nature research

https://doi.org/10.1038/s41893-020-00610-5

Supplementary information

Unprecedented health costs of smoke-related $PM_{2.5}$ from the 2019–20 Australian megafires

In the format provided by the authors and unedited

Supplementary Information for

Health costs of bushfire-related $PM_{2.5}$ from the 2019-20 Australian megafires – Supplementary material

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1. Supplementary Methods

Alternative economic evaluations of wildfire smoke related mortality based on long term health risk estimates to calculate the attributable number of premature deaths and years of life lost.

Approach

(a) **The number of premature deaths using long term exposure risk coefficients.** We applied the same modelling approach as described in the main text, but instead using long term health risk coefficient for all-cause mortality, for people aged 30 years or more. We used a RR= 1.062 (95% CI, 1.040 – 1.083) as recommended by the WHO.[1] This approach captures the contribution of wildfire smoke to annual average air pollution. We multiplied the value of a statistical life (VSL) by the total estimated premature deaths.

(b) **Year of life lost.** We estimated the number of years of life lost (YLL) using the following equation:

$$YLL = \sum_{ag} Cases_{deaths_{ag}} \times LE_{ag}$$

Where YLL is the estimated years of life lost, $Cases_{deaths_{ag}}$ is the estimated number of deaths on a particular age group 'ag' using the long-term health risk coefficient, and LE_{ag} is the life expectancy in years for age group 'ag'. We used the 2016-2018 life tables by State from the Australian Bureau of Statistics, [2] and estimated life expectancy by 5 year age groups using the following equation:

$$LE_{ag,s} = \frac{\sum_a LE_{a,s} \times Pop_{a,s}}{\sum_a Pop_{a,s}}$$

Where $LE_{ag,s}$ is the life expectancy in years for a person of state 's' and age group 'ag', $LE_{a,s}$ is the life expectancy in years of a person of state 's' and age 'a' and $Pop_{a,s}$ is the total population for state 's' and age 'a'.

In this analysis we used the value of a statistical life year (VSLY) and multiplied it by the estimated number of YLLs.

For the VSL and VSLY we used values recommended by the Office of Best Practice and Regulation.[3] Both estimates (VSL and VSLY) are a representation of how much society values risk reductions that would sum up to one life (VSL) or one year of life (VSLY). All values were adjusted to reflect the value of Australian Dollars of 2018 by applying inflation factors from the Reserve Bank of Australia.[4] VSL and VSLY values in 2018 $AUD were of $AUD 4,486,062 per statistical life and $AUD 194,396 per statistical life year, respectively.

2. Supplementary Tables

Supplementary Table 1. Correlation statistics for $PM_{2.5}$ observed vs. predicted for Queensland – Station Level

Region	Station	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
Gladstone	Barney Point	0.72	187	0.020020952	36.0	1.05764E-85	87.4%	87.4%	90.4%
	Boat Creek	1.05	2,785	0.012715570	82.4	0	70.9%	70.9%	74.6%
	Boyne Island	1.18	2,950	0.014382962	82.3	0	69.7%	69.6%	77.2%
	Clinton	0.98	3,110	0.010612399	92.4	0	73.3%	73.3%	74.8%
	Fishermans Landing	0.41	919	0.008883203	46.2	9.6322E-242	69.9%	69.9%	82.2%
	Mobile: Mt Larcom	0.88	73	0.034784934	25.4	1.05315E-37	90.0%	89.8%	81.2%
	South Gladstone	1.09	2,717	0.011899673	91.6	0	75.5%	75.5%	77.7%
	Targinie	1.14	2,277	0.015984414	71.0	0	68.9%	68.9%	75.2%
South East Queensland	Arundel	0.99	431	0.016603679	59.7	2.8505E-210	89.2%	89.2%	83.8%
	Brisbane CBD	0.95	100	0.014799934	64.3	1.438E-82	97.7%	97.6%	89.6%
	Cannon Hill	0.97	2,084	0.008810176	110.5	0	85.4%	85.4%	80.5%
	Dinmore	0.79	160	0.024552935	32.2	1.8204E-71	86.7%	86.6%	76.4%
	Jondaryan	0.54	776	0.015205558	35.2	5.3522E-163	61.5%	61.5%	60.2%
	Luscombe	1.10	222	0.028203324	38.9	9.2975E-101	87.2%	87.2%	79.9%
	Lutwyche	0.97	397	0.014047140	69.1	3.8615E-223	92.3%	92.3%	88.9%
	Lytton	0.82	1,857	0.012493261	66.0	0	70.1%	70.1%	67.9%
	Rocklea	0.76	4,968	0.005822179	130.7	0	77.5%	77.5%	75.8%
	South Brisbane	0.72	3,415	0.007820479	92.4	0	71.4%	71.4%	71.7%
	Southport	1.05	423	0.023805455	44.1	3.7099E-160	82.2%	82.1%	84.2%
	Springwood	0.87	5,146	0.006689898	130.1	0	76.7%	76.7%	76.1%
	Woolloongabba	0.75	2,676	0.008358726	89.9	0	75.1%	75.1%	74.3%
	Wynnum	0.69	3,455	0.008114844	84.6	0	67.5%	67.5%	70.7%
	Wynnum West	0.91	1,579	0.015255696	59.6	0	69.2%	69.2%	68.7%
South West Queensland	Condamine	0.95	280	0.025653957	37.1	5.4215E-110	83.2%	83.1%	82.9%
	Hopeland	0.75	658	0.017977803	41.7	1.1478E-186	72.6%	72.5%	75.6%
	Miles Airport	0.63	732	0.011588196	54.5	7.932E-260	80.3%	80.2%	85.3%
Toowoomba	North Toowoomba	0.96	1,531	0.006756602	141.8	0	92.9%	92.9%	84.5%
Townsville	North Ward	1.07	374	0.017102750	62.6	6.0823E-200	91.3%	91.3%	87.5%

Supplementary Table 2. Correlation statistics for $PM_{2.5}$ observed vs. predicted for New South Wales – Station Level

Region	Station	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
Bushfire Emergency - Coffs Harbour	Coffs Harbour	1.12	150	0.039435384	28.3	7.05776E-62	84.3%	84.2%	88.3%
Bushfire Emergency - Lismore	Lismore	0.83	128	0.038888770	21.3	9.21075E-44	78.1%	78.0%	80.6%
Bushfire Emergency - Port Macquarie	PORT MACQUARIE	1.27	149	0.040681425	31.3	4.66068E-67	86.8%	86.8%	91.6%
Central Coast	WYONG	1.08	2,738	0.009212734	117.2	0	83.4%	83.4%	82.0%
Central tablelands	BATHURST	1.03	1,453	0.017474581	58.8	0	70.5%	70.4%	78.0%
	ORANGE	1.17	459	0.024279199	48.1	3.1616E-181	83.5%	83.4%	89.6%
Illawarra	ALBION PARK STH	0.96	1,868	0.008327684	114.7	0	87.6%	87.6%	80.4%
	KEMBLA GRANGE	0.96	1,852	0.009521455	100.4	0	84.5%	84.5%	76.2%
	WOLLONGONG	0.91	7,275	0.004992157	181.3	0	81.9%	81.9%	78.9%
Lower Hunter	BERESFIELD	0.65	6,953	0.005203162	124.3	0	69.0%	69.0%	70.7%
	NEWCASTLE	1.04	2,305	0.008786489	117.9	0	85.8%	85.8%	77.0%
	WALLSEND	0.69	6,929	0.004280717	161.5	0	79.0%	79.0%	85.3%
Newcastle local	CARRINGTON	1.00	2,082	0.008225840	121.3	0	87.6%	87.6%	77.4%
	MAYFIELD	1.02	2,086	0.008454967	120.7	0	87.5%	87.5%	79.6%
	STOCKTON	0.96	1,989	0.008851741	108.8	0	85.6%	85.6%	69.5%
Northern Tablelands	ARMIDALE	1.19	741	0.020705816	57.5	2.0407E-275	81.7%	81.7%	87.8%
North-west slopes	GUNNEDAH	0.80	859	0.015911706	50.4	1.3831E-258	74.7%	74.7%	71.9%
	NARRABRI	0.67	867	0.017574942	37.9	3.6298E-186	62.4%	62.4%	65.1%
	TAMWORTH	0.84	1,495	0.013302406	62.9	0	72.6%	72.6%	72.4%
Research Monitoring	KATOOMBA	1.22	373	0.008919892	137.3	0	98.1%	98.1%	99.0%
Roadside Monitoring	BRADFIELD HIGHWAY	1.22	189	0.025531580	47.6	7.2587E-107	92.3%	92.3%	94.6%
South-west slopes	ALBURY	1.37	1,155	0.017471070	78.3	0	84.2%	84.1%	91.9%
	WAGGA WAGGA NTH	0.89	3,139	0.017272366	51.4	0	45.7%	45.7%	47.3%
Sydney central-east	CHULLORA	0.73	6,163	0.005785487	126.9	0	72.3%	72.3%	67.2%
	COOK AND PHILLIP	1.20	206	0.021401780	56.1	2.5021E-126	93.9%	93.9%	95.5%
	EARLWOOD	0.74	7,174	0.005657906	130.8	0	70.4%	70.4%	65.9%
	MACQUARIE PARK	1.10	985	0.014825968	74.5	0	84.9%	84.9%	84.9%
	RANDWICK	1.11	1,100	0.016284893	68.0	0	80.8%	80.8%	79.2%
	ROZELLE	1.08	1,751	0.009206086	117.9	0	88.8%	88.8%	85.4%
Sydney north-west	PARRAMATTA NORTH	1.06	2,215	0.007826153	135.0	0	89.2%	89.2%	85.2%
	PROSPECT	1.02	1,945	0.009162862	110.8	0	86.3%	86.3%	81.3%
	RICHMOND	0.67	6,975	0.006844086	98.3	0	58.1%	58.1%	60.8%
	ROUSE HILL	1.08	332	0.032320744	33.4	6.9154E-108	77.1%	77.0%	81.2%
	ST MARYS	1.04	1,415	0.011914573	87.7	0	84.5%	84.5%	83.2%
Sydney south-west	BARGO	1.18	1,231	0.018398014	64.3	0	77.1%	77.1%	84.0%

Region	Station	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
	BRINGELLY	1.03	1,378	0.012773309	81.0	0	82.7%	82.6%	81.9%
	CAMDEN	1.11	2,729	0.009758223	113.4	0	82.5%	82.5%	83.1%
	CAMPBELLTOWN WEST	0.99	1,660	0.010209621	96.6	0	84.9%	84.9%	80.6%
	LIVERPOOL	0.80	6,950	0.005072381	157.0	0	78.0%	78.0%	75.8%
	OAKDALE	1.13	1,232	0.014407036	78.6	0	83.4%	83.4%	89.0%
Upper Hunter	CAMBERWELL	0.75	3,175	0.007338525	102.7	0	76.9%	76.8%	57.8%
	MUSWELLBROOK	0.90	3,408	0.006363797	142.0	0	85.5%	85.5%	71.0%
	SINGLETON	0.88	3,413	0.007293563	120.8	0	81.0%	81.0%	63.3%

Supplementary Table 3. Correlation statistics for $PM_{2.5}$ observed vs. predicted for Australian Capital Territory – Station Level

Region	Station	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
ACT	Civic	1.39	1,724	0.007467727	185.7	0	95.2%	95.2%	97.8%
	Florey	1.36	2,156	0.007082270	192.7	0	94.5%	94.5%	97.6%
	Monash	1.59	2,459	0.009153640	174.2	0	92.5%	92.5%	97.3%

Supplementary Table 4. Correlation statistics for $PM_{2.5}$ observed vs. predicted for Victoria – Station Level

Region	Station	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
EAST	Alphington	1.10	1,945	0.011188256	98.2	0	83.2%	83.2%	79.6%
	Dandenong	1.72	1,078	0.042416026	40.5	1.3041E-218	60.4%	60.3%	82.4%
	Mooroolbark	1.16	906	0.017940003	64.8	0	82.3%	82.2%	86.1%
GEELONG	Geelong South	0.90	1,221	0.017029603	53.0	0	69.7%	69.7%	66.1%
LATROBE V2	Traralgon	1.12	1,933	0.009680247	115.4	0	87.3%	87.3%	85.6%
WEST	Brooklyn	1.14	676	0.033740798	33.8	1.4625E-147	62.9%	62.9%	72.0%
	Footscray	1.06	1,630	0.011427202	93.2	0	84.2%	84.2%	83.2%

Supplementary Table 5. Correlation statistics for $PM_{2.5}$ observed vs. predicted for South Australia – Station Level

Region	Station	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
North Western Adelaide	Le Fevre 1	0.90	1,406	0.007916836	113.1	0	90.1%	90.1%	68.1%
	Le Fevre 2	0.90	2,332	0.006885891	130.9	0	88.0%	88.0%	63.0%
South Australia	Port Augusta	0.40	981	0.009908809	40.9	6.9394E-214	63.0%	63.0%	75.3%
	Sellicks Beach	0.67	211	0.020531112	32.8	1.27675E-84	83.7%	83.6%	70.2%
Western Adelaide	Netley	0.81	6,357	0.004074759	199.3	0	86.2%	86.2%	57.7%
Northern Adelaide	Elizabeth	0.77	1,150	0.011697575	65.4	0	78.8%	78.8%	49.1%
Adelaide CBD	CBD	0.94	1,839	0.006691172	140.0	0	91.4%	91.4%	69.5%

Supplementary Table 6. Correlation statistics for $PM_{2.5}$ observed vs. predicted for Tasmania – Station Level

Region	Station	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
Break O'Day	FI	1.05	2,515	0.013176641	80.0	0	71.8%	71.8%	68.0%
	SH	1.18	2,702	0.017663491	66.9	0	62.4%	62.3%	72.0%
Burnie	ER	1.63	2,496	0.019033728	85.5	0	74.5%	74.5%	90.2%
Central Coast	WU	1.29	380	0.024688071	52.1	7.4933E-175	87.7%	87.7%	92.6%
Circular Head	ST	1.29	2,457	0.018279383	70.8	0	67.1%	67.1%	78.8%
Clarence	MT	1.17	1,576	0.013444431	87.0	0	82.8%	82.7%	84.0%
Dervent Valley	BE	1.05	952	0.016902367	62.1	0	80.2%	80.2%	75.1%
Derwent Valley	GR	1.19	2,409	0.010499874	113.4	0	84.2%	84.2%	86.1%
	NN	1.08	1,946	0.004292969	251.9	0	97.0%	97.0%	97.4%
Devonport	DT	1.32	1,477	0.016208499	81.1	0	81.7%	81.7%	88.1%
Dorset	DE	0.90	2,836	0.010782245	83.5	0	71.1%	71.1%	64.3%
	SC	1.36	2,664	0.015851505	85.7	0	73.4%	73.4%	82.0%
George Town	GB	1.23	2,364	0.014349734	86.0	0	75.8%	75.8%	82.3%
Glamorgan/Spring Bay	TR	1.22	391	0.022255673	55.0	1.0207E-185	88.6%	88.5%	91.2%
Glenorchy	GO	1.27	591	0.013920490	90.9	0	93.3%	93.3%	95.9%
Hobart	CG	1.03	874	0.015037966	68.2	0	84.2%	84.2%	79.8%
	HT	1.10	2,757	0.006878267	160.2	0	90.3%	90.3%	90.9%
Huon Valley	CY	1.96	548	0.021082593	92.9	0	94.0%	94.0%	99.0%
	GV	1.31	2,908	0.012270273	106.6	0	79.6%	79.6%	86.6%
	HV	1.19	2,788	0.009684990	123.3	0	84.5%	84.5%	87.6%
	JB	1.81	2,407	0.026180178	69.0	0	66.4%	66.4%	86.8%
Kentish	SF	1.35	2,435	0.014388509	93.5	0	78.2%	78.2%	85.7%
Latrobe	LT	1.10	401	0.013222996	83.3	8.1964E-255	94.5%	94.5%	94.9%
Launceston	LD	1.18	2,753	0.011665616	101.4	0	78.9%	78.9%	81.4%
	SL	1.18	2,690	0.009845420	120.2	0	84.3%	84.3%	87.2%
	TI	1.31	392	0.020721015	63.2	2.7859E-207	91.1%	91.1%	95.3%
Meander Valley	CA	0.98	995	0.016003649	61.4	0	79.1%	79.1%	71.9%
	DL	1.10	1,061	0.007048594	155.6	0	95.8%	95.8%	96.0%
	HA	1.21	1,749	0.007059954	172.1	0	94.4%	94.4%	95.9%
	WE	1.16	409	0.015173143	76.1	2.8397E-243	93.4%	93.4%	94.2%
Northern Midlands	CT	1.14	1,890	0.010309393	111.0	0	86.7%	86.7%	87.4%
	LF	1.16	1,759	0.006233343	186.3	0	95.2%	95.2%	96.1%
	PE	1.23	1,609	0.007400391	165.9	0	94.5%	94.5%	96.1%
Sorell	BC	1.07	1,177	0.015727677	68.0	0	79.7%	79.7%	75.1%
Southern Midlands	OL	1.13	599	0.010640389	106.2	0	95.0%	95.0%	95.2%
Waratah/Wynyard	WY	1.16	404	0.018093619	64.1	1.9132E-213	91.1%	91.0%	92.2%
West Coast	QT	1.15	418	0.015525475	73.8	1.4215E-241	92.9%	92.9%	94.0%
West Tamar	EX	1.45	2,690	0.014502594	99.9	0	78.8%	78.8%	89.2%

Supplementary Table 7. Correlation statistics for $PM_{2.5}$ observed vs. predicted for Western Australia – Station Level

Region	Station	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
Western Australia	Bunbury	1.03	7,175	0.003652726	281.8	0	91.7%	91.7%	84.3%
	Caversham	0.96	4,863	0.003699435	259.7	0	93.3%	93.3%	78.9%
	Duncraig	0.98	7,122	0.002838214	346.8	0	94.4%	94.4%	80.0%
	South Lake	0.97	4,981	0.003714317	261.7	0	93.2%	93.2%	77.2%
	Kalgoorlie	0.97	64	0.041783300	23.3	1.13938E-32	89.6%	89.4%	68.5%

Supplementary Table 8. Correlation statistics for $PM_{2.5}$ observed vs. predicted for all States – Regional level

State	Region	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
Queensland	Gladstone	0.75	15,018	0.004982511	149.9	0	59.9%	59.9%	67.4%
	South East Queensland	0.78	27,689	0.002750769	283.8	0	74.4%	74.4%	73.9%
	South West Queensland	0.68	1,670	0.009225765	74.0	0	76.7%	76.6%	81.0%
	Toowoomba	0.96	1,531	0.006756602	141.8	0	92.9%	92.9%	84.5%
	Townsville	1.07	374	0.017102750	62.6	6.0823E-200	91.3%	91.3%	87.5%
New South Wales	Bushfire Emergency - Coffs Harbour	1.12	150	0.039435384	28.3	7.05776E-62	84.3%	84.2%	88.3%
	Bushfire Emergency - Lismore	0.83	128	0.038888770	21.3	9.21075E-44	78.1%	78.0%	80.6%
	Bushfire Emergency - Port Macquarie	1.27	149	0.040681425	31.3	4.66068E-67	86.8%	86.8%	91.6%
	Central Coast	1.08	2,738	0.009212734	117.2	0	83.4%	83.4%	82.0%
	Central tablelands	1.11	1,912	0.013508740	82.1	0	77.9%	77.9%	85.5%
	Illawarra	0.92	10,995	0.003943345	233.8	0	83.3%	83.3%	78.5%
	Lower Hunter	0.70	16,187	0.003238758	216.2	0	74.3%	74.3%	77.1%
	Newcastle local	0.99	6,157	0.004933900	200.6	0	86.7%	86.7%	75.6%
	Northern Tablelands	1.19	741	0.020705816	57.5	2.0407E-275	81.7%	81.7%	87.8%
	North-west slopes	0.79	3,221	0.008905433	89.1	0	71.1%	71.1%	71.0%
	Research Monitoring	1.22	373	0.008919892	137.3	0	98.1%	98.1%	99.0%
	Roadside Monitoring	1.22	189	0.025531580	47.6	7.2587E-107	92.3%	92.3%	94.6%
	South-west slopes	1.06	4,294	0.013450594	79.0	0	59.3%	59.3%	68.4%
	Sydney central-east	0.81	17,379	0.003684713	220.6	0	73.7%	73.7%	68.0%
	Sydney north-west	0.83	12,882	0.004821801	172.6	0	69.8%	69.8%	68.0%
	Sydney south-west	0.94	15,180	0.004013596	234.9	0	78.4%	78.4%	77.9%
	Upper Hunter	0.85	9,996	0.004074265	208.0	0	81.2%	81.2%	64.2%
Australian Capital Territory	ACT	1.44	6,339	0.004794357	301.1	0	93.5%	93.5%	97.1%
Victoria	EAST	1.20	3,929	0.011459049	104.4	0	73.5%	73.5%	77.8%
	GEELONG	0.90	1,221	0.017029603	53.0	0	69.7%	69.7%	66.1%
	LATROBE V2	1.12	1,933	0.009680247	115.4	0	87.3%	87.3%	85.6%
	WEST	1.09	2,306	0.013538603	80.8	0	73.9%	73.9%	76.6%
South Australia	North Western Adelaide	0.90	3,738	0.005208450	172.6	0	88.9%	88.8%	65.1%
	South Australia	0.41	1,192	0.009088571	45.6	2.4212E-263	63.6%	63.5%	75.1%
	Western Adelaide	0.81	6,357	0.004074759	199.3	0	86.2%	86.2%	57.7%
	Northern Adelaide	0.77	1,150	0.011697575	65.4	0	78.8%	78.8%	49.1%
	Adelaide CBD	0.94	1,839	0.006691172	140.0	0	91.4%	91.4%	69.5%
Tasmania	Break O'Day	1.11	5,217	0.010874891	102.0	0	66.6%	66.6%	70.4%
	Burnie	1.63	2,496	0.019033728	85.5	0	74.5%	74.5%	90.2%

State	Region	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
	Central Coast	1.29	380	0.024688071	52.1	7.4933E-175	87.7%	87.7%	92.6%
	Circular Head	1.29	2,457	0.018279383	70.8	0	67.1%	67.1%	78.8%
	Clarence	1.17	1,576	0.013444431	87.0	0	82.8%	82.7%	84.0%
	Dervent Valley	1.05	952	0.016902367	62.1	0	80.2%	80.2%	75.1%
	Derwent Valley	1.09	4,355	0.003691308	295.9	0	95.3%	95.3%	96.3%
	Devonport	1.32	1,477	0.016208499	81.1	0	81.7%	81.7%	88.1%
	Dorset	1.08	5,500	0.009668536	111.8	0	69.5%	69.5%	70.8%
	George Town	1.23	2,364	0.014349734	86.0	0	75.8%	75.8%	82.3%
	Glamorgan/Spring Bay	1.22	391	0.022255673	55.0	1.0207E-185	88.6%	88.5%	91.2%
	Glenorchy	1.27	591	0.013920490	90.9	0	93.3%	93.3%	95.9%
	Hobart	1.09	3,631	0.006184146	176.7	0	89.6%	89.6%	90.0%
	Huon Valley	1.32	8,651	0.007322619	180.9	0	79.1%	79.1%	86.8%
	Kentish	1.35	2,435	0.014388509	93.5	0	78.2%	78.2%	85.7%
	Latrobe	1.10	401	0.013222996	83.3	8.1964E-255	94.5%	94.5%	94.9%
	Launceston	1.19	5,835	0.007071781	168.4	0	82.9%	82.9%	86.1%
	Meander Valley	1.17	4,214	0.004648554	252.6	0	93.8%	93.8%	95.3%
	Northern Midlands	1.18	5,258	0.004175881	283.4	0	93.9%	93.9%	95.4%
	Sorell	1.07	1,177	0.015727677	68.0	0	79.7%	79.7%	75.1%
	Southern Midlands	1.13	599	0.010640389	106.2	0	95.0%	95.0%	95.2%
	Waratah/Wynyard	1.16	404	0.018093619	64.1	1.9132E-213	91.1%	91.0%	92.2%
	West Coast	1.15	418	0.015525475	73.8	1.4215E-241	92.9%	92.9%	94.0%
	West Tamar	1.45	2,690	0.014502594	99.9	0	78.8%	78.8%	89.2%
Western Australia	Western Australia	0.99	24,359	0.001747846	567.2	0	93.0%	93.0%	81.0%

Supplementary Table 9. Correlation statistics for $PM_{2.5}$ observed vs. predicted for all States - State Level

State	Estimate	Observations (N)	Standard Error	t-value	p-value	R^2	Adjusted R	Correlation
Queensland	0.77	46,282	0.002399759	320.6	0	69.0%	69.0%	71.1%
New South Wales	0.91	102,671	0.001589195	573.4	0	76.2%	76.2%	77.4%
Australian Capital Territory	1.44	6,339	0.004794357	301.1	0	93.5%	93.5%	97.1%
Victoria	1.11	9,389	0.006583850	168.7	0	75.2%	75.2%	76.3%
South Australia	0.75	14,276	0.003104388	241.1	0	80.3%	80.3%	59.4%
Tasmania	1.21	63,469	0.002113611	573.7	0	83.8%	83.8%	88.6%
Western Australia	0.99	24,359	0.001747846	567.2	0	93.0%	93.0%	81.0%

3. Air quality (AQ) monitoring stations data availability

Supplementary Table 10. Number of AQ monitoring stations with data available for each State and Year

Year	Queensland	New South Wales	Australian Capital Territory	Victoria	South Australia	Tasmania	Western Australia	All analysed States
2000	10	13		11			4	37
2001	13	14		12	1		4	43
2002	12	15		14	2		4	46
2003	15	16		14	3		4	51
2004	17	19		13	4		4	56
2005	18	19		13	5		4	58
2006	16	19		14	6		7	61
2007	17	20		13	7		7	63
2008	19	20		12	7		8	65
2009	23	21		13	7		9	72
2010	20	23		15	6	17	9	89
2011	23	36		14	7	19	9	107
2012	23	40	2	14	7	21	9	115
2013	21	39	2	14	9	27	9	120
2014	25	42	3	15	10	25	9	128
2015	28	42	3	17	10	24	9	133
2016	32	42	3	18	11	28	9	143
2017	23	45	3	19	12	33	9	144
2018	15	46	3	19	11	34	8	136
2019	12	54	3	21	11	35	10	146
2020	12	54	3	19	11	35	7	141
Any year between 2000 - 2020	**45**	**55**	**3**	**26**	**12**	**38**	**11**	**189**

4. Proportion of exposed population

Supplementary Table 11. Percentage of exposed population (and total state population) captured by IDW method and availability of AQ monitoring stations for each State and Year

Year	Queensland	New South Wales	Australian Capital Territory	Victoria	South Australia	Tasmania	Western Australia	All analysed States
2000(*)	78.4%(3,571,469)	80.9%(6,530,349)	0.0%(321,538)	86.3%(4,763,615)	0.0%(1,503,461)	0.0%(473,668)	84.0%(1,906,274)	72.4%(19,070,374)
2001	81.3%(3,571,469)	82.0%(6,530,349)	0.0%(321,538)	86.3%(4,763,615)	82.6%(1,503,461)	0.0%(473,668)	84.0%(1,906,274)	79.8%(19,070,374)
2002	81.4%(3,653,123)	82.0%(6,580,807)	0.0%(324,627)	86.8%(4,817,774)	82.7%(1,511,567)	0.0%(474,152)	84.1%(1,928,512)	80.0%(19,290,562)
2003	83.0%(3,743,121)	82.0%(6,620,715)	0.0%(327,357)	91.0%(4,873,809)	88.6%(1,520,399)	0.0%(478,534)	84.2%(1,952,741)	81.8%(19,516,676)
2004	83.3%(3,829,970)	82.2%(6,650,735)	0.0%(328,940)	87.0%(4,927,149)	88.9%(1,528,189)	0.0%(483,178)	84.4%(1,979,542)	81.0%(19,727,703)
2005	83.4%(3,918,494)	82.9%(6,693,206)	0.0%(331,399)	87.1%(4,989,246)	89.0%(1,538,804)	0.0%(486,202)	84.6%(2,011,207)	81.3%(19,968,558)
2006	83.5%(4,007,992)	82.9%(6,742,690)	0.0%(335,170)	91.2%(5,061,266)	89.1%(1,552,529)	0.0%(489,302)	86.8%(2,050,581)	82.6%(20,239,530)
2007	83.5%(4,111,018)	83.1%(6,834,156)	0.0%(342,644)	91.3%(5,153,522)	89.4%(1,570,619)	0.0%(493,262)	87.0%(2,106,139)	82.7%(20,611,360)
2008	83.6%(4,219,505)	83.2%(6,943,461)	0.0%(348,368)	87.6%(5,256,375)	89.5%(1,588,665)	0.0%(498,568)	87.4%(2,171,700)	81.9%(21,026,642)
2009	84.3%(4,328,771)	83.3%(7,053,755)	0.0%(354,785)	87.8%(5,371,934)	89.6%(1,608,902)	0.0%(504,353)	89.6%(2,240,250)	82.4%(21,462,750)
2010	84.3%(4,404,744)	83.5%(7,144,292)	0.0%(361,766)	87.9%(5,461,101)	89.7%(1,627,322)	100.0%(508,847)	89.6%(2,290,845)	84.9%(21,798,917)
2011	83.8%(4,476,778)	85.1%(7,218,529)	0.0%(367,985)	88.0%(5,537,817)	89.8%(1,639,614)	100.0%(511,483)	89.7%(2,353,409)	85.3%(22,105,615)
2012	83.9%(4,569,863)	85.4%(7,308,205)	100.0%(376,564)	88.2%(5,653,429)	89.8%(1,656,711)	100.0%(511,848)	89.8%(2,426,846)	87.2%(22,503,466)
2013	84.0%(4,654,521)	85.5%(7,409,082)	100.0%(383,652)	88.3%(5,775,808)	89.9%(1,671,661)	100.0%(512,520)	90.0%(2,492,951)	87.3%(22,900,195)
2014	85.7%(4,724,417)	85.6%(7,517,195)	100.0%(389,406)	88.5%(5,901,970)	89.9%(1,687,673)	100.0%(513,839)	90.2%(2,523,100)	87.7%(23,257,600)
2015	86.2%(4,784,367)	85.8%(7,627,418)	100.0%(396,690)	88.6%(6,032,968)	90.0%(1,701,843)	100.0%(515,396)	90.5%(2,544,267)	88.0%(23,602,949)
2016	86.5%(4,848,877)	85.9%(7,739,274)	100.0%(403,468)	92.4%(6,179,249)	90.1%(1,713,054)	100.0%(517,588)	90.7%(2,558,951)	89.1%(23,960,461)
2017	84.5%(4,929,152)	86.5%(7,861,674)	100.0%(411,667)	92.5%(6,321,648)	90.1%(1,723,671)	100.0%(522,152)	90.9%(2,575,452)	88.9%(24,345,416)
2018	82.9%(5,011,216)	87.1%(7,988,241)	100.0%(420,960)	92.6%(6,460,675)	90.2%(1,736,422)	100.0%(528,201)	91.0%(2,595,192)	88.8%(24,740,907)
2019(*)	73.6%(5,011,216)	94.6%(7,988,241)	100.0%(420,960)	92.8%(6,460,675)	90.2%(1,736,422)	100.0%(528,201)	91.0%(2,595,192)	89.4%(24,740,907)
2020(*)	73.6%(5,011,216)	94.6%(7,988,241)	100.0%(420,960)	92.8%(6,460,675)	90.2%(1,736,422)	100.0%(528,201)	91.0%(2,595,192)	89.4%(24,740,907)

(*): Population of 2000 assumed same as that of 2001. Population of 2019 and 2020 assumed same as that of 2018.

Annual exposed total population proportion for each state remained similar over time for all states (range of state specific variation from 0% to 14%) apart from the Australian Capital Territory and Tasmania which had no exposure data prior to 2012 and 2010 respectively and then 100% coverage after then. South Australia had no exposure data prior to 2001.

Supplementary Table 12. Exposure-response functions used to calculate the attributable health burden

Outcome	Cause	Age group	Exposure	Beta (*)	Standard Error	RR per 10 ($\mu g/m^3$) (95% Confidence Interval)
Premature Mortality	All-cause	All	24h $PM_{2.5}$	0.001222	0.000393	1.0123[1] (1.0045-1.0201)
Hospital Admissions	Cardiovascular	All	24h $PM_{2.5}$	0.000906	0.000377	1.0091[1] (1.0017 – 1.0166)
	Respiratory	All	24h $PM_{2.5}$	0.001882	0.001051	1.019[1] (0.9982 – 1.0402)
ED visits	Asthma	All	24h $PM_{2.5}$	0.00639	0.001344	1.066[5] (1.038 – 1.094)

(*) Beta estimated as follows: $\beta = {\ln(RR)}/{\Delta C} = {\ln(RR)}/{10}$

Supplementary Table 13. Unitary health costs used to assess the economic burden

Outcome	Value ($AUD)	Period of value	Inflation[4]	Value 2018 ($AUD)
Cardiovascular hospital admissions	7,193[6]	2015-2016	3.9%	7,473
Respiratory hospital admissions	7,280[6]	2015-2016	3.9%	7,564
ED asthma visits	705[7]	2015-2016	3.9%	732
Premature mortality	4,200,000[3]	2014	6.8%	4,486,062

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