



## **A new setup for combined turbulence and radiation measurements using a tethered balloon in the cloudy Arctic**

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Arctic boundary layer clouds modify the surface energy budget as well as the vertical profiles of turbulent and radiative energy fluxes between the surface and the free troposphere. Thus, cloud radiative effects and their imprints on the cloud dynamics are key to quantify the processes leading to Arctic Amplification. However, collocated observations of turbulent and radiative energy flux profiles in the Arctic boundary layer are challenging and very scarce.

Therefore, we developed a combined modular setup to measure vertical profiles of turbulence and radiation energy fluxes using a tethered balloon. Turbulent fluxes of heat and momentum were measured with a hot-wire and an ultrasonic anemometer. Broadband sensors measure the solar and terrestrial irradiance profiles from which heating rate profiles were derived.

Data from three Arctic field campaigns north of 81° (ACLOUD/PASCAL in 2017, PAMARCMiP and AO18-MOCCHA in 2018) are presented to illustrate the potential of the measurements. Vertical profiles have been recorded under different meteorological conditions: a low stratocumulus cloud layer, multilayer clouds and surface-based inversions in cloudless conditions. For those cases, interesting examples of interactions between clouds, radiation and turbulence are discussed.

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