

Marine Boundary Layer Clouds

The focus of some of my recent work is marine boundary atmospheric layer (MABL) clouds, principally stratus and stratocumulus. The MABL couples ocean surface processes with clouds and convection over the eastern Pacific, including over the regions covered by a year-long deck of stratus/stratocumulus (i.e., the northeast Pacific off of the California and Mexican coasts and the southeast Pacific off of the South American coast). Over these regions, the MABL is directly affected by entrainment processes linked to cloud-top radiative and evaporative cooling, while the amount of clouds are closely connected to the structure of the MABL (e.g., Albrecht et al. 1995, Stevens et al. 2003).

The importance of the marine atmospheric boundary layer (MABL) and stratus/stratocumulus clouds in atmospheric and atmosphere-ocean coupled models has been widely recognized, particularly over the Southeastern Pacific (SEP). However, the simulation of these processes still has serious deficiencies even in the most recent model versions, as discussed in the VOCALS Modeling Plan (2006). As part of the overall [VOCALS](#) modeling efforts, we integrated the in situ data from VOCALS and previous field experiments as well as satellite ([CloudSat](#), [CALIPSO](#), [ICESat](#), [MODIS](#)) data to address these issues in order to document and understand the temporal and spatial variation of MABL height and clouds over the southeast Pacific and to evaluate and improve the treatment of MABL, cloud microphysics, and cloud fraction in CCSM3 and CFS03.

To this end, we performed a multi-platform comparison of cloud properties with those simulated by CAM (Brunke et al. 2010). This comparison revealed that CloudSat radar-only integrated cloud liquid water (liquid water path or LWP) is generally too high over the SEP and that CloudSat/CALIPSO cloud bases are generally too low. This results in the unadiabatic relationship [LWP proportional to the ninth power of the cloud thickness rather than to the second power as in Albrecht et al. (1990) for instance]. Such biases are reduced if profiles potentially contaminated by precipitation are removed and if cloud base is determined based upon the adiabatically-determined cloud thickness. Model LWP is quite reasonable, but its simulated clouds are too low. Its diurnal cycle in cloud properties is opposite to what is observed by ship.

For more information on this project, check out:

Brunke, M. A., S. P. de Szoeke, P. Zuidema, and X. Zeng, 2010: A comparison of ship and satellite measurements of cloud properties with global climate model simulations

in the southeast Pacific stratus deck. *Atmospheric Chemistry and Physics*, **10**, 6527-6536, doi:10.5194/acp-10-6527-2010.