EGU21-9371
https://doi.org/10.5194/egusphere-egu21-9371
EGU General Assembly 2021

A new approch for measuring ocean vertical velocities

Jean-Luc Fuda[1], Stéphanie Barrillon[1], Andrea Doglioli[2], Anne Petrenko[2], Gerald Gregori[1], Roxanne Tzortzis[2], Caroline Comby[2], Melilotus Thyssen[1], Michel Lafont[2], Nagib Bhairy[1], Denis Malengros[1], Dorian Guillemain[1], and Chistian Grenz[1]

[1]CNRS, Mediterranean Institute of Oceanology (MIO), Marseille, France (jean-luc.fuda@mio.osupytheas.fr)

[2]Aix-Marseille University, Mediterranean Institute of Oceanology (MIO), Marseille, France (jean-luc.fuda@mio.osupytheas.fr)

Compared to horizontal components, the vertical components of ocean currents are generally very weak (a few mm/s) in all oceanic regions of the world. Due to their major role in the vertical distribution of physical and biogeochemical properties of sea water, their extended knowledge is of utmost importance for oceanographers. However, their in-situ measurement represents a real technical challenge, even using sophisticated instruments such as ADCPs.

As a complement to the ADCP method presented in another session (Comby et al.), we have developed an original alternative instrument, called the VVP (Vertical Velocity Profiler). It was inspired by several published works which exploit the difference between the real vertical speed Wr of a submarine glider (~dP/dt, from the onboard pressure sensor) and its theoretical vertical speed Wth extracted from a flight model. The oceanic vertical speed Woc is thus expressed by the simple difference $Woc = Wr - Wth$ at any point in the water column.

The very first prototype of the VVP consisted of a float and a friction disc, ballasted to sink at a very low speed (~ 0.1 m / s) and dragged down to the desired depth by a dead-weight which was automatically released after a suitable delay. The release system was developped in-house (patent filled in March 2020), based on a textured insert trapped in a volume of ice melting at controlled speed. Since then, the concept of the profiler has evolved considerably. The last design uses an electric thruster that drives the profiler down to a predefined setpoint depth. Once the depth is reached, the thruster is stopped and the profiler then rises slowly (~0.1 m/s) to the surface under the sole effect of its slightly positive buoyancy. The mechanical balance between buoyancy and hydrodynamic drag results in a constant vertical speed of ascent in water at rest. Any deviation from this constant speed is then interpreted as an oceanic vertical velocity signal. This new design allows a very large number of consecutive profiles to be collected, the number of descent-ascent cycles and the setpoint depth being programmed and controlled using an ARDUINO microcontroller board. The selected Li-Io battery allows for several hours of continuous profiling. When on surface, the profiler is currently located by a commercial GPS tracker integrated into the electronic case. The vertical velocity of the profiler is accurately measured at high frequency (2Hz) thanks to the fast-response pressure sensor of the onboard RBR-CONCERTO autonomous CTD, which also measures the sea water density involved in drag and buoyancy.

Trials both in deep pool and in the field are scheduled in spring 2021 in order to refine the prototype design and to definitely set the flight model parameters. This development benefits from CNES (Centre National d'Etudes Spatiales) financial support in the framework of the BIOSWOT international program.