



NATIONAL INSTITUTE FOR  
FOREST PRODUCTS INNOVATION

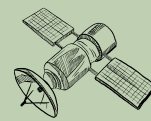
# INITIAL DEVELOPMENT OF A TOOL FOR FOREST EVAPOTRANSPIRATION AT HIGH RESOLUTION

## FINAL RESULTS & INSIGHTS

Dr Eriita Jones

Funded via Forest and Wood Products Australia (FWPA) National Institute for Forest Products and Innovations. Project NS024 “Optimising the management of plantation, water and environmental assets” (2019-2023).

**PI Dr Baden Myers**



University of  
South Australia



Curtin University

# TABLE OF CONTENTS

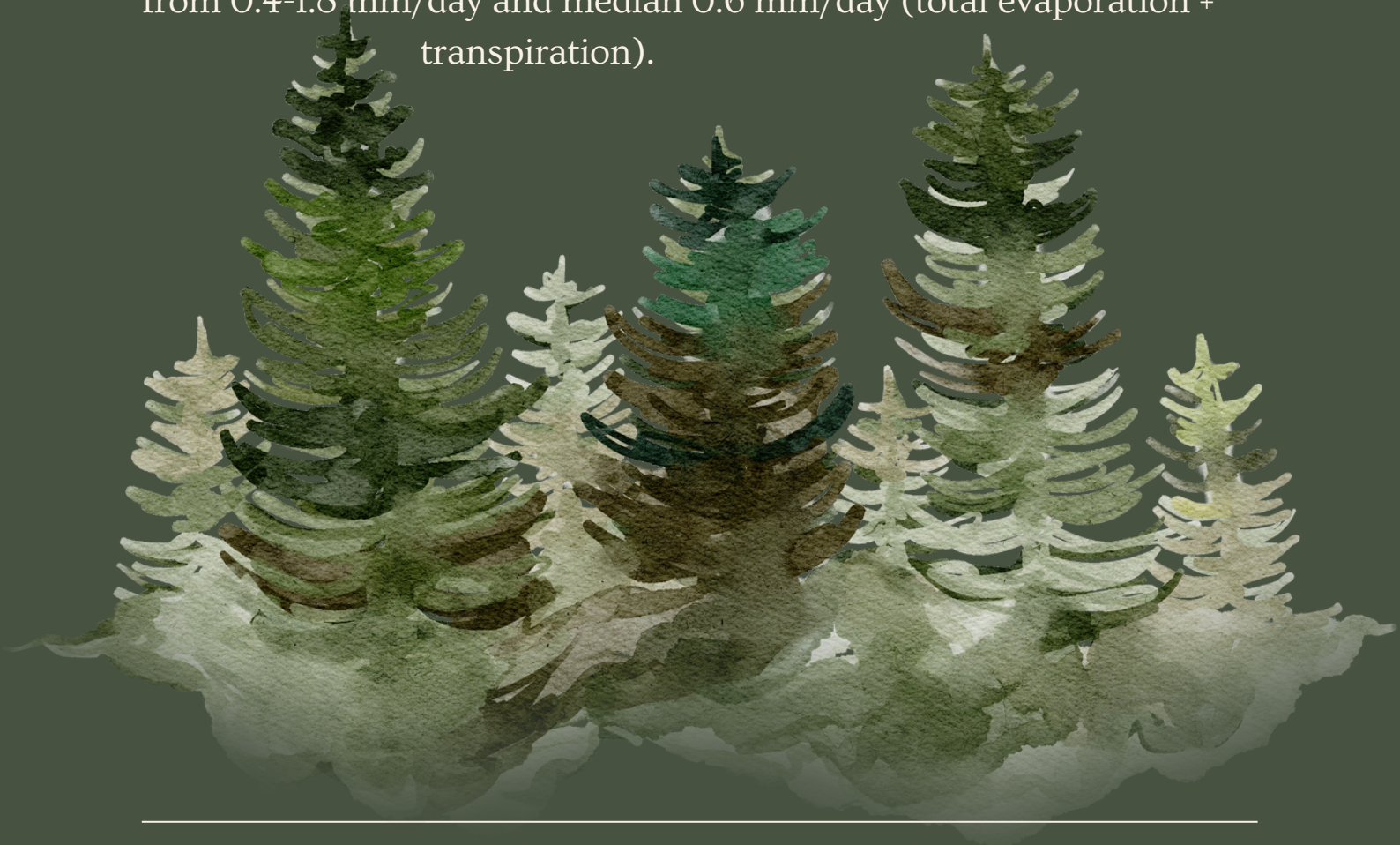
- 01 Our Product
  - 02 Our Method
  - 03 A Results Snapshot
  - 04 Our Applications
  - 05 Our Leadership Team
- 



# OUR PRODUCT

---

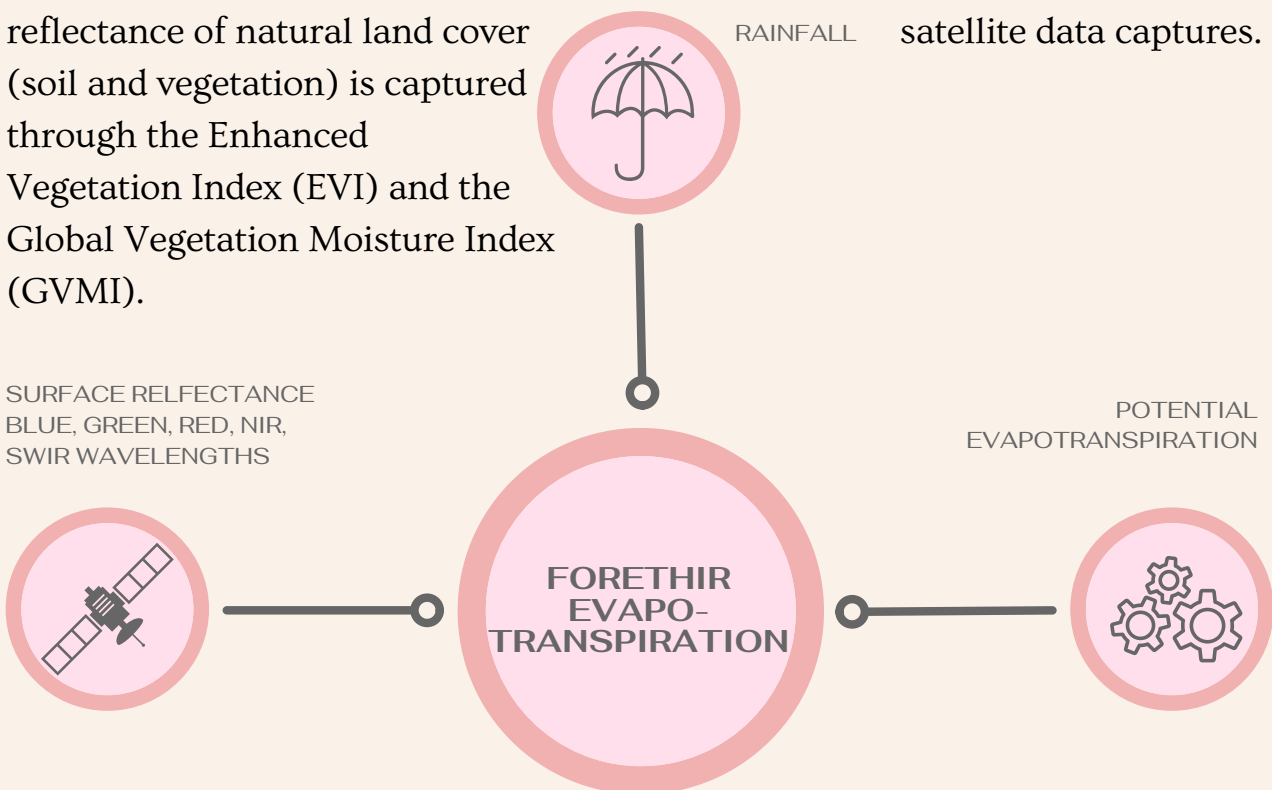
We developed a satellite-based Forest Evapotranspiration at High Resolution tool (FORETHIR) which calculates the volume of daily land surface water loss (mm/day) as evapotranspiration (ET) for any area. FORETHIR provides the forestry industry with the information needed for water budget accounting and for sustainable management and tracking of plantation water assets including groundwater management. FORETHIR provides greater spatial detail and more frequent information products than any current publicly available models, supplying 1 value per day for each 10m x 10m ground area. Accuracies after 1 year of calibration/validation data in Lower Limestone Coast Green Triangle plantations in South Australia range from 0.4-1.8 mm/day and median 0.6 mm/day (total evaporation + transpiration).



# OUR METHOD

The satellite derived ET model is a hybrid model incorporating both spectral vegetation indices and climate data, developed from models of Guerschman et al. (2009) and McVicar et al. (2017). The surface reflectance of natural land cover (soil and vegetation) is captured through the Enhanced Vegetation Index (EVI) and the Global Vegetation Moisture Index (GVMI).

FORETHIR provides daily outputs by using statistical infilling and machine learning techniques that capture the relationships between the satellite and climate data sets, to produce pseudo-multispectral images on days between satellite data captures.

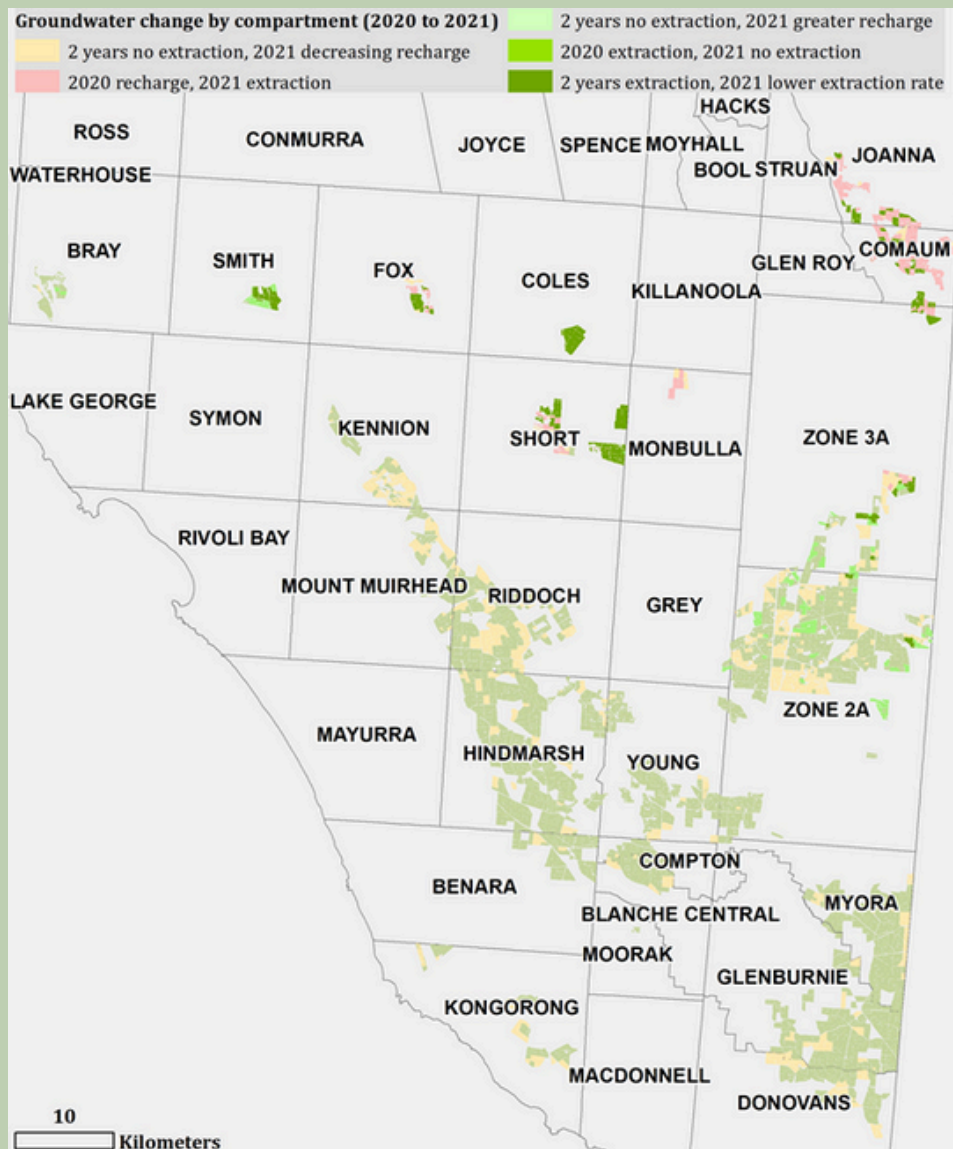


Relationships between them are used to produce scaling factors: a crop-coefficient and an evaporative-coefficient. These factors derived from multispectral satellite imagery are then used to re-scale daily climate data to provide the cumulative total of soil and vegetation evaporation (E) and transpiration (T).

FORETHIR was calibrated using 109 matching satellite data : field data measurement points, across four sites in South Australian plantation forests (2 in blue gum, 2 in pine), and validated using 374 x 4 data points. This allowed us to measure the current accuracy in the model, which will improve as more cal/val sites are established in more diverse forests.

# A RESULTS SNAPSHOT

Groundwater change in softwood plantation compartments in the LLC South Australia, showing areas of recovering and replenishing in green, while those with extraction or decreased recharge are shown in red.



When applied to 2020 and 2021 data FORETHIR finds that, even within model error, the rates of extraction for both softwood and hardwood plantations are generally lower than the deemed rates of the Lower Limestone Coast Water Allocation Plan and significant areas of recharge are predicted to occur across the region, consistent with the findings of other methods.

# OUR PROJECTS

## 01 PLANTATION WATER ASSETS

FORETHIR provides the forestry industry with the information needed for water budget accounting (e.g. cumulative annual water use in ML/ha/year) and for sustainable management and tracking of plantation water assets including groundwater management (e.g. total water use compared to rainfall inputs).

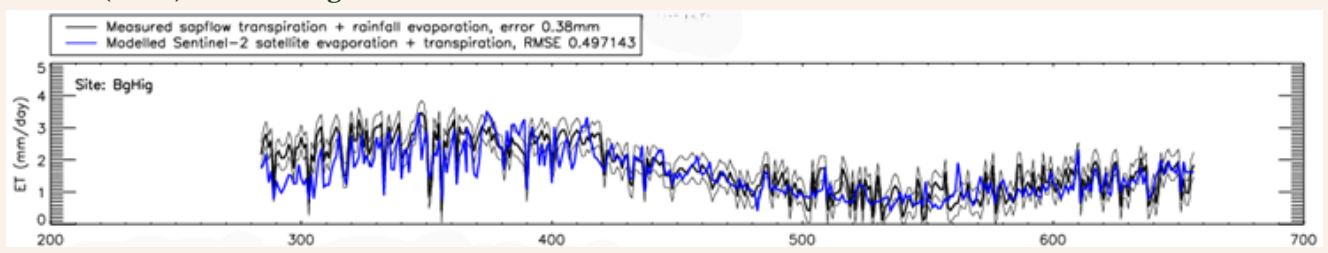
## 02 FOREST, CROP AND WATER INSIGHTS

FORETHIR captures complex and rapid variations in vegetation water use and its interplay with groundwater, climate, plant life cycles, stressors such as pest and diseases, crop management practises (e.g. rotations, irrigation), and more. It has also been applied to river catchments for estuaries ranging across Western Australia to observe the interaction between on-land water use and estuarine water quality; and to Jarrah stands replanted for post-mine rehabilitation in Western Australia.

## 03 BUSHFIRE MITIGATION

FORETHIR may be used as a tool for informing the mitigation/prevention and active management of fire. This is being explored in a collaboration with the Department of Biodiversity, Conservation and Attractions in Western Australia.

Comparison between daily sap-flow sensor data (black) and calibrated, infilled satellite model (blue) at a blue gum forest site.



Jones, E.G. Myers , B. (December 2023) Initial Development of A Tool For Forest Evapotranspiration at High Resolution (FORETHIR) : Final Results & Insights.

# OUR LEADERSHIP TEAM

---



## DR ERIITA JONES

Curtin University PI, Remote Sensing

I am a Planetary Scientist and Remote Sensing Analyst working on applications of space-based data for: (i) sustainable water resource management for the forestry and agriculture industries and environmental and government agencies; (i) bushfire detection and risk mitigation; (iii) and hydrothermal mineral detection.



## DR BADEN MYERS

University of South Australia PI, Wetlands, Rotations, Monitoring.

I am an environmental engineer focussing on hydrology, specifically urban hydrology, water resources and climate. More recently I am involved in forestry through leading projects funded through the Green Triangle Forest Industries Hub.

## OTHER CONTRIBUTORS

Mr Jeff Lawson, Senior Research Engineer, UniSA

Dr Daniel Partington, Research Fellow, Flinders University

Prof Okke Batelaan, Strategic Professor in Hydrogeology, Flinders University of South Australia

Prof. Richard Benyon, Principal Research Fellow in Forest Hydrology, University of Melbourne

Dr Stefan Peters, Lecturer: Surveying and Geographic Information Systems, UniSA

