5.10 INFORMATION SPARSENESS, A KEY OBSTACLE TO RADAR DATA ASSIMILATION IN CONVECTION

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Radar is our best instrument to monitor storms; data assimilation is our best method to merge information; numerical forecasting is our best forecasting tool. So why are a) simple nowcasting approaches beating numerical forecasting for a couple of hours, b) the skill of numerical forecasting aided by radar data assimilation dropping so rapidly in the first forecast hour, and c) assimilated radar data showing positive effect for much shorter periods (e.g., about two hours) than other instruments (e.g., six hours for surface observations)?

In an attempt to answer these questions, we tried to understand what made the assimilation of radar data assimilation more challenging and limiting than that of other data sources. The rapid drop in the skill of radar data assimilation with forecast time suggests that radar data assimilation has difficulties affecting the fields that will shape storm development in the future. Reasons why this arises include:

- Over 90+% of the troposphere, the only information available from radar is no precipitation, largely limiting new information to a few areas where either the analysis or the observations have precipitation;

- The air feeding the storms and controlling their environment in a few hours largely come from regions of no precipitation; hence its properties are largely unconstrained directly by radar. Any innovation must hence come from distant correlations with precipitation areas;

- Though there is significant correlation between overall storm intensity and thermodynamic properties, the correlations computed at the scale of model grid points are limited because the field of precipitation and its errors have much more energy at smaller unpredictable scales compared to other fields. Limited ensemble sizes and localization then prevent such weak long-distance correlations to be fully utilized. And as model resolution increases, this problem becomes worse.

In the end, it appears that it is the sparseness of the radar information, and the inability of many assimilation approach to deal with this sparseness, that currently limits the usefulness of radar data assimilation.