The role of temporal imagery in improving land cover and land use mapping from satellite imagery

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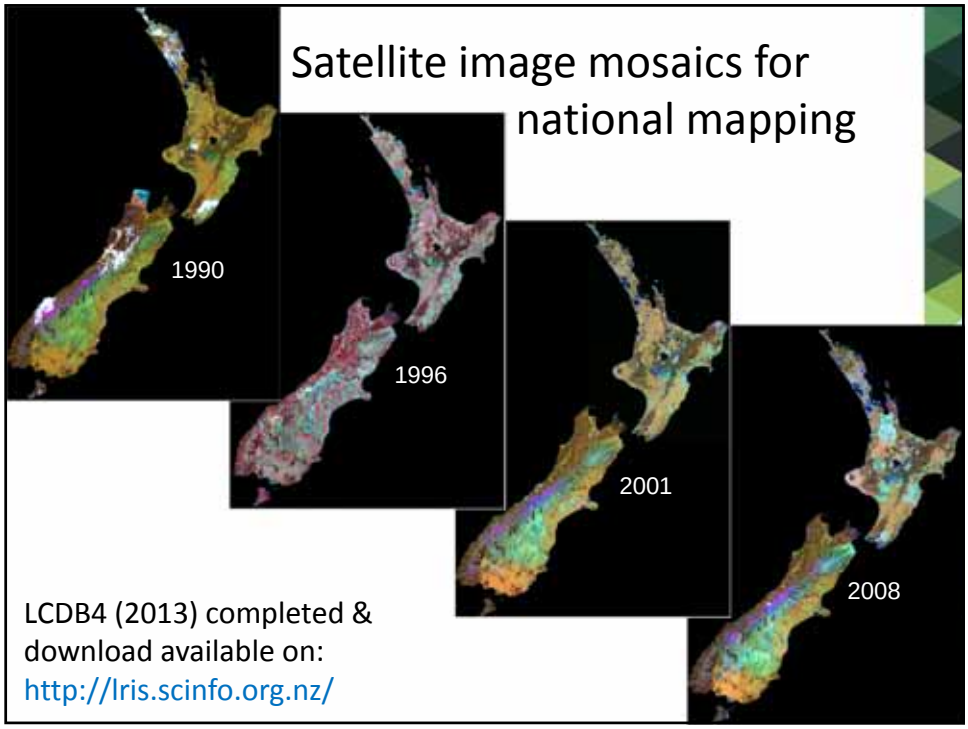
Two national mapping programmes in NZ

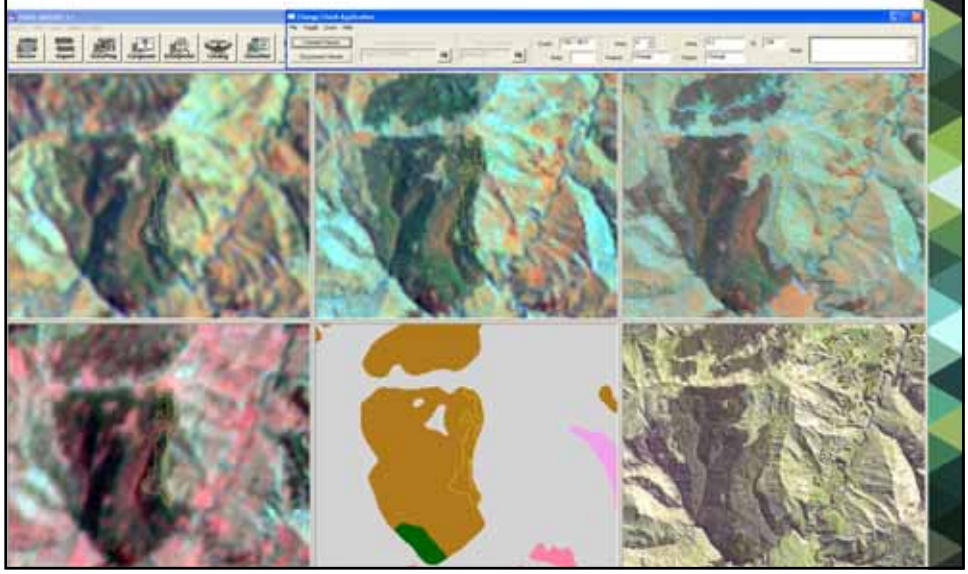
	Kyoto Land Use Map (LUM)	NZ Land Cover Database (LCDB)
Client	Ministry for the Environment	Ministry for Science and Innovation
Format	Vector	Vector
MMU	1 ha	1 ha
Polygons	500,000	500,000
Classes	12	34
Dates	1990, 2008, 2012, 2017?	1996, 2001, 2008, 2012, 2017?...
Sources	Satellite imagery, aerial photography, sector monitoring programmes, other databases	Satellite imagery, stakeholder verification, other databases
Used for	International & national reporting of land use changes (Kyoto Protocol, UNFCCC)	Environmental analysis, reporting and management locally, regionally and nationally

Satellite image mosaics for national mapping

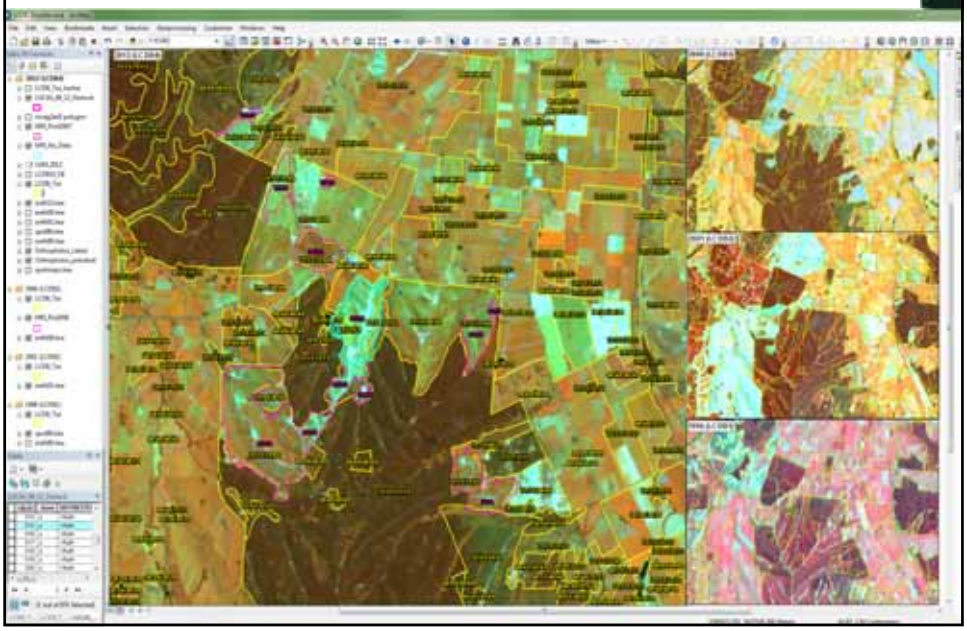


LCDB4 (2013) completed & download available on:
http://lris.scinfo.org.nz/

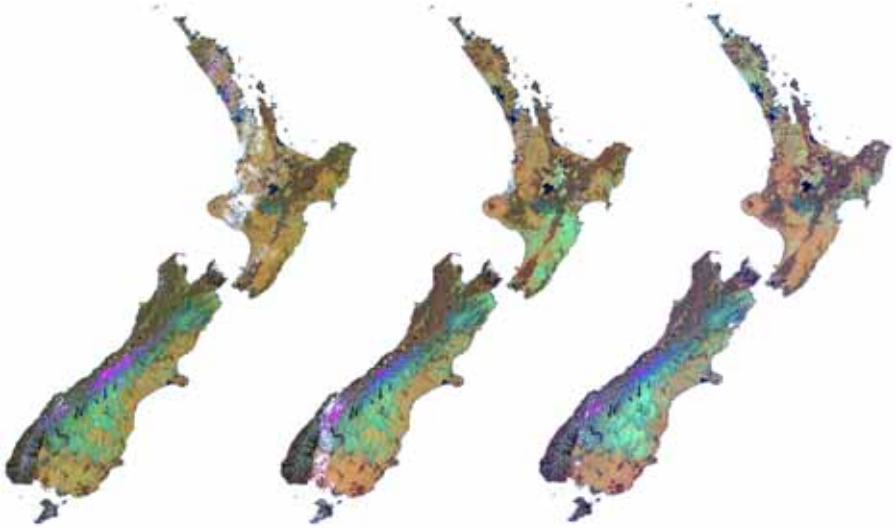
Screening potential change – automatically generated sites



LCDB Mapping Environment (using ArcGIS)



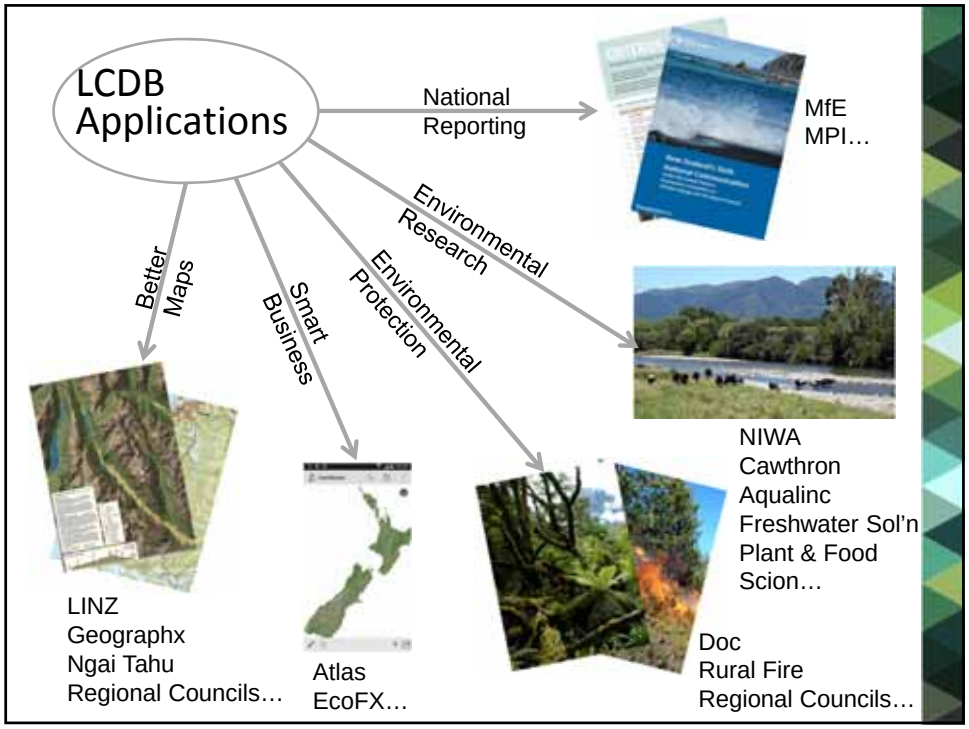
Timed mosaics



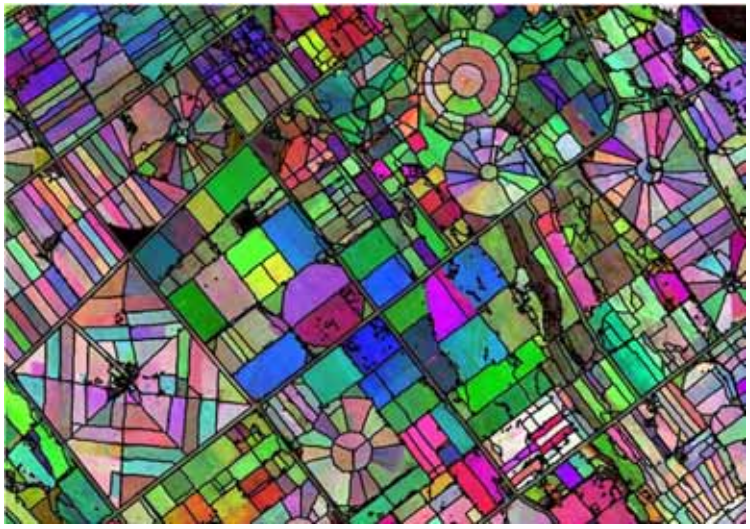
2011/12
Oct 11 – Feb 12

2012/13
Oct 12 – Feb 13

2013/14
Nov 13 – Feb 14



More detailed land use mapping for regions & districts




Different crops can look exactly the same: Potatoes, turnips, pasture, clover, & lucerne are not spectrally separable at some stages of their growth cycles


One crop can look completely different at different times: Potatoes at various stages of their growth

Time series of satellite images

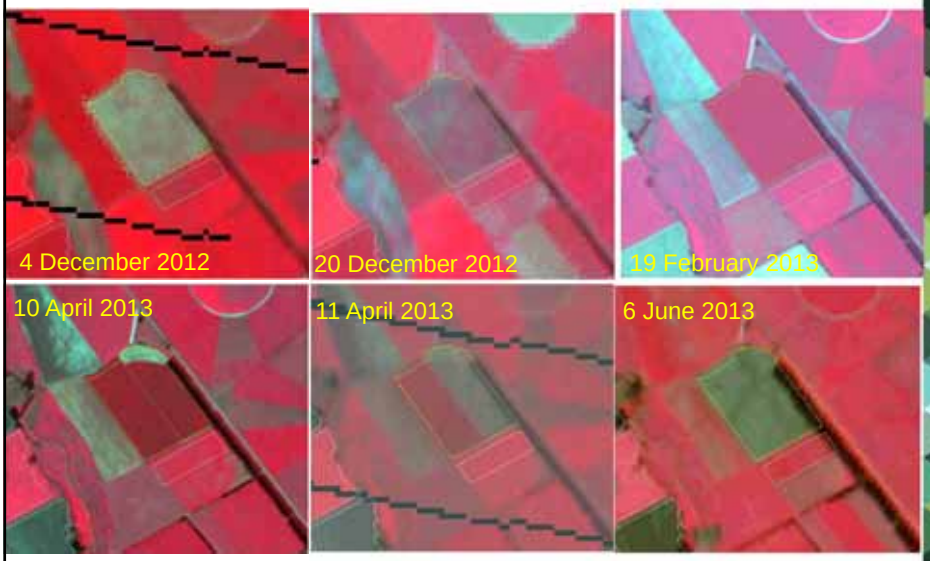
The challenge of land use mapping: not just what but when & why

Most crops have multiple uses, e.g.

Grass – pasture for grazing, to make hay, to harvest for seed
Oats – grain crop, winter forage for cows and sheep
Carrots – fresh for market, to harvest for seed
Kale – winter forage for cows, to harvest for seed
Maize – green feed for livestock, harvested to make silage

The different uses affect when the crop is planted, how long it is left in the ground, when it is harvested, and also it's environmental impact

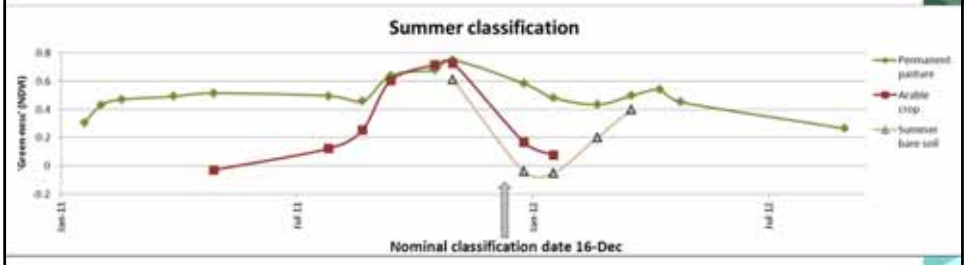
Temporal sequences to aid crop identification: Maize for silage.



Plants were ~20-30cm high on 20 December. Full canopy coverage February 2013. Harvesting began 10 April & was half complete on the 11th. Paddock is fallow June 2013. Imagery is Landsat-7 & -8 and SPOT-5.

Broad land use types for summer classification (16-Dec)

-Uses images from 12 months before to 9 months after classification date



Graph shows examples of real paddocks in these classes
Each graph point is extracted from a satellite image at the given date
Expressed as 'green-ness' of paddock (Normalised Difference Vegetation Index -NDVI)

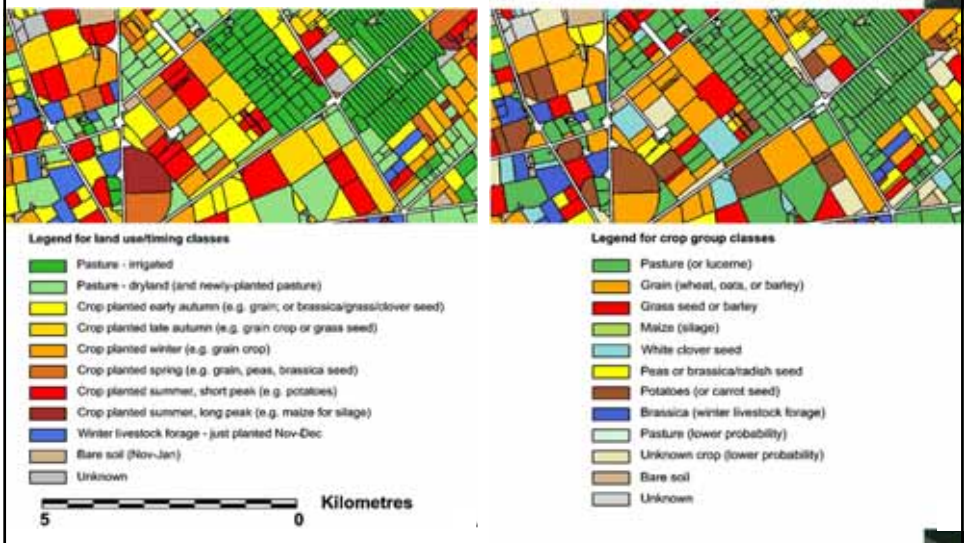
Classification steps

Identify paddocks

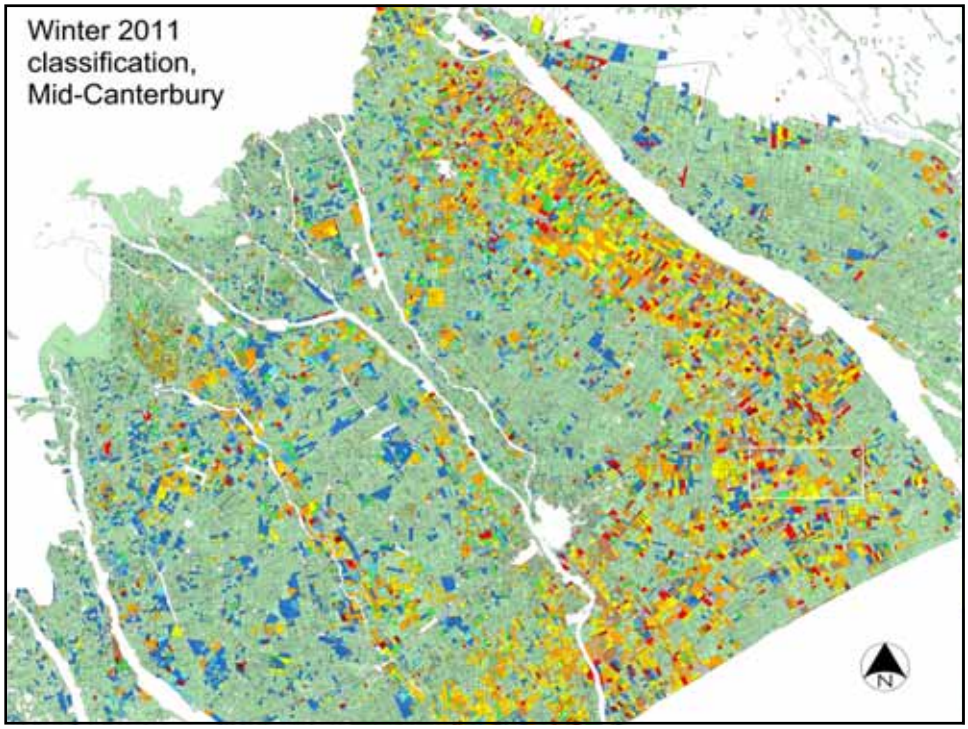
Match paddock temporal profiles to model curves

Spectral classification at NDVI peak (crop groups)

Timing and crop type information produced by summer classification



Timing & crop-type information produced by the winter classification



Current-near future mapping improvements from:

- More free-to-download satellite services with improved spatial, spectral and temporal resolutions
- Better pre-processing, especially geometric orthorectification, calibration, & higher level image products – e.g. cloud masks
- Incorporation of textural information from synthetic aperture radars
- Incorporation of better DEMs & canopy height information from LiDAR