## ACHIEVEMENTS

Visit of HMoES (Hon'ble Minister of Earth Sciences)

The Hon'ble Cabinet Minister of Earth Sciences, GoI, Shri Kiren Rijiju along with Secretary, MoES, GoI, Dr. M. Ravichandran visited several R&D facilities and laboratories at IITM & interacted with researchers. He took stock of the various R&D projects being executed by IITM and discussed future directions.

Visit of Shri Kiren Rijiju, Hon'ble Cabinet Minister of Earth Sciences, Govt. of India.

IITM signed two MoUs with Tezpur University, Tezpur, Assam and Aryabhatta Research Institute of Observational Sciences (ARIES), Nainital, Uttarakhand (for Metflux Project of CCCR). The MoUs were signed by Dr. R. Krishnan, Director, IITM and the respective registrars of Tezpur University and ARIES. The MoU with Tezpur University aims to promote collaborative research on biosphere-atmosphere exchange of Greenhouse Gases and Energy Fluxes being monitored at the Kaziranga National Park, Assam. The MoU with ARIES targets collaborative research on biosphere-atmosphere exchange of Greenhouse Gases and Energy Fluxes being initiated at Devasthal, near Nainital in Uttarakhand.
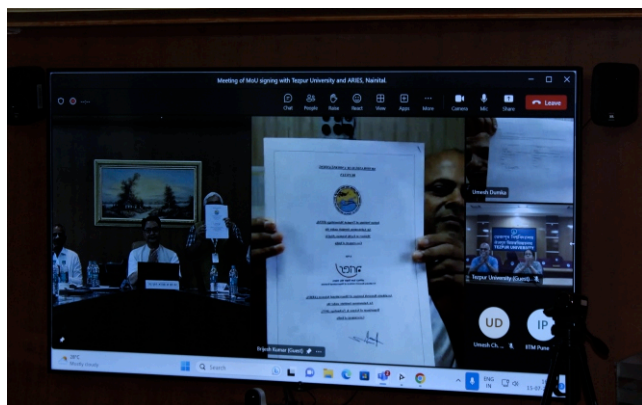
MoU signed between IITM and Tezpur University

The latest issue of IITM's in-house Rajbhasha magazine 'Indradhanush was released by the hands of HMoES.

Shri Kiren Rijiju, Hon'ble Cabinet Minister of Earth Sciences releasing in-house 'Rajbhasha' magazine.

Dr. R. Krishnan, Director, IITM delivered an invited talk on Monsoon Mission during the 17th Foundation Day of the Ministry of Earth Sciences (MoES) on 27 July 2023.

CAIPEEX report, entitled "Cloud Aerosol and Precipitation Enhancement Experiment CAIPEEX Cloud Seeding Experiment Results and Recommendations" has been released by the Honorable Minister Kiren Rijiju, Ministry of Earth Sciences, Govt. of India during the MoES 17th Foundation Day on 27 July 2023. The Report is available on IITM website (https://tropmet.res.in/399-news_details).

Shri Kiren Rijiju, Hon'ble Cabinet Minister of Earth Sciences releasing 'CAIPEEX' report.

Urban Mesonet for Delhi has been approved by Hon. Secretary, MoES. The collaborative work with NCMRWF for data assimilation has been started by sharing sample data sets from C-band radar, Wind Profiler, Radiosonde, Microwave radiometer and Disdrometer observations.

C-band radar at Solapur is now operational and the plots are being shared with IMD and made available at

https://mausam.imd.gov.in/responsive/radar.php?id=Solapur.

The Cloud Aerosol Interaction and Precipitation Enhancement Experiment (CAIPEEX) is a state-of-the-art experiment conducted by IITM Pune to evaluate the efficacy of cloud seeding over the arid regions. CAIPEEX followed the WMO recommendations for the scientific investigation of cloud seeding. The experiment has contributed to 267 randomized samples of convective clouds seeding. The cloud base (hygroscopic seeding) was conducted with aircraft, radar and rain gauges are used to document the seeding impact. The report includes the evaluation of these experiments, outcome, recommendations.

CAIPEEX was done in four phases and the lessons learned from the first three phases are used to plan and execute the fourth phase. CAIPEEX IV phase has shown that there is a relative enhancement of rainfall in the seeded samples compared to no-seed samples. The rainfall can be enhanced by up to $\cong 46\pm13$ percent at some locations and on average based on the raingagues, $\cong 18\pm2.6$ percent in 100 square kilometers (km2) area in the downwind of seeding location over the rain shadow region of Solapur, Maharashtra. https://www.tropmet.res.in/~lip/Publication/Technical-Reports/CAIPEEX-Report-July2023.pdf

IITM participation in EKAMSAT/ ASTRAL (Arabian Sea Transition Layer) cruise field campaign during 8-26 June 2023 over Arabian Sea:

This is first time that concurrent observations of black carbon aerosols (BC) have been made over the Arabian Sea as well as over the inland location Solapur, Maharashtra by the CAIPEEX team during the summer monsoon period over the important geographical region.

Winter Fog Experiment (WiFEX): Review meeting on the "Winter Fog Experiment (WiFEX): Retrospect and Foresee" was held at IITM, Pune on 17 July 2023 under the Chairmanship of Dr. K.J. Ramesh. More Photos at: https://www.tropmet.res.in/204-gallary

Winter Fog Experiment (WiFEX) review meeting

Monsoon Mission

The Extreme Forecast Index (EFI) has been developed at IITM using the 10 years of climatology of Global Ensemble Forecast System (GEFS). The EFI is generated for 5 days lead time and has been handed over to IMD for operational implementation on daily operational forecast.

Unified model framework for Monsoon Variability and Predictability (UMVP) has participated in the ILS4P project of GEWEX, to inter-compare model and find/understand sources of monsoon predictability associated with soil temperature and snow of elevated region on S2S time scale.

Centre for Climate Change Research (CCCR)

Project entitled "Assessing the Miyake events and bomb pulse 14C using the speleothems" have been defended successfully at the Inter-University Accelerator Centre, New Delhi for studying the radiocarbon content in the U/Th dated speleothem.

Climate Variability and Prediction

Successfully implemented CMIP6 stratospheric aerosol forcing monthly data (AOD) from 1850-2014 into the ESM model for decadal hindcast/prediction. Also implemented volcanic and climatological tropospheric aerosol data for both SW and LW.

IITM Monsoon Discussion Forum (IMDF)

The first discussion seminar of this series for the year 2023 was organised on 3 August 2023 by IITM Scientists.

ICRC-CORDEX 2023 Conference

IITM Hub of International Conference on Regional Climate – Coordinated Regional Climate Downscaling Experiment 2023 (ICRC-CORDEX 2023) was successfully organized in a hybrid mode, at Indian Institute of Tropical Meteorology, Pune & Trieste, Italy, during 25-29 September 2023. It was attended by 67 offline (in person) participants and 36 online participants. For more, see the Important Events Section.

Dignitaries on dias, Lamp lighting and Participants

Global Forecast System for Short Range Forecast

The experimental IITM HGFM (Tco1534) global model at horizontal resolution of ~6.5 km over global tropics has been run on MoES HPC "PRATYUSH" daily to generate 10 days forecast.

Air Quality Early Warning System (AQEWS)

An MoU has been signed between the Rajasthan State Pollution Control Board (RSPCB) and the Indian Institute of Tropical Meteorology (IITM), Pune on 26 September 2023. The project aims to give early warning and decision support for air quality management in Jaipur.


MoU signed between RSPCB and IITM

RESEARCH HIGHLIGHTS

On the modern deep learning approaches for precipitation downscaling

In this work, a DL-based downscaling was carried out to estimate the local precipitation using gridded data from the India Meteorological Department (IMD). To test the efficacy of different DL approaches, it applied SR-GAN and three other contemporary approaches (viz., DeepSD, ConvLSTM, and UNET) for downscaling and evaluating their performance. The downscaled data is validated with precipitation values at IMD ground stations. This study has found overall reasonably well reproduction of original data in SR-GAN approach as noted through M.S.E., variance statistics and correlation coefcient (CC). This DL method offers a promising alternative to other existing statistical downscaling approaches. It is noted that superiority in the SR-GAN approach is achieved through the perceptual loss concept, wherein it overcomes the issue of smooth reconstruction and is consequently able to capture better fine-scale details of data considered. (Kumar Bipin, Atey K., Singh B.B., Chattopadhyay R., Acharya N., Singh Manmeet, Nanjundiah R.S., Rao Suryachandra A, Earth Science Informatics, 16, June 2023, DOI:10.1007/s12145-023-00970-4, 1459-1472)
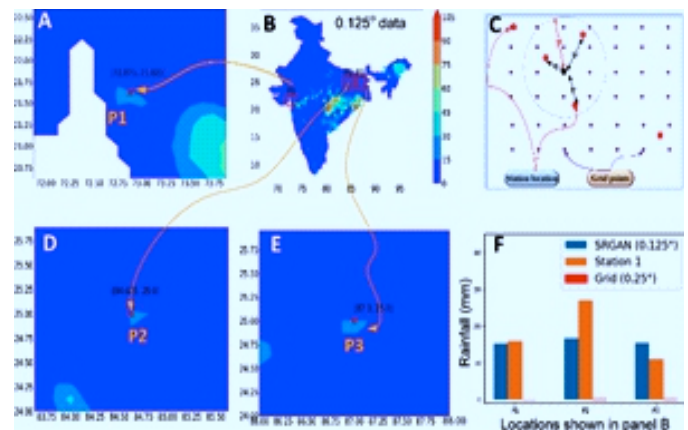
Fig. 1: Validating the extra points obtained from the SR-GAN method for high-resolution data. The additional rainfall points obtained are shown in panel (B). The zoomed versions of those points are represented in panels (A, D, and E). We used a search radius of 12 km to locate the nearest ground station, as depicted in panel (C). In this panel, the blue dots represent grid points in gridded data, and the red dots represent the IMD station locations. Panel (F) compares the predicted rainfall values, and actual values recorded at the nearest stations

Natural short-lived halogens exert an indirect cooling effect on climate

This study shows that short-lived halogens exert a substantial indirect cooling effect at present (–0.13±0.03 watts per square metre) that arises from halogen-mediated radiative perturbations of ozone (–0.24±0.02watts per square metre), compensated by those from methane (+0.09±0.01watts per square metre), aerosols (+0.03±0.01watts per square metre) and stratospheric water vapour (+0.011±0.001watts per square metre). Importantly, this substantial cooling effect has increased since 1750 by –0.05±0.03watts per square metre (61per cent), driven by the anthropogenic amplification of natural halogen emissions, and is projected to change further (18–31per cent by 2100) depending on climate warming projections and socioeconomic development. Finally It concludes that the indirect radiative effect due to short-lived halogens should now be incorporated into climate models to provide a more realistic natural baseline of Earth's climate system.(Saiz-Lopez A., Fernandez R.P., Li Q., Cuevas C.A., Fu X., Kinnison D.E., Tilmes S., Mahajan A.S., Martín J.C.G., Iglesias-Suarez F., Hossaini R., Plane J.M.C., Myhre G., Lamarque J.F, Nature, 618, June 2023, DOI:10.1038/s41586-023-06119-z, 967–973)
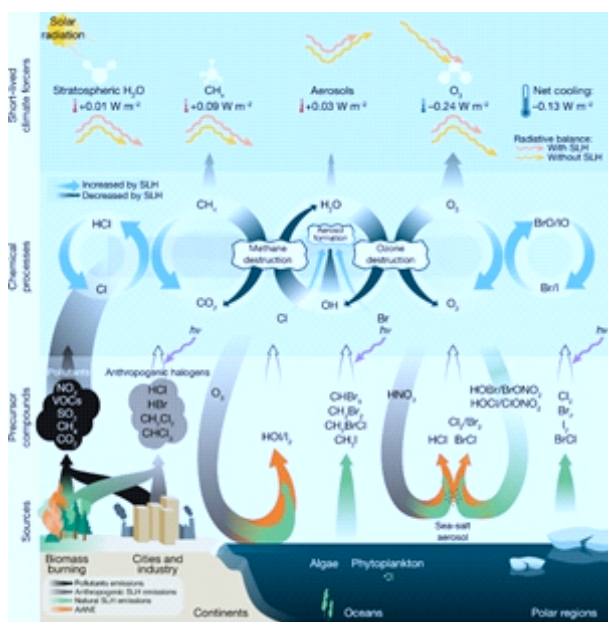

Fig. 2: Conceptual representation of the SLH influence on atmospheric composition and radiative feedbacks within the climate system. Halogens influence the climate system through direct changes in O_3 and OH radical chemical cycling, which in turn regulate the abundance of radiatively active SLCF such as CH_4, aerosols and stratospheric water vapour (H_2O). The widening (thinning) of the semi-circular arrows within the chemical process layer represents an enhancement (reduction) of the efficiency of the direct SLH-driven (light blue) and indirect OH-driven (dark blue) chemical recycling of CH_4, H_2O and O_3. The green, grey and black upwards arrows within the precursor's layer are the direct emissions of natural SLH, anthropogenic SLH and anthropogenic air pollutants, respectively. The U-shaped arrows show natural atmospheric cycling processes of halogenated (greenish tail) and anthropogenic (greyish tail) chemical reservoirs, respectively, both of which have been anthropogenically amplified (orange head) and altered the baseline state of the climate system. The length variation of the curly yellow and pink arrows on the uppermost SLCF layer represents the effect induced by SLH on Earth's radiative balance. The individual warming and cooling effect of each individual SLCF, as well as the net SLH-driven cooling RE, are synthesized as coloured thermometers. Figure 5 was created by NorArte Visual Science (https://www.norarte.es/en/) upon request.

Improving the subseasonal variability of the Indian summer monsoon in a climate model

Many global climate models, including the Climate Forecast System version 2 (CFSv2), have a biased representation of subseasonal modes of variability of the Indian summer monsoon. For instance, they simulate a weaker summer mean monsoon low-pressure systems (LPS) climatology, faster than observed northward propagation of monsoon intraseasonal oscillations (MISOs), and a systematic dry bias over Indian landmass. The Bay of Bengal (BoB), with its shallow mixed layers and unique thermal stratification, significantly modulates the convective activity in this region at subseasonal-to-seasonal timescales through modulation of sea surface temperature. The highly stratified upper ocean in the BoB is due to the enormous freshwater it receives from rains and rivers. A river routing model is coupled to the CFSv2 to account for the riverine freshwater and the improvements in modelling the upper-ocean structure are analysed. Model simulations indicate that inclusion of temporally varying riverine freshwater improves the upper-ocean state in the BoB and the observed mixed-layer temperature gradients in the Bay are simulated reasonably after incorporating the time varying river runoff. This resulted in increased LPS lifetime and track density, and enhanced rainfall over central India. Better

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representation of the upper-ocean stratification in the model leads to larger post-convection shoaling of mixed layers at intraseasonal timescales, thereby forming thick barrier layers. Enhanced air–sea interactions restricted to the shallow mixed layer are associated with stronger vorticity, specific humidity and low-level convergence to the north of the intraseasonal convection band. This enhanced low-level moisture convergence north of the convection centre results in realistic northward propagation of MISO and aids LPS activity. It is demonstrated that better simulation of the upper-ocean structure in coupled climate models can improve the representation of subseasonal modes of monsoon variability. These results bear important implications for operational forecasting. (Srivastava Ankur, Rao Suryachandra A., Ghosh S., International Journal of Climatology, 43, September 2023, DOI:10.1002/joc.8142, 5227-5247)
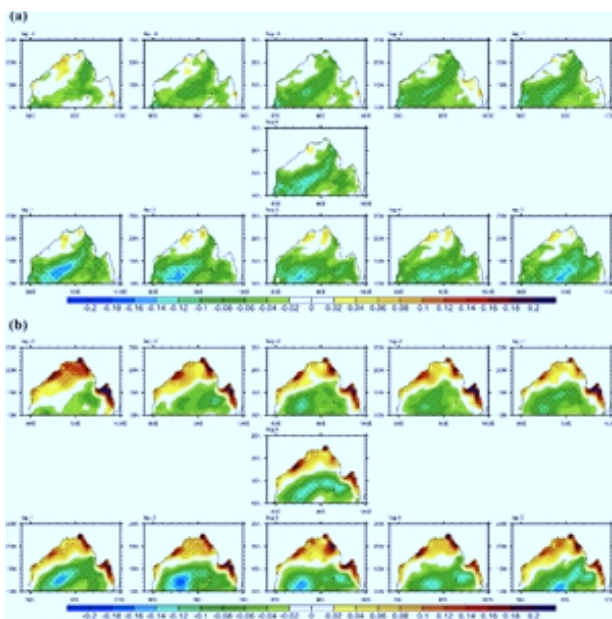

Fig. 3: The lag composites of RIV-CTL differences (×10¹°C·day−1) in the mixed-layer heat budget terms centred on the LPS genesis (lag 0 denotes the day of LPS genesis). (a) Mixed-layer temperature tendency and (b) net surface heat flux (SHF). Differences significant at 90% confidence level are stippled.

Diagnostics and real-time extended range prediction of cold waves over India

This study proposes an objective criterion using the actual, departure from normal and the percentile values of the daily gridded minimum temperature (Tmin) data for the monitoring of the CW events over the Indian region and also checks its usefulness in a multi-model ensemble extended range prediction system. Utilizing this proposed criterion and considering the number of average CW days/year for the entire study period and recent decades, the CW prone region has been identifed. By calculating the standardized area-averaged (over the CW prone region) Tmin anomalies time series, the CW events are identifed over the period 1951–2022. Analyzing the temporal variability of these events, it is seen that there is no compromise in the occurrences of the CW events even under the general warming scenarios. The multi-model ensemble prediction system is found to be reasonably skilful in predicting the CW events over the CW prone region up to 2–3 weeks in advance with decreasing confdence in longer leads. Based on the forecast verifcations it is noticed that this forecasting system has a remarkable strength to provide an overall indication about the forthcoming CW events with sufcient lead time in spite of its uncertainties in space and time.(Mandal R., Joseph S., Sahai A.K., Dey Avijit, Phani M.K.R., Pattanaik D. R., Kaur M., Karmakar N., Climate Dynamics, 61, September 2023, DOI:10.1007/s00382-023-06666-1, 2051–2069)
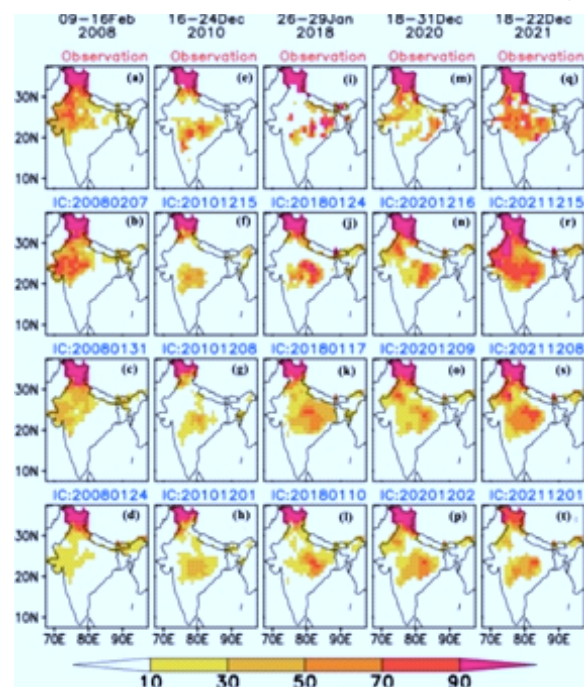

Fig. 4: Probabilities (%) of occurrence of CW events (column-wise). Row 1 represents observed and row 2–4 represent the model predicted values from nearest three ICs for individual event. a–d Event-1: 09–16 Feb 2008, e–h event-2: 16–24 Dec 2010, i–l event-3: 26–29 Jan 2018, m–p event-4: 18–31 Dec 2020 and q–t event-5: 18–22 Dec 2021. [Figure is created using free software Grid Analysis and Display System (GrADS) version 2.1.a2

Revised cloud processes to improve the simulation and prediction skill of Indian summer monsoon rainfall in climate forecast system model

The performance of six-class weather research forecasting (WRF) single moment (WSM6) cloud microphysical scheme in the National Centre for Environmental Prediction (NCEP) Climate Forecast System version 2 (CFSv2) at T126 (~ 100 km) horizontal resolution in the simulation and prediction skill of the Indian summer monsoon (ISM) is investigated with 34 years of hindcast runs with 10 ensemble members. The results reveal that the revised version of CFSv2 (EXPT) shows relative improvement in summer monsoon precipitation, its variability, rainfall annual cycle, rainfall probability distribution function, synoptic and intraseasonal variance, etc. over ISM region compared to standard CFSv2 (CTRL). Robust representation of cloud hydrometeors in the WSM6 microphysics scheme leads to better large-scale precipitation distribution compared to CTRL simulation which resulted in realistic northward propagation of rainfall bands in the EXPT. The interannual variability of rainfall in EXPT simulation suggests improved prediction skill of summer monsoon than CTRL run and comparable to higher resolution (T382;~ 38 km) version of CFSv2. The above improvements are mainly attributed to the better simulation of vertical and spatial distribution of cloud hydrometeors in the EXPT simulation. Further, the cold bias in sea surface temperature (SST) in CTRL simulation is replaced with slightly warm bias in EXPT run which has resulted in wet bias in precipitation over the tropical oceanic region. Introduction of more physically based cloud physics parameterization helps to improve the cloud hydrometeor, cloud variability, and the rainfall variability. (Phani M.K.R., Ganai M., Tirkey S., Mukhopadhyay P., Climate Dynamics, 61, September 2023, DOI:10.1007/s00382-023-06674-1, 2189–2210)

Development of a high-resolution emissions inventory of carbonaceous particulate matters and their growth during 2011–2018 over India

A high-resolution ($10 \times 10 km^2$) gridded SAFAR (System of Air Quality and Weather Forecasting And Research) emission inventory of BC-OC has been developed for 2011 and 2018 over India using bottom-up Geographical Information Systems (GIS) based statistical model with the latest activity data and updated emission factors. The emission inventory accounted for major sectors like transport, residential, industries, Thermal Power Plant (TPP), and rest (Mobile towers, Irrigation pumps, Municipal solid waste burning, Waste to energy plants, Construction, Crematorium, Incense stick, Brick kiln). The total national BC and OC emissions for the latest year, 2018 are estimated to be 1480 Gg yr–1 and 3116 Gg yr–1, respectively. The most dominant sector is found to be the transportation sector for BC with 46% share, whereas the residential sector for OC with 39% share. An overall growth of 32% and 36% is estimated in 2018 compared to 2011 for BC and OC, respectively. This high-resolution inventory of BC-OC will be helpful to policymakers in identifying the hotspot regions and prioritizing mitigation options, thus benefitting Human health and climate. The current gridded emissions will provide much-needed input for the regional chemistry transport models. (Kumar Praveen, Beig G., Sahu S.K., Yadav R., Maji S., Singh V., Bamniya B.R., Atmospheric Environment, 303: 119750, June 2023, DOI:10.1016/j.atmosenv. 2023.119750)
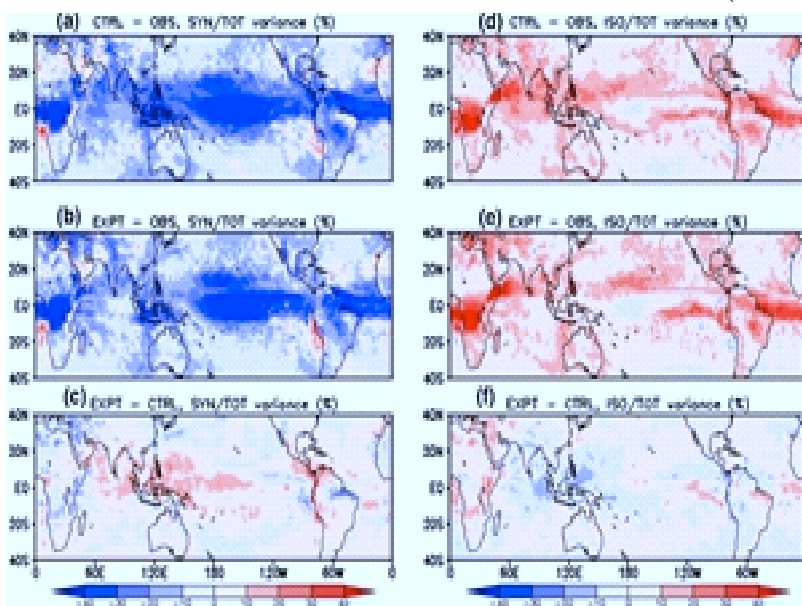
Fig. 5: The spatial distribution of biases (%) in ratio of synoptic scale (2–10 day bandpassed) variance to total precipitation variance in a CTRL, and in b EXPT with respect to observation. c Indicates bias in EXPT with respect to CTRL simulation. d–f Represent similar analyses but for ratio of ISO scale (10–90 day bandpassed) variance to total precipitation variance
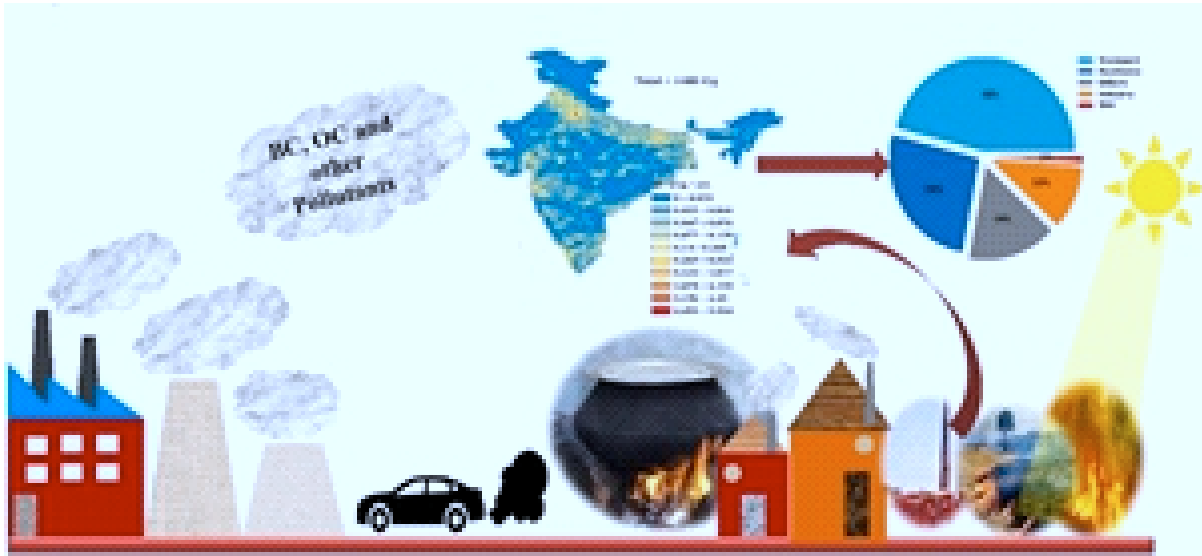
Fig. 6: Graphical presentation of the research

Thermodynamic framework for effective mitigation of high aerosol loading in the Indo-Gangetic Plain during winter

This study provides new mechanistic insight into aerosol mitigation by integrating the ISORROPIA-II thermodynamical model with high-resolution simultaneous measurements of precursor gases and aerosols. A mathematical framework is explored to investigate the complex interaction between hydrochloric acid (HCl), nitrogen oxides (NOx), ammonia (NH3), and aerosol liquid water content (ALWC). Aerosol acidity (pH) and ALWC emerge as governing factors that modulate the gas-to-particle phase partitioning and mass loading of fine aerosols. Six "sensitivity regimes" were defined, where PM1 and PM2.5 fall in the "HCl and HNO3 sensitive regime", emphasizing that HCl and HNO3 reductions would be the most effective pathway for aerosol mitigation in the IGP, which is ammonia-rich during winter. This study also provides evidence that precursor abatement for aerosol mitigation should not be based on their descending mass concentrations but instead on their sensitivity to high aerosol loading. (Acharja P., Ghude S.D., Sinha B., Barth M., Govardhan G., Kulkarni R., Sinha V., Kumar Rajesh, Ali K., Gultepe I., Petit J.-E., Rajeevan M.N., Scientific Reports, 13: 13667, August 2023, DOI:10.1038/s41598-023-40657-w, 1-10)
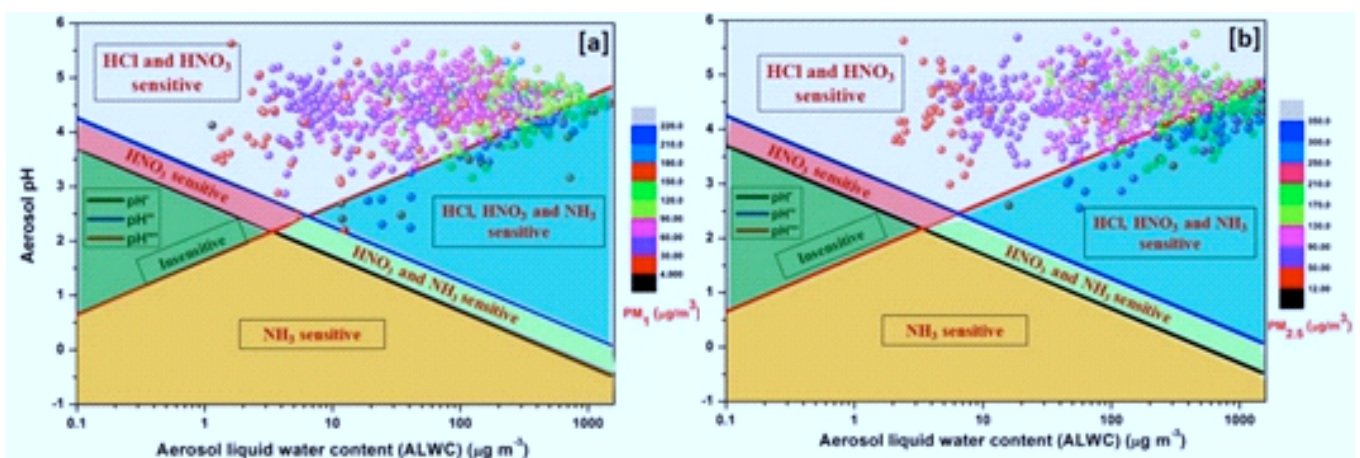

Fig. 7: The conceptual thermodynamical framework with the "coordinates" being pH and aerosol liquid water content (ALWC). Aerosols are sensitive to HCl, HNO3, and NH3 concentrations. The black, blue, and red lines define the "characteristic pH" where chemical regimes are separated by a pre-defined threshold value of = 10%. Above pH , pH , and pH aerosols are sensitive to the variation in precursors like HCl, HNO3, and NH3, and below which aerosols are deemed insensitive to variations in precursors. The six chemical regimes of (a) PM1 and (b) PM2.5 aerosols are shown in different color shades, with the observational data points colored by mass concentrations (μg m−3) of PM1 and PM2.5 monitored during the Winter Fog Experiment (WiFEx) field campaign of 2017–18.

IMPORTANT EVENTS

Prof. R. Ananthakrishnan Colloquium

Prof. Mark M. Baskaran, Professor & Chair, Department of Environmental Science and Geology, Wayne State University, Detroit, MI, USA
- Radon and its Progeny as Atmospheric Tracers, 45th Series, 14 July 2023

Prof. Ralf Toumi, Co-Director, Grantham Institute - Climate Change and Environment, Imperial College, London
- The Dependence of Tropical Cyclone Pressure Tendency on Size, 46th Series, 25 July 2023

Dr. Jothiram Vivekanandan (Vivek), Senior Scientist, Earth Observing Laboratory, NCAR, Boulder, Colorado, USA
- Identification of Hydrometeor Particle Types and Estimation of Liquid Water Content from Cloud Radar and Lidar Measurements, 47th Series, 31 July 2023

Lecture series on Cloud and Precipitation Physics & Dynamics

Mr. Gautam Martanda, Institute for Atmospheric Physics Johannes Gutenberg University, Germany delivered the lecture on "Experimental Studies on Retention of Secondary Organic Aerosol (SOA) Precursors", 5 September 2023.

ICRC-CORDEX 2023 Conference

The International Conference on Regional Climate – Coordinated Regional Climate Downscaling Experiment (ICRC-CORDEX 2023) was organized jointly by Centre for Climate Change Research at Indian Institute of Tropical Meteorology (CCCR-IITM), the Ministry of Earth Sciences (MoES), the Abdus Salam International Centre for Theoretical Physics (ICTP, Italy), the Swedish Meteorological and Hydrological Institute (SMHI), and the World Climate Research Program (WCRP) with physical hubs in Pune, India and Trieste, Italy in hybrid mode during 25-29 September 2023. The conference sessions were devoted to address a wide range of topics ranging from the key scientific discussions to user impacts and applications thus eventually focusing on how the regional climate science community through the WCRP CORDEX can better respond to societal and policy needs and questions, and also how to connect climate science with solutions/action.

Dr. M. Ravichandran, MoES-Secretary, Dr. Kamaljit Ray, Advisor at MoES and Dr. M. Mohapatra, DGM, India Meteorological Department were the Chief Guests of the program for the inaugural session. It was attended by 67 offline (in person) participants and 36 online participants. The Conference observed an extraordinary session WCRP My Climate Risk (MCR) Lighthouse Activity titled "Leveraging Climate Research and Modeling for Action in the Indo-Pacific region." This interactive session explored climate risk & its impacts. For More Photos: https://www.tropmet.res.in/213-gallary

Dignitaries on dias (L-R) Dr. R. Krishnan, Dr. Kamaljit Ray and Dr. J. Sanjay

HINDI ACTIVITIES

राष्ट्रीय राजभाषा संगोष्ठी-2023

संस्थान में दिनांक 13 सितंबर 2023 को "भारतीय संस्कृति, साहित्य और पर्यावरण विज्ञान" विषय पर राष्ट्रीय राजभाषा संगोष्ठी-2023 का आयोजन किया गया जिसमें देश भर से आए विभिन्न वक्ताओं ने अपने विचार व्यक्त किए।

हिंदी दिवस के अवसर पर तृतीय अखिल भारतीय राजभाषा सम्मेलन-2023 का आयोजन 14-15 सितंबर के दौरान पुणे में किया गया। इस सम्मेलन में संस्थान से निदेशक महोदय सहित अन्य 11 अधिकारियों/कर्मचारियों द्वारा प्रतिभागिता की गई।

हिंदी पखवाड़ा -2023 (Hindi Week)

संस्थान में दिनांक 14-29 सितंबर 2023 के दौरान हिंदी पखवाड़ा मनाया गया जिसमें निबंध लेखन, टिप्पणी एवं आलेखन, अंताक्षरी, काव्यपाठ, एकलगीत गायन, प्रश्नमंच इत्यादि प्रतियोगिताओं का आयोजन गया।

VISITORS

Shri. Parimal Singh, Project Director Maharashtra Project on Climate Resilient Agriculture (PoCRA) and **Prof. Mark Mahalingam Baskaran**, Department of Environmental Science and Geology, Wayne State University, Detroit, MI, **USA,** 7 July 2023 and 14 July 2023 respectively.

Mr. Siddhant Kerhalkar, PhD Scholar, University of Massachusetts, Dartmouth, **USA** on 11 July 2023 and deliver a seminar on "Lateral gradients in Diurnal Warm Layers in the Bay of Bengal"

Shri Kiren Rijiju, Hon'ble Cabinet Minister of Earth Sciences, Govt. of India, along with **Dr. M. Ravichandran,** Secretary, Ministry of Earth Sciences (MoES), Govt. of India, 15 July 2023.

Dr. J. Vivekanandan, Senior Scientist, Earth Observing Laboratory, NCAR, Boulder, Colorado, **USA,** 27 July to 5 August 2023, also visited the ART facility, Silkheda near Bhopal.

Dr. V. Narayanan Director, LPSC (Liquid Propulsion System Centre) ISRO - Indian Space Research Organisation along with 6 delegates from ISRO, 25 September 2023.

Dr. Sharmila Sur, Hydro climate Research Scientist, The Bureau of Meteorology, Australia, 5-8 August 2023 and deliver a seminar on "Predicting ENSO events and their regional impacts in Australia beyond a year", 7 August 2023.

Ms. Anja Katzenberger, Doctoral Researcher, Potsdam Institute for Climate Impact Research, Germany on 10 August 2023 and deliver a seminar on "Indian summer monsoon under global warming: Updates from the Latest Generation of Climate Models (CMIP6) and an idealized Monsoon Planet"

45 Students of Computer Engineering and 5 faculty members, from Computer Engineering Department, G.H. Raisoni College of Engineering & Management, Pune, 17 August 2023.

75 students of Computer Engineering and 3 faculty members, from P K Technical Campus (Engineering & Management), Pune , 23 August 2023.

Mr. Rajesh Kapadia and his group of vagaries of Weather (a group of Amateur Meteorologists), 29 August 2023 .

Mr. Gautam Martanda, Institute for Atmospheric Physics Johannes Gutenberg University, **Germany**, 3-5 September 2023

200 First year students & their faculty from Vishwakarma Institute of Information Technology, Pune, 7 & 8 September 2023.

40 Students and 3 faculty teachers from A.P. College of Engineering, Khargar, Navi Mumbai, 11 September 2023

Prof. Toru Terao, Faculty of Education, Kagawa University, Japan, visited IITM on 18 September 2023. and had discussions on proposed precipitation observations campaign at HACPL and ART-CI, Mumbai alongwith AsiaPEX campaign.

IITM Participation in Important Meetings/Events

- WWRP/WCRP S2S Summit 2023 at University of Reading, United Kingdom, 3-7 July 2023.

- 28th General Assembly of the International Union of Geodesy and Geophysics (IUGG 2023), Berlin, Germany, 11-20 July 2023.

- 17th Foundation Day of the Ministry of Earth Sciences (MoES), 27 July 2023.

- 9th International Conference on Fog, Fog Collection and Dew (FOGDEW2023), Fort Collins, Colorado, USA, 23-28 July 2023.

- ICTP-CLIVAR Summer School on Marine Heatwaves: Global Phenomena with Regional Impacts, International Centre for Theoretical Physics (ICTP), Trieste, Italy, 24- 29 July 2023.

- NWP Review meeting, MoES, 26 July 2023.

- International Climate Conference 2023, Vigyan Bhavan, New Delhi, 13-16 September 2023.

- NIAS-DST training program "Policy for Science and Science for Policy", National Institute of Advanced Studies (NIAS), Bengaluru, 11-15 September 2023.

- WCSSP-India meeting on discussion of collaboration on sea ice and polar processes, 13 September 2023.

- WCSSP India Work Package 3 (WP3) working group online meeting on 26 September 2023.

ACADEMIC ACTIVITIES

- Nine M.Sc/M.Tech students from DASS, SPPU assigned to IITM for project work.

- Project completion certificates issued to students.

- Summer Internship completion certificates issued.

- Application window opened for M.Sc/M.Tech projects in June 2023, 6 candidates selected.

- Second semester classes for IITM JRF batch 2022-23 ongoing.

- 15 applications for extension from SRFs completing 5 years and 1 application for extension from SRF completing 4 years forwarded to RF/RA committee.

- M.Sc/M.Tech classes from DASS, SPPU ongoing at IITM.

- IITM Academic Cell committee meetings held.

- Seven Research Fellows have joined IITM.

- An introduction meeting of newly joined JRF batch 2023-24 with the Director was arranged on 25 September 2023.

- Semester II final examination of IITM JRF batch 2022-23 have been conducted during the month of September 2023.

- Semester I result of IITM JRF batch 2022-23 has been prepared.

PhD Synopsis and PhD Proposal Seminar:

Mrs. Roja Chaluvadi
Variability of large-scale circulation over Indo-Pacific region in relation with south Asian monsoon under changing climate.
Guide: Dr. Hamza Varikoden and Prof. S.T. Ingle (NMU)
Co-guide: Dr. Milind Mujumdar

Mr. Prithviraj Mali
Title of Topic: Retrieval of aerosol and trace gas vertical profiles using multi-axis differential optical absorption spectroscopy (MAX-DOAS) observations
Guide: Dr. Anoop Mahajan

PH.D. THESIS AWARDED

Mr. Mandal Raju (SPPU)
Development of Extended Range Prediction strategy of extreme temperature events over Indian region for societal benefits.
Guide: Dr. Joseph Susmitha,
Co-Guide : Dr. Sahai A.K.

Shri. Sandeep Narayanasetti (SPPU)
Teleconnections of the North Atlantic with the Asian monsoon in a warming climate. Guide: Dr. Swapna Panickal, Co-Guide: Dr. R. Krishnan.

Ph.D. THESIS SUBMITTED

Mr. Abirlal Metya (SPPU)
Source-sink characterization of carbon dioxide and methane in urban and natural environments of India based on their concentration and isotopic time series.
Guide: Dr. Chakraborty S.
Co-Guide: Dr. Tiwari Yogesh K.

Mr. Bhupendra Bahadur Singh (BHU)
Investigations of Asian summer monsoonal links to water vapor variability in the upper troposphere and lower,
Guide: Dr. R. Krishnan (IITM), Prof. Manoj Srivastava (BHU) and co-supervised: Dr. Ramesh Vellore (IITM).

DEPUTATION

Dr. R. Krishnan, Dr. Ayantika Dey Choudhury, Dr. Sandeep Narayansetti, Dr. Manmeet Singh
Participation in the Berlin Summit for Earth Visualization Engine, Berlin, **Germany,** 3-7 July 2023.

Dr. Thara Prabhakaran
Participation in the 28th General Assembly of the International Union of Geodesy and Geophysics (IUGG), Berlin, **Germany**, 11-14 July 2023.

Dr. P. Mukhopadhyay and Dr. Susmitha Joseph
attended WWRP/WCRP S2S Summit 2023, University of Reading, **United Kingdom**, 3-7 July 2023.

Dr. Anoop Mahajan
Participation in the Arctic Expedition 2023, Svalbard, **Norway**, 27 July – 22 August 2023.

Dr. S.D. Ghude
the 9th International Conference on Fog, Fog Collection and Dew, Colorado, **USA**, 23-28 July 2023

Participation in the IGAC Scientific Steering Committee (SSC) meeting as an I LEAPS liaison, **Singapore,** 26-28 September 2023.

Dr. Roxy Mathew Koll
(i) ICTP-CLIVAR Summer School on Marine Heatwaves as a Director/Organizer (ii) Summer School as an invited lecturer and mentor and (iii) First Research Foci Meeting as the CLIVAR Regional Foci Member,ICTP, Trieste, **Italy**, 23-29 July 2023.

Dr. Shikha Singh
Participation in the ICTP- CLIVER SUMMER School on Marine Heat Waves: Global Phenomena with Regional Impacts, ICTP, Trieste, **Italy**, 24-29 July 2023.

Dr. Atul Kumar Sahai
Participation in the WMO Sub-seasonal to Seasonal (S2S) Summit and S2S Project Steering and Liaison Groups meeting, University of Reading, **United Kingdom**, 3-8 July 2023.

Participation in the WWRP Scientific Steering Committee meeting at Geneva, **Switzerland** from 29 August to 1 September 2023.

Shri Abhijeet Murlidhar Gangane, Shri Vikas Kumar Kushwaha, Shri Amol S. Vibhute, Shri Sumit Kumar
Participation in the 28th General Assembly of the International Union of Geodesy and Geophsics (IUGG), Berlin, **Germany**, 11-20 July 2023.

Dr. S.S.V.S. Ramakrishna
Participation in a research meeting on lightning strikes, Tokyo, **Japan,** 17-21 July 2023.

Dr. Ipsita Roy
Participation in the XXI International Union for Quarternary Science (INQUA) Congress 2023, Rome, **Italy,** 13-20 July 2023.

Ms. Aditi Modi
Participation and delivered an oral presentation in the Trevor Platt Science Symposium, Plymouth, **United Kingdom**, 9-11 August 2023.

Ms. Shruti Saini
Participation in the URSI General Assembly and Scientific Symposium (URSI GASS 2023) as Young Scientist Awardee, Sapporo, **Japan,** 19-26 August 2023.

Dr. Atar Singh Pipal
Participation and Paper Presentation in European Aerosol Conference (EAC-2023), Malaga, **Spain,** 3-8 September 2023 .

Mr. Abhijeet Kumar
Paper presentation at EUMETSAT conference, Malmo, **Sweden**, 11-15 September 2023.

HONOURS AND AWARD

Dr. Thara Prabhakaran
Invited to be part of the WMO/WWRP Steering Group member of the Integrated Hydrology and Precipitation project (2024-2028).

Dr. G. Pandithurai
Selected as an Associate Editor for the Journal Meteorological Applications, Royal Meteorological Society.

Dr. Suvarna Fadnavis
Guest of Honour, 2nd International Conference on the Asian Summer Monsoon Anticyclone, SRM Chennai, 11-13 September 2023 and chaired a plenary session.

Dr. P. Mukhopadhyay
Chaired a session in the International conference "Renewable Energy and its social impact towards making clean and green India", University of Calcutta, Kolkata, 6 August 2023.

Dr. Padmakumari
Member, MoES "Project Appraisal and Monitoring Committee (PAMC)-Technology" for pre appraisal and review of proposal received for extramural funding in the thrust area of Earth System Technology.

Member, Technical Program Committee, 'IASTA Conference – 2023'.

श्री सोमनाथ महापात्र
भारत मौसम विज्ञान विभाग (IMD) शिवाजीनगर, पुणे में हिंदी पखवाड़े के अंतर्गत कविता प्रतियोगिता के प्रतिभागियों का मूल्यांकन करने के लिए आमंत्रित, 20 सितंबर 2023

Dr. (Mrs) Susmitha Joseph
Chaired the session on "Predictability and Processes: Precipitation and Tropical Waves" in the S2S Summit 2023, University of Reading, UK, 3-7 July 2023.

Editorial Board Member, Vayumandal.

Dr. Roxy Mathew Koll and **Dr. Shikha Singh**
Represented the World Climate Research Program (WCRP) CLIVAR, as Directors of the 'ICTP-CLIVAR Summer School on Marine Heatwaves: Global Phenomena with Regional Impacts', the International Centre for Theoretical Physics (ICTP), Trieste, Italy, 24-29 July 2023.

Dr. Phani Murali Krishna and **Mr. S.M.D. Jeelani**
Dr. APJ Abdul Kalam HPC Group Award 2023 by Hewlett Packard Enterprise (NYSE: HPE) for efficient deployment, administration & management of the largest HPC system in India.

Shri M. Mahakur
Elected Member, Executive Council Indian Remote Sensing Society, Pune Chapter.

Dr. Ankur Srivastava
Invited for model evaluation sub-group, Fresh Eyes on CMIP, on behalf of the CMIP Panel and Working Group on Coupled Models (WGCM) Infrastructure Panel (WIP), 23-25 August 2023, INCOIS Hyderabad.

Dr. Ipsita Roy
DST-SERB International Travel Scheme for attending and presenting research at the XXI-INQUA Congress in Rome, Italy, 13-20 July2023.

Ms. Shruti Saini
Young Scientist Award, Wave Propagation and Remote Sensing at Union radio-scientifique internationale/ International Union of Radio Science (URSI GASS) 2023, 19-26 August 2023, Sapporo, Japan.

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YEARS OF
CELEBRATING
THE MAHATMA

Indian Institute of Tropical Meteorology

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