

Climate Change Summary, Shenandoah National Park, Virginia

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Climate Trends for the Area within Park Boundaries

- The park lies in an area of the southeastern U.S. that is a global anomaly because temperature has not increased (Figures 1, 3) due to the cooling effects of increased precipitation and the El Niño-Southern Oscillation (Portmann et al. 2009).
- Precipitation shows a statistically significant increase since 1950 (Figures 2, 4).
- Analyses of weather station data from around the world confirm that emissions from cars, power plants, and other human activities are causing climate change (IPCC 2013).
- Models project substantial future warming and increased precipitation (Figures 3-6).
- The table on page 2 presents results of spatial analyses of climate trends.

Potential Future Vulnerabilities for Shenandoah National Park

- Modeling of potential mammal ranges under a 3° C future increase projects a potential loss of 3 species but potential gain of 8 species, including 4 rodents (Burns et al. 2003).
- Winter ranges of numerous bird species have shifted northward 0.5 ± 2.4 km (0.3 ± 1.5 mi.) per year (1975-2004) across the U.S. and shifts may continue (La Sorte and Thompson 2007).
- If greenhouse gas emissions continue, numerous eastern tree species ranges may shift upslope and northward (Iverson et al. 2008).
- Higher temperature-exacerbated hemlock wooly adelgid infestations may further decrease hemlock forest extent and productivity (Albani et al. 2010).
- The U.S. Geological Survey, University of Virginia, and National Park Service are downscaling climate data and modeling potential vulnerability of the Shenandoah salamander to loss of its high-elevation habitat.
- The U.S. Geological Survey is collecting and analyzing weather station data to examine potential changes in plant and animal phenology.

Table. Historical and projected changes (data Daly et al. 2008, IPCC 2013; analysis Wang et al. in preparation). The table only gives central values. Figures 1 to 3 show the uncertainties.

	1950-2010	2000-2050	2000-2100
Historical			
Temperature, annual average	no change		
Precipitation, annual total	+23% per century		
Projected (compared to 1971-2000)			
Low emissions (IPCC RCP 4.5)			
Temperature, annual average		+2.2°C (4°F.)	+2.8°C (5°F.)
Precipitation, annual total		+8%	+9%
High emissions (IPCC RCP 6.0)			
Temperature, annual average		+1.8°C (3°F.)	+3.2°C (6°F.)
Precipitation, annual total		+7%	+10%
Highest emissions (IPCC RCP 8.5)			
Temperature, annual average		+2.8°C (5°F.)	+4.9°C (9°F.)
Precipitation, annual total		+9%	+14%

Figure 1.

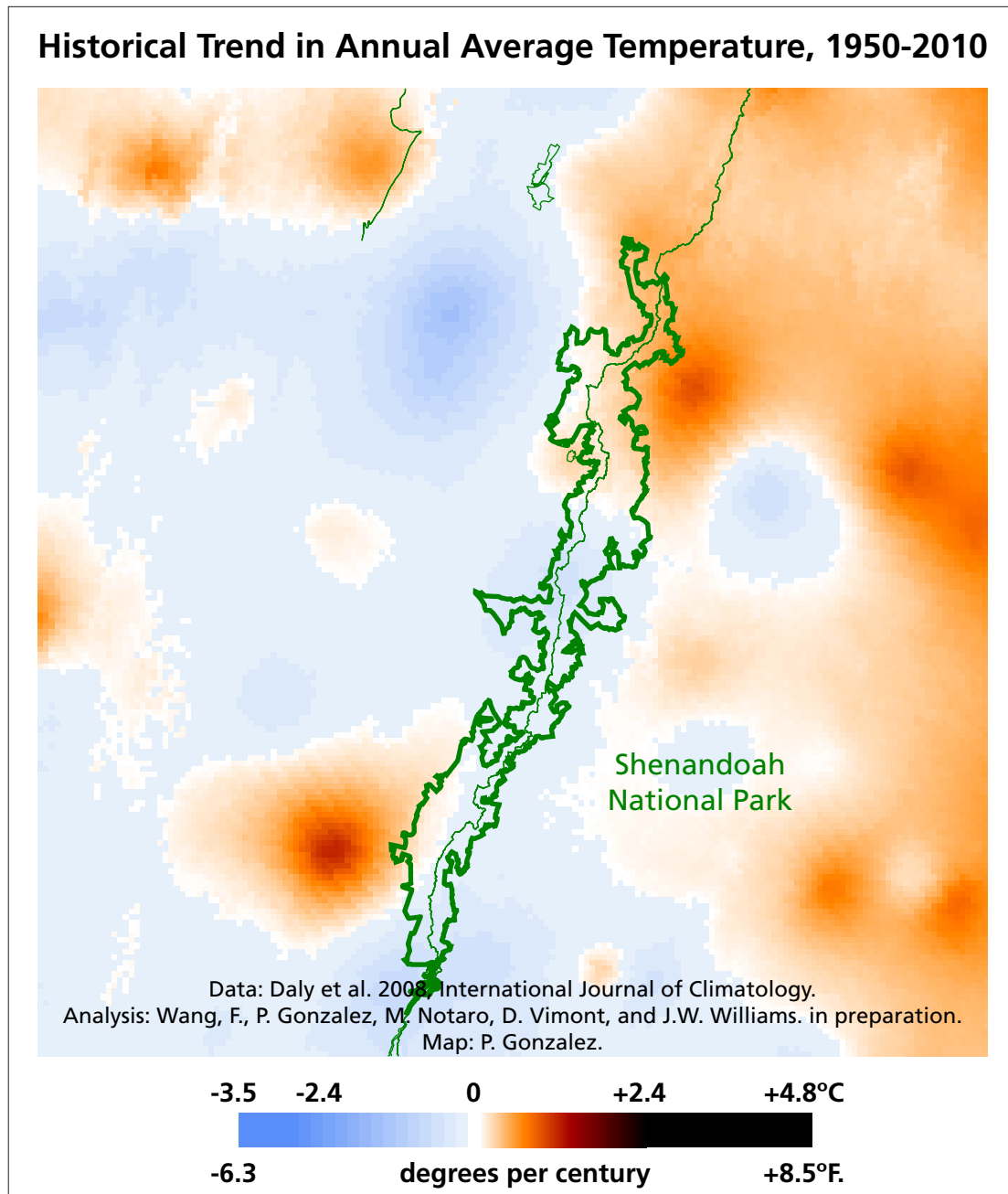


Figure 2.

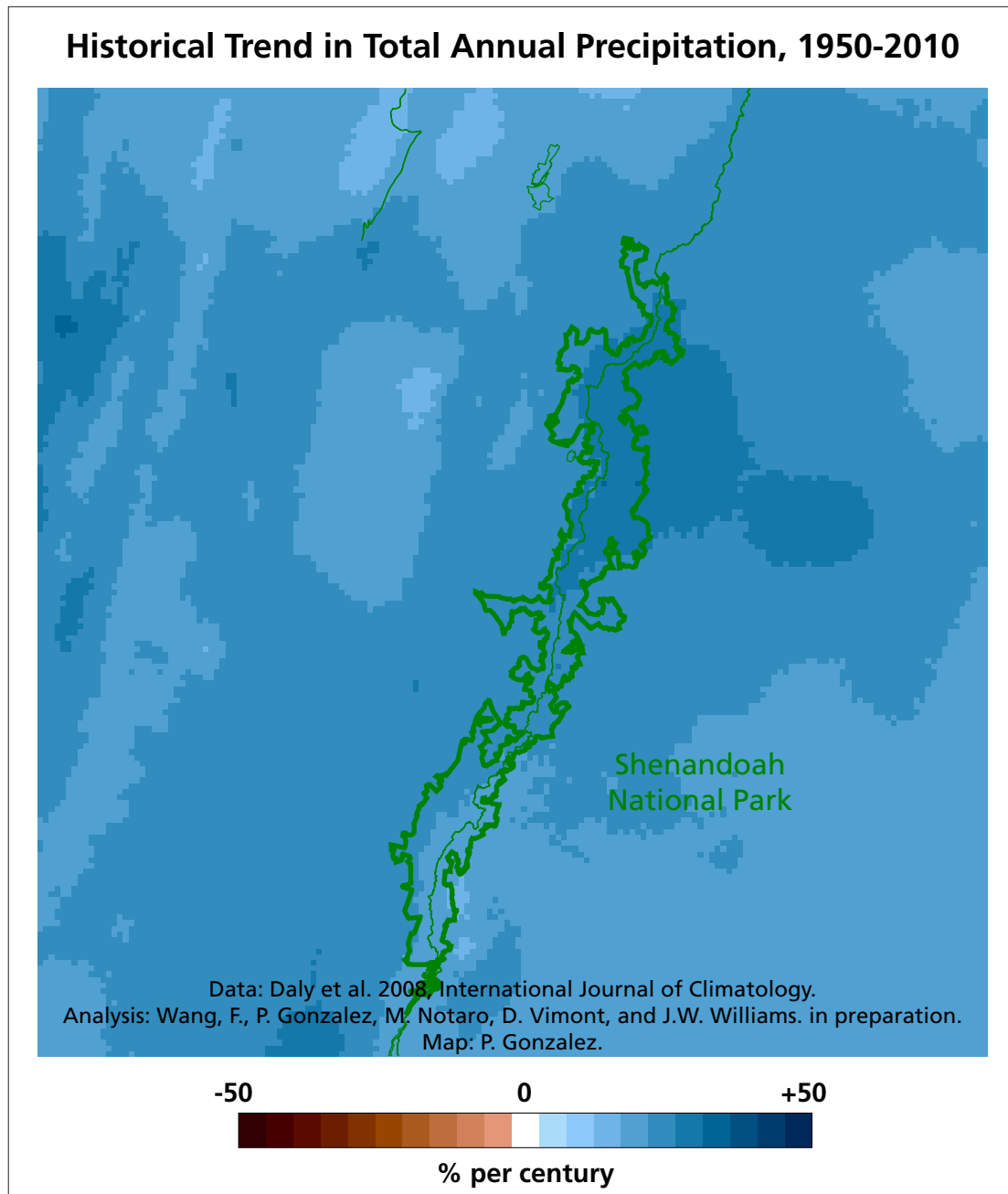


Figure 3. Temperature.

Historical and projected average annual average temperature for the area within park boundaries. For projections, each bar shows one standard deviation above and below the average of up to 33 climate models. (Data: Daly et al. 2008, IPCC 2013. Analysis: Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).

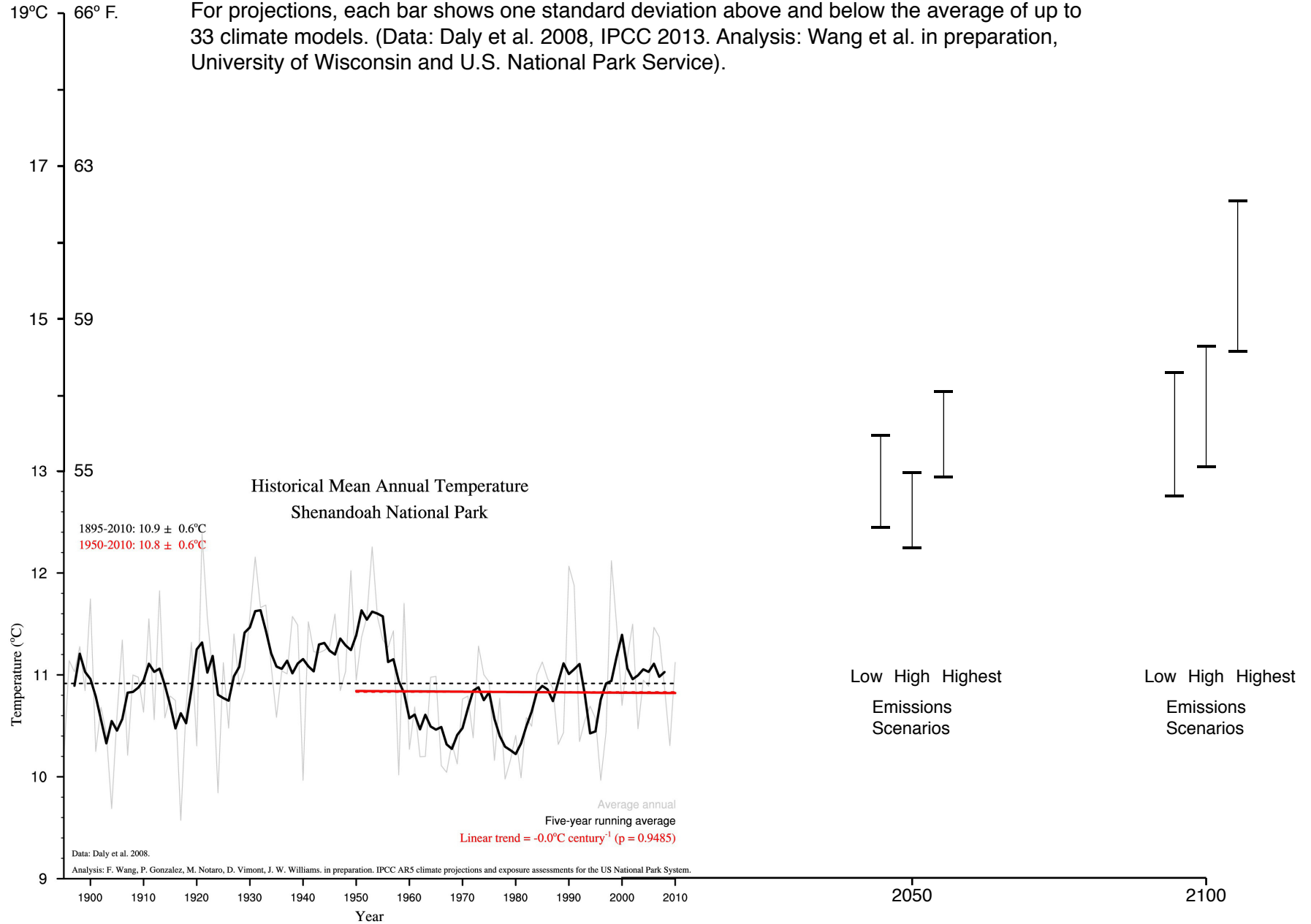


Figure 4. Precipitation.

Historical and projected annual total precipitation for the area within park boundaries. For projections, each bar shows one standard deviation above and below the average of up to 33 climate models. (Data: Daly et al. 2008, IPCC 2013. Analysis: Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).

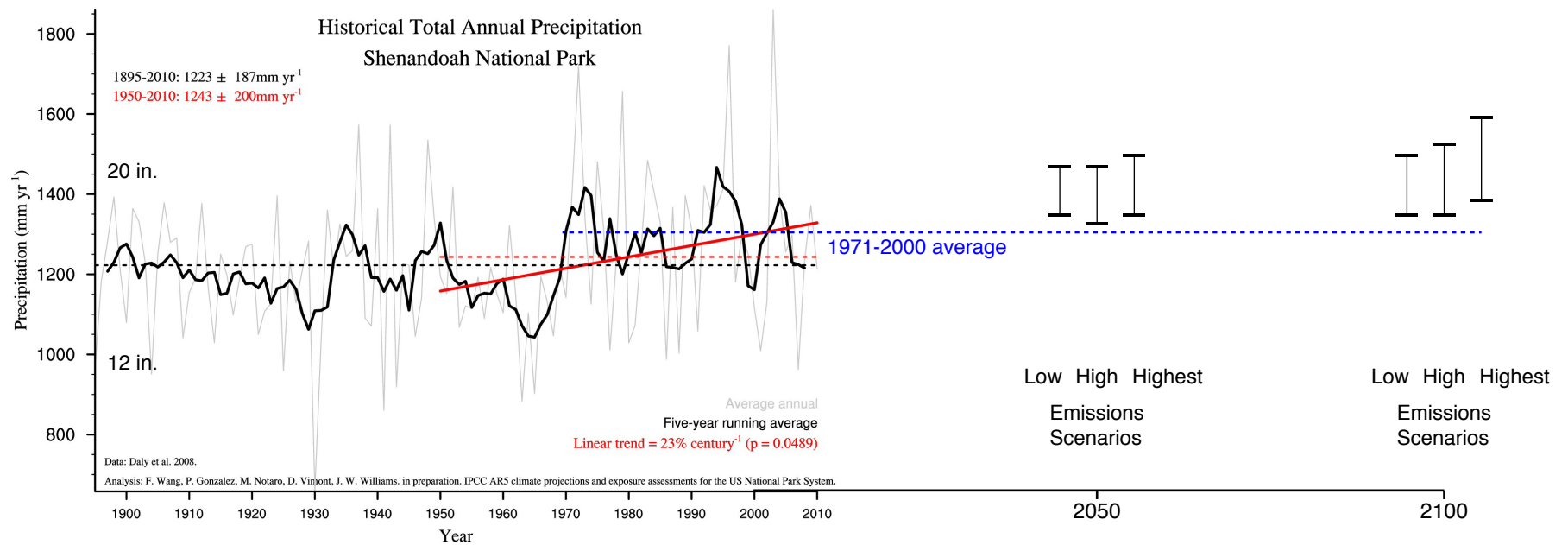


Figure 5.

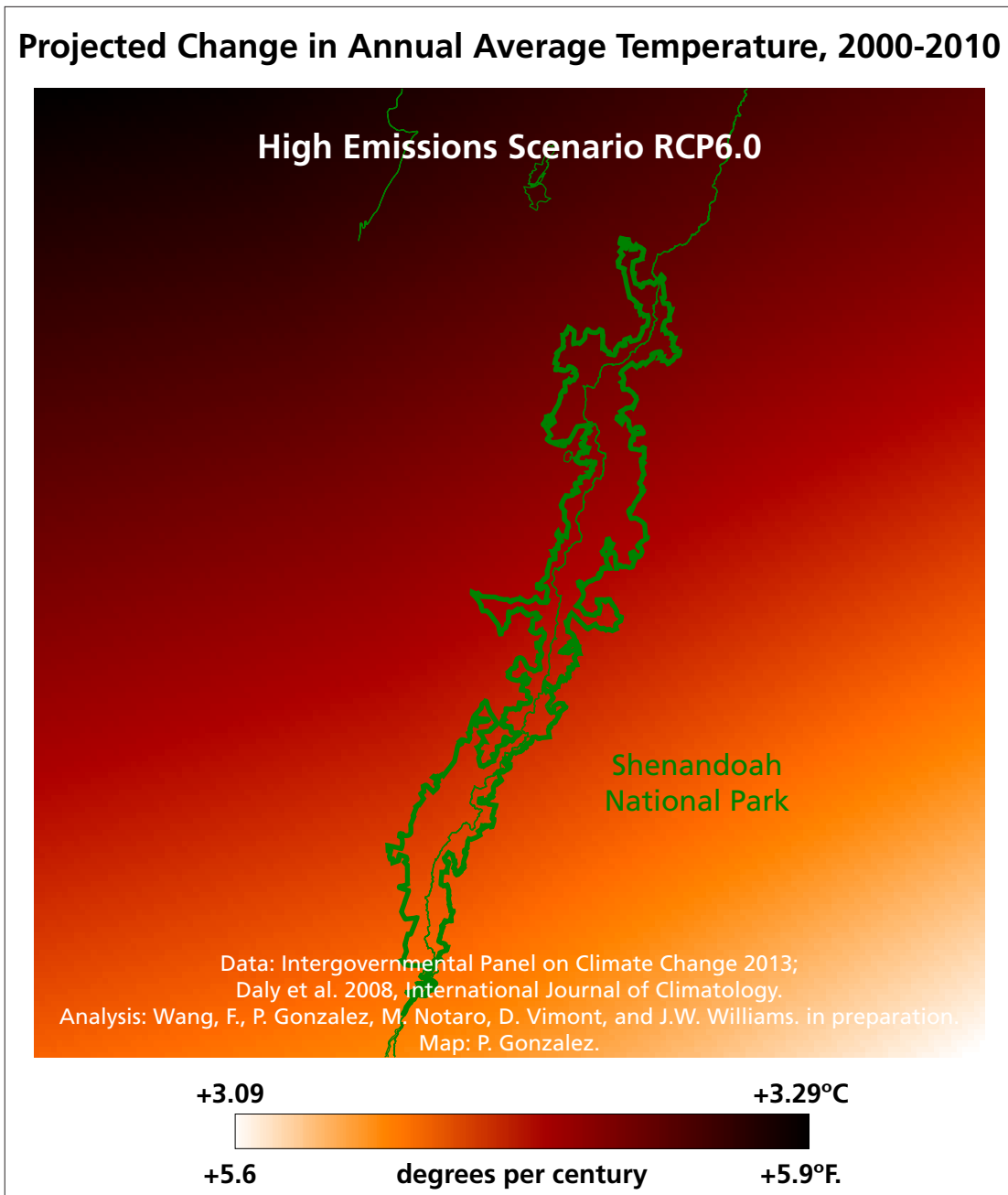
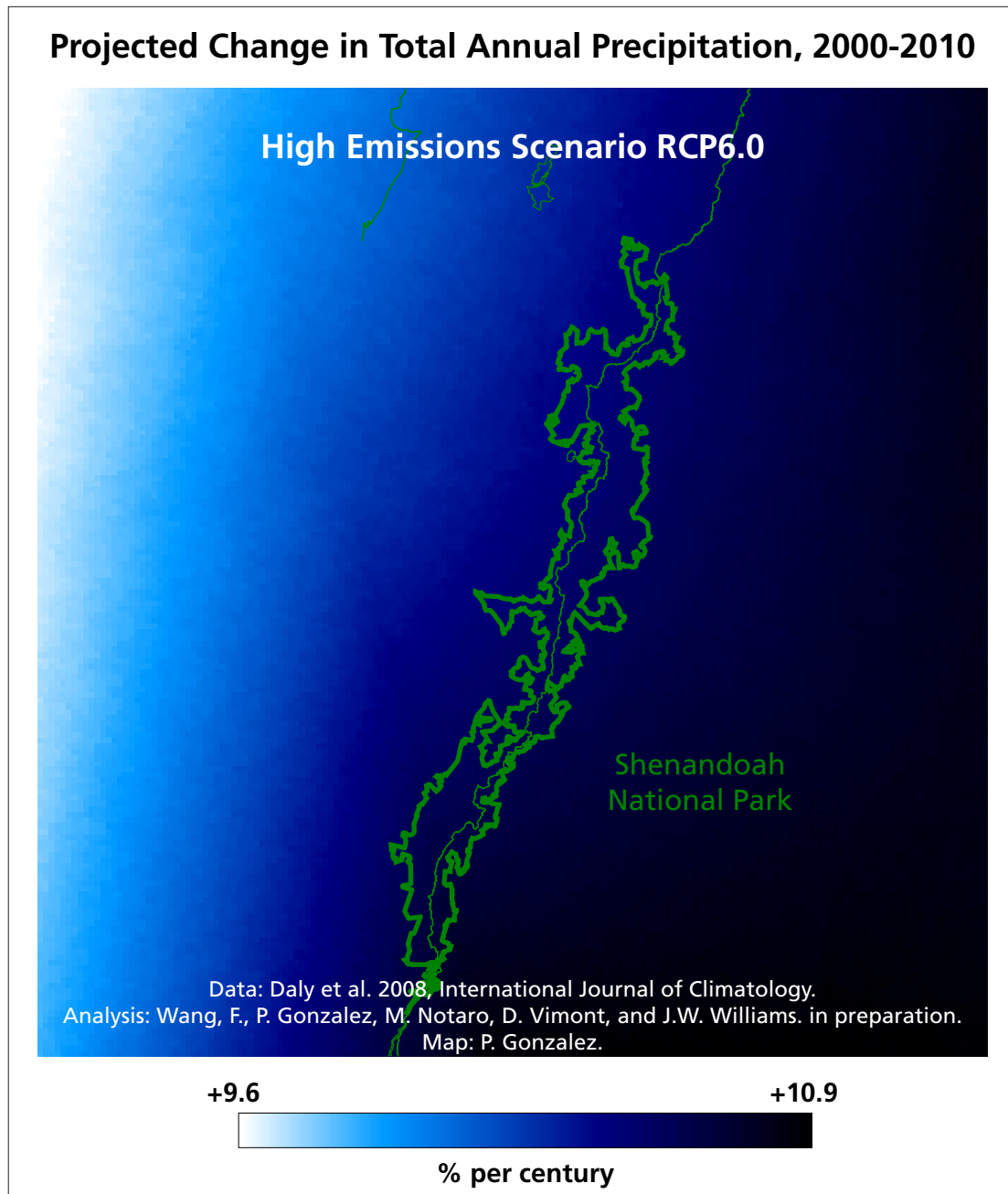


Figure 6.



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