

Climate Change Trends at Santa Monica Mountains National Recreation Area, California

Patrick Gonzalez

Natural Resource Stewardship and Science, National Park Service, Washington, DC

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Introduction

Greenhouse gas emissions from vehicles, power plants, deforestation, and other human activities have increased temperatures around the world and changed other aspects of climate (IPCC 2007a). Published field research shows that climate change is also altering ecosystems by shifting biomes, contributing to species extinctions, and causing numerous other changes (IPCC 2007b). To help Santa Monica Mountains National Recreation Area (NRA) integrate climate change into its foundation document and resource management planning, this report presents results of spatial analyses of historical and projected climate for the area that includes the park.

Historical Climate Changes

Average annual temperature increased across the United States (U.S.) in the 20th century (Figure 1) and showed statistically significant increases in the 50 km x 50 km (30 mile x 30 mile) square that includes Santa Monica Mountains NRA (1901-2002) and at Los Angeles International Airport (1945-2012) (Figure 2, Table 1). Precipitation increased across the U.S., (Figure 3) in the 50 km x 50 km square that includes Santa Monica Mountains NRA, and at Los Angeles International Airport, but the increases in the area of the park and at the airport were not statistically significant (Figure 4).

Future Climate 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 (Le Quéré et al. 2013, Raupach et al. 2007).

For the three main IPCC emissions scenarios, projected 21st century mean annual temperature in the Santa Monica Mountains area could increase two to four times the 20th century increase

(Table 1). The average of ensembles of general circulation models (GCMs) of the atmosphere project decreased precipitation for the Santa Monica Mountains NRA area under all three IPCC emissions scenarios, but with wide uncertainties (Table 1). For emissions scenario A2, 12 out of 18 GCMs project decreases in precipitation (Figure 5).

Projections indicate potential changes in the frequency of extreme temperature and precipitation events. Modeling under emissions scenario A2 projects 20 to 25 more days with a maximum temperature $> 35^{\circ}\text{C}$ (95°F.) and five to ten more days each year with precipitation $< 3\text{ mm}$ (one-tenth of an inch) between the periods 1980-2000 and 2041-2070 (Kunkel et al. 2013).

Table 1. Historical and projected climate trends for Santa Monica Mountains NRA (Mitchell and Jones 2005, IPCC 2007, Gonzalez et al. 2010) and Los Angeles International Airport (data National Oceanic and Atmospheric Administration). Historical area climate and projections for IPCC emissions scenarios B1 and A1B calculated at 50 km spatial resolution (Gonzalez et al. 2010). Climate under emissions scenario A2 calculated at 4 km spatial resolution (data from Conservation International, using method of Tabor and Williams (2010)).

	mean SD/SE		mean SD/SE	
Historical				
<i>Area that includes the park (1901-2002)</i>				
temperature annual average ± SD	15.7	0.6 °C	60	1 °F.
temperature linear trend ± SE	0.9	0.2 °C/century	1.6	0.3 °F./cent.
precipitation annual average ± SD	430	180 mm/y	17	7 in./year
precipitation linear trend ± SE	16	14 %/century	16	14 %/century
 <i>Los Angeles Int.'l Airport (1945-2012)</i>				
temperature annual average ± SD	17.2	0.7 °C	63	1.3 °F.
temperature linear trend ± SE	1.3	0.5 °C/century	2.3	0.8 °F./cent.
precipitation annual average ± SD	300	140 mm/y	12	5.5 in./year
precipitation linear trend ± SE	33	30 %/century	33	30 %/century
 Projected (1990-2100) ± SD				
IPCC B1 scenario (lower emissions)				
temperature annual average	2.2	0.7 °C/century	4.0	1.3 °F./cent.
precipitation annual average	-22	22 %/century	-22	22 %/century
 IPCC A1B scenario (medium emissions)				
temperature annual average	3.0	0.7 °C/century	5.3	1.3 °F./cent.
precipitation annual average	-15	15 %/century	-15	15 %/century
 IPCC A2 scenario (higher emissions)				
temperature annual average	3.5	0.7 °C/century	6.3	1.3 °F./cent.
precipitation annual average	-3	11 %/century	-3	11 %/century

SD = standard deviation; SE = standard error

Figure 1.

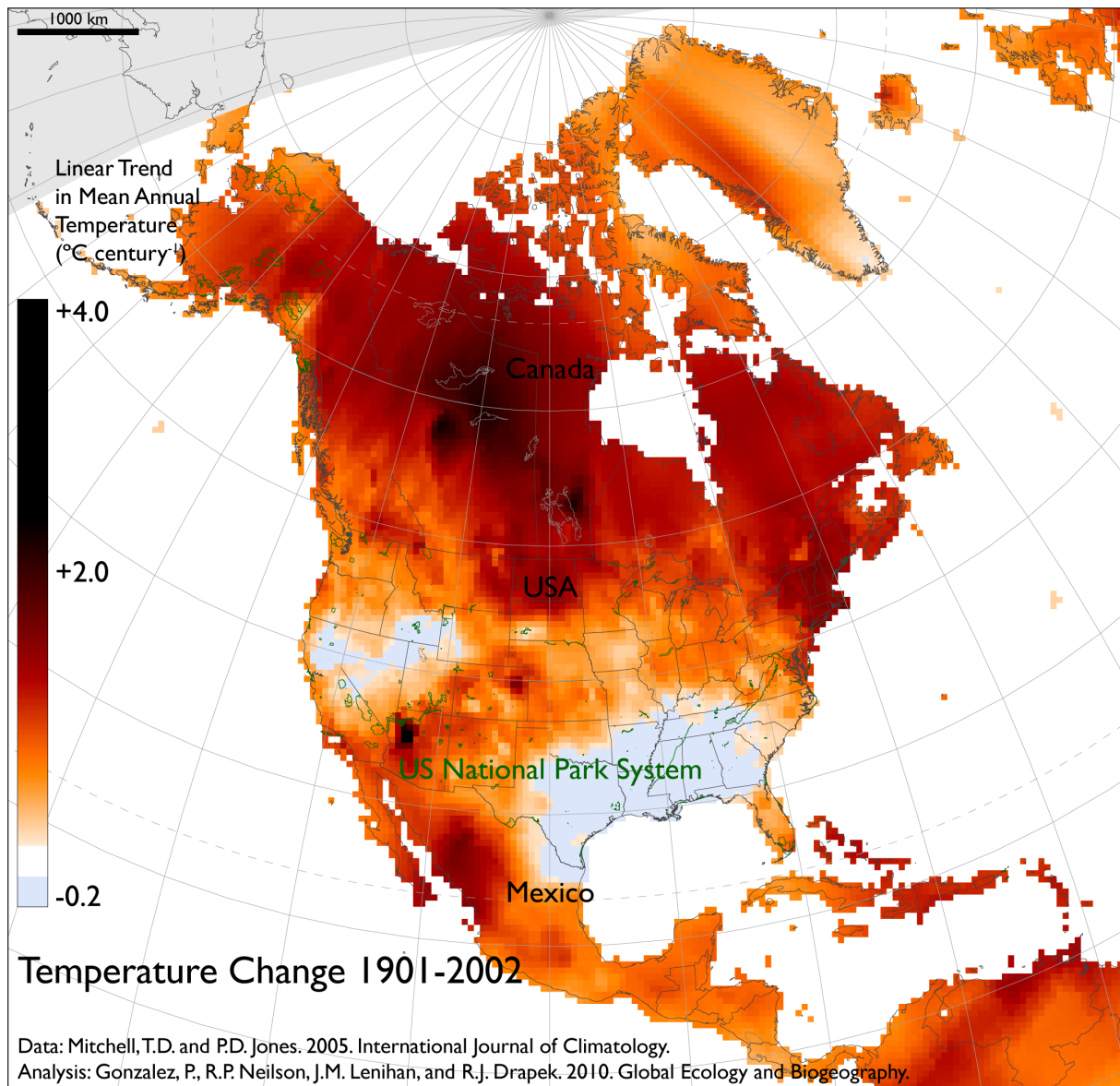


Figure 2.

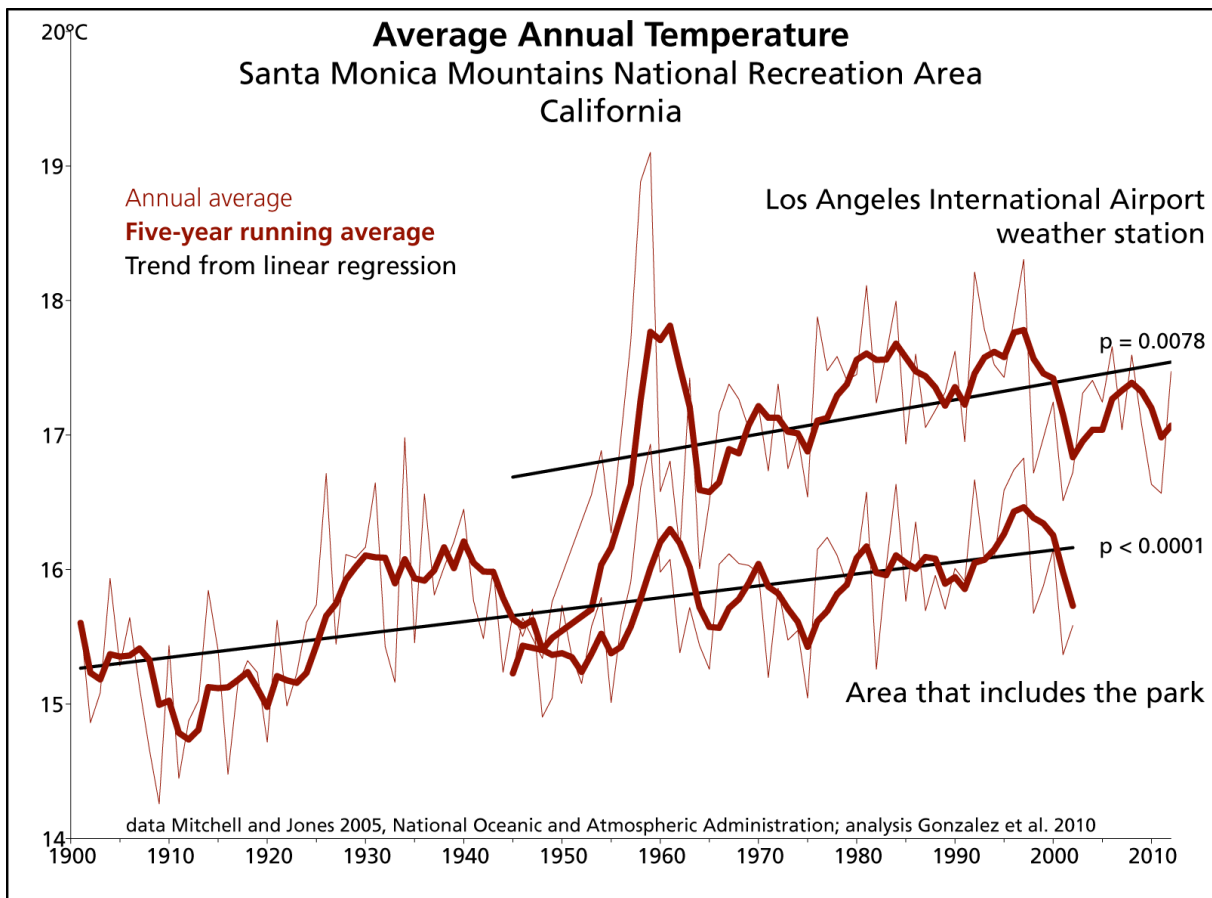


Figure 3.

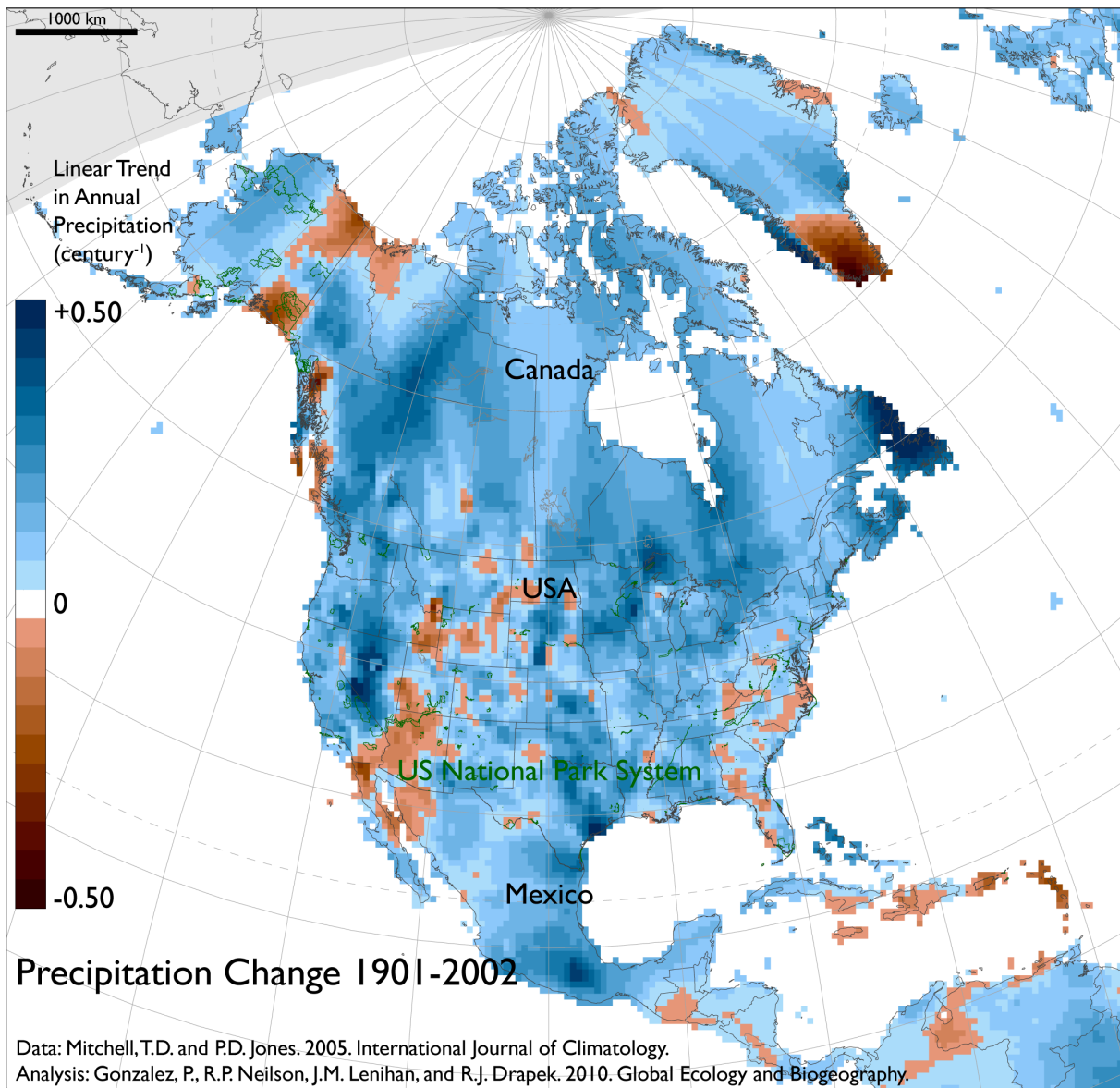


Figure 4.

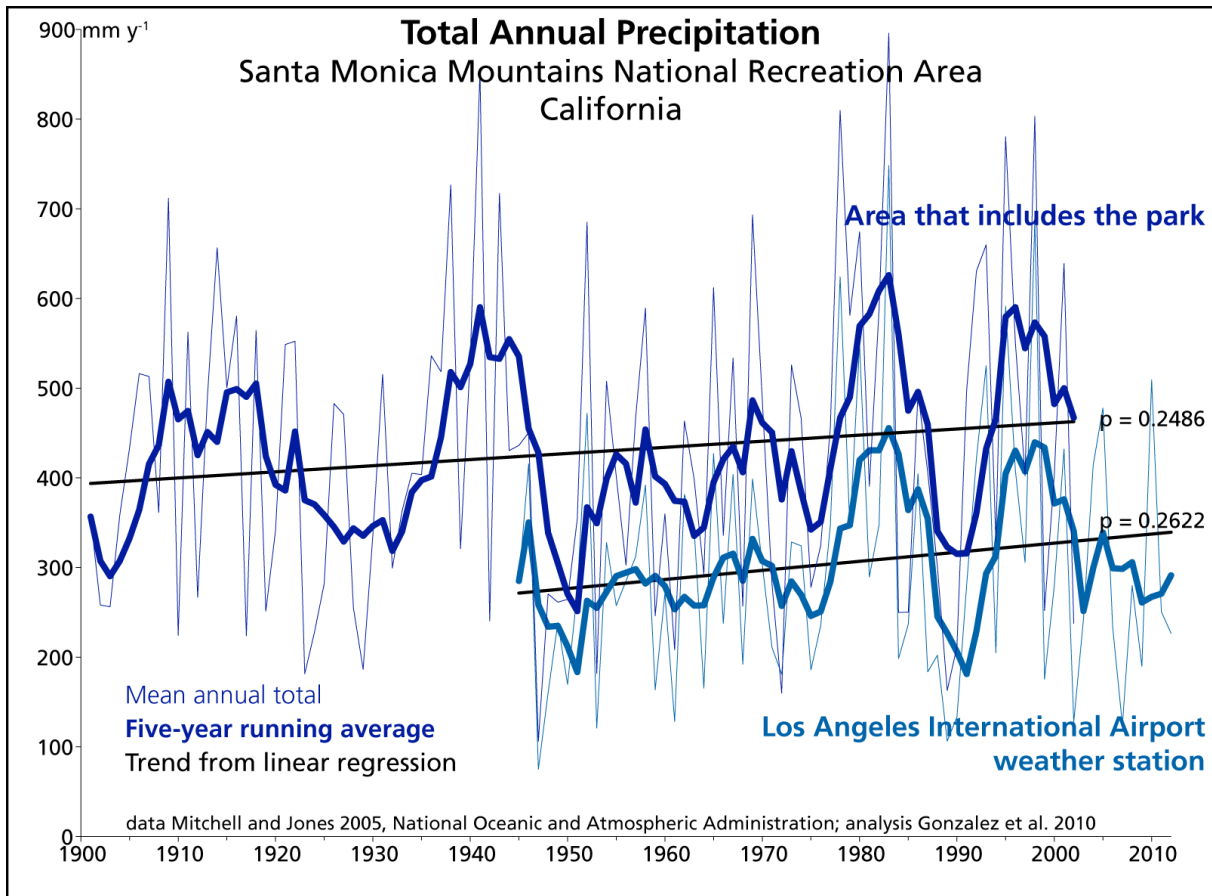
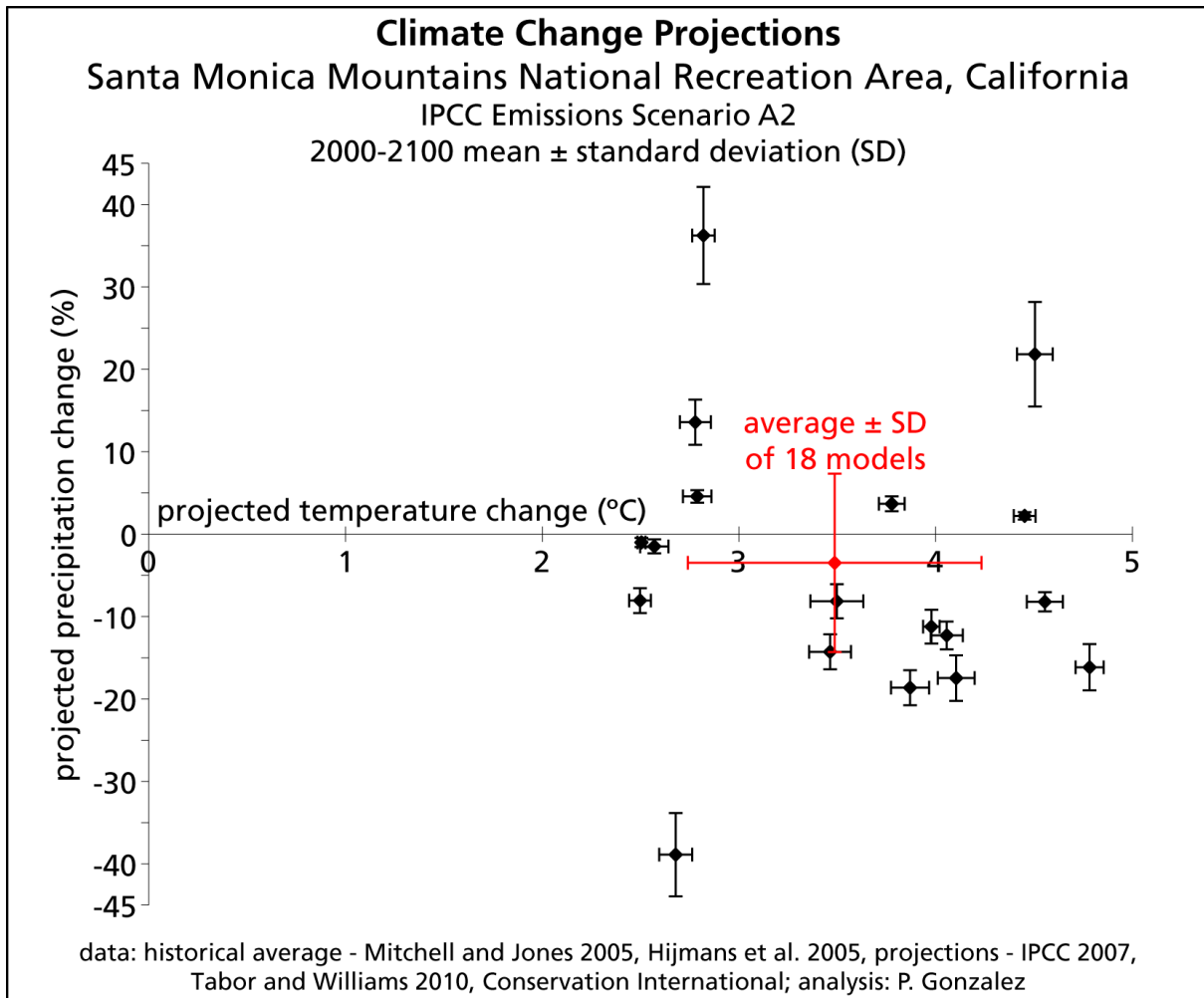


Figure 5.



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