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Numerical simulation of low-level jets during the Perdigão field campaign 2017

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During the Perdigão field campaign, which took place in spring 2017 at the double hill experiment site Perdigão Portugal, thermally driven low-level jets (LLJ) were observed frequently by wind lidars and in-situ instruments. These jets occured mainly under weak synoptic conditions in the early morning when a thermally driven mountain-to-plain circulation developed in the boundary layer. The interaction of this north-easterly flow with the double hill topography, which is oriented nearly perpendicular to the flow direction, resulted in the formation of trapped lee waves. For strong upstream winds and Froude numbers of 1 the horizontal wavelengths of these waves were in the order of 1.5 km, which is the distance of the two ridges. Smaller wavelengths of 0.5 to 0.7 km were observed for weaker upstream wind conditions and Froude numbers smaller than 1. The WRF model is used to simulate the general meteorological conditions during the campaign in a long run with a duration of 1.5 months from May to mid June with a horizontal resolution of 1 km. This simulation reproduces the cross-valley surface winds very well and captures the diurnal changing SW and NE flow. In addition, several short runs of selected LLJ events were performed in LES mode with horizontal resolutions of 40 m. These runs often show too strong surface winds in LLJs over the double ridge and missing trapped waves. This was caused by significantly too small roughness lengths obtained from the CORINE data set. Wind speeds and wave structures in the LLJ could be improved by implementing an additional roughness term on the first model level, which shows that corrected roughness lengths are necessary to perform realistic wind fields.