Citizen scientists help NASA researchers understand auroras

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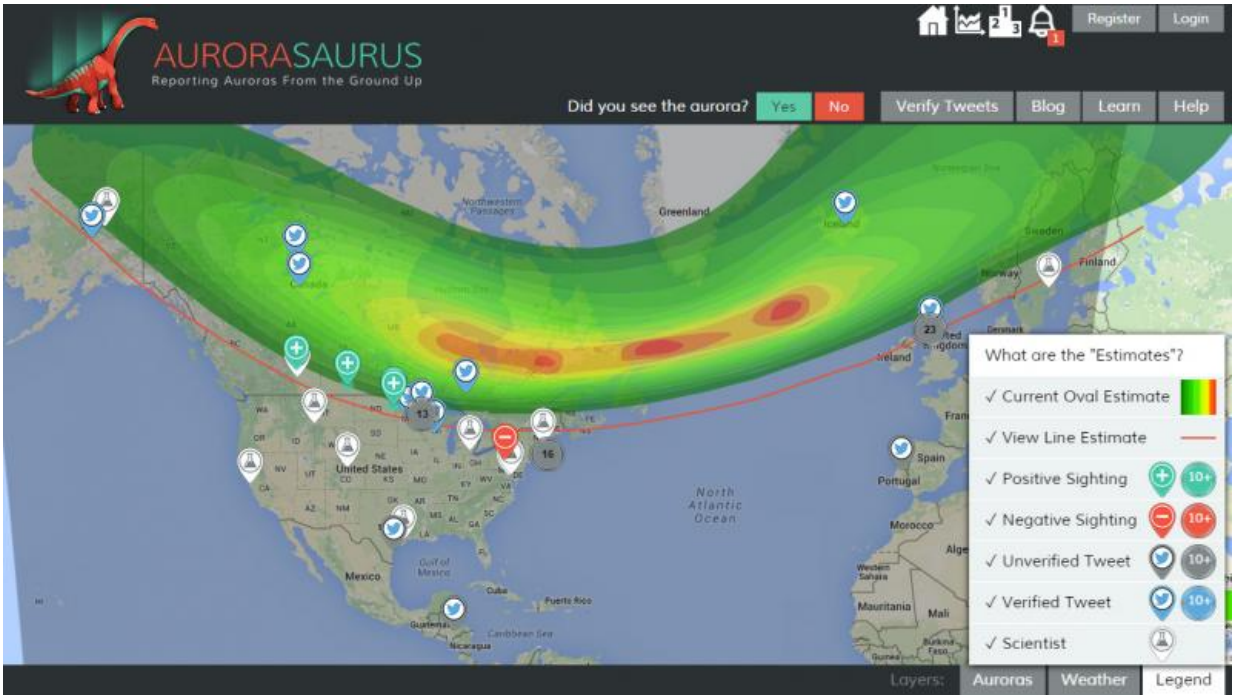

This is a screenshot of the Aurorasaurus map that the public can see by logging onto aurorasaurus.org. The map shows an aurora storm on March 6, 2016. Citizen scientists reported seeing aurora in the midlands of England, the north coast of the Netherlands, and areas in the United States such as Maine, New York, Minnesota and North Dakota. The green, yellow and red areas show the current oval estimate. Green plus signs mean positive sightings. Blue Twitter icons mean verified tweets. Credit: Aurorasaurus

Space weather scientist Liz MacDonald has seen auroras more than five times in her life, but it was the aurora she didn't see that affected her the most.

On the evening of Oct. 24, 2011, MacDonald was sitting in front of her computer at her home in Los Alamos, New Mexico. Forecasts predicted a geomagnetic storm would hit Earth that night and potentially create beautiful aurora. The aurora didn't come to Los Alamos, but MacDonald was still amazed—not by any bright, dancing lights in the sky, but by the number of aurora-related tweets on her computer screen.

People across the eastern United States, from Alabama to Chicago, tweeted about seeing the aurora in real-time. This storm became one of the first wide-scale documentations of aurora activity with social media.

After witnessing the viral response, MacDonald, now at NASA's Goddard Space Flight Center in Greenbelt, Maryland, founded Aurorasaurus—a citizen science project that tracks auroras through the project's website, mobile apps and Twitter. For the first time, citizen science observations are being used in a concerted effort to track auroras in real-time.

Since inception, Aurorasaurus and its users have documented some of the biggest and recent aurora displays. In a study published online on March 3, 2016, in AGU's Space Weather journal, the team found that citizen scientists are regularly able to spot auroras farther south of an area where prediction models indicated.

"Using these observations, we can make better short-term predictions of when and where the aurora is for aurora enthusiasts—and scientists," said MacDonald.

Improving Science with Citizen Reports

Improving forecasts and studying auroras are important because auroras are features of geomagnetic storms. While geomagnetic storms can lead to beautiful auroras, they can also cause power outages and interrupt satellite systems. Though many satellites study the sun and near-Earth space environment responsible for auroras, predicting precisely where, when and how strongly the dancing natural light display—and the geomagnetic storm—will occur on Earth is challenging. One reason is because large geomagnetic storms occur infrequently so scientists do not have as much data on them.

Aurorasaurus can help provide more data points in the form of citizen science observations. Sky watchers can submit their aurora sightings directly to aurorasaurus.org or use the free Aurorasaurus mobile apps. The project also searches Twitter using keywords to find aurora-related tweets. Users can then confirm or deny these crowdsourced tweets. The submitted observations and verified tweets are displayed on a global map showing real-time auroral visibility.

The map also includes a "view-line" that predicts where a person should see the aurora based on the National Oceanic and Atmospheric Administration's OVATION Aurora Forecast Model. After a certain number of users have reported aurora sightings in a local area or near the view-line, Aurorasaurus sends out notifications to nearby registered users.

Citizen scientists have helped track auroras worldwide with their observations. On St. Patrick's Day on March 17, 2015, many sky gazers around the world were entranced by a supersized geomagnetic storm—one of the biggest of the past decade—that lit the sky with red, purple and green auroras. Users from the United Kingdom, Germany, Poland and the northern to mid-United States, including Pennsylvania, Virginia and Colorado, reported more than 160 aurora sightings and verified more than 250 reports from Twitter. The project sent out 361

notifications during the St. Patrick's Day storm.

After analyzing 500 citizen science aurora observations during March and April 2015—encompassing the St. Patrick's Day storm and several smaller storms—the team found that many people reported seeing the aurora further equatorward (that is, farther south in the Northern Hemisphere, and farther north in the Southern Hemisphere) than the OVATION Prime model suggests. The team now incorporates the citizen science observations to improve the aurora view-line on the project's map.

"Without the citizen science observations, Aurorasaurus wouldn't have been able to improve our models of where people can see the aurora," said the study's lead author, Nathan Case, a previous Aurorasaurus team member and now a senior research associate at Lancaster University, United Kingdom. "The team is very thankful for our community's dedication and are excited to have more people sign up."

More Participants, More Possibilities

With a larger number of actively participating users, Aurorasaurus can be a great research tool in other disciplines. For example, information scientists from Pennsylvania State University are analyzing Aurorasaurus as a prototype early warning system for emergency responders.

Although an aurora isn't an emergency or dangerous, the phenomenon has similar qualities as emergencies that can happen without much notice and can be observed over a large area. When a certain number of users in an area report seeing an aurora via social media, the project sends out notifications to other registered users notifying them of the sight.

As part of the Aurorasaurus mission, the project also posts educational material such as blog posts on space weather, quizzes and infographics

on their website. Users will also see a solar wind power graph that shows the level of auroral activity on Earth in the next hour.

"The short term vision for Aurorasaurus is to become an interactive hub for aurora enthusiasts at the intersection of citizens and science," said MacDonald. "Long term, this engaged community can be sustained and evolve together—and the tools can be expanded to be useful in other disciplines within our technological society."

Provided by NASA's Goddard Space Flight Center