Interactive Comment on **S. Crowell, P. Rayner, S. Zaccheo, and B. Moore, "Impacts of spectroscopic errors on O2 measurement requirements for the ASCENDS mission"**

The retrieval of atmospheric CO2 using lidar observations depends not only on the lidar differential absorption measurement itself, but also on the assumed state of the atmosphere in the vicinity of the measurement. The surface pressure, temperature profile, and water vapor profile are the key atmospheric parameters that influence the retrieval. An O2 lidar, co-aligned with the CO2 lidar, can be employed to retrieve the surface pressure. The authors address the question "How accurate must a lidar determination of the surface pressure be in order to improve the estimate when compared with using surface pressure data derived from NMP models?" The authors use an information-content based methodology for assessing the O2 lidar measurement requirements. Their results are an important finding.

Specific Comments:

This manuscript appears to be excerpted from a larger, more in-depth investigation. Curiously, the first table and the first figure are denoted Table 11 and Figure 11, respectively. The reader would be more informed with the inclusion of additional information to subsection 4.2 and section 5, where the "environmental contribution" to the observation uncertainty is described and quantified, and the impact on the O2 measurement requirement is quantified.

First, it is important to clarify specifically what lidar on-line/off-line frequency pairs were used in this analysis. For the 1.571 μm CO2 lidar, we understand that on-line wavelengths are either 3 picometers (pm) or 10 pm displaced from line center. The on-line frequencies are provided for the other three lidars in section 4.2. What are the off-line frequencies for the 1.571 μm and 2.051 μm CO2 lidars? Ditto for the 0.765 μm and 1.263 μm O2 lidars. The sensitivities to water vapor uncertainties in particular can depend on the specific off-line laser frequencies as well as the on-line laser frequencies, as pointed out in Caron and Durand [Applied Optics 48, 5413-5422, 2009].

Figure 12 ("Spectroscopic Error Variance") provides results vs. altitude for each of the four lidar cases. I would like more insight into the relative contributions due to temperature uncertainties and water vapor uncertainties. What governs the altitude dependences of the 2.05 μm and 1.26 μm cases? Why the dramatic increases near the surface? Is this due to water vapor uncertainty? Can you separately show results for the continental U.S. vs. the global basis? The near-surface values for the 2.05 μm case, relative to the values for the 1.57 μm case, do not appear to agree with the relative sensitivities to temperature and water vapor that are in Caron and Durand [2009].

The "Information-Based O2 Requirement" (section 5) provides a clearly stated discriminant. The result is interesting and informative to the community. Since the NWP analyses continue to improve, it would be interesting to comment on the extent to which this result may change in a few years.