



A Linear Array of Wind and Pressure Sensors for High Resolution in situ Measurements in Winter Tornadoes

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On Japan railroads, wind conditions affect operating efficiency, infrastructure, and safe passage of people and freight. For instance, strong and gusty winds cause regional delays or shutdowns, and especially hazardous crosswinds may lead to overturn of railcars. Although propeller-vane/cup anemometers densely cover on the railroads for operations through some wind speed thresholds (e.g., winds in excess of 25 ms⁻¹), small-scale but strong gusty winds are difficult to detect with the present system. The Shonai area railroad weather project has investigated fine-scale structure of wind gust dynamics and kinetics such as tornadoes, downbursts, and gust fronts. The ultimate goal of the project is to develop an automatic strong gust detection system for railroads, which the decision to warn is generally based upon information from a single-Doppler radar at low elevation angles. Improving our knowledge of near surface properties of tornado (e.g., wind speeds and structures) are important, because knowledge of those circulations are key elements in the development of vortex identifications, and possible feedbacks to tornado forecasting and warning.

As part of the project, in order to improve our understanding of near-surface tornadic features, we developed a linear array of wind and pressure sensors (LAWPS: Linear Array of Wind and Pressure Sensors) for high resolution in situ measurements in winter tornado cores. The wind and pressure sensors were deployed along a 1.2-km-long linear array that is located parallel to and about 100m from the shoreline. Wind data are obtained using 12 two- dimensional fast-response ultrasonic anemometers placed at a height of 5 m at intervals of 100 m. Pressure data are obtained using 25 barometers placed at a height of 50cm at intervals of 50 m. The pressure ports are designed and loaded to the barometers to reduce the dynamic pressure associated with wind and turbulence. Sampling intervals for both wind and pressure measurements are 100 msec and the sampling are synchronized by the external trigger from data logging computer. In this presentation, the system overview and the measurement technique will be described.