Replay to the editor report of the "ENSO contribution to the assessment of long-term cloud feedback on global warming" by Liu et al.

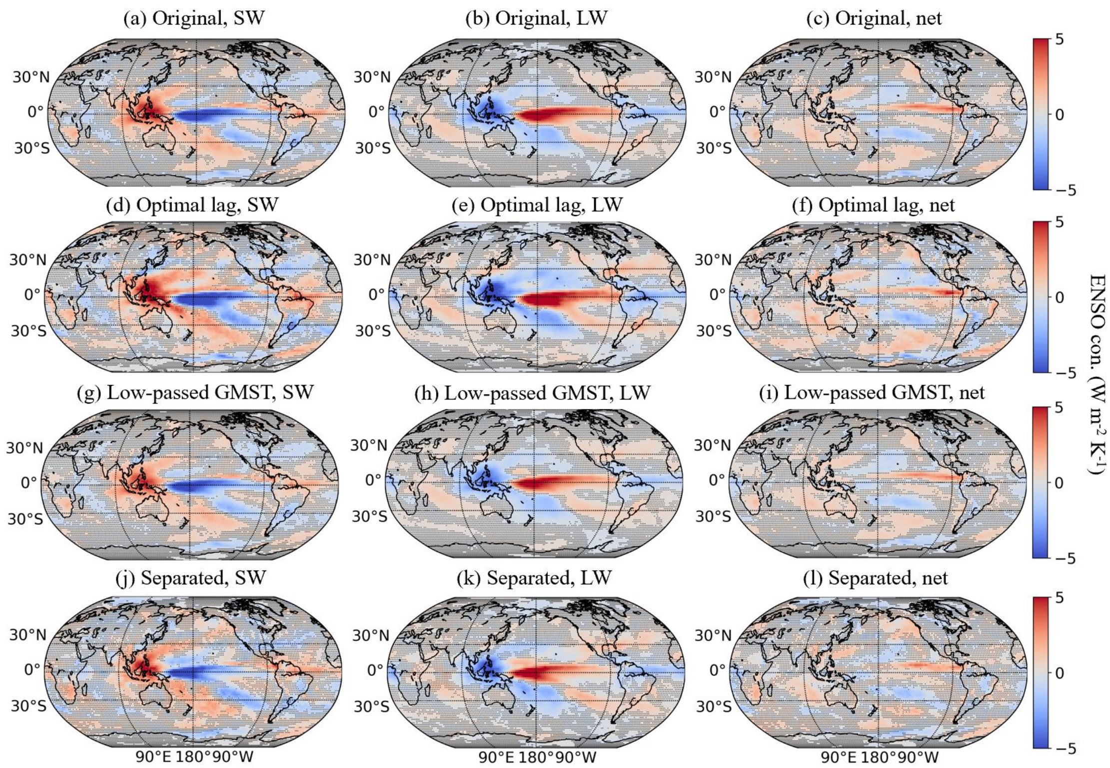
Editor report:

Upon reviewing your revisions and item-by-item responses, I have concluded that your additional analysis and item-by-item responses sufficiently address the third reviewer's comments. However before accepting the manuscript for publication in Atmospheric Chemistry and Physics, I request that you provide additional information detailing your methods to evaluate the robustness of your model by considering lag dependence, nonlinearity of the trends, and the asymmetry of El Nino and La Nina in Section Text S1 of the Supplementary Materials.

Answer: We sincerely thank the editor for the positive feedback. We have revised Text S1 in the Supplementary Materials to include detailed methodological descriptions regarding lag dependence, non-linearity of trends, and ENSO asymmetry. The revised text is presented below:

"***Text S1: Validation of Regression Model Assumptions***

To assess the sensitivity of our OLS multivariate regression model (Eq. 1, main text) to its underlying assumptions, we conducted three sensitivity tests using ERA5 data (January 1981–December 2020) (Fig. S1). First, we tested the zero-lag assumption by determining the optimal lag for each variable within a range of –12 to +12 months (negative values indicate ONI leads) (Figs. S1d–f). While the optimal lag (determined by the highest correlation) for GMST is –5 months, the optimal lags for CREs exhibit high spatial heterogeneity. Second, we evaluated the assumption of linear trends by replacing the linear time term (t in Eq. 1) with low-pass filtered GMST (frequencies higher than (15 years)$^{-1}$ removed) (Figs. S1g–i). Since the filtered ONI is mathematically uncorrelated with the long-term trend, this substitution has minimal impact on the ENSO coefficient estimation. Third, we examined ENSO asymmetry by performing separate regressions for warm (ONI > 0) and cold (ONI < 0) phases. We removed ENSO signals by applying the respective phase-specific models to the corresponding months and then merged the corrected segments into a continuous time series for calculating the ENSO contribution. Despite the identification of specific optimal lags and the presence of ENSO asymmetry, the spatial patterns and magnitudes of the ENSO contributions derived from these sensitivity tests remain consistent with those from the original model (Figs. S1a–c), validating the robustness of the OLS multivariate regression model used in the main text."



"*Figure S1: Maps of the ENSO contribution to CRE_{SW} (left column), CRE_{LW} (middle column), and CRE_{net} (right column), derived from ERA5 data (January 1981–December 2020). (a–c) Original model (Eq. 1). (d–f) Model incorporating optimal lags. (g–i) Model with the linear time term t replaced by low-pass filtered GMST. (j–l) Model considering warm and cold phases separately. Black dots denote grids with statistically insignificant results at the 95% confidence level. For (j–l), significance is determined where the coefficient from either the warm or cold phase regression is significant.*"