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Snow estimation based on manual snow measurements and airbone snow surveys (GPS system from helicopter)

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Manual measurements are traditionally carried out two or three times a year to estimate snow reserves for fields. Strict requirements are imposed on the accuracy of these snow estimates. Having good models is important, but equally important is knowing the actual snow quantity. The aim of the project was to test an airborne system (Ground Penetrating Radar, GPR) for mapping snow, and to investigate whether it is an appropriate technology for use in operational hydrology. The measurements were taken during the spring of 2008. Snow measurements were taken using the airborne GPR system from a helicopter and through manual measurements. Both sets of measurements were taken along a marked line of approx. 1.9km, referred to as the 'Reference Line'. In the case of manual snow measurement, snow depth and density were measured. Approximately three snow depths were measured every 50 metres, giving a total of around 124 snow depths, and five density samples of the snow were also taken. In the case of radar, measurements were taken every 25 centimetres, giving a total of 7325 estimated snow depths based on the travel time (TWT (ns). In the case of the radar measurements, the density was calculated on the basis of the signal amplitude. For each measurement, the amplitude varies according to the properties of the snow; equally ice has an amplitude and the density of ice is of course known (917 kg/m^3). Based on the measured amplitude and its relationship to the reference amplitude of ice, the density was calculated for each snow depth. A comparison shows that the average snow depth for the manual measurements was 2.51m, while the corresponding figure for the radar measurements was 2.57m. The average density of five manual measurements was 386 kg/m^3, while the average density calculated from the amplitude was 350 kg/m^3. The estimated water equivalent of the snow for the entire Reference Line based on manual snow estimation was 974mm, and for radar measurement 899mm. This gives a discrepancy of 8%. Such differences can have important consequences for the estimation of snow reserves in a small field, but for a large field this figure represents an acceptable discrepancy. The reason for the different results is that the measurement techniques are different, so there will always be a discrepancy (relatively small) between manual measurements and airborne radar measurements.