

# Observations and Theory of Ocean Fronts: Arabian Gulf Drifters

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Award Number: N00014-01-0020  
<http://rsmas.miami.edu/groups/mooring>

## LONG-TERM GOALS

The ultimate goal of his research is to understand the dynamics of the mesoscale eddy field in the coastal oceans and marginal seas as an extension of the earlier work of the investigators on the open ocean eddies and fronts. The physical focus is on the interaction of different regimes. For example, the interactions from the land-side in terms of riverine input and shallow embayment dynamics versus offshore forcing in the creation of the coastal circulation features. Of particular interest is the impact of atmospheric forcing along coastal margins. Similar to the previous work, the objective is to provide an understanding of the role the physics has in producing the biological responses that produce the optical and acoustic properties of the coastal domain. The studies will explicitly consider the role of topography, sediments and benthic communities in coastal dynamics.

## OBJECTIVES

The goal of the present research is to provide a seasonal charting of the circulation of the Arabian (Persian) Gulf that also resolves the tides and diurnal land-sea breeze forcing of the surface layer. The idea is to deploy a Gulf wide WOCE-style drifter array and monitor the wind stress over the region using QUICKSAT microwave winds. A specific part of the effort involves assuring that the information is available in near real-time to all interested parties and that the effort be used to promote cooperation in research in the region.

## APPROACH

The primary observations are to be accomplished with remote Lagrangian surface current and SST from a drifter array coupled with satellite remote sensing. The drifters, an original 30 plus 30 extra from year end equipment funds, are equipped with a 10 meter holey-sock drogue deployed at a 10 m depth to accommodate the shallow waters of the Gulf. The units have Global Positioning System (GPS) navigation recorded at one-hour intervals to resolve tides and inertial motions. All of the ARGOS retrieval numbers are registered through the World Meteorological Organization (WMO) making the data stream available in near realtime through the GTS system. With the demise of the NOAA ship of opportunity system in the region deployment is being organized through regional efforts and NAVO.

To complete the data set QUICKSAT scatterometer winds and AVHRR SST data are being collected. This involves collaboration with T. Liu (NASA/JPL) and the Miami remote sensing group who are also using the data to ground truth MODIS data. To consider high frequency wind shifts tied to daily

# Report Documentation Page

Form Approved  
OMB No. 0704-0188

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|   |                                    |                                     |                            |   |                                 |
|---|------------------------------------|-------------------------------------|----------------------------|---|---------------------------------|
| 1. REPORT DATE<br><b>30 SEP 2001</b>  |                                    | 2. REPORT TYPE                      |                            | 3. DATES COVERED<br><b>00-00-2001 to 00-00-2001</b> |                                 |
| 4. TITLE AND SUBTITLE<br><b>Observations and Theory of Ocean Fronts: Arabian Gulf Drifters</b>  |                                    |                                     |                            | 5a. CONTRACT NUMBER                                 |                                 |
|   |                                    |                                     |                            | 5b. GRANT NUMBER                                    |                                 |
|   |                                    |                                     |                            | 5c. PROGRAM ELEMENT NUMBER                          |                                 |
| 6. AUTHOR(S)  |                                    |                                     |                            | 5d. PROJECT NUMBER                                  |                                 |
|   |                                    |                                     |                            | 5e. TASK NUMBER                                     |                                 |
|   |                                    |                                     |                            | 5f. WORK UNIT NUMBER                                |                                 |
| 7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)<br><b>RSMAS/MPO University of Miami,,4600 Rickenbacker Cswy.,,Miami,,FL, 33149</b>   |                                    |                                     |                            | 8. PERFORMING ORGANIZATION REPORT NUMBER            |                                 |
| 9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)   |                                    |                                     |                            | 10. SPONSOR/MONITOR'S ACRONYM(S)                    |                                 |
|   |                                    |                                     |                            | 11. SPONSOR/MONITOR'S REPORT NUMBER(S)              |                                 |
| 12. DISTRIBUTION/AVAILABILITY STATEMENT<br><b>Approved for public release; distribution unlimited</b>   |                                    |                                     |                            |   |                                 |
| 13. SUPPLEMENTARY NOTES   |                                    |                                     |                            |   |                                 |
| 14. ABSTRACT<br><b>The ultimate goal of his research is to understand the dynamics of the mesoscale eddy field in the coastal oceans and marginal seas as an extension of the earlier work of the investigators on the open ocean eddies and fronts. The physical focus is on the interaction of different regimes. For example, the interactions from the land-side in terms of riverine input and shallow embayment dynamics versus offshore forcing in the creation of the coastal circulation features. Of particular interest is the impact of atmospheric forcing along coastal margins. Similar to the previous work, the objective is to provide an understanding of the role the physics has in producing the biological responses that produce the optical and acoustic properties of the coastal domain. The studies will explicitly consider the role of topography, sediments and benthic communities in coastal dynamics.</b> |                                    |                                     |                            |   |                                 |
| 15. SUBJECT TERMS   |                                    |                                     |                            |   |                                 |
| 16. SECURITY CLASSIFICATION OF:   |                                    |                                     | 17. LIMITATION OF ABSTRACT | 18. NUMBER OF PAGES                                 | 19a. NAME OF RESPONSIBLE PERSON |
| a. REPORT<br><b>unclassified</b>  | b. ABSTRACT<br><b>unclassified</b> | c. THIS PAGE<br><b>unclassified</b> |                            |   |                                 |

radiative forcing, the effort is concentrating on morning and evening QUICKSAT passes in the swath (non-gridded) product. The resulting data sets are being verified and incorporated into both atmospheric and ocean models in collaboration with S. Chen (UM) and C. -A. Blaine (NRL).

## **WORK COMPLETED**

- Procurement and deployment to the Gulf of the first thirty drifters. The second set will be ready in November.
- Identification of sea-land breeze domains around the Indian Ocean using NSCAT and QUICKSAT scatterometer winds (Olson et al., 2001).
- Participation in regional fisheries meeting in Oman. This provides access to an array of regional scientists in Oman, United Arab Emirates, Kuwait and Iran.

## **RESULTS**

The first half of the drifters is now in Baharain and Abu Daubi and is ready for deployment. The first array should go in as soon as the state of international affairs in fall 2001 sort out. The initial deployments will seed the mid and southern Gulf. Additional units will be emplaced in the northern Gulf in cooperation with Kuwait and in the Gulf of Oman. The data will be made freely available in near realtime. Assistance in using the data will be provided for investigators in the Gulf region.

The observed diurnal wind changes seen across the Gulf in the scatterometer winds have been verified against regional land stations (see S. Chen's report) and successfully modeled by Chen in a regional MM5 atmospheric model. Preliminary scatterometer data has been used in C. -A. Blaine's model of the Gulf circulation and new simulations are being produced using the MM5 results. The drifter array will produce a data set to consider the performance of the models and to develop a complete description of the dynamics of the Gulf. In particular, the temporal resolution of the drifter data should allow fundamental improvements to Gulf circulation models by correctly separating the influence of tides and the diurnal wind cycle. The latter problem has been a problem in understanding the earlier mooring work in the southern Gulf (Johns and Olson, 1998).

## **IMPACT/APPLICATIONS**

The effort is still in mid-term, but it should have a number of very important implications. Foremost is the combination of data sets, there near realtime availability, and there promise for charting the circulation of the Gulf and improvement of models. A very important issue behind the effort, given current events, is the degree to which it allows a very low risk means of maintaining a significant engagement with scientists in the region. Finally, the realtime flow of data allows the drifter array to contribute to Navy needs.

## **TRANSITIONS**

The effort is still at the pilot stage and it is premature to discuss transitions. The direct linkages to NAVO and NRL in the effort suggest, however, that the program will lead to important results that will transition into operational Navy programs.

## **RELATED PROJECTS**

The effort is closely tied with the ONR and NASA programs mentioned above. It has linkages with Kuwait fisheries research involving the circulation in the northern Gulf, the UAE wildlife agency's work on dispersion of larval fish, and fisheries research in Oman. The entire project has been discussed with the regional ocean science consortium (ROPME) and has involved contacts with scientists in Iran who have offered support in redeploing grounded drifters.

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