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Indian Meteorological Society, Pune Chapter

(IMSP)

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Indian Meteorological Society, Pune Chapter

(IMSP)

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About IMSP and Bulletin of IMSP

The Indian Meteorological Society was established in 1956 and was registered on 26 May 1972 under the societies Registration act of 1860 as amended by Punjab Amendment Act 1957 applicable to Delhi. Registration No. of the society is 5403. The Society's headquarter is located at Delhi and its local chapters are functional at various places of India. The Society is a non-profit making organization and none of its income or assets accrues to the benefit of its members.

Objectives of the Society:

1. Advancement of Meteorological and allied sciences in all their aspects
2. Dissemination of the knowledge of such sciences both among the scientific workers and among the public and
3. Promotion of application of Meteorology and allied sciences to various constructive human activities

Any person, who is interested in above objectives of the society, is eligible to become a Life member. The Life membership fee is Rs. 3000/- only for Scientists / Researchers from India. Please visit https://imetsociety.org/wp-content/pdf/docs/forms/IMS_LM_form.pdf for IMS life membership form. The detailed information for becoming a member of IMS is also available at, https://imetsociety.org/become-member/

"Bulletin of IMSP" is generally published quarterly. Correspondence and contributions to the bulletin may be sent to Editorial Board (*mahap@tropmet.res.in*), with copy (cc) to the IMSP Chairman (*mujum64@gmail.com*). The manuscript should be typed at 1.15 space using Times New Roman font size 12, in MS-Word file. The author's name should be typed on the line below the title, the affiliation and email ID should follow on next line. The first author is requested to send softcopy of his/her passport size photograph.

Editors, Managing Editor/Editorial Board and the Society are not responsible for the views expressed by any author in his/her contribution(s) published in Bulletin of IMSP.

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Contents

Indian Meteorological Society: Connecting Scientific Insights with Community Needs

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The Indian Meteorological Society (IMS), established in 1956, plays a pivotal role in advancing meteorology and allied sciences across India. It focuses on promoting the application of meteorological knowledge in fields such as agriculture, health, and disaster preparedness. The society has over 15 chapters, including the Indian Meteorological Society Pune Chapter (IMSP), one of its most active branches.

History and Objectives

IMS was initially conceived during the Indian Science Congress in Calcutta, and since then, it has grown in both influence and size. Dr. S. Basu, the Director-General of Observations, was the first President, with the society being formally registered in 1972. The IMS seeks to:

- Advance meteorological and related sciences.
- Disseminate knowledge in these fields.
- Promote the application of meteorology in sectors such as agriculture, irrigation, engineering, technology, navigation, public health, and power development.
- Encourage scientific cooperation, research, and discussions.

IMS also actively organizes symposia, conferences, and meetings to promote collaboration between scientists and policymakers. Its chapters across India serve as hubs for regional engagement and scientific communication.

The Pune Chapter (IMSP)

IMSP, one of the largest and most vibrant branches, is based in Pune and has more than 200 life members and over 150 annual members. Its members include prominent professionals from the India Meteorological Department (IMD), Indian Institute of Tropical Meteorology (IITM), universities, and other research institutions. Even retired professionals continue to engage with the chapter, passing on their knowledge to the younger generation.

IMSP's key activities include:

1. Organizing lectures by eminent meteorologists to share recent advancements.

2. Conducting annual workshops, such as the Monsoon Workshop, where scientists discuss the monsoon's behavior and broader climate patterns.

3. Hosting national symposiums on extreme events like the one on Heatwaves and its linkage with climate change, which address urgent issues such as global warming's impact on health, agriculture, and ecosystems.

Contribution to Science and Society

The IMSP is committed to making scientific advancements accessible to all, especially rural communities, where understanding weather patterns can have direct impacts on agriculture and public health. Through its numerous programs and partnerships, IMSP strives to bridge the gap between science and society. Its efforts to popularize meteorology through public outreach programs and social media aim to create a more scientifically informed society.

IMSP's Monsoon Workshop offers a platform for meteorologists to present operational service work and research on monsoon variability, which is critical for India's agriculture and water management. This event also fosters collaboration among professionals, encouraging the exchange of innovative ideas for disaster preparedness and climate resilience.

Climate and Health Initiatives

One of IMSP's recent focus areas is the impact of Climate change on human health. Rising global temperatures, changing precipitation patterns, and more frequent extreme weather events are disrupting ecosystems and livelihoods. These changes have led to an increase in infectious diseases, worsening mental health, and heat stress-related health risks. IMSP, through symposiums and research, is helping bring these issues to the forefront.

National symposiums also address climate services for health, identifying how real-time climate data can help predict and manage disease outbreaks or protect vulnerable populations during extreme weather events. This is part of a larger global movement under the Global Framework for Climate Services (GFCS), which recognizes the vital role of meteorological services in protecting public health.

Activities during 2023-2024

- IMSP organised the IMSP–SPPU National Seminar with IMD & IITM at the Department of Geography, Savitribai Phule Pune University, on 11th April 2023. On this occasion, Dr. MR Ramesh Kumar, former Chief Scientist, NIO, Goa delivered a talk on "Antarctica - A Natural Lab to Study Climate Change".

- IMSP in collaboration with The Climate Research and Services (CRS) of the India Meteorological Department (IMD) Pune, organized a media workshop on 1st June 2023 at CRS, IMD, Pune. The workshop, titled "Enhancing Weather Reporting and Climate Communication," aimed to improve the role of media in delivering accurate weather and climate information. Journalists from Pune and Maharashtra, along with IMD scientists, discussed key topics such as the long-range monsoon forecast, IMD's new weather forecasting initiatives, and Maharashtra's observational network. The workshop fostered valuable interactions between media professionals and meteorology experts.

- A Stakeholder Consultation Workshop for establishing the National Framework for Climate Services in India (NFCS–India) was held from 5-6 October 2023, organized by IMD and co-hosted by Christ University at Lavasa, Pune. The event brought together experts from various central ministries, state governments, research organizations, industries, and NGOs to discuss the development of climate services in India. Key presentations and discussions focused on creating a coordinated framework, with the workshop concluding on a roadmap for sustainable implementation. The event was graced by Dr. M. Ravichandran, Secretary, MoES, and Dr. M. Mohapatra, Director General of Meteorology, IMD.

- IMSP published one recent online issues of Bulletin of IMSP April-December 2023 Vol 21 (10-12) on 21 February 2024. Compilation and Editing by Dr. Somnath Mahapatra. All BISMP Bulletins are available on the following sites. https://www.imdpune.gov.in/imsp/Bulletins/

- The annual Monsoon Workshop 2023 was held at IITM, Pune on 18th March 2024 and was organized jointly by IMSP in collaboration with IMD, IITM and Ocean Society of India. The event was attended by several notable scientists in the field of meteorology including Shree K.S. Hosalikar, Dr. Rupakumar Kolli, Dr. R. Krishnan, Dr. M. Mohapatra, Dr. Ajit Tyagi, Dr. R.R. Kelkar and Dr. Satyaban. The main agenda of this workshop was to discuss the large-scale and synoptic features of monsoon 2023, evaluate the performance of the seasonal forecasts. Along with this workshop also addressed the implications of distribution of 2023 south-west monsoon rainfall on the agriculture sector and hydrology. Further, the key aspects of north-east monsoon-2023 are also discussed. In this workshop, the **IMSP's new website** was launched with several new user-friendly features. https://imdpune.gov.in/imsp/

- A national symposium on "Understanding the Science of Heatwaves under the Warming Scenario and Challenges Ahead" was held on 19th March 2024, organized by the Indian Meteorological Society Pune Chapter (IMSP) in collaboration with IMD, IITM, and OSI. The event was attended by notable figures including Dr. M. Ravichandran, Secretary MoES, and Prof. Shekar Mande, Distinguished Professor, SPPU. It featured various sessions, including invited talks and a panel discussion on topics like the impacts of heatwaves, heat action plans, and the role of climate services. The symposium highlighted the need for multidisciplinary collaboration and capacity building to address heatwave-related challenges effectively.

- IMSP annual review meeting was held on 16th April 2024 at IITM, Pune. The agenda of this meeting to review of the Annual Monsoon workshop and national symposium on heatwaves. Suggestions for future IMSP annual monsoon workshops. Discuss the outcome of National symposium on heatwaves and discussion on IMS Pune chapter election for 2024-2026.

- IMSP in collaboration with Akashvani Pune, organized a program focused on sustainable development and lifestyle. This event, held on August 20-21, 2024, featured notable experts such as Dr. Medha Khole, Siddhesh Sakore, and Gaurang Lele, who spoke on topics related to climate sustainability, sustainable agriculture, and eco-friendly architecture. The event aimed to engage students from institutions like Fergusson College and Savitribai Phule Pune University through interactive sessions. This initiative, recorded and broadcast by Akashvani Pune, highlighted the important role of meteorology in promoting sustainability.

Reaching the Last Mile

The role of IMSP in reaching the last mile is evident through its efforts to provide weather and climate services to underserved communities. Farmers, in particular, benefit from IMSP's weather forecasts, which assist them in managing irrigation, improving crop yields, and protecting against extreme weather events such as droughts, floods, hailstorms etc. Additionally, IMSP effectively uses social media to communicate the latest nowcasts to urban populations, helping them make quick decisions regarding their daily outdoor activities.

IMSP plays a pivotal role in making meteorological science accessible and beneficial to the general public, especially underserved communities. Through a blend of educational initiatives, research, and real-time data dissemination, IMSP transforms complex meteorological information into actionable insights. By organizing lectures at academic institutions and partnering with NGOs, IMSP extends the reach of meteorological benefits to even the most remote and vulnerable communities.

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Summary of the Panel Discussion of the National Symposium on "Understanding the science of heatwaves under the warming scenario and challenges ahead", held on 19th March 2024 at Meghdoot Auditorium of IITM, Pune

Satyaban B. Ratna[1], Ananya Karmakar, Sandhya Jose, S. Lekshmi, K. S. Hosalikar, and Somnath Mahapatra

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A national symposium on "Understanding the science of heatwaves under the warming scenario and challenges ahead" was organized by Indian Meteorological Society Pune Chapter (IMSP) on 19th March 2024 at Meghdoot Auditorium of IITM Pune, in association with India Meteorological Department (IMD), Indian Institute of Tropical Meteorology (IITM) and Ocean Society of India (OSI). This symposium was followed by IMSP's Annual Monsoon Workshop held on 18th March 2024 at the same venue

IMSP members including many scientists, researchers, academicians & students as well as many distinguished guests, policy makers and media persons participated in this Symposium. The symposium included invited talks, contributed talks and poster presentations which covered various aspects of heatwaves such as economy, health, heat action plans, communications, mitigation and adaptation, etc. The details of the above has been summarized in the Proceedings of the Symposium which was released during the inaugural function of the symposium.

The inaugural function of the symposium was attended by (i) Dr. M. Ravichandran, Secretary, MoES (Online), (ii) Prof. Shekar Mande, Distinguished Professor, SPPU, (iii) Dr. Ajit Tyagi, President, SAMA, (iv) Dr. R. K. Kolli, President, IMS, (v) Dr. R. Krishnan, Director, IITM, (vi) Shri K. S. Hosalikar, Chairman, IMSP (Online), and (vii) Dr. Satyaban B Ratna, Secretary, IMSP (Picure-1). They released the proceedings of the symposium.

Picture 1: Distinguished guests (Online & offline) at the National symposium on heatwaves

Distinguished speakers of this National Symposium included Prof. Purnamita Dasgupta, Prof. S. C. Bhan, Prof. Rajashree Kotharkar, Dr. Roxy Mathew Koll, Dr. Abhiyant Tiwari, Prof. Mahaveer Golechha, Prof. Joy Monteiro and Mr. Sahidul Islam (**Picture-2**).

Picture 2: Distinguished Speakers (Online & offline) at National symposium on heatwaves

A group photograph of participants of the Symposium was taken near the entry of the Meghdoot Complex of IITM Pune (Picture-3)

Picture 3: Group Photograph of Participants at the National symposium on heatwaves

Panel Discussion:

As part of this National symposium, a panel discussion was conducted at the Meghdoot Auditorium, IITM, Pune in the presence of all the participants (Picture-4).

Picture 4: Panellist at the panel discussion in the National symposium on heatwaves

The panel consisted of the following members with expertise on various aspects of heatwaves:
Dr. Rupa Kumar Kolli, President, IMS, Pune;
Dr. R. Krishnan, Director, IITM, Pune;
Dr. S. C. Bhan, Scientist-G, IMD, Delhi;
Dr. (Mrs) Purnamita Dasgupta, Professor, IEG, Delhi; and
Dr. (Mrs) Rajashree Kotharkar, Professor, VNIT, Nagpur.

Dr. S. C. Bhan moderated the panel discussion session.

Summary of the Panel Discussion:

A brief summary of the panel discussion is follows:
The key topics for the panel discussion were introduced by Dr. Satyaban Bishoyi Ratna, Secretary, IMSP as listed below.
1. Importance of upscaling Heat Action Plan (HAP) and minimising the morbidity and mortality associated with heat waves.
2. Comprehensive assessment of the impacts of extreme heat, including data on health parameters.
3. How the National Framework for Climate Services (NFCS) could help in coordinating the efforts to minimize the negative impacts of extreme heat.

▪ Dr. Rajashree Kotharkar spoke on the topic of upscaling HAPs. She elaborated on the importance of focusing on identifying the vulnerable areas and implementing short-term HAPs. She emphasised the necessity of realising these plans in multiple cities of different climatic conditions, so as to identify the local thresholds. Once these thresholds are identified, she suggested extending the plans to other areas. Additionally, she highlighted the need for extensive capacity building of urban local bodies to achieve this goal.
▪ Dr R. Krishnan focused on the future of climate and how research can be utilised for societal applications. He emphasised the significance of developing various indices for heatwaves and

improving the long-term forecasting techniques. Further, he stressed the importance of using the AI-ML techniques to make projections about the future.

▪ Prof. Purnamita Dasgupta illustrated how heatwaves differentially impact the vulnerable and disadvantaged groups in the community. To quote an example, reducing the outdoor working hours, women have to face extra burden as it reduces the time for domestic engagement and increases domestic expenditures. She stressed on the importance of gearing up the health system itself for tackling the heatwave effects. Further she emphasised on the importance of investing in cross-disciplinary research, developing sensitive heat indices and collaborating on heatwave related work for reducing the effects of heatwaves.

▪ Discussing the question on how NFCS can help in the heat wave management system, Dr. Rupa Kumar Kolli highlighted its role in facilitating multidisciplinary collaboration, and noted that it is important to integrate traditional knowledge with the newly acquired knowledge and values. He also emphasised on the need for fine resolution data for a more realistic assessment of thermal environment within human settlements, suggesting the introduction of inexpensive and simple micrometeorological monitoring equipment in housing societies. To further reduce the gap between science and the general public, he stressed on using simplified language in science communications. An active audience interaction followed the panel discussion. Dr. S.C. Bhan addressed a question regarding India's position in reducing GHG emissions, highlighting that India ranks third in renewable energy usage. Additionally, he mentioned that four out of the ten Prime Ministerial missions are focused on climate change. Prof. Purnamita Dasgupta added that focusing on greening urban infrastructure, reducing pollution and encouraging afforestation could further improve India’s effort in fighting GHG emissions.

Suggestions from the media representative Mrs. Nidhi Jamwal included finding a common language in conveying science to the public and providing regular media training including vernacular media for climate-sensitive reporting. Expanding the focus from urban-centric discussion on heat waves to rural India was also recommended. Dr. Rajib Chattopadhyay noted that science doesn’t differentiate between urban and rural. However, community engagement for heatwave in rural areas is lacking and needs to be improved. Another query which was raised by the audience was whether our current scientific understanding helps us explain the small-scale variabilities, their sources or driving mechanisms, given high-resolution observations are available. Dr. Kotharkar responded that by using such small-scale information in urban areas and by getting information about the microclimate, risks can be assessed and mitigation measures can be planned in advance and the administrative bodies will get to know where to invest, which is important for urban development. Also, Dr. Kolli added the importance of proper guidance in placing sensors and keeping records of the metadata which helps to avoid any misguidance (such as the ones caused by placing sensors near any local heat sources) or narrows the representativeness of the data. This will make the high-resolution observation datasets more explainable scientifically. Dr. Bhan added that such observations together with the understanding of the urban geometry can help translate the model forecasts to weather warnings or alerts for operational purposes.

The following are the key points that emerged out of the panel discussion:

• Development of customised thresholds and indices is needed to characterise extreme heat for different regions and sectors;

• It is important to focus on awareness, education and capacity building including involving media to reduce the negative impacts of heatwaves. Also, traditional knowledge needs to be integrated with modern scientific knowledge while developing coping mechanisms in the present context;
• High-resolution data sets need to be generated for urban areas for heat island mapping.

The panel and the participants agreed on the following overarching recommendations:
a. Development of climate predictions and projections should be strengthened at regional and local levels to help the local stakeholders for more effective planning for adaptation and mitigation;
b. A more effective integrated approach by all Government agencies including MoES and all private players, industries, and societies like IMS, SAMA, OSI, Red Cross and many others together is needed to help in building the understanding and resilience in the country at the grassroots levels. Joint research proposals on heatwave science and impact assessment on various critical sectors including the socio-economic aspects should be encouraged;
c. National initiatives like NFCS India need to work for well-coordinated and sustained multidisciplinary interactions with all stakeholders including the media and the general public to take science to society, along with more field studies and surveys.

Felicitation of distinguished persons:

During the National Symposium, following 6 distinguished persons were felicitated by IMSP for their special services to IMS & IMSP for a long duration, and in recognition to their continued support to the society in various forms, science popularization activities, editing works & international representations (Picture-5).

Picture 5: Distinguished persons awarded at the National symposium on heatwaves

Following six distinguished persons were felicitated by IMSP:

1. **Dr. Rupa Kumar Kolli,** for his continued efforts for Indian Meteorological Society (IMS) and his contributions to strengthen the climate services in the country.

2. **Ms. Nidhi Jamwal,** for her continued efforts in bringing out media reports on climate and its socio-economic impacts especially in the rural India.
3. **Mr. Somnath Mahapatra,** for being Managing Editor of the Bulletin of IMSP since 2018, and his continuous support to IMSP for a long period of time.
4. **Mr. Sikandar M. Jamadar,** for his continuous support to IMSP and for contributing to science popularization activities in different forums over a long period of time.
5. **Dr. Rajib Chottopadhyay,** for his continuous support to IMSP and for contributing to science popularization activities in different forums.
6. **Dr. Satyaban Bishoi Ratna,** for representing as a member in the WCRP CLIVAR/ GEWEX Monsoons Panel and CLIVAR Climate Dynamics Panel.

IMSP congratulates the above distinguished persons and wish their active support during future activities of IMSP.

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Indian Monsoon: a poetic memoir

Supriyo Chakraborty[1]

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I am the Indian monsoon
One of the several nature's boon
In early June of every year
The Kerala coast, where I appear.

When temperature soars high in the month of May
The land gets hot while the oceans say
"I am cool, create the temperature gradient"
Initiate the westerly circulation, beginning a monsoon event.

Westerly winds stir, a dance they start
Circling, swirling, from ocean to heart
Monsoon awakens, raindrops descend
Life rejoices—the parched earth to men.

I carry my moisture from the Mascarene high
That crosses the equator and touches the sky
Thereby follows condensation and precipitation
Aided by abundant aerosol distribution.

I come down heavily on certain region
Over the Ghats in western India and places in Assam
The northern Bay of Bengal is my favourite choice

I can't help when others raise their voice.
Uneven distribution is a natural process
You may consider my principle a failure or a success
Apart from the space, I possess temporal variability
Meteorologists try to predict as per their capability.

They have devised means to study my characteristics
But I am more than mean ± sigma statistics
I am a force of life and death
I am a breath of hope and faith.

I feed the rivers, I fill the ponds
Land-ocean-atmosphere, I make the bonds
I can turn barren lands with awesome greens
They look like art on nature's screens.

I help CO_2 move from the atmosphere to vegetation
I can convert a desolate place into a lush creation
The lavish green and a spell of shower
Bring joy and romance to a pair of lovers.

I can make a peacock dance
In my rhythm, its feathers prance
I bring joy and sorrow to the land
I shape the culture and the sand.

Hundreds of poets got their inspiration
As I weave my liquid creation
The scientists and researchers have a different vision
Want to dissect me through their ‘Monsoon Mission’.

They produce graphs and explain my anomalous nature
Yet I dance, untamed, and show my feature

Sometime I burst from the clouds, throw my vent
You, the sufferer, call it an extreme event.

I am characterized by the monsoon trough
A low-pressure zone where winds converge and storms play rough
The low-pressure systems, my unique characteristics
Play havoc over the CMZ, altering rainfall statistics.

From the Bay of Bengal, they gather their might
Monsoon dancers in the sky, painting rainbows at night
Their winds whisper secrets, their clouds weave tales
A seasonal symphony, where every drop prevails.

Global variables like IOD and ENSO shape my distribution
NAO and the sea-ice pattern are my inspiration
The temperature gradient of the troposphere
Also contributes to my strong-weak feature.

I weave my distribution pattern anew
A consequence of fossil fuel's fiery hue
Should you want my serenity back
Seek the quietude where raindrops stack
Stop the emission, increase your green capacity
Maintain this planet's unique habitability.

Do not play with nature, do not tamper my gene
I will remain forever elusive and unseen
Whether you use a circulation model or fly a balloon
You can't unravel my mystery; I am the Indian monsoon.

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Special Quartets: An innovative new concept in Mathematic

Somnath Mahapatra[1]
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We know that in a group of 3 natural numbers (i.e., positive integers) "a", "b" & "c", if the square of the highest number "c" is equal to the sum of the squares of the other two numbers ("b" and "c"), then, they form a Pythagorean triple. Thus, a Pythagorean triple consists of three positive integers "a", "b", and "c", such that $(a^2 + b^2) = c^2$ … (1) (Wikipedia), and is commonly written as a triplet (a, b, c). This mathematical relation (1) can be referred as Pythagorean triple (PT) relation and has been very useful in various fields of Science and Technology, especially in Mathematics. Some well-known examples of Pythagorean triples are as follows: (3, 4, 5), because $(3)^2 + (4)^2 = 9 + 16 = 25 = (5)^2$
(5,12,13), because $(5)^2 + (12)^2 = 25 + 144 = 169 = (13)^2$
(8,15,17), because $(8)^2 + (15)^2 = 64 + 225 = 289 = (17)^2$ etc.

A primitive Pythagorean triple (PPT) is a Pythagorean triple (a, b, c), in which a, b and c are co-primes, i.e., highest common factor (HCF or GCD) of a, b, and c is 1 (Long, 1972; Romik, 2008; Kak and Prabhu, 2014; Wikipedia), thus they do not have any common factor other than 1. There are 16 primitive Pythagorean Triples (a, b, c) with c less than 100 (Wikipedia), these PPTs are (3,4,5), (5,12,13),(8,15,17), (7,24,25), (20,21,29),(12,35,37),(9,40,41),(28,45,53),(11,60,61), (16,63,65), (33,56,65),(48,55,73), (13,84,85), (36,77,85), (39,80,89), and (65,72,97).

Given a Primitive Pythagorean triple (a, b, c), its multiple (na, nb, nc) is also a Pythagorean triple, where n is a natural number, since $\{(na)^2 + (nb)^2\} = (nc)^2$. Thus, all multiples of the PPT (3, 4, 5), e.g., (6, 8, 10), (9, 12, 15), (12, 16, 20), (15, 20,25), etc. are also Pythagorean triples.

In recent past, some new triples (x, y, z) of 3 natural numbers are found, which show the mathematical relation: $x^2 + y^2 = z^2 + 1$ … (2), (very close to the PT relation), and was given the name "Almost Pythagorean Triples" (APT) (Frink Orrin, 2018).

I have found several Almost Pythagorean Triples (APT) in prime numbers for 3 prime numbers (a, p, t) which follow the relation $a^2 + p^2 = t^2 + 1$ … (3) (Mahapatra, Somnath, 2021). Some examples of such APTs in 3 prime numbers are (5,5,7), (7,11,13), (11,13,17), (13,19,23),(23,29,37),(13,41,43),(29,37,47),(31,43,53),(41,53,67),(43,59,73), (43,71,83), etc. where all these numbers are prime numbers. I have shown that their relation has very small percentage of deviation from PT relation (Mahapatra, Somnath, 2021).

Multiples of primitive APTs (or MAPTs) follow the relation $(A^2 + P^2) = (T^2 + m^2)$ … (4), where m is a natural number, and A = m a , P = m p , T = m t for the APT (a, p, t). For example, we can form MAPTs from the APT (7,11,13), like (14,22,26), (21,33,39), (28,44,52), etc. with multipliers (m) of 2, 3, 4, etc. and we can easily show that $14^2 + 22^2 = 26^2 + 2^2$; $21^2 + 33^2 = 39^2 + 3^2$; $28^2 + 44^2 = 52^2 + 4^2$; etc. It has been also shown that multiples of a primitive APT (MAPT) show same amount

of percentage of deviation (from PT relation) as the primitive APT. APTs and MAPTs can have several uses and applications in Mathematics and other fields of Science & Technology (Mahapatra, Somnath, 2021).

In this article, let me introduce a new concept of 4 natural numbers (a, b, c, d), which follow the relation: $(a^2 + b^2) = (c^2 + d^2)$

This set of 4 natural numbers (a, b, c, d) can be referred as "Special Quartet" (SQ) and Special Quartets will follow the relation: $(a^2 + b^2) = (c^2 + d^2)$ … (5)
The above relation (5) can be called SQ relation.

By investigation, we can have several examples Special Quartets (SQ), like:
(7, 24, 15, 20), because $(7)^2 + (24)^2 = 49+576 = 625 = 225+400 = (15)^2 + (20)^2$;
(16, 63, 33, 56), as $(16)^2 + (63)^2 = 256+3969 = 4225 = 1089 +3136 = (33)^2 + (56)^2$;
(13, 84, 36, 77), as $(13)^2 + (84)^2 = 169+7056 = 7225 = 1296+5929 = (36)^2 + (77)^2$
and many more.

Multiples of SQs (MSQs) also follow this relation $A^2 + B^2 = C^2 + D^2$ … (6)
where A = ma, B = mb, C = mc and D = md for SQ (a, b, c, d) and "m" is a natural number (multiplyer like 2 or 3 or 4 or 5, …). Thus, (7, 24, 15, 20) being a SQ, its multiples like (14, 48, 30, 40), (21, 72, 45, 60), (28, 96, 60, 80) etc. also follow the SQ relation.
Similarly, multiples of other SQs will also follow the SQ relation.

Again, if we consider the special case of d = 1 in SQ formula (5), so that $d^2 = 1$, then the relation (5) reduces to $a^2 + b^2 = c^2 + 1$ … (7) which is the same relation as the APT relation
as earlier given by $x^2 + y^2 = z^2+1$… (2), OR $a^2 + p^2 = t^2+1$ … (3).

Thus, APTs can be considered to generate SQs, where the fourth number "d" of the SQ is 1. Some of important examples are (10, 15, 18, 1), (20, 25, 32, 1), (25, 35, 43, 1), etc., these can be checked by following calculations:
(10, 15, 18, 1) as 100 + 225 = 325 = 324 +1
(20, 25, 32, 1) as 400 + 625 = 1025 =1024 + 1
(25, 35, 43, 1) as 625 + 1225 = 1850 = 1849 +1

Similarly, MAPTs, which follow the relation $(A^2 + P^2) = (T^2 + m^2)$ can be utilized to generate SQs (A, P, T, m). Thus, from earlier examples, we can have SQs like (7,11,13,1), (14, 22, 26, 2), (21, 33, 39, 3), (28, 44, 52, 4), etc. which follow the SQ relation given by $(a^2 + b^2) = (c^2 + d^2)$ … (5)

Applications:

Special Quartets comprise 4 natural numbers (a, b, c, d), which follow the special relation $(a^2 + b^2) = (c^2 + d^2)$. The concept of "Special Quartets" can be useful in Mathematics and other fields of Science & Technology. For example, in Geometry field of Mathematics, we can have a theorem stating that: "If the lengths of four sides of a quadrilateral, taken in order, are equal or proportional to the numbers of a Special Quartet (SQ), then the quadrilateral will be a Cyclic Quadrilateral". For proving this, let lengths of 4 sides of the Quadrilateral, taken in order, be "a", "b", "c" and "d",

which satisfy SQ relation, and let $(a^2 + b^2) = D^2$, where "D" can be rational or irrational, then $(c^2 + d^2)$ will also be D^2 as it follows the SQ relation: $(a^2 + b^2) = (c^2 + d^2)$.

Thus, we get $(a^2 + b^2) = D^2 = (c^2 + d^2)$. Then, as per Pythagorus Theorem, the angle between sides of lengths "a" and "b" will be right angle, as well as the angle between sides of lengths "c" and "d" will also be right angle. We know that semi-circular angle is a right angle. Thus, the above quadrilateral will be a Cyclic Quadrilateral having length of its Diameter "D". If there is no existing theorem like the above, then we can call it "Mahapatra Theorem".

Acknowledgements:

I sincerely dedicate this article in the memory of my beloved mother Late Smt. Bhawani Mahapatra, my first teacher who taught me dignity of life and protected & supported me with her love & affection. I sincerely thank Indian Institute of Tropical Meteorology (IITM) Pune and IMSP for their continued support, even after my superannuation. I am thankful to all authors in the reference list and to my cousin brother Dinabandhu Mahapatra (for his help). I also thank all sources of information & data used in this article.

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Western Disturbances

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Being in the tropics, broadly speaking, the winter over India is characterized by cool and dry weather. We all are aware that it snows over Himalayas in winter. For snowfall to occur, the presence of clouds is necessary. But where do these clouds come from after the monsoon has withdrawn from the subcontinent? The reason for this winter precipitation which is in the form of rain/snow over Himalayas and rain over parts of north Indian plains is the Western Disturbances (WDs).

What is a Western Disturbance (WD)?

The name itself suggests that it is a disturbance coming from the west i.e. the movement is mainly from west to east. Disturbance implies that it is characterized by disturbed weather which can be in the form of rain, snow, cloudiness and reduced pressure. WD is an extra-tropical system which means that it is a system which is observed beyond the tropics or beyond 23.5°N latitude.

WDs are sometimes also referred to as mid-latitude frontal systems in scientific terms. A Front is a boundary between two different air masses. WDs can be said to be a part of extra-tropical cyclones originating as mid-latitude frontal systems. These systems develop due to imbalance between the cold polar air and the warm tropical air. This difference is most pronounced during winters over mid-latitudes and hence the systems are strongest in this season. The stronger the north-south temperature gradient, the stronger a western disturbance can get provided additional conditions like moisture availability are satisfied.

Western Disturbances usually originate over the Mediterranean Sea or sometimes from as far as the Atlantic Ocean (in few cases, WDs are seen forming over the Caspian Sea as well). They travel eastwards across Iraq, Iran, Afghanistan and Pakistan, and finally enter north India and move away further eastwards (Figures 1 and 2). They ride over the subtropical westerly jet stream which is present at 200 mb pressure level (equivalent to 11.5-12 km altitude). A jet stream is a river-like current of air circulating across the globe at upper levels of the troposphere. A trough or dip in the jet stream is an indication of the presence of a disturbance. This trough in the jet stream can be seen from the weather charts as shown in Figure 3.

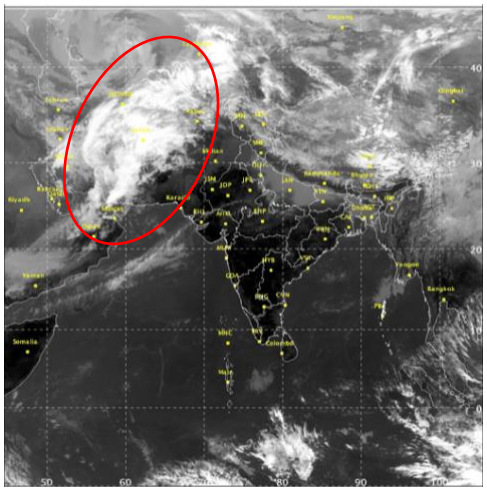

Figure 1: WD approaching India from the west.

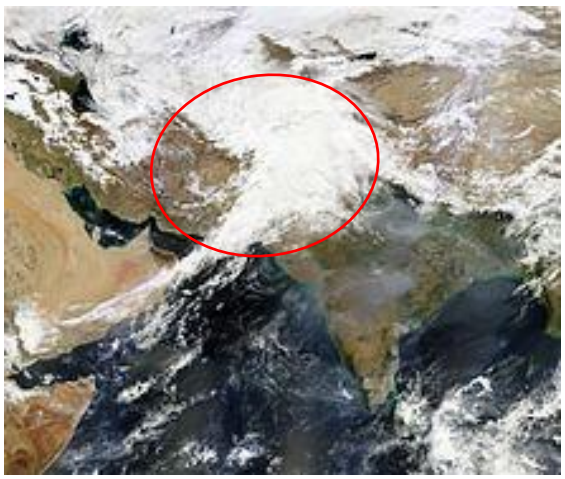

Figure 2: WD affecting north India.

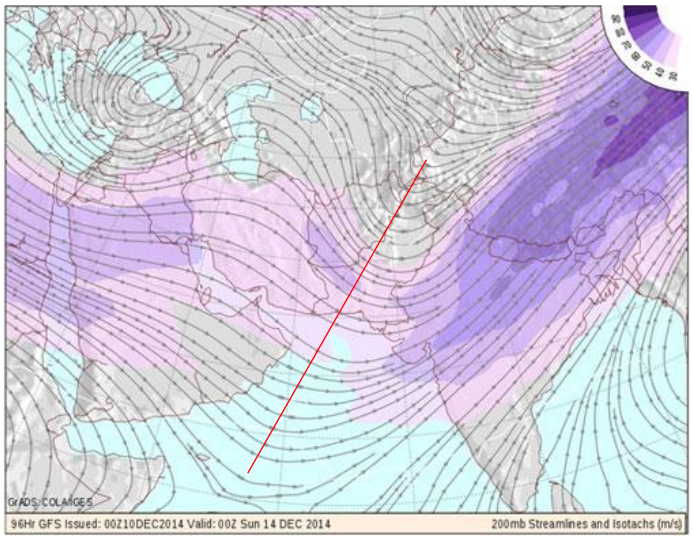

Figure 3: Trough in the westerly jet at 200 mb level (indicated by the red line).

Over north India, increased cloudiness and rise in the minimum temperature is an indication of an approaching western disturbance. Figure 4 shows the schematic of a WD, which denotes the wind features ahead and behind the approaching WD. At the surface and lower levels (up to around 700 mb i.e. approx. 3km altitude), winds turn southerly to southeasterly in the northern plains when a WD approaches (Figures 5 and 6). Initially high-level clouds (above 8km altitude) can be seen, followed by mid-level (clouds in 2 to 8 km height) and then low clouds (up to 2 km height) as well as thunderclouds which give rain (or at times even hail) over the plains of Punjab, Haryana, Rajasthan, west UP, Delhi-NCR and the foothills of Himalayas. The mid and upper reaches of Himalayas receive snowfall. To the south of the WD, there is often the presence of an induced low pressure area or a cyclonic circulation (anticlockwise rotation of winds) which is instrumental in bringing precipitation to the plains of north India. After moving eastwards from the Mediterranean, the main source of moisture for WDs is the Persian Gulf/Gulf of Oman and the Arabian Sea. The cloudy and rainy conditions over north India due to WDs result in the maximum temperatures remaining significantly below normal.

After the passage of a WD, the wind direction changes and cold northerly to northwesterly winds start blowing over the north Indian plains (Figures 7 and 8). The cold winds coupled with the availability of moisture in the air immediately after the passage of a WD often lead to the formation of widespread fog over the plains of north India. Such fog events are at times spread across hundreds of kilometers and very dense fog is observed up to eastern Gangetic plains along with northwest India. If dense fog persists throughout the day, then the maximum temperature over those regions remains significantly below normal leading to cold-day like conditions. The blowing of cold northerlies after the passage of WD drops the minimum temperature across much of northern, eastern and central India and can at times lead to cold wave conditions.

Thus, to summarize, the movement of a western disturbance across north India causes an inflow of warm and comparatively moist air from relatively southern latitudes ahead of the disturbance and of cold and dry air from relatively northern latitudes in the rear of the disturbance (as indicated in the illustration below). Occasionally, in the rear of a western disturbance there is an influx of markedly cold and dry air from much higher latitudes into northwest India and the adjoining regions, which spreads to other parts of the subcontinent as cold wave. Cold and dry winter like conditions return to most of the country until the weather is changed again by another approaching western disturbance.

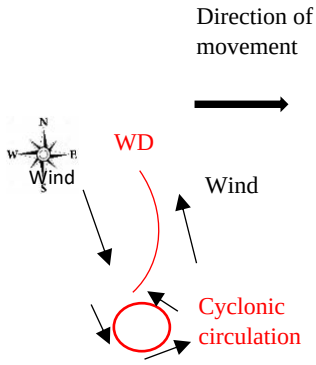

Figure 4: Schematic of a Western Disturbance.

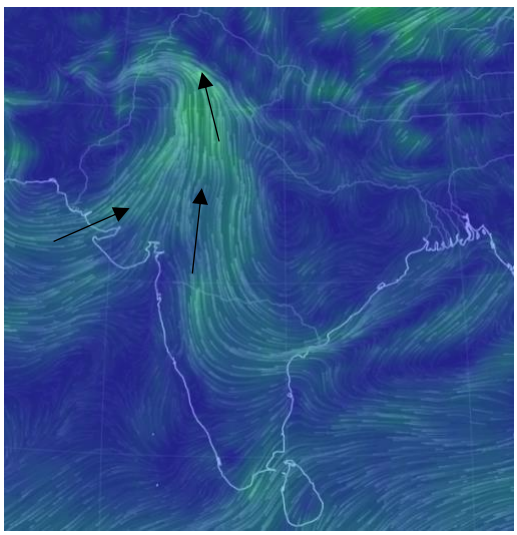

Figure 5: Winds at 850 mb when a WD is approaching.

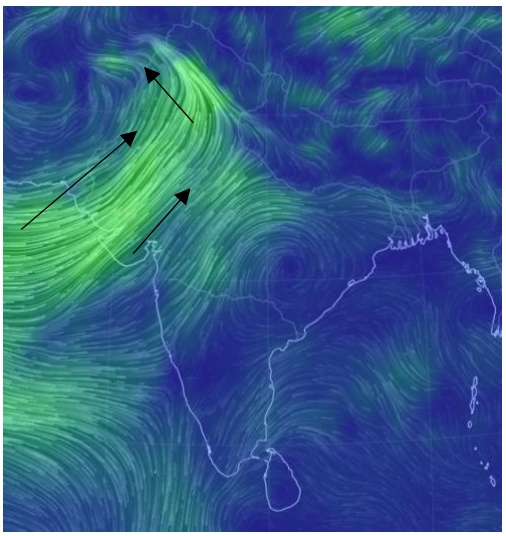

Figure 6: Winds at 700 mb when a WD is approaching.

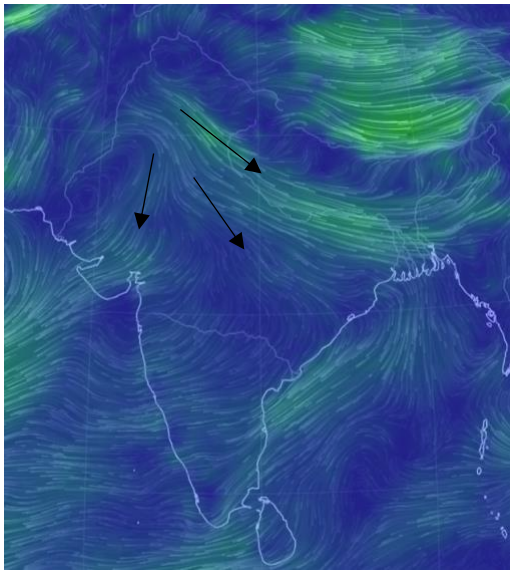

Figure 7: Winds at 850 mb after a WD has passed.

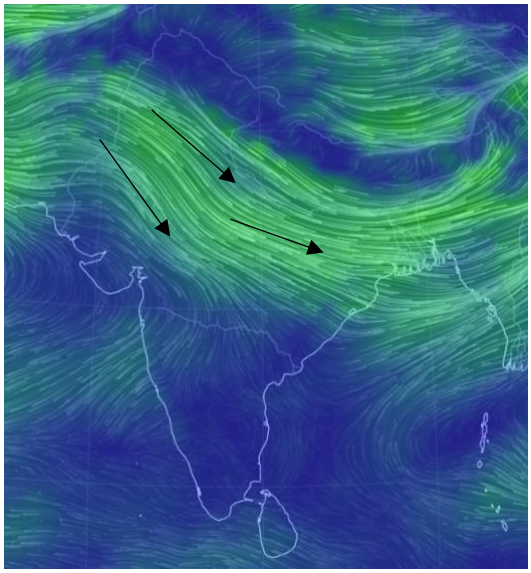

Figure 8: Winds at 700 mb after a WD has passed.

(850 millibar pressure level corresponds to around 1.5 km altitude above sea level and 700 millibar pressure level corresponds to around 3 km altitude above sea level)

Usefulness and adverse impacts of WDs:

The precipitation associated with western disturbances helps in the replenishment of Himalayan glaciers and in maintaining the snow cover. The snow over Himalayas is the source of water for the numerous perennial rivers flowing downstream towards northern plains of the country. In addition, the rainfall associated with WDs helps in retaining soil moisture as well as in the growth of rabi crops like wheat in Punjab, Haryana and UP. The rain also helps in cleansing the air of pollutants over the Delhi-NCR region and temporarily helps in improving the air quality. The continuous period of cold and dry weather is broken with the arrival of a WD.

However, very strong WDs with the westerly trough dipping to southern latitudes of Gujarat, Maharashtra and MP can cause widespread rain in these areas which can potentially damage the rabi crops in these regions. Also, strong WDs can lead to intense precipitation and hail which can be detrimental for crops. Late season WDs occurring in May-June can result in slight cooling of the northern plains of the Indian subcontinent and may delay the northward advancement of the Southwest Monsoon over the subcontinent. Also, if a WD approaches simultaneously with the advancing monsoon over north India, it can result in some areas receiving very heavy rain (one example of this is the Uttarakhand floods of June 2013).

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IMSP News

(1) Result of IMS Pune Chapter Election for the term 2024 - 2026

Dr. Samir Pokhrel performed the role of Returning Officer and Dr. Ashutosh Mishra performed the role of Assistant Returning Officer for conducting the IMS Pune Chapter Election for the 2-year term of 2024-26. During due procedure of the Election processes, they informed that they had received one nomination for each post, and there were no withdrawals of nominations. As a result, there was no need for an election, and all candidates were selected unopposed. They declared the names of the candidates, who have been selected as per the received nominations and congratulated the new members, and wished them all the best for their IMSP activities.

The following members were selected for the Executive Council of the IMS Pune Chapter for the year 2024-26:

Chairperson: Dr. Milind Mujumdar (IITM)

Secretary: Dr. Sabin TP. (IITM)

Joint Secretary: Dr. Satyaban Bishoyi Ratna (IMD)

Treasurer: Shri Jalindar Pandurang Sabale (IMD)

Council Members (8) :

- Dr. Suvarna S. Fadnavis (IITM)
- Dr. Avijith Dey (IITM)
- Dr. Rohini L. Bhawar (SPPU)
- Dr. B. Sudarshan Patro (IMD)
- Dr. Somnath Mahato (IMD)
- Shri Sunil Sahebrao Varpe (IMD)
- Ms. Shahenaz Mulla (IMD)
- Ms. Madhuri Musale (IMD)

On behalf of IMSP, we sincerely thank Dr. Samir Pokhrel and Dr. Ashutosh Mishra for kindly performing the role of Returning Officer and Assistant Returning Officer very efficiently, and our heartiest congratulations to all elected persons in the new Executive Council of the IMS Pune Chapter for the year 2024-26.

(2) International Visibility of Bulletin of IMSP:

Ms. Viji Chandran, Acquisitions Librarian of the United States Library of Congress New Delhi India Office, (situated at American Center, 23 Kasturba Gandhi Marg, New Delhi - 110001), visited Pune during 26-29 February 2024 for her official work related to collection of printed copies (hardcopies) of some publications. She visited IITM Pune on 27th and 28th February 2024. On 27th February, she met Smt. Shompa Das, the In- Charge of LIP (Library Information &

Publication) Division and informed her that she was very interested to obtain hardcopies of BIMSP issues for last 6 years (2018 to 2023). In this connection, she met Mr. Somnath Mahapatra and discussed with him about various publications of Bulletin of IMS Pune Chapter (BIMSP). Mr. S. Mahapatra told her that BIMSP issues are generally prepared online and are uploaded at IMSP website for visualization of IMS members and other interested persons. Only, in special cases, when any BIMSP issue is released in an important function, few hard copies of that particular issue are printed. On her special request, Mr. Somnath Mahapatra gifted Ms. Viji Chandran a hard copy of the April to September 2023 issue of BIMSP (vol. 22, No. 4-9), as it was released in a function at the Prof. Pisharoty Conference Hall of IITM on 16th February 2024 by Director IITM, Chairman IMSP and other dignitaries, and one copy of this issue was available with him. Ms. Viji Chandran told that she will keep it properly in her library. She also attended the scientific lecture by Mr. S. Mahapatra on various scientific activities of IITM, delivered 28th February 2024, on the occasion of "National Science Day" celebration of IITM Pune. On behalf of IMSP, we thank Ms. Viji Chandran (E-mail: cvij@loc.gov) for her visit to IITM Pune and taking keen interest in Bulletin of IMSP.

(3) Membership drive for adding more members to the IMS:

Scientists, researchers, PG students and persons interested in Meteorology/Atmospheric Sciences/Allied Sciences, if not still a member of Indian Meteorological Society (IMS), can become a Life Member of IMS through submission of the Application Form (directly or online submission of the scanned copy of the duly completed application form) along with the required fee (preferably, through online transfer to the given Bank account. Become a Life Member (LM) of IMS, "Application Form for IMS LM Enrolment" is provided in Pages 30-31 of this Bulletin.

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INDIAN METEOROLOGICAL SOCIETY

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7. Profession and present appointment

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9. Date of Birth

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11. Professional Record (appointments held)

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13. Member of Societies and Institutions:

14. Amount paid as Membership fee:

I hereby declare that I shall abide by the Statutes and Regulations of the Society and offer my co-operation in promoting its objectives:

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References

Name	Designation	Email	Mobile No.
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