



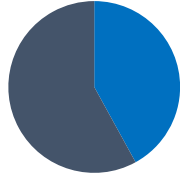
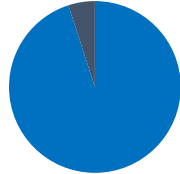
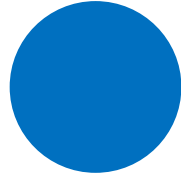
Aotearoa New Zealand's contributions to planetary defence

Michele Bannister



NZ provides
unique longitudinal coverage

Planetary Defence: International Cooperation for an International Issue

Asteroid Size	4 meters	25 meters	160 meters	1,000 meters	10,000 meters
Frequency	~1 per year	~1 per 100 years	~1 per 25,000 years	~1 per 500,000 years	~1 per 100-200 million years
Impact	Bright flash, no ground effects, but could leave meteorites	Air burst explosion, could cause widespread injuries if over populated area	Crater of 1-2 kilometer diameter, deadly over metro areas/states, mass casualties	10-kilometer crater, global devastation, possible collapse of civilization	100-kilometer crater, global devastation, mass extinctions of terrestrial life
# of NEOs	~500 million	~5 million	~20,000	~900	4
% Discovered	< 0.1%	0.4%	42%	> 95%	100%
					



UC's Mt John Observatory at Ōtehiwai, Takapō 1029 m

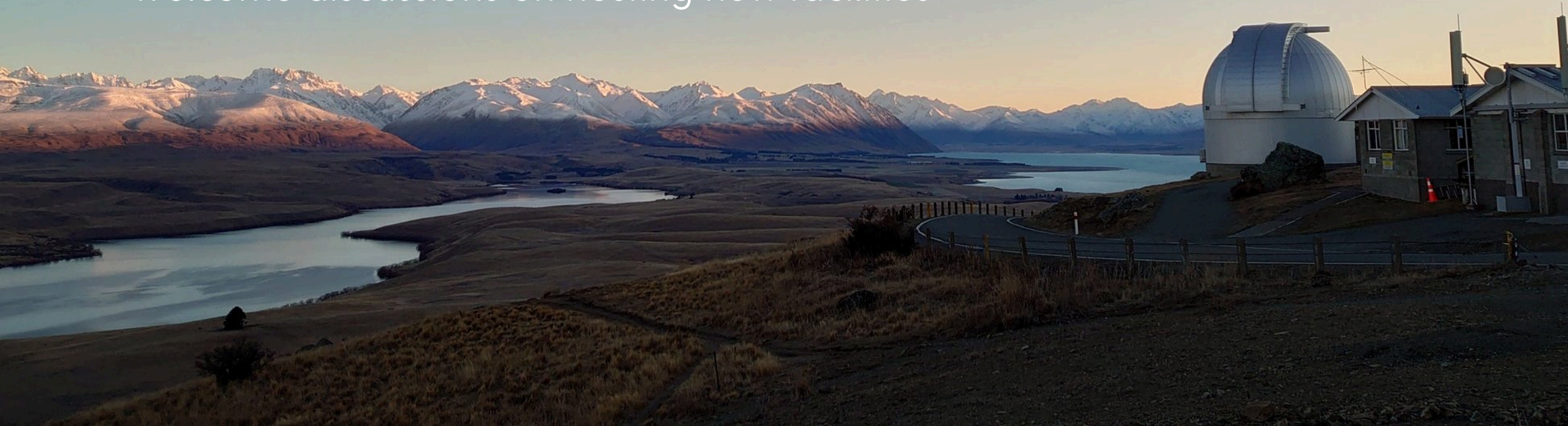
1.8 m telescope

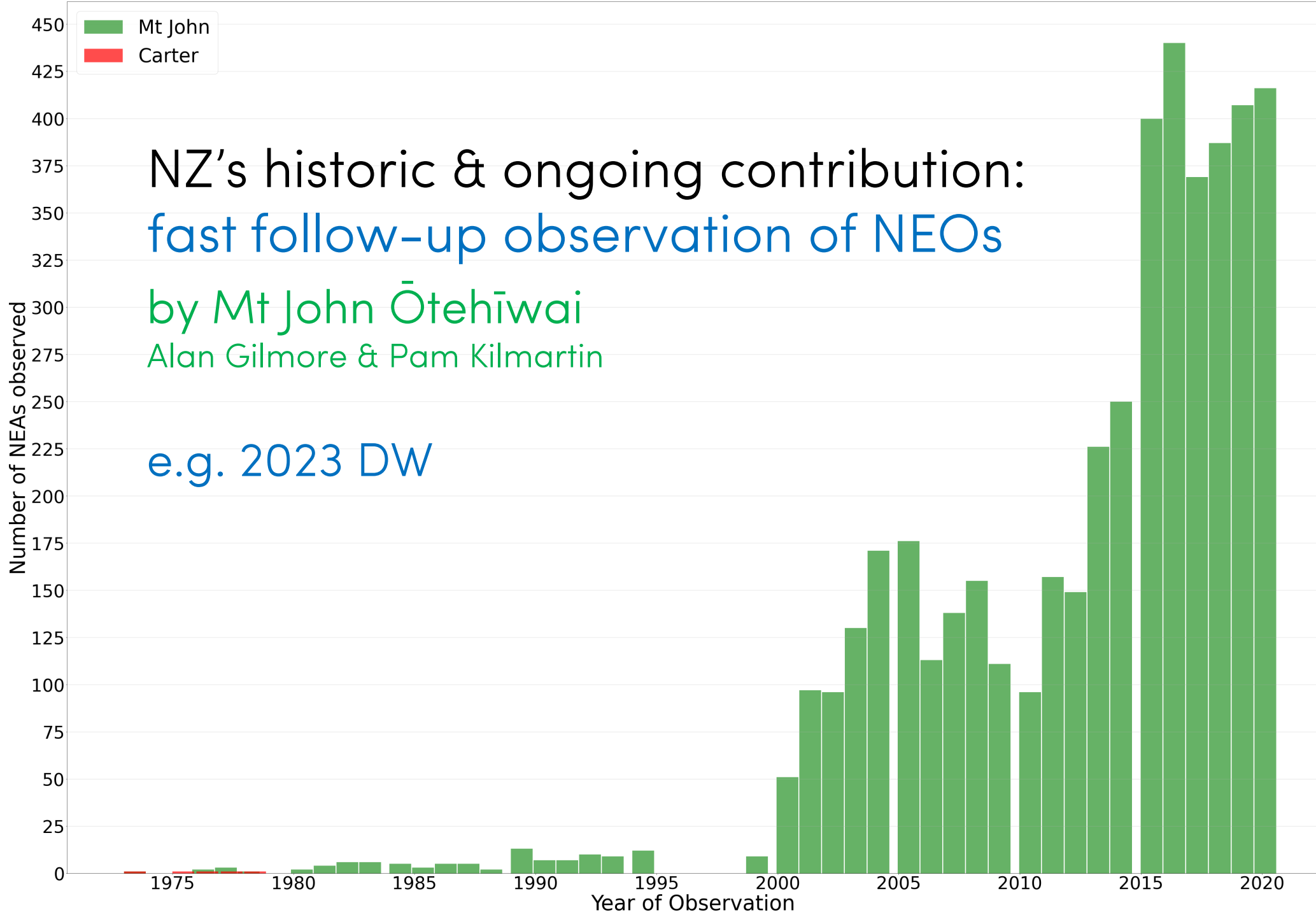
- 2.2 sq. deg imager

1 m and two 0.6 m telescope

- 30' imager, high-resolution spectrograph

Welcome discussions on hosting new facilities





NZ's historic & ongoing contribution:
fast follow-up observation of NEOs

by Mt John Ōtehiwai
Alan Gilmore & Pam Kilmartin

e.g. 2023 DW

DART support Sep-Nov 2022

UC's Mt John Observatory 1.8 m telescope



T + 1 (days)
2022-09-27 UT

4'
~13000km

Nicole Tan, Ryan Ridden-Harper, Tyler Brown, Paul Tristram

Kareta et al., in prep

International partnerships: NZ's in-kind contribution to Rubin

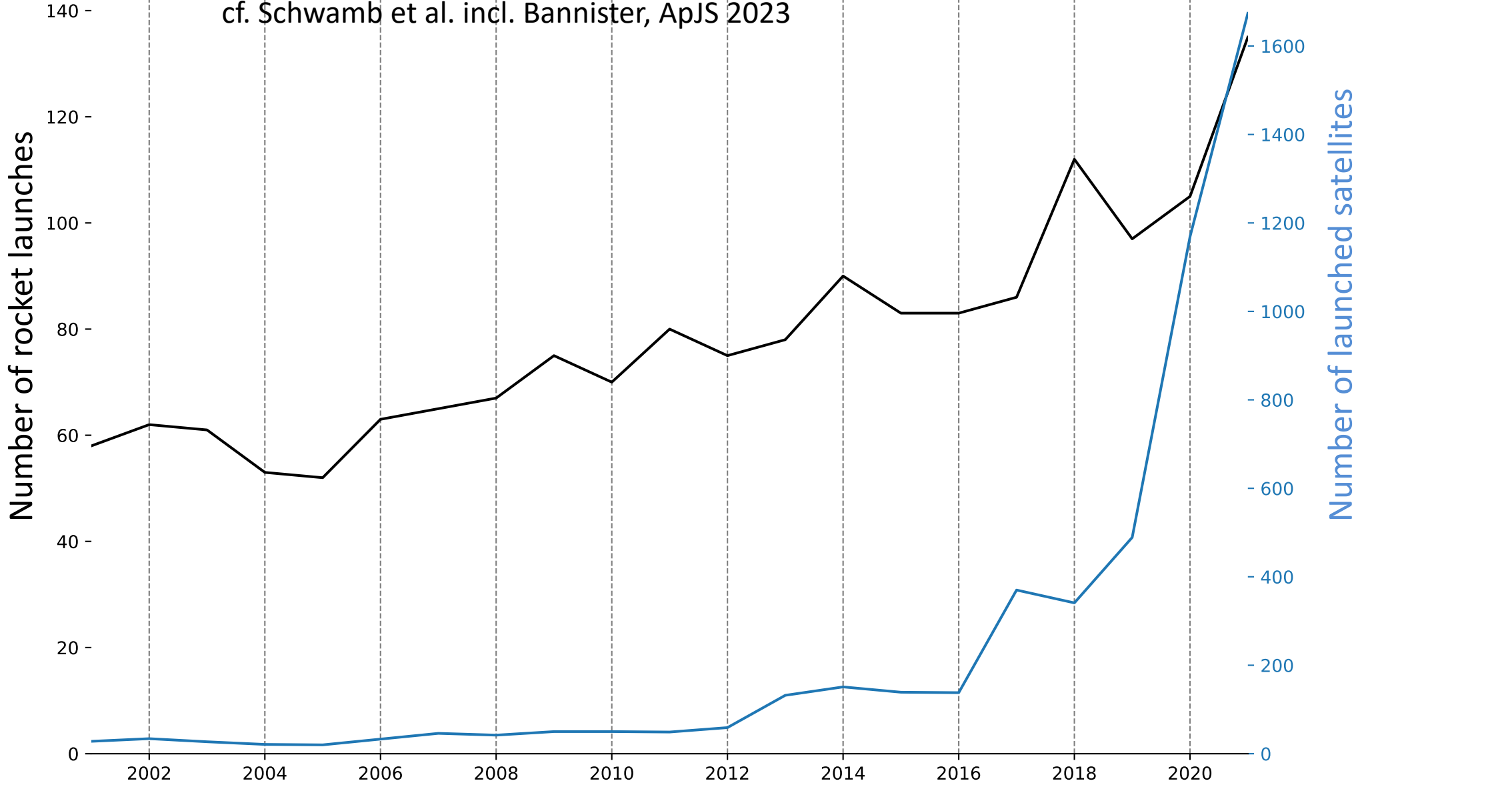


International partnerships: NZ's in-kind contribution to Rubin



Rubin “will look into a hyper-industrialised sky”

cf. Schwamb et al. incl. Bannister, ApJS 2023



New Zealand Space Policy Review Consultation

SEPTEMBER 2022

Regulating to ensure space activities are safe and secure

MBIE regulates the use of all launch vehicles, facilities, payloads, and high-altitude vehicles from New Zealand under the Outer Space and High-altitude Activities Act 2017 (the Act). A key purpose of the Act is to facilitate the development of New Zealand's space industry and provide for its safe and secure operation. This includes preserving New Zealand's national security and national interests and adhering to our international obligations relating to space activities.

A review was completed on the operation and effectiveness of the Act in May 2022. The review's report concluded that New Zealand's regulatory regime operates effectively and is well regarded by entities that engage with it. For further information on the review of the Act, visit www.mbie.govt.nz/assets/report-on-the-statutory-review-of-the-oshaa-2017.pdf

Objectives

The New Zealand government regulates to ensure New Zealand space activities are safe and secure. This means:

- › Facilitating the safe and secure use of emerging space technologies from New Zealand
- › Clarifying what New Zealand space activities are inconsistent with the national interest
- › Promoting and protecting New Zealand's interests through permitting space technologies

FACILITATING THE SAFE AND SECURE USE OF EMERGING SPACE TECHNOLOGIES FROM NEW ZEALAND

The review report highlighted emerging technology areas where future regulation may be required. This included constellations. Some of the relevant policy considerations here are set out in the following pages.

RIGHT: A satellite internet constellation transiting the night sky over the Pacific coast of California in 2019.



SATELLITE CONSTELLATIONS

What are they?

A satellite constellation is a group of artificial satellites that work together as a single system. They are now a growing proportion of all satellites being developed, manufactured and launched globally.



What are their uses?

Large satellite constellations (which can sometimes comprise hundreds or thousands of satellites) are used for a range of reasons including navigation, broadcasting, taking images of the Earth, or providing internet access to communities that have no access.

Are there concerns?

There are some concerns about the impact of constellations, including effects on night sky observation by scientists and astronomers – observation may be interrupted by frequent or bright satellites passing over observation points at viewing times. This may also affect astro-tourism, such as the Aoraki Mackenzie International Dark Sky Reserve. A paper submitted to the United Nations Committee on the Peaceful Uses of Outer Space makes recommendations about keeping skies dark and quiet for science and society.¹⁵

Are there benefits?

New Zealand is well placed to benefit from the growth of constellations, due to our broad-based space sector that covers manufacturing, launching, tracking and data. All of these functions are needed to build and operate constellations. Some applications of constellations also have the potential to directly benefit New Zealanders – such as improving internet access for rural communities.

Mātauranga Māori

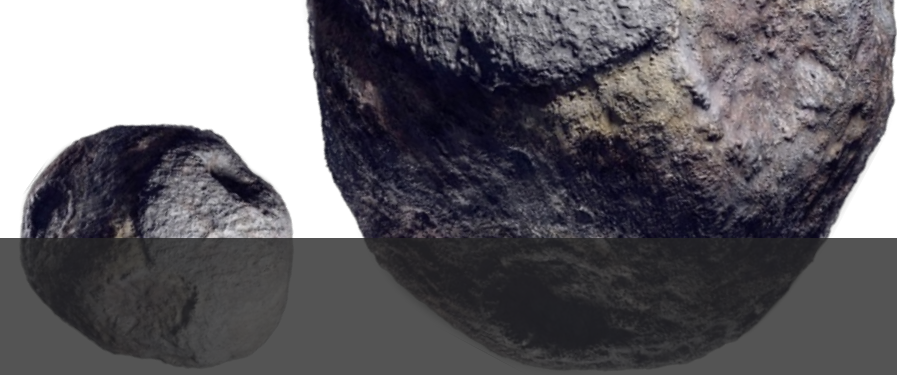
There is a deep connection between mātauranga Māori and space, including through tātai arorangi (knowledge of outer space), whakapapa (genealogical origins being linked to the beginning of the universe) and waiuatanga (the spiritual connection between the Earth and the universe derived from Māori cosmology). Broad mātauranga Māori views received through this consultation will also inform future constellations policy work.

Future regulations

New Zealand has previously launched satellite constellations – but not those which have comprised hundreds or thousands of satellites. Although an operational policy is in development for constellations, future regulation may be required to give more certainty and transparency on our approach to the public and regulated parties.

¹⁵ Scientific and Technical Subcommittee. Recommendations to keep dark and quiet skies for science and society. United Nations Committee on the Peaceful Uses of Outer Space, 58th session, UN Doc A/AC.105/C.1/2021/CRP.17 (19 April 2021).

Planetary Defence: International Cooperation for an International Issue



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<ul style="list-style-type: none"> ● Located ● Not located 					



Fireballs

AOTEAROA

Global Meteor Network

- Began early 2022
- Now one of the densest networks on Earth
 - 54 installed, 33 in connection, another 20 on order
 - istrastream.com/rms-gmn/?country=NZ
 - Also with CAMS, AllSky7

U. Otago (James Scott & team)

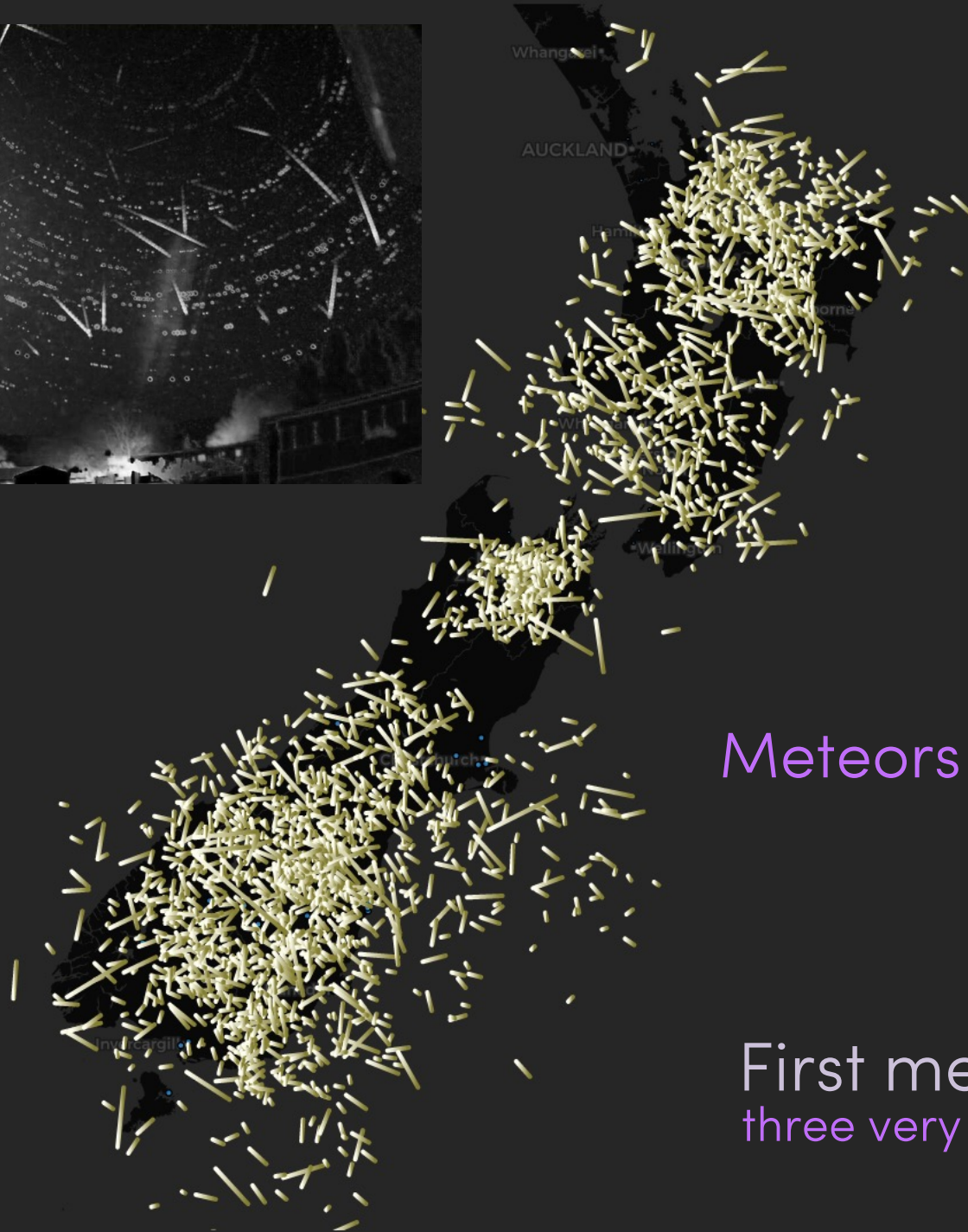
- Supporters: Royal Astronomical Society of New Zealand, the Geological Society of New Zealand, the Raspberry Pi Ltd, two private donors, and a MBIE Curious Minds Participatory Science Platform grant administered by the Otago Museum



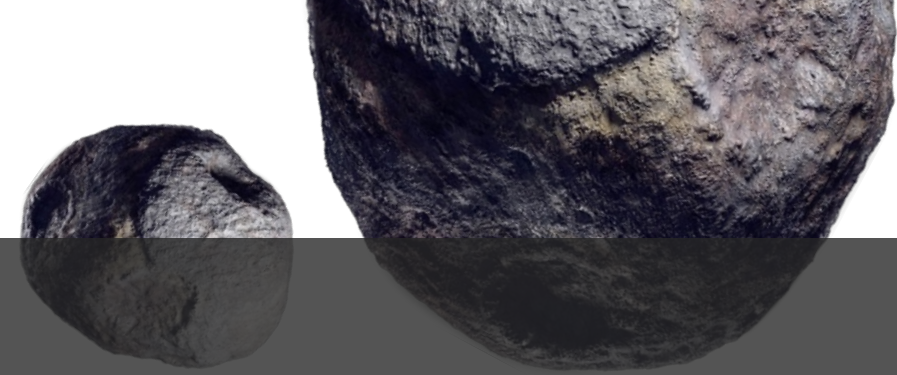
Fireballs AOTEAROA

Meteors imaged by ≥ 2 cameras
in March 2023

First meteorite hunt Sep 2022
three very small falls (unattempted) since



Planetary Defence: International Cooperation for an International Issue



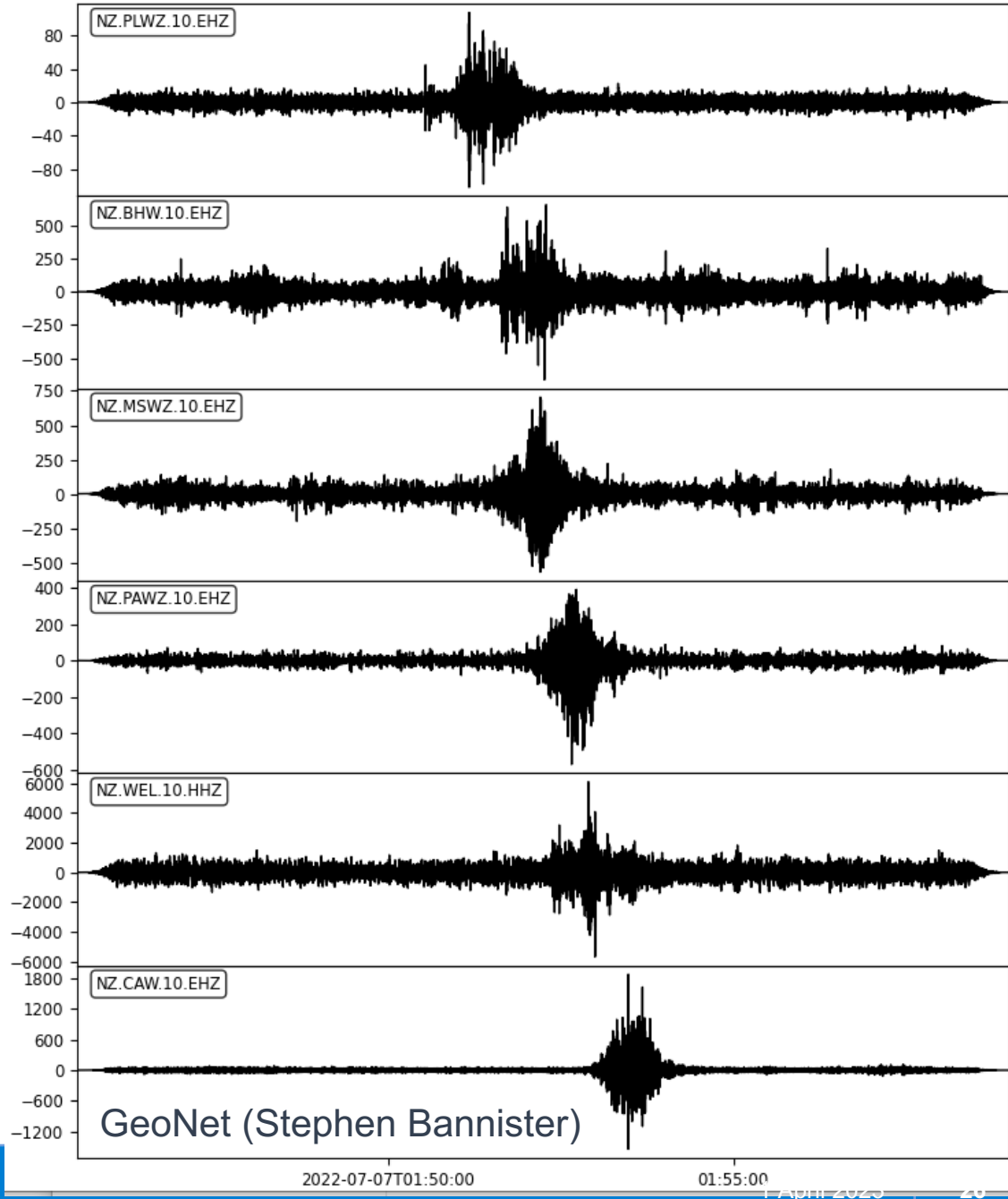
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2022-07-07 Wellington bolide

- Very bright daytime bolide
- 1.8 kton at 35 km from CNEOS
- Public reports + dashcams suggest fall was beyond Cape Palliser (in the ocean)



NZ government structure: where to place planetary defence?

- Requires interlock/responsibility across NZ government agencies



**DEPARTMENT OF THE
PRIME MINISTER AND CABINET**
TE TARI O TE PIRIMIA ME TE KOMITI MATUA



Set up in 2016, the New Zealand Space Agency is the lead government agency for space policy, regulation and sector development.



**National Emergency
Management Agency**
Te Rākau Whakamarumarū



hazard risk &
research incl. tsunami

NZ government structure: where to place planetary defence?

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- Space agency has been working to develop partnerships (e.g. DLR, NASA)
 - NZ membership in Horizon Europe
 - NASA-NZSA partnership call: includes work supporting Artemis and space exploration



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 - NZ membership in Horizon Europe
 - NASA-NZSA partnership call: includes work supporting Artemis and space exploration
- NZ has an established track record of supporting our Pacific neighbours
 - e.g. Hunga Tonga Hunga Ha’api



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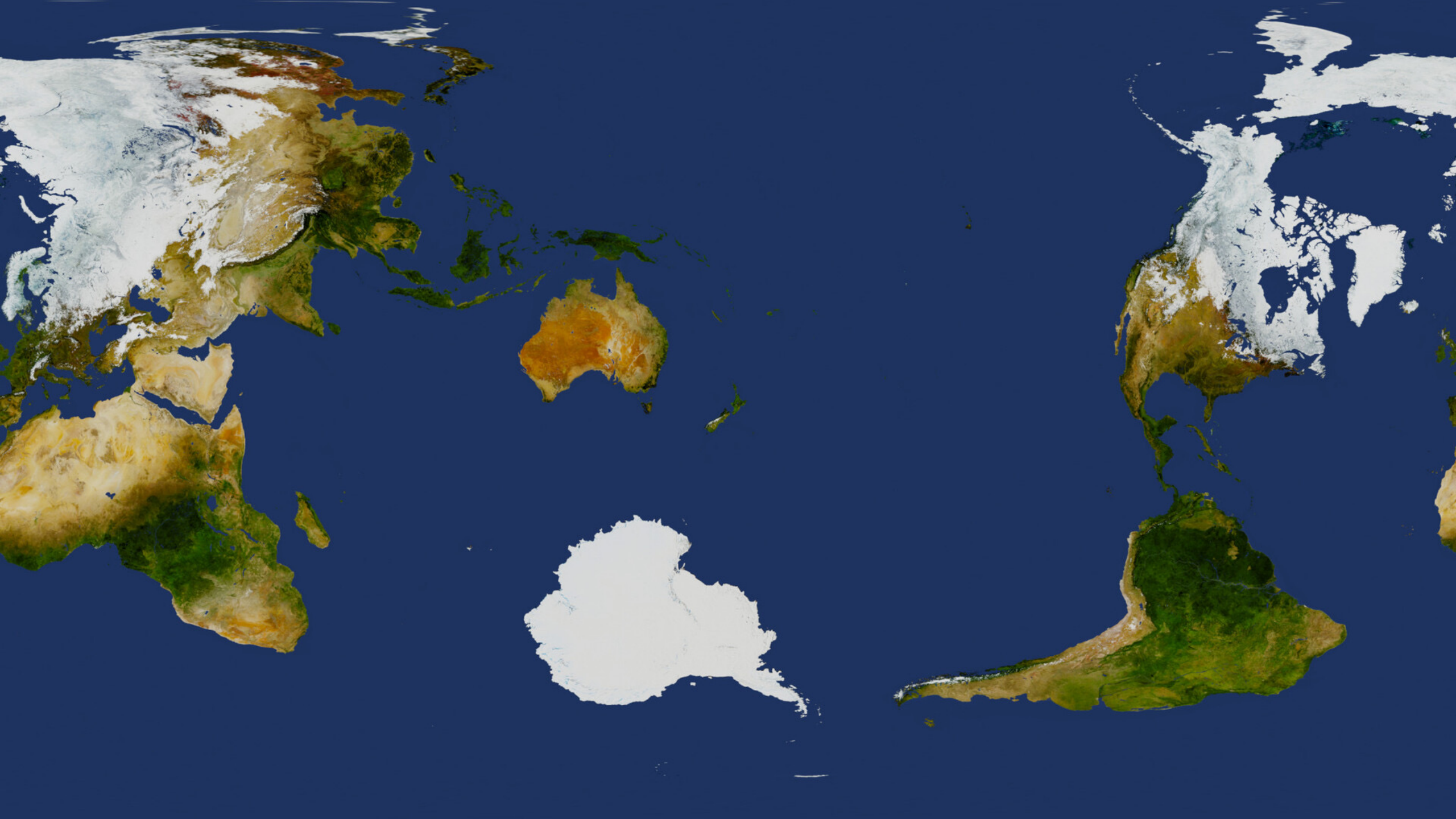
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Conclusions

- NZ has 50+ years of fast NEO followup contribution
- Keen on partnerships: at observatory level (DART, Rubin)
 - Open to new facilities at established site
- Now building out efforts in fireball tracking
- At governmental level, space agency developing its portfolio, interest within civil defence
- Welcome engagement for next steps!