

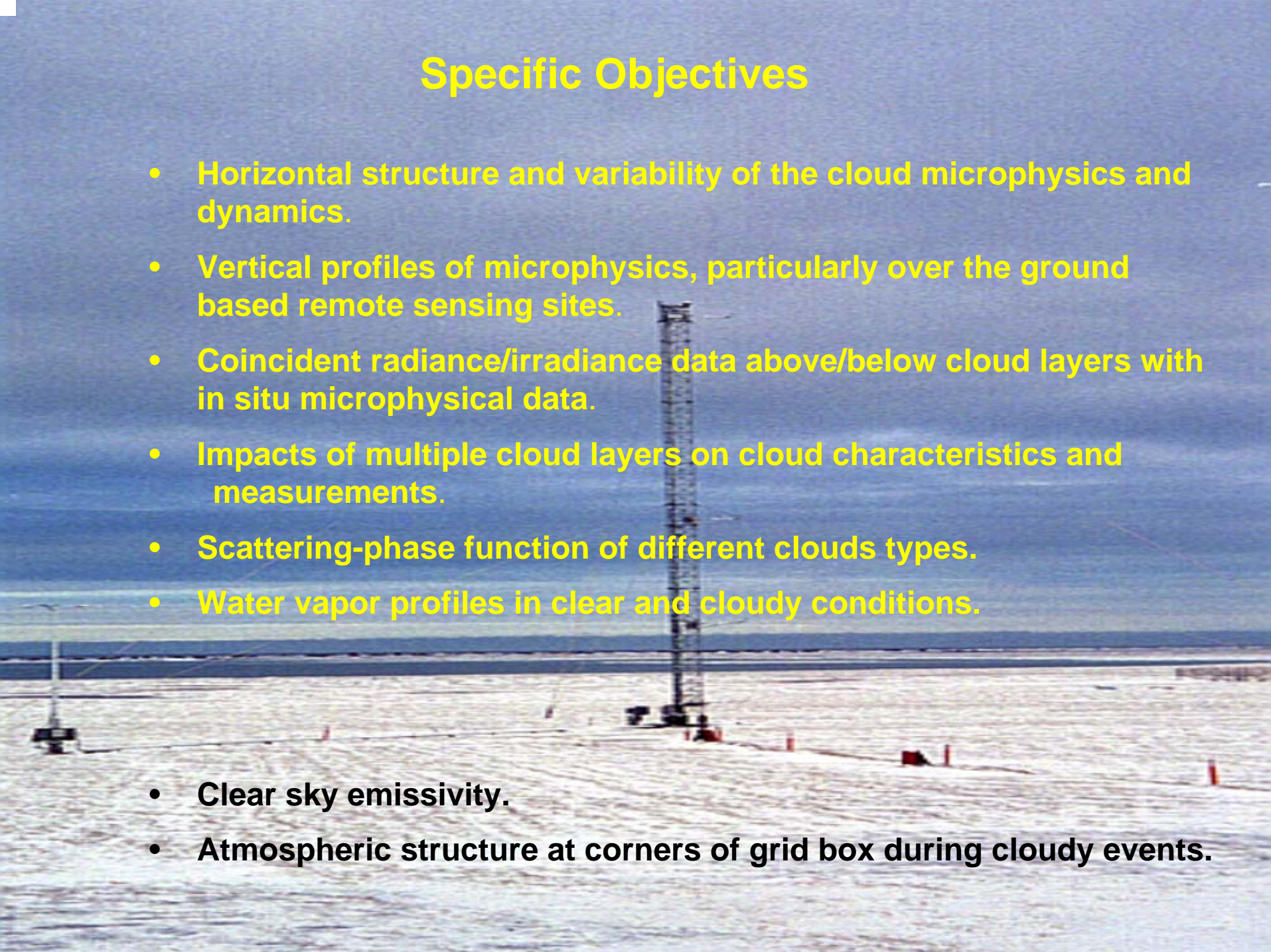


## Science Questions

### How are mixed-phase cloud microphysics, radiation, and cloud dynamics linked?

- Local Effects: *Mixed-phase microphysics (growth, spatial and temporal distributions) and the subsequent direct and indirect links to radiation and cloud turbulence. How well do cloud models capture these processes?*
- Large-Scale Effects: *How important is large-scale convergence/divergence of heat and moisture to mixed-phase longevity (vs. local processes)?*
- Connections to Observations: *Can we use radar/lidar retrievals (which provide measures of cloud properties and turbulence) in a synergistic fashion with cloud models to improve retrievals?*

## Specific Objectives

- Horizontal structure and variability of the cloud microphysics and dynamics.
  - Vertical profiles of microphysics, particularly over the ground based remote sensing sites.
  - Coincident radiance/irradiance data above/below cloud layers with in situ microphysical data.
  - Impacts of multiple cloud layers on cloud characteristics and measurements.
  - Scattering-phase function of different clouds types.
  - Water vapor profiles in clear and cloudy conditions.
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- **Clear sky emissivity.**
  - **Atmospheric structure at corners of grid box during cloudy events.**
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# Experimental Design

## Observing facilities in place:

1. DOE-ARM ground base observing sites at Barrow and Atqasuk supplemented with de-pol. lidar (Sassen)
2. Oliktok Point – PNNL Atmospheric Remote Sensing Lab. (PARSL), scanning HIS.
3. Enhanced radiosonde releases at Barrow, Atqasuk, Oliktok, and Toolik Lake.
4. In-situ aircraft -- UND Citation (microphysical inst.), based in Deadhorse
  - CSU Continuous Flow Diffusion IN counter
  - NCAR CCN Counter
  - DMT Cloud Spectrometer and Impactor
  - SPEC Cloud Particle Imager
5. Remote sensing aircraft – DOE UAV (Proteus) with lidar, cloud radar, and in-situ microphysical inst. Based in Fairbanks.

## Potential collaborations:

1. Aerosonde (NSF)
2. CIN on Citation (NSF)

# Citation Instrumentation

- State parameters: 2 temperature probes, pressure
- Cooled mirror (EG&G) and laser hygrometer for dew point
- Rosemont ice detector for supercooled water



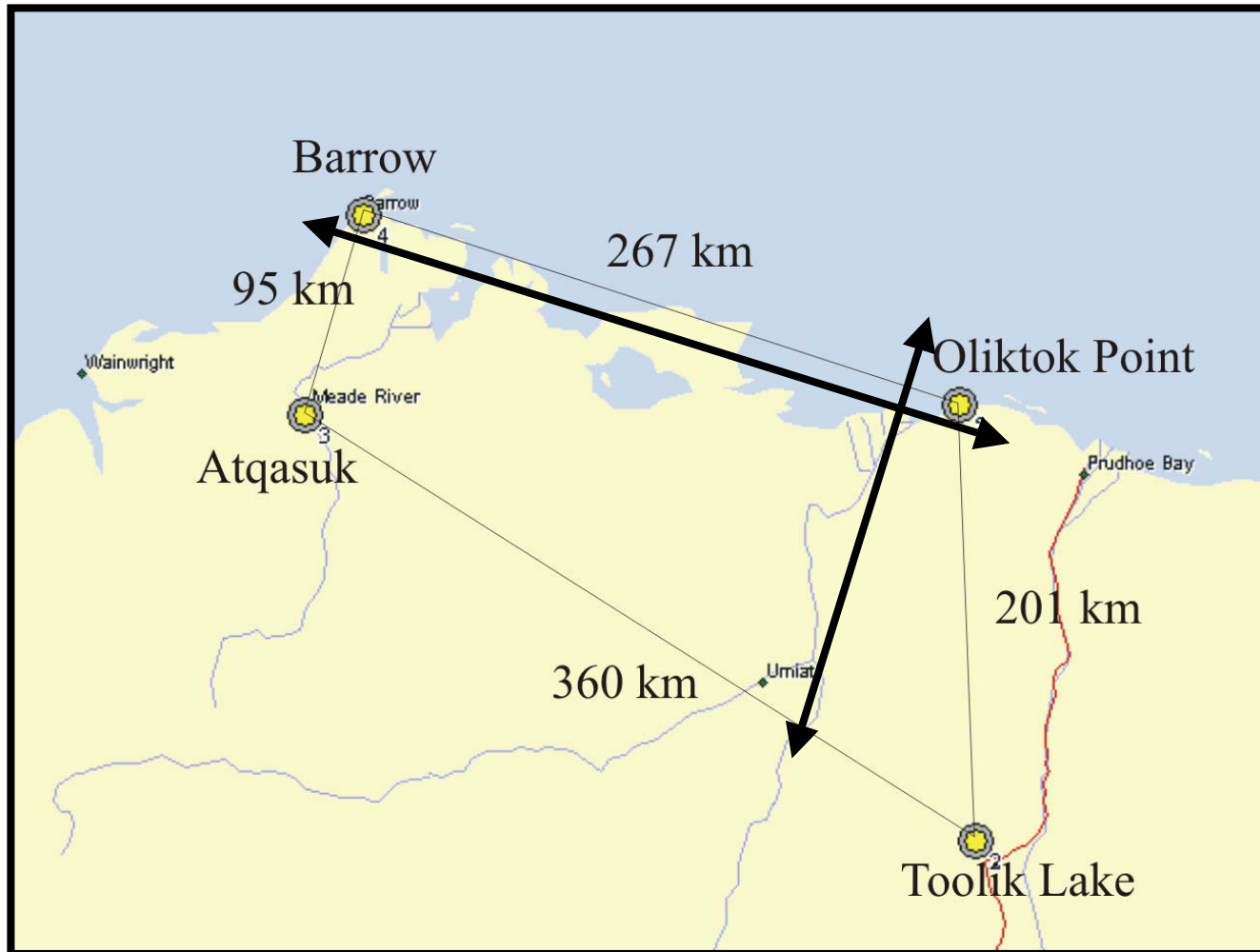
CSIRO King probe and Nevzorov Probe for LWC  
CSI and Nevzorov Probe for total condensed water  
FSSP 100 for cloud droplet spectrum  
2D-C, 2D-P or HVPS, CPI for particle imaging  
Cloud integration nephelometer  
NCAR CCN and CSU CFDN IN counter

# Proteus Instrumentation

- Active remote sensing:
  - Millimeter wave cloud radar
  - Cloud detecting lidar
- Passive Remote sensing
  - Spectral radiance package
  - Broadband radiometers
  - Solar spectral flux radiometers
  - Scanning high-resolution interferometer sounder
  - Diffuse field camera
- In Situ:
  - State parameter package
  - Cloud, aerosol and precipitation spectrometer (CAPS)
  - Cloud integrating Nephelometer
  - Video ice particle sampler
  - Nevzorov Probe



# Experimental Layout



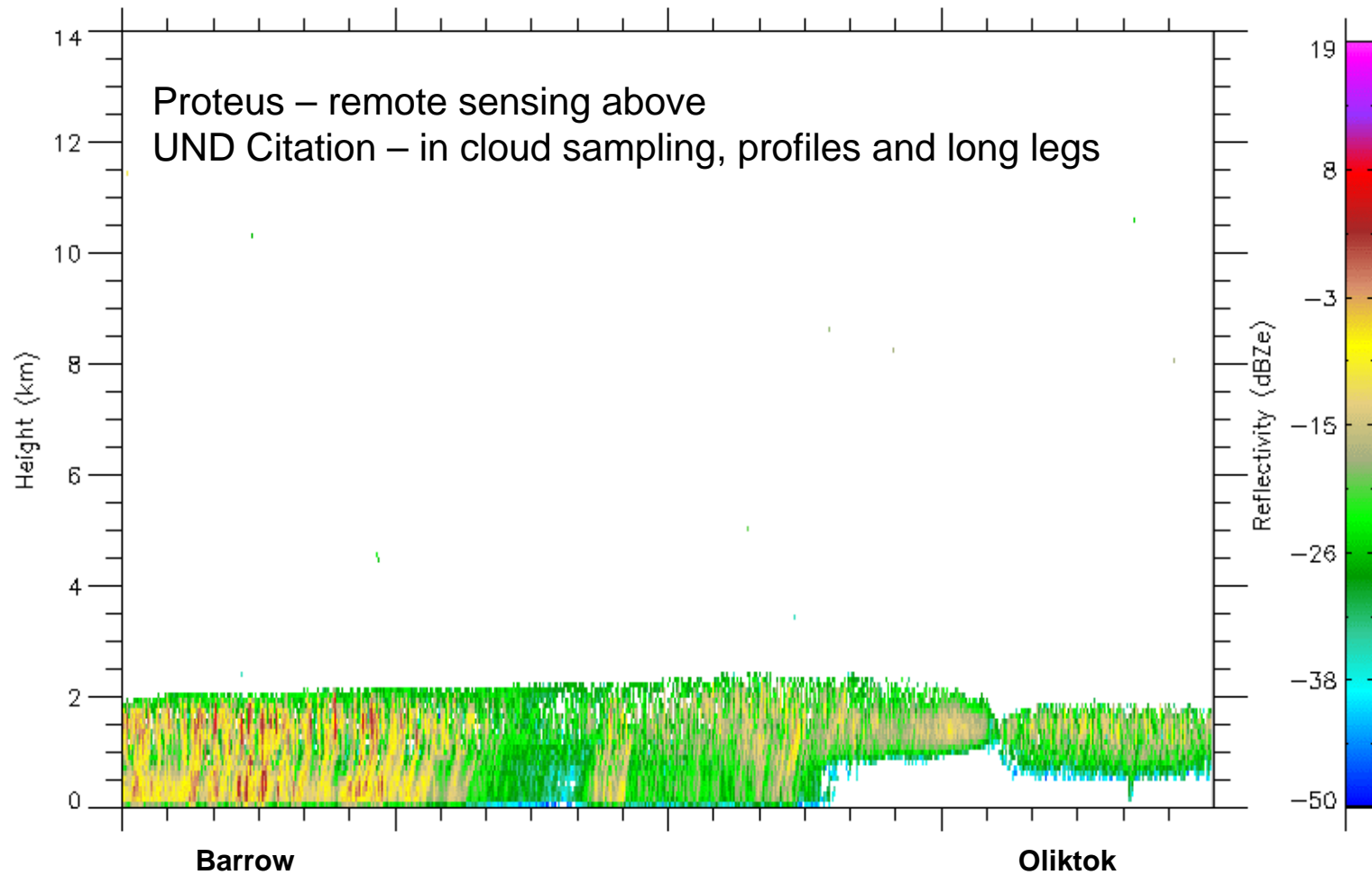
Oliktok Point

DEW Line Site



Appx. Scale

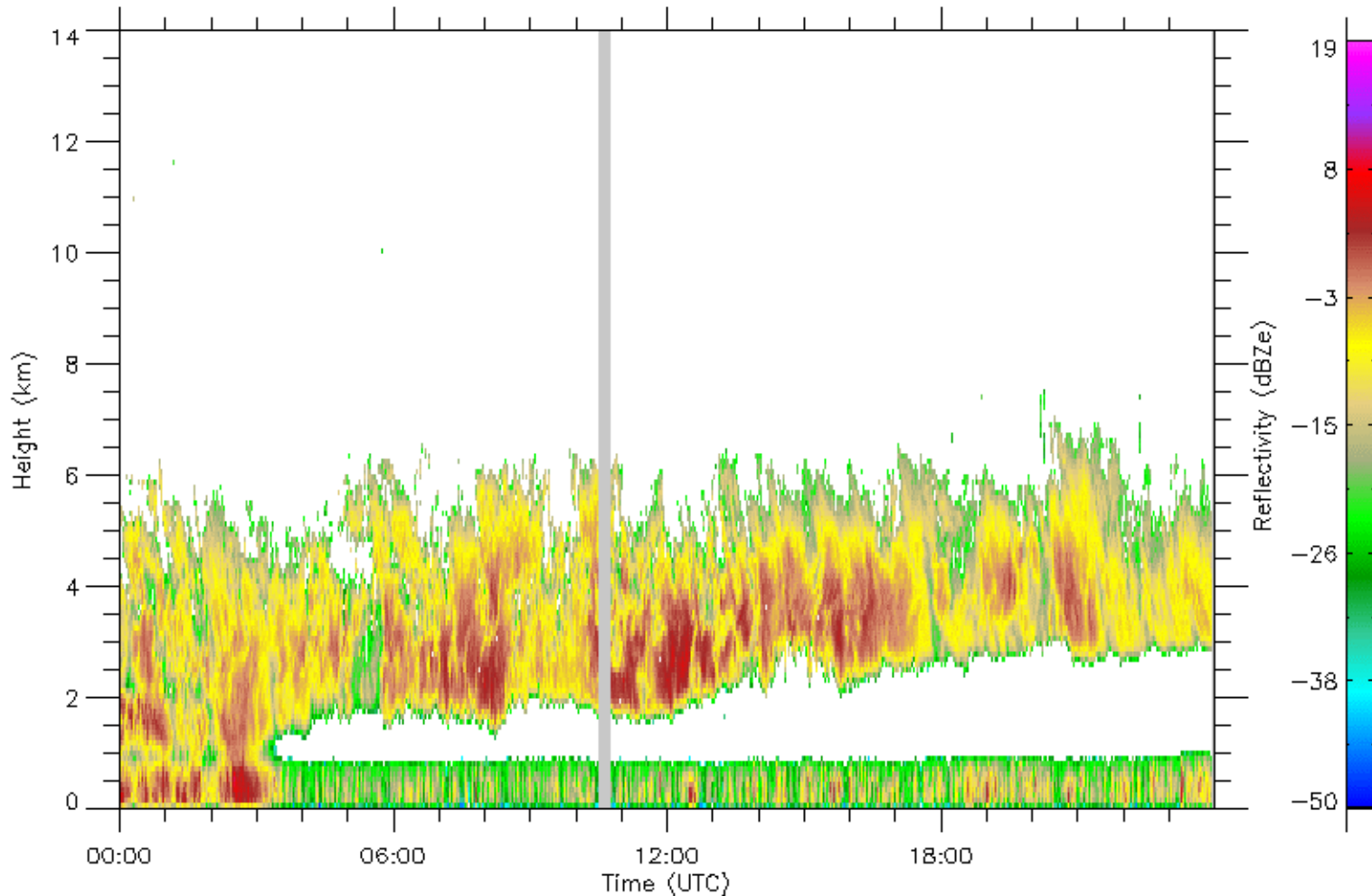
# Experiment 1. Persistent boundary layer cloud between Oliktok Point and Barrow



## Experiment #2: Boundary layer cloud overlaid by cirrus or ice virga with clear space in between

Proteus – remote sensing above and sampling in cirrus

UND Citation – sampling in both clouds, profiles and long legs



# Other Experimental Flights

3. Similar flights parallel to coast
4. Satellite validation
5. Ground-based retrieval validation
6. Surface and clear-sky emissivity validation
7. Thick cloud (convection) sampling

