Climate Change Trends for Planning at Capulin Volcano National Monument, New Mexico

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Historical Trends
From 1901 to 2002, mean annual temperature increased across North America (Figure 1; Gonzalez et al. 2010) and showed a statistically significant increase in the area that includes Capulin Volcano National Monument (NM) (Figure 2, Table 1). From 1901 to 2002, precipitation increased across most of North America (Figure 3; Gonzalez et al. 2010), although it showed no statistically significant trend in the Capulin Mountain area (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).

For the three main IPCC emissions scenarios, projected 21st century temperature in the Capulin Mountain area could increase four to eight times the amount of historical 20th century warming (Table 1, Mitchell and Jones 2005, Gonzalez et al. 2010). General circulation models (GCMs) of the atmosphere project decreased annual precipitation in the Capulin Mountain area under all three emissions scenarios (Table 1, Mitchell and Jones 2005, Gonzalez et al. 2010). For emissions scenario A2, the average projected change in annual precipitation is -17 ± 18%, with 14 out of 18 GCMs projecting 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).
References
Table 1. Historical and projected climate (mean ± standard deviation (SD)) trends for the area that includes Capulin Volcano NM (Mitchell and Jones 2005, IPCC 2007, Gonzalez et al. 2010). Climate projections for IPCC emissions scenarios B1 and A1B are calculated at 50 km spatial resolution (Gonzalez et al. 2010) and, for emissions scenario A2, at 4 km spatial resolution (data from Conservation International using method of Tabor and Williams (2010)). Note “century⁻¹” is the fractional change per century, so that -0.17 century⁻¹ is a decrease of 17% in a century.

<table>
<thead>
<tr>
<th></th>
<th>mean</th>
<th>SD</th>
<th>units</th>
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<td>century⁻¹</td>
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Figure 1. Linear Trend in Mean Annual Temperature °C, century VI

Temperature Change 1901-2002


Figure 2. Mean Annual Temperature

Capulin Volcano National Monument
New Mexico

Average annual
Five-year running average
Trend from linear regression
Area that includes the park

p = 0.0002

Data: Mitchell and Jones 2005, National Oceanic and Atmospheric Administration; analysis Gonzalez et al. 2010
Figure 3.

Precipitation Change 1901-2002


Figure 4.

Total Annual Precipitation
Capulin Volcano National Monument
New Mexico

Mean annual total
Five-year running average
Trend from linear regression
Area that includes the park

Figure 5.

Climate Change Projections
Capulin Volcano National Monument, New Mexico
IPCC Emissions Scenario A2
2000-2100 mean ± standard deviation

Projected precipitation change (%) vs. projected temperature change (°C)