

Vaisala CL61 and the potential of measuring depolarization in wind energy applications

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Observations for a better world

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A dramatic coastal scene featuring waves crashing onto a pebbly beach. The sky is filled with dark, heavy clouds, with some light breaking through near the horizon. In the background, a range of dark mountains stretches across the horizon. The water is a deep teal color, and the waves are white with foam as they break. The beach is composed of small, light-colored pebbles and sand. The overall mood is powerful and atmospheric.

CL61 Lidar Ceilometer

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CL61

As a technology

- Direct detection of elastic backscatter at **910.55 nm**
- Monostatic system for great near range overlap (0.8 at 180m)
- Single receiver polarization measurement
- Class 1M eyesafe
- Traceable factory calibration
- Measurement interval of 5-seconds
- Range resolution (reporting) 4.8 meters
- 100W without heating, 370W with heating



Data products – netCDF over SFTP

Profiles

- Attenuated backscatter
- Linear depolarization ratio
- Parallel-polarized backscatter
- Cross-polarized backscatter

Derived from profiles

- Cloud heights
- Cloud thickness / penetration depth
- Sky Condition
- Vertical visibility
- Precipitation and fog detection
- Mixing layer height (with BL-View SW)



Environmental robustness

- Tested in extreme conditions for robustness
 - Field tests
 - Laboratory tests
- Extreme installations
 - Antarctica and Lapland
 - Mobile van
 - Research ship



Heater system helps to maintain good measurement performance in cold conditions



Blower system ensures clean window even in violent volcanic ash rain situation

Operationally Interesting Conditions



CL61



Low and high-altitude
clouds



Icing conditions
Precipitation

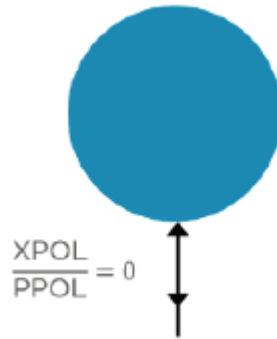


Volcanic ash plumes
Sand/Dust/Air Quality

What is Depolarization?

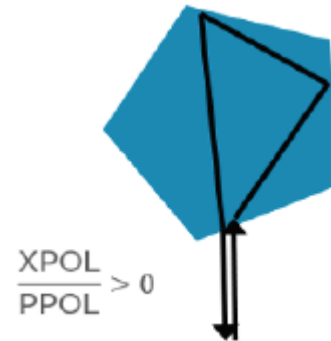
Spherical scatterers

- Due to the symmetry of the scattering event, the detected return signal is not depolarized.



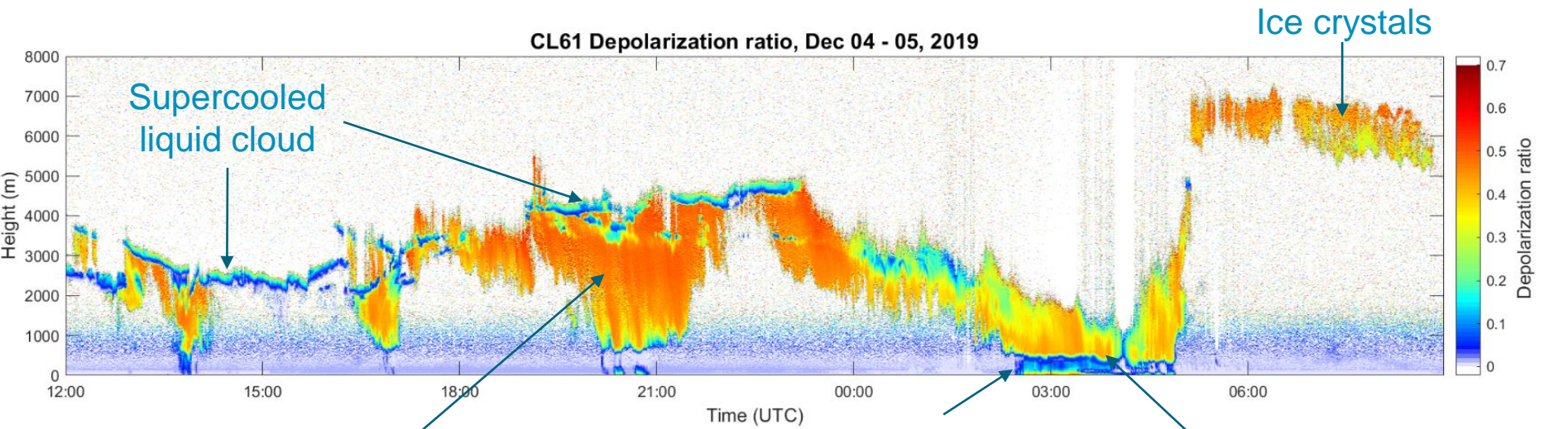
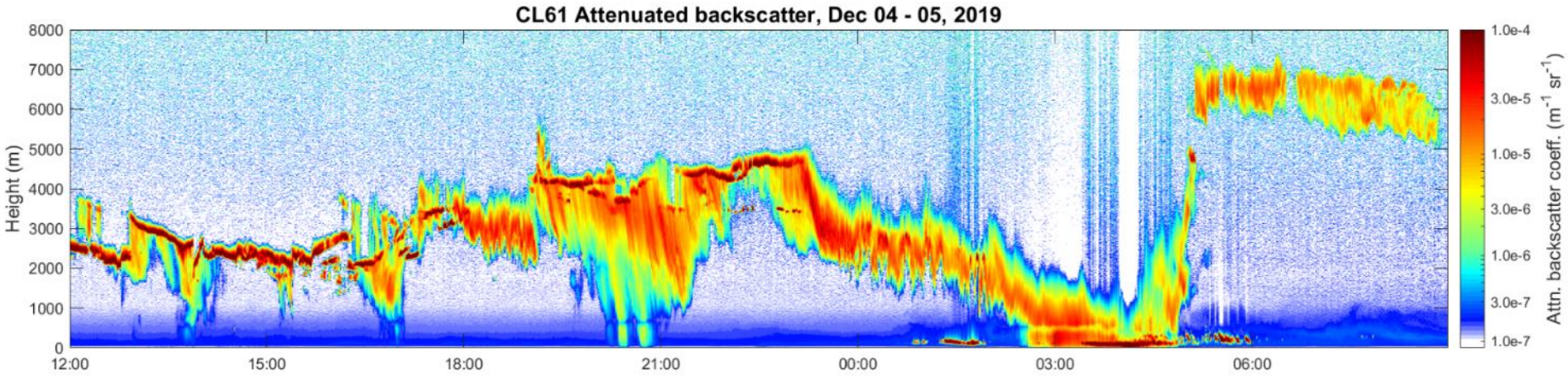
Non-spherical scatterers

- Cause significant depolarization due to multiple internal reflections at solid-air interfaces

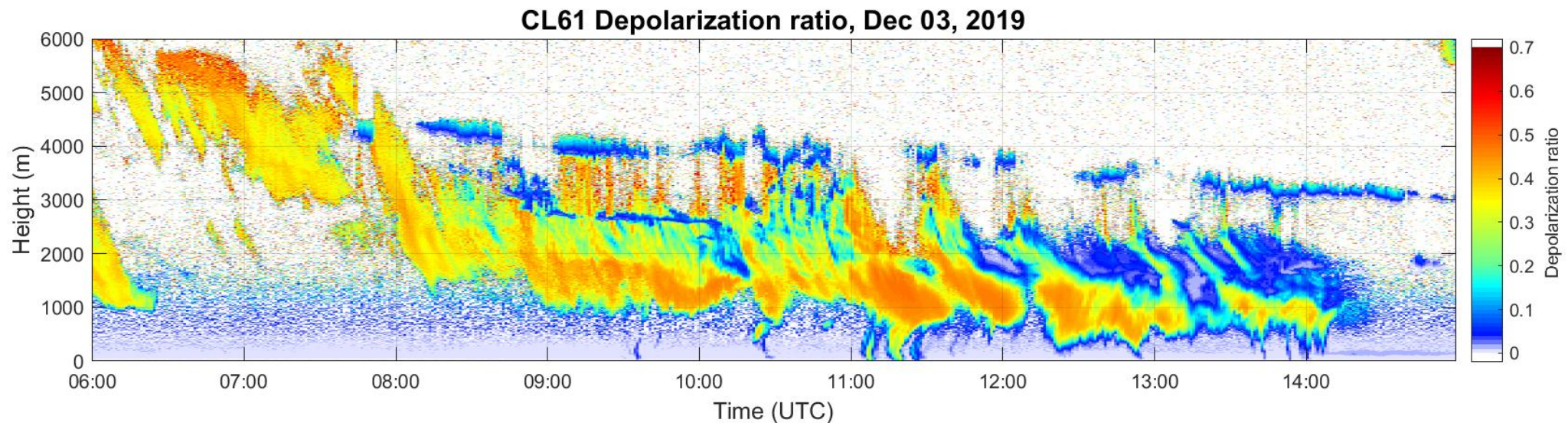
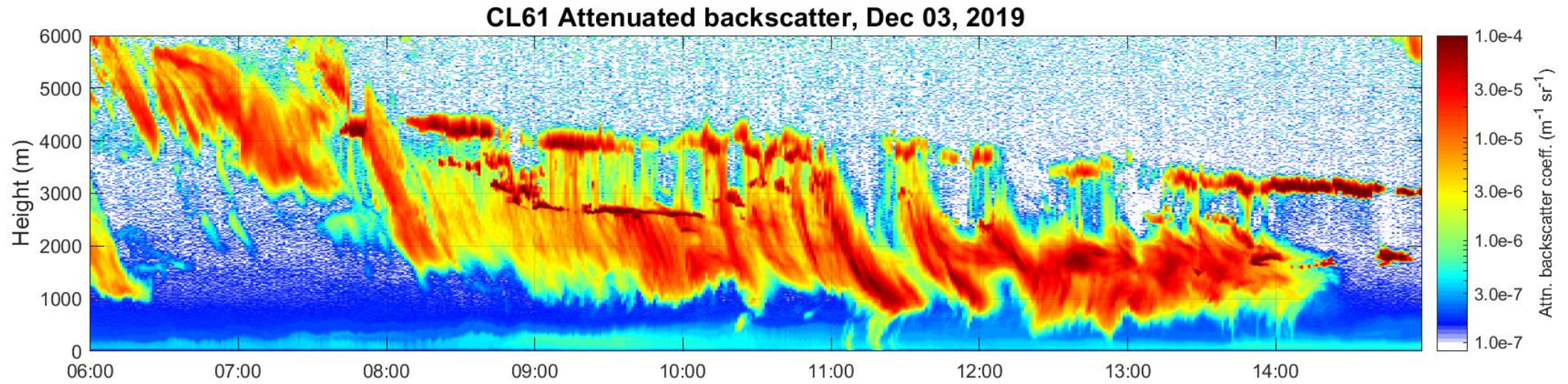


- CL61 emits linearly-polarized light.
- The polarization direction of this light can change when scattered back to the instrument.
- This depolarization depends strongly on scatterer shape, orientation, and laser wavelength.

More information with depolarization measurement



Multiple layers of super-cooled precipitating water clouds





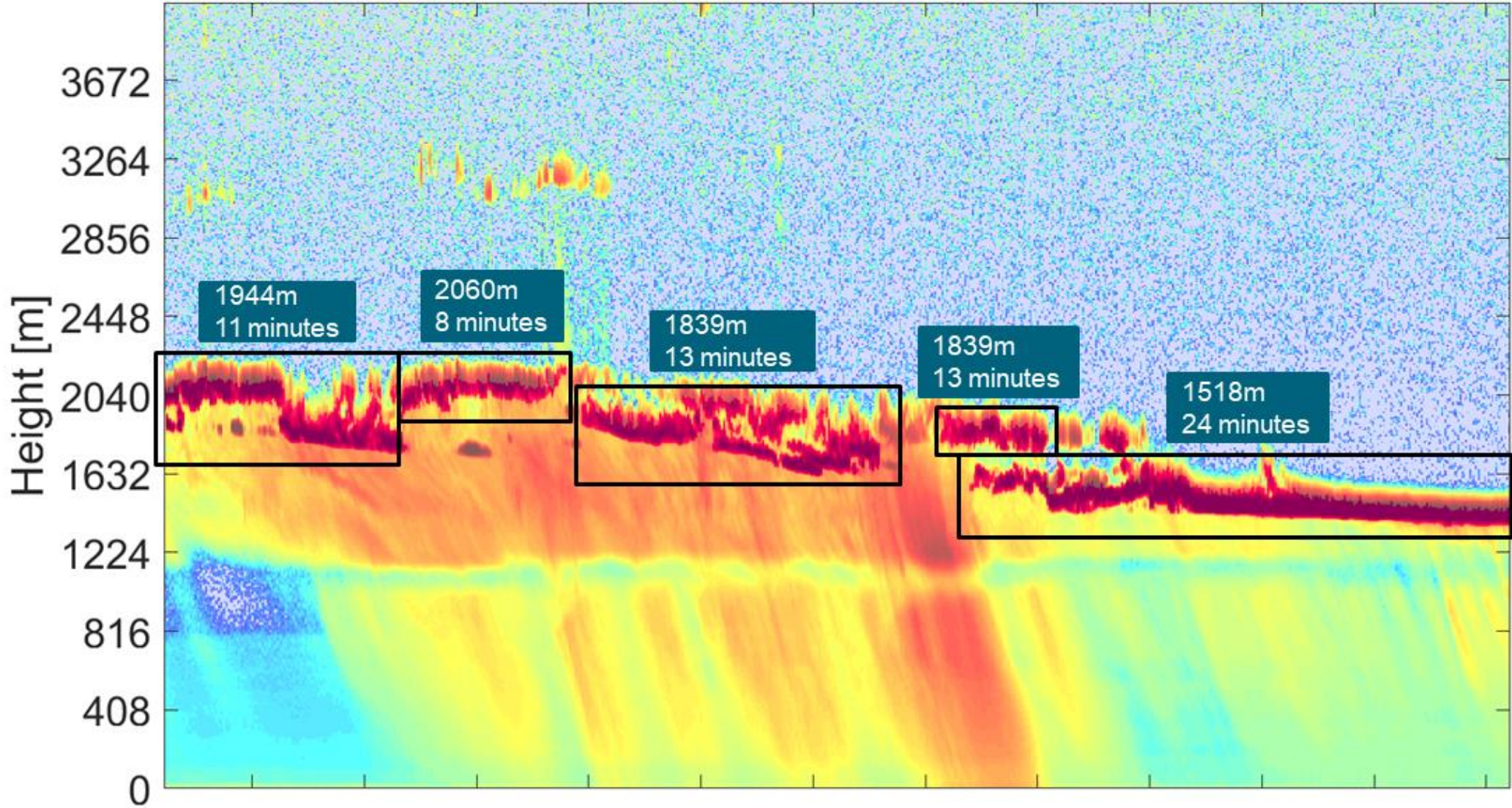
Wind energy potential?

What could the CL61 capabilities enable?

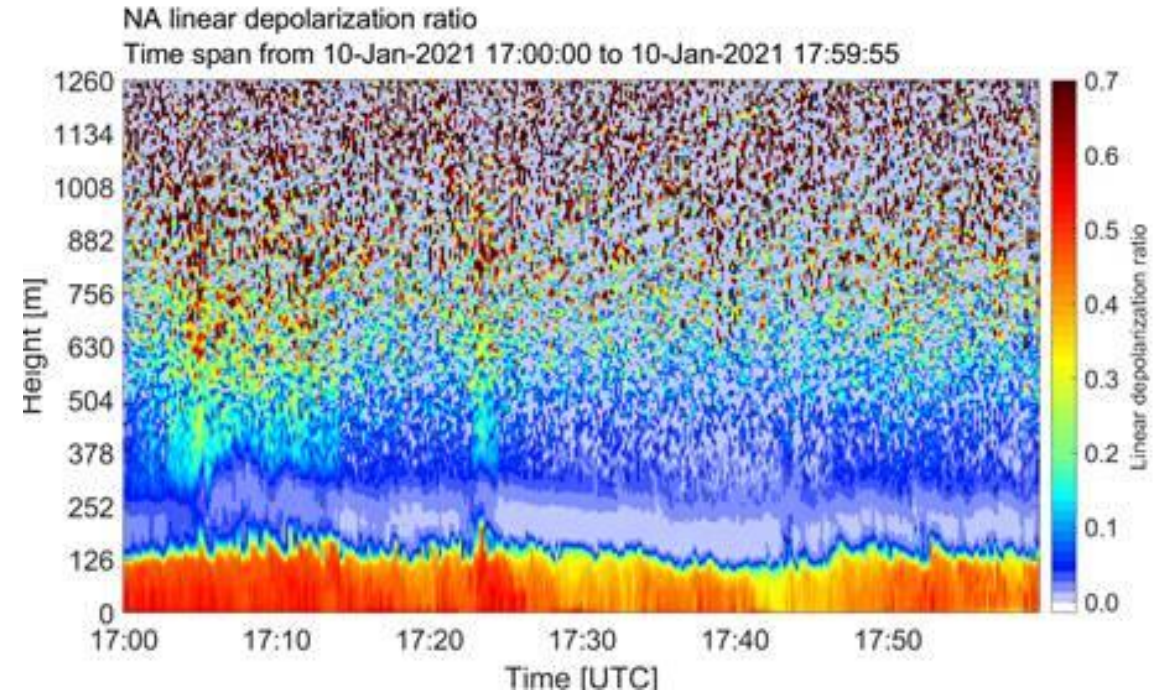
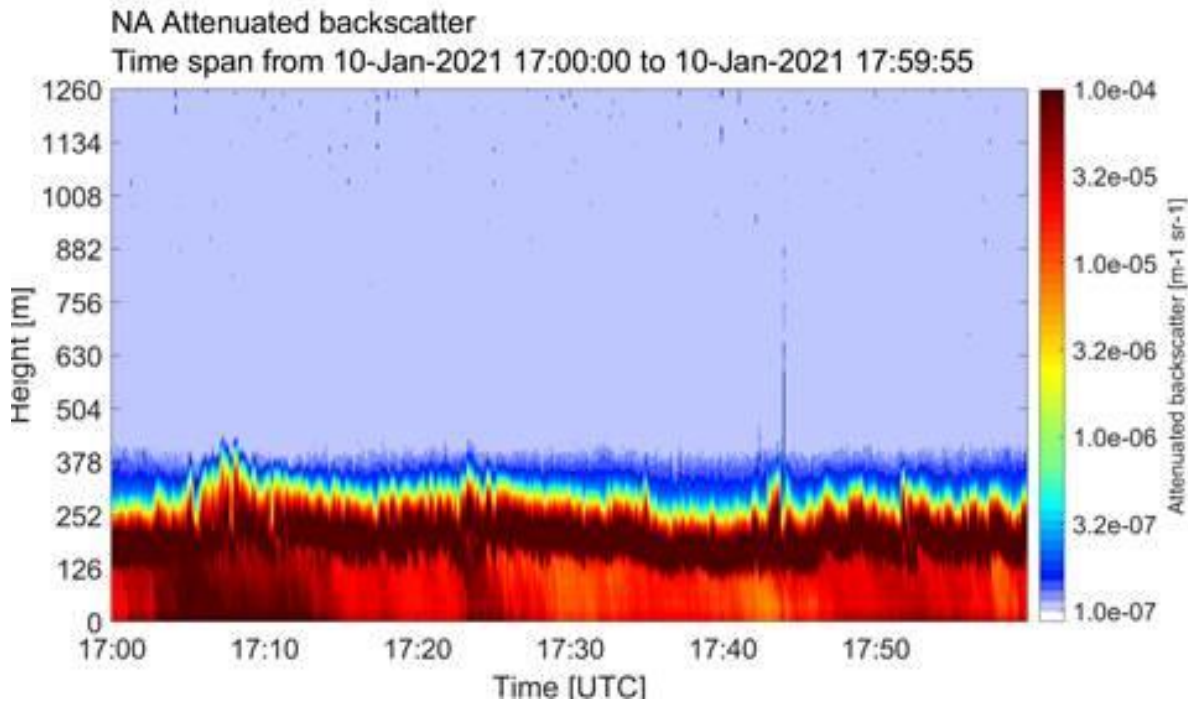
Wind turbine icing

- Processes
 - In-cloud icing (super-cooled liquid)
 - Precipitation (freezing rain, wet snow)
- Relevance
 - Production losses
 - Increased load
 - Ice throw

Detection of atmospheric icing – being developed



Example, low altitude super-cooled liquid cloud



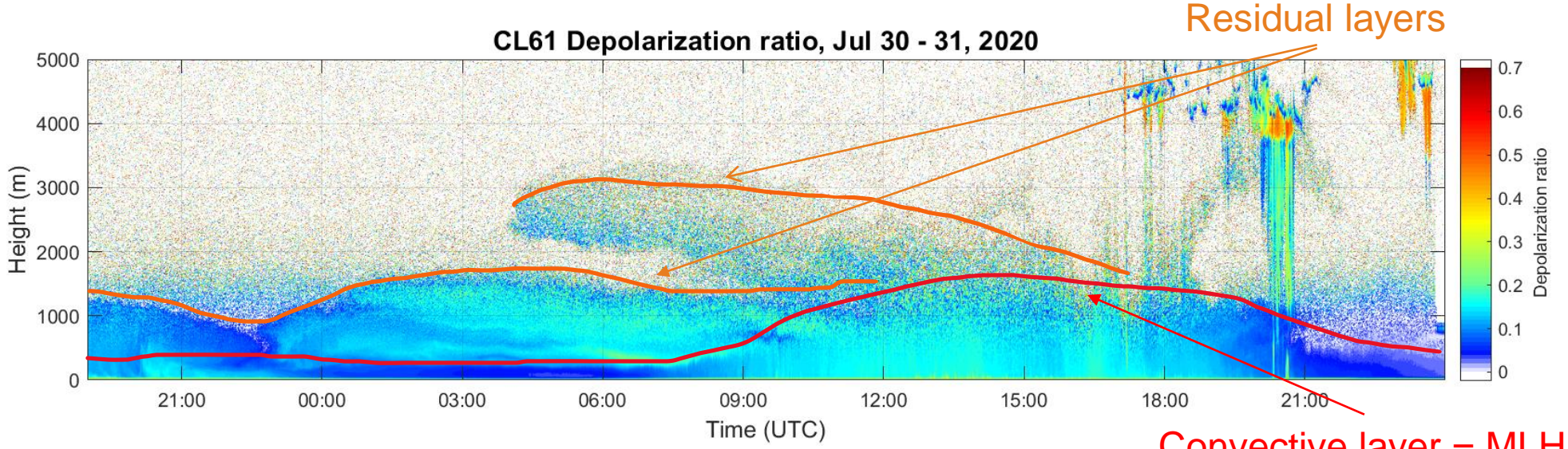
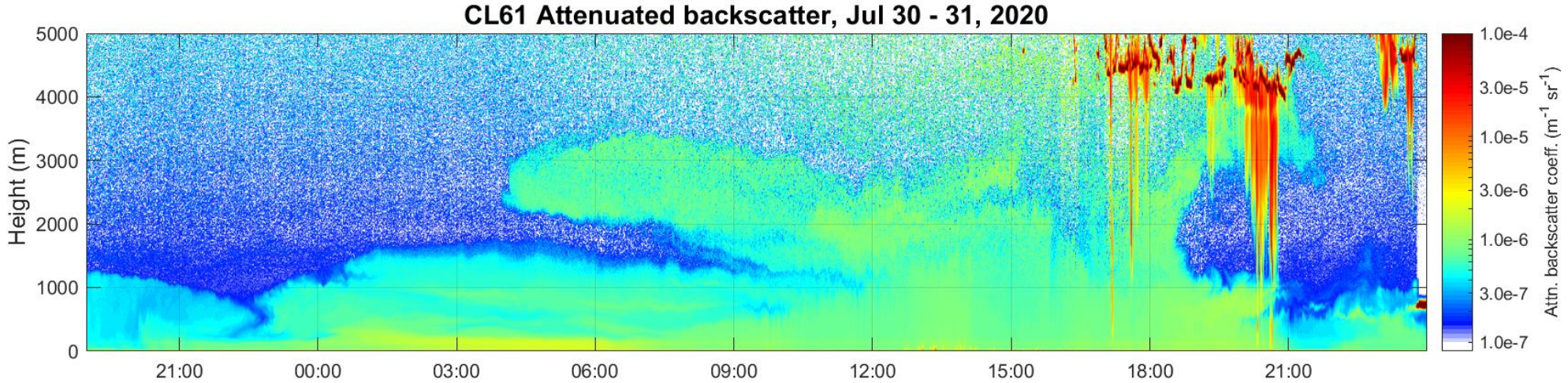
A photograph of an industrial facility with several tall smokestacks emitting thick plumes of smoke or steam. The scene is set against a warm, orange-hued sky, likely during sunset or sunrise. The foreground shows a dark, silhouetted landscape with some structures and a body of water.

Boundary layer – Air Quality

More details about aerosol mixing

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Boundary layer aerosols with residual layer and clouds



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