Reply to reviewer's comments on the paper

'VAHCOLI, a new concept for lidars: technical setup, science applications, and first measurements'

submitted to AMT by Franz-Josef Lübken and Josef Höffner

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Reviewer #3:

We appreciate the encouraging and positive comments from the reviewer. We have taken the suggestions for improvements into account when preparing the revised version of the manuscript. We have marked the changes and respond to the reviewer's comments point by point in the following. In this response we repeat the reviewer's comments in blue, put our comments in green, and mark the modified version of the text in the manuscript in red. We have polished the text somewhat with the help of a native english speaker (shown in cyan in the manuscript).

„The paper presents the development and first implementation of a lidar system that has the potential to transform observations of the middle atmosphere. The development of these compact and robust wind solid-state wind-temperature capable lidars is a significant technical achievement in itself. Combining precision resonance lidar techniques with Rayleigh and Mie techniques to yield winds and temperature in the troposphere, stratosphere, mesosphere, and lower thermosphere. The fact that these instruments are field deployable as compact units (1 m) allows deployments of distributed arrays of profilers that will support a variety of new investigations of the middle atmosphere. The paper provides a technical description of the instrument as well as a discussion of investigations that will supported (e.g. waves versus large scale turbulence). "

Specific Technical Comments

1)+2) „The paper would benefit if some of the technical details were explained in greater detail, particularly in terms of the determination of the frequency stability of the seed laser and the confocal etalon using the Doppler-free spectroscopy (Figure 5). Does the locking use the Pound-Drever-Hall technique combined with the Doppler-free spectroscopy? What are the fundamental limitation of the tuning accuracy and precision based on the Doppler-free spectroscopy. How was the stability of the confocal resonator determined relative to that of the seed laser? The diagram of the lidar system could be presented in more detail as the schematic of record.

We understand the desire to learn more about instrumental details, in particular since several aspects are new to the lidar community. We note, however, that basically all components of VAHCOLI could be described in much more detail. This goes way beyond the scope of this paper and would, as we think, distract from the key point of this paper, namely to describe the principles of the technical subsystems and to give an overview of VAHCOLI and its atmospheric applications. Some subsystems have already been described in more detail in the literature (see, for example, references in the manuscript regarding the power laser) or will be published in the near term future. Following the request of the reviewer, we have expanded the description of the laser frequency control in this paper since this is fundamentally different from most lidars and is a key feature of VAHOCLI. The main point is that we do not stabilize the seeder laser (nor the power laser) to a single frequency (as is done in several other lidars) but instead use Doppler-free spectroscopy (DFS) to calibrate the frequency characteristics of the seeder laser (and thereby the power laser) when its frequency is tuned up and down. We hope that the added text (see below) helps to better understand the principle of frequency control of VAHCOLI.

„The individual peaks of the Doppler free spectrum serve as an absolute frequency calibration for the seeder laser which is tuned up and down in frequency and fed into the DFS system. Thereby the seeder laser frequency is known precisely (within a few kHz) as a function of time and is subsequently used to control the frequency of the power laser. The seeder laser also serves as a reference to lock a transmission peak of the confocal etalon. Note that this procedure implies that (different to other lidar systems) we do not lock the frequency of the seeder laser (nor the power laser) to a single frequency.“

3) „There are places where the the writing could be polished and made more concise.“

We have improved the text with the help of a native english speaking colleague.

Minor point

„The authors note that the lasers were trucked from Aachen to Kühlungsborn (600 km) without significant misalignment. Can they determine the relative contribution of the laser design, the driving skills of the shippers, and the quality of the autobahn conditions to this result?“

Unfortunately, it is not possible to address the various contributions to the magnitude and the cause of the vibrations. We did not make any attempt to measure or record the accelerations imposed to VAHOCLI during transport. However, we thank the reviewer for this comment and will make an attempt to quantitatively record the vibrations during the next shipment.