

PACIFIC NORTHWEST CLIMATE IMPACTS RESEARCH CONSORTIUM (CIRC) ANNUAL PROGRESS REPORT 2011

Award Title: Pacific Northwest Climate Decision Support Consortium (CDSC)

(NOTE: The CDSC RISA name has been changed to the Climate Impacts Research Consortium (CIRC))

Performance Period (from previous progress report through April 2011): **May 2011 – April 2012**

Who are your Team Members?

Leads

- Philip Mote, OSU - Oregon Climate Change Research Institute, College of Oceanic and Atmospheric Sciences Professor pmote@coas.oregonstate.edu
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Principal Investigators

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- David Turner, OSU – vegetation modeling, Department of Forest Ecosystems and Society david.turner@oregonstate.edu
- Peter Ruggiero, OSU – coastal issues, Department of Geosciences ruggierp@geo.oregonstate.edu

• **Other participants**

- Chris Daly, Northwest Alliance for Computational Science & Engineering, OSU
- Bob Doppelt, The Resource Innovation Group, Willamette University
- Von Walden, Idaho Water Resources in a Changing Climate, UI
- Cathy Whitlock, Montana State University
- University Extension in Idaho, Oregon, and Washington; and Oregon and Washington Sea Grant

What are your **new areas of focus or partnerships** that have begun this past year?

- Extension leadership: This year, CIRC co-lead PIs and the cooperative extension services directors from Idaho, Oregon and Washington established the Climate Extension Advisory Council, or CEAC, to advise the Regional Extension Climate Specialist (RECS) and act as a forum for coordinating climate extension activities in the Pacific Northwest. Under the direction of CEAC the RECS is pursuing several efforts, one focused on developing a knowledge-to-action network around hydrological impacts and another to develop training for regional extension faculty in climate science.
- Extension training: A second priority for the CEAC is training regional extension faculty in fundamental climate science and projected regional impacts. This priority has been addressed through a series of three climate science training workshops for each state's extension service. While each event was tailored to the specific audience they generally included an introduction to climate modeling mechanics, validation and projections; sector specific impacts; and select case studies addressing the challenges of discussing climate change with extension audiences. The workshop concluded with a facilitated discussion among participants on implications of climate research for their programming. Approximately 70-80 regional extension faculty attended these workshop with the majority from natural resource or agricultural extension programs.
- Extension Snake River Basin: Earlier this year, the RECS toured the Snake River Basin to meet with water managers and users to identify interest in participating in a CIRC knowledge-to-action network around changes to hydrological processes. Using initial contacts from the regional extension service this group has grown to include representatives from two prominent canal companies operating in Southern Idaho, a water engineering consulting firm, the Idaho Department of Water Resources, the Bureau of Reclamation, and extension faculty from University of Idaho. This March, the RECS hosted a workshop with these stakeholders and several CIRC PIs in Boise, ID that identified specific hydrological research priorities for the basin and a commitment to participate in a CIRC knowledge-to-action network. The RECS will continue facilitating this network to refine research questions, study approach, and a timetable for delivery of climate adaptation services.
- Local urban adaptation: through the Piloting Utilities Modeling Application (PUMA) effort, CIRC has been discussing two adaptation-oriented projects with Seattle Public Utilities and Portland Water Bureau. CIRC also discussed supporting adaptation planning in the cities of Portland and Eugene, Oregon
- Willamette Valley partnerships: The Resource Innovation Group (TRIG), as part of the UO PNW CIRC effort, focused on developing a number of new partnerships. As part of the Willamette Valley Resilience Compact, TRIG is engaging agencies, community based organizations, and researchers to identify and address the disproportionate impacts of climate change on

vulnerable populations. TRIG is also working with business leaders to enhance understanding of the impacts of climate change on Oregon's businesses and strategies for building resilience. In other work, TRIG and CIRC are collaborating with the Oregon Health Authority and five counties from around Oregon to utilize data from the PNW CIRC to develop local climate action plans for health jurisdictions

- Through work with the public health sector, TRIG has made connections between projects happening at the local level (e.g. a local health jurisdiction in Oregon), to the state level (working with Oregon Health Authority), regional level (working with the National Climate Assessment PNW partners and the Northwest Center for Public Health Practice) and national level (National Climate Assessment, NOAA-CDC initiatives, national public health organizations). At all levels, TRIG is helping to show how local and regional climate data can support planning within the public health sector. Through the NOAA and CDC coordinated National Climate Assessment public health meeting, we've also been able to broaden our connections across the entire Pacific Northwest and share lessons learned in Oregon with partners in Washington and Idaho.
- Proposal to Climate Change and Health: Assessing and Modeling Population Vulnerability to Climate Change, NIEHS - *Building Climate Change Capacity through Health Impact and Hazard Vulnerability Assessment*: Public health and health system infrastructures in the Pacific Northwest will be stressed by a range of climate change-related threats to human health including heat-related morbidity and mortality, increased threat of vector-borne diseases and emerging infections, increased injuries and deaths as a result of flooding and landslides, and increased exacerbations of respiratory disease. While local health jurisdictions in Oregon have begun to conduct public health vulnerability assessments focusing on public health system infrastructure, few have linked with climatologists to ensure existing adaptation strategies matches current and future threats due to climate change. The objectives of the proposed studies are to 1) determine and prioritize the greatest climate-related risks (environmental and health) for 3 coastal communities in Oregon; and 2) increase capacity to address climate change mitigation and adaptation in 3 coastal communities in Oregon.

Please provide a list of 1 - 5 research findings (e.g. dust-on-snow reduces Colorado River runoff by 5%)

- Data set development: A new gridded dataset of historical meteorological data that overcomes limitations in previously used spatially and temporally explicit data required for broad scale modeling efforts (Abatzoglou, 2012). The new observed gridded dataset provides the primary meteorological variables needed for most agricultural and ecological applications and is being used to paint a more thorough picture of historical climatology (e.g, FIG). These data also serve as a baseline for downscaling of

climate scenarios on an affiliated regional project to study the impacts of climate change on cereal crops in the Pacific Northwest. Datasets and information are currently publicly available at <http://bit.ly/so55Ii>.

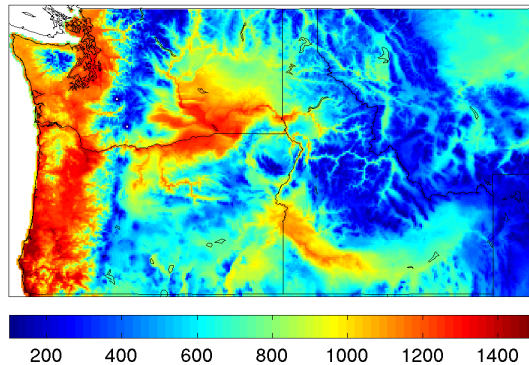
- Climate scenario development: in an early examination of CMIP5 global model results for the Pacific Northwest, we have found some similarities and some differences from the previous generation of modeling results. We have also evaluated performance of USGS regCLIM and our own climateprediction.net regional modeling. Papers describing the results are being developed.
- Survey of local governments: TRIG is continuing to analyze survey results from 2010 in preparation for submission for publication. Survey results have shown that engaging individuals, particularly local government staff, in hands on adaptation workshops leads to action. We have been able to show that, at least for Oregon, providing localized, downscaled climate information is critical to leading to action on adaptation and mitigation. In addition, our study shows that by providing adaptation related information and training, communities are also able to move forward with mitigation work.

****Please provide a summary of 1 - 5 ACCOMPLISHMENTS from your research activities and stakeholder collaborations. In your summary, please include PIs, partners including stakeholders, abstract, findings, leveraged funding sources. Where possible, please include a relevant high-resolution graphic or figure.**** (You can include an accomplishment recently submitted to the RISA program annual report, but we encourage you then to come up with at least one more accomplishment with a relevant graphic.)

- CIRC established a stakeholder-driven research agenda and began carrying it out
- CIRC contributed to the development of the Northwest Climate Science Center, by sharing results of our stakeholder survey, augmenting and utilizing regional partnerships, and using lessons learned from the RISA experience in, for example, planning and carrying out a meeting of all 8 CSCs in October 2011.
- Integrated Modeling: Mote, Abatzoglou, Lettenmaier, Sridhar, and Turner developed a vision for integrated climate scenarios compatible across climate-hydrology-vegetation and have submitted proposals to two other agencies, leveraging the RISA funding, to support this work. Over the past year, Dr. Abatzoglou and Dr. Turner have communicated to best implement historical and future projections into vegetation modeling platform in preparation for the broader integrated scenarios project. Likewise, Dr. Abatzoglou, Lettenmaier and Mote are currently involved in a project to evaluate different downscaling methodologies for hydrologic impacts. This work includes testing the sensitivity of including additional meteorological variables such as humidity, wind and radiation not explicitly included in previous macroscale hydrological modeling efforts. Finally,

while not directly funded through RISA to work on CMIP5, PI's Abatzoglou and Mote are currently working to evaluate over 20 models on their ability to capture salient climatological features that determine PNW climate and are starting to downscale CMIP5 models using the Multivariate Adaptive Constructed Analogs (MACA) method.

Growing Degree Days (base 5.5°C), 1979-2010 Climatology



Map of cumulative growing degree days (base 5.5°C, used in wheat growth models) averaged over 1979-2010, developed with the MACA method.

- Hulse is working collaboratively with John Bolte on affiliated NSF-funded project Willamette Water 2100 (focused on predicting water scarcity in the context of climate change and variability), improved Envision-based model of urban and rural residential growth and expansion for the period 2010 – 2050 in southern Willamette Valley. Also on WW 2100 project, Hulse participated in a variety of citizen stakeholder efforts aimed at clarifying assumptions of future water use/consumption scenarios in the Willamette Basin. Hulse also coordinated CIRC involvement (via sub-contract) of The Resource Innovation Group (Doppelt) and (as UO co-investigator) Adell Amos (University of Oregon Law School).
- Hydrological model enhancement in terms of surface water – groundwater exchanges (Sridhar): A coupled VIC-MODFLOW framework for representing dynamic interactions between unsaturated and saturated sub-surface zones with the land surface is being developed. This is a physically-distributed, process-based simulation tool to partition runoff, baseflow, reach gain/loss and recharge in the river basin. Both models were calibrated based on the available long-term historical streamflow and groundwater data. In order to develop and capture the hydrology of the basin, at present we focus on the Henry's Fork subbasin, which is the

headwater catchment of the Snake River Basin. Integrated model simulation is currently being conducted for 6 years from 1980 to 1985. This will be extended for future climate change scenarios to study the climate change impact on the water table, reach gain and recharge. Therefore, this integrated platform for the water resources assessment of the system by linking surface and subsurface fluxes into systems modeling will be tested using downscaled climate model information in the near future. Also, calibration of hydrological models and climate impacts assessments for various basins in Idaho are being performed (Snake, Salmon and Boise). This is done for those basins, where there is limited groundwater –surface water exchanges such as the Salmon and Boise River basins.

- Hydrologic Sensitivity Analysis (Lettenmaier/Vano): (1) We proposed to conduct a subbasin-scale hydrologic sensitivity analysis over the eight digit Hydrologic Unit Code (cataloging unit) subbasins within the Columbia River basin and adjacent coastal drainages, which would help to understand the hydrologic changes that can be expected to be associated with summer and winter warming. To date, we have: 1. Identified the cataloging units within the region, and equivalent sub-basins within the Canadian portion of the Columbia River basin. These sub-basins are essentially equivalent to the Water Resource Inventory Areas (WRIAs) within Washington but cover the entire Columbia River basin and adjacent coastal drainages, consisting of 226 watershed units, with an average area of about 3000 km² (see Section 3.2 for more details). (2) We have conducted sensitivity analyses similar to those reported in Vano et al. (2012) and Das et al. (2011) for the Columbia River basin as a whole (in addition to the Colorado River basin, and two partitions of the Sacramento-San Joaquin basin) using the Variable Infiltration Capacity (VIC) model applied at 1/16th degree latitude and longitude. Preliminary results are shown in Figures 1 and 2. (3) We are in the process of including additional models that are hydrologically credible in the analysis. These include the National Weather Service Sacramento model, the NASA Catchment model, the new Unified Land Model (a merger of NOAA’s Noah and Sacramento Models) and the new GFDL land surface model. (4) Our early results (Figure 1) have allowed us to categorize subbasins with similar winter and summer sensitivities. Generally, the subbasins group into a high elevation category which has a positive sensitivity to cool season warming (meaning that warmer winter temperatures lead to increased annual flows), and two categories (both of which have reduced annual flows in response to winter warming): one that is more sensitive to cool season warming (mostly low elevation subbasins) and another that is more sensitive to warm season warming (mostly transitional rain-snow watersheds). These variations and differences will be explored in a paper that is in progress.

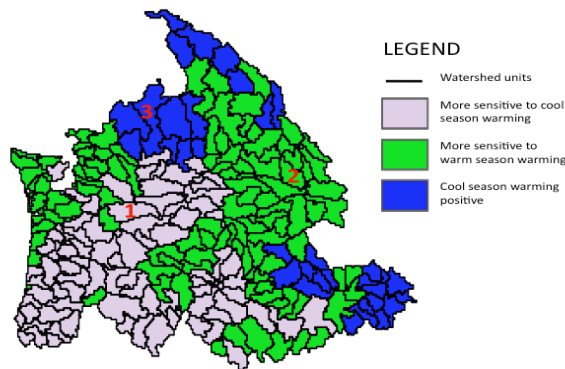
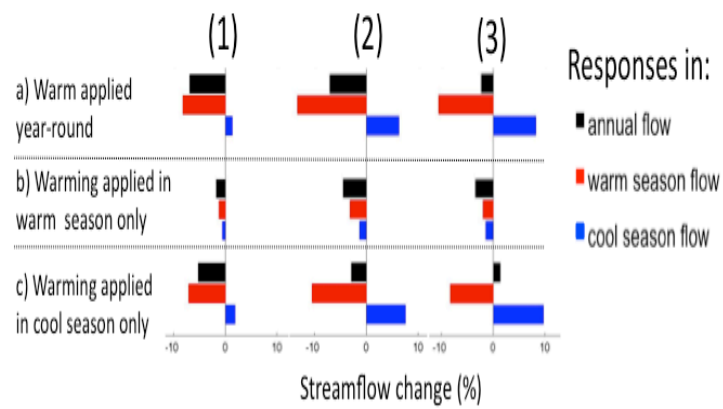


Figure 1. Sub-basin level sensitivities using the VIC model

Figure 2. Three examples of the diversity of sub-basin level responses from Figure 1.



- Coping with Drought (Lettenmaier): last year we proposed to extend the existing Drought Monitoring and Prediction System for Washington State (DMPS) operated by the University of Washington to the entire Pacific Northwest (U.S. water resources region 17 and Canadian headwaters of the Columbia River basin; see figure). This was intended to be a two-year project. To date we have:



Fig. 1: Domain of the extended DMPS

- Identified a set of watersheds (see figure) within the domain that are consistent with the 62 Water Resource Inventory Areas (WRIAs) within Washington used in the DMPS. These watersheds are essentially HUC 8-code basins, and an equivalent set of divisions that we made for the Canadian portion of the Columbia basin. We have had discussions with Oregon DWR as to the usefulness of the Oregon basins, and they have concurred on the basis of consistency with the existing WA WRIAs.
 - begun to transfer the software to estimate the three primary drought-related indices in the WA DMSP to the regional system: Standardized Precipitation Index (SPI), Standardized Runoff Index (SRI), and Soil Moisture Percentiles (SMP) for each of those watershed units. The SPI values are being taken from a new 1/16 degree extension to the Maurer et al (2002) data set on which the original DMSP was based (period of record extended to 1916-2010 from 1950-2000 in the original data set). We have used the new data set, which is described in Livneh et al. (2012), to force the VIC model, which provides the estimates of SRI and SMP.
 - begun to generate SMP plots for the Klamath basin, which has begun to show signs of an evolving drought, on a daily basis. We are considering extending the domain of the PNW DMPS to include the Klamath as well.
- Update on CIRC Social Science (Assessment Activities: Completed first year evaluation of CIRC. Information reviewed by Co-Leads and Project Manager to identify key areas of focus for upcoming, which concentrate on ways to disseminate climate information in the region. Discussed evaluation with PIs to share findings. Began development of a database that inventories existing capabilities of organizations in the Pacific Northwest, the projects and activities they are engaged in, and partners they collaborate with. Two separate databases are being developed:

- Following the protocol developed by other RISAs, we have collected information about PNW capacities based on documents posted on the web. The information in this database will be used to construct a network analysis of nodes of information, trusted sources of information (both individuals and organizations), and existing collaborations. We will use this analysis to (1) collaborate with existing networks to provide specific information and decision support needs; (2) ensure that CIRC projects leverage or enhance effort or capacities of existing organizations; (3) disseminate specific climate-related information; (4) develop effective engagement strategies; and (5) track changes in stakeholder views and capacities over time.
- An activities database is being developed that catalogs the activities ongoing in the PNW regarding climate adaptation. This database is intended to be available on the CIRC website and used by individuals and organizations looking for expertise, examples, and information about climate adaptation projects.
- Through leveraged funding from the Sectoral Applications Research Program of NOAA's CPO, PI Ruggiero and colleagues have recently developed probabilistic coastal change hazard zones that have been adopted by Tillamook County, Oregon into their Coastal Change Adaptation Plan
- TRIG's research describes a regionally-based, collaborative process called Climate Futures Forums (CFF), designed to help communities become more resilient to the effects of climate change through promoting interactions and relationships between professionals and local stakeholders from a wide variety of sectors. The process illustrates how local professional expertise can be used to integrate "top-down" scientific assessments of the impact of climate change with "bottom-up" vulnerability assessments, personal experience, behavioral and organizational change, and policy development. It builds on systems theory and analyses of behavioral and organizational change that stress the importance of building dissonance, a sense of efficacy, and a knowledge of co-benefits. Data from four replications in varied locations indicate that the process resulted in strong buy-in and support from participants as well as recommendations that spanned various systems and yielded numerous co-benefits. Results indicate that the CFF process provides lessons for practitioners and scholars interested in bridging the gap between scientific experts and those engaged in local climate adaptation planning. This research involved staff from The Resource Innovation Group, University of Oregon, local government staff, and was partially funded through the Kresge Foundation.

List of [completed publications, white papers, or reports \(with internet links if possible\)](#) from the past year. These can be either non-peer reviewed or peer-reviewed. For peer-review publications, please list either **published** or in **press**, but *not* "in review". Please * the ones where any of the information has been communicated to decision makers and stakeholders (please identify to whom the information has been communicated)(**italicized are 'uncompleted'**).

- Abatzoglou, J. T. (2012), Development of gridded surface meteorological data for ecological applications and modelling. *International Journal of Climatology*. doi: 10.1002/joc.3413
- Baron, 2011. Coastal hazards and community exposure in a changing climate: the development of probabilistic coastal change hazard zones, unpublished MS thesis, Oregon State University, Corvallis, OR, 84 pp.
- Beever, E.A., C. Ray, J.L. Wilkening, P.F. Brussard, and P.W. Mote, 2011: Contemporary climate change alters the pace and drivers of extinction. *Global Change Biology*, doi:10.1111/j.1365-2486.2010.02389.x.
- Das, T., D. W. Pierce, D. R. Cayan, J. A. Vano, and D. P. Lettenmaier, 2011. The importance of warm season warming to western U.S. streamflow changes, *Geophys. Res. Lett.*, 38, doi:10.1029/2011GL049660
- Dulière, V., Y. Zhang, P.W. Mote, E.P. Salathé Jr., 201X: *Extreme precipitation and temperatures over the U.S. Pacific Northwest: a comparison between observations, reanalysis data and regional models. J Climate, in press.*
- Hoekema, D. J., V. Sridhar (2011) Enhancement of the Snake River Plain Model for the Study of Conjunctive Management of Water Resources under Non-Stationary Hydrologic Regimes” *Journal of Water Resources Planning and Management* (in revision)
- Jaks, W.T., V. Sridhar, J. Huntington (2011). *Evaluation of the Complementary Relationship using Noah Land Surface Model and North American Regional Reanalysis (NARR) Data to Estimate Evapotranspiration in Semiarid Ecosystems, Journal of Hydrometeorology (in revision)*
- Livneh B., E.A. Rosenberg, C. Lin, V. Mishra, K.M. Andreadis, and D.P. Lettenmaier, 2012: *Extension and spatial refinement of a long-term hydrologically based dataset of land surface fluxes and states for the conterminous United States, Journal of Climate (in preparation)*
- Mote, P.W., and K.T. Redmond, 2011: Western climate change. in *Ecological Consequences of Climate Change*, E.A. Beever and J.L. Belant, eds., Taylor and Francis. ISBN: 978-1-4200-8720-8.

- Mote, P.W., L. Brekke, P. Duffy, and E. Maurer, 2011: Guidelines for constructing climate scenarios. EOS, Transactions, Amer. Geophys. Union, 92, doi:10.1029/ 2011EO310001.
- Ruggiero co-authored in Williams et al. (20 co-authors including Ruggiero) in review, Physical Climate Forces, Chapter 2 of: Coastal Impacts, Adaptation and Vulnerabilities: 2012 Technical Inputs Report to the 2013 National Climate Assessment.
- *Sridhar, V., W.T. Jaksa, Spatial mapping of evapotranspiration using the complementary relationship in the natural ecosystems, Nova Science Publishers, Inc. (in press)*
- Sridhar, V., X. Jin**, Climate change impacts: An assessment for water resources planning and management in the Pacific Northwest of the U.S, Published in Climate Change / Book 1 (ISBN 978-953-307-419-1), 2011
- TRIG Climate Futures Forums: Using Local Experts to Bridge the Gap Between Climate Impacts Research and Regional Decision-Makers: Stacy Vynne, Jean Stockard, Steve Adams, Bob Doppelt, and Roger Hamilton (November 2011)
- TRIG *Building Watershed Resilience: Stacy Vynne, Roger Hamilton, Bob Doppelt (January 2012) - distributed to watershed councils, watershed managers and related organizations around the PNW as well as some national watershed organizations
- TRIG *Public Health and Climate Change: A Guide for Increasing the Capacity of Local Public Health Departments: Stacy Vynne, Sarah Mazze, Adele Houghton (April 2012) - distributed to public health jurisdictions in Oregon, participants of the NCA public health meetings, and national public health organizations (e.g. CDC, NAACHO, APHA, ASTHO)
- Vano, J.A., T. Das, and D.P. Lettenmaier, 2012. Hydrologic sensitivities of Colorado River runoff to changes in precipitation and temperature, J. Hydrometeorology, doi:10.1175/JHM-D-11-069.1

Please provide one specific example of how your team has linked this past year with a [NOAA entity and/or NOAA regional partners](#) (eg. Regional Climate Service Directors, RCCs, Sea Grant extension, etc...) to exemplify regional climate services.

- Dello, Deputy Director of the Oregon Climate Service, travelled to NOAA CPC to participate in the State Climatologist Exchange Program

- Mote visited NOAA Headquarters and CPO in December 2011 and gave a talk about CIRC
- CIRC members including Mote, Foster, and Dello participated significantly in the WGA-NOAA PNW meeting April 3-4, 2012, and preparation
- Ruggiero participated and presented research findings at the ‘Towards a Consensus Methodology for Projecting Sea Level Rise and Coastal Inundation in the Pacific Islands’ Meeting, held in Honolulu Hawaii on January 10-11, 2012. This meeting was organized by John Marra, the Pacific Region Regional Climate Service Director, and sponsored by PaCis, the Pacific Climate Information System.
- Foster and Hulse participated in a RISA Strategy Session in Boulder, Colorado Nov. 9-11, 2011. A key topic of discussion at that time was delivery of climate services both within and across regions.

Please explain how much of a priority NCA activities will be (and in what form the NCA activities will take) for your RISA team after June 1, 2012, compared to the rest of your RISA activities.

- NCA activities, to the extent that funding exists to support them, CIRC will continue to be very important. Mote will continue to serve on the NCADAC, and CIRC intends to lead the production of a NW regional report in connection with the full NCA report.

Other NCA activities 2011-12

- CIRC hosted a first-ever risk identification workshop in the Northwest, for the National Climate Assessment, in Portland in December. This workshop engaged researchers and stakeholders in a risk-framing discussion of climate impacts in the Northwest. We considered it important to include representatives from all sectors, affiliations, and states and communities within the region to ensure that the outcomes of this workshop are truly representative of the collective region. The objectives of the workshop were 1) discuss and rank the likelihood and consequences of climate risks to the northwest region, 2) provide opportunity to help inform the NW chapter of the NCA, and 3) build capacity for a long term sustained regional assessment process. This workshop served as an initial step toward identifying key risks and vulnerabilities to highlight in the Northwest chapter. A detailed write-up of the workshop description and outcomes was submitted as a technical input to the NCADAC and

serves as a resource for the members of the Northwest lead author team as they continue to prepare the NCA Northwest chapter building off the lessons learned during the workshop to further the risk assessment of NW climate impacts. The lead author team held meetings in February and April 2012, and has agreed to write a regional report that is a natural extension and a more in depth version of the 8-page NCA NW regional chapter.

- Hulse is working as one of 8 co-authors of the Land Use and Cover Change chapter of the National Climate Assessment. The due date for our chapter on Land Use and Cover Change for the National Climate Assessment is June 1, 2012. Following that date Hulse expects to be involved in final editing and reviewing of the chapter. This will be a significant part of our RISA activities between now and June, with NCA time demands expected to decline after June 1.

Please fill out the attached table and indicate which team projects are RISA-led* (RISA-led means RISA investigator is leading the effort and/or RISA funding is primary source) and which ones your team or a RISA PI contributes to (where RISA funding and/or RISA-funded investigator time contributes to the project but is not the main component of the project)**.

PI	Project Title	End Date	Deliverables/Products	Abstract/Description	Partners	If this is a RISA-led project, please mark A*. If RISA is a contributor, please mark B**.	If B, please indicate who is the primary lead
Sea level rise, increasing storminess, and accelerating	Incorporating uncertainty associated with climate	July 14	Build coastal 'Knowledge to Action Networks' consisting of collaborative teams of stakeholders,		WA DOE, DOGAMI, Neskowin Coastal	B**	Ruggiero

<p>development pressures are conspiring to leave coastal communities along the U.S. West Coast increasingly vulnerable to coastal change hazards and inundation. Along the coasts of Oregon and Washington, many beaches have not fully recovered from the major El Niño and moderate La Niña of the late 1990s which produced coastal flooding and erosion not seen in some decades.</p>	<p>change into coastal vulnerability assessments: toward developing an adaptive capacity</p>	<p>researchers, and outreach specialists who will co-produce knowledge to inform climate resilient strategies in select PNW coastal counties. Develop an integrated methodology for projecting the evolving probability of coastal flooding and erosion, through time along the PNW coast, explicitly accounting for climate controls on the various processes relevant to coastal hazards. Develop the information and tools necessary to enable PNW stakeholders to envision future scenarios, assess impacts and associated evolving community and ecosystem vulnerability, and initiate adaptation strategies over the next several decades in the context of SLR and</p>		<p>Hazards Committee</p>		
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<p>Several PNW communities remain at high risk of coastal inundation in ensuing winter seasons and at present local decision makers lack both the information and tools for an adaptive capacity to reduce their vulnerability, particularly in light of the uncertainty of climate change. Several stakeholder sectors (e.g., local community activist groups and land use planners) are struggling to</p>			<p>changing storminess.</p>				
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define appropriate responses to the perceived recent increase in the frequency and magnitude of coastal hazards and the increasingly startling, yet uncertain, predictions of how much worse their problems may get. Unfortunately, rather than being continuously refined by improved knowledge and predictions over time, possible 'credible'							
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scenarios of both SLR and future extreme wave climates have increased in uncertainty in recent years. It is within this context of uncertainty and dearth of information that we propose to develop a transferrable approach for projecting the evolving probabilities of coastal flooding and erosion, and the associated evolving community vulnerability, through time along PNW dune-backed							
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shorelines. In addition, we aim to co-develop, with PNW stakeholders, the information and tools necessary to assess impacts and initiate adaptation strategies over the next several decades in anticipation of potential SLR and changing patterns of storminess.							
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