低コスト吹雪観測装置の複数台連携による風速測定
Wind speed estimation by low-cost visibility meter network

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Poor-visibility with the blowing snow sometimes causes serious troubles such as car crashes. Previously we reported the development of a low-cost visibility meter, which estimates visibility quantitatively, measuring the reduction of laser intensity caused by the laser blocking by snow particles. Those laser intensity data together with ambient temperature are sent to a personal computer via a wireless network. The remarkable characteristic of this apparatus is a very compact body, achieving enough length of the light path by reflecting laser light three times by mirrors facing each other. We confirmed the performance as poor-visibility meter, by investigating the correlation between the reduction of laser intensity and the visibility simultaneously recorded by the conventional video system.
In regard to wind speed, which is essential in order to predict poor-visibility caused by blowing snow, conventional propeller-type anemometer has been used up to now. However, such propeller anemometer has moving parts so that the low-cost type lacks durability. On the other hand, the hot-wire and thermocouple type anemometer needs relatively high-power consumption. In this study we developed a new methodology for wind speed measurement using densely placed visibility meters, making use of the time difference between the snow particle passing at different apparatus. Experiments were performed using a wind tunnel at Cryospheric Environment Simulator of the Shinjo Branch (Snow and Ice Research Center, National Research Institute for Earth Science and Disaster Resilience). The three units of the visibility meter were set at an interval of 4-5 m in the wind tunnel and connected with a computer for data collections by wireless communication. The time interval of data sampling was set to 0.5 s. The propeller type anemometer to measure the wind speed as a reference was set downstream of the three observation units. The wind speed can be measured by detecting the delay time for snow particles to move from one unit to the next one. The wind speed obtained by our system was 8.8 m s^{-1}, being averaged for data obtained at three points, while the wind speed measured by the anemometer was 9.1 m s^{-1}. These results mean only with this poor-visibility meter network we can estimate the wind velocity with an accuracy of 3 percent.

キーワード：吹雪、防災、装置開発
Keywords: Blowing snow, Disaster Prevention, Instrument Development

