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Representation of the afternoon transition in Numerical Weather Prediction models: evaluation with BLLAST data

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The Boundary Layer Late-Afternoon and Sunset Turbulence (BLLAST) field campaign was conducted from 14 June to 8 July 2011 in southern France in complex terrain. It provides a new dataset combining measurements from various platforms in order to simultaneously document the temporal and spatial evolution of the Planetary Boundary Layer (PBL) during the transition from a well mixed convective boundary layer to a residual layer overlying a stabilized nocturnal layer. The present study evaluates two french numerical weather prediction models AROME (a 2.5km limited area non-hydrostatic model) and ARPEGE (a global model with a 10km resolution over France) as well as the operational ECMWF analyses, focusing on the representation of the vertical profiles of temperature and humidity and the time evolution of near surface atmospheric variables as well as the radiative and turbulent fluxes.

A special emphasis is given on IOP days for which high-frequency soundings were acquired (about 1h time interval from 1300 to 2000 UTC). In general, the models exhibit a cold bias, the ARPEGE model also indicates a dry bias. The high-resolution model AROME resolves the vertical structures better, in particular the strong inversion during the day and the thin stable boundary layer during the evening. This model is also capable to capture typically observed features, as subsidence and a well-defined maximum in water vapor mixing ratio in the upper part of the residual layer that occurs during the evening and that is linked to mesoscale advection. The representation of the various surface characteristics by the NWPs is also evaluated, showing that at least part of the observed variability is reproduced. The properties of the observed boundary layers are linked to local surface fluxes, but they also involve mesoscale (orographic) atmospheric circulations which are only captured by the finer resolution models.