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Improving high-resolution atmospheric simulations of local weather using in-situ realtime observations from small unmanned aircraft

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Observations from the SUMO, a small unmanned aircraft, are used to improve very high resolution simulations of local weather for chosen locations in Iceland. Without the observed vertical profiles the atmospheric model fails to reproduce the observations of winds, temperature and pressure from the SUMO aloft as well as at the surface from a small mesonet of automatic weather stations, even at a horizontal resolution of 500 m. For the case presented here the winds aloft in the lee of Mt. Esja (900 m) were observed on 15 July 2009 with the SUMO as a part of the international MOSO-project in Iceland. The observed vertical profiles up to approx. 1500 m are used to nudge the atmospheric simulations of the ARW-model at 9, 3 and 1 km as well as at 500 m. The observed synoptic winds at mountain top level were weak from the northeast and near to perpendicular to the mountain ridge. Nevertheless, the observed low-level winds in the lee were strong, gusty and oriented down the mountain slopes, with far weaker winds found further aloft and even near mountain top level. The observed wind maximum does not reach the surface thus making only surface based observations inadequate in describing this situation correctly. In spite of the relatively weak winds at mountain top level the observations from the SUMO indicate gravity wave activity aloft. This is verified by the atmospheric model nudged by the SUMO-observations which reproduces a localized weak gravity-wave induced downslope accelerated flow with a maximum in wind speed at approx. 100 m in the lee of the mountain. This wind maximum is weaker and more diffuse a short distance further downstream. Without the observed vertical profiles the atmospheric model fails to capture the observed atmospheric flow, both at the surface and aloft, in a relatively large region in the lee of the mountain. With the system developed, observations from the SUMO may be feed in realtime into the ARW-model for improved operational forecasting of local weather, e.g. in complex terrain.