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**AUTONOMOUS OCEAN PROFILER****Trimester Report — June 1991 through September 1991**

Six of the original ten Autonomous Lagrangian Circulation Explorers (ALACES) deployed in Drake Passage in January 1990 were still operational at the end of September 1991. After 20 months and 40 vertical cycles these ALACES are nearing their design life of 25 months and 50 cycles. Since the Drake Passage deployment, ALACE has been extensively improved. The redesigns appear to be successful and of 36 ALACES deployed during early 1991, only one has suffered infant mortality; two of the 10 Drake Passage ALACES died in their first cycle.

Four temperature-profiling ALACES deployed in the North Atlantic are providing information directly transferable to the prototype CTD ALACE. These four are returning temperature profiles from 750 m depth once every four days via ARGOS; using 3 Argos messages of 32 bytes each, we are relaying temperatures with a better than 0.1 degree resolution at 84 depths over the upper 750 meters. These profilers are serving as trial-horses for the data transmission scheme to be incorporated into the CTD ALACE. The four-day cycle period has resulted in over 25 profiles over the past three months with excellent data return and no failures, confirming that the basic profiler is robust and that the data transmission scheme works well.

Following successful local tests of the prototype ALACE CTD profiler, we feel that it is time to demonstrate its capabilities in the field and to get the field experience necessary to uncover real-world problems. Work on the prototype CTD ALACES is now directed towards preparing one for deployment in February 1991 as part of our participation in the ONR-sponsored Subduction Experiment. A second identical unit is being built with the latest modifications but will be withheld from the field until a suitable mechanism for transition can be found.

Recent modifications are pressure and temperature electronics are being completed in-house, while Falmouth Scientific Instruments (FSI) is modifying their conductivity cell for improved power efficiency. The 8-bit A/D in the standard-ALACE does not provide the precision in depth or temperature that is required for the CTD ALACE. A new in-house pressure-temperature circuit board incorporates a 12-bit A/D, with the required stable circuitry to minimize long-term offsets and thermal drift. Environmental tests show less than 1/2 LSB (.005 degrees) drift in the temperature circuit when subjected to ambient temperature variation between 0 and 25 degrees C. The pressure circuit drifted less than 3 m over the same temperature range. Both of these specifications are well within the design parameters required to measure sound velocity to .25 m/s (15 m depth, .05 deg C accuracy).

The FSI conductivity cell is being modified electrically and mechanically, working towards something more suitable as a production-run ALACE model. New components are

being incorporated to reduce power consumption by half. Circuitry has also been added to allow the FSI electronics to interface directly to the ALACE CPU. The first prototype required an interface board built at SIO but the new FSI board will eliminate this, reducing cost and man-hours needed on future CTD ALACES. The electrical-mechanical connection between the sensor head and electronics are being improved to provide more robust wiring and a better interface connector, thought to be the major weak links with the first FSI cell.

Software development has been concerned with creating a simplified algorithm for salinity, and finalizing the ARGOS message format for the February 1992 test. Since typically 90% of the variance in conductivity (C) is due to temperature, sending back both T and C repeats much the same information and wastes limited Argos data relay capabilities. Our objective is to transmit a function of temperature and conductivity which approximates salinity (and is more efficient to transmit) and to then compute salinity and sound speed during post processing. The present ALACE operating system does not include floating-point capability so implementing the full UNESCO salinity algorithm is difficult. The UNESCO algorithm spans wide pressure, salinity, and temperature ranges. By limiting these parameters to the realistic ranges that the CTD ALACE will experience ($P < 1000$ m, $3 < T < 30$ C, $33 < S < 36$ PSU), a simple quadratic in both T and C has been found which approximates S to within about 0.1 PSU. This will be used in post-processing to compute salinity and sound speed with expected accuracies (assuming no sensor errors) of 0.02 PSU and 0.06 m/s, respectively.

Ultimately, sound-speed precision and depth resolution are limited by the Argos communication channel. Data compression is achieved by using knowledge to avoid sending unnecessary information. The prototype ARGOS message will be programmed on the conservative side, emphasizing simplicity and robustness of decoding over maximal compactness. Experience from the temperature-profiling ALACE has shown success with this kind of code. Although not the most energy-efficient scheme, the data lost compared with the most optimistic assumptions for our most efficient coding is only 10-20%. As more experience with sensor behavior is logged, we can fine-tune the data compression code to minimize power consumption or maximize resolution.



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