

Details of mixing events at the top of marine stratocumulus observed during ACORES2017

Jakub Nowak (1), Kai Szodry (2), Holger Siebert (2), and Szymon Malinowski (1)

(1) University of Warsaw, Institute of Geophysics, Faculty of Physics, Warszawa, Poland, (2) Leibniz Institute for Tropospheric Research, Leipzig, Germany

Intensive mixing in the inversion layer capping marine boundary layer over northeastern Atlantic has been investigated with high resolution (down to 1 cm) using UltraFast Thermometer 2.0 (UFT-2) for measuring temperature, particle volume monitor (PVM-100A) for liquid water content, and open-path infrared hygrometer (LI-7500) for humidity. Instruments operated in close spatial collocation (30 cm) onboard the Airborne Cloud Turbulence Observation System (ACTOS), carried by a helicopter, which provides relatively slow horizontal airspeed (20 m/s) and fast climb rate (up to 5 m/s) resulting in steep profiles. Measurements were performed in the course of the field project Azores stratoCumulus measurements Of Radiation, turbulEnce and aeroSols (ACORES) in summer 2017.

Turbulent mixing at the interface between boundary layer (BL) and free troposphere (FT) manifests in abrupt changes in temperature, humidity and liquid water content sampled along the flight path. Details of mixing are presented and discussed for the selected events, including both stratocumulus-capped and clear-air BLs. The interface layer often contains vigorous filaments of cloud or clear or cloud-free air with different thermodynamic properties, at different stages of stirring and homogenization. Borders between those filaments might be very sharp, depending on the gradient of temperature, humidity and wind velocity between BL and FT.

Haman, K.E., Malinowski, S. P., Kurowski, M. J., Gerber, H., Brenguier, J.-L.: Small scale mixing processes at the top of marine stratocumulus – a case study, Quarterly Journal of the Royal Meteorological Society, 133, 213-226, 2007.

Malinowski, S. P., Gerber, H., Jen-La Plante, I., Kopec, M. K., Kumala, W., Nurowska, K., Chuang, P. Y., Khelif,D., and Haman, K. E.: Physics of Stratocumulus Top (POST): Turbulent mixing across capping inversion, Atmospheric Chemistry and Physics, 13, 12 171-12 186, 2013.

Siebert, H., Franke, H., Lehmann, K., Maser, R., Saw, E. W., Schell, D., Shaw, R. A., and Wendisch, M.: Probing fine-scale dynamics and microphysics of clouds with helicopter-borne measurements, Bulletin of the American Meteorological Society, 87, 1727-1738, 2006.