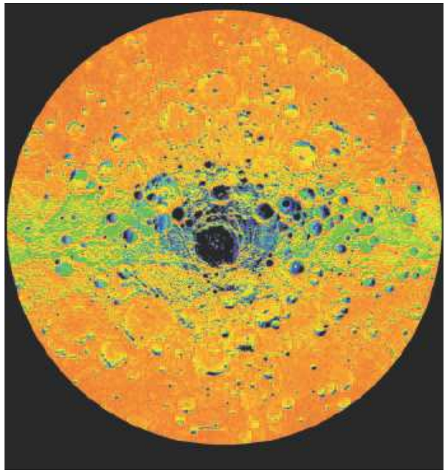
# RESEARCH SPOTLIGHT

Highlighting exciting new research from AGU journals

## New images support proposal for water ice on Mercury

Two decades ago, radio telescope observations showed radar-bright features in Mercury's polar regions. The radar characteristics are similar to those of the icy satellites of Jupiter and at the south polar ice cap on Mars. The radar-bright spots on Mercury were therefore believed to be water ice, and images from MESSENGER provide new support for this idea. MESSENGER, the first spacecraft to orbit Mercury, has provided a view of Mercury's south polar terrain over a full Mercury day that makes it possible to identify areas in permanent shadow. *Chabot et al.* compared the MESSENGER images of craters in the south pole region with the distribution of radar-bright features from previous radio telescope studies. They found that the radar-bright areas do correspond to areas in permanent shadow in the new images. The authors also applied thermal models to confirm that water ice could be stable in these craters if the ice is insulated by a thin covering layer of regolith. The study supports the hypothesis that Mercury's south polar region contains deposits of water ice in permanently shadowed craters. (*Geophysical Research Letters*, doi:10.1029/2012GL051526, 2012) —EB



*Map of fractional illumination of Mercury's south polar region during one Mercury solar day. Blue and purple areas receive little sunlight.*

## An efficient approach to imaging underground hydraulic networks

To better locate natural resources, treat pollution, and monitor underground networks associated with geothermal plants, nuclear waste repositories, and carbon dioxide sequestration sites, scientists need to be able to accurately characterize and image fluid seepage pathways below ground. With these images, scientists can gain knowledge of soil moisture content, the porosity of geologic formations, concentrations and locations of dissolved pollutants, and the locations of oil fields or buried liquid contaminants.

Creating images of the unknown hydraulic environments underfoot is a difficult task that has typically relied on broad extrapolations from characteristics and tests of rock units penetrated by sparsely positioned boreholes. Such methods, however, cannot identify small-scale features and are very expensive to reproduce over a broad area. Further, the techniques through which information is extrapolated rely on clunky and mathematically complex statistical approaches requiring large amounts of computational power.

*Saibaba and Kitanidis* have developed a way to significantly simplify this extrapolation through a mathematical technique that breaks down dense matrices of data into easily digestible blocks. They describe their approach from theory to implementation and demonstrate how results from using their techniques increase computational efficiency while maintaining the accuracy of previous methods for large-scale extrapolations. (*Water Resources Research*, doi:10.1029/2011WR011778, 2012) —MK

## Ross Ice Shelf airstream driven by polar vortex cyclone

The powerful air and ocean currents that flow in and above the Southern Ocean, circling in the Southern Hemisphere's high latitudes, form a barrier to mixing between Antarctica and the rest of the planet. Particularly during the austral winter, strong westerly winds isolate the Antarctic continent from heat, energy, and mass exchange, bolstering the scale of the annual polar ozone depletion and driving the continent's record-breaking low temperatures. Pushing through this wall of high winds, the Ross Ice Shelf airstream (RAS) is responsible for a sizable amount of mass and energy exchange from the Antarctic inland areas to lower latitudes.

Sitting due south of New Zealand, the roughly 470,000-square-kilometer Ross Ice Shelf is the continent's largest ice shelf and a hub of activity for Antarctic research. A highly variable lower atmospheric air current, RAS draws air from the inland Antarctic Plateau over the Ross Ice Shelf and past the Ross Sea. Drawing on modeled wind patterns for 2001–2005, *Seefeldt and Cassano* identify the primary drivers of RAS.

In their analysis of the 150-meter altitude wind field, the authors identified the northward flow of RAS. They found that RAS was more prevalent in winter than summer and that it was most common when there was an atmospheric cyclone over the Ross Sea. The authors suggest that the primary driver for RAS is the pressure gradient established by such atmospheric cyclones. (*Journal of Geophysical Research-Atmospheres*, doi:10.1029/2011JD016857, 2012) —CS

## Vegetation affects hillslope hydrodynamics

Hillslopes are an important part of the hydrological cycle because water from rainfall or snowmelt runs downhill to networks of streams. Understanding hillslope hydrological dynamics is important for flood and debris flow prediction.

However, because hillslopes are highly varied, developing general frameworks for analyzing them is difficult. *Bachmair et al.* compared three hillslopes to try to synthesize understanding of subsurface flow processes at the hillslope scale, focusing on the effect of vegetation. Over a period of 9 months, the researchers compared the dynamics of three hillsopes in the Black Forest in southwestern Germany. The three hillslopes had similar slope, curvature, soil type, and climate but different vegetation cover (grass, coniferous forest, and mixed forest).

The researchers observed clear differences in hydrologic response between the grassland and forested hillslopes. They also observed that water table dynamics varied between the wet fall and winter and the dry summer seasons. (*Water Resources Research*, doi:10.1029/2011WR011196, 2012) —EB

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