

An Indian-Australian research partnership

Project Title:

Distributed hydrological modelling of murray darling basin through assimilation of remotely sensed datasets

Project Number

IMURA0351

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Department of Civil Engineering

Research Academy 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

The research problem

Define the problem

A great variety of distributed hydrological models have been developed, ranging from simple empirical equations, to complex systems of partial differential equations, which can incorporate the spatial distribution of various inputs and boundary conditions, such as topography, vegetation, land

use, soil characteristics, rainfall, and evaporation, and produce spatially detailed outputs such as soil moisture, water table, groundwater fluxes, and surface saturation patterns. However, distributed modelling of hydrological processes has its limitations. The major problems are over-parameterization and uncertainty, in the sense that most models have not been validated in all their details. New data sources for observation of hydrological processes can alleviate some of the problems facing the validation and operational use of hydrological models. Satellite, airborne and ground-based remote sensing has begun to fulfil some of its potential for hydrological applications, allowing monitoring and measurement of rainfall, snow, soil moisture, vegetation, surface temperature, energy fluxes, and land cover over large areas. The main reason is that remote sensing data can provide large-scale, systematic land surface observations consistently over the large scale.

The integration of data and models is referred to as data assimilation (DA) which provides a means of integrating data in a consistent manner with model predictions and merge measurements of different types, accuracies, and resolutions into spatially distributed models. The fundamental operative unit for water resources management is the catchment or river basin. Combining and integrating the capabilities and information within an integrated framework from simulation and remote sensing techniques is thus both appealing and necessary for improving our knowledge of fundamental hydrological processes and for supporting water resources management in the catchment or basin scale. Therefore, it's urgent to investigate appropriate DA and modelling approaches at the catchment/river basin scale, and more case studies should be conducted to realize the operational potential of DA for a broad range of water resources management problems.

Project aims

Define the aims of the project

The main aim of the proposed research is to develop a methodology for integration of remotely sensed rainfall, landuse, topography, soil moisture and evapotranspiration estimates by means of data assimilation into a distributed hydrological model for improving the predictions of spatial water distribution over a large river basin in Australia. Thus, we can answer questions related to model physics errors.

Expected outcomes

Highlight the expected outcomes of the project

A Simple Distributed Hydrological Model with RS data assimilation capability to improve its predictive performance in a large river basin.

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.

Because water is becoming the limiting factor for development in many parts of the world, more systematic approaches are needed to analyze the uses, depletion, and productivity of water. An improved knowledge of the land surface hydrologic states and fluxes, and of their spatial and temporal variability across different scales, is urgently needed in many hydrologic studies and water resources management. At present many tools can help for water budget analysis, including distributed models, geographic information systems (GIS) and remote sensing techniques. With advances in the above mentioned scientific areas in recent years, there has been an increasing attention on estimating uncertain model parameters from remote sensing observations via data assimilation. The results of the project would be useful to understand the computational/scientific issues that arise when assimilating large number of remotely sensed datasets into a hydrological model.

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.

Academic Qualifications:

Masters in Engineering/Technology with specialization in any of the following areas: Remote sensing/Geo-informatics/ Hydrology/ Water Resources Engg.

Or

BE./B.Tech in Civil Engineering/Geoinformatics with interests in remote sensing image analysis and hydrological modelling.

Minimum Skills Required: Good knowledge in statistics, excellent programming skills in FORTRAN / C /C++/ Matlab.

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.

NA

Please provide a few key words relating to this project to make it easier for the students to apply.

Distributed Hydrological Modelling, RS data Assimilation, Uncertainty Estimates