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The North Dakota Dual Aurora Camera (NoDDAC), a student-led citizen science project: one-year retrospective, future developments, and scientific potential

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Undergraduate student showcase

Construction of the North Dakota Dual Aurora Camera (NoDDAC) to aid in citizen science and space weather applications

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Wayne Barkhouse[1]

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motivation

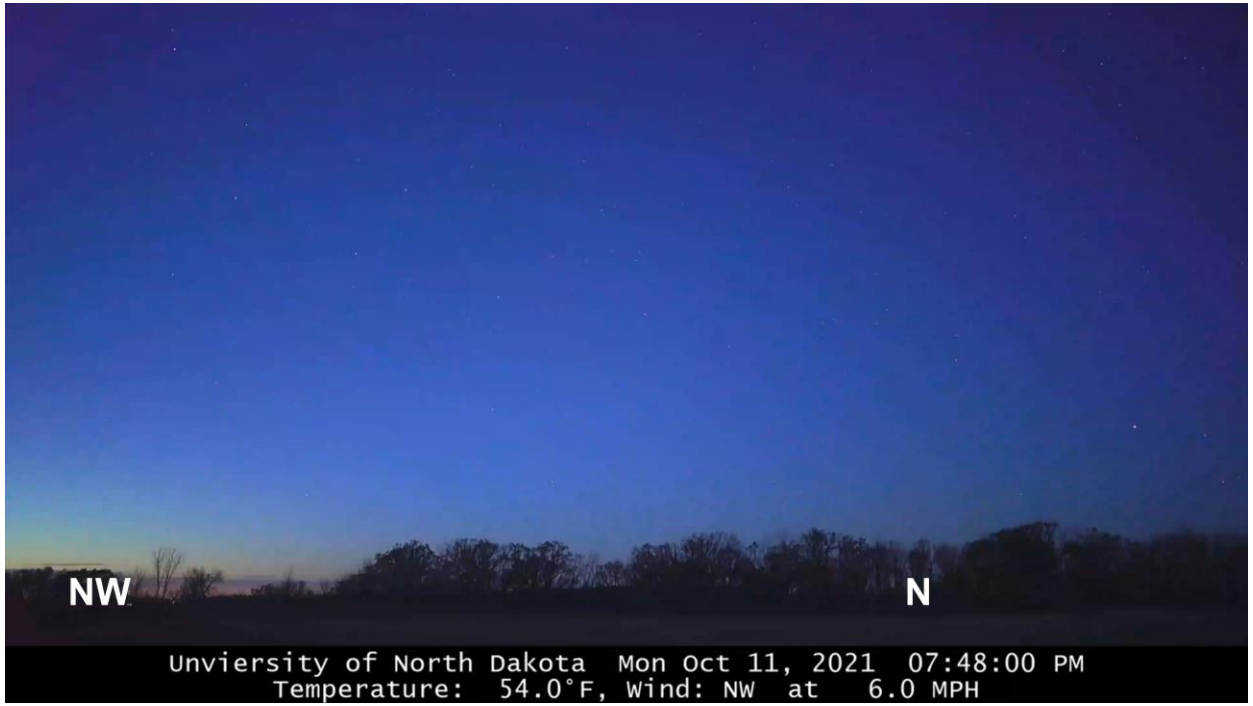
An aurora camera in North Dakota provides a unique mid-latitude perspective to benefit scientists and aurora chasers.

- There is a deficit of aurora cameras in mid-latitudes
- Aurora cameras have many benefits
  I. Aurora chasers can access ground-truth data
  II. Scientists have more robust data from a unique mid-latitude perspective
  III. Camera images can be used for a variety of citizen science applications
- Aurora cameras help solve accessibility issues for aurora chasers

Noddac – an overview

NoDDAC is a “dual” aurora camera consisting of a north-facing video camera and allsky stills camera.

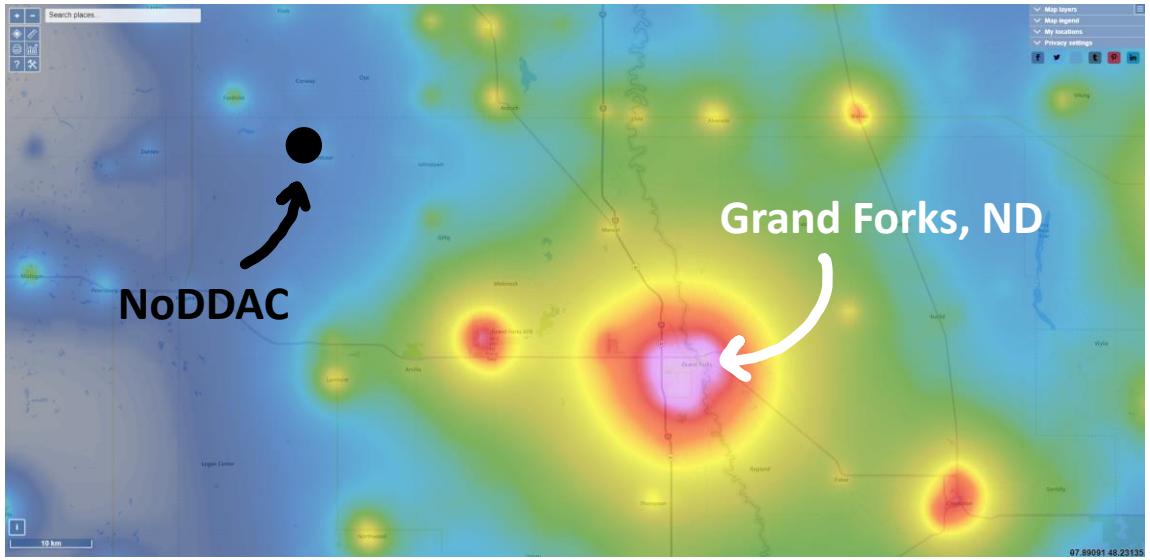
- Emphasis on accessibility and open data
  - YouTube aurora livestream
  - Publicly-accessible image archive
  - COTS equipment
- Incorporates Aurorasaurus citizen science
- Platform for community engagement



location

NoDDAC is located at Martens Observatory, a facility owned and operated by the Department of Physics and Astrophysics at UND.

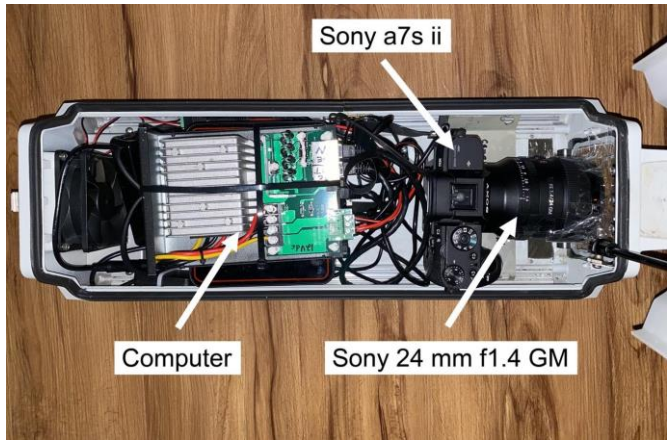
- Onsite power and internet
- 48.1°N latitude
- Bortle-2 dark sky location



North-facing camera

A Sony a7s ii camera and Sony 24 mm f/1.4 GM lens livestreams HD video of the northern sky to YouTube and uploads images to a publicly-accessible FTP server.

- Use case: aurora detection, public resource, high framerate recording
- Camera – capable of recording aurora in real-time
- Lens – 84o field of view; wide aperture to gather light
- Video settings: 1/4 s, f/1.4, Auto ISO, 1920x1080 resolution
- 12 MP stills captured every 60 seconds and uploaded to an FTP server

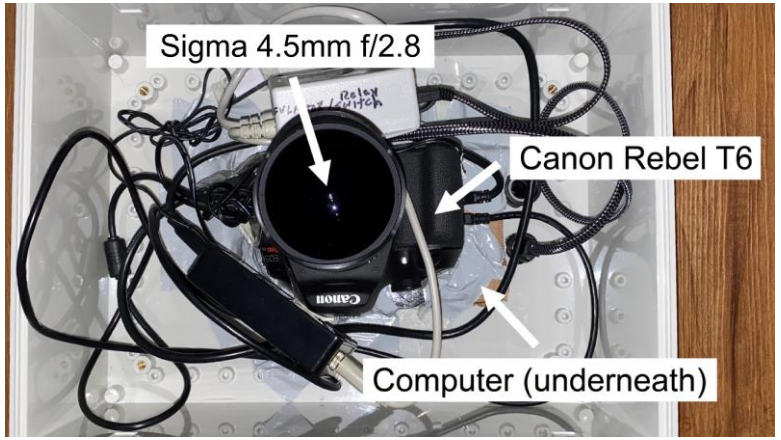


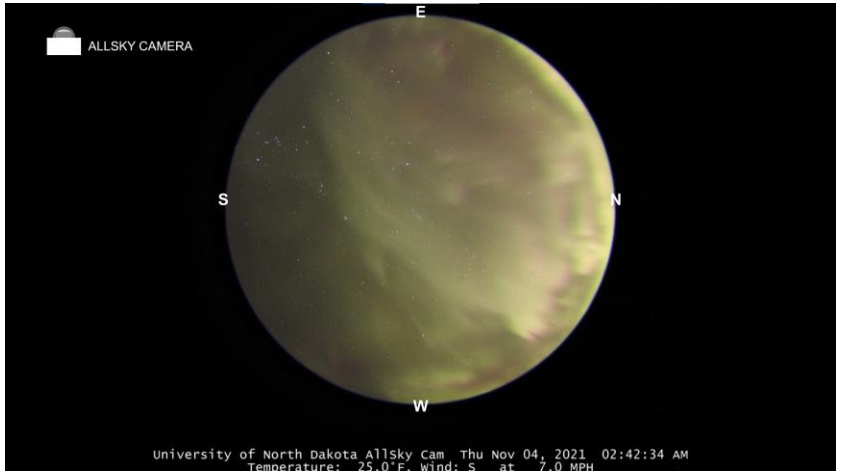
North-facing camera

Allsky camera

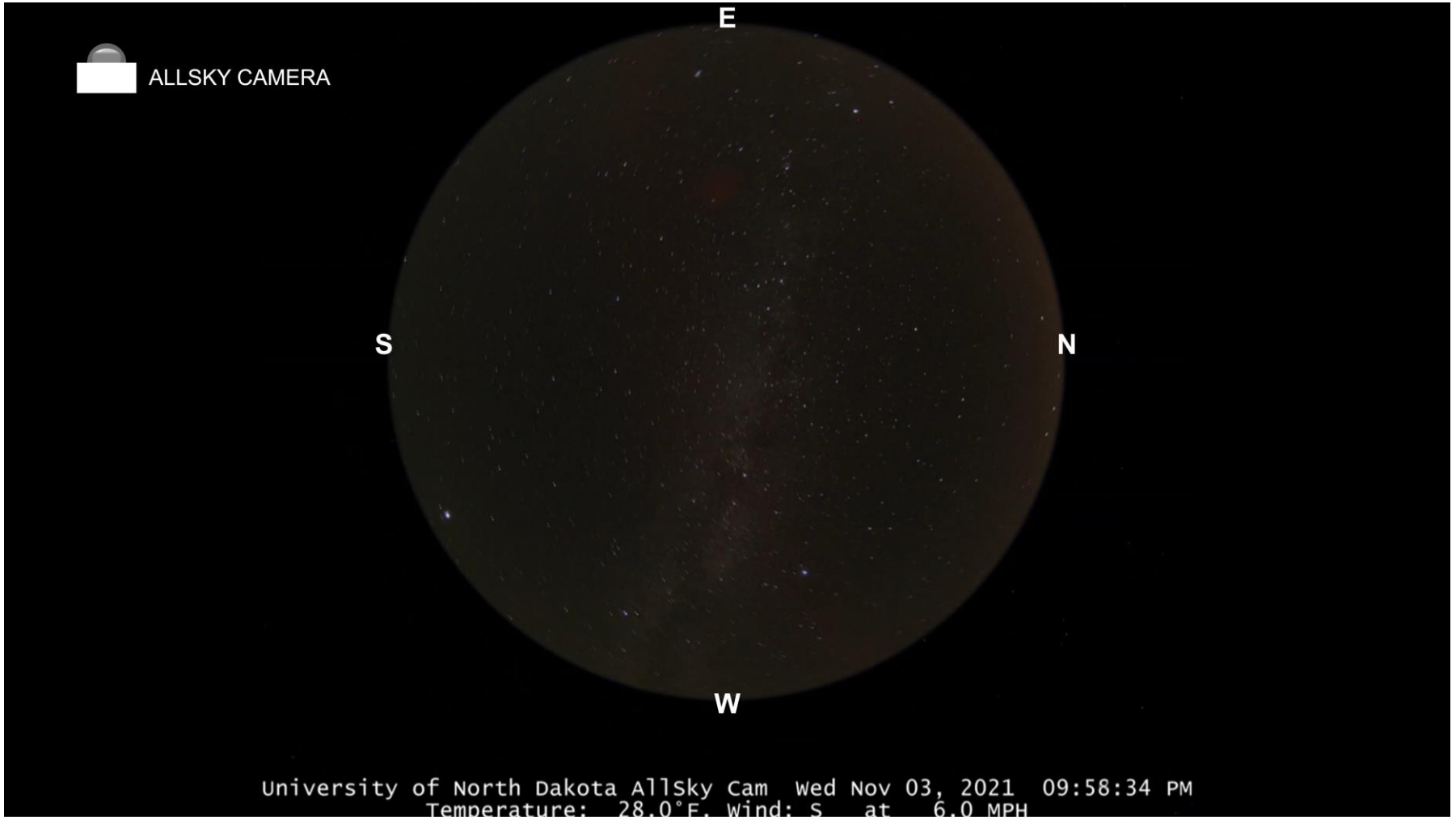
A Canon Rebel T6 camera and Sigma 4.5 mm f/2.8 lens capture images of the entire sky which are uploaded to a publicly-accessible FTP server.

- Use case: cloud cover, larger auroral displays, and subauroral phenomena (STEVE).
- Camera – 18 MP; low-cost solution
- Lens - ≈ 160o field of view
- Camera settings: 30s, f/2.8, Auto ISO; images captured every 2 minutes
- JPEGs uploaded to FTP server





Allsky camera



Supporting hardware and software

Supplied by the LiveAuroraNetwork, both cameras are housed in PELCO enclosures and run IPTimelapse software to control camera functions.

- PELCO enclosures contain Intel NUC computers
  - Weatherproof
  - Uses POE to minimize cables
  - Remote power cycling
- IPTimelapse controls the cameras
  - Automated twitter activity:
    - Daily timelapses
    - Aurora detection
  - Livestream function
  - Auto-upload images to FTP

Aurorasaurus citizen science

NoDDAC tweets an image of aurora when spotted, and in the future, the Aurorasaurus platform will display these tweets on their auroral oval map.

- North-facing camera detects aurora using IPTimelapse
- Tweets will be incorporated into Aurorasaurus algorithm
- Future capabilities:
  - Permanent icon displayed on auroral oval map
  - Live video clip displayed with alert

A collaborative effort

NoDDAC is a unique partnership between a university, citizen science project, and commercial aurora livestreaming service.

- Partnership leverages strengths from each stakeholder
- University connection promotes student research opportunities
- Aurorasaurus involvement drives citizen science efforts, aurora scientific expertise, and provides access to an innovative platform with public impact
- LiveAuroraNetwork provides expertise in aurora livecams and technical guidance

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AURORASAURUS
Reporting Auroras From the Ground Up

LIVE AURORA NETWORK

Community impact

NoDDAC is a vital resource for aurora chasers.

- In principle:
  - Mid-latitude location means NoDDAC can help many aurora chasing groups
  - Interpreting auroral activity from cameras may be easier for the public to understand compared to interpreting solar wind or magnetometer data
  - Twitter and YouTube accounts promote community engagement
- In practice:
  - NoDDAC Twitter account has over 500 followers.
  - On 10/31/21 and 11/03/21 (active aurora nights), the YouTube livestream was viewed over 100,000 times.

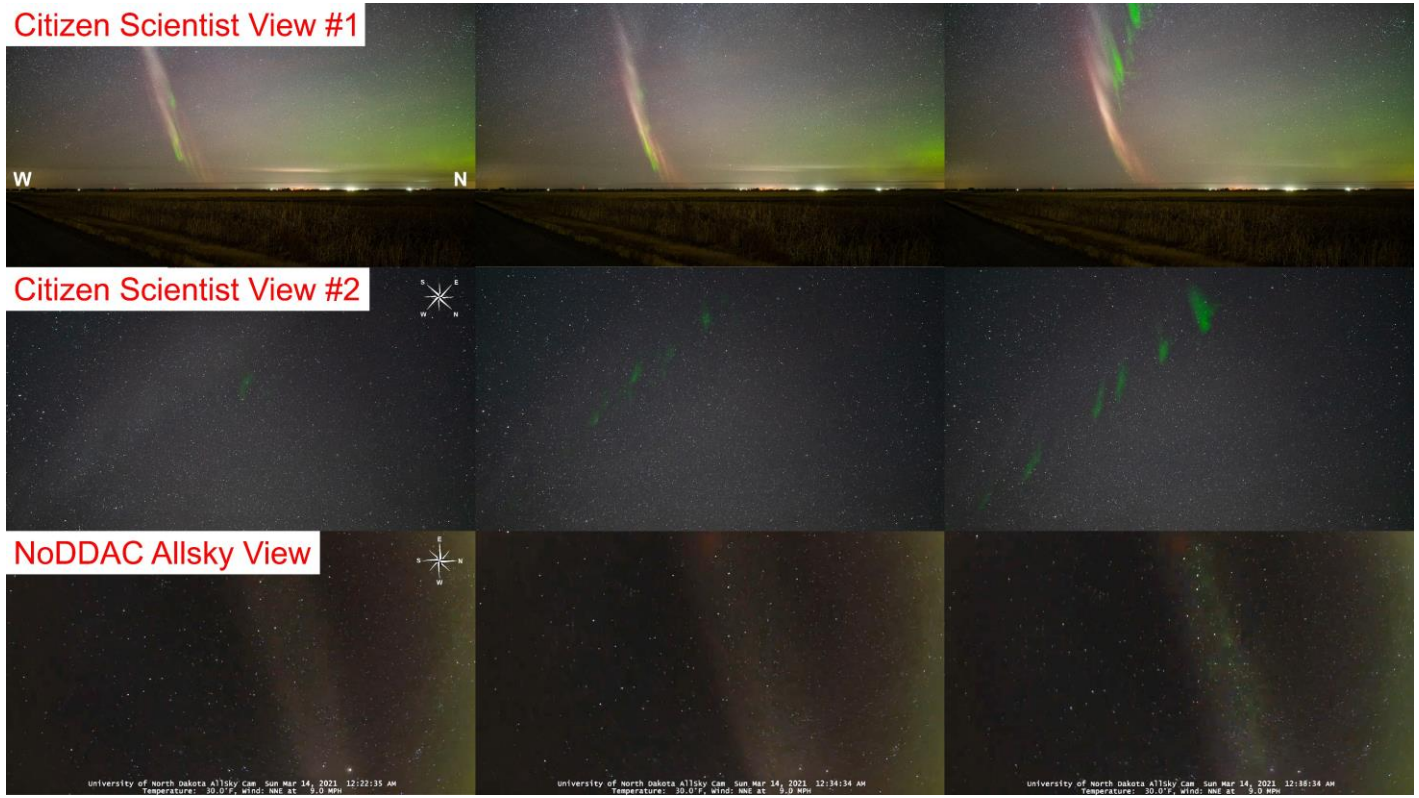
Science capabilities

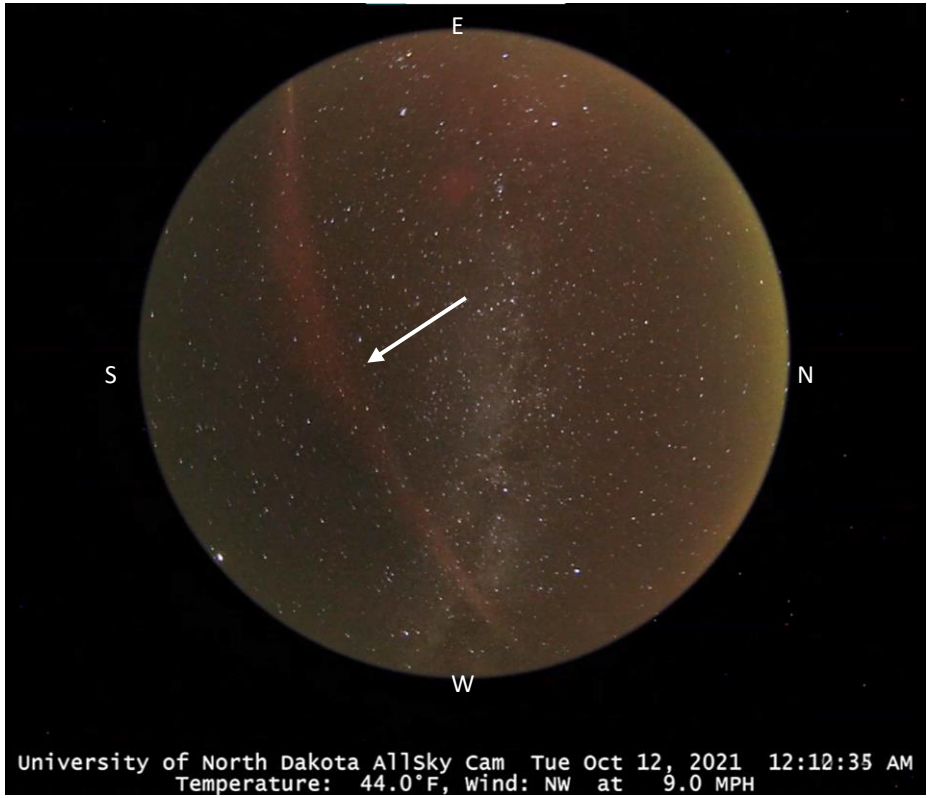
NoDDAC's mid-latitude perspective and dual cameras make it primed to detect and analyze unique auroral phenomena.

- Mid-latitude perspective gives important data during large geomagnetic storms
- Anomalous phenomena (i.e. STEVEs, SAR arcs, dunes) can be easily observed
- Features appearing in both field of views can be analyzed for height and spatial extent
- High frame-rate video on the north-facing camera can capture fast-moving aurora and fine structures.
- Nearby magnetometers and weather stations may be used for correlative studies

STEVE SIGHTINGS

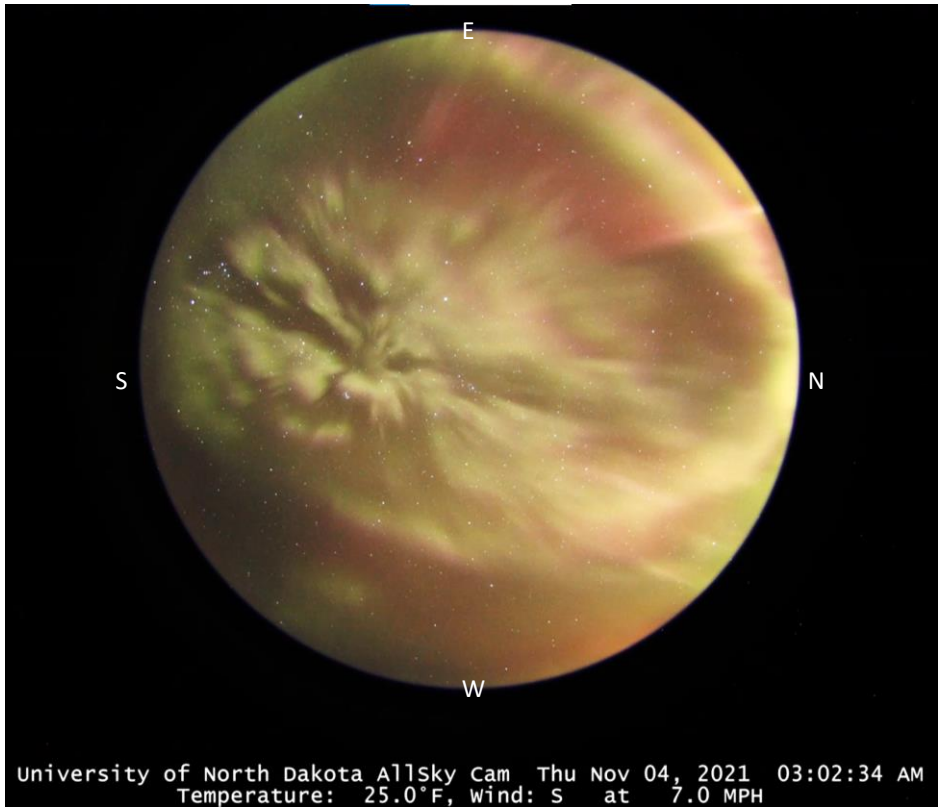
NoDDAC has observed STEVEs which could be used in scientific and citizen science settings.
Left: March 14, 2021; Right: Oct. 12, 2021





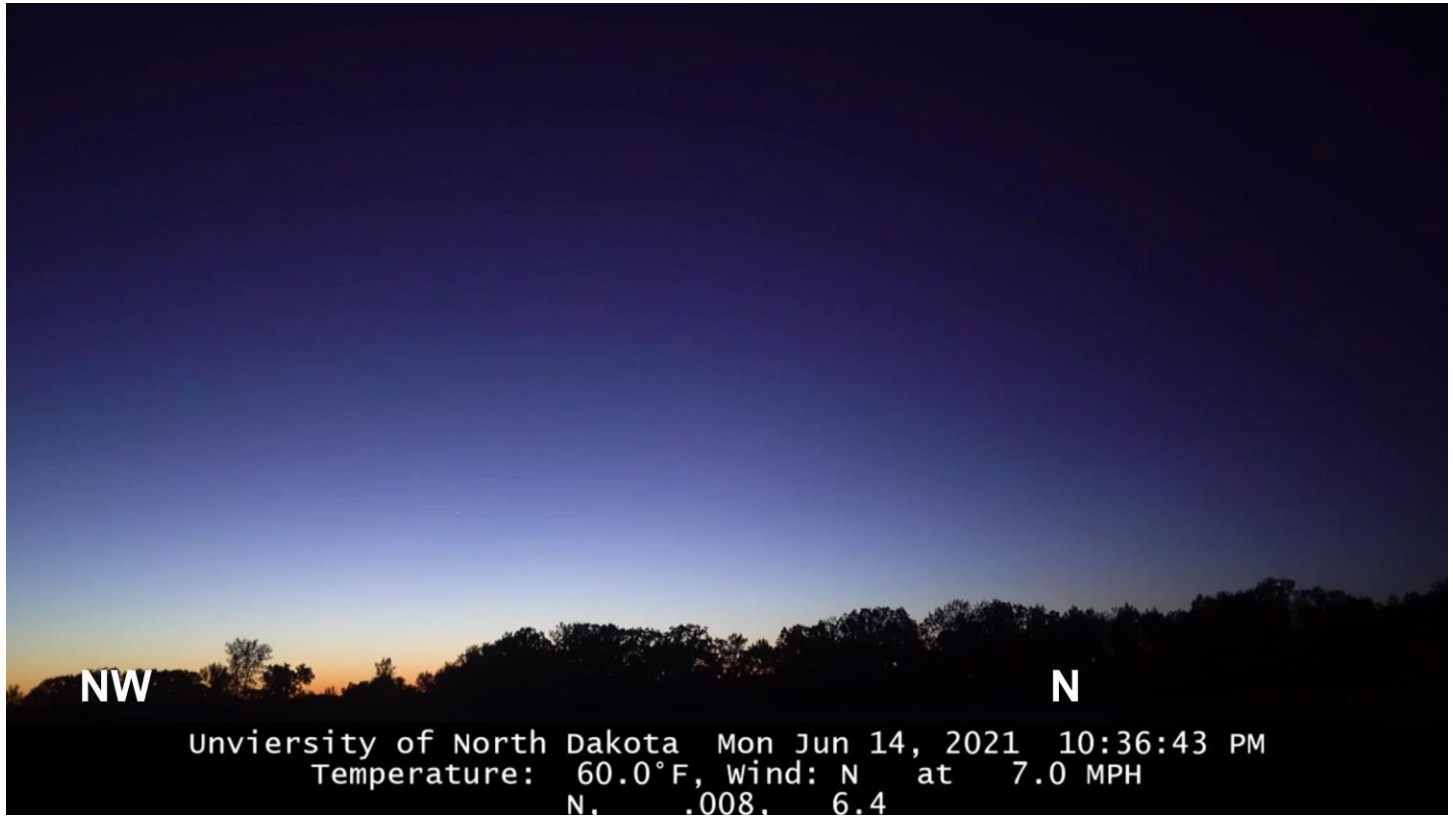
Geomagnetic storms

NoDDAC has observed over 30 auroras the first year of operation, including a spectacular G3 geomagnetic storm on Nov. 3-4, 2021.



Noctilucent clouds

NoDDAC observed noctilucent clouds during the summer of 2020, demonstrating its versatility and use case beyond aurora spotting. This example is from June 14.



Future plans

We will improve the accessibility of NoDDAC data and live feeds and seek collaborations with science efforts and other relevant citizen science projects.

- Create NoDDAC webpage with project overview, live image feeds, and links to image database
- DOIs for image sequences of strong aurora and anomalous phenomena
- Comprehensive statistics for aurora seen in North Dakota
- Advanced integration with Aurorasaurus citizen science

Thank you for your attention

Any questions, feedback, or proposals?

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