U.S. FACES DRAMATIC RISE IN EXTREME HEAT, HUMIDITY

Methodology

Future Danger Days Projections

The danger-day analysis was based on "Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections" archive produced by a consortium of government agencies and academic researchers[1].

The bias-corrected statistically-downscaled (BCSD) climate projections[2][3] used are derived from the global climate model (GCM) runs in the Coupled Model Intercomparison Project 5 (CMIP5) experiment. Climate threat analysis was performed for outputs based on 29 GCMs available in the archive under the RCP 8.5 emissions scenario. These climate and hydrology projections have a spatial resolution of 1⁄8° (about 140 square kilometers per grid cell), and cover the conterminous United States.

Our analysis covered daily projections over three time periods: 1991-2010 (the baseline period, representing the year 2000); 2021-2040 (representing 2030); and 2041-2060 (representing 2050). Our calculations were made on the daily data for all 52,425 grid cells in the continental United States.

We calculated projected daily humidity using the MTCLIM4.3 software package from the Numerical Terradynamic Simulation Group at the University of Montana[4] which implements a humidity-estimation algorithm that incorporates daily maximum and minimum temperature and precipitation patterns[5]. We combined projected daily maximum temperature and estimated humidity using the standard "heat index" lookup table from the National Weather Service[6] to produce a count of danger days (days with a heat index of 105°F or above) over each 20-year period. This was converted to an annual average.

To calculate danger day values for Metropolitan Statistical Areas (MSA), we averaged the danger day values for the counties making up each MSA. To calculate a national average increase in danger days, we performed an area-weighted average of the danger-day values for all states.

Dew Point trend analysis

Dewpoint was calculated using the Daymet vapor pressure dataset from the Oak Ridge National Laboratory. Vapor pressure data are generated as a function of the predicted daily minimum temperature and the predicted daily average daylight temperature. The dewpoint analysis included June, July and August.

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Days Above 90ºF, 95ºF, and 100ºF trends analysis

The number of days above a particular temperature threshold was determined using the maximum daily temperature from the Applied Climate Information System (http://www.rcc-acis.org/). Because these temperatures can occur outside of the summer months, this analysis was not restricted to June, July and August. Climate Central retrieved daily data from 1970 – 2015 for the top 200 MSAs (note: 178 cities had sufficient data to be included in the analysis) and calculated the average annual number of days above a threshold temperature in the 2000s (2000-2015), comparing it to the average annual number of days from an equal number of years beginning in 1970 (1970-1985).

Summer warming by state

State warming trends are the linear trends in the annual average temperature for June, July and August from 1970 - 2015. Average summer temperatures were obtained from the National Center for Environmental Information.

Future Summers in your city

Summer high temperatures (average of daily maximum temperatures for June, July, and August) were calculated for 1,001 U.S. cities with 1986-2005 data from PRISM Climate Group, Oregon State University, http://prism.oregonstate.edu, accessed 1 July 2014. The projected summer high temperatures were calculated for these cities for the period 2081-2099, based on the RCP8.5 emissions scenario (and the other scenarios in a subsequent analysis), which is the high emissions scenario used in the IPCC's 5th Assessment Report. This is essentially a continuation of our current emissions trends through the end of the century. The temperature change was calculated through that period using a downscaled multi-model ensemble approach (Downscaled CMIP5 Climate Projections archive at http://gdo-dcp.ucllnl.org/downscaled_cmip_projections/) and that number was added to the current temperature (from PRISM) to get the future temperature.

References

[1] http://gdo- dcp.ucllnl.org/downscaled_cmip_projections/
[2] Reclamation, 2013. 'Downscaled CMIP3 and CMIP5 Climate and Hydrology Projections: Release of Downscaled CMIP5 Climate Projections, Comparison with preceding Information, and Summary of User Needs', prepared by the U.S. Department of the Interior, Bureau of Reclamation, Technical Services Center, Denver, Colorado. 47pp.
[3] Maurer, E. P., L. Brekke, T. Pruitt, and P. B. Duffy (2007), 'Fine-resolution climate projections enhance regional climate change impact studies', Eos Trans. AGU, 88(47), 504.
[4] http://www.ntsg.umt.edu/project/mtclim
[5] Kimball, J.S., S.W. Running, and R. Nemani, 1997. An improved method for estimating surface humidity from daily minimum temperature. Agricultural and Forest Meteorology, 85:87-98.
[6] http://www.wrh.noaa.gov/psr/general/safety/heat/heatindex.png