FINDINGS

The influence of soil moisture on litter fuel moisture content (FMC) depends on the soil condition and the arrangement of the litter layer. Wetter soil can contribute to higher litter FMC. Subsurface litter, which is in contact with the topsoil, is more sensitive to the influence of soil moisture than surface litter. The influence of soil moisture on litter FMC is through its influence on local air humidity.

Coupling Litter and Soil Moisture Dynamics for Surface Fine Fuel Moisture Content Forecasting-Field Experiment

Li Zhao[1,2], Marta Yebra[1,2,3] , Albert I.J.M. van Dijk [1,2], Geoff Cary[1,2]

[1] Fenner School of Environment & Society, College of Science, Australian National University, ACT

[2] Bushfire and Natural Hazards Cooperative Research Centre, Melbourne, Australia

[3] Research School of Aerospace, Mechanical and Environmental Engineering, College of Engineering & Computer Science, Australian National University, ACT

Introduction

- Fuel moisture content (FMC) of surface fine fuel (or forest litter fuel) is a critical factor determining fire ignition and spread.
- Several models have been developed to forecast litter FMC
  - Empirical regression functions against incorporating weather variables
  - Physics-based models with water and energy conservation equations.
- Soil moisture has been shown to influence FMC but few models explicitly consider it

Objective

Evaluate how soil moisture content affects litter FMC forecasts by coupling soil moisture in a physics-based model (Matthews, 2006).

Methodology

A series of controlled factorial field experiments have been carried out in the *Eucalyptus* woodland in the Australian National Botanic Gardens to better understand and quantify the processes involved in litter and soil moisture dynamics.

Experiment Design

- 1 ×1 m control and treatment plots were selected at both a dry and a wet site for the experiment (Fig. 1).
- In each site there are two parallel experiments (Fig. 1) including:
  - A control plot where there is direct contact between soil and litter;
  - A treatment plot where a water-proof material was placed as a barrier between soil and litter to prevent the influence of soil moisture.
- Fuel sticks, a soil moisture sensor and RH/T sensors were installed at different heights to measure variables in different layers. A Microclimatic weather station was installed to measure local weather variables.
- Data has been collected since September 2019.

Preliminary Results

- **Dry Site**

Litter with the water-proof material has a relatively lower RH than the other treatment in both surface and subsurface litter; the maximum surface and subsurface FMC difference between two treatments was no more than 3% during the long drying period (Fig.2).

- **Wet Site**

Litter with the water-proof material has a much lower RH than the other treatment in the subsurface litter; the maximum FMC difference between two treatments is around 5% in the surface litter and 10% in the subsurface litter (Fig.3).

Conclusions and Future Work

- The influence of soil moisture is limited at the dry site but is apparent at the wet site.
- The influence of soil moisture on FMC is through the influence on local air relative humidity as the evaporation of soil moisture increases the air humidity of the fuel.
- The ongoing work is analysing and quantifying the influence of soil moisture on litter FMC.

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

For more information, please email li.zhao@anu.edu.au

Figures

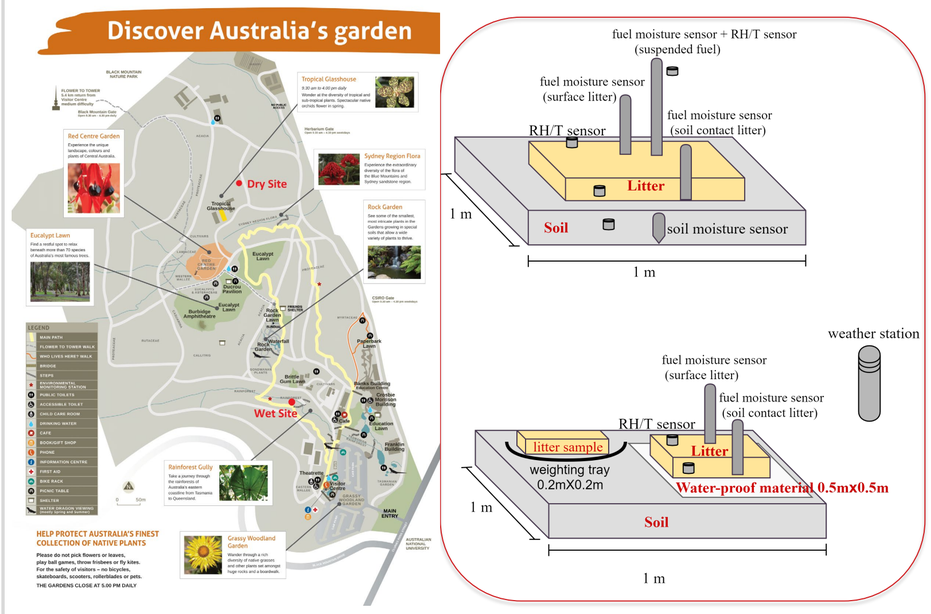

Fig. 1. The two experiment sites on the visitor map (left), and the parallel experiments and instruments at each site (right).

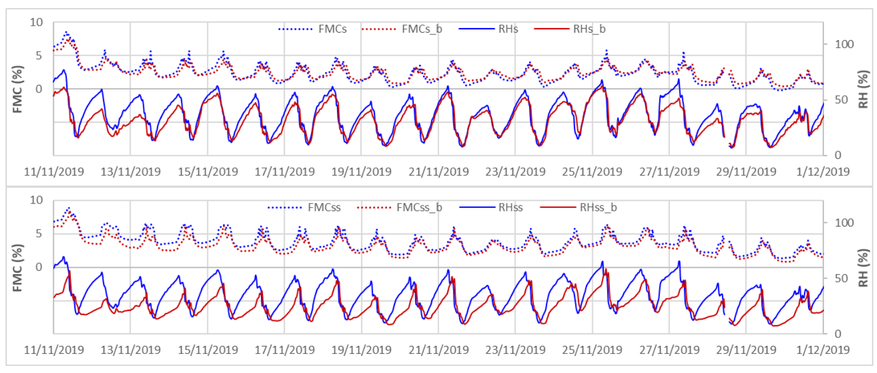

Fig. 2. Time series of FMC and RH at the dry site. FMC_s, RH_s and FMC_{ss}, RH_{ss} represent FMC and RH in surface and subsurface litter, respectively, for the treatment without the barrier. FMC_{s_b}, RH_{s_b} and FMC_{ss_b}, RH_{ss_b} represent FMC and RH in surface and subsurface litter, respectively, for the treatment with the barrier.

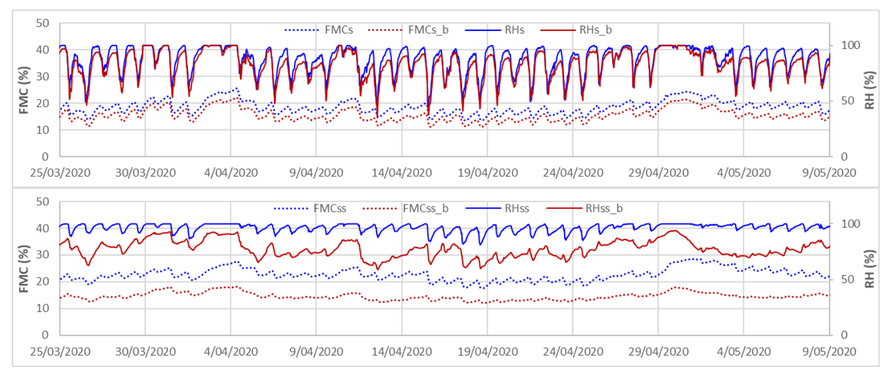

Fig. 3. Time series of FMC and RH at the wet site. Symbols refer to Fig. 2.

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