Improving rain retrievals from airborne Doppler cloud radar, with EarthCARE in mind

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Spaceborne cloud radar measurements from CloudSat have enabled major advances in global retrievals of light to moderate rain. However estimates of rain rate are sensitive to underlying assumptions, in particular to the rain drop size distribution; and retrievals of rain rates over land remain an outstanding challenge. The upcoming EarthCARE satellite mission will feature a Doppler cloud radar alongside lidar and radiometers: spaceborne Doppler measurements will provide an excellent opportunity to better constrain rain drop size, helping to reduce uncertainties in rain retrievals over both ocean and land.

In this study we explore how the new Doppler capability can be used to retrieve an additional parameter of rain drop size distribution, and we quantify the improvement in rain rate estimates. We use examples of airborne Doppler radar measurements made during the Tropical Composition, Cloud and Climate Coupling (TC4) field campaign in the eastern Pacific in 2007. Doppler radar measurements are included in a novel synergistic retrieval method to characterise rain rate and rain drop number concentration for a wide range of cases from light to heavy rain and from stratiform to convective regimes. These results will inform how we can best make use of the new Doppler measurements from EarthCARE.