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| **World Meteorological Organization &**  **Intergovernmental Oceanographic Commission (of UNESCO)**  **Data Buoy Cooperation Panel Thirty Eighth Session**,  Hybrid meeting, 1 -4 November 2022 | Image result for ioc logo unesco  **DBCP-38/Doc. 6.9** |
| Submitted by: Secretariat  28.07.2022  **DRAFT 1** |

**AGENDA ITEM 9: RECOMMENDATIONS BY THE TASK TEAMS**

**AGENDA ITEM 9.3: Task Team on Wave Measurements (TT-WM)**

# SUMMARY

### This document provides a report on the activities of the Task Team on Wave Measurements including recommendations to the panel for approval and actions/decisions required.

### A. INTRODUCTION/SUMMARY[[1]](#footnote-1):

9.3.1 Robert Jensen/Val Swail reported on the progress of wave measurement activities undertaken during the last intersessional period. Continuous testing and evaluation of operational and pre-operational measurement systems continues to be an essential component of a global wave observing system, to ensure consistent wave measurements, with accompanyimg metadata, to a level of accuracy that will serve the requirements of the broadest range of wave information users.

9.3.2 Work continued on the evaluation of both legacy and emerging measurement sensors and platforms, with several ongoing field studies. Two of those evaluations were published in scientific journals (Hall et al., 2022; Collins and Jensen, 2022), others presented to the user community.

9.3.3 The key achievement for the Task Team in the intersessional period was the organization of a virtual Wave Measurement Workshop, October 11-12, 2022, jointly with the WMO Standing Committee on Marine Meteorology, bringing together data providers and the end user community, with more than 60 participants (<https://oceanexpert.org/event/3623>) . The program described four of the most prominent wave drifter developments, as well as their evaluation results, and evaluations of other existing and legacy wave measurement systems. The participants in the meeting overwhelmingly agreed that another such workshop be held addressing other toics of interest to the community in the next 6-12 months.

9.3.4 A particular highlight of the workshop was the development of the USACE Coastal and Hydraulics Laboratory Quality Controlled, Consistent Measurement Archive.  The database contains the complete NOAA-NDBC moored buoy data set, consistently quality-controlled, with accompanying metadata. It will be updated annually. Subsequently, all of the Environment Canada wave data and metadata housed at MEDS were similarly consolidated into the database. We now have, in one place with public access, moored buoy data from the two largest moored buoy networks.

9.3.5 The moored buoy user community was very clear that access to the full metadata, i.e. that in the DBCP moored buoy template, is critical. It is also clear that **DBCP and OceanOps have completely failed this community, and worse, have now abandoned them.** The minimal metadata contained in the proposed integrated metadata repository does not serve the needs of the users. Action is needed immediately to rectify this situation.

### B. ACTIONS/DECISIONS REQUIRED:

(a) A[9.3/1](#_Draft_Decision_X.X.X(X)/1) — *Wave Measurement Workshop 3*

* Organize the next in a proposed series of follow up wave measurement workshops including researchers in the field of wave measurements, institutional end users, data providers, manufacturers. (TT-WM chair to work with Candice Hall and Val Swail), 2023.

**Draft Recommendations**

**C. RECOMMENDATIONS:**

(a) [R9.3/1](#_Title_of_the_1) *— Consolidated Wind-Waves Data Base*

* Encourage data management agencies, especially in Europe and Australia, to consider implementing a waves database comparable with the [USACE Coastal and Hydraulics Laboratory Quality Controlled, Consistent Measurement Archive](https://www.nature.com/articles/s41597-022-01344-z). to house QC’d point-source wave measurements and complementary metadata.

(b) R9.3/2 — *Establish QC Flag for Wind-Generated Surface Gravity Wave Frequency Spectra*

* Recommend establishing QC flags on wind-generated surface gravity waves frequency spectra, in the form of a simple Checksum factor, well described by CDIP and others, coordinated with TT-MB, DM and OceanOps, to be included by data providers.

(c) R9.3/3 – *Observations of Raw Displacement Time Series*

* Encourage buoy operators to collect, where feasible, time series of raw displacement time series of waves in addition to spectral and integral properties. Ongoing.

# C. BACKGROUND INFORMATION

1. Noteworthy Developments with respect to wave measurements:
2. We held a very successful Wave Measurement Workshop, virtually 11-12 October 2022, after a delay of 2 years from the originally scheduled in-person meeting at ECMWF. The workshop was organized jointly between the DBCP and the WMO Standing Committee on Marine Meteorology and Oceanography, an important interface between the data provider and the end user communities . We had more than 60 participants representing both communities. (<https://oceanexpert.org/event/3623>). Some highlights were:

* Description of 4 of the most prominent wave drifter developments – we know that there are also others
* Evaluation results from legacy wave measurement systems as well as emerging technologies, in particular wave drifters – again we know that there are additional evaluation results
* Consolidated Wave Measurement Database discussion – see item #2
* There was strong support for a follow on workshop in the 6-12 month timeframe to discuss these and other items
* The meeting recordings are online for those in unfortunate time zones, and we hope to have all of the presentations online

1. One presentation which received high acclaim was from Candice Hall of the US Army Corps of Engineers. USACE, working with NDBC, has recently published the USACE Coastal and Hydraulics Laboratory Quality Controlled, Consistent Measurement Archive journal paper; this was republished within the Ocean Best Practices Repository and received 2533 page visits and 874 pdf views/downloads in just three weeks! This incredible interest in that activity showcases how important accurate and consistent across-agency measurement data, and accompanying metadata, are to the international and national research and operational community. The database contains the complete NDBC moored buoy data set, consistently quality-controlled, with accompanying metadata painstakingly gathered and included. It will be updated annually. Subsequently, all of the Environment Canada wave data and metadata housed at MEDS were similarly consolidated into the database. We now have, in one place with public access, moored buoy data from the two largest moored buoy networks, representing more than 50% of the global wave measurements.
2. We had a serious discussion of moored buoy metadata. The moored buoy user community, as well as the DBCP participants in the meeting, was very clear that easy access to the full metadata, i.e. that in the DBCP moored buoy template, in a machine readable format, is critical. It is also clear that **DBCP and OceanOps have completely failed this community, and worse, have now abandoned them.** The minimal metadata contained in the proposed integrated metadata repository does not serve the needs of the users – including WMO members. So who does it serve?

Other evaluation studies are presently in progress, as noted below:

1. Field Experiments: Collaboration with NDBC, CHL and CDIP. DWR’s funded by USACE.
   1. OWL payload sensor system: 2.1D Foam buoy and 3D Aluminum buoy. Dual wave sensor system, the new motion sensor and a 3DMG (NDBC standard). Datawell Directional Waverider co-located. Analysis in progress.
   2. Mini-Buoy Experiment: Tripp Collins (USACE/Coastal and Hydraulics Laboratory, Field Research Facility). Deployed five buoys (SoFar Spotter; Datawell 4-G; Zunibal Anteia; Scripps (E. Terrill) mini wave buoy; University of Washington Swift buoy). Field experiment completed. Documentation in progress.
   3. Sensor from E. Terrill mini-wave buoy mounted in 0.7m Datawell hull. Deployed in Lake Superior (near 45001 and DWR) Aug 2021 to remain in water through the winter season to evaluate wave-ice interactions. Analysis in progress.
2. Additional Publications in progress:
   * 1. Mini-buoy intra-measurement evaluation, documentation in progress (T. Collins).
     2. Foam Buoy Evaluation in review in *Ocean Dynamics*.
3. While the primary focus of an operational wave measurement program is on bulk properties of the wave field (height, period, direction) and on the First-5 components of the wave spectra, for some purposes including measurement evaluation, research such as wave breaking, rogue waves, etc. it is necessary to have the raw surface elevation time series. Where feasible, on a limited number of platforms, it would be very useful to record this data onboard and make available afterwards. See Recommendation R9.3/3.
4. Bulk wave parameters are routinely quality controlled, based on one standard or another. No such process is applied to wave spectra. Quality control for wave spectra should based on a simple Checksum should be applied to all transmitted spectra with suitable flags. See Recommendation R9.3/2.
5. Wave data, and particularly metadata, are fragmented and incomplete, existing in many different data centres globally. There has been an increasing call among the various users communities (climate, satellite, NWP centres, engineering design) for a consolidated, quality-controlled data base of wave measurements, with complete machine-readable metadata. Inquiries have so far failed to identify a single, financially-supported sustainable host. The database efforts of the US Army Corps of Engineers, described above, represents a landmark step forward, whereby more than 50% of the global moored buoy wave data, with accompanying metadata, are now available in one location. If other notable data sets, e.g. Europe, Australia, India could develop similar databases, then a linked global wave database covering almost all of the networks would be achieved. See Recommendation R9.3/1.

### References (if any):

[USACE Coastal and Hydraulics Laboratory Quality Controlled, Consistent Measurement Archive](https://www.nature.com/articles/s41597-022-01344-z). Hall, C. & R.E. Jensen. 2022. Scientific Data 9:248

[Performance evaluation of the newly operational NDBC 2.1-m hull](https://journals.ametsoc.org/view/journals/atot/39/6/JTECH-D-21-0172.1.xml). Hall, C., Jensen, R.E. & D.W. Wang. 2022. Journal of Atmospheric and Oceanic Technology. Vol. 39, 6; 861–880

[Tilt Error in NDBC Ocean Wave Height Records](https://doi.org/10.1175/jtech-d-21--0079.1). C. O. Collins III and R. E. Jensen. 2022. Journal of Atmospheric and Oceanic Technology 39, 7: 915-928

**Draft Actions/Decisions**

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1. Half a page or less of Summary [↑](#footnote-ref-1)