ai forum NEW ZEALAND
Te Kāhui Atamai Iahiko o Aotearoa

and the

AI Alliance for Biodiversity

submission
to
Department of Conservation and
Toitū Te Whenua Land Information New Zealand
on
use of information and emerging technologies to enhance biodiversity

January 2023

Background

The Artificial Intelligence Forum of New Zealand (AI Forum) is a purpose-driven, not-for-profit, non-governmental organisation (NGO) that brings together New Zealand's community of artificial intelligence technology innovators, end users, investor groups, regulators, researchers, educators, entrepreneurs and interested public to work together to find ways to use AI to help enable a prosperous, inclusive and thriving future for our nation.

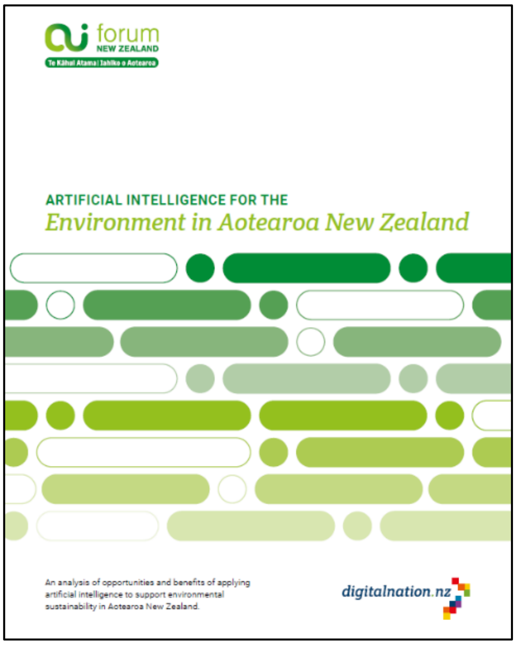
The AI Alliance for Biodiversity is a cross functional group of practitioners and experts working in the field of AI and biodiversity working in support of the Eco Index mission. This group has several goals including sharing information about available tools and materials (largely those which are free and open), identifying where interoperability is needed to make the greatest use of these tools, and discussing and developing strategies to help improve AI for Biodiversity tools.

AI is transforming industries around the world by augmenting human labour, automating processes, and providing intelligent analytics. AI is a catch-all term for a range of automation technologies that most often use "machine learning" to make predictions using data. We include a range of computational techniques that can be applied to problems in environmental studies and biodiversity studies including robotic process automation, computer vision, reinforcement learning and generalised deep learning. AI is increasingly used in conjunction with remote sensing to better understand the planet and its component systems.

From climate change to the loss of biodiversity, Aotearoa New Zealand's interconnected environment is facing unprecedented strain. This is starting to have a substantial and recurrent impact on our health, wellbeing and economic prospects. AI can help in a number of compelling ways, delivering data and insights at local and national scales.

Our submission to this consultation on the use of information and emerging technologies to enhance biodiversity focuses on satellite imagery, remote sensing, AI, and data-driven technologies.

It draws on knowledge from across our members and our 2022 report on AI for the Environment in Aotearoa New Zealand which explored an Aotearoa where artificial intelligence (AI) and advanced data collection methods are seamlessly combined with human expertise to ensure our environment is healthy and can sustain us physically, economically and spiritually for generations to come.



The report incorporates research and the expertise of many people in the field to explore the huge possibilities for AI to assist with the collection, analysis, and modelling of environmental data at scale.

The report also evaluated how AI can impact the five main drivers of biodiversity loss: invasive species, climate change, pollution, changing land use, and protecting freshwater and marine resources.

Response to Consultation Questions

Note: The application of genetic technologies is not included in our response

What aspects of these technologies (remote sensing and AI) should be taken into account when considering their use?

There are multiple factors that should be considered when reviewing the utility of remote sensing, deep learning and other AI technologies for biodiversity monitoring.

The range, type and affordability of sensors is steadily increasing and now include low and medium resolution satellites, high resolution satellites, aerial photography, LiDAR, UAV, ROV and terrestrial sensors including acoustic monitoring devices, thermal infrared cameras, CCTV and GoPro.

Every project should consider multiple aspects of each sensor/dataset including:

- Spectral range
- Spatial resolution
- Geographic coverage
- Seasonal limitations and temporal sampling (revisit frequency)
- Sensor lifetime
- Battery life and edge compute potential
- Cost and access terms, e.g. open, minimum area restrictions
- Data infrastructure requirements
- Image processing, e.g. rectification, cloud masking, atmospheric correction
- End-user data access and visualisation

Advances in satellite technology have provided new avenues for remote counting and mapping of animal populations. Lower spatial resolution satellite images have proven inadequate to detect and count individual animals but the availability of commercial satellite images with a spatial resolution of one meter or less (e.g. Airbus Pleiades, Maxar WorldView, Planet and more) has made such an undertaking more feasible. In the New Zealand context, the widely available and open aerial ortho-photography data sets also hold much promise for longitudinal studies.

A benefit of remote sensing is the use of multi-spectral band combination indices such as Normalised Difference Vegetation Index (NDVI) and Normalised Difference Water Index (NDWI). NDVI is a measure of vegetation density and vigour while NDWI estimates the leaf water content at canopy level. Researchers have also found that Synthetic Aperture Radar (SAR) sensors which acquire information under vegetation canopies and in cloudy conditions are useful with short-wavelength SAR data (e.g. C-band of RADARSAT) and more helpful for mapping herbaceous ecosystems. Similarly, several recent studies have found that LiDAR data can provide high spatial-resolution information on elevation which is an important contributor to habitat identification, e.g. mangrove, forest habitat.

In Remote Sensing there are two types of image classification methods: pixel-based and object-based. Object based approaches start with partitioning an image into homogenous segments (called objects). These objects are then used in the classification as the minimum mapping unit. This has several advantages over the pixel-based classification method, including utilising spatial information of the objects, reducing dimension of datasets, cutting down noise, and producing more interpretable results.

AI provides conservationists with the tools to reduce the bottlenecks and long-term costs of monitoring threatened species. Automating the collection, transfer, and processing of data provides managers access to greater information, thereby facilitating timely and effective management. Machine learning (ML), a subset of AI, is fundamental to automation. ML algorithms use experience through exposure to data to improve model performance and make accurate predictions from large volumes of data. After implementation, automated systems should require minimal input to report on the state of an ecosystem and are potentially more cost-effective than traditional approaches.

AI models can also outperform the predictive power and inference of common statistical tests used in the environmental sector. They can combine data from multiple sources, e.g. cameras, acoustic recorders, weather stations or satellite monitoring systems. This enables national scale, holistic and multidisciplinary insights to guide research and environmental management. AI models can also standardise ways of collecting data and reduce human-induced bias. Two of the key ML approaches used in biodiversity studies include decision tree algorithms and neural networks.

Decision tree algorithms belong to the family of supervised learning algorithms. They often mimic structured human level thinking, with simple rules to understand and make good interpretations. A decision tree is a tree where each node represents a feature (attribute), each link (branch) represents a decision (rule), and each leaf represents an outcome (categorical or continuous value). Unlike other supervised learning algorithms, the decision tree algorithm can be used for solving regression or classification problems. The goal of using a decision tree is to create a training model that can be used to predict the class or value of the target variable by learning simple decision rules inferred from prior data (training data).

Unlike other supervised learning algorithms, the decision tree algorithm can be used for solving regression or classification problems. The goal of using a decision tree is to create a training model that can be used to predict the class or value of the target variable by learning simple decision rules inferred from prior data (training data). Random forest is an example of a decision tree where multiple machine learning algorithms are combined to obtain better predictive performance. The random forest approach has often been used alongside or in comparison to deep learning models.

A neural network is a series of algorithms that endeavours to recognise the underlying relationships in a set of data through a process that mimics the way the human brain operates. In this sense, neural networks refer to systems of neurons, either organic or artificial in nature. Convolutional neural networks (CNNs) are a popular group of neural networks that belong to a wider family of methods known as deep learning. CNNs may have an advantage over pixel-wise classification techniques such as remote sensing or machine learning algorithms that consider one pixel at a time.

A summary of key aspects that should be considered are:

I. Automated monitoring using remote sensing, couple with ML, can significantly assist in broadening our understanding of relatively inaccessible ecosystems. These technologies can provide managers with a comprehensive, cost-effective, and constant supply of accurate information for long-term monitoring and management, particularly where systems are vulnerable to anthropogenic influences.
II. Optical remote sensing data provides spectral information of molecular and structural features related to leaf area index, biomass and coverage of vegetation canopy. On the other hand, SAR data provides structural information of the land surface (roughness and geometry) and dielectric (water presence).

III. Computer vision techniques have been used extensively around the world for species identification and population assessment in both terrestrial and marine environments.
IV. The red edge and near-infrared (NIR) bands are the most useful channels in optical imagery for vegetation and ecosystem service classification. Derived indices such as NDVI and NDWI are also useful indicators of flora health.
V. Decision tree models such as random forest, gradient boosting, categorical boosting, CART and XGBoost have been demonstrated to produce reliable earth observational results with higher accuracies than remote sensing alone.
VI. Convolutional Neural Networks (CNNs) have been increasingly used in the last five years with slightly greater accuracy levels than other methods with a smaller standard deviation in accuracy. CNNs allow multiple inputs to be considered including imagery, topographic indices, NDWI and NDVI and will continuously improve and become more efficient over time through ongoing training.
VII. Machine learning models are often a few orders of magnitude faster than other physically based (deterministic) models.
VIII. Understanding functional geography and making intelligent decisions is also beneficial for biodiversity analysis. GIS is key to visualise and assess spatial-temporal distribution, location, distribution patterns, population assessment, and identification of priority areas for conservation and management

A recent paper by Kerry et. al., 2022 provides a comprehensive summary of remote monitoring methods in biodiversity conservation.

How could these tools be used at an iwi or community level. How involved do you think community and iwi groups should be?

Remote sensing and AI are very effective tools to use at community levels. Citizen science — public participation in scientific research — can be carried out by many groups and communities around Aotearoa. Citizen science projects may include monitoring water and soil quality and collecting data on wildlife populations. These projects empower communities and support a broad range of positive environmental outcomes.

AI can be used to drive and support community efforts in many ways, including access to expertise. An example is identifying species spotted in a certain area. It can also help facilitate environmental reporting, for example a chatbot can provide an easy way for people to report environmental pollution or wildlife incidents to the relevant authorities. An example of effective public consultation via a chatbot is https://frankly.ai/, which has been used to engage a diverse range of communities. This could be used to collect long term observations about the environment from residents. Machine learning can also provide easy-to-understand information about the impact of people's activities, including environmentally focused efforts like planting, trapping and beach clean-ups and other activities like farming, forestry or fishing.

During our AI for the Environment research, we did not find a great number of examples of Māori-led projects that currently use AI for environmental outcomes and centre mātauranga Māori. However, there are many projects and initiatives underway which centre tikanga and mātauranga Māori that are vital in a thriving AI ecosystem — including data collection and labelling methodologies, clear indicators of success, and governance frameworks. The following examples are of projects which demonstrate some of the building blocks that can contribute to well-balanced and integrated AI for Biodiversity projects where iwi groups are intimately involved.

Knowledge labels that protect and support Māori data: A key part of te ao Māori approaches to data includes ensuring Māori communities benefit from the use of their knowledge and genetic resources, which are often harnessed by others for commercial gain. In response, Traditional Knowledge (TK) and Biocultural (BC) labels were developed by Local Contexts, an initiative co-led by Maui Hudson (Whakatōhea), Director of the University of Waikato Te Kotahi Research Institute. These labels offer indigenous communities the tools to add cultural and historical context and political authority to cultural heritage content in non-indigenous digital archives, as well as to their own local digital heritage archives. The labels can include information about which iwi or groups are the primary cultural authority for the material, or what activities the community has approved as generally acceptable use of the material.

Storing data in Aotearoa: For many Māori data experts, it is important to consider the jurisdiction in which data is stored. For example, in its Māori Data Sovereignty Principles, Te Mana Raraunga notes "where possible, Māori data should be stored in Aotearoa, reflecting the need to make decisions about storing Māori data in ways that enhance control for current and future generations". In 2019, DOC agreed that genome sequence datasets for the kākāpo, previously held in AWS servers in Australia, would be transferred to a database located in Aotearoa New Zealand. This move was made at the request of Ngāi Tahu, DOC's partner on decisions about kākāpo care, who has a relationship with the taonga species going back centuries.

Building mātauranga into environmental indicators: Te Mahere Wai o Te Kāhui Taiao, the Wellington region Mana Whenua whaitua implementation plan to return mana to freshwater bodies, sets out target states for freshwater across 42 tikanga (attributes). These target states are explained as "narratives that describe freshwater states that are pristine or in a state of wai ora". For example, a target state for water quantity is that "rangatahi (youth) can do bombs without getting sick or hitting the bottom of the awa." An attribute for water quality is "I would feed water that comes from this stream to children or kaumātua (elders) without hesitation."

Mauri-centred decision-making frameworks: The Mauri Model is a decision-making framework that uses the concept of mauri as the measure of sustainability. The model measures mauri in four dimensions – environmental wellbeing (taiao mauri), cultural wellbeing (hapu mauri), social wellbeing (community mauri) and economic wellbeing (whānau mauri) – using culturally-relevant indicators. Organisations and communities can then input their qualitative and quantitative data into the "mauriOmeter" data analysis tool, and identify the state of mauri and trends in order to assess different courses of action and their relative outcomes and impacts over time. The Mauri Model and mauriOmeter is currently in use by various groups including Te Arawa River Iwi Trust, which uses custom computer software to analyse raw data from real-time sensors and other data sources such as iwi surveys and LAWA records. Researcher Dr Kepa Morgan has proposed using AI to monitor the video feed and issue alerts when changes that might be of concern occur, such as increased wastewater discharges.

How should we build stronger international relationships?

Currently, several global technology companies including Google and Microsoft are making significant contributions to AI supporting environmental outcomes and sustainability focused AI services. For example, Microsoft's Planetary Computer combines large volumes of global environmental data with application programming interfaces (APIs), enabling users to answer global questions about the data, and making the answers available to conservation stakeholders.

Google's Environmental Insights Explorer (EIE) is a freely available platform using a range of data sources and modelling capabilities to help cities measure and analyse emission sources. The platform provides actionable data to help cities identify strategies to reduce emissions. This includes air quality, building, transportation and tree canopy data, plus rooftop solar potential.

The recently announced Multi-Mission Algorithm and Analysis Platform, jointly developed by the National Aeronautics and Space Administration (NASA) and the European Space Agency, is another example of an initiative collating data and applying AI to make a difference to at-risk ecosystems. The open source project collects data on the biomass of forests across the planet from a variety of sources including satellite instruments, the International Space Station, and airborne and ground surveys. AI is then developed and refined by a team of global scientists to combine these heterogeneous data sets and make them interoperable.

The AI Alliance for Biodiversity has also made good connections into the United Nations Environmental Program (UNEP) and United Nations Development programme which jointly launched their UN Biodiversity Lab recently. This digital tooling is intended to help member states with the process of monitoring (and reporting on) their biodiversity levels. This collaboration will allow UNEP to learn from the progress already made here in Aotearoa New Zealand and vice versa.

The Eco-index Programme (part of the Biological Heritage National Science Challenge) is the first group in Aotearoa New Zealand to achieve digital public good status for their developing biodiversity remote-sensing and monitoring toolkit. This has opened doors to international interest in their work and to make the most of these opportunities their team will be seeking a New Zealand Government advocate for the international digital public goods charter in early 2023.

"Researchers in New Zealand can participate effectively and meaningfully in these initiatives contributing data, algorithms and knowledge delivering global and New Zealand scale returns."

What areas could Aotearoa New Zealand provide global leadership in?

We can build unique solutions that contribute to the preservation and stewardship of our biodiversity and the development of the sector globally. As government, organisations, researchers, and businesses deepen their understanding of these technologies it will be important to:

I. unite and align researchers and innovators across the education, public and private sectors.
II. ensure our efforts are climate-friendly and avoid external carbon costs.
III. support our economy and reward innovation.
IV. deliver equitable, inclusive and distributed benefits to all.
V. consider mātauranga Māori traditional knowledge, including in the identification of environmental and biodiversity indicators and algorithm design.

Incorporating these principles will result in a diverse range of remote sensing and AI applications with positive biodiversity outcomes. For example:

- AI modelling tools which have mātauranga Māori built into their logic help demonstrate the impacts of potential interventions, so communities can make decisions about future land use and conservation projects. For example, a local iwi monitors sections of their river with sensors. The resulting data is combined with local knowledge to deepen a holistic understanding of the ecosystem.
- Partnerships to better understand our environment: farmers, iwi and regional councils share relevant privacy-protected environmental monitoring data with government agencies. This interoperable data is combined with national satellite imaging to gain a nationwide picture

of our land and climate. The government is able to make strategic funding decisions using AI and other tools. This national level data is reciprocated with communities for their own purposes and benefits.

- AI citizen science: Family and whānau throughout Aotearoa New Zealand use chew cards and IoT sensors with low-powered cameras in their backyards to track native wildlife and pests. Photos of chew cards and images from IoT cameras will be analysed by an AI tool. As species are identified in real time, data is added to their household dashboard. This information can then be shared to help build a picture of predator populations in their town or city.

Are you aware of any particularly good work underway overseas that we could think of adopting or adapting here in Aotearoa New Zealand?

This response focuses on progress made in developing AI strategies on a country scale.

Countries are at different stages of the development and implementation of national AI strategies and policies. According to research from the Organisation for Economic Cooperation and Development (OECD), 21 countries have released national-level AI strategies as of 2021, however only seven of these include the environment or climate change as an area of focus for AI.

An analysis of these strategies finds a varying degree of detail. The Australian report identifies the environment as a major area for AI work and the French AI strategy has a clear focus on the environment, including specific ways to address issues. Likewise, China's AI strategy mentions sustainability and the environment, including specific plans for the use of AI for environmental protection. Meanwhile, the United Kingdom's (UK) AI Sector Deal only lightly touches on the subject, including examples of open environmental data.

There has been significant work produced by international AI organisations and consultancies to identify opportunities and challenges presented by AI for the environment. In 2018, PwC published "Harnessing Artificial Intelligence for the Earth", which was developed alongside the World Economic Forum (WEF) and other partners. The report outlines opportunities for AI to support six global "earth challenges" aligned broadly to the themes covered by this report.

In 2021, the Global Partnership on AI published "Climate Change and AI: Recommendations for Government Action", examining the potential applications of AI for climate outcomes in a global context. The report concluded that AI brings significant opportunities to accelerate strategies for climate change mitigation and adaptation, across multiple areas including energy, land use and disaster response. The report also highlighted that lesser-resourced regions, including those in the southern hemisphere, are likely to suffer the most from both climate change and digital transformation of the global economy.

If we decide to use emerging technologies, how can we build social license, cultural licence and trust to support their safe and effective use for biodiversity?

AI practitioners and environmental monitoring organisations face a number of challenges to successfully build and operationalise AI for the biodiversity projects. Several key challenges need to be resolved in order to strengthen and expand the field.

Collaboration between and across different organisations is necessary to support the development and operationalisation of AI for the environment. However, currently this can be challenging. For example, competing institutional incentives (academia's publishing requirements, intellectual property (IP) constraints and financial imperatives) can hinder successful partnerships.

Government research funding has increased significantly in the last decade. However, its distribution has led to precarity in organisational revenue for CRIs and unproductive competition across the research system. This lack of coordination and collaboration can result in some replication of efforts while other areas of AI remain underdeveloped.

Meanwhile, considerable decision making and monitoring of the environment occurs in industry, especially in the agricultural sector. Partnership and information sharing is essential for developing biodiversity-oriented AI, but privacy, IP and regulation concerns often constrain these opportunities.

Inclusive approaches to data collection and use will look different to scientific data practices, reflecting that incorporating Māori data approaches will require a significant cultural and mindset shift. There are already a number of frameworks in place or under development. For example, Nga Tikanga Paihere is a tikanga-based framework to guide researchers using microdata in the Government's Integrated Data Infrastructure. This approach could potentially be applied to broader uses of data in ethical and responsible ways.

Areas where further work is needed include developing best practices for Māori data access and availability, for example whether Māori have access to nationally-collected data to help inform decisions for their communities. Consideration also needs to be given to how data is used and shared without engagement with, or permission of, local iwi and hāpu who have kaitiaki responsibilities for areas of land and water and species living there. For example, when is it appropriate for data to be gathered by satellite or remote sensors, without a physical presence on the land or in the water?

"Māori have strong intergenerational science knowledge and practice in dealing with real-world problems and opportunities. And we know this knowledge continues to have immense potential, especially where it can be aligned with western science and technology."

AI for the Environment Report, AI Forum 2022.

How much of a role should government have in biodiversity protection. How can government best collaborate with others?

This long-term insights briefing is an opportunity to build open, collaborative approaches in the data science arena of biodiversity protection and restoration. Sharing knowledge, funding and responsibility within government and with iwi, Crown Research Institutes (CRIs), the private sector, universities, not-for-profit and non-governmental (NGO) organisations holds the greatest promise for advancing this field at the rate required to help reverse biodiversity decline.

Biodiversity protection work needs to be facilitated by government as the private sector will not have the economic incentives to undertake the critical work that is required and iwi are currently limited in their ability to resume full kaitiaki roles. Broadly speaking, government can best collaborate with others by further supporting, with both funding and expertise, the many strong organisations that are currently undertaking excellent biodiversity work but are limited by funding and/or knowledge gaps. Examples of existing environmental AI collaborations include data communities of practices for CRIs and regional councils, and through the Time-Evolving Data

Science/Artificial Intelligence for Advanced Open Environmental Science (TAIAO) project. The government-funded Eco-index team is also building partnerships with eight partners to co-develop data science approaches with the intention of filling knowledge gaps and boosting biodiversity protection in locally-relevant ways. These partners include iwi, industries, a community group and regional council. There is potential opportunity for broader collaborations to further connect the environmental and technical aspects of these AI systems.

Education initiatives are required to uplift a new generation of technologists and support capability building within Māori communities interested in using AI to support their local environment.

Government can also set the regulatory environment up to support and enable private sector and NGO involvement – for example biodiversity incentive schemes for farming and electronic monitoring of commercial fishing. There is significant interest in biodiversity credits across all sectors.

Transitioning AI for the environment projects from research to operation can also be complex and expensive. For organisations interested in implementing environmental AI projects there is a big learning curve and trial and error process. These challenges do not only apply to environmental projects – only an estimated 13 percent of data science projects make it into production. Many organisations have limited resources and capability to contemplate the opportunities and potential that AI can offer. Data sharing and collaboration can reduce some inefficiencies in this space.

The hype of AI can also lead people to be disillusioned when projects underperform or do not offer immediate results. While CRIs, universities, not-for-profits and NGO organisations are developing new applications there is currently a gap in scaling and operationalising them in partnership with businesses or government agencies. It is also likely that organisations will underestimate the time it takes to implement and operationalise an AI system. Our recent AI for the Environment research also identified the need for better financial incentives for organisations to implement AI systems.

In the corporate sector, improving opportunities for early career AI specialists to gain relevant experience, and incentivising organisations to offer training and mentorship, will help build capability. This will help increase the number of businesses implementing AI systems. Alongside developing local capability, there remains an ongoing need to supplement this with international talent. Ensuring immigration policy is responsive and fit-for-purpose is a key part of a robust capability building plan.

Work to increase skills and capability for the wider digital sector more broadly is already underway. The Digital Tech Industry Transformation Plan Skills Workstream Report and Draft Plan published in 2021 includes 10 actions to build the digital skills pipeline in Aotearoa New Zealand. The Skills Plan recognises that "our industry is suffering greatly from a mismatch of skill supply and demand, however the only way we're going to fix this long-term is if we invest in domestic development".

How can we ensure the diverse voices and views of the community are represented in biodiversity conversations?

This will require strong, balanced and reciprocal relationships between people using remote sensing and AI systems to gain insights, decision makers, and kaitiaki local guardians of the land and species. Currently, decisions are often made by people who are removed from the local context. In most cases consideration is required to understand where relationships could be built or strengthened to support the use of data. For example, where remote sensing techniques or satellite imagery is used to gather information about Māori land. In addition, strong relationships will also enable data-driven insights to be combined with mātauranga Māori and local knowledge to gain the best biodiversity outcomes.

What are the key data issues that the government will need to think about to get the foundations right for using data-driven and emerging technologies?

Key data issues that need to be considered include:

I. Medium resolution (10 m – 60 m) satellite imagery from Landsat, Sentinel-1 and Sentinel-2 are suitable for biodiversity monitoring at broad scales such as the North Island of New Zealand. These sensors provide high repeat-visit frequency and temporal value which enables indicators to be monitored across seasons and multiple years.

II. High resolution satellites such as Maxar, Planet and Airbus provide multispectral optical imagery at higher resolution than Sentinel-2. These sensors are well suited to sub-hectare mapping but are cost prohibitive for mapping entire regions. They do provide the option of winter imagery which is generally not possible with aerial photography.

III. Vertical high-resolution aerial photography (orthophotography) is proven as a resource for detailed land cover, habitat and biodiversity mapping. It is also relatively expensive to acquire, is usually summer only (due to required sun angles), and has not been widely used internationally.

IV. LiDAR at 1-3 m resolution is a rich resource for land form mapping and delineation. Used in combination with optical imagery it presents an increasingly important input to decision tree and deep learning models.

V. Derived vegetation and moisture indices such as NDVI, NDWI, TWI and TPI are valuable inputs to machine learning models.

VI. The fusion of LiDAR with multispectral, optical and SAR imagery can produce the best overall accuracies compared to any data type alone or any other combination of data types.

VII. Many applications of AI require large, high quality data sets to function well. Access to sufficient quality environmental data is a challenge especially in government agencies. Agencies may encounter gaps, with not enough data to properly report on the environment, while available data may not be high quality or consistent enough to use with AI applications. This is especially the case when scaling reporting to a national level.

VIII. Environmental measurements and data standards are not consistent between regional bodies. As a result, comparisons are difficult and analysis is time consuming. Collecting more data, and changing monitoring and data standards to improve interoperability, is costly and complex, but is necessary to advance applications within government agencies. Currently, the National Environmental Monitoring Standards (NEMS) project, led by a steering group from regional councils and the Ministry for the Environment, "aims to ensure consistency in the way environmental monitoring data is collected and handled throughout New Zealand".

IX. Beyond government, access to good data is essential for all AI projects. For Māori communities, enabling access to existing data or increasing culturally appropriate environmental data collection will be key to fostering Māori AI initiatives

What areas should we put funding or resourcing into, and why?

Aotearoa New Zealand has a relatively low maturity in terms of advanced remote sensing and AI application for biodiversity. This presents immense opportunities for growth and innovation for a range of organisations. Collectively, accelerating our efforts to monitor, understand and support the environment and biodiversity benefits us all.

The AI for the Environment Report made three key recommendations (repeated here) which are also valid for this consultation:

1. Build a coherent data ecosystem
    - Deploy AI alongside other new technologies to enhance data collection.
    - Develop a national environmental open data framework.
    - Consider where and how mātauranga Māori may be incorporated within AI systems.
    - Coordinate the development of standards and best practices for biodiversity data.

2. Build capabilities and relationships
    - Invest in increasing the institutional understanding of AI in businesses and Government.
    - Increase the exposure of AI specialists to environmental challenges and environmental scientists to AI.
    - Increase collaboration within the AI for the environment ecosystem.

3. Increase and align funding to support impactful projects
    - Target funding to accelerate AI for the environment uptake.
    - Align funding with measurable environmental impacts.
    - Target funding to outcomes of national importance.

In addition to the key areas identified above, there are other issues that need attention in order to further the AI for the environment ecosystem. These include:

- Fit-for-purpose digital infrastructure – This includes data storage facilities and cloud computing services, high-speed internet access across the country.
- Looking forward to emerging opportunities – This includes supporting initiatives that leapfrog current technologies and being more agile in approaches to monitoring the environment and responding to a range of needs.
- Defining the problem before jumping into a project – It is imperative projects begin with a clear problem definition and involve all stakeholders in the framing of the problem being addressed.
- Climate friendly AI approaches – As well as using AI to support environmental outcomes, organisations are required to understand the environmental impact of AI and mitigate appropriately.

Thank you for the opportunity to provide feedback on the consultation document. We are happy to engage further to discuss our submission and provide any further assistance.

If you have any further queries, please do not hesitate to contact us.

Yours sincerely,

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