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In situ geophysical monitoring of liquid water movement in an Alpine snowpack from self potential signals

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Modelling and monitoring seasonal snow is critical for water resource management, flood forecasting and avalanche risk prediction. Snowmelt processes are of particular importance. The behaviour of liquid water in snow has a big influence on melting processes, but is difficult to measure and monitor non-invasively. Recent work has shown the promise of using electrical self potential measurements as a snow hydrology sensor. Self potential magnitudes can be used to infer both liquid water content of snow and bulk meltwater runoff. In autumn 2018, a prototype self potential monitoring array was installed at Col de Porte in the French Alps, alongside full hydrological and meteorological measurements made routinely at the site. Self potential measurements were taken throughout the following winter, with manual snow pit data obtained in spring 2019. A physically-based snow hydrology model was run for the winter, and an electrical model was coupled to the snow model to create a synthetic set of self potential observations. These synthetic observations were compared to the observed self potential magnitudes to evaluate the effectiveness of the snow model, and to investigate the potential for using the self potential array as part of a coupled geophysical monitoring and modelling system.