Testing the Continuous Haines Index in British Columbia

The codes and indexes of the Canadian Fire Weather Index System, the foundation of fire danger rating in Canada, are based entirely on surface weather observations. However, it is well known that unstable conditions in the lower atmosphere can contribute to severe wildfire behaviour, including "blowup fires". Numerous atmospheric stability indexes have been developed by meteorologists to integrate measures of temperature, moisture and wind speed at different pressure levels into a single value. Among these, the Lower Atmospheric Stability (LASI) or Haines Index (HI) was specifically developed for wildfire applications.

The Haines Index is derived from temperature and dewpoint depression differentials across two pressure levels and is constructed such a manner that it can only take on 5 integer values. Initial testing of the Haines Index in the Kamloops Fire Centre did not discriminate high and low fire danger days very well – the mid elevation HI indicated high fire danger or the potential for extreme fire behaviour almost every day, while the high elevation variant indicated very few high fire danger days. This study examined a modified version of the Haines Index developed in Australia, which uses the same inputs, but expresses the outputs on a continuous, expanded scale.

A climatology of the continuous and standard Haines Index was developed for upper stations in British Columbia and the Yukon, including the joint distribution with the Fire Weather Index. Case histories of three wildfires were also examined. The results of the study suggest that the continuous Haines Index, which used as an adjunct to the FWI and FBP System, helps flag those days with very unstable atmospheres that may contribute to rapid fire spread, even though surface winds are moderate.

Haines Index Calculation

STABILITY TERM + MOISTURE TERM = HAINES INDEX		
LOW ELEVATION	Stability Term (T950-T850) 1 - 3 degrees Celsius or less 2 - 4 to 7 degrees Celsius 3 - 8 degrees Celsius or greater	Moisture Term (T850-Td850) 1 - 5 degrees Celsius or less 2 - 6 to 9 degrees Celsius 3 - 10 degrees Celsius or greater
MID ELEVATION	Stability Term (T850-T700) 1 - 5 degrees Celsius or less 2 - 6 to 10 degrees Celsius 3 - 11 degree Celsius or greater	Moisture Term (T850-Td850) 1 - 5 degrees Celsius or less 2 - 6 to 12 degrees Celsius 3 - 13 degrees Celsius or greater
HIGH ELEVATION	Stability Term (T700-T500) 1 - 17 degrees Celsius or less 2 - 18 to 21 degrees Celsius 3 - 22 degrees Celsius or greater	Moisture Term (T700-Td700) 1 - 14 degrees Celsius or less 2 - 15 to 20 degrees Celsius 3 - 21 degrees Celsius or greater

- 2 = Very Low Potential (Moist Stable Lower Atmosphere)
- 3 = Very Low Potential
- 4 = Low Potential
- 5 = Moderate Potential
- 6 = High Potential (Dry Unstable Lower Atmosphere)

Haines Index climatology. From 1977 to 2007, Kelowna's sounding station data revealed a HI value of 6, on average, over 60% of the time for the summer fire season.

Haines Index 30-Year Summary for Kelowna 1977-2007

Month	HI 2/3	HI 4	HI 5	HI 6	Total Days	% HI 4	% HI 5	% HI 6
Mid Elevation								
May	105	77	191	534	907	8.49	21.06	58.88
June	97	59	170	565	891	6.62	19.08	63.41
July	56	48	149	662	915	5.25	16.28	72.35
August	56	44	132	690	922	4.77	14.32	74.84
September	90	107	993	356	846	12.65	34.63	42.08
Total Days	404	335	935	2807	4481	7.56	21.07	62.31
High Elevation								
May	847	31	7	3	888	3.49	0.79	0.34
June	846	31	1		878	3.53	0.11	0.00
July	845	37	5	1	888	4.17	0.56	0.11
August	835	47	9	1	892	5.27	1.01	0.11
September	696	93	30	1	820	11.34	3.66	0.12
Total Days	4069	239	52	6	4366	5.56	1.23	0.14

Studies conducted by Werth and Werth (1998), Long (2006), and McCaw et al. (2007) all indicated that HI did not sufficiently identify exceptional atmospheric unstable days conducive to extreme fire behaviour. Mills and McCaw (2010) realized this when trying to apply the index in Australia (differing lapse rates and humidity climatology), so they proposed an alternate extended version of HI

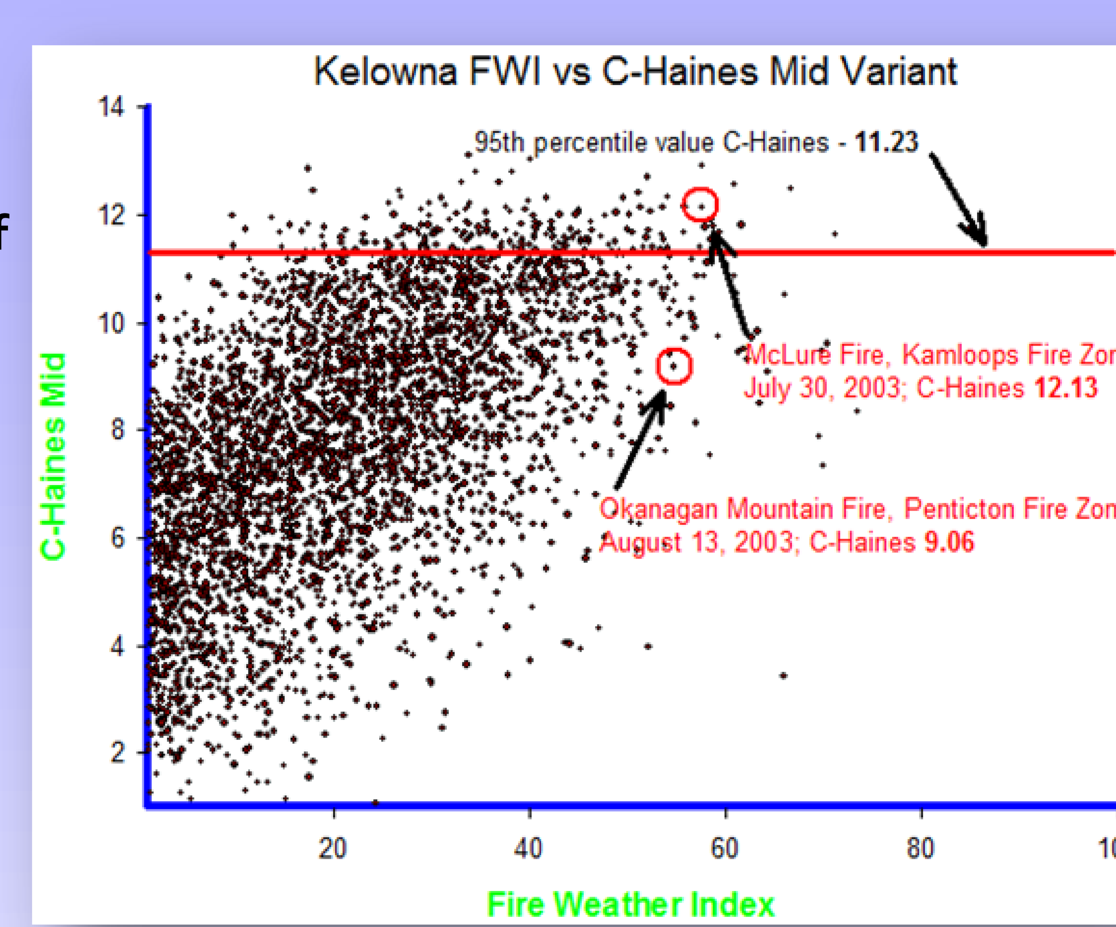
Continuous Haines Index (C-Haines) Calculation

Step (1) CA = 0.5 (T850 – T700) – 2

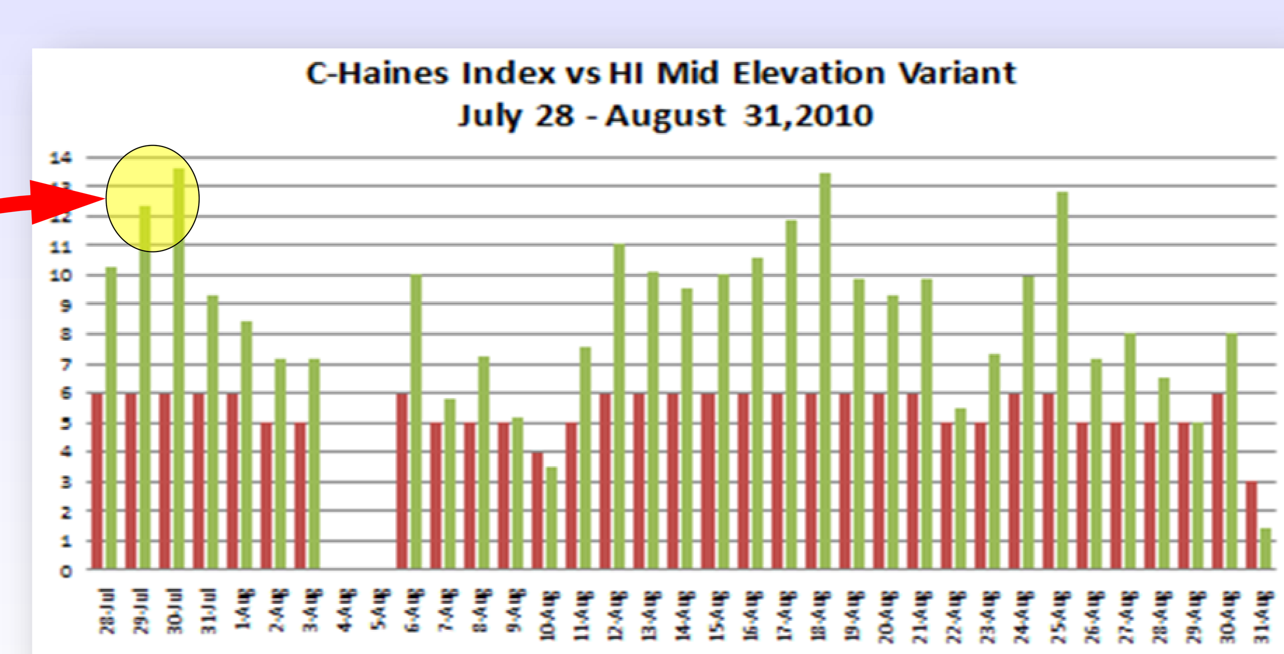
Step (2) CB = 0.3333 (T850 – DP850) – 1

Step (3) CA + CB = C-Haines Index

Using the same length of time (30 years climatology, 1977 to 2007), an individual threshold C-Haines value of 11.23 is calculated (95th percentile) for the Kelowna station .



Tweddle Creek fire case study



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