EMS Annual Meeting Abstracts
Vol. 18, EMS2021-313, 2021
https://doi.org/10.5194/ems2021-313
EMS Annual Meeting 2021

Evaluation of thermally driven local winds in a deep Alpine valley in a high-resolution numerical weather prediction model

Juerg Schmidli[1,2] and Julian Quimbayo-Duarte[1,2]
[1]Hans Ertel Centre for Weather Research, Model Development branch, Goethe University Frankfurt, Frankfurt am Main, Germany
[2]Institute for Atmospheric and Environmental Sciences, Goethe University Frankfurt, Frankfurt am Main, Germany

In fair weather conditions, thermally driven local winds are dominant feature of the atmospheric boundary layer over complex terrain. They may dominate the wind climatology in deep Alpine valleys resulting in a unique wind climatology for any given valley. The accurate forecasting of these local wind systems is challenging, as they are the result of complex and multi-scale interactions. Even more so, if the aim is the accurate forecasting of the winds from the near-surface to the free atmosphere, which can be considered a prerequisite for the accurate prediction of mountain weather. This study investigates the skill of the COSMO model at 1.1 km grid spacing in simulating the thermally driven local winds in the Swiss Alps for a month-long period in September 2016. The study combines the evaluation of the surface winds in several Alpine valleys with a more detailed evaluation of the wind evolution throughout the depth of the valley atmosphere for a particular location in the Swiss Rhone valley, the town of Sion. The former is based on a comparison with observations from the operational measurement network of MeteoSwiss, while the latter uses data from a wind profiler stationed at Sion airport. It is found that the near-surface valley wind is generally well represented for the larger Alpine valleys, except for the Rhone valley at Sion. The reasons for the poor skill at Sion are investigated and shown to be attributable to several factors. One of which is a too strong cross-valley flow reaching down to the valley floor and displacing the daytime up-valley wind. A second factor is the particular local valley geometry. It is shown that an increase of the initial soil moisture and the use a finer horizontal grid spacing results in an improved simulation of the diurnal valley wind at Sion.