

# Case Study of Blowing Snow Potential Diagnosis with Dynamical Downscaling

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Reference: Tanji, S., and M. Inatsu 2019: Case study of blowing snow potential diagnosis with dynamical downscaling. *SOLA*, 15, 32–36, doi:10.2151/sola.2019-007.

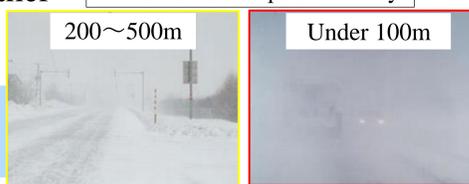


## Introduction

Blowing snow is a phenomenon that strong wind resuspends surface snow particles or blows snowfall particles. Blowing snow in road often causes poor visibility and these situations have risks for traffic accidents. Some blowing-snow prediction systems operated in Japan use weather forecast data with 5-km grid mesh. However, blowing snow is caused by background wind, mostly turbulent surface flow under the boundary layer. We found a large scale gap between the resolution of weather forecast data in conventional blowing snow prediction system and the scale of blowing snow development.

This study aims to diagnose blowing-snow potential with 1-km resolution dynamically downscaled (DDS) data and find an add value of DDS data.

Driver's view in poor visibility



[http://northern-road.jp/navi/info/guide1\\_2.html](http://northern-road.jp/navi/info/guide1_2.html)

## Case

31 Jan 2019 - 1 Feb 2019

- Strong wind caused blowing snow around Sapporo in the morning on 1 Feb.
- Expressway between Sapporo and Ebetsu had been closed from 2330 UTC on 31 Jan to 0410 UTC on 1 Feb.
- Traffic accidents had happened for low visibility in Ishikari city.

## Data & Methods

### DDS

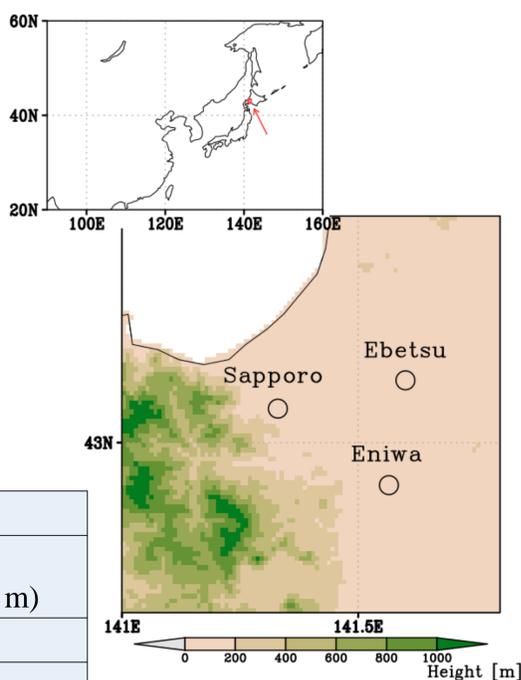
#### Original data

MesoScale Model (MSM) analysis provided by the Japan Meteorological Agency

Time interval	3 hourly
Resolution	5 km

#### Model configuration

Horizontal grid mesh	90 × 90
Vertical layers	32 layers (model top: 19,981 m)
Integration time	72 hours
Resolution	1 km
Domain	141.0 °E - 141.8 °E by 42.7 °N - 43.4 °N



### Snow concentration $n$ ( $\text{g}/\text{m}^3$ )

$$n(z) = \frac{P}{w_f} + \left( n_1 - \frac{P}{w_f} \right) \left( \frac{z}{z_1} \right)^{-\frac{w_b}{kU_*}} \quad (1)$$

$$U_* = \frac{kU(10)}{\ln \frac{10}{z_0}} \quad (2)$$

Red character: use meteorological data

#### Thresholds of environment

$$\begin{aligned} U_{10} &\geq 5 \text{ m/s} \\ T &\leq 0^\circ\text{C} \end{aligned} \quad (3)$$

If weather conditions violate these thresholds, we neglect the second term of the right hand of (1).

### Visibility (m)

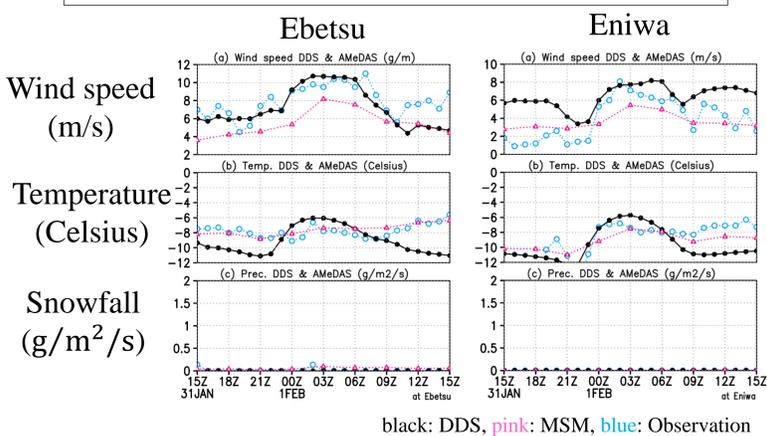
$$\log(vis) = -0.773 \cdot \log(n(z) \cdot U(z)) + 2.845 \quad (4)$$

We estimate snow concentration and visibility at **1.2 m** from the surface, a height of driver's eyes.

Matsuzawa and Takeuchi (2002)

## Results

### 1. Comparison with observation



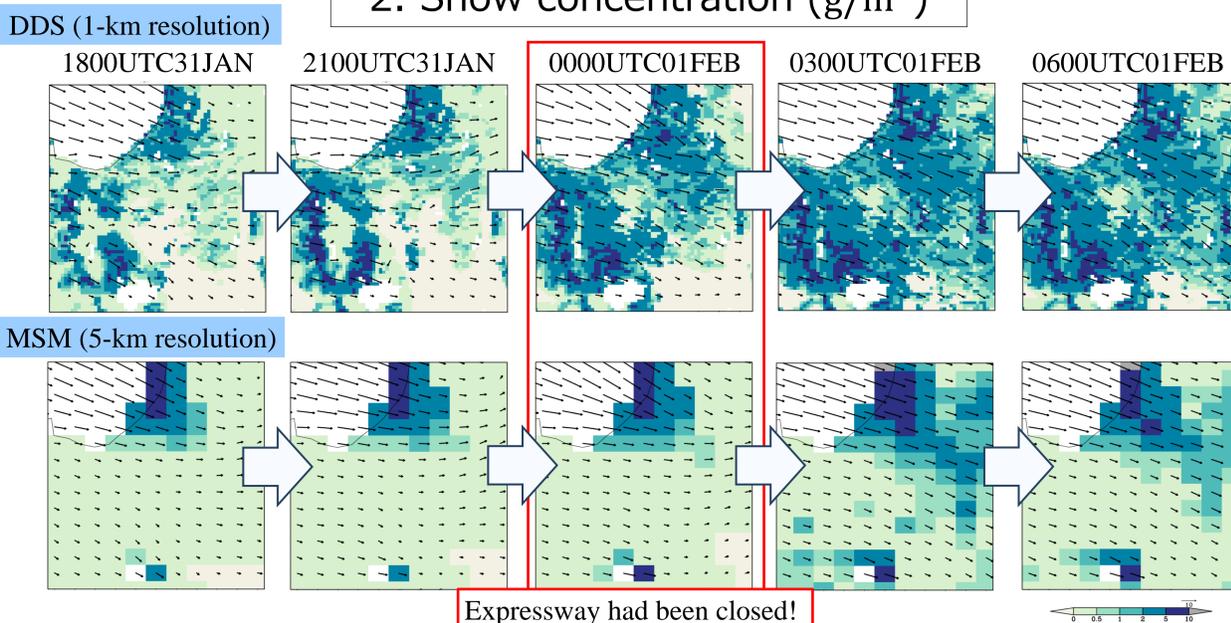
black: DDS, pink: MSM, blue: Observation

1. The DDS reproduced an increase of the wind speed after 0000 UTC on 1 Feb, whereas the MSM analysis provided a rather constant wind.

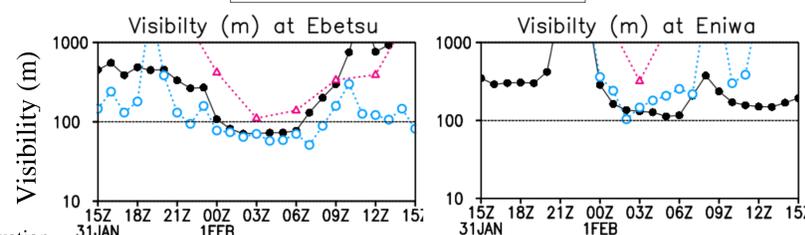
2. Based on DDS data, the snow concentration increased on almost all grids in the three hours just before expressway closing.

3. Visibility based on DDS data and based on observation data became low rapidly, about 100-500 m visibility, at 0000UTC. This time was just after closing expressways around Ebetsu.

### 2. Snow concentration ( $\text{g}/\text{m}^3$ )



### 3. Visibility (m)



black: DDS, pink: MSM, blue: Observation

## Summary

- We have estimated snow concentration and visibility based on the dynamically downscaled data with 1-km resolution.
- The temporal variation of blowing snow **could be diagnosed based on the DDS data.**
- In contrast, the blowing snow potential **with the meso-scale model analysis did not reproduce the blowing snow development.**