The Bureau of Meteorology

Spectrum Reliance, Challenges and Future Innovation

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The Bureau of Meteorology Spectrum Reliance

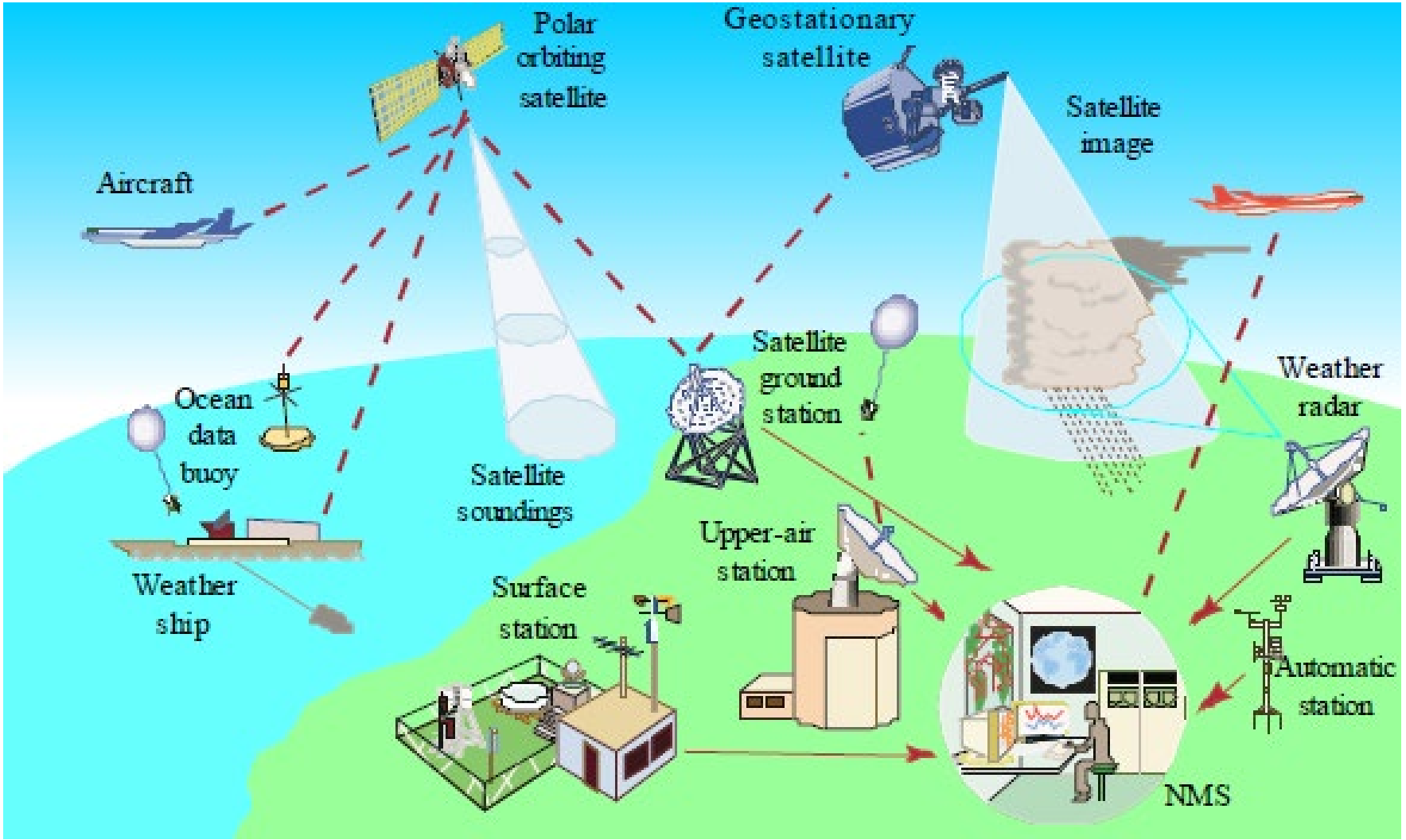
- Meteorology is a crucial part of our everyday life and has many connections with our daily routines and activities, direct impact on economic, public safety and many more.

- To address the expectation of different sectors from Met services, it is required to have a reliable access to radio frequencies from few KHz to several hundreds of GHz.

- A wide variety of radiocommunication services/technologies are used ranging from terrestrial to satellite services, active & passive services, and fixed and mobile systems.

- All these radio-frequency applications are inter-related and help to comprise a global Meteorological system. Lack of any of this system's components, can put the whole meteorological process at risk.

Global Observing System

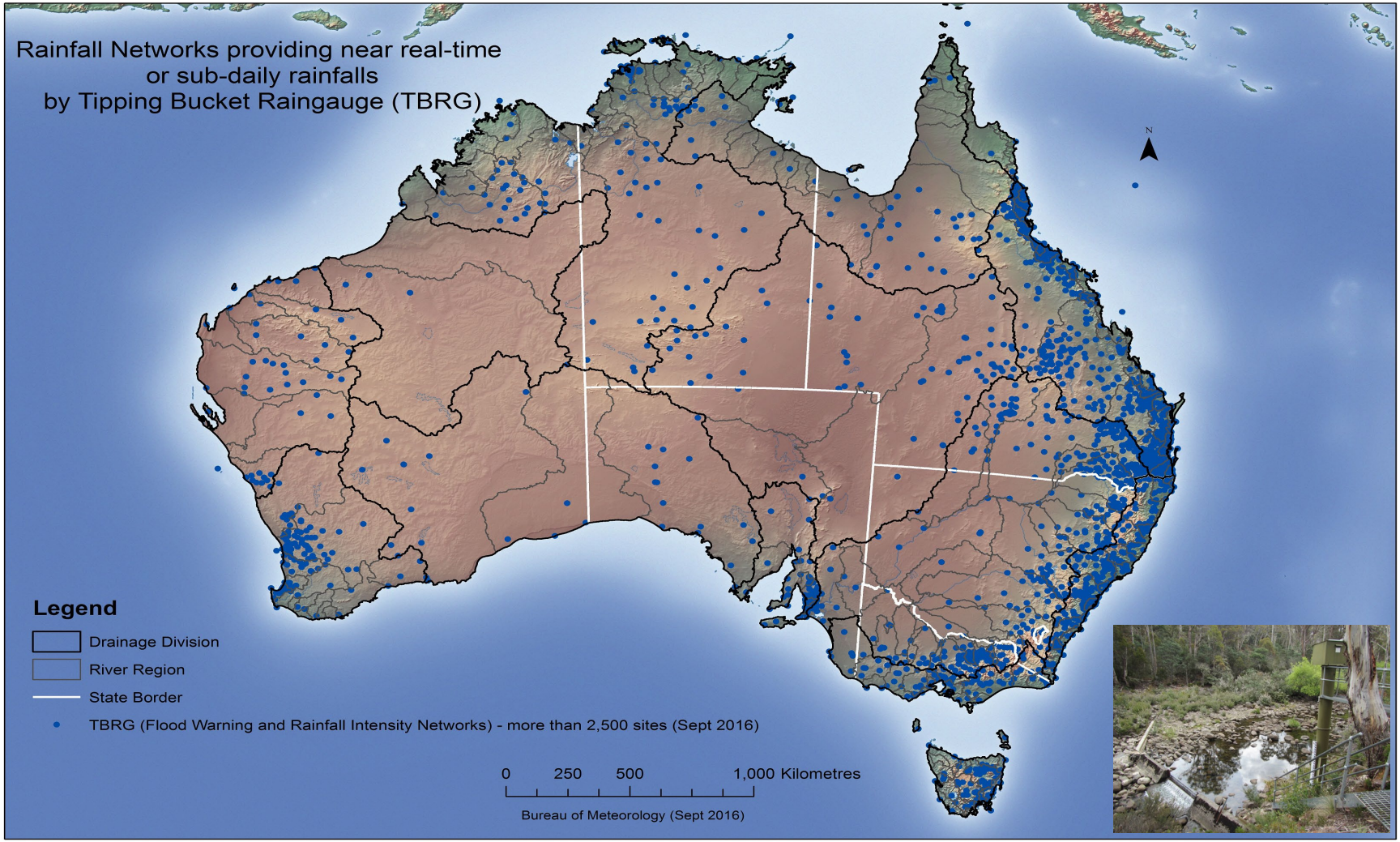


Observing Network 2022

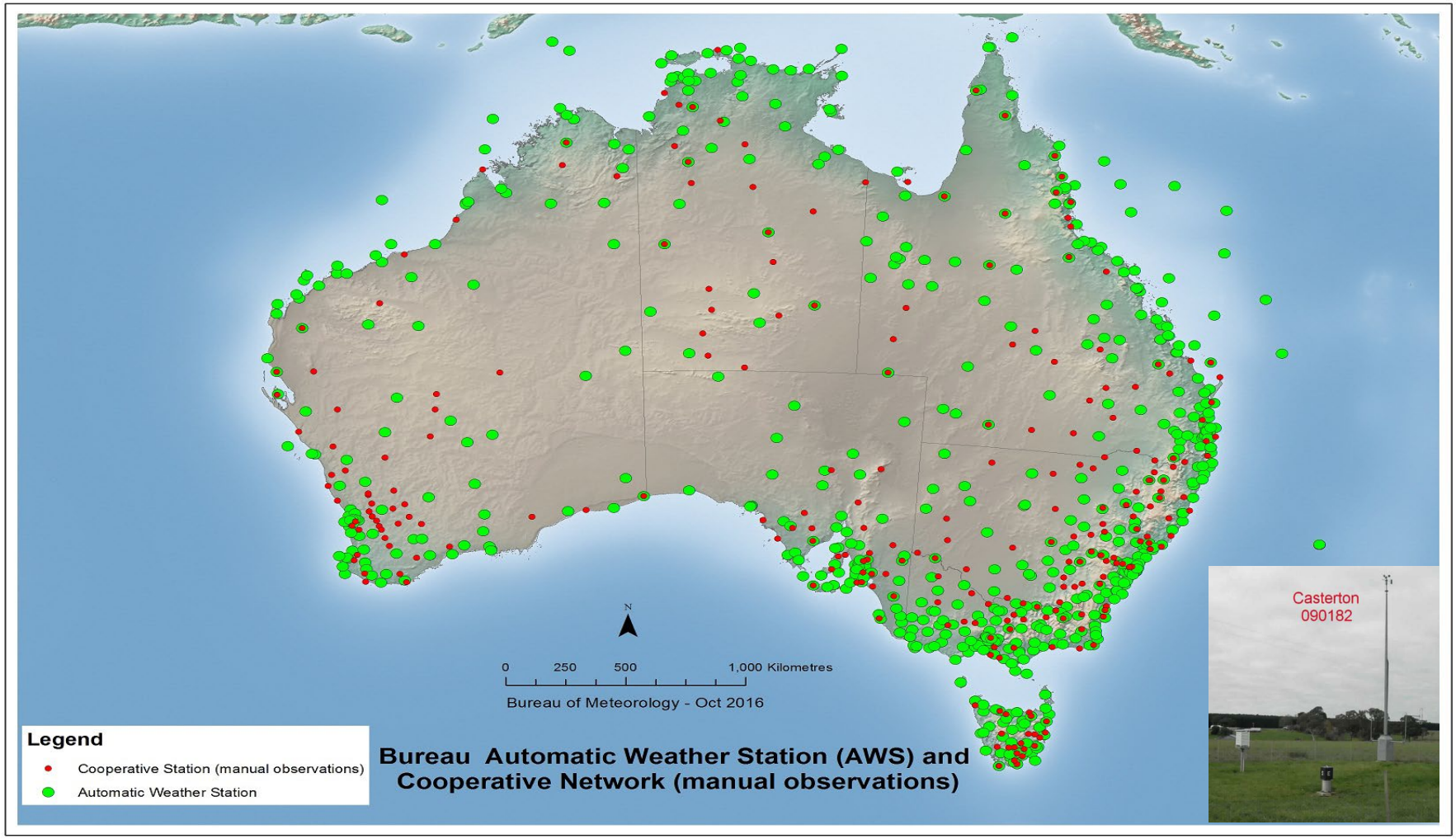
- The Bureau / Data and Digital Group (DDG) / Observing Systems and Operations (OSO)
- Current Observing Network comprises 11 Key systems
- Around 700 Licences in frequency range 1 MHz-100 GHz
- 2 Observatories (Cape Grim and Learmonth)
- Approximately 300 staff
- 8000+ sites
- 1000-1500 field trips per year

System 1 - Weather Radars
Spectrum Reliance 5600-5650MHz, 2800-2900MHz, 9300-9500MHz

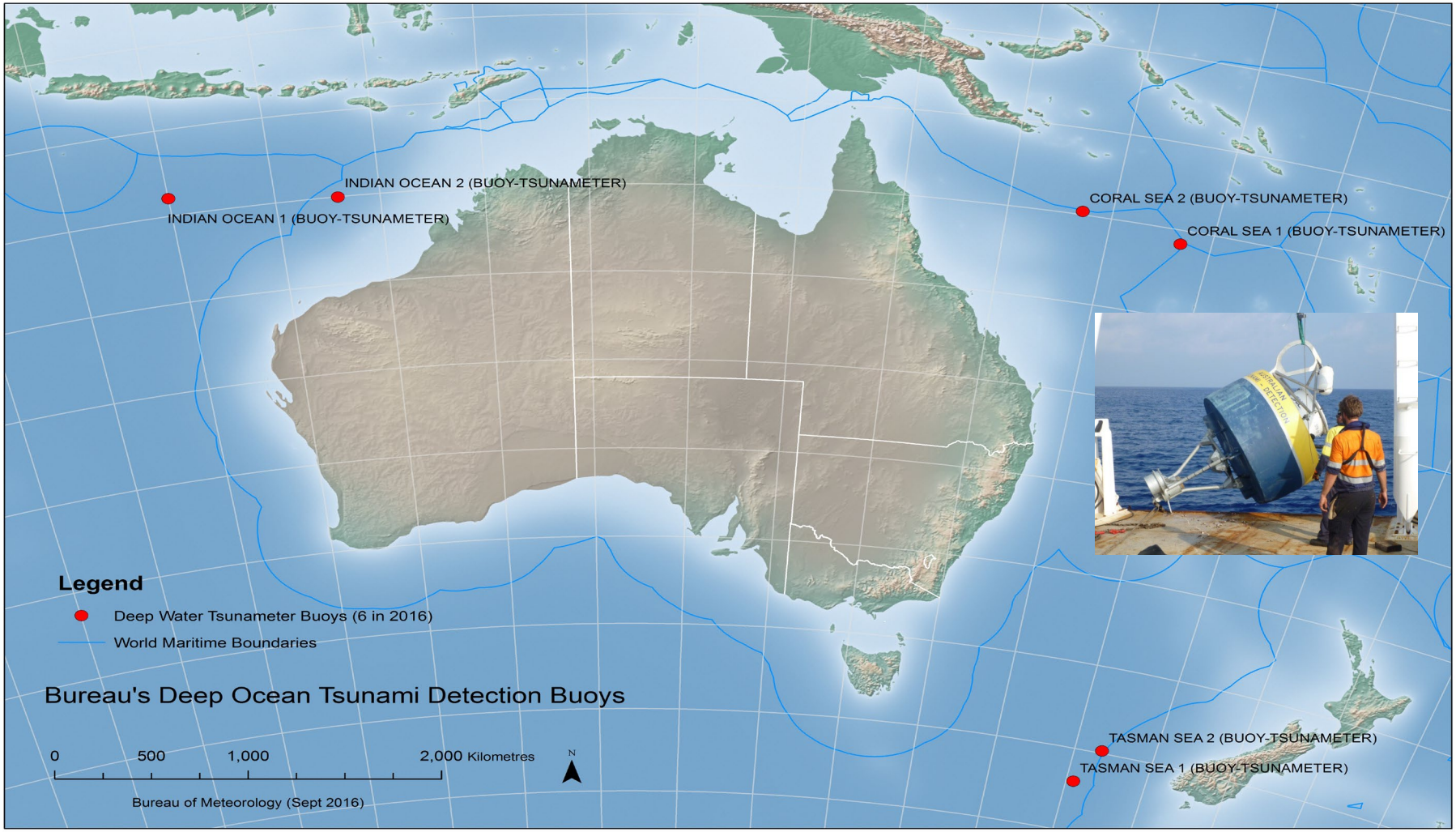
System 2 - Flood and Rain
Spectrum Reliance 151.5 and 152.4 MHz



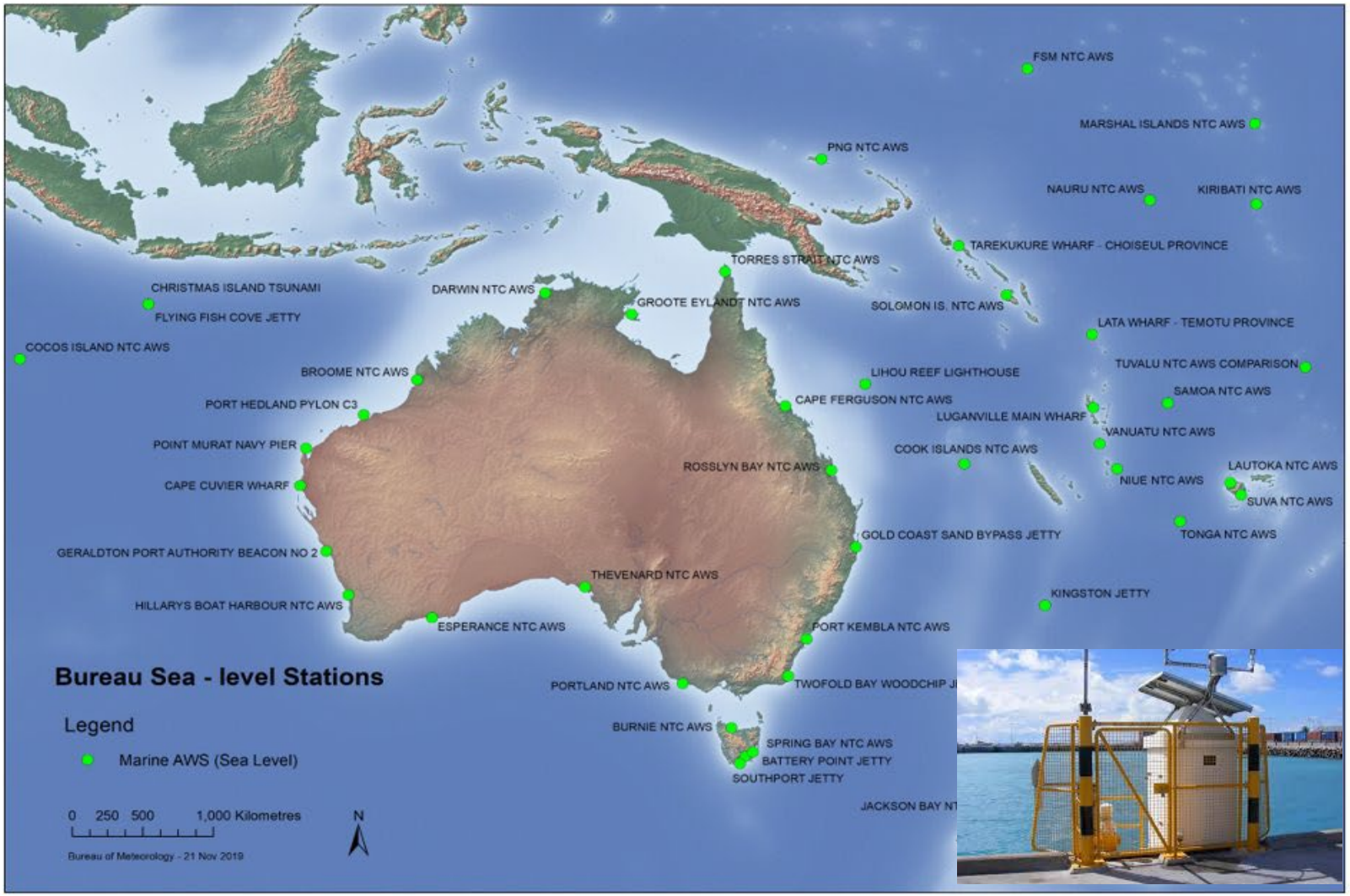
System 3 - Surface Network (AWS and Co-ops) Spectrum Reliance, Commercial use of 3G, 4G networks



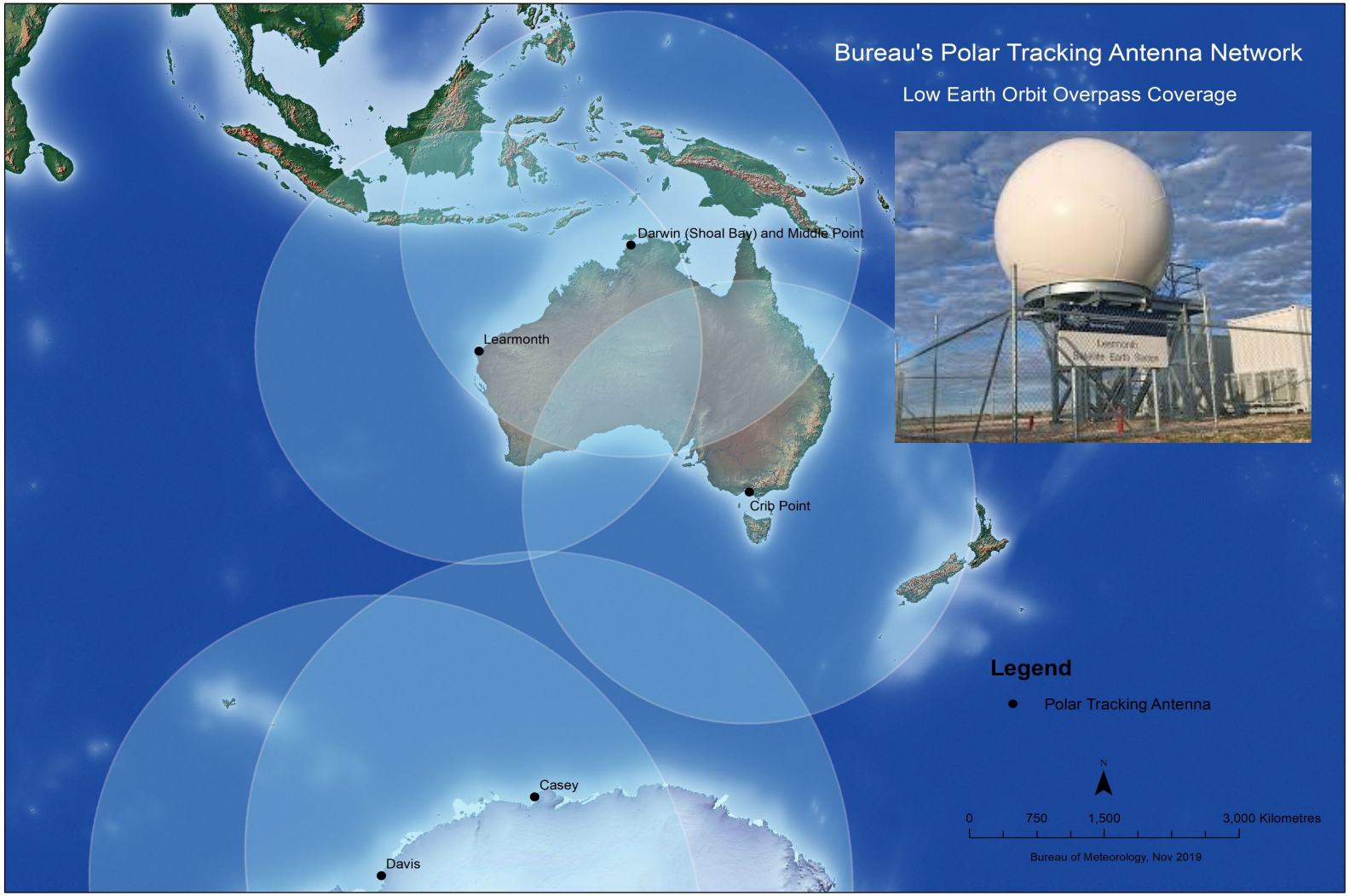
System 4 - Tsunami Part A
Spectrum Reliance ranging from 400 MHz to 40 GHz



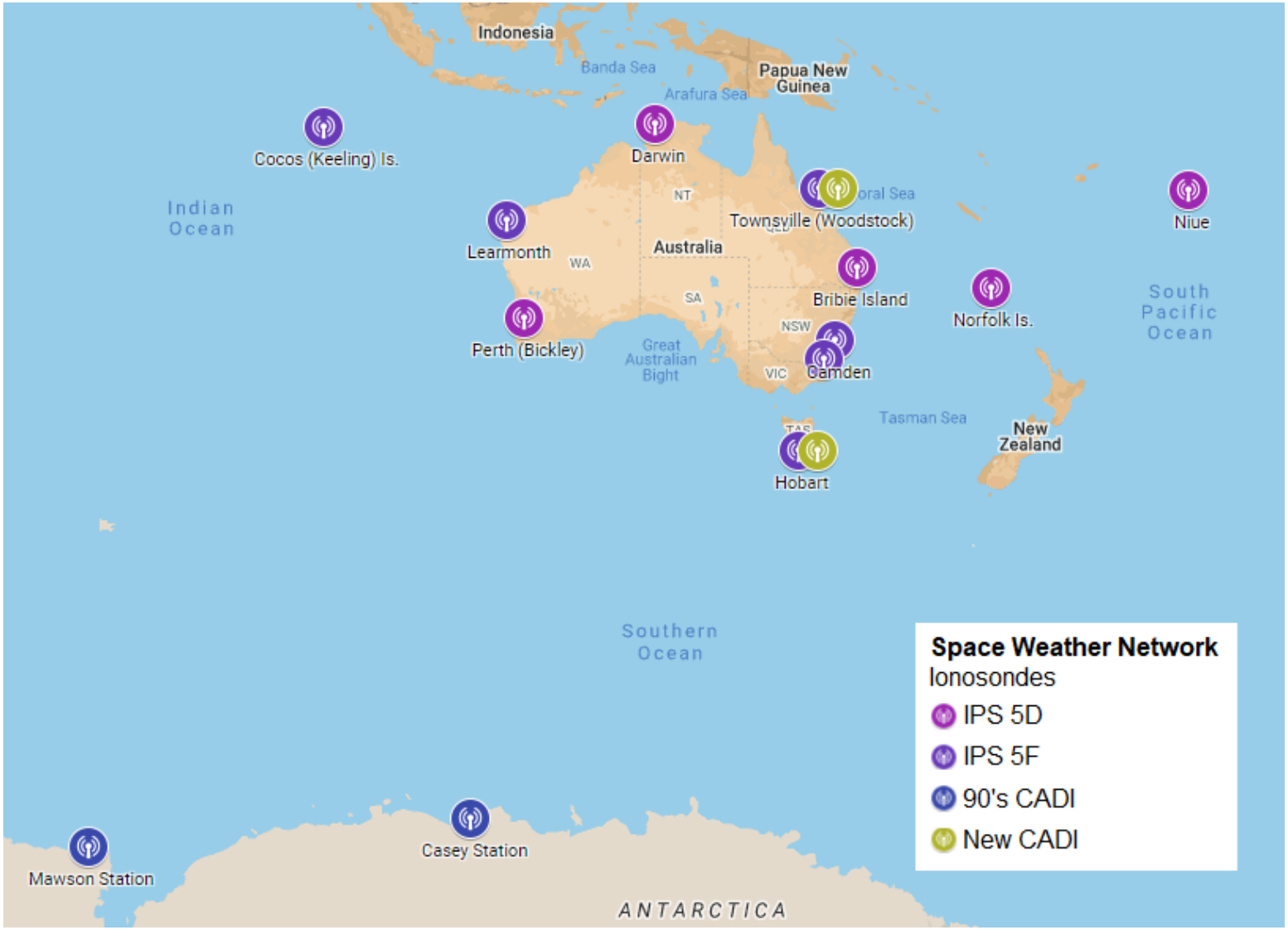
System 4 - Tsunami Part B Sea Level Spectrum Reliance ranging from 400 MHz to 40 GHz



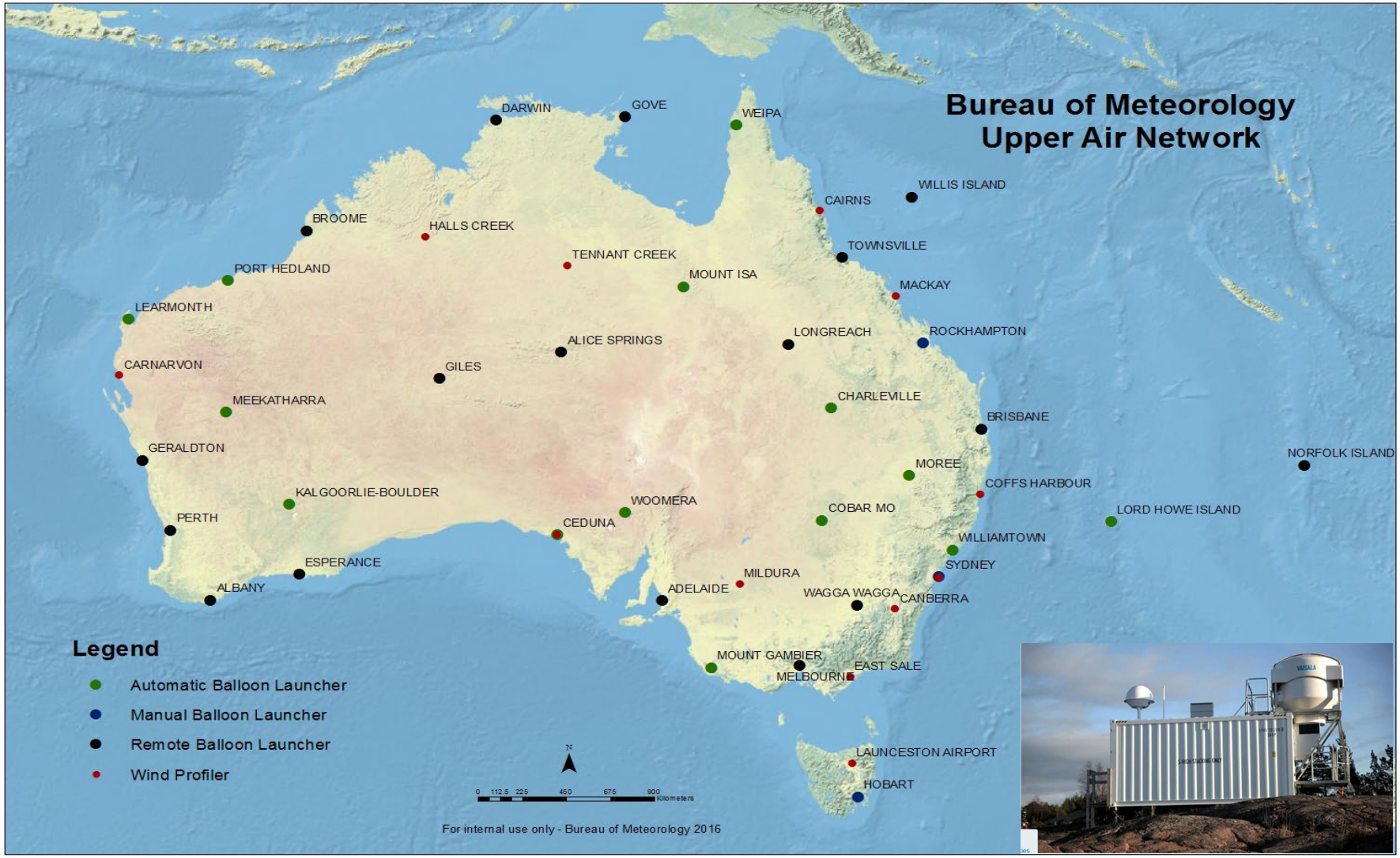
System 5 – Satellite
Spectrum Reliance Different frequencies(1700 MHz; 4000 MHz and 8GHz)



Ionosondes
Spectrum Reliance, HF systems (1-25 MHz)



System 9 - Upper Air
Spectrum Reliance 400.5 / 402.5KHz 1680Mhz



Bureau's Spectrum Summary

BoM is the third biggest government agency in terms of spectrum usage (Number of licences)

Frequency Bands	No. of Licenses	Application
2-25 MHz (Licensed at 11.3 MHz)	30	Ionosonde station
55 MHz	14	Wind profiler radar
150.8-152.4 MHz	282	PtP, PMP
400.1-403 MHz	101	Fixed receive (Upper air network)
450-472 MHz	38	PtP, PMP
1680 MHz	54	Fixed receive (Upper air network)
1690 MHz	26	Earth receive
2800-2900 MHz	30	S-band weather radar
5350-5650 MHz	56	C-band weather radars
7110-8500 MHz	30	Earth receive
9300-9500 MHz	8	X-band weather radar
10.7-13 GHz	12	PtP

Bureau Spectrum Related Challenges - Weather Radars

✓ Approximately 65 weather radars open to public across S, C and X bands
- Any technical & interference issues is directly visible to public
- Requirement for a more agile interference settlement process
- New technologies (like 5G) impose more regulatory & technical challenges

✓ Interference with WISPs at 5.6 GHz range. As an international concern, we face issues in Australia like:
- Outdoor WISP working on a higher power level than their regulatory limit
- International Shipping
- Their frequency hopping nature makes it difficult to find the interferer
- OOB emissions is another aspect that is difficult to prove/measure

✓ Interoperability with other radars, Defence and ASA (S-band licencing)

Bureau Spectrum Related Challenges - Weather Radars

✓ Licencing is sometimes a real bottle neck for the project due to:

- No time frame has been in place yet for the response by the spectrum stakeholders (A process, like what is in place by ITU-R for satellite coordination would facilitate it)
- Sometimes dispute in agreeing on a technical basis for discussion (e.g. ITU-R Recs & Reports? Or on criteria that seems to suit)
- Concern on protection/ co-existence between Mobile BTS and radars at S-band at this stage (RALI MS 35 for example)

✓ Other non-spectrum challenges

- Wind farms cause clutter on Weather Radars
- RADHAZ issues for inhabited infrastructure
- Clear view of horizon, power and physical access
- Co-Location and competition with other infrastructure. Communication and water Infrastructure

Future Innovations - Weather Radars

- ✓ Our current operational model is placing high power, high value assets in perfect locations.
- ✓ Eventually the Bureau will have to accept siting issues will make the above operational model infeasible.
- ✓ Interim Innovations
  - Continue to work with RF stakeholders to ensure license conditions for future High Power High value radar installs
  - Work with radar and software developers to develop and implement wind farm clutter removal and interference removal software
  - Investigate solid state radar options.
- ✓ Medium Term
  - Develop a larger low cost, low power radar network to meet community requirements
  - Deploy solid state mechanical or phased array radars
- ✓ Longer Term
  - Investigate existing and future commercial RF network metrics that could support meteorological observations
  - Collate RF attenuation meta data to support meteorological observations

Future Innovations
Satellite to Support Meteorological Observations

✓ Bureau's plan accessing space for:

- Independent satellite network as owner or shareholder
- Filling the gaps that international space fleet are currently providing for Australia
- Expanding the coverage of satellite networks
- Introducing extra vertical applications through space services for the meteorological purposes

✓ New challenges include:

- Investigation of frequency allocation and orbital position for the NGSO or GSO fleet
- Involvement with international stakeholder making sure that all the Bureaus' interest are adequately addressed and understood

The Bureau of Meteorology

Thank you