The Behaviour of the Haines Index for the 2009/10 New Zealand Fire Season

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bushfire CRC

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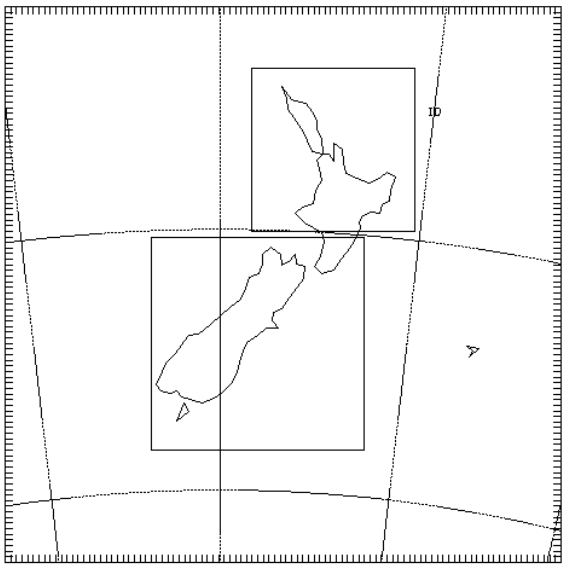
Research Questions

- Does the Haines Index (HI) provide additional value to existing indices already used in NZ?
- What is the behaviour of the HI in NZ?
- Which variant of the HI is best suited to NZ?
- Does the HI distinguish extreme fire weather days?
- What is the typical persistance time of a HI forecast?

Experimental Setup

- Retrospective analysis of the 2009/10 NZ fire season
- NWP model called WRF (v3.2)
- Model run from 01/10/2009 to 30/04/2010
  - April 2010 results not yet included
- Nudged every six hours using:
  - NCEP FNL Operational Model Global Analyses Files
- Three domains:
  - Parent Domain: 24km resolution, whole of NZ
  - “North Island” Domain: 8km resolution
  - “South Island” Domain: 8km resolution
  - Two-way interactive nesting
- Model grids, not station points

Model Domains



Background on Haines Index

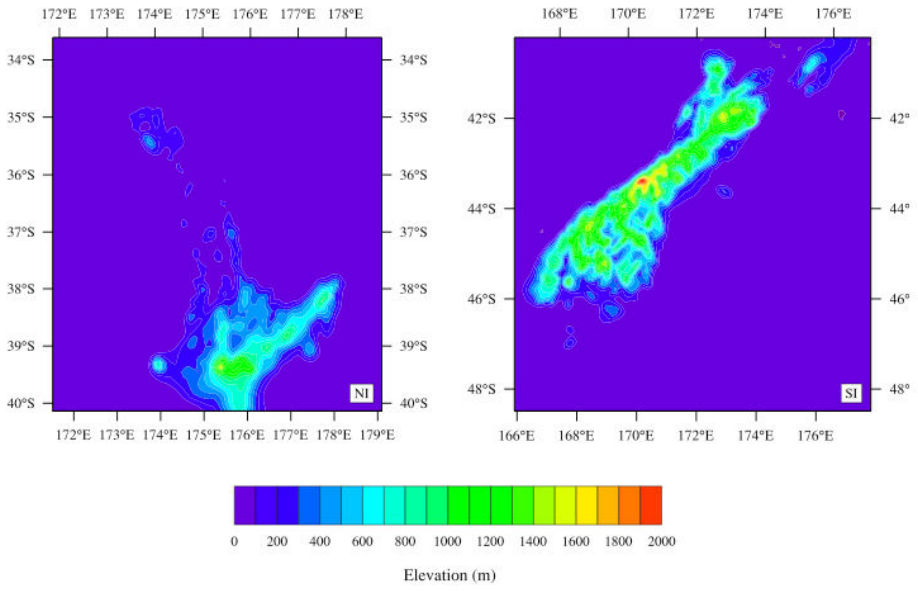
- Developed for operational use in the USA
- Measure of atmospheric stability and moisture
  - best suited for convection driven fires
- Easily derived from NWP model output
- Severe wildfires often coincide with high Haines Index
- Three variants: low, mid and high elevations

Low Elevation Haines Index

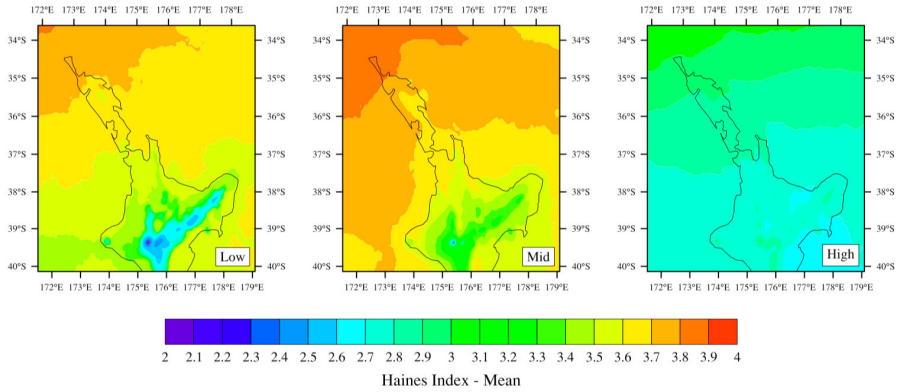
(A)	$T\,(950\,mb) - T\,(850\,mb)$	Value of A
	less than $4\,K$	1
	4 to $8\,K$	2
	greater than $8\,K$	3
(B)	$T\,(850\,mb) - T_{dew}\,(850\,mb)$	Value of B
	less than $6\,K$	1
	6 to $10\,K$	2
	greater than $10\,K$	3

$H = A + B$	Potential for Large Fires
2 or 3	very low
4	low
5	moderate
6	high

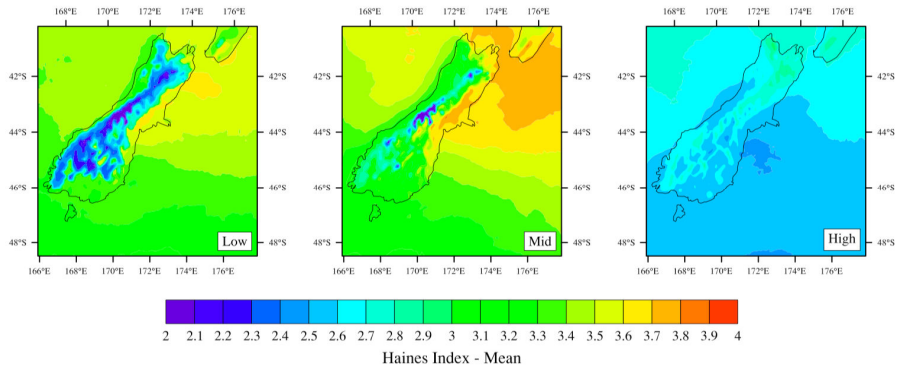
Model Topography



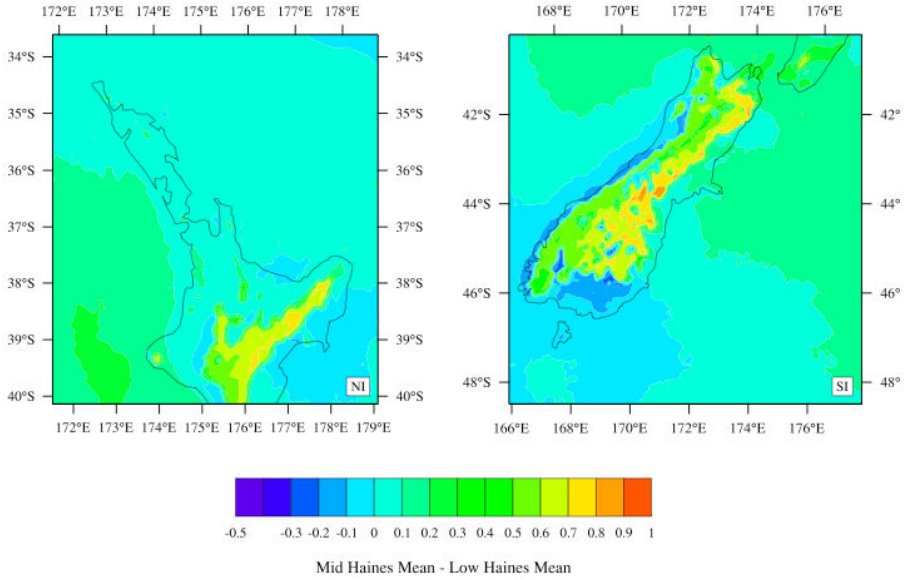
Mean - North Island



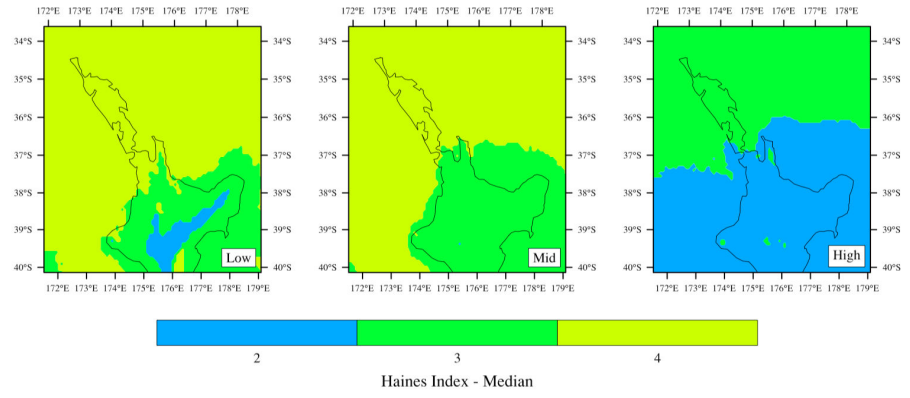
Mean - South Island



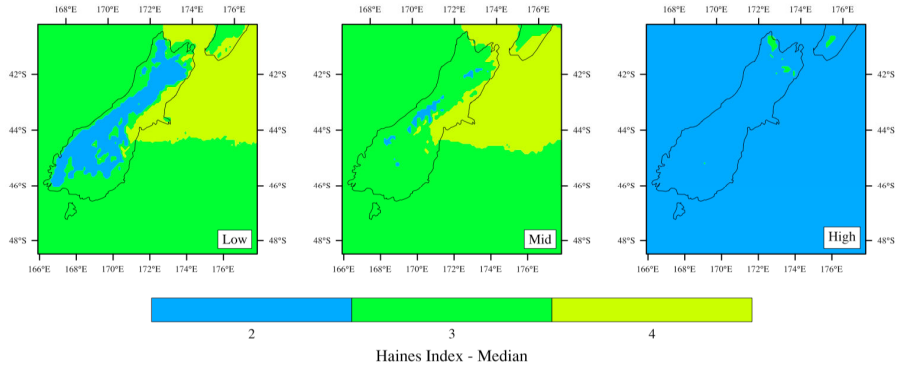
Difference in Mid and Low Means



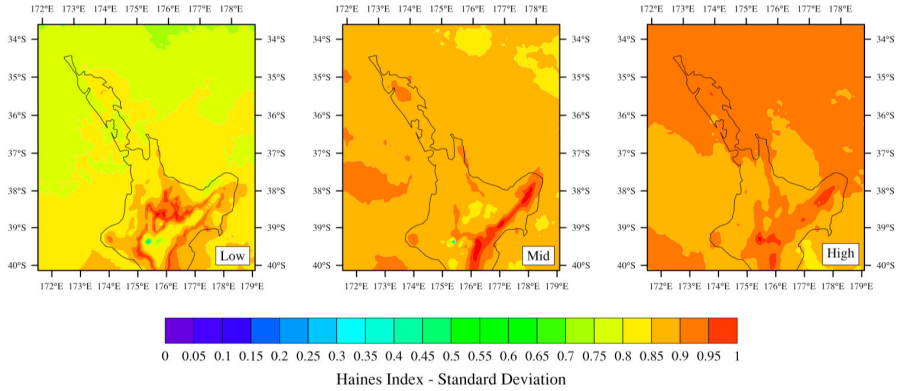
Median - North Island



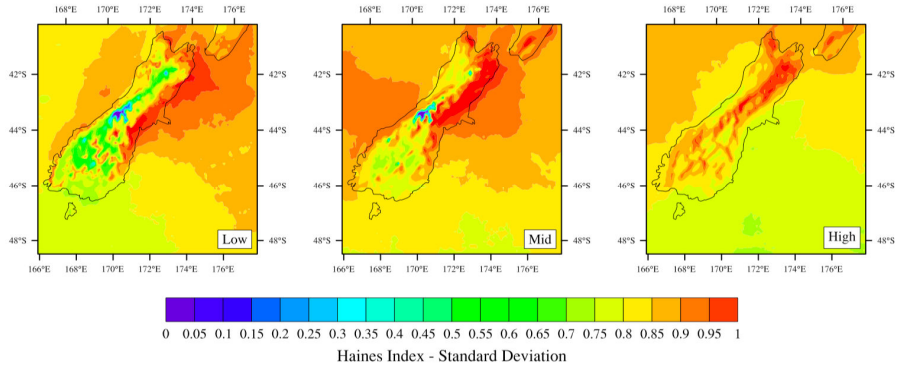
Median - South Island



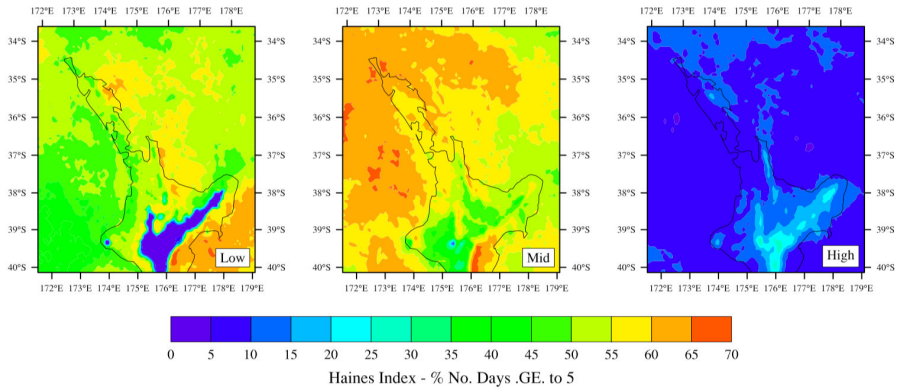
Standard Deviation - North Island



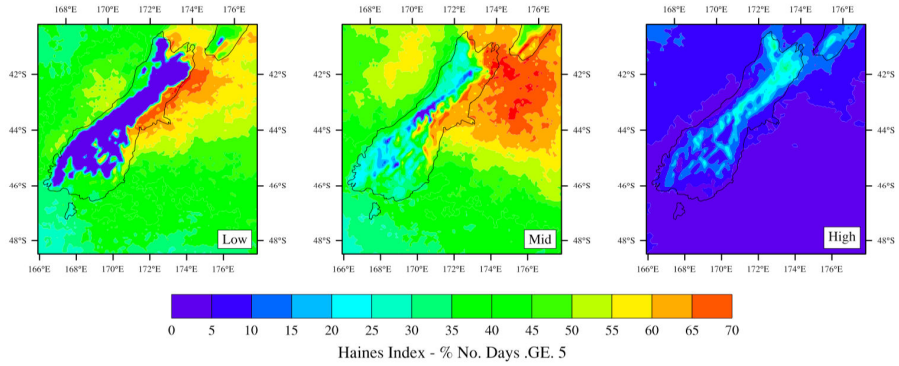
Standard Deviation - South Island



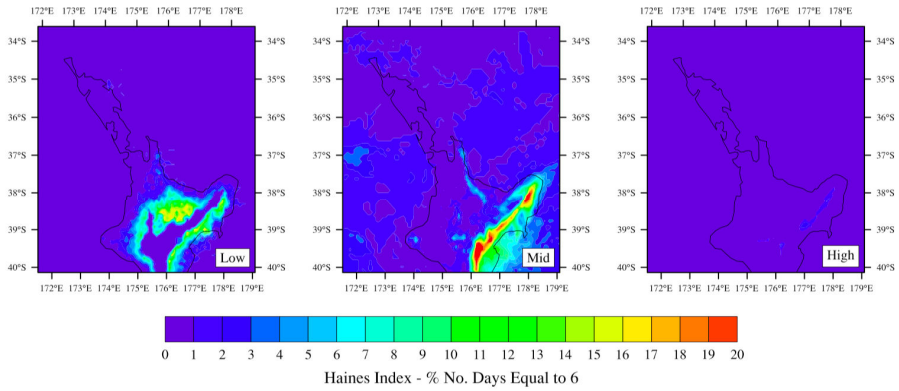
Frequency 5/6 - North Island



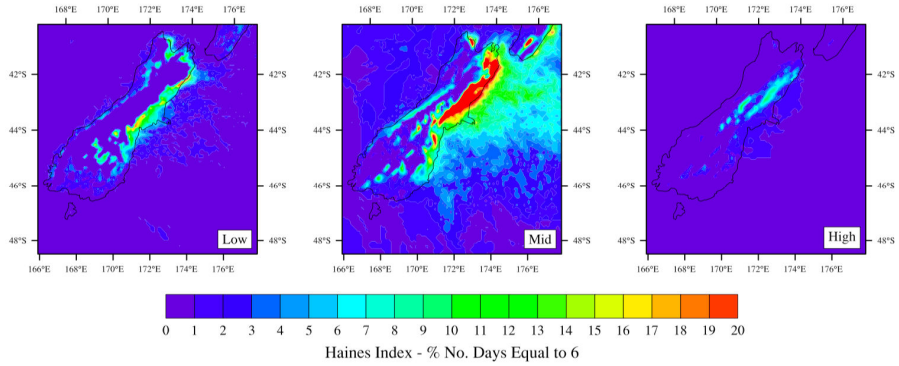
Frequency 5/6 - South Island



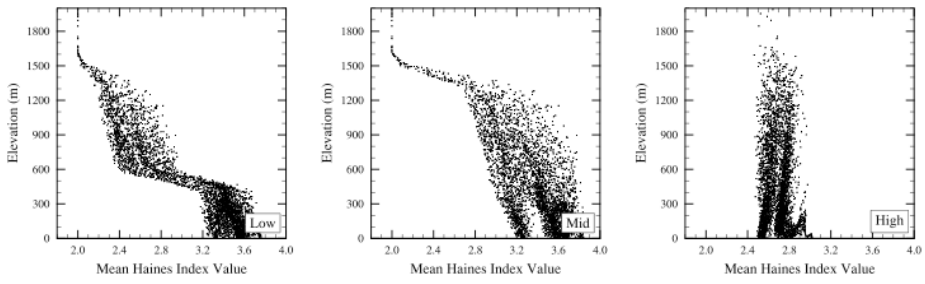
Frequency 6 - North Island



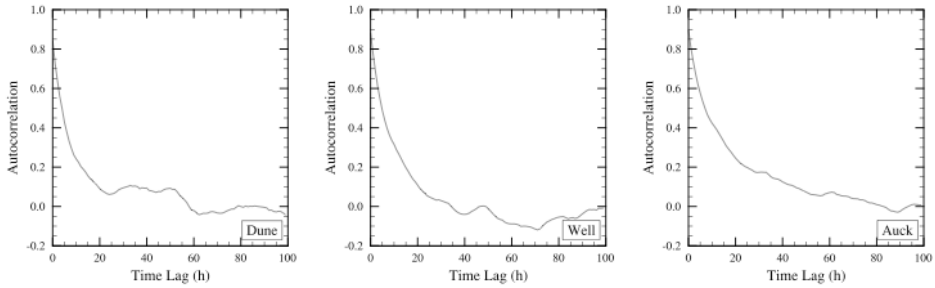
Frequency 6 - South Island



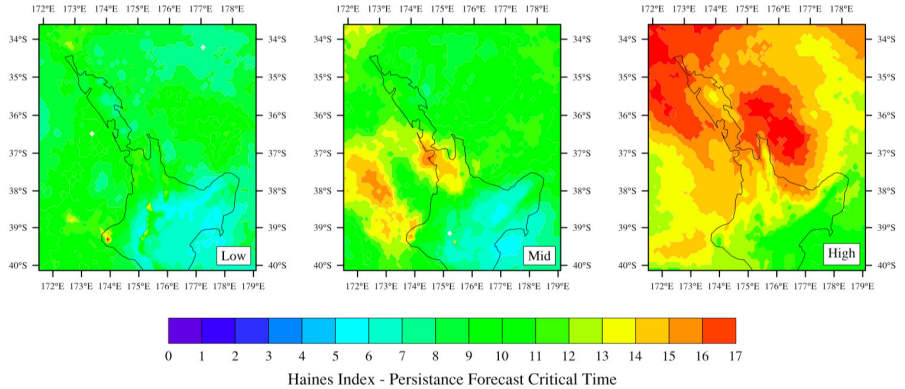
Elevation vs Mean HI



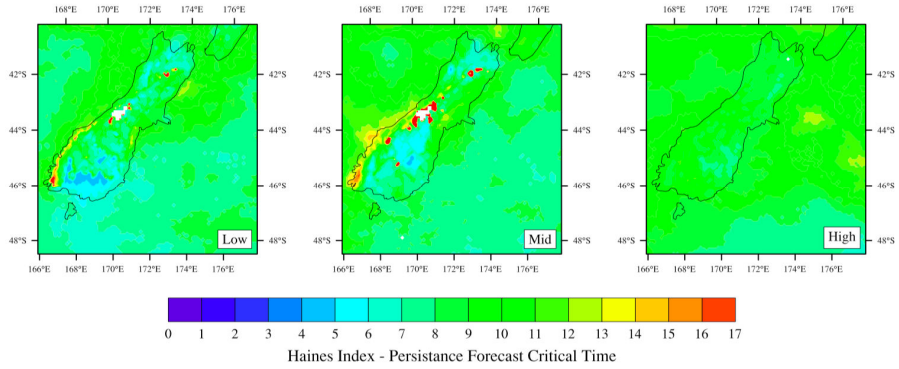
Autocorrelations



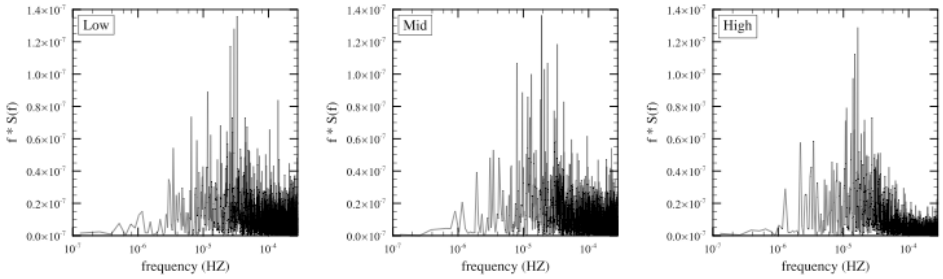
Persistance Forecasting - NI



Persistance Forecasting - SI



Diurnal Signal, Dunedin



Conclusions

- Low HI: unsuitable for elevations > 400m
- Mid HI: unsuitable for elevations > 1300m
- Mid elevation variant best suited for use in NZ
  - Small difference in mean values for Mid/Low
- Regional variations in HI values
  - Highest values on lee side of mountain ranges
- Up to 20% of fire season days have maximum HI=6
- Diurnal signal is present higher values during daytime
- Forecast persistance of HI typically 8-12 hours

Future Work

- Relate HI behaviour to known fire events across NZ
- Similar analysis with Fire Weather Index
- Relation to between Haines Index and Fire Weather Index
- Verification of model output using observational data
- Case studies of extreme fire weather days
- Detection of seasonal signals in index values