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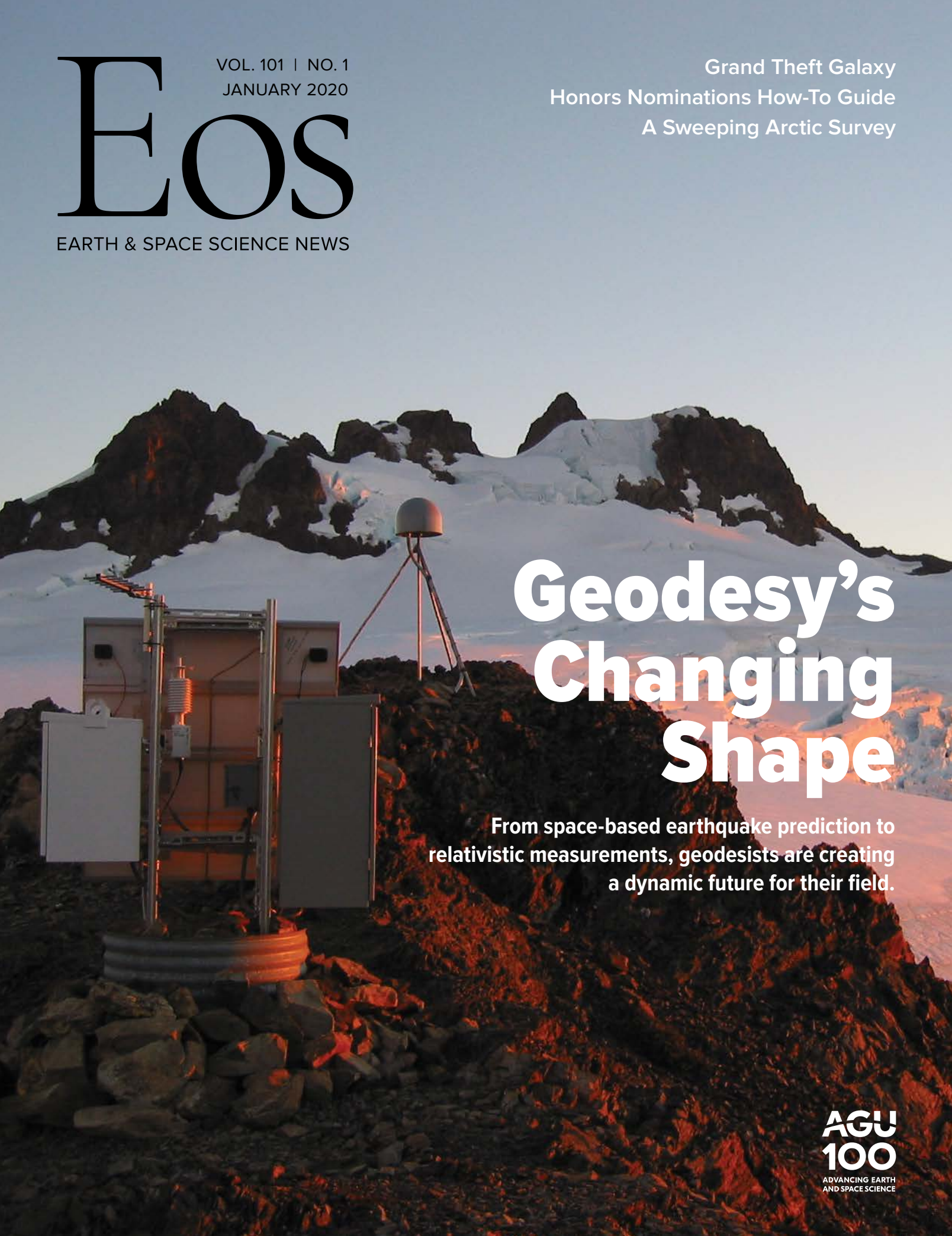

Geodesy's Changing Shape

From space-based earthquake prediction to relativistic measurements, geodesists are creating a dynamic future for their field.

AGU 100
ADVANCING EARTH AND SPACE SCIENCE

Capturing Snowmelt Patterns from Cloudy Satellite Images

Using daily satellite images of snow cover in the Upper Snake River Basin in Wyoming, researchers developed a snowmelt model that could help improve streamflow predictions. Here snow blankets East Gros Ventre Butte, just west of Jackson, in the basin. Credit: Lori Iverson, USFWS, CC BY 2.0 (bit.ly/ccby2-0)

Many regions around the world rely on mountain snowmelt to provide fresh water for a variety of uses, such as irrigation and drinking water. Accurately modeling snowmelt in real time can aid predictions of when and how much water will be released. In a new paper, *Woodruff and Qualls* present a novel strategy for efficiently modeling snowmelt from daily satellite images.

Satellite images easily reveal snowmelt patterns on clear days, but clouds often obscure images captured from space. Existing methods allow scientists to identify and subtract cloud cover from satellite imagery and to discern where snow has melted and where it remains. However, these methods are complex and come with time delays that make them unsuitable for real-time snowmelt monitoring.

The new method addresses the cloud cover problem by leveraging the observation that snowmelt in a given region tends to follow the same spatial pattern from year to year. To develop the approach, the researchers drew on 17 years of daily satellite images of the 8,894-square-kilometer Upper Snake River Basin in Wyoming that were captured by the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard NASA's Terra satellite. The authors combined the images using a data compression method known as principal component analysis. The resulting model efficiently removes cloud cover from satellite images, allowing researchers to map daily snow cover pixel by pixel.

The team tested the model by applying it to satellite images from two additional years. This testing showed that the model reproduces snow patterns with 85%–98% accuracy, even for satellite images with 95% cloud cover. Previously developed methods achieve similar accuracy but are less efficient. The new model accommodates different snow volumes, as well as shifts in the timing and duration of the melting process, as documented by on-the-ground measurements captured by snow telemetry (SNOTEL) instruments.

The authors note that to their knowledge, this is the first means of remotely mapping snow cover that takes advantage of consistent yearly snowmelt patterns. It has a variety of potential applications, such as improving representations of snow cover in climate models and boosting researchers' ability to model streamflows that result from snowmelt. (*Water Resources Research*, https://doi.org/10.1029/2018WR024546, 2019) **—Sarah Stanley,** *Science Writer*

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