IITB-Monash Research Academy

Indian Institute of Technology Bombay | MONASH University

An Indian-Australian research partnership

Project Title:	**Modelling Evapotranspiration under all weather conditions combining traditional remote sensing and passive microwave radiometry**	
Project Number	**IMURA0863**	
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Research Clusters:

Highlight which of the Academy's CLUSTERS this project will address?
*(Please nominate JUST **one.** For more information, see www.iitbmonash.org)*

1	*Material Science/Engineering (including Nano, Metallurgy)*
2	*Energy, Green Chem, Chemistry, Catalysis, Reaction Eng*
3	*Math, CFD, Modelling, Manufacturing*
4	*CSE, IT, Optimisation, Data, Sensors, Systems, Signal Processing, Control*
5	***Earth Sciences and Civil Engineering (Geo, Water, Climate)***
6	*Bio, Stem Cells, Bio Chem, Pharma, Food*
7	*Semi-Conductors, Optics, Photonics, Networks, Telecomm, Power Eng*
8	*HSS, Design, Management*

Research Themes:

Highlight which of the Academy's Theme(s) this project will address?
(Feel free to nominate more than one. For more information, see www.iitbmonash.org)

1	***Advanced computational engineering, simulation and manufacture***
2	*Infrastructure Engineering*
3	*Clean Energy*
4	***Water***
5	*Nanotechnology*
6	*Biotechnology and Stem Cell Research*
7	*Humanities and social sciences*
8	Design

The research problem

Evapotranspiration (ET) is a key variable linking the water, energy and carbon cycles. The high spatiotemporal variability in ET has led to the development of several remote sensing (RS) based methods for modelling ET at various scales. The accuracy of the modelled ET depends on the ability of the model to effectively capture the surface controls of ET such as soil moisture and canopy stomatal resistance. In that context, land surface temperature (LST) is a diagnostic variable representing soil moisture and vegetation water stress. Further, LST provides information about partitioning of the available energy at the surface into various components. The LST is observed by thermal infrared (TIR) sensors onboard satellites. However, TIR observations are obscured by cloud cover and hence LST data will not be available during cloudy days, which is a limiting factor during extended periods of cloud cover and severely hinders our ability to estimate and map ET during cloudy days. The brightness temperature (T_b) observations from Ka-band passive microwave radiometers is being considered as a proxy for deriving LST during cloudy conditions. However, the estimation of ET from Ka-band observations is still at a very nascent stage and needs further detailed analysis. In addition, the spatial resolution of the Ka-band sensors is extremely coarse when compared with the spatial resolution of the ET required for the majority of applications. Hence, there is a need to develop an approach for estimating ET from Ka-band observations and further downscaling it to finer spatial resolutions as required. Downscaling during cloudy days is further compounded by the lack of ancillary surface information at fine spatial resolution and the trajectory of high resolution information during such days. To address these issues, this study aims to combine passive microwave and TIR observations with land surface models to create an all-weather ET dataset with improved spatial resolution.

Project aims

The objectives of the proposed research are:

1. To estimate LST from Ka-band passive microwave observations and compare against TIR observations.
2. To develop a model for estimating ET using microwave derived LST.
3. To develop an approach for downscaling microwave-based ET to finer spatial resolution.

Expected outcomes

The research work is expected to result in a novel methodology for estimating ET using passive microwave observations and downscaling. This will reduce the uncertainty in ET estimations especially under cloudy conditions thereby benefitting various applications. The methodology to be developed through this research work is expected to result in 2–3 high quality publications in reputed journals.

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

The project will involve setting up and running computational models to simulate the various land surface parameters. In addition, the final expected output of ET will be useful in water management applications improving the understanding about water availability and usage, in particular for irrigated areas. Further, the output will also be useful in sustainable water management. Hence, the proposed research work addresses the two themes of the IITB Monash academy viz. advanced computational simulation and water.

Capabilities and Degrees Required

The candidate should have an exceptional academic background and a strong interest in research. Candidates with BTech/MSc./MTech degrees related to the fields of Civil Engineering (specialised in Hydrology and water resources), Remote Sensing, Applied Mathematical or Physical Sciences are encouraged to apply. A background in computer programming and basic mathematics including probability and statistics is favourable. Any prior experience of using numerical models will be considered as advantage. Student should have good attitude towards mathematical concepts and modelling.

Potential Collaborators

Valentijn Pauwels

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.

Water, Modelling and simulation, passive microwave remote sensing