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SST Control by Subsurface Mixing during Indian Ocean Monsoons: 1-yr Pilot Project

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Award Number: N00014-13-1-0357

LONG-TERM GOALS

Our long-term goals are:
→ to better understand the dynamics, including internal wave interactions, governing the fate of freshwater input into the Bay of Bengal, feedbacks between salt-stratification and heat flux, and the role these processes play in maintaining the barrier layer and affecting SST, and
→to provide the observational basis and physical interpretation for new mixing parameterizations that will contribute to improved monsoon predictions in this sensitive part of the global ocean.

OBJECTIVES

Our objectives are to:

1. quantify the variability in upper ocean mixing associated with changes in barrier layer thickness and strength across the BoB and under different forcing conditions,
2. quantify the subsurface heat flux divergence across the thermocline and through the barrier layer that contributes to changes in SST, and
3. contrast barrier layer character (e.g., maintenance, turbulent mixing, strength) associated with relatively weak but uniform freshwater pools (e.g., originating from distant storms and/or riverine sources) to that of strong, patchy pools created through local precipitation.

APPROACH

- Conduct exploratory research of the upper ocean across the Bob using shipboard Doppler sonar and CTD specially-equipped with a χpod for turbulence measurements. These measurements will be targeted to contrast stratification, internal wave, and mixing conditions along the north-south axis of the central BoB. The primary survey will occur as part of Leg 2 of the Pilot. A CTD χpod was also supplied to the Indian vessel, the Sagar Nidhi, for high-resolution survey work in the northern Bay of Bengal.
- Deploy 10 χpods distributed over 6 NRL moorings offshore of the Sri Lankan Exclusive Economic Zone. These will target vertical mixing within 1) the Sri Lankan cold dome (a seasonal feature marked by the upwelling of isotherms), 2) offshore extensions of filaments and instabilities from the Sri Lankan coastal current, and 3) the internal wave field as it approached the shelf/slope.

- Deploy 3 χpods on existing RAMA moorings located along 90E at approximately 8N, 12N, 15N. Both χpod deployments will be for one year capturing variability associated with the monsoon and allowing of for the first long-term evaluation of the turbulent mixing environment throughout the Bay of Bengal.

WORK COMPLETED

All χpods have been manufactured and shipped to their destinations. Those χpods slotted for deployment on RAMA moorings will be deployed in October/November 2013. χpods destined for the NRL mooring array will be deployed in December 2013 after completion of the shipboard survey. The locations of moorings to be equipped with χpods are shown in Figure 1. Red squares indicate RAMA moorings; and white squares show NRL mooring positions.

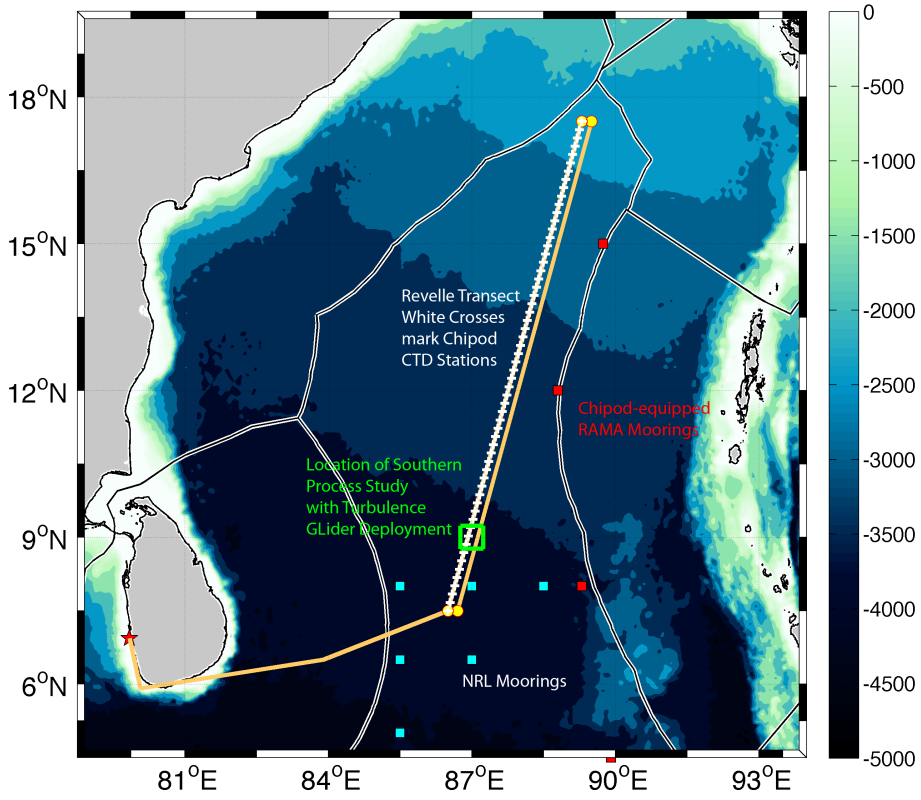

Figure 1: Map of study region. NRL mooring locations (white squares), RAMA mooring locations (red squares), survey transect path, and process study location (green box) are indicated. Tentative χpod CTD stations are shown with white crosses.

Preparations for the pilot (Leg 2 survey and process leg) are underway. The cruise will consist of two parts: 1) a large-scale (roughly) N/S hydrographic survey of the BoB (Figure 1: transect line) and 2) a short process study in the southern BoB (Figure 1: green box). The large-scale survey is motivated by our need to understand the heat and freshwater distribution in the Bay of Bengal at small-spatial scales, given large-scale gradients associated with forcing (e.g., large source of freshwater input, heat fluxes,

and wind forcing) and small-scale mixing processes (both lateral and vertical). The survey will be conducted using Revelle underway systems, underway CTD (uCTD), and χpod-equipped CTD. Sampling goals for the second leg are constrained by the large distances that will be covered. We will aim to 1) deploy turbulence gliders in the southern BoB in a small-scale sampling configuration, 2) cover a 1300 nm transect line (~ 6 days) with underway systems, 3) include 60-80 CTD/optical profiling stations (~45-60 minutes per station), and 4) conduct a 2.5 day process study near the southern Slocum glider site.

IMPACT/APPLICATIONS

The Bay of Bengal experiences a strong seasonal input of freshwater from riverine sources and rainfall. Resultant salt-stratification can form a barrier layer, dynamically isolating the thermocline from the surface, trapping heat and momentum fluxes near the surface. This stabilizes the near-surface layers and requires an greater energy input to effectively mix cool fluid up from the thermocline. Together the offshore flux of riverine water and the local input from precipitation contribute to barrier layer formation and consequent modification of SST. This work addresses the role of SST modification by mixing and nonlinear processes related to freshwater dispersal, applicability of results is expected to exist for most low latitude regions with strong salt stratification.

RELATED PROJECTS

None.