

Climate Change Trends and Ecological Impacts for Park Planning at River Raisin National Battlefield Park

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Historical Trends

Temperature has increased across the midwestern United States in the 20th century (Figures 1, 6) and shown a statistically significant increase in the 50 km x 50 km area that includes River Raisin National Battlefield Park (Figure 2, Table 1; Mitchell and Jones 2005, Gonzalez et al. 2010). Precipitation has also increased across the midwestern U.S. (Figures 3, 7) and shown a statistically significant increase in the area including the park (Figure 4, Mitchell and Jones 2005, Gonzalez et al. 2010). Analyses of causal factors attribute 20th century temperature and precipitation changes to greenhouse gas emissions from vehicles, power plants, deforestation, and other human activities (Intergovernmental Panel on Climate Change (IPCC) 2007).

Future Projections

The Intergovernmental Panel on Climate Change (IPCC) has coordinated research groups in projecting possible future climate under defined greenhouse gas emissions scenarios (IPCC 2007). For the three main IPCC emissions scenarios, temperature could increase three to five times the warming already observed (Table 1, Mitchell and Jones 2005, Gonzalez et al. 2010). Precipitation could increase in the 50 km x 50 km area surrounding the park (Mitchell and Jones 2005, Gonzalez et al. 2010). For the 4 km x 4 km area surrounding the park, 15 out of 18 General Circulation Models project increases in precipitation for IPCC emissions scenario A2 (Figure 5; historical average from Mitchell and Jones 2005, Hijmans et al. 2005; projections from IPCC 2007, Tabor and Williams 2010, Conservation International; analysis by P. Gonzalez).

Ecological Impacts and Vulnerabilities

Lake Erie near-shore water temperatures have increased 1°C in the 20th century and summer thermal stratification duration has increased 2 weeks (McCormick and Fahnenstiel 1999). If global greenhouse gas emissions are not reduced, Lake Erie water temperatures could increase another 2-3° C in the 21st century (Trumpickas et al. 2009). Ice cover across the Great Lakes region has reduced in the period 1975-2004, with the freeze occurring up to 3 days later and

each decade and breakup occurring 2 days earlier each decade (Jensen et al. 2007).

Climate change could shift vegetation at the biome level, from temperate mixed to temperate broadleaf forest (Figures 8-10; Gonzalez et al. 2010). A vulnerability analysis indicates that natural forest ecosystems of the River Raisin National Battlefield Park region are highly vulnerable to future biome shifts (Figure 11; Gonzalez et al. 2010).

References

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Table 1. River Raisin National Battlefield Park. Historical and projected climate (mean $\pm$ standard deviation (SD)) for the 50 km x 50 km square area that includes the park (Mitchell and Jones 2005, IPCC 2007, Gonzalez et al. 2010).

	mean	SD	units
Historical			
temperature 1901-2002 annual average	9.5	0.8	°C
temperature 1901-2002 linear trend	0.8	2.6	°C/century
precipitation 1901-2002 annual average	800	100	mm/year
precipitation 1901-2002 linear trend	90	330	%/century
Projected			
IPCC B1 scenario (lower emissions)			
temperature 1990-2100	2.8	0.6	°C/century
precipitation 1990-2100	3	2	%/century
IPCC A1B scenario (medium emissions)			
temperature 1990-2100	4.2	0.8	°C/century
precipitation 1990-2100	2	2	%/century
IPCC A2 scenario (higher emissions)			
temperature 1990-2100	4.5	0.9	°C/century
precipitation 1990-2100	2	2	%/century

Figure 1.

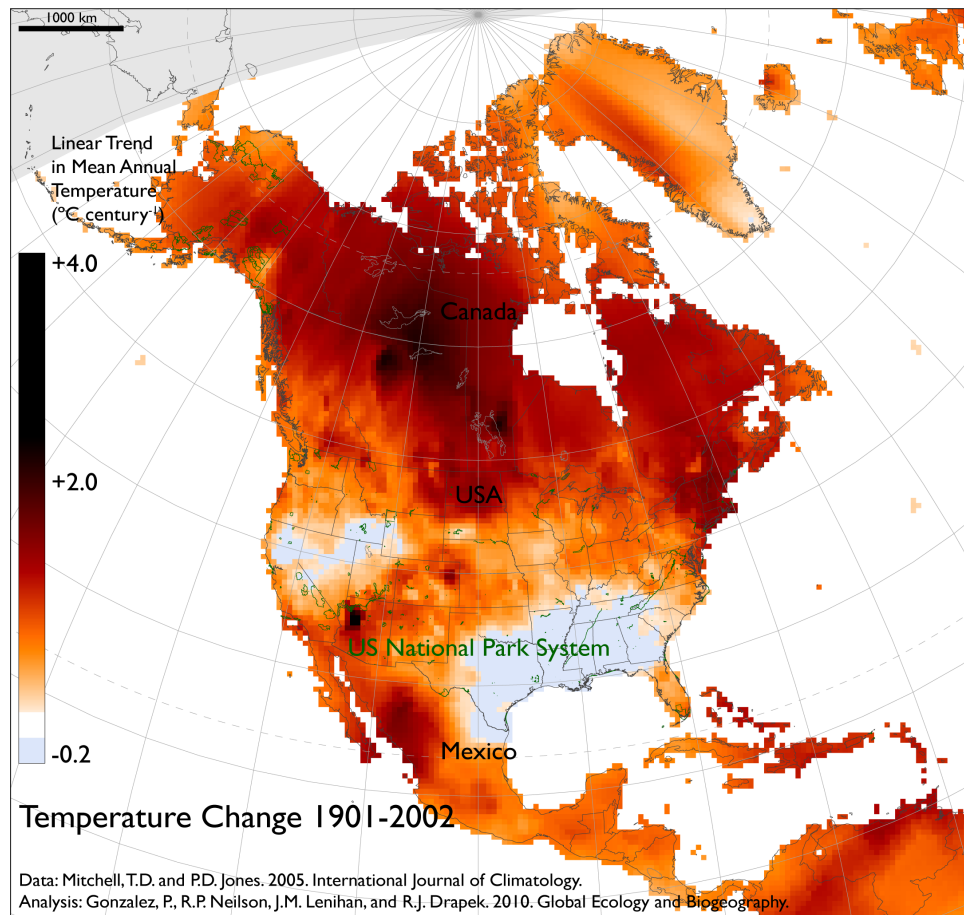


Figure 2.

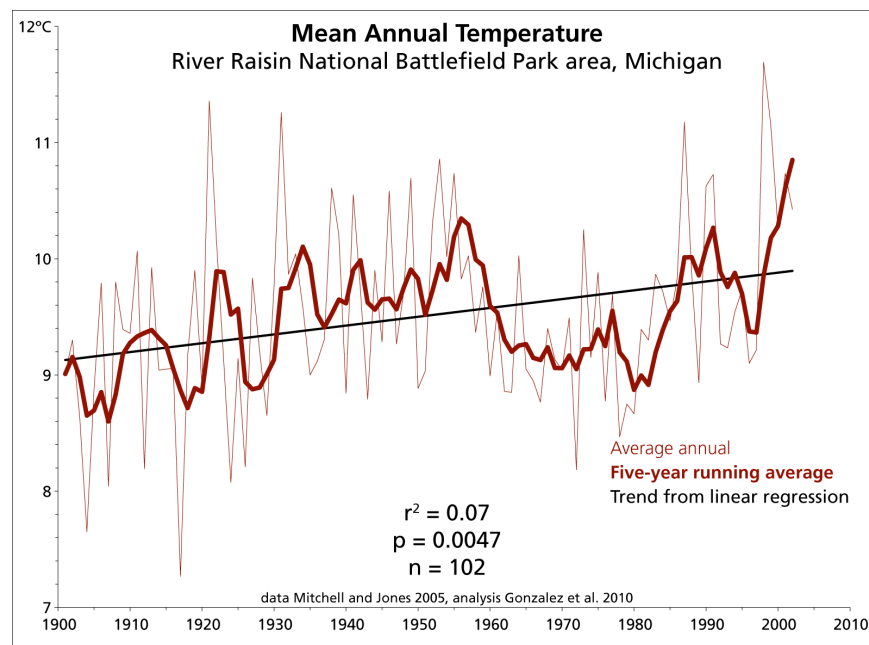


Figure 3.

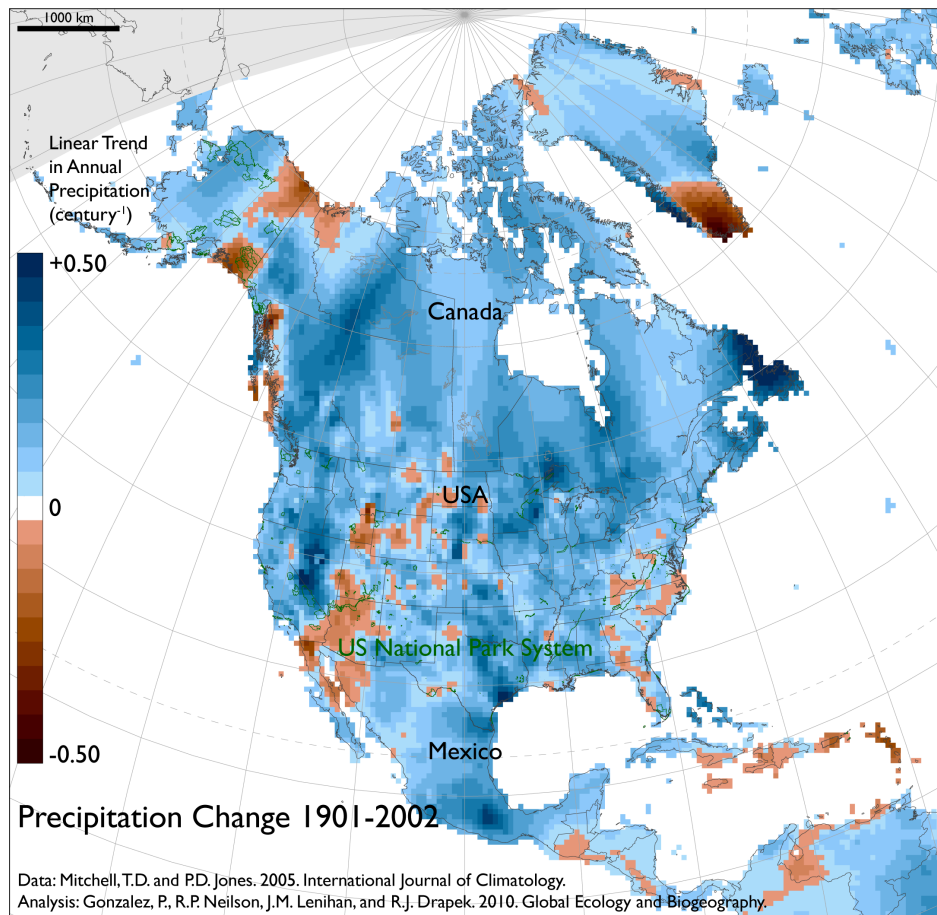


Figure 4.

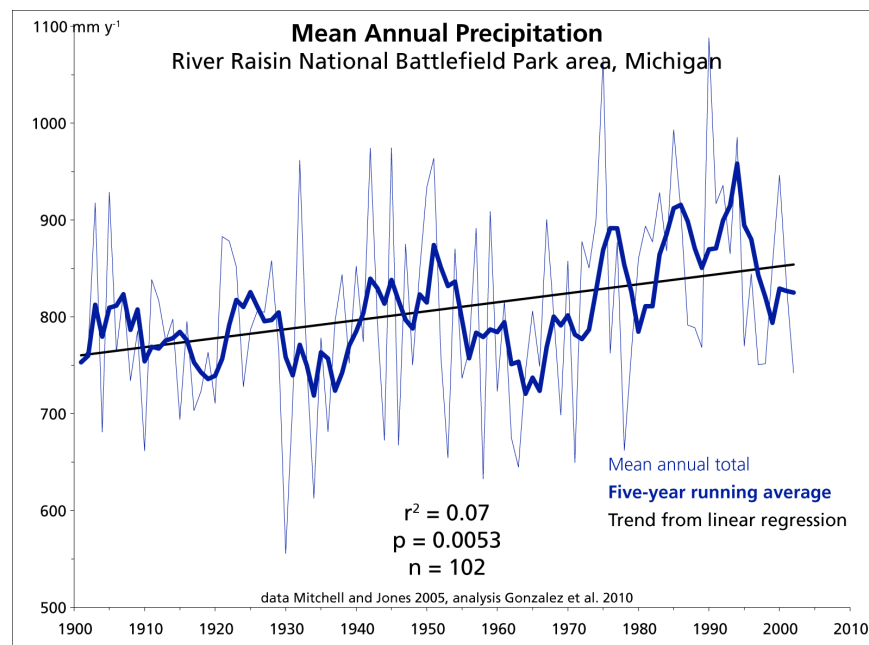


Figure 5.

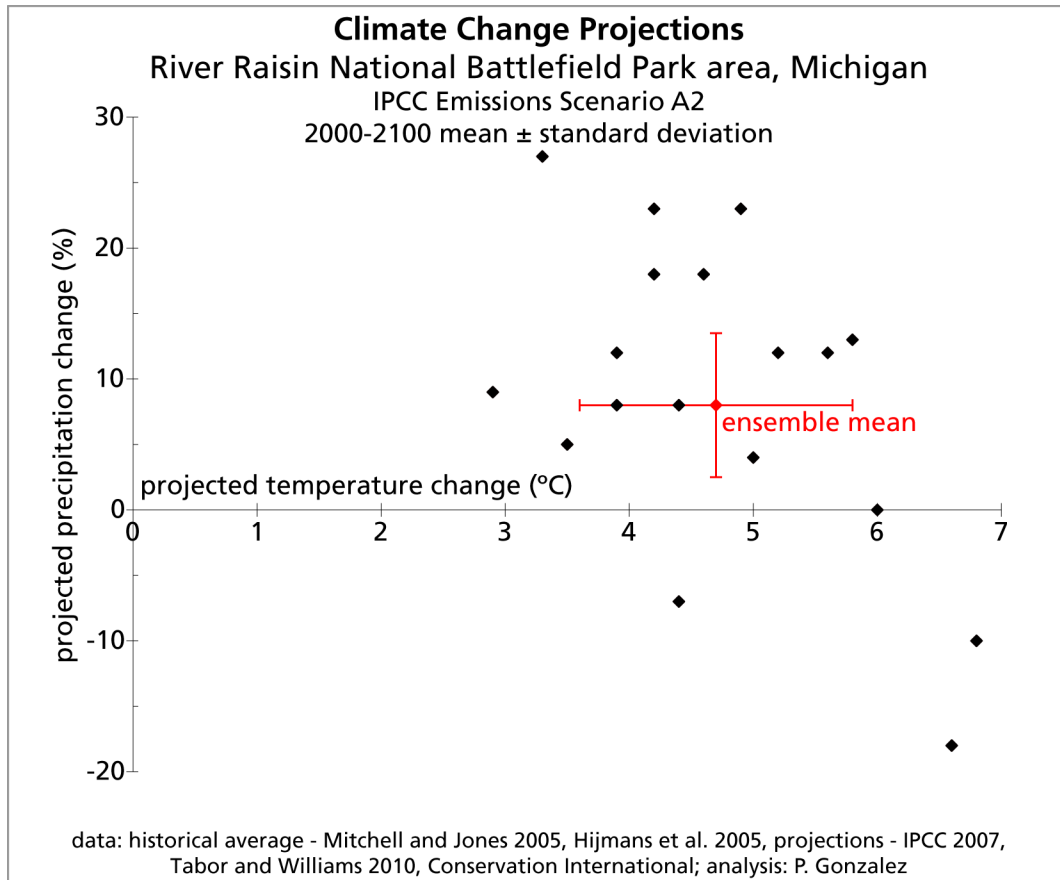


Figure 6

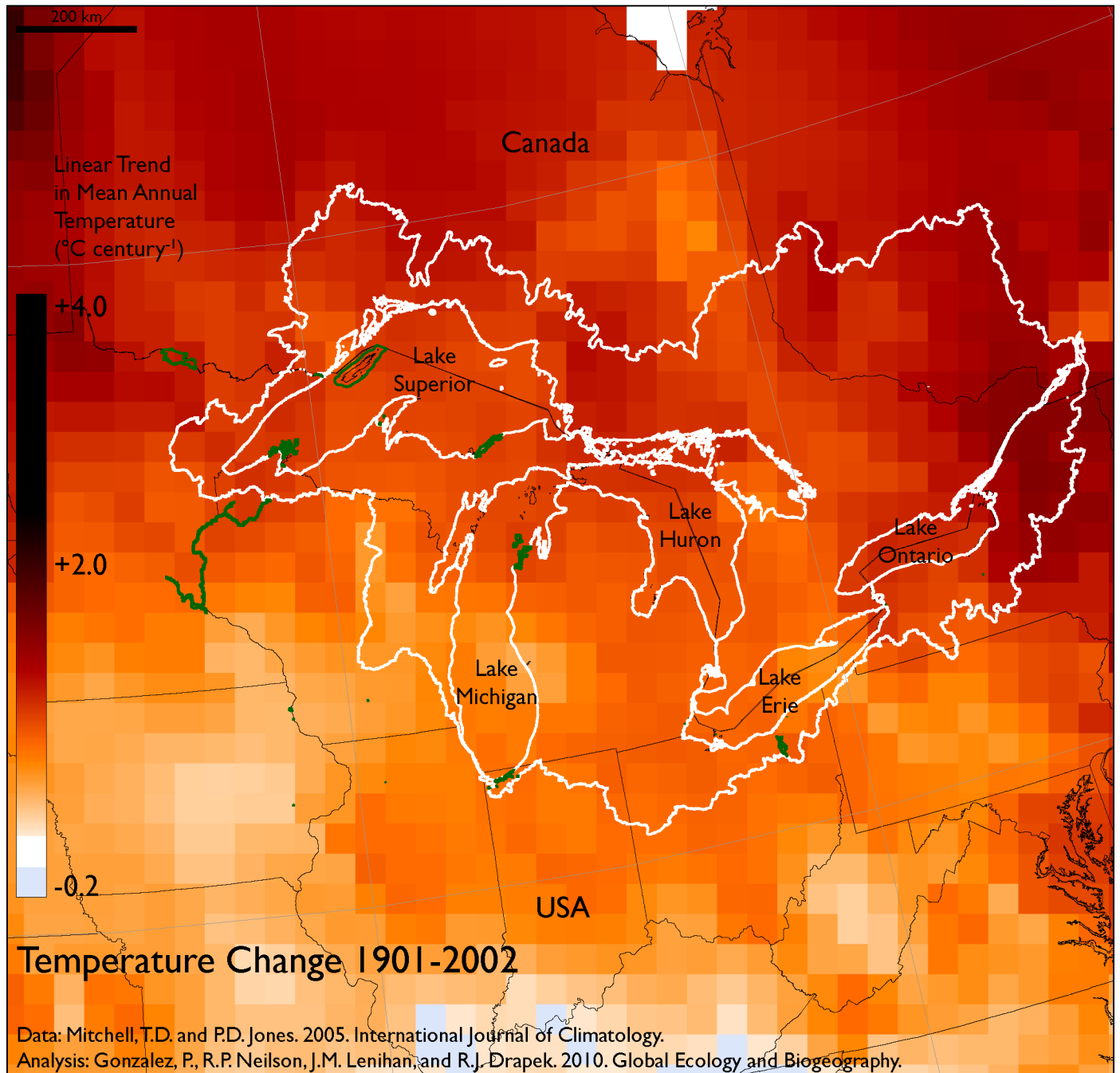


Figure 7

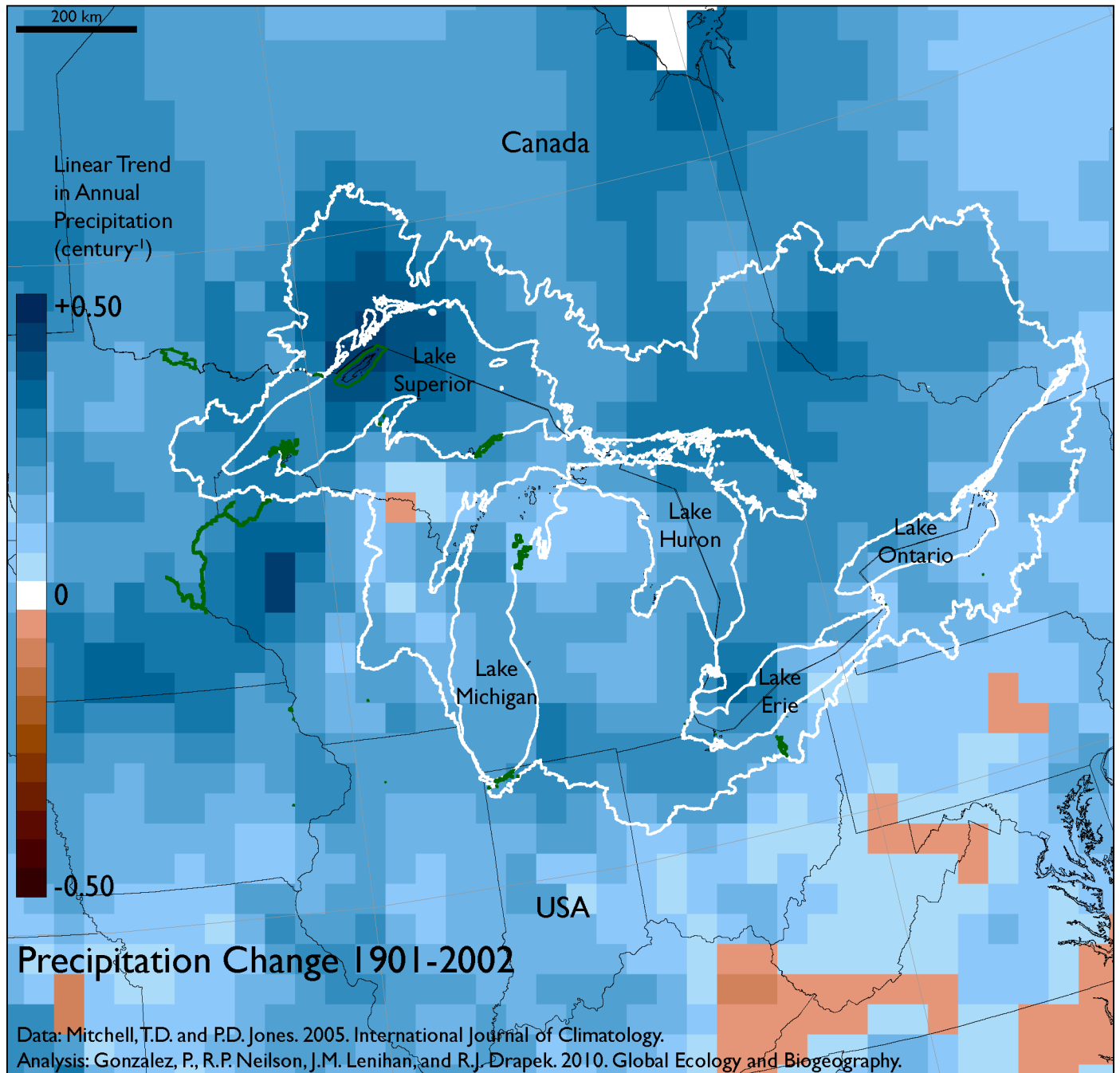


Figure 8

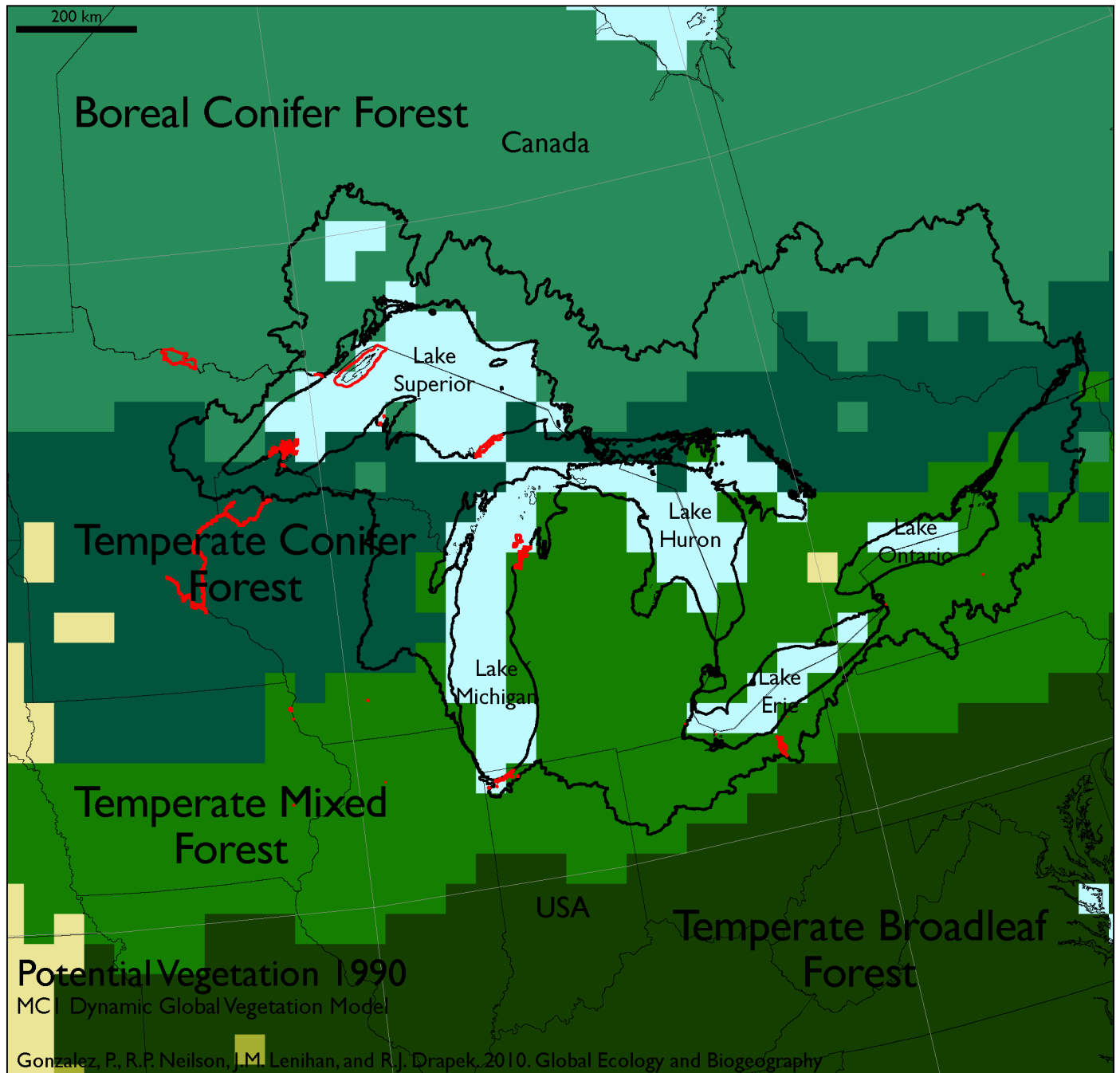


Figure 9

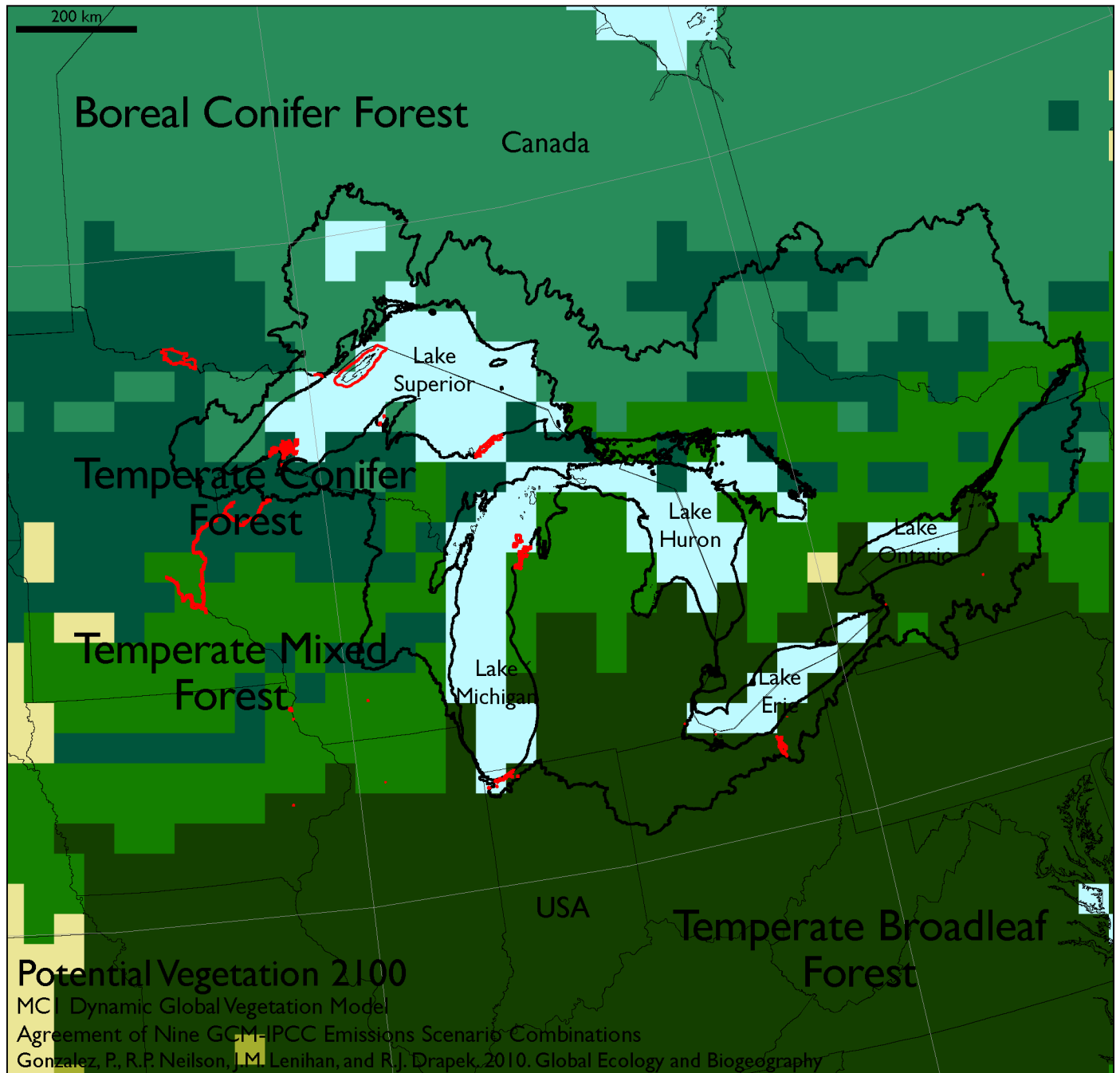


Figure 10

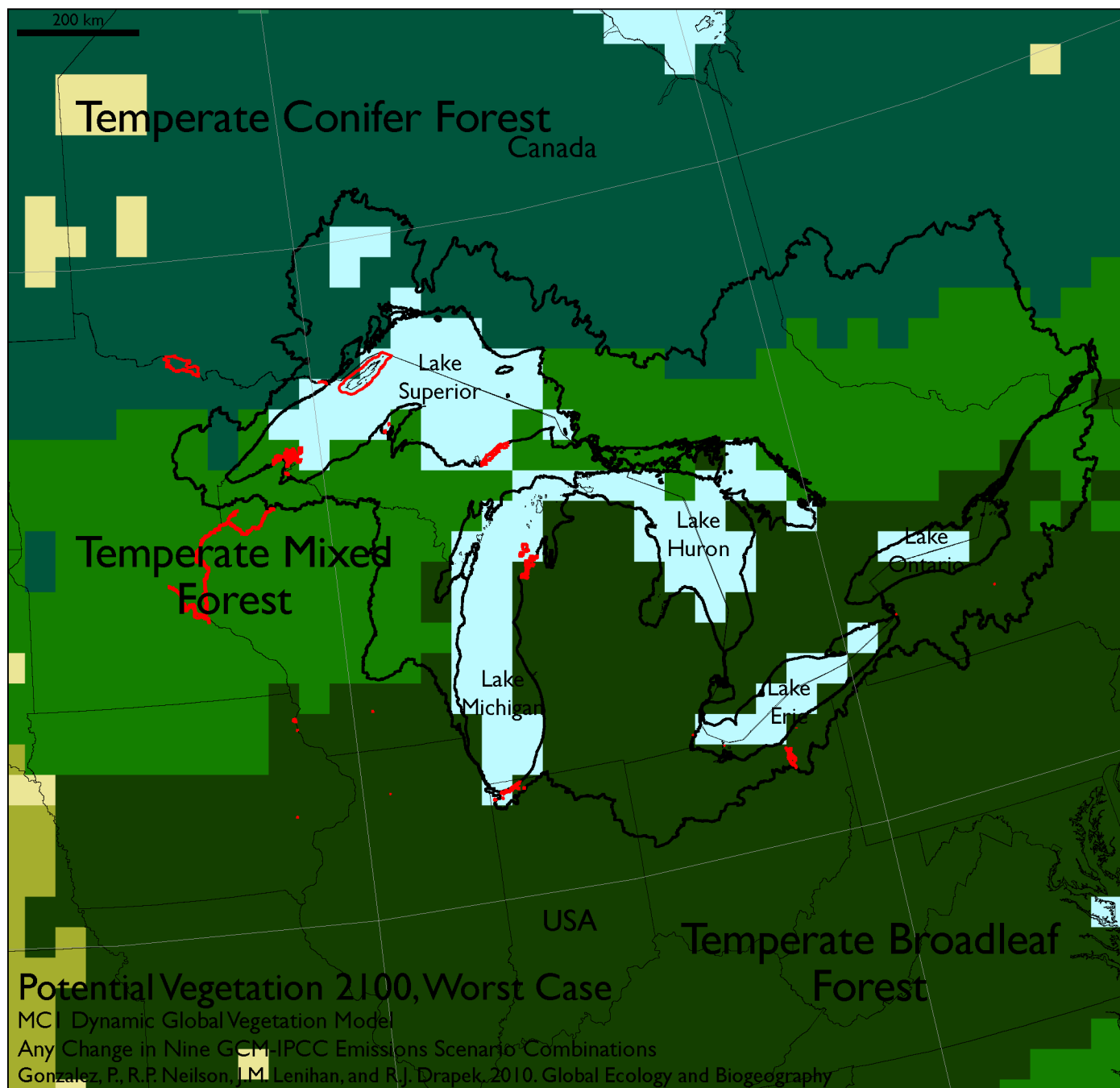


Figure 11

