

Fighting smoke with smoke: Prescribed burning and human health

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Sydney December 26th 2001



Sydney May 9th 2016



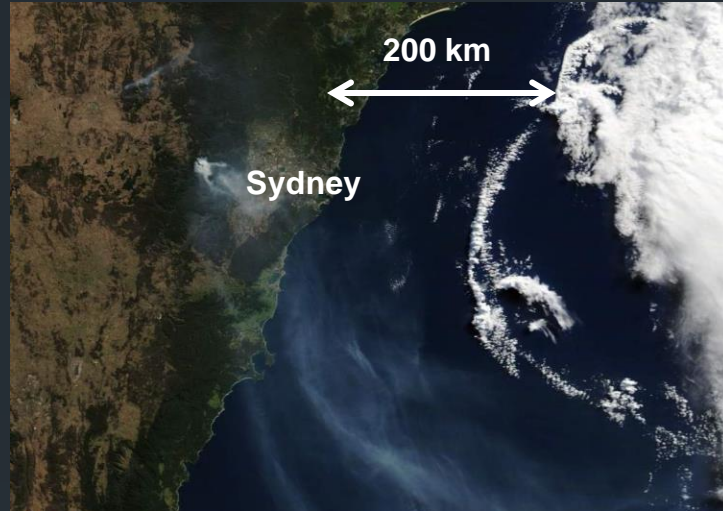
UNIVERSITY OF
WOLLONGONG



OEH Bushfire
Research Hub

Planned burns and poor air quality in NSW

Sydney May 9th 2016



Mt Solitary Burn 8th May 2018 3500 ha



Wednesday 9 May 2016 1 - 2 pm (AEST)
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		VERY GOOD	GOOD	FAIR	POOR	VERY POOR	HAZARDOUS		
Pollutants		Ozone O3	Ozone O3	Nitrogen dioxide NO2	NEPH	Carbon monoxide CO	Sulfur dioxide SO2	Particles PM10	Particles PM2.5
Averaging Periods		1-hour average	rolling 4-hour average	1-hour average	1-hour average	rolling 8-hour average	1-hour average	rolling 24-hour average	rolling 24-hour average
Sydney East	Randwick	2.0	1.8	3.1	0.81		0.3	34.8	18.7
	Rozelle	3.6	2.4	0.7	0.47		0.4	23.5	
	Lindfield	3.1	2.4	1.4	0.70	0.5	0.1	44.4	24.3
	Chullora		1.8		0.95			39.9	23.3
	Earlwood								
	Macquarie Park	3.9	2.9	0.3	0.33	0.3	0.4	22.1	11.0
Sydney North-west	Parramatta North	3.6	2.7	0.6	0.40	0.5	0.1	37.0	19.2
	Richmond	4.1	2.9	0.3	0.43		0.1	28.3	18.0
	St Marys	3.9	3.3	0.5	0.57			38.4	26.4
	Vineyard								
	Prospect	3.8	2.7	0.4	0.57	0.4	0.1	41.0	21.9
Sydney South-west	Bargo			0.1	0.37		0.2	30.8	12.1
	Bringelly	4.3	4.1	1.0	1.33		0.0	53.4	21.8
	Camden	5.3	4.1	0.3	5.42	0.5		43.2	21.8
	Campanelltown West	4.4	3.7	0.7	1.44	0.5	0.2	37.9	19.9
	Liverpool	2.8	4.0	2.4	1.63		0.7	75.1	37.4
	Oakdale	3.7	3.3	0.1	0.61			22.5	11.5
Illawarra	Wollongong	3.8	3.2	0.1	0.52	0.5	0.1	33.6	14.4
	Kembla Grange	3.6	3.0	1.0	0.87			42.1	13.8
	Albion Park Sth				0.82			35.3	14.6
Lower Hunter	WallSEND	3.0	2.7	0.8	0.26		0.4	23.2	11.0
	Newcastle	2.7	1.9	0.6	0.26	0.5	0.4	28.7	12.4
	Beresfield	2.0	1.5	1.0	0.16		0.7	31.7	11.7
Central Coast	Wyong			0.9	0.34	0.2	0.5	27.6	13.1
Central Tablelands	Bathurst							30.9	10.3
North-west Slopes	Gunnedah							27.2	8.9
	Narrabri							19.9	4.9
	Tamworth							16.0	5.8
South-west Slopes	Albury							22.8	9.2
	Wagga Wagga Nth							48.6	17.3
Upper Hunter - Muswellbrook	Muswellbrook			0.5			0.0	37.4	12.0
Upper Hunter - Singleton	Singleton			0.6			0.1	37.0	10.2

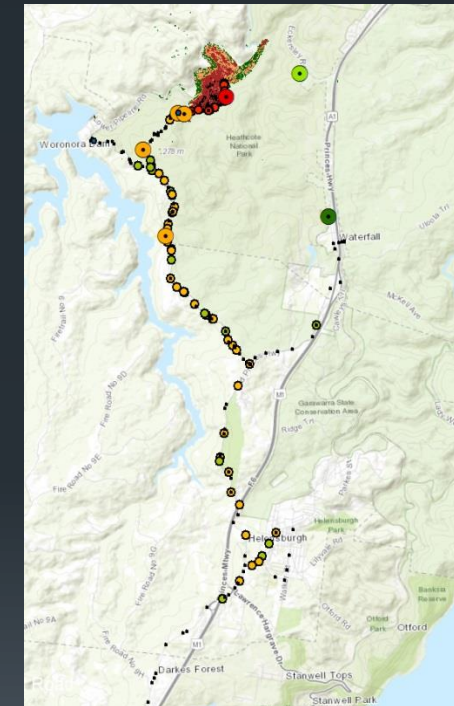
Monday 29 April 2019 5 - 6 am (AEST)
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		VERY GOOD	GOOD	FAIR	POOR	VERY POOR	HAZARDOUS		
Pollutants		Ozone O3	Ozone O3	Nitrogen dioxide NO2	NEPH	Carbon monoxide CO	Sulfur dioxide SO2	Particles PM10	Particles PM2.5
Averaging Periods		1-hour average	rolling 4-hour average	1-hour average	1-hour average	rolling 8-hour average	1-hour average	rolling 24-hour average	rolling 24-hour average
Sydney East	Randwick	0.3	0.3	1.9	1.30	0.4	0.0	29.9	16.9
	Rozelle	0.7	0.7	1.0	1.15		0.0	26.5	
	Lindfield	0.3	0.2	1.9	2.63	0.3	0.1	31.3	21.5
	Chullora	0.0	0.1	1.9	0.94			31.9	23.6
	Earlwood	0.3	0.4	0.5	0.88	0.4	0.0	26.3	17.6
	Macquarie Park	0.1	0.1	2.0	2.32	0.4	0.1	33.9	21.9
Sydney North-west	Parramatta North	0.0	0.2	0.5	0.54		0.0	23.0	14.8
	Richmond	0.1	0.2	0.1	1.07			26.2	12.8
	St Marys								
	Vineyard								
	Prospect	0.1	0.1	1.5	1.79	0.3	0.1	33.8	24.1
Sydney South-west	Bargo	0.1	0.5	2.1	0.14		0.0	21.9	11.2
	Bringelly	0.1	0.2	0.5	1.80		0.0	27.3	17.9
	Camden	0.0	0.0	0.7	1.78	0.4		43.8	38.3
	Campanelltown West	0.5	0.6	1.9	2.65	0.3	0.0	45.1	37.5
	Liverpool	0.4	0.2	2.2	4.68	0.4	0.1	42.9	29.5
	Oakdale	2.2	2.3	0.1	0.29			25.0	12.2
Illawarra	Wollongong	0.2	0.9	1.4	0.11	0.2	0.0	15.8	8.2
	Kembla Grange	0.0	0.1	1.2	0.19			13.7	9.0
	Albion Park Sth	0.2	0.3	0.3	0.08		0.0	13.3	4.2
Lower Hunter	WallSEND	0.1	0.1	0.9	0.29		0.0	22.6	11.1
	Newcastle	0.0	0.0	2.3	0.42		0.1	28.1	9.9
	Beresfield	0.0	0.0	0.8	0.52		0.1	29.8	12.2
	Wyong	0.5	0.7	0.5	0.37	0.2	0.0	21.0	15.2
Central Coast	Bathurst							25.7	7.1
Central Tablelands	Orange							20.0	6.9
North-west Slopes	Armidale				0.24			14.9	4.3
	Gunnedah	1.1	0.8	0.5	0.29			19.2	4.0
Northern Tablelands	Narrabri							21.3	5.6
North-west Slopes	Tamworth							35.9	10.3
South-west Slopes	Albury							15.9	7.9
	Wagga Wagga Nth							24.9	8.6
Upper Hunter - Muswellbrook	Muswellbrook			1.4			0.1	30.2	7.4
Upper Hunter - Singleton	Singleton			1.1			0.0	35.8	9.0

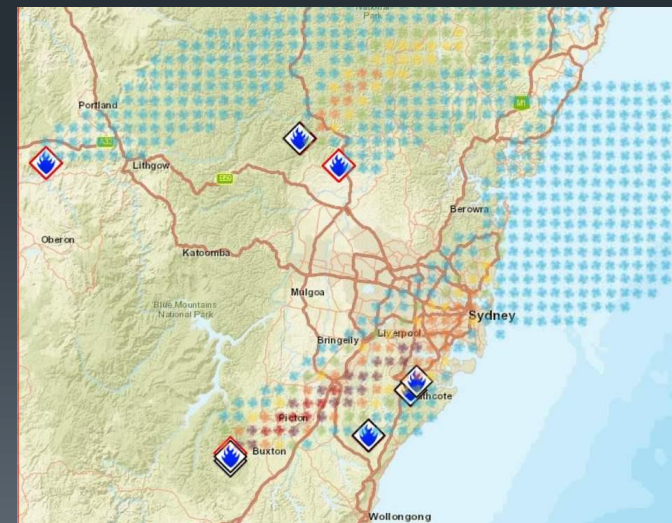
The OEH Bushfire research hub project: The trade-off between prescribed and wildfire smoke



- \$900k funding over 5 years from the NSW Office of Environment and Heritage
- Measuring particulate emissions from prescribed and wildfires
 - Fine-scale spatial measurements
 - Exploring the causes of variability of emission factors
 - Measuring fuel consumption in prescribed and wildfires
- Analysis of historical smoke patterns from individual fires
- Evaluating smoke dispersion modelling
- Ultimately scenario modelling with different levels of prescribed burning



Currently 9 months into the project



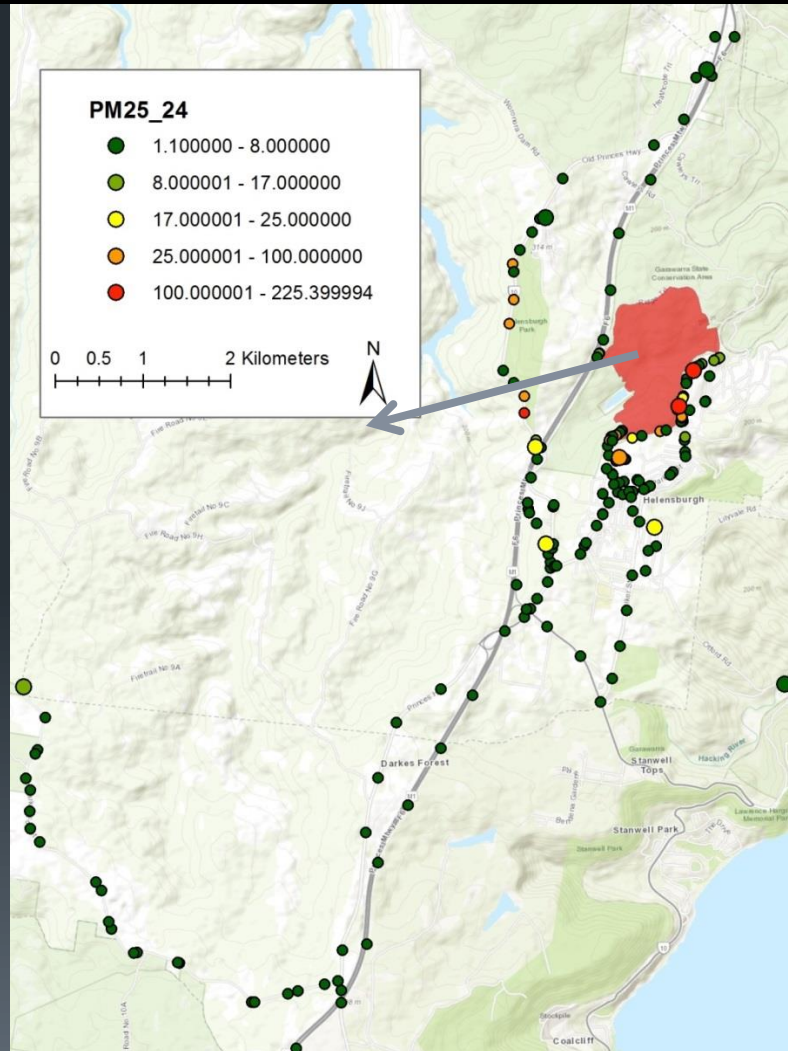
Smoke Monitoring at Prescribed Burns

5 so far from a planned 40

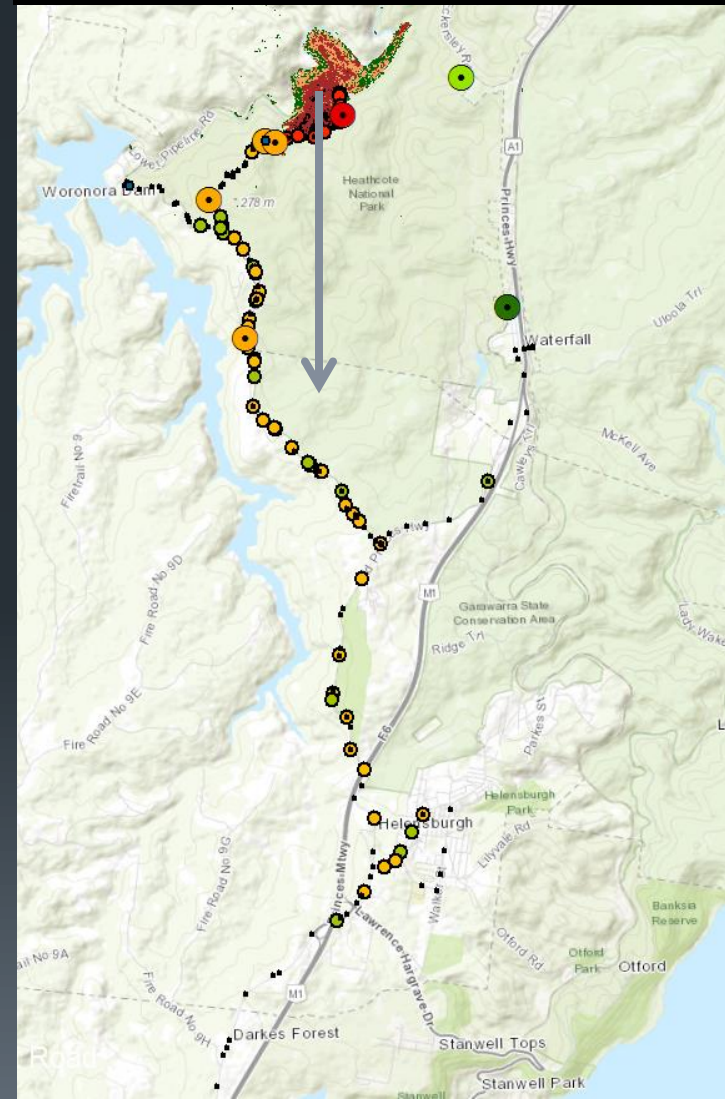


Spatial patterns in smoke

Wilsons Creek 138 ha, 17/4/2019

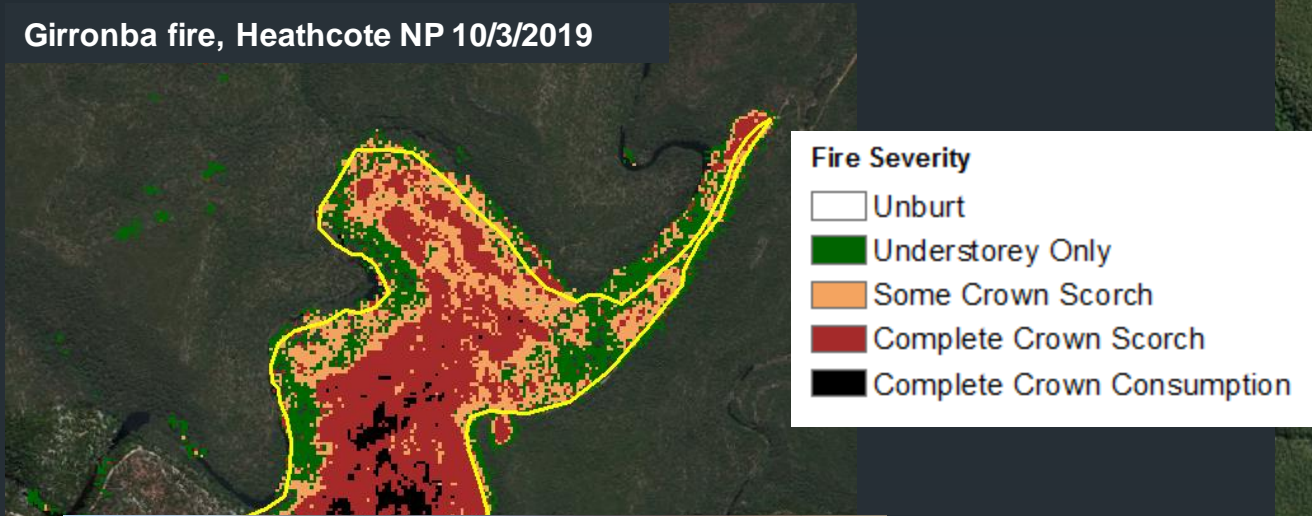


Girronba 98 ha, 10/3/2019

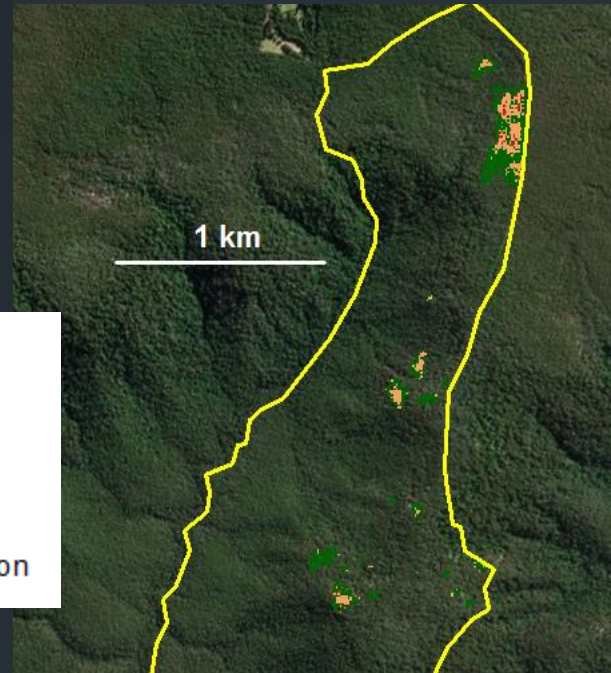


Variation in emissions

Girronba fire, Heathcote NP 10/3/2019



Back Run Creek fire, Moreton NP
10/3/2019



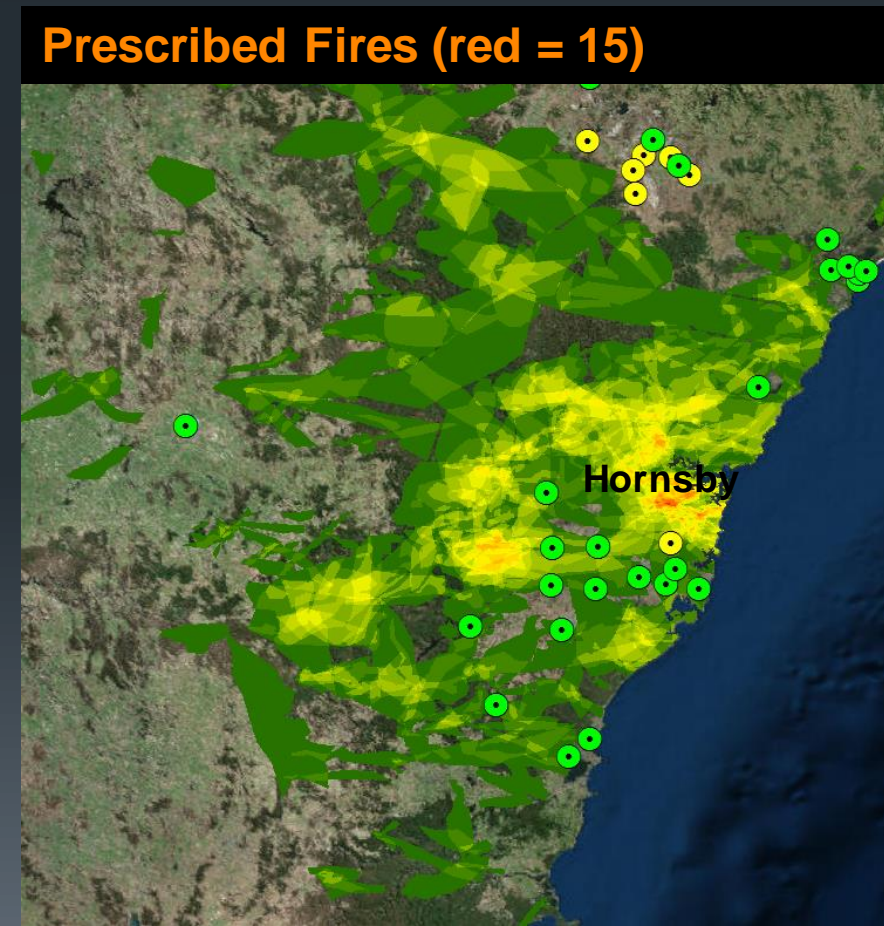
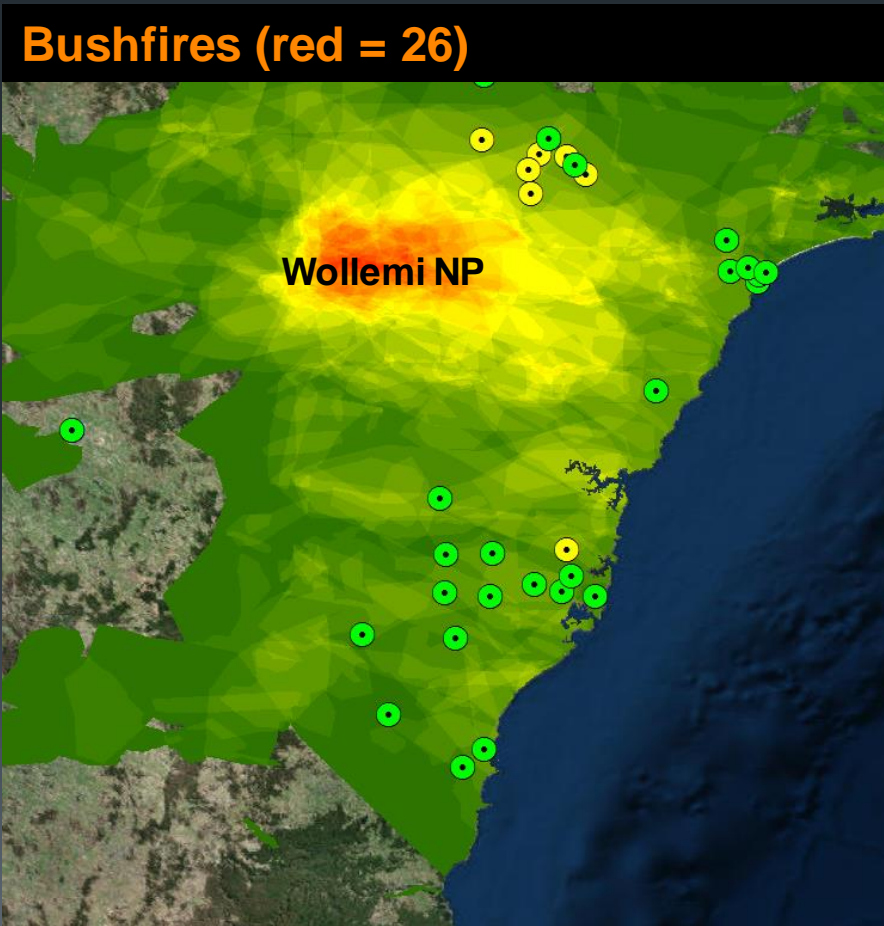
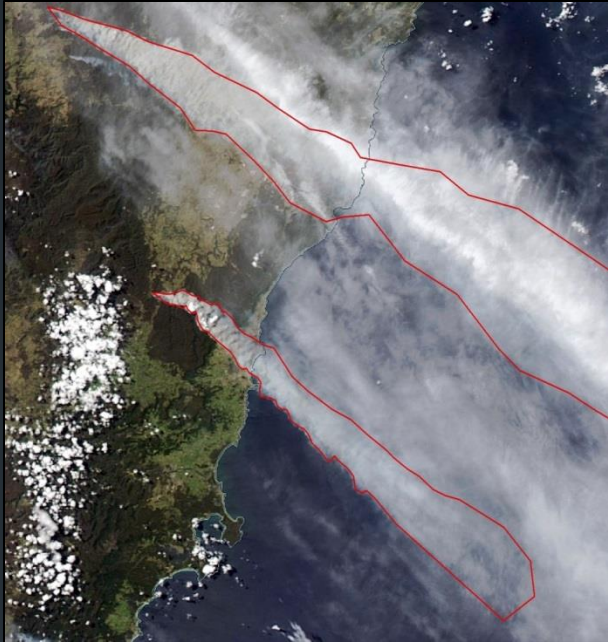
Fuel Consumption

So far, pre-fire fuel measured in 16 fires, post in 2



Smoke Plumes observed on MODIS imagery

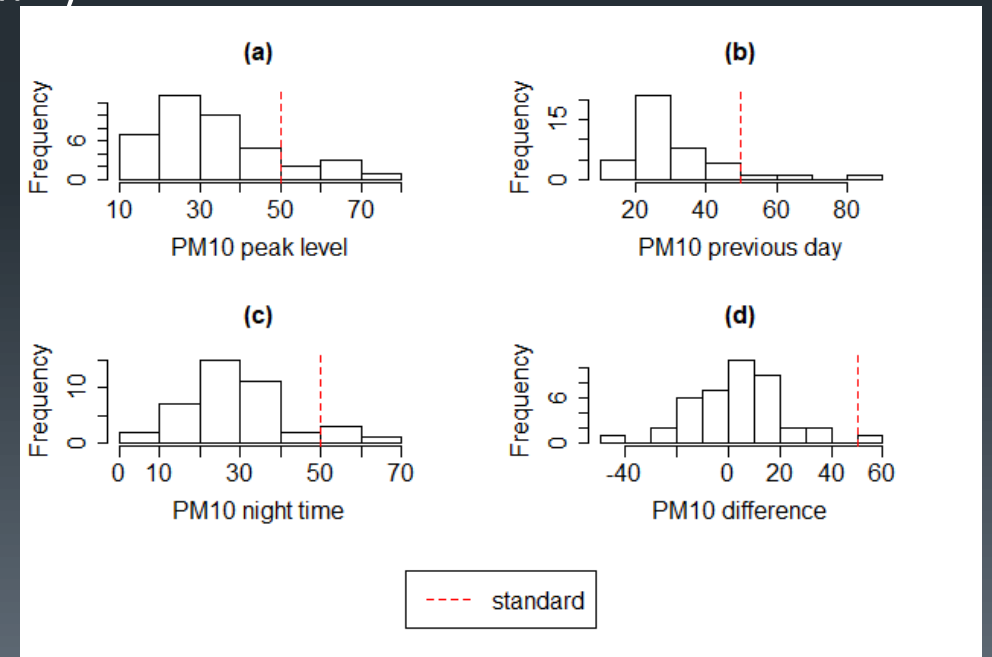
(Steph Samson)



Study 4: Air Quality Under the Plume

(Simin Rahmani student project)

- Examined 256 plumes mapped from MODIS and 126 from radar n= (382)
- 68 cases where a mapped plume was above a NSW AQ monitor (41 radar, 27 MODIS)
- 10 cases were HR burns
- Mean increase in PM10 $\sim 8 \mu\text{g m}^{-3}$ cf day before
- 12 cases where PM10 $> 50 \mu\text{g m}^{-3}$ for at least 3 hour period
- 1 HR burn caused night-time inversion with PM10 ($212 \mu\text{g m}^{-3}$)



Components of Air Quality in Auburn: (Maximilien Desservettaz)

- Open Path Fourier Transform Spectrometer project
- Examined pollutants from 1 year of air quality data from Auburn, Sydney
- Compared 42 Domestic Wood Heating days and 4 Prescribed Burning days
- Found heaters had larger impact

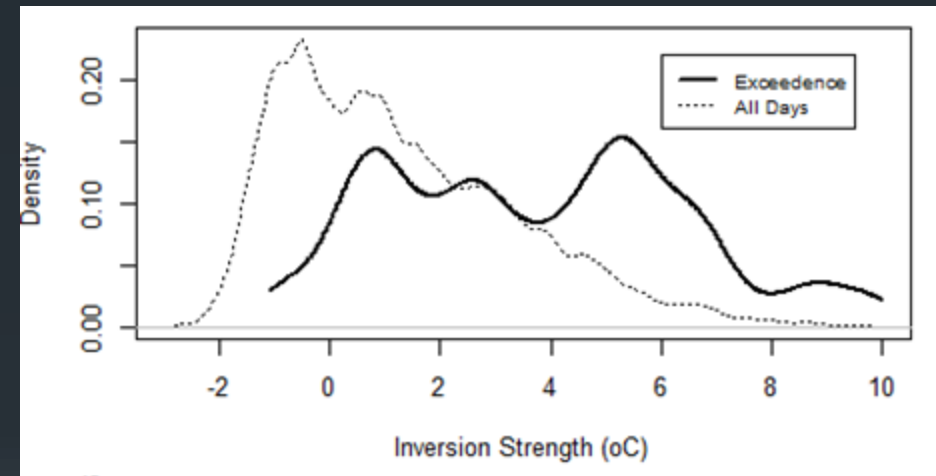
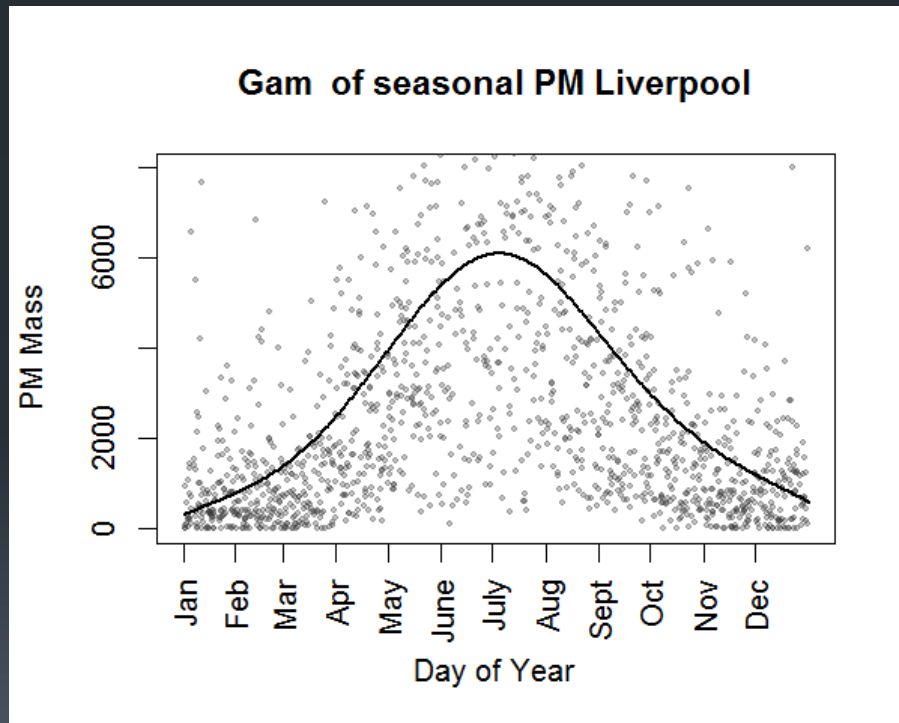
Table 2. 1h averaged enhanced levels above background (1hΔC) and total enhanced levels ($\Sigma \Delta C$) from domestic wood heating and hazard reduction burns events, as measured at the Auburn site between June and September 2017.

	Domestic Wood Heating		Hazard Reduction Burns	
	average 1hΔC	Σ 1hΔC (42 events)	average 1hΔC	Σ 1hΔC (4 events)
CO ₂ (ppm)	35	17,500	36	6,797
CO (ppb)	412	208,000	420	74,354
CH ₄ (ppb)	466	235,000	499	93,700
CH ₃ OH (ppb)	2	1,130	4	779
NH ₃ (ppb)	4	1,880	4	784
C ₂ H ₂ (ppb)	2	829	1	288
C ₂ H ₄ (ppb)	4	1,900	4	651
C ₂ H ₆ (ppb)	8	4,280	12	2,210
CH ₂ O (ppb)	2	942	3	581
NO (ppb)	38	17,800	32	6,370
NO ₂ (ppb)	15	7,040	19	3,510
NO _x (ppb)	52	24,400	50	9,680
PM _{2.5} (μg/m ³)	12	5,820	23	3,870
PM ₁₀ (μg/m ³)	14	7,300	26	4,560
SO ₂ (ppb)	1	536	1	214

Initial Analysis of Historical Air Quality Data

ANSTO Ion Beam Analysis
Biomass burning PM2.5 mass

PM2.5 from OEH Air Quality Network data
Association between exceedance and
temperature inversion





**NSW BUSHFIRE RISK MANAGEMENT RESEARCH HUB
ANNUAL CONFERENCE - 4 JUNE 2019, SYDNEY**

Thanks for listening
Find out more at the Hub Conference