Referee #2

A very interesting paper looking at taking laboratory testing techniques out into the field and automating them. There are several drawbacks to their current methods (which they do address in the paper, but perhaps could be expanded upon):

We want to thank the reviewer for the positive feedback. Detailed answers are given below using blue font.

- low range - only 0-10 ppm NO_3^- - this is a very low nitrate level in an agricultural setting where we would expect levels a magnitude or two higher than this. The use of dilution to compensate for this is discussed.

Following this comment on the measurement range that the other reviewer also raised, we revised the text in the following sections:

(1) The title was changed to emphasize the system's low range of nitrate:
   "Technical note: An open-source, low-cost system for continuous monitoring of low-concentration nitrate in soil and open water".

(2) We added the range of our system at the end of the introduction:
   "For validation, three field tests with a concentration range of 0-10 ppm NO_3^--N were conducted over five weeks."

(3) The discussion on this limitation was extended in section 3.2 (System limitations and modifications):
   "The system, considering our sample to reagent ratio, can accurately measure nitrate concentrations up to ~10 ppm NO_3^--N. This is a well-known limitation (Doane and Horwath, 2003) of using the Vanadium III Chloride reagent, which also exists in the lab. It would be possible to increase the range with the current system by either increasing the amount of reagent, decreasing the amount of sample, or both. However, further experiments would be necessary to implement and test this extended range. When analyzing samples with higher concentrations (70-80 ppm NO_3^--N), adding the reagent results in unusual colors (salmon, orange, and yellow) that cannot be accurately measured and calibrated using known concentration standards and the spectrophotometer. For example, a sample with a high concentration (e.g., approximately 120 ppm NO_3^--N) will

turn yellow and the spectrophotometer will register absorbance corresponding to concentrations lower than 1 ppm NO_3^--N, indicating a false reading. A possible solution could be the addition of a visual color sensor to notify the user when the color is exceeding the concentration range covered by the standard (i.e., high nitrate concentrations) to then dilute the sample accordingly. This will require changing the design of the system and adding a dilution mechanism."

(4) We added the applicability limitation to the conclusion section:

"This nitrate range is suitable for soils with low nitrate concentrations or open water"

- use of dry ice for cooling, perhaps a peltier cooling plate could be used (although this would have much higher power requirement)

We added this suggestion as another possible solution:

"Warmer conditions will require a more frequent replacement time of the dry ice or adding a cooler box or more advanced solutions, such as a small field refrigerated unit or a Peltier cooling plate based on solar panel or gas."

- relies on soil-pore water being available - would not work in dry soil conditions. Measuring soil moisture/temperature as well would be beneficial.

We added this suggestion to the modification section:

"In very dry conditions, water samples cannot be extracted from the soil and the system will not work. A possible optimization solution could be the addition of a soil moisture sensor to deactivate the system under very dry conditions. We note that this is a common problem of using suction cups in dry soils unrelated to this specific system."

References: include Bristow et al, 2022 in the discussion on LoRa sensing (section 3.2, 1a), as that work developed a remote LoRaWAN nitrate sensor

Done:

"This, together with the addition of a low-cost modem or wireless communication such as Wifi or LoRa (Bristow et al., 2022; Sanchez-Iborra et al., 2018; Levintal et al., 2021), will make the device completely autonomous for weeks to months."

Overall a good, well written paper which presents a new automated field testing utilising existing laboratory techniques. It might be that this system is better suited to open water testing rather than in an agricultural situation, due to the requirement for water to sample and the low measurement range. It was good to see a github resource.