School of Earth Sciences
UNIVERSITY OF TASMANIA

Transportable seismic stations and arrays in Australia and Antarctica: The challenge of southern hemisphere coverage

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and

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Overview

This presentation: foundation for discussion on some aspects of international deployments of ?new arrays.

1. Current locations of permanent stations and arrays.

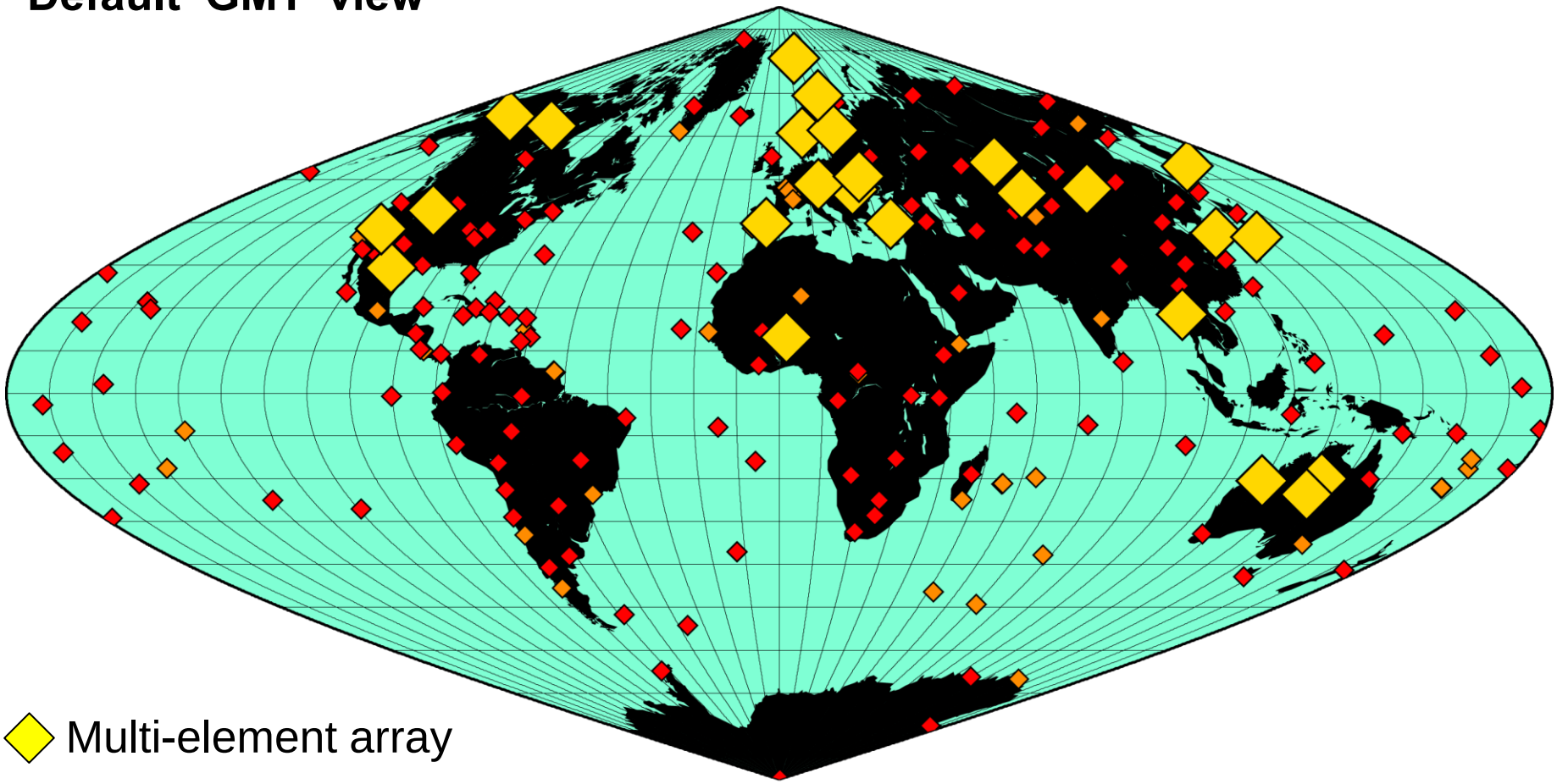
2. Selected initiatives over the last decade (or so): Transportable stations and arrays in Antarctica and Australia.
What kind *of stations, deployed* ***where*** *and* ***by whom****.*

3. Addressing the challenge of southern hemisphere coverage.

NOT COVERED: **Ocean-bottom deployments**
Upgrades of existing arrays (shortperiod, single component)

Global distribution of seismic arrays

Default ‘GMT’ view



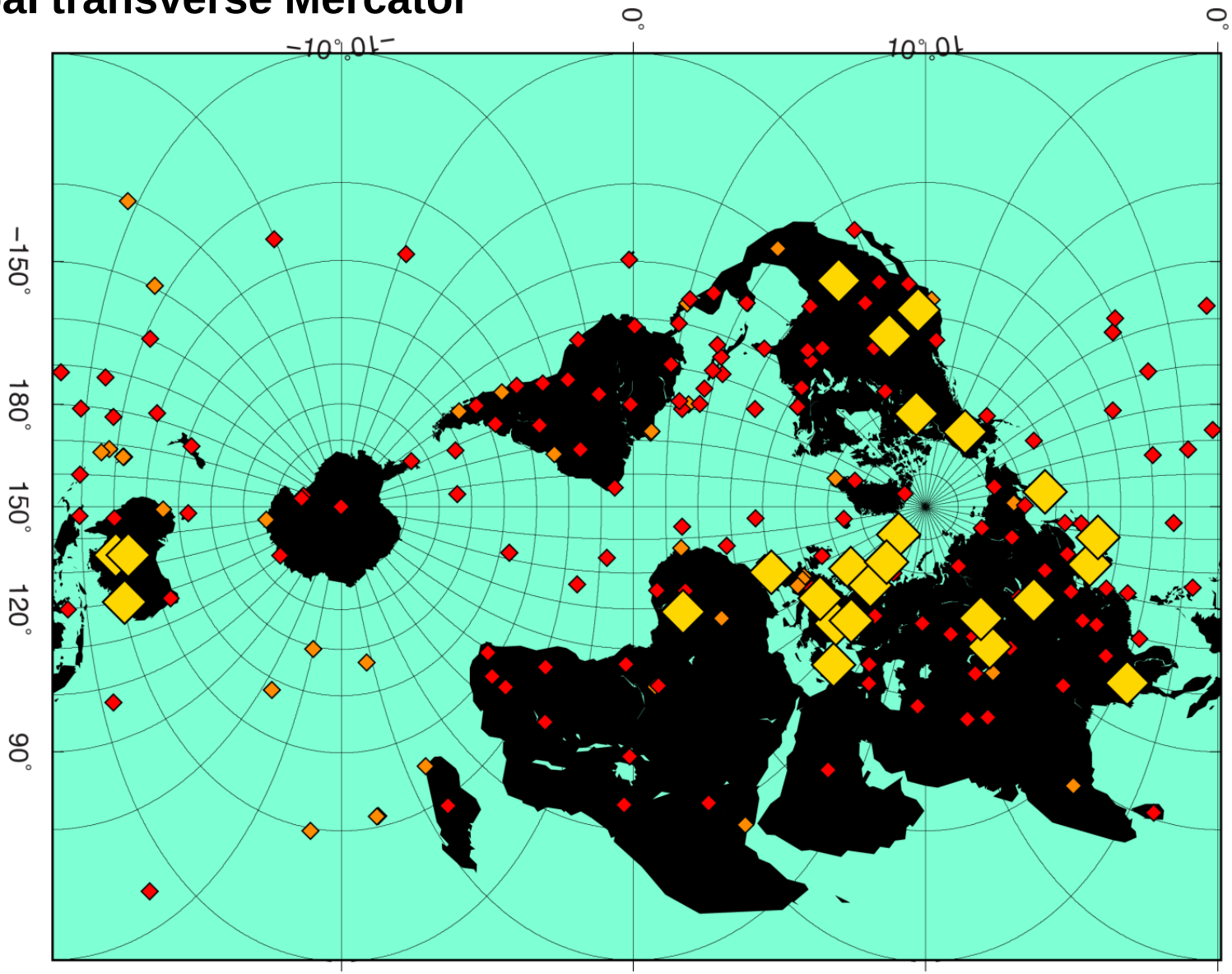
Multi-element array

GSN station

Geoscope station

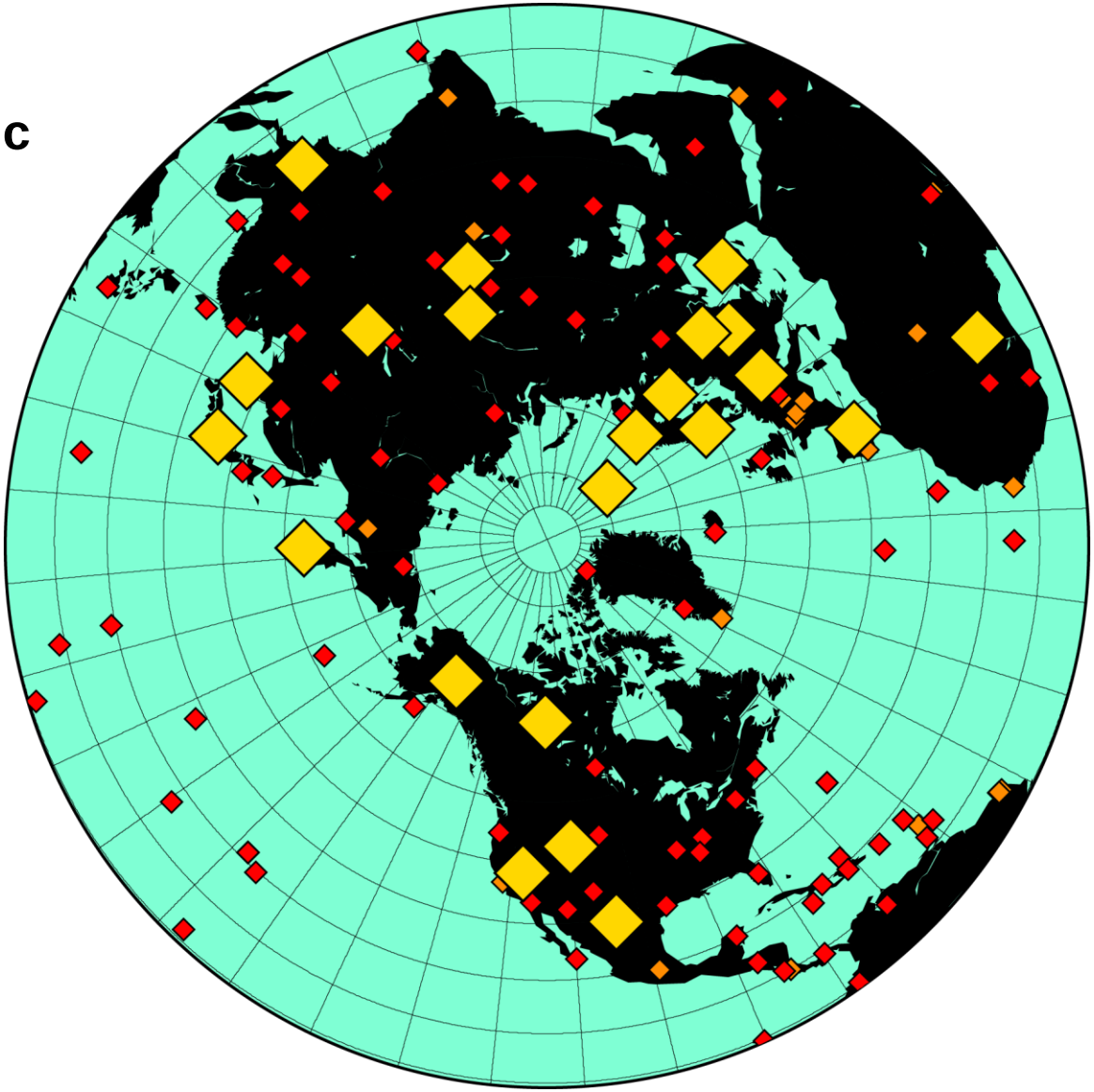
Global distribution of seismic arrays

Global transverse Mercator



Northern Hemisphere Seismic Arrays

Orthographic



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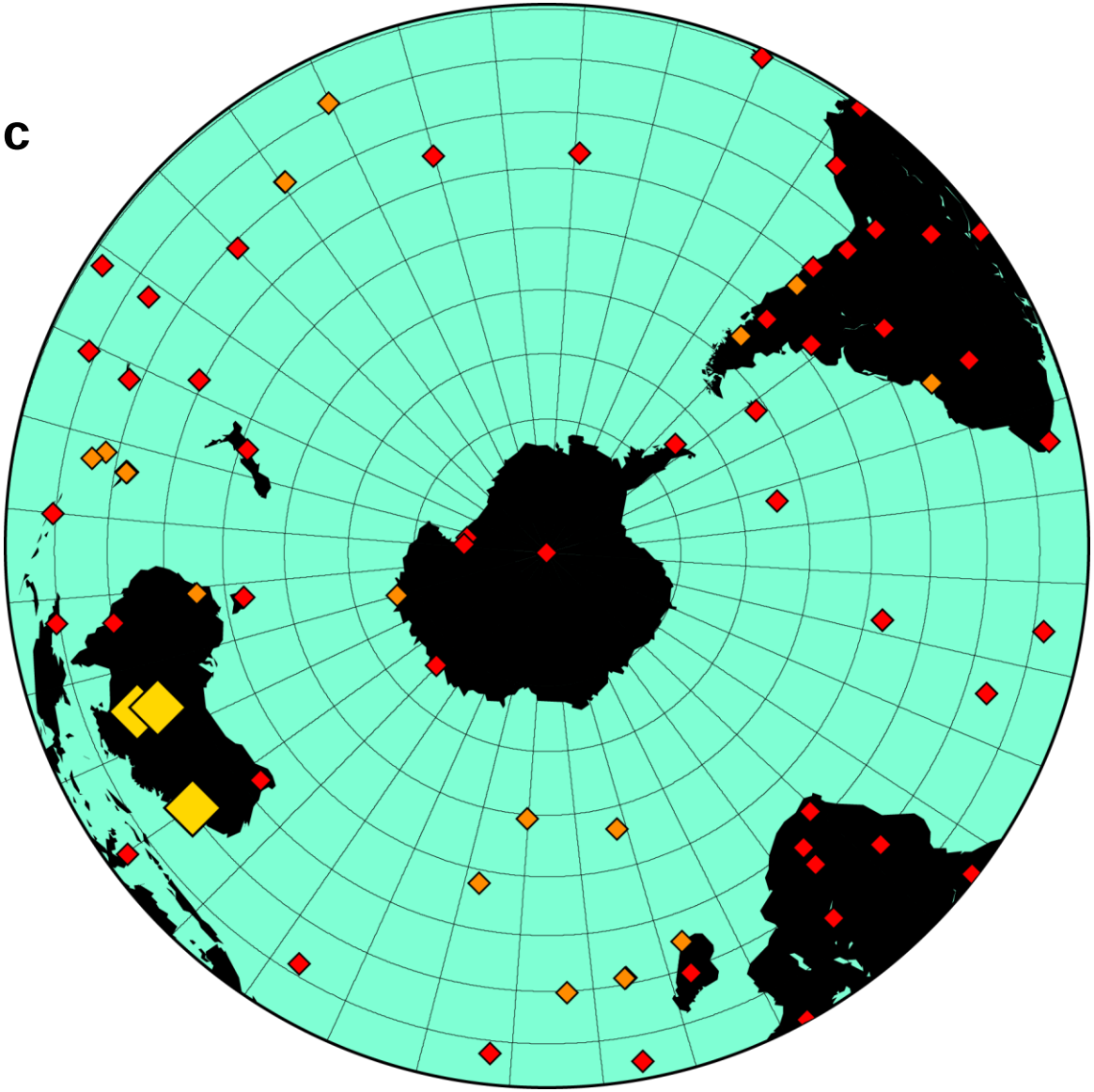


Transportable stations

Transportable stations and arrays in Antarctica and Australia:

- **significant impact on lithospheric structure studies**
- **some impact for deep earth studies**
- **opportunistic impact on source mechanism studies**

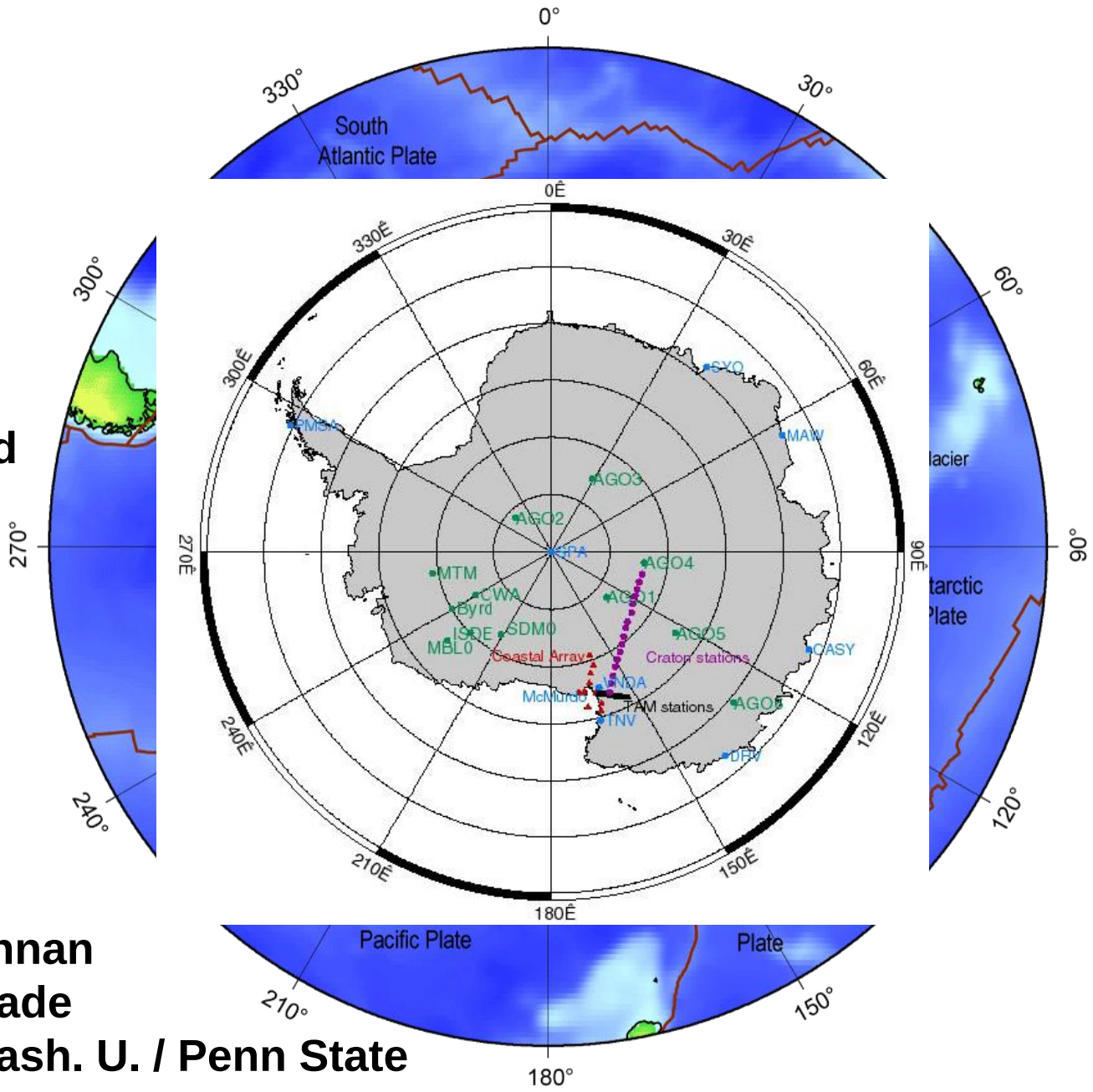
What kind *of stations, deployed* ***where*** *and* ***by whom ?***

Transportable stations - Antarctica

ANUBIS
1999-2001

TAMSEIS
2000-2003

Broadband

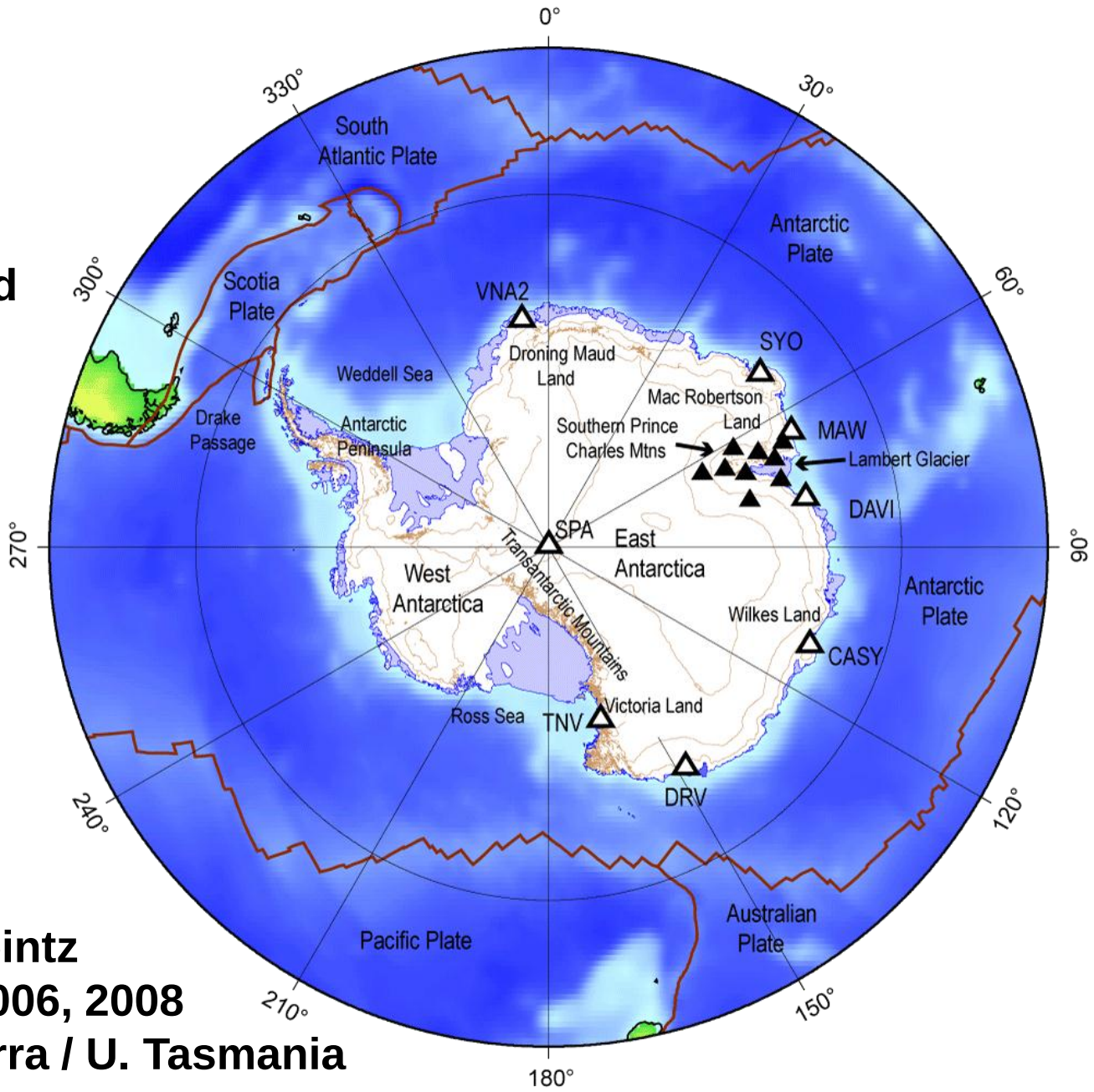


Anandakrishnan
Wiens, Nyblade
Alabama/ Wash. U. / Penn State

Transportable stations - Antarctica

SSCUA
2002-2005

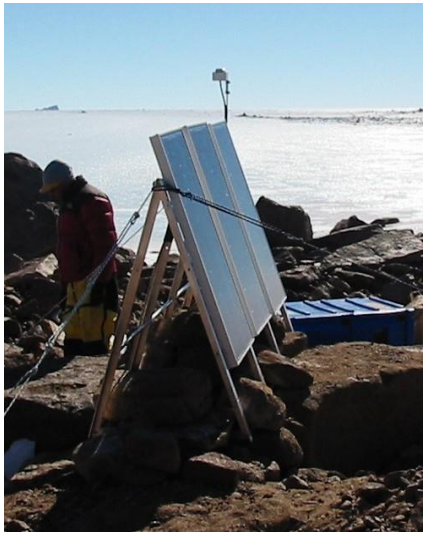
Broadband



Reading, Heintz
e.g. EPSL 2006, 2008
ANU Canberra / U. Tasmania

Transportable stations - Antarctica

SSCUA 2002-2005

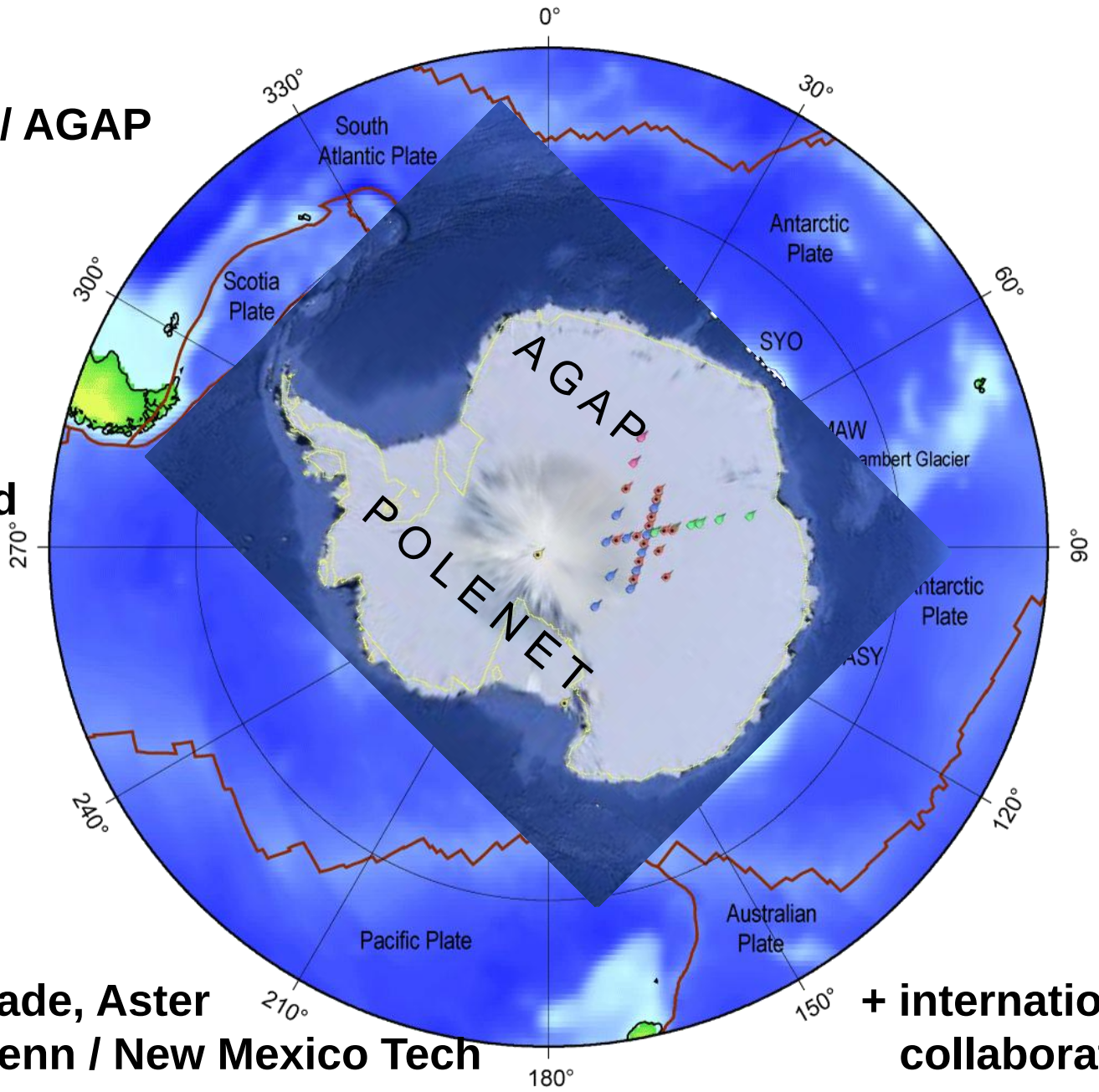


Transportable stations - Antarctica

GAMSEIS / AGAP
2007-2009

POLENET
2007-
ongoing

Broadband



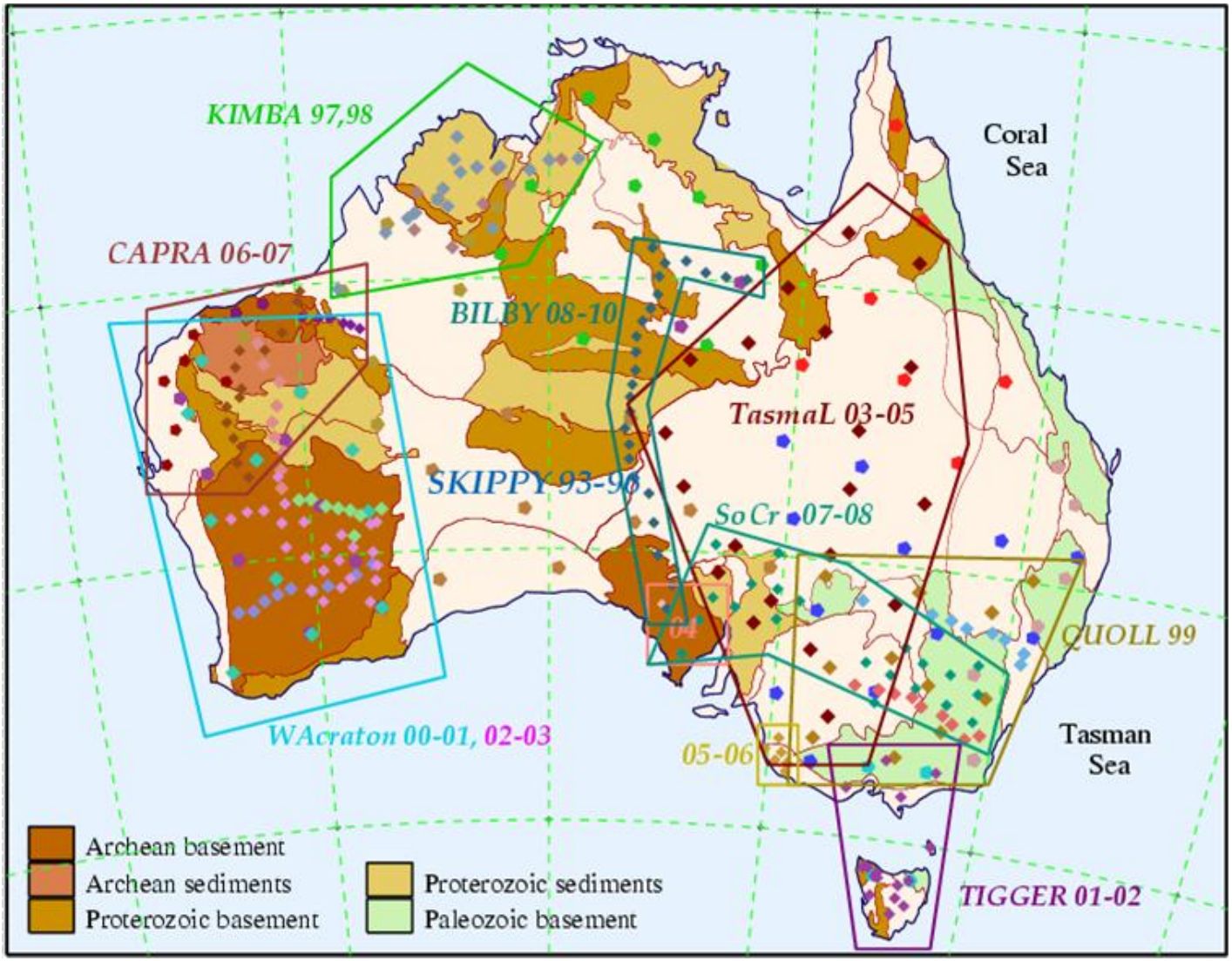
Wiens, Nyblade, Aster
Wash. U. / Penn / New Mexico Tech

+ international collaborators

Transportable stations - Australia

Broadband

e.g.
CAPRA



Kennett et al., GJI, 2011, ANU / Geoscience Australia
Reading et al., Precambrian Res. 2012, ANU / UTas

Transportable stations - Australia

Transportable stations - Australia

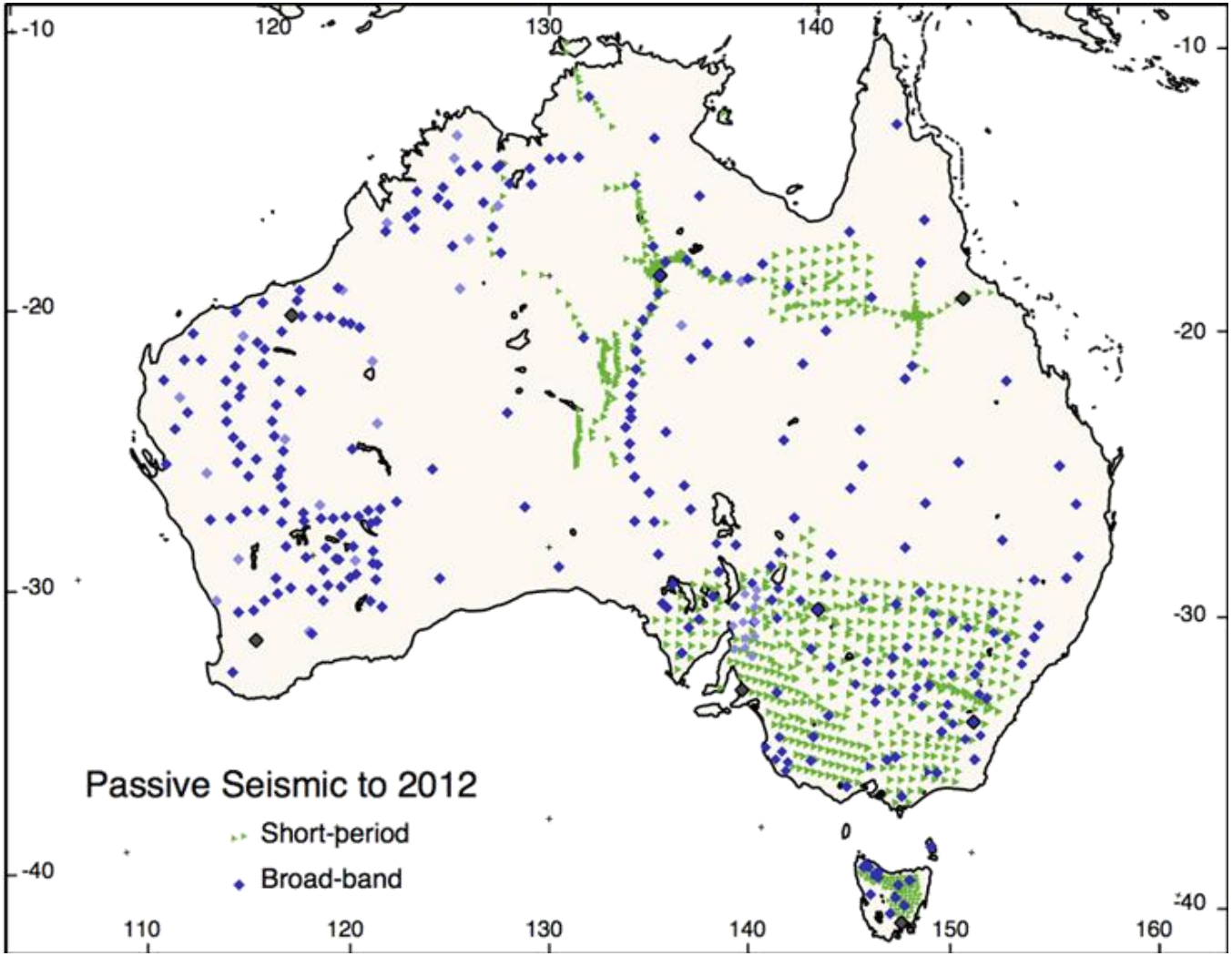
Broadband and Shortperiod

Nominal sep.

50 km (bb)

45 km (sp)

15 km (Tasmania)



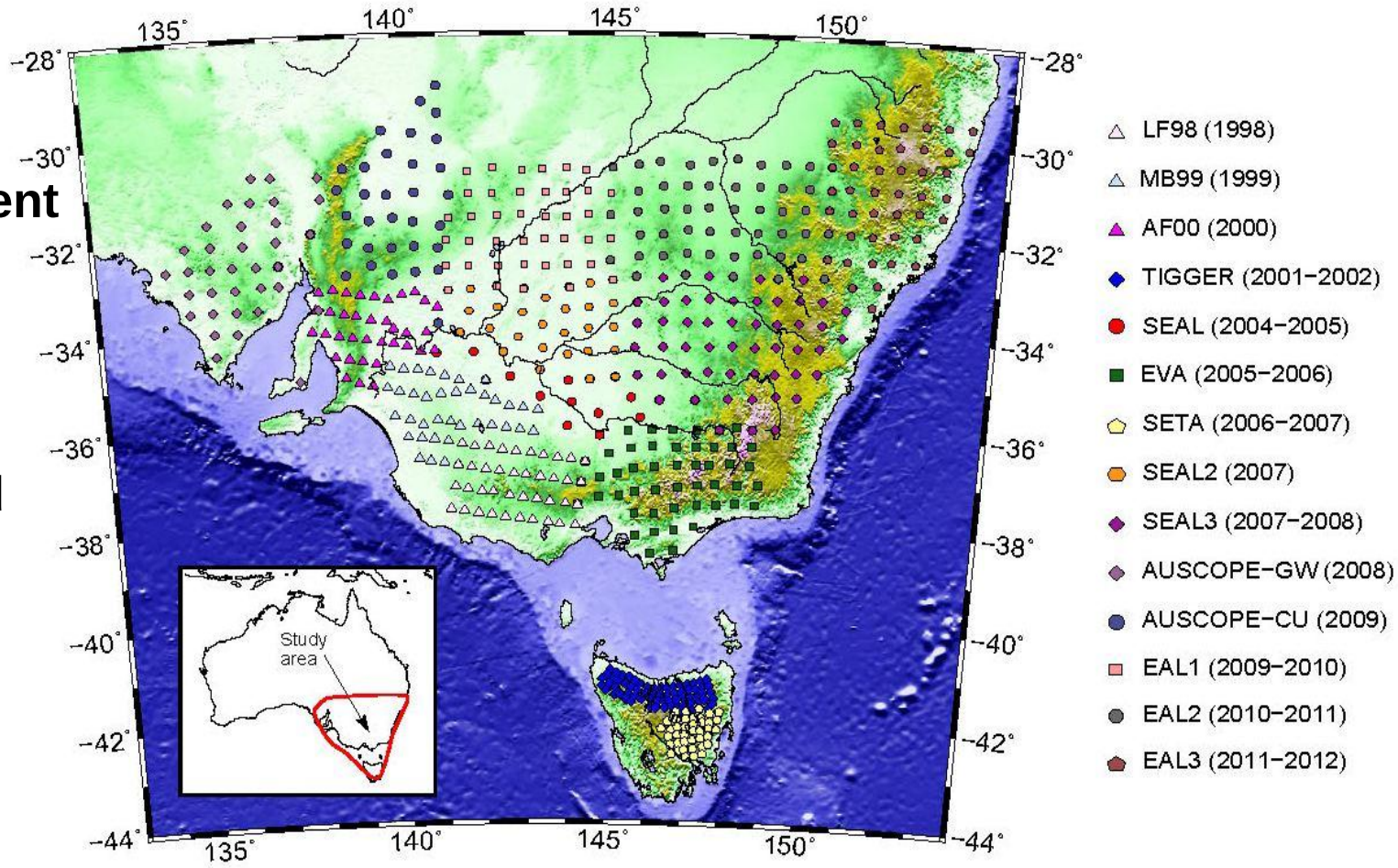
Kennett / Rawlinson / Reading / Tkalčić and many others
ANU / Geoscience Australia

Transportable stations – SE Australia

WOMBAT

Mostly 3-component short period

Some broadband

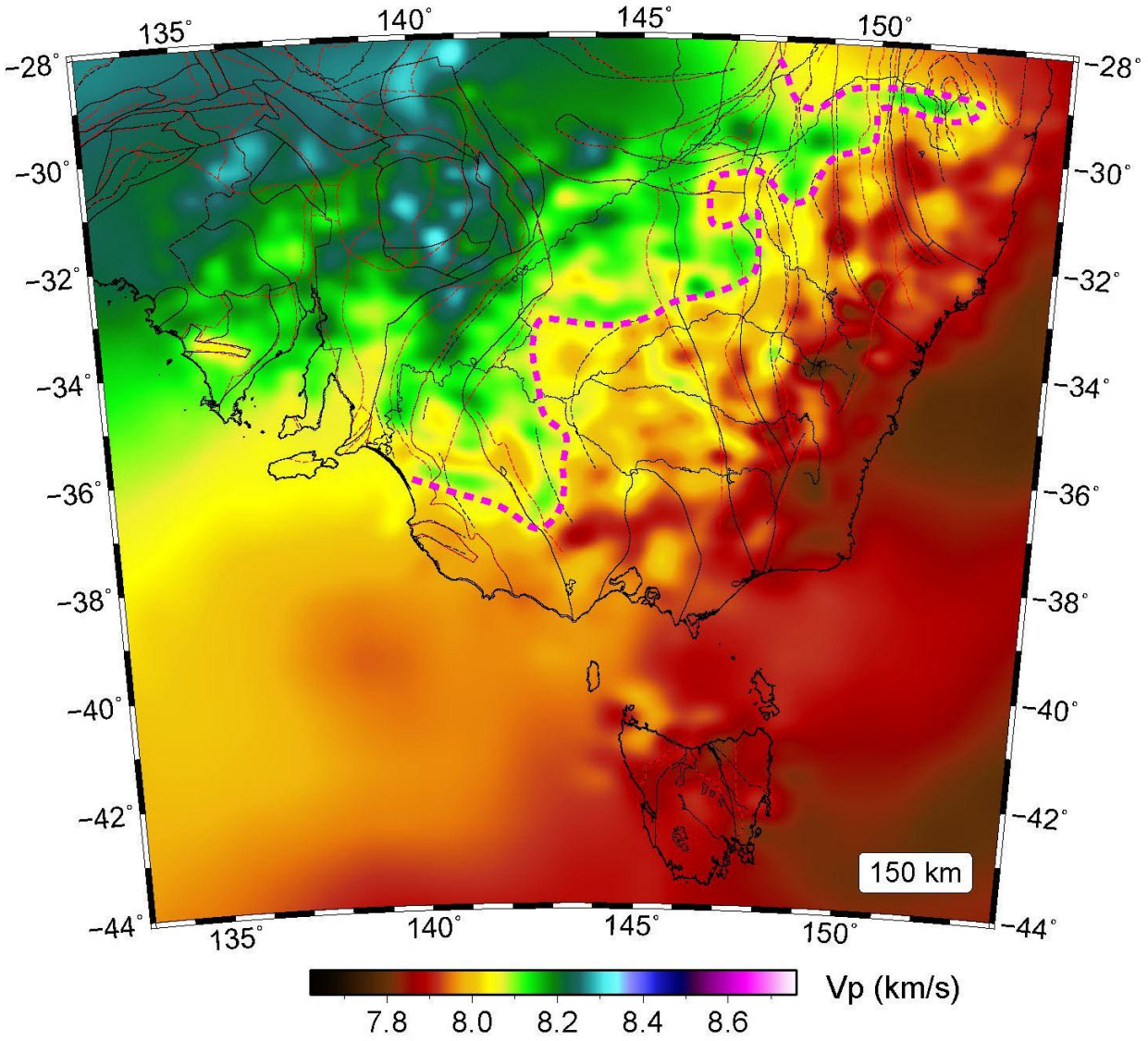


Rawlinson + Tkalčić, Reading and many others, ANU / UTas / Geol. Survey of NSW

Example result – high resolution structure

WOMBAT

Teleseismic and ambient noise



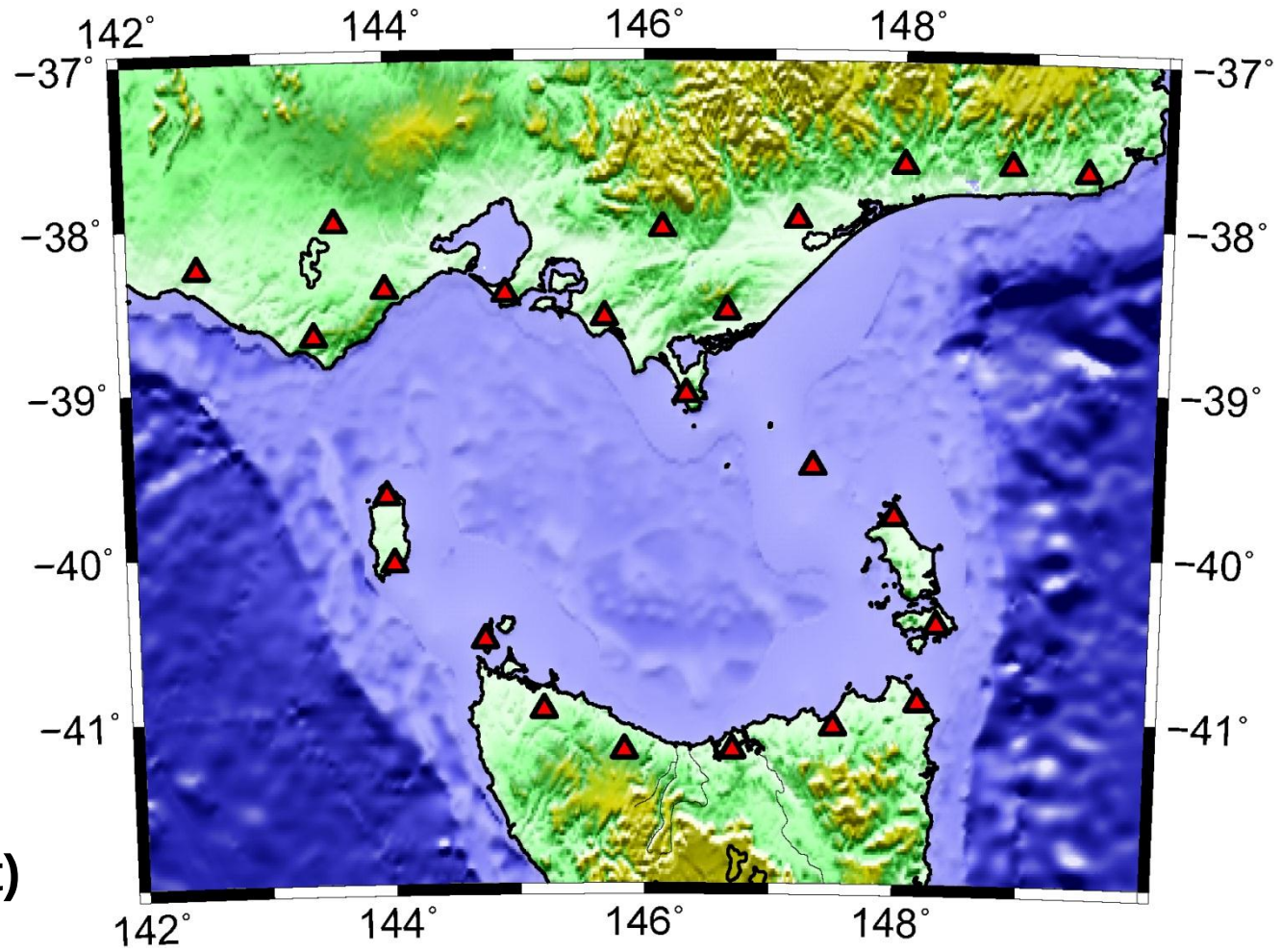
Rawlinson et al. (submitted) Lithos

Transportable stations – Bass St

Broadband

(currently operating)

NB Significant component of field time by academics (little, or no, technical support)



Rawlinson / Reading and others
ANU / Utas / GSV / MRT / FrOGTech

10 Grand Challenges

2008 NSF workshop on seismological research frontiers identified
10 ‘Seismological Grand Challenges’

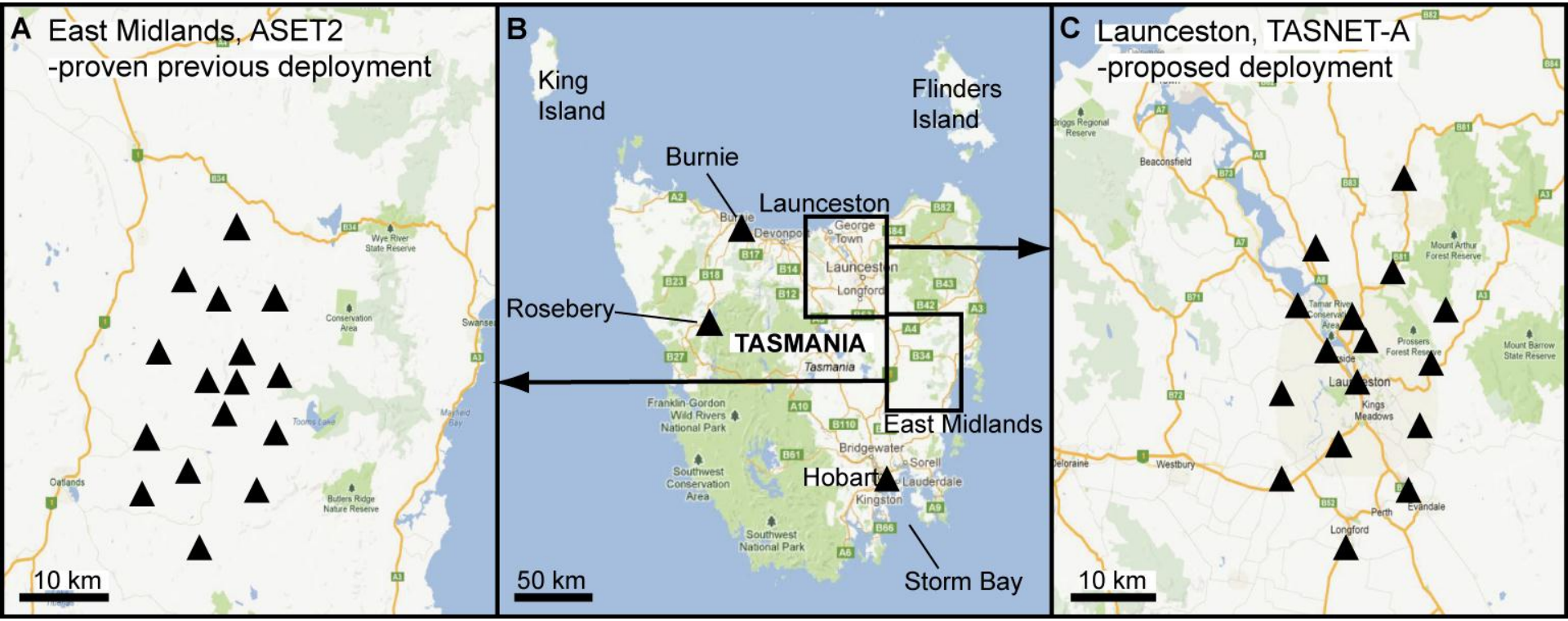
Improved array coverage will enable research in these areas:

✓ ✓	1. How do faults slip?
✓	**2. Near surface environment/natural hazards and resources**
✓	3. Stress and strain in the lithosphere
✓ ✓	**4. Ocean/atmosphere interaction with the solid Earth**
	5. Water and hydrocarbon exploration
✓	6. How do magma’s ascend and erupt?
✓ ✓	7. Lithospheric-asthenosphere boundary
✓ ✓	8. Plate boundary system evolution
✓ ✓	9. Temperature/composition variation, mantle/core convection
✓ ✓	**10. Earth’s internal boundaries and dynamics**

Transportable arrays – Tasmania

Previous

?Next year



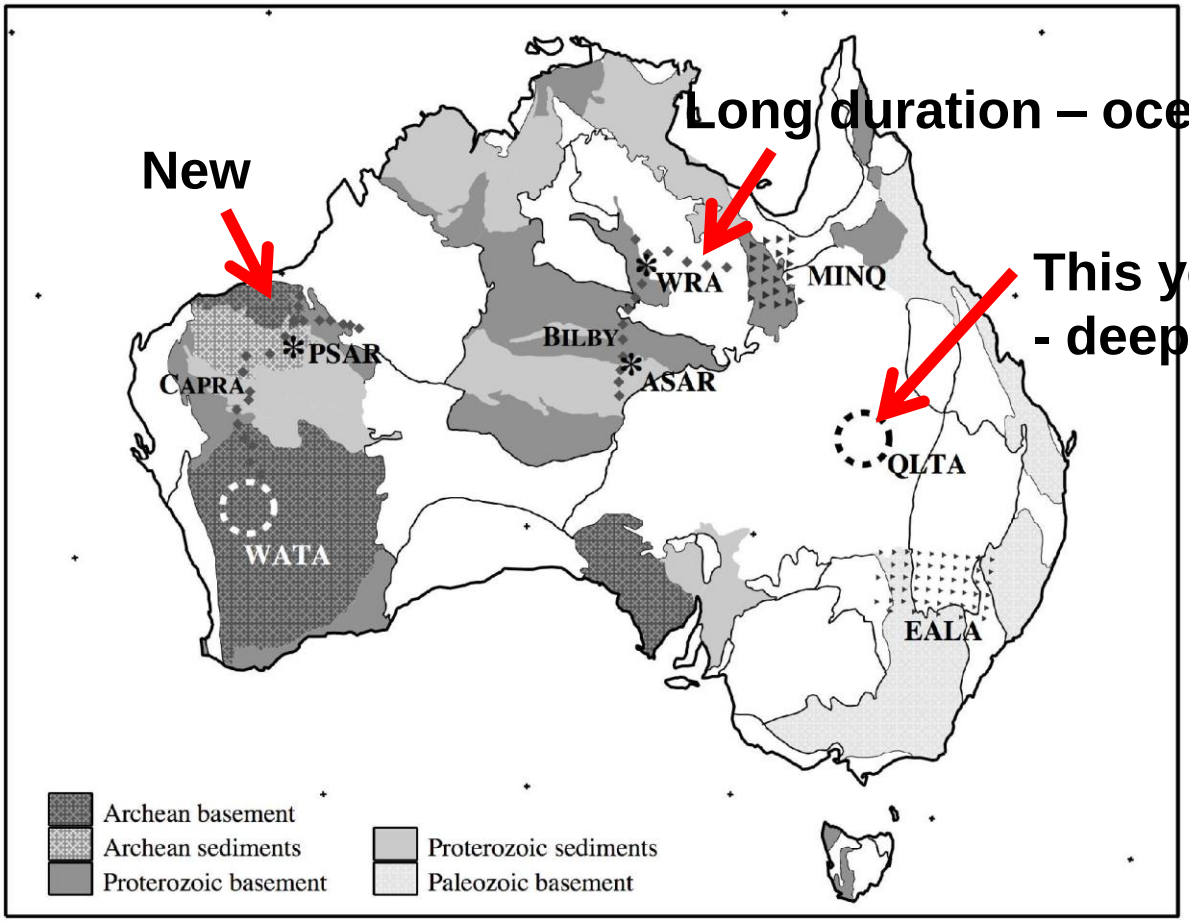
3-component sp

3-component bb

Reading / Rawlinson
UTas / ANU / KUTh Energy Ltd

Reading + others
UTas

Permanent and transportable arrays

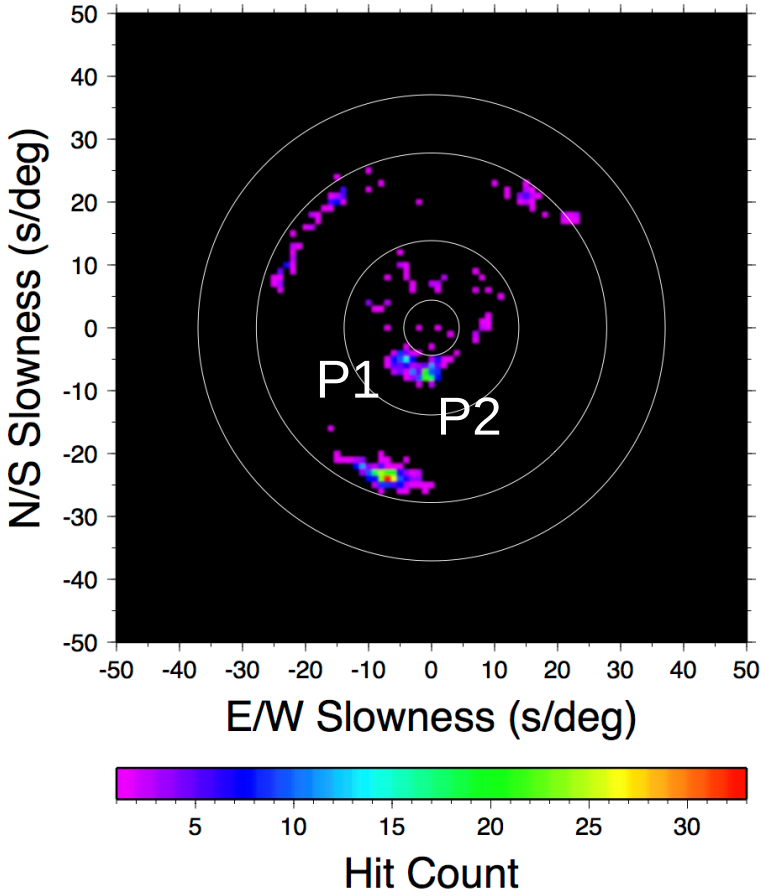


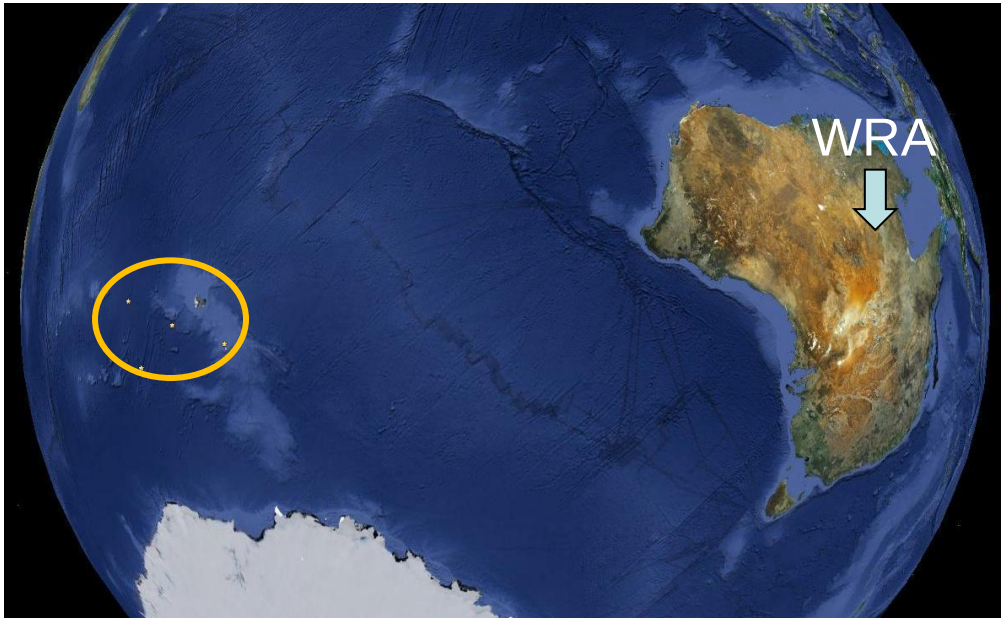
Tkalčić / Kennett Reading
ANU / Geoscience Australia

Example result – Southern Ocean noise

Data from Waramunga (WRA) array, 1 hour, every 3 hours, 1990-2009

e.g. southern winter, 2000





Dominant P wave sources: Reading, Koper, Tkalčić et al. (in prep.)
Variability over two decades: Reading, Koper, Tkalčić, et al. IASPEI 2013.

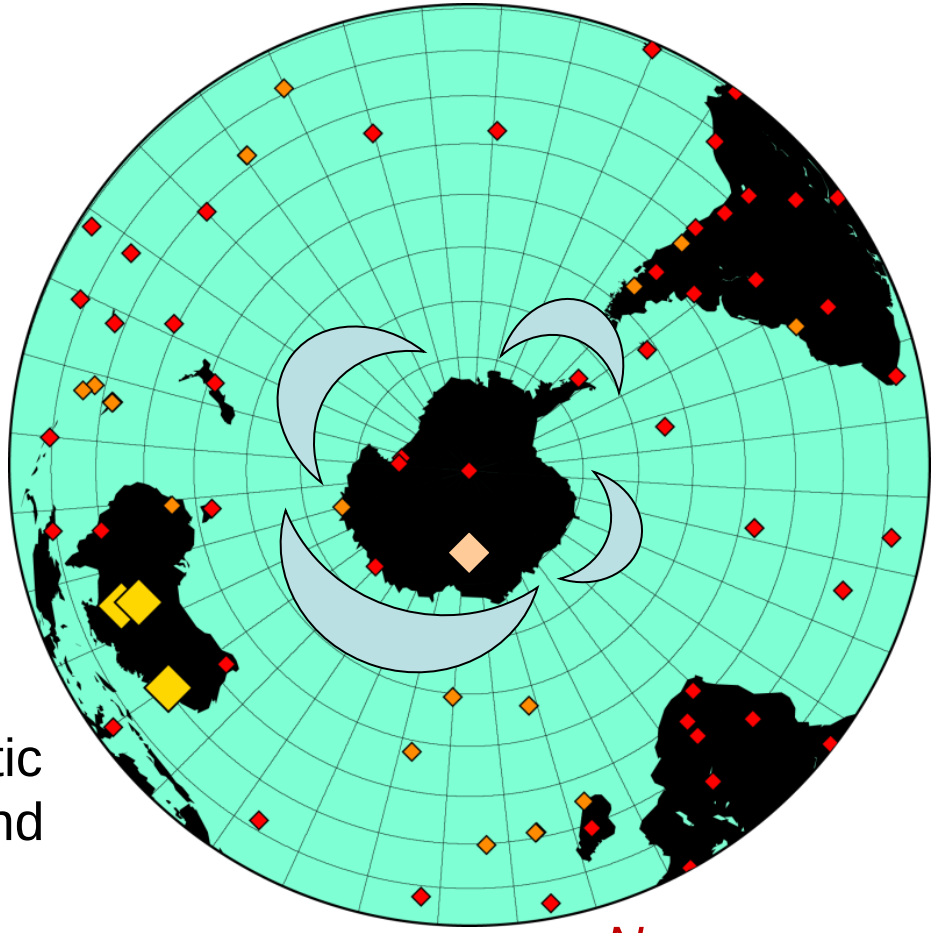
The challenge of the challenges

Thought experiment – new array located close to SSCUA stations

- Any big logistic effort suggests broad scale array with smaller-sep. array at centre.
? Possible model for less remote sites too.

- Strong precedents for international collaboration (e.g. AGAP).

- Reconnaissance is advanced.
Much technical knowledge and logistic experience held by IRIS/UNAVCO and scientists working in Australia, Africa and South America.



New array

Summary

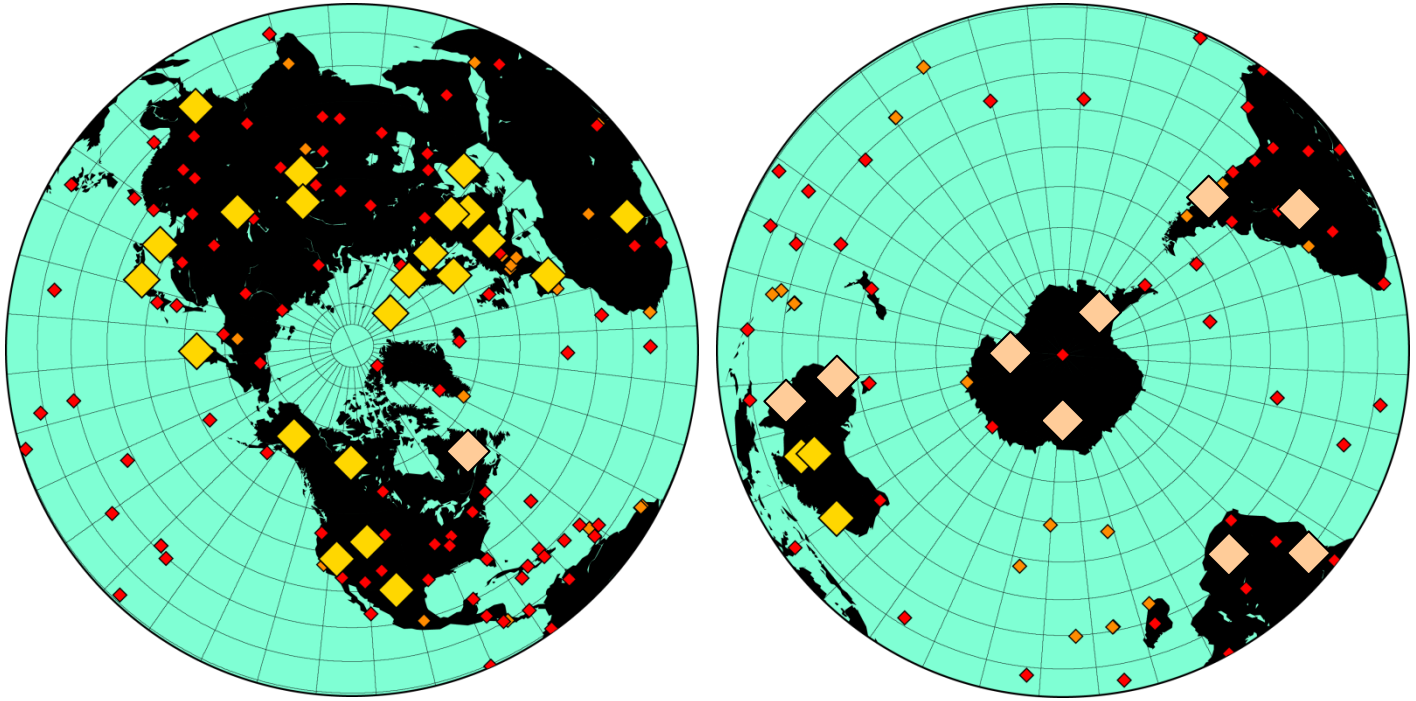
1. **Acknowledge the global perspective of this workshop and of the Grand Challenges documents**

2. **Southern hemisphere station distribution is *dramatically inferior* to the station distribution in the northern hemisphere. !!! Biased sampling of global structure and patchy sampling of source mechanisms.**

3. **Small but significant community of US and southern hemisphere-based researchers and science support with previous experience in Antarctica and Australia (also S. America and Africa). We can optimise new array deployments using results from previous (transportable) array and station data.**

Thank-you

?



10 Grand Challenges