Outline of the Automated Continuous Snowdrift Transport Rate Observation System and Analysis of the Conditions Necessary for Blowing Snow to Occur in Light of Meteorological Factors

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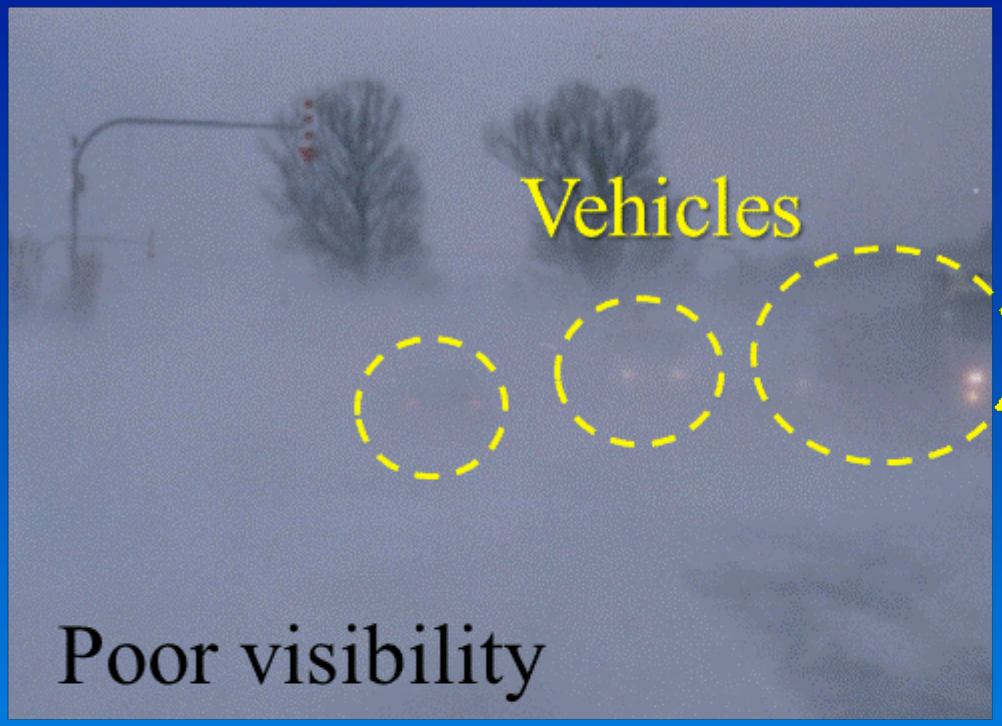
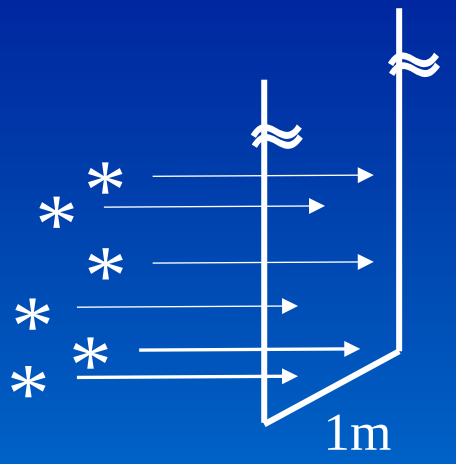
Introduction



"Snowdrift Transport Rate" is important quantity for blowing snow countermeasure

About the Snowdrift Transport Rate

"Snowdrift transport rate" is Mass of snow particles that passes a unit width perpendicular to the wind direction per unit time.



but ....

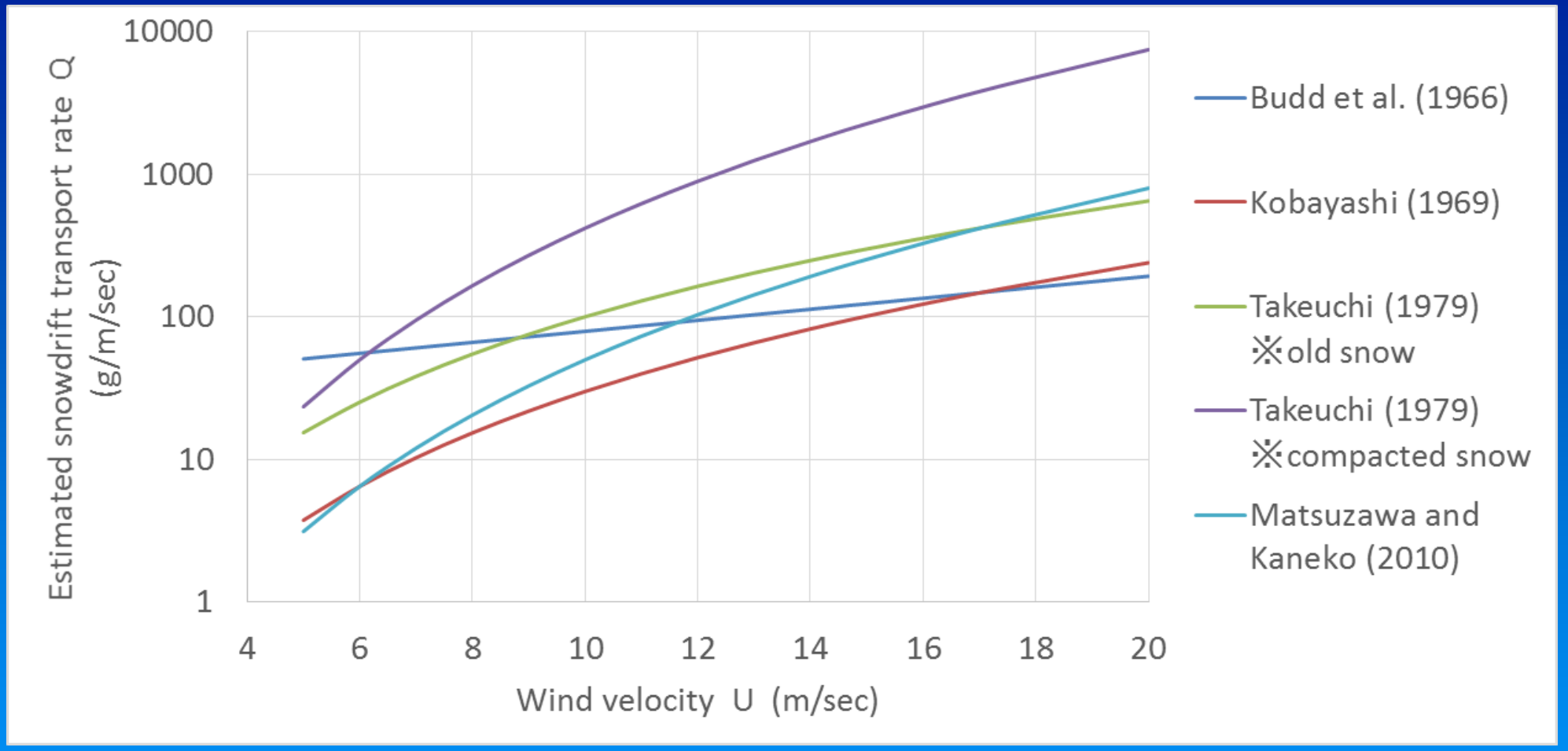
Direct and continuous measurements are difficult

In general, we use empirical equations to estimate "Snowdrift transport rate"

- Log Q = 1.18+0.089 U ・・・ Budd et al. (1966)
- Q = 0.03 U^3 ・・・ Kobayashi (1969)
- Q = 0.2 U^2.7 ・・・Takeuchi (1979) …old snow
- Q = 0.029 U^4.16 ・・・ Takeuchi (1979) …compacted snow
- Q = 0.005 U^4 ・・・ Matsuzawa et al. (2010)

etc…

Comparison results of empirical equations



There are quantity gaps

One reason is an influence of the complicated blowing snow occurrence conditions

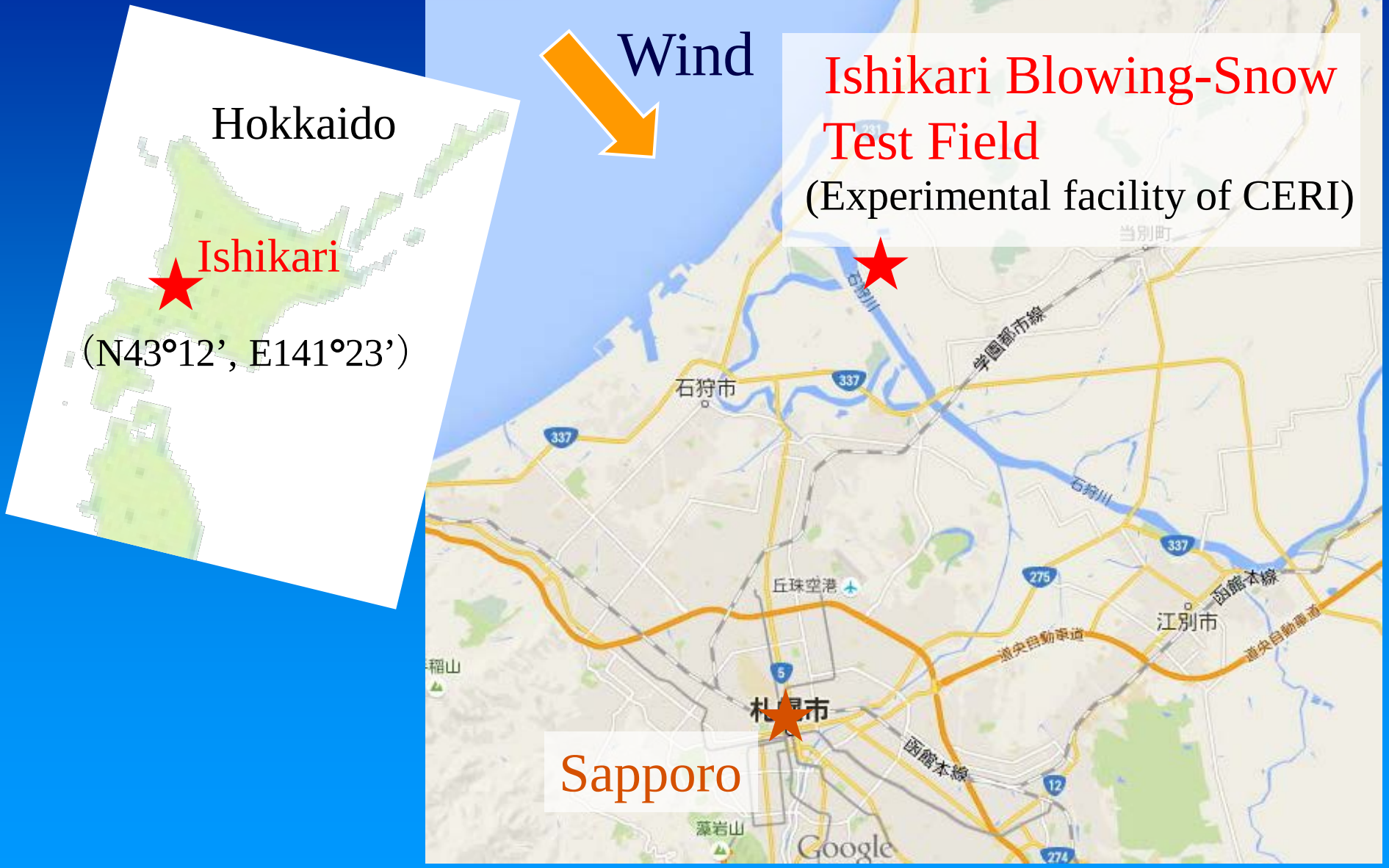
Topics of this presentation

1. Outline of the “Automated Continuous Snowdrift Transport Rate Observation System”

2. Analysis results of the Occurrence conditions of blowing snow

   (without concurrent falling snow)

Installation point of the observation system

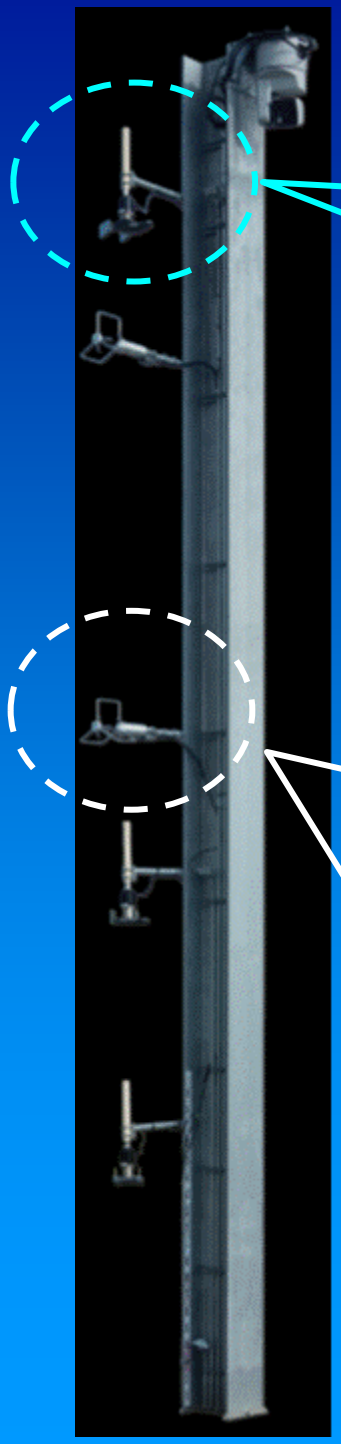


Appearance of Automated Continuous Snowdrift Transport Rate Observation System

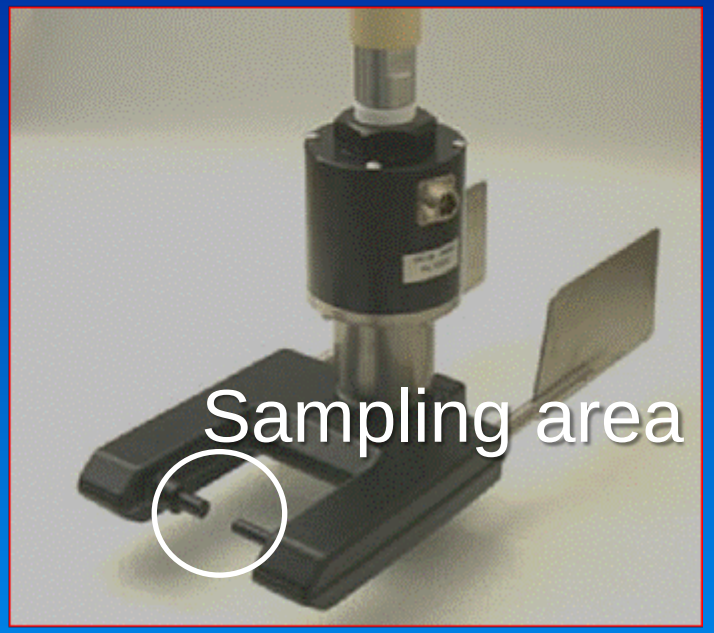
Four observation towers

Monitoring and collection of the observation data can be accessed remotely online.

Details of observation tower



Snow Particle Counter (SPC)



Classify 64 class (50 – 500 μm)

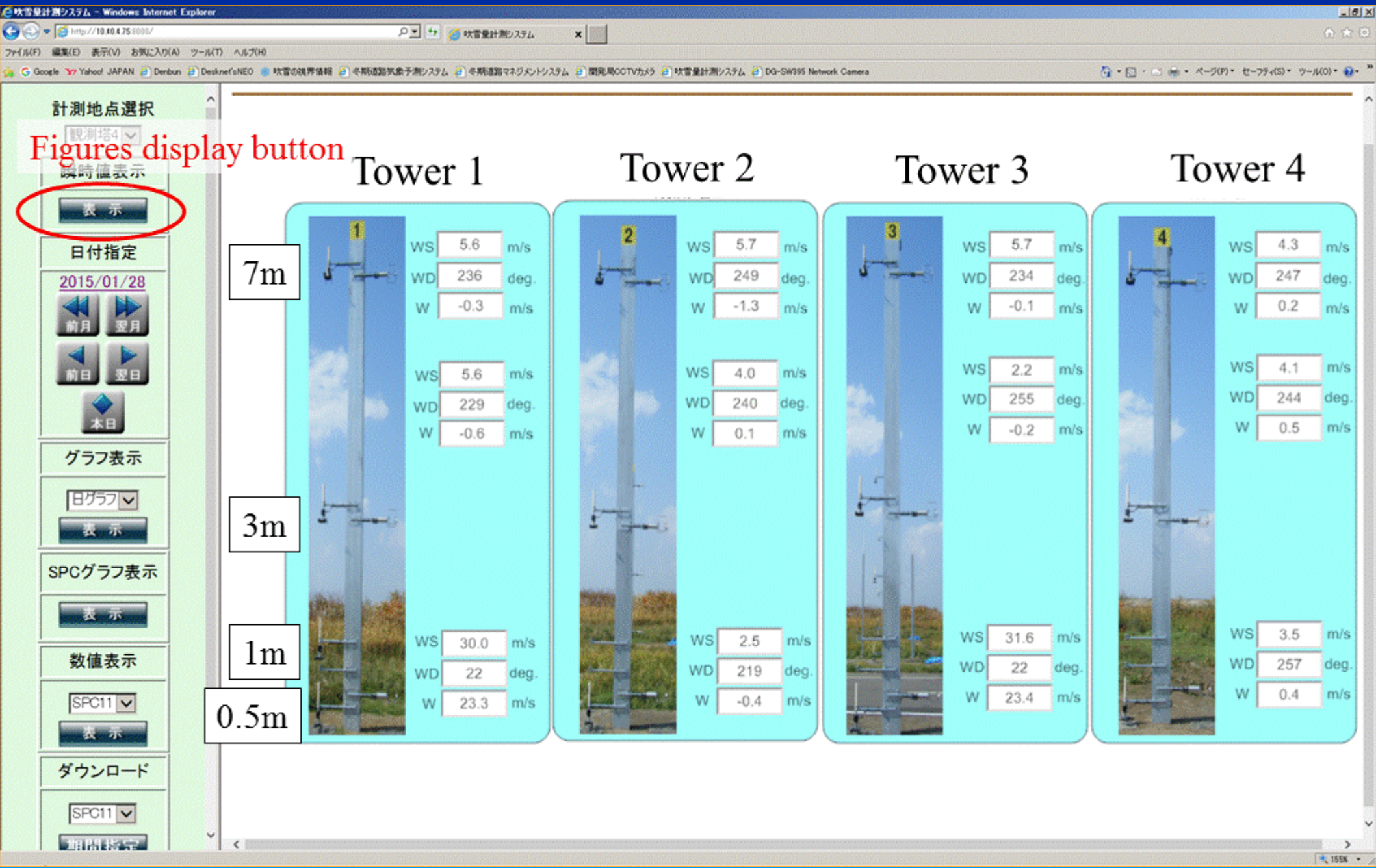
Supersonic type anemometer

Install height

- 3m, 7m (fixed height)
- 0.1m - 2m (movable height)

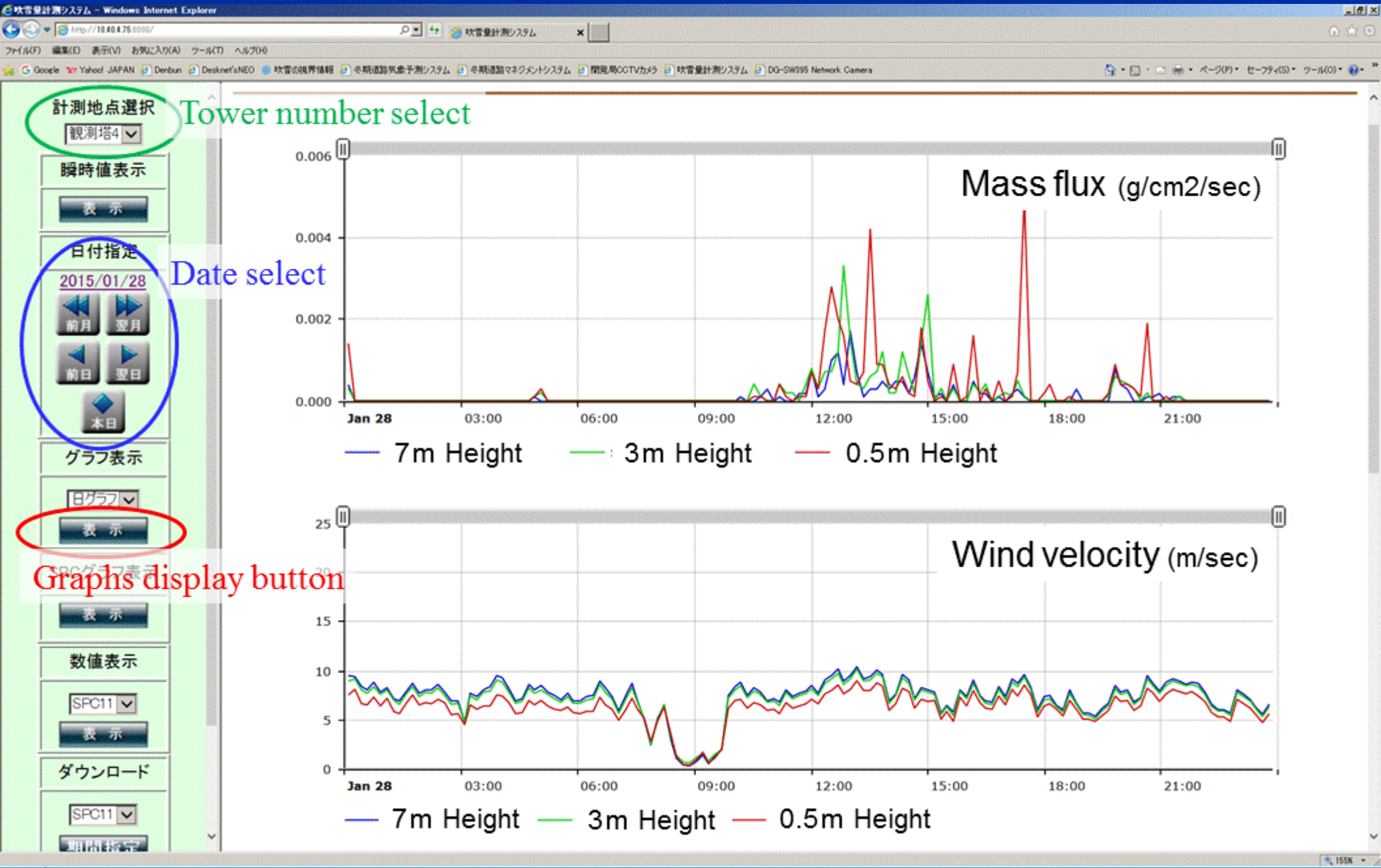
Monitor screen on the web

Instantaneous data of the wind velocity and direction



Monitor screen on the web

Day-data of the mass flux and wind velocity



Monitor screen on the web

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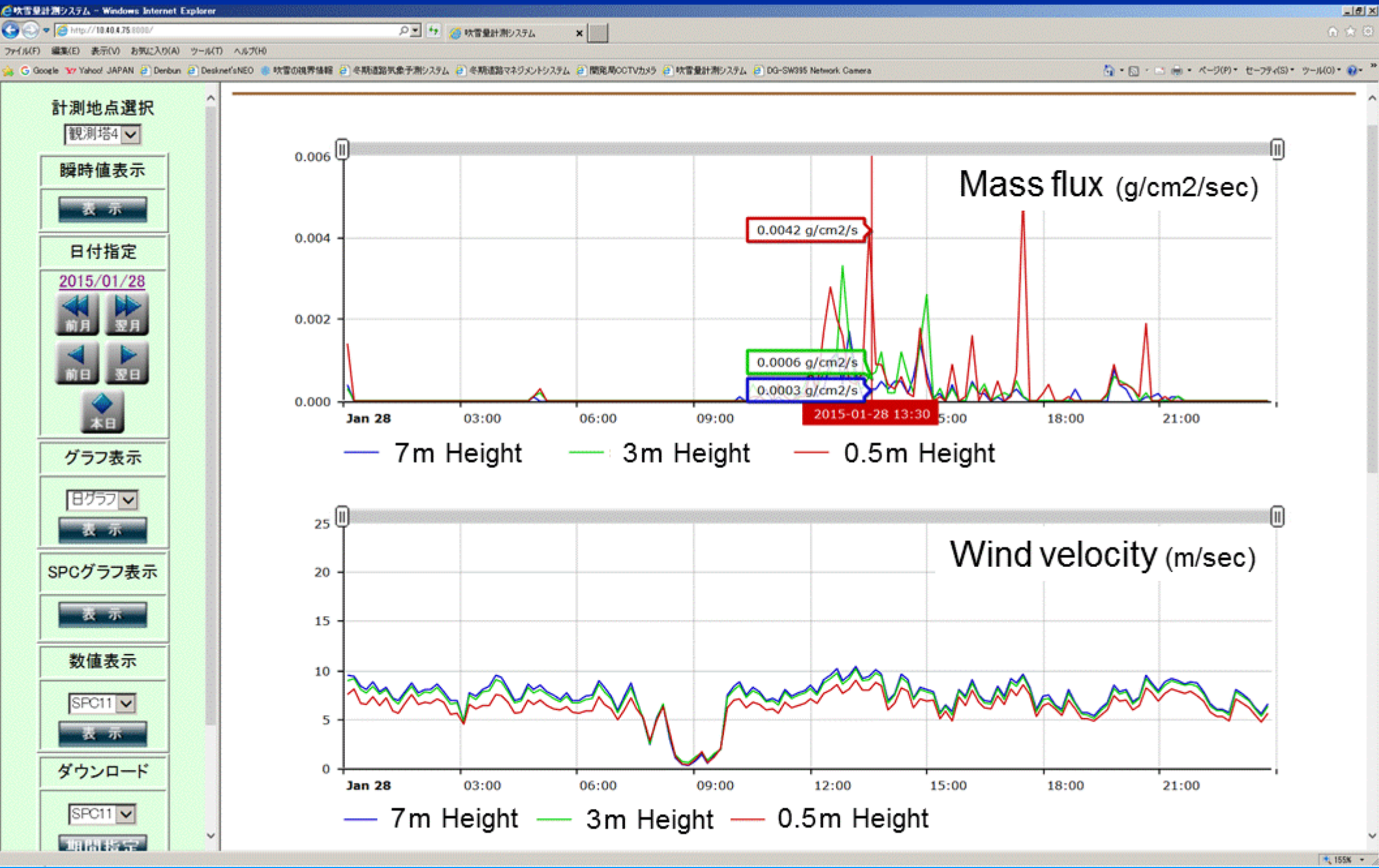

Monitor screen on the web

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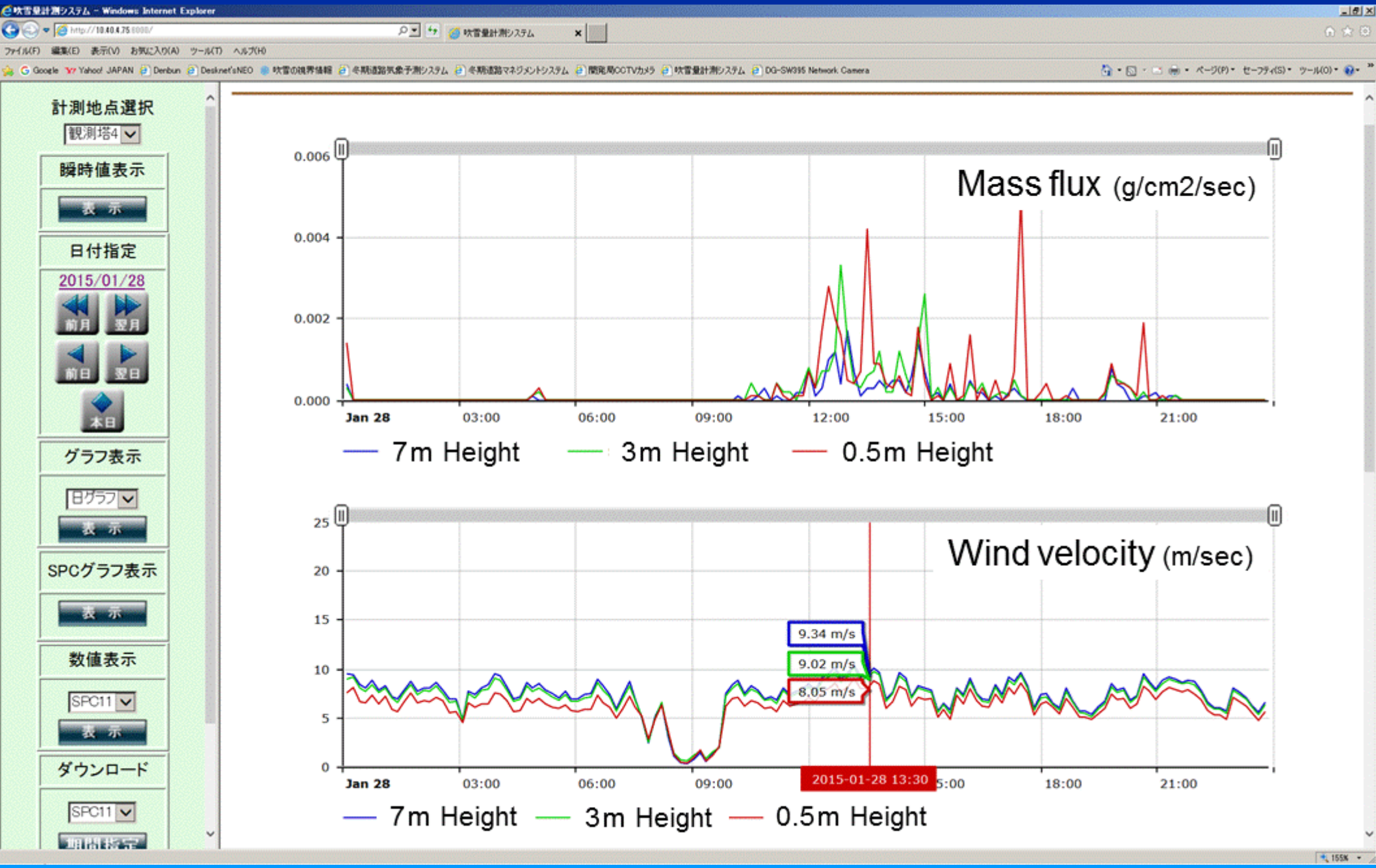
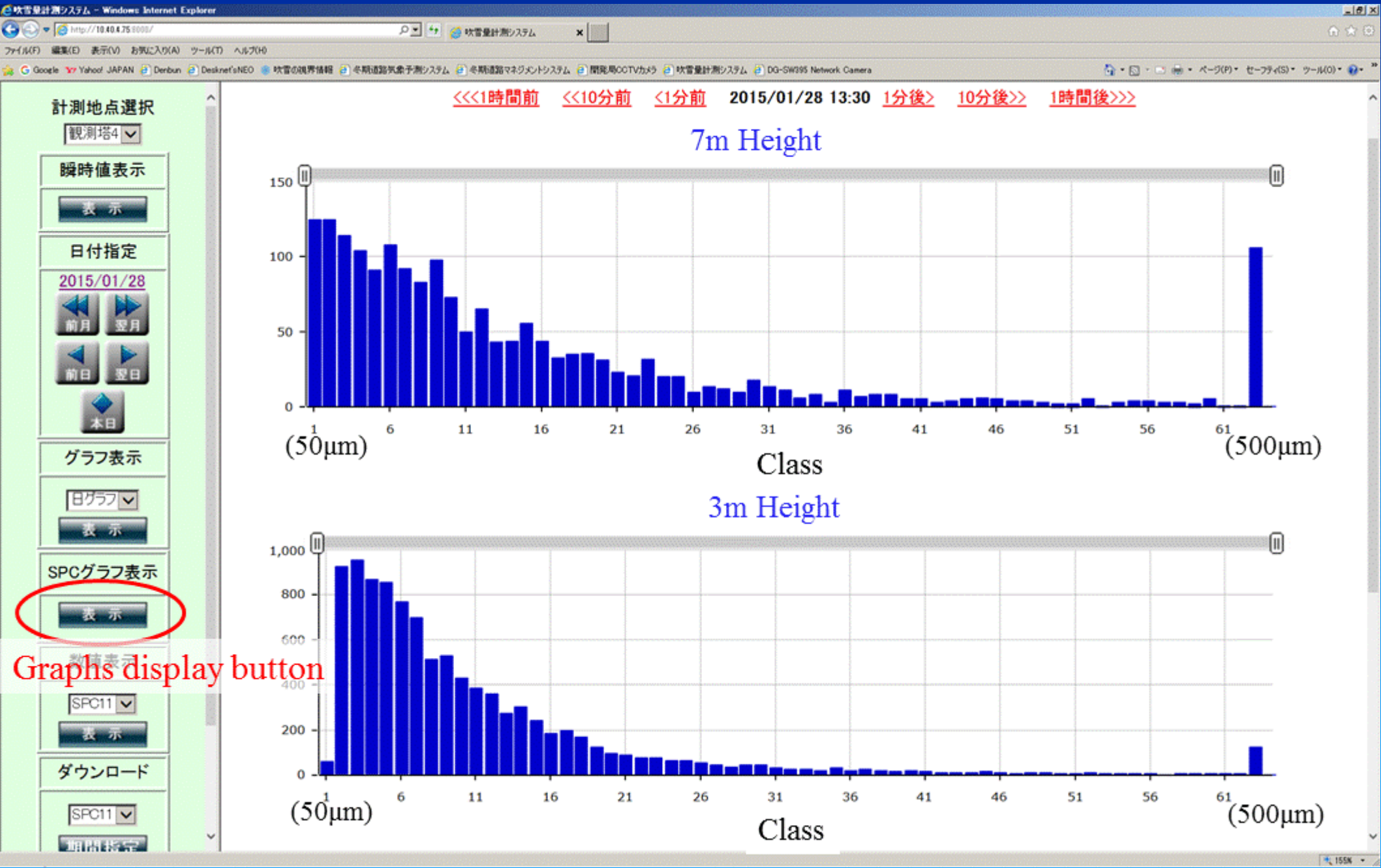


Monitor screen on the web

Size distribution of blowing snow particle



Graphs display button

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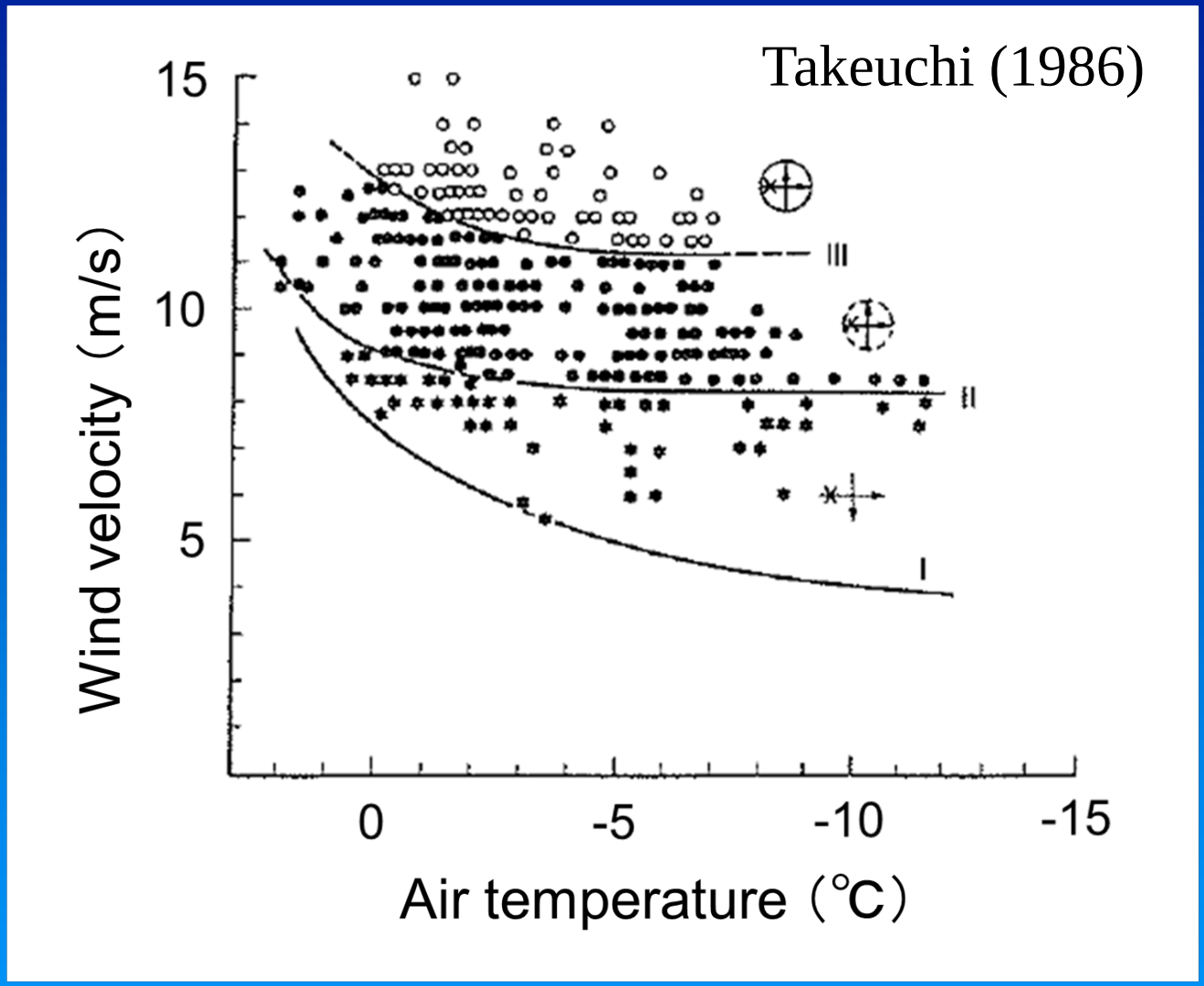
2. Analysis results of the Occurrence conditions of blowing snow

   (without concurrent falling snow)

Previous study



Curve Ⅰ: Low height blowing snow
Curve Ⅱ: Intermittent high height blowing snow
Curve Ⅲ: Continuous high height blowing snow

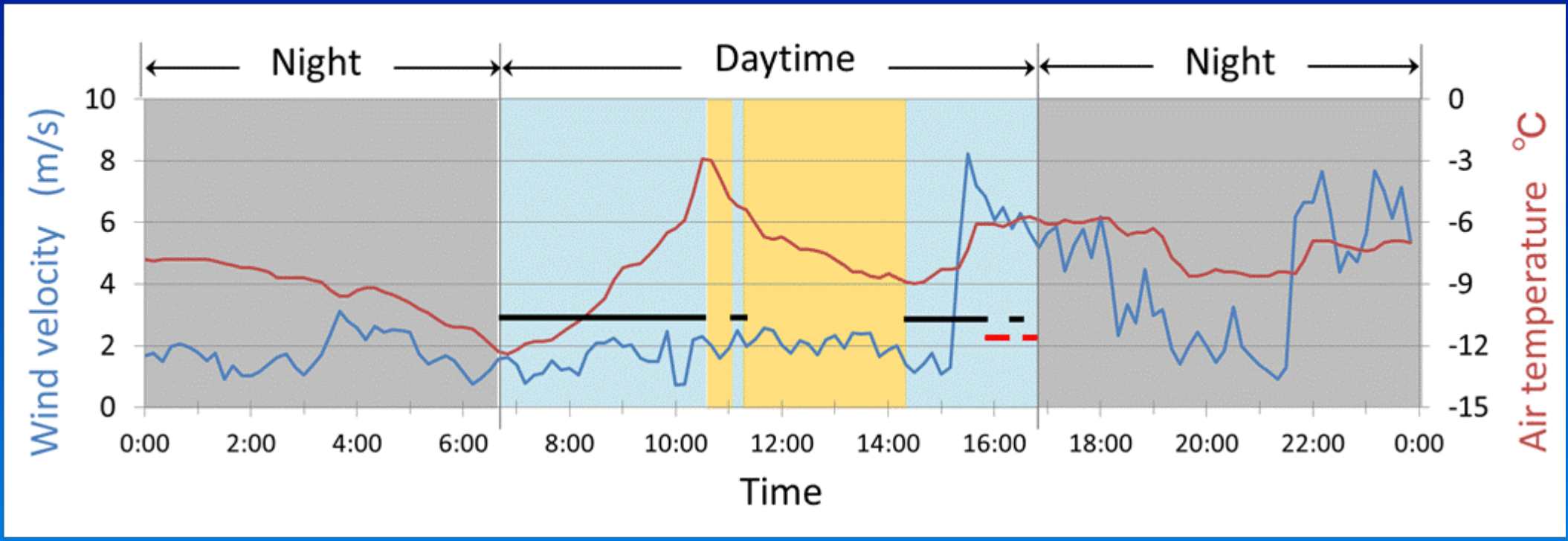
Observation site

<u>Observation items</u>

- Air temperature
- Wind velocity
- Wind direction
- Snow depth
- Intensity of solar radiation
- Visibility
- Mass flux of blowing snow particles

Ishikari Blowing-Snow Test Field

Analysis



: Absence of falling snow

: Presence of falling snow

: Exclude data from analysis

Occurrence of blowing snow

Non-occurrence of blowing snow

Total number of events

Occurrence: 1449 cases

Non-occurrence: 8001 cases

Analysis

Discriminate analysis

T：Air temperature

t：Elapsed time from the snowfall end

Tmax：Maximum air temperature after the snowfall end

Umax：Maximum wind velocity after the snowfall end

Usum：Fourth power of the calculation of wind velocity from the snowfall end

Sol：Integration of solar radiation amount from the snowfall end

SF：Snowfall depth just before blowing snow has occurred

⊿SD：Snowfall amount just before blowing snow has occurred

In the case of　t <12:

$$N = -0.59U + 0.2T - 0.08SF + 4.77$$

In the case of　t ≧ 12:

$$N = -1.18U + 0.16T + 0.09t + 0.03Usum + 4.93$$

Accuracy of the formulae

		Real condition	
		occurrence	Non-occurrence
Formulae output result	occurrence	802	792
	Non-occurrence	308	10438

Hit ratio = 91.1%

The accuracy verification test showed the formulae to be useful in determining the occurrence of blowing snow

Summary

1. "Automated Continuous Snowdrift Transport Rate Observation System"

   - System has four observation towers and each tower has supersonic type anemometers and Snow Particle Counters
   - Monitoring and collection of the observation data can be accessed remotely online

Summary

2. Occurrence conditions of blowing snow

- Using multiple meteorological elements, we made formulae to discriminate the occurrence of the blowing snow
- As a result of an accuracy verification test, the results was 91.1%.