

Surface & Internal Wave Processes in the Coastal Zone of an Atoll Island

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LONG-TERM GOALS

A long-term goal of the Flow Encountering Abrupt Topography (FLEAT) experiment is to quantify the pathways of energy and momentum exchange from large-scale current systems, such as the North Equatorial Current (NEC), to smaller scales as flows encounter island and submarine topography characteristic of the western Pacific Ocean. We seek a better understanding of these processes to improve numerical simulations of mesoscale and finescale variability in the vicinity of steep and abruptly changing topographic features.

OBJECTIVES

The farfield ($>$ than a baroclinic deformation radius) and nearfield ocean states in the vicinity of island and submarine topography will be measured using shipboard, mooring arrays, remote sensing, and autonomous and Lagrangian platforms over the course of a multi-year experiment. A likely focus site is the island of Palau, which poses a significant barrier to zonal currents in the region. The observations will be used for model assimilation and model comparison studies to resolve processes that are expected to characterize flow-topography interactions, such as form drag, lee waves, eddy generation, and turbulent island wakes. A key objective is to translate the outcomes of FLEAT in to assimilation strategies and sub-grid scale parameterization algorithms that improve the skill of regional ocean models near island/ridge topography. To isolate low frequency current/topography processes, it is anticipated that a detailed understanding of tidal current interactions with topography will be required, as well as nearfield flows driven by surface gravity waves and local wind forcing.

APPROACH

We will collaborate with a team of FLEAT scientists (Wijesekera, Peacock, Musgrave, Alford, MacKinnon, Voet, Nash/Moum) to deploy mooring arrays over a nearly two-year span from October 2015 to summer 2017. Our group will be contributing McLane profiling moorings, thermistor and MicroCat chains, and low and high frequency ADCPs. The mooring array configurations will be decided after preliminary analyses of high-resolution model runs. In particular, our group will be working closely with Brian Powell to analyze the extensive set of high-resolution model data that his group is generating for FLEAT. The mooring arrays will focus on conditions upstream of topography, with extensive sampling over the topographic feature of interest, and a distributed sampling of the broad and energetic island wake regime. The mooring data will provide insights in to a range of

phenomena including form drag, internal lee wave generation, propagation and dissipation, internal tides, boundary layer turbulence, eddy shedding, and island wakes.

We will participate in a research cruise in October-November 2015 under chief scientist Shaun Johnston. We will be deploying a mooring on a shallow (300m) ridge on the south or north side of the island of Palau, depending on the state of large-scale flows encountered during the cruise. Based on previous field data from this site, we anticipate energetic mean and oscillatory tidal flows over the island flanks, with subsequent generation of internal tides and lee waves. The full-depth mooring will be used to define the strength of the flow over the ridge, as well as changes in finescale variability that may indicate the presence of internal wave generation and/or enhanced mixing. During the mooring deployment, the Revelle will do repeat surveys in deep water adjacent to the ridge to map flow features generated by the mean and time-varying flows. One goal is to link lee wave signatures in the shipboard data to the low frequency flow variability sampled by the mooring over topography. The mooring will be recovered at the end of the cruise.

A second year PhD graduate student from the University of Hawaii, Mika Siegelman, will take part in the October cruise and will be responsible for analyzing our mooring datasets. We will compare the mooring results with the shipboard surveys, with glider observations made in the vicinity of Palau, and with model simulations provided by Brian Powell, Bruce Cornuelle, and other FLEAT modeling teams. The mooring results will be presented at the FLEAT meeting in January 2016, and recommendations for future FLEAT field experiments will be presented. In the meanwhile, the UH profiling moorings are being assembled for the 2016 field experiments.

WORK COMPLETED

The start of our project was delayed to take advantage of the FLEAT DRI, hence we have not yet collected data for analysis and we are still in the early stages of the program. Our tasks to date have primarily involved mooring and sensor preparation. We've been testing and calibrating sensors, and refurbishing a pair of McLane Moored Profilers. The initial Palau mooring has been constructed and shipped, with sensor contributions from Jen MacKinnon and Jonathan Nash. We expect to have a substantial amount of data analysis from the October cruise mooring deployment ready for the January 2016 FLEAT meeting.

RESULTS

We have no technical results to report at this time.

IMPACT/APPLICATIONS

Ocean state prediction around islands is a considerable challenge as deep-water flows interact with island topography over a range of time and space scales. There have been few comprehensive datasets available to assess island processes and to evaluate and improve predictive models for island regions. The FLEAT project should have a significant impact on the skill of physical models, which in turn will have broad applications for coupled biogeochemical modeling efforts.

RELATED PROJECTS

We have multi-year coastal current observations from the east side of the island of Guam as part of an Army Corps of Engineers (via subcontract from UCSD) monitoring program to monitor extreme water level events. The sensor array includes current meter measurements from 9-10m depth that we intend to analyze for wind-forced signals, including potentially remote wind forcing via the island rule effect.