Evaluating the Marine Atmospheric Boundary Layer in Reanalyses over Subtropical Eastern Oceans with in-situ radiosondes, COSMIC Radio Occultation and CALIPSO Lidar Measurements

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The highly reflective low clouds that are generally trapped below the shallow marine atmospheric boundary layer (MABL) inversion layer produce profound radiative cooling effects in the climate system. The low cloud feedback remains a primary cause of uncertainty in global climate model projections. Understanding how climate sensitivity is controlled by these low clouds remains one of the key challenges due, partly, to lacking of observational data of, for example, the low cloud height, thickness, and their cover and cloud top inversion strength which are difficult to model and integrate into global climate/forecast simulations.

High-resolution, self-calibrated Global Positioning System (GPS) radio occultation (RO) soundings from Constellation Observing System for Meteorology Ionosphere and Climate (COSMIC) provide a unique capability for MABL sensing in all-weather conditions. The sharp temperature inversion along with a large moisture gradient across the MABL top results in a sharp bending angle and a large refractivity gradient that can be precisely detected by the GPS RO measurements.

In this study, we will derive the MABL height climatology from COSMIC RO and CALIPSO over five selected regions in subtropical eastern oceans, which include the northeast and southeast Pacific and Atlantic as well as the southeast Indian Ocean off the coast of west Australia. A further investigation of the MABL structures in the state-of-the-art global reanalyses, such as, the ECMWF-ERA-interim, the NOAA Climate Forecast System Reanalysis (CFSR), and the GMAO Modern Era Retrospective-Analysis for Research and Applications (MERRA) will also be presented. The differences in MABL height climatology among the global reanalyses and the in-situ radiosondes, COSMIC and CALIPSO observations will be explored, and the implication to the MABL parameterization in weather and climate models will also be discussed.