

Climate Change Trends for Planning at Cuyahoga Valley National Park, Ohio

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Historical Trends

From 1901 to 2002, mean annual temperature increased across the midwestern United States (Figure 1; Gonzalez et al. 2010) and showed a statistically significant increase in the area that includes Cuyahoga Valley National Park (NP) (Figure 2, Table 1). From 1901 to 2002, precipitation increased across the Midwest (Figure 3; Gonzalez et al. 2010) and showed a statistically significant increase in the area that includes Cuyahoga Valley NP (Figure 4, Table 1). Analyses of causal factors attribute 20th century warming and precipitation changes to greenhouse gas emissions from vehicles, power plants, deforestation, and other human activities (Intergovernmental Panel on Climate Change (IPCC) 2007, Bonfils et al. 2008).

Future Projections

The Intergovernmental Panel on Climate Change (IPCC) has coordinated research groups to project possible future climates under defined greenhouse gas emissions scenarios (IPCC 2007). The three main IPCC greenhouse gas emissions scenarios are B1 (lower emissions), A1B (medium emissions), and A2 (higher emissions). Actual global emissions are on a path above IPCC emissions scenario A2 (Friedlingstein et al. 2010).

In the Cuyahoga Valley, projected 21st century temperature could increase three to four times the amount of historical 20th century warming (Table 1, Mitchell and Jones 2005, Gonzalez et al. 2010). Precipitation projections from the three scenarios project increases for the ensemble of general circulation models (GCMs) (Table 1). For emissions scenario A2, 12 out of 18 GCMs project decreases in precipitation (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).

Climate change could shift vegetation at the biome level, from temperate mixed to temperate broadleaf forest (Figures 6-8). A spatial analysis of historical 20th century climate and projected 21st century vegetation (Gonzalez et al. 2010) indicates that the Cuyahoga Valley is highly

vulnerable to future biome shifts (Figure 9).

References

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Table 1. Historical and projected climate trends for the area that includes Cuyahoga Valley NP (Mitchell and Jones 2005, IPCC 2007, Gonzalez et al. 2010). Historical climate and projections for IPCC emissions scenarios B1 and A1B are calculated for the 50 x 50 km pixels that include the park (Gonzalez et al. 2010). Climate under emissions scenario A2 is calculated for the 4 x 4 km pixels that include the park (data from Conservation International, using the method of Tabor and Williams (2010)).

	mean	SD	units
Historical			
temperature 1901-2002 annual average	9.5	0.8	°C
temperature 1901-2002 linear trend	0.7	2.5	°C century ⁻¹
precipitation 1901-2002 annual average	910	110	mm year ⁻¹
precipitation 1901-2002 linear trend	12	41	% century ⁻¹
Projected			
IPCC B1 scenario (lower emissions)			
temperature 1990-2100	2.4	0.9	°C century ⁻¹
precipitation 1990-2100	2	1	% century ⁻¹
IPCC A1B scenario (medium emissions)			
temperature 1990-2100	3.5	1.3	°C/century
precipitation 1990-2100	3	1	% century ⁻¹
IPCC A2 scenario (higher emissions)			
temperature 1990-2100	3.8	1.4	°C/century
precipitation 1990-2100	4	1	% century ⁻¹

Figure 1.

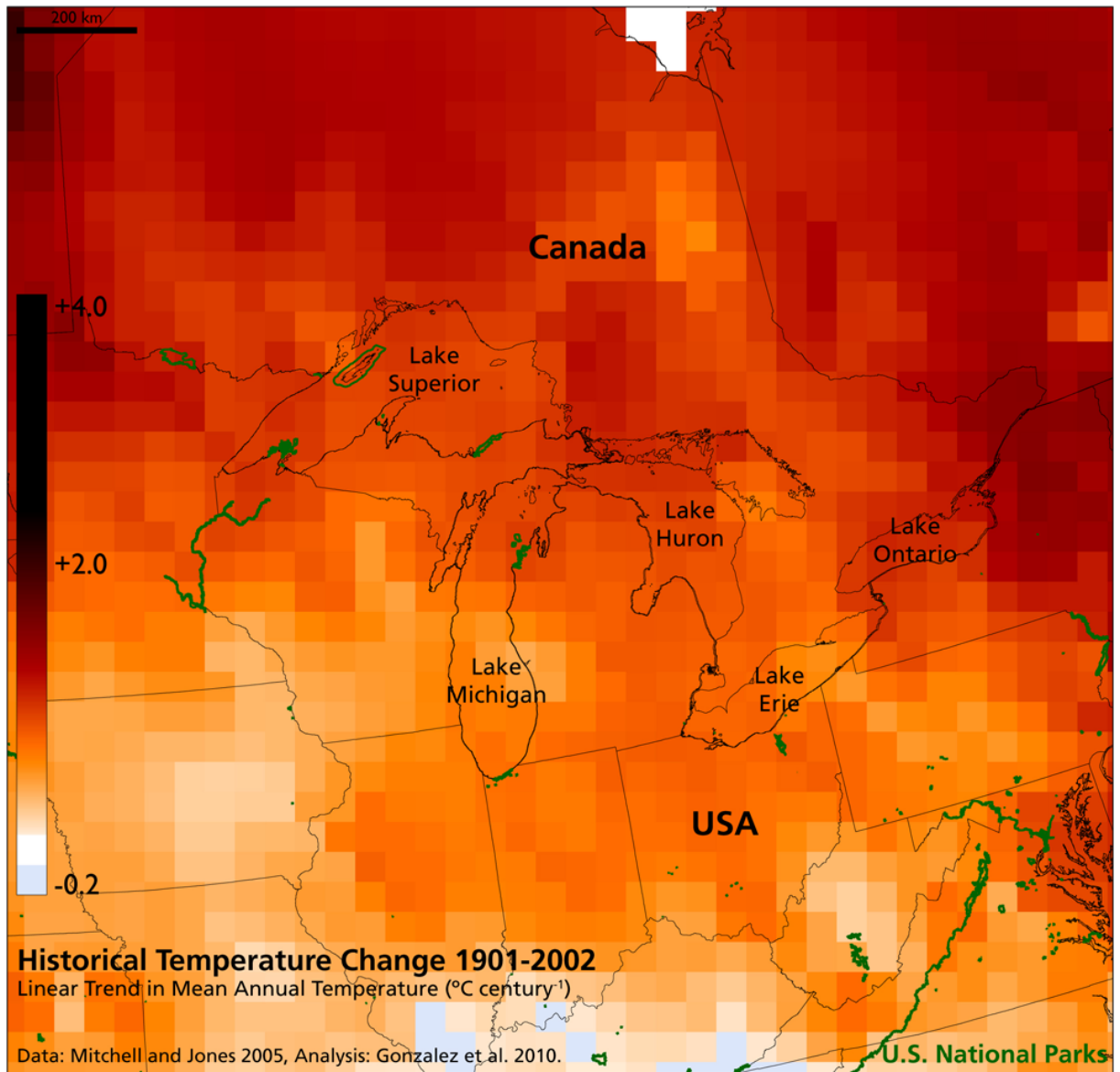


Figure 2.

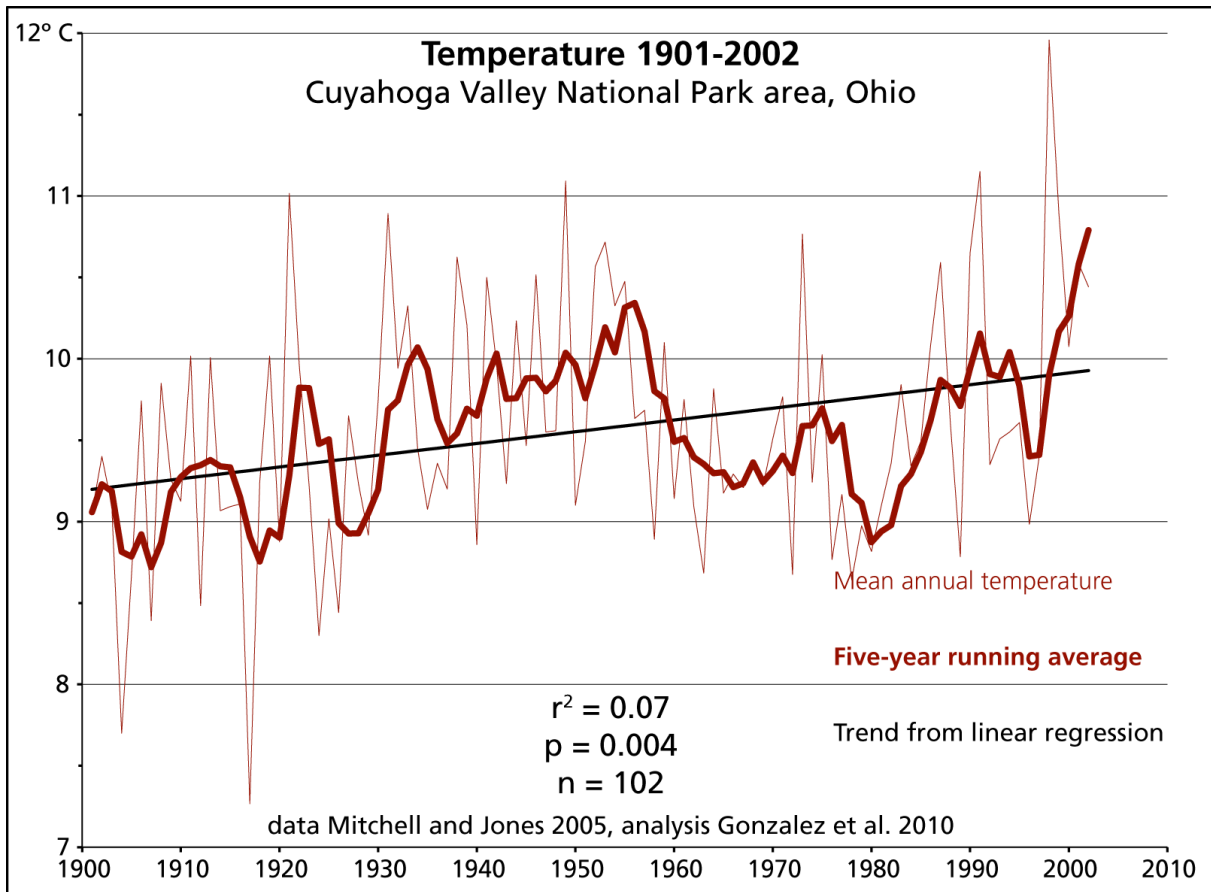


Figure 3.

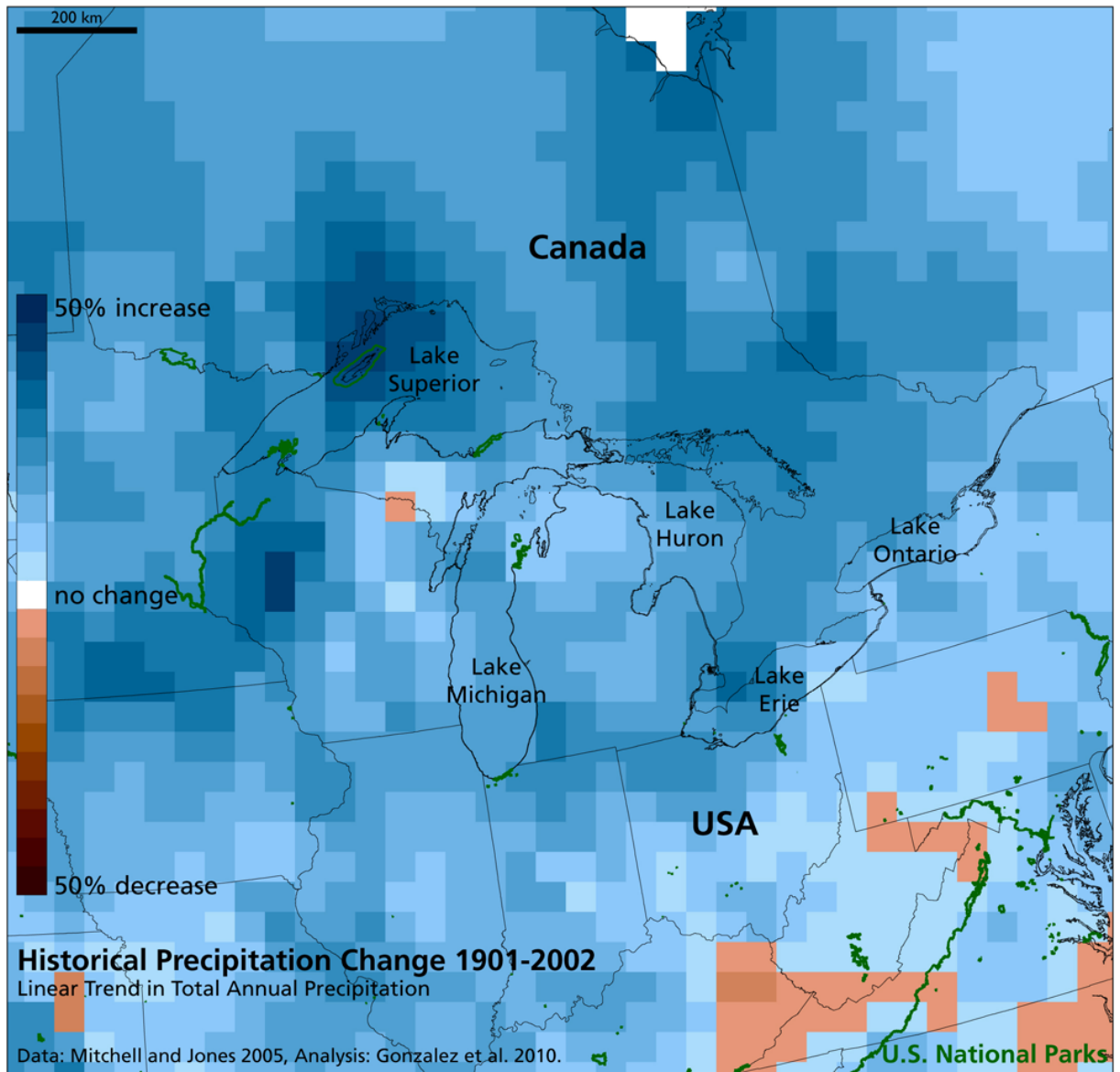


Figure 4.

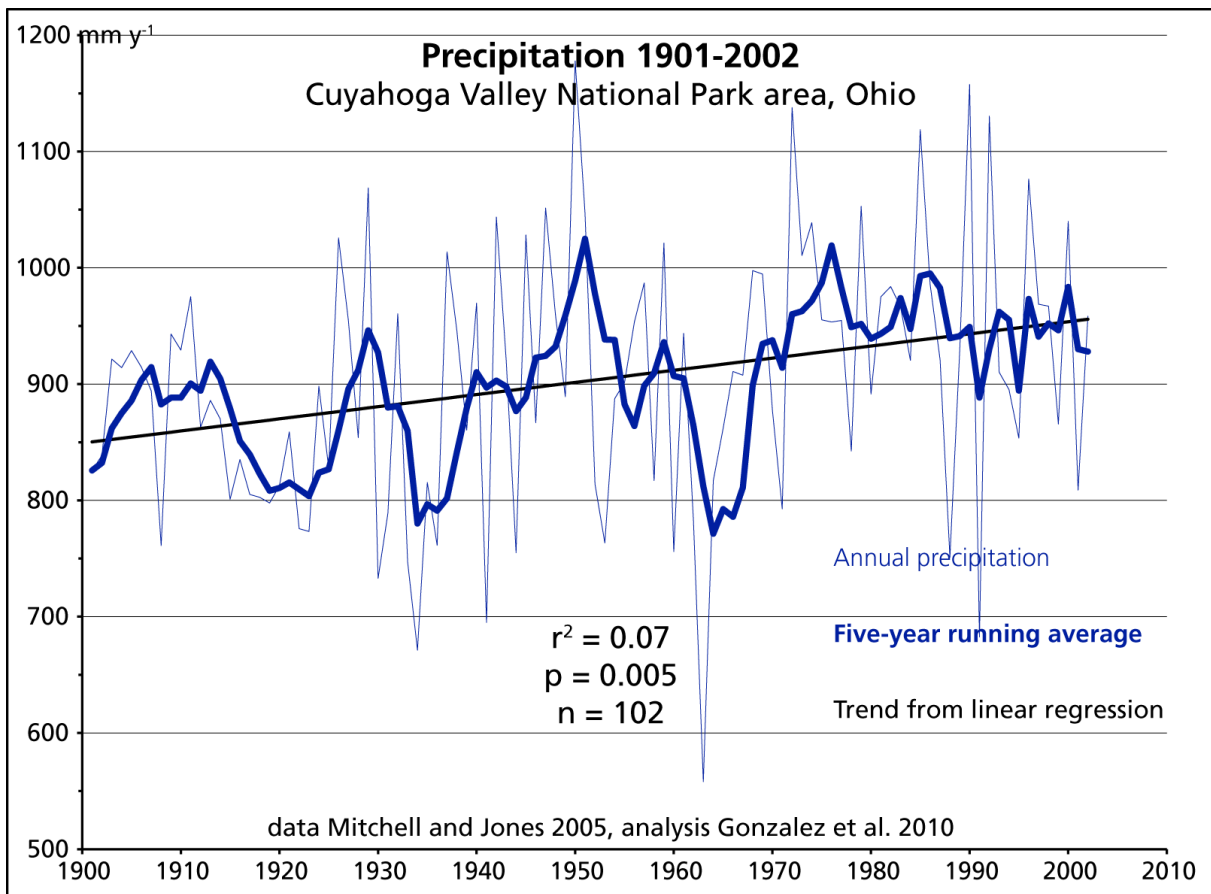


Figure 5.

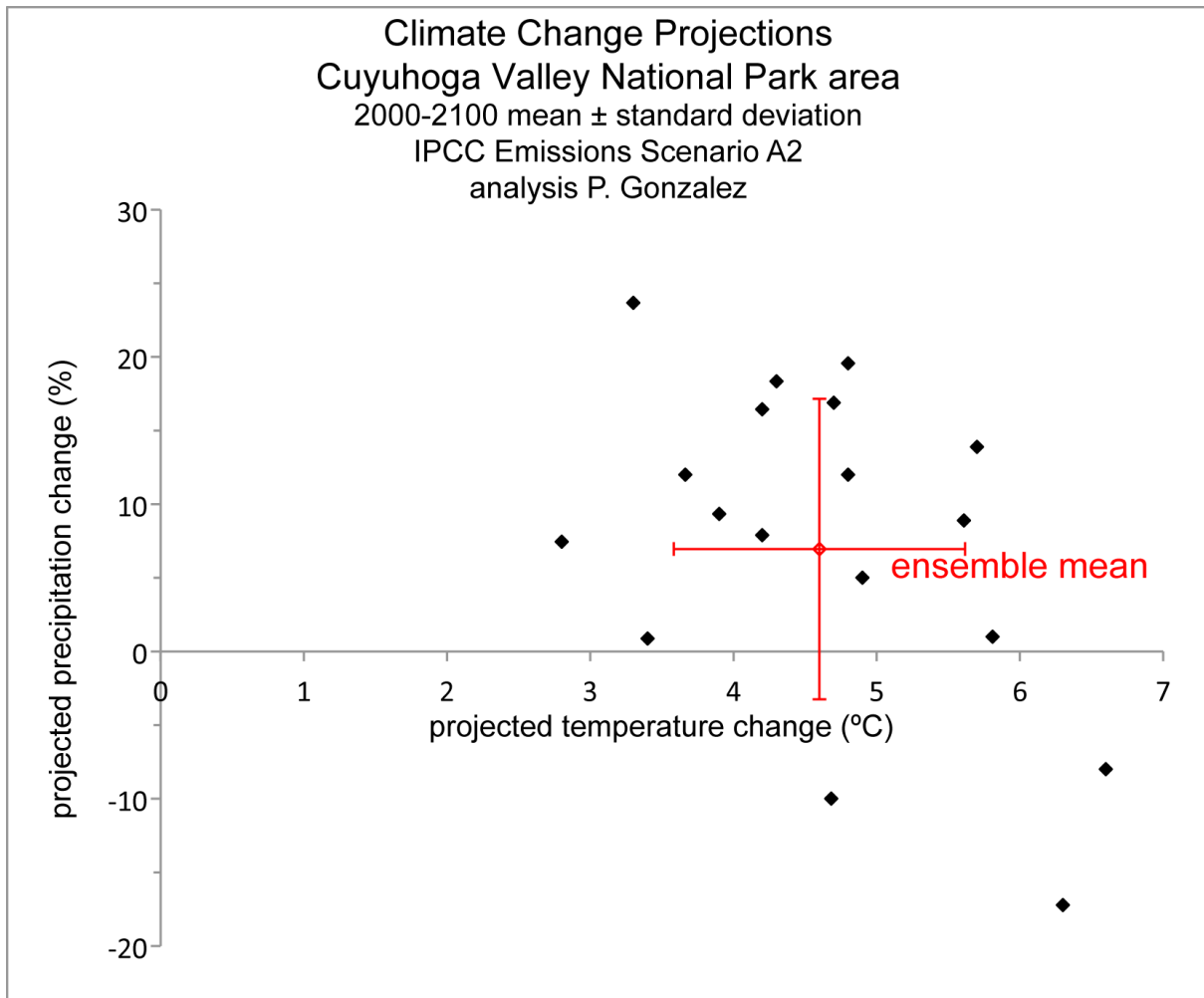


Figure 6.

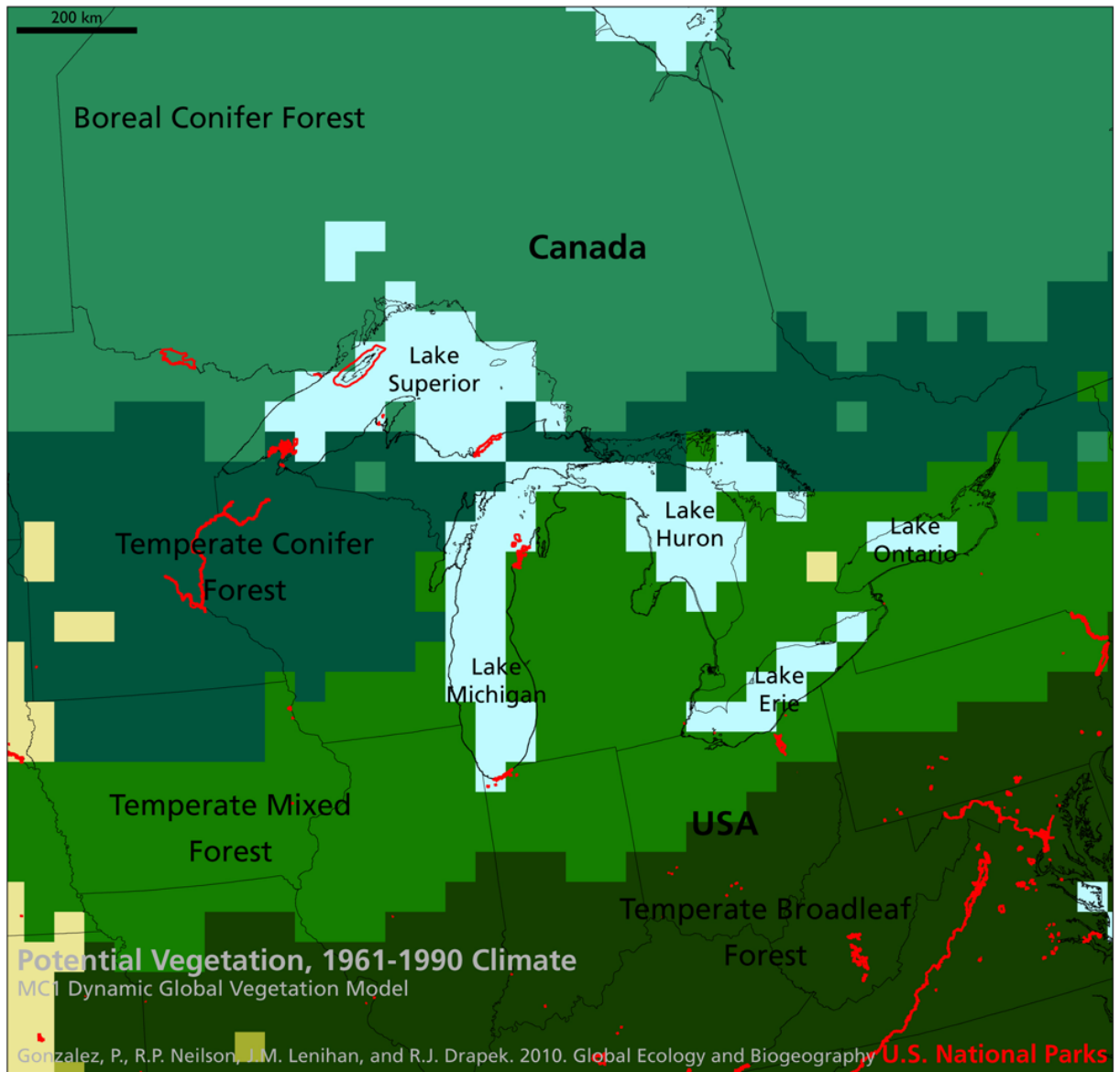


Figure 7.

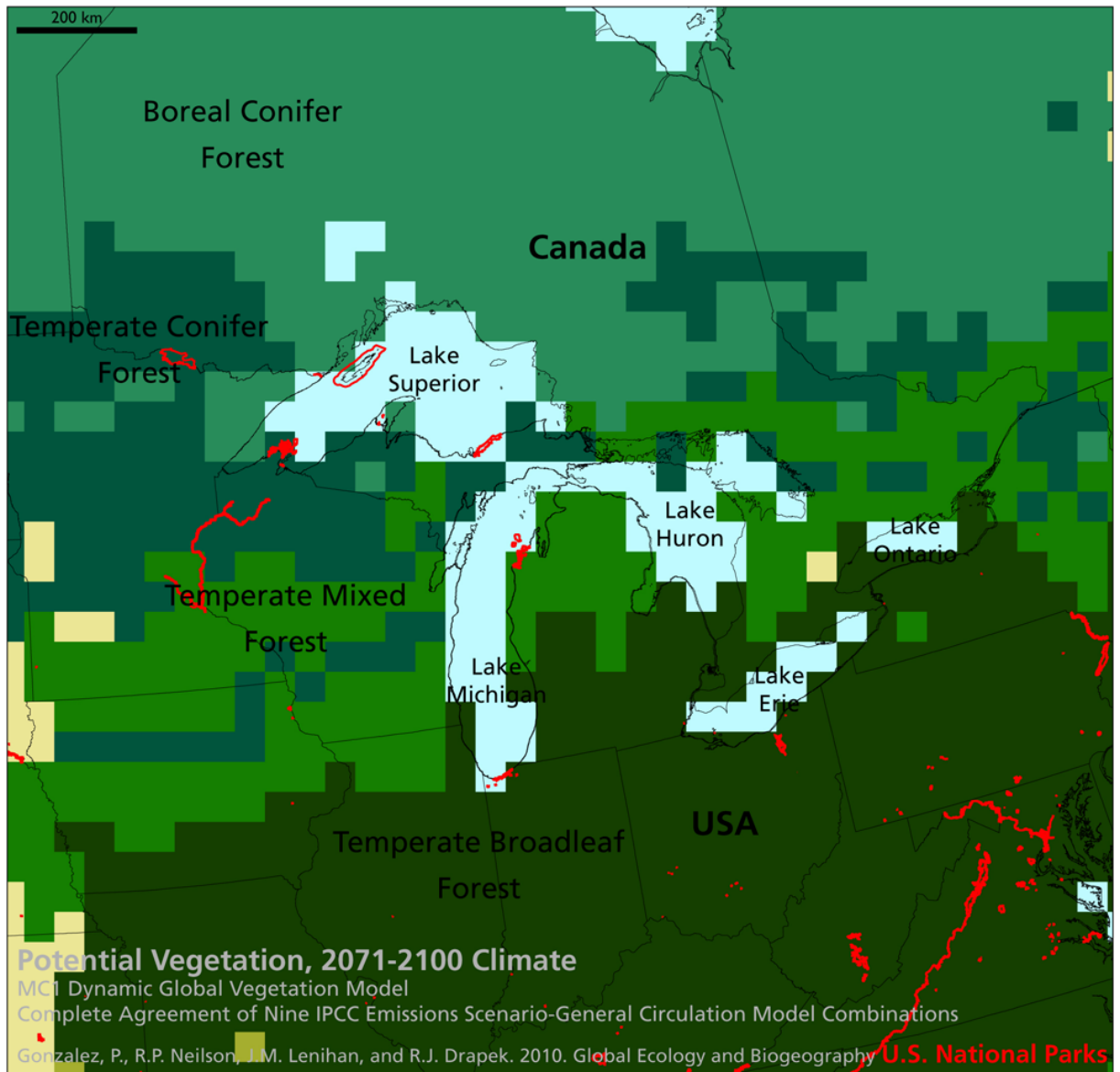


Figure 8.

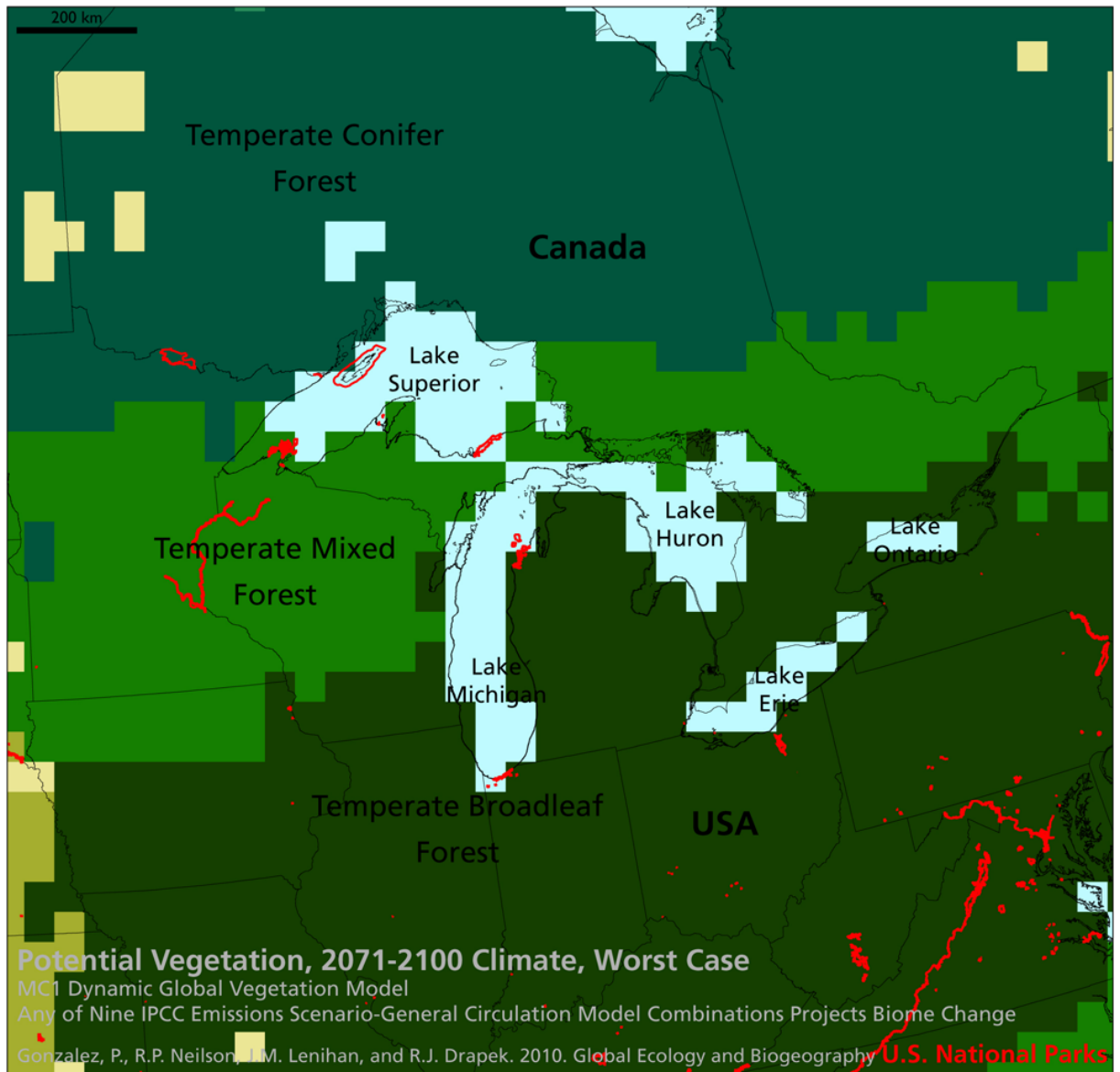


Figure 9.

