NEP-CCS Progress Report 2004

LONG-TERM MONITORING AND ANALYSIS OF CURRENTS AND WATER PROPERTIES ON THE SOUTHERN OREGON (COOS BAY) AND MID WASHINGTON (GRAYS HARBOR) SHELVES

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PROJECT SUMMARY

Objectives:
The objectives of this project are 1) to provide data on alongshore and temporal variability in the coastal ocean nearshore environment of the Pacific Northwest region on scales of hours to several years; and, 2) in conjunction with other GLOBEC investigators, to determine dominant factors controlling alongshore and temporal variability in ocean water properties and currents.

To fulfill these objectives we maintained moored arrays measuring currents and water properties at two locations, one off southern Oregon (Coos Bay); the other off the central Washington coast (Grays Harbor). These moorings have been maintained continuously since April 2000 to September 2004 with servicing at 6 month intervals, except for the last year. The last year was an additional deployment, done at no extra cost to the program. Moorings were deployed for one year. Data collected are summarized in Table 1 below.

Status:
The data set is of high quality and nearly continuous. Editing has been done in most cases. The Coos Bay data was given to the Ramp group for final processing and placement on the web, including pictures. The Grays Harbor should be completed this spring. We have hired an additional person for one month to help complete this task.

Subsets of data have been given to John Allen, Mike Kosro and Steve Ramp as well as the modeling group (Hermann) for a variety of purposes. The second objective above will be addressed in part this year with existing funding.

Papers:
One paper has been published, another is under review. Both use GLOBEC data and were partially supported by GLOBEC. Both papers are available as pdfs on the Hickey group web site http://coast.ocean.washington.edu/. The first is an overview of important processes of ecological relevance in the Pacific Northwest (Hickey, B.M. and N. Banas, 2003, Oceanography of the Pacific Northwest Coastal Ocean and Estuaries with Application to Coastal Ecosystems. Estuaries, 26(48):1010-1031). The second demonstrates for the first time that the plume from the Columbia River is frequently on the Washington shelf in summer. It's fronts may have important relevance for larval and juvenile fish transport as well as plankton blooms. The manuscript includes a data-derived schematic showing how the Columbia plume responds to a sequence of downwelling and upwelling winds (Fig. 1). The abstract follows.

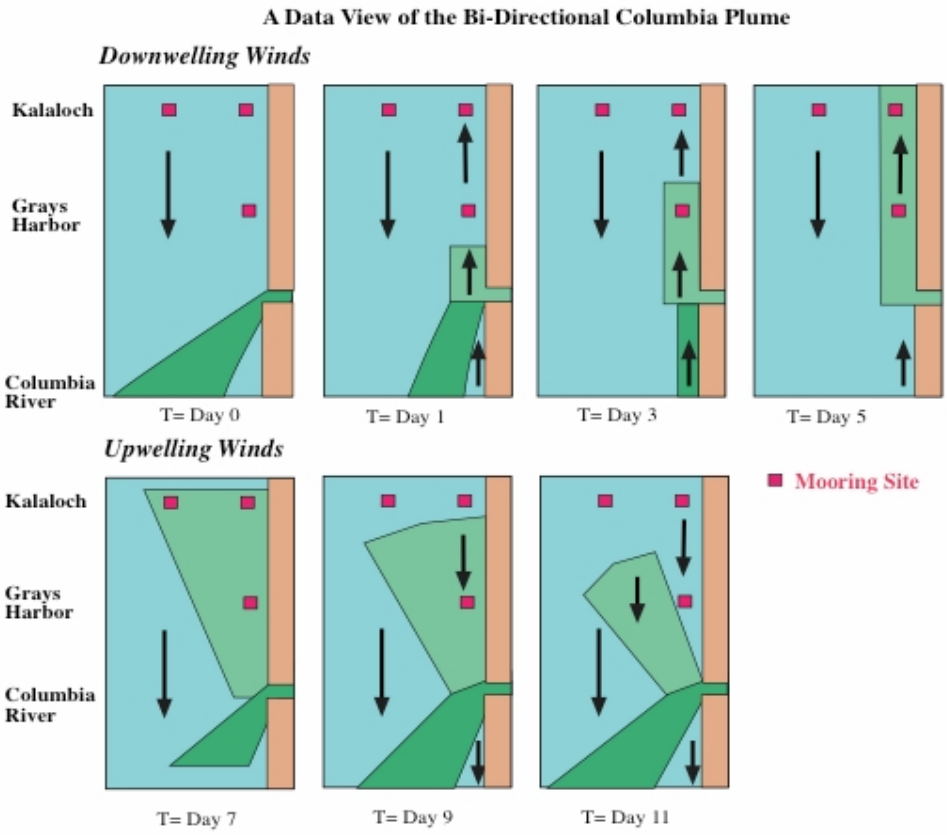

Figure 1. Data-derived model showing the development and erosion/advection of a bi-directional plume during summer. Sites of moored sensor data used to derive this model are shown.

A Bi-Directional River Plume: The Columbia in Summer

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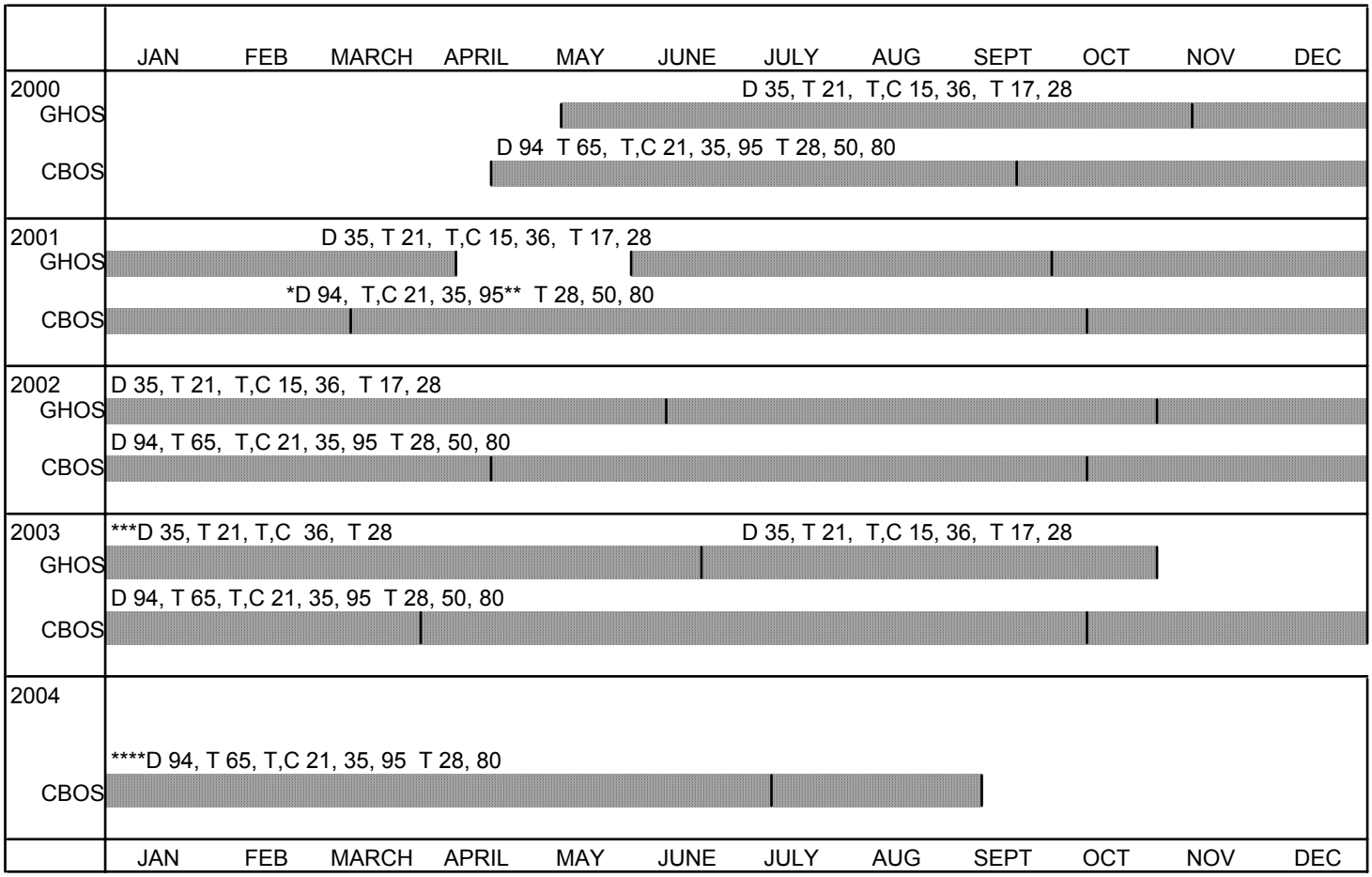
Abstract

Freshwater plumes have important effects on marine ecosystems: in the presence of a plume, stratification, nutrient pathways, light and circulation patterns are significantly altered from patterns that occur under the influence of wind and ambient currents alone. The historical picture of the plume from the Columbia River is of a freshwater plume oriented southwest offshore of the Oregon shelf in summer and north or northwest along the Washington shelf in winter. Both new and historical CTD data and new data from moored sensors support a picture quite different from the historical seasonal pattern. Specifically, the plume is frequently present up to 150 km north of the river mouth on the Washington shelf from spring to fall, even during periods of upwelling. The plume is frequently bi-directional, with branches both north and south of the river mouth. During a downwelling event, the southwest plume moves onshore over the Oregon shelf. At the same time, a new plume forms north of the river mouth over the Washington shelf, trapped within ~20-30 km of the coast. This plume propagates and also is advected northward by inner shelf currents that reverse during the downwelling. When winds return to upwelling-favorable, inner shelf currents reverse immediately to southward and the shallow plume is advected offshore in the wind-driven Ekman layer to the central shelf and southward in the seasonal mean ambient flow. Overall, we estimate that

freshwater from the Columbia plume overlies the Washington shelf 50% or more of the summer. Capping of upwelling on the inner shelf by the Columbia freshwater plume is illustrated, where the "capping potential" is related to stratification and wind magnitude and duration via a mechanism presented in Csanady (1977). Evidence is also presented to suggest that the seaward front of the Columbia River plume may provide a barrier to the transport of harmful algal blooms to coastal beaches in summer and early fall.

Summary of GLOBEC Data collected at Grays Harbor Offshore & Coos Bay Offshore Sites



Data collection beginning in the spring 2000 through fall 2004 at both sites was sponsored by GLOBEC

D denotes upward looking Doppler profiler, V velocity, T temperature, C conductivity

Table1. University of Washington component GLOBEC data at Washington (GH) and Oregon (CB) locations.