Quantifying ecosystem service tradeoffs in response to alternative land use and climate scenarios: Pacific Northwest applications of the VELMA ecohydrological model

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Scientists, policymakers, community planners and others have discussed ecosystem services for decades, however, society is still in the early stages of developing methodologies to quantify and value the goods and services that ecosystems provide. Essential to this goal are highly integrated models that can be used to define policy and management strategies for entire ecosystems, not just individual components. We developed the VELMA ecohydrological model to help address this need. VELMA links a hydrological model with a terrestrial biogeochemistry model in a spatially-distributed framework to simulate the integrated responses of vegetation, soil, and water resources to changes in land use and climate. Here we briefly describe watershed-scale applications of VELMA conducted in Oregon and the Puget Sound Basin in partnership with community and governmental organizations. Our goal is to evaluate how alternative policy, land use and climate scenarios affect tradeoffs among ecosystem services – specifically, provisioning services (water; food from land and sea; fiber), supporting services (cycling of water and nutrients; habitat for fish, shellfish, wildlife), regulating services (climate; peak and low flows), and cultural services (recreational and spiritual pursuits). A major focus is to assess the effectiveness of natural and engineered green infrastructure (riparian buffers etc.) for protecting water quality of coastal and inland waters. Products of this work include (1) alternative-future scenarios capturing stakeholder-relevant choices and drivers of change; (2) tools for mapping production of ecosystem goods and services under current and projected conditions; and (3) tools for evaluating ecosystem service tradeoffs so that natural capital can be more fully accounted for in alternative-future decision scenarios. We are using these products in a participatory planning approach that integrates researchers, stakeholders and decision makers in the process of identifying drivers, ecosystem services of concern, and solutions for a more sustainable future. For example, can optimal "decision paths" be identified for restoring the ecosystem services needed to sustainably support communities dependent on resource-based economies and traditions, such as agriculture, forestry, and fishing?