

AIRBORNE DOPPLER WIND LIDAR INVESTIGATIONS OF OLES AND LLJS IN THE MARINE BOUNDARY LAYER AND THEIR IMPLICATIONS FOR FLUX PARAMETERIZATION

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Abstract

Organized Large Eddies (OLEs) and Low Level Jets (LLJs) are well known features found in the marine atmospheric boundary layer (MBL). OLEs can be supported by both convective and dynamic instabilities. The LLJs may have their maximums near the middle or top of the MBL. Prior to Airborne Doppler Wind Lidars (ADWL), details of the OLE and LLJ features have been difficult to observe and relate to theoretical models.

In addition to understanding/describing the coherent structure (or lack thereof), a key question driving research on these features is “how important are these structures in the net energy exchange at the air/sea interface and in the transport throughout the MBL and above”.

An airborne DWL operated by CIRPAS (ONR) has been used for more than a decade on board a Twin Otter aircraft to explore atmospheric boundary layers over land and water. During a 2012 campaign, the Twin Otter Doppler Wind Lidar (TODWL) was used to investigate the MBL off the coast of Monterey, CA. While the ADWL mapped the wind and aerosol structures within the MBL and above, flux measurements were made near the surface and throughout the boundary layer. The target flux parameterization scheme has been the Eddy Diffusivity and Mass Flux (EDMF) scheme which was developed for use in regional and global models in recognition of the role of organized circulations in contributing greater vertical transport than can be reasonably represented by eddy diffusivity. While this bifurcation of the vertical flux term is not new, the challenge has been to better partition the fluxes under varying conditions such as stratiform or cumuliform cloud cover or cloud free conditions.

Current instantiations of the EDMF are designed to estimate convectively driven organized structures such as OLEs or uncoupled convective cloud roots. The near-neutral to stable conditions over the cool waters off the coast of Central California provide an ideal laboratory for the investigation of shear driven organized rolls. We present data in the form of ADWL wind and aerosol mapping as well as in situ flux measurements to suggest that the Mass Flux term in the EDMF parameterization may be made more general by distinguishing convectively driven rolls and dynamic (shear) driven rolls. Both model and observations will be used to estimate the relative importance of these two OLE generation mechanisms.

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