

# RISE-4 cruise report from R/V Point Sur leg 1cruise RISE2006a in the Northeast Pacific coastal waters off states of Washington and Oregon in 2006 (RISE project)

**Website:** <https://www.bco-dmo.org/dataset/3342>

**Data Type:** cruise report

**Version:** final

**Version Date:** 2006-05-31

## Project

» [River Influences on Shelf Ecosystems](#) (RISE)

Contributors	Affiliation	Role
<a href="#">Nash, Jonathan</a>	Oregon State University (OSU-CEOAS)	Principal Investigator
<a href="#">Kilcher, Levi</a>	Oregon State University (OSU-CEOAS)	Co-Principal Investigator
<a href="#">Moum, Jim N.</a>	Oregon State University (OSU-CEOAS)	Co-Principal Investigator
<a href="#">Gegg, Stephen R.</a>	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

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## Dataset Description

Cruise Report - RISE-4, Leg 1, R/V Point Sur, 2006

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## Parameters

*Parameters for this dataset have not yet been identified*

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## Deployments

### RISE2006a

<b>Website</b>	<a href="https://www.bco-dmo.org/deployment/58013">https://www.bco-dmo.org/deployment/58013</a>
<b>Platform</b>	R/V Point Sur
<b>Report</b>	<a href="http://bcodata.whoi.edu/RISE/CruiseReports/RISE-4_a_PtSur_CruiseReport_Nash.pdf">http://bcodata.whoi.edu/RISE/CruiseReports/RISE-4_a_PtSur_CruiseReport_Nash.pdf</a>
<b>Start Date</b>	2006-05-21
<b>End Date</b>	2006-05-31
<b>Description</b>	One of the RISE project cruises carried out in 2005 with the R/V Wecoma (W0508) in the coastal waters of Washington and Oregon. This cruise focused on mixing rates and large scale physical, nitrate, fluorescence surveys as well as frontal frontal processes, and data from remote sensing and model studies.

## Project Information

### River Influences on Shelf Ecosystems (RISE)

**Website:** <http://www.ocean.washington.edu/rise>

**Coverage:** Northeast Pacific, coastal waters off states of Washington and Oregon

### **River Influences on Shelf Ecosystems (RISE) - A Study of the Columbia River Plume A Multi-Institutional Collaborative Project Sponsored by the National Science Foundation**

In 2004 an interdisciplinary study "River Influences on Shelf Ecosystems" (RISE) was initiated to determine the extent to which alongshore gradients in ecosystem productivity might be related to the existence of the massive freshwater plume from the Columbia River. RISE was designed to test three hypotheses: - During upwelling the growth rate of phytoplankton within the Columbia plume exceeds that in nearby areas outside the plume being fueled by the same upwelling nitrate.

- The plume enhances cross-margin transport of plankton and nutrients.
- Plume-specific nutrients (Fe and Si) alter and enhance productivity on adjacent shelves.

Within those constraints, RISE provides the first comprehensive interdisciplinary study of the rates and dynamics governing the mixing of river and coastal waters in an eastern boundary system, as well as the effects of the plume formed by the mixing processes on rates, standing stocks and community structure of plankton in the local ecosystem. The RISE project, includes 4 field and two different numerical model applications. We collected simultaneous measurements of water chemistry, phytoplankton growth and grazing rates, zooplankton populations, water currents, and turbulent mixing. These are being combined with data from satellites, radar, and moorings, as well as detailed numerical simulations, to develop a deeper understanding of this important ecosystem.

The overall RISE sampling strategy was to compare mixing rates, nutrient supply, and phytoplankton production, grazing and community structure within the plume and outside the plume; i.e. on the shelf to the north of the river mouth, presumed more productive, and on the shelf to the south of the river mouth, presumed less productive, as well as in the important "plume lift off" area (the region where the plume loses contact with the bottom) near the river mouth and the plume "near field". The backbone for this project consists of data collected during four cruises that took place in the seasonally high-flow period (May-June) in each of three years (2004-06) and in a low-flow period in the second year (August, 2005). The sampling was spread over three years to attempt to include interannual differences in processes related to wind and river flow variability. The 21-day length of the cruises ensured that a variety of circulation and growth regimes, including upwelling and relaxation/downwelling and neap/spring tides, were observed.

The field studies used two vessels operating simultaneously. The R/V Wecoma obtained primarily biological and chemical rate data: a) at individual stations on cardinal lines north and south of the river mouth (off Grays Harbor, WA and Cape Meares, OR) and near the river mouth; b) at selected process study stations; and c) at fixed stations near the river mouth during strong neap and spring tides (time series). A towed sensor package was used to obtain micronutrient samples near the sea surface on cardinal lines and other selected transects. Underway measurements included macronutrients (N, P, Si), dissolved trace metals (Fe, Mn), supplemented with discrete samples from the underway system (microscopy, FlowCAM and particulate trace metals). At CTD stations vertical profiles (0-200 m where possible; and 500 m at selected stations) of T, S, vertical shear and currents, dissolved O<sub>2</sub>, in vivo fluorescence, PAR, chlorophyll a, dissolved macronutrients (NO<sub>3</sub>, NH<sub>4</sub>, urea, PO<sub>4</sub>, SiO<sub>4</sub>), dissolved trace metals, and heterotrophic and autotrophic plankton composition were obtained. Surface drifters were used to follow the mixing of individual plumes and to provide information on surface currents.

On the R/V Pt. Sur, synoptic mesoscale and fine-scale features were sampled with underway measurements of near-surface T, S, velocity, particle size and concentration, PAR, transmissivity and fluorescence and nitrate+nitrite. The Pt. Sur's Triaxus tow fish provided high-resolution sections of T, S, zooplankton (Laser-OPC), PAR and transmissivity, fluorescence, particle size and concentration (LISST-FLOC25X), UV absorption and nitrate (Satlantic ISUS) and radiance/irradiance (7 channels) through the upper water column to 50 m. Rapidly-executed transects of turbulence and fine-structure were also carried out using the Chameleon

profiler; these provide full-depth profiles of T, S, optics (880 nm backscatter and fluorescence), turbulence dissipation rates and turbulent fluxes every 1-3 minutes. During selected periods, transects were repeated hourly to capture the high-frequency evolution in the plume's nearfield and river estuary. Acoustics (surface-deployed 1200 kHz ADCP and 120 kHz echosounder) were used to image fine-scale features of the velocity and backscatter fields, resolving fronts, nonlinear internal waves, and turbulent billows.

The temporal context for observed variability was provided by an array of moored sensors deployed in the plume near field as well as on the shelf north and south of the plume (complemented by the pre-existing long-term estuarine and plume stations of the CORIE/SATURN network. To better resolve regional differences, moorings were moved farther north and south to the cardinal sampling lines after the first year of the program. Surface currents were mapped hourly from the shore using HF radar with two simultaneously operating arrays, one with a 40 km range and a 2 km range resolution, the other with a 150 km range and a 6 km range resolution. Satellite ocean color, sea surface temperature, turbidity and synthetic aperture radar (SAR) were also obtained when available.

Two modeling systems were developed or enhanced during RISE. The system developed specifically for RISE employed a structured grid model (ROMS) and was used in hindcast mode (MacCready et al., 2008). The CORIE/SATURN modeling system (Baptista, 2006)- based on two unstructured-grid models (SELFE, Zhang and Baptista, 2008; and ELCIRC, Zhang et al., 2004)- was used in both near real-time prognostic mode and multi-year hindcast mode. Both modeling systems incorporated the estuary in the simulation domain (although at different resolutions) and used realistic river, ocean and atmospheric forcing conditions, tidal forcing, and Columbia River estuary forcing. Wind/heat flux model forcing for ROMS was derived from the 4 km MM5 regional wind/heat flux model. SELFE and ELCIRC were also forced by MM5. Conditions on open boundaries were provided by ~9 km resolution models from the Navy Research Laboratory (NRL) (NCOM); ROMS used the smaller domain NCOM-CCS NRL model, SELFE and ELCIRC used the larger domain Global-NCOM model. The biological model is a four-box ("NPZD") nitrogen-budget model that tracks nutrients, phytoplankton, zooplankton, and detritus in every cell of the ROMS grid. The rich RISE biological dataset allowed model validation against not just stocks (chlorophyll, microzooplankton, nutrients) but rates (phytoplankton growth and grazing) directly, a level of validation that is seldom possible. These rate observations also allowed the setting of key model parameters (e.g., zooplankton ingestion rate and mortality) empirically (Banas, et al., 2008).

#### **References:**

Banas, N. S., P. MacCready, and B. M. Hickey (2008), The Columbia River plume as cross-shelf exporter and along-coast barrier, doi:10.1016 Cont. Shelf Res., 2008.03.011

Baptista, A. M. (2006), CORIE: the first decade of a coastal-margin collaborative observatory, Oceans'06, MTS/ IEEE, Boston, MA.

Hickey, B.M., and the RISE Pls. River Influences on Shelf Ecosystems: Introduction to the RISE Volume, Cont. Shelf Res., in press.

MacCready, P., N. S. Banas, B. H. Hickey, E. P. Dever, and Y. Liu (2008), A model study of tide- and wind-induced mixing in the Columbia River Estuary and Plume, doi:10.1016/j. Cont. Shelf Res. 2008.03.015.

#### **RISE Cruise Reports and Figures:**

##### **2004 RISE-1**

RISE04W1=R/V Wecoma, W0407A, July 8-28, 2004

[Cruise Report](#)

[Cruise Track](#)

[Stations and Moorings](#)

[Wind Events](#)

RISE2004=R/V Point Sur, (tbd), July 8-28, 2004

[Cruise Report](#)

##### **2005 RISE-2**

RISE05W2=R/V Wecoma, W0505C, May 29-June 21, 2005

[Cruise Report](#)

[Cruise Track](#)

[Stations and Moorings](#)

[Wind Events](#)

RISE2005a=R/V Point Sur, (tbd), May 29-June 21, 2005  
[Cruise Report](#)

**2005 RISE-3**

RISE05W3=R/V Wecoma, W0508, August 4-August 26, 2005  
[Daily Cruise Report](#)  
[Lessard Cruise Report](#)  
[Peterson/Shaw Zooplankton Report](#)  
[Cruise Track](#)  
[Stations and Moorings](#)  
[Wind Events](#)

RISE2005b=R/V Point Sur, (tbd), August 2-August 27, 2005  
[Cruise Report](#)  
[Cruise Log](#)

**2006 RISE-4**

RISE06W4=R/V Wecoma, W0605B, May 21-June 13, 2006  
[Cruise Report 1](#)  
[Cruise Report 2](#)  
[Cruise Track](#)  
[Stations and Moorings](#)  
[Wind Events](#)

RISE2006a=Leg 1, R/V Point Sur, (tbd), May 21-May 31, 2006  
[Cruise Report Leg 1](#)  
RISE2006b=Leg 2, R/V Point Sur, (tbd), June 2-June 12, 2006  
[Cruise Report Leg 2](#)

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