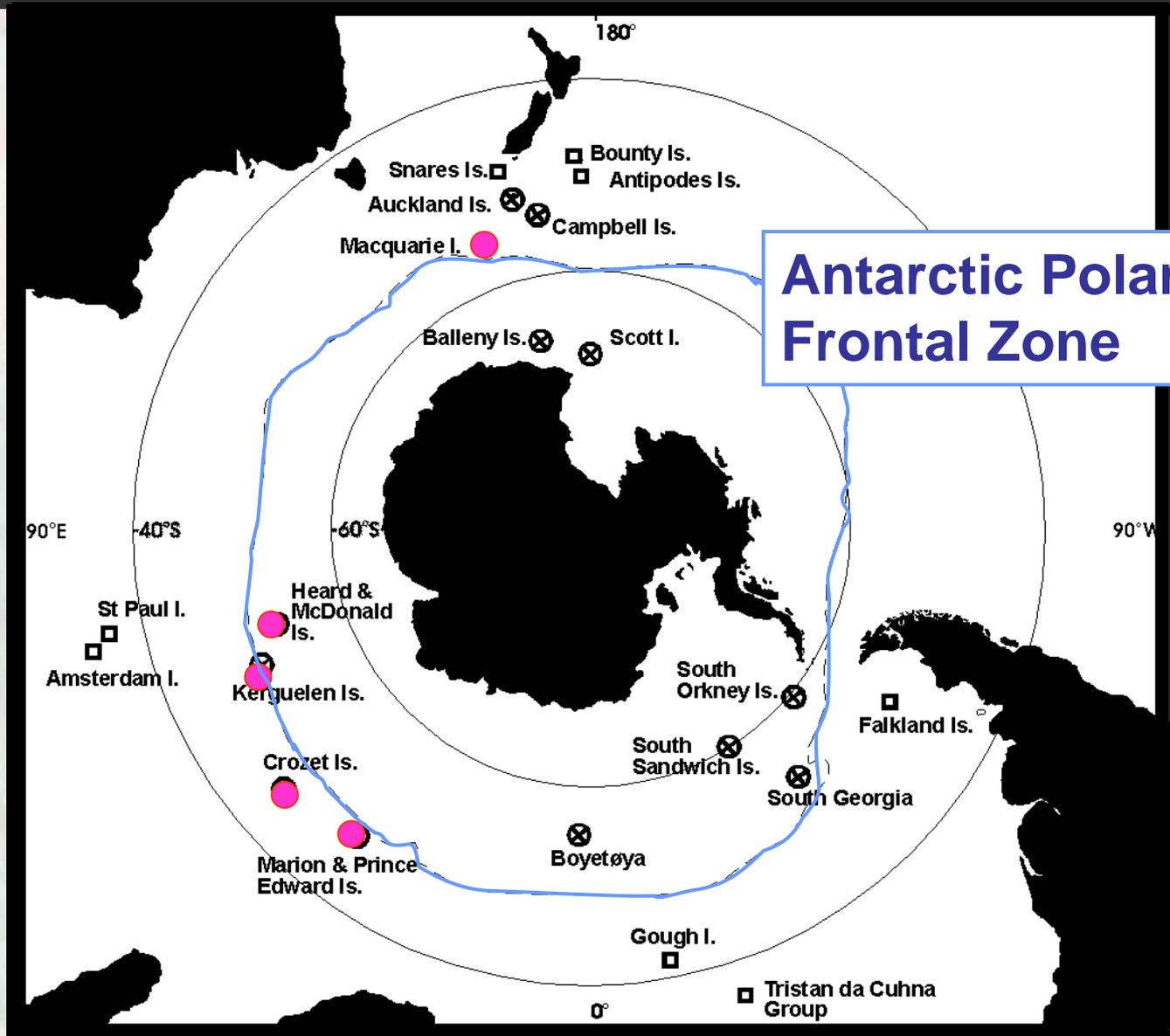


Texture-based random forest classification of sub-Antarctic vegetation on Macquarie Island from QuickBird and WorldView-2 imagery

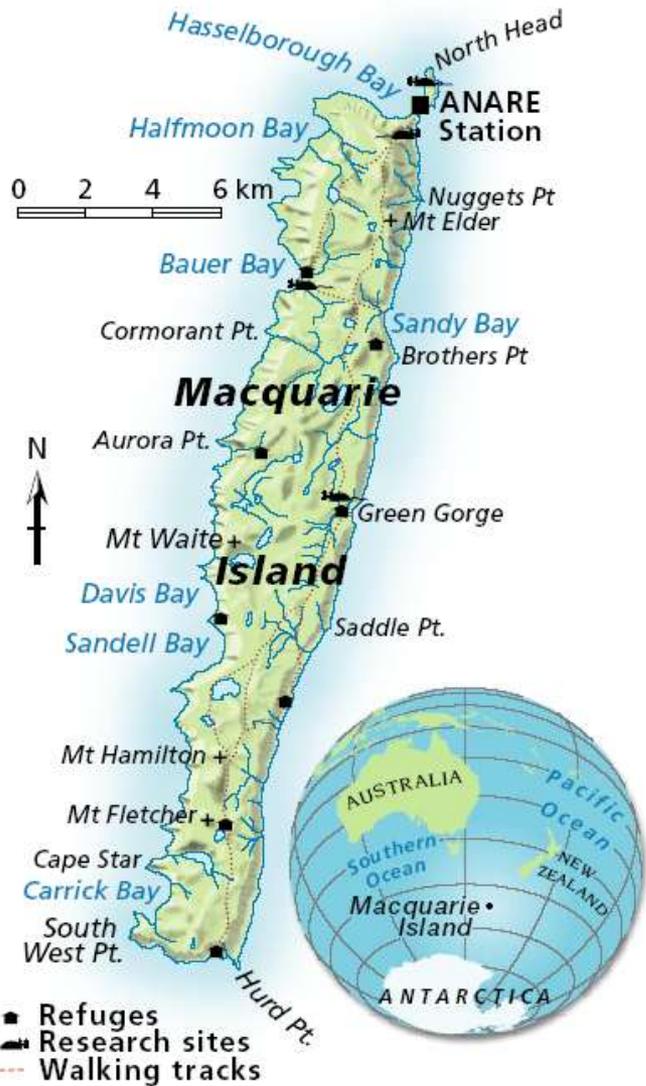
Arko Lucieer and Harald van der Werff
School of Geography and Environmental Studies,
University of Tasmania



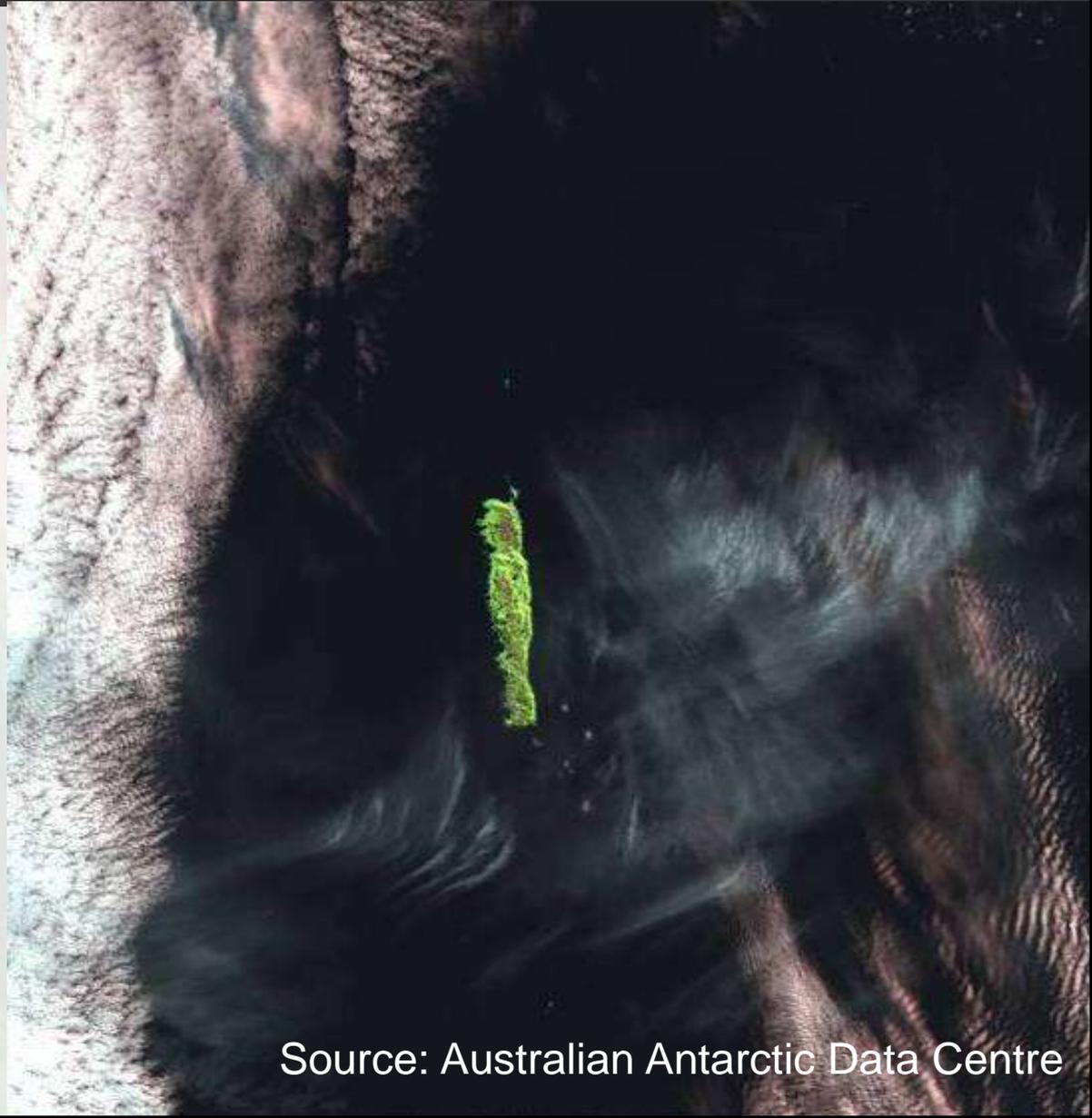
The 12th International Circumpolar Remote Sensing Symposium
Levi, Finland, 14 – 18 May 2012



Macquarie Island

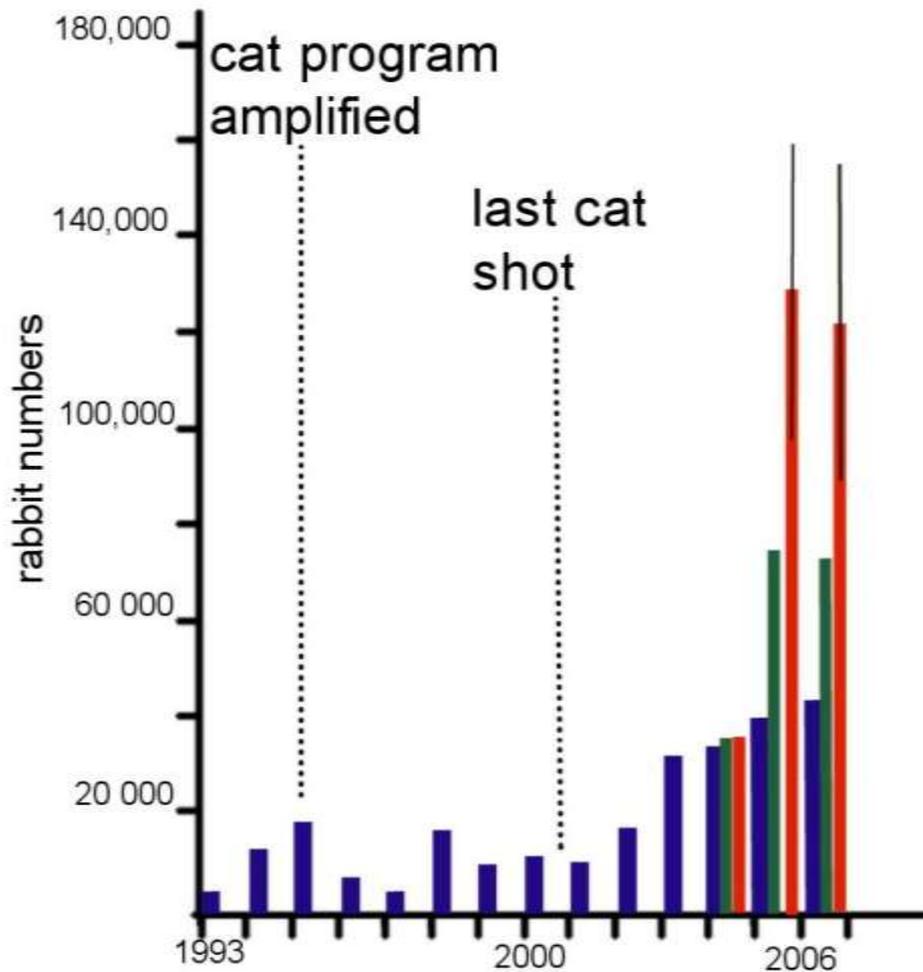


INFO COURTESY: AUSTRALIAN ANTARCTIC DIVISION
AUSTRALIAN GEOGRAPHIC CARTOGRAPHIC DIVISION

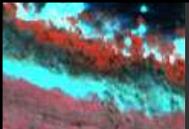


Source: Australian Antarctic Data Centre

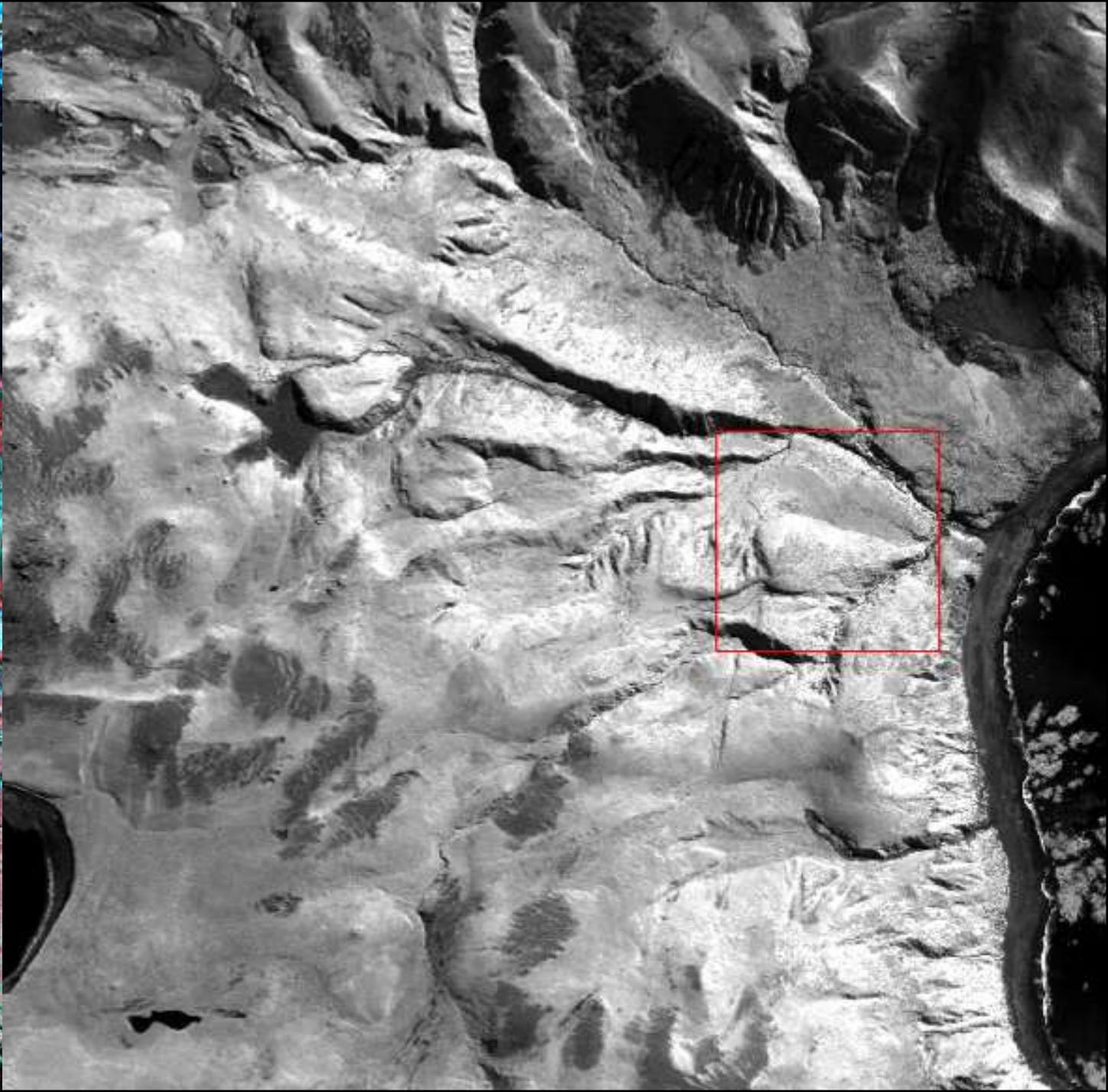
Rabbit numbers



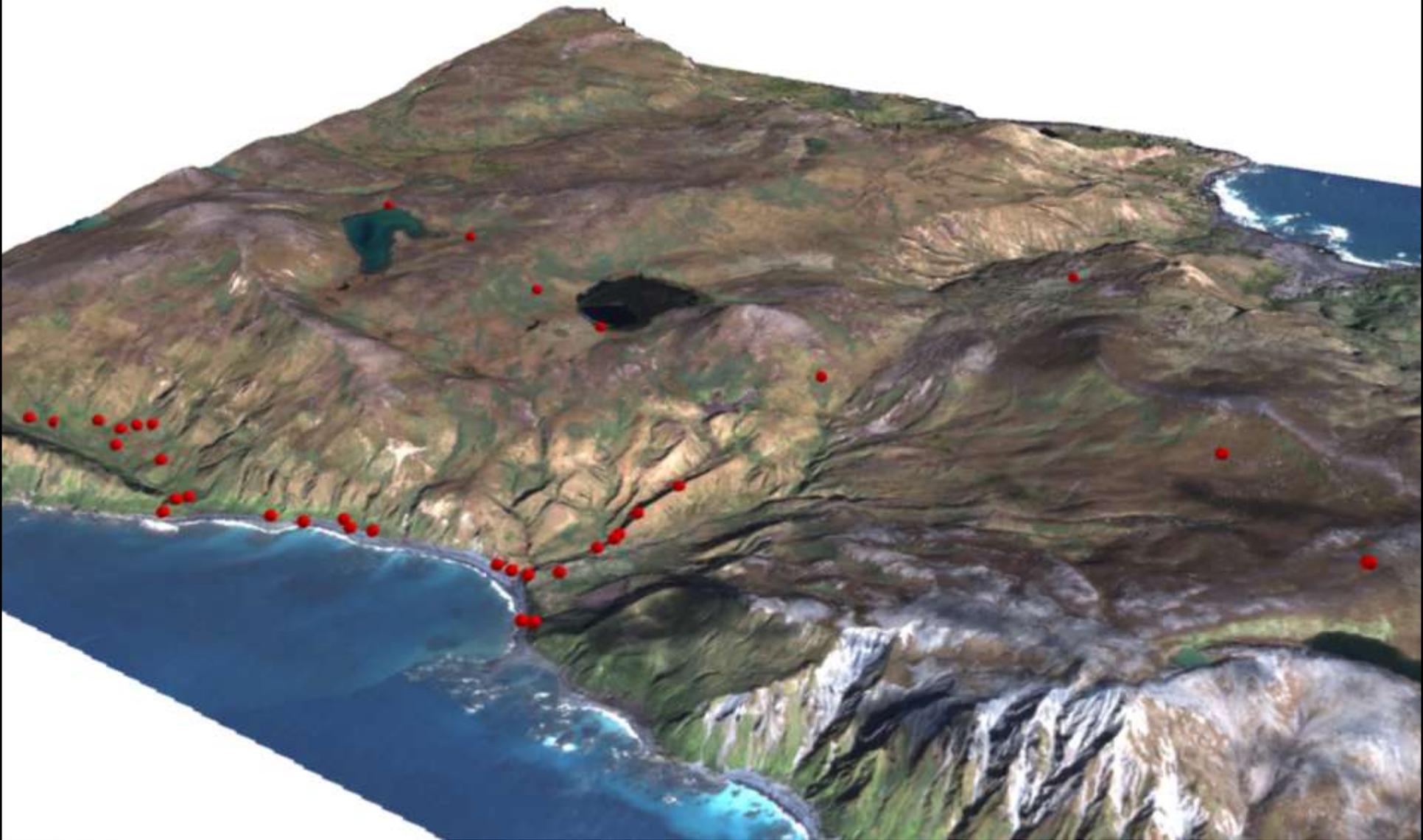
Source: Parks & Wildlife Service Tasmania, Keith Springer

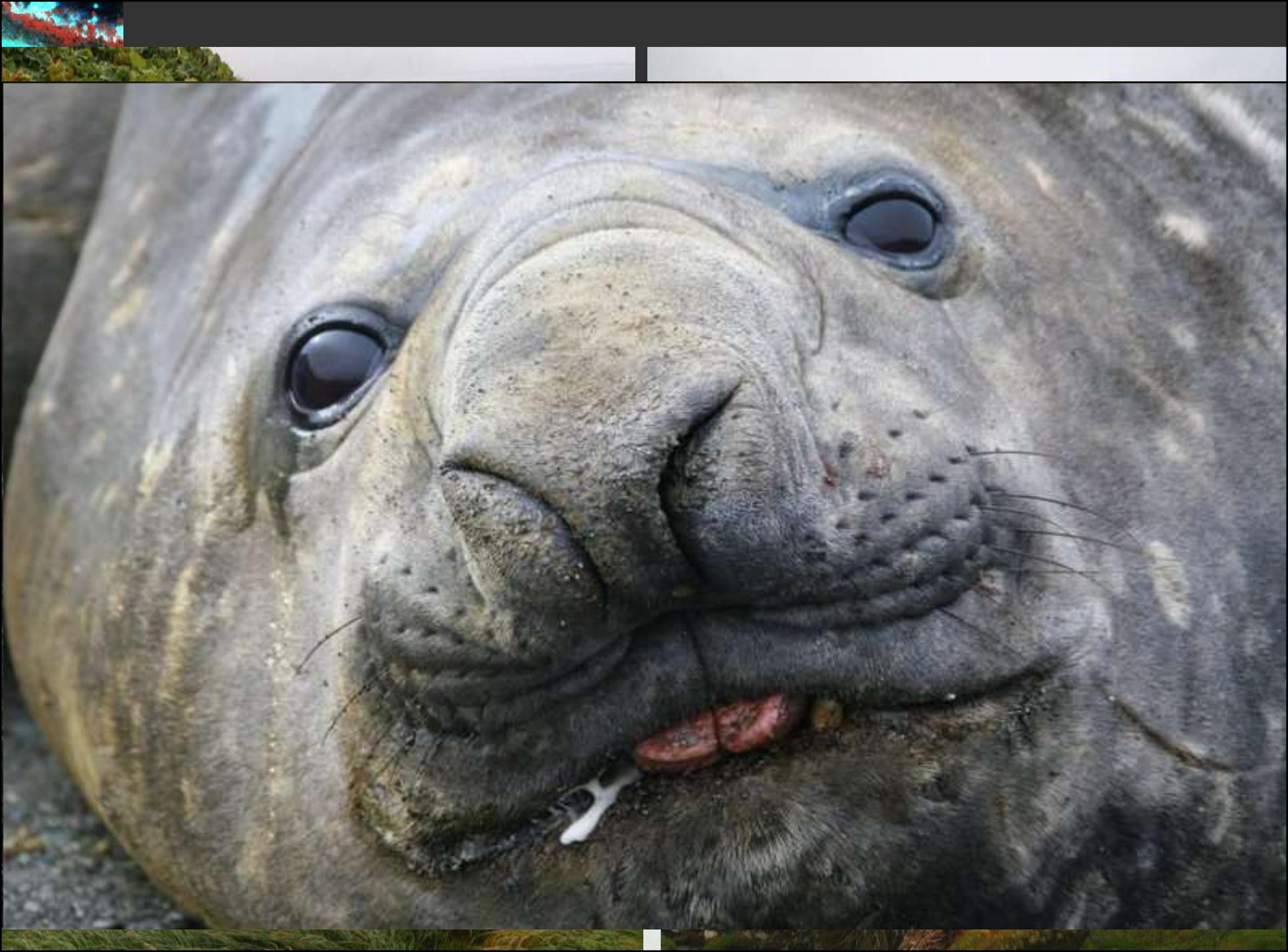


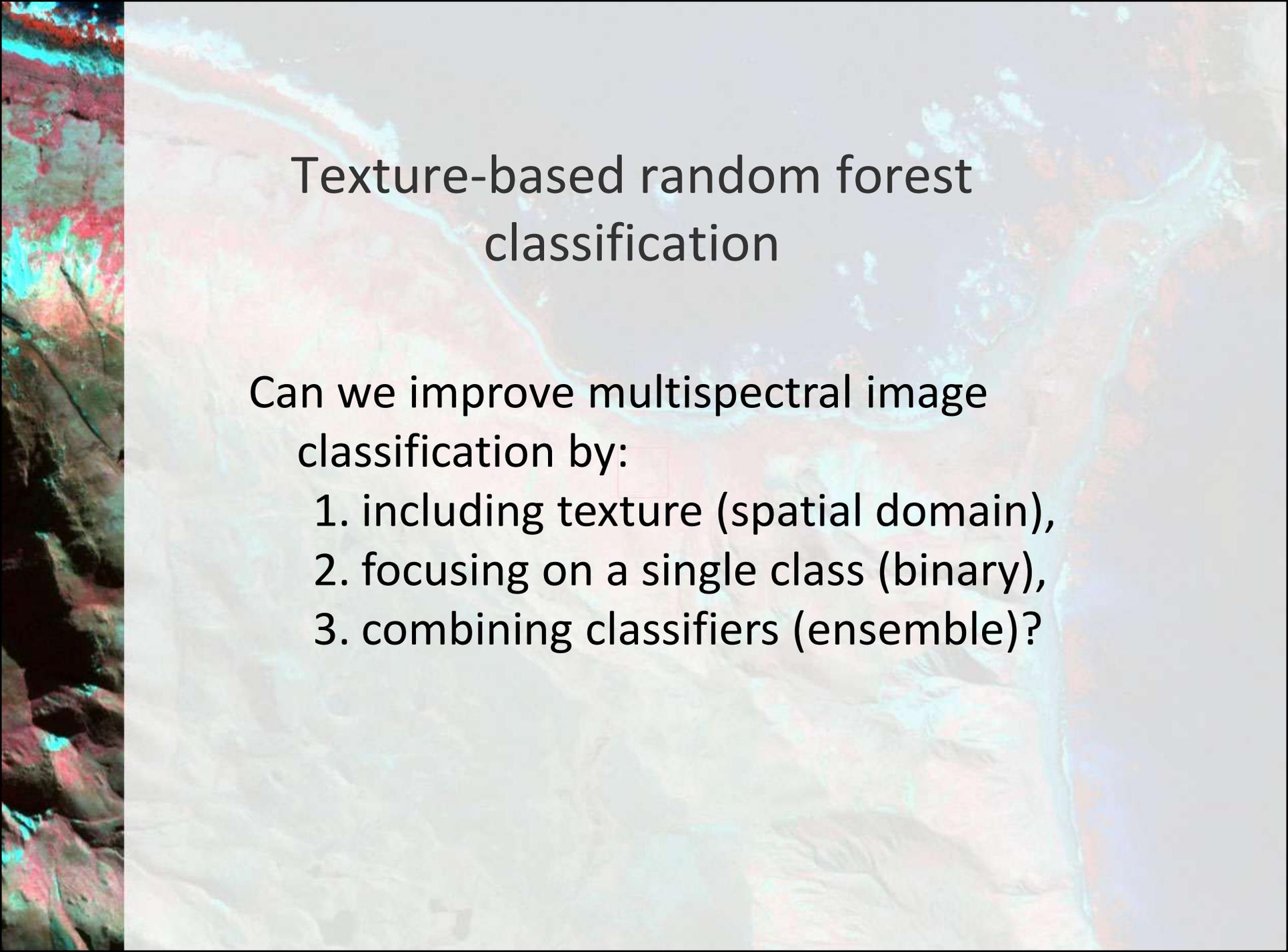




Field input for classification





The background of the slide is a large, semi-transparent aerial multispectral image of a landscape. It shows a winding river or stream, likely the Amazon, cutting through a dense forest. The colors are non-natural, representing different spectral bands, with shades of red, green, and blue. The text is overlaid on this image.

Texture-based random forest classification

Can we improve multispectral image classification by:

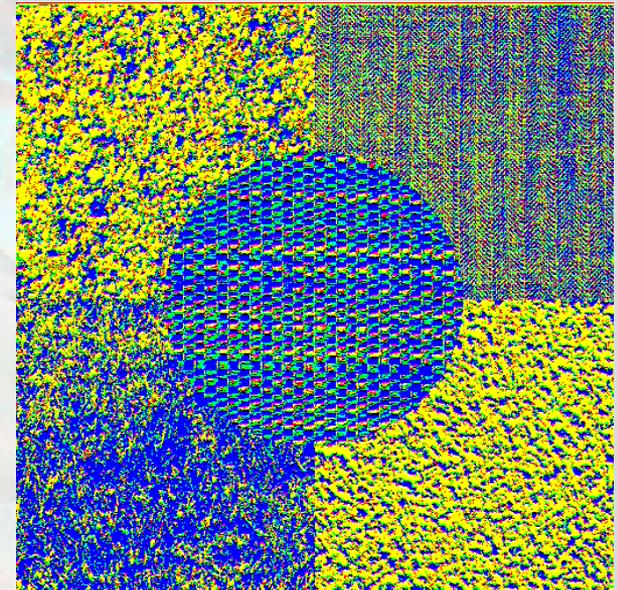
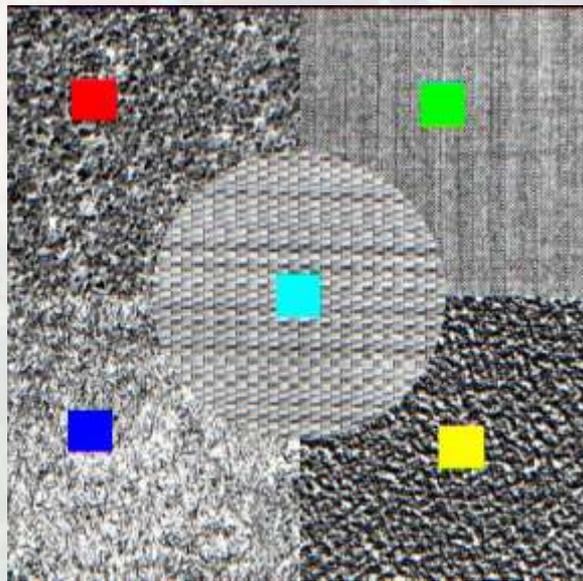
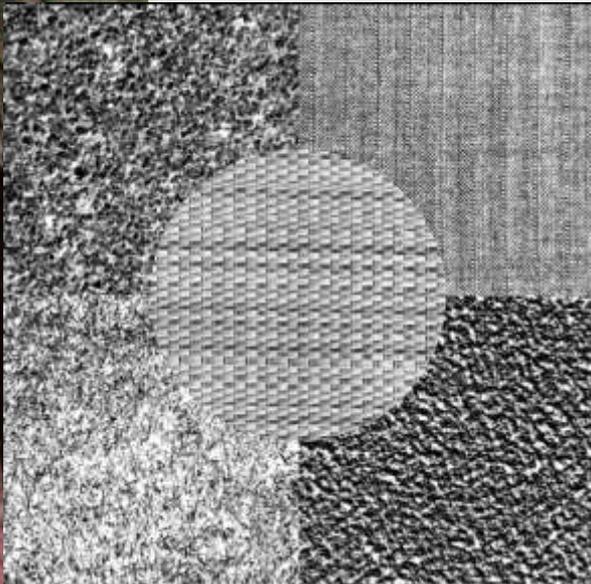
1. including texture (spatial domain),
2. focusing on a single class (binary),
3. combining classifiers (ensemble)?

Tall Tussock slopes



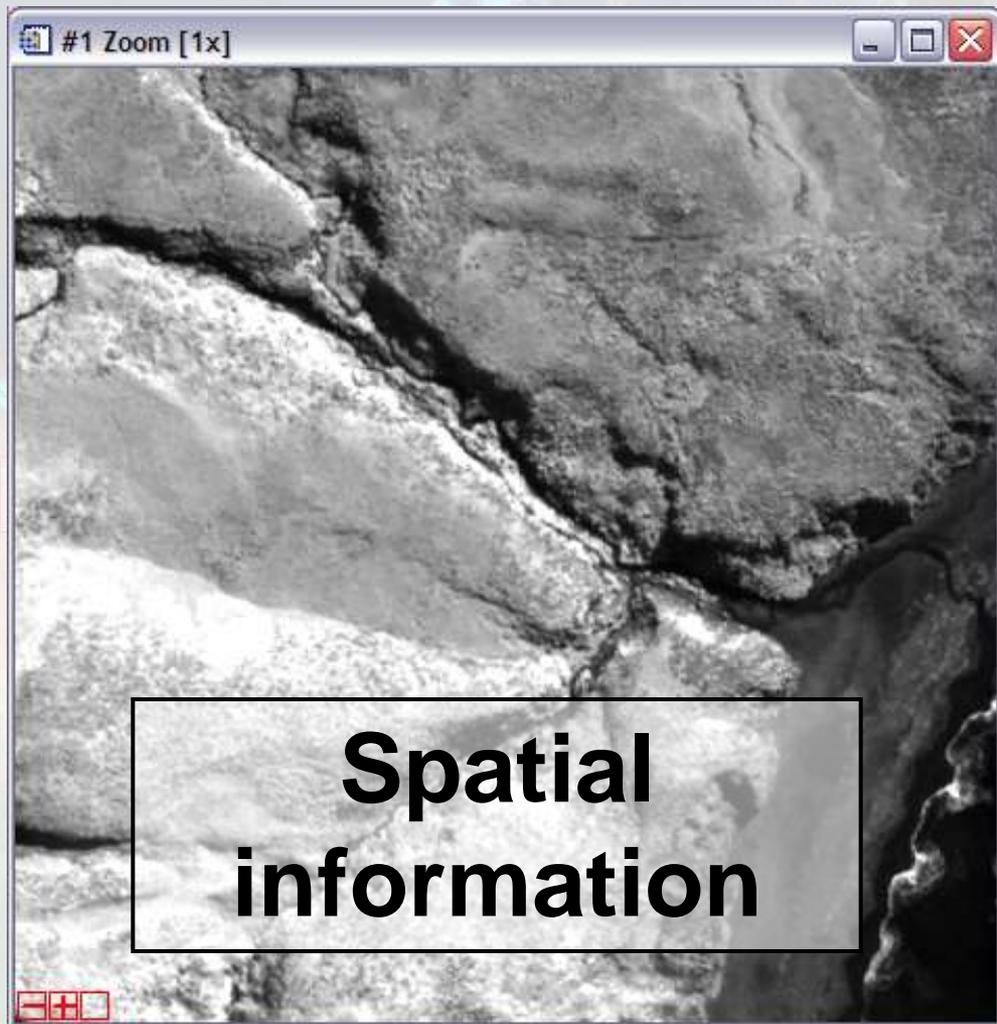
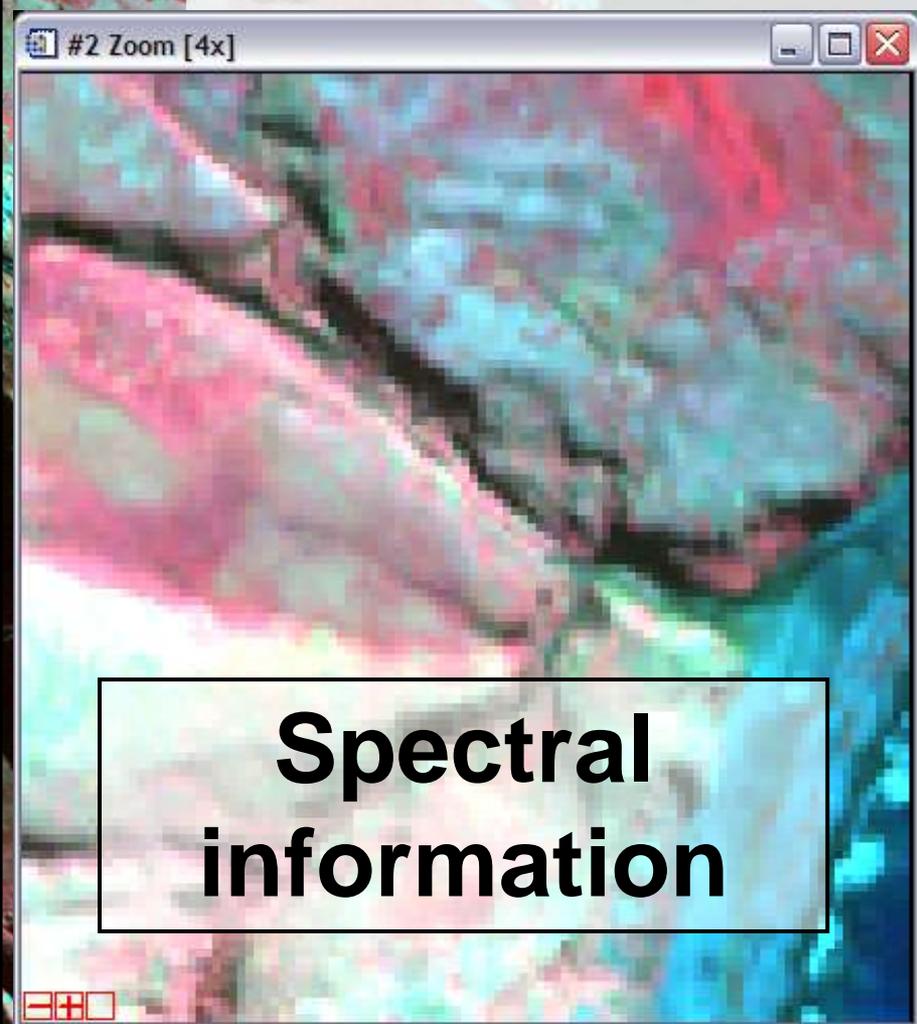
Texture

- Pixel based approaches might fail
- Example of a supervised classification



- A texture model is needed!

Combine MS with PAN

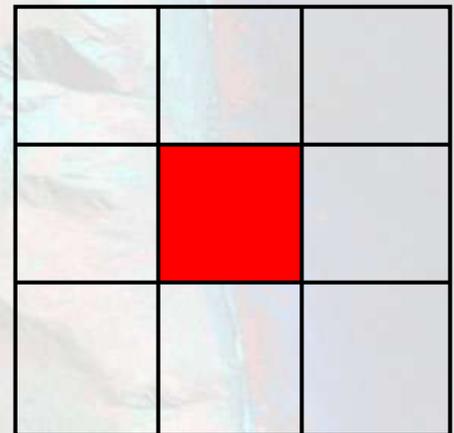


Co-occurrence

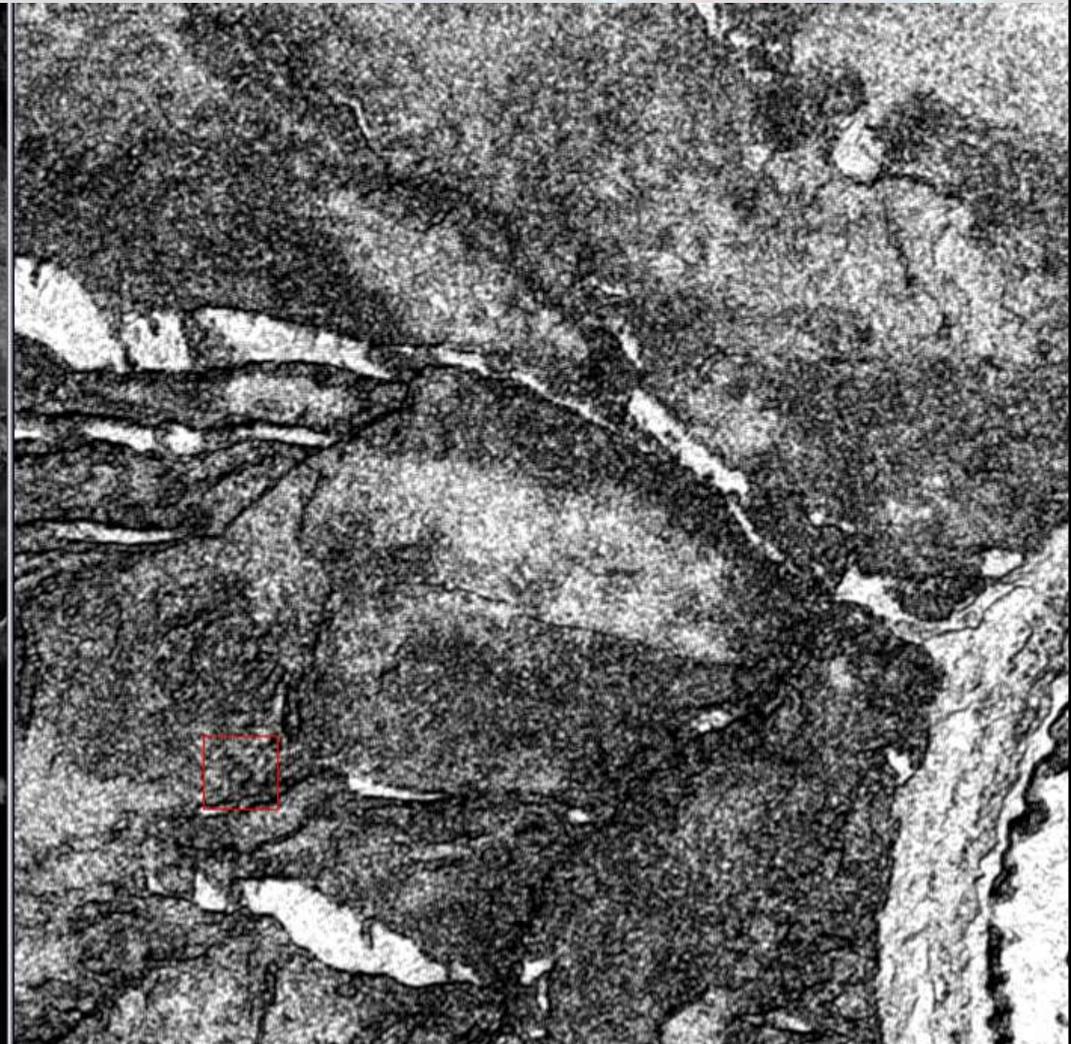
- Grey-level occurrence of **neighbouring** pixels
- For every window/kernel (e.g. 3x3, 5x5) a co-occurrence matrix is calculated
- Summary measure is assigned to the centre pixel, examples:
 - Energy
 - Entropy
 - Contrast
 - Homogeneity
 - Correlation



Kernel

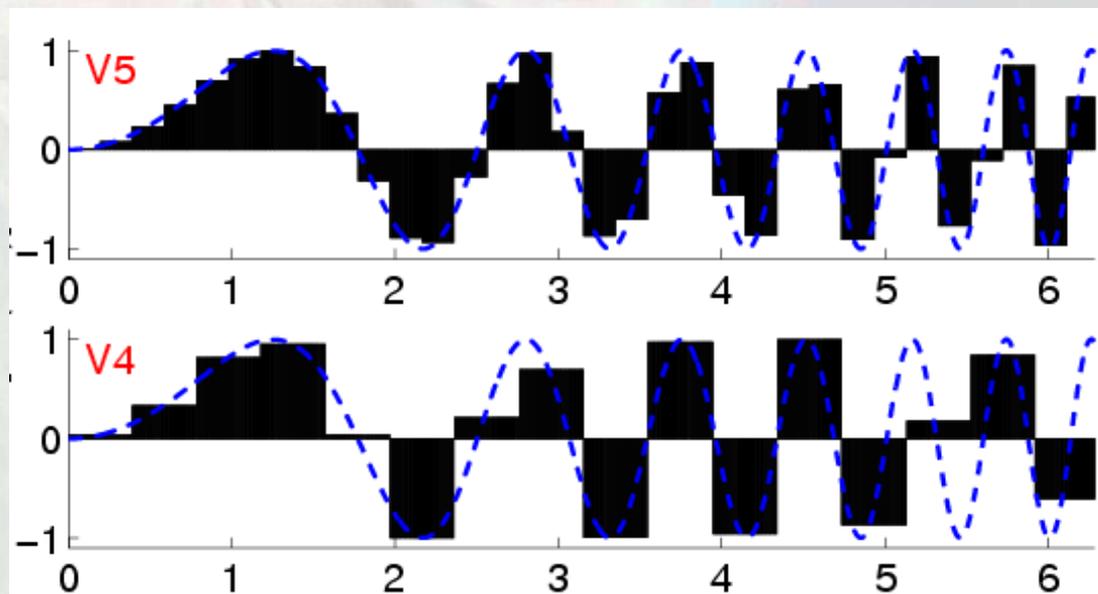


Co-occurrence Homogeneity



Wavelet transform

- Decomposition of a signal into small elements (wavelets) at multiple scale levels (resolutions)
- Wavelet transform approximates a signal
- Useful for:
 - Timeseries analysis: frequencies
 - Noise filtering
 - Compression
 - Multi-resolution analysis
 - Texture measure!



Wavelets – “building blocks”



Duplo

Coarse scale patterns



Lego

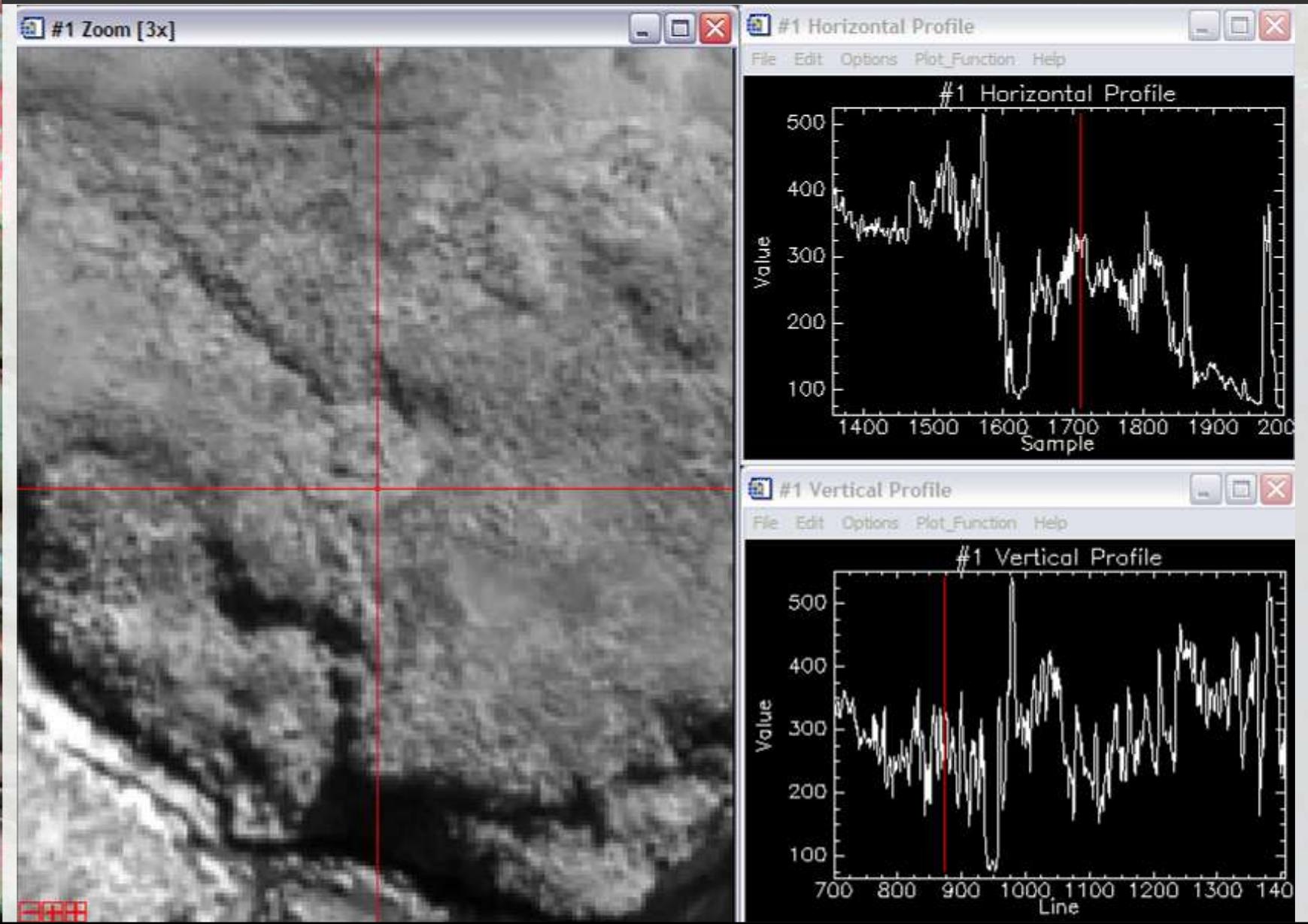


Real ‘function’

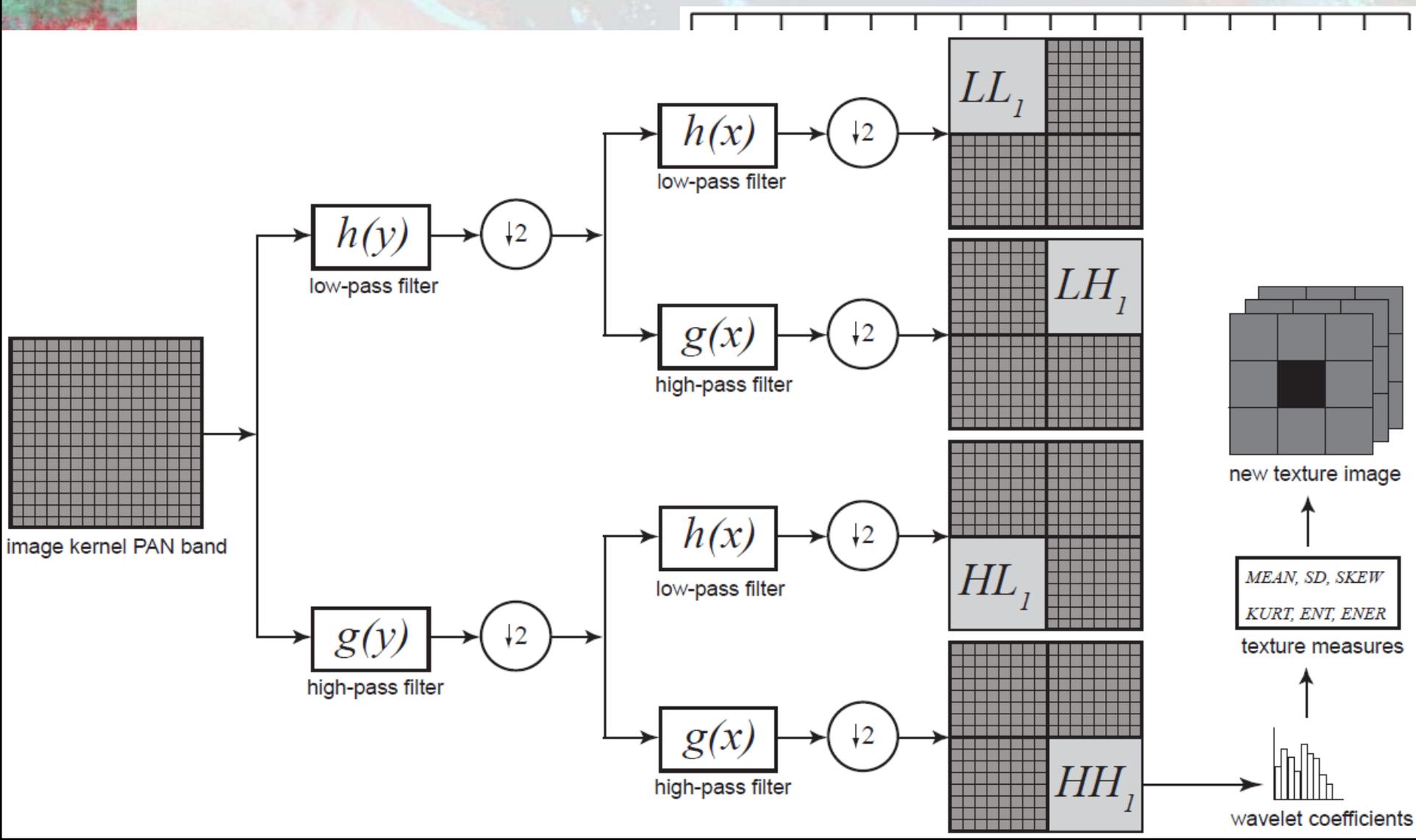
Fine scale patterns



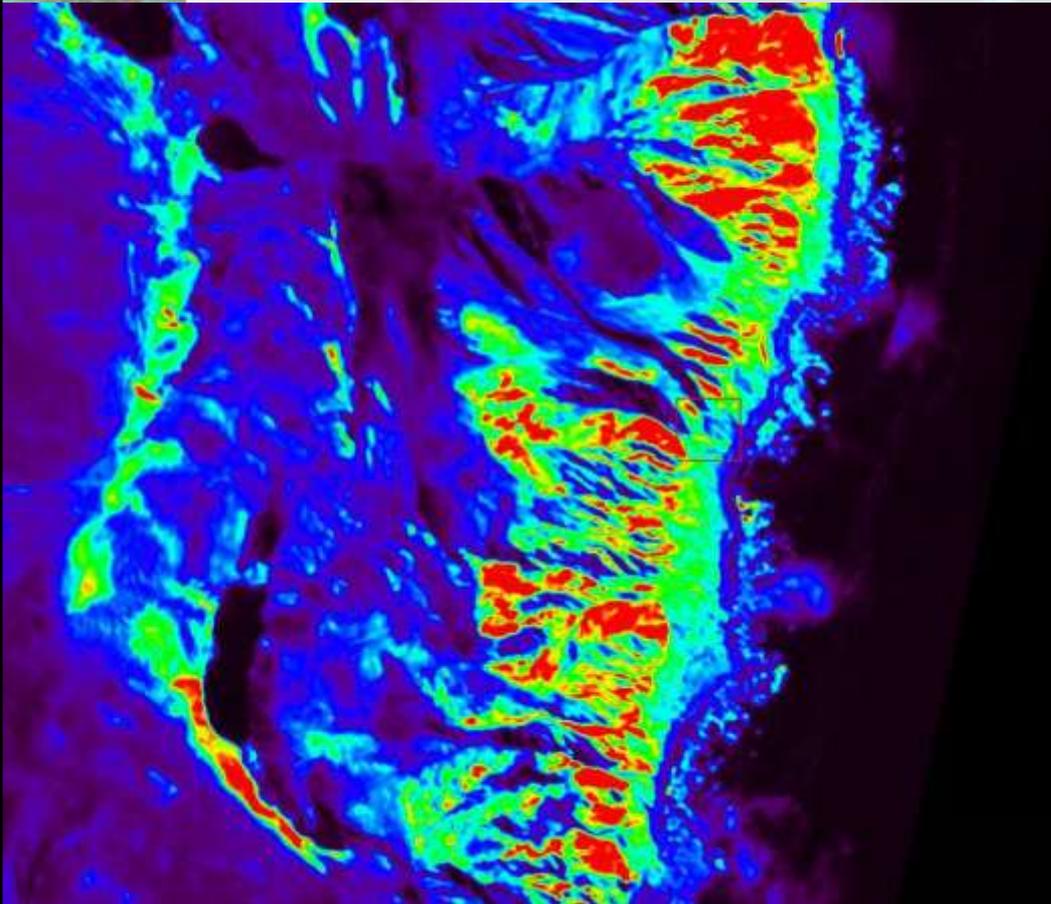
Wavelet decomposition



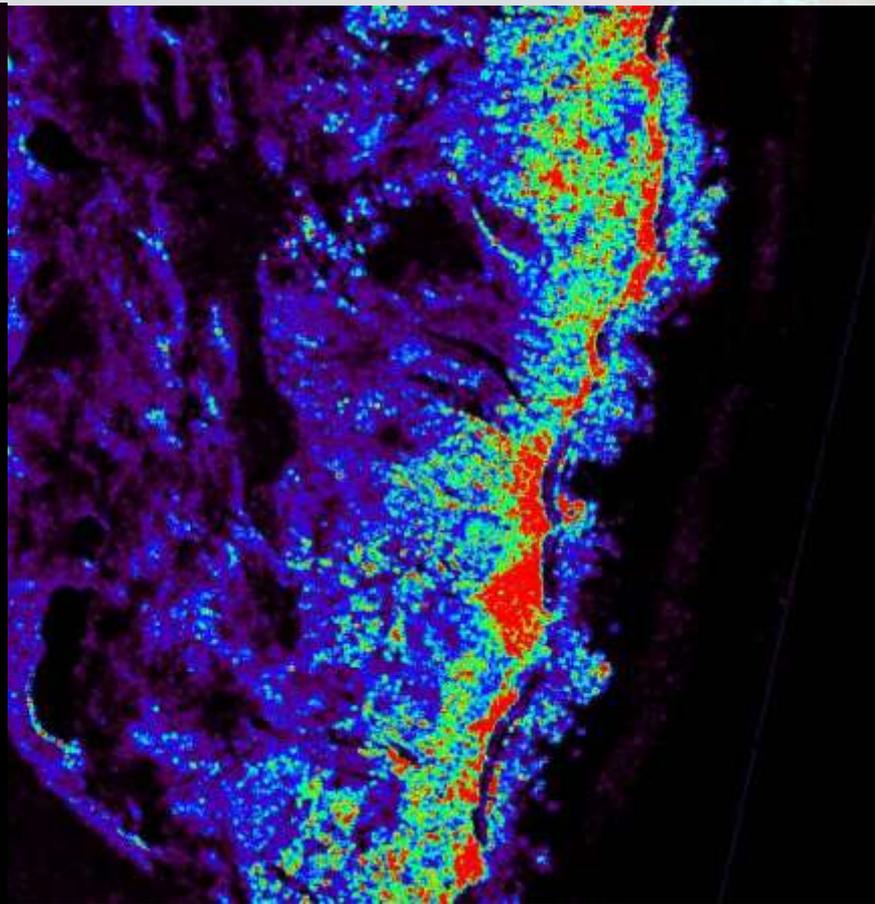
PAN + MS texture fusion



Wavelet Coefficient Entropy

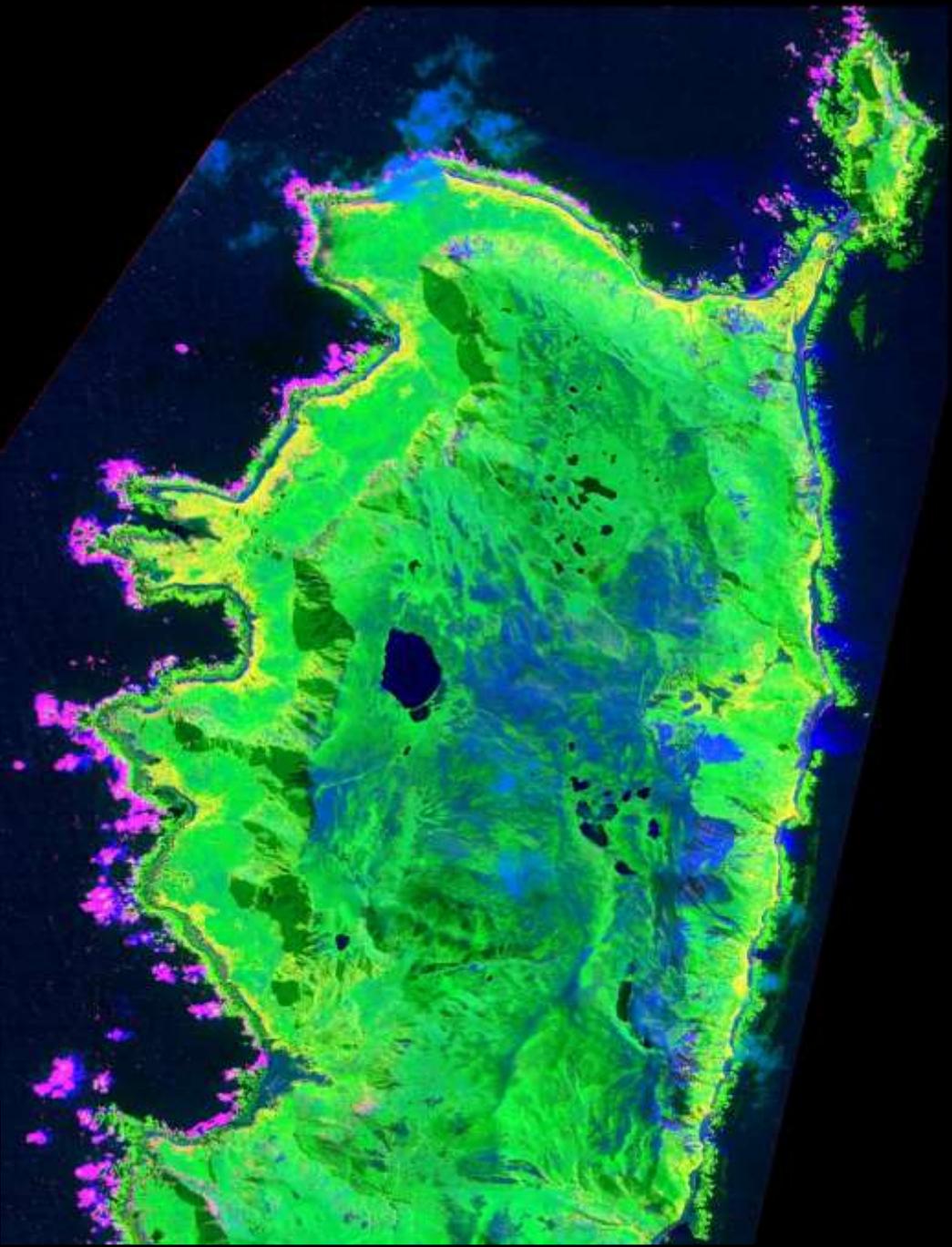
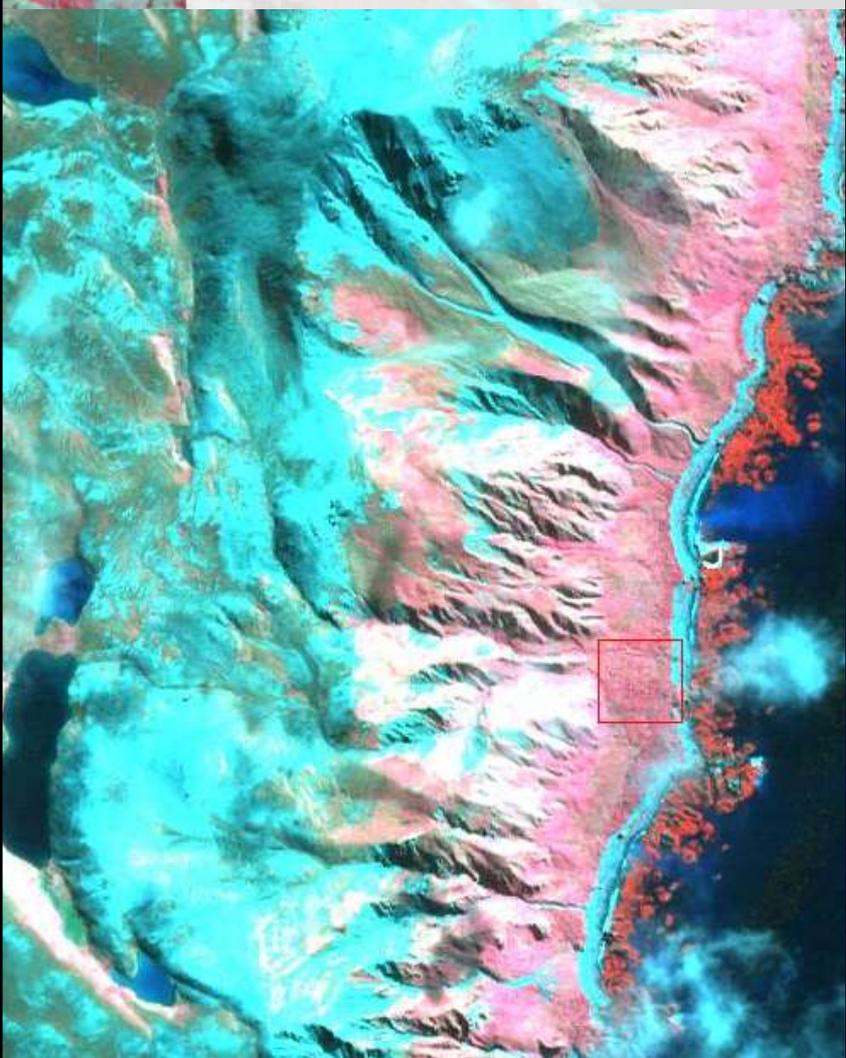


0.6 m pixel size

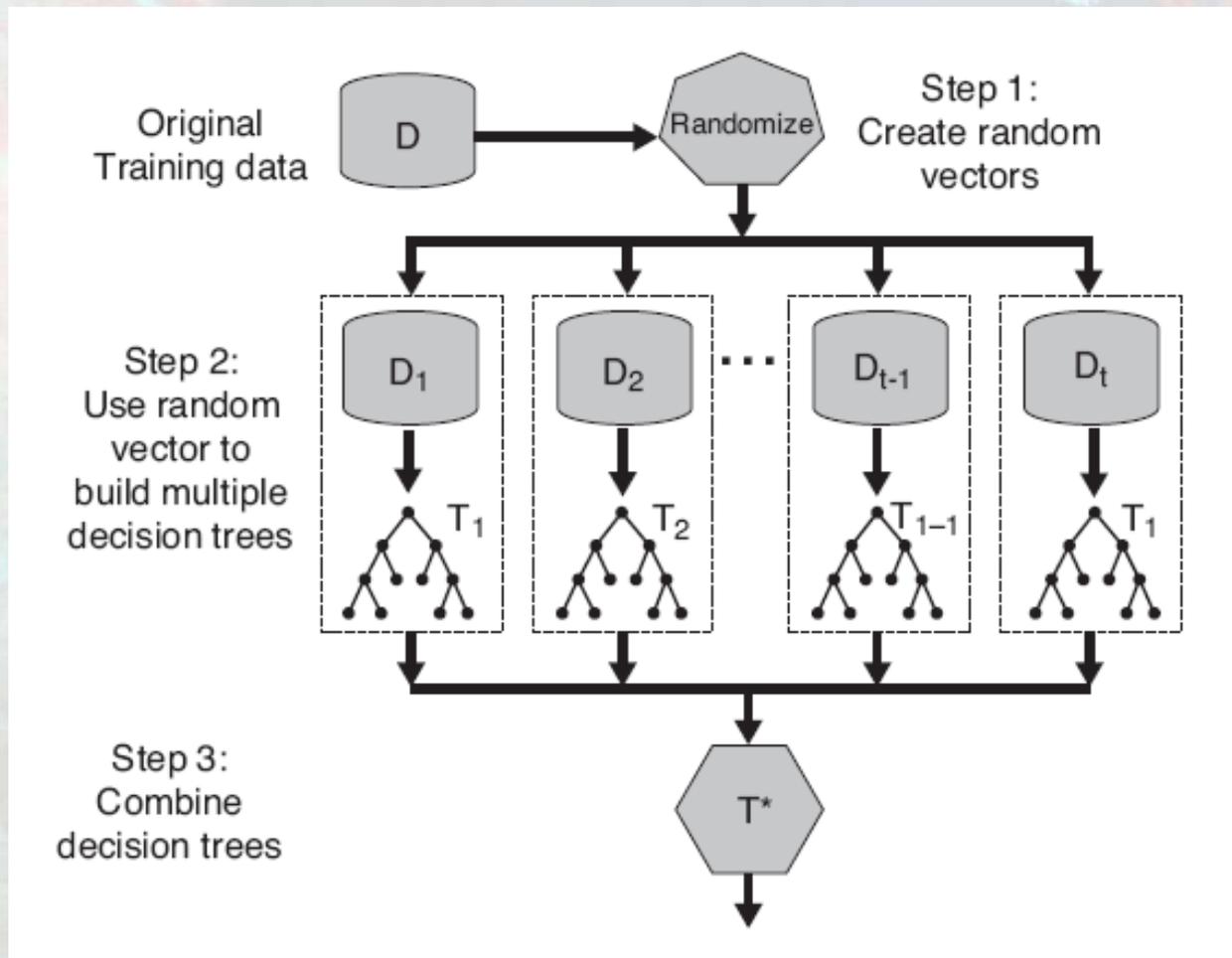


2.4 m pixel size

RGB=WV Ent



Random Forest classifier



Breiman, Leo (2001). "Random Forests". *Machine Learning* 45 (1): 5–32. [doi:10.1023/A:1010933404324](https://doi.org/10.1023/A:1010933404324).

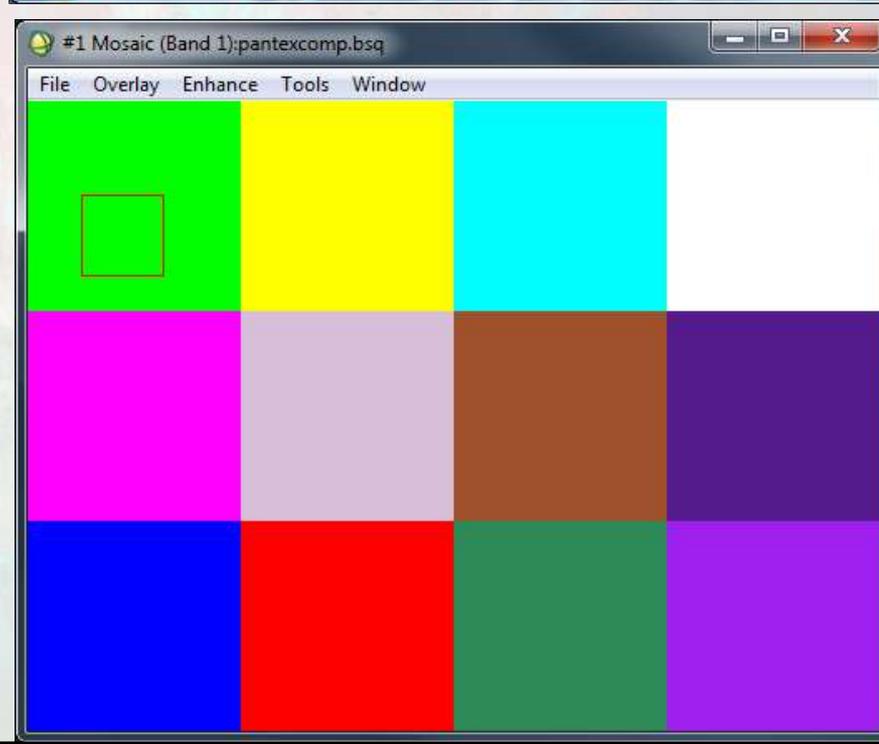
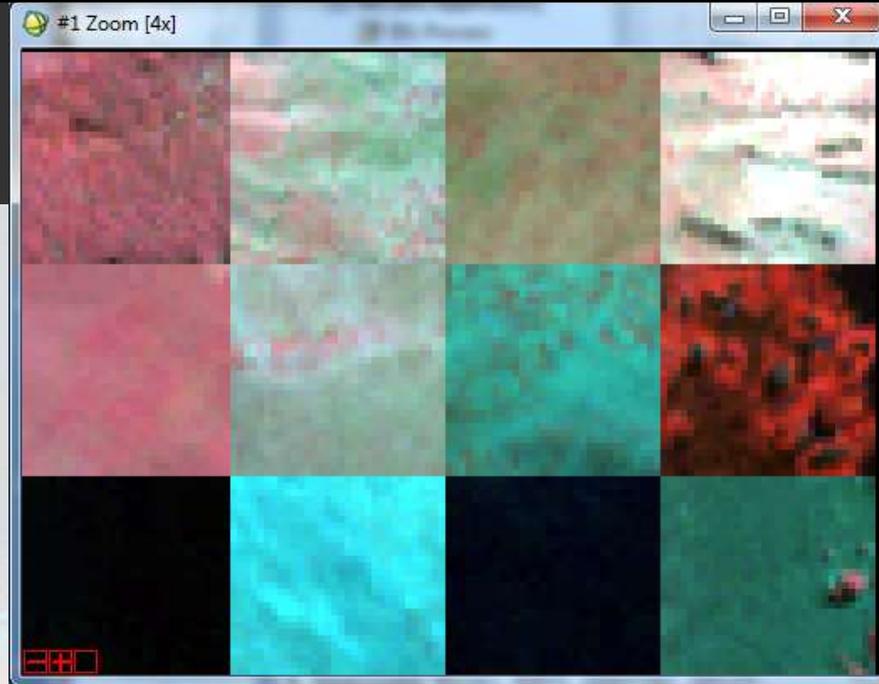
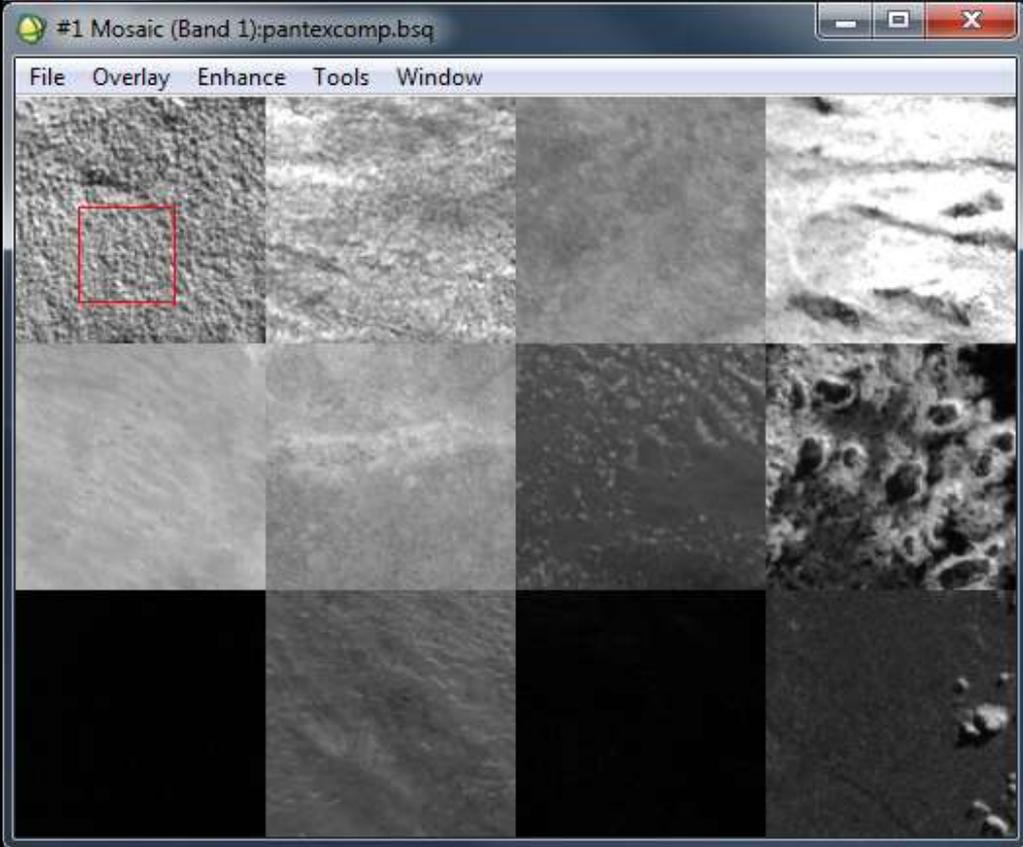
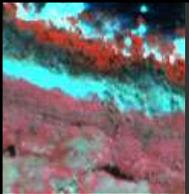
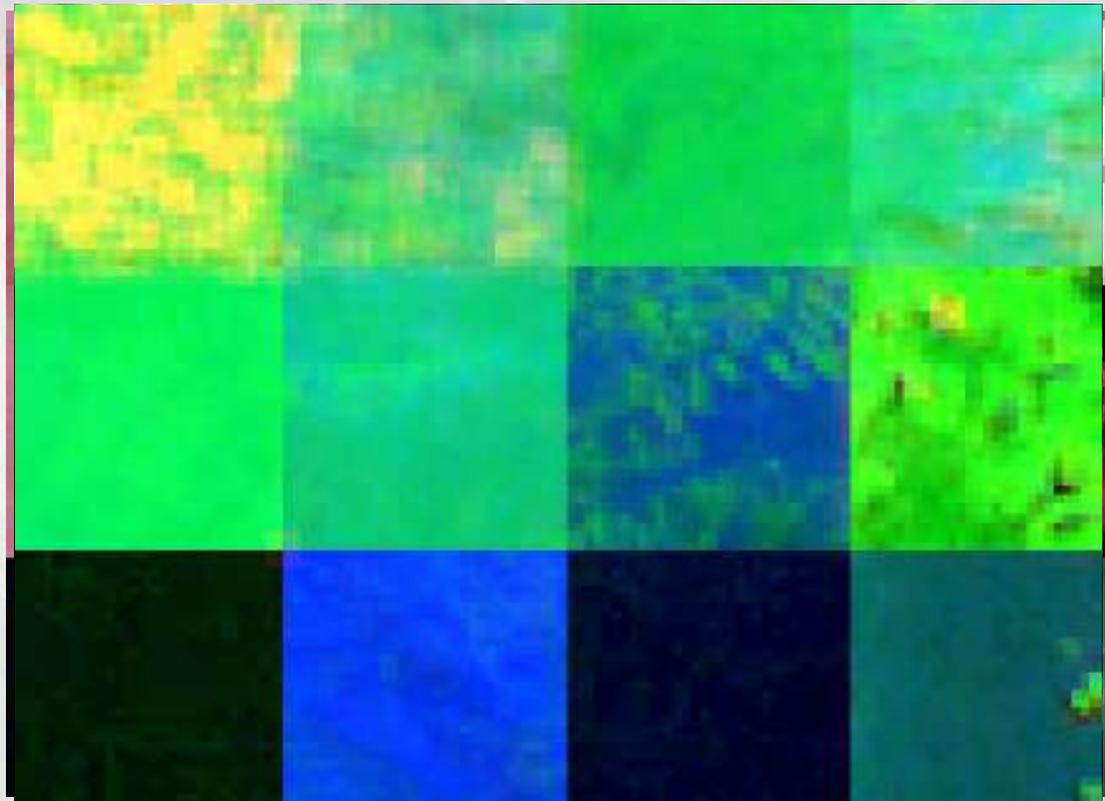
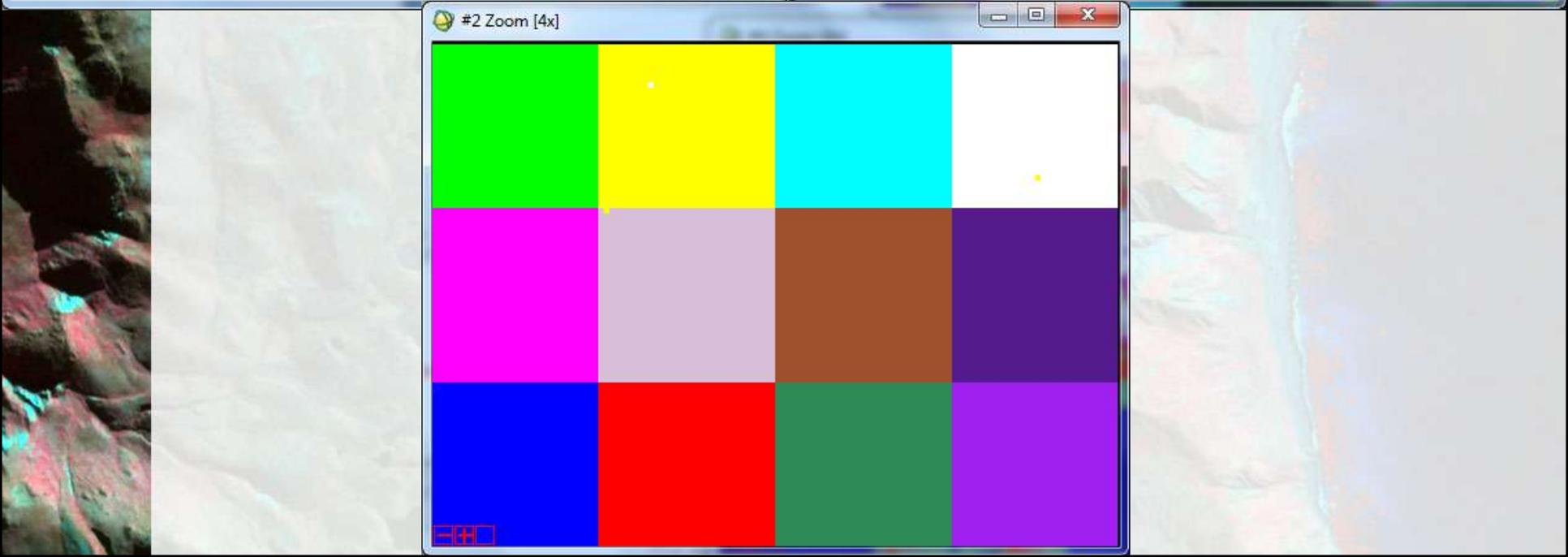
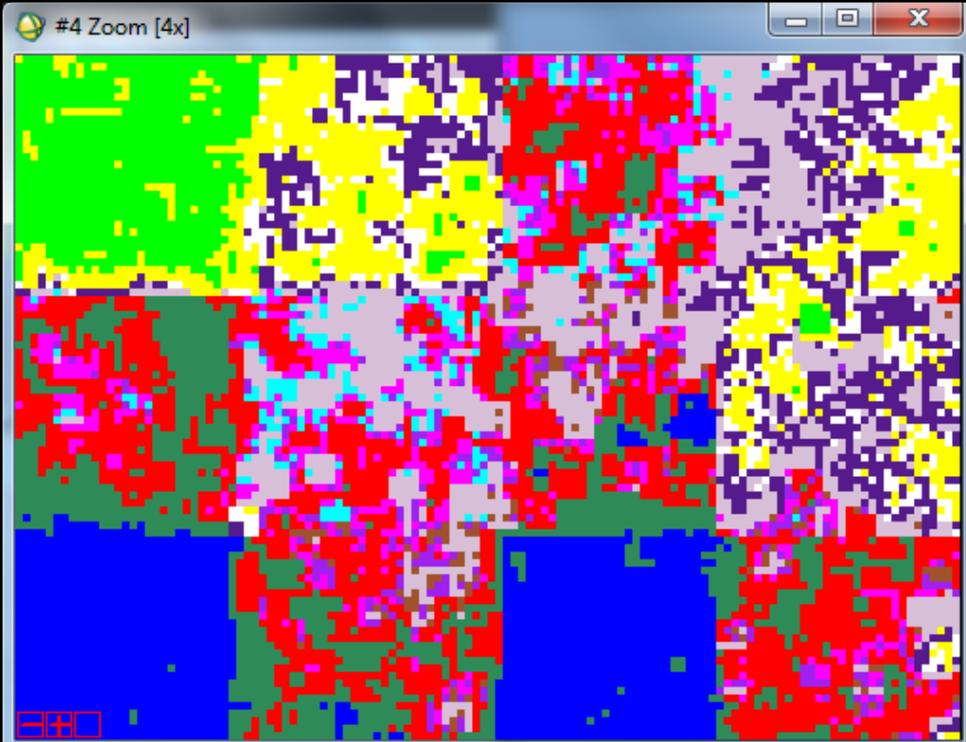


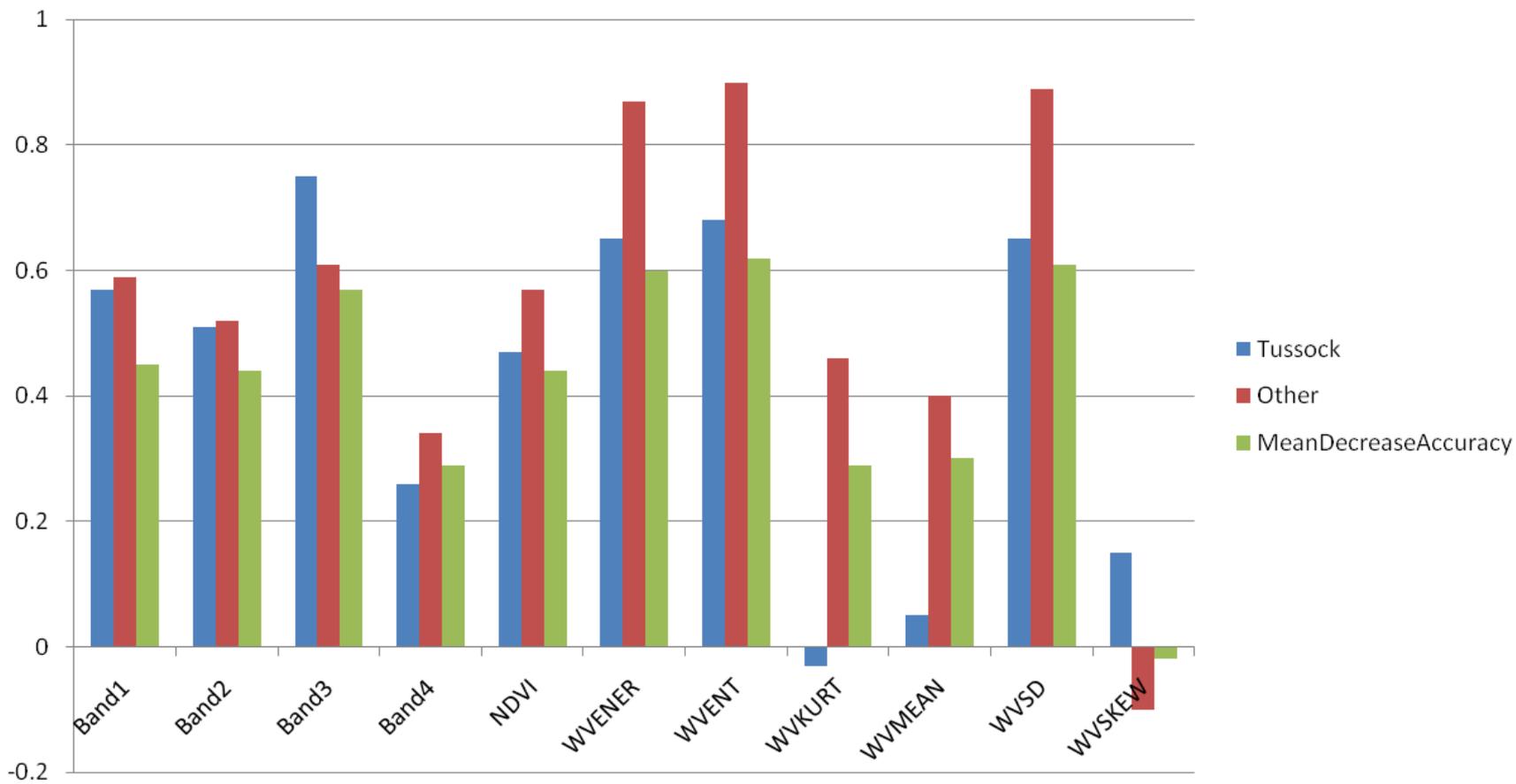
Image stack

1. **Band1 (blue)**
2. Band2 (green)
3. Band3 (red)
4. Band4 (NIR)
5. **NDVI**
6. WVMEAN
7. WVSD
8. WVKURT
9. WVSKEW
10. **WVENER**
11. WVENT





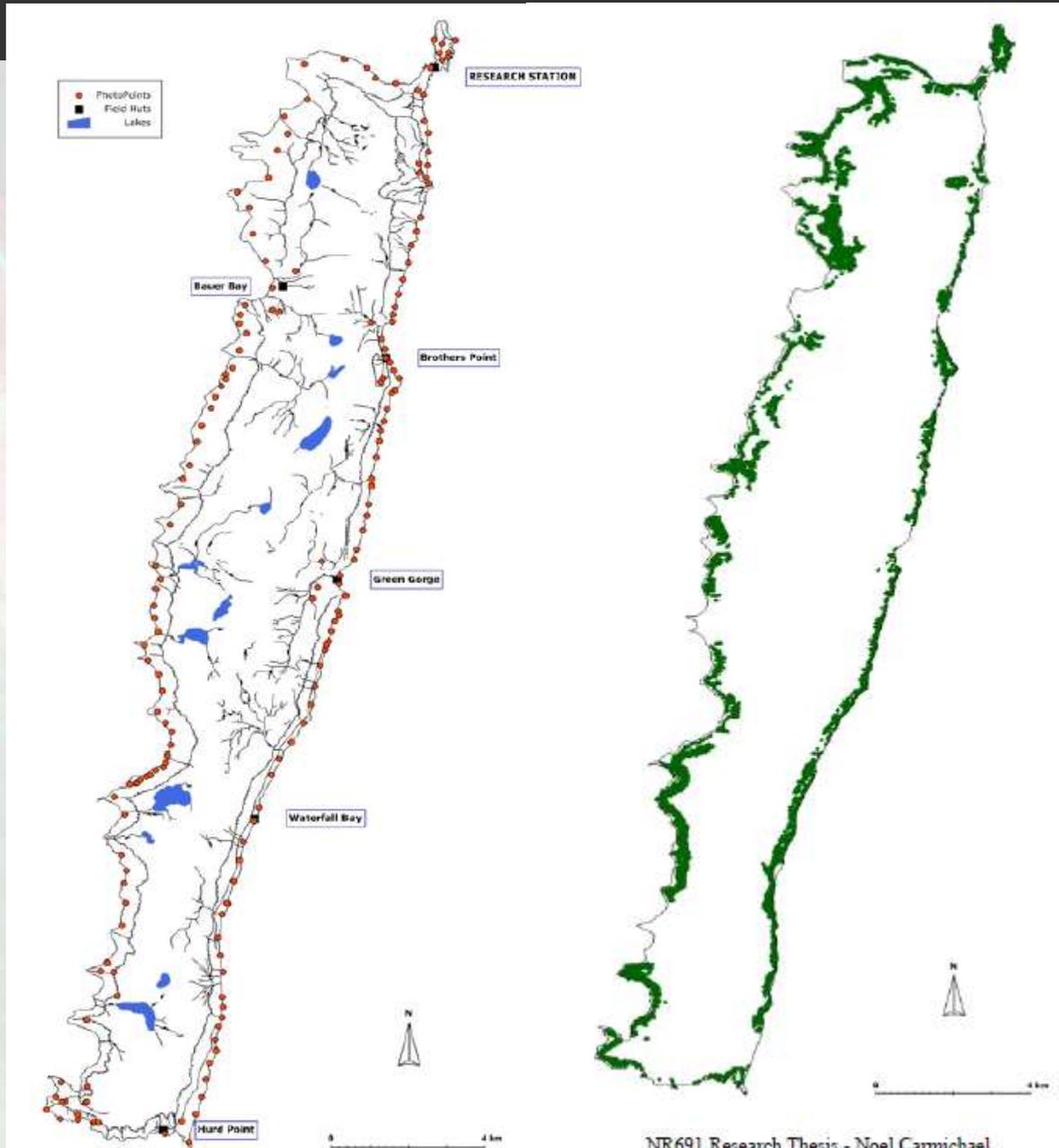
Variable importance

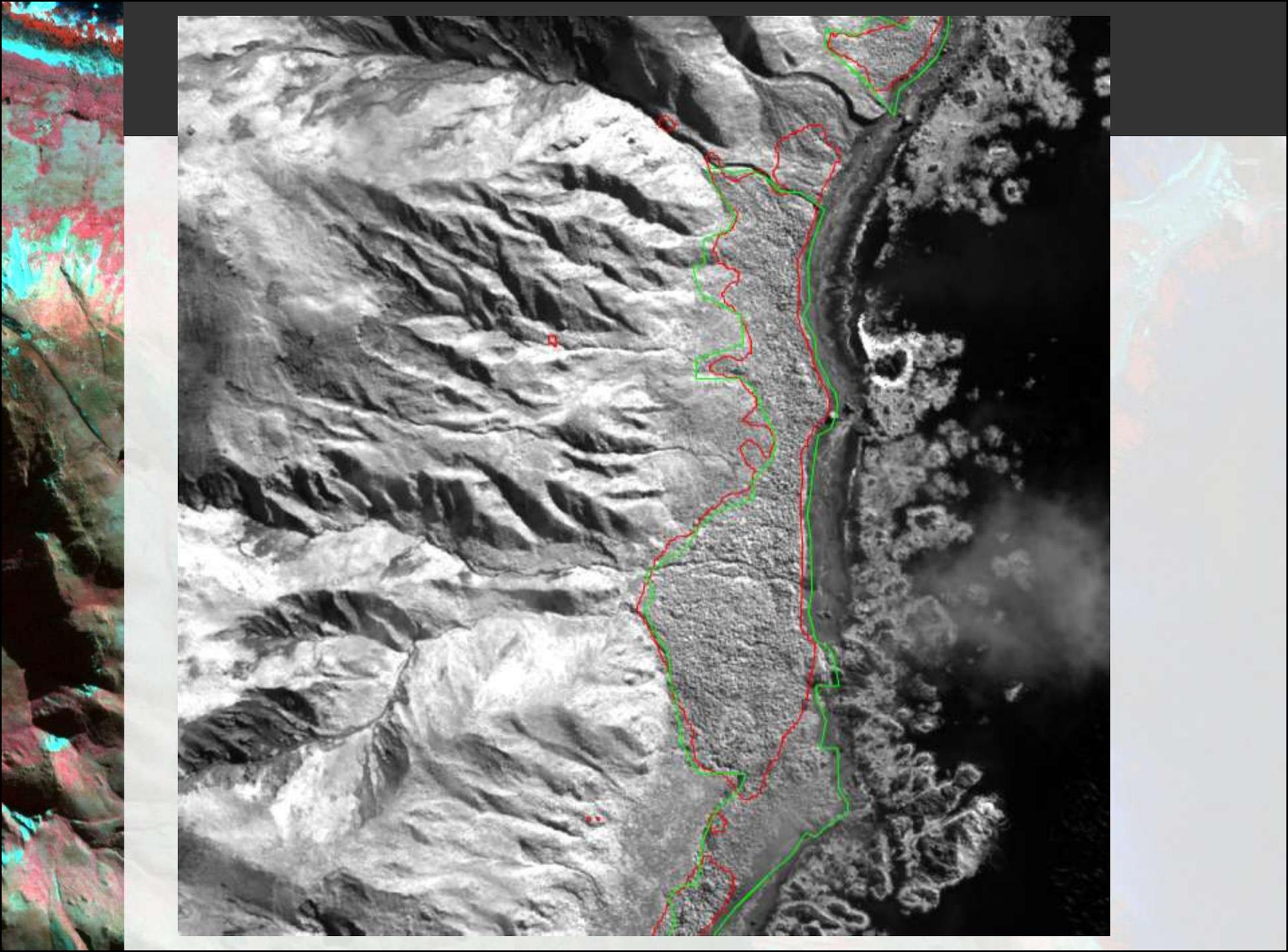




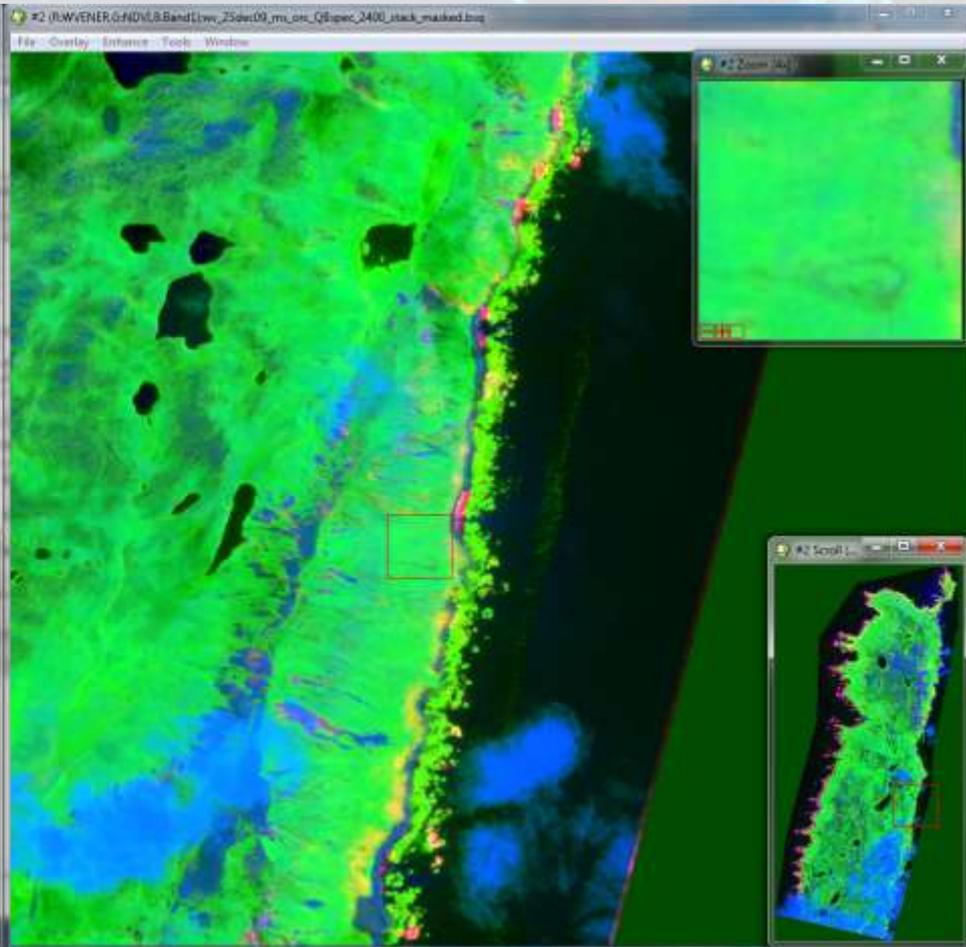
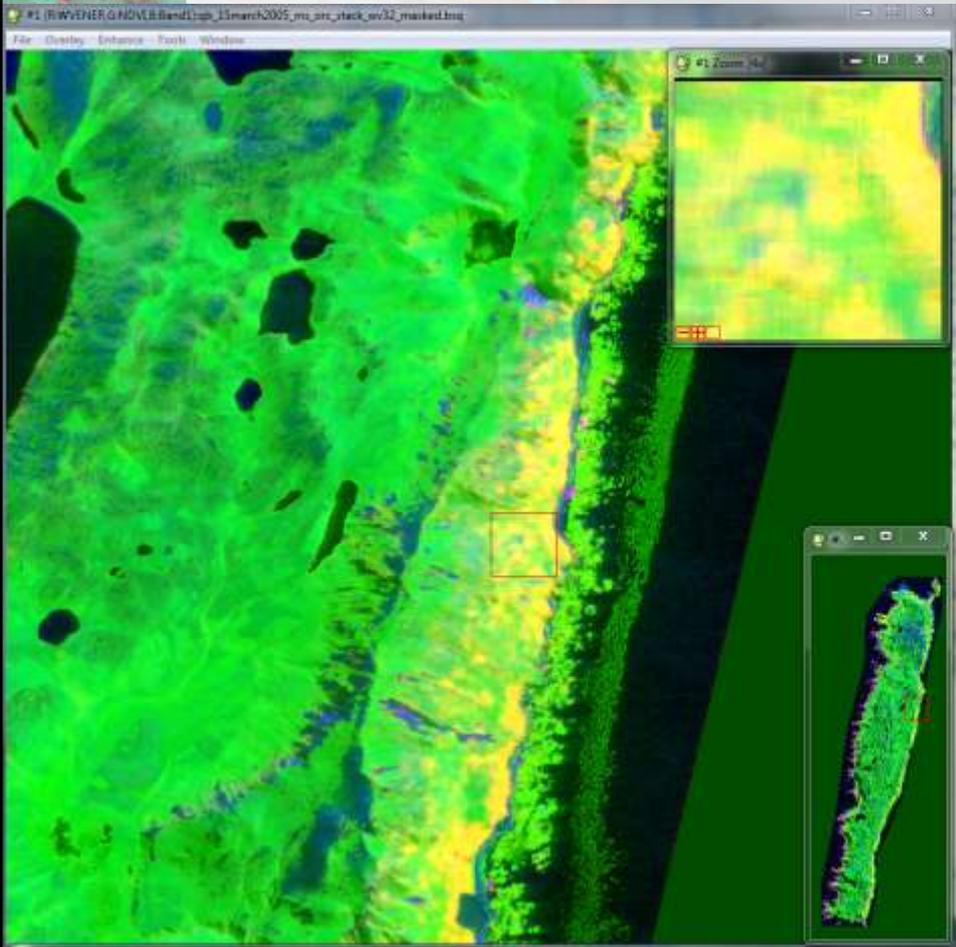
Validation

- Noel Carmichael TPWS
- Visual image interpretation
- 3000+ photos
- Expert knowledge



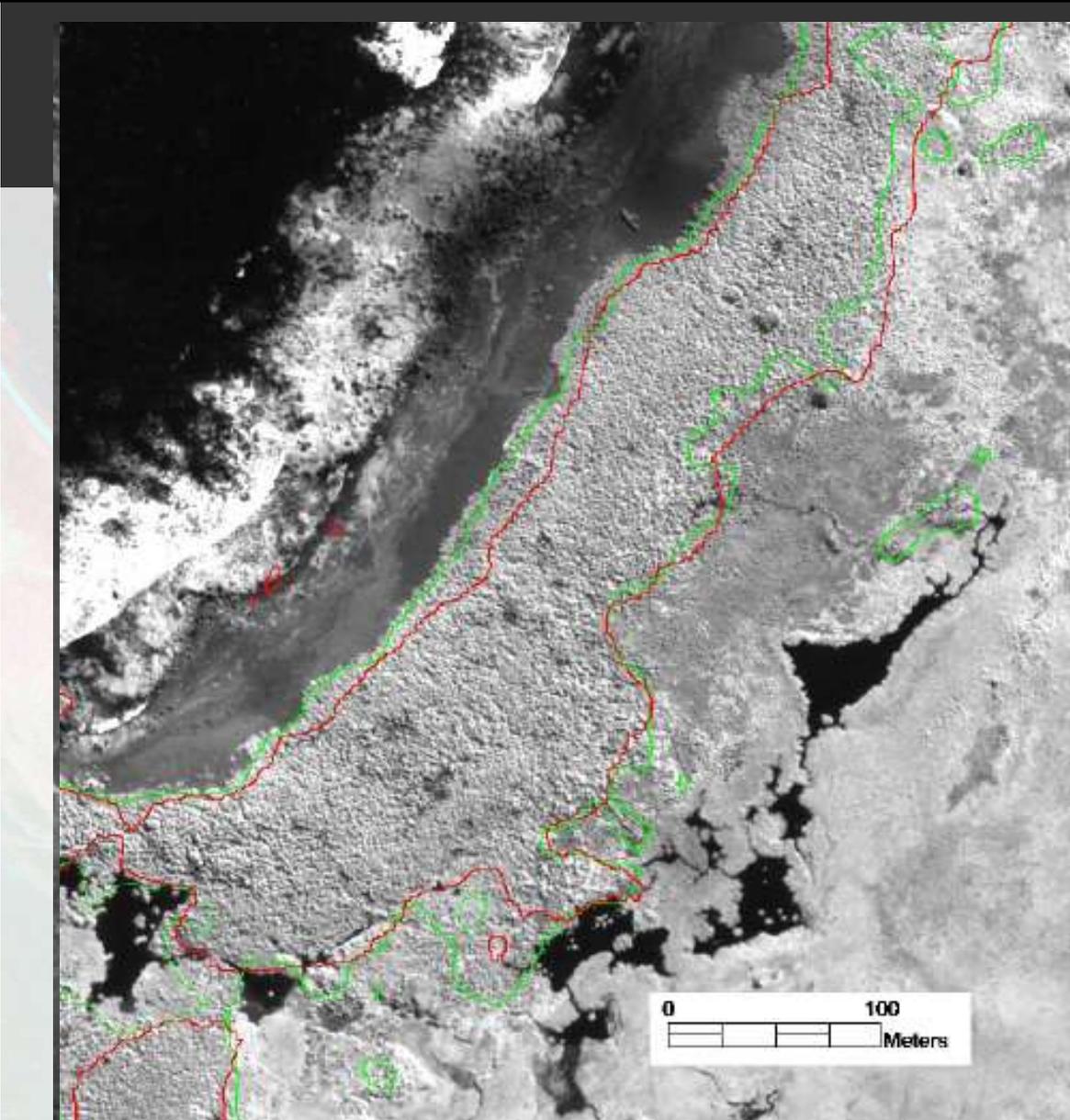
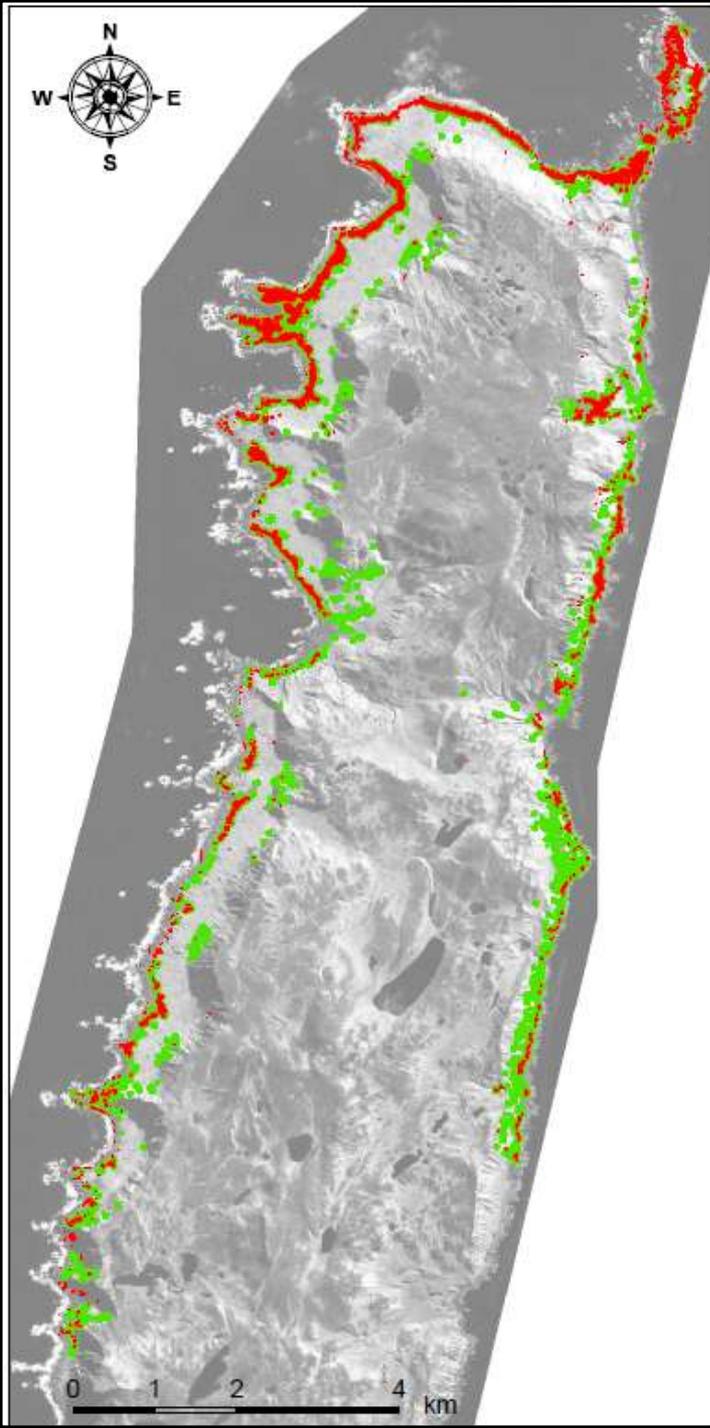


Change detection 2005 – 2010



Quickbird 2005

WorldView2 2010



2005: 169 ha

2010: 91 ha

78 ha reduction

Conclusions

- Wavelet texture measure works very well for specific vegetation classes, such as tussock
- Random forest classifier is a high performing classifier suitable to identify tussock
- Tussock classification can be used to *quantitatively* assess change
- The proposed image analysis workflow can be used in the future to monitor recovery of the island

Questions?

Contact details:

Arko Lucieer
University of Tasmania
School of Geography & Environmental Studies
Centre for Spatial Information Science

Arko.Lucieer@utas.edu.au

<http://www.lucieer.net>

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New QuickBird acquisitions

