# Coupling Litter and Soil Moisture Dynamics For Dead Fuel Moisture Content Forecasting

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## 1. INTRODUCTION

Several models have been used for dead fuel moisture content (FMC) forecasting. However, none of these models explicitly consider how soil moisture affects FMC. This project aims to evaluate the role of soil moisture in determining FMC and improve the forecast of FMC by coupling litter and soil moisture dynamics. The Australian Water Resources Assessment system Landscape model (AWRA-L) (Van Dijk, 2010; Frost et al., 2016) and the physical-based litter prediction model (Koba) (Matthews, 2006) are used for the coupling.

## 2. COUPLING MODEL

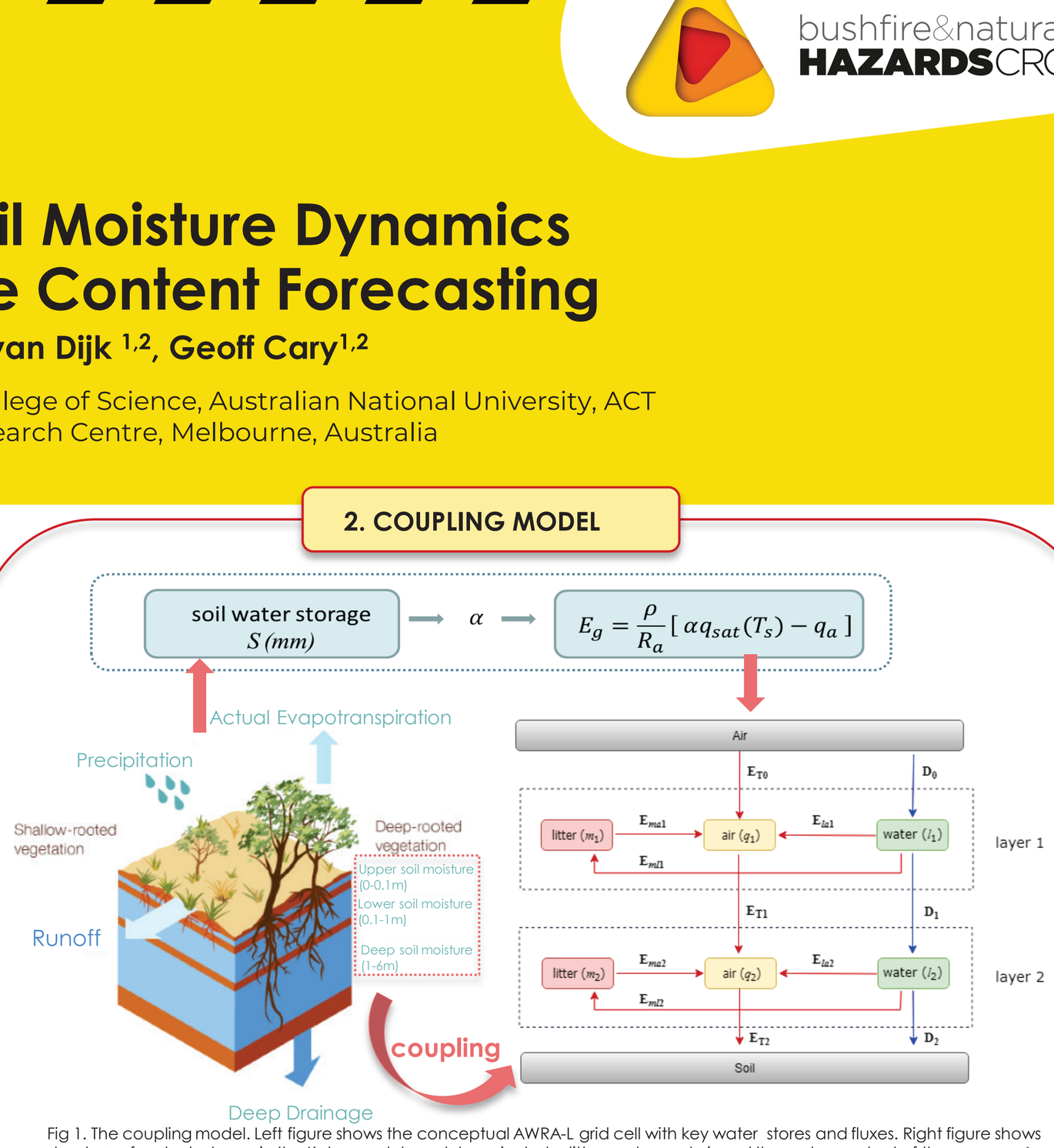


Fig 1. The coupling model. Left figure shows the conceptual AWRA-L grid cell with key water stores and fluxes. Right figure shows structure of water balance in the Koba model: each layer includes litter, water and air and the water content of them are $m_1$, $l_1$ and $q_1$ respectively. Red arrows represent vapor flux between materials (vapor flux between litter and air $E_{ma}$, vapor flux between water and air $E_{ml}$ and turbulent vapor flux $E_T$) and blue arrows represent liquid water drainage(D).

## 3. CASE STUDY: VICTORIA

- Study area and location of automated fuel sticks (Fig 2)

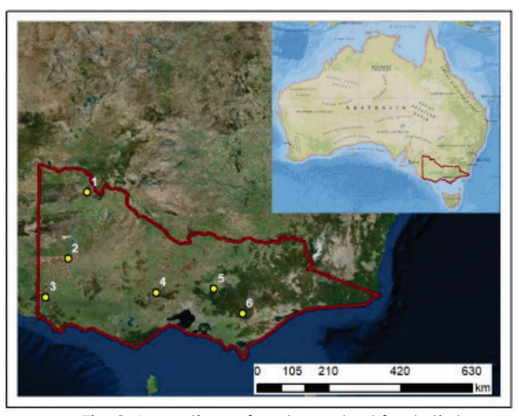


Fig 2. Location of automated fuel sticks

- Data Processing
  - ✓ Calibration of fuel sticks observations:

    July 2014 ~January 2015 (DELWP, Victoria)
  - ✓ Input data downscaling from daily to hourly:
    - Daily max and min temperature (BOM 5km)
    - Daily 3pm vapour pressure (BOM 5km)
    - Daily rainfall (BOM 5km)
    - Daily radiation (BOM 5km)
    - Daily mean wind speed (McVicar *et al.* (2008), 5km)
    - Daily soil water storage(OzWALD)

## 4. PRELIMINARY RESULTS

Table 1. Pearson correlation between modeling and observations at all sites for all FMC observations

| Sites | Surface layer litter | | Bottom layer litter | |
|---|---|---|---|---|
| | No Coupling | With Coupling | No Coupling | With Coupling |
| **1** | 0.68 | 0.74 | 0.75 | 0.80 |
| **2** | 0.73 | 0.78 | 0.69 | 0.70 |
| **3** | 0.7 | 0.74 | 0.73 | 0.77 |
| **4** | 0.68 | 0.75 | 0.74 | 0.76 |
| **5** | 0.70 | 0.75 | 0.67 | 0.74 |
| **6** | 0.44 | 0.44 | -0.16 | 0.06 |

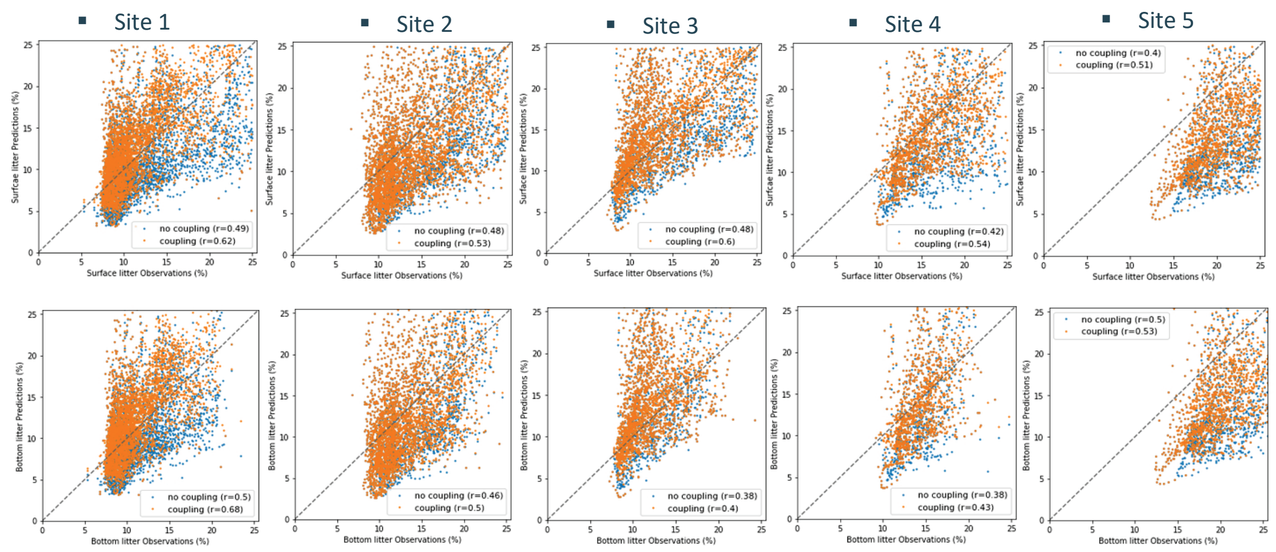


Fig 3. Pearson correlation between observations and model predictions for FMC values <25%

## 5. CONCLUSIONS AND FUTURE WORK

- Dead FMC modeling is affected by soil moisture, especially with relatively high soil moisture content when there is flux from the soil to the litter.
- Dead FMC estimation can be improved by coupling soil moisture.
- The coupling method we used does not improve model predictions much, which might be explained by the coarse input data. Future work will focus on the improvement of the coupling method.

**END USER STATEMENT:**

"Predictions of fuel moisture are vital for many aspects of fire management. This important project will help improve predictions as well as aiding adoption of new soil moisture models."

**Stuart Matthews, NSW Rural Fire Service**

Australian Government
Department of Industry, Innovation and Science
Business Cooperative Research Centres Programme
Australian National University

### MAIN REFERENCES

[1] Matthews, S., 2006. A process-based model of fine fuel moisture. *International Journal of Wildland Fire*, 15(2), pp.155-168.

[2] Van Dijk, A.I.J.M., 2010. AWRA Technical Report 3, Landscape Model (version 0.5) Technical Description, WIRADA. CSIRO Water for a Healthy Country Flagship, Canberra.

[3] Frost, A. J., Ramchurn, A., and Smith, A., 2016. The Bureau's Operational AWRA Landscape (AWRA-L) Model. Bureau of Meteorology Technical Report.

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