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Tall tower or mountain top measurements?

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Resolving the regional transport and distribution of greenhouse gases in the troposphere is a key topic that challenges both modelers and experimentalists. A dense network of measurement stations would be required, in particular including measurements at high elevation to better represent the entire lower troposphere, and not only small-scale local conditions in the near-surface atmosphere. While this can be achieved by tall towers, also mountain top stations (e.g. Schauinsland, Brocken) and other stations at high elevation (e.g., Mouna Loa, Jungfraujoch) are often appropriate, due to their extended concentration footprint. However, especially over complex, mountainous terrain, the transport of atmospheric gases and their spatio-temporal distribution is difficult to predict due to the development of thermally induced local wind patterns and boundary layer processes.

Therefore, the main goal of our study is to test to what extend boundary layer processes at the surface and local wind patterns close to the ground at a mountain top site influence the ambient greenhouse gas patterns compared to measurements taken at a similar altitude but at a tall tower site. To this end we use measurements from the Zugerberg mountain top station, located at a pre-Alpine mountain ridge (987 m a.s.l., 4 m above ground) exposed to the prevailing synoptic winds in Switzerland, and compare these measurements with a neighboring tall tower site (Beromünster radio broadcast tower with its top at 1014 m a.s.l., 217 m above local ground level, and $\approx$500 m above the Swiss Plateau). The Beromünster tall tower is located at a distance of only 30 km from the mountain top station as the bird flies, and hence a direct comparison minimizes confounding factors that are not related to the tall tower vs. mountain top position of the measurements. Both stations are part of the CarboCount CH greenhouse gas observation network (http://www.carbocount.ch) initiated for long-term monitoring and modeling of greenhouse gas fluxes at a regional scale in order to achieve a better understanding about CO_2 and CH4 fluxes and their response to climate. We will present first direct comparisons of measurements obtained from continuously calibrated laser absorption spectrometers to quantify the atmospheric concentrations of carbon-dioxide and methane, but also from meteorological sensors and turbulence measurements. Data from the sensors at the two stations will be used to address the following question: can a mountain top station provide similar quality of data and spatial representativeness as a tall tower for the investigation of atmospheric patterns of greenhouse gases at diurnal to seasonal scale?