Climate Change in the Dominican Republic

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Background: CCSM3 Climate Model, IPCC SRES A1FI Scenario, LandScan Global Population

About CCSM3: The physical science basis of the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) relied heavily on a few selected climate models: The Community Climate System Model version 3 (CCSM3) was one of the leading models. The model development and analysis has been supported by the Department of Energy and the National Science Foundation. The Oak Ridge National Laboratory and the National Center for Atmospheric Research are major players. Science magazine cited CCSM as “the nation’s foremost academic global climate model”.

About A1FI: Climate projections in the future rely on anticipated emission Special Report on Emissions (SRES) scenarios. The IPCC has generated forty emission SRES scenarios. The A1FI is the best estimate for what was thought to be a “high scenario” and projects a global average temperature rise of 4.0 °C with a likely range of 2.4 to 6.4 °C. The A1FI anticipates “… a future world of very rapid economic growth, global population that peaks in mid-century and declines thereafter, and the rapid introduction of new and more efficient technologies. Major underlying themes are convergence among regions, capacity building and increased cultural and social interactions, with a substantial reduction in regional differences in per capita income. … technological emphasis: fossil intensive.” However, while recent emissions trends appear to closely follow the assumptions made in A1FI.

About LandScan Global: The LandScan Global population databases are “the world's most accurate and reliable, geographically based, time-of-day population distribution model and databases.” The population data, developed at the Oak Ridge National Laboratory, are available at 30 arc-second resolutions, which correspond to about 1 km resolution at the equator.

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CCSM3 A1FI Projections for the Dominican Republic

The analysis presented here uses twelve CCSM3 model grid cells overlaying the Dominican Republic and the immediately surrounding areas. The outputs from CCSM3 were interpolated using commercial GIS. The results show average temperature and precipitation differences in 2025, 2050, and 2100, compared to current, or 2000 values. The numbers correspond to decadal averages, where the decades are around the corresponding years. The bounding coordinates of the analysis area used in this study are -72.4 to -66.7 degrees West and 16.8 to 21.0 degrees North. The center points of each grid cell were used for interpolation and analysis.

Precipitation Trends

In low-latitude islands such as the Dominican Republic, precipitation is more seasonal than temperature. This was verified using observations and model outputs.

Mean monthly rainfall was calculated for ten-year windows around 2000 (2000-2009), 2025 (2020-2029), 2050 (2045-2054), and 2100 (2090-2099). Results and polynomial fits for each time period are presented in the following chart.

According to model output, the Dominican Republic’s wet season currently runs from July through December with peak rainfall occurring in December. [Note: This differs slightly from the literature review which indicated that the Dominican Republic’s wet season runs from May through November.]
In the baseline “2000” scenario, approximately 7 cm of rain are received in the first half of the year, and about 14 cm of rain are received in the second half of the year, giving an average annual total rainfall of 21 cm. In 2025, total annual rainfall drops slightly to 20 cm, with 8.5 cm being received in January-June and 11.5 cm falling in July-Dec. By 2050, total annual rainfall has decreased to 14 cm with 6 cm falling in Jan-Jun and only 8 cm falling in July-Dec. Annual rainfall decreases to 12 cm by 2100, with 5 cm falling in Jan-Jun and 7 cm falling in July-Dec. Thus, over the 100-year period, total annual rainfall is projected to decrease by over 40% and precipitation is expected to show less and less seasonality. There is also an indication that peak rainfall will begin to arrive earlier in the year, shifting from December in 2000 to November in 2025 and to October by 2050 and 2100. The model output indicates that the driest month will remain fairly constant, around May/June. A time-step comparison of wet/dry seasons as depicted by the model output is shown in the figures available on the website.

**Temperature Trends**

Temperatures in the Dominican Republic do not vary much throughout the year and are not expected to become any more seasonal in nature over the next 100 years. However, average monthly temperatures are expected to increase in each month of the year, as shown in the chart below.

![Average Monthly Temperatures in the Dominican Republic (Projected by CCSM3, A1FI)](chart)

Overall, the annual average temperatures in the Dominican Republic are expected to increase by nearly 0.5 degree Celsius by 2025, approximately 1 degree C by 2050, and by over 2.5 degrees C by 2100 when compared to a baseline of 2000. A time-step comparison of temperature change as depicted by the model output is shown in the figures available on the website.
Sea Level Rise in Conjunction with Population

According to the IPCC’s AR4, sea level is expected to rise by 0.26-0.59 m from 1980-1999 to 2090-2099. The elevation data currently available to us for this specific analysis is to the nearest meter. Thus, we prepared a grid of those areas currently equal to 0-1 meters and intersected these cells with the current population distribution map (each at a resolution of 30 arc-seconds) in order to determine how many people may be directly affected by sea level rise. The ambient population at risk was estimated based on the current LandScan Global model and databases. Assuming that the population remains static in space/geography and does not change over time, we estimate that 17,780 people would be directly impacted by a sea level rise of up to 1 meter. The majority of these people are located in two administrative provinces: Monte Cristi and Barahona. These projections are preliminary and subject to the various assumptions stated here. The analyses may be made stronger with credible population projections at high resolutions.

Hurricanes in Conjunction with Population

Hurricane impacts at decadal may be estimated by developing statistical extreme value fits to loss over time, or perhaps more precisely, by investigating the potential increase (or decrease) of intensity-duration-frequency (IDF) of hurricanes in space and time as a result of changing climate and overlaying with population. Unfortunately however, there is no strong consensus yet among the scientific community regarding the impact of global warming on Atlantic hurricanes. However, a peer-reviewed article in the journal Nature published in 2008 indicated that stronger hurricanes in the region are likely to grow even more intense as a result of global warming. On the whole, even if hurricanes remain as they are, population and economic growth would likely cause larger vulnerability.