Use of high-resolution dynamical adaptation for the extreme wind estimate

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Prior to the intorduction of the high-resolution dynamical adaptation, local strength of bura has not been forecasted by operational models in the Croatian Meteorological Service. The forecast of bura was subjective, depended on forecaster's experience and local knowledge. In addition, the insufficient spatial density of measurements often prevented detection of the most affected areas

The high-resolution dynamical adaptation was developed by Žagar and Rakovec (1999). It is performed in the following way. The 8-km resolution wind field is interpolated to 2-km grid and then dynamically adapted using ALADIN model. The model is run for 30 min with 60-sec time-step at 2-km resolution. During this run part of the physics describing the moist and radiation processes is switched-off and the number of levels in the upper troposphere and stratosphere is reduced. The high resolution dynamical adaptation significantly improves the large scale wind field when the main forcing is exerted by the pressure gradient over mountains, as it is the case with bura. However, it can not predict local thermal circulation nor circulation caused by convection processes.

For the purpose of the construction of the new highway in the area with strong bura, the extreme wind speeds have to be estimated. The spatial density of wind measurements was insufficient for the task; the measurements were available only at the two locations, from Maslenica and Pag bridges. The extreme wind speeds in that area belong to bura episodes. Using operational 2-km resolution dynamical adaptation, expected wind speeds were estimated for extreme bura cases.

When the construction of the road began, additional automatic meteorological stations were set up. The results from 2-km resolution dynamical adaptation forecast were compared to the measurements at new stations (Figure 1). For one case of bura, operational wind speed forecasts were compared to the two alternatives (Figure 2);

- the dynamical adaptation was run with full physics
- the full 48 hour forecast was run with 2-km resolution

The choice of the operational dynamical adaptation set-up for the estimation of the extreme wind speed was good.

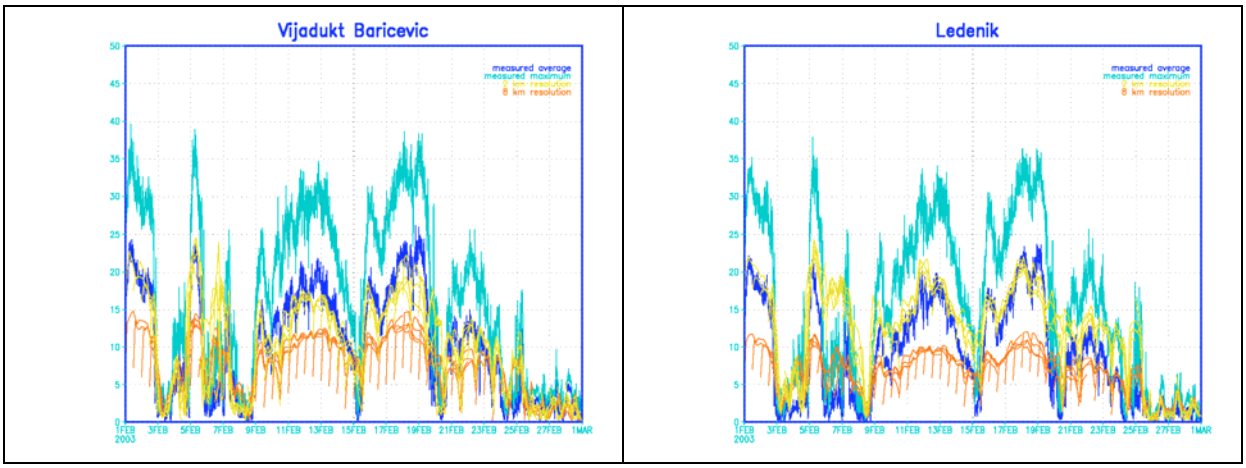

Figure 1. Measured wind speed for the Baričević Viaduct (left) and the Ledenik Tunnel (right) automatic stations and modeled data from the closest model point for February 2003. Measured 10 min average wind speed (dark blue), 10 min maximum (light blue), all model forecasts for February 2003 (00 and 12 UTC runs) with 8-km resolution (orange) and 2-km resolution operational dynamical adaptations (yellow). The 2-km resolution predicts the occurrence and strength of the 10-min average wind speed well.

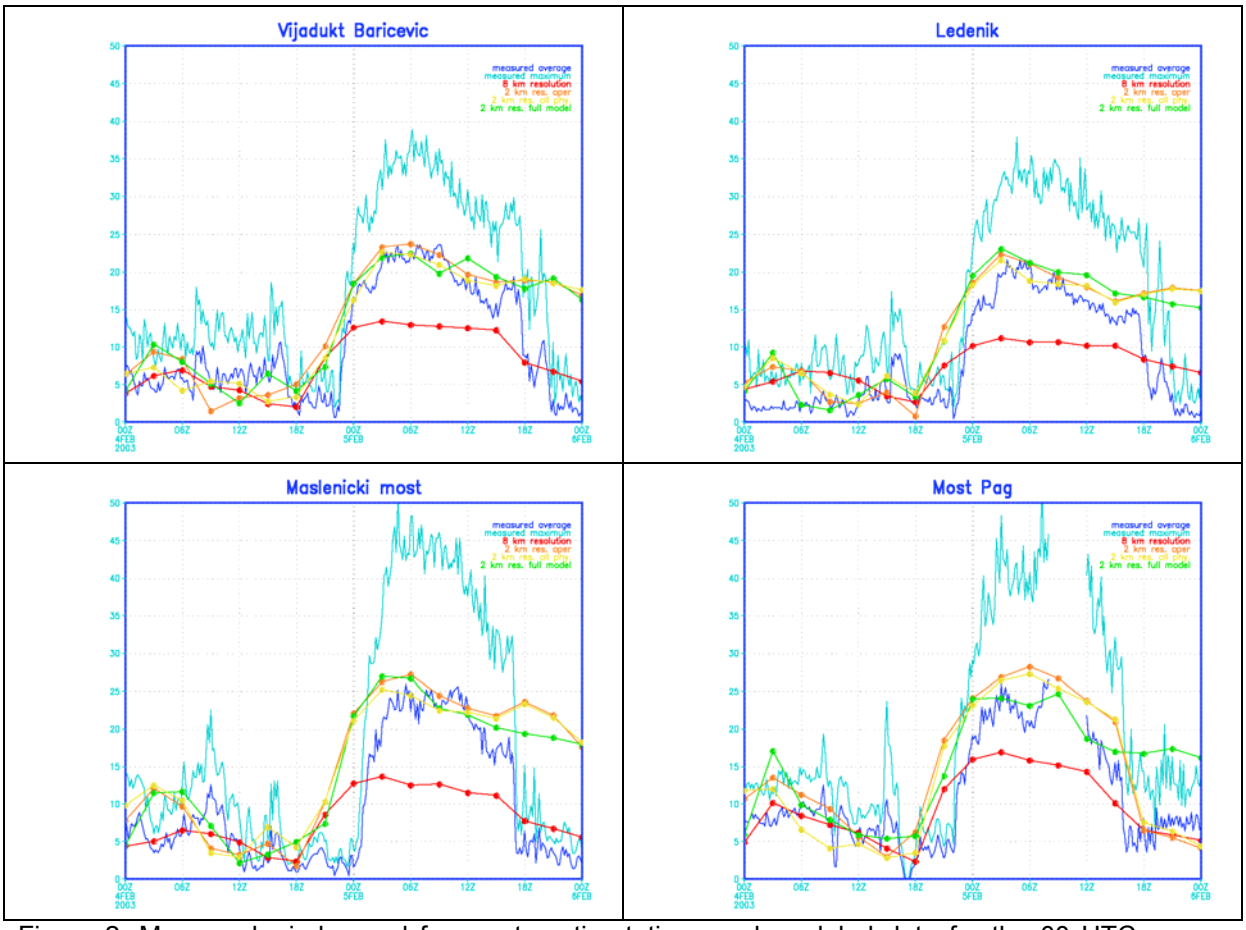

Figure 2. Measured wind speed from automatic stations and modeled data for the 00 UTC run on February 4th 2003 from the closest model point. Measured 10 min average wind speed in m/s (dark blue), 10 min maximum (light blue), 8-km resolution model forecast (red), 2-km resolution dynamical adaptations; operational (orange), using whole physics package (yellow) and 2-km resolution 48-hour model integration (green).

The high resolution dynamical-adaptation approach used in the operational suite works well when the wind is strong enough to overcome the circulation induced by local thermal or convection induced circulation. Therefore, it represents a powerful tool for estimation of the expected wind speed during the extreme weather events induced by pressure gradient forcing.

References

Žagar, M. and J. Rakovec, 1999: Small-scale surface wind prediction using Dynamical adaptation. *Tellus*, **51A**, 489-504.