

Notes on frontal statistics

September 27, 2022

1 Statistics from a Gulf Stream simulation (without waves)

We check here the relation between vorticity, strain, vertical velocity, divergence, and other frontal quantities (buoyancy gradient and frontogenetic tendency). The aim is to check that we recover expected relations close to the surface – that frontal region (strain dominated region - with cyclonic vorticity) are linked to negative divergence and negative velocity close to the surface – and investigate what happens at depth.

2 Statistics from LatMix)

Data from the Latmix cruise (Shcherbina *et al.*, 2013), from March 2012, can be used to estimate velocity gradients in the region south of the Gulf Stream. Latmix data come from 2 different adcps, a 300 kHz one, measuring down to 85 m and a 75 kHz, measuring down to 574 m. Sections are shown in Fig. 6.

2.1 Differences between ADCPs?

Data from the 75 kHz adcp seem slightly noisier than the others. But the comparison is better once data are binned/averaged in the vertical (Fig. 9).

References

SHCHERBINA, A.Y., D'ASARO, E.A., LEE, C.M., KLYMAK, J.M., MOLEMAKER, M.J. & MCWILLIAMS, J.C. 2013 Statistics of vertical

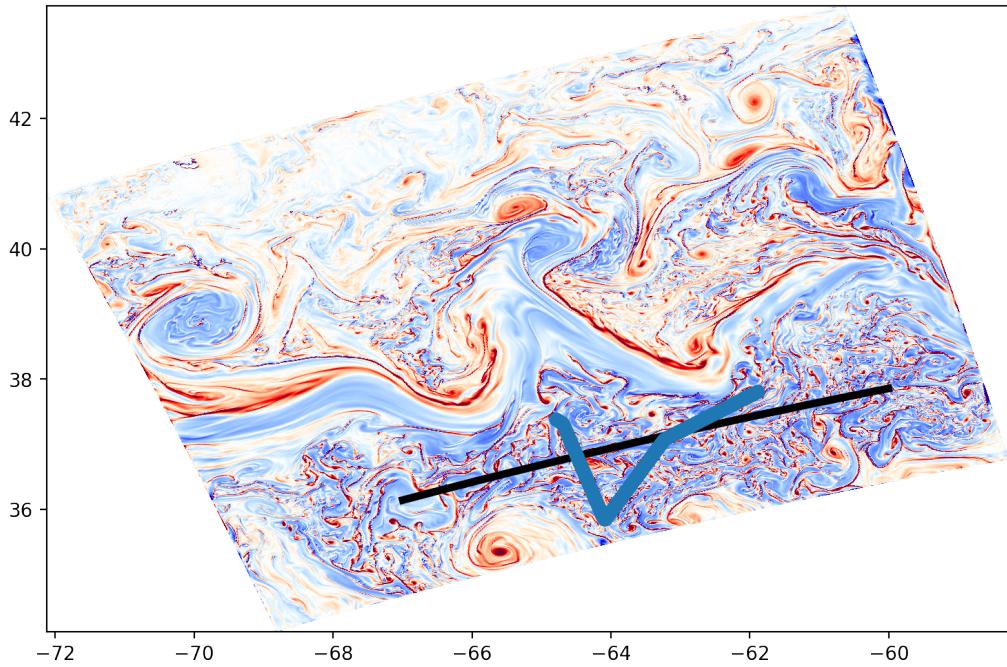


Figure 1: Surface relative vorticity from a ROMS 500-m simulation. This simulation uses climatological forcings, with daily winds and not tides. The Latmix track is shown in blue.

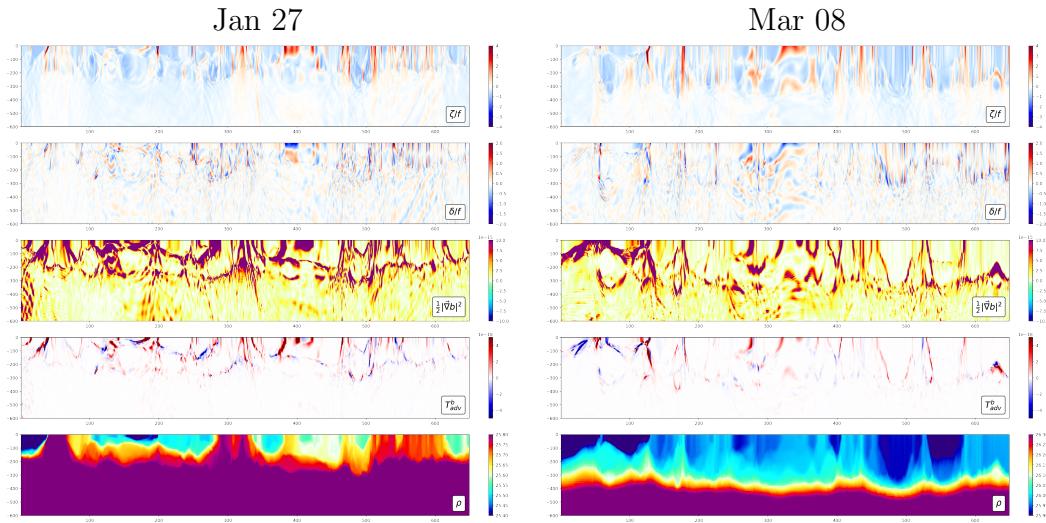


Figure 2: Example vertical sections at 2 different times (see black line in Fig. 9

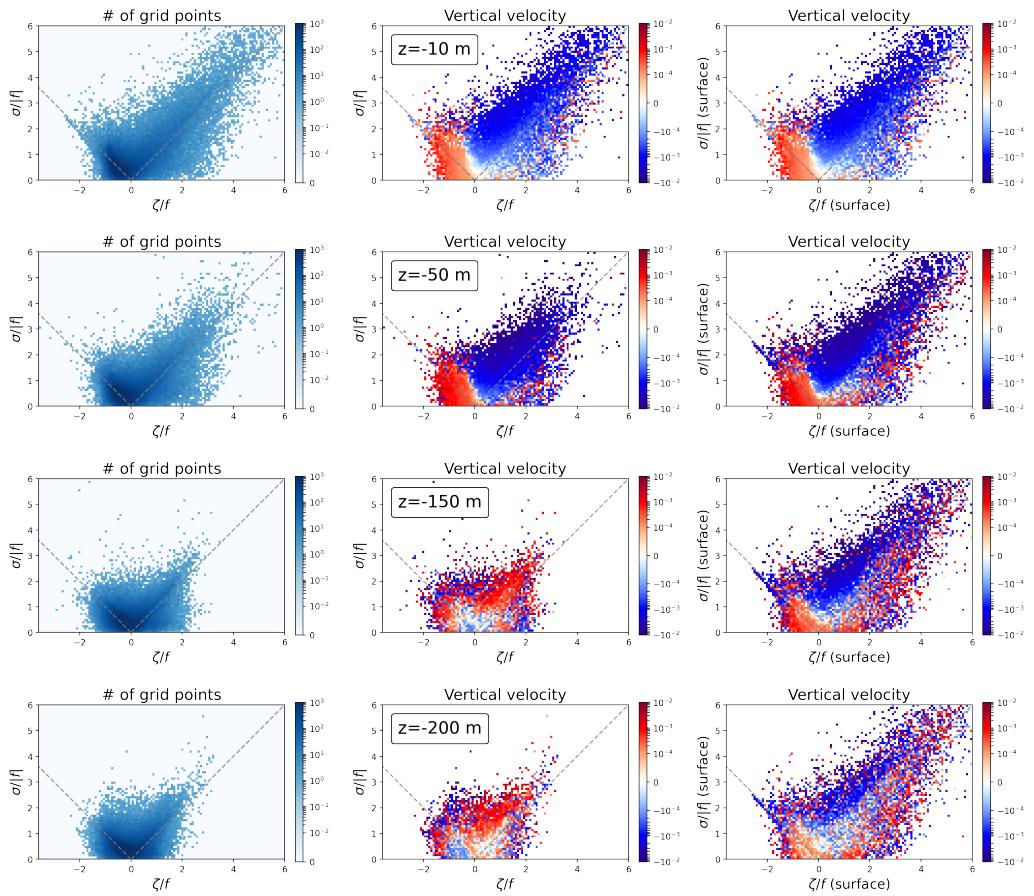


Figure 3: density of points (left) and Vertical velocity (middle) in the vorticity/strain space at different depths. The right column is similar to the middle one, except that vorticity and strain are computed at the surface.

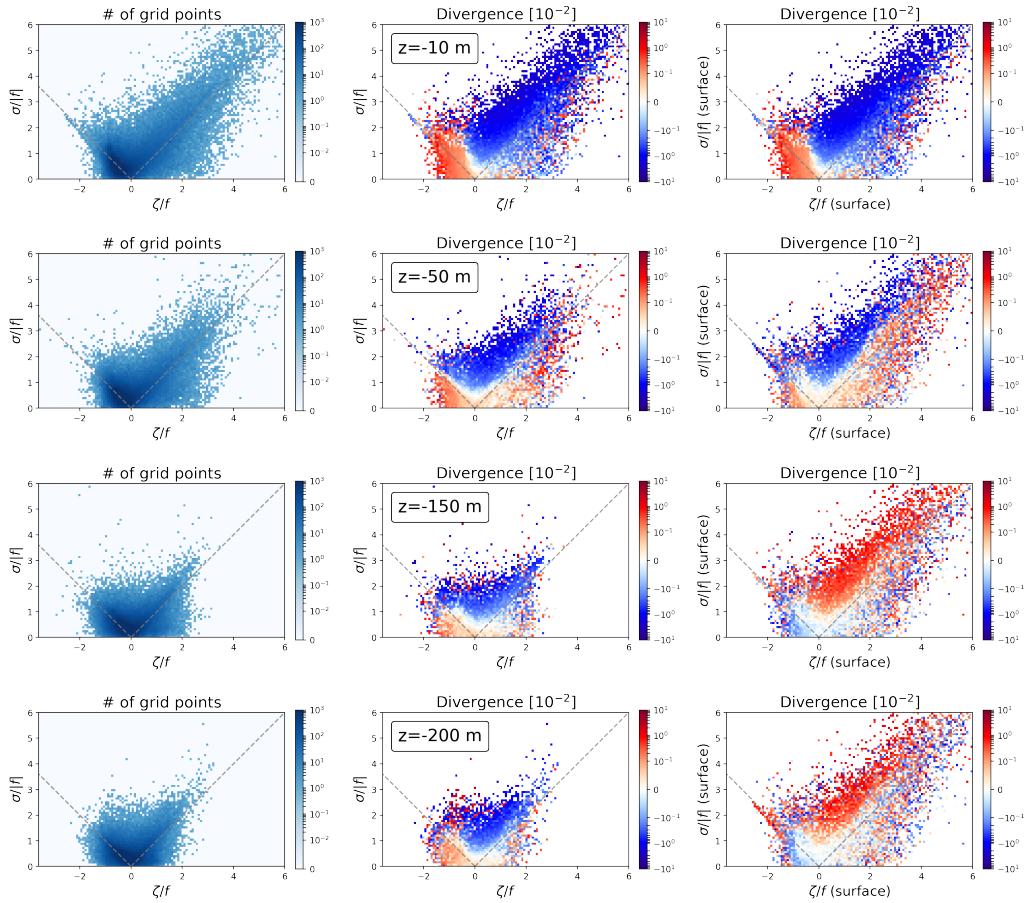


Figure 4: density of points (left) and divergence (middle) in the vorticity/strain space at different depths. The right column is similar to the middle one, except that vorticity and strain are computed at the surface.i

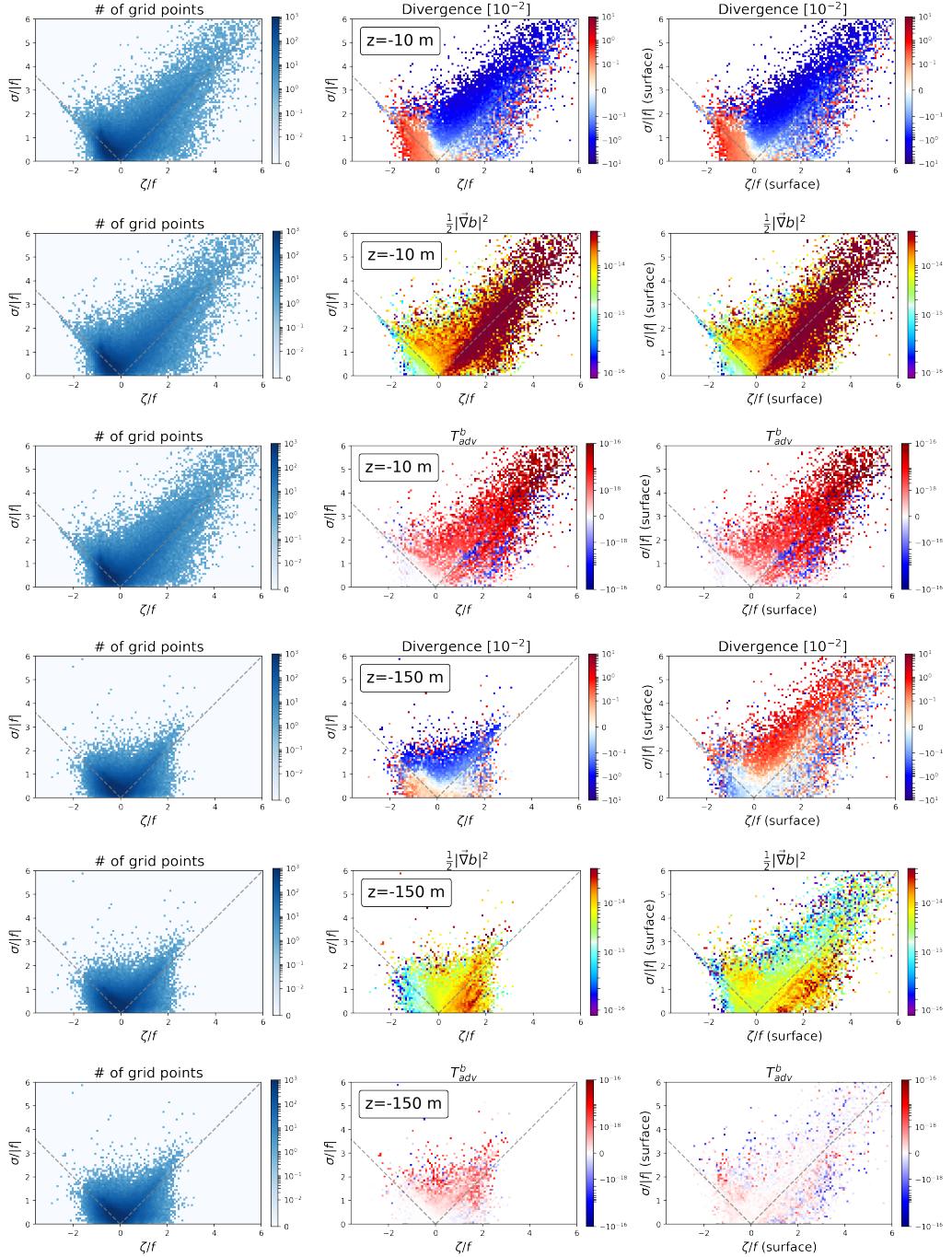
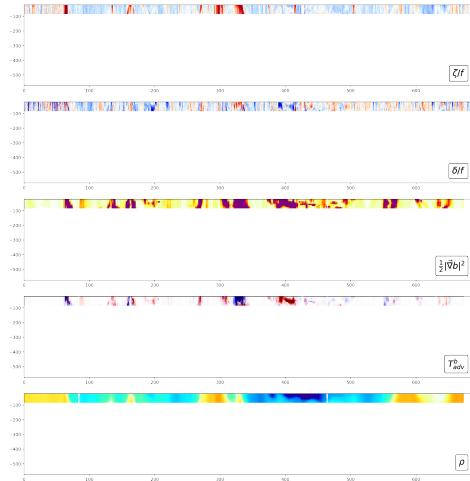


Figure 5: density of points (left) and divergence (middle) in the vorticity/s-train space at different depths. The right column is similar to the middle one, except that vorticity and strain are computed at the surface.

adcp 300 kHz



adcp 75 kHz

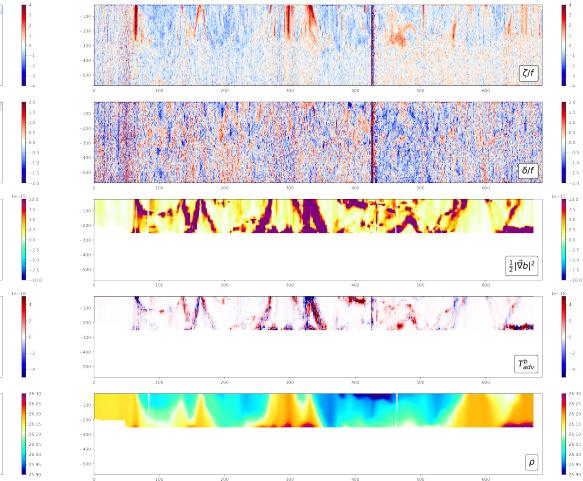


Figure 6: .

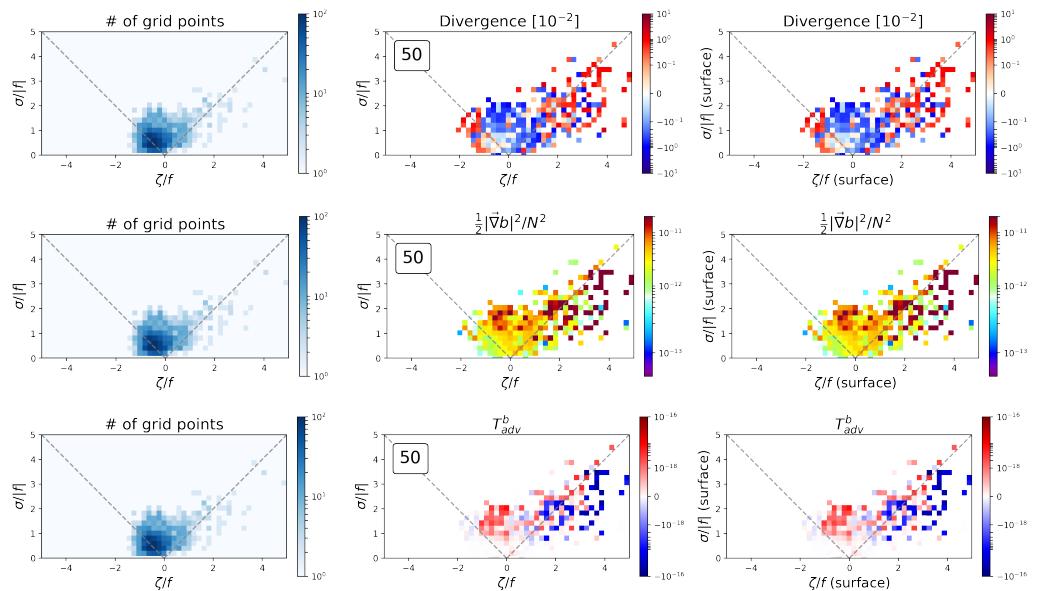


Figure 7: Statistics from vertically averaged velocity gradients computed from the 300 kHz adcp

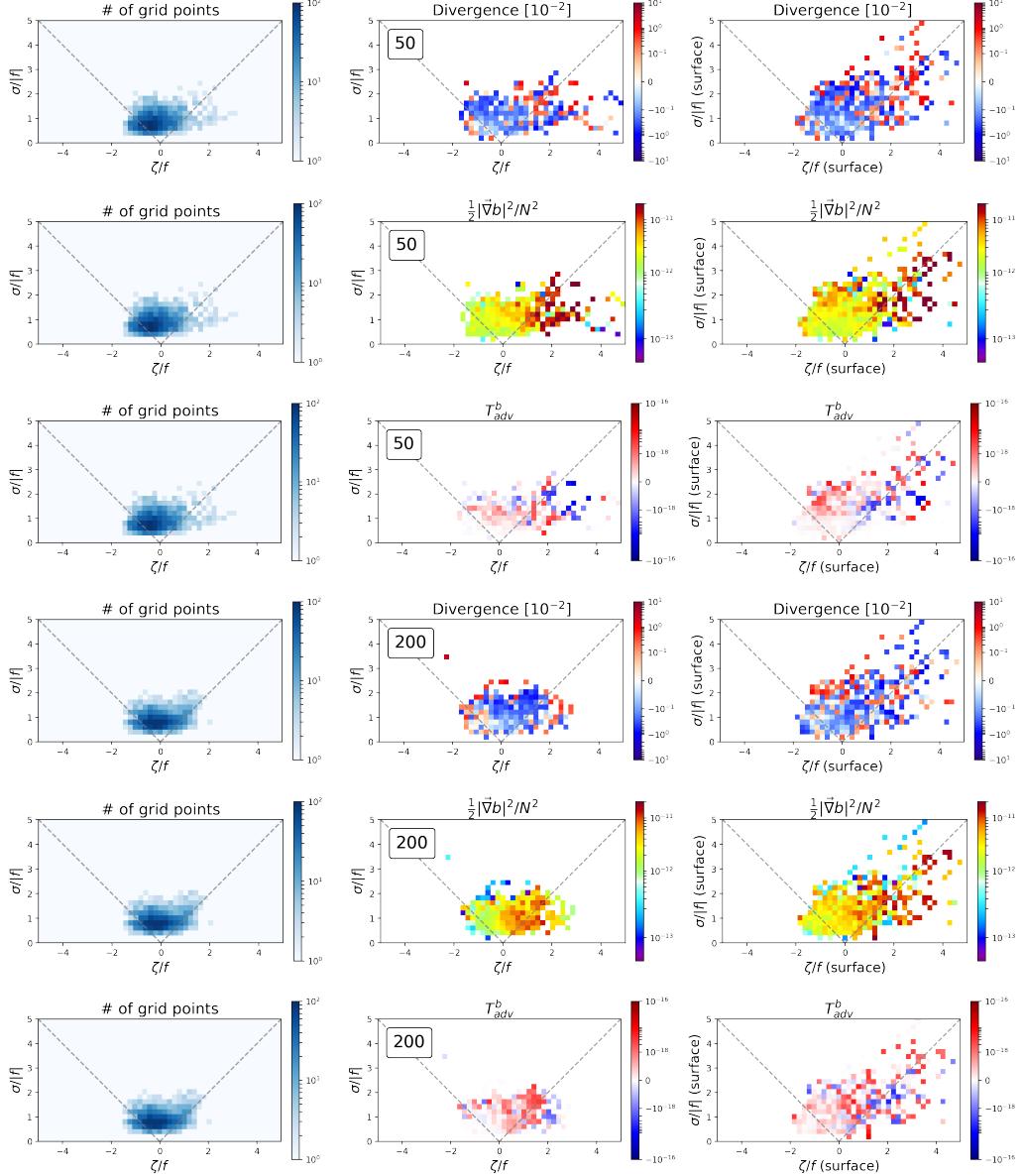


Figure 8: Statistics from vertically averaged velocity gradients computed from the 75 kHz adcp

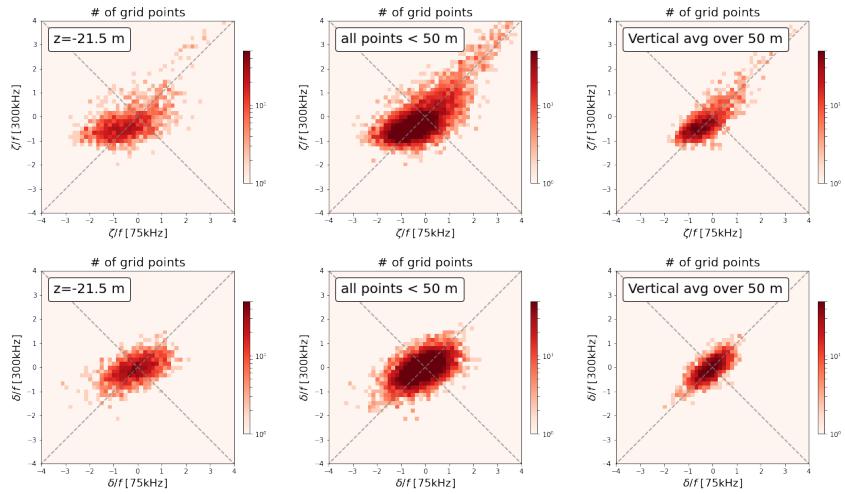


Figure 9:

vorticity, divergence, and strain in a developed submesoscale turbulence field. *Geophys. Res. Lett.* **40**.