RELEVANT EXPERTISE RELATED TO CLIMATE CHANGE

RESPONSES TO THE PRE-MEETING QUESTIONNAIRE

QUESTIONS INCLUDED IN THE PRE-MEETING QUESTIONNAIRE:

1) What is your area of expertise related to climate?
2) Please indicate any research that you are doing that is relevant to climate change and the possible impacts on the Pacific Northwest and provide a synopsis of your findings to date.
3) In your opinion, what is the most important thing for Oregonians and Washingtonians to know about climate change and its potential impacts?
4) In your opinion, what actions can Oregonians and Washingtonians take in the next 5 years to reduce emissions of greenhouse gasses?
5) In your view, what are the biggest uncertainties and the greatest impacts that might be caused by climate change in the Pacific Northwest that could be addressed with further research?
6) Please provide a list of up to five of your publications related to climate research.
7) Please provide a list of your close collaborators on climate research.

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Area of Expertise: My expertise is not on climate. However, I have a strong interest in understanding the effects of climate on the physics and ecology of PNW estuaries and coastal margins.

Relevant research and synopsis of findings to date: Through a coastal observatory for the Columbia River estuary and plume, I am developing the long-term data (observations and simulations) on circulation - including salinity and temperature - that will be required to understand the impacts of climate on a major PNW ecosystem. I anticipate that most of the technology and many of the lessons learned will be transferable beyond the Columbia River. This is on- going research, a synopsis thus being premature.

Most important thing for the public to know: In general: to realize that they should be informed about climate change and its potential impacts. Close to my area of expertise: to realize that climate change has local and regional impacts in the estuaries and shorelines of OR and WA.

What actions can be taken: Not my area of scientific expertise. Biggest uncertainties and greatest impacts that could be addressed with research: There are major uncertainties on what changes in the estuaries and shorelines of OR and WA (including status of endangered species) are due to climate and which are due to cumulative human activity. Some of these uncertainties can and will eventually be resolved through research.

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Area of Expertise: climatology climate change relevant research and synopsis of findings to date:
http://geography.uoregon.edu/envchange/
http://geography.uoregon.edu/bartlein/personal/cv0404.h

Most important thing for the public to know: That it is ongoing and that its impacts will become significant.

What actions can be taken: Not much.

Biggest Uncertainties: Multiple-system synergisms.

List of five publications:

Shafer, S.L., P.J. Bartlein and C. Whitlock, in press, Understanding the spatial heterogeneity of global environmental change in mountain regions, in U. Huber, M. Reasoner and H. Bugmann (eds.) Global Change and Mountain Regions. Kluwer.

Bonfils, C., N. de Noblet-Ducoudré, J. Guiot, P.
Bartlein and PMIP participants, in press, Some mechanisms of mid-Holocene climate change in Europe, inferred from comparing PMIP models to data. Climate Dynamics.

Williams, J.W., B.N. Shuman, T. Webb III, P.J.
Bartlein, P.L. Leduc, in press, Late Quaternary vegetation dynamics in North America: scaling from taxa to biomes. Ecological Monographs 74:3090334

Bartlein, P.J., and S.W. Hostetler, 2004, Modeling paleoclimates, Ch. 27 in A. Gillespie, S.C. Porter, B. Atwater (eds.), The Quaternary Period in the United States. (2003 INQUA volume) Elsevier, p. 563-582.

Whitlock, C. and P.J. Bartlein, 2004, Holocene fire activity as a record of past environmental change. Ch. 22 in A. Gillespie, S.C. Porter, B. Atwater (eds.). The Quaternary Period in the United States. (2003 INQUA volume) Elsevier, p. 479-490.

Collaborators: Whitlock, Hostetler, Shafer & Solomon

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Area of Expertise: Economics, utility energy efficiency, renewable resources, generation integration, transmission policies climate change.

Relevant research and synopsis of findings to date: Chair of the Technical Subcommittees of the Oregon Governor's Advisory Group on Global Warming.

Most important thing for the public to know: Long term need to reduce emissions by 60 to 80 percent from 1990 level by 2050-2100.

What actions can be taken: See draft options papers at www.energy.state.or.us under the global warming tab.

Biggest Uncertainties: Ocean Storm surge design criteria (harbors), May 1 snowpack levels, and forest fire, disease and infestation risks.

Collaborators: Sam Sadler, Oregon Dept. of Energy

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Area of Expertise: Clouds, aerosols, Earth's radiation budget and climate change.

Relevant research and synopsis of findings to date:
Cloud Feedback Problem – Probably the largest source of uncertainty in assessments of climate change is the uncertainty in the sensitivity of the climate resulting from almost no knowledge concerning the cloud-climate feedback.

Much of my work is devoted to developing new methods for obtaining cloud properties from satellite imagery data. The hope is that reliable observations of clouds from space will lead to improved methods of treating clouds in climate models and thus improved assessments of potential climate change.

I've recently overcome a long standing problem with the characterization of clouds from satellite observations, accounting for the effects of imager pixels, typically 1-km in diameter, that are only partially covered by clouds. Accounting for the partial coverage leads to the estimates of cloud properties that differ radically from those now being obtained by NASA, in which 1-km pixels are assumed to be either overcast or cloud-free, and the new results are more in line with what cloud physicists would expect for broken clouds. It will, however, take years for this new way of dealing with the problem is either accepted--or ignored.

The Effects of Aerosols on Climate – Aerosols reflect sunlight, thereby offsetting somewhat the effects due to the buildup of greenhouse gases, but aerosols also affect the sizes and numbers of cloud droplets. The latter is known as the indirect effect of aerosols, and ranks as the largest source of uncertainty in assessments of the human impact on climate. The indirect effect of aerosols could, based on current model estimates, largely mask the effects due to the buildup of greenhouse gases. Using satellite observations, I'm focusing on developing empirically derived bounds for the indirect effect of aerosols.

Recently, I've used clouds polluted by ships off the westcoast of the U.S. to demonstrate that polluted clouds appear to loose their liquid water. This result is contrary to all climate model simulations of polluted clouds. The clouds in the models gain liquid water when they become polluted. Consequently the models are overestimating the indirect effect of aerosols, possibly by factors of two or three.

Recently, Mark Matheson, a graduate student and I, have also used satellite observations to demonstrate that the marine stratus in the North Atlantic are being affected by haze from Western Europe. As with the ship tracks, we're finding evidence that the indirect effect in the observations is much less than is being predicted in climate models. We're also linking the strength of the effect we're seeing to the column burden of water vapor above the marine stratus. The results have implications not just for the indirect effect of aerosols, but for the cloud- climate feedback problem as well.

It's clear from my descriptions that the work I'm doing focuses on issues in the global climate system, not the Pacific Northwest.

Most important thing for the public to know: As I tell my undergraduate class, “Man's Impact on Climate”. “The Pacific Northwest is due for a drying. First, global warming will slow down the Hadley circulation bringing about a more summer-like circulation during the winter season. Second, temperatures will be higher; so, precipitation will come as rain, not snow, and what snow falls, will melt more quickly. It's pretty clear that the Pacific NW won't be able to be as cavalier about its water supplies as it now appears to be.

What actions can be taken: To reduce emissions of greenhouse gasses: I'm in favor of mass transit. I'm in favor of smaller dwellings. I'm in favor of more efficient appliances.

I'm also in favor of developing alternative energy sources. So, I'd recommend 1) greater support for the development of mass transit, 2) a focus on developing communities that are attractive for people to live in smaller, energy efficient, dwellings near where they work and play, 3) incentives for switching from energy wasting to energy efficient appliances, 4) encourage research on alternative energy sources and greenhouse gas sequestration.

Biggest Uncertainties: The cloud-climate feedback and the global water cycle are clearly the source of the biggest uncertainty--not just globally, but for the Pacific NW as well. If we cannot tie down the water cycle and cloud-feedback, you can all-but forget about accurate assessments of regional climate change.

List of five publications:

Coakley, J.A., Jr., M.A. Friedman, and W.R. Tahnk, 2004: Retrievals of cloud properties for partly cloudy imager pixels. JAOTech. (in press).

A.S. Ackerman, O.B. Toon, D.E. Stevens, and J.A. Coakley, Jr., 2003: Enhancement of cloud cover and suppression of nocturnal drizzle in stratocumulus polluted by haze. Geophys. Res. Lett., 30, 10.1029/2003GL017189.

Liu, G., H. Shao, J.A. Coakley, Jr., J.A. Curry, J.A. Haggerty, and M.A. Tschudi, 2003: Retrieval of cloud droplet size from visible and microwave radiometric measurements during INDOEX: Implication for aerosols' indirect radiative effect. J. Geophys. Res. 108, 10.1029/2001JD001395.

Coakley, J.A., Jr. and C.D. Walsh, 2002: Limits to the aerosol indirect radiative effect derived from observations of ship tracks. J. Atmos. Sci., 59, 668- 680.

Ramanathan, V., et al., 2001: Indian Ocean Experiment: An integrated analysis of the climate forcing and effects of the great Indo-Asian haze. J. Geophys. Res., 106, 28,371-28,398.

Collaborators: V. Ramanathan, Scripps Institution of Oceanography B.A. Wielicki, NASA Langley Research Center Y.J. Kaufman, NASA Goddard Space Flight Center S. Platnick, NASA Goddard Space Flight Center M.D. King, NASA Goddard Space Flight Center N. Leob, NASA Langley Research Center D. Winker, NASA Langley Research Center A.S. Ackerman, NASA Ames Research Center

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Area of Expertise: Impact of global climate change on the occurrence of plant pathogens including the development of methodology to quantify how climate variability has impacted the severity of plant diseases.

Relevant research and synopsis of findings to date: Current efforts are primarily administrative; was involved in the US Global Climate Change plan development and continue to be involved in various international efforts directed at global climate change scenarios and potential impact on pests of agricultural crops (insects, pathogens, weeds).

Previous research documented the impact of climate variability on stripe rust of wheat in the Pacific Northwest and the contribution that it could have to other foliar diseases of important food crops.

Most important thing for the public to know: That global warming is happening and that altering the trajectory predicted for the increase in CO2 will be difficult. A more variable climate is to be expected and maintaining economic stability may be more difficult under this scenario.

What actions can be taken: Place a surtax on gas guzzling vehicles; require purchase of CO2 credits to compensate for activities that contribute to CO2 increases (e.g. air travel, automobile travel, factory emissions) biggest uncertainties and greatest impacts that could be addressed with research: Largest uncertainties include changes in precipitation patterns; for plant diseases, moisture and relative humidity are very important drivers. Another large uncertainty is how to respond to the changes in regards to perennial crops. Both could benefit from more research.

List of five publications:

Coakley SM (1995) Biospheric change: Will it matter in plant pathology? Canadian Journal of Plant Pathology 17, 147-153.

Coakley, SM, Scherm, H (1996) Plant disease in a changing global environment. Aspects of Applied Biology 45, 227-238.

Coakley SM, Scherm H, Chakraborty S (1999) Climate change and plant disease management. Annual Review of Phytopathology 37, 399-426

Scherm H, Coakley SM (2003) Plant pathogens in a changing world. Australasian Plant Pathology 32, 157- 165.

Collaborators: At OSU, occasional collaboration with Ronald Neilson, USDA/Forest Service

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Area of Expertise: Hydrology

Relevant research and synopsis of findings to date: Remote sensing sensor development for soil moisture with NASA-JPL. Test site in Sisters, OR

Most important thing for the public to know: More fuel efficient cars

Collaborators: Larry Marht-OSU, Michael Ek-NCEP, Mahta Moghaddam-U. Mich, JPL

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Area of Expertise: fisheries, estuaries, invertebrates

Relevant research and synopsis of findings to date: I am studying the abundance of pelagic fish (which includes salmon) off Oregon and Washington. I am also looking at the feeding of large predator fishes (hake, mackerel, and sharks).

As climate changes the circulation patterns, the ocean temperatures off Oregon, will change. This affects the distribution and abundance of the various pelagic species and undoubtedly affects salmon and other commercially important species. My findings indicate that cool/productive ocean conditions enhance forage fish populations (anchovy, herring, smelt) which in turn provide an alternative prey (instead of juvenile salmon) to large fish predators (birds, mammals, large fishes). I have also observed that warm ocean conditions cause large predatory fishes to arrive earlier and have larger impacts on forage fish (and probably salmon) populations.

Bottom line - climate change will produce a different fish community off the Northwest and this fish community may not support the large salmon population or other presently commercial species.

Most important thing for the public to know:
1) Climate change will alter terrestrial, freshwater, and marine habitats
2) Exotic species could become more abundance
3) Marine fish populations will change- they may become less abundant and the species composition will change.

What actions can be taken: Drive less, utilize conservation technology, and engage in prototype programs to investigate alternative energy sources/utilization.

Biggest Uncertainties: Will climate change increase or decrease upwelling and thus primary production off Northwest. How will climate change alter the migratory distributions (special and temporal) and feeding habits of migratory marine fishes (salmonids, hake, sardine, etc.)? How will climate change alter the recruitment of demersal fishes (rockfishes and flatfishes)? How will reduced Columbia River flows affect the adjacent marine environment (productivity, pelagic fishes, marine mammals, birds, etc.)? How will lower freshwater flows, warmer temperatures affect estuarine fauna?

List of five publications:
Emmett et al. (in review) Fluctuations in the abundance of forage fish, changing oceanographic conditions, and salmon marine survival off N Oregon/S Washington, 1999-2003. Fish. Ocean.

Emmett, R.L., and R.D.Brodeur 2000. Recent changes in the pelagic nekton community off Oregon and Washington in relation to some physical oceanographic conditions. N. Pac. Anad. Fish. Comm. 2:11-20.

Emmett et al. 2000. Geographic signatures of North American west coast estuaries.

Morgan, CA, Peterson,WT and Emmett, RL. 2003. Onshore-offshore variations in copepod community structure of the Oregon coast during the summer upwelling season.

Brodeur, RD, Fisher, JP, Teel, DJ, Emmett, RL, Casillas E., and Miller, TW. 2004. Juvenile salmonid distribution, growth, condition, origin, and environmental and species associations in the Northern California Current. Fish. Bull. 102:25-46.

Collaborators: W.T. Peterson, NOAA, Fisheries, Newport

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Area of Expertise: Application of naturally occurring chemical tracers to answer questions of ocean circulation pathways and variability with over a decade of experience in this endeavor in the Arctic.

Relevant research and synopsis of findings to date: I am presently involved in two major projects regarding climate change in the Arctic. One is a 10 year effort called the North Pole Environmental Observatory (http://psc.washington.edu/northpole/) and the other is a 5 year effort that I am leading to study freshwater flow and its variability through Canadian passages (http://newark.cms.udel.edu/~cats/index.html). Signs of dramatic changes in the Arctic region are already manifest. While it has not been the direct focus of my research, if the current rate of loss of the Arctic ice cover continues, the summertime cover could disappear by 2050. Models of climate suggest that as the ice cover diminishes, storms will tend to track further north at key times of the year and the Pacific Northwest could see reductions of precipitation of up to 40%.

Most important thing for the public to know: Residents of the Pacific Northwest should realize that the global climate is interconnected in ways that we are still uncovering. A good deal of the public is probably aware that the El Nino/La Nina phenomenon affects our climate. Very few are probably aware that change in a seemingly obscure place like the Arctic has the potential to diminish our local water resources with all of the economic disruption that implies.

What actions can be taken: I believe conservation measures at a national level are key. In addition, locally relevant incentives to conserve should be put on a fast track of development and enactment by states. In the Pacific Northwest this would include both the use of fossil fuels and water.

Biggest Uncertainties: There are considerable uncertainties in climate models and probably will continue to be for some time. I think we need to continue to pursue a broad base of research activities aimed at climate change because our climate system doesn't recognize political borders. In view of what we know now, we should work up regional plans for dealing with prolonged precipitation shortfalls.

List of five publications:

R.W. Macdonald, E.C. Carmack, F.A. McLaughlin, K.K. Falkner and J.H. Swift (1999) Connections among ice, runoff and atmospheric forcing in the Beaufort Gyre, GRL 26:15:2223-2226.

C.K.H. Guay, K.K. Falkner, R.D. Muench, M. Mensch, M. Frank and R. Bayer (2001) Wind-driven transport pathways for the Eurasian Arctic river discharge, JGR 106:C6:11,469-11,480

E.P. Jones, J.H. Swift, L.G.Anderson, M. Lipizier, G. Civitarese, K.K. Falkenr, G. Kattner and F.McLaughlin (2003) Tracing Pacific water in the North Atlantic Ocean, JGR 108:C4:3116

J.R. Taylor, K.K. Falkner, U. Schauer and M. Meredith (2003) Quantitative considerations of dissolved barium as a tracer in the Arctic Ocean, JGR 108:C12:3374

Collaborators: Jamie Morison Knut Aagaard Rebecca Woodgate Humfrey Melling Robie Macdonald Andreas Muenchow

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List of five publications:

Franklin, J.F., F.J. Swanson, M.E. Harmon, D.A. Perry, T.A. Spies, V.H. Dale, A. McKee, W.K. Ferrell, J.E. Means, S.V. Gregory, J.D. Lattin, T.D. Schowalter, and D. Larsen. 1991. Effects of Global Climatic Change on Forests in Northwestern North America. The Northwest Environmental Journal 7:233-254.

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Area of Expertise: Potential sea level rise impacts on Oregon beaches.

Relevant research and synopsis of findings to date: None now, but collaborated with the UW Climate Impacts Group on coastal impacts of climate change in the PNW several years ago. Contributed to CIG's regional report on climate change impacts.

Most important thing: That there is a great deal of uncertainty about how warming will affect our region, given climate model resolution, but that there will likely be significant impacts on water availability during times of high demand such as summer.

What actions can be taken: Tax breaks for low emission vehicles; other incentives for driving less; outreach education focused on improving understanding of carbon emissions each one of us generates and strategies for reducing one's emission footprint; establishing a new land use planning goal (or modifying existing ones) that focuses on climate change impact reduction so that cities and counties can better institutionalize many of the programs that some have for energy conservation and transportation; establishing a new carbon emissions reduction initiative within the OSU Extension Service to get programs out to youth and producers; establishing a climate change education goal and strategy within the Oregon Department of Education; funding the OSU climate change research initiative.

Biggest Uncertainties: See above -- it would be good to invest in more finely-resolved models to determine likely changes in the amount of precipitation, both spatial and temporal.

Also, I would like to see some research about how we might promote more natural storage of waters in the landscape through restoration and creation of wetlands that could make for a portion of lost storage in snow pack.

List of five publications:
Good, J.W. 1994. Shore protection policy and practices in Oregon: An evaluation of implementation success. Coastal Management 22(4):327-355. (discusses scenarios of sea level rise and impacts on Oregon beaches)

Collaborators: Doug Canning, Washington State Department of Ecology Paul Komar, COAS, OSU (sea level) Jonathan Allan, Oregon Department of Geology and Mineral Industries (sea level)

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Area of Expertise: Economic analysis of climate impacts, focused on loss of snowpack and sealevel rise.

Relevant research and synopsis of findings to date: Climate Change in the Pacific Northwest: Valuing Snowpack Loss for Agriculture and Salmon

Most important thing for the public to know: Reduction in summer streamflow from loss of snowpack.

What actions can be taken: 1. Adopt California CO2 tailpipe standards 2. Institute a 20% by 2020 RPS

Biggest Uncertainties: How can infrastructural decisions (water, ag) best be made in the face of climate uncertainty? How can we value large scale (non-marginal) ecosystem changes?

Collaborators: Laura Matson, Susan Whitmore

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Area of Expertise: Modeling of ecosystems, in particular with regard the carbon they can store.

Relevant research and synopsis of findings to date: Aside from the modeling work, which indicates the PNW has the potential to store a great deal more carbon, I am involved in managing a network of permanent plots of forests within the PNW. Thus far, we have not seen a consistent, long-term trend in growth response or mortality in these plots. However, studies of tree growth rings indicate there may be an increase in wood production in the last 20 years.

Most important thing for the public to know: It will change the rate ecosystems are disturbed and possibly lead to major shifts in the species dominating ecosystems. The system is going to be less predictable and we may not be able to count on it to produce the things we want and count it to produce.

What actions can be taken:
1. Local – Reduce their own demands, increase their own conservation efforts
2. National – Insist that there be a sensible national strategy via the ballot box

Biggest uncertainties and greatest impacts that could be addressed with research: The response of conifer forests is highly uncertain at this point. There could be more conifer forest area, growing faster or there could be less conifer forest growing slower. The reason for the uncertainty is lack of understanding of water availability versus carbon dioxide fertilization effects.

Biggest Uncertainties: The interaction of climate change with disturbance. This could really change the system in ways that are difficult to control. Assume climate change is happening and that models of changes will improve. We not only need to understand change that is likely, we need to focus on ADAPTATION strategies. More research on the social science side of the equation is needed. Change will happen...how will we make needed adjustments to minimize adverse impacts on society, economy, and environment? The Canadians are focusing their efforts on adaptation research...we could learn from their example.

List of five publications:
Harmon, M. E., K. Bible, M. J. Ryan, D. Shaw, H. Chen, J. Klopatek, and Xia Li. 2004. Production, respiration, and overall carbon balance in an old-growth *Pseudotsuga*/*Tsuga* forest ecosystem. Ecosystem 7:1-15.

Acker, S. A., C. B. Halpern, M. E. Harmon, and C.T. Dyrness. 2002. Trends in bole biomass accumulation, net primary production, and tree mortality in *Pseudotsuga menziesii* forests of contrasting age. Tree Physiology 22:213-217.

Harmon, M. E. and B. Marks. 2002. Effects of silvicultural treatments on carbon stores in forest stands. Canadian Journal of Forest Research 32:863-877.

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Area of Expertise: International environmental law; ocean and coastal resources management

Relevant research and synopsis of findings to date: Precautionary approach to resources management

Most important thing for the public to know: The time scales involved

What actions can be taken: Reduce fossil fuel use

Biggest Uncertainties: Sea-level rise impacts; streamflow impacts

List of five publications:
Roles for a precautionary approach in marine resources management (Ocean Yearbook 19)

Improving regional ocean governance in the U.S. (Coastal Zone 1991 Proceedings)

Coastal natural hazards management (59 Ore. Law Review)

Collaborators: M. Casey Jarman (University of Hawaii School of Law)

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Area of Expertise: Circulation and water properties in Oregon's Ocean and their seasonal and interannual variability over the continental shelf and slope, out to 150 km from shore.

Relevant research and synopsis of findings to date: Currently working on an NSF-funded project entitled "GLOBEC Long-Term Observation Program in the Marine Ecosystem of the Northern California Current"; with J.A. Barth, P. M. Kosro, R. L. Smith and P. A. Wheeler. We have completed more that 30 cruises in six years to study seasonal and inter-annual variations in the coastal ocean between Newport and the California border. We found that both seasonal signals and inter-annual signals are strong. The equatorial El Niño/La Niña cycle is a major source of inter-annual variability in the temperature, currents, salinity and density in this region. An unusual invasion of Sub-arctic Pacific Water from the northwest into this region produced dramatic results in the summer of 2002: upwelling source waters were unusually cold and enriched in nutrients; southward flow was unusually strong; chlorophyll concentrations were exceptionally high; and hypoxia occurred in the near bottom waters over the inner shelf.

What actions can be taken: Reduce use of automobiles for commuting; increase use of public transportation such as buses and trains. Walk or bicycle for transportation and to get exercise. Eat more local seasonal foods, less processed foods. Dress more simply, use fewer gadgets and toys.

Biggest Uncertainties: The productivity of the marine environment is highly variable, but we do not understand all the important causes of those variations. Fairly simple monitoring of the coastal ocean (e.g., measuring the temperature, salinity, currents, and nutrients over the shelf-break at regular intervals or continuously) would be helpful to forecast impacts of climate change on salmon and other fishery stock. Further interdisciplinary analysis of data sets already collected may also provide important new insights.

List of five publications:
Huyer, A., R. L. Smith and J. Fleischbein, 2002: The coastal ocean off Oregon and Northern California during 1997-8 El Niño. Progress in Oceanography, 54, 311-341.

Freeland, H. J., G. Gatien, A. Huyer and R. L. Smith, 2003. Cold halocline in the northern California Current: An invasion of subarctic water, Geophysical Research Letters, 30(3), 1141, doi:10.1029/2002GL016663.

Huyer, A. 2003. Preface to special section on enhanced Subarctic influence in the California Current, 2002. Geophysical Research Letters, 30(15), 8019, doi:10.1029/2003GL017724.

Lynn, R. J., S. J. Bograd, T. Chereskin and A. Huyer. 2003. Seasonal renewal of the California Current: The spring transition off California. J. Geophys. Res., 108(C8), 3279, doi: 10.1029/2003JC001787.

Collaborators: Robert L. Smith, Patricia A. Wheeler, P. Michael Kosro, John A. Barth, William T. Peterson.

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Area of Expertise: Governor's Advisory Group on Global Warming member- been active in environmental matters for 15 years. Jubitz Family Foundation supports programs that enhance our natural environment.

Relevant research and synopsis of findings to date: None.

Most important thing for the public to know: Scientists agree it is happening at a rapid rate with unknown but probable consequences.

What actions can be taken: Educate each other and the citizenry in the belief that good science leads to good public policy. Also believe an informed citizenry eventually does the right thing.

Biggest Uncertainties: Effects on agriculture and water availability and the need for power.

Collaborators: Gus Speth, Dean, School of Forestry and Environmental Science, Yale University, David Suzuki, University of British Columbia

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Area of Expertise: Seasonal to interdecadal changes in marine pelagic ecosystem structure and biogeochemical cycles in the North Pacific Subtropical gyre and California Current. Ocean color remote sensing.

Relevant research and synopsis of findings to date: Present research includes: 1) Long-term response of pelagic ecosystems to environmental perturbations in the North Pacific subtropical gyre, 2) how the intensity and frequency of physical perturbations affect phytoplankton assemblages and the fate of organic carbon production in the California current off Oregon.

The general pattern that appears to be common to all ecosystems is that biological mediated sequestration of carbon dioxide is the result of the uncoupling between photosynthesis and respiration. This uncoupling in the pelagic environment, and the subsequent export of organic matter into the deep ocean, is mainly driven by event scale perturbations. Hence, it may not be enough to characterize changes in the mean state of the marine environment, but also we need to estimate changes in the intensity and frequency of short time scale perturbations, if we want to understand the role of the ocean ecosystems in global elemental cycles under different climate change scenarios.

Most important thing for the public to know: Climate change is an intrinsic part of nature, however, human activities can enhance the rates of environmental change. It is the rate of change, relative to the rate of adaptation of species, including ours, which is important in evaluating the impact of climate change in the environment. Because the effects of climate change may not manifest themselves in gradual form, predicting the effects of climate change in ecosystem structure and the environment is difficult to predict.

What actions can be taken: Reduce energy consumption per capita by reducing home energy use (energy and water efficient houses) and increasing the use of alternative energy sources for transportation.

Biggest Uncertainties: Probably, changes in hydrological cycles and water availability.

List of five publications:

Abbott, M. R., and R. M. Letelier, “Decorrelation scales of chlorophyll as observed from bio-optical drifters in the California Current”, Deep Sea Res., v45, 1639-1667 (1998).

Karl, D. M, R. R. Bidigare and R. M. Letelier, “Long-term changes in plankton community structure and productivity in the subtropical North Pacific Ocean: The domain shift hypothesis” Deep-Sea Res. II, 48: 1449-1470 (2001).

Letelier, R. M., J. E. Dore, C. D. Winn, and D. M. Karl, “Seasonal and interannual variations in autotrophic carbon assimilation at Station ALOHA” - Deep-Sea Res., 43, 467-490 (1996).

Letelier, R. M., D. M. Karl, M. R. Abbott, P. Flament, M. H. Freilich, R. Lukas, and P. T. Strub, ”Role of late winter mesoscale events in the biogeochemical variability of the upper water column of the North Pacific Subtropical Gyre”, J. Geophys. Res., 105, 28,723-28,739 (2000). Correction in J. Goephy. Res., 106, 7181-7182 (2000).

Collaborators: David M Karl (U. Hawaii), Robert Bidigare (U. Hawaii), Kenneth Johnson (MBARI), Michael Landry (UCSD), Mark Abbott (OSU)

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Area of Expertise: Microclimatology climate change relevant research and synopsis of findings to date: We have deployed several microclimate networks in the Oregon to examine spatial variability on horizontal scales of 100 m to about 10 km.

Biggest Uncertainties: We need to better understand many of the details of the existing microclimatology and its year to year variations.

Collaborators: Dean Vickers, Beverly Law

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Area of Expertise: I study the geologic history of ocean circulation and how it is related to long term climate change.

Relevant research and synopsis of findings to date: My research has focused on the eastern Pacific basin from Chile to Alaska, on time scales spanning several glacial cycles. Studies have illustrated the range of oceanic and continental climates of the Pacific Northwest during the last glacial cycle. During the last glacial maximum for example, significant reduction in coastal upwelling occurred in the northeast Pacific which can be related to marked changes in continental vegetation of western North America.

Most important thing for the public to know: 1. that change in inevitable whether it involves human induced global warming or through natural variability. 2. Change is of sign cant magnitude to effect management of natural resources. 3. The rate of change may be much faster than the rate in which human “institutions” may respond.

What actions can be taken: This is clearly a national problem. But Oregonians and Washingtonians have a strong reputation of environmental stewardship and through local changes in attitudes can make a difference??????

Biggest Uncertainties: The biggest uncertainties are the rate and magnitude of future change. The greatest impact will be on water resources in a region use to having more than enough water for agriculture and other uses.

List of five publications:
N.G. Pisias, and A.C. Mix, 1997 Spatial and Temporal Oceanographic Variability of the Eastern Equatorial Pacific During the Late Pleistocene: Evidence from Radiolaria Microfossils. Paleoceanography, 12(3), 381 -393.

L.A. Welling, and N.G. Pisias, 1998. How do Radiolarian Sediment Assemblages Represent Surface Ocean Ecology in the Central Equatorial Pacific? Paleoceanography, 13(2), 131-149

N.G. Pisias, A.C. Mix, and L. Heusser, 2001. Millenial Scale Climate Variability of the Northeast Pacific Surface Ocean and Atmosphere based on Radiolaria and Pollen. Quaternary Science Reviews 20:1561 -1576.

P.U. Clark, N.G. Pisias, T.F. Stocker, and A.J. Weaver, 2002. The role of the thermohaline circulation in abrupt climate change, Nature 415, 863-869.

Collaborators: Alan Mix, COAS, OSU Steve Hostetler, USGS Linda Heusser, Lamont-Doherty Earth Observatory, Columbia Univ. Peter Clack, COS, OSU, Nicholas Shackleton, Cambridge University

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Area of Expertise: My area of expertise related to climate is the fluid dynamics and thermodynamics of the ocean and the atmosphere.

Relevant research and synopsis of findings to date: Part of my research is directed at understanding the large-scale structure and circulation of the ocean, and its interaction with the atmosphere. The ocean plays an important role in the global climate system. The goal of my this research has been to develop quantitative conceptual models that clarify the manner in which the ocean organizes itself on the long time and large space scales relevant to climate dynamics and climate change, and so to isolate the specific processes and model elements that must be analyzed and improved in order that climate change can be better understood and predicted.

Recently my work in this area has focused on the control of the global ocean circulation by surface wind forcing, interior turbulent diffusion, and the geometric configuration of the ocean basins. Another part of my research is directed at understanding the local ocean and atmosphere circulation along the Pacific Northwest coast. Global climate change is likely to induce changes in the local coastal ocean circulation and ecosystem, and in regional meteorological conditions. My recent research in this area has focused on understanding present-day conditions, including the influence of coastal topography on coastal winds, and on the influence of coastal winds on coastal ocean circulation.

Most important thing for the public to know: Climate change will happen, in part because of human activities, and it will affect us; we will be best served if we learn to predict, mitigate, and adapt to it.

What actions can be taken: Drive less, and take advantage of other opportunities to conserve fuel and energy.

Biggest Uncertainties: Regional manifestations of global climate change are difficult to predict, so there is a lot of uncertainty. My impressions is that the probability that warmer temperatures will lead to reduced annual water storage in snow and glaciers seems relatively high, and consequently the possibility of persistent water shortages and drought conditions needs to be taken seriously. I believe that effects on coastal ocean circulation and ecosystems are more difficult to predict at this stage.

List of five publications:

Samelson, R. M., Simple mechanistic models of mid-depth meridional overturning. Journal of Physical Oceanography, in press.

Gan, J., J. S. Allen, and R. M. Samelson, 2004. On open boundary conditions for a limited-area coastal model off Oregon. Part II:
Response to wind forcing from a regional mesoscale atmospheric model. Ocean Modelling, accepted.

Samelson, R. M., and E. Tziperman, 2001. Instability of the chaotic
ENSO: the growth-phase predictability barrier. Journal of the Atmospheric Sciences, 58, 3613-3625.

Samelson, R. M., 1998. Large-scale circulation with locally enhanced vertical mixing. Journal of Physical Oceanography, 28, 712-726.

Samelson, R. M., and G. K. Vallis, 1997. Large-scale circulation with small diapycnal diffusion: the two-thermocline limit. Journal of Marine Research, 55, 223-275.

Collaborators: W. K. Dewar, Florida State University E. Tziperman, Harvard University G. K. Vallis, GFDL/Princeton University.

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Area of Expertise: My area of expertise is in climate change impacts on terrestrial ecosystems, particularly vegetation response to climate change and the implications of potential future vegetation change for conservation and natural resource management.

Relevant research and synopsis of findings to date: My current research involves simulating vegetation response to potential future climate change using a variety of vegetation and physically-based process models. The vegetation simulations indicate that vegetation response to future climate change in Oregon and Washington will be large and that regional-scale vegetation shifts will not simply be northward and upward in elevation but will occur in all directions, including both southward and downward in elevation in some cases. The vegetation simulations also indicate that the physiological response of vegetation to changes in atmospheric carbon dioxide concentrations may be more important, in the near term, than the response of vegetation to potential future changes in climate.

Most important thing for the public to know: It is important that Oregonians and Washingtonians be made more aware of the complexity and interactions of potential future climate change impacts in the Pacific Northwest, including economic, social, cultural and ecosystem effects.

What actions can be taken: My personal opinion is that the following actions would be useful:

- Increase public outreach and education on the potential impacts of climate change and the ways that individuals, organizations, businesses, etc., can reduce greenhouse gas emissions.
- Increase incentives for improved energy efficiency and renewable energy use (e.g., solar energy, hybrid vehicles, etc.) for individuals, organizations, businesses, etc.
- Continue to support and improve mass transportation options.

Biggest Uncertainties: There is still uncertainty concerning the rate and magnitude of future climate change in the Pacific Northwest. This uncertainty could potentially be reduced with additional research. Important potential future climate change impacts requiring additional research include:

Potential future changes to hydrologic regimes, including the timing and amount of runoff and snow pack, and the corresponding impacts to ecosystems (e.g., salmon), economies (e.g., tourism, agriculture), natural resource management, etc.

Potential future changes to fire regimes, which will be affected both by changes in climate and by vegetation response to climate change (e.g., changes in the distribution of certain types of vegetation).

Potential future increases in sea-level and its impacts (e.g., beach erosion).

Potential future changes in the distributions and severity of insect pests and diseases, particularly those affecting agriculture and natural resources.

List of five publications:
Shafer, S. L., P. J. Bartlein, and R. S. Thompson. 2001. Potential changes in the distributions of western North America tree and shrub taxa under future climate scenarios. Ecosystems, 4:200-215.

Hansen, A. J., R. P. Neilson, V. Dale, C. Flather, L. Iverson, D. J. Currie, S. Shafer, R. Cook, and P. J. Bartlein. 2001. Global change in forests: Responses of species, communities and biomes. BioScience, 51:765-779.

Whitlock, C., S. L. Shafer, and J. Marlon. 2003. The role of climate and vegetation change in shaping past and future fire regimes in the northwestern U.S. and the implications for ecosystem management. Forest Ecology and Management, 178:5-21.

Shafer, S. L., P. J. Bartlein, and C. Whitlock. (in press) Understanding the spatial heterogeneity of global environmental change in mountain regions. In: U. Huber, H. K. M. Bugmann, and M. A. Reasoner (eds.), Global Change and Mountain Regions: A State of Knowledge Overview. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Collaborators: Patrick J. Bartlein (Univ. of Oregon); Robert S. Thompson (U.S. Geological Survey)

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Area of Expertise: Physical oceanography of “the Oregon ocean.”

Relevant research and synopsis of findings to date: Present grant (1997-2004): Long-term observation program in the marine ecosystem of the northern California Current. Proposed (for 2005-8): Changing ocean conditions in the northern California Current - effects on primary productivity and salmon.

Findings: The seasonal cycle and the effects of El Nino are strong in the Oregon ocean. Detecting “climate change”,” per se” in contrast to the historical decadal or regime “shifts” will require long-term monitoring of the ocean. That is not to say that significant super-seasonal and non-El Nino changes have not been observed (see references cited by Huyer for this meeting), which may be earlier indications of climate change.

Most important thing for the public to know: The majority consensus of scientists studying the oceanic and atmospheric conditions is that humans are causing the climate to change. The degree of change and whether that may be manifested as greatly increased variability (more extreme weather and seasonal variability) is uncertain. A prudent people would prepare for the change, especially since it makes economic sense to do so now while we have resources and time - and since it would reduce our national dependence on “foreign oil” and help the environment. See next question.

What actions can be taken: Based on my experience in Germany and in my frustration driving I-5 between Corvallis, Portland and Seattle:

1. Increase the availability of “mass transport” locally and regionally. Wouldn't it be wonderful to have frequent high-speed rail in the Eugene-Vancouver B. C. corridor?
2. Increase the tax on gasoline and diesel fuel.

From my perspective as a marine scientist:
Increase the effort to protect the coastal and riverine environment so that further degradation doesn't compound the stress of climate change on those ecosystems.

Biggest Uncertainties: here in Oregon and Washington? Can effects be mitigated by increased protection of the local coastal and riverine habitats?

In the marine field: Do small changes in oceanic conditions cause substantial changes in the marine biota including salmon, as suggested by present studies? How do changes in oceanic conditions in the larger Northeast Pacific effect the salmon fish search: 1. The coastal ocean off Oregon from 1961 to 2000: Is there evidence of climate change or only of Los Niños?

List of five publications:
Smith, R. L., A. Huyer & J. Fleischbein, 2001. In: Progress in Oceanography, 49:63-93, 2001.) (on http://ltop.coas.oregonstate.edu/~ctd/pdf/pub.html)

Upwelling in the ocean: Modern processes and ancient records. (C.P. Summerhayes, K.-C. Emeis, M. V.Angel, R. L. Smith & B. Zeitzschel, eds.: Dahlem Workshop Environmental Sciences Research Report ES 18. John Wiley & Sons, 1995). (The first chapter discusses relevance of topic to climate change problem and provides recommendations for future oceanographic research.)

The signature of El Niño off Oregon, 1982-83. (Huyer, A. and R. L. Smith, 1985. In: Journal of Geophysical Research, 90:7133-7142, 1985.)

Collaborators: Prof. Adriana Huyer Prof. Pat Wheeler Prof. Bill Pearcy Dr Michael Kosro

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Area of Expertise: Physical Oceanography: I have used satellite data to look at the large-scale changes in circulation in the eastern Pacific (from 55S to 62N) on intraseasonal, seasonal and interannual time scales.

Relevant research and synopsis of findings to date: Our research using satellite data shows that prior to the appearance of cool, fresh and nutrient rich water off Oregon in summer 2002, which led to anoxic conditions and the death of crabs and bottom fish, anomalous transport from the north occurred for over a year. This type of change in the large-scale ocean circulation may be what we should expect with large-scale changes in the climate. The relative magnitude of the circulation changes may be small and undramatic, but the appearance of different water masses can strongly alter the ecosystem characteristics and cause changes in populations of commercially important fish and invertebrate species.

On the interannual (3-7 year scale), we have documented changes in the large-scale circulation that were associated with the 1997-1998 El Nino, as part of the U.S. GLOBEC program in the NE Pacific (NEP). We have a proposal in for the synthesis phase of GLOBEC NEP, which would continue our work over the next 3 years, and a proposal to NASA (which I believe is funded) to compare the variability in circulation in the NE Pacific (California Current) to the circulation in the SE Pacific (the Peru-Chile Current). Our previous results show that the oceanic connection of the El Nino signal to mid-latitudes (typical of the Pacific Northwest) is more direct off S. America than off N. America, where the mouth of the Gulf of California slowed down the northward propagation of the signal in summer, 1997. The high sea level and warm coastal temperature signals spread northward more strongly in fall 1997, after the atmospheric teleconnection strengthened. Studies of previous El Ninos confirm that as one moves from Baja California to Canada and Alaska, the relative influence of the atmospheric connection increases, in comparison to the weaker contribution from the oceanic signal.

During each of the two peaks in high sea level and temperature at the equator in 1997, symmetric signals left the equator and propagated into both hemispheres. The seasonal cycle of winds and currents enhanced the movement of the signal off S. America during the first peak (May-July 1997) and opposed it off N. America. The opposite was the case during the second peak, which was amplified off N. America and diminished off S. America. The message is that the ocean along the coast of the Pacific Northwest is more strongly affected by the signals that come through the atmosphere (modifying the strength of fall-winter storms) than through the ocean. On the other hand, signals that do arrive through changes in the large-scale circulation have dramatic effects, as shown by the incursion of subarctic water in summer 2002 (described above). Thus the Pacific Northwest is located in a transition region, where relatively large changes in commercially important populations can be caused by moderate changes in either the atmospheric or oceanic circulation.

<u>Most important thing for the public to know:</u>
1) The PNW lies in a transition region for both the atmosphere (between the Aleutian Low and N. Pacific High) and the ocean (between the northward boundary current of Alaska Gyre and the southward California Current). Relatively small changes in either can cause large changes in the ocean's water properties. These, in turn, affect the abundance and distribution of commercially important marine populations.
2) The general prediction for a warmer and moister atmosphere is for more extreme events: stronger storms, wetter wet periods and dryer droughts.
3) The interannual changes that have occurred during El Nino and La Nina events may serve as indications of the kind of changes the PNW might experience in a perturbed climate, as may the changes associated with the decadal scale Pacific Decadal Oscillation (PDO).
4) While climate models may not be accurate enough to predict the details of regional changes, they have progressed enough that most atmospheric scientists and oceanographers agree that both the atmosphere and ocean have already been affected by greenhouse gas warming and that these effects will continue to increase over the next 50 years, even if we stopped increasing the emissions now. Those effects will be amplified by a continuing increase in emissions.

<u>What actions can be taken:</u> I'm an oceanographer, not a politician. We should be encouraging alternative forms of energy and transportation.

<u>Biggest Uncertainties:</u> The PNW will be affected by changes in the regional and global atmospheric circulation and ocean currents. There is a national effort at this moment to increase research in the basin-scale and coastal ocean. Many other regions on the east coast and now in Southern California have tapped into the resources (funding) that are being made available for coastal ocean observing systems. This takes active participation by the State (often matching funds are needed) and the State's congressional representatives. Oregon (especially) and Washington have not been active supporters of oceanographic research.

<u>List of five publications:</u>
Strub, P.T. and C. James, 2003. “Altimeter estimates of anomalous transports into the California Current during 2000-2002.”; Geophys. Res. Lett., 30(15) 8025, doi:10.1029/2003GL017513.

Thomas, A.C., P.T. Strub, and P. Brickley, 2003.”Anomalous satellite-measured chlorophyll concentrations in the northern California Current in 2001-2002.”; Geophys. Res. Lett., 30(15), 8022, doi:10.1029/2003GL017409.

Strub, P.T., H.P. Batchelder, and T.J. Weingartner, 2002.”U.S. GLOBEC Northeast Pacific Program: Overview”, Oceanography, 15, 30-35.

Strub, P.T., and C. James, 2002. The 1997-1998 “El Nino signal along the SE and NE Pacific boundaries - an altimetric view”; Prog. Oceaongr., 54/1-4, 439-458.

Strub, P.T., and C. James, 2002. “Altimeter-derived surface circulation in the large-scale NE Pacific Gyres: Part 2. 1997-1998 El Nino anomalies.”; Prog. Oceaongr., 53/2-4, 185-214.

Collaborators: Jane Huyer (COAS, OSU), Hal Batchelder (COAS, OSU), Bill Peterson (NOAA/NMFS, HMSC, Newport, OR), Andrew Thomas (U. Maine), Frank Schwing(NOAA/NMFS/PFEL, Monterey, CA)

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Area of Expertise: Atmospheric chemistry and physics.

Relevant research and synopsis of findings to date: I am primarily studying aerosol deposition to vegetation.

Most important thing for the public to know: Regional effects will not necessarily follow global mean temperature changes.

What actions can be taken: Conserve energy. Buy more fuel efficient cars.

Biggest Uncertainties: Effects of clouds and aerosol.

List of five publications:
Vong,R.J. and D.S.Covert, Simultaneous observations of aerosol and cloud droplet size spectra in marine stratocumulus, Journal of the Atmospheric Sciences 55, 2180-92, 1998.

Collaborators: David S. Covert, University of Washington