EVALUATION OF KINEMATIC VERTICAL EDDY FLUXES FOR MULTIPLE WINTER BORA EVENTS

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GOALS

- vertical kinematic eddy momentum and heat fluxes haven't been yet obtained for the bora wind event (downslope windstorm, east Adriatic coast)
- estimation of the averaging interval based on the gap in the wind velocity spectra
- initial assumption: all three eddy fluxes ($\overline{u'w'}$, $\overline{v'w'}$, $\overline{w'T'}$) are nearly constant with height; however, results show the opposite (especially for momentum fluxes)

DATA AND BORA CRITERIA

- the measurements used from 1 Jan – 31 Mar 2011
- site of Pometeno brdo (600 m ASL) on the eastern mid-Adriatic coast (*Fig.1.*)
- WindMaster Pro ultrasonic anemometers (5 Hz sampling rate) -> u,v,w,T @ {10,20,40}m AGL

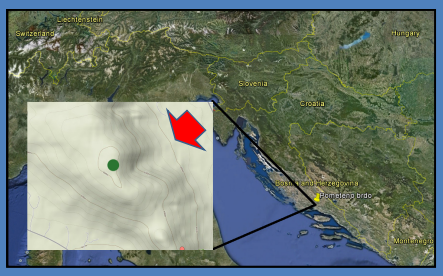

Fig.1. Site of Pometeno brdo: zoomed picture shows terrain and orientation of the hill relative to the mean bora direction (red arrow). Green circle denotes the position of the tower with anemometers.

- Total horizontal speed ≥ 4.5 ms^{-1}
- Wind direction ϵ [25°, 85°]
- Duration ≥ 10 h
- 17 bora events registered, ranging from 10 up to 123 h in duration (cummulative duration = 539 h) (*Fig.2.*)

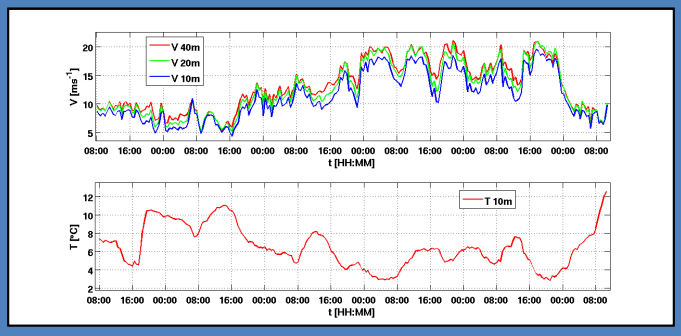

Fig.2. Total horizontal wind speed (all heights) and sonic temperature @ 10 m (10-min averages) for the longest registered bora event (123 h), blowing from 21 Feb, 8:15 to 26 Feb, 11:15.

REYNOLDS' AVERAGING INTERVAL

- Based on *Fig.3.*, an averaging interval of *15 min* is used in further calculations (primarily to define turbulent perturbations u',v',w',T')

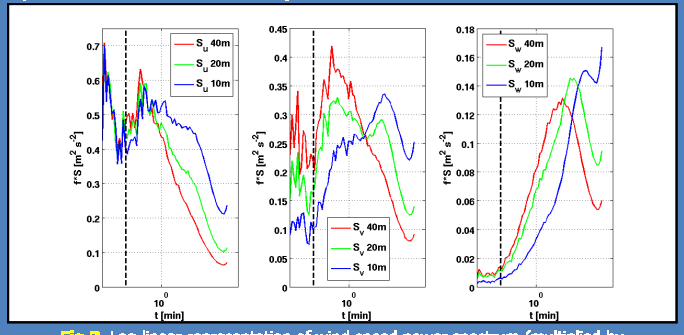

Fig.3. Log-linear representation of wind speed power spectrum (multiplied by frequency), averaged across all 17 bora events. Left to right: u,v,w spectra @ all three heights, respectively. Dashed line indicates averaging interval of 15 min.

FLUX ANALYSIS

- all 17 bora events have been classified into three groups based on length (short (10), semi-long(6) and long(1))
- eddy fluxes are initially assumed to be constant within 20% at two mid-levels (15 and 30 m), according to

$$K_{15} = \left|\frac{flux_{20}-flux_{10}}{flux_{10}}\right| \leq 0.2 \ , \ K_{30} = \left|\frac{flux_{40}-flux_{20}}{flux_{20}}\right| \leq 0.2 \quad (1)$$

%	$\overline{u'w'}_{15}$	$\overline{u'w'}_{30}$	$\overline{v'w'}_{15}$	$\overline{v'w'}_{30}$	$\overline{w'T'}_{15}$	$\overline{w'T'}_{30}$
short	25	25	8	22	18	48
semi	24	21	8	12	17	39
long	20	24	2	20	12	36

Tab.1. Percentage values for all fluxes on both mid-levels (averaged across all events in a particular group), which satisfy the condition in (1).

- very similar flux behavior has been observed across all events, hence a case study of only the longest and most complex event (123 h) is conducted

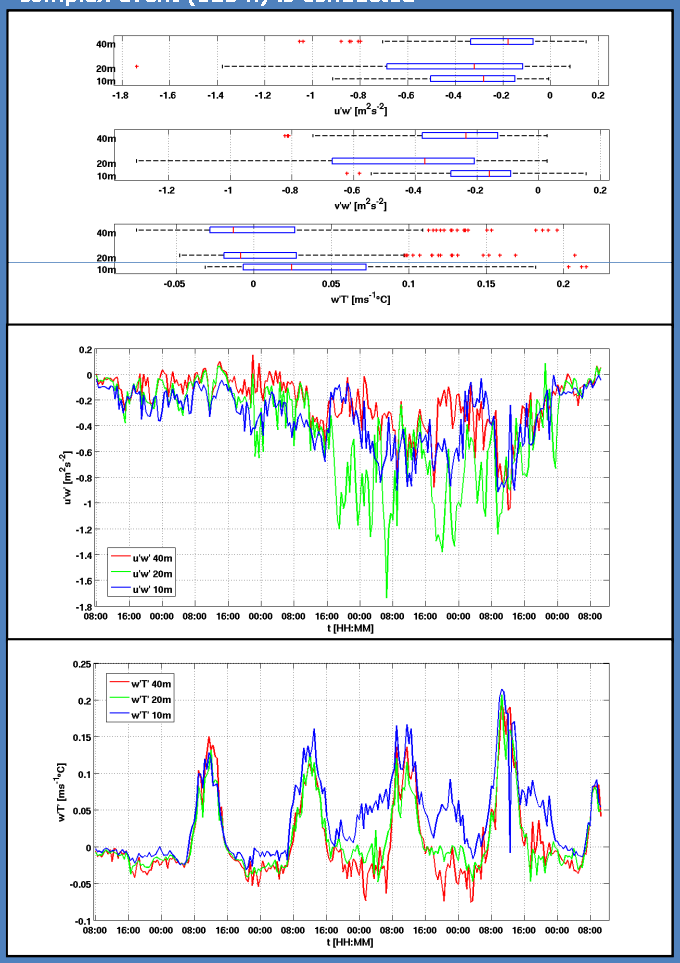

Fig.4. Top to bottom: box-plots of all three fluxes; 30-min blocks of $\overline{u'w'}$; 30-min blocks of $\overline{w'T'}$. Momentum flux $\overline{v'w'}$ shows similar behavior as $\overline{u'w'}$ (not shown).

CONCLUSION

- crucial in explaining the observed momentum flux behavior is the S_w spectra @ 20 m (*Fig.3.*, rightmost panel) and the fact that the area under the graph (which is proportional to the variance, i.e. energy) is the largest exactly @ 20 m
- heat flux (*Fig.4.*) shows rather weak variability with height (except during night, where some upward heat transport, typical for daytime, still occurs)

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