FORECASTING SMOKE EMISSIONS AND TRANSPORT- ADDRESSING THE KNOWLEDGE GAPS

bushfire&natural HAZARDSCRC

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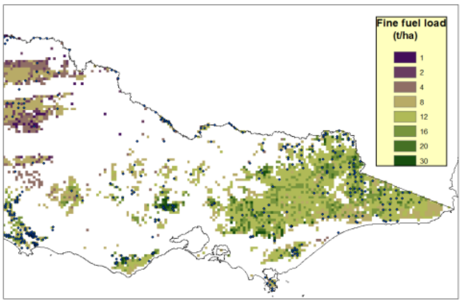
M. Cope, M. Meyer, A. Sullivan, N. Surawski, F. Reisen, S. Lee[1], A. Wain[2], C. Weston, L. Volkova, K. Tolhurst, T. Duff, D. Chong, S. Walsh[3], N. Tapper[4], C. Paton-Walsh, E-A. Guerette, M. Desservettaz[5], G. Edwards, D. Howard[6]

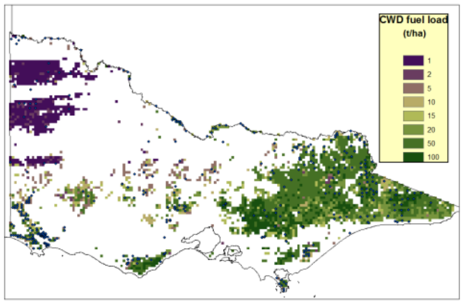
[1]CSIRO, [2] Bureau of Meteorology, [3]University of Melbourne, [4]Monash University, [5]Wollongong University, [6]Macquarie University

A NUMERICAL FORECASTING SYSTEM IS BEING DEVELOPED FOR SMOKE MANAGEMENT IN VICTORIA. UNDERPINNING THE SYSTEM ARE OBSERVATION STUDIES WHICH TARGET SPECIFIC KNOWLEDGE GAPS. 1/ THE SPATIAL AND COMBUSTION CHARACTERISTICS OF COARSE HEAVY SHRUB AND BARK FUELS; 2/THE EMISSION RATES OF THE KEY SMOKE CONSTITUENTS; 3/ THE USE OF REMOTE SENSED FIRE RADIATIVE POWER TO CHARACTERISE HEAT RELEASE

1. FUEL LOADS

Fuel load maps were developed by assimilating field observation data sets collected by Volkova, Weston and others , supplemented by data from DELWP, with estimates of litter + grass and coarse woody debris (CWD) fuel loads generated by a biogechemical model (Haverd et al, 2012). For the most part, the fine fuel map is comparable to the current PHOENIX (floristic-based fuel map



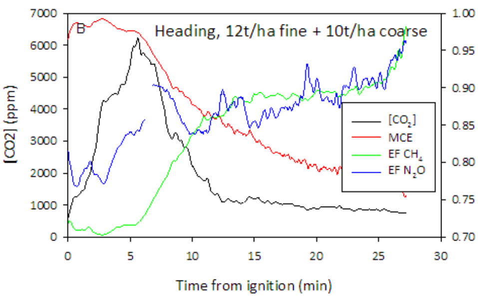


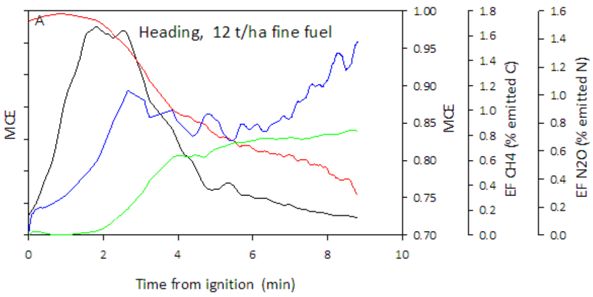
2. FUEL COMBUSTION AND EMISSIONS

Fuel combustion and emission characteristics have been measured in the field during fuel-management burns, and in the CSIRO Pyrotron (a 25 metre long fire-proof wind tunnel).

Pyrotron tests confirmed that the presence of coarse fuel did not significantly change the time course of the combustion and that course fuels (6mm-50mm size class) for most purposes can be assigned the same emission factors as fine fuels. In contrast, larger fuel sizes tend to bun incompletely by smouldering combustion.

The emission factors applied in the model (Table) come from field measurements of emissions at the fire line and from shouldering logs. Modified combustion efficiency (MCE) explains much of the variation in the emission of organic carbon species (including PM10). In combination, the specific emission factors for litter and CWD (>50 mm) agree well with emission factors observed in well mixed plumes.



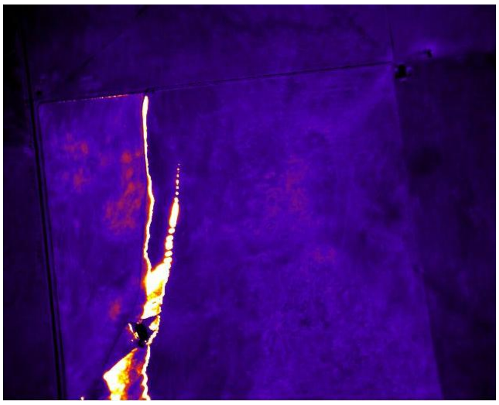


	Emission factor (g kg^{-1} fuel)					
	MCE	CO2	CO	CH4	N2O	PM25
Litter	0.95	1730	57	0.94	0.072	7.5
CWD	0.33	1513	213	10.9	0.038	28
Plume[1]	0.90	1594	116	2.8	nm	15

[1]Plume data averaged from Hurst et al. (1996); Paton-Walsh et al. (2014) Surawski et al. (2015)

3. SATELLITE FIRE RADIATIVE POWER (FRP)

A key objective of our FRP activity is the assessment of the potential of satellite or aircraft monitoring of combustion characteristics using FRP for operational applications. An aircraft campaign on 17 May over a prescribed grassland burn, 27 km west of Echuca collected raw infrared, optical, radar, thermal infrared (shown in Figure) and spectral data. We plan to compare remotely sensed heat release with fire intensity predicted by the Phoenix Rapid Fire model.



REFERENCES

Haverd et al., (2012), Biogeosciences 10: 2011 -2040, DOI:10.5194/bg-10-2011-2013.

Hurst DF, Griffith DWT, Cook GD (1996),International Journal of Wildland Fire23(6), 771–780. doi:10.1071/WF14009.

Paton-Walsh et al. (2014) , Atmospheric Chemistry and Physics Discussion 14, 4327–4381. doi:10.5194/acpd-14-4327-2014.

Surawski et al., 2015, Atmospheric Chemistry and Physics, (in press)