Cirrus cloud formation and break up

- When relative humidity with respect to ice (RHi) exceeds values of typically 140 %, cirrus clouds form by nucleation of ice crystals. Aerosol particles can lead to nucleation at lower supersaturations.
- Ice crystals in a supersaturated environment will grow by water vapor deposition.
- When supersaturation vanishes due to warming or sedimentation, ice crystals sublimate and clouds break up.

> How are evolution stages spatially distributed?
> How is this distribution influenced by atmospheric dynamics?
> What are their specific optical and microphysical properties?

Two cirrus cases obtained during ML-CIRRUS campaign 2014

Lee wave case 29.03.2014

- Driven by strong gravity lee wave
- Formation in fast uplift region
- Homogeneous freezing
- Nucleation path in-situ
- Lagrangian flight path against main wind direction
- Prominent horizontal distribution order

WCB outflow region 11.04.2014

- Warm conveyor belt outflow region
- Formation on longer time-scale
- Heterogeneous freezing
- Nucleation path: liquid origin and in-situ
- Lagrangian flight path along main wind direction
- Prominent vertical distribution order

Cloud properties show different distributions in both cirrus cases

Absolute humidity

Relative Humidity over ice

Lin. Depolarization ratio

Driven by strong gravity lee wave

Formation in fast uplift region

Homogeneous freezing

Nucleation path in-situ

Lagrangian flight path against main wind direction

Prominent horizontal distribution order

Warm conveyor belt outflow region

Formation on longer time-scale

Heterogeneous freezing

Nucleation path: liquid origin and in-situ

Lagrangian flight path along main wind direction

Prominent vertical distribution order

Identifying cirrus evolution stages

The Classification scheme employs temperature dependent relative humidity thresholds

HOM, HET, DEP, SUB

Airborne water vapor Differential Absorption Lidar (WALES) provides 2D cross-sections of:

- Water vapor
- Backscatter ratio BSR @ 532 nm
- Linear depolarization ratio @ 532 nm

Relative humidity over ice (RHi) is calculated using ECMWF temperature fields and WALES water vapor measurements.