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Summer cloud and precipitation properties at Utsteinen, Dronning Maud Land, Antarctica, measured by ground-based remote sensing instruments

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A unique comprehensive observatory on meteorological-cloud-precipitation interactions has been built at the new Belgian Princess Elisabeth station, situated on the Utsteinen ridge, at the foot of Sør Rondane mountains in East Antarctica (http://ees.kuleuven.be/hydrant). The instruments already installed include an automatic weather station (AWS) and three ground-based cloud and precipitation remote sensing instruments (ceilometer, infra-red pyrometer and 24GHz vertically pointing radar). The cloud and precipitation instruments have been operating during three summer periods (2009-2010, 2010-2011 and 2011-2012), while the AWS has been operating almost continuously since February 2009 through present time. The measurements are combined in order to obtain basic statistics of clouds properties (height and cloud base temperature), their radiative forcing, as well as frequency and vertical extension of snowfall events, together with the meteorological situation at Utsteinen. Measurements during the first two summer campaigns showed that cloud base temperatures ranged between -20^{0}C for low-level clouds (1-1.5 km agl) and -35^{0}C - -40^{0}C for midlevel clouds (2-4 km agl). The 1-3 km height range was found to have the highest cloud frequency. Synoptic events with and without snowfall have been related to the water vapor transport and local cloud properties. One of the analyzed storms with snowfall in February 2010 showed a two-day evolution with low-level and mid-level clouds observed during the first day, forming multiple layers with short periods of light precipitation, and lowering cloud bases during the second day followed by snowfall and blowing snow. Increase in the cloud base temperature associated both with warm air advection and cloud base lowering (to 1-1.5 km agl) before the snowfall resulted in significant increase in downwelling longwave flux (up to 20 W m^{-2}) recorded by the AWS pyrgeometer. While ceilometer measurements are limited during the storm due to the signal attenuation by the falling and/or blowing snow, the radar measurements indicated that the depth of precipitating layer ranged from 1 km to at least 3 km agl (the limit of the radar vertical resolution). Analysis will be completed with the new data from the recent Antarctic summer season 2011-2012. With this new observatory, we aim at improving our understanding of the Antarctic hydrologic cycle and accumulation