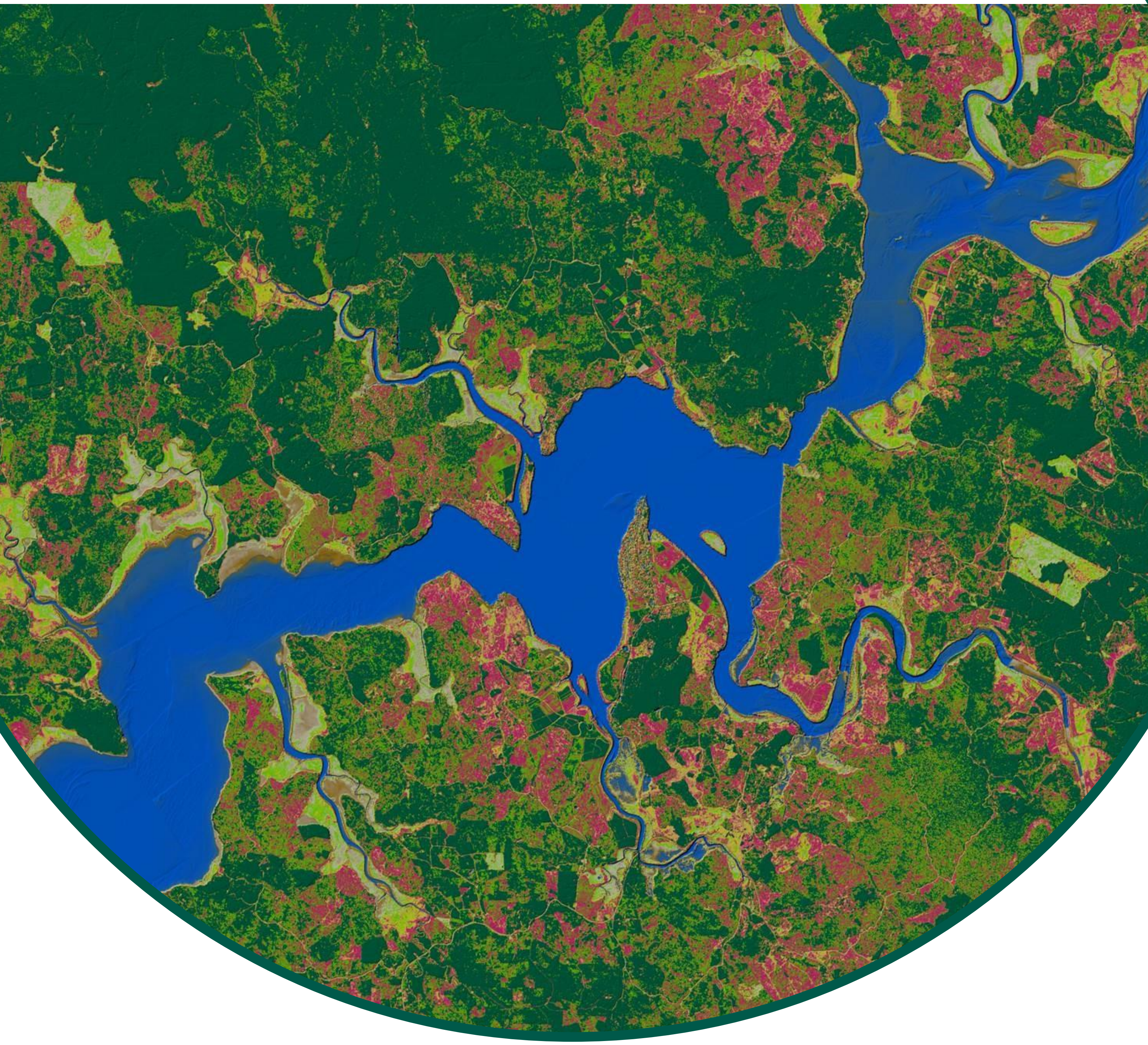

Northland intertidal vegetation mapping methodology

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Purpose and summary of the mapping

A remote sensing method has been used to map wetland/saltmarsh and mangrove habitat in Northland. This mapping aims to improve spatial intertidal habitat data for Northland.

The extent and location of mapped wetland/saltmarsh and mangrove habitat is presented in 19 worksheets that combined, encompass the Northland region. The worksheets also identify intertidal saltmarsh habitat, that exceeds the Regional Policy Statement for Northland (RPS) wetland area threshold of 0.5 hectare for significant saltmarsh (referred to below as significant saltmarsh). Oblique aerial images of all significant saltmarsh features and a summary of significant avifaunal values that are associated with this coastal wetland are also included in the worksheets. The saltmarsh and mangrove layers are available via an online viewer:

https://localmaps.nrc.govt.nz/LocalMapsGallery/

Where coastal wetlands extend inland, the degree of salt influence reduces until wetland transitions from saltmarsh to a freshwater wetland. In order to limit the identification of significant features to saltmarsh habitat and avoid mapping freshwater wetland, the landward extent of significant saltmarsh was delimited using selected LINZ hydro parcels. In a small number of instances (eg. Whangārei Harbour, Pataua Estuary, Horahora Estuary and Kāretu River), where the hydro parcel clearly omitted areas of intertidal habitat, the LINZ NZ property parcel was used. By limiting the mapping of significant saltmarsh to areas within the LINZ hydro parcels, there is a high level of confidence that the significant saltmarsh mapped by this project is saltmarsh and not freshwater wetland.

During the validation process it was apparent from the oblique imagery that typically inland of the hydro parcels the saltmarsh transitions to freshwater habitat. By utilising the LINZ hydro layer, degraded habitat that may not have dominant indigenous vegetation has been avoided, as has wetland or saltmarsh on private title. However, by using the LINZ NZ property parcel and LINZ hydro parcels as the inland boundary, some saltmarsh habitat inland of these boundaries will have been omitted. Further work is required to develop a robust method to delineate the landward extent of saltmarsh habitat.

Datasets

Datasets used during this project included:

- Northland Regional Council 'Northland Region 2014-15 Aerial imagery Rural' (capture dates November 2014 and July 2016);
- the draft Northland Region LIDAR data set (data acquisition 2019); and
- Photoblique oblique images (capture dates between 16/01/2017 and 08/05/2018).

Methods

Council engaged Biospatial Ltd. to facilitate the mapping of saltmarsh and mangrove vegetation in the Northland Region. Mapping and identifying saltmarsh sites that exceed the 0.5ha significance threshold, was broken down into the following stages:

1. Delineating intertidal vegetation

Biospatial Ltd applied the normalised difference vegetation index (NDVI) algorithm to colour infrared aerial images (Figure 1) to create a normalised differentiated vegetation raster layer, using ArcGIS pro v2.5 (Figure 2). The algorithm used was NDVI = (NIR - red) / (NIR + red). This layer was used to delineate the outer (seaward) extent of vegetation from water, mudflats and sand flats.

Because the algorithm does not distinguish between mangroves/saltmarsh and terrestrial vegetation, the landward extent of the layer was delimited using a coastline layer developed by the Northland Regional Council for the natural character component of the Regional Policy Statement for Northland.

Because wetland/saltmarsh vegetation and mangrove often extended landward of this coastline layer, the landward extent was manually edited in places, using visual cues from the colour infrared aerial images. To reduce the complexity of the data file all polygons less than $25m^2$ were removed and voids were filled. The output from this first stage was a combined saltmarsh and mangrove geospatial feature class.

Figure 1: Colour aerial image (with infrared channel) of Mangawhai Harbour

Figure 2: Normalised differentiated vegetation index raster layer, using the equation NDVI = (NIR - red) / (NIR + red)

2. Identifying saltmarsh/wetland habitat

Biospatial Ltd. then applied an enhanced vegetation index (EVI) algorithm to the colour infrared image, using ArcGIS pro v2.5 to create an enhanced vegetation index raster layer (Figure 3). The equation used was EVI2 = 2.5 * (NIR - RED) / (NIR + 2.4 * RED + 1.0).

This enhanced vegetation index was used to differentiate saltmarsh habitat from mangrove. This was effective at identifying saltmarsh habitat, with dark red spectral properties (Apodasmia similis + Juncus australis saltmarsh complex) but was not able to accurately differentiate saltmarsh with pale grey spectral properties.

Subsequently a LiDAR laser pulse intensity raster layer with an averaging algorithm of 1m, was applied to reduce noise, in Global Mapper v19.1 from the draft Northland LiDAR dataset (Figure 4). The LiDAR was captured with a Trimble AX60 LiDAR system which incorporates the Riegl Q780 scanner with a near infrared laser wavelength. The intensity values were used to identify saltmarsh with pale grey spectral qualities.

These two data sets were then merged in ArcGIS pro v2.5 to create one wetland/saltmarsh feature class.

Figure 3: Enhanced vegetation index raster layer created using the equation EVI2 = 2.5 * (NIR - RED) / (NIR + 2.4 * RED + 1.0)

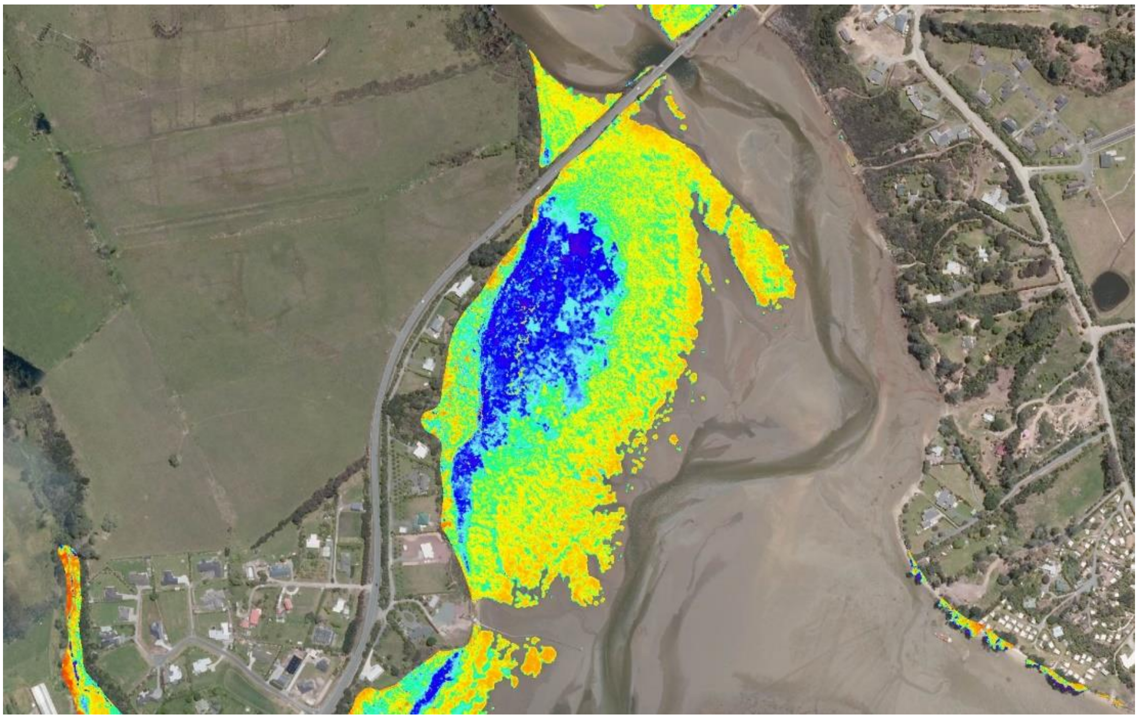
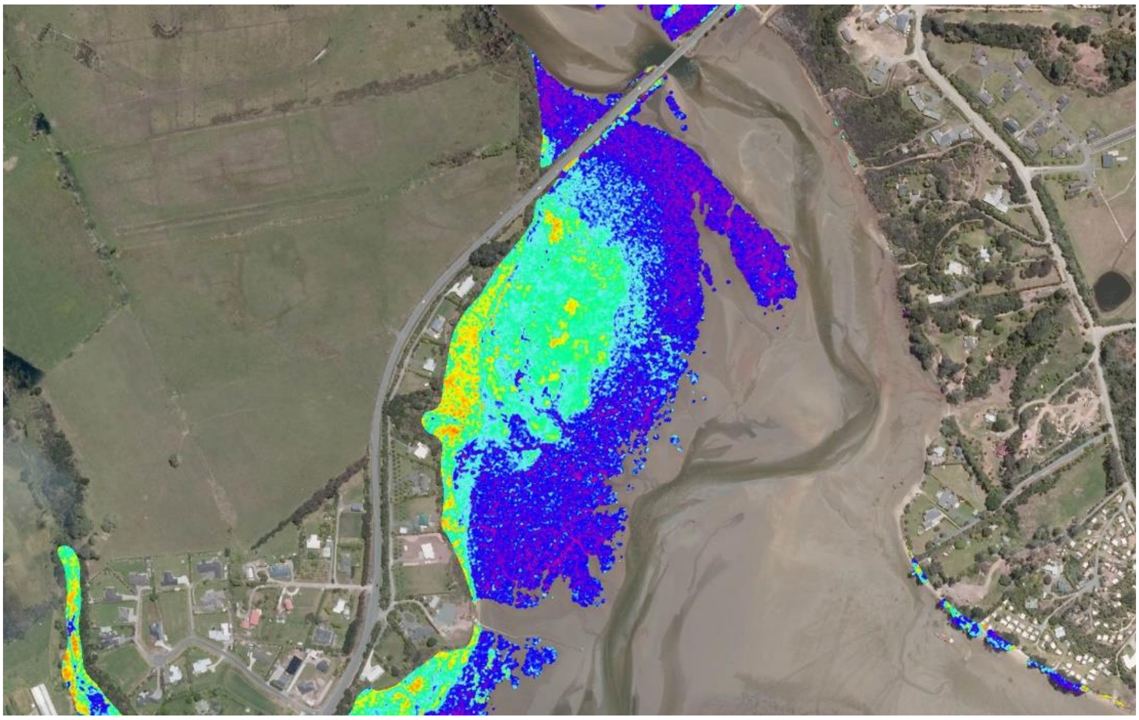


Figure 4: LiDAR intensity raster image with an averaging algorithm of 1m was created from the point cloud data



The feature class was then manually validated using oblique images (Figure 5) in Photoblique software version v59 and the Northland aerial images (2016). Any errors with the wetland/saltmarsh dataset were edited in ArcGIS pro v2.5.

Figure 5: Oblique aerial image of saltmarsh and mangrove habitat in Mangawhai Harbour.

3. Separating wetland, saltmarsh and mangrove vegetation

A union geoprocessing function was then applied between the wetland/saltmarsh and mangrove layers using ArcGIS pro v2.5, with the intertidal vegetation feature class. This produced a mangrove feature class and a wetland/saltmarsh feature class. An intersect geoprocessing function was then applied to the wetland/saltmarsh layer and the LINZ hydro parcel feature class, using ArcGIS pro v2.5, to create a saltmarsh layer (within the hydro parcel) and a wetland layer (landward of the hydro parcel).

4. Significant saltmarsh

The geometry of each saltmarsh polygon was calculated in ArcGIS pro v2.5, using the calculate geometry processing tool. All shapes over 5,000m^2 (0.5ha) were selected and exported as a new layer 'significant saltmarsh'. This produced a feature class with 500 polygons. Each polygon was manually validated using oblique aerial images in Photoblique v59, and an oblique image of each saltmarsh tagged and added to a worksheet.

Each significant saltmarsh was given a unique code. First the centroid of each polygon was calculated, in ArcGIS pro v2.5, using the calculate geometry processing tool. The unique code was derived from the topographical map sheet number (Topo50) and the three middle digits of the easting and northing, for the centroid of the polygon. The code is therefore a unique geospatial identifier for each significant saltmarsh habitat (to within 100m of the centroid).

Limitations

The following limitations were identified during the process:

1. The three data sets used in this project all have different capture data. The capture dates start in November 2014 and extend to May 2018. Because the spatial extent of wetland/saltmarsh and mangrove is relatively static over short time periods, the difference in the capture dates is unlikely to have a large impact on the extent of the different vegetation types mapped in this project;

2. Variations in the sun angle, shadow and capture date of the aerial imagery;

3. Interference of water with the spectral signature of saltmarsh particularly with EVI;

4. Interference with the NVDI and EVI of algae growing on intertidal sand and mud flats;

5. Variations of vegetation signatures further up the reaches of each harbour;

6. The scan angle of the LiDAR sensor created variation in the intensity values interfering with the accurate delineation of saltmarsh in some localities. These errors were identified and manually edited during the verification process;

7. LiDAR canopy height was not available for this project. It may have been possible to utilise Lidar canopy height to differentiate saltmarsh habitat from terrestrial manuka/kanuka scrub. Lidar canopy height could have also been used to delineate mangrove habitat from saltmarsh; and

8. The application of the RPS significance criteria was limited to the rarity criteria involving wetland extent and applied to mapped saltmarsh habitat within the LINZ Hydro Parcels. Some saltmarsh located landward of the hydro parcel may have been missed. During the validation process, analysis of the oblique images indicated that inland of the hydro parcels the saltmarsh typically transitions to freshwater habitat. In areas where it was apparent that the hydro parcels omitted obvious saltmarsh habitat the LINZ NZ property parcel used in place of the LINZ hydro parcel.

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