

Summary of operations and measurements for OSU/URI group.

Narrative:

Our operations were to consist of four basic components:

- 1) SuperSoar towed undulating vehicle-based measurement of T, S, PAR, chl-fluorescence, CDOM fluorescence, beam transmission, optical backscatter, O₂, pCO₂, TCO₂, and nitrate (ISUS and shipboard analysis), plus physical microstructure measurements of turbulent mixing rates. (Hales/Strutton/Hebert)
- 2) Incubations of discrete water samples to obtain new production. (Strutton)
- 3) At sea processing, visualization, and interpretation of shipboard ADCP data. (Hebert)
- 4) Sampling to characterize the POC content of the upper water column, coincident with the in situ sensor based measurement of beam transmission. (Strutton)

The first SuperSoar deployment lasted about 7 hours before meeting its catastrophic end.

We added the following three modified operations as a result:

- 5) High-resolution surface mapping of the T, S, chl, beam attenuation, O₂, pCO₂, TCO₂, NO₃ characteristics of the tracer patch and surroundings (Hales/Strutton/Hebert).
- 6) Contributed our PAR sensor to the CTD rosette package, and provided estimates of euphotic zone depths. (Strutton/Hales)
- 7) low-speed deployments of TOMASI (Hebert turbulence microstructure instrument) on reduced-payload, short-cable configuration of SuperSoar. (Hebert/Hales)

The first deployment of TOMASI resulted in a flooded pressure case, and no data was collected.

Data collected:

1) SuperSoar:

Seven hours of SuperSoar data, consisting of approximately 50 10-60m profiles. Data for T, S, chl, O₂, beam attenuation, optical backscatter, CDOM fluorescence, PAR, NO₃ (ISUS-based), and pCO₂. TCO₂ analyzer was not working due to elevated CO₂ content in the chopper cell of the LI6262. Shipboard NO₃ analyzer was not online. TOMASI was not deployed on SuperSoar for this first survey.

Data currently available in crudely-processed 1-second resolution files, and un-processed 24-Hz raw files. The former is sufficient for qualitative visualization purposes.

Data processing will include reduction of 24-Hz data to 1-Hz time series files, with improvements over real-time processing. Subsequent to that, data will be turned into gridded 2-D sections for each parameter. Additional processing to determine mixed-layer depth and 1% light level will follow. Processed data will begin to be available by mid-June.

2) Incubations:

The LDEO group (section 4.7.1) performed ^{14}C incubations to measure gross and net primary productivity. To quantify new production we performed incubations using the stable isotope ^{15}N . Discrete water samples (1.17L) were taken from 6 depths between 0 and 50m on the evening CTD casts (usually 5, 10, 15, 25, 35 and 50m). The samples were kept cold and in the dark until just before local sunrise (~08:30 GMT), whereupon they received an addition of 0.2ml of ~10mM K^{15}NO_3 . This represents an NO_3 enrichment of a little less than 2uM or 10% given the ambient NO_3 concentrations. Samples were incubated for 12-24 hours at light levels approximating those from which the water samples were taken (85, 40, 27, 11, 4 and 1% of surface light) and at surface seawater temperatures in an incubator bath located on the starboard side of the fantail. When the incubations were terminated, the water samples were filtered, the filters dried, and will be analyzed on return to the lab. The amount of ^{15}N taken up by the phytoplankton community, when compared with the total C uptake, will provide an estimate of the f ratio and new production. Results are expected to be available in August. Data similar to these were used by Strutton *et al.* (2004) and Sabine *et al.* (2004) to close the carbon budget for the mixed layer during GasEx 2001.

3) ADCP processing

Data from the 75 kHz Ocean Surveyor acoustic Doppler current profiler (ADCP) was operated in two modes, broad-band and narrow-band, throughout most of the cruise using the University of Hawaii Data Acquisition System (UHDAS). Preliminary processing using the UH CODAS package was conducted at sea. This provided the science party with several valuable pieces of information. First, it assisted in site selection by giving estimates of velocity and shear distributions. Second, progressive vector calculations gave predictions of patch trajectories and assisted with the patch tracking/mapping exercises. Third, advective corrections applied to survey tracks gave more robust estimation of the patch-survey 'snapshots', correcting for apparent temporal/spatial variability that resulted from advection of hydrographic features within the surveys. Final processing will be performed by Jules Hummon at UH. Hebert will collaborate with her in this aspect and provide the dataset to the data center.

4) Discrete water sampling

Discrete water samples (1.17L) were taken from six depths between the surface and 100m on each CTD cast. Four samples were usually taken in the mixed (<60m) layer to ensure accurate quantification of changes in mixed layer POC. The remaining two samples were usually obtained from within the thermocline (~75m) and below the thermocline (~100m). These water samples were filtered, the filters dried and will be analyzed on return to the lab. The POC data from the ~9am/11am local CTD casts will be compared with the optical profiles of beam attenuation at ~660nm (see section 4.8.3) to obtain continuous vertical profiles of derived POC (Gardner *et al.*, 2003). The near-surface samples from both the morning and evening CTD casts, and occasional calibration samples from the underway seawater line, will be compared with the corresponding

data from the surface underway transmissometer (again, beam attenuation at 660nm) to produce high spatial resolution underway maps of POC in and surrounding the patch. The surface underway and CTD data represent complimentary approaches to determining the time rate of change in POC for the patch. Changes in POC were not quantified by measurements during GasEx2001, so this represents a potential improvement on the carbon budget constructed for that experiment.

5) Underway surface mapping

Four systems were run in the surface underway line: $p\text{CO}_2$, TCO_2 , NO_3^- (wet-chemical analysis), and NO_3^- (ISUS).

$p\text{CO}_2$ was configured to also record the analog (0-5V) outputs of a WetStar chlorophyll fluorometer, a CStar beam transmissometer, an SBE43 O_2 electrode, and the output of a SBE45 thermosalinograph. $p\text{CO}_2$ system was running near continuously between 08 March and the time of reaching Uruguayan Economic Zone waters, at which point it was shut off. Data was collected at 1Hz frequency. CO_2 gas standards and an atmospheric sample were run every 2-4 hours. Data is available now in uncalibrated files of duration 1-2 hours. Datafiles where the CO_2 standards have been removed and nominal calibrations, and temperature and pressure corrections, have been applied to the CO_2 data, will be available by the end of the cruise. These data will include TSG T and S data. Reported TSG T about 0.7C warmer than true SST. S data is believed to be more accurate than Ship's S data. Data are calibrated using the factory-provided standard-gas concentrations, and have not been corrected for the difference between equilibrator humidity and atmospheric humidity or dry air. These corrections will be made when our standard gases are shipped back to our home laboratory. Final data expected in July.

Chl-fluorometer, beam transmissometry, and O_2 electrode signals will be calibrated with discrete Chl, POC, and O_2 measurements of the underway seawater. These data will also likely be available in July.

TCO_2 data is archived in uncalibrated LI6262 output at 1-Hz frequency. Data processing steps to be performed include correction for atmospheric pressure fluctuations, calibration with liquid and gas standards, which were run every 2-4 hours, and quality control. TCO_2 data collection was initiated on 9 March, but problems with pump instability make the first few days of data collection plagued with drop-outs. Data is nearly continuous from about 12 March onward. This system will be kept online until the reference gas, intended to last for a half-dozen SuperSoar deployments, runs out. This data will likely be available in August.

Wet-chemical-analysis NO_3^- data is archived in two separate sets of files. One set contains 60-Hz raw data that fully resolves the square-wave form of the bubble-segmented flow. A second set contains the real-time processed individual bubble segments. This latter data is stored at a frequency of about 0.5Hz. Post-processing will include extraction of individual segments from the full 60-Hz files, and extraction and application of standard sequences. This system was brought online on 9 March and has been in operation nearly continuously since then. We will run this system until our supply of reagents, intended for 6 days of SuperSoar operation, runs out. This data will likely be available in August.

The ISUS NO_3^- sensor was brought online on 8 March and has run nearly continuously since then, save for a period of down-time while stationed off South Georgia Island. Post-processing will include comparison with analytical NO_3^- data and corrections, if necessary. Data will be available following the completion of post-processing of the wet-chemical NO_3^- data.

6) PAR sensor data

A Photosynthetically Available Radiation (PAR, 400-700nm) sensor was mounted on the CTD rosette. PAR data from the morning (~9am/11am) CTDs were used to calculate the diffuse attenuation of solar radiation with depth. These data were then used to calculate the depth of the % light levels that were used for the ^{14}C and ^{15}N incubations. These calculations are important because the % light depths are used in the trapezoidal integration of new production and primary production. The PAR attenuation data can also be used to calculate the attenuation of solar radiation for constructing a heat budget for the mixed layer, or as input into a Price-Weller-Pinkel (PWP) model (Price *et al.* 1986).

7) TOMASI

No data collected with TOMASI prior to pressure case flooding.