CSIRO
Report on Cal/Val Activities

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CSIRO, Australia

Agency Report VIII

WGCV Plenary # 40

Canberra, Australia

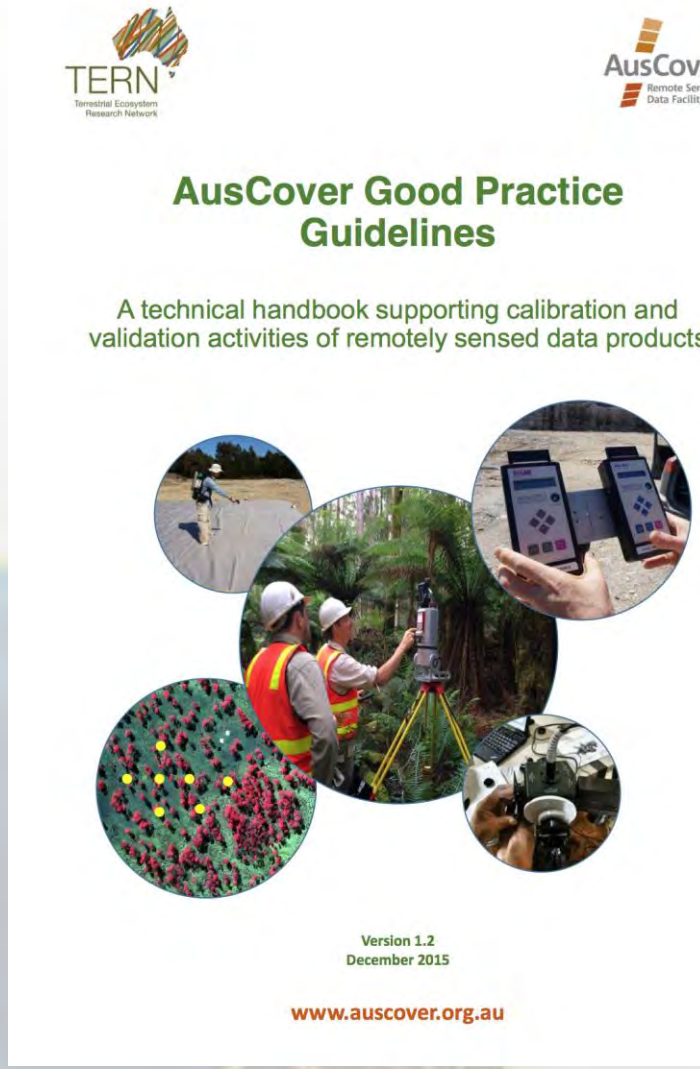
March 14 - 18, 2016

Working Group on Calibration and Validation

Australian Satellite Calibration Working Group

- Not met since January 2015
- Established web presence:
  - http://www.aeoccg.org.au/ascwg

TERN guidelines



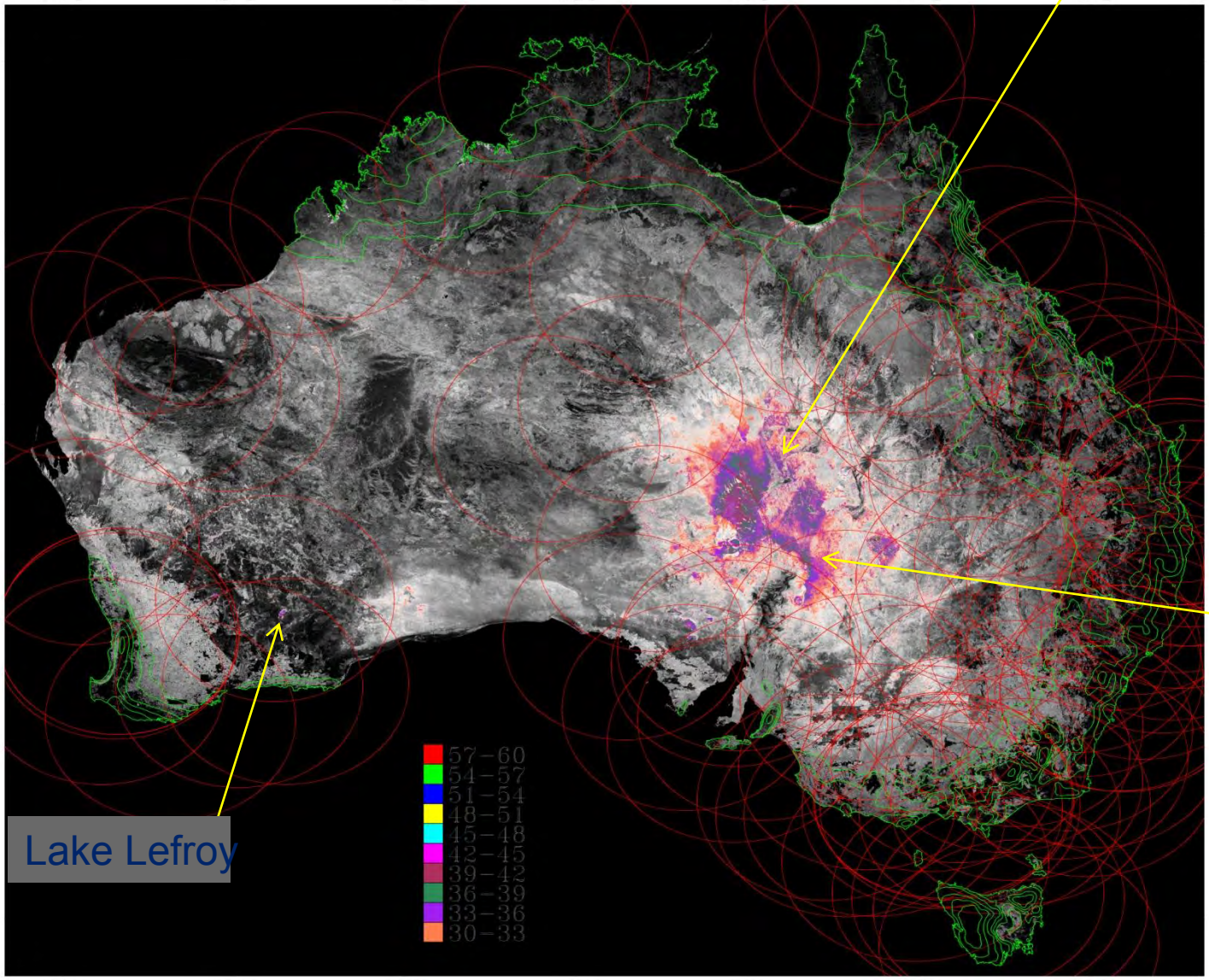
- http://www.auscover.org.au/node/227

Second vicarious cal-val site central Australia

- To build a vicarious calibration site(s) specifically for imaging spectroscopy missions.
- To meet current CEOS endorsed vicarious calibration sites
- Serve multiple purposes for optical sensors beyond just imaging spectroscopy
- Underpinned by NIST traceable calibration facilities
- Field campaign for site characterisation, sample collection, field spectral measurements, trial new instruments
- Potential for automated acquisition of VNIR-SWIR spectral measurements

Landsat 5 continental analysis

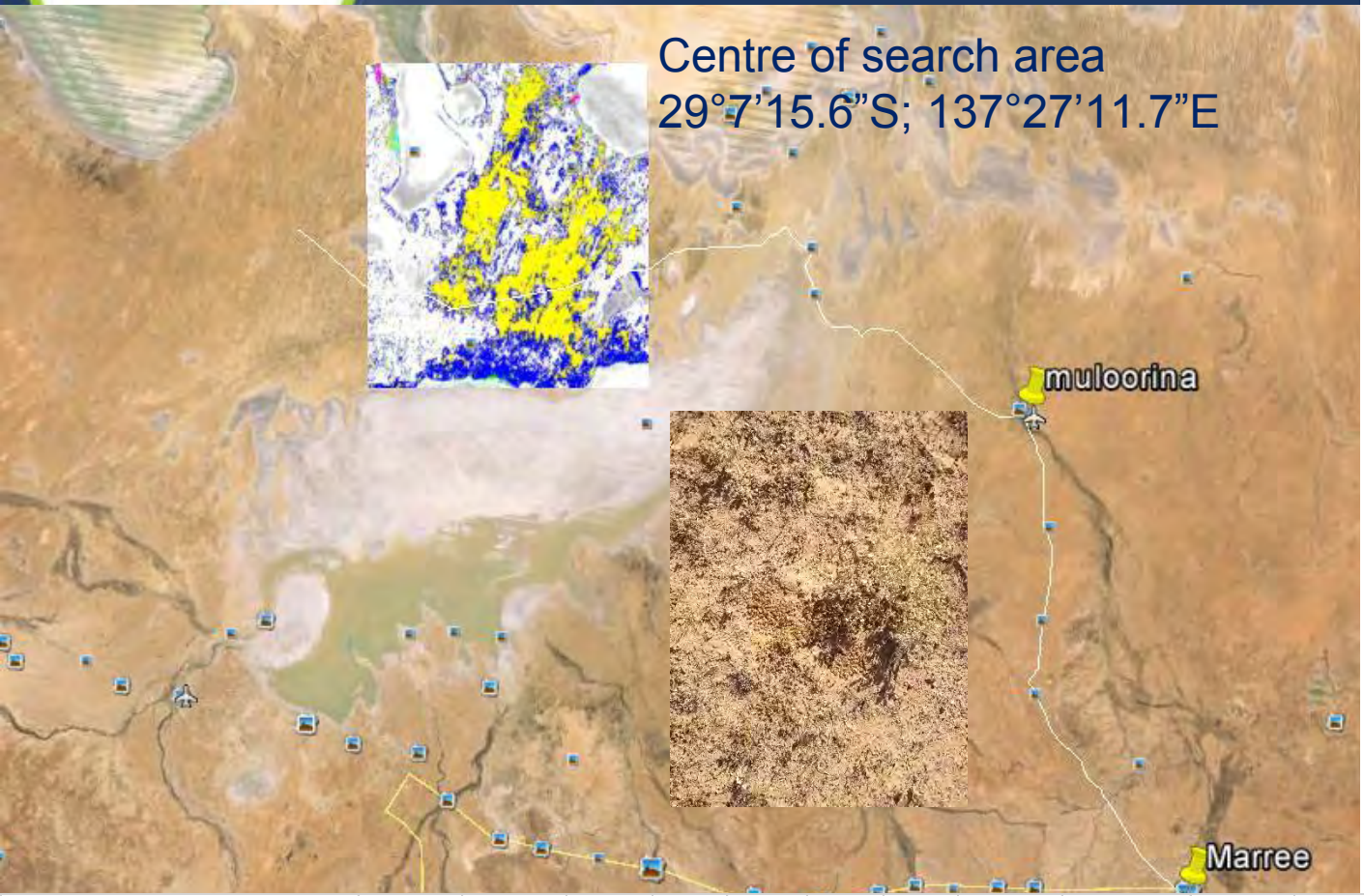
Simpson Desert



- Green vectors show high rainfall zone >600 mm pa
- Red circles show radius of 400 km (half day's drive) from major airport
- Image is VNIR-SWIR temporal means

Strzelecki Desert

d Validation



Access

- ~ 700 km N of Adelaide
- Nearest airport Olympic Dam, ~ 150 km away
- Nearest town Maree, ~ 100 km away
- Nearest accommodation Muloorina Station, ~50 km
- Sealed roads from Adelaide to Lyndhurst (~600km N), good unsealed road to Marree (~80km N), good unsealed road to Muloorina Station (~80km N), unsealed tracked to site (~ 50-80km E).

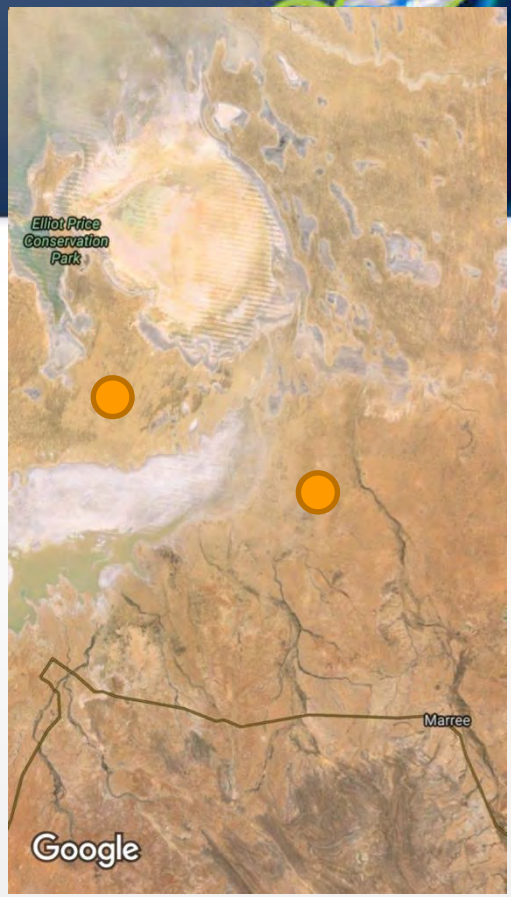
Communications

- Likely to be satellite phone only

Permissions

- Site is on BHPBilliton lease area, permissions required from BHPBilliton, protocol similar to Lake Lefroy

	January	February	March	April	May	June	July	August	September	October	November	December	Annual
Mean max temp (°C)	38	36.8	33.9	28.5	23.2	19.6	19.1	21.5	25.8	29.6	33.3	36.1	28.8
Highest max temp (°C)	49.4	47.9	46.1	40.1	34	30.1	29.6	35	39.5	43.7	47.4	49	49.4
Lowest max temp (°C)	18.9	19	18	13.4	12.1	10.6	10.4	11.1	11.6	12.9	17.2	21.4	10.4
Mean rainfall (mm)	17.3	21.5	14.3	11	13.3	13.6	9.9	9.1	10.6	13.1	11.8	16.4	161.8
Highest rainfall (mm)	186	203.3	178.6	215.9	72.8	86.1	53.9	75.9	83.7	69.7	78	107.5	408.7
Lowest rainfall (mm)	0	0	0	0	0	0	0	0	0	0	0	0	39.3
Mean number of cloudy days	4.2	4.2	3.3	4.1	5.8	5.5	5.3	3.8	3.8	4.7	4.9	5.3	54.9
Mean 9am relative humidity (%)	34	41	40	48	62	71	69	58	47	40	36	34	48
Mean 3pm relative humidity (%)	21	26	25	31	39	44	41	34	29	25	23	21	30



- Owned by BHP Billiton, no grazing
- Sand reflectance meets 60% threshold
- Too vegetated, heterogeneous

- Surface reflectance transects
- Trials with NERC FSF dual field of view (DFOV) instrument

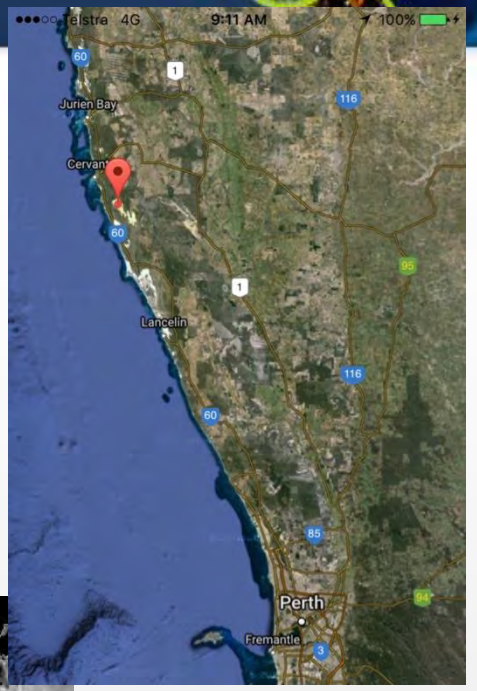
Second site

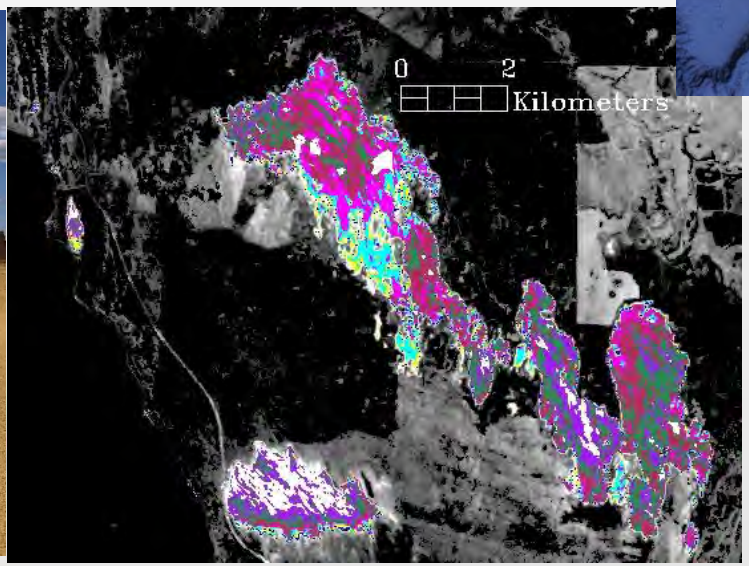
- On Muloorina station, grazed
- Very low vegetation cover
- Does not meet 60% reflectance criteria

Conclusion from visit

- Although Landsat analysis suggests this area is best, the sites found were not ideal
- The potential advantages do not therefore outweigh the disadvantages:
  - Remoteness
  - Access issues
  - Un-networked
  - Cost to maintain a site adequately

Plan B – The Pinnacles, WA



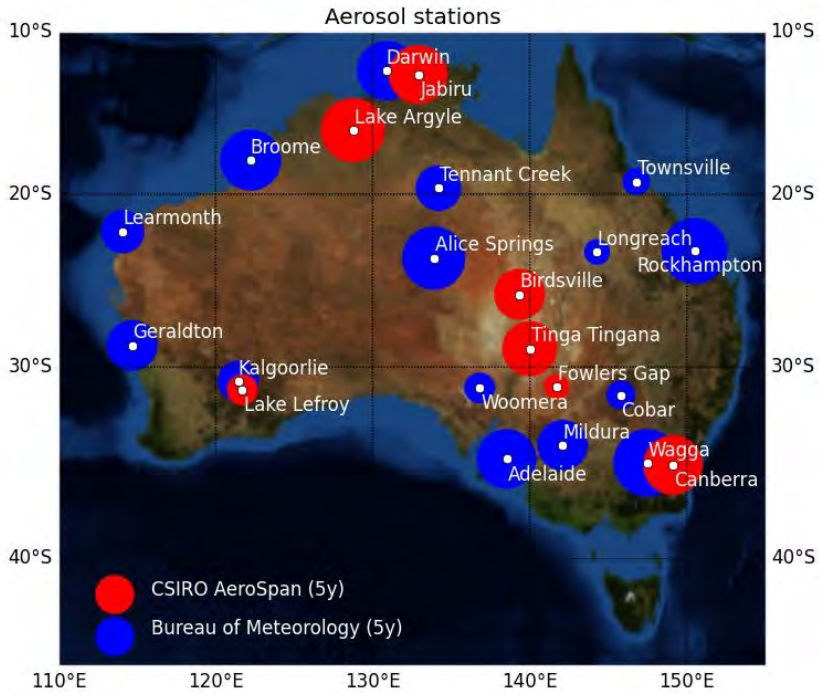


- ~ 250 km N of Perth, sealed roads all the way from Perth
- All forms of communication

Permissions

- Department of Parks and Wildlife

Australian aerosol climatology Stations



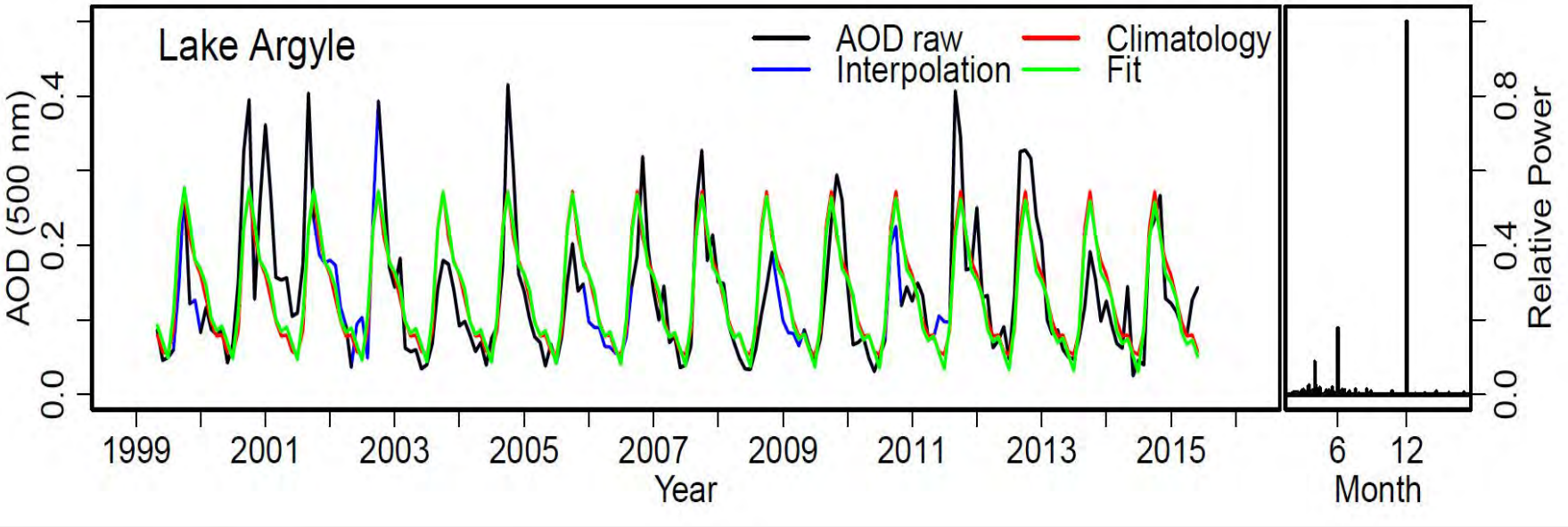
- Ross Mitchell, Susan Campbell – CSIRO
- Bruce Forgan – Bureau of Meteorology

Bureau stations:
Aligned with WMO/GAW

CSIRO Stations:
AeroSpan-federated with NASA ‘s AERONET

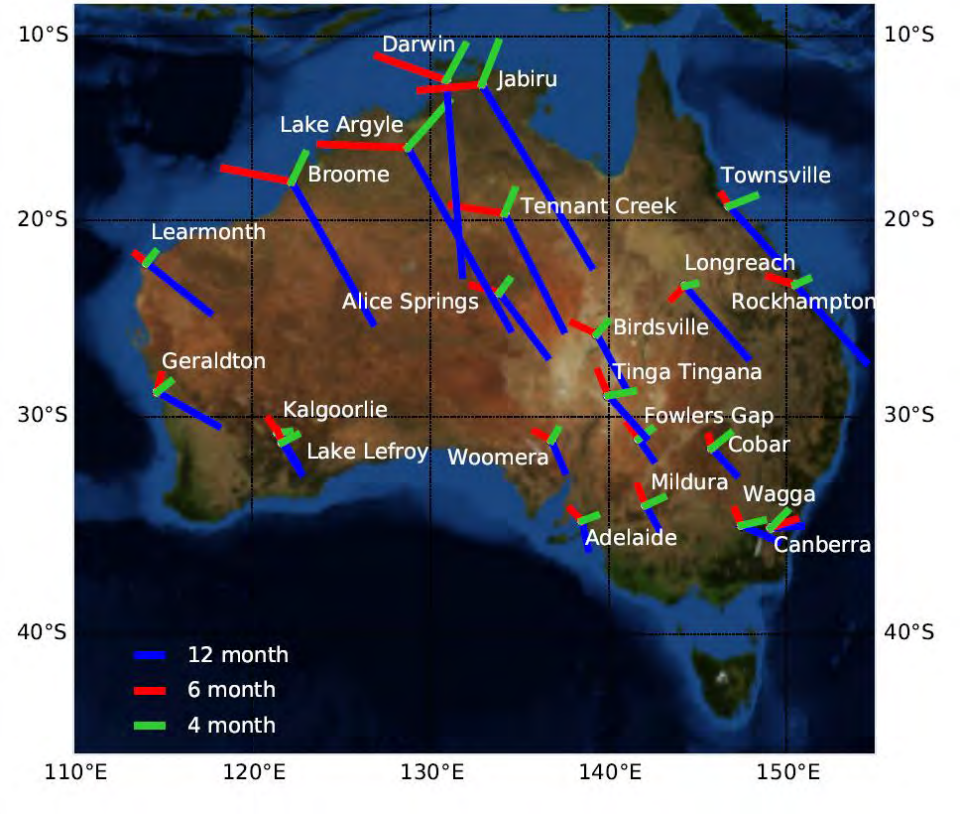
WMO/GAW: World Meteorological Organisation / Global Atmospheric Watch
AeroSpan: Aerosol characterisation via Sun Photometry: Australian Network
AERONET: Aerosol Robotic Network (NASA/GSFC)

Data and analysis (Lake Argyle, Kimberly, tropical)



- Data screened for quality and cloud,
- Aggregated into monthly means
- Fourier analysis reveals significant frequency components
- Majority of sites show dominant 12, 6 and 4 month periodicity
  - Annual cycle + 2nd and 3rd harmonics
- Sharp increase in Aug-Sep, followed by more gradual decline, often with a secondary peak in Jan-Feb

Amplitude and phase show consistent patterns across the continent



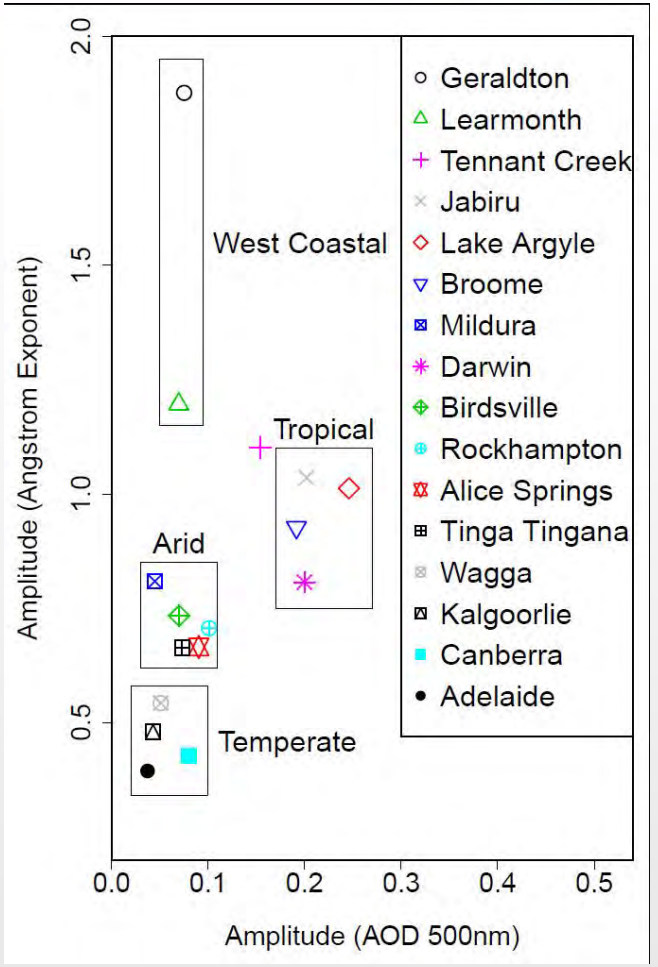
Regional classification

Aerosol properties show regional clustering:
Classify using

1. Periodic amplitude plane:
   - Angstrom exponent vs AOD
2. Harmonic analysis:
   - Relative strength of 12, 6 and 4 month cycles
3. Episodic variation vs periodic amplitude

This yields classification into 4 regions:

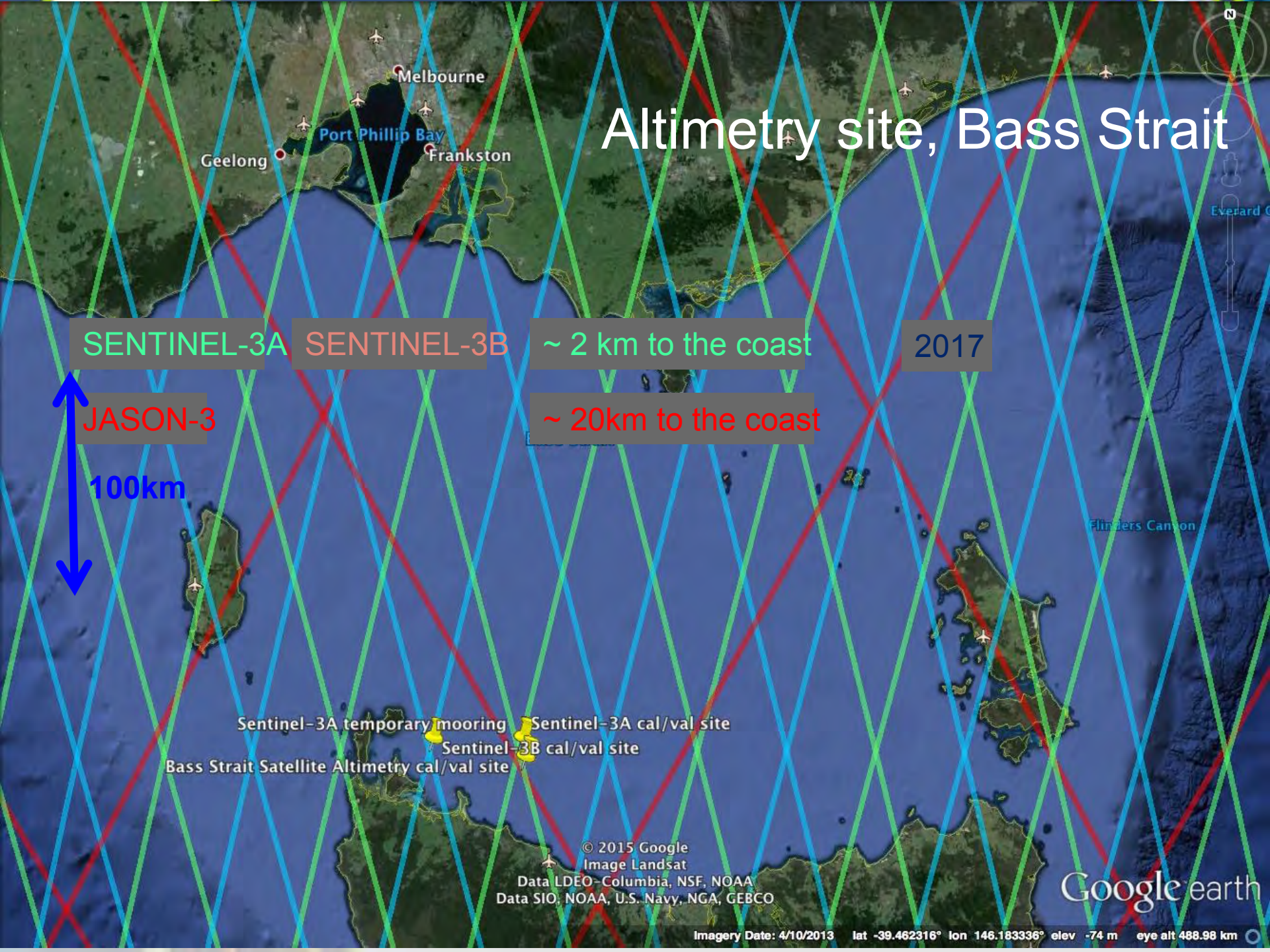
1. West Coastal
2. Tropical
3. Arid
4. Temperate

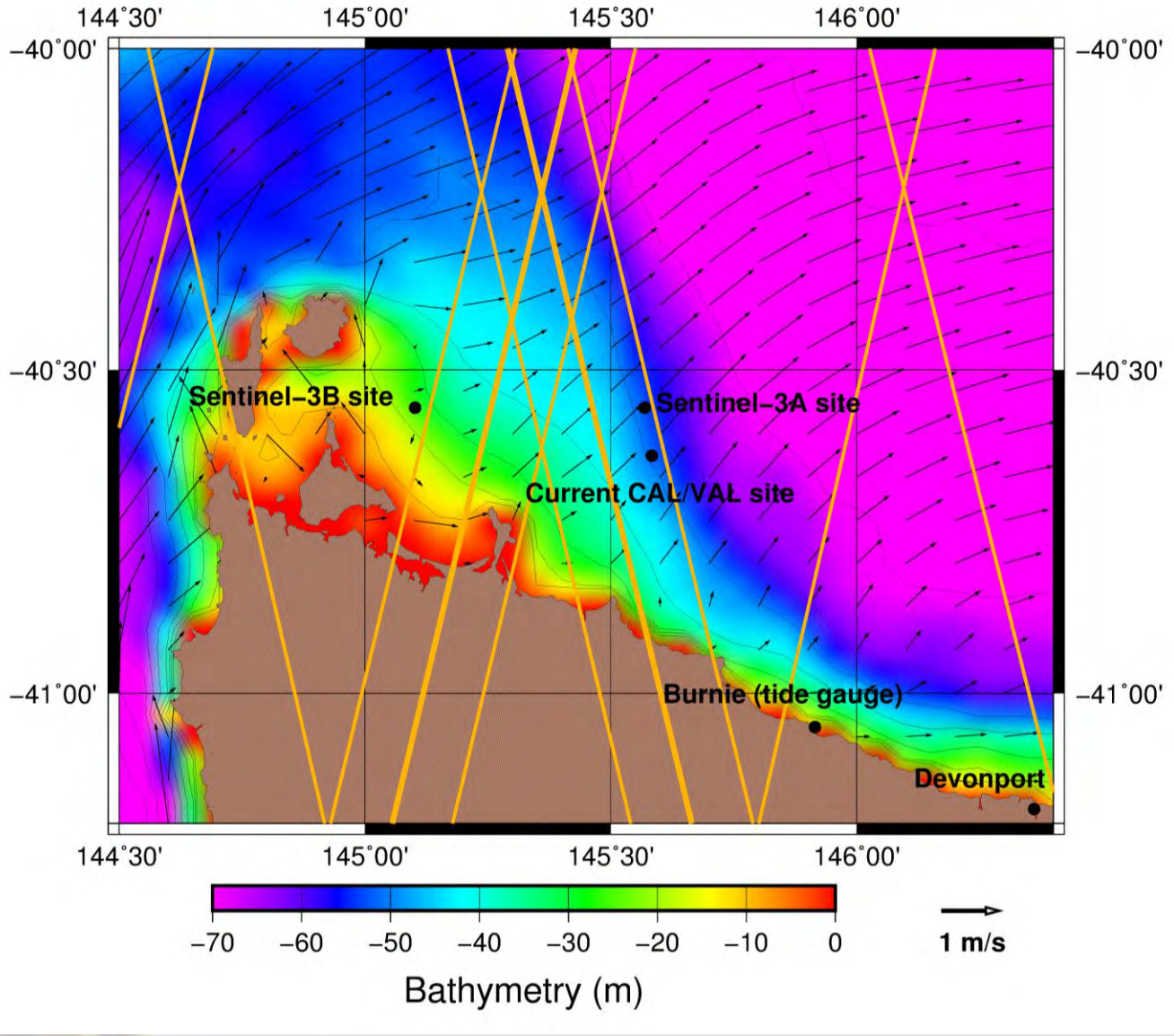


Conclusion – Aerosol climatology

First systematic climatology of Australian aerosol shows

1. Australian aerosol can be regionally classified into 4 groups
2. Australian aerosol shows remarkable long-range coherence (teleconnections)
3. The resulting monthly climatology – to be published soon- will form the basis for
    1. Validation of aerosol modules in climate simulations
    2. **Validation data set for satellite aerosol products – which struggle for accuracy over Australia**
    3. Estimates of regional air quality exceedances
    4. **Base level data set for atmospheric correction of satellite data across the continent**
    5. Mapping of solar resource across the continent (together with cloud cover statistics)


Altimetry site, Bass Strait
Melbourne
Port Phillip Bay
Geelong
Frankston
SENTINEL-3A
SENTINEL-3B
~ 2 km to the coast
2017
JASON-3
~ 20km to the coast
100km
Flinders Canyon
Sentinel-3A temporary mooring
Sentinel-3A cal/val site
Sentinel-3B cal/val site
Bass Strait Satellite Altimetry cal/val site
© 2015 Google
Image Landsat
Data LDEO-Columbia, NSF, NOAA
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Google earth
Imagery Date: 4/10/2013 lat -39.462316° lon 146.183336° elev -74 m eye alt 488.98 km


144˚30'
145˚00'
145˚30'
146˚00'
–40˚00'
–40˚30'
–41˚00'
Sentinel–3B site
Sentinel–3A site
Current CAL/VAL site
Burnie (tide gauge)
Devonport
–70
–60
–50
–40
–30
–20
–10
0
1 m/s
Bathymetry (m)

How to cope with an increasing number of satellites to calibrate

- Global tide gauge network = give up the collocation with the satellite, take advantage of improving land vertical mvt with GPS
- Regional high res model to complement in situ instrumentation
- Global higher resolution models to combine global tide gauge network and improve the tide gauge to satellite point representativity.
  - SAR altimetry will bring the altimetry to the coast.
  - The future altimetry constellation will not only allow to resolve the mesoscale but opens the opportunity to observe sub-mesoscale, i.e. mixing, transfers, exchanges.
  - If you haven't already started, it's the best time to start multi sensors approaches for process studies.
  - Higher resolution brings lot more signals to light… and lot more issues (e.g. swell,...)
  - Ocean-coast exchanges, ocean-land exchanges. (SWOT = Surface Waters / Ocean Topography)

Threat to CSIRO cal/val facilities

- FSP in Earth Observation Informatics
- Terminates 1st July 2016
- Has partially kept key calibration facilities going
  - Cosmos soil moisture network
  - AeroSpan
  - Vicarious calibration
  - Lucinda Jetty Coastal Observatory
  - Calibration laboratories
- Future support of these facilities is currently uncertain

- Letters of support from CEOS WGCV and Australian EO community through the AEOCCG

CSIRO Oceans and Atmosphere Flagship

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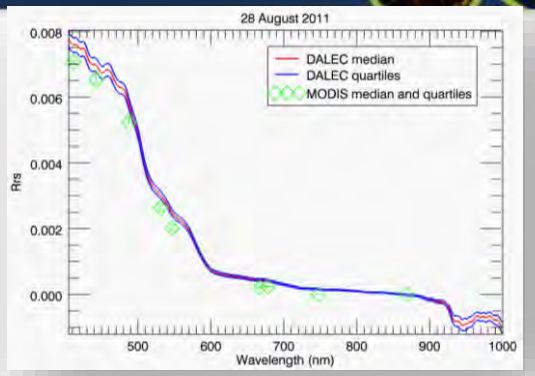
Thank you

IMOS activities

- Lucinda Jetty Coastal Observatory – Southern hemisphere vicarious aquatic cal-val site – now fully re-instated
- Ship mounted DALEC radiometers
- http://imos.aodn.org.au/webportal/



Dalec v MODIS comparison