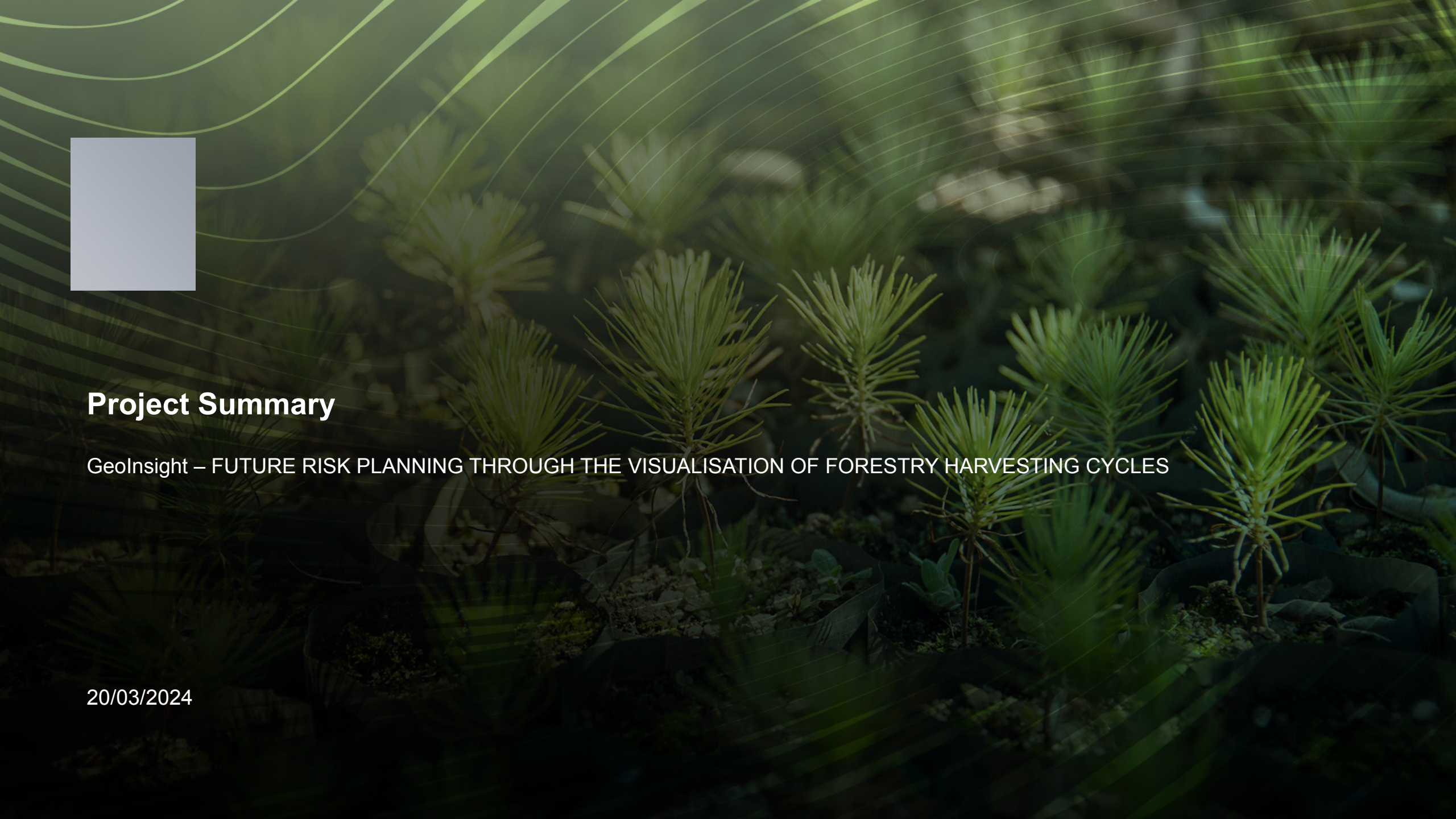


Project Summary

GeoInsight – FUTURE RISK PLANNING THROUGH THE VISUALISATION OF FORESTRY HARVESTING CYCLES

20/03/2024

Project Summary

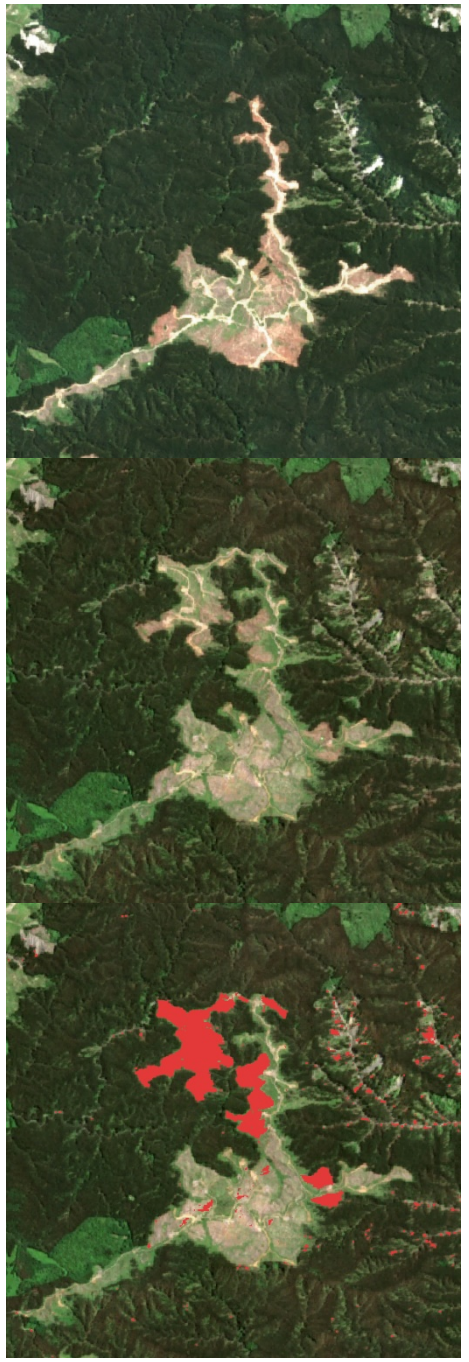
Mar 2024

Both the North Island regions (Gisborne and Hawkes Bay) and South Island regions (Nelson, Marlborough and Tasman) have been delivered. LCDB V5.0 remained the base dataset=; however, a review highlighted a few missing areas. These were included via NZ Topo 1:50k Exotic Forest dataset, which was differenced against the LCDB boundaries and was included with manual review and a conservative minimum contiguous area of 10 ha. A few areas were also manually added, generally representing small recent plantings predated by existing plantation boundary datasets. The overall minimum contiguous feature size included in the dataset delivered was 3 ha. Using this threshold reduced the noise contributed by very small features, which are unlikely to represent plantation forest stands.

The final process flow developed uses LiDAR and the Hansen Global deforestation dataset. The LiDAR-derived predictions formed the base of the age classing result, as it achieved the largest total coverage. Next, Hansen's Global deforestation data V1.10 was added, superseding the LiDAR results in case of data overlaps as testing showed that it gave more accurate age class predictions. Finally, any remaining gaps were covered with the LUCAS NZ Forest Clearing data (2008-2018).

The resulting dataset was then assessed for recent change using Sentinel-2 image time series analysis. North Island image dates are 2022-10-22 (T1) and 2023-11-26 to 2023-12-13 (T2). South Island image dates are 2022-11-14 to 2022-12-04 (T1) and 2023-11-11 to 2024-01-28 (T2). The example provided (top to bottom) shows the detection of harvest for a forest located on the East Coast – T1, T2 and the highlighted harvest area difference. A minimum area of 1 ha was used as the initial cutoff for S2 harvest.

After feedback, additional post-processing steps were undertaken to coalesce adjacent patches with similar age predictions (generally from LiDAR). This was achieved by grouping LiDAR results into three-year buckets, dissolving them, and taking the average age of the local bucket. From here, the internal boundaries (between areas with different age predictions) were smoothed to remove obvious stair-stepping in the age class boundaries. Minimum internal feature size was set to 1.5 ha to further reduce the complexity of the results. Finally, the 2023 generalised regional boundaries were applied to remove any areas beyond the coastal edges or outside the regions of interest.



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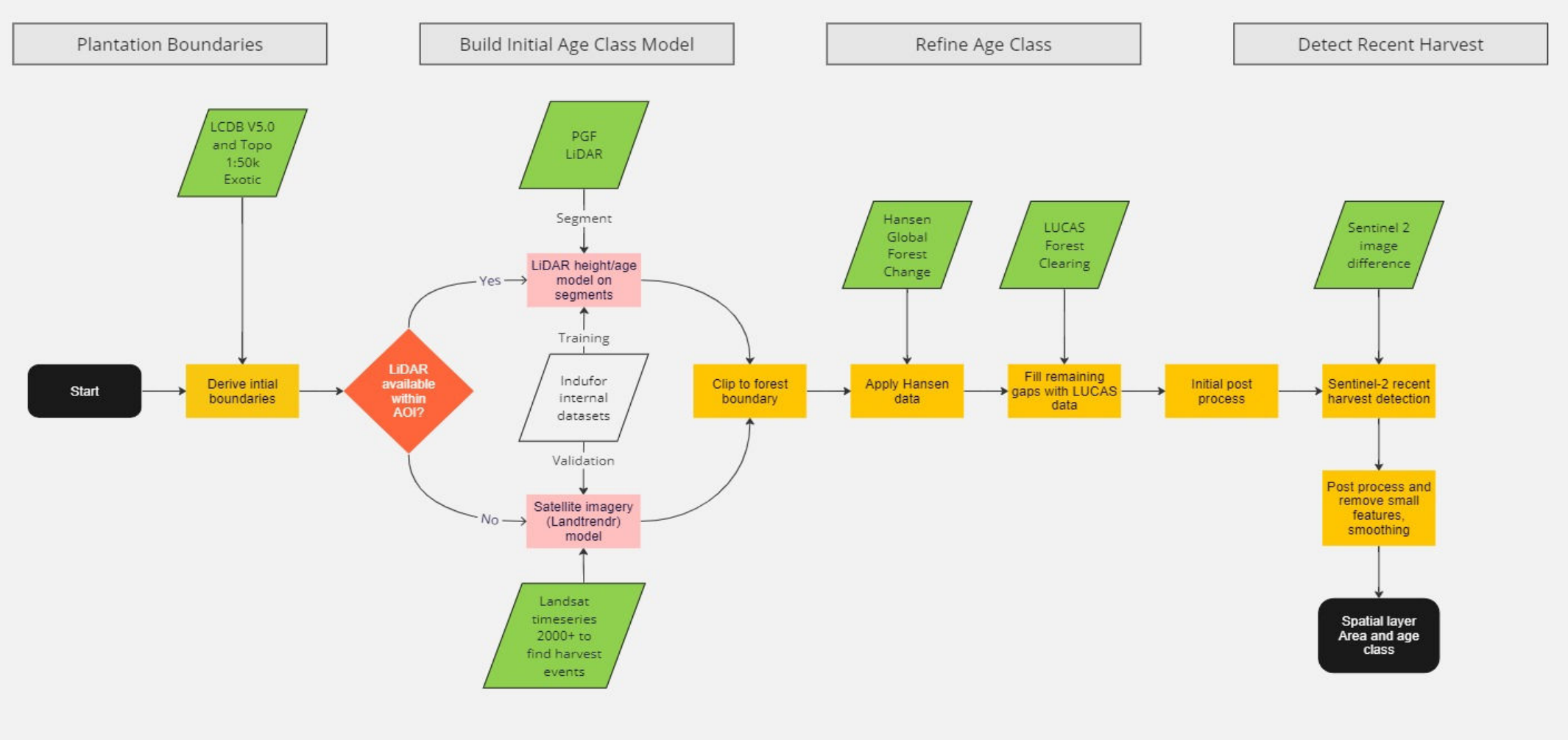
Age class Process

The following diagram shows the analysis steps used to create the plantation age layer



Note: Green boxes identify where data collected/process starts

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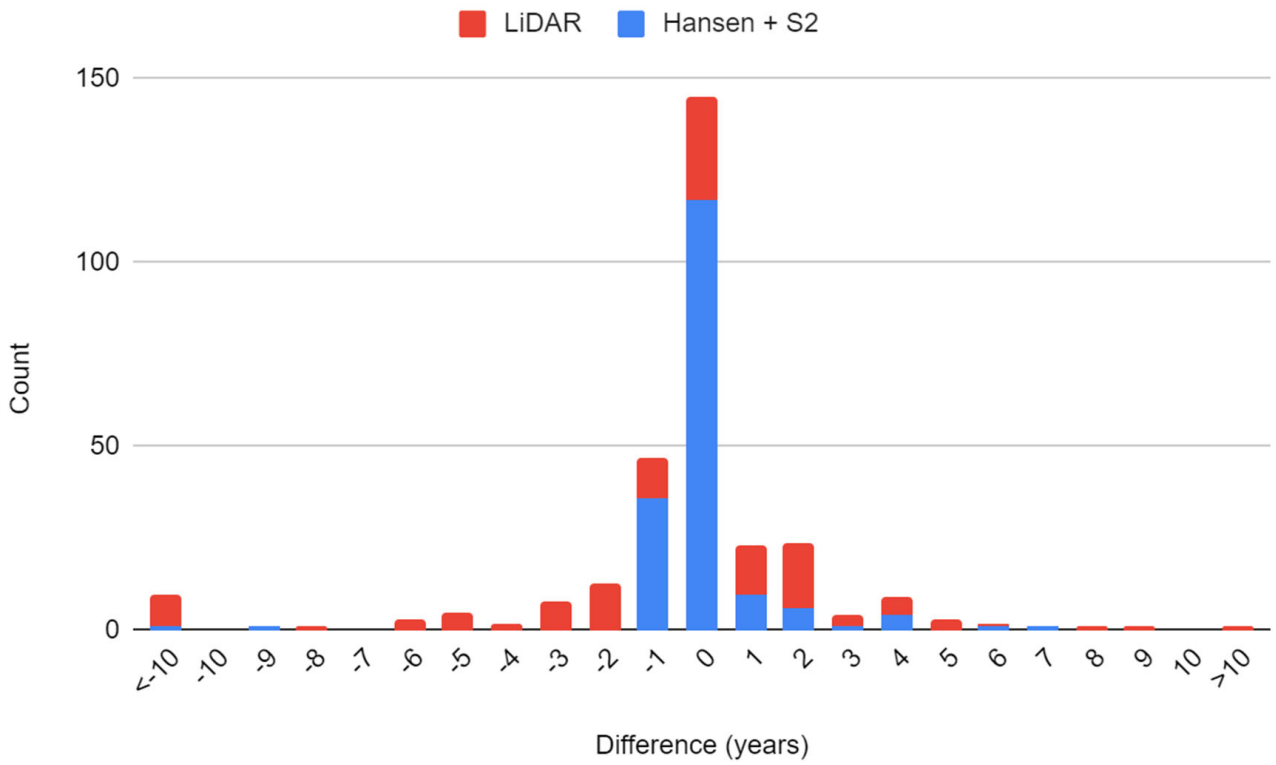
Age class accuracy – North Island

Age class accuracy relative to assessed value for Gisborne and Hawkes Bay regions

The combined accuracy of the Gisborne and Hawkes Bay regions was 71% within a year, 83% within two and 87% within three, after post-processing was applied.

Notably, the estimates based on harvest detection (Hansen V1.10 and Sentinel-2) were more accurate than the LiDAR-derived results. 92% of points estimated using Hansen or S2 were within a year, while this dropped to 41% for LiDAR, though 75% of LiDAR points were within three years. The split between the two sources was relatively even, with 59% using Hansen and Sentinel and 41% using LiDAR.

304 points were assessed, which can be viewed by using the North Island QC tool.



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Age class accuracy – South Island

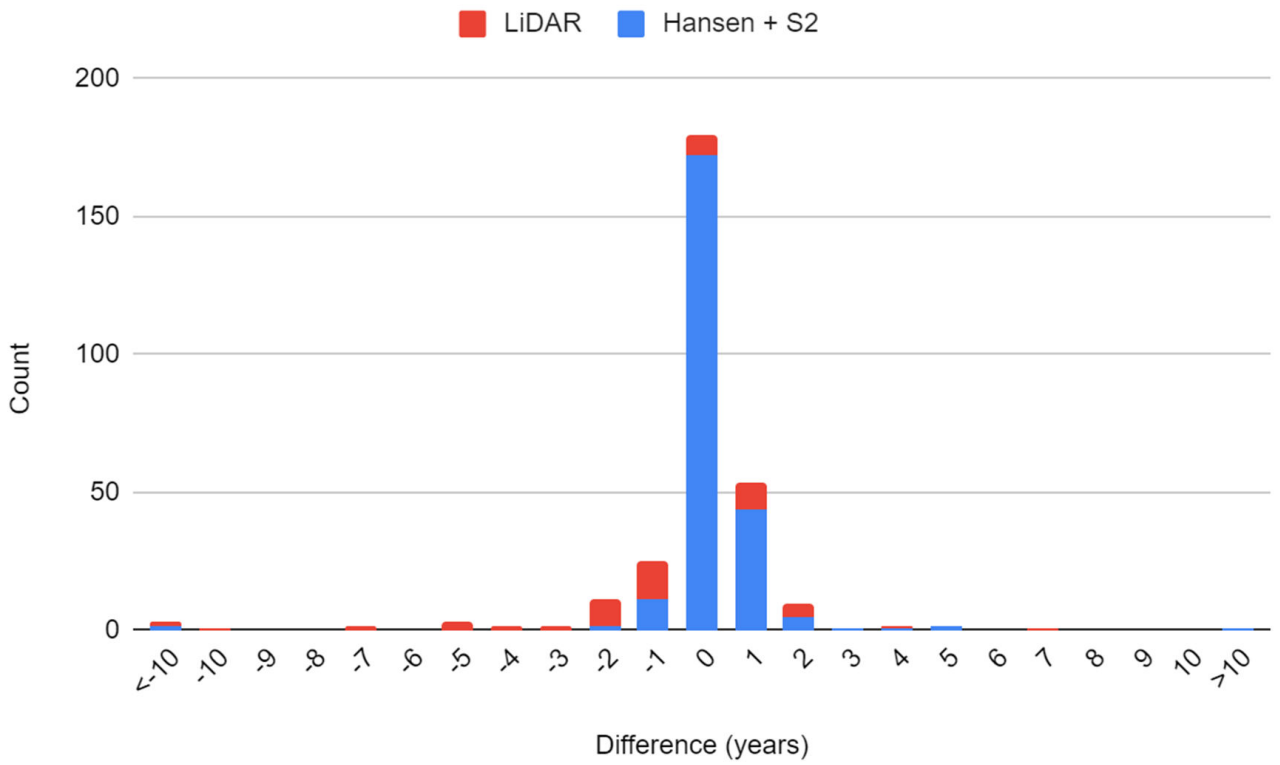
Age class accuracy relative to assessed value for the Nelson, Marlborough and Tasman regions

The combined accuracy of the Nelson, Marlborough and Tasman regions was 86% within a year, 93% within two and 94% within three, after post-processing was applied.

The improvement relative to the North Island results was due to the greater proportion of results that we estimated using Hansen and Sentinel-2 (which had a similarly higher degree of accuracy compared to the LiDAR-derived results as the North Island) which thus improved the overall accuracy.

About 80% of the QC points were estimated with this data, while the remaining 20% were classified using LiDAR. This difference in proportions likely highlights the younger resource age in these regions, resulting in a greater number of features having a change post 2000 which was then captured by the satellite imagery based data sources.

300 points were assessed, which can be viewed by using the South Island QC tool.



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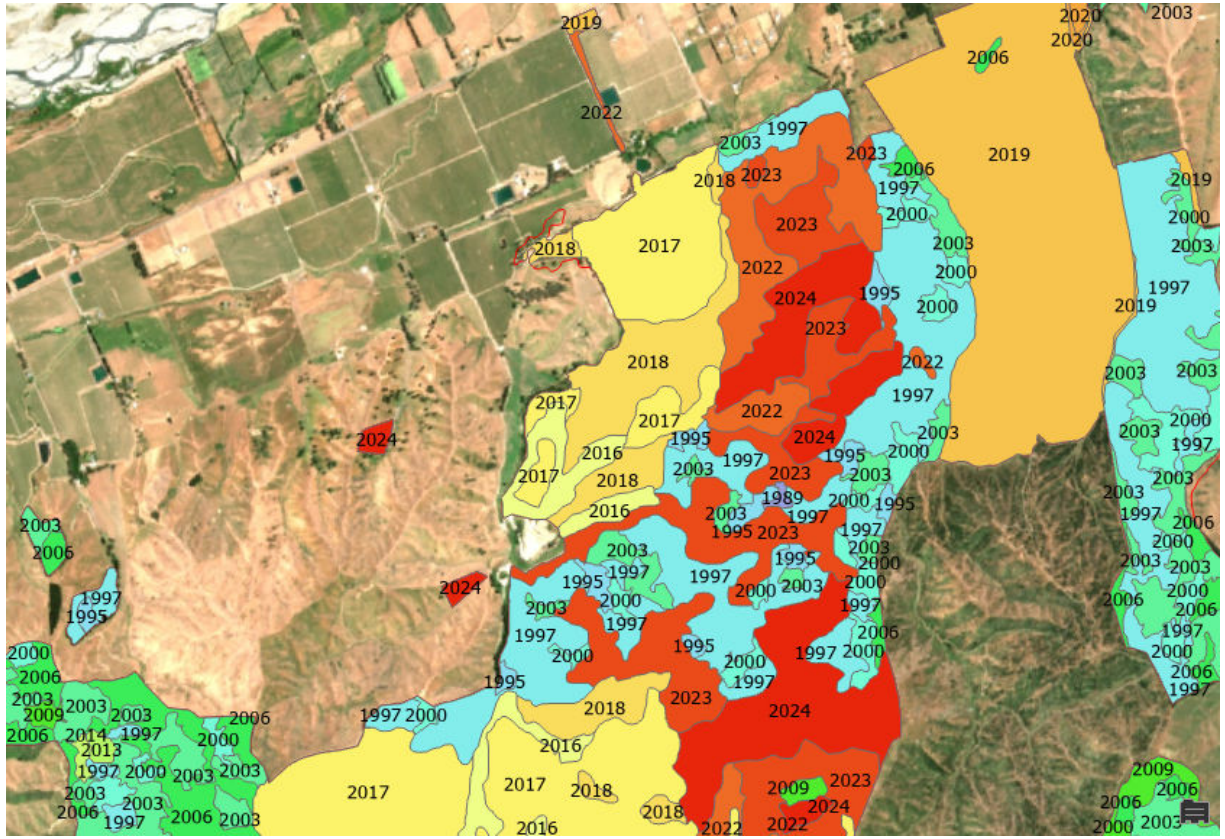
Output example

An example of the final output for the South Island, showing the Sentinel-2 basemap and LCDB boundaries (post minimum area filter), then the initial processed dataset, and then the final version post smoothing. Of note are the recent plantings, which are generally captured with Hansen and Sentinel-2, and the earlier, pre-2000 areas which were estimated using LiDAR.

Where there are clear edges between harvest and remaining mature forest, the internal boundaries can be quite accurate despite the generalization and smoothing processes that were applied.



Contains modified Copernicus Sentinel data 2023, processed in Google Earth Engine

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Annex 1: Datasets

Data Source	Region	Category	Data Link	License	Citation
Marlborough LiDAR 1m (2020 - 2022)	Marlborough	LiDAR	Link	CC BY 4.0	Marlborough District Council, Toitū Te Whenua Land Information New Zealand (LINZ) (2023). Marlborough, New Zealand 2020-2022. Collected by Aerial Surveys, distributed by OpenTopography and LINZ. https://doi.org/10.5069/G97D2SB0. Accessed: 2023-11-30
Tasman Bay LiDAR 1m (2022)	Tasman	LiDAR	Link	CC BY 4.0	Tasman District Council, Toitū Te Whenua Land Information New Zealand (LINZ) (2023). Tasman Bay, Tasman, New Zealand 2022. Collected by Aerial Surveys, distributed by OpenTopography and LINZ. https://doi.org/10.5069/G9N29V5H. Accessed: 2023-11-30
Gisborne LiDAR 1m (2018-2020)	East Coast	LiDAR	Link	CC BY 4.0	Gisborne District Council, LINZ (2021). Gisborne, New Zealand 2018-2020. Collected by Aerial Surveys, distributed by OpenTopography and Land Information New Zealand (LINZ). https://doi.org/10.5069/G92V2D9X. Accessed: 2023-11-30
Hawke's Bay LiDAR 1m (2020-2021)	Hawke's Bay	LiDAR	Link	CC BY 4.0	Hawke's Bay Regional Council, Wairoa District Council, Hastings District Council, Napier City Council, Central Hawke's Bay District Council, Toitū Te Whenua Land Information New Zealand (LINZ) (2023). Hawke's Bay, New Zealand 2020-2021. Collected by Ocean Infinity, distributed by OpenTopography and LINZ. https://doi.org/10.5069/G9S75DH2. Accessed: 2023-11-30
Tasman LiDAR 1m (2020-2022)	Tasman	LiDAR	Link	CC BY 4.0	Tasman District Council, Toitū Te Whenua Land Information New Zealand (LINZ) (2023). Tasman, New Zealand 2020-2022. Collected by Aerial Surveys, distributed by OpenTopography and LINZ. https://doi.org/10.5069/G9S46Q5N. Accessed: 2023-11-30
Motueka River Valley 1m (2018-2019)	Tasman	LiDAR	Link	CC BY 4.0	Tasman District Council, LINZ (2020). Motueka River Valley, Tasman, New Zealand 2018-2019. Collected by Aerial Surveys, distributed by OpenTopography and Land Information New Zealand (LINZ). https://doi.org/10.5069/G9D21VRX. Accessed: 2023-11-30
Abel Tasman and Golden Bay LiDAR 1m (2023)	Tasman	LiDAR	Link	CC BY 4.0	Tasman District Council, Toitū Te Whenua Land Information New Zealand (LINZ) (2024). Abel Tasman and Golden Bay, Tasman, New Zealand 2023. Collected by Aerial Surveys, distributed by OpenTopography and LINZ. https://doi.org/10.5069/G94M92SX. Accessed: 2024-03-04
Nelson LiDAR 1m (2021)	Nelson	LiDAR	Link	CC BY 4.0	Nelson City Council, Toitū Te Whenua Land Information New Zealand (LINZ) (2021). Nelson, New Zealand 2021. Collected by Aerial Surveys, distributed by OpenTopography and LINZ. https://doi.org/10.5069/G9R78CD4. Accessed: 2023-11-30
Hansen Global Forest Change V1.10 (2000 to 2022)	All	Landsat Change Detection	Link	CC BY 4.0	Hansen Global Forest Change sourced from the Google Earth Engine Data Catalog and licensed for reuse under the CC BY 4.0 licence. Hansen, M. C., P. V. Potapov, R. Moore, M. Hancher, S. A. Turubanova, A. Tyukavina, D. Thau, S. V. Stehman, S. J. Goetz, T. R. Loveland, A. Kommareddy, A. Egorov, L. Chini, C. O. Justice, and J. R. G. Townshend. 2013. High-Resolution Global Maps of 21st-Century Forest Cover Change. Science 342 (15 November): 850-53. Data available on-line from: https://glad.earthengine.app/view/global-forest-change.
LUCAS NZ Forest Clearing 2008-2020 v019	All	Aerial Change Detection	Link	CC BY 4.0	ANZLIC LUCAS NZ Forest Clearing 2008 2020 v019 by Ministry for the Environment sourced from the MfE Data Service and used under the Creative Commons Attribution 4.0 International license.
LCDB v5.0 - Land Cover Database version 5.0, Mainland, New Zealand	All	Boundaries	Link	CC BY 4.0	LCDB V5.0 Sourced from the LRIS portal and licensed for reuse under the CC BY 4.0 license. Data was modified.
NZ Exotic Polygons (Topo, 1:50k)	All	Boundaries	Link	CC BY 4.0	NZ Exotic Polygons (Topo, 1:50k) data sourced from the LINZ Data Service and licensed for reuse under the CC BY 4.0 licence. Data was modified.
NZ Coastlines and Islands Polygons (Topo 1:50k)	All	Boundaries	Link	CC BY 4.0	Coastline data sourced from the LINZ Data Service and licensed for reuse under the CC BY 4.0 licence. Data was modified.
Regional Council 2023 Clipped (generalised)	All	Boundaries	Link	CC BY 4.0	This work is based on/includes Stats NZ's data which are licensed by Stats NZ for reuse under the Creative Commons Attribution 4.0 International licence.
Site Index	All	Productivity Surface	Link	Productivity Prediction Tool Licence	Watt, M.S., Palmer, D.J., Leonardo, E.M.C, Bombrun, M. (2021) Use of advanced modelling methods to estimate radiata pine productivity indices. Forest Ecology and Management, 479, 118557.

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Annex 1: Datasets cont

Data Source	Region	Category	Data Link	License	Citation
Sentinel-2 Level 2A	All	Imagery	Link	Link	Contains modified Copernicus Sentinel data, 2022 to 2024, processed in Google Earth Engine
Landsat Collection 2	All	Imagery	Link	Link	Landsat 4, 5 ,7 8 and 9 images courtesy of the U.S. Geological Survey

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