Image Muting of Mixed Precipitation to Improve Identification of Regions of Heavy Snow from Radar Data

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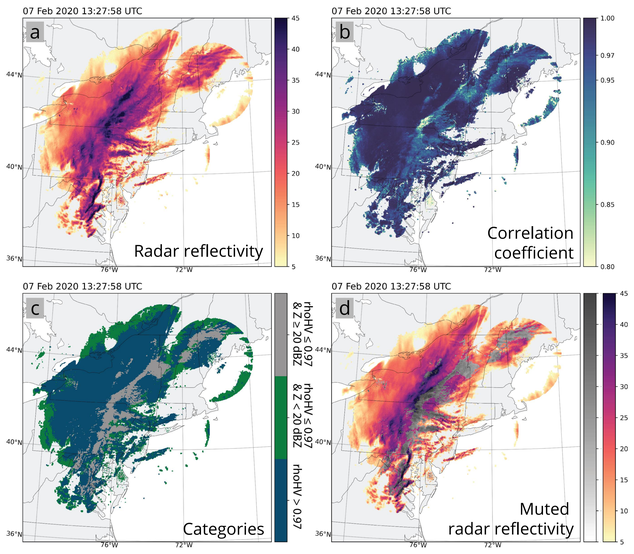
Motivation

Radar reflectivity is commonly used to observe the intensity of precipitation. Higher reflectivity values, usually indicate higher precipitation mass per unit volume. But in winter storms, regions of heavy snow can be mistakenly identified in locations where mixtures of rain, snow, and partially melted precipitation locally increase reflectivity. To aid interpretation of winter storm radar reflectivity maps, we employ a visualization technique using the correlation coefficient field (RHO_{HV}) to reduce the visual prominence of mixed precipitation.

Description	Increase number of ice particles	Increase size of ice particles	Mixtures of partially melted ice, ice, and rain
Change to mass/volume of precipitation	Increases	Increases	No change
Change to reflectivity value	Increases	Increases	Increases
RHO_{HV} value (Giangrande et al. 2008)	~1	~1	< 0.97

Methods

RHO_{HV} is ~1 in regions of uniform hydrometeors (i.e. only rain and only snow) and decreases in regions where there is an increasing diversity of hydrometeor orientations and shapes (i.e. mixed precipitation). Regions where the correlation coefficient is less than 0.97 (Giangrande et al. 2008) and the reflectivity is greater than 20 dBZ are identified as mixed precipitation and are "muted' in gray scale in panel d below.



Applications

Image muted composites compared to high resolution aircraft data and ASOS

Multi-radar reflectivity maps with muting based NEXRAD 0.5 elevation angle PPIs, vertically-pointing X-band radar (EXRAD) data from the NASA ER-2 aircraft deployed during the NASA IMPACTS 2020 field campaign, and NOAA ASOS data for Albany, NY.

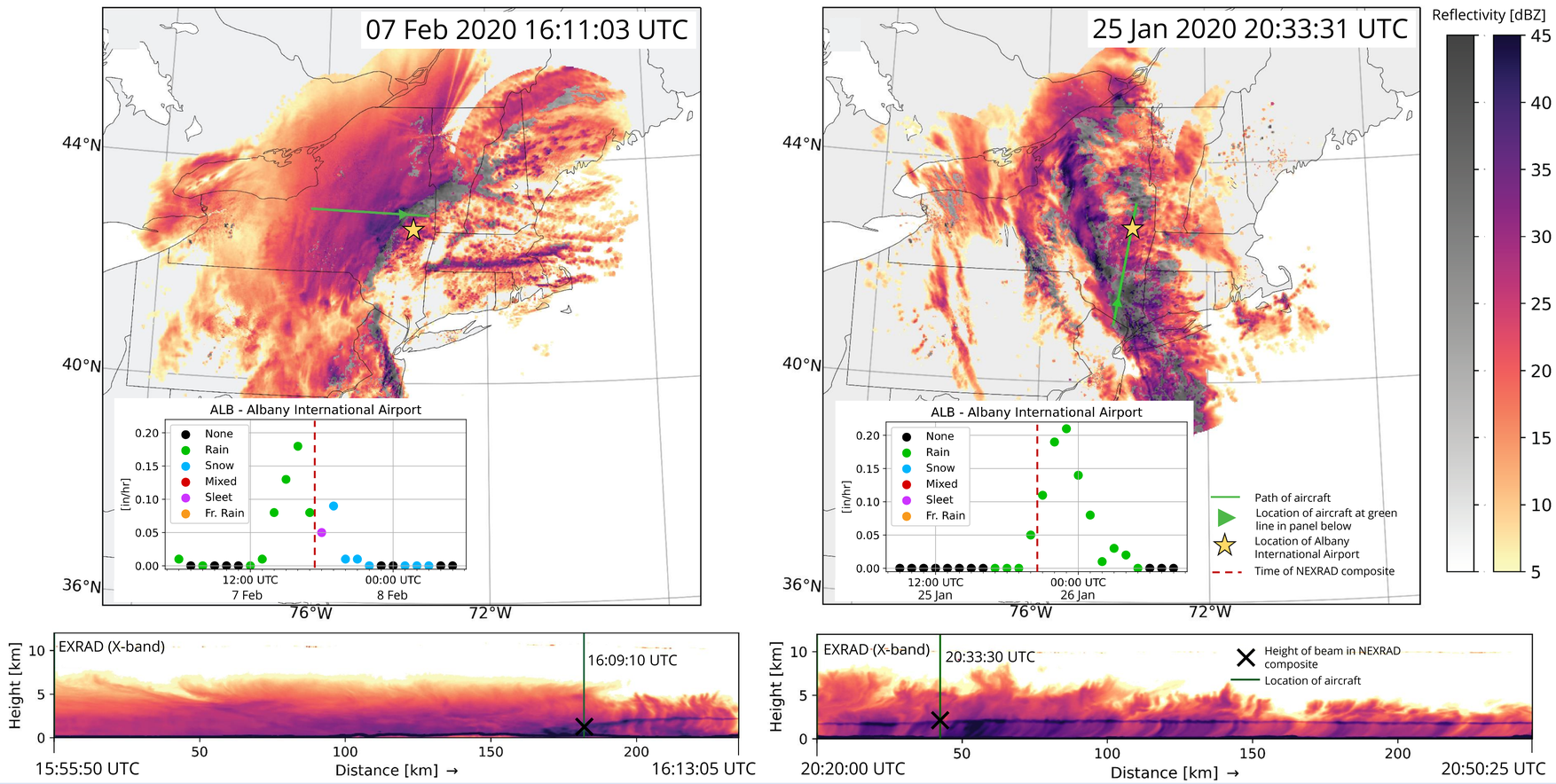
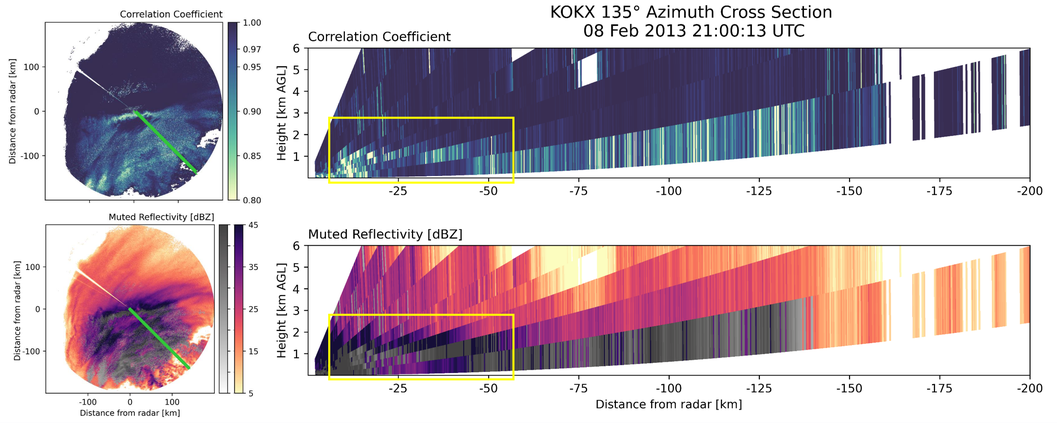


Image muted RHIs constructed from NEXRAD volume scans

We have also applied this technique to RHIs constructed from the full set of PPIs in a volume scan. This example is from the Long Island, NY (KOKX) radar during a winter storm on 8 February 2013. The green line in the PPIs corresponds to the RHI azimuth. Rather than a simple flat or tilted melting layer, this storm had a 3-D "arc-like" mixed precipitation structure (yellow box) associated with horizontal temperature gradients spanning 0 deg C.



References.
Giangrande, S. E., and A. V. Ryzhkov, 2008: Estimation of rainfall based on the results of polarimetric echo classification. *J. Appl. Meteor. Climatol.*, **47**, 2445–2462.

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Animated versions of all figures available at QR code link or **bit.ly/3DuKtz4**