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WRF-based simulation of wind field at bridge site in a complex mountainous area in southwest China

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ABSTRACT

The southwestern mountainous areas of China have complex topography and unique landforms, where the wind field characteristics are quite different from place to place, and also from those in the plain areas, thus is difficult to predict. In order to provide a basis for the wind-resistant design of bridges in mountainous areas in the southwest China, WRF model was used in this study to simulate the wind and temperature field over the complex mountainous terrain around the Murong Bridge in the west part of Sichuan Province. The WRF model was nested in three domains with a resolution of 9 km for d01,3 km for d02 and 1 km for d03, and the simulation results were compared with the measured values at both the bridge site and the DAWU meteorological station in the north of the bridge site. The simulation periods ran from Jan. 1st to 23rd, 2020in winter and Jun. 22nd to 27th, 2020 in summer. The sensitivity test of the parameter scheme was also carried out, and an error analysis of wind speed and temperature results for both the bridge site and the DAWU station was conducted for the winter and summer seasons, including the correlation coefficient (R), mean error (ME), mean absolute error (MEA), and root mean square error (RMSE).

The results indicate that the WRF model performs relatively poorly in simulating short-term high wind speeds in complex mountainous regions. The use of the ETA-MYJ boundary layer scheme yields better simulation results for high wind speeds in Murong mountainous area. The simulation results at the DAWU station are overall better than those at the bridge site. This may be due to the smaller difference of terrain elevation at the meteorological station than at the bridge site. Moreover, the scheme that performs well in simulating winter wind speeds is not applicable to summer conditions, while the simulation of the temperature in summer is significantly better than in winter. Therefore,

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different underlying surface conditions, such as vegetation condition, need to be considered for different seasons, requiring the selection of different parameter schemes.