REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
<p>The public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing the burden, to Department of Defense, Washington Headquarters Services, Directorate for Information Operations and Reports (0704-0188), 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to any penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number. PLEASE DO NOT RETURN YOUR FORM TO THE ABOVE ADDRESS.</p>					
1. REPORT DATE (DD-MM-YYYY) 5/2/11		2. REPORT TYPE FINAL		3. DATES COVERED (From - To) 04/01/2008 - 12/31/2010	
4. TITLE AND SUBTITLE Measurements of 3-D Circulation and Dispersion in Skagit Bay from Lagrangian Drifters				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER N00014-08-1-0637	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S) Dr. Luca Centurioni Dr. Peter Niller				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) University of California, San Diego Scripps Institution of Oceanography Climate, Atmospheric Science and Physical Oceanography 9500 Gilman Drive La Jolla, CA 92093-0213				8. PERFORMING ORGANIZATION REPORT NUMBER Final - Fund 27230A	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Office of Naval Resear 875 North Randolph Street Arlington, VA 22203-1995				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT public					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT Several River Drifters (RD) deployments were made during this past year. Whilst the target was to sample the Tijuana river plume during major rain events, the rarity of the latter hindered our efforts. The deployments of 01/13/2009 and 01/14/2009 were coordinated with the other participants in the project. To gain further operational experience an array of two river drifters was deployed during a storm surge at a river estuary at Lido di Dante (Italy) in April 25-27, 2009.					
15. SUBJECT TERMS 3-D Circulation, Lagrangian Drifters, Skagit Bay, River Drifters, Hydronamics					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT none	b. ABSTRACT none	c. THIS PAGE none			Dr. Luca Centurioni
			none	6, incl. cover	19b. TELEPHONE NUMBER (include area code) 858-534-6182

FINAL TECHNICAL REPORT FOR:

**“Measurements of 3-D Circulation and Dispersion in Skagit Bay
from Lagrangian Drifters”**

ONR Award #:ONR- N00014-08-1-0637

Luca Centurioni

Scripps Institution of Oceanography

9500 Gilman Drive, MC 0213, La Jolla, CA 92093-0213

Phone: (858) 534-6182; email: lcenturioni@ucsd.edu

Pearn P. Niiler

Scripps Institution of Oceanography

9500 Gilman Drive, MC 0213, La Jolla, CA 92093-0213

Phone: (858) 534-0378 ; email: pniiler@ucsd.edu

Contents

Long Term Goals.....	1
Objectives	2
Approach.....	2
Work Accomplished.....	2
Results	3
Impact/Applications.....	4
Transitions	5
Related Projects.....	5
Publications from This Grant	5

Long Term Goals

The long term goal of this proposal is to study the hydrodynamics of the near-shore environment using novel instrumentations and techniques. Special focus is on the spatial structures of the flow that dominate erosion, transport and dispersion processes. We also aim to provide a methodology to test the validity of numerical simulations of coastal flows, the predictions of which are highly sensitive to the large scale initial conditions and model output verification is

20110804191

required.

Objectives

The first objective of the program was to develop an efficient sampling scheme to measure the flow in the shallow estuarine and coastal environments and to provide the partners of the project with three-dimensional circulation data and horizontal dispersion estimates of the particles in the surface flow. Our self-training period resulted in the acquisition of the operational experience to manage an array of RD as well as identifying the optimal set of mission parameters of the RD in different environmental conditions.

The second objective was to measure the flow within the plume of the Tijuana River as well as the circulation in adjacent coastal sea.

The third objective was to redesign and re-build the firmware of the RD to add new capabilities to the instrument, such as two-way communication, deployment and recovery modes, power saving mode and high frequency GPS.

Approach

To achieve our first objective we targeted RD deployments during significant rain events at the mouth of the Tijuana River, off La Jolla, and in northern Italy. To achieve our second objective we coordinated our deployment efforts with other project participants, both from the numerical modeling community and from the observational community.

To achieve the third objective we replaced the RD controller originally designed by Clearwater Inc., and we reprogrammed a Persistor microcomputer to manage all the RD functions.

Work Accomplished

Several River Drifters (RD) deployments were made during this past year. Whilst the target was to sample the Tijuana river plume during major rain events, the rarity of the latter hindered our efforts.

The table below contains a list of deployments in the San Diego area.

Date	Location	# of RD deployed	duration
12/16/2008	Tijuana river	1	2 hours
01/13/2009	La Jolla	4	2.5 hours
01/14/2009	La Jolla	4	3.5 hours

02/18/2009	Tijuana river	4	2.4 hours
12/08/2009	Tijuana river	2	3.5 hours
12/12/2009	Tijuana river	2	1.6 hours
1/25/2010	Tijuana river	2	2.9 hours
1/27/2010	Tijuana river	3	1.2 hours

The deployments of 01/13/2009 and 01/14/2009 were coordinated with the other participants in the project.

To gain further operational experience an array of two river drifters was deployed during a storm surge at a river estuary at Lido di Dante (Italy) in April 25-27, 2009.

Results

The main results are:

- 1) RD's operated near the surf zone. We observed that most, if not all, of the rain events were associated with storm conditions (high waves and winds). Small boats were not suitable for operations in such situations and several cancellations occurred. We did operate two jet sky's for our Tijuana River plume observations;
- 2) Several ADCP and bottom pinger sampling schemes were adopted. We concluded that for most applications a 1s sampling (as logged internally by the ADCP module) was appropriate in light of a more flexible post-processing approach. The RD firmware was then modified to allow 1s sampling of all the sensors. The two-way communication capability does allow us to turn on and off the ADCP.
- 3) The RD mechanical design was improved: the sails were fitted with zippers, rechargeable batteries implemented, need for extra buoyancy in extremely shallow water assessed, external, add-on, salinity sensors implemented;
- 4) The RD computer was rebuilt.
- 5) Results of runs made available to numerical modeling community for consistency checks of their numerical simulations (Figure 1)

Figure 1: Example of data collected with one RD on January 14, 2009, off La Jolla, California. This run was performed during the acquisition of the boundary conditions for the Deltares model from a variety of sensors.

- 6) The plume trajectories (see example in figure 2) and the measured vertical shear are being used to investigate the controlling hydrodynamics of the plume, and a manuscript for a refereed journal is in preparation.

Impact/Applications

The drifter data were placed on a SIO website for the use of the Tijuana Plume research group (<http://tjplumexp.ucsd.edu/>). This research program did investigate ways to operate efficiently multiple arrays of RD and CODE drifters. For the NAVY such methodology is crucial for application of these instruments for both tactical operations and for testing and initialization of hydrodynamic predictive models of littoral conditions.

Figure 2: tracks of a River Drifter advected by the Tijuana River plume during the high discharge event of February 18, 2009.

Transitions

None to date

Related Projects

The Global Drifter Program

Publications from This Grant

'Modeling the controlling hydrodynamics of a coastal plume. part 2: transport and mixing', in preparation for Journal of geophysical Research.