9.4 DERIVING AND COMPOSITING MOTION FIELDS SPEED AND QUALITY CHALLENGES

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In weather radar data, atmospheric motion vectors (AMV's) can be extracted using two alternative approaches: by using Doppler measurements directly, when operationally available, and by detecting apparent, visual motion in consecutive images of reflectivity. Both approaches involve challenges. Doppler measurement is beam-directional, hence principally one-dimensional, and further subject to ambiguity problem caused by aliasing (wrapping, folding) around the Nyquist velocity range. Detection of visual motion depends critically on applied window scale and level of detail in image frames. In addition, there are challenges shared by both approaches, like essentially three-dimensional structure of original velocities and definition of prevailing motion field in the presence of local phenomena like convection.

Aiming at renewing the current radar-based short-time precipitation forecast scheme "Tuliset" in the Finnish Meteorological Institute, we have tested optical flow based methods for deriving motion field. Two requirements have proven central at this stage. Firstly, computational complexity of any algorithm candidate should be analysed and fitted to operational (five-minute) production cycle. Secondly, quality control should be applied for both in preprocessing input and in the actual computation to ensure smooth, reliable vector fields. The performance of the end products precipitation forecasts depends directly on the quality of the vector input.

In this paper, we present how two-dimensional atmospheric motion fields generated from Doppler data and optical flow algorithm can be combined smoothly using quality information. That information is obtained by combining input quality fields and mathematical uncertainty of the motion vector computation. While these motion fields are somewhat different by nature motion of hydrometeors vs. motion of precipitation area the key assumption is that these fields complete each other when combined appropriately. We demonstrate the performance of the suggested methods in variable types of precipitation.