Trends in wildfire burn severity across Canada, 1985 to 2015

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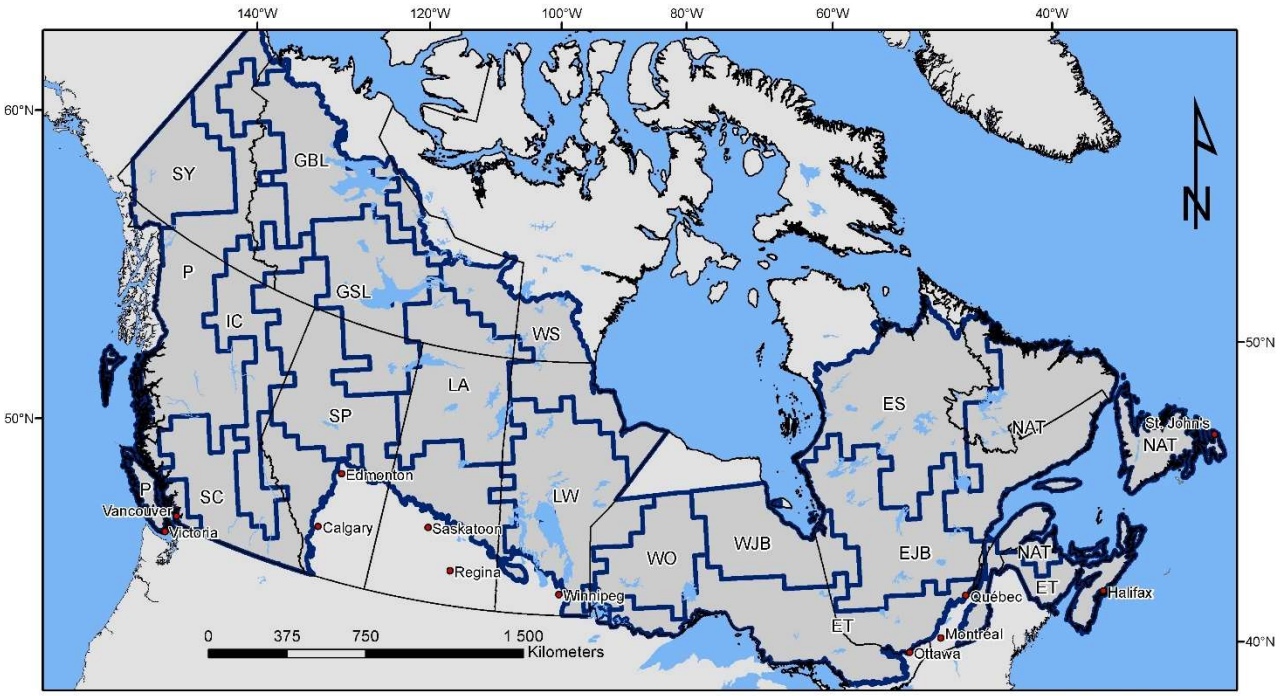
Supplementary Material 6

SM6. Results for the HFR zonation

All the results of the analyses conducted at the Homogeneous Fire regime (HFR) zone level are presented here. It includes the tables with all the regression coefficient for the three regression analyses conducted for both the complete and the coniferous datasets (Table S6.1, S6.2 and S6.3) and three figures (S6.1, 6.2,and 6.3).

The following map allows to locate all the forested zones as defined by Boulanger et al. (2014) and includes the abbreviation associated with each HFR.



Abbreviation	Name	Abbreviation	Name	Abbreviation	Name
EJB	Eastern James Bay	LA	Lake Athabasca	SY	Southwestern Yukon
ES	Eastern Subarctic	LW	Lake Winnipeg	WJB	Western James Bay
ET	Eastern Temperate	NAT	North Atlantic	WO	Western Ontario
GBL	Great Bear Lake	P	Pacific	WS	Western Subarctic
GSL	Great Slave Lake	SC	Southern Cordillera		
IC	Interior Cordillera	SP	Southern Prairie		

SM 6 a. Seasonal trends in burn severity

Similar trends to the ecozone ones are observed when the analysis is performed across the HFR zones of Boulanger et al. (2014) (Figure S6.1 and Figure S6.2) instead of the ecozones. We observed significant seasonal relationships between the median of $dNBR_{event}$ and the Julian day periods for 13 of the 16 zones HFR zones with the complete data set, and for 12 of the 16 HFR zones with the coniferous subset. Regression equations presented in Table S6.1.

SM 6 b. Burn severity and increasing annual area burned

When analyzed at the scale of the homogeneous fire regime (HFR) zones for the complete dataset, we found a significant increase in burn severity with increasing annual area burned for the median (second quartile) burn severity in the Eastern subarctic (ES) HFR. We also found negative trends with increasing annual area burned in the first and second quartiles of burn severity for the Lake Winnipeg (LW) HFR and in the first quartile of the North Atlantic (NAT) HFR (Table S6.2). For the coniferous dataset, we only found barely significant increase in the Eastern subarctic (ES) HFR.

SM 6 c. Burn severity over time

When analyzed by Homogeneous fire regime zones for the complete dataset, only one HFR showed significant increase in the first quartile of $dNBR_{event}$ (Lake Winnipeg) since 1985, whereas a few had a significant decrease (suppl. Material Table S6.3 and Figure S6.3). For the coniferous subset, the Lake Winnipeg HFR showed a significant increase for both the median and the first quartile, whereas Eastern Temperate (ET) also showed an increase for the 1^{st} quartile. On the other hand, great Slave Lake (GSL) HFR showed a significant decrease for the three quartiles (Table S6.3), whereas Pacific (P) HFR showed a decrease for the first quartile and SC for the first and the third ones.

Table S6.1. For HFR, parameter values and fit statistics of the regression equation of the median values of the quartiles of $dNBR_{event}$ as a function of Julian day periods. When the quadratic regression are significant, x^2 values are provided. The gray scale relates to the significance of the parameter, the red scale to that of the regression. Note that a negative R^2 *indicates that the* model fit is worse than a horizontal line (i.e. using the mean).

dNBR vs Julian day																	
		Median					Percentile 25 %					Percentile 75 %					
		Equation					Equation					Equation					
		b	x	x^2	R^2	p	b	x	x^2	R^2	p	b	x	x^2	R^2	p	n
Complete	EJB	276.2411	1.425		0.5142	0.04221	194.8772	1.4926		0.4269	0.06651	-1.09E+03	1.71E+01	-4.10E-02	0.8718	0.007304	7
	ES	399.1048	0.7124		0.3886	0.1104	277.8214	0.9857		0.3556	0.1245	440.919	0.7829		0.3665	0.1198	6
	ET	188.1588	1.3859		0.5054	0.01914	61.2762	1.6308		0.6588	0.004837	246.4096	1.3998		0.5175	0.01744	9
	GBL	-7.33E+02	1.12E+01	-2.51E-02	0.8643	0.002926	-1.63E+03	1.93E+01	-4.43E-02	0.8564	0.00337	-7.50E+02	1.27E+01	-3.05E-02	0.8687	0.002694	8
	GSL	-8.45E+02	1.23E+01	-2.88E-02	0.8127	0.002771	199.6924	0.8008		0.3754	0.04677	-6.88E+02	1.18E+01	-2.82E-02	0.6166	0.02378	9
	IC	-1.09E+03	1.56E+01	-3.53E-02	0.852	0.000517	-1.48E+03	1.86E+01	-4.26E-02	0.7591	0.002848	-808.2608	13.48288	-0.02965	0.7389	0.003774	10
	LA	356	0.9467		0.4168	0.03586	304.809	0.8836		0.4917	0.02123	-3.72E+02	9.92E+00	-2.44E-02	0.7943	0.003675	9
	LW	-1.21E+03	1.72E+01	-4.15E-02	0.807	0.003031	-1.38E+03	1.80E+01	-4.30E-02	0.852	0.001369	-1.32E+03	1.89E+01	-4.56E-02	0.8536	0.001324	9
	NAT	350.5536	1.1405		0.1152	0.2396	279.2634	1.0387		0.04018	0.3142	-1.72E+03	2.53E+01	-6.58E-02	0.6788	0.04585	7
	P	-1.01E+03	1.48E+01	-3.31E-02	0.981	2.87E-06	-8.62E+02	1.27E+01	-2.98E-02	0.8141	0.002712	-1.47E+03	2.10E+01	-4.97E-02	0.9097	0.000311	9
	SC	71.4841	2.2264		0.6945	0.001683	14.0777	2.0501		0.783	0.000412	231.9375	2.0283		0.5315	0.01011	10
	SP	-3.37E+02	7.79E+00	-1.71E-02	0.8561	0.00047	132.9212	1.4671		0.8786	3.88E-05	-5.35E+02	1.07E+01	-2.39E-02	0.9272	4.31E-05	10
	SY	302.625	1.388		0.8174	0.003249	75.5625	2.2345		0.8724	0.001304	474.3951	0.7711		0.4381	0.06293	7
	WJB	408.0893	0.531		0.1292	0.2276	278.2009	0.8708		0.5497	0.03439	488.942	0.3696		-0.09613	0.5219	7
	WO	-3.02E+02	9.07E+00	-2.27E-02	0.8909	0.000178	-8.41E+02	1.29E+01	-3.00E-02	0.7962	0.001586	-228.2291	8.91658	-0.02213	0.7454	0.003456	10
	WS	-6.08E+02	1.03E+01	-2.40E-02	0.9063	0.003899	286.5625	0.6083		0.3228	0.1066	-1.25E+03	1.73E+01	-4.10E-02	0.9213	0.002755	7
Coniferous	EJB	236.009	1.523		0.4864	0.04913	152.8281	1.6705		0.7052	0.0112	-1212.588	17.79663	-0.042533	0.9601	0.000708	7
	ES	328.869	1.0429		0.4271	0.09534	295.819	0.8362		0.2476	0.1792	382.7667	1.1467		0.4934	0.07253	6
	ET	184.0794	1.0742		0.2846	0.09966	77.3483	1.3387		0.4642	0.03763	200.4747	1.2156		0.343	0.07435	8
	GBL	-861.22359	12.57937	-0.02838	0.8083	0.006941	-1525.817	18.12917	-0.04095	0.8403	0.004395	-795.8504	13.10556	-0.030966	0.8775	0.002263	8
	GSL	-1072.5841	14.30543	-0.03316	0.8279	0.002151	-707.7804	9.756735	-0.021527	0.7811	0.004426	-1221.514	16.78353	-0.039982	0.7709	0.005073	9
	IC	-922.75204	13.96417	-0.031267	0.8441	0.000621	-1177.755	15.38567	-0.034194	0.8195	0.001037	-1177.223	17.63817	-0.040798	0.8226	0.000977	10
	LA	-532.36702	10.81522	-0.027367	0.8839	0.000661	-431.4069	8.837973	-0.021795	0.876	0.000805	-583.7585	11.65715	-0.028618	0.9195	0.00022	9
	LW	-721.21618	11.81807	-0.027749	0.9001	0.000421	-949.6772	13.48615	-0.031736	0.8798	0.000732	-929.203	14.87718	-0.036319	0.8979	0.000449	9
	NAT	590.68571	-0.03429		-0.2486	0.9506	514.2214	-0.0819		-0.2363	0.8435	-1936.804	27.02256	-0.06888	0.6657	0.08983	6
	P	176.5937	1.9125		0.6136	0.01313	198.8482	1.2774		0.4455	0.04213	306.4866	1.9554		0.6392	0.01057	8
	SC	-5.9333	2.4156		0.7498	0.000739	-79.8322	2.3218		0.8489	9.43E-05	230.5402	1.7017		0.4529	0.01968	10
	SP	138.3106	1.5335		0.8516	8.76E-05	49.4818	1.6506		0.8985	1.88E-05	207.4856	1.6169		0.7262	0.00107	10
	SY	386.5446	1.056		0.6391	0.01905	192.3683	1.7366		0.7973	0.004251	508.1496	0.7539		0.47	0.05356	7
	WJB	361.625	0.7071		0.3835	0.08157	256.9955	0.8863		0.808	0.003696	374.8884	0.8792		0.5148	0.04208	7
	WO	-695.97349	11.25788	-0.02532	0.7606	0.002786	130.8765	1.5672		0.6154	0.004392	-643.3741	11.71596	-0.027424	0.7873	0.001842	7
	WS	-776.57887	12.20714	-0.028757	0.9386	0.001676	327.125	0.4643		0.2304	0.1554	-1132.728	16.17143	-0.038175	0.9211	0.002766	7

	p > 0.05
	p < 0.05
	p < 0.001

	p > 0.05
	p < 0.05
	p < 0.01
	p < 0.001

Table S6.2. For HFR, parameter values and fit statistics of the regression equations for median values of the quartiles of $dNBR_{event}$ as a function of annual area burned per HFR, for the complete and coniferous datasets. N is the number of years with more than 5 events totalising at least 1000 pixels. The gray scale relates to the significance of the parameter, the red scale to that of the regression.

dNBR vs annual area burned																
		Median					Percentile 25 %					Percentile 75 %				
		Equation					Equation					Equation				
		b	x	x^2	R^2	p	b	x	x^2	R^2	p	b	x	x^2	R^2	p	n
Complete	EJB					0.8854					0.2581					0.9338	31
	ES	4.62E+02	2.21E-04		0.1269	0.03268					0.1461					0.08907	29
	ET					0.7239					0.08422					0.5833	28
	GBL					0.8566					0.9617					0.7543	29
	GSL					0.6217					0.2281					0.7941	30
	IC					0.3766					0.8536					0.6808	30
	LA					0.1887					0.06304					0.6348	31
	LW	4.89E+02	-3.48E-05		0.1298	0.02638	4.06E+02	-8.69E-05		0.4474	2.34E-05					0.163	31
	NAT					0.5674	4.44E+02	-3.13E-04		0.09726	0.04876					0.8165	31
	P					0.7631					0.8593					0.1582	31
	SC					0.7451					0.6959					0.6962	30
	SP					0.2219					0.07					0.289	31
	SY					0.9205					0.3897					0.7978	26
	WJB					0.9287					0.4162					0.9695	26
	WO					0.08674					0.2017					0.1174	28
	WS					0.7537					0.1218					0.922	29
Coniferous	EJB					0.6823					0.5521					0.4709	30
	ES	464.3357	0.000405		0.1138	0.04432	383.3071	0.000455		0.1112	0.04629					0.07692	28
	ET					0.8407					0.3776					0.7134	13
	GBL					0.09393					0.5084					0.7199	29
	GSL					0.5348					0.788					0.4306	30
	IC					0.5058					0.8876					0.7953	28
	LA					0.8119					0.798					0.8019	31
	LW					0.9232					0.05503					0.8632	31
	NAT					0.4401					0.1068					0.3041	29
	P					0.0702					0.08964	598.7979	0.001292		0.1053	0.04787	29
	SC					0.9969					0.873					0.9709	30
	SP					0.5503					0.8356					0.6362	30
	SY					0.6015					0.4986					0.8931	26
	WJB					0.9768					0.9808					0.7165	26
	WO					0.3959					0.07682					0.5262	27
	WS					0.7462					0.2891					0.7608	29

	p > 0.05
	p < 0.05
	p < 0.001

	p > 0.05
	p < 0.05
	p < 0.01
	p < 0.001

Table S6.3. For HFR, parameter values and fit statistics of the regression equations for median values of quartiles of $dNBR_{event}$ as a function of year (from 1985 to 2015) by HFR for the complete data set and the coniferous subset. N is the number of years with more than 5 events totalising at least 1000 pixels. The gray scale relates to the significance of the parameters, the red scale to that of the regression. Note that a negative R^2 indicates that the model fit is worse than a horizontal line (i.e. using the mean).

dNBR over time (1985-2015)																	
		Median					Percentile 25 %					Percentile 75 %					
		Equation					Equation					Equation					
		b	x	x^2	R^2	p	b	x	x^2	R^2	p	b	x	x^2	R^2	p	n
Complete	EJB	2154.694	-0.8383	-	-0.01575	0.4705	-1024.77	0.7013	-	-0.02769	0.6649	2599.843	-1.017	-	-0.01608	0.4744	31
	ES	1933.01	-0.7274	-	-0.025	0.578	629.9679	-0.1119	-	-0.03682	0.9408	1694.022	-0.569	-	-0.02928	0.6556	29
	ET	-2250.13	1.312	-	0.009162	0.2738	-2285.43	1.286	-	0.004086	0.3016	-2982.28	1.725	-	0.007065	0.2849	28
	GBL	2891.254	-1.216	-	0.0158	0.2391	3032.863	-1.332	-	-0.00304	0.3472	1824.323	-0.647	-	-0.02289	0.5463	29
	GSL	6223.33	-2.9026	-	0.3087	0.000851	7661.149	-3.6643	-	0.3471	0.000366	4378.03	-1.9407	-	0.09882	0.05041	30
	IC	3527.531	-1.514	-	0.009949	0.2654	3399.525	-1.507	-	0.001583	0.3152	3248.646	-1.318	-	-0.00912	0.3976	30
	LA	3259.46	-1.3697	-	0.05079	0.1173	4355.919	-1.97	-	0.05237	0.1139	1286.879	-0.3425	-	-0.0273	0.6559	31
	LW	-962.097	0.7225	-	0.01415	0.2413	-3235.78	1.8127	-	0.1097	0.03858	985.6371	-0.2069	-	-0.03126	0.7655	31
	NAT	1250.105	-0.3655	-	-0.03262	0.8208	3.63E+02	3.29E-02	-	-0.03447	0.9837	776.8669	-0.07571	-	-0.03441	0.9649	31
	P	10003.92	-4.775	-	0.2046	0.006188	9890.94	-4.77	-	0.2317	0.003584	7137.964	-3.279	-	0.05225	0.1141	31
	SC	9200.957	-4.3928	-	0.4844	1.17E-05	7935.012	-3.815	-	0.3075	0.000873	11503.02	-5.472	-	0.3822	0.000163	30
	SP	2528.298	-1.046	-	0.001681	0.3139	1387.419	-0.5215	-	-0.02607	0.6294	4797.617	-2.1284	-	0.1166	0.03386	31
	SY	2597.102	-1.029	-	-0.02092	0.4917	-4801.07	2.614	-	0.02616	0.2084	1850.402	-0.6159	-	-0.0325	0.6486	26
	WJB	1733.071	-0.6276	-	-0.02945	0.5984	1018.276	-0.3065	-	-0.03823	0.7804	1665.12	-0.5536	-	-0.03025	0.6108	26
	WO	3459.04	-1.48	-	-0.00486	0.3597	3291.458	-1.451	-	-0.00747	0.3793	4515.652	-1.963	-	0.02933	0.1894	28
	WS	2562.133	-1.0443	-	0.007626	0.28	3528.184	-1.564	-	0.03766	0.1592	1596.693	-0.5274	-	-0.02206	0.5346	29
Coniferous	EJB	2965.033	-1.24	-	-0.01184	0.4231	4015.973	-1.817	-	0.01075	0.2612	3391.151	-1.41125	-	-0.01112	0.4162	30
	ES	1740.17	-0.6302	-	-0.02949	0.638	-121.542	0.261	-	-0.03726	0.8637	381.4224	0.09026	-	-0.03816	0.9312	28
	ET	-8607.73	4.486	-	0.1665	0.09242	-13650.8	6.973	-	0.3472	0.02004	-5728.4	3.074	-	0.0179	0.2932	13
	GBL	1775.361	-0.6502	-	-0.02253	0.5411	4309.643	-1.961	-	0.04143	0.1487	3325.486	-1.3901	-	0.03488	0.1675	29
	GSL	5989.45	-2.7855	-	0.3486	0.000354	6215.442	-2.935	-	0.2857	0.001385	4428.419	-1.9685	-	0.1545	0.01813	30
	IC	-918.209	0.7227	-	-0.02929	0.6343	-177.533	0.2997	-	-0.03692	0.8458	1790.41	-0.58	-	-0.03326	0.7204	28
	LA	2903.057	-1.2023	-	0.02626	0.189	3372.331	-1.482	-	0.03418	0.1617	2392.71	-0.9085	-	0.003354	0.3027	31
	LW	-2215.43	1.3433	-	0.09646	0.0495	-3797.82	2.0978	-	0.2474	0.002597	-1621.74	1.084	-	0.03734	0.1521	31
	NAT	-723.108	0.6208	-	-0.03113	0.6973	-103.557	0.2637	-	-0.0361	0.8769	-2381	1.494	-	-0.01109	0.4124	29
	P	2882.816	-1.191	-	-0.0258	0.5911	7392.513	-3.503	-	0.1036	0.04931	987.5156	-0.1841	-	-0.03675	0.9314	29
	SC	4542.197	-2.055	-	0.07122	0.08338	5219.518	-2.445	-	0.1345	0.02625	6346.603	-2.89	-	0.1038	0.04599	30
	SP	1474.429	-0.5409	-	-0.02565	0.6043	1161.75	-0.4164	-	-0.02787	0.6475	2908.175	-1.221	-	0.01024	0.2639	30
	SY	688.0491	-0.05998	-	-0.04158	0.9647	-491.309	0.4861	-	-0.03756	0.7605	-766.984	0.7047	-	-0.02852	0.5848	26
	WJB	829.7712	-0.1841	-	-0.04041	0.8663	890.8362	-0.2467	-	-0.03951	0.8253	-1763.66	1.148	-	-0.01101	0.402	26
	WO	1063.91	-0.2937	-	-0.03893	0.8738	-1071.33	0.7376	-	-0.03192	0.6621	2293.704	-0.8705	-	-0.02437	0.5425	27
	WS	-1154.73	0.814	-	-0.01679	0.4697	1101.385	-0.3487	-	-0.03368	0.7695	-1100.92	0.8227	-	-0.01779	0.481	29

	p > 0.05
	p < 0.05
	p < 0.001

	p > 0.05
	p < 0.05
	p < 0.01
	p < 0.001

A) Complete data set

B) Coniferous subset

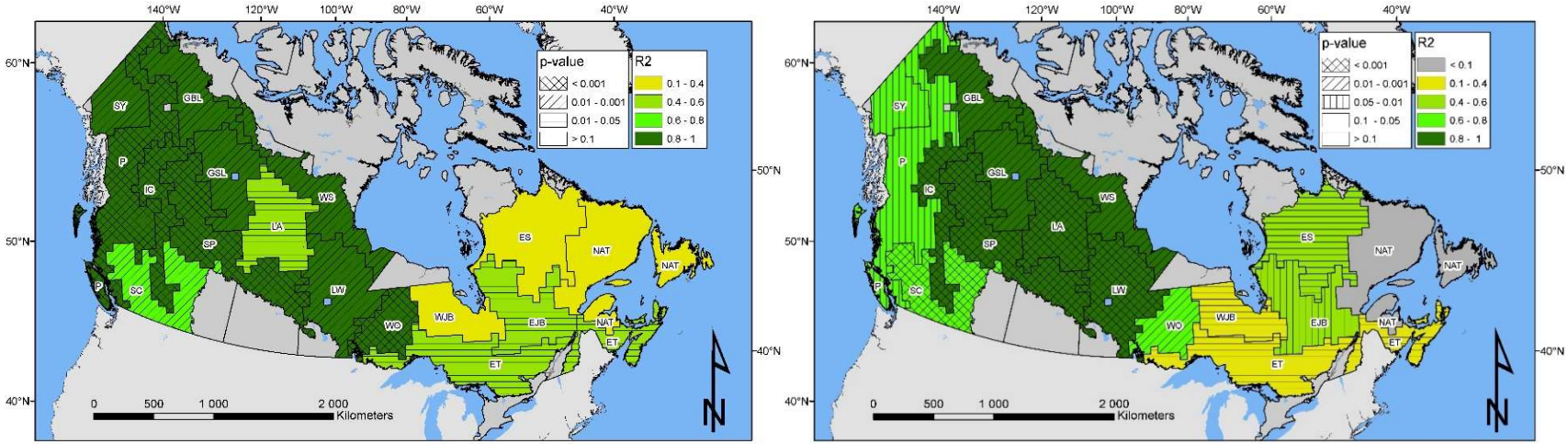
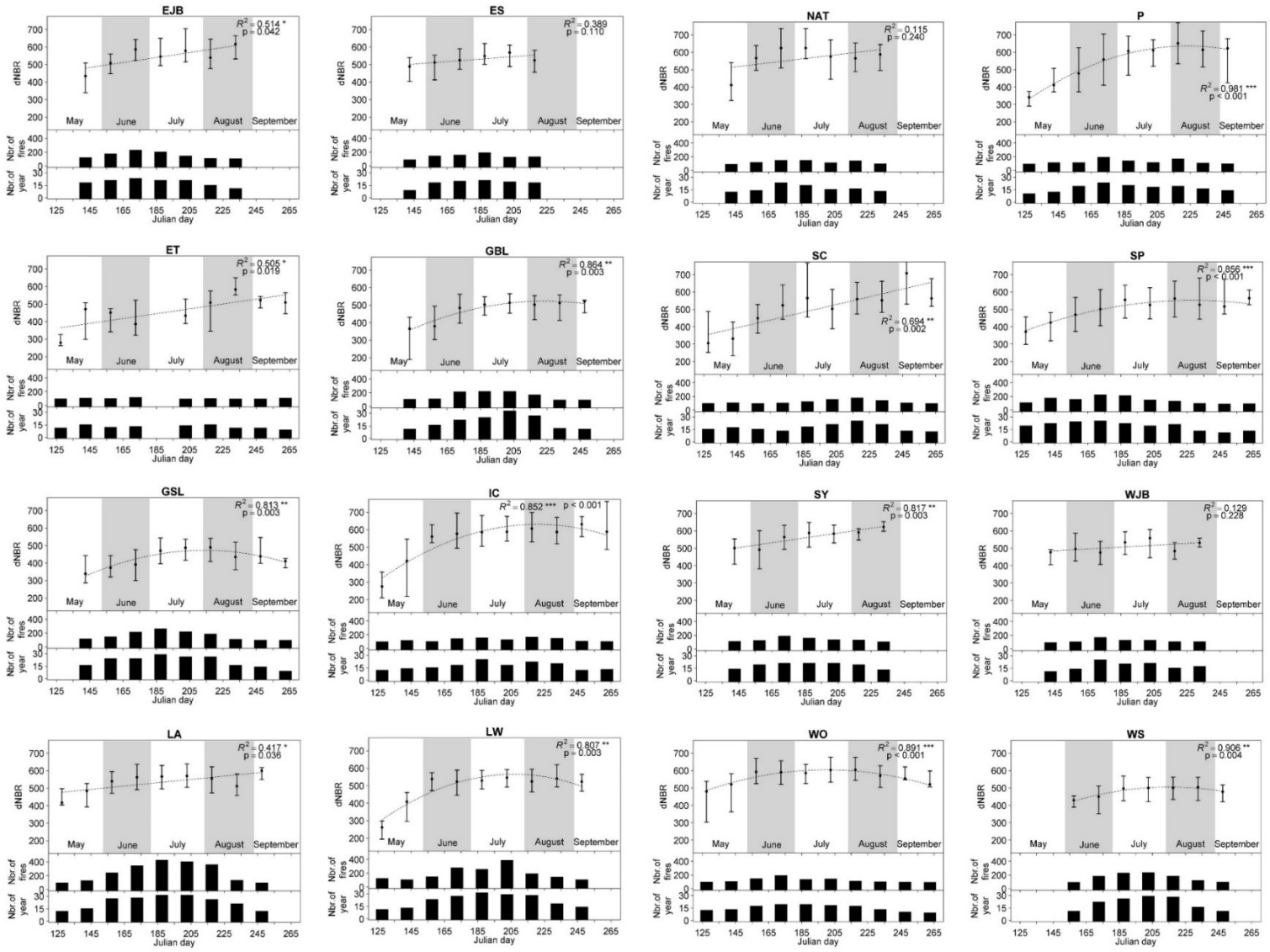


Figure S6.1. Map of the seasonal trends of burn severity in the 16 HFR zones. A) Complete data set; B) coniferous subset.

A) Complete data set



B) Coniferous subset

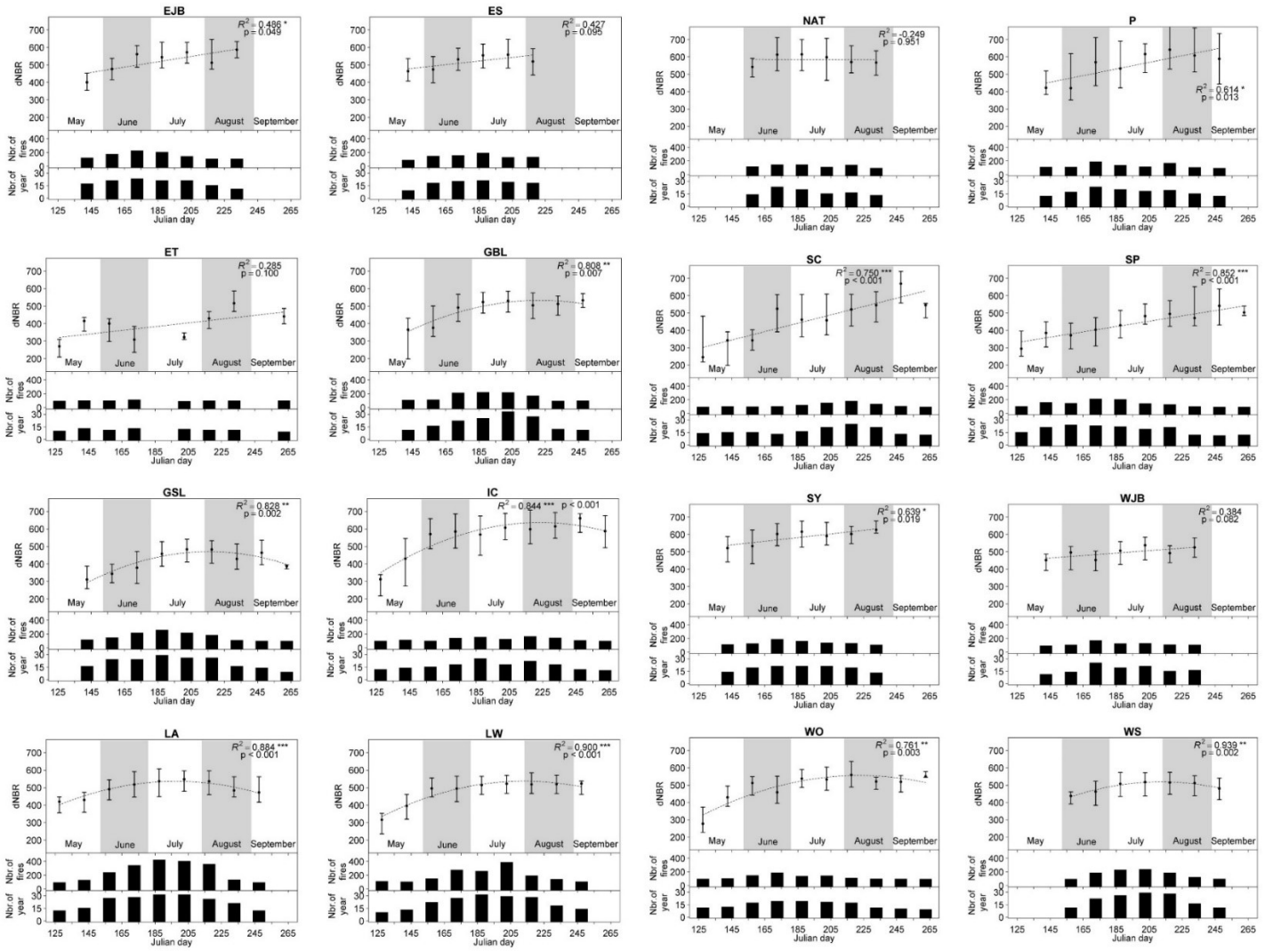


Figure S6.2: Bi-weekly (15 Julian days) median values of the quartiles of $dNBR_{event}$ for all events >1 ha during the 1985-2015 period by Homogeneous Fire Regime zones. For any given year, only periods with more than five events that totaled at least 1000 pixels were included in the analysis. Also shown are the number of fire events and of number of years used in the analysis for each period. A) Complete (all species) data set and B) Coniferous subset. R^2 and p are for the regression on the median values.

A) Complete data set

B) Coniferous subset

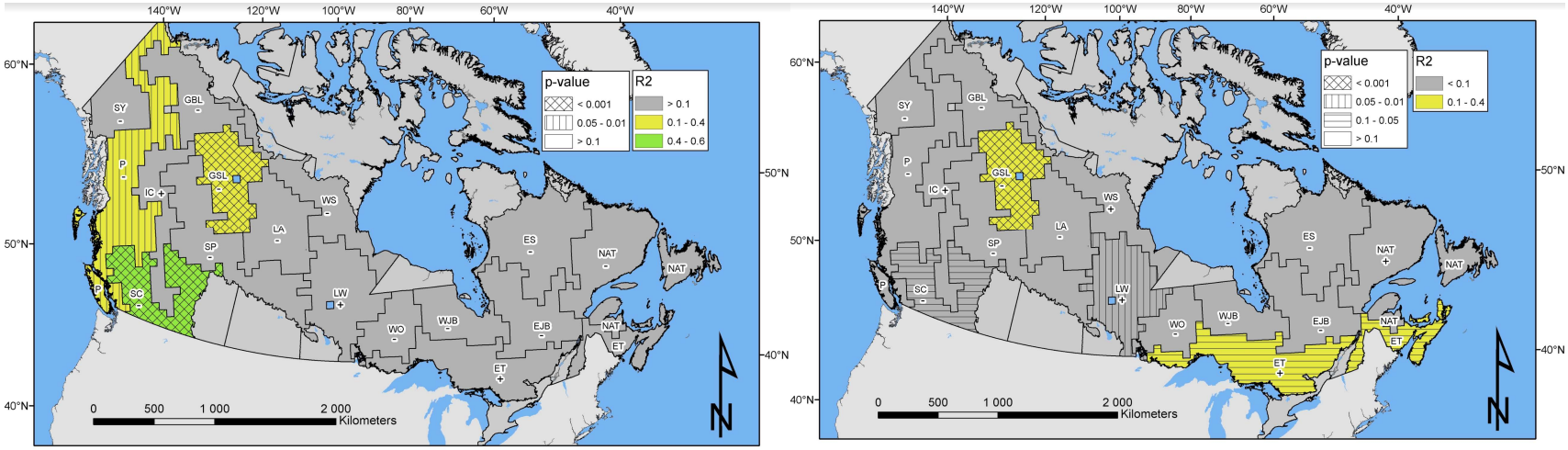


Figure S6.3. Map showing the significant increase (+) or decrease (-) in $dNBR_{event}$ over time with R^2 and P value in the 16 HFR zones. A) Complete data set; B) coniferous subset.

REFERENCE

Boulanger, Y., Gauthier, S., and Burton, P.J., 2014. A refinement of models projecting future Canadian fire regimes using homogeneous fire regime zones. Canadian Journal of Forest Research **44**(4):365-376.