Evaluation of the correlation of oceanic water parameters unmasked by representative sampling and sample analysis uncertainty

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Problem Identification:

Oceanic water masses present conservative oceanographic parameters like temperature and salinity. Correlations between nutrients and some of these parameters have been identified. However, these correlation can be masked by system heterogeneity and measurement uncertainty. This masking will be larger when large, heterogeneous systems are studied.

Methodology:

Sampling:
- Portuguese Continental Platform, between 40.12° N and 40.46° N and 8.96° W and 9.30° W
- Sampling dates: October 2018 and April 2019
- Number of samples, n = 20
- Grid of 15 x 20 nautical miles
- Distance between samples, d = 5 x 5 nautical miles
- Sampling level: 25 m

Analysis:
- Segmented Flow Analysis

Uncertainty Modelation:
- Monte Carlo Simulations of georeferenced information applied to Temperature and NOx
- Single Sampling (SS) modeling strategy used

Purpose:
- Estimate the correlation between pairs of parameters, considering the impact of system heterogeneity, sampling uncertainty and sample analysis uncertainty

Results:

Simulated uncertainty of the measurement of NOx and t, from random sampling, in the studied area for 95% confidence level on two sampling occasions and relevant uncertainty components. (σ - Value obtained by the Monte Carlo Method: Analytical components of uncertainty are, for NOx, $s'_\mu = 6.10\%$ (May2019) and $s'_\mu = 3.09\%$, $s'_\rho$, $s'_I$, and $s'_r$ are, respectively, the sampling, repeatability, internal, precision and veracity standard uncertainties and $U'$ is the relative expanded uncertainty ($k=2, \approx 95\%$ conf. Level)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>October 2018</th>
<th>May 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean § $s'_\mu$ (%)</td>
<td>1.18</td>
<td>0.789</td>
</tr>
<tr>
<td>Mean § $s'_\rho$ (%)</td>
<td>3.49</td>
<td>57.0</td>
</tr>
<tr>
<td>Mean § $s'_I$ (%)</td>
<td>1.02</td>
<td>4.61</td>
</tr>
<tr>
<td>Mean § $s'_r$ (%)</td>
<td>1.60</td>
<td>115</td>
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</tbody>
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- the total uncertainty main contributor is the uncertainty arising from sampling
- the relative expanded uncertainty associated with NOx is 1 to 2 orders of magnitude higher than that of t;
- an agglomerate of points at lower concentrations of NOx, more evident in May 2019, is observed.

Conclusions:

- A stronger temperature stratification in May 2019 can explain a somewhat weaker correlation between studied parameters than the one determined for October 2018 ⇒ A more heterogeneous water mass masks temperature and NOx correlation;
- The correlation is slightly affected by system heterogeneity;
  **Nevertheless, it can be stated that the correlations are meaningful**

References


Acknowledgements

This work was financed by the Operational Program Mar2020 through project AQUIMAR – Caracterização geral de áreas aquáticas para estabelecimento de culturas marinhas” and Fundação para a Ciência e Tecnologia (FCT) through the multiannual financing program 2020–2023 of Centro de Química Estrutural.