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Terrestrial radar observations of snow on Alpine slopes

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Remote sensing of snow with active and passive microwaves has a long tradition. Terrestrial instruments are used to investigate the interaction of snow with microwaves at selected locations, while air- and space-borne sensors are used to image a larger area. While the terrestrial instruments are usually doing point measurements, the satellite based instruments have defined observation geometry and observation schedule. These constraints hamper the potential to investigate dynamic processes in the snowpack spatially, especially of slopes. Terrestrial imaging radars such as the GPRI (GAMMA Portable Radar Interferometer, Werner et al. 2012), overcome some of these constraints due to their portability and image acquisition time of less than 30 seconds and the possibility to do repeat acquisitions within minutes. The radar image is acquired by the GPRI while rotating the antennas around the vertical axis. Image resolution is 0.95 meters in range and 6.8 m at 1 km range in azimuth (proportional to range). The acquired radar images are complex and have phase and amplitude information per image pixel. Recent campaigns conducted in the Swiss Alps are covering dry and wet snow conditions as well as measurements before and after an artificial avalanche release.

The high density of acquired data allows to investigate the backscatter behavior spatially with time. Due to the coherent nature of the data it also allows to investigate the spatial distribution of the interferometric coherence with time. Combined the information can be used to track changes in the snowpack due to wind drift and melting but also the location of free riders and changes due to avalanche release. Furthermore the stacking of phase changes allows to produce displacement maps of the creeping snow.