

Te Puawānanga Report

A Landscape Report on the Aims,
Aspirations, Opportunities, Issues
and Concerns on Aerospace for Māori

Pauline Harris
Graeme Everton
Kirsty Doyle
Leo Watson

On Behalf of the Māori
Working Group on Aerospace
maoriinaerospace@gmail.com

The Puawānanga (Clematis plant) flowers in the month of Hereturikōkā. It is one of the tohu or signs of the changing of a month. It is a time where it is still cold but will next be moving into a warmer month and season, transitioning into the next month where the earth will begin to warm and there will be more growth and abundance. We here name this report Puawānanaga to indicate a change in state as we engage and grow into the aerospace sector.

A phase change of growth.

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Kia whakatōmuri te
haere whakamua

I look to the past and
the knowledge of my
ancestors to help guide
me into the future

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Dedication

Ko Tūwharetoa te iwi
Ko Ngāti Raukawa te iwi
Ko Graeme Everton te tangata
Moe mai rā e te rangatira
Moe mai rā
Moe mai rā

This report is dedicated to Graeme Everton who led the vision that is to become the future Māori Aerospace sector. His contribution to Māori technology and innovation will be remembered for many years to come.

Haere atu rā e te rangatira



Graeme Everton

Acknowledgements

I would like to express my deepest gratitude to the people and organisations who contributed to this report, including the writing, editing and design team. Their support, insights, and expertise have been invaluable in shaping the findings and conclusions presented here.

To the many participants who were interviewed and surveyed, your perspectives and knowledge have been instrumental in highlighting the aspirations, challenges, and opportunities within the aerospace sector for Māori. We thank you very much.

To the Māori Working Group on Aerospace who have contributed so much to the direction, expertise, input and support of this report, thank you all very much.

To groups such as the Society of Māori Astronomy, Research and Traditions (SMART) for your advice and guidance on this work also, many thanks to you.

A special thanks to the co-authors of this report including Pauline Harris, Graeme Everton, Kirsty Doyle, and Leo Watson and to our other valuable contributors. So much gratitude to you all, thank you. To our family, friends, and colleagues for their encouragement and unwavering belief in this work. Your support has been a constant source of inspiration throughout this journey.

I also acknowledge the support of the MBIE Endeavour fund and the NZ Space Agency for financially supporting this work.

Most importantly this report is dedicated to the memory of our dear friend and colleague, Graeme Everton, who passed away in February 2024, whose passion, wisdom, and unwavering commitment to advancing Māori innovation and leadership in aerospace continue to inspire us. His contributions have left an indelible mark on this work. His work in the radio spectrum, alongside his entrepreneurial and community work, and his legacy will live on in the strides we take together.

For our children and our mokopuna, the next voyagers into space.

Tohunga at the Aerospace Summit 2023





The International Space Station orbits 267 miles above the South Pacific Ocean, east of Aotearoa, as seen through a window of its iconic seven-windowed cupola.

Executive Summary

As Aotearoa sees the growth and economic potential in aerospace, we ask where are Māori in the decision-making and research and development of this sector? Various developments in the aerospace industry, technology, law, and the recognition of Indigenous perspectives mean now is the appropriate time to focus on Māori perspectives on Tuarangi Space and aerospace as a whole. These developments are converging and can be meaningfully informed by a Māori worldview. This is also the basis of the partnership relationship between Māori and the Crown under Te Tiriti o Waitangi.

Māori have a deep connection to tuarangi – space, through whakapapa (genealogy), described and embedded in traditional origin narratives. These narratives describe the inherent relationships that Māori have with tuarangi, the atmosphere, and the inter-relationships therein, setting the values, principles, tikanga, and kawa of how Māori conduct themselves in the natural world, including space and aerospace.

The burgeoning growth of the aerospace industry in Aotearoa New Zealand, including the use of Māori land by the space industry, Māori involvement in engineering, data, cyber security, technology, and medicine has demonstrated the growth and potential of Māori in the aerospace sector.

We have seen the ongoing development of the Government's journey in acknowledging and valuing a Māori worldview. There is still so much to be achieved to manifest a partnership relationship that honours Te Tiriti o Waitangi. Some recent positive examples include:

- After advocacy from Māori in the aerospace sector to the Ministry of Business Innovation and Employment (MBIE) in 2023, officials within the Ministry did include Māori comment on the draft Government aerospace strategy and provided some funding for research to be undertaken;
- The 2022 Memorandum of Understanding entered between the Crown and Māori relating to a partnership concerning the policy, regulation, and allocation of radio spectrum under the Radiocommunications Act;
- An increasing acceptance of the importance of taonga and mātauranga Māori through the Crown's Te Pae Tawhiti whole-of-Government approach to Wai 262;
- The establishment of Matariki as a national holiday, through Te Kāhui o Matariki Public Holiday Bill 2022, and the increased visibility and revitalisation of Māori traditional practices in relation to celestial knowledge.



ESA astronaut Matthias Maurer is seen working on the International Space Station's truss structure during a spacewalk to install thermal and electronic components, 268 miles above the Pacific Ocean near Aotearoa.

This Landscape Report has involved interviewing and surveying Māori to gather their perspectives on aerospace. The questions covered a range of topics, including Māori rights and interests under Te Tiriti o Waitangi, the view of space as a taonga (treasure), opportunities in aerospace, and concerns about the sector. The report revealed a strong desire by many to see the development of a flourishing Māori aerospace sector. Participants highlighted entrepreneurial and business potential, linking opportunities to current strengths in the Māori economy, as well as new areas of research and development.

Key concerns were raised about environmental impacts, emphasising the importance of kaitiakitanga (guardianship) in decision-making. The militarisation of space was also a significant issue, as well as concerns about the effects of aerospace activities on Māori communities, cultural practices, and mahinga kai (food-gathering). Furthermore, participants stressed that Māori rights under Te Tiriti o Waitangi have been overlooked in the aerospace sector, calling for more leadership opportunities and increased participation.

Major findings from this report:

Aims, Aspirations and Opportunities

Māori relationship to Space

1. 95% of participants agreed that space is a taonga.
2. Space and the atmosphere are important as Māori are related through genealogy.

3. Māori have a deeply spiritual connection with aerospace. Māori need to be involved in decision-making and policy setting.
4. Māori values and principles need to guide aerospace decision-making.
5. Māori seek leadership roles at global, international, and national levels, and aim to be involved in decision-making, legislation, and policy creation.

Economic Opportunities

6. There is economic potential for Māori businesses. This includes utilisation of Māori land; use of primary industry markets; raw materials for new industries; employment and training in the aerospace skills sector itself.
7. Fostering and growing Māori aerospace business.
8. Develop current capacity and capability in Māori owned companies, institutions, and the aerospace workforce (there are only an estimated 50 Māori involved in the aerospace sector).
9. Education, capability, and capacity development is key; the establishment of internships, scholarships, outreach, and training courses is wanted.
10. Funding allocation for research and development, creation of networks, international relationship development (catalyst), and international and national meetings. Equitable investment fund, equity to develop Māori capacity, capability, research, and development.

11. Supporting existing Māori companies to become successful and contribute to the

economic growth of NZ and Māori economies.

12. Fostering existing relationships with NASA, ESA, and private companies, and to foster existing collaborations in earth observations, aerospace engineering, space medicine, and space communications systems.

Environmental Perspectives

13. Many Māori want to explore space through an Indigenous lens, using approaches and methods that ensure Ranginui (Sky Father) is cared for, protected from exploitation, and free from colonial practices.
14. There are a range of perspectives among participants as to their future aspirations to be involved in aerospace: many Māori are eager to be involved in aerospace, while others took a precautionary approach, or expressed a preference to not participate.



A stunning view captured during a night pass by the Expedition 40 crew aboard the International Space Station: the aurora glows over Aotearoa, with the Moon about to dip into a sea of green light. Docked Soyuz and Progress spacecraft are visible in the frame.

Research and Development

15. Māori want to lead research programmes and science and innovation for aerospace.

16. Advance existing and new interest in telecommunications and digital technologies.

17. Grow space based earth observations and enable iwi to establish their own programmes. Collaboration and Connection with other Indigenous perspectives

18. Many Māori are wanting to collaborate with other Indigenous peoples on aerospace.

19. Māori want to establish both national and international networks to grow and foster collaboration with other Indigenous peoples and to collaborate with institutions.

Issues and Concerns

Kaitiakitanga

20. Lack of tikanga Māori in aerospace activities.
21. Animal and human well-being concerns.
22. Deep concerns of colonisation of space continuing.

Space Junk and Debris/Pollution

23. Pollution including space junk, falling debris, and waste during production.
24. Irresponsible and unnecessary use of space.

Mining

25. Exploitation of space through mining here on earth and in space.
26. Mineral extraction concerns.

Impacts of Aerospace on Community

27. Inadequate consultation by aerospace companies with Māori communities.

28. Deep concerns of the colonisation of space continuing.

29. Lack of consultation in Māori communities and with key stakeholders, and advisors.

30. Representation lacking internationally and nationally.

Military

31. Military use of space and association of NZ companies and Government to other military entities.

Legislation, policy & regulation

32. Fast tracking of policy and procedures for approvals.

33. Government capability in decision-making in aerospace.

34. Inadequate and fast-tracked Environmental Impact reports.

35. Lack of Māori values and principles in Government decision-making, policy, and legislation.

36. Non-inclusion of Māori into decision-making by the Government and/or companies.

Te Tiriti o Waitangi and Space as a Taonga

37. Mātauranga Māori must be protected.

38. Funding inequity for Māori.

39. Education inequity for Māori.

40. Government capability in treaty relations.

41. Lack of acknowledgement of Te Tiriti o Waitangi.

As this report was being finalised, the Coalition Government announced at the Aerospace Summit in Christchurch during September 2024 that it was releasing its aerospace strategy that same day; it is now called the Space and Advanced Aviation Strategy. Regrettably, there was no mention in the strategy as to the Crown's Treaty partner, Māori. The MWGA was not aware that the new strategy was being released.

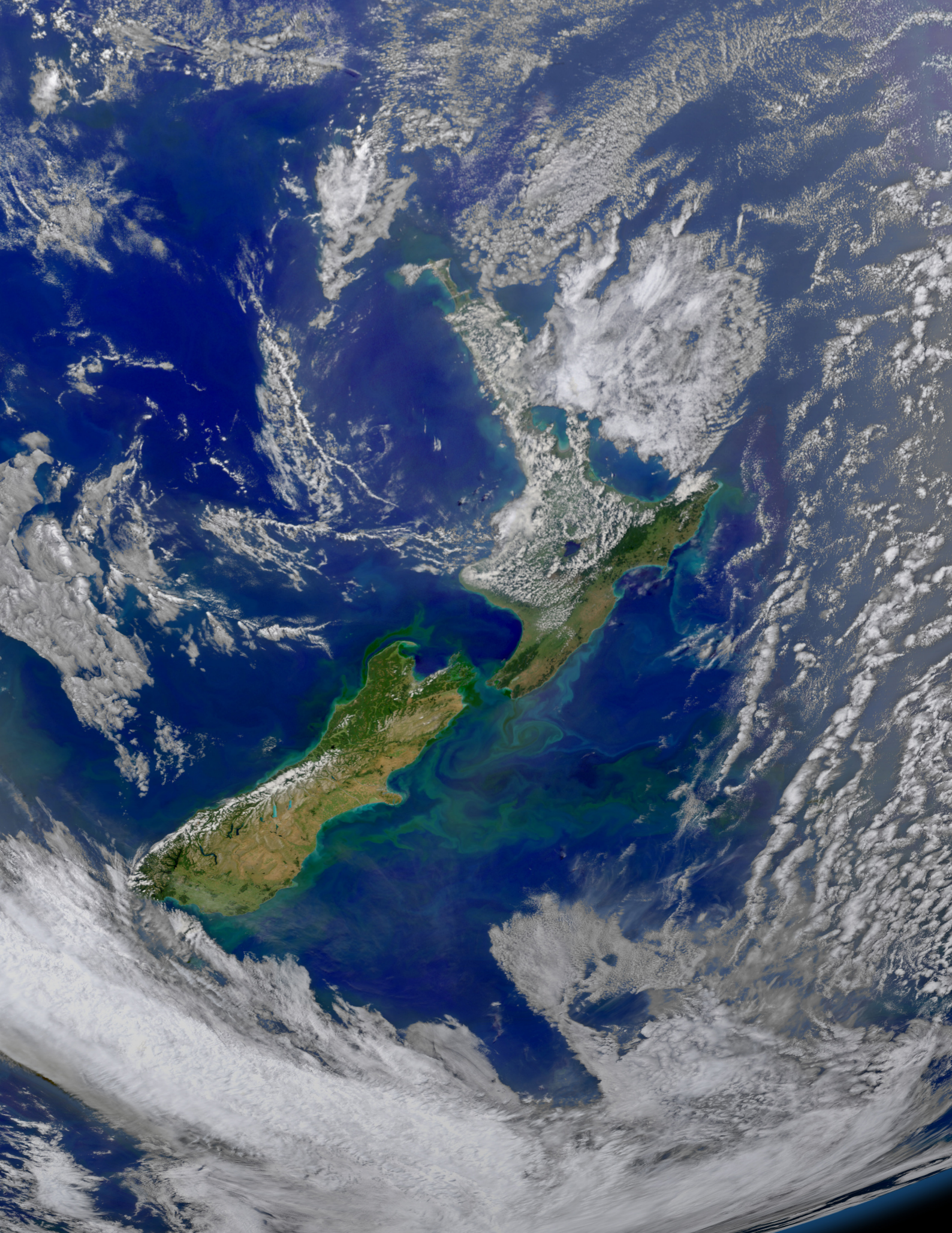
In terms of the incoming briefing to Ministers, MBIE had not listed MWGA as a stakeholder to be engaged with, despite that being one of the key functions of the MWGA when it was established. These points highlight the dire and urgent need for the Crown and Māori to properly engage on aerospace strategy and potential, for our mutual benefit as Treaty partners.



Dr Pauline Harris speaking at the Aerospace Summit 2024.

Panel discussion at the Aerospace Summit 2024





A clear satellite view of Aotearoa.

Key Recommendations

Key recommendations from the report:

1. That the rights and interests of Māori in aerospace as identified in this Report be incorporated into New Zealand's aerospace strategic planning, policy setting, and decision-making.
2. That the Māori Working Group on Aerospace continue to broaden its representation of Māori in the sector and work with Crown officials on a partnership approach to aerospace regulation and management.
3. That the economic opportunities available for Māori in aerospace be advanced by the creation of:
 - a. A Training, Capacity and Capability Fund for Māori;
 - b. An Entrepreneur, Research and Innovation Fund for Māori, including provision for mātauranga Māori (traditional knowledge) in aerospace projects.
4. That private aerospace companies be encouraged to:
 - a. Provide for Māori cultural expertise within the strategies and objectives of the companies;
 - b. Provide for Māori representation on aerospace advisory and industry fora;
 - c. Actively create opportunities within the companies for Māori employment and training in the aerospace industry.
5. That Māori be resourced and included in New Zealand's international participation in the United Nations and other relevant international forums in consideration of aerospace regulation.
6. That specific Crown funding is dedicated to an educational outreach programme for Māori relating to aerospace, to be overseen by a group of Māori experts to develop and administer the Fund. The Fund would be prioritised to grow a pipeline of expertise, including science, research, and development for Māori.



Near the edge of the Small Magellanic Cloud, about 200,000 light-years from Earth, the young star cluster NGC 602 glows in a new image from the NASA/ESA/CSA James Webb Space Telescope, captured using its NIRCam and MIRI instruments.

Introduction

As New Zealand developed its aerospace sector, with the enactment of the Outer-Space and High-altitudes Activities Act 2017, and with the publicity about Rocket Lab's launches from Māhia Peninsula, it became clear that there was a need to bring together experts to discuss and assess Māori perspectives and values on aerospace, and to ensure that these perspectives were properly recognised.

In 2021, a Māori Working Group on Aerospace (MWGA) was formalised with a particular focus at that time on the draft Government Aerospace Strategy. The MWGA consisted of experts in their various fields such as:

- Tohunga and experts in traditional Māori practices;
- Iwi leaders;
- Astrophysics;
- Entrepreneurs;
- Cyber security;
- Space medicine experts;
- Educationalists and academics;
- Te Tiriti o Waitangi and indigenous rights practitioners; and
- Māori astronomers.

Upon reviewing this strategy, MWGA unanimously agreed that the strategy did not reflect Māori perspectives, worldviews, and customary interests, and there were only a few references in the strategy for the potential for Māori aspirations to be realised. Indeed, the Māori perspective, when it was referred to, was in the same category as “interests of minorities” or special interest groups such as advancing women in space, or those with disabilities. Māori as tangata whenua and as a Treaty partner were not referred to.

To effectively respond to the strategy, the MWGA needed to have access to expertise, and

underlying data, and to engage with Māori space stakeholders as to Māori perspectives, aims, aspirations, opportunities, issues and concerns, interests, as well as the significant economic potential across the aerospace sector. MWGA stated that, most importantly, there needed to be a dedicated body of work around the rights and interests of Māori in aerospace and inclusion of Te Tiriti o Waitangi in the development and implementation of aerospace policy to ensure that the Treaty relationship and further partnership opportunities can be identified and realised. MWGA advised MBIE that three bodies of work needed to be undertaken:

1. A Landscape Report identifying:

- The existing participation of Māori in the space and aerospace sectors – as much as possible down to a granular level within each sub-sector (education, training, employment, business, health etc.);
- Māori perspectives on the challenges, benefits, and opportunities in the space sector and sub-sectors;
- A whānau, hapū, and iwi perspective on tuarangi – space.

2. Potential specific economic opportunities for Māori in Tuarangi – Space:

- High level quantification of the economic opportunity of the Māori space economy;
- The potential of the space industry to contribute to the transformation of the Māori economy;
- Contribution to building Māori capacity to lead science and innovation and businesses;

- How to grow significantly more high-tech exports coming from the Māori Space industry.

3. A technical/legal perspective on Māori rights and interests in Tuarangi:

- Review of space regulation in NZ;
- Review of international space instruments, with particular focus on where Indigenous rights are relevant.
- Literary review of Space and Indigenous rights;
- NZ's current Treaty jurisprudence as applicable to space law;
- Identification of key legal issues relevant to Māori in the aerospace sector.

This current report is specifically focused on the first workstream, as being a Landscape Report on Māori perspectives generally. However, MBIE has not supported funding for any additional work to date, and therefore this Report has taken the opportunity to consider economic and legal issues with a view to providing Recommendations (such as in this report) for future action.

By way of a methodology to ascertain the landscape, a set of questions were designed, and implemented through interviews and a survey. The questions asked focused on participants' views and opinions on what aerospace means from a Māori perspective, whether space is considered a taonga, the values and principles associated with aerospace, the aims, aspirations, opportunities, issues, and concerns

surrounding it, and the significance of Te Tiriti o Waitangi in aerospace.

This report summarises the findings from 40 of the interviews (20) and surveys (20) conducted, and also collates the feedback that the MWGA members have received from Māori on aerospace issues from other people over the period 2021 to 2024.



An orbital sunrise casts a golden glow as seen from the International Space Station, 267 miles above the Tasman Sea between Australia and Aotearoa.



A group of people gaze up at the early morning sky, watching for Matariki — the rising star cluster that marks the Māori New Year and a time of remembrance, celebration, and renewal in Aotearoa.

Māori Perspectives on Aerospace

Defining Aerospace

To assess the responses and feedback given to the MWGA, we first need to introduce what aerospace encompasses from both Māori and Western perspectives. It is acknowledged that there is a need to carefully determine the appropriate lexicon for how we are to talk about Māori and Western perspectives on aerospace. This report uses terms that were broadly and frequently used by those who were surveyed and interviewed. However, the process of determining correct terminology and defining those terms accurately is a clear need for the future.

Aerospace, as defined from a Western perspective, refers to both the atmosphere and space and is usually used in reference to aerospace activities or industries (Allen, 1965). The New Zealand regulatory context is also framed in terms of “activities” and the “space industry”, in the Outer-Space and High-altitudes Activities Act 2017, and the Act’s associated regulations. New Zealand has obligations under international conventions it has ratified, including the United Nations Outer Space Treaty (1967), the United Nations Convention on Liability for Damage Caused by Space Objects (1972), and the United Nations Convention on Registration of Objects Launched into Outer Space (1976), which establish principles for regulating space activities. “High Altitude” is a specific term focused on the launch and operation of high-altitude vehicles, HAVs, and is defined as the higher of flight level 600 or the upper limit of controlled airspace under the Civil Aviation Act 1990. New Zealand has promoted a pro-industry regulatory regime, while also focusing on national security interests. There is no reference whatsoever in the Outer Space and High-altitudes Activities Act 2017 to

Te Tiriti o Waitangi or the perspective of Māori as a Treaty partner with regard to outer space.

For Māori, the perspective comes from a deep connection to *tuarangi* – space, through *whakapapa*, which is described and embedded in traditional origin narratives. These narratives outline the inherent relationships that Māori have with *tuarangi* –space and the atmosphere – through genealogical ties, linking Māori to these realms and the beings that reside within them. These inter-relationships, connections, and *whakapapa* determine the inherent set of values, principles, *tikanga*, and *kawa* that guide decision-making and conduct in the realms of space and aerospace. From a Māori perspective, the atmosphere and space encompass the realms of *Tāwhirimātea* (God of Wind and Storms) and *Ranginui* (the Sky Father), along with various deities and beings residing within these realms, such as *Tamanuiterā* (the sun), *Marama* (the moon), *ngā whetū* (the stars), ancestors who have passed, and many more.

Leading Māori astronomy experts, such as Tohunga Chief Advisor *Mātauranga Matariki*, Professor *Rangi Mātāmua* (Tūhoe), have developed a significant body of astronomical knowledge (Matamua, 2017), including over 1,000 star names and narratives, as well as understandings of the environmental and ecological knowledge associated with many of these celestial bodies. Other experts, such as Tohunga *Rereata Makiha* and *Apanui Skipper*, have also developed extensive knowledge about the celestial realm and the domain of *Tāwhirimātea*, including weather systems (Husband, 2021) (Skipper, 2020).

It is important to understand the extent of this realm. During an interview with Professor Mātāmua, he was asked how far Ranginui extends, to which he stated that Ranginui extends across the Universe:

“So, all of space is Rangi, anything celestial is Rangi, that’s from above your heads to the end of the known universe is Rangi and there are many domains of Rangi, Rangi is not fixed into one domain. And we talk about there being different levels of heavens. There are different aspects of Rangi: Rangi-ātea which is open space, Rangi-tamaku which is near space, there’s all these different terms. But what you’re saying is our relationship to that domain goes from where we are above our heads to as far as it goes, that’s what it is, and we have a connection.”

Over the past twenty years, a greater appreciation by non-Māori about Māori understandings of these realms has grown, but this has not translated into mainstream regulation and participation in the aerospace sector. It is vitally important to understand the relationship that Māori have with space and the how far these understandings and relationships extend.

Space as a Taonga

Another question that was posed to participants was “What does space mean to you personally?” and “Do you think space is a taonga?”. Most participants opened their answer by talking about the whakapapa relationship between Māori and space, with most indicating it was as a given that space is a taonga. Most participants agreed that space is indeed a taonga. Some described the

sacredness of space, whilst some queried deeper, discussing whether space was a tangible or intangible taonga. Many also described what space meant to them in the context of exploration, with many describing the importance of exploring space and their desire to travel into space, explore it, but in a way that followed Māori values and principles, particularly kaitiakitanga (as discussed later in this report). For example, Participant 31 acknowledged the sacredness of space and the importance of conducting ourselves correctly as we explore it:



A crisp view of the half-moon hangs in the sky, its illuminated side sharply contrasted against the darkness of space, revealing detailed craters and lunar terrain.

“I think it’s a yes to be looked after.... Just like the whenua where we stand on. Yes. But that doesn’t mean you can’t take journeys. It doesn’t mean you can’t explore or walk that whenua or fly on that path. It’s how you do it, and why you’re doing it.”

In recent years we have seen the public of Aotearoa-New Zealand embrace Māori celestial knowledge through the establishment of the Matariki public holiday, Te Rā Aro ki a Matariki/ Matariki Observance Day (Te Kāhui o Matariki Public Holiday Act 2022; New Zealand

Parliament, 2022). The holiday has raised awareness of not only how Māori recognise the Māori New Year but also how deeply spiritual the connection is between people, the Sky Father Ranginui, the celestial, and the natural world. When entrepreneur and technology expert Graeme Everton (Tūwharetoa and Ngāti Raukawa) was asked about space as a taonga he described the importance of this relationship for Māori as being embedded in their lineage, DNA, and whakapapa. He stated:

“I think it’s a taonga because we already accept that it’s part of our lineage. Everything that’s led us to where we have a relationship. So, there’s no way it can be denied that we have it. Yeah, it is a rich taonga that we cherish. If anybody tried to tell us differently, we’d be marching in the streets. I certainly think that that’s been helped over the last couple of years with the recognition of Matariki, you know, it’s enhanced people’s understanding that we have this rich relationship. So, absolutely it’s a taonga.”

Astrophysicist Associate Professor Pauline Harris (Rongomaiwahine, Ngāti Rakaipaaka and Ngāti Kahungunu) reinforced this perspective, saying:

“Space is a taonga, with its own life-force (mauri). There is no denying that it is a taonga; Ranginui is an atua, Ranginui is an ancestor, and Ranginui needs to be protected.”

There was broad agreement that Ranginui can be explored, but it is critical to consider the purpose and approach. Participants emphasised the need to address key aspects of conduct, particularly understanding the purpose and impact of our

exploration. On a practical level, participants acknowledged the necessity of placing certain technologies in space, such as telecommunications and weather satellites. However, they stressed the importance of the respectful use of space within the realm of Ranginui, as space is considered a taonga. As participant 32 states:

“Just because the limits of space are unknown, its value as a taonga is significant. Let’s be respectful in the journey of understanding and valuing space and what it has to offer.”

The respectful use of space and our conduct in it are shaped by our values and principles. For aerospace, we posed the question: What values and principles should guide this sector?



A pou (carved post) stands tall against the landscape, embodying ancestral presence, tribal identity, and cultural guardianship in Māori tradition. Intricate carvings tell stories of whakapapa (genealogy), history, and connection to the land.

Māori Values and Principles

Principles and values shape how we behave, make decisions, and conduct ourselves ethically. They form the foundation of

morality and guide us both individually and as a community. In te ao Māori, Professor Hirini Moko Meade describes principles and values as they relate to tikanga (Mead, 2016). Principles are seen as fundamental truths, and in Tikanga Māori, concepts such as tika (correct) and pono (truth) are essential principles. Values, on the other hand, pertain to ethical beliefs and preferences that shape our sense of right and wrong (Oxford English Dictionary, n.d.).

When considering the aerospace sector, we asked participants: What are the key values and principles that should guide us in the aerospace sector?

Participants described several important values and principles, these being:

Values and Principles:

- Mauri (lifeforce)
- Whakapapa (genealogy)
- Mātauranga Māori (Māori knowledge)
- Kaitiakitanga (stewardship)
- Manaakitanga (nurturing)
- Tikanga (cultural laws)
- Mana Motuhake (self-determination)
- Tino Rangatiratanga (sovereignty)
- Kāwanatanga/Te Tiriti o Waitangi (governorship, Te Tiriti)
- Mana Ōrite (equality)
- Titiro Whakamua (moving forward)

We delve into more detail on these, unpacking how participants view them in the context of aerospace.

Mauri (Lifeforce):

Mauri refers to the life essence or energy present in both animate and inanimate beings or objects. Humans, animals, rivers, lakes, mountains, space, air, and planets all possess

mauri. To protect the mauri of aerospace, it is essential to act as responsible kaitiaki, treating space with respect, ensuring balance, enhancing its well-being, and preventing harm or exploitation. Space itself is a taonga (treasure), with its own mauri.

Whakapapa (Genealogy):

Whakapapa is a central concept in Māori culture, connecting Māori identity to not only other humans but also to animals, plants, fish, forests, seas, the sky, the earth, and celestial bodies — the entire universe. Through whakapapa, Māori are genealogically linked to Ranginui, the Sky Father, and thus to space. This connection fosters a deep respect for aerospace and a duty of care toward it. Whakapapa encompasses all elements of the environment, forming an integrated ecosystem. It establishes both rights and obligations with respect, responsibility, and reciprocity acting as guiding principles for conduct in relation to space, the atmosphere, and the wider natural world.

Mātauranga:

Māori have traditional knowledge of space, handed down through generations and encapsulated in oral tradition. These include celestial navigation and voyaging traditions, astronomy, and relationships with the spiritual realm. The traditional knowledge of Indigenous peoples is relevant to, and important for, human activities in space. Increased night-glow and light pollution (and increased radio spectrum communications) from human activities including satellite technology and mega-constellations has a measurable impact on the regeneration of traditional space knowledge and the transmission of that knowledge to the next generation of kaitiaki.



Another clear satellite view of Aotearoa.

Kaitiakitanga (Guardianship):

The role of kaitiaki is to ensure the health and well-being of aerospace, promoting its sustainable use and acting in a mana-enhancing way to uplift and preserve it in its most optimal state. There is an obligation to be good stewards of space (kaitiaki), ensuring its sustainability for current and future generations. Mineral extraction and resource use in space should be guided by ethical and sustainable practices. Decision-making must prioritise the cultural, social, and economic well-being of whānau, hapū, and iwi. Space pollution, whether through debris or Earth-based activities related to aerospace, directly impacts Indigenous communities and must be addressed to protect their environment and way of life.

Manaakitanga:

The space resource is available for the benefit of all, not just a select few. Benefits and opportunities in space should be extended to the wider community. Valuing Māori principles in relation to the space resource is a win for all New Zealanders. The peaceful exploration of space includes transparency and shared decision-making, particularly in the context of military and defence activities.

Tikanga Māori (Cultural Practices):

Through the exercise of customary practices, (tikanga), the use of and relationship with space as a resource is maintained and enhanced. Tikanga provides a set of adaptable rules and guidelines that can respond to new situations and technologies while ensuring adherence to fundamental Māori values. Whether it be space travel or the establishment of Māori telecommunications networks using satellites orbiting around earth - or other planets in the future, tikanga can guide us through these new and emerging spaces. Te Reo Māori also plays a crucial role in the retention and practice of tikanga. It is vital for planetary and outer space nomenclature, ensuring that Māori language and knowledge shape how we name and understand space.

Mana Motuhake (Self-Determination):

Mana Motuhake represents the autonomy of Māori to make decisions about their land, culture, and governance without external interference. It affirms the right of Māori, as Indigenous peoples, to self-determination. In the context of aerospace, strategies and solutions for Māori in the space sector must be developed by Māori themselves. The commercialisation of outer space must not replicate the colonisation of Indigenous lands.

Tino Rangatiratanga (Sovereignty):

Tino Rangatiratanga refers to the governance and authority over Māori lands, resources, and people. In the context of aerospace, it encompasses the right of Māori to exercise decision-making power that is representative of, and accountable to, their whānau, hapū, and iwi. This ensures that any developments or activities in aerospace respect and uphold Māori sovereignty and self-determination.

**Kāwanatanga/Te Tiriti o Waitangi
(Governorship, Te Tiriti):**

The Crown's obligations as kāwana are to actively protect taonga and uphold its role as a Treaty partner. While national security interests are important, they should not be used as a barrier to shared decision-making and meaningful input from Māori. In the context of space, the assumption of State authority is not automatic. There is a unique opportunity to reimagine constitutional relationships with Indigenous peoples, avoiding the mistakes of colonisation. For example, Article I of the United Nations Outer Space Treaty (1967) refers to outer space as "the province of all humankind," signalling potential for inclusive governance and collaboration.

Mana Ōrite (Equality):

Ensuring equitable funding is available for research and development to support Māori opportunities. This includes providing early and fair access to technology and development initiatives, as well as actively supporting Māori entrepreneurs, innovators, and businesses to create and advance new concepts.

Titiro Whakamua (moving forward):

Building the capacity of Māori through education programmes, mentoring, and employment opportunities is essential for developing researchers, engineers, and technologists in the aerospace sector. Additionally, ensuring Māori control over a dedicated innovation, research, and development fund for space will empower Māori to drive their own advancements in the industry.

As Dr Pauline Harris states:

"It is important to understand our own tikanga and values and principles when it comes to aerospace, as that is what is going to guide us in how we engage with aerospace. Especially if we are voyaging to other planets or putting satellites into orbit, we need to be guided by our tikanga, our values, and our principles so we know what is tika and pono."

Humans are guided by principles, values, ethics, and morals. As we develop the aerospace sector in Aotearoa New Zealand, it is essential to consider the values and principles outlined above. New Zealanders are known for their commitment to environmental values, such as being a clean, green nation and creating a healthy environment. As we strive for Net Zero carbon by 2050 and seek clean rivers, waterways, and a sustainable planet, these values should form a common foundation across all frameworks including that of aerospace.

With these values and principles explained, the next two sections present the key Māori aims, aspirations, and opportunities, as well as the issues and concerns in the aerospace sector, based on the responses to questions posed to participants.

Matariki, the Māori name for the Pleiades star cluster, marks the Māori New Year — a time of remembrance, reflection, celebration, and renewal. Its rising in the

midwinter sky signals a season to honour the past, celebrate the present, and plan for the future with whānau and community.





A young child dreaming big of exploring the stars and reaching for the vast wonders of the universe.

Aims, Aspirations and Opportunities

The emerging aerospace sector in Aotearoa has sparked great interest and excitement from government, businesses, the scientific community, educational institutions, and local communities. Māori iwi, businesses, and communities have shown similar interest in aerospace as well as concern with how the sector is developing both locally and globally. Survey and interview participants shared their aims, aspirations, opportunities, issues, and concerns with the aerospace sector. Underpinning nearly all these discussions was a Māori worldview grounded in its foundational pillars, whakapapa, and core Māori values and principles that guide their vision and direction on how to develop the aerospace sector. In this section, we will focus on the former and describe the issues and concerns in the next section.

Participants discussed a wide range of aims, aspirations, and opportunities. They expressed a strong desire to nurture the next generation of engineers and scientists who will venture into space and develop the necessary technologies to make this leap. Their goals include travelling to the moon, Mars, and beyond, as well as securing a place at the decision-making table to shape the development and implementation of the aerospace sector internationally, nationally, and within the private sector.

Economically, many participants see great potential to grow Māori businesses by utilising their lands, materials, and natural resources, while building on their existing success in industries such as the primary sector, where they are already significant stakeholders. They are also interested in creating new businesses focused on technology and innovation within the aerospace sector, with the goal of generating high-value jobs for their people and future generations.

Exploration of Space



Tamariki in a spacesuit.

Many Māori have dreamt about exploring space, creating space missions, travelling to the international space station, to the moon and beyond. With the recent developments we have seen, this will be a reality in the near future. Māori were renowned explorers who sailed the great Pacific Ocean, exploring and travelling to new lands. Our leading navigators have described how you would explore space and what is needed. Based on a wealth of experience, navigation and waka voyaging share the same great exploration. They note that the exploration of space from an Indigenous approach has similarities with home voyaging techniques. This will be explored in further reports by MWGA, however other Indigenous peoples have already published around space exploration that explores how Indigenous principles can guide long-duration space travel (Marsden, 2021). Some participants, they described how they wanted Māori to be involved with the exploration of space; Participant 35 expressed how it was important:

“To explore unknown places, unknown worlds, and to develop new civilizations somewhere else other than here on Earth.”

Some of the participants expressed a strong desire to go into space, to go to the moon and beyond. They stated that what is needed is for Māori to have the opportunity to reach their potential in the expert areas required to become space explorers. There are a growing number of Māori who are indeed in those expert areas, with some who are endeavouring to become space explorers. Māori are embedded in the aerospace sector already from aerospace engineering and astrophysics to space medicine. Our Mātauranga Māori experts are also engaged within the aerospace sector, too, advising and discussing ethics, tikanga, and opportunity pertaining to space travel.

Space medicine expert Dr. Lisa Brown (Ngāi Tahu) also stated that one of the advantages of Aotearoa is its connection to Antarctica where research into extreme environments is useful and already completed:

“In terms of space research for health, particularly utilising extreme environment analogues, including how we can use technology in remote places – New Zealand has the perfect infrastructure for this in Antarctica. We need to utilise that more.”

Extreme environments have also been investigated in areas such as Rotorua, where scientists from NASA have explored geothermal pools and their hospitality to life.

The want to explore is a natural human endeavour and for Māori it is something that continues today. As Graeme Everton states:

“Like when we go to a new planet, when we do enter a new planet, this isn’t all going to be about us trying to profitise and make a lot of money out of it, which is okay, but it is going to be about creating the best way to explore, the best way to make things you know, not exploits, you know, how do we do things that actually is at the high moral end of stuff. You know, because we’re going to be squeezed between the interests of big countries and you need this third, fourth, fifth voice, which is about a community which is global, but has these values, that it wants to see a value-driven space industry, not just about how you can exploit another thing, another opportunity like space.”

Rangatiratanga - Māori and Indigenous Peoples in Leadership

Nearly all participants expressed a strong desire for Māori representation and involvement in the aerospace sector. There was a clear consensus that Māori should be involved at every level, from decision-making at governmental and international levels to influencing policy, legislation, frameworks, and agreements. Māori aspire to lead technological innovation in research and development across communities, institutions, businesses, and startups.

In recent years, there has been a significant shift towards greater Māori inclusion, participation, leadership, and engagement, resulting in a notable increase in Māori-led innovation and capability. Previously, many Māori scientists and communities described their experiences with

science, innovation, and technology as unwelcoming, with limited opportunities. However, over the past decade, much-needed progress has been made. There has been a rise in interaction, engagement, collaboration, and leadership, with Māori now at the forefront of large scientific institutions and research projects, both in academia and within their communities. This demonstrates the success of more inclusive policies.

Initiatives such as the National Science Challenges (MBIE, n.d.a) have opened doors for Māori, with significant efforts made to incorporate Māori values and principles. These organisations have committed to increasing Māori participation in research and leadership, ensuring that research and development is properly resourced and aligned with Māori frameworks. While the implementation varied across different Challenges and was not without flaws, the progress has shown that when Māori are given the opportunities and resources in science, technology, and innovation, they can thrive and succeed.

As Dr Pauline Harris states:

“I was part of the SfTI, that’s the Science for Technological Innovation National Science Challenge. We had a mission around enhancing Aotearoa in the physical sciences and engineering space. I’ve been in science for a long time, and for a long time we faced a lot of closed doors in the science sector, it was hard to get funding on projects that mattered to us as Māori, it was hard to get jobs, where people from overseas were prioritised and Mātauranga Māori was disrespected. When I joined SfTI, it was such a contrast. The doors were open, we had Māori who were leading, on the board,

advisory, funding dedicated to Vision Mātauranga, and huge projects led by Māori on important Māori kaupapa. And you know, that was a real game changer, it changed the landscape of physics and engineering. It still has a lot of ways to go, but now there are way more of us and it’s growing. That’s how it can work, open the door, invest, have good Māori leaders guiding the process and then grow it. That’s what we need to do in aerospace.”

Participant 1 shared how Māori perspectives can shape the future of aerospace, going beyond the integration of Māori perspectives into frameworks to have a more substantive impact. They stated:

“I’m less interested in how to integrate Māori perspectives into the sector and more interested in how Māori perspectives lead and inform the growth and development of the sector. It’s time for Māori perspectives to not just be integrated but to lead the way in shaping the aerospace sector’s future.”

Participants also talked about how Māori can bring different approaches, skills, viewpoints, and knowledge to the aerospace sector. Some participants involved in the research sector said they have been battling the incorrect perception for many years that Māori knowledge (mātauranga Māori) wasn’t science.

As Dr. Pauline Harris states:

“One of the key issues is that some non-Māori individuals believe they are experts in Mātauranga and claim that we

don't have any science. This is simply not true. We see Māori science all the time, from Māori astronomy to maramataka, ecological and environmental knowledge, forms of categorisations, taxonomy, understandings of interspecies relationships, observations and changes in biological systems, climate change, weather predictions, and many more. We have a lot of upcoming projects, research ideas, and frameworks in the pipeline, many of which are aerospace related.”

Participants have described how the science system has become more inclusive in recent times; as described above, with the establishment of the National Science Challenges and the development of some of the Centres of Research Excellence, we are seeing greater Māori participation in the science sector than ever before, both in research and leadership. This has created a significant opportunity for Māori to explore and create new knowledge, technology, and innovation. This change has been influenced by strong Māori leadership across the entire system. Through their guidance and leadership, new opportunities have been created, and previously closed doors have opened further. As entrepreneur Graeme Everton stated:

“So, my passion in this industry is again, we can be leaders in this space; we can bring new thinking; bring new opportunity, new skills. So, I am passionate about it because of the opportunity.”

Dr. Harris also spoke of the opportunity and how leadership is key to growing the sector. She said:

“There is a vast opportunity for Māori in this space, technical and non-technical leadership, business and entrepreneurial; our limit is only our vision to our own mind's horizon, we need to support this and nurture this potential. We need investment into programmes that grow capacity and capability and support entrepreneurs and innovators; this proper support will realise Māori potential. We saw how it worked in the NSC's and some of the COREs, it's a no brainer.”

At an international level, Dr. Lisa Brown, a space medicine expert from Kāi Tahu who has worked in the aerospace sector for several years, emphasised the need for Māori and Indigenous peoples to have a seat at the global decision-making table. Discussions have already taken place at United Nations meetings regarding the inclusion of Indigenous perspectives, participation, and leadership in space-related decisions.

Dr. Brown shared how Māori can lead in this space and be an exemplar globally:

“I think we can lead the world in the Indigenous use of space and space industry. We have so many people interested in the work that our group has done, that we can really lead other Indigenous groups around the world that maybe don't feel that they have a voice. New Zealand is an integral part of the space industry and we should definitely have a seat at the table.”

Coupled with a rapidly growing interest from Indigenous peoples to engage with and participate in the aerospace sector, there is a growing need for their voices to be included in shaping and guiding the future of this industry.

Indigenous participation in discussions, decision-making, and development will be essential in ensuring a more inclusive and representative aerospace sector, both nationally and internationally.

Leo Watson, an Indigenous rights lawyer described how the values and principles resonate at international levels:

... these [values and principles] are actually already resonant in international law, incorporated in treaties and conventions that explicitly provide for self-determination and rights of indigenous peoples and their traditional knowledge. This is applicable to aerospace and outer space, but also in the wider context of indigenous rights. The challenge now is to apply those principles and values to action.

He continues to describe the actions that need to manifest in order for Māori to fully participate and flourish in the sector and to give effect to those principles and values:

For me, it's decision making authority. It's "equity, it's sustainability, it's free and prior informed consent of the use of the resource or use of mātauranga (traditional knowledge) associated with the resource... its access to benefit sharing. It's active participation in international fora where the space resource is being regulated."

In order to be at the table in decision making, the door has to be open. Representatives from the Māori working group on aerospace (MWGoA) have begun conversations and collaborations with international organisations such as NASA, sharing perspectives and viewpoints on space. Nationally in Aotearoa the Māori working group

have stated that they are open to discussions with the current government and are awaiting their response. Meanwhile as Māori continue to advance and grow into the aerospace sector, they are forming an international Indigenous network in aerospace, working with Indigenous people in the US, Canada, the Pacific and here in Aotearoa.



STS-116 astronauts Michael S. Curbeam Jr. and Christer Fuglesang work together on the S1 Truss during their first spacewalk (EVA 1) to assemble and maintain the International Space Station.

Māori Economy, Business, and Entrepreneurship

The Māori economy has an approximate net worth of around \$70 billion dollars (Los'e, 2022) and is growing fast. Most of its investments are in primary industries such as forestry and agriculture. However, in recent years there has been an increasing interest in the technology and innovation space. This growth includes innovative techniques in agriculture and farming as well as interest in the larger innovation sector (McAleer, 2021), with some seeing this space as potential for sites of investment for Māori. A prominent example in the aerospace sector is Tāwhaki National Aerospace Centre (Tāwhaki, n.d.), with goals to rejuvenate the whenua at

Kaitorete Spit and to develop a world class aerospace facility.

Over the past decade, we have witnessed significant growth in the digital and technology sector for Māori. This was evident at the recent New Zealand Hi-Tech Awards (n.d.), where several Māori companies were recognized for their excellence. The Hapori Matihiko Awards (Te Hapori Matihiko, 2024) further highlighted this success by celebrating the achievements of many high-calibre Māori companies and organisations in the digital tech space.

This surge in Māori-led companies can be attributed not only to the hard work and dedication of their founders but also to the support provided by key organisations and institutions such as Te Hāpori Matihiko, Te Huarahi Tika Trust, and Te Matarau—the Māori Tech Association, as well as the many groups, mentors, training facilities, whānau, and iwi that contribute to their growth.



STS-116 astronauts Michael S. Curbeam Jr. and Christer Fuglesang collaborate on the S1 Truss during their first spacewalk (EVA 1) to support the International Space Station assembly.

This collaborative effort showcases how manaakitanga (the act of care and hospitality) and strategic investment can foster new and emerging sectors. It aligns with the concept of the Manaaki Economy, a term coined by Mr. Te Atawhai Tibble (Ngāti Raukawa, Tūwharetoa, Ngāti Porou) at the Ara Ake conference, 2024, which describes a model where economic success is achieved through the core value of manaakitanga. As we explore how we would develop a Māori aerospace sector, it is essential for us to understand what we would consider as part of the industry.

Entrepreneur Graeme Everton emphasised the need for a broader perspective when defining the aerospace sector. He explained that the industry encompasses much more than just engineering and science. To get people and technology into space, a wide range of industries must be involved — from those producing food and materials for space technology to the companies creating clothing and living environments for space travel. Everton highlighted areas where Māori already have strengths and identified potential opportunities for Māori to expand and innovate these strengths within the aerospace sector. He also stressed the importance of leaving room for new ideas, innovation, and the development of future Māori entrepreneurs.

He stated:

“I think when we talk about the space industry, we may perceive the space industry to be space right, about rockets or about survival in, you know, inhospitable places or landing things on planets. I think what we may forget is, there’s a lot that goes into a space industry or into a space mission that isn’t necessarily grounded in space, it’s

grounded on the ground. So, astronauts still need to be fed; computers still need to work. So, a lot of the technology aspects, a lot of the advance in technology is based on the ground but utilised in space.”

He continued:

“So I think as soon as we recognise that the space industry isn’t exclusive to people who jump on rockets, or isn’t exclusive to people that are highly, you know, academic and we actually start to realise there’s quite a lot of function to space, when people that may be may not see themselves as space people, actually are quite relevant in the space sector.”

“It’s all the components that make it work. Just as we have at the Marae, the importance of those who work in the kitchen in the back whilst we have our hui in the front, to those that grow the food, that install the heating, that build the infrastructure, to those that ensure that the correct tikanga and kawa are upheld. The aerospace sector is much bigger than just engineers and scientists and we need to think about it in that sense.”

Everton emphasised that Māori are active across a wide range of sectors, and it’s crucial to consider where Māori are currently, and could potentially be, in the aerospace industry. He highlighted that Māori are specialists in the food and agriculture sectors, experts in long-distance voyaging, and have notable expertise in medicine and engineering. Additionally, Māori are now owners of aerospace launch sites.

He stressed the importance of understanding the existing landscape and building on these strengths to create new opportunities for Māori interested in pursuing careers in aerospace.

Iwi Investment

Many participants referred to Māori development, economic growth, and social progress as well as Māori values and principles as fundamental lenses for decision-making when discussing investment. Expert strategist and tech entrepreneur Mahi Paurini (Raukawa, Tūwharetoa) highlighted the significant opportunities for iwi to invest in innovation and the aerospace sector, given their large asset base. He emphasised the need for iwi to explore how tech and innovation in aerospace could enhance existing investment areas. He stated:

“We are heavily invested in land development. We’re also invested in natural resources. We tend not to take many risks when it comes to investment. So, you’ll see our tribes invest in housing, commercial property, fisheries, land development, and dairy. Some, like the central plateau, invest in energy. Some are world experts in how they invest in those sectors.”

He continued by stating that these traditional investment pillars serve as the foundation for growing assets, but suggested that iwi should now consider innovation from the aerospace sector to enhance these areas. As mentioned previously, many technologies developed for space have been used in other industries (NASA, n.d.a). Mahi Paurini continued with:

“...one obvious one is the type of investment that has been done in the drone work, or the drone investment. What does that mean for aerospace? But you know, drones is also a major accelerant for other industries like horticulture, agriculture, and agribusiness, and leans into so many different sectors, right? Drones are part of the mobility sector, like space, is part of the mobility. And when you talk about mobility, you talk about all the different tangents of mobility in terms of transport, logistics, air freight, air, sea, land travel, all of those types of types of industries can borrow from the innovation from the aerospace sector.”

“Those are our pillars, the foundations we lean on to grow assets. Then, we should look at how to innovate those assets by considering the space sector, especially in terms of research, development, and innovation. These could be easily adopted in sectors we’re already investing in, like agribusiness and fisheries. What are the gaps in these sectors that could benefit from aerospace innovation?”

He further questioned why Māori tribes aren’t more actively involved in managing assets like spectrum and satellites.

“We invest in boats, but let’s get real—what is the new digital fish? What’s the future?”

He further suggested that these future investment opportunities could include satellites, which would align well with the existing telecommunications investments.

Mr. Paurini went on to then pose another critical question about other opportunities, particularly around materials, emphasising both the potential and the importance of ensuring these ventures align with Māori values and principles. He posed the question:

“Where do we [Māori] sit in terms of the value chain?”

He identified three key areas of opportunity for Māori: raw materials, natural resources, and rare minerals—fundamental building blocks of technology and aerospace hardware.

“We as Māori have land and resources. From a cultural perspective, we also have a deep relationship with space through whakapapa. So, when I think about aerospace, where do Māori sit in that value chain? I think we sit at 0.0, right at the beginning—raw materials, natural resources, and rare minerals. These are the foundational building blocks for technology and aerospace. Māori landowners and resource owners provide the raw materials that are processed and manufactured into hardware and software for aerospace.”

Many participants stressed the importance of investment and building relationships. Harry Burkhardt (Ngāti Kuri) underscored the need for Māori to understand the opportunities within the aerospace sector and to foster meaningful partnerships, stating:

“We do have opportunities. And those opportunities lie in how we engage and invest in that sector. We don’t need anybody’s permission to do that. It’s about being close to the opportunity, understanding the nuances, and then

**deciding where to engage and invest.
The first step is building relationships.”**

Digital Technologies and Telecommunications

Māori have been key players in the telecommunications arena for several years. The radio spectrum claims WAI 776, and then later WAI 2224, led by Mrs. Rangiaho Everton and Graeme Everton, sought allocation of spectrum to Māori. Although the Waitangi tribunal found in favour of the 3G spectrum claim, the Government ignored their recommendations. Following the 3G auction, the Government established Te Huarahi Tika Trust and allocated \$5 million to promote Māori participation in ICT (Te Huarahi Tika Trust, n.d.). By 2008, the Trust had secured a 20% shareholding in what is now 2degrees and by 2013 a \$30 million fund called the Ka Hao Fund was allocated to support Māori ICT initiatives, administered by Te Puni Kōkiri (MBIE, 2022). Many agree that investment and support from these funds significantly contributed to the growth of Māori in the digital tech field. In a similar sense, some participants described how support from the Government to boost Māori development in aerospace would enable more Māori to lead in the sector. This would contribute to increased numbers of high-value jobs and companies, in turn contributing to economic growth and well-being, not just for Māori but for Aotearoa New Zealand as a whole.

Mahi Paurini described how Māori are always innovating and adapting in the digital space. As previously detailed, there are a growing number of Māori companies in the digital and tech sector, but we are also seeing how communities are adapting to digital technologies when they experience hazards and natural disasters. Recent disasters saw Māori communities mobilising as

they usually do in times of need. During the major 2023 disasters on the East Coast and in Hawke’s Bay, power and telecommunications infrastructure collapsed. People needed these to establish swift disaster responses. Māori were, as always, at the forefront in establishing communication and emergency hubs.

Mr. Paurini stated:

“So, you saw tribes, some individuals from different hapū and different tribes rally, and then access Starlink satellite capability, so our whanau could communicate with one another and coordinate relief. If that’s not an indicator of the — of what’s required to be a sustainable community and all that kind of jazz, well, then let’s get serious about this stuff. Because we got serious about fish; we got serious about education, and we got serious about social development; we got serious about housing. And we need to be serious about technology.”

Strengthening telecommunications is important not only to Māori but to all of Aotearoa. As Māori expand in the telecommunications sector, aerospace is a key area that this sector can grow into. In order to do this, capacity and capability must be developed so Māori can engage at both economic and technological levels.

Participants also talked about how it is more than the short play for economic prosperity; it’s about the long play that focuses on the opportunities, nurturing them and budding the knowledge so that when Māori are ready, they are better informed. Others are in the

middle of the long game, investing, developing, innovating, and partnering in the aerospace sector through business and research institutes, whilst some are at the forefront, researching and innovating at the coalface of the aerospace sector.

Many of the participants described how Māori needed to be part of the aerospace sector from the beginning. Harry Burkhardt stated:

“It’s like any sector, if you’re in the beginning stages of its evolution, you have more chances of crystallising opportunities as a shape as you move forward. So, you know, I’m not thinking about firing rockets into the sky, I’m not thinking about the specific skill sets that are required to advance space knowledge. Or more thinking about how might we use technical technological step change to create a database or insights, programmes that allow you to think a bit differently around resources, relationship, and responsibilities. They require us as Māori to respond in terms of our obligations as tangata whenua.”

Capacity and Capability Development

Māori naturally think long-term and intergenerationally. Māori will often refer to the importance and benefit to their children’s children, often developing intergenerational plans anywhere between 25 to 500 years or longer. Thus, when Māori talk about capacity and capability development, it’s about the long-game and developing Māori in the sector with an intergenerational plan and long-term strategy. One participant described the importance of assessing what and where

Māori capacity and capability is currently in the aerospace sector and the immediate steps needed to take to grow Māori in the sector and to understand where Māori want to go in future.



Discussions at the Aerospace Summit 2024.

The capacity and capability development of Māori to support the growing space and aerospace industry in New Zealand is crucial for fostering diversity and innovation in these fields. Taking a narrower lens where we look predominantly at STEM, statistics from the Tertiary Education Commission reveal a significant gap between Māori and non-Māori enrolment in STEM subjects, highlighting the urgent need for interventions to address this disparity (Harris & Doyle, 2024).

Over the past decade, enrolments of Māori and Pacific students in the Natural and Physical Sciences fields have remained disproportionately low compared to the total enrolments (Harris & Doyle, 2024). Systemic barriers persist, hindering Māori and Pacific individuals' access to and participation in STEMMM (Science, Technology, Engineering, Mathematics and Mātauranga Māori) education.

To bridge this gap, concerted efforts are required to ensure equitable opportunity and outcomes for Māori students in STEMMM fields. Building a robust pipeline starting from seedling STEMMM curiosity in small children, and then to more developed outreach and engagement initiatives for high school students is essential. Inspiring Māori students to explore the opportunities within the space industry and showcasing a flourishing future in this field are crucial to igniting their interest and ambition.

One way to achieve this is through targeted outreach programmes that specifically engage Māori students in STEMMM subjects. These programmes can include interactive workshops, mentorship opportunities, and exposure to real-world applications of STEMMM concepts. Additionally, partnerships between schools, universities, and industry professionals can provide Māori students with valuable insights into potential career paths and opportunities within the space and aerospace industry.

Support programmes and scholarships at the tertiary level play a vital role in enabling ongoing success for Māori students in STEMMM fields. These initiatives provide necessary resources and guidance, ensuring Māori individuals have equal opportunities to pursue and excel in careers such as aerospace. Furthermore, mentorship programmes that pair Māori students with experienced professionals in the field can provide invaluable guidance and support as they navigate their academic and professional journeys.

Role models also play a crucial role in inspiring and empowering Māori individuals to enter a workspace that is predominantly non-Māori. By showcasing successful Māori professionals in the space and aerospace industry, students can see firsthand the possibilities available to them and feel encouraged to pursue their passions.

Additionally, initiatives that highlight the contributions of Māori scientists and researchers to the field can help challenge stereotypes and misconceptions about who belongs in STEM.

In addition to formal education and support programmes, as mentioned previously, there are also community-based initiatives, such as those developed and run by organisations such as the Society of Māori Astronomy Research and Traditions (SMART), Pūhoro STEM Academy (Pūhoro, n.d.), Te Roopu Awhina, and The MacDiarmid Institute's outreach programmes and Discovery Camp. These serve as invaluable resources for inspiring and engaging Māori youth in STEMMM fields. Such initiatives provide hands-on learning experiences, mentorship opportunities, and access to resources and support networks, empowering Māori students to pursue their academic and professional aspirations.

Addressing the underrepresentation of Māori individuals in the space and aerospace industry requires a comprehensive approach that encompasses systemic changes within educational institutions, targeted outreach and engagement initiatives, and community-based support programmes. By leveraging resources and partnerships, we can empower Māori youth to contribute their unique perspectives and talents to the rapidly growing fields of space and aerospace in New Zealand, thereby fostering diversity, innovation, and ensuring equitable opportunity and equal outcomes for all.

Graeme Everton described a need to establish programmes to foster educational research and entrepreneurial initiatives to grow Māori participation and leadership in the aerospace sector.

Inspiring our next generations is hugely important. As Dr. Pauline Harris said:

“We need the curiosity to be sparked in our people when they are young. As an educator, we have been doing educational outreach around science, both western and Māori, and our kids love it. Building the pipeline involves supporting our people both young and old in their educational and entrepreneurial journey”.

Funding needs to be dedicated to developing Māori interests in aerospace research, that is specific to the research interests of Māori, including: Mātauranga Māori, innovation hubs to foster ideas, grow networks and connections, and to develop capability. A Māori aerospace network is currently being established. These networks and initiatives aim to support the development of research programmes and entrepreneurial opportunities that enhance Māori economic value and prepare highly skilled Māori for high-value employment.

“When we are told we are good at something, then we excel. We are good at sport, we excel; we are told we are good at law, we excel, well how about we are good at science and engineering... we will excel.”
Graeme Everton Entrepreneur

Barriers to building capacity and capability

Education was seen as a huge barrier and Māori are still underrepresented in the sciences. A lack of role models, particularly with highly visible ones, was identified as a key challenge. Some participants described how access to education and mentoring for young people is needed. Some described the injustice they experienced when young. Māori

were and still are downtrodden in the education system, where many Māori will describe experiences of being told they weren't good enough or smart enough. Dr. Pauline Harris said in her interview:

“I did have some great teachers at school, particularly my physics and mathematics teacher who were amazing, that helped me get to where I am. But unfortunately, some of my teachers also told me I was stupid and no good for nothing. Mostly I did not listen to those comments but throughout my life this has affected me negatively. Also, it's a really common story you hear from a lot of Māori, this type of negative messaging and nastiness has affected so many Māori. We need to address this and deal with what's been done. We need initiatives that will help those affected like this, be given the opportunity to realise their potential.”

Participant 24 shared their experience in education:

“We grew up in the South Island in Christchurch and it was very, at that time, very racist. And so, it wasn't uncommon for your teachers to also exhibit that, that racism, you know, and they weren't shy about it either. So, off the bat you normally got you know, you were discounted, basically. And they look down on you just because of the colour of your skin and their attitude towards you as if you're never anywhere because you're Māori.”

This participant shared how they performed extremely well and still were confronted with racism in their schooling:

“I performed well at school, I was in the top 8% of the country in exams. I remember going to maths class and my teacher would say, why do you bother showing up? I know you Māori are too dumb for maths. I remember her saying that in front of the class, which really was discouraging and humiliating. So, I actually stopped going to class and failed maths as a result, even though I was good at maths.”

Participant 24 also talked about how there were no pathways shown for a career in STEM when they were younger. They stated:

“No career path, pathways for Māori. They’re usually very specific areas. Usually customer service, hospitality, or trade training. It’s never science, any of the sciences or STEM. And it’s only now later in my life that I’ve gone back to study STEM at university and do programming and computer science. But if I had had those role models, I might have been able to access that a lot earlier.”

Another barrier is also the prejudice against Mātauranga Māori and constant need for Māori to reaffirm or validate Mātauranga Māori as having scientific merit to non-Māori. This is particularly important as Mātauranga Māori is a fundamental element of how many Māori want to develop their objectives within the research and development, education, and outreach sectors. This prejudice can hinder research and development opportunities that would utilise Mātauranga Māori, a pursuit which is unique and innovative. This is also particularly relevant for many of the educational programmes that aim to make aerospace culturally relevant to Māori, to help build and inspire the capacity and capability of Māori in the aerospace

sector but in a Māori way.

The disestablishment of the Curious Minds fund has placed financial strain on several organisations, leading to reduced community engagement efforts. This reduction is impacting the development of STEMMM (Science, Technology, Engineering, Mathematics, and Mātauranga Māori) in Māori communities. Māori have expressed a strong desire for equal opportunities to engage with, develop, and thrive in the aerospace sector, which can ultimately foster Māori-driven technology, innovation, and entrepreneurial initiatives.

Equitable Investment by Government

Many participants made numerous comments about unequal investment. A large amount of investment has been put into research and capacity and capability development in the aerospace sector in Aotearoa (MBIE, 2023b). Criticism by participants centres on the small amount of investment for Māori research interests. Participants state that in order to grow a Māori-led industry, proper investment needs to be made. As described previously, the Māori economy is close to 70 billion dollars (Los’e, 2022; PwC, n.d.) with a growth of interest in the technology and innovation sector.

Māori iwi, hapū, and communities are also developing an interest in the aerospace sector, as are Māori businesses. As described, Māori businesses are experiencing significant growth in the digital and tech sectors. This presents an opportunity to build on this interest and support the development of an aerospace sector. Another key issue discussed was the need for more widespread and equitable distribution of funding. Concerns were raised that funding often goes to the same

recipients, and non-Māori businesses have received more opportunities from the Government compared to Māori businesses. Adequate resources must be allocated to Māori initiatives, research, and projects to ensure the growth of opportunities and development for Māori in the aerospace industry.

Dr. Lisa Brown stated:

“It should be for all, and we should be inclusive and create opportunities for people and I just don’t feel like that’s happening. I think for New Zealand as a small country, with not as much money as other big countries, how will we fund any kind of space research? Whether it will have to come from more private companies, whether we can get more universities on board, and I think because we’re small we have to be more collaborative.”

Current Māori and Iwi Initiatives

Māori aerospace companies are emerging as significant players in the industry, with one poised to become a major leader. This section highlights key initiatives led by Māori and/or iwi. These companies are guided by Māori values, principles, and the integration of mātauranga Māori (Māori knowledge) into their operations.

Tāwhaki National Aerospace Centre

One of the leading Māori space initiatives is Project Tāwhaki, situated near Ōtautahi-Christchurch. Tāwhaki represents a collaboration between the New Zealand Government and the Māori communities of Kaitorete-Wairewa Rūnanga and Te Taumutu Rūnanga. Together, they have

founded the Tāwhaki National Aerospace Centre at Kaitorete. Tāwhaki stands as a globally recognized Indigenous partner poised to enhance initiatives for the revitalization of Kaitorete, aiming to establish itself as the premier national hub for aerospace testing by 2025 (Tāwhaki, n.d.).

This example of Māori vision and innovation in the aerospace sector shows the potential for Māori in the aerospace sector and how proper investment and support from the Government can help develop and grow these initiatives. Tāwhaki aims to support all aspects of aerospace endeavours—from research and development to full-scale operations. This includes providing both the physical and digital infrastructure needed for cutting-edge aerospace, space flight, and launch activities (Tāwhaki, n.d.).

VertiLink

VertiLink has established itself as a growing aerospace company (VertiLink, n.d.). VertiLink is a majority Māori-owned organisation, dedicated to the integration of Advanced Air Mobility (AAM) into New Zealand's aviation system. A key focus of VertiLink's mission is public advocacy for the AAM sector, with a strong commitment to ensuring that Māori interests are effectively represented as the sector develops and matures. It is paramount for VertiLink's directors to ensure that Māori communities are informed about the opportunities that a future modern aviation system can offer, particularly those living in remote communities. To this end, VertiLink has established partnerships with iwi and is conducting research on behalf of the Ministry of Business, Innovation and Employment to understand how Māori can benefit from emerging aviation technologies (VertiLink, n.d.).

Envico

Envico Technologies is a Māori-owned company based in Tauranga, New Zealand, specialising in innovative drone technology for conservation and biosecurity (Envico Technologies Ltd, n.d.). Co-founded by Cameron Baker (Te Rarawa, Tūhoe, Ngāti Kahungunu) and Samuel Vye, the company has developed a comprehensive conservation technology ecosystem. Their solutions include aerial drone baiting, Spitfire smart traps, drone seed pods, and drone thermal imaging, all designed to address invasive pest eradication, protect native wildlife, and regenerate native flora.

In May 2024, Envico was honoured with the Hi-Tech Kamupene Māori o te Tau (Māori Company of the Year) award at the New Zealand Hi-Tech Awards. On the same night, they received a Gold Stevie Award for Project of the Year in the Area of Nature & Biological Diversity in the Philippines (RNZ, 2024b). These accolades recognise their pioneering work in using drone technology for conservation efforts, such as distributing seeds and implementing pest control measures to protect native species. Envico is committed to integrating Māori values and mātauranga Māori into their business (Envico Technologies Ltd, n.d.).

Potential Business Development

There is a significant opportunity for iwi to invest and engage in areas of aerospace. As described before, there are substantial economic opportunities in telecommunications and technology, building on existing strengths and investments. Additionally, participants described the benefits of economic development for iwi. Governance and legal expert Megan McKay (Ngāi Tahu) stated:

“Knowing that the space industry is going to bring an enormous amount of income to New Zealand, we need to position our people to benefit individually and collectively.”

Kaiarataki Deputy Pro-vice Chancellor Māori Michael Steedman (Ngāti Whātua Ōrākei) stated that there's a great opportunity available if iwi want to be part of the launch side of aerospace. In 2022, New Zealand ranked fourth globally in rocket launches, trailing only the United States, China, and Russia (Aerospace New Zealand, n.d.).

“So, the opportunity is not necessarily to slow things down, but to get the relationship stuff right at the beginning... I mean, that's one of the opportunities around launch pad space. I mean, it makes sense that there's some natural partnership that could occur there. But again, it needs to begin with that basis of whanaungatanga underpinned by kaitiakitanga.”

For some, it was about building a better future for their mokopuna, so they can experience the wonders of space.

Participant 31 (Consultant) stated that they are already engaging with rangatahi who are ahead in the thinking around aerospace and the opportunities that it presents to them in terms of real career opportunity. They reflected on a time when:

“A child was looking at a space plane and she pulled at my jacket saying I want to be the first Māori astronaut in space, can you help me do that.”

They also commented on the economic opportunity:

“I just think there's a massive opportunity in this area. For people, for the economic prosperity of who we are. For us, we've been looking at how you transition away from land uses that were inflicted over time to something that could be better, better for our people and planet so I'm all for exploring those opportunities and how we lift people's capability capacity. Open the discussions. Yeah, and have some real key focuses that are going to make an impact.”

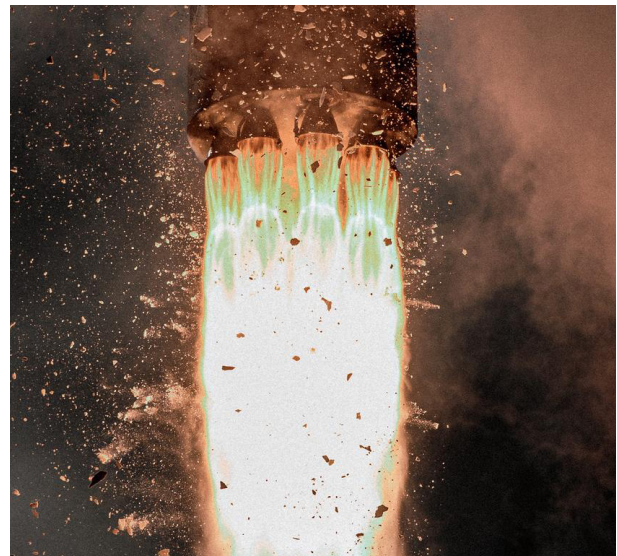
Dr. Lisa Brown also commented that Māori initiatives like Project Tāwhaki would make an excellent space port, enabling new, green innovations to align with their environmental commitment.

“So, I think the value is that space is for all. I do think that we need to think about the cultural heritage of our ancestors looking to space and what that was like, and weaving that through the whole model looking forward. Collaboration within New Zealand, like collaboration between Iwi and the Government in this project is so important. Further collaboration between different industry sectors such as medicine, engineering, physics will enable further initiatives.”

Research and Innovation

Research and Innovation is well known as a driver of economic growth with long term economic benefits. For the Māori economy, we are seeing a fast growth, with a projected 100 billion NZD of assets estimated by 2030

(PwC, n.d.). Māori, as described previously, have investments predominantly in the primary sector, forestry, agriculture, etc. However, with the growing interest by Māori in the Research, Science and Innovation (RSI) area, we ask the question: what could the economic potential be in the Māori RSI sector if supported properly, and how do we support and foster it? As described in the previous section, within the aerospace sector we have seen the development of aerospace centres such as Tāwhaki, which has the potential to be a world class space port and research centre. How do we grow these opportunities and what is needed to develop capacity and capability to ensure the success of these initiatives?



The first stage engines of Rocket Lab's Electron rocket ignite as it lifts off from Launch Complex 1, Pad B, in Māhia, carrying two NASA TROPICS CubeSats designed to study tropical cyclones by measuring microwave frequencies to monitor storm temperature, precipitation, water vapour, and clouds.

The interviews and surveys enquired about Māori capacity and capability in the field. Participants were asked to describe areas that Māori were in, including themselves. A number of areas were described relating to aerospace,

such as astrophysics, computer science, aerospace engineering, physics, law, ethics, architecture, education and space medicine, with many of these people working at aerospace companies around the country and overseas. The top employer was Tāwhaki Aerospace Institute, with the rest working or studying across universities, overseas hospitals, and organisations such as NASA. Based on responses from participants, we estimated there to be around 40-50 Māori working in the industry, with many working at the interface between technology, western science, and Māori science. In addition, an unknown number of Māori work or practice in the Māori GIS network, whilst in the Māori astronomy and maramataka (Māori calendar) space there has been a huge resurgence over the last decade, with growing numbers which are estimated to be in the order of thousands.

Within the research space, we look at the projects and initiatives Māori are leading and researching in the aerospace sector. We include areas primarily in the western science space and those at the interface with the mātauranga Māori-Pūtaiao space (Māori Science).

Examples of projects Māori are involved in researching are:

- Ko Tātai Arorangi hei Kaiarataki i te Ra: Integrating Space-Based Observations into Maramataka project. This is a feasibility study focused on collaboration with NASA to integrate space-based earth observations with the traditional Māori calendar system, the maramataka. This project aims to help Māori communities monitor environmental changes like coastal erosion and climate variations using satellite data and advanced analytics (Massey News, 2024; MBIE, n.d.b).
- Space systems involves developing systems for managing an international network of optical ground stations for large volume data transfer between Earth and space.
- Aerospace engineering focuses on spacecraft systems, including life support, and the design of systems for missions aiming to explore beyond Earth's orbit, including Mars.
- Aerospace medicine involves research investigating how the human body reacts in space environments, particularly microgravity and feasibility of surgical procedures in space and how long-duration space missions impact human health.
- Māori Space Strategy involves research that investigates how Māori values, principles, and perspectives are embedded in the sector and promotes Māori participation in RS&I, education, policy, and entrepreneurship while emphasising a respectful relationship with space as a taonga (treasure) and honouring Te Tiriti o Waitangi.
- The Tāwhaki National Aerospace Centre, located at Kaitorete Spit near Christchurch, is a cutting-edge facility aimed at advancing both the country's aerospace industry and environmental stewardship (RNZ, 2024a). The site is strategically positioned to support space launches and advanced aviation, with both domestic and international companies already utilising the centre to develop groundbreaking aerospace technologies. Tāwhaki integrates Indigenous knowledge (mātauranga Māori) with modern aerospace innovation (Tāwhaki, n.d.).

- The Māori GIS network utilises geospatial technologies and accessing satellite data to help Māori communities map land and cultural sites, supporting environmental monitoring and resource management.
- The Māori Aerospace network is in early development to establish a network of Māori involved or interested in the aerospace sector. Membership interest has reached at least 50 people. An aerospace network is currently being developed. Participants described the importance of these sorts of networks and the wider discussion with other Indigenous peoples. In order to do this, key partnerships need to be developed.
- Indigenous Aerospace network discussions have been had with Indigenous peoples, led by Aotearoa's Māori Working Group on Aerospace with Indigenous peoples, from Hawaii, Canada, US, and the Pacific to establish a network. The formation of the group has begun, with first meetings to be held in early 2025.
- Indigenous Conference on Aerospace discussing Indigenous aerospace perspectives is currently being planned for late 2025.

The breadth of activity and engagement has been described here. In order to develop and support Māori in the aerospace sector it is essential that Māori and other Indigenous peoples come together to discuss matters of importance regarding aerospace.

Relationships and International Collaboration

Relationships are essential for fostering collaboration in the aerospace sector. Through collaboration, organisations gain access to

expertise, technology, and diverse knowledge, as well as ethical approaches and frameworks. There is growing interest from international aerospace organisations to engage with Indigenous peoples such as NASA. For some, this is driven by goals of inclusivity and equity, while others focus on integrating ethical considerations into aerospace development.

Some participants in Aotearoa expressed concerns that the aerospace industry may not view Māori as key stakeholders, assuming that Māori lack a connection to space. However, the opposite is true—Māori have a profound relationship with the cosmos, and this presents an opportunity for meaningful partnerships with companies and organisations. These collaborations could foster shared objectives, including educational opportunities and advancements in aerospace.

Additionally, there is a growing opportunity for Māori to connect with other Indigenous peoples globally. Several discussions and publications have emerged from Indigenous communities regarding aerospace, offering both criticisms of certain practices and recognition of opportunities for growth and leadership in the sector (Neilson & Ćirković, 2021).

Dr. Pauline Harris stated:

“It’s a great opportunity for us to gather as Indigenous peoples to discuss matters around Indigenous opportunities and issues around aerospace and Indigenous knowledge. We have already started reaching out to meet with other Indigenous people to discuss these matters.”

Participants emphasised that funding is essential to support these efforts, forge new relationships, and collaborate with other Indigenous peoples,

space entities, and companies. As with all new partnerships, gatherings such as hui, wānanga, and talanoa are necessary to bring people together and discuss shared goals, aspirations, and efforts. As described earlier, the MWGA is developing relationships with Indigenous peoples in the Pacific, the USA, and Canada.

As Dr. Harris stated:

“We are really excited about building a Māori aerospace sector, but we want to do it right with the right tikanga to guide us.”

Many participants agreed on the opportunity to collaborate with other Indigenous nations, as discussed previously. Some nations, such as the Navajo, are observing the development of the aerospace sector globally, and with Indigenous astronauts already pioneering this field, there is growing interest in forming alliances to amplify Indigenous voices and strategies in aerospace. This sentiment has been echoed in meetings at the UN, which have supported the inclusion of Indigenous voices in discussions on the use of outer space (United Nations, 2023, p. 18).

Participants also highlighted the importance of connecting with institutions like NASA, ESA, and private companies. Delegations of Māori have begun engaging with these entities, with more collaboration expected.

For the project listed previously (Ko Tātai Arorangi hei Kaiarataki i te Ra: Integrating Space-Based Observations into Maramataka) one of the MBIE-NASA Catalyst funded projects is currently collaborating with the Indigenous Peoples Initiative (IPI) at NASA. This and other meetings with NASA leadership have begun, and there is huge interest in Māori and Indigenous perspectives on space as a primary discussion point. Participants have

stated that this project is a game changer and has opened up a huge opportunity for Māori.

As Participant 9 stated, key partnerships are critical in the development of an aerospace sector:

“So, locally, we need to develop laws to protect the use of space. And that would come from the Government, but we should be actively involved with all those decisions and that law-making. We also need to be involved internationally, such as when signing treaties on space. And with that, we need to be involved with the partnerships for space exploration, in terms of agency level, and at the moment, we’re just, we’re not.”

Graeme Everton discussed the radio spectrum and how it took 20 years to get traction and action, whereby real benefits to Māori are now being seen. Internationally, the radio spectrum has a growing interest within Indigenous communities. He said:

“Our other biggest opportunity is to work with other Indigenous communities. Canada, US, big players, you know?”

He continued:

“There’s a lot more Indigenous people actually in the space sector, and we had two, we’ve got two people who have indicated themselves as Indigenous First Nations from the US that have been into space, or are going into space. You know, so they’re a bit further ahead. So, we can join a bigger community, whereas we haven’t been able to join a bigger

community when it comes to the radio spectrum, even though it is a global thing. So, we won't be alone if we build an international community of Indigenous space experts who can have a voice that represents what it is, 100 and, 380 million voices, you know, Indigenous people.”

“So I think that's the critical part, right now is to start building the ability to coordinate both internally with Indigenous people, Māori, but then also doing that in a global sense. I think our statement as Indigenous people as we go into space, we have to be honest brokers, it's not going to be about – it's not all going to be about money, right? It's not going to be about a \$3.2 billion rocket industry called Rocket Labs. It's going to be a whole lot of small Māori communities contributing to this bigger goal that we have in mind. But in doing so, there's so much value given back. Jobs, new ways of doing things. So, I want us to commit to it, and I want us to believe in it as a mission. I want us to set some big goals. But constantly making sure that it doesn't just end up in the hands of a few, but is constantly being, creating a base capability. I think if that is done really well, and when I talk about doing things differently, you know, the way that we approach, the way, the things we put emphasis on.”

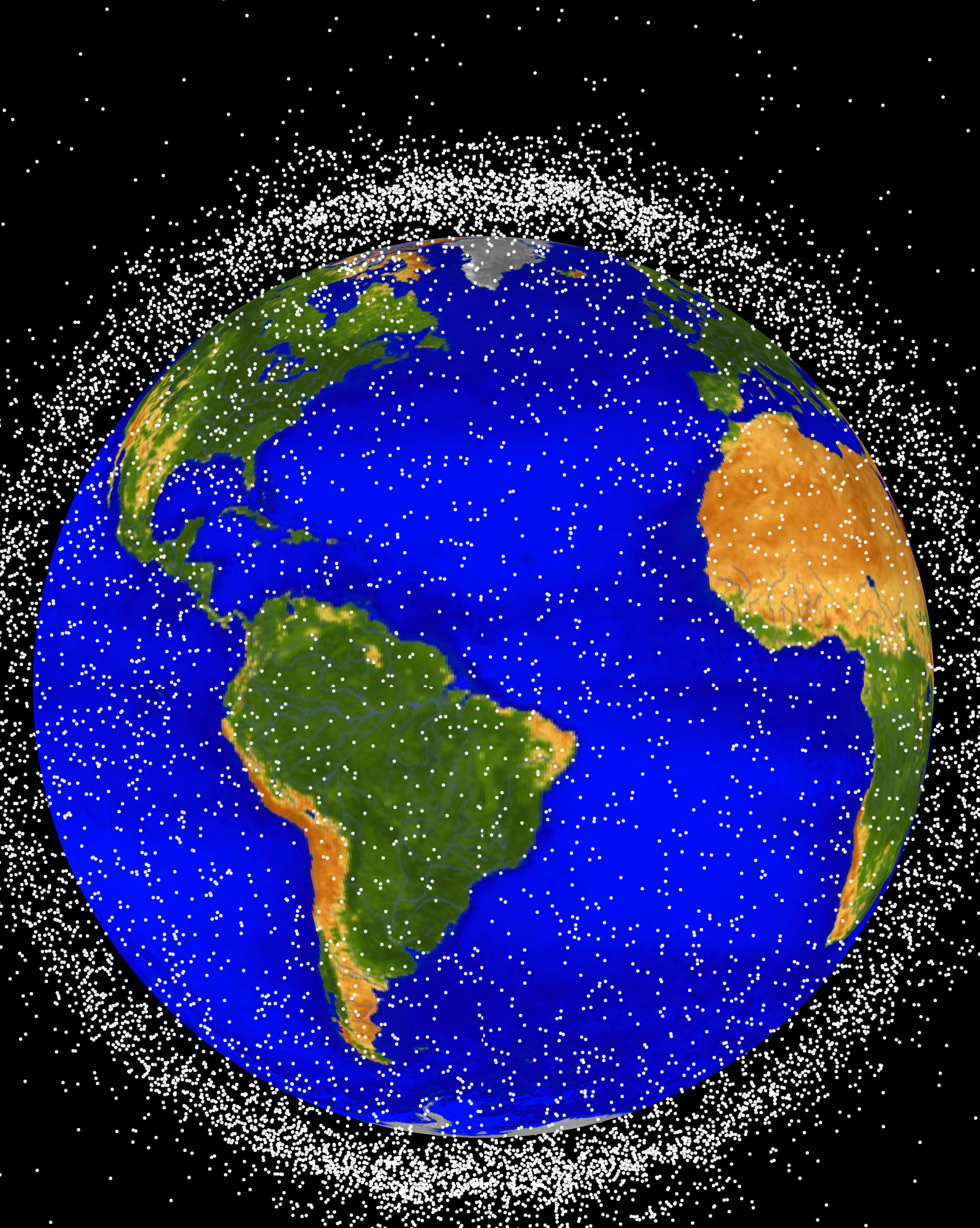
Fostering strong relationships and international collaborations is pivotal for the growth of the Māori aerospace sector. By working together with Indigenous communities and global aerospace organisations, Māori can ensure their

perspectives are integral to shaping the future of space exploration, benefiting not only their communities but also contributing to a more inclusive and sustainable, global aerospace industry.

This section focused on Māori aims, aspirations, and opportunities in the aerospace sector. There is a strong desire among Māori to lead and innovate in this rapidly evolving industry, ensuring that their unique perspectives and values guide the development of aerospace technologies and policies. Through meaningful engagement and collaboration with both national and international partners, Māori seek to create educational and entrepreneurial opportunities, foster technological advancements, and secure high-value jobs for their communities. By integrating mātauranga Māori, they aim to establish a sustainable and inclusive aerospace sector that benefits both Indigenous and global communities.



X-rays stream from the Sun's west limb in this first image captured by NASA's NuSTAR, overlaid on a photo taken by the Solar Dynamics Observatory (SDO).



Orbital debris encircling Earth — millions of fragments from discarded satellites and rocket parts — that contribute to growing space environment pollution, increasing collision risks and threatening the sustainability of space activities.

Issues and Concerns

The aerospace industry's rapid growth has seen the development of large technological and innovative leaps. These leaps have provided advancement in high-speed telecommunication and connectivity, high-speed travel, deeper insights into the universe, and much more. These advances, however, have come with many issues and concerns from the general public including, but not limited to, its impact on pollution, including carbon emissions, space debris, resource consumption, military use, noise pollution, and cost (The University of Auckland, 2024). For example, the aviation sector alone is one of the largest contributors to CO₂ emissions, making up more than 2% of the overall greenhouse emissions contributing to global warming (Ritchie, 2024).

Māori share many of these same issues and concerns, but also have additional ones that stem from Māori cultural understandings, beliefs, philosophies, and experiences. These unique viewpoints are often shared by other Indigenous peoples who also have many of the same underlying cultural understandings. The main issues and concerns in the aerospace sector that participants described include, but are not limited to: (full list in the executive summary)

- Pollution, space junk and falling debris
- Responsible use of space
- Mining
- Military use of space
- Abuse of policy and procedure
- Non-inclusion of Māori in decision-making
- Representation inequity
- Funding inequity
- Educational inequity
- Lack of acknowledgement of Te Tiriti o Waitangi

We start here with a reminder about kaitiakitanga and its relevance to aerospace, as many of the aspects above are linked to kaitiakitanga.

Kaitiakitanga Protecting Ranginui and Papatūānuku

Throughout the interviews and survey, nearly all participants described the importance of protecting and looking after Ranginui and Papatūānuku and other atua of aerospace. The main concern is around the health and wellbeing of these atua and the impacts on current and future generations. As described previously, in Māori cosmology, Māori whakapapa to these atua and there is a deep understanding of the relationship between Māori and the natural world. When Māori talk about their role to care for the natural world, the concept surrounding that is kaitiakitanga. Used and described regularly in the political and environmental sphere in Aotearoa, kaitiakitanga is translated simplistically as guardianship and linked to sustainability. For Māori, however, the depth of the concept of kaitiakitanga is based on the whakapapa in which Māori are direct descendants or related to these atua. This deeper understanding means that often kaitiakitanga is not understood properly and is lost in translation. For our description here, kaitiakitanga encapsulates the roles and responsibility of Māori to care for and protect the environment based on the genealogical links through whakapapa relating all Māori to Papatūānuku Earth mother, Ranginui Sky Father, and all animals, rivers, lakes, mountains, space, stars, planets; that is, everything in the universe. All participants described aspects of this relationship and the importance of it.

Space Junk and Debris

One of the main concerns is pollution and space debris, including debris that is falling to Papatūānuku and onto other celestial objects/beings. With over 25,000 objects of space junk larger than 10cm (ARES, n.d.), the monitoring of such objects is a significant concern to many. This is in contrast to the estimated 10,400 active payloads in space (Space-Track, n.d.). Currently the disposal of objects relies on deorbiting them in a controlled manner whilst the rest is left in space to eventually deorbit accidentally and hopefully burn up on re-entry. Space junk has also become problematic. For example, in 2022 a three-tonne rocket part travelling at 8,000 km/hour hit the moon (BBC, 2022).

For Māori the issues and concerns around space junk and debris centred around the irresponsible disposal of junk, disrespect to Marama (the moon), and the safety issues in general around unknown, untracked, uncontrolled, and unclaimed space debris. In the example of the three-tonne rocket hitting the moon, no responsibility was claimed and the object's origin is still unknown. Some participants described how there need to be policies and processes that ensure the safe and responsible use of space, disposal and/or deorbit of spacecraft, and a more robust criteria for what is allowable in space.

Although international policies exist such as the Artemis Accords (NASA, 2020) and nationally here in Aotearoa with the Orbital Debris Mitigation Plan (ODMP) (MBIE, 2023a), there is concern that Indigenous, including Māori, perspectives, values, and principles have not been included in the design of these policies. Concern was also expressed with the fact that at the

international level these agreements are not binding and rely on good faith.

Another issue that has arisen is what is appropriate to take into and leave in space. In 2024, attempts to take human remains to the moon by a private company raised huge concern for some Indigenous peoples. Both Māori experts and the Navajo nation President Buu Nygren were highly critical of this. President Nygren stated in an open letter to NASA and the U.S. Department of Transportation (DOT) (Navajo Nation, 2023) that:

“We view it [the moon] as a part of our spiritual heritage” with them regarding the moon as “an object of reverence and respect.” In the letter President Nygren states that landing human remains on the moon is “tantamount to desecration of this sacred space.”

Similarly, some participants had much concern about this type of activity, referring also to the sacredness of the Moon and this being an unethical use of space. In 1999, NASA had an agreement with the Navajo Nation to inform them on activity around human remains going into space after astrogeologist Eugen Shoemaker's cremains were purposely crashed onto the moon, leading to concerns being expressed by the Navajo Nation. NASA, in this more recent case, stated that since this was a private company venture, they had no say over what activities the company was conducting. However, NASA agreed that there was a need for discussion around the matter and that a meeting would be held regarding this (Grossman, 2024). The mission by the private space company ended up failing and has now burnt up in the earth's atmosphere.

Another example of unnecessary use of space is the disco ball-like object that was taken into space by a New Zealand-based company. This was highly criticised by many people in and outside the scientific community, noting that unlike other satellites it had no scientific or civil purpose (Crane, 2018). Others in the general public stated it was indulgent and wasteful.



Hubble reveals heavy-metal stars in the 10.5-billion-year-old globular cluster NGC 6496, located 35,000 light-years away in Scorpius. Rich in elements heavier than hydrogen and helium, the cluster hosts variable stars whose changing brightness helps astronomers study their properties and evolution. Discovered in 1826 by James Dunlop, NGC 6496 offers unique insights into stellar life cycles.

Professor Hēmi Whaanga
(Ngāi Tahu, Ngāti Kahungunu) stated:

“People are going to come up with different ideas on how to use space and particular types of use in different scenarios on what they want to do, whether it be for the environment or whether it be for monitoring or whether it be even for financial gain.”

He continued to describe the need for tikanga and protocols to be determined on what, why, how things go into space, how they stay there, and/or how they are returned. Tikanga, as described earlier, guides us on what is tika and what is pono. From a Māori perspective in the aerospace sector, Professor Whaanga describes that from the very material we get to build the

rockets and the components all the way to launching and cleaning up, we need protocols and rituals to do all those things:

“Like we have to consider this as well in terms of where we gather those materials to create those rockets, to create the satellites from and have a particular ceremony associated with the gathering, the construction, with how we interact with that tool, rocket, or whatever, that system, and then how we send it into Rangi, another one of our atua, our parents, and then how we bring it back safely, or do we leave it up there? All that needs to be discussed. And then just some sort of, you know, some sort of procedure or protocol, or regulate the way that we do things in that route.”

Some participants said that although they wouldn't like to see the policing of polluters in space, there was a strong expression for accountability on what goes into space and for what purpose. As participant 32 expressed:

“Just because the limits of Space are unknown, its value as a taonga is significant. Let's be respectful in the journey of understanding and valuing space and what it has to offer.”

Pollution

As mentioned previously, pollution from CO₂ emissions and other pollutants are a key concern. International agreements established by the United Nations Framework Convention on Climate Change (UNFCCC) to reduce the dangerous impact humans were having on our climate, saw the establishment of the Kyoto Protocol in 1997 that was later superseded by the Paris Agreement in 2016

(UNFCCC, n.d.). These agreements are to ensure that nations are actively attempting to reduce their carbon and greenhouse emissions to limit climate warming to two degrees. Other pollutants such as nitrous oxides and particulates from exhausts are also of concern. Research and innovation into electrification of alternatives or more efficient fuels is an ongoing area of development, whilst others call for a reduction in activity as a solution. There is, however, no decline and only an increase in activity being observed. For participants, this concern means that further discussions are needed to address this issue and for solutions to be developed with Māori and other Indigenous peoples. Climate change experts to date are only starting to discuss the impact of aerospace from a climate change perspective. The impacts of climate change on Māori were recently reported in a notable piece of work by the Māori Climate Change group led by Ngā Pae o te Maramatanga which summarises the health, economic, environmental and ecological, and cultural impacts from climate change called: He huringa āhuarangi, he huringa ao: a changing climate, a changing world. Aerospace did not feature in the report, however this report can provide a lens from a te Ao Māori perspective when discussing aerospace (Landcare Research, 2021).

Mining

The aerospace sector consumes substantial amounts of materials and energy and requires significant infrastructure, such as laboratories, testing facilities, spacecraft and rockets, as well as the fuels that enable the transport of these craft into space (NASA, n.d.b; Monteiro et al., 2022). As described previously, as an opportunity, there were also significant concerns expressed around how

many materials and resources are used and how they are extracted. In particular there is concern around mining here on Papatūānuku and also in space. In a practical sense, mining will be required if space travel to other planets and exploration is done, but how it is done is something that Māori want to be guided by Māori and Indigenous values and principles that align with sustainability and kaitiakitanga. As described within the Māori Space Strategy 2023 - 2028 (The Māori Working Group on Aerospace, 2023):

“Mineral extraction and resource use in space is to be guided by ethical and sustainable parameters. Decisions are exercised in a manner that provides for the cultural, social and economic well-being of whānau, hapū, and iwi.”

One participant points out that we need to ensure that both the land below and sky above are be treated with respect in the same way as they are both taonga. Participant 34 said:

“Kaitiaki responsibilities ensure humans have tikanga that promote restoration and do not compromise our atmosphere through poor, selfish decisions. I believe the space above the whenua should be treated the same as the whenua. This is because the whenua is directly affected by what goes on above it. Since whenua is a taonga in the eyes of Te Tiriti, then so should space.”

Impacts of Aerospace on Community

One of the primary concerns has been the establishment of aerospace companies within Māori communities. Key issues raised include environmental impacts, sustainability, and a lack of transparency in decision-making processes. Environmental concerns, as previously

mentioned, focus on chemical and noise pollution from rockets and aircraft. Participants also criticised the quality and transparency of environmental impact assessments, questioning both how they were conducted and by whom. Human health and safety were significant concerns as well. Some communities highlighted issues surrounding exclusion zones created by aerospace activities, which restrict fishing and access to land. This has been a major point of contention, as it underscores a cultural divide that has not been properly considered. For instance, when a *rāhui* (a traditional Māori prohibition) is in place, it should take precedence over all other activities in the area.



Floating at the centre of this new Hubble image is a lidless purple eye, staring back at us through space. This ethereal object, nicknamed SBW1, is a nebula with a giant star at its centre. The star was originally twenty times more massive than our Sun, and is now encased in a swirling ring of purple gas — the remains of the distant era when it cast off its outer layers via violent pulsations and winds.

Additionally, the need for *whānau* (families) to obtain permits and carry identification to access their ancestral land has caused frustration. These restrictions have disrupted *mahinga kai* (traditional food gathering) practices, forcing them to occur during less optimal or higher-risk times. According to participants, this has even

led to accidents. Concerns about animal welfare were also raised, with some participants noting that noise from aerospace activities may have harmful effects on animals.

Participants also voiced concerns about the processes for obtaining consents, expressing that the fast-tracking of approvals lacked transparency. Some felt that consultation processes were mishandled or misrepresented when companies applied for permits. Additionally, several participants were concerned that the scale of aerospace activities in their areas may exceed what was initially presented in community meetings, creating anxiety about the long-term impact on their communities.

Participant 6 remarked:

“But we don’t even know that; so, where’s our obligation to the Treaty as Treaty partners to be able to have a say in that? We’ve had absolutely no say—it’s all the Government. That’s what gets me: we’re exploited, and we’re vulnerable. And it’s on Māori whenua, so how do you pass that? How do you make that law, when we can’t even get *papakāinga* homes? It’s so tied up for us to be able to make our own whenua into *papakāinga*. We’ve got to jump through hoops to do that. But you could put a corporate company on a piece of Māori land. They’ll cut the red tape when it’s something they want.”

Housing pressures have also been an issue in regions where significant aerospace activities are taking place. As new people move into these small communities, participants noted increased strain on housing and

roads. Inequity was another concern, as Government resources were directed toward infrastructure improvements for technologically advanced companies, while locals still struggled to access basic services like power and telecommunications. This imbalance has led to growing frustration within these communities.

Additionally, promises of local economic benefits, such as job creation, have not materialised as expected in these regions. Participants noted that while some jobs were created, many were later outsourced, leaving locals disappointed. Participants also stated that their hopes for economic prosperity have not been fulfilled, with criticism of gestures such as scholarships and other initiatives seen as attempts to create a favourable image rather than be meaningful contributions.

Concerns about the consultation process were also raised. Participant 3 stressed the need for proper consultation to take place before any developments begin, emphasising the importance of clear information to fully understand the risks involved and to respect the mana (authority) of Māori in consultation processes. They remarked:

“I suppose their awareness of the social, cultural, and political landscape they were treading was lacking. There was naivety about who they needed to talk to and consult with. These are issues that need to be addressed in planning or policy documents. What’s the appropriate level of consultation with Māori, with iwi, with hapū, around the land base? If you’re going to have a rocket site, who are you going to talk to? And being aware that once you launch something, it’s going

to travel up and across to reach a particular altitude. I was at a meeting where [company name] went to the [location] and discussed the trajectory of their rockets. There was a very slim chance of them crashing into [location], but even a slim chance is something to consider.”

These meetings, the participant noted, occurred only after the activities had already been established.

Māori voices have been increasingly heated and adamant that some aerospace activities are unwelcome. Criticism, protests, and calls for the removal of certain companies have followed. Participants emphasised the need for policy changes to prevent previous engagement methods from being repeated. They were vocal about the necessity for consultation to be conducted properly, with permits and permissions granted only after significant, meaningful engagement. There was a clear demand for proof that activities were carried out in a manner that is tika and pono (true and correct), with a genuine commitment to honouring Te Tiriti o Waitangi.

Military Involvement

There have been significant concerns regarding military involvement in the Aotearoa New Zealand aerospace sector, expressed by both Māori and non-Māori communities. Military links have been the focus of protests in Mahia, Auckland, and Christchurch (1 News, 2021; Neas & Trump, 2021; Black, 2021; Spector, 2019). At the most recent protest during the 2023 Aerospace Summit, serious ethical concerns were raised about the potential for aerospace activities to be repurposed for military applications (Brownlie, 2023).

Calls for transparency have been growing, with

many Māori wanting clarity on the involvement of New Zealand-based companies with military-linked organisations. Similar concerns were echoed in this study. Additionally, some participants expressed fears that their communities could become targets. Even though the aerospace activities are commercial, being labelled as having launch capabilities increases the perceived risks to both the local community and surrounding areas.

Legislation, policy and regulation

Rushed legislation

According to Graeme Everton, a key issue is that legislation put in place when first established set the wrong tone. He said that it was rushed to respond to incoming companies in aerospace and was acting reactively to have the legislation required to cater for the incoming companies. So, this process excluded Māori and missed vital questions as to what it all means for Māori. These “are key questions that needed to be answered at the beginning.

He stated:

I think the legislation that was put in place firstly set the wrong tone. It was rushed.... It didn't allow for the conversation, and a broad conversation about, you know, what does that mean for Māori? What did it mean for Māori? You know, what does this piece of legislation do? ... So, we never got the opportunity to really explore the legislation, and then when the legislation came in, it was very difficult to have that retrospective conversation.”

Everton goes on to say that the space agency itself has been incredibly closed to conversation about the aspects of Māori and Te Tiriti in it. The 2023 iteration of the aerospace strategy talked

about Māori as a stakeholder group, not a Treaty partner and once again failed to recognise the Treaty relationship with Māori.

Within the 2024 version of the Space and Advanced Aviation Strategy (MBIE, 2024), all references to Māori, Iwi and Te Tiriti o Waitangi were entirely removed; this shows the worsening extent of not recognising the Treaty relationship with Māori.

Payloads

Concerns around government meetings have been expressed, with Māori expressing they want to know about what payloads are being launched into space. They said that, as a true “Treaty partner, we have the right to know what is being launched. Participant 6 recalled saying to government officials:

I'd like a Māori voice or a Māori panel or some other Māori panel to have a Māori perspective, because you've got the Government's, but then you're speaking on behalf of us. And under the Treaty, if you were really abiding by the Treaty, like you say you are and all that, then you would ensure that we had a voice and could see it have the same voice that you have?”

International Regulation

Another issue is the considerable international compliance required by various treaties, regulations, and standards set by international organisations. Alongside powerful companies, participants expressed that this poses a challenge for Māori, as they must engage with numerous influential players in the sector. This further complicates the ability for Māori to have their voices heard at the decision-making table. Participant 18 said:

“And there’s international compliance, legislation, regulations from different governments, that’s always the same, we have problems dealing with one government with multiple silos. You’ve got an industry, which has got so many different governments involved with their various agendas as well.”

“A key challenge is that aerospace involves a lot of different international stakeholders, governments and powerful companies. A challenge for us is how do we negotiate this space as tangata whenua. When powerful companies are at play who can throw their weight around.”

Government Capability

Government legislation and regulation in the aerospace sector have faced challenges, particularly in terms of the Government’s capacity and expertise related to space. Intergovernmental coordination on space issues is generally insufficient, potentially due to a lack of resources or specialised knowledge. While other government agencies have more effective processes for engaging with Māori, there is room for improvement in the space sector’s capacity for meaningful Māori engagement. Other sectors have made progress in integrating te ao Māori and tikanga Māori, but as redundancies increase in Wellington, concerns are growing that these challenges may worsen in the future. Everton stated that relationships with companies can be more straightforward if they see benefits. However, with the Crown, there are more hurdles to develop relationships. According to the Māori Working Group on Aerospace, they were held in a holding pattern for a long time. Māori have potential to help grow the

sector but need support to help develop it; this is afforded to other industry players. As Graeme Everton said:

“We want to be and are leaders, advocates, excelling as pioneers, all whilst using our unique Mātauranga Māori.”

International Inclusion

As previously mentioned, there are ongoing international discussions about Indigenous inclusion in the aerospace sector, with concerns being raised about the lack of Indigenous representation in major aerospace decision-making. The United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) (2007) highlights the rights of Indigenous peoples to self-determination, equality, and protection from discrimination. Neilson and Ćirković (2021) emphasise the importance of Indigenous rights and treaties in shaping space law and policy. Finnegan (2022) also discusses the impact of satellites and mega-constellations on Indigenous astronomy. These concerns echo many of those of the participants, such as the exclusion of Māori and other Indigenous peoples from critical space law discussions, as in the Artemis Accords. Many in the aerospace sector have called for the inclusion of Indigenous voices and Everton described it as being a missed opportunity for engagement.

“As Everton expressed:

Māori weren’t consulted on the Artemis Accords. There are some interesting things in the Artemis Accords. I would love to have had a policy statement from Māori... it wouldn’t have lessened the value of the Artemis Accords; it would have actually improved it.”

This underscores the growing demand for more inclusive practices in international space law and policy development.

Te Tiriti o Waitangi and Space as a Taonga

One of the most important questions asked was how does aerospace relate to Te Tiriti o Waitangi. For the MWGA, it has been a key focus of discussion. Here we discuss Māori rights and interests in aerospace, discussing space as a taonga, and also Te Tiriti in the private sector.

Māori Rights and Interests

The rights and interests of Māori in space and aerospace are a central focus for the Māori Working Group on Aerospace (MWGA). During discussions, participants agreed that Te Tiriti o Waitangi holds significant relevance to space, with most viewing space as a taonga (treasure) protected under Te Tiriti. The key issue raised was how these rights can be properly developed and incorporated into space law and policy.

Concerns were raised about current space legislation, which many felt breached Te Tiriti. Mr Everton highlighted that the regulations are too narrow and fail to recognize the Māori relationship with space. He expressed that this alienates Māori from fully participating in the industry and from developing Mātauranga Māori (traditional knowledge) in this field. He criticised the legislation for being "one-dimensional" and not considering how Māori want to engage with space through their own cultural frameworks.

He stated:

“The legislation itself breaches Te Tiriti. At minimum, it doesn’t recognise within the legislation Māori relationship with space. And there has been very little work since to really, you know, move that conversation along. So, for me, fundamentally, the

industry is based on too-narrow Treaty breaching regulation and concepts, which is both alienating Māori from, you know, being able to participate fully in the industry. And it’s just one-dimensional in terms of the way it’s catering for what it perceives the industry is, you know, rocket launches and stuff, and it hasn’t really considered how Māori want to develop its Mātauranga Māori in that space. So, it’s incredibly one-dimensional.”

Aerospace Companies and Te Tiriti

Many concerns have been raised concerning aerospace companies and Te Tiriti. Participant 6 raised the issue that there was a lack of meaningful engagement with Māori by aerospace companies. They recounted an instance during a meeting in Mahia with Rocket Lab where they discussed international treaties but failed to mention Te Tiriti. They challenged them, saying,

“You’ve got every other treaty, but what about our bicultural nation’s Treaty? Where’s your obligation to do that?”

In the participant’s view, they did not provide adequate responses and treated presentations as consultation, which they stated were not genuine consultations. Participant 6 asked them:

“Where is your obligation to the Treaty that we have, besides the global treaties? And they just had no answer. She [the company’s representative] said we’ll have to get back to you on that answer?”

Members of the Māori Working Group on Aerospace did meet with Rocket Lab representatives at their headquarters in

Auckland, and discussed ways in which engagement with Māori could be improved. Rocket Lab representatives told the MWGA of Rocket Lab's aspirations to grow its relationship with tangata whenua.

There are examples of other non-Māori companies, including ones involved in the aerospace sector, who are committed to Te Tiriti o Waitangi and have embedded approaches into their company frameworks. Members of the MWGA have recently met an aerospace company located in the lower North Island that is committed to Te Tiriti. This can provide excellent examples for companies to follow, if desired.

Report on Māori Rights and Interests

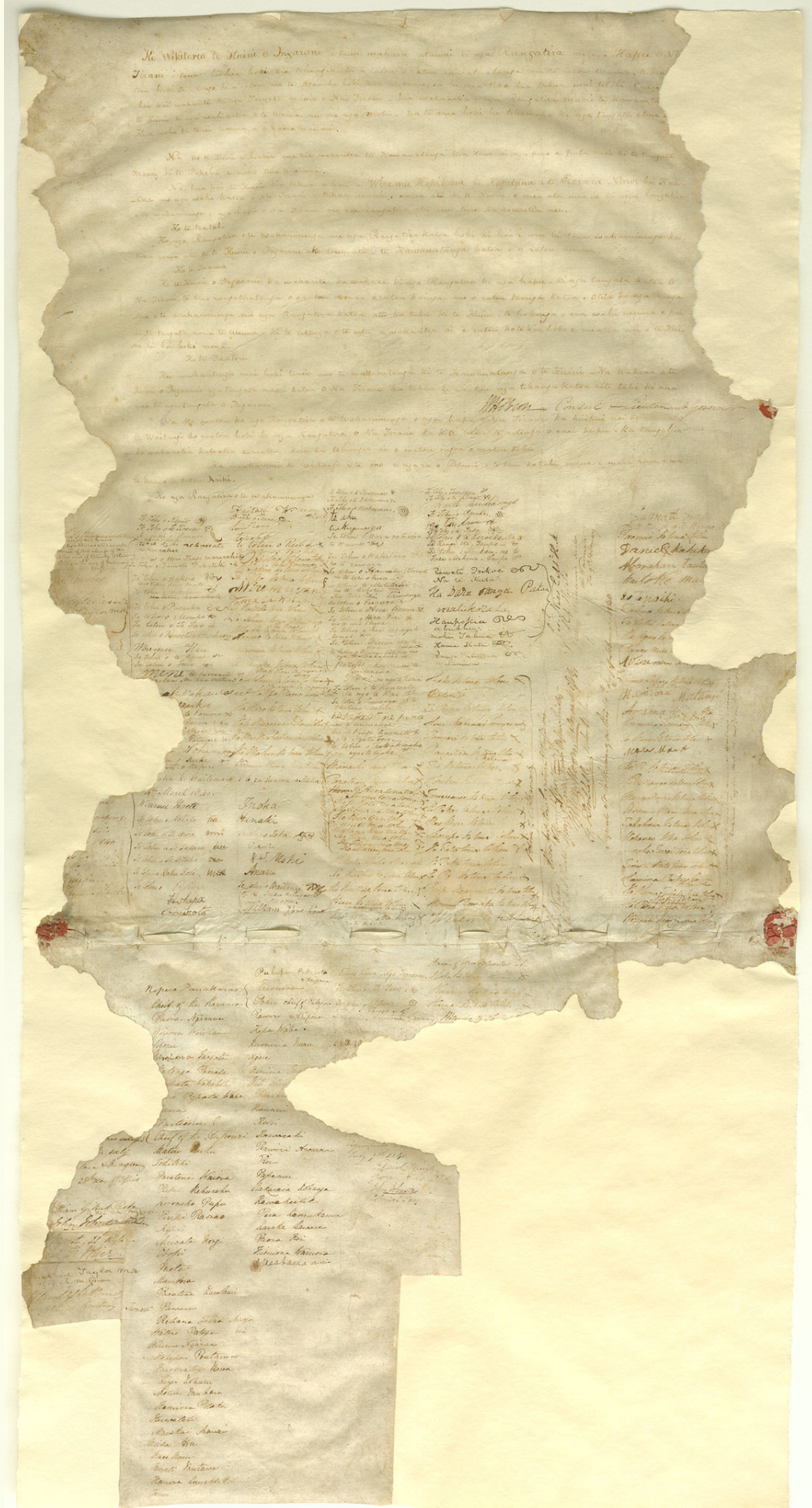
The Māori Working Group have recommended commissioning an independent report on Māori rights and interests in aerospace. Leo Watson, Indigenous rights lawyer, comments on the importance of such a piece:

“..a specific piece of work that is needed on this....it is a central question....we need to be deliberating and exploring what indigenous rights and obligations means in terms of this resource [aerospace] it is essential to have that perspective around Te Tiriti o Waitangi, it is the founding document that holds the government to account and then provides a platform for constitutional change. Because what does tino rangatiratanga mean? It does not mean that Māori are in a position of consultee or advisor. It is about decision making authority and influence. Te Tiriti specifically refers to that decision making authority to all “taonga” or treasured possessions

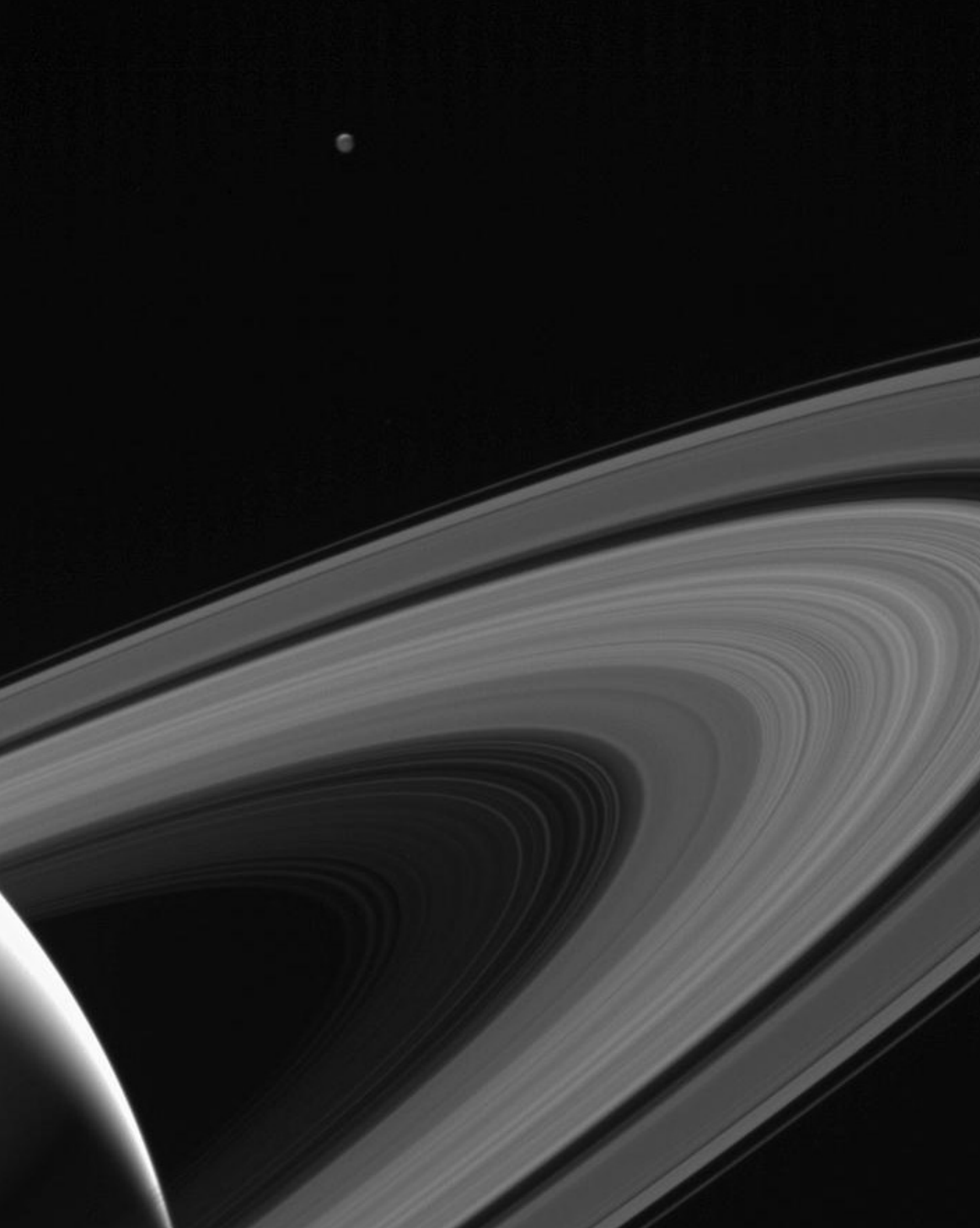
... me ō rātou taonga katoa”. Given that Māori have whakapapa and mātauranga to their taonga of outer space, so Article II of the Treaty directly applies to this resource, and all of the relationships and rights and obligations that arise as tangata whenua exercising your mana motuhake.”

The Māori space policy group has received legal advice from Matewai Tukapua (Barrister, Kōkiri Chambers) which confirms the group's position that Te Tiriti and its principles give rise to Māori rights and interests and Crown duties in relation to space. This includes duties to protect mātauranga Māori associated with space, to protect Māori interests when developing space policy and legislation, and to engage with Māori. The reference to this legal advice is not a waiver by the Māori space policy group of any legal privilege.

As space and aerospace development progresses, participants emphasised the need for policies and laws that align with Te Tiriti and ensure that Māori rights and interests are not only acknowledged but actively protected. The exclusion of Māori from current decision-making frameworks was seen as a breach of Te Tiriti o Waitangi, and many advocated for a more inclusive approach that respects Māori cultural values, traditions, and their connection to space as a taonga.



Te Tiriti o Waitangi, signed in 1840, is the founding document establishing the relationship between Māori and the British Crown, shaping Aotearoa's history, law, and ongoing partnership.



Orbital debris encircling Earth — millions of fragments from discarded satellites and rocket parts — that contribute to growing space environment pollution, increasing collision risks and threatening the sustainability of space activities.

Summary

This report provides an in-depth exploration of Māori perspectives on the aerospace sector, highlighting Māori aims, aspirations, opportunities, issues and concerns around aerospace. Through interviews and surveys with over 40 Māori actively engaged or interested in aerospace, alongside broader discussions with a wide range of community members and experts, this report captures diverse insights and reflections that have shaped its findings.

The report highlights how Māori values and principles should guide how we conduct ourselves in aerospace. The responsibility for Māori as kaitiaki is driven by these values and principles, which innately ensure that we will protect the atmosphere and space. We need to ensure that policies are developed to ensure its protection from human activity; this, as many said, can help towards building a sustainable future in the aerospace sector.

We have described how nearly all participants agreed that space, or Ranginui, is both a taonga (treasure) and an atua (deity), imbued with its own life force. From a Māori worldview, when this life force becomes unwell, there are inevitable consequences. Just as global warming and pollution have disrupted the mauri (life force) of both Papatūānuku (Earth) and Tāwhirimātea (God of weather), they have also impacted Tangaroa (God of the sea) and the species within the ocean.

These effects also extend to humans. The degradation of these life forces results in more extreme weather events, rising temperatures, rising sea levels, and increased ocean acidity. This interconnected cycle of cause and effect is understood by Māori through whakapapa

(genealogy) and mauri, and managed with tikanga (customs) and kawa (protocols).

Māori are active across a wide range of sectors, and it's crucial to consider where Māori are currently, and could potentially be, in the aerospace industry. Everton highlighted that Māori are specialists in the food and agriculture sectors, experts in long-distance voyaging, and have notable expertise in medicine and engineering. Additionally, Māori are now owners of aerospace launch sites and other companies. He stressed the importance of understanding the existing landscape and building on these strengths to create new opportunities for Māori interested in pursuing careers in aerospace.

A number of economic opportunities were also identified, from iwi investment opportunities to materials and digital technologies development. Whilst there is also a growing number of Māori in the RST&I sector, from space medicine, space-based earth observations, astrophysics and aerospace engineering, the growth of these areas needs to be nurtured and supported in order to realise their economic potential.

Participants identified a range of issues and concerns, including pollution, mining, military involvement, and the fast-tracking of approvals without sufficient representation in decision-making. Many expressed disappointment with Government consultation processes, highlighting a lack of transparency and engagement. Concerns about inequity were also raised, particularly the limited funding for research, science, technology, and innovation (RST&I) that addresses Māori interests. Participants cited regulatory challenges and the need for clearer

payload identification protocols. And within Māori communities, we see significant concerns where aerospace companies have established operations within their regions.

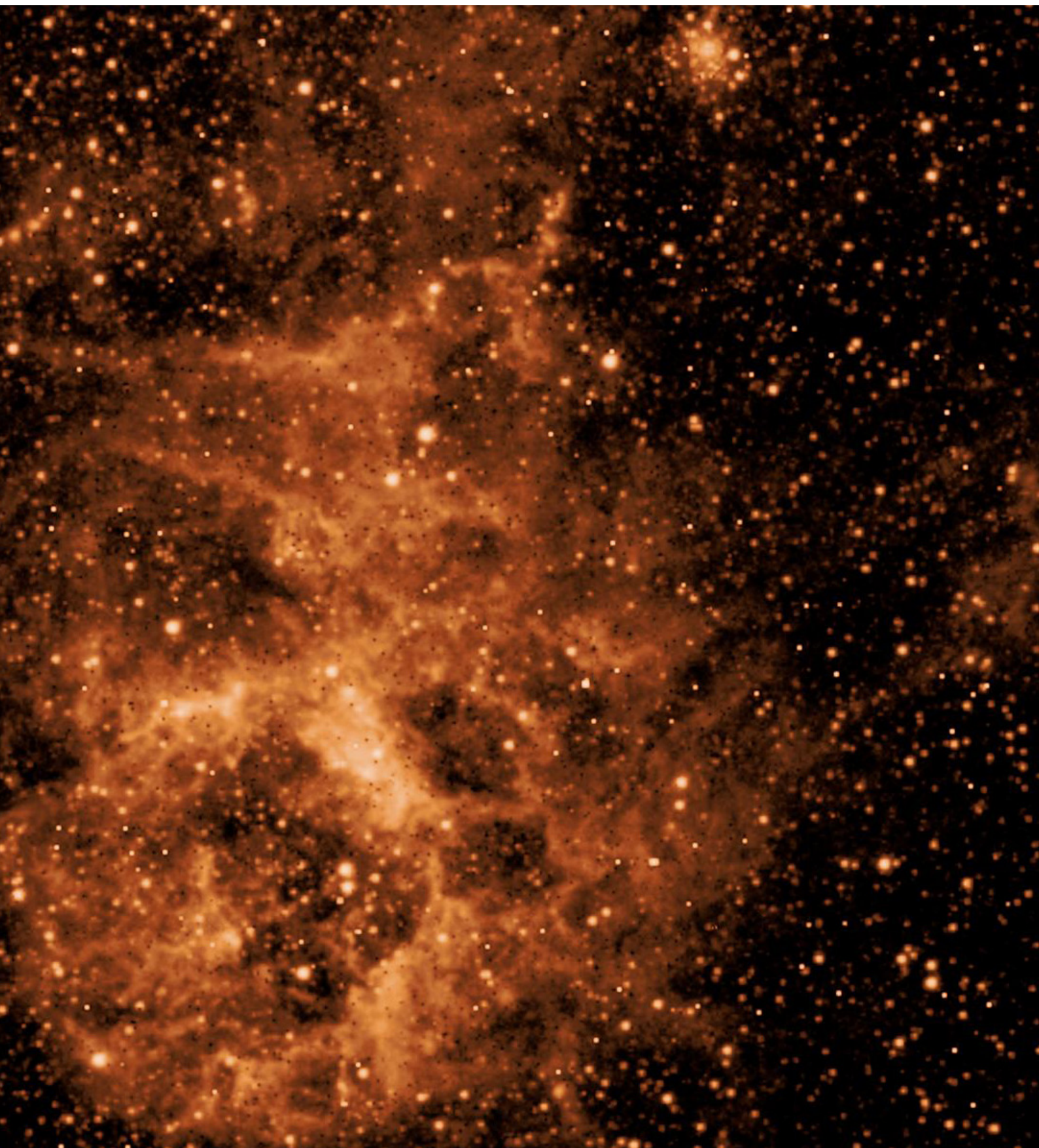
Both international and national inclusion in decision-making were discussed. There were concerns around representation and having an Indigenous Māori voice at the table. Māori have most recently been engaging with organisations such as NASA and strengthening relationships with Indigenous aerospace communities in the U.S., Canada, and the Pacific. Māori values, principles, and perspectives are increasingly recognised and valued on the international stage.

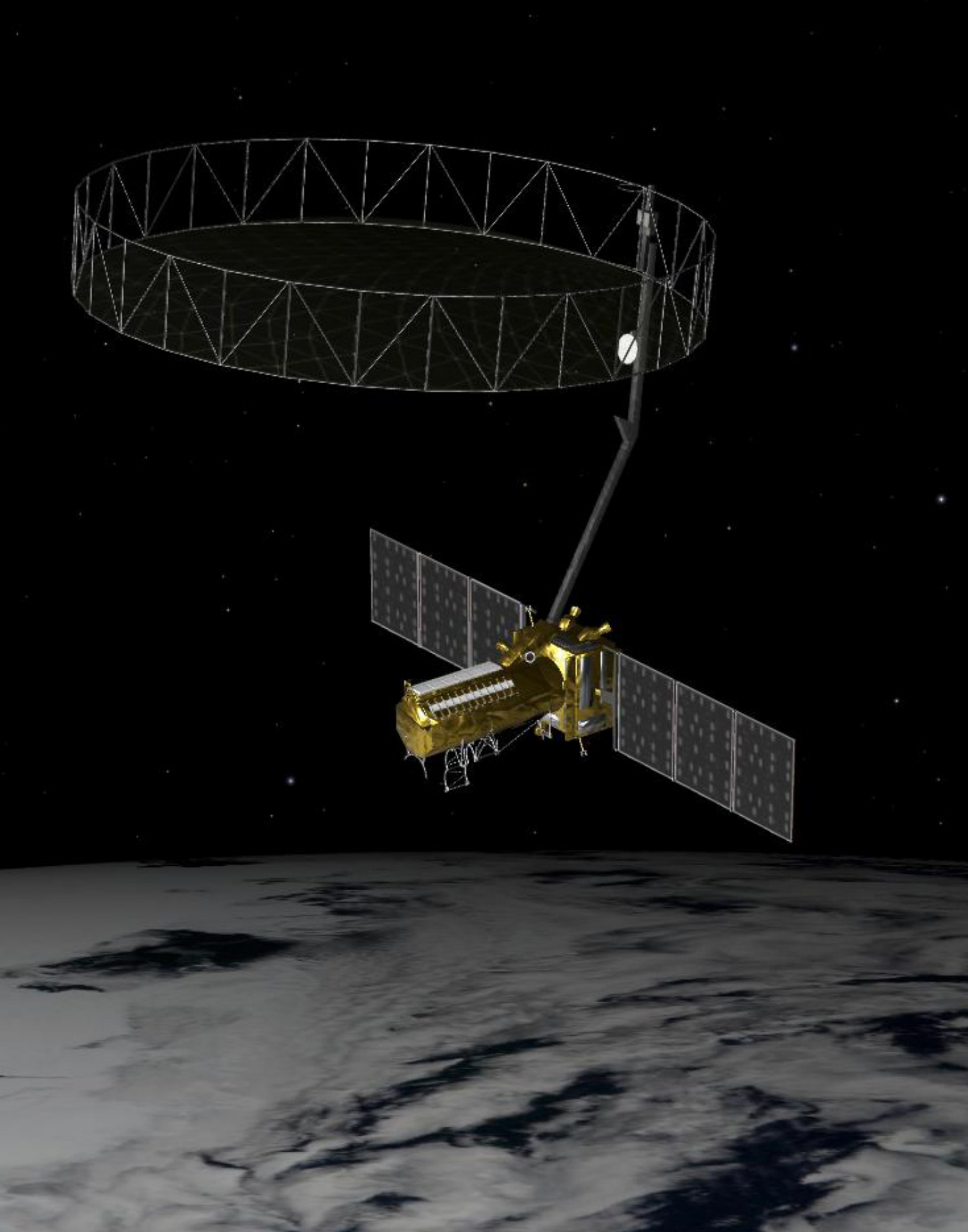
However, at a national level here in Aotearoa New Zealand, engagement has been fragmented, stalled, and, at times, entirely ceased. This inconsistency has left MWGA uninformed by the Government, excluded from decision-making, and unaware of recent strategy releases, with the release of the Space and Advanced Aviation Strategy coming as a surprise to the MWGA who had not been informed, especially given the document's lack of reference to Māori, iwi, or Te Tiriti o Waitangi. This omission was met with shock and disappointment. The MWGA has called for a review of the strategy and for open dialogue as Treaty partners with the Crown, advocating for the inclusion of Māori rights and interests, as outlined in this report, in the latest and any future strategies.

The MWGA has developed a Māori aerospace strategy which is now the subject of engagement and consultation with Māori stakeholders. This will guide the programme of work by the MWGA moving forward.

This landscape report provides a comprehensive snapshot of Māori aims, aspirations, opportunities, issues, and concerns within the sector. The following key recommendations are based on the insights and perspectives shared by participants, as well as the broader community whose contributions have shaped the findings of this report:

SPHEREx unveils the intricate structure of cosmic dust clouds, shedding light on the hidden regions of our galaxy.





Artist's concept of NISAR in orbit above Antarctica, poised to provide detailed radar observations of Earth's changing ice, land, and ecosystems.

Key Recommendations

Key recommendations from the report:

1. That the rights and interests of Māori in aerospace as identified in this Report be incorporated into New Zealand's aerospace strategic planning, policy setting, and decision-making.
2. That the Māori Working Group on Aerospace continue to broaden its representation of Māori in the sector and work with Crown officials on a partnership approach to aerospace regulation and management.
3. That the economic opportunities available for Māori in aerospace be advanced by the creation of:
 - a. A Training, Capacity and Capability Fund for Māori;
 - b. An Entrepreneur, Research and Innovation Fund for Māori, including provision for mātauranga Māori (traditional knowledge) in aerospace projects.
4. That private aerospace companies be encouraged to:
 - a. provide for Māori cultural expertise with the strategies and objectives of the companies;
 - b. provide for Māori representation on aerospace advisory and industry fora;
 - c. Actively create opportunities within the companies for Māori employment and training in the aerospace industry.
5. That Māori be resourced and included in New Zealand's international participation in the United Nations and other relevant international forums in consideration of aerospace regulation.
6. That specific Crown funding is dedicated to an educational outreach programme for Māori relating to aerospace, to be overseen by a group of Māori experts to develop and administer the Fund. The Fund would be prioritised to grow a pipeline of expertise, including science, research, and development for Māori.

Overall, the aspirations and insights shared by participants underscore a powerful vision for Māori leadership and meaningful participation in the aerospace sector. As Māori leaders, scientists, and innovators continue to shape the future of aerospace, they bring a unique set of values that not only enhance the industry but also resonate with global Indigenous rights frameworks. For Māori to fully thrive in this space, equitable decision-making, sustainable practices, and respect for mātauranga Māori must be prioritised. This is not only vital for Māori but also presents a model for Indigenous inclusion in aerospace on an international scale.

As interest grows from Indigenous communities worldwide, the experiences and achievements of Māori in this sector will serve as a powerful example, demonstrating how Indigenous leadership can influence and transform the future of aerospace.



NASA's Galileo spacecraft captured this image of the Moon on 7 December 1992 during its journey to the Jupiter system. The bright crater with prominent rays at the bottom is the Tycho impact basin.

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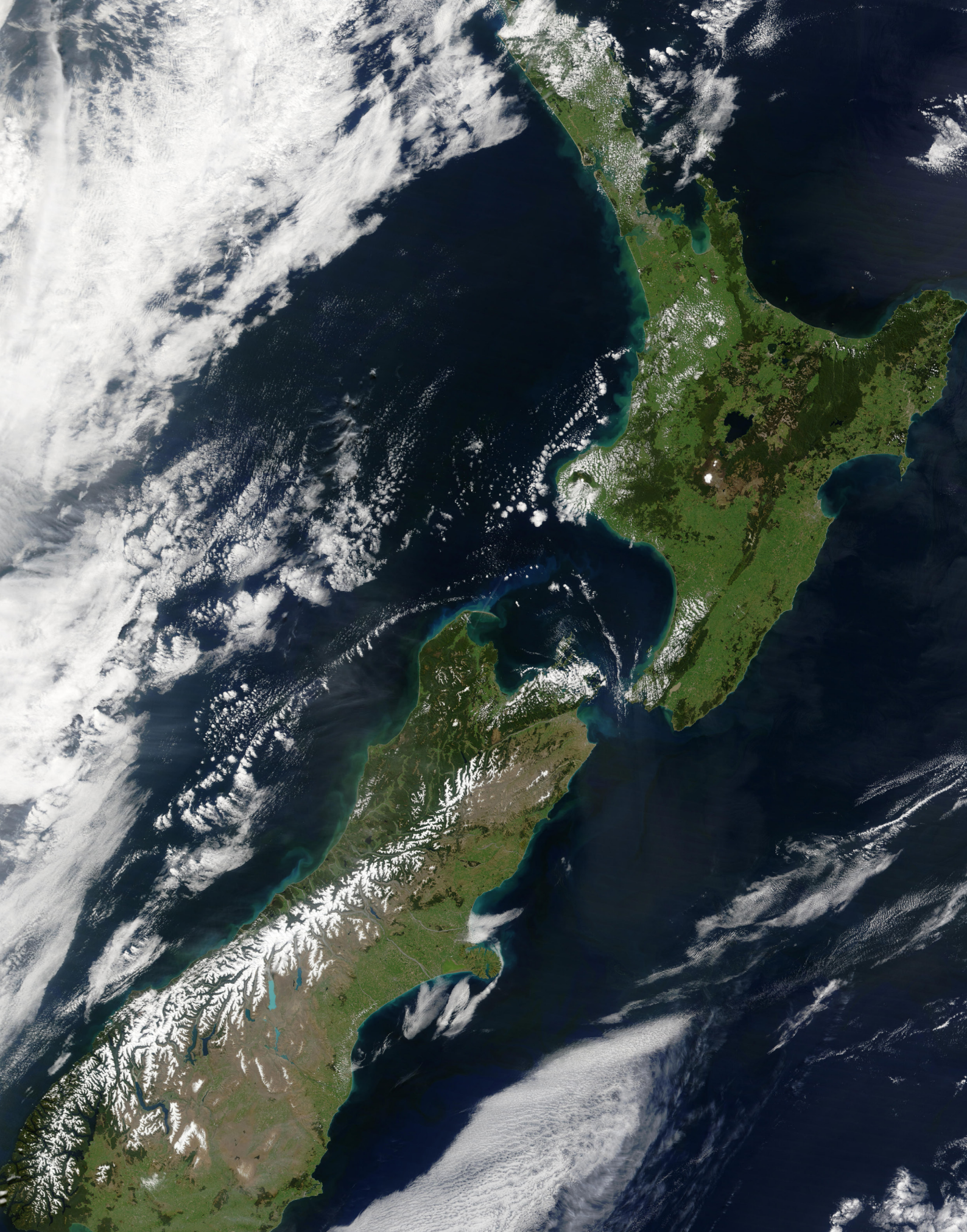
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Jacques Descloitres of NASA's MODIS Land Rapid Response Team at Goddard Space Flight Center captured this detailed Earth observation image.

Appendices

Appendix A Glossary of Māori Terms

Atua

Definition: Deity or spiritual being.

Context: Often used to refer to gods in Māori cosmology, such as Ranginui (Sky Father) and Papatūānuku (Earth Mother).

Hui

Definition: Meeting or gathering.

Context: Used for meetings to discuss important matters such as with community, business, work or family.

Iwi

Definition: Tribe or extended kinship group.

Context: A large social unit in Māori society, typically comprising several hapū (sub-tribes).

Kaupapa

Definition: Topic, purpose, or plan.

Context: Refers to the underlying principles or themes guiding a project or discussion.

Kawa

Definition: Protocol or ceremonial customs.

Context: Refers to the rules, etiquette, protocols observed in formal settings.

Māori

Definition: The Indigenous people of Aotearoa (New Zealand).

Context: Refers to the people, language, and culture of the Māori.

Mātauranga Māori

Definition: Māori knowledge, wisdom, and understanding.

Context: Encompasses traditional Māori and contemporary knowledge and systems. It originates from the Māori ancestors and is a growing and evolving body of knowledge. It includes such knowledge as history, religion, culture, practice, Māori science and more.

Mauri

Definition: Life force, essence or life principle.

Context: Both inanimate and animate object/beings can have mauri.

Papatūānuku

Definition: Earth Mother.

Context: A central being/god in Māori cosmology, she is earth mother and wife of Ranginui Sky Father, all beings are genealogically related to her.

Rangatiratanga

Definition: Leadership, autonomy, or self-determination.

Context: Refers to the right of Māori to self-govern and exercise sovereignty. In other contexts can also refer to authority, ownership and leadership of a group, and is referred to as the domain of the chief, the rangatira.

Ranginui

Definition: Sky Father

Context: A central being/god in Māori cosmology, he is Sky Father, husband of Papatūānuku Earth Mother, all beings are genealogically related to him.

Rūnanga

Definition: Iwi authority or tribal council

Context: For many iwi (tribe), rūnanga are an essential part of their decision-making structure.

Tāwhirimātea

Definition: God of weather, wind and storms.

Context: An atua associated with winds, storms, and climate in Māori cosmology.

Taonga

Definition: Treasures or valued possessions

Context: Taonga encompasses both tangible and intangible elements significant to Māori culture, including socially and culturally valuable objects, resources, phenomena, ideas, and techniques, language, customs, and natural resources like flora and fauna.

Tangata Whenua

Definition: People of the land, local people, hosts, Indigenous people of Aotearoa New Zealand.

Context: Māori, along with their whānau (families), hapū (subtribes), and iwi (tribes), trace their genealogical connections (whakapapa) to the land through their ancestors, established by initial occupation or maintained through long-term presence or conquest.

Tangaroa

Definition: God of the sea.

Context: An atua responsible for the ocean and its creatures. Tangaroa is genealogically related to the creatures of the ocean.

Te Ao Māori

Definition: The Māori world.

Context: Used to describe concepts and perspectives from a Māori world view.

Te Tiriti o Waitangi

Definition: Te Tiriti o Waitangi

Context: A foundational document of Aotearoa New Zealand signed in 1840 between Māori and the British Crown, setting out the relationship between Māori and the Crown (central government).

Tikanga

Definition: Customs, traditions, lore, or practices.

Context: A system of Māori values and principles, lore, customs, belief and practices.

Tuarangi Space

Definition: Outer space

Context: Ranginui is the sky father and Tuarangi refers to outer space.

Wānanga

Definition: Forum of knowledge sharing

Context: A place or session for learning and discussion. Usually used in the context of intense discussion, knowledge sharing and learning.

Whakapapa

Definition: Genealogy or lineage.

Context: A framework for understanding relationships between people, land, animals and the cosmos.

Terms and definitions have been sourced and contextualised to aerospace from Landcare research glossaries and online Māori dictionaries.

Appendix B - Research Process

Methodology

Interviews were conducted with a range of Māori from community members to experts in space medicine to entrepreneurs. This breadth of people has enabled a broad range of views and opinions on how Māori want to engage in the Aerospace sector and what are the key aims, aspirations, opportunities, issues and concerns associated with the Aerospace sector. A Kaupapa Māori methodological approach (Smith, 1997; Smith, 2012) was used for this research and a low-risk ethics application was also done through Massey University. Karakia were done before and after each interview and participants were given information sheets and consent forms where consent was obtained, with anonymity being optional. For the survey all information was described as to the use of their information, and all were made anonymous.

Participants

A range of experts/participants were interviewed and surveyed for this report. Many of the Māori Working Group on Aerospace (MWGA), a group formed in 2001 to advise the Government on the Aerospace Strategy, were interviewed; this group have met regularly for the past three and half years. Participants included experts in the aerospace industry and mātauranga Māori space including tohunga, astrophysicists, engineers, space scientists, aerospace stakeholders, people associated with Māori Aerospace organisations, iwi leaders, Māori businesses, entrepreneurs, architects, space medicine physicians, digital technology experts, software designers, academics, concerned citizens and space enthusiasts. Ages ranged from early 20's to 60's. All were Māori from a range of iwi around the motu. There were over 40 participants but additional information was obtained over the years of discussion within the MWGA and their wider

community that they brought to the table. Non-Māori experts also were brought in for their expertise.

Interview Questions

Questions were open ended to allow for a broader conversation and to allow for the participants to interpret and express their thoughts freely.

- Can you tell me your name and where you are from?
- Can you tell me about your role in the aerospace sector and the roles of any other Māori you know of currently working in this industry?
- Can you tell me about your relationship with space and what it means to you?
- What are the potential opportunities and/or impacts/challenges of the aerospace industry in your area?
- What are the aims and aspirations for Māori (whanau/iwi/hapū/organisation) in the aerospace industry?
- What does a flourishing Māori aerospace industry look like to you?
- And what support is needed for Māori to enable this future state?
- What are the values and principles that must be considered when thinking about how we use and explore space?
- What should be implemented to ensure that we protect the way we use and explore space?
- How do you think aerospace relates to the Treaty of Waitangi?
- Do you think that space is a taonga? (Yes/No)
- Do you have anything else you would like to talk about?

Similar questions were posed in the survey also.

