PM Ecology

Environmental monitoring solutions

MARINE MONITORING STATIONS

Monitoring ocean currents and waves utilizing an ADCP sensor



WE DESIGN

WE BUILD

WE MAINTAIN

WE REPORT

PM Ecology

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We provide comprehensive marine measurements — from the physicochemical parameters of seawater, through currents and wave conditions, to meteorological data.

We don't just supply equipment. We design complete measurement systems tailored to the specific conditions and requirements of each project.

Redundant recording – no data loss if the logger fails – the system continues recording data for up to one month if the primary recorder or wired connections fail.

Real-time data, available 24/7 – continuous access to measurements from all connected sensors enables a rapid response to irregularities and failures.

UV antifouling – longer service intervals, lower operating costs – the UV system can extend the interval between sensor cleanings by up to three times, reducing biofouling and service visits.

Configurable sensor payload – sensors can be tailored to project requirements, with the platform easily expandable as needs evolve.

Compact platform – lower transport and installation costs – reduced system size and weight lower production and transportation costs while eliminating the need for large vessels.

PME-480 MEASUREMENT BUOY

All our measurement stations use the proprietary PME-480 power and transmission buoy, which serves as the system's central component.

The buoy facilitates power supply, data recording, and transmission of measurement information. Its sealed container accommodates a recorder, a communication modem, and a battery integrated with the ballast system. Additionally, the system is outfitted with GPS and AIS AtoN, allowing for continuous position tracking and ensuring adherence to IALA navigation marking standards.

The buoy is secured in the specified location with the use of two gravity anchors.
The configuration and apparatus of the PME-480 are illustrated in the figure below.

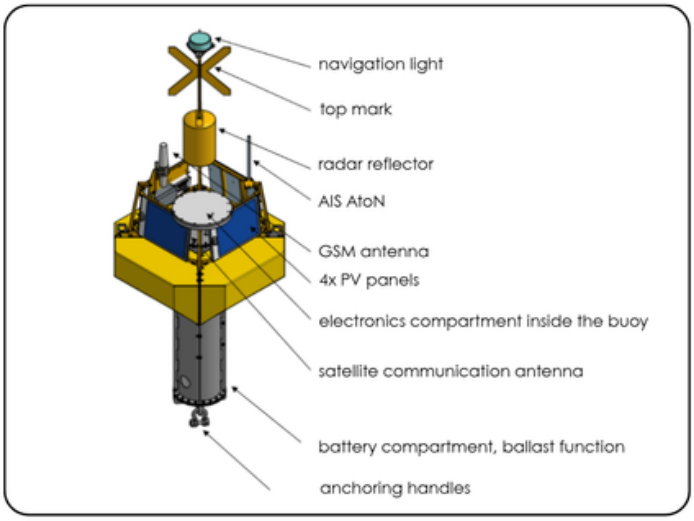


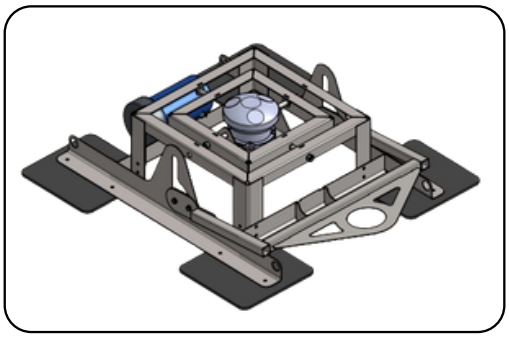
Fig. 1 PME-480 Measuring Buoy Source: Author's Research

The primary benefits of the PME-480 buoy

- It is equipped with a high-capacity battery of 10 kWh, enabling extended autonomous operation.
- More compact and lightweight than rival solutions offering comparable autonomy and functionality.
- Reduced transportation expenses.
- No need for large installation vessels
- Significantly lower overall system and operating costs

STATION FOR THE MEASUREMENT OF OCEAN CURRENTS AND WAVES UTILIZING AN ADCP SENSOR

The measurement station comprises a PME-480 power and transmission buoy, its anchoring system, and an Acoustic Doppler Current Profiler (ADCP) sensor—an advanced instrument affixed to a specialized platform on the seabed.



One device – numerous parameters

The ADCP concurrently measures current velocity and direction across the water column, in addition to wave parameters. This integration eliminates the need for installing separate sensors for each measurement, thereby decreasing installation, maintenance, and operational costs.

Fig. 2 Mounting platform for the ADCP profiling current meter. Author's research

Installation and power supply

The sensor is positioned approximately 30 meters north of the buoy, ensuring that its movements, floats, and anchor lines do not disrupt the measurements. It is affixed to a mounting platform—a proprietary design by PM Ecology—characterized by its robust, corrosion-resistant structure that facilitates easy installation and removal, while being compatible with various ADCP models. The platform maintains the sensor in a vertical orientation, irrespective of wave action, thereby ensuring precise and consistent measurements; the sensor is situated approximately 0.5 meters above the seabed (mounting method – see Fig. 3).

The device is powered by batteries and photovoltaic panels on the buoy. In the event of a power outage, it automatically transitions to a backup battery pack, which, at the anticipated measurement frequency, will sustain approximately 30 days of operation.

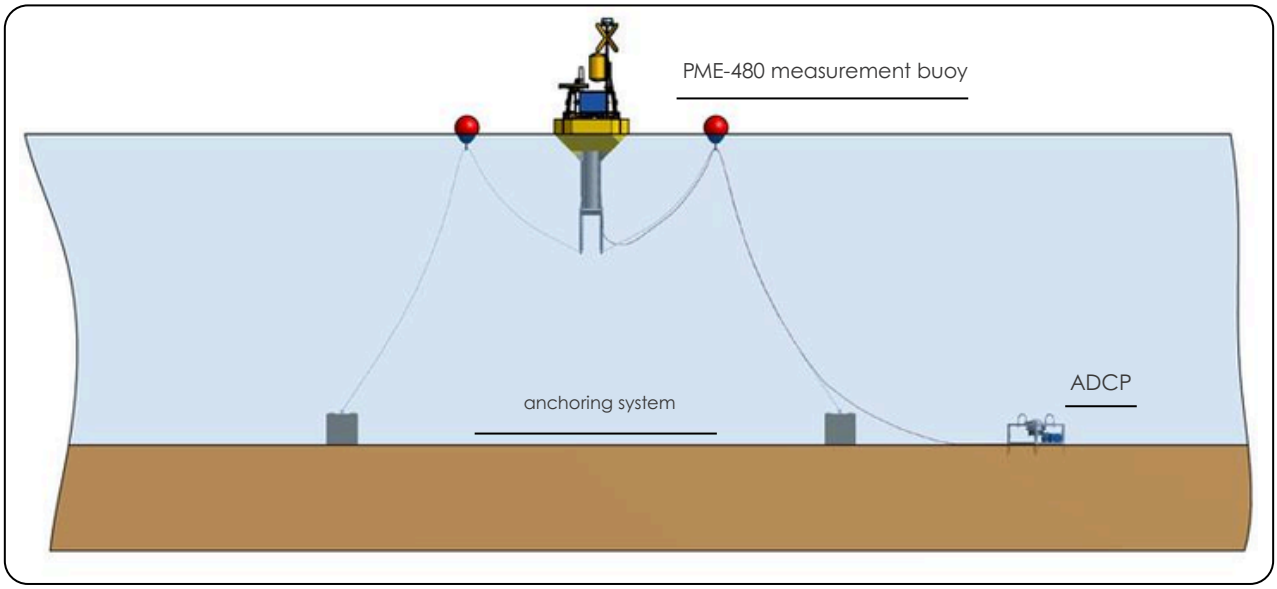


Fig. 3. Diagram of the measuring device - lateral section. Author's research

Wave assessment

The device enables wave measurements to be conducted at a designated frequency, with adjustable measurement interval settings as required. In the event of errors during measurement, the device logs a relevant error code. This data aids in the analysis of results and verification of data quality, while also permitting the evaluation of possible causes of measurement discrepancies.

The range of wave measurements that can be conducted is influenced, among other factors, by the depth of the ADCP device. The acoustic beams emitted by the device, which maintain a constant angle of propagation, cover a surface area on the water with a diameter that is contingent upon the measurement depth. As the depth increases, the diameter of this area diminishes, impacting the range of wave parameters that can be accurately measured. Consequently, the minimum measurable wave period is determined by the depth of the device.

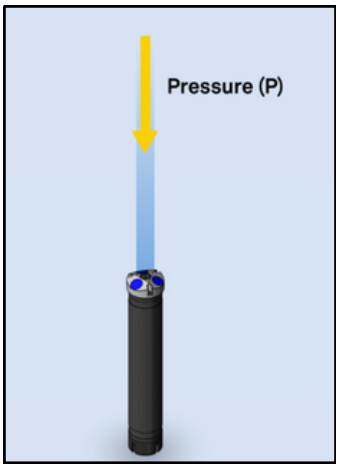


Fig. 4. Illustration of wave measurement through the assessment of instantaneous variations in hydrostatic pressure. Source: manufacturer's documentation https://www.nortekgroup.com

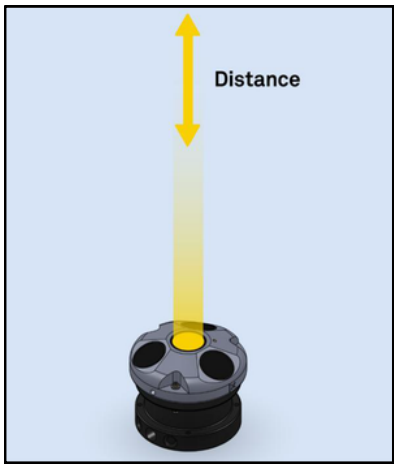


Fig. 5. Illustration of wave measurement through the assessment of water surface height utilizing a vertical acoustic signal beam. Source: manufacturer's documentation https://www.nortekgroup.com

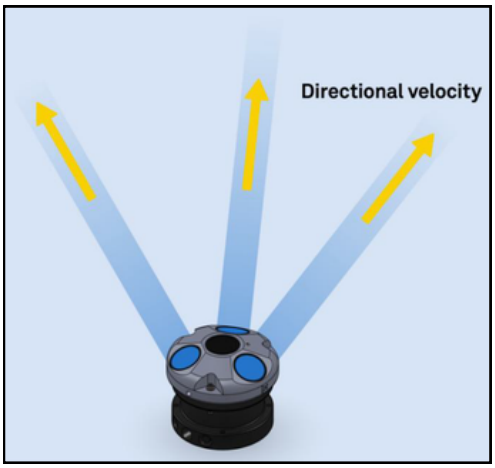


Fig. 6. Illustration of wave measurement through the assessment of orbital water velocity. Source: manufacturer's documentation https://www.nortekgroup.com

Main specifications of the AWAC 1 MHz sensor for wave measurement:

Maximum depth of the apparatus	35 m
Wave measurement spectrum	from -15 to 15 meters
Accuracy of wave height (Hs) measurements	Less than 1% of the measured value
Wave height measurement resolution (Hs)	1 cm
Wave direction measurement precision (Dir)	2°
Wave direction measurement resolution (Dir)	0,1°
Wave period range	0,5-50 s
Cut-off period (significant wave height Hs)	at a depth of 5 m: 0.5 seconds at a depth of 20 m: 0.9 seconds at a depth of 60 m: 1.5 seconds
Cut-off period (wave direction Dir)	at a depth of 5 m: 1.5 seconds at a depth of 20 m: 3.1 seconds at a depth of 60 m: 5.5 seconds

Present measurement

ADCP utilizes sound to gauge water currents. This method resembles sonar. The instrument sends sound waves toward the water's surface, and these waves reflect off different components found in the water, including solid particles, air bubbles, phytoplankton, and more.
A fundamental phenomenon that underpins contemporary measurement is the Doppler effect. When sound waves are emitted and reflect off suspended particles in water, their frequency alters. If these particles are approaching the transmitter, the reflected sound exhibits a higher frequency; conversely, if they are receding, it displays a lower frequency. This change in frequency is a consequence of the Doppler effect and serves as a crucial indicator of the water's velocity.

The 1 MHz AWAC sensor assesses water velocity at multiple depths by examining variations in sound frequency following reflection from objects found in the water at a specific level. Utilizing these measurements, the device can compute the water velocity across various sea layers. The measurements employ three beams positioned 120 degrees apart. This configuration enables the detection of different flow velocity components, thereby facilitating the determination of the speed and direction of the current at a specific level.

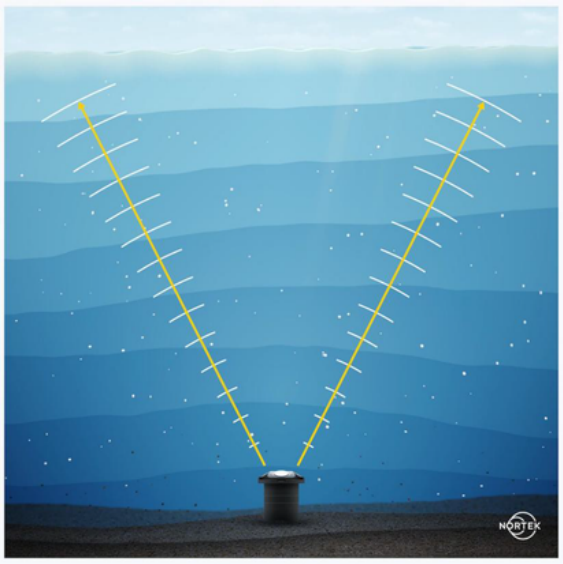


Fig. 7. Illustration demonstrating the method by which the ADCP sensor gauges the velocity of ocean currents.
manufacturer documentation https://www.nortekgroup.com

Main specifications of the AWAC 1 MHz probe for measuring ocean currents:

Maximum profiling range	30 m
Depth cell dimensions	adjustable within the range of 0.25 - 4.00 m
Speed measurement range:	±10 m/s horizontally, ±5 m/s along the beam
Accuracy of speed measurement	±1% of the measurement value ±0.5 cm/s