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Penetration and Interruption of Alpine Foehn (PIANO): Overview and highlights of the 2017 field experiment

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For decades, Alpine foehn has been an ongoing research topic and the subject of several field experiments. Most of these studies focused on synoptic to mesoscale processes and the well-developed phase of foehn. Hence, there is a lack of understanding of atmospheric processes which lead to the penetration of foehn into valleys and foehn breakdown. This is especially the case for microscale processes such as turbulence. For example, the complex interaction of the foehn flow with the relatively colder air in the valley, which accompanies these transition phases, is poorly understood.

The aim of the research project “Penetration and Interruption of Alpine Foehn (PIANO)” is to increase the understanding of these processes. In particular, processes that control the removal of the valley cold-air pool will be studied in detail, such as: (i) turbulent erosion of the cold air by the foehn flow aloft, (ii) heating by the sensible heat flux from the underlying land surface or (iii) dynamic displacement of the cold air by the foehn flow. The methodology is based on a combination of turbulence-resolving observations and high-resolution numerical simulations using the Weather Research and Forecasting Model (WRF). Furthermore, Large-Eddy Simulations (LES) with a horizontal grid spacing of O(10-100 m) will be used to analyze the three-dimensional structure of the turbulence kinetic energy as well as the heat budget of the cold air pool.

In this framework, a field campaign was conducted in the Inn Valley (Austria) near the city of Innsbruck between 27 September and 12 December 2017. A network of temperature and humidity loggers, several automatic weather stations and eddy covariance stations, two scintillometers and four Doppler wind lidars were installed. Additionally, radiosondes were launched at two different sites during Intensive Observation Periods (IOPs). The Doppler wind lidars formed the key measurement system of the campaign and were located on some of the highest buildings of Innsbruck. Their scanning patterns were optimized to measure the mean and turbulent part of the wind field in three dimensions. In total 7 IOPs were performed to capture a variety of different foehn cases. From this dataset, several prototypes of foehn breakthrough and interruption will be deduced. Furthermore, the observations will be used to evaluate the mesoscale numerical simulations and LES.

This contribution will present the motivation and goals of the project. It will provide an overview of the field campaign and include observational highlights.