Sawada, M. and K. Ueno, 2021: Heavy winter precipitation events with extratropical cyclone diagnosed by GPM products and trajectory analysis. *J. Meteor. Soc. Japan*, **99**, 473-496. http://doi.org/10.2151/jmsj.2021-024

Plain Language Summary: The mechanisms for producing heavy precipitation regarding the structure of an occluding extratropical cyclone during the cold seasons were analyzed using the products of the Dual-frequency Precipitation Radar (DPR) onboard the Global Precipitation Measurement (GPM) core satellite and trajectory analysis on the European Centre for Medium-range Weather Forecasts atmospheric reanalysis data.

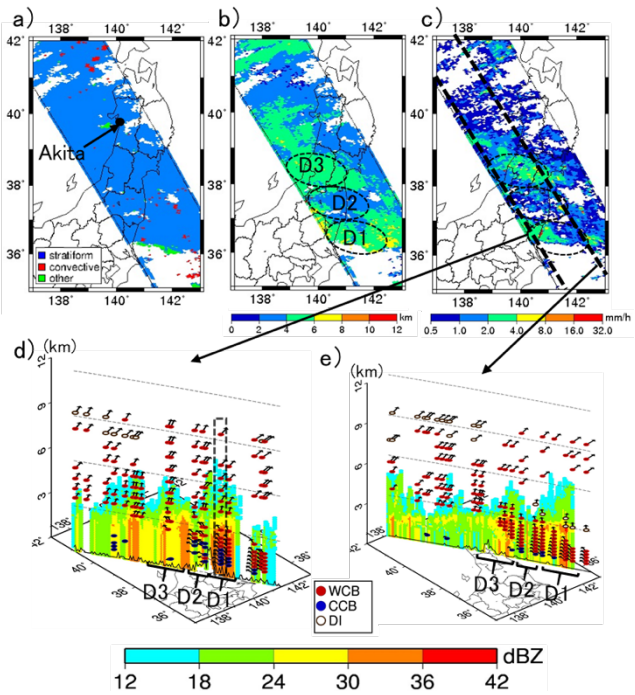

Figure 1. Distribution of a) precipitation type, b) echo-top height, and c) precipitation intensity at the surface for case α (December 11, 2015, 5 JST), produced by GPM-DPR observation. Vertical cross section of the DPR precipitation echo intensity along the southwest (d) and central (e) transect illustrated in (c). Marks with different-colored arrows on the cross sections correspond to the airstream with horizontal air parcels.

- Hourly precipitation changes at stations that recorded heavy precipitation were primarily affected by a combination of the warm conveyor belt (WCB), cold conveyor belt (CCB), and dry intrusion (DI).
- Wide-ranging stratiform precipitation east of the cyclone center was composed of low-level WCB over the CCB and upper WCB, and convective clouds around the cyclone center were associated with the upper DI over the WCB that provided an extreme precipitation rate at the surface.
- DPR products also identified deep stratiform precipitation in the cloud-head area behind the cyclone center with mid-level (near-surface) latent heat release (absorption) with increased potential vorticity along the CCB, making feedback intensification of the cyclone possible.