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Observing and documenting the snow surface processes creating the isotopic signal in the snow at Summit, Greenland

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Only a very limited understanding of the physical processes influencing the formation of the isotopic signal observed in the Greenland and Antarctica snow pack exists. Current knowledge is to a large extent based on essentially ad hoc assumptions and observed empirical relations. During the spring of 2011 a suite of state-of-the-art instruments were installed at the NSF-operated station, Summit, on top of the Greenland Ice Sheet. The instrument package includes measurements performed at several heights (from 0.1 m to 50 meter) above the snow surface by sonic anemometers, high precision temperature sensors, particle size and shape spectrometers, and isotopic water vapor spectrometers. To support the interpretation of the above snow surface measurements, an array of temperature and pressure sensors as well as inlets for measuring the interstitial isotopic water vapor composition were installed to a depth of 1.0 meter. We present here the setup and the preliminary results that have come out of the installed suite of instruments together with the projection of these observations. Especially we focus on the following three questions: 1) What is the variation in isotopic composition of vapor and accumulated precipitate caused by changes in moisture source conditions? 2) What is the influence of differing cloud microphysics on the isotopic composition of snow? 3) To what extent are these aspects of the atmospheric hydrology operating on time scales of seconds to seasons masked in the ice core record due to post-depositional processes. The instruments installed at Summit will be continuously operated for the following three years thereby providing key information of how these processes evolve seasonally.