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From Cloud Tops to Surface: Statistical Insights into Stratiform Microphysics over Germany and Türkiye

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This study presents a statistical analysis of stratiform precipitation events across Germany and Türkiye using quasi-vertical profiles (QVPs) derived from three C-band radars in Germany and five C-band radars in Türkiye, covering the time period from 2015 to 2020. The dataset allows for an in-depth examination of microphysical processes at all height levels from the dendritic growth layer, where precipitation is generated, to the melting layer and down to the surface. Comparative analysis highlights notable regional differences in precipitation profiles and microphysics, linked to the distinct climates of Germany and Türkiye. For instance, QVPs from Türkiye show higher values of specific differential phase KDP in the dendritic growth layer with deeper and colder cloud tops compared to Germany, linked to greater ice water content in Turkish clouds. Additionally, two radars in Türkiye exhibit decreasing reflectivity ZH from the melting layer to the surface while maintaining stable differential reflectivity ZDR, indicating evaporation effects, consistent with a drier climate region. A riming detection algorithm further reveals enhanced riming frequency in Germany compared to Türkiye, with the exception of a Turkish coastal radar at low altitude. The latter shows dominant riming processes in up to 30% of the events, similar to German observations. Interestingly, we observe a correlation between increased riming frequency and lower cloud-top heights, while no relationship is found between riming frequency and melting layer thickness. This analysis provides new insights into the varying dominant microphysical processes in stratiform precipitation and different climate regimes and enables in the next step an in-depth evaluation of numerical weather prediction models.

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