

Investigation of coastal zone complex MBL circulations and their potential impact on energy transport

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Abstract

Since 2002, the investigators have been flying an airborne wind lidar on board a Naval Postgraduate School Twin Otter aircraft off the coast of Monterey, CA. During the most recent experiments in September 2012, the Twin Otter Doppler Wind Lidar (TODWL) flew with a Controlled Towed Vehicle (CTV) to measure the near-surface and boundary layer fluxes and winds over the coastal waters. The TODWL flights have revealed the presence of Organized Large Eddies (OLEs) in the boundary layer that interact with and are presumably modified by coastal jets over the ocean and thermally driven flows over coastal mountains. Interactions between the topography, the coastal zone, and the atmospheric boundary layer play an important role in the evolution and structure of OLEs that contribute to mass, energy, and momentum fluxes in the boundary layer. Investigation of the most recent flights have revealed structures in the organized Marine Boundary Layer (MBL) that we had never seen before in our lidar data until we developed new navigation and processing software. With the new software, we now see “turbulence channels” sandwiched between boundary layer rolls. These channels appear to be conduits for delivering turbulent energy to the upper part of the MBL without significant dissipation. The presence of such a vertical transport mechanism has significant implications to MBL growth models, especially parameterization of entrainment at the top of the layer. Foster has been modifying his phenomenological model of OLEs to handle the complex MBL situations revealed by the TODWL. In particular, the lidar has revealed an interesting and likely common situation (near the California coast) where a boundary layer jet bifurcates the MBL and generates “stacked rolls”; one set bounded by the surface and the jet maximum and the other set bounded by the jet maximum and the top of the MBL.