

Description of water masses using Argo profilers

In oceanography, a *water mass* refers to a body of ocean water with a distinctive narrow range of temperature and salinity and a particular density resulting from these two parameters¹. It can also be defined as a body of water with a common formation history which has physical properties (temperature, salinity, chemicals) distinct from surrounding water.

The temperature-salinity (*T-S*) *diagram* constitutes a tool to classify water masses. Some water masses can be represented as a single point on the diagram: it happens when they have a uniform temperature and salinity. More generally, the water masses appear as a curve on the diagram, since their properties vary with depth. A point on the T-S diagram is called a *water type*. A straight line on a T-S diagram may be due to the mixing of two water masses, though it is not always the case.

Here are some examples of ranges for different water masses in the Atlantic Ocean, based on the paper by Emery and Meincke². They divide the ocean in 3 main layers:

1. the *upper waters*, between 0 and 500 depth. Due to the proximity to the atmosphere, it is where the strongest variations occur. In this layer we have, for example:
 - Atlantic Subarctic Upper Water (ASUW) T: 0-4°C, S: 34. - 35.0
 - West North Atlantic Central Water (WNACW) T: 7.0-20.0°C, S: 35.0-36.7
 - East North Atlantic Central Water (ENACW) T: 8.0-18.0°C, S: 35.2-36.7
 - South Atlantic Central Water (SACW) T: 5.0-18.0°C, S: 34.3-35.8
2. the *intermediate waters*, between 500 and 1500 m depth, where one can find, for example:
 - Mediterranean Water (MW) T: 2.6 - 11°C, S: 35.0 - 36.2
 - Antarctic Intermediate Water (AAIW) T: 2.6°C, S: 34.4 - 35.3
3. the *deep and abyssal waters*, deeper than 1500 m. Examples:
 - North Atlantic Deep Water (NADW) T: 1.5 - 4.0°C, S: 34.8 - 35.0
 - Antarctic Bottom Water (AABW) T: -0.6 - 1.7 °C, S: 34.64 - 34.72

Argo floats are a type of autonomous instrument that provides temperature and salinity profiles from the upper 2000m of the ice-free global ocean and currents from intermediate depths³. As of July 2016, 3739 floats were deployed over the World Ocean.

The standard mission cycle takes approximately 10 hours and is as follows:

- Descent to a target depth (1000 m) ; duration ~ 6 hours.
- Drift at 1000 m ; duration ~ 9 days.
- Continue the descent to 2000 m.
- Ascent and acquisition of temperature and salinity profiles ; duration ~ 6 hours.

1 <https://global.britannica.com/science/water-mass>

2 Emery, W.J. and J. Meincke. 1986 Global water masses: summary and review. *Oceanologica Acta*, 9:-391.

3 http://www.argo.ucsd.edu/How_Argo_floats.html

Thanks to their spatial distribution and number, Argo floats allow for a characterisation of the water masses in different oceanic region. We will show a few example based on the profiles available in the CMEMS catalog. The product is INSITU_GLO_NRT_OBSERVATIONS_013_030 and the plots were created for data corresponding to May 2016. They show the diversity of T-S diagram that can be obtained and the water masses characteristics of different regions.

The in situ data are the only source of information on the water masses, since satellite are limited to the surface layers. The correct representation of the water masses by the numerical models is essential if one wants to properly understand the changes occurring in the ocean.











