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A field deployment apparatus for observing the stable isotope signature of water vapour from kinetic fractionation during evaporation in Arctic conditions

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There are critical knowledge gaps in non-equilibrium (kinetic) fractionation during cold and dry conditions. It is the aim of this work to thoroughly investigate stable water isotope fractionation under conditions associated with Cold-Air Outbreaks (cold and dry), focusing on diffusion fractionation factors and their dependency on temperature and humidity. This includes reevaluating previously estimated diffusion fractionation factors, with the goal of reinterpreting secondary isotope parameters (d-excess and 17O-excess) as evaporation condition tracers. By making measurements in the lab and field, the current knowledge gap will be filled with empirical evidence.

Here we present a setup to acquire measurements from the field, under conditions comparable to those in previous laboratory studies. These field measurements will be made using novel measurement techniques and cutting-edge instrumentation. This includes the design and construction of a new field deployment apparatus: a rugged, modular system with a stable water isotope analyzer at its heart. It must be designed to withstand harsh Arctic conditions, while still facilitating transportation, installation, and use. Additionally, the system must allow for expansion and interaction with other components necessary to the success of our future field campaigns. Through this construction, we endeavor to reduce our field deployment siting limitations, and ensure that the data obtained in the field will be of high-quality. Ultimately, this data collection will put us closer to our goal of refining the interpretation of d-excess and 17O-excess as tracers for atmospheric water's source.