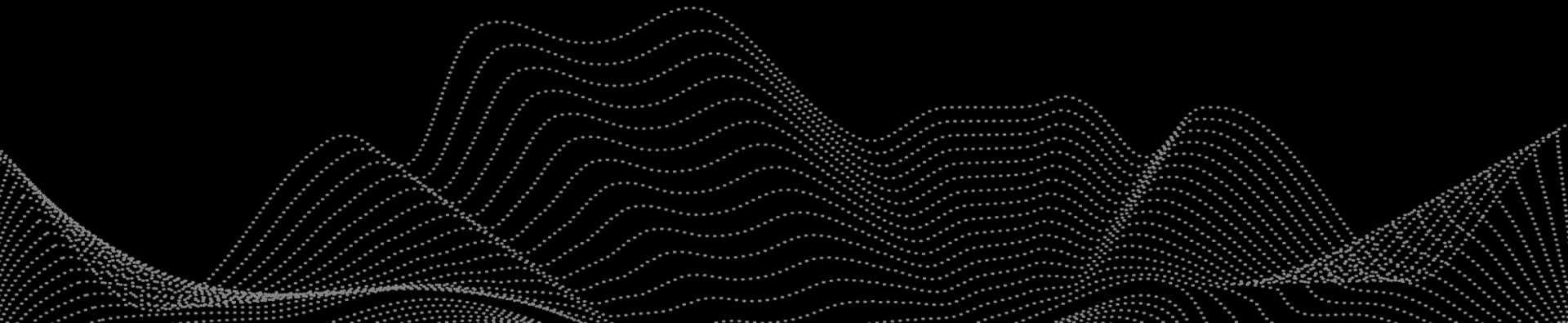
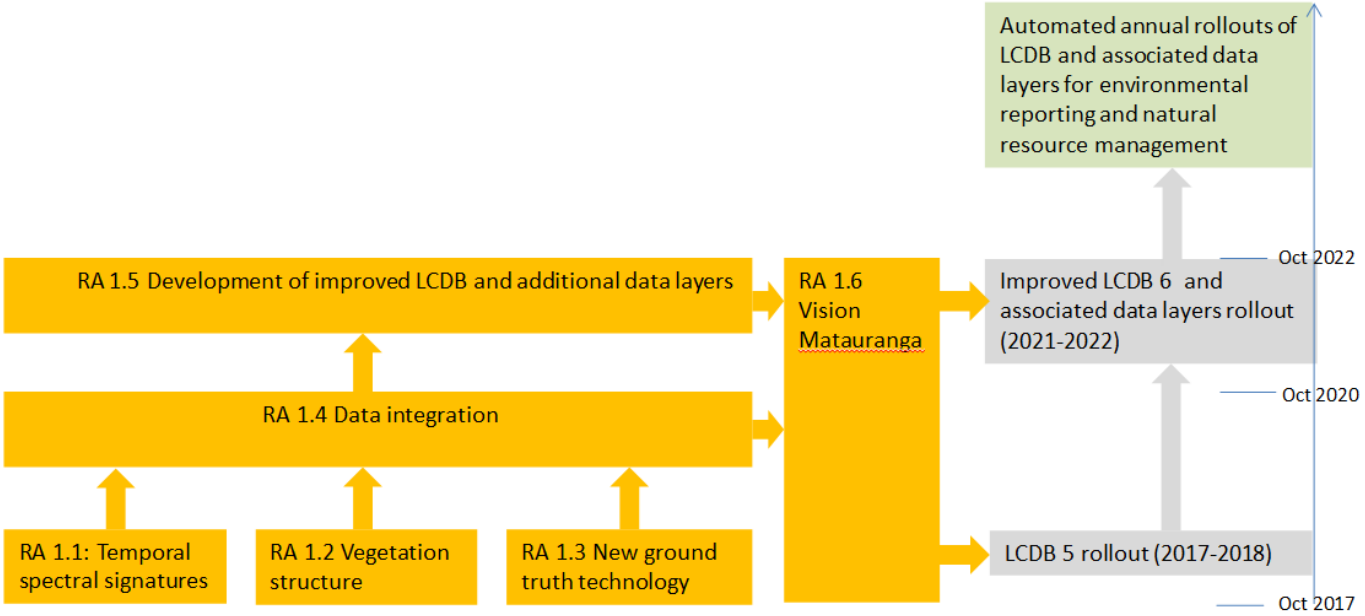
Advanced remote sensing of Aotearoa

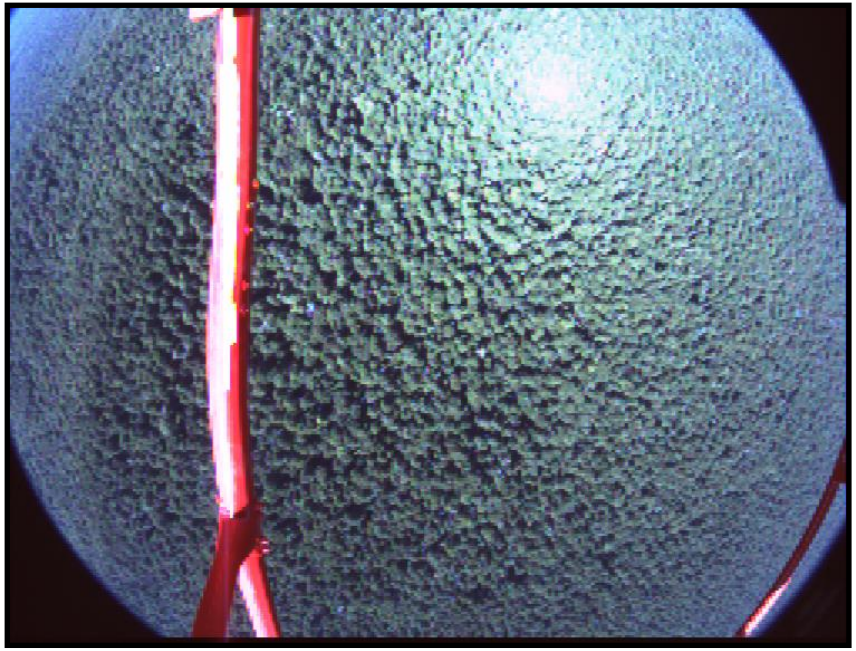
John Dymond, James Shepherd, David Pairman, Ben Jolly, Peter Newsome

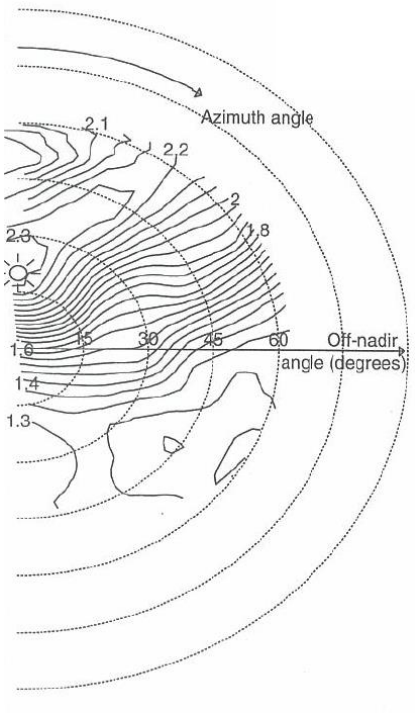


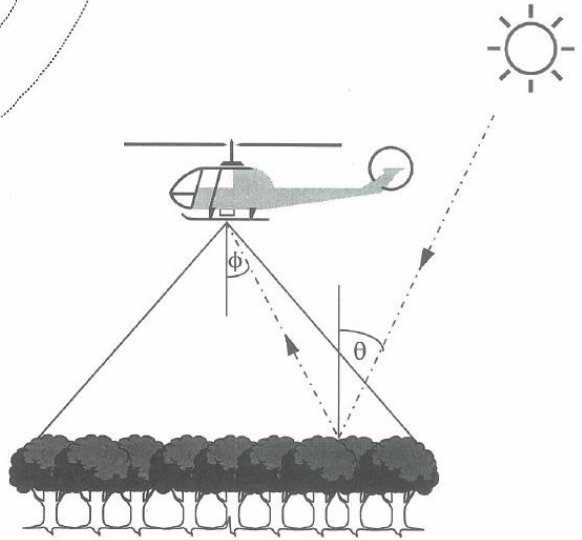
MBIE funded $7.75 million (ie $1.55 million p.a. over 5 yrs)

Central government consortium cofunding $1.2 million (ie $300K p.a. over 4 yrs)

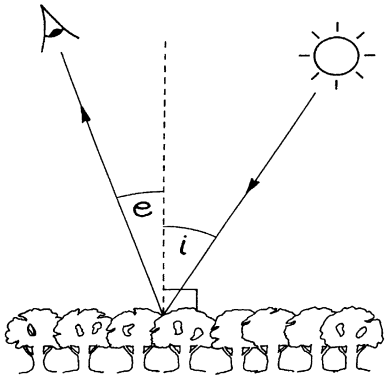


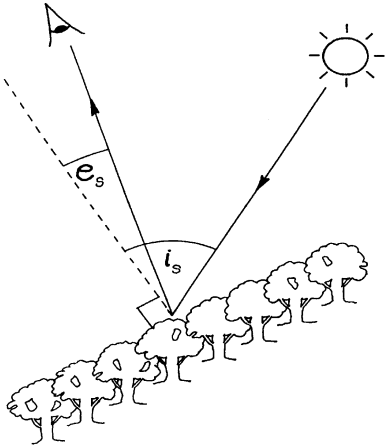



Azimuth angle
2.1
2.2
2
1.8
2.3
1.0
1.4
1.3
15
30
45
60
Off-nadir
angle (degrees)


ϕ
θ

Directional Reflectance Model





$$L = \frac{2wE\ \cos i}{3\pi^2(\cos i + \cos e)}[a + (\pi - a)e^{-k\alpha}]$$

$$L = \frac{Ew\ \cos i}{4\pi(\cos i + \cos e)}[\frac{8}{3\pi}(a + (\pi - a)e^{-k\alpha}) + H(\cos i)\,H(\cos e) - 1]$$

$$H(x) = \frac{1 + 2x}{1 + 2x(1 - w)^{0.5}}$$

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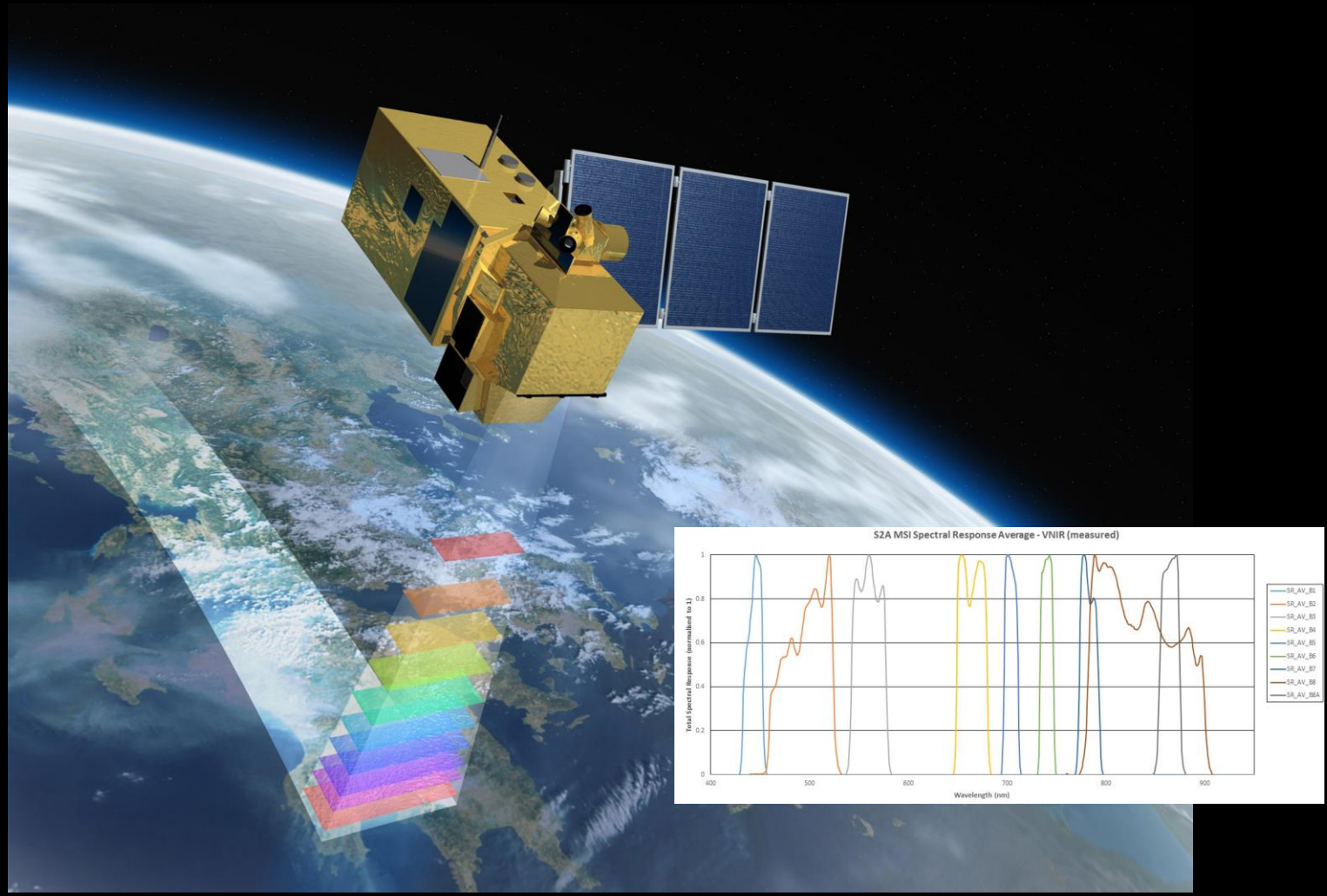
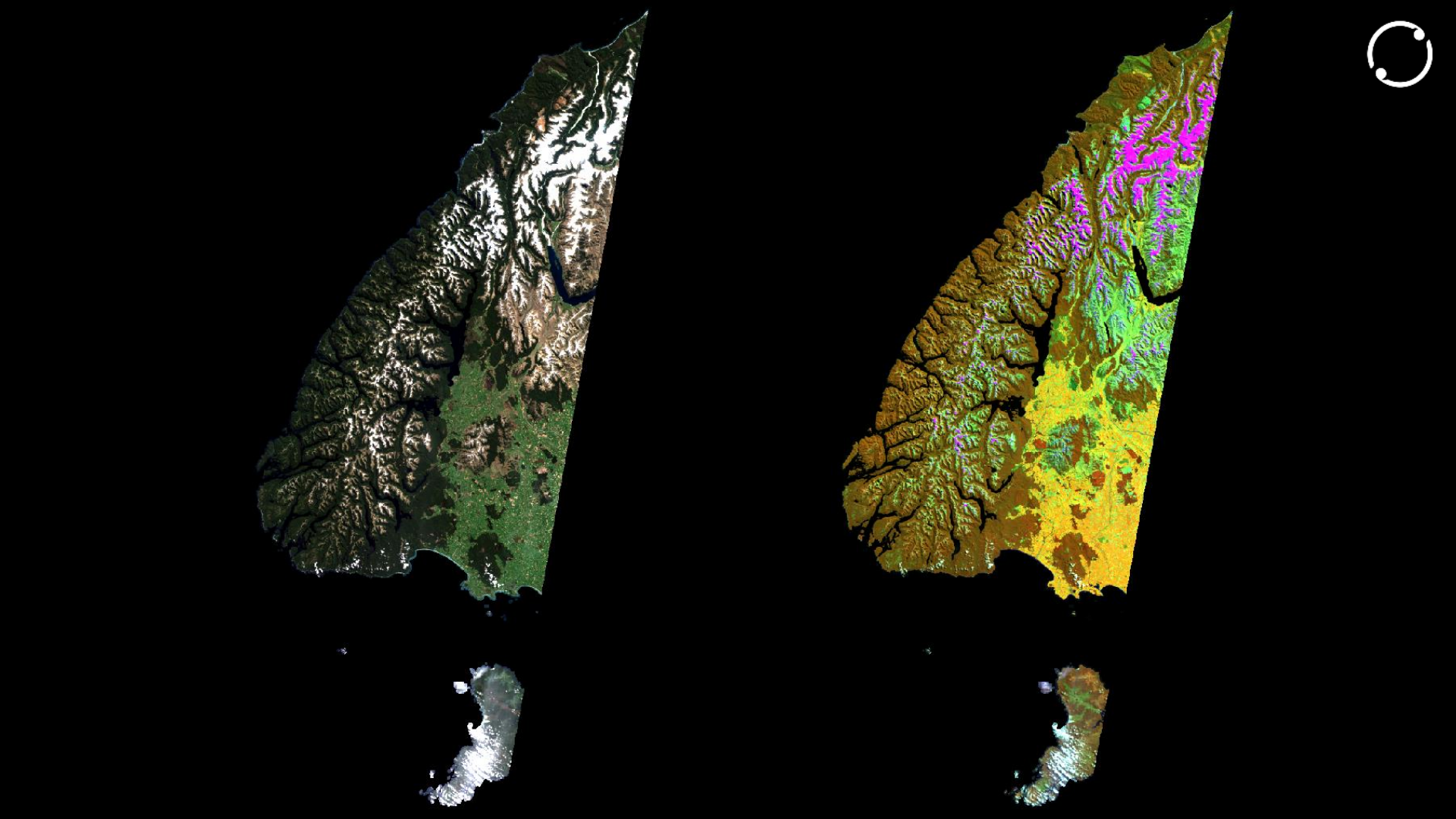
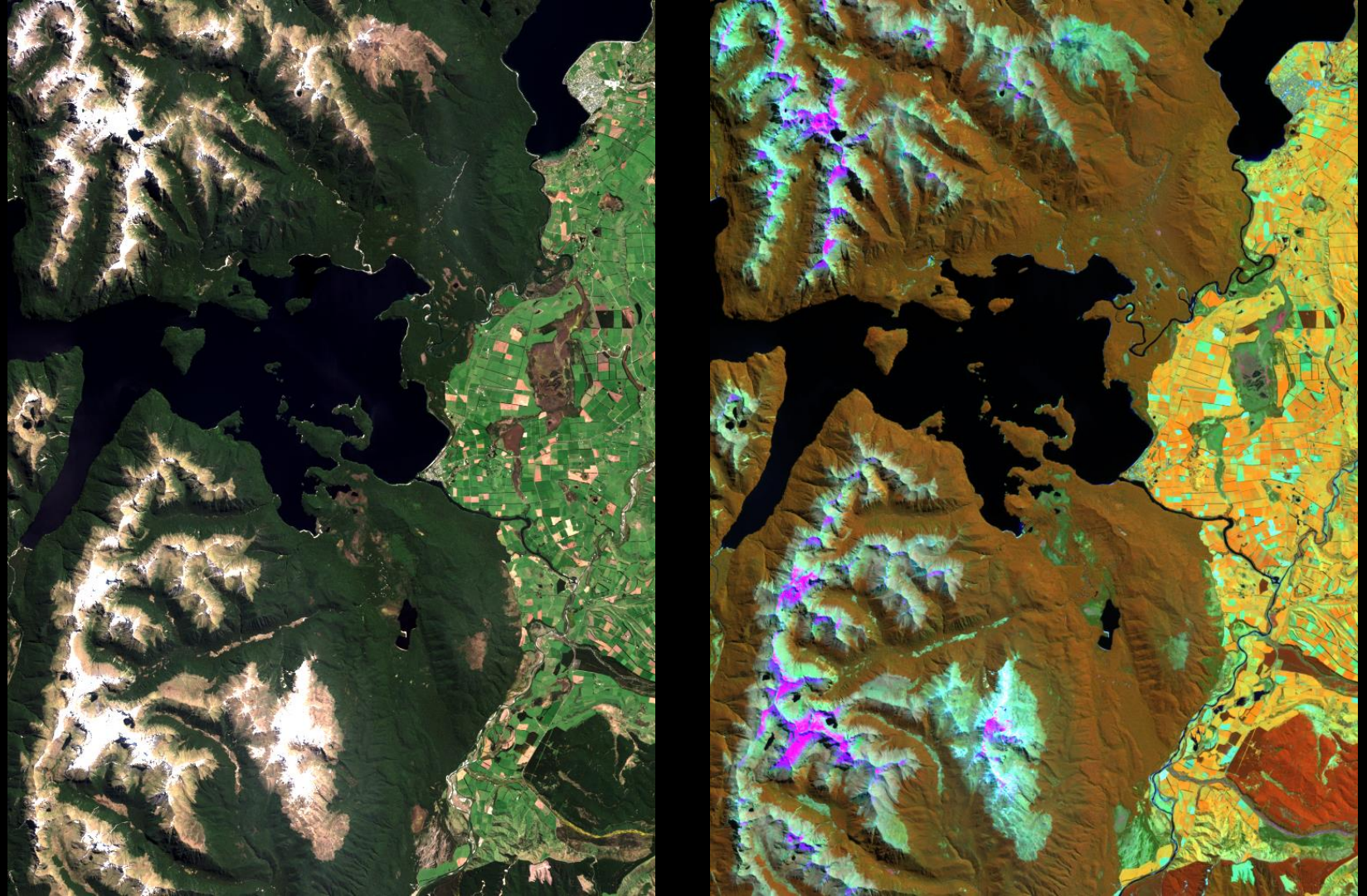
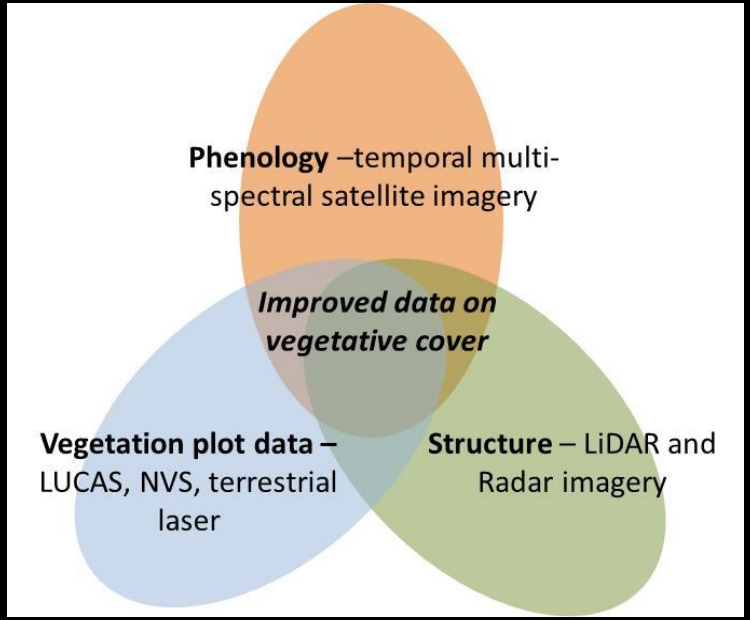
February 18


S2A MSI Spectral Response Average - VNIR (measured)
Total Spectral Response (normalised to 1)
Wavelength (nm)
0
0.2
0.4
0.6
0.8
1
400
500
600
700
800
900
SR_AV_B1
SR_AV_B2
SR_AV_B3
SR_AV_B4
SR_AV_B5
SR_AV_B6
SR_AV_B7
SR_AV_B8
SR_AV_B8A






Phenology –temporal multi-spectral satellite imagery
Improved data on vegetative cover
Vegetation plot data – LUCAS, NVS, terrestrial laser
Structure – LiDAR and Radar imagery

Remotely Piloted Aircraft Systems (RPAS)

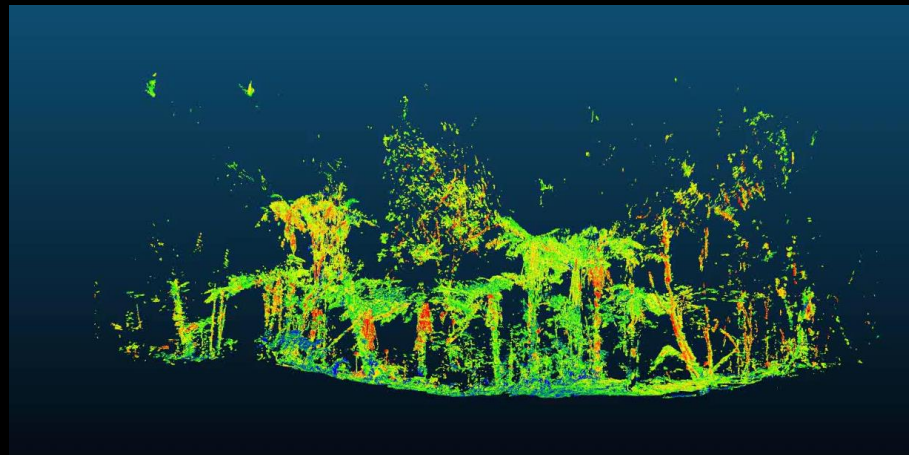
- Fixed-wing and multi-rotor platforms with various sizes and shapes

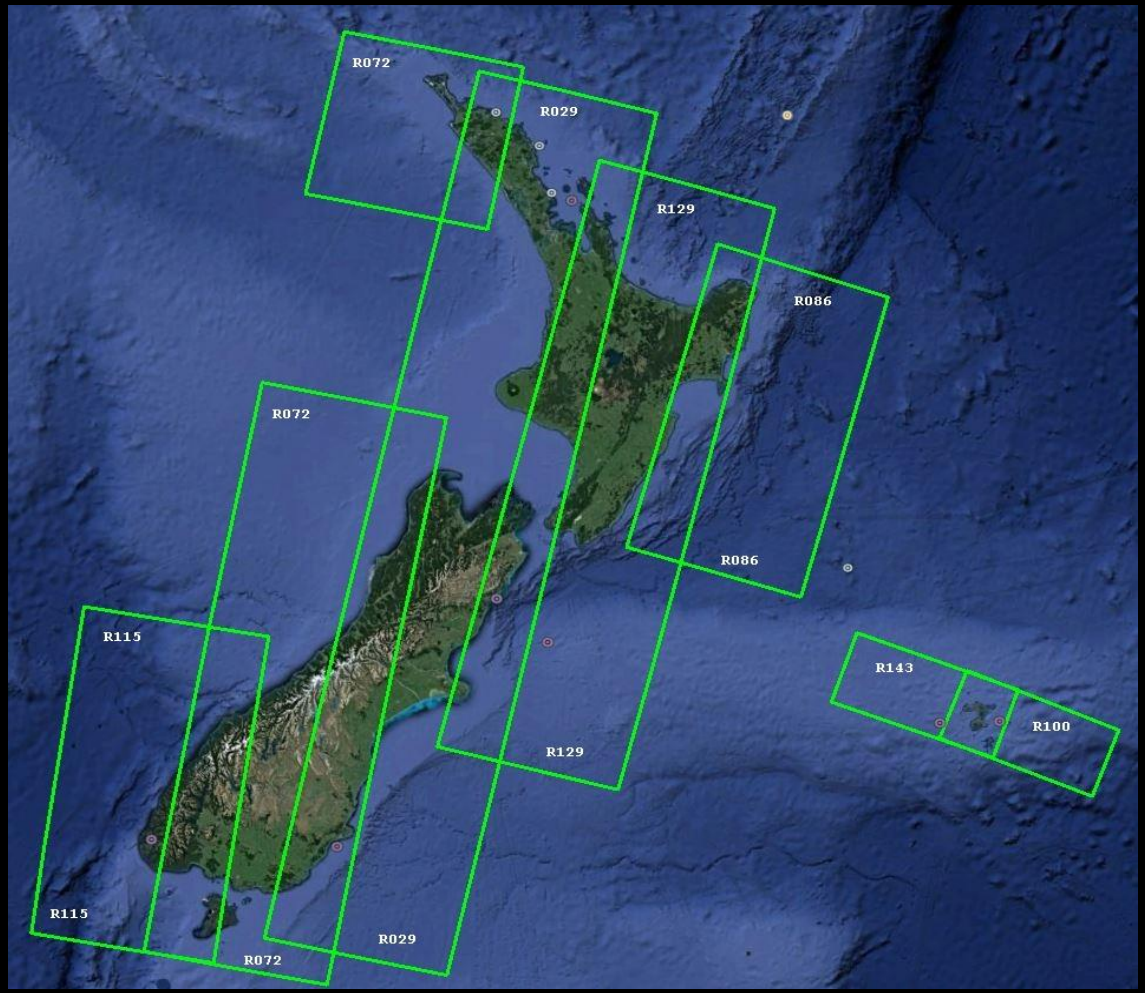
- Mainly used at Manaaki Whenua-Landcare Research for aerial surveys with the following sensors:
  - ‘Standard’ digital camera (RGB)
  - Multi-spectral 2D digital sensor*
  - Hyper-spectral 1D digital sensor*
  - Mobile Laser Scanner (MLS)

* coming later this year

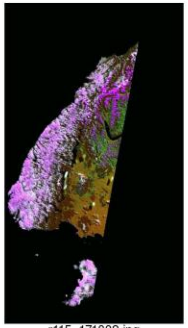
Terrestrial and Mobile Laser Scanners (TLS/MLS)

- Detailed three-dimensional scans from underneath the forest canopy
- MLS on RPAS (drones) can provide extra information from above
- Information on forest structure
- Provides information on:
  - Sub-canopy tree height
  - Trunk diameter and shape
  - Leaf density




R072
R029
R129
R086
R072
R086
R115
R143
R100
R129
R115
R029
R072

Sentinel-2 Oct/Nov/Dec/Jan/Feb R115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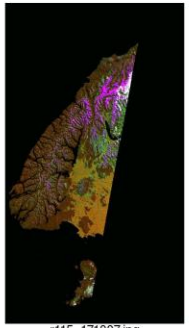
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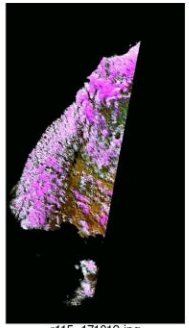
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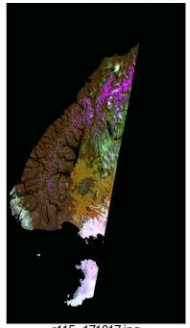
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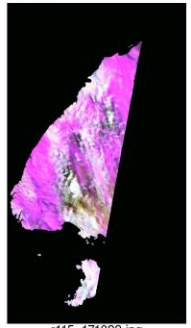
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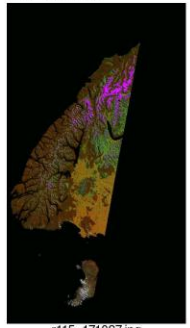
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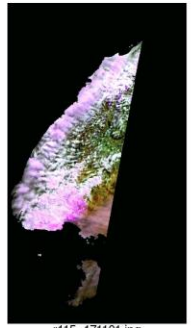
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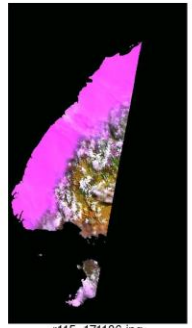
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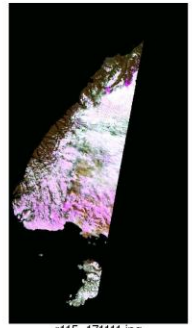
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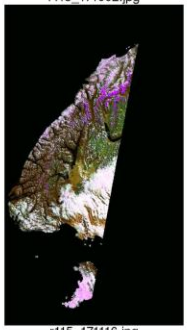
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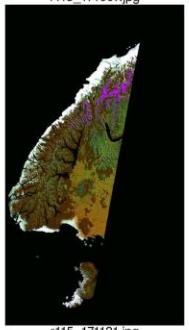
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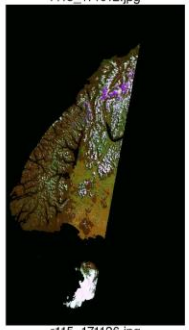
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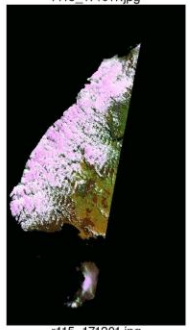
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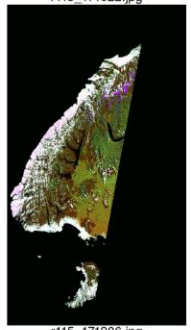
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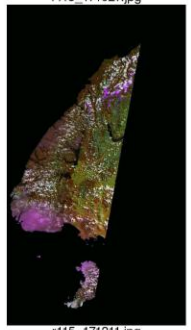
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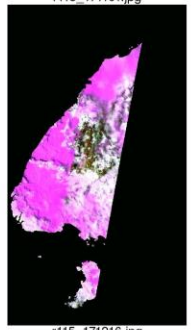
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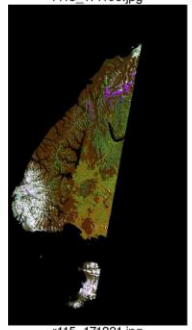
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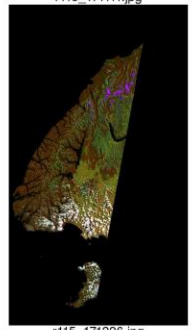
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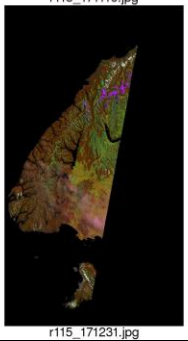
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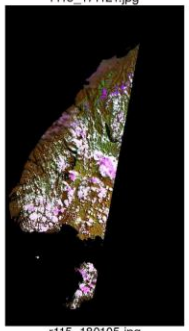
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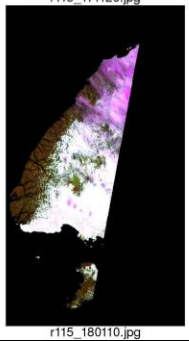
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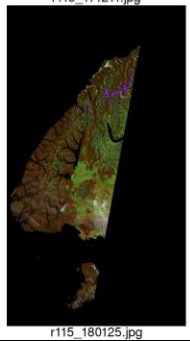
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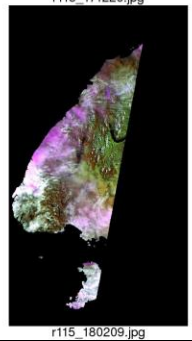
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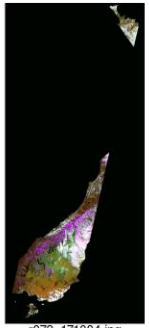
Sentinel-2 Oct/Nov/Dec/Jan/Feb R072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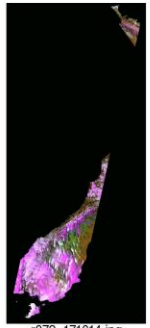
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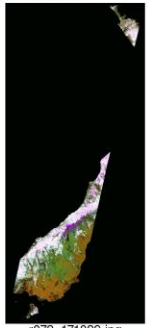
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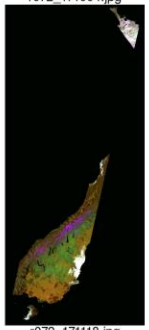
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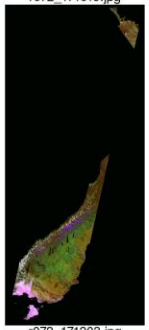
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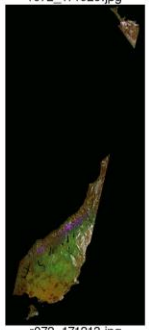
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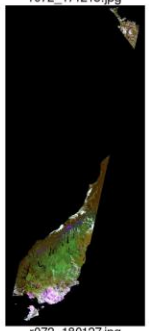
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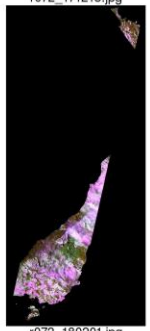
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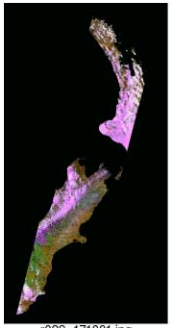
Sentinel-2 Oct/Nov/Dec/Jan/Feb R029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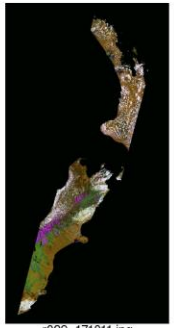
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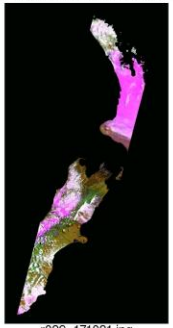
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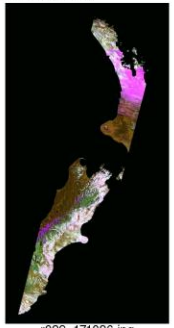
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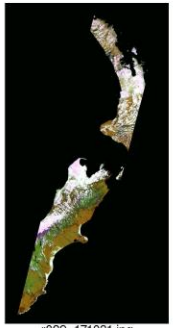
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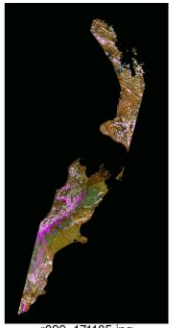
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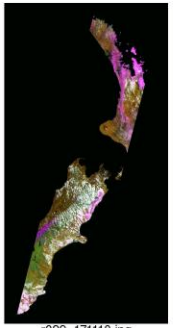
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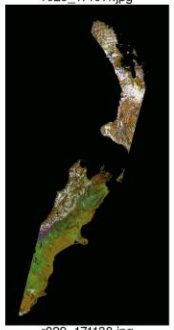
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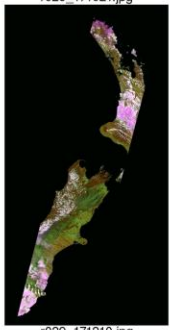
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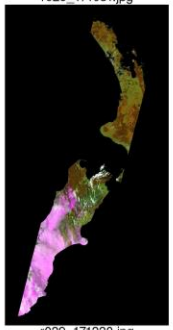
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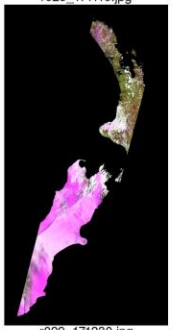
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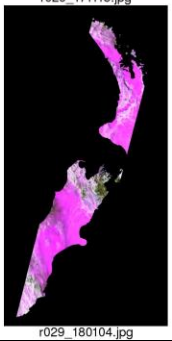
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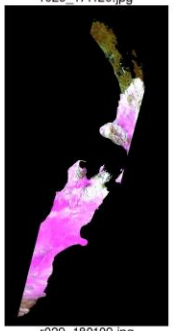
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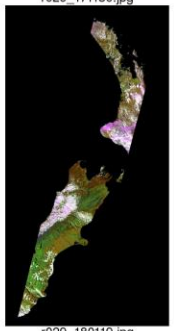
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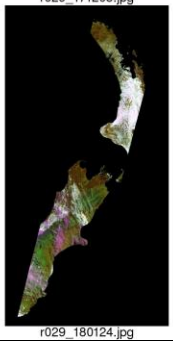
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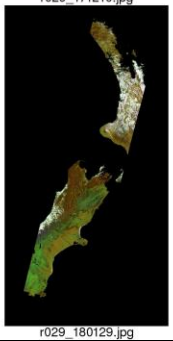
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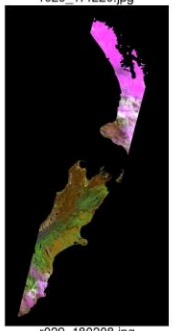
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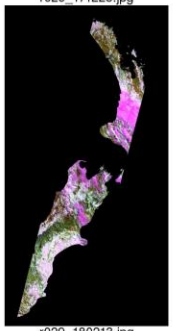
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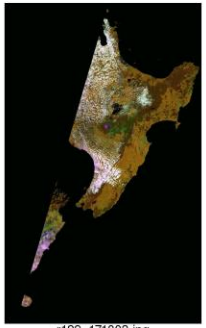
Sentinel-2 Oct/Nov/Dec/Jan/Feb R129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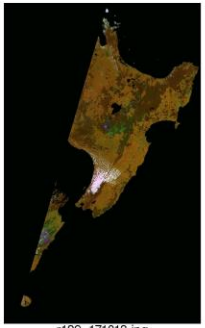
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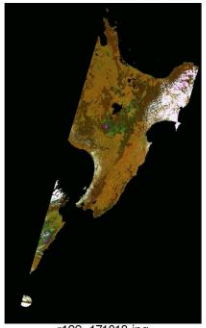
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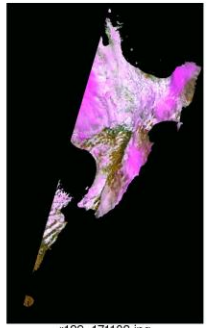
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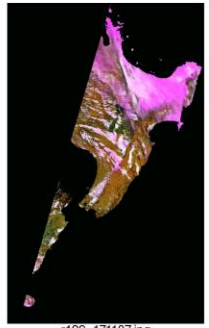
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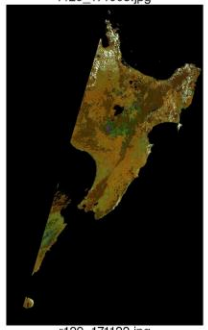
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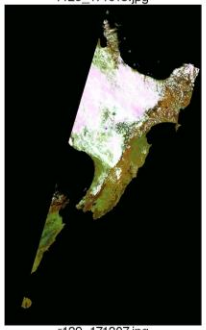
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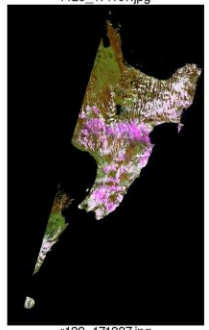
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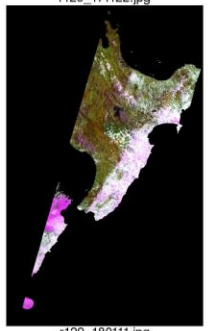
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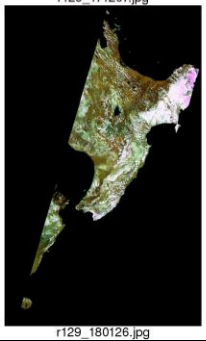
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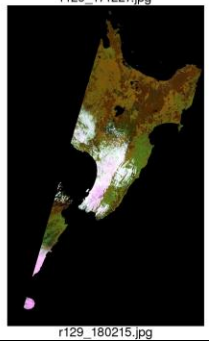
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Sentinel-2 Oct/Nov/Dec/Jan/Feb R086

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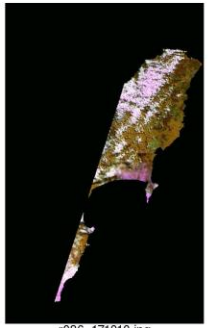
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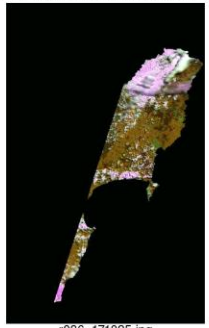
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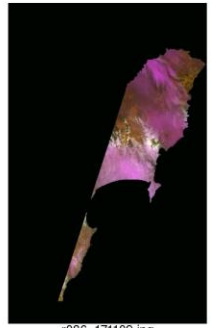
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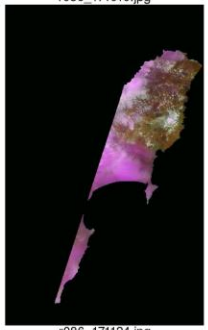
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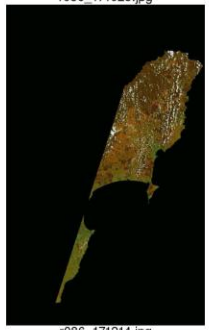
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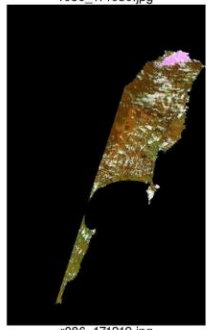
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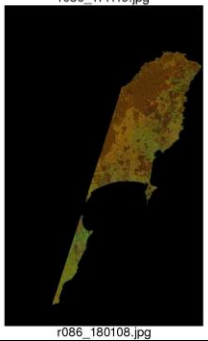
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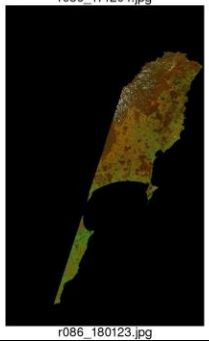
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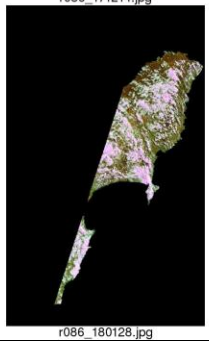
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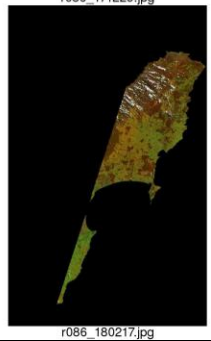
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Sentinel-2 Oct/Nov/Dec/Jan/Feb R143

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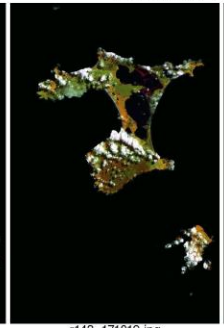
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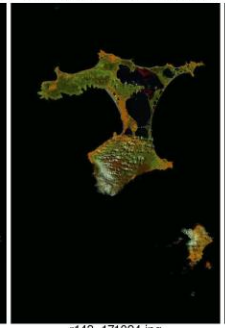
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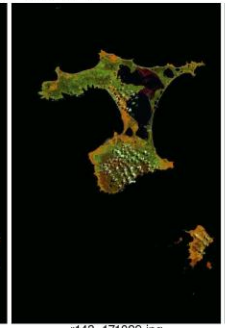
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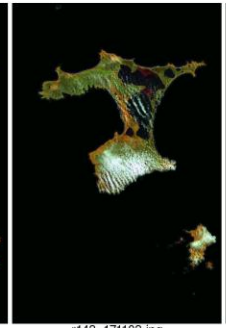
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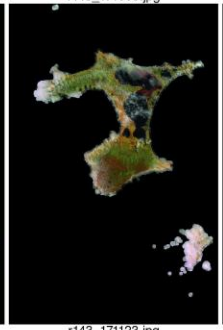
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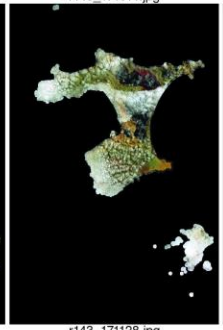
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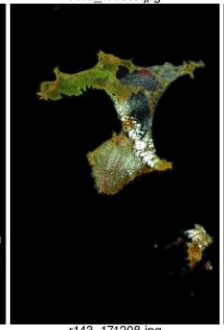
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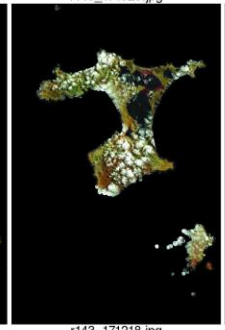
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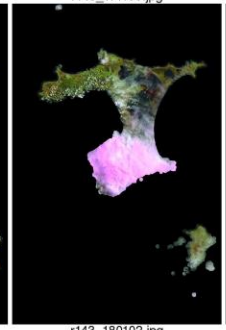
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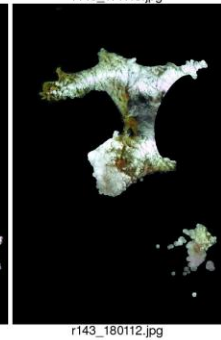
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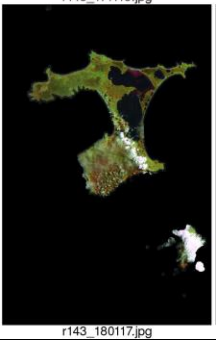
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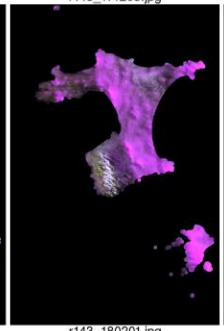
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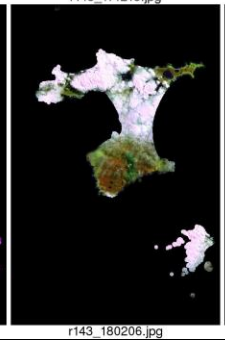
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Sentinel-2 Oct/Nov/Dec/Jan/Feb R100

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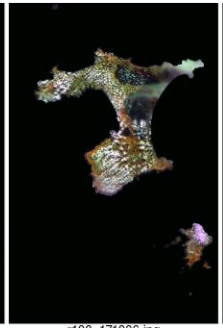
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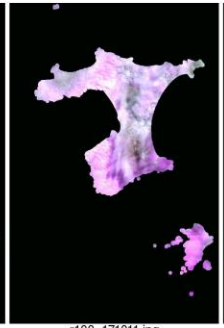
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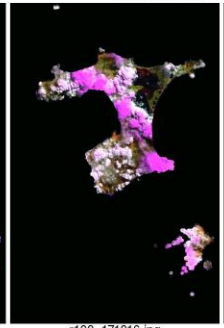
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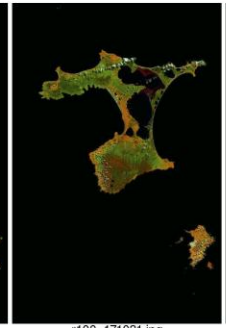
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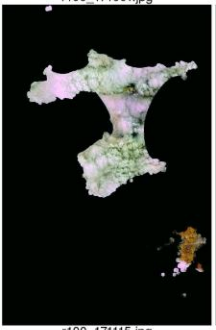
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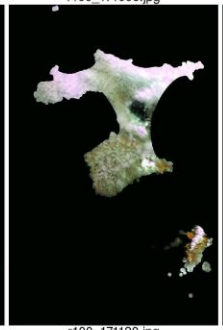
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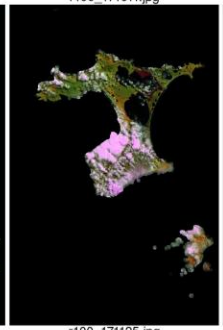
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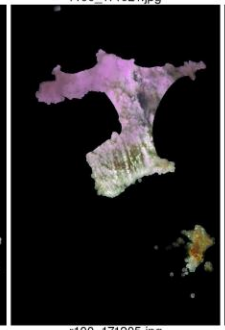
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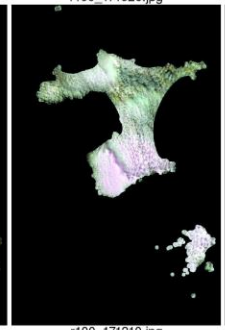
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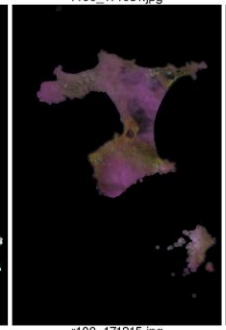
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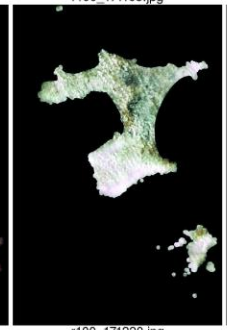
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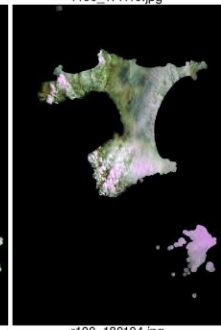
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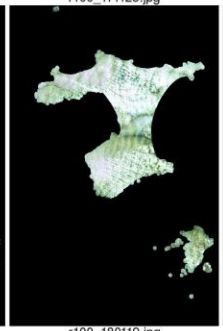
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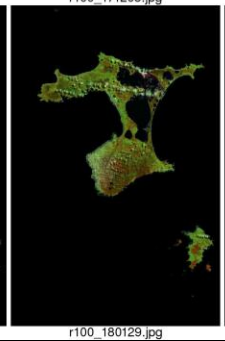
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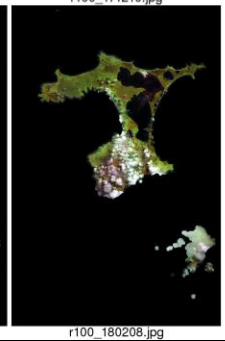
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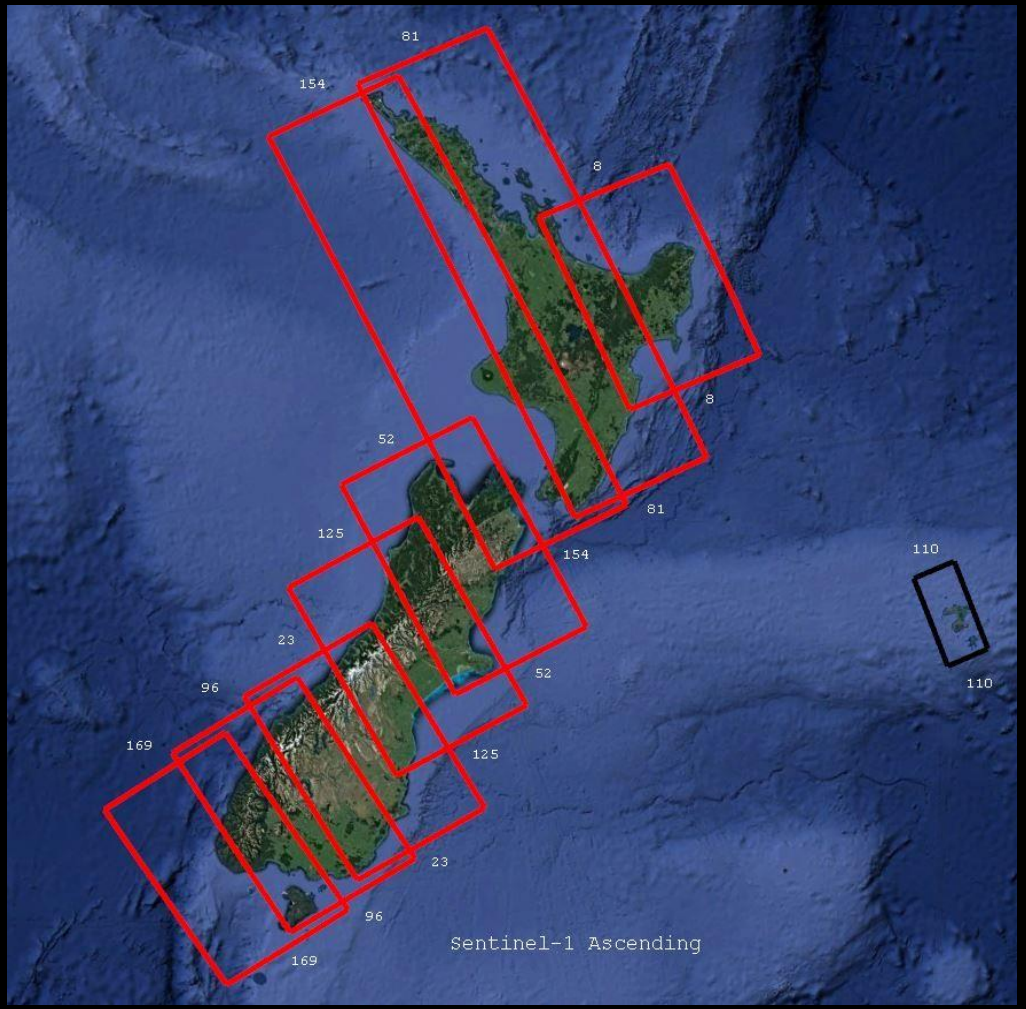
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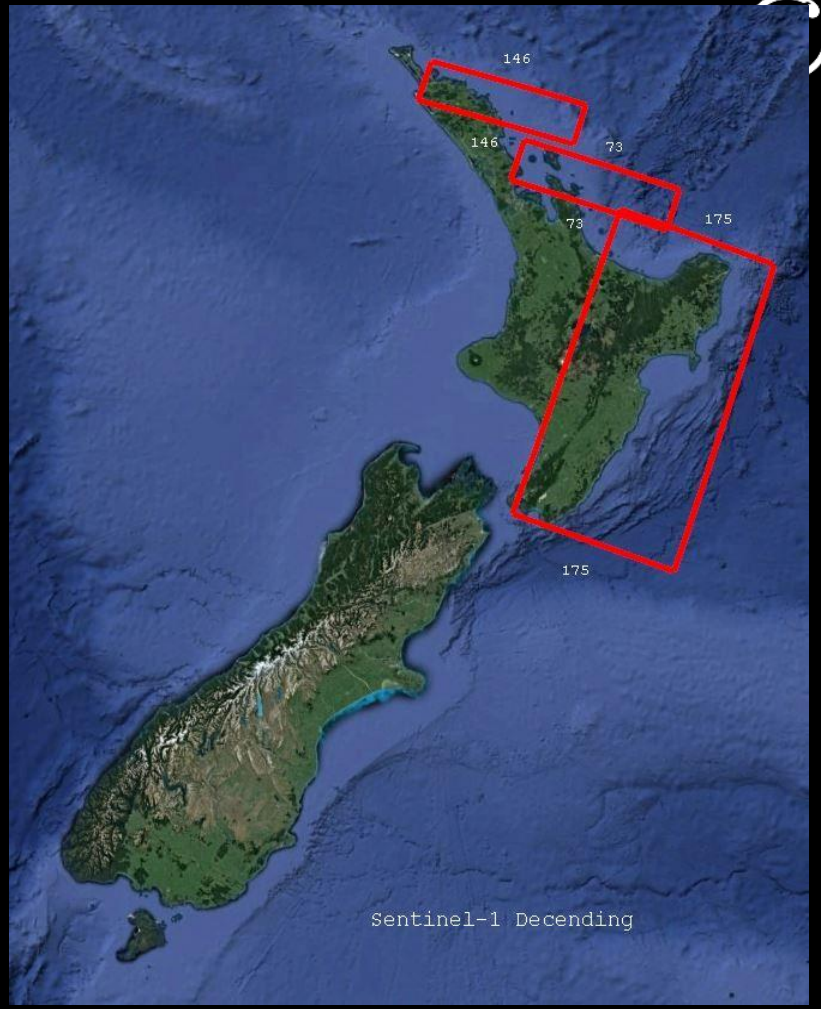
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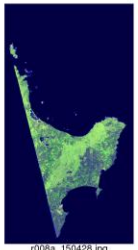
Sentinel-1 R008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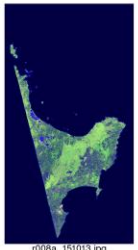
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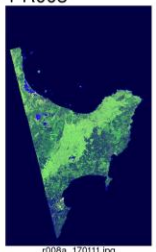
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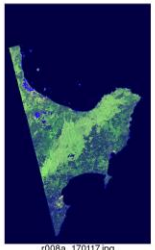
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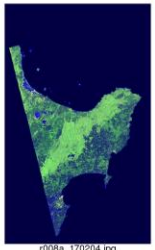
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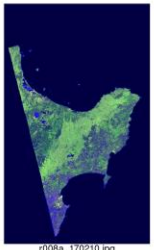
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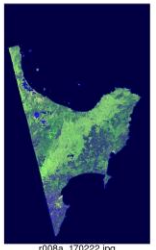
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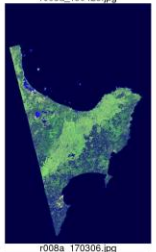
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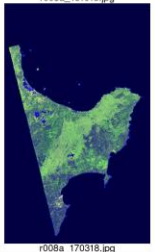
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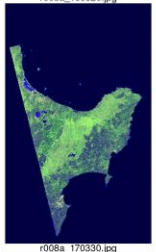
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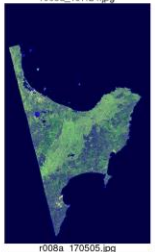
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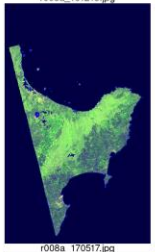
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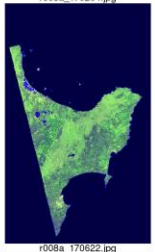
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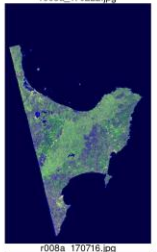
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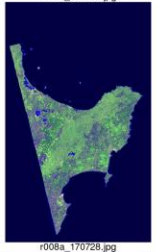
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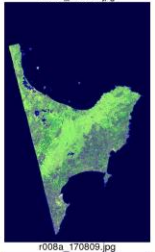
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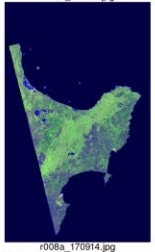
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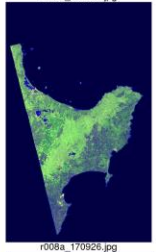
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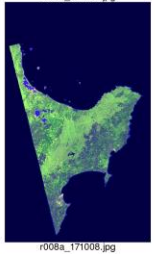
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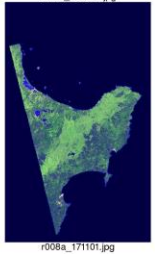
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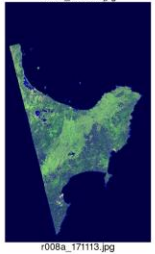
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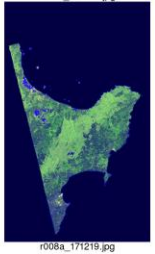
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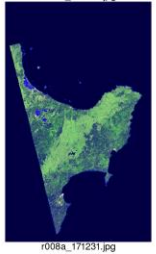
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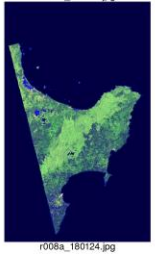
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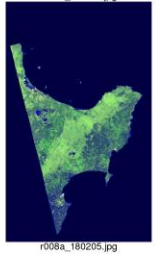
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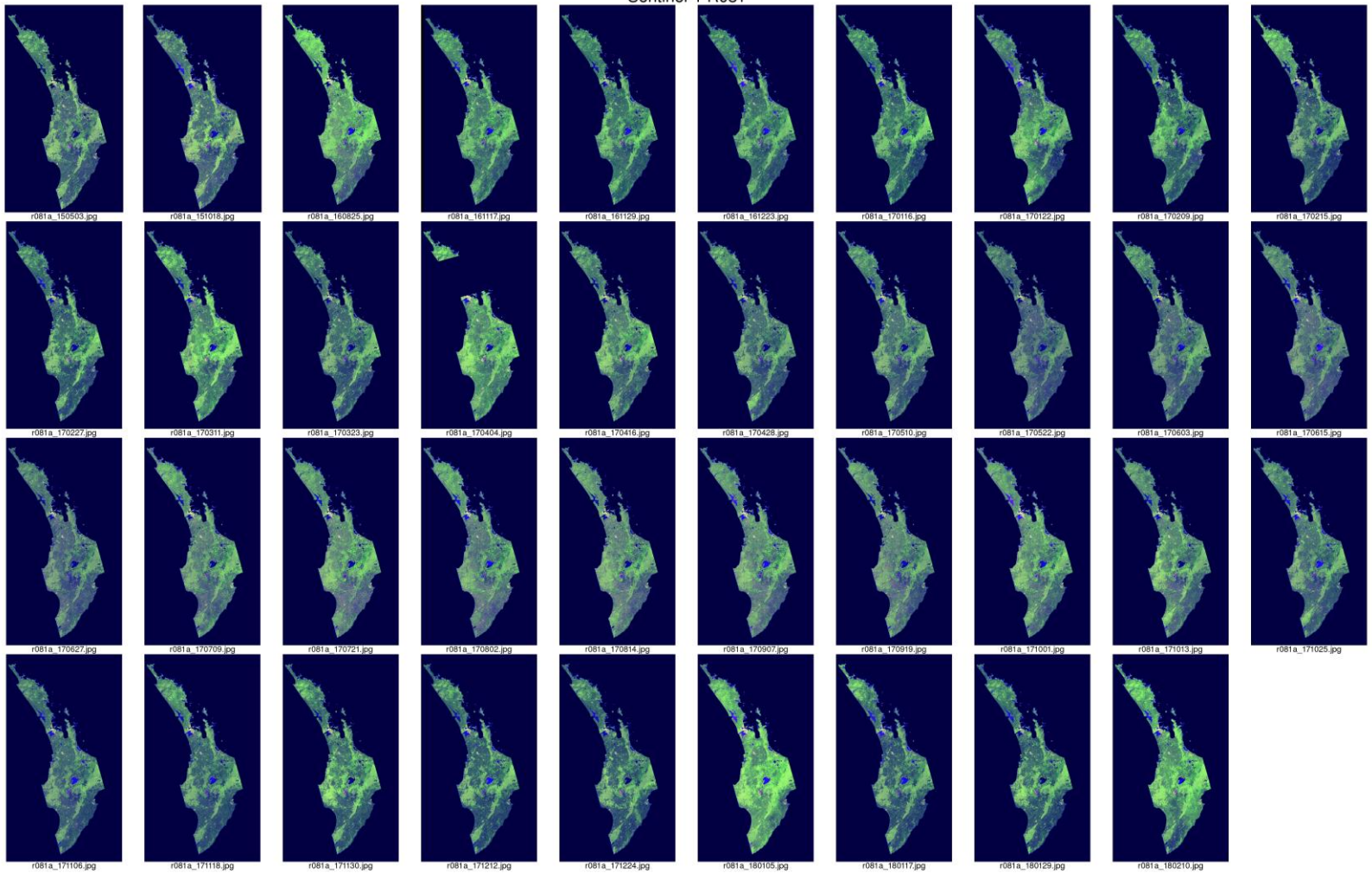

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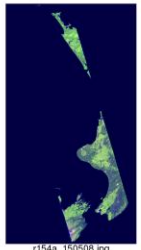
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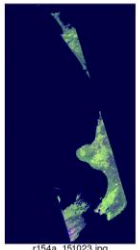
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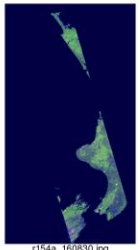
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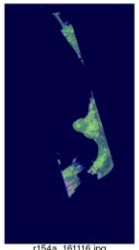
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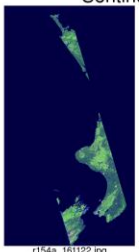
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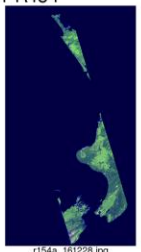
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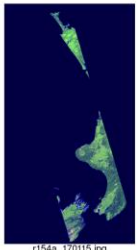
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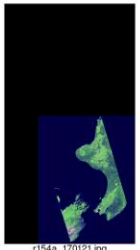
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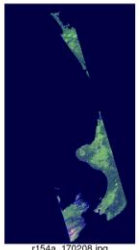
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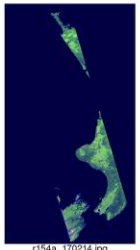
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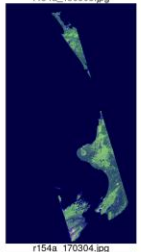
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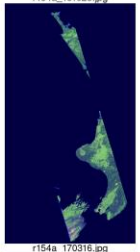
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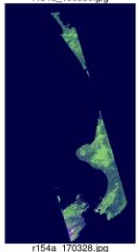
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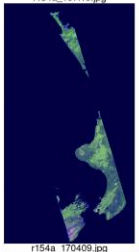
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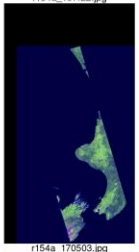
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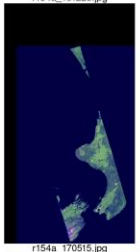
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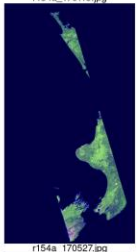
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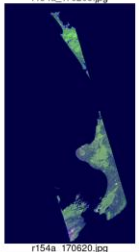
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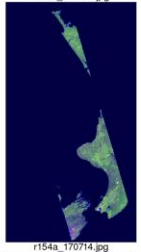
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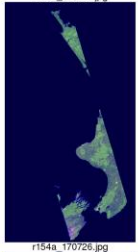
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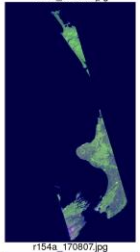
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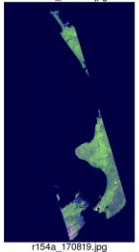
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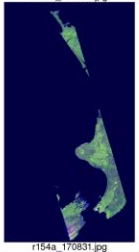
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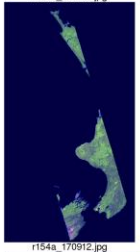
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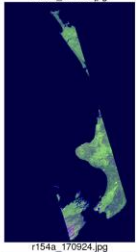
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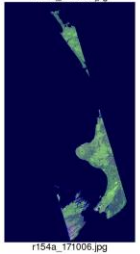
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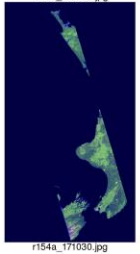
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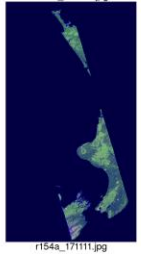
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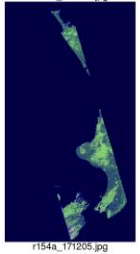
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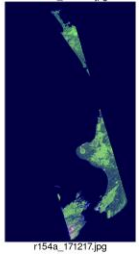
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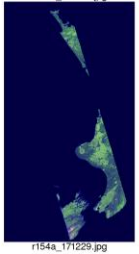
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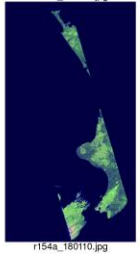
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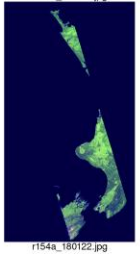
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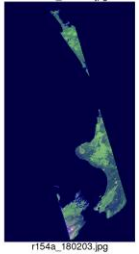
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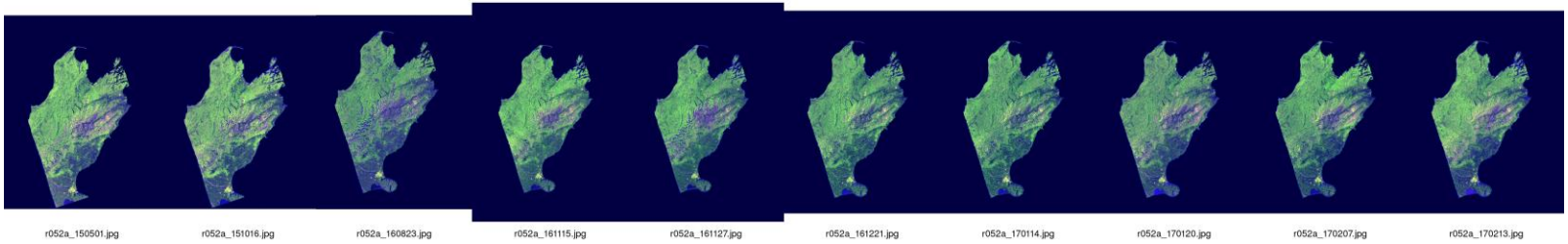
Sentinel-1 R052



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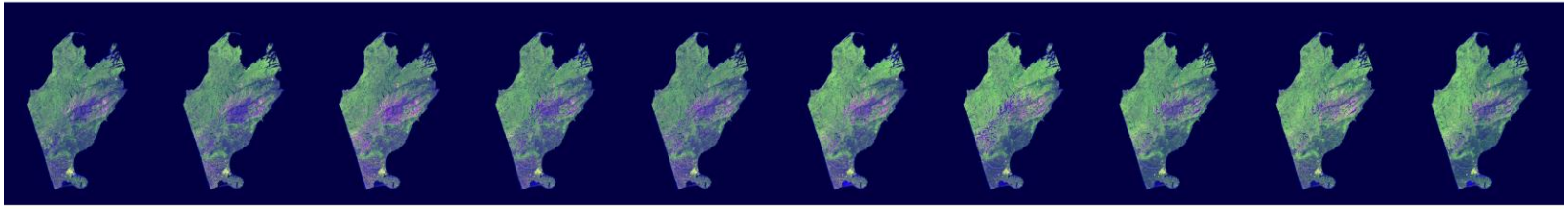

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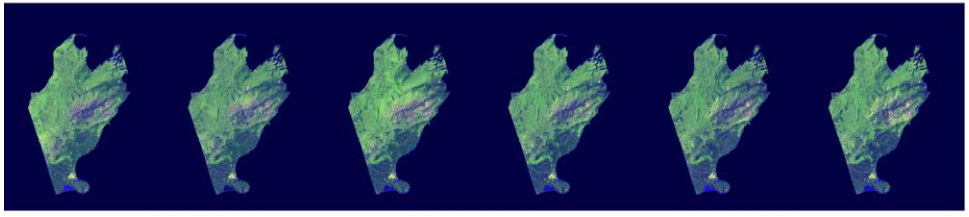

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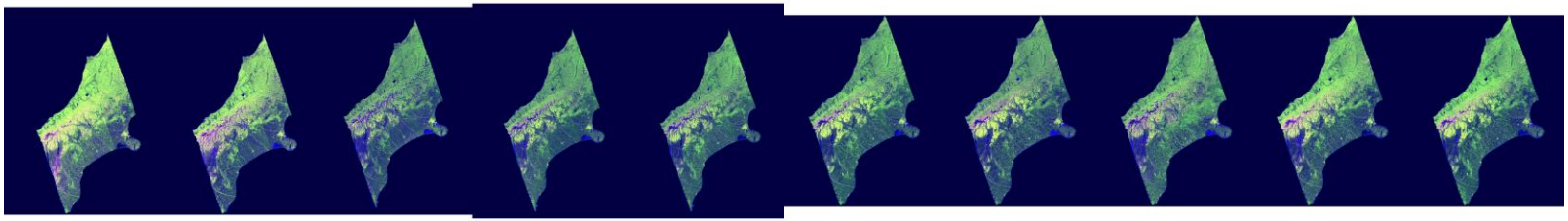
Sentinel-1 R125



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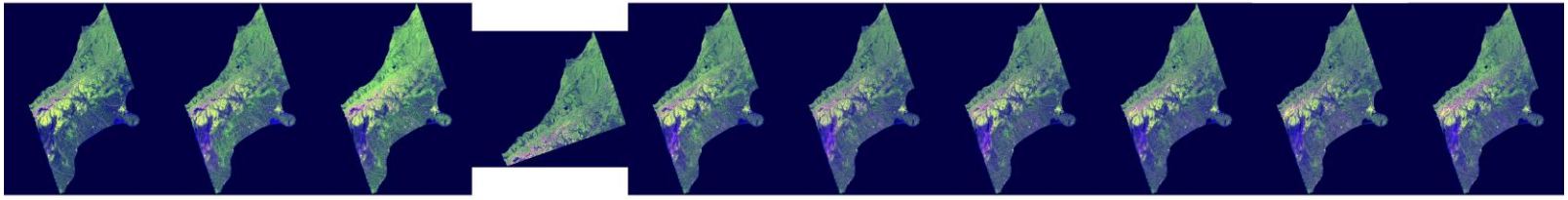

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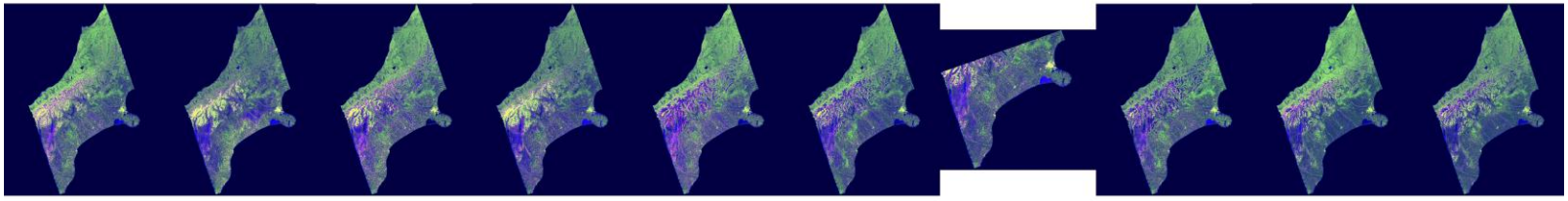

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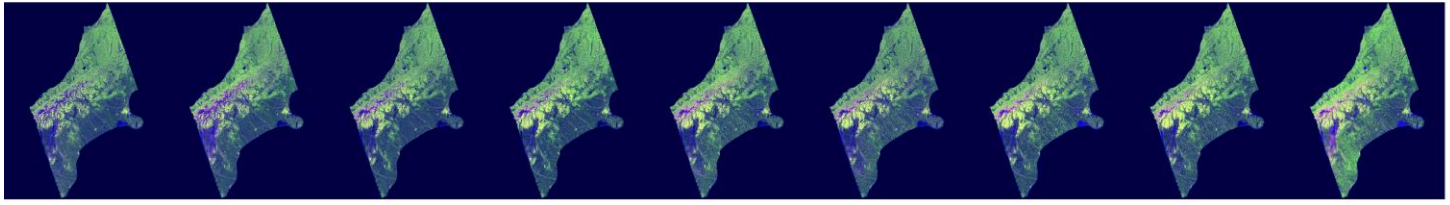

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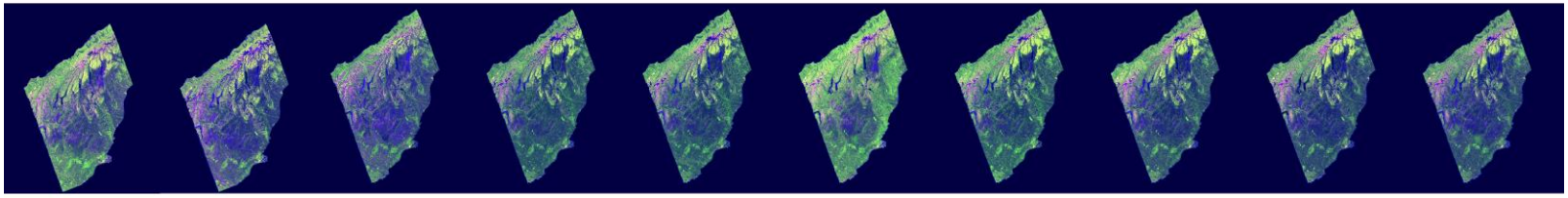
Sentinel-1 R023



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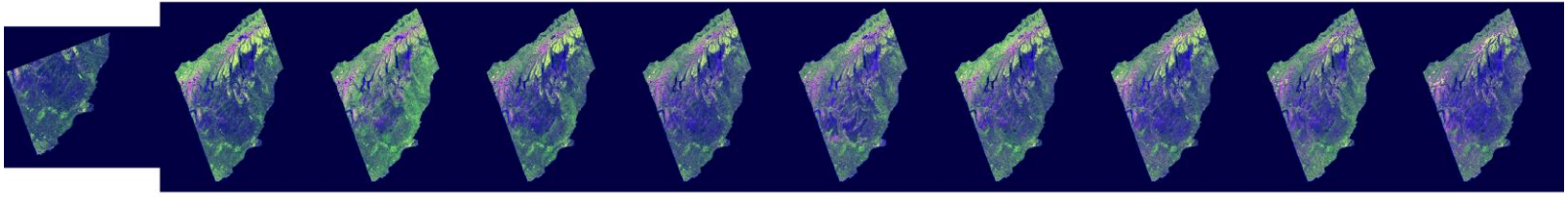

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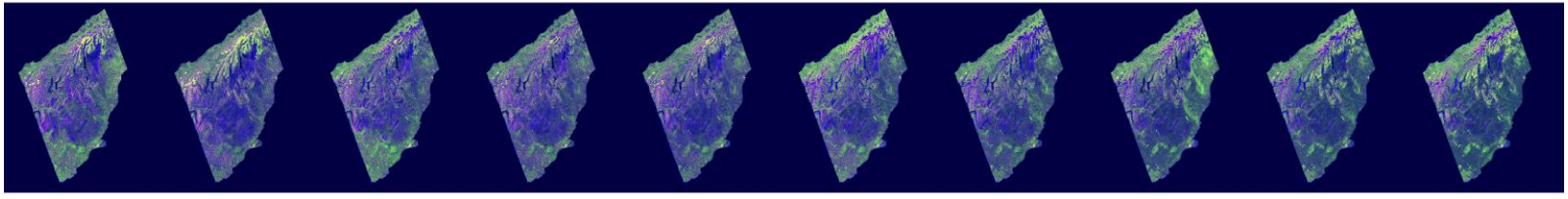

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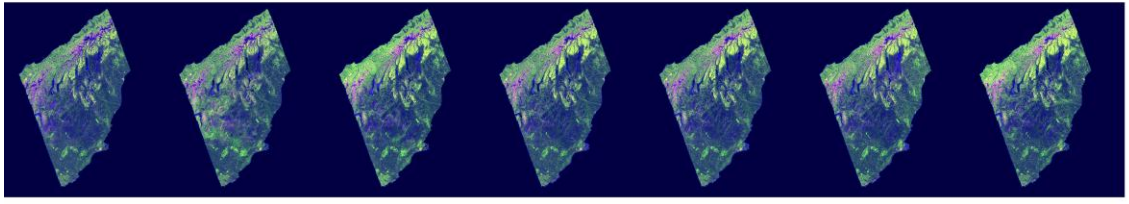

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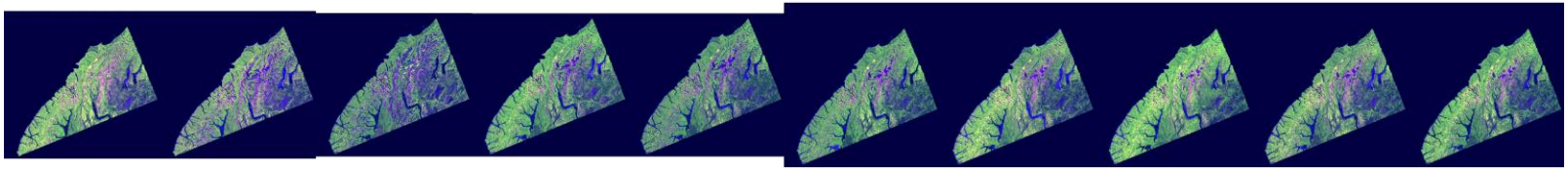
Sentinel-1 R096



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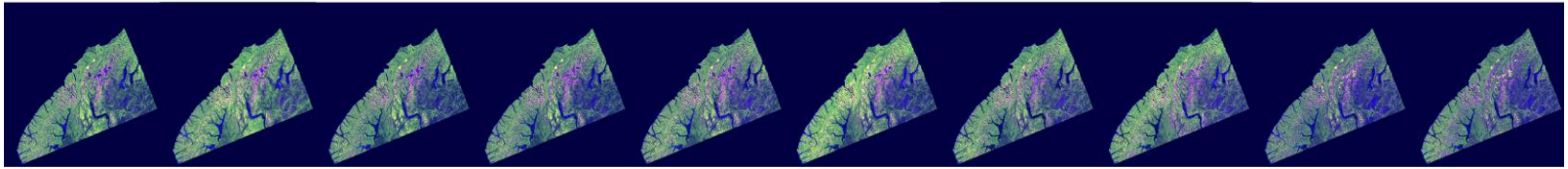

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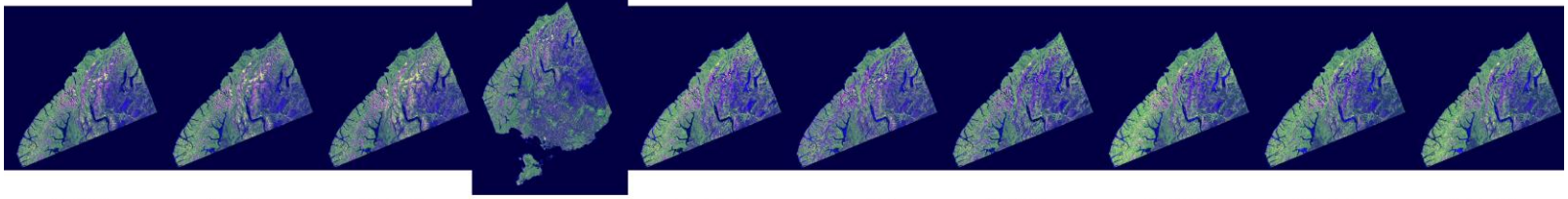

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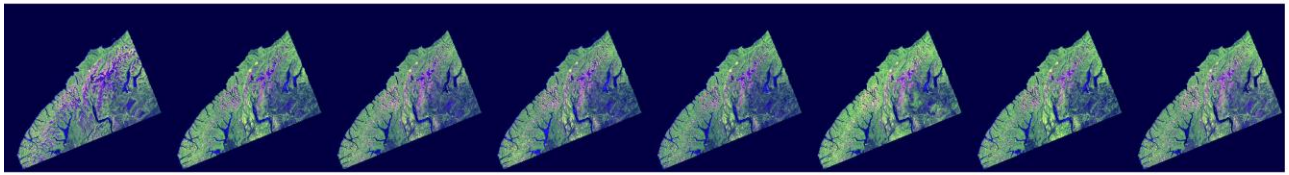

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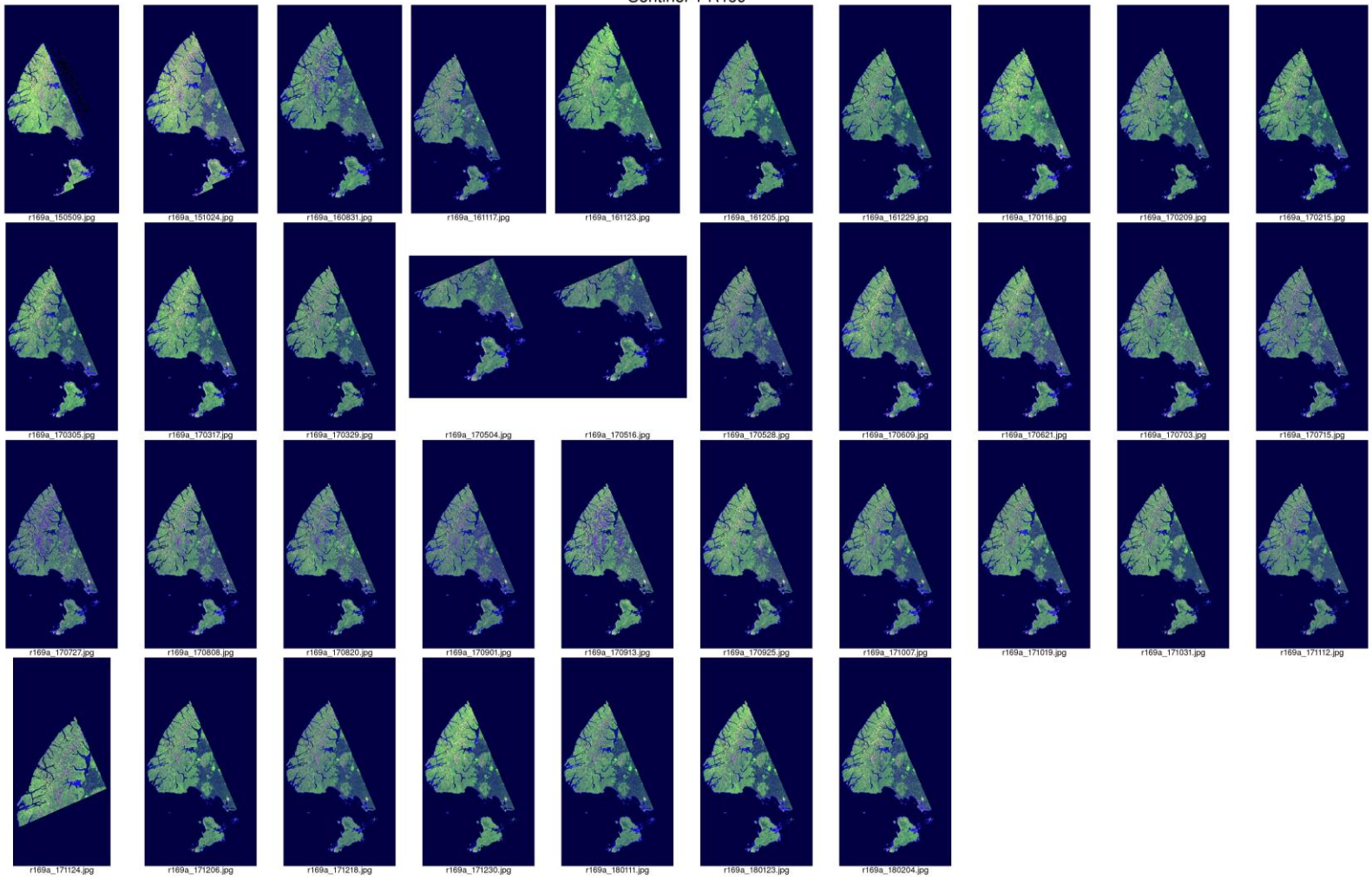
Sentinel-1 R169



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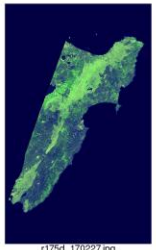
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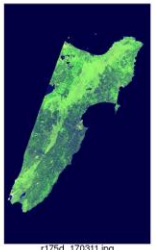
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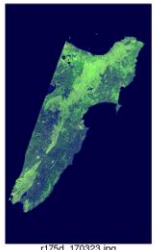
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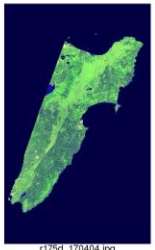
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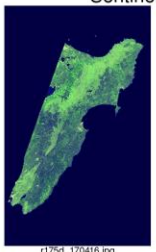
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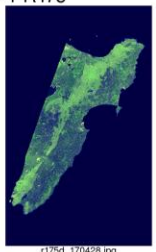
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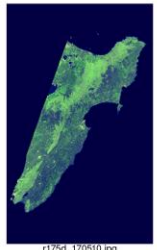
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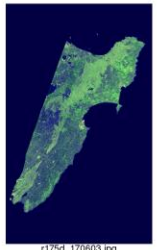
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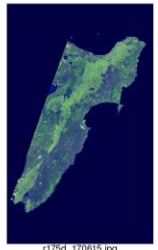
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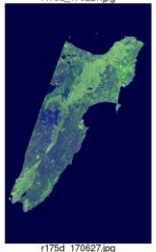
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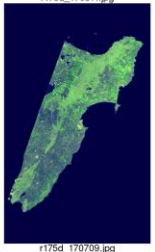
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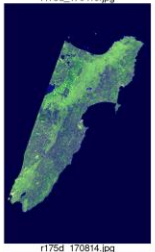
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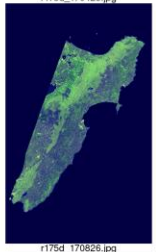
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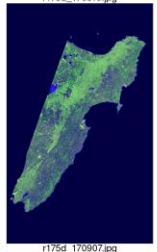
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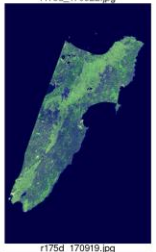
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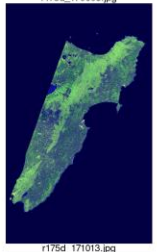
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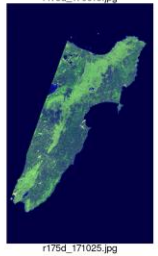
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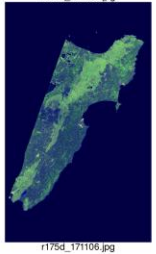
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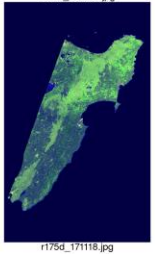
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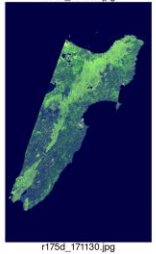
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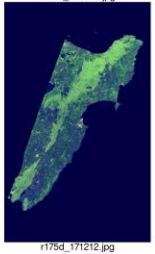
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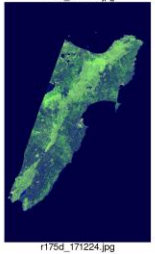
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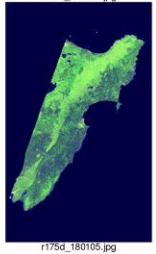
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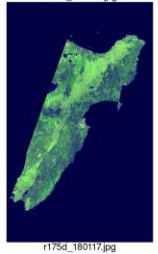
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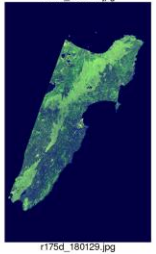
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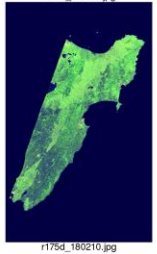
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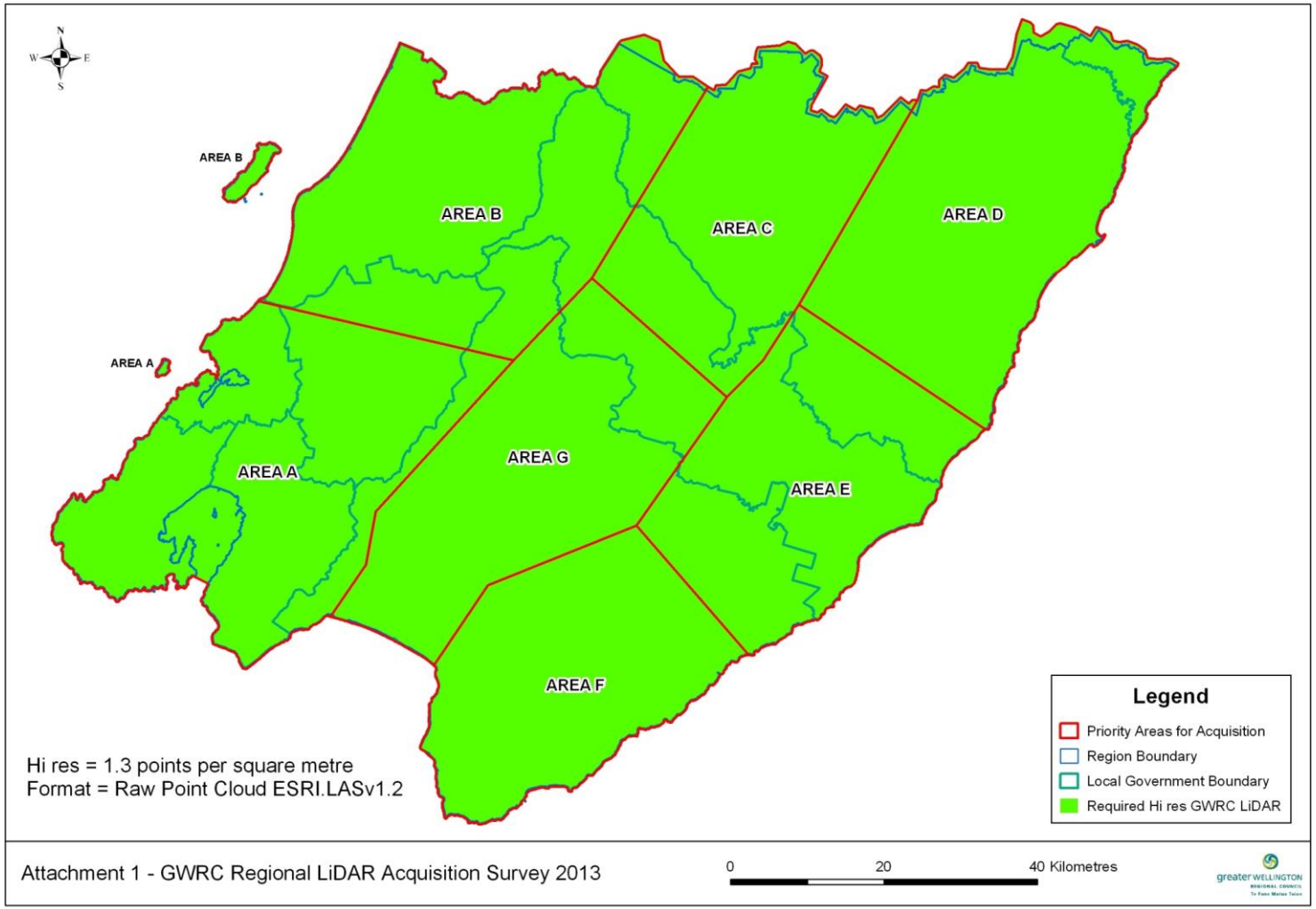
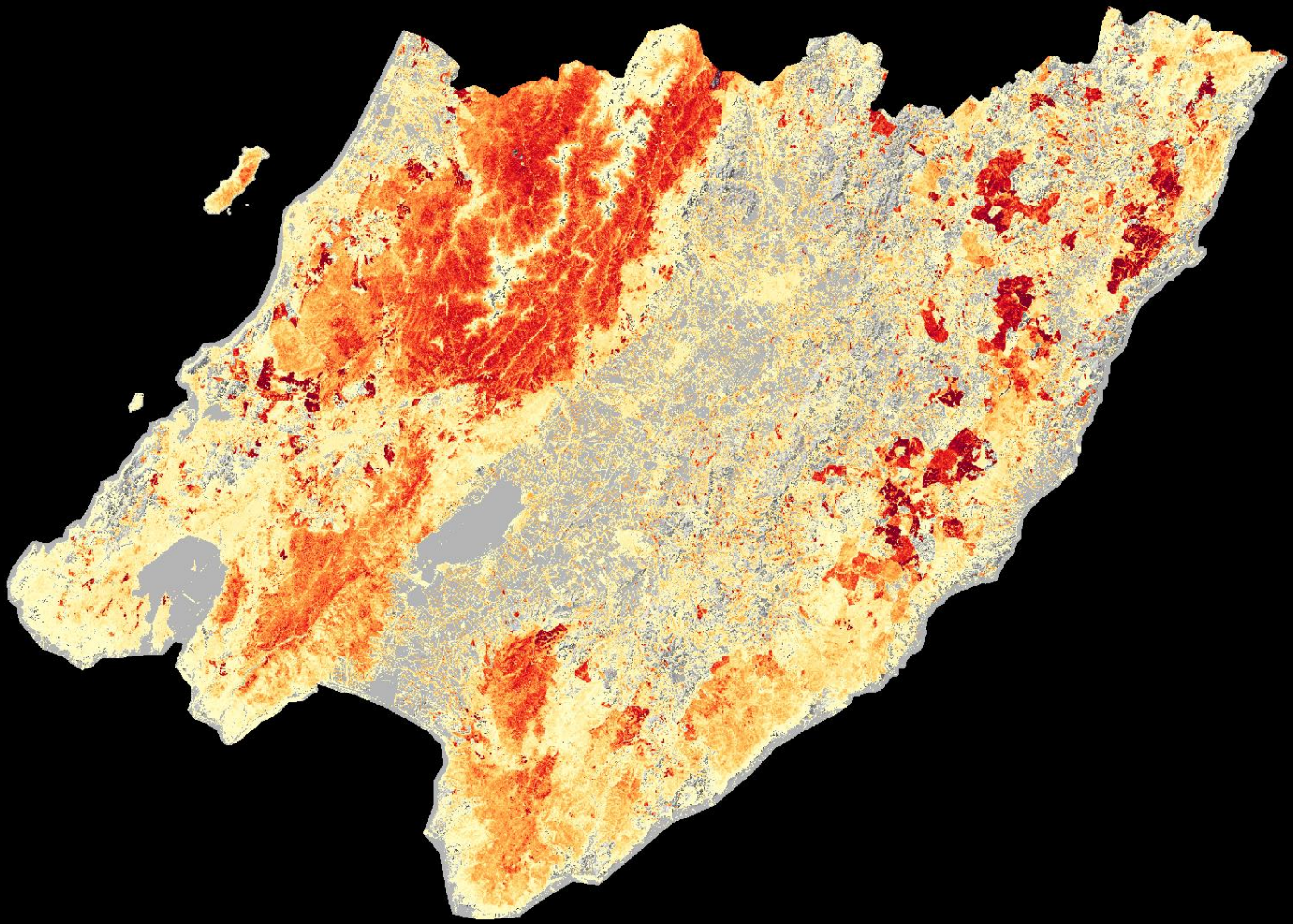
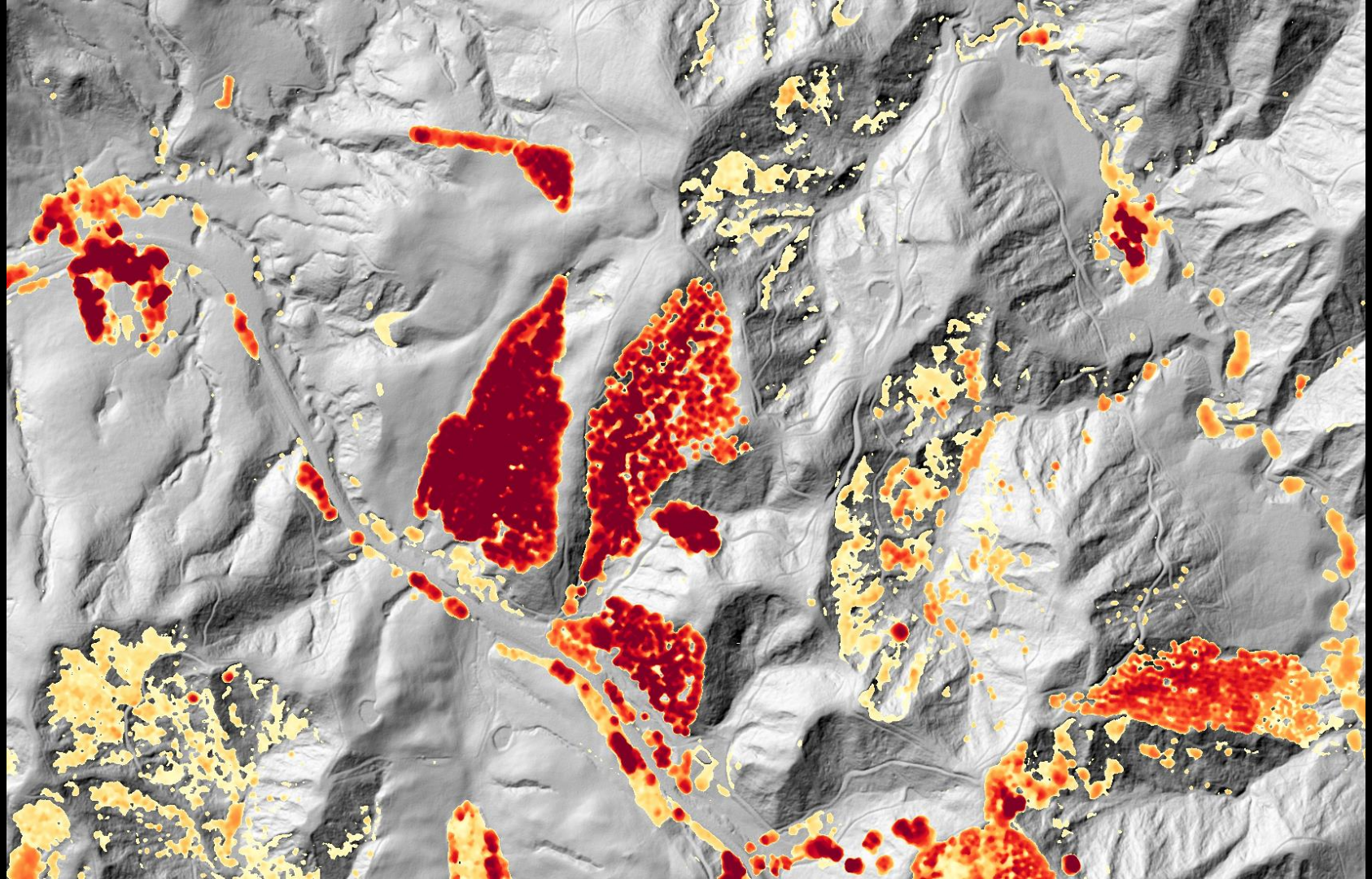
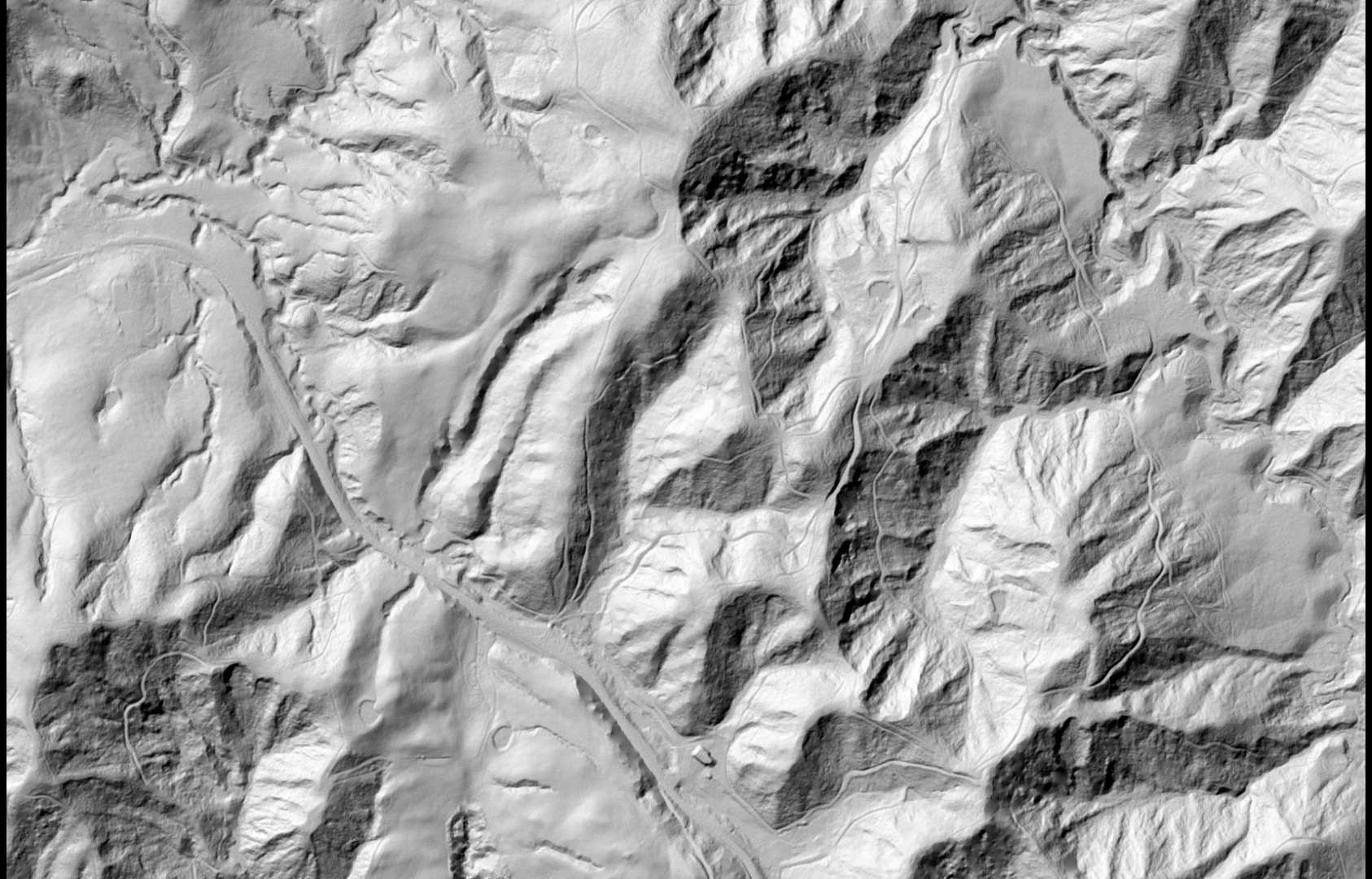
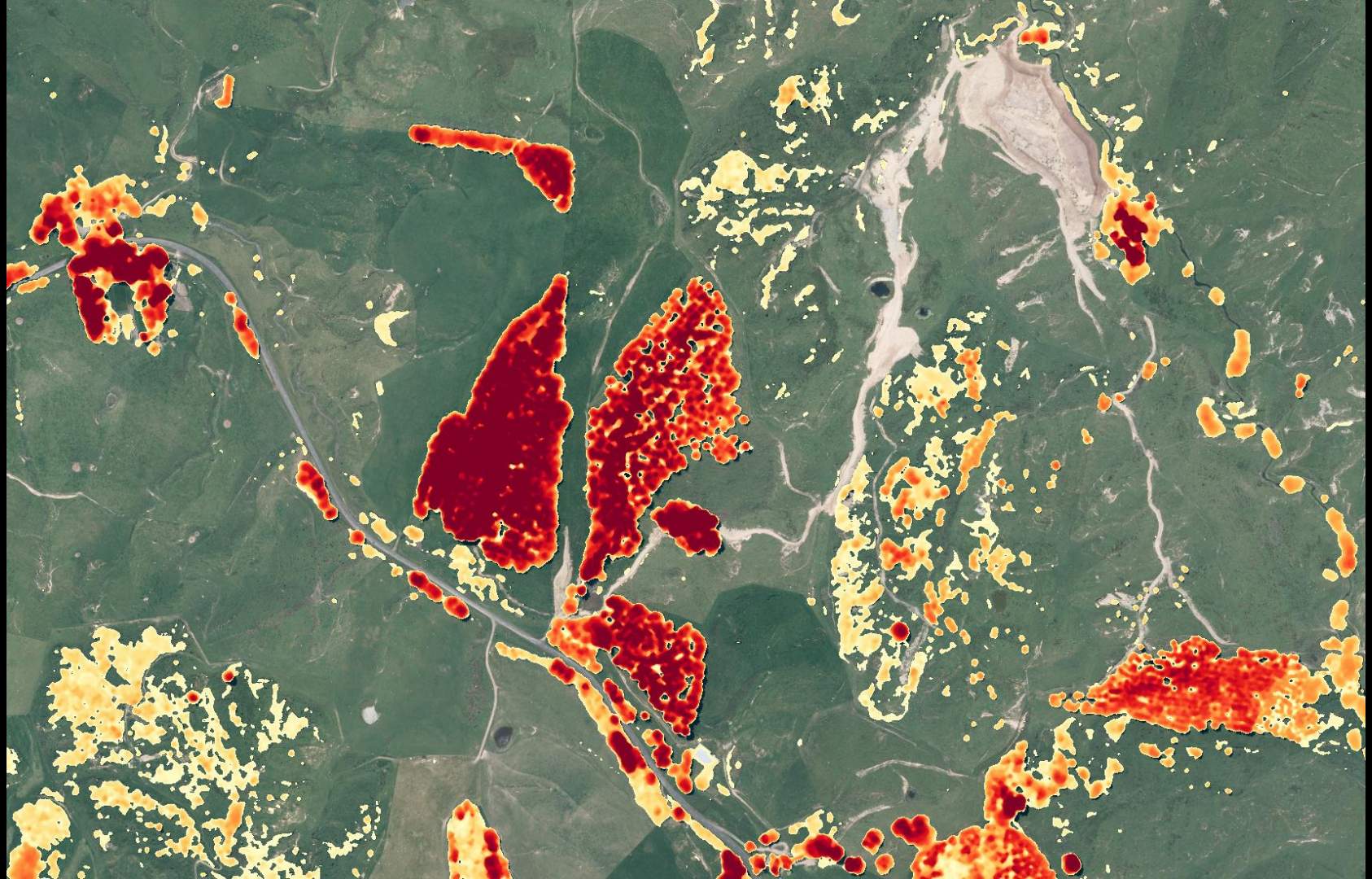
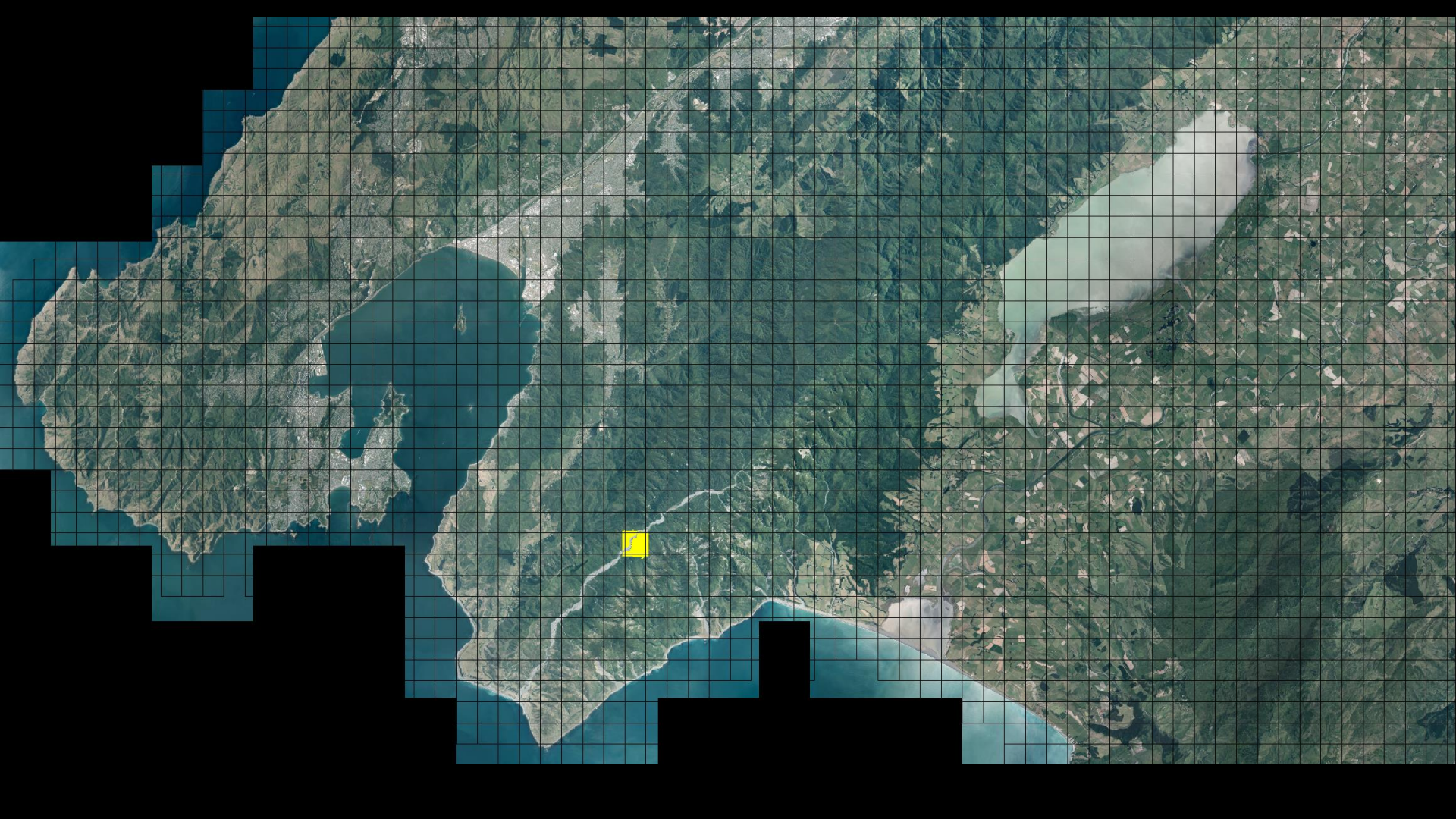

N
W
E
S
AREA B
AREA A
AREA B
AREA C
AREA D
AREA A
AREA G
AREA E
AREA F
Legend
Priority Areas for Acquisition
Region Boundary
Local Government Boundary
Required Hi res GWRC LiDAR
Hi res = 1.3 points per square metre
Format = Raw Point Cloud ESRI.LASv1.2
Attachment 1 - GWRC Regional LiDAR Acquisition Survey 2013
0
20
40 Kilometres
greater WELLINGTON
REGIONAL COUNCIL

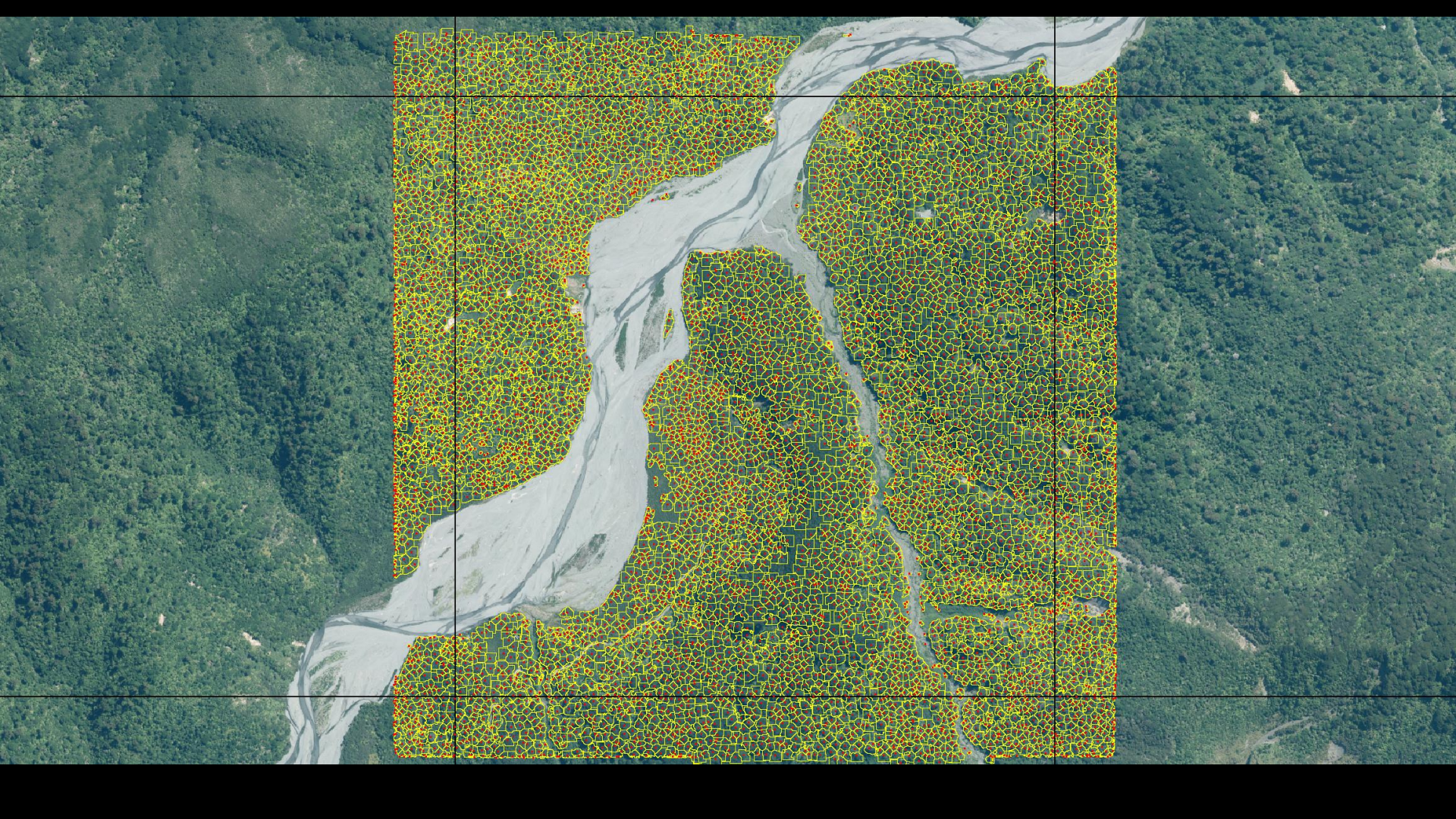


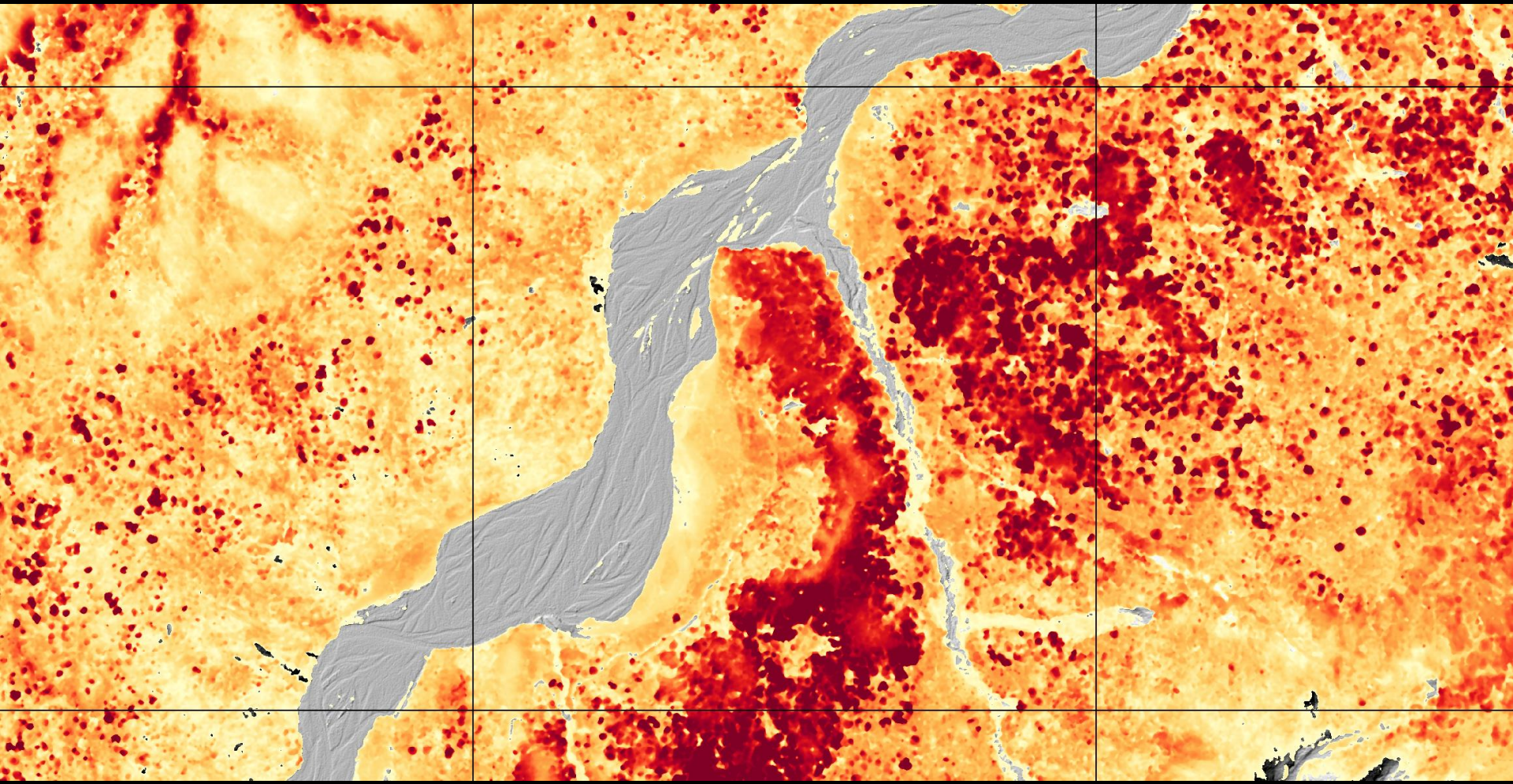


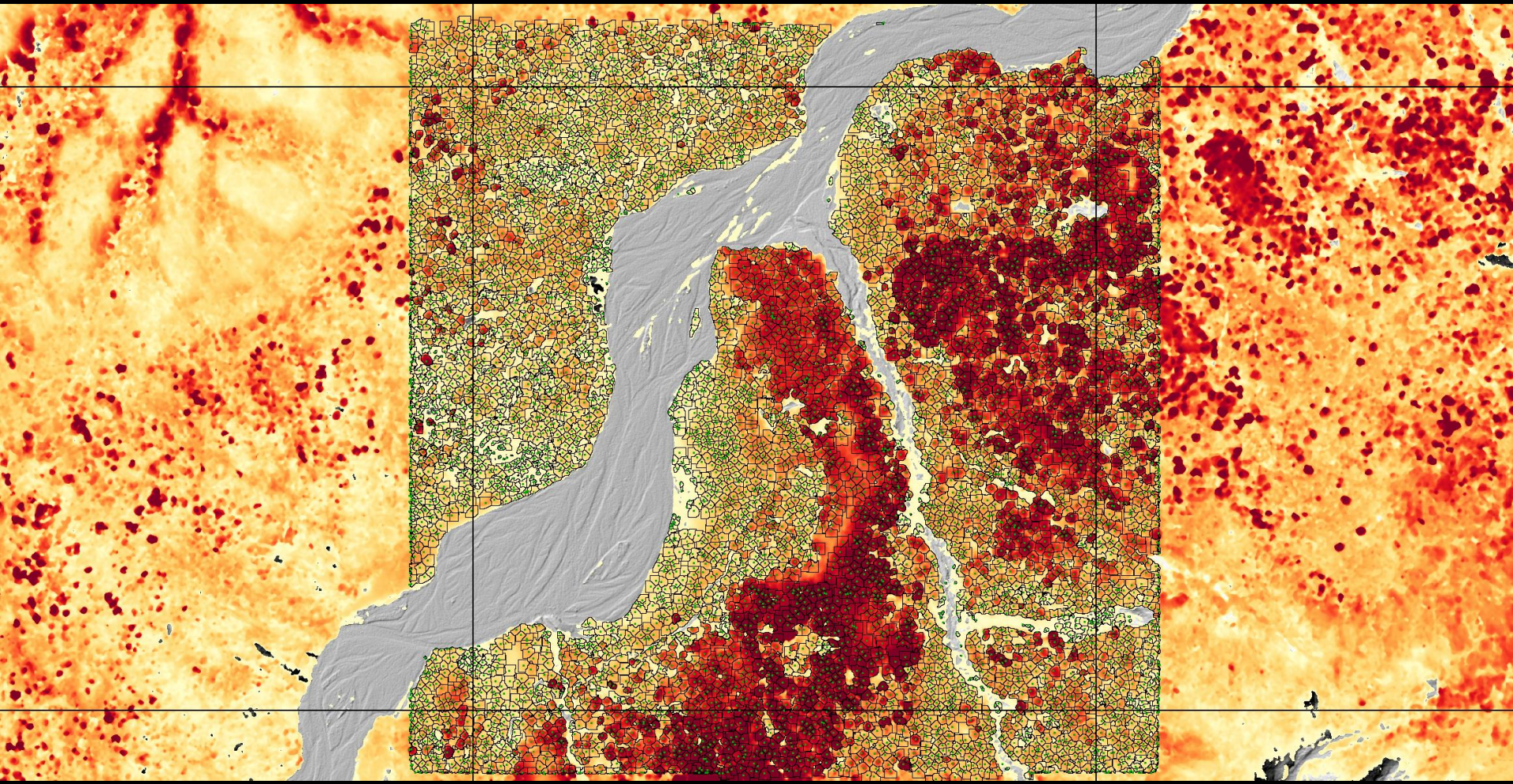


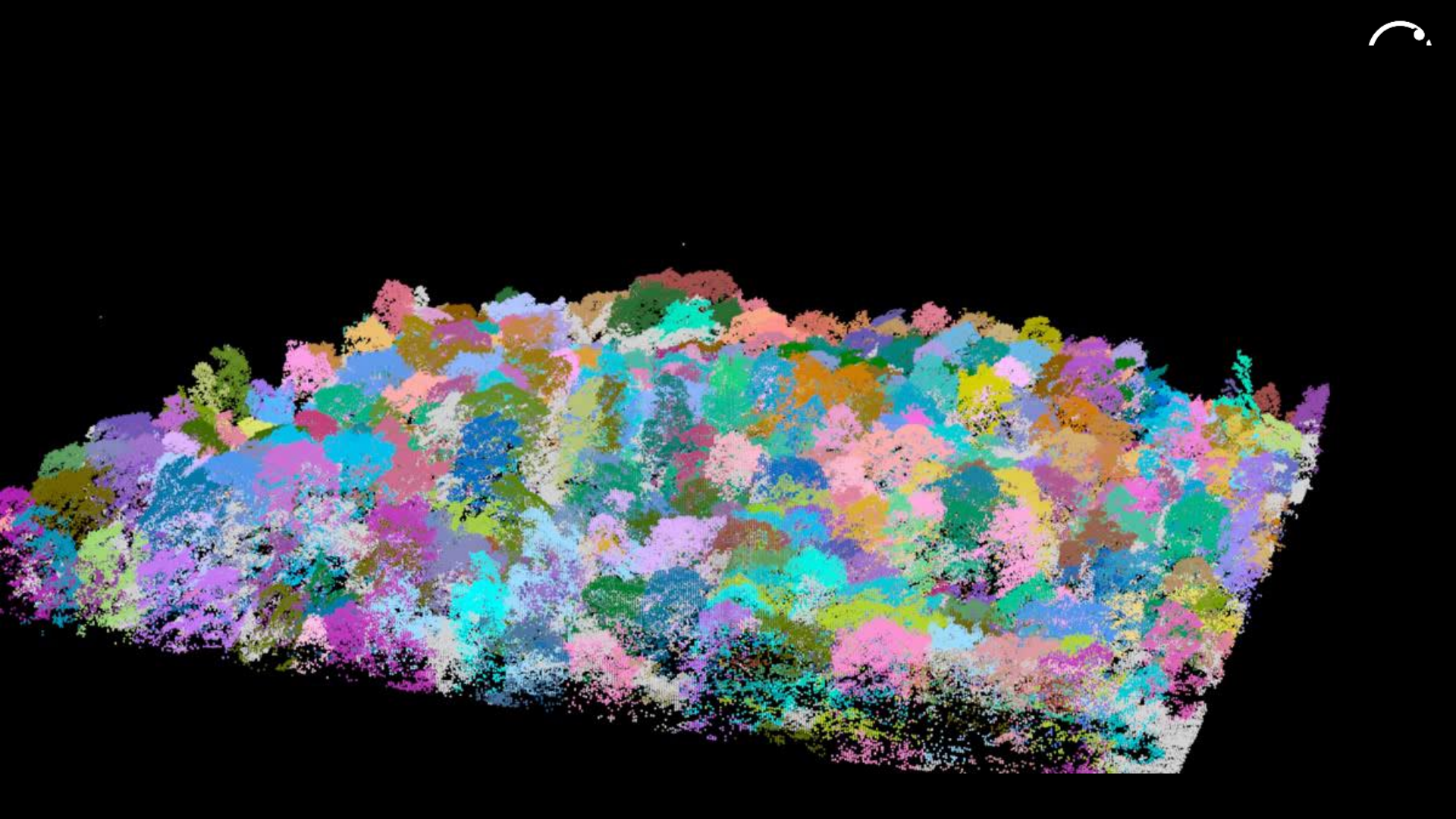






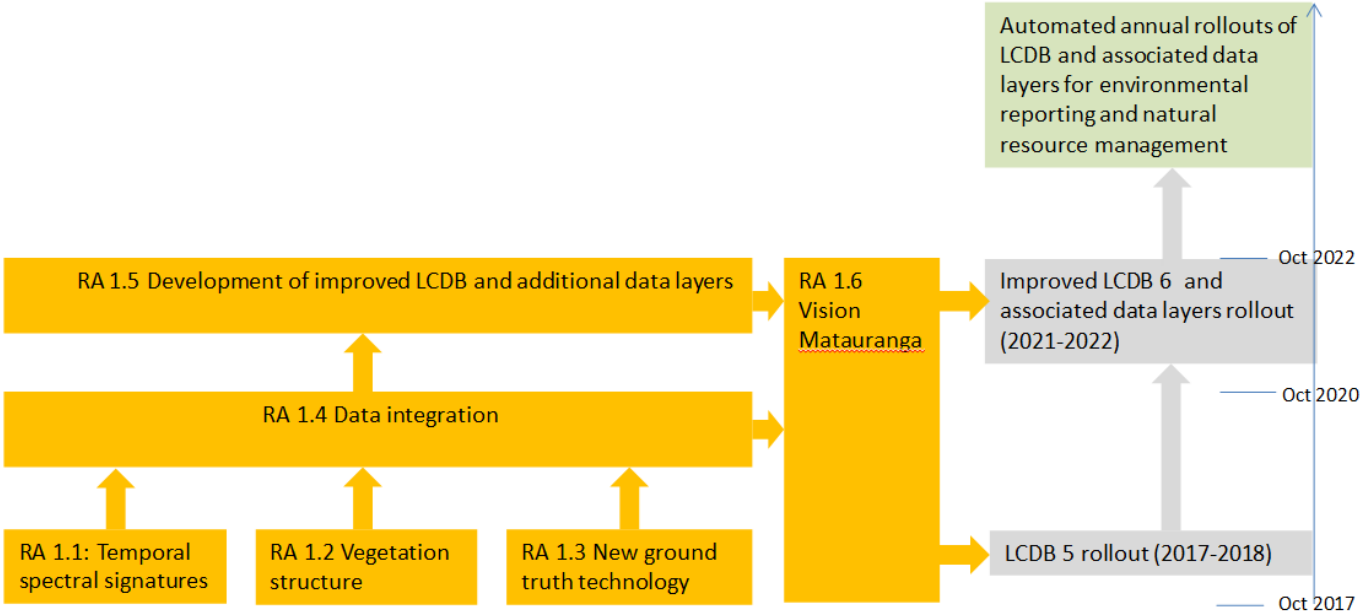






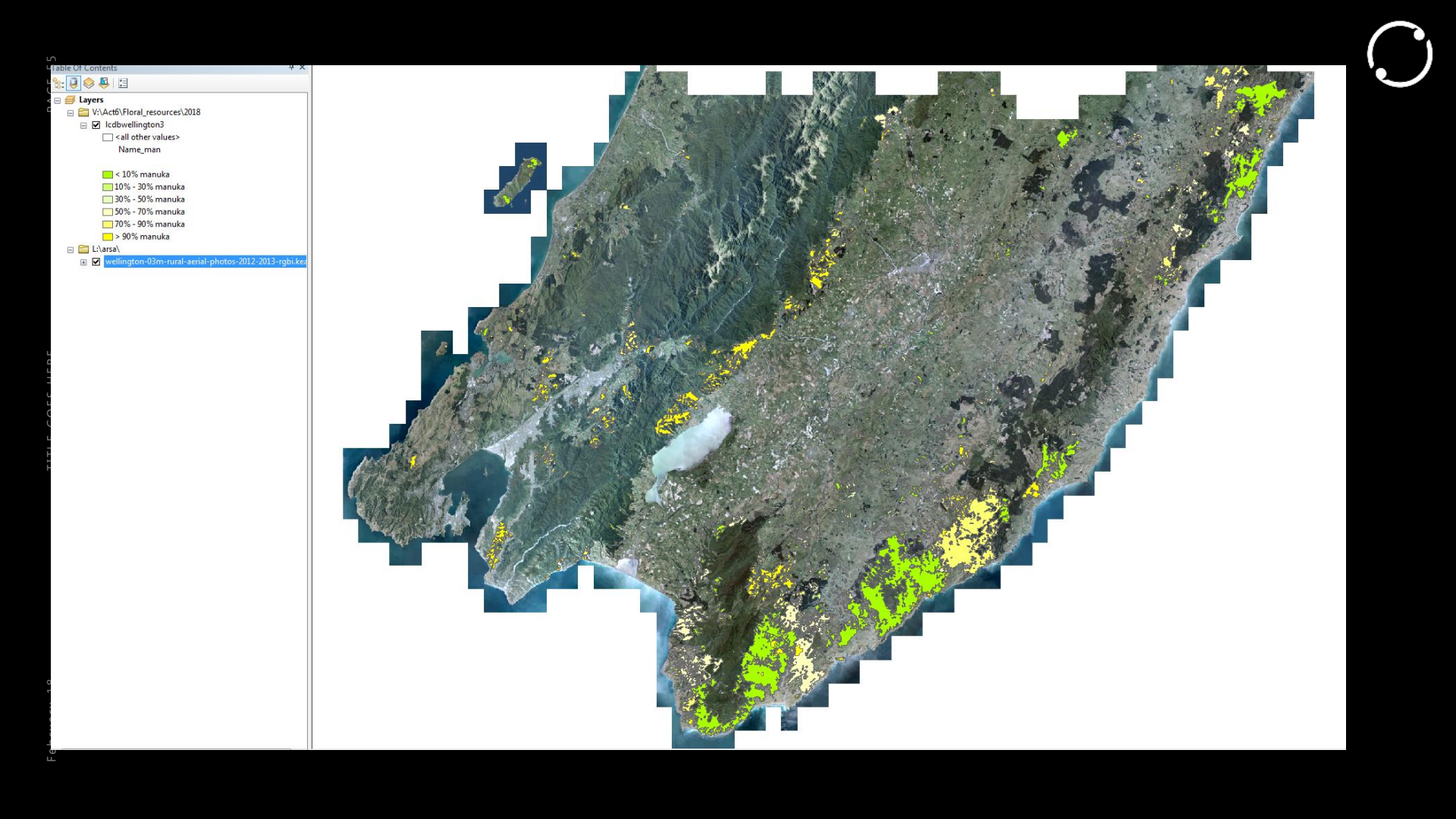
MBIE funded $7.75 million (ie $1.55 million p.a. over 5 yrs)

Central government consortium cofunding $1.2 million (ie $300K p.a. over 4 yrs)



Proposed new data layers:

(1) indigenous forest classes (>20) for biodiversity and pest control
(2) shrubland classes (>20) for weed control and honey industry
(3) indigenous grasses for biodiversity management
(4) spatially detailed (10m) woody vegetation for pest control and soil conservation
(5) pasture productivity for agricultural management
(6) monthly bare ground for soil erosion monitoring
(7) wetlands for biodiversity management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30% - 50% manuka
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70% - 90% manuka
> 90% manuka
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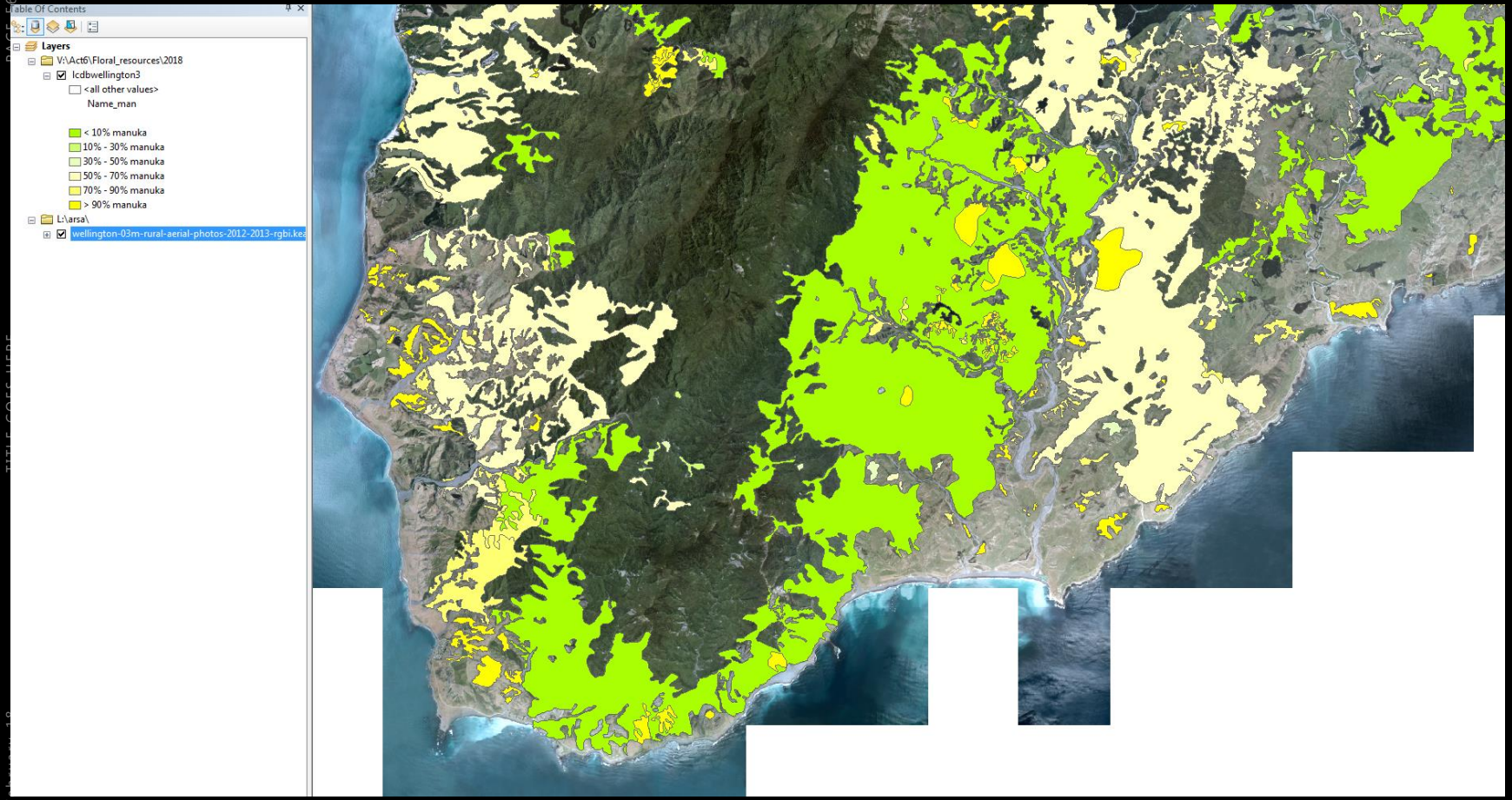
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