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mGEODAR – a new mobile radar for avalanche mass movement monitoring

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Radar imaging has become increasingly important in either the detection of avalanches or in the scientific characterization of the avalanche flow. Detection radars usually base on the Doppler radar principle that is sensitive to the velocity of moving object but lack sufficient resolution which can be circumvented with frequency-modulated pulsed radars. We present a new radar device as a follow up of the successful GEODAR radar that suit the need for both applications – low resolution detection and high resolution observation. While the original GEODAR is permanently installed in the full-scale avalanche Test site “Vallée de la Sionne" in Valais, Switzerland, our new device is much smaller and can be deployed in fast response to the metrological forecast and avalanche situation. Currently the mGEODAR is installed at Nordkette ski resort above Innsbruck that is known for its frequent artificial avalanche releases. The new radar features a versatile frequency generation scheme using direct digital synthesis and can be quickly reprogrammed into a low-resolution detection mode for continuous data recording that switches to a high-resolution observation mode as soon as an avalanche is detected.

Beside the radar system itself, avalanche data are presented of the winter season 2020/21. A focus is on small to medium sized avalanches that are just on the limit to develop into a powder snow avalanche which is characterized by surging in the intermittent frontal region. Connecting the radar data of the dynamic flow evolution with snow conditions will lead to drivers of this flow regime transition. The snow conditions are taken from nearby weather stations and manual snow profiles but also from the radar itself. A continuous scanning of the resting snow cover in the avalanche path during the season further allows snow cover monitoring. This application allows to identify new snow fall, warming and wetting of surface layers as well as diurnal melt-freeze cycles.

The radar data should be consequently used for model validation, calibration, and development. With the current measurement campaign of small to mid-sized avalanches, we hope to close a gap in data availability for those events as they are increasingly the object of simulation scenarios, but current modelling and simulation tools are usually calibrated for larger and extreme events. In the future, we expect the mGEODAR radar to be deploy on other gravitational mass-movements phenomena like soil slides and rock-fall.