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On the potential of improving numerical weather prediction by real-time assimilation of atmospheric data from an Unmanned Aerial System (UAS).

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With the ever increasing computer power as well as the recent miniaturization of electronic components, new possibilities within meteorological research and forecasting emerge. On one hand, modern numerical weather prediction (NWP) systems allow for very high resolution simulations and on the other hand new instrument platforms make in-situ measurements more readily available. The latter are not only important for validation of NWP products, they also bear a potential of improving the NWP products themselves through data assimilation. Unmanned aerial systems are one example for platforms with large potential towards the desired improvements in the future. With their unique flexibility, relatively user friendly and cost efficient operation, these systems are capable of providing a data coverage in both space and time not achievable by conventional instrument platforms.

At hand, we have the Small Unmanned Meteorological Observer (SUMO), an UAS developed at the Geophysical Institute at the University of Bergen and the NWP system Weather Research and Forecasting model (WRF). The SUMO system, as currently configured, is an ideal platform for studies of meteorological phenomena on a local scale. One such example is sea-breeze, a phenomenon frequently occurring during summertime along coast lines throughout the world. The differential surface heating (cold ocean and warm land during daytime) responsible for the corresponding circulation is a finely balanced system and typically a challenge for NWP systems to accurately reproduce. A successful forecast of e.g. the position of the sea-breeze front may prove crucial in the event of e.g. an accidental release of poisonous chemicals. Another highly relevant phenomenon is down-slope wind storms. For such winds, a slight difference in the atmospheric stratification can imply vastly different wind regimes on the lee side of the mountain accounting for wind speed discrepancies of 10 m/s or more. In this study we demonstrate how numerical weather forecasts using the atmospheric model WRF can be improved by assimilation of SUMO data for two cases of the described weather phenomena that occurred in Iceland, summer 2009.

The examples mentioned above are related to a central future application of the described concept for search and rescue (SAR) operations, where the accuracy of a short-term weather forecast may prove vital. A system that applies this concept, named SARWeather, is currently under development at the Institute for Meteorological Research in Iceland. SARWeather provides high-resolution, on-demand weather forecasts where optional SUMO data, fed live from the field, can be assimilated in the WRF model to improve the forecast.