Investigating autoconversion processes in liquid clouds using higher Doppler spectra moments

C. Acquistapace[1] , U. Löhnert[1], M. Maahn[1], S. Crewell[1], A. Hirsikko[2], P. Kollias[3]

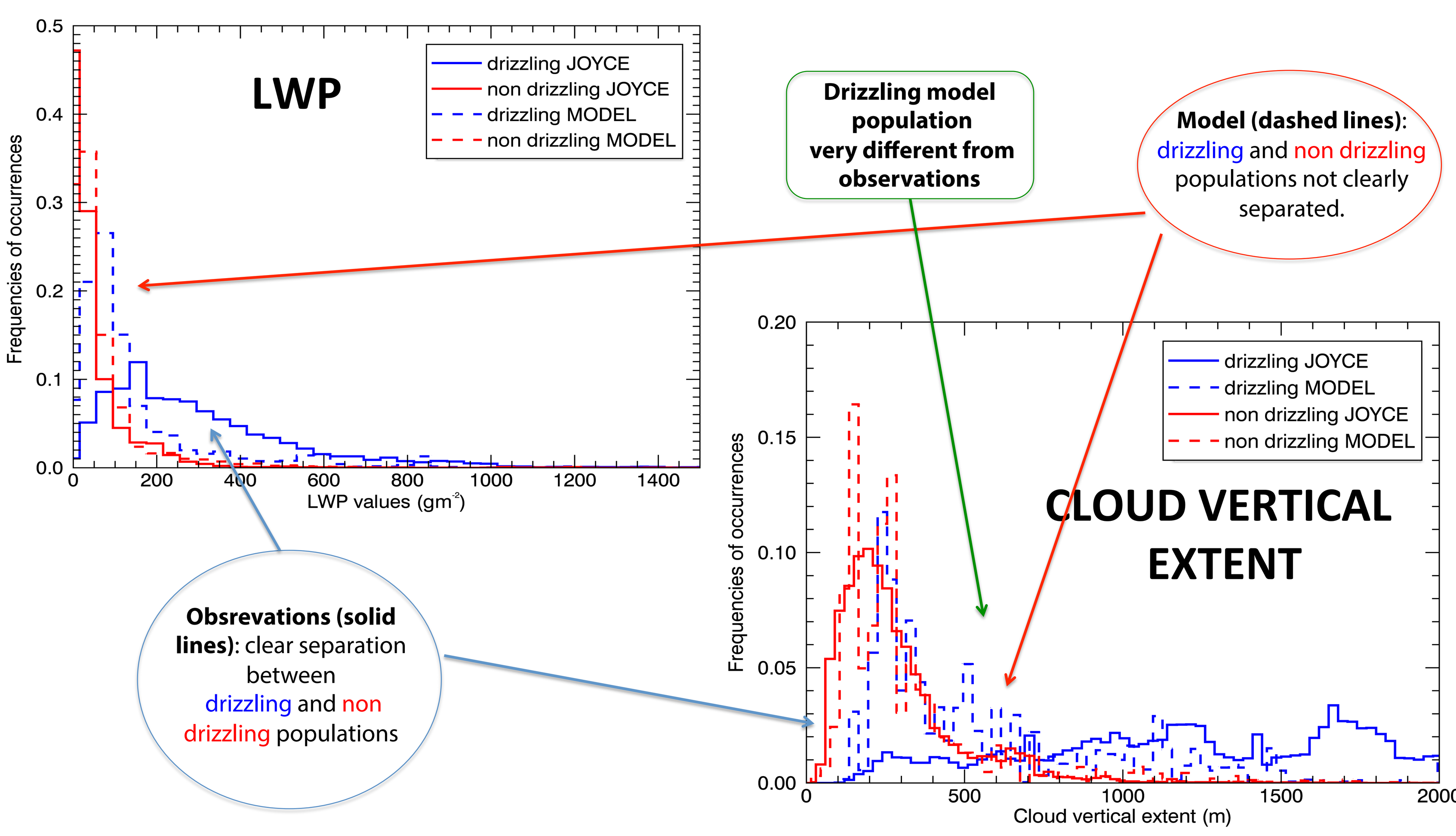
[1]Institute for Geophysics and Meteorology, University of Cologne, [2]Forschungszentrum Jülich GmbH, [3]McGill University, Montreal

1. Introduction: focus on autoconversion

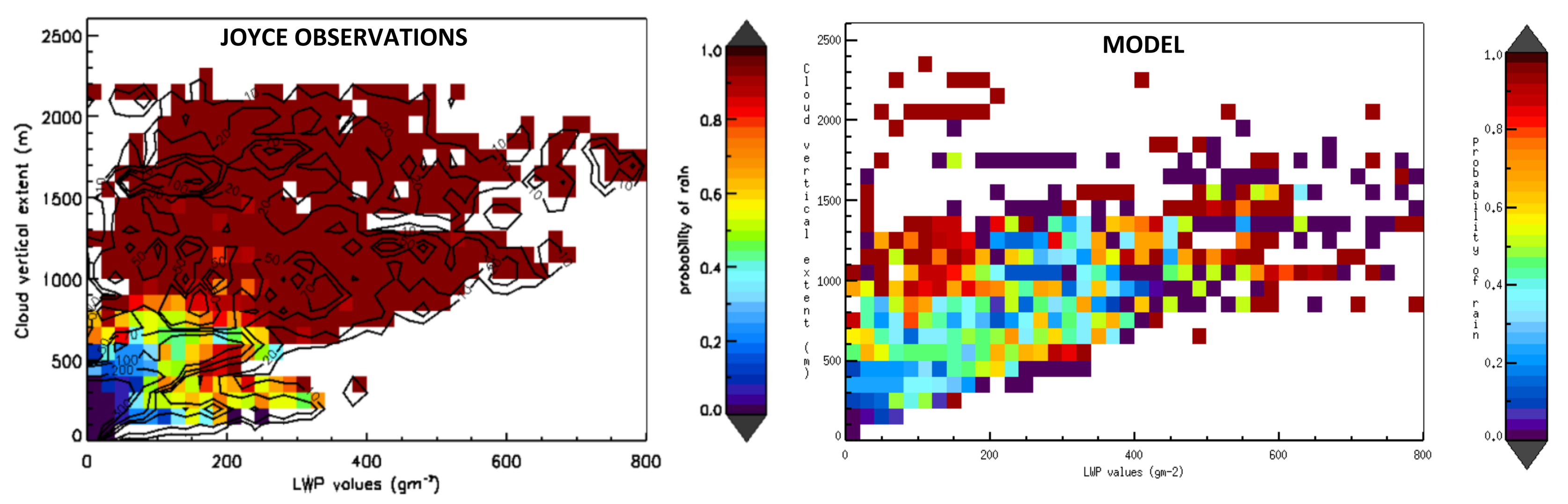
- **What is autoconversion?** Collision/coalescence between cloud droplets.
- **How to deal with it in models?** Parametrized subgrid scale process.
- **Where are the challenges?** Parametrizations are based on thresholds in liquid water mass mixing ratios (q_c) and number concentration (N); however they differ very much from each other, showing big uncertainties over the process as a whole.
- **What is the goal of this study?** Understand when and where in the cloud onset of precipitation occurs and improve model parametrizations.
- **How to get there?** Two different approaches:
  - *Statistical analysis of one year of measurements from JOYCE and comparison with corresponding COSMO.DE model data*: drizzling and non drizzling populations are determined on the basis of Cloudnet target categorization. Analogous populations for model data are calculated and compared with real data.
  - *Analysis of Doppler spectra skewness for case studies:* application of the technique described in Luke et al. 2012.

2. Comparing JOYCE measurements and COSMO model

SETTINGS	MODEL	JOYCE
Cloud type	Single layer liquid clouds	Single layer liquid clouds
Period	mar 12 - mar 13	mar 12- mar 13
Rainy columns	3590	18690
Non rainy columns	11505	15708
Categorization tool used	Categorization built on thresholds of mixing ratio	Cloudnet target categorization
Location	7X7 grid points over JOYCE	JOYCE supersite measurements
Dataset/instruments	German operational NWP COSMO-DE 3 hourly forecasts	Cloud radar, ceilometer, microwave radiometer measurements constrained by temperature profiles from NWP models + derived variables

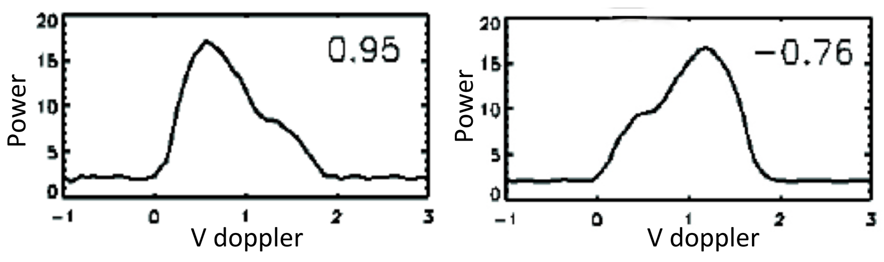


Probability of Precipitation (POP):



3. Improved precipitation detection

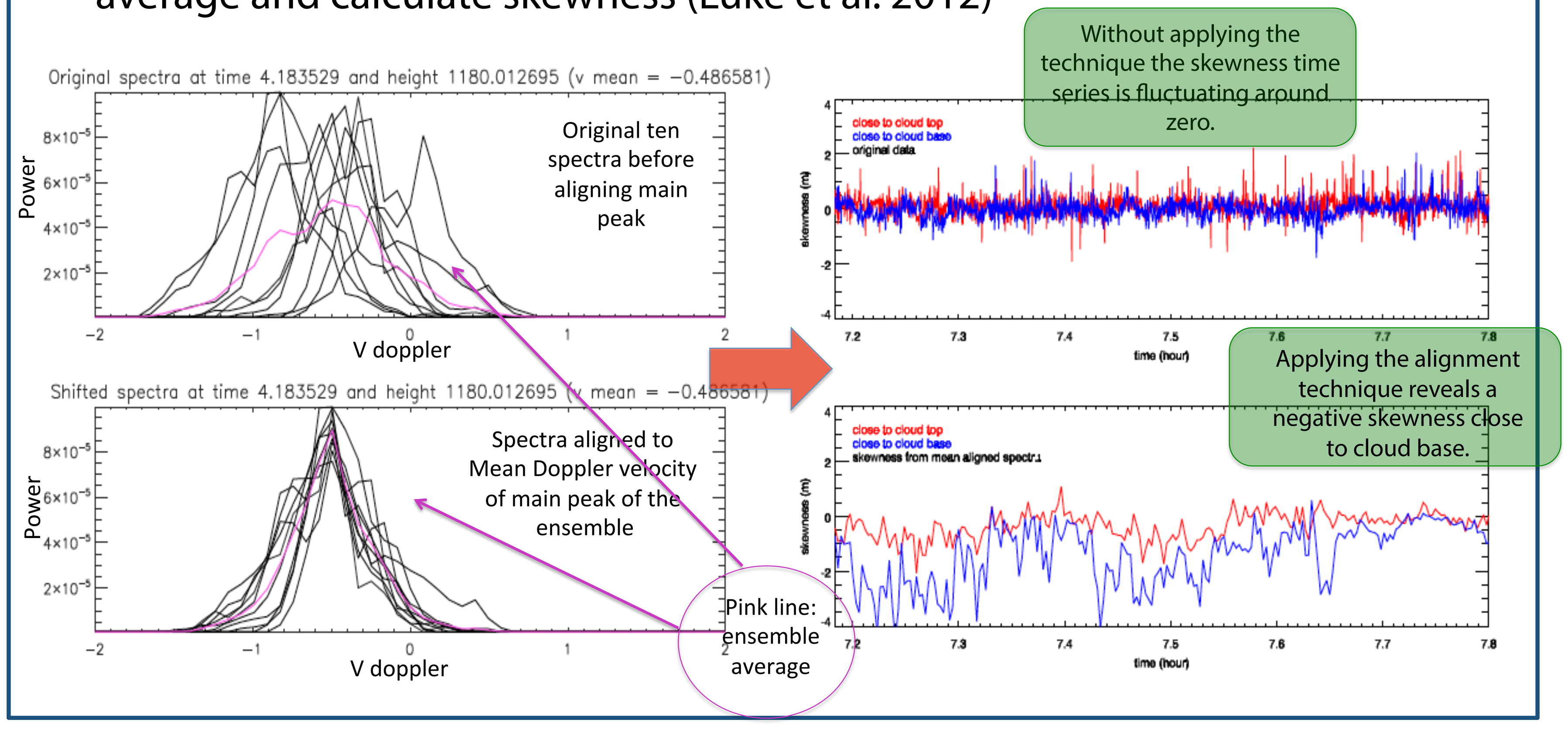
- **Skewness of cloud radar Doppler spectrum:** much more sensitive to precipitation onset



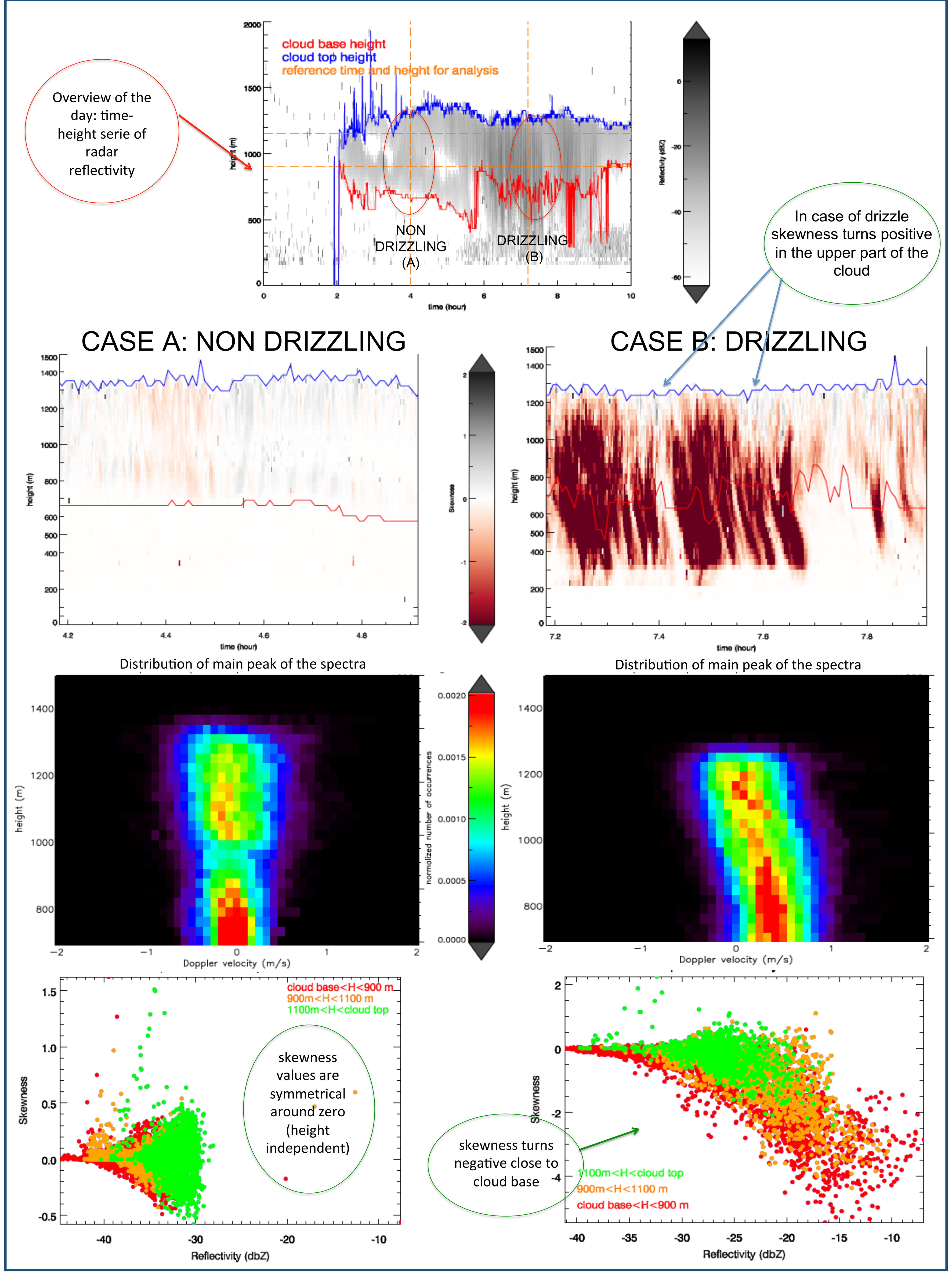
Skewness > 0 Drizzle appears, cloud droplets dominates the spectra

Skewness < 0 Drizzle dominates the spectrum

- **Technique**: align maximum peak of 10 consecutive Doppler spectra (int. time 1 sec), average and calculate skewness (Luke et al. 2012)



4. Skewness analysis: a case study (17/03/14, JOYCE)



Future work:

- Statistical analysis of skewness data, simulation of Doppler spectra starting from model data,
- Process study of autoconversion,
- Improve precipitation classification (Cloudnet).

contact: cacquist@uni-koeln.de