

The manuscript discusses MERRA-2 reanalysis of wet and dry dust deposition over the Upper Colorado River Basin and compares them to SAIL field measurements and MODIS SPIReS observations of dust concentration data. The authors conclude that wet deposition is the dominant form of dust deposition. They also highlight the spatial and temporal variability of dust deposition and dust concentration, stressing the need for advancing aerosol-precipitation scavenging to improve predictions of water resource. The manuscript is well-written with great logical flow and clear explanations. There is potential for more detailed analysis using the precipitation data available in MERRA-2, which is a missed opportunity, and could bolster the scientific rigor of the manuscript. The manuscript is suitable for publication after minor revisions.

Specific comments:

1. Section 3 – Line 195: The authors provide wet/dry deposition percentages over 1980-2023. They should also provide these percentages calculated over 2022-2023.
2. Figure 2: Why is there a discrepancy between the wet dust deposition on the last hour of April 11 and the first hour of April 12? The authors should extend the hourly averages for the full 24 hours of both days.
3. Figure 2: Is the wet dust deposition exactly zero for most of April 11? If not, the authors should consider a logarithmic y-axis for the plot.
4. Figure 3: The authors should include precipitation values at Gothic. If the plots end up being too busy, the precipitation values (rain and snow) could be presented in separate subplots.
5. Figure 4: I understand that the authors want to use blue colorbars for the wet deposition and red colorbars for the dry deposition, but they should consider using the same color palette for both colorbars, since they're inviting a direct comparison of the magnitudes. The colorbar palette used in Figure 5 would still get the point across, with wet deposition showing up in blues and dry deposition in warmer colors.
6. Figure 4: Please change the symbol, size and color for Gothic and Senator Beck Basin for improved visibility and contrast. For Gothic, include that it is the SAIL site in the legend. What is the relevance of the Senator Beck Basin, since it isn't referred to anywhere else in the manuscript?
7. Table 2: Please include precipitation values (rain and snow) and also averages of deposition over the full range (1970-2023), in addition to 2022 and 2023.
8. Lines 278-279, 283: "When comparing MERRA-2 with SPIReS, we see that MERRA-2 and SPIReS generally align on dust-in-snow spatially and have a slight disagreement temporally", "disagree slightly" - The temporal disagreement is pretty significant for Gunnison watershed and the SAIL site. Both places show huge decreases (-32% and -42%) in MERRA-2 dust deposition in 2023, but show small

increase (+11%) and small decrease (-10%) in SPIReS dust concentration in Gunnison and SAIL site, respectively, in 2023.

9. Line 299: The authors mention the total snowfall for 2022 and 2023, please provide z-scores for the snowfall (and possibly rainfall). These values could be included in Table 3, as well.
10. Line 300: The authors report a Spearman's coefficient of 0.42 between precipitation and wet deposition. The reviewer recommends calculating the Spearman's coefficient between snow and wet deposition, and between rain and wet deposition. This would be of interest to include in the manuscript especially if the coefficients are not close.
11. Lines 340-341: "The SAIL site received slightly more total dust-on-snow deposition than the Gunnison Watershed in 2022 (13%) and in 2023 (3%). This means that the SAIL field data cannot accurately represent dust-on-snow deposition rates in the broader UCRB but are representative of dust-on-snow deposition in the Gunnison Watershed" - This is not accurate analysis. The 13% and 3% comparison values are between Gunnison and UCRB, not between the SAIL site and Gunnison. The SAIL site shows significantly more dust-on-snow deposition than Gunnison in 2022 (62%) and 2023 (37%).
12. Figure 6: The authors should plot the dust concentration data over Feb-May or Nov-May to be consistent with the MERRA-2 results in Figures 4 or 5, or justify the choice of Feb-June in detail.
13. Throughout the manuscript, the authors use cumulative, total, mean, average, etc, while reporting and plotting the dust deposition, precipitation, and dust concentration values. Sometimes, it is a bit unclear if the totals are temporal and/or spatial sums and the averages are temporal and/or spatial. The authors could clarify the wording by using consistent terms for temporal/spatial sums/averages throughout the manuscript and by paying extra attention to the units.

Minor comments:

1. Check that the affiliations of all the authors are correct.
2. Colorado Dust on Snow Program is referred to in lines 41 and 48. Please provide citations to specific peer-reviewed literature for reference.
3. Line 82: "which translates to a ~54 km x ~55 km ~~in meters~~ across the UCRB".
4. Line 94: SKYRAD - Please include the full name of the instrument (ARM sky radiometers on stand for downwelling radiation)
5. Figure 1: Please include details about the SAIL circle and the corresponding MERRA2 grid point in yellow in the caption. Show the 100 km scale in both the latitude and longitude axes, to clarify that 1:1 aspect ratio is maintained.

6. Line 163 - Eqn. (1): Is there an N_i missing in the denominator?
7. Section 2.3: Please include the spatial and temporal resolution of SPIReS analysis, when introducing the method.
8. Line 176: National Snow and Ice Data Center - include **(NSIDC)**
9. Table 1 should be moved closer to Sec. 2.1, where it is referenced first.
10. Figure 2 caption: “MERRA-2” and “wet dust” need to be included in the captioning
11. Figure 3 caption: Shouldn’t the daily wet deposition totals units be $\text{mg m}^{-2} \text{ day}^{-1}$? Also include the explanation of the particle counts and wet deposition events in the caption.
12. Line 210: “was able to detect most deposition events” should be changed to “was able to detect **a majority of the** deposition events”
13. Table 2 reports UCRB Total Deposition (mg m^{-2}) and UCRB Average Deposition (mg m^{-2}). The reviewer believes the units for one of the quantities needs to be different.
14. Consider combining Tables 2 and 4 for direct comparisons and conciseness.
15. Lines 228-229: Change “total dust deposition” to “(total) **mean** dust deposition”
16. Line 249: “0.63 and 0.44 with p-values below 0.001, respectively” should be changed to “0.63 and 0.44, respectively, with p-values below 0.001”