Geospatial Studies of Fire Regime Characteristics in Alaska's Boreal Forest

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Research Goals

- Develop new approaches to analyze the spatial and temporal characteristics of the fire regime of Alaska's boreal forest region
- 2. Evaluate factors that can be used to explain variations in these fire regime characteristics

Data Sets Available for Geospatial Studies

- 1. AFS daily fire reports
- 2. Reconstructed seasonal burned area estimates
- 3. AFS large-fire database
- 4. Weather station records/RAWS FWI data (back to 1990)
- 5. Landsat TM derived maps of vegetation cover
- 6. Landsat TM derived maps of burn severity and fire perimeters, spectral reflectance data
- 7. MODIS Hotspot data products (daily fire occurrence and fire radiative power)
- 8. Digital elevation data: topography and drainage products
- 9. Extensive field-based data set on pre-/post-fire organic layer depths

Land Cover Data

NLCD

LANDFIRE







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Topographic Datasets



DNBR









MODIS Hotspot data





Year	LFDB Fires	Analyzed Fires	Area Analyzed (ha)	Percent of LFDB Area
2002 (large)	63	27	776,551	96.2
2003 (small)	28	8	211,241	91.3
2004 (ultra large)	119	41	2,531,569	95.0
2005 (ultra large)	135	59	1,771,543	98.4
2006 (small)	26	9	101,477	96.2
2007 (small)	79	20	92,916	70.5
2008 (small)	33	5	31,230	86.9
Total		169	5,516,527	
	60 by 60 m pixels		15,323	3,686

Controls on fire severity in black spruce forests

Fire severity model performance



Barrett et al. 2011, Ecological Applications

Wildfire Impacts, 2004

Area of black spruce burned in 2004 with < 3 cm of surface organic material

Area of black spruce burned in 2004 with > 3 cm and < 10 cm of surface organic material

Proportion of area likely to experience a successional shift and permafrost degradation

OL = 1.5 cm 14% OL = 4 cn25%

= 39%

Fire Frequency and Ground-layer depth

- LI burned stands had deeper soil organic layers prior to burning
- Less organic matter remained after fire in SI burned stands
- Both LI and SI burned stands had similar depth of burn measurements
- SI burned stands had greater depth reduction than mature stands

	No	Estimated Pre-	Post-fire	Depth of	Depth
	NU. Diote	fire Depth (cm ±	Depth	Burn	Reduction
	FIUIS	SE)	(cm ± SE)	(cm ± SE)	(% ± SE)
LI Burn	93	22.5 ± 0.5	10.2 ± 0.5	12.3 ± 0.4	55.5 ± 1.8
SI Burn	39	14.4 ± 0.7	3.4 ± 0.4	11.0 ± 0.4	79.0 ± 2.3



Based on results from Kasischke and Hoy 2012, Global Change Biology



Controls on spatial/temporal patterns of burning

		Low	< 25	Moderate	25 to 100	High	>100	
	1995	1996	1997	1998	1999	2000	2001	2002
31-May		9,394	5,983	15,554	6	5	124	134,430
10-Jun		60,357	7,682	4,872	199	662	403	24,483
20-Jun		13,340	0	4,872	74,759	8,407	1,682	100,929
30-Jun		116,276	106,324	345	28,754	101,138	79,671	61,132
10-Jul	6,392	14,793	236,522	20,644	254,112	157,465	4,863	24,110
20-Jul	1,037	2,312	204,344	1,475	38,454	30,145	983	20,030
30-Jul	4,201	0	74,644	0	10,217	0	1,910	56,805
9-Aug	2,940	0	122,984	0	5,684	5,394	0	313,420
19-Aug	2,996	0	13,886	0	434	436	0	91,366
29-Aug	0	0	995	8	0	0	0	44,851
8-Sep	0	0	0	43	0	0	1	0
18-Sep	0	10,220	0	0	6	0	179	0
	2003	2004	2005	2006	2007	2008	2000	2010
21 May	2003	2004	2005	2006	2007	2008	2009	2010
31-May	2003 4,510	2004 23	2005 4,416	2006 710	2007 0	2008 9	2009 23,857	2010 20,737
31-May 10-Jun	2003 4,510 620	2004 23 5,105	2005 4,416 2,487	2006 710 38,553	2007 0 15,194	2008 9 241 730	2009 23,857 29,691	2010 20,737 184,142
31-May 10-Jun 20-Jun	2003 4,510 620 16,092	2004 23 5,105 53,624	2005 4,416 2,487 89,142	2006 710 38,553 23,975 22 529	2007 0 15,194 7,029	2008 9 241 730	2009 23,857 29,691 41,762	2010 20,737 184,142 80,408
31-May 10-Jun 20-Jun 30-Jun	2003 4,510 620 16,092 67,162	2004 23 5,105 53,624 427,205	2005 4,416 2,487 89,142 144,002	2006 710 38,553 23,975 22,529	2007 0 15,194 7,029 2,849 24,112	2008 9 241 730 1,497	2009 23,857 29,691 41,762 15,596	2010 20,737 184,142 80,408 2,625 28,517
31-May 10-Jun 20-Jun 30-Jun 10-Jul	2003 4,510 620 16,092 67,162 42,762	2004 23 5,105 53,624 427,205 518,056	2005 4,416 2,487 89,142 144,002 202,267	2006 710 38,553 23,975 22,529 1,885	2007 0 15,194 7,029 2,849 34,112	2008 9 241 730 1,497 15,333	2009 23,857 29,691 41,762 15,596 180,455	2010 20,737 184,142 80,408 2,625 28,517
31-May 10-Jun 20-Jun 30-Jun 10-Jul 20-Jul	2003 4,510 620 16,092 67,162 42,762 19,944	2004 23 5,105 53,624 427,205 518,056 619,678	2005 4,416 2,487 89,142 144,002 202,267 90,750	2006 710 38,553 23,975 22,529 1,885 4,778	2007 0 15,194 7,029 2,849 34,112 32,198	2008 9 241 730 1,497 15,333 4,596	2009 23,857 29,691 41,762 15,596 180,455 157,109	2010 20,737 184,142 80,408 2,625 28,517 65,522
31-May 10-Jun 20-Jun 30-Jun 10-Jul 20-Jul 30-Jul	2003 4,510 620 16,092 67,162 42,762 19,944 45,490	2004 23 5,105 53,624 427,205 518,056 619,678 265,423	2005 4,416 2,487 89,142 144,002 202,267 90,750 226,999	2006 710 38,553 23,975 22,529 1,885 4,778 16,919	2007 0 15,194 7,029 2,849 34,112 32,198 4,317	2008 9 241 730 1,497 15,333 4,596 115	2009 23,857 29,691 41,762 15,596 180,455 157,109 291,388	2010 20,737 184,142 80,408 2,625 28,517 65,522 23,129
31-May 10-Jun 20-Jun 30-Jun 10-Jul 20-Jul 30-Jul 9-Aug	2003 4,510 620 16,092 67,162 42,762 19,944 45,490 10,349	2004 23 5,105 53,624 427,205 518,056 619,678 265,423 36,281	2005 4,416 2,487 89,142 144,002 202,267 90,750 226,999 245,268	2006 710 38,553 23,975 22,529 1,885 4,778 16,919 0	2007 0 15,194 7,029 2,849 34,112 32,198 4,317 2,652	2008 9 241 730 1,497 15,333 4,596 115 0	2009 23,857 29,691 41,762 15,596 180,455 157,109 291,388 423,400	2010 20,737 184,142 80,408 2,625 28,517 65,522 23,129 7,457
31-May 10-Jun 20-Jun 30-Jun 10-Jul 20-Jul 30-Jul 9-Aug 19-Aug	2003 4,510 620 16,092 67,162 42,762 19,944 45,490 10,349 22,647	2004 23 5,105 53,624 427,205 518,056 619,678 265,423 36,281 223,489	2005 4,416 2,487 89,142 144,002 202,267 90,750 226,999 245,268 372,557	2006 710 38,553 23,975 22,529 1,885 4,778 16,919 0 0	2007 0 15,194 7,029 2,849 34,112 32,198 4,317 2,652 1,923	2008 9 241 730 1,497 15,333 4,596 115 0 0	2009 23,857 29,691 41,762 15,596 180,455 157,109 291,388 423,400 15,560	2010 20,737 184,142 80,408 2,625 28,517 65,522 23,129 7,457 11,805
31-May 10-Jun 20-Jun 30-Jun 10-Jul 20-Jul 30-Jul 9-Aug 19-Aug	2003 4,510 620 16,092 67,162 42,762 19,944 45,490 10,349 22,647 2,603	2004 23 5,105 53,624 427,205 518,056 619,678 265,423 36,281 223,489 406,617	2005 4,416 2,487 89,142 144,002 202,267 90,750 226,999 245,268 372,557 243,947	2006 710 38,553 23,975 22,529 1,885 4,778 16,919 0 0 0	2007 0 15,194 7,029 2,849 34,112 32,198 4,317 2,652 1,923 718	2008 9 241 730 1,497 15,333 4,596 115 0 0 0 29	2009 23,857 29,691 41,762 15,596 180,455 157,109 291,388 423,400 15,560 0	2010 20,737 184,142 80,408 2,625 28,517 65,522 23,129 7,457 11,805 12,787
31-May 10-Jun 20-Jun 30-Jun 20-Jul 30-Jul 9-Aug 19-Aug 29-Aug 8-Sep	2003 4,510 620 16,092 67,162 42,762 19,944 45,490 10,349 22,647 2,603 0	2004 23 5,105 53,624 427,205 518,056 619,678 265,423 36,281 223,489 406,617 159,236	2005 4,416 2,487 89,142 144,002 202,267 90,750 226,999 245,268 372,557 243,947 170,907	2006 710 38,553 23,975 22,529 1,885 4,778 16,919 0 0 0 0 0	2007 0 15,194 7,029 2,849 34,112 32,198 4,317 2,652 1,923 718 4,391	2008 9 241 730 1,497 15,333 4,596 115 0 115 0 0 29 29 495	2009 23,857 29,691 41,762 15,596 180,455 157,109 291,388 423,400 15,560 0 0	2010 20,737 184,142 80,408 2,625 28,517 65,522 23,129 7,457 11,805 12,787 8,860





The occurrence of vegetation within a perimeter does not match its occurrence on the landscape



The occurrence of fire across the landscape changes as a function of seasonal weather patterns Fire "seeks out" more flammable vegetation cover and sites that support fire activity



There are only slight differences in the fraction of burning as a function of vegetation type compared to the frequency of vegetation type within a perimeter



Short Interval Study Sites



Site	Ye		
Code	Historic Burn	Recent Burn	FFI
FC	1967	2005	38
KC	1969	2004	35
LD	1958	2010	52
СК	1966	2004	38
BD	1969		

Slope Position ¹			
0	Flat upland/shoulder slopes		
٥	East-West-South backslopes		
North backslopes			
	Flat lowland/foot and toe slopes		
	¹ opened – recently reburned plot,		

¹ opened – recently reburned plot, closed symbol – historic burn only

Chicken Fire Reburn Event



Fire Event	Fraction of Area Burned
Chicken Fire (2004)	0.82
Long FFI Burn Only	0.85
Reburn Only	0.67

Year	Fire Year Type	Fraction of Area Burned within Fire Perimeters
2001	small	0.91
2002	large	0.87
2003	small	0.86
2004	ultra large	0.79
2005	ultra large	0.84
2006	small	0.85
2007	small	0.91
2008	small	0.90
Overall Average		0.84

Conclusions

- Improved information now exists on factors controlling different characteristics of Alaska's fire regime
- Additional results are forthcoming in the near future