Evaluation of Climate Extremes in the Indian Himalayan Cities: Historical Trends and Future Projections

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Submitted By : Mr. Nikhil Kumar
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Submission Date : 18-Aug-2023

PROPOSAL DETAILS

(PDF/2023/003983)

Principal Investigator	Mentor & Host Institution
Mr. Nikhil Kumar	**Saket Dubey**
phd1901204010@iiti.ac.in	saketdubey@iitbbs.ac.in
PhD Student(Civil Engineering)	Assistant Professor(School of infrastructure)
Contact No : +919739970452	**Indian Institute of Technology Bhubaneswar**
Date of Birth : 23-Dec-1990	Jatni road argul, Bhubaneswar, Odisha-752050
Name of Father/Spouse :	**Contact No.** : +919741171476
Kuldeep Kumar	**Registrar Email** : registrar@iitbbs.ac.in
	No. of PHD Scholars : 0
	No. Post-Doctoral Fellow : 0

Details of Post Doctorate

Ph.D. (Hydrology and Water Resource Engineering) [Not yet Awarded. Thesis Submitted On : 09-Jun-2023]

Understanding hydroclimatic extremes and their implications in India

Research Supervisor/Guide & Institution :

Professor Manish Kumar Goyal

Indian Institute of Technology, Indore

Brief details of Thesis work :

In my thesis, I assessed the joint probabilities of climate extremes indices in India. I also developed a new approach using copulas to
investigate the relationship between compound dry-hot extremes and vegetation loss. Presently, I am working on a unique approach to study the relationship between extreme precipitation and floods using generalized extreme value (GEV) models. Throughout my research, I have honed my skills in modern probability and statistical tools like copulas, non-stationary analysis, machine learning, and extreme event analysis. Furthermore, my expertise extends to the use of hydrological models such as SWAT and the Variable Infiltration Capacity model.

Technical Details :

Research Area : Earth & Atmospheric Sciences (Earth & Atmospheric Sciences)

Project Summary :

The project emerges from the urgent need to understand regional climatic variations. With rising climate extremities, targeted research in Himalayan cities is essential. The scientific objectives include 1) assessing historical precipitation and temperature trends in selected cities; 2) utilizing CMIP6 models to project future extremes; 3) creating vulnerability maps to guide policy decisions. The research will test the hypothesis that historical climatic data can be used to forecast future changes and that vulnerability mapping can enhance policy decisions. Main experiments include analyzing historical data, employing CMIP6 models for future trend projections, and generating maps integrating climatic data. The project promises to deepen understanding of the region's climate dynamics and provide tools for policy, offering strategies to adapt and mitigate climate extremes in the Himalayan region.

Objectives :

1. To assess the historical trends in precipitation and temperature extremes in selected Himalayan cities 2. To project future trends in precipitation and temperature extremes using CMIP6 climate models. 3. To generate vulnerability maps for selected cities to guide policy for climate adaptation and mitigation.

Keywords :

Climate Extremes, Indian Himalayan Region, Future Projections, Climate models, Urbanization

Expected Output and Outcome of the proposal :

The project is expected to yield detailed reports on historical trends in precipitation and temperature in selected Himalayan cities, alongside projections of future climate extremes using CMIP6 models. GIS-based maps identifying vulnerable areas and tailored guidelines for climate adaptation and mitigation will also be produced. The outcomes promise to enhance preparedness by enabling policymakers and communities to better anticipate and respond to climate extremes. The insights will support the shaping of local and national policies for sustainable development, fostering collaboration between environmental agencies, urban planners, and governments. In sum, the outputs and outcomes will deepen understanding of climate dynamics in the Himalayan region, offering valuable strategies for adaptation and mitigation, with potential widespread impact.

Reference Details :

S.No	Reference Details
1	**Dr. Rajdeep Singha** **Assistant Professor** **School of Social Sciences and Humanities** **Tata Institute of Social Sciences, Guwahati Assam, India** **Email: rajdeep.singha@tiss.edu[+9401013889]** rajdeep.singha@tiss.edu
2	**Professor Manish Kumar Goyal (PhD supervisor)** **Department of Civil Engineering** **Indian Institute of Technology Indore** **Madhya Pradesh, India[+9435880989]** mkgoyal@iiti.ac.in

Methodology and Work Plan

Methodology

The methodology for evaluating climate extremes (Kumar et al., 2021) in the Indian Himalayan cities spans several intricate phases (Singh et al., 2019). Initially, data collection and preprocessing involve gathering historical climate data, including temperature and precipitation, from meteorological stations, satellite data, and existing climate databases. The data are then cleaned, organized, and pre-processed to ensure quality and consistency. For the climate trend analysis, the Mann-Kendall test (Mann, 1945) is employed to detect trends and patterns in historical climatic data, while Sen's slope method (Sen, 1968) is utilized to estimate the magnitude of the trend. The selected CMIP6 models are then used to project future climate extremes under various scenarios, assessing uncertainties. Vulnerability mapping integrates climate data with socio-economic indicators, utilizing GIS tools to create maps identifying high-risk areas in the selected cities. Finally, the findings are synthesized to develop policy guidelines and recommendations for climate adaptation and mitigation. This comprehensive methodology ensures an in-depth understanding of the region's climate dynamics and provides valuable tools for decision-makers, aligning with the project's objectives.

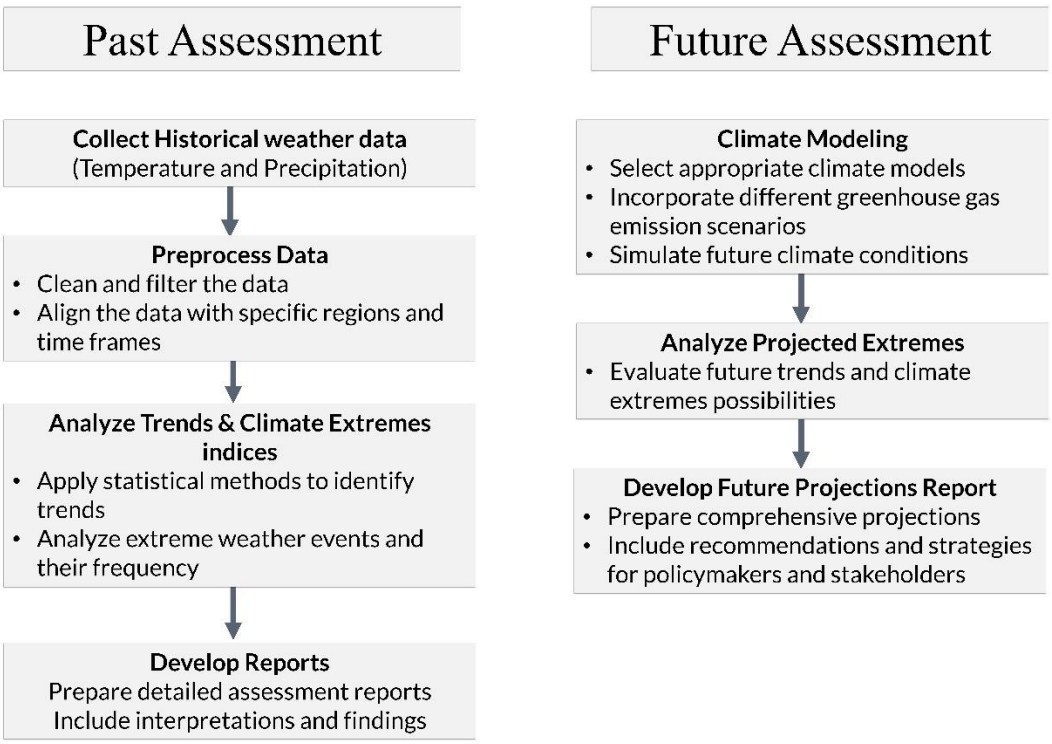

Fig. 2. A schematic for assessment of climate extremes in Indian Himalayan region for past and future

Study Area

The project's study area encompasses nine smart cities in the Indian Himalayan region. These cities are Dharamasala, Namchi, Srinagar, Shimla, Dehradun, Pasighat, Jammu, Gangtok, and Itanagar. They are situated within the states of Himachal Pradesh, Sikkim, Uttarakhand, and Arunachal Pradesh, as well as the union territory of Jammu and Kashmir.

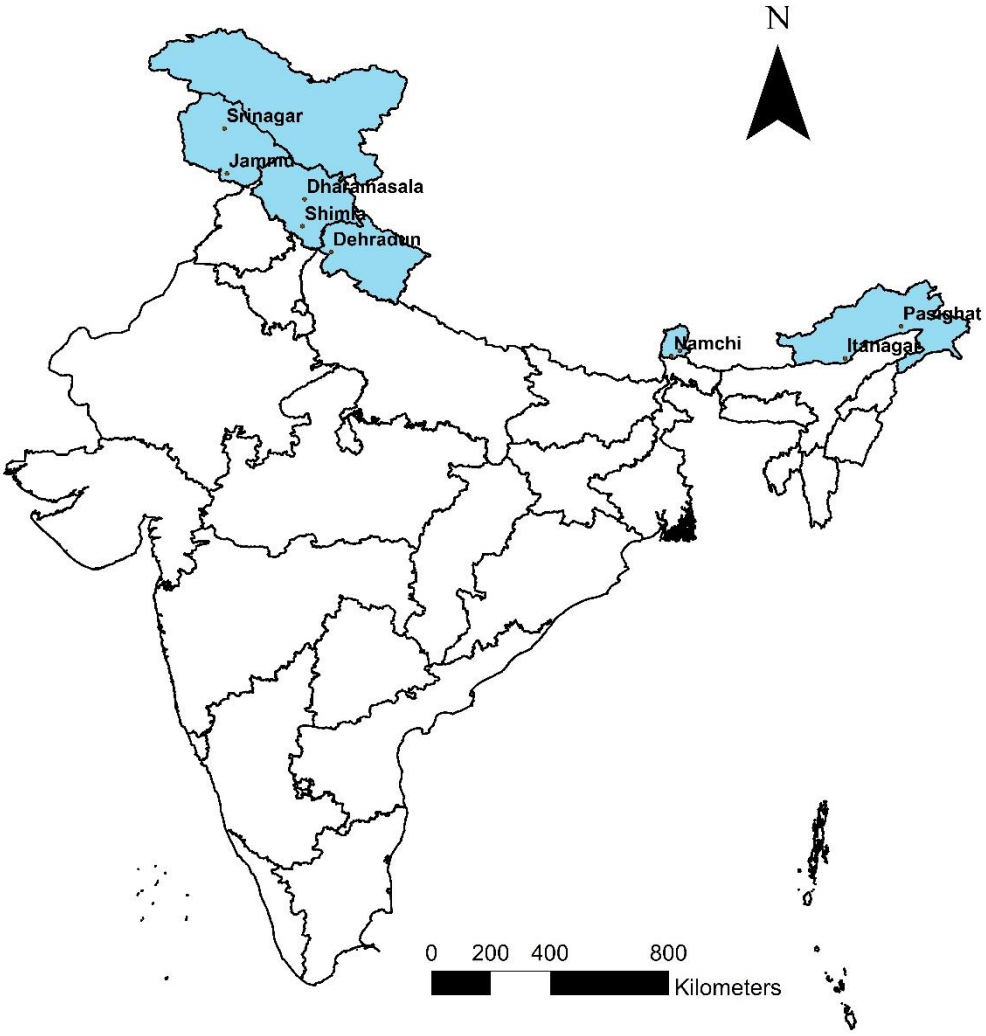

Fig. 2. Study area including 9 smart cities across the Indian Himalayan region.

Work Plan

Year	Month	Activities
Year 1	1-3	Define scope, finalize selected cities. Begin data collection and preprocessing.
	4-6	Complete data collection and preprocessing. Start historical trend analysis.
	6-9	Complete historical trend analysis. Begin projection using CMIP6 models.
	9-12	Complete future climate projections. Start initial vulnerability mapping.
Year 2	1-3	Complete vulnerability mapping. Begin synthesis of findings
	4-6	Start preparation for dissemination (reports, publications). Complete policy recommendations.
	6-9	Finalize all reports and papers.
	9-12	Final review and project closure. Submit all deliverables and finalize dissemination.

References

Kumar, N., Poonia, V., Gupta, B.B., Goyal, M.K., 2021. A novel framework for risk assessment and resilience of critical infrastructure towards climate change. Technol. Forecast. Soc. Change 165, 120532.

Mann, H.B., 1945. Nonparametric tests against trend. Econom. J. Econom. Soc. 245–259.

Sen, P.K., 1968. Estimates of the regression coefficient based on Kendall's tau. J. Am. Stat. Assoc. 63, 1379–1389.

Singh, V., Sharma, A., Goyal, M.K., 2019. Projection of hydro-climatological changes over eastern Himalayan catchment by the evaluation of RegCM4 RCM and CMIP5 GCM models. Hydrol. Res. 50, 117–137.

PROFORMA FOR BIO-DATA (to be uploaded)

1. Name and full correspondence address: Nikhil Kumar

Address: VPO Nagrota Surian Teh. Jawali
Distt. Kangra, Himachal Pradesh
India, 176027

2. Email(s) and contact number(s): phd1901204010@iiti.ac.in

3. Institution: Indian Institute of Technology, Indore

4. Date of Birth: 23-December-1990

5. Gender (M/F/T): M

6. Category Gen/SC/ST/OBC: OBC

7. Whether differently abled (Yes/No): No

8. Academic Qualification (Undergraduate Onwards)

	Degree	Year	Subject	University/Institution	% of marks
1.	B.Tech	2012	Industrial and Production Engineering	Dr. B.R Ambedkar National Institute of Technology, Jalandhar	68.12
2.	M.A	2017	Ecology, Environment and Sustainable Development	Tata Institute of Social Sciences, Guwahati	73
3.	Ph.D in Civil Engineering	2023	Hydrology and water resource Engineering	Indian Institute of Technology, Indore	8.55 GPA (Thesis submitted on 9-June-2023)
4.					

9. Ph.D thesis title, Guide's Name, Institute/Organization/University, Year of Award.
Understanding hydroclimatic extremes and their implications in India, Professor Manish Kumar Goyal, Indian Institute of Technology, Indore, 2023 (Thesis submitted on 9-June-2023)

10. Work experience (in chronological order).

S.No.	Positions held	Name of the Institute	From	To	Pay Scale
1	Junior Research Fellow	Indian Institute of Technology, Indore	31-August-2019	23-July-2020	3 LPA

11. Professional Recognition/ Award/ Prize/ Certificate, Fellowship received by the applicant.

S.No	Name of Award	Awarding Agency	Year
1	Mukhya Mantri Protsahan Yojna	Government of Himachal Pradesh	2020
2	Young Scientist Award	36th MP Young Science Congress, Government of Madhya Pradesh	2021
3	SERB- Overseas Visiting Doctoral Fellowship	Science and Engineering Research Board (SERB)	2021

12. Publications *(List of papers published in SCI Journals, in year wise descending order).*

S.No.	Author(s)	Title	Name of Journal	Year
1	**Kumar, N.,** Goyal, M.K., Gupta, A.K., Jha, S., Das, J. and Madramootoo, C.A.,	Joint Behaviour of Climate Extremes across India: Past and Future	Journal of Hydrology	2021
2	**Kumar N**., Sinha J, Madramootoo CA, Goyal MK	Quantifying groundwater sensitivity and resilience over peninsular India	Hydrological Processes	2020
3	**Kumar, N.**, Patel, P., Singh, S. and Goyal, M.K, 2023	Understanding non-stationarity of hydroclimatic extremes and resilience in Peninsular catchments, India	Scientific reports	2023
4	**Kumar, N**., Poonia, V., Gupta, B.B. and Goyal, M.K.	A novel framework for risk assessment and resilience of critical infrastructure towards climate change	Technological Forecasting and Social Change	2021
5	Singh, S., **Kumar, N**., Goyal, M.K. and Jha, S., 2023	Relative influence of ENSO, IOD, and AMO over spatiotemporal variability of hydroclimatic extremes in Narmada basin, India	AQUA - Water Infrastructure, Ecosystems and Society	2023
6	Keesari, T., Goyal, M.K., Gupta, B., **Kumar, N**., Roy, A., Sinha, U.K., Surampalli, R.Y., Zhang, T.C. and Goyal, R.K.	Big data and environmental sustainability based integrated framework for isotope hydrology applications in India	Environmental Technology & Innovation	2021

13. Detail of patents.

S.No	Patent Title	Name of Applicant(s)	Patent No.	Award Date	Agency/Country	Status
	NA					

14. Books/Reports/Chapters/General articles etc.

S.No	Title	Author's Name	Publisher	Year of Publication
1	Agriculture Resilience Assessment Over Central India Under Climate Change	Goyal, M.K., Poonia, V., Kumar, N., Jha S., Gupta, A.K. and Acharya, P	National Institute of Disaster Management	2020
2				

15. Any other Information (maximum 500 words):

I am nearing the completion of my PhD in Hydrology and Water Resource Engineering at the Indian Institute of Technology Indore (IIT-I), India, and recently concluded a visiting researcher term at the University of Alberta, Canada. I anticipate graduating in September 2023. I believe that my expertise in hydrological modelling, spatio-temporal data handling, climate extremes, and data visualization skills, coupled with remote sensing, align me well for this fellowship.

During my PhD journey, I investigated the behaviour of hydroclimatic extremes, assessing their frequency, intensity, duration, and spatial extent, along with estimation of their joint impacts. My PhD thesis, titled *"Understanding hydroclimatic extremes and their implications in India"*, allowed me to explore and contribute to the area of hydrological modelling and climate extremes. Throughout my research, I have honed my skills in modern probability and statistical tools like copulas, non-stationary analysis, machine learning, and extreme event analysis. Furthermore, my expertise extends to the use of hydrological models such as SWAT and the Variable Infiltration Capacity model. In my thesis, I assessed the joint probabilities of climate extremes indices in India. I also developed a new approach using copulas to investigate the relationship between compound dry-hot extremes and vegetation loss. Also, I developed machine learning based hydrological models for 54 catchments using SVM, RVM, and Random Forest techniques. Presently, I am working on a unique approach to study the relationship between extreme precipitation and floods using a process based hydrological model (SWAT model) and generalized extreme value (GEV) models.

Additionally, I have mentored graduate students in their research projects, leading to co-authored publications. These diverse experiences throughout my academic journey have endowed me with skills in securing research grants, manuscript preparation, and innovating novel methodologies. These proficiencies make me well-suited for independent work as well as collaborative endeavours. I hope to enrich my knowledge of hydroclimatalogy with postdoctoral training focused on climate extremes in Himalayas. Confident in my abilities, I am committed to contributing to, leading, and driving high-quality research, thereby advancing scientific pursuits.

Undertaking by the Fellow

I, **Nikhil Kumar**, Son of Shri Kuldeep Kumar, resident of VPO Nagrota Surian Teh. Jawali, Distt. Kangra, Himachal Pradesh, agree to undertake the following, If I am offered the SERB N-PDF
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1. **I shall abide by the rules and regulations of SERB during the entire tenure of the fellowship.**
2. **I shall also abide by the rules, discipline of the institution where I will be implementing my fellowship**
3. **I shall devote full time to research work during the tenure of the fellowship**
4. **I shall prepare the progress report at the end of each year and communicate the same to SERB through the mentor**
5. **I shall send two copies of the consolidated progress report at the end of the fellowship period.**
6. **I further state that I shall have no claim whatsoever for regular/permanent absorption on expiry of the fellowship.**

Date: 9-Aug-2023 **Signature**

Endorsement from the Mentor & Head of the Institution

This is to certify that:

1. The applicant, **Mr. Nikhil Kumar**, will assume full responsibility for implementing the project.
2. The fellowship will start from the date on which the fellow joins Institute where she implements the fellowship. The mentor will send the joining report to the SERB. SERB will release the funds on receipt of the joining report.
3. The applicant, if selected as SERB-N PDF, will be governed by the rules and regulations of the Institute and will be under administrative control of the Institute for the duration of the Fellowship.
4. The grant-in-aid by the Science & Engineering Research Board (SERB) will be used to meet the expenditure on the project and for the period for which the project has been sanctioned as indicated in the sanction letter/ order.
5. No administrative or other liability will be attached to the Science & Engineering Research Board (SERB) at the end of the Fellowship.
6. The Institute will provide basic infrastructure and other required facilities to the fellow for undertaking the research objectives.
7. The Institute will take into its books all assets received under this sanction and its disposal would be at the discretion of Science & Engineering Research Board (SERB).
8. The Institute assume to undertake the financial and other management responsibilities of the project.
9. The Institute shall settle the financial accounts to the SERB as per the prescribed guidelines within three months from the date of termination of the Fellowship.

Date: 16.08.2023

Signature of the Mentor:

Name and Designation: Dr. Saket Dubey,
Assistant Professor, School of Infrastructure.

Place: IIT Bhubaneswar

Signature of Head of Institution

संकायाध्यक्ष (प्रायोजित अनुसंधान और औद्योगिक परामर्श)
Dean (Sponsored Research & Industrial Consultancy)
भा.प्रौ.सं.भुवनेश्वर / IIT Bhubaneswar
अरगुल/ Argul-752050,ओडिशा/ Odisha

Saket Dubey

Assistant Professor, Indian Institute of Technology Bhubaneswar

Former Postdoctoral Researcher, University of Dayton

PhD, Indian Institute of Technology Indore

M-3, Yadunandan Nagar, Tifra, Bilaspur, Chhattisgarh, India - 495223

Email: saketdubey4@gmail.com

Mob: +91 9741171476

Researchgate

Research Interests

Mountain Hydrology, Remote Sensing, Hydroclimatology, Risk and Hazard Assessment, Machine Learning Applications

Education

Indian Institute of Technology, Indore — Indore, MP, India

PhD — Dec.2018 – Dec.2021

Hydro-climatology Lab, Discipline of Civil Engineering

Advisor: Dr Manish Kumar Goyal, Dr Nitin Joshi (IIT Jammu)

PhD Thesis: Assessment of hazard associated with mass movements in the Himalayan region

Description: The goal of my PhD work was to assess the susceptibility of catastrophic events such as avalanche, landslides and GLOFs in the Himalayas. It comprises of

- Developing a novel algorithm for the determination of mass movement trajectories in various mountain ranges of Himalaya.
- Quantification of risk associated with mass movement events on existing and future populations
- Comprehensive assessment of Glacial Lake Outburst flood in the Indian Himalayas.
- Novel algorithms on snow cover mapping.
- Large scale national and transboundary downstream impact assessment.

National Institute of Technology, Raipur — Raipur, CG, India

Master of Technology — Jul. 2016 - Jul. 2018

(Master of Technology in Water Resource Development and Irrigation Engineering)

Department of water resources and irrigation engineering

Advisors: Dr Sandeep Kumar Chouksey

Master's thesis: Climate change impact assessment on discharge of river basins

Description: Evaluation of various climate models and projection of river discharge using hydrological model (SWAT) and meteorological forcing from CORDEX Experiment.

Work Experience

University of Dayton, — Ohio, USA

Postdoctoral Researcher

(NASA Funded Project) — March.2022-present

Indian Institute of Technology, Indore — Indore, MP, India

Teaching Assistant — Dec.2018 - Sep.2021

Hydro-climatology Lab, Discipline of Civil Engineering

Indian Institute of Technology, Indore — Indore, MP, India

Junior Research Fellow / Senior Research Fellow — Sep.2018 - Sep.2021

National Mission on Himalayan Studies,

Ministry of Environment Forest and Climate Change

Awards

- **Young scientist award** at 35th M.P. Young Scientist Congress, by M.P. Council of Science and Technology, Government of India, Feb. 2020, Bhopal, India.
- **Best Student Presentation Award** by University of Bristol and Department of Science and Technology **(**Indo-Uk partnership development workshop) on Water security assessment of Indian rivers originating from the Himalayas (WEIGH), September 2020.
- **Travel grant** by Madhya Pradesh Council of Science and Technology to attend 34th MP Young Scientist Congress, Mar. 2019, Bhopal, Madhya Pradesh, India.
- **Awarded doctoral fellowship** by National Mission on Himalayan Studies, Ministry of Environment Forest and Climate Change, Government of India Dec. 2018.
- **Graduate Aptitude Test (GATE)** qualified in the year 2016 and 2018.

Publications– Journal Papers

- **Dubey, S., & Goyal, M. K. (2020).** Glacial lake outburst flood hazard, downstream impact, and risk over the Indian Himalayas. **Water Resources Research**, 56(4), e2019WR026533. (Impact Factor: 4.31). Link
- **Dubey, S.,** Gupta, H., Goyal, M. K., & Joshi, N. (2021). Evaluation of precipitation datasets available on Google earth engine over India. **International Journal of Climatology**. (Impact Factor: 3.92) Link
- **Dubey, S.,** Sharma, A., Panchariya, V. K., Goyal, M. K., Surampalli, R. Y., & Zhang, T. C. (2021). Regional sustainable development of renewable natural resources using Net Primary Productivity on a global scale**. Ecological Indicators.** (Impact Factor: 4.98) Link
- **Dubey, S.,** Goyal, M. K. & Joshi, N. (2021). Glacial lakes and Outburst Flood Hazard in Northwestern Himalayas**, IEI Special Centenary Volume on "Flash Floods: Challenges and its Management".** Link
- **Dubey, S.,** Gupta, H., & Goyal, M. K., (2021). Artificial Intelligence-based snow cover dynamics: impact on critical infrastructure. **IEEE Internet of Things Magazine** (Impact Factor: 9.92) (under review)
- Poonia, V., Goyal, M. K., Jha, S., & **Dubey, S**. (2021). Terrestrial Ecosystem Response to Flash Droughts over India. Journal of Hydrology. ***Journal of Hydrology****,* 577, 123970. (Impact Factor: 5.77) (under review)

Publications–under preparation (submission journal)

- **Dubey, S**., Sattar, A., Goyal, M. K., Allen, S., Huggel, C., & Haritashya, U. (2021) Changing hazard of ice-rock avalanche in the Himalaya. (Earth's Future)
- **Dubey, S**., Gupta, H., & Goyal, M. K., (2021) A novel approach for the determination of long-term snow cover dynamics based on random forest algorithm and Google Earth Engine (Journal of Hydrology).
- **Dubey, S**., Gupta, V., Sattar, A., & Goyal, M. K (2021) Trans-boundary hazard of glacial lakes in the Himalayas (Science Bulletin).
- Gupta, A., **Dubey, S**., & Goyal, M. K. (2021) The status of Indian Ramsar Wetlands sites: long term inundation mapping using Google Earth Engine (Science of the Total Environment)

Publications–Book Chapters

- **Dubey, S**., & Chouksey, S. K. (2020). Evaluation of CORDEX multi-RCM for Indian subcontinent using NASA's RCMES. In Applications of geomatics in civil engineering (pp. 577-591). Springer, Singapore. Link
- Kumar N, **Dubey S**, Goyal M, K, Jimenez-Bescos C, Talei (2020) "Technological advancement and pandemic" Chapter 17 in Integrated Risk of Pandemic: Covid-19 Impacts, Resilience and Recommendations. Link
- Singh S, **Dubey S**, Kumar N, Goyal M.K., Pal I (2020) "Psychological impacts of pandemic" Chapter 7 in Integrated Risk of Pandemic: Covid-19 Impacts, Resilience and Recommendations Link

Conference/Workshops/Posters

- **Dubey, S.,** Goyal, M., Sattar, A., & Haritashya, U. (2021). Susceptibility of glacial lakes to avalanche and rockfall in the Hindu-Kush-Himalaya (No. EGU21-12475). **EGU Copernicus Meetings.** Link
- Presented a paper at **35th MP Young Scientist Congress**, 28 Feb-1 Mar. 2020, Bhopal, Madhya Pradesh, India.
- Presented a paper at **17th CG Young Scientist Congress**, 28 Feb-1 Mar. 2019, Raipur, Chhattisgarh, India.
- Presented a poster at **International Symposium on Water: Resources, Challenges & Sustainability** organized by Indian Institute of Technology Indore, 10 Mar. 2018, Indore, India.
- Presented a paper at **international conference on Geomatics IN Civil Engineering**, organized by Indian Institute of Technology Roorkee, 5-6 Apr. 2018, Roorkee, India. Link
- Presented a paper at **'International conference on Ecosystem Restoration for Resilience and Sustainability: Living with nature**" jointly organized by IIT-Indore and NIDM, New Delhi from 5-7 June, 2021.
- Presented a paper at "**IGU India International Conference, 2020 on Global to local Sustainability and local Earth" organized by MLSU, Udaipur, India.**
- Attended **Basics of Remote Sensing, Geographical Information System and Global Navigation Satellite Systems** organized by Indian Institute of Remote Sensing (IIRS) and Indian Space Research Organisation (ISRO), 22nd August 2016- 18 November 2016
- Attended workshop on **Mike Urban+**, DHI India, 3rd August- 4th September2020.
- Attended workshop on **MIKE HYDRO River**, DHI India, 2rd February - 7th February 2020.

Skills

Remote Sensing and GIS	ArcGIS, Google Earth Engine, Geospatial Analysis
Programming	MATLAB, R Programming, Python, Java
Data Science	Machine Learning and Data Mining, Data Visualization
Hydrological Modelling	Mike Flood, Mike Urban+, SWAT
Organization and management	Conference and Workshop Organization, Scientific Communication and Outreach Management

Teaching

- Teaching Assistantship for CE 257, Civil Engineering Drawing and Computer Aided Drawing Lab, IIT Indore
- Teaching Assistantship for CE 203, Fluid Mechanics I and Fluid Mechanics Lab I, IIT Indore
- Teaching Assistantship for CE 204, Fluid Mechanics II and Fluid Mechanics Lab II, IIT Indore
- Teaching Assistantship for CE 206, Surveying and Geodesy-I, IIT Indore.
- Assisted undergraduate students in their B. Tech Projects at Discipline of Civil Engineering, IIT Indore.

Events/Volunteering

- **Recent Advancements in Water Resources and Environment Engineering** organized by Discipline of Civil Engineering & Discipline of Biosciences and Biomedical Engineering, Indian Institute of Technology Indore, 22-27 Apr. 2020, Indore, India
- TEQIP short term course on **Hydrometeorological and Extreme Events Disaster Risk Management,** organized by Discipline of Civil Engineering, Indian Institute of Technology Indore and National Institute of Disaster Management, 1 -22 Jun. 2020, Indore, India
- 'International conference on **Ecosystem Restoration for Resilience and Sustainability: Living with nature"** jointly organized by IIT-Indore and NIDM, New Delhi from 5-7 June, 2021.

Media Outreach- Press Releases and Interviews

Nature Climate Change, Free Press Journal, The Times of India

References

Dr. Manish Kumar Goyal
(Professor)
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Indian Institute of Technology Indore
Email: mkgoyal@iiti.ac.in
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Dr. Ashutosh Sharma
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Department of Hydrology,
Indian Institute of Technology Roorkee,
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Dr. Umesh Haritashya
(Professor)
Mann – Chair Geology Earth and Environmental
Sciences, University of Dayton, Ohio, USA
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Undertaking by the Principal Investigator

To

The Secretary
SERB, New Delhi

Sir

I **Nikhil Kumar** hereby certify that the research proposal titled "**Evaluation of Climate Extremes in the Indian Himalayan Cities: Historical Trends and Future Projections**" submitted for possible funding by SERB, New Delhi is my original idea and has not been copied/taken verbatim from anyone or from any other sources. I further certify that this proposal has been checked for plagiarism through a plagiarism detection tool i.e., Turnitin approved by the Institute and the contents are original and not copied/taken from any one or many other sources. I am aware of the UGCs Regulations on prevention of Plagiarism i.e., University Grant Commission (Promotion of Academic Integrity and Prevention of Plagiarism in Higher Educational Institutions) Regulation, 2018. I also declare that there are no plagiarism charges established or pending against me in the last five years. If the funding agency notices any plagiarism or any other discrepancies in the above proposal of mine, I would abide by whatsoever action taken against me by SERB, as deemed necessary.

Nikhil Kumar
PhD Student
Indian Institute of Technology, Indore

तहसीलदार कार्यालय
office of Tehsildar
तहसील : नगरोटा सुरियाँ (उप-तहसील) जिला : काँगड़ा
Tehsil : Nagrota Surian (ST) District : KANGRA

प्रमाणपत्र का प्रारूप भारत सरकार के अधीन पदों पर नियुक्ति के लिए आवेदन करने वाले अन्य पिछड़े वर्गों द्वारा प्रतिस्थापित करने के लिए

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Validity: **One Year From The Date Of Issue**

यह प्रमाणित किया जाता है कि **श्रीNIKHIL KUMAR पुत्र श्री KULDEEP KUMAR निवासी .गाँव/ मुहाल नगरोटा सूरियां तहसील नगरोटा सुरियाँ (उप-तहसील) जिला काँगड़ा (हि.प्र.), में कुम्हार के अंतर्गत आते है , जो हिमाचल प्रदेश में अन्य पिछड़ा वर्ग के रूप में सरकार द्वारा मान्यता प्राप्त है |**

श्री NIKHIL KUMAR और उसका परिवार आमतोर पर राज्य के गाँव/ मुहाल नगरोटा सूरियां तहसील नगरोटा सुरियाँ (उप-तहसील) जिला काँगड़ा में रहता है | यह भी प्रमाणित किया जाता है कि वह वित्तीय वर्ष 2023-2024 के लिए जारी आय प्रमाण पत्र के अनुसार (क्रीमी लेयर) का हिस्सा नहीं है |

It is certified that Mr. NIKHIL KUMAR Son of Mr. KULDEEP KUMAR Resident of Village/ Muhal Nagrota Surian Tehsil Nagrota Surian (ST) Distt KANGRA H.P. belongs to Kumhar which is recognised as Other Backward Class in Himachal Pradesh by Government.

Mr. NIKHIL KUMAR and his/her family ordinarily resides in Village/ Muhal Nagrota Surian Tehsil Nagrota Surian (ST) of District KANGRA of state. This is also to certified that he/she is not part of (Creamy Layer) as per the income Certificate issued for the financial year 2023-2024.

Approving Authority

Executive Magistrate
Nagrota Surian

Name: Netra Meti
Designation: Tehsildar
District: KANGRA
Tehsil: Nagrota Surian (ST)
Approval Date: 01/05/2023

Disclaimer:-This is a digitally signed certificate and does not require hand signature. The responsibility of verification of this document before accepting the same for any legal purpose, would rest with the institution or organization or company or any other entity where this document is produced.

Note:- This document can be verified online at Himachal Online Seva (HP e-District) portal http://edistrict.hp.gov.in using unique certificate ID.

भारतीय प्रौद्योगिकी संस्थान इंदौर
Indian Institute of Technology Indore
Khandwa Road, Simrol, Indore 453552, India

IIT Indore

IITI/Acad/2022-23/ 1901204010 June 13, 2023

TO WHOMSOEVER IT MAY CONCERN

This is to certify that **Mr. Nikhil Kumar** S/o Mr. Kuldeep Kumar, Roll no. 1901204010, Ph.D. student in the **Department of Civil Engineering**, has submitted a thesis entitled "**Understanding hydroclimatic extremes and their implications in India**" in partial fulfillment of the requirements of the Ph.D. degree of this Institute on **June 9, 2023**.

The award of Ph.D. degree will be considered only after satisfactory defense of the thesis at the Viva Voce.

Assistant Registrar
(Academic Affairs)

सहायक कुलसचिव (शैक्षणिक कार्य)
Assistant Registrar (Academic Affairs)
भारतीय प्रौद्योगिकी संस्थान इंदौर
Indian Institute of Technology Indore

क्रमांक 493084 केन्द्रीय माध्यमिक शिक्षा बोर्ड
S.No. 2006 CENTRAL BOARD OF SECONDARY EDUCATION

अंक विवरणिका MARKS STATEMENT

ALL INDIA सेकण्डरी स्कूल परीक्षा, 2006
SECONDARY SCHOOL EXAMINATION, 2006

नाम Name NIKHIL KUMAR अनुक्रमांक Roll No. 2185668
माता का नाम Mother's Name SNEH LATA
पिता का नाम Father's Name KULDEEP KUMAR
जन्म तिथि Date of Birth 23RD DECEMBER NINETEEN HUNDRED NINETY
विद्यालय School 23023 D A V PUBLIC SCHOOL NAGROTA DT. KANGRA HP

विषय कोड SUB. CODE	विषय SUBJECT	प्राप्तांक MARKS OBTAINED				स्थितीय ग्रेड POSITIONAL GRADE
		लि. TH	प्रै/आं.मू PR/IA	योग TOTAL	योग शब्दो में TOTAL IN WORDS	
101	ENGLISH COMM.	067	XXX	067	SIXTY SEVEN	B2
002	HINDI COURSE-A	070	XXX	070	SEVENTY	B1
041	MATHEMATICS	078	XXX	078	SEVENTY EIGHT	B1
086	SCIENCE & TECH.	058	024	082	EIGHTY TWO	A2
087	SOCIAL SCIENCE	065	020	085	EIGHTY FIVE	A2

AB : विषय में अनुपस्थित Absent in the Subject
PR : प्रयोगात्मक Practical
IA : आंतरिक मूल्यांकन Internal Assessment

परिणाम Result PASS

दिल्ली Delhi
दिनांक Dated 27-05-2006

परीक्षा नियंत्रक
Controller of Examinations