

Analysis of Particle Size–Velocity Distribution of Precipitation Using Latent Dirichlet Allocation

*ASAMI YAMASHITA¹

1. National Institute of Technology, Toyama College

In recent years, the frequency of severe weather events has increased, highlighting the importance of accurate precipitation analysis for disaster mitigation. Although electromagnetic remote sensing is widely used to estimate rainfall intensity, differences in scattering characteristics among precipitation types can degrade estimation accuracy. Consequently, automatic identification of precipitation particles based on observational data is essential. In this study, we apply Latent Dirichlet Allocation (LDA), a probabilistic clustering framework, to the particle size–velocity distribution (PSVD) obtained from ground-based measurements.

Observational data were collected using a Parsivel disdrometer installed on the rooftop of the National Institute of Technology, Toyama College. Each one-minute PSVD record was treated as a document in the LDA framework, where PSVD bins correspond to words and precipitation types to topics. To objectively determine the optimal number of clusters, the singular Bayesian Information Criterion (sBIC) was introduced.

The analysis indicates that the optimal cluster number is two, suggesting that the observed precipitation is primarily composed of rain and snow. The resulting clusters exhibit clear physical distinctions: one cluster is characterized by fast-falling small particles associated with rain, whereas the other represents slower and larger particles corresponding to snow. Moreover, Doppler spectra derived from each cluster reveal distinct velocity distributions, demonstrating that LDA effectively extracts meaningful precipitation characteristics from PSVD data.

These findings suggest that integrating LDA-based ground observations with Doppler radar measurements may enhance precipitation-type classification and improve rainfall estimation accuracy. Future work will extend the proposed method to longer observational periods.