Fire Behaviour Tools

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www.scionresearch.com/fire

Overview

Latest tools for fire behaviour prediction:

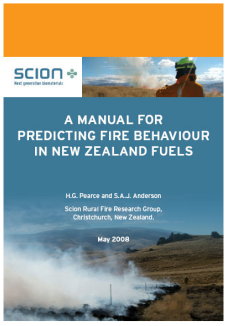
1. Manual for Predicting Fire Behaviour
2. NZ Fire Behaviour Toolkit
3. Photoguide to NZ fuels
4. Prometheus
5. Satellite Imagery for grassland curing

Here's your chance to have a say….

SCION
Next generation biomaterials

A Manual for predicting fire behaviour

- Intended for predicting fire behaviour in NZ fuel types
- A well explained easy to use guide
- Consists of sections related to fuel and fire behaviour characteristics
- Durable binder, A5 sized and bright orange
- Purchase at Scion $45 + postage



Manual consists of tables

SECTION E. Equilibrium Rate of Spread (ROS) and Fire Intensity Class on flat terrain

Care should be taken when selecting the most appropriate fuel type for Rate of Spread (ROS) determination. This should be the dominant fuel that is contributing to fire spread. For example, in an immature pine stand with a dominant scrub understorey, the scrub fuel type is likely to provide more accurate estimates of fire behaviour.

Models for estimating the equilibrium or steady-state rate of fire spread on flat ground (usually of the head fire) currently exist for the following New Zealand fuel types:

In addition to equilibrium rate of spread (ROS), the following tables (and subsequent sections) also indicate likely fire intensity based on the appropriate available fuel load information for each fuel type. These intensity estimates have been colour-coded using the following classes:

INTENSITY CLASS

<10 kW/m
10-500 kW/m
500-2000 kW/m
2000-4000 kW/m
>4000 kW/m

Equilibrium Rate of Spread (ROS) on flat terrain – Mature Pine Plantations

ISI	Mature Pine Plantations, ages 11-20 and 20+ BUI											
	10	20	30	40	50	60	70	80	90	100	110	120
	Rate of Spread (m/h)											
0.5	0	0	0	0	0	0	0	0	0	0	0	0
1.0	0	1	1	1	1	1	1	1	1	1	1	1
1.5	1	2	2	2	2	3	3	3	3	3	3	3
2.0	2	4	5	5	6	6	6	6	6	6	6	6
2.5	4	7	9	10	10	11	11	11	11	11	12	12
3	7	12	14	16	17	17	18	18	18	19	19	19
4	15	25	31	33	35	37	38	38	39	40	40	40
5	25	44	53	58	62	64	66	67	68	69	70	70
6	39	68	82	90	96	99	102	104	105	107	108	109
7	56	97	117	129	136	141	145	148	150	152	154	155
8	75	130	157	172	182	189	194	198	201	204	206	207
9	95	167	201	220	233	242	248	253	257	261	263	265
10	118	206	248	272	288	299	307	313	318	322	325	328
12	166	290	349	383	405	420	432	440	447	453	458	461
14	216	377	454	499	527	547	562	573	582	589	595	600
16	266	464	559	614	649	673	691	705	716	725	733	739
18	314	548	660	724	766	795	816	833	846	856	865	872
20	359	627	755	829	876	910	934	953	968	980	990	998
25	456	797	960	1054	1114	1157	1188	1212	1231	1246	1259	1269
30	531	927	1117	1226	1296	1345	1381	1409	1431	1449	1464	1476
35	585	1022	1231	1351	1428	1482	1522	1553	1577	1597	1613	1627
40	623	1089	1311	1439	1522	1579	1622	1654	1680	1701	1719	1733
45	650	1135	1367	1500	1586	1647	1691	1725	1752	1774	1792	1807
50	668	1167	1405	1542	1631	1693	1738	1773	1801	1823	1842	1858
55	680	1189	1432	1571	1661	1724	1771	1806	1834	1857	1876	1892
60	689	1203	1449	1590	1682	1745	1792	1828	1857	188 0	1899	1915
65	694	1213	1461	1604	1696	1760	1807	1844	1872	1896	1915	1931
70	698	1220	1469	1612	1705	1769	1817	1854	1883	1906	1926	1942

Equilibrium rate of spread (and indicative fire intensity classes) for surface fires only, based on Canadian FBP System Fuel Type C-6, Conifer Plantation.

The **Pine Plantation model** has been developed for use in mature radiata pine stands of age 20+ years. However, it can also be used to derive the rate of spread component for immature pine plantations of age 11-20. It could also be used with some caution for mature stands of other conifer species (e.g., other pines or Douglas-fir).

Rule of thumb: As a general indication, crowning is likely to occur in a mature pine stand pruned to 6 m once the fire intensity exceeds 4000 kW/m. Broader guidance on the likelihood of crown fire initiation can be obtained in Section H (see page H-1).

Future ahead

- Version 2
  - AFL & ROS tables updated for scrub and grass
  - Those who have V1 manuals will be sent new pages to replace
  - Available soon in new year
- Discussion
  - This is not a replacement of the green handbook *although the tables in here could be updated also!*
  - Before V2 is printed, what would you like to see included or changed?

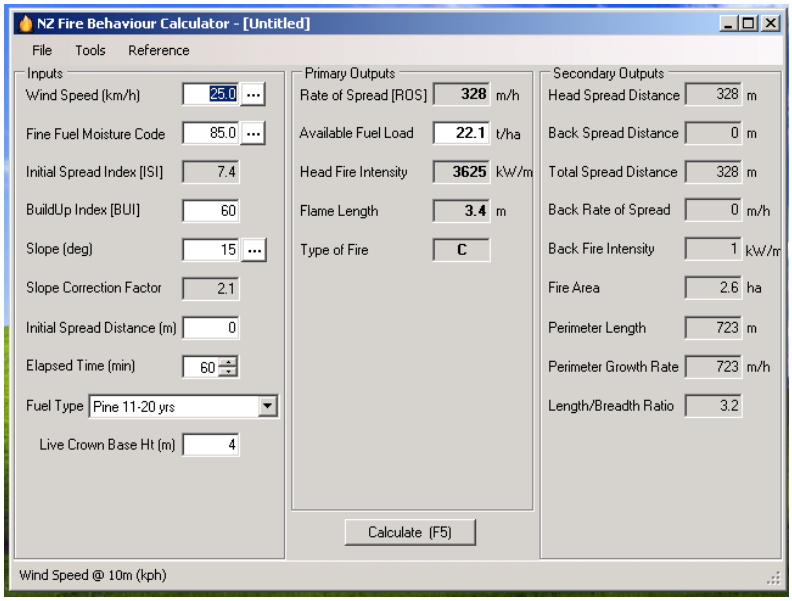
NZ Fire Behaviour Toolkit

- Designed for quick and easy calculations
- Currently used on a desktop or laptop
- Future use on handheld devices

•This is available for download (free of charge)
www.scionresearch.com/fire

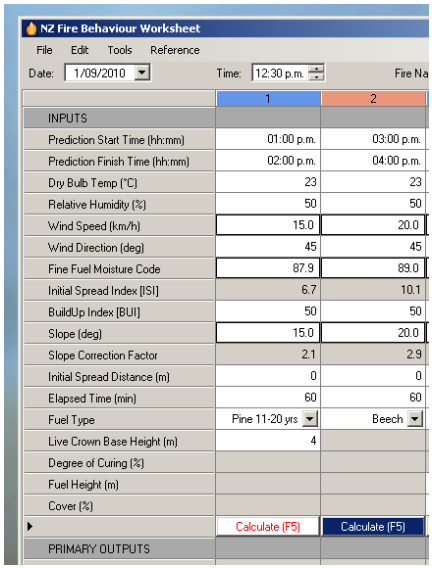
Calculator function

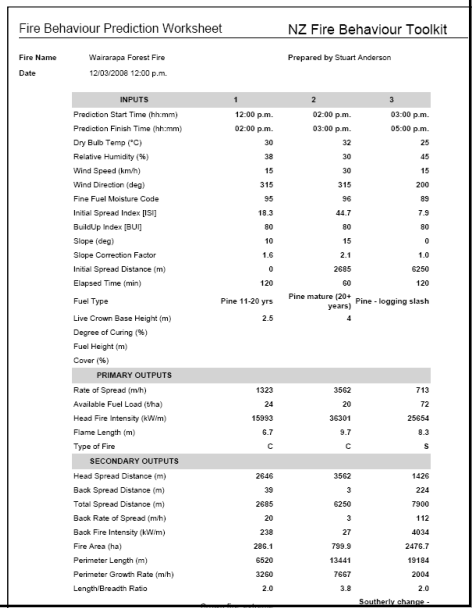
- Quick what if scenario



Worksheet function

- Detailed predictions, compare best & worst case



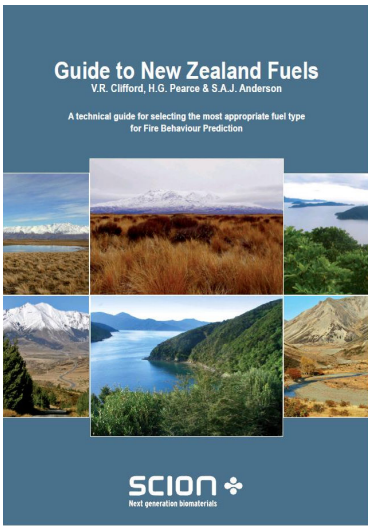


Future ahead

- Version 2
  - Updated with new ROS and AFL models
  - Printer error fixed (currently only those with adobe writers can make pdf's)
  - Available soon in new year
- Discussion
  - what is missing/what do you want included, such as:
    - Resource productivity function
    - FWI forecast 3 days ahead function
    - Basic calculator as an application on smart phones/hand held devices

Guide to New Zealand Fuels

- Select the most appropriate fire behaviour models
- Use with fire behaviour toolkit and manual
- Available as a stand alone book and an insert
- Available soon in new year



Immature Pine, age 11-20 years

Description

Immature pine aged 11 to 20 years is represented by areas of immature pine plantations with a closed canopy. Tree heights are in the order of 10 – 20 m, depending on the stand age, stocking and site productivity. Tree crowns overlap, and while there may still be scrub understorey present, this will generally reduce over time due to shading by the canopy. By the age of 20 years, scrub fuels may have disappeared altogether.

The forestry regime being managed for will also determine stand characteristics and therefore resulting fuel loads and fire behaviour. For example, framing grade timber stands will feature heavier and later thinning, with ladder fuels being present for longer than in similar aged board regime stands. Similarly, unmanaged pulpwood stands will have more ladder fuels, and a greater likelihood of crown fire occurrence.

The primary carrier of surface fire is the pine litter layer with some slash residue. High levels of understorey slash from pruning and thinning activities may decompose slowly, contributing to a build up of near-surface fuels. The presence of scrub fuels in these stands can act as ladder fuels, enabling torching or crowning to take place. Crown fires can initiate with ladder fuels and be supported by a closed canopy under moderately windy conditions.

15 year old pine stand. Canopy not fully closed, presence of scrub and slash residue on forest floor.
Location: Bottle Lake Forest.

Close up of 15 year old pine stand forest floor.
Location: Bottle Lake Forest.

16 year old pine stand. Canopy not fully closed, presence of scrub and slash residue on forest floor.
Location: Bottle Lake Forest.

Landscape view of pine stand.
Location: Gowan Lea Forest, Whitecliffs, Canterbury. Photo courtesy of Selwyn Plantation Board.

Fire Behaviour

Fuel loads and rate of spread models for immature pine aged 11 to 20 years are based on modifications of models for other coniferous forests derived from expert opinion. The rate of spread model assumes that pine litter and other surface fuels are the primary carriers of fire.

Available fuel loads (Figure 7a) are calculated from the **Immature Pine age 11-20 model** using the Buildup Index (BUI) (page D-3 of the Field Manual). Fuel loads are moderate compared to other pine models and can reach up to 26 t/ha.

Rate of fire spread (Figure 7b) is usually calculated from the **Mature pine plantations model** using the Initial Spread Index (ISI) and Buildup Index (BUI) (page E-2 of the Field Manual). A scrub rate of spread model can be used if scrub fuels are present and is the primary carrier of fire. Relatively low rates of spread are usually predicted, and reach 1940 m/h (1.9 km/h).

A spreading fire requires a relatively higher ISI than most other forest models due to the effect of the closed canopy on reducing the wind speed acting on a surface fire beneath the canopy. Moderate to extreme fire intensities are possible, especially with the occurrence of torching and crowning where ladder fuels are present.

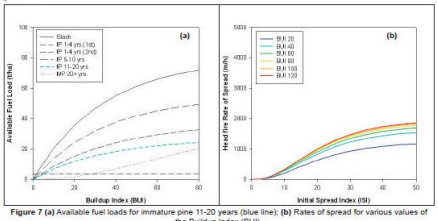


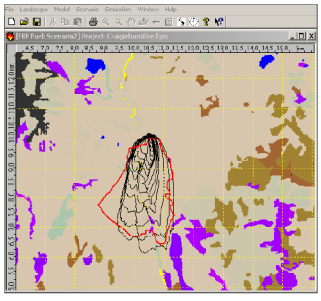
Figure 7 (a) Available fuel loads for immature pine 11-20 years (blue line); **(b)** Rates of spread for various values of the Buildup Index (BUI).

Future ahead

- Version 1
  - Available soon, released with V2 of Manual and toolkit in early new year
- Discussion
  - what is missing/what do you want included, such as:
    - Make this into a poster guide
    - Pine plantations look too clean – try North Island
    - Include a NZ grass curing guide similar to CFA
    - Other fuel types included i.e. rose hip, coastal grasses

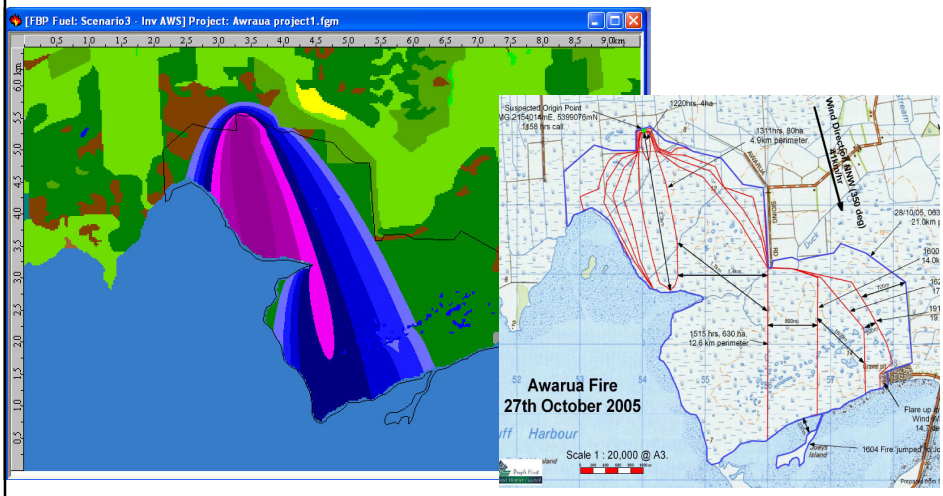
Fire Growth Simulation

- Project funded and supported by DOC
- Canadian tool *Prometheus* modified
- Software that simulates growth of fires across landscape
- It has been validated
- It can be used for:
  - Pre-planning
  - Operationally
  - Post-fire assessment



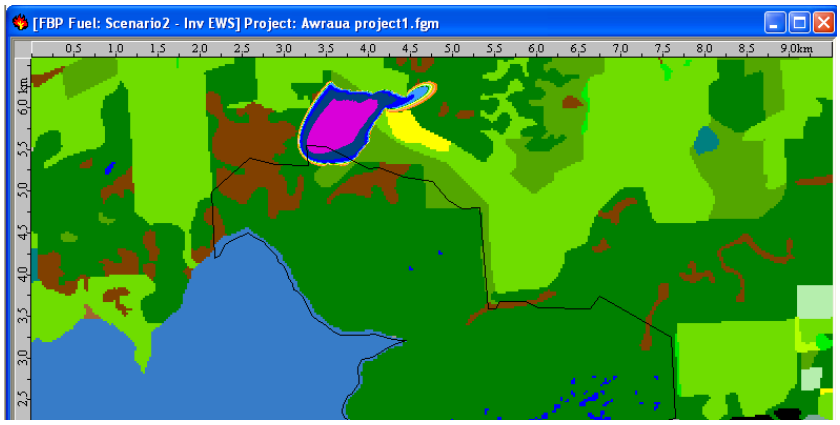
Example

- validation fire. simulated historical fire well



Example

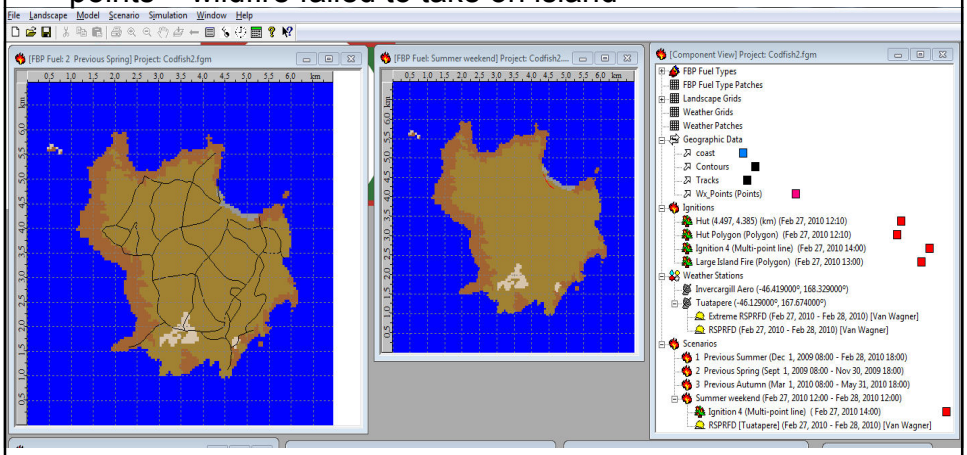
when it doesn't get it right
– value of reliable/right weather info



Example

pre-planning – likelihood of ignition on Codfish

- using 'Normal' to Extreme weather, and various ignition points = wildfire failed to take on island

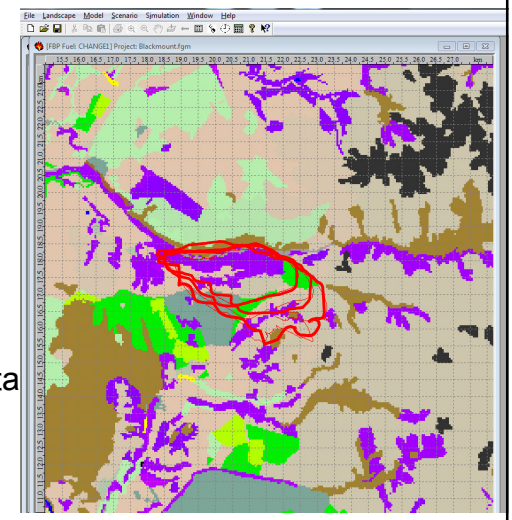


Slide provided by A. Buddle from SRFA

Example

Operationally - SRFA Rural Fire training exercise 2010 at Blackmount Forest

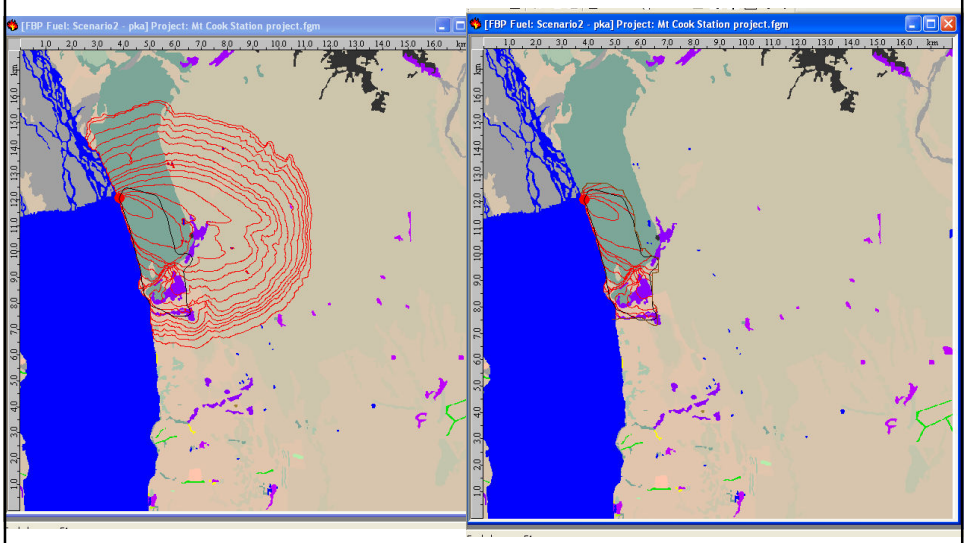
- Verdict:
  - Able to run 'real time' in operational scenario
  - Faster than green or orange manual
- Main issues
  - Documentation
  - Preparation of some data ahead of fire season



Slide provided by A. Buddle from SRFA

Examples

- Post fire investigation – values saved vs cost of suppression



16hrs Without suppression | With suppression

Future ahead

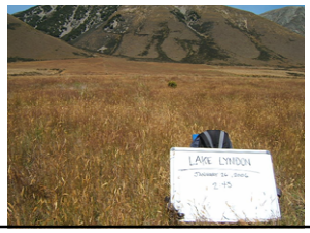
- Software available to trained operators
- Aimed at technical experts, not operational fire managers
  - GIS/Mapping, FBO/Situation in IMTs, and fire strategic planners (e.g. WTA)
  - Computing and GIS skills, fire behaviour understanding necessary
- Summary report available in new year
- NZ user guide available in new year

Discussion

- Current *Prometheus* users could share with others how they're using it.

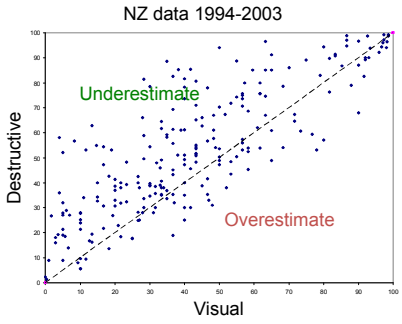
Grassland curing assessment

- aim to develop better methods to assess current and predicted levels of curing in grasslands
- grass “curing” refers to seasonal die-off of annual and perennial grasses
- key input into fire behaviour models and fire danger rating systems



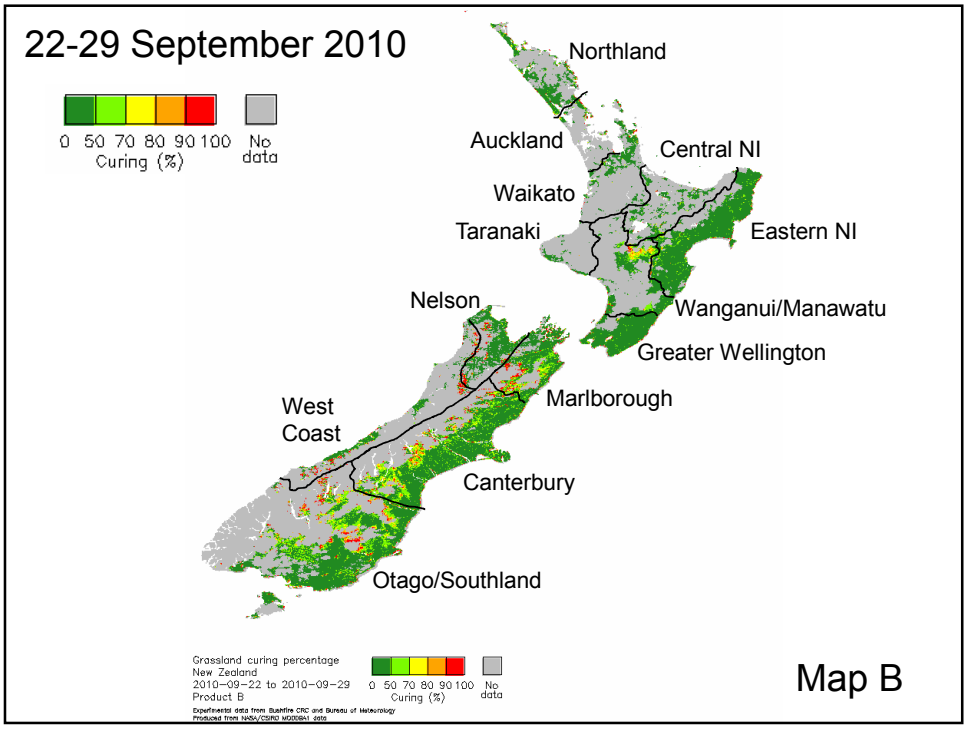
Visual assessment

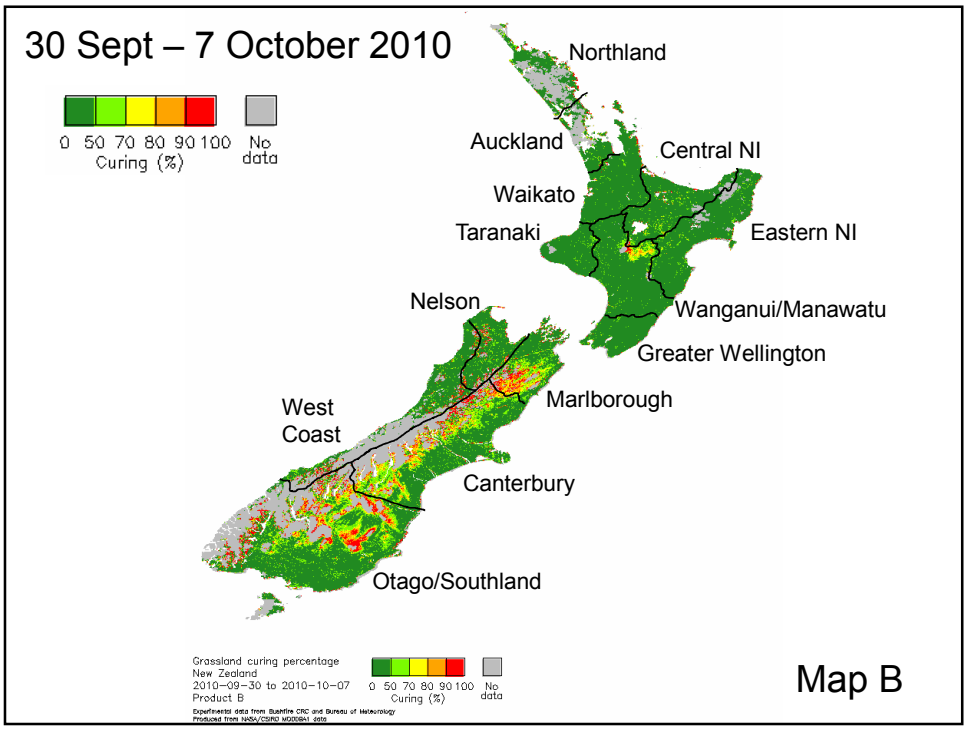
- often inaccurate – subjective, difficult & infrequent
- tendency to underestimate
- Need for a NZ grass curing guide?

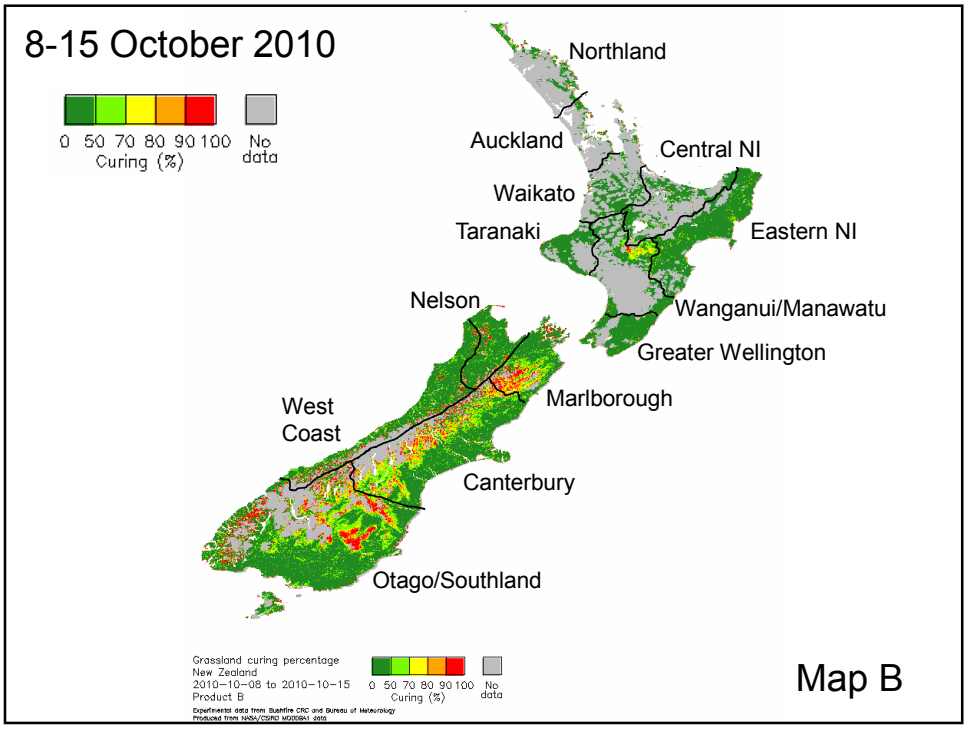


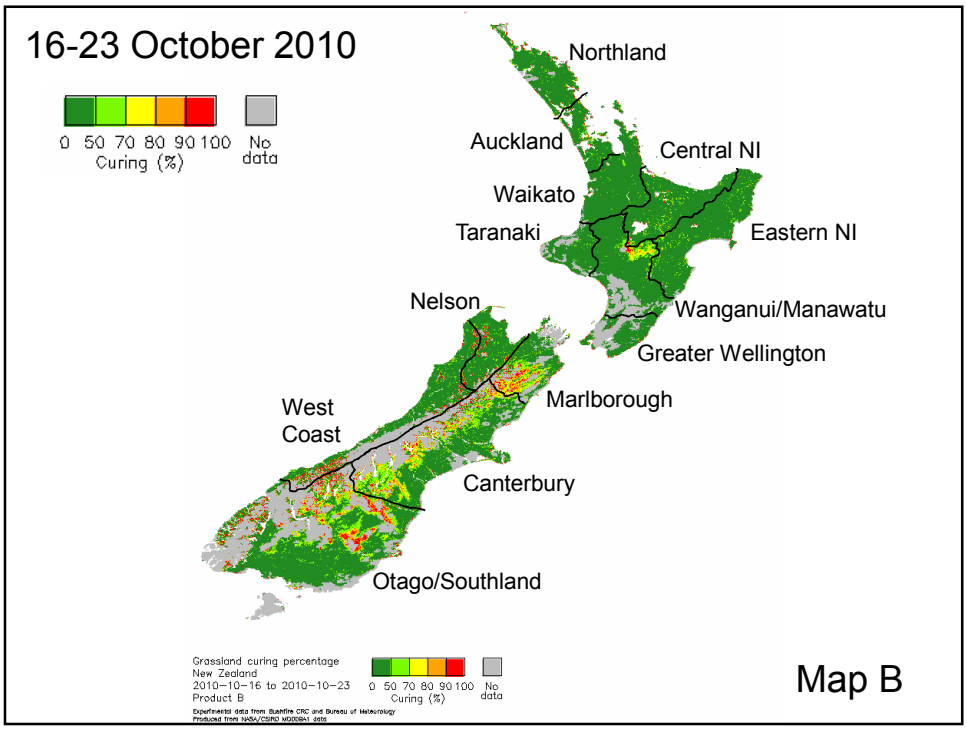
NZ pilot trial using Satellite images

- Conducted end of 2009/10 summer
  - Rank four maps provided by Aust BoM
  - To determine best product for NZ
- Repeat the same process but for entire season (September 2010 – April 2011)
  - Rank two maps (B & C)
  - To determine best product




30 Sept – 7 October 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-09-30 to 2010-10-07
Product B
0 50 70 80 90 100
Curing (%)
No data
Map B


8-15 October 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-10-08 to 2010-10-15
Product B
0 50 70 80 90 100
Curing (%)
No data
Map B


16-23 October 2010
0 50 70 80 90 100
Curing (%)
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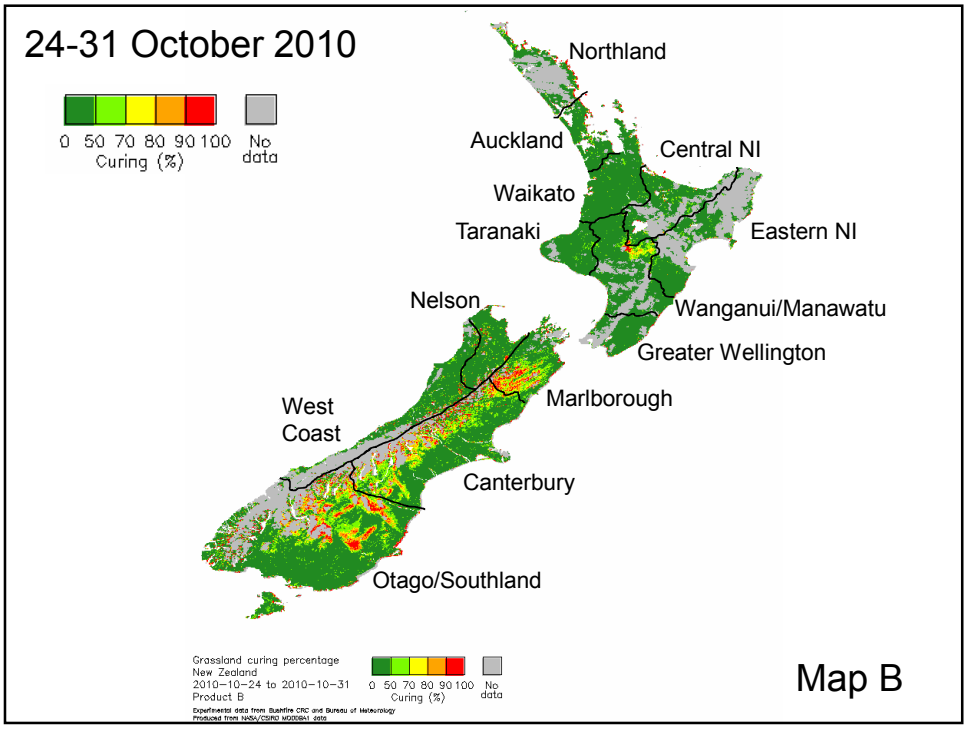
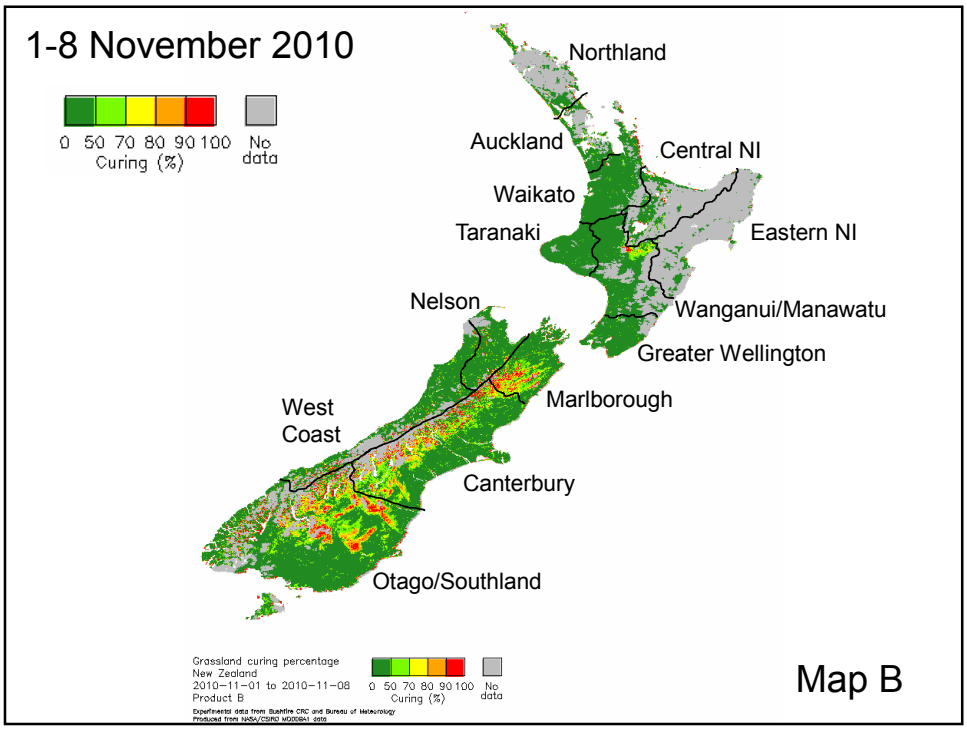
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-10-16 to 2010-10-23
Product B
0 50 70 80 90 100
Curing (%)
No data
Map B


24-31 October 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-10-24 to 2010-10-31
Product B
0 50 70 80 90 100
Curing (%)
No data
Map B


1-8 November 2010
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Curing (%)
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Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-11-01 to 2010-11-08
Product B
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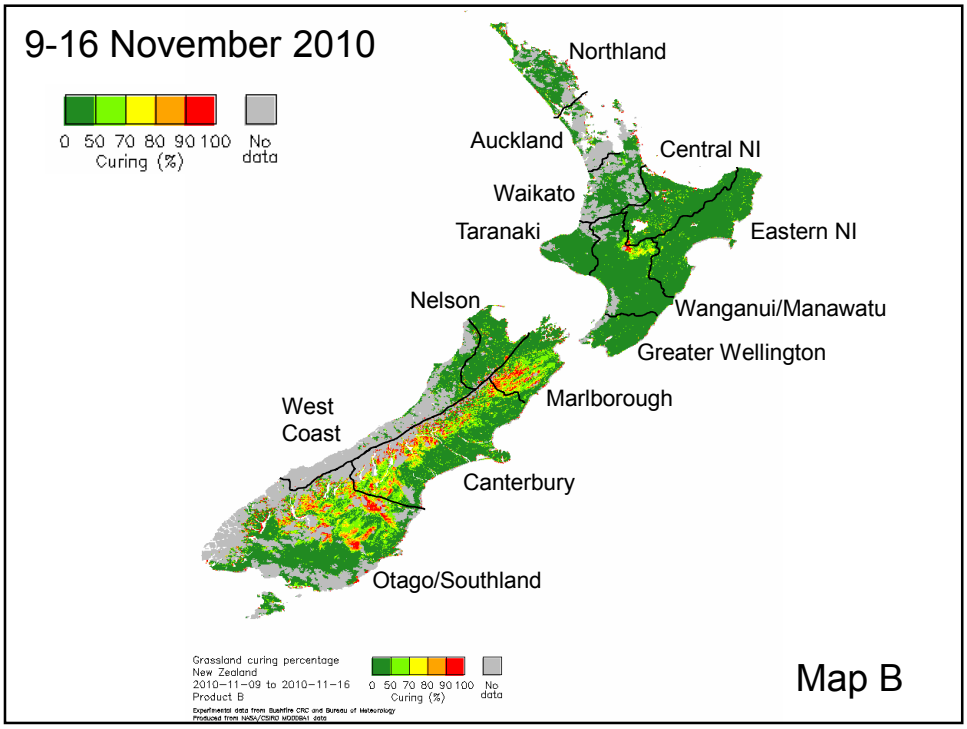
Curing (%)
No data
Map B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Curing (%)
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Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-11-09 to 2010-11-16
Product B
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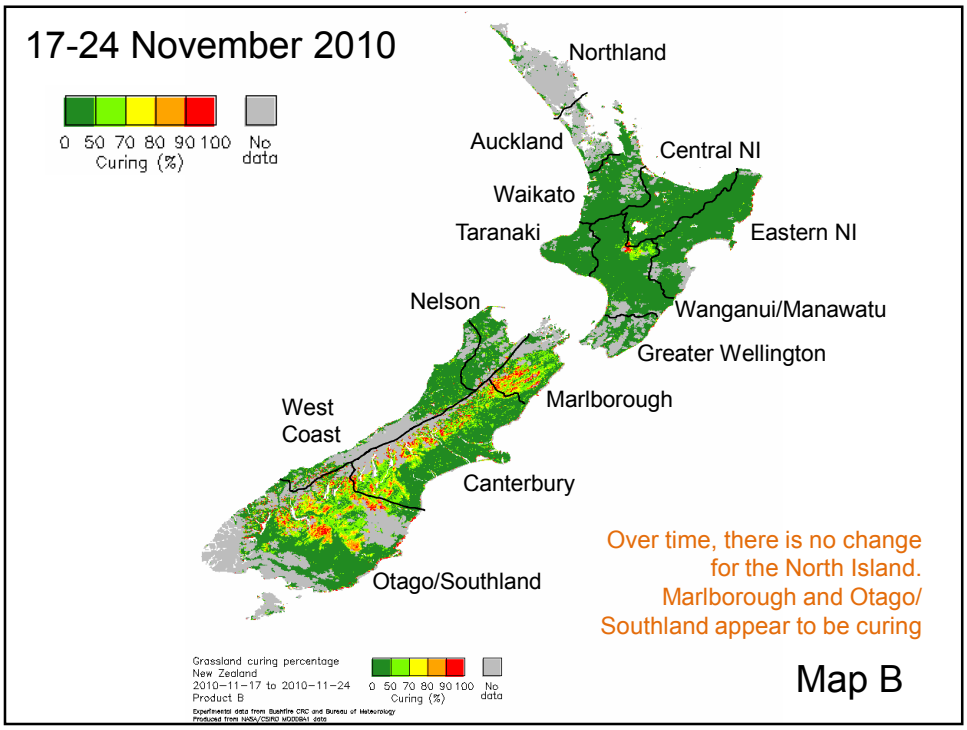
Curing (%)
No data
Map B


17-24 November 2010
0 50 70 80 90 100
Curing (%)
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Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Over time, there is no change for the North Island. Marlborough and Otago/ Southland appear to be curing
Grassland curing percentage
New Zealand
2010-11-17 to 2010-11-24
Product B
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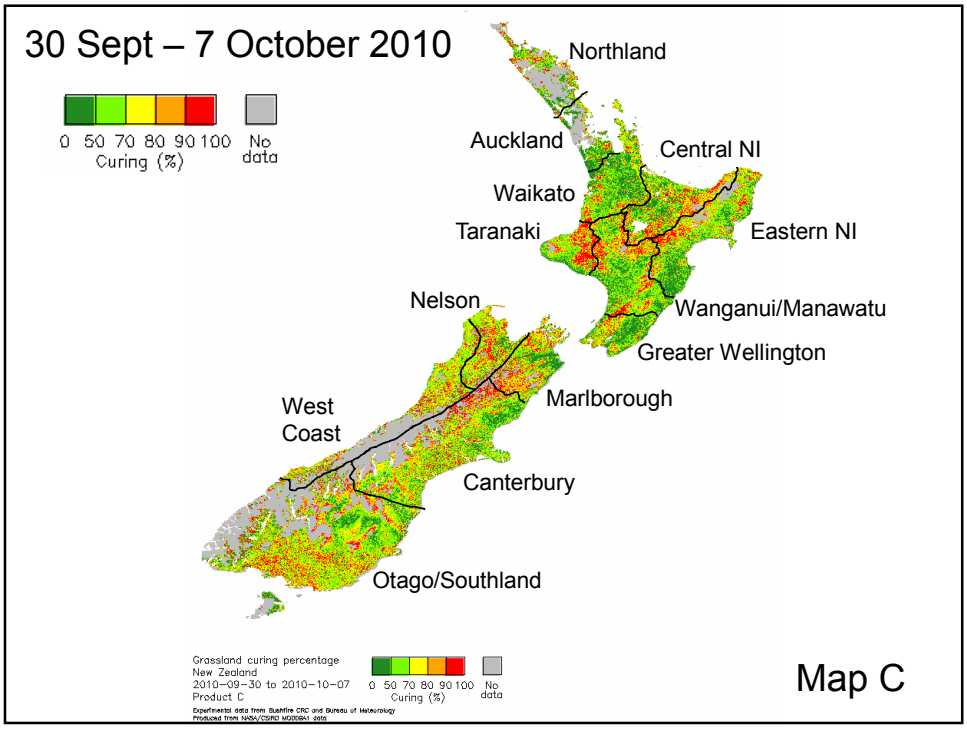
Curing (%)
No data
Map B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Curing (%)
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Northland
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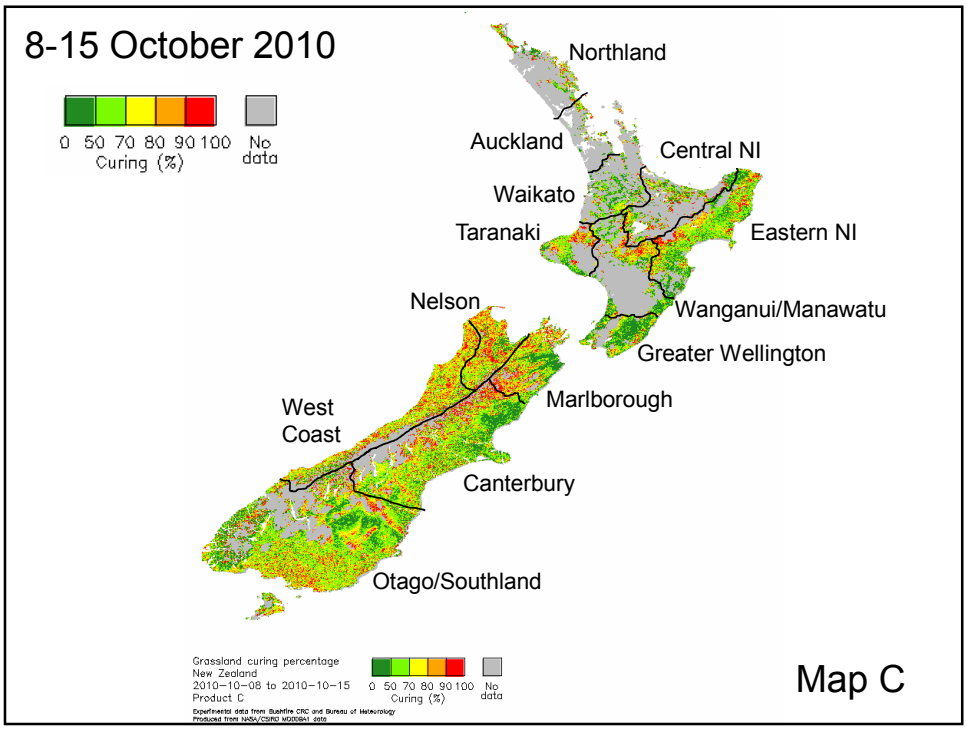
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-09-30 to 2010-10-07
Product C
0 50 70 80 90 100
Curing (%)
No data
Map C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New Zealand
2010-10-08 to 2010-10-15
Product C
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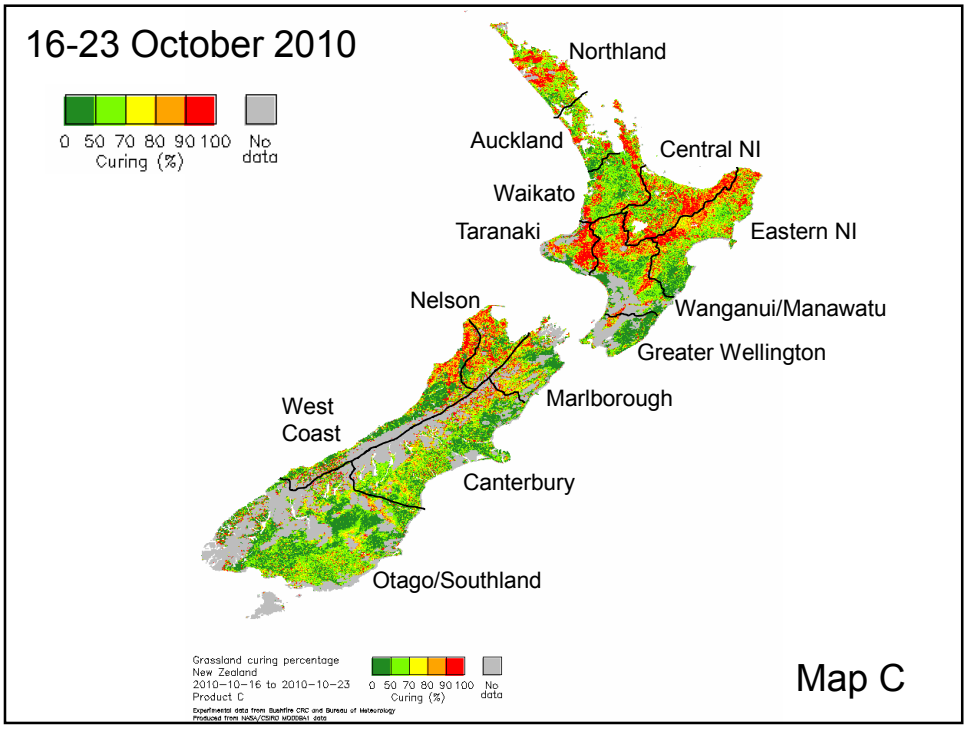
Curing (%)
No data
Map C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Product C
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Curing (%)
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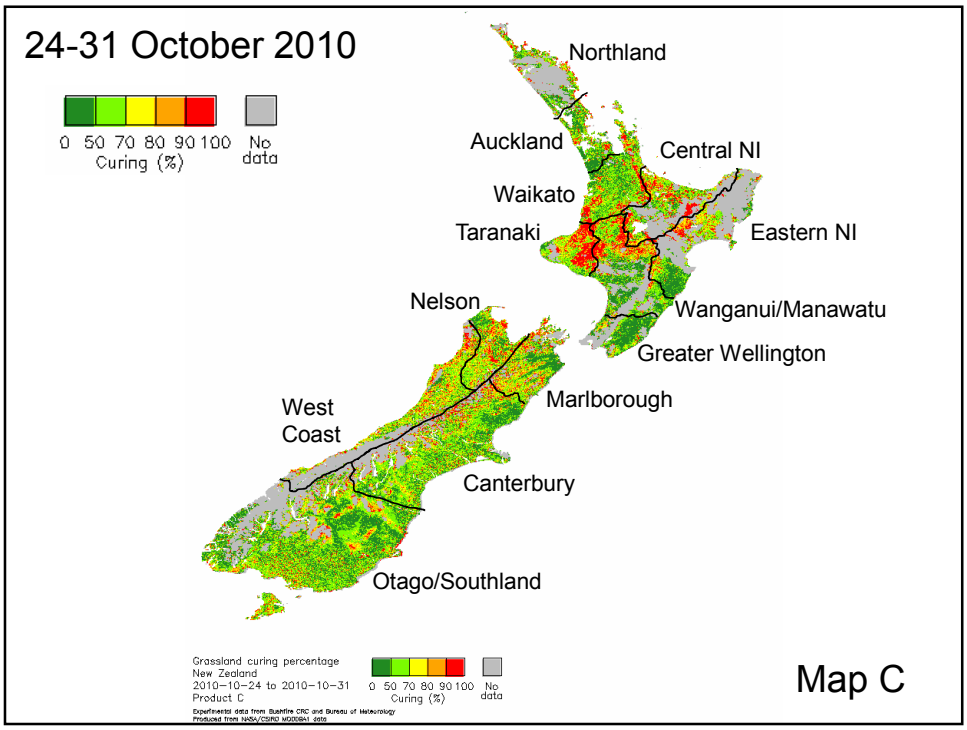
Map C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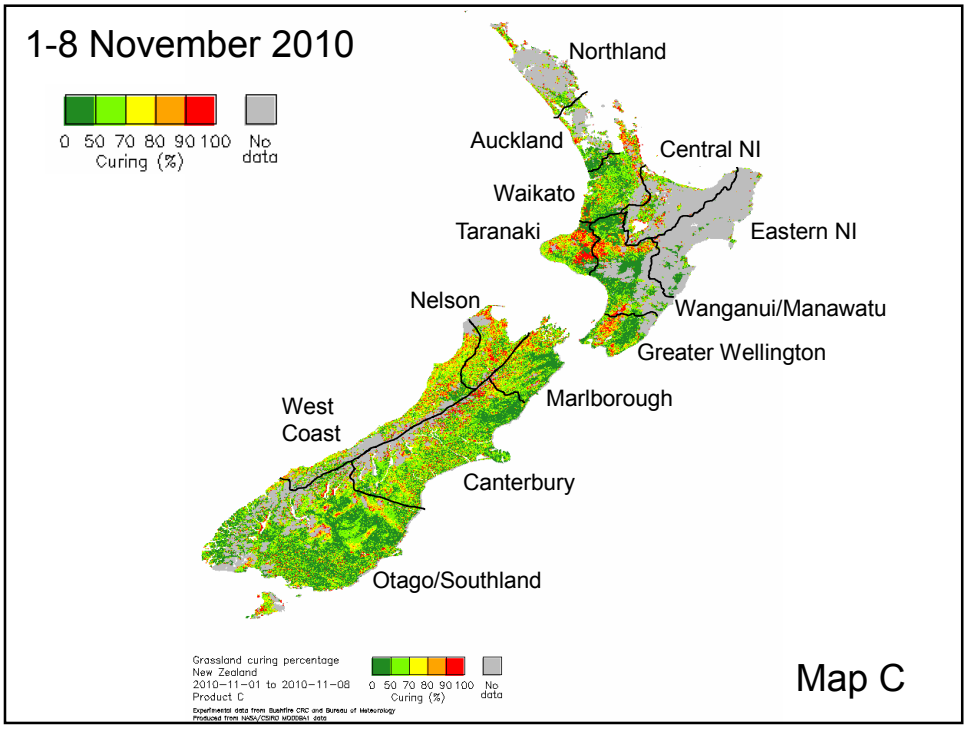
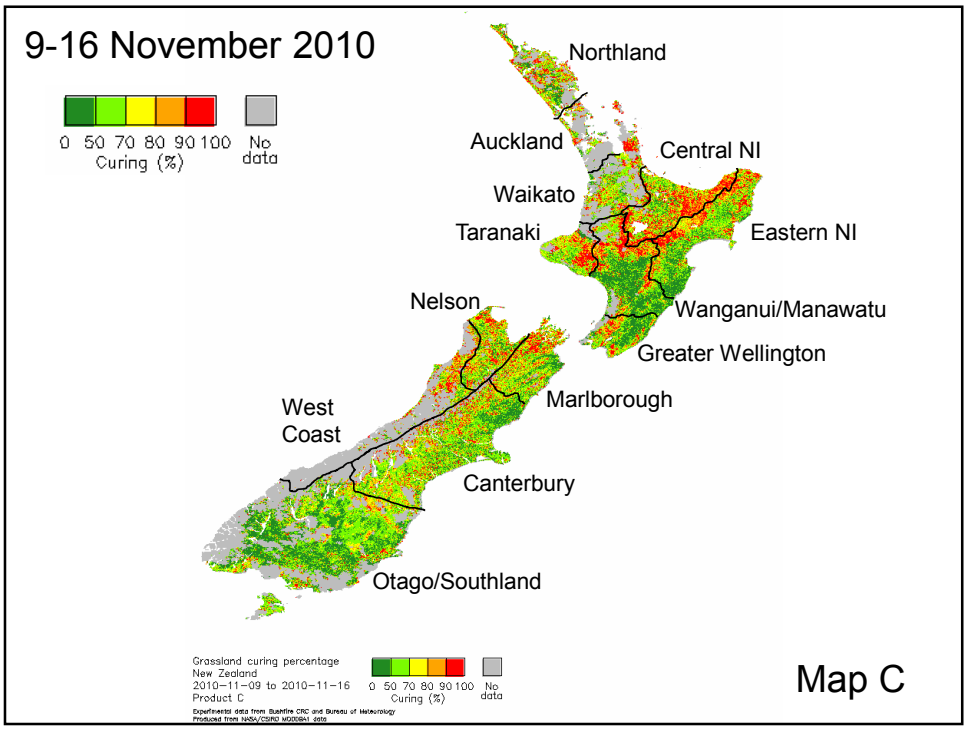
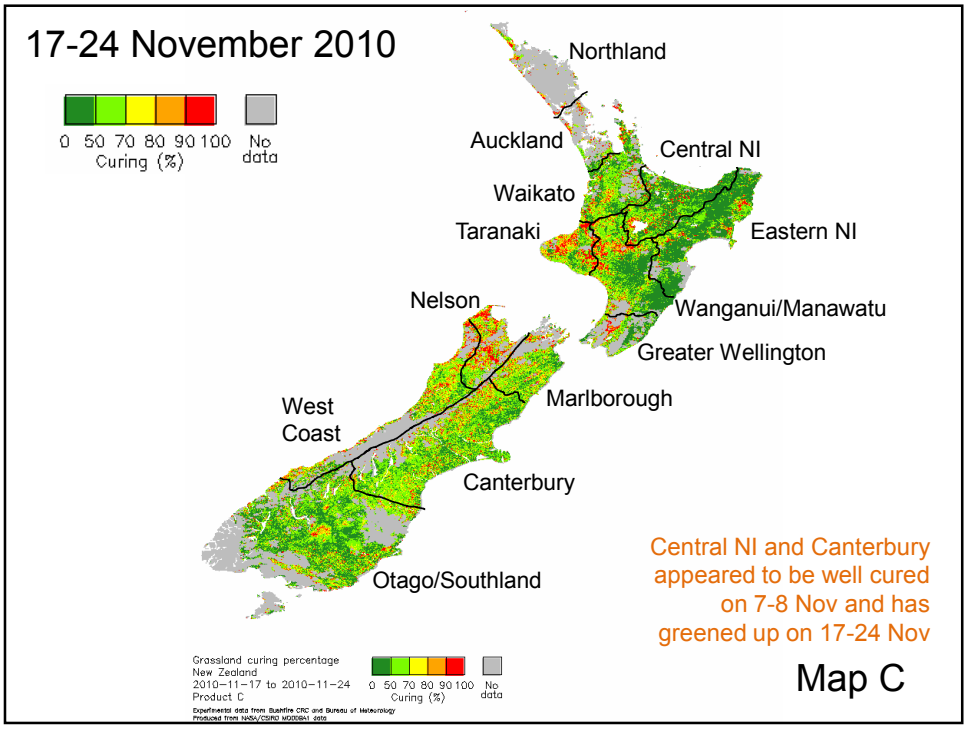
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-10-24 to 2010-10-31
Product C
0 50 70 80 90 100
Curing (%)
No data
Map C


1-8 November 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-11-01 to 2010-11-08
Product C
0 50 70 80 90 100
Curing (%)
No data
Map C


9-16 November 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Grassland curing percentage
New Zealand
2010-11-09 to 2010-11-16
Product C
Map C


17-24 November 2010
0 50 70 80 90 100
Curing (%)
No data
Northland
Auckland
Central NI
Waikato
Taranaki
Eastern NI
Nelson
Wanganui/Manawatu
Greater Wellington
Marlborough
West Coast
Canterbury
Otago/Southland
Central NI and Canterbury appeared to be well cured on 7-8 Nov and has greened up on 17-24 Nov
Grassland curing percentage
New Zealand
2010-11-17 to 2010-11-24
Product C
Map C

Future ahead

- Continuing with full season trial
- Explore implementation options (provider, coord. agency)
  - Web based instead of email alerts

Discussion:

- More enduser feedback please!
  - Paul Baker and Mike Grant in the lead
- Limitations: clouds, non-grassland cover, resolution 500m)

Summary

Latest tools for fire behaviour prediction:

1. Manual for Predicting Fire Behaviour
2. NZ Fire Behaviour Toolkit
3. Photoguide to NZ fuels
4. Prometheus
5. Satellite Imagery for grassland curing

Tools training workshops & IFB refreshers

- Nelson & Alexandra
- Christchurch x2