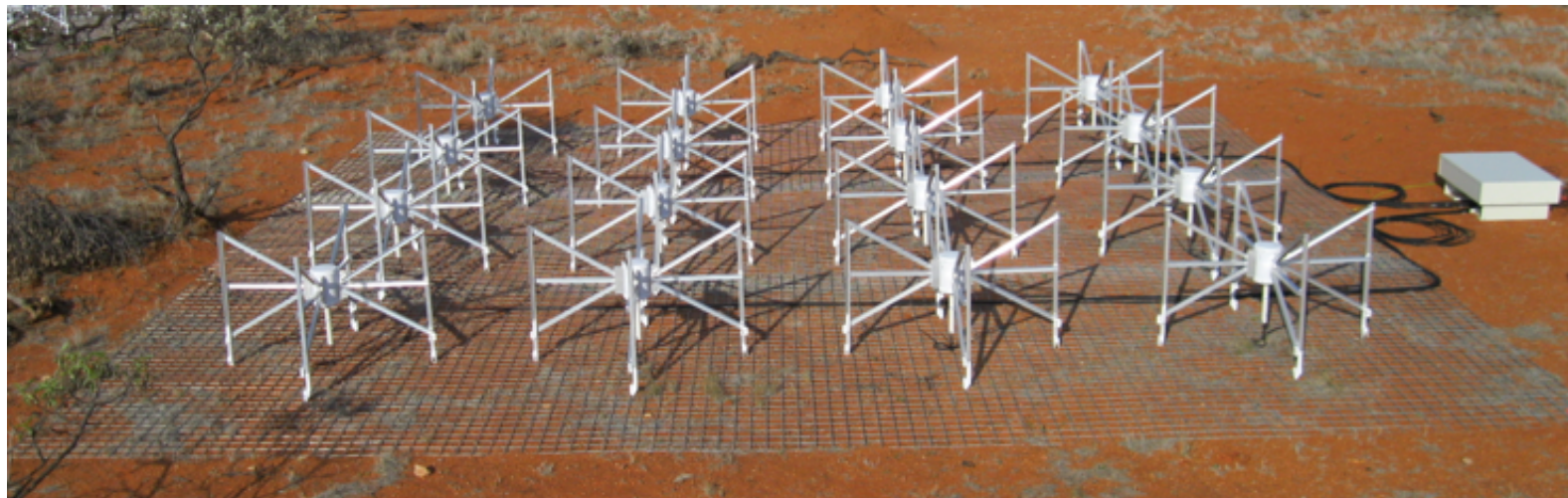




Murchison Widefield Array



Randall Wayth
Director, MWA



Australian Government





Phase II MWA

Partners



Australian National University



Brown University



Curtin University



Kagoshima University



Kumamoto University



Nagoya University



Tohoku University



University of Melbourne



University of Sydney



University of Tokyo



University of Toronto



University of Washington



University of Western Australia



University of Wisconsin-Milwaukee



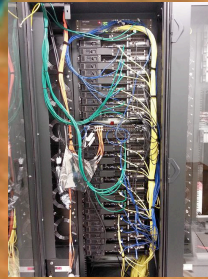
Victoria University of Wellington



Western Sydney University

MWA: SKA Low precursor





Murchison Shire Boundary

MRO (operated by CSIRO)

On site: data rate into central building ~60 Gbps

41,000 sq. km = The Netherlands

Population density = 0.002 people/sq. km

Geraldton

Off site: data rate into science archive ~3 Gbps

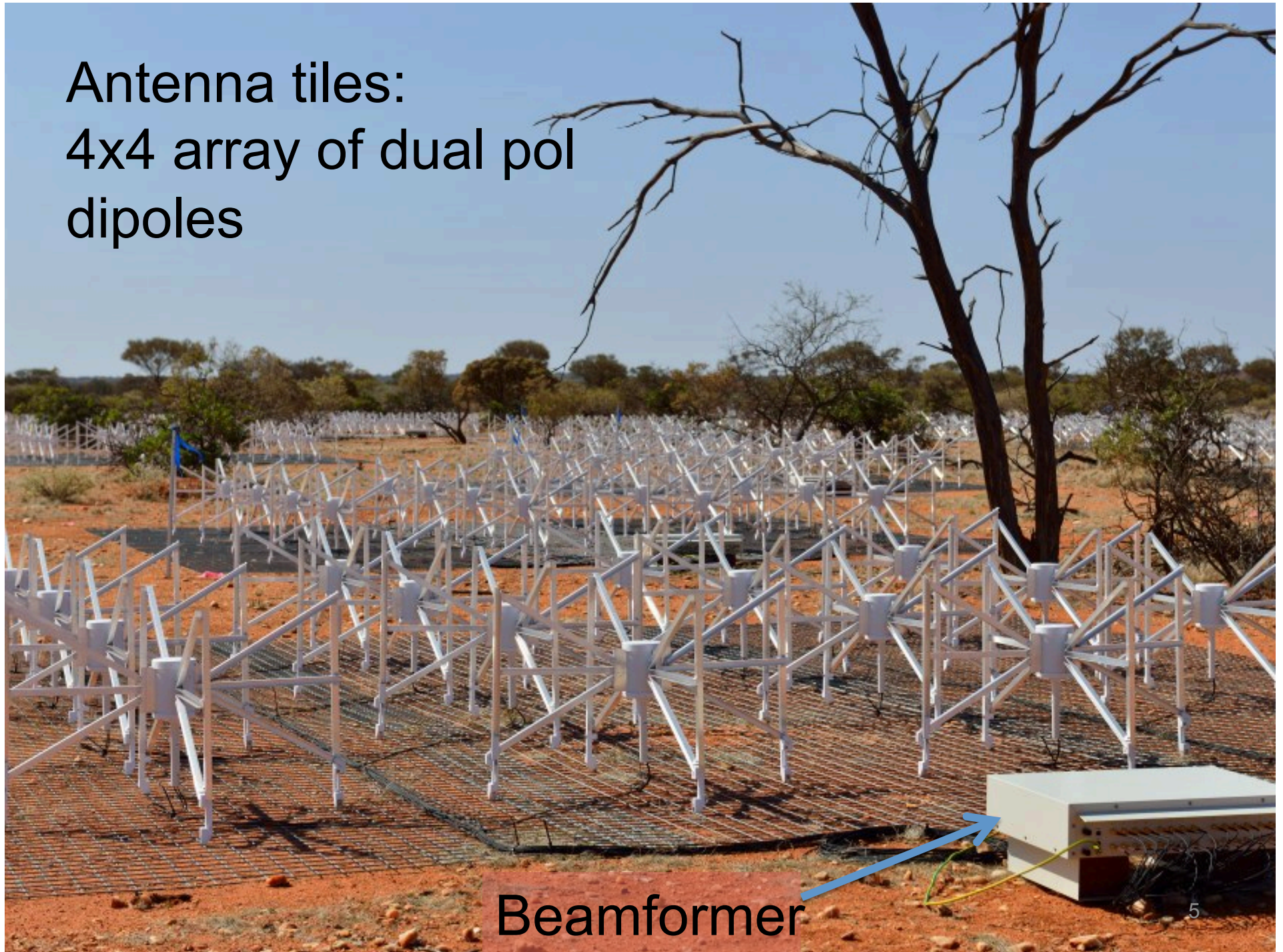
~200 km

Perth



Pawsey Centre 9 PB storage for MWA

Antenna tiles:
4x4 array of dual pol
dipoles



Beamformer

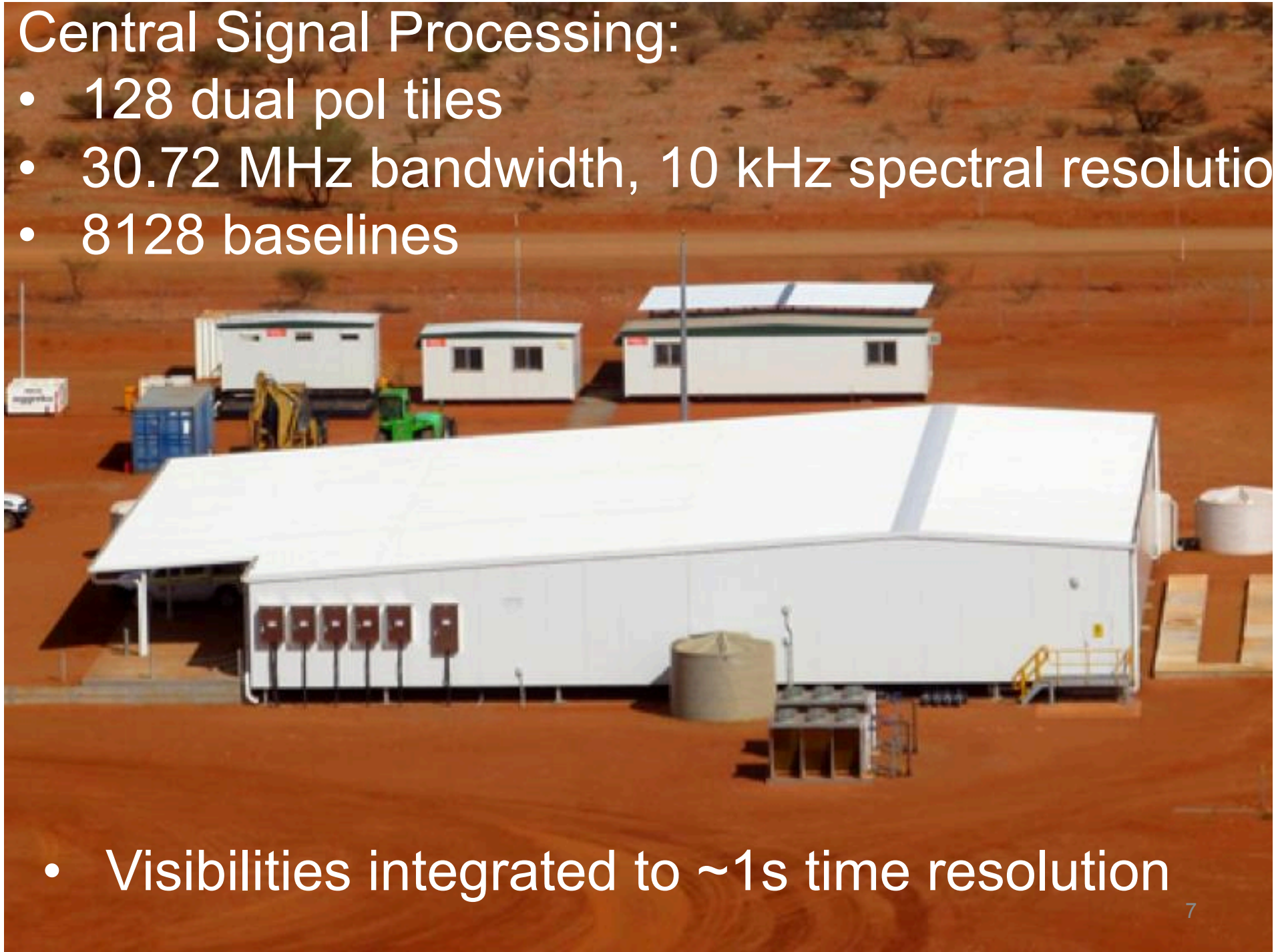
Receivers:

- Each receiver services 8 tiles
- Sky signal is digitised and sent to central processing facility



Central Signal Processing:

- 128 dual pol tiles
- 30.72 MHz bandwidth, 10 kHz spectral resolution
- 8128 baselines



- Visibilities integrated to ~ 1 s time resolution

800 km of optical fibre



Pawsey Supercomputing Centre (Perth, next to Curtin)

- Data archive & data portal for all users
- Galaxy supercomputer for:
 - Data quality & flagging
 - Calibration & imaging
 - High time resolution data processing



www.pawsey.org.au

u

RADIO QUIET ZONE

You are now entering the Murchison
Radio-Astronomy Observatory



Please switch off and do not use your mobile and satellite
phones or CB radio while inside the Observatory.

Please only use these devices in case of Emergencies

Your co-operation is appreciated

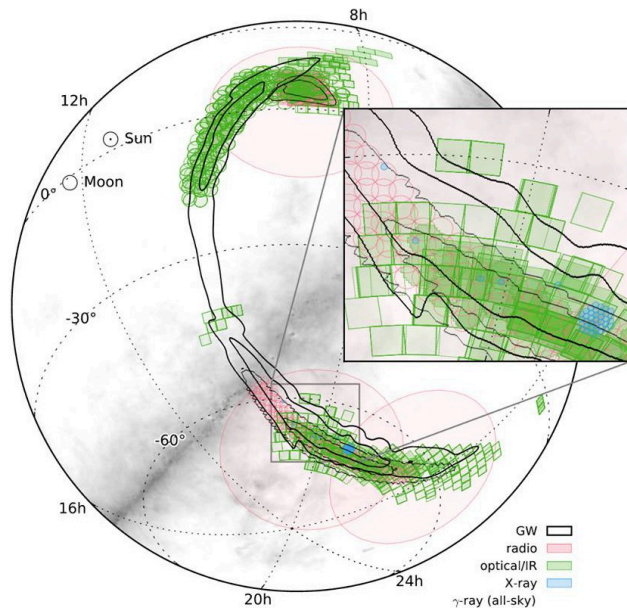


Phase I MWA: 128 tile system

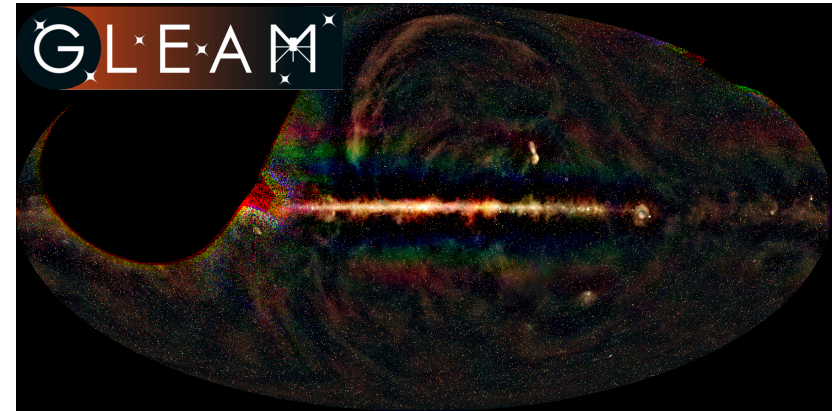
- Antenna tiles: 128
- Operating frequency: 70-300 MHz
- Array diameter: 3 km
- Processed bandwidth: 30.72 MHz / 10 kHz
- Field of view: 30 degs @ 150 MHz
- Many small antennas -> huge field-of-view and excellent image fidelity (arcmin resolution)
- 2016-2017: *MWA phase 2 upgrade*. Doubles number of antennas and array diameter



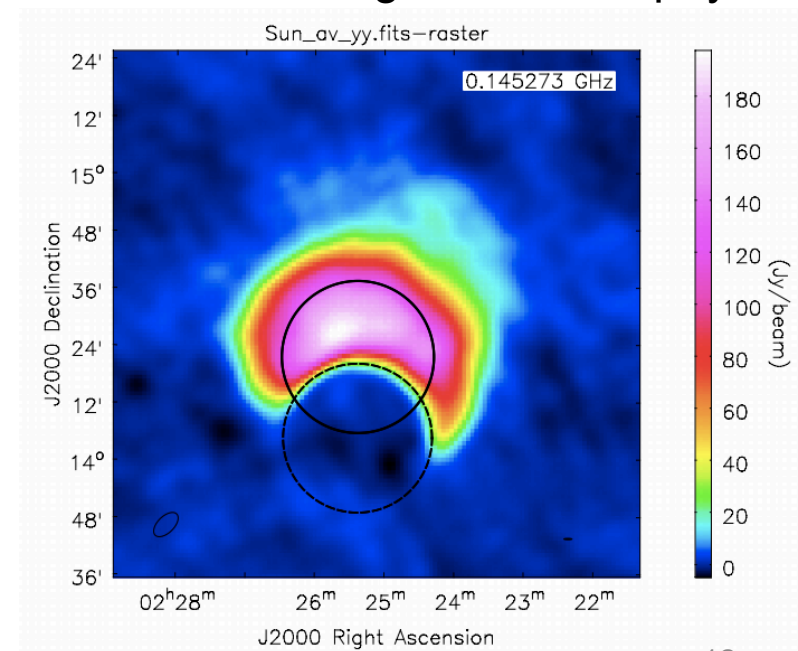
The Epoch of Reionisation



Transient & variable universe



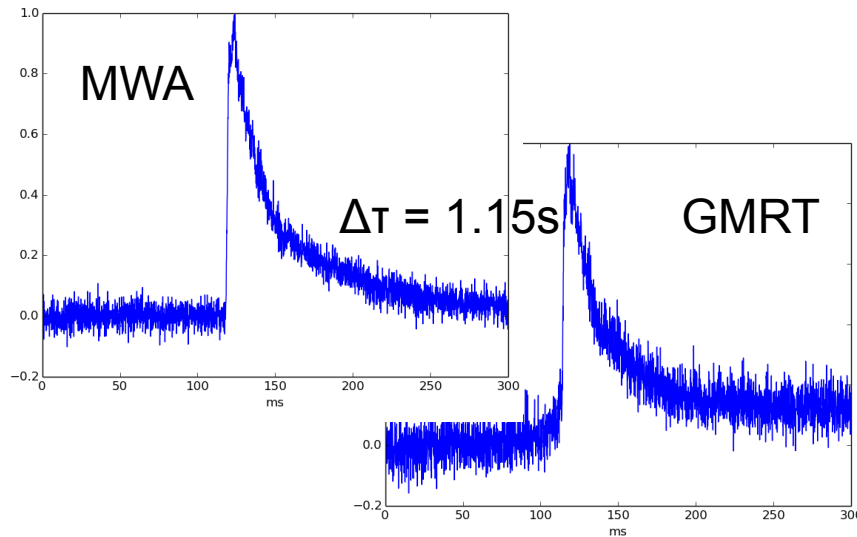
Galactic & extragalactic astrophysics



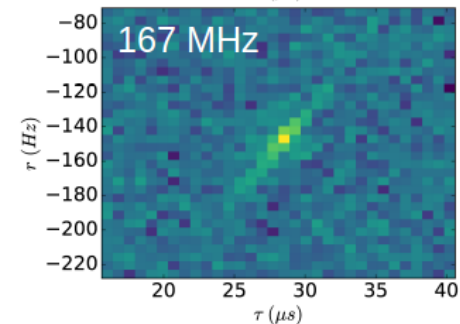
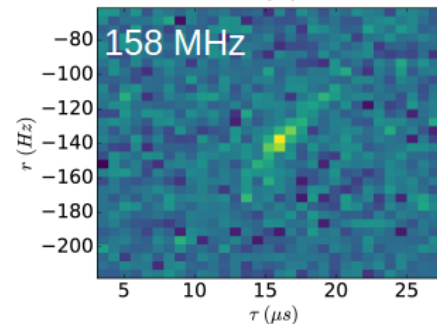
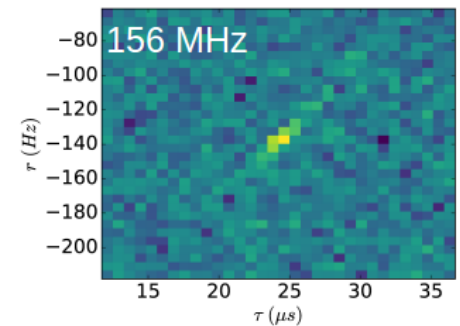
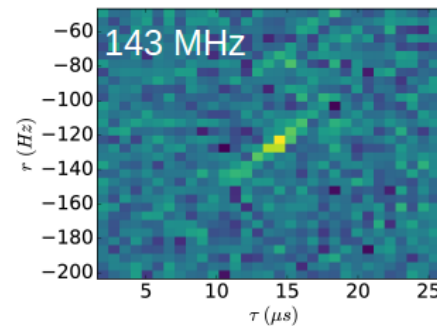
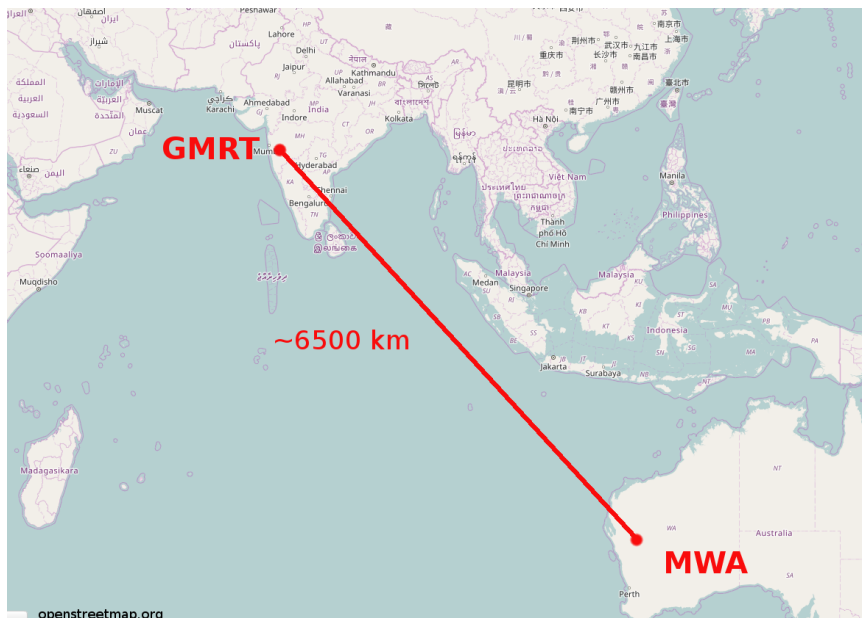
Solar & heliospheric science¹²

VLBI between MWA and GMRT on Crab Giant Pulses

Franz
Kirsten
ICRAR/Curtin

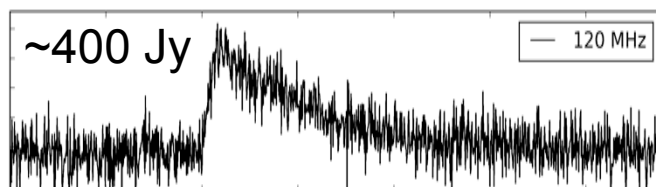
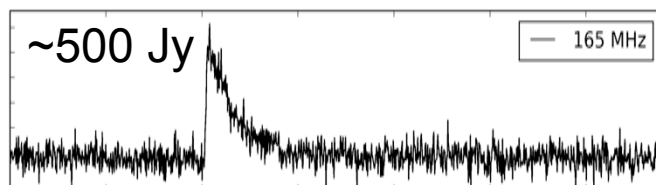
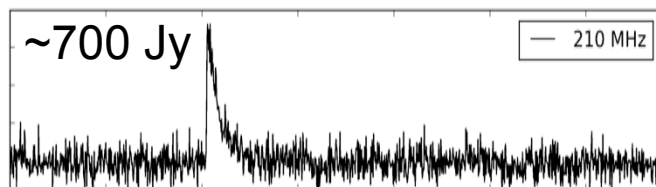
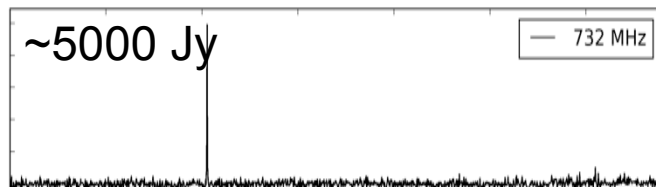
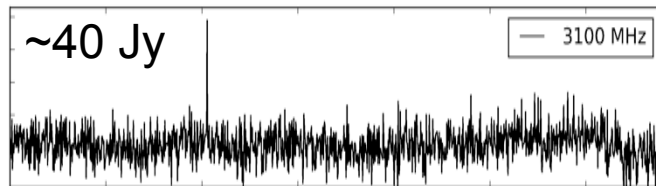


- VLBI at ~ 160 MHz
 - Use giant pulses to align streams
 - Fringe on one giant pulse!
 - Amplitude \sim few percent
- mostly resolved



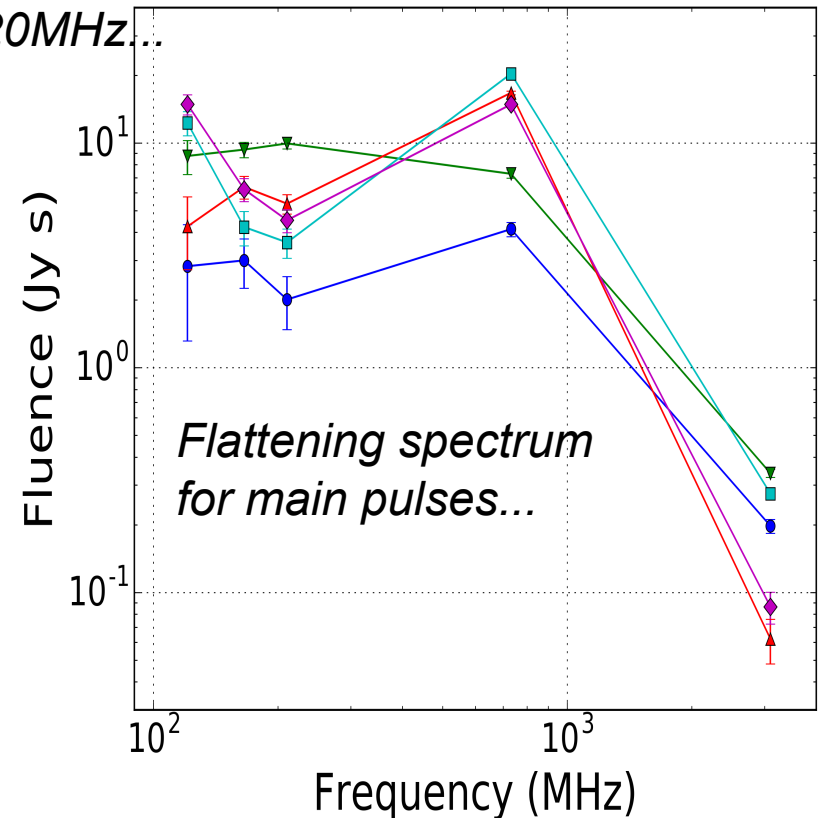
Chasing Crab Giant Pulses from GHz to MHz

Bradley Meyers
ICRAR-Curtin



~30 ms

*Simultaneous coverage
with Parkes and the MWA
from 3.1GHz to 120MHz...*



**What does this tell us about
the emission mechanism?**



Ben McKinley

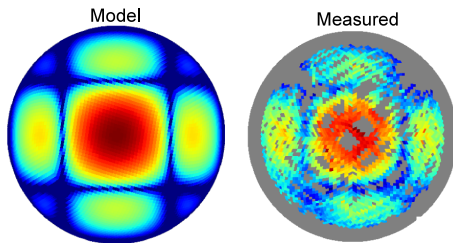
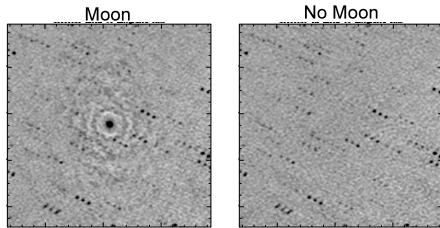
ben.mckinley@unimelb.edu.au

 @benjy_man

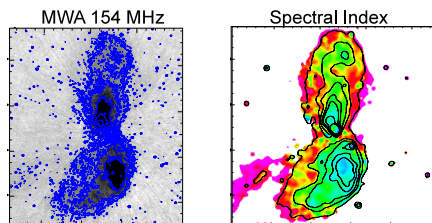


Currently working on.....

Detecting the Global EoR with the MWA and the Moon!



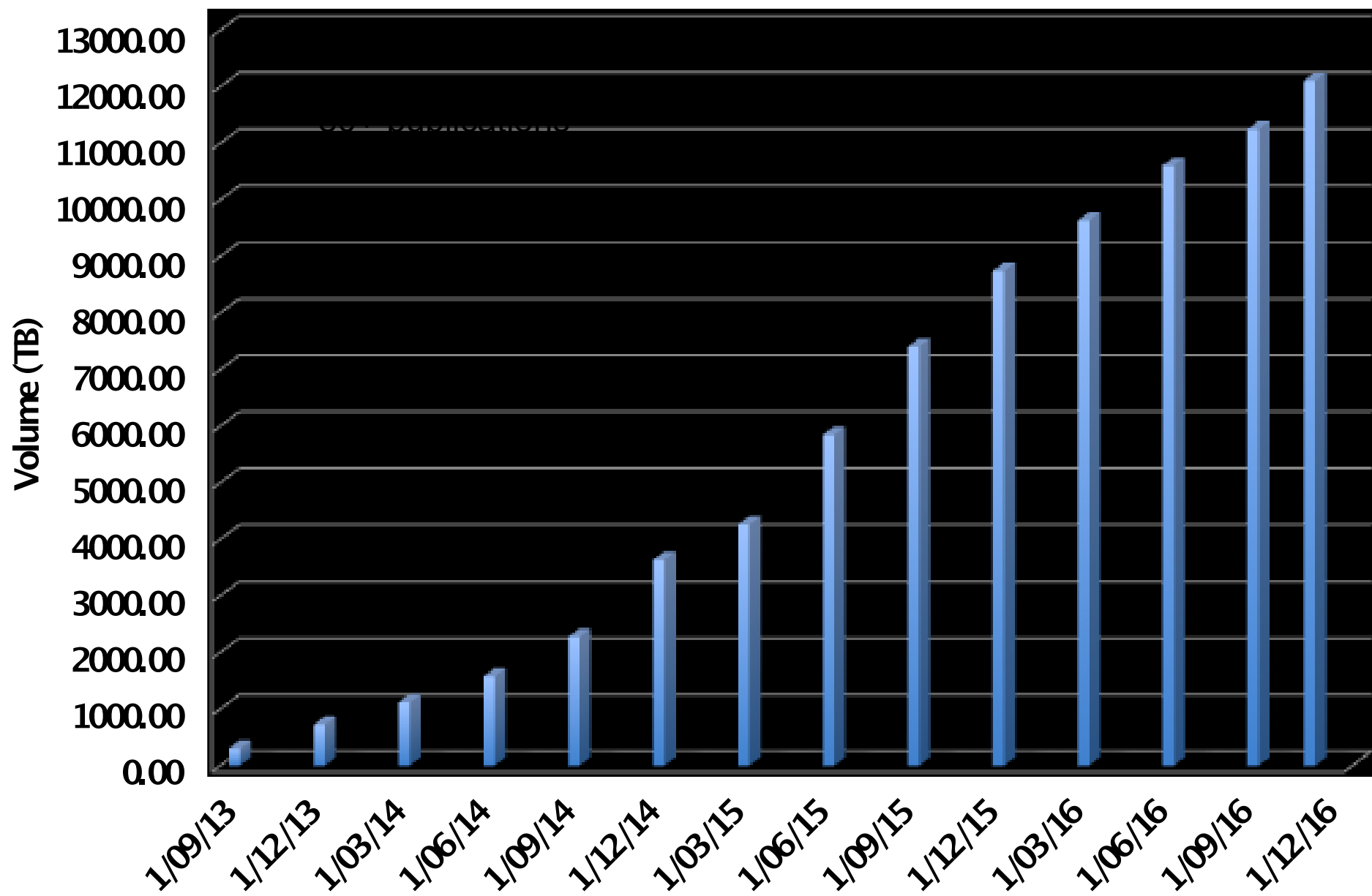
MWA Tile beam measurements with ORBCOMM satellites (see poster)



Centaurus A Multiwavelength Analysis

Please come and talk to me if you are interested in any of this!

Growth of Archive Volume



Past, present, future

- **Phase 1: 2013-2016**
 - 128 antennas, 2.5 km max baseline
- **Phase 2: 2016-2018**
 - Expand with additional 128 antennas, comprised of
 - 72 closely spaced in 2x hexagonal grids approx 100m size
 - 56 new long baseline antennas to double max baseline to 5km
 - Only 128 antennas used at any time: reconfigure for
 - ‘EoR array’ (existing core tiles plus new hexes)
 - ‘Long baseline array’ (existing non-core tiles + new long baseline tiles)
 - Same correlator, receivers: reconfigure by manual re-plugging of tiles into receivers

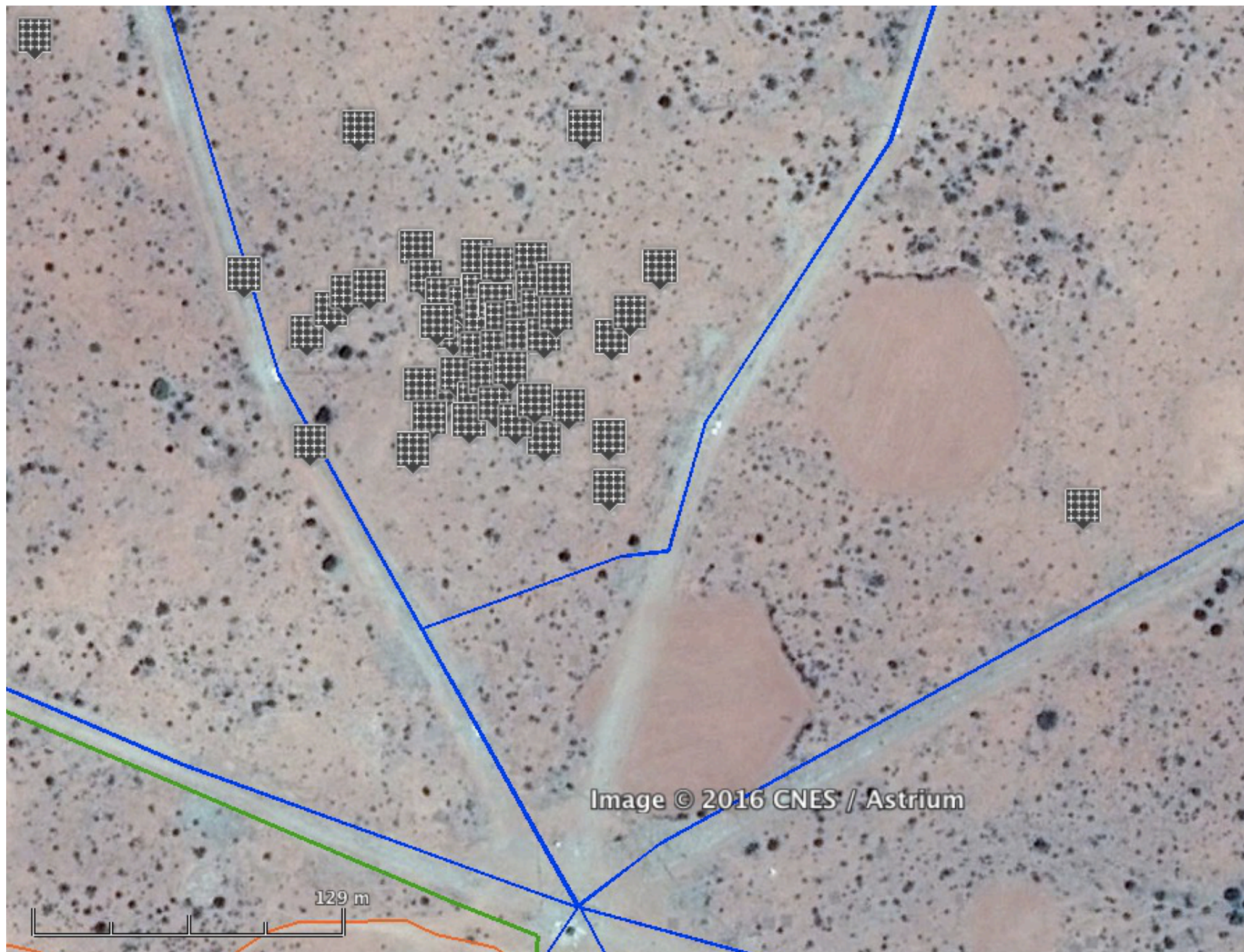
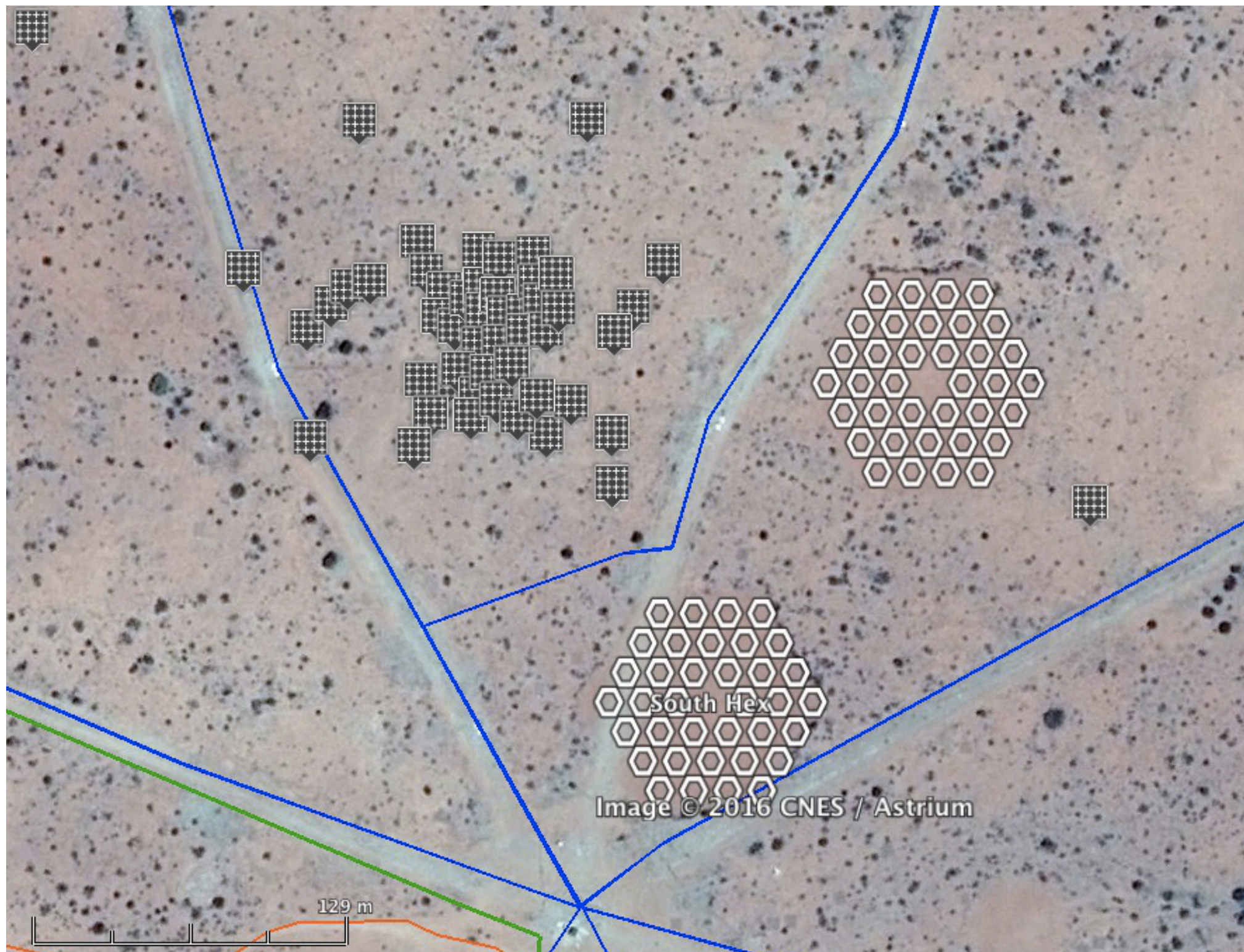


Image © 2016 CNES / Astrium

129 m



South Hex

Image © 2016 CNES / Astrium

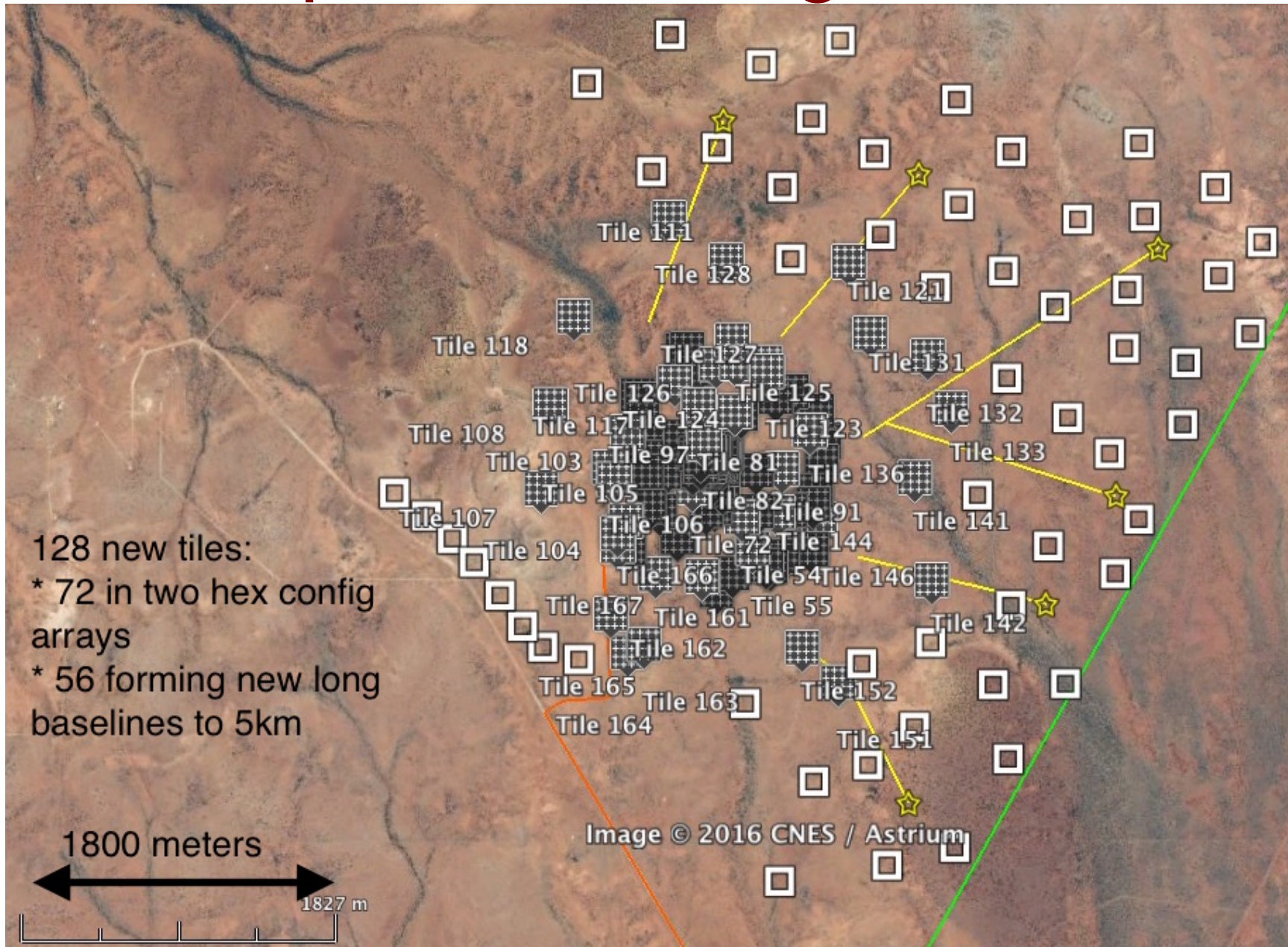
129 m

Phase 2 hex config region

Images: Kim Steele/MWA



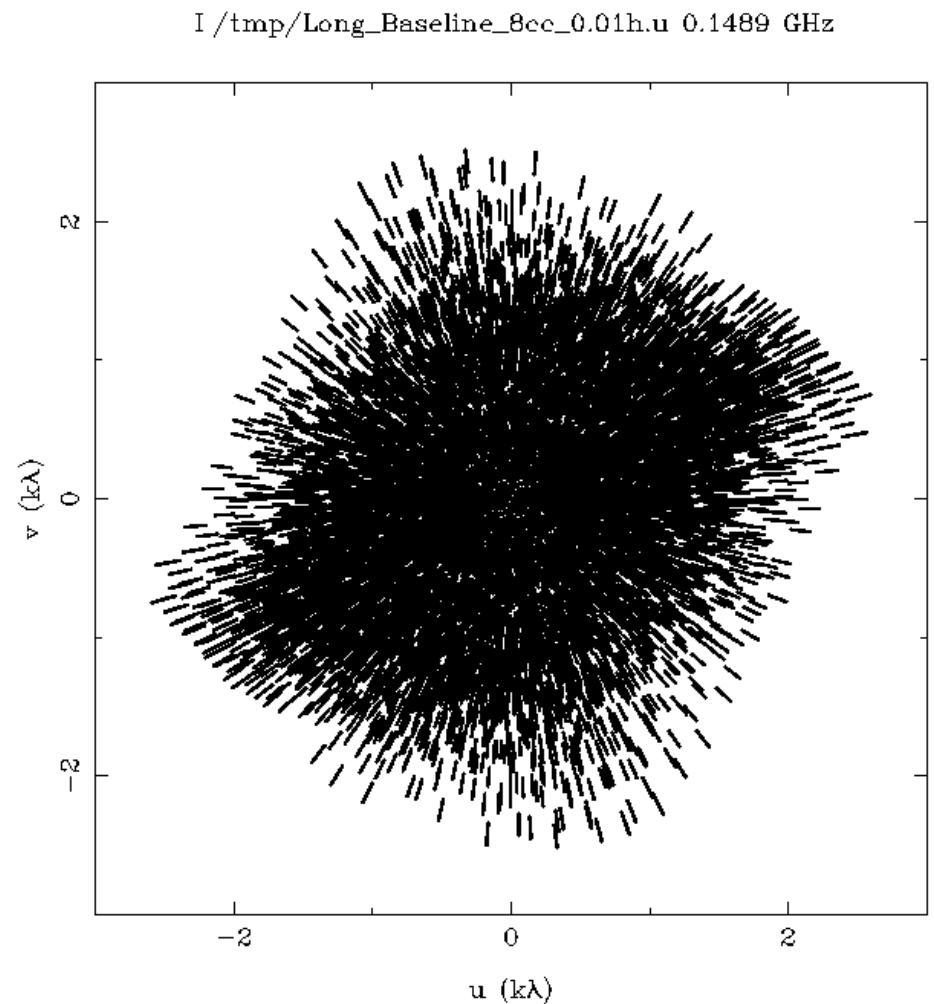
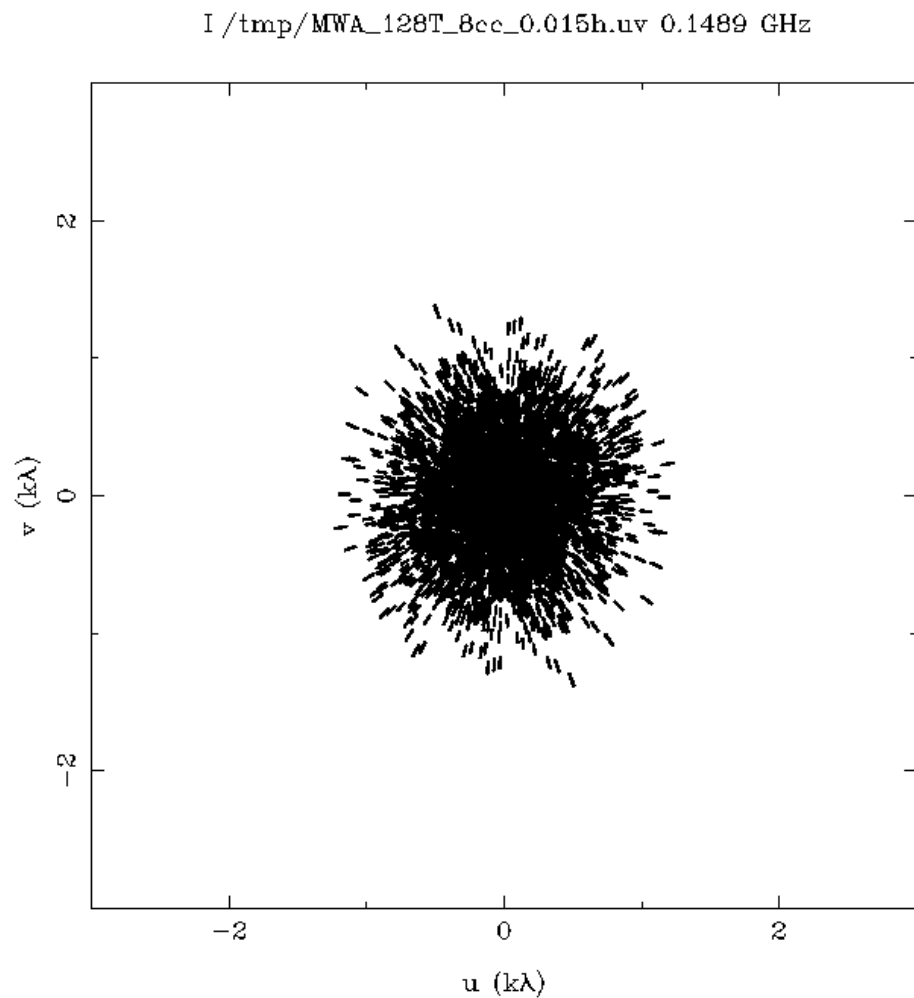
MWA phase2 – long baselines



Phase 1 vs Phase 2

extended

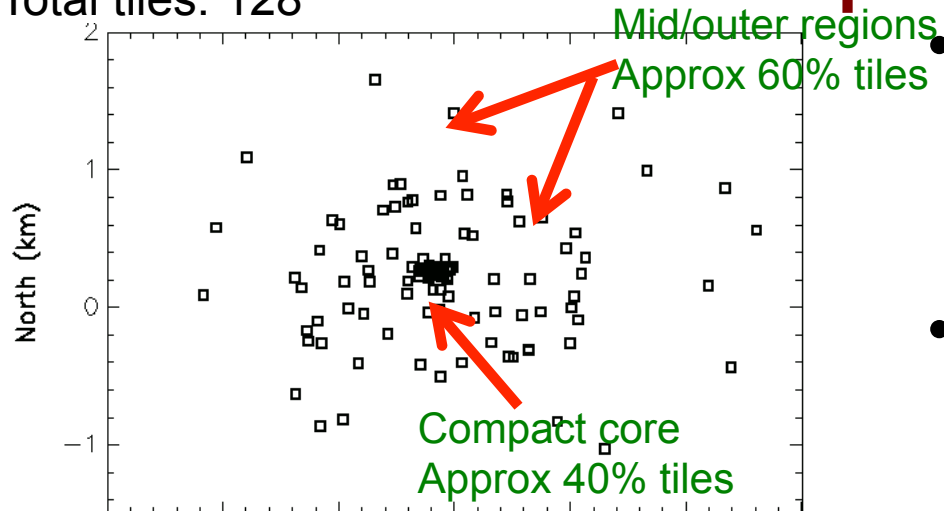
10 MHz MFS u,v coverage @ 150 MHz.



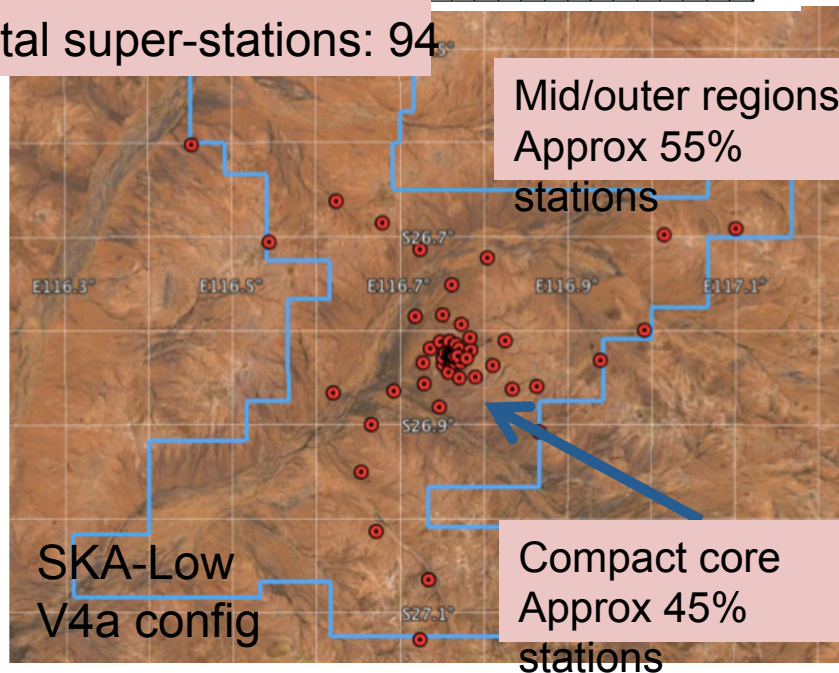
MWA: The SKA-Low

precursor

Total tiles: 128



Total super-stations: 94



- MWA operating frequency & location same as SKA-Low
 - Density distribution of antennas (core vs long baseline) very similar
- Scale of calibration/imaging problem (determined by station diameter / array diameter) is similar
- All MWA knowledge and experience is relevant to SKA-Low

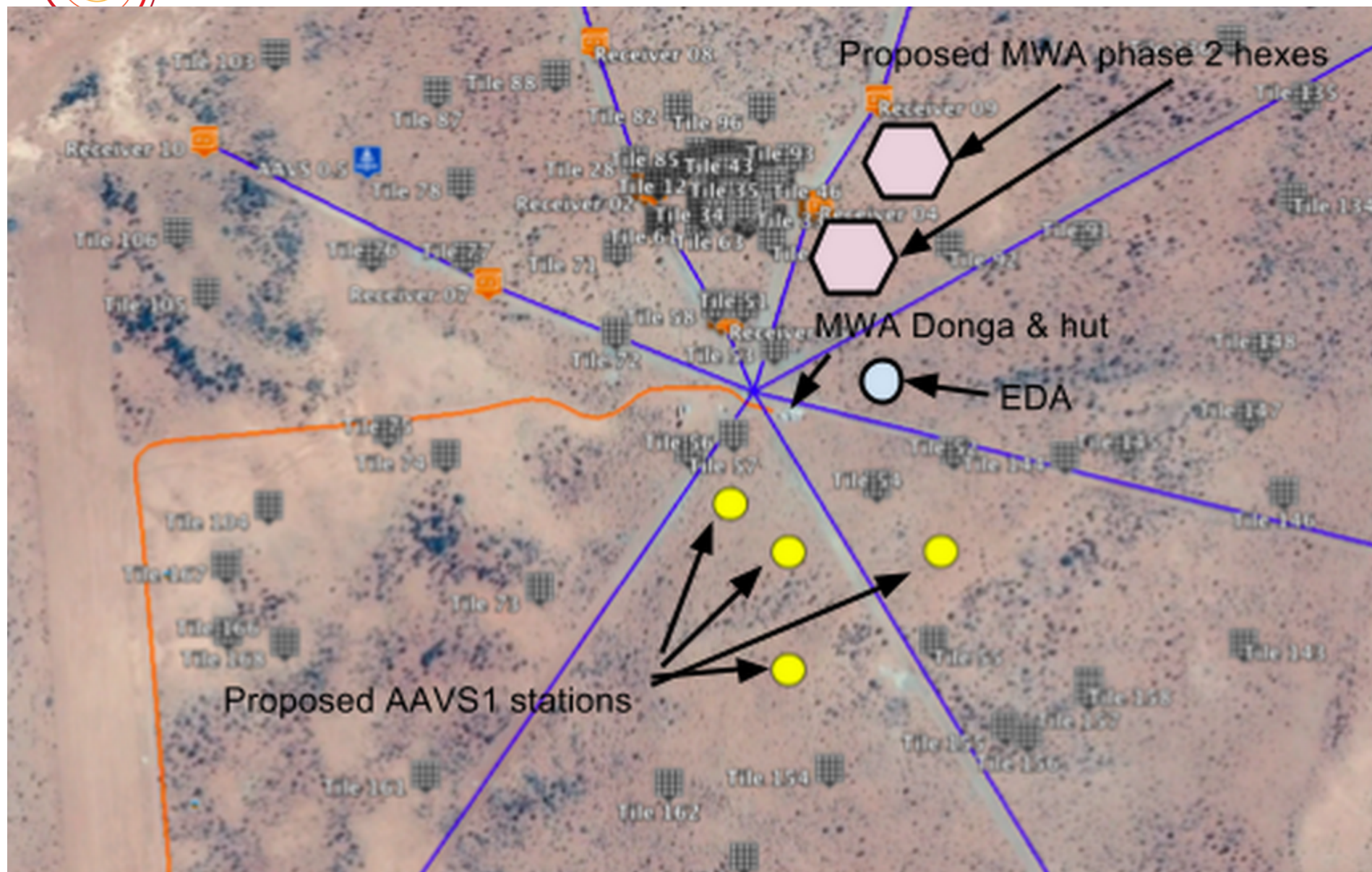
SKA-Low Precursor

- MWA experience & expertise directly feeds back to SKA-Low (several recent publications and memos, + membership in working/consultation groups)
- Engineering Development Array (EDA)
 - Test & verification system aimed at MWA & SKA-Low prototyping





New MRO arrays – locations



THANKS!!!



Wadjarri Yamatji
people

Traditional Owners
of the MRO site



Yamatji Marlpa
ABORIGINAL CORPORATION

CSIRO

Operates the MRO



Astronomy Australia
Limited

Administers
Federal funding for
MWA operations



Australian
Government

Provides
Federal funding



Western Australian
Government

Provides
State funding



CAASTRO

Major science partner



Pawsey Supercomputing Centre Provides data archive and
computing services

