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Radar-based mesocyclone detection and tracking in alpine regions

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Radar-based mesocyclone detection is a successful framework to identify rotation in convective storms in Doppler wind measurements. Existing algorithms are mainly tailored to radar scan strategies that allow for high Nyquist velocities and thus reliably dealiased wind fields. In Switzerland, where the Alps cover a large portion of the country, radar measurements are notoriously difficult and the current scan strategy favours a high measurement frequency and large range coverage over the Nyquist velocity.
To reliably identify rotation in measurements with low Nyquist velocities, we propose a novel approach to use the raw, folded velocity data. The rotation detection is based on identifying congruent azimuthal shear groups. Azimuthal shear from velocity folds is corrected for. To avoid using the actual velocity field, rotation strength is estimated based on the Stokes theorem, integrating azimuthal shear.
Dealiasing velocity is particularly challenging in high-shear environments and low data coverage, as is often the case for single convective cells. Errors in dealiasing may introduce artificial shear regions or remove significant data due to continuity violations. Basing rotation detection on raw velocity makes use of more data and does not introduce artificial shear. It is an approach that is independent of the configuration of the radar network, as it only utilises the Nyquist velocity of each scan and does not depend on the processing chain.