CONSIDERATIONS ON THE COLLECTION OF DATA FROM BIO-ARGO FLOATS ACROSS SAMPLING SCALES.

Ian D. Walsh, Ph. D,
Joel Reiter,
Dan Quittman,
David J. Murphy,
Thomas O. Mitchell, Ph.D.
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ABSTRACT

The flexibility of the current generation of float sensor packages peovides an opportunity to craft mission specific sampling schemes that balance the collection of data for specific sampling goals with the practicalities of float operation.

Autonomous floats operate within constraints of battery life and data transfer rates. For simplicity of data transfer and handling, most float data sets are transmitted after binning on pressure. Within a given pressure bin different instruments will be sampling within a particular defined sequence. A sampling sequence should be balanced towards minimizing energy consumption while maximizing data accuracy of each instrument. As the number of sensors increases and the breadth of mission parameters expands it becomes more difficult to optimize data sequencing and reporting.

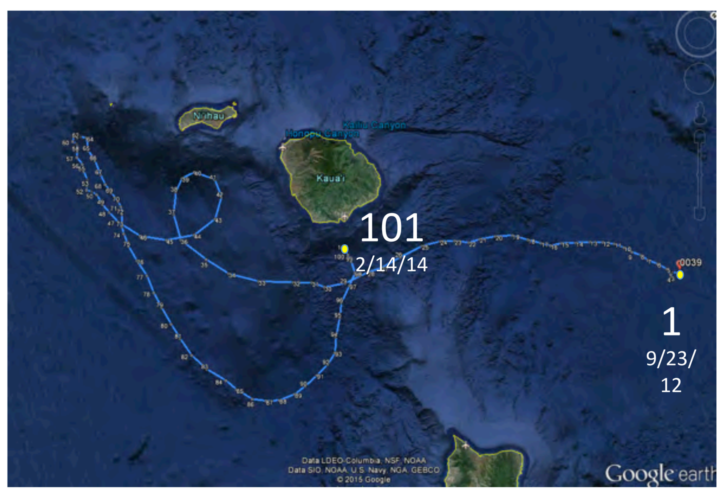
We consider methods to reduce the size of the problem by setting rules for sequence development and test those rules relative to field data. We examine a set of data from a float that was equipped with internal memory that captured the full set of sample data taken during the profiling mission. Comparing the 'raw' data and the transmitted data we examine the variance around the transmitted data and discuss the impact of data sequencing on the data.

Navis BGCi Float

Sea-Bird Scientific has developed the Navis BGCi 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 SBE 41N CTD measures conductivity, temperature, and pressure (depth). The SBE 63 Optical Dissolved Oxygen sensor is integrated within the CTD flow path, providing optimal correlation with CTD measurements.

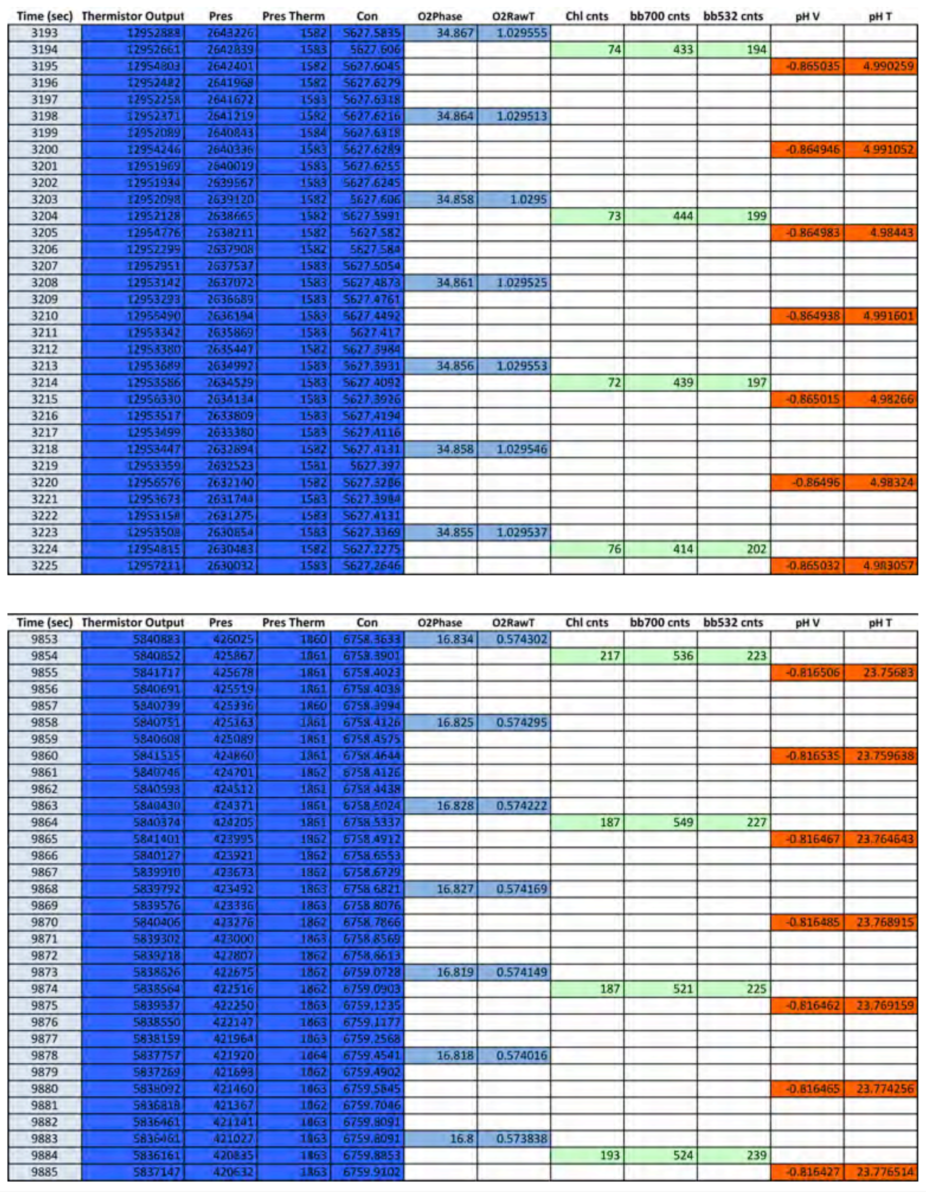
The MCOMS has three optical sensors, providing chlorophyll a, backscattering, and CDOM, or chlorophyll a and 2 backscattering channels. MCOMS is integrated directly into the float end cap and co-located with DO and physical measurements. The Navis float can be expanded with additional sensors, in this case with an experimental pH sensor.

NAVIS BGC float 0028 (above) after deployment in the Mediterranean Sea. The float used in this study was equipped with and MCOMS and pH sensor. Photo by Christoph Gerigk.



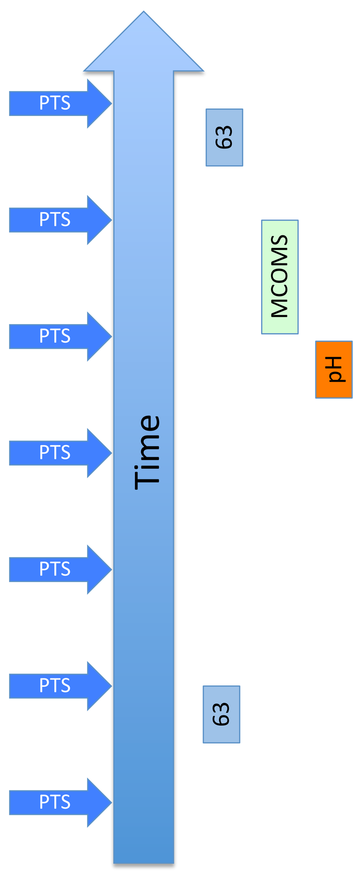
NAVIS BGCi float 0038 was an experimental float deployed off Hawaii. The float was recovered after 100 profiles and five months at sea.

Data Output Structure



Data from each instrument is recorded as the float rises according to the programmed instrument sequence. The rise rate of the float determines the data density within the profile as the instruments are driven by the time sequence. For example, as the float rises past 700 dbar (top panel), four complete sequences of data are completed over 4.1 dbar in 32 seconds. Later in the profile as the float passes 100 dbar (bottom panel), the float covers 1.5 dbar in 32 seconds and records four complete sequences.

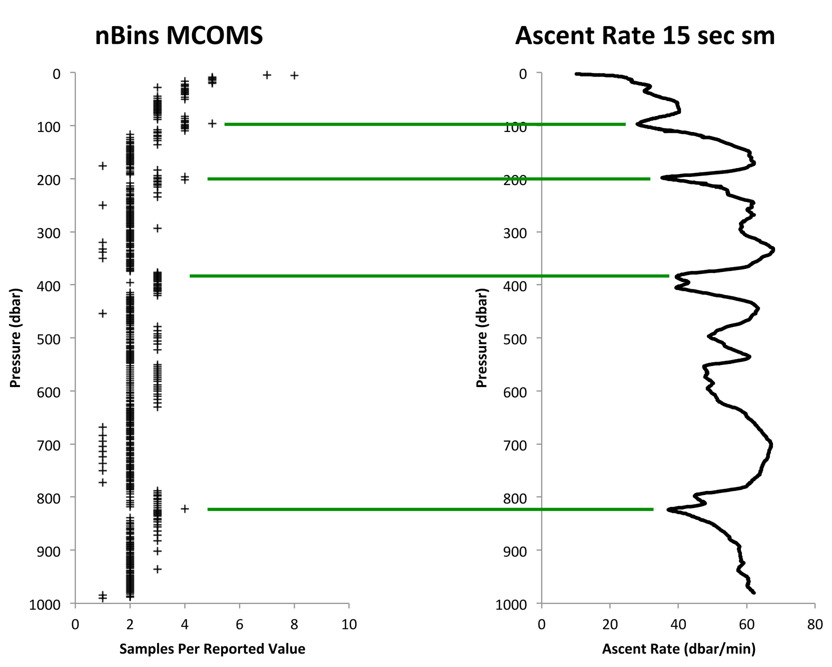
Instrument Sequencing



Pressure, temperature and conductivity (PTS in the diagram) are measured at 1Hz while serial instruments can have independent update rates up to 1Hz and be mixed and matched, as the deployment requires. Each instrument can have its own inquiry mode: queried for a sample or free running with continuous output. In this example, the SBE 63 and pH sensors are continuously powered, queried for a value, and put to sleep between each measurement. In contrast, the MCOMS port is powered, the output is recorded, and power is removed at the desired update rate. The MCOMS operates at 1.4 kHz and internally averages packets of LED on/off cycles to remove ambient light. The MCOMS output rate is set at 1 Hz.

The sampling technique for each instrument can be tuned to optimize the data density for the power expended.

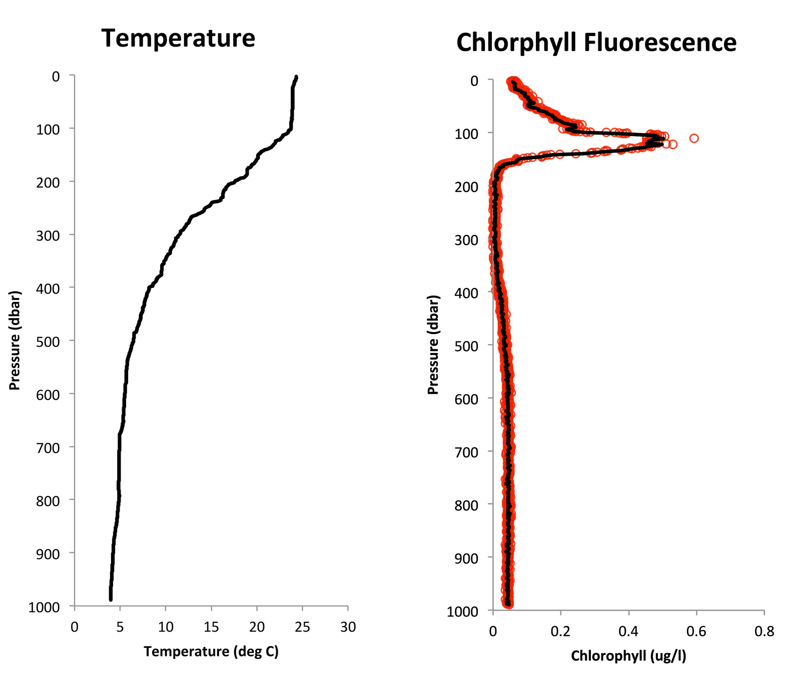
Profiling Rate and Data Output



The Navis float's ascent rate modulates the number of subsamples within each individual transmitted bin. The horizontal lines connect the negative peaks in the ascent rate with the local increases in the number of subsamples per pressure bin.

Since the ascent rate is a function of the density gradient, the float will collect more samples where the gradient is increasing.

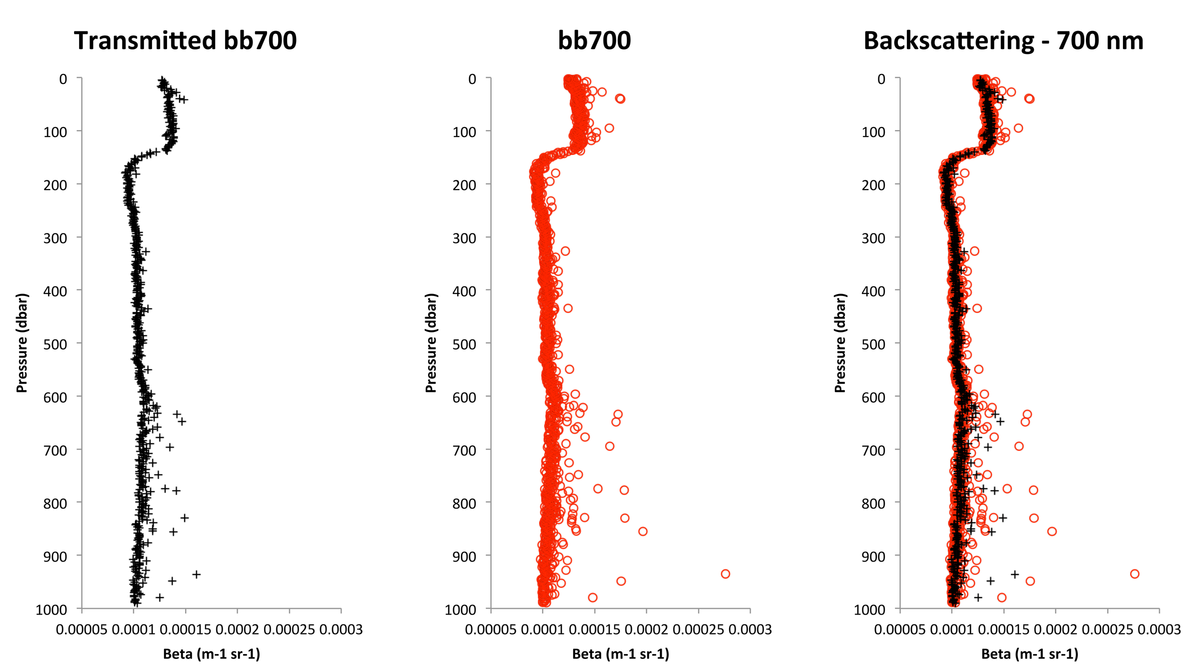
Transmitted v Recorded Data – Temperature and Fluorescence



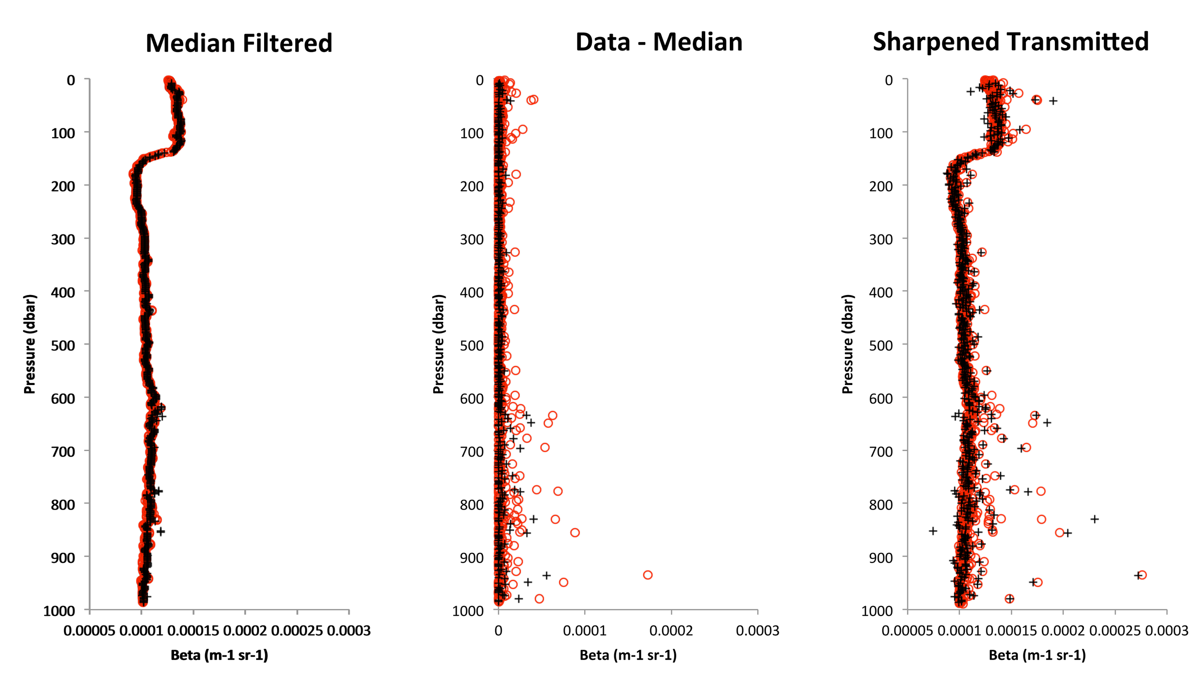
Temperature data (left panel) from both the transmitted and recorded data sets overlaid in the left panel demonstrates no effective difference between the two data sets.

Chlorophyll data (right panel) from both data sets demonstrates no effective difference except for at the chlorophyll maxima. Transmitted data is the red circles.

Transmitted v Recorded Data – Backscattering



The transmitted backscattering data (far left), the recovered data (middle), and both data sets overlain (right). The recovered data demonstrates that the transmitted data smooths the variance in the recovered data. Assuming the 'spikes' represent relatively rare large particles, the transmitted data undercounts the large particles.



Applying a running median filter to both data sets (far left) generates coherence between both profiles. The residual data, assumed to be the large particles, again shows the undercounting in the transmitted data (middle). Using a sharpening algorithm (right), much of the recovered data can be generated from the transmitted data.