Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2020-227-RC2, 2020

Atmospheric Measurement Techniques Discussions

Interactive comment on "LiSBOA: LiDAR Statistical Barnes Objective Analysis for optimal design of LiDAR scans and retrieval of wind statistics. Part I: Theoretical framework" *by* Stefano Letizia et al.

Anonymous Referee #2

Received and published: 12 October 2020

This manuscript presents a new algorithm to retrieve wind speed and turbulence intensity from Doppler lidar measurements. The algorithm is based on Barnes objective analysis, which was developed to interpolate unevenly spaced observations of a scalar field over a regular grid. Here, this method is extended to 3D-fields, i.e. radial velocity from Doppler lidar. Furthermore, the new algorithm is used to optimise Doppler lidar scan strategy for optimal retrieval.

On the other hand, the algorithm requires substantial preliminary information about the flow in the area of interest as well as stationary conditions during the period when the

Printer-friendly version

Discussion paper

scans are conducted, which limits the use of the algorithm. Overall, I find this work within the scope of AMT, but there are several major issues that need to be addressed first.

Specific comments

1. Benefits of the new algorithm are not demonstrated. Synthetic data is used to show that this method can retrieve wind speed and turbulence intensity (defined as u'/U), but these parameters can be retrieved with much simpler methods and less previous information about the flow from Doppler lidar data. How much does the new algorithm improve the retrieval?

2. Can this method be used to retrieve information about turbulence in the inertial sub-range, or is it limited to the outer scale of the velocity spectrum?

3. Section 3. It seems that LiSBOA is validated with a velocity field (Fig. 1a), which I cannot imagine being ever observed in the atmosphere. Furthermore, the sampling appears to be completely random points, when a lidar would always observe radial velocity along line of sight, i.e. denser spacing of (radial) observations near the instrument. Is this assessment valid for atmospheric use of LiSBOA? Please consider using the LES data from Part II for the validation. Moving analysis of LES from Part II to Part I would also shorten Part II, which now has 31 figures.

4. L290: "Firstly, it is crucial to estimate the integral quantities of the flow under investigation required for the application of the LiSBOA, such as extension of the spatial domain of interest, characteristic length-scales, integral time-scale, characteristic temporal standard deviation of the velocity, and expected total sampling time, T, which depends on the typical duration of stationary boundary conditions over the domain." How sensitive is LiSBOA to uncertainty in these parameters? How strict is the requirement of stationary boundary conditions? I'm afraid that these requirements will become a severe limitation for the use of LiSBOA.

5. L327-329: “The angular resolution of the LiDAR scanning head, can be selected to modify the angular spacing between consecutive line-of-sights (i.e. the data spacing)” Do you propose to use the same spacing for both azimuth and elevation angles? Or use only one PPI scan? Please include both angles in the optimization process.

6. It seems that instrumental noise is not considered in the algorithm. What is suitable instrumental uncertainty in radial velocity for use in LiSBOA? This is vital information for scan design as sampling time per profile and/or gate length may need to be increased to cover the full area of interest with strong enough signal.

7. Fig. 7. Thank you for the diagram. Please also provide code for the optimisation process using these inputs.

8.L395 The code is not available where stated. Please include the code as supplementary information so that a copy is permanently archived.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2020-227, 2020.

Printer-friendly version

Discussion paper