

# **ATOMIX: Analysing Turbulence Ocean MIXing observations**

## **WG #160 – Third annual update 2023**

Develop best practices, quality-control measures, and algorithms' benchmarks to estimate the ocean dissipation rate of turbulence kinetic energy (mixing) from observations

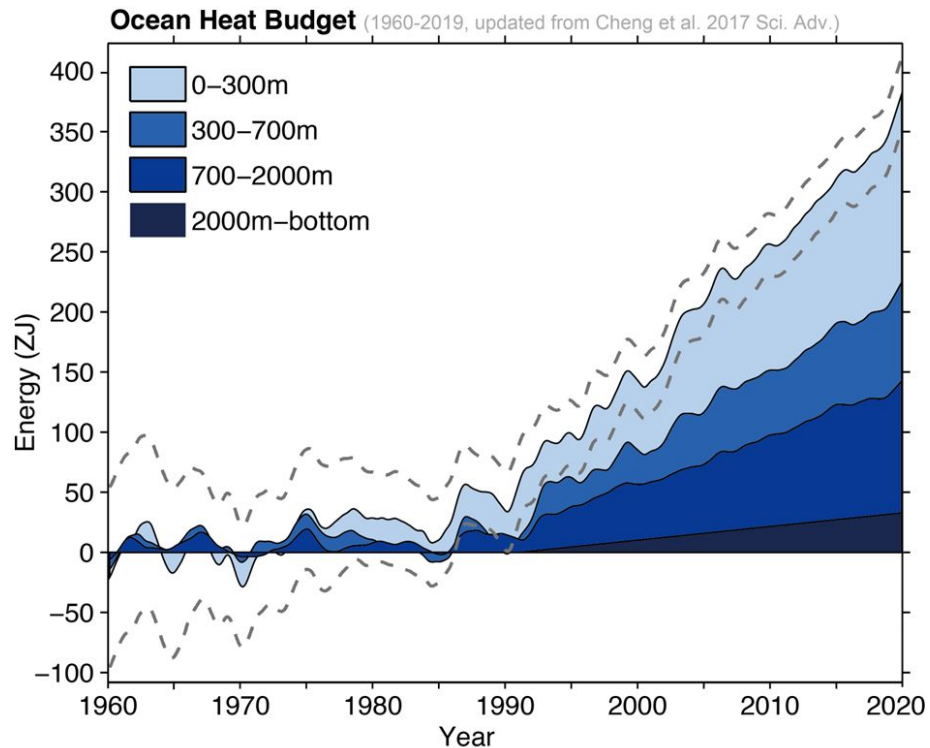
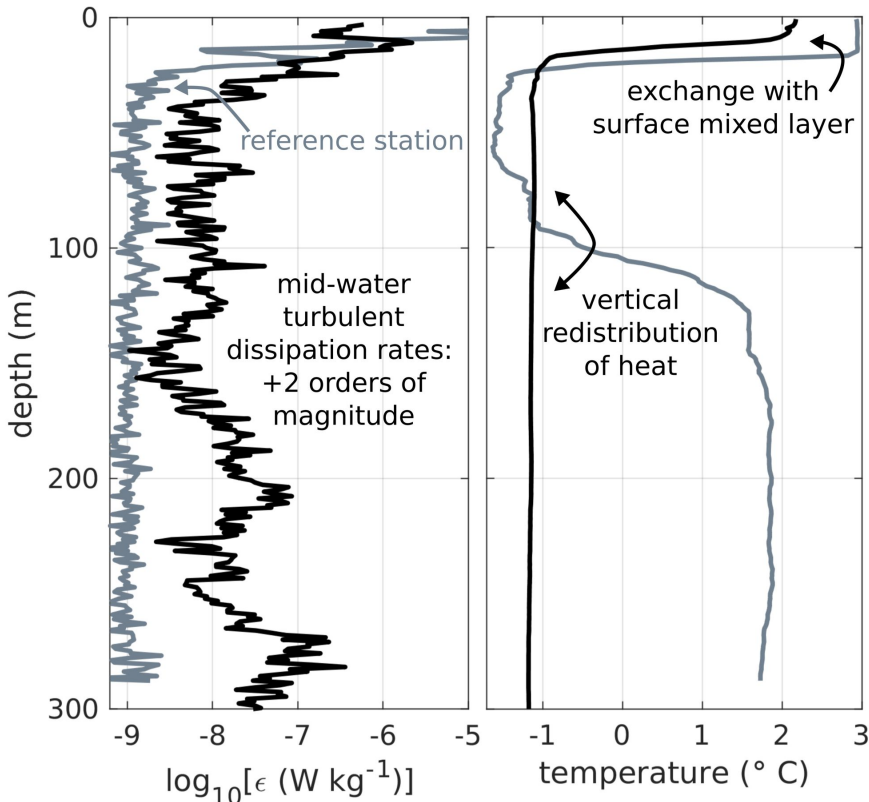
**Co-chairs:** Cynthia Bluteau (Canada), Ilker Fer (Norway), Yueng-Djern Lenn (UK)

**Other Full Members:** Ryuichiro Inoue (Japan), Arnaud LeBoyer (USA), Zhiyu Liu (China), Rolf Lueck (Canada), Amelie Meyer (Australia), Craig Stevens (New Zealand), Danielle Wain (USA)

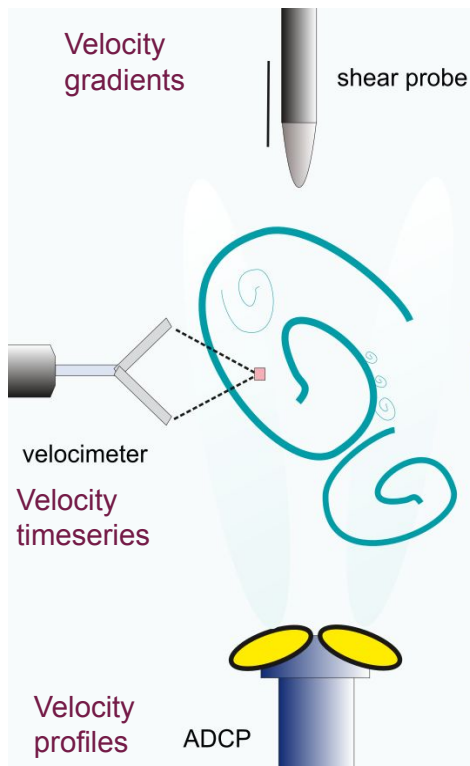
**Associate-Members:** Marcus Dengler (Germany), Jenson George (India), Peter Holtermann (Germany), Natasha Lucas (UK), Justine McMillan (Canada), Stephen Monismith (USA), Julia Mullarney (New Zealand), Sarah Nicholson (South Africa), Kirstin Schulz (USA)



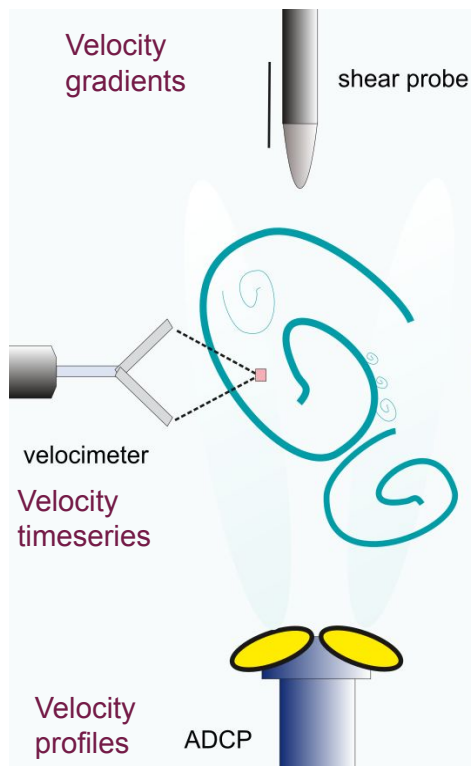
# Fundamental quantity – turbulent kinetic energy dissipation $\epsilon$ for estimating redistribution of heat, salt, nutrients, etc



# Three subgroups for each type velocity-based technique used to obtain dissipation $\epsilon$



# Many steps and decisions before obtaining $\epsilon$



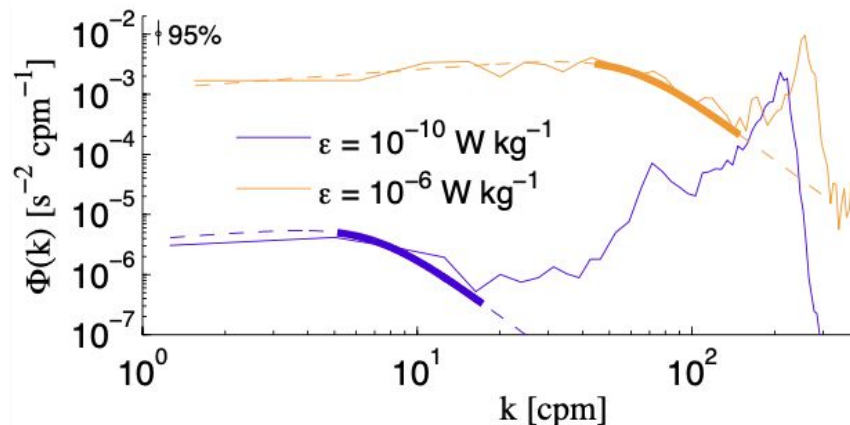
Deployment choices

Pre-processing

Raw data quality checks

Theoretical assumptions

Statistical and spectral methods

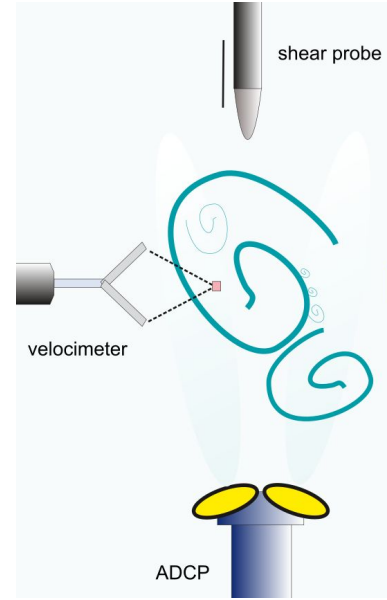


Quality controlled  $\epsilon$

- Can estimate diapycnal mixing
- Assess mixing parameterizations in global & regional models

# Terms of Reference

1. Develop **best practices** for obtaining dissipation rate  $\epsilon$
2. Establish database of **benchmark datasets to validate processing algorithms**
3. Develop **quality control guidelines for publishing and archiving** turbulence quantities
4. **Build capacity** by creating a **collaborative, living wiki-platform** for processing observations

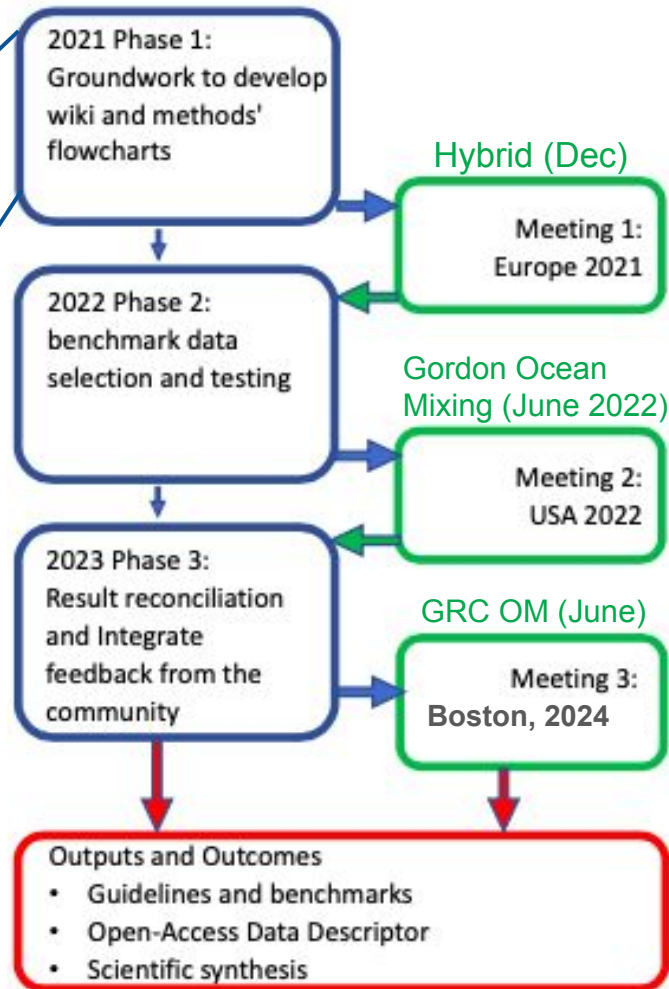
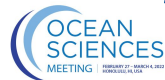




# Phase 1 – completed

- Developed benchmark dataset format
- Create Wiki on best practices development
- Townhall and presentations
  - Ocean Sciences Feb 2022 - Townhall
  - Gordon Ocean Mixing Jun 2022 -poster
  - AOGS Aug 2022 - presentation
  - Newsletters (2x) to community (~100 pp)
- Hybrid meeting Boston (June 2022, June 2024)

Developed testing plan, and brainstorm format of capacity building



# Phase 2 - almost done

2024 onwards

- Finish **benchmark testing** for all platforms/datasets selected
- Developed framework for training videos on best practices, instrument setup and how to use benchmarks
- Revisit wiki with updated best practices

+2023

2021 Phase 1:  
Groundwork to develop  
wiki and methods'  
flowcharts

2022 Phase 2:  
benchmark data  
selection and **testing**

2024

~~2023~~ Phase 3:  
Result reconciliation  
and Integrate  
feedback from the  
community

Why use a structure function?

- Uses 'standard' oceanographic equipment
- A variety of temporal and spatial scales



Julia Mularney, U. Waikato

# Phase 3 – activities:

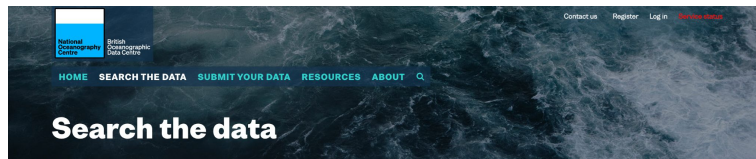
2024

- Provide ATOMIX community access to the benchmarks (~100x people)

*Shear probes datasets published at BODC*

ADV datasets currently on Zenodoa, BODC upload imminent.

*ADCP datasets in final stages of testing*



Data > Published data library

## Published Data Library (PDL)

### ATOMIX shear probes benchmark dataset for vertical microstructure profiler

This is the most recent published version of these data held at BODC.

These data are made available under CC-BY 4.0 Licence.

Download

0 citations

56 views

Cite these data

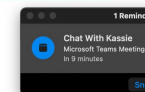
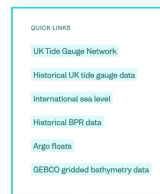
Title ATOMIX shear probes benchmark data: a dissipation profile from the Farne Bank Channel overflow obtained by a vertical microstructure profiler in June 2012.

Author(s) Ikar Fer<sup>1</sup>

Organisation(s) <sup>(1)</sup> University of Bergen Geophysical Institute

Subject elevation, oceans

Digital object identifier (DOI) doi:10.5285/0572f5e-4f5e-5549-e053-6186ac08846



+2023

2021 Phase 1:  
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2022 Phase 2:  
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2024

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Result reconciliation  
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2024 BOSTON  
HYBRID

# Phase 3 – activities:

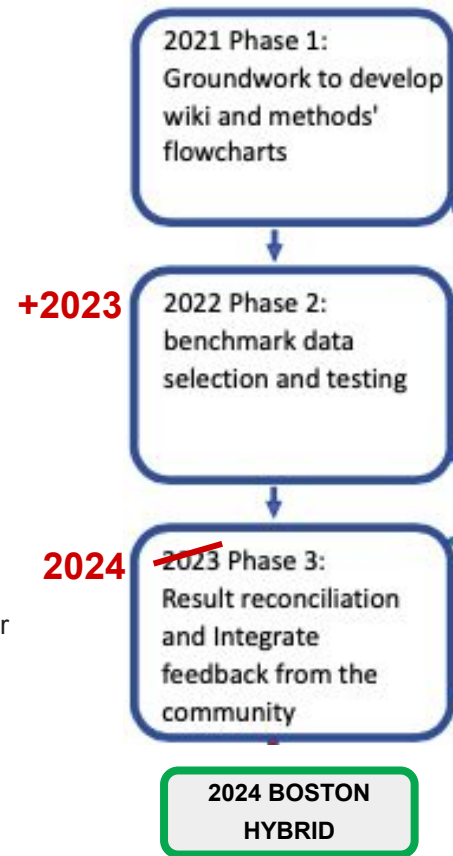
2024

- Publications on best practices and usage of benchmark datasets:

- *Shear probes = 2 publications:*

Lueck R, Fer I, Bluteau C, Dengler M, Holtermann P, Inoue R, LeBoyer A, Nicholson SA, Schulz K, Stevens C. Best practices recommendations for estimating dissipation rates from shear probes. *Frontiers in Marine Science*. 2024 Mar 19;11:1334327.

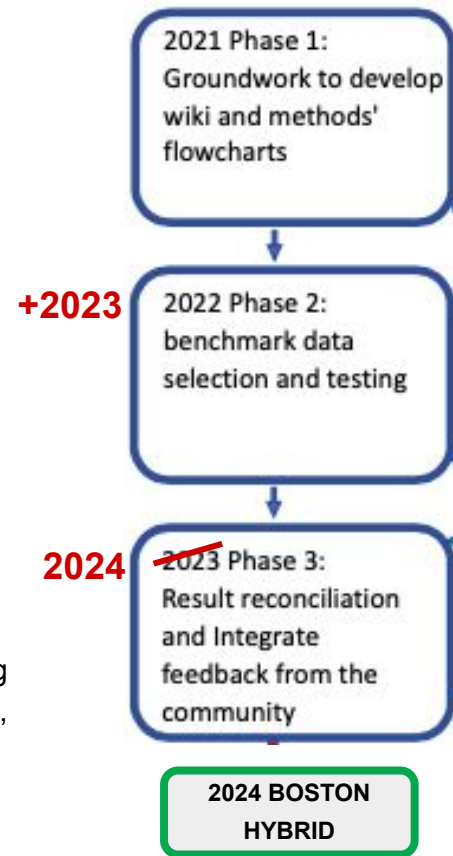
Fer I, Dengler M, Holtermann P, Le Boyer A, Lueck R. ATOMIX benchmark datasets for dissipation rate measurements using shear probes. *Scientific Data*. 2024 May 21;11(1):518.



# Phase 3 – activities:

2025

- Publications on best practices and usage of benchmark datasets:
  - *ADV = 2 publications:*
    1. Bluteau, C. E. Synthetic spectra for assessing statistical fitting methods used to estimate ocean turbulence. <https://doi.org/10.5281/zenodo.14681252>, [dataset], 2025
    2. Bluteau, C. E., Stevens, C. L., Wain, D., and Mullarney, J.: NetCDF templates and code for creating and loading ATOMIX ADV benchmark datasets, <https://doi.org/10.5281/zenodo.16798905>, [dataset], 2025
- ADV datasets currently available on Zenodo, being formatted for BODC

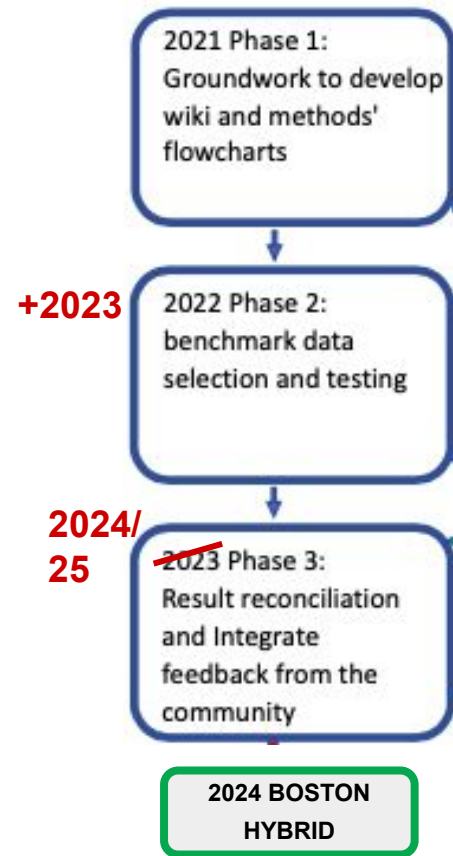


# Phase 3 – activities ongoing

2025 onwards

- ADCP best practise manuscript is nearing completion
  - Resolving questions around flagging for L4 data
- ADCP dataset testing complete, production of final datasets depend on flagging decisions.

ADCP subgroup continues to meet monthly to fulfil ToR.



# Summary

ATOMIX is developing **best practices**, **quality-control measures**, and **benchmark datasets** to test algorithms to estimate energy dissipation estimates ( $\epsilon$ ) from observations.

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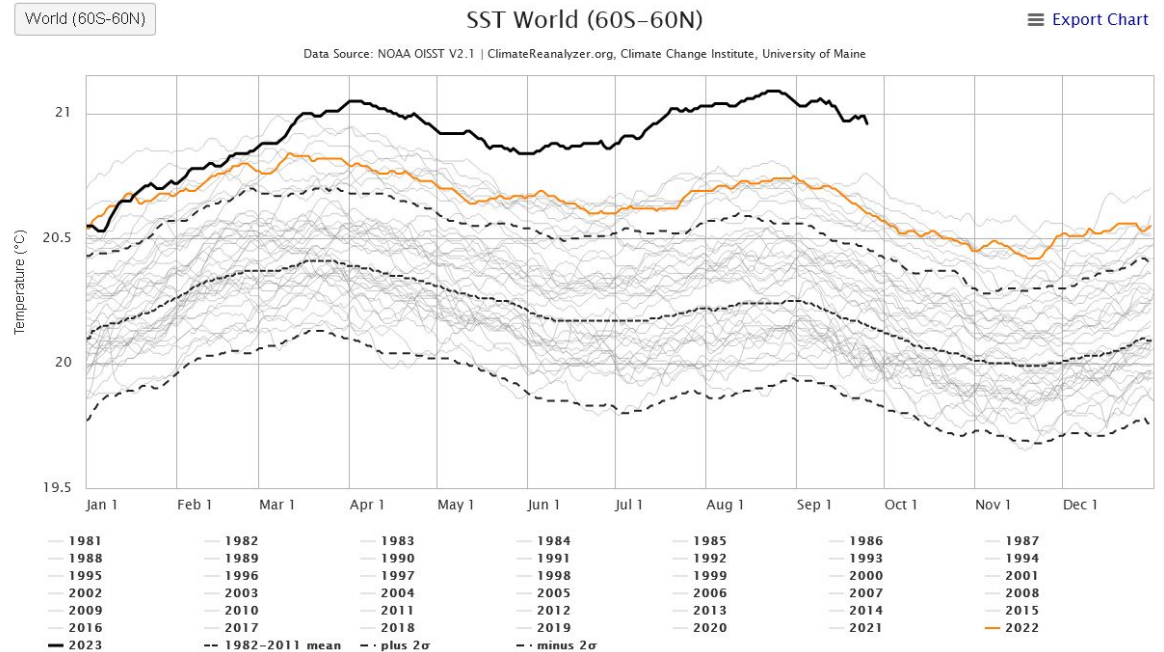
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End of talk – additional slides

# New slide??? Increasing need for understanding ocean mixing

The need for systematic and reliable quantification of mixing is becoming more urgent with changes in SST and ocean circulation.



[https://climateranalyzer.org/clim/sst\\_daily/](https://climateranalyzer.org/clim/sst_daily/)