



Characterization of mixed-phase clouds – description of ATR42 aircraft measurement within the COPS campaign

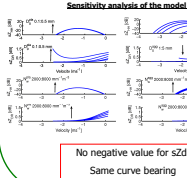
Y. Dufournet (aircraft PI), H. W. J. Russchenberg
Delft University of Technology, The Netherlands.

EUFAR activity - Principle

> Name of the project: OSMOC (Observation strategy for Mixed-phase Orographic Clouds) part of EUFAR(1) activities

> Main goal: Study of the microphysical properties of mixed-phase clouds (ice cloud with supercooled water layer embedded) within mid-level non-precipitating clouds during the COPS campaign using a synergy of remote-sensing and in-situ devices.

> General overview:

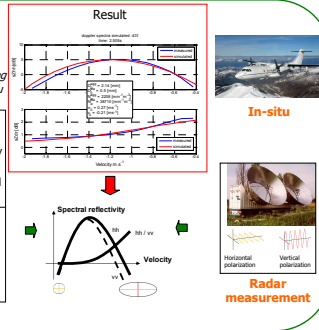


Particle characterization
density, relative permittivity, shape, terminal fall velocity

Distribution characterization
 $N(D) = N_0 \cdot f(D) \cdot \exp(-0.87 \cdot \frac{D}{D_0})$
 $f(D) = 3.07 \cdot \exp(-4.3 \cdot D)$
Distribution of the particle orientation

Microphysical model(4)

No negative value for sZdr
Same curve bearing



Instruments

ATR42 (SAFIRE(2))

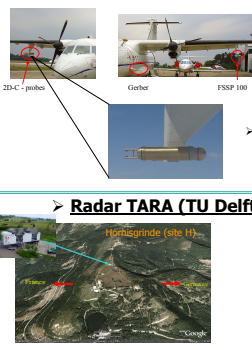
- Instruments:**
- basic avionics devices
 - chemistry probe
 - Gerber and king probe
 - FSSP100
 - 2 PMS 2D-C probes (oriented 90°)
- positioning measurements (lat, long, altitude)
meteorological measurement (T, P, H)
aerosols chemistry
LWC
droplet size distribution
Ice crystal distribution + 'shape' + particles orientation (processed in collaboration with C. DUROURE - LAMP)

> Data format:

- Quicklooks (Netcdf): 1 Hz
- data: 10 Hz

Quality check:

- Validation of the 2D-C data with Poldirad (along the first ascent leg)
- Validation of the wind with triangular shape



Other ground-based measurements:

Other devices will be used in the future to better characterize the meteorological situation and help to calibrate and validate the retrieval technique

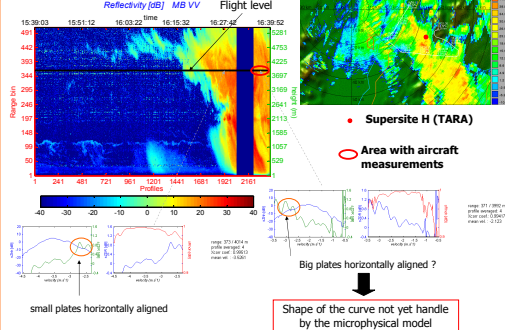
Aircraft campaign setup

- Ascent leg
- Horizontal leg(s)

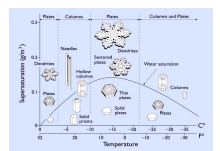
- Main setup:**
- 10 flight hours allocated by EUFAR (European Fleet for Airborne Research)
 - 5 flights performed following the same flight pattern (21/07 - 23/07 - 24/07 - 28/07 (2 times))
 - meteorological condition required: presence of mixed-phase region (mid-level clouds below 0°C temperature level)

Some first highlights

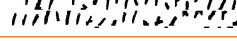
Different spectral product behavior within the same cloud region



Relation particle shape – temperature confirmed



Preferred orientation found within columns and plates



Future plan

- > **Within the next months:**
- with the first highlights; improvement of the model for cases which are not working yet + development of an automatic detection of mixed-phase region
 - when receiving calibrated in-situ data: comparison of the PSD retrieved with the technique and measured with in-situ data
 - with BAE146: work on the radar – in-situ data relation for other meteorological situation
- > **later:**
- use of other ground-based instruments to better validate the retrieval technique and work on a LWC retrieval technique using Lidar measurements

21/07

Rimed particle (collision of ice crystal and drops) → mixed-phase region!

Direct comparison between Tara data and in-situ measurements

Orographic effect?

Plenty of plates and dendrites

23/07

Golden day! in term of mixed-phase region

Seeding of pristine plates from cloud above?

Plenty of long columns (needles?) ~ 1 mm

Frontal activity dominating

No TARA data due to a technical failure

24/07

High rugosity exponent → rimed particles → mixed-phase region

Plenty of columns and dendrites during the flight

Frontal activity dominating

No TARA data due to a technical failure

28/07 (first flight)

Only water clouds → no ice crystal

1st and 2nd flights not interested for the EUFAR activity

Data required

- Calibrated PSD from the PMS 2D-C probe → used for validation of the products retrieved with the technique
- Calibrated in-situ data.
- In-situ data from the 29/08/07 (from the BAE146) → used to increase the data amount in order to get a better statistical evaluation of the retrieval technique (when presence of columns for example)

References:

- (1) www.eufar.net (OSMOC project)
- (2) www.safire.fr (ATR42 aircraft)
- (3) C.M.H. Unal et al., Combined Doppler and Polarimetric Radar Measurements: Correction for Spectrum Aliasing and Nonsimultaneous Polarimetric Measurements, J. Atmos. Oceanic Technol, nov.2004
- (4) A new technique to categorize and retrieve the microphysical properties of ice particles above the melting layer using radar dual polarization spectral analysis, accepted for publication in J. Atmos. Oceanic Technol.

