RESEARCH SPOTLIGHT

Highlighting exciting new research from AGU journals

Model shows human activity influences temperature extremes in China

In Dalian, a city in northern China, more than 160,000 people went to the beach to cool off during the heat wave on 6 August 2006. Wen et al. *used simulations to show that human activity has contributed to the recent increase in heat waves in China.*

Extreme temperatures have been occurring more frequently and becoming more severe around the world in recent decades as Earth's climate warms. Some studies have been able to use model simulations and observations to attribute the increase in temperature extremes on a global scale to human activity—especially carbon dioxide emissions—but there are fewer studies that look at human influence on temperature extremes at continental or regional scales.

Focusing on China, *Wen et al.* used China's National Climate Center's data set of temperature observations from 1961 to 2007 along with ensembles of model simulations to study changes in warm extremes (annual maximum daily maximum and annual maximum daily minimum, which are usually summer daytime highs and summer nighttime lows) and in cold extremes (annual minimum daily maximum and annual minimum daily minimum, which are usually winter daytime highs and winter nighttime lows).

The authors used simulations conducted using the Canadian Earth System Model (CanESM2) with a variety of external climate forcings, including anthropogenic forcings such as greenhouse gas emissions, anthropogenic aerosols, and land use change as well as natural forcings such as solar irradiance and volcanic activity. The authors used a statistical analysis to separate out the effects of anthropogenic influence on the changing temperature extremes.

They found clear evidence of human influence on both the warm and cold extremes in China, and they also found that natural forcings could not explain the observed changes in temperature extremes. Furthermore, they indicate that the effects of greenhouse gases in particular can be separated out from other forcings in warm extreme temperatures: They estimate that greenhouse gases contributed about 89% to the warming of summertime daytime highs and 95% to the warming of summertime nighttime lows. (*Geophysical Research Letters*, doi:10.1002/grl.50285, 2013) —EB

Devastating East African drought made more likely by climate change

In 2011 a powerful drought gripped East Africa. Vastly reduced 2010 fall rains and 2011 spring rains caused a drought that stacked on an already unstable political climate, caused a famine that led to hundreds of thousands of deaths. Whenever an extreme weather event strikes a population—a drought, a hurricane, or a powerful flood—questions arise as to whether ongoing global climate change is complicit. Most scientists, when confronted with such questions, suggest that no one act of weather can be attributed to the long-term statistical shifts that make up a change in climate. The nascent field of event attribution, however, is seeking to provide a more satisfying answer to this question. Using climate modeling techniques, researchers estimate how the probability or magnitude of a specific extreme event—in this case, the failure of the East African rains—was affected by climate change.

Comparing modeled East African precipitation patterns in a world affected by anthropogenic forcings against a climate change–free scenario, *Lott et al.* found that the probability of failure of the 2011 East African spring rains was increased by climate change, though the various models used disagreed on the exact size of the increase. The authors suggest that the reduction of the spring rains hinged on the rise in sea surface temperature caused by anthropogenic climate change. They found that the failure of the 2010 fall rains, however, was due not to anthropogenic climate change but to the ongoing La Niña conditions. (*Geophysical Research Letters*, doi:10.1002/grl.50235, 2013) —CS

Tracing nitrate in watersheds

Plants need nitrogen to grow, and nitrate is a common fertilizer ingredient, but high levels of nitrate contamination in drinking water sources can cause health problems. It is generally known that nitrogen flows through watersheds from upslope areas down to streams, but the relationships between upslope soil solution or groundwater nitrate concentrations and stream water nitrate levels—and the ways in which land use changes may alter this relationship—are not fully understood.

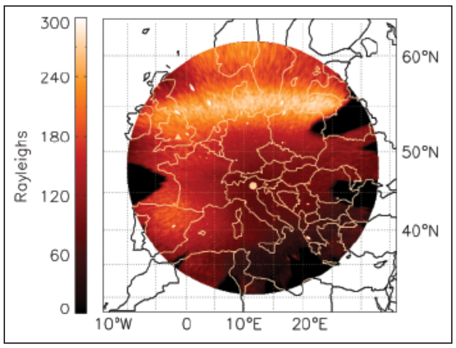
Sudduth et al. analyzed published studies of 62 watersheds to see if a consistent relationship between upslope soil solution or groundwater nitrate concentrations and stream water nitrate concentrations exists and whether ecosystem disturbances such as fire or land use changes such as clearing forests for agriculture or urbanization affected the relationship between soil and stream water nitrate concentrations.

For 40 undisturbed forest watersheds and 10 disturbed forest watersheds, they found that stream water nitrate concentrations were typically about half that of soil solution nitrate concentrations, indicating that a significant amount of nitrate is removed as water passes through watersheds to streams. For the 12 watersheds in their study that had significant agricultural or urban development, there was less reduction in nitrate concentrations between soil solutions and stream waters, suggesting that in human-dominated landscapes, upland soils and riparian zones are less efficient at removing nitrate than in undisturbed ecosystems.

The study suggests that, in general, stream water nitrate concentrations can provide an indication of upland soil solution or groundwater nitrate levels. The authors conclude that undisturbed watersheds have a significant capacity to remove nitrate, but land use changes tend to diminish the efficiency of nitrate removal from watersheds or alter the flow paths of nitrate. (*Journal of Geophysical Research-Biogeosciences*, doi:10.1002/jgrg.20030, 2013) —EB

Italian all-sky imager tracks auroral red arcs over Europe

During geomagnetic storms, stable auroral red (SAR) arcs reach down from polar latitudes, their faint glow stretching equatorward of the traditional auroral oval. Invisible to the naked eye, SAR arcs are an upper atmospheric occurrence produced by the emission of light from oxygen atoms in the thermosphere. The excitation of the ionospheric oxygen that produces SAR arcs is caused, in turn, by the conduction of heat from the magnetospheric ring current. Advances in camera optics, including more sensitive sensors and highly specific filters, have allowed researchers to track the occurrence of SAR arcs, opening a window into the dynamics of the inner magnetosphere.



Joei Wroten

An image, with map grid overlay, of a stable auroral red arc over Europe captured using an all-sky imaging system in northern Italy.

In northern Italy a new all-sky imaging system, described by *Baumgardner et al.*, uses highly sensitive sensors and a fish-eye lens to simultaneously observe SAR arc and faint auroral activity over the majority of Europe. The authors report on the all-sky SAR arc observations made during a geomagnetic storm that took place from 26 to 27 September 2011. Comparing their observations with coincident satellite- and ground-based observations, the authors found that their all-sky imager was able to identify the lowest latitudes where magnetospheric sources can create a SAR arc. They suggest that the detection of a SAR arc, separated from the diffuse ionospheric aurorae, can indicate the region of maximum electron heating from the inner magnetosphere to the ionosphere. They also suggest that the new all-sky imager could be used to help interpret in real time the effect of space weather on radio communications or to help validate space weather modeling efforts. (*Space Weather*, doi:10.1002/swe.20027, 2013) —CS

Evolution of the Qin Mountains as part of the supercontinent Rodinia

The Qinling-Dabie orogenic complex, part of a large east-west mountain range in the heart of China, plays a key role in helping scientists understand the formation and breakup of the supercontinent Rodinia, but the exact configuration and geodynamic history of the Qinling-Dabie orogenic complex and the surrounding region are not fully known. Contributing a piece to the puzzle, *Bader et al.* use uranium-thorium-lead geochronology—both from published studies and new data—to investigate the Neoproterozoic (1 billion years ago to 700 million years ago) evolution of the Qinling-Dabie orogenic collage. The authors outline a tectonic model for evolution of this orogen, placing it into the context of the evolution of Rodinia, which formed around 1 billion years ago and broke up around 700 million years ago. Their synthesis could help researchers gain a more complete understanding of the geologic history of one of Earth's supercontinents. (*Tectonics*, doi:10.1002/tect.20024, 2013) —EB

—Ernie Balcerak, Staff Writer, and Colin Schultz, Writer