
Earth Sciences New Zealand
On July 1, 2025 NIWA and GNS Science merged
to become a new Public Research Organisation called
Earth Sciences New Zealand
Earth Sciences
New Zealand

Snow and Ice Loads for OHL Design in NZ

Overhead Line Design Forum
Commodore Hotel, Christchurch
20 May 2026

Richard Turner
ESNZ

Outline

1. Objective
2. Background
3. Methods
4. Results
5. *Recommendations*

Objectives

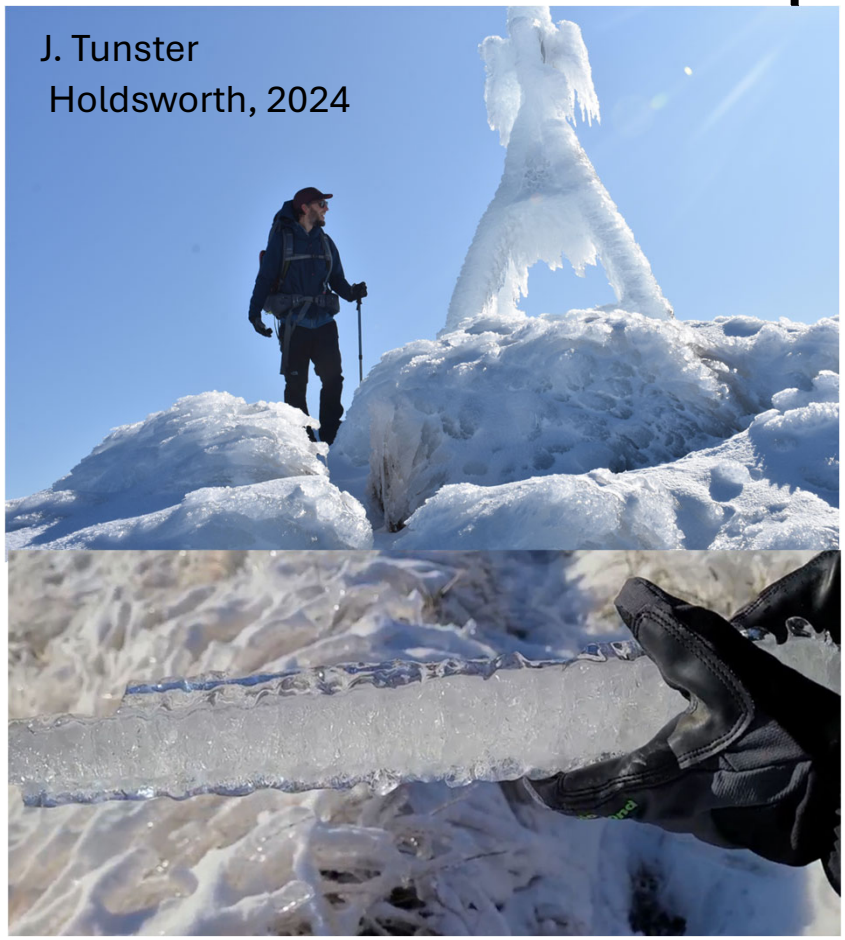
- Examine recent snow/ice photos, latest weather datasets & re-analyses, and literature to review the snow/ice provisions of AS/NZS 7000.

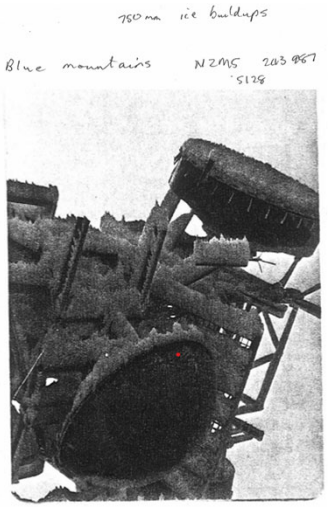
- Outcome:

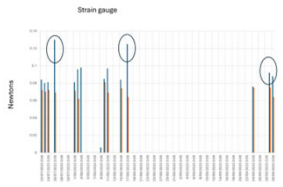
- Recommend any changes to wording, guidance, region boundaries, radial ice thicknesses etc.

- Provide some documentation of work/data done here to standards review working group (current an dfuture).

Some accretion cases with photos







Mt Hutt – May 2021

Near
SH5
2016

Background

Methods

Collate observations, dates – estimate snow/ice build up.

Using Numerical Weather model output and observed data (where observation station is located at site (i.e. for Ruapehu and Crawford) calculate using two methods

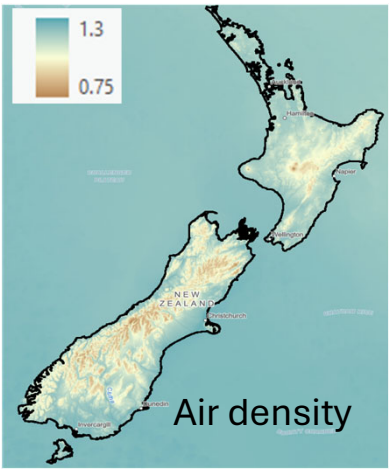
Makkonen set of equations: for wet-snow/glaze/rime ice

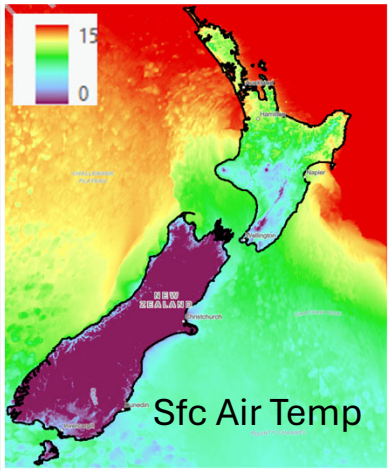
$$\frac{dM}{dt} = \alpha_1 \alpha_2 \alpha_3 q_l V A$$

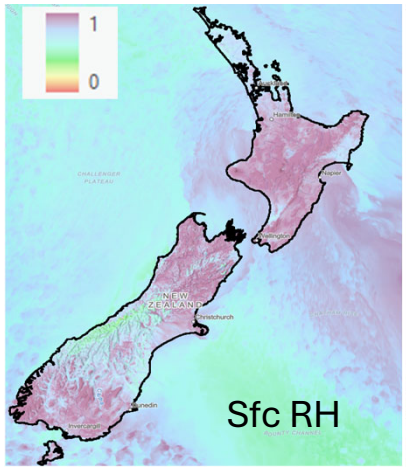
[units] g s^{-1} = g m^{-3} . m s^{-1}. m^2

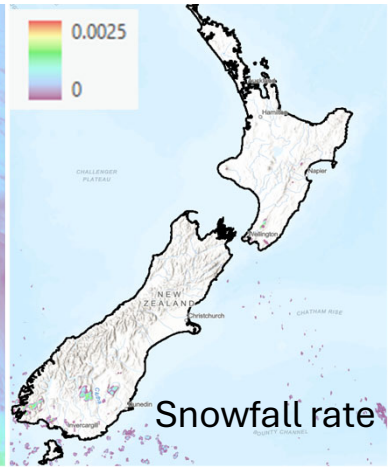
Or

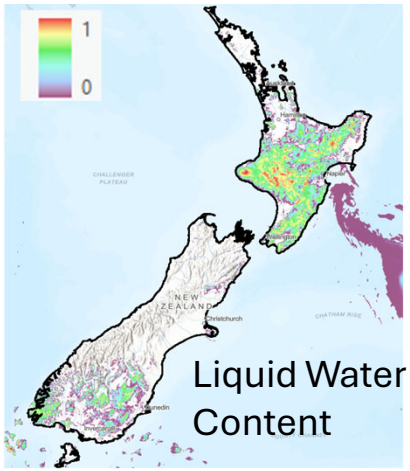
Duration of conditions – times ‘typical’ accretion rate


1.3
0.75
Air density


15
0
Sfc Air Temp


1
0
Sfc RH


0.0025
0
Snowfall rate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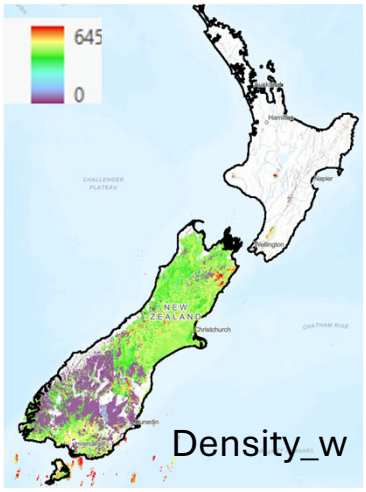
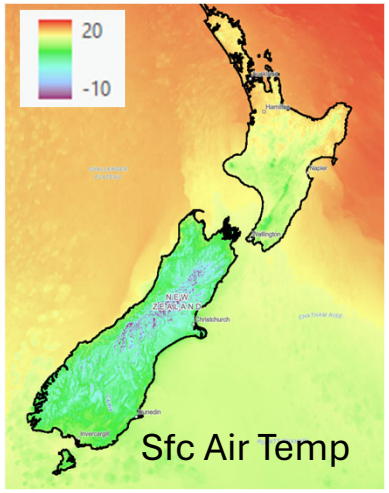
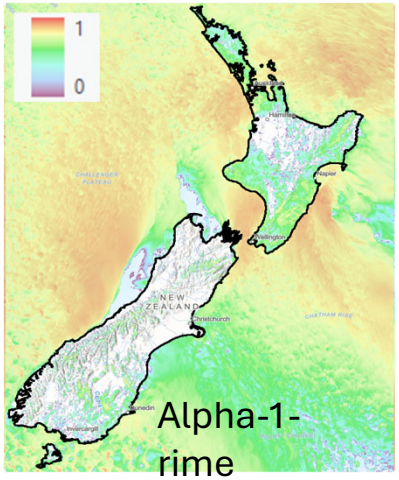
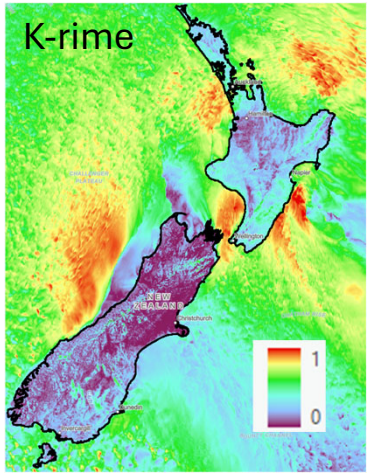
0
Liquid Water Content


645
0
Density_w

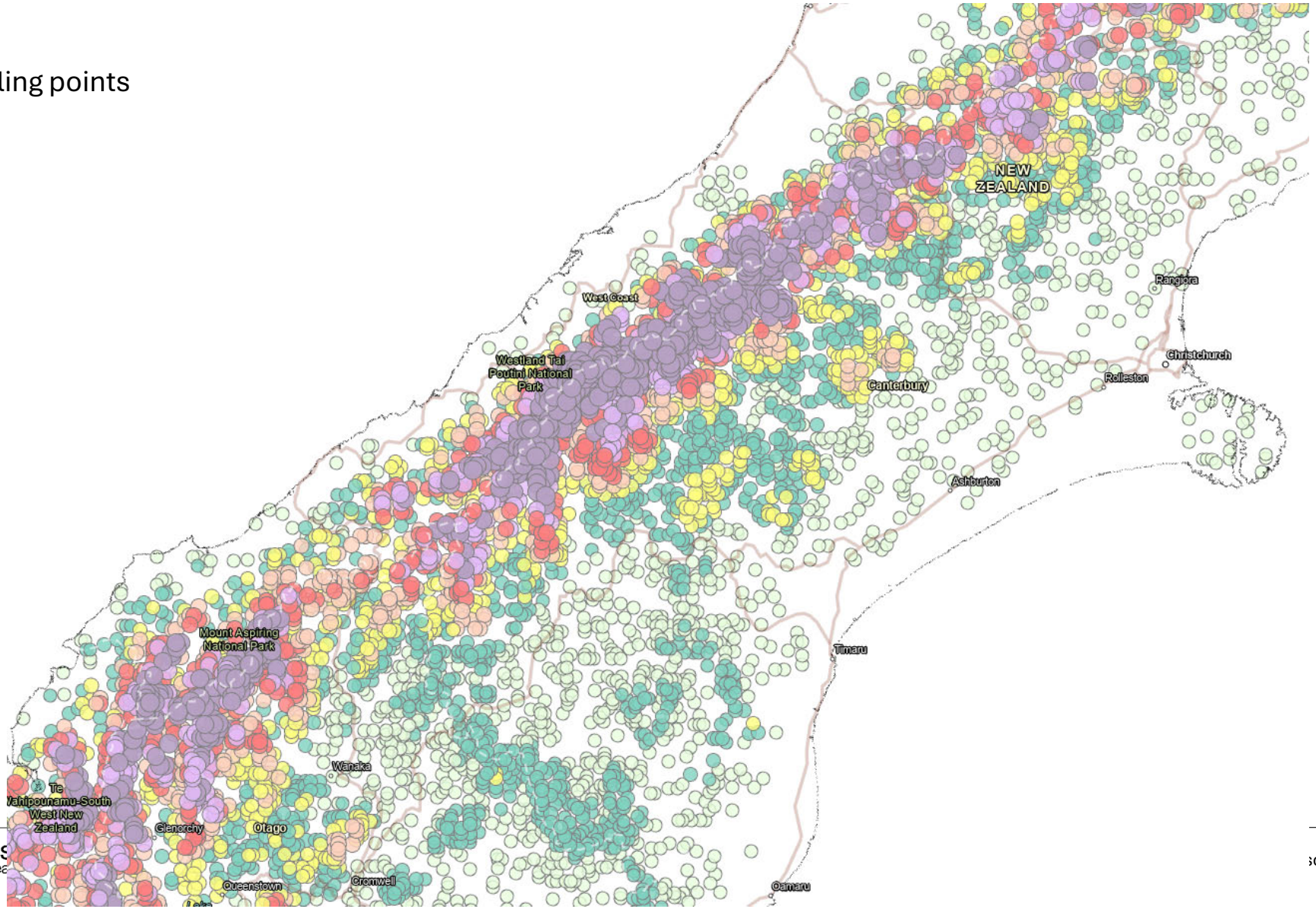

20
-10
Sfc Air Temp


1
0
Alpha-1-rime


K-rime
1
0


NEW
ZEALAND
West Coast
Westland Tai
Poutini National
Park
Canterbury
Rangiora
Christchurch
Rolleston
Ashburton
Timaru
Mount Aspiring
National Park
Wanaka
Te
Wahipounamu-South
West New
Zealand
Glenorchy
Otago
Queenstown
Cromwell
Oamaru

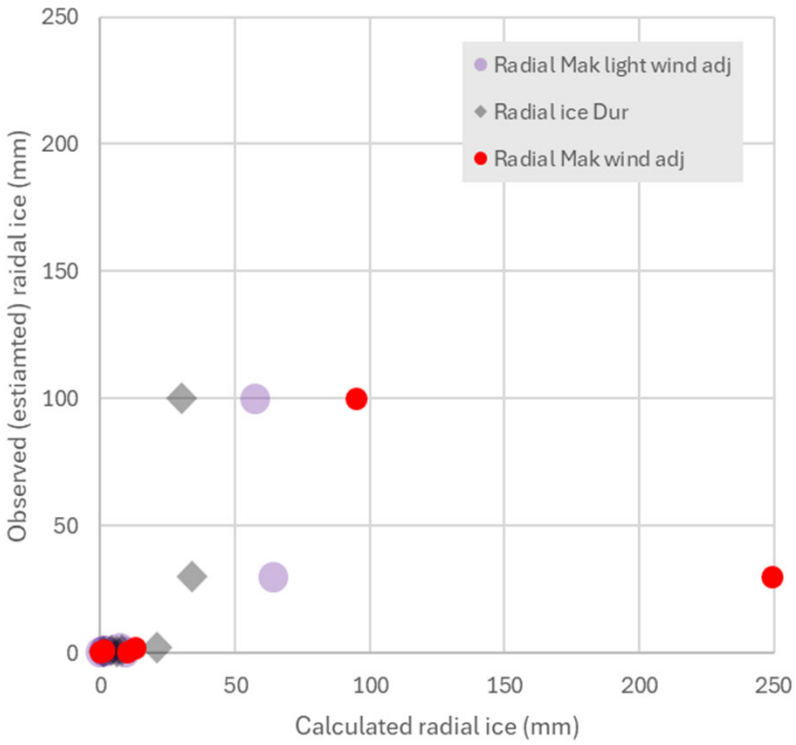
Sampling points



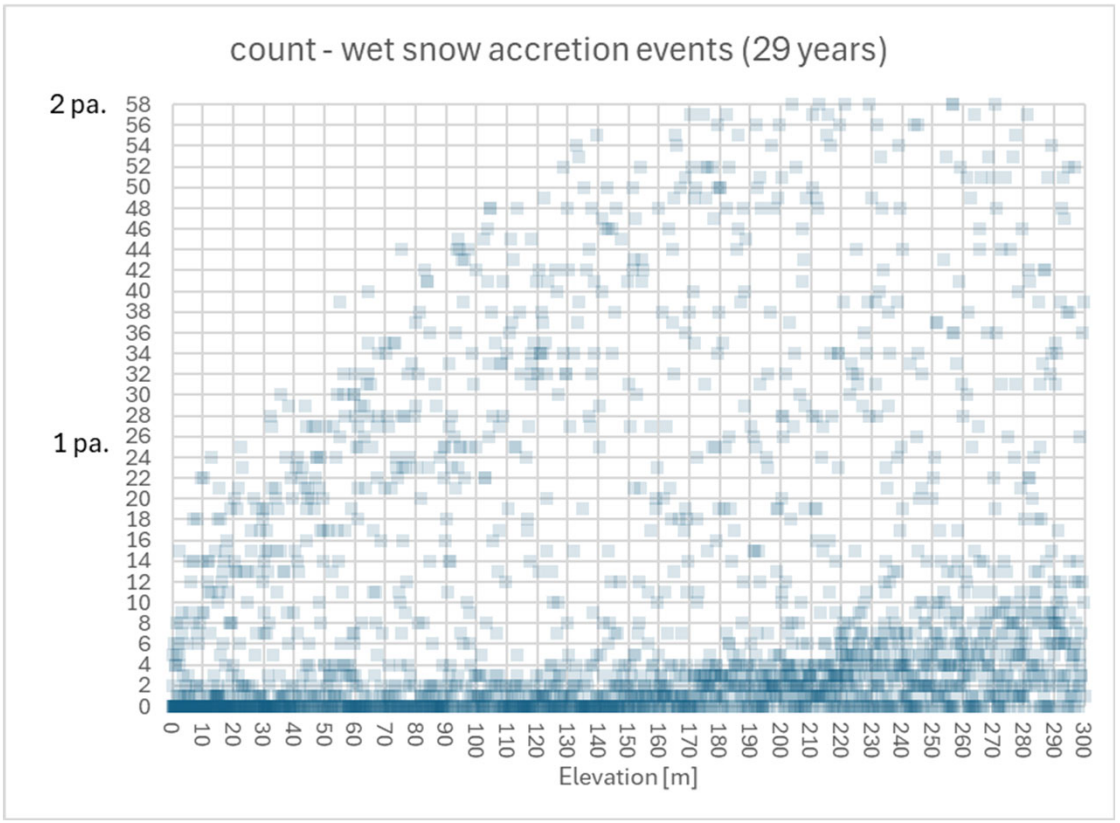
Results

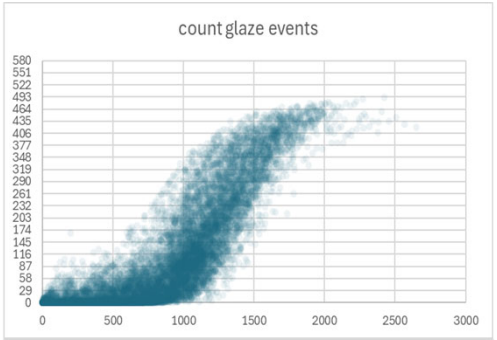
Comparison of model results with estimates from photos.

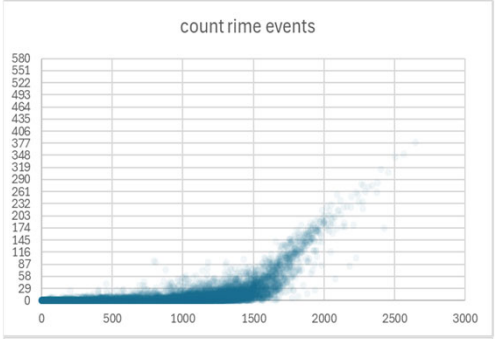
Date	Location	Mass kg-Mak	Radial Mak no wind adj	Radial ice Dur	Ob radial ice (mm) (Estimated)	density model	spd-adj	SWE - model mm	Comment
20200712	Crawford	0.03	7	21	2	380	light	46	snow
20201121	Crawford	0.06	9	6	0.5	416	light	12	snow
20210530	Mt Hutt	2.7	57	30	100	655	light	300	50% ice
20230725	Chateau	0.016	1	4	1	917	light	4	80% ice
20230816	Chateau	0.008	1	8	1	586	light		30% ice
20230929	Chateau	0	0	1	0.5	-99	light	0.5	snow
20240730	Tararua	10.46	64	34	30	820	light	64	80% ice
Date	Location	Mass kg-Mak	Radial Mak wind adj	Radial ice Dur	Observed radial ice (mm)(Estimated)	density model	spd-adj	SWE - model mm	Comment 1
20200712	Crawford	0.19	13	21	2	429.8	windy	46	snow
20201121	Crawford	0.09	10	6	0.5	398	windy	12	snow
20210530	Mt Hutt	14.7	95	30	100	514	windy	300	20% ice
20230725	Chateau	0.016	1	4	1	921	windy	4	80% ice
20230816	Chateau	0.005	1	8	1	798	windy		75% ice
20230929	Chateau	0	0	1	0.5	-99	windy	-0.5	snow
20240730	Tararua	80.7	249	34	30	490	windy	64	2% ice

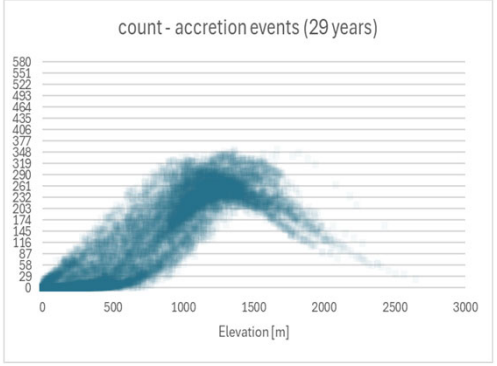


Relationship with orography



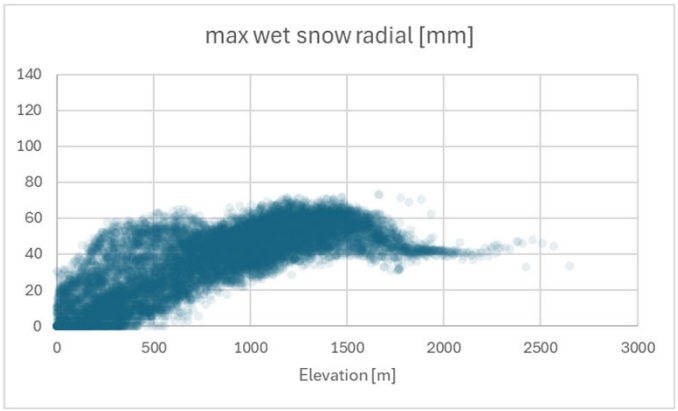


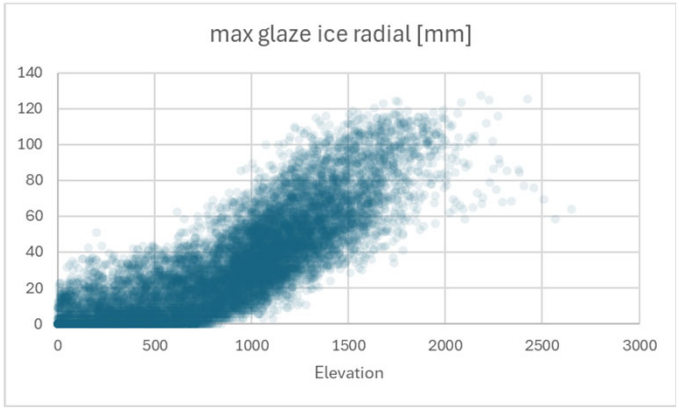


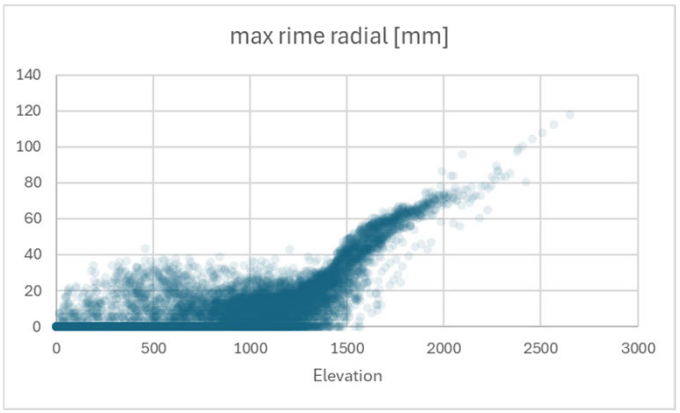


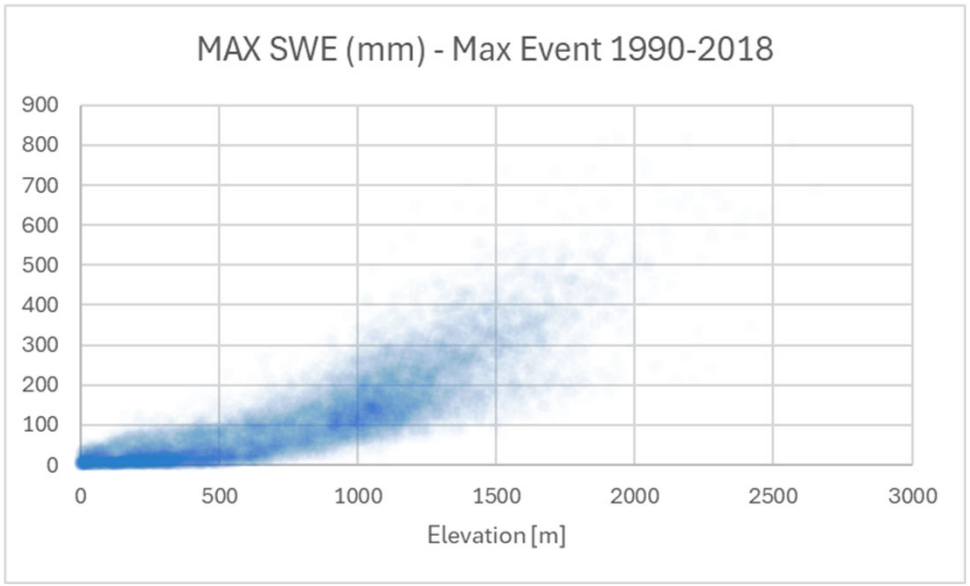
Relationship with orography

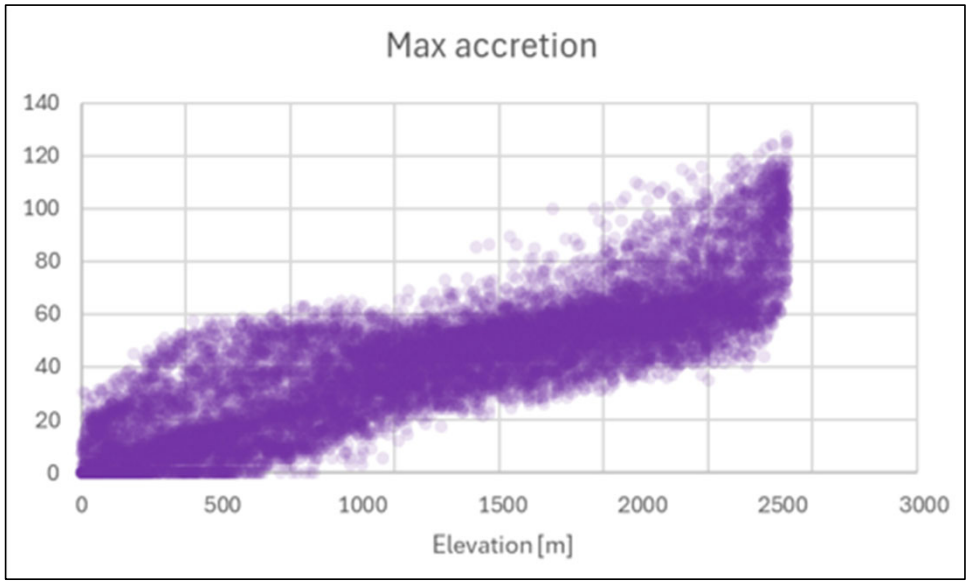
Maximum 1990-2018



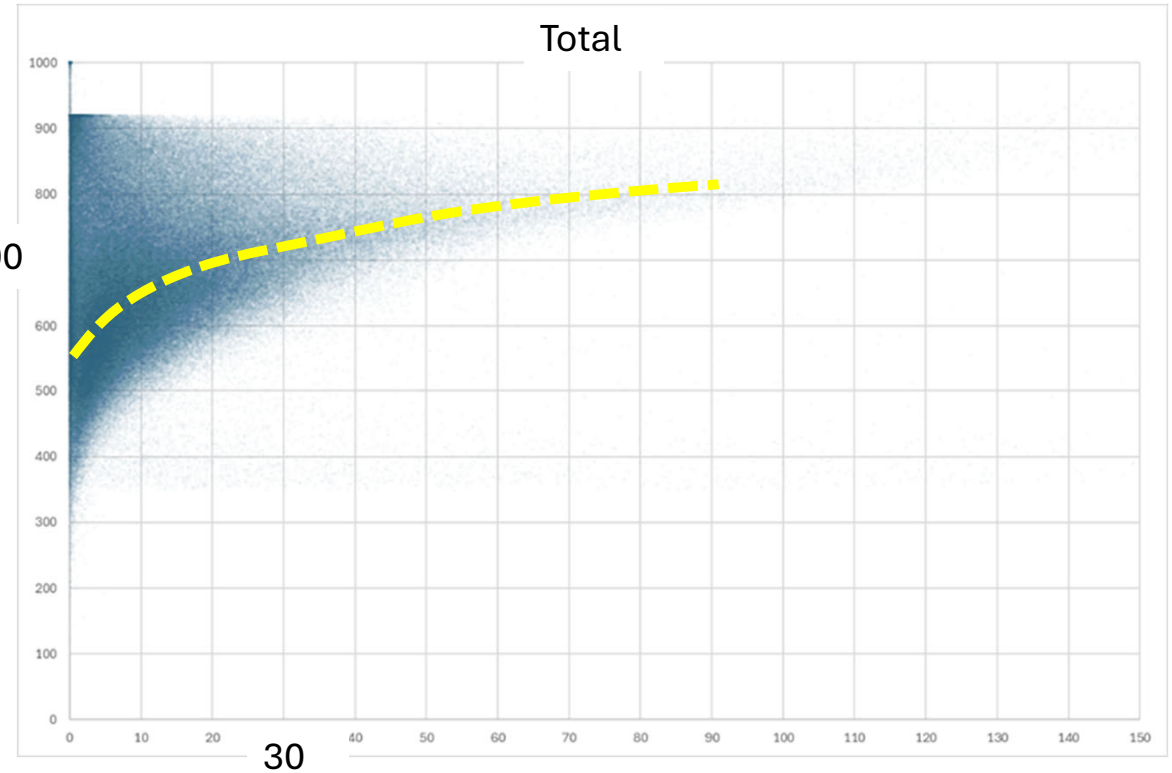


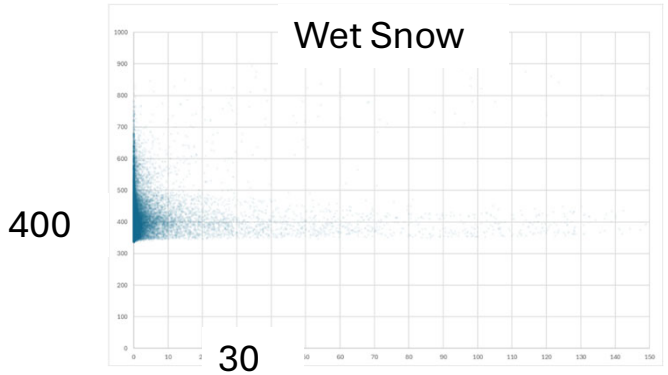


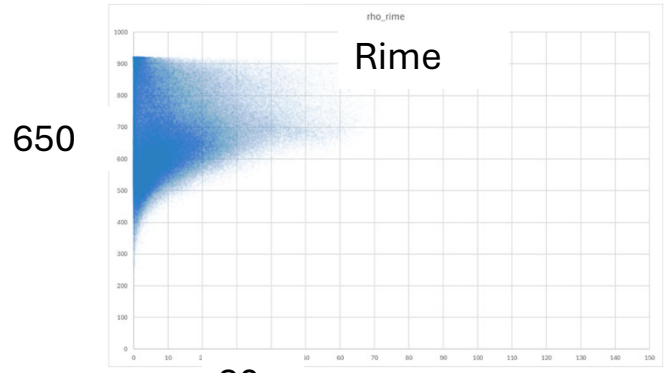

MAX SWE (mm) - Max Event 1990-2018
900
800
700
600
500
400
300
200
100
0
0
500
1000
1500
2000
2500
3000
Elevation [m]


Max accretion
140
120
100
80
60
40
20
0
0
500
1000
1500
2000
2500
3000
Elevation [m]

Density


Total
1000
900
800
700
600
500
400
300
200
100
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
30
Radial ice (mm)


Wet Snow
400
30


rho_rime
Rime
650
30
Radial ice (mm)

Snow regions

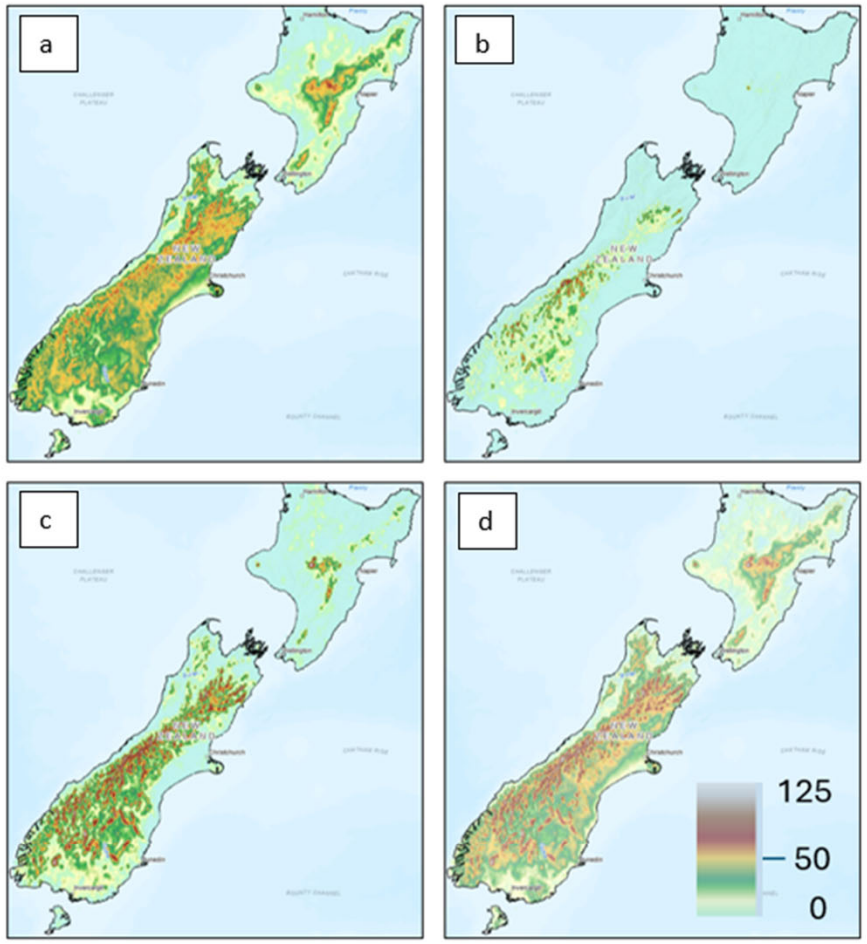


Figure 2 The maximum radial ice (mm) per any 'snow' event in the period 1990-2019 as determined by analysis of the duration at which humidity, temperature and precipitation criteria were suitable for a) wet-snow accretion, b) rime ice accretion or c) glaze ice formation; d) shows the maximum accretion across all of a), b) , and c).

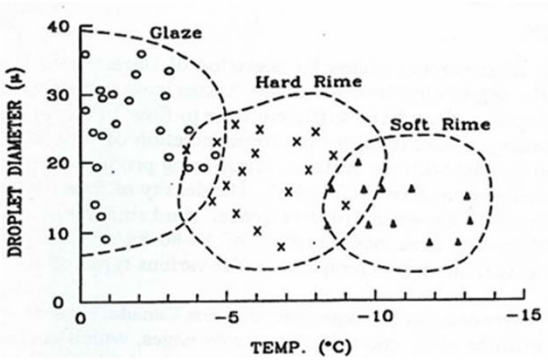


Figure 2 : Ice accretion type as a function of air temperature, wind speed and droplet size

From CIGRE, 2004, adapted from Kuroiwa, 1965

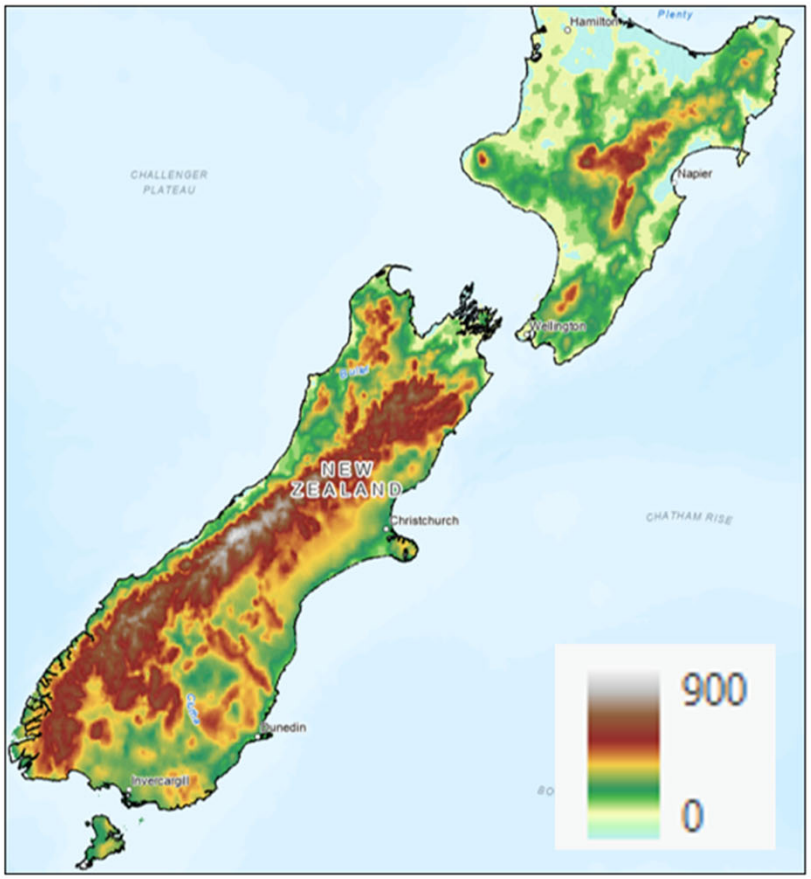


Figure 2: Maximum Snow Water Equivalent (mm == kg m^{-2}) from any 'snow' event in the period from 1990 to 2018 over New Zealand

SWE

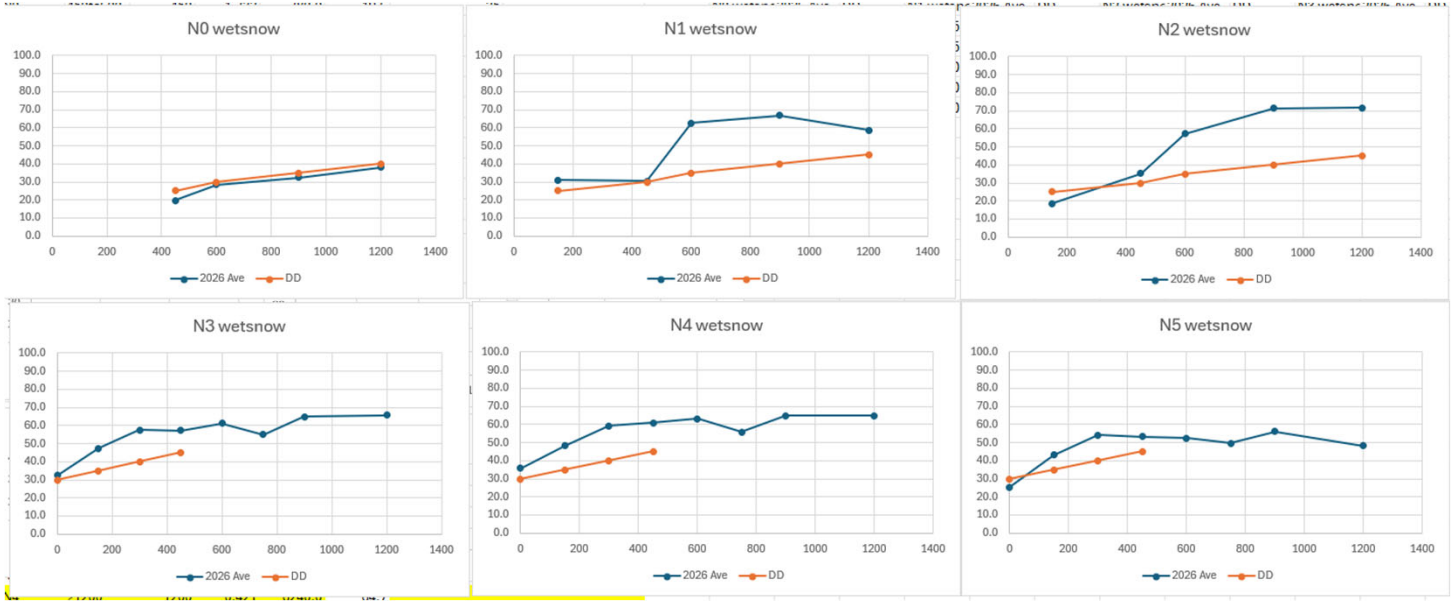
Ground snow loads

Recommendation and still to do:

Graphical comparison with Table DD4

Max 30-year value and trend from model (**Blue line**) (should approximately match DD4 value and trend (**orange line**).

Where there are large differences – need to reconsider the DD4 value or do further investigation



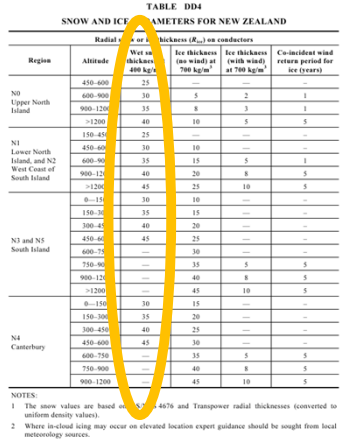


TABLE DD4

SNOW AND ICE PARAMETERS FOR NEW ZEALAND

Region	Altitude	Radial snow or ice thickness (R_{sn}) on conductors: Wet snow thickness 400 kg/m³	Ice thickness (no wind) at 700 kg/m³	Ice thickness (with wind) at 700 kg/m³	Co-incident wind return period for ice (years)
N0 Upper North Island	450–600	25	—	—	–
	600–900	30	5	2	1
	900–1200	35	8	3	1
	>1200	40	10	5	5
N1 Lower North Island, and N2 West Coast of South Island	150–450	25	—	—	–
	450–600	30	10	—	–
	600–900	35	15	5	1
	900–1200	40	20	8	5
	>1200	45	25	10	5
N3 and N5 South Island	0–150	30	10	—	–
	150–300	35	15	—	–
	300–450	40	20	—	–
	450–600	45	25	—	–
	600–750	—	30	—	–
	750–900	—	35	5	5
	900–1200	—	40	8	5
	>1200	—	45	10	5
N4 Canterbury	0–150	30	15	—	–
	150–300	35	20	—	–
	300–450	40	25	—	–
	450–600	45	30	—	–
	600–750	—	35	5	5
	750–900	—	40	8	5
	900–1200	—	45	10	5

NOTES:

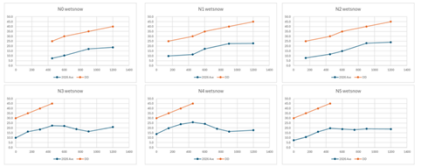
1 The snow values are based on [illegible]-4676 and Transpower radial thicknesses (converted to uniform density values).

2 Where in-cloud icing may occur on elevated location expert guidance should be sought from local meteorology sources.

Wet Snow

Average

Table DD4 – average radial (mm) all snow/ice vs design – (since average) so expect too be lower values

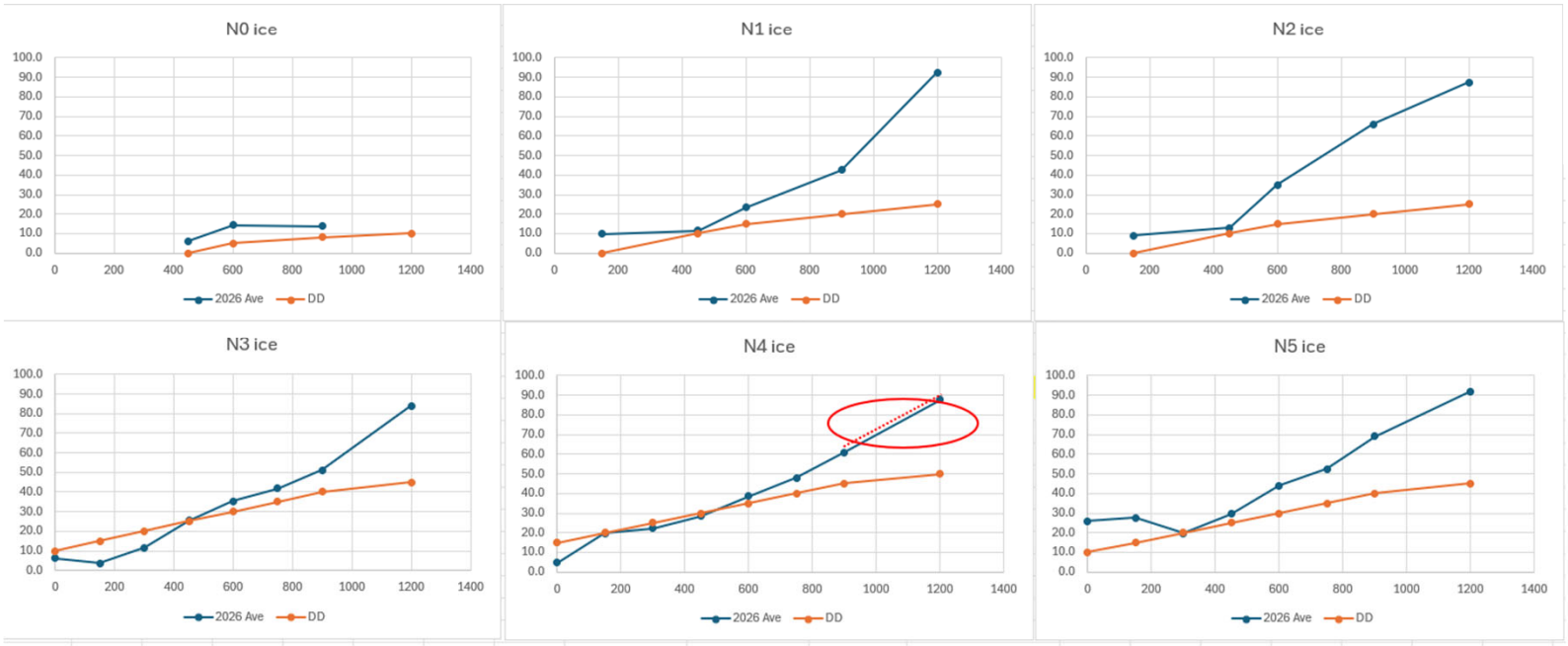


Recommendation and still to do:

Graphical comparison with Table DD4

Max 30-year value and trend from model (**Blue line**) (should approximately match DD4 value and trend (**orange line**).

Where there are large differences – need to reconsider the DD4 value



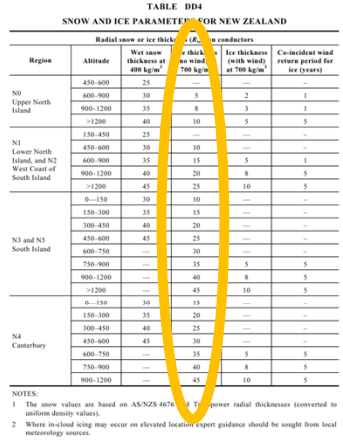


TABLE DD4

SNOW AND ICE PARAMETERS FOR NEW ZEALAND

Region	Altitude	Wet snow thickness at 400 kg/m³	Ice thickness (no wind) at 700 kg/m³	Ice thickness (with wind) at 700 kg/m³	Co-incident wind return period for ice (years)
N0 Upper North Island	450–600	25	—	—	–
	600–900	30	5	2	1
	900–1200	35	8	3	1
	>1200	40	10	5	5
N1 Lower North Island, and N2 West Coast of South Island	150–450	25	—	—	–
	450–600	30	10	—	–
	600–900	35	15	5	1
	900–1200	40	20	8	5
	>1200	45	25	10	5
N3 and N5 South Island	0—150	30	10	—	–
	150–300	35	15	—	–
	300–450	40	20	—	–
	450–600	45	25	—	–
	600–750	—	30	—	–
	750–900	—	35	5	5
	900–1200	—	40	8	5
	>1200	—	45	10	5
N4 Canterbury	0—150	30	15	—	–
	150–300	35	20	—	–
	300–450	40	25	—	–
	450–600	45	30	—	–
	600–750	—	35	5	5
	750–900	—	40	8	5
	900–1200	—	45	10	5

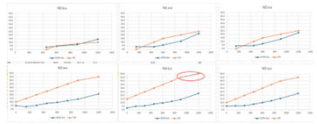
NOTES:

1 The snow values are based on AS/NZS 4676 [illegible] power radial thicknesses (converted to uniform density values).

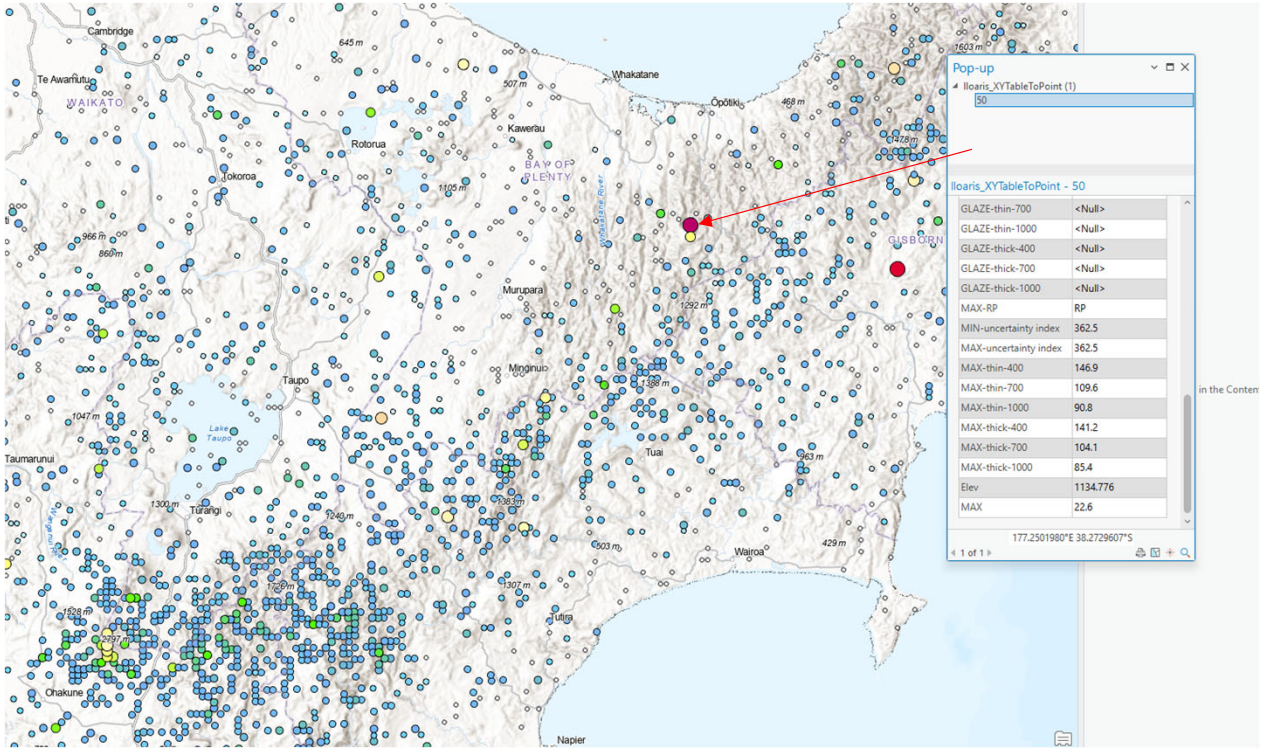
2 Where in-cloud icing may occur on elevated locations expert guidance should be sought from local meteorology sources.

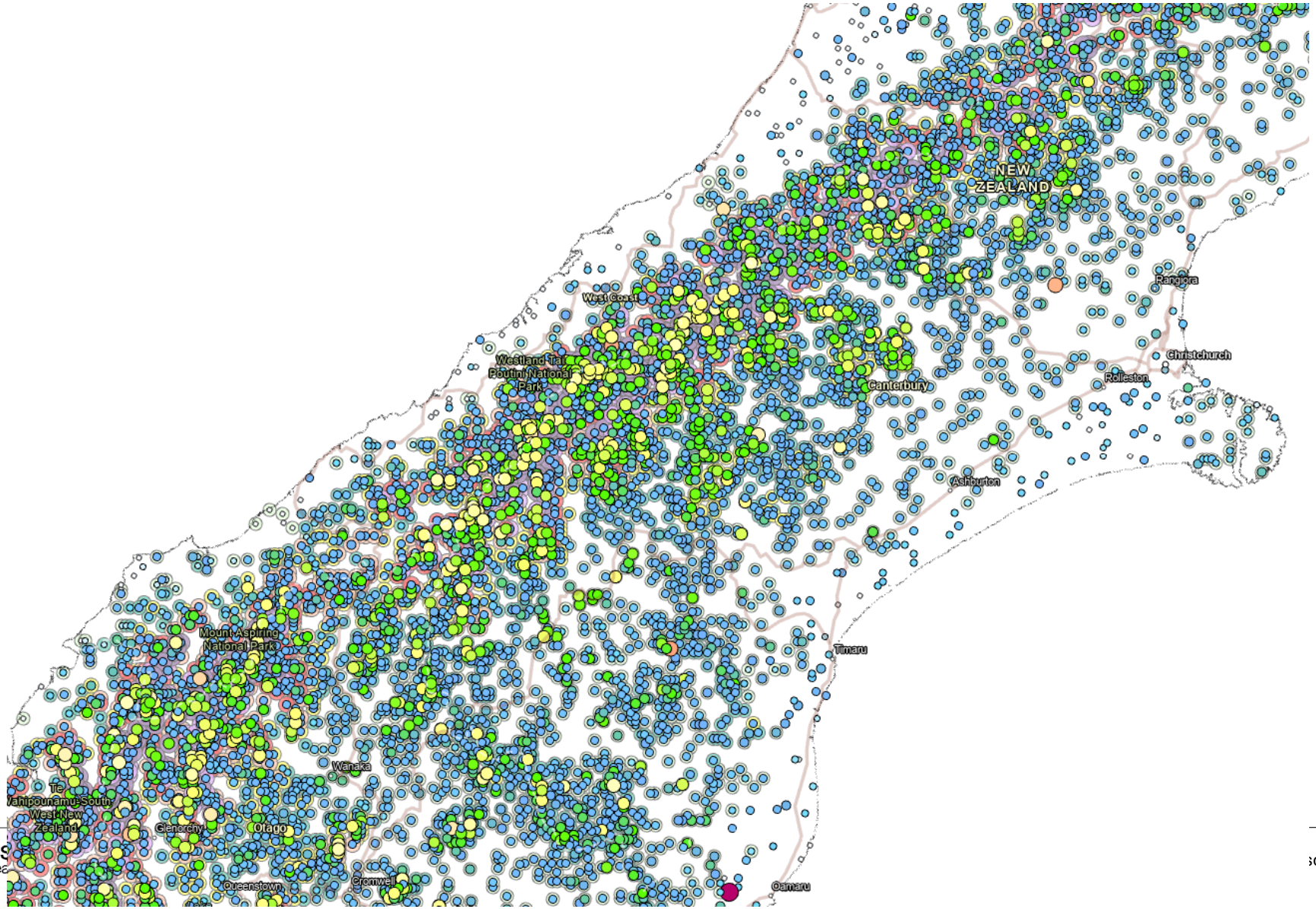
Ice

Average



Have done RP calculations, but need to aggregate results appropriately, and deal with outliers/uncertainty




NEW
ZEALAND
West Coast
Westland Tai
Poutini National
Park
Canterbury
Rangiora
Christchurch
Rolleston
Ashburton
Timaru
Oamaru
Mount Aspiring
National Park
Wanaka
Te
Wahipounamu-South
West New
Zealand
Glenorchy
Otago
Queenstown
Cromwell

Earth Sciences New Zealand

Richard Turner

ESNZ

Acknowledgement

Carl Rathbone of OLENZ