Development of Hydrometeor Classification Algorithm for Korea Precipitation Systems

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Introduction

1. Korea Meteorological Administration (KMA) has installed dual polarized radar since 2014.
2. In addition there is a plan to replace existing single polarized doppler radars to dual polarized radars until 2019.
3. The Weather Radar Center (WRC) in KMA is providing real time hydrometeor information, which is developed by National Center for Atmospheric Research (NCAR). However, this hydrometeor classification (HC) algorithm is not quite suitable for precipitation systems in Korea.
4. We have improved a membership function of the HC algorithm based on NCAR technique and have developed a HC algorithm of 7 classes of hydrometeors including non-precipitation and 6 precipitation types.
5. In particular, the classification increased as 3-Dimensional temperature data from KLAPS (Korea Local Analysis and Prediction System, WRF based weather prediction model developed by KMA) was used for high resolution of space and time.

Data

Radar Network of KMA

Basic specifications of Baengnyeongdo radar (BRI)

- Manufacturer: WSR-88D
- Transmitting Side: Klystron
- Band: S
- Effective observation range (km): 240
- Range resolution: 250
- Observation period (min): 10
- Elevation angles (°): 0, 15, 30, 45, 60, 90
- Minima height (m): 107

Korea Local Analysis and Prediction System (KLAPS)

- Space resolution: 5 x 5 km grid, 23 layer
- Time resolution: 1 hour
1. Select the grid point closest to the object to observe.
2. Interpolate two vertical temperatures closest to the point's height and use the value as temperature input data

Hydrometeor types

- Non-precipitation: Rain, Heavy Rain, Hail/Rain, Wet Snow, Dry Snow, Ice Crystal

Result

Case 1: 00UTC 28 November 2014 (Bright Band)

- Symbol: ● rain on the surface
- Bright band (Z = 35 - 42 dBZ, Zr > 1.25 dB, \( \rho_{HV} = 0.9 - 0.95 \)) is classified as wet snow.
- Wet snow is existed at about 1 - 2 km in altitude. Within this area 0°C of radiosonde is appeared at the height of 1.65 km.
- The \( \rho_{HV} \) value less than 0.7 at the edge of the precipitation echo is classified as non-precipitation.

Case 2: 10UTC 18 January 2015 (Snow & See Clutter)

- Snow: Z > 12 - 30 dBZ, Zr > 0.25 - 1
- symbol: snow on the ground
- Nearby radar site (Red Circle): Sea Clutter
- HC: Non-precipitation

Case 3: 1120-30UTC 10 October 2015 (Hail)

- Hail (diameter=1 - 2 cm) was observed in the east of Seoul.
- The hail echo (Z = 40 - 48 dBZ, \( \rho_{HV} = 0.25 - 0.75, \rho_{DR} = 0.99 \))
- HC: Hail/Rain (Red Circle)
- Rain came down in the surrounding area of the region where hailed. However, HC algorithm is classified as snow because the radar observed it at a high altitude.

Conclusions

1. The purpose of this study is to provide categorized hydrometeor information for Korea Precipitation Systems using polarimetric variables gained from dual polarized radars to prove extreme weather detection and precaution.
2. Hydrometeor classification algorithm were well matched with observation data from surface for the case of hail and bright band.
3. Korean hydrometeor classification algorithm will be improved through more case studies using various types of precipitation, and the achievement will be contributed for real time weather forecast.