Ice pellets (IP) and Freezing rain (FZ) occurred on 29 January 2016 in the Kanto region of Japan. This event was observed by the MACS-POL (MRI advanced C-band solid-state polarimetric radar) and 2DVD (2D-video distrometer) and recorded by several meteorological observatories (e.g., Mito; 60km NE from MRI) and some mountains.

We focused on the reason of Z_{DR} increment at refreezing level, and the dynamical characteristics to determine refreezing.

MACS-POL detected the refreezing from completely or partially melted snowflakes by \rho_{HV} (correlation coefficient) and Z_{DR} (differential reflectivity). On the other hand, 2DVD monitored two microphysical characteristics (Wet/Dry) of IP. It suggests that the increase in Z_{DR} corresponds to the slight flatness of wet IP.

VAD (Velocity Azimuth Display) analysis using doppler velocity of MACS-POL suggested that the refreezing corresponded to the downward wind area by enhanced convergence of the melting layer.

### 2.Data at MRI

**MACS-POL**
- Parameter: Ze, Ψe, Z_{DR}, ρ_{HV}, K_{DP}, (Φ_{θb}) ... [Normal/MTI]
- Frequency: 5370 MHz (C-band)
- Transmitters: GaAs Power FET (solid state)
- Peak Power: 3.5 kW
- Antenna diameter: 4 m (beam width 0.7°)
- Antenna speed: 4 rpm (max 10 rpm)
- Range gate spacing: 150 m
- PRF: 624 / 780 Hz (EL<8°) 936 / 1170 Hz (EL>8°)
- Pulse width: 1 μs (R<20km), 129 μs (R>20km) (EL<8°)
- Scan sequence: 4 min, RHI = 2. PPI = 13
  - (0.5°, 1°, 1.5°, 2°, 2.5°, 3°, 4°, 5°, 6.8°, 8°, 10.4°, 14°, 18°)
- Vertical Profile of AZ40

**2D-Video-Distrometer (2DVD)**
- Parameter: Diameter, Velocity, Oblateness, Shape, ...
- Sounding (47646 Tateno)
- Parameter: Temperature, Relative Humidity, Wind, ...

### 4.2 DVD

**Diameter-Velocity relation of rain and ice pellet period**

- IP and FZ (Rain at ground) observed separately.
- IP were reported under the condition
  - when High Z_{DR} (Low ρ_{HV}) line were lowered below Ze bright band top.
  - when second High Z_{DR} (low ρ_{HV}) line occurred.

**Time-series of MACS-POL Parameter and Dynamical component**

**4.3. The reason of Z_{DR} increase at refreezing**

[Average precipitation shape]

[Time-series of MACS-POL Parameter and Dynamical component]

**4.4. The dynamical characteristics at refreezing**

**TVS of MACS-POL Parameter and Dynamical component**

IP were observed under the condition
- Downward wind across melting layer toward sub-freezing zone (Z_{DR} > ~20 dBZ)