

An Indian-Australian research partnership

<b>Project Title:</b>	<b>Rainfall-runoff relationships and catchment resilience in India</b>	
<b>Project Number</b>	IMURA0949	
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**Research Clusters:**
**Research Themes:**

<b>Highlight which of the Academy's CLUSTERS this project will address?</b> <i>(Please nominate JUST <u>one</u>. For more information, see <a href="http://www.iitbmonash.org">www.iitbmonash.org</a>)</i>		<b>Highlight which of the Academy's Theme(s) this project will address?</b> <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	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	<b>Water</b>
5	<b>Earth Sciences and Civil Engineering (Geo, Water, Climate)</b>	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

*Define the problem*

Traditionally in hydrology, it is assumed that rainfall-runoff processes in a catchment are resilient to stressors such as major floods or droughts, and that rainfall-runoff relationships are restored after the effect of the stressor is removed. However, recent evidence from Southeast Australia shows that catchment resilience is only finite, and some catchments may not display complete drought recovery, even after the period of drought gets over. In this study, we aim to investigate rainfall-runoff changes and drought non-recovery across India. By studying the behavior of catchments in major river basins in India before, during and after major drought events, using observed records and statistical models, this project wishes to understand long-term hydrological change, memory and recovery. The study will involve development of new statistical methods for identification and characterization of thresholds or tipping points in hydrological systems between multiple steady states. The project will initially characterize average hydrological dynamics and then focus on regime changes in runoff extremes. Finally, this project will also explore the implications of changes in rainfall-runoff relationships and drought non-recovery on hydrological modelling and long-term planning and management of water resources.

## Project aims

*Define the aims of the project*

The following are the broad aims of this project.

- 1) Development of statistical approaches to identify if and when Indian water catchments move from one steady state to another in response to droughts and floods.
- 2) Extend the statistical analysis to identify if and when hydrological events change hydrological state
- 3) Identify the implications for long-term water resource and flood management.

## Expected outcomes

*Highlight the expected outcomes of the project*

Identifying that water catchments in India have multiple self-reinforcing hydrological states will falsify the widely held assumption that catchments always recover from droughts and flood. This will be a paradigm shift for Indian water management that will open new directions for research and practice. Specific to the student, three to four high-impact international journal papers are expected as outcome of this project.

## 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 proposed study suits the IITB-Monash Research Academy's goals related to the theme of 'Water'. Through this study, we will investigate changes in rainfall-runoff processes and drought recovery in India. India is a largely agriculture-dependent country with links between water shortage and the socio-economic health and prosperity. Freshwater availability in terms of runoff and streamflow is essential to sustain water security. Further, understanding the rainfall-runoff relationships and changes therein can aid in long-term planning and management of water resources.

## 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.*

The candidate should have an exceptional academic background and a strong interest in research. Candidates with BTech/MTech degrees related to the fields of Civil Engineering and/or Hydrology/Water Resources Engineering are encouraged to apply. A background in hydrological processes, programming and statistics is necessary. Any prior experience using hydrologic models or programming to build statistical models will be considered an advantage.

Candidates are strongly encouraged to write to supervisors during the application process, before attending the interviews.

## **Potential Collaborators**

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

Prof. Riddhi Singh (Civil Engineering)

Prof. L Karthikeyan (CSRE)

Dr Murray Peel (University of Melbourne)