Three-Dimensional Flow in Tidal Channels

Stephen M. Henderson
School of Earth and Environmental Sciences
Washington State University (Vancouver)
14204 NE Salmon Creek Ave
Vancouver, WA 98686
phone: (360) 546-9268 fax: (360) 546-9064 email: steve_henderson@wsu.edu

Award Number: N000140810442
http://tidalflats.org/

LONG-TERM GOALS

The long-term goal is improved understanding and prediction of coastal water flows and sediment transport.

OBJECTIVES

The objective of this project is to improve understanding of shallow estuarine flows and sediment transport by collecting and analyzing measurements of three-dimensional flow structure in tidal channels and adjacent tidal flats.

APPROACH

Water flows over the tidal flats and channels of Skagit Bay will be measured, first during a pilot experiment in 2008, and then during a larger second experiment in 2009. Observed water flows will be compared with bathymetric evolution, to improve our understanding of the migration of tidal channels. Observed surface water flows and temperatures will be used to test the airborne and terrestrial remote sensing techniques of other investigators (Arete Associates, University of Washington). A feature of the research will be the deployment of a large array of high-resolution Acoustic Doppler Current Meters (ADCPs), which resolve the strong vertical structure of estuarine tidal flows. To obtain these observations, beginning Assistant Professor Stephen Henderson will develop a new laboratory capable of conducting field experiments in the nearshore ocean. This new capability (including a unique array of ADCPs, supporting instruments, equipment, boats, postdoctoral researcher Julia Mullarney, graduate student Kassondera Dallavis, and undergraduate researcher Nate Raynor,) will be established using a combination of Stephen Henderson's startup funds and ONR funds.

WORK COMPLETED

A new laboratory capable of conducting field experiments in the nearshore ocean was assembled between January and September of 2008. One important feature of the laboratory is the capability to resolve the three-dimensional flows common in estuaries using a unique array of high-resolution acoustic profilers.

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2008		**00-00-2008 to 00-00-2008**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Three-Dimensional Flow in Tidal Channels	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) **Washington State University (Vancouver),School of Earth and Environmental Sciences,14204 NE Salmon Creek Ave,Vancouver,WA,98686**	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
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**Same as Report (SAR)**	**4**	

During the 2008 pilot experiment, all major instruments functioned successfully, and were recovered on 28 September 2008. Tidal propagation over the flats and channels was measured using ADCPs mounted on fixed frames (figures 1 and 2), on small boats, and on GPS drifters (figure 3). Temperature and salinity were also measured using fixed and mobile gauges.

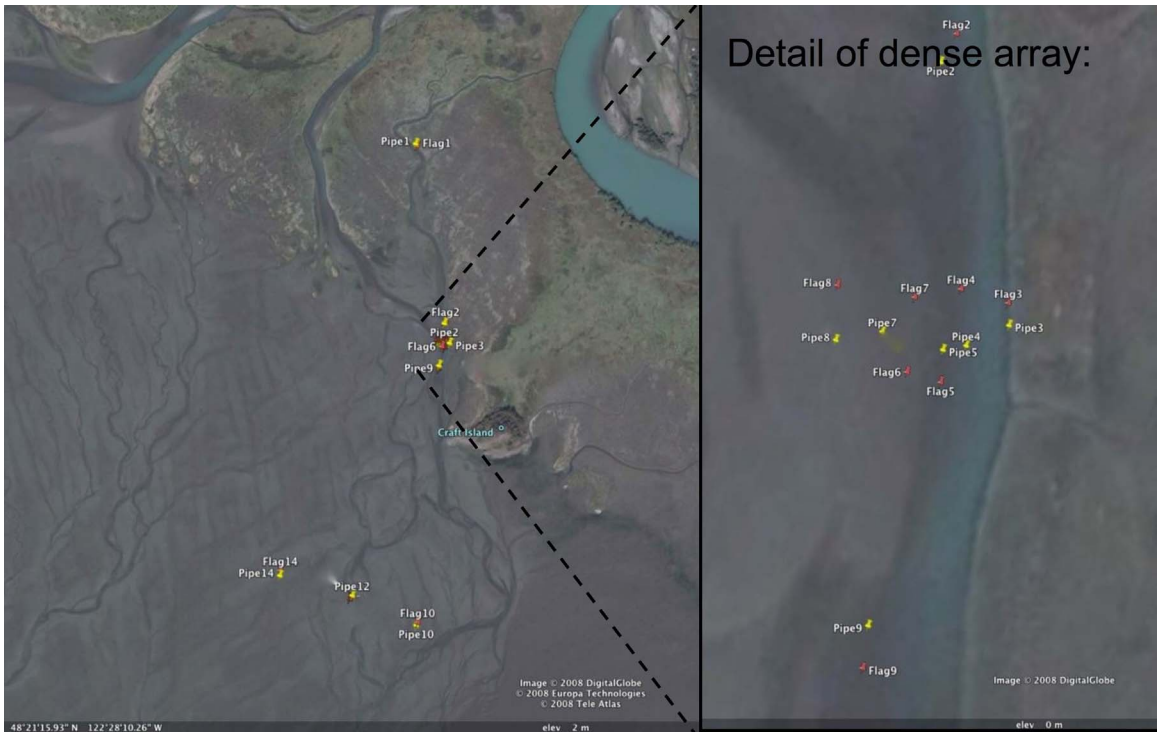

Figure 1: Locations of fixed instruments during fall 2008 deployment. Instruments were moved between locations, and all marked locations were occupied by an instrument at some stage during the experiment.

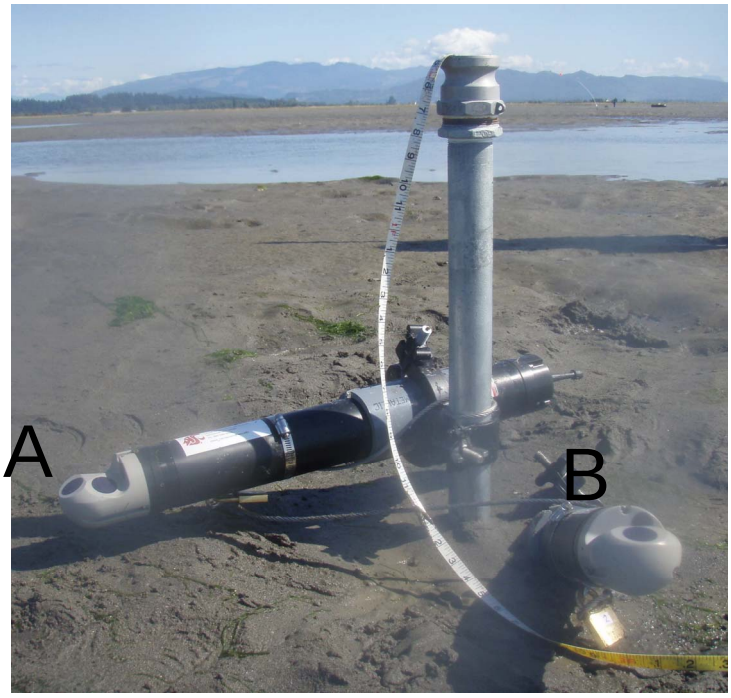

Figure 2: Fixed Acoustic Doppler Current meters at low tide (these current meters were about 6 feet underwater at high tide). Six instruments were deployed in standard configuration (e.g. current meter labeled A), measuring mean currents from near the seabed to the water surface. Two current meters were deployed in a variety of high-resolution configurations (e.g current meter labeled B), providing very rapidly sampled profiles of the turbulence responsible for mixing momentum, heat, and salt.

Figure 3: A surface drifter designed to operate in very shallow tidal flats environments. Drifters were drogued to a depth of 30cm, and were mounted with GPS loggers to measure drifter locations, ADCPs to measure the velocity shear beneath the drifters, and thermisters to measure water temperatures.

RESULTS

The first experiment of this project was successfully completed on 28 September 2008. Analysis of data has not yet begun, and consequently substantial scientific results have not yet obtained. However, the successful deployment and recovery indicates that a new capability to conduct nearshore field experiments has been developed.

IMPACT/APPLICATIONS

This project is likely to improve understanding of water flows and sediment transport in tidal flats and channels. Measurement of three-dimensional flows in rapidly evolving channels will aid development of improved models for channel migration. Measurement of tidal flows over flats and channels will provide a valuable baseline for improving hydrodynamic models and remote sensing techniques.

RELATED PROJECTS

The major 2009 deployment will be timed to coincide with the deployments of other groups, especially the Chickadel/Thomson group of the University of Washington, and the Raubenheimer *et al*. group of Wood's Hole Oceanographic Institution. In-stiu profiling measurements will complement the remote sensing measurements of the Chickadel/Thompson group, and the point measurements of the Raubenheimer *et al*. group.