Response to Referee #1

We are very appreciative of the reviewer's thorough review of the paper and encouraging comments. His/her suggestions and comments are helpful in improving the paper. We hope that the revised version of the paper has addressed much of the reviewer's concerns and is now acceptable for publication. The following are our point-by-point responses to the reviewer's comments:

Major concerns:

1. Aerosol optical properties such as aerosol optical depth (AOD, single scattering albedo (SSA) are retrieved using POM-01 measurements, which are also derived from CIMEL measurements, so the authors should compare two products, including not only AOD but also SSA.

Response：

Yes, we can also derive SSA from CIMEL measurements. However, the retrieval and comparable data points of SSA are quiet few. In this case, we couldn't give the comparison of SSA.

2. Pure dust single scattering albedo was retrieved to be 0.98(±0.01) using CIMEL measurements at Dunhuang during spring of 2001. Aerosol SSA at Beijing during dust period was estimated to increase from about 0.91 at 440 nm to about 0.96 at 870 nm (Xia et al., Tellus, 2005, 57B, 28-39). This indicates that mixing of dust and anthropogenic aerosols leads to higher SSA, although particle size increases as dust activities impact Beijing.

Response：

Originally, we speculated that mixing of dust and air pollutants (mainly is black carbon at SACOL) and Wang et al. (2010) also showed that the concentration of black carbon (BC) reached its high peak during the dust plume at SACOL. However, since only optical measurements were performed in this study, we cannot definitively say the mixture of dust aerosol and absorbing aerosol leads to lower SSA.

3. CM21 measurements of diffuse solar radiation are used to adjust aerosol SSA. It should be noted that field measurement uncertainties were estimated to be 3%, 6%, and 6% for direct, diffuse and global measurements using NIP and B&W radiometers (Stoffel, 2005, ARM-TR-035, http://www.arm.gov). This means we should take CM21 measurement uncertainties (zero offset, cosine response, et al.) into consideration and CM21 measurement is not a standard.

Response：

Yes, we considered the uncertainties during analyzing and calculating now. The temperature dependence of the response of the CM21 to radiation was investigated by examining the data for the 30-min periods before sunrise and after sunset. The output of CM21 showed the maximum negative value about -2.0 Wm^{-2}. The negative values depend on the atmospheric conditions during complete nighttimes and show a gradual increase with an increasing solar elevation. We have added this point in the revision.

In addition, aerosol asymmetry factor can also contribute to difference

between CM21 measurements and SBDART simulations.

Response：

Yes, we considered the contribution of the aerosol asymmetry factor. During the radiative closure experiments, we considered the contribution from SSA and ASY and adjusted SSA and ASY simultaneously.

4. Meteorological report was used to select dust cases, which is objective in nature, suggest to use aerosol Angstrom wavelength exponent, at least, Angstrom wavelength exponent should be provided in the text.

Response：

Yes, we should select dust cases combining meteorological report and Angstrom wavelength exponent. According to meteorological report, 21 March was a strong dust day and 8 April was a floating dust day. However, after combing Angstrom wavelength exponent analysis, we found the dust days are 19 March, 21 March, 23 March, 25 March, 29 March, 31 March, and 8 April. During these days, almost all the Angstrom exponents are less than 0.5. The daily mean values of Angstrom exponent on 19 March, 21 March, 23 March, 25 March, 29 March, 31 March, and 8 April are 0.47, 0.10, 0.32, 0.25, 0.40, 0.27, and 0.56, respectively.

5. A few words should be added to describe SBDART model simulation, including how to set spectral variation of aerosol optical properties, atmospheric profile, et al. Model uncertainty should also be noted.

Response：

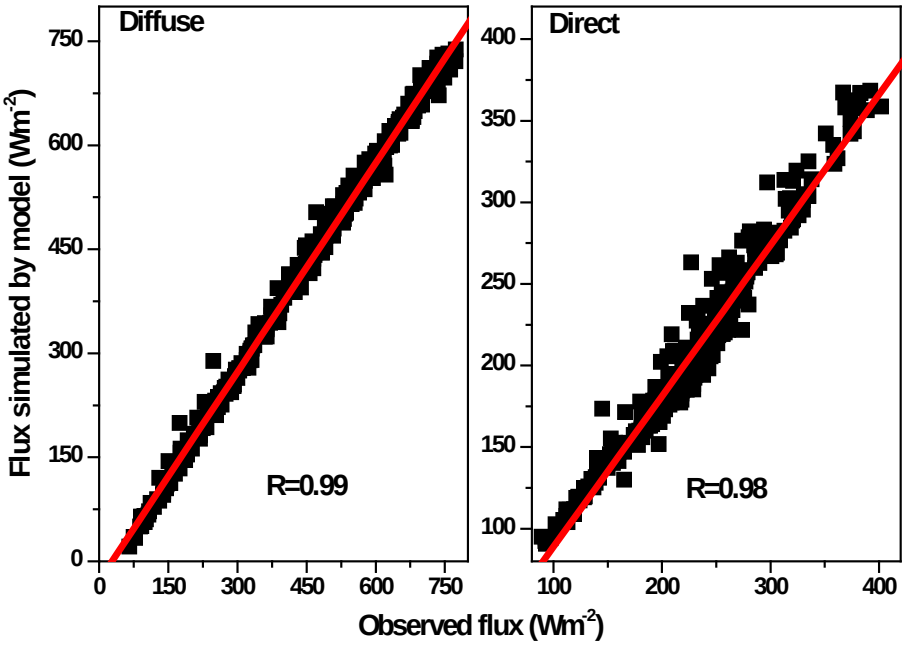
According to the average humidity profile derived from microwave

radiometer, we chose atmospheric profile as sub-arctic winter atmosphere (water vapor is 0.418 gcm^{-2}) in SBDART model simulation. We chose LOWTRAN_7 solar spectrum. The spectral variation of aerosol optical properties is set from 0.305 to 2.8. We have added this point in the revision.

6. Direct + diffuse are suggested to represent global radiation in the analysis of aerosol direct radiative effect.

Response:

Figure 6 has been replaced by the following figure.



7. Suggest to compare results of aerosol direct radiative forcing and atmospheric heating here to results derived in North China. The aerosol radiative forcing efficiency is often used in comparison.

Response:

We calculated the daily-average surface aerosol radiative forcing efficiency (ARFE), which is defined as the diurnally-averaged ARF

divided by the daily-average AOD. For easy comparison to other work, we used the AOD at 0.5 μm to calculate the ARFE. The average surface ARFE is -132.24 Wm^{-2} tau^{-1} (tau^{-1} is AOD at 500 nm). The result of Kim et al. (2005) shows that the values of ARFE due to Asian dust can range from -55 to -106 Wm^{-2} tau^{-1}, our result is about 25 Wm^{-2} tau^{-1} larger than the value at the larger (in absolute value) end of this range.

Minor comments:

1. Suggest to add aerosol radiative effects in the title

Response: By following reviewer's suggestion, we have changed the title to: Aerosol optical properties and radiative effect determined from sky-radiometer over Loess Plateau of Northwest China

2. Abstract, p1, retrieved change to "derived" because forcing cannot be retrieved.

Response: By following reviewer's suggestion, we have changed "retrieved" to "derived".

3. The elevation of station is 1965.8, so the atmospheric pressure should not be set 1 atm.

Response: Reviewer is right. We should not set 1atm but 0.78 atm. We have replaced all the results to those at 0.78 atm.

4. p7, l3-4, my understanding is that sunphotometer can work under cloudy and heavy dust storm if it is not rain determined by the humidity sensor, generally, we cannot get aerosol retrieval because measurements under these

situations are often cloud-screened out.

Response: Skyradiometer can work under cloudy and dust storm if it is not rain. But it cannot work cloud overcover and almost cannot catch the heavy dust storm. The data quality is not good even it can measure heavy dust storm.

5. Background aerosol is used to compare dust aerosol, however, background is generally used to describe the condition with very low aerosol loading.

Response: In order to distinguish the effect of aerosol from clean day, we defined the day which is not dust or floating dust day according to AOD, Angstrom exponent, and meteorological report.

6. wm^{-2} change to $W\ m^{-2}$.

Response: We have changed it to 'Wm^{-2}'.