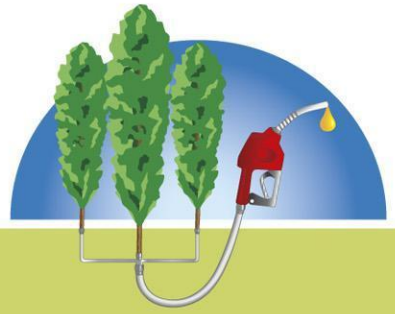


hardwoodbiofuels.org

Advanced **Hardwood Biofuels** Northwest

# Modeling Poplar Growth as a Short Rotation Woody Crop for Biofuels in the Pacific Northwest


Quinn Hart

Dept. Land, Air and Water Resources

UC DAVIS
UNIVERSITY OF CALIFORNIA



Feedstock


Conversion


Sustainability


Education


Extension

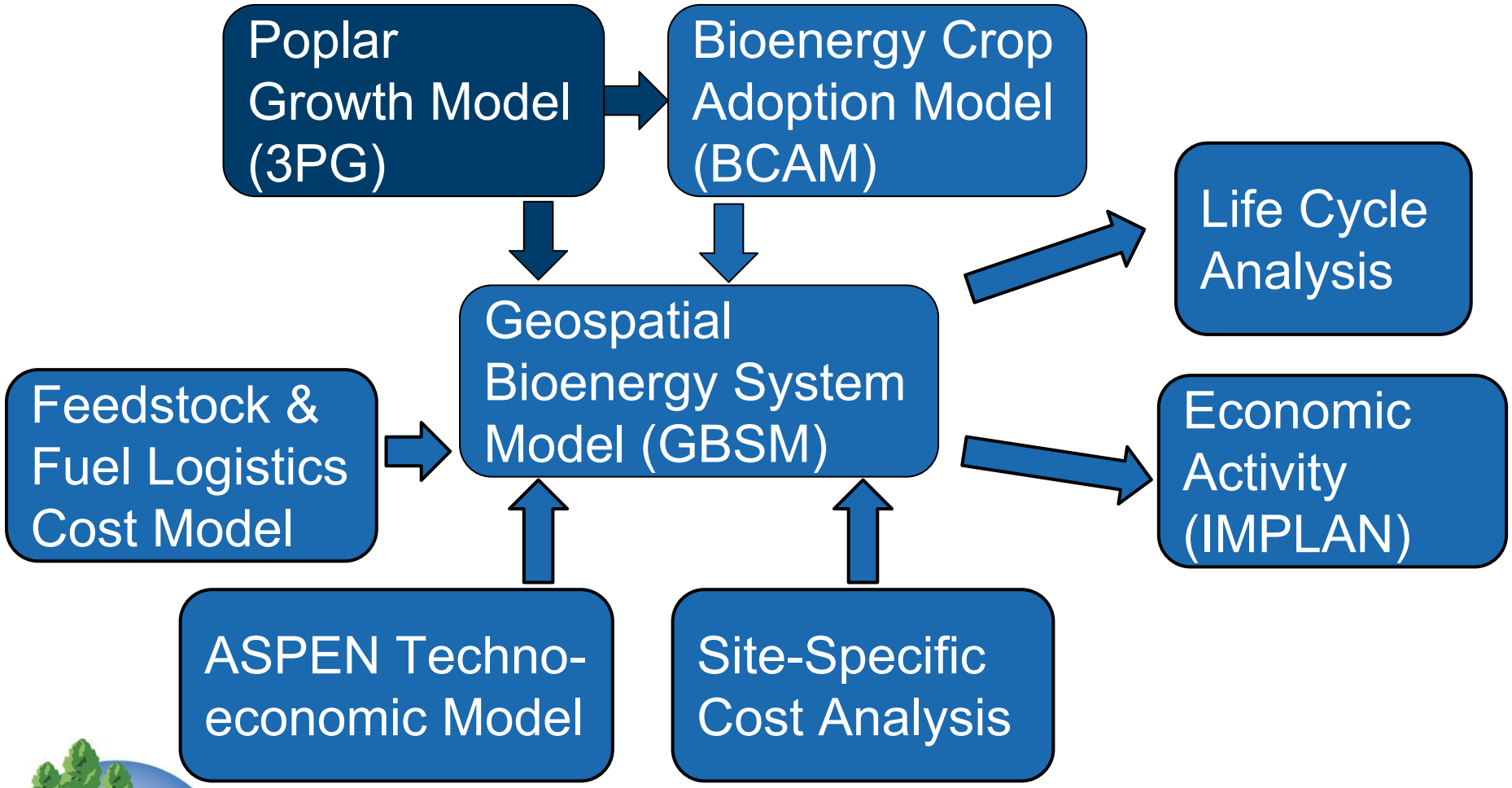
USDA United States Department of Agriculture

National Institute of Food and Agriculture

# AHB Economic Sustainability

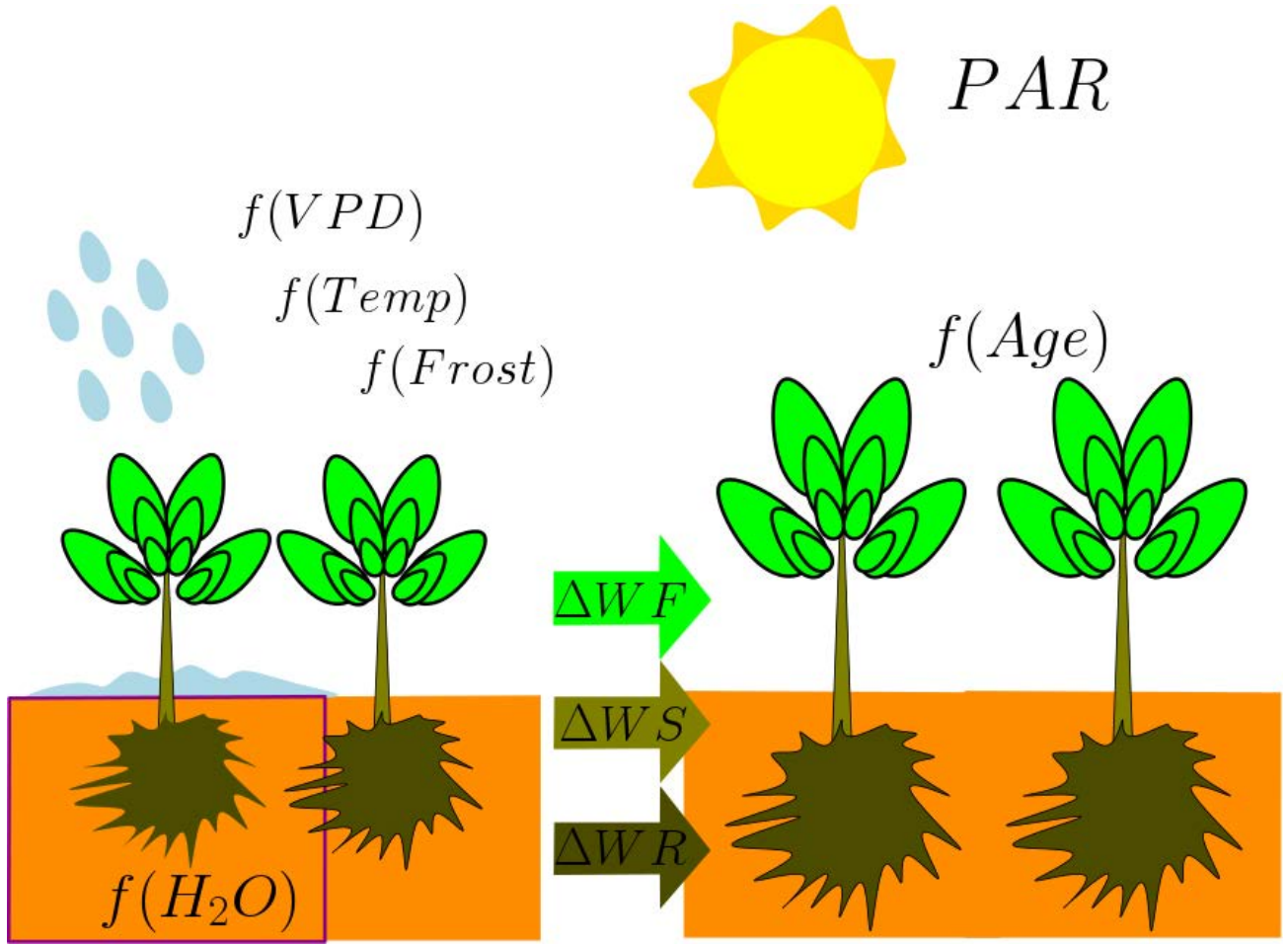
To evaluate the economic potential for drop-in biofuels produced from hybrid poplar in the Pacific Northwest and to estimate the regional impacts of the industry on the region. Inform and support the environmental sustainability work.

# Integrated Bioenergy Sustainability Assessment and Modeling Framework

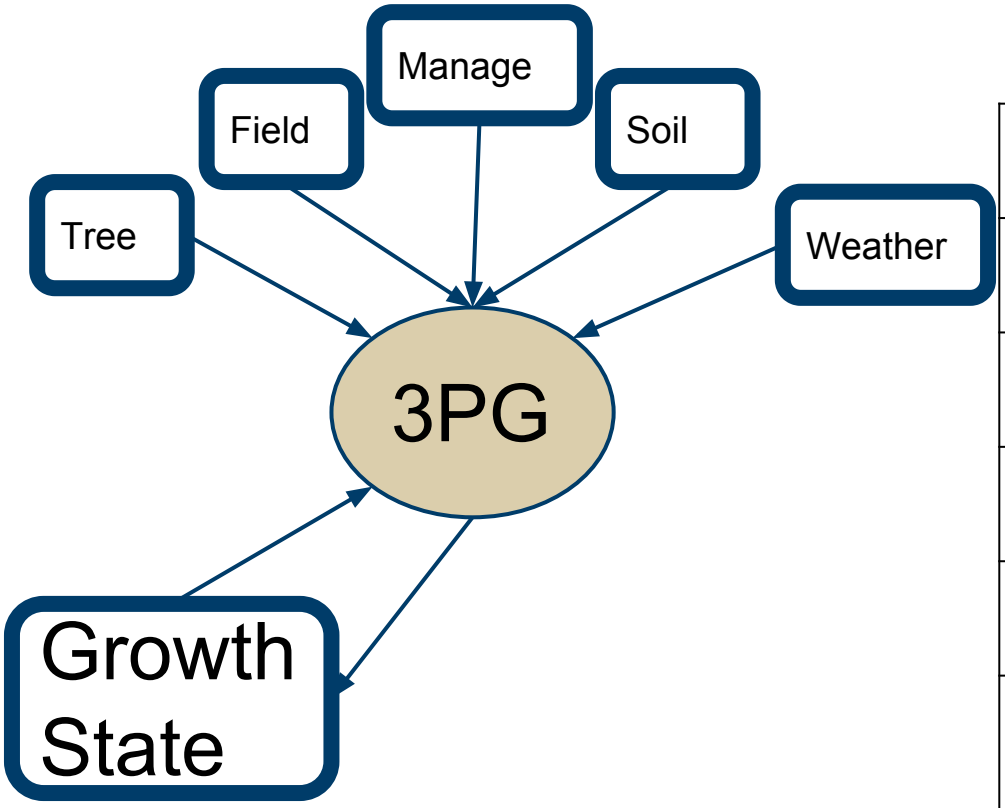


# Poplar Growth Model

## Physiological Processes Predicting Growth (3-PG)

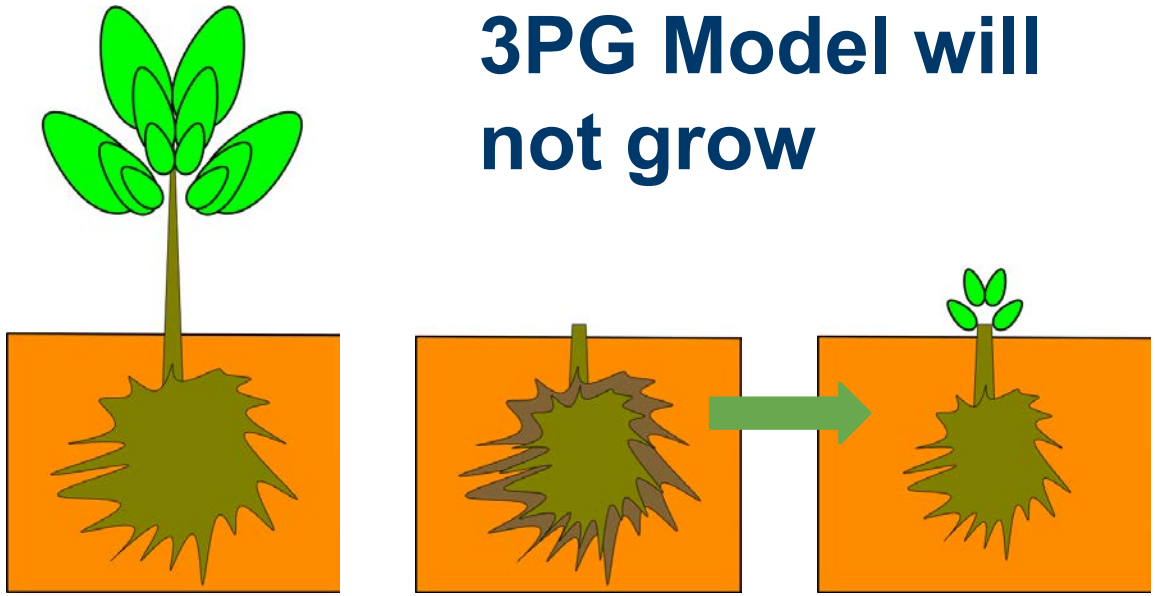


# 3PG - Input Types




| | |
|---|---|
| Tree Parameters | 35 |
| Plantation | 5 |
| Management | 3 |
| Weather | 6 |
| Soil | 3 |
| Growth State Variables | 30 |

# 3PG - Coppicing



**Without Foliage 3PG Model will not grow**

**Small, Monthly Contributions from Root**

**Roots Contribute Productivity**

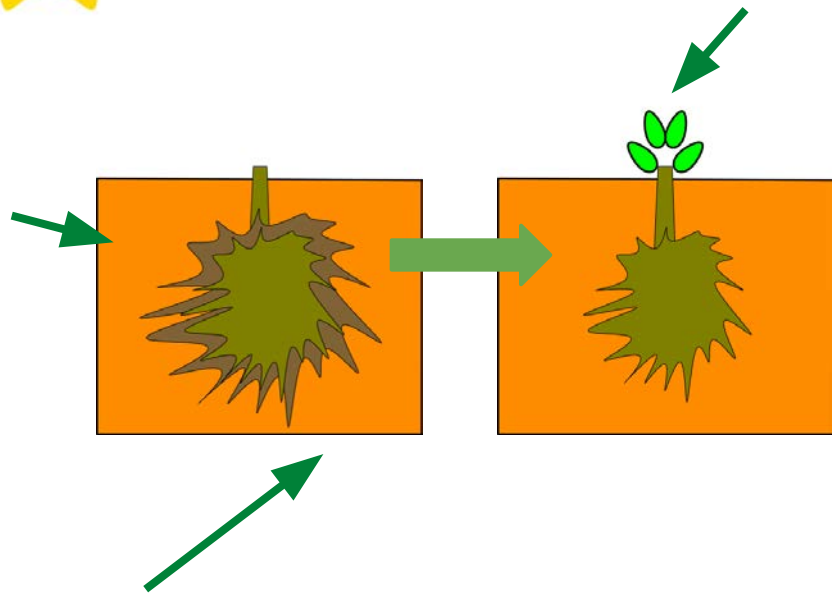
**Target based on NPP, LAI, and Root Mass**

# 3PG - Coppicing Variables

Target LAI [>0]

Root

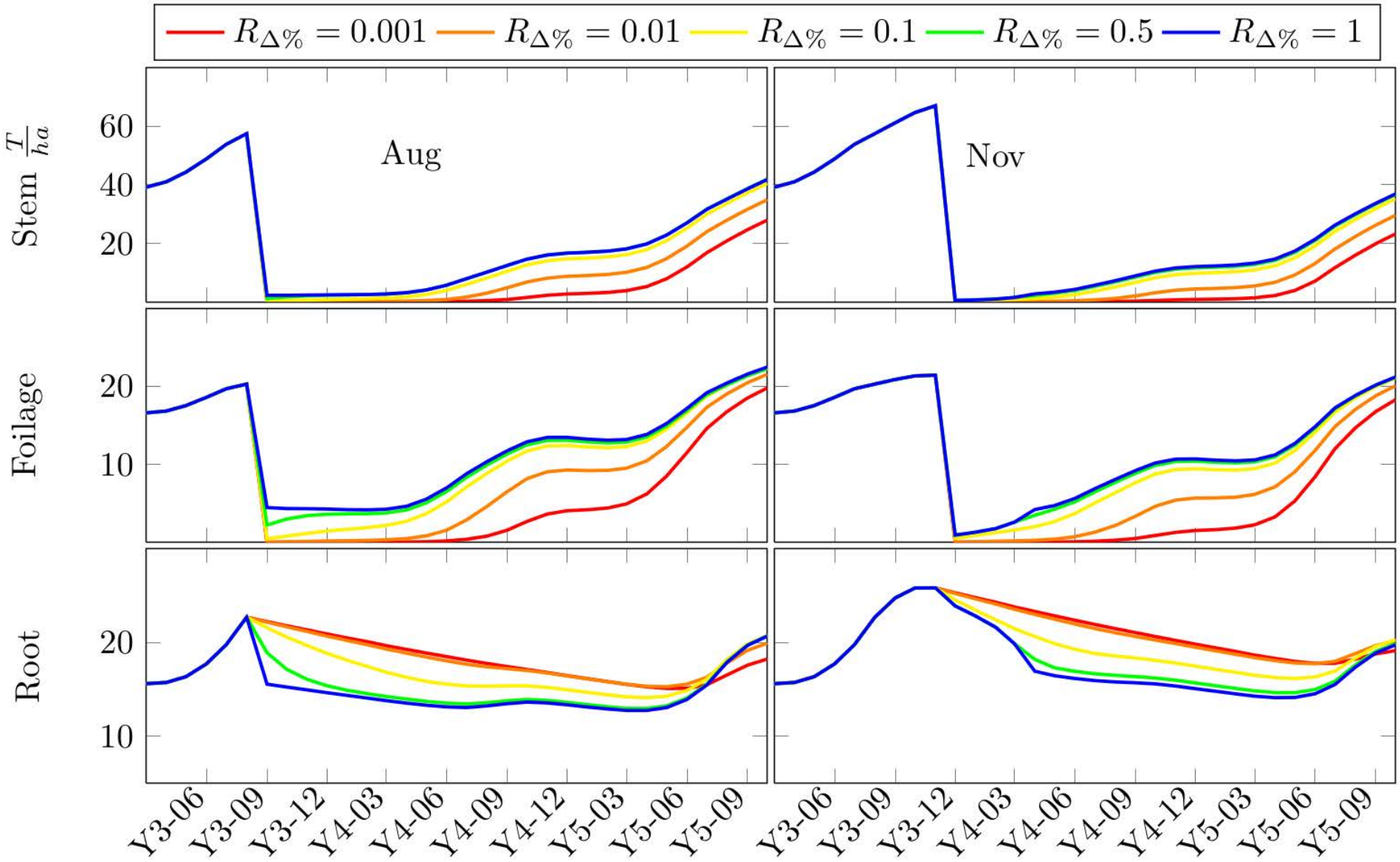
Contribution [0 -1]



Root

efficiency [0-1]

# Coppicing - Root Contribution



# 3PG Web Application

http://alder.bioenergy.casil.ucdavis.edu/3pgModel/

## Inputs

Location

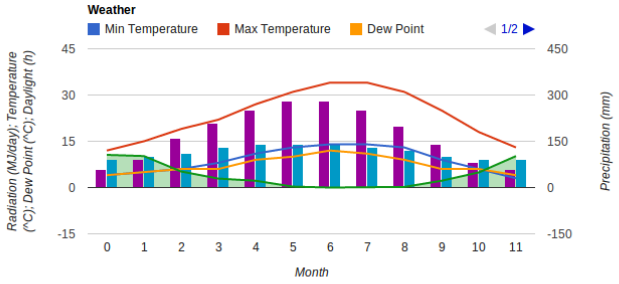
Tree | Plantation | Soil | **Weather** | Constants | Manage | Setup

Averages | Actual

Upload

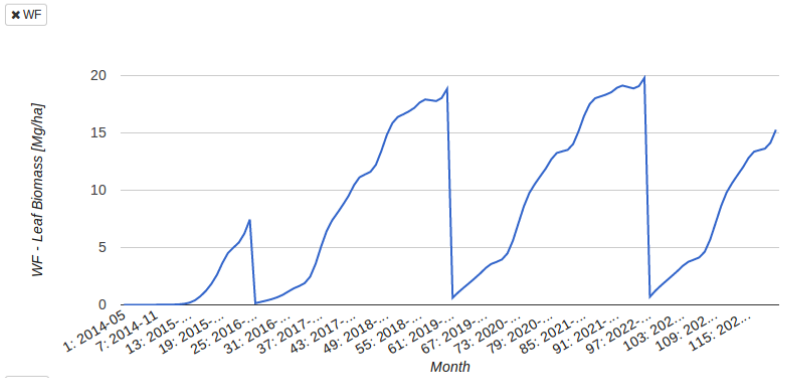
Select location to set the average weather data

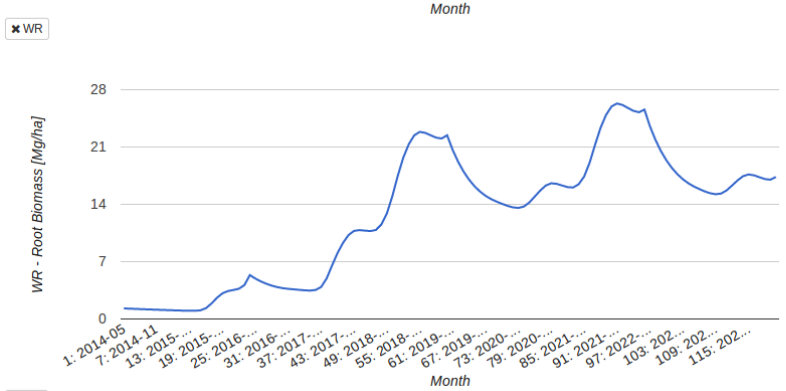
| month | tmin | tmax | tdmean | ppt | rad | daylight |
|---|---|---|---|---|---|---|
| 1 | 4.13 | 12.96 | 4.93 | 106.93 | 6.1840926754 | 9.6577272415 |
| 2 | 5.41 | 15.57 | 5.64 | 102.14 | 9.5755560000 | 10.584639549 |
| 3 | 6.78 | 19.65 | 6.24 | 52.76 | 16.473222815 | 11.813981056 |
| 4 | 8.1 | 22.46 | 6.61 | 29.47 | 21.740109469 | 13.090333938 |
| 5 | 11.33 | 27.44 | 9.06 | 22.52 | 25.258268483 | 14.136204719 |
| 6 | 13.56 | 31.42 | 10.59 | 3.83 | 28.441792601 | 14.648213386 |
| 7 | 14.62 | 34.38 | 12.08 | 0.18 | 28.160318300 | 14.356233596 |
| 8 | 14.19 | 34.03 | 11.56 | 1.34 | 25.035703175 | 13.388724327 |
| 9 | 13.14 | 31.82 | 9.76 | 2.62 | 20.393404917 | 12.158249855 |
| 10 | 9.82 | 25.84 | 6.92 | 22.97 | 14.574858312 | 10.886029243 |
| 11 | 6.52 | 18.19 | 6.28 | 49.25 | 8.8032305427 | 9.8185014725 |
| 12 | 3.88 | 13 | 4.5 | 102.7 | 6.4661356281 | 9.3347291946 |

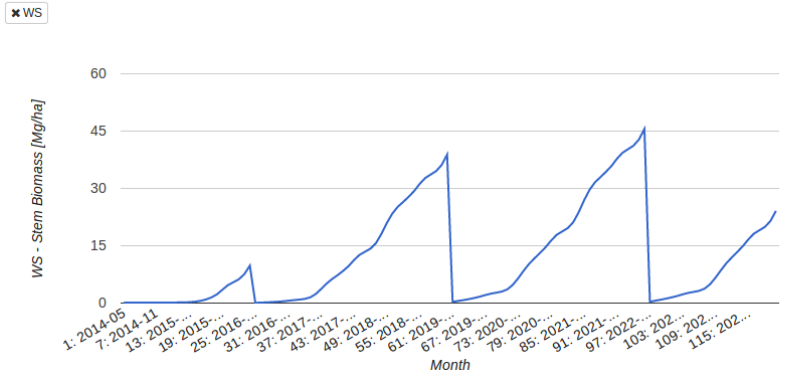



## Charts

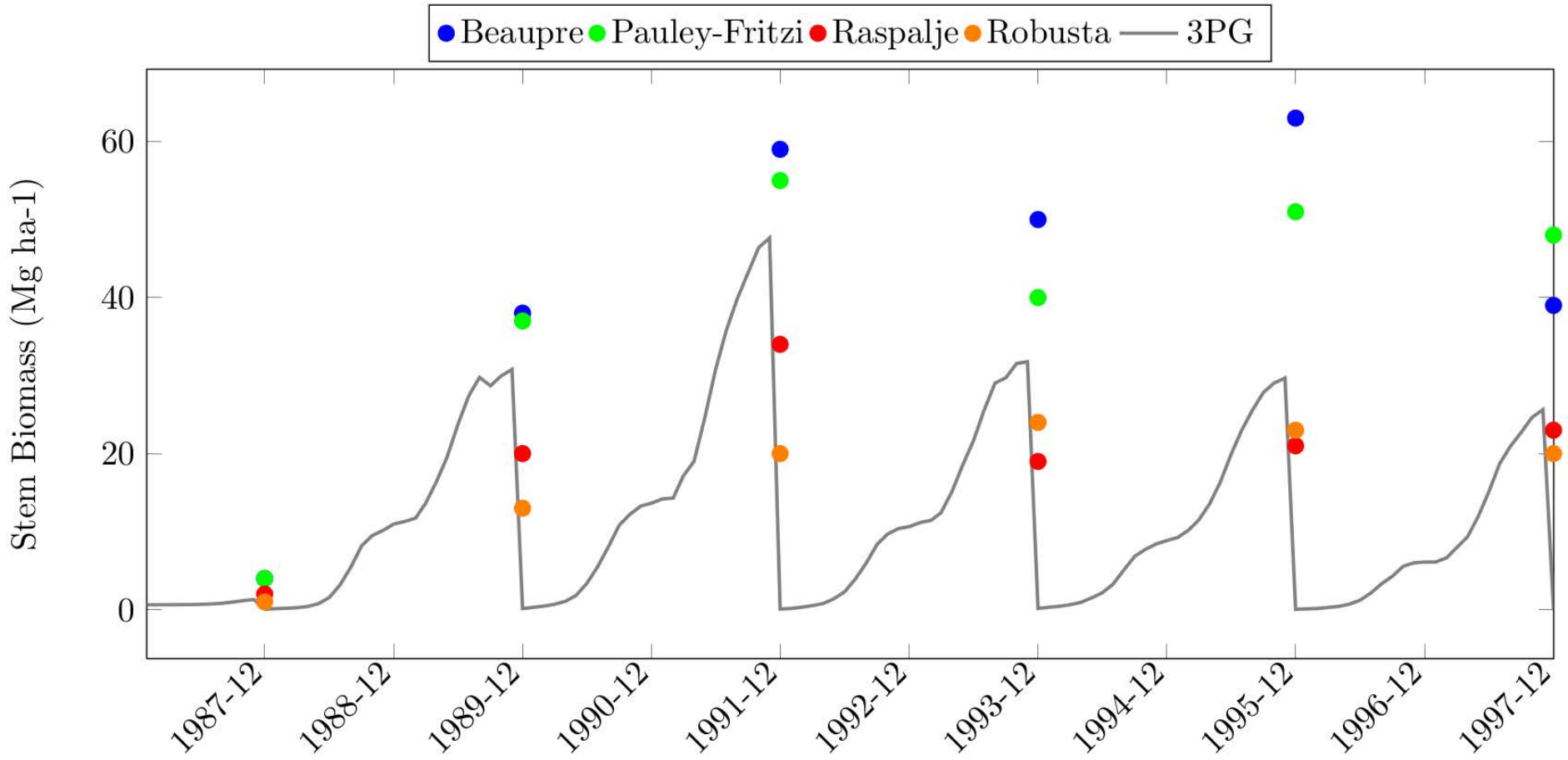
Add | Basic | Interactive



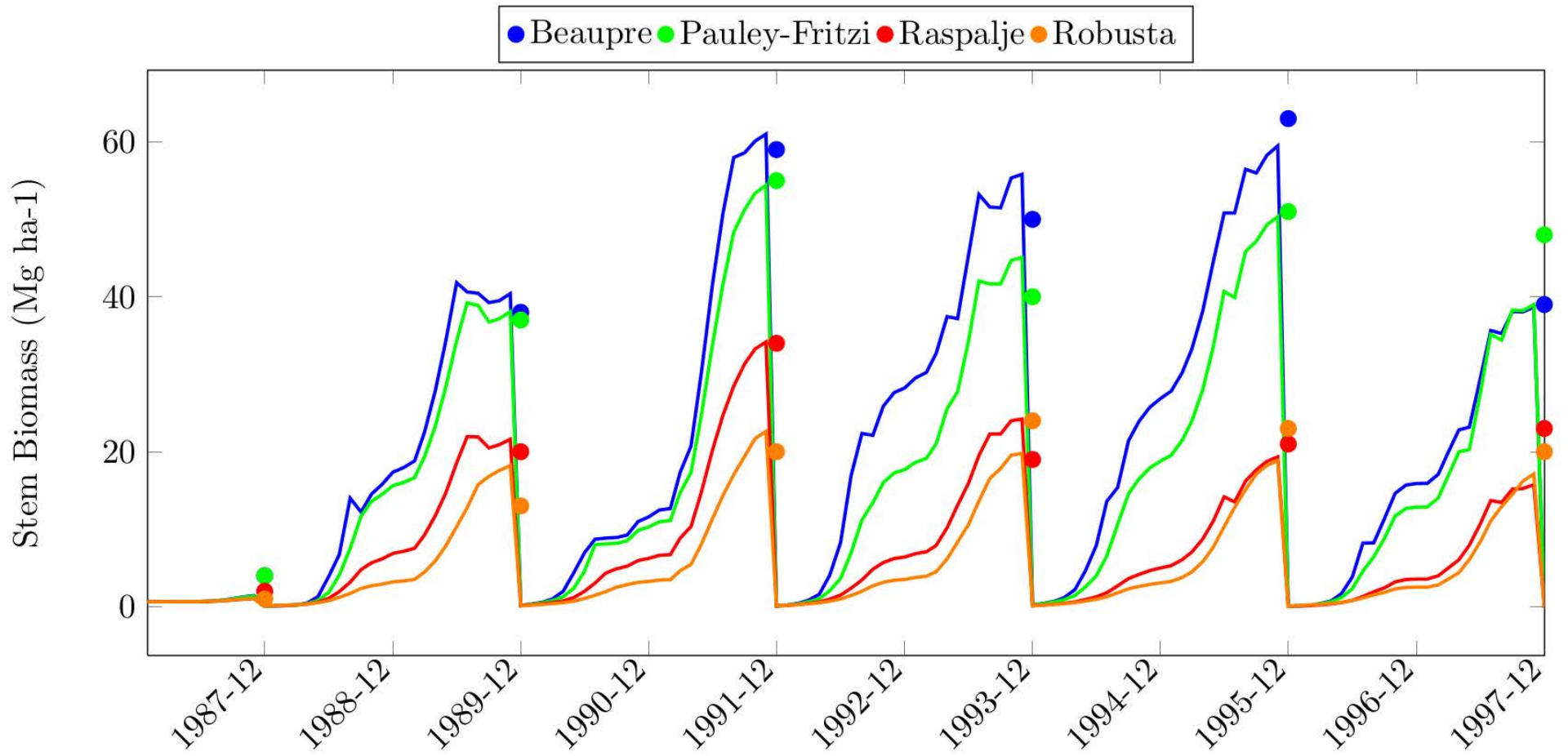



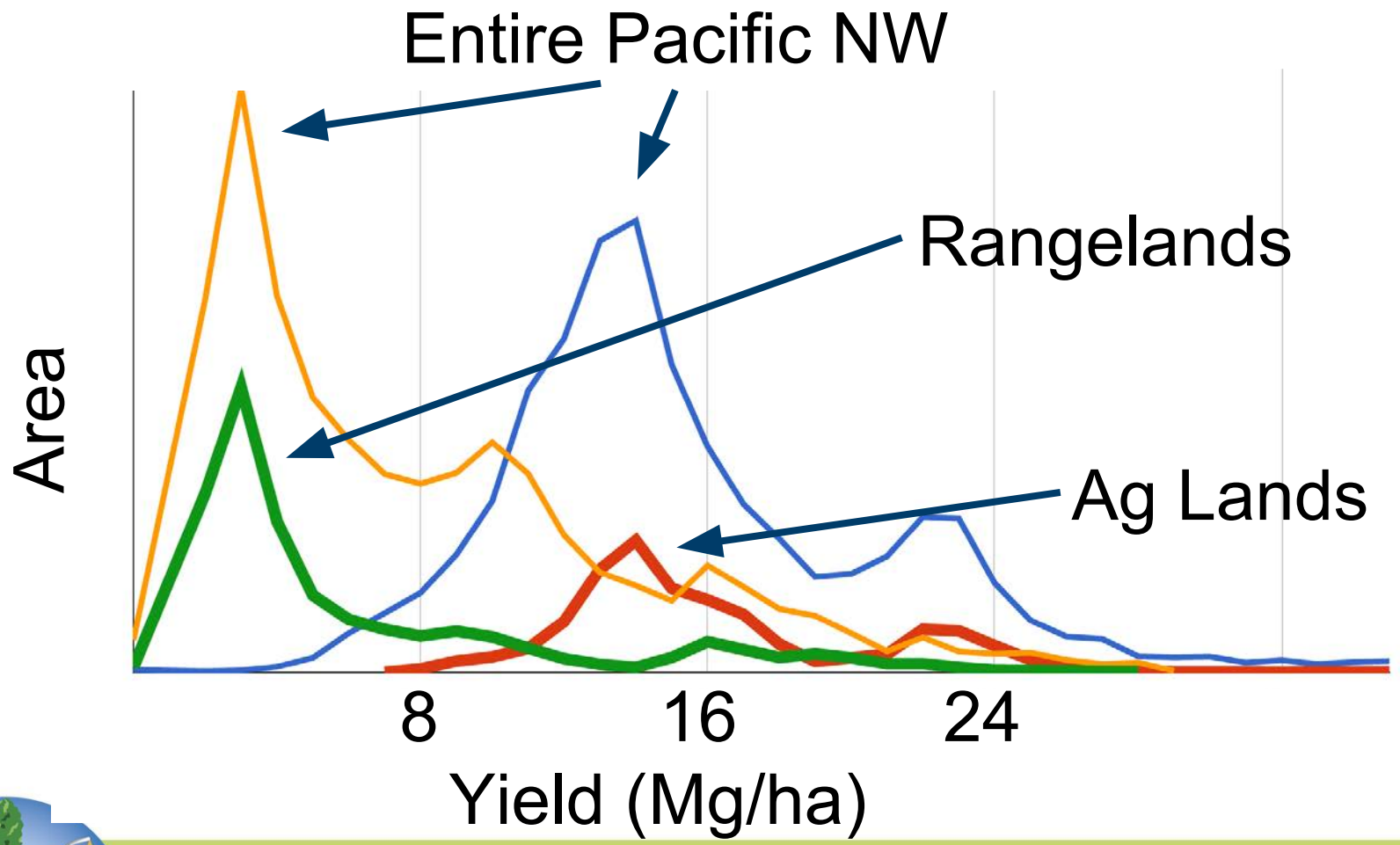
# Poplar Growth Model



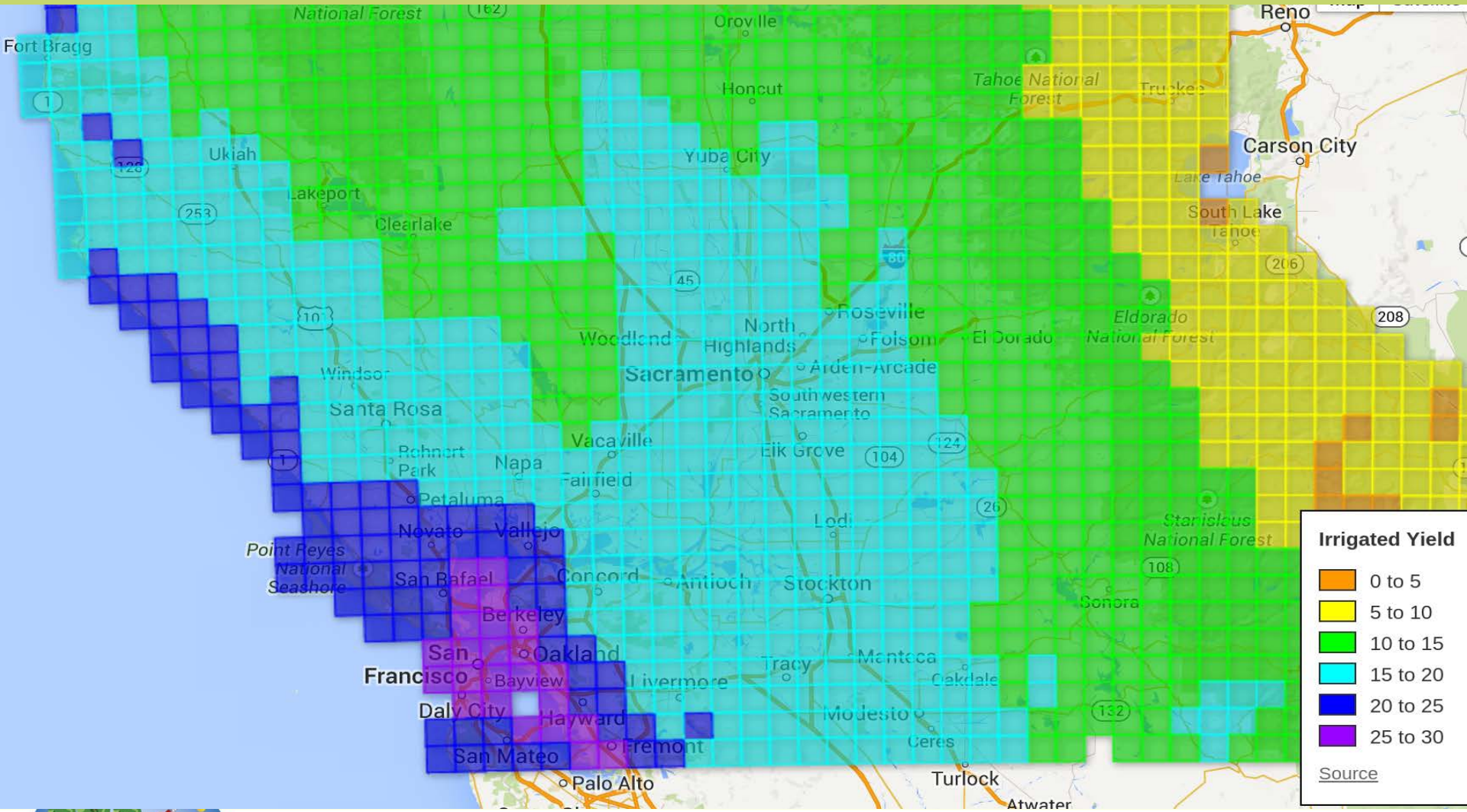
# Poplar Growth Model



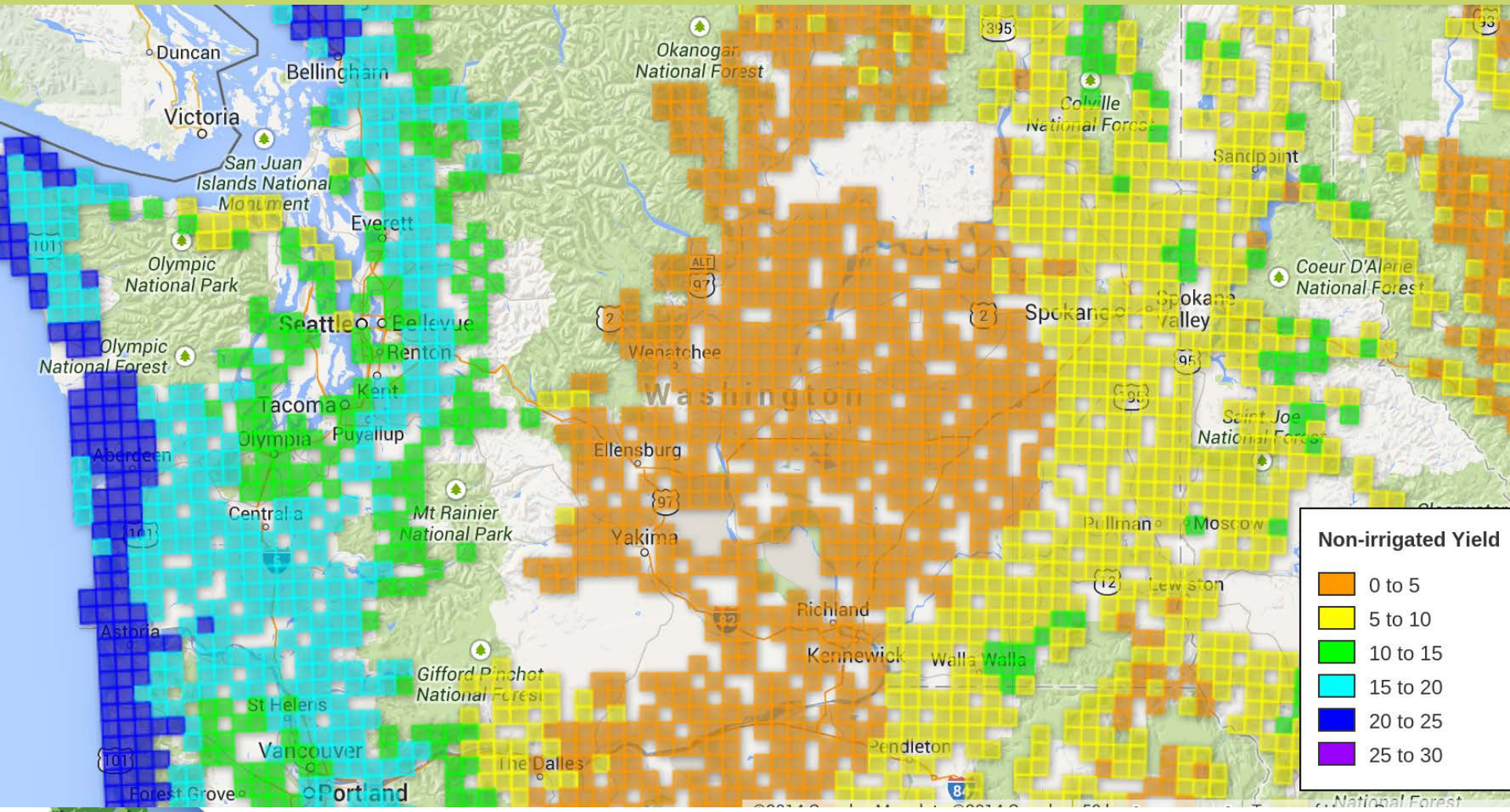
# Poplar Yields



# Irrigated Yield, Northern CA



# Non-Irrigated Yield, WA



# Conclusions

- 3PG w/ Coppicing for Yield Prediction
- Simple Coppice Model
- Yields for the PNW
- Online Tool for interactive scenarios
- Inputs to Economic Models

## TBD

- AHB Field Trial Validation
- Volume Index Allometric Relations

**4:20-4:40 pm: Varaprasad Bandaru**, *Can Short Rotation Hybrid Poplar Be a Promising Sustainable Energy Supply Source in Pacific Northwest Region?*

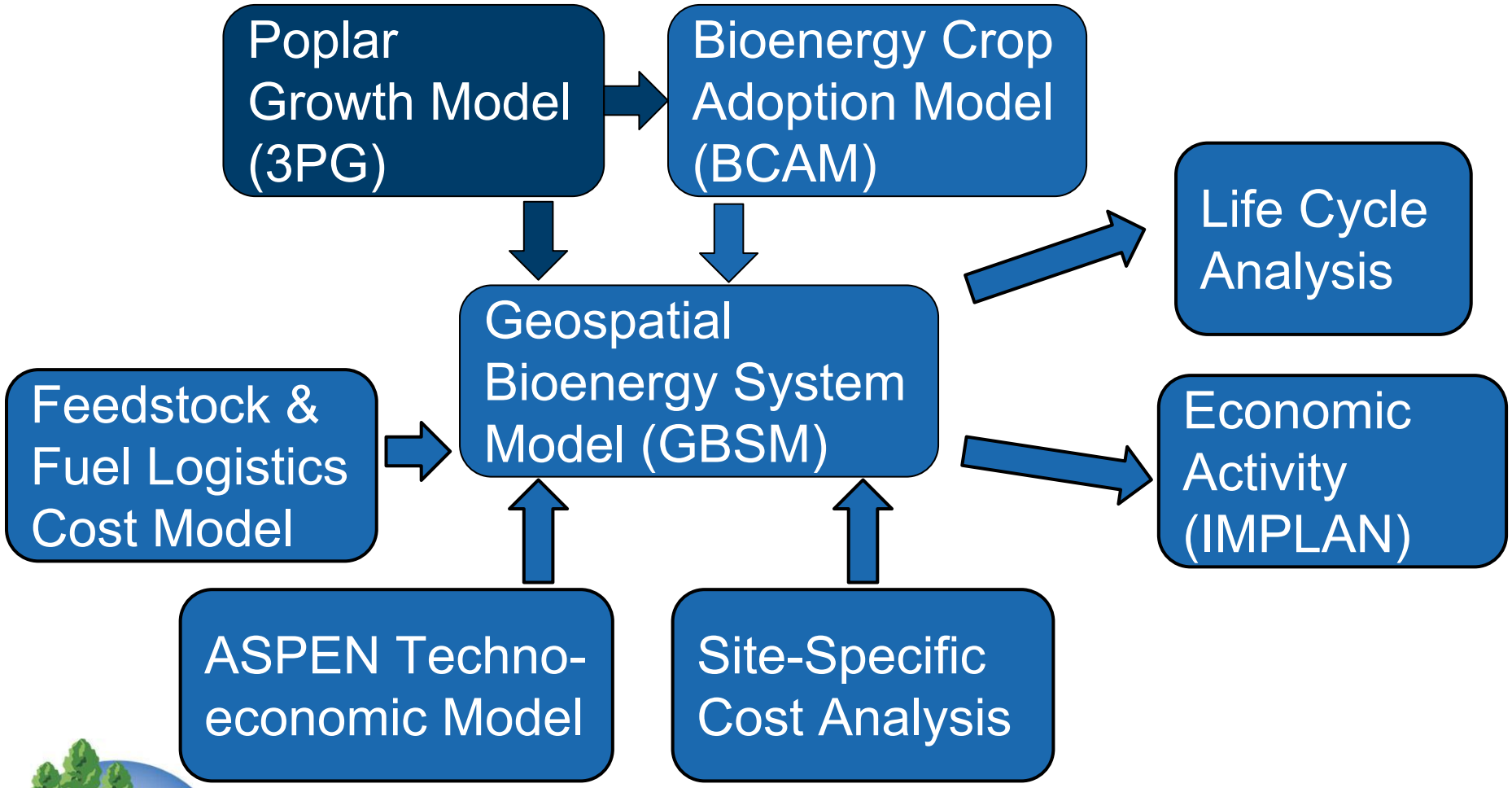
**Poster: Boon-Ling Yeo et al,** *The Bioenergy Crop Adoption Model (BCAM): Economics of sustainably producing hybrid poplars as a short-rotation woody biomass feedstock in the Pacific Northwest*

# UC Davis Research Team

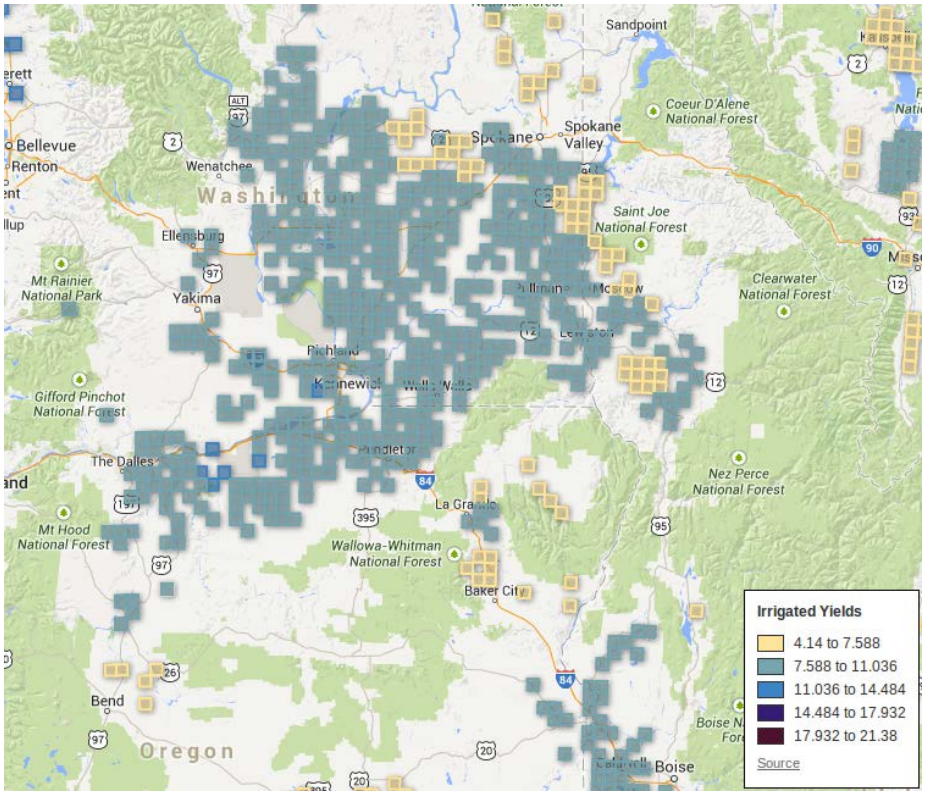
Bryan Jenkins

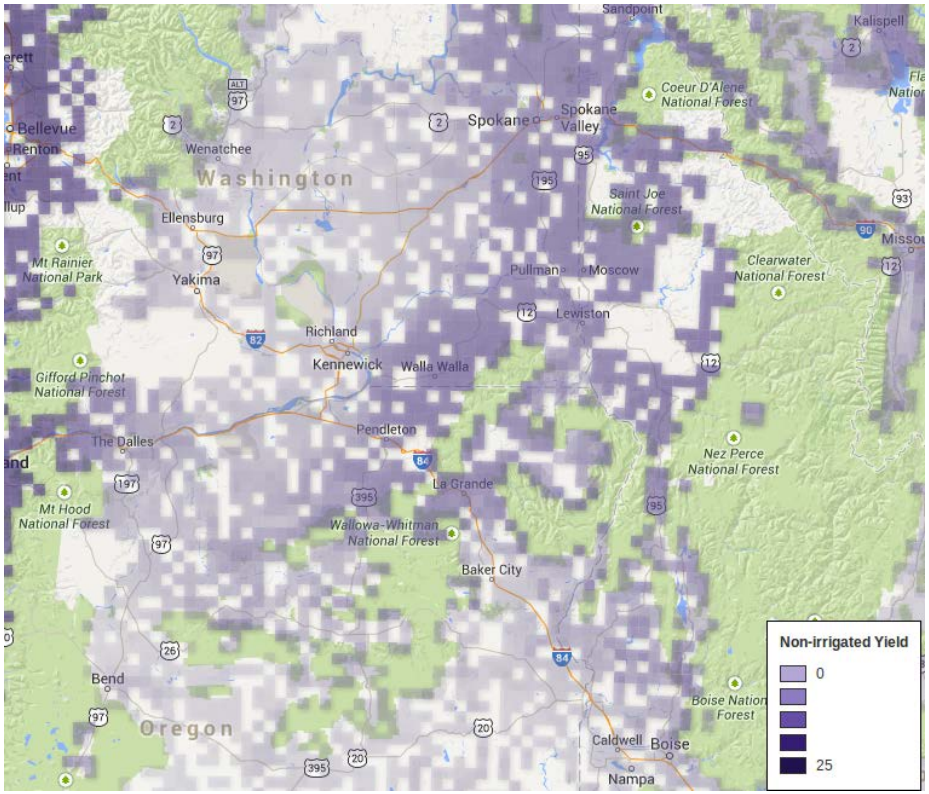
Varaprasad Bandaru
Yueyue Fan
Quinn Hart
Mark Jenner
Stephen Kaffka
Mui Lay
Yuanzhe Li
Justin Merz
Nathan Parker
Yu Pei
Olga Prilepova
Peter Tittmann
Boon-Ling Yeo

# Integrated Bioenergy Sustainability Assessment and Modeling Framework

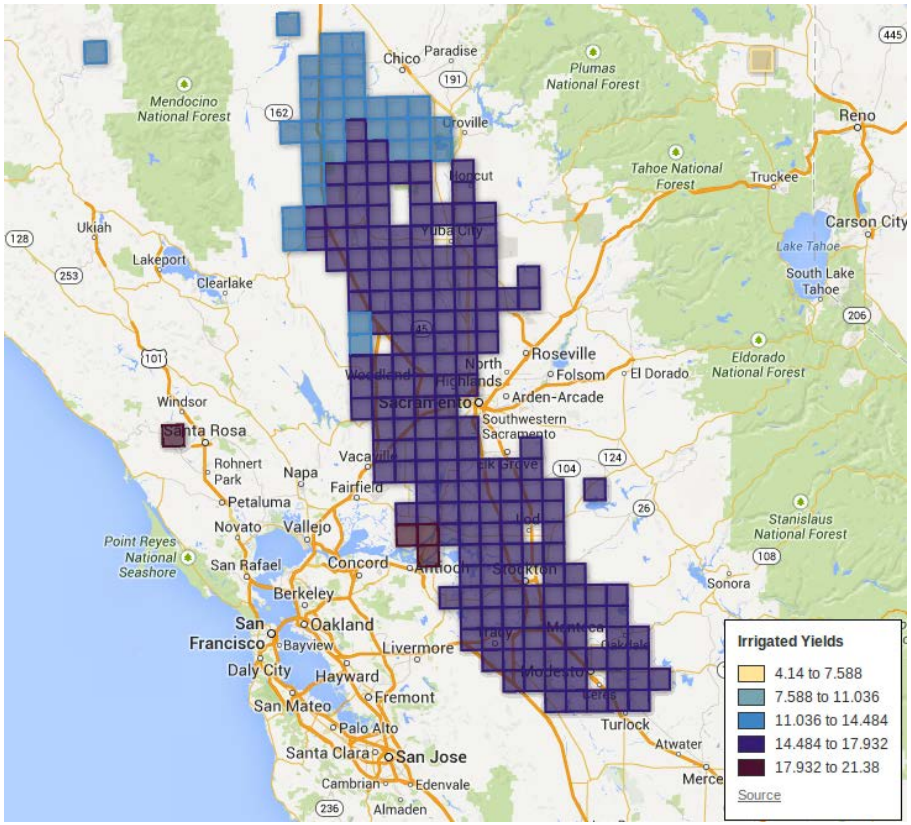


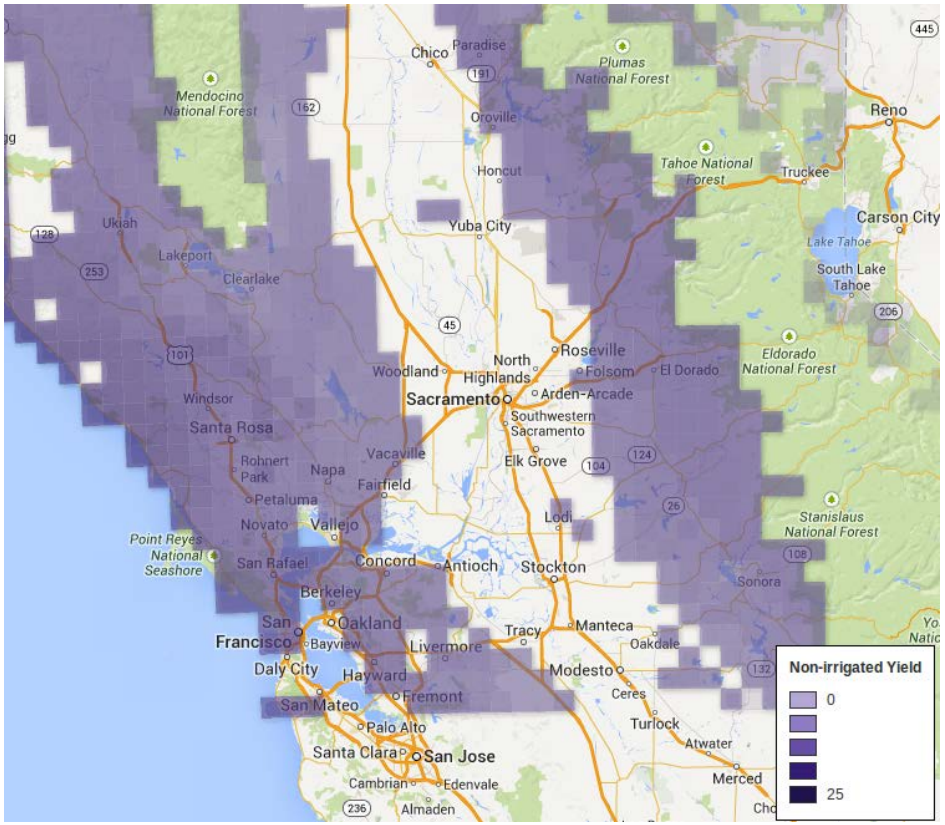
# Yield Maps (Walla-Walla, WA)



# Poplar Yield Maps (Clarksburg, CA)

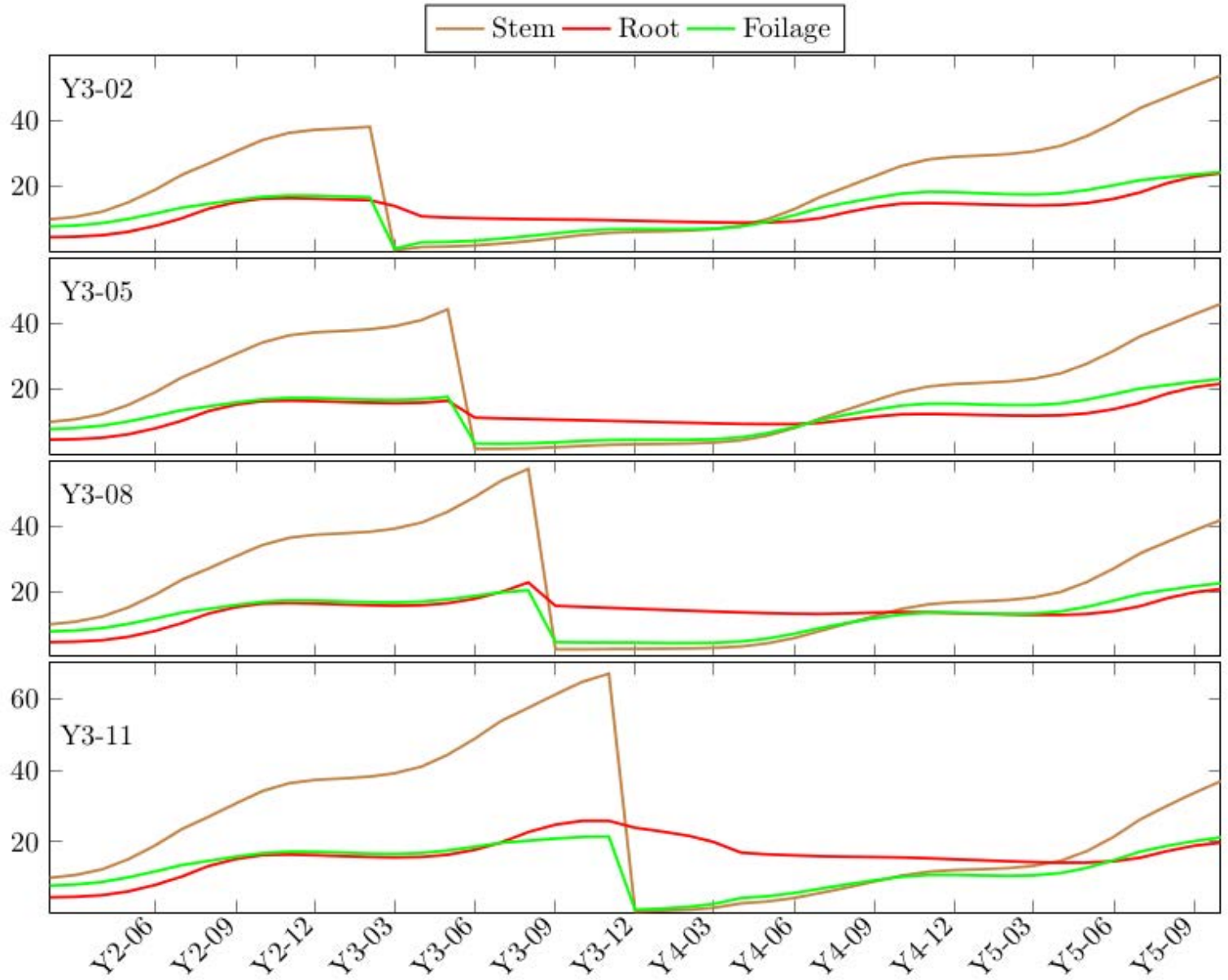


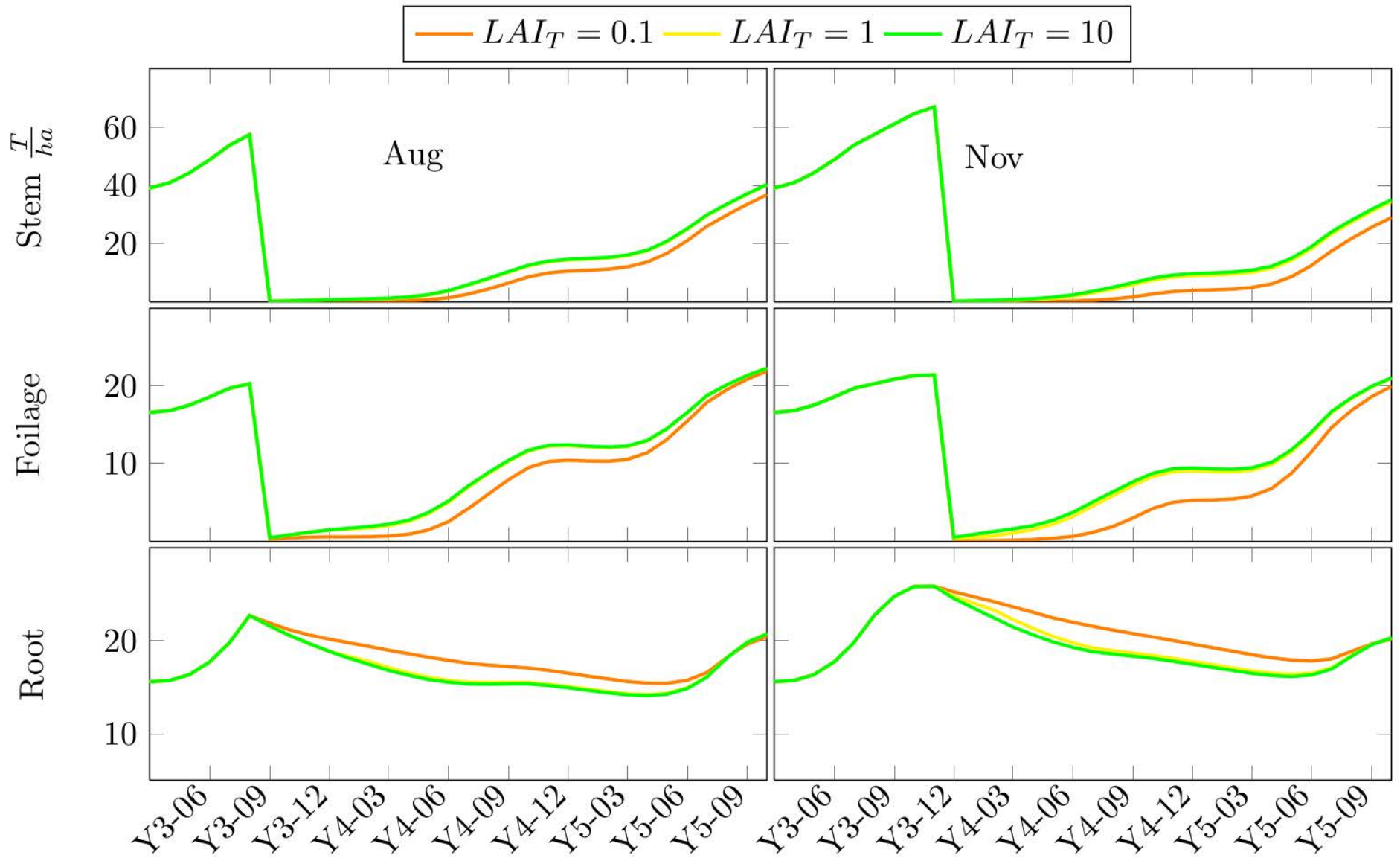
# Abstract

AHB is researching the potential development of a system for growing and converting hardwoods, in particular hybrid poplars, into biofuels, compatible with existing infrastructure. Predicting the economic and environmental viability of a biofuels industry based on poplar requires good estimates of the growth and yield of short rotation woody crops (SRWC) throughout the entire Pacific Northwest region. The Physiological Principles in Predicting Growth (3PG) model was selected and modified for SRWC, particularly for poplar plantation methodologies. The 3PG model was trained against field studies of poplar growth as a SRWC biofuel feedstock. The parameterized model was then applied to the entire Pacific Northwest region, using appropriate climatological and soil input data. Important findings from the model include; validation of the 3PG model for coppiced SRWC plantings, estimates of biomass feedstock yields under different irrigation patterns and weather conditions, and annual estimates for feedstock availability when combined with various crop adoption scenarios.

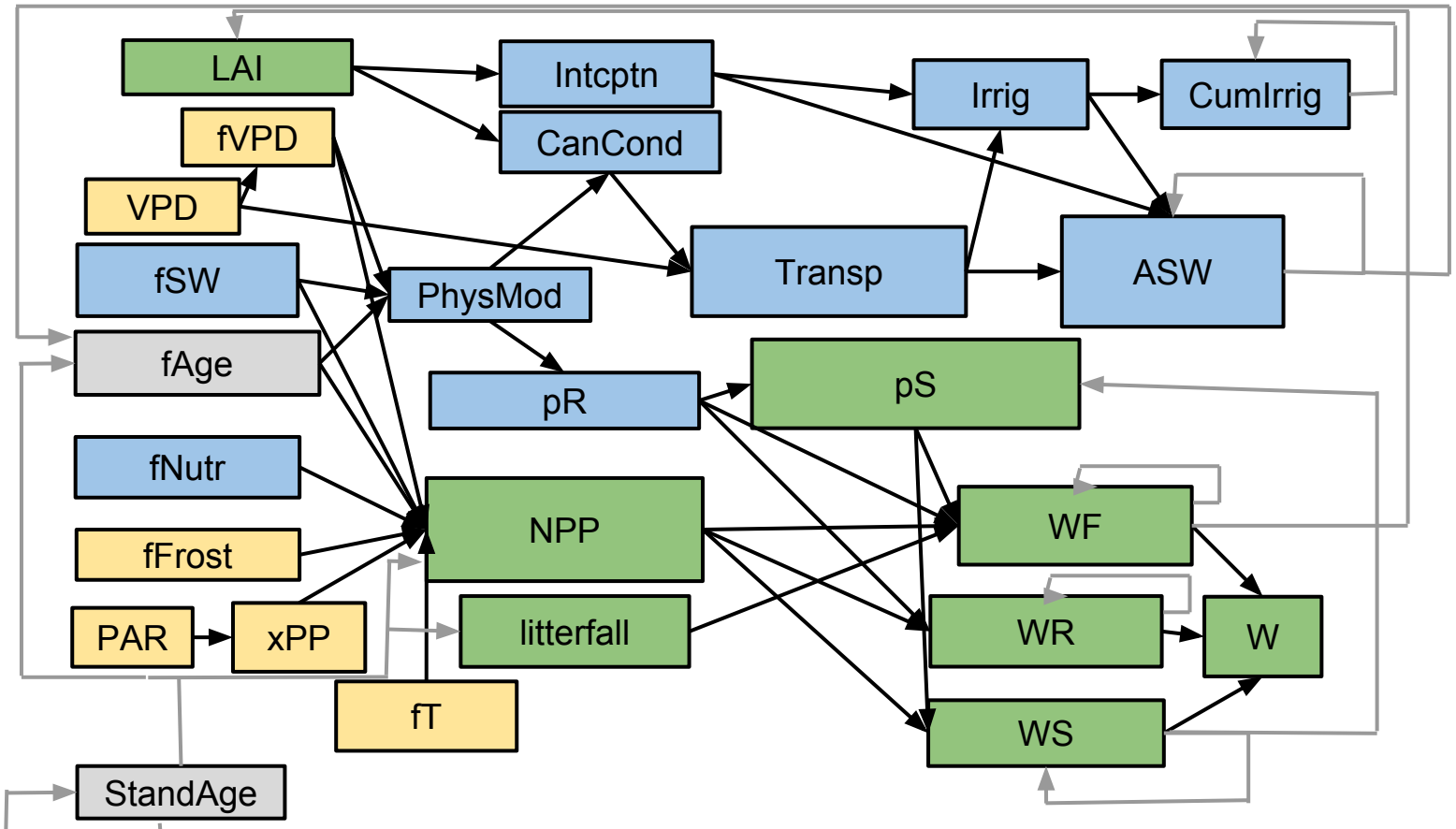
# Coppicing - Coppice Date



# Coppicing - Target LAI

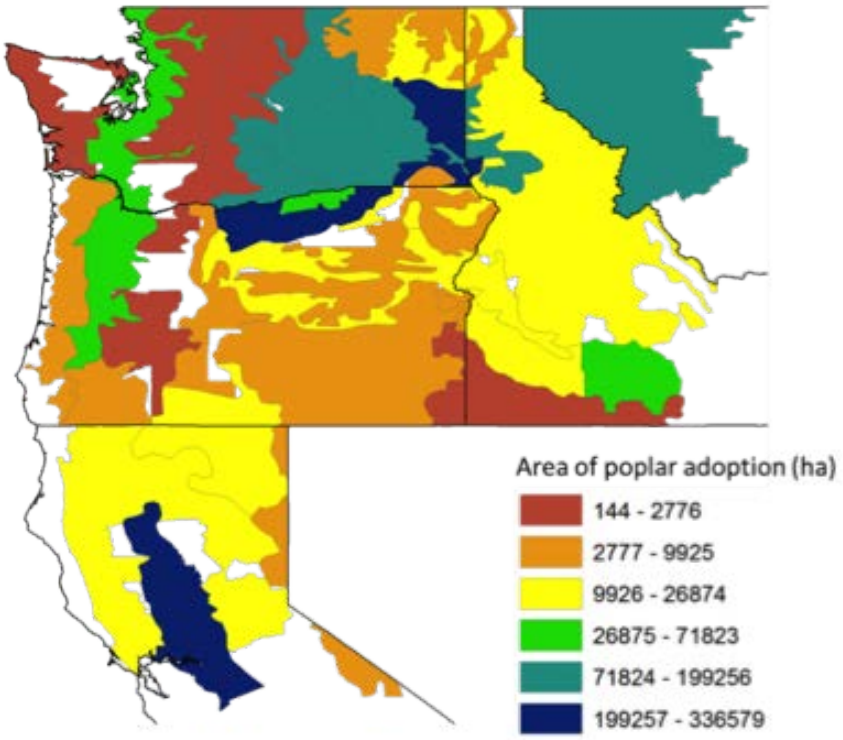


# Poplar Growth Model

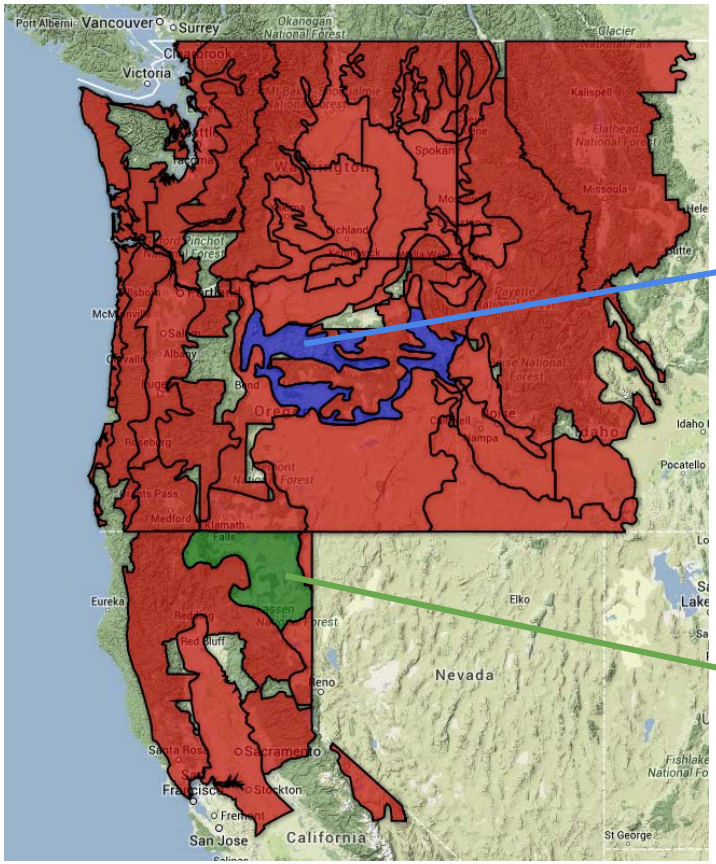


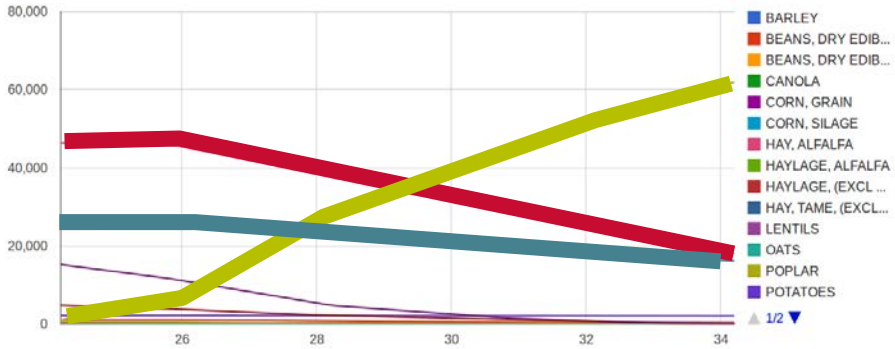
# Biomass Crop Adoption Model (BCAM)

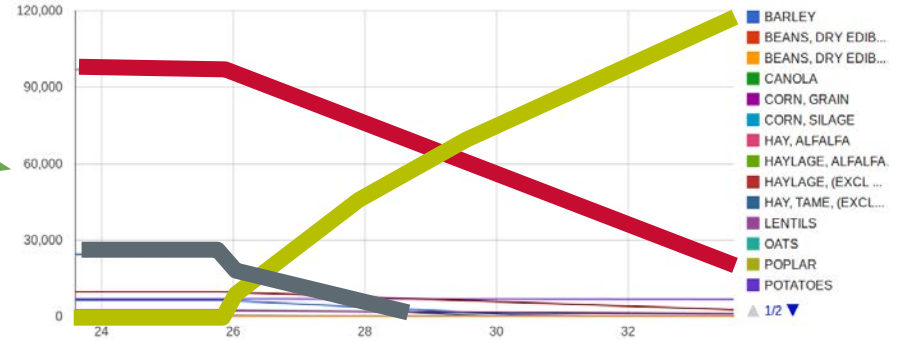
**Profit optimization** model utilizing historical farming patterns and production economics to determine when poplar becomes a profitable alternative to other crops.



# BCAM - Multiple Regions



# Geospatial Biorefinery Siting Model

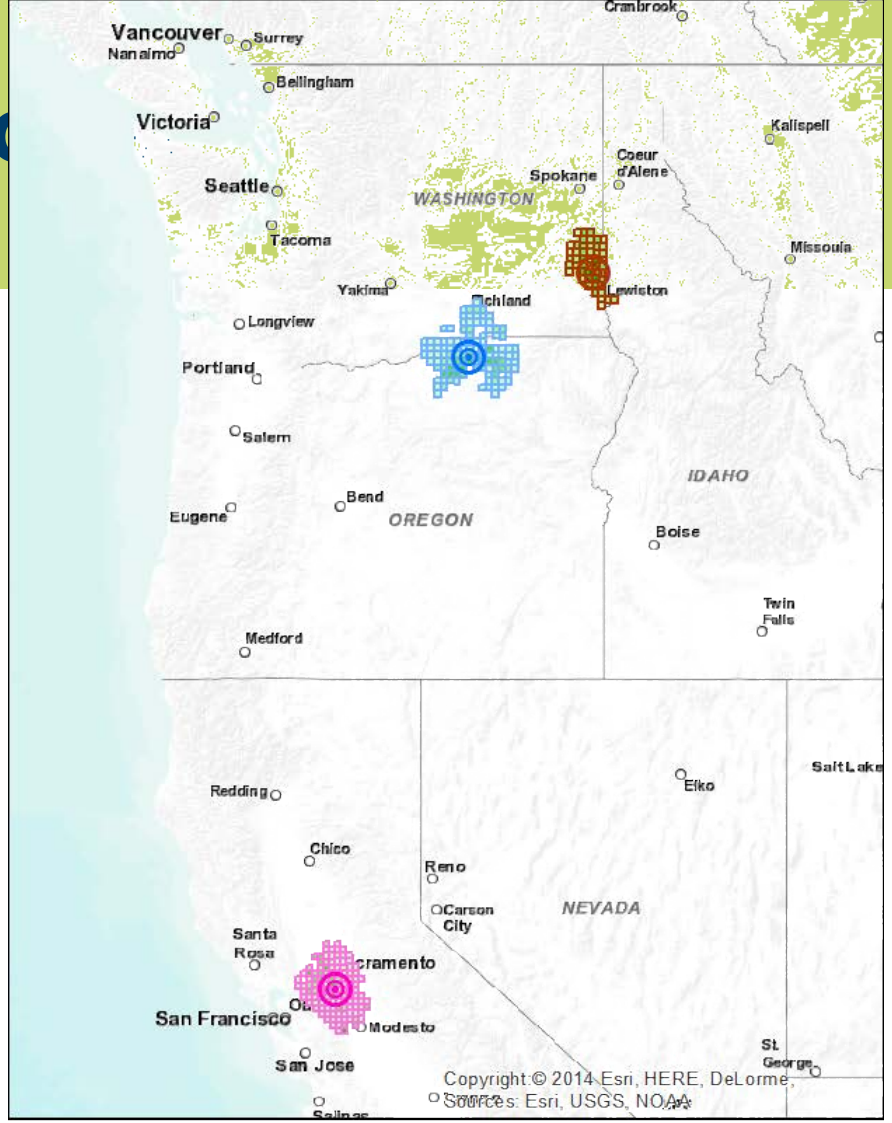
## Inputs

- **Feedstocks**
  - Farm Gate Price
- Transportation Costs
- Facility Costs
  - Labor
  - Transportation
  - Economies of scale
- Distribution Costs

## Outputs

- Biorefinery Locations
- Feedstock Used
- Cost Estimates
- Profit at various Fuel Prices

# GBSM Mo

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