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Soil-Plant-Atmosphere Relations in the Water and Energy Cycle

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Dept. of Geography, University of Kansas
brunsell@ku.edu

Unicamp, Campinas, BR, November 11, 2013

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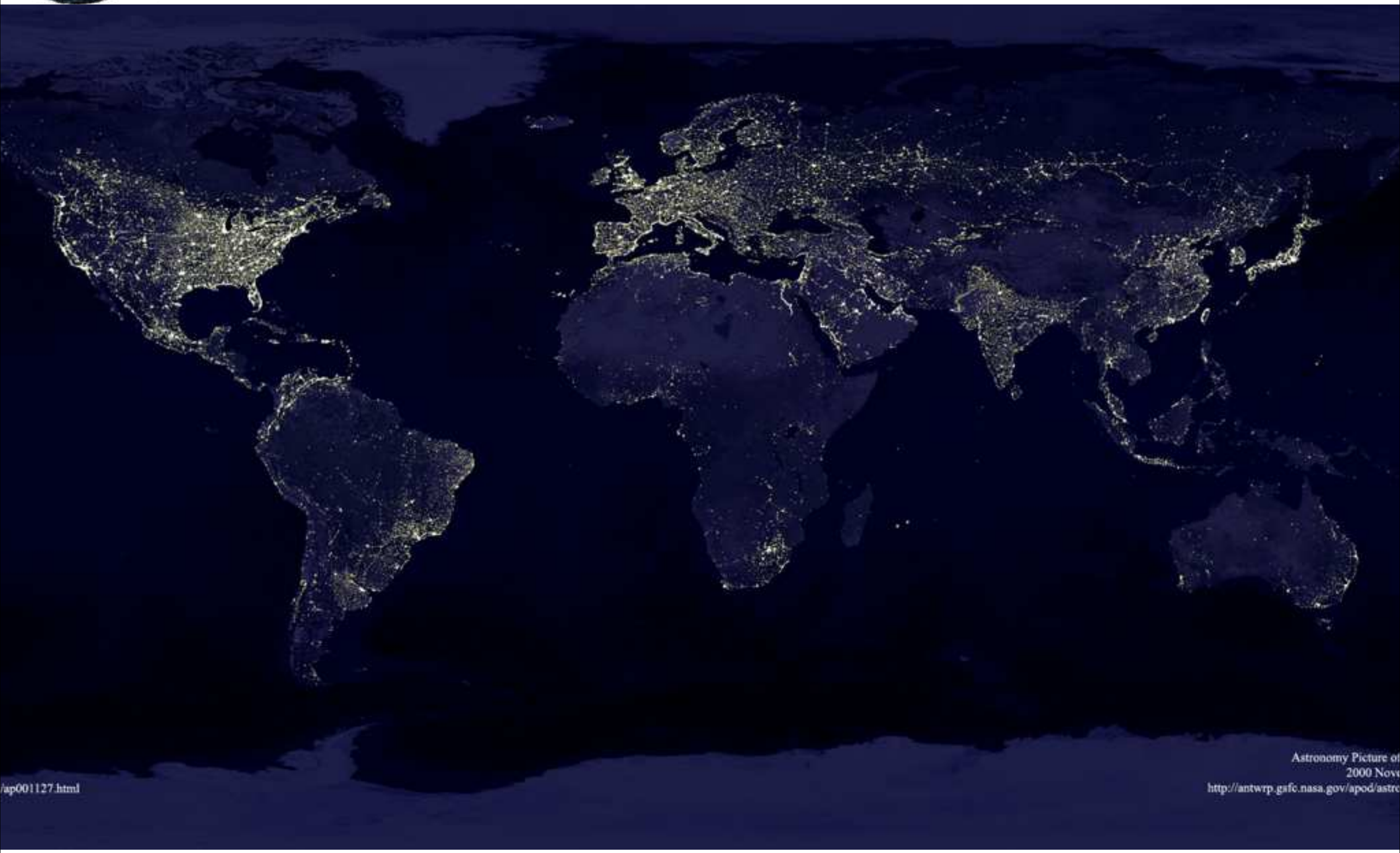
The Human Footprint



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Changing Scale

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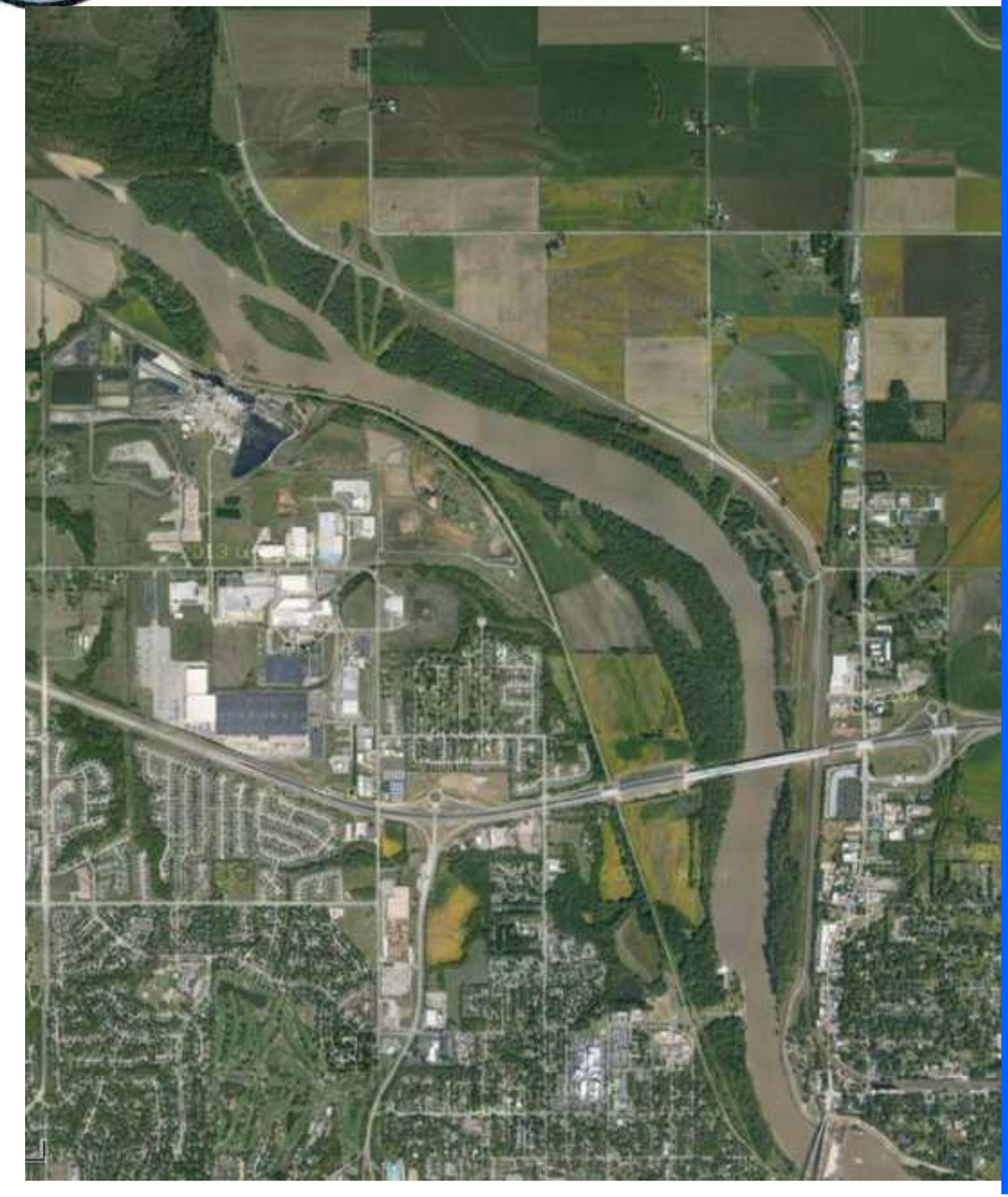
Changing Scale



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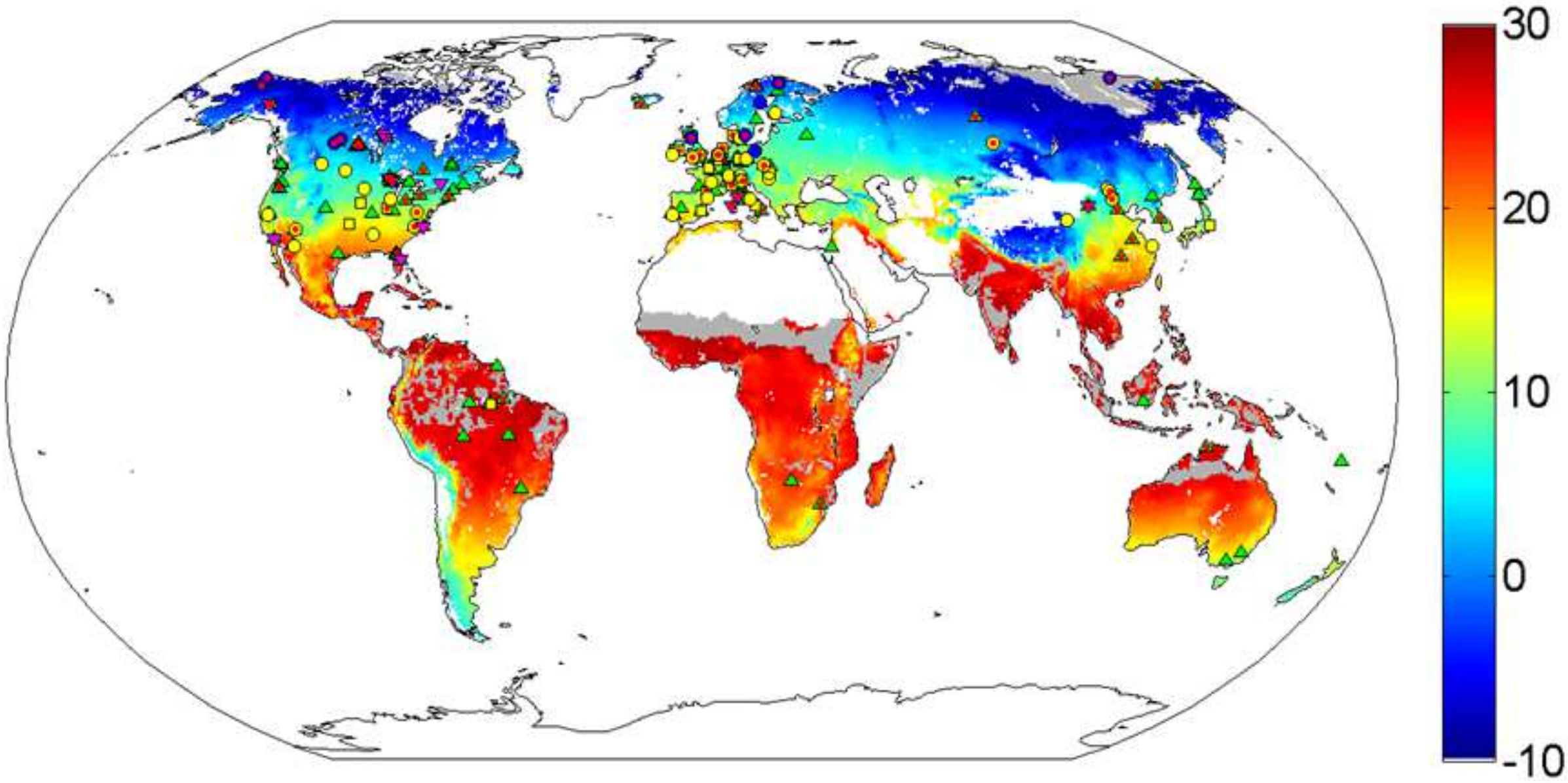
Fluxnet



Reichstein et al. (in Prep)

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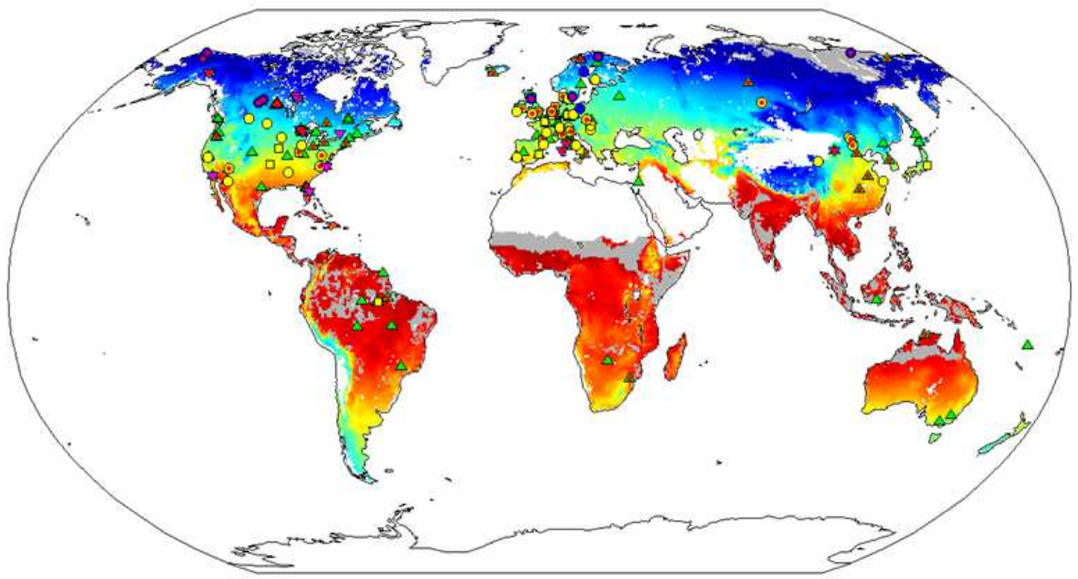
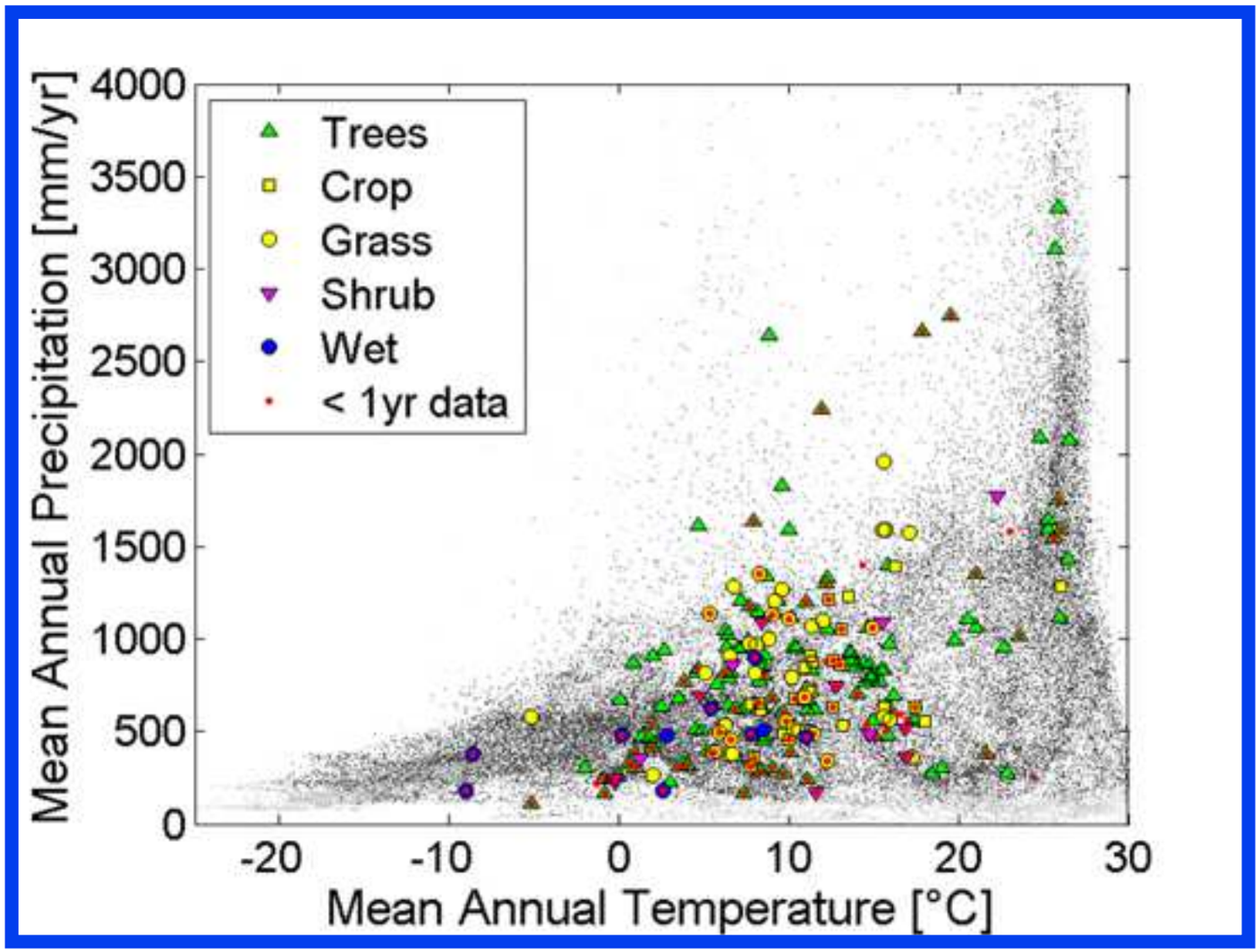
Fluxnet





Reichstein et al. (in Prep)

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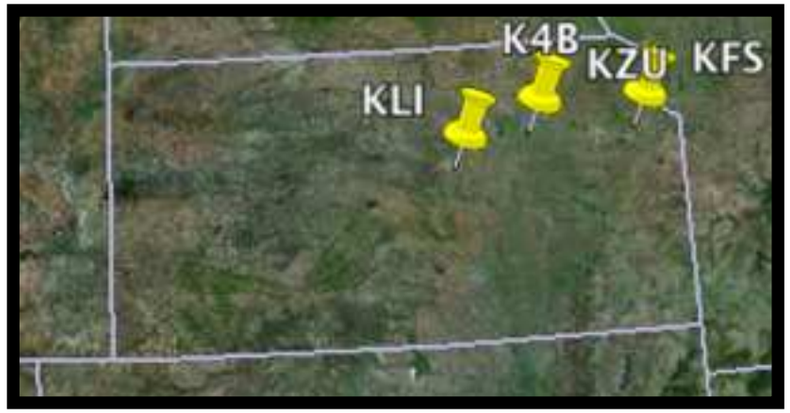
Towers



KZU: Konza Prairie, 1 year burn cycle
C_4 grass (2006)

KFS: KU field station, ~4 year burn cycle
Mixed C_3/C_4 grass with shrubs (2007)

KLI: Perennial Wheat Agricultural Field (2012)

K4B: Konza Prairie, 4 year burn cycle
Mixed C_4 grass with shrubs (2007)

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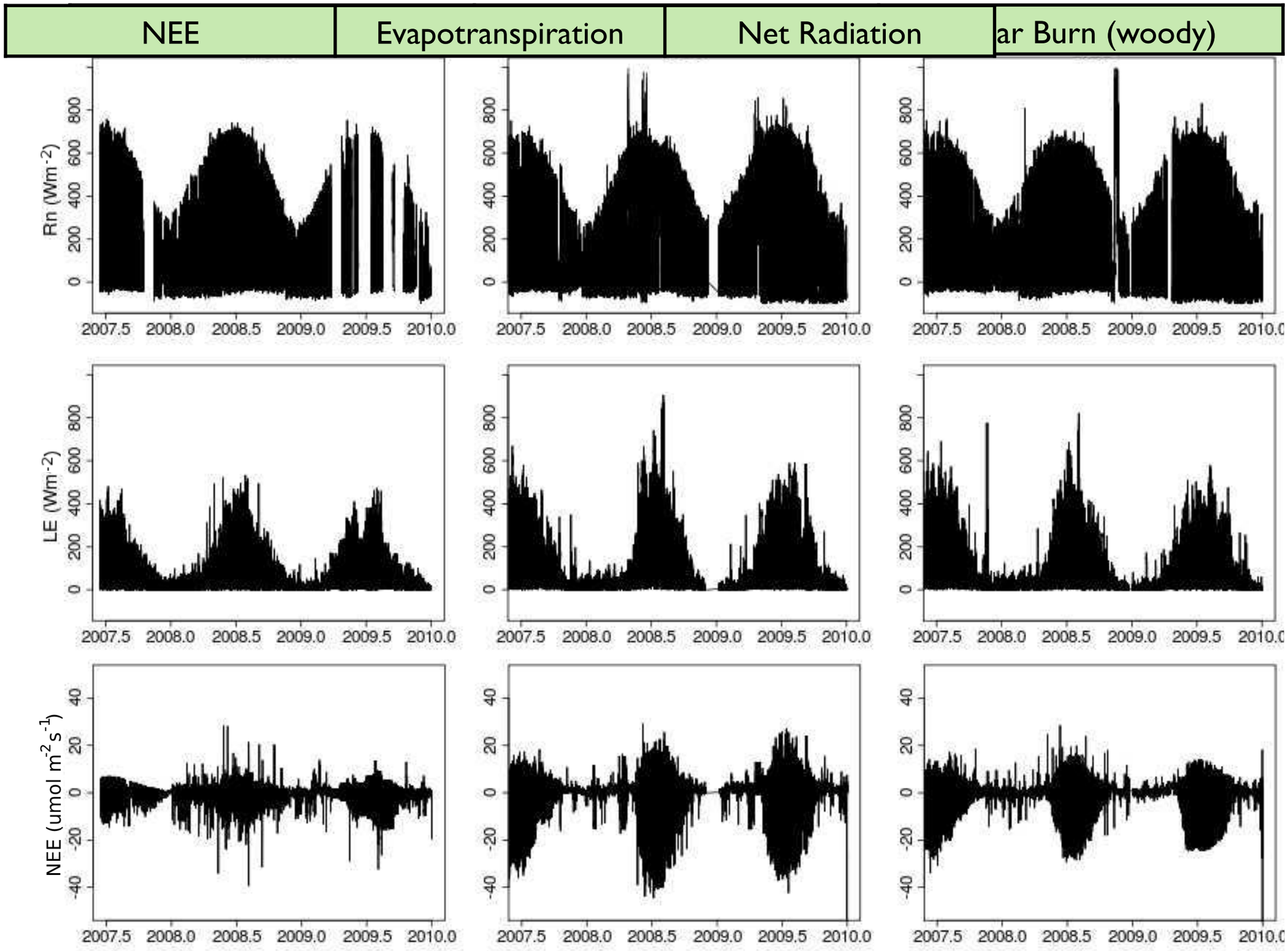
Land Use - Land Cover impacts on Water Use



Brunsell et al. (In Press) Ecohydrology

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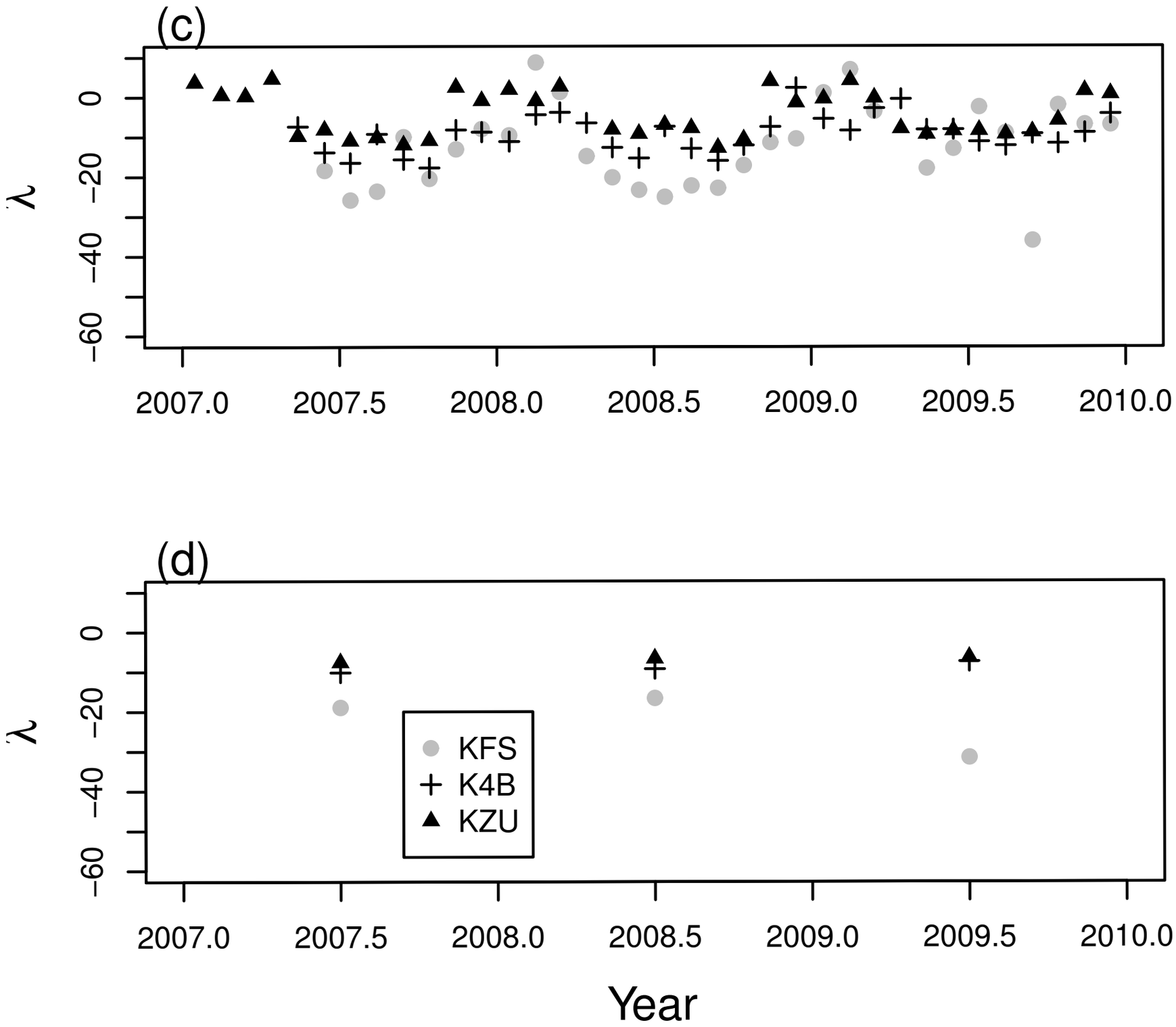
Land Use - Land Cover impacts on Water Use



Brunsell et al. (In Press) Ecohydrology

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Variation within a Watershed

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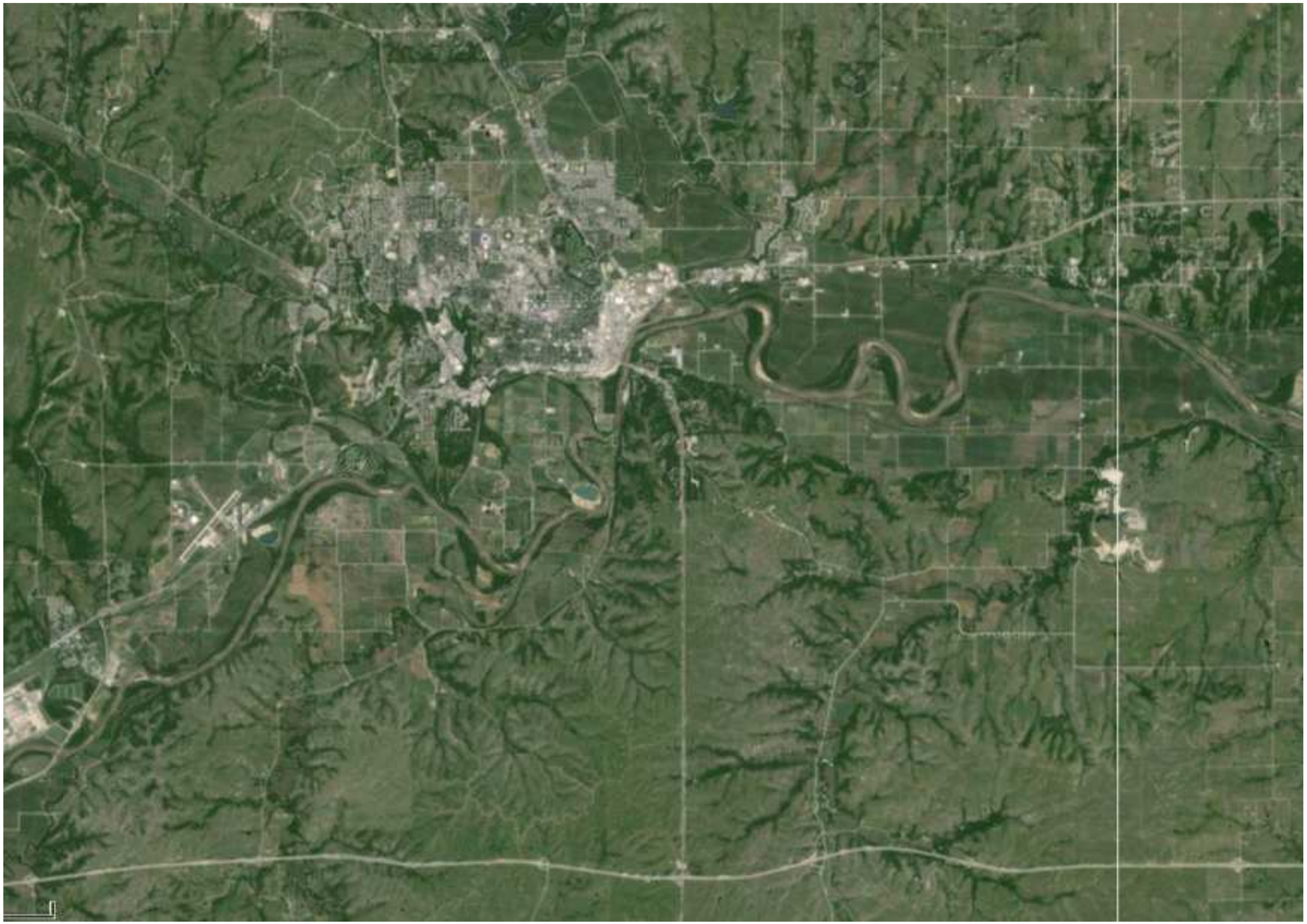
Variation within a Watershed



Google Maps

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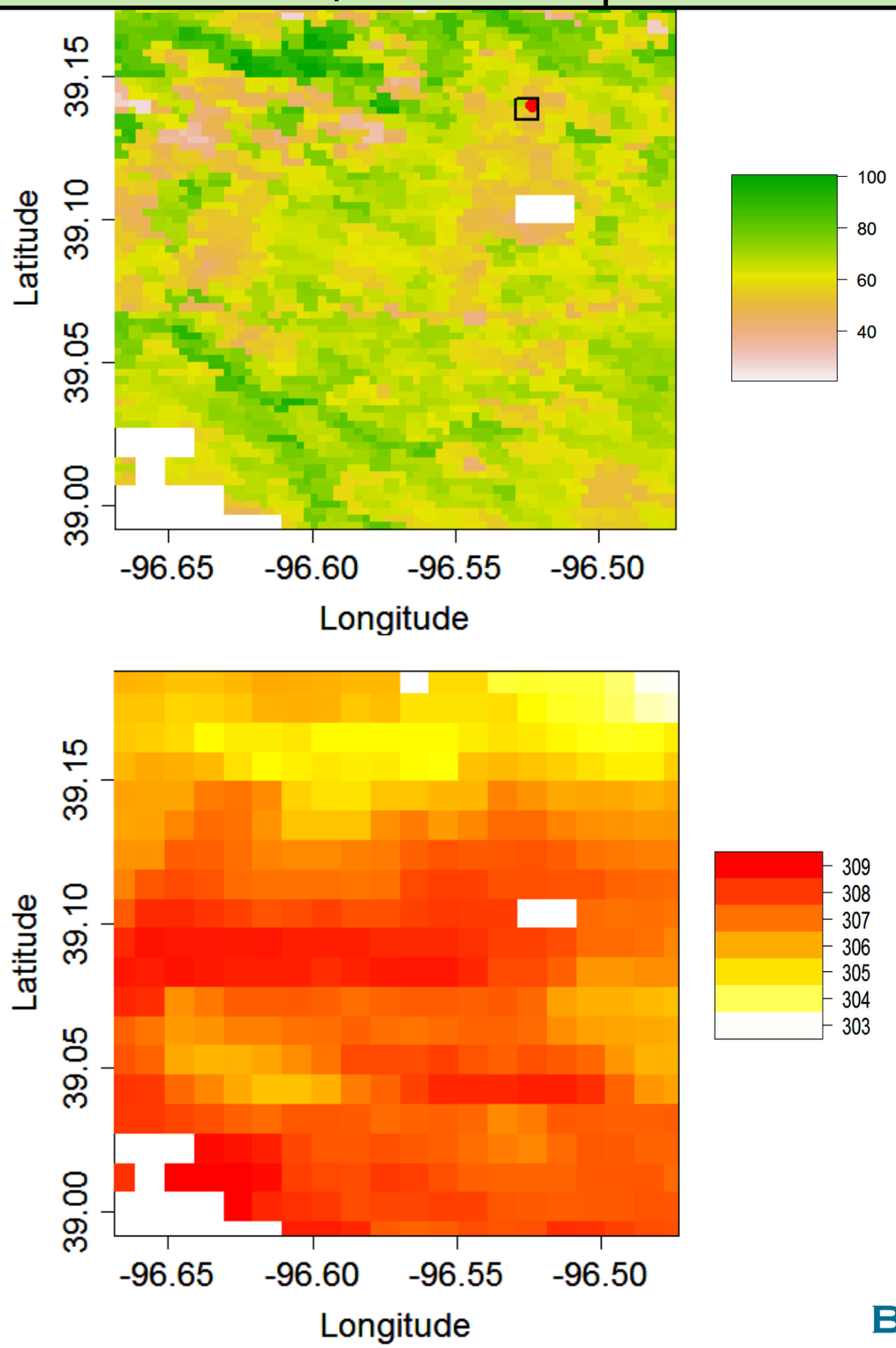
Remote Sensing of Evapotranspiration

Radiometric Temperature	Fractional Vegetation



Brunsell et al. (2008) Remote Sens. Environ.

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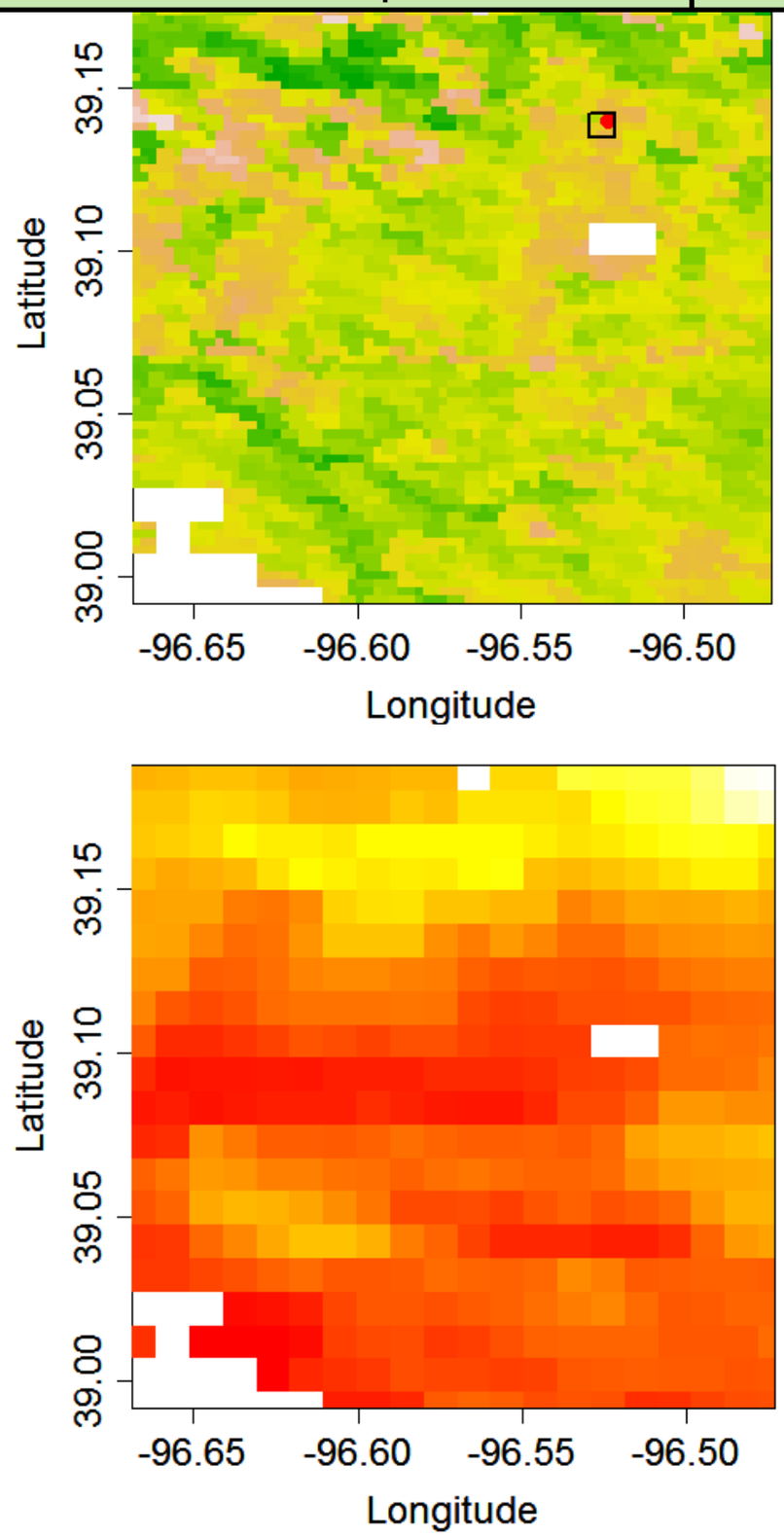
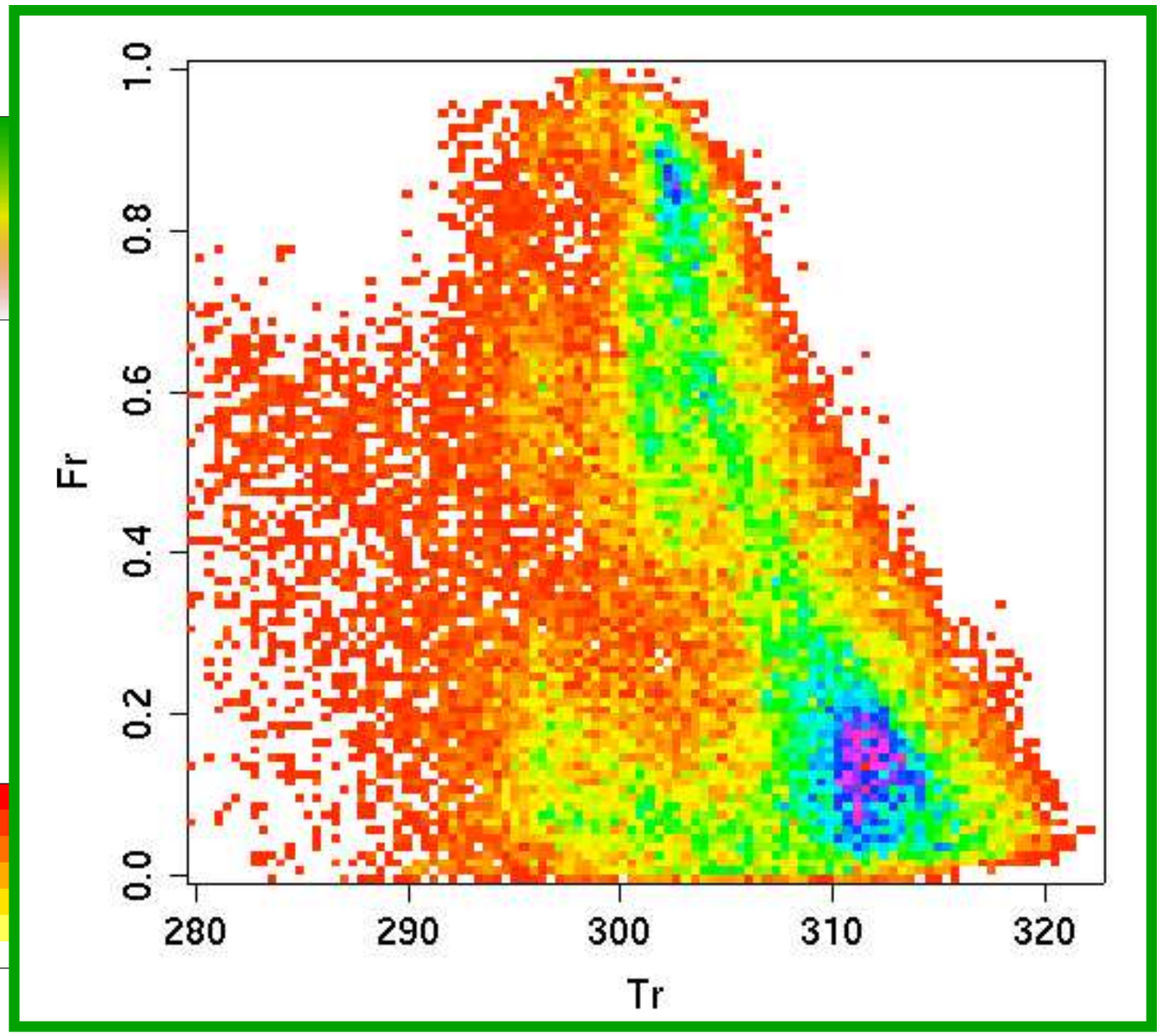
Remote Sensing of Evapotranspiration

Radiometric Temperature	Fractional Vegetation





Brunsell et al. (2008) Remote Sens. Environ.

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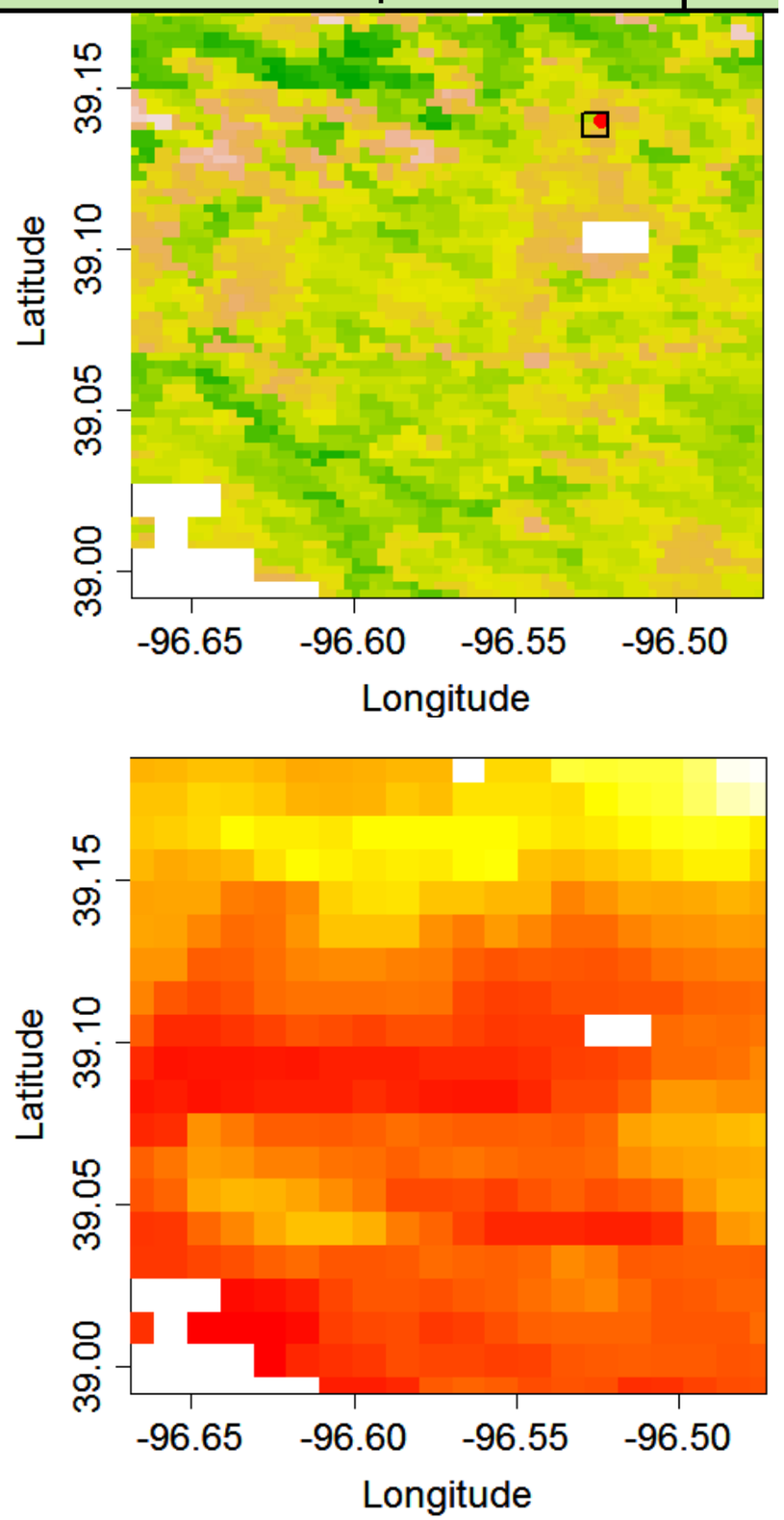
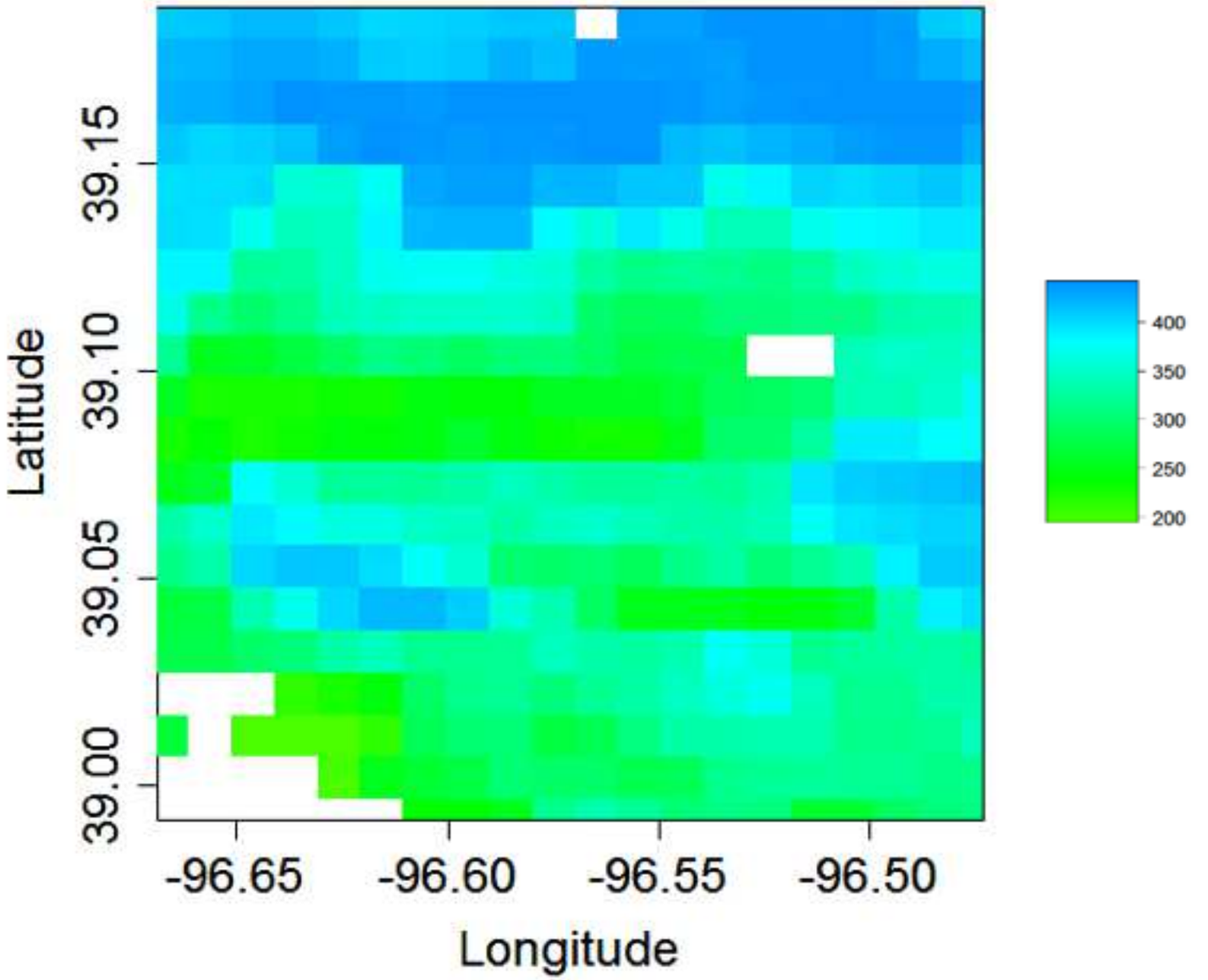
Remote Sensing of Evapotranspiration

Radiometric Temperature





	LE (measured)	LE (remote sensing)
Rannells (ungrazed)	292	384
Rannells (grazed)	388	413
Konza	235	229
LAS	378	384

BRUNSELL ET AL. (2008) REMOTE SENS. ENVIRON.

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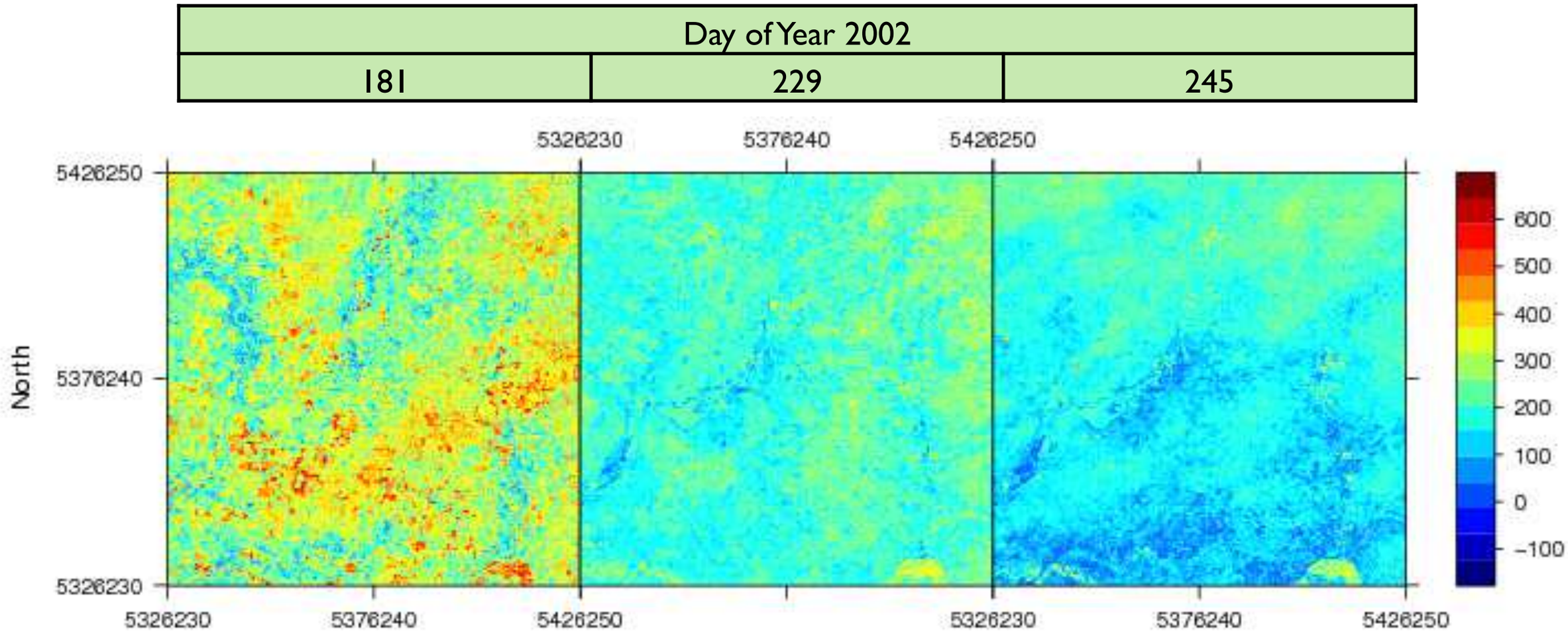
Evapotranspiration



Brunsell and Anderson (2011) Biogeosciences

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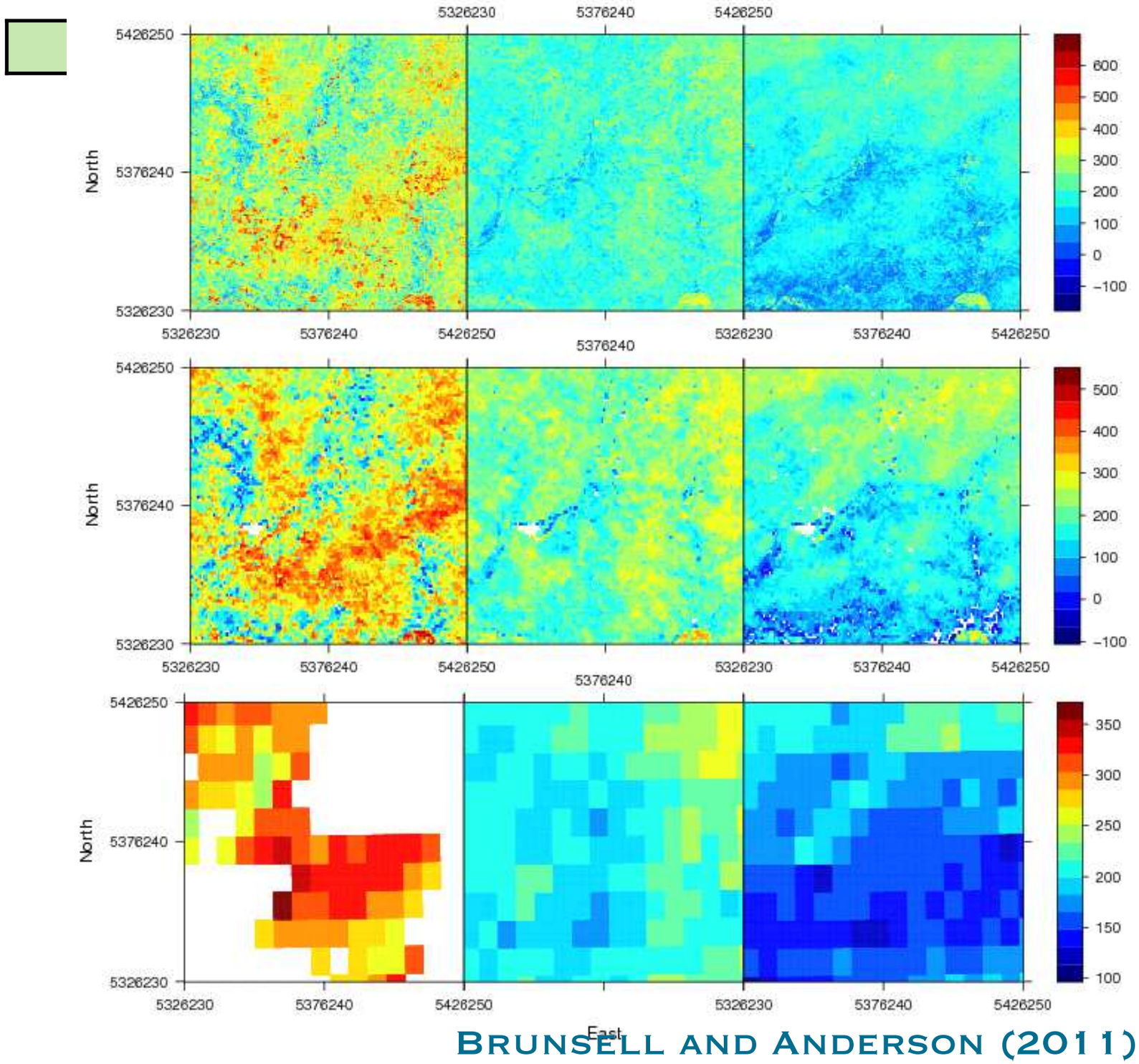
Evapotranspiration

Day of Year 2002		
181	229	245



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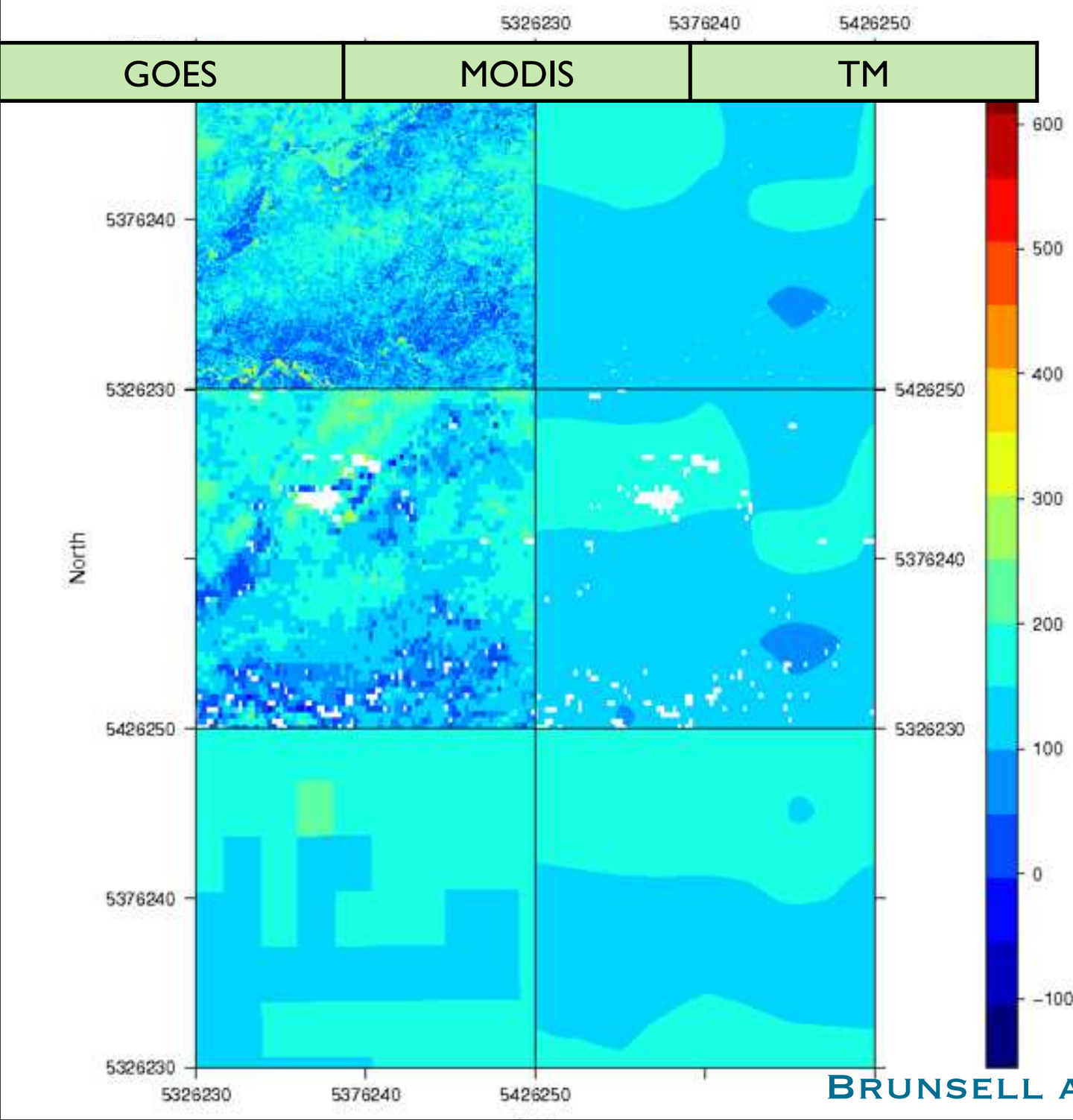
Evapotranspiration

Level of Decomposition	
1	9



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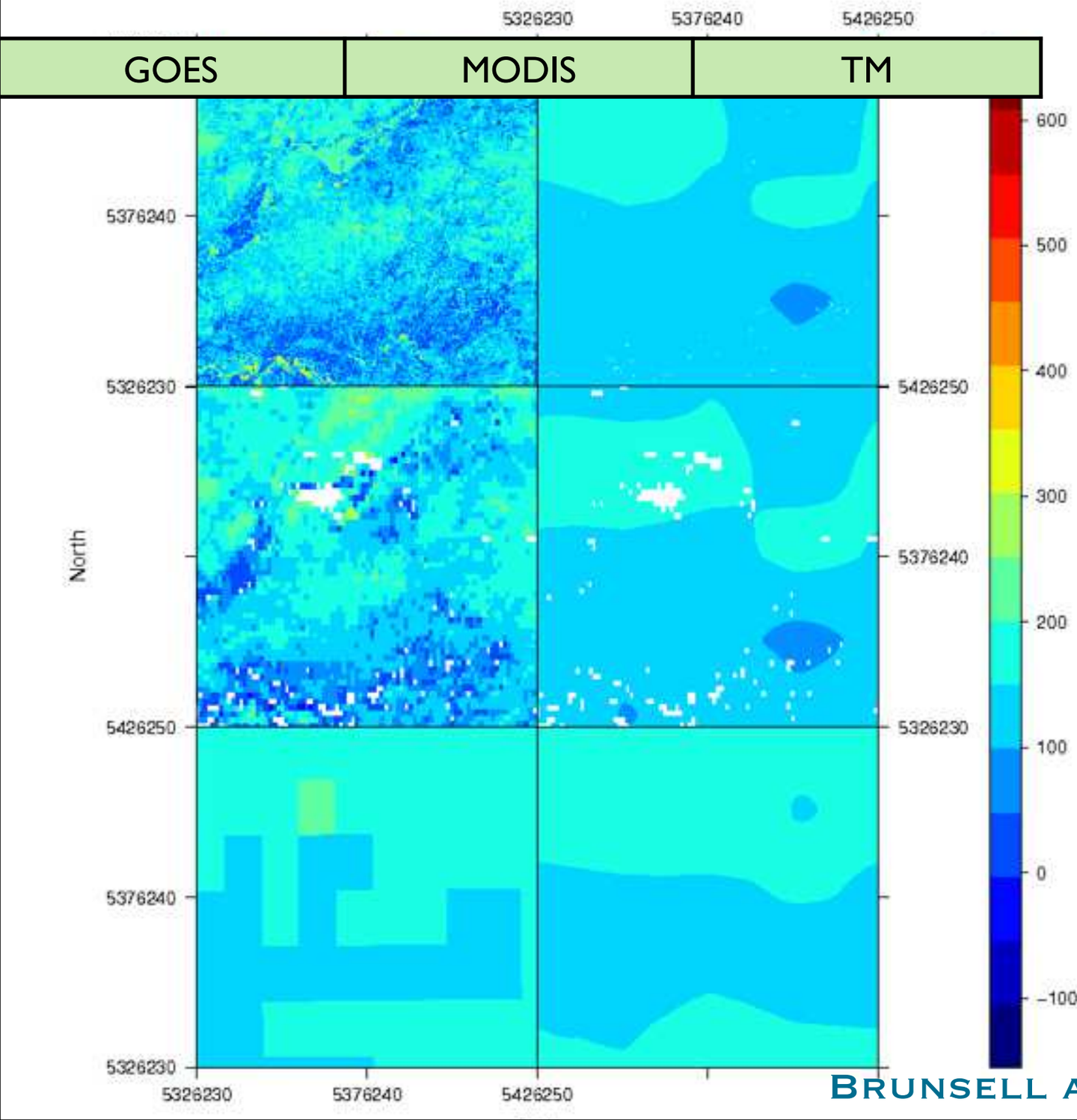
Evapotranspiration

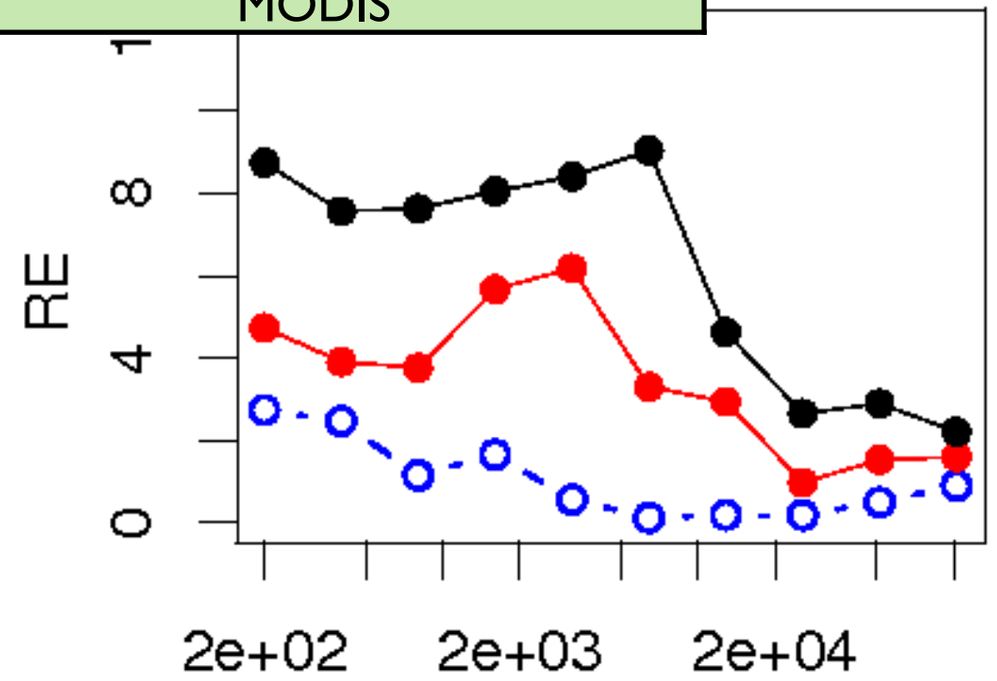
Level of Decomposition	
1	9

GOES	MODIS	TM



Fractional Vegetation

MODIS



Brunsell and Anderson (2011) Biogeosciences

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Land Use History

Brunsell et al. (2011) Earth Sys. Dyn.

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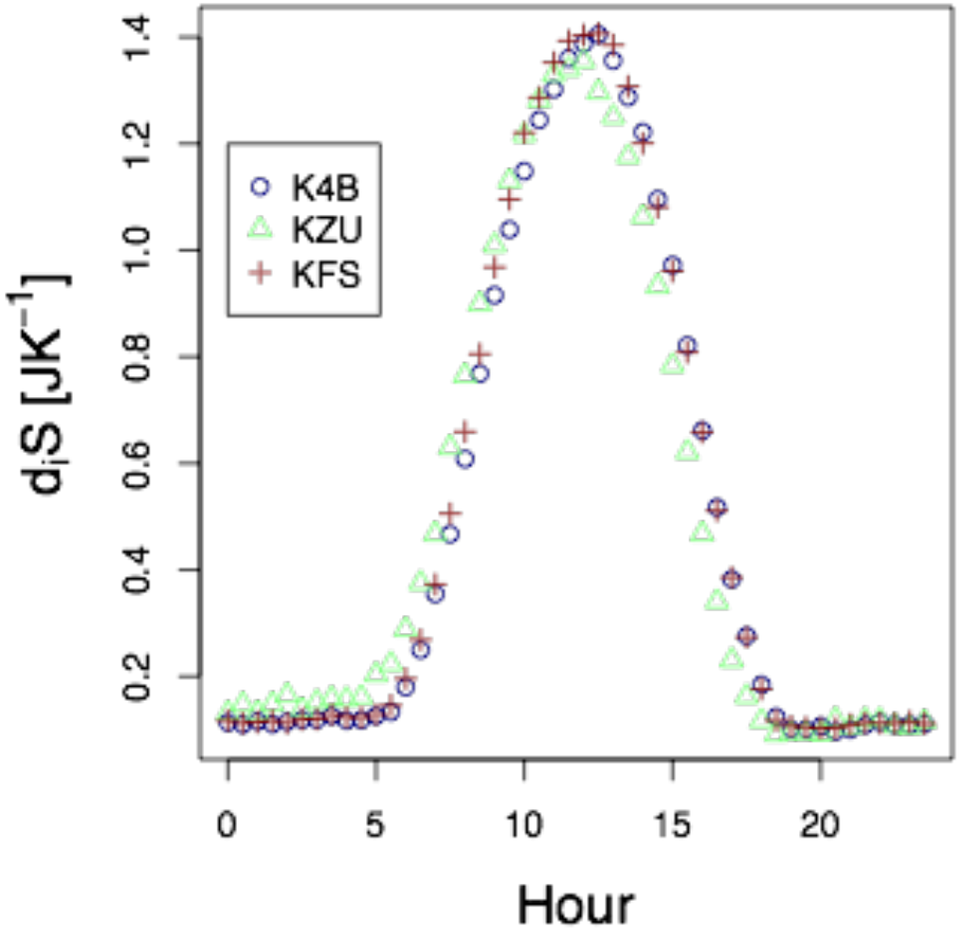
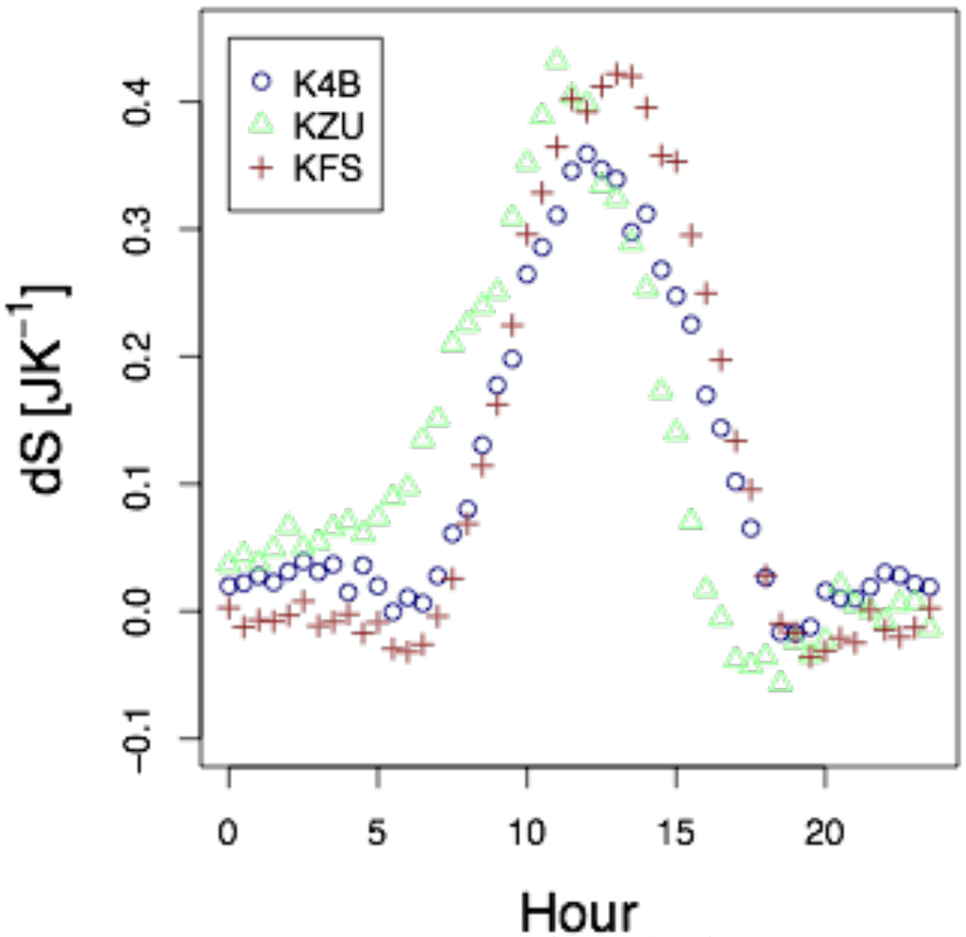
Land Use History

Entropy Production	Total Entropy





Brunsell et al. (2011) Earth Sys. Dyn.

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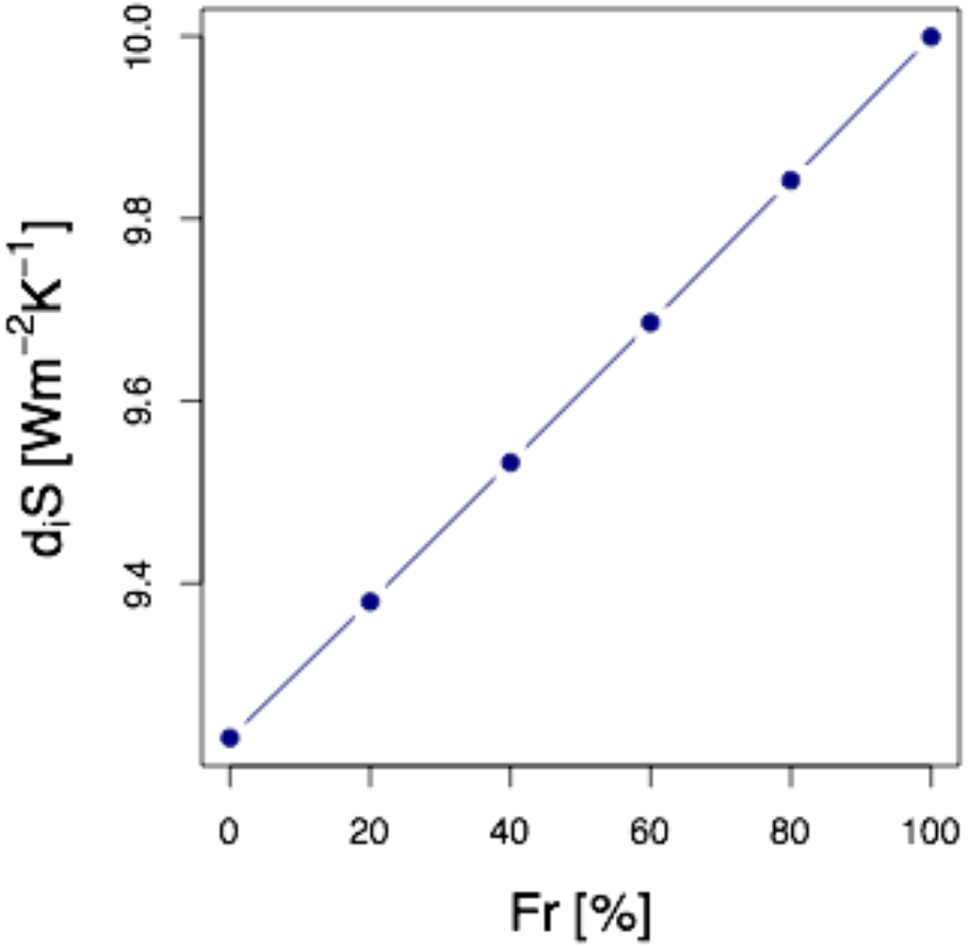
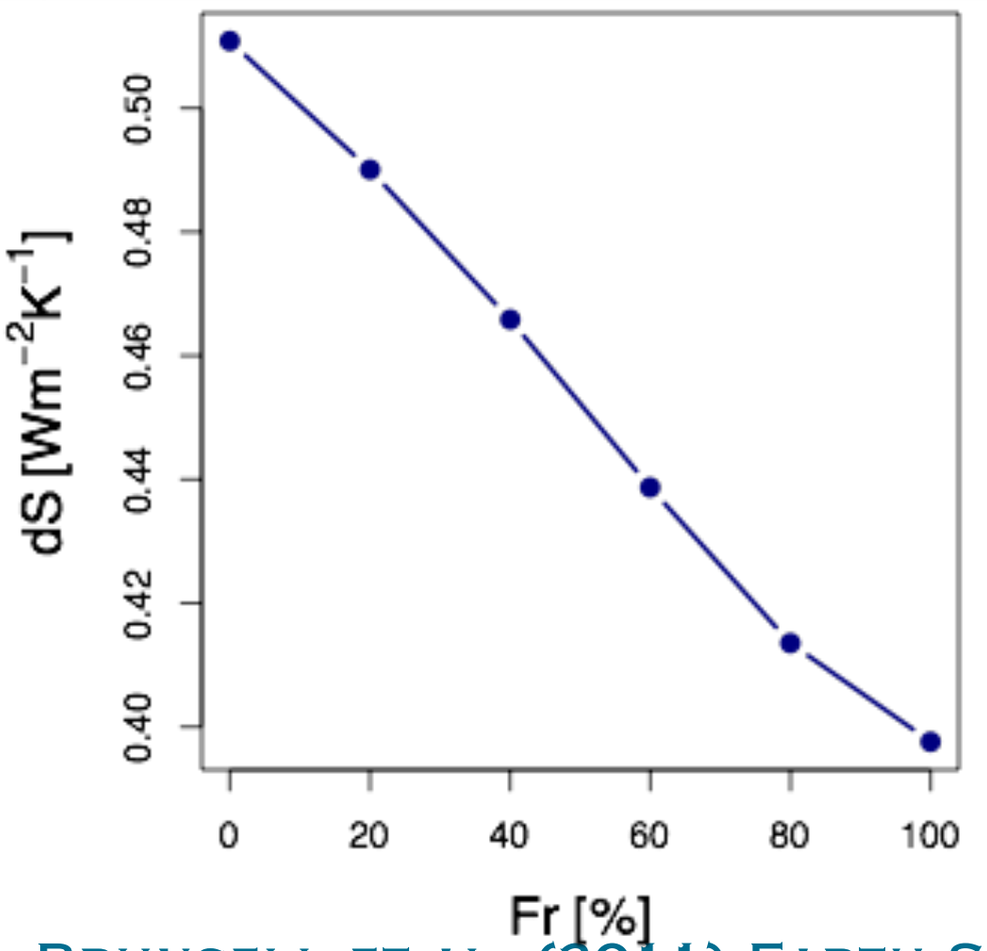
Land Use History

Entropy Production	Total Entropy





Brunsell et al. (2011) Earth Sys. Dyn.

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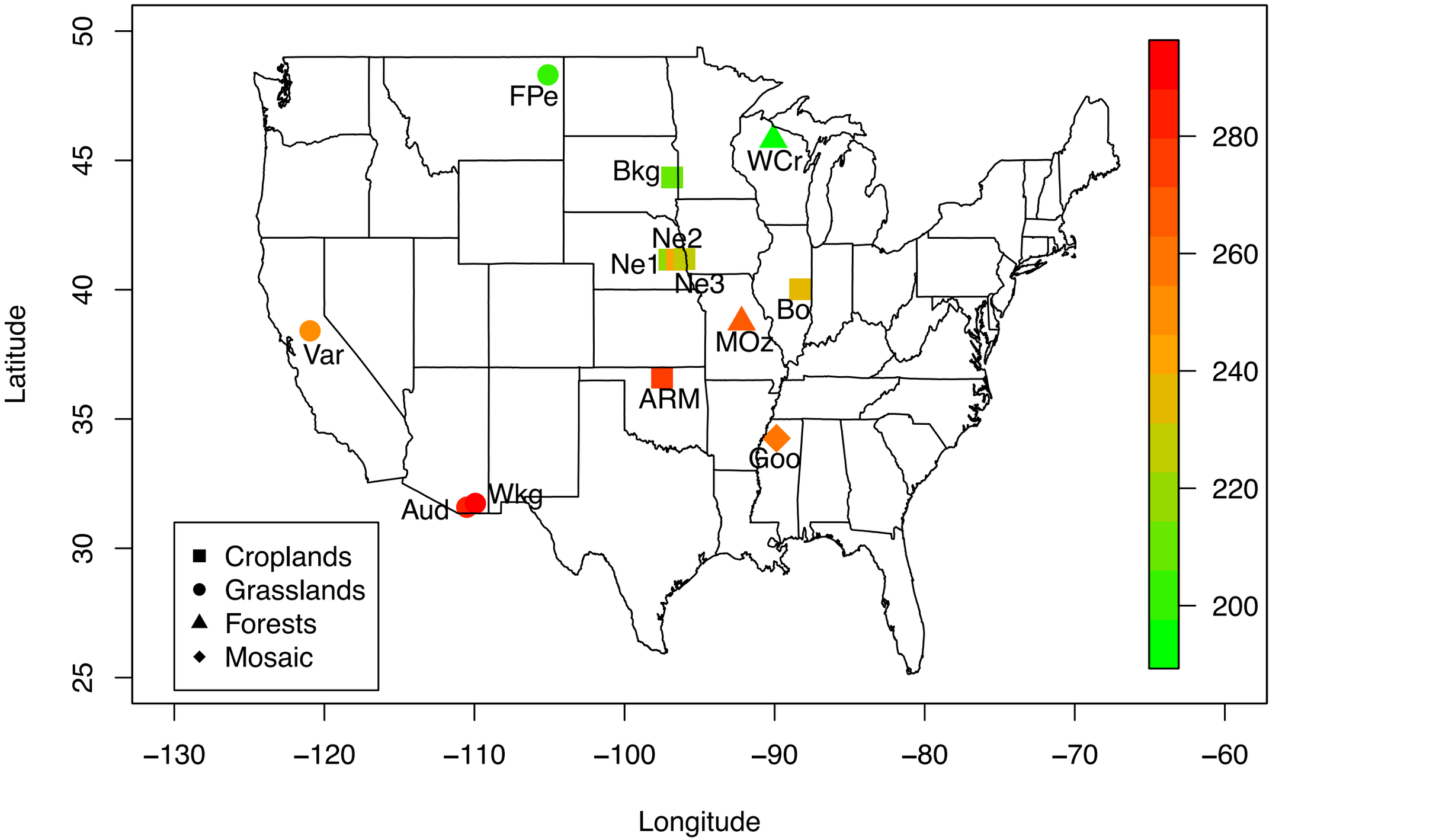
Quantifying Sustainability



Cochran et al. (in Prep)

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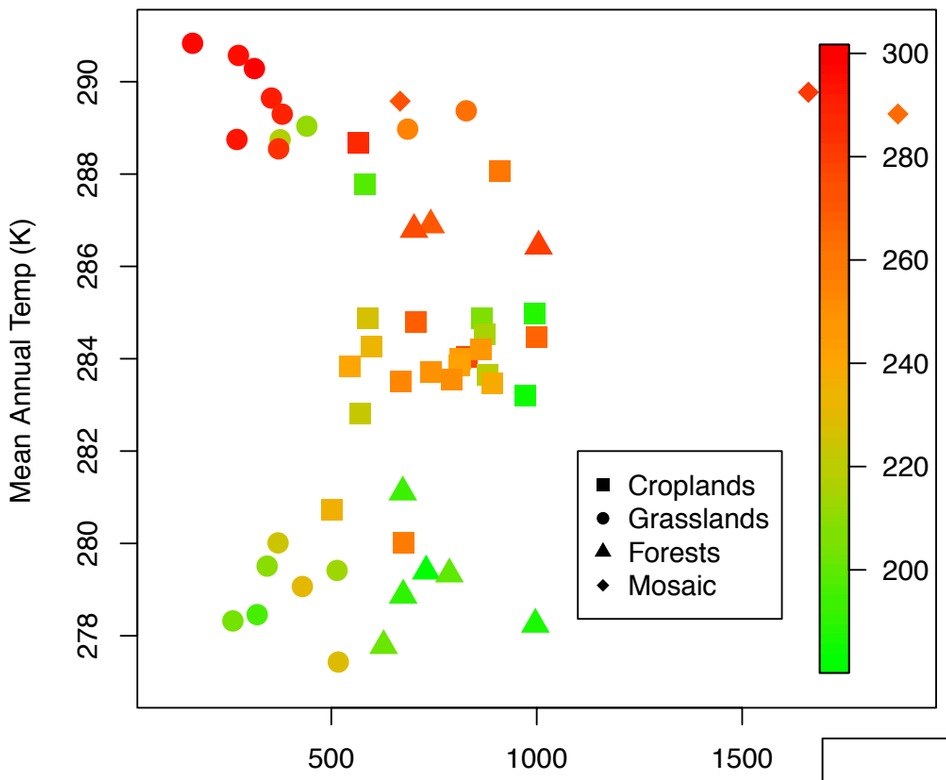
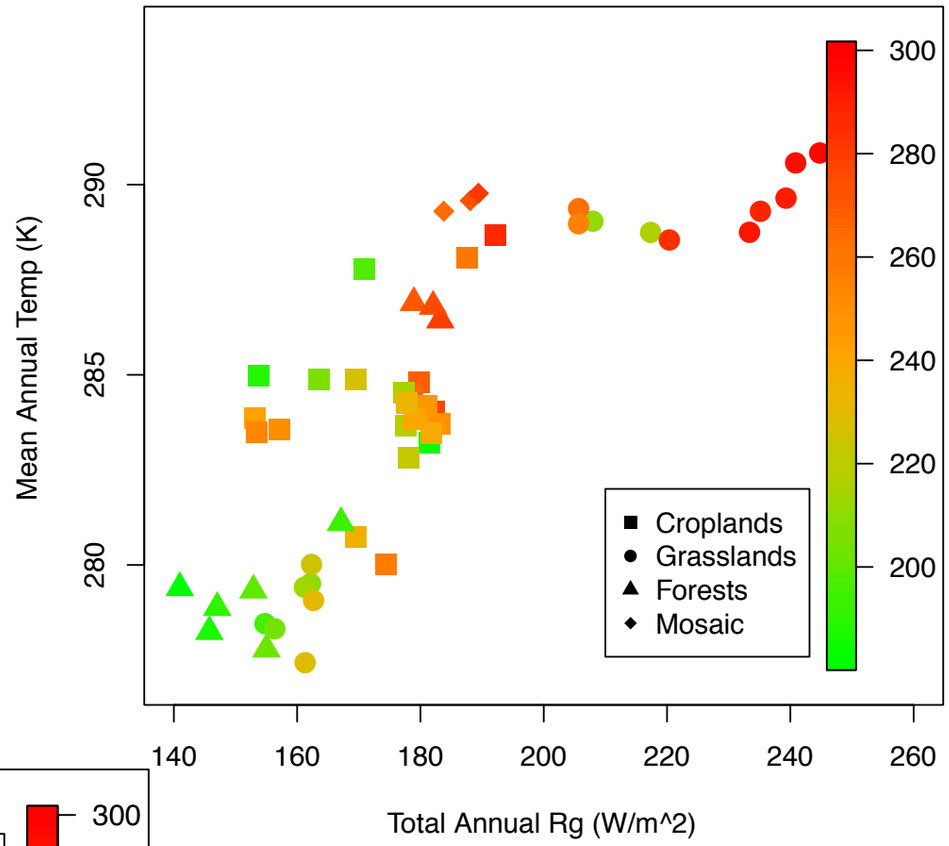
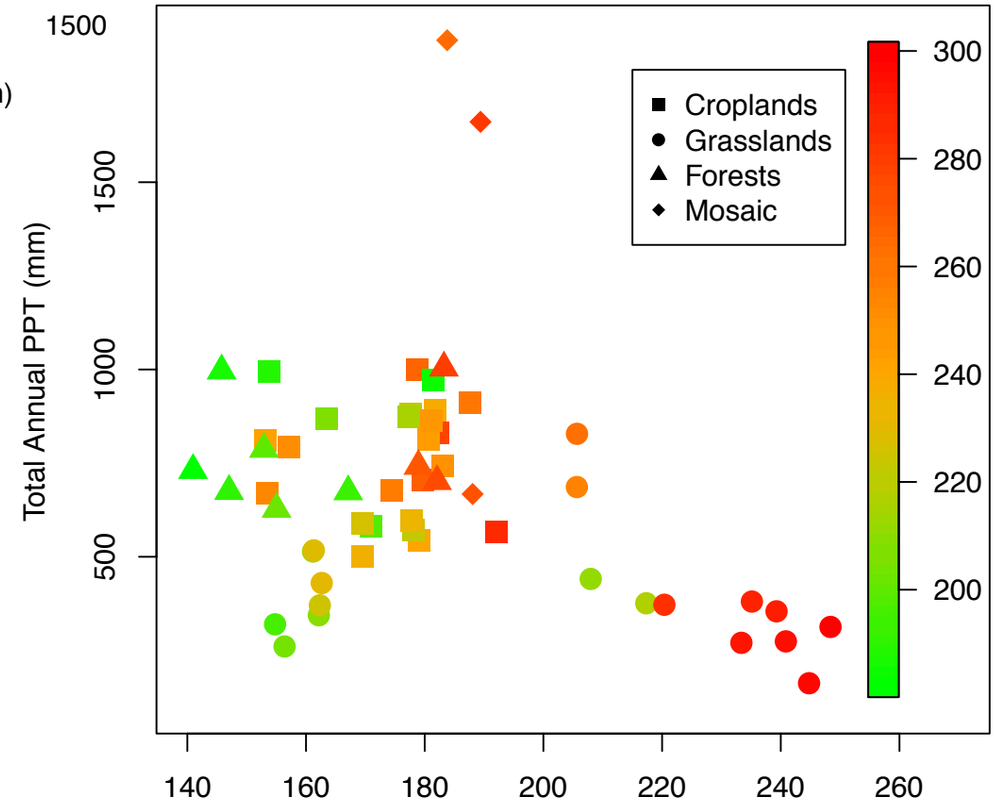
Quantifying Sustainability







Cochran et al. (in Prep)

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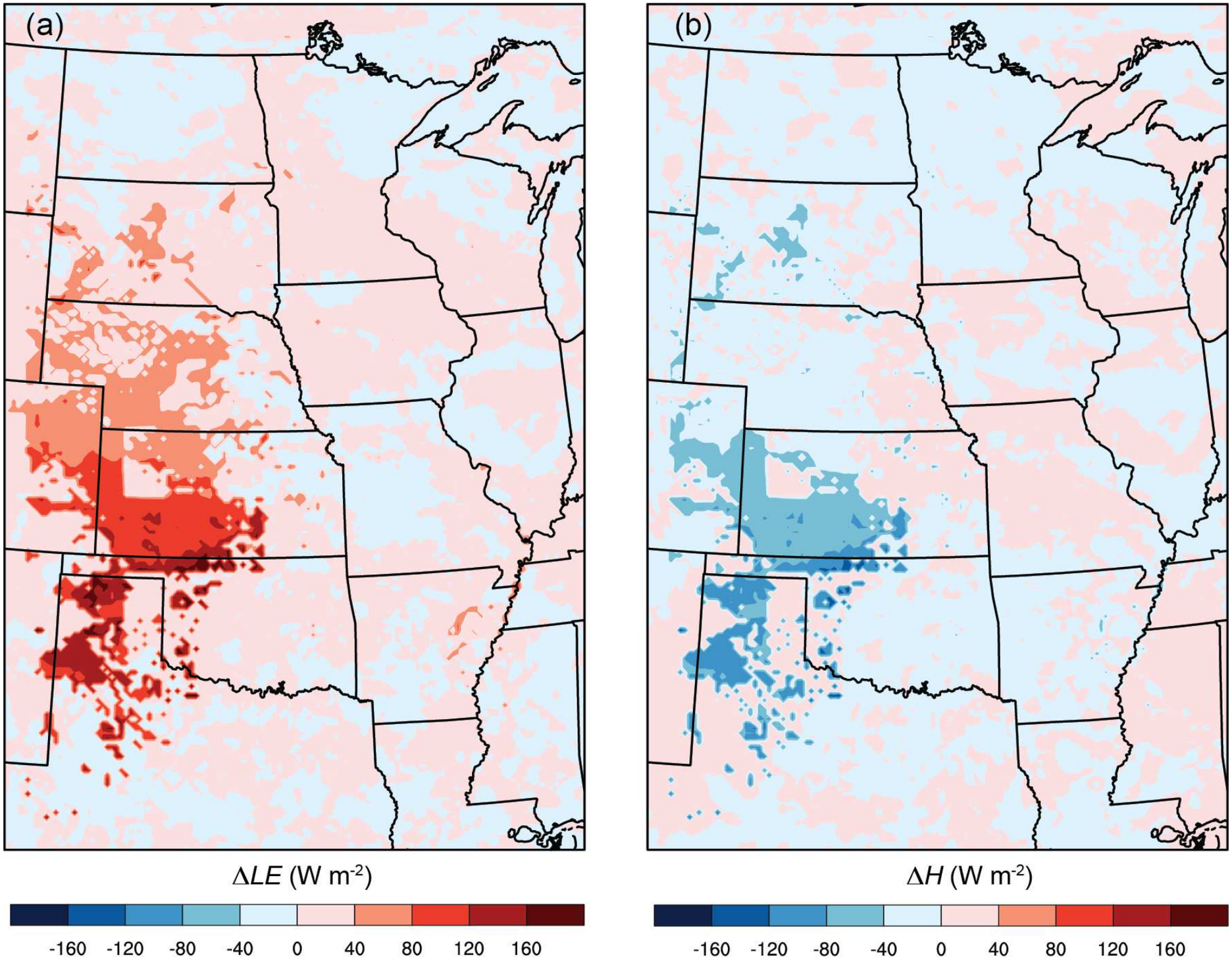
Environmental Impacts of Irrigation



Huber et al. (in Review) Global & Planetary Change

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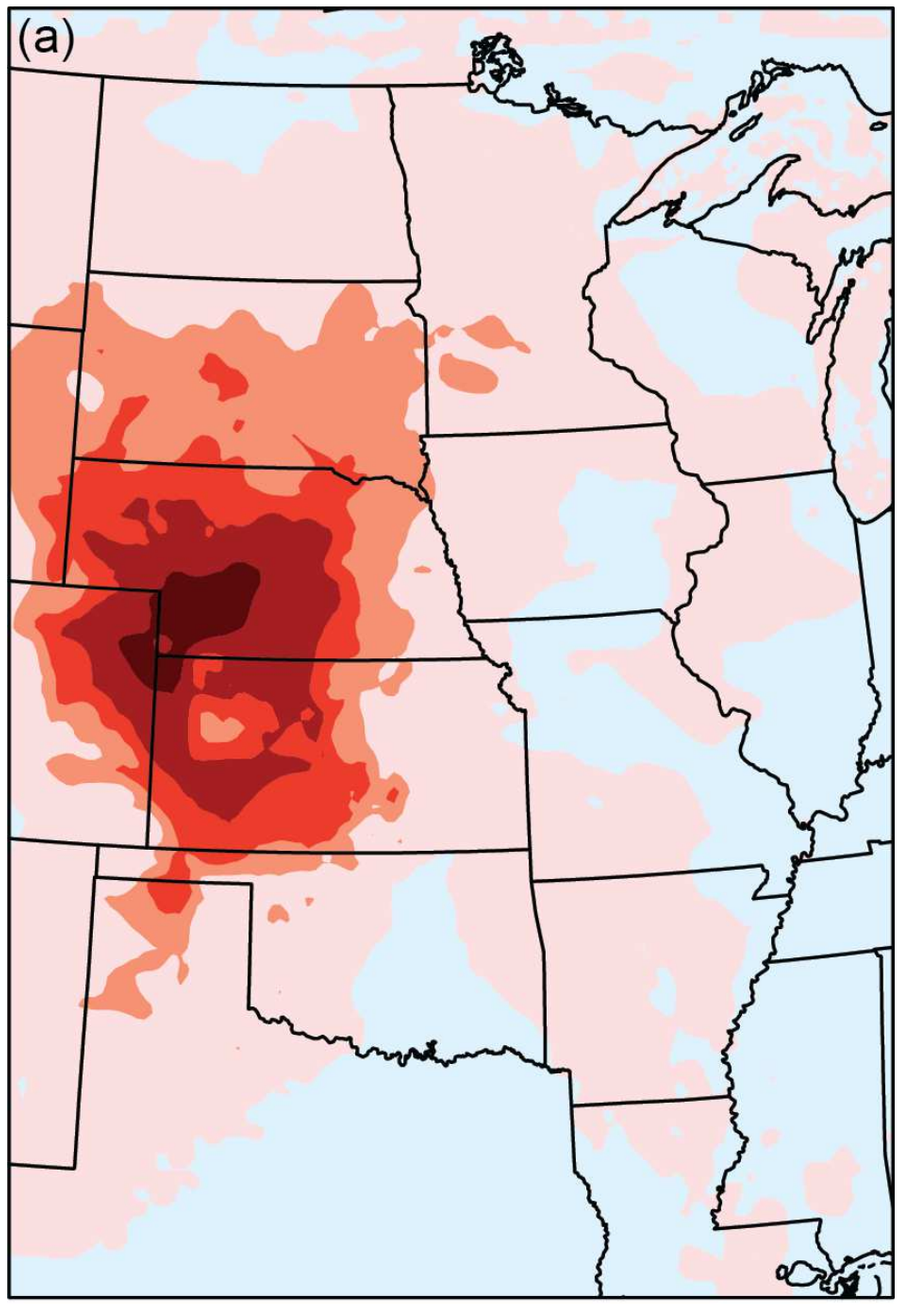
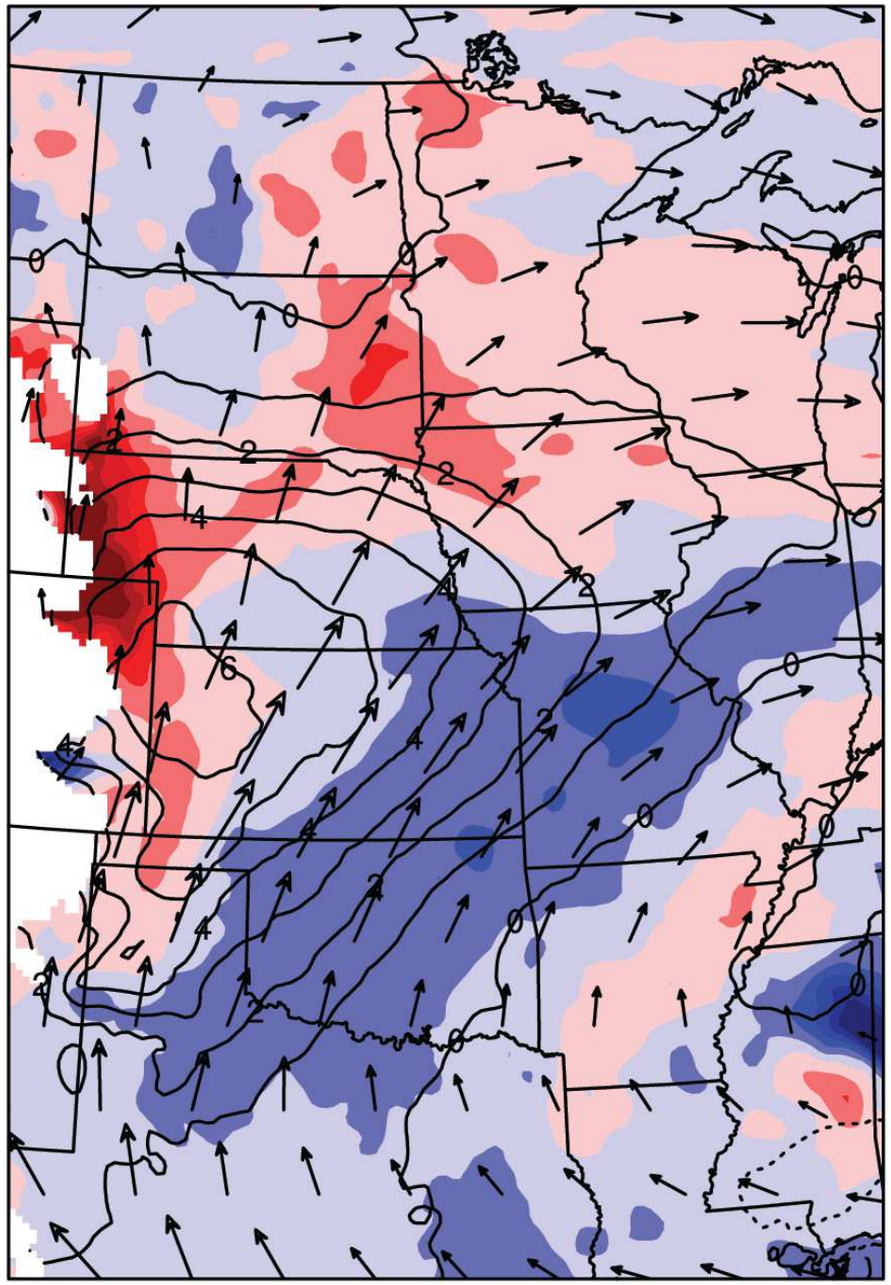
Environmental Impacts of Irrigation





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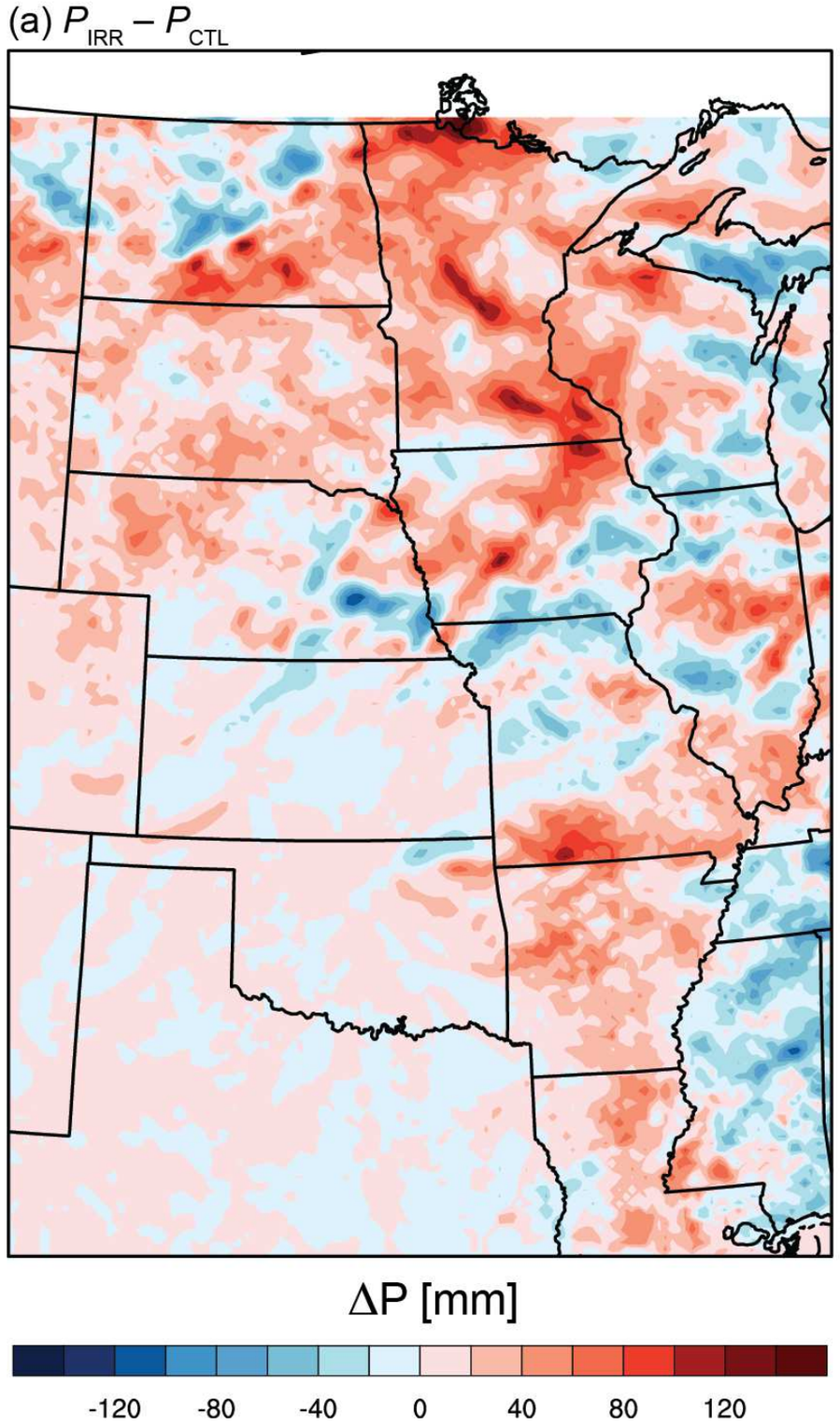
Environmental Impacts of Irrigation



Huber et al. (in Review) Global & Planetary Change

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Energy Decisions

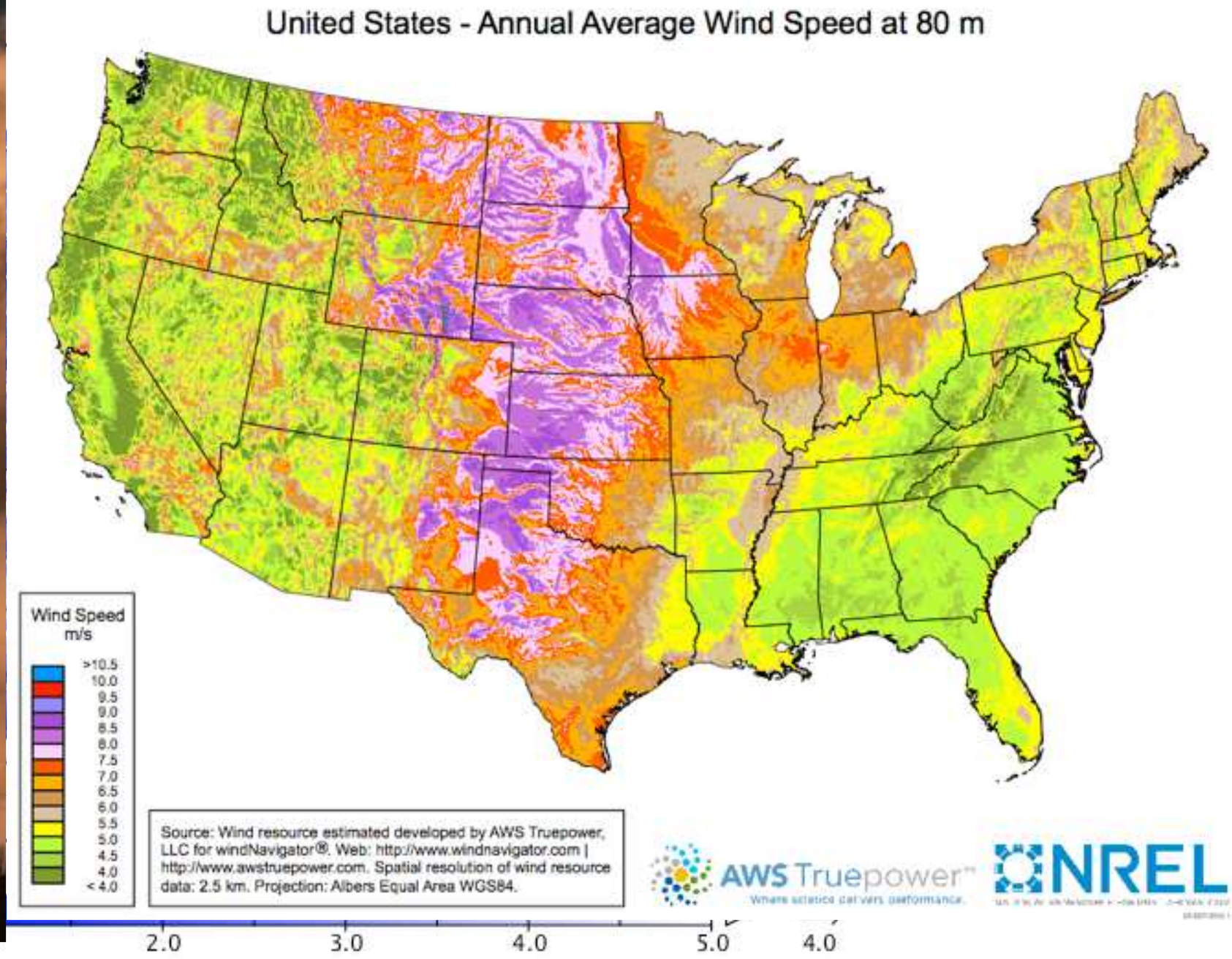

Photo: http://www.flickr.com/photos/frizztext/2245399905/

Miller et al. (in prep)

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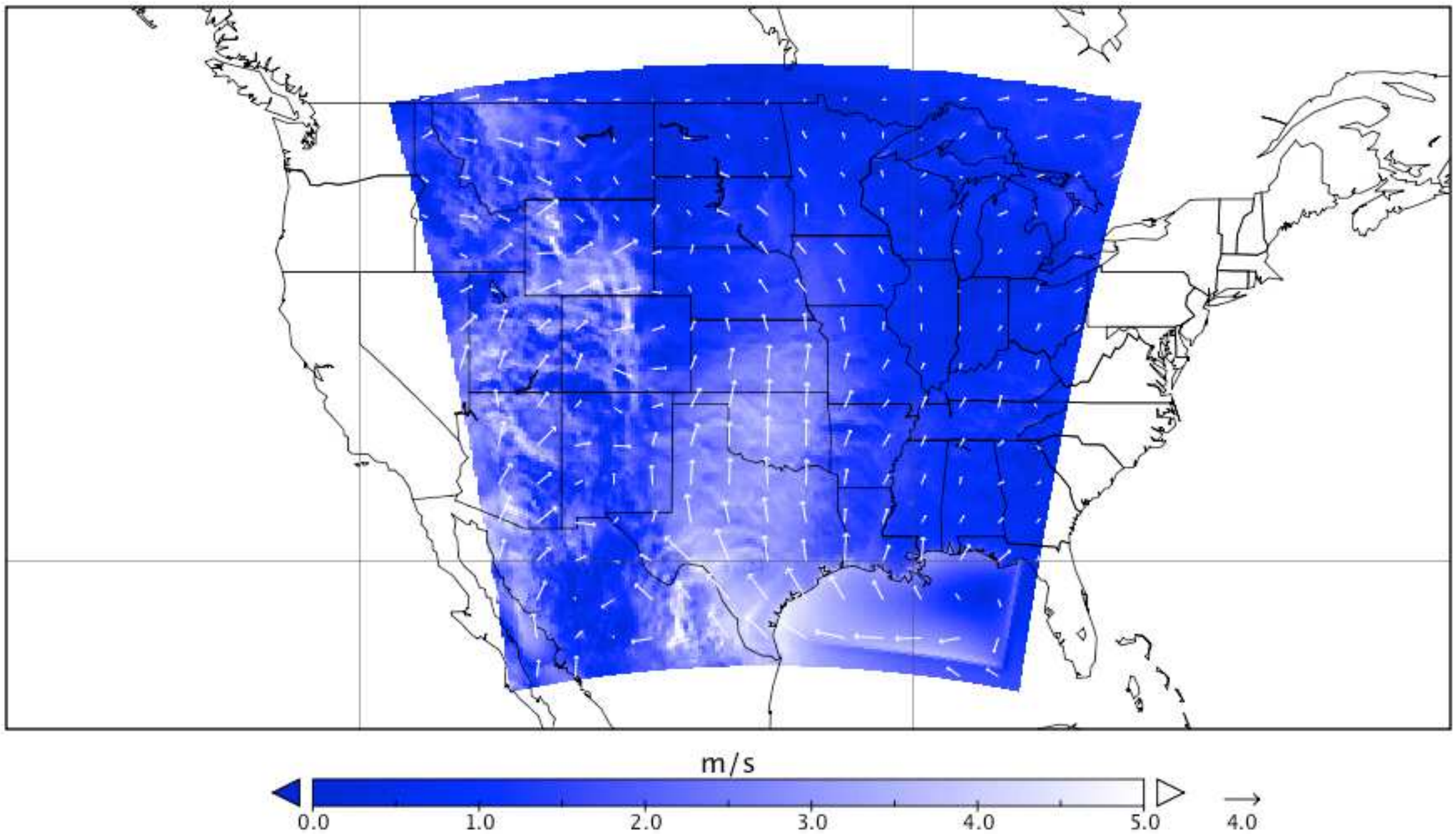

Miller et al. (in prep)

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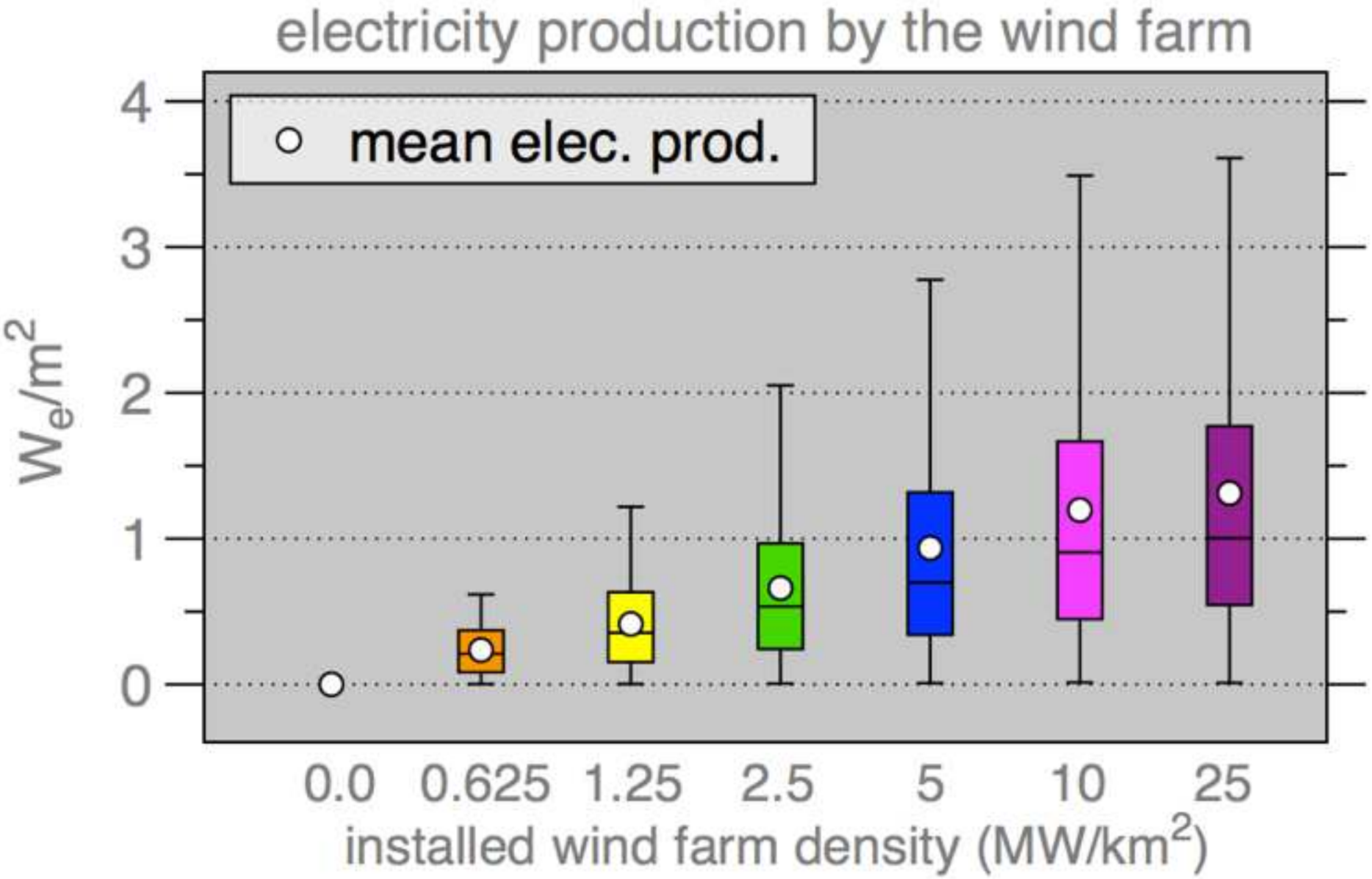

Miller et al. (in prep)

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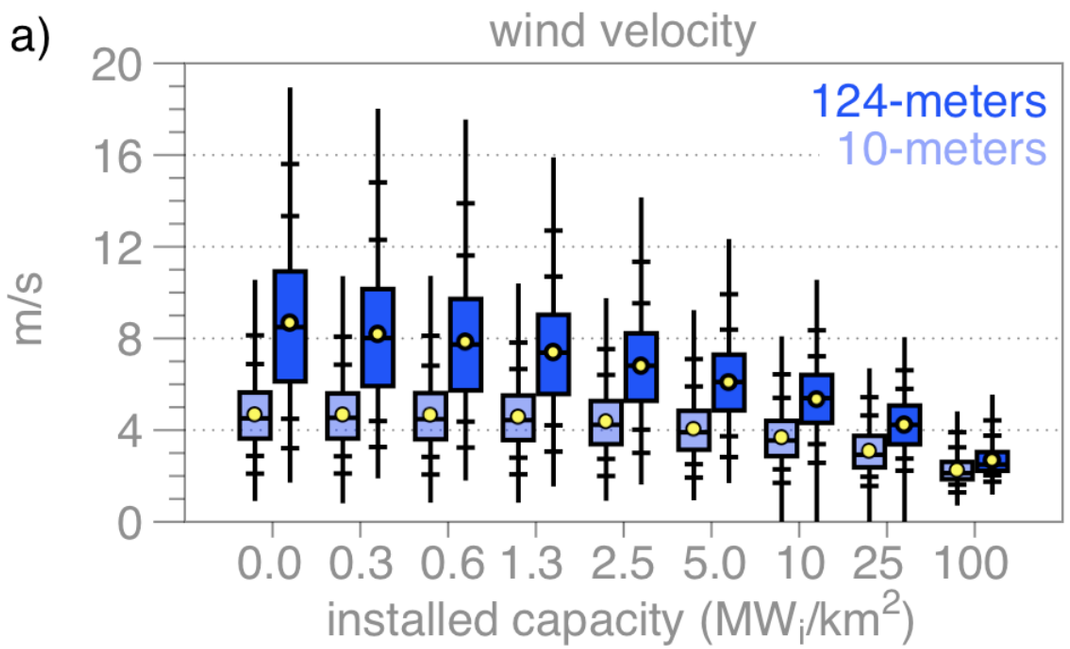

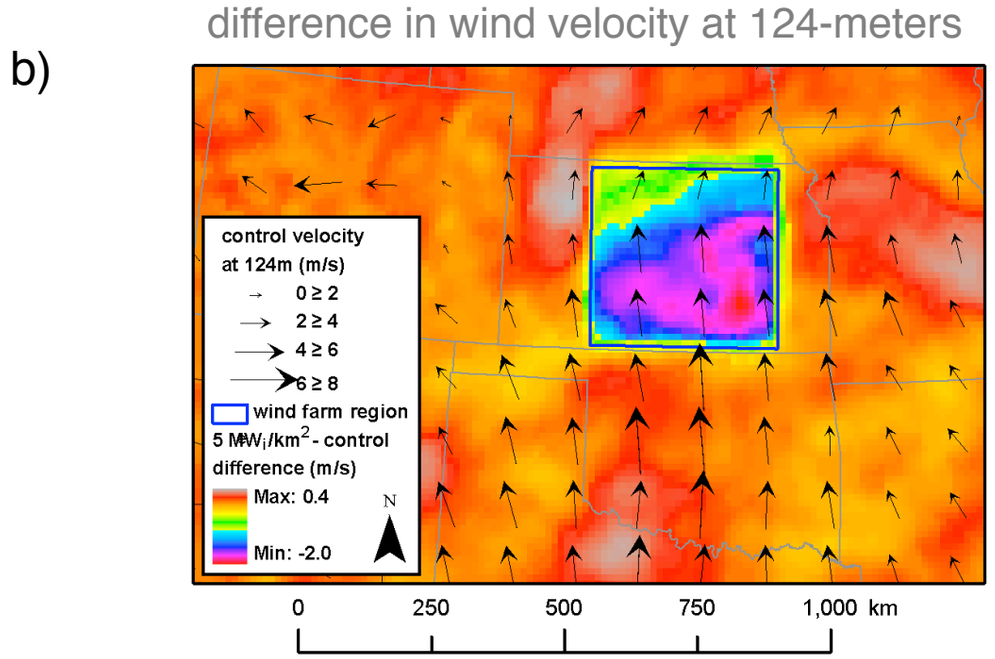

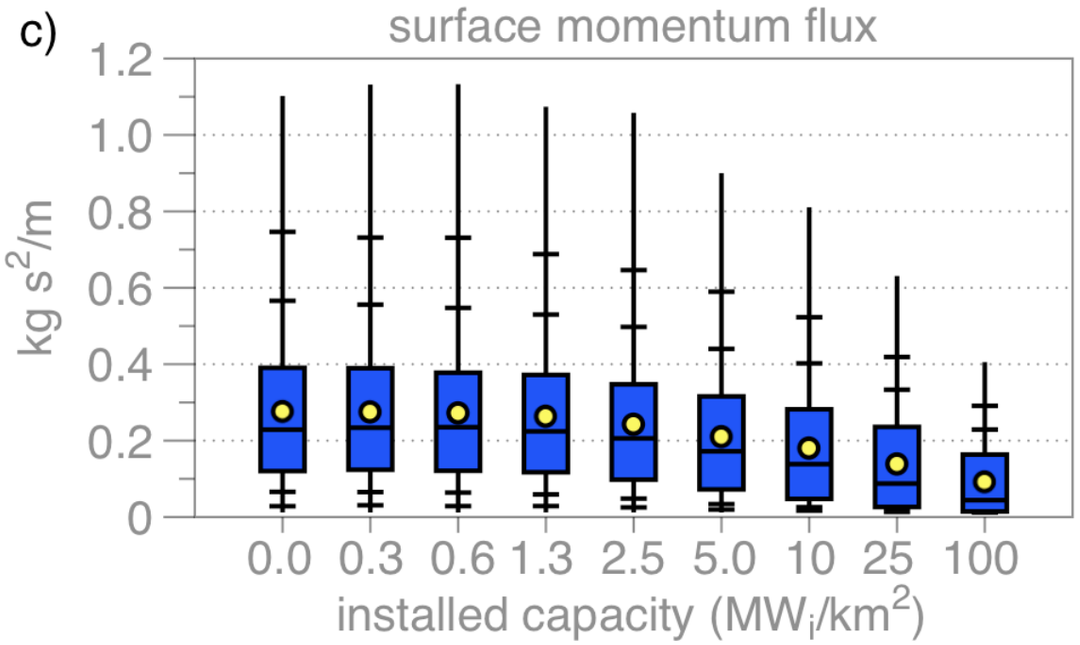

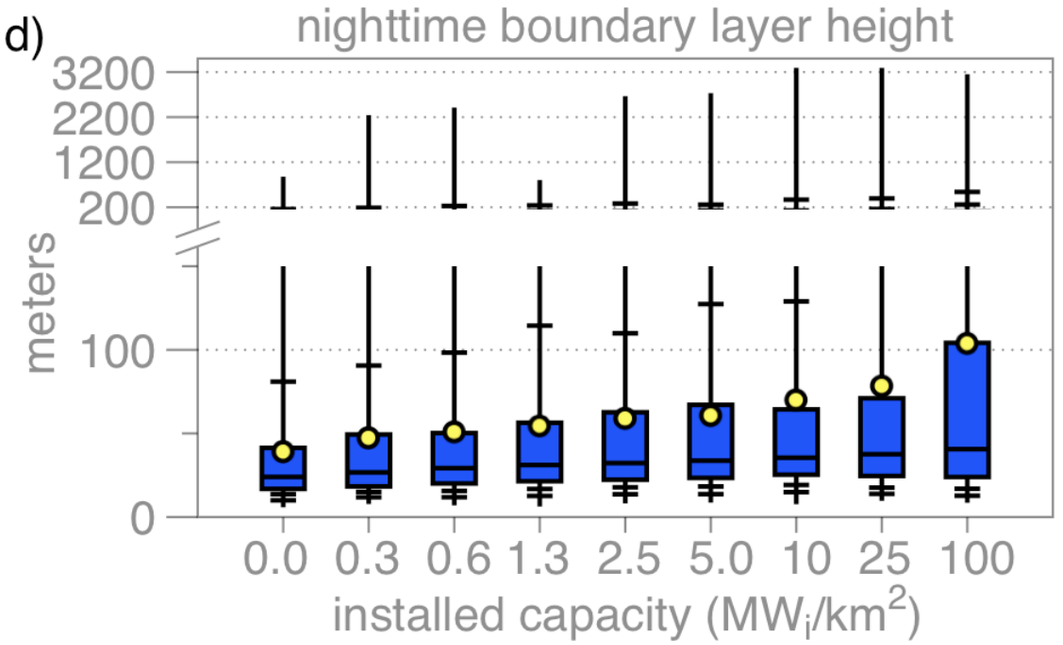

MILLER ET AL. (IN PREP)

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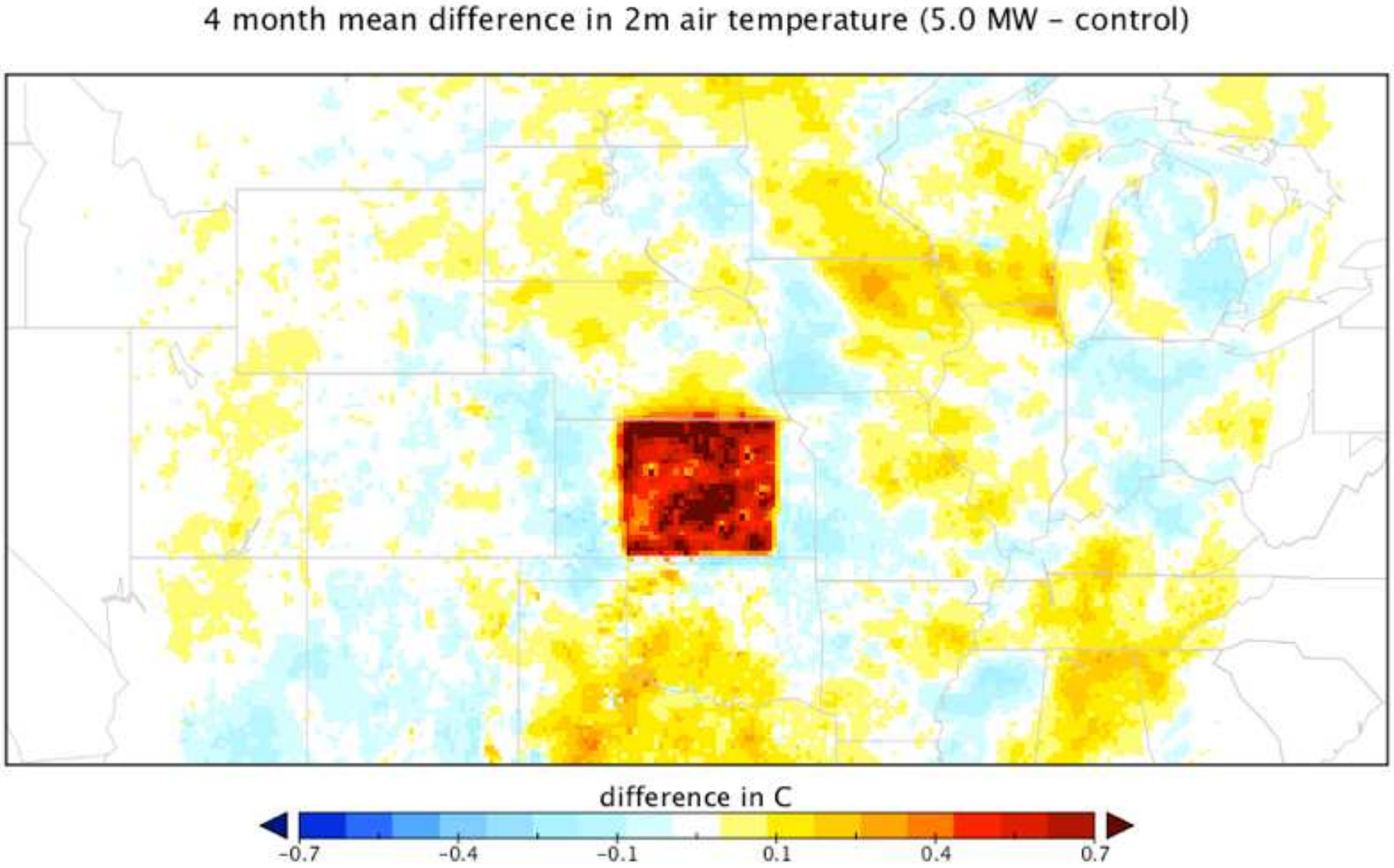

Miller et al. (in prep)

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Ecological Impacts of Climate Extremes

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Ecological Impacts of Climate Extremes

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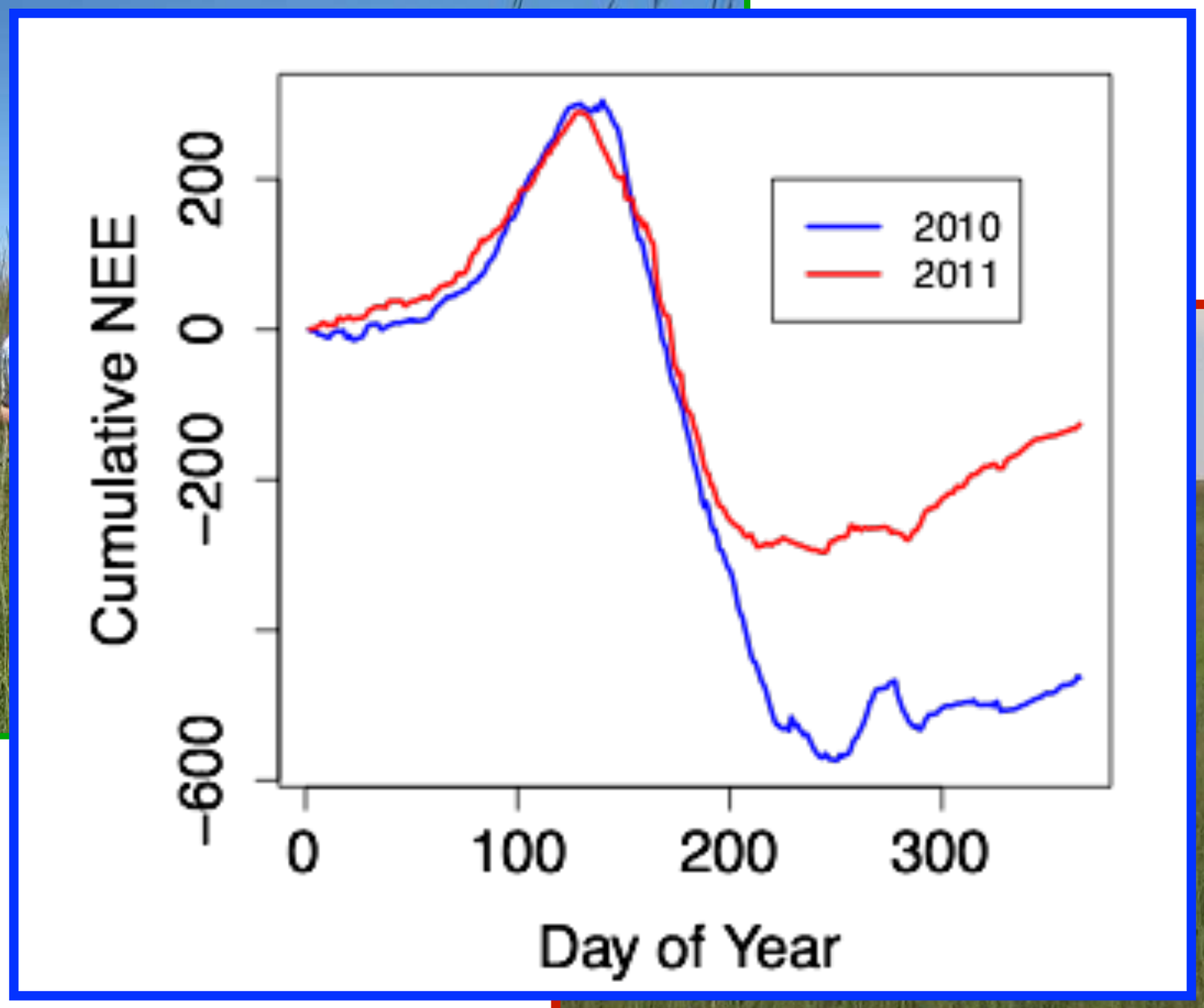
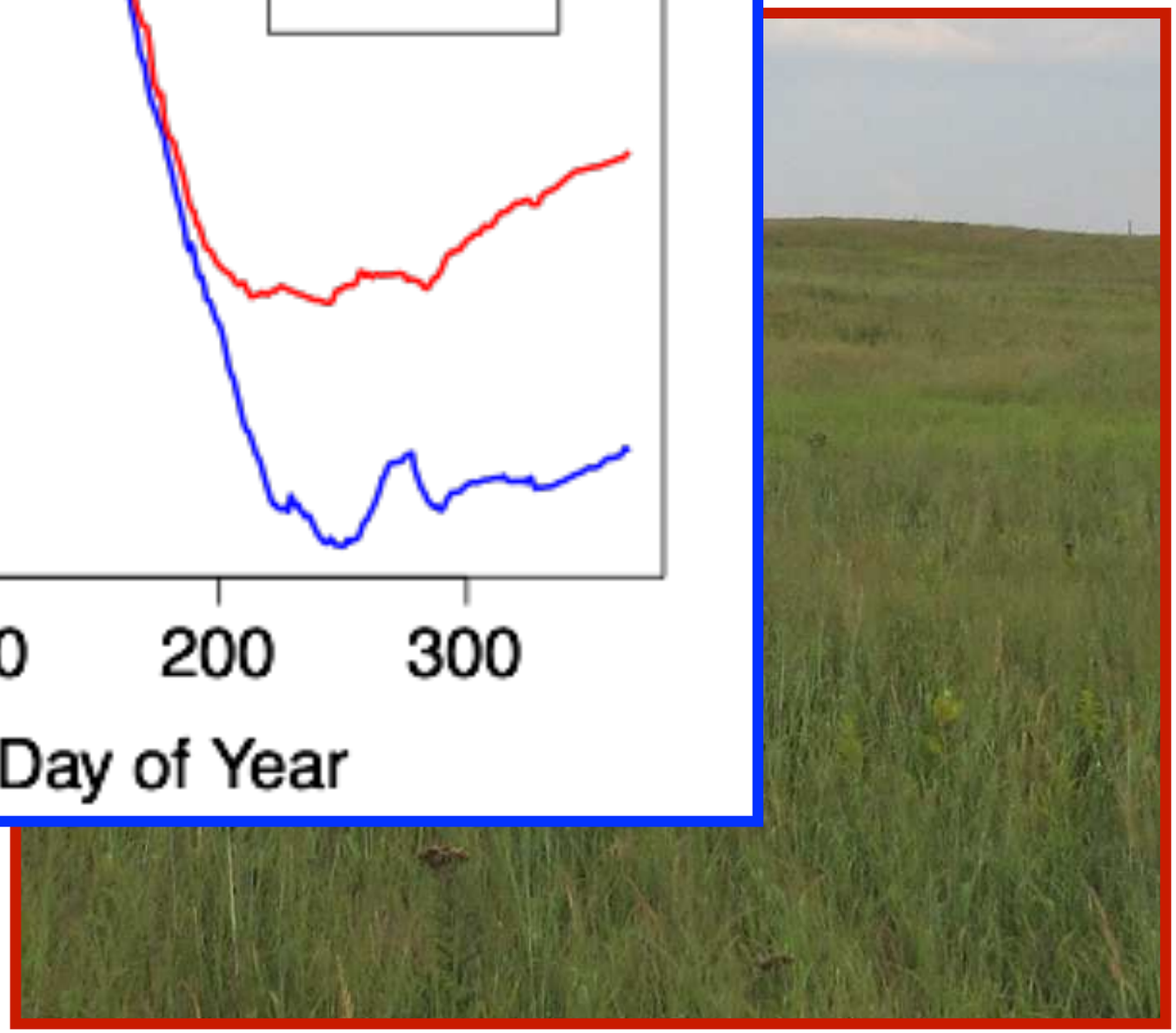
Ecological Impacts of Climate Extremes





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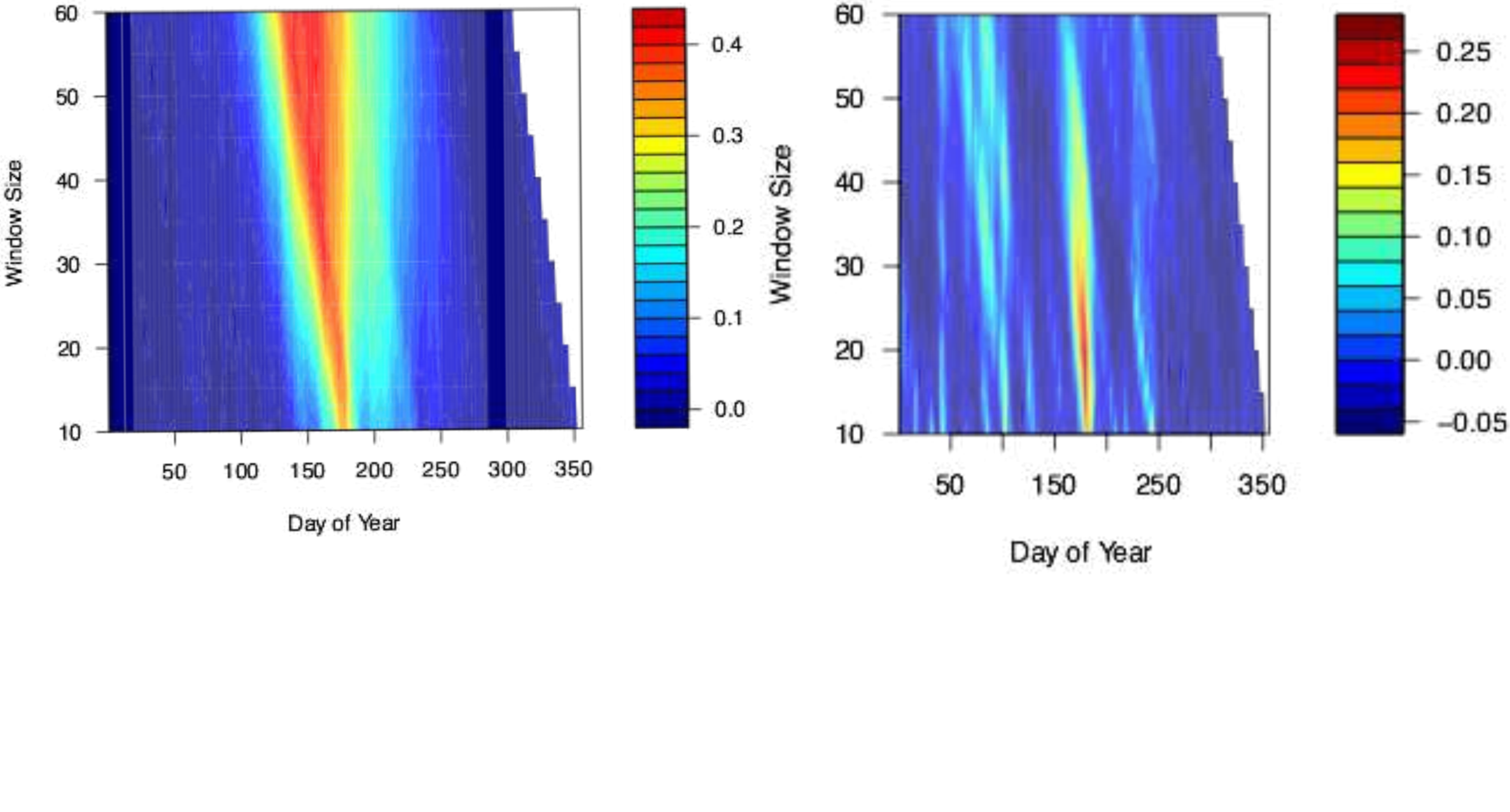
Critical Climate Periods: Temperature

Model	Data



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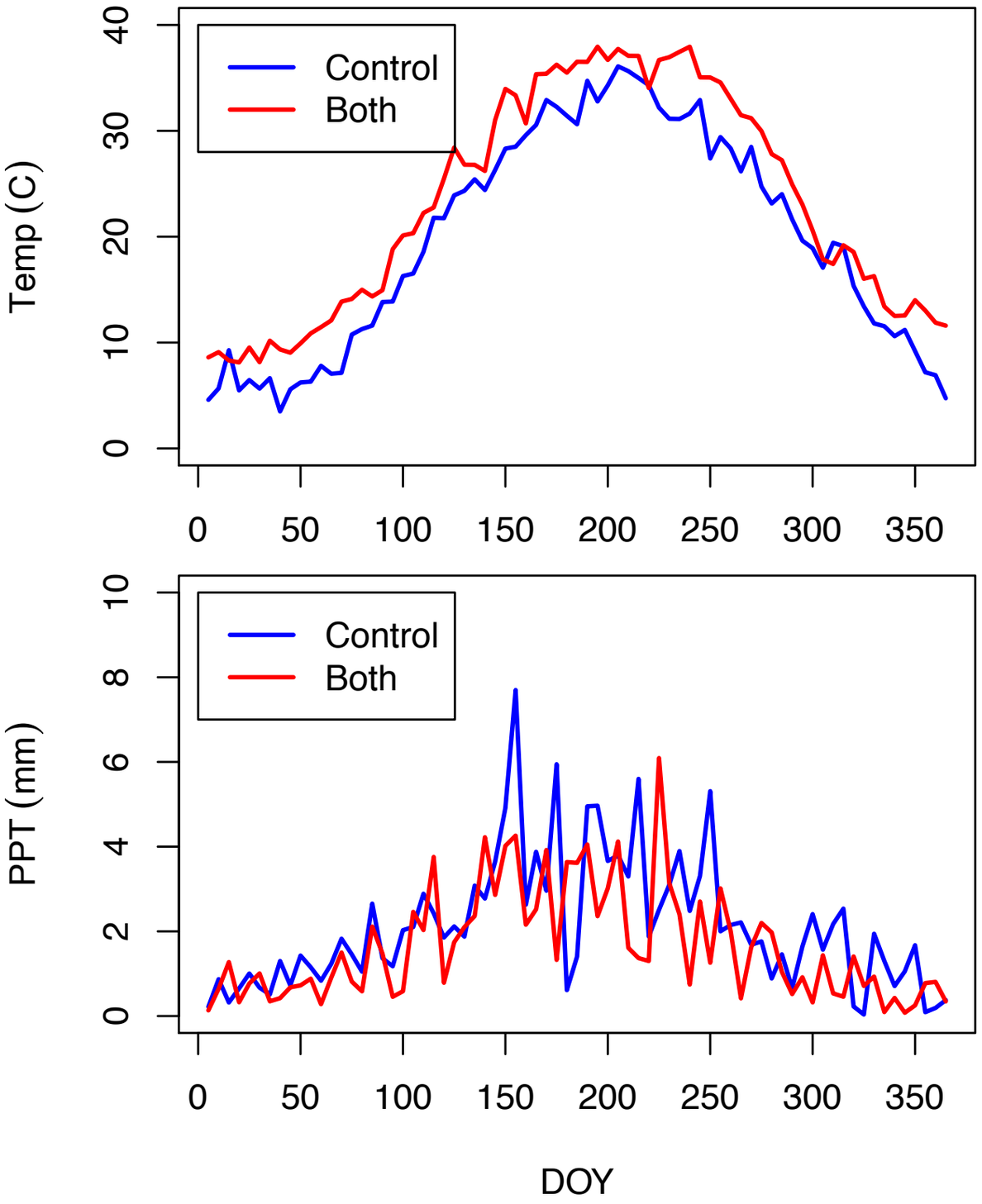
Water and Carbon Impacts



Brunsell et al. (in prep)

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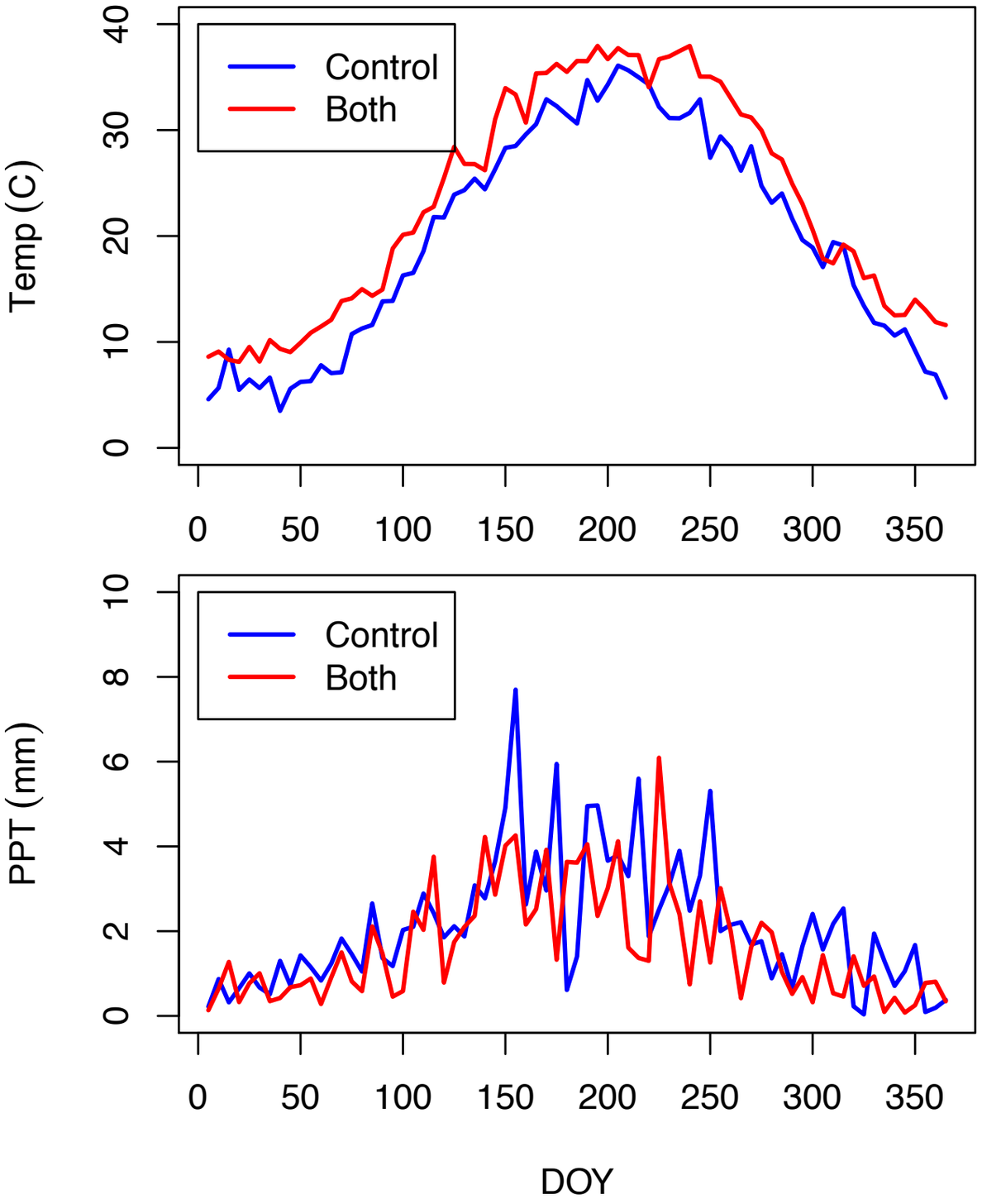
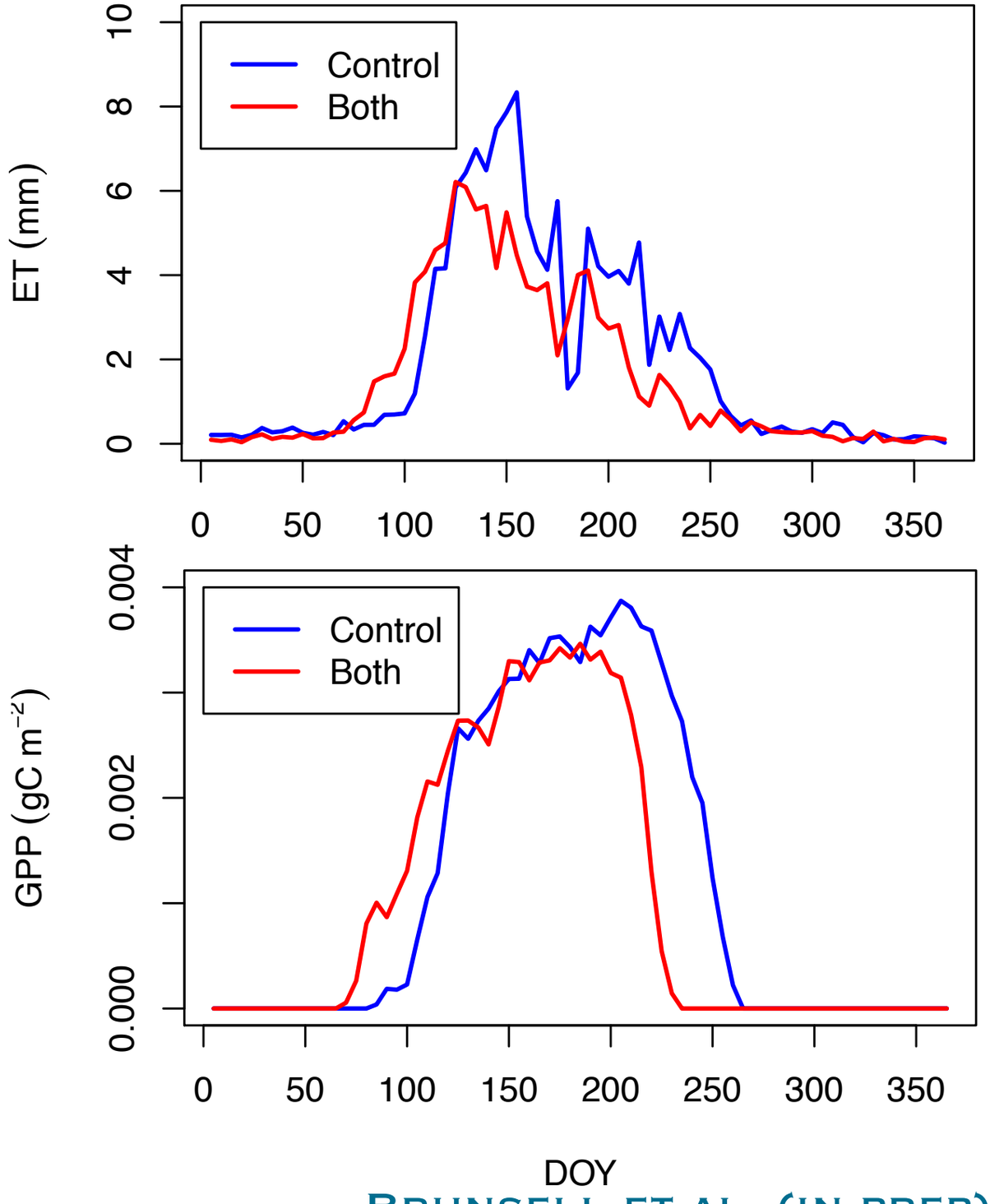
Water and Carbon Impacts





Brunsell et al. (in prep)

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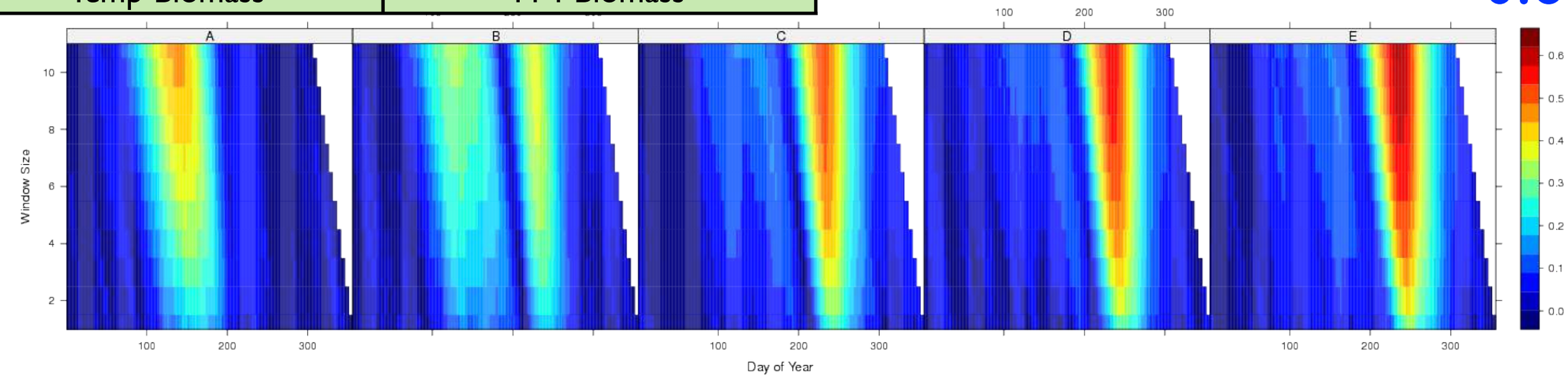
CCP-Biomass

2450	1264	860	645	516

Temp-Biomass	PPT-Biomass

0.6



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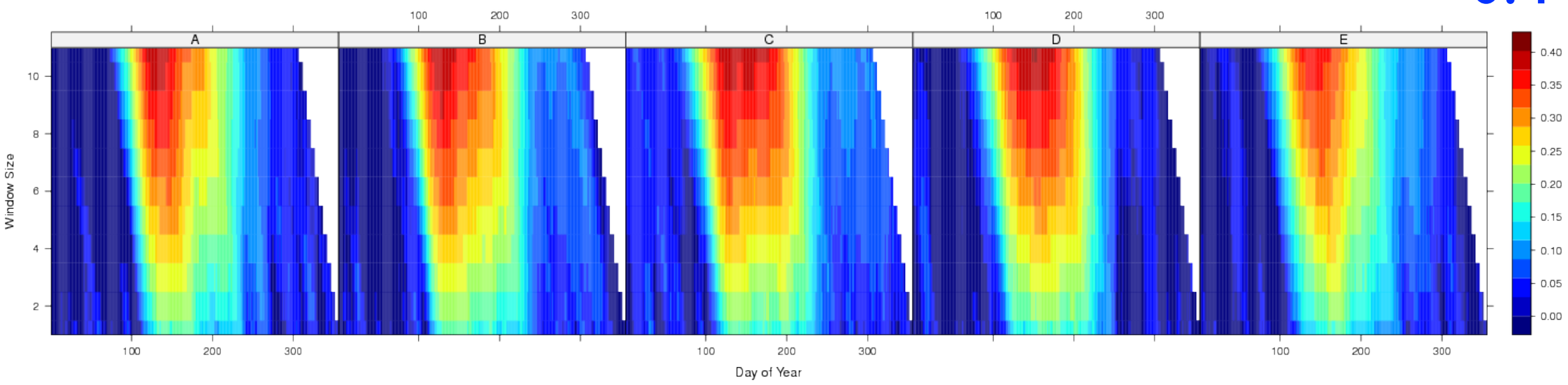

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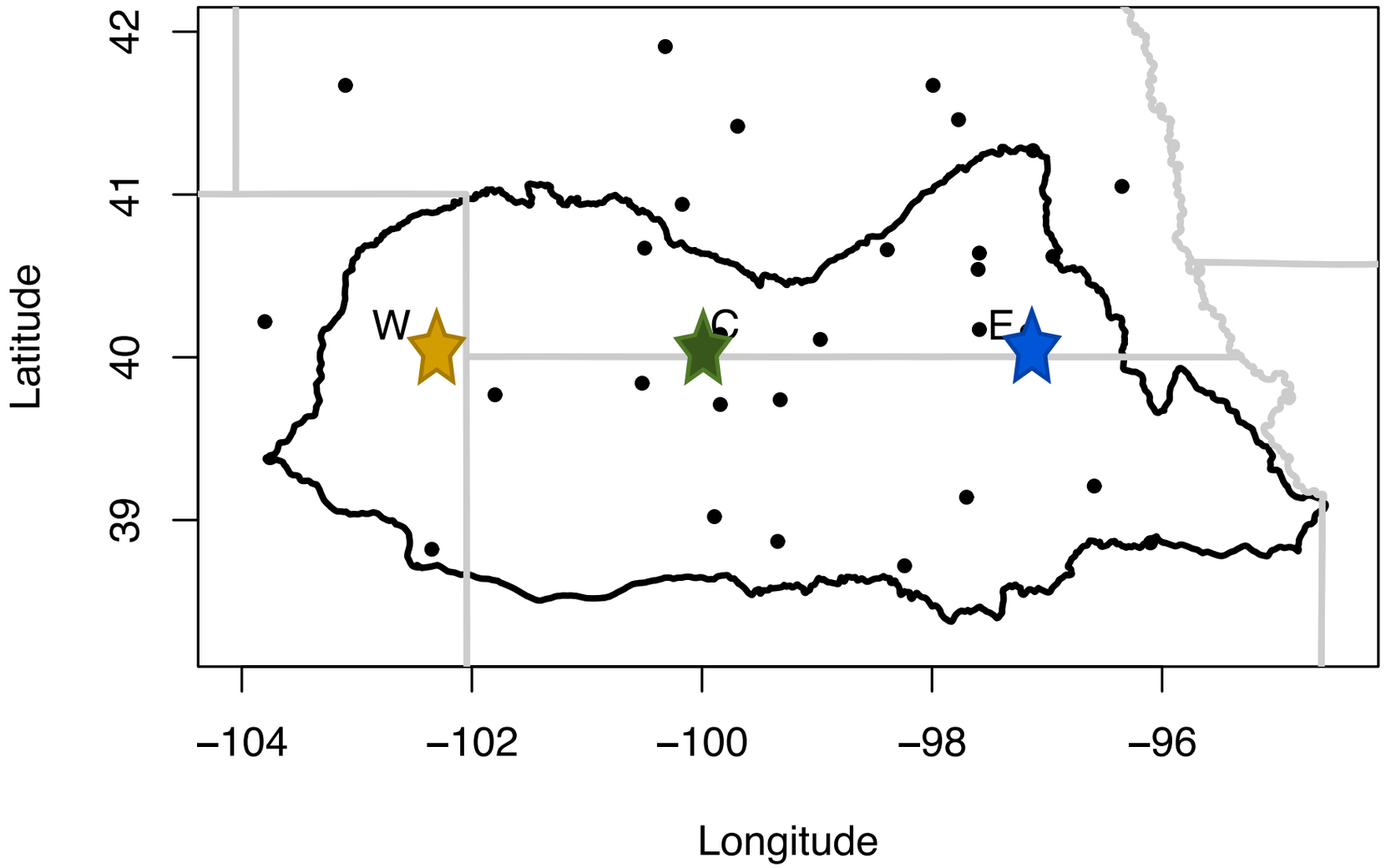
Ecological Implications of Climate Change



Petrie and Brunsell (2012) Ecohydrology

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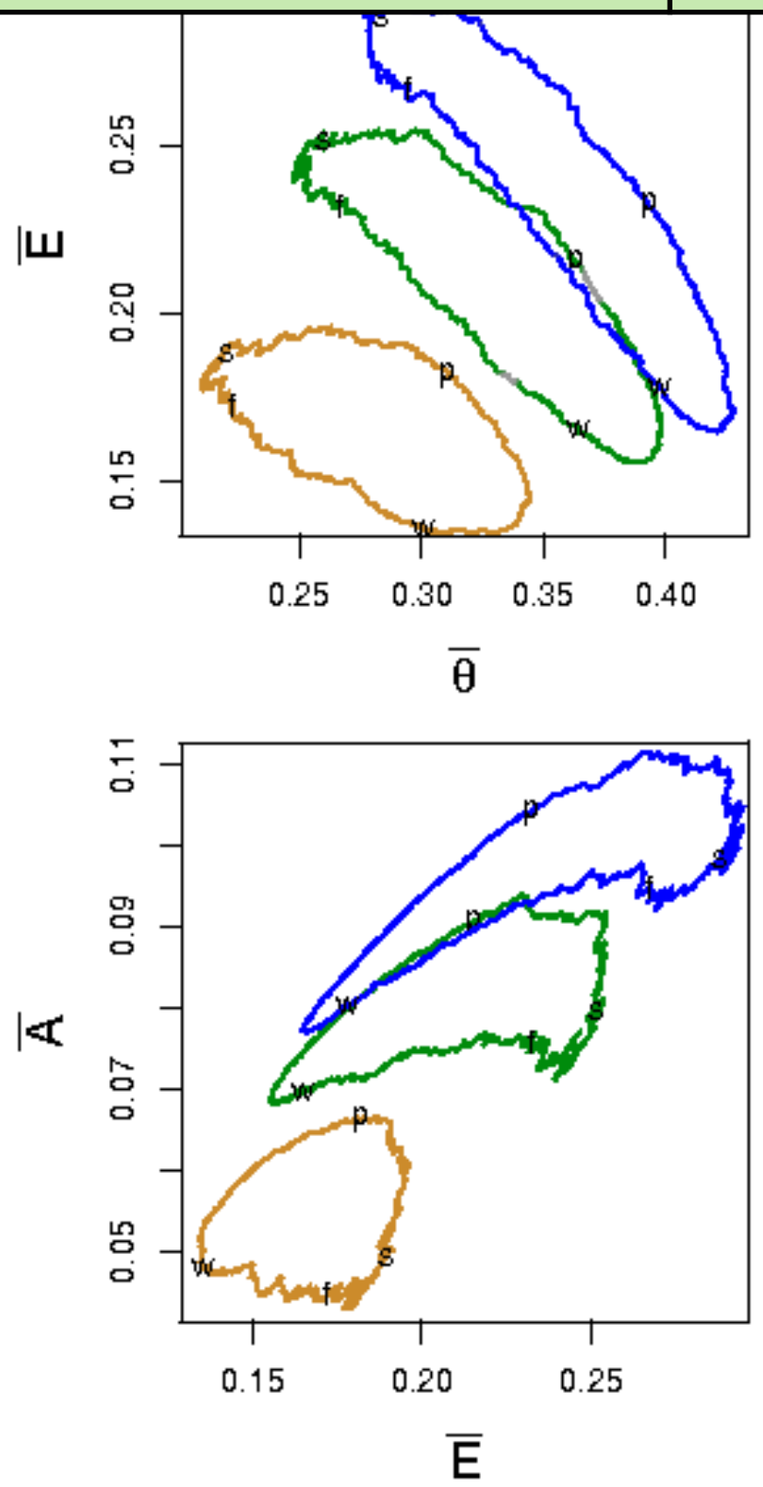
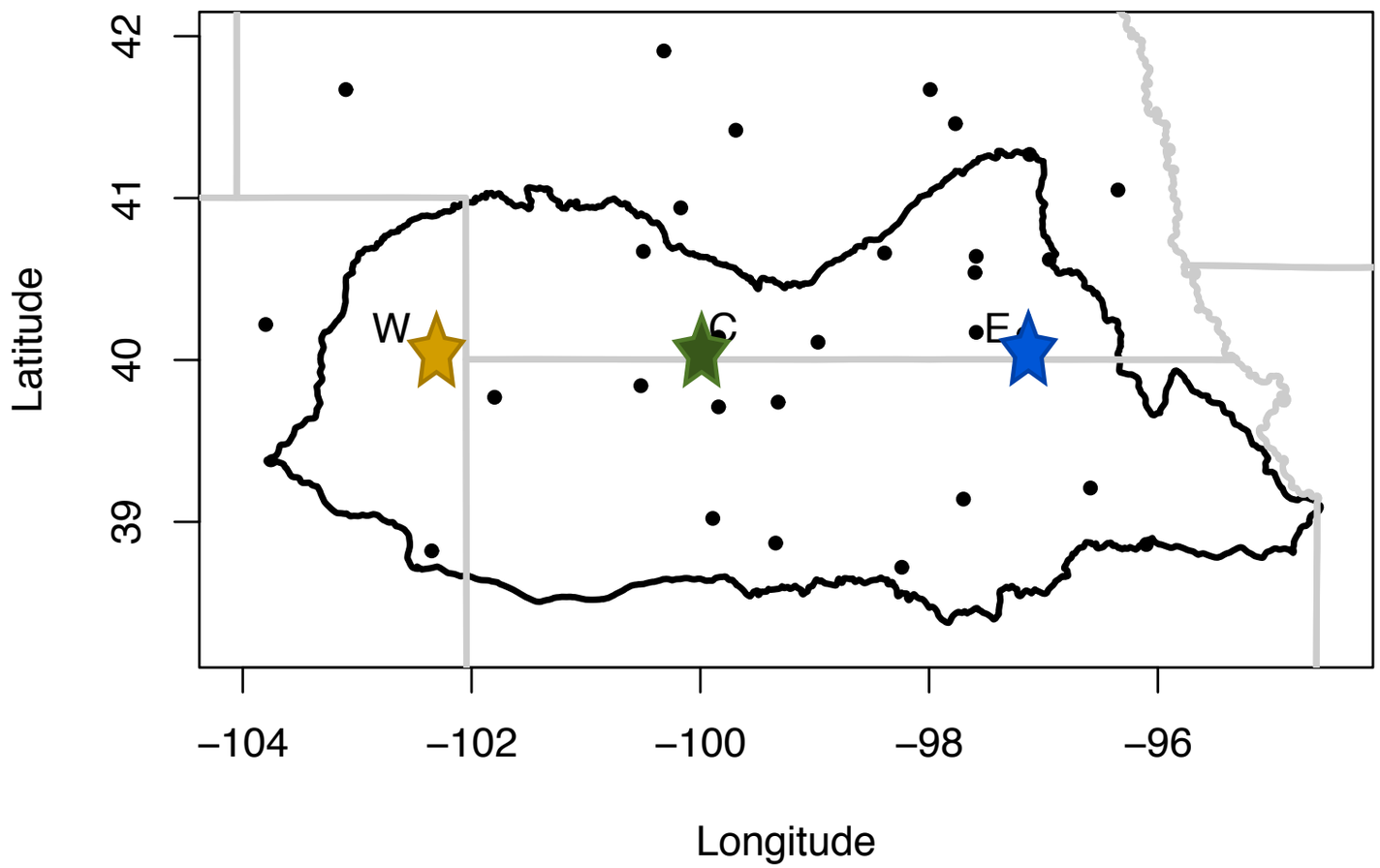
Ecological Implications of Climate Change

Carbon Assimilation	Evapotranspiration





Petrie and Brunsell (2012) Ecohydrology

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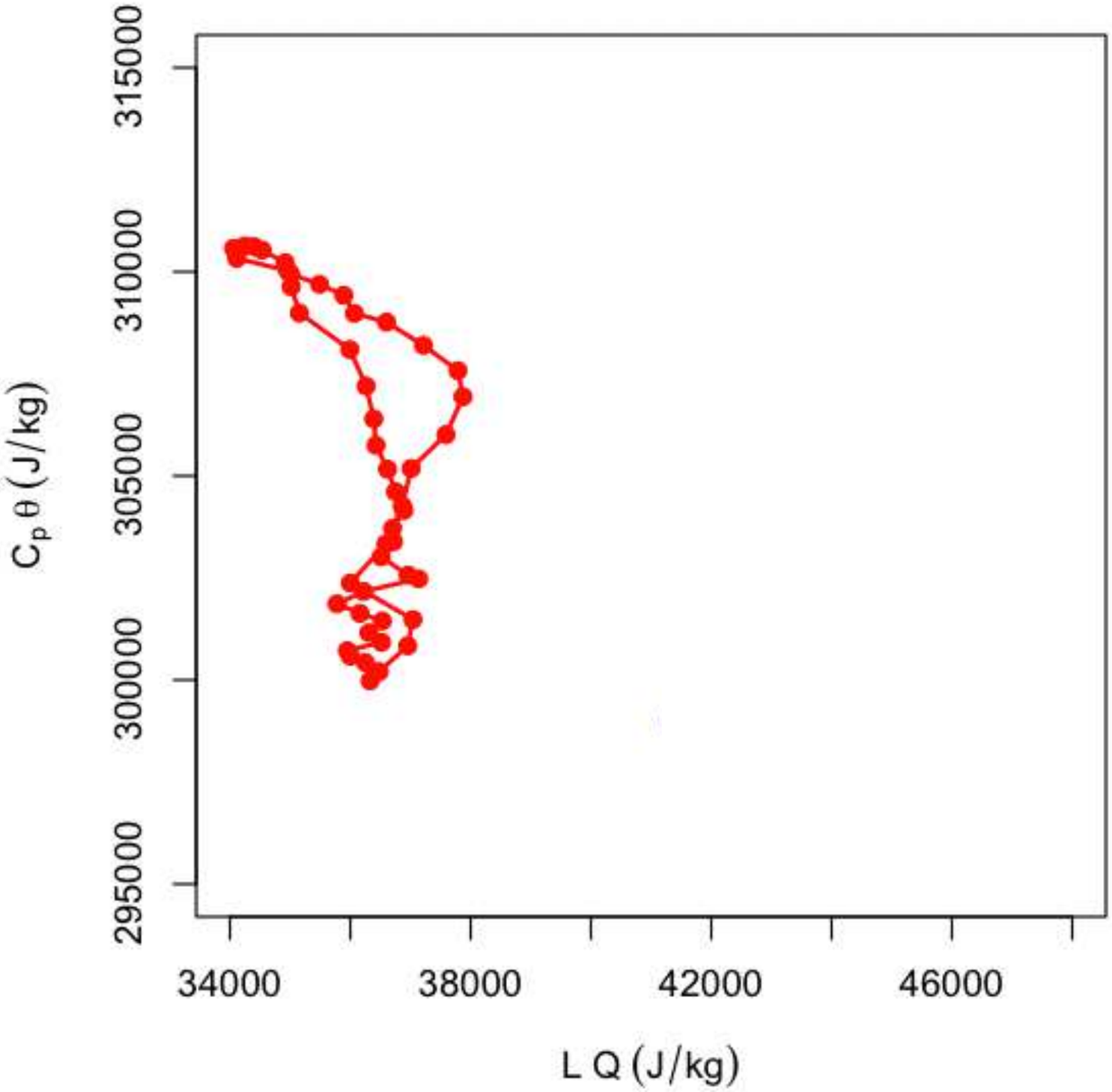
Land-Atmosphere Coupling



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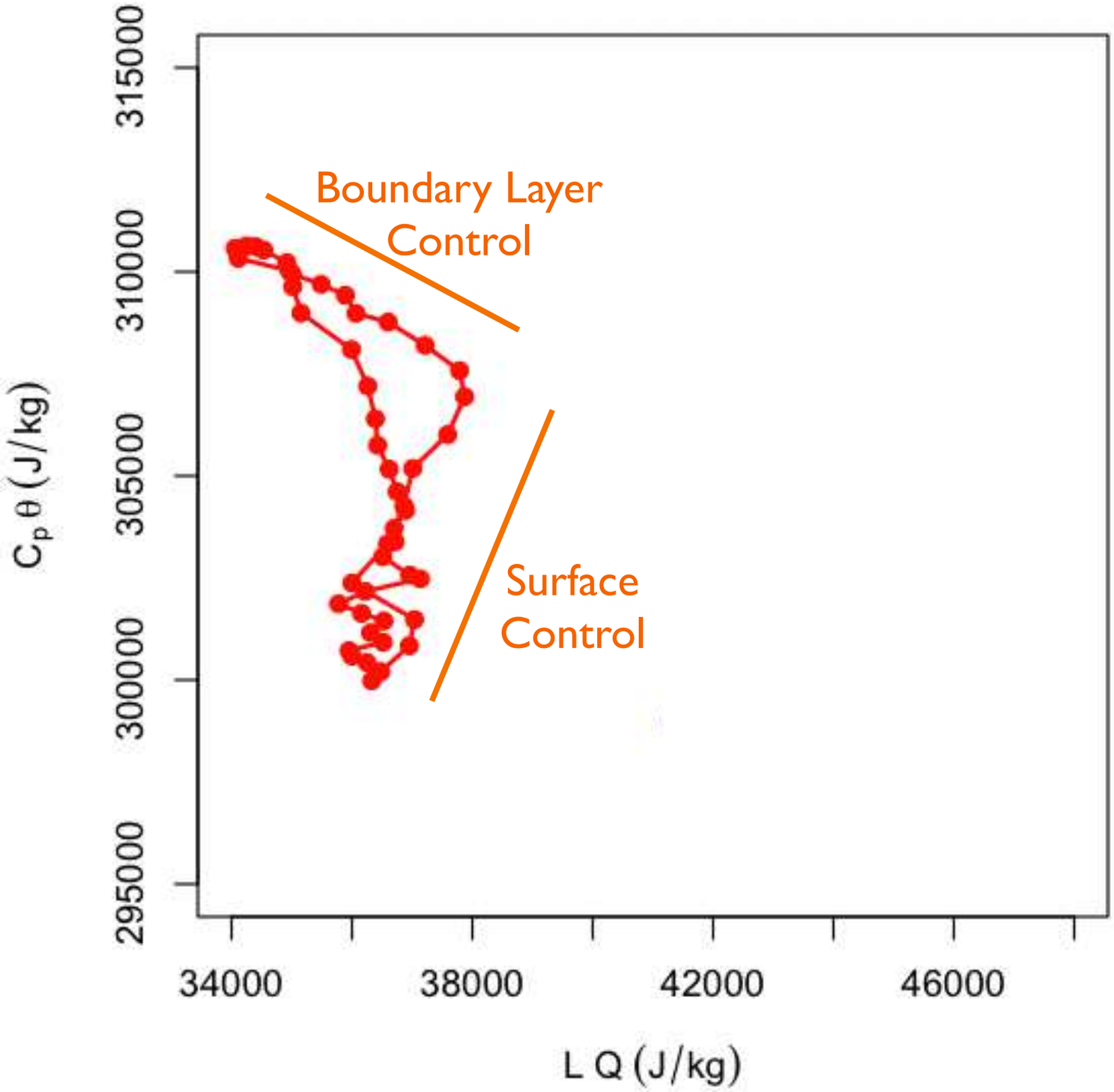
Land-Atmosphere Coupling



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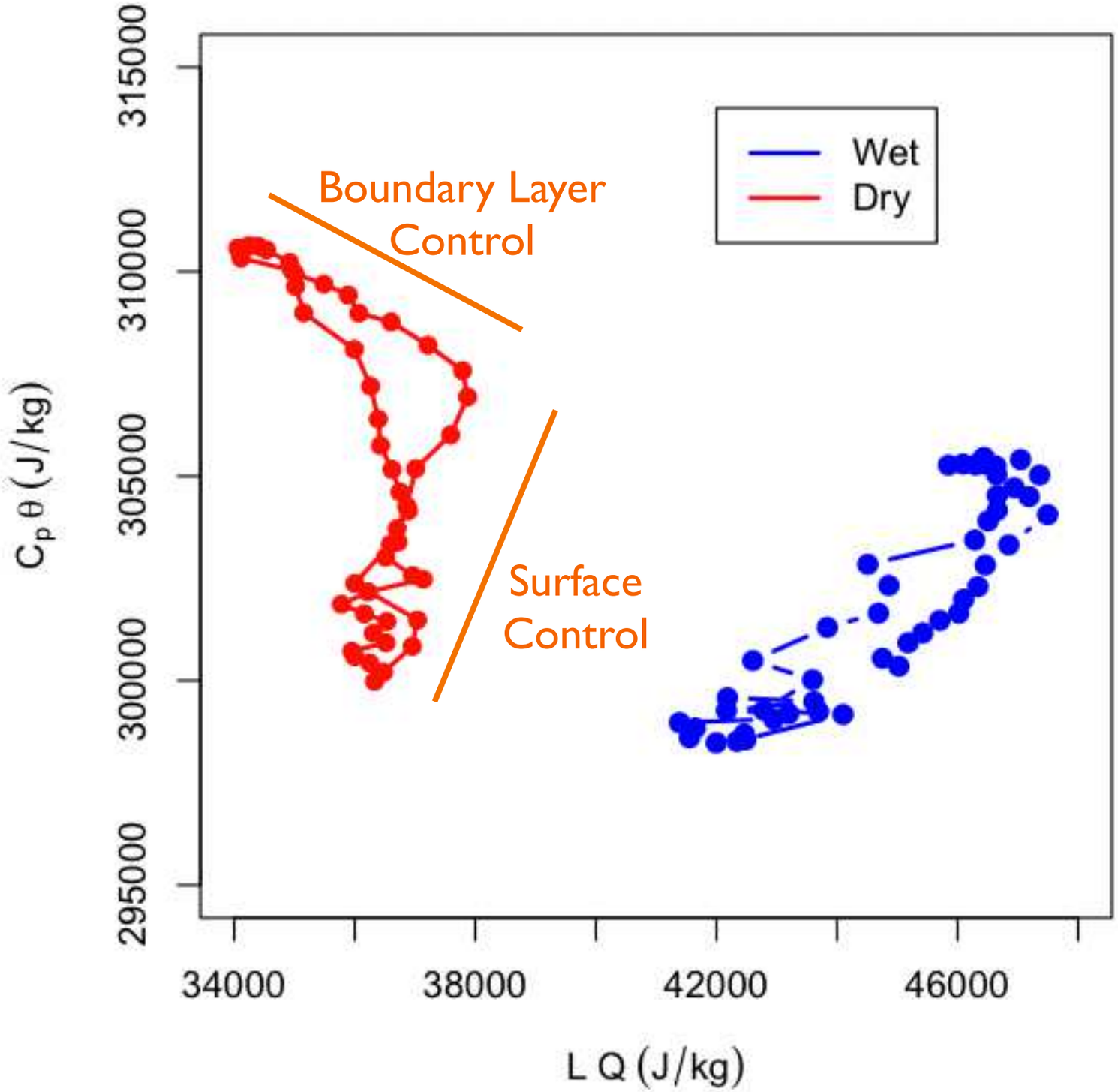
Land-Atmosphere Coupling



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The Real World

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Summary

Goal:
To understand the interactions of different spatial and temporal scales for understanding land-atmosphere coupling

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Summary

Goal:
To understand the interactions of different spatial and temporal scales for

Motivating Factors:

Spatial scaling: quantifying surface-boundary layer-precipitation interactions

Temporal scaling: vegetation-soil moisture responses, local vs. regional controls

Land cover change: impacts on water, energy and carbon cycling

Combination of LSM/WRF/LES models w/ remote sensing and surface measurements flux towers

Climate change and human decision making

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Summary

Goal:
To understand the interactions of different spatial and temporal scales for

Motivating Factors:

Spatial scaling: quantifying surface-boundary layer-precipitation interactions

Temporal scaling: vegetation-soil moisture responses, local vs. regional

(Near) Future Ideas:

Impact of spatial length scales on boundary layer processes - coupling

Timescales of responses to environmental forcings/extreme events

Drought 2011/2012

Impacts of land cover/management/burning on water and carbon fluxes (Yield)

Variation in land cover parameters temporally/spatially

Thermodynamic entropy/boundary layer physics

Climate Change

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