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Generation of free convection due to changes of the local circulation system

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Abstract. Eddy-covariance and Sodar/RASS experimental measurement data of the COPS (Convective and Orographically-induced Precipitation Study) field campaign 2007 are used to investigate the generation of near-ground free convection conditions (FCCs) in the Kinzig valley, Black Forest, Southwest Germany. The measured high-quality turbulent flux data revealed that FCCs are initiated near the ground in situations where moderate to high buoyancy fluxes and a simultaneously occurring drop of the wind speed were present. The minimum in wind speed – observable by the Sodar measurements through the whole vertical extension of the valley atmosphere – is the consequence of a thermally-induced valley wind system, which changes its wind direction from down to up-valley winds in the morning hours. Buoyancy then dominates over shear within the production of turbulence kinetic energy near the ground. These situations are detected by the stability parameter (ratio of the measurement height to the Obukhov length) when the level of free convection, which starts above the Obukhov length, drops below that of the sonic anemometer. An analysis of the scales of turbulent motions during FCCs using wavelet transform shows the occurrence of large-scale turbulence structures. Regarding the entire COPS measurement period, FCCs in the morning hours occur on about 50% of all days. Enhanced surface fluxes of latent and sensible heat are found on these days.

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