

## WG 160- Analysing Turbulence Ocean MIXing observations (ATOMIX)

1. Brief summary with the main highlights (200-300 words)

Over the last 12 months, the ATOMIX working group has met virtually on a regular basis to fulfil our terms of references. Notable advancements in the last 12 months include:

1. Producing benchmark datasets for all three subgroups. Those for the ADV and ADCP subgroups are at testing stage and available on the wiki. The datasets from the shear probe subgroup were finalized and deposited to British Oceanographic Data Centre, which is also accessible from the wiki.
2. Publication of a best practices method paper and a data descriptor for the shear probe subgroup.
3. Brainstorming and collating existing materials for teaching core principles of processing turbulence analysis to develop capacity in estimating mixing.
4. Improvement and updates on our wiki site.

2. Activities since previous report to SCOR (e.g., virtual or in-person meetings, email discussions, special sessions). Limit 1000 words

The working group is split into three subgroups with members overlapping across instrument types. The three subgroups focus on the three main techniques used to derive turbulence estimates, but some overlap exists. Each subgroups meets regularly and focuses on fulfilling the terms of reference, in particular working through the 'contentious' processing steps, and for the case of the shear probe subgroup, finalizing the ATOMIX data format and the benchmark datasets, and discussing the content of publication and reviewers' comments.

The three subgroups have met online much more frequently given the focus on testing the benchmarks and refining guidelines and quality-control indicators. For example, the point-velocity subgroup has met almost monthly (zoom), while the other two subgroups have met at least every other month. We have elected to prepare online videos to teach certain aspects of turbulence data processing so that we can reach a wider audience than possible through a one-off workshop that was supposed to be held in July 2023. Instead, we held a hybrid two-day meeting in Boston June 6-7 2024 ahead of the Gordon Ocean Mixing Conference. The shear probe subgroup focused on a workplan for improving the wiki, while the other subgroups on the publications. All subgroups participated in creating a workplan for the videos to meet our capacity building objectives.

Other organizational decisions are being made through asynchronous discussions via a Microsoft TEAMS group. This platform is provided by Bangor's University, through Lenn's institutional affiliation. The platform enables polling, sharing of articles and messages relevant to the group's activities. It also holds the working documents, and minutes from our meetings.

3. Documents published since previous report to SCOR (e.g., peer-reviewed journal articles, reports, Web pages) and should be limited to publications that resulted directly from WG activities and which acknowledge SCOR support

Two new publications have been published since the last report for the shear probe subgroup. There are three more publications planned. Two of these publications are in draft form and describe the best practices associated with the point-velocity and ADCP subgroups. These two publications will be seeking financial support from SCOR. A third publication has also been drafted from the ADV subgroup as it was deemed too technical and lengthy to be presented within their best practice paper. Overall, there are 5 publications planned for the SCOR working group. The two published can be found at these hyperlinks:

1. Lueck Rolf, Fer Ilker, Bluteau Cynthia, Dengler Marcus, Holtermann Peter, Inoue Ryuichiro, LeBoyer Arnaud, Nicholson Sarah-Anne, Schulz Kirstin, Stevens Craig. 2024. "Best practices recommendations for estimating dissipation rates from shear probes" *Front. Mar. Sci.*, 11. doi: <https://doi.org/10.3389/fmars.2024.1334327>
2. Fer, I., Dengler, M., Holtermann, P. et al. ATOMIX benchmark datasets for dissipation rate measurements using shear probes. *Sci Data* 11, 518 (2024). <https://doi.org/10.1038/s41597-024-03323-y>

The manuscript version of the first publication was circulated widely to researchers and shear probe users to collect feedback. All received comments from the community were addressed before submitting the manuscript to Frontiers. The submission was reviewed by two experts, whose comments and names have been published alongside the final version of the article.

The benchmark datasets for the shear probe subgroup have been archived with the British Oceanographic Data Center. The landing page can be found on [seadatanet](#) and also hyperlinked on the [ATOMIX wiki](#). They also submitted code for manipulating the benchmark datasets, code for checking the ATOMIX data format requirements, and code for producing the paper's figures to zenodo under [SCOR's banner](#). The ADV subgroup also submitted datasets under SCOR's banner in zenodo. These datasets include synthetic spectra used to assess different spectral fitting techniques, and various quality control indicators.

3. Shear probe code can be found at this web address: <https://zenodo.org/doi/10.5281/zenodo.10610149>
4. Synthetic velocity spectra datasets with variable accuracy can be found at this web address: [10.5281/zenodo.10576542](https://zenodo.org/doi/10.5281/zenodo.10576542)

The wiki is still currently work in progress, which will remain the main focus of the working group. Namely, more introductory pages are being created to provide a longer term training resources for newcomers to the field. Some videos (see Section 4 for details) are also planned with one completed, which are intended to provide more context to the working group activities. Namely, to describe the differences between the different types of instruments and which conditions each instrument is best suited for.

4. Progress toward achieving group's terms of reference. List each term of reference separately and describe progress on each one. Limit 1000 words

Our proposal included four terms of reference (in *italics*):

1. *Develop best practices for acquiring and processing turbulence observations collected from conventional and emerging autonomous platforms, which measure velocity or velocity gradients.*

The three subgroups have progressed at different rates with the shear probe group having completed the work related to this term of reference. The ADV subgroup has just finished developing their best practices and drafting a manuscript that will be submitted to a journal with an open peer-review. The ADCP subgroup has still a few outstanding questions related to quality-control measures specifically to allow for a range of environments, and given the variability in current practices within the Ocean Mixing Community. They are working through these issues in tandem with the preparation of the manuscript and finalizing of the benchmark datasets.

2. *Establish an open-access database of benchmark datasets collected in diverse ocean environments via different measurement techniques. These raw datasets will be accompanied by agreed-upon "best" processed epsilon estimates to enable validating data processing algorithms irrespective of programming language.*

The benchmark datasets have been collated and converted into NetCDF format, at least the first data level. The shear probe subgroup has submitted their benchmarks to the British Oceanographic Data Center with each dataset linked from the [wiki](#). The other subgroups' datasets are currently residing on a temporary repository that is accessible from the wiki. Their datasets should be ready for submission to the British Oceanographic Data Center before the end of the calendar year.

All WG members who had their own tools tested the benchmark to ascertain differences in the implementation of the best practices. Some changes to our best practices have resulted from his testing exercise. Some WG members also tested the impact of executing certain processing steps differently on the final results. For example, the point-velocity members tested different techniques for identifying the inertial subrange on synthetic datasets for which the result is known a priori. This subgroup has drafted a manuscript using these synthetic datasets. Some WG members were tasked with generating tools for issuing the comparative plots and processing charts, which have been deposited in a public code repository to accompany the published Data descriptor paper.

3. *Develop quality control measures and guidelines for publishing and archiving turbulence quantities computed from velocity or velocity gradients.*

This item is complete for the shear probe and ADV subgroups, but still ongoing for the ADCP subgroup. All subgroups have nonetheless identified misfit criteria for theoretical models applied to observations, in addition to listing techniques for deeming data unsuitable for deriving turbulence quantities. Some of the subgroups have additional indicators to evaluate for the final epsilon estimates, namely there are some ongoing discussions about how the quality should be reported in the archived datasets.

4. *Build capacity by creating a collaborative, living wiki-platform that consolidates knowledge on processing of turbulence observations, both from existing and future technologies, as they become available.*

The wiki is continuously being updated, but it was put on the backburner to focus on developing and testing the benchmark datasets since the results of this testing will ultimately influence the content of the wiki. During the hybrid meeting in Boston, the shear probe subgroup created a workplan to improve the material for newcomers. Notably increase the number of figures and break up the material into smaller blocks/topics.

In the original terms of reference, we had also proposed holding a workshop on best practices for new inexperienced users alongside the AOGS 2023 meeting in Singapore. However, we canvassed the community as widely as we could beforehand to gauge interest and there was still considerable reluctance in committing to travel. Thus, we settled on the alternative plan of providing free short introductory videos to explain the work of the ATOMIX group, and how to access and use the wiki and benchmark datasets. Note that there are already a surfeit of good teaching videos on turbulence already online, so we will not reproduce these, but will instead highlight a carefully curated list of these on the wiki.

A rudimentary draft video was produced last year by the ADCP subgroup that provided some useful templates for the future look of all these videos. At the recent Boston meeting, the structure and content of the full suite of ATOMIX videos was agreed upon as follows: 3 videos to introduce (1) ATOMIX, (2) different ATOMIX platforms and (3) Benchmark datasets; then each subgroup will be responsible for producing two additional videos on platform-specific methods and introducing the Data processing algorithms (i.e. demonstrate the flowcharts and use of benchmark data). These will all be published on an ATOMIX youtube channel linked to the wiki. The general idea is for ATOMIX members to produce the material for the videos and then have the final videos professionally edited. We are currently inquiring into whether any of our institutions have the resources to support this activity.

5. WG activities planned for the coming year. Limit 500 words

- Submit the benchmarks datasets of the ADV and ADCP subgroups to the BODC.
- Submit the best practices publications for the ADV and ADCP subgroups, which are in draft form.
- Finalize the wiki with more beginner-centric material (all subgroups).
- Create more capacity building videos that will be uploaded to the Wiki and Youtube, a few videos have been collated/recorded from existing members' teaching material. The ADCP subgroup has produced their first video.

6. Is the group having difficulties expected in achieving terms of reference or meeting original time schedule? If so, why, and what is being done to address the difficulties Limit 200 words

We have probably accumulated a year worth of delays since being approved as a working group in October 2020. We have made a few leaps and bounds in the last year. The shear probe working subgroup outputs should be completed by the end of this year once they update their wiki pages. The other two, smaller, subgroups are further behind but have implemented monthly virtual meetings until all the best practices are delineated. These meetings involved discussing one “contentious” processing step, along with the tests and review of existing literature. Both subgroups have been moving through their steps at a more regular pace. The ADV and ADCP subgroups intend on submitting their best practices manuscripts before the end of 2024, and revisit their wiki pages in the first half of 2025 following the community and peer-review of their manuscripts. Our intention is to finish all activities by 2025 annual report.

7. Any special comments or requests to SCOR. Limit 100 words.

None

Additional information can be submitted and may be posted at the SCOR Annual Meeting webpage at the discretion of the SCOR Executive Committee Reporter for the WG and the SCOR Secretariat.