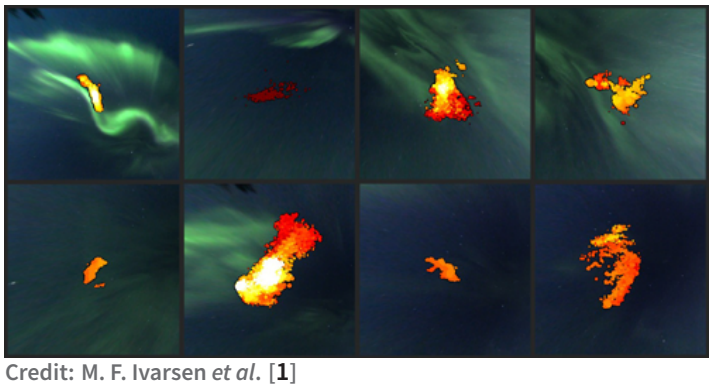
Tracking the Chaos That Surrounds the Aurora

Applying data mining tools to a rich observational dataset has enabled researchers to track the turbulent plasma clouds that accompany the aurora.

By **Susan Curtis**

The dazzling light show of the aurora appears in the night sky when charged particles ejected from the Sun's surface interact with Earth's atmosphere. Those dancing lights are accompanied by turbulent clouds of plasma that form in the lower ionosphere, around 100 km from the ground, which act to dissipate the energy brought to Earth by the solar wind. In recent years a new generation of digital radars has enabled scientists to capture 3D images of these plasma clouds, but their chaotic behavior has made it challenging to isolate and track their movement. Now researchers from Norway and Canada have developed an automated data-processing technique that can reveal the speed and direction of the plasma structures, clearly showing that they closely follow the motion of the auroral lights [**1**].

The technique exploits an established machine learning algorithm for decoding complex 3D datasets that is used, for example, in self-driving cars to locate and avoid moving obstacles. This algorithm clusters the data on the basis of the proximity of individual data points in a space defined by two or more variables, which can reveal structural features that are buried in the raw data.



Credit: M. F. Ivarsen *et al*. [**1**]

The researchers apply this clustering technique to 3D observational data recorded by the ICEBEAR digital radar in Saskatchewan, Canada, which can capture around 200,000 images every second. While their analysis shows that the clouds generally track the aurora, they find that the clouds can move back and forth at considerable speeds around this overall trajectory during the most intense auroral events. The researchers attribute this unusual motion to a significant strengthening of the local electric field, which is caused by energetic particles from the Sun interacting with Earth's atmosphere.

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REFERENCES

1. M. F. Ivarsen *et al.*, "Point-cloud clustering and tracking algorithm for radar interferometry," **Phys. Rev. E 110, 045207 (2024).**