VIEWpoint 新观点

Safer operation for urban rail transport: wind risk warning system

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Explainer

Accessible research from Climate Science for Service Partnership (CSSP) China, for decision-makers No.08

Focus

People in big cities rely on urban rail transport, but these systems can be vulnerable to strong winds. As part of the CSSP China project, an integrated wind risk warning system was developed and assessed to support the network operation and contingency planning.

Importance

Along with rapid urban growth comes an expanding urban rail transport system in the coastal city of Shanghai, home to more than 24 million people. The Shanghai Metro system is the world's second biggest by route length, which comprises 676km of lines and 414 stations. Currently around 11.8 million passengers use it every day.

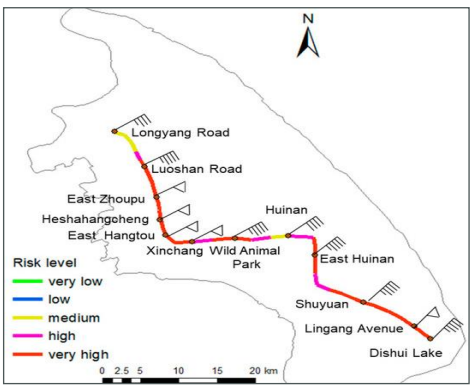
Urban rail transport is vulnerable to severe weather conditions which can seriously affect the rail operations. In Shanghai, the damaging winds of typhoons making landfall can influence the stability of carriages and even lead to derailment, causing significant economic loss and casualties.

Thus, it is crucial to better understand the impact of such adverse weather conditions on rail vehicles' performance and to assess risk levels for the rail network operation and contingency planning. In particular, an early warning system is needed urgently.

Approach

Han et al. (2020) developed an integrated wind risk warning system for rail transport. It comprises high-resolution wind data from observations or model predictions, a vulnerability model to evaluate the influence of the wind on rail carriages, and a risk assessment system to issue warning alerts.

The warning system has been assessed for the 59km-long Shanghai Metro Line 16 (45km of elevated tracks) in the southeast of Shanghai. The southern section of Line 16 is exposed to typhoons almost every year. In the scenario of typhoon Chan-hom making landfall on 11 July 2015, risk levels along the whole Shanghai Metro Line 16 were determined and areas with high to very-high risk identified (above). In the morning of that day, the trains on Line 16 in the areas with high risk were slowed down in real rail operation, which indicates a useful risk assessment provided by the warning system.



The determined wind risk of Shanghai Metro Line 16 (Han et al. 2020)

Next steps

This integrated wind risk warning system for rail transport can provide finer scale warning information for safe rail operation in strong winds. By using the predictions of wind conditions from computer simulations, the system has the skill in forecasting safety risk level of the rail network and issuing real-time warnings. The system has been made available to the Shanghai Shenlong Metro Group since July 2016. It also has potential to be applied to other cities with overground rail systems that are vulnerable to strong winds.

Reference

Han et al., 2020 DOI:10.3390/atmos11010053

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