A high resolution soil moisture analysis system for Australia

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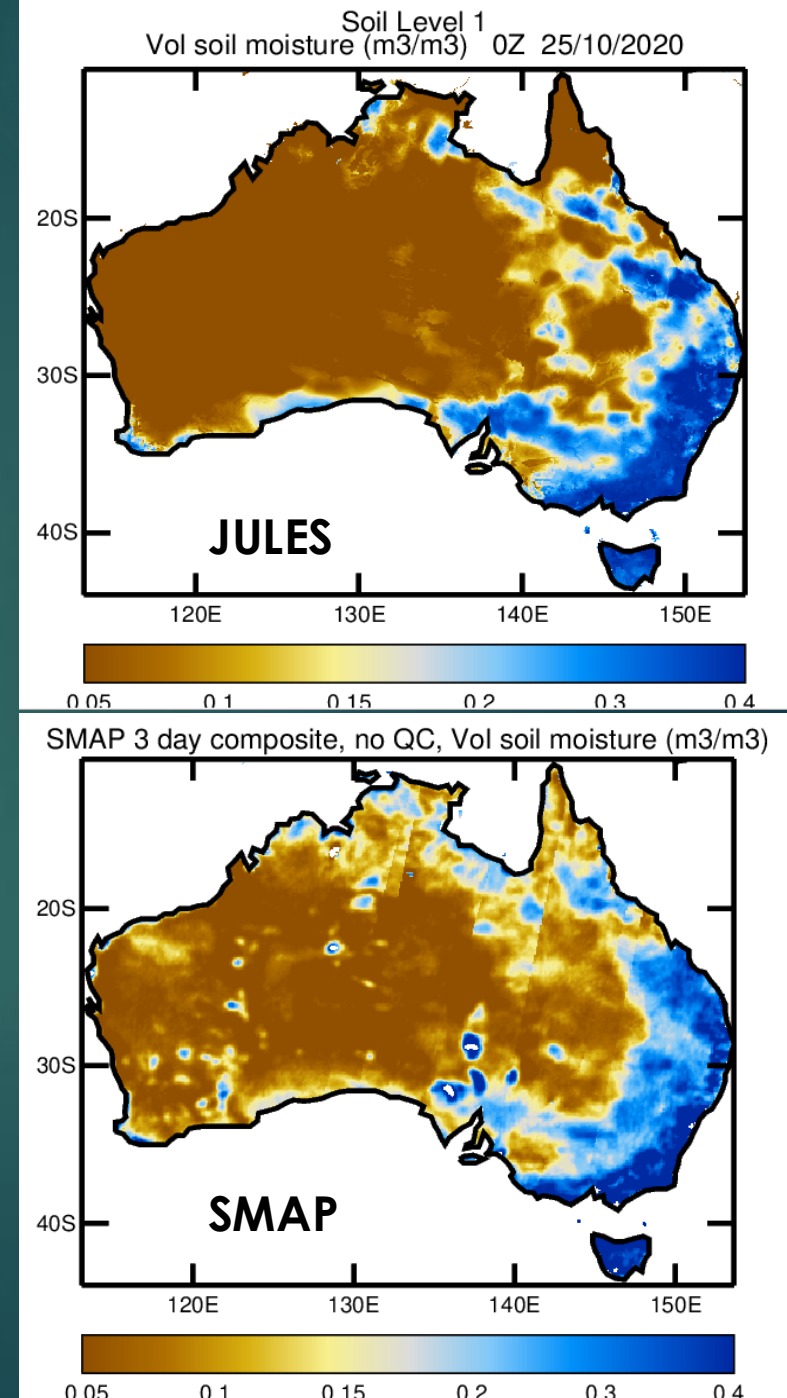
NOV 2020

UM WORKSHOP

Contents

- ✓ Soil Moisture Analysis System
- ✓ Validation Against ground based observations
- ✓ Live Fuel Moisture Content Forecasts
- ✓ NASA Land Information System (LIS)
- ✓ Collaboration with LIS team to assimilate SMAP Vegetation Optical Depth

Soil Moisture Analysis System

- ✓ Developed for Natural Hazard Prediction, particularly Fire Danger

- ✓ Uses the JULES land surface model (~GL6 settings)
  - ✓ JULES also used by the Bureau of Meteorology for NWP and Seasonal prediction

- ✓ 5 km spatial resolution, 4 soil layers, topmost layer 10 cm thick and total soil thickness is 3 m

- ✓ System uses observation based rainfall, temperature, humidity, wind speed, and SW radiation as inputs

- ✓ Comparisons against ground based observations show that the system has very high skill for surface soil moisture and good skill for sub-surface soil moisture

- ✓ Overall the JULES based system is better than other models used at the Bureau for surface soil moisture

Soil Level 1
Vol soil moisture (m3/m3)   0Z 25/10/2020

JULES

0.05   0.1   0.15   0.2   0.3   0.4

SMAP 3 day composite, no QC, Vol soil moisture (m3/m3)

SMAP

0.05   0.1   0.15   0.2   0.3   0.4

Technical Report and Downloads

Technical Report

Dharssi, I and Vinodkumar. | October 2017

JASMIN: A prototype high resolution soil moisture analysis system for Australia

Bureau Research Report No. 026

http://www.bom.gov.au/research/publications/researchreports/BRR-026.pdf

## THREDDS Server (~ 10 years of analyses)

http://opendap.bom.gov.au:8080/thredds/godiva2/godiva2.html?server=
http://opendap.bom.gov.au:8080/thredds/wms/c35ee8d2a475e10ea06d0
ad53b46ce2a/JASMIN_land_dryness/native/jasmin.vol.smc.2020.nc#

# Ground based Soil Moisture Observations

COSMOZ

1. Network of cosmic ray soil moisture probes installed at about 13 locations around Australia (Hawdon et al. 2014).

2. The effective sensing depth depends strongly on soil moisture itself, decreasing from about 70 cm (dry soils) to 10 cm (wet soils).

3. We only use the 9 calibrated and quality controlled CosmOz sites.

4. Range of land-cover types.

5. CosmOz is managed by CSIRO.
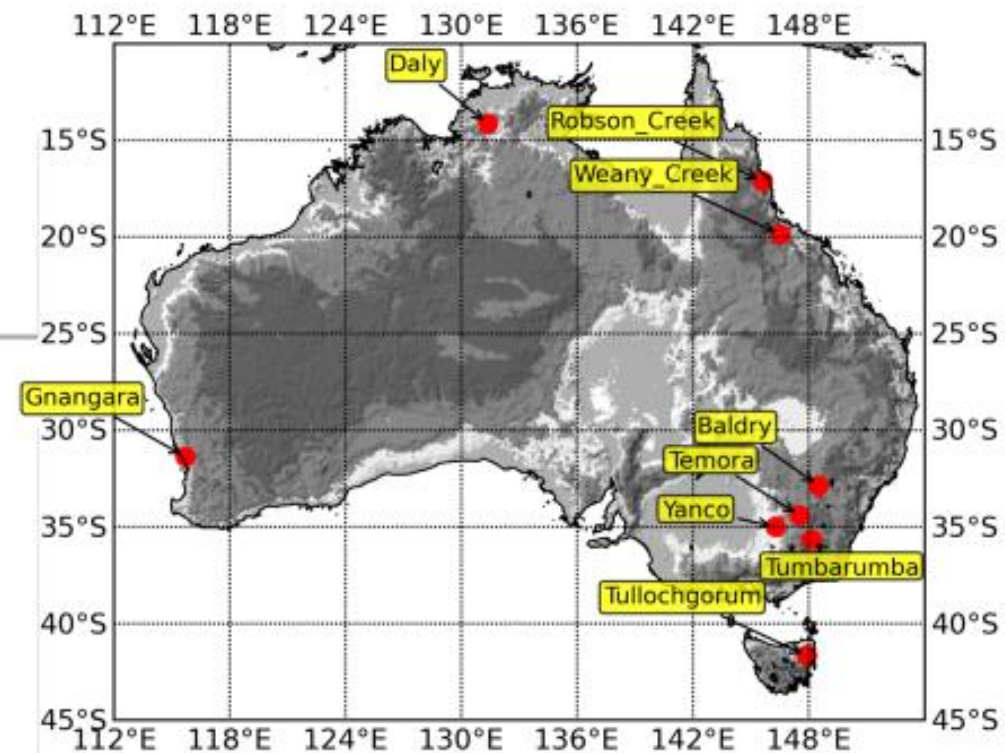
Ground based Soil Moisture Observations

OZNET

1. 38 observing stations situated in the Murrumbidgee river catchment.
2. Most stations are located in croplands or grasslands.
3. Observations are visually inspected to identify quality issues, the quality control includes comparisons with rainfall observations.
4. Managed together by Monash University and University of Melbourne
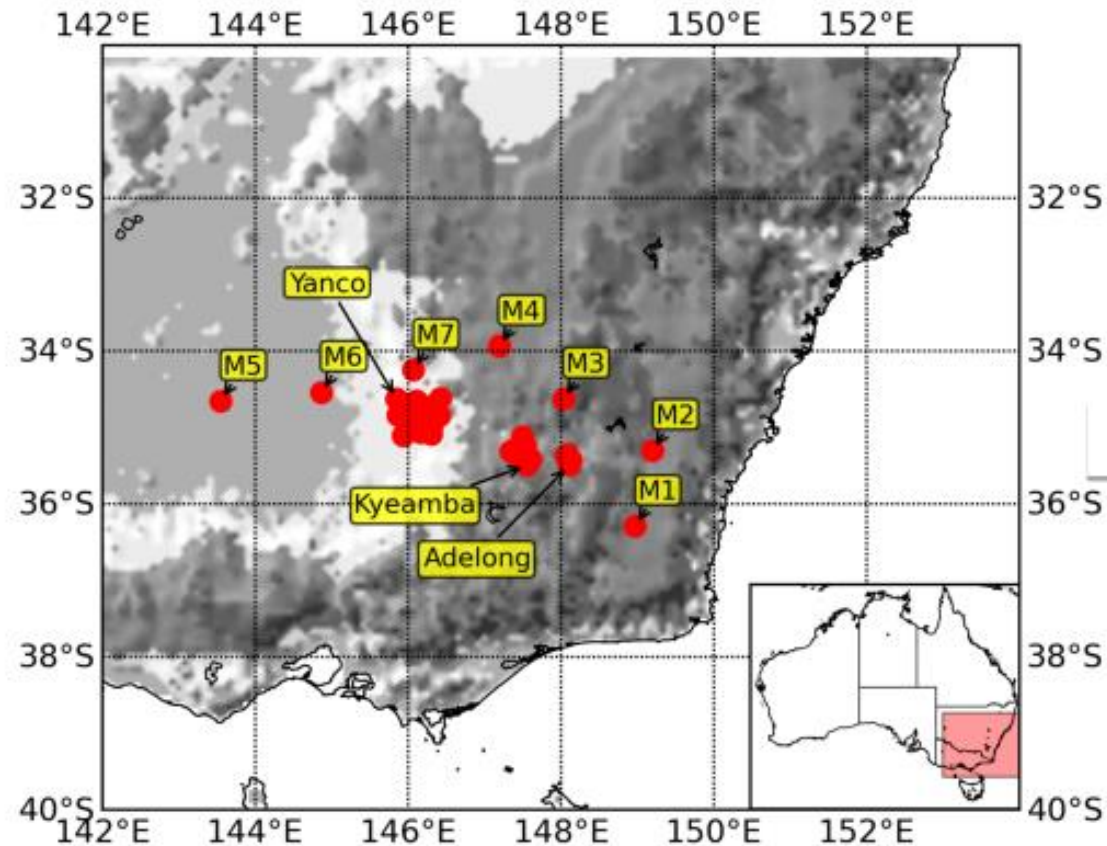
OZFLUX

1. Provides continuous data over a long time period (van Gorsel 2015)

2. Many stations located in Wooded or Forested areas

3. Very little Quality Control (QC)

Soil Moisture Validation: Temporal Correlation vs Observations

The Technical report shows other verification metrics such as Bias, RMSD and Anomaly Correlation. These also show that the JULES based system has high skill.
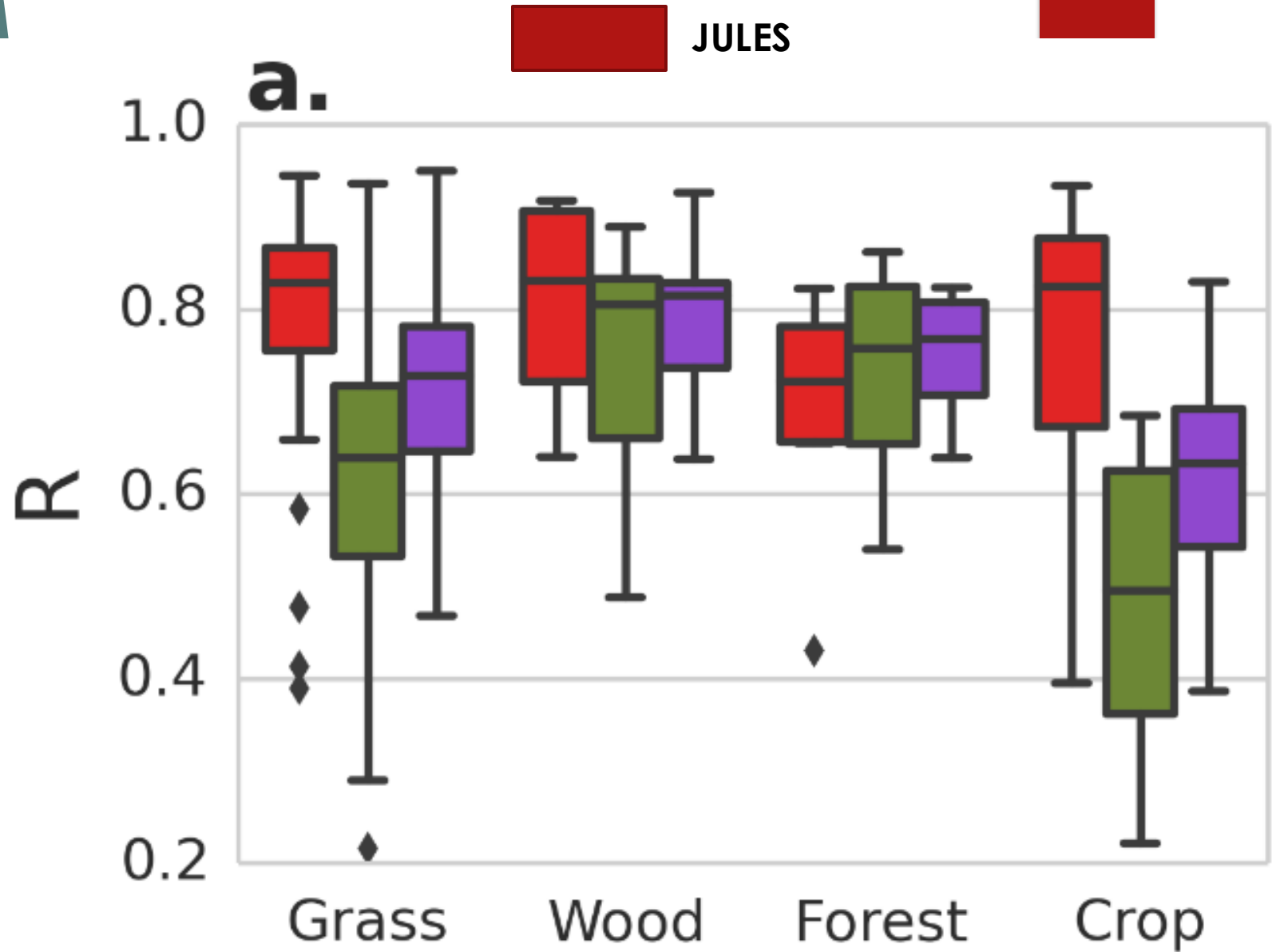
Live Fuel Moisture Content (LFMC)

- LFMC represents the moisture content of living vegetation
  - Defined as Percent Vegetation water/Dry Mass (ranges from about 30% to 300%)
- A statistical method has been developed to Forecast 14 days ahead, LFMC from soil moisture analyses
  - Validation against 60 ground based LFMC sites shows a temporal correlation of 0.8

Estimating live fuel moisture content using soil moisture content at a continental scale. Vinodkumar, Imtiaz Dharssi, Marta Yebra and Paul Fox-Hughes

*To be submitted to Agriculture and Forest Meteorology*
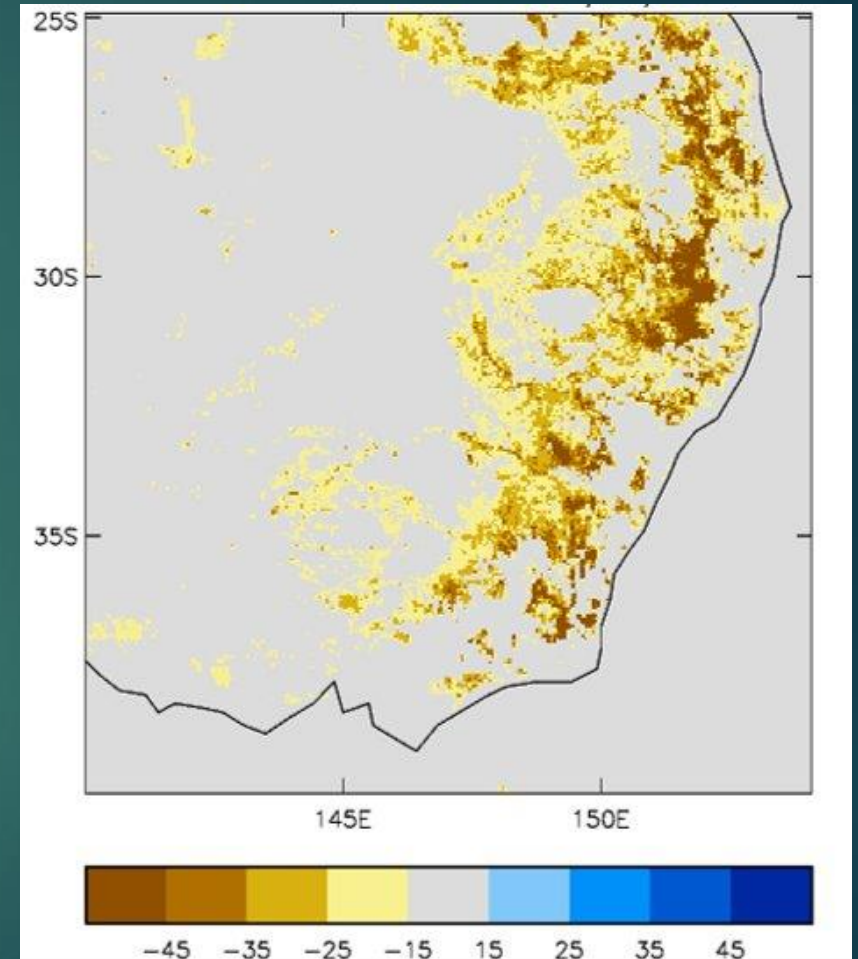
JULES based LFMC anomaly forecasts for Jan 2020

NASA Land Information System

▶ Imtiaz Dharssi and Vinodkumar attended the NASA LIS training workshop at Washington DC during March 2020

▶ A paper in collaboration with Sujay Kumar and the LIS team has been written on Assimilation of SMAP derived Vegetation Optical Depth (VOD)

  ▶ VOD is related to vegetation water content

  ▶ Assimilating SMAP VOD improves analyses of root zone soil moisture, Evapotranspiration and Runoff

▶ Work is underway to port the NASA LIS system to Bureau Supercomputers

Characterizing the 2019-2020 Australian bushfires using SMAP vegetation optical depth retrievals. Sujay Kumar et al
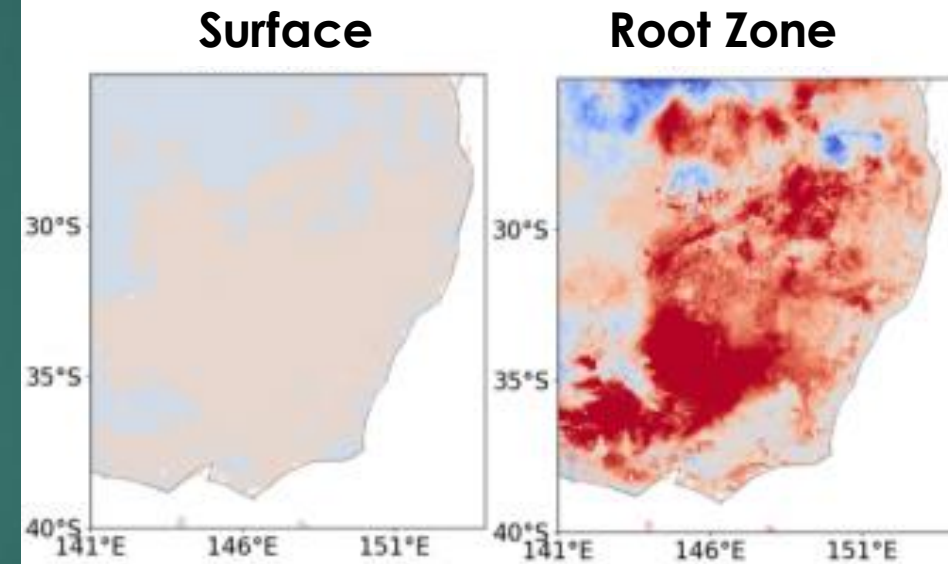
Surface   **Root Zone**

Differences in anomaly correlation values for surface and root zone soil moisture from SMAP VOD assimilation. The warm colors (Reds) indicate improvements from DA.

Conclusions

▶ A high resolution soil moisture analysis system has been developed, primarily for Fire danger prediction

▶ Validation against ground based observations shows the system has high skill

▶ A statistically based system to derive Live Fuel Moisture Content from Soil Moisture has been developed

▶ Collaboration with the NASA LIS team has begun

  ▶ A manuscript on assimilation of SMAP Vegetation Optical Depth (VOD) is in preparation

▶ Future work will focus on assimilation of a greater number of remotely sensed measurements, such as ASCAT and SMAP soil wetness and SMAP VOD