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The vertical structure and variability of the meso-scale motion field in the trades

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We use measurements from the *Elucidating the role of clouds-circulation coupling in climate* (EUREC^{4}A) campaign to characterise the variability in the meso-scale divergence and vertical motion (pressure velocity, □□) ranging across time-scales from a few hours to a month (the entire campaign period from 19th January - 15th February, 2020). The area-averaged divergence is estimated using measurements of horizontal winds from dropsondes launched in a circular flight path (~200 km diameter), something that was carried out extensively during EUREC^{4}A – 85 circles over 19 flight-days in the North Atlantic trade-wind region.

From these estimates, we characterise the vertical structure and variability of divergence and □□ in the trades. We find that □□ above the sub-cloud layer is quite consistent vertically when averaged over long periods. The value stays around 1-1.5 hPa/h, which agrees well with the roughly 1.5 K/day cooling rate of the trades. However, significant intra- and inter-day variability can be found between □□ profiles, in terms of the magnitudes, ranging from -7 hPa/h to 6 hPa/h as well as in terms of the vertical structure of these profiles. Daily mean sub-cloud layer divergence varies significantly from that of the cloud-layer in magnitude, and for most flight days, we also observe a sign change between the two. Changes in the vertical structure over different days suggest that a local maximum of either divergence or convergence is usually seen near the inversion layer. Our findings can provide insight into how the atmospheric state varies over short time-scales, as well as their impact on cloudiness, thus providing clues about a predominantly important question in climate science — the clouds-circulation coupling.