

TESTING THE NEW SUB-GRID SCALE OROGRAPHY ON BURA CASES

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OUTLINE

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INTRODUCTION

Bura is the outbreak of cold continental air over Dinaric Alps

Its onset and intensity are strongly dependent on wavelength and height of orography

Current operational forecast is satisfactory but sometimes overestimates wind speed

INTRODUCTION contds

Aim of this study: test how envelope removal and modifications in gravity wave parametrization (modified drag and introduced lift) affect the wind forecast

Use of **envelope** has many disadvantages: excessive precipitation on windward side, stronger katabatic winds in the lee, overestimated wave amplitudes

Many measurements from stations below the envelope are rejected in data assimilation

Models underestimate mountain drag and envelope is not a good substitute

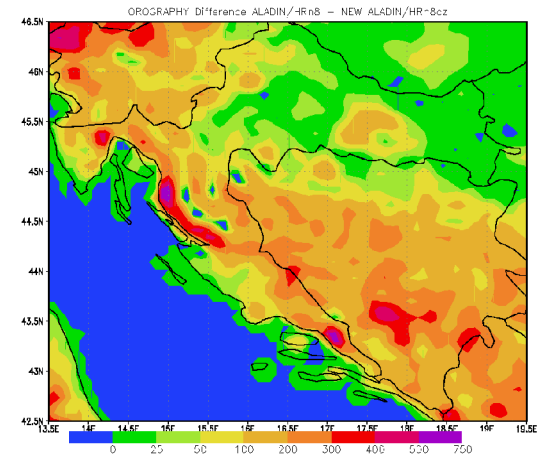
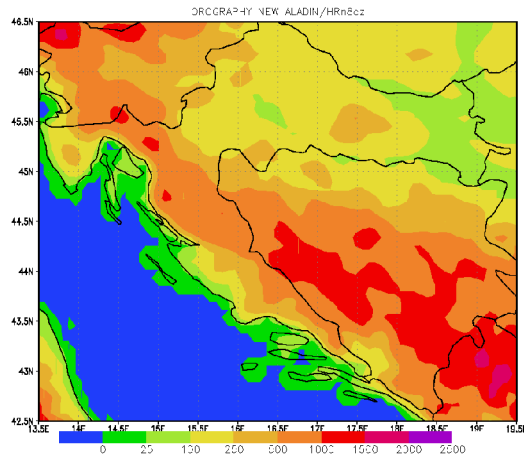
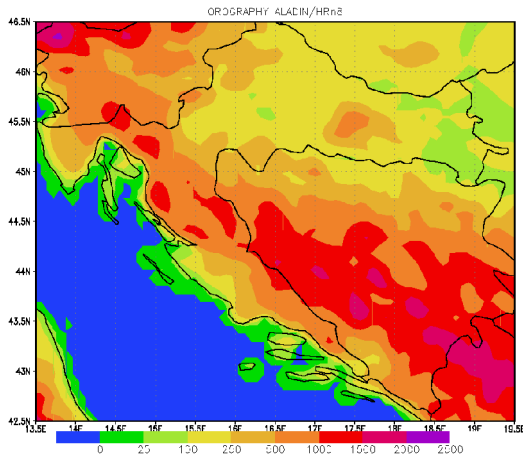
EXPERIMENTS

Operational model set-up: AL25_T1, currently operational in Croatia

Experimental model set-ups: no envelope + with/without new gravity wave parametrization (recently introduced into ALADIN/CZ, AL25_T1_op4)

1. ENVELOPE OROGRAPHY

Removing the envelope means: lowering mountain peaks and valleys- difference is largest where orographic variability is highest (slopes)



2. NEW GWD PARAMETRIZATION

Pressure drag: lift+drag(wave+form)

Form drag:

Dependence on the inverse Froude number F (low level breaking at F_c) is included

$F < F_c$ surface stress = wave drag, form drag = 0

$F > F_c$ surface stress = wave drag + form drag

GWDCD 6 \rightarrow 5.4 (form drag coefficient, slightly decreased)

Form drag is increased at high F and wave drag reduced at low F by a factor F/F_c

2. NEW GWD contd

Surface drag, high level deposition:

GWDSE 0.0035 → 0.025 (total coefficient, pressure drag increased ~8 times- more realistic value)

Orographic lift:

Switched on, applied to an estimate of geostrophic wind

GWDLT 0 → 1

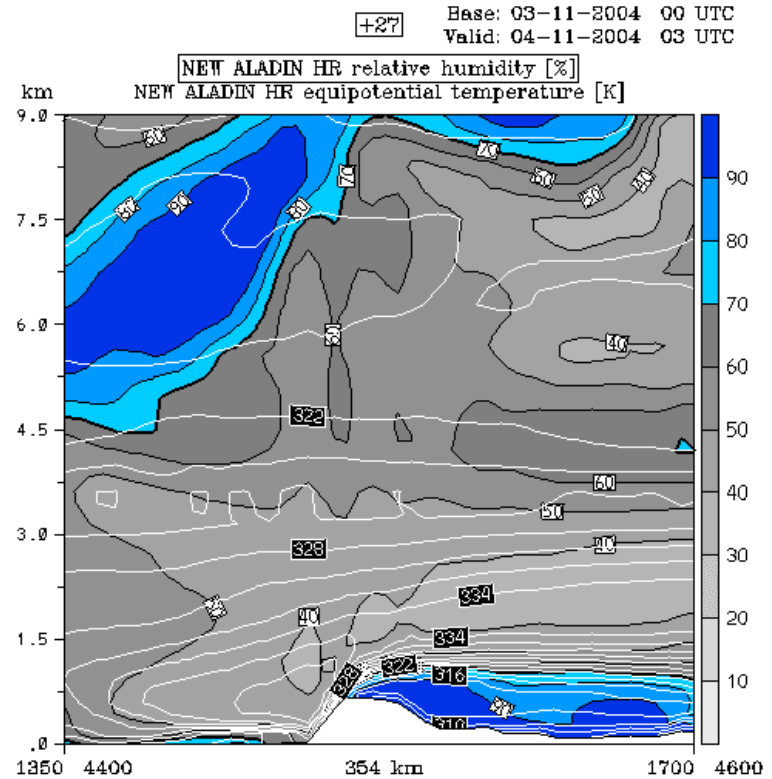
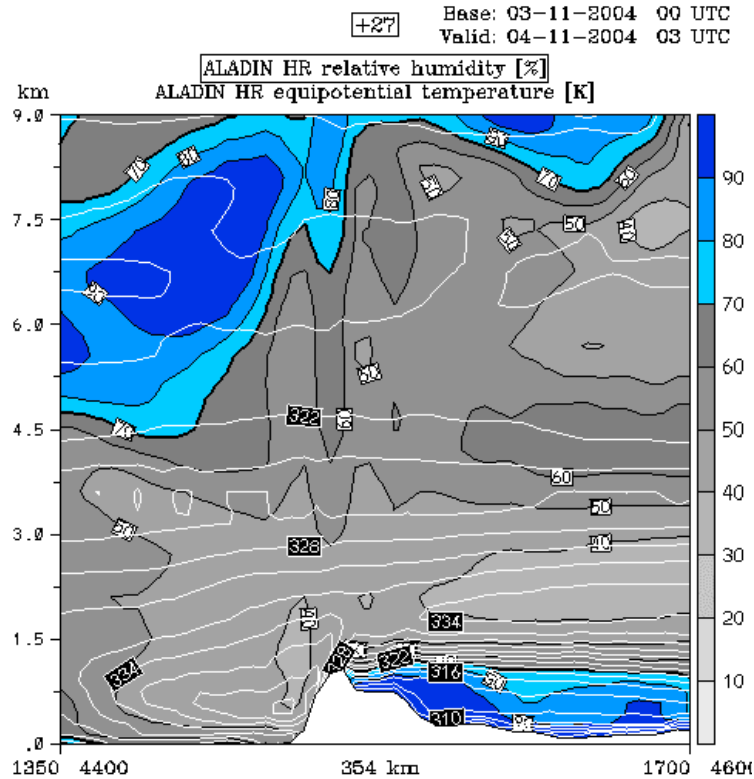
- **See more in J.F. Geleyn: Foreseen changes..., 13th ALADIN workshop**

3. BURA CASES

Case of **generally weak bura** (3rd November 2004): air drainage through mountain passes induced by pronounced difference in air-mass characteristics between the inland and coastal part of the region

Two **extreme bura events** (24th December 2003 and 13th November 2004): synoptically generated

RESULTS

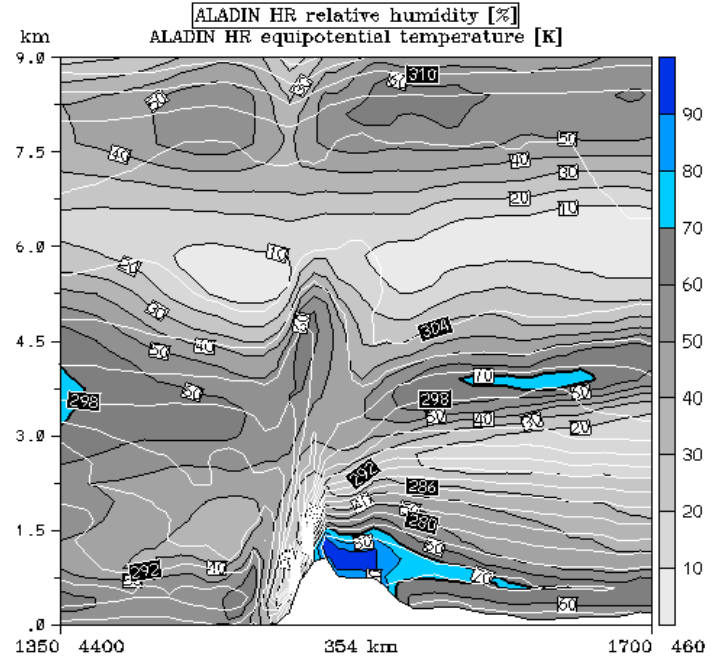


Less pronounced blocking on the upwind side, as result of smaller mountain drag

Cold continental air drainage starts earlier leading to weaker winds

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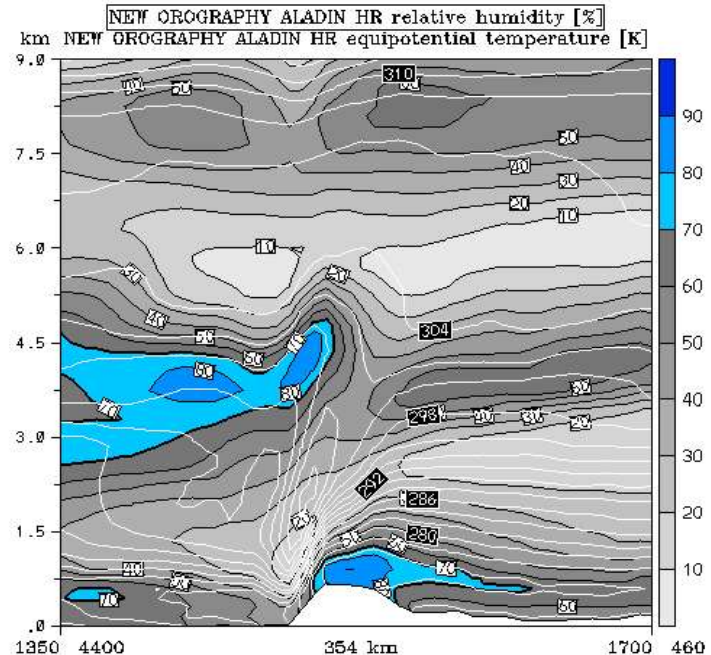


Wave structure is smoothed
Unrealistic wave breaking and reflection off the ground is reduced

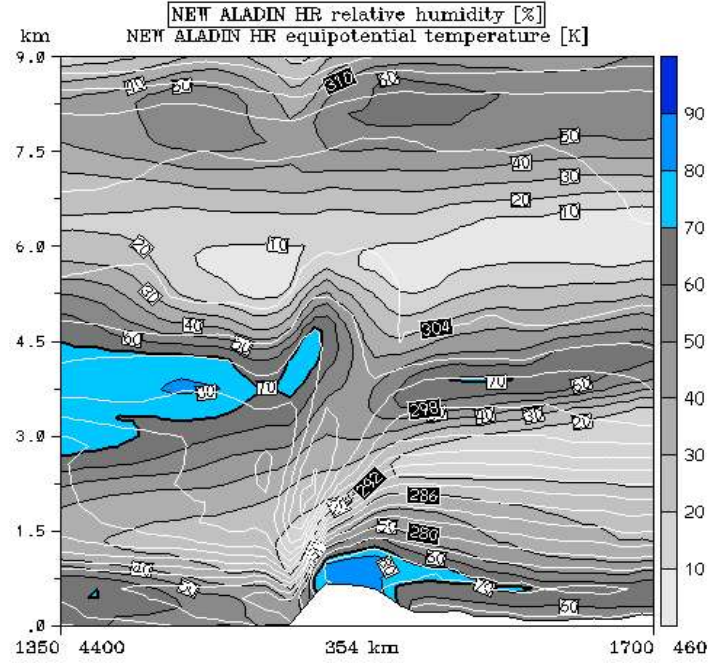
Excessive upwind humidity maximum (cloudiness) development near the mountaintop is diminished

Orography representation has bigger impact on the results

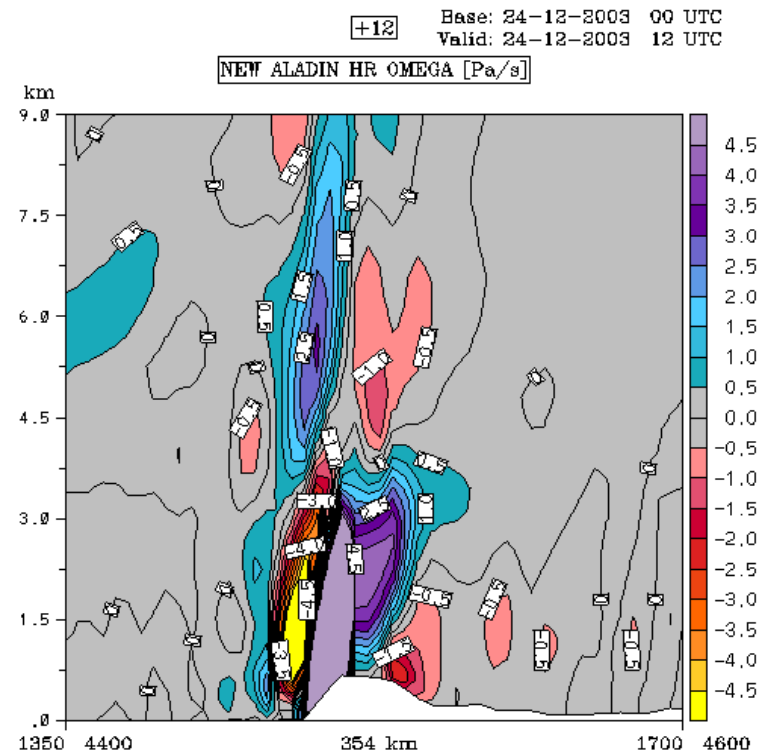
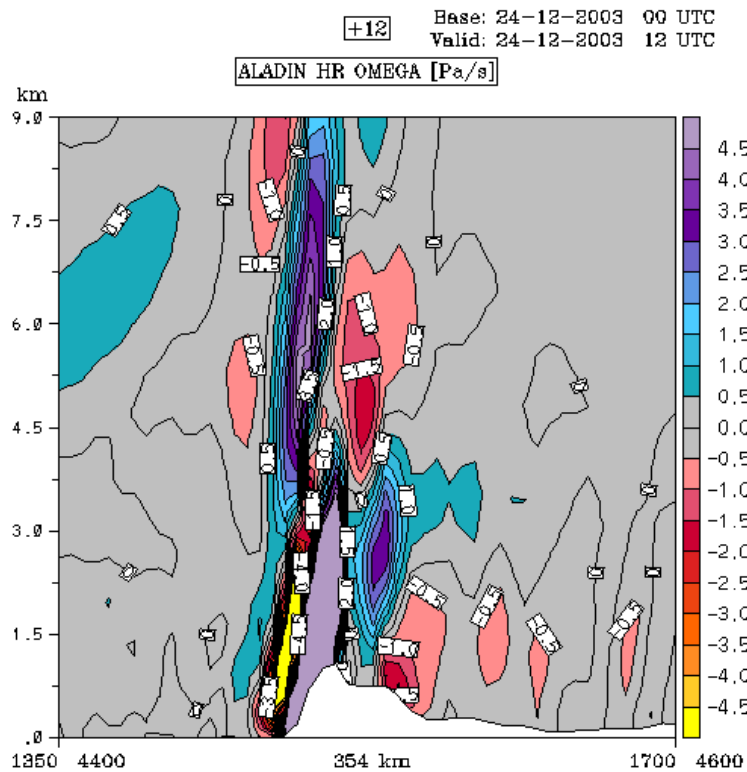
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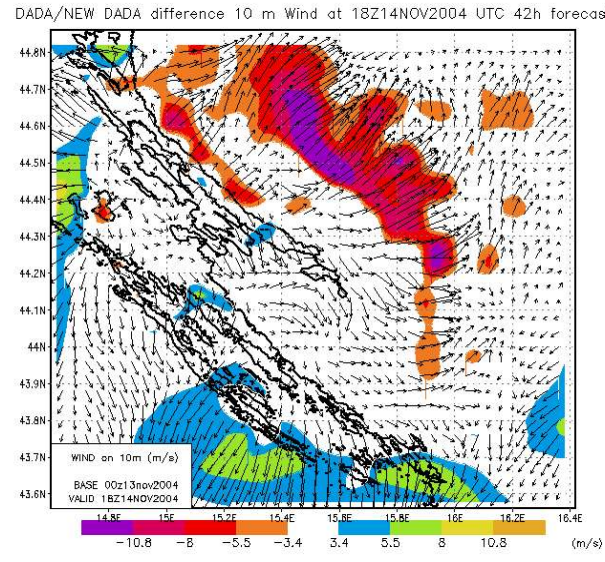
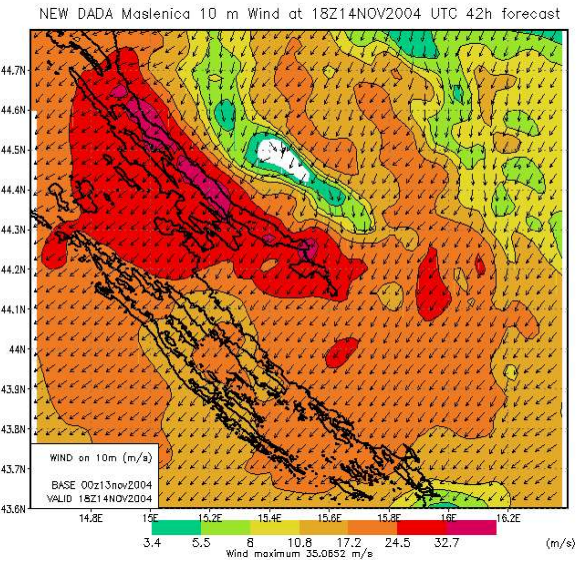
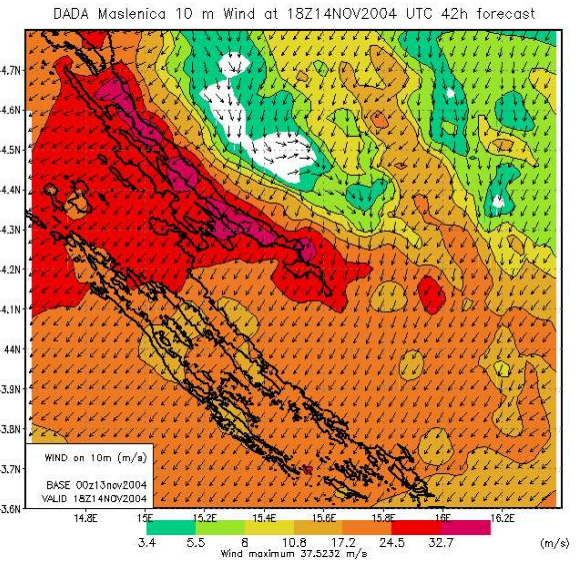
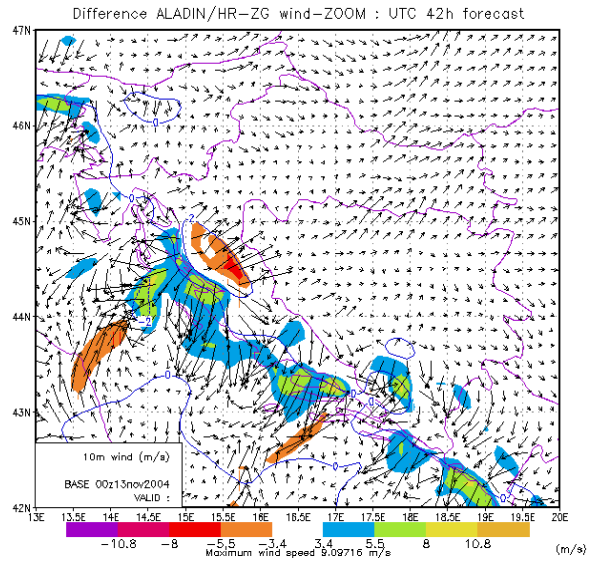
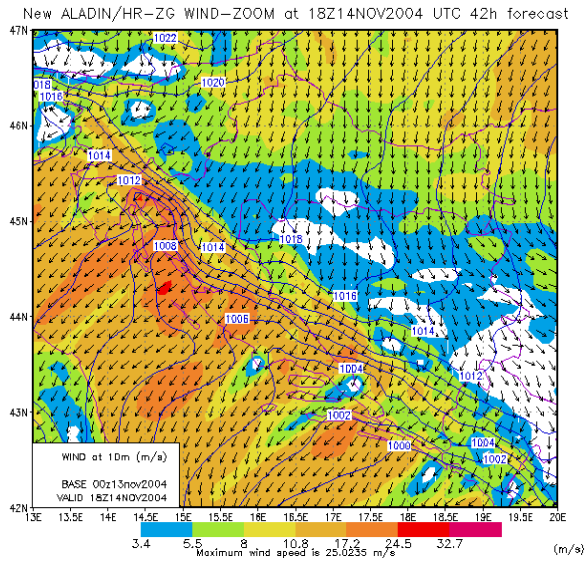
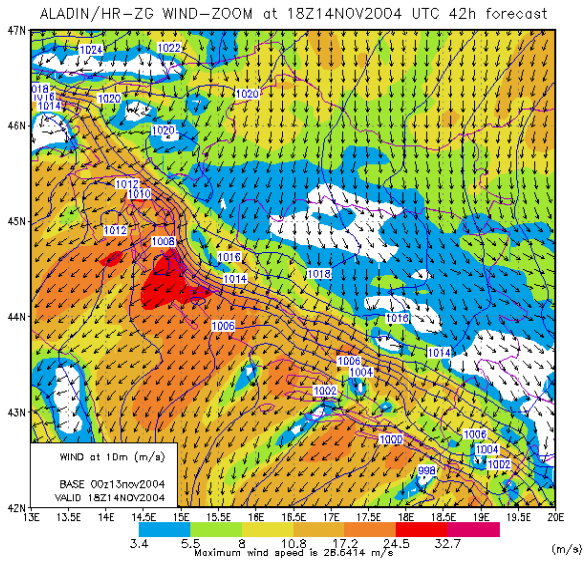
More pronounced downstream momentum transfer:
different distribution of vertical motion induced by
the obstacle

RESULTS contd.

Increase of 10m wind speed on the windward side, more pronounced decrease downwind, due to reduction of pressure gradient across the coastal mountains

Loss of canalised structure, due to smaller relative differences between mountaintops and valleys

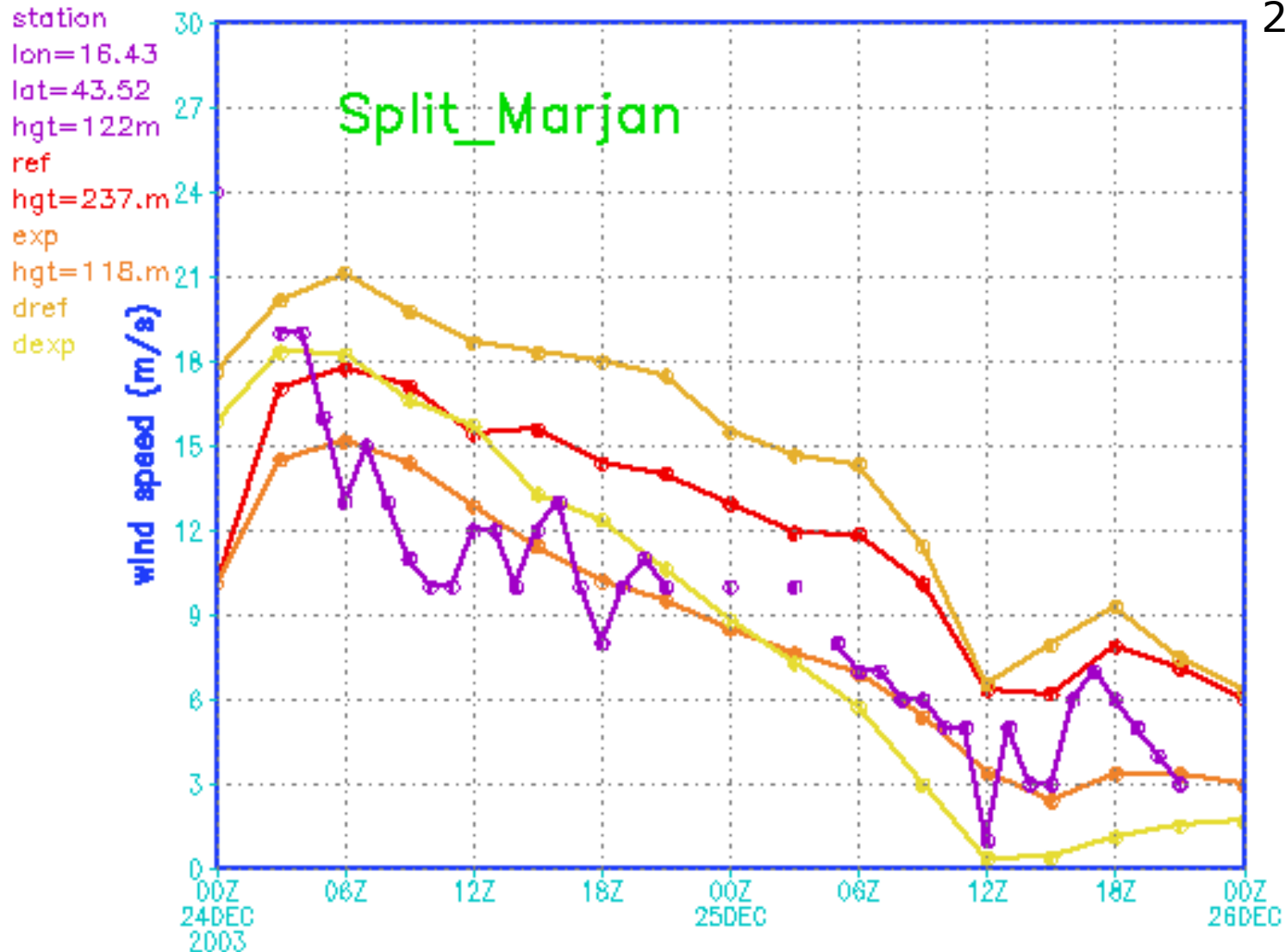
No significant change in modelled wind direction



10m wind in the operational (left) and experimental (centre) model version, and their difference (right), for the 8km (top) and 2km model resolution (bottom)

good

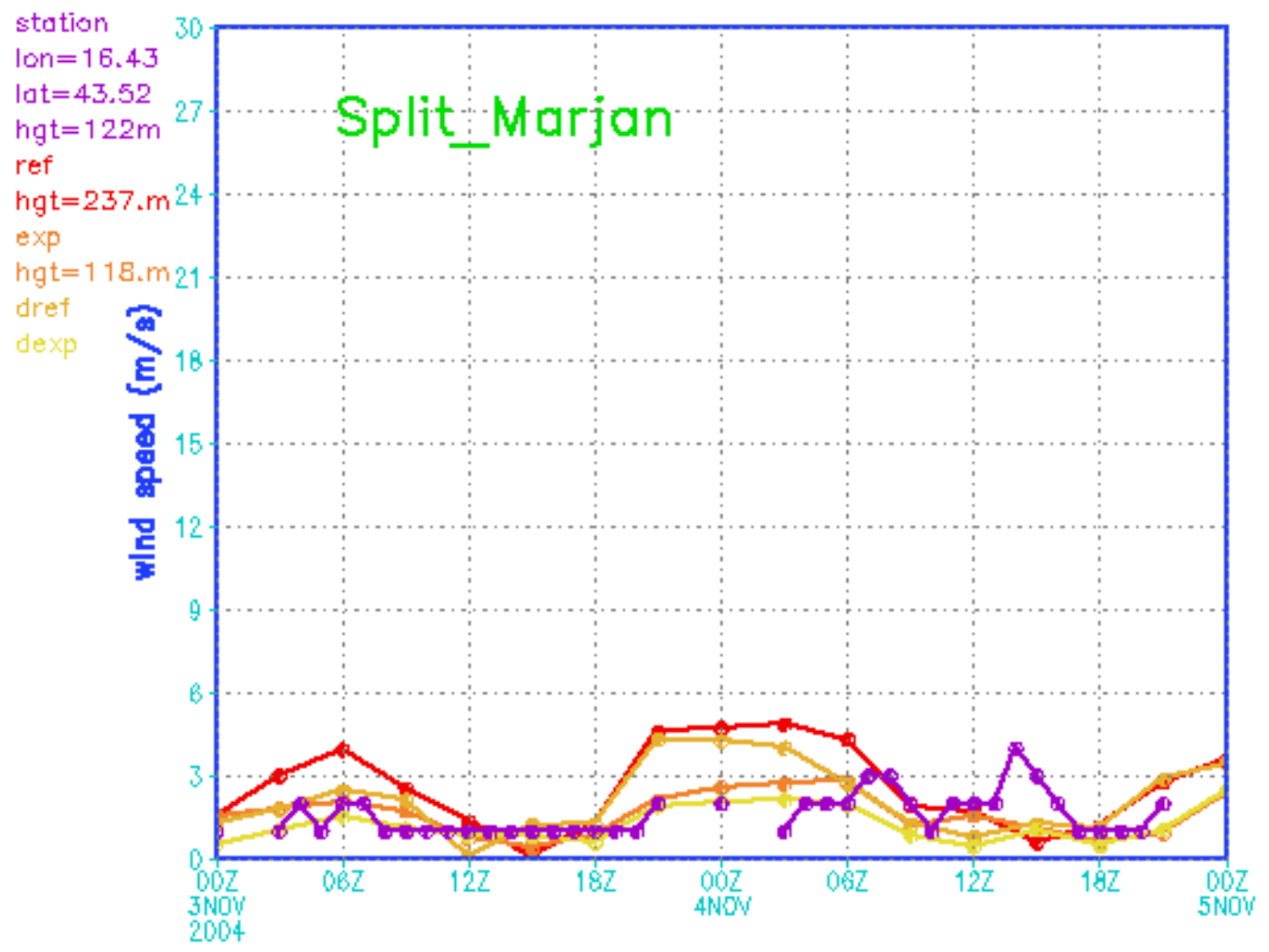
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10m wind speed for synoptic station data, operational 8km, 2km, experimental 8km and 2km resolution model

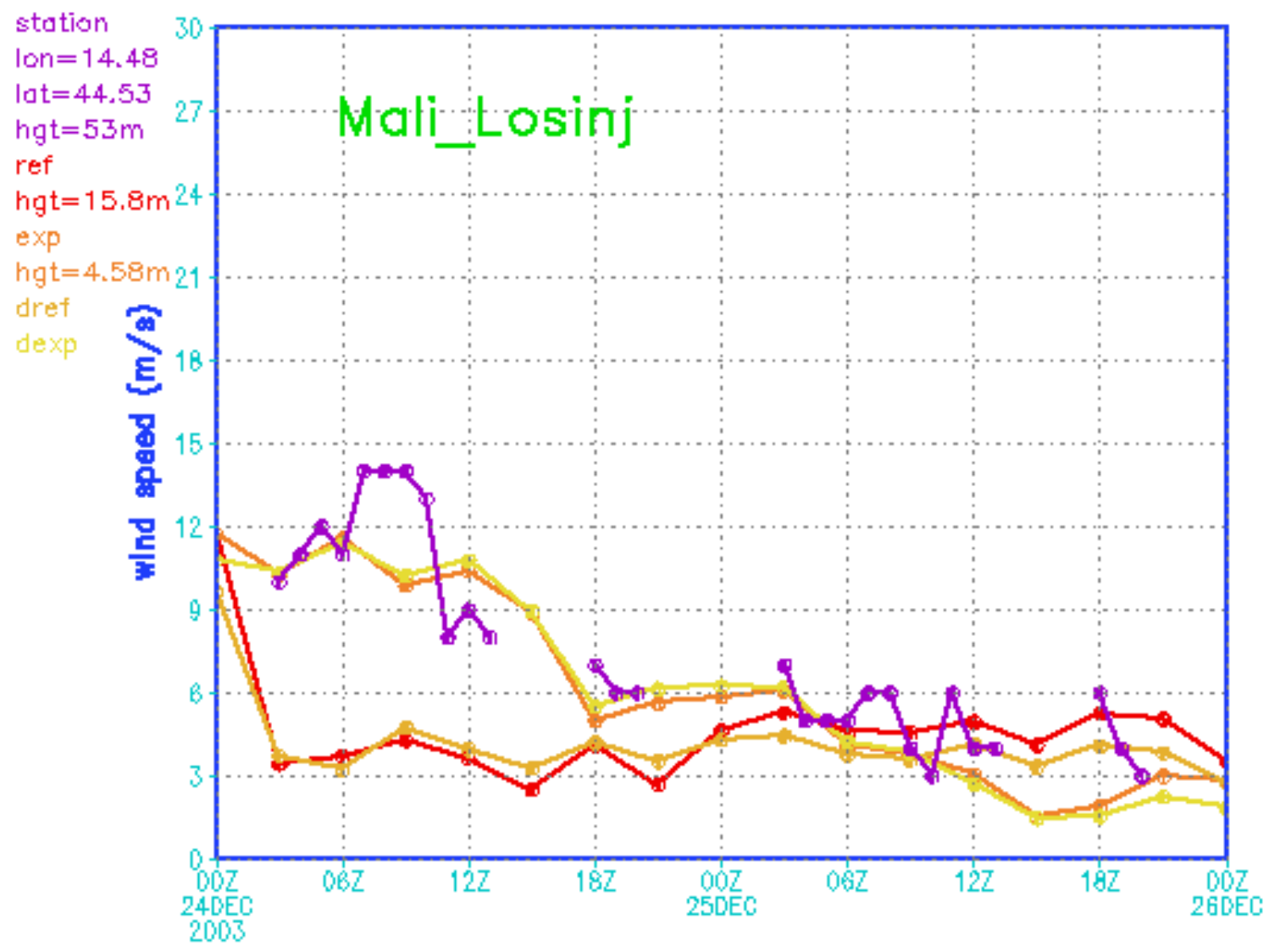
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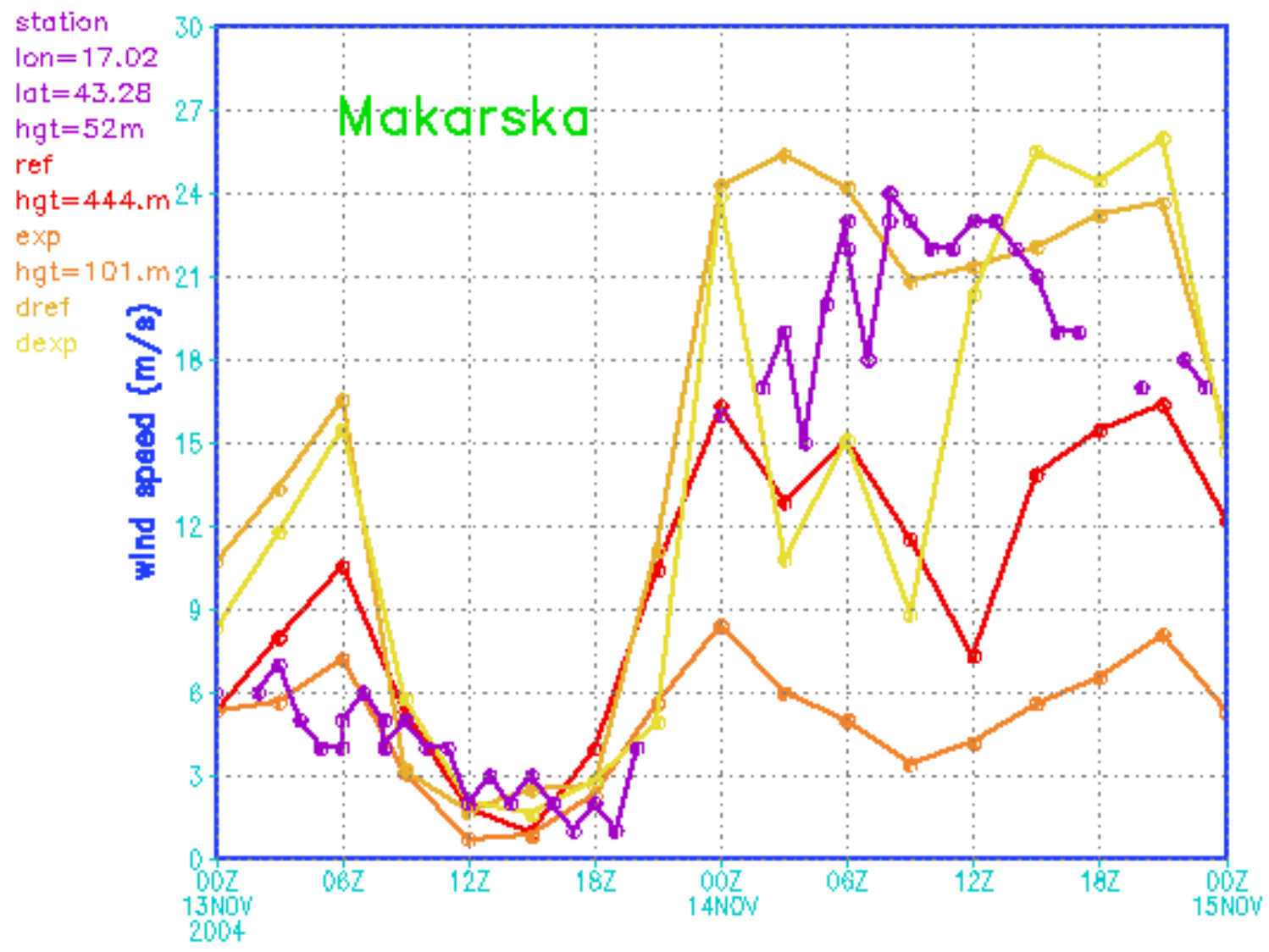
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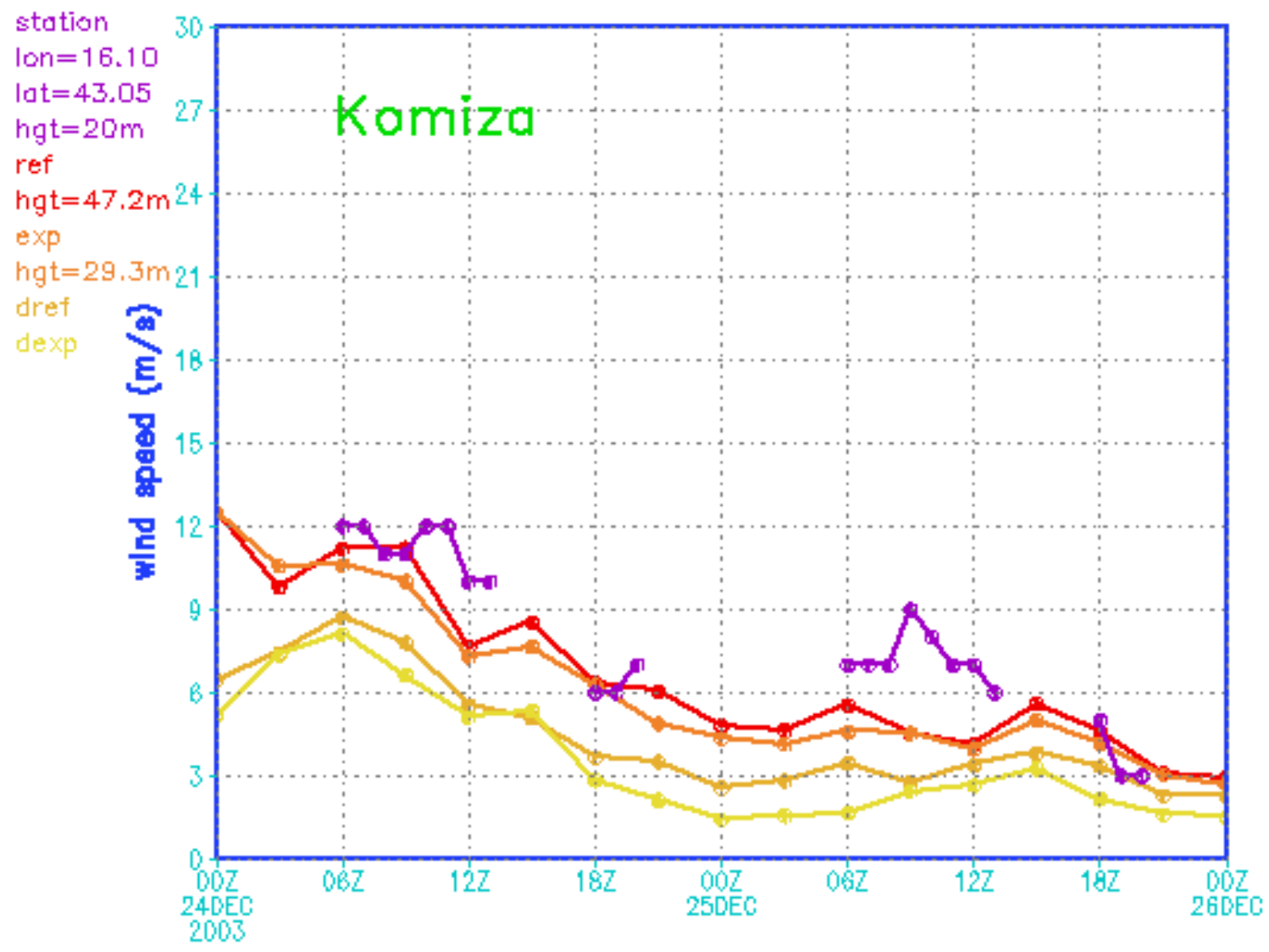


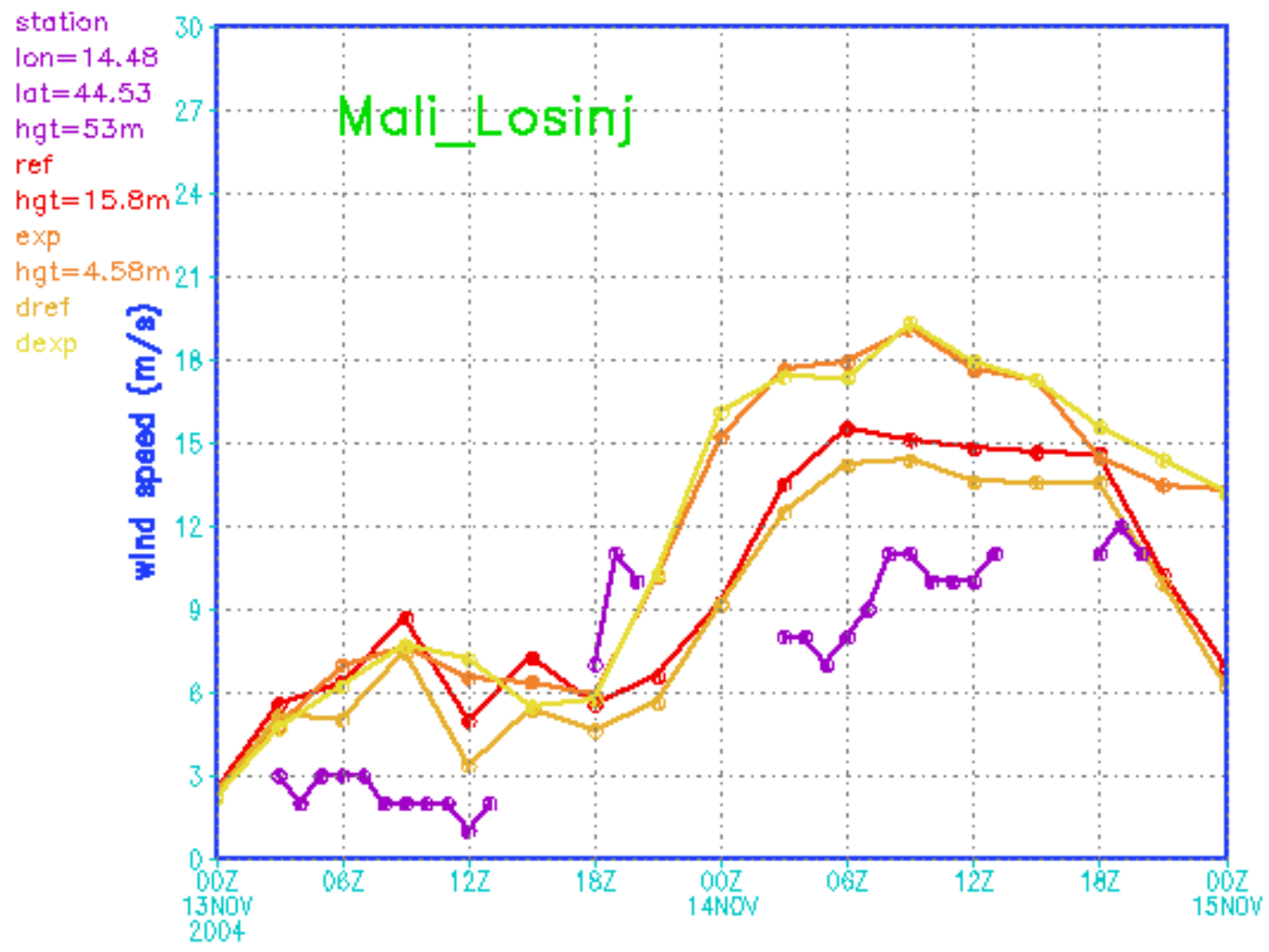
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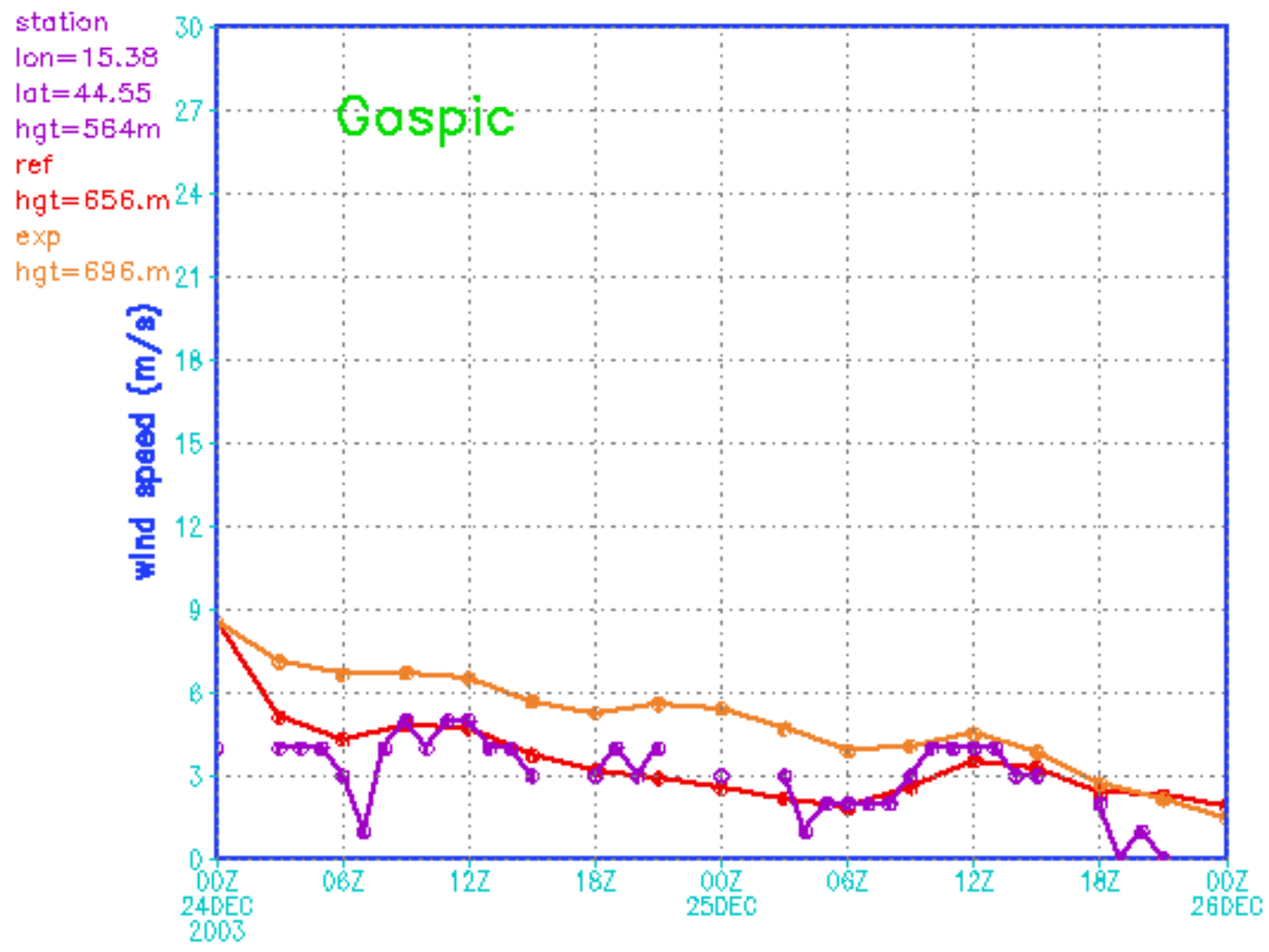






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CONCLUSIONS

Removal of the envelope and changes in gravity wave drag parametrization result in **stronger** winds on the windward and generally **weaker** winds on the leeward side of the obstacle, as expected

Mountain wave amplitude is reduced and smoothed

Sub-grid scale orography representation had bigger impact on the results than modified gravity wave parametrization

CONCLUSION contd

Results are **ambiguous**: The effects are not of the same intensity and sense in all places (improvement or deterioration: increase or decrease)

Although the modelled wind speed in the lee is sometimes overestimated, in the new set-up the decrease is not always an improvement (sometimes too strong)

The canalized structure of bura is reduced

OUTLOOK:

More case studies on bura

Test of new scheme on different weather types (not only bura)