer decides to get into the thick of things straightaway..

The user name " Varun & weather " is born..an odd post or a question turns. takes a different direction here..from a mere fifteen minutes of time spent in the weather blog initially becomes hours and hours in few months time... there's no stopping here as its monsoon season and an active one at that...system after system takes shape in the bay leaving no room for Varun to concentrate on his studies..Gets chided by his parents for being a weather aficionado..

Year's pass by and the routine would continue..his passion, his zeal & zest brings in a new avatar in himself as he finds lot of takers for his knowledge sharing posts in the social media sites.. gets flooded with lot of questions debates and the like..enjoys every bit of accolades that start pouring on him within a short span of time.. its a new world of sorts...an unimaginable journey which was not in the wildest of dreams for him...

His understanding of the subject surprises one and all. His friends look upto him for his acumen and happy to be enlightened every now and then..

Meanwhile, the thirst doesn't stop here as his understanding of the subject of meteorology is questioned ,put to endless debates in where he participates or where he's being part off..

The spark is ignited yet again..Not the one to be contended with what he has achieved, got himself acquainted to the weather world without a formal training, a professional course in the subject of meteorology..

Finally after an year of deliberation, consultation takes the first step towards meteorology as a career.. enrolls himself in a two year couse of Atmospheric science..

A new beginning indeed..been there and being there moment for our Varun...A whole new weather world unfolds in front of him..a thought he realizes in the very first class room session . .Passion is one thing....,enlightenment is more than one ....

The journey of enlightenment continues...for him....

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கிரிக்கெட் – வானிலை

எண்ணும் எழுத்தும் கண் எனத்தகும்.

கல்வியும் விளையாட்டும் கண் எனத்தகும் – புதுமொழி

பாரத மக்களின் உள்ளம் கவர்ந்த விளையாட்டுகளில் கிரிக்கெட் முக்கியத்துவம் பெற்றுள்ளது. ஆண்டுதோறும் பொங்கல், தீபாவளி, கிறிஸ்துமஸ், ரம்ஜான் என கொண்டாடப்படும் பண்டிகை போல " கிரிக்கெட்" விளையாட்டும் கொண்டாடப்படுகிறது. குழந்தைகள் முதல் முதியவர்கள் வரை சுவையான கருத்துப்பரிமாற்றத்துடன் அலசி ஆராய்கிறார்கள். ஆடுகளத்தில் இருவர், கணிப்பொறி வாயிலாக மூன்றாவது நபர் துல்லியமாக ஆய்ந்து தீர்ப்பு வழங்குகிறார்கள். இயற்கை அன்னை "மழை" – பார்வை தூரம் ஆட்டத்தை தீர்மானிக்கும் 4-வது அம்பையராக செயல்படுகிறது. வெற்றி, தோல்வி, டிரா மூன்றில் வானிலையின் பங்கு முக்கியத்துவம் பெற்றுள்ளது.2022-ஜூன் திங்கள் தென் ஆப்பிரிக்கா-இந்தியாவிற்கு இடையே நடைபெற்ற T20 ஐந்து ஆட்டங்களில், இரு அணிகளும் தலா இரு ஆட்டங்களில் வெற்றி பெற்றது. ஐந்தாவது ஆட்டம் மழையின் காரணமாக கைவிடப்பட்டது. இரு அணிகளும் சமநிலையுடன் விடைபெற்றது.

இங்கிலாந்து மண்ணில் ஆயர்கள் ஆடு மேய்க்கும் ஆட்டம் படிப்படியாக வளர்ந்து, சில வரைமுறைகளை உருவாக்க கிரிக்கெட் முழுமையான உருவம் பெற்றுள்ளது. இங்கிலாந்தில் கெண்ட் பிரதேசத்தில் 1300 ஆம் ஆண்டிலிருந்து ஆடப்படுவதாக கூறுகிறார்கள். 1835- ஆம் ஆண்டு மெரில்போன் என்னும் கிளப், ஆட்ட விதிகளை உருவாக்கியது. 1877 மே மாதம் கிரிக்கெட் என்னும் முதல் டெஸ்ட் ஆட்டம் அதிகாரப்பூர்வமாக துவங்கியது.

IPL T20 – 2021 கிரிக்கெட் ஓர்கண்ணோட்டம்

நாடுகளுக்கிடையே நல்லுறவுகளை வளர்க்க கிரிக்கெட் பாலமாக அமைத்துள்ளது. மேற்கத்திய நாடுகளில் குளிரின் தாக்கமும், நம் பாரத நாட்டில் வெப்பத்தின் தாக்கமும் இருக்கும். வானிலையின் பாதிப்புகளை அறிந்து ஒவ்வொரு நாட்டிலும் ஆட்டங்களின் காலம், நேரம் தீர்மானிக்கப்படுகிறது. கனமழை, வெள்ளம், புயல் போன்ற இயற்கை சீற்றங்களும் நிகழ்கின்றன. IPL T20 ஆட்டங்கள் பெரும்பாலும் ஏப்ரல், மே மாதங்களில் இரவு 07:30 மணிக்கு துவங்குகிறது. இக்காலங்களில் வெப்பத்தின் தாக்கம் இருக்கும். டிஹைட்ரேசன் ஏற்படாத வண்ணம் வீரர்களின் அசௌகரியங்களை அறிந்து செயல்பாடுகள் இருக்கும்.

வெப்பம், காற்றின்வேகம், திசை, ஈரப்பதம், பனிப்புள்ளி, பார்வைதூரம் முக்கியபங்குவகிக்கிறது. பனிப்புள்ளி அதிகமாக பதிவாகும்போது பந்தை துண்டால் துடைத்து, துடைத்து வீசுவார்கள். மிகுந்த சிரமப்படுவார்கள். பனிப்பொழிவை அறிந்து முதலாவதாக பேட்டிங்கை தேர்ந்தெடுப்பார்கள்.

மட்டை வீரர்களும், ஆடுகளத்தில் உள்ள வீரர்களும் சறுக்கிவிழும் நிலை ஏற்படும். குறிப்பாக பந்து கை நழுவி கீழே விழுந்துவிடும்.

IPL T20 – 2021 ஆட்டம் சென்னை, மும்பை, அகமதாபாத், டில்லி, மாநகரங்களில் ஏப்ரல், மே மாதங்களில் நடைபெற்றது. ஏப்ரல் திங்களில் அகமதாபாத் 40 டிகிரி செல்ஸியஸ், ஈரப்பதம் 12-23 சதவீதம், காற்று தென்மேற்கு திசை 15-28 கி.மீ/மணி பதிவானது. டில்லி 42 டிகிரி செல்ஸியஸ், ஈரப்பதம் 10-12 சதவீதம், காற்றுதிசை வடமேற்கு 19-15 கி.மீ/மணி பதிவானது.

மொயின் அலி, சாம்கர்ரன், டாம்கர்ரன், பட்லர், பென்ஸ்டோக்ஸ் போன்ற இங்கிலாந்து வீரர்கள் வெப்பத்தின் தாக்கத்தினால் மிகுந்த சிரமப்பட்டிருப்பார்கள். தாக்கத்தை தணித்துக்கொண்டு, ஆட்டத்தின் போக்கில் தங்களை சரியாக ஈடுபடுத்த முடியாத சூழ்நிலை உருவாகும். காற்றின் திசையோடு பயணிக்கும் பந்து வீச்சாளர்களுக்கு சாதகமாகவும், மட்டைபிடிப்பவர்களுக்கு எதிராகவும் அமையும். வெப்பகாலங்களில் பிட்ச் வறண்டு காணப்படும். பிட்ச்சின்நிலை அறிந்து பந்து வீசப்படும்.

வர்ணணையாளர்கள் பெரும்பாலும் " பனிப்பொழிவை" அதன் தாக்கத்தை வர்ணிப்பார்கள்.

பரிந்துரை

தானியங்கி வானிலை ஆய்வகங்களை, ஸ்டேடியத்தின் ஒரு பகுதியில் அமைக்கப்பட வேண்டும். டிஜிட்டல் முறையில் வானிலை குறிப்புகளை பெற்று வர்ணணை செய்யலாம். அனைத்துப் பிரிவினரும், வானிலையின் சாதக, பாதகங்களை அறிந்துகொள்ள வாய்ப்பு உள்ளது. சேலம், சென்னை மாநகரங்களில் சர்வதேச அளவில் கிரிக்கெட் பயிற்சி ஆண்களுக்கும், பெண்களுக்கும் வழங்க அக்கடமிகள் உருவாக்கப்பட உள்ளது. தானியங்கி வானிலை ஆய்வகங்கள் அமைக்கப்பட்டால் தரவுகள், நிர்வாகத்தினருக்கும், வீரர்களுக்கும், தீர்மானம் எடுக்க உதவிகரமாக இருக்கும். ரசிகர்கள் வீரர்களாக படிப்படியாக வளர்ந்து வரும் வீரர்களாக மாறலாம். சேலம் நடராஜன் எளிய குடும்பத்தில் பிறந்து சர்வதேச அளவில் புகழ் பெற்று விளங்குவதை முன் உதாரணமாக எடுத்துக்கொள்வோம்.

ஈ.ரா. சுகுமார்

Obituary

With heavy heart and grief, Indian Meteorological Society Chennai records the sad demise of the following members of the Society.

1.Dr.Nammalwar Rajan Former Principle Scientist CICAR -Central Marine Fisheries Research Institute -CMFRI,Ministry of Agriculture and Farmers Welfare Govt of India ,Former Project Leader INCOIS,Ministry of Earth Sciences Govt of India,

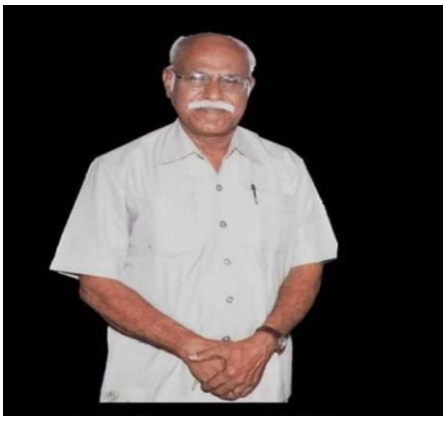
Advisor Project Advisory guest faculty, Faculty of Science and Humanities, Anna University Chennai

2.Shri.S.Kalyanasundaram Director (Rtd) IMD Chennai

3.Shri B.Amatya, Meterologist(Rtd) IMD Chennai

May their noble Souls Rest in Peace.

The Society coveys heartfelt condolences to their bereaved families



Dr. P. Nammalwar Rajan

Shri. S. Kalyanasundaram

Shri. B. Amatya