

Blowing Snow Studies at Iqaluit Airport

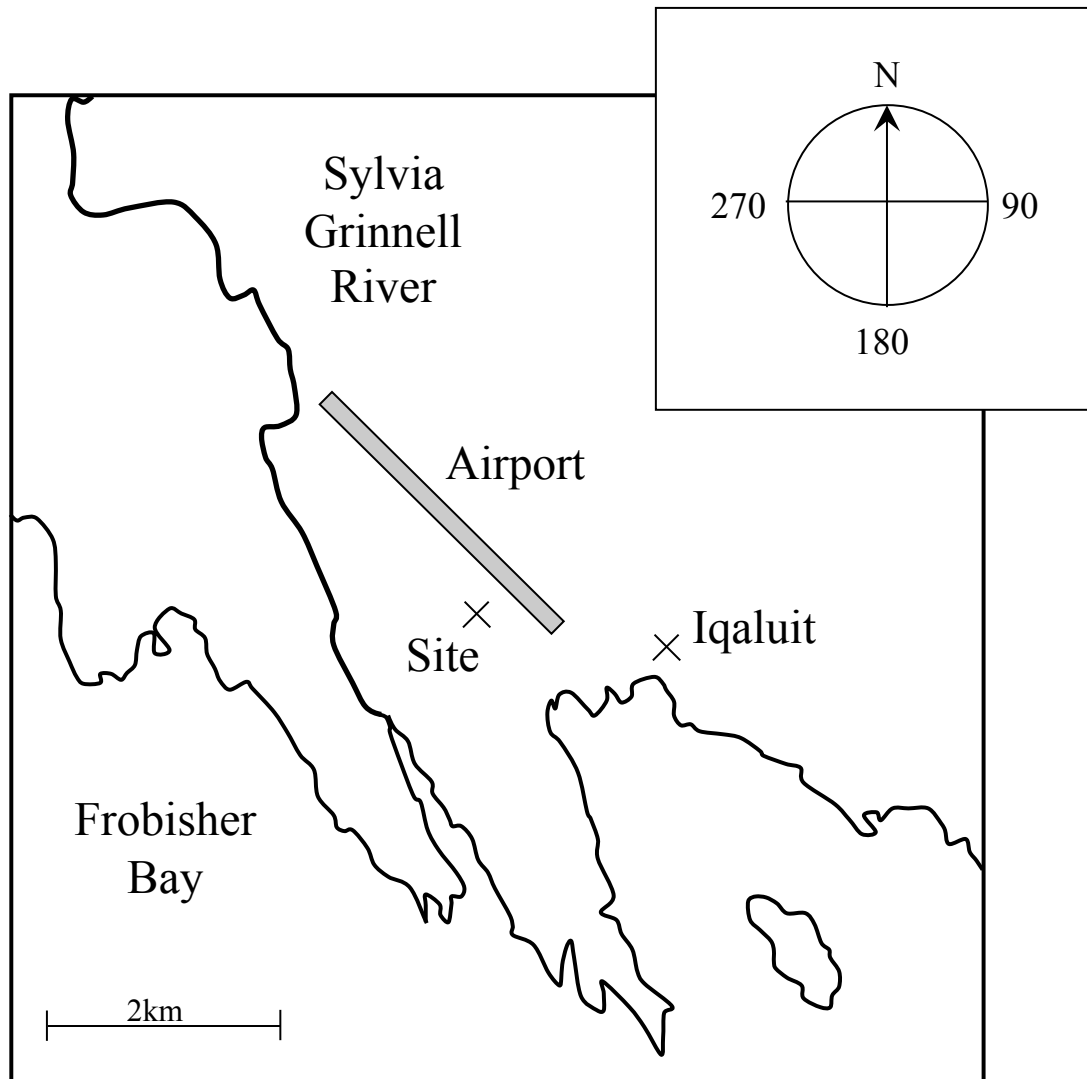
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York University

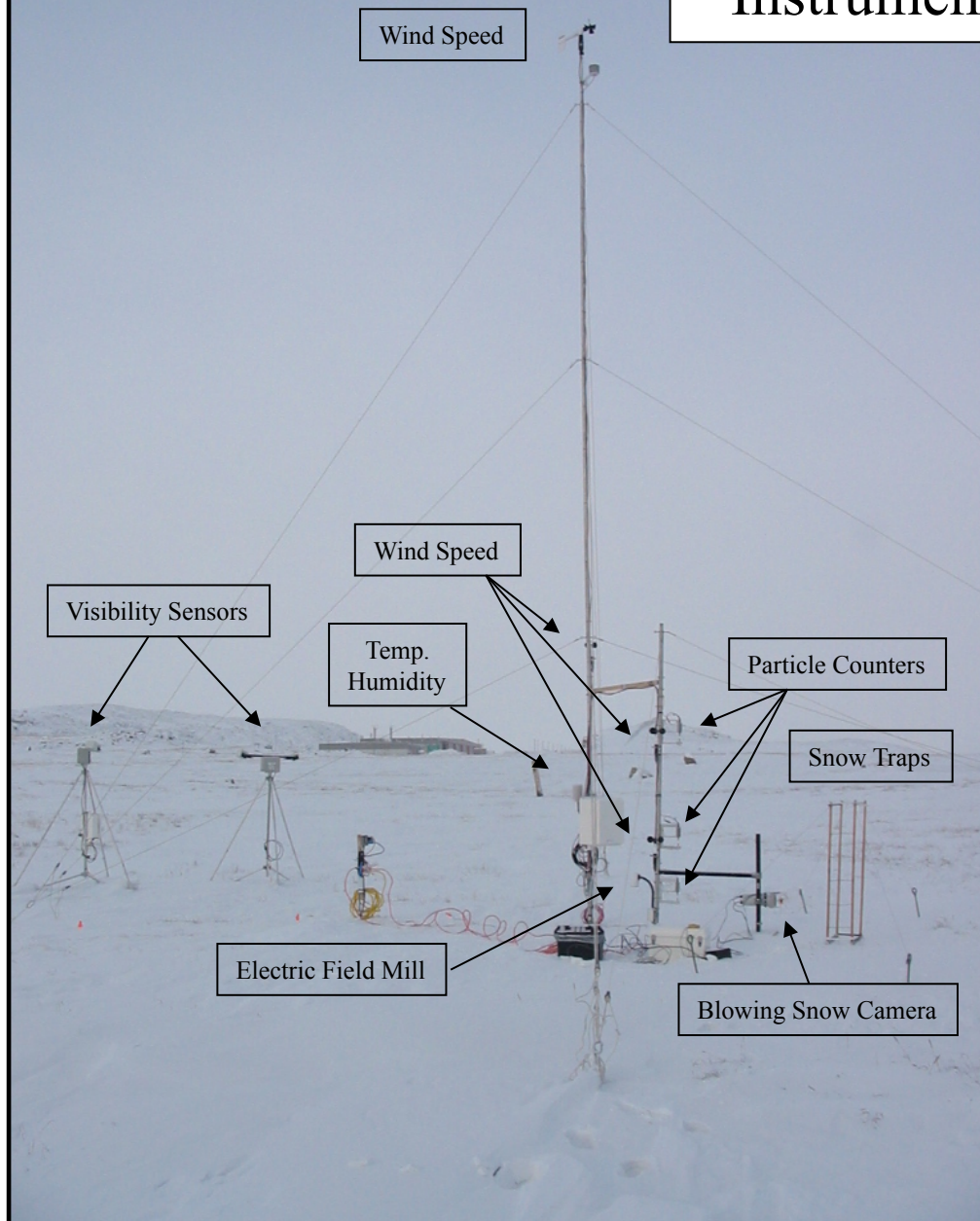
² Dept. of Geography, Trent University



Site Location



Instrumentation



- 10-m Wind Speed and Dir.
- 3-m Wind Speed
- 2-m “ ”
- 1-m “ ”

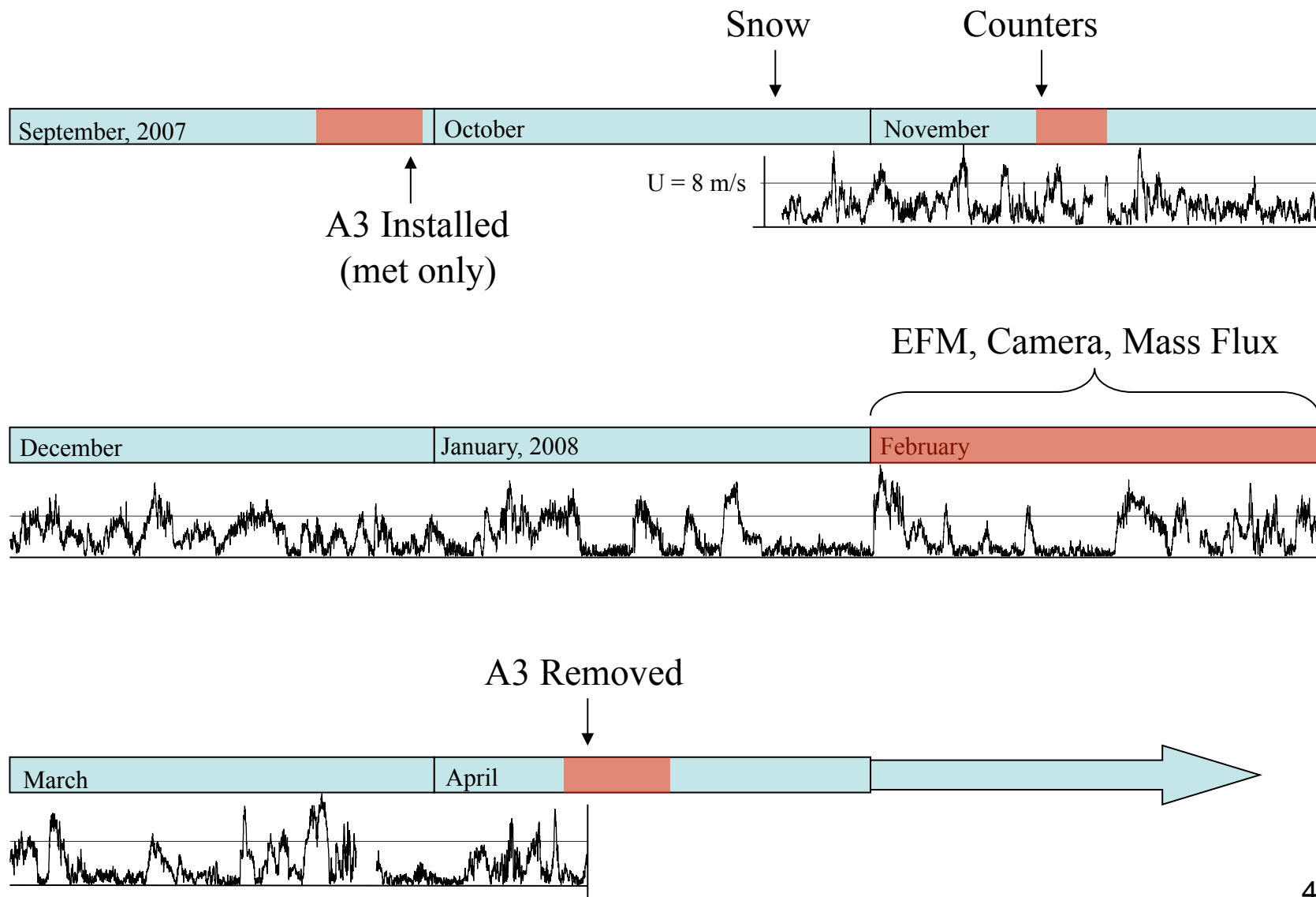
- 1.5-m Air Temp.
- 1.5-m Air Humidity
- 1.5 / 9-m Temp. Difference
- Snow Temperature

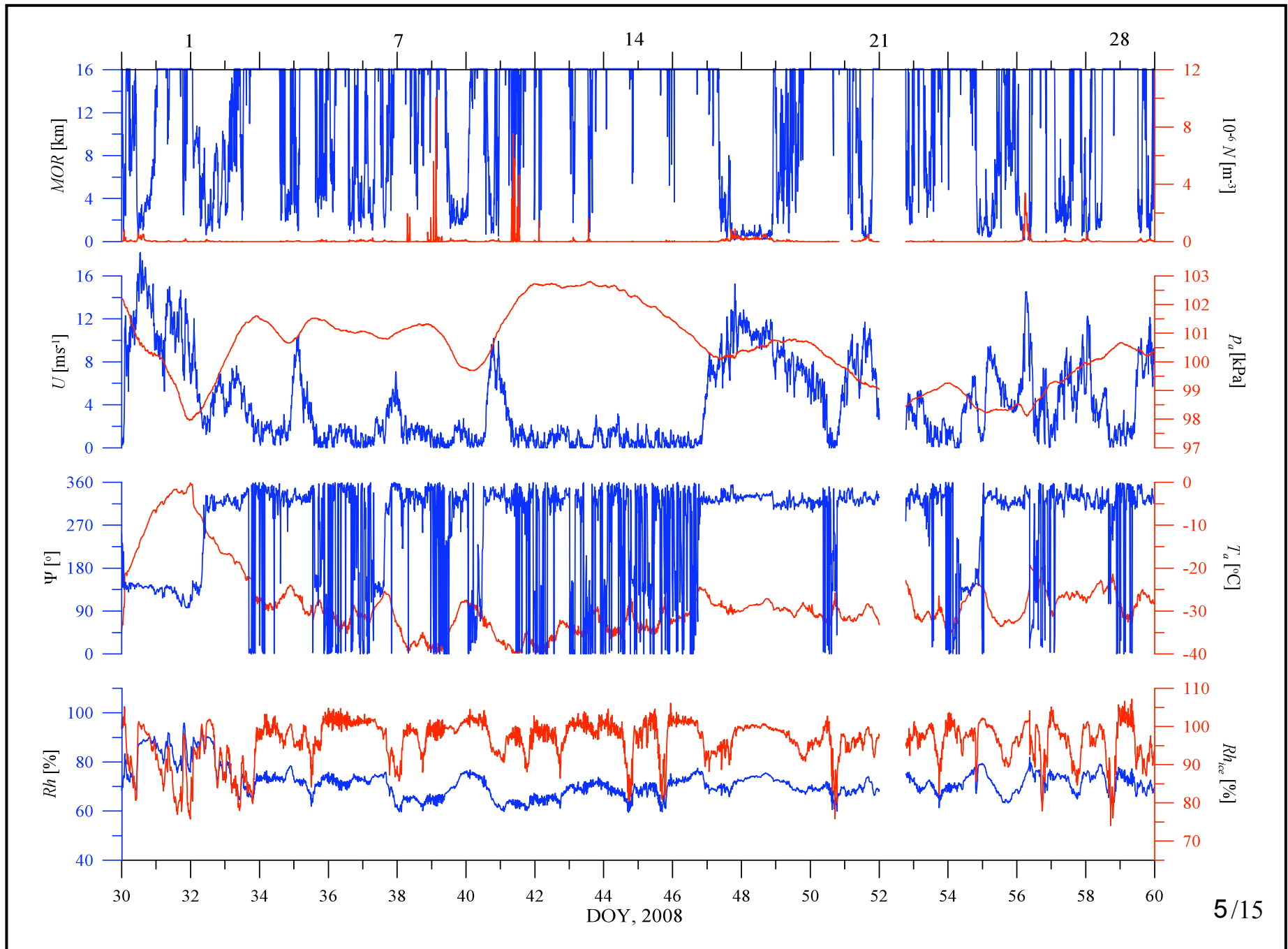
- 2-m Visibility (x2)

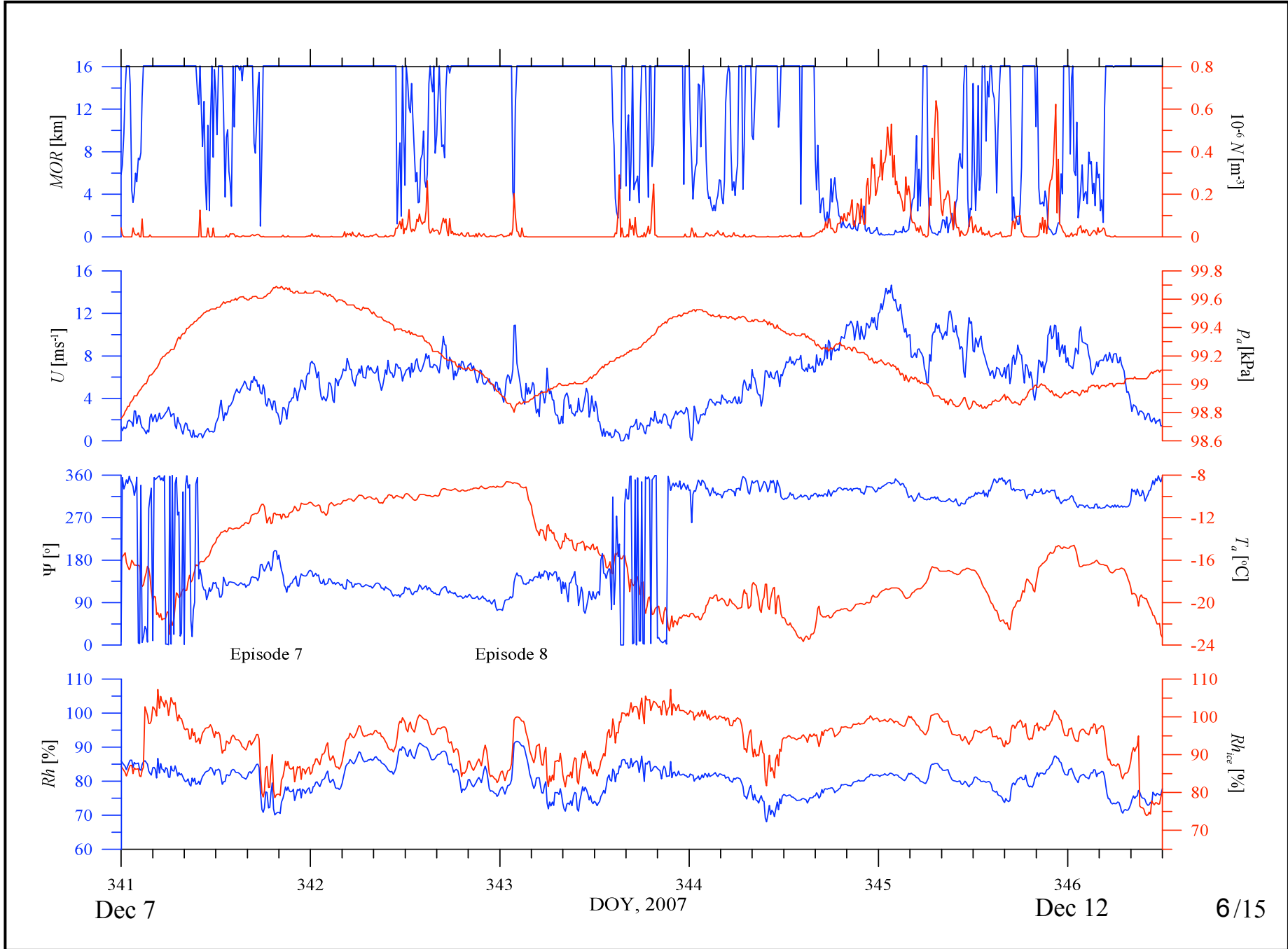
- 2-m Particle Number Flux
- 1-m “ ” “ ”
- 0.5-m “ ” “ ”
- Snow Traps

- Electric Field Strength
- Particle Number and Size

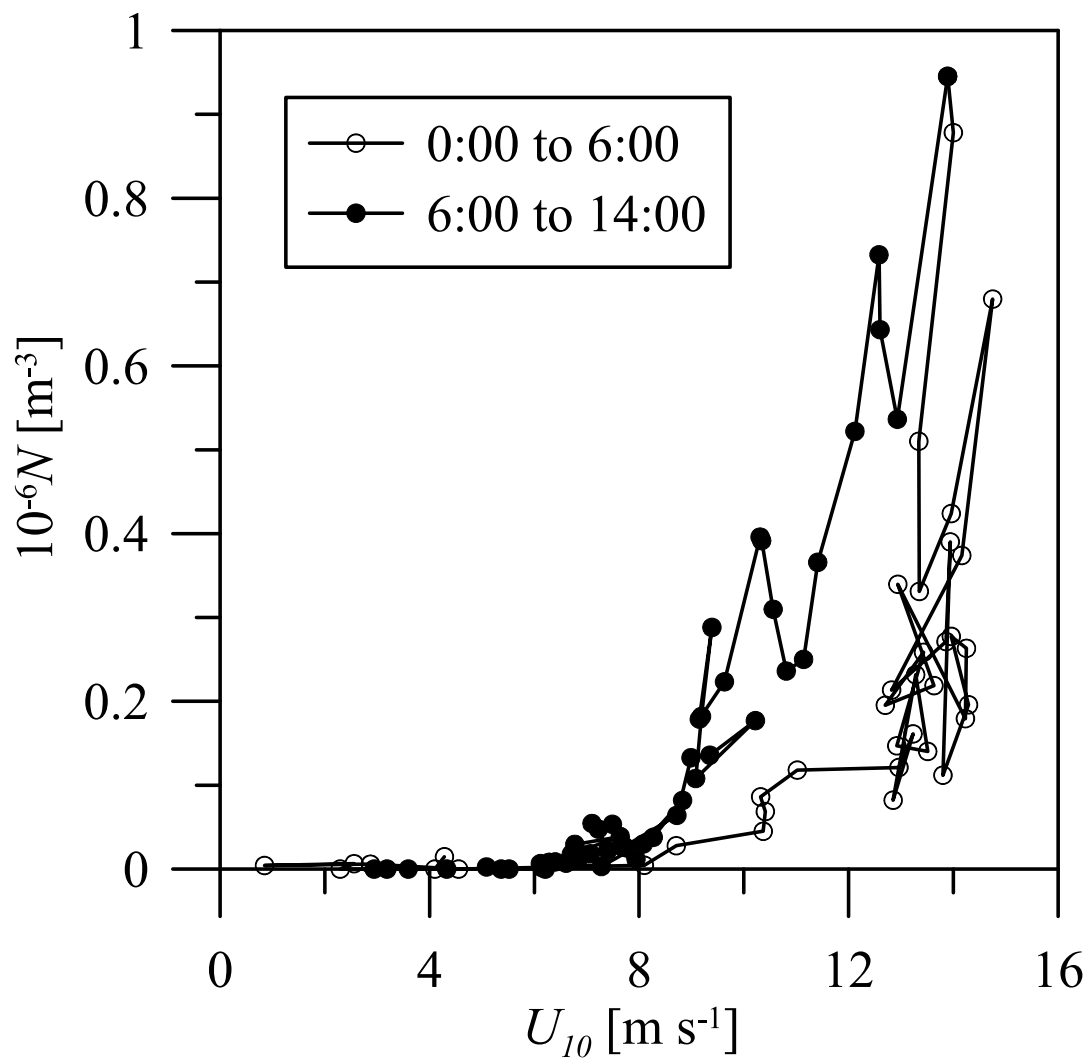
Time Line



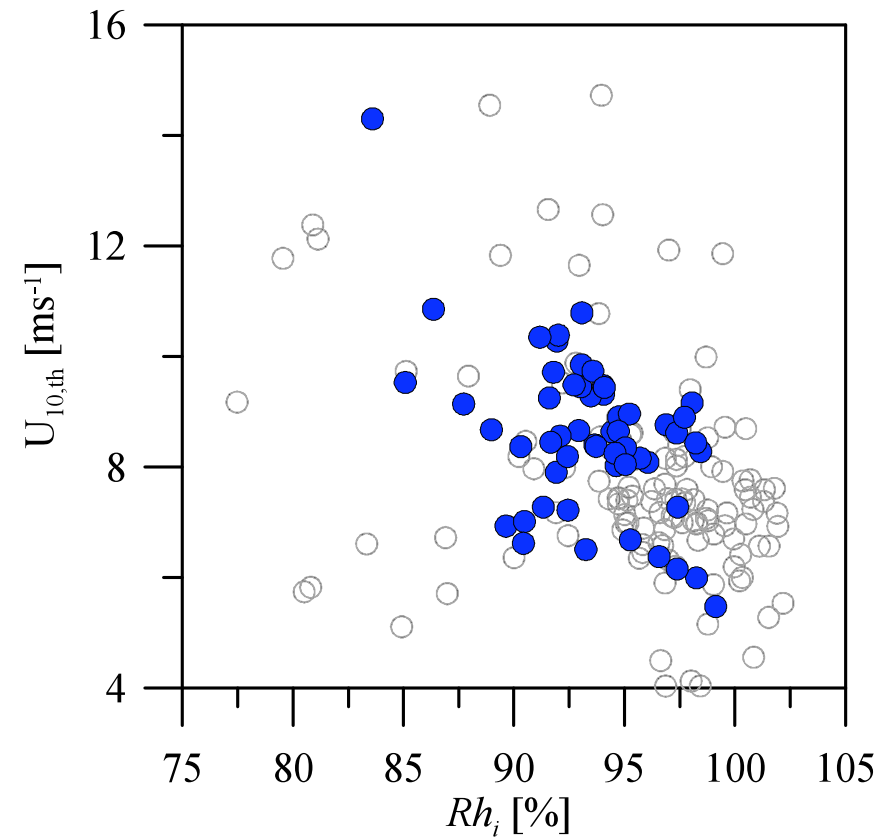
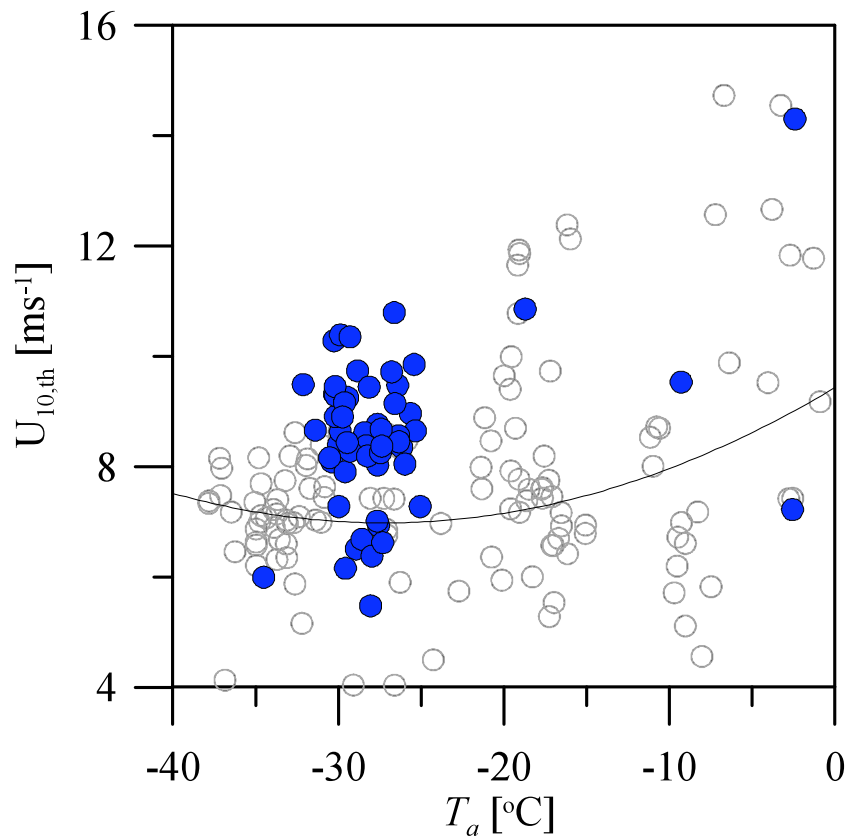




Blowing Snow Number Density Nov. 18, 2007

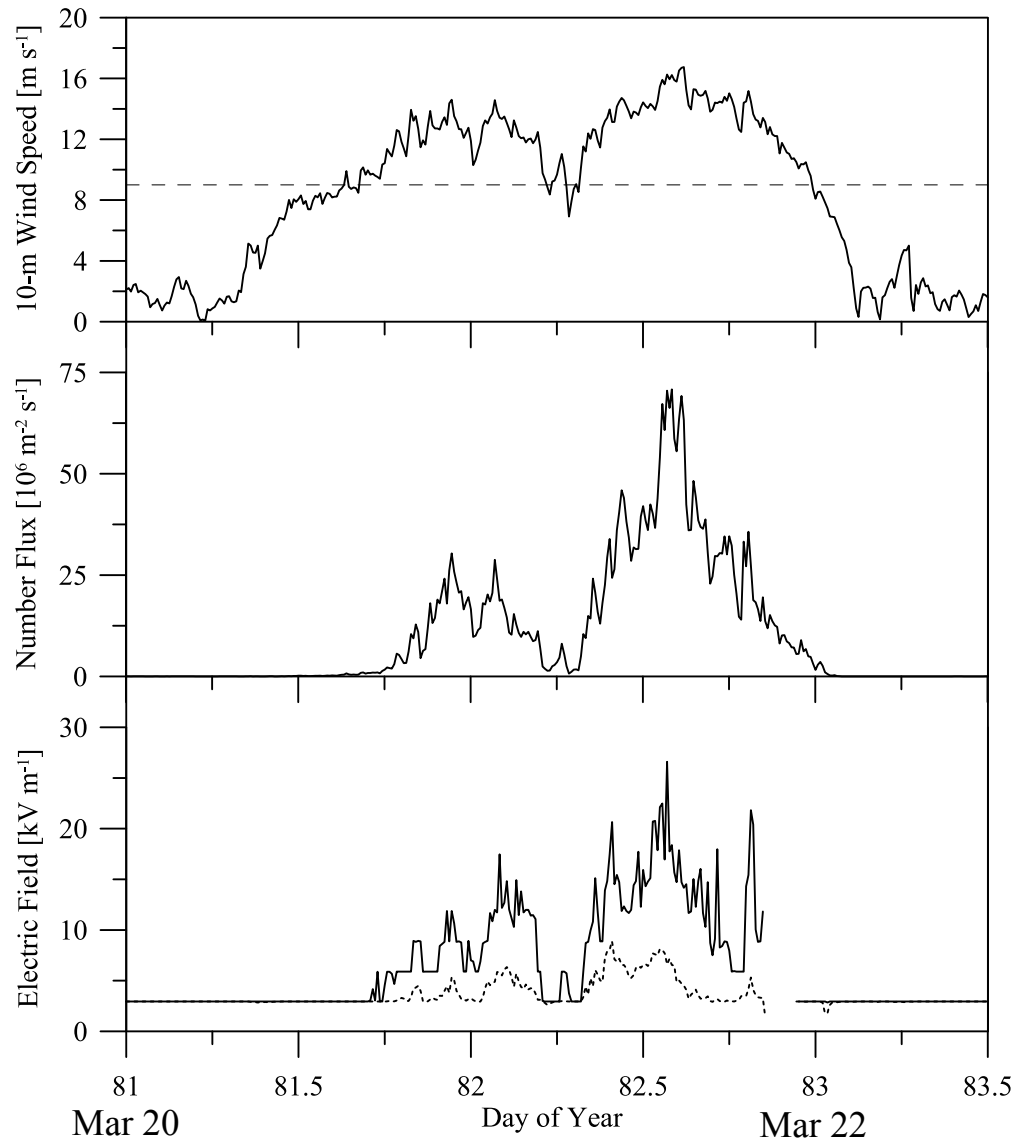


Threshold Wind Speed



- Blowing Snow Only
- Blowing Snow with Ice Crystals or Falling Snow

Electric Field Strength



For $E = 30 \text{ kV m}^{-1}$

with

(max measured)

$$q = -200 \mu\text{C kg}^{-1}$$

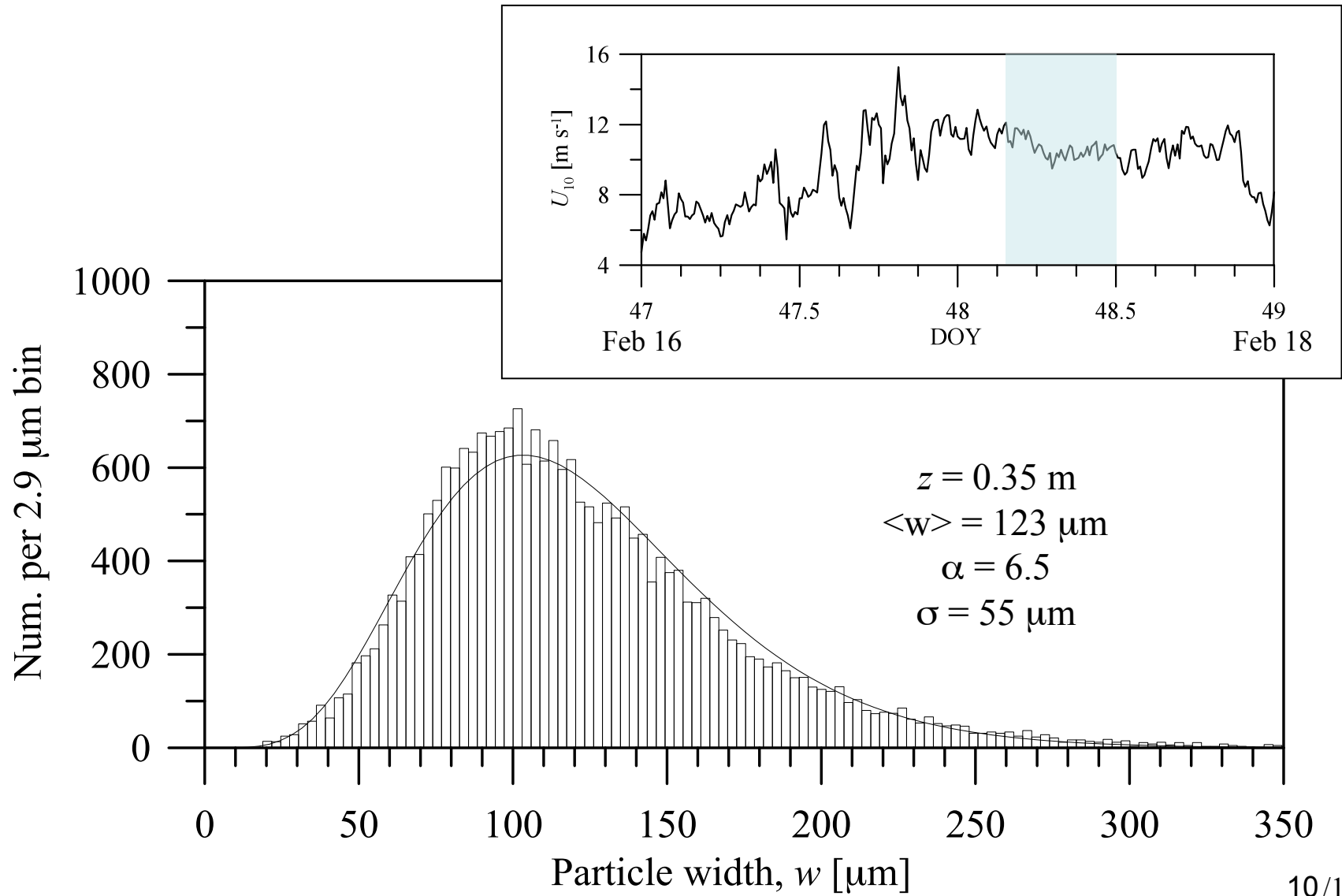
$$a = 0.6 \text{ g}$$

(avg measured)

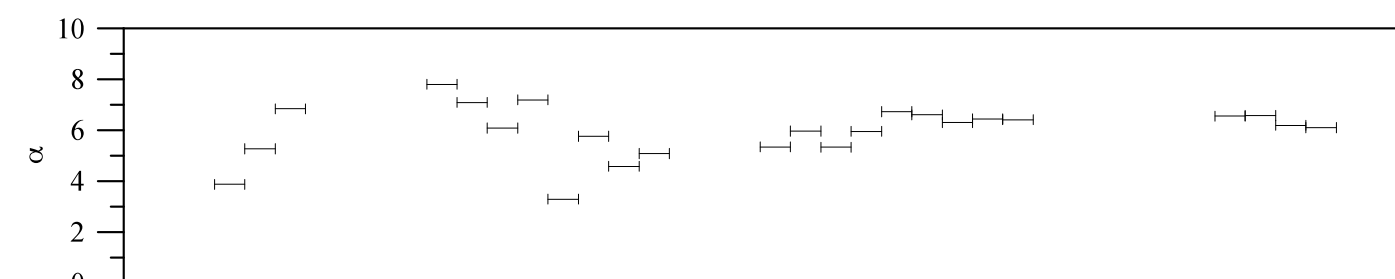
$$q = -25 \mu\text{C kg}^{-1}$$

$$a = 0.08 \text{ g}$$

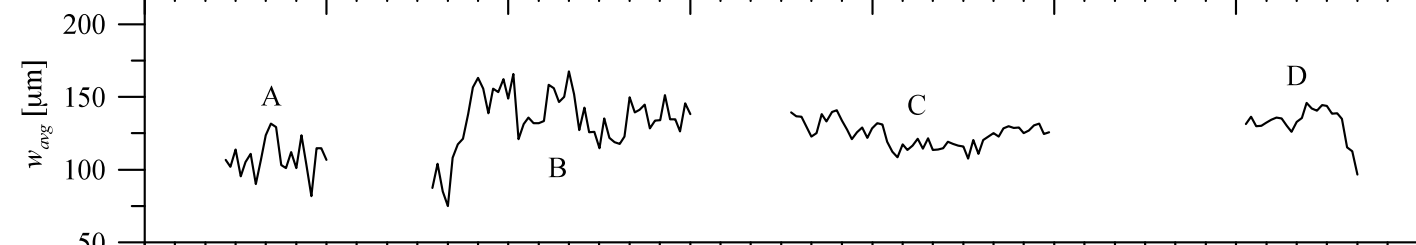
Blowing Snow Camera



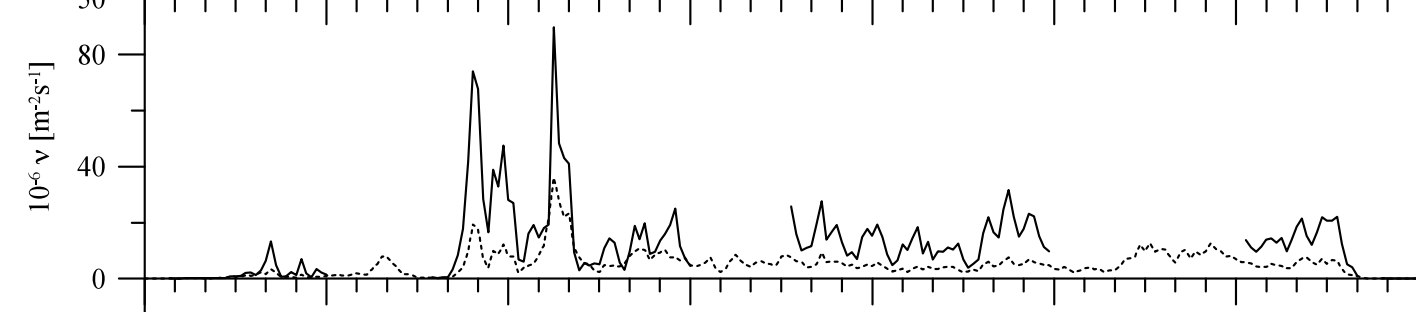
Shape
Parameter



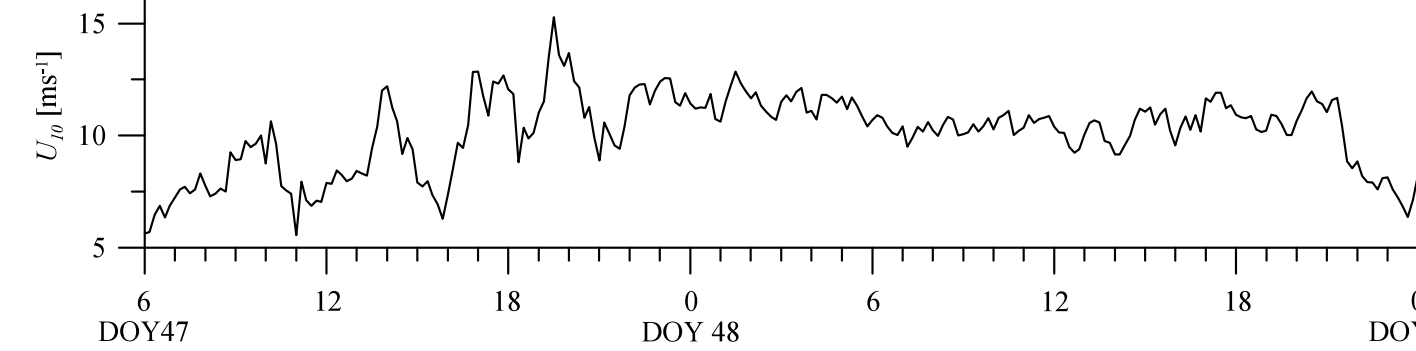
Mean
Width



Number
Flux

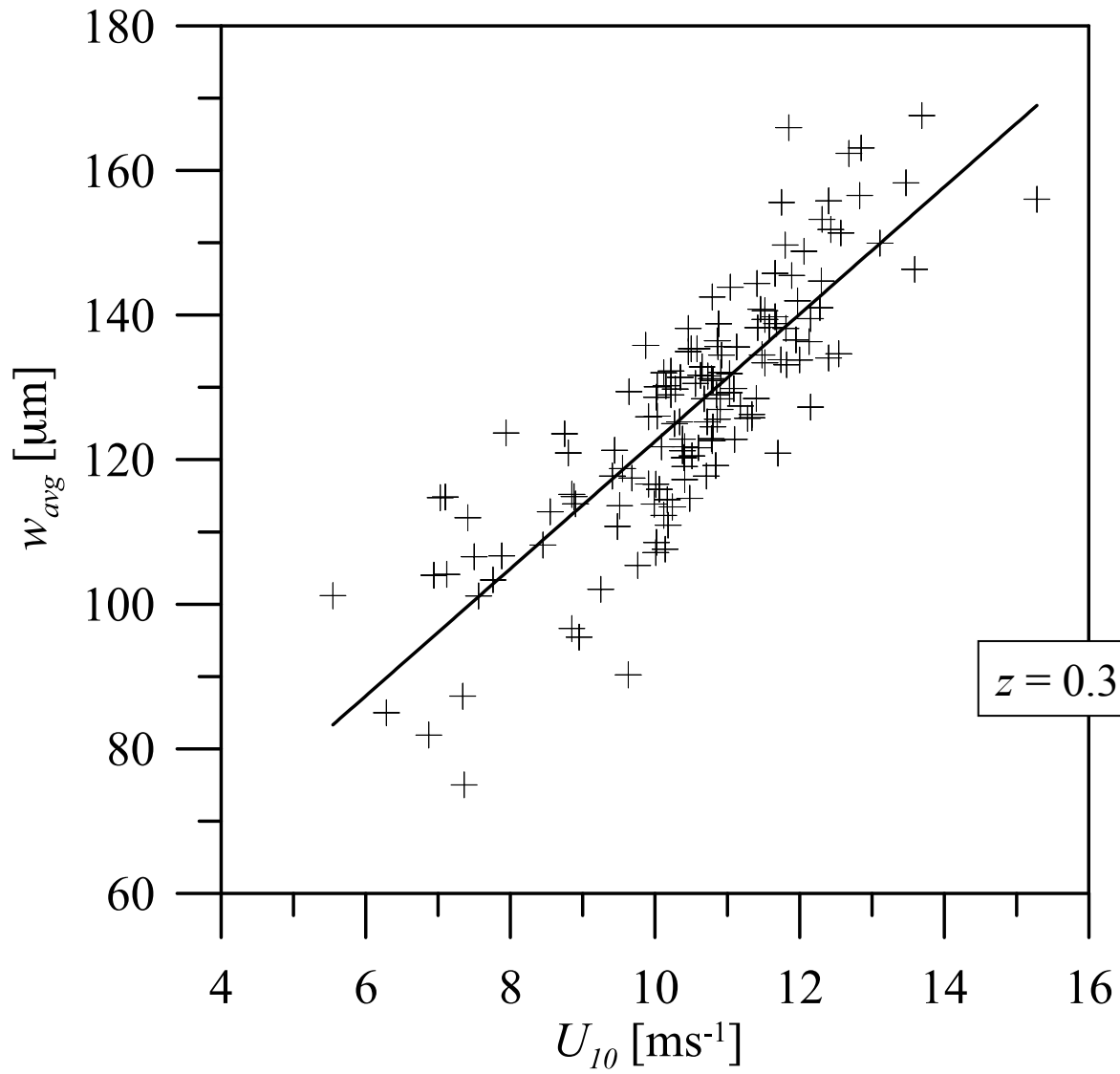


10-m
Wind
Speed

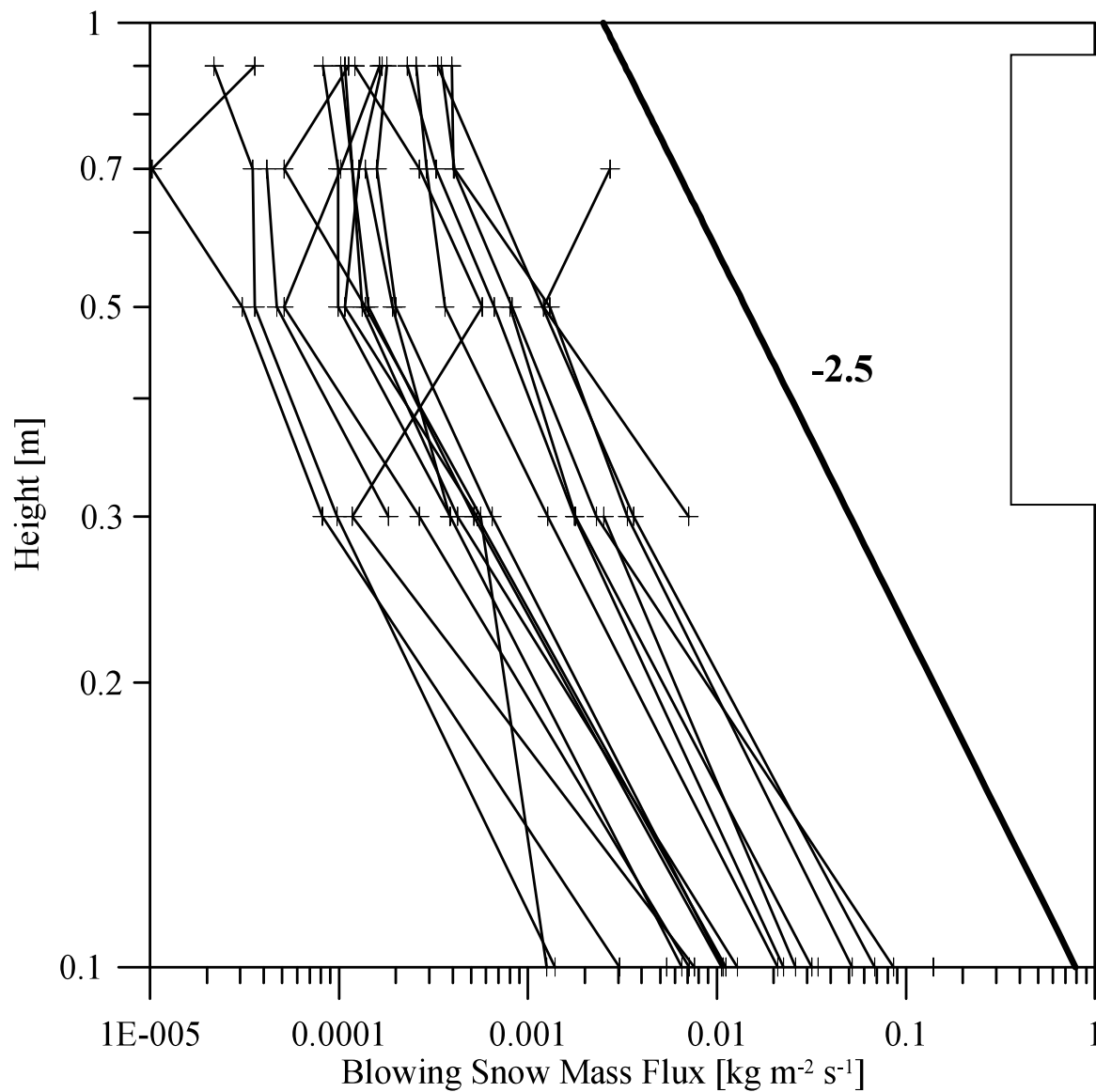


6 DOY47 12 18 0 DOY 48 6 12 18 0 DOY 49

Blowing Snow Particle Size



Mass Flux Measurements

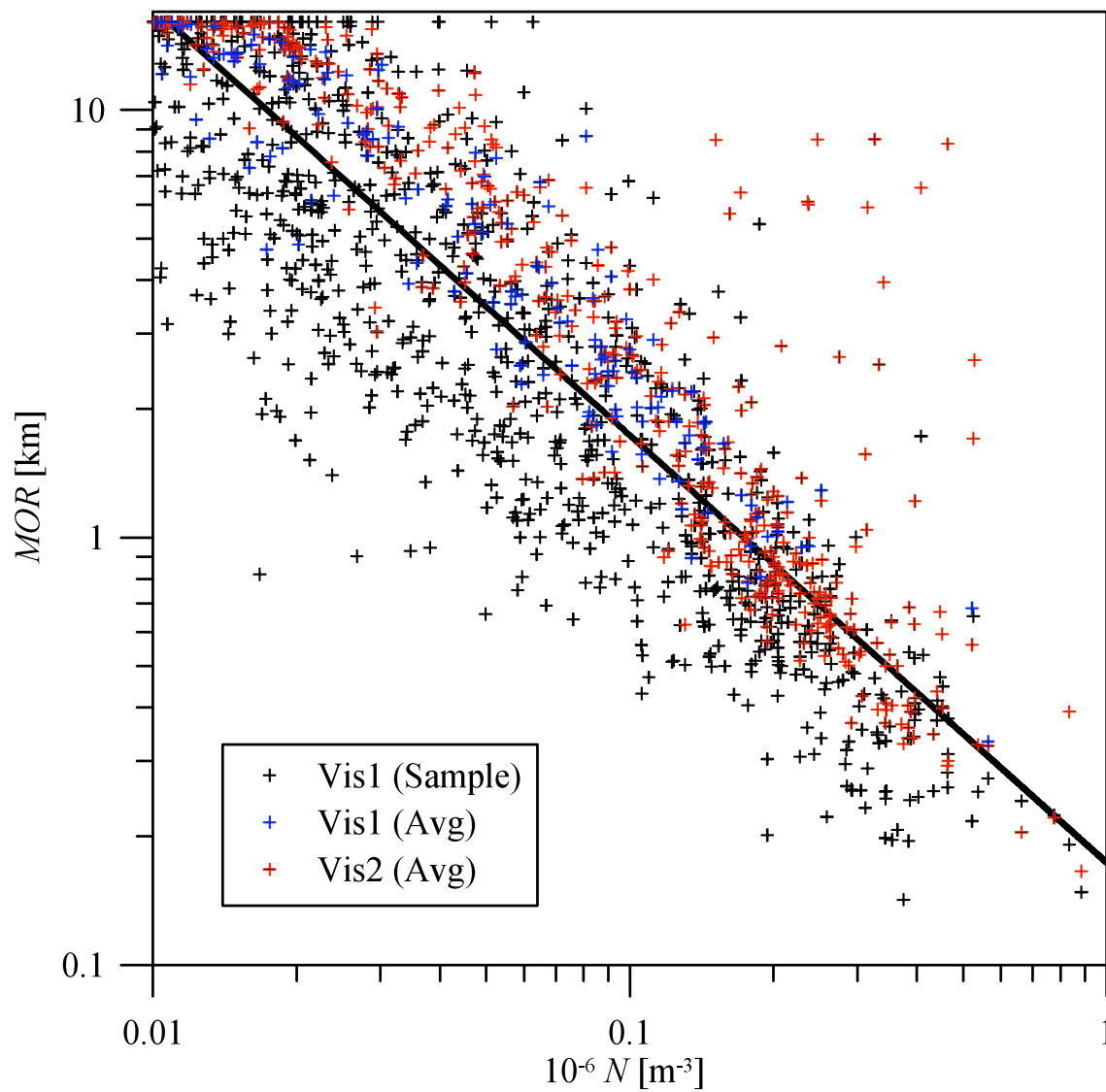


$$\mu(z) = \mu_{ref} \left(\frac{z}{z_{ref}} \right)^{-\gamma}$$

$$\gamma = \frac{\omega_s}{\kappa u_*}$$

$$\omega_s \approx u_*$$

Visibility



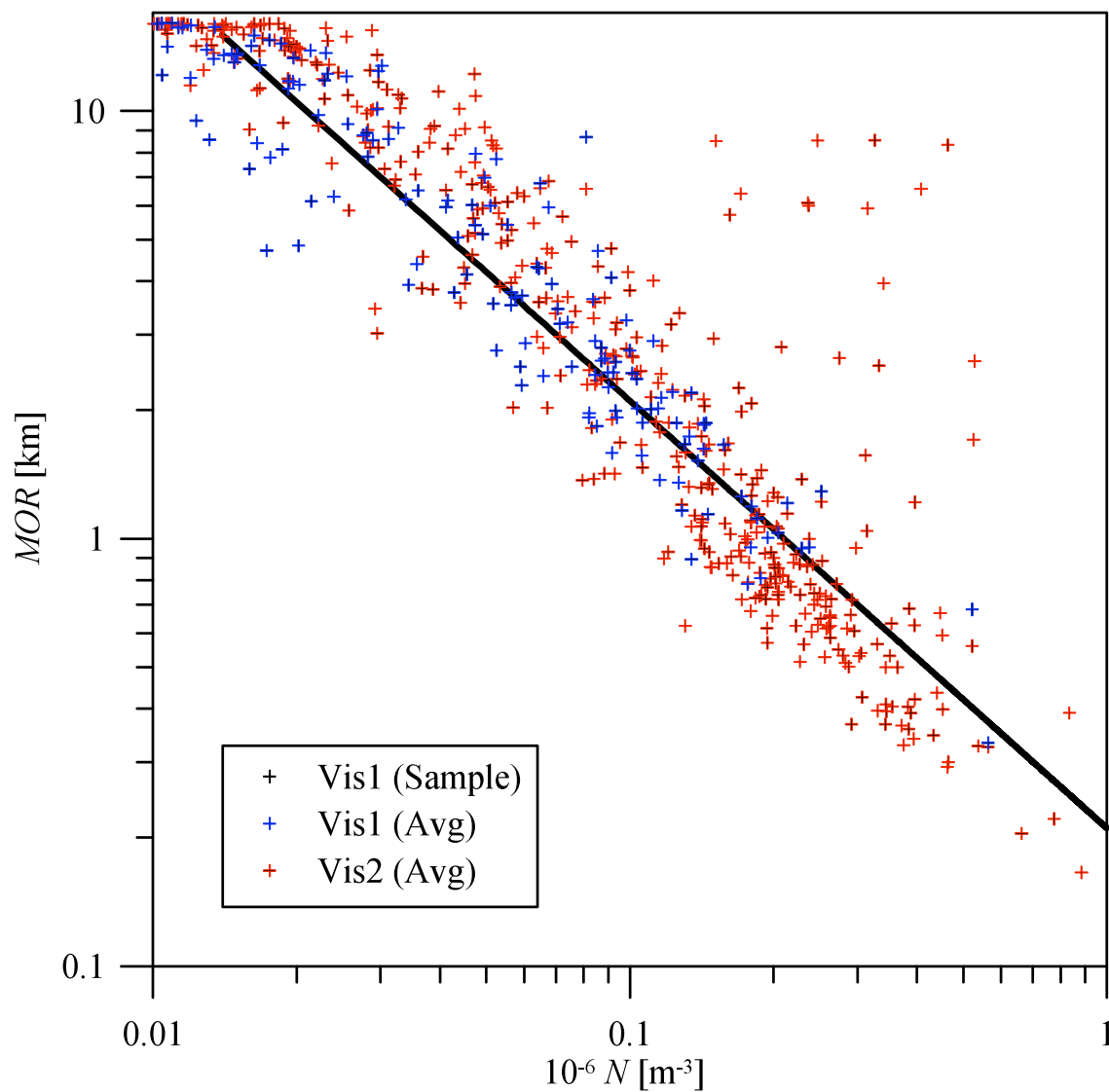
- + Vis1 (Sample)
- + Vis1 (Avg)
- + Vis2 (Avg)

$U_{10} > 6 \text{ m s}^{-1}$

Observations:
Clear,
Cloudy,
Blowing Snow

Best-fit:
 $MOR = 1.96 / (N \pi d_m^2)$
gives $d_m = 120 \text{ } \mu\text{m}$

Visibility



$$U_{10} > 6 \text{ m s}^{-1}$$

Observations:

Clear,
Cloudy,
Blowing Snow

Best-fit:

$$MOR = 1.96 / (N \pi d_m^2)$$

gives $d_m = 109 \mu\text{m}$

Summary

170 Days of Data (Oct. 23 to Apr. 10)

- Max Wind Speed, $U_{10} = 18.2 \text{ ms}^{-1}$ (65 km h⁻¹)
- Temperatures between $0 < T_a < -40 \text{ C}$

Results (In Progress):

- | | |
|---------------------------------------|---|
| • Threshold Wind Speeds | Variation with T_a and Rh |
| • Electric Field Strength | To Compare with Models |
| • Particle Size Measurements | 120 – 150 μm at 0.35 m
Linear Variation with Wind Speed |
| • Mass Flux Measurements | Constant Exponent γ |
| • Visibility and Particle Number Flux | Model with $d \approx 109 \mu\text{m}$ (at 2 m) |
| • Surface Roughness near 0.06 m | Increase with Wind Speed |