Answers to Reviewer 1

1. An article by Stoffelen et al. (Bull. Amer. Meteor. Soc., 101, 2020) on the requirements and capabilities of future satellite-borne wind observations was recently published. As the study, amongst others, discusses the way forward toward an operational wind profiling mission, its conclusions should also be considered and referenced in the present manuscript.

This reference will be included in the revised version of the manuscript and cited in the introduction.

2. In the entire paper and especially in the introduction, I am also missing a reference to the Optical Autocovariance Wind Lidar (OAWL) developed by Ball Aerospace (Tucker et al., J. Atmos. Ocean. Tech., 35, 2018), although the citation is included in the reference list. The OAWL instrument also relies on a quadrature Mach–Zehnder interferometer and thus represents a very similar concept as the one described in the manuscript. Therefore, I suggest expounding on the advantages and disadvantages of the proposed lidar design compared to the OAWL system.

The references will be added in the introduction. It is to be noticed that a reference on OAWL was cited in the text along with BP03 when the four-channel detection technique is introduced in section 3.2., this will be updated.

We believe that our all-prism design is, a priori, more stable than the free-space cat-eye design which depends on the mechanical stability of independent optical elements. Nevertheless it is difficult go further in this discussion without a careful comparison of the two systems which would be too long and out of the scope of our paper. The main differences between the OAWL and HSRD-LNG designs are discussed in section 3.2.

3. Page 5, line 152: Please clarify what is meant by off-axis MI interferometer. Otherwise many readers might be lost in the following section.

Better than trying an explanation that may be long and awkward, we will refer to Liu et al 2012 to introduce the off-axis (or tilted) MI.

4. Page 7, lines 202 ff.:

- The proposed design envisages the use of multimode fibers for guiding the signal and reference beams to the receiver. What is the expected signal loss introduced by the fibers? Do the authors expect speckle noise to be an issue for the measurement accuracy?

In the HSRD-LNG system, the transmission of the fiber arrangement, including the input and output lenses and the mode scrambler, is approximately 80% (added in section 3.1). The speckle noise is not an issue for the measurement accuracy, as the design is based on a large aperture and wide field of view. The receiver the number of spatial speckles Ms, defined as the ratio of the solid angle of the transmitted beam to the diffraction solid angle of the telescope is about 2.75 10^4. The number of temporal speckles Mt is around 500, due to the extended range gates. The total number of speckles M=Ms.Mt is then approximately 1.4 10^7. As the number N of collected photo-electrons per shot and range gate is on the order of 10^3, the speckle noise (given by the ratio N/M) is much smaller than 1, so that the noise variance is not modified. Note also that the fiber beam étendue is necessarily larger than the telescope beam étendue in order to accept the received beam with a substantial alignment margin. The maximum number of spatial speckle of the fiber (9 10^4) is then larger than Ms and does not limit the total number of speckle of the signal. This will be added in section 4.1.

- *How is the mode scrambler realized and what is its expected transmission based on the experience with the LNG?*

The beam scrambler principle is based on the fact that the near field (illumination distribution) at the fiber output, after a propagation of about 1m, is always uniform, whatever the light illumination at input (in the limits of the fiber beam acceptance). The mode scrambler arrangement consists in two lenses, the first lens images the output of the first fiber on the second lens while the second lens images the first lens aperture (not homogenously illuminated) on the second fiber. This way, the near and far fields at the output of the second fiber are uniform and fill the whole fiber beam étendue. A plate with an uncoated face is also introduced in the arrangement in order to inject the reference signal with the same characteristics thanks to a symmetrical optical imaging (this will be added in section 3.1).

5. Although the theoretical error estimation yields convincing results, it would be desirable if the authors could add some experimental results from the LNG to support their theoretical findings. Is it possible to transfer the results from Bruneau and Pelon (2015), particularly in terms of the SNR and the impact of solar background, to the proposed spaceborne lidar in order to estimate the systematic and random wind and backscatter ratio errors based on actual atmospheric measurements? In the discussion chapter, the authors state that "a better overall performance is expected to be achieved as based on realistic parameters derived from airborne operation with a minimized risk and increased design compactness and reliability". At the end of the conclusion chapter, it says "The performance analysis on the QMZ interferometer is supported by measurements performed in the frame of the UV HSRD-LNG airborne lidar developed and operated by LATMOS." Could they please elaborate on these statements?

We agree with the reviewer that confronting observations and numerical simulations of measurements with our airborne lidar would be of added value to support our design proposal. We thus propose to add a new Appendix (Appendix C) to the paper, to show and discuss dispersion of measurements (bias and accuracy). As our system is performing nadir viewing, we propose to use slant observations obtained as the aircraft was turning. This allows to compare lidar VHLOS measurements through VAD analysis to collocated radiosonde measurements and analyze bias in retrievals as well as fluctuations. The Appendix would include figures based on dispersion analysis between VHLOS observations and VAD fit. The differences between lidar measurements and theoretical error calculation will be derived from our simulation model (from Eqs 6 and A17) to show statistical agreement. A table can be added to synthetize results.

6. The quality of the figures should be improved. In particular, the resolution of Figs. 3 to 11 is rather low which makes it difficult for the reader to get the details of the plots.

The quality of these figures will be improved.

Technical corrections listed by the reviewer will be made in the text.