# Vertical profiles of primary productivity from R/V Wecoma multiple cruises in the Northeast Pacific coastal waters off states of Washington and Oregon from 2004 to 2006 (RISE project)

**Website**: https://www.bco-dmo.org/dataset/3248
**Version**: 14 July 2015
**Version Date**: 2015-07-14

**Project**
» River Influences on Shelf Ecosystems (RISE)

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|---|---|---|
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## Dataset Description

RISE - Vertical Profiles of Primary Productivity

These data are also submitted to NODC
NODC_EDDF_Form

CTD and biological primary productivity (chlorophyll) data collected during four cruises from 2004-2006 off the Oregon and Washington coast, centered on the Columbia River.

**Related References:**
Bruland_2008_JGR
Kudela_2006_GRL
Kudela_2008_Oceanography

### Methods & Sampling

**Chlorophyll a**
Turner Designs 10AU with non-acidification method
Chlorophyll and Primary Productivity processed as described by Kudela R. M., W. P. Cochlan, T. D. Peterson, C. G. Trick (2006), Impacts on phytoplankton biomass and productivity in the Pacific Northwest during the warm ocean conditions of 2005, Geophys. Res. Lett., 33, L22S06, doi:10.1029/2006GL026772.

Depth Integration was done using trapezoidal integration with the CORRECTED DEPTH parameter.

**Primary Productivity/Productivity Index**
C14 radiocarbon method (JGOFS protocols) with deckboard incubation using neutral density screening

**KPAR**
Log-linear slope of the PAR data from a Biospherical Instruments spherical PAR sensor attached to the CTD frame

**CTD Data (depth, temperature, salinity, fluorescence, beam-attenuation, dissolved oxygen)**
CTD data processed as described in Hickey, B., R. McCabe, S. Geier, E. Dever, and N. Kachel (2009), Three interacting freshwater plumes in the northern California Current System, J. Geophys. Res., 114, C00B03, doi:10.1029/2008JC004907.

**Data Processing Description**

**BCO-DMO Processing Notes**
Generated from original text file "RISE-ProfilePP.txt" contributed to BCO-DMO by Raphael Kudela

**BCO-DMO Edits**
- Date formatted to YYYYMMDD
- Time formatted to HHMM
- lon set to West (negative) by value *= -1.0
- decimal data values padded to consistent decimal places

**BCO-DMO Edits - 14July2015/srg**
- Inconsistent and incorrect dates found for many stations on all cruises
- Station dates replaced with correct dates from CTD Stations data for all cruises

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## Data Files

| File |
|---|
| **ProfilePP.csv** (Comma Separated Values (.csv), 37.97 KB) MD5:0458c6167edf6dab66cc128139f9d286 Primary data file for dataset ID 3248 |

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## Parameters

| Parameter | Description | Units |
|---|---|---|
| Cruise | RISE cruise name | text |
| CruiseID_CTD | RISE CTD Data Specific Cruise Id | text |

| | | |
|---|---|---|
| Station | Station Id | integer |
| Date | Station Date (UTC) | YYYYMMDD |
| Time | Station Time (UTC) | HHMMSS |
| Lat | Station Latitude (South is negative) | decimal degrees |
| Lon | Station Longitude (West is negative) | decimal degrees |
| depS | CTD BOTTLE DEPTH | meters |
| CorDepth | PRODUCTIVITY DEPTH | meters |
| KPAR | ATTENUATION COEFFICENT | 1/m |
| percent_Eo | CORRECTED DEPTH PERCENT SURFACE IRRADIANCE | (tbd) |
| CHL | CHLOROPHYLL A | mg/m3 |
| PP | PRIMARY PRODUCTIVITY | mg C /m3/d |
| PB | PRODUCTIVITY INDEX | PP/CHL |
| TEMP | TEMPERATURE | degrees Celcius |
| SAL | SALINITY | psu |
| FLUOR | FLUORESCENCE | RFU |
| BEAM_C | BEAM ATTENUATION | 1/m |
| DOXY | DISSOLVED OXYGEN | mL/L |

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## Instruments

| | |
|---|---|
| **Dataset-specific Instrument Name** | CTD Seabird 911 |
| **Generic Instrument Name** | CTD Sea-Bird 911 |
| **Generic Instrument Description** | The Sea-Bird SBE 911 is a type of CTD instrument package. The SBE 911 includes the SBE 9 Underwater Unit and the SBE 11 Deck Unit (for real-time readout using conductive wire) for deployment from a vessel. The combination of the SBE 9 and SBE 11 is called a SBE 911. The SBE 9 uses Sea-Bird's standard modular temperature and conductivity sensors (SBE 3 and SBE 4). The SBE 9 CTD can be configured with auxiliary sensors to measure other parameters including dissolved oxygen, pH, turbidity, fluorescence, light (PAR), light transmission, etc.). More information from Sea-Bird Electronics. |

| | |
|---|---|
| **Dataset-specific Instrument Name** | Niskin Bottle |
| **Generic Instrument Name** | Niskin bottle |
| **Generic Instrument Description** | A Niskin bottle (a next generation water sampler based on the Nansen bottle) is a cylindrical, non-metallic water collection device with stoppers at both ends. The bottles can be attached individually on a hydrowire or deployed in 12, 24, or 36 bottle Rosette systems mounted on a frame and combined with a CTD. Niskin bottles are used to collect discrete water samples for a range of measurements including pigments, nutrients, plankton, etc. |

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## Deployments

**W0407A**

| | |
|---|---|
| **Website** | https://www.bco-dmo.org/deployment/58008 |
| **Platform** | R/V Wecoma |
| **Report** | http://bcodata.whoi.edu/RISE/CruiseReports/RISE-1_Wecoma_CruiseReport.pdf |
| **Start Date** | 2004-07-08 |
| **End Date** | 2004-07-28 |
| **Description** | W0407A, RISE-1, RISE1W, RISE04W1 This cruise is the first of four cruises in the RISE program aboard the R/V Wecoma, which was charged with the task of conducting hydrographic surveys. The R/V Pt. Sur conducted studies of the Columbia R. plume frontal structure, mixing processes and zooplankton dynamics concurrently with this cruise on the R/V Wecoma. Cruise Objectives The purpose of this cruise was to make physical, chemical and biological measurements within the plume of the Columbia River and over the shelves north and south of the river mouth, with the objective of determining the effect of the river plume on regional productivity. Historical observations have shown that in spite of weaker upwelling winds the Washington shelf is more highly productive than much of the Oregon shelf. Comparative measurements of biological rates, chemical constituents including iron and other micro nutrients and plankton growth and grazing as well as community distributions were made in the three regions. These data complement data from three moored arrays deployed in the study area, data from a second ship, the R/V Pt. Sur, that focused on mixing rates and large scale physical, nitrate, fluorescence surveys as well as frontal processes, and data from remote sensing and model studies. RISE-1 Figures: Cruise Track Stations and Moorings Wind Events |

**W0505C**

| | |
|---|---|
| **Website** | https://www.bco-dmo.org/deployment/58010 |
| **Platform** | R/V Wecoma |
| **Report** | http://bcodata.whoi.edu/RISE/CruiseReports/RISE-2_Wecoma_CruiseReport.pdf |
| **Start Date** | 2005-05-29 |
| **End Date** | 2005-06-21 |
| **Description** | W0505C, RISE-2, RISE2W, RISE05W2 This cruise is the second of four cruises in the RISE program aboard the R/V Wecoma, which was charged with the task of conducting hydrographic surveys. Cruise information and original data are available from the NSF R2R data catalog. The R/V Pt. Sur, concurrently with this cruise on the R/V Wecoma, conducted studies of the Columbia R. plume frontal structure, mixing processes and a Triaxis survey of the shelf |

**W0508**

| | |
|---|---|
| **Website** | https://www.bco-dmo.org/deployment/58012 |
| **Platform** | R/V Wecoma |
| **Report** | http://bcodata.whoi.edu/RISE/CruiseReports/RISE-3_CruiseReport_Daily.pdf |
| **Start Date** | 2005-08-04 |
| **End Date** | 2005-08-26 |
| **Description** | W0508, RISE-3, RISE3W, RISE05W3 This cruise is the third of four cruises in the RISE program aboard the R/V Wecoma, which was charged with the task of conducting hydrographic surveys. The R/V Pt. Sur, concurrently with this cruise on the R/V Wecoma, conducted studies of the Columbia R. plume frontal structure, mixing processes and a Triaxis survey of the shelf Stations and Moorings |

**W0605B**

| | |
|---|---|
| **Website** | https://www.bco-dmo.org/deployment/58015 |
| **Platform** | R/V Wecoma |
| **Report** | http://bcodata.whoi.edu/RISE/CruiseReports/RISE-4_Wecoma_CruiseReport_F_TDP.pdf |
| **Start Date** | 2006-05-21 |
| **End Date** | 2006-06-13 |
| **Description** | W0605B, RISE-4, RISE4W, RISE06W4 This cruise is the fourth of four cruises in the RISE program aboard the R/V Wecoma, which was charged with the task of conducting hydrographic surveys. Cruise information and original data are available from the NSF R2R data catalog. The R/V Pt. Sur, concurrently with this cruise on the R/V Wecoma, conducted studies of the Columbia R. plume frontal structure, mixing processes and a Triaxis survey of the shelf |

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## 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 O2, in vivo fluorescence, PAR, chlorophyll a, dissolved macronutrients (NO3, NH4, urea, PO4, SiO4), 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 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 LCIRC 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 PIs. 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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## Funding


| Funding Source | Award |
|---|---|
| NSF Division of Ocean Sciences (NSF OCE) | OCE-0238347 |


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