Argo floats in the Nordic Seas and the European Artic Ocean

Why do we need other CTD data?

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BSH: Federal Maritime and Hydrographic Agency (Germany)

Euro-Argo: The European contribution to the global Argo ocean observation network
Argo: autonomous profiling floats

- Measure ocean temperature and salinity up to 2000 m depth
Argo floats: Operating in partially-ice covered areas

• Pilot projects in the Arctic and Nordic Seas:

  ▪ Tests occurring in Barents Sea, north of Svalbard, and Baffin Bay (NAOS project)

  ▪ First promising results of Ice Sensing Algorithm definition for the Barents Sea and north of Svalbard
Argo floats with ICE option: Ice Sensing algorithm

- Avoid damage during ascending or at the surface
- Assumption: Temperature in the water column is related to the presence of sea ice
- Parameters to be tuned for Arctic environments: Pressure range, median threshold.
Argo floats with ICE option: Ice sensing Algorithm in the Barents Sea

MASIE ice edge information used to classify hydrographic profiles from UDASH (Behrendt et al., 2017)

From profiles in ice and near ice (< 50 km) typical conditions for ice sensing are derived.

Local ISA parameters
Temperature treshold: -1.0 between 20-10 dbar

Courtesy Katrin Latarius
Salinity Delayed-mode quality control (DMQC)

- 0.01 PSU Target accuracy (Argo Science Team, 2000).

- Check for drifts and offsets in salinity relying in reference datasets and statistical methods.

- OW (Owens & Wong, 2009) and OWC methods (OW + Cabanes et al. 2016)
  - Uses climatological salinity interpolated (objective mapping) to the float positions and observed $\theta$ surfaces.
  - Chooses 10 ‘best’ levels that are within well-mixed mode waters or deep homogeneous water masses.

- Quality of the correction depends on the quality of the references databases!
CTD reference database for DMQC

• Contents
  - Metadata: latitude, longitude, dates (timestamp), source (profile ID) and qclevel (origin of the data)
  - Data: Pressure, Temperature, Salinity and Potential Temperature

• Selection requirements
  - Casts deeper than 900 dbar (to exclude coastal stations). Full profile is stored.
  - Only good quality data
  - Unique stations by removing duplicates
Issues

• Lack of profiles after 2010
• Not paired values (pres,temp,sal)
• Duplicated profiles (header and content)
• Mislabeled stations (boxes 1700, 7701, 7600)
• Traceability is limited (Coriolis internal profile ids)

Improvements for 2019v1

• **Temporal** and spatial coverage: *Adding profiles from alternative data sources*
• Traceability: *meaningful profile ID code*
• Quality: *Remove redundant (duplicates) and faulty (outliers) and uncertain data*
For all data:
- Clean samples with invalid values in pressure, salinity and temperature
- Check for multiple profiles in the same cast

**ICES: Requires extra quality control!**
- Manually removed outliers
- Suspicious profiles in “quarantine”, until quality is assured

### CTD reference database for DMQC – Data sources

<table>
<thead>
<tr>
<th>DATABASE (qclevel)</th>
<th>PROFILE ID (source)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Directly from PIs (SPI)</td>
<td>Cruise + station (traceable)</td>
</tr>
<tr>
<td>CLIVAR and Carbon Hydrographic Data Office -CCHDO (CCH)</td>
<td>Cruise name (semi-traceable)</td>
</tr>
<tr>
<td>Ocean Library – WOD (OCL) – through COR</td>
<td>Coriolis internal ID code (untraceable)</td>
</tr>
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<td>Coriolis (COR)</td>
<td>Coriolis internal ID code (untraceable)</td>
</tr>
<tr>
<td>UDASH: Unified Database for Arctic and Subarctic Hydrography (Behrendt at al., 2018) – up to 2015</td>
<td>UDASH profile number (traceable back to WOD13)</td>
</tr>
<tr>
<td>ICES: International Council for the Exploration of the Sea (after 2015)</td>
<td>SHIP ID + Coriolis internal ID cde (semi-traceable)</td>
</tr>
</tbody>
</table>
CTD reference database for DMQC – Data redundancy

• High data redundancy is expected: Main source of UDASH is WOD 13

• Same profiles are slightly different between databases: Challenge for duplicate check
CTD reference database for DMQC – Duplicate checks

• Comparing contents (Gronell & Wijffels, 2008)
  ▪ Exact duplicates (sum of pressure, sum of temperature, sum of salinity)
  ▪ Near duplicates: % similarity between samples
    ✓ Profile with highest vertical resolution is interpolated to the pressure levels of the one with lowest resolution (overlapping pressure levels)
    ✓ Compare sample by sample. Rounding and truncation are used: 1 decimal digit for temperature and 2 for salinity
    ✓ This detects pairs were interpolated to different vertical resolutions, pairs that extend to different depths, pairs with salinity stored with different number of decimal digits.
    ✓ If similarity
      • >95% in both temperature and salinity = Duplicate
      • >75% Confirm with visual check