

防雪柵の端部・開口部対策に関する研究

Study on Measures for the Ends and Openings of Snow Fences

積雪寒冷地の北海道では、吹雪対策施設として防雪柵などが整備されています。しかし、防雪柵の整備区間であっても防雪柵の端部や開口部における局所的な視程障害により追突事故等が発生しています。

雪氷チームでは、寒地機械技術チームと協力して、防雪柵の端部と開口部における吹雪による被害軽減を目的として、視程が局所的に極端に低下するメカニズムの解明と、視程急変を緩和する効果的な対策手法に関する研究に取り組みました。

Snow fences have been used as blowing-snow control facilities in Hokkaido, a snowy and cold region. However, even on road sections where snow fences have been installed, accidents such as rear-end collisions resulting from localized poor visibility have occurred at the ends and openings of the fences. In collaboration with the Machinery Technology Research Team, the Snow and Ice Research Team has researched the mechanism behind extremely poor, localized visibility on road sections near the ends and openings of snow fences. This research aims to mitigate accidents from blowing snow at such locations. The team has been studying effective measures to mitigate sudden changes in visibility.

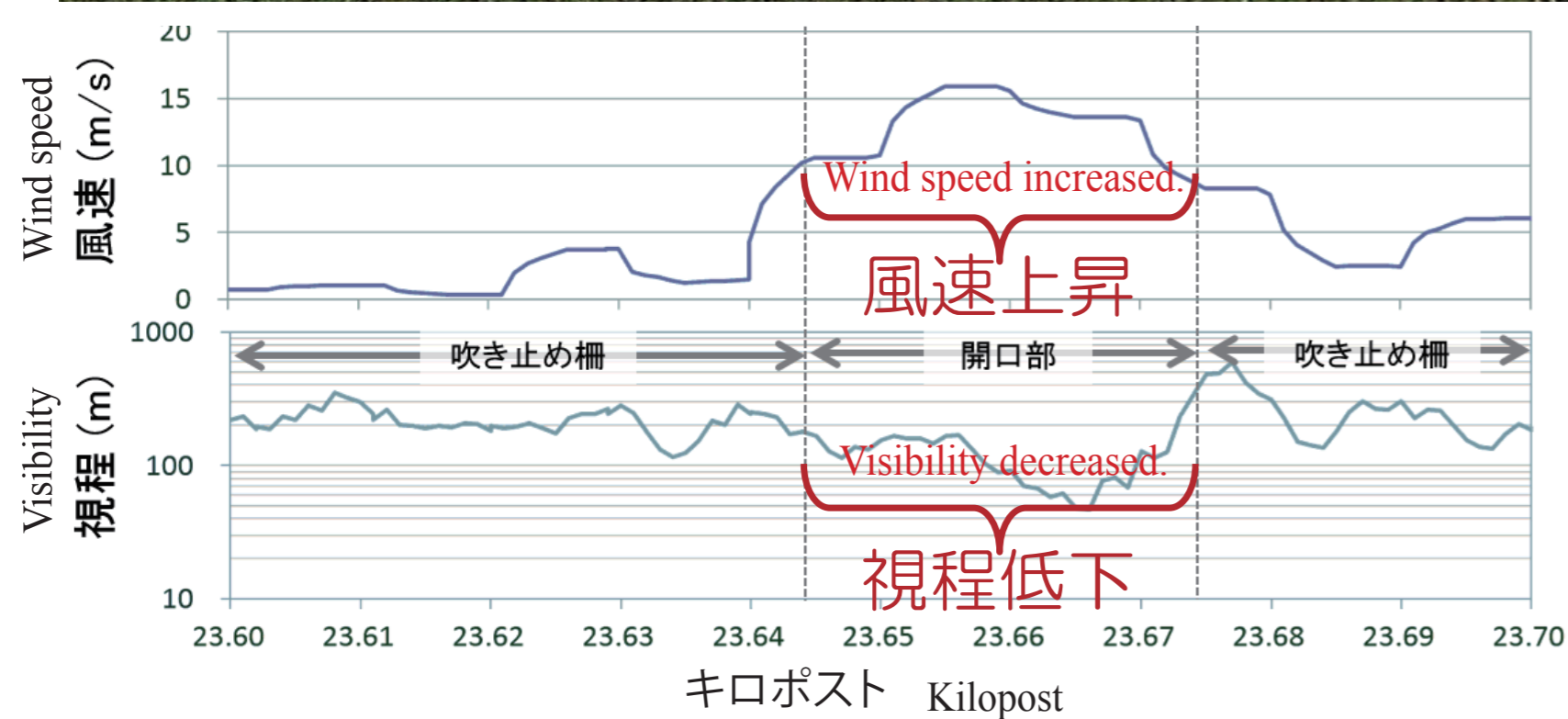
防雪柵端部の視程障害の例
Visibility reduction at the end of a fence

視程急変メカニズムの解明

Clarification of the mechanism behind sudden visibility changes

防雪柵（吹き止め柵）の端部や開口部における視程急変メカニズムを解明しました。防雪柵の開口部では、防雪柵の整備区間に比べて風が強くなり、視程が悪化する傾向にあります。これは、開口部における風の収束に伴う飛雪によって局所的に視程障害（エンドエフェクト）が発生するためです。

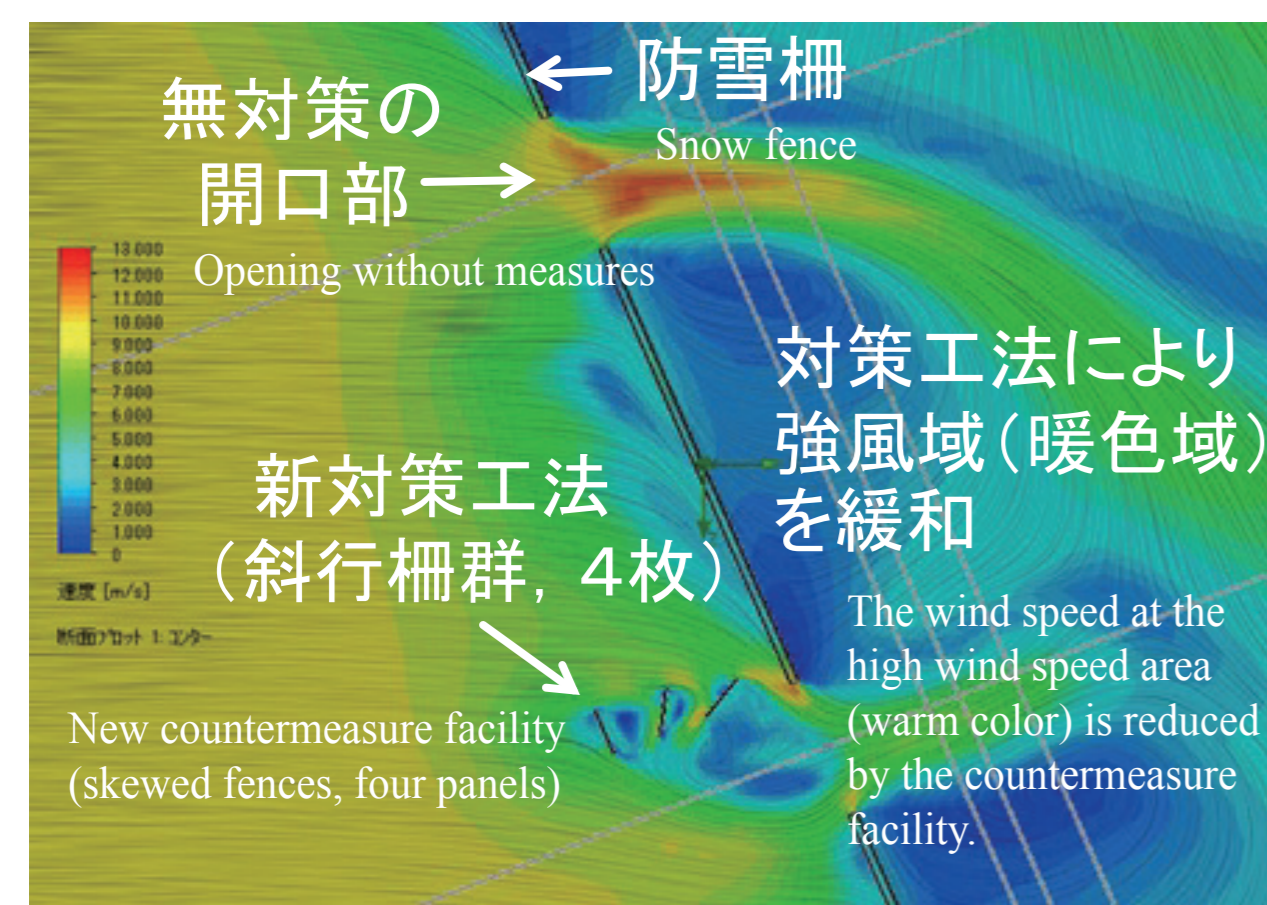
We clarified the mechanism behind sudden changes in visibility at the ends or openings of snow fences (collector snow fences). Winds tend to be stronger and visibility tends to be worse near the openings of snow fences than at other sections along the fence. Localized visibility reductions (the "end effect") may occur from drifting snow when winds converge at the openings of a snow fence.



▲防雪柵開口部における移動気象観測事例（上：平面図、下：風速と視程の観測値）
A mobile weather observation at the opening of a snow fence
(top: plan view, bottom: observed values of wind speed and visibility)

視程急変箇所の効果的な対策手法の提案

A proposal for effective countermeasures at locations with sudden visibility changes



▲数値シミュレーション解析による副防雪柵の構造と配置の検討例
Numerical simulation results to examine the structure and layout of supplementary snow fences

Using numerical simulations, we examined new alternatives to the supplementary snow fence and devised a group of skewed fences and a V-shaped fence. Based on onsite observations and a wind tunnel experiment using snow fence models, we found that the skewed fences and the V-shaped fence effectively mitigate sudden changes in wind speed and visibility even when the incident wind is perpendicular to the fence.

副防雪柵に替わる新たな対策工法を、数値シミュレーション解析によって検討し、「斜行柵群」と「くの字型柵」を考案しました。

現地観測と防雪柵模型を使った風洞実験の結果、斜行柵群とくの字型柵は、防雪柵に対して直交する風向の条件でも、風速や視程の急変緩和効果があることを確認しました。

視程急変の緩和対策効果の解明

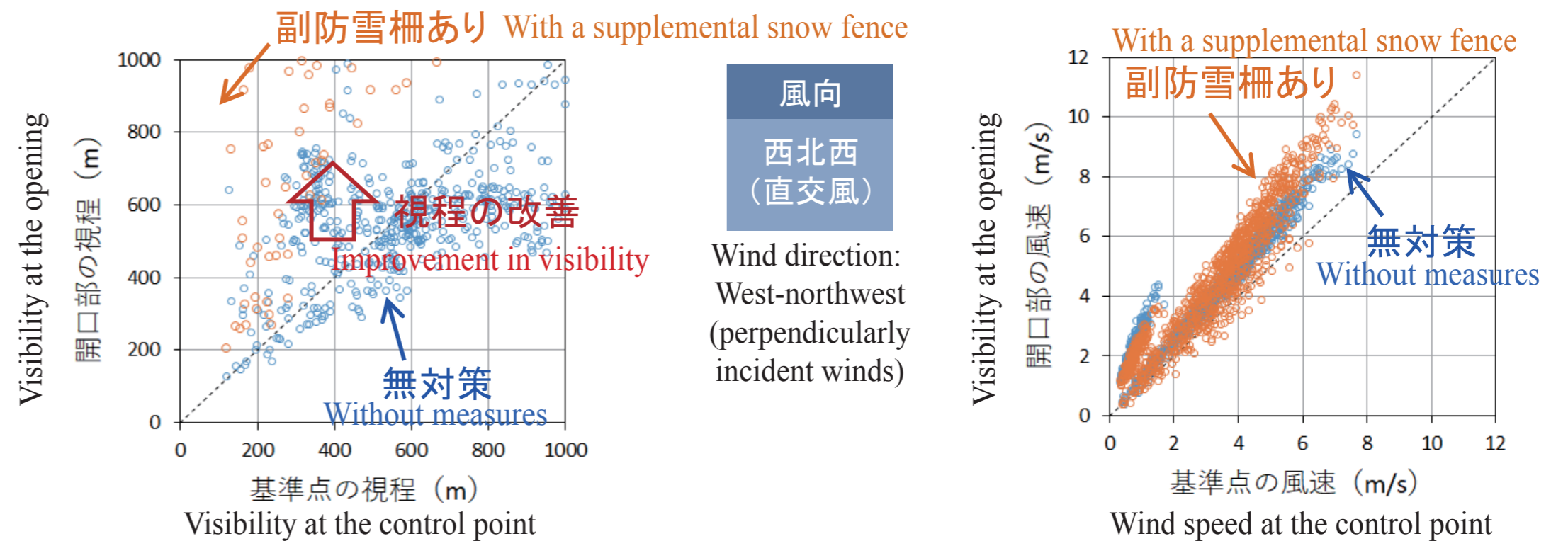
Clarification of the effectiveness of a measure to mitigate sudden visibility changes

防雪柵の端部や開口部の対策として、副防雪柵が設置されています。現地観測などの結果、副防雪柵の設置により、開口部の視程と風速の急変を緩和できることが明らかになりました。ただし、風向が防雪柵に直交する条件では、緩和効果が低減する場合があることもわかりました。

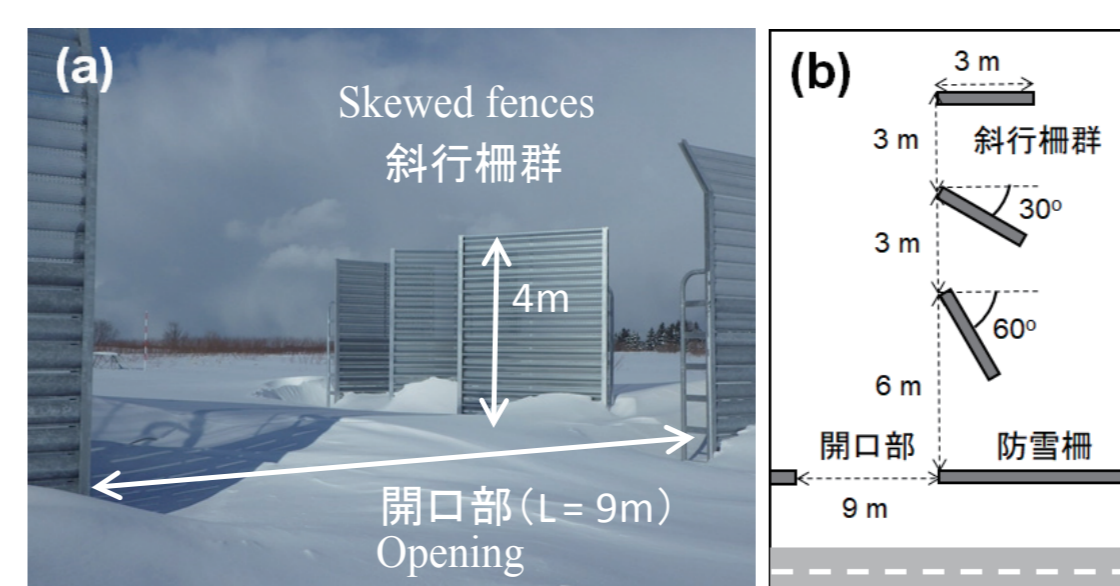
Supplementary snow fences are installed as a measure to mitigate poor visibility at the ends and openings of the snow fence. An onsite observation clarified that installing a supplementary snow fence could mitigate sudden changes in visibility and wind speed. However, when the incident wind direction is perpendicular to the snow fence, the effectiveness of a supplementary snow fence may be reduced.



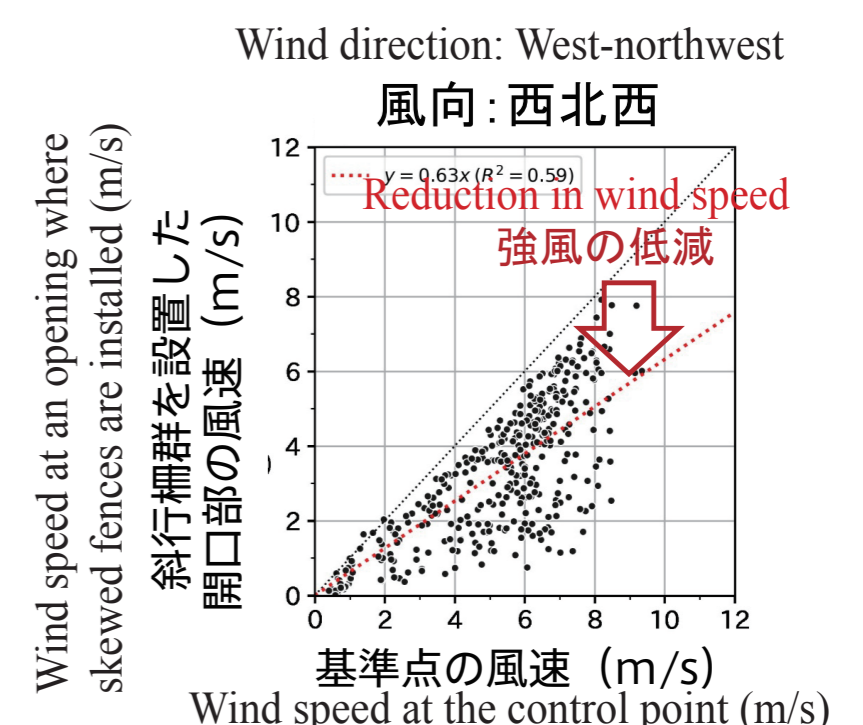
▲L字型副防雪柵の現地観測
Onsite observations of an L-shaped supplementary snow fence



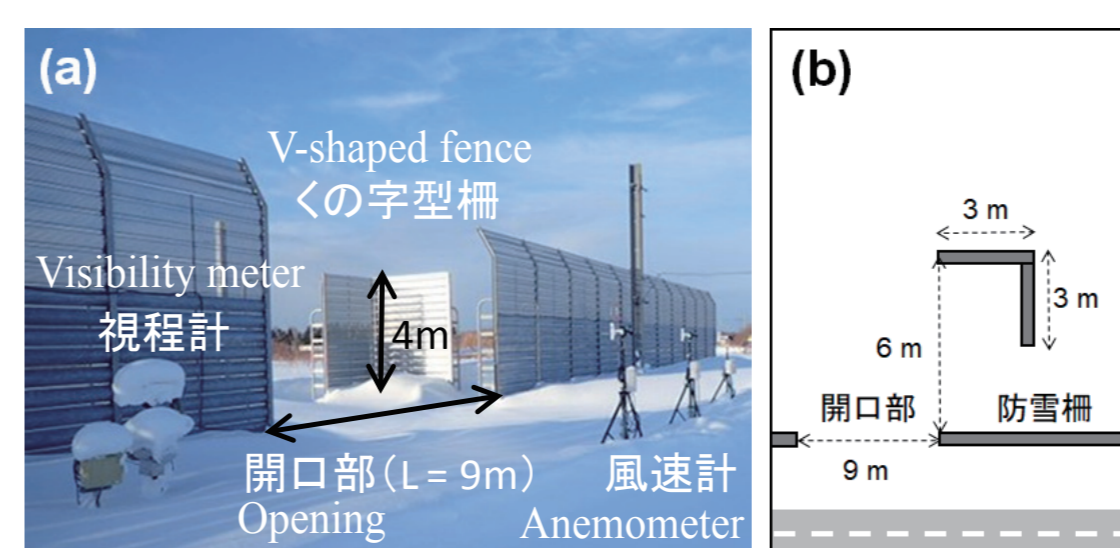
▲現地観測による開口部の視程と風速の比較（○：副防雪柵を設置した開口部、○：無対策の開口部）
Comparison between the visibility and the wind speed at the opening, using data from onsite observation
(○: the opening with a supplementary snow fence, ○: the opening with no measures)



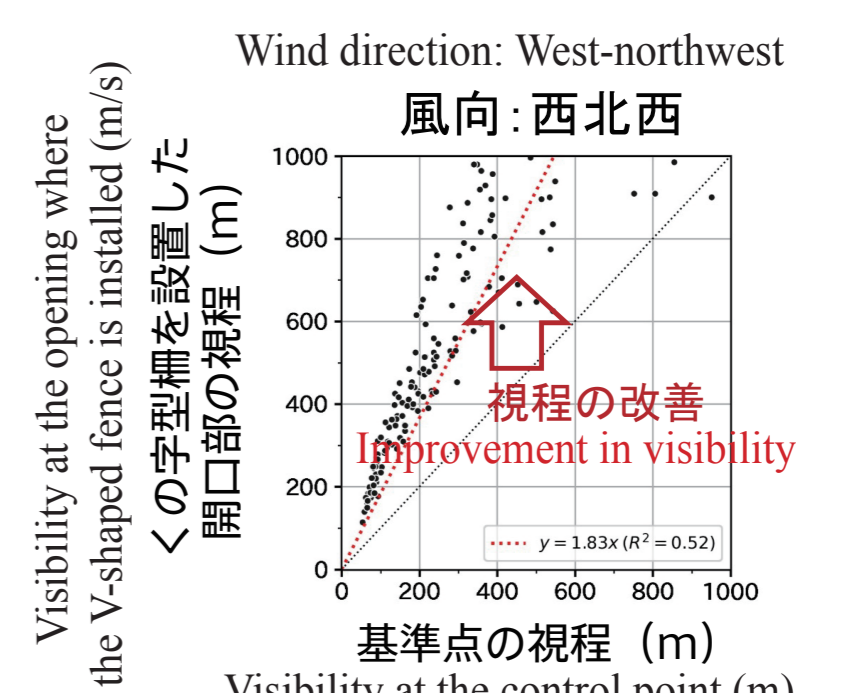
▲斜行柵群の現地観測と平面図
Onsite observation setup, and a plan view of the skewed fences



▲風速の比較例（斜行柵群）
Example of wind speed comparison (skewed fences)



▲くの字型柵の現地観測と平面図
Onsite observation setup, and a plan view of the V-shaped fence



▲視程の比較例（くの字型柵）
Visibility comparison (V-shaped fence)