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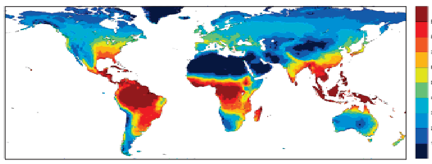
RESEARCH SPOTLIGHT

Highlighting exciting new research from AGU journals

Comparing different land surface heat flux estimates

Land surface heat fluxes are an important component of Earth's energy and water cycle, and quantifying these fluxes can help scientists better understand climate change. These heat fluxes are affected by factors such as cloud cover, precipitation, surface radiation, air temperature, and humidity. Different methods are used to estimate monthly mean land surface heat flux.



As part of an intercomparison study of different land surface heat flux products, researchers created this map showing the all-product annual average land surface latent flux (in watts per square meter) for 1994.

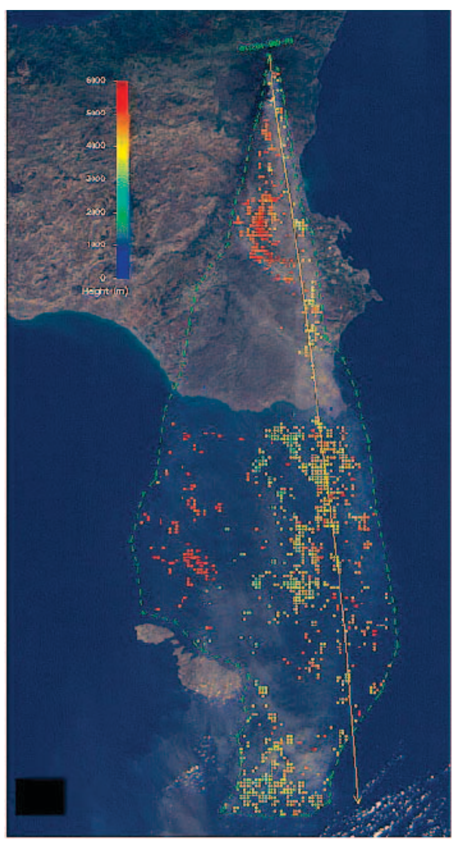
To determine how well these different methods agree with one other, *Jiménez et al.* present a detailed global intercomparison of 12 such products for the period 1993–1995. Some of these products are based on combining global satellite-based data and physical formulations, while others come from atmospheric reanalysis and land surface models. The authors found that although there were some differences among the products, the products all captured the seasonality of the heat fluxes as well as the expected spatial distributions related to major climatic regimes and geographical features. Furthermore, the products correlate well with each other in general, in part due to large seasonable variability and the fact that some of the products use the same forcing data. (*Journal of Geophysical Research-Atmospheres*, doi:10.1029/2010JD014545, 2011) —ET

Three-dimensional ash cloud observations could help aviation

In the spring of 2010 the Icelandic volcano Eyjafjallajökull erupted, sending a towering column of ash floating above the North Atlantic Ocean. The ash cloud shut down air traffic over much of Europe, significantly affecting the European economy. Although Eyjafjallajökull was one of the more recent, prominent displays of the effects of volcanic ash, similar disturbances are felt in the shadows of active volcanoes the world over.

To ensure the safety of both planes and passengers, regulators rely on ash cloud dispersal models to forecast areas that might be affected by an active volcano. The models use measurements of meteorological conditions and ground-or satellite-based observations of ash plumes to forecast the expected path and size of the cloud. Unfortunately, the two-dimensional plume observations used as inputs typically lack information that could significantly improve the forecast, such as details of the volcanic cloud's vertical extent.

In an attempt to improve forecasting accuracy, *Scollo et al.* used observations from the Multiangle Imaging Spectroradiometer (MISR) to produce three-dimensional reconstructions of ash cloud geometry. MISR, which flies aboard NASA's polar-orbiting Terra satellite, takes images across multiple angles and wavelengths using a suite of nine cameras and can be used to derive plume height, erupted mass, and the size distribution of fine particles—among the most sensitive inputs for ash dispersal modeling. The researchers found good agreement between observations made by MISR and model simulations produced using independent two-dimensional field data of two past eruptions of Mount Etna, a volcano in Italy. These results lend credence to the idea of using MISR for improving the reliability of particle dispersion forecasts and helping to mitigate the threat of volcanic eruptions to aviation. (*Journal of Geophysical Research-Atmospheres*, doi:10.1029/2009JD013162, 2010) —CS



Multiangle Imaging Spectroradiometer view of the Mount Etna volcano plume on 27 October 2002. The image shows wind-corrected heights (color coded), the digitized plume outline (green line), and the average wind direction (yellow line).

Low solar irradiance may not be the primary driver for the Little Ice Age

Total solar irradiance (TSI), essentially a measure of the amount of light the Sun puts out, varies with the 11-year sunspot cycle and influences Earth's climate, especially when TSI is notably higher or lower than its average values. It had been thought that TSI was especially low during a period known as the Little Ice Age, which began in the late seventeenth century and coincided with a period of unusually low sunspot activity known as the Maunder Minimum. However, *Schrijver et al.* now suggest that TSI during that period may not have been as low as previously thought. They analyzed direct measurements of solar magnetic activity during the recent 2008–2009 period of low sunspot activity, which they argue was similar to the activity level during the Maunder Minimum.

They found that even when there were no sunspots, the Sun had a baseline level of magnetic activity. This baseline had not been taken into account in previous estimates of TSI during the Maunder Minimum, which were based solely on sunspot numbers. Therefore, the authors suggest that earlier estimates of the TSI during the Maunder Minimum were too low. The researchers argue that the Maunder Minimum probably had levels of magnetic activity and TSI similar to 2008–2009 values, and therefore factors other than low solar irradiance resulting from low sunspot activity must have contributed to the Little Ice Age. (*Geophysical Research Letters*, doi:10.1029/2011GL046658, 2011) —ET

The traveling rings of the North Brazil Current

The North Brazil Current (NBC) moves northward along the northeastern coast of Brazil. Drawing from the South Equatorial Current and the outflow of freshwater from the Amazon River, the NBC carries warm, nutrient-rich water north of the equator. Up near the coast of French Guiana, part of the NBC makes a hard right, flowing east along the equator. Once in a while the turn is especially sharp and the current loops around, pinching off an independently traveling parcel of ocean water. This portion of current travels northwest with a clockwise rotation, moving through the ocean like a Frisbee™ travels through air.

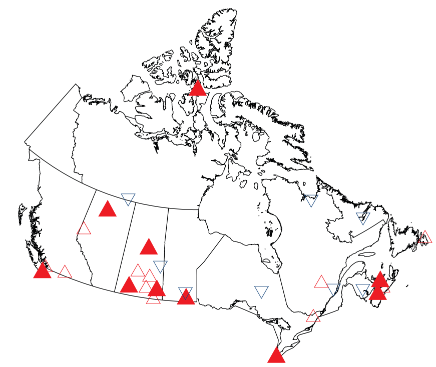
These current rings have been known to exist for decades, but knowledge of their basic properties such as size, speed, depth, and rotation velocity is limited. Drawing on current profiles from both shipboard and stationary instruments, *Castelão and Johns* describe the basic properties of 10 rings sampled between 1998 and 2000. The authors find that the rings are best described as solid, clockwise-rotating parcels of water enclosed within a band of lower-speed water that tends to shield them from the surrounding environment.

For many of the rings the sea surface height increases parabolically toward the center, reaching to 38 centimeters above the surrounding ocean. The inner core can be more than 300 kilometers across, and the outer edge of the core can have a maximum speed of more than 1 meter per second. Overall, the NBC rings seem to be bigger, faster, and taller than previous observations suggested. (*Journal of Geophysical Research-Oceans*, doi:10.1029/2010JC006575, 2011) —CS

Soil temperature trends in Canada

Global warming increasingly is becoming a concern for society. Most reported warming trends are based on measured increases in air temperatures. However, trends in soil temperatures, also an important indicator of climate change, are less often reported. *Qian et al.* analyzed soil temperature data from 30 climate stations across Canada covering the period from 1958 to 2008; the data cover soil temperatures at several depths up to 150 centimeters. They also analyzed air temperature, precipitation, and snow cover depth at the same locations.

During that time period, rising soil temperatures were generally associated with rising air temperatures, and snow cover depth generally decreased, although there were variations between the sites. The researchers found that at about two thirds of the stations, soil temperatures at depths below 5 centimeters showed a warming trend over the 50-year record. Many sites showed a significant positive trend in average spring and summer soil temperatures but not in winter soil temperatures. Because snow insulates the ground, keeping soil warm, the trend of declining snow depth explains why winter soil temperatures did not show a warming trend. The median warming rate in spring for soil at all depths was about 0.3°C per decade. (*Journal of Geophysical Research-Atmospheres*, doi:10.1029/2010JD015012, 2011) —ET



Trends of monthly mean soil temperature across Canada in May at a depth of 100 centimeters for the period 1958–2008. Red and blue triangles show positive and negative trends, respectively. Solid triangles indicate trends significant at the 5% level.

—COLIN SCHULTZ and ERNIE TRETKOFF, Staff Writers