

Interactive comment on “Departure from K -theory in the planetary boundary layer” by Pedro Santos et al.

Anonymous Referee #2

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The manuscript examines the turning of the wind with height in the atmospheric boundary layer over land and sea, in relation to the angle α between the stress vector and the mean wind direction, and the angle β between the stress vector and the vertical gradient of the mean velocity vector. Processed data from Doppler Lidar measurements are presented at two sites, one located over land near Hamburg, Germany, and one located over sea, offshore in the North Sea at the FINO3 research platform. The data show that β is approximately between -20° and -10° in the range 100–500 m above the surface for those two sites. When averaged over this range, β is somewhat larger at the site over sea (-18°) than at that over land (-12°).

This range of values for β over land near Hamburg, reported in the present manuscript, is consistent with that reported over land at the Høvsøre measurement site in Denmark

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by Berg et al. (2013), though larger values were reported at the latter site. The very same data for the offshore site had already been presented by Santos et al. (2020) and large parts of the present manuscript are paraphrasing/plagiarising the work by Santos et al. (2020). The present manuscript does not offer any additional insight in relation to the observed values of β (and α). How do we explain that they vary from site to site the way they do?

The manuscript correctly points out that the often-used flux–gradient relationship, whereby the stress vector is proportional to the vertical gradient of the mean velocity vector through a turbulent eddy viscosity, leads to $\beta = 0$. Yet, the manuscript presents a comparison of the observed values of β to those simulated with models using such a formulation. Not surprisingly, the simulated values of β are close to zero and the agreement with the counterpart observed values is very poor. The present manuscript does not offer any additional insight in relation to the simulated values of β (and α). How do we explain that they vary from site to site the way they do?

What is to be learnt from the manuscript? The manuscript needs substantial, significant work so as to be make a contribution to scientific progress. I suggest not to further proceed with its consideration for publication in a journal in the current form.

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