Submesoscale Dynamics in the South China Sea
Cruise Report - RR1401
R/V Roger Revelle
24 January – 20 February 2014

1. Objectives

Investigate evolution of submesoscale eddies and filaments in the Kuroshio-influenced region off the SW coast of Taiwan. Questions include:

- What role does the Kuroshio play in generating mesoscale and submesoscale variability modeled/observed off the SW coast of Taiwan?
- How does this vary with atmospheric forcing? (This could be phrased as a contrast between opposing monsoons, but we will not be out there to sample the summer monsoon. We should witness significant variations in winter monsoon wind and heat flux, though, especial if we extend into the late winter/early spring.)
- How do these features evolve in response to wintertime (strong) atmospheric forcing?
- What role do these dynamics play in driving water mass evolution and interior stratification in the South China Sea?
- What role do these dynamics/features have on the transition of water masses from northern SCS water into the Kuroshio branch water/current and local flow patterns?

2. Cruise Plan

Characterization of Large-Scale Circulation

Prior to the cruise, the following efforts were undertaken to capture Kuroshio position and strength, water mass variations, basic spatial statistics.

- Regular drifter deployments upstream in the Kuroshio, designed to maintain a stream of drifters passing through the regiobn.
- Repeated occupation of one section (R3) with a Seaglider deployed in December 2013 by Prof Sen Jan (NTU) from OR5.
- Collection of Taiwanese HF radar surface velocity maps.
- Satellite remote sensing.

Moored Observations

Mooring were deployed over the northern shelf at the start of RR1401 and recovered at the end, augmenting the Taiwanese array deployed over the eastern shelf. These instruments focused on characterizing temporal statistics and observing Kuroshio branch currents and shelf/slope exchange.

- 2 moorings were deployed along line R0 (from pilot) in shelf/slope region Moored observations at northern end of domain, in shelf/slope region near the 2013 mooring sites.
- Link with NTU moorings offshore towards R3 and R4, possibly centrally located within the anticipated sampling region.

Wintertime Cruise

Characterize mesoscale and submesoscale variability and relationship to Kuroshio strength/position and atmospheric forcing. Attempt to capture both processes (e.g. MLE restratification, symmetric instability) and their 'footprints'. The former will be difficult due to the rapidly-evolving nature of the target processes. Look for signatures, the imprint of these processes, during monsoon breaks, the intermonsoon (late in our sampling period), after forcing has dialed back.

Small-Scale Drifting Surveys: Conduct mix of small-scale surveys (5-20 km span) following drifting wire walkers.

- Deploy wire walkers and gliders. Gliders survey within a small domain defined by the wire walkers.
- Use towed profilers to rapidly sample region in and around the wire walkers. Aim for rapid (4-hour?) repeats. Interrupt survey periodically to occupy a longer section that radiates away from the wire walker region. Provide mesoscale context for submesoscale observations, capture broad range to spatial and temporal scales.
- Gliders and ship/towed profiler follow wire walkers as they drift. When wire walker array disperses beyond what Revelle can span in its surveys, recover array and reset. resume survey work.
- Could try to target specific features, but the submesoscale evolves rapidly, and it might be just as effective to maintain sampling over extended periods, capturing a wide range of conditions.

Repeat Surveys: Conduct repeat survey patterns to build up statistics on submesoscale/mesoscale variability.

- Use towed profilers and VMP to repeatedly sample selected sections or patterns.
- Aim for rapid repeat cycle- thus small, simple patterns.
- Could do larger, more sweeping patterns, but target features evolve rapidly, and there will be aliasing by internal waves, tides, etc.
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Deploy drifters within the footprint of the CODAR array for TORI: Three drifters

supplied by TORI will be deployed early in the cruise.

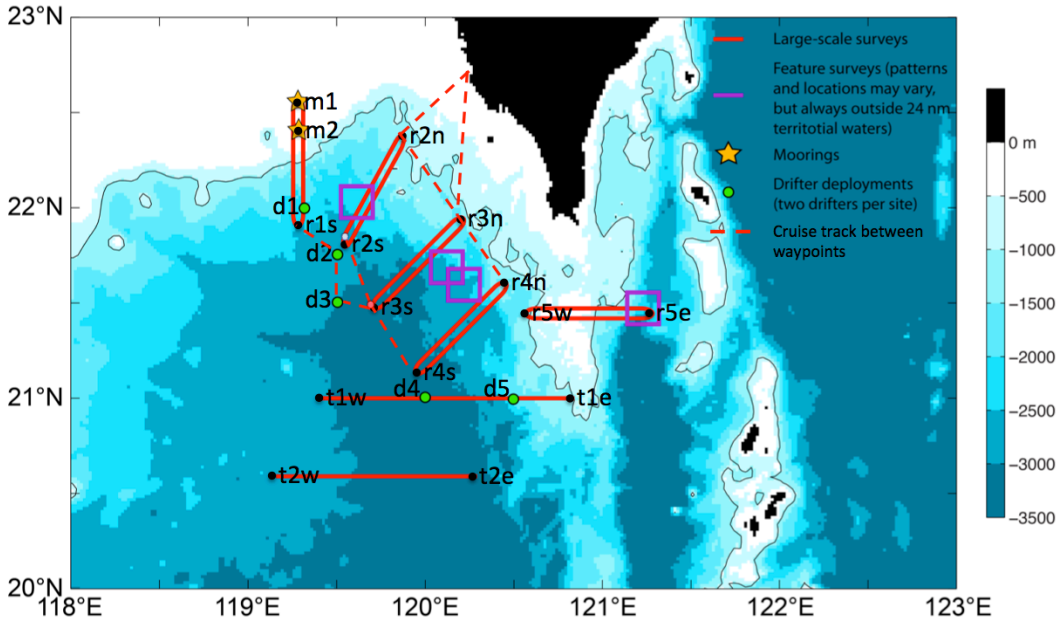

Figure 1. *Potential sampling activities. Red lines mark repeat survey tracks from the 2013 cruise, with labels indicating waypoints. Green dots mark possible drifter launch positions (leg 1) and yellow stars indicate mooring positions. Purple squares mark notional areas for intensive surveys.*

3. RR1401 – Cruise Narrative

24 January – 20 February 2014

Times in local unless otherwise specified (Taiwan local is UTC+8).

Refer to sampling chart (Fig. 2) for sampling locations for moorings, R/V Revelle/Triaxus, gliders and Wirewalker.

Leg 1: 24 January – 9 February

Leg 2: 9 – 20 February

24 Jan

Depart Kaohsiung 16:00 in good weather. Steam for WHOI A, the deeper of the two mooring sites.

Arrive WHOI A at 21:30 and begin bathymetric survey. Heavy fishing activity and shipping traffic complicate survey.

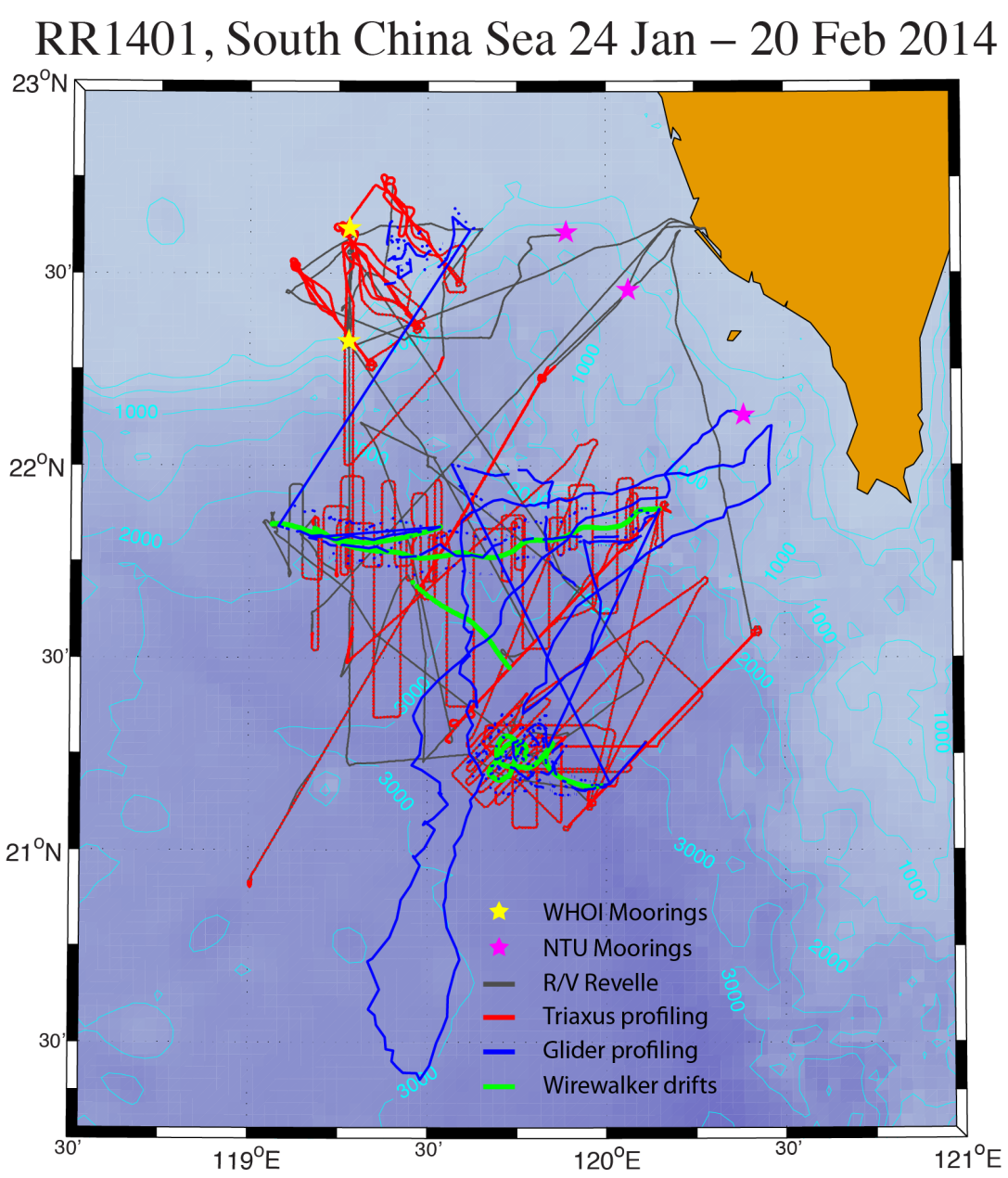

Figure 2. Sampling chart for RR1401. Yellow stars mark the locations of moorings WHOI A and WHOI B, while magenta star make IONTU moorings KH2, KH1 and JS1. Grey and red lines mark the track of the R/V Revelle, with red indicating periods when the ship was sampling with the Triaxus towed profiler. Blue lines mark the paths of gliders Bob, Doug, Helo and Saul. Green lines indicate Wirewalker drift paths.

25 Jan

Complete survey of site WHOI A and shift to survey WHOI B. The second site is fairly flat, and thus requires less intensive mapping.

Steam south to TORI drifter sites. Deploy 3 TORI drifters (A-C) between 12:11 and 13:36 (with a fire and boat drill in-between).

Decide to deploy 2 gliders onto R3, to sample in conjunction with Triaxus/VMP survey. Sea state prohibits small boat work, so plan for over-the-side deployments.

Deploy mooring WHOI B at 05:16, followed by WHOI A at 9:22.

Winds grow to roughly 25 knots over the morning, producing steep, choppy seas. Seas continue to lay down during the transit south.

Glider operations go smoothly, with gliders Doug and Saul deployed into the middle of R3, slightly off the main survey line to avoid conflicts with the towed surveys. Gliders deployed at 16:46 and 17:13, respectively. Issues with the Dockserver and ballasting keep us on site until 20:20, at which point both vehicles are declared operational and we depart for r3s.

Arrive on site at r3s and deploy Triaxus at 22:35. Deployment goes smoothly.

26 Jan

Continue R3 survey. Inshore end captures the edge of the Kuroshio branch current, Striking T-S interleaving, but no other strong meso- or submeso-scale structure. Offshore end has partially compensated front where the Kuroshio waters meet the ambient South China Sea. There's a strong salinity change that following a subsurface isopycnal (~23.7), nearly 0.5 psu. Extend the southward reach of the section to capture this transition. Will need to increase speed, sacrificing lateral resolution and/or depth range, to regain some of the synopticity we're loosing by extending the section.

Late evening, Glider Saul aborts it mission due to pump failure. Although the gliders are being carried NW by the Kuroshio Branch Current, drift is slow enough that we elect to monitor and move for recovery at the end of the Triaxus survey, around noon on the 27th.

Significant fishing activity along the line. Not surprisingly, this concentrates at the interface between the Kuroshio Branch Current and the ambient South China Sea waters. Mostly long line gear, but their density forces us to abort the northern end of the first occupation, and causes several diversions from the survey track.

27 Jan

Continue Triaxus surveys, recovering around noon. Depart to recover Saul and Bob.

Saul recovered at dinnertime, under conditions that are marginal for small boat operations. Instead, we hook the recovery bail and use the air tugger and squirt boom to bring it aboard.

Return to R3. Join the line near the northern edge of the front and steam south, looking for a place near the middle of the front to deploy a wire walker. Deploy wire walker at 00:00.

28 Jan

Stream back NE along the track, looking for the northern boundary of the front.

Deploy Wirewalker within the front that defines southern edge of Kuroshio Branch Current. Instrument deployed into strong currents and swept rapidly northwestward.

Turn around and move northeast, back along the R3 line. Find the northern boundary of the front (warm, salty water) and begin VMP survey going southwest, back across the front to the South China Sea waters.

End VMP survey at southern end of R3 and transit to recover Wirewalker. We've arranged for a 16:00 transfer of Seagliders offshore of Kaohsiung, and thus need to be place tomorrow for the rendezvous. Following Wirewalker recovery, we'll sprint to 20° 50' N, 119° 00' W, deploy Triaxus and occupy an extended version or R2, designed to capture the South China Sea endmember and provide a complete crossing of the Branch Current.

Deploy Triaxus at ~22:30 to execute a 100 nm long section that should span the Kuroshio Branch Current at R2.

Inverted temperature profile with a remnant mixed layer to the south of the Branch Current. Fresh and cold in the mixed layer, warmer and more saline in the pycnostad directly below. All optics and oxygen are working at the start of this section (relative to the initial occupation of R3, where beam-c returned poor data from the start, and oxygen failed mid-way through the tow). This sensor stream was cleaned and flushed during the deck period, so it seems likely that some fouling in the plumbing caused the earlier issues. In response to severe, depth-dependent spiking during the first deployment, the primary T-C pair (along with cabling) were also replaced during the deck period. The initial hours of the Kuroshio Branch Survey show no spiking in the primaries or secondaries.

29 Jan

Triaxus occupation of an extended R2. The Branch Current seems to be closer to the coast here, and the northern boundary is clearly inside the 24 nm exclusion region, such that we cannot sample across it. The section reveals similar interleaving structures on the southern flank. Complete extended R2 at ~11:00, recover Triaxus and steam for the rendezvous site outside of Kaohsiung harbor.

A fast launch carries the pupae of SG017 and SG123 out to Revelle. Relatively flat conditions make the cargo transfer straightforward, though language difficulties made it hard to communicate with the boat handlers about proper rigging. We transfer Brett to the launch to oversee rigging and hookup.

Following glider pickup, we steam for R4N. We plan to sample R4 with Triaxus to identify launch points for gliders and Wirewalker.

Deploy Triaxus and tow southwestward on R4. Encounter strong northward currents (>1 knot) that keep speed over ground to 4 knots, stretching the occupation of R4 into the morning.

30 Jan

Following Triaxus scouting survey along R4, deploy gliders Bob, Doug, Helo and Saul. Deploy Wirewalker and begin conducting Triaxus surveys along Wirewalker drift path.

31 Jan

Continue Triaxus surveys around the drifting wirewalker and gliders. Although these were deployed on strong northwestward flow, the drift has taken an unpredictable track, sometimes slow, sometimes fast. A range of directions, but net displacement is modest.

A PRC frigate, Dongguan, comes by to check us out in the afternoon. They ask questions and linger near the ship for a while, creating some tension because they move unpredictably at close quarters. They spend some time paralleling Revelle's course, and then move off.

The Wirewalker array appears to have drifted south from the main Branch Current, and now sits in South China Sea water, though still over an area inhabited with small interleaving features. Triaxus surveys in the immediate vicinity (10 km) of the drifting array fail to capture any signs of Kuroshio waters, suggesting that we've drifted some distance from the main current. SSH/SST imagery from 30 Jan suggests that the Branch Current has turned strongly westward, and perhaps sits north of the array. In ordered to orient measurements taken by the drifting array and Triaxus, we range east, and then northeast, until we encounter the Branch Current again. The array appears to have been spit out to the south, along with some of the interleaving structures it was deployed into. Tidal currents have grown to a full spring tide, and the Wirewalker drift traces out a diurnal loop.

After ranging out to find the Branch Current, we return to collecting sections around the drifting array. Four gliders are keeping a tight formation around the Wirewalker, with remarkably little distortion in the sampling pattern. Two additional gliders are taking up station at R2 and R4, and will occupy repeat sections at these sites.

1 Feb

Continue running sections oriented SW-NE around the drifting array. Early morning the Wirewalker position is broadcast via radio (as a warning to an approaching vessel). A military vessel (assumed military due to its 18-kt speed) immediately raced to the broadcast position, loitered and then departed. Perhaps the Dongguan, though the bridge was unable to identify it.

Conditions are deemed too rough for small boat operations, so we elect to continue the drift, surveying with Triaxus and VMP, until at least Sunday morning, when we will re-evaluate the value of this drift and decide whether to terminate.

The array still sits near a small subsurface salinity maximum, that we believe represents Branch Current waters that have been stirred into the ambient South China Sea background.

Mid-afternoon, we recover Triaxus in ordered to conduct a VMP section through the drifting array. After several profiles, the small VMP winch fails, possible due to bearing failure or brake lockup. The backup winch is missing its controller, so efforts focus on repairing the small primary winch. As VMP might be on deck for some time, we resume sampling with Triaxus, once again towing SW-NE around the array.

VMP winch overhauled by Revelle's electrician and Chief and brought back to working order.

2 Feb

Recover Triaxus after completing a grid survey around the drifting array. The intrusion shifted north overnight, perhaps simply due to tidal displacement. A slightly warmer, fresher surface layer appears at the southern end of the last two survey line. Unclear where this originated from, but it is distinct from the South China Sea waters previously observed.

Resume VMP survey, trying to site the section over an area of active interleaving.

Conditions are good for small boat operations, so recover two of the Slocums, leaving the other two for later in the day. After Slocum recovery, we begin a VMP section back across the line, aimed at sampling the interleaving features observed by Triaxus.

Recover the remaining two Slocums and Seaglider 017 (for compass repair) after dark.

Once all gear is aboard, steam full speed ahead for WHOI A, where we will begin an extended survey of the Branch Current.

3 Feb

Triaxus looses signal just before dinnertime, forcing recovery. Inspection reveals that the tow cable has developed roughly two complete twists, which ultimately led

to a kink forward of the weak link and a break in the fiber. Fortunately this happened at the end of the southward section radiating from the WHOI moorings, with significant interleaving structures present at the terminus of the line. We begin sampling with VMP, working northward along the line, while the Triaxus cable is reterminated.

4 Feb

Triaxus is deployed after midnight, and we begin towing the next, northeastward, leg of the survey pattern. Winds pick up to 30+ knots during the morning, with a corresponding increase in sea state. Conditions are better close to the coast, where the landmass provides shelter. Winds and wave height increase on the offshore ends of our survey lines. Continue occupying a sawtooth survey line designed to delineate the Kuroshio Branch Current.

5 Feb

Completed large scale survey. The Branch Current was present in the northern sections, but vanished in the last (southern) pair. Unclear whether the current is pressed tight against the Taiwan coast, inside the 24 nm limit, or if it's pinched off. Satellite SSH/SST from 2-5 Feb suggest a pinching off, though it's unclear how trustworthy the results are this close to the coast.

In ordered to situate the Wirewalker in the Branch Current, we elect to occupy a line extending northward, west of the final two lines in the large survey. This should put us back in the area we last observed Kuroshio waters at the surface.

The new line puts us into Branch Current waters at its northernmost reach, where the currents are flowing rapidly to the west. We decide to deploy at this location, this time leading with Wirewalker to minimize the time between targeting and deployment. Three Slocums and one Seaglider are deployed after this, with one Slocum held in reserve because it lacks proper bales for over-the-side deployment. The Seaglider launch goes poorly, with the slip line tangling in the antenna and, ultimately, pulling the stalk out of the shoe. The glider is recovered, antenna cables inspected and stalk epoxied into the shoe. However, the delay causes us to miss the launch window, and the last Seaglider deployment will thus be delayed until later in the cruise.

Deploy Triaxus and begin occupying sections around the Wirewalker. Orient sections such that they run across the main axis of the Branch Current (roughly perpendicular to the Wirewalker drift). Alternate between short (~10-20 km lines) centered on the Wirewalker and longer lines that are allowed to range southward far enough to capture the front between Branch Current and South China Sea waters. We attempt to bracket the drifting array with each pair of lines.

6 Feb

Continue Wirewalker-following survey.

7 Feb

Continue WW-following survey through the day in calm, hot weather. Gliders are keeping position well. We alternate between a series of lines fore and aft of the WW position, radiating 5-7 km to the north and south, and occasional long lines that run 40-60 nm south, focused on capturing the interface between the Branch Current and South China Sea waters.

Over the past few days, remotely sensed SSH and SST continue to indicate a westward shift in the Branch Current, perhaps pinching off Kuroshio waters that had been flowing north along the Taiwan coast. The WW remains north of the interface between Branch Current and South China Sea, embedded in the Branch Current waters. Drift remains consistently westward, with some sense that the front has been shifting southward over the course of the drift.

8 Feb

Continue the drift. Temperatures drop and winds pick up late afternoon. We decide to sweep assets prior to dinner, beginning with the three Slocums and ending with the Wirewalker. Slocums are all ship-based recoveries, as the Slocum team has decided that this approach carries less risk than small boat recoveries for these sea states.

9 Feb

Conduct VMP survey near the site where the Wirewalker drift ended, shifting in an attempt to better target the intrusion region. This effort ends at roughly 05:00, after which we sail for Kaohsiung. Strong winds and waves slow the transit to Kaohsiung, such that we arrive a half hour late, around 12:30. Revelle ties up and we quickly load stores and debark off-signing science. It takes longer to round up all the on-signing science, as some of the Taiwanese students encountered difficulties getting their paperwork cleared. Nevertheless, we are loaded and sailing within 4 hours of tying up, and are underway at 16:30.

Winds and seas are growing, and we encounter relatively rough conditions as we depart Kaohsiung. Deploy Triaxus at r2n and begin the series of repeat sections, aiming for a 36-h repeat occupation followed by VMP profiling along the line.

10 Feb

The first set of sections reveal interleaving features similar to those observed previously, with a striking layer of elevated attenuation (660 nm beam-c) and dissolved oxygen associated with the strongest salinity front. There is also a thin (20 m, growing to 40 m), buoyant, fresh surface layer that appears near the southern end of the survey line. The initial passes show elevated chlorophyll fluorescence associated with the fresh patch, but later occupations show capture lower chlorophyll concentrations. After discussion, we decide to terminate the repeat sections early (~30 h) so that we can devote some time some time toward a Wirewalker drift at the interface between the buoyant patch and the subsurface interleaving features.

11 Feb

Finish R3 early in the morning, immediately turning back north to run two targeting sections across the frontal region. We select a deployment site, recover Triaxus, and immediately deploy one Wirewalker, followed by 3 Slocum gliders. We then work to deploy a second Wirewalker- this one modified at sea to provide data telemetry via Iridium SBD messages. This deployment takes considerable time, but ultimately provides an additional profiling element for the drifting array. Once all autonomous assets have been deployed, we resume towing with Triaxus.

12 Feb

Continue drift survey through the night, with assets moving westward at speeds of roughly 1 kt. Intensity of the interleaving features appears to weaken with time and/or downstream distance. Assets eventually drift to within 5 nm of 119°E, the western boundary of our sampling domain. The tow Wirewalkers have not diverged much, and remain with 0.5 nm of each other. Recover assets, starting with the westernmost, before they exit the domain.

Transit to R4 for a 36-hour repeat occupation. Wind and seas are moderate, with the forecast predicting light winds and weak wave activity through the remainder of the cruise.

13 Feb

Repeat Triaxus surveys along R4.

14 Feb

Complete R4 surveys and recover Triaxus in late morning. Transit to 21° 15’ N, 119° 17’ E to begin a northward Triaxus line to WHOI B, but abort when we discover broken strands in the tow cable armor. As in previous incidents, the breaks occurred at the end of the pre-form grip, perhaps due to repeated flexing about this constriction. We decide to reterminate rather than risk deployment on the weakened cable, putting Triaxus on deck for 8 hours. We thus transit directly to mooring WHOI B. By the time we’ve interrogated the releases, surveyed and deployed the Wirewalker mooring, Triaxus should be ready to redeploy.

15 Feb

We target the WHOI-A repeat line, but arrive a bit after midnight to find the northern end occupied by a small fleet of fishing boats, that are clearly in the processes of deploying gear. This are also appears to be a transit lane for container ships, so there’s considerable traffic. Rather than fight the fishing fleet, we decide to begin with the WHOI-B line, off the southwest where traffic appears to be lighter.

The 24-hour occupation of WHOI-B sees considerable vessel traffic, forcing many deviations off the line. The most notable incident is an encounter with a fishing vessel that crosses within a ship length of our stern (between the ship and Triaxus), running over the tow cable. Fortunately the vehicle was at the apogee and we escaped without damage.

16 Feb
Compete WHOI-B survey and shift to WHOI-A late-night.

17 Feb
Conduct 24-hour occupation of the WHOI-A line. A modest fishing fleet is parked on the shallow end of the line, working the shelf. This forces frequent deviations from the track. Most of the fishing boats are uncommunicative, even when hailed in Mandarin by our students. We also have several close encounters, including a couple that involved vessels cutting within a boat length behind us, passing over the cable between Revelle and Triaxus.

18 Feb
Transfer to line WHOI-X, a third cross-shelf section to the northeast of the first two. We aim for another 24-hour repeat occupation. Weather is excellent, with little wind or sea. Instead, we have hordes of fishing boats, punctuated by the passage of various container ships. This forces frequent excursions off the line, as we dodge boats and gear.

19 Feb
Winds pick up earlier than forecast, with 30 kts blowing down the Strait by 04:00. Seas have steepened significantly, with worse to come. We thus elect to bring Triaxus aboard and begin the final recovery of gliders, moorings and Wirewalker.

Recoveries go without incident, despite 30+ kt winds and steep seas.

During the 16:00 deployment, we notice a broken strand in the Triaxus tow cable, approximately 18 m from the termination. After a short consultation we elect to abort the final deployment of the cruise, ending science operations. Retermination would have required 8 hours, running out the clock, and we deemed the risk of deploying on the weakened cable unnecessarily risky.

Steam south to find deep water for cable wash and lube.

20 Feb
Return to Kaohsiung.

5. Event Log

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20140124 2116 22 37.038N. 119 16.782E. WHOI A mooring deployed. DM
20140125 0030 22 19.381N. 119 16.679E. WHOI B mooring deployed. AG
20140125 0122 22 19.363N. 119 16.639E. WHOI B anchor deployed. AG
20140125 0411 22 00.983N. 119 30.020E. TORI A deployed MS
20140125 0521 21 59.989N. 119 30.002E. TORI B deployed MS
20140125 0536 21 59.908N. 119 30.006E. TORI C deployed MS
20140125 0846 21 41.133N. 119 55.129E. UAV BOB deployed EW
20140125 0913 21 41.000N. 119 55.405E. UAV SAUL deployed MS
20140125 1435 21 27.563N. 119 42.318E. Triaxus 1 deployed. AG
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20140127 0504 21 16.774N. 119 33.681E. Triaxus 1 on deck MS
20140127 0954 22 06.678N. 119 18.730E. UAV SAUL on deck EW
20140127 1601 21 28.444N. 119 43.794E. Wirewalker 1 deployed MS
20140127 1839 21 36.778N. 119 52.358E. Profiler 1 deployed MS
20140127 1933 21 35.703N. 119 51.174E. Profiler 2 deployed MS
20140127 2005 21 35.685N. 119 51.184E. Profiler 2 on deck EW
20140127 2040 21 33.550N. 119 49.052E. Profiler 3 deployed EW
20140127 2112 21 33.549N. 119 49.050E. Profiler 3 on deck EW
20140127 2148 21 31.387N. 119 46.864E. Profiler 4 deployed EW
20140127 2206 21 31.339N. 119 46.965E. Profiler 4 on deck EW
20140127 2340 21 29.092N. 119 44.478E. Profiler 5 deployed AG
20140128 0008 21 29.093N. 119 44.478E. Profiler 5 on deck AG
20140128 0042 21 27.085N. 119 42.319E. Profiler 6 deployed AG
20140128 0106 21 27.085N. 119 42.319E. Profiler 6 on deck AG
20140128 0138 21 24.744N. 119 40.188E. Profiler 7 deployed AG
20140128 0200 21 24.747N. 119 40.188E. Profiler 7 on deck AG
20140128 0228 21 22.658N. 119 37.999E. Profiler 8 deployed AG
20140128 0248 21 22.659N. 119 37.999E. Profiler 8 on deck AG
20140128 0322 21 20.536N. 119 35.999E. Profiler 9 deployed AG
20140128 0346 21 20.531N. 119 36.003E. Profiler 9 on deck MS
20140128 0422 21 18.296N. 119 33.727E. Profiler 10 deployed MS
20140128 0520 21 15.967N. 119 31.535E. Profiler 11 deployed MS
20140128 0544 21 15.969N. 119 31.535E. Profiler 11 on deck MS
20140128 0614 21 13.721N. 119 29.332E. Profiler 12 deployed MS
20140128 0633 21 13.721N. 119 29.335E. Profiler 12 on deck MS
20140128 0938 21 42.814N. 119 26.821E. Wirewalker 1 on deck EW
20140129 0354 20 54.857N. 119 00.152E. Triaxus 2 deployed AG
20140129 0438 22 15.356N. 119 50.312E. Triaxus 2 on deck MS
20140129 1325 21 33.641N. 120 24.599E. Triaxus 3 deployed AG
20140130 0151 21 14.779N. 120 05.103E. Requested profile position AG
20140130 0200 21 15.345N. 120 05.698E. Begin Triaxus 3 recovery AG
20140130 0234 21 16.899N. 120 06.520E. Triaxus 3 on deck AG
20140130 0416 21 10.308N. 120 00.619E. Glider 1 deployed MS
20140130 0421 21 10.323N. 120 00.636E. Glider 2 deployed MS
20140130 0424 21 10.325N. 120 00.651E. Glider 3 deployed MS
20140130 0455 21 10.328N. 120 00.648E. Glider 4 deployed MS
20140130 0713 21 10.051N. 119 59.395E. Wirewalker 2 deployed MS
20140130 0730 21 10.087N. 119 59.597E. Triaxus 4 deployed MS
20140201 0638 21 24.364N. 119 46.709E. Triaxus 4 on deck MS
20140201 0747 21 18.139N. 119 44.044E. Profiler 13 deployed MS
20140201 0836 21 18.473N. 119 44.372E. Profiler 13 on deck EW
20140201 0840 21 18.477N. 119 44.378E. Profiler 13 redeployed EW
20140201 0905 21 18.600N. 119 44.498E. Profiler 13 on deck AG
20140201 1111 21 18.977N. 119 44.532E. Triaxus 5 deployed EW
20140202 0012 21 17.656N. 119 53.165E. Triaxus 5 on deck AG
20140202 0152 21 14.863N. 119 41.995E. Glider "HELO" on deck AG
20140202 0230 21 16.838N. 119 40.784E. Glider "DOUG" on deck AG
20140202 1220 21 15.380N. 119 49.618E. Glider "SAUL" on deck AG
20140202 1248 21 15.494N. 119 50.110E. Glider "BOB" on deck AG
20140202 1501 21 27.508N. 120 05.712E. Glider "SG017" on deck AG
20140202 2157 22 33.071N. 119 17.793E. Triaxus deployed DM
20140203 0855 21 27.729N. 119 15.729E. Triaxus on deck EW
20140203 1000 21 30.021N. 119 17.385E. VMP deployed EW
20140203 1648 21 34.559N. 119 17.320E. VMP on deck MS
20140203 1739 21 29.274N. 119 16.586E. Triaxus deployed MS

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20140205 0900 21 52.664N. 120 10.870E. Tri Axus on deck EW
20140205 0952 21 53.204N. 120 09.096E. Wire walker deployed EW
20140205 1000 21 53.207N. 120 09.095E. Glider Bob deployed EW
20140205 1015 21 53.205N. 120 09.106E. Glider Saul deployed EW
20140205 1047 21 53.204N. 120 09.120E. Glider Helo deployed EW
20140205 1135 21 52.999N. 120 09.065E. Triaxus deployed EW
20140208 0536 21 42.932N. 119 14.843E. Triaxus on deck MS
20140208 0808 21 52.090N. 119 11.011E. Glider Helo on deck EW
20140208 0908 21 50.559N. 119 10.824E. Wirewalker on Deck MS
20140208 0939 21 51.251N. 119 10.654E. Triaxus deployed EW
20140208 1350 21 33.718N. 119 10.706E. Triaxus on deck AG
20140208 2040 21 37.118N. 119 10.626E. VMP recovered DM
20140209 1212 22 13.677N. 119 48.992E. Triaxus deployed AG
20140211 0128 21 47.883N. 119 32.481E. Triaxus on deck AG
20140211 0223 21 50.478N. 119 32.245E. Wirewalker A deployed AG
20140211 0238 21 50.479N. 119 32.244E. Glider "HELO" deployed AG
20140211 0256 21 50.476N. 119 32.247E. Glider "BOB" deployed AG
20140211 0313 21 50.475N. 119 32.245E. Glider "SAUL" deployed AG
20140211 0531 21 49.612N. 119 29.941E. Wirewalker B deployed MS
20140212 0815 21 52.540N. 119 03.781E. Helo on deck EW
20140212 0915 21 49.606N. 119 04.233E. Saul on deck EW
20140212 1508 21 07.579N. 119 57.370E. Triaxus deployed AG
20140214 0248 21 09.200N. 119 57.151E. Triaxus on deck AG
20140214 0322 21 09.303N. 119 57.180E. Glider SG017 deployed AG
20140214 1923 22 24.935N. 119 16.703E. Wirewalker deployment MS
20140214 2045 22 34.003N. 119 17.145E. Triaxus deployed DM
20140215 0553 22 16.915N. 119 32.621E. Triaxus on deck MS
20140215 0843 22 36.744N. 119 39.075E. Glider Bob deployed EW
20140215 0854 22 36.920N. 119 39.174E. Glider Helo deployed EW
20140215 1218 22 31.338N. 119 07.929E. Triaxus deployed AG
20140218 2036 22 43.977N. 119 23.595E. Triaxus on deck PS
20140218 2207 22 29.187N. 119 22.209E. Glider Helo on deck DM
20140218 2242 22 30.015N. 119 19.947E. Glider Bob on deck PS
20140218 2343 22 24.327N. 119 15.508E. Wirewalker on deck PS
20140219 0240 22 19.442N. 119 16.235E. WHOIB Mooring on deck AG
20140219 0747 22 27.121N. 119 06.124E. Triaxus deployment aborted EW
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6. Waypoints

waypoint	latitude			longitude			depth (m)
r1n	22	31.934	N	119	17.088	E	100
r1s	21	53.253	N	119	17.093	E	2500
r1n-2 (actual)	22	30.8	N	119	0.9	E	< 100 m
r1s-2 (actual)	21	49.8	N	119	42.0	E	3000 m (?)
r2n	22	13.500	N	119	49.153	E	1400
r2s	21	46.911	N	119	32.703	E	2700
r3n	21	53.184	N	120	9.078	E	1250
r3s	21	27.646	N	119	42.957	E	3050
r4n	21	33.433	N	120	24.642	E	1300
r4s	21	7.642	N	119	57.601	E	3330

r5e	21	25.803	N	121	16.782	E	2350
r5w	21	26.084	N	120	33.875	E	1250
WHOI-A	22	37.04	N	119	16.78	E	100
WHOI-B	22	19.36	N	119	16.64	E	300
NTU-KH2	22	36.37	N	119	53.28	E	576
NTU-KH1	22	27.39	N	120	03.84	E	566
NTU-JS1	22	07.93	N	120	23.10	E	469

7. Personnel

Science Party Leg 1 (24 January – 9 February 2014)

Craig Lee (Chief Scientist)	APL-UW
Jason Gobat	APL-UW
Ben Jokinen	APL-UW
Adam Huxtable	APL-UW
Louis StLaurent	WHOI
Glen Gawarkiewicz	WHOI
Scott Worrilow	WHOI
Sophia Merrifeld	WHOI
James Reilly	WHOI
Kipp Shearman	OSU
Emily Shroyer	OSU
Zen Kurokawa	OSU
Alejandra Sanchez	OSU
Andrew Lucas	SIO
Tsung-Han Yu	ROC Navy
Brett Hembrough	SIO-UCSD
Brent DeVries	SIO-UCSD

Science Party Leg 2 (9-20 February 2014)

Craig Lee (Chief Scientist)	APL-UW
Jason Gobat	APL-UW
Ben Jokinen	APL-UW
Adam Huxtable	APL-UW
Louis StLaurent	WHOI
Glen Gawarkiewicz	WHOI
Sophia Merrifeld	WHOI
Steven Lambert	WHOI

Kipp Shearman	OSU
Zen Kurokawa	OSU
Alejandra Sanchez	OSU
Andrew Lucas	SIO
Matthieu Leclair	MIT
Kai-Chieh Yang	NTU
Chung-Yaung Lee	NTU
Wei Wang	NTU
Wan-Ting Hsieh	NTU
Kuan-Hsiang Wang	NSYSU
Chih-Hsing Chang	NSYSU
Tzu-Hao Huang	NSYSU
Chia-En Chuang	NSYSU
Yu-Chi Lin	NSYSU
Yi-Bei Liang	NSYSU
Cheih-Yuan Tsai	NTOU
Sin-Huei Yu	NTOU
Bin Li	ROC Navy
Brett Hembrough	SIO-UCSD
Brent DeVries	SIO-UCSD

R/V Revelle Crew

David Murline	Master
Eric Wakeman	1st Mate
Matthew Serio	2nd Mate
Antonette Gomowad	3rd Mate
Gary Curry	Boatswain
Paul Shute	AB
Kevin Moran	AB
Charles Bellafiore	AB
Joseph Martino	OS
Marc Maluda	Sr. Cook
Jerry Gold	Cook
John Healy	Chief Engineer
Thomas Johnston	1st Assistant Engineer
Todd Andrew Carter	2nd Assistant Engineer
Justin Deane	3rd Assistant Engineer

Harry Smith	Electrician
Michael Paul Judson Gaylord	Oiler
Robert Juhasz	Oiler
Jesse Huettl	Oiler
Eduardo Angeles	Oiler
Joseph Brown	Wiper