Uncertainties and Recommendations for Multi-Doppler Radar Vertical Velocity Retrievals

Mariko Oue, Pavlos Kollias
Stony Brook University
Aleksandra Tatarevic, Kirk W. North
McGill University
Ann M. Fridlind, Toshihisa Matsui
NASA Goddard Institute for Space Studies
Application of Radar Forward Simulator to Evaluation of Multi-Dopler Retrieval

**Input**
WRF simulated $u, v, w, Q, N$
This study: MC3E, dx=500, 20-sec outputs

**Output**
Simulated retrieval parameters
This study: multi-Doppler radar retrieved $w$

**Forward Model (CR-SIM)**
$Zhh$, $DV$, $SW$, $Zvv$, $Zdr$, $Kdp$, $Ah$, $Av$, and $LDRh$ for each hydrometeor type at each gridbox.
Account for radar elevation angles.

**Instrument Model (Convert to CFRadial)**
Sampling geometry, sampling volume, attenuation, and sensitivity.

**Retrieval Model**
Gridding using smoothing factor.
3DVAR multi-Doppler radar wind retrieval.

Compare and investigate uncertainties from error sources separately
Multi-Dop Retrievals for Mesoscale Convection

Sources of errors include:
- Time differences amongst PPI scans
- Gridding (e.g. smoothing factor)
- Radar characteristics (e.g. beam width)
- VCP (e.g., elevations, locations)
- Particle fall speed estimate

Fast volume scans (< 1 min) by 3-4 radars (e.g., sector scans, phased array radars) at high spatial resolution can provide best performance.

Non-attenuation reflectivity (e.g., NEXRAD) should be used to estimate particle fall speed.

WRF simulation:
MC3E of 2011/05/20 12:18:00, DX=DY=0.5 km, 50 km x 50 km domain, 20-sec outputs
Multi-Dop Retrievals for Isolated Convection

WRF simulation:
- Houston 2013/06/08 17:25-17:30,
- $DX=0.5$ km, $30 \text{ km} \times 30 \text{ km}$ domain,
- 20-sec outputs
- Distance between cloud and radar is $\sim 25-30$ km.

- Time delay in PPI scans can cause underestimation of updrafts and tilted vertical structures of radar observables.
- Use of 2 radars may not enough to quantitatively capture the updraft core.
- Fast volume scans ($< 1$ min) by 3 radars can provide best performance.