The Detection of Autoconversion Processes in Clouds using Ground-Based Passive and Active Microwave Sensors.

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Motivation and Data

Autoconversion is the process of transition between cloud droplets and drizzle and is deeply involved in the process of formation of precipitation.

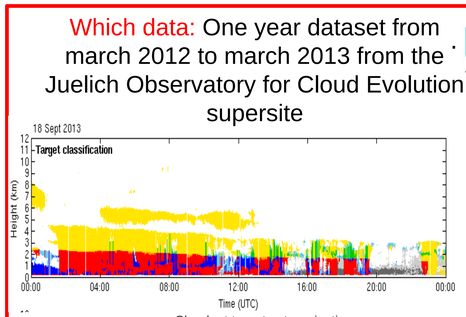
The retrieval of drizzle in clouds is still a major challenge in remote sensing especially when drizzle particles and cloud droplets are coexisting in the cloud.

Thesis aim

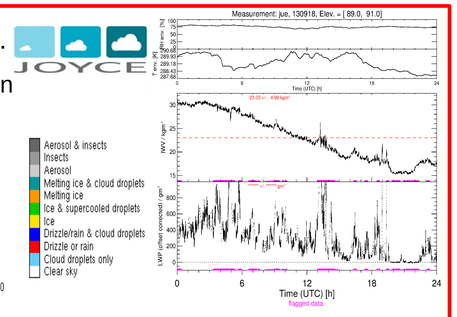
- Set up of an algorithm for the retrieval of the relevant drizzle parameters
- Evaluation of the description of the autoconversion processes in cloud models.

Leading idea of the initial stage of the project:
Provide some statistical features of precipitating clouds, basically trying to find out if a threshold in LWP values for the onset of precipitation exists: derivation of probability of having rain for a given LWP value.

Which data: One year dataset from march 2012 to march 2013 from the Juelich Observatory for Cloud Evolution supersite

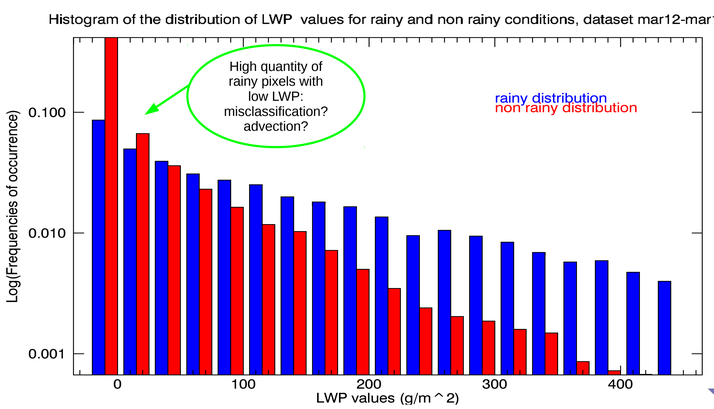


Cloudnet target categorization



MWR IWP and LWP measurements

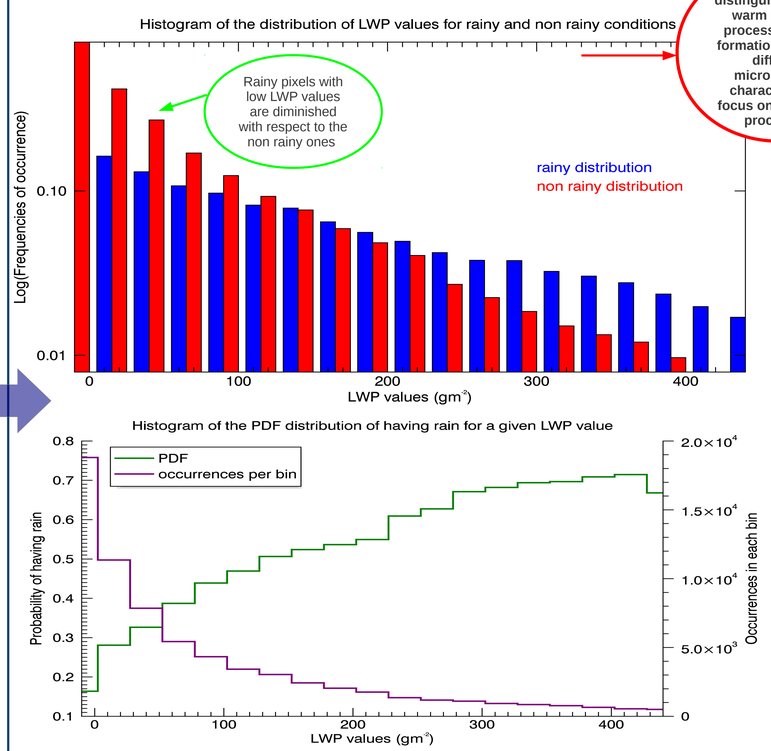
First rough attempt



First attempt:

- LWP zenith measurements from MWR radiometer
- Loop on time variable from cloudnet classification and flagging of the time value as rainy or non rainy on cloudnet target categorization basis
- Collection of the closest in time LWP value from MWR and subdivision of the values in two distributions (rain and no rain) depending on the flag.
- Derivation of the probability of having rain for a given LWP value.

Applying a clear sky filter...

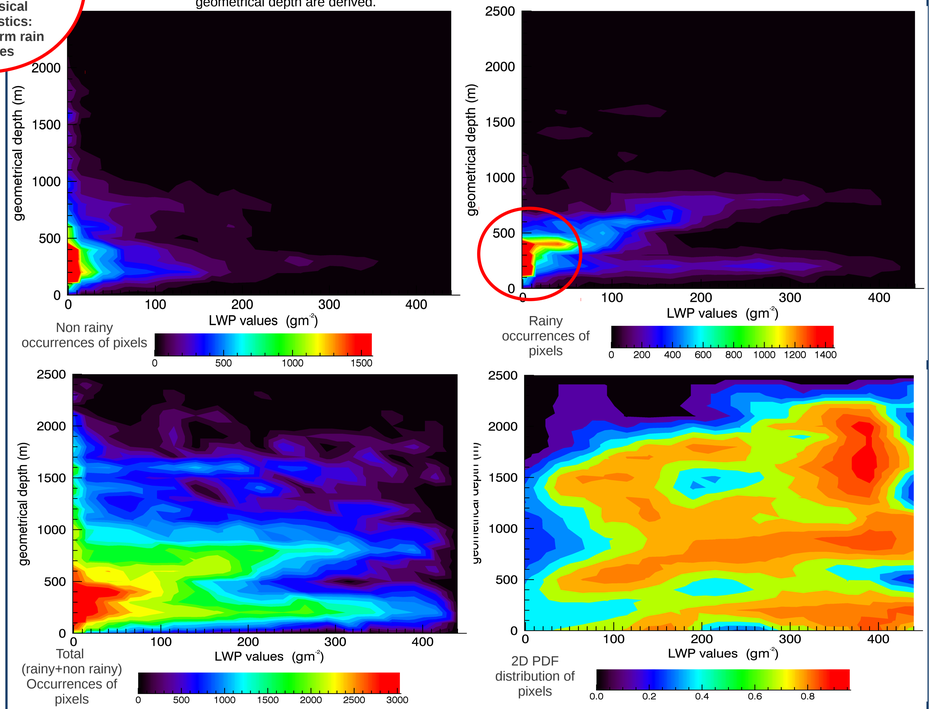


Still need to distinguish between warm and cold processes of rain formation that have different microphysical characteristics: focus on warm rain processes

Clear Sky Filter: standard deviation (STD) of LWP MWR values is calculated for every two minutes interval and if the STD > 2 g/m² the interval is collected as cloudy. LWP value is derived as mean value of the interval and rain/no rain classification is derived from cloudnet. Then, rain/no rain histograms and PDFs are derived as before.

Working on a warm cloud selected dataset...

Warm cloud dataset: selection of clouds after application of clear sky filter. Clouds selected are with small cloud droplets inside only (no ice), cloud top temperature greater than 0 ºC, without warm clouds above and with possibly ice clouds above at a distance greater than 500 m. For each cloud of the dataset cloud base and top, geometrical depth, categorization, LWP, date and time are collected, and 2D distributions of pixels and PDFs with respect to LWP and geometrical depth are derived.



OPEN PROBLEMS:2D plots still show a strong presence of rainy pixels at very low LWP values, which is anomalous. This spread of rainy pixels makes the LWP threshold identification challenging.

HOW TO SOLVE THEM? FUTURE WORK:

- New criteria for rain detection can be implemented (three consecutive rainy pixels adjacent to cloud base and removal of other cloudy layers above of any kind) and analysis of higher radar doppler moments (case studies) to derive additional rainy conditions to be fullfilled..
- Focus on doppler velocities to get information on how turbulence can influence rain formation in clouds.
- Focus on aerosol and its indirect effects at cloud base for supersaturation