

WaSSI: Modeling Impacts of Global Change on Ecosystem Services

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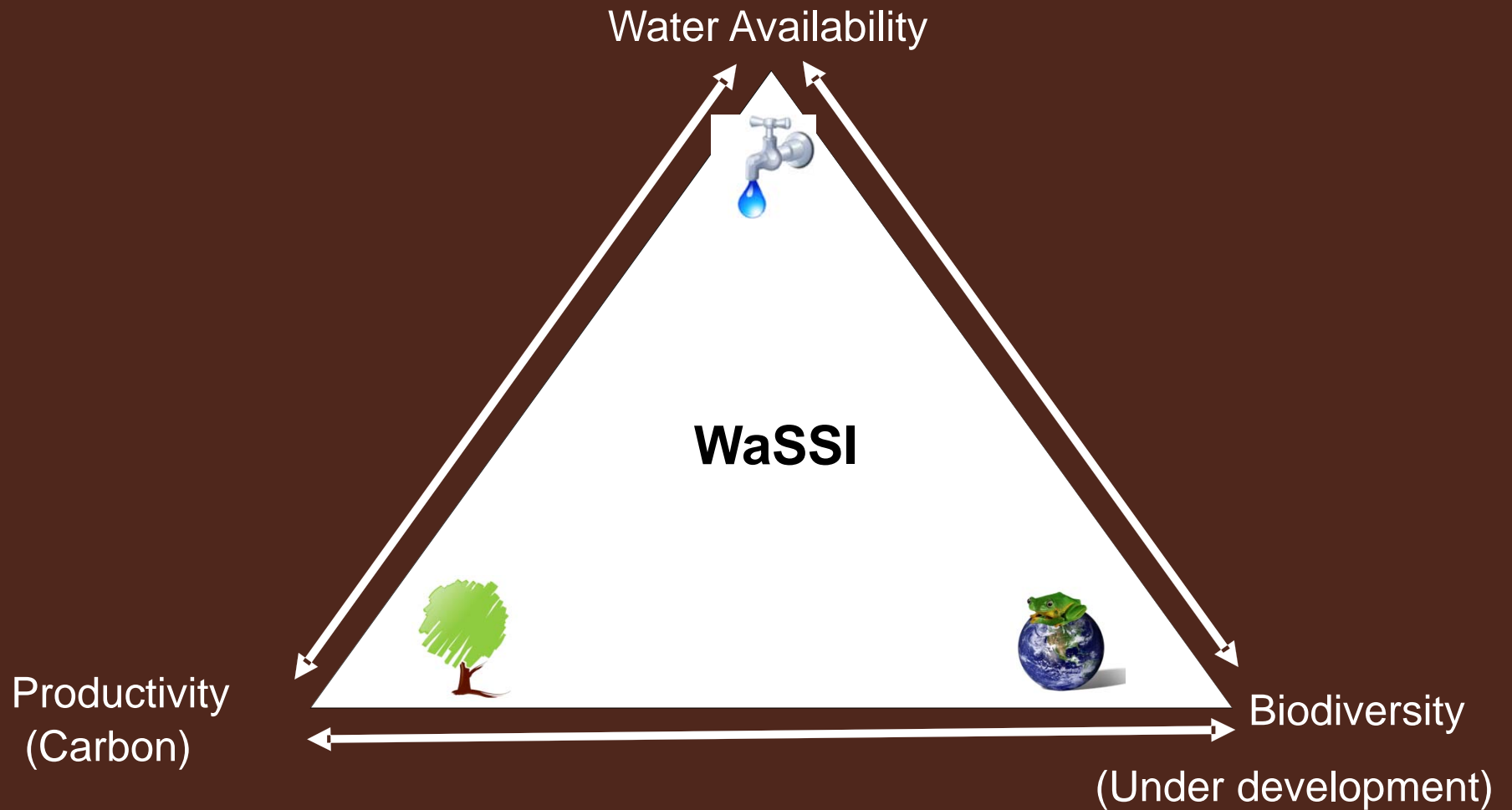
Raleigh, NC



Key Issues for climate change

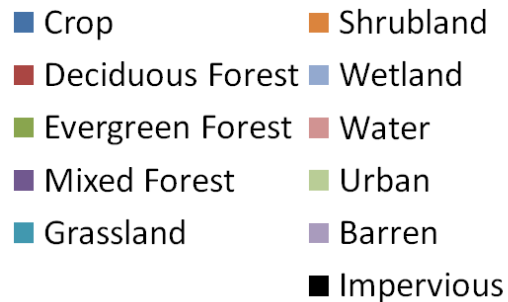
- Adaptation
 - Options for increasing water availability
- Mitigation
 - Opportunities to increase carbon sequestration
- Tradeoffs between managing for water or for carbon

WaSSI Ecosystem Services Model



Watershed and Land Cover Based

8-digit HUC Watersheds of the U.S.



Water

$$ET=f(PET, PPT, LAI, SM)$$

Sun et al., Ecohydrology, 2011

$$Q_{out} = Q_{in} + Q_{gen} - WU$$

Caldwell et al., HESS, 2012

Carbon

$$NEE=f(ET)$$

Sun et al., JGR, 2011

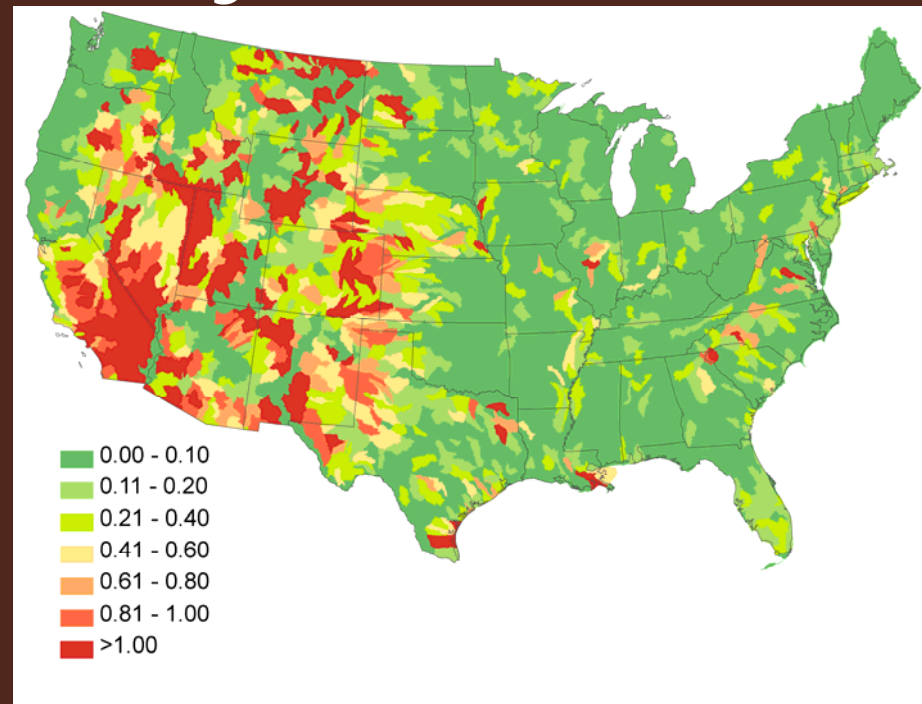
Water Supply Stress Index (WaSSI)

$$\text{WaSSI} = \frac{\text{Demand}}{\text{Supply}}$$

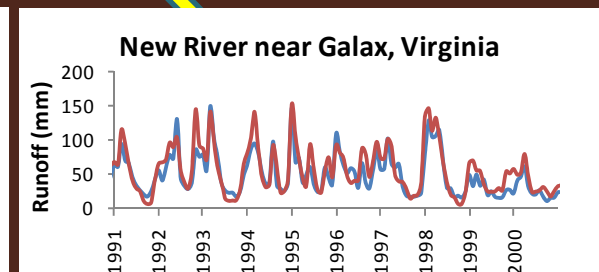
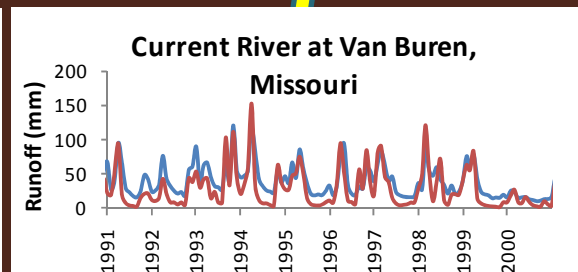
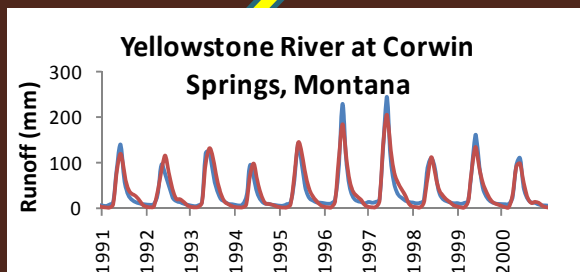
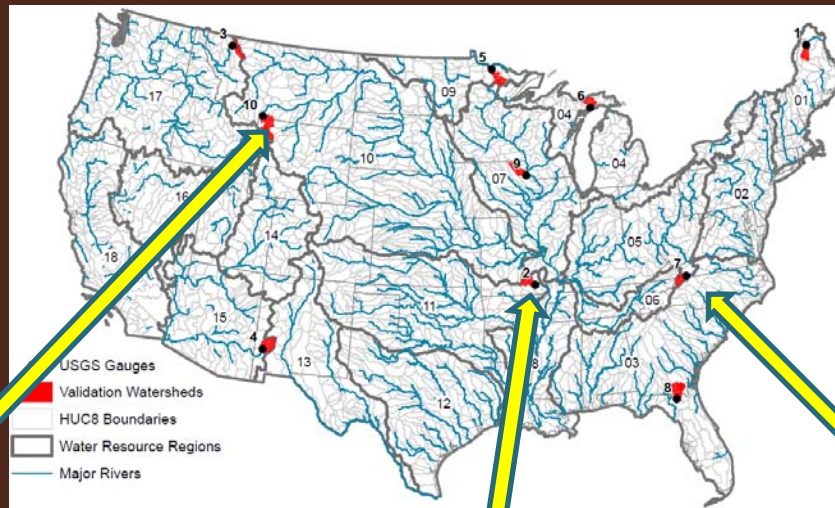
Sectors

1. Domestic
2. Industrial
3. Irrigation
4. Thermopower
5. Mining
6. Livestock
7. Public Supply
8. Aquaculture

1981-2000 WaSSI

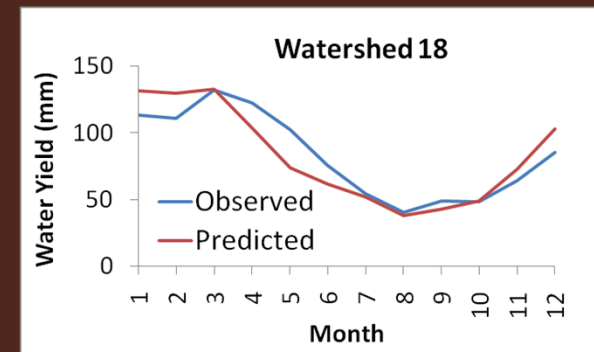
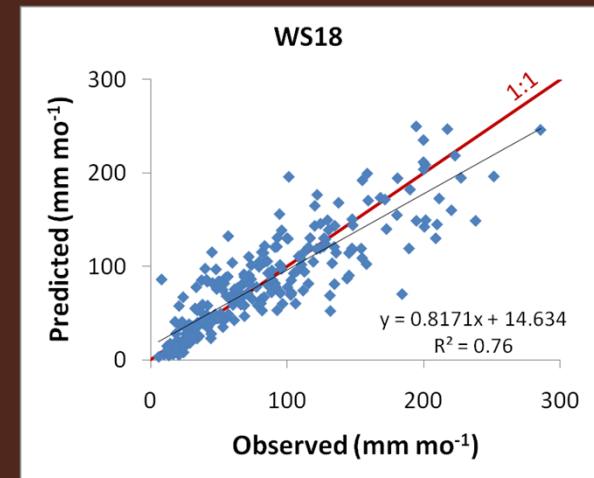
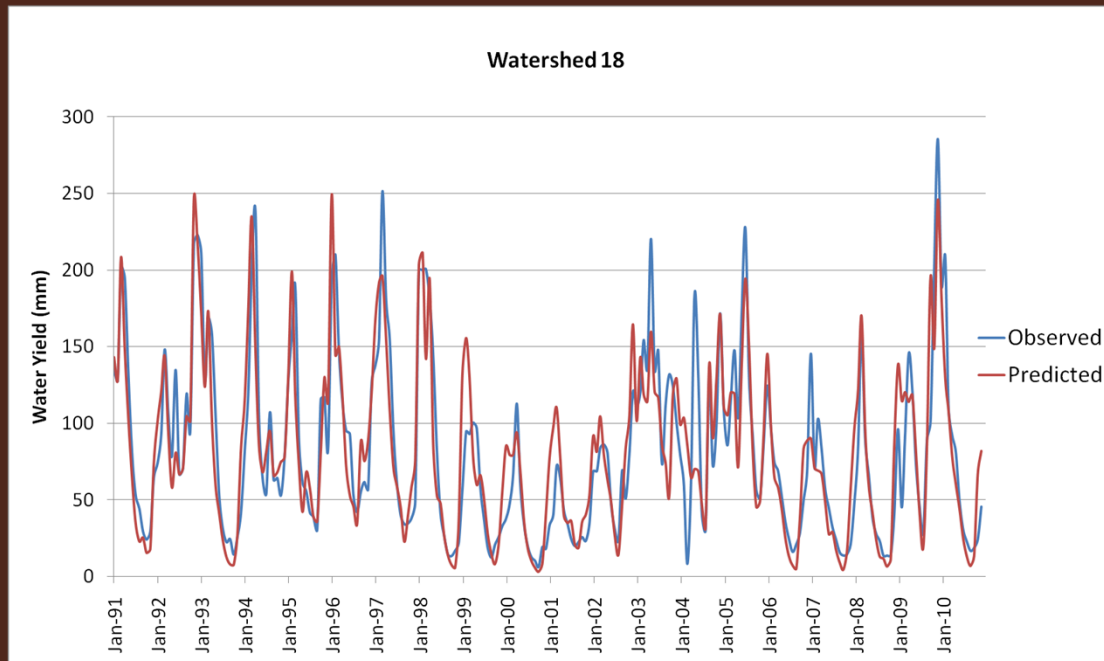


Continental scale validation (~850 km²)



Fine-scale validation ($\sim 0.1 \text{ km}^2$)

Watershed 18, Coweeta, NC

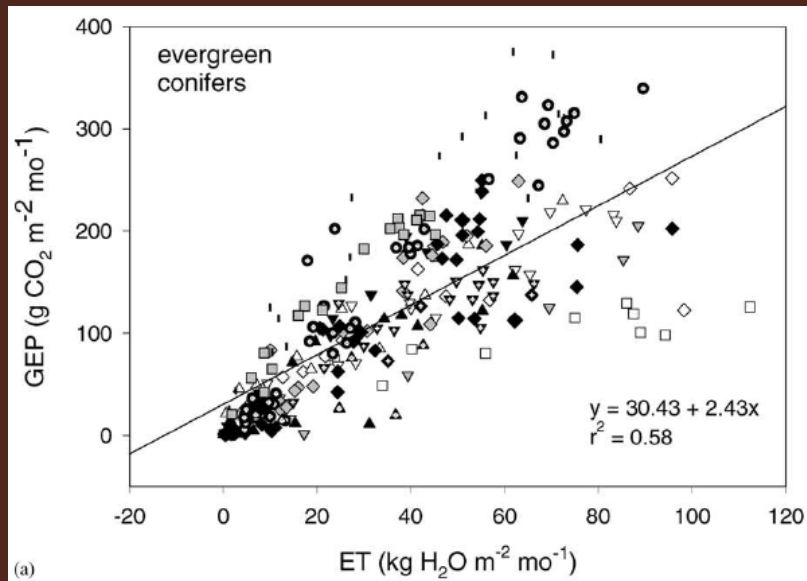


Mean Annual Bias: -6.6 mm (-0.7%)

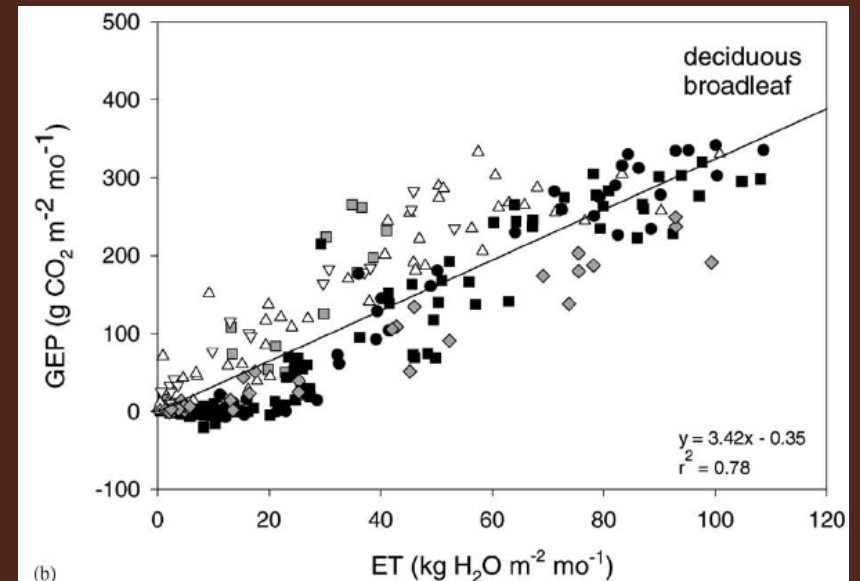
Monthly NSE: 0.75

Carbon & Water Relationships

Evergreen Conifers



Deciduous Broadleaf



(Law et al., 2002)

Ecosystem Productivity (Carbon)



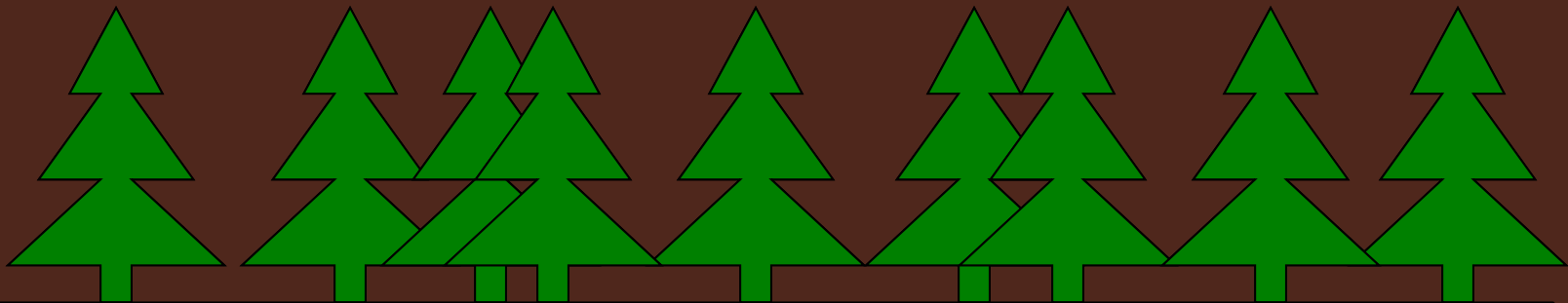
Gross
Ecosystem
Productivity



Ecosystem
Respiration

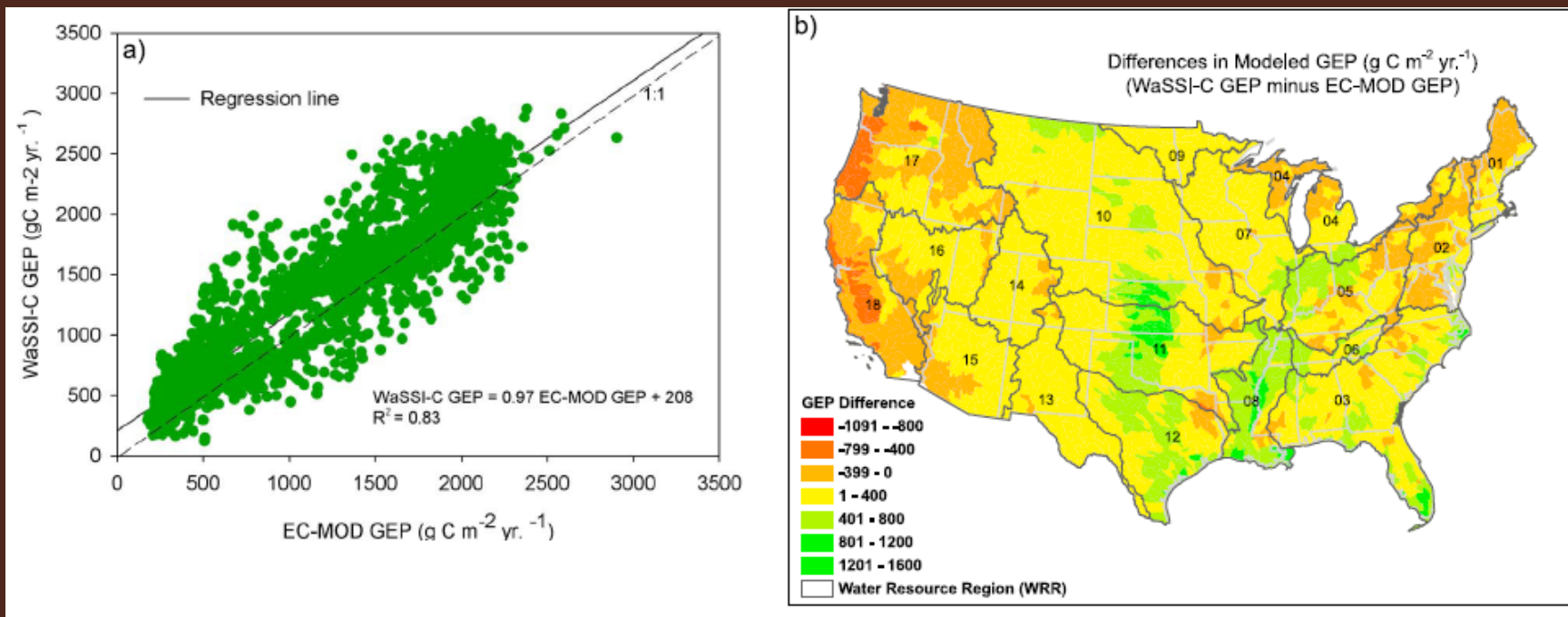


Net Ecosystem
Exchange



Sun et al., JGR, 2011

Carbon Validation



How WaSSI can be useful for resource management?

- Help answer the “So what?” questions of climate predictions
 - What effect might climate change have on magnitude and timing of water yield?
 - Carbon sequestration?
- Assess sensitivity to management options for climate change mitigation and adaptation
 - How can forest management mitigate climate change impacts on water supply?
 - What are the tradeoffs of water management with carbon sequestration?
 - What is the effect of forest land conversion to other uses on water yield and carbon?
- And many others...

www.forestthreats.org/research/tools/WaSSI

Create Scenario

WaSSI Ecosystem Services Model Version 2.0

About Options Input Viewer Simulation Tool

Past Simulations: Time May 15 09:49:32 2012

Region: ? US
Climate: ? C20 (A1) (1961-2000)
Start Year: ? 1961
End Year: ? 2099

Precipitation Change (-100% to 100%): ? 0 %
Temperature (-10C to 10C): ? 0 C

Forest Land Cover Change (-100% to 0%): ? 20 %
Forest Land Cover Changed to: ? Grassland
Forest Leaf Area Index Change (-100% to 100%): ? 0 %

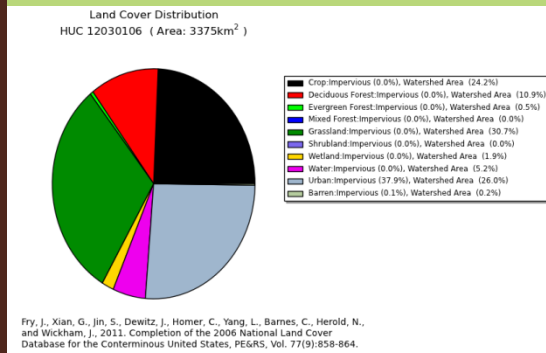
Total Ground Water Withdrawal Change (-100% to 100%): ? 0 %

Domestic Water Use scenario: ? Calculate Domestic Water Use Based on Population
Base Population Year for Domestic Water Use Calculations: ? 2000
Population Change from Base Year (-100% to 100%): ? 0 %

Industrial Water Use Change (-100% to 100%): ? 0 %
Irrigation Water Use Change (-100% to 100%): ? 0 %
Livestock Water Use Change (-100% to 100%): ? 0 %
Mining Water Use Change (-100% to 100%): ? 0 %
Thermo Water Use Change (-100% to 100%): ? 0 %
Public Supply Water Use Change (-100% to 100%): ? 0 %
Aquaculture Water Use Change (-100% to 100%): ? 0 %

Run Simulation

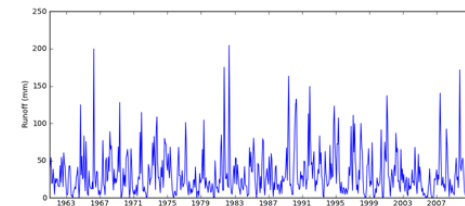
View Inputs



WaSSI
Ecosystem
Services
Model

View Outputs

Time Series



Map View

