Bio-Data

1.	**Name**	**Dr. MRUTYUNJAY MOHAPATRA**
2.	**Date of Birth**	**12th August, 1965**
3.	**Present Affiliation**	**Director General of Meteorology,** **India Meteorological Department,** **Permanent Representative of India to WMO** **3rd Vice President of WMO**
4.	**Phone**	**011-24611842**
5.	**Email**	**India Meteorological Department,** **Mausam Bhawan, Lodi Road, New Delhi-110003** **Mobile No. 91-8826354400, 91-9868623475,** **E-Mail: mohapatraimd@gmail.com** **m.mohapatra@imd.gov.in**
6.	**Educational Qualification**	**M. Sc. (Physics) and Ph.D. (Physics)**
7.	**Professional Training details**	

Organization	Period		Details of Training
	From	To	
IMD, Pune	20 Oct. 1992	19 Oct.1993	Meteorologist Gr II Training on General Meteorology (Weather forecasting)
IMD, New Delhi	12 Sep. 1994	23 Sep. 1994	Advance Refresher Course on Satellite and Radar input for cyclone warning
IMD, Pune	15Jan. 1996	19 Jan. 1996	Advance Refresher Course on Long Range Forecasting and Climate Change
Centre for Atmospheric Sciences, IIT, Delhi	08 Apr. 2002	04 May 2002	Third SERC School on Numerical Weather Prediction (NWP) on Parameterisation of physical processes
-Do-	14 Apr. 2003	10 May 2003	Fourth SERC School on NWP on Process modeling
Central Water Commission, Govt. of India, Bhubaneswar	9 Nov. 2003	13 Nov. 2003	Training workshop on 'Design Flood Estimation for Water Resources Projects'
Administrative Staff College of India, Hyderabad	01 Aug. 2005	09 Sep. 2005	Advanced Techno-Management programme for Scientists and Technologists on Various theoretical aspects of management
Meteo-France and Meteo-France International, Toulouse, France	31 Aug. 2009	25 Sep. 2009	Weather forecasting for IMD and Synergie System Forecasters Factory Training on Application of satellite, radar and NWP in weather forecasting, nowcasting and heavy rainfall warning
NationalHurricane Center (NHC), NOAA, Miami, Florida, USA	21 Mar. 2011	01 Apr. 2011	RA IV Training Workshop on Hurricane Forecasting and Warning and Public Weather Services

8.	**Employment records (in chronological order starting with the first job)**		
	Name and address of	Period	Details including designation and responsibility area

	employer/institution				
		From	To	Designation of post held	Responsibility area
	Interim Test Range (ITR), Defence Research and Development Organisation (DRDO), Chandipur, Orissa	29. 02. 1988	04. 03. 1990	Junior Scientific Assistant II and I,	Fiber Optic Communication and Data Management
	D. K. College, Jaleswar, Balasore, Orissa	05. 03. 1990	17. 10. 1992	Lecturer in Physics,	Teaching in undergraduate classes
	India Meteorological Department (IMD), Pune	20. 10. 1992	19. 10. 1993	Meteorologist Gr. II Trainee	Training
	Meteorological Centre, and Agromet Research Unit, IMD, Bangalore	20. 10. 1993	14.06. 1998	Meteorologist Gr.II	Weather forecasting, Climatology, Aviation Meteorology, Agrometeorology
	Meteorological Centre, IMD, Bhubaneswar	15. 06. 1998	09.12. 1998	Meteorologist Gr. II	Weather forecasting and Cyclone Warning, Climatology, Aviation Meteorology
	Meteorological Centre, IMD, Bhubaneswar	10. 12. 1998	22.02. 2004	Meteorologist Gr. I	Weather forecasting and Cyclone Warning, Climatology, Aviation Meteorology
	Regional Meteorological Centre, IMD, Guwahati	23. 02. 2004	16. 10. 2005	Director	Weather forecasting, Climatology, Aviation Meteorology
	National Weather Forecasting Centre (NWFC) IMD, New Delhi	17. 10. 2005	30. 06. 2010	Director	Weather forecasting and Cyclone Warning,
	NWFC, IMD, New Delhi	01.07. 2010	30.06. 2015	Scientist-E	Weather forecasting and Cyclone Warning, Disaster management.
	NWFC IMD, New Delhi	01.07. 2015	28. 01. 2016	Scientist-F	Weather forecasting, Numerical Weather prediction (NWP) & Cyclone Warning, Disaster management
	IMD New Delhi	29.01. 2016	31.07. 2019	Scientist-G	Weather forecasting, Numerical Weather prediction (NWP) and Severe weather warning, Disaster management
	IMD New Delhi	01.08. 2019	Till date	Director General of Meteorology	Upgradation and enhancement of observational, communicational, computing, modeling, forecasting & warning dissemination infrastructure for growth of meteorology & weather/climate services, National and international collaboration & progammes execution

9.	Details of research work and publication.	Research work and scientific publications are mainly based on weather forecasting and cyclone warning including (i) Cyclonic disturbances, (ii) Monsoonal low pressure systems, (iii)Heavy rainfall, (iv) Thunderstorm and (v) Forecast verification • **Papers published in journals:166** (National=85, International=81) • **Proceedings in Symposiums/Workshops/Conference:26** (National = 11, International = 15) • **Publication in Books:43** (National=17, International = 26) • **Books edited: 20**(National = 5, International = 15) • **Journals edited: 08** (National = 4, International = 4) •**Journals/Books reviewed:18** National=4, International=14) Details of research work and publications are given in **Enclosure – I** **H-Index:34, I_{10}=98, Total Citations: 5587**
10.	**Specialization**	Specialization in (i) Weather forecasting Services (**Enclosure II)** (ii) Project/Programme Management: No. of Projects dealt**: 7 (Enclosure II)** (iii) Research & Development: (**Enclosure I)** (iv) General Administration & Management: Worked as (a) Head, Regional Specialised Meteorological Centre-Tropical Cyclone (RSMC) since 2008 (b) Head (Numerical Weather Prediction Division) during 2015-16 and 2018 onwards (c) Head (Services) 29 January 2016 to 31 July 2019 (d) Head of Regional Subproject Management Team of Severe weather Forecasting Demonstration Project (SWFDP)-Bay of Bengal (e) Looked after duties of Director General of Meteorology, IMD on many occasions during leave/tour of DGM (From Feb.,2016 to July 2019) (v) Capacity Building of IMD, MoES & WMO/ESCAP Panel region, RA II region and South Asia through: • Organising National/International Trainings: 23Trainings programmes • Organising National/International Workshops: • **11** Workshops/ conferences conducted • Delivery of **92** invited lectures during 2009-21**.** • Delivery of **47** assigned talks during 2009-21, • Delivery of more than **128** popular lectures, • Writing of popular articles • Development of **6** Movies on IMD. • Interviews to press & electronic media on weather and climate
11.	**Major Contribution**	(a) Contribution to Science (Given in **Enclosure IIIa**) (b) Contribution to Society (Given in **Enclosure IIIb**)
12.	**Membership of Societies**	(i) President of Indian Meteorological Society (2020-2022) (ii) Vice-President, Indian Meteorological Society (2016-18) (iii) Life Member, Indian Meteorological Society (iv) Life Member, Administrative Staff College of India Society (v) Life Member, Indian Climate Congress.

13.	**Details of awards and recognitions received**	**(a) Awards earned (40)** **International Awards (2):** 1) United Nations Sasakawa Award-2025 for Disaster Risk Reduction 2) Scientific and Technological Activities Commission Outstanding Service Award, 2025 by American Meteorological Society **National Awards (36):** 3) National Awards For E-Governance (NAeG)-2025 for development of Multi Hazard Early Warning Decision Support System 4) Honorary Doctor of Science (D.Sc.), 2024 from Utkal University, Bhubaneswar, India 5) Honorary D. Sc., 2024 from Maharaja Chattrasal Bundelkhand University, Madhya Pradesh, India. 6) Honorary D.Sc. from OUAT University, Bhubaneswar, Odisha-2022 7) Honorary D.Sc. from FM University, Balasore, Odisha-2020 8) Honorary D.Sc. from Kalinga Institute of Industrial Technology (KIIT), Bhubaneswar, Odisha-2020 9) Fellow, Indian Meteorological Society, 2019 10) Certificate of Merit for Young Scientist Award – 2008 by Ministry of Earth Sciences, for outstanding contribution in the field of atmospheric science and technology. 11) 25th Biennial Mausam Award (2008-2009) for the paper, published in MAUSAM 12) 31st Biennial Mausam Award (2020-21) for the paper published in MAUSAM 13) Achiever's Award-2013 for excellence in cyclone warning services to Cyclone Warning Division from India Meteorological Department 14) Prananath Samman Award by Prananath College, Odisha in 2025 15) Sir Radhanath Sikdar Memorial Award 2025 by Radhanath Sikdar Institute of Geospatial Science & Technology 16) Ekamrashree Award by Ekamra Sanskrutika Prakashani, Bhubaneswar on 26th February 2025 on the eve of Mahashivratri. February 2025 17) Dr. Sabuj Sahoo Memorial Lifetime Achievement Award by Society for Agricultural Research and Management (SARM) in 2022 18) Bharat Gaurav Award-2019 by Jai Bharat Foundation, Cuttack Odisha 19) Vyasagourab Samman-2022 by Fakir Mohan University 20) Environment & Societal Development Association (ESDA) Environmental Excellence Award-2022 during World Environment Summit 2022 21) Pride of India Award 2022 by South Asian Institute for Advanced Research and Development, Kolkata 22) Most Inspirational Personality Award 2022 by the Interview Times, Bhubaneswar 23) Shrikshetra Samman-2022 by NGO Shree Shrikshetra Soochna, Odisha 24) Showcase Odisha Award-6th Edition, 2021 by PNV Group for contribution in improvement of cyclone warning services. 25) Felicitation by Sh. Naveen Pattanaik, Chief Minister, Odisha for outstanding contribution in disaster management 26) Satyasai Samman-2019 by Satyasai Charitable and Education Trust, Odisha for distinguished contribution in cyclone forecasting and

		meteorological applications 27) Fellow Indian Climate Congress, 2019 28) Bhumiputra Samman 2020 by the Biplbi Beera Chakradhar Smruti Sansad, Ghanteswar, Odisha for Cyclone Warning Services 29) Commendation Certificates-2019 and 2020 from various organizations for prediction of cyclone 30) Ganatantrik Nagarik Parishad, Bhadrak Odisha 31) Zila Biju Smriti Committee, Bhadrak Odisha 32) Odisha Forum, New Delhi 33) Retired Employees Association, Bhadrak, Odisha 34) Felicitation by Utkal University in recognition to cyclone warning services-2020 35) Felicitation by Berhampur University, Odisha for excellence in cyclone warning services-2021 36) Felicitation by Sambalpur, University, Odisha in 2022 37) Felicitation by Reva University, Bengaluru in 2023 38) Commendation certificate in 1989 from Defence Research & Development Organisation for contribution to Integrated Guided Missile Development Programme **Awards earned for IMD (2):** 39) World Congress of Disaster Management (WCDM) Disaster Risk Reduction (DRR) Award, 2022 40) ICHL 2013 Award for Excellence in Humanitarian Action for early warning services during cyclone Phailin in 2013 **b) Appreciations:** 1) Appreciations received for improvement in cyclone and other severe weather warning services a. Appreciations received globally and nationally from government and non- government agencies including WMO, NDRF, IAF, State Govts for successful predicting of cyclones during 2013-2020 b. Publications in leading TV/News Papers of India highlighting the role of Dr M Mohapatra in improvement of cyclone warning services c. Documentary/interview in TV and Newspapers on life and achievements of Dr M Mohapatra 2) Appreciations from WMO, NIDM, IMD for official publications 3) Appreciations from WMO, IMD for delivering and organizing lectures, conference/workshop. **c) Recognitions:** **(i) Chairman/Head of International Committees (10)** 1) **3rd Vice President of World Meteorological Organisation 2023-27** 2) **Secretary** WMO/ESCAP Panel on Tropical Cyclones 2024-27 3) **Co-Chair** Joint Commission Board (JCB) of WMO and Inter-governmental Oceanographic Commission (IOC) 4) Chairman, WMO/ESCAP Panel on Tropical Cyclones for 2017- 18. 5) Chairman, Regional Sub-project Management Team of Severe Weather Forecast Programme for South Asia 6) Chairman, WMO Task Team for coordination of activities in Regional Association II (Asia) 7) Chairman, Executive Council, South Asia Hydrometeorological Forum 8) Chairman of International Committee of WMO for selection of Väisälä Award-2021 for an Outstanding Research Paper on

		Instruments and Methods of Observation 9) Chairman, WMO RA II task Team for review of regional partnership and sub-regional cooperation (TT-RP) 10) Rapporteur of WMO/ESCAP member countries for preparation of TC names **(ii) Expert Member of the International Committees (13)** 1) Permanent Representative of India to WMO from June, 2019 2) Member Executive Council, WMO with effect from June, 2019-27 3) Member of International Meteorological organization (IMO) Committee for selection of IMO Prize 2021 4) Evaluation Committee for International Meteorological Organisation (IMO) Prize 5) WMO Committee for selection of Vaisala Award-2021 6) Member, WMO Technical Coordination Committee 7) Storm Surge India (SSI) group under the auspices of Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) since 2009 8) International Organising Committee (IOC) of WMO's 8th and 9th International Workshop on Tropical Cyclones (IWTC-9), 2014 and 2018 and WMO's 3rd and 4th International Workshop on Tropical Cyclone Landfall Processes (IWTCLP-4), 2014 and 2017 9) WMO's Tropical Cyclone Panel: Climate impact on TC. 10) WMO Commission for Climatology (CCl): Weather and Climate Extremes evaluation committee for Weather Mortality extremes. 11) WMO Executive Council of Panel of Experts on Polar and High Mountain Observations, Research Services (EC-PHORS) 12) WMO Committee for deciding mortality extremes due to severe weather events. 13) WMO Committee for selection of Young Scientist Award **Chairman of National Committees (8)** 1) President, Indian Meteorological Society since 2020, 2) Vice President of Indian Meteorological Society during 2017-18 3) Chairman, Project Review Board of National Institute of Ocean Technology 4) Chairman, Task Team for finalization of Meteorological Payloads of INSAT-4 satellites 5) Chairman, MoES Committee for development of Thunderstorm Prediction System in 2018 6) Chairman, Indian National Academy of Engineering (INAE) peer committee for technological preparedness to avoid national disruptions (weather and water related disasters) 7) Chairman, Committee for revision of NDMA Guidelines for cyclone management in 2016, 8) Chairman, Technical Evaluation Committee for Consultancy on National Cyclone Risk Mitigation Project **(iv)Expert Member of the National Committee (26)** 1) Committee by National Disaster Management Authority (NDMA), Government of India for preparation of Cyclone Hazard Prone Districts of India. 2) Committee by Ministry of Home Affairs, Govt. of India for preparation of Blue Book on lessons learnt on management of

		cyclones. 3) Management Committee to review the progress/functioning of existing Research Chairs established in IITs/NITs on Climate Change 4) Committee for development of Chennai Flood warning System 5) Expert Member from MoES for the Bureau of Standards Smart City 6) Sub-committee for Atmospheric Applications and Research for better coordination between ISRO/DOS and ESSO-MoES in enhancing satellite data utilization for weather and climate. 7) Committee constituted by Central Electricity Authority to study the causes of frequent failures of transmission towers and sub-station equipment in and around Agra region 8) Cauvery Water Regulation Committee constituted by Ministry of Water Resources 9) Committee constituted by NDMA for preparation of Guidelines on Thunderstorms, Squall and Lightning. 10) Management Committee and Chairman of the sub-committee on "Short and Medium range Forecast" for development of Monsoon Mission Products website and Mobile App. 11) Cyclone Resistant Structure Sectional Committee (CED-57), Bureau of Indian Standards for development of guidelines for design and construction of Cyclone Shelters/Tsunami Shelters. 12) Steering Committee, Common Alert Protocol(CAP) project of NDMA 13) Research Advisory Committee of INCOIS to provide guidance for scientific research & technical activities at INCOIS during 2015-19 14) National Coordination Committee for Polar Science Programme 15) Monsoon Mission Programme, Ministry of Earth Sciences 16) Governing Council, Indian Institute of Tropical Meteorology, Pune 17) National Water Development Authority, Ministry of Jal Shakti 18) National Maritime Search and Rescue Board 19) Peer Committee constituted by Indian National Academy of Engineering for technological preparedness for dealing with national disruptions. 20) Research Advisory Committee, Indian National Centre for Ocean Information Services (INCOIS), Hyderabad 21) Research Advisory Committee, National Centre for Medium Range Weather Forecasting, Noida 22) Research Advisory Committee, National Centre for Coastal Research (NCCR), Chennai 23) Research Advisory Committee, SAMEER, MEITY, Govt. of India 24) Advisory Committee in the Centre for Ocean, Rivers, Atmosphere and Land Sciences (CORALS), IIT, Kharagpur 25) Expert member of Selection Committee for Young Scientist Award-2021 given by MoES 26) Expert Member, Board of Governors of IIIT Vadodara, August, 2022 under category 'Eminent person out of research laboratories". **(v) Recognition as Guide for research** **(i)** Recognised as Guide for Ph. D work in (a) Banaras Hindu University, (b) Amity University, Gurgaon, (c) Amity University, Noida, (d) IIT, Delhi, (e) Andhra University **(ii)** Ph.D. Awarded/submitted: 2 and Continuing: 8 **(iii)Ph. D. Examiner** in 8 Universities/Institutes

Enclosure I: Publications and Research & Development

(a) Papers published in reviewed national and international journals (166)

1. A Kumar, **M Mohapatra**, A Chauhan, G Kumar, 2025, Assessment of Radar-Derived Wind Profiles in Comparison with Radiosonde Wind Observations Over Delhi, India, Journal of the Indian Society of Remote Sensing, 1-16
2. **Mrutyunjay Mohapatra** and M. Sharma, 2025, Cyclone Warning System in India: A journey of success over 25 years, Weather and Forecasting, Accepted
3. M. Sharma, **M. Mohapatra** and P Suneetha, 2025, Evaluation of operational extended range forecast of cyclogenesis over the North Indian Ocean, TCRR, Accepted
4. Litta A. J., **M. Mohapatra**, M. Sharma and Daisuke Abe, 2025, Tornado associated with Very Severe Cyclonic Storm "YAAS" over West Bengal on 25 May 2021, Mausam
5. Soma Sen Roy, Kavita Navria, Anshul Chauhan, Pradeep Sharma, Shikha Verma, Harshit Shukla, KC Saikrishnan, Sankar Nath, **M Mohapatra**, A method for automatic verification of thunderstorm nowcasts, 2025, Journal of Earth System Science, 134 (1), 1-16
6. A Madhulatha, Ashok Kumar Das, SC Bhan, **M Mohapatra**, DS Pai, DR Pattanaik, P Mukhopadhyay, Feasibility of model output statistics (MOS) for improving the quantitative precipitation forecasts of IMD GFS model, 2025, Journal of Hydrology, 649, 132-454
7. P Goyal, C Jena, A Kumar, VK Soni, **M Mohapatra**, Identification of aerosol and meteorological parameters threshold for visibility conditions over Delhi city, 2025, Atmospheric Pollution Research, 16 (2), 102-373
8. SS Roy, **M Mohapatra**, Evolution of thunderstorm monitoring & Forecasting in India, 2025, MAUSAM 76 (1), 317-328
9. **M Mohapatra**, M Sharma and Dr Pattanaik, Evolution of Cyclone Monitoring and Forecasting System in India: A review, 2025, MAUSAM, 76 (1), 103-124
10. UC Mohanty, Raghu Nadimpalli, Akhil Srivastava, Ananda K Das, Krishna K Osuri, Ashish Routray, Sudheer Joseph, PLN Murty, Dr Pattanaik, SG Gopalakrishnan, Dev Niyogi, **M Mohapatra**, A Journey Through Time The History of Mesoscale Severe Weather Monitoring and Forecasting in India, 2025, MAUSAM 76 (1), 79-102
11. **M Mohapatra**, A Srivastava, R Nadimpalli, N Kumar, Evolution of Heat Wave Monitoring and Forecasting in India, 2025, MAUSAM 76 (1), 303-316
12. PR Naskar, **M Mohapatra**, GP Singh, Variations in air-sea heat fluxes over the North Indian Ocean in recent period, 2025, Meteorology and Atmospheric Physics 137 (1), 11
13. KS Hosalikar, P Mukhopadhyay, S Sen Roy, SD Pawar, S Zacharia, Shijo Zacharia, Priya Kumari, S. K. Muppa, **M. Mohapatra**, Unfolding the mechanisms of the development of thunderstorms over eastern India: THUNDER-F field experiment, 2024, Journal of Earth System Science 133 (4), 1-18
14. PR Naskar, GP Singh, **M Mohapatra**, Association of air sea heat fluxes with tropical cyclones, intensity, energy and destructiveness, 2024, Meteorology and Atmospheric Physics 136 (6), 1-10
15. A Srivastava, P Kumar, SK Panda, AK Das, DR Pattanaik, **M Mohapatra**, Development of India Meteorological Department: High Resolution Rapid Refresh (IMD-HRRR) Modelling System for Very Short Range Weather Forecasting, 2024, Pure and Applied Geophysics 181 (11), 3393-3408
16. CR Khadke, **M Mohapatra**, N Nandwani, Satellite based analysis of rapid intensification of Super Cyclone Amphan, 2024, MAUSAM 75 (4), 1031-1038
17. T Sharma, SB Ratna, DS Pai, A Bandgar, M Rajeevan, **M Mohapatra**, Indian summer monsoon rainfall response to two distinct evolutions of La Niña events, 2024, International Journal of Climatology 44 (12), 4405-4427
18. Bipin Kumar, Hrishikesh Haral, MCR Kalapureddy, Bhupendra Bahadur Singh, Sanjay Yadav, Rajib Chattopadhyay, DR Pattanaik, Suryachandra A Rao, **Mrutyunjay Mohapatra**, Utilizing deep learning for near real-time rainfall forecasting based on Radar data, 2024, Physics and Chemistry of the Earth, Parts A/B/C 135, 103600

19. Sundar Ranganathan, Robert A Weller, Ramasamy Venkatesan, Amit Tandon, M Arul Muthiah, **Mrutyunjay Mohapatra**, Performance of Moored Real-Time Ocean Observations During Cyclones in the Bay of Bengal, 2024, Marine Technology Society Journal 58 (3), 56-69
20. SD Kotal, **M Mohapatra** , An analysis of minimum potential visibility and forecasting of fog for Indira Gandhi International Airport, New Delhi (India), 2024, Natural Hazards, 1-44
21. PR Naskar, **M Mohapatra**, GP Singh, CMIP6 projections of surface latent heat flux over the North Indian Ocean, 2024, Theoretical and Applied Climatology 155 (8), 8067-8076
22. S Prakash, DS Pai, **M Mohapatra**, Meteorological Sub-Divisional Scale Comparison Between Two Indian Rain Gauge-Based Rainfall Datasets for the Southwest Monsoon Season, 2024, Pure and Applied Geophysics 181 (8), 2613-2630
23. Satyaban B Ratna, CT Sabeerali, Tanu Sharma, DS Pai, **M Mohapatra**, 2024, Combined influence of El Niño, IOD and MJO on the Indian Summer Monsoon Rainfall: Case Study for the years 1997 and 2015, Atmospheric Research
24. Nadao Kohno, Cody Fritz, Monica Sharma, Robbie Berg, Diana Greenslade, Devon Telford, Sakeasi Rabitu, PLN Murty, **M Mohapatra**, Maria Cristina C Uson, 2024, TCRR,
25. Pravat Rabi Naskar, **Mrutyunjay Mohapatra**, Gyan Prakash Singh, Umasankar Das, 2024, Spatiotemporal variations of UTCI based discomfort over India, 133(1), pp 47
26. Yerni Srinivas Nekkali, Krishna Kishore Osuri, **M Mohapatra**, 2024, Physical understanding of the tropical cyclone intensity and size relations over the North Indian Ocean, Climate Dynamics, pp 1-14
27. **Mrutyunjay Mohapatra**, 2024, Climate and Weather Forewarning Systems for Disaster Preparedness and Response, Disaster Risk and Management Under Climate Change, Springer, pp 39-54
28. Bhanu Magotra, Ved Prakash, Manabendra Saharia, Augusto Getirana, Sujay Kumar, Rohit Pradhan, CT Dhanya, Balaji Rajagopalan, Raghavendra P Singh, Ayush Pandey, **Mrutyunjay Mohapatra**, 2024, Towards an Indian land data assimilation system (ILDAS): A coupled hydrologic-hydraulic system for water balance assessments, Journal of Hydrology, 629
29. Satya Prakash, **M Mohapatra**, 2024, Vertical structure of tropical cyclone precipitation over the North Indian Ocean: a space borne precipitation radar perspective, Remote Sensing Letters, 17(1), pp77
30. Satyaban B Ratna, CT Sabeerali, Tanu Sharma, DS Pai, **M Mohapatra**, 2024, Combined influence of El Niño, IOD and MJO on the Indian Summer Monsoon Rainfall: Case Study for the years 1997 and 2015, Atmospheric Research
31. SD Sanap, **M Mohapatra**, DR Pattanaik, S Sunitha Devi, Satendra Kumar, A Kashyapi, 2024, Arctic–midlatitude–tropics interactions in January 2020: linkages to precipitation extremes over Indian region, Meteorology and Atmospheric Physics, 136(1)
32. KK Hon, Robert Ballard, Eric Blake, Steph Bond, Robb Gile, Daniel Halperin, Charles Helms, Hoang Lam, Xinyan Lyu, **Mrutyunjay Mohapatra**, Monica Sharma, Akira Shimokobe, Ralf Toumi, Seonghee Won, 2023, Recent Advances in Operational Tropical Cyclone Genesis Forecast, TCRR
33. Radhika Kanase, Snehlata Tirkey, Medha Deshpande, R Phani Murali Krishna, CJ Johny, P Mukhopadhyay, Gopal Iyengar, **M Mohapatra**, 2023, Correction to: Evaluation of the Global Ensemble Forecast System (GEFS-T1534) for the probabilistic prediction of cyclonic disturbances over the North Indian Ocean during 2020and 2021, Journal of Earth System Science, 132(4), pp185
34. A Madhulatha, Jimy Dudhia, Rae-Seol Park, Subhash Chander Bhan, **Mrutyunjay Mohapatra**, 2023, Effect of Single and Double Moment Microphysics Schemes and Change in Cloud Condensation Nuclei, Latent Heating Rate Structure Associated with Severe Convective System over Korean Peninsula, Atmosphere, 14(11), pp1680
35. Lekshmi S, Chattopadhyay R, Pai DS, Rajeevan M, Valsala Vinu, Hosalikar KS, **Mohapatra M**, 2023, On the relative role of east and west pacific sea surface temperature (SST) gradients in the prediction skill of Central Pacific NINO3. 4 SST, Ocean Dynamics, pp1-19

36. Prakash, S., **Mohapatra, M**. Mean rainfall characteristics of tropical cyclones over the North Indian Ocean using a merged satellite-gauge daily rainfall dataset. Nat Hazards (2023). https://doi.org/10.1007/s11069-023-06158-9
37. Abhiram Nirmal CS, Abhilash S, Martin M, Sankar S, **Mohapatra M**, Sahai AK. Changes in the thermodynamical profiles of the subsurface ocean and atmosphere induce cyclones to congregate over the Eastern Arabian Sea. Sci Rep. 2023 Sep 22;13(1):15776. doi: 10.1038/s41598-023-42642-9. PMID: 37737291; PMCID: PMC10516911.
38. Bondyopadhyay, S., **Mohapatra, M.**, 2023, Suitable thermodynamic indices for the prediction of thunderstorm events for different cities throughout India. Meteorol Atmos Phys 135, 48. https://doi.org/10.1007/s00703-023-00984-z
39. Roose, S., Ajayamohan, R.S., Ray, P., Shang-Ping Xie, C. T. Sabeerali1, **M. Mohapatra**, S. Taraphdar, K. Mohanakumar & M. Rajeevan, 2023, Pacific decadal oscillation causes fewer near-equatorial cyclones in the North Indian Ocean. Nat Commun 14, 5099 (2023). https://doi.org/10.1038/s41467-023-40642-x
40. Kanase, R., Tirkey, S., Deshpande, M., R Phani Murali Krishna, CJ Johny, P. Mukhopadhyay, Gopal Iyengar and **M Mohapatra**, 2023, Evaluation of the Global Ensemble Forecast System (GEFS T1534) for the probabilistic prediction of cyclonic disturbances over the North Indian Ocean during 2020 and 2021. J Earth Syst Sci 132, 143 (2023). https://doi.org/10.1007/s12040-023-02166-2,
41. Zhang Zhan, Wang Weiguo, Doyle James, Moskaitis Jon, Komaromi Will, Heming Julian, Magnusson Linus, Cangialosi John P, Cowan Levi, Brennan Michael, Ma Suhong, Das Ananda Kumar, Hosomi Takuya, Clegg Peter, Birchard Thomas, Knaff John, Kaplan John, **Mohapatra Mrutyunjay**, Sharma Monica, Masaaki Ikegami, Wu Liguang, Blake Eric, 2023, A review of recent advances (2018-2021) on tropical cyclone intensity change from operational perspectives, Part 1: Dynamical model guidance, TCRR
42. Wang Weiguo, Zhang Zhan, Cangialosi John P, Brennan Michael, Cowan Levi, Clegg Peter, Hosomi Takuya, Masaaki Ikegami, Das Ananda Kumar, **Mohapatra Mrutyunjay**, Sharma Monica, Knaff John, Kaplan John, Birchard Thomas, Doyle James, Heming Julian, Moskaitis Jon, Komaromi Will, Ma Suhong, Sampson Charles, Wu Liguang, Blake Eric, 2023, A review of recent advances (2018-2021) on tropical cyclone intensity change from operational perspectives, Part 2: Forecasts by Operational Centers, TCRR
43. Bushair MT, Pattanaik DR, Mohapatra M, 2023, A multi-model ensemble tool for predicting districts level monsoon rainfall and extreme rainfall events over India, Mausam, 74(2), 429-454
44. **Mohapatra Mrutyunjay**, Anshul Chauhan, Avnish Varshney, Suman Gurjar, MT Bushair, Monica Sharma, RK Jenamani, Kuldeep Srivastava, Pulak Guhathakurta, Rajib Chattopadhyay, Mamta Yadav, Radheshyam Sharma, AK Mitra, Ananda KumarDas, Sankar Nath, Naresh Kumar, Soma Senroy, T Arulalan, Amit Bharadwaj, DR Pattanaik, BP Yadav, Rahul Saxena, Ashok KumarDas, Asok Raja, B Hemlata, KVH Arun, S Nitha, Atul KSingh, Shobhit Katiyar, Krishna Mishra, Surendra PratapSingh, Shashikant Mishra, Akhil Srivastava, B Geetha, M Rahul, K Nagaratna, HR Biswas, Manorama Mohanty, R Thapliyal, Shivinder Singh, Sonam Lotus, Sandeep KumarSharma, VK Mini, Sunit Das, GK Das, Abhishek Anand, Gayatri KVani, 2023, Short to medium range impact based forecasting of heavy rainfall in India, Mausam
45. Bondyopadhyay S, **Mohapatra M**, 2023, Determination of suitable thermodynamic indices and prediction of thunderstorm events for Eastern India, Meteorology and Atmospheric Physics 135 (1), 1-13.
46. Srivastava A, Mohapatra M, Kumar N, 2022, Hot weather hazard analysis over India, Scientific reports published by Nature Publishing Group, 12 (1), 1-15
47. Ahmed R, Prakash S, **Mohapatra M**, Giri RK, Dwivedi S**,** Understanding the rapid intensification of extremely severe cyclonic storm 'Tauktae' using remote-sensing observations, 2022, Meteorology and Atmospheric Physics 134 (6), 1-16

48. Ahmed R, **Mohapatra M**, Dwivedi S, Giri RK, Kant S, An overview of the Satellite Consensus (SATCON) algorithm to estimate tropical cyclone intensity over the North Indian Ocean, 2022, Journal of Earth System Science 131 (3), 1-16
49. Suneeth KV, Pattanaik DR, Das AK, **Mohapatra M**, Das SS, Features of upper tropospheric temperature fluctuations during drought years of Indian summer monsoon: results inferred from COSMIC GPS RO observations, 2022, Meteorology and Atmospheric Physics 134 (4), 1-17
50. Narkhede Neetin, Chattopadhyay Rajib, Lekshmi S, Guhathakurta Pulak, Kumar Naresh, **Mohapatra M**, An empirical model-based framework for operational monitoring and prediction of heatwaves based on temperature data, 2022, Modeling Earth Systems and Environment, 1-18
51. Sahu RK, Tyagi B, Vissa NK, **Mohapatra M**, Pre-monsoon thunderstorm season climatology of Convective Available Potential Energy (CAPE) and Convective Inhibition (CIN) over Eastern India, Mausam 73 (3), 565-586
52. Dash Kumar S, Jenamani RK, **Mohapatra M**, India's prolonged heatwave linked to record poor summer rains, 2022, Nature India.
53. Harikumar R, Sirisha P, Modi Anuradha, Girishkumar MS, Vishnu S, Srinivas K, Kumari Rakhi, Yatin G, Dinesh Kumar P, Nair Balakrishnan, **Mohapatra M**, Ocean state forecasting during VSCS Ockhi and a note on what we learned from its characteristics: A forecasting perspective, 2022, Journal of Earth System Science 131 (2), 1-20
54. Sisodiya A, Pattnaik S, **Mohapatra M**, Localized prediction of rainfall over Odisha using multiple physics ensemble approach, 2022, Journal of Earth System Science 131 (2), 1-14
55. Guhathakurta Pulak, Kumar Prasad Ashwini, Chattyopadhyay Rajib, Sangwan Neha, Wagh Nilesh, Pattanayak DR, Pai DS, **Mohapatra M**, The evaluation of weekly extended range river basin rainfall forecasts and a new bias correction mechanism for flood management in India, 2022, Meteorology, Hydrology and Water Management
56. Prajapati J, Pattanaik DR, Das AK, Kumar R, **Mohapatra M**, Assessment of SAR Derived Wind Speed Accuracy with Numerical Model Generated Wind Speed, 2022, Journal of the Indian Society of Remote Sensing, 1-4
57. Kuttippurath J, Akhila RS, Martin MV, Girishkumar MS, **Mohapatra M**, Sarojini B Balan, Mogensen K, Sunanda N, Chakraborty A, Tropical cyclone-induced cold wakes in the northeast Indian Ocean, 2022, Environmental Science: Atmospheres
58. Pattanaik DR, **Mohapatra M**, Evolution of IMD's operational extended range forecast system of tropical cyclogenesis over North Indian Ocean during 2010-2020, 2021, Mausam 72 (1), 35-56
59. Medha Deshpande, Radhika Kanase, R Phani Murali Krishna, Snehlata Tirkey, P Mukhopadhyay, Vs Prasad, CJ Johny, VR Durai, Sunitha Devi, **M Mohapatra**, Global Ensemble Forecast System (GEFS T1534) evaluation for tropical cyclone prediction over the North Indian Ocean, 2021, MAUSAM 72 (1), 119-128
60. Ahmed R, **Mohapatra M**, Giri RK, Dwivedi S, An Evaluation of the Advanced Dvorak Technique (9.0) for the Topical cyclones over the North Indian Ocean, 2021, TCRR, 10, 4, 201-208
61. **Moh**apatra **Mrutyunjay** and Sharma Monica, 2021, Comparative analysis of vital parameters of extremely severe cyclonic storms Phailin & Hudhud over the Bay of Bengal, JESS, 130 (4), 1-29
62. Mukhopadhyay, Parthasarathi, Bechtold Peter, Zhu Yuejian, Krishna R Phani Murali, Kumar Siddharth, Ganai Malay, Tirkey Snehlata, Goswami Tanmoy, Mahakur M, Deshpande Medha, Prasad VS, Johny CJ, Mitra Ashim, Ashrit Raghavendra, Sarkar Abhijit, Sarkar Sahadat, Roy Kumar, Andrews Elphin, Kanase Radhika, Malviya Shilpa, Abhilash S, Domkawale Manoj, Pawar SD, Mamgain Ashu, Durai VR, Nanjundiah Ravi S, Mitra Ashis K, Rajagopal EN, **Mohapatra M**, Rajeevan M, 2021, Unraveling the Mechanism of Extreme (More than 30 Sigma) Precipitation during August 2018 and 2019 over Kerala, India, Weather and Forecasting 36 (4), 1253-1273, DOI:https://doi.org/10.1175/WAF-D-20-0162.1
63. Shroyer, Emily, Amit Tandon, Debasis Sengupta, Harindra JS Fernando, Andrew J Lucas, J Thomas Farrar, Rajib Chattopadhyay, Simon de Szoeke, Maria Flatau, Adam Rydbeck, Hemantha Wijesekera, Michael McPhaden, Hyodae Seo, Aneesh Subramanian, R Venkatesan, Jossia Joseph,

S Ramsundaram, Arnold L Gordon, Shannon M Bohman, Jaynise Pérez, Iury T Simoes-Sousa, Steven R Jayne, Robert E Todd, GS Bhat, Matthias Lankhorst, Tamara Schlosser, Katherine Adams, SUP Jinadasa, Manikandan Mathur, **M Mohapatra**, E Pattabhi Rama Rao, AK Sahai, Rashmi Sharma, Craig Lee, Luc Rainville, Deepak Cherian, Kerstin Cullen, Luca R Centurioni, Verena Hormann, Jennifer MacKinnon, Uwe Send, Arachaporn Anutaliya, Amy Waterhouse, Garrett S Black, Jeremy A Dehart, Kaitlyn M Woods, Edward Creegan, Gad Levy, Lakshmi H Kantha, Bulusu Subrahmanyam, 2021, Bay of Bengal Intraseasonal Oscillations and the 2018 Monsoon Onset, Bulletin of the American Meteorological Society, 1-44, DOI: https://doi.org/10.1175/BAMS-D-20-0113.1.

64. Bondyopadhyay, S., **Mohapatra, M.** & Sen Roy, S. Determination of suitable thermodynamic indices and prediction of thunderstorm events for Kolkata, India. *Meteorol Atmos Phys* **133,** 1367–1377 (2021). https://doi.org/10.1007/s00703-021-00813-1.
65. Pattanaik, D.R., Raju Mandal, R Phani, Avijit Dey, Rajib Chattopadhyay, Susmitha Joseph, AK Sahai, **M Mohapatra**, 2021, Large-scale features associated with excess monsoon rainfall over india during 2019 and the real-time extended range forecast. *Meteorol Atmos Phys* **133,** 1275–1297 (2021). https://doi.org/10.1007/s00703-021-00808-y
66. Kumar, N., **Mohapatra**, M., Dimri, A.P. *et al.* Spatial and temporal variation in daily precipitation indices over Western Himalayas, 2021, *J. Earth Syst. Sci*., **130,** 151 (2021). https://doi.org/10.1007/s12040-021-01647-6
67. **Mrutyunjay Mohapatra**, Monica Sharma, Sunitha S. Devi, S. V. J. Kumar and Bharati S. Sabade, 2021, Frequency of genesis and landfall of different categories of tropical cyclones over the north Indian Ocean, **Mausam**, 72, 1-26.
68. Ahmed, R., **Mohapatra, M,** Dwivedi, S., Giri, R.K., Characteristics features of Super Cyclone 'AMPHAN'- Observed through Satellite images, 2021, Tropical Cyclone Research and Review,https://doi.org/10.1016/j.tcrr.2021.03.003
69. Medha Deshpande, Radhika Kanase, R. Phani Murali Krishna, Snehlata Tirkey, P. Mukhopadhyay, V. S. Prasad, C. J. Johny, V. R. Durai, Sunitha Devi and **M. Mohapatra**, 2021 "Global Ensemble Forecast System (GEFS T1534) evaluation for tropical cyclone prediction over the North Indian Ocean", Mausam, 72, 1, 119-128.
70. Soma Sen Roy, Pradeep Sharma, Bikram Sen, K.Sathi Devi, S.Sunitha Devi, Neetha K. Gopal, Naresh Kumar, Krishna Mishra, Shobhit Katyar, Surendra Pratap Singh, Shibin Balakrishnan, Charan Singh, Kuldeep Srivastava, Sonam Lotus, Surendra Paul, Bikram Singh, J.P.Gupta, S. Bandopadhyay, Ganesh Das, Anand Shankar, S.D. Kotal, H.R. Biswas, S. O'Neil Shaw, Sunit Das, Ranjan Phukan, K. Nagarathna, S. Balachandran, N.Puviarasan, S.Stella, R.Bibraj, V. K. Mini, M. Rahul, G. Agnihotri, J. Sarkar, M. Mohanty, Ved Prakash, K. Hosalikar, T. S. Nitha, M. L. Sahu, Bhawna Kumari, Anupam Kashyapi, Manmohan Singh, H. A. K. Singh, Radhey Shyam Sharma , G. N. Raha, Y. K. Reddy, K. J. Ramesh, **M. Mohapatra**, 2021, A new paradigm for short range forecasting of severe weather over the Indian region, Meteorology and Atmospheric Physics, 10.1007/s00703-021-00788-z
71. D. R. Pattanaik, **Mrutyunjay Mohapatra,** 2021, Evolution of IMD's operational extended range forecast system for tropical cyclogenesis over North Indian Ocean during 2010-2020, **Mausam,** 72, 35-56
72. **M. Mohapatra**, Kumar, N., Mishra, K., S. Devi, 2021, Evaluation of heavy rainfall warnings of India National Weather Forecasting Service for monsoon season (2002–2018), 2021, **J Earth Syst Sci** 130, https://doi.org/10.1007/s12040-020-01549-z
73. **Mrutyunjay Mohapatra**, Ashim K. Mitra, Virendra Singh S.K Mukherjee, Kavita Navria Vikram Prashar, Ashish Tyagi, Atul kumar Verma, Sunitha Devi, V S Prasad, M R Raj Kumar, 2021, INSAT-3DR rapid scan operations for weather monitoring over India: A new initiative at IMD", Current Science, 120, 1026-1034.
74. Mishra, K., Sharma, M. & **Mohapatra M**., 2021, Correction to: Performance of numerical weather prediction models in predicting track of recurving cyclone Vayu over Arabian Sea during June 2019. J Earth Syst Sci 130,. https://doi.org/10.1007/s12040-021-01583-5

75. Mishra Krishna, Sharma M. and **Mohapatra M.**, 2021, Performance of numerical weather prediction models in predicting track of recurving Cyclone VAYU over Arabian Sea during June 2019, J. Earth Syst. Sci., 130, 1-18, https://doi.org/10.1007/s12040-020-01533-7
76. **M. Mohapatra,** D. S. Pai, A.K. Sahai, P. Mukhopadhyay, Ashis Mitra, Aarti Bandgar, C.J. Johny, D.R. Pattanaik, Divya Surendran, M. Benke, Medha Deshpande, Malay Ganai, Monica Sharma, Naresh Kumar, O.P. Sreejith, R. Chattopadhyay, R. Phani Murali Krishna, S. Abhilash, Sunitha Devi, S. Joseph, Suryachandra Rao, Sahadat Sarkar, Snehlata Tirkey, Tanmoy Goswami, and V.S. Prasad, 2020, Contribution of Monsoon Mission to Operational Advances: Short to Medium Range, Extended Range and Seasonal Forecasts, **CLIVAR Exchanges**, 79, 15-21, DOI: 10.36071/clivar.79.2020
77. **Mohapatra, M**., Monica Sharma and Sunitha Devi, 2020**,** Cyclones and Disaster Management, Journal of Governance, 22, 200-220.
78. S. D. Kotal, Soma Sen Roy, Radheshyam Sharma, **Mrutyunjay Mohapatra**, 2020, A location-specific nowcast and SMS-based dissemination system for thunderstorm and lightning warning over Jharkhand, India., Current Science, 120, 1194-1201
79. D. S. Pai, Arti Bandgar, Sunitha Devi**,** Madhuri Musale, M. R. Badwaik, A. P. Kundale, Sulochana Gadgil, **M. Mohapatra** and M. Rajeevan, Normal Dates of Onset/Progress and Withdrawal of Southwest Monsoon over India, ***Mausam,*** **71,** 553-570**, 2020.**
80. U C Mohanty, **M Mohapatra** , Karumuri Ashok , R Krishnan , Jasti S Chowdary and Parthasarathi Mukhopadhyay, 2020 Indian Monsoons Variability and Extreme Weather Events: Recent Improvements in Observations and Modelling, *Proc Indian Natn Sci Acad* 86, 503-524
81. K. Singh, Panda, J. & **M. Mohapatra**, 2020 Robustness of best track data and associated cyclone activity over the North Indian Ocean region during and prior to satellite era. *J Earth Syst Sci* **129,** https://doi.org/10.1007/s12040-020-1344-x
82. SD Sanap, **M Mohapatra**, MM Ali, P Priya And D Varaprasad, 2020, On the dynamics of cyclogenesis, rapid intensiBcation and recurvature of the very severe cyclonic storm, Ockhi, J. Earth Syst. Sci., 129, https://doi.org/10.1007/s12040-020-01457-2
83. P Mukhopadhyay, R Krishnan, RS Nanjundiah, **M Mohapatra**, 2020, Prediction of Extreme Events: Current Status and Future Pathways against the backdrop of climate change, Bulletin of the American Meteorological Society, https://doi.org/10.1175/BAMS-D-20-0037.1
84. Shyama Mohanty, Raghu Nadimpalli, UC Mohanty, **M Mohapatra**, A Sharma, Ananda K Das, S Sil, 2020, Quasi-operational forecast guidance of extremely severe cyclonic storm Fani over Bay of Bengal using high-resolution mesoscale models, Meteorology and Atmospheric Physics, 1-18
85. **M. Mohapatra** and M. Sharma, 2019, Cyclone Warning Services in India during recent years: A review, Mausam, 70, 635-666
86. S Parihar, AK Mitra, **M Mohapatra**, LS Rathore, R Bhatla, RS Singh, 2019, Use of the Moon to promote on-board calibration of INSAT-3D imager visible channel, Indian Journal of Physics 93 (10), 1241-1246
87. T. Knutson, S. Camarago, JCL Chan, K Emanuel, C H Ho, J. Kossin, **M. Mohapatra**, M. Satoh, M. Sugi, K. walsh, L.Wu, 2019, Tropical Cyclones and Climate Change Assessment: Part II, Projected Response To Anthropogenic Warning, Bulletin of the American Meteorological Society, 101, E303-E322, https://doi.org/10.1175/BAMS-D-18-0194.1
88. Soma Sen Roy, **M. Mohapatra**, Ajit Tyagi And S. K. Roy Bhowmik, 2019, A review of Nowcasting of convective weather over the Indian region, Mausam, 70, 3 (July 2019), 465-484
89. Thomas Knutson, Suzana J. Camargo, Johnny C. L. Chan, Kerry Emanuel, Chang-Hoi Ho, James Kossin, **Mrutyunjay Mohapatra**, Masaki Satoh, Masato Sugi , Kevin Walsh, Liguang Wu, 2019, Tropical Cyclones and Climate Change Assessment: Part I. Detection and Attribution, Bulletin of the American Meteorological Society, 100, 1987-2007, 10.1175/BAMS-D-18-0189.1.
90. Subimal Ghosh, Subhankar Karmakar, Anamitra Saha, Mohit Prakash Mohanty, Shees Ali, Satya Kiran Raju, Vrinda Krishnakumar, Maneesha Sebastian, Manasa Ranjan, Behera, R Ashrit, P L N Murty, K Srinivas, B. Narasimhan, Tune Usha, M V Ramana, Murthy, P Thiruvengadam, J Indu, D Thirumalaivasan, John P. George, S Gedam, A B Inamdar , B S Murty, P P Mujumdar, **M**

Mohapatra, Arun Bhardwaj, Swati Basu, 2019, Development of India‟s First Integrated Expert Urban Flood Forecasting System for the City of Chennai, Current Science, 117(5), 741-745

91. Julian Heming, Fernando Prates, Morris Bender, John Cangialosi, Phillippe Caroff, James Doyle, AnumehaDube, Ghislain Faure, Brian Howell, Yohko Igarashi, Ron McTaggart- Cowan, **Mrutyunjay Mohapatra**, Jon Moskaitis, Jim Murtha, Rabi Rivett, Monica Sharma, Chris Short, Amit Singh, Vijay Tallapragada, Helen Titley, Yi Xiao, 2019, Review of Recent Progress in Tropical Cyclone Track Forecasting and Expression of Uncertainties, TCRR, 8 (4), 181-218
92. K Singh, J Panda, M Sahoo, **M Mohapatra**, 2018, Variability in Tropical Cyclone Climatology over North Indian Ocean during 1891 to 2015, Asia-Pacific Journal of Atmospheric Sciences, 1-19
93. S, Parihar, AK Mitra, **M Mohapatra**, R Bhatla, 2018, Potential of INSAT-3D sounder-derived total precipitable water product for weather forecast, Atmospheric Measurement Techniques, 11, 6003-12
94. S Goyal, A Kumar, **M Mohapatra**, LS Rathore, SK Dube, R Saxena, 2017, Satellite-based technique for nowcasting of thunderstorms over Indian region, JESS, 126, 79
95. S, Goyal, **M Mohapatra**, P Kumari, SK Dube, K Rajendra, 2017, Validation of Advanced Dvorak Technique (ADT) over north Indian Ocean, Mausam 68 (4), 689-698
96. N,Kumar, AK Jaswal, **M Mohapatra**, PA Kore, 2017, Spatial and temporal variation in daily temperature indices in summer and winter seasons over India (1969–2012), Theoretical and Applied Climatology 129 (3-4), 1227-1239
97. Pattanaik, D.R., **M Mohapatra**, AK Srivastava, A Kumar, 2017, Heat wave over India during summer 2015: an assessment of real time extended range forecast, Meteorology and Atmospheric Physics 129 (4), 375-393
98. Randall S Cerveny, Pierre Bessemoulin, Christopher C Burt, Mary Ann Cooper, Zhang Cunjie, Ashraf Dewan, Jonathan Finch, Ronald L Holle, Laurence Kalkstein, Andries Kruger, Tsz-cheung Lee, Rodney Martínez, **M Mohapatra**, DR Pattanaik, Thomas C Peterson, Scott Sheridan, Blair Trewin, Andrew Tait, MM Abdel Wahab, 2017, WMO Assessment of Weather and Climate Mortality Extremes: Lightning, Tropical Cyclones, Tornadoes, and Hail; Weather, Climate and Society 9 (3), 487-497
99. N Kumar, **M Mohapatra**, AK Jaswal, 2017, Meteorological features associated with unprecedented precipitation over India during 1st week of March 2015, Journal of Earth System Science 126 (5), 62
100. DR Pattanaik, **M Mohapatra**, 2017, Active North-East Monsoon Over India During 2015–An Assessment of Real Time Extended Range Forecast, Current Science, 112 (11), 2253-2262
101. **M Mohapatra**, B Geetha, M Sharma, 2017, Reduction in uncertainty in tropical cyclone track forecasts over the North Indian Ocean, Current Science 112 (9), 1826
102. **M Mohapatra**, VV Kumar, 2017, Interannual variation of tropical cyclone energy metrics over North Indian Ocean, Climate Dynamics, 48, 1431-1445
103. PLN Murty, J Padmanabham, T Srinivasa Kumar, N Kiran Kumar, V Ravi Chandra, SSC Shenoi, **M Mohapatra**, 2017, Real-time storm surge and inundation forecast for very severe cyclonic storm ‘Hudhud’, Ocean Engineering, 131, 25-35
104. S Goyal, **M Mohapatra**, A Kumar, SK Dube, K Rajendra, P Goswami, 2016, Validation of a satellite-based cyclogenesis technique over the North Indian Ocean, Journal of Earth System Science 125 (7), 1353-1363
105. S Goyal, **M Mohapatra**, SK Dube, P Kumari, I De, 2016, Mesoscale convective systems in association with tropical cyclones over Bay of Bengal, Natural Hazards 82 (2), 963-979
106. D.R. Pattanaik, **M. Mohapatra**; 2016; Seasonal Forecasting of Tropical Cyclogenesis over the North Indian Ocean; Journal of Earth System Science; 125, 231-250;
107. M. Mandal, K. S. Singh, M. Balaji, **M. Mohapatra**; 2016; Performance of WRF-ARW model in real-time prediction of Bay of Bengal cyclone ‘Phailin’; Pure and Applied Geophysics; 173, 1783-1801, DOI:10.1007/s00024-015-1206-7

108. U.C. Mohanty, Krishna K. Osuri, Vijay Tallapragada, Frank D. Marks, Sujata Pattanayak, **M. Mohapatra**, L. S. Rathore, S. G. Gopalakrishnan, Dev Niyogi; 2015; A Great Escape from the Bay of Bengal "Super Sapphire-Phailin" Tropical Cyclone: A Case of Improved Weather Forecast and Societal Response for Disaster Mitigation; Earth Interactions; **pp;** 19(17):151104123042003. DOI:10.1175/EI-D-14-0032.1
109. T. Srinivasa Kumar, P.L.N. Murty, M. Pradeep Kumar, M. Krishna Kumar, J. Padmanabham, N. Kiran Kumar, S.C. Shenoi, **M. Mohapatra**, ShaileshNayak, Prakash Mohanty; 2015; Modeling Storm Surge and its Associated Inland Inundation Extent Due to Very Severe Cyclonic Storm Phailin; Marine Geodesy; 38(4); 345-360; DOI:10.1080/01490419.2015.1053640
110. **M. Mohapatra**, Monica Sharma; 2015; Characteristics of surface wind structure of tropical cyclones over the north Indian Ocean. Journal of Earth System Science; 124(7):1573-1598. DOI:10.1007/s12040-015-0613-6
111. **M. Mohapatra**, B. Geetha, S. Balachandran, L.S. Rathore; 2015; On the Tropical Cyclone Activity and Associated Environmental Features over North Indian Ocean in the Context of Climate Change; Journal of Climate Change,1, 1-26.
112. **M. Mohapatra;** 2015; Tropical cyclone forecast verification by India Meteorological Department For north Indian Ocean: a review; Tropical Cyclone Research and Review**,** 03, 1-14
113. **M. Mohapatra**, D P Nayak, Monica Sharma, R P Sharma, B K Bandyopadhyay; 2015; Evaluation of official tropical cyclone landfall forecast issued by India Meteorological Department; Journal of Earth System Science; 124(4), 861-874; DOI:10.1007/s12040-015-0581-x
114. **M Mohapatra;** 2015**;** Cyclone hazard proneness of districts of India; Journal of Earth System Science; 124(3), 515-526; DOI:10.1007/s12040-015-0556-y
115. Manorama Mohanty, **M. Mohapatra**, SNA Jaaffrey; 2014; Some characteristics of rainfall over major urban centres of Gujarat; Mausam; 65; 608-618
116. Krishna K. Osuri, U. C. Mohanty, Ashish Routray and **M. Mohapatra**; 2013; Real-Time Track Prediction of Tropical Cyclones over the North Indian Ocean Using the ARW Model; Journal of Applied Meteorology and Climatology; 52(11), 2476-2492
117. **M. Mohapatra**, B K Bandyopadhyay, D P Nayak; 2013; Evaluation of operational tropical cyclone intensity forecasts over north Indian Ocean issued by India Meteorological Department; Natural Hazards; 68(2); 433-451; DOI:10.1007/s11069-013-0624-z
118. **M. Mohapatra**, D P Nayak, R P Sharma, B K Bandyopadhyay; 2013; Evaluation of official tropical cyclone track forecast over north Indian Ocean issued by India Meteorological Department; Journal of Earth System Science; 122(3); 589-601; DOI:10.1007/s12040-013-0291-1
119. D.R. Pattanaik, **M. Mohapatra**, B. Mukhopadhyay, AjitTyagi; 2013; A preliminary study about the prospects of extended range forecast of tropical cyclogenesis over the north Indian Ocean during 2010 post-monsoon season; Mausam; 64(1);171-188.
120. T.N. Jha, **M. Mohapatra**, B.K. Bandyopadhyay; 2013; Estimation of intensity of tropical cyclone over Bay of Bengal using microwave imagery; Mausam; 64(1);105-116.
121. Suman Goyal and **M. Mohapatra**; 2013; Comparison of best track parameters of RSMC, New Delhi with satellite estimates over north Indian Ocean; Mausam; 64; 25-34.
122. **M. Mohapatra**, D.R. Sikka, B.K. Bandyopadhyay, AjitTyagi; 2013; Outcomes and challenges of Forecast Demonstration Project on landfalling cyclones over Bay of Bengal; Mausam; 61(1):01-12.
123. **M. Mohapatra**, G. S. Mandal, B. K. Bandyopadhyay, AjitTyagi, U. C. Mohanty; 2012; Classification of cyclone hazard prone districts of India. Natural Hazards; 63(3); 1601-1620; DOI:10.1007/s11069-011-9891-8
124. Krishna K. Osuri, U. C. Mohanty, A. Routray, Makarand A. Kulkarni, **M. Mohapatra;** 2012; Customization of WRF-ARW model with physical parameterization schemes for the simulation of tropical cyclones over North Indian Ocean; Natural Hazards; 63(3); 1-23; 1337-1359; DOI:10.1007/s11069-011-9862-0

125. Geeta Agnihotri, **M. Mohapatra;** 2012; Prediction of occurrence of daily summer monsoon precipitation over Karnataka; Meteorological Applications; 19(2); 130 – 139; DOI:10.1002/met.246
126. AJ Litta, UC Mohanty, S. Kiran Prasad, **M. Mohapatra**, AjitTyagi, SC Sahu; 2012; Simulation of tornado over Orissa (India) on March 31, 2009, using WRF–NMM model; Natural Hazards; 61(3).; 1219-1242; DOI:10.1007/s11069-011-9979-1
127. Krishna K. Osuri, U. C. Mohanty, A. Routray, **M. Mohapatra**; 2012; The impact of satellite-derived wind data assimilation on track, intensity and structure of tropical cyclones over the North Indian Ocean; International Journal of Remote Sensing; 33(5-5); 1627-1652; DOI:10.1080/01431161.2011.596849
128. **M. Mohapatra;** 2012; Evaluation of Cone of Uncertainty in Tropical Cyclone Track Forecast over North Indian Ocean Issued by India Meteorological Department; Tropical Cyclone Research and Review, 01, 331-339
129. **M. Mohapatra**, B. K. Bandyopadhyay, AjitTyagi; 2012; Best track parameters of tropical cyclones over the North Indian Ocean: A review; Natural Hazards; 63(3); 1285-1317
130. Suresh Ram and **M. Mohapatra**, 2012, Some aspects of squall over Indira Gandhi International Airport, Mausam, 63, 4, 623-638
131. N. Kumar, **M Mohapatra** and B.P. Yadav, 2011, Boundary layer impact on mountain waves across Western Ghats of India, Mapana, J. Science, 10, 1, 25-31
132. Charan Singh, **M. Mohapatra**, B.K. Bandyopadhyay, AjitTyagi; 2011; Thunderstorm climatology over northeast and adjoining east India; Mausam; 62(2); 163-170.
133. **M. Mohapatra**, R.H. Biswas, G.K. Sawaisarje; 2011; Spatial variability of daily rainfall over northeast India during summer monsoon season; Mausam; 62(2); 215-228.
134. **M. Mohapatra**; 2011; Weather and weather system at Schirmachar Oasis (Maitri): - A review during past two decades; Mausam; 62; 513-534.
135. **M. Mohapatra**; 2011; Modulation of cyclonic disturbances over the north Indian Ocean by Madden - Julian oscillation; Mausam; 62; 375-390.
136. U. C. Mohanty, Krishna K. Osuri, A. Routray, **M. Mohapatra**, Sujata Pattanayak; 2010; Simulation of Bay of Bengal Tropical Cyclones with WRF Model: Impact of Initial and Boundary Conditions; Marine Geodesy; 33(4); 294-314; DOI:10.1080/01490419.2010.518061
137. **M. Mohapatra**, Naresh Kumar, B K Bandyopadhyay; 2010; Role of mesoscale low and urbanization on exceptionally heavy rainfall event of 26th July 2005 over Mumbai: Some observational evidences. Mausam; 60(3); 317-324
138. Ramesh Chand, **M. Mohapatra;** 2010; Diagnostic study of a recurving cyclone - 'MALA' over the Bay of Bengal. Mausam; 61(1); 11-18.
139. **M. Mohapatra** & S. Adhikary; 2010; Seasonal prediction of cyclonic disturbances over Bay of Bengal during monsoon season: Identification of potential predictors; Mausam; 61; 461-486.
140. **M. Mohapatra**, Naresh Kumar, B K Bandyopadhyay; 2010; Unprecedented Rainfall over Bangalore City during October, 2005; Mausam; 61(1); 105-112.
141. **M. Mohapatra**, H.R. Hatwar, B.K. Bandyopadhyay, V. Subrahmanyam; 2009; Evaluation of heavy rainfall warning over India during summer monsoon season; Mausam; 60(4); 475-490.
142. **M. Mohapatra**, H.R. Hatwar, S.R. Kalsi; 2009; Verification of heavy rainfall warning over Bihar and Uttar Pradesh; Mausam; 60(2); 175-184.
143. **M. Mohapatra**, U.C. Mohanty; 2009; Excess and deficient summer monsoon rainfall over Orissa in relation to low pressure systems; Mausam; 60(1); 25-38.
144. Sunit Das, **M. Mohapatra** and Suresh Ram; 2009; Some characteristics of heavy rainfall over northeast India during monsoon season; Mausam; 60; 525-533
145. **M. Mohapatra;** 2008;Sub-divisional monsoon rainfall over Orissa in relation to low pressure systems over Bay of Bengal and adjoining land regions during 1982-1999; Mausam; 59; 327-338.
146. **M. Mohapatra**, U. C. Mohanty; 2008; Periodicity in intraseasonal variation off summer monsoon rainfall over Orissa, India in relation to synoptic disturbances; Meteor Atmos Phys. Meteorology and Atmospheric Physics; 99(1); 25-42; DOI:10.1007/s00703-007-0268-1

147. **M. Mohapatra**, H. R. Biswas and G. K. Sawaisarje; 2008; Daily summer monsoon rainfall over northeast India due to synoptic scale system; Mausam; 59; 35-50.
148. Suresh Ram and **M. Mohapatra;** 2008**;** Some characteristics of fog over Guwahati airport; Mausam; 59; 159-166.
149. **M. Mohapatra**, U. C. Mohanty; 2007; Inter-annual variability of summer monsoon rainfall over Orissa (India) in relation to cyclonic disturbances; Natural Hazards; 42(2); 301-315; DOI:10.1007/s11069-006-9090-1
150. U. C. Mohanty, **M. Mohapatra;** 2007;Prediction of occurrence and quantity of daily summer monsoon precipitation over Orissa (India); Meteorological Applications; 14(1); 95 – 103; DOI:10.1002/met.9
151. **M. Mohapatra;** 2007; Relative contribution of synoptic systems to monsoon rainfall over Orissa; Mausam; 57(1); 17-32
152. **M. Mohapatra** and U.C. Mohanty; 2007; An objective approach for prediction of daily summer monsoon rainfall over Orissa (India) due to interaction of mesoscale and large scale synoptic systems; Pure and Applied Geophysics**;** 164; 1683-1698
153. **M. Mohapatra**, U. C. Mohanty; 2006; Interannual variability of summer monsoon rainfall over Orissa in relation to tropospheric circulation features; Current Science; 90(9); 1218-1229.
154. **M. Mohapatra**, U C Mohanty; 2006; Spatio-temporal variability of summer monsoon rainfall over Orissa in relation to low pressure system; Journal of Earth System Science; 115(2); 203-218;
155. G. Kumar and **M. Mohapatra;** 2006; Some climatological aspects of thunderstorms and squalls over Guwahati airport; Mausam; 57; 231-240.
156. **M. Mohapatra**, U. C. Mohanty; 2005; Some characteristics of very heavy rainfall over Orissa during summer monsoon season; Journal of Earth System Science;114(1); 17-36. DOI:10.1007/BF02702006
157. **M. Mohapatra**; 2005; Some characteristics of inter-relationship in monthly and seasonal monsoon rainfall over Orissa; Mausam; 693-697
158. **M. Mohapatra**, U. C. Mohanty; 2004; Some characteristics of low pressure systems and summer monsoon rainfall over Orissa; Current Science; 87(9); 1245-1255.
159. **M. Mohapatra**, A. L. Kopar and A. Thulasidas; 2004; Some climatological aspects of thunderstorm activity over Bangalore city; Mausam; 184-189
160. S. Mishra and **M. Mohapatra**; 2004; Some climatological characteristics of fog over Bhubaneswar; Mausam; 55; 695-698
161. **M. Mohapatra;** 2004;Some characteristics of spatial variability of monsoon rainfall over Orissa; Mausam; 55; 351-355
162. **M. Mohapatra**, U. C. Mohanty, S. Behera; 2003; Spatial variability of daily rainfall over Orissa (India) during southwest summer monsoon season; International Journal of Climatology; 23(15); 1867–1887;
163. **M. Mohapatra** and U.C. Mohanty; 2003; Some features of 24 hours highest rainfall over Orissa during monsoon season; Journal of Power and River Valley development**,** 198-206
164. **M. Mohapatra**; 2002; Recent trends in climate of Bangalore; Mausam; 53; 425-438.
165. **M. Mohapatra**, D. C. Gupta, N. K. Chanchalani and S. K. Dastidar; 2002; Orissa Super Cyclone,1999- a case study; Journal of Indian Geophysical Union; 6; 93-106
166. **M. Mohapatra** and A. Thulasidas; 1998; Analysis and forecasting of fog over Bangalore Airport; Mausam; 49; 135-142

Enclosure I: Publications and Research & Development

(b) : Research papers published in Proceedings of Symposia/Seminars/Conference/Workshop

1. Julian Heming, Fernando Prates, Morris Bender, John Cangialosi, Phillippe Caroff, James Doyle, AnumehaDube, Ghislain Faure, Brian Howell, Yohko Igarashi, Ron McTaggart-Cowan, **Mrutyunjay Mohapatra**, Jon Moskaitis, Jim Murtha, Rabi Rivett, Monica Sharma, Chris Short, Amit Singh, Vijay Tallapragada, Helen Titley, Yi Xiao, 2018, Review of Recent Progress in Tropical Cyclone Track Forecasting and Expression of Uncertainties, Reports of WMO/TCP/WWW Ninth International Workshop On Tropical Cyclones (IWTC-9) held at Honolulu, USA
2. **M Mohapatra**, B. K. Bandyopadhyay and L. S. Rathore; 2014; Very Severe Cyclonic Storm (VSCS), "Phailin" over the Bay of Bengal during 08-14 October 2013 : A Demonstration of Early Warning Capability of India Meteorological Department; Proceedings of Third International Workshop on Tropical Cyclone Landfall Processes, WMO/CAS/WWW, 1-20.
3. Woo Wang-Chun,Wallace Hogsett, **M. Mohapatra**, Kazuhiko Nagata, Peter Otto, Qi Liangbo,Vo Van Hoa, Xu Yinglong; 2014; Challenges and Advances related to TC Rainfall Forecast; Third International Workshop on Tropical Cyclone Landfall Processes,WMO/CAS/WWW-8.2, 8.2.1-8.2.29pp.
4. Sai-tick Chan Jim Davidson, Philippe Caroff, Joe Courtney, David Grant, Koji Kato, **M. Mohapatra** and C.H. Qian; 2014; Track, Intensity, and Structure Changes at Landfall – Forecasting Challenges; Third International Workshop on Tropical Cyclone Landfall Processes, WMO/CAS/WWW-6.2, 6.2.1-6.2.23pp.
5. Betty Hearn Morrow,Jeff Lazo, Gary Foley, **M. Mohapatra**, Ray Tanabe, C. C. Lam, Thelma Acebes-Cinko, Chris Landsea, Dong-Jin Kim, Baek-Jo Kim, José M. Robiera Torres, Alvaro Palache, Angel Meulenert, Zhengquan Cheng; 2014; Effective Warning Process: Recent Social Science Contributions; Eighth International Workshop on Tropical Cyclone(IWTC), Topic 3.2, 1-16pp.
6. Charles Sampson and John Knaff,Joe Courtney, Brian Strahl, Tsukasa Fujita, Naohisi Koide, Olivier Bousquet, Thierry Dupont, Mike Brennan, Vijay Tallapragada, Tim Marchok, S.G. Gopalakrishna, Baode Chen, **M. Mohapatra**, S. D. Kotal and U. C. Mohanty, Mike Fiorino, Jim Doyle, Russ Elsberry; 2014; Advances In Intensity Guidance; Eighth International Workshop on Tropical Cyclone(IWTC), Topic 2.7, 1-26pp.
7. Christopher W. Landsea,Lixion Avila, Thierry Dupont, S. D. Kotal and **M. Mohapatra;** 2014;Cyclogenesis: Operational Forecasting Perspective; Eighth International Workshop on Tropical Cyclone(IWTC), Topic 2.2, 1-22pp.
8. Grant Elliott, Munehiko Yamaguchi, Thomas Birchard, Johnny C. L. Chan, Thierry Dupont, Russell L. Elsberry, T C Lee, Xiaotu Lei, Sharanya J. Majumdar, **M Mohapatra** and Li Ying; 2014; Tropical Cyclone Motion - Recent Advances; Eighth International Workshop on Tropical Cyclone(IWTC), Topic 2, 1-44pp.
9. Monica Sharma and **M. Mohapatra;** 2013; Possible causes of explosive intensification of VSCS GIRI over the Bay of Bengal; Proceedings of International Conference on Indian Ocean Tropical Cyclone and Climate Change (14 - 17 February 2012) New Delhi, India, published by WMO, WWRP 2013-4, 131-138
10. T. N. Jha, **M. Mohapatra** and B. K. Bandyopadhyay; 2013; A study of intensification and movement of cyclonic storm " Keila" over Arabian sea; Proceedings of International Conference

on Indian Ocean Tropical Cyclone and Climate Change (14 - 17 February 2012) New Delhi, India, published by WMO, WWRP 2013-4, 121-125

11. Naresh Kumar and **M. Mohapatra;** 2013;Physical features associated with rare track and intensity of severe cyclonic storm, AILA over the bay of Bengal during May 2009; Proceedings of International Conference on Indian Ocean Tropical Cyclone and Climate Change (14 - 17 February 2012) New Delhi, India, published by WMO, WWRP 2013-4, 115-120
12. R.P. Sharma, **M. Mohapatra** and B.K. Bandyopadhyay; 2013; Performance of modified CLIPER model for tropical cyclone track prediction over the north Indian Ocean during geostationary satellite era; Proceedings of International Conference on Indian Ocean Tropical Cyclone and Climate Change (14 - 17 February 2012) New Delhi, India, published by WMO, WWRP 2013-4, 29-32
13. D. P. Nayak, **M. Mohapatra** and B.K. Bandyopadhyay; 2013; Variation of tropical cyclone track forecast difficulty over North Indian Ocean; Proceedings of International Conference on Indian Ocean Tropical Cyclone and Climate Change (14 - 17 February 2012) New Delhi, India, published by WMO, WWRP 2013-4, 23-28
14. Ajit Tyagi, **M Mohapatra**, B. K.Bandyopadhyay and Naresh Kumar; 2010; Interannual variation of frequency of cyclonic disturbances landfalling over WMO/ESCAP Panel Member Countries; WMO Technical Document, WMO/TD-No.1541, WWRP-210-2, 1-7
15. **M. Mohapatra** and B.K. Bandyopadhyay; 2008; Spatio-temporal variability of heavy rainfall over India during monsoon season; SAARC Workshop held in Kathmandu during 27-28 March 2008
16. U. C. Mohanty and **M. Mohapatra;** 2007;Heat waves over Orissa : Problems and perspectives; Understanding heat waves in Orissa, Proceedings of national workshop on heat wave held on 13. 03. 2006 organised by Orissa State Disaster management Authority, Bhubaneswar
17. **M. Mohapatra**, 2003; Southwest monsoon circulation and rainfall over Orissa- A review of characteristics; 7th Orissa Vigyan Congress, Bhubaneswar
18. **M. Mohapatra**; 2003; Climate change and environmental hazards; Seminar on Mitigation of Environmental Hazard- Utkal University
19. S. Mishra, **M. Mohapatra** and U.C. Mohanty; 2002; Some characteristics of monsoon activity over Orissa; National symposium, TROPMET, 2002, organised by Indian Meteorological Society
20. **M.Mohapatra**, U.C. Mohanty, S. Mishra and L. Maharana; 2002; Characteristics of monsoon circulation leading to flood and drought over Orissa; National symposium, TROPMET, 2002, organised by Indian Meteorological Society
21. **M. Mohapatra**; 2002; Tropical cyclone and environmental risk; National Seminar on environmental risk analysis and management, Utkal University
22. **M. Mohapatra**, S.K. Dastidar and D.C. Gupta; 2001; Some aspects of recent heat wave over Orissa; National symposium, TROPMET, 2001, organised by Indian Meteorological Society
23. **M. .Mohapatra** and D.C. Gupta; 2000; Meteorology of Eastern Ghat region of Orissa; National Symposium, RRL Bhubaneswar
24. **M. Mohapatra**, 2000; Weather related disasters and their management; National Seminar on Environment and Disaster Management organised by Utkal University
25. **M. .Mohapatra** and D.C. Gupta; 2000; The impact of monsoon depressions on paddy cultivation over Orissa; National symposium, TROPMET, 2000 organised by Indian Meteorological Society
26. **M. Mohapatra** and G.S. Vijayraghavan; 1997; Climatic variation of temperature over Bangalore; IGBP National Symposium at Bhubaneswar

Enclosure I: Publications and Research & Development

(c) Publications in books/reports

1. Attri SD, **Mohapatra M,** Agrometeorological Services for Climate Resilient Agriculture, 2021, Climate Resilience and Environmental Sustainability Approaches, 127-139
2. **M. Mohapatra** and M. Sharma, 2019, Recent Advances in Cyclone Warning Services in India, Article for Souvenir published by ClimFish Conference held at CUSAT, Kochi
3. **M. Mohapatra** and M. Sharma, 2019, India's contribution in trans boundary early warning system in south Asia: A review, South Asia Disaster Report, Published by Ill India Disaster Management Institute, Ahmedabad.
4. **M Mohapatra**, AK Srivastava, S Balachandran, B Geetha, 2017, Inter-annual Variation and Trends in Tropical Cyclones and Monsoon Depressions Over the North Indian Ocean, In Observed Climate Variability and Change over the Indian Region, Ed. M. Rajeevan and ShaileshNayak, published by Springer, Germany, 89-106.
5. K Ray, **M Mohapatra**, K Chakravarthy, SS Ray, SK Singh, AK Das, 2017, Hydro-Meteorological Aspects of Tropical Cyclone Phailin in Bay of Bengal in 2013 and the Assessment of Rice Inundation due to Flooding, In Tropical Cyclone Activity over the North Indian Ocean, Ed.M.Mohapatra, B.K. Bandyopadhyay and L.S. Rathore, Co-published by Capital Publishers, New Delhi and Springer, Germany, 29-43
6. M Sharma, **M Mohapatra**, 2017, Standard Operation Procedure for Tropical Cyclone Vital Parameters over North Indian Ocean, In Tropical Cyclone Activity over the North Indian Ocean, Ed.M.Mohapatra, B.K. Bandyopadhyay and L.S. Rathore, Co-published by Capital Publishers, New Delhi and Springer, Germany, 367-381
7. LS Rathore, **M Mohapatra**, B Geetha, 2017, Collaborative Mechanism for Tropical Cyclone Monitoring and Prediction over North Indian Ocean, In Tropical Cyclone Activity over the North Indian Ocean, Ed.M.Mohapatra, B.K. Bandyopadhyay and L.S. Rathore, Co-published by Capital Publishers, New Delhi and Springer, Germany, 3-27.
8. B Sabade, **M Mohapatra**, 2017, Very Severe Cyclonic Storm MADI over Bay of Bengal, 6–13 December 2013: A Diagnostic Study, In Tropical Cyclone Activity over the North Indian Ocean, Ed.M.Mohapatra, B.K. Bandyopadhyay and L.S. Rathore, Co-published by Capital Publishers, New Delhi and Springer, Germany, 117-130
9. PS Chinchole, **M Mohapatra**, 2017, Some Characteristics of Translational Speed of Cyclonic Disturbances Over North Indian Ocean in Recent Years, In Tropical Cyclone Activity over the North Indian Ocean, Ed.M.Mohapatra, B.K. Bandyopadhyay and L.S. Rathore, Co-published by Capital Publishers, New Delhi and Springer, Germany, 165-179
10. DP Nayak, **M Mohapatra**, 2017, Rapid Movement of Cyclone Viyaru Just Before Landfall-A Case Study, In Tropical Cyclone Activity over the North Indian Ocean, Ed.M.Mohapatra, B.K. Bandyopadhyay and L.S. Rathore, Co-published by Capital Publishers, New Delhi and Springer, Germany, 149-163
11. SVJ Kumar, SS Ashthikar, **M Mohapatra**, 2017, Life Period of Cyclonic Disturbances Over the North Indian Ocean During Recent Years, In Tropical Cyclone Activity over the North Indian Ocean, Ed.M.Mohapatra, B.K. Bandyopadhyay and L.S. Rathore, Co-published by Capital Publishers, New Delhi and Springer, Germany, 181-198
12. **M Mohapatra**, 2017, Tropical Cyclone Track, Structure and Intensity Changes at Landfall, In Tropical Cyclone Activity over the North Indian Ocean, Ed.M.Mohapatra, B.K.

Bandyopadhyay and L.S. Rathore, Co-published by Capital Publishers, New Delhi and Springer, Germany, 97-116

13. RP Sharma, **M Mohapatra**, 2017 Rapid Weakening of Very Severe Cyclonic Storm 'Lehar'–A Case Study, In Tropical Cyclone Activity over the North Indian Ocean, Ed.M.Mohapatra, B.K. Bandyopadhyay and L.S. Rathore, 2017, Co-published by Capital Publishers, New Delhi and Springer, Germany, 131-147
14. **M Mohapatra**, 2017, Monitoring and Forecasting of Tropical Cyclones over North Indian Ocean, In Advanced Numerical Modeling and Data Assimilation Techniques for Tropical Cyclone Prediction, Ed. UC Mohanty and SG Gopalakrishnan, Co-published by Capital Publishers, New Delhi and Springer, Germany, 409-447 pp.
15. **M. Mohapatra**, M.R. Ranalkar& S. Sunitha Devi, 2015, Validation of automatic weather station (AWS) data for monitoring and prediction of the low pressure systems during the monsoon season, IMD Met. Monograph: ESSO Document No.: ESSO/IMD/SYNOPTIC MET/01(2015)/17, pp171-188., IMD, Pune
16. **M. Mohapatra**, B.K. Bandyopadhyay, B. Geetha, Bharati S. Sabade, D.P. Nayak, Monica Sharma, R.P. Sharma, P.S. Chinchole, R.G. Bali, S.V.J. Kumar & V. Vijayakumar, 2015, "Cyclonic activities over north Indian ocean during 2014" and "Performance of track and intensity predication of cyclones by IMD during 2014", IMD New Delhi, Report No. ESSO/IMD/CWD-1(2015)/13, IMD, New Delhi
17. **M. Mohapatra**, B.K. Bandyopadhyay, B. Geetha, Bharati S. Sabade, D.P. Nayak, Monica Sharma, R.P. Sharma, P.S. Chinchole, R.G. Bali, S. V. J. Kumar & V. Vijayakumar, 2015, Verification of operational tropical cyclone forecast over north Indian Ocean during 2014 by India Meteorological Department, IMD Met. Monograph: Synoptic Meteorology No.: ESSO/IMD/SYNOPTIC MET/02-2014/16], pp 46-79., IMD, New Delhi
18. **M. Mohapatra**, B.K. Bandyopadhyay, Kamaljit Ray and L. S. Rathore, 2014, Early Warning Services for Management of Cyclones over North Indian Ocean : Current status and future scope, High Impact Weather Events over SAARC Region, Ed. Kamaljit Ray, M Mohapatra, BK Bandyopadhyay and LS Rathore, Capital Publishing Co. and Springer Publications Ltd
19. **M. Mohapatra** and Manish Ranalkar, 2014, Utility of automatic weather station (AWS) data for monitoring and prediction of cyclonic disturbances during monsoon season, 2013, IMD Met. Monograph, Synoptic Meteorology No. 1/2014, pp. 161-172, IMD, Pune
20. **M. Mohapatra**, Naresh Kumar and Manish Ranalkar, 2012, Utility of automatic weather station (AWS) data for monitoring and prediction of cyclonic disturbances during monsoon season, 2011, IMD Met. Monograph, Synoptic Meteorology No. 1/2011, pp. 161-172, IMD, Pune
21. Manorama Mohanty, **M. Mohapatra** and S.N.A. Jaafry, 2013, Characteristic features of heavy rainfall over Gujarat and Rajasthan states of India due to very severe cyclonic storm, PHET over the Arabian Sea (31 May to 07 June 2010), Monitoring and Prediction of Tropical Cyclones in the Indian Ocean and Climate Change, Edited by: U.C.Mohanty, M.Mohapatra, O.P.Singh, B.K.Bandyopadhyay, L.S.Rathore, pp-412-421, Capital Publishing Co. & Springer Publications Ltd
22. S. K. Dube, A.D.Rao, JismyPoulose, **M. Mohapatra** and T.S.Murty, 2013, Storm surge inundation in South Asia under climate change scenarios, Monitoring and Prediction of Tropical Cyclones in the Indian Ocean and Climate Change, Edited by: U.C.Mohanty,

M.Mohapatra, O.P.Singh, B.K.Bandyopadhyay, L.S.Rathore, pp-355-363, Capital Publishing Co. & Springer Publications Ltd

23. D. R. Pattanaik and **M. Mohapatra**, 2013, Multi-model Ensemble Based Extended Range Forecast of Tropical Cyclogenesis over the North Indian Ocean, Monitoring and Prediction of Tropical Cyclones in the Indian Ocean and Climate Change, Edited by: U.C.Mohanty, M.Mohapatra, O.P.Singh, B.K.Bandyopadhyay, L.S.Rathore, pp-203-218, Capital Publishing Co. and Springer Publications Ltd
24. Suman Goyal and **M. Mohapatra**, 2013, Estimation of Centre and Intensity of Tropical Cyclones over the North Indian Ocean using Microwave Imageries, Monitoring and Prediction of Tropical Cyclones in the Indian Ocean and Climate Change, Edited by: U.C.Mohanty, M.Mohapatra, O.P.Singh, B.K.Bandyopadhyay, L.S.Rathore, pp-192-202, Capital Publishing Co. and Springer Publications Ltd
25. **M. Mohapatra**, B. K. Bandyopadhyay and AjitTyagi, 2013, Status and Plans for operational Tropical Cyclone Forecasting and Warning Systems in the North Indian Ocean region, Monitoring and Prediction of Tropical Cyclones in the Indian Ocean and Climate Change, Edited by: U.C.Mohanty, M.Mohapatra, O.P.Singh, B.K.Bandyopadhyay, L.S.Rathore, pp-149-168, Capital Publishing Co. and Springer Publications Ltd
26. **M. Mohapatra**, B. K. Bandyopadhyay and AjitTyagi, 2013, Construction and Quality of best tracks parameters for study of climate change impact on Tropical Cyclones over the North Indian Ocean during satellite era, Monitoring and Prediction of Tropical Cyclones in the Indian Ocean and Climate Change, Edited by: U.C.Mohanty, M.Mohapatra, O.P.Singh, B.K.Bandyopadhyay, L.S.Rathore, pp-3-17, Capital Publishing Co. and Springer Publications Ltd
27. D. R.Pattanaik and **M. Mohapatra**, 2012, Extended range prediction of cyclonic disturbances over the north Indian Ocean, Met Monograph, IMD, New Delhi
28. **M. Mohapatra**, Naresh Kumar and Manish Ranalkar, 2012, Utility of automatic weather station (AWS) data for monitoring and prediction of cyclonic disturbances during monsoon season, 2011, IMD Met. Monograph, Synoptic Meteorology No. 1/2011, pp. 161-172., IMD, Pune
29. **M. Mohapatra**, TN Jha, Suman Goyal, Charan Singh, Naresh Kumar, SD Kotal, K Nagaratna, S Balachandran, Osuri Krishna, AjitTyagi, BK Bandyopadhyay, OP Singh, UC Mohanty, DR Sikka, Kusuma G Rao and EN Rajagopal., 2011, Forecast Demonstration Project (FDP) for improving track, intensity and landfall of Bay of Bengal tropical cyclones, Implementation of Pilot Phase, 2010 : A report, Research Report, Cyclone Warning Division, IMD, New Delhi
30. A.J. Litta, U.C. Mohanty, S.C. Bhan, and **M. Mohapatra**, 2011, Simulation of Tornadoes over India Using WRF-NMM Model, Challenges and Opportunities in Agrometeorology, Eds. S. D. Attri, L. S. Rathore, M. V. K. Sivakumar, S. K. Dash, Springer Publications, pp. 173-186, Springer Publications Ltd
31. Ajit Tyagi, B. K. Bandyopadhyay, **M. Mohapatra**, Suman Goel, Naresh Kumar, A. B. Mazumdar&MedhaKhole, 2011, A report on the super cyclonic storm, "Gonu" during 1-7 June 2007, IMD Met. Monograph, Cyclone Warning Division No. 08/2011, p.1-87, IMD, New Delhi
32. **M. Mohapatra**, Naresh Kumar and Manish Ranalkar, 2011, Utility of automatic weather station (AWS) data for monitoring and prediction of cyclonic disturbances during 2010, IMD Met. Monograph, Synoptic Meteorology No. 10/2011, pp. 189-203, IMD, Pune

33. AjitTyagi, **M. Mohapatra**, B. K.Bandyopadhyay and Naresh Kumar, 2010, Inter-annual variation of frequency of cyclonic disturbances landfalling over WMO/ESCAP Panel Member Countries, WMO Technical Document, WMO/TD-No. 1541 WWRP-210-2, pp. 1-7, WMO, Geneva
34. AjitTyagi, **M. Mohapatra**, B. K.Bandyopadhyay and Naresh Kumar, 2009, Characteristics of very severe cyclonic storm "NARGIS" over the Bay of Bengal during 27th April to 3rd May, 2008, In Indian Ocean tropical cyclones and climate change, Ed. YassineCharabi, 315-326, Springer Publications Ltd
35. AjitTyagi, B. K. Bandyopadhyay, **M. Mohapatra**, Charan Singh, 2009, Characteristics of very severe cyclonic storm "SIDR" over the Bay of Bengal, In Indian Ocean tropical cyclones and climate change, Ed. YassineCharabi, 327-338, Springer Publications Ltd
36. AjitTyagi; B.K. Bandyopadhyay, **M. Mohapatra**, Charan Singh, and Naresh Kumar, 2009, The First Ever Super Cyclonic Storm "Gonu" Over the Arabian Sea during 01-07 June, 2007 – A Case Study, In Indian Ocean tropical cyclones and climate change, Ed. YassineCharabi, 305-314, Springer Publications Ltd
37. **M. Mohapatra**, Tyagi, Ajit and B.K. Bandyopadhyay, 2009, Monitoring and Prediction of Cyclonic Disturbances over North Indian Ocean by Regional Specialized Meteorological Centre, New Delhi (India): Problems and Prospective, InIndian Ocean tropical cyclones and climate change, Ed. YassineCharabi, 93-103, Springer Publications Ltd
38. U.C. Mohanty etal including **M. Mohapatra**, 2009, Weather summary, analysis and preliminary evaluation of meso scale model during pilot experiment of severe thunderstorms : observations and regional modeling(STORM) programme–2007, Research report, MoES and DST, Govt. of India, New Delhi
39. A.B. Mazumdar, MedhaKhole, **M. Mohapatra** and S. Sunitha Devi, 2009, Semi Permanent Systems & Synoptic Features, Met. Monograph on 'Southwest Monsoon–2008', 7/2009, IMD,
40. **M. Mohapatra**, A. K. Sharma and Suman Goyal, 2009, Utility of Automatic Weather Station (AWS) data for monitoring and prediction of monsoon circulations, Meteorological Monograph on 'Southwest Monsoon – 2008', 7/2009, IMD, Pune
41. R. C. Bhatia, **M. Mohapatra**, S. K. Roy Bhowmik and S. Das, 2008, Utility of automatic weather station data and water vapour derived wind vector in monitoring and prediction of monsoon disturbances, Meteorological Monograph on 'Southwest Monsoon – 2007', 2/2008, IMD, Pune
42. H. R. Hatwar, V. Subrahmanyam, **M. Mohapatra**, B. K. Bandyopadhyaya, S. K. Roy Bhowmik and Kuldip Singh, 2008, Cyclonic storm, 'OGNI' – A case study, Meteorological Monograph Cyclone Warning, 2/2008, IMD, Pune
43. U.C. Mohanty etal including **M. Mohapatra**, 2007, Weather summary, analysis and preliminary evaluation of meso scale model during pilot experiment of severe thunderstorms: observations and regional modeling (STORM) programme – 2007, Research report, DST, Govt. of India, New Delhi

Enclosure I: Publications and Research & Development

(d): Details of Books Edited

1. Annual Cyclone Review- 2007 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2008, WMO, Geneva
2. Annual Cyclone Review-2008 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2009, WMO, Geneva
3. Annual Cyclone Review-2009 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2010, WMO, Geneva
4. Annual Cyclone Review-2010 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2011, WMO, Geneva
5. Annual Cyclone Review-2011 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2012, WMO, Geneva
6. Annual Cyclone Review-2012 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2013, WMO, Geneva
7. Monitoring and prediction of Indian Ocean tropical cyclones and climate change Ed. U.C. Mohanty, **M. Mohapatra**, O.P. Singh, B.K. Bandyopadhyay and L.S. Rathore, 2013, Co-published by Capital Publishers, New Delhi and Springer, Germany
8. High impact weather events over SAARC region, Ed. K. Ray, **M. Mohapatra**, B.K. Bandyopadhyay & L.S. Rathore, 2014, Co-published by Capital Publishers, New Delhi & Springer
9. Annual Cyclone Review-2013 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2014, WMO, Geneva
10. Cyclonic disturbances over north Indian Ocean during 2013, IMD New Delhi
11. Annual Cyclone Review-2013 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2014, WMO, Geneva
12. Cyclonic disturbances over north Indian Ocean during 2014, IMD New Delhi
13. Annual Cyclone Review-2014 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2015, WMO, Geneva
14. Annual Cyclone Review-2015 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2016, WMO, Geneva
15. Annual Cyclone Review-2015 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2017, WMO, Geneva
16. Annual Cyclone Review-2015 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2018, WMO, Geneva
17. Tropical Cyclone Activity over North Indian Ocean, Ed. **M.Mohapatra,** B.K. Bandyopadhyay and L.S.Rathore, 2017, Co-published by Capital Publishers, New Delhi & Springer, Germany, 365 pp.
18. Monsoon 2016- A report, Ed PCS Rao, DS Pai and **M Mohapatra**, 2017, Published by India Meteorological Department, Pune, 374pp.
19. Annual Cyclone Review-2016 for WMO/ESCAP Panel countries, Ed. **M. Mohapatra** and other representatives from WMO/ESCAP Panel countries, 2017, WMO, Geneva
20. Monsoon-2017- A report, Ed O.P. Sreejith, DS Pai and **M Mohapatra**,2018, IMD, Pune
21. Monsoon-2024: A Report, Ed. Dr. M. Mohapatra, Dr RK Jenamani, Dr. Satya Prakash, 2025, IMD New Delhi

Enclosure I: Publications and Research & Development

(e) Details of Journals edited

1. Editor, **Mausam** published by IMD since August 2019
2. Associate Editor, **Journal of Climate Change**, Capital Publishing Co, New Delhi since 2015
3. Editor, Special Issue of Journal, **Mausam** (**Volume, 64, No. 1**) on Proceedings of National Conference on Bay of Bengal Tropical Cyclone Experiment (BOBTEX)-2011, Ed. D.R. Sikka, M. Mohapatra and BK Bandyopadhyay, 2013, IMD, New Delhi
4. Editor, Special Issue of Magazine, „**Geography and You**" on cyclone, **2014,** Published by Iris Publication, New Delhi, India
5. Member of Editorial Board, **Tropical Cyclone Research and Review**
6. Member of Editorial Board, **Vayu Mandal**
7. Member of Editorial Board, **Arabian Journal of Geo Sciences**
8. Guest Editor, Special Issue of **Journal of Natural Hazards**, 2020
9. Chief Editor**, PTC News Letter** since January 2024

Enclosure I: Publications and Research & Development

(f) Reviewer of journals/books: Worked as a Reviewer for publication of research papers in following Journal/ publications

International Journals:

(1) International Journal of Natural Hazards
(2) International Journal, 'Marine Geodesy'
(3) Advances in Space Research
(4) Geomatics, Natural Hazards and Risk
(5) Tropical Cyclone Research and Review
(6) Theoretical and Applied Climatology
(7) Weather and Climate Extremes
(8) Climate Dynamics
(9) International Journal of Remote Sensing

National Journals

(10) Journal of Earth System Sciences
(11) Current Science
(12) Journal, 'Mausam',
(13) Vayu Mandal

Books

1. Indian Ocean Tropical Cyclones and Climate Change, Ed. Yassine Charabi, Sultan Qubus University Muscat, Oman in 2009 and published in 2011 by Springers
2. Monitoring and Prediction of Tropical Cyclones in the Indian Ocean and Climate Change published in 2013 by Springer and Capital Publishers.
3. High impact weather events over SAARC region published in 2014 by Springer and Capital Publishers.
4. Tropical Cyclone Activity over the North Indian Ocean, published in 2017 by by Capital Publishers and Springer, Germany
5. Book on Advances in observation, assimilation and forecasting of tropical cyclones published in 2017 by Springer and Capital Publishers

ENCLOSURE II:

Specialisation: Weather Forecasting and Cyclone Warning Services

Specialisation of Dr. M. Mohapatra, IMD in Weather Forecasting and Cyclone Warning Services included (i) project and programme management, (ii) policy and planning at national and international levels, (iii) Modernisation of Weather Forecasting &Warning System and Services through introduction of new technology, new methodology, national and international collaborations, R&D and warning dissemination mechanism. Details of contribution in this specialized field are given below in section (i) to (iii). The outcome of the specialized contribution made by Dr Mohapatra is presented in Section iv.

(i) Major projects/programmes dealt

- Atmosphere & Climate Research-Modelling Observing Systems & Services (ACROSS) (2019-24)
- Mission Mausam (2024-26)
- Modernisation of Indian Meteorological observational systems and applications (MIMOSA)/ VARSAMAN Project as Associate Project Director.
- Modernisation of Cyclone Warning System as Project Director
- Forecast Demonstration Project (FDP) on landfalling cyclones over Bay of Bengal as Project Director
- WMO South Asia Severe Weather Forecasting Programme as Head of Regional Sub-Project Implementation Team (2014-2019)
- FDP on Severe Thunder Storm Observation and Regional Modeling (STORM) project (2006-18)
- FDP on Winter Weather (2016-19)
- FDP on southwest monsoon (2017-18)
- Impact Based Forecast and Risk Based Warning for severe weather (2019-2023)
- Implementation of Web-GIS for severe weather warning(2019-2021)
- Implementation of Dynamic Composite Risk Atlas for Cyclone in IMD (2018-21)
- Implementation of Common Alerting Protocol (CAP) in IMD (2019-21)
- Development of Indigenous Decision Support System by IMD for daily weather forecasting and warning(2019-24)
- Automation of weather forecasting and warning bulletins & products (2021-25)

(ii) (a)Policy and Planning: National

- Vision document on cyclone and weather forecasting
- Benchmarking of severe weather forecasting
- Standard Operation Procedure (SOP) for weather forecasting and cyclone warning services
- Introduction of district level impact based forecast and its verification for all severe weather events.
- Chairman/member of expert committee for NDMA Guidelines for (i) cyclone management, (ii) Thunderstorm management, (iii) heat wave management
- Chairman of Technical Evaluation Committee for Consultancy on World Bank aided National Cyclone Risk Mitigation Project (NCRMP), Govt. of India
- Disaster Risk Reduction as member of various committees for policy, planning and guidelines

(b) Policy and Planning: International

- Contributed as 3rd Vice President of WMO since 2 June 2023.
- Contributed as Permanent Representative of India with WMO with effect from 10th June, 2019
- Contributed as Member Executive Council, WMO with effect from 13th June, 2019
- Contributed as Chairman of WMO/ESCAP Panel on Tropical Cyclones over Bay of Bengal and Arabian Sea for 2017-2018for development of Coordinated Technical Plan
- Contributed as Chairman for Regional Sub-Project management Team for WMO"s SWFDP-Bay of Bengal and prepared implementation plan

- Contributed as Rapporteur of WMO/ESCAP Panel on Tropical Cyclones for development and updating of Annual Tropical Cyclone Operational Plan for the region
- Contributed as Chairman of Executive Council, South Asia Hydromet Forum
- Contributed as Chairman of WMO RA II Task Team for review of regional partnership and sub-regional cooperation (TT-RP)

(iii) Modernisation of Weather Forecasting &Warning System and Services:

(a) Introduction of Scientific and technological methodology:

- Development of indigeneous GIS based Decision support System
- Pre-genesis forecast from the stage of low pressure area for next 72 hours from 2022
- Automation of Weather Bulletins at National level from 2021
- Introduction of Graphical Marine Bulletins (QGIS) from 2021
- Introduction of Geospatial applications from 2021
- Implementation of Web based Dynamic Composite Risk Atlas from 2020
- Increase in lead period of cyclogenesis forecast to 3 days from 2014, 5 days from 2018 and 7 days from 2023
- Extended range forecast of cyclogenesis for next two weeks issued every Thursday from 2018,
- Track, cone of uncertainty & intensity forecast upto 72 hrs since 2009 and 120 hrs since 2013
- Track and intensity forecast from deep depression stage since 2009 and from depression stage since 2018
- Hourly update on day of landfall since 2013
- Nowcasting of severe weather for all districts round the clock and for 1084 cities and towns
- Bi-weekly outlook for all severe weather events
- Forecast demonstration project for all severe weather events round the year from 2016
- Prognostic & diagnostic features and cyclone since 2009 and other severe weather events since 2016
- Warning graphics since 2009,
- Fishermen warning for entire north Indian Ocean valid upto five days from 2018.
- Colour coded impact based forecast & warning for all districts, capital cities & all severe weather events from 2018 and warning with impact information & suggested actions since 2020 in nowcast and short to medium range forecast scale.
- Introduction of Movie loop on 5 days forecasts & warning in IMD website Door Darshan
- Synergised SOP with INCOIS for sea state, marine weather and cyclone forecasting.
- Verification of forecast from 2008 and for past forecasts upto 2003 for heavy rain and cyclone.
- Verification of forecast from 2008 and for past forecasts upto 2003 for heavy rain and cyclone.
- Introduction of Sub-city forecast in 2020
- Modification of NDMA guidelines for thunderstorm, lightning, heat & cold wave and fog in 2019
- Extension of city forecast to 518 stations in 2020
- Extension of nowcast for all severe weather and all districts and 1084 stations by 2021
- Cyclone forecast in GIS in 2020
- Extensive use of social media including press release, press conference, Facebook, Twitter, Instagram, Blog, You Tube, Videos, whats-app group etc since 2019
- Augmentation of Sectoral applications
  - Implementation of IFLOWS for Chennai, Mumbai and Kolkata for urban flood warning
  - Introduction of probabilistic quantitative precipitation forecast for all river basins upto 5days
  - Introduction of extended range forecast for river basins
  - Introduction of Flash Flood Guidance System for South Asia
  - Agriculture sector (Connectivity among SMS, MCs/RMCs through VC and Whats app group, dissemination improvement)
  - Graphics product for fishermen warning covering entire north Indian Ocean, IBF over Ocean
  - Augmentation of model guidance, observational network and number of airports under

Udaan Scheme

- Observational and forecast service for Railways along the Railway line
- Observational and Forecast services for Golden Quadrilateral
- Customised forecast for offshore Oil & Exploration Operators from 2022

(b) Introduction of new technology:

- Development of indigenous **Decision Support System on GIS platform**
- Development of Multi Model Ensemble technique for cyclone track, intensity, structure and landfall and rainfall, wind and temperature forecasts
- Adaption of new versions of global & regional deterministic & ensemble models
- Implementation of atmosphere Ocean coupled Hurricane weather research forecast model
- Tropical Cyclone Module and Ensemble prediction system (EPS)
- Synthetic vortex of cyclone for NWP model improvement.
- Implementation of IIT Delhi storm surge model and INCOIS Coastal inundation model
- Digital Forecasting workstation and PWS
- Visualisation tool and decision support system, METCAP PLUS
- Development of forecasting infrastructure for all MCs and RMCs
- Implementation of GIS application in weather forecasting
- Automation of weather monitoring and forecasting products generation and presentation
- Multi-model ensemble based Long range forecast of spatial distribution of monsoon rainfall for individual months of the season and season as a whole
- Implementation of Common Alerting Protocol (CAP), social media, multilingual bulletins, video and graphics for forecast and warning dissemination.

(c) Networked programmes initiated/conducted:

- **Between lab to lab** Network programmes initiated and continued with

(i) INCOIS for storm surge modeling, HWRF modeling and warning dissemination
(ii) NIOT for meteorological buoy network planning and data exchange and evaluation
(iii) NCMRWF for implementation of global deterministic and ensemble models,
(iv) ISRO for customized satellite product development, planning and validation
(v) IAF, Indian Navy for meteorological observations including lightning data
(vi) IIT Delhi for storm surge modeling, coastal inundation
(vii) IIT, Bhubaneswar for HWRF Modeling

- **Bilateral/Multilateral** network programmes conducted with

(i). NOAA USA for adaptation of HWRF model in IMD,
(ii). JMA for Ensemble prediction system,
(iii). WMO/ESCAP Panel for regional cyclone operational plan,
(iv). WMO Typhoon Committee for synergized SOP for coastal multi-hazard warning,
(v). WMO's Severe weather forecast Programme(SWFP)-southeast Asia
(vi) WMO's SWFP-South Asia for forecast on heavy rain, wind, wave & storm surge
(vii) International best track archives for climate stewardship (IBTrACS), USA
(viii) Typhoon committee and WMO/ESCAP Panel on Tropical Cyclones for synergized standardized Operation procedure (SSOP) for coastal hazards in the region
(ix) NDMA and state Govts for Guidelines and common alert protocol,
(x) Bureau of Indian Standards for Standardisation of smart cities, cyclone shelters etc,
(xi) Ministry of Urban Affairs for preparation of Vulnerability Atlas

(d) R&D activity

- **Forecast demonstration Programmes (FDP)** on landfalling cyclones during 2008-2022
- **FDP** on winter season severe weather events since 2016-17
- **FDP** on pre-monsoon convective weather systems since 2017
- **FDP** on southwest-monsoon season since 2017
- **Data bases prepared** for R&D activity: **(i)** Six hourly best track parameters of cyclones during 1982-2024, **(ii)**Digitisation of Annual RSMC Reports during 1990-2024, **(iii)** Hazard proneness of

coastal districts, (**iv**) Tropical Cyclone Energy Metrix, (**v**) Life Cycle, (**vi**) Structure, (**vii**) Translational Speed and direction of Movement since 1990 onwards

- Organisation Conference and Workshops and Publication of research papers

(e) Warning dissemination mechanism:

Introduced **(i)** Press Conference, **(ii)** Press release, **(iii)** Dedicated website/web page for cyclone and other severe weather events, **(iv)** SMS alert to fishermen, farmers, disaster managers with extension of whats app groups upto active farmers, **(v)** Email for warning service (**vi**) Implementation of common Alert protocol for warning dissemination, (**vii**) Implementation of warning dissemination through social media. (viii) Development of new website for general public (www.mausam.imd.gov.in), development of mobile apps (Umang, Damini, Meghdoot and Mausam)

(f) Confidence building measures for disaster managers:

- ❖ Organisation of users workshop for severe weather and documentation of each cyclone and its forecast since 2008
- ❖ Pre-cyclone and pre-monsoon excercises with disaster managers
- ❖ Verification of all forecasts

(g) Outreach programmes

- FAQs, Terms and Terminology of weather monitoring and forecasting,
- Popular talks/lectures, Popular articles
- **Production of video films on**
  i. A Glorious Decade of IMD (2006-2016) released on First Decadal Celebration of Ministry of Earth Sciences, Govt. of India
  ii. Cyclone Warning in India: A Success Story, released on Foundation Day of India Meteorological Department on 15 January 2017.
  iii. Early Warning System of IMD released on Foundation Day of India Meteorological Department on 15 January 2019.
  iv. Cyclone Warning and Management in India: An End to End System
  v. IMD in the service of Nation since 1875
  vi. Achievements of IMD during last decade (2014-23)
  vii. Mission Mausam

(iv) Outcome:

1. Improvement in forecast accuracy:

There has been significant improvement in forecast accuracy with respect to severe weather events including tropical cyclones, heavy rainfall, fog, heat wave, cold wave, thunderstorm. Overall, there has been an improvement of 30-40% in forecast accuracy of various severe weather events during last 10 years. The details are given below.

(a) Tropical Cyclones:

Comparing the performance during past 5 years (2020-2024) with preceding 5 years (2015-19), the track forecast errors have decreased from 81 km, 126 km & 171 km during 2015-19 to 72 km, 111 km & 154 km during 2020-2024 for forecast issued for 24 hours, 48 hours and 72 hours ahead. The landfall point forecast errors of 45 km, 69 km, 109 km during 2015-19 have decreased to 16 km, 39 km and 70 km during 2020-24 for forecast issued 24 hours, 48 hours & 72 hours ahead of landfall of cyclone. The intensity (wind) forecast errors have decreased from about 8.9, 13.0, 15.4 knots during 2015-2019 to 5.9, 8.3, 9.8 knots during 2020-2024 for the forecast issued 24, 48 and 72 hours ahead..

(b) Heavy rainfall:

The heavy rainfall forecast issued in 2023 five days ahead has the accuracy of about 52% against the forecast accuracy of 50% in 2014 only 24 hrs ahead. Thus there is a gain of four days in lead period of forecast of heavy rainfall in 2023 as compared to 2014.

(c) Heat wave: The probability of detection in case of heat wave at meteorological subdivision levels has improved from 67% (2014) to 95% (2023).

(d)Thunderstorm: The probability of detection (POD) for thunderstorm warning with 24 hr lead period has improved from 52% during 2016-19 to 85% during 2020-23 (an improvement of 33%).

2. Reduction in loss of lives & properties

There has been improvement in confidence of disaster managers and the society benefitted in terms of security to life and property in NIO region as given below:

(a) Improvements in cyclone warning services increased confidence of disaster managers and public to manage cyclones. According to National Centre for Applied Economic Research Survey in 2015, more than 95 percent population believe and appreciate cyclone warnings by IMD. Survey in 2020 indicated huge reduction in losses to farmers and fishermen.

(b) Minimum loss of human lives(limited to double digits) in recent years due to TCs (Dana(2024), Biparjoy(2023), Tauktae(2021), Yaas(2021), Amphan(2020), FANI(2019), Titli(2018), Hudhud(2014), Phailin(2013)), against 10,000 during Odisha Super Cyclone(1999) in India

(c) Decrease in area of evacuation by 300km and evacuation cost by 60 percent in 20 years.

(d) Decrease in exgratia paid by Govt. by 99 percent compared to 1999.

(e) Gains to various sectors like power, communication, health, offshore industries, transport, marine (ship, fisheries), aviation, hydrology and agriculture. Power sector saved around 500 crores (60 million USD) using cyclone warnings during Phailin(2013) and Hudhud(2014) each.

(f) 590 crores (70 million USD) in exgratia payments and 32 crores (4 million USD) in evacuation are saved for each landfalling cyclone against 437 crores (52 million USD) towards cost of modernisation programme of IMD during 2007-10.

(g) TC advisories and capacity building programmes helped reduce number of deaths in NIO countries to double digit in recent years (Remal (Chapala (2015), Megh (2015), Sagar(2018), Mekunu(2018), Luban(2018), Bulbul (2019), Amphan(2020), Tej(2023), Remal(2024)) against thousands in past 10 years (1,40,000 deaths during Nargis in Myanmar, 2008).

h) He also contributed to significant improvement in services to Farmers as per details below;

- ❖ substantial 52.5% increase in income due to optimal utilization of advisories to farmers by IMD.
- ❖ Among agricultural households in rain-fed areas below the poverty line (BPL), the adoption of weather advisories resulted in an additional income of ₹12,500 per household annually, providing a crucial financial cushion for this vulnerable group.

i) His contribution to the in-house development of the WebGIS-based Decision Support System has resulted in significant cost savings of approximately ₹250 crore. Previously, this system was procured from MFI France for weather forecasting, but with its indigenous development, IMD has successfully eliminated the need for external procurement, enhancing self-reliance and reducing operational expenses. It has also saved annually ₹5cr towards AMC of decision support system.

3. Awards and appreciations to India and IMD/MoES

Awards and Appreciations are received to India and IMD/MoES from various national and international agencies including UN, WMO and countries of south Asia and middle east. Notable awards earned for IMD include:

(a) World Congress of Disaster Management (WCDM) Disaster Risk Reduction (DRR) Award, 2022

(b) ICHL 2013 Award for Excellence in Humanitarian Action for early warning services during cyclone Phailin in 2013

Enclosure III:

(a) Summary of Scientific Contributions of Dr Mrutyunjay Mohapatra

- India received worldwide accolades due to remarkable improvement in cyclone warning services by India Meteorological Department (IMD) enabling reduction in human deaths to less than 100 due to cyclones and significant reduction in loss of property since 2010. Accurate prediction of Biparjoy cyclone(2023) enabled disaster managers achieve zero death over Gujarat.
- Above achievement was possible with contribution of Dr Mohapatra as Project Director of modernisation of cyclone warning and weather forecasting services of IMD since 2007, Head of WMO recognised Regional Specialised Meteorological Centre since 2008, Head(Services) since 2016 and DG, IMD since 2019.
- He led upgradation of early warning services for severe weather including cyclones, impact based forecast(IBF) and risk based warnings(RBW) and addressed holistically (i)policy, (ii)planning, (iii)vision, (iv)strategy, (v)observations, (vi)monitoring, (vii)analysis, (viii)modelling, (ix)forecasting, (x)early warning generation, (xi)dissemination, (xii)capacity building, (xiii)confidence building and (xiv)outreach. My contributions led to development and modernization of end to end cyclone warning system of India which is better than many leading centres of world today.
- For improvement in policy and planning, he developed Vision 2020 document in 2010 and Vision 2030 in 2015. It helped in planning of cyclone observational, monitoring, analysis, modeling and forecasting system. Following benchmarking procedure, he fixed target of improving cyclone forecast accuracy by 20 percent by 2015 and 40 percent by 2020. Already IMD has crossed this benchmark set for 2020 by 2015. There is improvement in cyclone track(path) forecast accuracy by 60 to 70 percent and landfall forecast accuracy by 70 to 80 percent by 2020 compared to 2010. While 48 hour track forecast accuracy was 50% less than that of USA in 2010, it is better than USA by 30% in 2020.
- He contributed in standardization of various operational procedures, National and International Guidelines for monitoring and prediction of cyclones. He modified standard operation procedure(SOP) for cyclone monitoring and forecasting services by IMD(2013 and 2021), updated annual cyclone operational plan for WMO ESCAP Panel countries (since 2010) and South Asia Severe Weather Forecasting Plan (since 2016). He contributed in development of NDMA guidelines for Cyclone Management(2008) and revised these guidelines as Chairman in 2018. He Chaired Technical Committee for development of web based decision support system under National Cyclone Risk Mitigation Project (since 2018). He led team IMD for indigenous development of Decision Support System for all severe weather events.
- Based on strategy document, he played active role for introduction of new technologies in monitoring and forecasting of cyclones such as (i) establishment of digitised forecasting platform replacing conventional system and public weather services system, (ii) cyclone decision support system (iii)adoption of new versions of global and regional deterministic and ensemble prediction systems, storm surge and coastal inundation models (Mohapatra et al, 2013). His contribution in numerical modeling led to customization of high resolution meso-scale model for cyclone and associated adverse weather prediction (a. Osuri, Mohapatra et al; 2013; Journal of Applied Meteorology & Climatology; b. Osuri and Mohapatra et al, 2012, Natural Hazards; c. Mohanty and Mohapatra et al, 2010, Marine Geodesy and d. Osuri, Mohapatra et al, 2010, IJRS).
- Introduced scientific methodology like (i)extension of lead period of cyclogenesis forecast from 1 day(2008) to 3 days(2014) to 5 days(2018) to 7 days(2023), (ii)cyclone track and intensity forecast from 24 hrs(2009) to 120 hrs(2013), (iii)2 weeks advance forecast for cyclogenesis(2018), (iv)fishermen warning for next 5 days for entire North Indian Ocean(2018) against previous one day forecast along Indian coast, (v)impact based forecast(IBF) and risk based warning(RBW) upto district level for severe weather(2019), (vi)web GIS tool, (vii)customized objective sectoral forecast for ports, shipping, off shore operations, fisheries, power, urban, hydrology, health, transport and agriculture, (viii)forecast verification(2005) for further improvement, (Mohapatra and Sharma, 2019). Introduction of technology & scientific methods for improving track, intensity & structure forecasting(Mohapatra et al, 2013, JESS; Mohapatra et al, 2013, Natural Hazards; Mohapatra et al, 2015, Mohanty, Mohapatra, et al, 2015,

Earth Interactions and Mohapatra & Sharma, 2015, JESS, Mohapatra and Kumar, 2017, Climate Dynamics) and associated adverse weather including heavy rain, gale wind, storm surge forecast(Mohapatra, 2015, TCRR, Srinivas Kumar, Mohapatra et al, 2015, Marine Geodesy, Murty, Mohapatra et al, 2017, Ocean Engineering) helped in improving forecast accuracy, increased lead period, impact and action oriented warning. The track forecast accuracy increased by 70 percent and landfall forecast accuracy by 80 percent by 2020 compared to 2010.

- His contribution to development of decision support system led to objective decision making and significant improvement in accuracy of severe weather forecasting and service delivery.
- His contribution towards development of impact-based forecast and risk-based warnings for severe weather events like tropical cyclones, thunder storms, heat wave, cold wave, heavy rainfall, flooding etc. led to early and effective actions for disaster mitigation
- His contribution towards enhancing sectoral applications especially in the field of agriculture, urban, power, health, hydrology, environment, agriculture, surface transport, aviation, marine weather and tourism helped in minimizing losses and enhancing the optimal use of weather information for socio-economic activities.
- His contribution towards development of Meteogram helped in implementation of "Har Har Mausam, Har Ghar Mausam" (weather information at any time and at any place), so as to enable anyone to access weather forecast anywhere at anytime.
- His research contributions (more than 165 papers) led to (i)better understanding of the physical processes associated with cyclones, (ii)customization of models and (iii)value addition to model guidance. It led to significant improvement in all components of Cyclone Warning System including early detection of cyclogenesis and forecast of track, intensity, landfall, structure, heavy rain, gale wind and storm surge.
- His research contributions in cyclone hazard proneness mapping are utilized by Government in planning and execution of National Cyclone Risk Mitigation Project (NCRMP) to plan cyclone shelters and disaster resilient infrastructures in cyclone prone districts. His research contributions on climate change impacts on cyclones help in planning mitigation measures.
- He improved outreach and warning dissemination with introduction of (i)common alerting protocol (CAP), (ii)dedicated websites, (iii)SMS based warning, (iv)warning through social media (facebook, Twitter, Whatsapp, Instagram, Youtube), mobile app, multi lingual bulletins, videos, (v)users workshop, (vi)pre-cyclone exercise, (vii)post cyclone review, (viii) frequently asked question, terms, terminologies, brochures and (ix)popular lectures.
- His contribution towards development of common alerting protocol (CAP) by National Disaster Management Authority led to extension of outreach with warnings reaching to every mobile holder in the affected region
- He contributed towards capacity building by (i)organizing trainings, workshops, conferences; (ii)delivering lectures and talks, (iii)documenting each cyclone since 2008; (iv)developing (a)cyclone database including cyclone electronic Atlas, (b)dedicated websites; (v)establishing national and international collaborations; (vi)publishing more than 144 research papers.
- All the above helped in better management of cyclones by disaster managers leading to minimum loss of human lives (double digits) since 2010, decrease in area of evacuation by 300km in 20 years, evacuation cost by 60 percent and exgratia payments by 99 percent compared to Odisha Super Cyclone (1999) and Kandla Cyclone (1998).

(b) Summary of Societal Contributions of Dr Mrutyunjay Mohapatra

Due to improvement in cyclone warning system led by Dr. Mohapatra, there is increase in confidence of disaster managers and public to manage cyclones. It has resulted in

- Minimum loss of human lives (limited to double digits) in recent years (Biparjoy-0, Tauktae-65, Amphan-76, FANI-64, Titli-85, Hudhud-46, Phailin-21, Biparjoy-0, Dana-0 against 10,000 deaths during Odisha Super Cyclone in 1999)
- Decrease in area of evacuation by 300 km and evacuation cost by 60 percent in 20 years.
- Decrease in ex-gratia paid by Govt. by 99 percent compared to 1999.

- ❖ Gains to various sectors such as power sector saved around 500 crores each using cyclone warnings during Phailin (2013) and Hudhud (2014).
- ❖ Gains to sectors like Oil & Exploration, marine, fishery in terms of saving of life and property.
- ❖ About Rs590 crores in ex gratia payments and Rs32 crores in evacuation are saved for each landfalling cyclone against Rs437 crores towards cost of modernisation programme of IMD during 2008-12.
- ❖ His contributions not only benefitted India, but also 13 Bay of Bengal and Arabian Sea countries. The number of deaths due to cyclones hitting these countries in recent years is limited to less than 100 in recent years (Sagar-53, Mekunu-26, Luban-14, Chapala-5, Megh-18, Bulbul (6), Amphan (18), Biparjoy & Dana (0)) against deaths in lakhs ten years back (1,40,000 deaths due to Nargis, Myanmar in 2008).
- ❖ Based on independent Survey by National Centre for Applied Economic Research (NCAER) in representative states of Andhra Pradesh and West Bengal in 2015, more than 95 percent population believe and appreciate cyclone warnings by IMD.

h) He also contributed to significant improvement in services to Farmers leading to substantial gains to them as per details below;

- ❖ 52.5% increase in income due to optimal utilization of advisories to farmers by IMD.
- ❖ Among agricultural households in rain-fed areas below the poverty line (BPL), the adoption of weather advisories resulted in an additional income of ₹12,500 per household annually, providing a crucial financial cushion for this vulnerable group.

Thus, society benefitted in terms of security to life and property in India and neighboring countries.

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