Intelligent All-sky Cameras for Dense Mesoscale Observations: From Field Trials to Operational Pilots

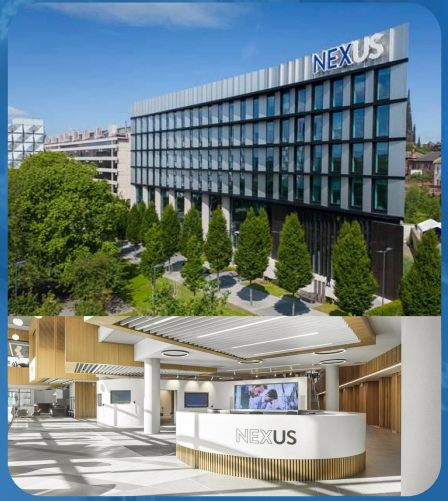
Dr. Ben Pickering, Director, Wx Labs Ltd

5th May 2026

Hello Wx Labs

Mission

Accelerate the skill of weather prediction through novel observing technologies



Wx Labs

Five Principles

1) Open-source Guarantee:
if company can no longer serve customers—publish all IP.

2) Observations are the operational bedrock of meteorology and climate science.

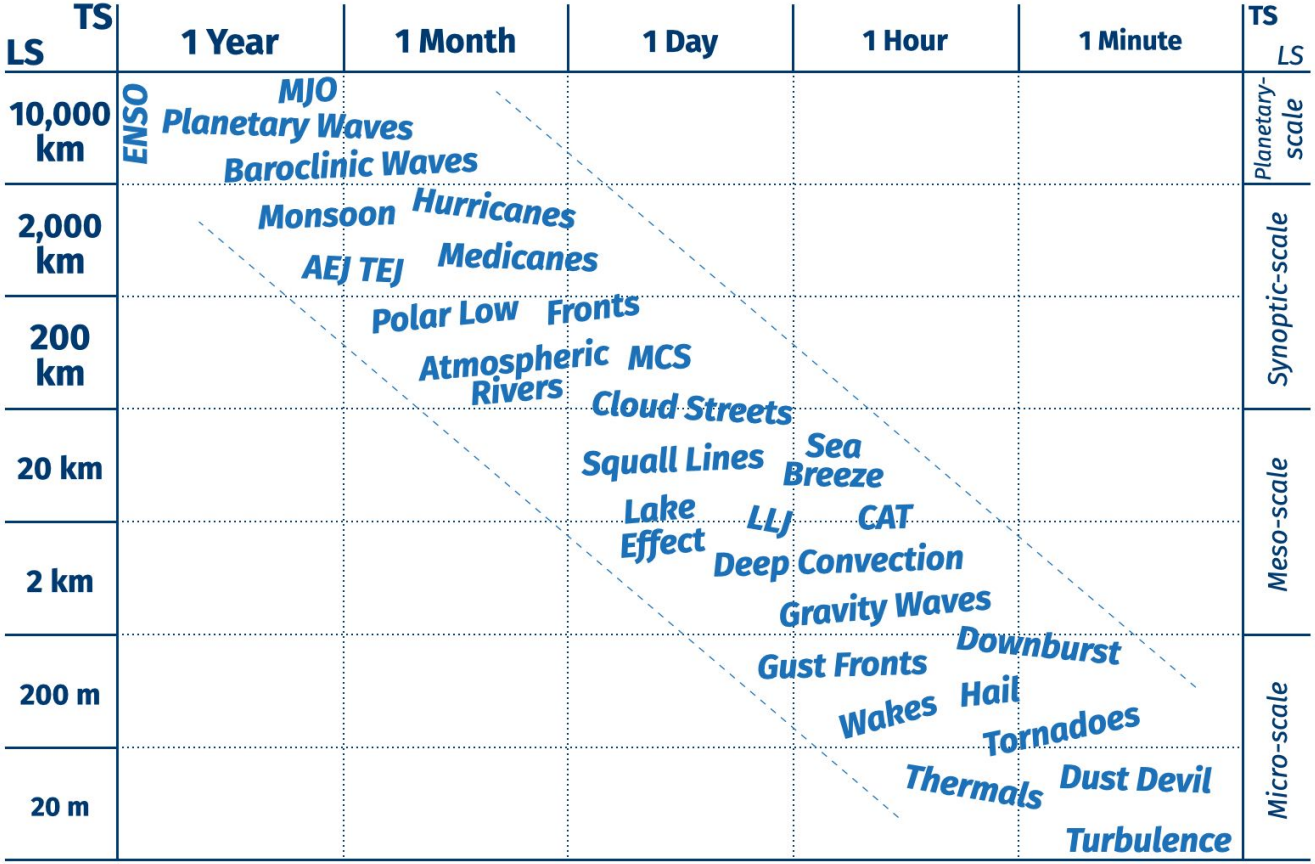
3) Vertical integration—a unified, passionate team with a highly focussed mission.

4) Holistic approach; build systems not things.

5) High operational efficiency for low overheads, thus lower product costs, and a greater global reach.

EGU26 ben.pickering@wxlabs.co.uk linkedin.com/in/wxUAS

The Observing ~~Gap~~ Opportunity



Adapted from Orlanski 1975. BAMS, http://www.jstor.org/stable/26216020

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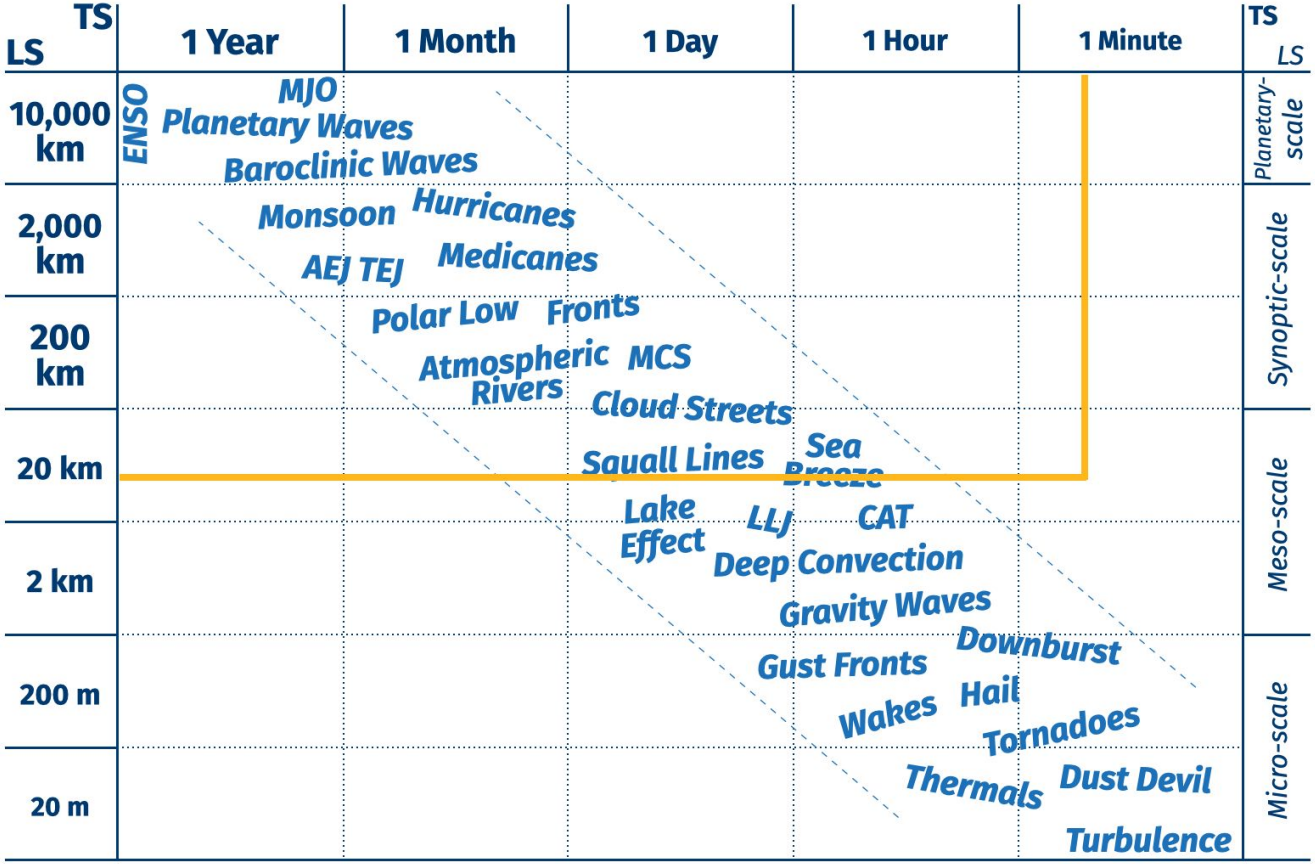

Station spacing average for Oklahoma Mesonet, UK Met Office SYNOP, and SwissMetNet

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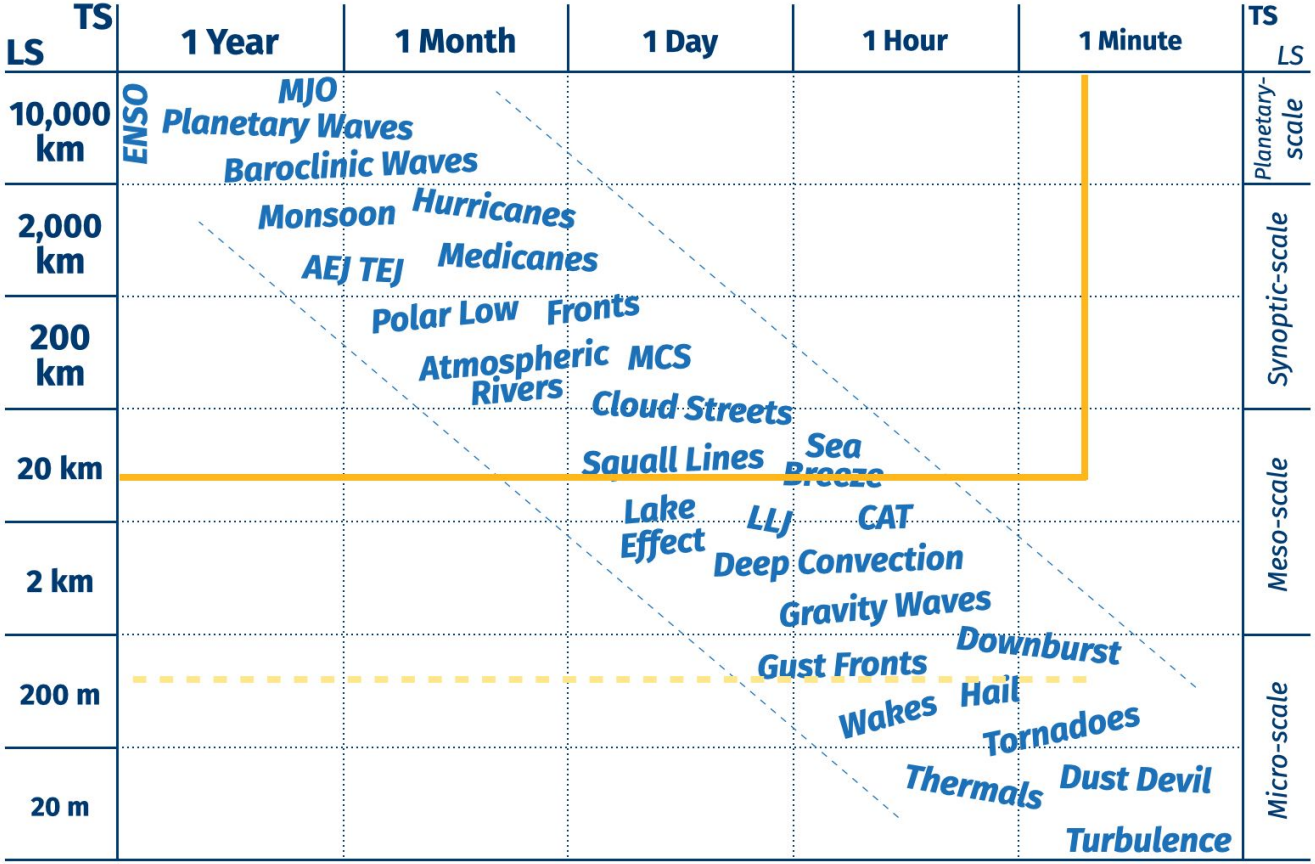

The Hectometric era is coming

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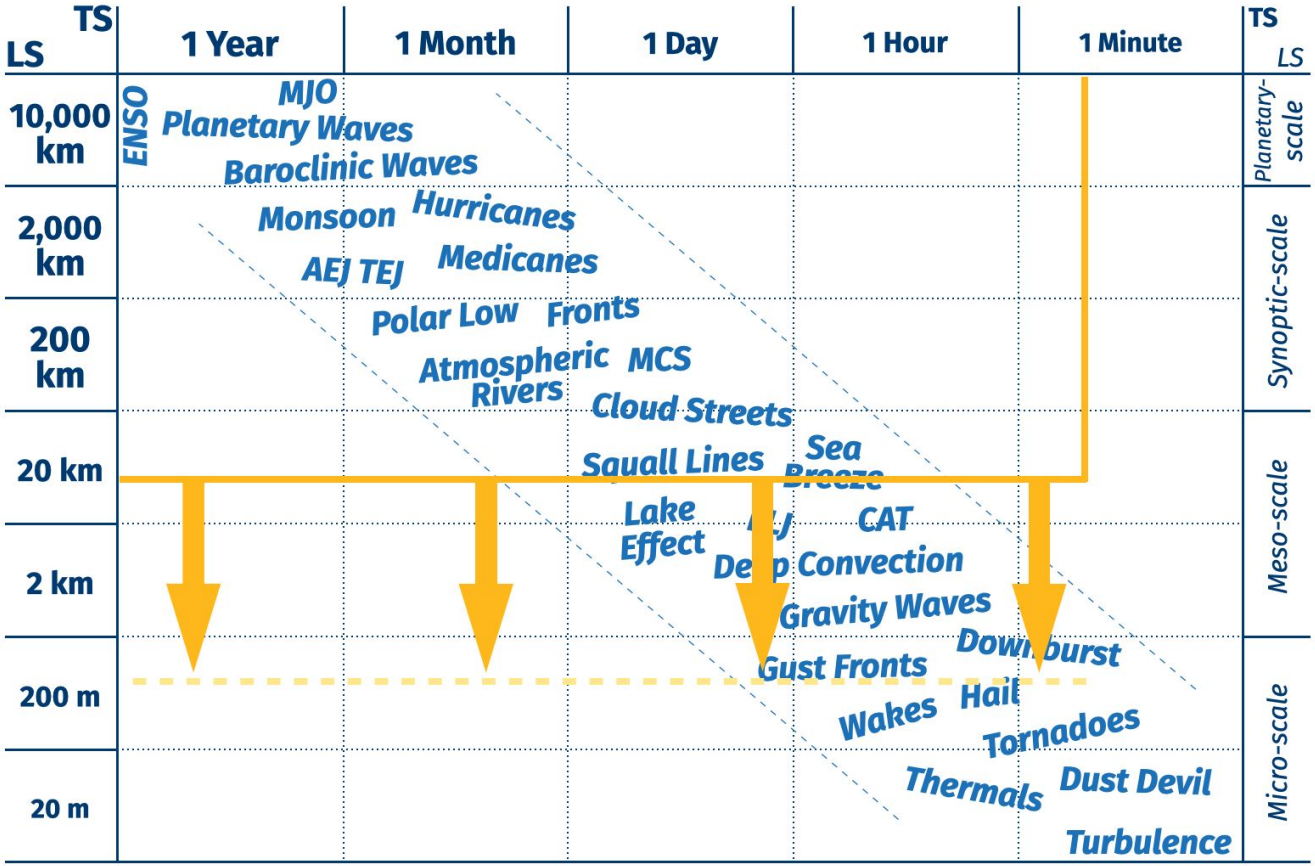

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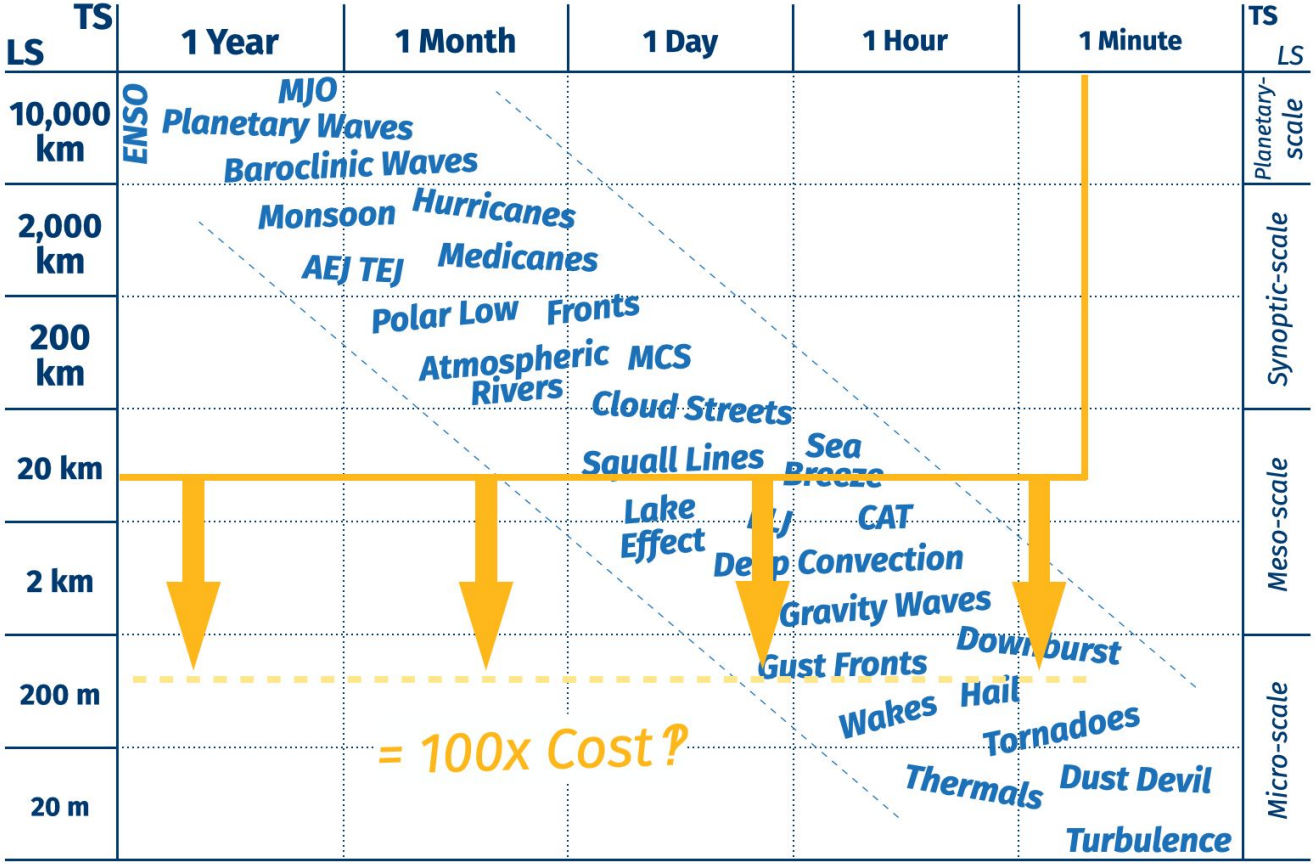

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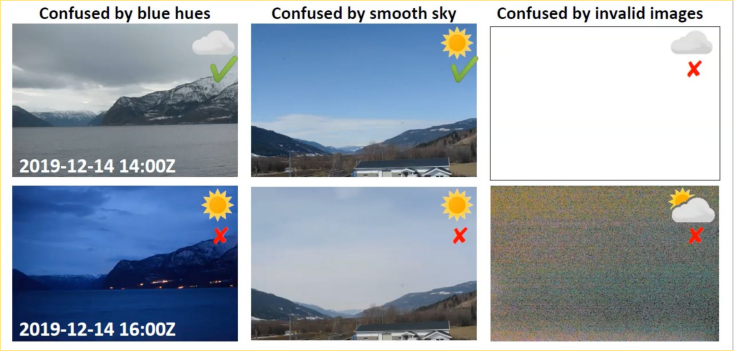
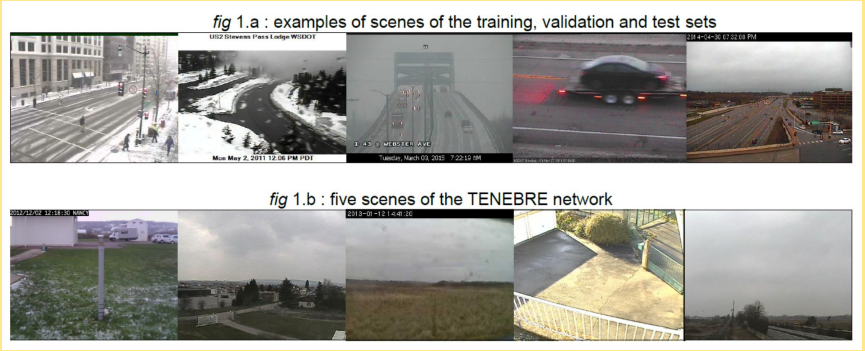
What about Webcams?



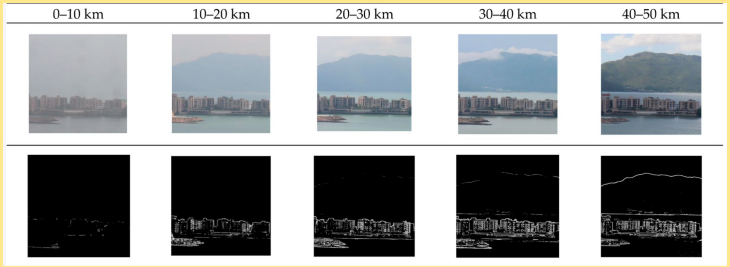
Nipen et al., 2020, AMS 100th Conference



Lepetit et al., 2020. 10th Conf. on Cli. Informatics [hal-02926386v1]

Challenges -> Solutions

1. Image FOV/res differences -> **Standardise**
2. Fraction of sky observed -> **All-sky Camera**
3. Lack of weather context -> **Co-locate Wx Sensors**
4. Class imbalance/long-tail -> **Deploy at Scale**



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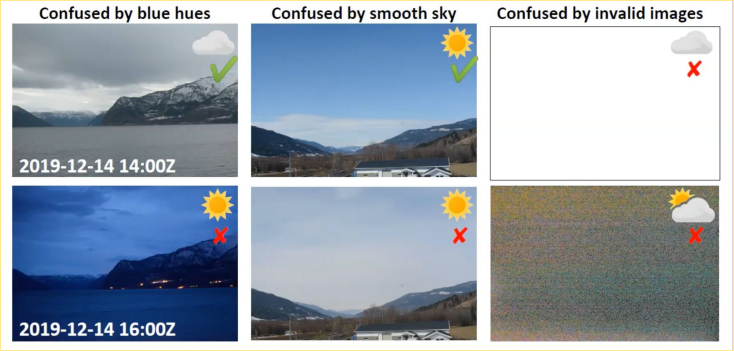

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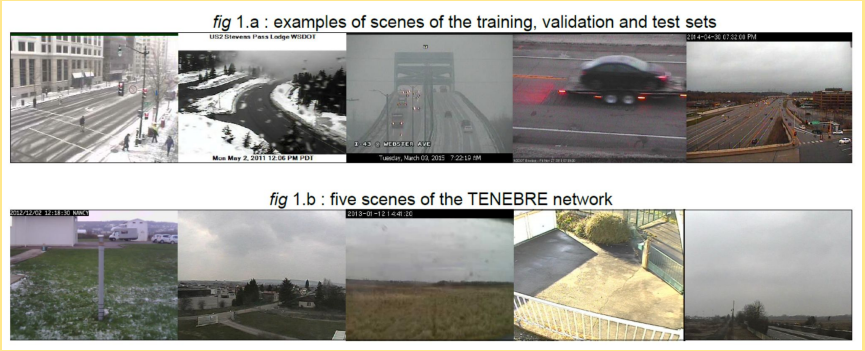

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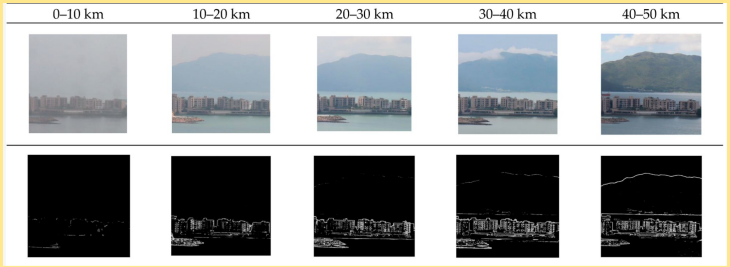
An Opportunity Exists for Improvement



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Introducing WxVision

360x180° All-sky 7.3 MP Camera

Back-illuminated CMOS

7.3 MP effective sky resolution

0.06° pixel angular resolution (sun/moon 9 px ∅)

~10 W dome heater for condensation

Lightning Detection

40 km range in 14 increments

Unibody Stevenson Screen

White exterior, black interior (opposing spiral)

Simplified manufacture, strong, locally printable

Single cable for Power & Data

Power over Ethernet (PoE+ IEEE 802.3at)

Used widely in CCTV, routers, ecosystem of accessories

Local-hosted web app, cloud server optional

OTA software updates

Pressure

Absolute accuracy 0.5 hPa [1]

Relative accuracy 0.03 hPa [1]

Aspirated Temperature and RH

Absolute accuracy up to ± 0.1 ºC and up to ± 1% [1]

Aspiration vastly improves accuracy + response time (<10s)

[1] Typical accuracy claimed by manufacturer under lab conditions. Real world will be greater and site-dependent. Real-world intercomparison ongoing, contact for collaboration.

2D sonic anemometer compatible with WxVision base is in early development. Acoustic + visual precipitation estimation is in concept phase. Contact for collaboration.

Webcam vs. All-sky Camera

Demo: Equirectangular PANO

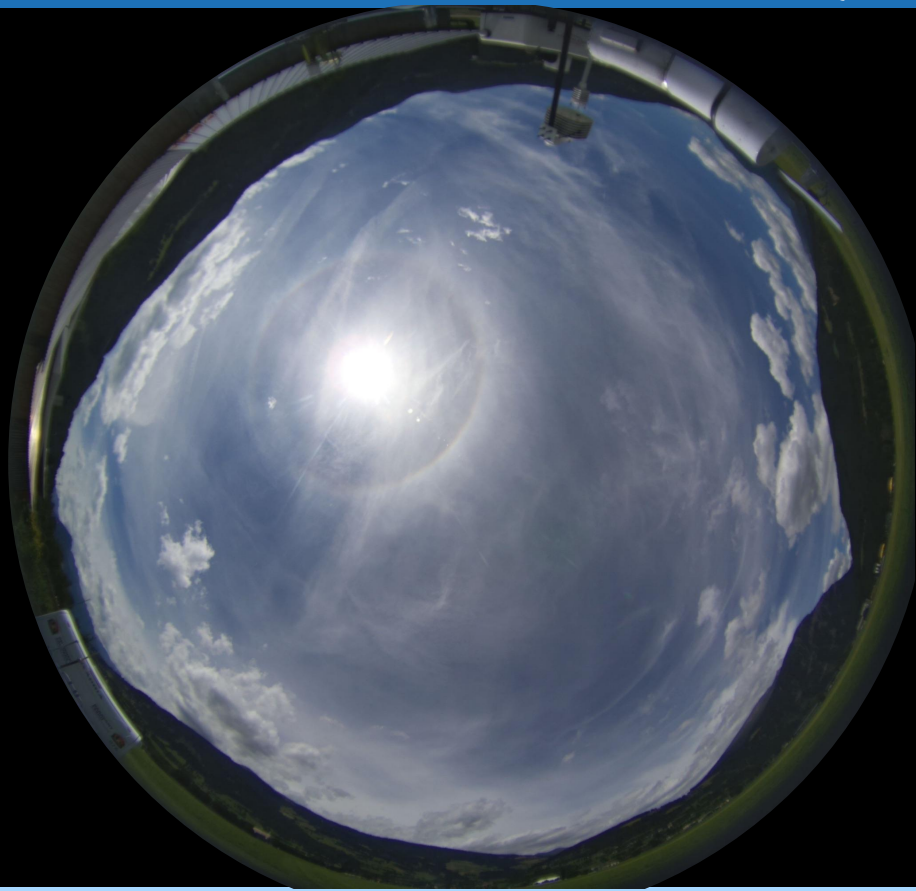
Produced on-device

Many potential applications

360° Demo

All-sky Imagery: Potential Applications

- Persistent contrail detection and attribution



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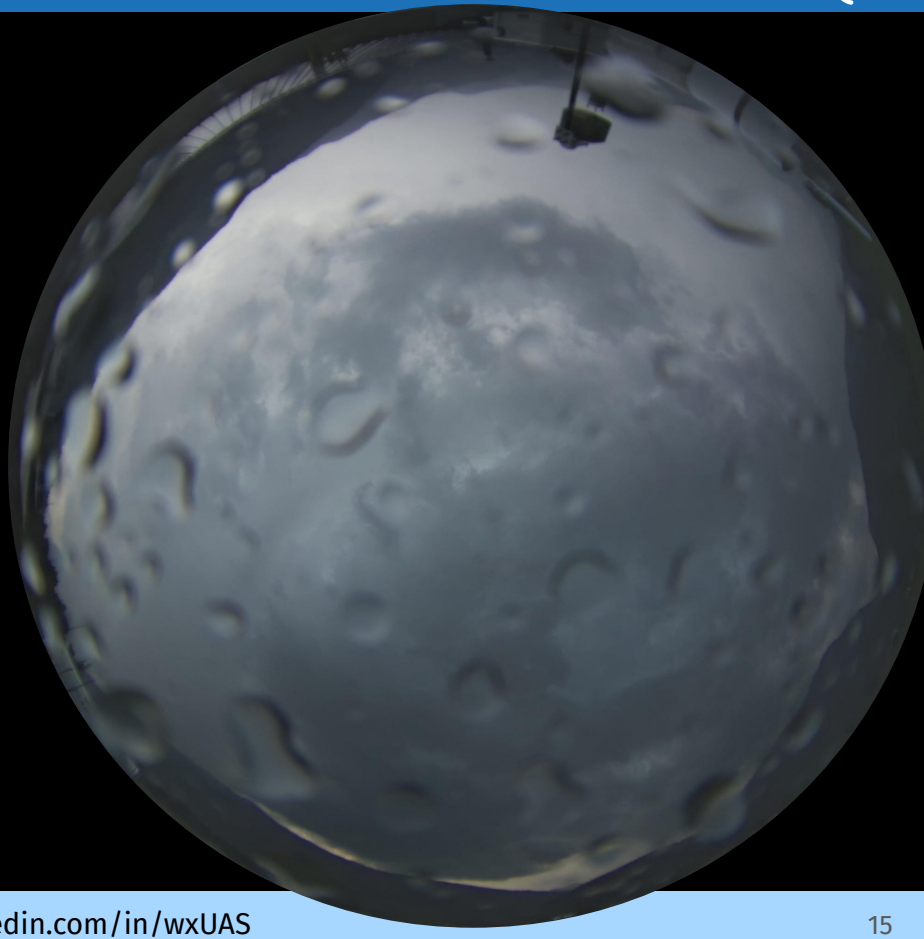

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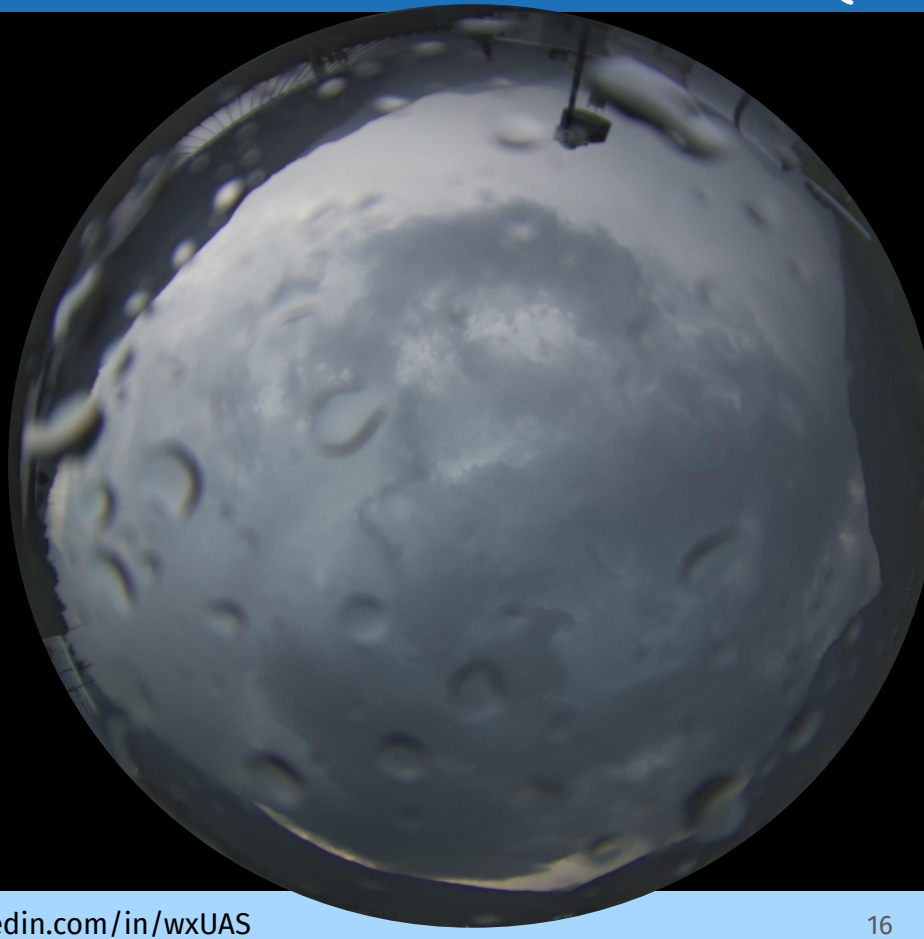

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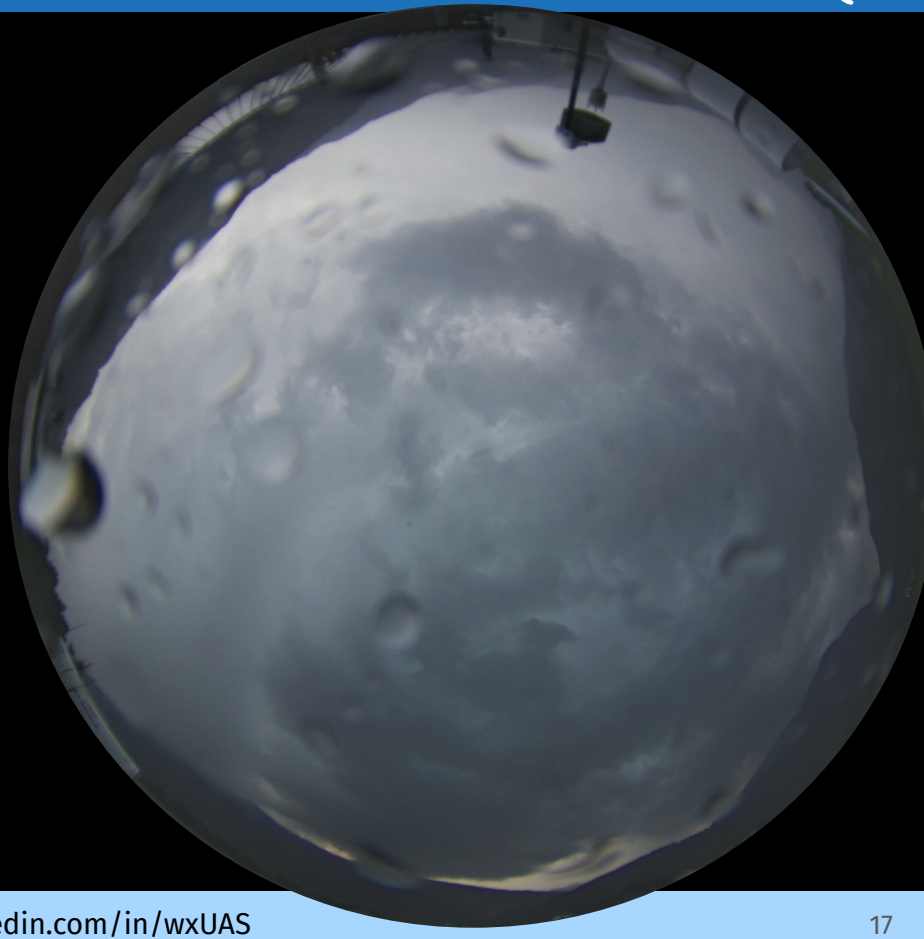

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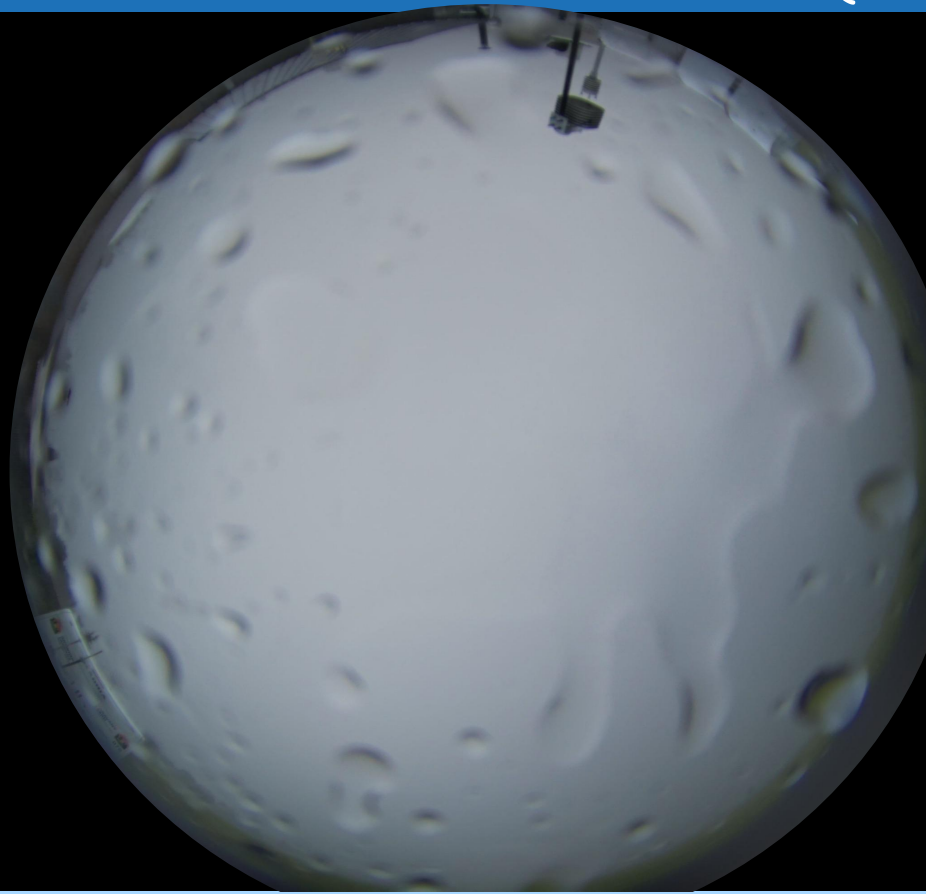

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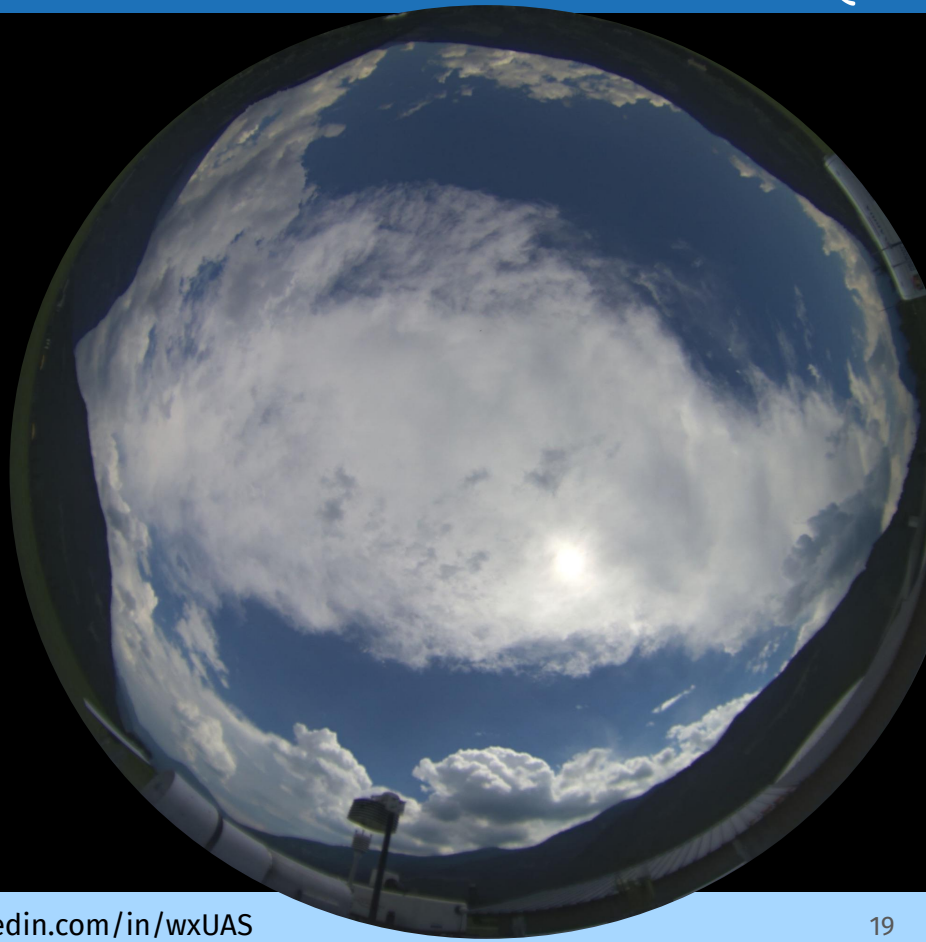

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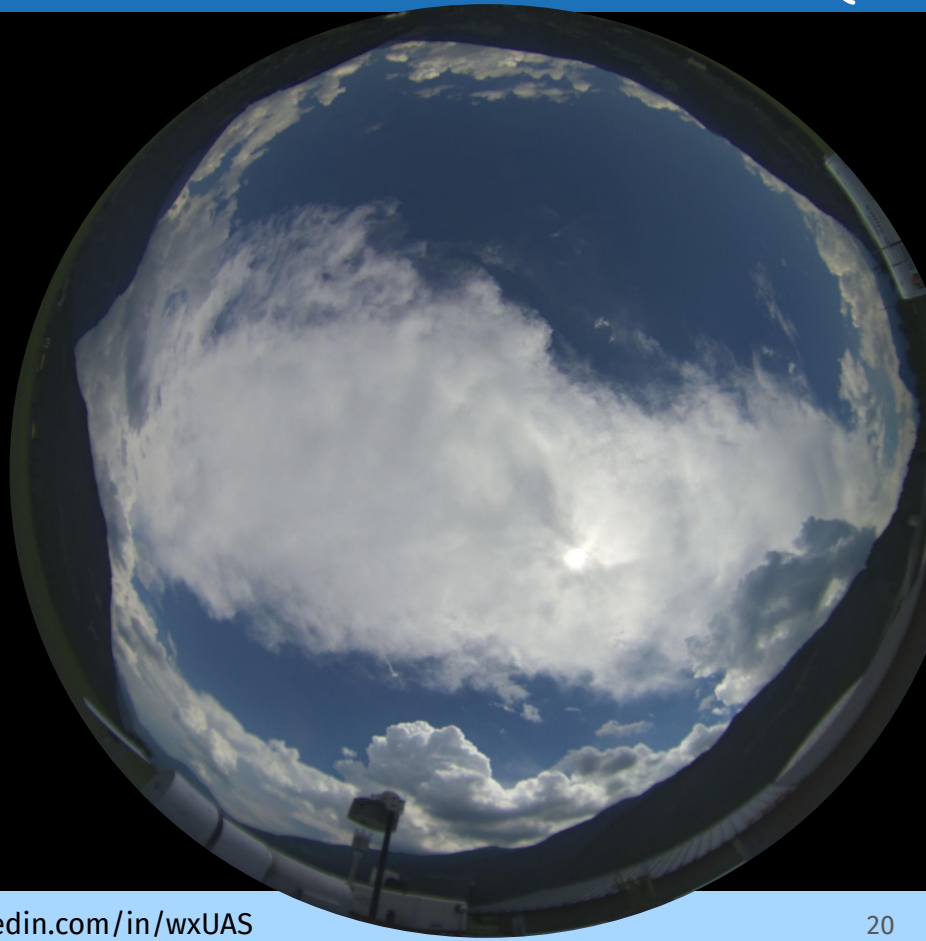

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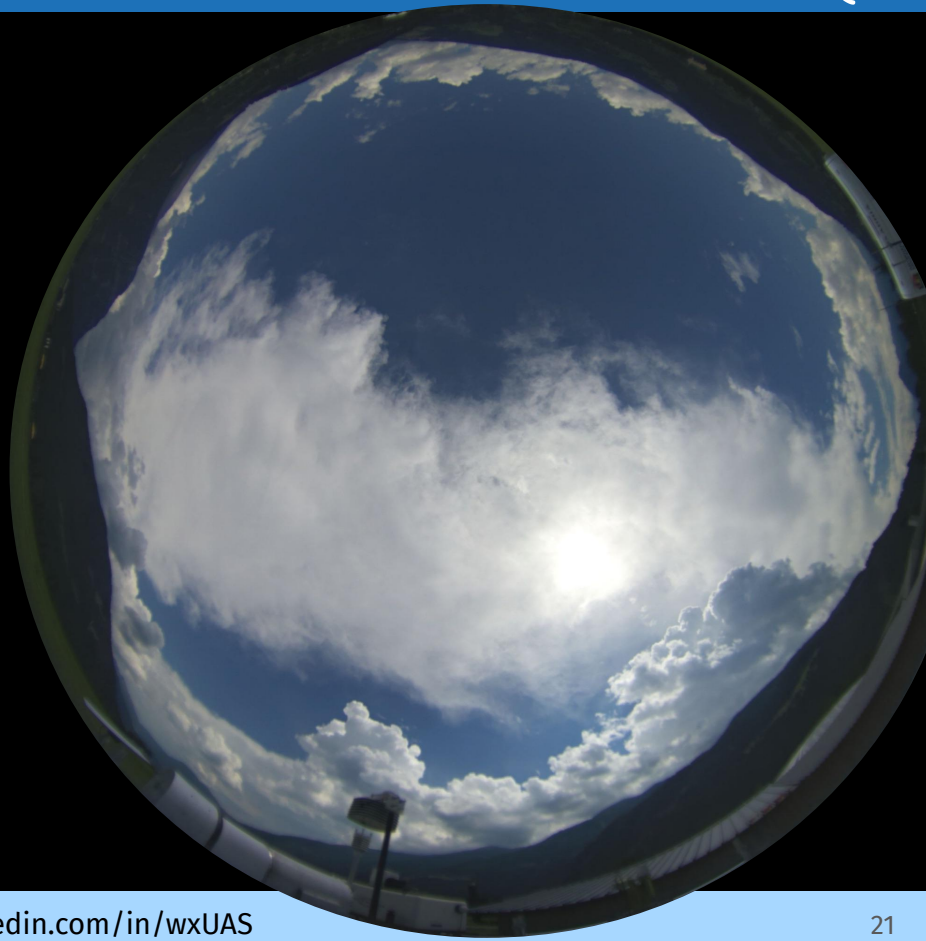

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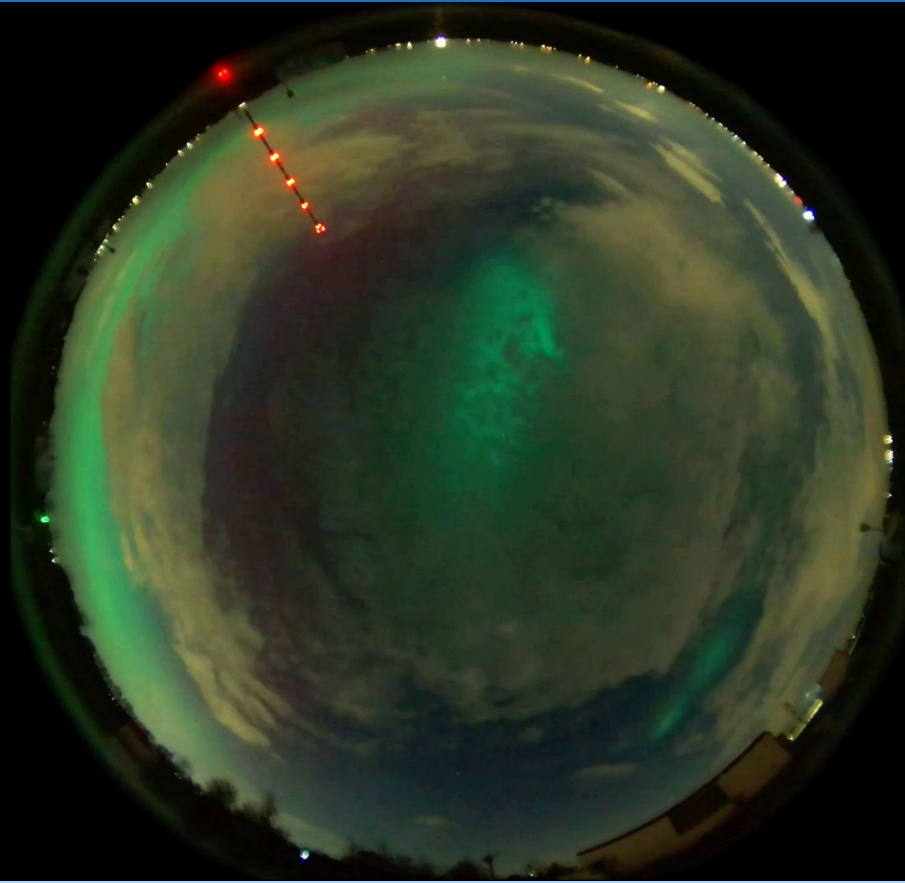
- Aurora detection, alerting and tracking



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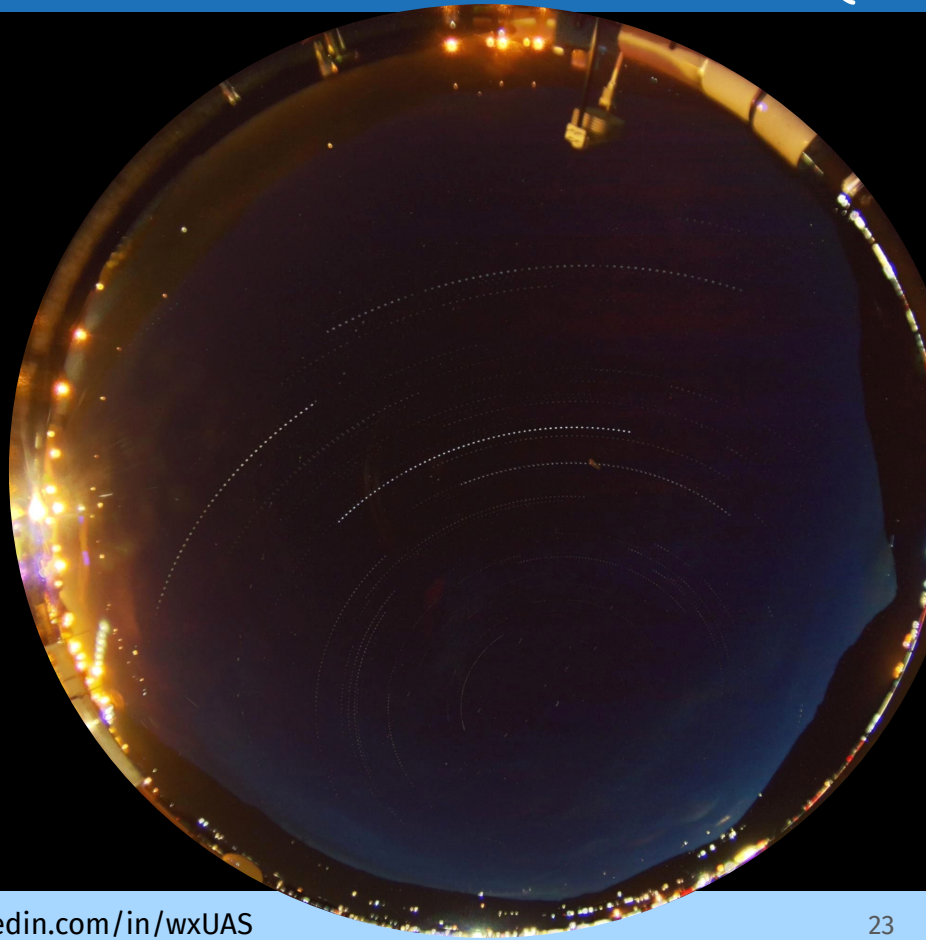
- Constellation tracking (also used for calibration)



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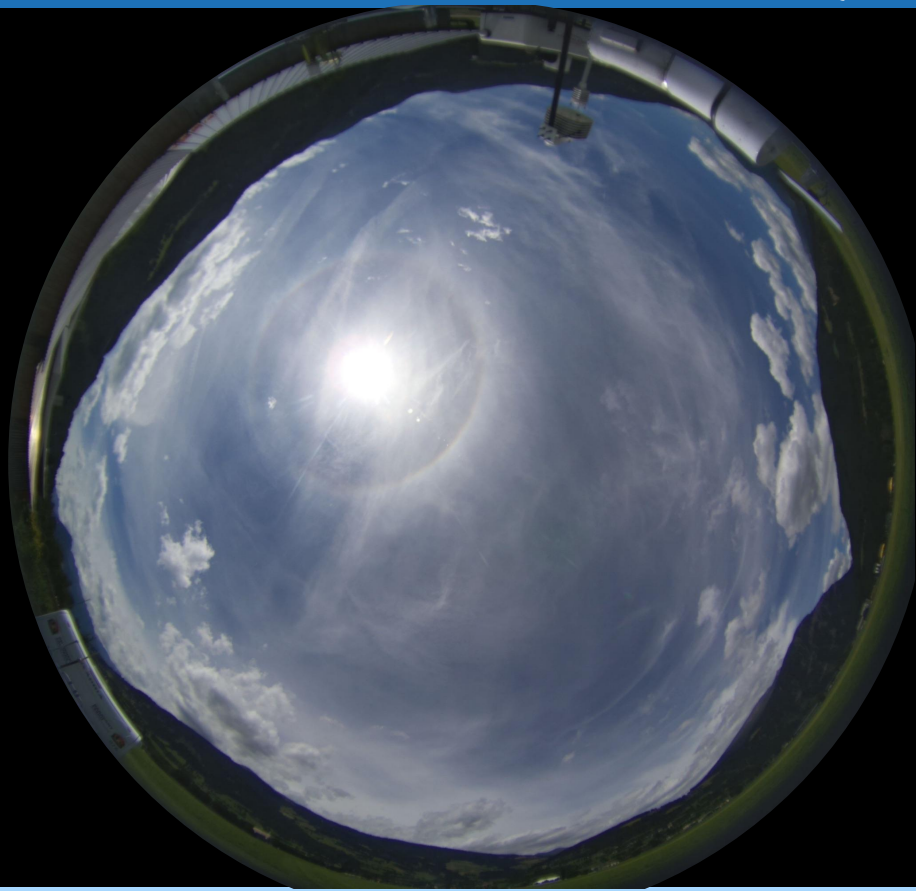
- Constellation tracking (also used for calibration)
- Solar nowcasting for energy trading
- Education & scientific communication
- Direct assimilation into NWP / AIWP (moonshot)
- Approximate aerosol optical depth *
- Wildfire smoke detection / triangulation
- Volumetric cloud reconstruction
- Light pollution mapping
- Mesocyclone rotation detection
- Sunshine duration
- … and future ideas via OTA software updates



TEAMx Deployment, June–September 2025

To improve our understanding of transport and exchange processes, both surface–atmosphere and within the atmosphere, over mountainous terrain.

Many thanks to Phil Rosenberg and James Groves at NCAS for enabling this opportunity!

National Centre for Atmospheric Science
NATURAL ENVIRONMENT RESEARCH COUNCIL

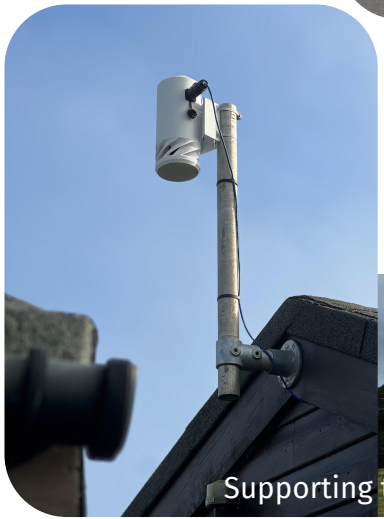
TEAMx

Will be available on CEDA soon!

Ongoing Deployments

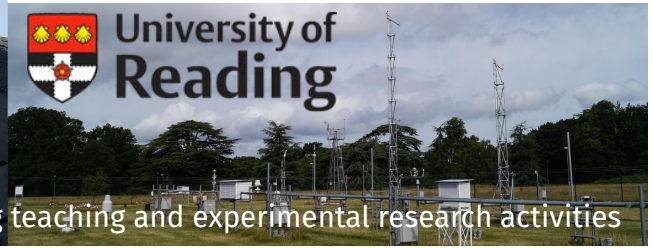
GAMB²LE
Greenland Automated Mass Balance and Boundary Layer Experiment

Preparations for a Greenland ice sheet off-grid observatory

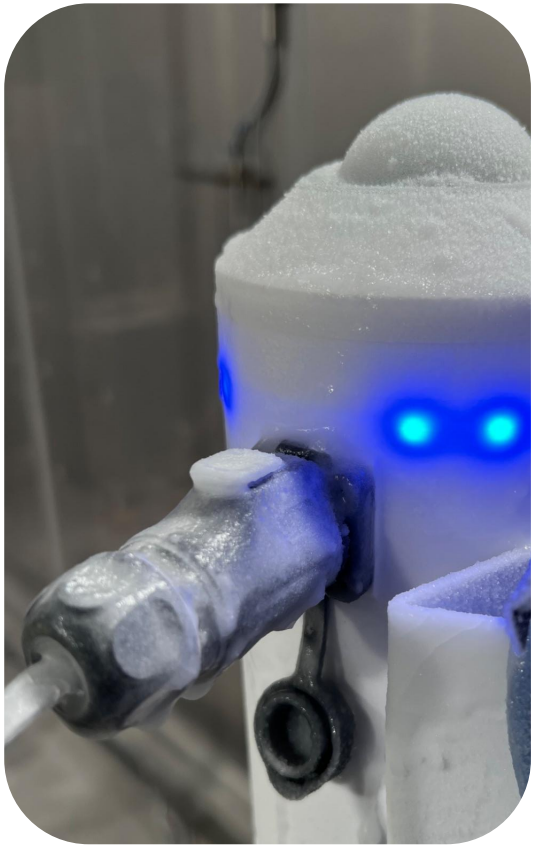


DOOC
Drone Observation Of Clouds

Nowcasting cloud motion for wxUAS interception



Environmental Testing: –50 °C



Thank You!

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