S-MODE Science Report: Oct 22-Oct 31, 2021

Science Highlights:

There have been two oceanographic target regions:

1. A strong SST front 37N, 125W (Figure 1). This front was sampled by DopplerScatt, MOSES, MASS, the RV *Oceanus*, and 5 Saildrones (black dots in Figure 1). During the S-MODE campaign, we observed a rapid sharpening of the front and its collapse. An example of data from the MOSES infrared imager is shown in Figure 2.
2. A region with strong and weak velocity gradients in close proximity, being used for velocity intercomparisons (Figure 3). This feature is still developing and satellite imagery has been obscured by clouds.

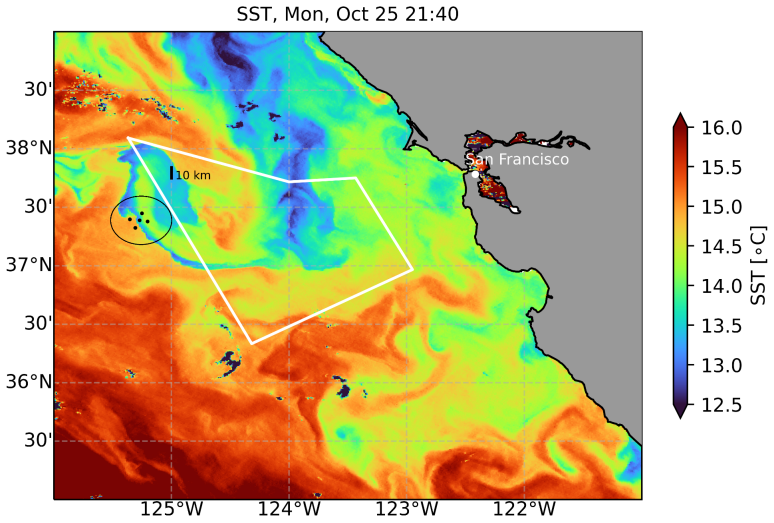


Figure 1: Sea surface temperature in S-MODE operations area on Oct 25. First oceanographic target area circled. The black dots are the position of the Saildrones around the time of the satellite overpass and the aircraft sampling.

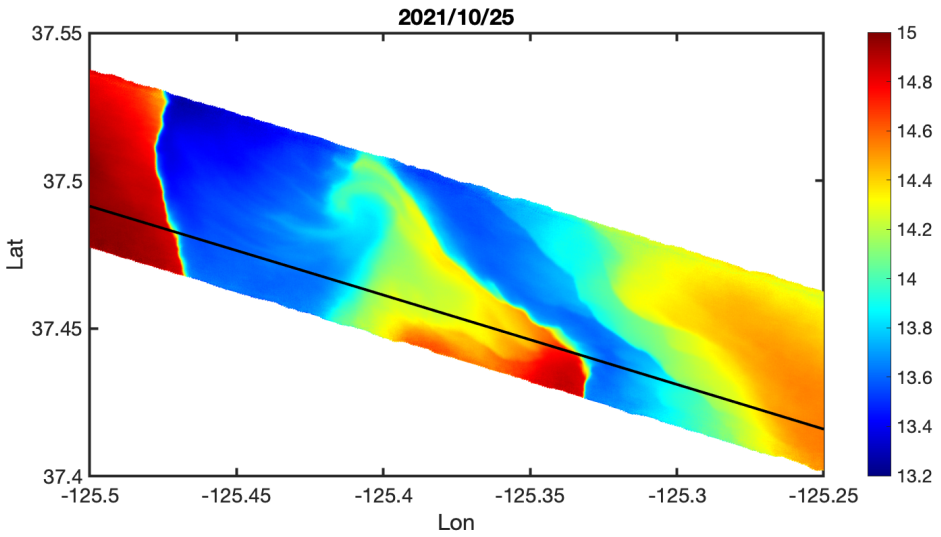


Figure 2: High-resolution measurements from the MOSES Infrared imager within focus area 1 showing: (1) a very sharp front near 125.47W, (2) development of a submesoscale eddy near 37.5N, 125.4W and (3) smaller-scale eddies developing near 37.45N, 125.35W.

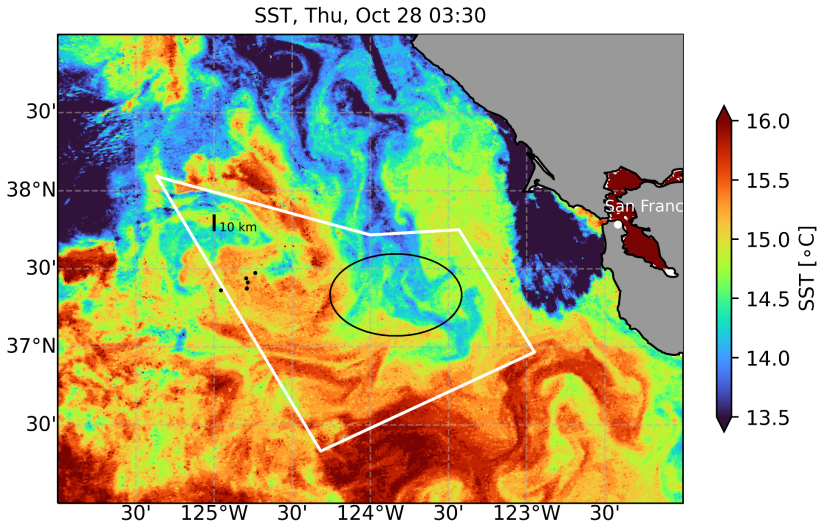


Figure 3: Sea surface temperature in S-MODE operations area on Oct 28. Second oceanographic target area circled.

R/V Oceanus and Wave Gliders

- On Oct 22, as the Oceanus first arrived at the S-MODE operations area to begin collecting data, a mechanical issue was discovered and the team had to cut their survey short to go to port in San Francisco. Fortunately, the issue was repairable and after spending four days in port, the ship departed San Francisco midday on Oct 27.
- The Scripps team arrived in San Francisco on Oct 23 and began work on repairing the three damaged Wave Gliders (WGs). All were repaired prior to Oceanus departing from San Francisco.

- On Oct 27, the four WGs were deployed. One WG (Planck) had to be recovered shortly after the deployment due to communication issues. It will not return to the water this campaign. However, the other three WGs have been collecting good data.

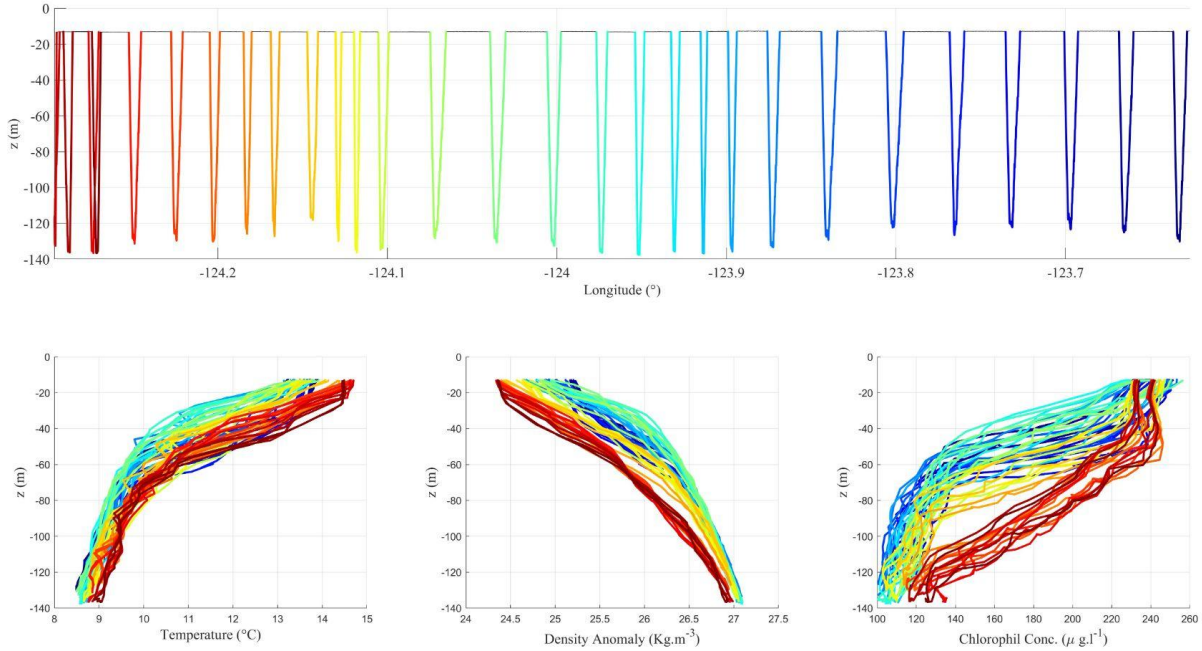


Figure 4: Example of temperature, density and chlorophyll-a concentration profiles (10-140m waterdepth) collected from one of the wave glider instrumented winch over a 75km transect (approximately 24hr transit).

AFRC B200

- The AFRC B200 has completed a total of nine science flights. Both the DopplerScatt and MOSES instruments are delivering good data.
- The first four science flights focused on a “cold filament area” in the western part of the operations area, but starting with fifth flight, the team turned its focus to strong frontal areas closer to the center of the ops area.
- From days where the operations area was inundated with rain due to a category 5 atmospheric river event, to days with little to no wind, the weather has been atypical for October and slowed the data collection tempo. In addition, the aircraft had to quickly return to base on Oct 26 due to an aircraft issue. Fortunately, the AFRC ground crew were able to quickly isolate and repair the problem in one day.
- The data collection has been high tempo since Oct 28 with flights on four straight days. The science team has been very happy with the velocity intercomparison data from the recent science days and have seen remarkable qualitative agreement among all platforms that measure velocity.

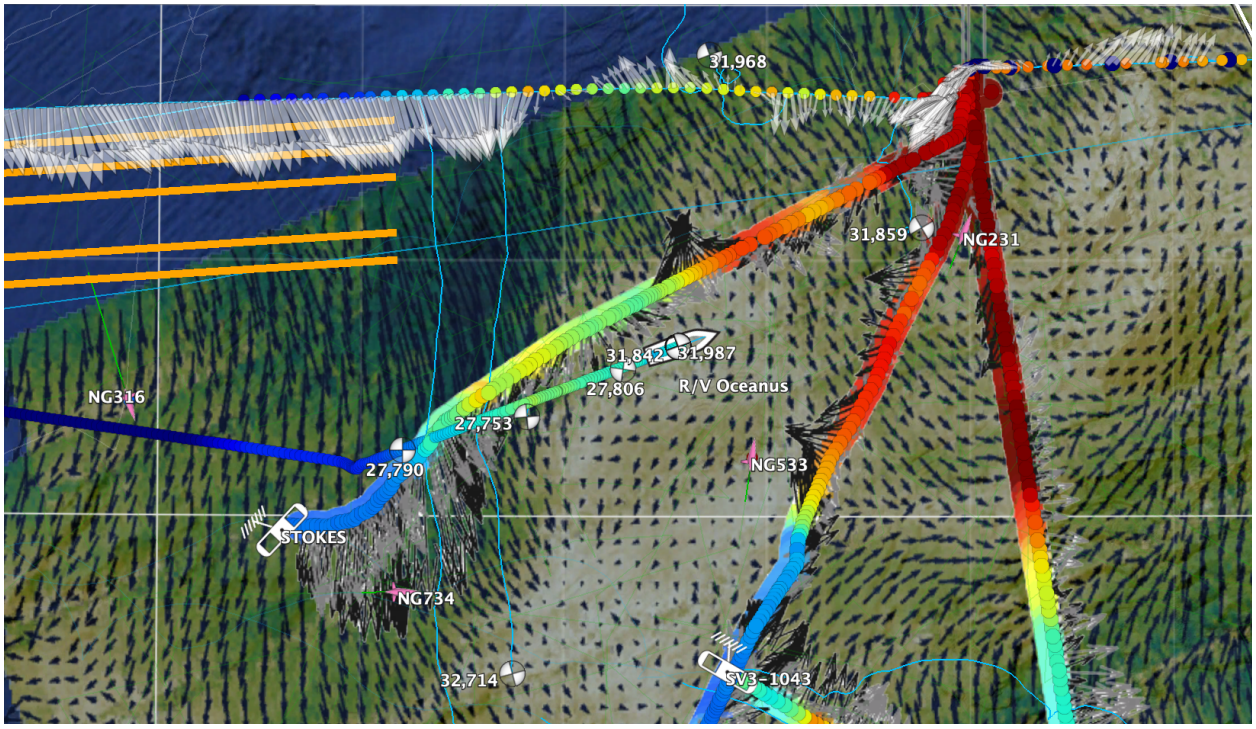


Figure 5: Quick-look DopplerScatt surface current map from Oct 28. Density data and ADCP vectors from Wave Gliders are overlaid on top.

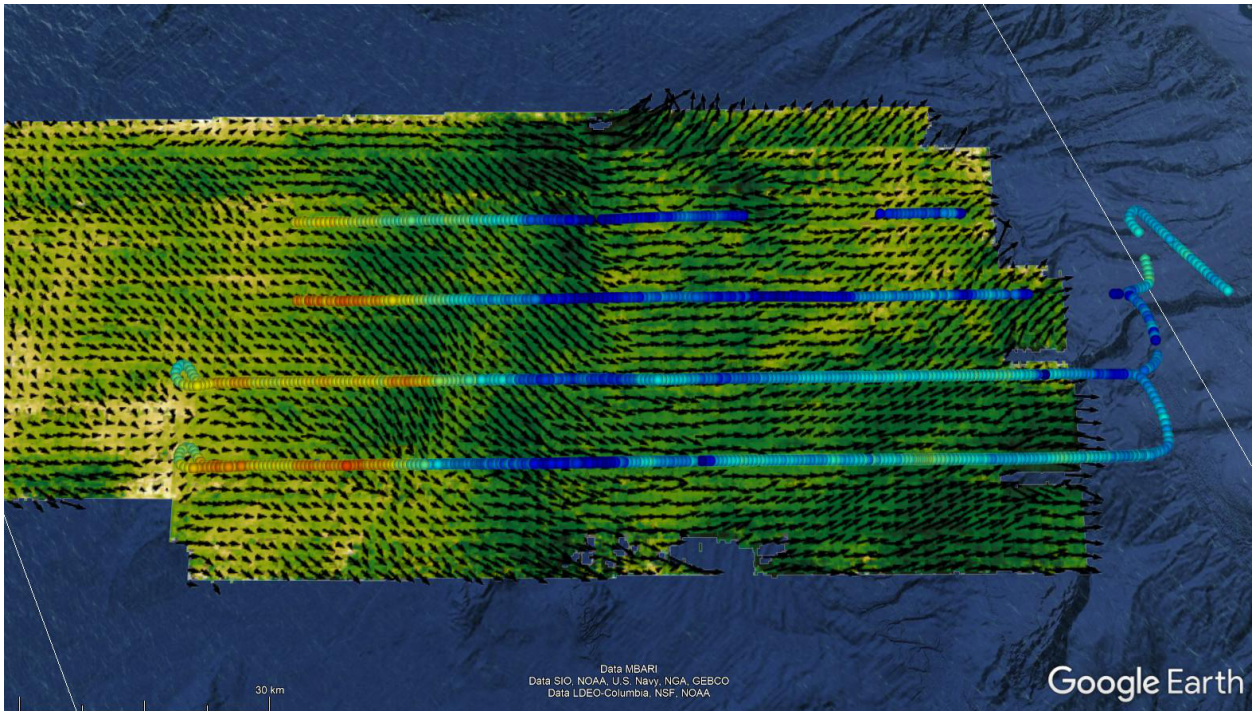


Figure 6: Quick-look surface velocity data from DopplerScatt (mosaic) and MASS (lines) from Oct 30 show good qualitative agreement.

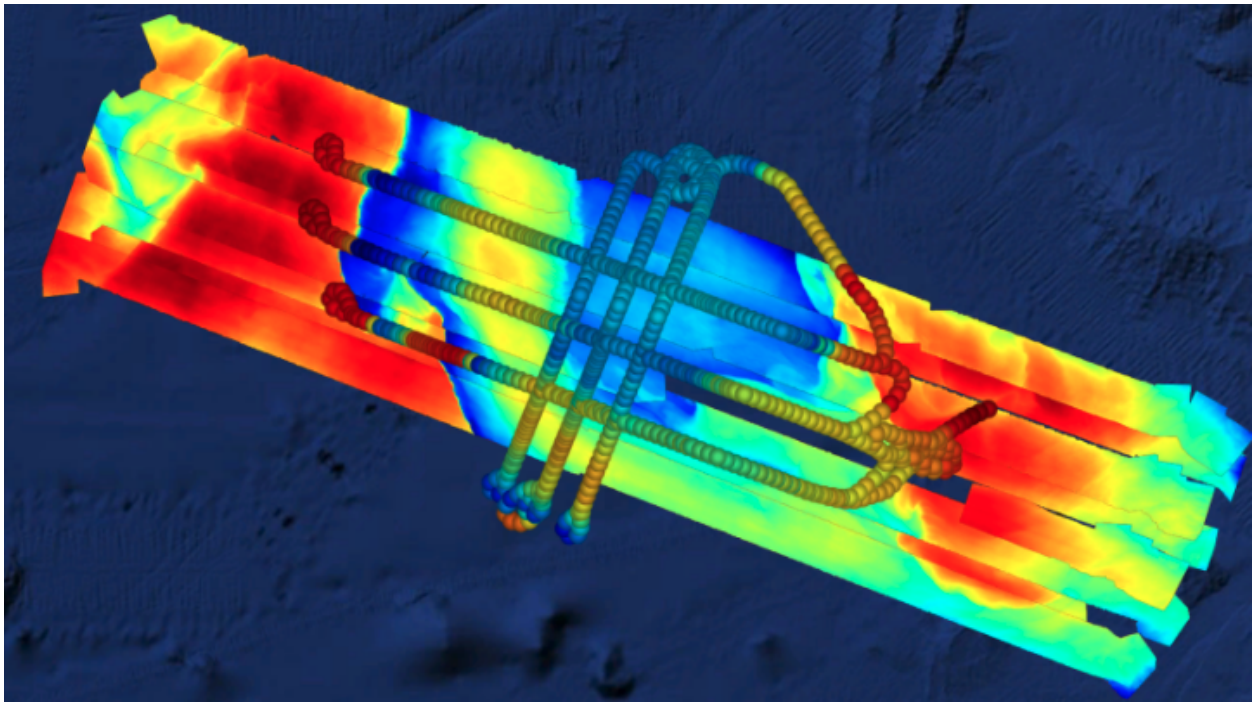


Figure 7: MOSES and MASS SST Mosaic from Oct 25. The prevalence of fog and clouds has hindered collection of MOSES SST data, but when the sky underneath the aircraft is clear, the team is producing excellent mosaic SST plots.

Twin Otter

- The Twin Otter with the Scripps MASS instrument has completed six science flights thus far. MASS is operating nominally and is producing good data. The extended endurance capability (additional fuel tank in the cabin) has proven to be especially effective, enabling longer flights (up to 7.25hr).
- While the weather conditions were at times challenging (low level clouds and fog), The MASS team was able to successfully collect observations (ocean topography and surface waves, SST, ocean color, and surface velocimetry) collocated and coincident with DopplerScatt and in-situ measurements from the autonomous vehicles and the research vessel, flying below the cloud base (800-1500ft AMSL). Emphasis was placed on coordinated shipborne biological measurements and remote sensing observations of ocean color (hyperspectral) from MASS on one of the flights.

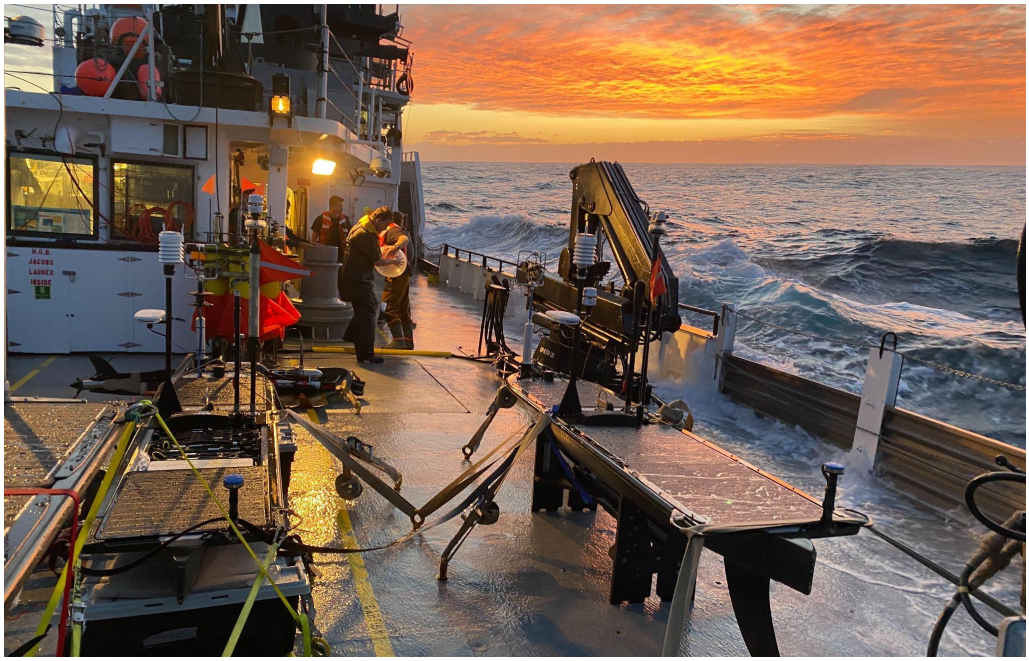
Saildrones

- Five Saildrones finished surveying a front in the northwestern portion of the operations area with a rendezvous with R/V Oceanus on Oct 29. The Saildrones then sailed east to join R/V Oceanus and the Wave Gliders near a front in the upper-center portion of the ops area.
- Taking advantage of excellent sailing conditions from late Oct 31 through Nov 1st, the Saildrones successfully occupied 16-km lines in tight submesoscale (1-1.5 km) formation close to R/V

Oceanus and the Wave Glider array, collecting a wealth of data for both velocity intercomparisons and estimation of submesoscale velocity gradients.

- All vehicles are operating nominally, with necessary small adjustments to payload frequency required for power conservation in response to a sequence of cloudy days.

Ready to depart for B200 flight on Oct 31. From left to right: Sam Habbal (AFRC), Karthik Srinivasan (JPL), Alex Wineteer (JPL), Tracy Phelps (AFRC), Delphine Hypolite (UCLA), David Carbajal (AFRC), Leroy Marsh (AFRC), Tom Lynn (ARC)



R/V Oceanus science party preparing a radiosonde deployment