Rejuvenating refractivity processing: A radar meteorology story (an intertwined tale of hardware, propagation, processing, and weather)

*Frederic Fabry[1], Daniel Hogg[1], Ya-Chien Feng[2]

1. McGill University, 2. NCAR

Doppler radars have the potential to use ground targets to estimate the refractive index of air near the surface. Few forecasters can use that information directly, and enthusiasm for that new measurement has been low (mea culpa!) primarily because of 1) the complexity of the processing needed to obtain refractivity information up to a limited range and especially 2) the labor-intensive work required to obtain reliable measurements. Yet in the context of data assimilation, refractivity can provide a key constraint on humidity for convective but also mesoscale models if the data from many radars are combined.

To help resolve this problem, the 20-year old processing approach used to estimate refractivity by radar is being rejuvenated:

- The flat Earth approximation of the original algorithm was replaced by an approach where varying topography and target heights are specifically taken into account in an attempt to retrieve refractivity at a specific level above the surface;

- The retrieval approach makes better use of past information as first guess for the initial retrieval. An attempt to handle the aliasing of phase directly in a variational framework by considering all possible solutions and weighting them based on their probability of occurrence failed miserably. We hence chose to simply freshen the original code that attempts to compute the slope of phase change with range;

- If time permits, we will automate the task of target selection and tuning and that of meteorological calibration so as not to require human decision-making. Instead of relying on two one-time process, target selection and tuning becomes a continuing process in an attempt to account for changes in targets on the ground; calibration can also be made a continuing process and now relies on longer-term comparisons between surface data and radar retrieval instead of hoping for a “perfect” situation of uniform N.

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