Experimental investigation of the spatiotemporal variability of blowing snow

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&
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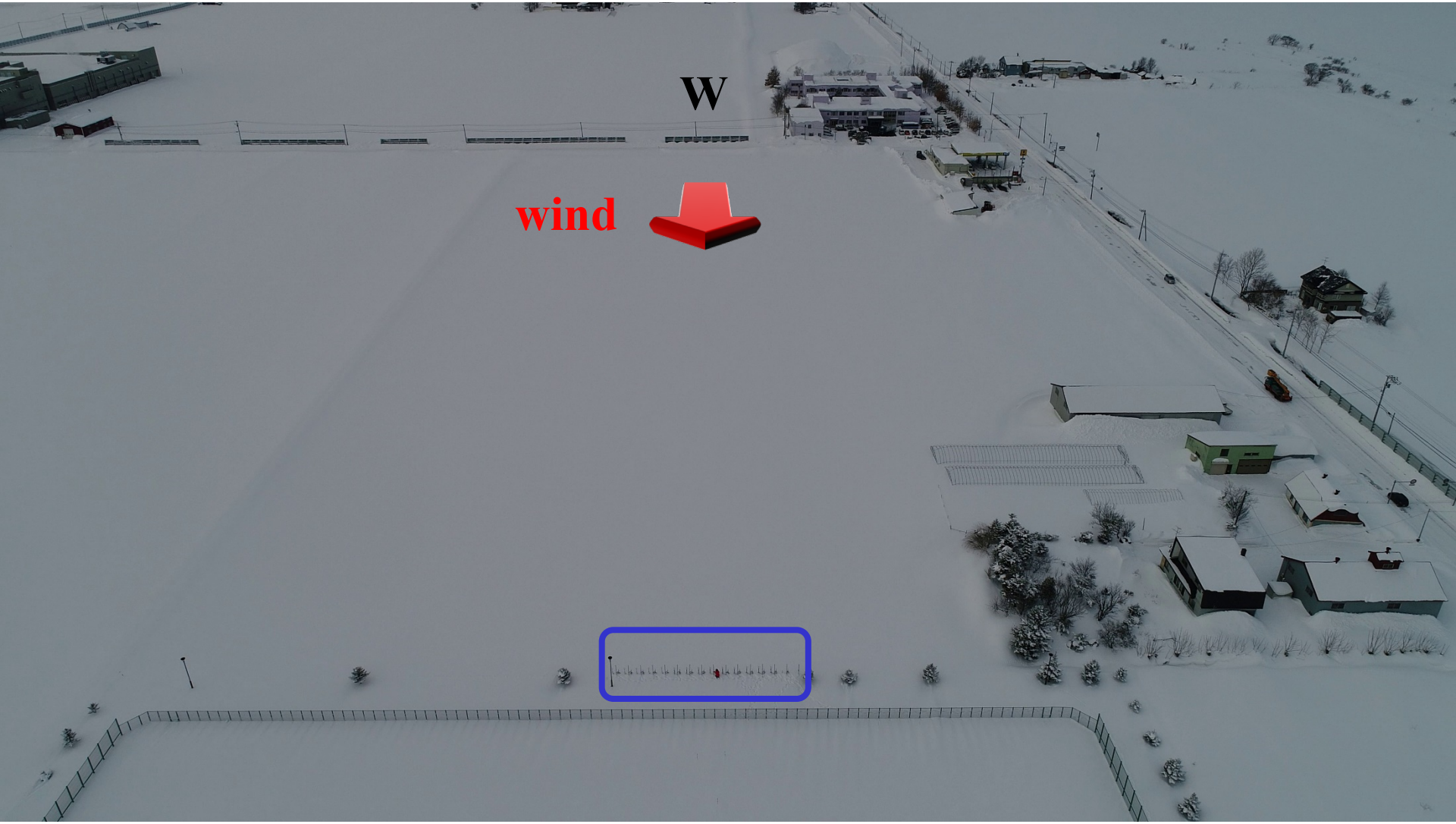
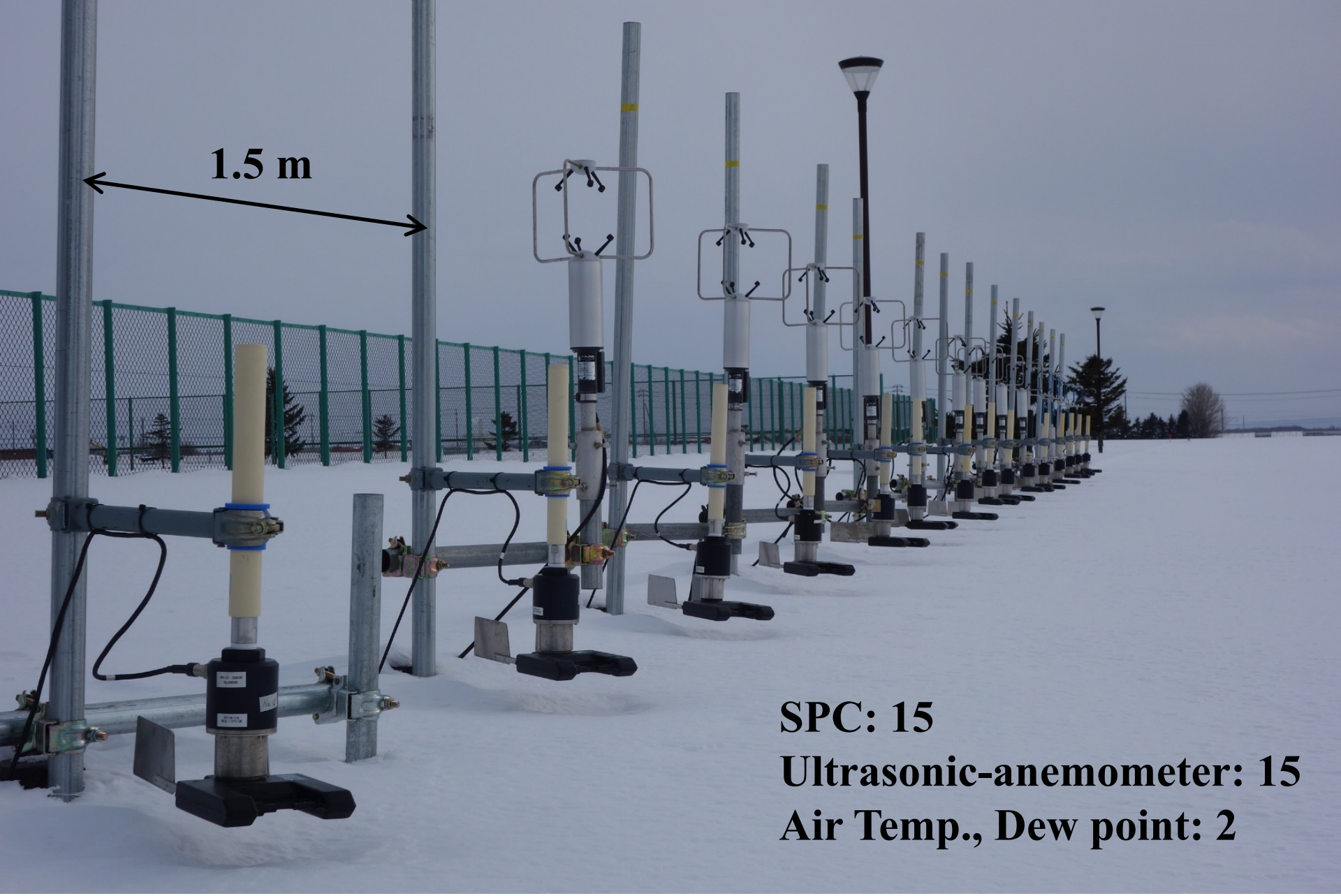
Hokkaido, Japan




1.5 m
SPC: 15
Ultrasonic-anemometer: 15
Air Temp., Dew point: 2

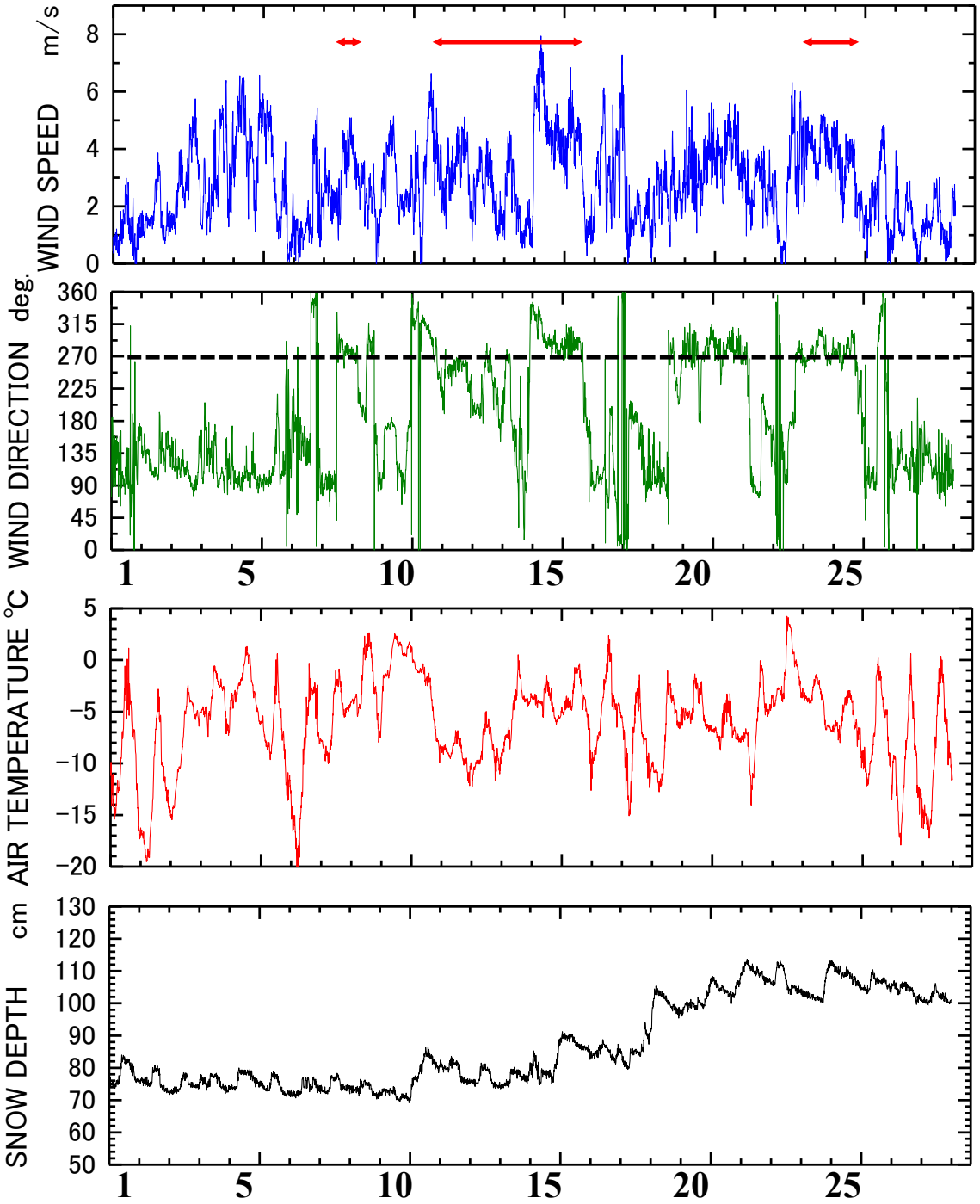
SPC: 100 kHz
others: 1 kHz

AWS

DFIR: Double Fence Intercomparison Reference

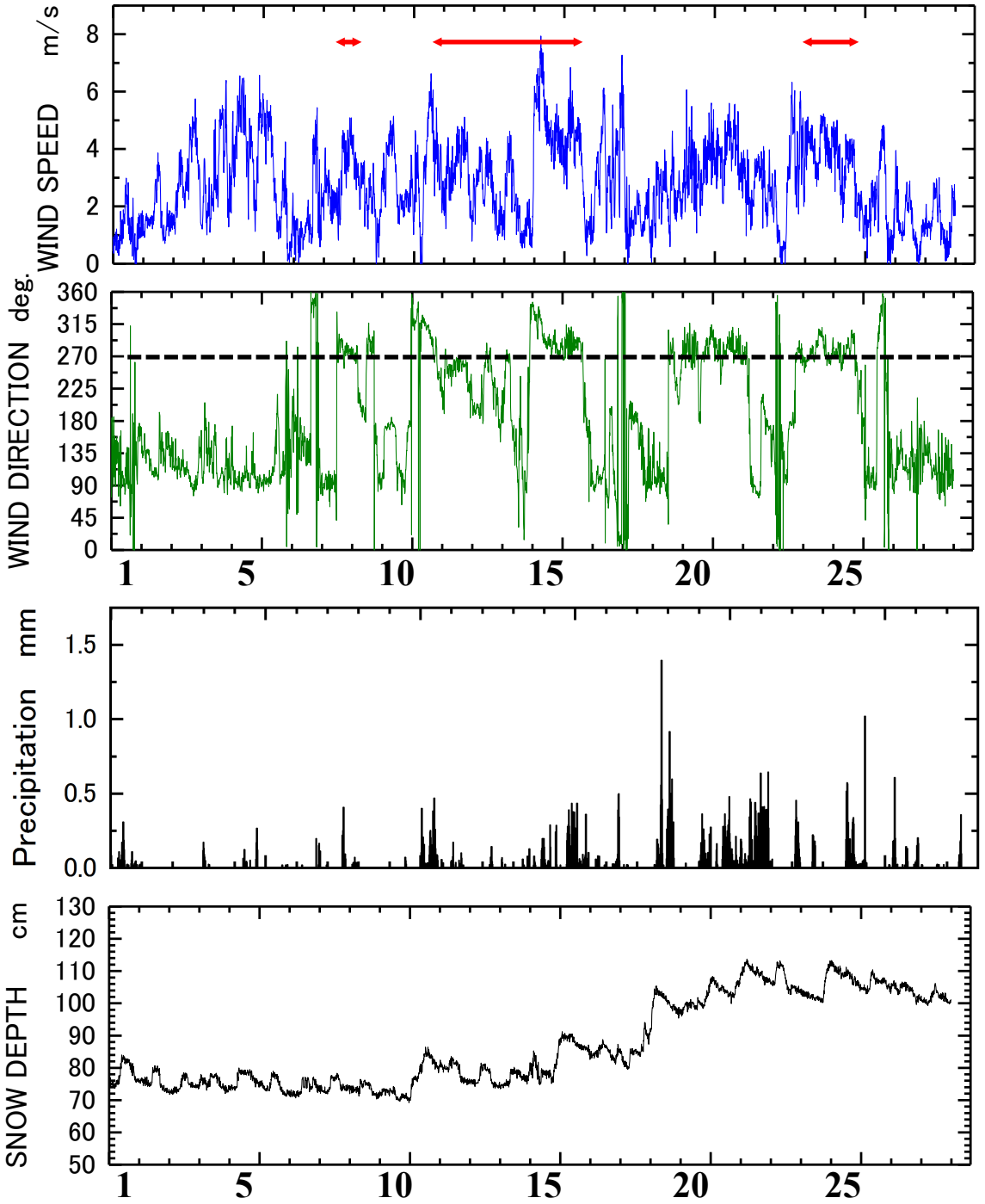
FEB. 2018
TOUBETSU

Obs. period

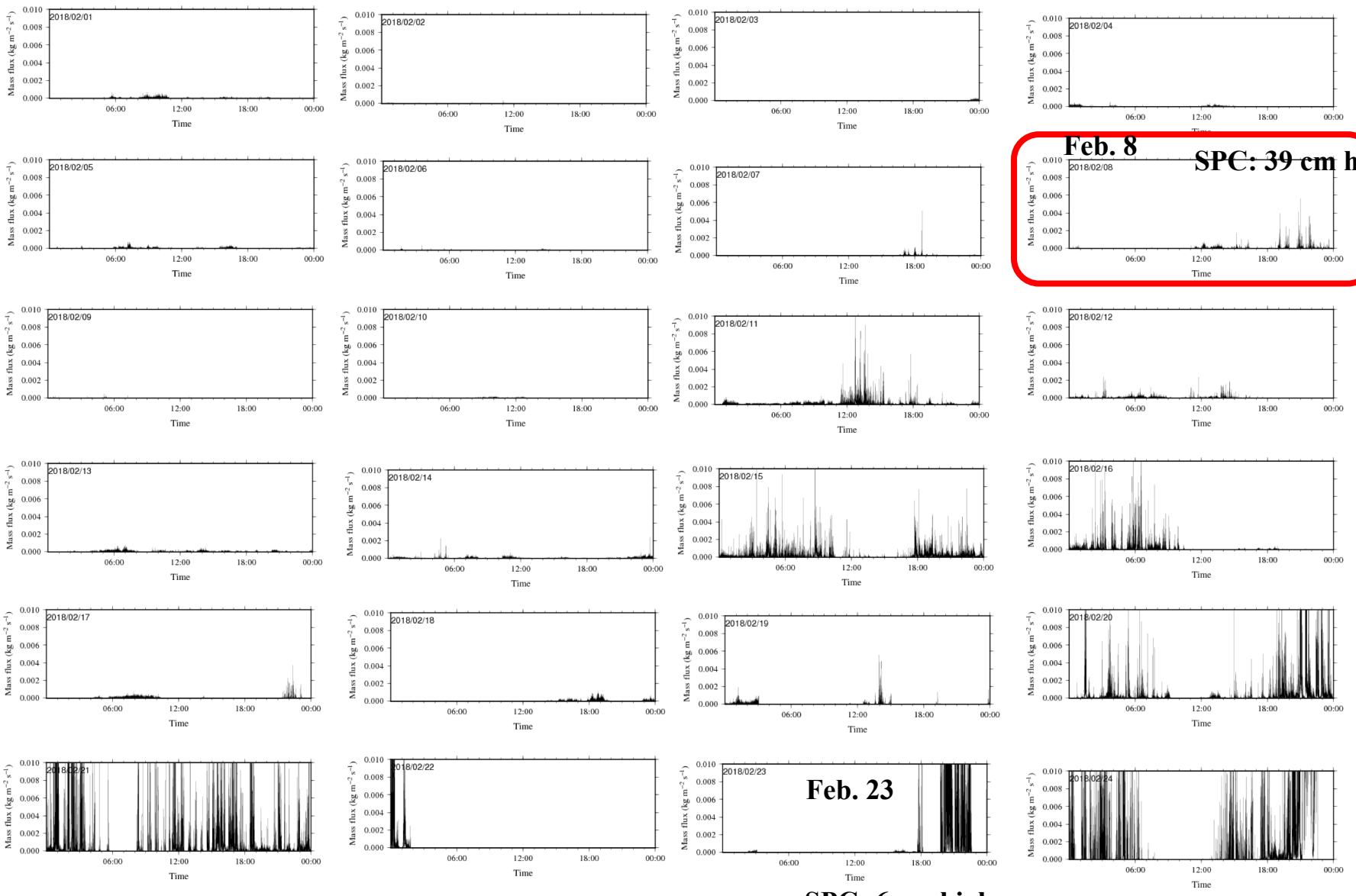


FEB. 2018
TOUBETSU

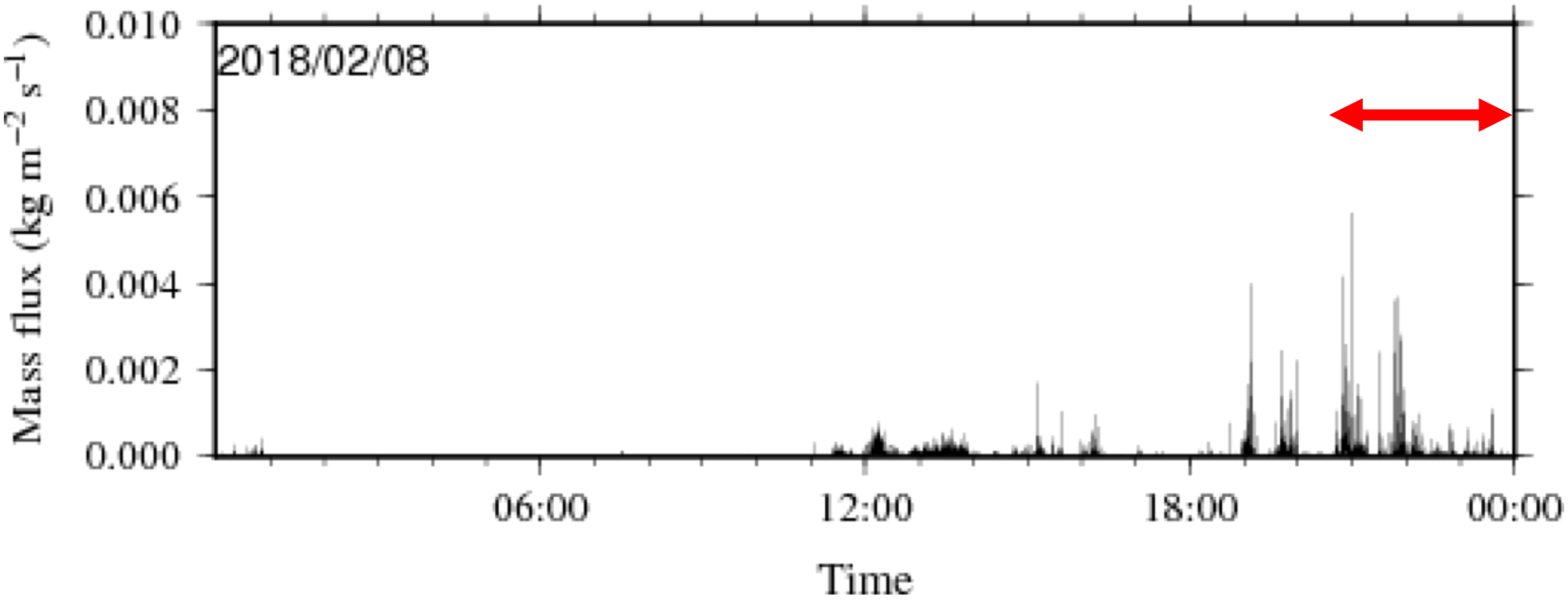
Obs. period



Blowing snow mass flux



Blowing snow mass flux



SPC: 39 cm high

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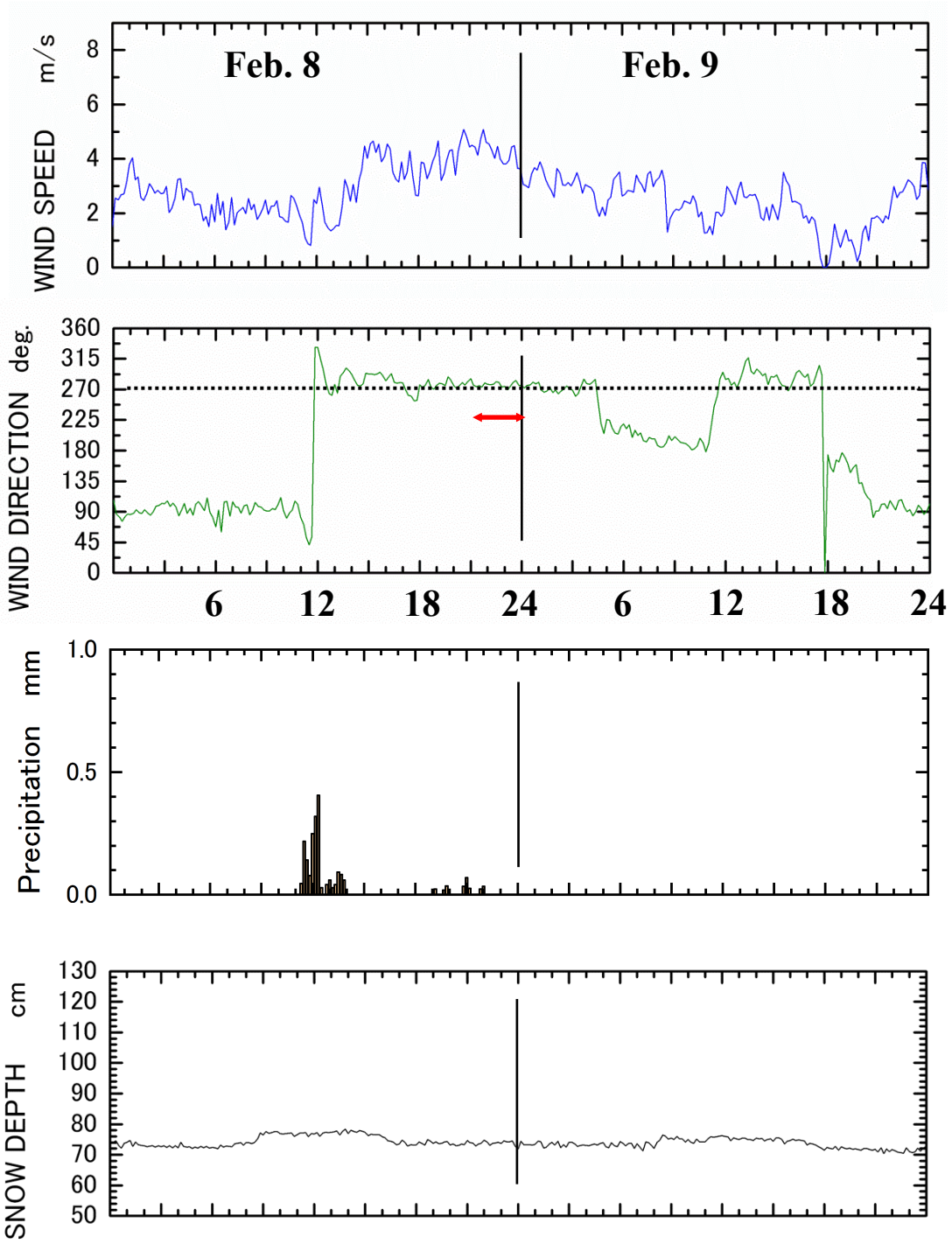
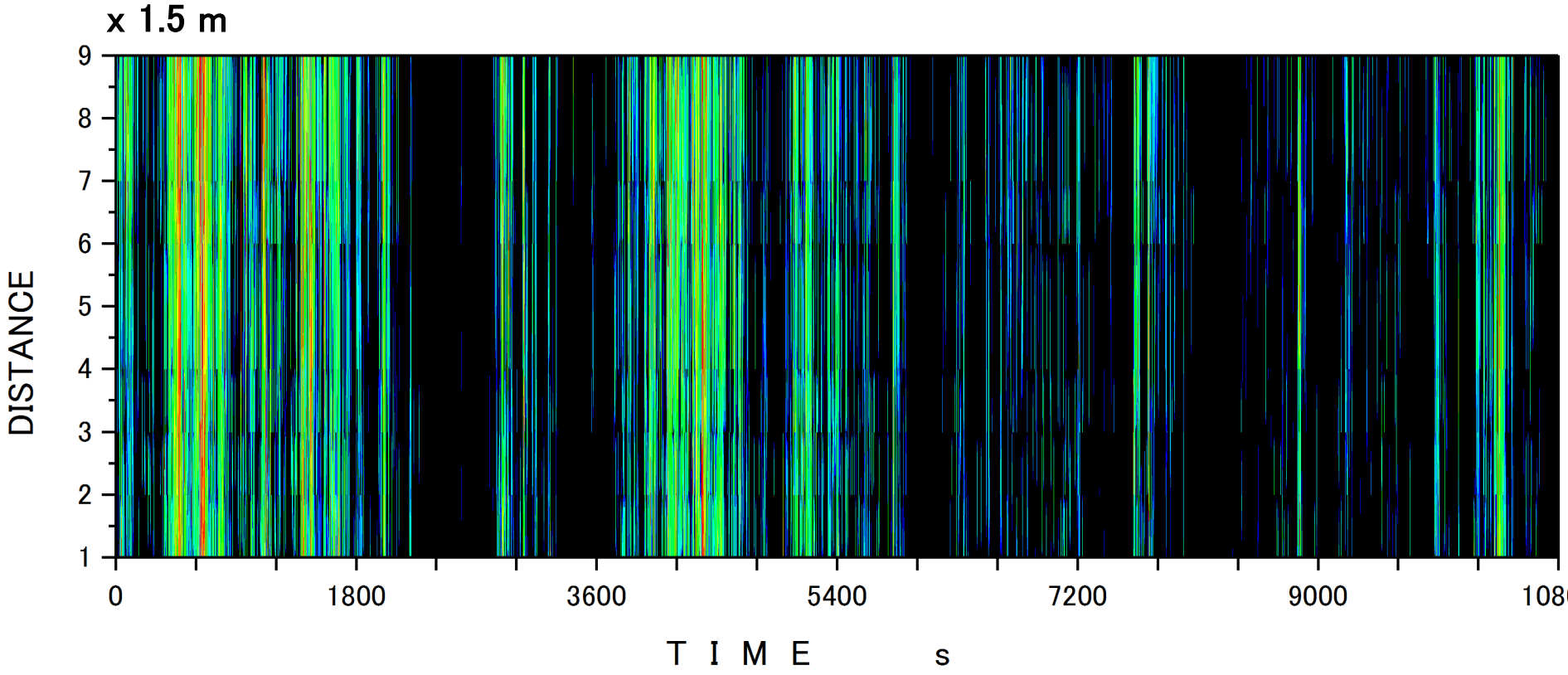
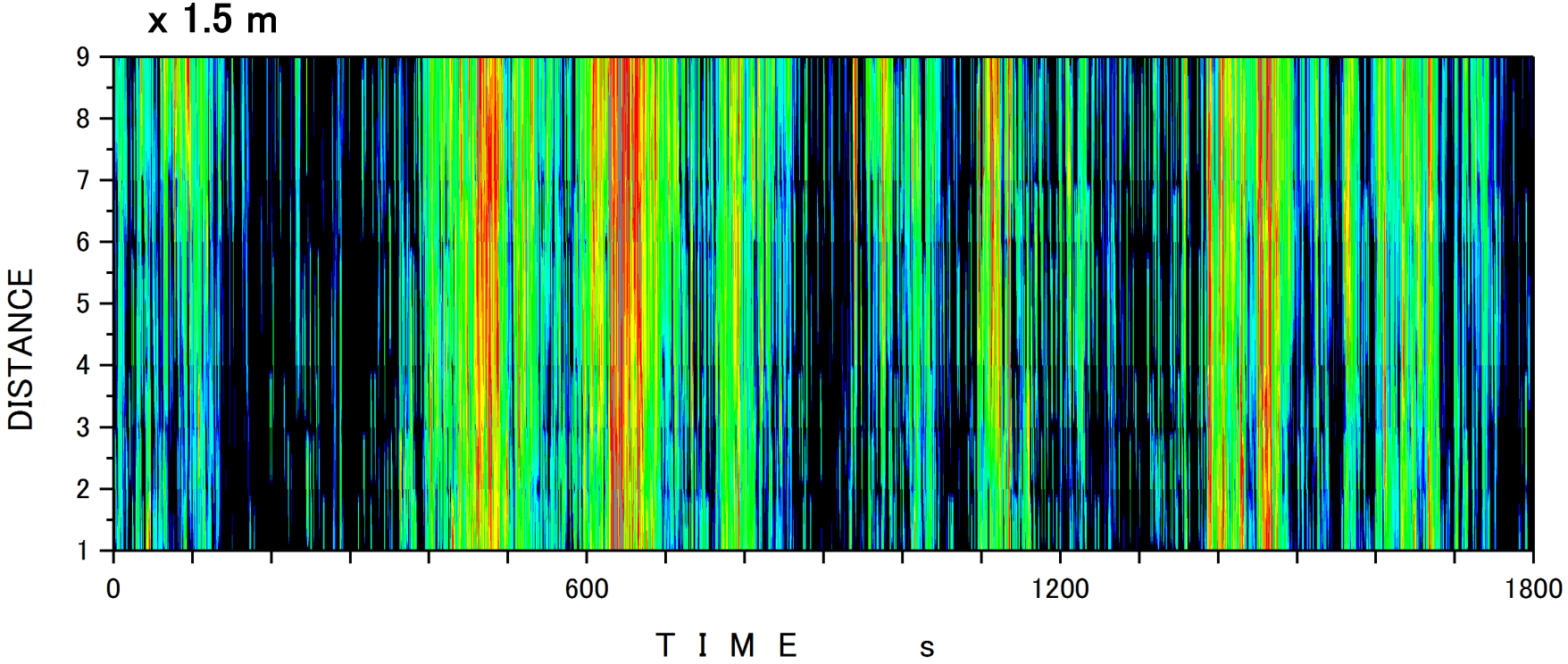


Spatiotemporal distribution of snow mass flux



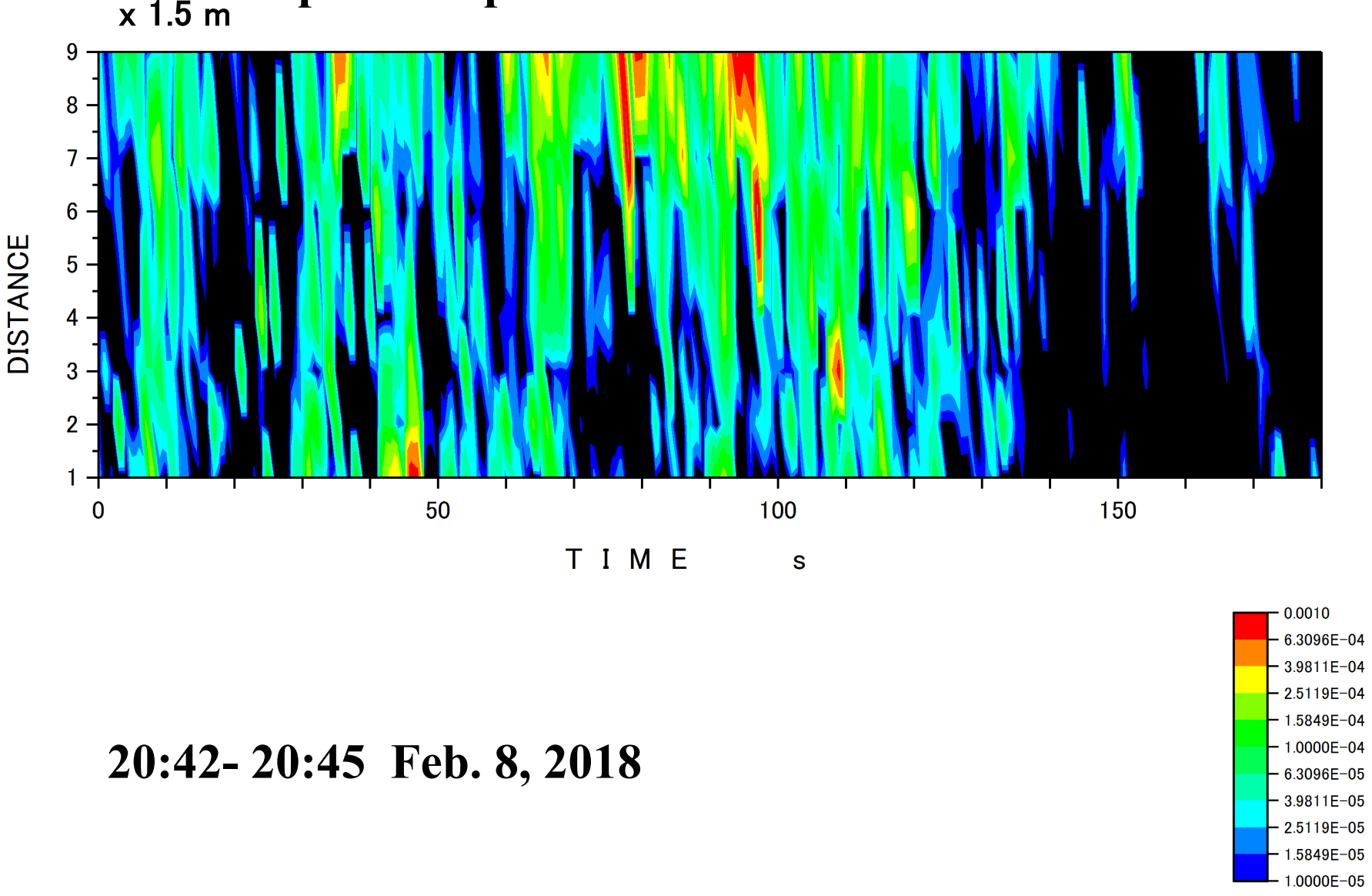
20:42- 24:00 Feb. 8, 2018

Spatiotemporal distribution of snow mass flux



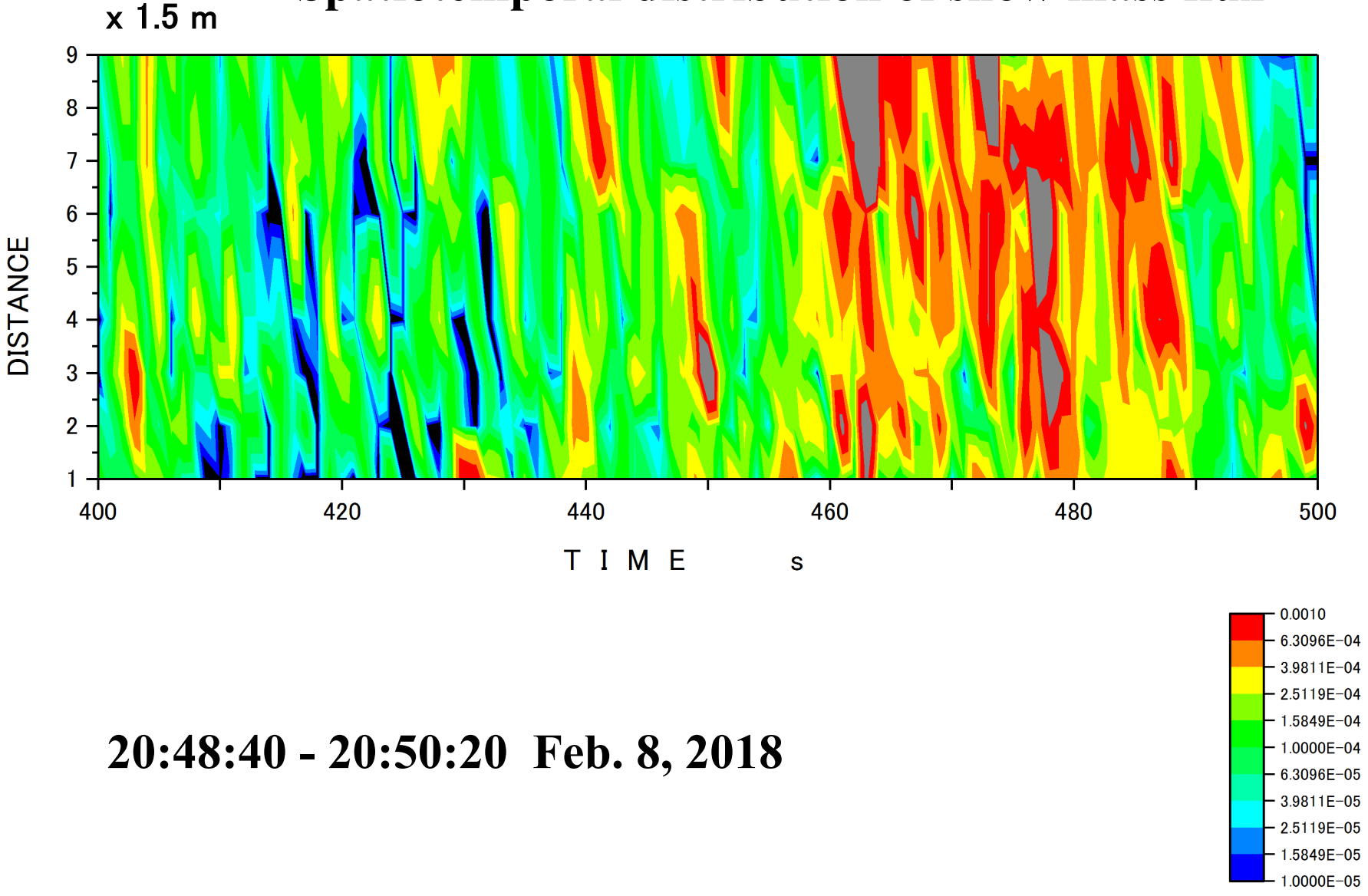
20:42- 21:12 Feb. 8, 2018

Spatiotemporal distribution of snow mass flux

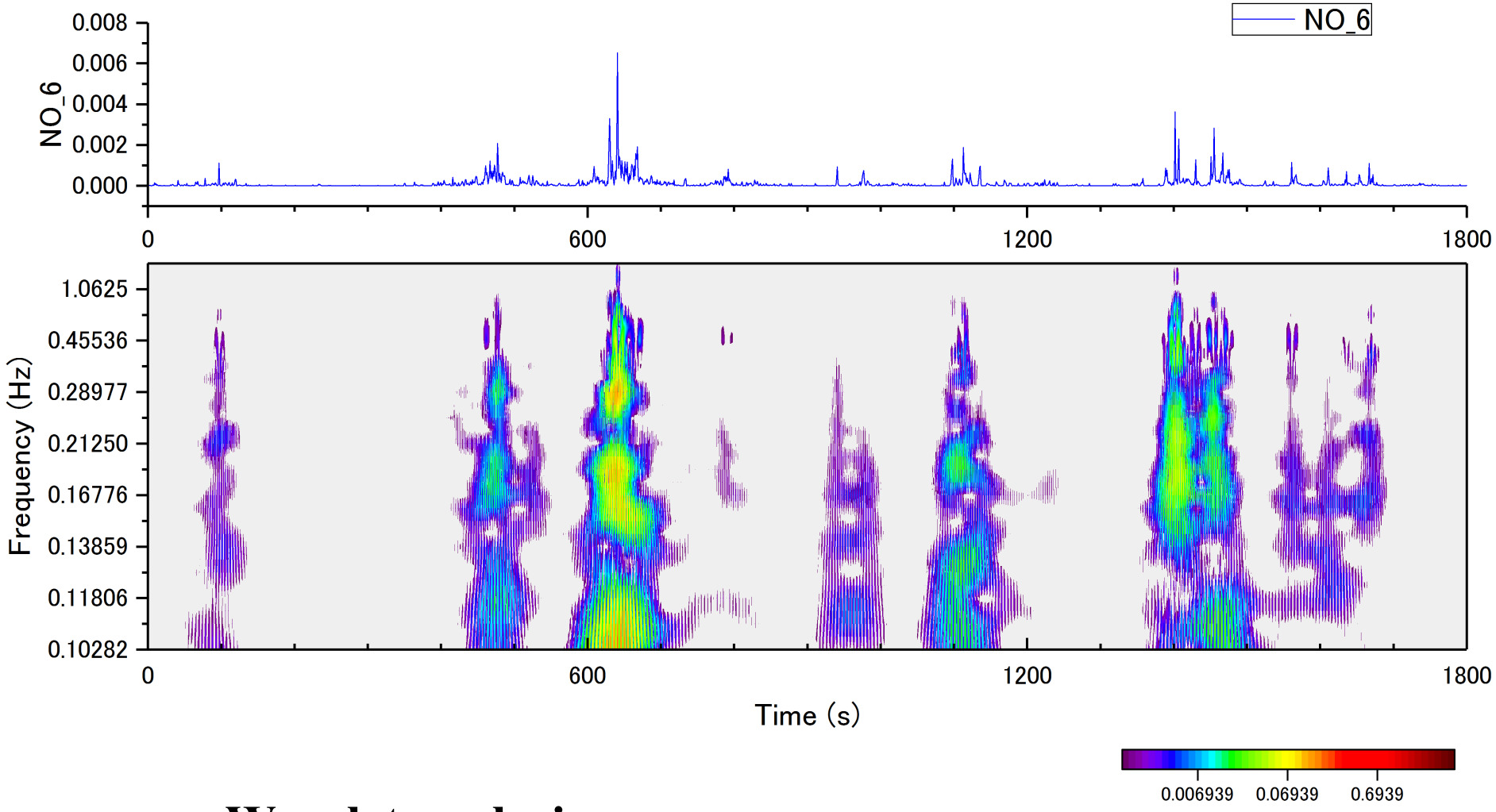


20:42- 20:45 Feb. 8, 2018

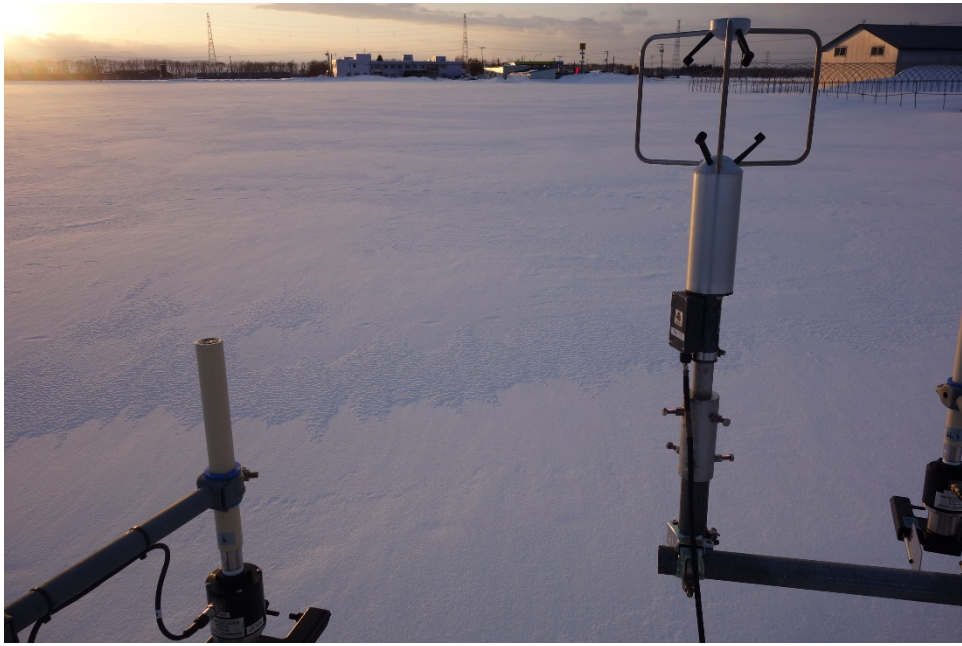
Spatiotemporal distribution of snow mass flux



20:48:40 - 20:50:20 Feb. 8, 2018



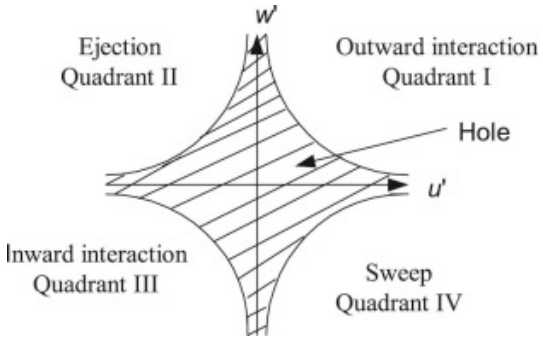
Wavelet analysis



Coherent structure in the boundary layer

Quadrant Analysis

Fluctuation of horizontal and vertical wind speed: *u*', *w*'



VITA: Variable Interval Time Averaging

Variance of turbulent energy production

Blackwelder & Eckelmann (1979)

$$\mathrm{var}_{uu}(t) = \frac{1}{T}\int_{t-T/2}^{t+T/2} u^2(t')dt' - \left[\frac{1}{T}\int_{t-T/2}^{t+T/2} u(t')dt'\right]^2$$

Ejection

$$D(t) = \begin{cases} 1 & \mathrm{var}_{uu}(t) > ku'^2 \ \text{ and } \ du/dt > 0 \\ 0 & (otherwise) \end{cases}$$

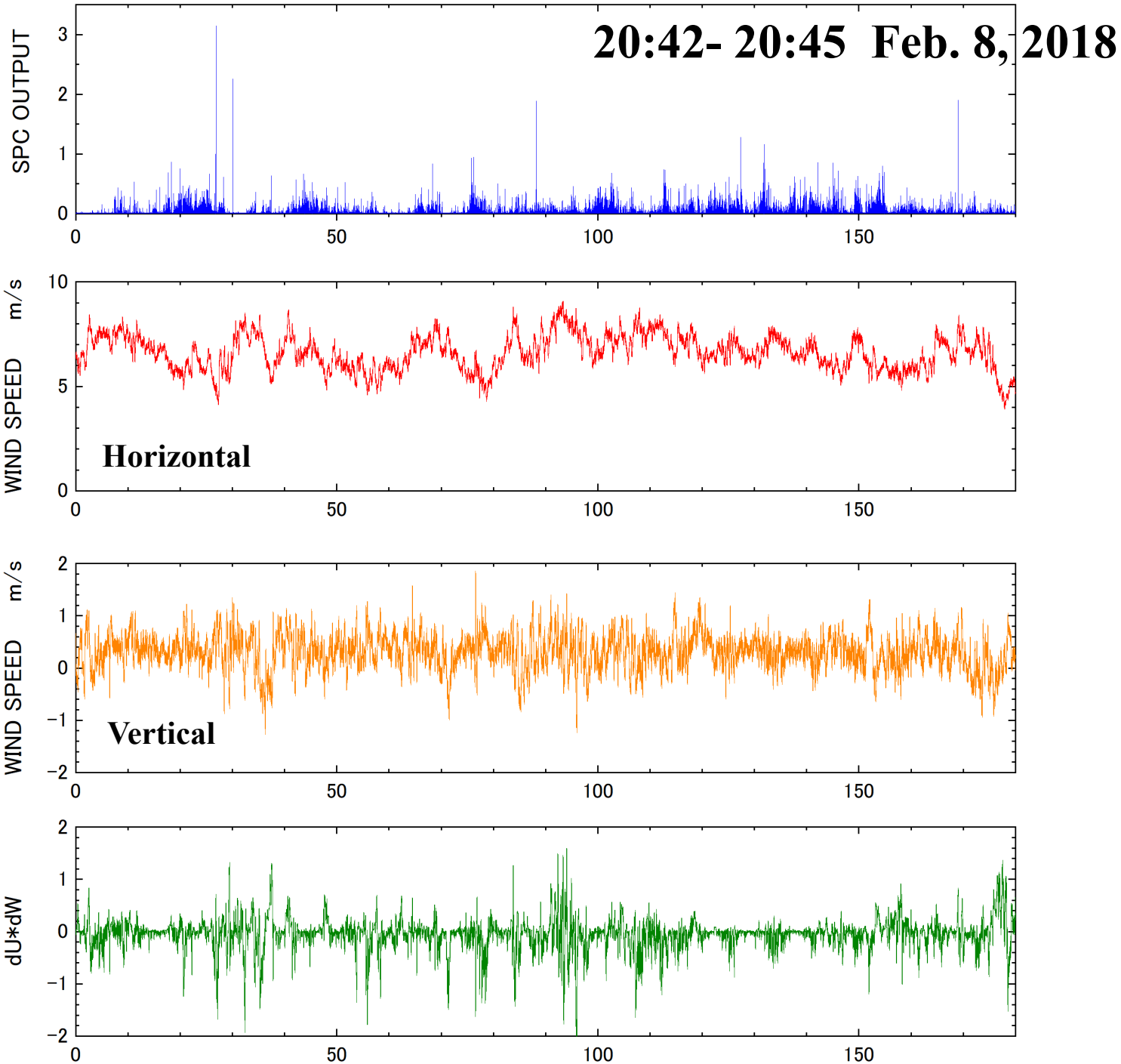
Sweep

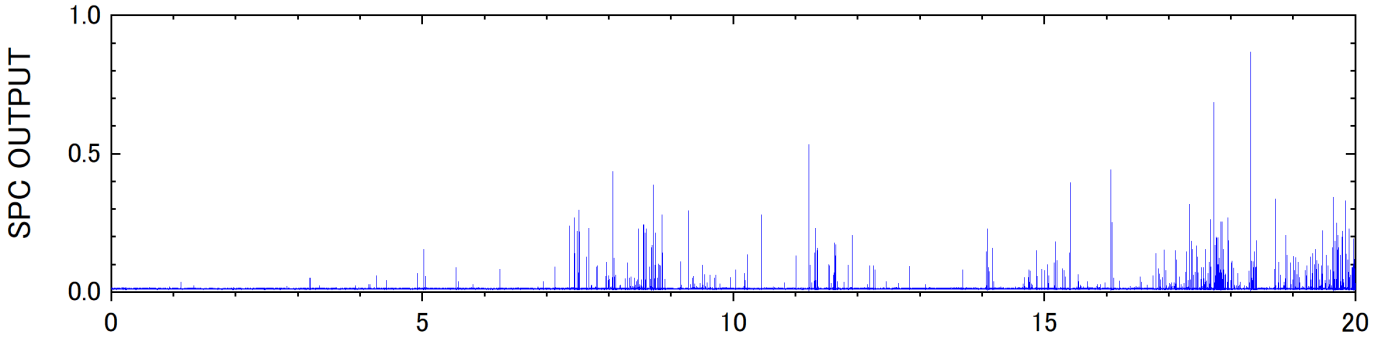
$$D(t) = \begin{cases} 1 & \mathrm{var}_{uu}(t) > ku'^2 \ \text{ and } \ du/dt < 0 \\ 0 & (otherwise) \end{cases}$$

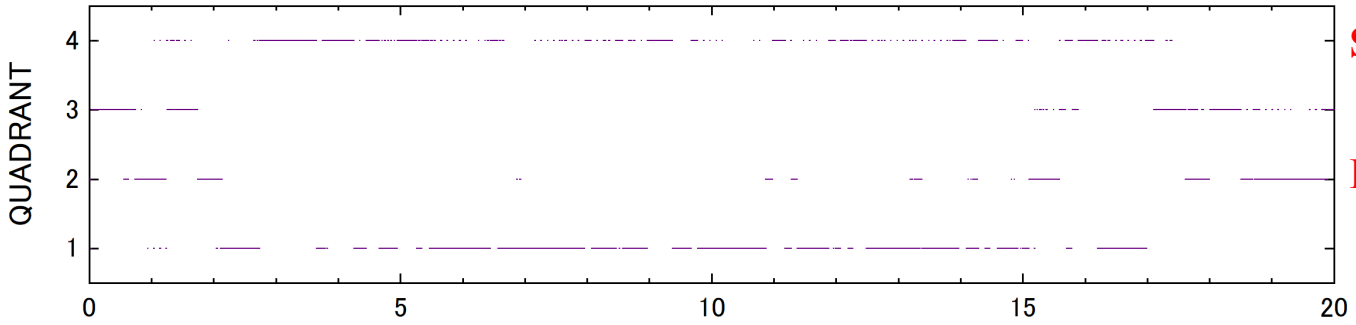
Quadrant Analysis, Quadrant-hole Analysis and VITA

Willmarth et al.(1979) , Morrison et al.(1989)

⇒ **Aksamit and Pomeroy (2017)**

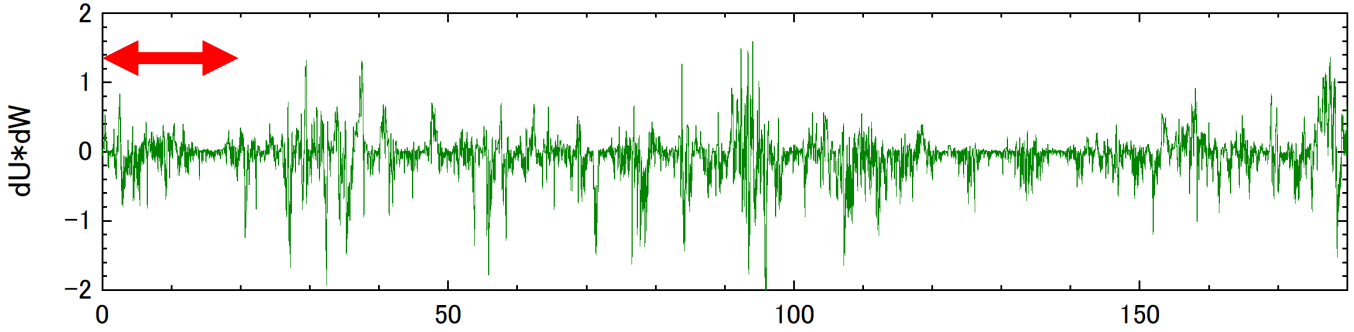

20:42- 20:45 Feb. 8, 2018
SPC OUTPUT
WIND SPEED m/s
Horizontal
WIND SPEED m/s
Vertical
dU*dW

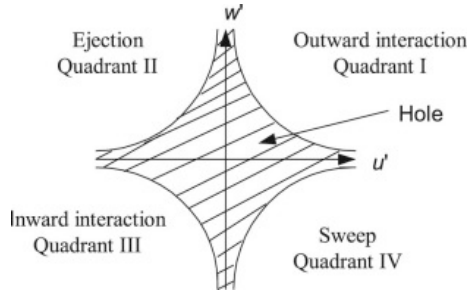




Sweep

Ejection





Large-Eddy Simulation coupled Lagrangian Snow Transport model (LLAST)

Main-process (in air)

Sub-process (on surface)

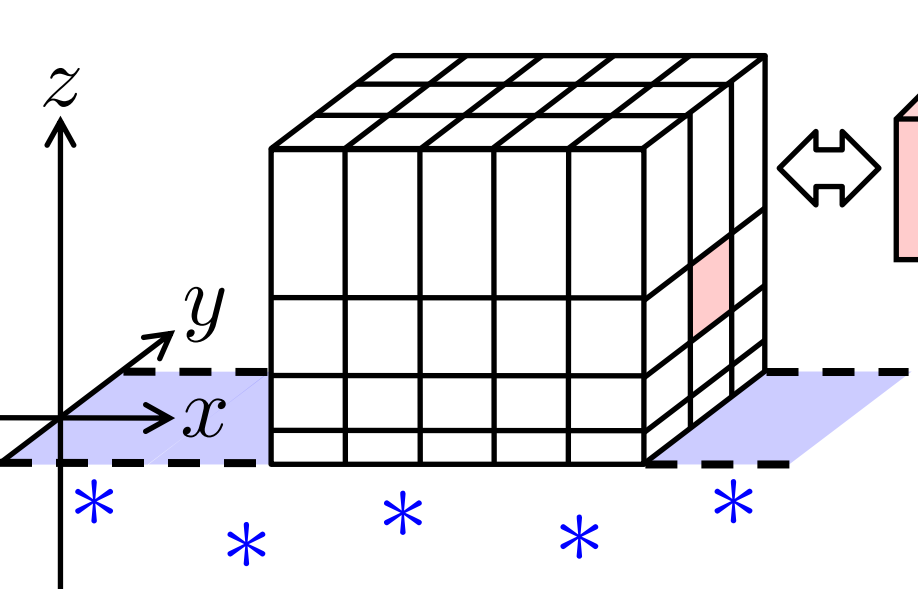
(3D) wind modification

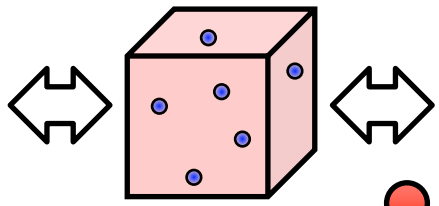
(3D) particle dynamics

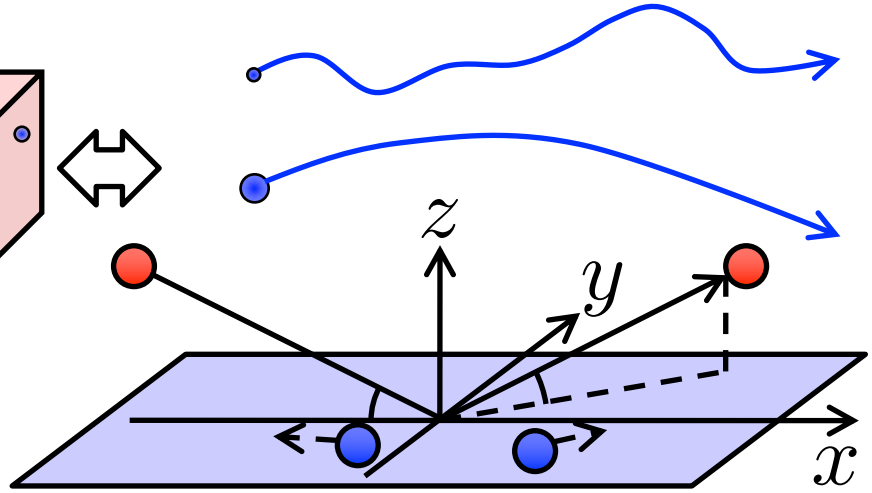
aerodynamical entrainment

splash process (collision)

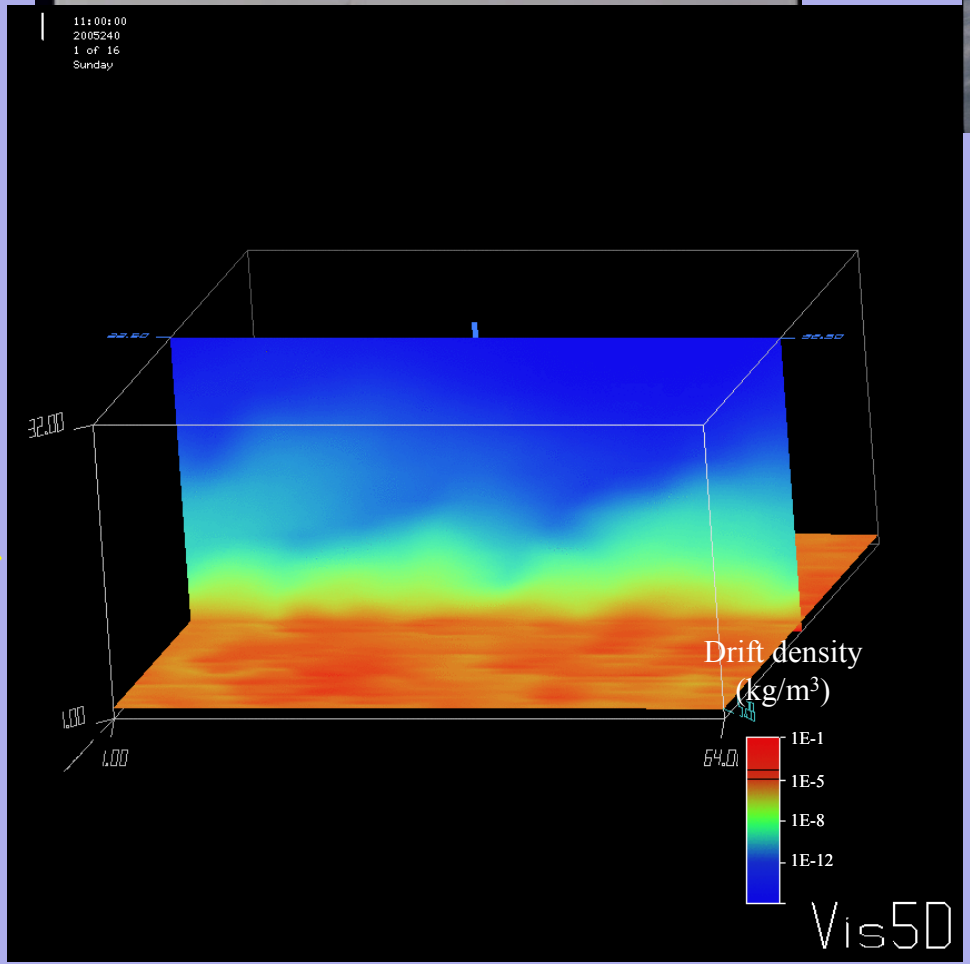
Large-Eddy Simulation (LES) ⇔ **Newton's equation of motion**

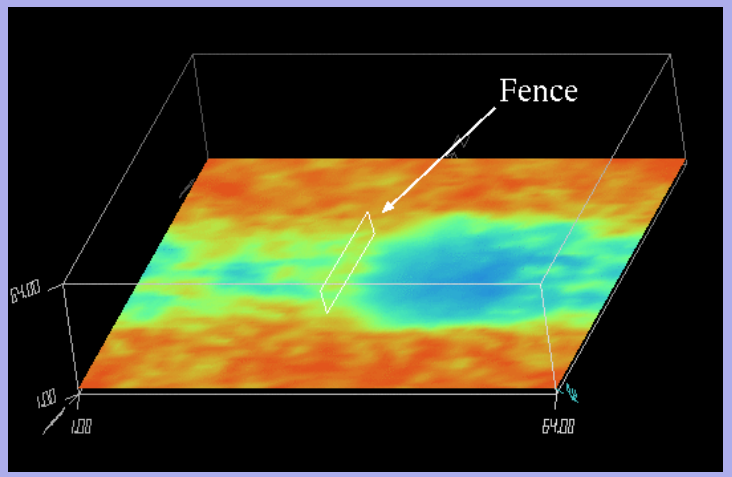






Wind


11:00:00
2005240
1 of 16
Sunday
32.00
1.00
1.00
64.00
Drift density
(kg/m3)
1E-1
1E-5
1E-8
1E-12
Vis5D


Fence
64.00
1.00
1.00
64.00