Recent developments in observing the Ny-Ålesund atmospheric column and beyond

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Detailed, continuous observations of the thermodynamic structure, clouds, aerosols, trace gases and radiative effects in the Arctic are crucial in many ways. Such observations allow for a better understanding of the Arctic atmosphere and the corresponding processes but are also essential since they can be used as a reference for model evaluation. Within the project E02 of $(AC)^3$, we exploit the detailed information provided by the various remote-sensing and in-situ instrumentation at Ny-Ålesund, Svalbard. Ny-Ålesund is here of particular interest since it is located in the North Atlantic atmospheric transport gateway to the Arctic and is located in the region where Arctic warming is most pronounced. In this presentation, we will a) highlight recent developments in observing the Ny-Ålesund atmospheric column, b) look at the variability of atmospheric variables on the local scale and c) also move to larger spatial scales setting Ny-Ålesund also in context to the MOSAiC and COMBLE experiments.

In particular, this will be:

a) IR emission measurements allow to distinguish aerosol types. Combined with the aerosol lidar Karl, which provides altitude information of the aerosol layer, the origin of the aerosol can be determined to some extend by backward trajectory calculation. We present results obtained for aerosol events in 2020.

b) We study the spatial variability in integrated water vapor around Ny-Ålesund by utilizing azimuth scans performed by the microwave radiometer HATPRO. Areas of increased (decreased) moisture were identified based on deviations from the mean. Together with auxiliary data, the variability in humidity is associated with wind direction, boundary layer dynamics, and surface conditions in order to better understand the processes modifying atmospheric moisture on local scale.

c) With seasonal dependence, the amplified warming in the Svalbard region is modulated both by northward advection of warm and moist air masses and air mass transport from the Central Arctic. We identify a trend in the occurrence of Marine cold air outbreaks over Fram Strait in spring, and present a related Lagrangian case study linking the Ny-Alesund column with corresponding observations of the MOSAiC expedition.

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