Ian D. Walsh, Ph.D
David J. Murphy,
Thomas O. Mitchell Ph.D,
Sea-Bird Scientific

Slope to Basin and Vertical Particle Transport Dynamics Measured with a Profiling Biogeochemical Float

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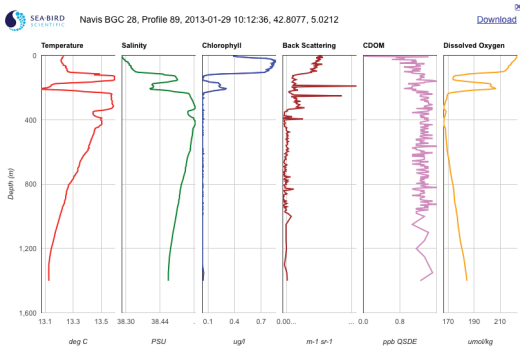
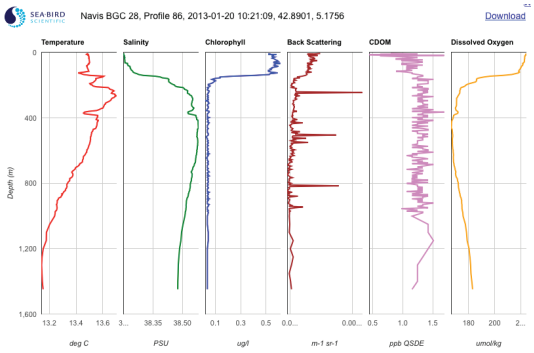
Abstract

Profiling floats have proven to be a stalwart technology generating robust basinal scale data sets of temperature and salinity. Biogeochemical profiling floats are proving to deliver reliable data over similar spatial scales. However, biogeochemical gradients are greatest at the margins, requiring greater data density at the margins compared to the basins. Profiling floats deployed on the slope can contribute to achieving sufficient data density. A Navis profiling float with biogeochemical sensors was released at the BOUSSOLE site southeast of Nice in September, 2012 and continues to operate. The float was captured by the westward trending boundary current and during the winter of 2012 – 2013 the float traversed the slope south of the Gulf of Lyon. The float recorded multiple mixing and lateral transport events below the mixed layer and pycnocline. The float also recorded the deep mixing associated with the formation of the Western Mediterranean Deep Water on the slope and subsequently in the basin. The biogeochemical sensors allow for the calculation of net transport of particulate mass and carbon associated with the mixing and lateral transport.

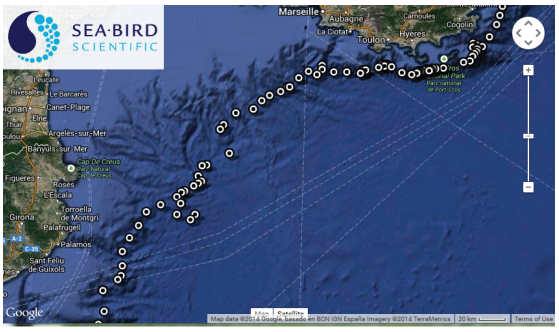
Intermediate Nepheloid Layers on the Slope off the Gulf of Lyon



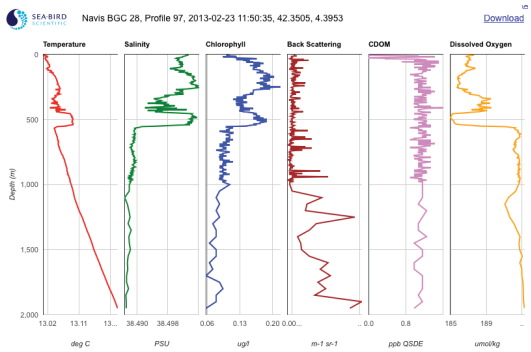


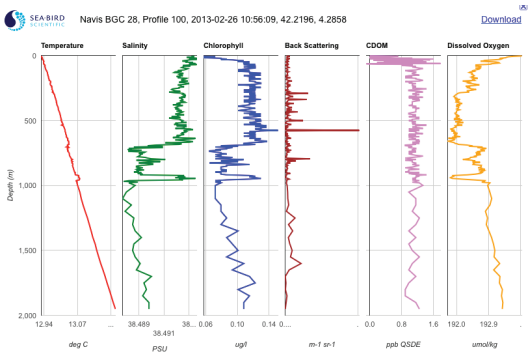
Intermediate nepheloid layers were captured in individual profiles, e.g. between 150 and 250 m on January 29, 2013. Note that the sub-mixed layer peak in the backscattering occurs at 330 m, suggesting that backscattering and chlorophyll particle populations are not tightly coupled. The January 20th profile is presented for contrast.

Deep Mixing Events on the Slope off the Gulf of Lyon



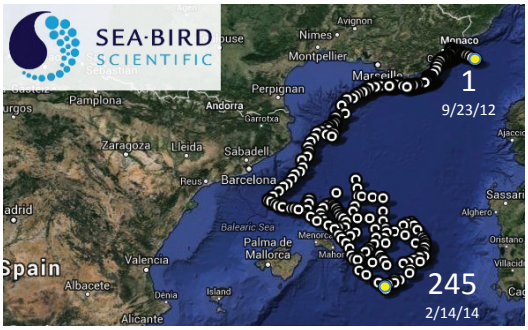
Deep mixing events were captured in profiles on the slope as winter progressed. The breakdown of stratification, seen in dramatic changes in the physical parameters, were also reflected in the biogeochemical parameters. Net vertical particle transport to the mid water column was as least as great as the particle load in the photic zone before the mixing events.





Navis BGC Float

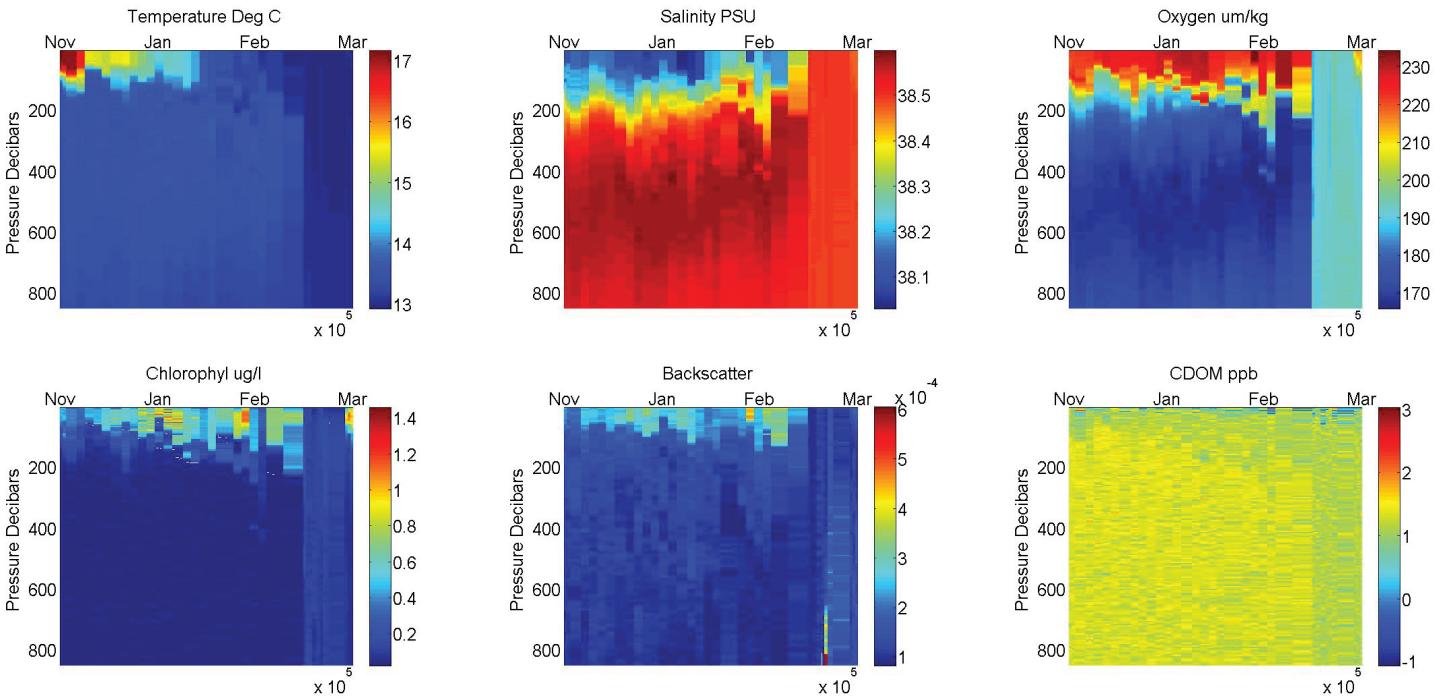
Sea-Bird Scientific has developed the Navis BGC float as a flexible, multi-role scientific platform for autonomous biogeochemical research. The float incorporates Iridium two-way satellite communications for fast data transfer and mission adaptation. Lithium batteries are included for long deployment missions. The Navis BGC float is designed to provide over 200 profiles to depths of 2000m with SBE 41 CTD, SBE 63 ODO, and WET Labs ECO Triplet oceanographic-quality instruments aboard.



Navis BGC float 0028 after deployment. The ECO Triplet is visible on the upper right side of the float. Photo by Christoph Gerigk.

Sea-Bird Scientific's Navis BGC float 0028 was deployed on September 22, 2012 at the site of the BOUSSOLE bouy, a few long-term optical time series mooring. located in the Mediterranean Sea south-east of Nice (obs-vlfr.fr/Boussole/html/home/home.php). The float deployment was generously supported through the efforts of Dr. David Antoine with assistance from Emilie Diamond during the cruise. Data management on shore was managed through the assistance of Dr. Hervé Claustre and Antoine Poteau. Additional feedback from Dr. Fabrizio D'Ortenzio and Dr. Lois Prieur regarding profile questions specific to the Mediterranean basin was greatly appreciated. All individuals are associated with the Marine Optics and Remote Sensing Lab at Laboratoire d'Océanographie de Villefranche (LOV).

Cross Sections of the Slope off the Gulf of Lyon, November 2012 to March 2013



Cross sections of physical and biogeochemical parameters measured on profiles by Navis BGC float 0028 as it traversed the continental slope off the Gulf in Lyon. Profile data has not been smoothed or interpolated except for the backscattering data set, for which we used a minimum filter to remove spikes. Note the deep mixing event in late February.

Vertical Integrations Demonstrate Net Vertical Transport Resulting from Deep Mixing Events

Vertical integrations demonstrate the transport associated with the deep mixing events. Upper panels are integrations from the surface to particular depths. Lower panels are integrated loads between 300 m and the particular depth. Backscattering was converted to POC using the relationship in Cetinić et al.(2012), JGR-Oceans, 117(C6), C06028.