How to use cloud sensitivity to constrain and predict changes in cloud cover

Arjun Babu N\textsuperscript{1,2}, June-Yi Lee\textsuperscript{1,2}, Axel Timmermann\textsuperscript{1,2,3}

\textsuperscript{1}Center for Climate Physics, Institute for Basic Science (IBS), Busan, Korea,
\textsuperscript{2}Research Center for Climate Sciences and Department of Climate System, Pusan National University, Busan, Korea,
\textsuperscript{3}International Pacific Research Center, University of Hawaii at Manoa, Honolulu, HI, USA

Many previous studies, including the recent IPCC fifth assessment report, have estimated the model spread in cloud feedbacks as being the largest contributor to the uncertainty in predicting the response to future GHG warming. A preliminary survey of cloud cover/fraction data from various climate models, reanalysis datasets and satellite observations, reveals significant disparities among them. This emphasizes the importance of understanding and reducing the model spread to obtain reliable future projections. In this study, we use observed and reanalysis data for the period 1980 - 2017 to estimate the sensitivities of simple climate variables (surface temperature, mean relative humidity, tropospheric stability, total precipitation and mean vertical velocity) to the cloud cover at different levels. Next, Alternating Condition Expectation (ACE) algorithm is implemented to identify the relationships (both linear and non-linear) between the aforementioned variables and the cloud cover. These results have the potential to aid predictions of future cloud cover changes, although improvements in prediction skill need further scrutiny. As a final goal, results from this study could be used to assess the credibility of future climate projections by constraining the predicted cloud sensitivities to the limits obtained from observational data.

Key words: Cloud Sensitivity, Future cloud cover change, Model uncertainty, Alternating Condition Expectation (ACE), Constrained Predictions