Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-346-RC1, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "Spectroscopic Imaging of Sub-Kilometer Spatial Structure in Lower Tropospheric Water Vapor" *by* David R. Thompson et al.

Anonymous Referee #1

Received and published: 21 September 2020

General comments

This manuscript presents spatially highly resolved two-dimensional AVIRIS-NG spectrometer measurements of the tropical water vapor column over the Bay of Bengal. Focus of this case study is to quantify the water vapor variability using second-order structure functions. The paper is suitable for AMT as it presents an innovative methodical approach to quantify the variability. I have three general comments.

First, unfortunately, the presented data set is very small. It only covers four about 9x2km large rectangular domains on two different days. I understand that these represent the best available high-resolution measurements over water. But still, this is

Printer-friendly version

Discussion paper

disappointing. How nice would it be to have a complementing example over land, or over a land-sea interface, or in a different climate zone, etc., even if the data were a little noisier. Please explain why your data set is so small, or show more.

Second, these few data, displayed in Figures 5 to 7, lack more explanation and description. Figures 5 and 6 show irregular patterns of water vapor column variability that could be related to turbulent processes in the boundary layer or at its top, but additional data and explanations on the meteorological conditions are lacking. Do we see eddies in the boundary layer, undulations of its top height, or features above, or a mixture of all? How would you interpret this variability? What are the underlying physical processes? For illustration, even already a photo out of the aircraft window could help set the scene a little. But it would be good to show more useful auxiliary data.

Third, I am lacking some discussion on possible implications due to the issue that the vertical water vapor distribution may be complex. The missing vertical resolution may lead to a superposition in the column between different atmospheric regimes, such as convective and non-convective, or boundary-layer and free-troposphere, blurring the variability in a particular layer and making the results in Figure 7 quite questionable. It is clear that most of the column is from the lower troposphere, but you should be more precise on this issue. How likely is it that variability in the mid- to upper troposphere is superposed to the lower troposphere patterns? At least, you should use a tropical humidity profile to show how much contribution to the column comes from the different layers.

Specific comments

Line 2: “total atmospheric column wv” but the title says “. . . Lower Tropospheric WV”, better make it more homogeneous. This issue is related to my third general comment above, that some discussion on the vertical wv distribution is missing.

Line 62, “at the finest scales, small sample sizes can increase uncertainty. . .”: usually, spectra and structure functions provide lowest uncertainties at the small scales due to

high sampling. This sounds like a contradiction. Furthermore, I do not see a relation with the sentence before on one-dim versus two-dim observations. Please explain.

Line 117, “tens or hundreds of meters”: this is much too small, you probably mean “tens or hundreds of km”?

Line 130, “the spatial footprint projected on the ground is not radially symmetric; it is long and thin”: this may entail issues with spatially oriented wv structures, you may want to comment on this?

Table 1: an extra column giving the length of the flight line in km would be fine.

Figure 6: make a white box in Fig 5 to show the location of Fig 6.

Technical corrections

Line 252, “pathological effects”, better “issues”

Caption of Fig 5: “A white arrow in B indicates. . .”

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-346, 2020.

Printer-friendly version

Discussion paper