

An Indian-Australian research partnership

**Project Title:** Climate change, air pollution and human health in India: Current impacts and future risks

**Project Number** IMURA1022

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**IITB Department:** Environmental Science and Engineering (ESED)

### Research Clusters:

### Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST <b>one</b>. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>		Highlight which of the Academy's Theme(s) this project will address? <i>(Feel free to nominate more than one. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>	
1	Material Science/Engineering (including Nano, Metallurgy)	1	Artificial Intelligence and Advanced Computational Modelling
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	Circular Economy
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	<b>Health Sciences</b>
5	<b>Earth Sciences and Civil Engineering (Geo, Water, Climate)</b>	5	Smart Materials
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Sustainable Societies
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Infrastructure
8	HSS, Design, Management		

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## The research problem

Over the coming decades, the number of hot days is projected to be more frequent, intense and of longer duration. If both average temperatures and extreme heat events increase as projected, India will be at high risk of increased heat strain during the hot season. Hence, there is an urgent need for a better quantitative understanding of the health effects of ambient temperatures, and this requires studies of both current health effects and scenario analyses of likely future health effects. The overarching aim of the proposed project is to generate essential scientific evidence needed by policy-makers and stakeholders in India for the development, prioritization and implementation of health protection strategies and policies regarding climate change, in particular to mortality/morbidity burden that can be attributed to ambient temperature in the context of climate and demographic change. Since the temperature-health effect association will be confounded by air pollution, primarily PM<sub>2.5</sub>, the modification of the relationship by daily PM<sub>2.5</sub> will be further examined.

## Project aims

1. To assess the current exposure-response relationship between ambient temperature and mortality/morbidity (hospital admission and emergency department visits) over time and space in India,
2. To predict future exposure-response relationships between ambient temperature and mortality/morbidity in India, and
3. To estimate the current and future health burden associated with ambient temperature in India under a range of climatic and demographic change scenarios by 2050, 2090s

## How skills/experience of the IITB and the Monash supervisor(s) support the proposed project

IITB and Monash supervisors bring in complimentary set of skills to support the proposed research project. While *Harish C. Phuleria* has extensive experience in environmental exposure assessment, air quality monitoring and modeling, emission characterization and environmental health studies, *Yuming Guo* brings in the expertise in environmental epidemiology, biostatistics, global environmental change, climate change and infectious disease modelling.

## What is expected of the student when at IITB and when at Monash?

The project will utilize secondary data from multiple resources for health indicators, climate indicators, air pollution indicators etc. - all of which the prospective student will need to collect, ensure the data quality and run the spatio-temporal models at IIT Bombay. Specific additional analyses will be explored at Monash with Yuming Guo's team including collating the India-centric data with Australian data or other global data sets to do comparative analysis. The later will be achieved at Monash.

## Expected outcomes

Having good measures of association between mortality/ morbidity response and ambient temperatures is essential for the development of future heat warning systems and mitigation and intervention measures targeting higher risk areas or time periods. However, there has been no comprehensive research on spatial variation in health impacts of ambient temperatures in India. Another key issue is the temporal variation in the exposure-response relationship between

ambient temperature and mortality/morbidity, which can be used to assess whether populations have adapted to the local weather or not. Ambient temperature, one of the most important environmental factors for human health, has not explicitly been included in the GBD study, due to a lack of epidemiological evidence and challenges of assessing the exposure-response relationship. This study will attempt to fill those gaps.

### **How will the project address the Goals of the above Themes?**

The research area directly addresses the research theme of health sciences and coupled with climate change and air pollution it broadly addresses the broader theme of sustainable societies as well.

### **Potential RPCs from IITB and Monash**

Prof. Subhankar Karmakar, ESED, IIT Bombay  
(Expert in environmental systems modeling, GIS, climate impacts and vulnerability)

Prof. Siuli Mukhopadhyay, Maths, IIT Bombay  
(Expert in spatio-temporal modeling of vector-borne diseases, advanced statistical methods and multinomial and multivariate modeling)

### **Capabilities and Degrees Required**

We are seeking for 1 Ph.D. student in this project. Candidates would be desirable with the following academic backgrounds:

1. MTech in Environmental Engineering **OR** M.Sc. in Environmental Science/ Atmospheric Science
2. A minimum of 1 year of research experience in air pollution/ atmospheric monitoring and assessment
3. Good spatial analysis skills including experience and training in GIS
4. Candidate should be conversant with basic statistics and prior experience with quantitative statistical methods will be desirable.

### **Necessary Courses**

A few advanced level courses in Spatial statistics and multivariate statistics may be necessary, depending on the prospective student's prior exposure. One or two courses may be helpful on environmental epidemiology and study designs.

### **Potential Collaborators**

Prof. Subimal Ghosh, CE, IIT Bombay; Prof. Chandra Venkataraman, ChE, IIT Bombay

Prof. Victor Chang, Env Engg., Monash Univ.

Select up to **(4)** keywords from the Academy's approved keyword list (**available at <http://www.iitbmonash.org/becoming-a-research-supervisor/>**) relating to this project to make it easier for the students to apply.

**Climate change, Health, Data science, Air Pollution**