Climate Change Summary, Tuzigoot National Monument, Arizona

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Climate Trends for the Area within Park Boundaries

- Since 1950, temperature has shown statistically significant warming.
- Since 1950, precipitation has increased slightly, but it was not statistically significant.
- Projections show that future temperatures may increase two to four times past rates.
- Projections of future precipitation indicate that increases or decreases are possible.

Historical and projected changes per century (data Daly et al. 2008, IPCC 2013; analysis Wang et al. in preparation). Figures 1 and 2 show climate variable uncertainties.

	1950-2010	**2000-2100**
Historical		
temperature	+1.8ºC (+3.2ºF.)	
precipitation	+2%	
Projected (compared to 1971-2000)		
Low emissions (IPCC RCP 4.5)		
temperature		+2.8ºC (+5ºF.)
precipitation		+1%
High emissions (IPCC RCP 6.0)		
temperature		+3.2ºC (+6ºF.)
precipitation		-2%
Highest emissions (IPCC RCP 8.5)		
temperature		+5ºC (+9ºF.)
precipitation		-1%

Potential Future Vulnerabilities for the Southwestern U.S.

- Under high emissions, fire frequencies could increase up to 25% by 2100 (Moritz et al. 2012).
- Recent drought and beetle infestations have killed piñon pines and other tree species, which may continue in areas experiencing drought in the future (Breshears et al. 2005).
- Past warming has reduced snowpack widely and rainfall in some areas, which may continue to reduce summer streamflow and water supplies (Garfin et al. 2013).

Figure 1. 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).

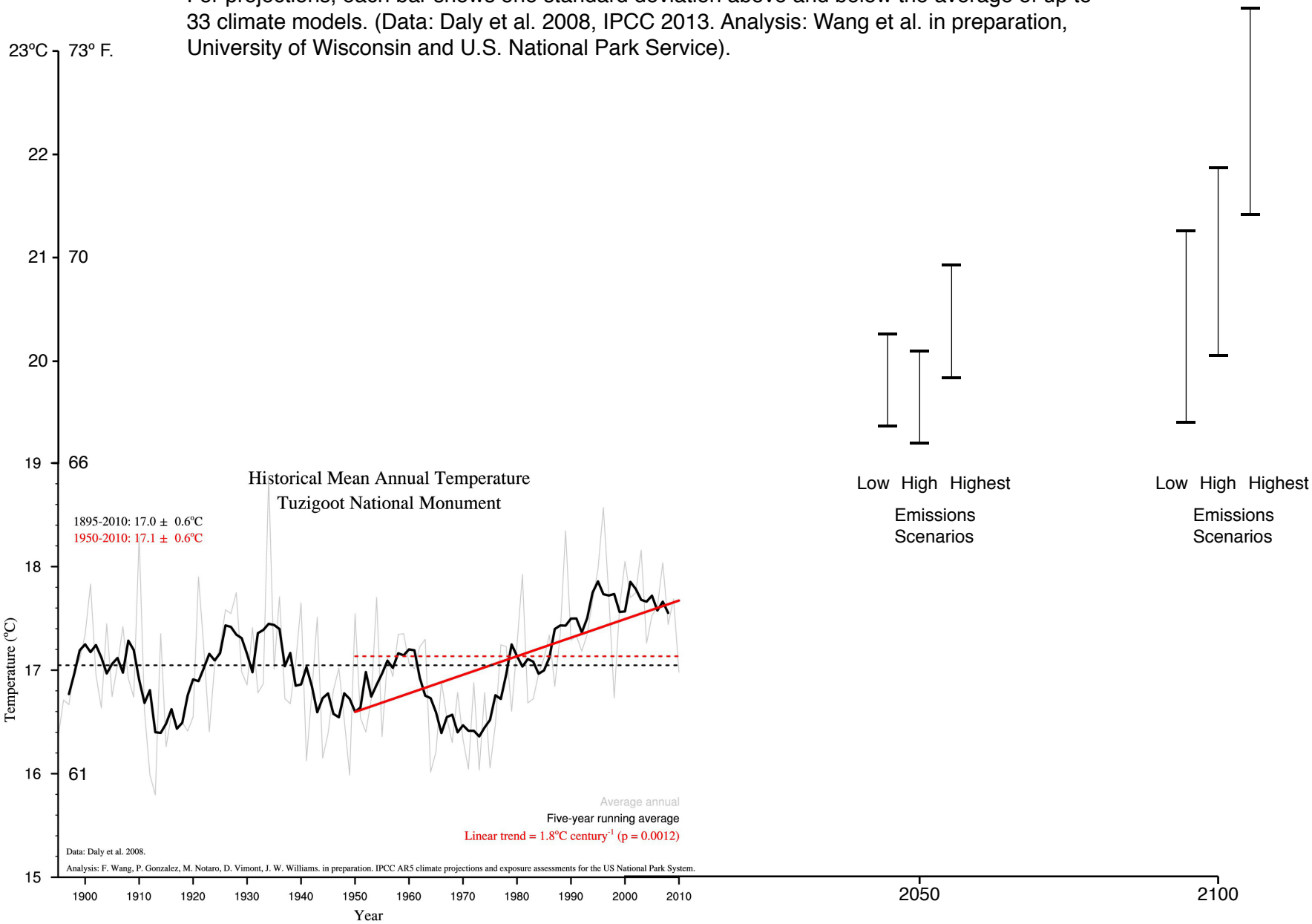


Figure 2. Precipitation.
Historical and projected annual total precipitation for the area within park boundaries.
For projections, each bar shows one standard deviation above and below the average of up to 33 climate models. (Data: Daly et al. 2008, IPCC 2013. Analysis: Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).

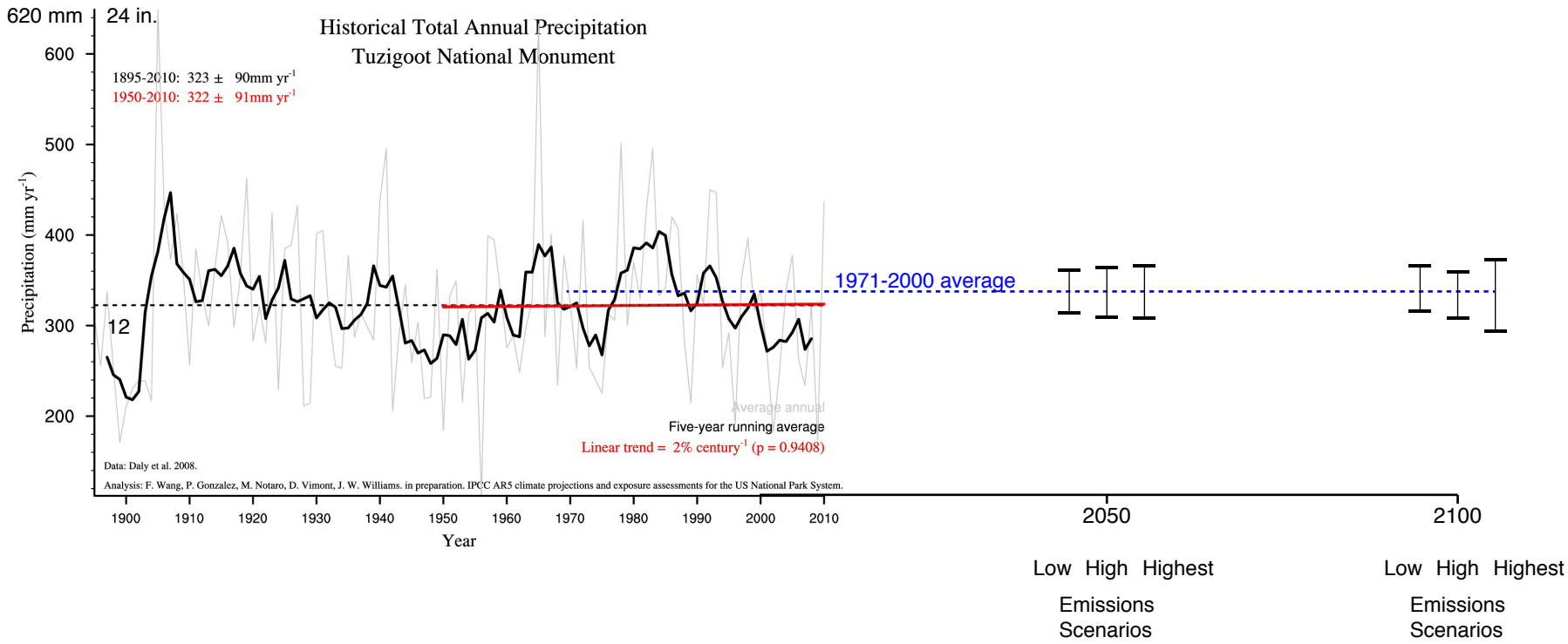


Figure 3.

Average annual temperature (1950-2010) across the landscape (data Daly et al. 2008; analysis Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).

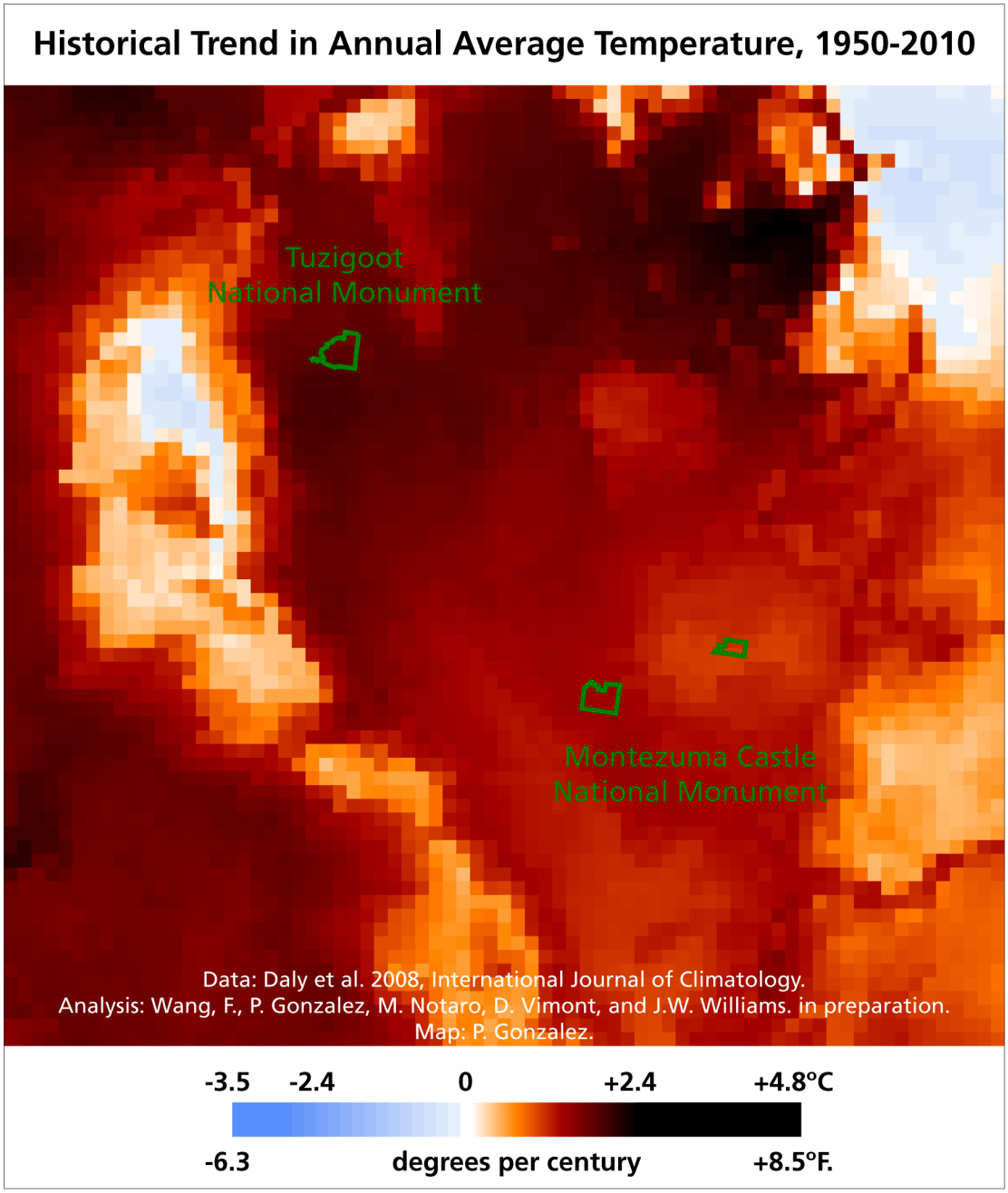


Figure 4.

Projected change in average annual temperature (difference between 2071-2100 average and 1971-2000 average), for the high emissions scenario (IPCC RCP 6.0) (data Daly et al. 2008, IPCC 2013; analysis Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).

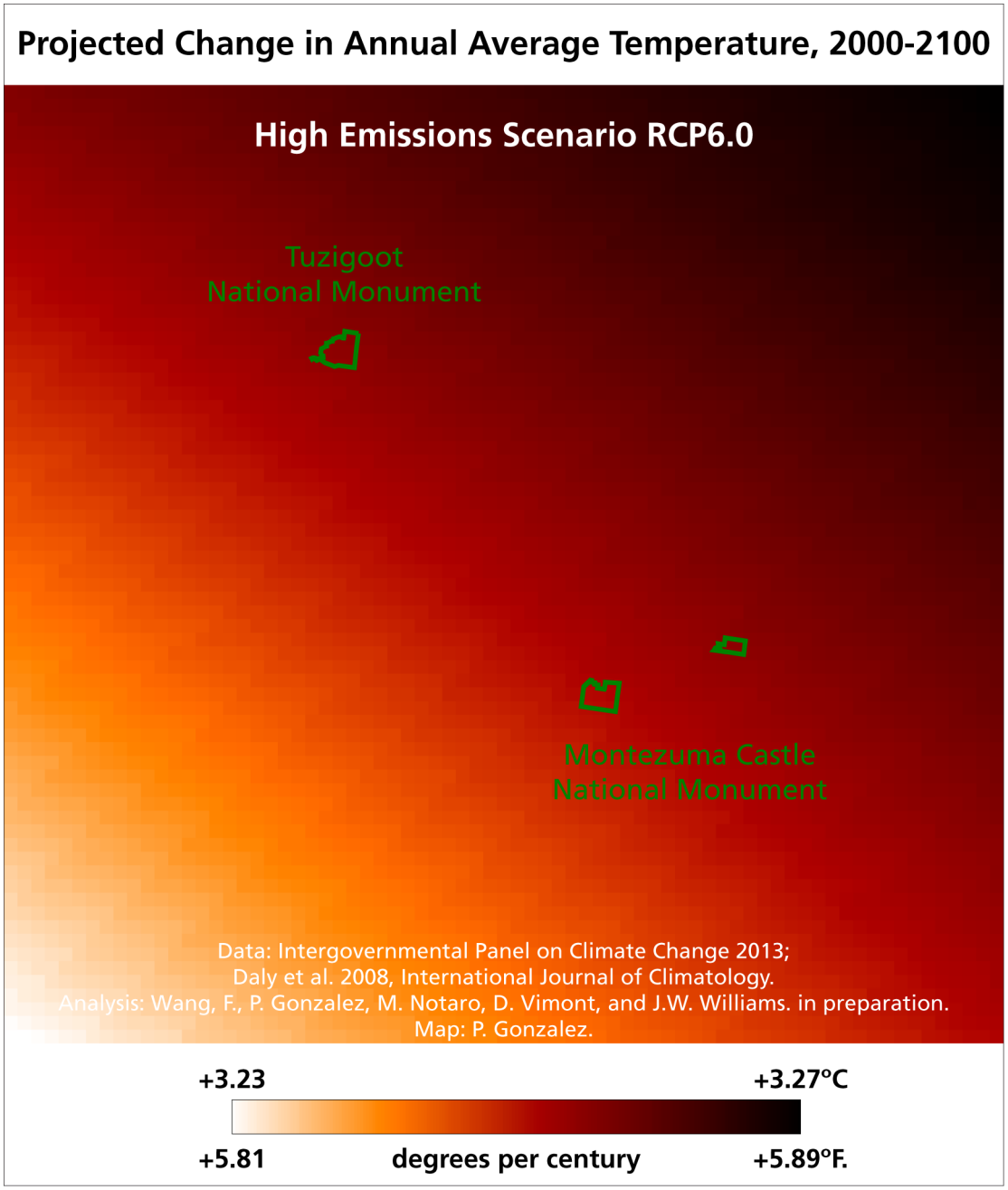
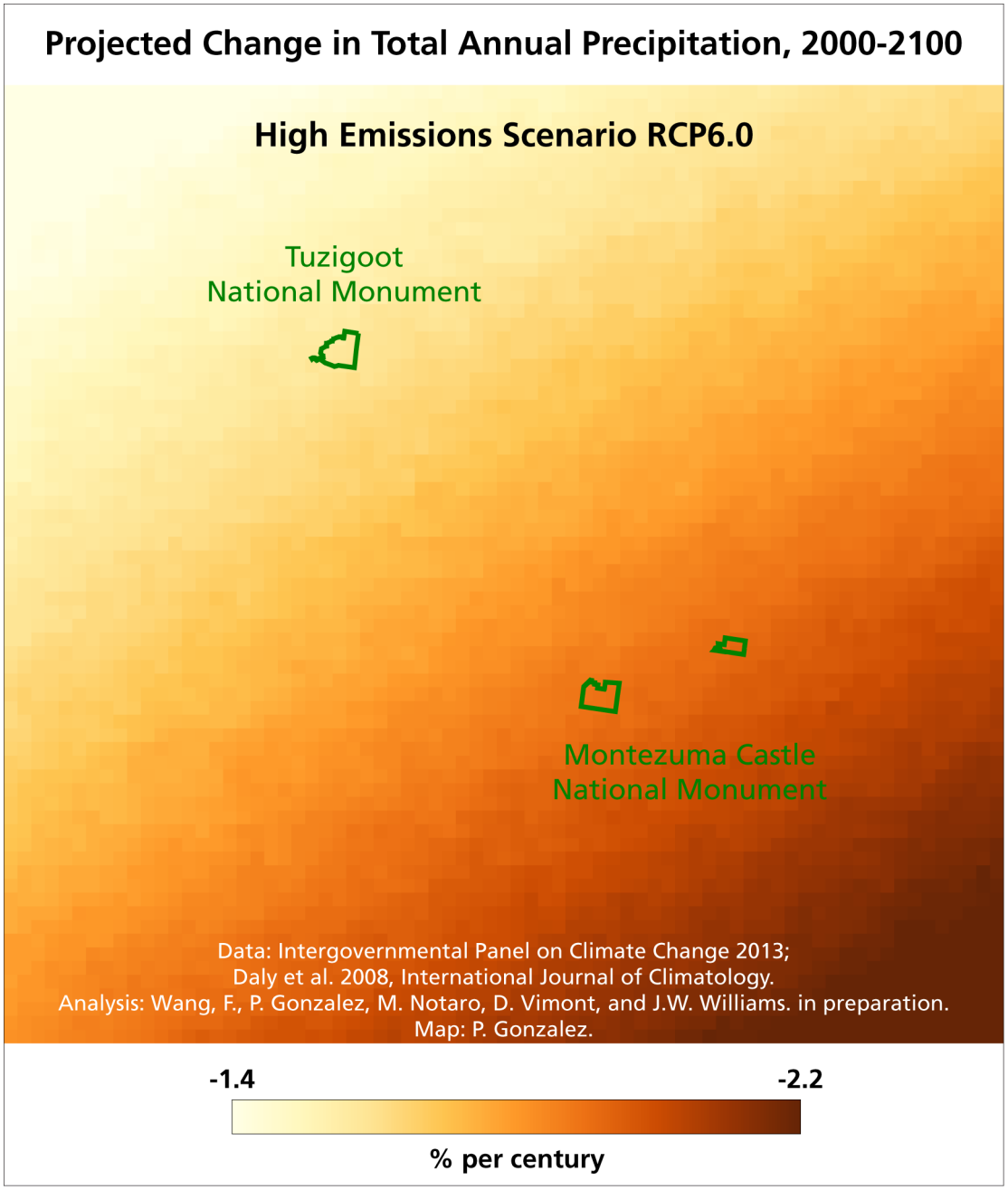


Figure 5.

Projected change in average annual precipitation (difference between 2071-2100 average and 1971-2000 average), for the high emissions scenario (IPCC RCP 6.0) (data Daly et al. 2008, IPCC 2013; analysis Wang et al. in preparation, University of Wisconsin and U.S. National Park Service).



References

Breshears, D.D., N.S. Cobb, P.M. Rich, K.P. Price, C.D. Allen, R.G. Balice, W.H. Romme, J.H. Kastens, M.L. Floyd, J. Belnap, J.J. Anderson, O.B. Myers, and C.W. Meyer. 2005. Regional vegetation die-off in response to global-change-type drought. Proceedings of the National Academy of Sciences of the USA 102: 15 144-15 148.

Daly, C., M. Halbleib, J.I. Smith, W.P. Gibson, M.K. Doggett, G.H. Taylor, J. Curtis, and P.P. Pasteris. 2008. Physiographically sensitive mapping of climatological temperature and precipitation across the conterminous United States. International Journal of Climatology 28: 2031–2064.

Garfin, G., A. Jardine, R. Merideth, M. Black, and S. LeRoy (eds.) 2013. Assessment of Climate Change in the Southwest United States: A Report Prepared for the National Climate Assessment. A report by the Southwest Climate Alliance. Island Press, Washington, DC.

Intergovernmental Panel on Climate Change (IPCC). 2013. Climate Change 2013: The Physical Science Basis. Cambridge University Press, Cambridge, UK.

Moritz, M.A., M.A. Parisien, E. Batllori, M.A. Krawchuk, J. Van Dorn, D.J. Ganz, and K. Hayhoe. 2012. Climate change and disruptions to global fire activity. Ecosphere 3: art49. doi:10.1890/ES11-00345.1.

Wang, F., P. Gonzalez, M. Notaro, D. Vimont, and J.W. Williams. in preparation. IPCC AR5 climate projections and exposure assessments for the US National Park System.