HIGH RESOLUTION SIMULATION OF A SEVERE BURA EVENT – AN INTERCOMPARISON OF TWO MODELS

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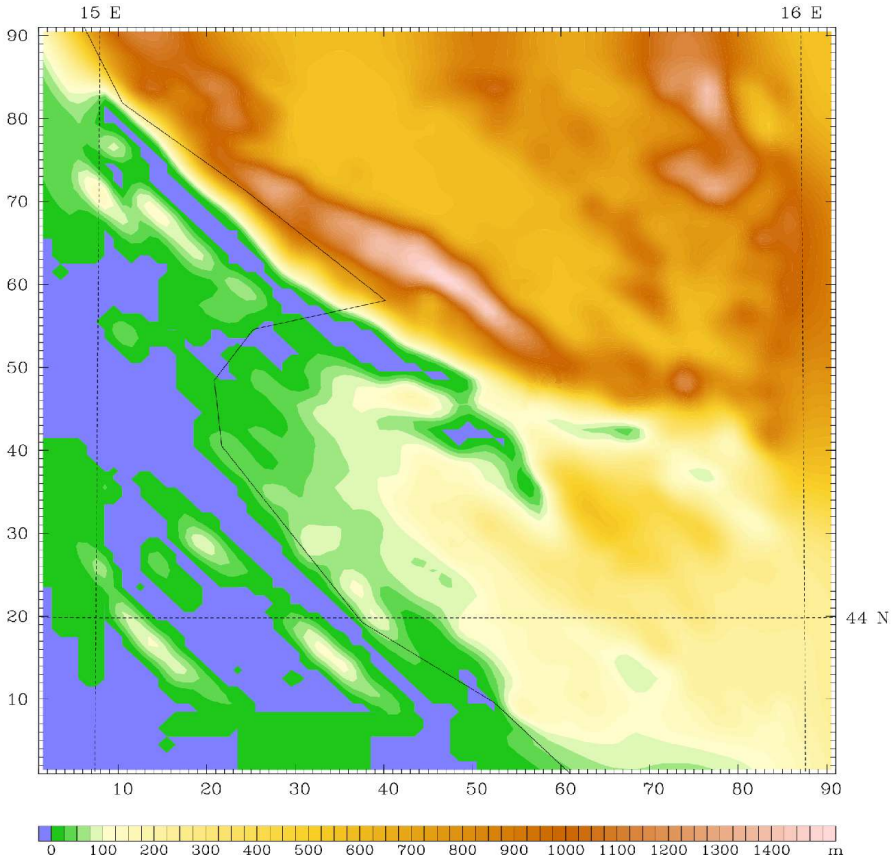
MOTIVATION

- to compare the ability of MM5 and operational ALADIN/HR dynamical adaptation to reproduce extreme variability of bura
- high resolution 1km MM5 is computationally very expensive
- ALADIN dynamical adaptation on 2km is computationally very cheap

MM5 SETUP



30 vertical levels; z_{top}=100hPa

Parent D.: 80x70 g.p. $\Delta x=\Delta y=3$km, $\Delta t=9$s

Child D.: 91x91 g.p. $\Delta x=\Delta y=1$km

PBL: eta; Mellor Yamada level 2.5

SEB: 5 layer soil model

Microphysics: Reisner graupel explicit

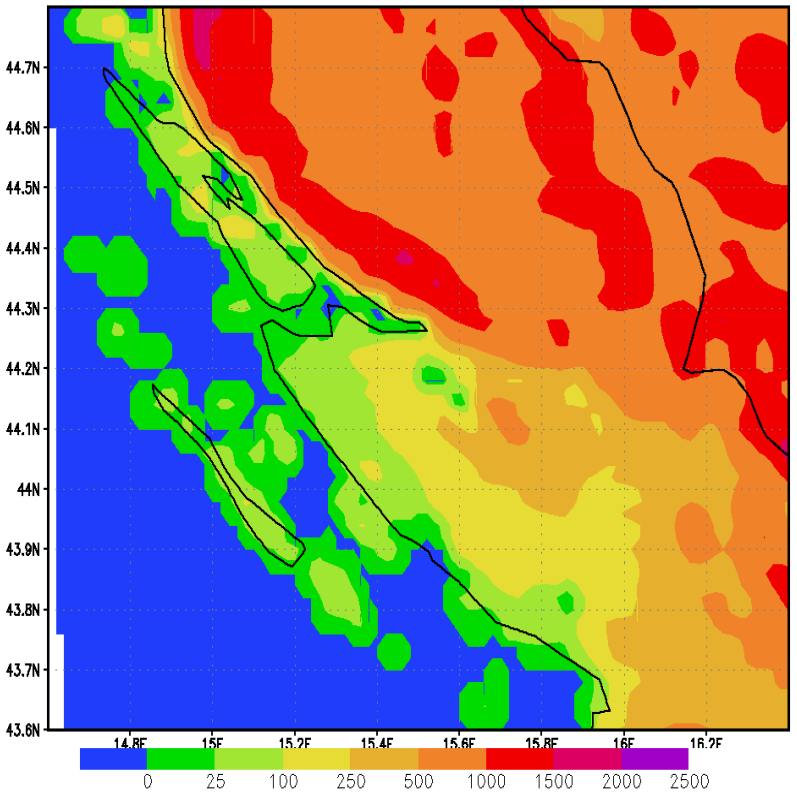
Radiation: RRTM

Initialization: operational ALADIN/HR

Forecast start: 00 UTC

Forecast duration: 30 hours

ALADIN SETUP



DINAMICAL ADAPTATION of operational ALADIN/HR (CY25T1)

15 vertical levels

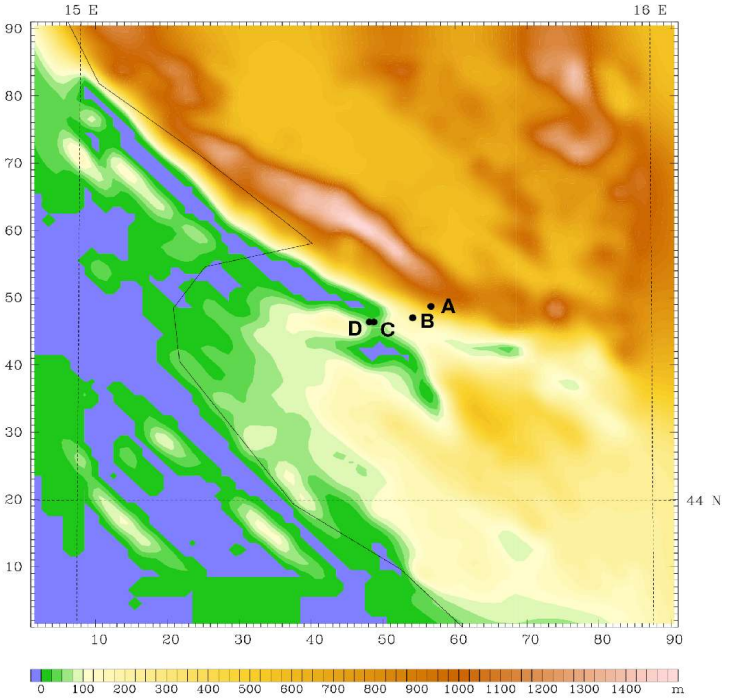
Domain size: 72x72 g.p. $\Delta x=\Delta y=2$km, $\Delta t=60$s, 30 steps

Forecast start: 00 UTC

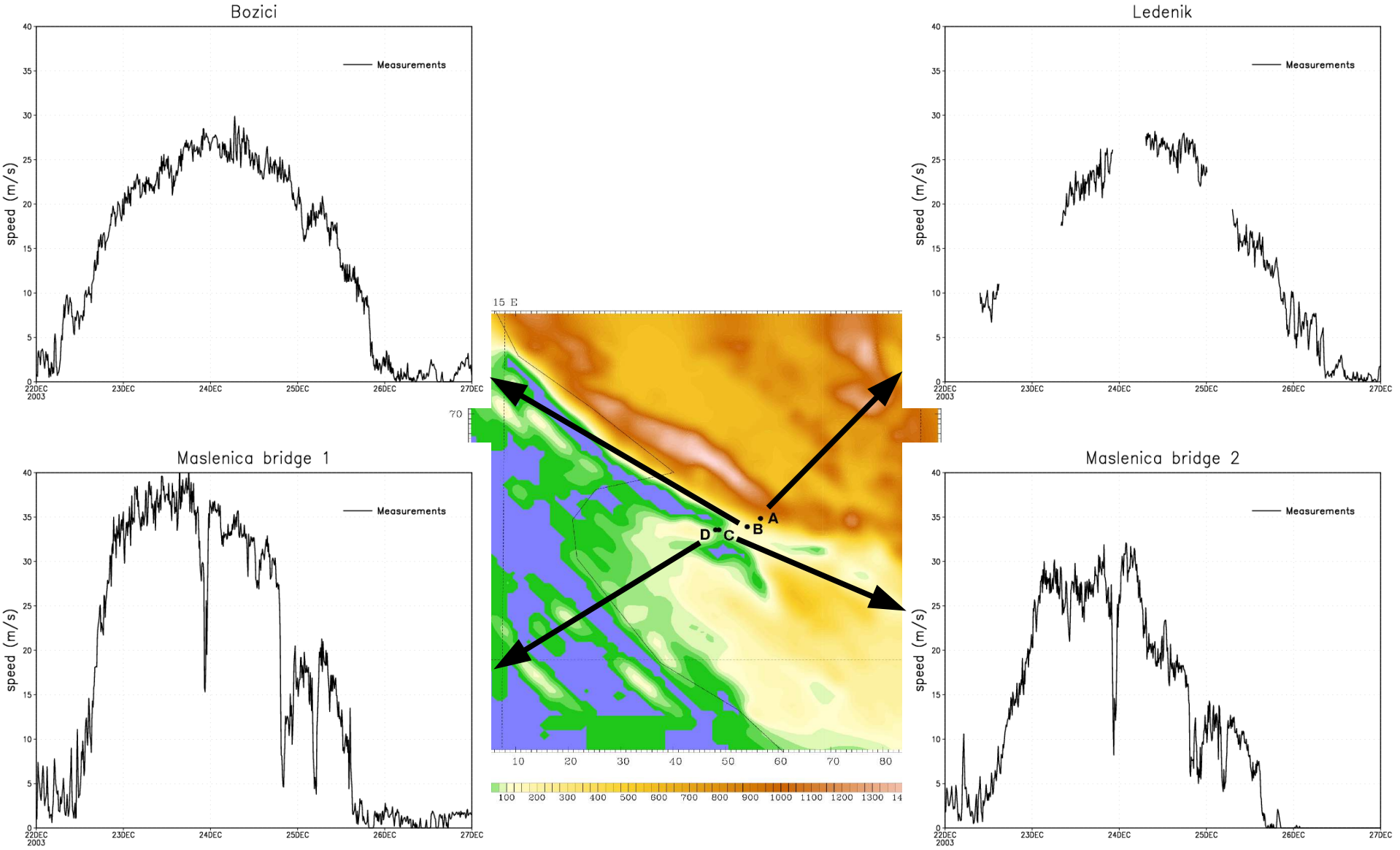
Forecast duration: 48 hours

BURA EPISODE

- start: 22.December 2003
- end: 26. December 2003
- the strongest bura of winter 2003/04
- analyzed at Zadar region
- 5 automatic measuring stations
- distance between the two most distant stations < 10km

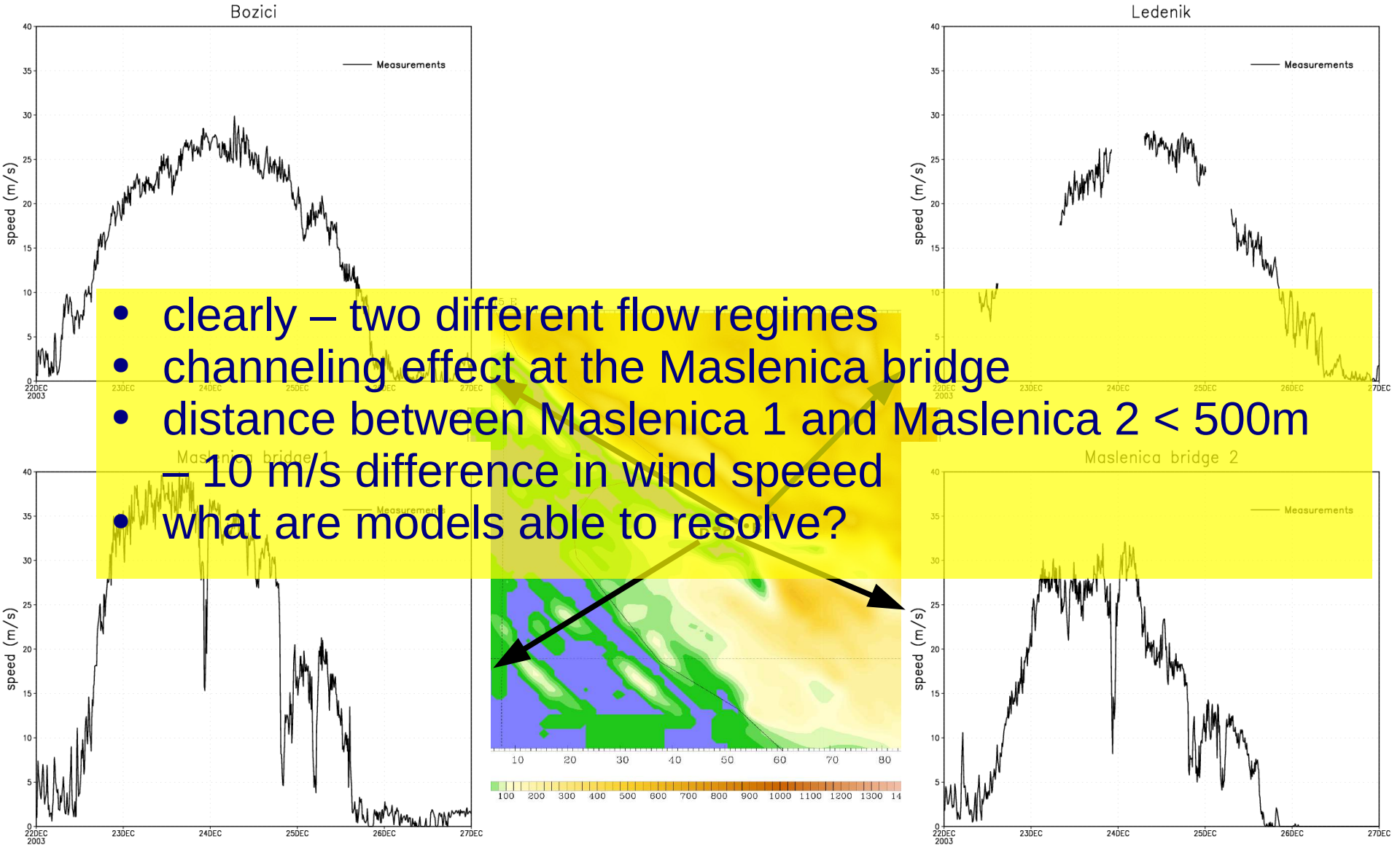


MEASUREMENTS



- maximum wind gusts 62.7 m/s
- maximum 10-minute mean wind speed 40.9 m/s

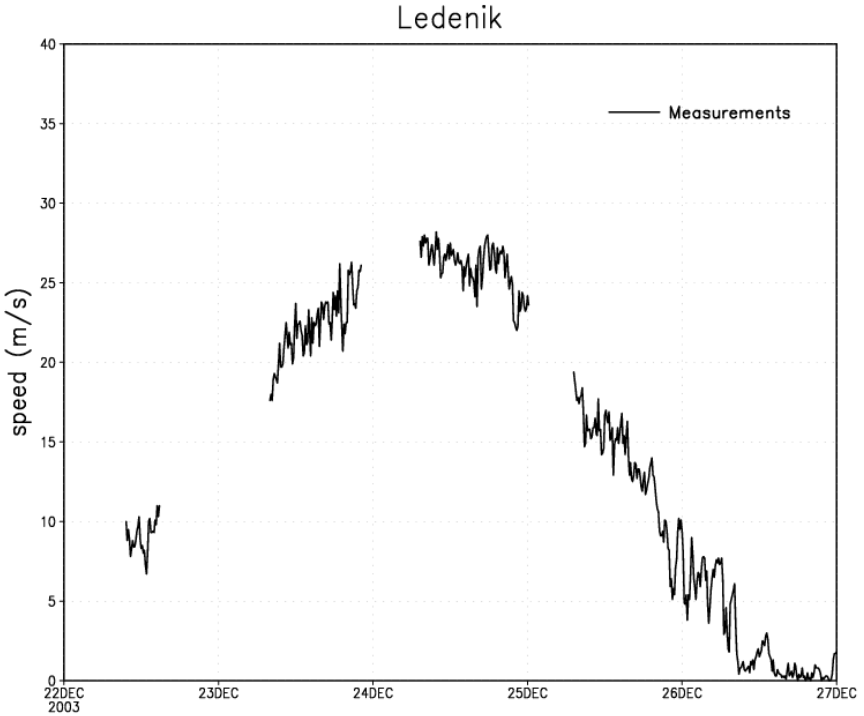
MEASUREMENTS



- clearly – two different flow regimes
- channeling effect at the Maslenica bridge
- distance between Maslenica 1 and Maslenica 2 < 500m – 10 m/s difference in wind speeed
- what are models able to resolve?

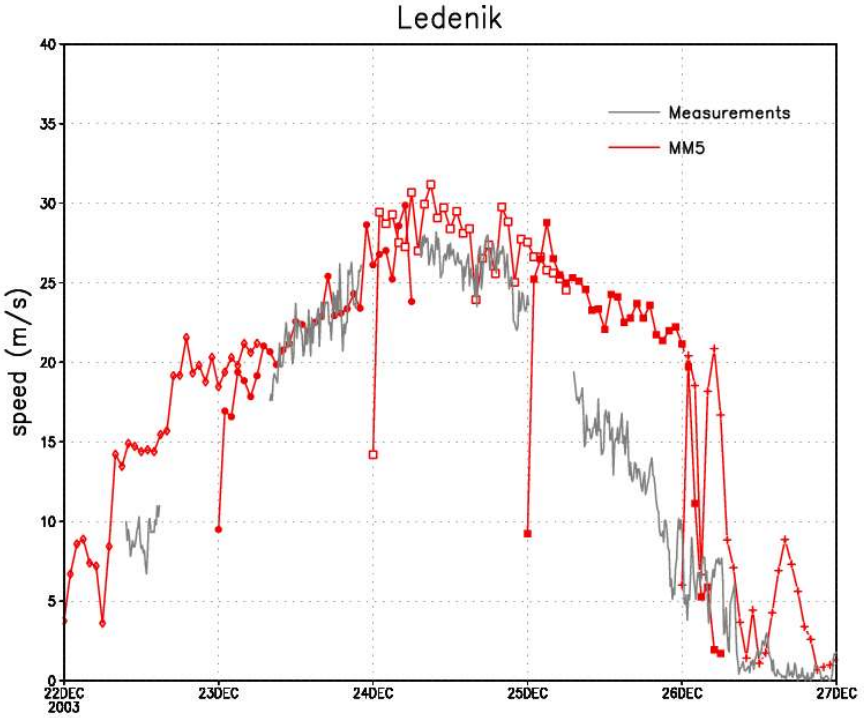
LEDENIK

- located at the slopes of Velebit



LEDENIK (MM5)

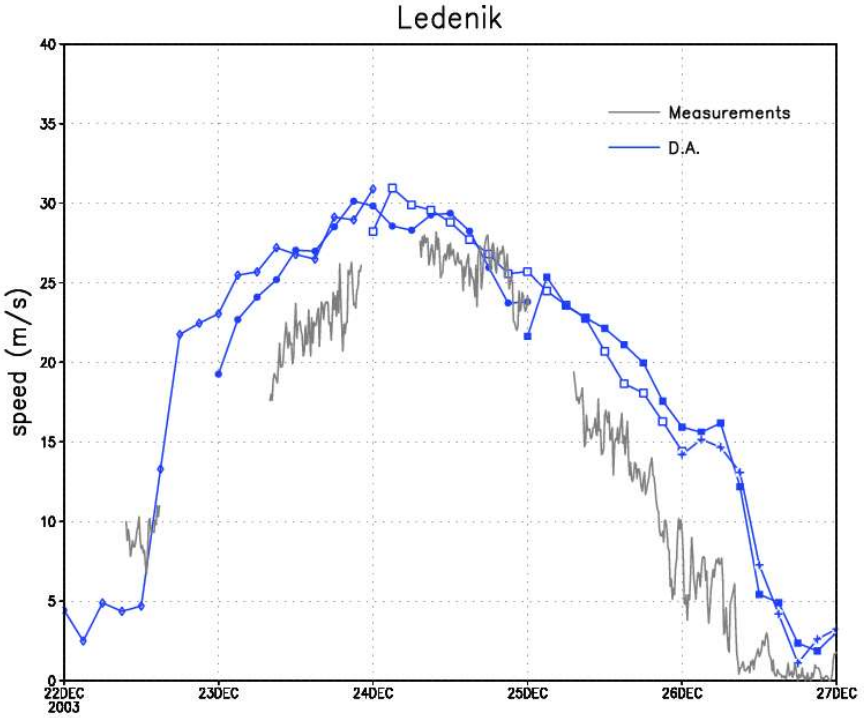
- located at the slopes of Velebit



- relatively good agreement during the first 3 days
- differences less than 5m/s
- slightly overestimates observed wind speed
- fourth day model performance gets worse
- correctly predicts end of the epizode

LEDENIK (ALADIN DA)

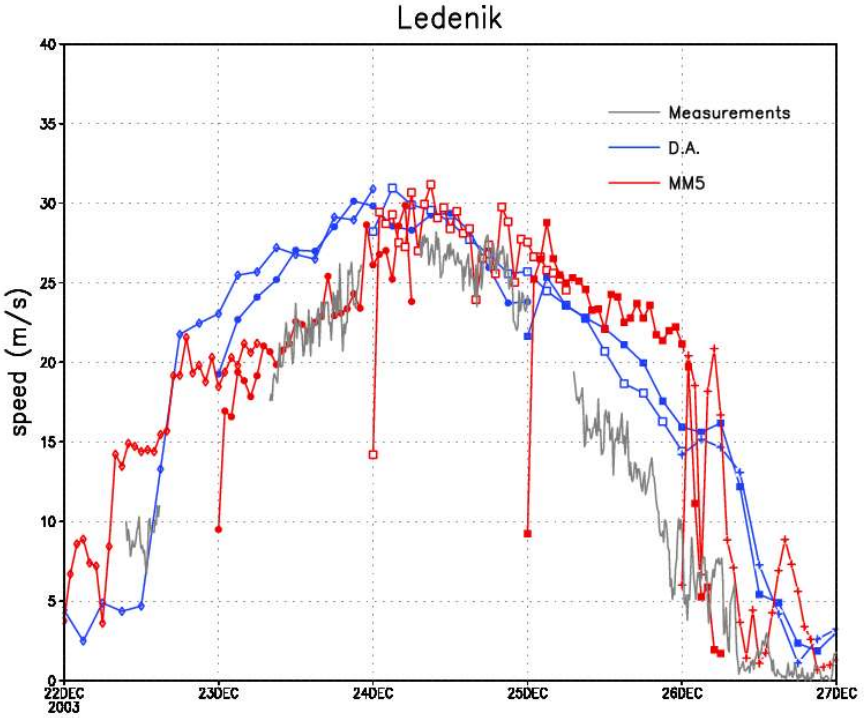
- located at the slopes of Velebit



- slightly overestimates observed wind speed
- differences less than 5m/s
- fourth day model performance gets worse
- correctly predicts end of the epizode

LEDENIK (DA+MM5)

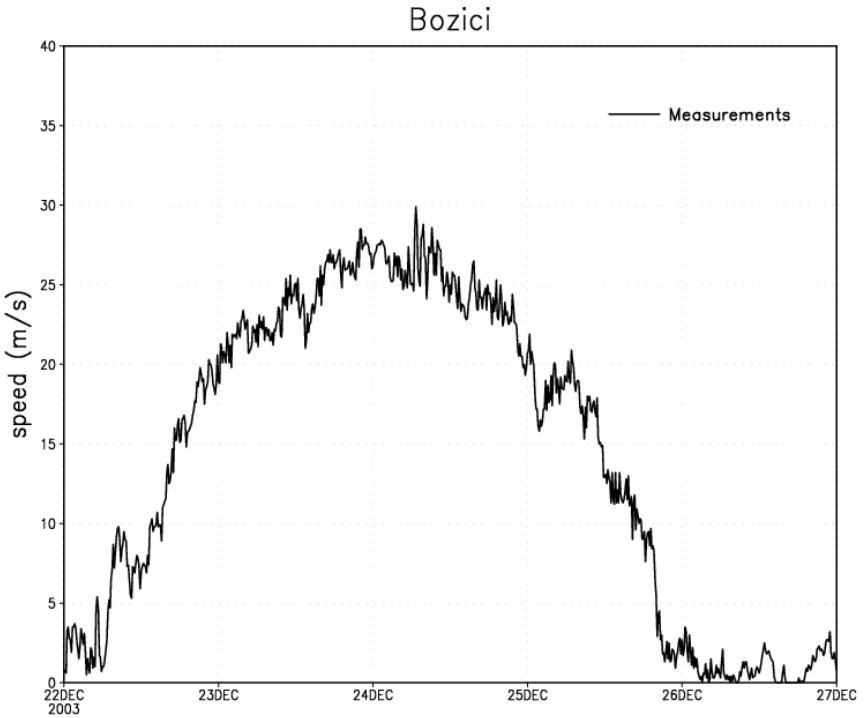
- located at the slopes of Velebit



- MM5 in slightly better agreement with observations

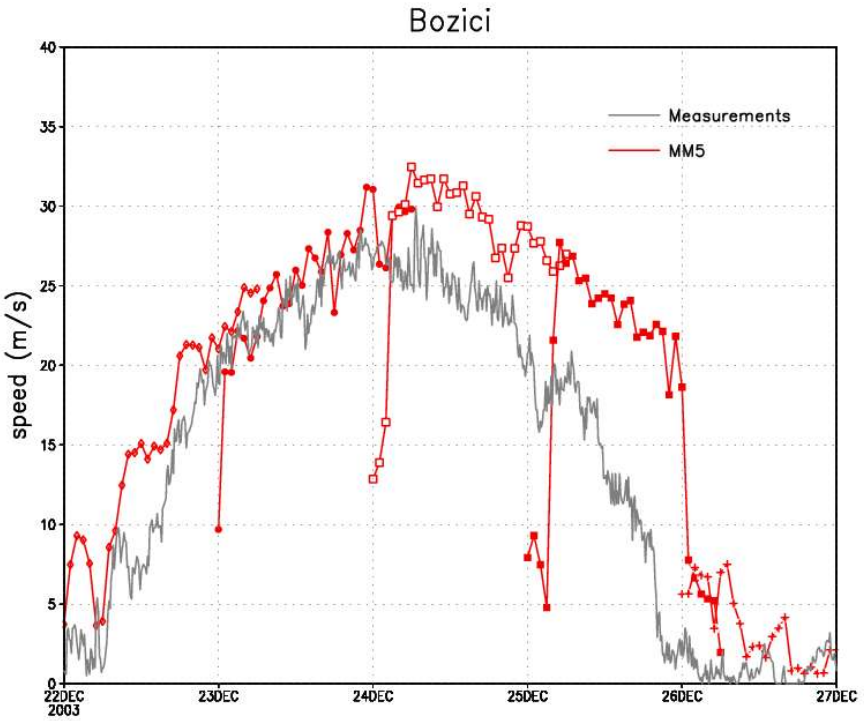
BOŽIĆI

- located beneath Velebit



BOŽIĆI (MM5)

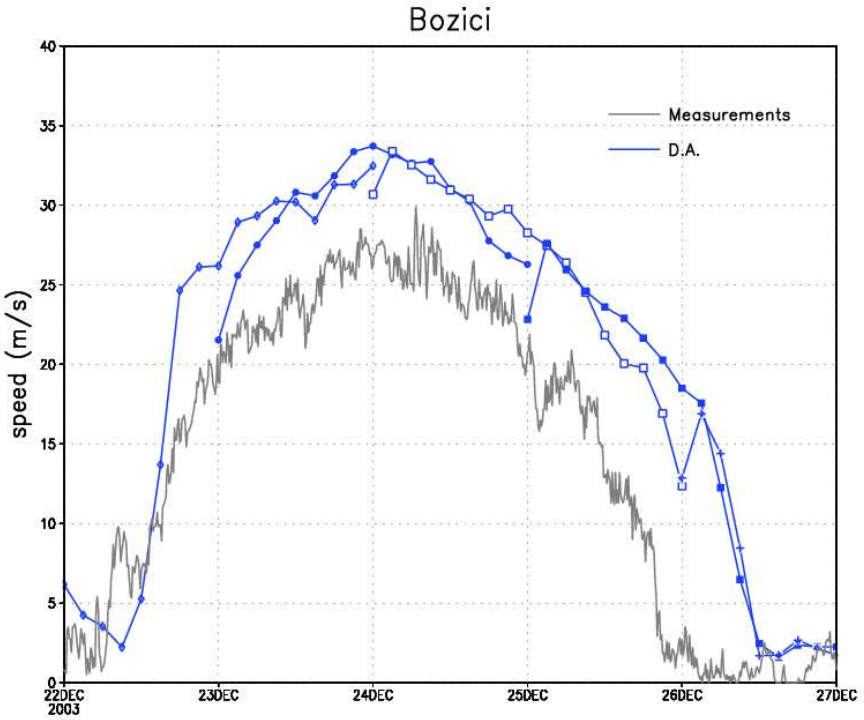
- located beneath Velebit



- MM5 in relatively good agreement
- differences less than 5m/s
- fourth day model performance gets worse
- correctly predicts end of the epizode

BOŽIĆI (DA)

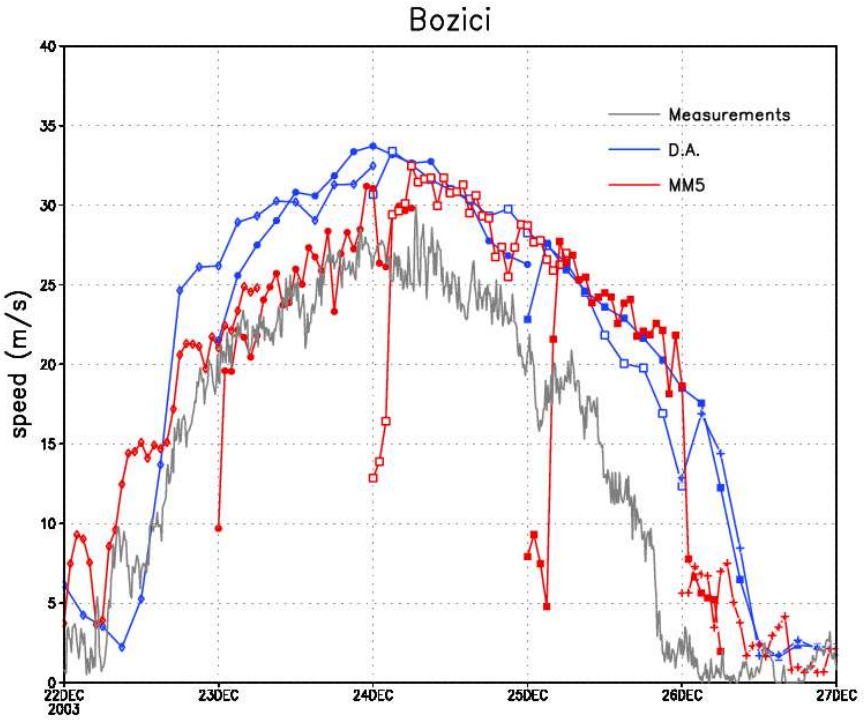
- located beneath Velebit



- overestimates observed wind speed
- differences around 5m/s and more

BOŽIĆI (DA+MM5)

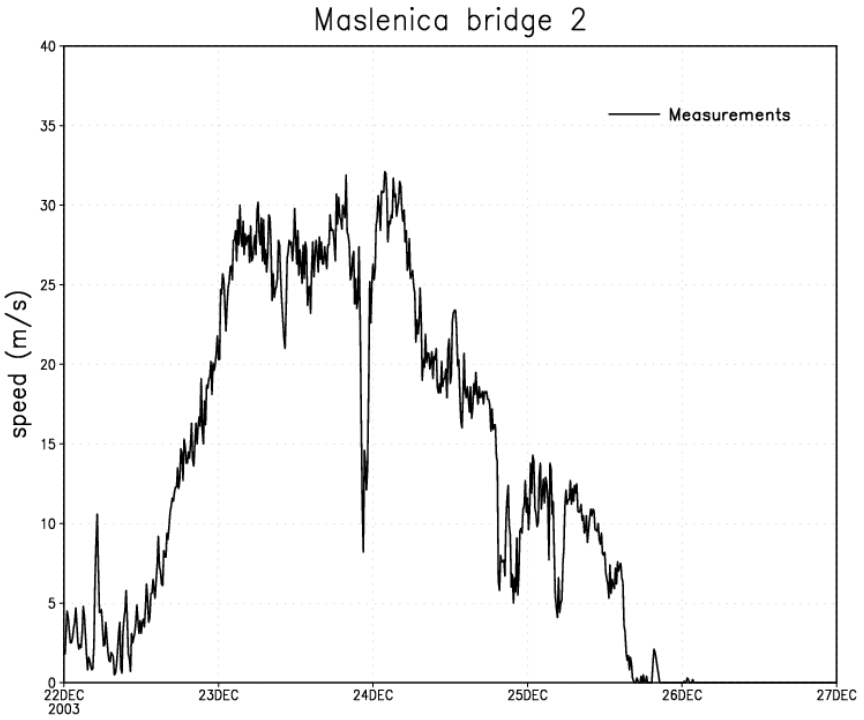
- located beneath Velebit



- MM5 in better agreement with observations

MASLENICA BRIDGE 2

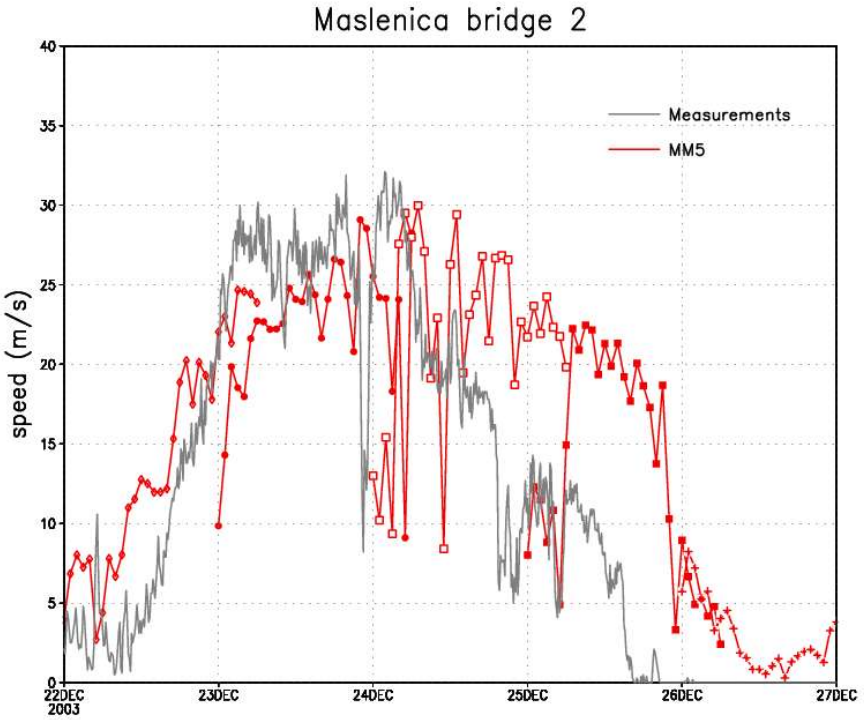
- located at the eastern side of Maslenica bridge



- lot of variations the wind speed
- bura ends half a day earlier than at Ladenik and Bozici

MASLENICA BRIDGE 2 (MM5)

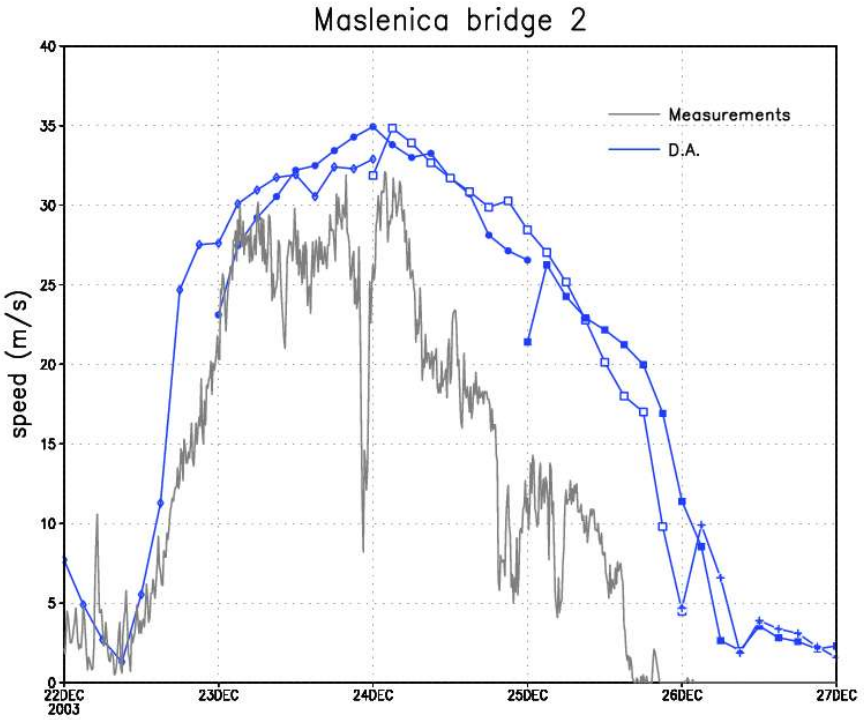
- located at the eastern side of Maslenica bridge



- MM5 shows relatively good agreement during the first 2 days
- able to reproduce short minimum but exaggerated variability
- predicted end of bura half day too late

MASLENICA BRIDGE 2 (DA)

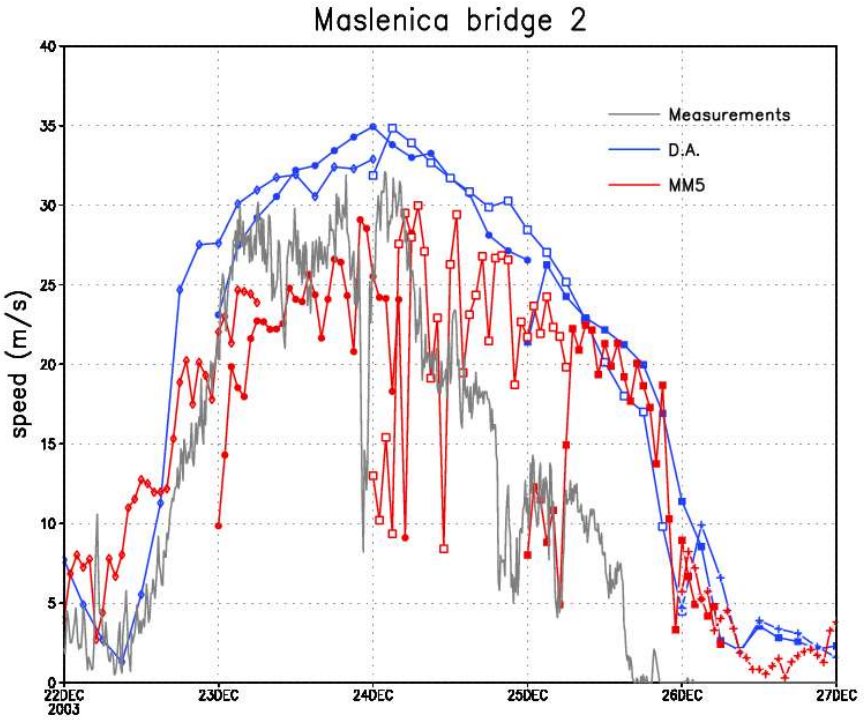
- located at the eastern side of Maslenica bridge



- overestimates observed wind speeds
- unable to reproduce temporal variability of bura on this location
- predicted end of bura half day too late

MASLENICA BRIDGE 2 (DA+MM5)

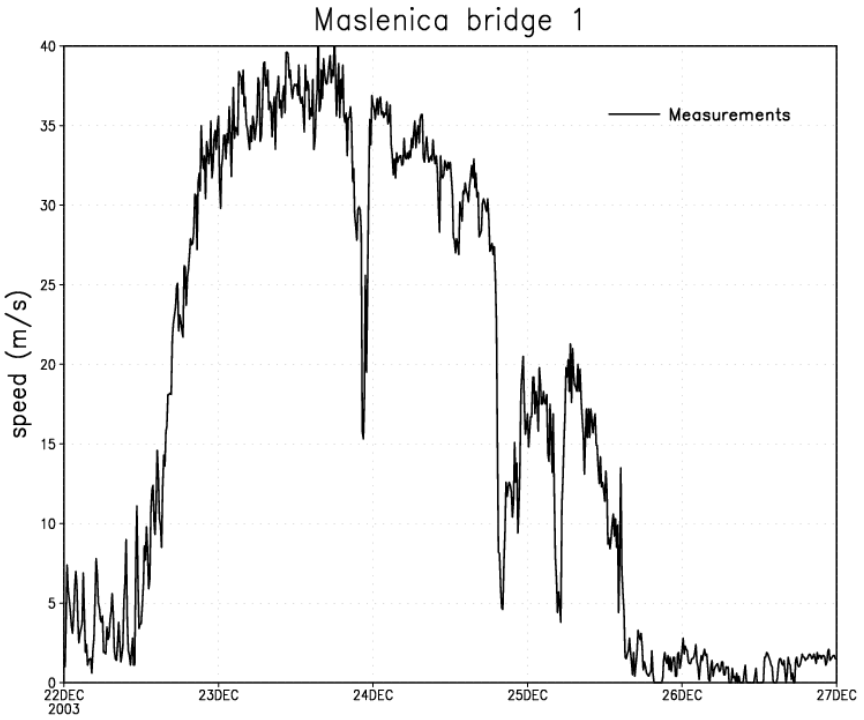
- located at the eastern side of Maslenica bridge



- MM5 in better agreement with observations but with lot of noise

MASLENICA BRIDGE 1

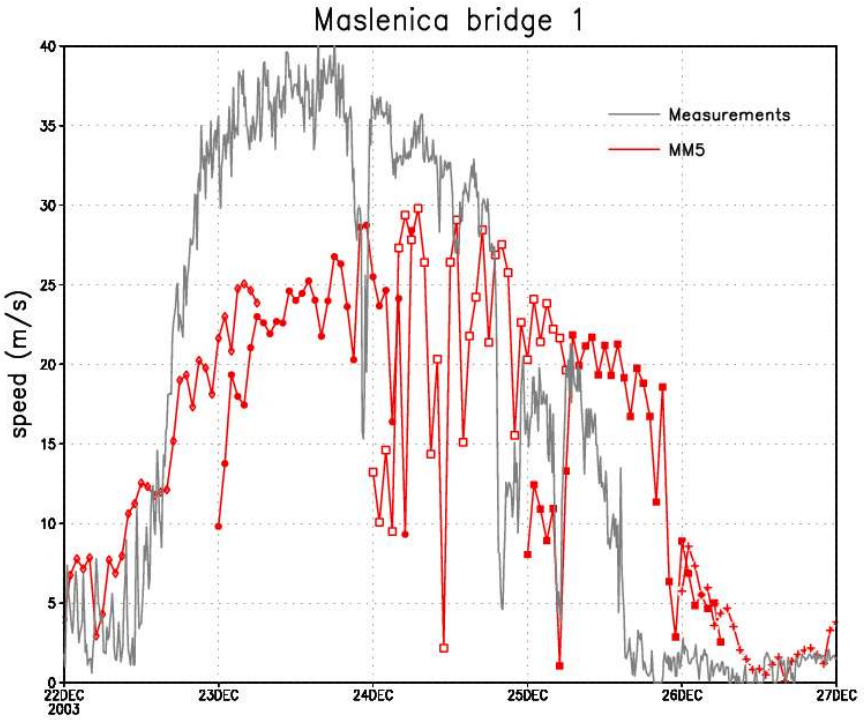
- located at the western side of Maslenica bridge



- the greatest wind speeds
- different from all the other stations

MASLENICA BRIDGE 1 (MM5)

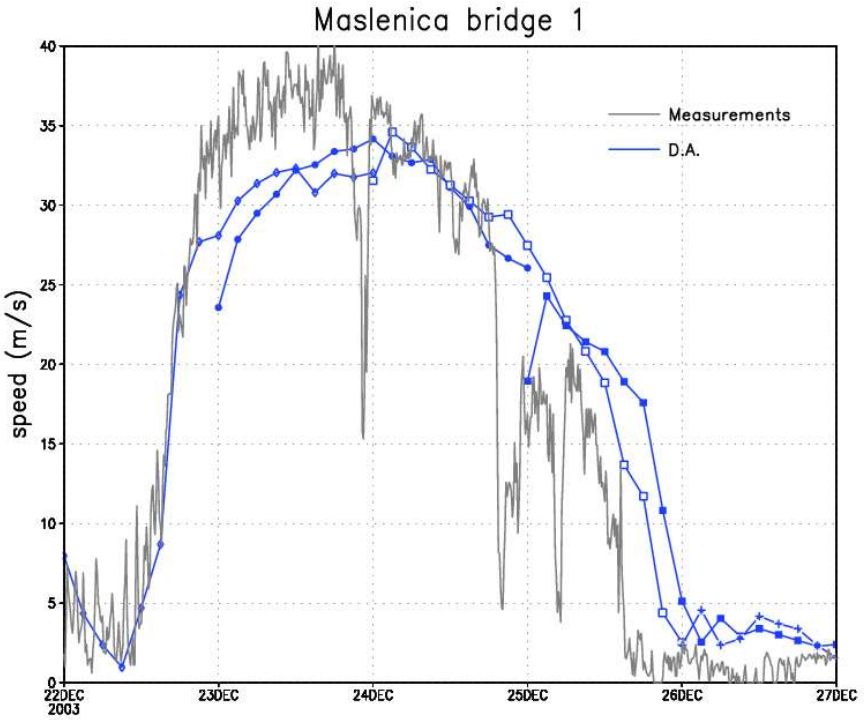
- located at the western side of Maslenica bridge



- MM5 significantly underestimates observed wind speeds
- maximum located 24h too late, 12 m/s too low

MASLENICA BRIDGE 1 (DA)

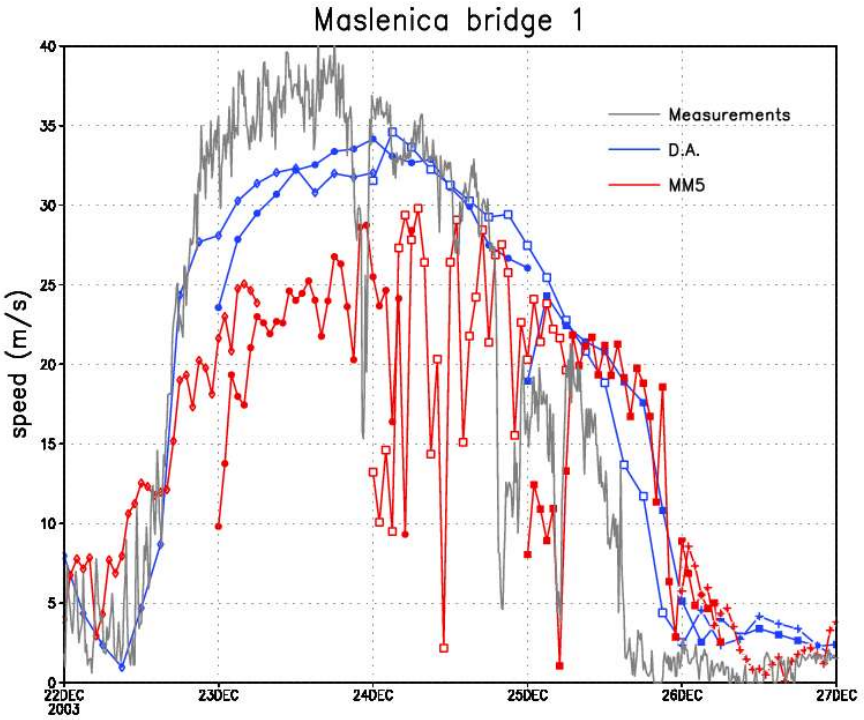
- located at the western side of Maslenica bridge



- closely resembles temporal evolution of bura except for the lack of short episodes of low wind speeds
- underestimates the bura maximum by 8 m/s

MASLENICA BRIDGE 1 (MM5+DA)

- located at the western side of Maslenica bridge



- DA in better agreement with the observations

CONCLUSIONS

- both models are unable to resolve small scale features of bura flow
- MM5 is able to reproduce two different flow regimes
- MM5 significantly underestimates observed wind speeds at Maslenica bridge 1
- DA overestimates wind speeds at all stations except Maslenica bridge 1
- DA is unable to reproduce different flow regimes

CONCLUSIONS (2)

- DA is a very good tool for predicting maximum wind speeds that occur in bura for operational NWP purposes
- for the research of the properties of bura flow a high resolution nonhydrostatic model is needed
- for bura grid size matters

Thank you (for not falling to sleep) !