

Small scale variability of water vapor in the atmosphere: implications for inter-comparison of data from different measuring systems

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This novel study presents a new methodology that demonstrates that the structure of water vapour concentrations at small scales (<6 km) can be approximated by Gaussian Random Fields (GRFs). The authors show that these GRFs have a spatial correlations with a structure function whose gradient is approximately $\frac{2}{3}$, which is consistent with Kolmogorov's theory of turbulence. This new methodology is applied to numerical weather forecasting (NWP) fields and a range of real observation systems with different spatial and temporal sampling, with the results discussed in the context of one another. Finally, the results are related to their potential use in Nowcasting.

Overall, I find this study highly relevant to current research and applications within NWP and Nowcasting. Therefore, I recommend this paper suitable for publication after the minor comments I have are addressed.

Specific Comments:

- page 2, line 2: reword the sentence "They measure over air regions of the order of linear measures of tens of kilometres." This doesn't read well, could change to something like: e.g. "These instruments measure air mass regions at scales of tens of kilometres."
- page 2, line 6: "mandatory" seems to be the wrong word, do you mean "necessary"?
- page 2, line 18: "below around 6 km", this doesn't read well and could replace around with ~.
- equation 10: does the vapour pressure "e" come in the radiosonde file or has it been calculated? If calculated, what vapour pressure formula was used? Is it consistent with what is used by GRUAN (Hyland and Wexler)? Please state this somewhere in the text.
- page 7, line 27-28: with the images you reference are they L1b files? the term "Level 1.5 ones" reads is a little non-specific. If the files are L1.5 are these fundamentally different to L1b? Therefore, maybe improve the description of the file contents and put "(L1.5)" at the end of the sentence.
- page 8, lines 24-27: This section needs restructuring, is confusing to someone who is not familiar with NWC SAF workflow. Is the software package the only package NWC SAF produces? A clearer description here is needed.

- page 9, line 7: “a slot” is not an appropriate term here or clear to what is meant. Do you mean a clear sky region? please improve.
- section 3.4: Is this ERA5? ERA Interim? or a specially run forecast at 0.125x0.125 deg run? Current IFS runs in ERA5 are available at 0.25x0.25, is this data just spatially interpolated? Please clarify and revise this section.
- Methods section: I think that this section could benefit from an algorithm flowchart to help the reader visualise the flow.
- page 12, line 13: replace the phrase “To get a feeling” with something more appropriate, e.g. “To produce a representation”
- section 4.2.3: are all the OLCI regions cloud free? not clear from the text.
- conclusions: Just needs a clear statement on the use or application to Nowcasting. This is done well in the abstract but not so strong here.