RESEARCH SPOTLIGHT

Highlighting exciting new research from AGU journals

Low-impact development boosts groundwater recharge

In San Francisco, as with other places, climate change is threatening to upset the balance the city has struck with the local hydrology. Precipitation in Northern California has already been increasing in winter and decreasing in summer, and projected changes to the behavior of the El Niño–Southern Oscillation hint at more of the same.

While any extra rain may sound like good news for a state currently plagued by drought, the projected increase in extreme winter precipitation events would also cause a host of problems, particularly in urban centers. Pavement and buildings increase overland flow, raising the potential for flash flooding and driving surface pollutants into the water supply. To mitigate against these issues urban planners have turned to "low-impact development," a suite of best practices and tools, such as building infiltration trenches and strategically placing vegetation to capture, filter, and slow down the water.

A suspected side benefit of low-impact development is that it could also work to boost groundwater recharge rates. Using experimental plots at San Francisco State University, *Newcomer et al.* tested how a low-impact development-style infiltration trench compared to an irrigated lawn for turning water inputs into groundwater. The authors found that the recharge efficiency of the infiltration trench, at 58% to 79%, was much higher than that of the lawn, at 8% to 33%.

Although groundwater will certainly be beneficial during San Francisco's increasingly dry summers, sustaining groundwater stores in coastal cities is particularly important long term. As the sea level rises, salt water threatens to infiltrate coastal aquifers. Only by maintaining sufficient groundwater stores can this important freshwater source be maintained. (*Water Resources Research*, doi:10.1002/2013WR014282, 2013) —CS

USGS

Increasing drainage could limit the amount of overland flow and the potential for flash flooding.

Model describes stratospheric condensation nuclei layer

Aerosol particles in the stratosphere, including the small particles known as condensation nuclei, affect atmospheric chemistry as well as how the atmosphere absorbs and scatters sunlight, making them a key component in Earth's climate. A new study by *Campbell et al.* provides the first global three-dimensional model of the source regions of condensation nuclei in the stratosphere.

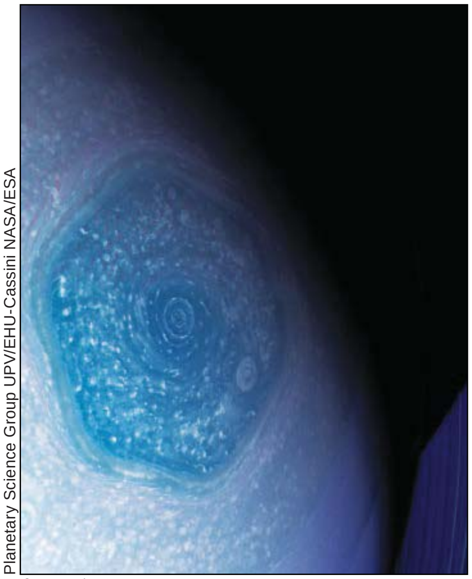
The authors used the National Center for Atmospheric Research's Community Earth System Model, version 1 (CESM1), with the high-top atmosphere component, the Whole Atmosphere Community Climate Model (WACCM), to model the formation of new stratospheric particles that appear in layers between 20 and 30 kilometers. The scientists compared their model with observations, primarily from balloon-borne observations in Antarctica and Wyoming, and found that the model agreed well with the observations.

The study provides new information on the stratospheric aerosol layer. In particular, the model shows that the global average of the number of stratospheric condensation nuclei varies significantly throughout the year and that formation of new stratospheric aerosols above the poles has a strong influence on the global condensation nuclei layer. (*Journal of Geophysical Research: Atmospheres*, doi:10.1002/2013JD020503, 2014) —EB

Polar jet stream could reveal Saturn's rotational period

A hexagon-shaped atmospheric phenomenon first spotted on Saturn by Voyager 1 and Voyager 2 has intrigued scientists since the 1980s. More recently, NASA's Cassini mission has periodically observed the hexagon and its embedded strong eastward jet that rotates at 120 meters per second. Scientists believe that the persistence of the hexagon could put to rest the oft-debated question of the length of Saturn's rotational period.

Sánchez-Lavega et al. have presented an estimate (in Earth hours) of the length of Saturn's day based on data from Cassini and ground-based images. They tracked the movement of Saturn's hexagon for 5.5 years and found that despite large radiative forcing in Saturn's atmosphere, the rotation of the hexagon remained constant. These findings suggest that the hexagon is deeply rooted within Saturn's atmosphere and that its rotational period could reveal the rotational period of Saturn's internal solid body, which the authors estimate as 10 hours, 39 minutes, and 23.01 ± 0.01 seconds. (*Geophysical Research Letters*, doi:10.1002/2013GL059078, 2014) —JW



Planetary Science Group UPV/EHU-Cassini NASA/ESA

Saturn's hexagon in an image taken by the Imaging Science Subsystem (ISS) on board the Cassini spacecraft on 26 February 2013.

Different types of El Niño affect global temperature differently

The El Niño–Southern Oscillation is known to influence global surface temperatures, with El Niño conditions leading to warmer temperatures and La Niña conditions leading to colder temperatures. However, a new study by *Banholzer and Donner* shows that some types of El Niño do not have this effect, a finding that could explain recent decade-scale slowdowns in global warming.

In recent decades, scientists have identified two distinct types of El Niño: the classic El Niño, characterized by warm sea surface temperatures in the eastern equatorial Pacific Ocean, and the central Pacific El Niño, which has peak sea surface temperatures in the central Pacific near the international dateline.

The authors examine three historical temperature data sets and classify past El Niño events as traditional or central Pacific. They find that global surface temperatures were anomalously warm during traditional El Niño events but not during the central Pacific El Niño events. They note that in the past few decades, the frequencies of the two types of El Niño events have changed, with the central Pacific type occurring more often than it had in the past, and suggest that this could explain recent decade-scale slowdowns in global warming. (*Geophysical Research Letters*, doi:10.1002/2014GL059520, 2014) —EB

Accurate estimates of sediment yield difficult to achieve

Sediment yield, the total mass of sediment discharged at a basin outlet during a hydrologic event such as a flood, is difficult to estimate. Scientists have tried to accomplish this task by developing relationships between sediment yield and hydrologic characteristics such as flow volume and peak flow. However, these relationships have generally not been successful at predicting sediment yield because they suffer from nonuniqueness—that is, the same flow and hydrologic characteristics sometimes yield different sediment amounts.

Kim and Ivanov aim to improve understanding of the problem of nonuniqueness in these models using a series of simulated hydrologic events of various rainfall intensities, durations, and lag times between events to determine the effects of rainfall patterns on sediment yield. They propose that in a soil bed with sediment particles of various sizes, the particles can form a sort of shield that in-creases or stops sediment flow in some cases and can lead to a nonunique sediment re-sponse even with similar hydrologic events. Their simulations support this hypothesis, and they conclude that in most cases, accurate predictions of sediment yield may never be possible because obtaining them would require too detailed a characterization of the size of soil bed particles in a basin before a precipitation event. (*Water Resources Research*, doi:10.1002/2013WR014580, 2014) —EB

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