Interactive comment on "The Niwot Ridge Subalpine Forest US-NR1 AmeriFlux site – Part I: Data acquisition and site record-keeping" *by* S. P. Burns et al.

Reply to Referee #2

S. P. Burns et al.

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The comments by Referee 2 are greatly appreciated. We have listed the comments by Referee 2 below in italics, followed by our responses.

Under the category "General comments":

Referee Comment: *This is one of the few papers (if not the only one) that document instrument setup, data acquisition and bookkeeping of metadata at such a detailed level among AmeriFlux sites. I am impressed by the thoughtful design of the data system at Niwot Ridge site and believe that their high quality data are to a large degree attributed to the well maintenance and continuous improvement of this data system. I have found that issue-resolving and data interpretation can sometimes become difficult at some flux sites because of the insufficient documents and poor or even missing metadata. In this sense, this manuscript set a good example on creating a history book of site operations (mainly on instrument setup and changes, hardware and software in data acquisition system, data archive, metadata and field logs, etc.). It is my opinion that a manuscript like this one should be encouraged among other sites.*

Reply to Referee General Comment: We thank Referee 2 for noting the positive aspects and objective of our manuscript. We also appreciate the careful attention to detail by Referee 2 and the comments about the data from the Niwot Ridge site. We hope that others pursuing similar research can find our experiences useful.

Under the category "Specific comments":

Comment 1: *(1) Niwot Ridge site has done a terrific job in building their data acquisition system, handling the clock drift of data loggers, archiving their data and bookkeeping metadata. From my experience of working with flux data, data-logger clock drift has been a common problem at flux sites and often be ignored or at least not given enough attention. At some sites, the percent of missing high frequency data (10 Hz) can be very high due to their inability to real-time transfer the records from instruments to data-loggers and to a much large storage (a PC or a work station). For these reasons I would like to see a paragraph in this manuscript discussing the possibility of whether and how the best practice and site experience at Niwot Ridge*

site can become applicable at other sites from the perspectives of resource, technique and cost requirements, and if a standard data system can be established within the AmeriFlux network (considering the huge variation of measurement environment from one site to another) using the Niwot Ridge as a benchmark.

Reply to Comment 1: Time-drift in clocks has been an issue that NCAR/EOL software developers have always paid close attention to. By using the NCAR/EOL software at US-NR1 (and improved versions over the years) the US-NR1 site has, by virtue of association, had relatively accurate time-stamping of data samples. In the conclusions we have added a sentence which highlights the importance of using GPS to keep clocks synchronized and have expanded our statements to suggest that GPS clocks should be a standard used by AmeriFlux (or other networks) for time-keeping. This is especially true because many companies, such as Campbell Scientific, sell a GPS (e.g., model GPS16X-HVS) that can be easily used with modern data loggers for time-keeping. For details about using GPS with a CR23X please see our reply to Comment 1 by Referee 1.

Comment 2: *(2) Section 4.1, page 10 – the time when the LI-6262 IRGA samples the nitrogen is recorded based on the data system clock. This is the time when nitrogen enters the sampling chamber of IRGA. MET logger (CR23X) records the time when valves open. There should be a delay (very tiny though) between the valve opening and calibration gas entering into the IRGA. Should this delay be included in considering the CR23X clock drift?*

Reply to Comment 2: It is true that there is a lag time between the valve changing and LI-6262 going to zero. Because of the rather high flow rate ($\approx$ 8–9 lpm) used, this lag time is on the order of 0.5 sec (an example is shown in Fig. R1 at the end of this reply). This small lag would cause a small shift in the estimated lags shown in Fig. 7 of the manuscript; however, all the points would be shifted equally so the overall drift of the logger with time, which is the main point of Fig. 7, would be unchanged. For this reason, we have left Fig. 7 as-is.

Comment 3: *(3) Lines 18-20 on page 12: it is hard to understand why "powering the CR23X data loggers with deep-cycle batteries provides some degree of lightning protection". More explanation might be necessary.*

Reply to Comment 3: Our original thought was that having the battery between the power source and the data logger would help protect the data logger from power surges due to lightning (i.e., the battery charger and battery would be destroyed, but not the data logger). However, after further consideration the reviewer is likely correct that the wires for the battery charger and the data logger are both connected to the battery at the same location. So, a power surge could destroy both things. In our experience, we have had battery chargers destroyed during storms, but we have never had a data logger destroyed by lightning. However, we have removed this statement because there could be situations where it might not be correct.

Under the category "Technical comments":

Comment 1: *(1) Table 1, footnote b – spelling error, "Atmospher-Surface".*

Reply to Comment 1: Thanks for noticing this. It has been corrected.

Comment 2: *(2) Table 1, footnote – there are two of them with the same label 'c' but none is labelled with 'd'.*

Reply to Comment 2: This has been corrected.

Comment 3: *(3) Table 2 – MARK datalogger shown here does not appear in Figs 1 or 2.*

Reply to Comment 3: We were trying to contrast the two systems with the same data loggers connected. The MARK data logger was added at a later date. We have left this as-is (mostly because there is not a lot of room in Fig. 2 to fit the MARK data logger).

Comment 4: *(4) Table 2 – does NCARTC logger shown here correspond to 'NCTC' in Figs 1 and 2? If so, a consistent name should be used.*

Reply to Comment 4: Good point. In the field, both names are used. To avoid confusion, we selected NCTC for the name of this data logger and changed Table 2 to use this name.

Comment 5: *(5) Line 3 on page 5: ADAMS. But you used ADAM in the following lines.*

Reply to Comment 5: Good point. We changed "ADAMS" to "ADAMs".

Comment 6: *(6) Figure 3 – "outlined in red in the upper right-hand corner of the cockpit window". Did you mean 'upper left-hand corner'?*

Reply to Comment 6: Thanks for catching this! We changed right-hand to left-hand.

Comment 7: *(7) Line 23 on page 10 – "Lost 1-Hz data from the MET CR23X". Unsure what 'Lost 1-Hz data' means?*

Reply to Comment 7: The "lost data" was due to an intermittent, faulty connection in the CSI SC932 (9-pin to RS-232 DCE interface converter) between the data logger and the data system. This faulty connection interrupted the transmission of the 1-Hz data into the data system (though the logger itself was fine). The loose connection was present for many years, with many periods when it worked perfectly. On 26 May 2010, we finally found the loose connection and fixed it. We have re-worded this sentence to make our original statement more clear.

Comment 8: *(8) Line 23 on page 10 – "based on when the the LI-6262 IRGA sampled the nitrogen". Two 'the's are next to each other. Please remove one.*

Reply to Comment 8: Thanks for noticing. This has been fixed.

Comment 9: *(9) Line 7 on page 11 – "the differences shown in Fig. 9 are all smaller than* $\pm 1\ \mu mol\ mol^{-1}$*". Did you mean Fig 8 here?*

Reply to Comment 9: Yes, it should be Fig. 8. This has been fixed.

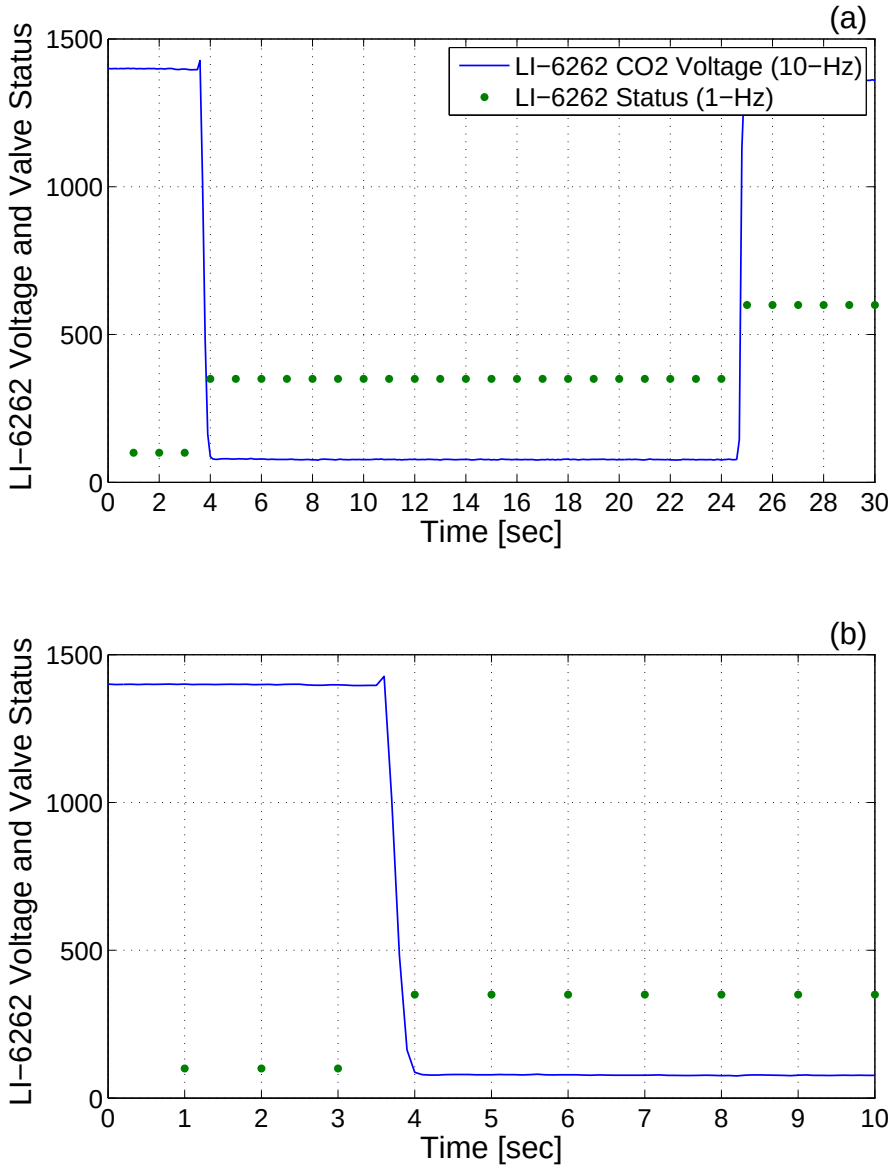

Figure R1: An example time series of the calibration of the LI-6262 starting on 1 July 2016 at 00:10 MST. (a) 30-sec time series that includes the entire period when the nitrogen was sampled, and (b) a 10-sec time series of the start of the calibration period. For the valve status: the lowest values indicate when the LI-6262 is sampling air, the middle values indicate sampling of Nitrogen, and the largest values indicate sampling of CO_2 in air. For this particular example, the estimated lag time for the CR23X MET data logger is ≈ 4 seconds.