BioEarth

Biosphere-relevant earth system model

2015 Water Quality Stakeholder Workshop Synthesis Report

Contents:

On March 12, 2015 the BioEarth project's communication and extension working group convened a stakeholder advisory workshop focused on water quality issues in the Pacific Northwest in order to build understanding among research team members of how the BioEarth integrated earth systems model might produce outputs that are relevant to the needs of decision-makers and other researchers concerned with intersections between water quality and regional environmental change. The workshop, held in Vancouver, WA brought together 20 stakeholders and 8 BioEarth researchers. This was the 6th and final workshop in a series of issue-based stakeholder meetings designed as a step toward greater information sharing and collaboration among university-based environmental modelers and stakeholders who can provide guidance and feedback to the modeling team and potentially use model results.

The workshop was designed to address three key objectives:

1. To understand current and future concerns about regional water quality (environmental, health, economic, resource availability, other problems)
2. To understand stakeholders' perspectives on decision making and what constitutes useable information
3. To guide the scenarios and issues the research team addresses in model development and application

I. Stakeholders represented at the workshops

Of the 105 individuals invited, 20 stakeholders were able to attend the workshop. Invited stakeholders consisted of government agencies, non-governmental organizations, research institutions and industry groups.

Federal Government Agencies: Environmental Protection Agency, Oak Ridge Institute for Science and Education, US Geological Survey

Tribal Government Representative: Columbia River Inter-Tribal Fish Commission

State Government Agencies: Oregon Department of Environmental Quality, Oregon Department of Agriculture, Washington State Department of Agriculture, Washington Ecology

Local Government Agencies: County Conservation Districts, Clean Water Services

Non-Governmental Organizations: Wild Fish Conservancy, Willamette Partnership, Lower Columbia River Estuary Partnership, Freshwater Trust

Industry, Environmental Consulting: Stillwater Sciences

Groups not represented at the stakeholder workshop, but recommended for future inclusion by attending stakeholders: USDA Natural Resources Conservation Service and Agricultural Research Service, tribal governments including water quality specialists from the Klamath Tribe, EPA Office of Environmental Assessment, private forest products and farming industry representatives, land owners, public water supply municipalities and other academic partners working on related water quality issues.

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II. Dominant regional issues of concern

Environmental issues:

- Changes in seasonality of water availability (changes in timing of precipitation and release of snowmelt). Snowmelt is an important source of clean water; if snowpack decreases, so does our summer supply of clean water, this increases reliance on less clean groundwater sources and storage in reservoirs.
- Changes in water temperature and impacts on native species.
- Phosphorous and nitrogen loading; harmful algal blooms are an emerging concern, as are impacts to drinking water.
- Sedimentation loading in relation to forest and agricultural land management practices.
- Pollution from pesticides and heavy metals is on water quality experts' radar, but typically not the highest priority concern.

Management and policy issues:

- Future reservoir operations are of interest, and their potential for modification. For example, possible emergence of federal water storage infrastructure programs to deal with flooding, increased storage needs, drinking water.
- Impacts of possible changes in riparian zone protections, best management practices guidelines, or enforcement of policies and guidelines.
- Urban and rural residential development and implementation of green infrastructure practices.
- Fertilizer application practices, and the possibility of a comprehensive state agricultural practices. There is generally a low level of understanding about impacts of agricultural practices on regional water quality (tendency for excess manure and synthetic fertilizer application).
- CAFO and dairy management practices and design criteria.
- Shipping, coal and oil impacts; mentioned as a potential growing source of toxic contaminants in the Columbia River basin.
- Transboundary relationships, agreements with Canada as related to power generation (e.g. the Columbia River Treaty) and salmonid populations.
- Concerns over conflicting management approaches and policies across jurisdictions.

Economic issues:

- Changing prices of crops and wood products may drive changes in land use. There is some anecdotal evidence of land conversions to wine grapes and increased clear-cutting of forestland. There may be different water quality impacts depending where on the landscape conversions occur.
- Changing demographics of farmers, their education levels, and their farming operations are potentially big drivers of the types and sophistication of management approaches. The current trend toward small farms employing traditional practices may have some environmental drawbacks (e.g. excess manure application).

III. Information that could improve decision-making

Model Scope:

- Investigate which agricultural management practices provide the biggest water quality impacts on a crop- and location-specific basis (e.g. is precision agriculture particularly impactful for specific crops and locations?).
- Thoroughly investigate climate change impacts on nutrient cycling. Modelers may want to incorporate prior work done by SPARROW in the region (look at smaller scale Yakima run and urban runoff coefficients).
- The importance of modeling phosphorous shouldn't be overlooked.
- Look at water quality impacts of regional population growth.
- Explicitly modeling characteristics of riparian buffer zones will improve accuracy of water quality projections and could contribute key information about minimum riparian zone enhancements needed to achieve water quality benefits.
- Look for ways to directly link model outputs to state-level water quality management.
- Specific data and models are increasingly important in regulatory decision-making; there's a need for detailed runoff modeling.
- Models can contribute to setting quantitative thresholds for regulatory targets such as defining what the "nuisance" level is for algal growth.
- Nutrient dynamics and runoff models should be calibrated for Northwest crops (nurseries, blueberries, hazelnuts etc.).
- Identifying and monitoring changes in cold-water refugia locations is an important area of research needed in the region.

Model Time Frame:

- Projections on a 10-20 year time scale and 20-50 year time scale are most relevant for policy-making and many industry decisions. There could be significant agricultural policy changes on the horizon in approximately 10 years.
- Providing results with resolution at a monthly or seasonal scale is essential for decisions about reservoir management and enforcement of instream water rights.
- No one identified 20-50+ years as the highest priority timescale for model projections.

Model Spatial Scale:

- Accurate stream network maps are essential; need to ground truth hydro-networks to have quality model inputs.
- Models that could help educate landowners about effective riparian buffer zones would be very valuable.
- Basin-scale and field scale models both play important roles in decisions about regulations, infrastructure development and land management practices.

IV. Recommendations about storyline and scenario development:

- Yield improvements and fertilizer use efficiency are big interests; ideally, scenarios could incorporate crop- and region-specific projections of possible fertilizer use efficiency rates (consider whether this can be accounted for in the environmental technology axis of the Shared Socioeconomic Pathways (SSP) framework).
- Thought should given to incorporating international issues, for example increased atmospheric pollution from SE Asia and the price drivers of overseas demand (e.g. powdered milk in China).
- Consider whether current water quality and native fish protection management approaches will be sufficient in the future.
- The proposed "sustainable" SSP storyline assumes that economic growth leads to environmental improvements, an assumption that should be supported or discarded on the basis of historical evidence.
- The "sustainable" SSP storyline should include language related to reductions in food waste, as this is a significant source of nitrogen pollution.
- The proposed "fragmentation" SSP storyline may not be a plausible future. Even though the regional storyline is consistent with published, global SSP storylines, is a reversal of globalization impacts, global trade, and increased border closures even possible at this point in time? In the future?
- Is comparing developing two storylines and quantifying two scenarios sufficient? It may be important to consider additional dimensions of change.
- Regional storylines/scenarios should consider changes in regulations and the role of government.
- Technological change axis of the SSP framework should encapsulate energy efficiency, hydropower production, and energy costs.
- Modeled scenarios should consider linkages between crop fertilization methods, soil quality, and water quality.
- There may be value in applying the Regional Agricultural Pathways scenarios being investigated in the REACCH project. State departments of agriculture and soil and water conservation districts can play a role in ground-truthing regional scenarios.
- Comparing scenarios is a challenge because social, economic and environmental variables change gradually; any future scenario that the region experiences would be something we transition to in increments.

V. Reflections on communication:

- Quantifying and communicating uncertainty is vitally important to management. An absolute factual answer is not what managers need; the best possible model output is something that can be interpreted with explanation of where uncertainties exist.
- Emphasize the role of modeling as a method to manage and mitigate risk.
- There is a continued need for more clarity about how easy to use and interactive the final integrated model products will be.
- Modelers need to continue to develop their capacity to tell a story about their work and to emphasize main points and how the details fit together. It would be valuable to present examples of how the model will work, showing both inputs and outputs.
- It would be helpful to have more information ahead of time about what BioEarth is and who the other participants at that advisory meeting will be. More clarity about the kind of feedback being solicited would be welcomed; researchers at other institutions, managers and regulatory officials are all "stakeholders" of BioEarth, but have different information needs and kinds of insight they can contribute.
- Graphical and visual presentation of material, whenever possible, is welcomed.
- Follow up communication should include face-to-face meetings as well as opportunities to participate remotely/webinars.
- Often the most useful resources for stakeholders are executive summary-style communications with more detailed reports or publications available.
- A perceived agricultural focus in this workshop limited participation of voices with other areas of expertise and interests.
- The structured format didn't allow for as much discussion time as would have been welcomed.

Additional findings from the water quality workshop session are available from the BioEarth communication team, including a spreadsheet of actionable recommendations prepared for the research team. We greatly appreciate the time and energy that BioEarth researchers and stakeholders have invested in the workshop process, and feel that the questions raised and perspectives shared at the stakeholder advisory workshops have been extremely valuable in guiding the research team's approach to model and scenario development.

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Appendix: Proposed Regional Storylines

"Sustainability" Scenario (SSP_{CRB} 1)

This is a world making relatively good progress towards water security, with sustained efforts to achieve development goals, while reducing resource use intensity. Elements that contribute to this are a rapid development of low-income counties, a reduction of inequality (regionally and within economic sectors), rapid technology development, and a high level of awareness regarding environmental degradation. Rapid economic growth in low-income counties reduces the number of people below the poverty line and increases quality of life and human well-being. The region is characterized by an open, globalized economy, with relatively rapid technological change directed toward environmentally-friendly processes, including water-quantity efficient and water-quality improving technologies, improved management practices and yield-enhancing technologies as they relate to agricultural, forest and urban lands. Consumption is oriented towards low material growth and water resource intensity, with a relatively low level of consumption of animal products. The population pressure is relatively low. The EPA's Safe and Sustainable Water Resource Action Plan (EPA 2012) is achieved within the next decade or two, resulting in educated populations with access to safe water, improved sanitation and medical care. Other factors that reduce vulnerability to climate and other exogenous changes include, for example, the successful implementation of ambitious policies to control air pollutants and water degradation, and rapid shifts toward universal access to high quality natural and aquatic resources in the region.

"Fragmentation" Scenario (SSP_{CRB} 3)

In this future vision for the region, it is separated into sub-regions characterized by inequity, with pockets of moderate wealth and a bulk of locales that struggle to maintain living standards for a rapidly growing population. Sub-regional blocks of administrative jurisdictions emerge with little coordination between them. This is a world failing to achieve global, national, and subnational development goals, and with little progress in reducing resource usage intensity, or addressing environmental concerns such as air pollution and water quality degradation. States, counties, resource districts and metropolitan areas focus on achieving water and food security goals within their own domain. The world has de-globalized, and international and national trade, including water-based product sectors and agricultural markets, are restricted. Little cooperation and low investments in technology development and education slow down economic growth in high-, middle-, and low-income sub-regions. Population pressure in this scenario is high as a result of education, economic, and climate-driven immigration trends. Growth in urban areas is haphazard and opportunistic without regard for sound land use planning principles and long-term horizons. Unmitigated water demand is relatively high, driven by high population growth, inefficient use and slow technological change in the water resources sector. Investments in human capital are low and inequality is high. A sub-regionalized world leads to reduced trade flows, market mechanisms for water resource trading, and an increased pressure on common resources, leaving large numbers of people vulnerable to climate change and water scarcity, particularly in locales with low adaptive and mitigation capacity.