

An Indian-Australian research partnership

Project Title: **Reconstruction of past glacier change in Ladakh Himalayas and future projections based on climate change scenario**
Project Number **IMURA0980**
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Research Clusters:
Research Themes:

Highlight which of the Academy's CLUSTERS this project will address? <i>(Please nominate JUST <u>one</u>. For more information, see www.iitbmonash.org)</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 www.iitbmonash.org)</i>	
1	Material Science/Engineering (including Nano, Metallurgy)	1	Advanced computational engineering, simulation and manufacture
2	Energy, Green Chem, Chemistry, Catalysis, Reaction Eng	2	Infrastructure Engineering
3	Math, CFD, Modelling, Manufacturing	3	Clean Energy
4	CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control	4	Water
5	Earth Sciences and Civil Engineering (Geo, Water, Climate)	5	Nanotechnology
6	Bio, Stem Cells, Bio Chem, Pharma, Food	6	Biotechnology and Stem Cell Research
7	Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng	7	Humanities and social sciences
8	HSS, Design, Management	8	Design

The research problem

As an important freshwater resource, glaciers play an essential role in the global water cycle as hydrological reservoirs at various timescales. However, the majority of glaciers around the world have decreased in mass, with an accelerated retreat trend during the past several decades because of global climate warming. Mountain glaciers such as in Himalayas are experiencing accelerated retreat due to their higher sensitivity to changes in climate forcing. These changes in glacier area and volume will eventually endanger the water security for millions of people who are dependent on these resources for agriculture, hydropower generation, etc.

Considering the need to understand how the glaciers would respond to climate change, recently, a lot of attention has been given to modelling mountain glaciers. Towards this, numerical modelling has been successfully used for estimating past retreat as well as future evolution of glaciers located in different climatic conditions, around the world. This research will focus on glacier in the Ladakh region that are key freshwater sources for villages in that region and further downstream. The project will use the state-of-the-art Ice-sheet and Sea-level System model (ISSM) and climate forcings from pre-industrial and 20th century simulations from the Coupled Model Intercomparison Project to investigate the sensitivity of Ladakh mountain glaciers to changing climate conditions.

Project aims

Define the aims of the project

Aim is to simulate the response of glaciers in the Ladakh region to past, present and future climatic change using pre-industrial and 20th century CMIP emission scenarios. The calculations would involve ice flow dynamics and high-resolution surface mass balance estimations.

Expected outcomes

Highlight the expected outcomes of the project

1. This project will provide the successful PhD candidate with highly valued and sought-after skills in numerical modelling and remote observation of ice and a deep understanding of glacier evolution processes. This will equip the student with the necessary expertise to develop leadership amongst the next generation of glaciologists, ready to carry out their own programme of innovative scientific research.
2. Glacier model suitable for modelling retreat of covered mountain glaciers.
3. Two/ three high impact publications.

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

Describe how the project will address the goals of one or more of the 6 Themes listed above.

The project very well fits into the two following themes viz. (i) complex mathematical modelling and computations and (ii) water. It involves advanced simulations using complex computation models to help us understand why and how the mountain glaciers evolve and behave under different climate scenarios. Moreover, it's about volume of glacier stored ice, global climate, implications to water security, etc.

Potential RPCs from IITB and Monash

Provide names of the potential research progress committee members (RPCs) and describe why they are most suited for the proposed project

IITB: Prof. Subimal Ghosh; Prof. Bellie Sivakumar;

Monash: Prof. Chris Rudiger; Prof. Julie Arblaster

Capabilities and Degrees Required

List the ideal set of capabilities that a student should have for this project. Feel free to be as specific or as general as you like. These capabilities will be input into the online application form and students who opt for this project will be required to show that they can demonstrate these capabilities.

1. Masters in Applied Mathematics & Computing/ Earth Science/Geology/ Earth System Science and Engineering/Geoinformatics/Water Resources Engg., related subjects.
2. Candidates should have good background in mathematical modelling; programming in Python/C++,

Desirable: Experience in handling large volume of remote sensing data related to Cryosphere, knowledge of GIS; knowledge of handling Regional climate Model (RCM) and reanalysis climate data will be added advantage.

Apart from these, the candidate should have very good English skills for oral as well as written communications.

Necessary Courses

Name three tentative courses relevant to the project that the student should complete during his/her coursework at IITB (the student will require to secure 8 point in these courses)

1. Remote Sensing of Cryosphere
2. Introduction to Climate Change
3. Applied Statistics/ Geospatial Statistics

Potential Collaborators

Please visit the IITB website www.iitb.ac.in OR Monash Website www.monash.edu to highlight some potential collaborators that would be best suited for the area of research you are intending to float.

In IITB: Prof. Subimal Ghosh;

In Monash: Prof. Julie Arblaster

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.

Modelling and Simulations; Geoscience; Water and Climate change