Towards a Better Use of the Time Dimension and Periodic Revisits of Near-Real Time Radar Products

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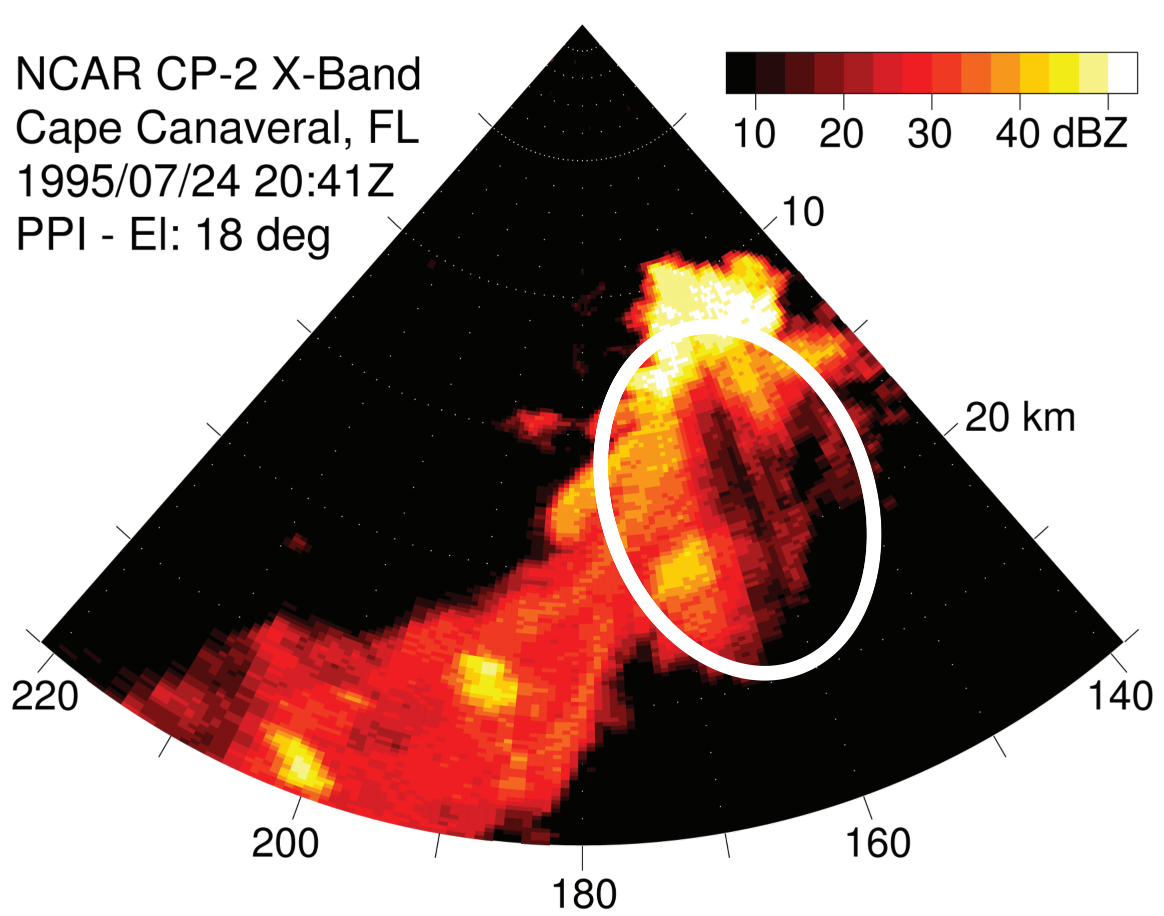
1) Current Mindset and Its Limitations

- We collect and process each atmospheric scan without considering past information (unless the product explicitly calls for it, as in 6-hr precipitation totals)
- Any information from past scans is ignored, even if the past scans represent a better understanding of the weather situation
- In short: we do not take advantage of new information to improve past scans

2) How Can We Better Use the Time Dimension?

Why would we want to use past and near-future data for products at time *t*?

- Some radar data at time *t* can be of poor quality (e.g., due to attenuation, clutter)
- One way to fix this data is to use information from other times when it could be beneficial, as in the example below



This scan shows dramatic attenuation. By incorporating reflectivity information from earlier (non-attenuated) scans, these data could become more accurate input for accumulation products or for assimilation into numerical models.

3) Which Products Deserve Regeneration?

- The use of near-future data requires product regeneration

Two criteria for regeneration:

i. The new information must improve the product
ii. The resulting product must still have value

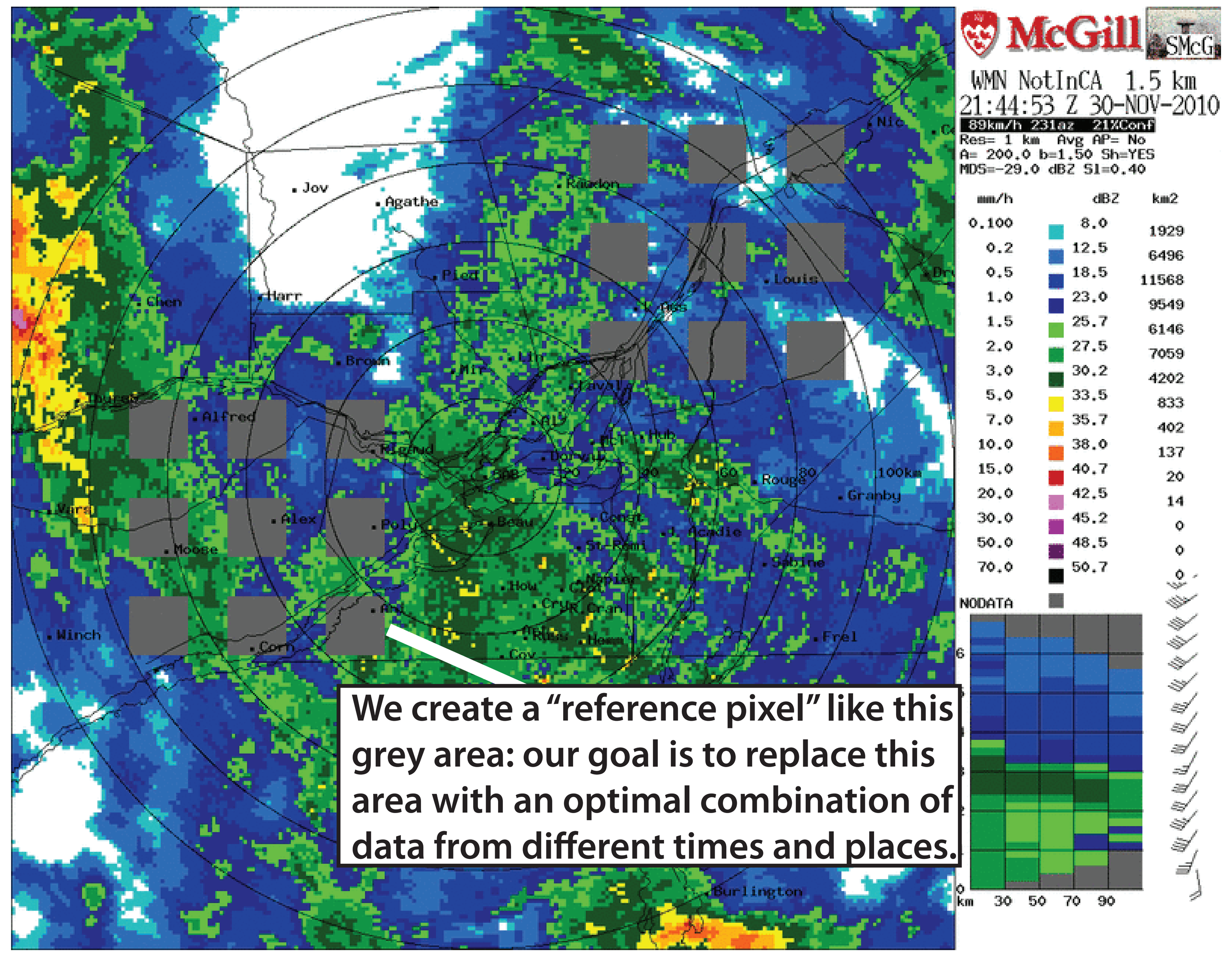
Which products would benefit from regeneration?

- Rainfall accumulations
- Nowcasting products
- Severe weather products relying on cell tracking
- Any products involved in data (re)assimilation

4) What Do We Need to Get There?

What is the value added by using other times?

- To know this, we must understand how best to use data from the past and near-future to enhance or replace data at time *t*
- Requires information about errors and correlation of errors

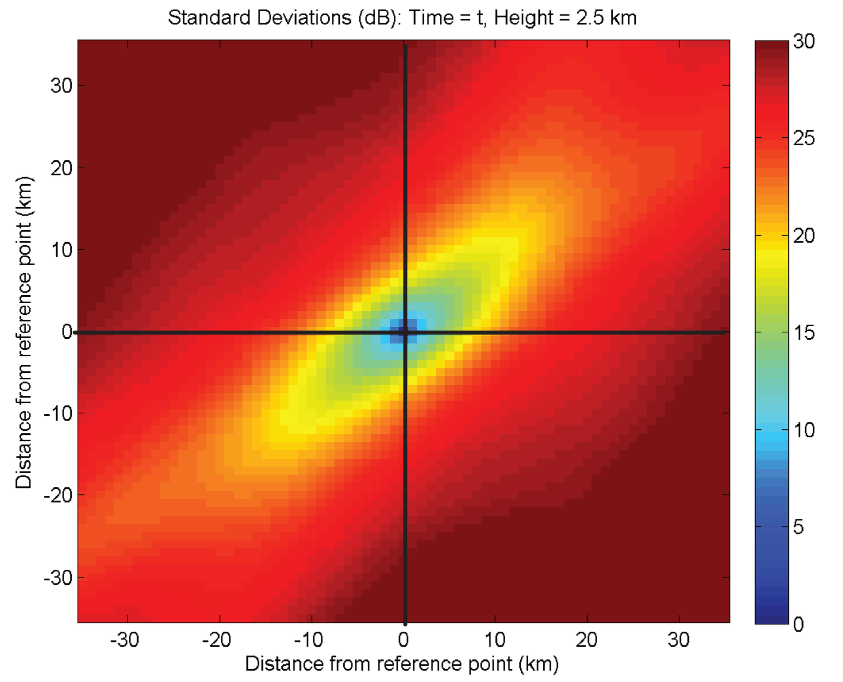


We create a "reference pixel" like this grey area: our goal is to replace this area with an optimal combination of data from different times and places.

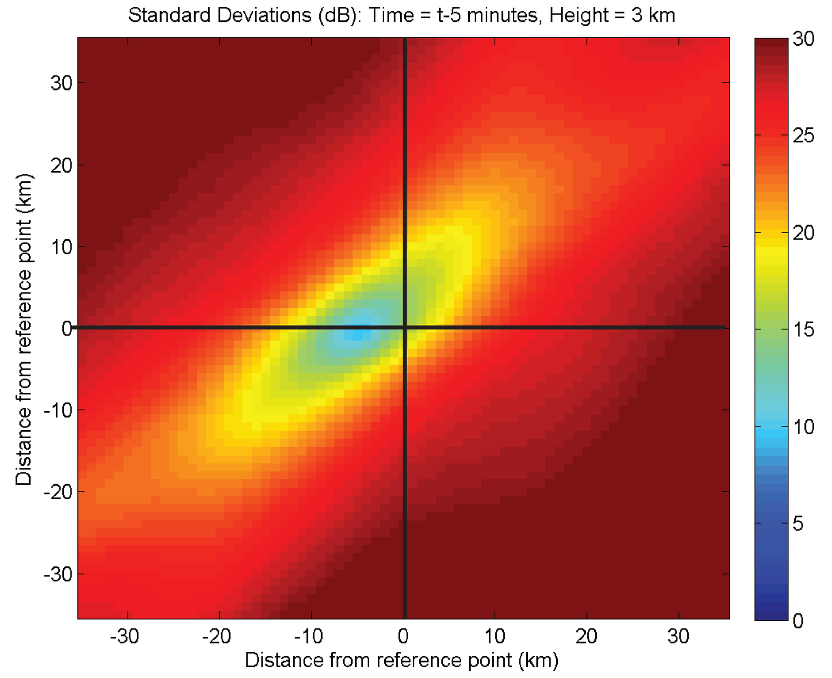
5) Where Are We Now?

What is the best possible combination of past and near-future reflectivity data that can replace or supplement information at time *t*?

- Look at multiple case studies featuring convective or widespread (stratiform) precipitation
- Correct for average vertical profile of reflectivity, and remove data corresponding to known ground clutter
- Create maps displaying the average difference in dB between a given pixel and its surroundings in time and space



This image shows the average standard deviation as a function of distance from a reference point. For instance, the yellow colour corresponds to a standard deviation of about twenty dB. If we were to replace a given pixel with data that falls within the yellow band, we would expect errors of around twenty dB.



For this convective case, five minutes earlier, the lowest errors (blue) occurred several km to the west and 500 m higher than the reference pixel.

Convective	Height (km)	Horizontal Distance (km)
T+/-25	4.3	7.6
T+/-15	3.2	4.8
T+/-5	1.3	2.0
Widespread	**Height (km)**	**Horizontal Distance (km)**
T+/-25	1.4	15.7
T+/-15	1.0	9.4
T+/-5	0.6	3.5

- This table includes data from six short convective events and one 36-hour stratiform event
- For each event, the "optimal" point with least error was found for 5, 15, and 25 minutes before and after the reference time *t*
- The table shows how far, in height or horizontal distance, we would have to go in order to get an equivalent error at time *t*
- For example, in our convective cases, if we replace our reference pixel with one from time *t*-15 minutes, we get the same result as we would if we took a point 3.2 km above the reference pixel, or at a horizontal distance of 4.8 km from the reference pixel, at time *t*
- This shows the value added by considering the time dimension

6) What's Next?

What is the optimal way to blend this information?

- What errors occur by taking data from different points at different times?
- How are these errors correlated?

How can we increase the size of the datasets?

- Examine more case studies (especially in the case of stratiform precipitation), and create new tables and figures like the above, sorted into groups based on more specific features of the data - i.e., height of the bright band, prevailing wind direction
- Expand the study to include other radars
- Study the error distribution of variables such as Doppler velocity

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The views expressed herein are solely those of McGill University.

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