International Quality-controlled Ocean Database (IQuOD)

Lijing Cheng, Guilherme Castelao, Rebecca Cowley,
on behalf of the IQuOD Team
IQuOD “Mission Statement”

To maximize the quality, consistency and completeness of the long-term global subsurface ocean temperature database.

IQuOD includes intelligent metadata for XBTs and has uncertainties assigned to each individual temperature observation. Some uncertainties have been assigned to depth and salinity.

IQuOD will soon include Automated QC flags from the IQuOD community A-QC benchmarking tests. Many duplicates have been identified in the WOD/IQuOD and have been removed.

The power of IQuOD: Ability to pull together the expertise from the international research community (producers/users) and to focus that combined effort into a single “best” dataset.
Happy 10\textsuperscript{th} Birthday to IQuOD!

- Inaugural meeting was June 2013 in Hobart, Australia.
- Agreed aim was to work towards: 

  \textit{A high-quality historical subsurface ocean temperature (salinity) global dataset, along with the most complete metadata information and formal error measurements for climate research needs.}
Five other workshops...

Silver Spring, USA, 2014

Hamburg, Germany, 2014

Tokyo, Japan, USA, 2016

Oostende, Belgium, 2018

Brest, France, 2019
Today’s big challenge: ‘Climate quality’ ocean database

Number of ocean temperature profile data

Current IQuOD structure

- Co-chairs since May:
  - Gui Castelao;
  - Lijing Cheng.

- Coordinator:
  - Rebecca Cowley

- Vote to formalise Gui and Lijing’s appointments in July 2023.
Achievements of IQuOD

- The community agreed best practice for benchmarking temperature profiles AutoQC
- IQuOD AutoQC flag

Benchmarking of automatic quality control checks for ocean temperature profiles and recommendations for optimal sets

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Good et al. 2023
Achievements of IQuOD

- Assign instrumental uncertainty to each individual temperature measurement
- The provision of a consistent set of observation uncertainties will provide a more complete understanding of historical ocean observations used to examine the changing environment.

International Quality-Controlled Ocean Database (IQuOD) v0.1: The Temperature Uncertainty Specification

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TABLE 2 IQuOD v0.1 uncertainty assignments.

<table>
<thead>
<tr>
<th>Instrument type</th>
<th>Temperature (°C)</th>
<th>Depth/Pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Botley-Reaving thermometer</td>
<td>0.02</td>
<td>9%</td>
</tr>
<tr>
<td>CTD uncalibrated and calibration status unknown</td>
<td>0.01</td>
<td>0.08%</td>
</tr>
<tr>
<td>CTD calibrated</td>
<td>0.002</td>
<td>0.015%</td>
</tr>
<tr>
<td>CTD animal mounted</td>
<td>0.005</td>
<td>-</td>
</tr>
<tr>
<td>CTD fixed</td>
<td>0.01</td>
<td>-</td>
</tr>
<tr>
<td>DBT</td>
<td>0.05</td>
<td>-</td>
</tr>
<tr>
<td>Profiling Drifting Buoy</td>
<td>0.01</td>
<td>-</td>
</tr>
<tr>
<td>Glider</td>
<td>0.002</td>
<td>-</td>
</tr>
<tr>
<td>MBT</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>MBT deployed from Soviet Union flagged ships</td>
<td>0.3</td>
<td>3%</td>
</tr>
<tr>
<td>Moored buoy</td>
<td>0.002</td>
<td>-</td>
</tr>
<tr>
<td>Moored line</td>
<td>0.3</td>
<td>-</td>
</tr>
<tr>
<td>Profiling floats (pre-Argo)</td>
<td>0.005</td>
<td>-</td>
</tr>
<tr>
<td>Profiling floats (Argo)**</td>
<td>0.002</td>
<td>2.4 dbar</td>
</tr>
<tr>
<td>STD</td>
<td>0.002</td>
<td>5 m</td>
</tr>
<tr>
<td>XBT manufacturers other than Sippican or TSK and unknown manufacturer type</td>
<td>0.2</td>
<td>≤230 m: 4.6 m; &gt;230 m: 2%</td>
</tr>
<tr>
<td>XBT deployed from autonomous or Tsurumi-Seki Co (TSK) manufacturer</td>
<td>0.15</td>
<td>≤230 m: 4.6 m; &gt;230 m: 2%</td>
</tr>
<tr>
<td>XBT Sippican manufacturer</td>
<td>0.1</td>
<td>≤230 m: 4.6 m; &gt;230 m: 2%</td>
</tr>
<tr>
<td>XCTD (pre-1998)</td>
<td>0.06</td>
<td>4%</td>
</tr>
<tr>
<td>XCTD (post-1998)</td>
<td>0.02</td>
<td>-</td>
</tr>
</tbody>
</table>

**XBT profiling float data provide a standard error for each measurement for delayed mode quality controlled cycles. This information was used for the QOD uncertainty value when available. The largest standard error for a variable in that cycle was applied to each measurement of that variable in that cycle. Pending assignment: N/A. Not applicable.

Cowley et al. 2021
Achievements of IQuOD

- Assign XBT probe type using a machine learning approach, which is often missing.

Diagram of machine learning pipeline for processing XBT profiles
Achievements of IQuOD

- IQuOD-v1 online, publicly available through NOAA/NCEI service

International Quality-controlled Ocean Database (IQuOD) version 0.1 - aggregated and community quality controlled ocean profile data 1772-2018 (NCEI Accession 0170893)

This dataset includes subsurface ocean profiles of temperature, salinity, oxygen, nutrients, ocean tracers, optics, and biology (chlorophyll, plankton) taken from 1772 to 2018 in the global ocean using bottles, CTD, XBT, MBT, profiling floats, moored buoys, ice drifting buoys, gliders, towed profilers, and instrumented pinnipeds. This dataset was prepared at NCEI in CF compliant netCDF ragged array format under the direction of the International Quality-controlled Ocean Database (IQuOD) project. The IQuOD effort is being organized by the oceanographic community, and includes experts in data quality and management, climate modelers and the broader climate-related community. The primary focus of IQuOD is to produce and freely distribute the

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IQuOD activities in 1-2 years

① Publish a data description/evaluation paper for next release of IQuOD dataset, there will be a regular update of IQuOD data (every 1-2 years)

② Develop new data processing and data QC techniques, including bias corrections (MBT, bottle, marine mammal data); Expert-QC; Duplicate check; code optimization, and machine-learning approach application.

③ Improve uncertainty definition/quantification, including instrumental error and representative error.

④ Increase outreach and international collaboration, e.g. OTGA.

⑤ Pilot activity for salinity.

⑥ Reframe IQuOD steering group.
Thanks!

IQuOD is an international group bringing together worldwide researchers working to improve ocean temperature and salinity data quality, which could support various applications from synopsis to climate scales.

Website:  
www.iquod.org

Bibliography:  
https://scholar.google.com/citations?user=qYD_0r8AAAAJ&hl
Also have a publication collection at Ocean Best Practices:  
http://repository.oceanbestpractices.org/handle/11329/1590

Github:  
https://github.com/IQuOD