

Aircraft Measurements of Temperature and Liquid Water Content in Entrainment Interface Layer of Stratocumulus Clouds.

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Entrainment of dry, warm air from above the cloud and its mixing with the colder cloudy air is an important process in dynamics of inversion topped stratocumulus, leading to formation of a transition layer of complex structure - Entrainment Interface Layer (EIL). It consists of mutual filaments of cloudy and clear air of various thickness at different stages of stirring, mixing and homogenization. Borders between these filaments are often very sharp, with temperature jumps of few kelvins and liquid water content (LWC) jumps of up to 0.5 gmE^{-3} over distance of few centimeters, which cannot be resolved by means of standard aircraft instrumentation. This layer is an area of various specific dynamic and thermodynamic phenomena; in particular it is a source of downdrafts penetrating the cloud as the so called "cloud holes". Small scale structure of EIL has been investigated in 2001 during DYCOMS II campaign in marine stratocumulus over Eastern Pacific, by means of Ultrafast Aircraft Thermometer (UFT-F) from University of Warsaw and PVM-100A LWC-meter from Gerber Scientific, Inc. Some results of this research has been published in 2007 in Quarterly Journal of RMS. UFT-F has a thermoresistive sensing element protected against impact of cloud droplets and response time constant of order $10\text{E}-4\text{s}$. PVM-100A is an optical instrument and has spatial resolution of order 10 cm. For recording a sampling rate of 1kHz has been typically applied with 10 kHz (for UFT-F only) on selected fragments of flights. Unfortunately, for some technical reasons, these two instruments, installed on the NCAR C-130 aircraft, were separated by about 6 meters what limited possibilities and precision of comparing their indications. There were also some failures during the flights due to which many potentially interesting measurements and observations have been lost.

Opportunity to get improved observations of EIL appeared in 2008 at POST (Physics of Stratocumulus Top) Project. During POST a number of flights in inversion topped marine stratocumulus over Eastern Pacific have been made with CIRPAS DHC-6 Twin Otter aircraft. UFT-F (modernized version) and PVM-100A were on this aircraft separated by less than 1m. Both instruments worked more reliably than during DYCOMS II, yielding a considerable amount of valuable data. UFT-F was sampled at 20 kHz rate what under relatively low speed of Twin Otter gave spatial resolution of temperature field below 1cm. In order to compare with PVM-100A these data were averaged down to 1 kHz rate, corresponding to the time resolution of the latter sensor.

After giving information on improvements introduced to UFT-F, arrangement of instrumentation on board of Twin Otter and organization of flights, selected examples of particularly interesting fragments of high frequency records of temperature and LWC demonstrating centimeter scale structure of EIL will be presented and discussed. Particular attention is paid to various forms and patterns of inhomogeneities identified already after DYCOMS II and suitable comparisons are conducted.