Soil moisture retrieval from active passive L/P-band microwave observations

Applications are invited for a 3 year PhD scholarship within the Remote Sensing Group of the Department of Civil Engineering at Monash University, on an exciting project focusing on soil moisture retrieval from airborne active passive L/P-band microwave observations. The project is funded by the Australian Research Council.

The Project

Accurate soil moisture data in the root zone are critical to agriculture, with information on near-real-time status critical for cropping, grazing, and irrigation management. Moreover, soil moisture is essential to providing information on drought severity and extent to support relief claims for drought exceptional circumstances, and to predict likely flow-on effects in food availability. Soil moisture is also an important boundary condition in weather and climate prediction, providing important information on both short and long-term rainfall and heat-waves. Furthermore, monitoring of soil moisture data will afford a greater understanding of the water resource impacts from global climate change and variability.

Microwave remote sensing has been widely acknowledged as the most promising approach to monitoring soil moisture at regional and global scales. A fundamental limitation is that current remote sensing technology can only provide coarse resolution moisture information (tens km) on the top 5 cm layer of soil at most, being one-tenth to one-quarter of the wavelength (21 cm at L-band; 1.4 GHz) using the existing soil moisture dedicated missions of National Aeronautics and Space Administration (NASA) and European Space Agency (ESA). Retrieval from longer wavelength (e.g, P-band; 435 MHz and 860 MHz) is being tested with individual instruments at a single frequency in field trials. However, alone these measurements cannot reach the accuracy, spatial resolution and sensing depth needed for soil moisture applications. Consequently, this project will demonstrate a new state-of-the-art satellite concept that will provide high spatial resolution (~100 m) soil moisture data for the root zone (>30 cm), by integrating active and passive P-band (35/69 and 40 cm; 860/435 and 750 MHz) with current L-band active and passive retrieval methods. Specifically, the technology will be trialed in a sequence of extensive airborne field campaign experiments.

The Opportunity

Three positions are available for developing and testing the three different retrieval strategies summarised below:

1) Passive-passive dominant method. This PhD student will be focused on the well-developed passive retrieval methods, combing L-/P-band passive data for soil moisture profile retrieval at a coarse resolution (tens km), and further integrating active data for spatial resolution enhancement.

2) Active-passive downscaling dominant method. This PhD student will be focused on developing active-passive downscaling algorithms for the unique L-/P-band microwave data combination. Downscaled data will then be merged in a similar way to in the passive-passive approach to provide soil moisture over the top 30 cm.
3) Active-active dominant method. This PhD student will be focused on scattering modeling at L-/P-band, with high resolution soil moisture profile inversion from the unique L-/P-band radar data combination. Here the coarse passive data will be used for accuracy enhancement.

Each position is for 3 years fulltime research towards a PhD. A tax-free stipend ($30,107 per annum) will be provided, with the possible opportunity to earn additional money through assistance in undergraduate teaching. Attendance at both national and international conferences will be expected and funded during the course of the degree. The applicant will work with an internationally recognized research team specializing in hydrologic remote sensing and water management.


**Selection Criteria**

The successful candidate must meet ALL of the following criteria:

1) Bachelor of Engineering or Science with Honours.

2) An excellent academic record.

Furthermore, the candidate should have an interest in (microwave) remote sensing applied to hydrology, proficiency in maths, physics, computer programming and GIS, excellent oral and written communication skills, and the ability to work efficiently alone as well as in a team. Experience with and interest in monitoring station maintenance and field experiments is highly desirable.

**Enquiries**

Prof. Jeffrey Walker,

Department of Civil Engineering, [jeff.walker@monash.edu](mailto:jeff.walker@monash.edu)

**Applications**

Applications should include:

1) Cover letter, specifying interests, qualifications and experience as it relates to the project.

2) Curriculum vitae which should include employment history, details of journal publications, and the names of two academic referees.

3) A certified copy of your academic transcript.

Applications should be sent to [jeff.walker@monash.edu](mailto:jeff.walker@monash.edu)

**Closing date**

31 January, 2021