DECEMBER 2024

INDIAN METEOROLOGICAL SOCIETY CHENNAI CHAPTER NEWSLETTER

BREEZE

NUGGETS OF IMD'S EARLIER DAYS

-DR. S BALACHANDRAN

THE POWER OF DEDICATION, HARD WORK, AND BELIEF

-DR. J VIVEKANANDAN

A JOURNEY OF AN INDIGENOUS X-BAND DWR AT CHENNAI

-DATA PATTERNS (INDIA) LIMITED

MYTH ON DECARBONIZATION: NATURE'S PATH TOWARDS SUSTAINABILITY

-DR. J BALAMURUGAN

VOL. NO.24
ISSUE NO. 1 & 2

Council Members
(2024 - 2026)

EDITORIAL COMMITTEE

"BREEZE NEWSLETTER,VOL. NO.24, ISSUE NO. 1& 2, DEC 2024"

From the Chairperson's Desk...

Dear members of IMS Chennai Chapter and readers of BREEZE,

Greetings. The new team of Local Council members took over in June 2024 for the tenure 2024-26. The current newsletter Breeze which you are flipping through is a digital make-over with the transformation brought in by the creativity of young minds guided by Secretary, IMSCC. My sincere appreciation to the team for making Breeze online reader friendly. This Vol.24 of Breeze is a combination of Issue Nos.1 & 2, June and December 2024.

I thank all members of IMSCC and Local Council for their support and suggestions in taking forward the activities of the Chapter. We were able to arrange two guest lectures out of which one was from eminent radar technologist from USA and the other from TNEDA, India.

A membership drive has been initiated and ten members have joined as Life members in the past eight months.

As we move ahead, continued cooperation and new ideas for enhancing outreach activities of Chennai Chapter are most welcome.

B. Amudha

With best regards
B. Amudha
Chairperson, IMSCC, 2024-26
28 Feb 2025

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Life Membership details of IMS Chennai Chapter (as on 01.02.2025) : 195
The members list is available in https://imetsociety.org/members-list/

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Message from the Secretary

Dear Members of the Indian Meteorological Society, Chennai Chapter,

It is with great honour that I express my gratitude for being elected as Secretary of our local council for the term 2024-2026. I am excited to collaborate with all of you to further the Society's objectives.

The new council officially commenced its duties in June 2024. During the local council meeting on June 11th, we engaged in productive discussions regarding our current status and shared ideas for the upcoming two years. One of our primary initiatives is to update the membership database, which will enhance our communication with members and facilitate the integration of new, younger members into our Chennai chapter.

Between June and December 2024, we organised two noteworthy lectures. The first was an online presentation by Dr. J. Balamurugan from TNEDA, while the second took place at RMC Chennai, featuring a talk by the esteemed scientist Dr. J. Vivekanandan from NCAR, USA.

A significant accomplishment within the last six months has been redesigning the IMS Chennai website and implementing a new design philosophy to improve outreach. Additionally, we have revamped the Breeze magazine to align with international standards, enhancing the reading and viewing experience. I want to extend my appreciation to Shri. Vikash for his work on the website, and Ms. Sruthi for her contributions to redesigning the Breeze magazine.

Dr. S. Balachandran, the head of RMC Chennai, has been a tremendous source of support for our activities at IMS. His insightful guidance motivates us to engage the community through various meteorology-related initiatives.

As we move forward, we are aware of the challenges posed by the Society's current financial state, which has hindered our progress toward achieving our goals. We are committed to stabilising our funds and ensuring they are utilised sustainably.

Let us all look ahead with enthusiasm as we contribute to advancing meteorological sciences for the benefit of the public.

Best regards,
Bibraj R
Secretary, Indian Meteorological Society, Chennai Chapter

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Description: Cumulonimbus clouds behind the mills of Santa María del Campo Rus (Cuenca), Spain.

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Nuggets of IMD's Earlier Days

- by Dr. S Balachandran , Head RMC Chennai

Recently India Meteorological Department celebrated 150 years of services to Nation since its inception in formally in the year 1875. The birth of modern meteorology in India took place through developments in the field of astronomy and geographical survey. The first meteorological observations were recorded at the Madras observatory in 1793, 82 years prior to 1875. From the perusal of some of the earlier records / publications related to IMD, Madras observatory as well of the science of meteorology some interesting facts / information were noted during the past few years which are shared in this article for the benefit of the interested readers.

Debate in UK Parliament for Establishment Of IMD

Records indicate that there were constant efforts made for about five years since 1871 to establish meteorology in India. Refereeing to dispatches to and from the Government of India, Mr.Egerton Hubbard M.P was rising issue and constantly argued for importance of the study of meteorology in UK parliament which resulted in establishment of IMD. He asked the Under Secretary of State for India that Whether the Meteorological Observations taken since 1867 at fourteen stations in the Madras Presidency have yet been published or utilized in any way. In the parliament debate it was informed that observations have been sent to the Astronomer Royal at Greenwich and if these observations were to be utilized, it will be necessary to adopt a system of general control and inspection, so as to insure uniformity of method.

Timings of Meteorological Observation

It is general practice that in class I departmental observatories, the meteorological observations are manually recorded at every 3 hourly interval which are known as synoptic observations. However, during disturbed weather conditions period like depressions and cyclone, hourly manual observations are also recorded. In 1800's, the observation times were sunrise, noon, 2 PM, sunset and 9 PM which were changed latter as 3 AM, 9 AM, 3 PM and 9 PM. Hourly observations for 24 hours were taken on equinoxes and solstices (on 21st of March, June, September and December) only and these observations are known as "term observations". Nowadays automatic weather stations are providing data at high temporal intervals even at seconds/minutes.

Physics Experiments Conducted At Madras Observatory

Apart from Astronomical and earth's magnetic field related observations, experiments in field of physics were also carried out madras observatory. Those days guns were fired from St George fort and St. Thomas mount both in the morning and night and observations were made about sound from these guns firing using chronometers at madras observatory.

Mr.Egerton Hubbard M.P

From these observations the variability of velocity of sound according to the state of atmosphere and weather was deduced and results were published in the scientific journal 'Philosophical Transactions' published by Royal society in 1823. It is quite interesting to note the degree of calmness and visibility without high rise buildings, so as to make observations from places which are far apart with notable distance, that prevailed in those days in the madras city. Similarly, Katers pendulum experiment were also carried out by astronomer John Goldingham with a telescope assessing the lags of swings of Kater's pendulum against the pendulum of the Haswell clock and measurement of acceleration due to gravity and results were published in the philosophical transactions of the Royal Society of London.

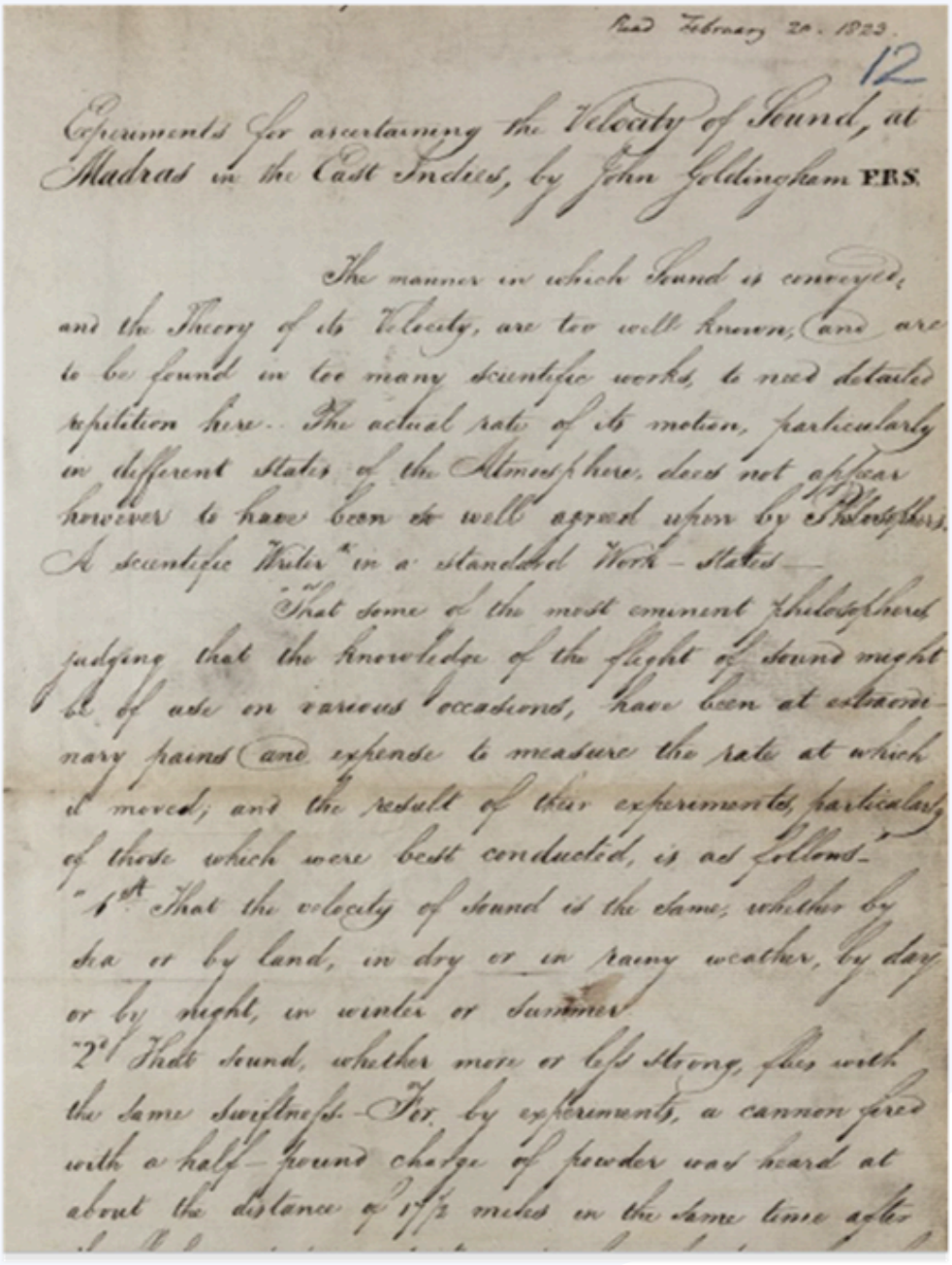
Illustration of the measurement of the acceleration of gravity with an invariable pendulum in Madras by John Goldingham, 1821

Astronomer Vs Chief Engineer Conflict in Construction of Madras Observatory

In 1789, astronomer Micheal Topping identified a house with garden at vepaery and submitted a proposal to East India company to construct observatory. The proposal consisted of buying the property at cost of 5000 pags and adapting it observatory at cost of 1500 pags. However, by the time approval came, owner increased the cost. Alternatively two places- one at Nungambakkam and another at Luz were considered. Selecting the place at Nungambakkam Michel Topping wanted to construct observatory by himself and prepared detailed plan for same. But major Mule, chief engineer contended that design and construction of public buildings were vested with department of chief engineer. He criticized that topping plan is not proper. Caught between two, EIC finally permitted topping to carry out his plan as the cost of 1500 pags* with property cost of 5000 pags. However, many modifications were carried out during construction and final work was completed in 1792 at cost of 2426 pags. But in 1794, within two years of construction, the walls of the buildings along with foundation started to sunk due to additional construction added to the old building. another proposal submitted to pull down entire building. Hence another proposal to pull down

entire building and construct new building was submitted. But EIC rejected same citing the excess money spent over and above the original approval on one hand and failure of building stability within short period on the other hand.

- Pagoda is the currency during East India Company period in the madras presidency which is round gold coin of diameter 12 mm weighing 3.43g.



Read February 20. 1823.

12

Experiments for ascertaining the Velocity of Sound, at Madras in the East Indies, by John Goldingham FRS.

The manner in which Sound is conveyed, and the Theory of its Velocity, are too well known, and are to be found in too many scientific works, to need detailed repetition here. The actual rate of its motion, particularly in different states of the Atmosphere, does not appear however to have been so well agreed upon by Philosophers. A scientific Writer in a standard Work states —

"That some of the most eminent Philosophers judging that the knowledge of the flight of sound might be of use on various occasions, have been at extraordinary pains and expence to measure the rate at which it moved, and the result of their experiments, particularly of those which were best conducted, is as follows."

"1st That the velocity of sound is the same, whether by sea or by land, in dry or in rainy weather, by day or by night, in winter or summer.

"2d That sound, whether more or less strong, flies with the same swiftness. For, by experiments, a cannon fired with a half-pound charge of powder was heard at about the distance of 17½ miles in the same time after

Velocity of Sound Experiment conducted by John Goldingham, 1823

Hand drawn image of the Madras observatory taken from the manuscript "Astronomical observations Madras 1792"

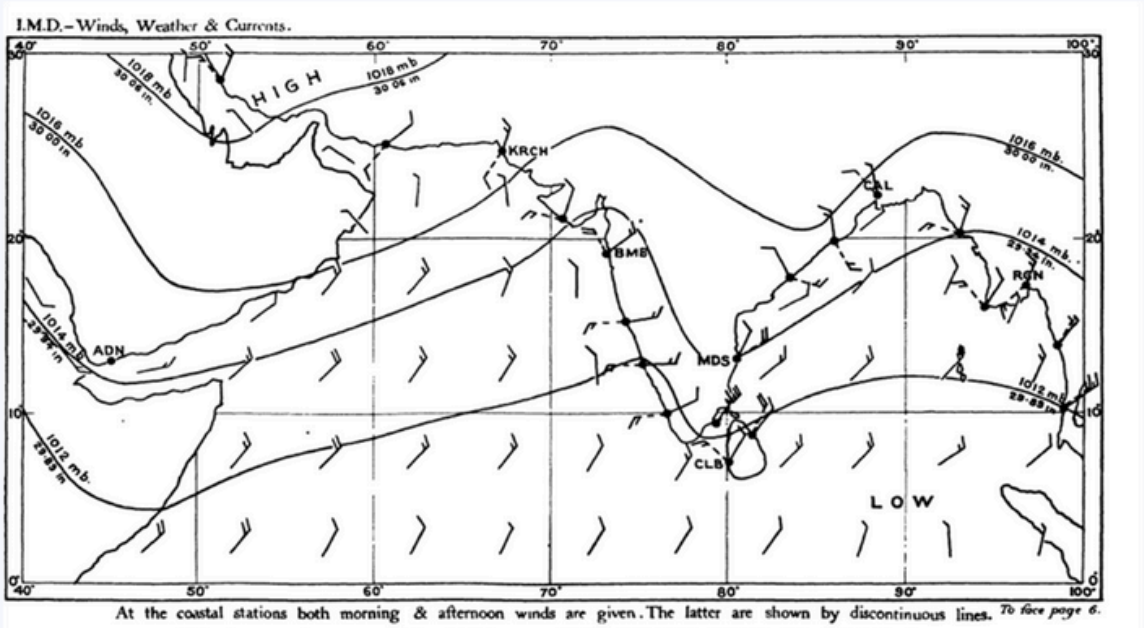
Variation in the classification of seasons and plotting of wind observation in weather maps

For quite Long time IMD follows the following seasonal classification:
1. Winter – January and February
2. Premonsoon – March to May
3. Southwest Monsoon – June to September
4. Northeast Monsoon – October to December.

Perusal of earlier publications indicate that different seasonal classifications were followed earlier occasions. In 'Memoirs of the Indian Meteorological Department' vol.XX, Part 4, published in 1908, the four seasons are mentioned as follows:
1. Northeast Monsoon – December to march
2. Hot weather period – April and May
3. Southwest monsoon season – June to September.
4. Transition monsoon Period – October and November.

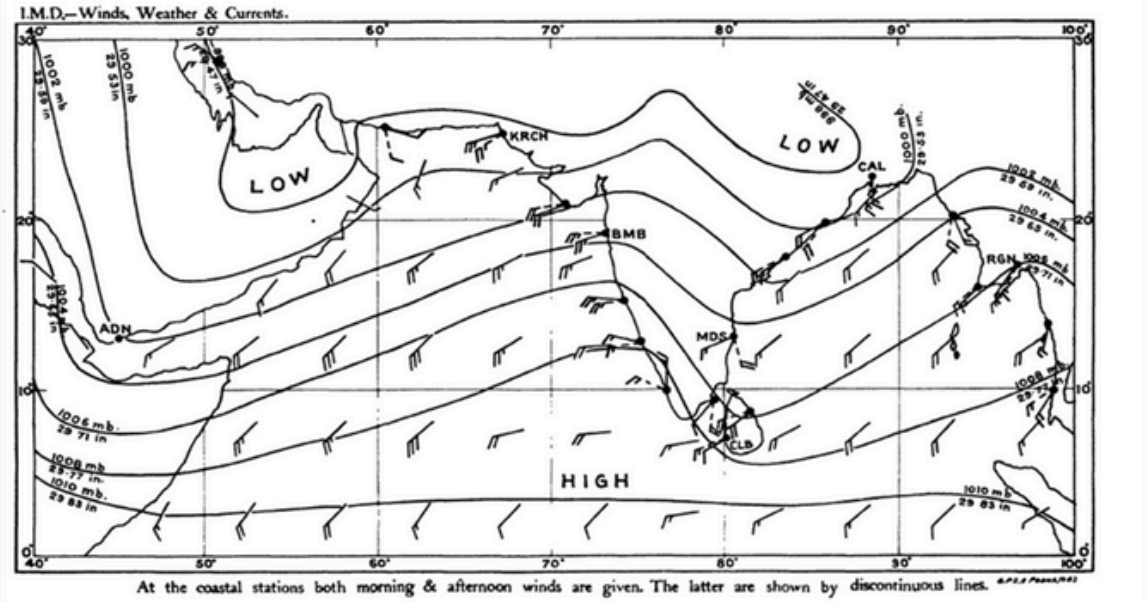
However, In the 'Memoirs of the Indian Meteorological Department' vol.XIX, published in 1914, the four seasons are mentioned as follows:
1. Northeast Monsoon – January and February
2. Pre monsoon transition period – March to May
3. Southwest monsoon season – June to September.
4. Post monsoon transition Period - October to December.

Moreover, the plotting winds was different from the currently followed practice as shown in the following.



At the coastal stations both morning & afternoon winds are given. The latter are shown by discontinuous lines. *To face page 6.*

FIG. 1. PRESSURE AND WIND IN THE INDIAN SEAS IN JANUARY.

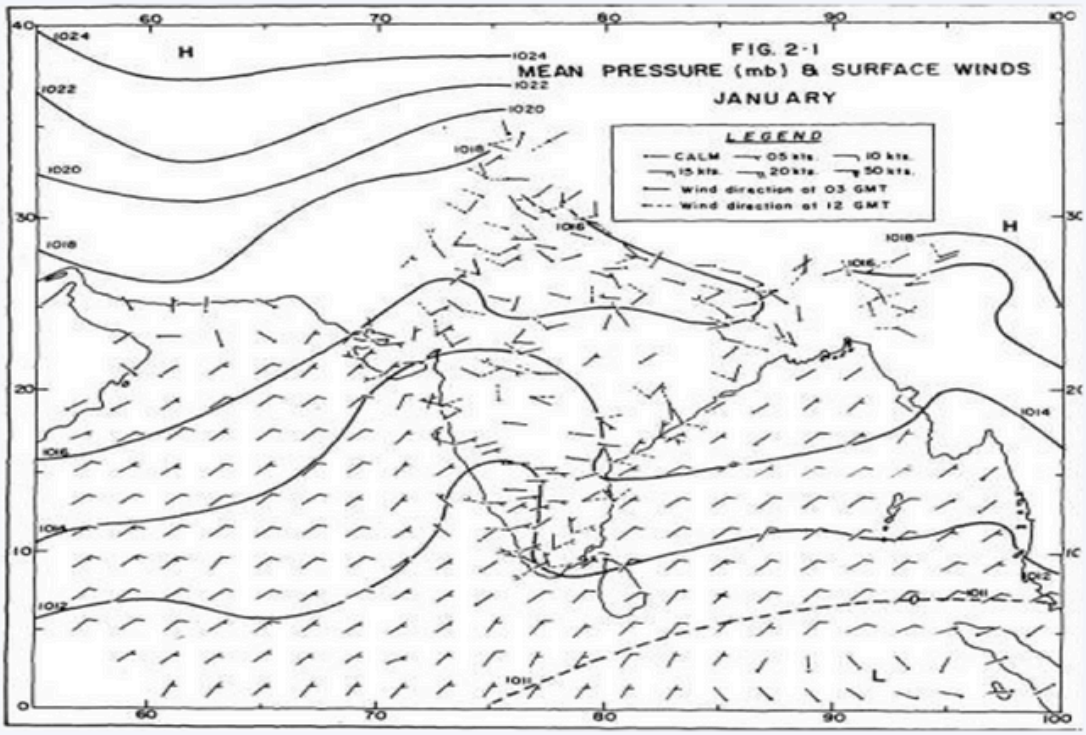


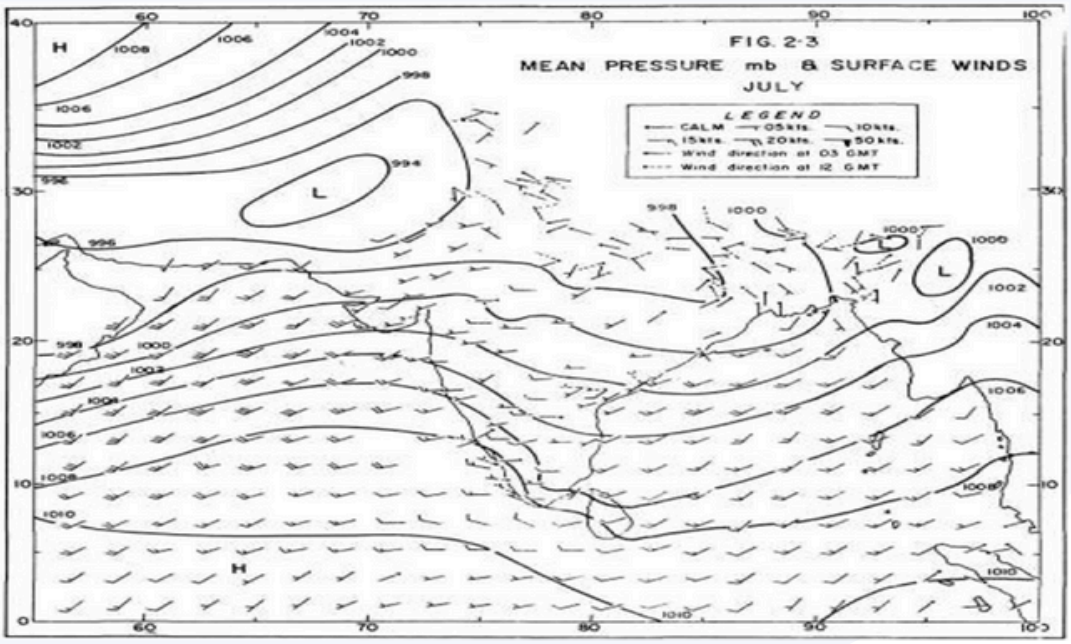
At the coastal stations both morning & afternoon winds are given. The latter are shown by discontinuous lines.

FIG. 2. PRESSURE AND WIND IN THE INDIAN SEAS IN JULY.

Wind plotting in earlier publications

Normally wind barbs directs towards low pressure side whereas the maps published earlier days depicts that wind barb plotting directs towards high pressure side.





Present day method of wind plotting

IMD Foundation Day – September or January?

The IMD foundation day is celebrated every year on January 15. Blandford submitted scheme of reorganization of the meteorological observatories to the government of in July 1875. The proposal was sanctioned on 27th September 1875 by the order of the government of India in the Department of Revenue, agriculture and commerce (letter No. 56) and hence the department was not formally established till date. But, Blandford in his report "Administration of the Meteorological Department of the Government of India in 1875-76" mentioned that he carried out many preliminary works, in anticipation of the order, towards remodeling the departmental activities on arrival in Bombay on 15th January 1875. This may be reasoning that foundation day is celebrated in month of January.

Iron Pillar inscription

The monument in RMC Chennai has 10 ton iron pillar over which it is inscribed in Tamil that "The observatory was built by Micheal Topping in The Kaliyugam year 4893 in order to facilitate the objects in the sky". The observatory establishment year is inscribed using Tamil numerals as follows.

The above image refers to Kaliyugam '4X1000+8X100+9X10+3' which is equal to 4893. According to Hindu cosmology, Kali Yuga began on 3102 BCE. Adding 1792, we get the figure 4893 which indicates that the observatory was built in 1791.

Summary

Several scientific and innovative works carried out by IMD during its early years of evolution could be brought out from the available historical records. Further perusal of still older publications /materials will bring out more interesting facts related meteorology and IMD during its early years. ■

The Power of Dedication, Hard Work, and Belief

- by Dr. Vivekanandan, NCAR

Dr.Vivekanandan's groundbreaking work in atmospheric remote sensing and his extraordinary journey from Tamil Nadu to global recognition exemplify the power of human potential. His story is a shining example for future generations striving to make a difference in science and beyond.

J. Vivekanandan, commonly known as Vivek, is a leading researcher in atmospheric remote sensing. His contributions have significantly advanced the understanding and application of weather radar technology. Dr. Jothiram Vivekanandan (Vivek) is an accomplished Senior Scientist at the Earth Observing Laboratory, NCAR, in Boulder, Colorado, USA. His extensive research and development expertise includes polarimetric radar, dual-wavelength radar, phased array radar, lidar, and microwave radiometers. His journey from a humble background in Tamil Nadu to becoming a renowned expert in atmospheric remote sensing is a testament to his dedication, hard work, and exceptional talent. Vivek grew up in Tamil Nadu and studied in Tamil medium before pursuing higher education in a government engineering college. He was a National Merit Scholarship holder and secured top ranks at his university and the Indian Institute of Technology (IIT).

His parents instilled in him the values of honesty and hard work, guiding him throughout his life. He excelled in ball badminton at both the district and college levels, which helped build his confidence and showed that he could succeed in both academics and sports. Below is an example of his research work, which provided a practical solution to a long-standing problem in the polarimetric

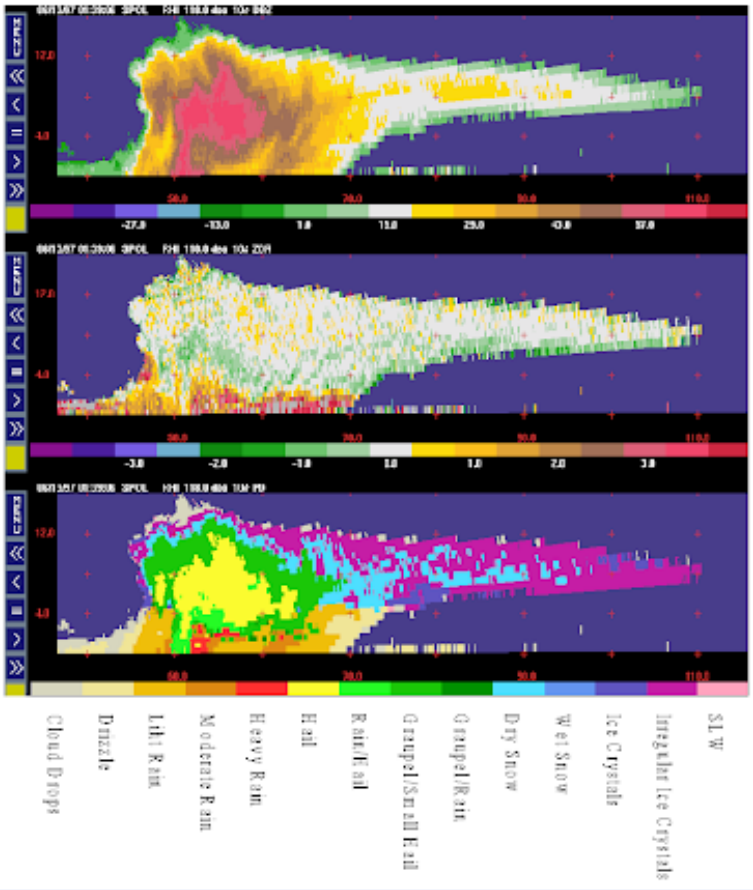
A mature cumulonimbus, or thunderstorm, cloud produces rain and hail on the Great Plains. The hail core is evident in the bright white streaks (center).Thunderstorms form as the moisture in updrafts-rapidly rising, warm air-condenses into raindrops or hail.

radar into a much more appealing tool for the entire field.

In the early 1980s, the interpretation of polarization radar observations was primarily qualitative and lacked a solid mathematical foundation. Vivek played a crucial role in creating a detailed numerical model that simulated the expected polarization radar observations of various atmospheric phenomena, including rain, hail, and graupel, in both melting and non-melting regions of a storm. This model accurately represented the polarization radar signals from different hydrometeors, providing a rigorous mathematical framework for interpreting radar data. This advancement significantly improved the field of radar meteorology.

Polarimetric radar observables are influenced by the microphysical characteristics of hydrometeors, which include: (a) particle size, (b) particle shape, (c) particle orientation relative to the local vertical direction, (d) phase (liquid or ice), and (e) bulk density (wet, dry, aggregate, or rimed). Reflectivity is defined as the sixth moment of the particle size

distribution when the particle size is small relative to the wavelength. Differential reflectivity (ZDR) is the ratio of the horizontal co-polar return to the vertical co-polar return and can be interpreted as the reflectivity-weighted mean axis ratio of precipitation particles within the radar's resolution volume.



Polarimetric radar reveals intricate patterns of precipitation types within a thunderstorm.

Consequently, ZDR, when used alongside reflectivity, effectively distinguishes between oblate raindrops (which typically show high ZDR) and more spherical hail (which usually exhibits low ZDR). In general, the rain medium is characterized by ZDR greater than 0.5 dB and ZHH less than 60 dBZ, while hail is generally associated with ZDR around 0 dB or even slightly negative, with ZHH exceeding 45 dBZ.

The algorithm relies on a straightforward linear mathematical operation, allowing the particle classification procedure to be implemented in real-time applications. This technique utilizes a fuzzy logic formalism that translates complex human interpretations of radar data into a set of membership functions. These functions enable the computer to emulate human decision-making processes. This approach effectively bridges the gap between human expertise and automated systems. For over a decade, several research groups have competed to implement this technology in real-time applications. Vivek successfully led a collaboration between NCAR and NOAA scientists to develop the first operational algorithm. This particle classification procedure has been seamlessly integrated into world-class research radars, serving the entire scientific community.

Field measurements using the National Center for Atmospheric Research (NCAR) polarimetric radar in various geographical regions confirmed Vivek's theoretical findings. These measurements demonstrated the potential of polarization radar technology to discriminate between liquid and ice phases and to detect biological scatterers like birds and insects. Based on his earlier research, Vivek developed an automated technique that uses polarimetric radar variables to classify precipitation into 15 different types. This algorithm is based on simple linear mathematical operations, making it suitable for real-time applications.

Vivek is one of the few researchers worldwide who has mastered the theory, modeling, and observational aspects of atmospheric remote sensing. His work has received widespread recognition and has significantly influenced the development of advanced radar systems and data interpretation techniques. In addition to his academic contributions, Vivek has made important advances in applied research and technology transfer, ensuring that the user community successfully adopts and utilizes his innovations. He has published numerous papers and articles in prestigious scientific journals, further establishing his reputation as a leading expert in the field.

His journey through academics, sports, and research in science and engineering inspires many, especially those from humble backgrounds. His achievements underscore the power of dedication, hard work, and the belief that anyone can excel in multiple areas of life. From a humble background to becoming a renowned atmospheric scientist, his story is a powerful testament to overcoming barriers and reaching remarkable milestones in his field. ■

A Journey of an Indigenous X-Band DWR at Chennai

- by Data Patterns (India) Ltd

Every Doppler Weather Radar Turn Key Projects executed will have their unique journey from Project initiation to Project completion. The journey would be more exciting, if such a project is a 100% Indigenous Make in India Project with no Transfer of technology from Foreign OEM. X-Band DWR at Chennai is one such Radar in which both the Hardware and Software are Designed and developed by an Indian Company named Data Patterns (India) Limited. This article is intended to share the experience of the firm in successfully establishing such a world class radar, which previously we are dependent only on foreign OEMs.

About Data Patterns

Data Patterns (India) Limited, a Chennai based distinguished Indian Defense and Aerospace Electronic Systems Company, with four decades of experience in offering solutions from solutions that range from building blocks to end systems. They possess comprehensive design capabilities spanning the entire spectrum of electronics, including processors, power, RF and microwave, as well as embedded software and firmware. The robust domain knowledge covers radar, electronic warfare (EW), communications, satellites, avionics, and automatic test equipment (ATE). With a wide range of qualified products in production and a process-driven, certified infrastructure, Data Patterns serves a diversified customer base with unmatched expertise and innovation.

Past Domain Experience

Data Patterns has undertaken several indigenous Radars systems which include the tracking radars for VSSC & SHAR with significantly advanced RF and microwave capabilities, allowing us to build complete systems.

Consequently, in 2012, it designed and developed one of Asia's largest ST wind-profile radar for CUSAT, incorporating 619 TX elements. With this experience in developing various tracking and surveillance radars, Data Patterns entered the weather radar domain. In 2018, Data Patterns got its first opportunity in Doppler Weather Radar from ISTRAC to upgrade the X-Band Doppler weather radar at the National Atmospheric Research Laboratory in Gadanki. Data Patterns has designed and developed entire Transmitter and Receiver Chain with signal processing and base products, replacing the traditional TWT/Klystron-based TX with advanced Solid State Power Amplifiers (SSPA). With this Data Patterns achieved the distinction of the first Indian company to have established a SSPA based weather radar in both X-Band and C-Band Frequencies and one of the few company in International level. Data Patterns fondly and respectfully acknowledges the review and guidance provided by ISTRAC, ISRO team members for achieving this distinction.

DWR Chennai Journey. In 2020, Data Patterns has received an order from ISTRAC for Supply of SSPA Based X-Band DWR through competitive bidding. Though the city for installation of the Radar was not known initially, ISTRAC, has later confirmed that the Radar needs to be installed at NIOT Campus, Chennai for use by IMD.

Specification Requirement of the System are as follows:

1. **Type** :- Dual Polarimetric Doppler Weather Radar with solid state technology
2. **Operating Frequency** :- 9300-9600 MHz with instantaneous BW of 100MHz
3. **Polarization** :- Simultaneous transmission of H&V and H/V Alternate transmission of H&V
4. **Volumetric Coverage** :- hemispherical
5. **Observation Time** :- ≤ 8 min
6. **AZ Coverage** :- 0 to 360 deg
7. **Elevation** :- -5 to +95 deg
8. **Beam width** :- <= 1.2 deg
9. **Beam point accuracy** :- <=0.1deg
10. **Beam pointing resolution** :- <=0.01deg
11. 11. System Sensitivity :- Better than 13dBz @ 100Km
12. **Antenna Side lobe Level** :- 28dB or better down from the main lobe to 12deg, 30dB or lower there after
13. **Scan strategy** :- 10 Elevations within -5 to 30deg for normal observations
14. **Scan capability** :- Upto 6 RPM
15. **Transmit & Receive RMS Phase Noise** :- ≤0.2deg
16. **Cross Polar Radiation** :- better than 36dB
17. **Transmitter** :- H&V Channel SSPA's should have minimum 300W
18. **Max Capability** :- 150Km
19. **Minimum range resolution**:- Better than 75m
20. **Range side lobes** :- Less than 35 dB

The Key Challenges for Data Patterns in executing this project are:
(a) Very Stringent Technical Parameters specified by ISTRAC especially the cross poll and first side-lobe specification, which are important for weather radar.
(b) Installation of entire Radar on a lattice metal tower which can with stand wind speeds of 180 kmph and design of the same need to be vetted and approved by an elite senior level mechanical committee of ISRO.
(c) Design of Antenna and Servo mechanism which can house the entire Tx/Rx system in the side arms
(d) Advanced signal processing.
(e) Drone calibration of the system.
(f) COVID 19 Lock-downs and associated Logistic Challenges.
(g) 100% unmanned and remote operations i.e., the complete radar can be powered and operated from anywhere around the world.

Very Stringent Technical Parameters specified by ISTRAC

The primary challenge was to create a tower based dual polarized Doppler Weather radar with remote operable capabilities, integrated servo control, web-based control and monitoring system with base and derived product generation.

The radar harware was designed, developed and integrated in-house and functionality tested. The GUIs and signal processing software developed at Data Patterns enabled us to create Made-in-India Radar. Each design stage was verified by external experts and approved by ISTRAC.

Through continuous improvement and dedication, Data Patterns developed X-Band Doppler Weather Radar with 35 dB cross polarization, achieving 28 dB or better down first side lobes from main lobe to 12 degrees and 30 dB or lower thereafter.

COVID 19, an uninvited challenge

The Entire Radar realisation was done during the Peak of deadly COVID 19 first and second waves i.e. in the year 2020 and 2021. The entire global logistics chains were at stand still especially the electronics components. This lead to huge shortage of components and the lead times associated were very high and surge in prices was manifold. Making manpower available at sites for civil works and testing of system at other facilities was a huge challenge.

The Tower

While Data Patterns has already had experience of X-Band DWR Tx/Rx chain, signal Processing, Data Products and Front End Application, it was yet to execute Radar on Tower Based Structure.

The challenge in the design of the tower structure is that it has withstand gusting wind speeds of 180 kmph. The site allocated for the Radar in NIOT is an Marshy Land which calls for a very strong to the tower.

To overcome this challenges, Data Patterns Civil Design Team has finalized 10-meter pile foundation to be used instead of typical raft foundation.

Foundation setup for weather radar installation

Weather radar foundation construction in progress

The material used in the tower were tested at Tower Testing and Research Station of CISR, Chennai, post fabrication so as to re-confirm the mechanical strength vis-a-vis Design. The tower design and material test results were reviewed by an High Level Mechanical Committee of ISTRAC who have expressed satisfaction and given “Go-Ahead”.

The pile foundation was laid with 16 strong 10 meter piles below the surface point and Tower foundation Pillars were made on this piles. The entire tower structure was made of high quality Steel i.e., E 350 grade material. Porta cabins were installed for UPS and Power distribution room and radar workstation room.

Assembling the X-band radar components during the installation process and Mounting the radar antenna on its platform for optimal positioning.

Antenna and Servo mechanism

The Antenna subsystem consists of a parabolic dish with mechanical mounting fixtures and side arms designed to accommodate our entire Tx and Rx subsystems. This design is exceptional compared to traditional antennas and is very compact. High precision servo systems are placed within the antenna structure for both azimuth and elevation. The system operates synchronously, allowing 360-degree rotation in azimuth and -5 to 95 degrees in elevation. Incidentally, the mechanical antenna system was designed, developed and fabricated by a Chennai based Company which is 15 kms North of Radar Site and Data Patterns is 15 Kms south of Radar Site. With this X-Band DWR at Chennai can be called a tune “Vocal for Local Radar”.

Advanced signal processing

The radar controller comprises processor module, DAC & IOT module. The processor module consists of on board Six ADC channel and piggy DAC module. The ADC channel digitizes the IF signal in synchronous with the same master reference clock. Thus the digitized data is processed till pulse compression in FPGA and sent to the radar signal processing computer through Ethernet for base product generation.

Our software development team has developed the advanced signal processing algorithms which process the I & Q data from the digital sub-system and plots the data in such required product formats.

In a conventional TWT based Radar, the signal processing scope is minimal. However, SSPA based systems cannot be nmade without a solid foundational knowledge on signal processing, since the advantage of SSPA based system can be derived only due to the superior signal processing capability.

Drone calibration

Special Approval was taken from AF Stn Tambaram to fly the drone till 500 meters height. AAI authorities are also informed about the same as per DGCA guidelines. A drone was equipped with a known calibration target, such as a metallic sphere, and flew to specific positions where the radar could receive its signal. The radar received the signal reflected from the drone, identified the exact position and characteristics of the drone, and compared the received signal with the expected signal to determine any discrepancies. Based on the comparison, the radar system made necessary adjustments to its settings to ensure accurate measurements, including

Final setup and calibration of the X-band radar system before deployment.

phase delays, amplitude errors, and other inaccuracies in the radar system.

As a result of the drone calibration, ISTRAC ensured product accuracy and quality.

The Final Acceptance

The Radar installation included bore-sight calibration and drone calibration. Our software team achieved a significant milestone by generating DWR base products and a wide range of derived products within the radar subsystem.

The ISTRAC team inspected the entire radar, witnessing its functionality and approving its product quality and user-friendly interface.

Similarly, C-Band Doppler weather radars were developed and installed in Veravali, Mumbai, and IGCAR, Kalpakkam. These radars, based on efficient and reliable solid-state transmitter technology, established Data Patterns as an advanced Made-in-India radar developer.

Myth on Decarbonization: Nature's Path towards Sustainability

- by Dr. J Balamurugan, TNEDA

Dr.J.Balamurugan emphasizes the need for active human intervention and innovation alongside nature-based solutions to achieve sustainable decarbonization.

About TEDA

The State of Tamil Nadu is rich in Renewable Energy (RE) sources, especially wind and solar. Globally, observations point towards a changing climate, as temperatures are increasing, sea levels are rising, with a perceptible increase in severity and frequency of extreme events. Its most severe impacts may still be avoided if efforts are made to transform current energy systems. Renewable energy sources have a large potential to displace emissions of greenhouse gases from the combustion of fossil fuels and thereby to mitigate climate change.

The Government of Tamil Nadu is committed to mitigate the climate change effects on the one hand and to tap and judiciously use the abundant source of RE on the other hand. To promote the use of New and Renewable Energy Sources and promote energy conservation activities, the Government of Tamil Nadu set up the Tamil Nadu Energy Development Agency (TEDA) in 1985.

Besides promoting and creating awareness on RE, TEDA is also acting as a bridge between small RE consumers and RE integrators to enhance renewable energy contribution in the overall energy mix in the State grid. Being the State Nodal Agency for the Ministry of New and Renewable Energy (MNRE), TEDA has facilitated implementation of RE projects with a medium and small level projects which include domestic rooftop solar PV systems and wind projects.

General objective of TEDA is to diffuse useful knowledge in various fields of energy, to deal with problems caused by existing uses of energy.

Main objectives are to:

- Promote use and propagation of New and Renewable, non-Conventional energy.
- Energy conservation activities in respect of conventional sources like oil and power.
- R&D in high technology areas of energy.
- Undertake projects related to Integrated Rural Energy Programme in Tamil Nadu.

Renewable Energy Strategies for Sustainable Development

To accelerate the growth rate of renewable energy in the generation mix and to mitigate the arising challenges thereupon Tamil Nadu Government will devise and implement the following measures:

- TEDA is coordinating with State Government Departments and Public Sector Undertakings to facilitate extensive adaptation of solar energy plants.
- Sustainable Development Goal(SDG) - TEDA is assisting TANGEDCO for attaining Affordable and Clean Energy indicators like households electrified in remote area with solar grid, increase the renewable energy share in the total installed capacity and reduce the AT & C losses by installing decentralised Solar power plants.
- Increased prioritization of clean energy projects and promotion of policies that support renewable energy.
- TEDA is involved in the development and promotion of biofuels, supporting the Biofuel Board in its efforts to advance biofuel technologies and usage of CBG for alternate energy sources.
- Demand side reforms to promote electric vehicles.
- Incentivizing power generated from renewable energy sources through subsidies.

1. Understanding Decarbonization

Decarbonization refers to the process of reducing carbon dioxide emissions, aiming to shift toward low-carbon or net-zero systems. This is essential for combating climate change and achieving sustainability.

Sustainable development aims to attain a state of society where living conditions and resources are used to continue to meet human needs without undermining the integrity and stability of the environment.

The SDGs also known as the Global Goals, adopted by the United Nations member states is a universal call to action to end poverty, protect the planet, and ensure that by 2030 all

UN's 17 Sustainable Development Goals for a better and sustainable future

people enjoy peace and prosperity.

- The world is not on track to meet the Paris target of limiting global warming to ideally 1.5°C. Current policies imply >3°C warming by the end of the century.
- This will be disastrous, and India will be among the countries most affected.

2. The Myth of Passive Decarbonization

There is a misconception that nature alone can solve the carbon crisis without human intervention. While natural processes like carbon sequestration in forests, soils, and oceans are vital, they are insufficient to counteract the rapid emissions caused by human activities.

Energy Transition Model:

Mostly consumers utilize their Energy either for heating or cooling their environment or for their transportation. Energy transition needs to happen starting from the home segment to the industry level when considering the energy transition awareness to the individual. For ex: whenever we are running on emergency for the natural call, we switch on the lights in the restroom, but after relieving ourselves, we don't claim the equal responsibility to switch it off – still continued with the family members as a habit. We are not here to scold the members, but we have the

responsibility to educate the consumers.

- **New Decade New Approach:** "the principles and practice of citizen and community engagement".
- **Consumer reference groups:** Virtual reference groups to develop a shared agenda and bring.
- **Energy Authority (one stop shop):** one stop shop that helps deliver adequate energy advice and information.
- **Environment and Public Health-** Contribution of Renewable.
- Substituting fossil fuels in power generation with renewable .
- Reduced GHG emissions.
- Prevents contamination of water sources .
- Combating climate change.

Energy Transition is built with this base idea

- Enhance electrification of industry, transport, agriculture, household energy use.
- Increase share of Renewable in electricity generation.
- Replace fossil fuels with biomass and green hydrogen.
- Encourage decentralized RE solutions .

3. Nature's Role in Sustainability:

- Carbon Sinks: Forests, wetlands, and oceans naturally absorb CO_2, helping regulate global carbon levels. Bhutan is the only Carbon-negative country in the world.
- Ecosystem Restoration: Reforestation, afforestation, and protecting biodiversity enhance natural carbon storage capacity.
- Nature-Based Solutions (NbS): Techniques like mangrove restoration, agroforestry, and regenerative agriculture integrate natural processes into decarbonization strategies.

4. The Need for Active Measures:

- Transitioning to renewable energy sources like solar, wind, and hydropower.
- Implementing circular economy principles to reduce waste and emissions.
- Developing carbon capture and storage (CCS) technologies to complement nature's efforts.

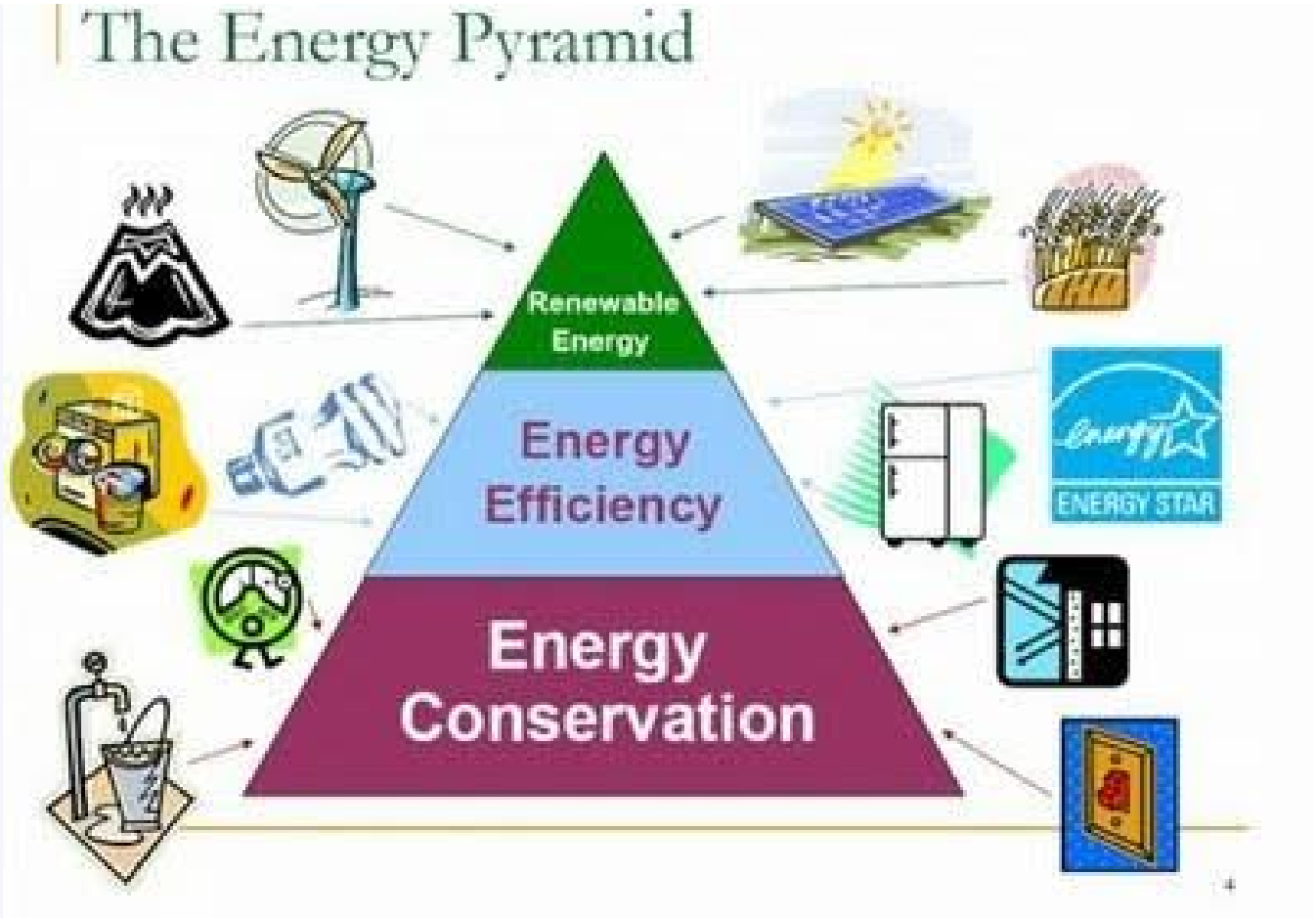
5. Challenges and Realities:

- Over-reliance on natural decarbonization risks neglecting urgent reductions in industrial and transportation emissions.

- Ecosystems have limits; excessive deforestation, urbanization, and climate stress reduce their carbon sequestration potential.

6. **Holistic Approach:**

- Combining technological innovations, policy frameworks, and community-driven efforts with nature-based solutions creates a comprehensive path toward sustainability. Balancing human interventions and nature's capacity is key to achieving lasting decarbonization.
- Enabling and protecting consumer: Policy options and regulatory framework that help enable and protect consumers during the transition to zero carbon.



The Energy Pyramid: Emphasizing energy conservation, efficiency, and the use of renewable energy sources

People need to understand the principle of Energy pyramid.

Sustainable Energy is “A three legged stool”
1) **Conservation** – Use less!
2) **Improve Efficiency** – Technology and “do more with less”
3) **Renewable Energy** – Invest in the future

Energy Transition is 3D modelled Translation happening namely **Decarbonisation, Decentralization and the foremost Digitalization**.
India has taken leadership position in global climate policy, raising the concerns of global south and developing nations.

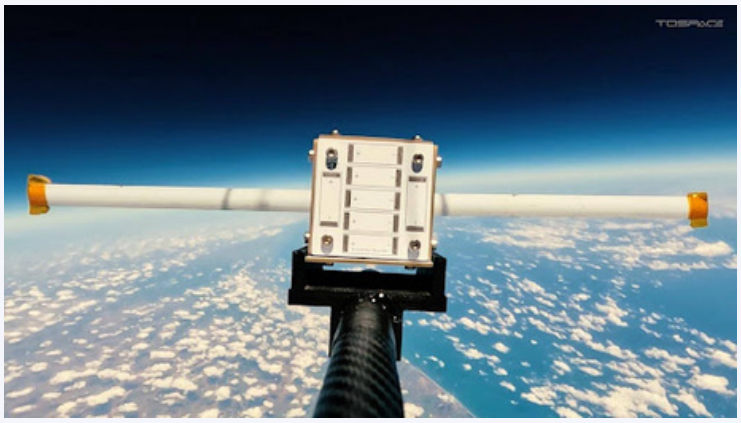
Conclusion

Decarbonization is not solely a "nature-driven" solution but requires active human participation and innovation to build sustainable systems. Misinterpreting nature's role as sufficient can delay critical climate actions, undermining the global fight against climate change. ■

Space Is Closer Than You Think: The Story of ToSpace and Kalvi

- by Adnaan M , Founder of ToSpace

Space is not far away; it's just a leap of innovation and determination." This sentiment captures the mission of ToSpace, a visionary startup in India's burgeoning space technology industry.



A high-altitude image showing an atmospheric payload device above Earth's horizon, capturing cloud and land formations.

Founded in 2021 by Adnaan M in Karur, Tamil Nadu, ToSpace has quickly established itself as a leader in space accessibility, specializing in PocketQubesatellites. This advancement allows for cost-effective launches of compact satellites into orbit, making space exploration not only a possibility but an achievable reality. However, ToSpace's most significant impact goes beyond these technological achievements; it is reshaping the educational landscape with ToSpace Kalvi, an initiative that equips young minds with the skills and knowledge needed to lead the fields of space exploration and atmospheric sciences.

Empowering Students Through ToSpace Kalvi

ToSpace Kalvi demonstrates the powerful intersection of space technology and education, inspiring and empowering students through experiential learning. Designed to bridge the gap between theory and application, Kalvi immerses students in the practical aspects of satellite technology and atmospheric science. Participants engage directly with meteorological instruments, aerospace engineering concepts, and satellite systems—preparing them for future careers in space technology, environmental science, meteorology, and STEM disciplines.

At the heart of Kalvi is the flagship "Skyward" program, where students participate in the full life cycle of a satellite mission. With the aid of high-altitude meteorological balloons, students design, build, and launch payloads equipped with sensors to collect at alltitudes reaching the lower stratosphere, approximately 30 kilometers (100,000 feet) above Earth. These payloads capture crucial atmospheric parameters such as temperature gradients, relative humidity, pressure, and gas concentrations, mirroring the data collection processes used in real-world satellite missions. With the aid of high-altitude meteorological balloons, students design, build, and launch payloads equipped with sensors to collect data at altitudes reaching the lower stratosphere, approximately 30 kilometers (100,000 feet) above Earth. These payloads capture crucial atmospheric parameters such as temperature gradients, relative humidity, pressure, and gas concentrations, mirroring the data collection processes used in real-world satellite missions.

Hands on data collection by students

The Journey of Learning: From Concept to Launch

The Skyward program begins with students diving into the science and technology behind satellite systems and atmospheric physics. They explore how changes in altitude affect air pressure and temperature, study the vertical structure of the atmosphere, and understand how meteorological data contributes to climate modeling and weather prediction. By the end of this initial phase, students have collaboratively designed functional payloads equipped with sensors, capable of measuring real-time atmospheric phenomena.

On launch day, students watch as their payloads rise through the troposphere into the lower stratosphere, gathering real-time telemetry data on atmospheric conditions such as temperature inversions, pressure drops, and wind shear.

This hands-on data collection offers students an invaluable insight into how meteorologists and climate scientists study atmospheric changes, enriching their learning with authentic, applied experiences.

Students from ToSpace Kalvi prepare a high-altitude balloon for an atmospheric science mission.

Expanding Horizons: Building a Community of Space Enthusiasts

Kalvi's mission extends beyond individual experiences. By partnering with schools, universities, and scientific communities, it has established an ecosystem that nurtures knowledge exchange and innovation.

Cultivating Critical Thinking and Innovation

The Skyward program extends beyond scientific learning, fostering critical thinking, teamwork, and innovation. Once the payloads return from near space, students analyze the collected data and compare their findings with established meteorological models. They interpret data on temperature lapse rates, pressure differentials, and humidity variations, bridging the gap between textbook concepts and practical applications. By engaging in these exercises, students gain a deeper understanding of Earth's atmosphere and its complexities.The initiative is committed to reaching students across diverse backgrounds, including those in rural areas, to provide access to state-of-the-art educational resources. Through annual events and competitions, Kalvi encourages students to present their payload designs, data analyses, and insights into atmospheric behavior, fostering a spirit of scientific inquiry and collaboration. Kalvi's impact is s amplified through these networks, forming a community of future space and atmospheric science enthusiasts.

This inclusive approach ensures that students from all walks of life can contribute to and benefit from the advancements in space education, promoting diversity in the next generation of scientists and engineers.

Bridging Theory and Practice in STEM Education

ToSpace Kalvi is redefining space and atmospheric science education in India by emphasizing both theoretical knowledge and practical application in STEM. Students learn how atmospheric pressure decreases with altitude, how atmospheric pressure decreases with altitude, how temperature and humidity vary across atmospheric layers, and how satellite technology enables observations of these variables from space. This comprehensive exposure helps students understand the scientific challenges of space exploration and environmental monitoring, inspiring curiosity and encouraging them to pursue careers in these fields.

Leaving a Legacy of Innovation and Education

As ToSpace prepares for its first orbital mission next year, the company's legacy will be defined

The ToSpace Kalvi payload on display before launch, inspiring future space enthusiasts.

not only by its technological achievements but also by the profound educational impact it has created through Kalvi. By making space science and atmospheric research accessible to students across India, ToSpace is democratizing space exploration, offering a platform for young scientists and engineers to thrive. Programs like Kalvi make it clear that space is closer than we think—available to anyone with the curiosity and drive to engage with the scientific wonders of our world.

Through ToSpace and Kalvi, Adnaan M and his team continue to break down barriers, proving that the next frontier is open to all who dare to dream and innovate. ■

Cyclone Fengal- Was it "Indifferent" or "Different"

- by J. Selvan, Weather Blogger / IMS Member

An in-depth analysis of Cyclone Fengal's unique trajectory, intensity changes, and environmental interactions during the North East Monsoon season, authored by Mr. J. Selvan.

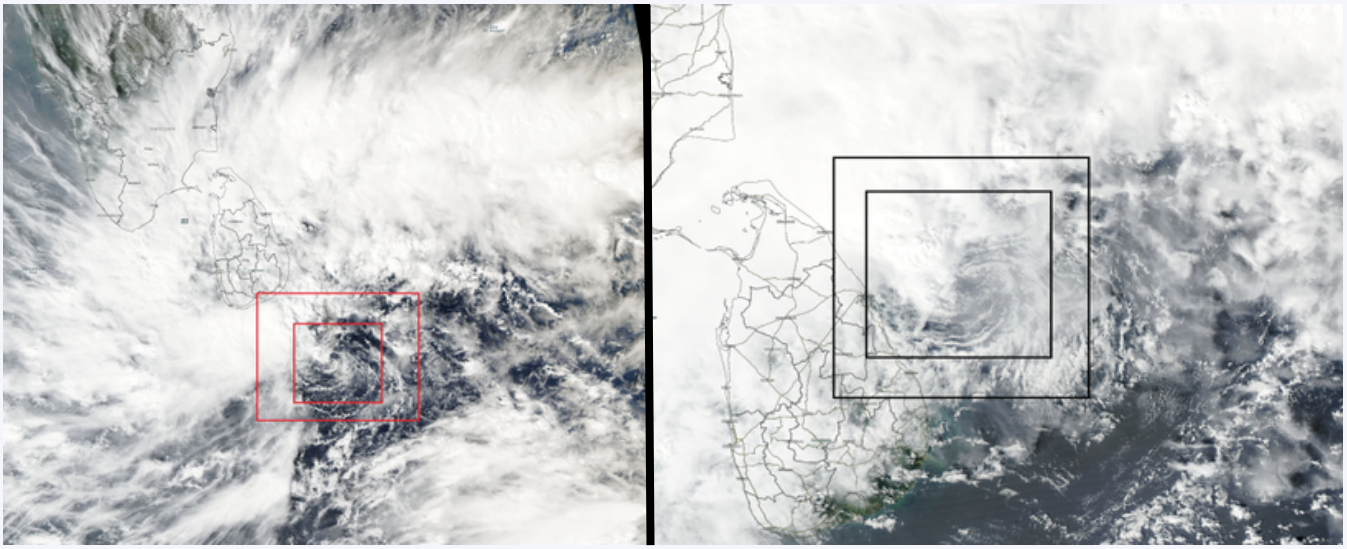
Cyclone "Fengal" got its name from Saudi Arabia, locally pronounced as "Feinjal" means "indifferent" but this cyclonic disturbance didn't live up to its name. With sudden changes in its movement and changes in intensity it was kind of different and easily one among the trickiest cyclonic storms in the recent times.

Around the 17th November 2024, this disturbance got initiated as a "vortex" over extreme southeast Bay of Bengal and adjoining northern Sumatra. This vortex was induced by a westerly wind burst on interaction with the northern Sumatran topography.

The physical mechanism by which the vortex got initiated is one of the interesting cases that happen many a times in the Bay of Bengal during the North East Monsoon season. Click the following link to know more about this mechanism:

https://journals.ametsoc.org/view/journals/mwre/148/7/mwrD190259.xml
https://doi.org/10.1175/MWR-D-19-0259.1

The disturbance gradually shaped up as it moved westward. Vertical wind shear started increasing along its path which hindered its development largely. With minor consolidation, it continued to move westward gradually and reached the southwest Bay on around the 24th of November. It was centred South-South east of Sri Lanka exposing its Low Level Circulation Centre (LLCC) and once conditions started favoring, it concentrated into a



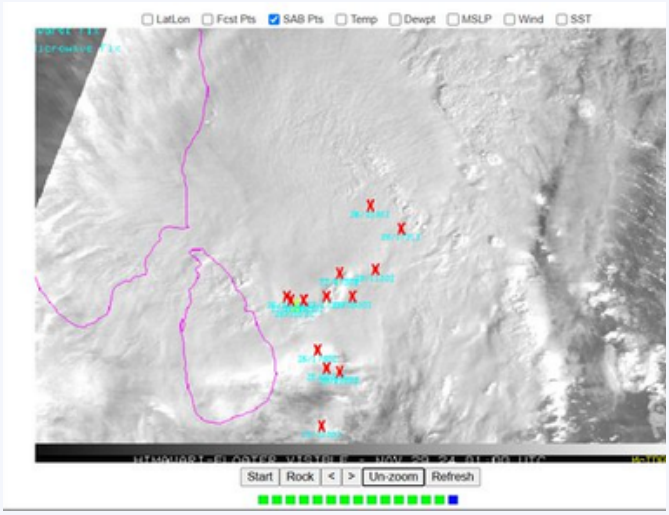
Exposed low level circulation center as seen from NASA Satellite images as the vortex was moving close to the coast of Sri Lanka

depression on the morning of 25th November. Upon reaching Sri Lanka and adjoining SW Bay the mid tropospheric winds changed so the steering flow for the disturbance also was seen changing. Strong-South-westerly flow in association with near equatorial ridge on interaction with Rossby gyre started pushing this disturbance pole ward.

This allowed the system (Low Level Circulation Centre - LLCC) to skip Sri Lankan landmass interaction. However LLCC partially interacted with east coast of Sri Lanka before it started moving northward.

On moving northward,it intensified into a Deep depression and laid centred Far East of Trincomalle (Sri Lanka) on 26th November.

Models expected it to intensify into a cyclonic storm but the

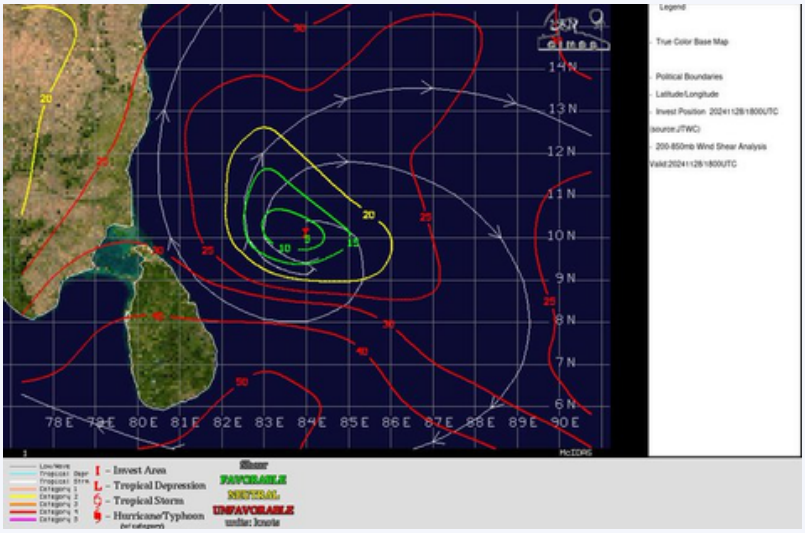


Visible Satellite Image seen from https://www.ssd.noaa.gov/ along with real time satellite based center positioning.

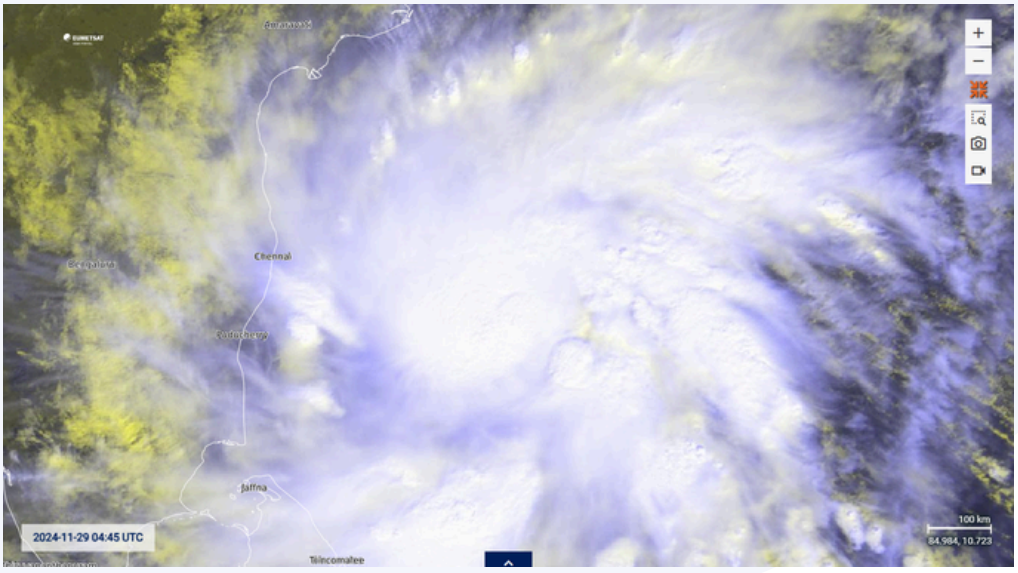
intensification got delayed due to increase in vertical wind shear conditions. This increase in wind shear came after the change in the steering flow and subsequent changes in the lower and upper level flow.

The disturbance moved North-North East briefly which disturbed the flow inthe upper & mid-level. Although

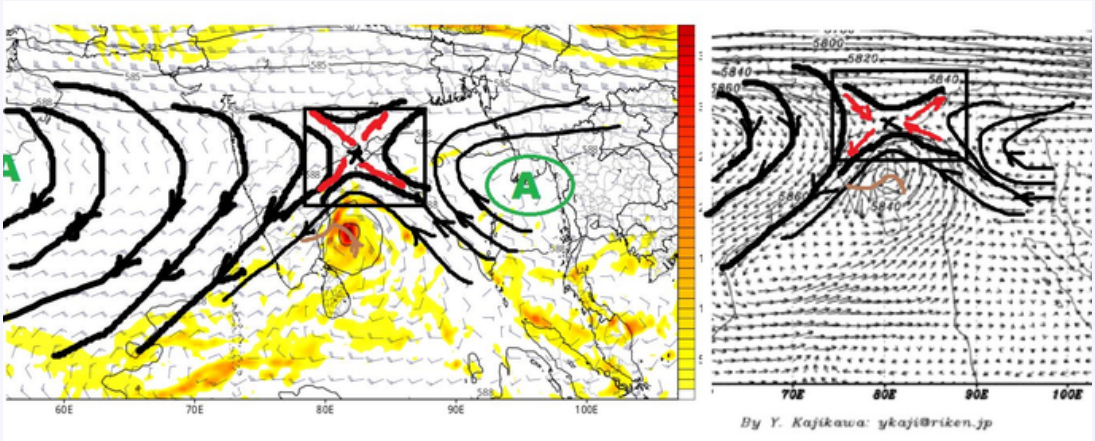
numerical weather prediction models anticipated these changes but it affected the overall rhythm so the system struggled to intensify into Cyclonic Storm. After 24hrs, the mid tropospheric ridge to the east extended westward and influenced thesystem to be steered north-westward from 28th November. So again the movement direction changed to NW.These changes made mid-level – lower level -upper level flow to align in the same direction thereby allowing directional shear to relax. As a result system started consolidated into a cyclonic storm on 29th November.



Real time analysis of environmental factors from CIMSS

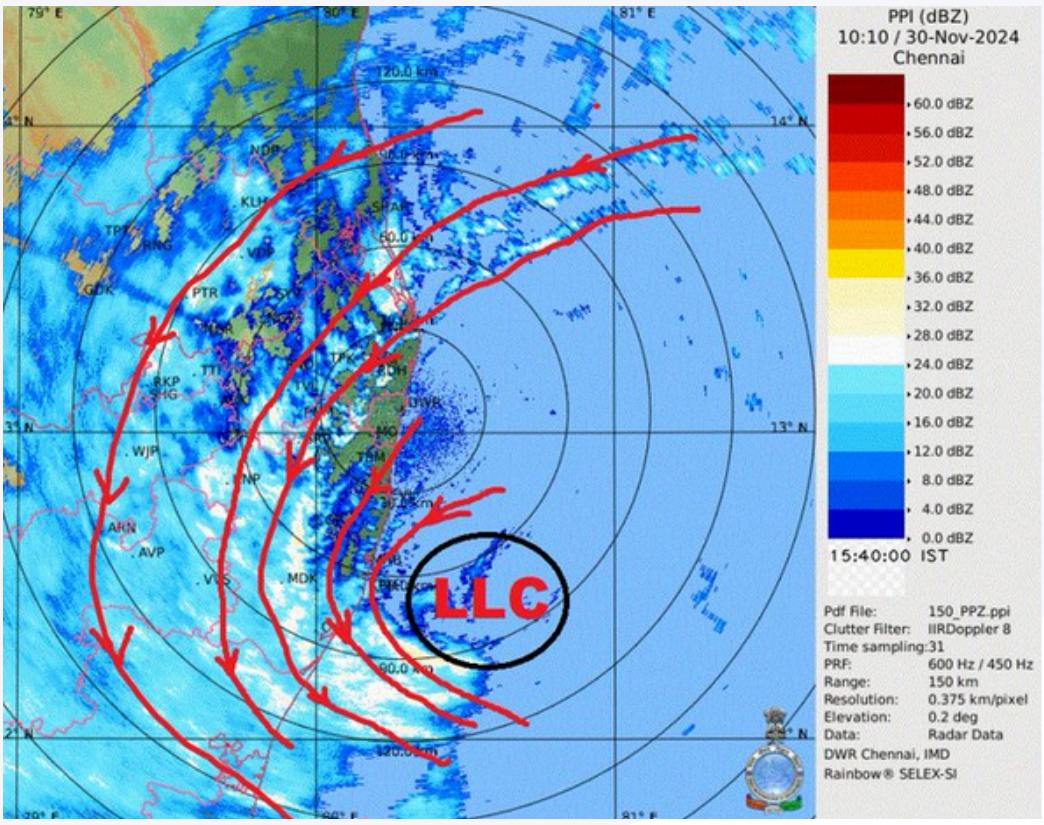


VIS satellite imagery of the system as it was seen consolidating with deep convection wrapping around the center offshore north coastal Tamil Nadu

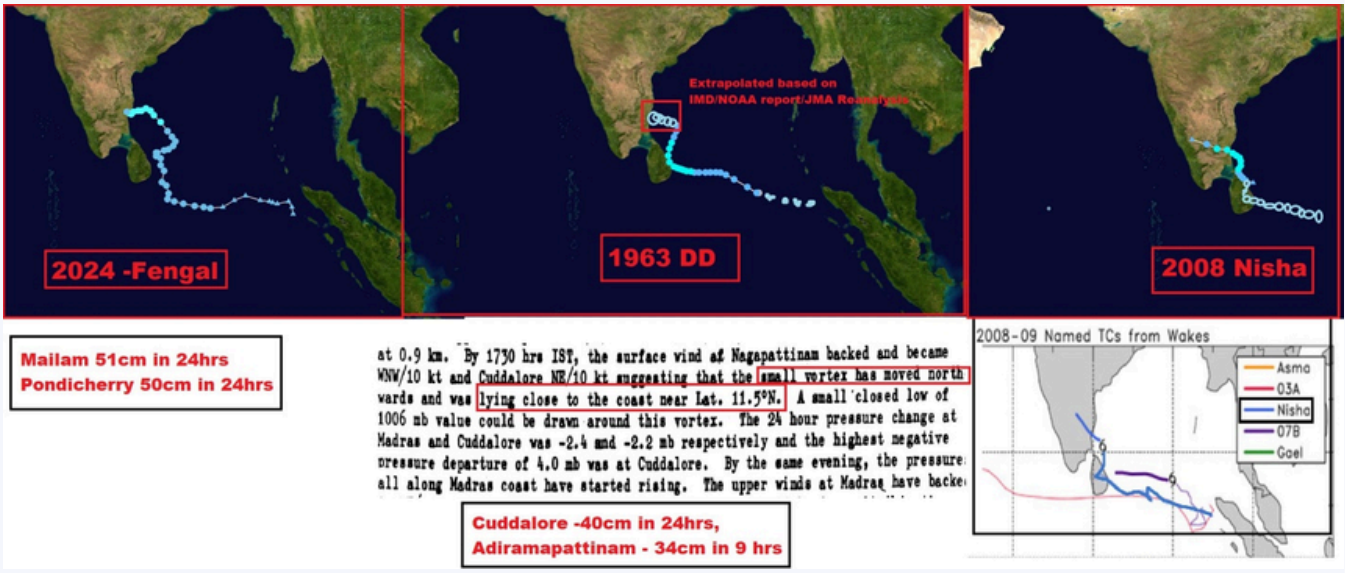


Mid-level Cyclonic Vorticity (shaded) and a rough sketch of streamline as the system started drifting WSW in response to change in the steering ridge. a) From Tropical Tidbits and b) From JMA Analyses

On moving North westward towards North coastal TN-Pondicherry, it intensified further and gained significant convection around the Northern semicircle of the LLCC. Banding features also got pronounced.



A snapshot of rain bands seen spiraling over north Tamil Nadu and the system approached landfall. Image from DWR IMD Chennai



Cyclonic Footprints: The Journey of Fengal (2024), DD (1963), and Nisha (2008)

The System continued to move further North westward close to Chennai- Pondicherry coastline and thereafter the Mid-level flow was very weak as the disturbance moved close to a weakness point of the ridge where winds were absolutely weaker so it moved very slow and changed its trajectory to west-south-westward in response to the flow.

It slightly drifted south westward and started making landfall at around the mid night of 29th November and the afternoon hours of 30th November. LLCC was seen stagnant for several hours causing extremely heavy rains over Pondicherry, Villupuram and neighbouring districts.

Analogous systems of Cyclone Fengal from the past

The track of Cyclone Fengal was pretty similar to 1963 Deep Depression and Cyclone Nisha of 2008. All these disturbances got initiated over Northern Sumatra in a similar way and interestingly all these disturbances followed similar trajectory.■

Varun's Weather World

- by Mr. Shiva, IMS Member

A captivating journey of how a childhood fascination with monsoon rains transformed into a lifelong passion for meteorology, narrated by Mr. Shiva.

Ambattur ,Madras. October 25.. 2005

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 some company ,Varun narrates his exploits on 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 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 up to him for his acumen and happy to be enlightened every now and then..

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 understood by mere observation of precipitation charts or radar images , feels there's lot more to learn....

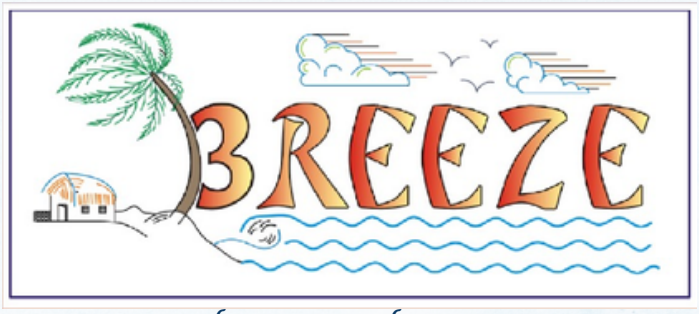
Finally after an year of deliberation, consultation takes the first step towards taking up meteorology as a career.. enrolls himself in a two year course of Atmospheric science..

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.... ■

A Tribute to the First Designer of Breeze Newsletter

The first IMS Breeze logo was in 1998



Colour Breeze logo in 2010

The Design of Breeze Newsletter has evolved quite a bit over its more than 25-year history since it first began. The most significant change has been introduced in this current edition.

The original logo for Breeze Newsletter, created for the Chennai chapter of IMS, was designed by Shri Julius Joseph in 1998 using just a pencil. At that time, he served as the Director (CWDS) in Chennai and had a deep passion for art, which inspired him to create this wonderful logo. Over the years, the logo changed from black and white to color in the May edition of 2010. Shri. Joseph later retired as DDGM (Training) from RMC Chennai. It was a true privilege to honor him during the 150th anniversary celebration of IMD.

Shri. Julius Joseph, DDGM(Retd.), 82 years, felicitated by S/Shri. Sundaram and Bhaskaran of MO Puducherry on 7.11.2024

Scientific Lecture on "Daily Rainfall Estimation: An Integrated Framework " - 24 Sep 2024
by Dr. J Vivekanandan, Senior Scientist (NCAR, USA)



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IMS Membership

To learn about the procedure for becoming a member of the Indian Meteorological Society (IMS) Chennai Chapter, please visit:

https://imetsociety.org/become-member/

New Members of IMS Chennai Chapter (Joined after the 2024-26 Council took over):

- Dr. B. Prabhu Dass Batvari
- Dr. D. Surendran
- Mr. J Beno Jones
- Dr. Ribu Cherian
- Dr. R I Sujith
- Dr. Somnath De
- Ms Sreelakshmi S
- Ms. Menaka Gandhi J
- Sruthi S
- Dhivya S

Support Our Society

Your generous donations help us in our ongoing efforts to enhance the understanding of meteorology, support educational activities, and contribute to the overall development of the scientific community. Every contribution makes a difference, no matter how big or small. Help us in our mission to foster knowledge and innovation.

If you'd like to contribute or need more information on how to support our initiatives, feel free to contact any of our council members. They are available to assist you with any inquiries related to donations, sponsorship, and ways to get involved.

We deeply appreciate your support in contributing to the Indian Meteorological Society. Together, we can make a significant impact!

Reach out to us:
ims.chennai6@gmail.com