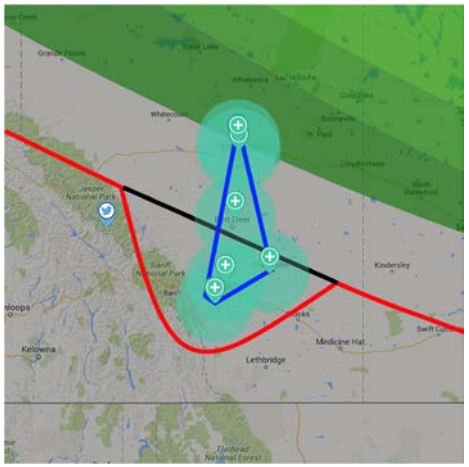
NASA Heliophysics Citizen Science Project Aurorasaurus is Changing Aurora Science, including Predicting Real-Time Models of Aurora Visibility

Case, N. A., D. Kingman, and E. A. MacDonald (2016). A REAL-TIME HYBRID AURORA ALERT SYSTEM: COMBINING CITIZEN SCIENCE REPORTS WITH AN AURORAL OVAL MODEL. Earth and Space Science, 3, 257–265, doi:10.1002/2016EA000167.

For hundreds of years, aurora sightings have left people intrigued – for both their beauty and unpredictability. Space weather events, such as coronal mass ejections, can impact Earth's magnetic field resulting in geomagnetic storms, which can trigger aurora. Although we can't yet fully predict space weather events, we do have some aurora prediction models that use measures or, more often, estimates of the disturbances in the Earth's magnetic field. Detecting these events gives us some warning that aurora may appear, but current models can only make general estimates regarding where aurora might appear, not specifically where they will. These models are also based on averages for large areas of Earth's surface and because of this, are not very precise. Accurate forecasting of aurora requires understanding the complex, dynamic system of interlinking space weather events and how they affect Earth. If we can more fully understand this link then we may be able to better prepare for other side effects of geomagnetic storms, such as fluctuations in our power grids and blackouts in our satellite communications systems.



This screenshot is showing a positive cluster of aurora sightings triangulated in blue. The black line indicates where the view line would have been had there been no citizen scientist data reported. The red line shows how the view line adapts to the cluster of positive sightings. This screenshot shows activity on 3 February 2016.

A paper on a hybrid aurora alert system that combines one of these aurora prediction models with real-time sightings from the citizen scientist project Aurorasaurus into a "nowcasting" system, founded by GSFC Heliophysics scientist Liz MacDonald, was recently published in *Earth and Space Science*. The Aurorasaurus project has been collecting data since November 2014. This hybrid system has already led to useful scientific contributions to aurora science. For instance, the Aurorasaurus aurora 'view lines' in both the Northern and Southern Hemispheres are more equatorward because of the significant number of citizen scientist reports confirming aurora sightings outside of the previous leading model's 'view line' estimates. Because these citizen scientist reports of aurora provide more localized, real-time information of where aurora can be seen, they are also helpful in learning more about the conditions around aurora sightings themselves. Aurorasaurus users can report both positive and negative sightings; negative sightings can inform us where cloud cover or light pollution may be obstructing the view of the aurora. These kinds of negative reports help in developing more accurate alerts.

Aurorasaurus also employs a unique algorithmic implementation of the alerts, which is being used for the first time to help 'nowcast' auroral visibility. The Aurorasaurus aurora alert system is a two-tier system with the first level alert issued to registered users whose profile location is within an area where at least three reports of aurora have been collected over a 90 minute period, referred to as a positive cluster. A Level 2 alert is issued to any registered users poleward of the view line that the model predicts. So far, the system has issued over 100,000 alerts of auroral visibility, including nearly 200 highly localized Level 1 alerts, to over 2000 citizen scientist users. The system will continue to improve and be tested as more users report.