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AEROSPAN

Australia's robotic aerosol network

Dr Ian C Lau| 19th September 2024

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I would like to begin by acknowledging the Whadjak people of the Noongar nation and the Bunerong people of the Kulin nation as the Traditional Owners of the lands in Australia we work from, and pay my respect to their Elders past and present.

AEROSPAN's strategy and raison d'etre 1997-2018

"Compared with the rest of the world, it is hard to see aerosols as a major climate change issue for Australia, even bearing in mind earlier work. However, a national observation and analysis program is important."

- The evidence about Australia's **continental** aerosol load is largely a result of the investment in this project over the last decade
  - Surface network & validation of satellite retrieval
- The project was instigated at the request of the Australian Climate Change Science Program (1989-2016)
- Australia contributes 15% of the world's aerosol (10% biomass burning, 5% dust) and 1.5% of the world's greenhouse gas
- Logistically provide effective Sun Photometry over a Land Area of 7.8 million km^2

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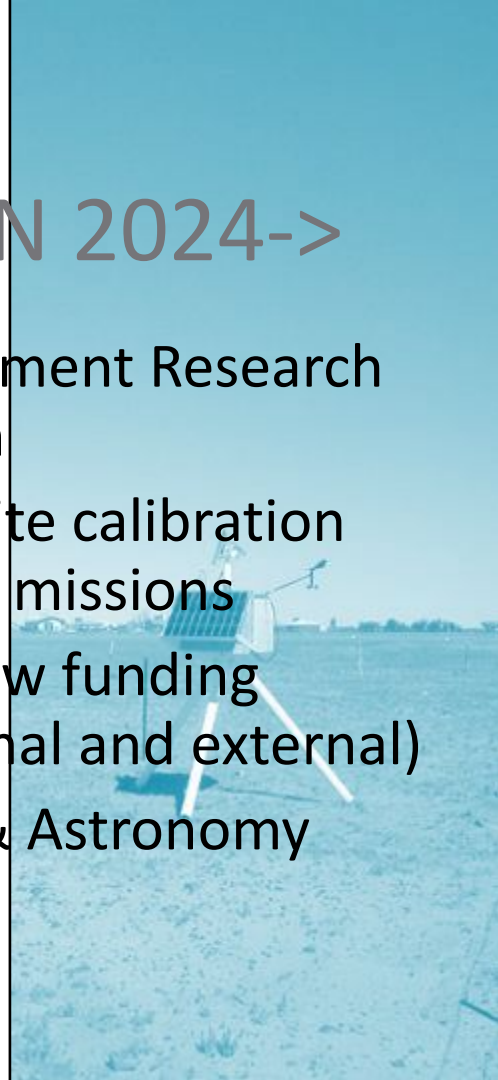
AEROSPAN 2018-2024

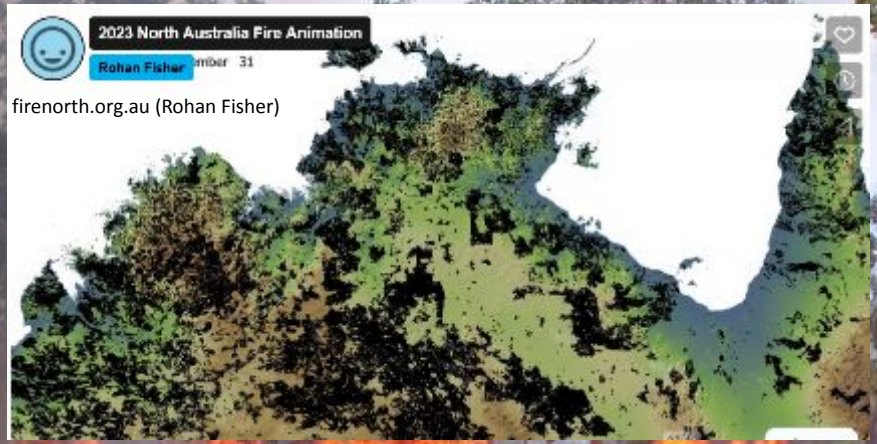
- 2018-2020
  - Transition/care-taker mode
  - Planning, internal and external review
- 2020-2022
  - Covid-19 crisis operation
- 2023
  - Return to a new normal operation with limited funding

AEROSPAN 2024->

- CSIRO Environment Research Unit transition
- Support satellite calibration and validation missions
- Looking for new funding sources (internal and external)
- CSIRO Space & Astronomy Research Unit



Australia is a globally significant source of biomass burning emissions



- Annual burnt area: 39 Mha (5% of the continent) on average.
- 2023: 89 Mha burnt!
- Australia contributes about 10% of the annual global carbon emission from biomass burning
- Effects of savanna smoke aerosol poorly understood

AeroSPAN active sites

- Australian sites
  - 11 CSIRO managed (+5 retired sites)
  - 2 Others (NSW Department of Environment)
  - 2 Hibernation sites (Adelaide - Defence Science and Technology Group and Brisbane - University of Queensland)

Active CSIRO sites
Non-Active sites
Active other sites
New site

Station Name	State / Territory	Year Start	Site Operator
Lake Argyle	NT	1999	CSIRO Environment/Mineral Resources
Jabiru	NT	2000	CSIRO Environment
Birdsville	QLD	2005	CSIRO Environment
Lucinda	QLD	2009	CSIRO Environment
Lake Lefroy	WA	2012	CSIRO Mineral Resources
Fowlers Gap	NSW	2013	CSIRO Environment
Learmonth	WA	2017	CSIRO Mineral Resources
Aspendale	VIC	2017	CSIRO Environment
Tumbarumba	NSW	2019	CSIRO Space and Astronomy/Mineral Res.
Pinnacles	WA	2022*	CSIRO Space and Astronomy
Perth	WA	2024	CSIRO Space and Astronomy/Mineral Res.

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AeroSPAN installation types

- Varies by location

Bollard (3)

Large Tripod (4)

Roof (2)

Mast (2)

CSIRO's Instrument pool

- Model N
  - 4x CE318-N model 3 (all retired)
  - 4x CE318-N model 4/5
  - 3x CE318-N model 6 (2 close to retirement)
  - 2X CE318-N Seaprism
- Model T x11
  - 3x CE318-TS9 with older style 3G Telit and older style CPU-CE1201A
  - 7x CE318-TS9 with upgraded 4G Telit/CPU-CE1701B
  - 2x CE318-TU12 (BRDF) upgraded 4G Telit
- 20 robots of varying age

- 9 land sites and 11 model TS-9 units, some need for N models until we have a larger pool.

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CSIRO EFTs / budget

- Organization – CSIRO Environment
  (Climate, Atmosphere, Ocean Interaction)
- People - approx**. 1.2** full time staff
  - Experimental Scientist (Aerosols) (Project Leader)
  - Technical Research Support (Victoria)
    - Technical incl. field support for central and eastern sites
  - Senior Experimental Scientist (Western Australia)
    - Technical incl. field support for western sites
- Future Growth
  - Contributing to upcoming in AusCalVal Program which will include data from multiple instruments from difference disciplines across CSIRO
  - Limited support for non-CSIRO AEROSPAN sites

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AeroSPAN – System Overview

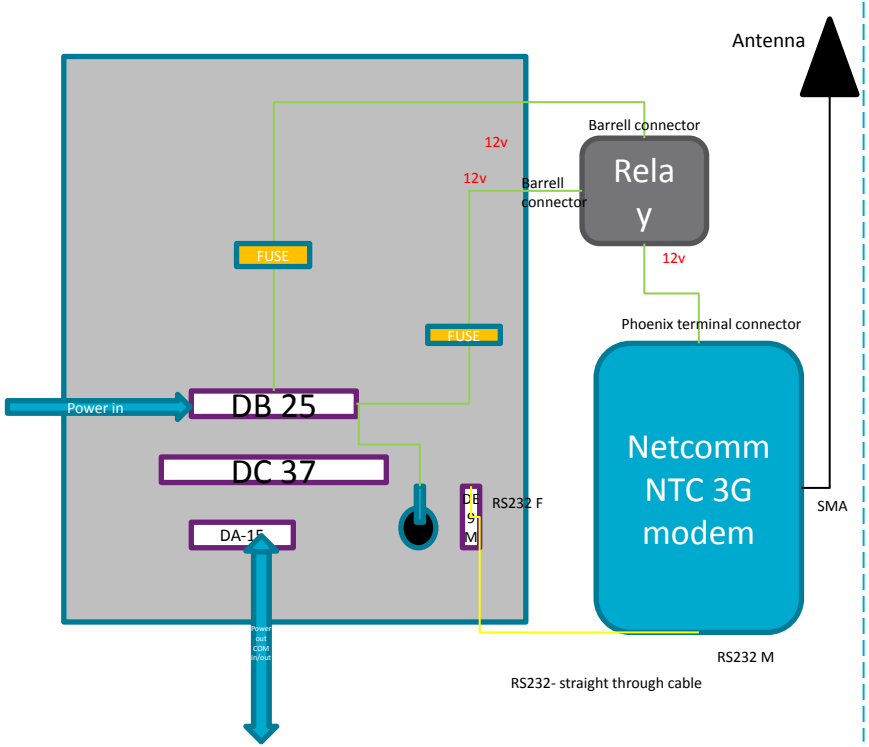
- AeroSPAN was initiated by the late Ross Mitchell in 1997 and the first field sites connected to the AERONET network from 1999.
- Sites were chosen to cover the three main climate zones available across Australia: Arid, Tropical and Temperate.
- At most sites data is collected in the 20-year-old **bespoke logger system** and data is downloaded to CSIRO. Early system configurations used additional site peripherals (including nephelometers and other air samplers) that collected data in parallel with the sun photometers. Current systems consist of just the logger units with either CE318N or CE318T sun photometers.
- Most photometer and system component repairs done in-house. External cabling upgraded from RJ12 to MILSPEC rated for environment considerations.
- Field systems have had an evolution of data communications over the last 25 years from the Satlink 2 transmitter units, POTS (telephone line), to Hughes Satellite Modems (BGAN) and 3G and 4G industrial IP modems to internal 4G modems.

AEROSPAN logger

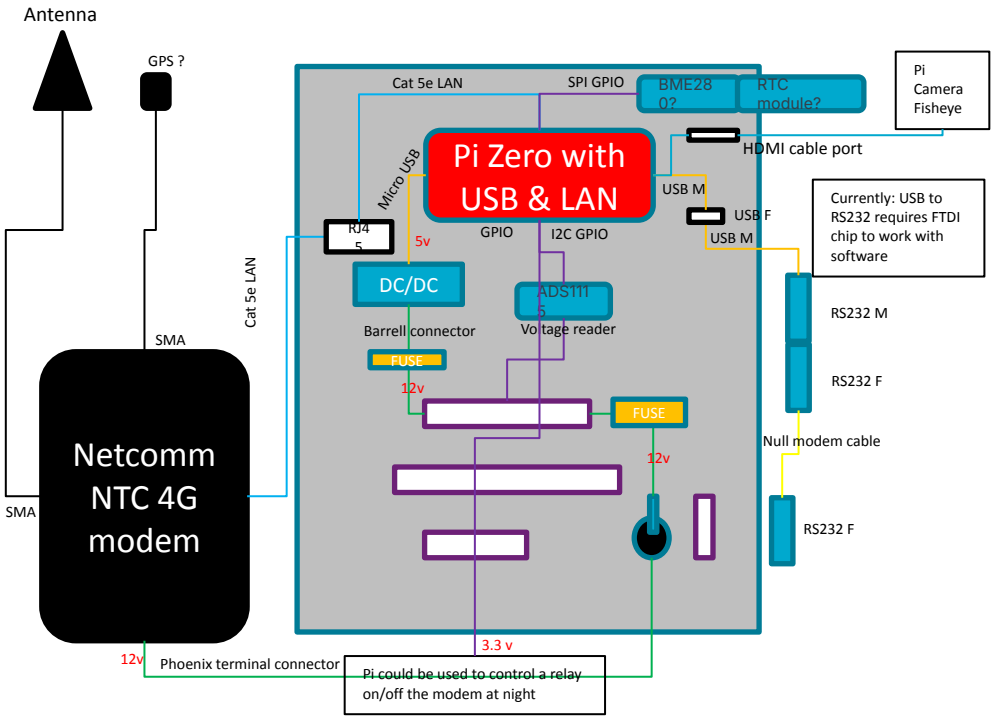
AEROSPAN wiring panel

CSIRO AEROSPAN by-pass box

- Existing Aerospan by pass box



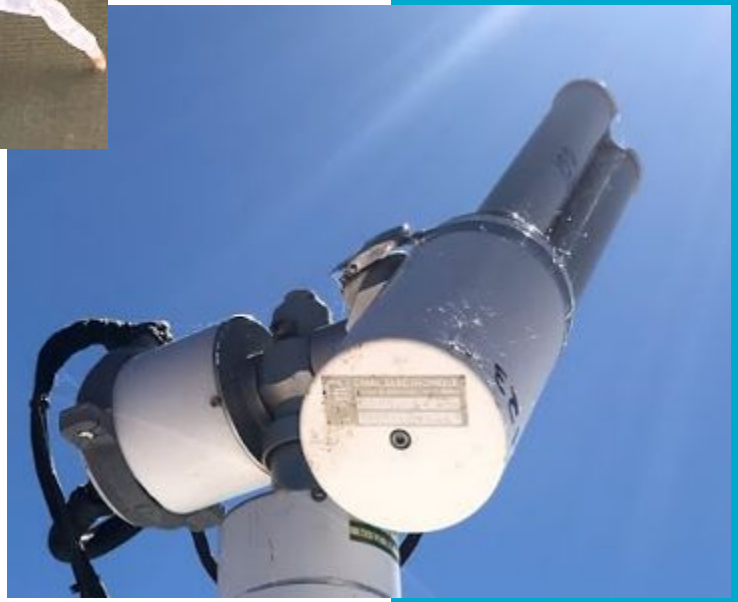
Modified box

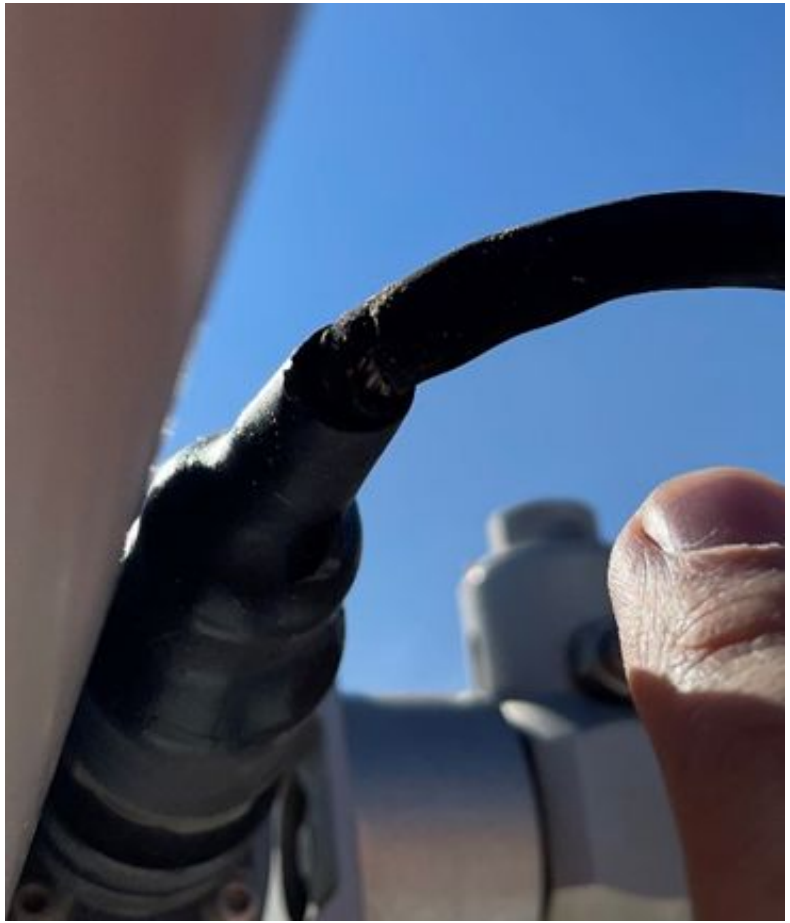


31/5/2022 Testing if turning off modem for 2 hours to see if data transmitted after turning back on

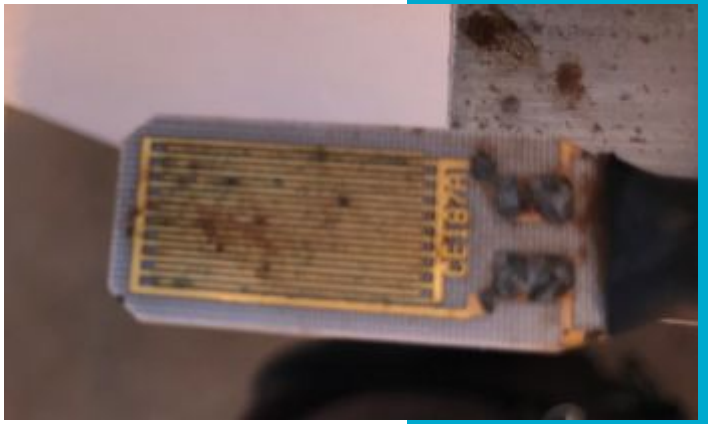
AeroSPAN – Challenges

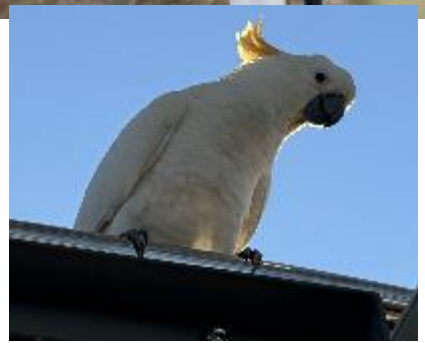
- Field Sites
  - Site distance – shortest 200 km, longest 3800 km
  - Logistics
    - Transport of field kit and equipment
    - Flights, Driving, Accommodation
    - Local indigenous location interests and involvement
    - Timing and delays due to environmental and other impacts (weather, floods, cyclones, pandemic)
  - Site Manager support
- Long term exposure
  - UV effects (‘zip ties’)
  - Sand/Dust ingress
  - Salt corrosion
  - Damage by fauna (birds, reptiles, insects, dingos)
- Equipment failures between visits
- Network coverage changes due to 3G switch off in late 2024






error at
starting plot


HEATER



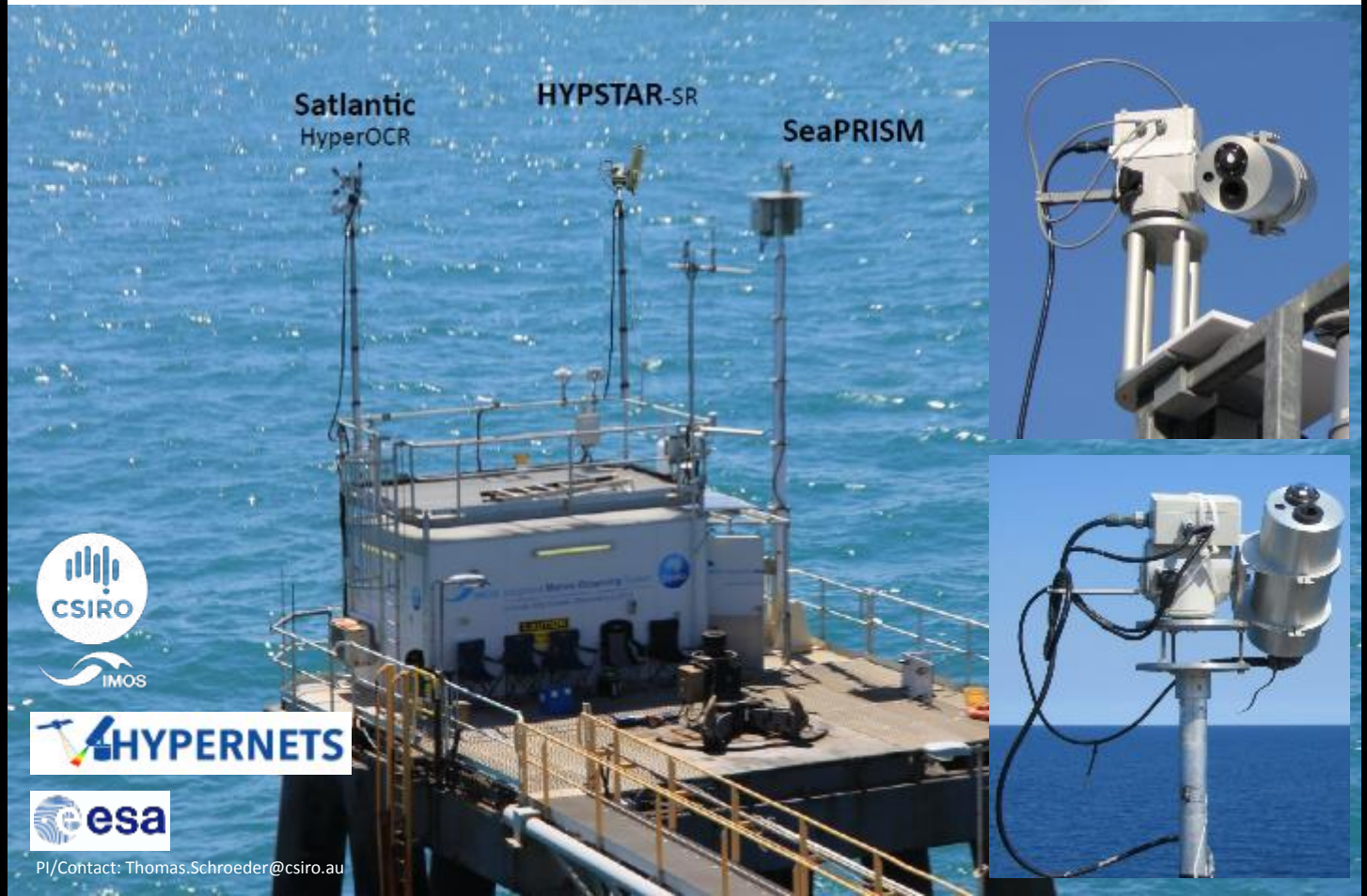
IMOS Lucinda Jetty Coastal Observatory (LJCO)

PI/Contact: Thomas.Schroeder@csiro.au

https://lucinda.it.csiro.au/

Upgrades 2025

HYPSTAR-SR hyper-spectral radiometer funded by ESA
Cimel/SeaPRISM upgrade to T-model



PI/Contact: Thomas.Schroeder@csiro.au

Pinnacles Cal Val site (PIAU)

- Operation since March 2022
- Located ~200 km north of Perth in Nambung National Pak
- Sand dunes
- Large enough for medium sized pixel optical satellite calibration
- Candidate site for RadCalNet and TIRCalNet
- Used for validation of EnMap, DESIS, Landsat 8, Sentinel 2 and PRISMA
- Cimel CE318-TU12 BRDF instrument on 9 metre mast (similar set up to La Crau/Gobabeb)
- Weather station, sky camera
- TIR radiometers and HyperNets instrumentation to be installed 2024/2025

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Perth site (Western Australia)

- Selection
  - New site setup on roof of ARRC building at CSIRO Kensington for testing of units and creation of a permanent AERONET site.
- Construction finished in May 2024
- CSIRO Space and Astronomy funded
- Site to include AC power source, 2-3 robot locations, solar panels (for testing), possibly WIFI communications.
- Other Earth observation instrumentation testing to be done at the site, including sky camera, thermal radiometers, hyperspectral spectrometers.

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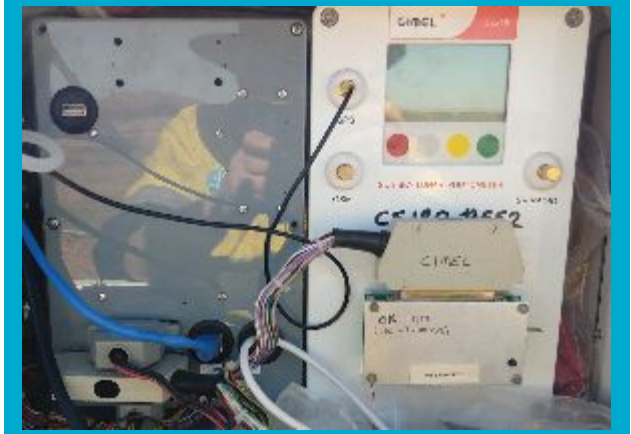
AeroSPAN – Updates

- Completed Activities FY 2023/2024
- Data sent weekly to AERONET via FTP and where available HTTPS including weekly status reports and actioned any AERONET requests as required
- Notified AERONET of changes to the network
- Completed annual site visits to update units and peripherals at Birdsville, Jabiru, Fowlers Gap (Env) and Lake Argyle, Learmonth, Lake Lefroy and Tumbarumba (MR)
- Upgraded data transmission for remaining field sites from 3G to 4G LTE
- Upgraded several CE318T units with internal 4G modem cards which allows for the phasing out of **Logger V1** at some sites
- Upgraded one site to CE318N to CE318T with HTTPS data to AERONET
- Upgraded internal 2x Telit 3G and 3x Sierra 3G modems to Telit 4G
- Configured and registered a new CSIRO Perth (MR) site for testing for AeroSPAN instruments and peripherals

AeroSPAN – Updates

- Completed Activities FY 2023/2024
  - Raspberry Pi loggers
  - Adaptation of AEROSPAN wiring panels to accommodate internal modems in CE318-TS9 units
  - Conversion of first generation TS-9 units to new 4G modems + chip guards to protect capacitors
  - Wet sensor manufacture



Plans for next 2024/25 FY

1. Further hardware upgrades at various sites
2. Network review to consider the ideal long-term operating model under constrained resourcing.
3. Move to Stage 2 of in-house AOD processing code conversion (in cooperation with National Air Quality Forecasting - AQFx).

Acknowledge collaborators and other workers

AEROSPAN Project team:

- David Barker (Environment)
- Ian Lau (Mineral Resources)
- Ruhi Humphries (Environment)
- Melita Keywood (Environment)

Lucinda IMOS Project team:

- **Thomas Schroeder (Environment)**
- Kahil Mitchell (Environment)

Thank you

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Thank you