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Soil Moisture in Ethiopia

NASA Earth Observatory

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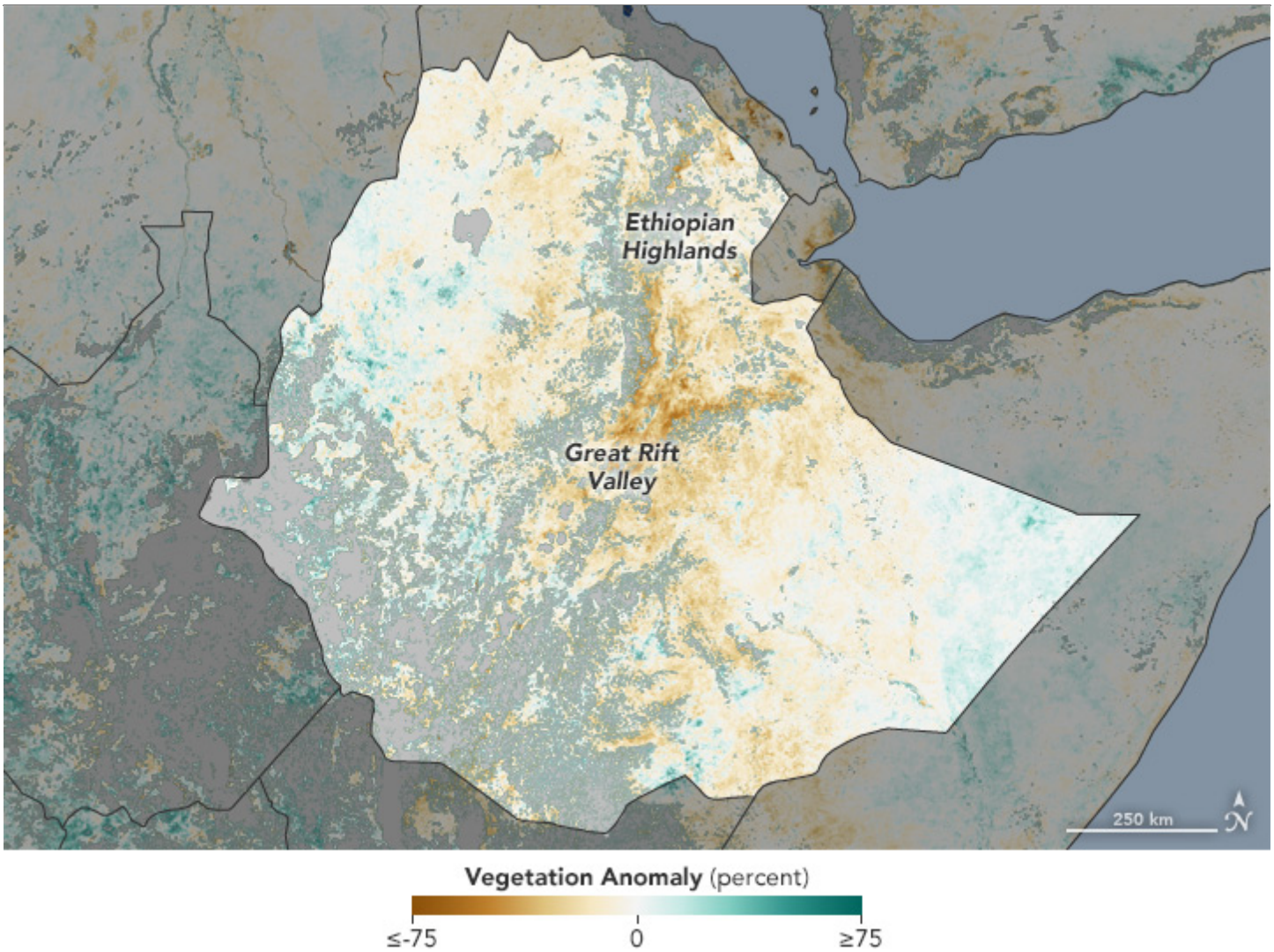
In 2015, Ethiopia endured its worst drought in decades. While there is some indication that this April has been drier than normal in some areas, the intensity of the drought this year will not be clear until later in 2016.

For now, satellite data can help show the conditions on the ground that are relevant for agriculture. Ethiopia is now in its second crop season—the “belg”—a short rainy season from March to May. Successful harvest of belg crops depends on adequate rainfall.

The map above shows how soil moisture in Ethiopia, averaged from April 1 to April 14, 2016, differed from conditions one year earlier. The map is based on data from NASA’s Soil Moisture Active Passive (SMAP) satellite, which can estimate soil moisture in the surface layer—the top 5 centimeters of the ground. That data, combined with other information such as temperature and previous rainfall amounts, can be used to estimate the amount of moisture even deeper—from the surface down to 1 meter. This so-called “root zone” is where the roots of most plants access water. Green indicates areas where root zone soil became wetter during the two-week period in April 2016; red areas became drier. (The resolution is about 9 kilometers per pixel.)

“The distinction between surface and root zone is also important in terms of the memory associated with the two layers,” said Rolf Reichle, a SMAP scientist at NASA Goddard. “Naturally, it takes much longer to recover from an anomaly in the much thicker root zone layer. In the context of droughts, a single rainstorm, no matter how large, isn’t enough to break the drought. But it could well fill up the surface layer to saturation.”

The belg rains came early in 2016. By starting in February, the rain allowed planting in the highlands to be underway by March, when the belg usually begins. It remained to be seen how and when plants would respond to early April’s relatively wetter root zone conditions in the highlands. At the time, satellite data indicated that vegetation in many areas of Ethiopia was still under more stress than usual, visible in the map below.



Map is based on data from the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite. The map shows the NDVI anomaly.

One way to gauge growing conditions is by analyzing the Normalized Difference Vegetation Index (NDVI), a measure of how plants absorb visible light and reflect infrared light. Drought-stressed vegetation is less green, and satellites, through NDVI measurements, can pick up on this.

The second map is based on data from the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite. The map shows the NDVI anomaly: it contrasts vegetation health from March 29 to April 5, 2016, relative to the long-term average from 2000–2015. Brown areas show where plant growth, or "greenness," was below normal. Greens indicate vegetation that is more widespread or abundant than normal for the time of year. Grays depict areas where reliable data were not available, usually due to cloud cover.

Most of the country's food is produced during the main growing season, the "meher," which is a longer rainy season that begins in June and runs through at least August. While it remains to be seen what the 2016 meher will bring, the effects of the 2015 drought are still being felt. According to news reports, more than 10 million Ethiopians are relying on food aid, and others need farming supplies to revive the area's agriculture.

Correction: This image and caption were updated on April 27, 2016, to show 2016 minus 2015 conditions (as opposed to 2015 minus 2016 conditions), and to show soil moisture throughout the root zone (as opposed to just the surface layer).

- **References**

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NASA Earth Observatory images by Joshua Stevens and Jesse Allen, using SMAP L4 data courtesy of JPL, GSFC, the National Snow and Ice Data Center, and the SMAP science team, and MODIS NDVI data. Caption by Kathryn Hansen.

Instrument(s):
SMAP
Aqua - MODIS

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