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# An advanced system for automatic strong gust detection and warning for railroads using deep learning - current progress and future plans -

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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. In 2007, the Meteorological Research Institute and the East Japan Railway company started a project to develop an automatic strong gust detection and warning system for railroads, which the decision to warn is based upon information from a single-Doppler radar at low elevation angles. Through ten years of R&D, a comprehensive operational system has been implemented over the coast of the Sea of Japan: the Shonai area, Yamagata Pref., Japan, and the utility of the system has been demonstrated for wintertime vortices (Fujiwara, 2018).
The primary objectives and related improvements of the advanced system are as follows:
1) To further improve the accuracy of this system, the Convolutional Neural Network (CNN) to extract vortex pattern from Doppler velocity field and to detect accurate objects (i.e. tornadoes) while reducing false pattern is employed.
2) The system will be extended to other regions and/or other seasons, especially tornadoes of warm- season over the Pacific coast in Japan. Since it can be difficult to privide the required amount of training data of warm-season tornadoes, we will use a transfer-learning from a pre-trained network by wintertime tornadoes. An additional learning dataset will be added from real observations in warm season and artificially generated data.
3) Risk levels and recommended actions for each train will be automatically generated in real time in advance of an wind gust that the train can be expected to encounter. Those are based on the train -relative tornado direction, speed and intensity, derived using parameters including the train heading, the course and speed over the ground as well as the tornado detection and tracking.The framework proposed here is also expected to be useful for near-future centralized traffic control system for railways, especially for automatic driving system.

In this presentation, we will introduce an overview of the advanced system, initial results, and future development plans.