Response to Reviewer #1's Comments:

Jiming Li et al. (Author)

We are very grateful for the Review #1's for pointing out a number of weaknesses and addressing significant comments on the original manuscript, which are very helpful and have led to significant improvements of this paper. Based on Reviewer #1's comments, we rewrote the manuscript and paid more attentions to investigate the impacts of meteorological parameters on the supercooled liquid cloud fraction under different aerosol loadings at a global scale. In addition, some superfluous information in each section was deleted and some interpretations in each section were added in order to make the manuscript more clear. Some grammatical errors already were corrected in the revision and the paper also be edited by a native English speaker to make it more readable.

Detailed information:

(1)Due to the modeled T-Phase relation cannot be compared directly to observations like it is done in the paper, Reviewer #1 suggested us to remove the comparison with "model relation" part and focused our study on the observational part (relation of the cloud phase transition with the aerosols). We very thank reviewer for pointing out the major flaws of this paper and providing some important explanations about these flaws. In the revised paper, we followed the suggestion from reviewer #1 to remove the comparison part with "model relation". In addition, duo to some studies have investigated the impact of different aerosol types on cold phase clouds over East Asia (Zhang et al., 2015) or at a global scale (Choi et al., 2010; Tan et al., 2014). However, systematic studies of the statistical relationship between cloud phase changes and meteorological parameters at a global scale have received far less attention. Thus, the revised paper paid more attentions to investigate the impacts of meteorological parameters on the supercooled liquid cloud fraction at a global scale.

(2) We reorganized the introduction section. Some confused sentences and wrong quotations were revised.

(3) In the section 2, we replaced the cloud phase information from the 2B-CLDCLASS-LIDAR product with the GCM-Oriented Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation (CALIPSO) Cloud Product (GOCCP). This product can provide us more longer-time cloud phase information. Thus, all statistical relationship in the revised paper were derived from 8 years (2008–2015) of data from CALIPSO-GOCCP, the ERA-Interim daily product and the CALIPSO level 2, 5 km aerosol layer product. Some introductions about datasets were added in this section. Please see the section 2.

(4) In the section 3 (results part), we did a lot of changes, and mainly investigated the temporal correlations over the 8-year period (96 months) between monthly supercooled water cloud fraction and different meteorological parameters. Some new results were added. For those regions with temporal correlations between SCFs and meteorological parameters at the 95% confidence level were further used to calculate the spatial correlations between SCFs and meteorological parameters.

Specific responses

We appreciated the insightful suggestion and comments made by reviewer. In the revised paper, the comparison with "model relation" part was removed. Thus, we only provided the point-by-point responses to the reviewer's comments about the observational part.

(1) Line 104: Can the authors reference studies here? (e.g. Forbes et al., 2014 MWR)

Response: In revised paper, we added this reference in the introduction section. In addition, some related latest studies also were added.

(5) Why did the authors choose -20degC. If there is a special reason, please explain, otherwise it would be worth to check the sensitivity of other temperature isotherms.

Response: We agreed with reviewer. In the revised paper, some statistical results at other isotherms (such as -10°C and -30°C) also are analyzed and summarized (see the Table 1).

(6) Line 477: The authors can't conclude this just based on 2 maps at -20degC without even looking for a statistical correlation between SLF and aerosols. A better way would be to focus on a specific region and study the SLF depending on the aerosol load. The last part is very confusing and could be squeezed easily. Also I don't understand the absolute value for the vertical velocity, which is very confusing because we expect different results from positive or negative vertical velocity. Besides, the authors should define what positive vertical velocity means somewhere because in GCM studies, positive generally mean subsidence.

Response: We appreciated the insightful suggestions and comments. In the revised paper, we added the statistical correlation between SLF and different meteorological parameters by performing the temporal and spatial correlation analysis. We found that same meteorological parameter has a distinct effect in different regions on the SCFs. Please the section 3.2 and 3.3 of revised paper.