# THE NORTH OLYMPIC PENINSULA SOLUTIONS NETWORK: EXTENDING NASA TOOLS BEYOND THE RESEARCH COMMUNITY TO RESOURCE MANAGEMENT USER GROUPS

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## ABSTRACT

The North Olympic Peninsula Solutions Network (NOPSN) is extending the tools, knowledge, and results of National Aeronautical and Space Administration's (NASA) Applied Sciences Program beyond the science and research communities to contribute to national priorities with societal benefits, such as in ecological forecasting, water management, and agricultural efficiency. NOPSN is interacting with local, state, regional, and national user groups to identify new opportunities to use NASA tools and technology; our overall approach will be to leverage these relationships and extend them to include the use of NASA tools and technologies to augment or improve existing or future decision-support systems or tools, ranging from single-issue, localized challenges to far-reaching issues associated with resource management and environmental protection and sustainability that are applicable across the United States and elsewhere in the world. This paper explains our Solutions Network and its initial project developing improved streamflow forecasting in a rain-and-snow-dominated watershed in western Washington state. Although our initial work on the Olympic Peninsula is centered on using NASA tools to improve water forecasting and to enhance the existing decision-support system for allocating water resources, many of the tools and concepts we are employing can be readily extended to regional and national scales, so there are opportunities for developing discussion partnerships with NOSPN to determine the best way to provide NASA tools and technologies to other user groups to improve existing or future decision-support systems or tools, to assess and manage ecological impacts across regional, national, and international borders.

## INTRODUCTION

Generating new ideas and engaging new users of NASA Earth Science products (Decision Support Tools, Missions, and Models) is a primary focus of the North Olympic Peninsula Solutions Network. We believe that working collaboratively with national, regional, state, and local management groups and networks will enable us to better understand current and emerging environmental issues and fully explore the best way to bring NASA tools and technologies to user groups (Ward et al. 2007). We will interact with local, state, regional, and national user groups to identify new opportunities to apply NASA tools and technology beyond the research community to support on-the-ground management needs of societal importance.

## EXAMPLE: IMPROVING WATER MANANGEMENT DECISION MAKING FOR THE DUNGENESS RIVER WITH ENHANCED FORECASTING

Ecological forecasting, a major focus of NASA's Applied Sciences Program work, involves the use of observations and models to predict the impacts of environmental changes on ecosystems. These models must span spatial scales from molecular to global, as well as take advantages of information across time scales to test and refine the accuracy of their predictions. NOPSN's work in ecological forecasting involves the use of MODIS and the Hybrid Hydrological Model applied to improve water management decision-making with improved streamflow forecasting for the Dungeness River Management Team and Dungeness River water managers.

The Dungeness River, like many rivers in the western U.S., is dominated by snowpack. The majority of the Dungeness Watershed is located within the rainshadow of the Olympic Mountains and does not receive as much precipitation as other coastal areas in Washington. Over-allocation of limited water resources in the Dungeness watershed has created competition between residents, farmers, and wildlife. The relatively sunny weather has made the Dungeness Valley the fastest growing area in Clallam County, particularly for retirees, and development has

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Poster paper presented Western Snow Conference 2008

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been explosive. Due to limited rainfall, agriculture relies heavily on groundwater and irrigation. Finally, the Dungeness River is home to threatened salmon stocks, which have legal minimum requirements for in-stream flows during spawning season. Improved water forecasts will help Dungeness River managers better allocate between competing users and enable them to initiate emergency response plans sooner, in the event of floods or droughts.

The Hybrid Hydrological Model was developed to estimate unregulated streamflow at the outlet of a drainage basin, utilizing inputs such as NASA MODIS data. MODIS (Moderate-resolution Imaging Spectroradiometer) is an imaging instrument aboard two NASA satellites which together, image the entire earth every 1-2 days. They are designed to provide measurements in large-scale global dynamics including changes in Earth's cloud cover, radiation budget and processes occurring in the oceans, on land, and in the lower atmosphere. Data is collected via remote sensing and from fixed locations like snow courses, USGS stream gages, area weather stations, and SNOTEL sites. These inputs are combined in a model simulating the watershed on a cell by cell basis, creating a raster image. Each cell within the model contains data corresponding to the location's snow accumulation and melt, evapotranspiration, and simplified vertical soil water movement to simulate total water movement flowing through the soil into the basin. Runoff is also calculated by the model and is assumed to leave the basin as it is generated (Figure 1).

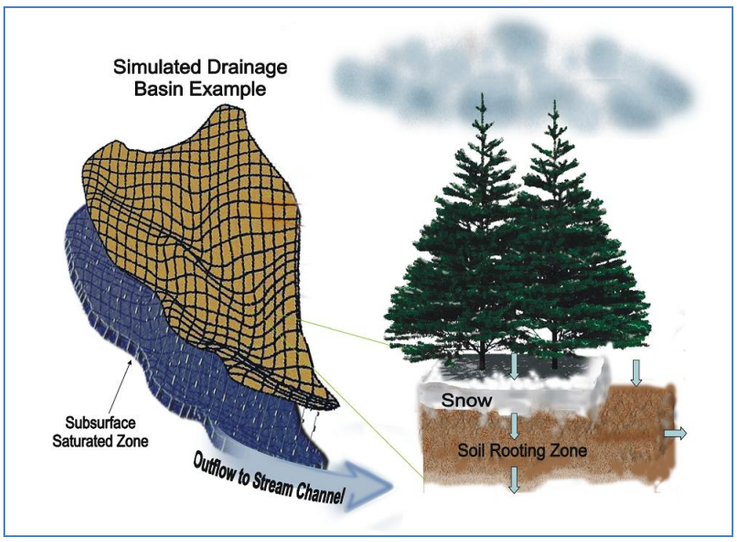


Figure 1. A conceptual diagram of the Hybrid Hydrological Model (Wigmosta et al. 2007).

Model outputs are assembled using the remote sensed and fixed station data inputs, past streamflows, and meteorological data to forecast streamflow (Figure 2). In addition, the system is designed to be extendable, keeping future data needs in mind. The linked Hybrid Hydrologic Model will improve streamflow forecasts on the Dungeness River and demonstrate how NASA tools and technologies can be used to improve an existing decision-support system.

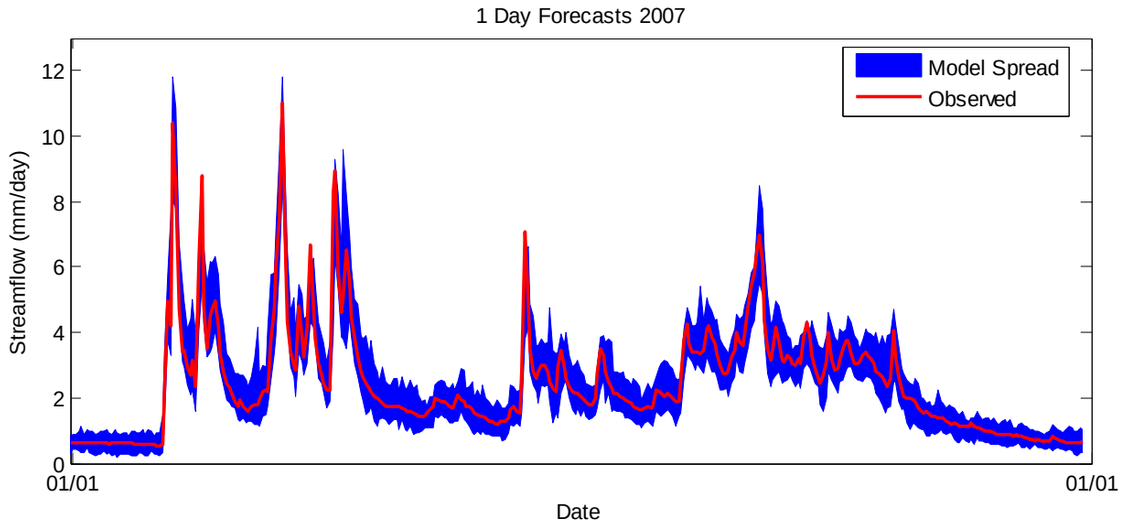


Figure 2. Hybrid Model output (blue) and actual observed streamflow (red line) on the Dungeness River for 2007.

## SUMMARY

Although our initial work on the Olympic Peninsula of Washington state is centered on using NASA tools to improve water forecasting and to enhance the existing decision-support system for allocating scarce, snow-pack driven water resources, we believe many of the tools and concepts we are employing can be readily extended to regional, national, and international scales.

NOPSN will work closely with NASA and interested user groups to explore how to use existing and emerging technology to address a variety of environmental issues, including concerns about water quality and quantity, the need to improve agricultural efficiency, contingency planning for unintended releases of contaminants onto land or into water, the need to couple potential environmental stressors associated with global warming to ecological forecasting models, and the need to assess and manage ecological impacts across regional, national, and international borders. Visit our website at pcnasa.ctc.edu to learn more.

## REFERENCES

Ward, J., T. Ingersoll, P. Morris, and M. Doherty. 2007. New Opportunities to use NASA Technology through Interactions with User Groups. North Olympic Peninsula Solutions Network Report 07-01. Center of Excellence, Peninsula College.

Wigmosta, M., J. Ward, J. Selhke, A. Coleman, K. Gill, R. Hruska, and L. Miller. 2007. Hybrid Model Development in the Dungeness Watershed. North Olympic Peninsula Solutions Network Report 07-02. Center of Excellence, Peninsula College.