

*Supplement of*

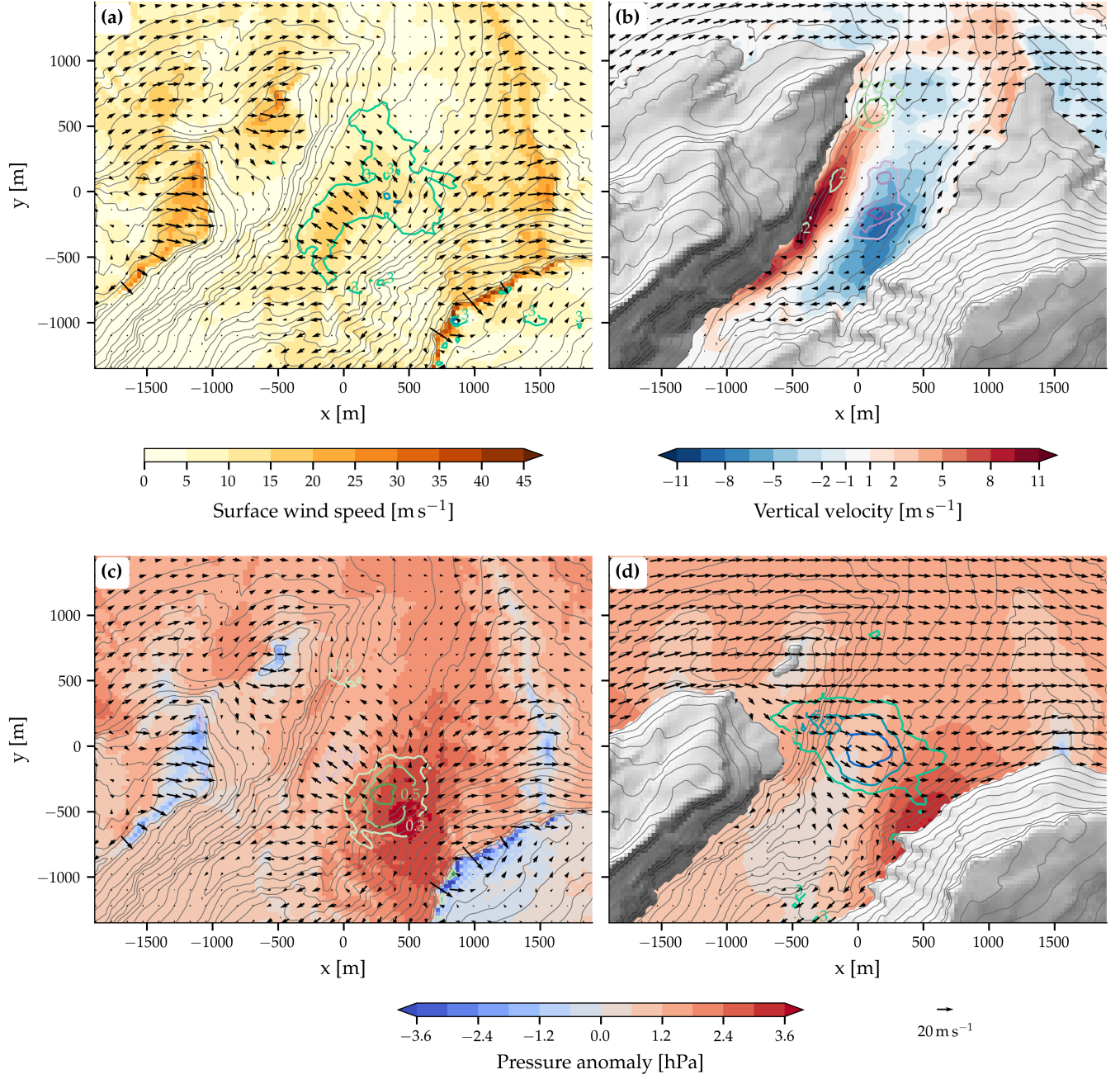
# **Revealing the dynamics of a local Alpine windstorm using large-eddy simulations**

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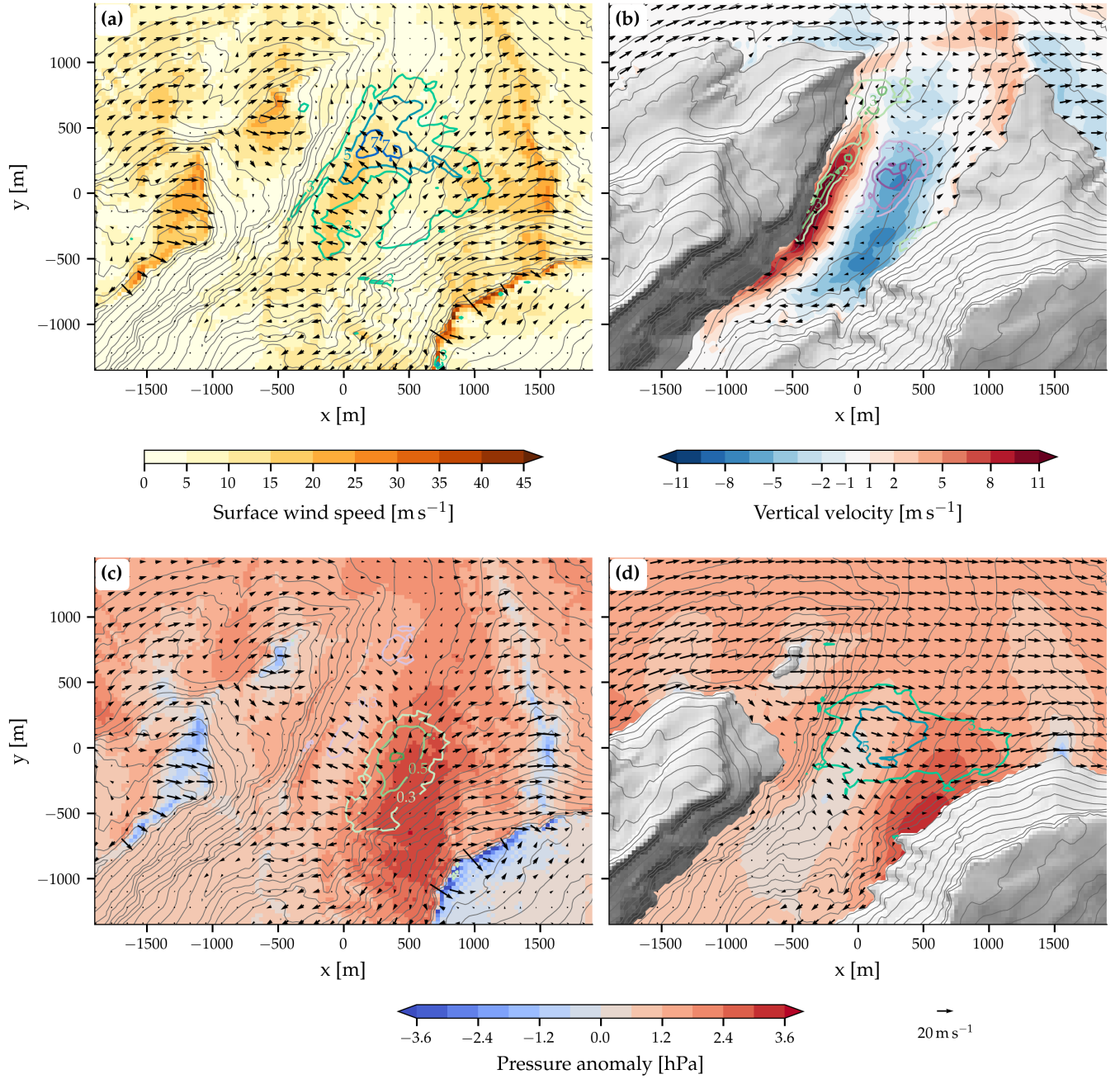
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## S1 Lagged gust composites

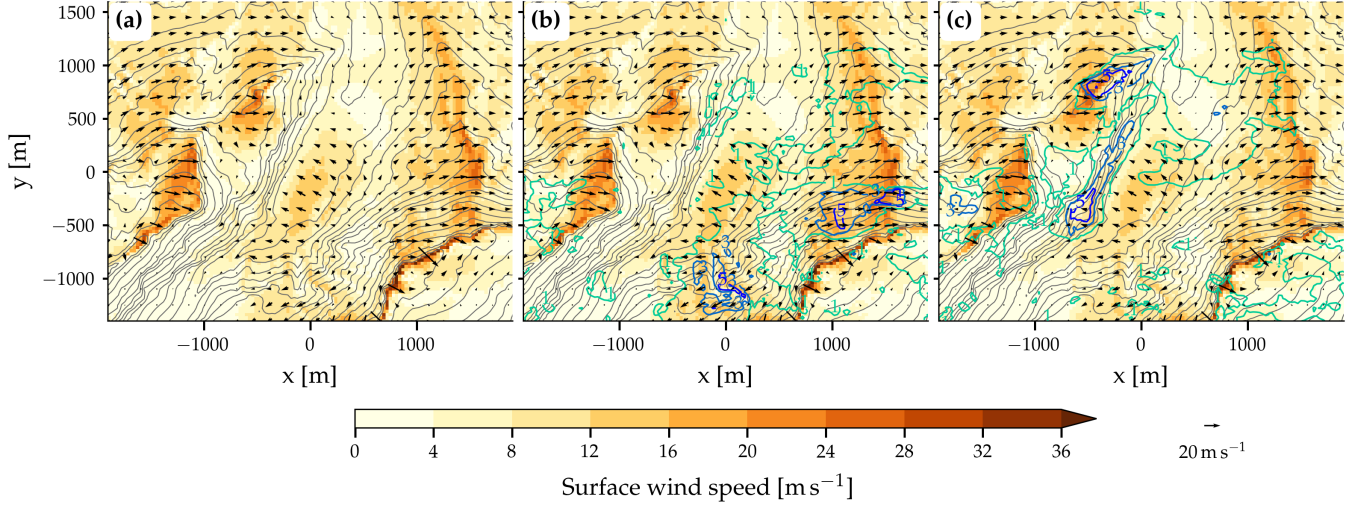


**Figure S1:** Laseyer gust composite with a lag of  $-30$  s relative to the gust peak. Shown are (a) surface wind, (b) vertical wind at an altitude of 1050 m, (c) surface pressure anomaly, and (d) pressure anomaly at an altitude of 1250 m. The pressure anomalies in (c,d) are calculated relative to a geostrophic flow over flat terrain. Grey shading and grey lines (interval is 50 m) indicate the height of the topography and coloured lines the deviation of the gust composite from the simulation mean. Note that in (d), the coloured lines depict the deviation of the wind speed (and not the pressure anomaly) in the gust composite from the simulation mean.

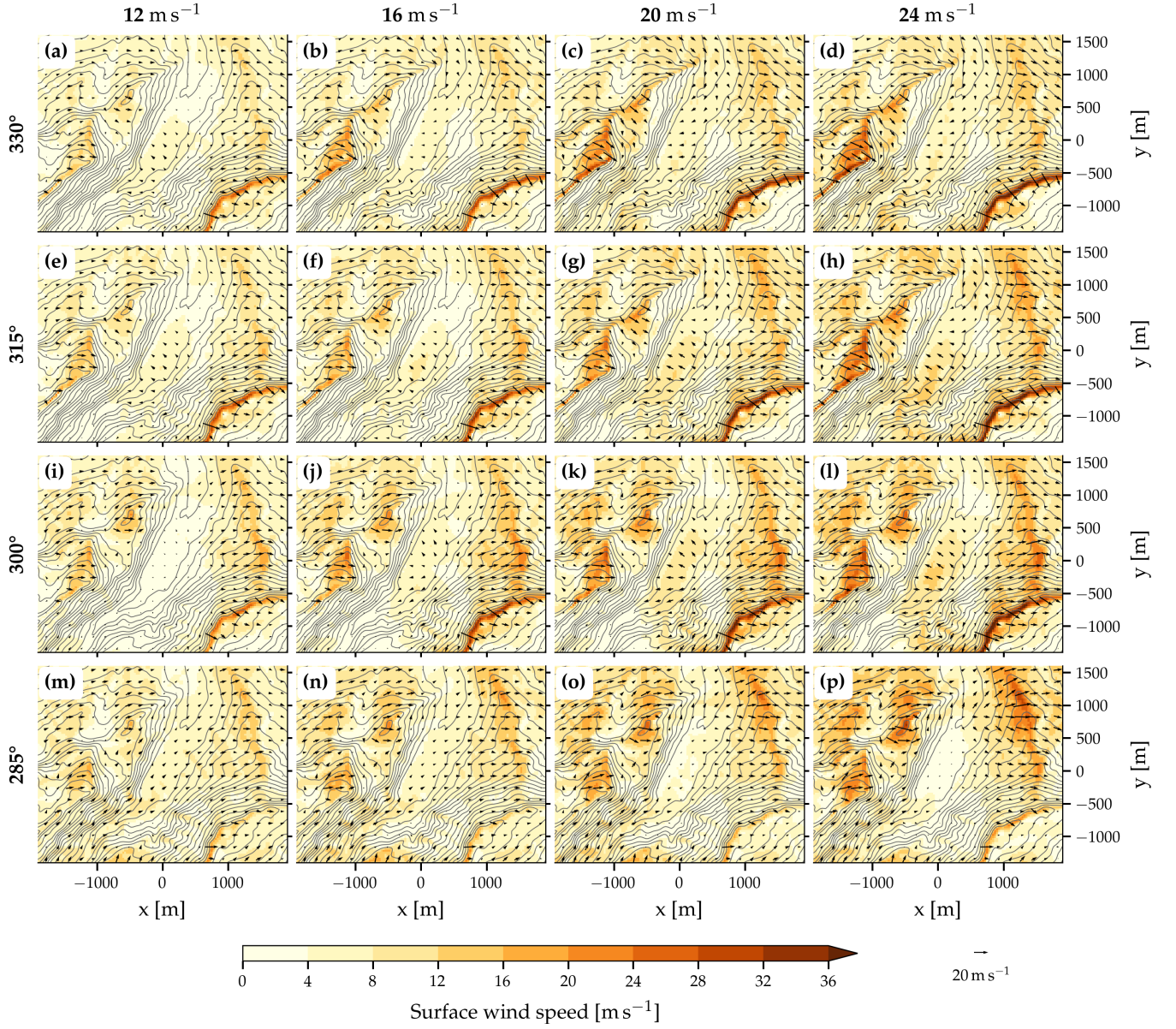


**Figure S2:** Laseyer gust composite with a lag of 30 s relative to the gust peak. Shading and lines as in Fig. S1

## S2 Sensitivity to surface characteristics and ambient flow conditions



**Figure S3:** Sensitivity of the mean surface wind to changes in the roughness length. Shown are simulations with an ambient wind speed of  $20 \text{ m s}^{-1}$  from  $300^\circ$  with (a) the default roughness length field, (b) the forest on the downstream mountain replaced by grass (areas A and B in Fig. 2b), and (c) the forest on the upstream mountain replaced by grass (area C in Fig. 2b). The coloured lines show the difference (magnitude of wind difference vector of 1, 3, and  $5 \text{ m s}^{-1}$ ) compared to the mean of the simulation in (a) and the grey lines indicate the height of the topography (interval is 50 m).



**Figure S4:** Sensitivity of the mean surface wind (arrows, colour shaded for wind speed) to different ambient wind speeds and directions. Presented are simulations with an ambient wind speed of (a,e,i,m)  $12 \text{ m s}^{-1}$ , (b,f,j,n)  $16 \text{ m s}^{-1}$ , (c,g,k,o)  $20 \text{ m s}^{-1}$ , and (d,h,l,p)  $24 \text{ m s}^{-1}$  and ambient wind direction of (a-d)  $330^\circ$ , (e-h)  $315^\circ$ , (i-l)  $300^\circ$ , and (m-p)  $285^\circ$ . The grey lines indicate the height of the topography (interval is 50 m).