OCCRI News

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Quarterly Newsletter of the Oregon Climate Change Research Institute
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In this Issue:

First Oregon Climate Assessment Report Released

The report, released and coordinated by OCCRI, was written by more than 70 scientists from universities, state, and federal agencies.

The report is mandated by the state and was delivered to Governor Kulongoski on November 30.

Key findings of the assessment of climate change in Oregon include:

- Temperatures will increase through the coming century.
- Summers will be warmer and drier.
- Summer water supply will decrease as a result of reduced snowpack and summer precipitation.
- The availability, quantity, and cost of of water will be the limiting factor for agricultural production systems under a warmer climate.
- Wildfire is projected to increase in all Oregon forest types in the coming decades.
- The frequency and magnitude of coastal flooding events may continue to increase.
- Many plant and animal species on land, in freshwater, and in the sea have and will shift their distributions and become less or more abundant.
- There will be changes in the marine environment, including increasing water temperatures.
- Oregon's economy, like many other states, is likely to be affected by a changing climate and by policies addressing projected changes.
- The primary drivers of greenhouse gas emissions population, consumption, and the emission intensity of the economy.
- Oregon is already experiencing the impacts of climate change.

Both a two-page executive summary, and the full 400-page report are available at occri.net/ocar.

OSU to Host the Headquarters of Two Regional Climate Science Centers

In coordinated announcements, the National Oceanic and Atmospheric Administration (NOAA) and the Department of the Interior (DoI) announced in September that OCCRI will be the anchor institution for two regional climate science centers.

The DoI will establish one of its eight planned Climate Science Centers in the Pacific Northwest, led by a consortium of three universities: Oregon State University, the University of Washington and the University of Idaho. OSU will host the administrative headquarters of the center.

On September 23rd, Secretary of the Interior Ken Salazar described the initiative as one that will bring together expertise in climate science, ecology, impacts assessment, and information technology:

> *"In the Northwest, changes in temperature, rain and snowfall will have significant impacts on forests, agriculture, and on streams and the salmon they support. The consortium of University of Washington, Oregon State University and University of Idaho provides enormous and complementary capabilities and familiarity with issues across the Northwest."*

This was the second major federally funded climate center recently announced in which OCCRI has been awarded a leadership role. On Sept. 22, NOAA announced one of six new Regional Integrated Sciences and Assessments (RISA) projects would be established at OSU. The official announcement was long anticipated--we received unofficial notice on December 18, 2009 and mentioned it in our first newsletter last spring. Named the Climate Decision Support Consortium, the new RISA includes scientists from University of Oregon, Boise State University, University of Idaho, and University of Washington, as well as the Extension programs of all three states. CDSC is coordinating with the UW Climate Impacts Group, which had been NOAA's first and longest-running RISA project, for a smooth transition.

The CDSC will interact with federal and state agencies, municipalities, utilities, businesses, and non-governmental organizations, while the Department of Interior Climate Science Center will focus on providing scientific support for decisions made by agencies within the DOI and its partners, particularly in the context of Landscape Conservation Cooperatives.

The DoI Climate Science Center will have a significant federal component, initially led by Carol Schuler, former director of the USGS Forests and Rangelands Ecosystem Science Center (FRESC) The university component will be led by Philip Mote, the director of OCCRI, and by Lisa Graumlich, the new dean of UW's College of the Environment. Steven Daley-Laursen, former interim president of UI, is also a co-leader. The new DOI climate center will advise federal and state agencies on policy decisions. It will also have a role in training students on climate change-related issues and preparing them to work in the organizations the center will serve.

The center will consist of both university and federal personnel: it will eventually bring three or more scientists each to OSU and UW, and allow the University of Idaho to house the data management infrastructure. The initial funding for university-guided operations is $3.6 million over five years, which will provide logistical support for the federal scientists and train graduate students. An additional $10-$12 million is intended to support a variety of research projects of importance to DoI.

The selection of the consortium to lead the Northwest Climate Science Center was made through a competitive bidding process. The combined strengths of the three universities in applied climate research made a compelling case for their selection.

These regional climate centers are part of the DOI's first coordinated strategy to address climate change in the United States and to engage local, state, and federal agencies on managing climate change impacts within the eight regions.

North Carolina State University will lead DoI Southeast Climate Science Center. The University of Alaska Fairbanks has been selected to lead the Alaska Climate Science Center. A Center for the North Central region has been established at Colorado State University. DoI also announced a Center for the southwest awarded to a partnership of six universities with University of Arizona as lead; this Center also has significant alignment with two RISA programs, in the Southwest and California-Nevada. Other regional centers are planned for the North Central, Southwest, Northeast, South Central and Pacific Islands.

Who We Are…

In each newsletter, we will publish a mini-bio of an OCCRI staff member. In this Issue, we hear about Darrin Sharp.

Darrin wears a number of hats within OCCRI. For starters, he is OCCRI's de-facto IT department. He administers the OCCRI servers, maintains the OCCRI website, and consults on most IT related issues.

In addition to his IT duties, Darrin is involved with many climate related projects at OCCRI. For example, he has created visualizations for climate and biogeographical data;

developed tools to extract regional climate data from continental-scale datasets; and worked with various stakeholders to provide climate data so they can make informed management decisions. Darrin also gives climate related presentations to a variety of groups. These groups may include the general public; representatives of nongovernmental organizations; and federal, state, and local municipality stakeholders.

After earning a B.S. and M.S. in Computer Science, Darrin spent a number of years in the high-tech industry. After returning to school and earning an M.S. in Ecology, Darrin worked for several companies in the environmental consulting and geospatial industries.
Darrin joined OCCRI in August 2009.

Climateprediction.net Launches Weatherathome.net

Climateprediction.net and the UK Met Office have launched an international project called weatherathome.net. Anyone with a computer and internet access will be able to take part in furthering scientific understanding of climate change.

The program is somewhat analogous to Seti@Home. Users download packets of data to be analyzed on their personal computer while it is otherwise idle.

Since 2003, climateprediction.net has harnessed computer time donated by hundreds of thousands of volunteers to run climate models. This new experiment takes results from those and other modeling experiments and uses them to drive higher resolution models in three regions: Europe, the Western United States and Southern Africa.

Understanding the impact of climate change on regional scales is challenging for a couple reasons. First, the models used for simulating global climate change do not resolve many relatively smaller-scale features, such as the Oregon Coast Range. Second, many simulations are required to develop robust statistics of rarely-occurring extreme weather events.

The new experiment uses a regional climate model that provides information on climate processes at much greater detail than is typically provided by global climate models. Because of the cost of computing and analysis time, the regional model is limited to a specific area and is supplied with key data from the global climate model at the regional boundaries. In this way, the regional model detects large-scale weather effects that can influence climate locally.

Both the global and regional models have been developed by the UK Met Office, and results from Western US region will be analyzed by scientists at Oregon State University.

The experiment is supported by Microsoft Research, the UK Natural Environment Research Council and the European Commission.

Researchers Examine Three Recent Flavors of Drought in the Pacific Northwest

The Pacific Northwest has experienced a number of droughts in the past decade. Karin Bumbaco of the Office of Washington State Climatologist and Philip Mote of OCCRI discuss three of these droughts in a recent article published in the Journal of Applied Meteorology. The conditions that led to each of these droughts, precipitation, soil moisture, and temperature, were different in each case but all impacted the Pacific Northwest.

The Pacific Northwest experiences dry conditions and mild signs of drought most summers, often seeing periods of weeks with little or no rain. Recent droughts in the Northwest, however, have exceeded these typical dry conditions.

Understanding drought in the Pacific Northwest is critical because snow-pack is important to the seasonal hydrology and the role that climate anomalies can play in altering streamflow and snowpack throughout the year.

Bumbaco and Mote (2010) describe the meteorological and hydrological conditions during three recent droughts in 2001, 2003, and 2005. These three flavors of drought are not the only mechanisms of drought in the Pacific Northwest (PNW), but they illustrate the different types of drought that occurred in a span of only 4 years.

The first flavor of drought in 2001, primarily affected farmers and occurred simply because of exceptionally low winter precipitation. Low winter precipitation led to critically low winter snowpack. The resulting low summer water supplies directly impacted farmers in the Yakima Basin, WA where rationing took place. In Klamath Basin, OR, increasing water demands conflicted with concerns over meeting the minimum streamflows required for sucker fish and coho salmon. Farmers lost $157 million in gross agricultural sales. The drought also resulted in hydroelectric power loss ($3.5 billion in WA and $5.8 billion in the PNW).

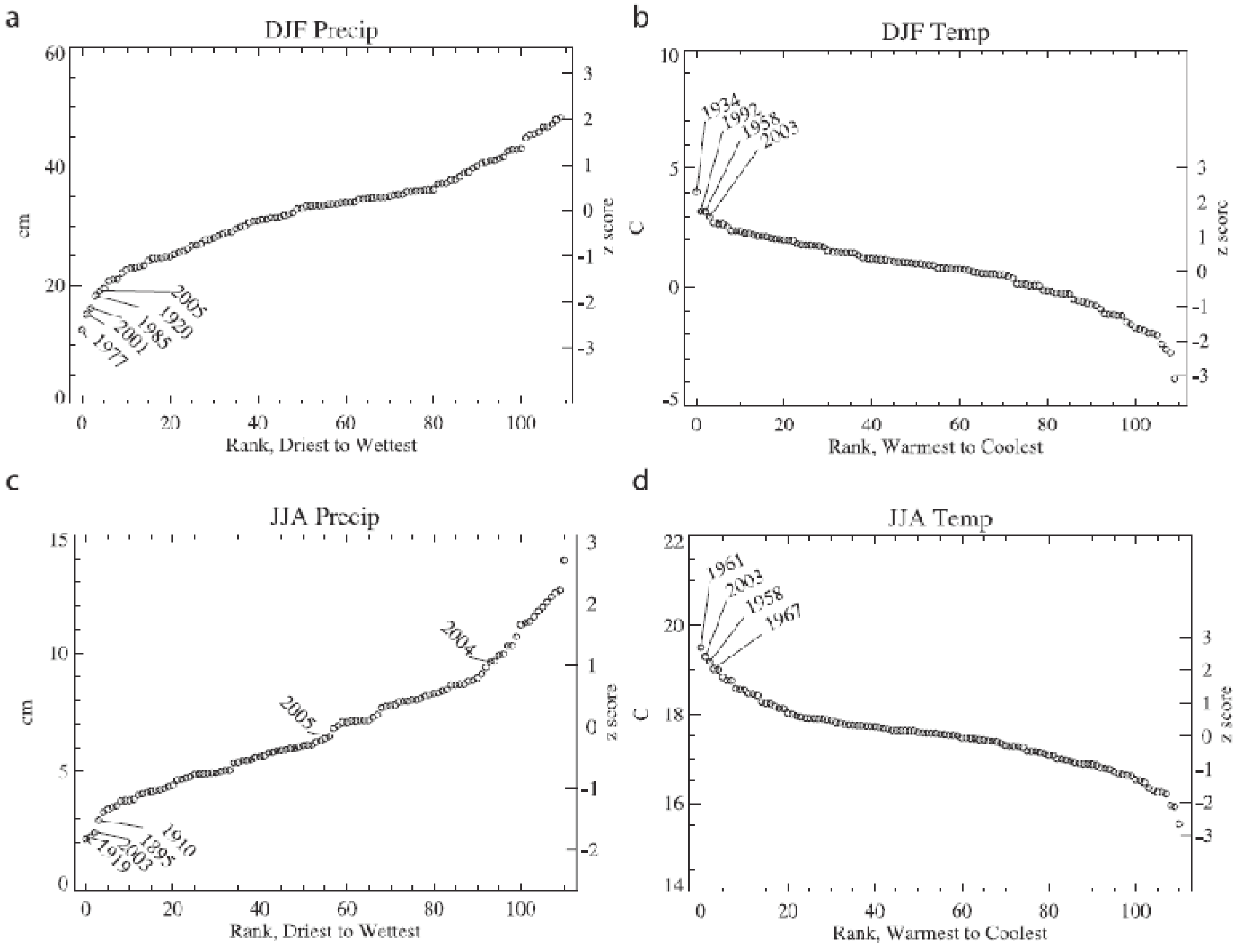

Figure 1. Plots of 1895–2005 ranked (a) precipitation (cm) for DJF, (b) average temperature for DJF, (c) precipitation for JJA, and (d) average temperature for JJA for the PNW with the value and z score (approx. standard deviation) on individual axes. Selected years are indicated.

The 2003 drought had slightly different causes in the two states: in WA, exceptionally low summer precipitation, and in OR, a combination of a warm winter and low summer precipitation. The 2003 drought primarily affected forests in OR, leading to forest fires, and also affected rivers and river uses in western WA and OR. In Oregon, 4956 fires occurred between June and September, compared with the 10-year average of 4342. One of the most serious fires in OR during 2003 was the Booth and Bear Butte (B&B Complex) fire that burned much of the Central Cascades and areas around Highway 20.

The third flavor of drought, in 2005, was brought on by a series of warm winter temperatures during precipitation events in the winter snow accumulation season in WA. In mid-January, temperatures remained above freezing for days and combined with heavy rainfall to wash away the snow. Farmers, horticulture, and the recreation industry were affected in WA in 2005. Recreational areas recorded a loss of $43 million based on admission fees alone, but actual losses were likely higher.

These three droughts illustrate three different drought mechanisms in the PNW. In 2001 and 2005, high temperatures or a combination of high temperatures and low precipitation produce low snowpack. In these situations, summer water shortages may be anticipated and mitigated. To deal with wintertime impacts from droughts similar to 2001 and 2005, accurate prediction as early as possible is needed. Droughts similar to that of 2003 are much more sudden and more difficult to predict. These are general statements, however, and independent predictions should be made for each basin.

Projections of future climate change for the PNW indicate future warming, but changes in future precipitation are less clear. Global Climate Models suggest that mean precipitation may increase in winter and will likely decrease in the summer. But even with moderately large increases in precipitation, warmer temperatures will still significantly decrease snowpack, leading to summertime hydrologic droughts in certain river basins.
Better drought information requires better observations and

better forecasting of streamflow. The analysis conducted by Bumbaco and Mote (2010) underscores that summertime droughts affect the PNW and that drought mechanisms are nuanced and require further attention.

For the complete article, please see:

Bumbaco, Karin A., Philip W. Mote, 2010: Three Recent Flavors of Drought in the Pacific Northwest. J. Appl. Meteor. Climatology. 49, 2058–2068.

Study Investigates Potential Climate Change Impacts on Spotted Owl

An analysis of northern spotted owls in the Pacific Northwest has found negative associations between population growth rates for northern spotted owls during both dry growing seasons and cold, wet winters and nesting seasons. This raises concerns that climate change may negatively affect their already fragile existence (Glenn et al., 2010).

The study looked at the rate of population growth among spotted owls over a period of 18-20 years at six areas: the Olympic Peninsula and Cle Elum in Washington; and the Oregon Coast Range, Tyee, the H.J. Andrews Forest, and the southern Cascade Mountains in Oregon. Regional weather and climate patterns varied throughout two-decade study. This variability provided scientists with records of stormy years, drought, and strong El Niño and La Niña events for comparison to spotted owl populations.


Photo courtesy U.S. Fish and Wildlife Service

The amount of variation in population growth rates that was explained by weather and climate varied widely across all six areas, indicating that other factors, such as habitat, also are important. The presence of barred owls affected spotted owl population growth rates in four of the six locations. Barred owls are more aggressive and compete with spotted owls for territory.

Adult spotted owls had fairly high annual survival rates, but reproduction was much more variable. Survival was more closely related to regional climate events such as drought (which produced fewer offspring), while integration of new owls into the population was more often associated with local weather conditions.

At four study areas, population growth rate was positively associated with wetter-than-normal conditions during the growing season, either through associations with annual survival, integration of other owls, or both.

Particularly dry summers may cause populations of northern flying squirrels, woodrats and other small mammals to decline, which negatively owl survival, integration and population growth rates of owls.

Many climate change models suggest the Pacific Northwest will experience warmer, wetter winters and hotter, drier summers. Those conditions were associated with lower population growth rates, survival, and integration, raising concern that future climate conditions may be less favorable for spotted owls.

The authors concluded that, "Given that natural resource managers cannot control climate variation and barred owls are likely to persist and increase in the range of the northern spotted owl, maintaining sufficient high quality habitat on the landscape remains the most important management strategy for the conservation of this subspecies."

For the complete article, please see:

Glenn, E. M., R. G. Anthony, E. D. Forsman, 2010. Population trends in northern spotted owls: Associations with cliate in the Pacific Northwest. Biological Conservation, 143, 2543-2552.

OSU Climate Scientists Return to Collier Glacier

An Oregon State University research program has returned to the Collier Glacier in the Three Sisters National Wilderness for the first time in almost 20 years. Findings indicate that the glacier has decreased more than 20 percent from its size in the late 1980s. The glacier has also lost more than half of its mass in the past 150 years. Research that began last year and is continuing this summer has found some rocks that are being exposed to daylight for the first time in thousands of years.

The findings are consistent with glacial retreat all over the world and provide some of the critical data needed to help quantify the effects of global change on glacier retreat and associated sea level rise.

Photo of Cody Beedlow courtesy Oregon State University

Glaciers provide information about climate change, because they respond predictably to changes in temperature and precipitation.

Collier Glacier, at an elevation of more than 7,000 feet, is one of the largest glaciers in Oregon and is one of the relatively few glaciers around the world that have been studied and monitored for extended periods of time.

The current work, supported by the National Science Foundation, is showing an ice mass that has shrunk to about half of its peak size in the 1850s, when it once was nearly two miles long. Records of the glacier are supplemented by those from early Oregon mountaineering clubs, particularly the Mazamas, founded in 1894 on the summit of Mount Hood.

The studies on Collier Glacier are now being conducted by Cody Beedlow, an OSU graduate student working with Professor Peter Clark. Beedlow and assistants have set up an automatic weather station that records temperature, humidity, and short and infrared radiation data. Other observations are made by drilling into the ice and inserting stakes to measure the amount of melting.

The research in the 1980s and 90s showed the glacier losing mass in four of the five years studied, and it also lost mass last year. Researchers have been able to get in to the glacier earlier in the season than they had previously, he said, providing important new data.

In most of the world, including the Pacific Northwest, glaciers have been in retreat since the late-1800s. Some of that melting will cause a noticeable increase in sea level, and some water resources at high elevation will be affected where glacial fields feed irrigation streams and reservoirs.

Recent Decline in the Global Land Evapotranspiration Due to Limited Moisture Supply

A study in Nature has found that moisture limitations in the Southern Hemisphere land masses led to a decline in evapotranspiration (ET) from 1998 to 2008 (Jung et al., 2010).

More than half of the solar energy absorbed by land surfaces is currently used to evaporate water. Climate change is expected to intensify the hydrological cycle and to alter

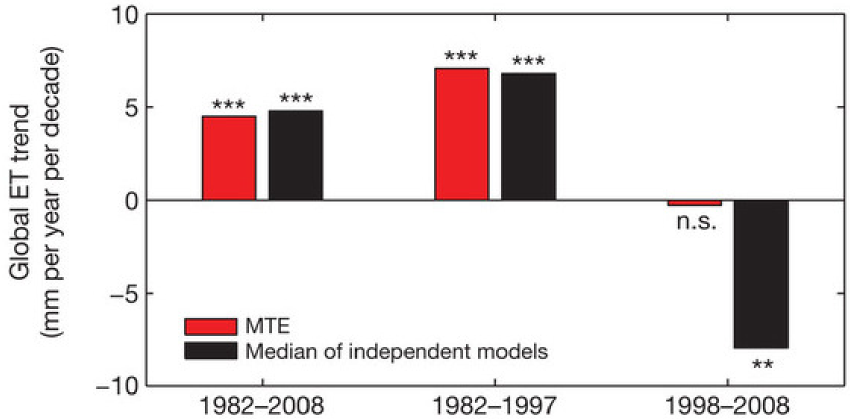

Figure 2. Trends in evapotranspiration based on the model tree ensemble estimates and based on the median of the independent models for three different time periods. Three asterisks denotes significance of the trends at the 99% confidence interval; two asterisks denotes significance of the trends at the 95% confidence interval. The trend in the MTE for 1998-2008 was not significant.

evapotranspiration, with implications for ecosystems and global and regional climate.
A data-driven estimate of global terrestrial evapotranspiration was provided over the past 2 years by combining in situ measurements, meteorology, and remote-sensing information. A rising trend in land-surface evapotranspiration was inferred between 1982 and 1997. After the late 1990s, the global land-ET trend decreases, but it is unclear whether the decrease is part of natural climate variability or a climate change signal in which land-ET becomes increasingly supply-limited with time.

The authors note that if the decline in land-ET is a climate change signal, it would imply that there is a limit to the energy- and temperature-driven acceleration of terrestrial hydrological cycle, and that the limit may have been reached. If this is the case, the consequences would lead to a reduced ability of the land to sequester carbon, and accelerated land-surface warming that could affect regional and global land-atmosphere feedbacks.

For the complete article, please see:

Jung, M., et al. Recent decline in the global land evapotranspiration trend due to limited moisture supply, 2010. Nature 467, pp. 951–954. doi:10.1038/nature09396

Climate Change and Flood-Induced Travel Disruptions in Portland

A study by Chang et al. (2010) investigated potential impacts of climate change on travel disruption resulting from road closures in two urban watersheds in the Portland, Oregon, metropolitan area. Four bridges surveyed in the watersheds were lower in elevation than the current 100-year flood water surface elevation, leading to relatively frequent flooding, and these roadway flooding events are expected to be more frequent under some climate change scenarios. The mileage driven by vehicles was not significantly larger due to road closures, but there was a significant increase in the number of hours vehicles were delayed.

Johnson Creek and Fanno Creek were the watersheds chosen for study, since historical flow data was available for both, the watersheds exhibit high flooding potential, and each has high road density. Fanno Creek is highly urbanized with steep slopes. Johnson Creek flows through mixed land use with gentle slopes.

Flood water surface elevations were determined using the Hydrologic Engineering Centers River Analysis System model. Although more intense flooding events inundated 4 of the 5 crossings in the two study areas, each crossing depended largely on the timing and volume of precipitation, as well as the drainage systems available. In general, the increased wet-season precipitation in the Pacific Northwest projected by many climate models will lead to more frequent flooding and more frequent traffic delays.

The authors conclude that the restoration of floodplains would serve as a proactive adaptation strategy for reducing flood damage. The use of porous pavement and detention ponds may also reduce the effects of flooding in a changing climate.

For the complete article, please see:

Chang, H., et al. Potential Impacts of Climate Change on Flood-Induced Travel Disruptions: A Case Study of Portland, Oregon, USA. 2010. Annals of the Association of American Geographers, 100:4, 938 – 952.

Climate Change May Shift Productive Forests to Higher Elevations in the Pacific Northwest

Latta et al., (2010) used temperature and precipitation data from 1971-2000 to model the aspects of climate important for the productivity of forests in the Pacific Northwest. The results indicate that climate scenarios with increase in future temperatures may lead to an overall increase in forest productivity in the Pacific Northwest. Lower elevations, however, may see a decrease in productivity.

Lower elevations include the locations where the vast majority of private harvests have occurred over the past decade. Future forests will either need to intensify management to continue to produce forest products at current levels, or allow harvest rates to fall.

Forests at higher elevations also tend to exist in more rugged terrain that is more difficult to access and less profitable to harvest. An increase in growth may lead to increases in fuel accumulation in remote areas which could lead to increases in fire frequency and severity.

For the complete article, please see:

Latta, G., H. Temesgen, D. Adams, T. Barrett, 2010. Analysis of potential impacts of climate change on forests of the United States Pacific Northwest, Forest Ecology and Management. 259, 4, Adaptation of Forests and Forest Management to Changing Climate - Selected papers from the conference on 'Adaptation of Forests and Forest Management to Changing Climate with Emphasis on Forest Health: A Review of Science, Policies and Practices', Umea, Sweden, August 25-28, 2008., 5 February 2010, Pages 720-729,

Pacific Northwest Climate Science Conference

Research institutions along with federal and state agencies from throughout the region met in June for the most comprehensive conference to date on the science of climate variability and change in the Pacific Northwest.

Key topics included:

- Climate in the PNW: Past, Present, Future;
- Climate Impacts on: Hydrology & Fresh Water; Terrestrial/Aquatic/Marine Species & Ecosystems; Managed Resources & Human Systems
- Greenhouse Gas Sinks & Fluxes
- Human Responses & Policy Initiatives

The conference was sponsored by:

- UW Climate Impacts Group
- OSU Oregon Climate Change Research Institute
- Idaho's EpSCOR Program
- Pacific Climate Impacts Consortium
- C3 - Climate Change Collaboration (a federal agency consortium)
- Washington Department of Ecology
- Oregon Dept of Land Conservation and Development

Climate Change Conference Explores Ocean Impacts and Policy

Marine scientists and policy experts met for a symposium in Eugene on September 10th to explore what new policies and management strategies are needed for dealing with the impacts of climate change on the world's oceans.

A key question discussed is whether the impacts of climate change on the oceans will be sufficiently mitigated by atmosphere-related policies, or if specific policies need to be developed to protect the world's oceans.

Discussions at the symposium also included ocean acidification, decreasing dissolved oxygen levels, increasing wave heights and the risks to vulnerable marine ecosystems. Ocean acidification occurs when the oceans take up carbon dioxide from the atmosphere. Dissolving CO_2 in seawater increases the hydrogen ion (H^+) concentration in the ocean and increases ocean acidity. Decreasing dissolved oxygen levels can lead to ocean dead zones, partially caused by the introduction of phosphorus and nitrogen. Increased levels of these elements can lead to algal blooms that deplete oxygen levels.

Currently, sea life is threatened by both increasing carbon dioxide and decreasing oxygen concentrations. Marine calcifying organisms are in particular danger. As ocean water becomes more acidic, carbonate may become undersaturated, and structures made of calcium carbonate are vulnerable to dissolution.

Marine spatial planning and siting also has major implications for the Pacific Northwest as fisheries wrestle with accommodating wave energy and marine reserves.

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