We would like to offer our sincere thanks to the reviewer for the valuable comments and constructive suggestions. We went through all of the comments thoroughly and revised the manuscript accordingly. All changes in red fonts have been marked in the revised manuscript. The explicit answers to the comments are given below in blue fonts.

Reviewer #2:

Review of "The solar induced 27-day modulation on polar mesospheric cloud (PMC), based on the combined observations from SOFIE and MLS" by Qiu et al.

The paper focuses on the investigation of 27-day oscillation of PMC based on satellite observations of IWC and temperature. The author conducted comprehensive data analysis and confirmed the correlation between the PMC variations with the solar activities, represented by the Y10 index. The presentation is reasonably clean the conclusions are solid. The data analysis algorithm follows Thurairajah et al., 2017 with more SOFIE data, coupled with MLS observations.

1. However, the role of MLS data are not clearly addressed in the paper. Shouldn't the simultaneous IWC and temperature measurements by SOFIE provide enough data already to establish their correlation? Involving a different instrument can cause unwanted bias in the results due to distinct sampling schemes, such as resolution and sensitivity issues, and may not help the investigation. If the author insists to include MLS data, the paper should articulate the motivation and, at least, provide some discussion on the consistency between the two instruments' measurements.

Thanks for the comment. We have highlighted the role of the data from MLS and modified the descriptions around lines 167 to 170. We use the temperature data from both MLS and SOFIE for the superposed epoch analysis (SEA), and the results between the two instruments are compared. The analyzed results for MLS and SOFIE are quite similar, indicating robustness of the results with minimal influence from how different instruments are used to acquire the data.

2. Note that the MLS IWC covers range starting from upper troposphere. Does the troposphere cloud ice affect the overall PMC results in the paper?

Thanks for the comment. The IWC data used in our manuscript is measured by SOFIE. According to Gordley et al., (2009) and Hervig et al., (2009a), it is shown clearly that the ice data from SOFIE can be retrieved at distinct altitude around the mesopause region.

Therefore, we think the troposphere cloud ice may have a very minimal impacts on the overall PMC results in the current study.

3. In addition, the objectives of this study are vaguely stated.

Thanks for the comment. We have rewritten the abstract and conclusions to revisit the purpose and results of this paper more clearly. In this paper we focus more narrowly (at least stated more clearly now than previous draft) on how solar radiation affects PMCs by modulating the mesospheric temperature.

4. The paper also lacks the discussions of the results. What do these new results help to understand the underline mechanism of the 27-day oscillation of PMC. The current version reads like an experimental report, simply repeating the analysis with more data and listing the outputs of the calculations. Overall, what are the new discoveries in this study and their contributions to the PMC dynamics and chemistry?

Thanks for the comment. In this paper, we have studied the impact of solar radiation activity on the polar mesospheric clouds (PMCs), based on the correlations between the composite solar index Y10, the mesospheric temperature, and the ice water content (IWC). It seems to be the first time that the composite Y10 index is adopted to study the responses of PMCs to solar activity variations. In addition, we wish to report on some new results obtained from these observations.

The differences of temperature responses to Y10 between 16 SH and 16 NH PMC seasons are studied, based on the on the data measured by MLS at 0.46 pa (about 84 km altitude). The analyzed PMC seasons can be classified into three categories: 1) The cases have distinct 27-day solar cycle characteristics, and the time lag days increase with latitude (e.g., NH 2009, NH 2012, NH 2016, NH 2017, SH 2013 / 2014, SH 2015 / 2016). 2) The seasons have obvious 27-day period, but the time lags do not change with latitude (e.g., NH 2008, SH 2005 / 2006, SH 2008 / 2009, SH2013 / 2014, SH2014 / 2015, SH2017 / 2018). 3) The seasons have no obvious periodic variation. Our results indicate the atmospheric dynamics and the 27-day oscillations are possible reasons for the interannual differences in the mesospheric temperature response to Y10. Meanwhile, it is also found that the temperature responses exhibit similar characters every 10 years, such as NH 2005 vs. NH 2016, and SH 2004 / 2005 vs. SH 2014 / 2015. This may be related to the 11-year cycle of the Sun. So, although somewhat preliminary, we think that it is good and meaningful to report evidence for the modulation of PMCs or PMCs-related properties by solar activity forcing on both the 27-day rotational and the 11-yr cycle timescales.

Minor comments:

Page 2, line43-45. This sentence reads somewhat strange. Please consider to rephrase.

Thanks for the comment. We have modified this sentence around lines 41 to 45.

Page 2, line 50 "…solar radiation will increase the mesopause temperature by heating". This statement is questionable. The MLT temperature variations are mostly

controlled by the dynamics and chemistry.

Thanks for the comment. We have revised that statement in line 50.

Page 3, line 60-62. This statement needs more clarification, I think. Is this a hypothesis based on observations or some model simulations?

Thanks for the comment. We have added the statement based on observations in line 62.

Are the temperatures in Figure 1 SOFIE temperature or MLS temperature?

Thanks for the comment. We have added the source of temperature in line 97. The temperature data used for Figure 1 is from MLS.

Page 6, line 162-164. This statement is only true when the temperature is low, I think. The equation is fine here, because the summer mesopause temperature is low. However, it would be good to set a limit.

Thanks for the comment. We have discussed a limit that when the temperature is low, in order to simplify the relationship between PMCs and solar activity, the effect of water vapor can be ignored around lines 164-165.

The MLS data site in the Data availability does not seem to demonstrate the data resource. At least it is not quite clear.

Thanks for the comment. We have changed the website of the data link in line 86.

Thanks again for all the comments and questions. We have learned a lot from your patience and valuable suggestions. We hope our revised manuscript has been satisfactorily improved.