Uncertainty quantification from the viewpoint of the ocean community

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Joint WMO-IOC Collaborative Board

Based on the recommendations of the Joint WMO-IOC Consultation Group on the Reform of JCOMM, Congress 18, through Resolution 9 (Cg-18), and the 30th IOC Assembly, through Resolution XXX-2, established the

Joint **WMO-IOC Collaborative Board**

(2019)

Ocean Science

is

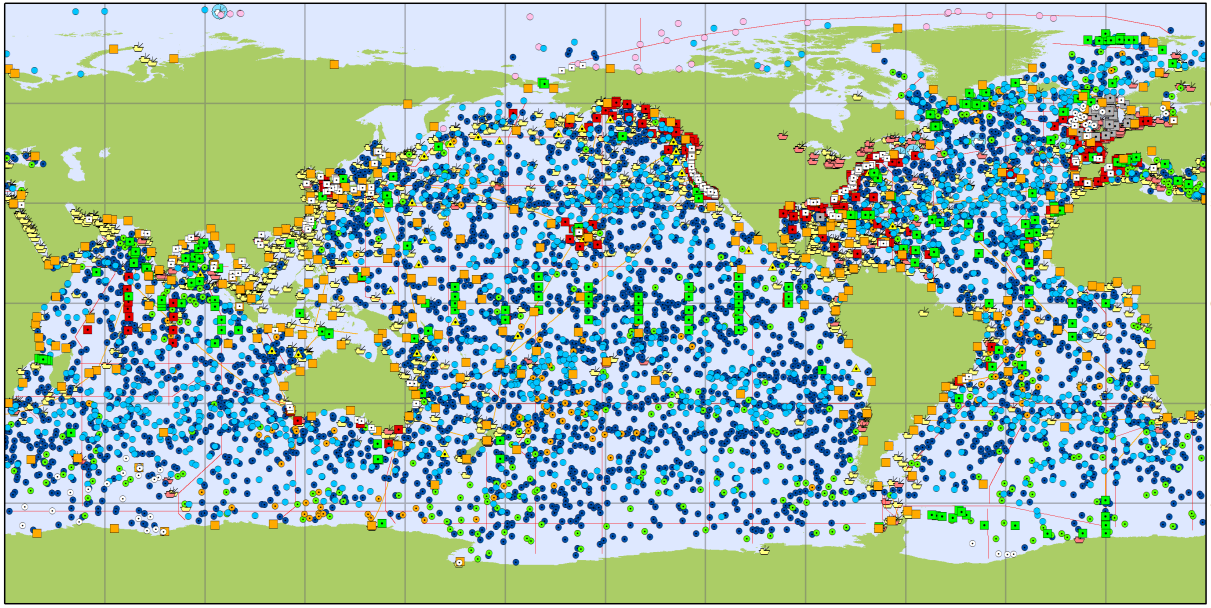
- mainly driven by **observations**
- characterised by a **significant number and diversity of parameters (ECVs or EOVs)** to address the **multidisciplinary** aspects of the domain
- typically organized in **networks** that have their own research agenda and **methodological approaches**

Consequence

No unified approach exists towards **metrology of ocean measurements**

Intergovernmental Oceanographic Commission

RESOURCES, MEETINGS, DOCUMENTS, PEOPLE



Main in situ Elements of the Global Ocean Observing System

January 2020

Profiling Floats (Argo)
- Core (3983)
- Deep (136)
- BioGeoChemical (387)

Data Buoys (DBCP)
- Surface Drifters (1460)
- Offshore Platforms (94)
- Ice Buoys (31)
- Moored Buoys (325)
- Tsunameters (31)

Timeseries (OceanSITES)
- Interdisciplinary Moorings (309)

Repeated Hydrography (GO-SHIP)
- Research Vessel Lines (63)

Sea Level (GLOSS)
- Tide Gauges (290)

Ship based Measurements (SOT)
- Automated Weather Stations (250)
- Manned Weather Stations (1269)
- Radiosondes (12)
- eXpendable BathyThermographs (32)

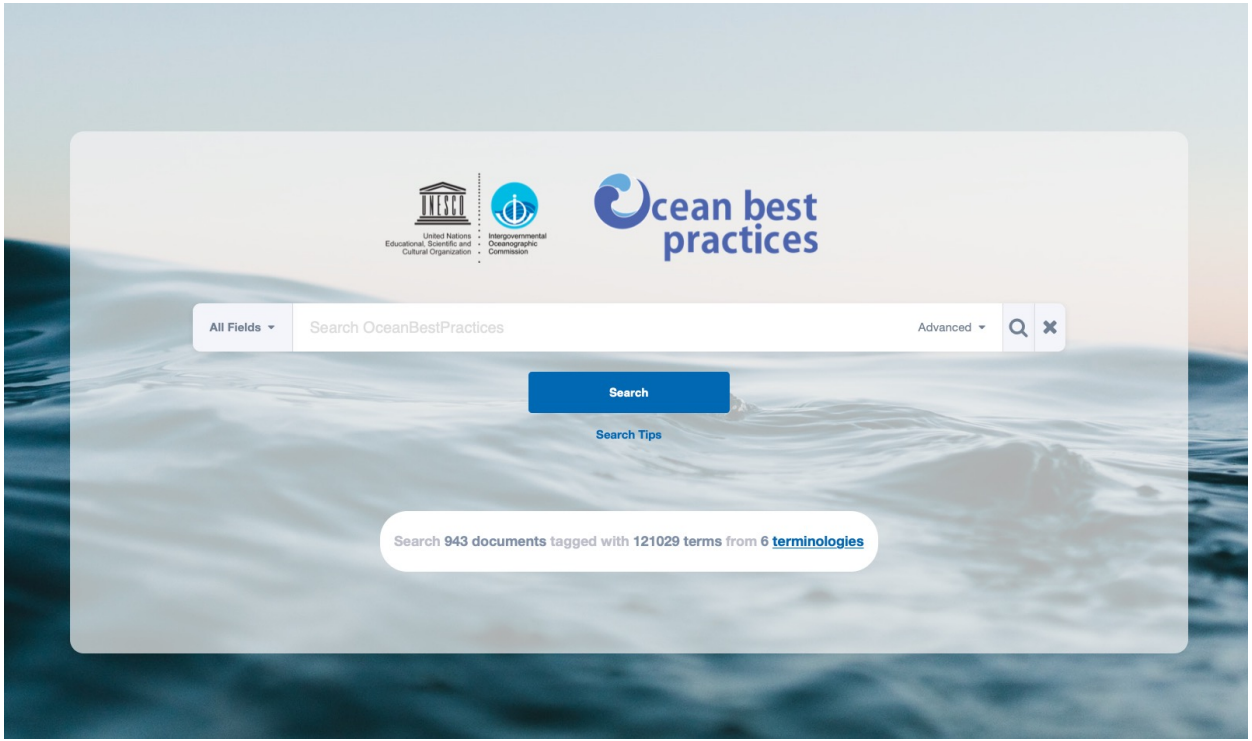
Other Networks
- HF Radars (270)
- Animal Borne Sensors (53)

Generated by www.jcommops.org, 06/02/2020

marum

Universität Bremen

Resource for Sharing Experiences - Ocean Best Practices Portal



Dedicated Conferences and Meetings

2022 IEEE INTERNATIONAL WORKSHOP ON

METROLOGY FOR THE SEA

OCTOBER 3 - 5, 2022

MILAZZO - MESSINA, ITALY

CALL FOR PAPERS

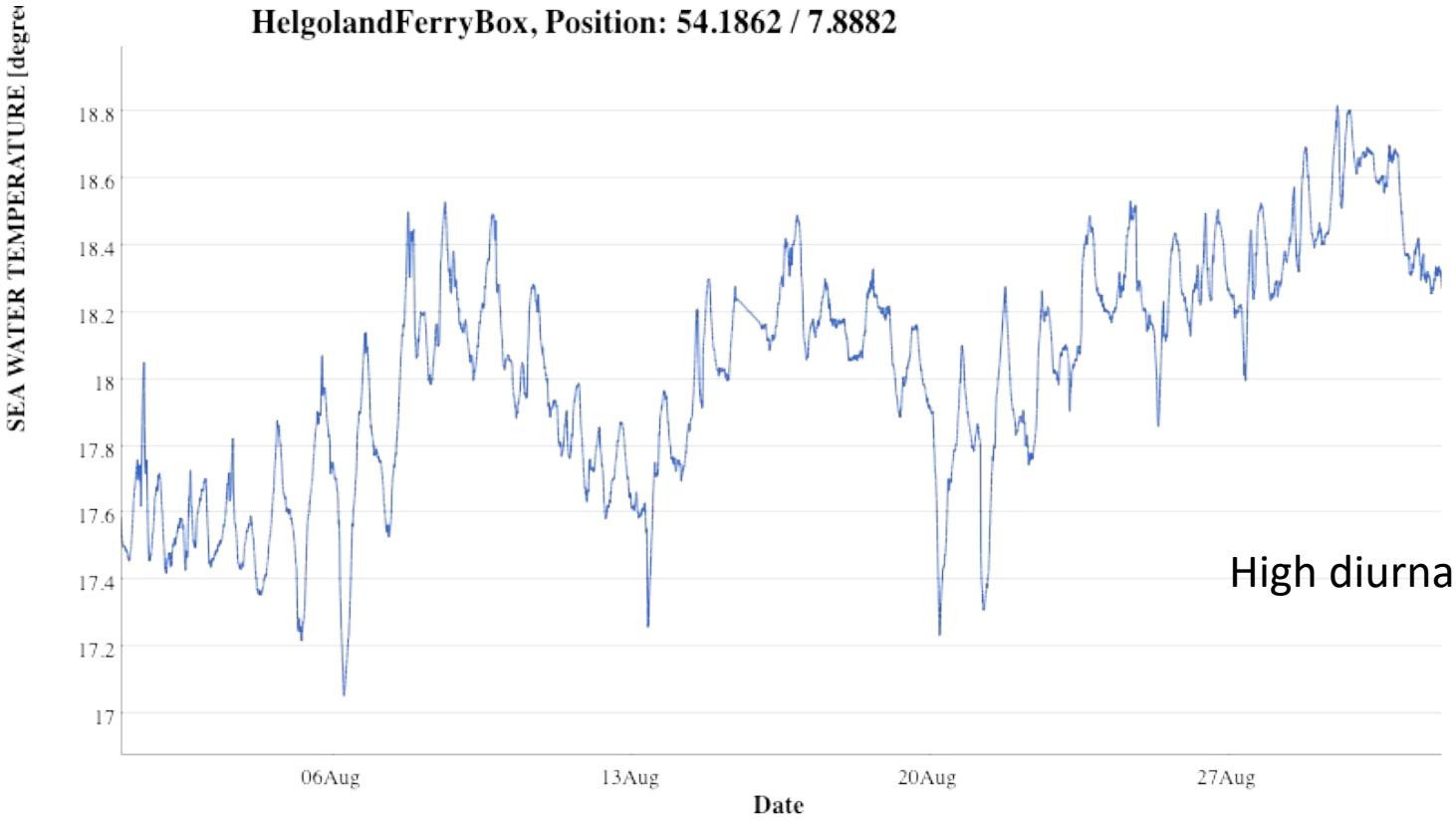
In Ocean Sciences

Metrology is often connected with certain Keywords

- Lab calibrations
- intercomparison exercises
- reference standards
- data quality flags
- EOV (essential ocean variables)

However, Metrology is NOT JUST ABOUT CALIBRATION !

Ocean measurements have a **transient character**



High diurnal variability

$$Measured\_Value(t) = Signal(t) + \textbf{\textit{Noise(t) + Bias + ...}}$$

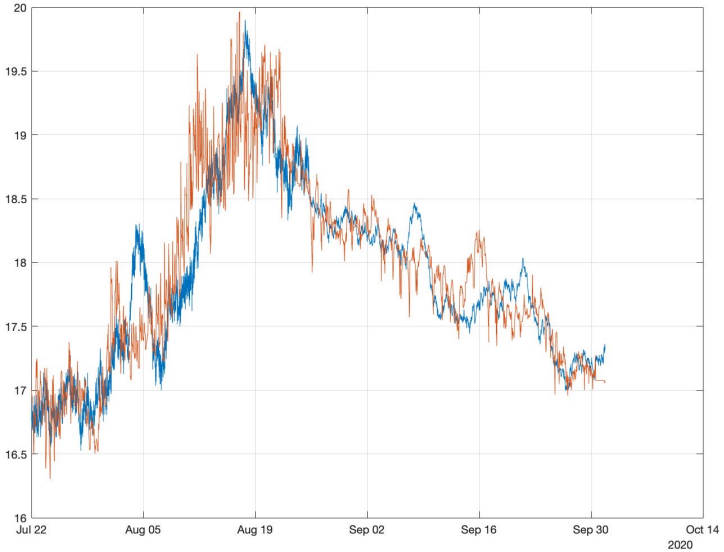
Uncertainty

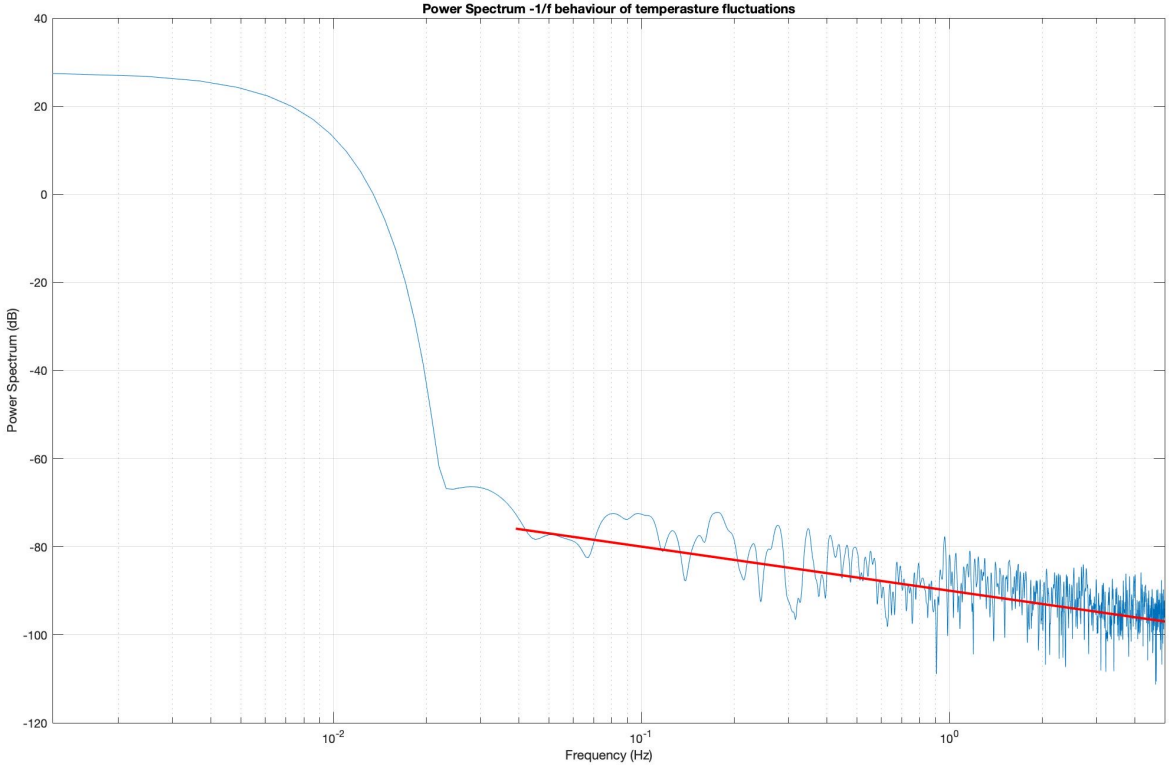
Issue of

separating signal from noise

or differently

what has to be seen as signal or noise

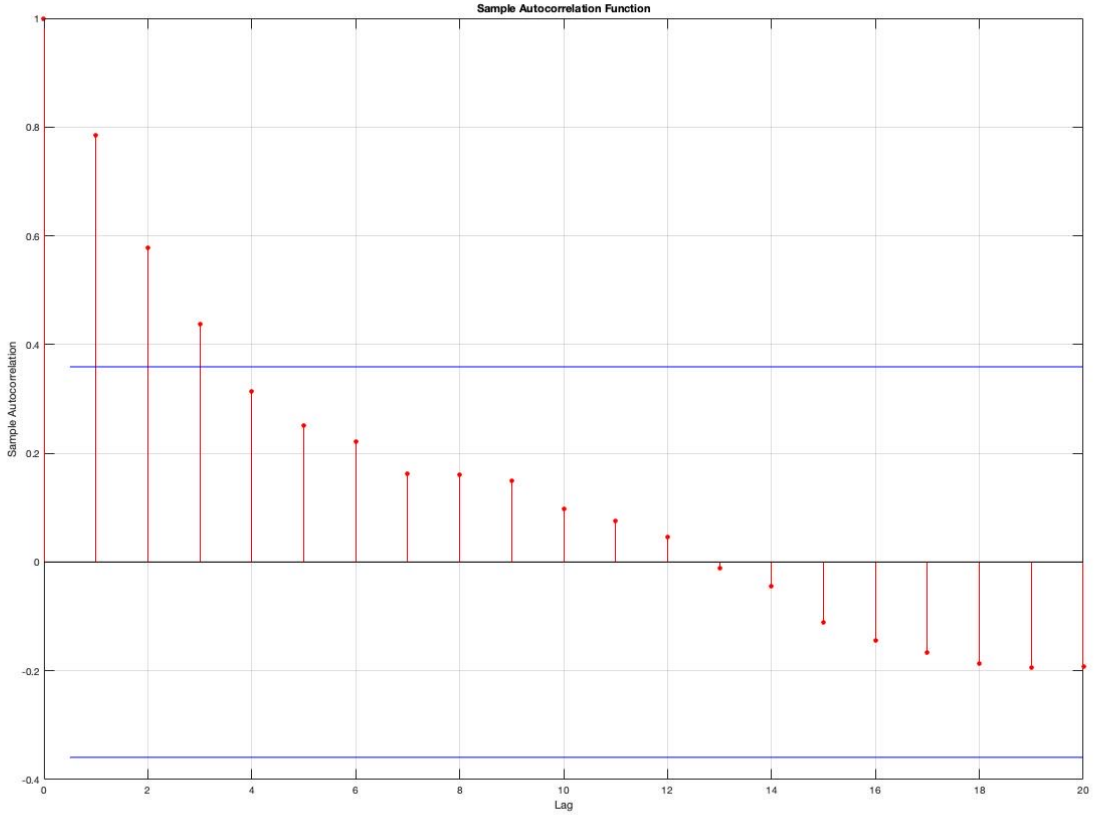




Since **1/f noise** is close to **non-stationarity**, statistical analyses have to applied carefully because **the mean cannot be estimated** using averages in finite time intervals

Cited from Blender, Zhu, Fraedrich 2011

Effective Sample Size



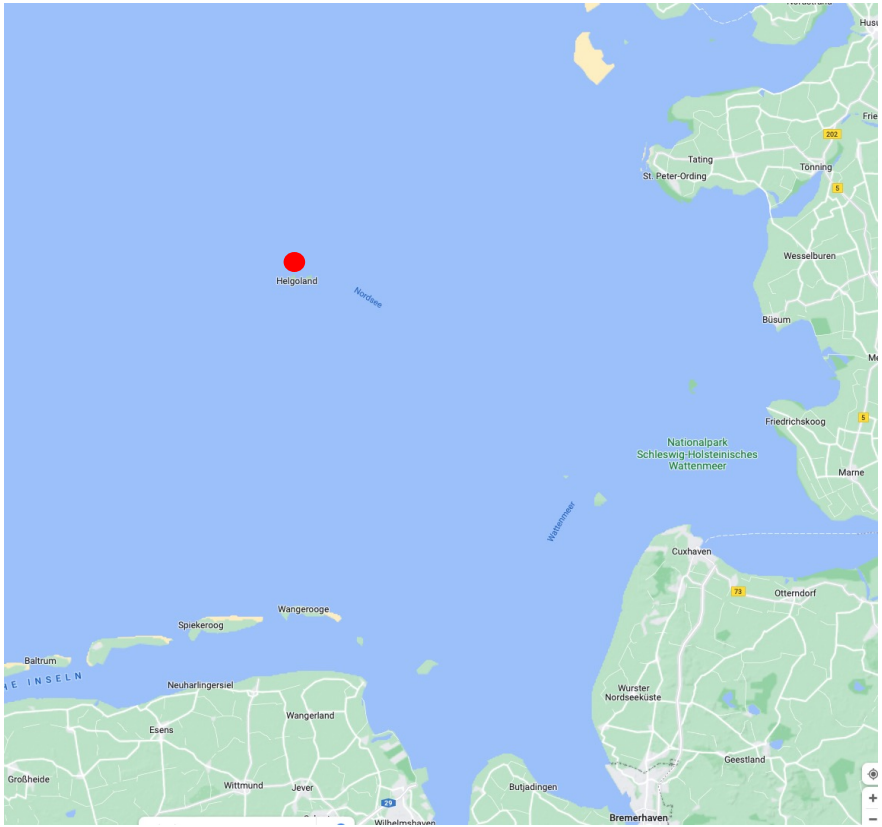
Uncertainty is actually higher than expected as samples cannot be be treated as independent

With a sample size of 30 and the shown **autocorrelation** an **effective sample size** of 4 results

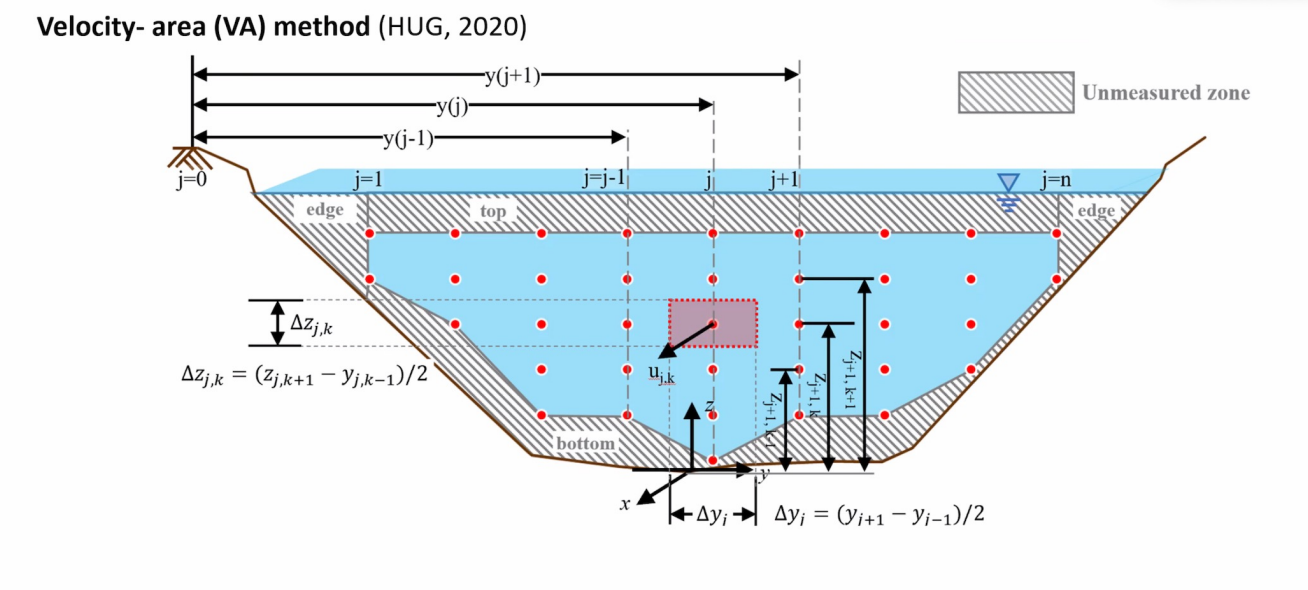
Representation “Error“ /Uncertainty

A measurement at a certain spot can represent a local or regional feature or a global trend

German Bight



Representation “Error“ /Uncertainty



US-CLIVAR In initiative on Uncertainty Qunatification

Elipot, S., K. Drushka, A. Subramanian, and M. Patterson (2022), Overcoming the challenges of ocean data uncertainty, *Eos, 103,* https://doi.org/10.1029/2022EO220021. Published on 12 January 2022

Conclusions

Uncertainty is a necessary specification for a field measurement. It is not just based on instrument specifications like accuracy.

Concepts have to be considered that combines modelling (process specifics at the measuring location) with observational concepts to quantify uncertainties

Often misunderstood - Metrology is not just the evaluation of deviations from the reference values during calibrations

Templates for uncertainty quantifications have to be developed based on use cases