**Comment on acp-2021-112**

Anonymous Referee #1

The manuscript by Debing Kong et al. provides the first attempt to examine the diurnal cycles of day-to-day temperature change and then investigates their possible impacts on winter air quality forecasting over the Sichuan Basin in China. A classification of meteorological situations is used to sort the main diurnal cycles of day-to-day temperature change occurring over this region. Three different diurnal cycles of the preceding day-to-day temperature change are identified. More interestingly, these identified diurnal cycles exhibit notably distinct effects on the evolutions of atmospheric dispersion conditions and air quality on the following day. These findings exhibit promising potential for air quality forecasting and are also critical to improve our understanding of air pollution in mountain-basin areas. The paper is well presented and logically organized. The proposed study is clear and methodologically robust. I recommend this paper to be published after these comments as follows are addressed.

1. The K-means clustering method used for classifying the diurnal cycles of day-to-day temperature change is one of the most important points in this paper. However, the methods discussion of the diurnal cycles’ classification method used is too brief. For instance, the variable used in the K-means clustering is not made clear. This section needs to be much more comprehensive.

2. In this paper, the authors found that the three different diurnal cycles of the preceding day-to-day temperature change exhibit notably distinct effects on the evolutions of air pollutants’ concentrations on the following day. However, Figure 4&5 only depict the spatial distributions of the following day-to-day changes in absolute concentrations of particulate pollutants and gaseous pollutants. To exhibit the change range of air pollutants’ concentrations on the following day more intuitively, I suggest the authors to add some investigations about the percentage values of the changes in air pollutants’ concentrations.

3. By using K-means clustering method, three dominant diurnal cycles of day-to-day temperature change are identified in Sichuan Basin. The basic features of the three diurnal cycles are shown in Figure 3, Cluster 1 exhibits diurnal cycle with increasing temperature throughout all day, Cluster 2 shows diurnal cycle with decreasing temperature in the
afternoon, and Cluster 3 exhibits diurnal cycle with decreasing temperature in the morning. As shown in Figure 3, the diurnal distributions of temperature changes corresponding to different clusters are very different, which also pose notably effects on the atmospheric dispersion conditions and air quality. In general, atmospheric radiation and temperature advection are the important factors leading to changes in air temperature. In particular, atmospheric radiation could play a key role in resulting the different features in temperature changes between daytime and nighttime. Thus, the authors should investigate the behaviors of cloud cover (including low cloud cover and total cloud cover) to reveal the possible causes inducing the above three dominant diurnal cycles of day-to-day temperature change.

(4) The blank space on the right side of Figure 1a is too large. I suggest the authors to adjust the X coordinate axis of Figure 1a to 70 °E~140 °E.

(5) Line 211 show higher temperature change in the level between middle level (800-850 hPa) than the lower level (900-950 hPa) -> show higher temperature change in the higher level (800-850 hPa) than the lower level (900-950 hPa).

(6) Line 22: for the first time we -> for the first time, we

(7) Lines 56-58: The key questions include ... -> There are two key questions. The first one is what are the behaviors of ... and the second one is how these behaviors affect air quality ...

(8) Line 59: understanding of winter air pollution -> understanding winter air pollution

(9) Line 62: local residents -> residents

(10) Line 69: conditions -> conditions'

(11) Line 77: Our study is expected to -> We expect our study to

(12) Line 91: since -> on

(13) Line 113: can be used to evaluate -> can evaluate

(14) Line 190: showed -> shown

(15) Line 237: playing key role -> playing a key role