

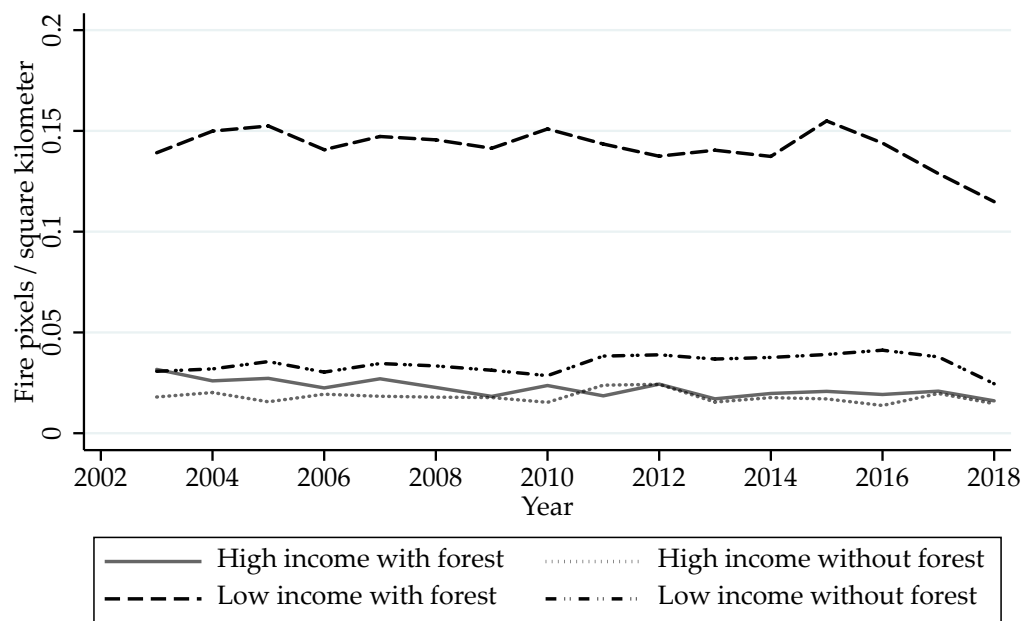
# Online Appendix (not intended for publication) for: The Origins and Control of Forest Fires in the Tropics

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October 8, 2021

## A. Additional figures

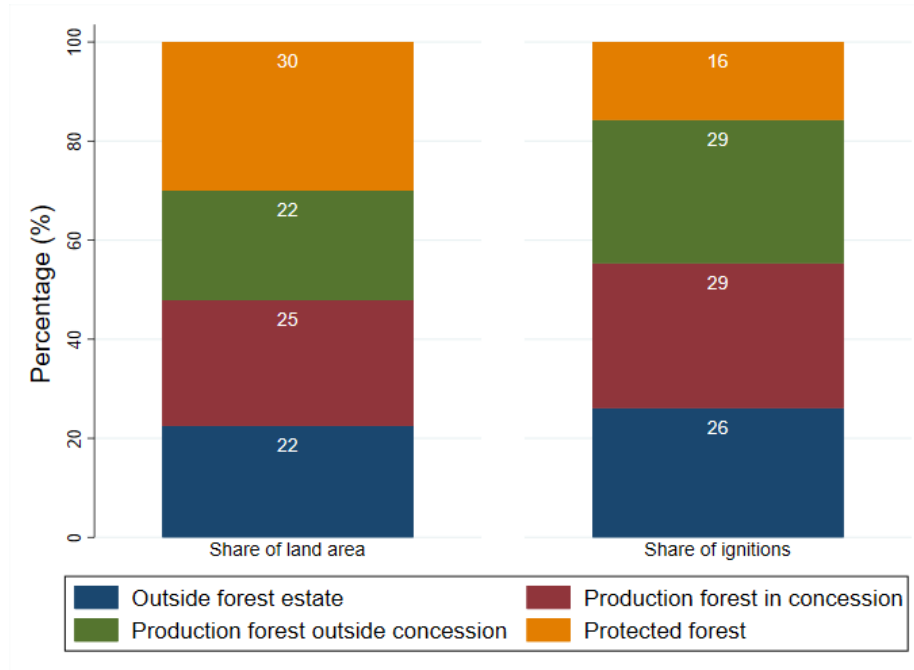
Figure A.1: Global (country-level) incidence of fires by forest cover and income level



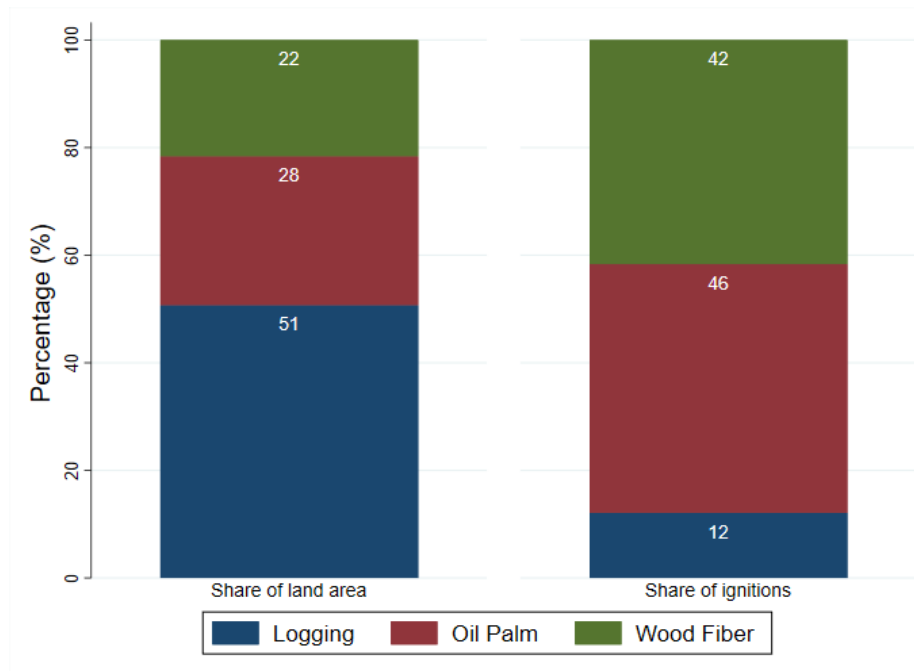
Note: The figure shows the number of fire pixels per square kilometer for four groups of countries, split by income and forest cover. High income countries are those designated as upper or upper middle income, and low income those designated as lower and lower middle income by the World Bank in 2016. With forest are countries with forest cover above 30%, and without those below 30% in 2016.

Figure A.2: Ignitions and land-use

(a) Share of Land Area and Ignitions by Forest Zone



(b) Share of Land Area and Ignitions Inside Concessions by Concession Type



## B. Serial correlation in wind speeds

Table B.1: Serial Correlation in Wind Speeds

Dependent variable = Wind speed in pixel m-y	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind Speed - 1 month lag	0.4109*** (0.008502)	0.4481*** (0.009000)	0.4082*** (0.007830)
Wind Speed - 2 month lag		-0.02086*** (0.006990)	-0.02780*** (0.007225)
Wind Speed - 3 month lag		-0.1420*** (0.006309)	-0.1065*** (0.009482)
Wind Speed - 4 month lag			-0.07454*** (0.003893)
Wind Speed - 5 month lag			-0.04641*** (0.01126)
Wind Speed - 6 month lag			-0.1145*** (0.008145)
Observations	39,744,086	39,300,018	38,633,916

Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## C. Results including concession fixed effects interacted with wind speed

Table C.1: Ignition Results by Surrounding Land Ownership - Including Concession Fixed Effects Interacted with Wind Speed

Dependent variable = Number of fires in pixel*month*year	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	1.9651*** (0.1777)	2.2243*** (0.1718)	2.1240*** (0.1725)	1.4309*** (0.2148)	1.8695*** (0.1658)	2.4978*** (0.2449)	(.) (.)
Wind speed in standard deviation units*	-0.007766***	-0.005212***	-0.003611**	-0.007140***	-0.003347**	-0.002124*	-0.001238
Num pixels in 6km buffer in same concession as central pixel	(0.001665)	(0.001716)	(0.001515)	(0.001593)	(0.001468)	(0.001267)	(0.0009739)
Observations	4,729,680	4,729,680	4,729,680	4,721,940	4,729,680	4,721,940	4,721,940
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES	-
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES	-
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES	-
Control: Wind speed × Concession FE	NO	NO	NO	NO	NO	NO	YES
Mean of Dep. Var.	0.00823	0.00823	0.00823	0.00823	0.00823	0.00823	0.00823

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## D. Results restricting to buffers containing at most two concessions or only own concession land and unleased productive forest

Table D.1: Ignition Results by Surrounding Land Ownership - Cases Involving Single Property Border

Dependent variable = Number of fires in pixel*month*year	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	2.4691*** (0.7507)	1.9887** (0.8302)	3.0228*** (0.6058)	2.0916*** (0.7632)	2.3407*** (0.7489)	2.2866*** (0.6893)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.01075** (0.004957)	-0.005786 (0.005106)	-0.004893 (0.003661)	-0.01104** (0.004847)	-0.004691 (0.005143)	0.0004399 (0.003652)
Observations	478,980	478,980	478,980	478,440	478,980	478,440
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.00798	0.00798	0.00798	0.00798	0.00798	0.00798

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. Sample: Pixels whose buffer contains land in a single or at most two concessions and that are inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table D.2: Ignition Results by Surrounding Land Ownership - Cases Where Buffer Contains Only Own Concession Land and Unleased Productive Forest

Dependent variable = Number of fires in pixel*month*year	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	2.5051*** (0.5386)	2.8616*** (0.4145)	2.6348*** (0.4202)	1.6474*** (0.5669)	2.3419*** (0.4933)	2.7752*** (0.3934)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.01300*** (0.003872)	-0.01093*** (0.003576)	-0.004100 (0.003664)	-0.01176*** (0.003697)	-0.007087** (0.003366)	-0.005550** (0.002700)
Observations	753,660	753,660	753,660	752,040	753,660	752,040
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.00824	0.00824	0.00824	0.00823	0.00824	0.00823

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. Sample: Pixels whose buffers contain only own concession land and unleased productive forest inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## E. Investigating strategic interactions

Table E.1: Ignition Results by Surrounding Land Ownership - Fires With Initial Size 1 Pixel

Dependent variable = Number of fires in pixel*month*year	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	1.8714*** (0.1951)	2.1615*** (0.1923)	2.0393*** (0.1775)	1.3197*** (0.2113)	1.7827*** (0.1863)	2.3829*** (0.2494)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.008305*** (0.001849)	-0.005536*** (0.001806)	-0.004155** (0.001703)	-0.007622*** (0.001797)	-0.004364** (0.001710)	-0.003061** (0.001561)
Observations	1,995,660	1,995,660	1,995,660	1,992,960	1,995,660	1,992,960
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.00673	0.00673	0.00673	0.00673	0.00673	0.00673

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Excludes fires where initial size is greater than 1 pixel. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table E.2: Ignition Results by Surrounding Land Ownership - Fires Where No Neighboring Concession Starts Fire In Same Period

Dependent variable = Number of fires in pixel*month*year	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	1.4530*** (0.1736)	1.6228*** (0.1784)	1.5662*** (0.1622)	1.0105*** (0.2092)	1.3966*** (0.1713)	2.0061*** (0.2253)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.006094*** (0.001653)	-0.002968* (0.001623)	-0.002604 (0.001604)	-0.005523*** (0.001632)	-0.002367 (0.001673)	-0.0004643 (0.001573)
Observations	2,302,560	2,302,560	2,302,560	2,295,900	2,302,560	2,295,900
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.00767	0.00767	0.00767	0.00767	0.00767	0.00767

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. Pixels whose buffers contain only own concession land and unleased productive forest inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Excludes fires where a neighboring concession starts a fire in the same period. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$



## F. Results broken down by wood fiber versus palm oil concessions

Table F.1: Ignition Results by Surrounding Land Ownership - Wood Fiber Concessions

Dependent variable = Number of fires in pixel*month*year	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	1.4006*** (0.2034)	1.7839*** (0.1881)	0.8515*** (0.1971)	1.3777*** (0.2004)	1.5830*** (0.1896)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.005236*** (0.001864)	-0.004050* (0.002119)	-0.004900*** (0.001868)	-0.002243 (0.001660)	-0.002816* (0.001575)
Observations	2,672,280	2,672,280	2,664,900	2,672,280	2,664,900
Control: Wind speed × Island	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.00807	0.00807	0.00807	0.00807	0.00807

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table F.2: Ignition Results by Surrounding Land Ownership - Palm Oil Concessions

Dependent variable = Number of fires in pixel*month*year	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	2.0797*** (0.2122)	2.6515*** (0.2717)	2.4970*** (0.3292)	2.0790*** (0.2152)	3.2397*** (0.3602)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.001523 (0.002437)	-0.001486 (0.002180)	-0.001688 (0.002338)	-0.003328 (0.002132)	-0.002561 (0.001876)
Observations	2,057,400	2,057,400	2,057,040	2,057,400	2,057,040
Control: Wind speed × Island	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.00843	0.00843	0.00843	0.00843	0.00843

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## G. Results in all concessions (logging, wood fiber and palm oil)

Table G.1: Impact of Deforestation on Ignitions (All Concessions)

Dependent variable = Number of fires in pixel*month*year	Pixel FE	Pixel Month & Year FE
Forest loss (km2) in year t-1	1.1251*** (0.1160)	1.3984*** (0.1236)
Forest loss (km2) in year t-2	-0.2845** (0.1258)	-0.2383* (0.1239)
Forest loss (km2) in year t-3	-0.4779*** (0.1772)	-0.3875*** (0.1495)
Observations	3,695,904	3,695,904
Mean of Dep. Var.	0.00995	0.00995

Poisson regressions. Robust standard errors clustered at level of 50km2 grid cells. All pixels inside wood fiber, palm oil, and logging concessions inside forest estate in Indonesia excl Java and Lesser Sunda Islands.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table G.2: Impact of Deforestation on Ignitions (All Land Types)

Dependent variable = Number of fires in pixel*month*year	Pixel FE	Pixel Month & Year FE
Forest loss (km2) in year t-1	1.4349*** (0.09448)	1.7519*** (0.09782)
Forest loss (km2) in year t-2	0.04941 (0.08316)	0.08461 (0.08173)
Forest loss (km2) in year t-3	-0.1754 (0.1119)	-0.2364** (0.1025)
Observations	11,723,184	11,723,184
Mean of Dep. Var.	0.0100	0.0100

Poisson regressions. Robust standard errors clustered at level of 50km2 grid cells. All pixels in Indonesia excl Java and Lesser Sunda Islands.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table G.3: Impact of Wind Speed on Fire Spread (All Concessions)

Dependent variable = Average fire spread area (burned area minus ignition area)	Pixel FE	Pixel Month & Year FE
Wind speed in standard deviation units	0.9204*** (0.1767)	1.2344*** (0.2257)
Observations	5,881	5,881
Mean of Dep. Var.	4.613	4.613

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All regressions control for number of ignitions in pixel-month. All pixels inside wood fiber, palm oil, and logging concessions inside forest estate in Indonesia excl Java and Lesser Sunda Islands.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table G.4: Ignition Results by Surrounding Land Ownership (All Concessions)

Dependent variable = Number of fires in pixel*month*year	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	1.6283*** (0.1535)	2.1828*** (0.1712)	0.4567*** (0.1332)	1.1590*** (0.1831)	1.5040*** (0.1435)	1.8882*** (0.2108)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.008013*** (0.001426)	-0.004667*** (0.001430)	-0.002987** (0.001280)	-0.007594*** (0.001367)	-0.002009* (0.001190)	-0.001349 (0.001114)
Observations	5,419,980	5,419,980	5,419,980	5,411,880	5,419,980	5,411,880
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.00814	0.00814	0.00814	0.00814	0.00814	0.00814

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber, palm oil, and logging concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table G.5: Ignition Results by Surrounding Land Ownership - Logging Concessions (All Concessions)

Dependent variable = Number of fires in pixel*month*year	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	0.08074 (0.1708)	1.7687*** (0.3422)	-0.5735*** (0.1949)	-0.002989 (0.1620)	1.3729*** (0.3581)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.002430 (0.002110)	-0.001401 (0.001574)	-0.002424 (0.001844)	0.002507* (0.001445)	0.0005991 (0.001237)
Observations	690,300	690,300	689,940	690,300	689,940
Control: Wind speed × Island	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.00759	0.00759	0.00758	0.00759	0.00758

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside logging concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table G.6: Ignition Results by Surrounding Land Type (All Concessions)

Dependent variable = Number of fires in pixel*month*year	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	2.0082*** (0.2970)	2.7962*** (0.2343)	0.7683*** (0.2621)	1.6578*** (0.3194)	1.8035*** (0.2702)	2.4322*** (0.2697)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.009974*** (0.002254)	-0.008901*** (0.002074)	-0.004113* (0.002135)	-0.009866*** (0.002183)	-0.003957** (0.001897)	-0.004894*** (0.001691)
Wind speed * Num pixels in 6km buffer in different concession from central pixel	0.005369* (0.002874)	-0.002091 (0.002303)	0.004801* (0.002580)	0.004949* (0.002733)	0.005606** (0.002812)	-0.0008835 (0.002175)
Wind speed * Num pixels in 6km buffer outside forest estate	-0.01064*** (0.003517)	-0.01445*** (0.002964)	-0.006862** (0.003354)	-0.01105*** (0.003462)	-0.01210*** (0.003487)	-0.01160*** (0.002874)
Wind speed * Num pixels in 6km buffer in protected forest	-0.01929*** (0.003633)	-0.01199*** (0.002528)	-0.01124*** (0.002881)	-0.01907*** (0.003657)	-0.01572*** (0.003349)	-0.008821*** (0.002214)
Wind speed * Average population density in 6km buffer	-0.0007915* (0.0004689)	-0.0005217* (0.0003164)	-0.0006762** (0.0003241)	-0.0005583 (0.0004714)	0.0003929 (0.0003630)	-0.0003097 (0.0003732)
Observations	5,419,980	5,419,980	5,419,980	5,411,880	5,419,980	5,411,880
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.008144	0.008144	0.008144	0.008143	0.008144	0.008143

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber, palm oil, and logging concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer in productive forest outside concession”. Suppressed categories: Interactions of wind speed and “Num pixels in 6km buffer in protected forest in concession”, “Num pixels in 6km buffer outside forest estate in concession”, “Num pixels in 6km buffer in sea”, “Num pixels in 6km buffer in Malaysia / PNG”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$



Table G.7: Spread Results by Surrounding Land Ownership (All Concessions)

Dependent variable = Spread extent (total fire area minus ignition area)	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	0.9253 (0.6528)	1.8816* (0.9579)	0.04750 (0.6608)	-0.01852 (0.5321)	0.9321 (0.6551)	0.4730 (0.9282)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.001004 (0.006475)	0.0005106 (0.006719)	0.002091 (0.006210)	0.0003039 (0.006263)	-0.001810 (0.007172)	-0.002612 (0.007049)
Observations	22,287	22,287	22,287	22,245	22,287	22,245
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	1.341	1.341	1.341	1.341	1.341	1.341

OLS regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. Pixels inside wood fiber, palm oil, and logging concessions inside forest estate excl Java and Lesser Sunda Islands containing at least one fire spreading beyond its ignition area. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table G.8: Spread Results by Surrounding Land Type (All Concessions)

Dependent variable = Spread extent (total fire area minus ignition area)	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs	Pixel M & Y FEs
Wind speed in standard deviation units	1.8876 (1.5794)	2.6869 (1.7626)	1.0615 (1.5666)	1.0551 (1.4451)	2.0480 (1.5632)	1.8898 (1.7511)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.007069 (0.01255)	-0.005366 (0.01218)	-0.003442 (0.01223)	-0.006372 (0.01243)	-0.01140 (0.01253)	-0.01239 (0.01227)
Wind speed * Num pixels in 6km buffer in different concession from central pixel	-0.0005831 (0.01205)	-0.003055 (0.01163)	-0.0004479 (0.01194)	-0.002086 (0.01202)	-0.0009616 (0.01182)	-0.005489 (0.01056)
Wind speed * Num pixels in 6km buffer outside forest estate	-0.02830* (0.01597)	-0.02924* (0.01566)	-0.02597 (0.01576)	-0.03108* (0.01632)	-0.02729* (0.01618)	-0.02616* (0.01550)
Wind speed * Num pixels in 6km buffer in protected forest	-0.02743* (0.01462)	-0.01806 (0.01407)	-0.02009 (0.01469)	-0.02712* (0.01453)	-0.03299** (0.01583)	-0.02521* (0.01529)
Wind speed * Average population density in 6km buffer	-0.0006346* (0.0003302)	-0.00009552 (0.0003664)	-0.0004541 (0.0004058)	-0.0001278 (0.0004337)	-0.001662 (0.001420)	-0.002596 (0.001705)
Observations	22,287	22,287	22,287	22,245	22,287	22,245
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	1.490	1.490	1.490	1.490	1.490	1.490

OLS regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber, palm oil, and logging concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer in productive forest outside concession”. Suppressed categories: Interactions of wind speed and “Num pixels in 6km buffer in protected forest in concession”, “Num pixels in 6km buffer in concession outside forest estate”, “Num pixels in 6km buffer in sea”, “Num pixels in 6km buffer in Malaysia / PNG”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table G.9: Government Punishment Results (All Concessions)

Dummy = 1 if firm investigated	No FEs	Island FEs	Province FEs
Pixels outside forest estate burned by fire	0.06521 (0.06175)	0.06165* (0.03712)	0.04487 (0.04179)
Pixels in unleased productive forest burned by fire	-0.05244*** (0.01225)	-0.02827 (0.02095)	-0.02733 (0.02209)
Pixels in protected forest burned by fire	0.04425 (0.04485)	0.08249* (0.04510)	0.08607** (0.04376)
Total area of fires burned Sep 2014-Aug 2015	0.01880*** (0.003039)	0.01431** (0.006204)	0.01444*** (0.005237)
Concession area (km2)	0.0004227 (0.0004972)	0.001034** (0.0004320)	0.001096** (0.0004751)
Population in fire extent	0.0005182*** (0.0001679)	0.0003435* (0.0001810)	0.0003640** (0.0001751)
Observations	659	659	625
Mean of Dep. Var.	0.158	0.158	0.162

Logit regressions. Robust standard errors clustered at level of firm groups. All pixels inside wood fiber, palm oil, and logging concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category “Pixels in productive forest in concession burned by fire”. Suppressed categories “Pixels in Malaysia / PNG burned by fire”, “Pixels in concession outside forest estate burned by fire”, and “Pixels in concession in protected forest burned by fire”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## H. Robustness to alternative fixed effect strategies

Table H.1: Impact of Deforestation on Ignitions (Month-Year FE & Month-Year-Island FE)

Dependent variable = Number of fires in pixel*month-year	Pixel Month-Year FE	Pixel Month-Year-Island FE
Forest loss (km2) in year t-1	1.3314*** (0.1314)	1.3492*** (0.1274)
Forest loss (km2) in year t-2	-0.3056** (0.1340)	-0.4218*** (0.1350)
Forest loss (km2) in year t-3	-0.3432** (0.1484)	-0.4081*** (0.1478)
Observations	3,224,160	3,100,194
Mean of Dep. Var.	0.0100	0.0104

Poisson regressions. Robust standard errors clustered at level of 50km2 grid cells. All pixels inside wood fiber and palm oil concessions inside forest estate in Indonesia excl Java and Lesser Sunda Islands.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table H.2: Impact of Wind Speed on Fire Spread (Month-Year FE & Month-Year-Island FE)

Dependent variable = Average fire spread area (burned area minus ignition area)	Pixel Month-Year FE	Pixel Month-Year-Island FE
Wind speed in standard deviation units	1.1191*** (0.2946)	1.3327*** (0.4361)
Observations	5,351	4,553
Mean of Dep. Var.	4.789	5.198

Poisson regressions. Robust standard errors clustered at level of 50km2 grid cells. All regressions control for number of ignitions in pixel-month. All pixels inside wood fiber and palm oil concessions inside forest estate in Indonesia excl Java and Lesser Sunda Islands.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table H.3: Ignition Results by Surrounding Land Ownership (Month-Year FE)

Dependent variable = Number of fires in pixel*month-year	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs
Wind speed in standard deviation units	1.8297*** (0.1823)	2.1561*** (0.2118)	1.9959*** (0.1811)	1.3234*** (0.2151)	1.7393*** (0.1713)	2.4492*** (0.2831)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.007786*** (0.001665)	-0.005204*** (0.001740)	-0.003739** (0.001513)	-0.007201*** (0.001608)	-0.003256** (0.001444)	-0.002142* (0.001286)
Observations	4,729,680	4,729,680	4,729,680	4,721,940	4,729,680	4,721,940
Control: Wind speed $\times$ Island	NO	YES	NO	NO	NO	YES
Control: Wind speed $\times$ Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed $\times$ Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed $\times$ Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.00823	0.00823	0.00823	0.00823	0.00823	0.00823

Poisson regressions. Robust standard errors clustered at level of 50km2 grid cells. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table H.4: Spread Results by Surrounding Land Ownership (Month-Year FE)

Dependent variable = Spread extent (total fire area minus ignition area)	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs
Wind speed in standard deviation units	0.8689 (0.5537)	2.4478*** (0.9004)	1.0351* (0.5490)	-0.07742 (0.4393)	0.8960 (0.5478)	2.1725*** (0.7914)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.001177 (0.007196)	-0.002710 (0.007638)	0.001347 (0.007362)	0.0002856 (0.007078)	-0.003244 (0.006713)	-0.003208 (0.006898)
Observations	20,099	20,099	20,099	20,068	20,099	20,068
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	1.335	1.335	1.335	1.335	1.335	1.335

OLS regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. Pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands containing at least one fire spreading beyond its ignition area. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table H.5: Ignition Results by Surrounding Land Type (Month-Year FE)

Dependent variable = Number of fires in pixel*month-year	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs
Wind speed in standard deviation units	1.9759*** (0.3552)	2.7858*** (0.2860)	1.9711*** (0.3300)	1.5386*** (0.3944)	1.9415*** (0.3371)	2.9113*** (0.3414)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.008672*** (0.002534)	-0.009380*** (0.002413)	-0.003987 (0.002563)	-0.008356*** (0.002448)	-0.004467** (0.002244)	-0.005716*** (0.001994)
Wind speed * Num pixels in 6km buffer in different concession from central pixel	0.003645 (0.003328)	-0.002090 (0.002619)	0.004313 (0.002961)	0.003055 (0.003115)	0.003537 (0.003238)	-0.0009509 (0.002473)
Wind speed * Num pixels in 6km buffer outside forest estate	-0.01662*** (0.004112)	-0.01982*** (0.003432)	-0.01121*** (0.003900)	-0.01690*** (0.004013)	-0.01593*** (0.003980)	-0.01624*** (0.003367)
Wind speed * Num pixels in 6km buffer in protected forest	-0.01298*** (0.004001)	-0.01213*** (0.003092)	-0.008453** (0.003673)	-0.01215*** (0.003874)	-0.01238*** (0.003835)	-0.009295*** (0.002889)
Wind speed * Average population density in 6km buffer	0.002815 (0.002305)	0.001252 (0.001991)	0.002303 (0.001810)	0.002774 (0.002391)	0.001419 (0.002047)	0.0008800 (0.001636)
Observations	4,729,680	4,729,680	4,729,680	4,721,940	4,729,680	4,721,940
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.008226	0.008226	0.008226	0.008226	0.008226	0.008226

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer in productive forest outside concession”. Suppressed categories: Interactions of wind speed and “Num pixels in 6km buffer in protected forest in concession”, “Num pixels in 6km buffer outside forest estate in concession”, “Num pixels in 6km buffer in sea”, “Num pixels in 6km buffer in Malaysia / PNG”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table H.6: Spread Results by Surrounding Land Type (Month-Year FE)

Dependent variable = Spread extent (total fire area minus ignition area)	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs	Pixel M-Y FEs
Wind speed in standard deviation units	1.5758 (1.5000)	3.3182* (1.7778)	1.6458 (1.4837)	0.7388 (1.3320)	1.5939 (1.4933)	2.8243* (1.5372)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.005169 (0.01351)	-0.008075 (0.01355)	-0.002938 (0.01392)	-0.005011 (0.01354)	-0.006956 (0.01270)	-0.008727 (0.01285)
Wind speed * Num pixels in 6km buffer in different concession from central pixel	-0.0009395 (0.01214)	-0.002428 (0.01184)	-0.0007375 (0.01204)	-0.003142 (0.01230)	-0.001183 (0.01203)	-0.002660 (0.01163)
Wind speed * Num pixels in 6km buffer outside forest estate	-0.02406* (0.01416)	-0.02665* (0.01477)	-0.02186 (0.01433)	-0.02692* (0.01443)	-0.02437* (0.01405)	-0.02535* (0.01478)
Wind speed * Num pixels in 6km buffer in protected forest	-0.02539 (0.01774)	-0.02714 (0.01806)	-0.02292 (0.01792)	-0.02464 (0.01758)	-0.02594 (0.01775)	-0.02346 (0.01821)
Wind speed * Average population density in 6km buffer	-0.003643 (0.003483)	-0.003827 (0.003584)	-0.003975 (0.003418)	-0.004822 (0.003669)	-0.003068 (0.003472)	-0.003367 (0.003942)
Observations	20,099	20,099	20,099	20,068	20,099	20,068
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	1.580	1.580	1.580	1.580	1.580	1.580

OLS regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer in productive forest outside concession”. Suppressed categories: Interactions of wind speed and “Num pixels in 6km buffer in protected forest in concession”, “Num pixels in 6km buffer in concession outside forest estate”, “Num pixels in 6km buffer in sea”, “Num pixels in 6km buffer in Malaysia / PNG”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$



Table H.7: Ignition Results by Surrounding Land Ownership (Month-Year-Island FE)

Dependent variable = Number of fires in pixel*month-year	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs
Wind speed in standard deviation units	1.3257*** (0.1539)	1.5730*** (0.1891)	1.4518*** (0.1672)	1.2940*** (0.1583)	1.3014*** (0.1474)	1.7893*** (0.2460)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.004098*** (0.001533)	-0.004291*** (0.001545)	-0.002627* (0.001529)	-0.004171*** (0.001503)	-0.002506** (0.001166)	-0.002099* (0.001169)
Observations	4,524,798	4,524,798	4,524,798	4,513,168	4,524,798	4,513,168
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.00860	0.00860	0.00860	0.00861	0.00860	0.00861

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table H.8: Spread Results by Surrounding Land Ownership (Month-Year-Island FE)

Dependent variable = Spread extent (total fire area minus ignition area)	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs
Wind speed in standard deviation units	1.1061* (0.6670)	2.4513*** (0.9091)	1.3431** (0.6536)	-0.1176 (0.5546)	1.1333* (0.6680)	1.4998* (0.8612)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.0001150 (0.007360)	-0.001334 (0.007191)	0.001833 (0.007641)	0.0006177 (0.007240)	-0.003545 (0.007128)	-0.002336 (0.007190)
Observations	19,985	19,985	19,985	19,960	19,985	19,960
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	1.337	1.337	1.337	1.337	1.337	1.337

OLS regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. Pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands containing at least one fire spreading beyond its ignition area. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table H.9: Ignition Results by Surrounding Land Type (Month-Year-Island FE)

Dependent variable = Number of fires in pixel*month-year	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs
Wind speed in standard deviation units	1.6739*** (0.2546)	1.9527*** (0.2645)	1.6986*** (0.2630)	1.6746*** (0.2719)	1.6351*** (0.2470)	2.0814*** (0.3059)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.006390*** (0.002180)	-0.006744*** (0.002192)	-0.004496** (0.002156)	-0.006596*** (0.002170)	-0.004722*** (0.001815)	-0.004154** (0.001857)
Wind speed * Num pixels in 6km buffer in different concession from central pixel	-0.0006885 (0.002239)	-0.0009856 (0.002207)	-0.00009108 (0.002168)	-0.0008773 (0.002248)	-0.0003711 (0.002220)	-0.0002552 (0.002166)
Wind speed * Num pixels in 6km buffer outside forest estate	-0.009369*** (0.002910)	-0.009929*** (0.002865)	-0.007299** (0.002895)	-0.009498*** (0.002918)	-0.008859*** (0.002886)	-0.007873*** (0.002848)
Wind speed * Num pixels in 6km buffer in protected forest	-0.01017*** (0.002654)	-0.009800*** (0.002622)	-0.008167*** (0.002648)	-0.01034*** (0.002664)	-0.009544*** (0.002546)	-0.008002*** (0.002603)
Wind speed * Average population density in 6km buffer	0.0006794 (0.001708)	0.0008059 (0.001662)	0.0005613 (0.001514)	0.0006798 (0.001728)	0.0003456 (0.001655)	0.0005005 (0.001430)
Observations	4,524,798	4,524,798	4,524,798	4,513,168	4,524,798	4,513,168
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	0.008598	0.008598	0.008598	0.008606	0.008598	0.008606

Poisson regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer in productive forest outside concession”. Suppressed categories: Interactions of wind speed and “Num pixels in 6km buffer in protected forest in concession”, “Num pixels in 6km buffer outside forest estate in concession”, “Num pixels in 6km buffer in sea”, “Num pixels in 6km buffer in Malaysia / PNG”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table H.10: Spread Results by Surrounding Land Type (Month-Year-Island FE)

Dependent variable = Spread extent (total fire area minus ignition area)	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs	Pixel M-Y-I FEs
Wind speed in standard deviation units	2.4021 (1.6812)	3.5084** (1.7630)	2.4644 (1.6497)	1.2031 (1.4508)	2.5053 (1.6771)	2.4541* (1.4839)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.008030 (0.01387)	-0.008408 (0.01389)	-0.006293 (0.01479)	-0.007253 (0.01366)	-0.01243 (0.01364)	-0.009762 (0.01423)
Wind speed * Num pixels in 6km buffer in different concession from central pixel	-0.006726 (0.01228)	-0.005043 (0.01256)	-0.006162 (0.01254)	-0.006983 (0.01223)	-0.008156 (0.01220)	-0.005604 (0.01264)
Wind speed * Num pixels in 6km buffer outside forest estate	-0.02769** (0.01396)	-0.02573* (0.01448)	-0.02570* (0.01460)	-0.02810** (0.01373)	-0.02889** (0.01388)	-0.02454* (0.01466)
Wind speed * Num pixels in 6km buffer in protected forest	-0.03052 (0.01878)	-0.03140* (0.01895)	-0.02814 (0.01981)	-0.02752 (0.01817)	-0.03282* (0.01904)	-0.02756 (0.01952)
Wind speed * Average population density in 6km buffer	-0.004797 (0.003919)	-0.003925 (0.003926)	-0.004875 (0.003946)	-0.005112 (0.003854)	-0.003883 (0.003879)	-0.003361 (0.003967)
Observations	19,985	19,985	19,985	19,960	19,985	19,960
Control: Wind speed × Island	NO	YES	NO	NO	NO	YES
Control: Wind speed × Concession Type	NO	NO	YES	NO	NO	YES
Control: Wind speed × Forest Cover 2000	NO	NO	NO	YES	NO	YES
Control: Wind speed × Concession Area	NO	NO	NO	NO	YES	YES
Mean of Dep. Var.	1.589	1.589	1.589	1.588	1.589	1.588

OLS regressions. Robust standard errors clustered at level of 50km<sup>2</sup> grid cells. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer in productive forest outside concession”. Suppressed categories: Interactions of wind speed and “Num pixels in 6km buffer in protected forest in concession”, “Num pixels in 6km buffer in concession outside forest estate”, “Num pixels in 6km buffer in sea”, “Num pixels in 6km buffer in Malaysia / PNG”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

# I. Robustness to different spatial cluster standard error specifications

Table I.1: Impact of Deforestation on Ignitions (Alternative Clusters)

Dependent variable = Number of fires in pixel*month*year	25x25km clusters	50x50km clusters	100x100km clusters
Forest loss (km2) in year t-1	1.3314*** (0.1082)	1.3314*** (0.1314)	1.3314*** (0.1525)
Forest loss (km2) in year t-2	-0.3056** (0.1218)	-0.3056** (0.1340)	-0.3056** (0.1460)
Forest loss (km2) in year t-3	-0.3432** (0.1335)	-0.3432** (0.1484)	-0.3432** (0.1730)
Observations	3,224,160	3,224,160	3,224,160
Mean of Dep. Var.	0.0100	0.0100	0.0100

Poisson regressions with pixel, month, and year fixed effects. Robust clustered standard errors as indicated in column titles. All pixels inside wood fiber and palm oil concessions inside forest estate in Indonesia excl Java and Lesser Sunda Islands.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table I.2: Impact of Wind Speed on Fire Spread (Alternative Clusters)

Dependent variable = Average fire spread area (burned area minus ignition area)	25x25km clusters	50x50km clusters	100x100km clusters
Wind speed in standard deviation units	1.3521*** (0.2383)	1.3521*** (0.2196)	1.3521*** (0.2327)
Observations	5,444	5,444	5,444
Mean of Dep. Var.	4.753	4.753	4.753

Poisson regressions with pixel, month, and year fixed effects. Robust clustered standard errors as indicated in column titles. All regressions control for number of ignitions in pixel-month. All pixels inside wood fiber and palm oil concessions inside forest estate in Indonesia excl Java and Lesser Sunda Islands.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table I.3: Ignition Results by Surrounding Land Ownership (Alternative Clusters)

	25x25km clusters	50x50km clusters	100x100km clusters
Number of fires in pixel*month-year			
Wind speed in standard deviation units	2.4978*** (0.1905)	2.4978*** (0.2449)	2.4978*** (0.3113)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.002124* (0.001200)	-0.002124* (0.001267)	-0.002124* (0.001194)
Observations	4,721,940	4,721,940	4,721,940
Control: Wind speed $\times$ Island	YES	YES	YES
Control: Wind speed $\times$ Concession Type	YES	YES	YES
Control: Wind speed $\times$ Forest Cover 2000	YES	YES	YES
Control: Wind speed $\times$ Concession Area	YES	YES	YES
Mean of Dep. Var.	0.00823	0.00823	0.00823

Poisson regressions with pixel, month, and year fixed effects. Robust clustered standard errors as indicated in column titles. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table I.4: Spread Results by Surrounding Land Ownership (Alternative Clusters)

	25x25km clusters	50x50km clusters	100x100km clusters
Spread extent (total fire area minus ignition area)			
Wind speed in standard deviation units	1.7668* (0.9344)	1.7668* (0.9782)	1.7668* (1.0178)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.001433 (0.006883)	-0.001433 (0.007270)	-0.001433 (0.006457)
Observations	20,068	20,068	20,068
Control: Wind speed $\times$ Island	YES	YES	YES
Control: Wind speed $\times$ Concession Type	YES	YES	YES
Control: Wind speed $\times$ Forest Cover 2000	YES	YES	YES
Control: Wind speed $\times$ Concession Area	YES	YES	YES
Mean of Dep. Var.	1.335	1.335	1.335

OLS regressions with pixel, month, and year fixed effects. Robust clustered standard errors as indicated in column titles. Pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands containing at least one fire spreading beyond its ignition area. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer outside same concession as central pixel”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$



Table I.5: Ignition Results by Surrounding Land Type (Alternative Clusters)

Number of fires in pixel*month-year	25x25km clusters	50x50km clusters	100x100km clusters
Wind speed in standard deviation units	2.9294*** (0.2711)	2.9294*** (0.3165)	2.9294*** (0.3834)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.005633*** (0.001745)	-0.005633*** (0.001991)	-0.005633*** (0.001995)
Wind speed * Num pixels in 6km buffer in different concession from central pixel	-0.001034 (0.002181)	-0.001034 (0.002467)	-0.001034 (0.002375)
Wind speed * Num pixels in 6km buffer outside forest estate	-0.01562*** (0.002683)	-0.01562*** (0.003225)	-0.01562*** (0.003717)
Wind speed * Num pixels in 6km buffer in protected forest	-0.008950*** (0.002872)	-0.008950*** (0.002913)	-0.008950*** (0.003065)
Wind speed * Average population density in 6km buffer	0.0007037 (0.001559)	0.0007037 (0.001625)	0.0007037 (0.001869)
Observations	4,721,940	4,721,940	4,721,940
Control: Wind speed × Island	YES	YES	YES
Control: Wind speed × Concession Type	YES	YES	YES
Control: Wind speed × Forest Cover 2000	YES	YES	YES
Control: Wind speed × Concession Area	YES	YES	YES
Mean of Dep. Var.	0.008226	0.008226	0.008226

Poisson regressions with pixel, month, and year fixed effects. Robust clustered standard errors as indicated in column titles. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer in productive forest outside concession”. Suppressed categories: Interactions of wind speed and “Num pixels in 6km buffer in protected forest in concession”, “Num pixels in 6km buffer outside forest estate in concession”, “Num pixels in 6km buffer in sea”, “Num pixels in 6km buffer in Malaysia / PNG”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

Table I.6: Spread Results by Surrounding Land Type (Alternative Clusters)

	25x25km clusters	50x50km clusters	100x100km clusters
Spread extent (total fire area minus ignition area)			
Wind speed in standard deviation units	2.8069** (1.3586)	2.8069 (1.8166)	2.8069 (1.8064)
Wind speed * Num pixels in 6km buffer in same concession as central pixel	-0.01018 (0.009591)	-0.01018 (0.01275)	-0.01018 (0.01116)
Wind speed * Num pixels in 6km buffer in different concession from central pixel	-0.008422 (0.009085)	-0.008422 (0.01114)	-0.008422 (0.01053)
Wind speed * Num pixels in 6km buffer outside forest estate	-0.02413* (0.01274)	-0.02413 (0.01596)	-0.02413 (0.01572)
Wind speed * Num pixels in 6km buffer in protected forest	-0.02037 (0.01606)	-0.02037 (0.01847)	-0.02037 (0.01605)
Wind speed * Average population density in 6km buffer	-0.003778 (0.003429)	-0.003778 (0.003410)	-0.003778 (0.003340)
Observations	20,068	20,068	20,068
Control: Wind speed × Island	YES	YES	YES
Control: Wind speed × Concession Type	YES	YES	YES
Control: Wind speed × Forest Cover 2000	YES	YES	YES
Control: Wind speed × Concession Area	YES	YES	YES
Mean of Dep. Var.	1.335	1.335	1.335

OLS regressions with pixel, month, and year fixed effects. Robust clustered standard errors as indicated in column titles. All pixels inside wood fiber and palm oil concessions inside forest estate excl Java and Lesser Sunda Islands. Omitted category: Interaction of wind speed and “Num pixels in 6km buffer in productive forest outside concession”. Suppressed categories: Interactions of wind speed and “Num pixels in 6km buffer in protected forest in concession”, “Num pixels in 6km buffer in concession outside forest estate”, “Num pixels in 6km buffer in sea”, “Num pixels in 6km buffer in Malaysia / PNG”.

\*  $p < 0.1$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## **J. Indonesian policies to prevent forest fires: background and sources**

This Appendix describes the sources used in section the paper on Indonesian policies to prevent forest fires. Ardiansyah et al. (2015) give a detailed review of forest governance in Indonesia. Jepson et al. (2002) describe how the 1967 Basic Forestry Law was used for zoning and particularly the designation of protected zones. The main text describes several instruments to control the conversion of land: The 2011 moratorium on forest clearing is discussed in Reuters (2011). Peatland protection policies were strengthened following the 2015 fires and made permanent in 2019, as described by Jong (2019). Presidential Instruction No. 11/2015 requires all levels of government to develop land and forest fire management systems and to apply sanctions for businesses who do not implement fire management. Mongabay (2018) discusses the 2018 moratorium on issuing palm oil plantation licenses . Finally, Indrarto et al. (2012) discuss general issues with land planning (ambiguous planning, tenure conflicts, and others).

As described in the main text, land use policies are supplemented by penalties on fire setters. The legal basis for this is the 1999 Forestry Law. The sections of the 1999 Forestry Law pertaining to forest fires are: Article 48 (responsibility to engage in forest protecting activities), Article 49 (responsibility for forest fires with title/license holders), Article 50 (prohibition of burning), and Article 78 (fines and criminal provisions). Details on the prosecution of firms after the 2015 fires and the failure of the firms to pay these fines are discussed in The Guardian (2017) and by Greenpeace (2019).

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