Dear Editor,

our answers to all comments of reviewer #2 are embedded in red.

The manuscript focuses on the specifications of an N2O lidar system suitable for agricultural emission concentrations. It is an important challenge, and the authors make a good description of a proposed system with relatively high technological readiness, though implementation is still a challenge. The general ideas and concepts seem reasonable and a good contribution to this relatively unexplored issue.

As this is a technological modeling investigation, I have relatively few comments.

Comments:

Terrestrial radiation is used throughout, but it's unclear – I assume they mean thermal? That would be more precise.

We replaced "terrestrial radiation" by "thermal emission" throughout the manuscript.

Line 152: Is water possible, given the reflections are not diffused in the same was as terrestrial sources? If this is applicable to water (e.g., wastewater ponds, oceans) then that should be better supported.

Lidar measurements over water are possible. However, since the manuscript primarily addresses measurements over land, we omitted mentioning water surfaces, as reviewer 1 suggested.

Table 2: What are the thermal conditions assumed for this table?

We assumed the "worst case" thermal emission of a blackbody with 288 K (the earth surface average temperature) and no atmosphere. We added this information in the text and the table.

Line 261: Are there safety concerns at this wavelength/power that may preclude use in agriculture?

No. In the wavelength range > 2.6 µm the human eye is not transparent for radiation and, thus, the exposure limit for the human eye and skin are identical, and uncritical.

Line 267: Please provide a citation for the modulated continuous wave approach.

Campbell, J. F., Lin, B., Dobler, J., Pal, S., Davis, K., Obland, M. D., et al.: Field evaluation of column CO2 retrievals from intensity-modulated continuous-wave differential absorption lidar measurements during the ACT-America campaign. Earth and Space Science, 7, e2019EA000847. https://doi.org/10.1029/2019EA000847, 2020. Included in the manuscript.

Discussion: A table outlining the technological options, strengths, and weaknesses would be helpful.

Given the actual technological progress and unavailable details on many components we think a table may be anticipating current progress too early with the risk to bias or mislead opinions.

Smaller comment:

Is the instrumentation described feasible to fit into an airplane that can fly that those altitudes and speeds? This is especially relevant for the instrumentation options that require active cooling.

Using detectors (MCT APD) that require cooling to 200 K the system could fit into a small- to mid-size research aircraft. We added this to the conclusion.