DOE Bioenergy Technologies Office (BETO) 2017 Project Peer Review

Resource Assessment of Sustainable Biomass through Forest Restoration

March 9, 2017
Analysis & Sustainability

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2015 & 2016 Wildfires

Sustainable use of biomass from forest restoration can reduce high fuel loads and subsequent fire risk and has been identified as a potentially significant source of energy.
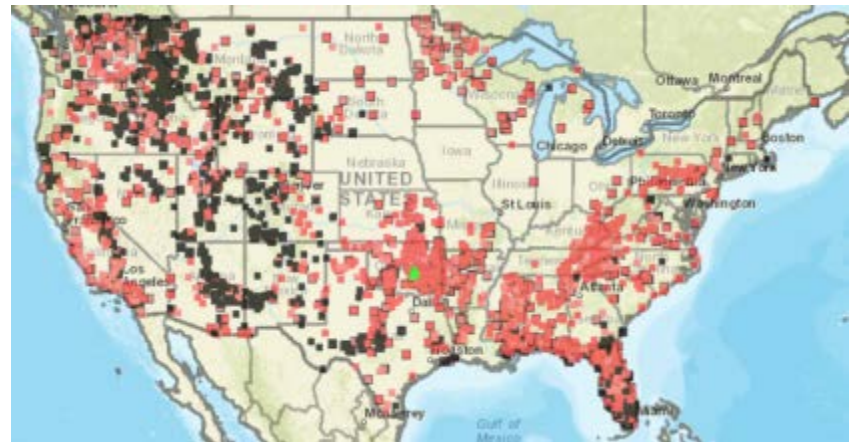
► **This project will develop and demonstrate an analysis framework to prioritize how and where to target forest restoration (timber harvest and thinning) and fuels reduction to have the greatest benefit for bioenergy, reduce severe wildfire risk, increase water yield, and improve ecosystem services.**

   ■ Multi-agency collaboration between DOE-BETO (PNNL, ORNL) and USFS R&D

► Capabilities developed under this project will provide an analysis framework for the bioenergy industry to increase forest derived biomass in a publically and ecologically acceptable manner.

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Quad Chart Overview

Timeline

- ► Project start date: Oct 2016
- ► Project end date: Sep 2019
- ► Percent complete: 5%

Budget

	Total Costs FY 10 –FY 12	FY 13 Costs	FY 14 Costs	Total Planned Funding (FY 17-Project End Date
DOE Funded	N/A	N/A	N/A	$890,000
Project Cost Share (Comp.)*				

*If there are multiple cost-share partners, separate rows should be used.

Barriers

- ► At-B. Analytical Tools and Capabilities for System-Level Analysis
- ► St-G. Land-Use / Landscape Design
- ► St-E. Best Practices

This DOE / USFS project will provide an analysis framework to prioritize how and where to target forest restoration to have the greatest benefit for bioenergy, reduce wildfire risk, and improve ecosystem services.

Partners

- ► ORNL
- ► USFS

Collaborators

- ► University of Washington
- ► PNNL HTL and Waste-to-Energy teams

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- ▶ Fire suppression and land management have resulted in greatly increased forest density which increases mega-fire frequency, and alters multiple hydrologic processes including streamflow patterns, and reduced water availability.

- ▶ USFS/DOI/States response: implement strategic thinning and prescribed burning across the U.S.
  - ■ Air quality standards, forest economic sustainability and budgets limit amount of annual restoration

- ▶ Excess biomass material has the potential to make large volumes of forest residues and small-diameter trees available for bioenergy
  - ■ 0.2 to 0.6 billion dry tons in 5 western states (USDOE, 2011; USFS, 2005)
  - ■ Red Rock Biofuels in southern Oregon, will utilize residue from forest and saw mill operations, and is under contract with FedEx and Southwest Airlines to supply aviation-grade biofuel

- ▶ This project will utilize a linked set of spatial, biophysical models coupled with existing USFS decision support software to develop and demonstrate an analysis and tradeoff framework to prioritize how and where to target forest restoration to address multiple objectives.
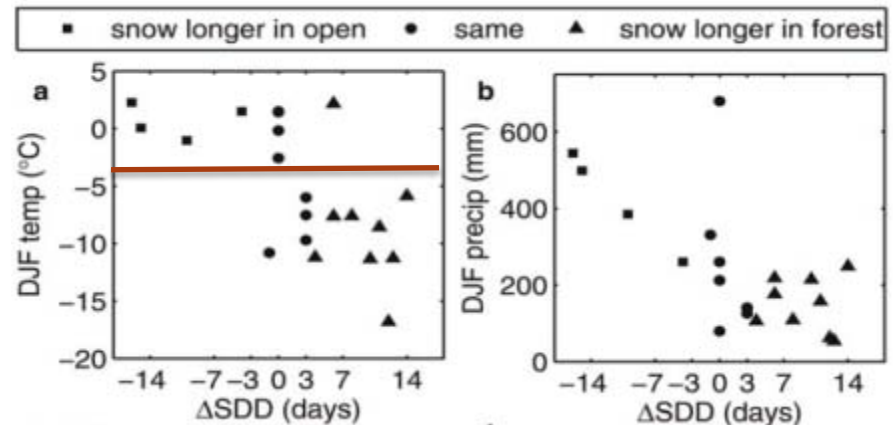
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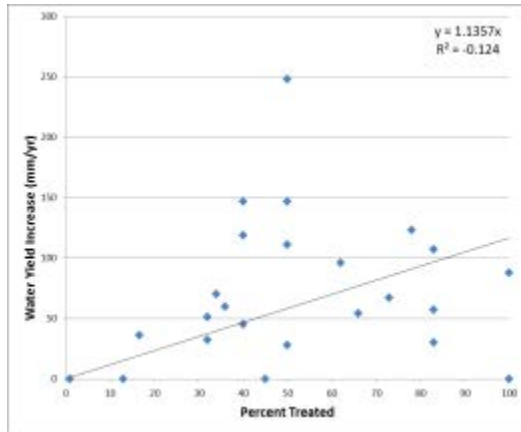
(Modified from Stednick, 1996)

Forest treatment generally increases annual flow volume

Reduction in forest cover may increase or decrease snow depth and duration depending on local topography, climate, and canopy characteristics

(modified from Lundquist, 2013)

Identify high fire risk locations for restoration that have sufficient biomass and the potential to increase peak snow water equivalent (SWE) and snowpack duration to improve summer low flows critical to fisheries.

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PI/PM Wigmosta

Task	Lead
Forest Restoration Planning and Biomass Yield	Hessburg (USFS)
Hydrologic Analysis	Wigmosta (PNNL)
Ecosystem Analysis and Sustainability	Jager (ORNL)
Decision Support	Reynolds (USFS)

▶ Following BETO project management protocols
- ■ Annual Operating Plan (AOP)
- ■ Quarterly Progress Reports to BETO

▶ Project Communications
- ■ Weekly planning with PNNL staff
- ■ Bi-weekly PNNL/ORNL/USFS conference calls
- ■ USFS subcontract reporting
- ■ Monthly calls with BETO Analysis and Sustainability

▶ Potential Challenges
- ■ State of the Science – limited datasets for model validation
- ■ Adequate datasets for application for other regions in U.S.
- ■ Communication and feedback from industry and stakeholders

▶ Fine resolution vegetation data will be used to accurately estimate sustainable forest biomass and support distributed hydrological, ecological, and wildfire risk modeling to assess priority restoration to reduce high fuel loads, increase biomass yield, streamflow and ecosystem services.

- Initial focus on high-risk areas in the Pacific Northwest at watershed to regional scale using data, models, and analysis techniques that can be applied nationally.

▶ **Technical Success**: Analysis framework prioritizing how/where to target restoration

▶ **Market Success**:

- Establishment of a BETO/USDA working group for this topic area with regular webinars, publications, and outreach to engage IEA Bioenergy and others.
- Dissemination of study results through peer-reviewed publications, conferences and workshops, and dissemination to Bioenergy KDF
- Strategic partnerships with industry (e.g., Red Rock Biofuels, Genifuel)

▶ **Key challenges**:

- State of the Science: Limited, but increasing, observational data to support model parameterization and validation
- Appropriate datasets for ultimate national application
- Integration in bioenergy feedstock mix (e.g., Billion Ton)

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► Prioritize forest locations with high fire risk, significant biomass, and the potential to improve streamflow characteristics for fisheries

■ Improve summer low flow and timing
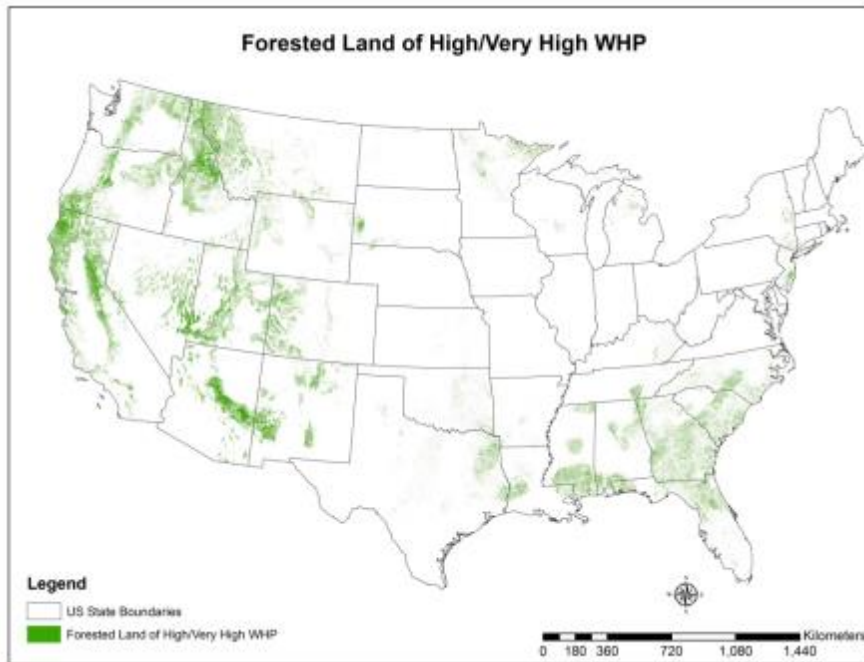
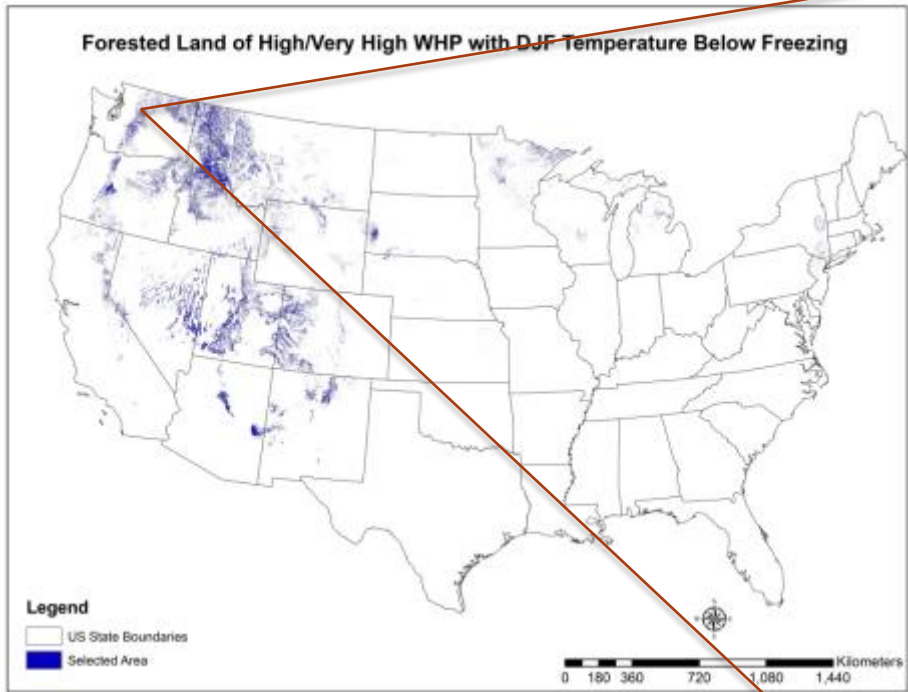Forest areas with high or very high wildfire hazard potential (90.7M acres)

2014: USDA Forest Service, Fire Modeling Institute wildfire hazard potential (WHP)
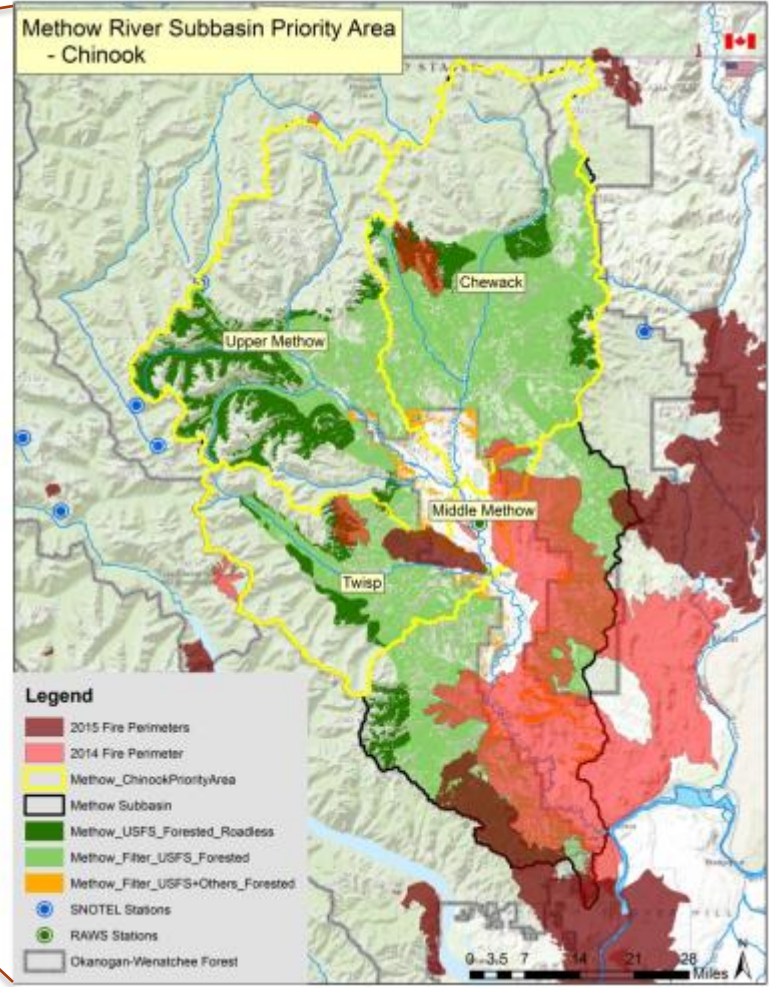
2015-16 Wildfires

Geospatial Multi-Agency Collaboration (GEOMAC) 2015-16 Wildfires (red: human caused, dark: natural). These data include wildfires in both forest and non-forest areas.

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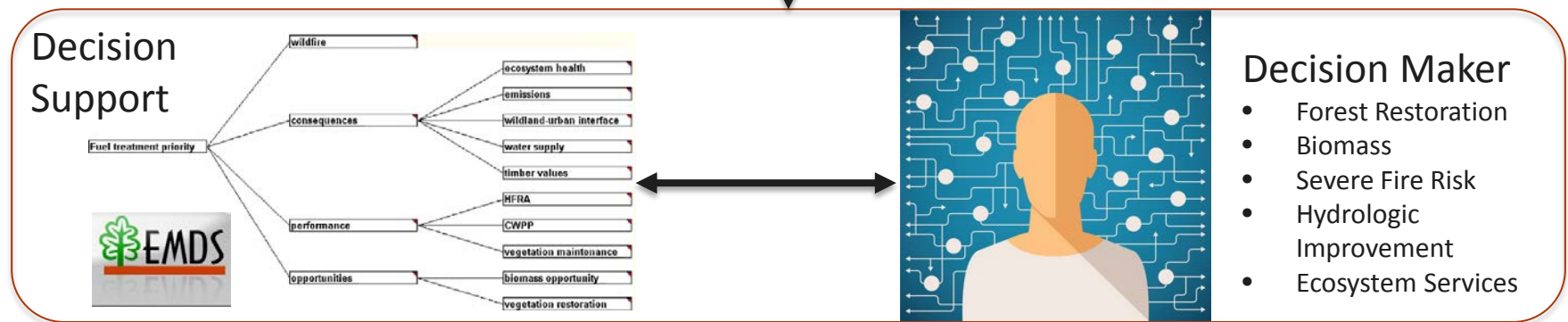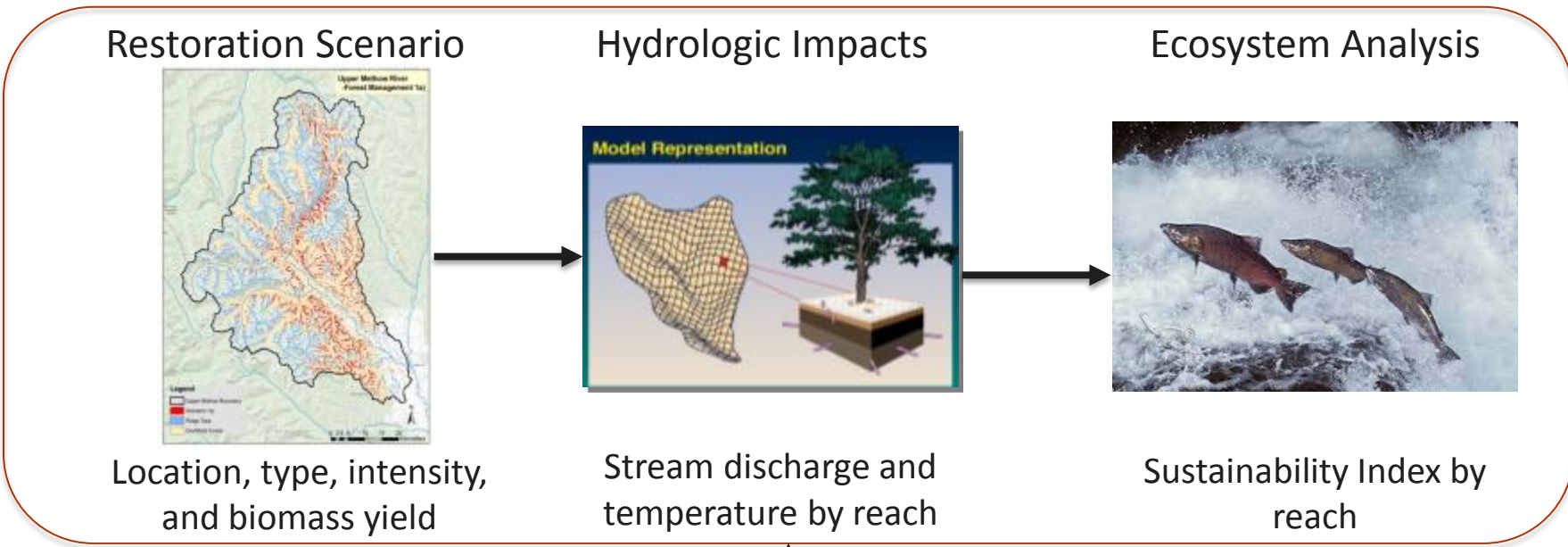Forested Land of High/Very High WHP with DJF Temperature Below Freezing

Forest areas with high or very high wildfire hazard potential with winter (DJF) mean air temperature below freezing (43.5M acres)
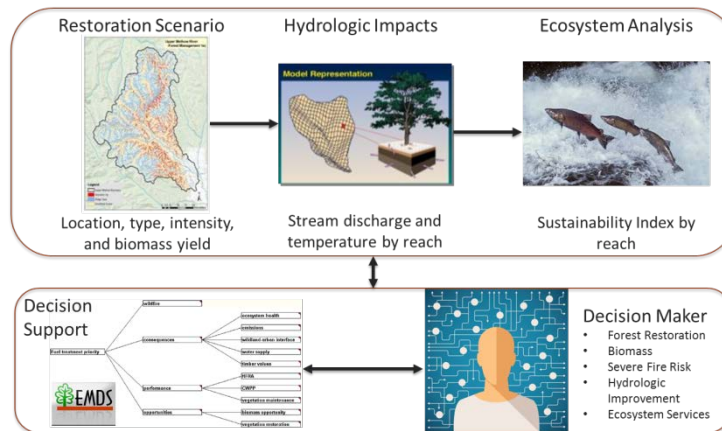
(Wigmosta et al., 2016)

Restoration Scenario

Hydrologic Impacts

Ecosystem Analysis

Location, type, intensity, and biomass yield

Stream discharge and temperature by reach

Sustainability Index by reach

Decision Support

Decision Maker
- Forest Restoration
- Biomass
- Severe Fire Risk
- Hydrologic Improvement
- Ecosystem Services

EMDS is the USFS corporate software solution for decision support used by the USFS and USDI since 2006 to evaluate wildfire potential across all administrative units in the continental US, and establish priorities for allocating fuel-treatment budgets.

- ▶ Completed on-site PNNL/ORNL/USFS team workshop

  - ■ Preceded by 2 webinars

  - ■ Identified key data requirements and model linkage

  - ■ Mapped model interaction with EMDS decision support software

  - ■ Plans for follow-on webinars

- ▶ Completed assembly of required vegetation, soils, wildfire potential, roads and processing facilities, and meteorological data

  - ■ Local – Demonstration basin application

  - ■ Regional (PNW) application

  - ■ Future national (CONUS) application
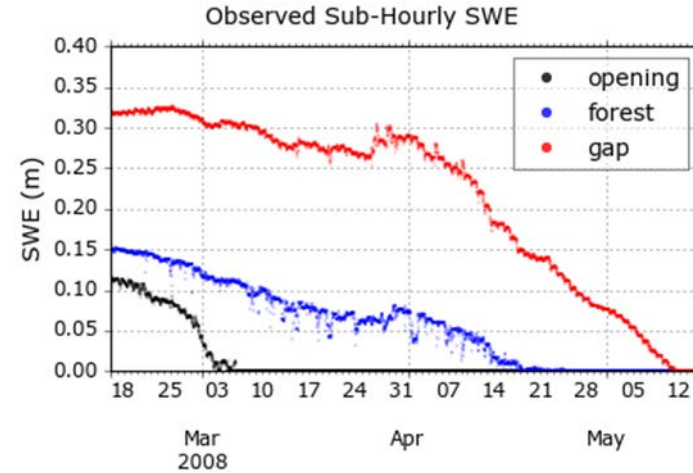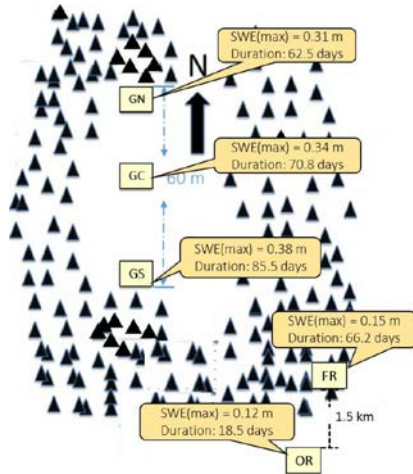
U. of Idaho Experimental Forest
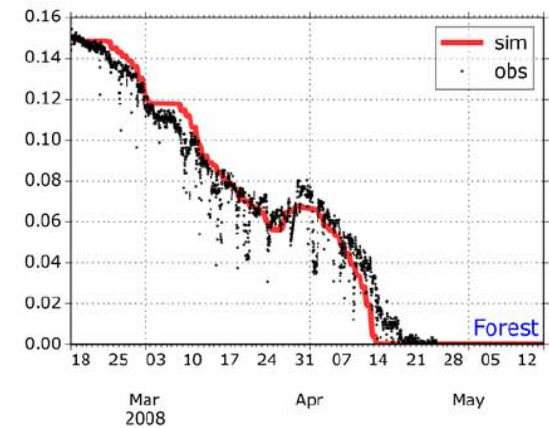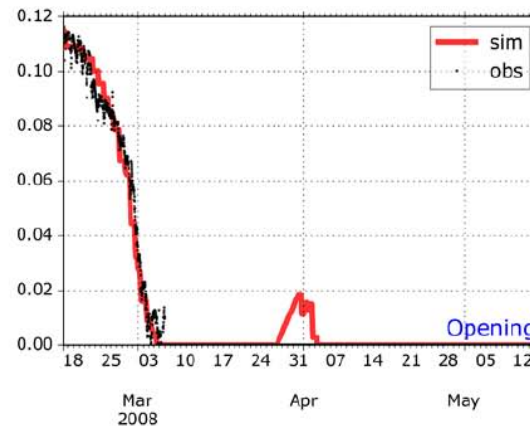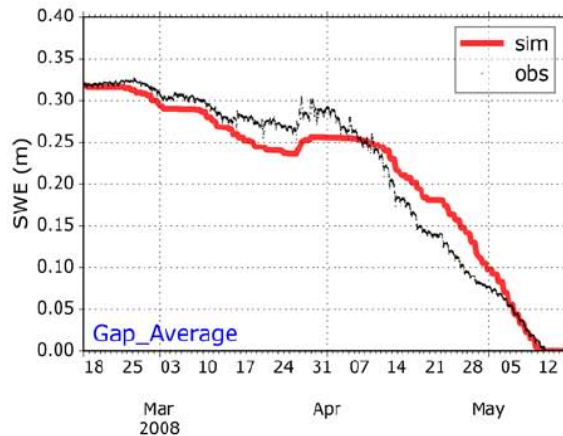
Excellent DHSVM simulation results for a range of forest conditions: gap in the forest, in the open, and under the forest canopy

Capabilities developed under this project will provide a foundation for the bioenergy industry to increase forest derived biomass in a publically and ecologically acceptable manner.

▶ Directly supports BETO's mission:
  - ◼ "Develop and demonstrate transformative and revolutionary bioenergy technologies for a sustainable nation"

▶ High resolution analysis helps address 2018 Terrestrial Feedstock Supply and Logistics R & D goal
  - ◼ "Establish nationwide <u>sub-county</u>-level environmental impact criteria and logistics strategies for all potential energy crops, including agricultural and <u>forestry residues</u>"

▶ Integration of biophysical models and existing decision support software to identify biomass available through forest restoration directly supports Strategic Analysis Program goals to
  - ◼ "Develop and maintain analytical tools, models, methods, and datasets to advance the understanding of bioenergy and its related impacts"
  - ◼ "Ensure high-quality, consistent, reproducible, peer-reviewed analyses"

▶ Technology transfer though establishment of a BETO/USDA working group, dissemination to Bioenergy KDF, and regular webinars, publications, and outreach to engage IEA Bioenergy and others addresses Strategic Analysis Program goal to "convey results to a wide audience…"

▶ Complete resource database for model inputs and decision support

▶ Complete suitability analysis to define areas with greatest biomass and hydrologic improvement potential

▶ Develop a logic model for the decision analysis that incorporates:

  ■ Biomass for bioenergy & biomass for forest products

  ■ Water yield

  ■ Wildfire protection

  ■ Aquatic habitat

▶ Document in a progress report the resource assessment framework methodology and design plan for model linkage and decision support

▶ Provide technical report on regional-scale PNW biomass production potential through forest restoration and fuels reduction

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▶ Select demonstration basin for detailed analysis based on FY17 PNW regional scale analysis

- Fire risk

- Significant forest biomass

- Potential for enhanced streamflow and ecosystem services

▶ Collaboratively develop spatially-detailed alternative forest restoration scenarios that will be used to drive DHSVM and test sustainability indicators in demonstration basin

▶ Couple sustainability indices to DHSVM and complete framework testing in demonstration basin <u>without</u> decision support

▶ Provide an integrated framework and demonstration <u>with</u> decision support to prioritize how and where to target forest restoration treatments considering tradeoffs between

- Severe fire risk

- Bioenergy potential

- Improved streamflow and salmon habitat

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Summary

► Ongoing/future forest restoration has the potential to make available significant quantities of biomass

- Air quality standards, forest economic sustainability and budgets limit amount of annual restoration

► This project will provide a integrated framework to prioritize how and where to target forest restoration treatments

► Direct benefit to bioenergy industry by increasing forest derived biomass in a publically and ecologically acceptable manner

Win-Win-Win: Capitalize on current/future forest restoration as a sustainable source of bioenergy while reducing fire risk and improving ecosystem services.

Additional Slides

Publications, Patents, Presentations, Awards, and Commercialization