

The dust aerosol has great impact on weather and climate both regional and global scales. However, quantifying this impact remains elusive, mainly owing to the lack of full consideration of dust aerosol properties, atmospheric profiling, and surface albedo. Li et al attempted to address the scientific question by calculating the ASRF by means of comprehensive observations, which was further compared with WRF-Chem and AERONET products. Overall, the manuscript is well structured, the methods are technically sound, and the main findings presented seem to be reasonable and be of general interests to the aerosol and climate fields. I think the topic fits within the scope of ACP. I would recommend acceptance of this MS for publication pending the following revisions:

Major comments:

1. P2L35-38: This sentence is confusing to me. If my understanding is right, it is meant to express the dust originated from Taklimakan Desert (TD) exerts influences the air quality and climate over the downstream regions via long-range transport. Therefore, please try to be specific instead of using general words. However, some key references are missing, since both observations (Liu et al., 2019, doi:10.1029/2019GL083508.) and model simulations (Chen et al., 2017, doi: 10.1007/s11430-016-9051-0) suggested that the dusts generated in TD have LESS impacts on downstream regions due to the unique terrain and low-level background wind climatology, compared with those from other deserts in northwestern China.
2. Figures 3, 5, 10, 12: The X-axis can be considered to be revised (more minor ticks and labels are needed to be given), given the ASRF and ASRFE are only able to be estimated during daytime without clouds. Another important issue is the cloud-induced impact on the radiation reaching the surface. The authors are better to analyze the day-by-day variation of cloud (fraction) over the study sites of Kashi, which is concurrent with the ground-based aerosol remote sensing and radiation observations. I believe this will provide more insights into the community of aerosol radiative forcing.
3. Figure 11: The readers would like to know how the ASRF is derived from AERONET, instead of the performance of ASRF product. The details will shed light on the difference between ASRF from RT model and ASRF from AERONET.

Minor comments:

Abstract: What are the two simulations in “The percent difference of daily mean ASRF between the two simulations.” ? which is supposed to be described specifically.

P2L34: The dust aerosol originated from western China was revealed to exert significant impact on the mesoscale convection in downwind regions such as North China (Li et al., 2017, doi: 10.1038/s41598-017-12681-0), which exemplified well the dynamic effect of dust. Therefore, this reference can be considered to be added here.

P2L34-35: Recent studies also show that the dust RF strongly depends on the overlapping pattern of dust aerosol and cloud layer in the vertical. Therefore, this sentence might as well be revised to “The dust radiative effects also depend on the surface albedo over the desert (Bierwirth et al., 2009) and the underlying clouds as well (Waquet et al., 2013, doi: 10.1002/2013GL057482; Xu et al., 2017, doi: 10.1016/j.atmosenv.2017.07.036)”

P2L50: “were used” should be revised.

P2L58-61: what does “the modulate effects” mean? Besides, it seems strange in “performances of models...validated by comparing with the observations of AOD..” . I guess it is supposed to mean that ASRF from model ...validated against that incorporating the observations of AOD.... Please clarify it or make modifications to them.

P3L84: Please specify the years in “more than six years”.

P3L85-85: it needs some references to support this statement “...the lowest among all sites in China. ” . it really depends on the stations you refer to. e.g., the aerosol properties at Tazhong should be dominated by dust aerosol if you have observations therein.

P5L122-123: More details are needed for the sounding measurements, including the launching time and location, sampling resolution, data uncertainties, e.t.c. Reference support is required.

P7L149-151: I am confused again for the descriptions shown here are not consistent with those in Fig. 3. For instance, “The maximum PM_{10} concentration ..from 24 to 25 April 2019 was up to 4 mg m^{-3} ” cannot be derived from Fig. 3. Also, “no CE318 measurement around the peak time of dust outbreak.” disagreed with continuous AOD curves.