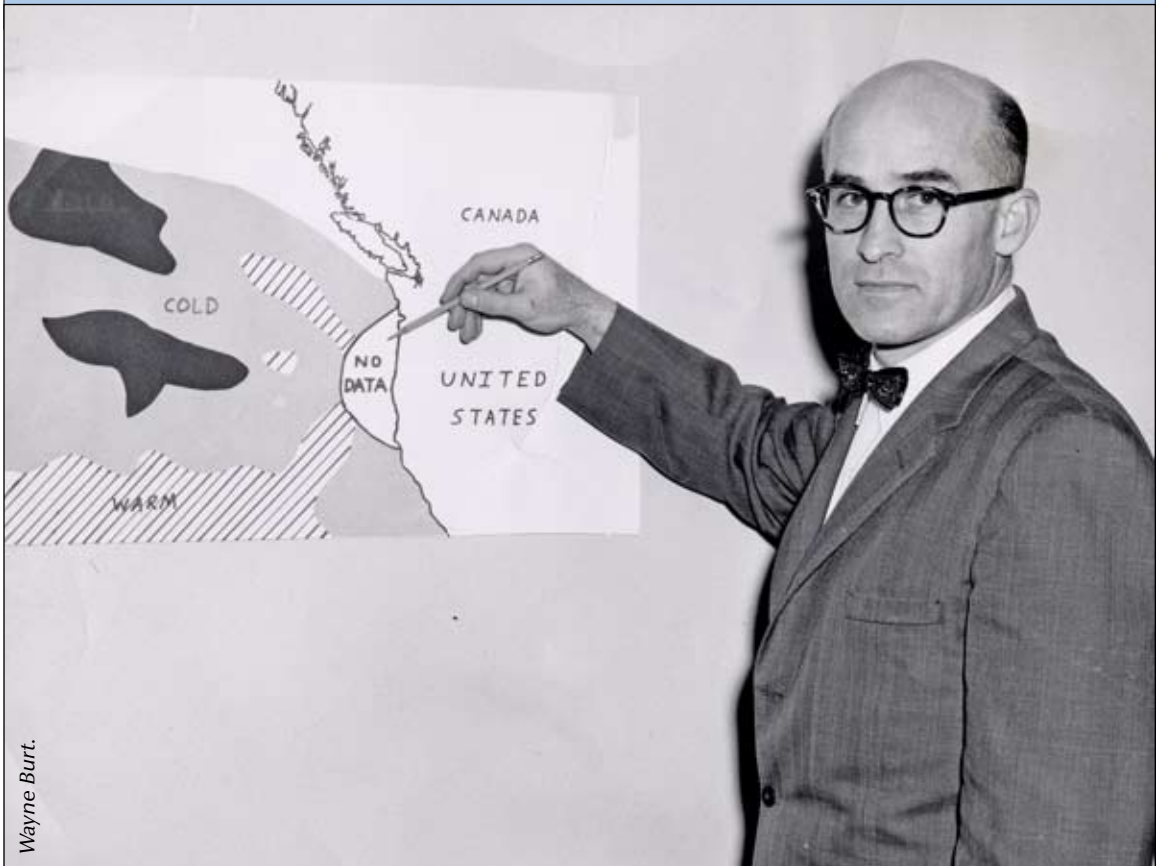


Oceanography and Atmospheric Sciences 1959–2009



Wayne Burt.

Oceanography and Atmospheric Sciences at Oregon State University 1959–2009



*Wayne Burt shortly after
arriving at OSU.*

1954

Wayne V. Burt arrives at Oregon State College, having received a grant from the Office of Naval Research for “Oregon Oceanographic Studies.”

1958

The Office of Naval Research announces Ten Years in Oceanography (TENOC). Wayne Burt immediately responds with proposal to President Strand of Oregon State College to start a graduate Department of Oceanography.

1959

Oregon State Board of Higher Education approves the establishment of Department of Oceanography at Oregon State College effective July 1.

Wayne Burt is named Department Chairman.

Herb Frolander (biological oceanography) joins the faculty.

1960

Graduate courses for degrees of MS and PhD in Oceanography are established.

John Byrne (geological oceanography), June Pattullo (physical oceanography), and Bill Percy (biological oceanography) join the faculty.

Oregon State College establishes marine geology program. Early studies focus on Oregon’s coastal morphology, beach sand composition and littoral transport, and distribution of estuarine deposits related to hydrography.



*Herb Frolander and Wayne
Burt.*



June Pattullo.



The R/V Acona.



Tony Loskota at the wheel of the Acona.

1961

The research vessel *Acona* (80 feet, 154 tons) is commissioned in May.

Using the *R/V Acona*, geological studies extend onto the Oregon continental margin and abyssal plain, focusing on their sediments, tectonics and structure. (1961–69)

In June, *R/V Acona* surveys Oregon coastal waters to 165 nautical miles off Newport, beginning a series of physical oceanographic cruises that continue for 11 years.

The geophysical program within Oceanography begins with several early studies, including surveys of the Oregon–Washington continental margins and adjacent abyssal plain with US Coast Guard vessels. The Corvallis seismic station is upgraded, relocated and tied into a worldwide network to detect earthquakes and underground nuclear explosions.

1962

OSU awards its first PhD in Oceanography.

Studies on the fate of radionuclides flowing into the coastal ocean from the Hanford Nuclear Reservation on the Columbia River are initiated, allowing some of the first data on sediment transport and on links in the oceanic food webs through radioactive ‘tags.’ These studies provided a major thrust into identifying pathways and timing of element transfer in different marine environments. These studies continue into the 1980s.

A fisheries oceanography program begins with micronekton and nekton studies off the Oregon coast. It grows to include studies on early life histories of fishes, vertical migration, ocean ecology of juvenile salmonids, albacore catches and participation in national and international cooperative studies.

Research in benthic ecology, phytoplankton ecology and ocean chemistry begins with initial studies off the Oregon coast. The research becomes some of the first work in upwelling zones off the Northwest coast of the US.

1964

In March, the department moves into the first permanent facility built at OSU for Oceanography (now Burt I).



Herbert F. Frolander displays a specimen to members of the Portland Rose Festival Court.



First Oceanography building, now Burt I.



The R/V Yaquina.

The research vessel *Yaquina* (180 feet, 800 tons) is commissioned in Portland, having been converted from a 1944 World War II FS-class support ship, allowing OSU to expand its sea-going studies to the entire Eastern Pacific from Peru to Alaska. (*R/V Acona* is transferred to Alaska.)

External funding to the Department first exceeds \$1 million; in 1959 funding was less than \$90,000.

1965

The Marine Science Center at Newport (now Hatfield Marine Science Center) is completed and dedicated.

June Pattullo submits proposal to the National Science Foundation for direct measurements of coastal currents. OSU begins studies of coastal circulation that continue today.

Several comprehensive geophysical and geological investigations are initiated along the Oregon–Washington continental margin and adjacent abyssal plain utilizing sedimentation patterns, stratigraphy and structural framework.

A five-year, US Geological Survey-funded program demonstrates how the subducting Juan de Fuca Plate sediments are accreted and uplifted onto the Oregon continental shelf and slope. Concurrent studies of submarine canyon, fan, deep-sea channel, and abyssal plain deposits—funded by the National Science Foundation and Office of Naval Research—produce models for recognizing similar deposits and features in the ancient rock record. (1965–75)

1966

The Department of Oceanography begins the study of optical oceanography as a major research topic. The use of optics in marine science continues to expand at OSU today. (1966 to present)

1967

John Byrne is named Department Chair after the resignation of Wayne Burt.

At the request of Governor Tom McCall, three faculty members from the OSU Department of Oceanography (a marine geologist, physical oceanographer, and biologist), together with



Isaacs-Kidd Midwater Trawl on Yaquina with Mike Laurs on right.



The TOTEM spar buoy.



The R/V Cayuse.

a Civil Engineer from the OSU School of Engineering, formulate a set of criteria that defines a measureable zone of public access across Oregon beaches. Using these criteria, the Oregon legislature passes the Oregon Beach Bill that establishes public ownership of land along the Oregon coast from the water up to sixteen vertical feet above low tide.

A 184-foot spar buoy, TOTEM, designed to be a stable platform in waves, is constructed, towed to sea and raised to the vertical position for testing. It is successfully deployed at sea for 5 months in spring 1968. TOTEM II is constructed and moored on Cobb Seamount off the Washington coast in 1968, but fails structurally. The goal of using TOTEM for telemetry of ocean data to shore is eventually abandoned.

1968

The research vessel *Cayuse* (80 feet) is commissioned.

OSU is designated one of 3 original Sea Grant Centers. (In 1971, OSU is designated a Sea Grant College).

A Technical Planning and Development Group is formed to develop instrumentation for the specific needs of various scientists, including electronically activated nekton net systems and deep-sea conducting swivels. Five patents are received for the Navy by the group; a newsletter for ocean technologists is published from 1973–82 and circulated by UNESCO in 98 countries.

1969

U.S. commits to participation in the International Decade of Ocean Exploration (IDOE) with funding through the National Science Foundation. OSU Oceanography plays a major part in many IDOE programs during the decade beginning in 1971 (see below). The experience and reputation gained during this decade makes OSU a leader in national and international programs in the subsequent decades.

Dozens of OSU marine geologists participate as Chief Scientists and shipboard scientists aboard the drilling vessel *Glomar Challenger* during the Deep Sea Drilling Project. The project collects sediment and rock samples used to decipher the history of the ocean basins and continental margins. (1969–83)

The first long-range *R/V Yaquina* cruise explores the Panama Basin where OSU marine geologists investigate the sediments,



Bob Still with drift bottles and bucket thermometer.



CTD sampling aboard the Yaquina, painted by E. Nelson Sandgren, an OSU Art Professor.

structure and the plate tectonics of the basin and surrounding spreading ridges. Geochemical and microfossil analyses of Panama Basin deposits provide a framework for subsequent deep-sea drilling. (1969–76)

1970

A second Oceanography building (now Burt II) is finished and occupied.

A beach, nearshore, and oceanic sediment process program begins in the Pacific Northwest and adjacent ocean, and later expands to other coastal regions of the globe.

OSU hydrographers begin using Geodyne CTD (conductivity, temperature, depth) instruments to measure temperature, salinity and depth continuously, in place of discrete bottle samples with reversing thermometers.

1971

The IDOE Nazca Plate Project conducts the first comprehensive investigation of an entire lithospheric plate. OSU partners with the Hawaii Institute of Geophysics to study the evolution of oceanic crust and metal-rich sediments on the spreading East Pacific Rise, and the transport and eventual subduction of the Nazca Plate beneath continental margins of Ecuador, Peru and Chile. (1971–79)

IDOE Climate: Long-Range Investigation, Mapping, and Prediction (CLIMAP) produces the first map of global climate conditions during the last glacial maximum. CLIMAP studies major changes in Earth climate over the past million years to provide a basis for predicting future climate change. (1971–80)

National Science Foundation and IDOE fund the construction of a cold storage and processing facility for oceanic sediment cores in OSU Oceanography. This national facility has grown from 4,800 to 36,000 cubic feet of walk-in refrigerator space. The facility curates and distributes sediment samples to investigators worldwide.

IDOE Geochemical Ocean Sections Studies (GEOSECS) surveys the chemical properties of the world ocean, leading to advances in understanding of origins and alterations. (1971–80)



Coastal Upwelling Ecosystem Analysis logo (1972).



Doug Caldwell, John Allen, Chris Mooers.



From left, John Allen, Chris Mooers and Bob Smith in chief scientist's cabin on the Yaquina.

The Oregon continental margin and abyssal plain (Cascadia Subduction Zone) is selected for exploration drilling in the early stages of the Deep Sea Drilling Project. OSU scientists play a lead role in the planning stage and participate in the cruise aboard the *D/V Glomar Challenger* (Leg 18). Leg 18 is the first deep-sea drilling expedition of an eastern Pacific subduction zone.

1972

Department of Oceanography becomes School of Oceanography. John Byrne is named Dean of Oceanography.

The University–National Oceanographic Laboratory System (UNOLS) is adopted by major oceanographic institutions, including OSU, to jointly schedule their major research vessels.

IDOE Coastal Upwelling Experiment (CUE) is conducted off Oregon and continues as IDOE CUEA program (Coastal Upwelling Ecosystem Analysis) with studies off Oregon (1972–73), Northwest Africa (1974) and Peru (1976–77).

1973

In March, the School of Oceanography hosts the first meeting of the SCOR/ICSU (Scientific Committee on Oceanic Research, International Council of Scientific Unions) Working Group on Coastal Upwelling Processes. Members of the working group are senior scientists from France, Germany (DDR and FRG), Japan, Spain, UK, USA, and USSR.

The School of Oceanography hosts the Coastal Upwelling Ecosystem Analysis (CUEA) Theoretical Workshop, funded by IDOE. The purpose is to bring theoreticians, modelers, and observational oceanographers together to accelerate an exchange of ideas and information. More than 50 oceanographers from around the world attend and present talks during the two-month summer workshop.

1974

Oceanography at OSU awards its 250th graduate degree.

Marine Resource Management (MRM) program is added to the curriculum of OSU School of Oceanography.

IDOE International Southern Ocean Studies (ISOS) has OSU current meters spanning the Drake Passage. (1974–81)



Dale Pillsbury preparing a meteorological buoy.



Larry Small, Konstantin Federov, John Byrne, Jim O'Brien, in SCOR working group (1973).



Joan Flynn with zooplankton sampling net.

OSU oceanographers begin investigations of El Niño and Southern Oscillation climatic changes over the eastern Pacific, later expanding the studies globally and temporally, including the historical record of Nile River flood data dating to 622 C.E. (1974–92)

1975

OSU Oceanography joins the Joint Oceanographic Institutions for Deep Earth Sampling (JOIDES) that provides oversight to the international scientific ocean drilling program.

WISP (Winter–Spring) field experiment investigates the transition in the Oregon coastal ocean from winter to spring conditions, showing that transition generally occurs more decisively and rapidly (in an order of days) in the coastal ocean than in the local weather.

1976

The newly constructed research vessel *Wecoma* (180 feet) goes into service, replacing the beloved *R/V Yaquina*. The *Yaquina* serves OSU well for 11 years, spending 2,402 days at sea and traveling 265,000 miles.

George Keller becomes Acting Dean of Oceanography when John Byrne becomes OSU Dean of Research.

Galapagos Rift (1976–79) and East Pacific Rise (1977–80) studies observe submarine hot springs on the seafloor, first on the Galapagos Rift in 1977 and then on the East Pacific Rise in 1979. Hydrothermal systems provide the chemical life support systems for a host of new species, the first known chemosynthetic food chain, and provide the geochemical elements that form the sulfide mineral deposits and massive chimneys on the seafloor.

1977

A multi-institutional Mixed Layer Experiment (MILE) studies mixing in the North East Pacific and includes stimulated studies of turbulence, mixing and microstructure. Studies of turbulence and mixing continue as a major focus of COAS physical oceanography. (1977 to present)

The determination of manganese in seawater is made. Observation begins of the metal-rich plumes associated with hydrother-



Dave Stein.



Captain Howard Linse and Jack Miller, on the Wecoma.



Erwin Suess and George Keller aboard the Wecoma.

mal regimes of spreading centers, such as the Galapagos Rift, East Pacific Rise, and Mid-Atlantic Rift. (1977–85)

Subsurface Undercurrent Study (SUS) begins. SUS intends to define the cross-margin structure of the poleward undercurrent off Oregon; however, instead it shows that the currents over the continental slope are highly variable in both space and time. (Joint study with University of Washington, 1977–78)

1978

Ross Heath is named Dean, School of Oceanography.

OSU faculty and graduate students initiate numerous investigations of Oregon's coastal, beach and estuarine sediments and sedimentary processes. Cascadia great earthquakes are recorded in the deposits of the several Oregon estuaries. (1978–95)

1979

A study of the suitability of the deep sea for disposal of defueled decommissioned nuclear submarines begins off northern California with funding through Sandia National Laboratories. An array of moorings with sediment traps and current meters are deployed in waters deeper than 3,000 meters during 1979–85. The later decision not to use deep-sea disposal results from political considerations. The project also supports deep biological trawling and sediment studies off Northern California. A mooring cruise on *R/V Wecoma* is memorialized in the mural on wall at entrance of the OSU Memorial Union.

The SPECMAP project is a multi-institutional paleoclimate program mapping variations in ocean climate with periods of 10 to 1000,000 years. (1979–85)

1980

OSU participates in Vertical Transport and Exchange (VERTEX), the first major multi-institutional study of sinking particles and food-chain modification of basic biological elements in the open Pacific Ocean. These studies help launch other major studies on global ocean flux. (1980–88)

The aging Geodyne CTD (conductivity, temperature, depth) system is replaced with a high precision Neil Brown CTD that greatly improves measurements.



Clayton Paulson and thermistor chain, MILE project (1977).



Electronic Multiple Plankton sampler.



Bob Smith and Jane Huyer, recovering Rosette/CTD package.

The Coastal Ocean Dynamics Experiment (CODE) is funded by the National Science Foundation as a major multi-institutional (OSU, Woods Hole Oceanographic Institution, Scripps Institution of Oceanography) study of the dynamics of wind-driven currents over the continental margin off northern California. The OSU SuperCODE project extends the study of coastal dynamics to include central California and Oregon. OSU continues to monitor coastal currents near Coos Bay into 1989. The mooring near Coos Bay provides current measurements before, during and after El Niño 1982. (1980–88)

1981

Peru Currents Study begins a study of the currents in the southeastern equatorial Pacific between 2N and 12S. The water upwelling along the coast in this region appears to come from the poleward Peru Undercurrent, which flows counter to the prevailing coastal winds. Serendipitously, this study observes the onset, peak and decay of the major 1982–83 El Niño. (1981–85)

Through Argon-geochronology and spatial relationships, it is recognized that basement rocks of the Oregon–Washington coast are the remains of an accreted hotspot chain and possibly related to the Yellowstone–Snake River–Columbia River Basalt age-progressive trail.

1982

The 1982–83 El Niño is recognized as a major erosion event all along the West Coast. OSU research concentrates on climate controls on coastal erosion, including the discovery that storm intensities and wave heights have been increasing in the North Pacific at least since the 1970s.

OSU begins a series of nearshore field experiments at Duck, North Carolina, that eventually includes six major experiments (Duck 82, 85, 86, 90, 94, and 97) and encompasses almost the entire nearshore research community. (1982–97)

The geophysics group initiates an extensive gravity and magnetic survey off the continental margins of California, Gulf of California, and Central America with funding from the Office of Naval Research to provide critical terrain data for the inertial



OSU Memorial Union mural, painted by Henk Pander from a study at sea, shows deployment of current meters and sediment traps aboard the Wecoma.



Vern Kulm and the submersible Delta.

guidance systems of US intercontinental ballistic missiles. Using these geophysical data, OSU scientists investigate the deep crustal structure of these margins and the spreading history of the Gulf of California. (1982–87)

1983

The School of Oceanography becomes the College of Oceanography with Ross Heath as Dean.

External funding for OSU Oceanography exceeds \$10 million.

Subarctic Pacific Ecosystem Research (SUPER) is initiated by OSU biological oceanographers to investigate phytoplankton–zooplankton–nutrient relationships in the North Pacific gyre. (1983–89)

Biogeochemistry studies begin in Crater Lake. They include the longest continuous sediment trap record in the world, use of the submersible Deep Rover, and the discovery of previously unknown warm springs and associated bacterial mats on the deep lake floor. (1983 to present)

OSU physical oceanographers participate in Australian Coastal Experiment (ACE), a joint Australian, Canadian and US study to investigate propagation of coastally trapped waves, with periods of days, over long distances (1,000km). The coastally trapped waves manifest as fluctuations in alongshore currents and sea level, independent of local wind forcing.

1984

An Alvin submersible investigation of the Oregon continental margin discovers the first cold-water fluid vent system and unique animal communities associated with a global subduction zone (Cascadia Subduction Zone). Geochemical, geological and geophysical studies incorporate submersible monitoring and deep-sea drilling. (1984–92)

The SPECMAP program develops the high-resolution chronology for oxygen isotope records. OSU Oceanography's new oxygen isotope laboratory produces data for scientists' research projects. (1984–93)

Douglas Caldwell is named Acting Dean of Oceanography when Ross Heath becomes Dean at University of Washington.



Bob Collier in Deep Rover submersible at Crater Lake.



Doug Caldwell and Louise Burt unveiling the plaque at the dedication of Burt Hall.



Divers at Duck, NC.

1985

California Basin Study (CABS) investigates the production, cycling and fate of organic matter in a region adjacent to a heavily populated coastal area. OSU chemical and biological oceanographers participate in the five-year study funded by the US Department of Energy.

Dozens of OSU marine geologists and geophysicists, including graduate students, are involved with all aspects of the Ocean Drilling Program (ODP) to investigate the architecture of the ocean crust and convergent margins, the genesis and evolution of oceanic plateaus and volcanic islands, and paleoclimate history. (1985–2003)

Douglas Caldwell is named Dean, College of Oceanography.

1986

Acoustic Doppler Current Profiler (ADCP) is installed on *R/V Wecoma* allowing it to continuously measure ocean currents to a couple of hundred meters below the ship.

OSU Oceanography hosts the Planning Office for the Ocean Drilling Program (1986–88)

The Argus Program of daily world-wide beach sampling begins when camera data collection is continued following a focused field experiment at Duck, NC.

1987

The Oceanography Building Complex is named after Wayne Burt.

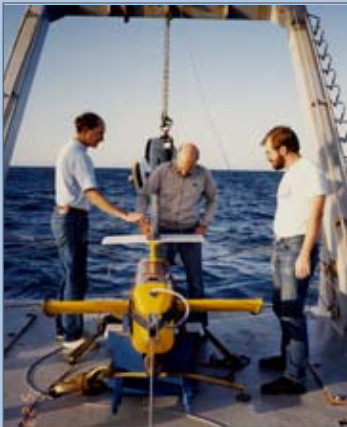
Coastal Transition Zone (CTZ) program in northern California studies the physical and biological dynamics of the ‘squirts, jets and filaments’ in the complex region between the coastal and the open ocean. (1987–88)

1988

Joint Global Ocean Flux Study (JGOFS) begins. JGOFS is an international program to study the physical, chemical, biological and geological interactions and fates of particles in several of the world’s major oceans, with particular reference to mesoscale processes affecting fluxes and connections to world carbon and nutrient cycling. OSU oceanographers are



Acoustic Doppler Profiler ready for deployment during Coastal Transition Zone, with written instructions for return of the buoy, in case the mooring is accidentally destroyed.



Readying SEASOAR; Jack Barth, Bob Smith and Fred Bahr.

involved in the Southern Ocean and the Equatorial Pacific studies.

Grants from the National Science Foundation, the Murdock Charitable Trust, and OSU allow COAS to purchase a Cameca SX-50 electron microprobe for the chemical analysis of solids that is used extensively by COAS, Geosciences, Engineering, Fisheries, and Hewlett Packard.

Hawaii Ocean Time-series (HOT) program begins nearly continuous monitoring of particle flux and transformation, coupled with studies of chemical cycling and physical variables. The study continues today with COAS as the lead institution for the bio-optics component.

1989

OSU Oceanography wins competition by NASA to develop new ways for data analysis of vast amounts of satellite data on the Earth environment.

Land Margin Ecosystem Research (LMER) involves OSU chemical and biological oceanographers in a 10-year, multi-institutional National Science Foundation program investigating physical, biological, and chemical interactions, and transformations of particulate material as it moves from major rivers through estuaries into the coastal ocean. (1989–2000)

An investigation of the earthquake hazards of the Cascadia Subduction Zone off Oregon and Washington begins with COAS marine geologists and geophysicists and the Department of Geosciences structural geologists. The investigation aims to identify the recurrence interval of great earthquakes from deep-sea sediments, the nature and distribution of active faults, and the tectonic implications of Juan de Fuca plate convergence with the Pacific Northwest. (1989 to present)

1990

OSU oceanographers contribute to Bermuda Atlantic Transport Studies (BATS), a multidisciplinary program similar in scope to Hawaii Ocean Transport program, but in the Atlantic. Silica cycling was the purview of OSU oceanographers.

The aging Neil Brown CTD (conductivity, temperature, depth) system is replaced with a reliable modular SBE CTD system.



LandSat concept image.



Marta Torres.



A rough day at the 'office' in the Southern Ocean.

1991

OSU Oceanography acquires a SEASOAR system with an undulating (surface to 200 m) vehicle carrying multiple instruments to measure physical, optical and biological properties while underway at 8 knots.

OSU Oceanography hosts the Planning Office for the US Science Support Program for Ocean Drilling. (1991–93)

1992

OSU physical oceanographers are heavily involved in the international, multi-ship TOGA–COARE (Tropical Ocean Global Atmosphere–Coupled Ocean Atmosphere Response Experiment) that studies the air–sea interaction in the “warm pool” of the western equatorial Pacific (the birthplace of El Niño). *R/V Wecoma* is in the western Pacific for six months in 1992–93 as part of this experiment.

The W. M. Keck Collaboratory for Plasma Spectrometry is established in Marine Geology and features state-of-the-art instruments to accommodate a wide range of elemental characterization, including isotopic analysis, with real-time interaction between OSU scientists and outside users. (1992 to present)

Variational data assimilation methods are being developed for mapping global ocean tides using altimetry data with the goal of improving tidal corrections for the TOPEX/Poseidon satellite mission and removing an important source of “noise” from the much lower frequency variations in sea level.

WET Labs (Western Environmental Technology Laboratories) of Philomath was founded. The COAS optical oceanography program was a “scientific godfather” to WET Labs, which is now a leading designer and manufacturer of undersea instrumentation to scientists and governmental agencies around the world.

1993

In January, the OSU Department of Atmospheric Sciences joins the College of Oceanography, which becomes the College of Oceanic and Atmospheric Sciences (COAS).

The Oregon Climate Service becomes part of COAS.



The R/V Wecoma.



*Satellite Tracked Drifter
deployed from Wecoma.*



*COAS Environmental
Computing Center.*

The multi-institutional Eastern Boundary Current (EBC, 1992–94; COAS/SIO/NPS) study—which includes large and mesoscale surveys of physical and biological variables, and a dense moored array over the continental margin—is designed to study weakly nonlinear interactions between mesoscale eddies/jets and larger-scale currents.

COAS scientists play a leading role in the Ocean Drilling Program that recovers subseafloor igneous rocks containing microbial trace fossil near the Galapagos Islands. Subsequent studies reveal that the Earth's oceanic and continental volcanic crust contains a vast and diverse microbial ecosystem.

Larry Small becomes Interim Dean of COAS after Doug Caldwell resigns following a sabbatical in the South Pacific.

1994

COAS oceanographers and atmospheric scientists enter into multinational studies of the Arctic Ocean, including sectional transects of physical, chemical, geological and biological measurements in open water and under sea ice (AOS), shelf–basin interaction studies (SBI), surface heat budgets to aid satellite interpretation (SHEBA), Bering Sea ecosystem studies (BEST), aerial surveys tracking sea ice changes (AON), physics and chemistry of exchange processes between Arctic and North Atlantic water, and others. COAS continues to be engaged in Arctic research.

Following on the successes of the Coastal Transition Zone and Eastern Boundary Zone programs, COAS researchers explore the Separation of a Coastal Jet (CJS) near Cape Blanco, Oregon. While primarily a physical oceanographic investigation, an important pioneering map of CO₂ flux across the air–sea interface in the coastal ocean was made. (1994–96)

Burt III, the COAS Environmental Computing Center (ECC) is completed and dedicated.

Brent Dalrymple becomes Dean of COAS.

COAS pioneers the use of *in situ* chemical sensors and develops fiber optic spectrometers for use in oceanic and coastal waters. (1994 to present)

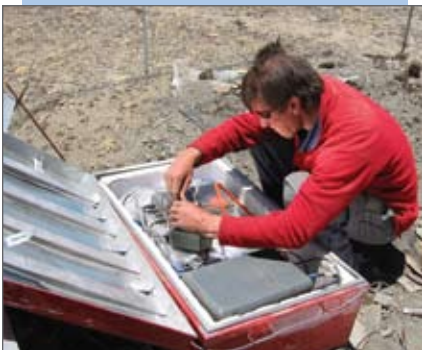
Theoretical studies of ocean tidal dynamics show that energy dissipated from the surface tides is converted into internal



Meteorological buoy on the Wecoma.



Cameras part of the worldwide Argus system, capturing the physics of beaches.



John Nabelek with seismic instruments in the Himalayas.

waves over rough topography in the deep ocean, with potentially important implications for ocean mixing and the meridional overturn circulation.

1995

Rock dredging and multibeam seafloor mapping of the Southeast Indian Ridge between 88°–115°E outline the morphology and geochemical composition of the longest, continuous section of unsampled and unmapped portion of the global mid-ocean ridge system.

HF (High Frequency) radar for measuring surface currents is tested near Coos Bay. Currents on the ocean surface are mapped from shore by measuring the Doppler shift induced by backscatter of HF radio waves from ocean surface waves.

1996

OSU Forestry and COAS faculty are among the first to establish sites in the AMERIFLUX network, providing continuous measurements of terrestrial ecosystem exchanges of carbon dioxide, water, energy and momentum. Some studies continue with a focus on climate and on how the exchanges themselves change during years following forest fires.

A major near-surface gas hydrate deposit, located on an accretionary feature named Hydrate Ridge, is discovered on the Oregon margin through international collaboration. It has become the prime location for gas-hydrate and cold-seep research worldwide. (1996–2006)

Large deposits of barite are discovered in association with cold fluid seeps in the Peru margin. Their geochemical behavior and geotectonic distribution explains the origin of these deposits in certain marine and continental settings.

1997

GLOBEC (Global Ocean Ecosystems Dynamics) begins a North East Pacific study (NEP) to better understand how climate variability affects the coastal ecosystems from northern California to along the Alaska coast. COAS biological and physical oceanographers play a seminal role in its development and continuation. COAS fieldwork focuses on effects of climate variability in Oregon coastal waters (1997–



W.M. Keck Collaboratory for Plasma Spectrometry.



Cold seeps at the seafloor; illustration by Rick Jones.

2008). The GLOBEC NEP regional office moves to COAS in 2000; COAS coordinates the program until its end in 2009.

COAS scientists participate in the Southern Ocean Joint Global Ocean Flux Study (JGOFS) of the Antarctic Polar Front and Ross Sea south of New Zealand. By using the towed vehicle SeaSoar, moorings, and ship-based chemical and biological analyses, estimates are made of the flux of CO₂ into this important part of the high-latitude oceans (1997–99).

An HF radar array is established with sites at Waldport and Yaquina Head. The present (2009) array has 11 sites, extending 500 km along the coast; surface currents to 150 km offshore are mapped once per hour. These are available on the web at <http://bragg.coas.oregonstate.edu>.

NASA space probe Pathfinder lands on Mars (4 July 1997). COAS researchers participate in the operations and measurements collected by the Pathfinder.

It is proposed that ocean plateau formation (large igneous province erupted at the beginning of hotspot activity) is linked to widespread ocean anoxia and accumulation of organic rich sediments (black shales). This is confirmed in high-resolution trace element anomalies.

1998

The National Oceanographic Partnership Program (NOPP) on “The Prediction of Wind-Driven Coastal Circulation” is a collaboration of observational physical oceanographers and coastal circulation modelers to improve our ability to forecast coastal currents from observations of wind stress and stratification. The small towed undulating MiniBAT system is especially valuable in measuring stratification over the inner shelf. (1998–2000)

COAS hosts the national office for Ridge InterDisciplinary Global Experiments (RIDGE), whose goal is a comprehensive, integrated understanding of the relationships among the geological and geophysical processes of planetary renewal on oceanic spreading centers and the seafloor and subseafloor ecosystems that they support. (1998–2001)



Steve Pierce and SEASOAR.



Kelly Falkner at North Pole Ice Camp.



Sara Banta (MRM 2003) working with ODFW to evaluate methods for reducing bycatch.

1999

COAS scientists join Indian Ocean Experiment (INDOEX), an international field project that measures the characteristics of the pollution plume from the Asian subcontinent to determine the effects of haze on the Earth's energy budget and climate.

The Cooperative Atmosphere–Surface Exchange Study 1999 (CASE 99) involves COAS faculty in a study to determine nighttime exchange of energy and momentum between the Earth's surface and the lowest layer of the atmosphere. Measurements from this experiment become the standard for testing theories of turbulence and models of the nighttime boundary layer.

2000

Coastal Advances in Shelf Transport (COAST) is the 5-year NSF multi-institutional and interdisciplinary study of marine ecology, ocean circulation and atmospheric forcing in contrasting regions of topography off the Oregon coast. It utilizes the advances in technology and modeling since CUEA (Coastal Upwelling Ecosystem Analysis) and CODE (Coastal Ocean Dynamics Experiment). (2000–05)

COAS scientists are developing long-term power sources for ocean sensors that harness electrical energy from marine sediments and decaying phytoplankton. These electrochemical devices are similar to fuel cells but they are fueled with marine organic matter and catalyzed by bacteria. (2000 to present)

Research vessel *Elakha* (54 feet) is commissioned for use in studies of Oregon's coastal ocean. 'Elakha' means 'sea otter' in the Chinook language.

2001

The first extensive CO₂-system measurements of Oregon coastal waters take place in 2001 as part of the COAST project. Oregon coastal waters are identified as exporters of organic carbon to the deep ocean and significant sinks for atmospheric

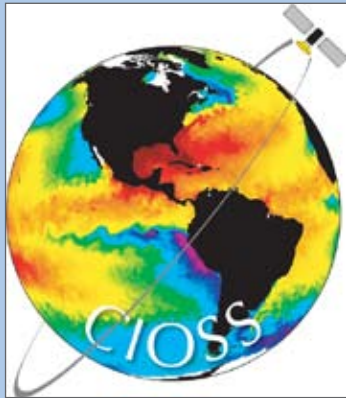
CO₂. COAS oceanographers and atmospheric scientists participate in East Pacific Investigation of Climate Processes (EPOC2001), an international field program to improve understanding and models of ocean–atmosphere interaction in the eastern tropical Pacific.



Mark Abbott in the Burt IV addition.



Michael Unsworth installs an instrument to measure gases given off by trees.



CIOSS logo.

COAS atmospheric scientists and physical oceanographers use fine-scale atmospheric models and satellite (QuikSCAT) measurements of wind stress to establish the importance of wind-stress curl on regional variations in the coastal upwelling system off Oregon and northern California.

COAS researchers are involved in Long-term Ecological Research (LTER) activities at the H.J. Andrews Experimental Forest, focusing on isotopes, cold air drainage, and climate change responses of mountainous forests in complex terrain.

Arctic Mid-Ocean Ridge Expedition (AMORE) discovers water column hydrothermal plumes on the spreading Gakkel Ridge, and geochemical evidence for large-scale domains within the Arctic upper mantle.

COAS scientific studies of the seafloor igneous rock ecosystem are determining its impact on groundwater, global carbon cycling, and erosion. This is likely to be relevant for rocky planets such as Mars. (2001 to present)

COAS leads the first Integrative Graduate Education and Research Traineeship program awarded to OSU by the National Science Foundation for fellowships, tuition, travel, and research expenses with focus on the Earth's Subsurface Biosphere. (2001–06).

Discovery of new hydrothermal vent sites is made in a polar region (the Bransfield Strait, Antarctica).

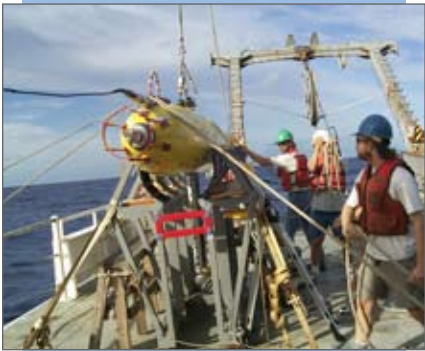
In-line water quality monitoring instrumentation is developed and used for commercial purposes to measure pesticide residues in drinking water. (2001–06).

Through the Ocean Drilling Program, COAS scientists confirm that the Hawaiian hotspot has moved southward during the Emperor Seamount formation, and that hotspots are no longer fixed in the mantle.

Tim Cowles is named Interim Dean upon the retirement of Brent Dalrymple.

Mark Abbott is appointed Dean of COAS.

External funding for COAS exceeds \$25 million.



Ocean Mixing Group members prepare to launch the Marlin.



Nick Piasis at the OSU core laboratory.



On board the Coast Guard ice breaker, Healy, off the coast of Greenland.

2002

Burt IV is completed, providing a modern seminar room and offices.

A project begins along the submerged northern San Andreas Fault, employing the techniques and lessons learned from Cascadia earthquake studies, to determine if an earthquake on one of the great faults can trigger an earthquake on the other one.

COAS oceanographers participate in Hawaiian Ocean Mixing Experiment (HOME), a multi-institutional project to study how tidal energy is dissipated over rough topography in the deep ocean.

COAS researchers participate in the Southern Ocean Fe enrichment experiment (SOFEX), studying the ability of ocean phytoplankton to draw down CO₂ when fertilized with iron.

2003

The Cooperative Institute for Oceanographic Satellite Studies (CIOS) is established in COAS to promote collaborative research in ocean remote sensing between COAS and NOAA (National Oceanic and Atmospheric Administration) research scientists. This is one of the first NOAA cooperative institutes awarded through open, national competition.

COAS scientists and graduate students continue to investigate the deep ocean biosphere, environmental and climatic change, geochemical processes, and solid earth cycles and geodynamics through the Integrated Ocean Drilling Program (IODP). (2003 to present)

COAS scientists and regional academic, private and government partners organize the Northwest Association of Networked Ocean Observing Systems (NANOOS) to promote shared regional real-time observing.

2004

COAS joins the Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO), a consortium of four West Coast universities (OSU, University of California Santa Cruz, Stanford, University of California Santa Barbara) carrying out long-term studies of rocky intertidal ecology and nearshore



Murray Levine and teaching assistants.



Lorenzo Ciannelli.



Cynthia Twohy.

oceanography. COAS and PISCO scientists take the lead in describing the recent appearance and evolution of low-oxygen “dead zones” off the Oregon coast.

COAS scientists form the Oregon Coastal Ocean Observing System (OrCOOS) to expand near real-time reporting of coastal ocean observations for the purpose of understanding and making informed decisions about the use of Oregon’s coastal ocean.

OSU and Portland State University purchase the next generation of electron microprobe, the SX-100. It is housed in COAS and can also be operated from PSU.

2006

COAS starts sustained, year-round observations along the Newport Hydrographic Line using autonomous undersea vehicles (AUV, or ‘gliders’). A glider samples the water column for three weeks while gliding up and down across the current and reporting via satellite. To date, over 100,000 profiles of data along over 25,000 km of track have been collected.

A five-year, multi-institutional, National Science Foundation-funded project called PALEOVAR deals with Past Climate Variability: Understanding Mechanisms and Interactions with the Mean State. COAS is joined by the University of Oregon and University of Minnesota in the project.

Spearheaded by the results from Land Margin Ecosystem Research (LMER), Coastal Margin Observation and Prediction (CMOP) is initiated through a new Science and Technology Center of the National Science Foundation with COAS chemical oceanographers as major participants.

2007

COAS and NOAA researchers identify ocean-acidification-driven corrosivity to natural biominerals in upwelled source waters off the Pacific coast of North America.

COAS researchers measure the rate at which haze particles are removed from the atmosphere during BEARPEX (Biosphere Effects on Aerosols and Photochemistry Experiment), a large national experiment designed to determine the contributions of oak and pine forest emissions to elevated atmospheric ozone



Anne Tréhu in the field.



Miguel Goñi in the Gulf of Mexico.



Kelly Benoit-Bird.

concentrations and particle formation in the California Sierra Nevada Mountains.

With an international science party and collaborators from around the world, OSU leads a cruise to investigate the tectonics and past history of great earthquakes in Indonesia; it is the first US ship to work off Indonesia in 22 years. (2007 to present)

Oregon Coastal Ocean Observing System (OrCOOS) becomes a sub-regional partner of the Northwest Association of Networked Ocean Observing Systems (NANOOS). NANOOS begins receiving funds to support Pacific Northwest observations.

2008

COAS, together with Woods Hole Oceanographic Institution and Scripps Institution of Oceanography, win the competition to install and operate the coastal and global portions of the National Science Foundation's Ocean Observatories Initiative (OOI). This Major Research Equipment and Facilities Construction project, totaling nearly three quarters of a billion dollars through the first 5 years of an anticipated 30-year lifetime, will include state-of-the-art ocean observing moorings, benthic laboratories and a fleet of underwater gliders.

The first EarthScope National Office is located in COAS and administered by the geophysical faculty and conducts multidisciplinary research across the Earth sciences. (2008 to present)

COAS develops software for processing and archiving of electromagnetic data, and runs the full electromagnetic component of national EarthScope program that is providing a new view of the crust and upper mantle in the Pacific Northwest.

COAS geophysical studies are currently centered on the development of data assimilation methods for the geodynamo that generates the Earth's magnetic field.

COAS researchers provide meteorological support for the NASA Phoenix Mission, which landed on Mars in May 2008.

COAS researchers participate in VOCALS (VAMOS Ocean-Cloud-Atmosphere-Land Study Regional Experiment) seeking to determine the impacts on climate caused by the interactions



Burke Hales.

between the ocean, clouds, air, and land in the Southeastern Pacific off the coast of Chile. The research involves the melding of shipboard, aircraft, and satellite observations collected during the experiment.

A Graduate Certificate in Marine Resource Management and Graduate Certificate in Fisheries Management are added to the COAS curriculum, broadening access to COAS educational opportunities. The Graduate Certificate in Fisheries Management is the first on-line graduate-level qualification offered through COAS.

2009

COAS researchers join with OSU and University of Concepción, Chile, colleagues to study microbial ecology in hypoxic waters: Microbial Initiative in Low-Oxygen areas off Concepción and Oregon (MI-LOCO).

COAS integrated geophysical and physical oceanographic studies focus on internal tides and ocean mixing, long period tides and Earth rotation, and tides in the last glacial maximum.

Philip Mote becomes the first Director of the Oregon Climate Change Research Institute, an entity housed within COAS.

R/V Wecoma has traveled almost 800,000 nautical miles since its arrival in 1976.

External funding to COAS approaches \$30 million.

COAS awards its 1,209th graduate degree in June. From its founding as the Department of Oceanography in July 1959 through June 2009, 828 Masters and 381 PhD degrees have been awarded.

Acknowledgements:

This timeline was compiled by Vern Kulm, Larry Small, and Bob Smith. Photos were assembled by Jane Huyer.

The photos and graphics used in this timeline are courtesy of Dennis Barstow, Harriet Lorz, Phyllis Mesecar, Rich Schramm, Dave Stein, Bob Still, OSU Archives, Oregon State University, NASA, and the heirs of Nelson E. Sandgren.

Our mission is to increase knowledge and understanding about oceanic and atmospheric sciences, helping Oregonians, the nation and the world respond to the challenges of a dynamic and changing Earth system.

Kipp Shearman and glider.

