Inter-Laboratory Calibration Traceability

DBCP September 2011 Geneva

Context

- Climate monitoring requires continuity of measurements
  - If you place two sensors in the same environment will they report the same values?
  - If they don't which is right?
  - If you place 10 or 100 sensors in the same environment what is the error distribution?
  - If two sensors are calibrated in different laboratories will they report the same value in the same environment?

Why this important to you

- Valid comparison of sensors deployed around the globe
- Valid comparison of sensors on different platforms
  - Surface drifters
  - ARGO
  - Shipboard data sources
- Sensors from different manufacturers must report with equivalent accuracy

Why this important to Sea-Bird

- Sea-Bird is opening a service and calibration center in Kempten Germany on November 15th
- Calibrations performed at the factory must be equivalent to those performed at Kempten
- Sea-Birds future plans include opening satellite facilities in other places
  - Asia
  - Australia

Focusing on Transfer Standards

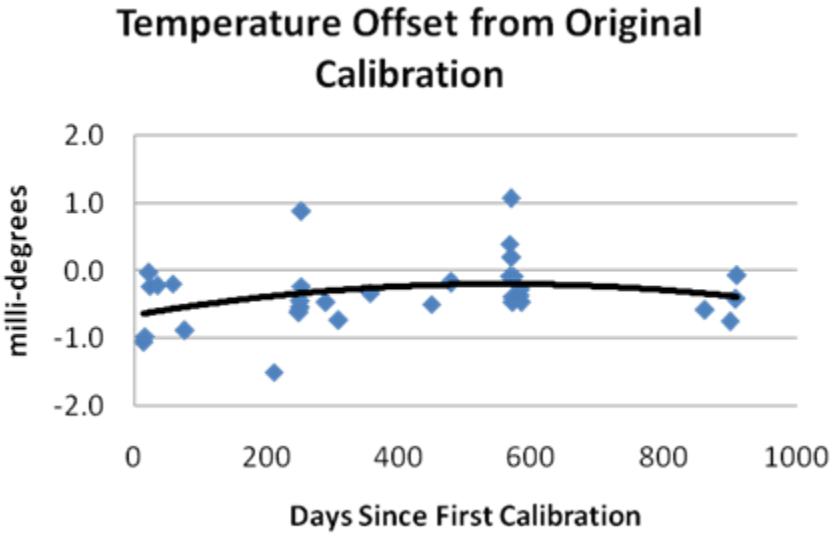
- Primary standards
  - Temperature – triple point of water, gallium melt point
  - Conductivity – standard seawater
  - Oxygen – potassium iodate for Winkler titration
- Sea-Bird secondary or transfer standards
  - SBE 35, SBE 3
  - Sub standard seawater
- Responsibility of manufacturer

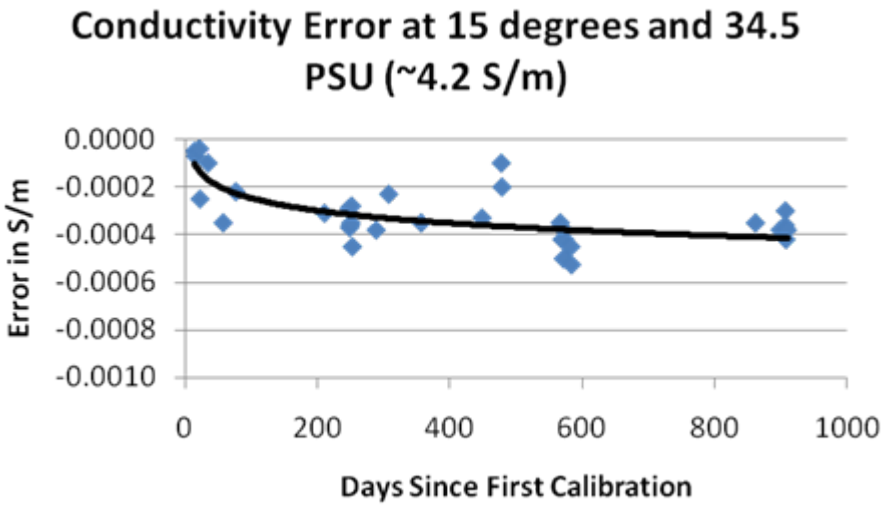
Where are We Now Within Sea-Bird?

- We desire to know errors associated with calibration equipment
  - Consider one temperature and conductivity instrument calibrated 36 times at random in 5 different calibration systems over a three year period

What Confidence Do We Have in the Equipment and Process?

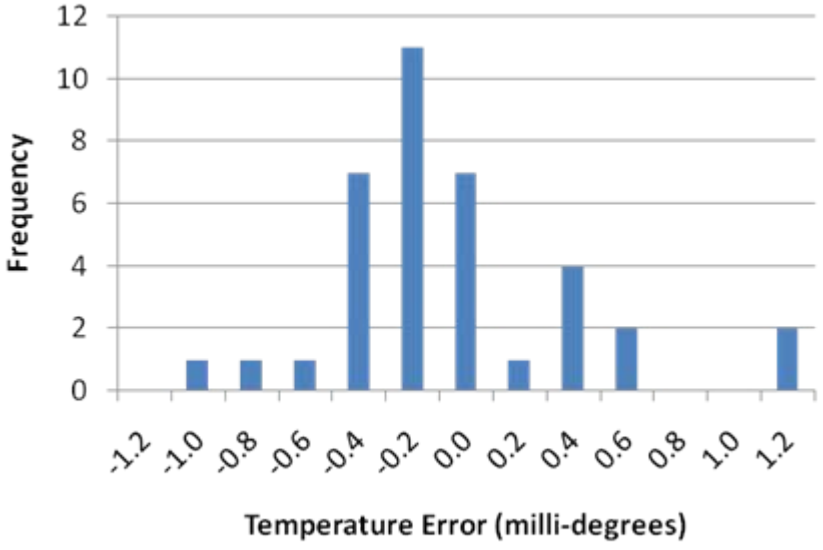
- Presume the instrument accuracy drifts monotonically
  - Use a calibration performed in January 2009 as basis
  - Can predict the “assumed drift” and separate the process error

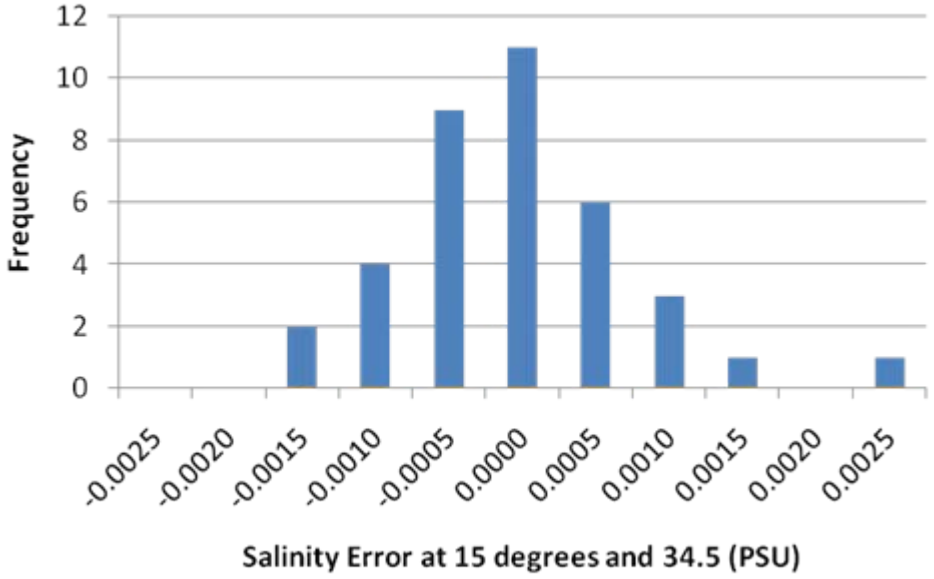




What is the Error Distribution?

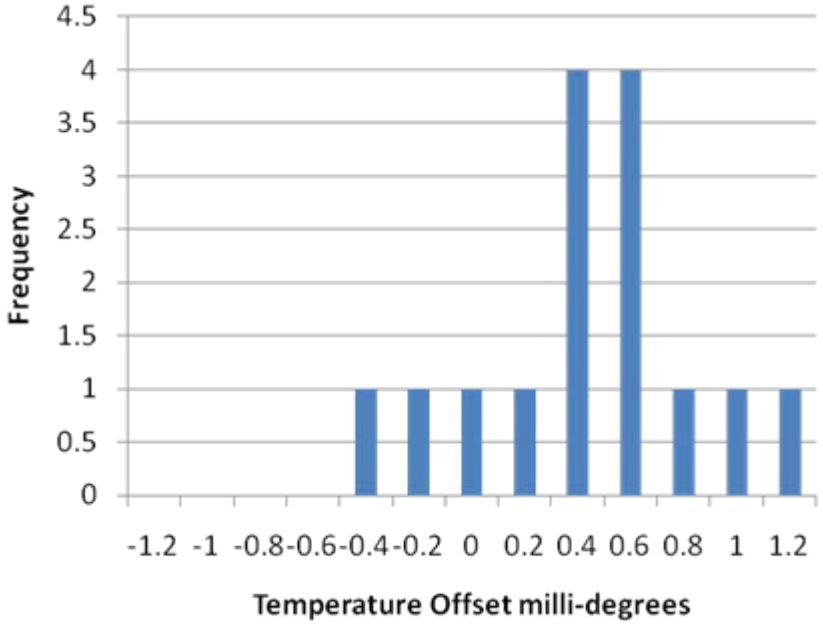
- Temperature error is centered at -200 micro degrees
- Conductivity error expressed as salinity at 15 degrees and 34.5 PSU has mode at 0, seems skewed toward low of correct

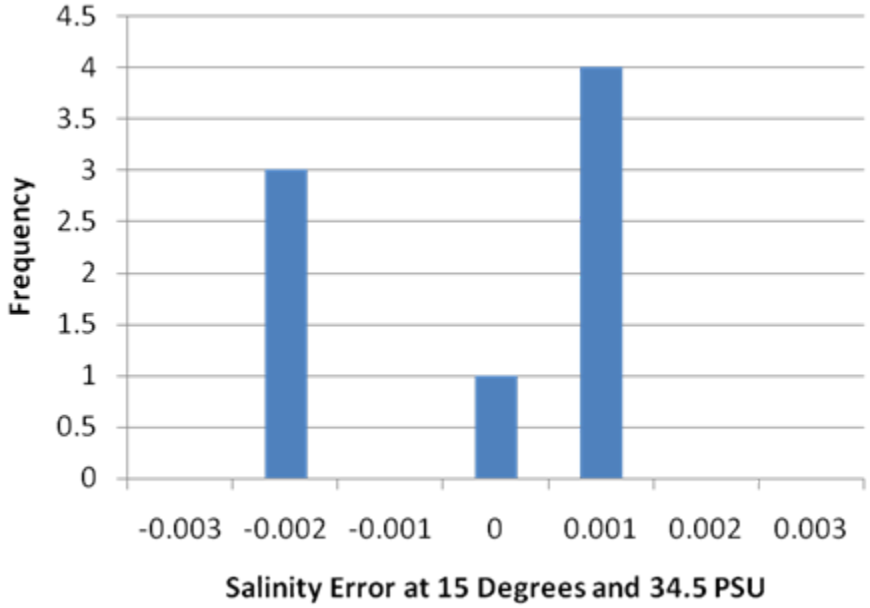




The Converse, 8 Sensors 1 Calibration System

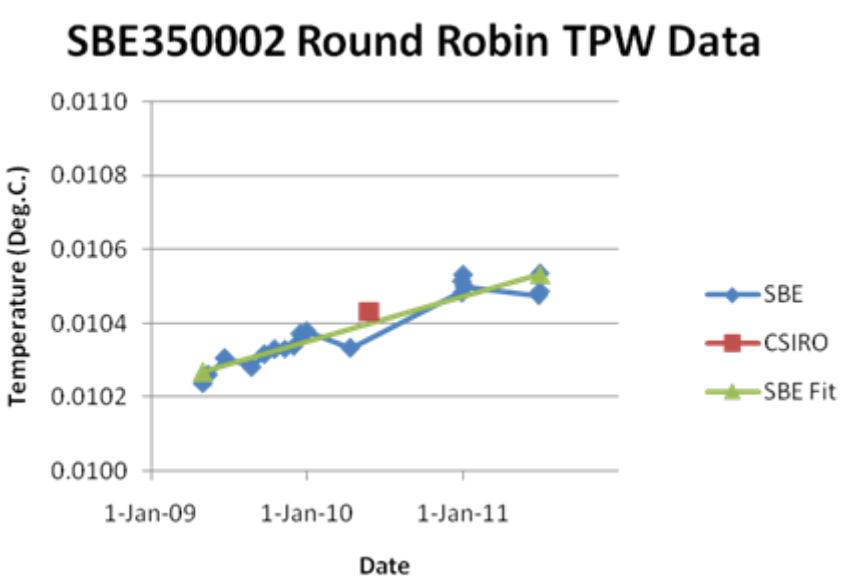
- Indicates measurement confidence
  - For temperature +/- 1.2 milli-degree
  - For salinity +/- 0.002 PSU

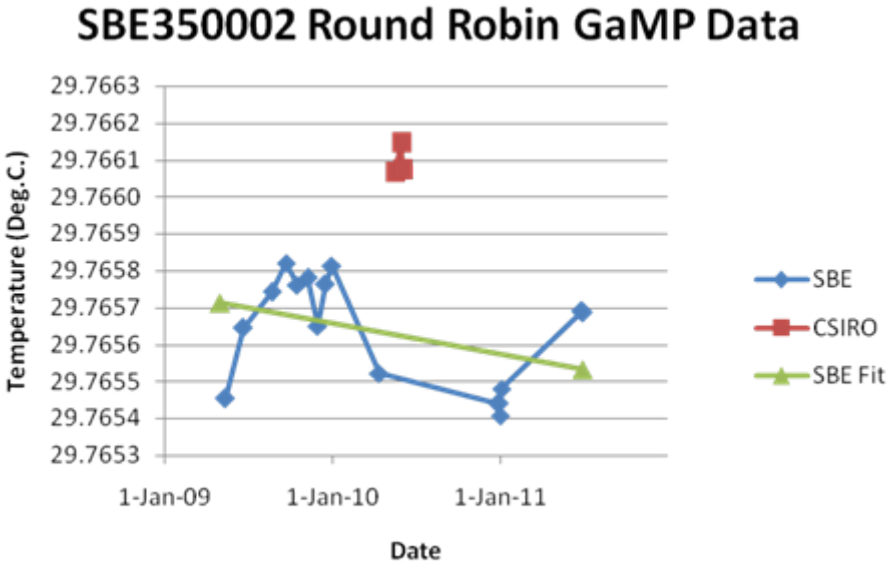




Where are We Outside of Sea-Bird

- Collaboration with CSIRO



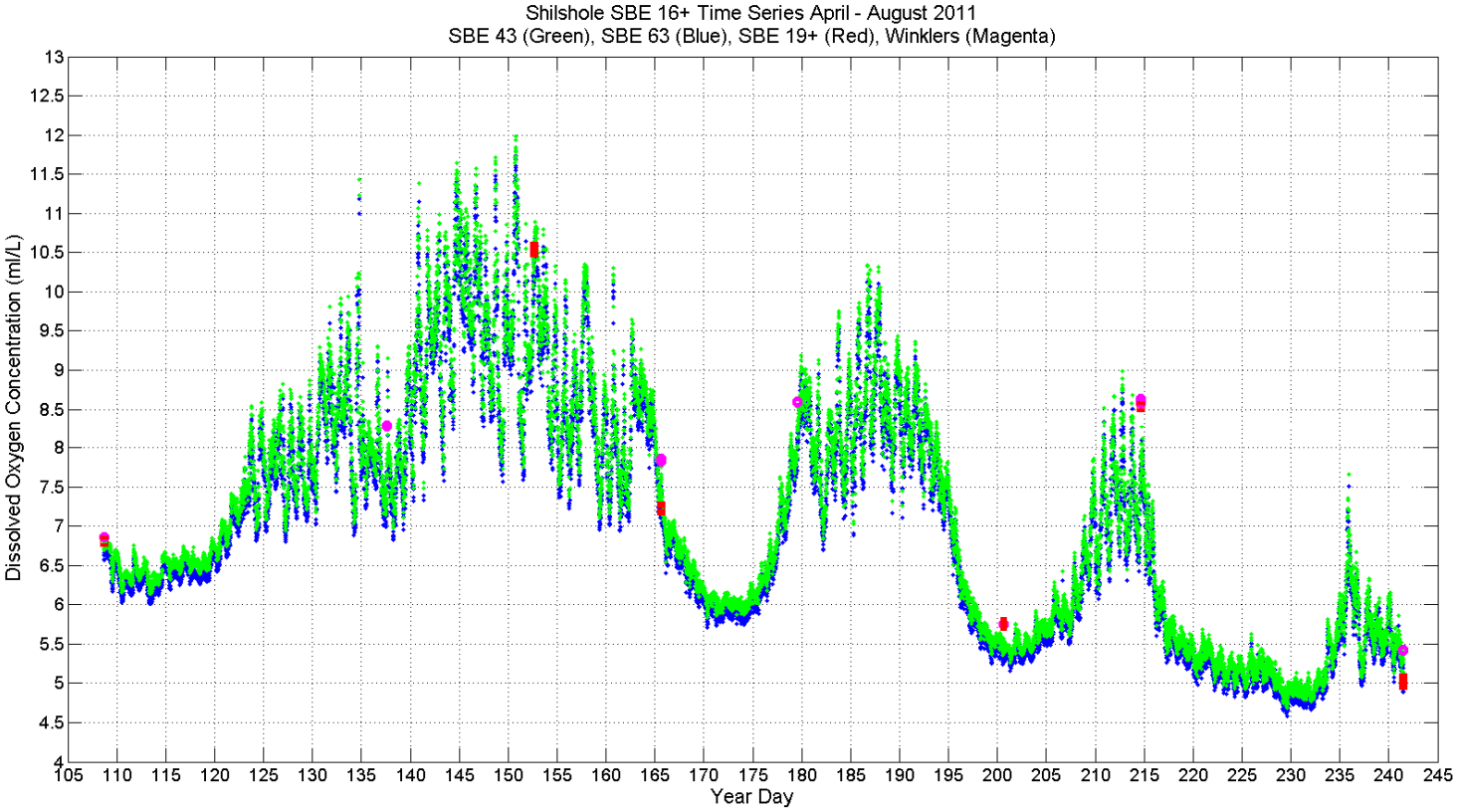


Ensuring Continuity Between Sea-Bird's Facilities

- Exemplar instruments will be calibrated alternately between facilities at scheduled intervals
- Require that error distributions do not exceed that of home facility in USA
- Require that error distributions are not bimodal or even multi-modal

Beyond Temperature and Conductivity

- Expansion of effort to dissolved oxygen
  - Field comparison of Sea-Bird's oxygen technologies, optical, electrode, Winkler titration



Where Should We Go With This?

- Continue Inter-Laboratory comparison
  - National calibration laboratories
  - Commercial calibration laboratories?
  - Other manufactures willing to get involved?