



# CSIRO

## Oceanographic Calibration Facility

**Hobart, Tasmania, Australia**

**Robert Kay** | Calibration Engineer  
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OCEANS & ATMOSPHERE / ENGINEERING & TECHNOLOGY  
[www.csiro.au](http://www.csiro.au)



# CSIRO Oceans & Atmosphere



- The Commonwealth Scientific and Industrial Research Organisation (CSIRO) is the Australian federal government agency for scientific research in Australia.
- Oceans and Atmosphere (O&A) provides the knowledge to manage Australia's marine estate and atmospheric environment.
- The O&A head office is in Hobart, Tasmania and has facilities on 4 other sites around Australia.
- The Oceanographic Calibration Facility is part of the Engineering & Technology research program

## O&A - E&T operates and supports:

- Marine National Facility RV Investigator
- Deep water and Coastal mooring teams
- UAV team – Gliders – ROV
- Ships of opportunity - ARGO
- Marine instrumentation
- Mechanical engineering services



# Why Calibrate Locally ?

CSIRO O&A believes that there are advantages for running its own oceanographic calibration facility, rather than returning instruments back to the original manufacturer:

- Cost
  - Fee for service covers running costs, facility is cost neutral to O&A
  - Reduced shipping costs for clients
  - Disadvantage - Facility set-up cost is high
- Time
  - Reduced overall calibration time
    - Reduced transit time
  - Ability to provide 'Priority' service
- Expertise
  - Focal point for metrological understanding
  - Knowledgebase of instrument performance
  - Direct link to NMI and accreditation bodies (NATA)



# Calibration Facility History

- Started in 1986, At the creation of the Marine National Facility
- CTD of the day where “Neil Brown CTD Mk III”.
- MK III were inherently linear, as they utilised an AC resistance bridge.
- This meant that a simple two point calibration was sufficient to fully characterise an instrument.



(26.863 Degrees)



Phenoxybenzene Melt Point  
Water Triple Point

(0.010 Degrees)



Neil Brown Mk IIIC CTD in shipping  
crate.

# Calibration Facility History

In 2000, purchased Seabird CTD (Thermistor based)

- Faster temperature response
- Temperature and Conductivity calibration more stable
- Ability for dual sensors, to allow real time checking of instrument performance
- Actual sensors were small and easy to swap
- More robust



Issues:

- Sensors inherently non-linear
- Multipoint calibrations now required across full sensor range



# Instrument development

- Instrument manufacturers / sensor types calibrated:
  - Seabird: C, T, CTD, TSG, Glider/Argo, DO, T/P loggers, pH
  - Wetlabs WQM, FL, NTU
  - RBR CTD, DO, T/P loggers
  - Teledyne-RDI CTD
  - Aqualogger T/P loggers
  - Star-oddi T loggers
  - Digiquartz P
  - CSIRO custom design T, P



# Temperature & Conductivity calibration

## CSIRO O&A Calibration Bath

140litres seawater

Uniformity:

Spatial  $\pm 0.0005^{\circ}\text{C}$

Temporal  $\pm 0.0003^{\circ}\text{C}$

CSIRO controller



Seawater bath

Water triple point

Gallium melt point

CSIRO bath controller

8ch Volt meter

8 port Serial server

8ch CSIRO Frequency Counter

ASL F18 bridge

SPRT

Standard resistor

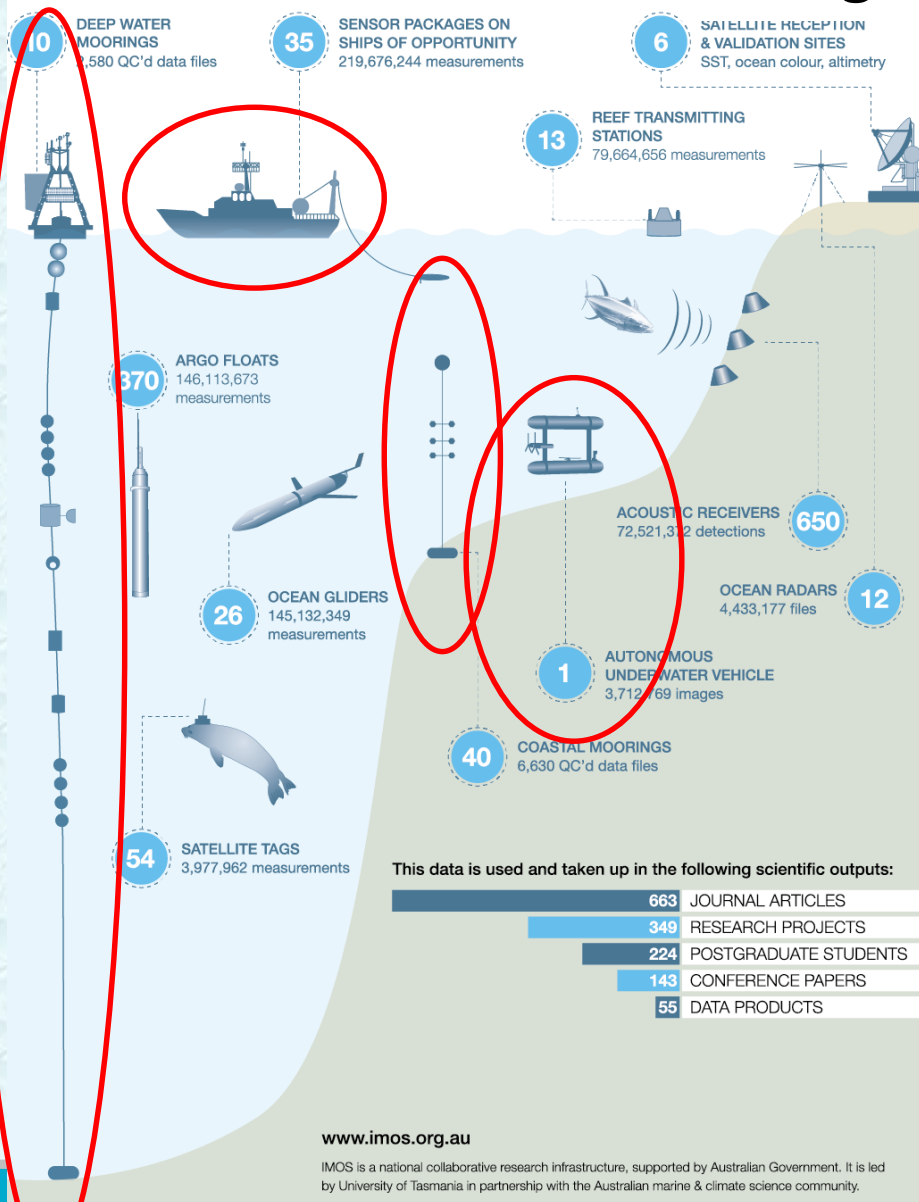
PC

12hr UPS

# Integrated Marine Observing System (IMOS)



# Integrated Marine Observing System



- Deepwater Moorings
- Coastal Moorings
- Ship based Instruments
- AUV sensors

Leading to strong links to new clients:

- ❖ Australian Institute of Marine Science
- ❖ Sydney Institute for Marine Science
- ❖ South Australian R&D Institute
- ❖ Oceanographic Field Services
- ❖ Victorian Environmental Protection Agency
- ❖ Australian Centre for Field Robotics

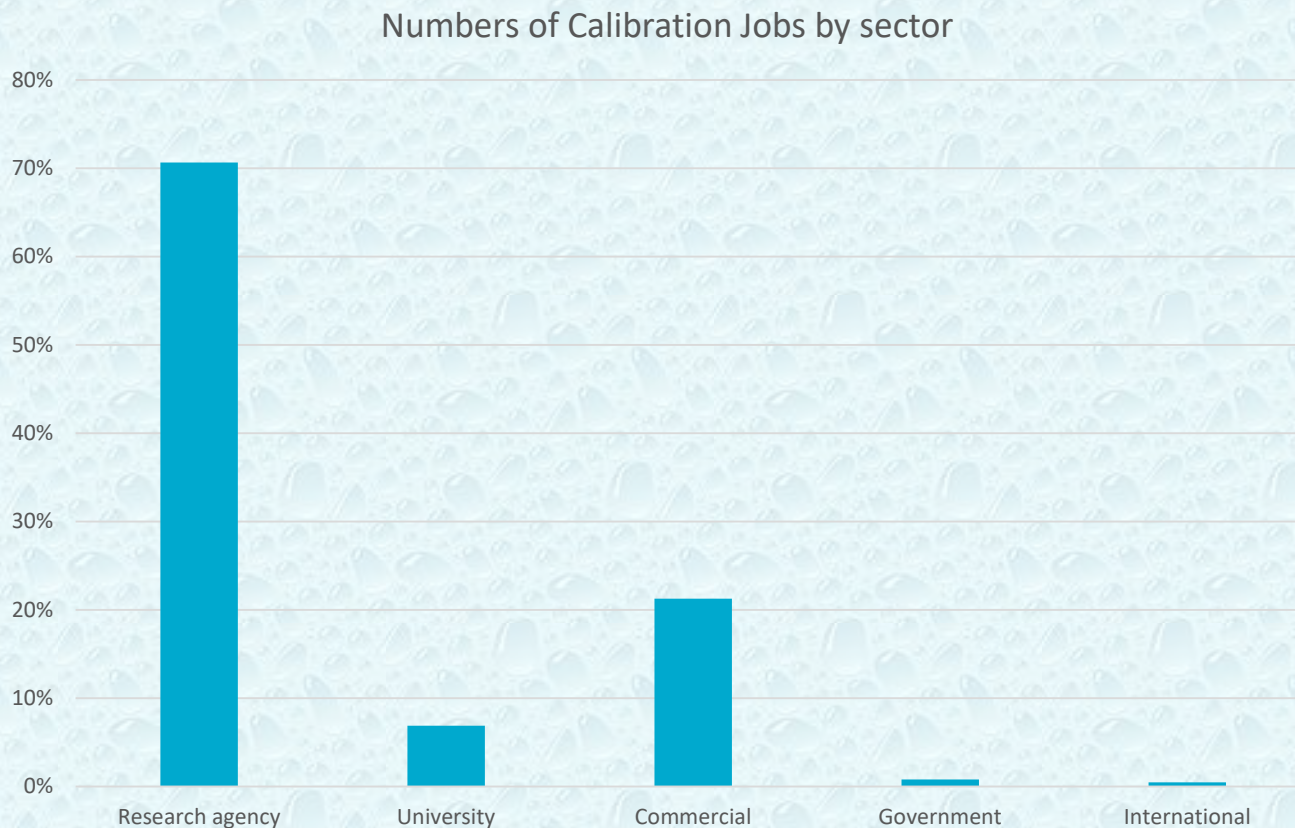
# CSIRO Oceanographic Calibration Facility

## Clients:



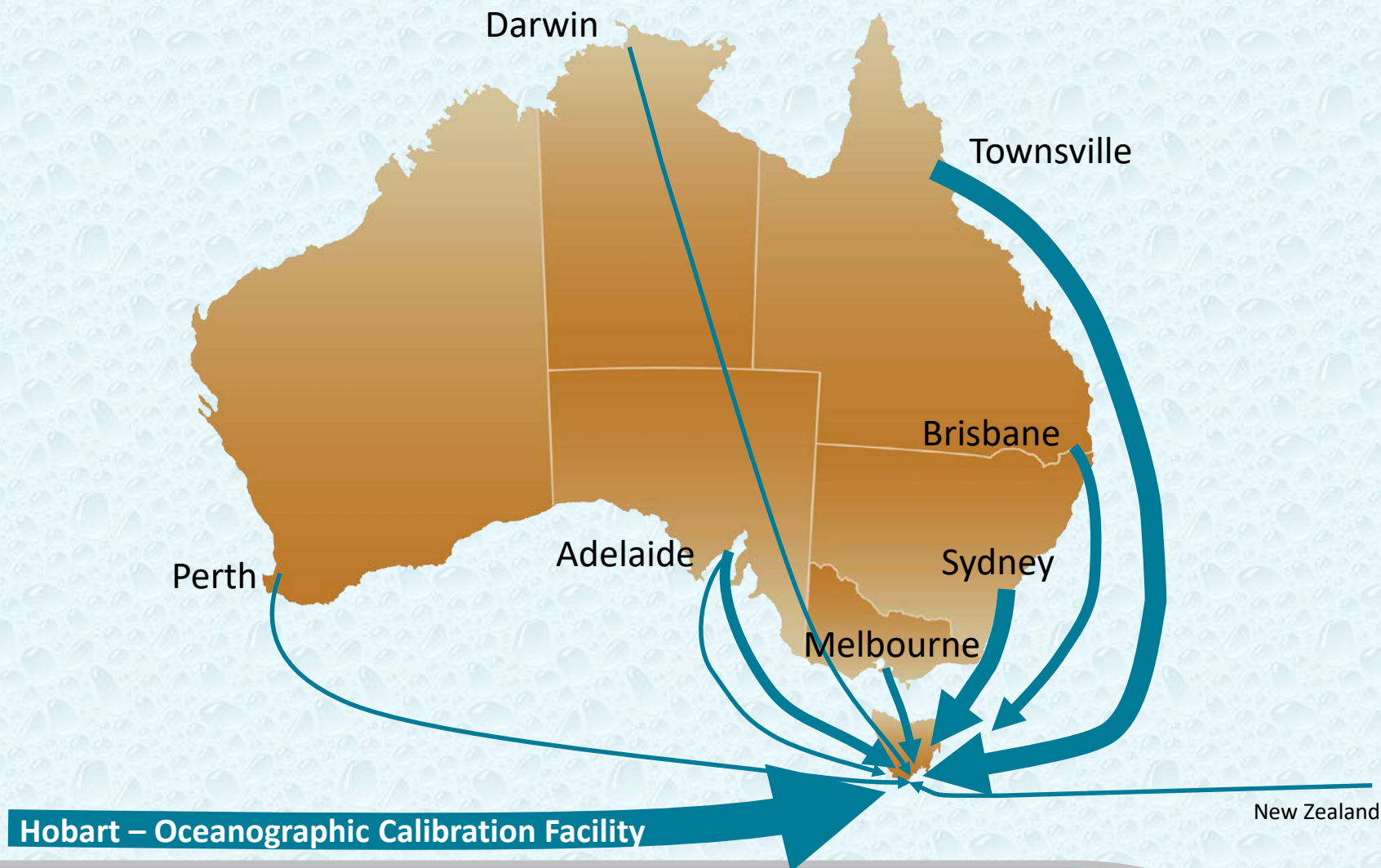
# CSIRO Oceanographic Calibration Facility

## Clients:

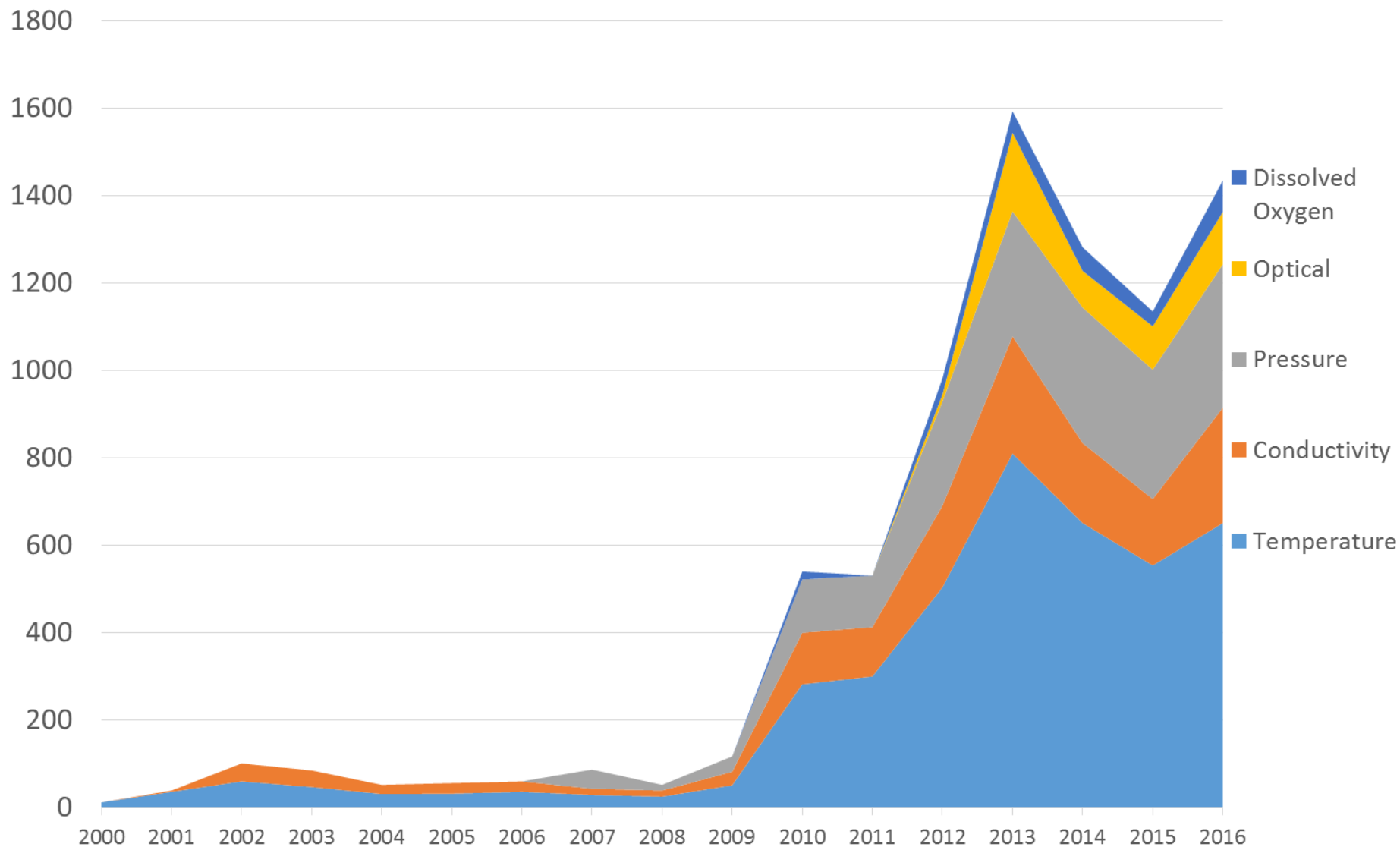




# CSIRO Oceanographic Calibration Facility



## Calibrations per year



# O&A Calibration Capabilities

- The facility calibrates a wide range of oceanographic instrumentation to a level of accuracy consistent with the world's best practice.
- The specification of the sensors drives the need for high accuracy calibration

• Temperature	-2 to 0 °C	± 0.0015 °C
	0 to 30 °C	± 0.001 °C
	30 to 35 °C	± 0.0015 °C
• Conductivity	0 to 7 S/m	± 0.0003 S/m
• Pressure	0 to 11000 dbar	± 0.01 % of reading

- Dissolved Oxygen, Turbidity, Fluorescence (Chl-a).
- The Facility is accredited for Temperature and Pressure in Australia by the National Association of Testing Authorities (NATA).  
ISO/IEC:17025 Laboratory Accreditation: 2981

- Regular internal and external audit to ensure compliance





# Temperature & Conductivity calibration

## CSIRO O&A Calibration Bath

140litres seawater

Uniformity:  
Spatial  $\pm 0.0005^{\circ}\text{C}$   
Temporal  $\pm 0.0003^{\circ}\text{C}$

CSIRO controller



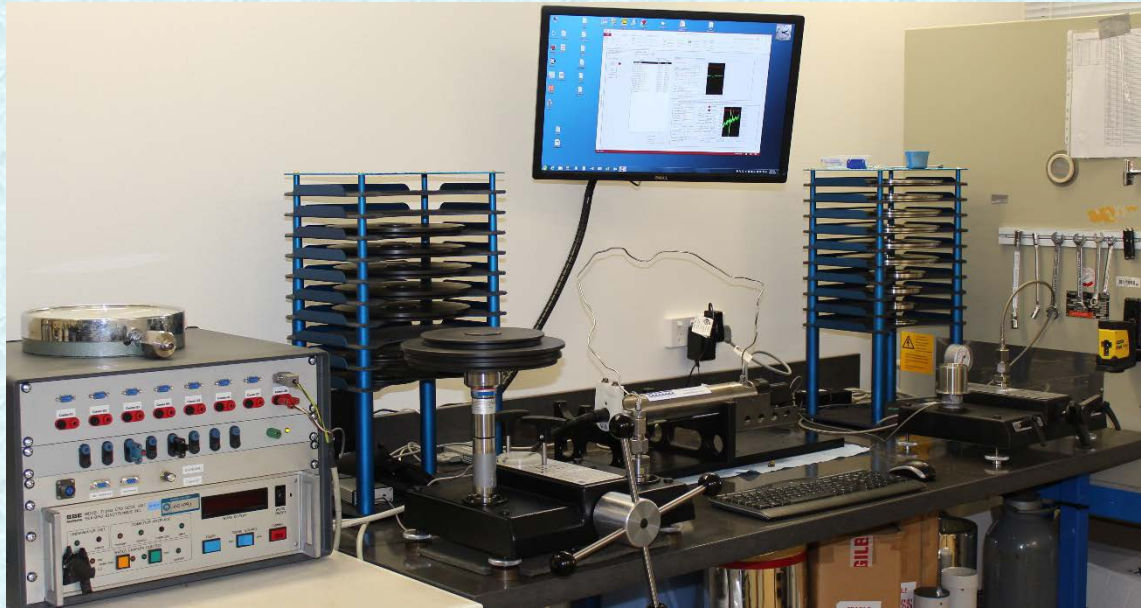
Seawater bath

Water triple point

Gallium melt point

CSIRO bath controller  
8ch Volt meter  
8 port Serial server  
8ch CSIRO Frequency Counter  
ASL F18 bridge  
SPRT  
Standard resistor  
PC  
12hr UPS

# Pressure calibration



8 port Serial server

8 voltmeter

SBE11 deck unit

Hydraulic  
Dead-Weight-Tester

Instrument jig

Oven

Level

Pneumatic  
Dead-Weight-Tester



# Instrumentation and standards:

The facility has primary reference instruments and primary standards.

- **Temperature:** Water Triple Point (WTP), Gallium Melt point (GaMP)  
Standard Platinum Resistance Thermometers (SPRT)  
ASL F18 & F900 Primary Thermometry Bridge,  
Constant temperature seawater baths
- **Pressure:** Dead Weight Testers; Hydraulic & Pneumatic
- **Salinity:** Guildline Autosol - IAPSO Standard Seawater
- Where possible multiple reference standards from different manufacturers are held
- Regular intra and inter laboratory intercomparison of standards undertaken





# Quality assurance

ISO/IEC:17025

General requirements for the competence of testing and calibration laboratories

Calibration facility Laboratory Quality Manual	(LQM)
Methods Manual	25 separate methods

External audit by the National Association of Testing Authorities (NATA)\*

Management Audit	-	Every 18 months
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Technical Audit	-	Every 36 months
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Calibrations are traceable to national and international standards

Regular reference standard cross check and measurement intercomparison with a number of facilities throughout the world

\* NATA is the authority that provides independent assurance of technical competence through a proven network of best practice industry experts for customers who require confidence in the delivery of their products and services. NATA provides assessment, accreditation and training services to laboratories and technical facilities

# Collaboration

The facility has a continuous program of sensor inter-comparisons with national and international institutions

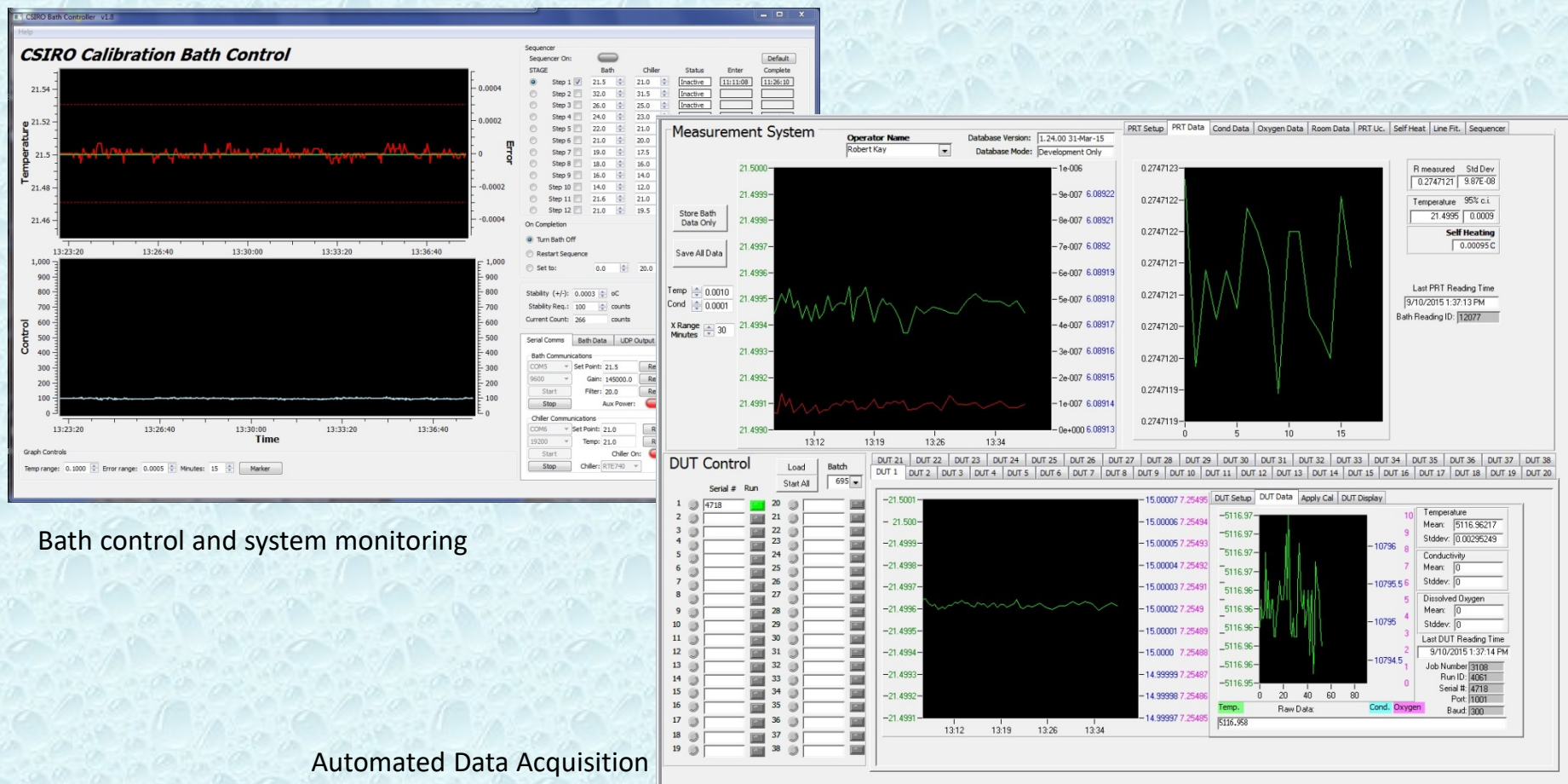
Temperature:      National Measurement Institute (NMI) Australia  
Seabird (Instrument Manufacturer) USA

C-T-D:              National Center of Ocean Standards and Metrology (NCOSM) China  
Japan Agency for Marine-Earth Science and Technology (JAMSTEC) Japan



# Software and Automation

To optimise adherence to best practice, and to maximise efficiency, the facility has a well developed set of programs and databases to collect, store, process, review data and to generate calibration reports.



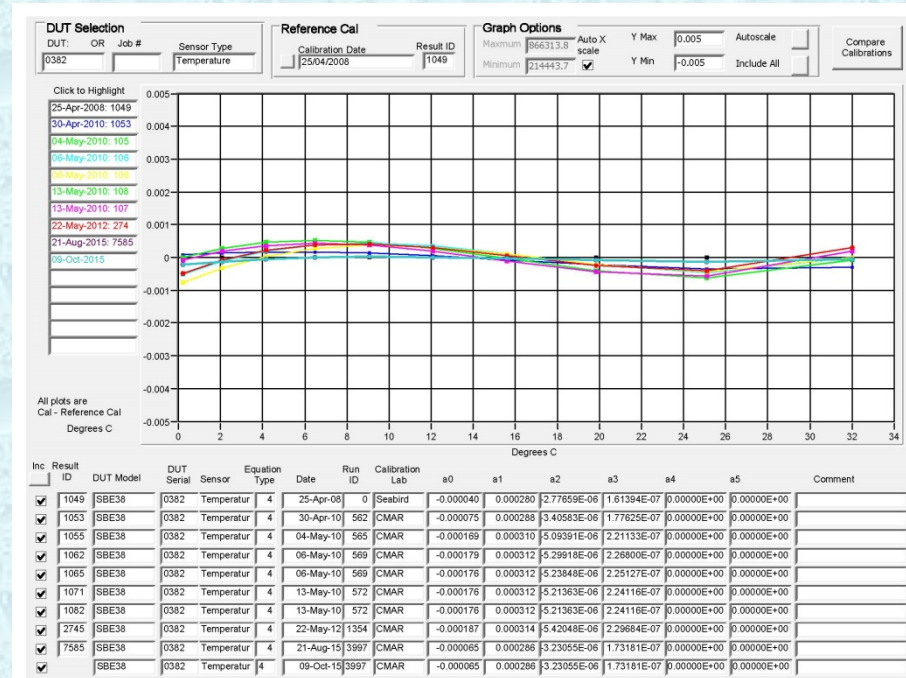
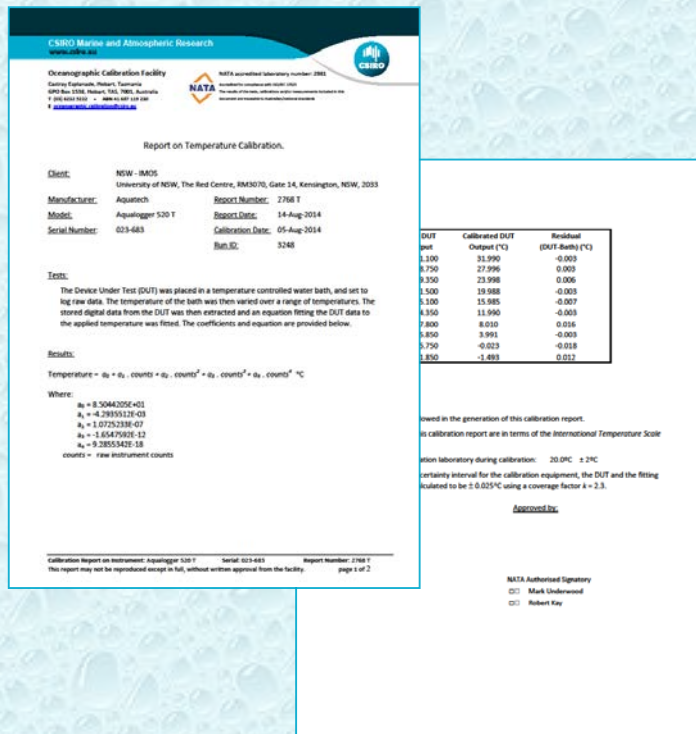
Bath control and system monitoring

Automated Data Acquisition



# Deliverables

- Calibration coefficients generated and entered into the instrument
- Uncertainty of measurement
- Calibration reports issued
- Sensor performance analysis and feedback



# Continuous development

The O&A Oceanographic Calibration Facility is client focused and we work with our client base to continually develop the facility's capabilities. Future developments planned are:

- Expansion of the facilities to accommodate increased throughput
  - Larger calibration bath
  - Additional reference instrumentation
- New clients and new instrument types
- Additional sensor calibrations:
  - PAR, pH, Backscatter
  - 'One stop shop' for all oceanographic instruments
- ISO/IEC 17025 accreditation for Conductivity calibration
  - Reassessment of current uncertainty calculations
  - Analysis of salinometer performance
  - Proficiency testing of sensor calibration
  - External audit



# Recent developments

- Additional staff: Kelly Brown
- Additional capability: New calibration bath, improved pressure uncertainties
- Increased collaboration:
  - Technical visit to NCOSM China
  - Visit to O&A facility by JAMSTEC
  - Technical visit to O&A facility by NCOSM
  - Visit to KIOST Korea
  - Visit to NOC UK

# Thank you

## Questions?

Robert Kay

Oceanographic Calibration Facility

t +61 3 6232 5104  
e [Robert.Kay@csiro.au](mailto:Robert.Kay@csiro.au)  
w [www.csiro.au/oceanographic-calibration](http://www.csiro.au/oceanographic-calibration)

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