

Accessory publication

Forest fire occurrence and climate change in Canada

Appendix 1

Human-caused fire occurrence models were developed using ecoregions (Fig. A1) within each province as a base unit of analysis using the following form, based on model form used in Wotton *et al.* (2003):

$$\ln(N_{HUMp}) = \alpha_{0,p} + \alpha_{1,p}(\text{ECOREGION}) + \alpha_{2,p} \cdot \text{FFMC} + \alpha_{3,p}(\text{ECOREGION}) \times \text{FFMC} + \alpha_{4,p} \cdot \text{DMC} + \alpha_{5,p} \cdot \text{DC} + \alpha_{6,p} \cdot \text{CAUSE_GROUP} + \alpha_{7,p} \cdot \text{SEASON} \quad (1)$$

where CAUSE_GROUP = 1 for the spring cause group and 0 for the summer cause group; SEASON = 1 in spring and = 0 in summer; and subscript p represents province.

Coefficients for this model appear in Tables A1 to A4. Models were fit using generalized linear modelling (PROC GENMOD, SAS Institute, 2002). Terms not significant at the $\alpha = 0.05$ (95% confidence) level were dropped from the model.

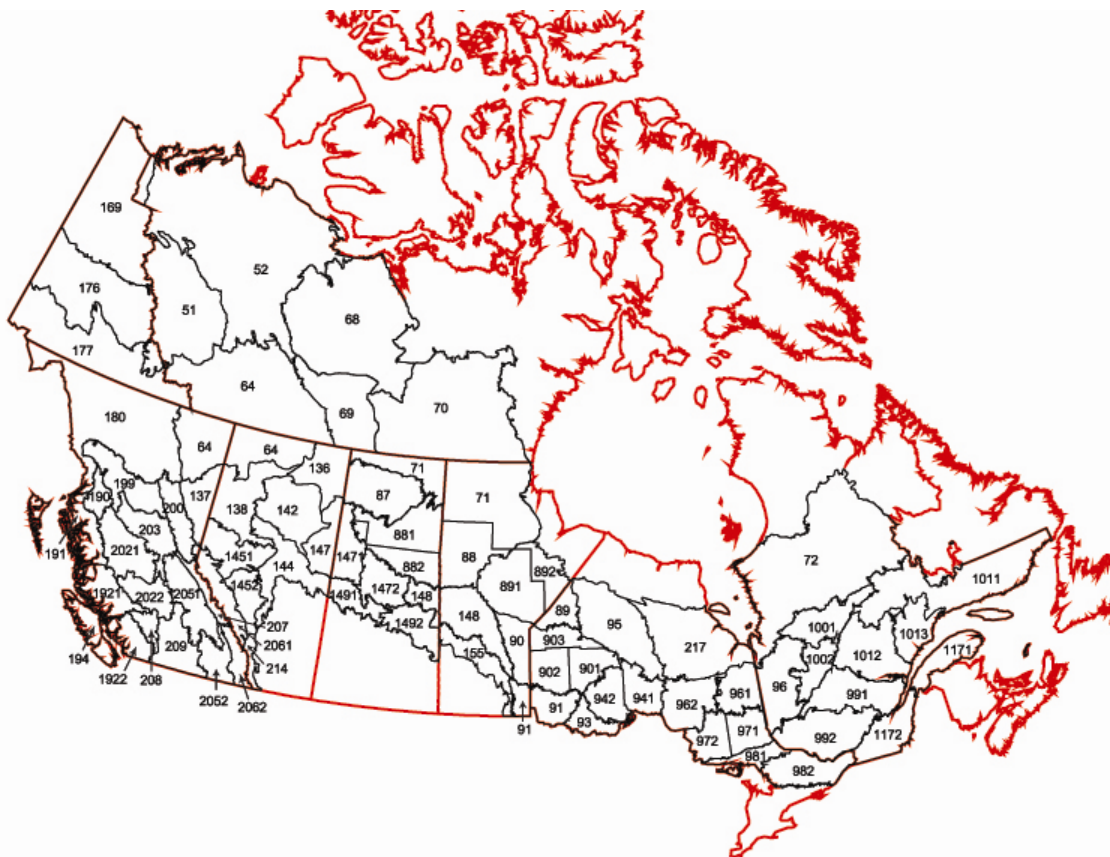


Fig. A1. Labelled ecoregion-based spatial units in which regression models were developed.

Table A1. Main coefficients for human-caused fire occurrence models as formulated in Eqn A1

Province	Regression coefficient (standard error)							
	α_0	α_1	α_2	α_3	α_4	α_5	α_6	α_7
British Columbia	-8.72 (0.07)	Table A2	0.068 (0.008)	Table A2	0.0091 (0.0003)	0.0005 (0.0001)	–	0.28 (0.02)
Alberta	-8.90 (0.51)	Table A2	0.052 (0.006)	Table A2	0.0109 (0.0008)	0.0017 (0.0001)	0.84 (0.03)	-1.23 (0.03)
Saskatchewan	-6.32 (0.31)	Table A2	0.045 (0.004)	Table A2	0.0114 (0.0005)	0.0006 (0.0001)	-0.45 (0.02)	0.42 (0.03)
Manitoba	-9.44 (0.46)	Table A3	0.090 (0.005)	Table A3	0.0148 (0.0006)	–	–	0.69 (0.03)
Ontario	-5.15 (0.11)	Table A3	0.043 (0.001)	Table A3	0.0184 (0.0005)	0.0021 (0.0001)	0.47 (0.01)	0.99 (0.02)
Quebec	-6.18 (0.22)	Table A3	0.062 (0.003)	Table A3	0.0230 (0.0008)	0.0016 (0.0002)	–	0.66 (0)
Yukon	-8.50 (0.31)	Table A4	0.047 (0.003)	–	–	–	–	–
Northwest Territories	-6.31 (0.24)	Table A4	0.033 (0.002)	–	0.0219 (0.0009)	-0.0022 (0.0002)	–	-1.63 (0.08)

Table A2. Regression coefficients for ecoregion specific terms in human-caused fire occurrence models as formulated in Eqn A1

Standard errors are not presented on these categorical variable terms

British Columbia			Province Alberta			Saskatchewan		
Ecoregion	α_1	α_3	Ecoregion	α_1	α_3	Ecoregion	α_1	α_3
137	-1.78	0.032	136	-1.22	0.003	147E	-0.05	0.006
180	3.75	-0.036	138	1.87	-0.005	147W	-1.12	0.023
190	2.13	-0.012	142	1.7	-0.012	148	-1.33	0.007
191	4.01	-0.039	144	1.6	-0.009	149E	-2.40	0.023
192N	2.94	-0.037	145N	0.23	-0.005	149W	-0.70	0.014
192S	3.36	-0.020	145S	2.72	-0.011	71	0.52	-0.017
194	4.90	-0.030	147	1.56	-0.009	87	-0.62	-0.008
199	2.52	-0.033	207	1.37	-0.022	88N	-0.99	-0.001
200	-0.35	0.001	214	2.69	-0.028	88S	0	0
202N	2.31	-0.005	64	0	0			
202S	3.56	-0.019						
203	3.22	-0.016						
205N	3.2	-0.021						
205S	3.93	-0.034						
206N	1.08	-0.024						
206S	3.12	-0.024						
208	3.16	-0.027						
209	5.21	-0.033						
64	0	0						

Table A3. Regression coefficients for ecoregion specific terms in human-caused fire occurrence models as formulated in Eqn A1

Standard errors are not presented on these categorical variable terms

Ecoregion	Manitoba		Province			Quebec		
	α_1	α_3	Ecoregion	α_1	α_3	Ecoregion	α_1	α_3
148	2.61	-0.034	217	-3.82	0.01	100N	-1.48	-0.029
155	-1.54	0.02	89	-7.66	0.04	100S	0.48	-0.028
71	1.7	-0.061	90E	-2.68	0.007	101N	0.18	-0.038
88	2.6	-0.039	90Ex	-6.86	0.0364	101SE	0.92	-0.019
89E	2.5	-0.060	90W	-3.16	0.0122	101SW	0.15	-0.008
89W	3.79	-0.042	91	-1.75	0.0087	117N	-0.49	-0.004
90	2.17	-0.030	93	-1.94	0.005	117S	-1.80	0.021
91	0	0	94E	-1.74	0	72	-0.25	-0.029
			94W	-3.06	0.015	96	-0.61	0.002
			95	-3.34	0.008	99N	0.59	-0.016
			96E	-3.06	0.013	99S	0	0
			96W	-2.64	0.015			
			97E	-2.34	0.014			
			97W	-2.94	0.015			
			98N	-2.44	0.023			
			98S	0	0			

Table A4. Regression coefficients for ecoregion specific terms in human-caused fire occurrence models as formulated in Eqn A1

Standard errors are not presented on these categorical variable terms

Ecoregion	Territory		Northwest Territories		
	Yukon	α_3	Ecoregion	α_1	α_3
169	0	-	51	0.87	-
176	2.24	-	52	1.59	-
277	3.5	-	64	2.22	-
			68	0.32	-
			69	2.018	-
			70	0	-

Appendix 2

Lightning-caused fire occurrence models were developed, again using ecoregions shown in Fig. A1, using the following form, based on model form used in Wotton *et al.* (2003) and Wotton & Martell (2005),

$$\ln(N_{\text{LTG}}) = \beta_{0,p} + \beta_{1,p,r} \cdot \text{ECOREGION} + \beta_{2,p} \cdot \text{DMC} + \beta_{3,p,r} \cdot \text{ECOREGION} \times \text{DMC} + \beta_{4,p} \cdot \text{FFMC} + \beta_{5,p} \cdot \text{DC} + \beta_{6,p} \cdot \text{SEASON} + \beta_{7,p} \cdot \text{R}_{\text{CLASS}} \quad (\text{A2})$$

where SEASON = 1 in spring and = 0 in summer; R_{CLASS} is a categorical variable with 6 levels based on the current and previous days rainfall (see footnote B); and subscript p represents province.

Coefficients for this model appear in Tables A5 to A8. Models were fit using generalized linear modelling (PROC GENMOD, SAS Institute 2002). Terms not significant at the $\alpha = 0.05$ (95% confidence) level were dropped from the model.

Table A5. Main coefficients for lightning-caused fire occurrence models as formulated in Eqn A2

Province	Regression coefficient (standard error)							
	β_0	β_1	β_2	β_3	β_4	β_5	β_6	β_7
British Columbia	-5.80 (0.1)	Table A6	0.038 (0.002)	Table A6	0.052 (0.001)	-0.0004 (0.0001)	-2.41 (0.04)	Table A9
Alberta	-5.16 (0.51)	Table A6	0.026 (0.001)	Table A6	0.061 (0.002)	-0.0019 (0.0001)	-1.36 (0.03)	Table A9
Saskatchewan	-7.11 (0.31)	Table A6	0.0319 (0.0009)	Table A6	0.082 (0.002)	0.0002 (0.0001)	-1.54 (0.05)	Table A9
Manitoba	-6.85 (0.18)	Table A7	0.026 (0.002)	Table A7	0.058 (0.002)	–	-1.33 (0.05)	Table A9
Ontario	-4.30 (0.07)	Table A7	0.036 (0.001)	Table A7	0.0327 (0.0009)	0.0028 (0.0001)	-0.93 (0.03)	Table A9
Quebec	-3.29 (0.12)	Table A7	0.066 (0.001)	–	0.021 (0.002)	-0.0029 (0.0002)	-2.36 (0.06)	Table A9
Yukon	-8.93 (0.53)	Table A8	0.032 (0.003)	Table A8	0.089 (0.006)	-0.0025 (0.0002)	-3.96 (0.28)	Table A9
Northwest Territories	-6.01 (0.2)	Table A8	0.017 (0.002)	Table A8	0.065 (0.002)	-0.0016 (0.0001)	-3.48 (0.12)	Table A9

Table A6. Regression coefficients for ecoregion specific terms in lightning-caused fire occurrence models as formulated in Eqn A2

Standard errors are not presented on these categorical variable terms

British Columbia			Province Alberta			Saskatchewan		
Ecoregion	α_1	α_3	Ecoregion	α_1	α_3	Ecoregion	α_1	α_3
137	-0.91	-0.007	136	-1.90	0.018	147E	-0.61	-0.001
180	0.03	-0.054	138	-0.49	0.005	147W	-0.32	-0.007
190	0.04	-0.015	142	0.45	0.011	148	-2.10	-0.006
191	-0.67	0	144	-0.60	0.014	149E	-1.88	-0.005
192N	-0.42	-0.014	145N	-2.52	0.022	149W	-2.52	-0.004
192S	0.42	-0.011	145S	0.15	0.02	71	-1.21	-0.007
194	0.47	-0.016	147	-0.38	0.02	87	-1.30	-0.006
199	-0.09	-0.005	207	-2.70	0.032	88N	-0.25	-0.006
200	-0.32	0.002	214	-2.69	0.004	88S	0	0
202N	0.02	-0.004	64	0	0			
202S	0.54	-0.018						
203	0.5	0						
205N	2.42	-0.008						
205S	1.4	-0.013						
206N	-0.66	0						
206S	-0.10	-0.012						
208	-0.40	-0.021						
209	2.08	-0.022						
64	0	0						

Table A7. Regression coefficients for ecoregion specific terms in lightning-caused fire occurrence models for as formulated in Eqn A2

Standard errors are not presented on these categorical variable terms

Ecoregion	Manitoba		Province			Quebec		
	α_1	α_3	Ecoregion	α_1	α_3	Ecoregion	α_1	α_3
148	0.3	0.005	217	-1.51	0.034	100N	-0.95	-
155	-0.48	-0.005	89	-1.68	0.017	100S	-0.53	-
71	-0.80	0.004	90E	-0.31	0.025	101N	-1.24	-
88	1.19	0.01	90Ex	-0.91	0.012	101SE	-0.06	-
89E	-0.25	0.015	90W	0.42	0.016	101SW	0.45	-
89W	1.2	0.014	91	0.26	0.016	117N	-0.99	-
90	1.39	0.006	93	-0.34	0.023	117S	-2.51	-
91	0	0	94E	-0.26	0.019	72	-0.17	-
			94W	0.3	0.016	96	-0.60	-
			95	-0.48	0.044	99N	-0.12	-
			96E	-1.44	0.018	99S	0	-
			96W	-0.45	0.014			
			97E	-0.52	0.038			
			97W	-0.51	0.029			
			98N	-0.78	0.019			
			98S	0	0			

Table A8. Regression coefficients for ecoregion specific terms in lightning-caused fire occurrence models for as formulated in Eqn A2

Standard errors are not presented on these categorical variable terms

Ecoregion	Territory				
	Yukon		Northwest Territories		
	α_1	α_3	Ecoregion	α_1	α_3
169	0	-0.000	51	-0.25	0.007
176	1.14	-0.004	52	1.12	-0.002
177	-0.38	0.004	64	1.16	-0.001
			68	-0.22	0.004
			69	0.07	0.008
			70	0	

Table A9. Coefficients for rainfall class variable in the lightning fire occurrence model Eqn A2

Province	Regression coefficient					
	R_0	R_1	R_2	R_3	R_4	R_5
British Columbia	-1.19	-0.78	-0.73	-0.54	-0.19	0.00
Alberta	-0.85	-0.63	-0.49	-0.21	-0.33	0.00
Saskatchewan	-1.59	-1.16	-0.91	-0.50	-0.42	0.0
Manitoba	-1.13	-0.88	-0.63	-0.51	-0.22	0.00
Ontario	-1.68	-1.27	-1.06	-0.79	-0.38	0.0
Quebec	-0.57	-0.64	-0.51	-0.18	-0.10	0.00
Yukon	-1.7	-1.06	-0.67	-0.34	-0.06	0.00
Northwest Territories	-1.60	-1.43	-1.02	-0.79	-0.53	0.00