One Week One Lab (OWOL) campaign of CSIR Fourth paradigm Institute (CSIR-4PI)

One Week One Lab (OWOL) campaign of CSIR Fourth paradigm Institute (CSIR-4PI), Bangalore was inaugurated on July 10, 2023 in CSIR 4PI. Dr Sridevi Jade, Head and Outstanding Scientist, CSIR-4PI gave a welcome address. Dr K S Yajnik, Founder Head, CSIR 4PI, (Formerly C-MMACS) was the Chief Guest and he inaugurated the event by releasing the CSIR 4PI OWOL video. Prof Annapurni Subramaniam, Director, Indian Institute of Astrophysics (IIA) was the Guest of Eminence, who released the Agenda of OWOL campaign. Dr I A Parvez, Chief Scientist and Chairman, OWOL organising committee briefed the gathering about the activities to be held during the week.

Different school children participated in the event “Scientist-Student Connect”. “What is this AI all about” a talk by Dr V Mudkavi, followed by a talk on “GNSS and its applications in earth sciences” by Chiranjeevi Vivek. Three infrastructure facilities in three groups were shown ie. Cyber security test bed, Visit to High-Performance Computing (CHAMP) facility and Demonstration of Greenhouse Gases data acquisition. It was concluded with a keynote address by Dr Narahari Shastry, Director, CSIR NEIST.

July 11: Event “College Youth Interaction” was inaugurated by Dr. Parvez. Dr Shastry, Director CSIR-NEIST, Chief Guest, delivered lecture on the importance of students and their upcoming role in shaping the future of cutting-edge technology in India. Dr Jade gave a presidential address emphasizing on human behavior and the authenticity of data information flowing on social media. Students from CMRIT, Cambridge Institute of Technology, Bengaluru and GSSSIET for Women – Mysuru were invited to be the part of this OWOL Programme. The event started with OWOL video. Mr Prabhu, CSIR-4PI presented HPC activities along with its advance computing facility provided to all across PAN CSIR. Dr Mohapatra presented the application of HPC in modelling and simulation of extreme weather events across India.

Mr Manmohan Brahma, resource person from Advanced Micro Device India Pvt Ltd and his team conducted a workshop. Mr Raghes Aloor presented “Introduction to Compiler Optimization in AOCC” which included the AMD’s own compiler and Ms Sireesha Sanga presented AMD Optimise CPU libraries. Dr Anilkumar, interacted with students on Intellectual Property Right as part of the National Intellectual Property festival. Students visited HPC (CHAMP) facility, Cyber security R&D Lab and the demonstration of GHG data acquisition. Dr Parvez gave a keynote address.

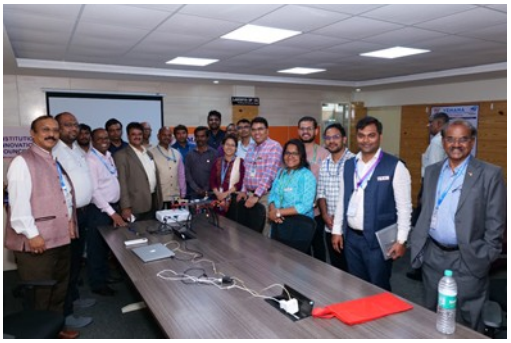
July 12: Campaign of OWOL was held at KSNDMC, Bengaluru. Dr Jade chaired the meeting and gave the welcome address. Shri Karee Gowda, IAS, Director, KSNDMC Co-Chaired the meeting and Dr. Sridevi Annapurna Singh, Director, CFTRI, Mysore addressed the gathering as the Chief Guest. It was dedicated to interaction with different stake holders from Karnataka State. Technical presentations were made by Drs Rakesh and KV Ramesh on various R&D activities and

technologies of CSIR 4PI relevant to the Karnataka State and technical presentations from KSNDMC on possible areas of research collaborations. Experts from different government agencies and academic institutes made presentations on on-going and future possible collaborations, natural disaster forecasting and management, Hydrology and water management, Geospatial crop monitoring and smart agro-technologies etc. and possible areas of new collaborations and formulation of MoUs in the concluding section of the meeting.

July 13: Dedicated to boost the collaboration between Industry, Academia and R&D. It was inaugurated by Chief Guest Dr VS Prasad, Head of NCMRWF. Prof RV Ravikrishna, IISc,Bangalore was the guest of honour. Keynote address on 'How to Foster a Strong Industry-Academia Connect'. Dr Jade presided over and in her address; she emphasized the need for collaboration among scientists, academia and industry for the benefit of common people of various sectors. Dr Gouda highlighted the significance of the meeting Dr Manish Modani, Principal Solution Architect at NVIDIA, he presented the application of modern computing in different sectorial applications. The session also witnessed signing of MoU of the CSIR-4PI with NCMRWF and NIT-K Surtahkal. Dr Parvez, as the Business Development officer signed the MoU on behalf of CSIR 4PI.

Prof DS Rao, Dean of AcSIR presented his industry collaboration works & new technologies, publications etc. Representatives from the MSME and start-ups presented their work. Karthikeyan, CSIR-NAL and coordinator of DSIR-PRISM presented the funding opportunities for the innovators. A panel discussion was moderated by Dr Parvez, and the discussion concluded with suggestions to create the synergy between research labs, industry and academia for the betterment of society, as summarized by Dr Gouda.

July 14: Science Outreach and Road show was organised and the campaign was held at two engineering college campuses in Bangalore. In Vemna Institute of Technology, Bangalore, it was inaugurated by Sri S. Jayram Reddy, President, KRJS, Dr Parvez, Chairman OWOL committee, Dr KC Gouda and Dr. Vijayasimha Reddy, Principal of VIT. Dr Parvez addressed the gathering and explained about the OWOL program. Drs Parvez, KC Gouda, V Senthilkumar, Kantha Rao, Mohapatra, Asha, Ashish and Mr Iranna G and Prabhu delivered expert talks on the on-going research at CSIR-4PI. Research scholars demonstrated the technologies to the faculty and students.



Similarly, at Dayanada Sagar College of Engineering, Bangalore, Principal Dr Prasad, VP, Dr Ramesh, Chief Scientist Dr V Anil Kumar, Mr Chiranjeevi and Ms Pavithra inaugurated the event. Dr Prasad congratulated the team and interterdisciplinary research activities, and expressed his pleasure on the existing MoU with CSIR 4PI for collaborative research. Dr Anil gave a talk on Intellectual Property and discussed on the advanced cyber security research work at CSIR 4PI. Ms Pavithra, Mr Chiranjeevi and Mr Iranna G interacted with the students. The research scholars also demonstrated the research technologies in the event. Dr Gouda highlighted the modelling and data science approaches for societal development projects. Dr Parvez thanked the college management and various depts. Prof Joseph, Dr Vindhya, Dr M Tajuddin, Dr Rashmi S, Dr Vinod, Dr Rajeshwari, Ms Radhika etc. from DSCE actively participated in the discussion with the scientific team from CSIR-4PI.

July 15 : Events were dedicated to Farmer-Student-Scientist interaction to create awareness on smart agro-technologies at CSIR 4PI among students and farming community. Dr Jade chaired the meeting and welcomed the gathering. Shri. Mahendra Kumar Gupta, Joint Secretary (Admin), CSIR was the Chief Guest of the event and he addressed the farmers, agriculture students and the guests. Dr. Mahendra P. Darokar, Chief Scientist, CSIR-HQ was the Guest of Honour and gave introductory remarks on CSIR's contribution particulary in farming and agriculture sectors. Dr. KV Ramesh presented an overview and relevance of the event to the gathering. Shri Prabhudev, a farmer, Hosahalli, Vijayanagar District, gave the feedback on R&D works carried out at his paddy field by CSIR 4PI team led by Dr. KV Ramesh and Dr. V Rakesh and shared his experience of realization of improved yield in his paddy field following farming practice advised by CSIR 4PI team. An interactive session of Farmer - Student (PG & Phd students from UAS, Bangalore) – Scientist on critical issues and challenges in farming environment was also carried out with demonstration of hand held instruments.

CSIR 4PI celebrated its 35th Foundation Day and concluded the OWOL campaign. Prof. KK Aggrawal gave the Foundation Day talk on 'Importance of data and increasing relevance of the Institute'. a glimpse of the day-wise activities of OWOL was presented in the form of a video to conclude OWOL. Shri. Mahendra Kumar Gupta, Joint Secretary (Admin), CSIR addressed the gathering as Guest of Honour.
The culmination of the day's event was the award ceremony where scientific and non-scientist staff of CSIR 4PI were recognised for their contribution in building up the organisation.

CSIR-4PI participated in CSIR Decadal Achievements Exhibition on the occasion of CSIR Foundation Day on 26 September 2023

Capacity building workshop on Himalayan High Impact weather events

As part of the NMHS project a capacity building workshop was conducted at GBPNIHE, Kullu, HP during 28-30 October 2023. The workshop was jointly organized by CSIR 4PI and GBPNIHE, Kullu. On day 1 i.e. 28th October the scientific team visited the various places affected by the recent cloud burst, heavy rain and landslide in the Kullu-Manali region covering the Beas river basin. The team interacted with the local stakeholders and the affected people about the disaster events and noted their experiences and the way forward for the mitigating such events were discussed. The impact of climate change and particularly LULC changes are emphasized in the discussion meeting to be the major cause of such events. The second day was dedicated for the field trip for the workshop participants in the disaster event regions. The third day i.e. on 30th Oct 2023 the interactive session of the workshop among scientists, stakeholders, research scholars and representative of local body, educational institites and students are organized. Dr R K Singh, Head, GBPNIHE-RC, Kullu welcomed the gathering and presented about the instates work on the environment research. Dr K C Gouda, Sr Principal Scientist, CSIR 4PI presented about the outcomes of the NMHS project and the implementation of the prototype for the prediction and analysis of high impact weather events in the Beas basin. Dr Ashish Routray, Scientist-F from NCMRWF discusse3d about the possible implementation of high resolution modelling of such meso-scale events along with data assimilation. Dr Sudhansu Sekhar, Scientist-F, DRDO DGRE presented about the importance of the mountain meteorology for the disaster studies. Dr G N Mohapatra, Principal Scientist, CSIR 4PI presented about the configuration for regional disaster modelling for advance simulation of extreme rainfall events. This is followed by the brain storming discussion among the participants and the recommendation of the meeting for further studies are noted to be submitted to NMHS, MoEFCC, GoI.

Unveiling Monsoons Mysteries: A Fresh Outlook on Their Origins

The seasonal and interannual variations of the Indo-Asian monsoon result from complex interactions among the atmosphere, oceans and land. Traditional explanations center around the thermal responses of land and ocean surfaces to solar radiation. Another perspective underscores the pivotal role of the equatorial trough's seasonal movement. However, both viewpoints fall short in explaining critical aspects of the monsoon phenomenon, prompting ongoing scientific exploration into the fundamental physical mechanisms. This study aims to reconcile these divergent perspectives by analyzing four distinct sets (only the first two are shown here) of multivariate seasonal cycles derived from Sea Surface Temperature, Surface Wind, Outgoing Long Wave Radiations, and Surface Pressure observations. Panel sets a and b align with classical monsoon understanding, emphasizing land-sea thermal contrasts, while panel sets c and d support the modern perspective of shifting convection patterns from north to south. The study proposes the first set as a background and highlights the importance of examining the spatial-temporal distribution of seasonal rainfall in relation to year-to-year changes in seasonal cycle amplitudes. This analysis focuses on the covariations of the leading two seasonal cycles.

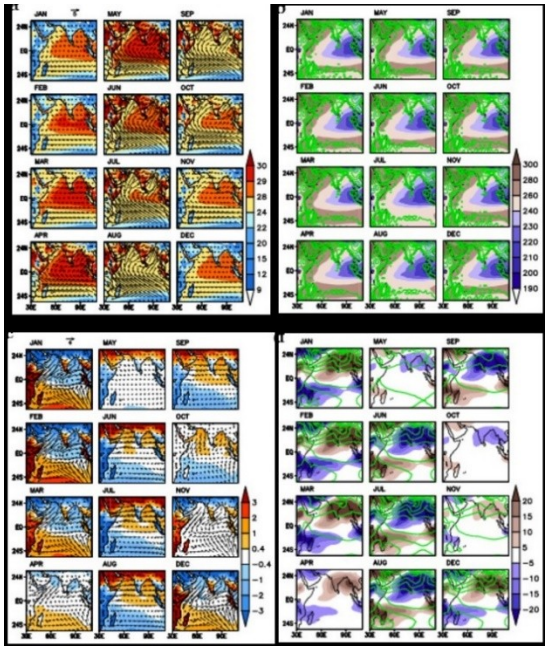


Figure 1: Two mean Seasonal cycles: seasonal cycle 1 (panel sets a and b), seasonal cycle 2 (panel sets c and d). In a and b, shades are for sea surface temperature and land surface temperature (oC) and vectors for wind (m sec−1). In b and d, shades are for OLR (Watts m−2) and green contours the Surface Pressure (hPa). In panel set b, the green contours are the deviations of SP from 1000 hPa. The negative values of Surface Pressure shown as the dashed-contours.

Impact of different land use data on WRF model short range forecasts during pre-monsoon and monsoon seasons in India

This study focuses to analyse the impact of land use changes on short range weather forecasts over Indian region. Weather Research and Forecasting (WRF) model simulation experiments are conducted by using land use data from Moderate Resolution Imaging Spectroradiometer (MODIS) and Indian Space Research Organization (ISRO) satellites for pre-monsoon and monsoon season. MODIS 2001 land use is used in control (CNT) experiment and updated land use with recent urban class from MODIS (EXP1) and ISRO (EXP2) for the year 2019 is used to generate model lower boundary conditions in other two experiments. Quantitative error measures and skill score computed for rainfall forecast showed that model skill is better with the use of realistic recent land use data from MODIS and ISRO during pre-monsoon and monsoon period. Extreme Dependency Index score computed also revealed that model skill in predicting extreme rare rainfall events is improved with recent landuse data. Model simulated surface meteorological variables and profiles at lower levels also found to be improved with the inclusion of realistic land use class from MODIS and ISRO. Between the two experiments, the one which used ISRO based land use showed larger improvement particularly during the monsoon season.

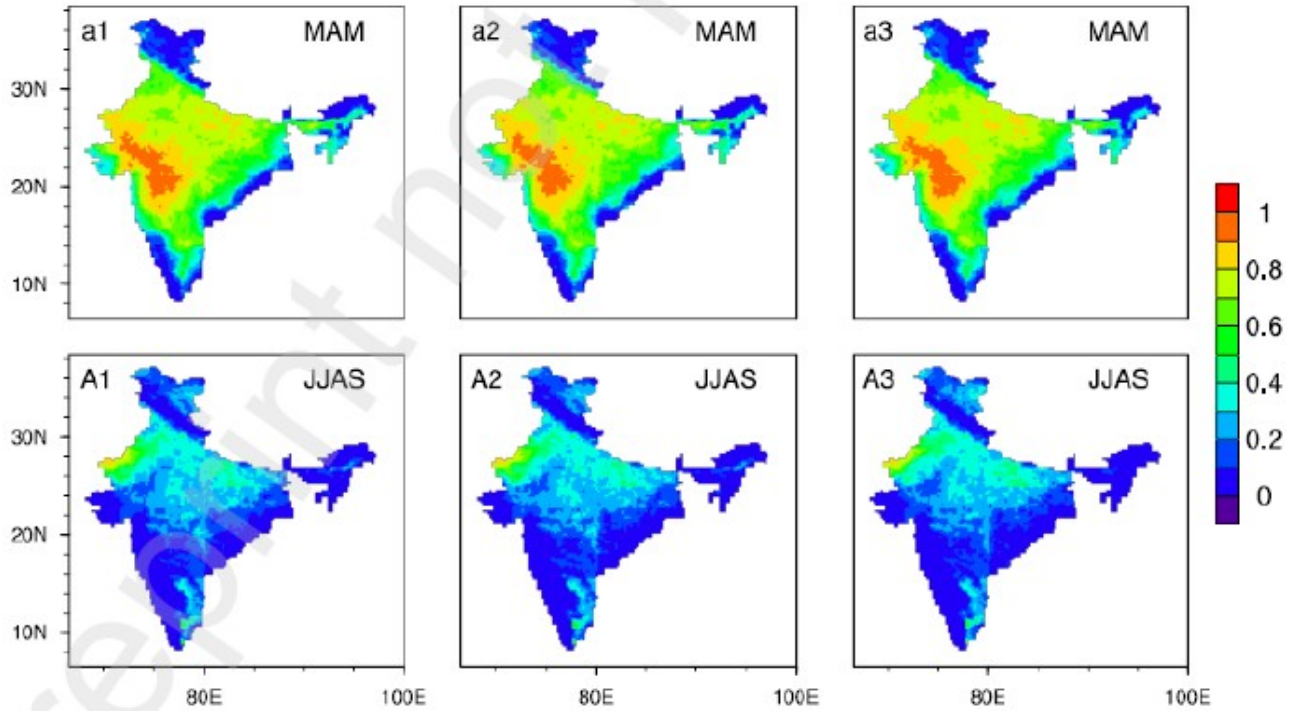


Figure 2: HSS score in 24-hour accumulated rainfall forecasts during MAM (top panel) and JJAS (bottom panel) for CNT (a1, A1), EXP1 (a2, A2) and EXP2 (a3, A3).

Analysis of heat wave over different physiographical regions in India

Heat waves (HW) in the tropical and subtropical region are the deadliest throughout the world. This study represents the HW characteristics over the tropical country India mainly divided in three different landmasses, i.e. hilly, plains and coastal. This work presents the HW characteristic quantification based on the physiography of the regions in India assessed over a period of 70 years (1951–2020) using the Indian Meteorological Department (IMD) observed data. Mostly, the earlier studies are more focused on HW in the plains and coastal regions. HW in hilly region has been excluded by using single threshold for the whole Indian region, so based on the topographical features, three thresholds of daily maximum temperature (DMT), i.e. DMT > 40 °C (plains), DMT > 37 °C (coastal) and DMT > 30 °C (hilly), are being applied. The spatio-temporal analysis of HW shows its occurrence in hilly regions (J&K, Manipur, Mizoram and Tripura) since 1972 and maximum 10-day HW in the northern region. The coupled model intercomparison project phase (CMIP6) model output for 7 models has been assessed to quantify the performance in capturing the HW parameters compared to IMD observations. The ensemble mean of 2 CMIP6 models, i.e. EC Earth3 and MPI LR, has been used to project future changes in HW properties over India under the different emission scenarios, i.e. SSP126 and SSP 585. The key finding of this study shows that for year 2050 onwards, a sharp increase in HW days, HW events and HW duration (average and maximum) will increase in hilly, coastal and plain region. Under SSP 585, the southern part will likely get more new hotspots of HW in India, and there will be significantly more longer, intense and frequent HW occurrence as compared to SSP 126. The results show the need of improvement in understanding of HW at regional scale and especially in hilly region.

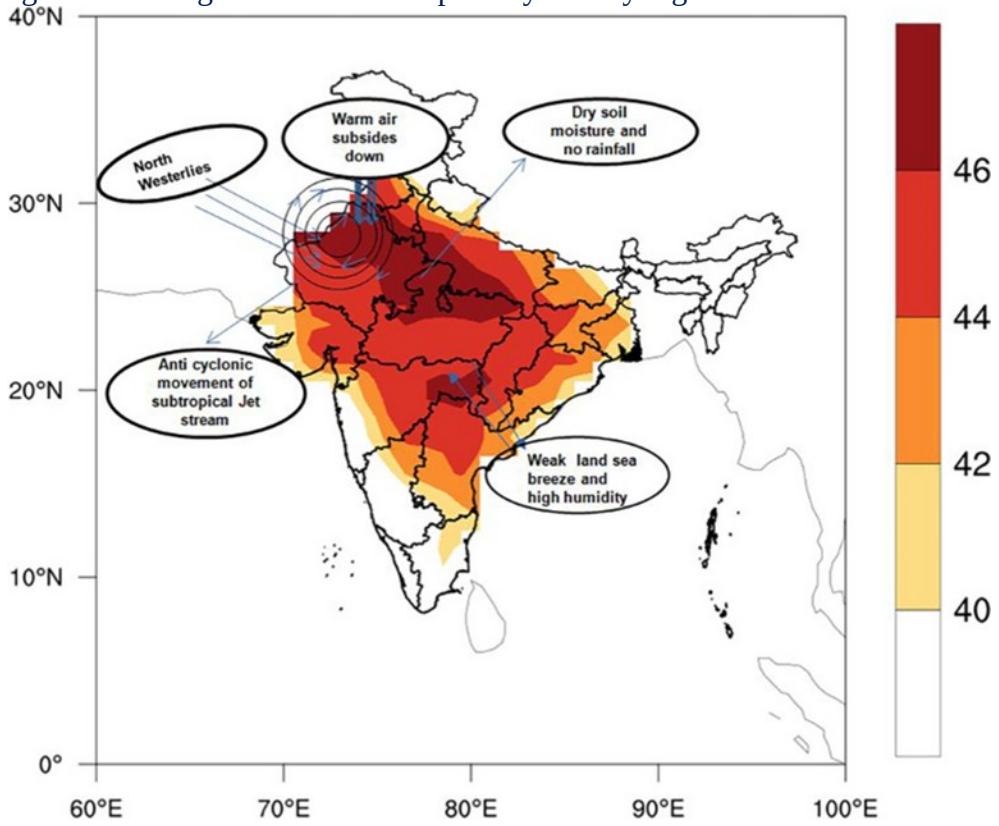


Figure 3: Schematic map showing the highest recorded daily maximum temperature associated with HW events during the period 1967–2012 and the possible HW mechanism in India

A case study on multiple self-interactions of MSTID bands: New insights

MSTIDs are ionospheric disturbances in which plasma density perturbations, comprising of plasma depleted and enhanced bands in the ionospheric F region propagates. On 15 September 2018, night time south westward propagating MSTIDs are observed by 630.0 nm air glow images from an all-sky imager at Hanle, Ladakh installed by IIT, Roorkee. For the first time, dense GNSS stations established by CSIR-4PI data is used to capture MSTID over this region. Digisonde data is also used to investigate the occurrence of ionospheric spread-F structures. This study shows two interactions of MSTID bands, in which one band decayed due to penetration of plasma from ambient medium and whereas remaining band interacted with another band resulting in dissipation.

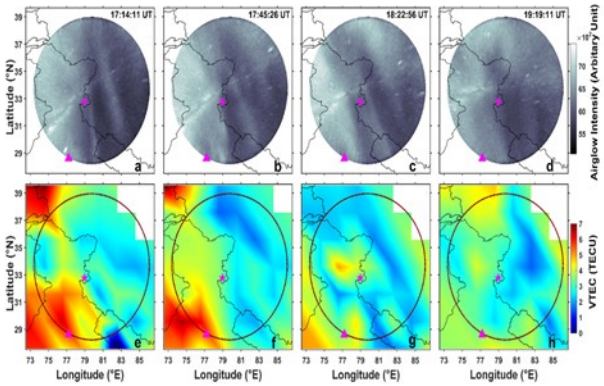


Figure 4: shows (a-d) Four airglow images at different times. (e-h) GNSS-TEC maps with time intervals of ± 3 min from the airglow image time. The timings in the airglow images depict four salient stages of the event: initial stage, interaction stage, interaction stage, and the stage of separation. Airglow images and GNSS TEC map show the higher airglow intensity and TEC on the western side of Hanle compared to the eastern side, respectively. (Magenta stars and triangles in (a-h) indicate the locations of the Hanle imager and New Delhi digisonde, respectively. The brown circle represents the FOV of the Hanle
imager at 250 km altitude.)

Spatio-temporal analysis of air pollution dynamics over Bangalore city during second wave of COVID-19

The country wide lockdown implemented during 27th April to 14th June 2021 in order to prevent the spread of COVID-19 during the second wave in India. Effect of the restricted lockdown resulted in improved air quality. This study focuses on analyzing the spatio-temporal distribution analysis of major air pollutant concentration over Bangalore city in India. The inverse distance weighting (IDW) method is implemented for the spatial analysis in order to quantify the distribution of the pollutant concentrations at each location in the Urban city of Bangalore. The research considers the distinct periods of pre-lockdown and lockdown during the second wave of COVID-19 pandemic in 2021 to investigate the impact of reduced human activities on air quality over the city. The study mainly utilizes the air pollution data collected from Central Pollution Control Board (CPCB) monitoring stations across Bangalore, including measurements of pollutants such as PM2.5, PM10, O3, NO2, SO2, and CO. The IDW method is implemented to create the high-resolution pollution concentration maps for both the pre-lockdown and lockdown periods. This spatial distribution provides valuable insights into the variations in the pollution levels though out the Bangalore city. The comparative analysis of the concentration maps reveals significant changes in air pollution levels between the two periods; similarly, the temporal weekly average analysis also witnessed negative anomalies during the lockdown weeks. The results indicate substantial reductions in pollutant concentrations during the second wave COVID-19 lockdown, attributed to decreased vehicular emissions, industrial activities, and construction operations. The pre-lockdown period serves as a baseline for assessing the improvements in air quality during the lockdown. The spatio-temporal modeling approach enhances our understanding of the distribution patterns of air pollutants across the Bangalore metropolitan city. The findings underscore the potential benefits of implementing sustainable strategies to maintain improved air quality even after the pandemic subsides.

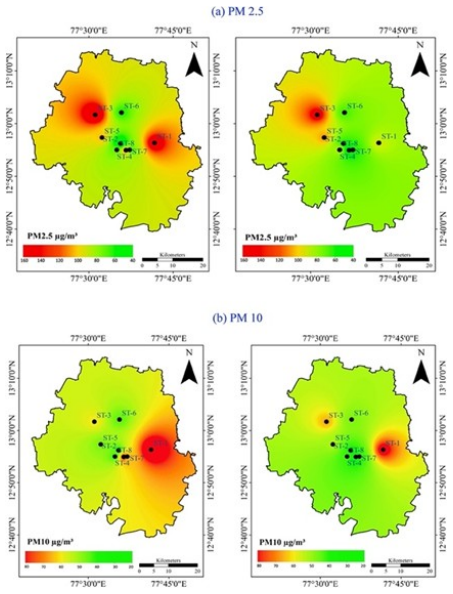


Figure 5: Comparison of the spatial variation of the air pollutants (a) PM2.5 (b) PM 10 across Bangalore city during pre-lockdown (left panels) and COVID-19 lockdown (right panels).

Impact Assessment of New and Emerging Waste Management Technologies on Human Life

Study includes change in waste composition due to Covid 19 pandemic and on the effects of pandemic on waste management and treatment technologies. To suggest appropriate technologies to be adopted during normal conditions and during pandemic like situations. To identify the triggering pollutants due to use of the technologies for waste Management with respect to human health and to recommend appropriate waste handling and disposal measures in accordance with human health, the current legislative and administrative requirements. Initial study revealed that in Hubei Province, China, the amount of MSW in large and medium sized cities has reduced by 30%, but the generation of medical waste (infectious and non-infectious) has increased by more than 370% (Klemes et al. 2020). More than 80% of total healthcare waste is non-infectious and needs to be collected and disposed as MSW (WHO 2020a, b, c, d). Findings from waste composition studies during the COVID-19 pandemic are also inconsistent, specifically with respect to plastic, food, and biomedical wastes. The increased sense of hygiene during the global pandemic has contributed to an increase in the plastic waste from packaging materials and personal protective equipment (Vanapalli et al. 2021, Wang et al. 2021). Plastic usage in the healthcare industry experienced an exponential growth (Torkayesh & Simic, 2022). On the other hand, plastic usage in commercial industries was found to decrease owing to their restrained operating hours during lockdowns (Fan et al., 2021), reducing the total quantity of plastic waste. Studies on the generation of food waste during the pandemic are also not entirely consistent. Rodgers et al. (2021) conducted an online survey and found that food waste decreased in the United States during the COVID-19 pandemic due to increased home cooking, alternative food choices, and fewer trips to grocery stores. A careful analysis of CPCB’s January and May 2021 reports suggests that 22 of the 35 states and Union Territories generate more biomedical waste than they can handle. The capacity of facilities to treat biomedical waste is nearly saturated in Maharashtra, Goa, Manipur, Andhra Pradesh, Meghalaya, Rajasthan and others. The volume of the waste in May month was massive at places. In Haryana, COVID-19 waste was responsible for 47 per cent of the biomedical waste, followed by Chhattisgarh (42 per cent), Himachal Pradesh (40 per cent), Andhra Pradesh (40 per cent) and Delhi (39 per cent).

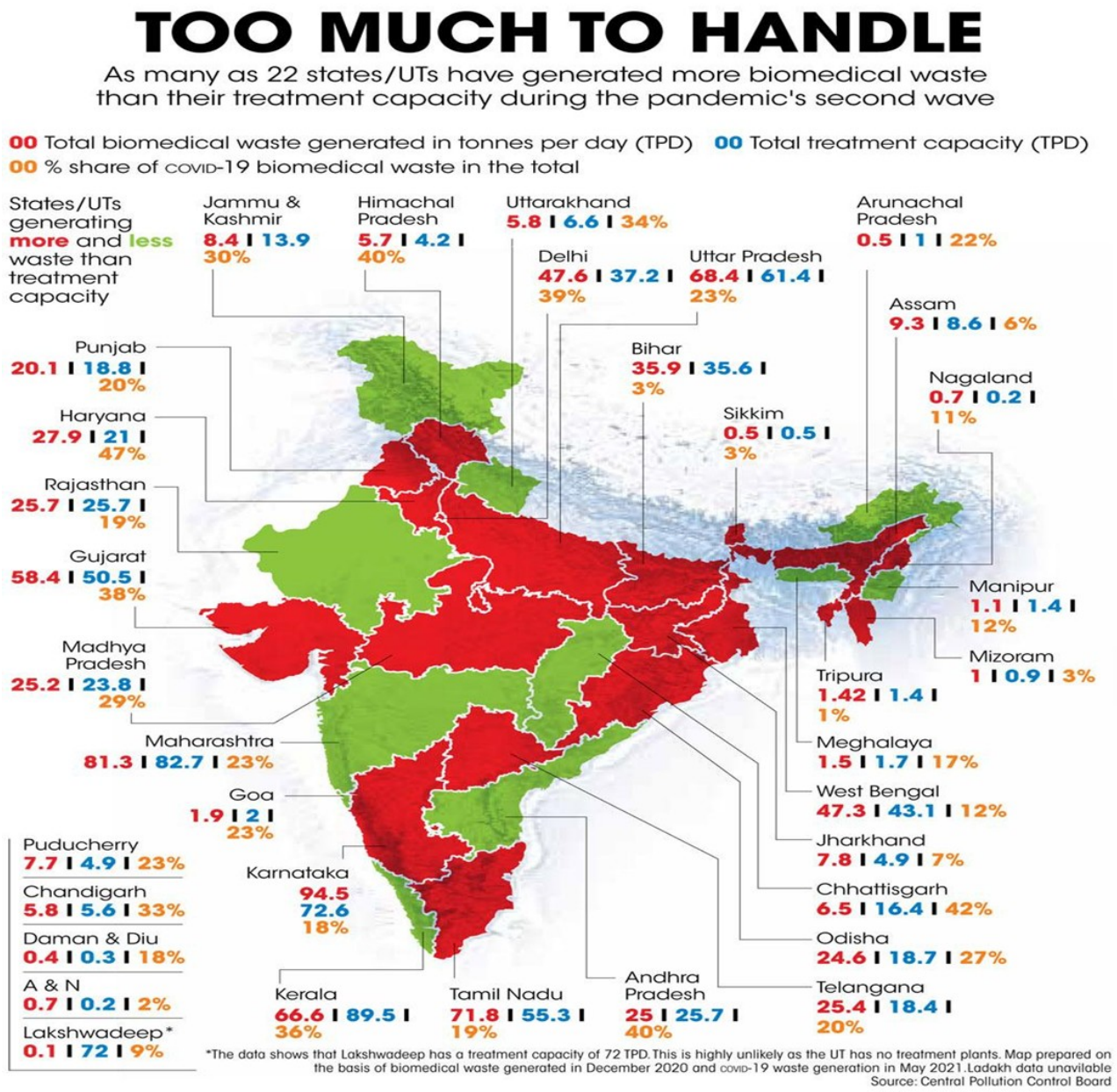

TOO MUCH TO HANDLE
As many as 22 states/UTs have generated more biomedical waste than their treatment capacity during the pandemic's second wave
00 Total biomedical waste generated in tonnes per day (TPD) 00 Total treatment capacity (TPD)
00 % share of COVID-19 biomedical waste in the total
States/UTs generating more and less waste than treatment capacity
Jammu & Kashmir 8.4 | 13.9 30%
Himachal Pradesh 5.7 | 4.2 | 40%
Uttarakhand 5.8 | 6.6 | 34%
Arunachal Pradesh 0.5 | 1 | 22%
Delhi 47.6 | 37.2 | 39%
Uttar Pradesh 68.4 | 61.4 | 23%
Assam 9.3 | 8.6 | 6%
Punjab 20.1 | 18.8 | 20%
Bihar 35.9 | 35.6 | 3%
Nagaland 0.7 | 0.2 | 11%
Haryana 27.9 | 21 | 47%
Sikkim 0.5 | 0.5 | 3%
Rajasthan 25.7 | 25.7 | 19%
Gujarat 58.4 | 50.5 | 38%
Manipur 1.1 | 1.4 | 12%
Mizoram 1 | 0.9 | 3%
Madhya Pradesh 25.2 | 23.8 | 29%
Tripura 1.42 | 1.4 | 1%
Maharashtra 81.3 | 82.7 | 23%
Meghalaya 1.5 | 1.7 | 17%
Goa 1.9 | 2 | 23%
West Bengal 47.3 | 43.1 | 12%
Puducherry 7.7 | 4.9 | 23%
Jharkhand 7.8 | 4.9 | 7%
Karnataka 94.5 72.6 18%
Chandigarh 5.8 | 5.6 | 33%
Chhattisgarh 6.5 | 16.4 | 42%
Daman & Diu 0.4 | 0.3 | 18%
Odisha 24.6 | 18.7 | 27%
A & N 0.7 | 0.2 | 2%
Kerala 66.6 | 89.5 | 36%
Tamil Nadu 71.8 | 55.3 | 19%
Andhra Pradesh 25 | 25.7 | 40%
Telangana 25.4 | 18.4 | 20%
Lakshwadeep* 0.1 | 72 | 9%
*The data shows that Lakshwadeep has a treatment capacity of 72 TPD. This is highly unlikely as the UT has no treatment plants. Map prepared on the basis of biomedical waste generated in December 2020 and COVID-19 waste generation in May 2021. Ladakh data unavailable
Source: Central Pollution Control Board

Figure 6:

Meeting of the COVID CARE NETWORK Committee on CSIR HPC cloud resource hosted at CSIR-4PI for COVID-19 research support for Indian researchers on 19th May 2023.

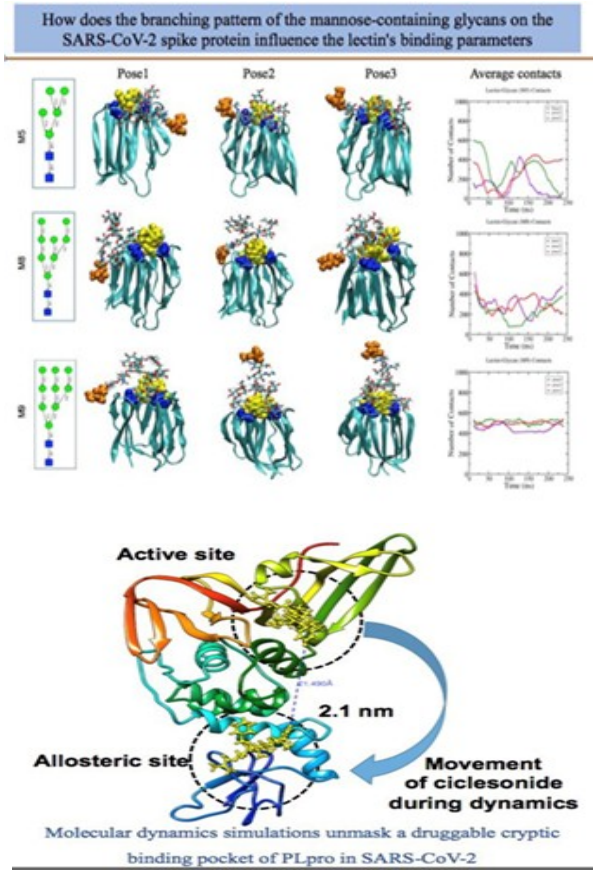


Figure 7:

GPS deformation and Earthquakes in Himalaya

We initiated GPS measurements in 1994 in the 2500km Himalayan Arc (figure) spanning Kashmir, Ladakh in the west to Arunachal in east to determine precise surface deformation in this seismically active and tectonically complex northern subduction boundary of Indian plate. Surface expressions of the major thrusts (Figure 1) in the Himalayan arc from south to north are Main Frontal Thrust (MFT), Main Boundary Thrust (MBT), Main Central Thrust (MCT), South Tibet Detachment System (STDS) and Indus Suture Zone (ISZ) which demarcates the Himalayas into frontal, lesser, higher, Tethyan and Trans Himalayan regions. These thrust faults sole in to the sub-surface basal decollement termed as Main Himalayan Thrust (MHT) along which Indian plate subducts below the Eurasian Plate. Three decades of GPS measurements in the Himalayas indicate surface convergence rates ranging from 10 to 20 mm/yr. in the various segments of Himalayas (Kashmir, Ladakh, Himachal, Gharwal, Kumaon, Nepal, Sikkim, Bhutan and Arunachal). Arc parallel extension rate of 8-16mm/yr. recorded by GPS observations is the manifestation of E-W extension rate of Tibet. Inverse modeling of surface convergence rates estimates oblique slip rate of 13 to 20 mm/yr along MHT at a depth of 12-18km and locking width of 70 to 100 km from the frontal Himalayas suggesting that each segment of Himalaya is unique in nature. Geodetic strain rates derived from the GPS derived surface convergence rates suggest that the Himalayan region is predominantly under high compression due to subduction of Indian plate along sub surface basal decollement MHT. Comprehensive analysis of geodetic and seismic strain rates and moments in Himalayas give precise estimate of strain budget since the last devastating earthquake which in turn give recurrence interval and probable magnitude of impending earthquake in each of these Himalayan segments.

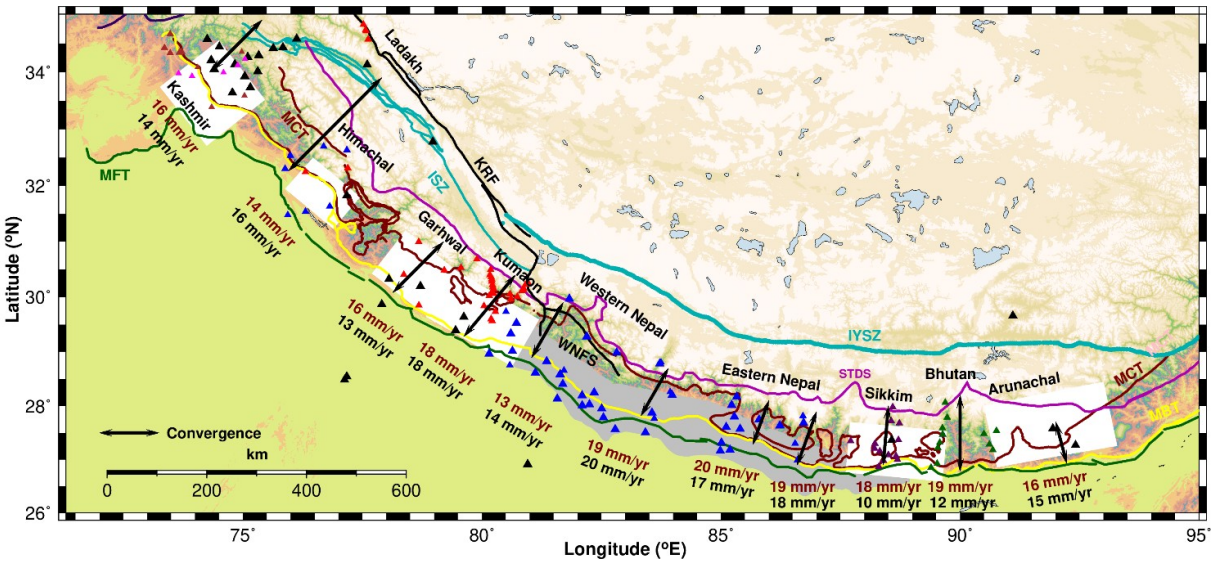


Figure 8: GPS derived surface convergence rates (black), rectangular dislocations (white solid rectangle) and dislocation model (solid grey patch) for Nepal Himalaya along with associated slip rates (red) along 2500 km Himalayan arc with major fault lines (Solid triangles denote GPS sites: black-CSIR-4PI sites)

Site Effects Investigation in Srinagar City of Kashmir Basin Using Microtremor and Its Inversion

The Srinagar region of Kashmir Valley in North West Himalayas, covers more than 2 million inhabitants and is exposed to high seismic risk. The city is located on the remnants of the ancient lake known as Karewas, which is paleo-bed partly enclosed by outcropping bedrock. These unconsolidated sediments (Karewas) can surely amplify the ground motion induced by both local and distant earthquakes. In order to gain insight on potential site effects and the subsurface structure of the region, we carried out an extensive high-resolution microtremor ambient noise survey at 429 locations in greater Srinagar. The acquired dataset was processed using the Horizontal to Vertical Spectral Ratio (HVSR) technique to map the fundamental resonance frequency, the thickness of sedimentary cover, and to identify areas prone to seismic amplification. The average shear wave velocity and the fundamental frequency are used to estimate the thickness of sediments. Thus, we provide a classification of the HVSR curves according to their location and we discuss how their shapes reflect the structure of the subsurface throughout the study region. In case of two layer homogeneous and viscoelastic system having soft sediments over the bedrock, the sharp impedance contrast between their layers and persistent seismic ambient noise over this system is supposed to be isotropic and dominated by surface Rayleigh waves.

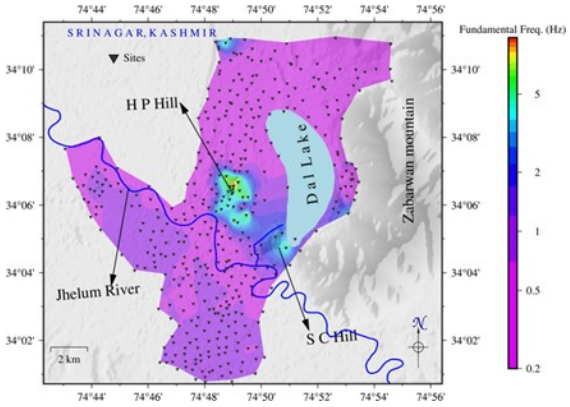


Figure 9: Predominant resonance frequency map for Srinagar region.

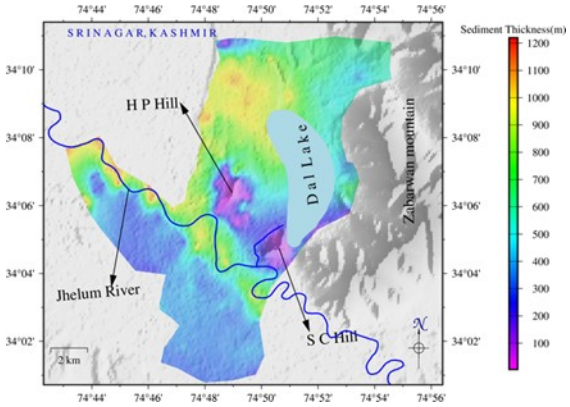


Figure 10: Sedimentary cover thickness map for Srinagar region.

Further to see the impact on risk assessment, we collected information about the characteristics of the existing important buildings available in the city. During an earthquake, a building oscillates and may suffer great damage if the main period of oscillation happens to be comparable with the

resonance frequency of the site on which it is built. The estimated building frequency range for Srinagar city and its suburbs has been estimated between 2.6 to 10.5 Hz and these frequency ranges possess a very few overlap with fundamental frequencies estimated for the sites in the city. Thus, in the present scenario, we do not see high risk of resonance from the existing structure. However, in future, any high rise building with period more than 1 sec has to be either avoided or must be properly designed.

We believe that being the very first high-resolution site-specific microzonation study of Srinagar city, the present study provides a valuable contribution for the assessment of seismic risk and vulnerability of the area. A fair agreement between estimated sediment thickness variation, local geology and fundamental frequency was observed. Besides, the intrinsic value of these maps for engineering and seismic hazard purposes, our results highlight the critical areas where moderate to high damage is likely to occur during probable future earthquakes.

Site Response Analysis Beneath the Kashmir Basin (NW Himalaya) through Ambient Noise Measurements

Deep sedimentary valleys entrap and amplify seismic waves, which is further responsi- ble for site-specific amplification over the allied region. Kashmir valley is a deep and active sedimentary basin in the northwest portion of the Himalayan lap. To character- ize the site response for the intermountain Kashmir valley for the first time, we acquire single station microtremor measurements using Lennartz (three components/ 5s seismometer) at 141 sites with a grid of (5 km 3 5 km) and two-dimensional (2D) array measurements using seven units of recording station of different geometry pattern at 38 sites across different lithological setup within the basin. We present here (1) a first-order predominant fundamental frequency (0.21–10.19 Hz) and subse- quent sedimentary thickness maps for the entire valley, reflecting deep deposition with spatial heterogeneity in the area using the horizontal-to-vertical spectral ratio (HVSR) technique; (2) spatial classification of generated HVSR curves linking subsur- face geomorphology and post strong ground-motion scenario in the valley; (3) extrac- tion of the best dispersion characteristics of Rayleigh waves (fundamental mode) from all recorded vertical signals at each array site using frequency–wavenumber (F-K) method with an emphasis on signal synchronicity; and (4) retrieval of one-dimensional (1D) shear wave velocity (VS) profiles across the valley from the inversion of disper- sion curves using the neighborhood algorithm. Distinct model parameterizations were tested for the inversion to achieve the optimal inversion misfit. The collocated 1D VS profiles are consistent with newly drilled borehole logs information. Besides, the presented first-ever ambient noise survey–based site response study meets the objectives of site-specific seismic hazard and risk analysis of the Kashmir valley at the regional scale.

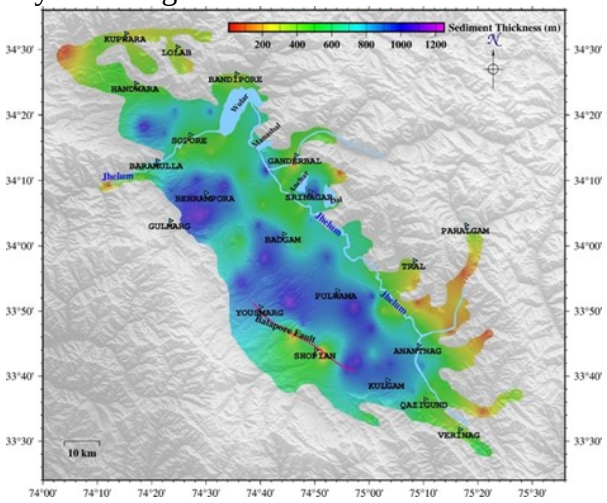


Figure 11: Sediment – Bedrock Interface map of the Kashmir valley

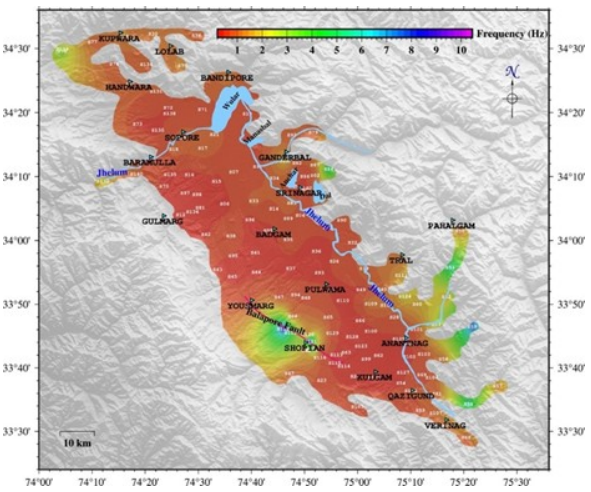


Figure 12: Fundamental resonant frequency map of Kashmir valley.

1) CSIR-4PI organized and conducted " VISMAYA VIGYANA SUMMER TRAINING" from April 17th to 22nd 2023. A total of 17 students participated and were given a glimpse of 1. HPC, 2. Climate Modelling, 3. Seismology, 4. GPS & 5. GHG measurements.The students also completed their energy literacy training from energy swaraj foundation

2) Jigyasa Scientist- Student Interaction Workshop On 16th & 17th October 2023, a group of students and faculty from Jaigopal Garodia Rashtrotthana Vidyalaya, “Registered Address: No. 21, 2nd "K" Cross Road, 9th B Main Road, HRBR Layout, 1st Block Kalyan Nagar, Bengaluru, Karnataka 560043” visited CSIR Fourth paradigm Institute, a leading institute in the fields of high-performance computing (HPC), global navigation satellite systems (GNSS), and greenhouse gas (GHG) monitoring, Cyber Security etc.

Purpose:

- To learn about the use of statistics and science in games in real life.
- To learn how statistics can be apply in game and how to learn & create new games.

Speakers:

1. Dr. Srinivas Bhogale - Honorary Scientist
2. Mrs. Mital Salia - Founder of Khel Khel Mein
3. Dr. V Mudkavi - Distinguished AcSIR Emeritus Professor

Topics Covered During Their Visit:

- Have Fun with Numbers by Dr. Srinivas Bhogale
- Will it happen, or will it not happen? How to compute probabilities by Dr. Srinivas Bhogale
- Experiential Science part-1,2 by Mrs. Mital Saalia
- Application of Statistics by Dr. V Mudkavi
- HANDS ON SESSION Computing mean and standard deviation plotting bar charts and pie charts

CSIR HPC, AI & ML Platform (CHAMP)

As a refresh to CSIR centralised High Performance Computing (HPC) facility, “CSIR HPC, AI & ML Platform” (CHAMP) Supercomputing system has been recently established to cater to the scientific computing needs of advanced scientific computational research requirements of CSIR scientists. The CSIR centralised HPC facility CHAMP is capable of handling both CPU and GPU workloads. The new system consists of 410 numbers of dual CPU (AMD EPYC 7763) compute nodes with each node having 128 processor cores and 512 GB main memory. The system has a total of 52480 processor cores, 205 TB of RAM, ~2.06 PetaFLOPS peak computing power with a sustained performance of ~1.55 PetaFLOPS on High Performance Linpack (HPL) benchmark. The system also has 12 compute nodes with 4 GPUs (NVIDIA A100 80G SXM4) each with a total peak performance of 985 TeraFLOPS and ~760 TeraFLOPS sustained performance on HPL benchmark. The GPU nodes also have a total of ~30 AI PetaFLOPS performance. The supercomputer is supported by a high performance online data storage using LUSTRE parallel file system of about 8 PiB useable capacity. The inter-node communication for the HPC system is powered by high speed HDR 200 InfiniBand switches, with HDR 100 (100 Gbps) IB links to each node in a fully non-blocking FAT tree topology configuration. A large number of scientific applications in Aerospace, Biology, Bioinformatics, Chemistry, Material Science, Physical & Earth Sciences, Engineering Sciences and Information science & technology are also made available on the CHAMP supercomputer.

Sybil attacks in Vehicular Ad-hoc Networks (VANET)

Identity authentication does not help prevent Sybil attacks in Vehicular Ad-hoc Networks (VANET), since a malicious driver can still get additional identity information by non-technical means such as stealing or simply borrowing from his friends. The goal of detecting Sybil attack is to ensure that each physical node is bound with only one legal identity. A physical node that claims multiple identities is classified as a malicious node, while its fabricated identities are classified as Sybil nodes. Existing Mechanisms in place include trust management systems and signature-based detection systems. These methods have been able to keep attacks in check, but are not foolproof and more often than not have been exploited and failed to detect attackers who efficiently mask themselves. We proposed a 2 pronged Deep Learning approach to tackle this situation, the approach would consist of identifying anomalies first by the textual data that is received and then verifying the same with images that are sent by the individual nodes. For implementation and testing of this mechanism, data was collected of real-time traffic of Bengaluru from six different routes, at 5 different timings, from three different vehicles, and over fifteen consecutive days. The text based data consists of 4 features: timestamp, speed, latitude, and longitude, and image-based data consists of images taken from the vehicle facing toward the traffic in front. Data for this process was collected at five-second intervals. The initial results shows promise and we are working on improving them.

The framework was tested for 10, 20, 30 and 40% anomalous data, a confusion matrix was plotted and the results were as follows:

Anomaly(%)	Accuracy(%)	Precision	Recall	F1
10	94.0909090	1.0	0.935	0.96640826
20	93.3333333	0.9792	0.94	0.9591836
30	88.07692307	0.904306	0.945	0.92420537
40	88.2142857	0.92385786	0.91	0.91687657

Network Telescope Related Research and Development

CSIR-4PI is pursuing research and development in the area of cybersecurity. One of the current focuses is on cyberspace surveillance through Active Network Telescope: a framework to capture, validate and analyze a special class of Internet traffic called Internet Background Radiations (IBRs) originating primarily from malicious activities taking place in the cyberspace. This project is funded by Ministry of Electronics and Information Technology (MeitY) under the Cybersecurity R&D programme. A Proof-of-Concept (PoC) implementation of Network Telescope is experimentally deployed for IBR gathering and analysis. As a representative result, Figure 1 shows the cumulative number of unique source IP addresses, which established TCP connections with the Network Telescope IP range during a period of 31 days in the month of January 2023.

In summary, about 0.38 million unique IP addresses located at various geographical parts on the Internet has established connections with the Telescope IP range. The raw data obtained from the Network Telescope is an asset, and its detailed analysis from various angles can provide useful insight on the origin and nature of malicious activities taking place on the Internet. The long-term objective of this research is Cyber Threat Intelligence (CTI) generation from Network Telescope observations through data driven approaches.

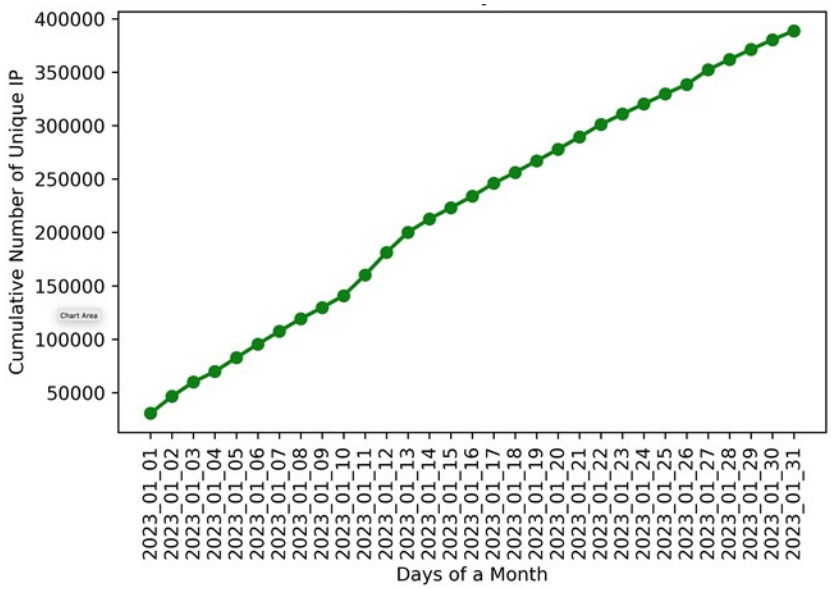


Figure Caption : Cumulative number of unique source IP addresses, which established TCP connections with Network Telescope on each day in the month of January 2023.