The case of very low $[O_2]$ area

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Outline:

i. WINKLER: analyses of the $O_2$ measurement quality in an Oxygen Minimum Zone (OMZ): detection limit, reproducibility

ii. $O_2$-CTD ADJUSTMENT WITH WINKLER: the OMZs issues

iii. ULTRA-LOW $[O_2]$ ADJUSTMENT: $O_2$-CTD using O-STOX reference

AMOP: PROJECT DEDICATED TO LOW $O_2$

1. WINKLER: analyses of the $O_2$ measurement quality in an OMZ

• Goal: to analyze the Winkler method quality for the specific $O_2$ distribution in an OMZ

1) Limit of Detection (LOD)
2) Reproducibility

Surface (supersaturation)

- OXYCLINE (extreme gradient)
- CORE ($O_2$-clime of detection)
- LOWER $O_2$ GRADIENT (LOG)

WHICH CONTAMINATION AT THE NISKIN SAMPLING?

Experiments with 15 replicates

1) WINKLER SAMPLING & FIXATION
2) REFERENCE FOR LOW $[O_2]$
II. O₂-CTD ADJUSTMENT WITH WINKLER

Collaborations with GLAZEO from 2015 to 2018 in 2 steps:

1) Classical approach and OMZ issues;
2) Improvement

III. ULTRA-LOW [O₂] ADJUSTMENT: O₂-CTD using O-STOX reference

After the adjustment with the Winkler reference (out of the core),
USE OF A REFERENCE for the ULTRA-LOW [O₂] in the OMZ core
(e.g., STOX/LUMOS with nano-/pico-molar detection limit)

TAKE HOME MESSAGE:

1) WINKLER MEASUREMENT
   a) In the OMZ core, not relevant as a reference
   Limit of detection > 4 μM due to:
   - O₂ release by the polymers in the Niskin bottle: 0.3-1 μM;
   - Winkler sampling and fixation process: 2-7 μM
   b) Reproducibility affected in the upper highest OMZ O₂ gradient
      (oxygen-core interface):
      Lower core & LOG: ~80% better reproducibility compared to
      the lower oxygen & upper core

2) ADJUSTMENT OF O₂-CTD WITH WINKLER
   a) Presence of very localized outliers, at the:
      - surface → strong natural temporal variability
      - oxygen → negative concentrations
   b) Focus on the upcasts, & on the adjustments parameters for downcasts
      (without Tau20 → smoothed profiles)

3) ADJUSTMENT OF O₂-CTD FOR LOW [O₂]
   a) Requirement of a canoxic reference: STOX/LUMOS, historical
   b) Limit of detection ×50 better than with Winkler: ~60 nmol/kg

TAKE HOME MESSAGE:

1) WINKLER MEASUREMENT
   a) In the OMZ core, not relevant as a reference
   Limit of detection > 4 μmol/kg
   b) Reproducibility affected in the upper highest OMZ O₂ gradient
      (oxygen-core interface):
      Lower oxygen & upper core: ~80% higher reproducibility compared to
      the lower core and LOG

2) ADJUSTMENT OF O₂-CTD WITH WINKLER
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NEXT:

1) Proposition to write a Paper of Recommendations according to the protocols of
   O₂ sampling, measurements and adjustment in O₂-perturbed regions
   (e.g., OMZs) in order to:
   - share the results of those methodological studies;
   - allow inter-comparisons between data, assessing and increasing the quality of the
     global datasets;
   - improve key-observations in terms of low O₂ concentrations and variability;
2) Importance to have connections between our communities and the international initiatives:

- GO-JOE (Global Ocean Oxygen Network), IOC-UNESCO WAO
- IODCP (International Ocean Carbon Coordination Project), SCOR/IOC-UNESCO
- VOICE project (Variability in the Oxycline and its Impact on the Ecosystems), outcome of WGO

Implementation of multi-disciplinary coordinated from international IODCP Global Ocean Observing Systems, IOC, UNESCO, WMO, marine environmental observations, UN Environment, IUC international union for conservation.

http://www.bscop.org/oxygen

http://ocf2.smu.edu.cn/summer/eq2014/
Application closes: November 15, 2018