Polarimetry **I**nfluenced by **C**CN a**N**d **I**NP in **C**yprus and **C**hile (**PICNICC**)

An assessment of hemispheric polarimetric contrasts and its relation to differences in aerosol load

Teresa Vogl, Heike Kalesse, Patric Seifert, Audrey Teissiere, Johannes Quaas
Collaborators: Rodanthi Mamouri (Cyprus University of Technology, Limassol, Cyprus), Boris Barja (University of Magallanes, Punta Arenas, Chile)

UNIVERSITÄT LEIPZIG

TROPOS
Leibniz Institute for
Tropospheric Research

DACAPO
PESO

Dynamics, **A**erosol, **C**loud
and **P**recipitation **O**bservations
in the
Pristine **E**nvironment
of the **S**outhern **O**cean

DFG

PROM

OUTLINE

1. Motivation + Hypothesis
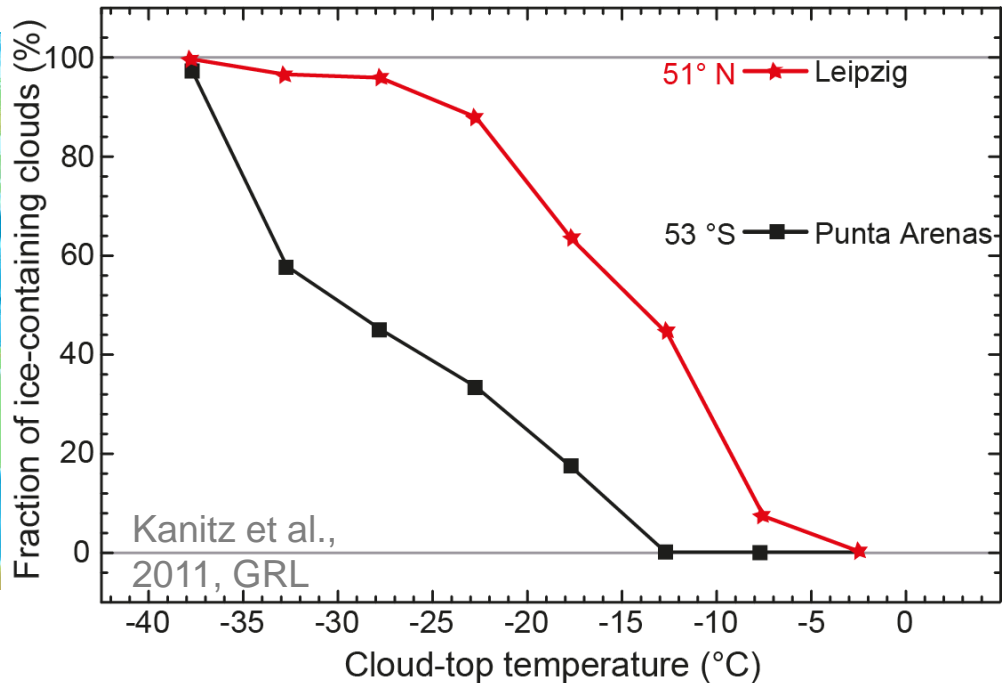2. CyCARE and DACAPO-PESO campaigns
3. Planned work packages for PhD1

MOTIVATION

- Clouds and aerosols are inseparably coupled
- There is a **strong spatio-temporal variability in aerosol** and cloud **properties**

Teresa Vogl, Heike Kalesse, Patric Seifert, Audrey Teissiere, Johannes Quaas   Kick-off meeting, Bonn, 17 October 2018   3
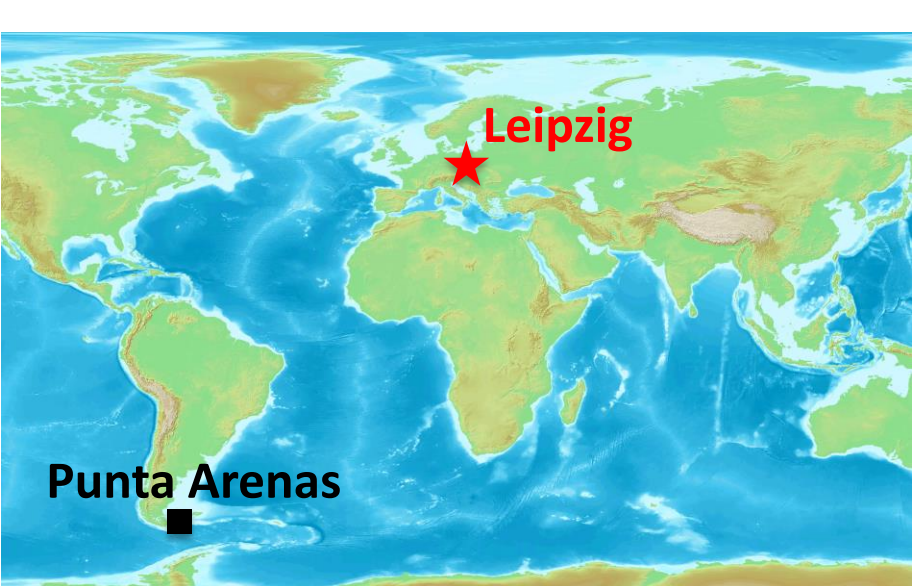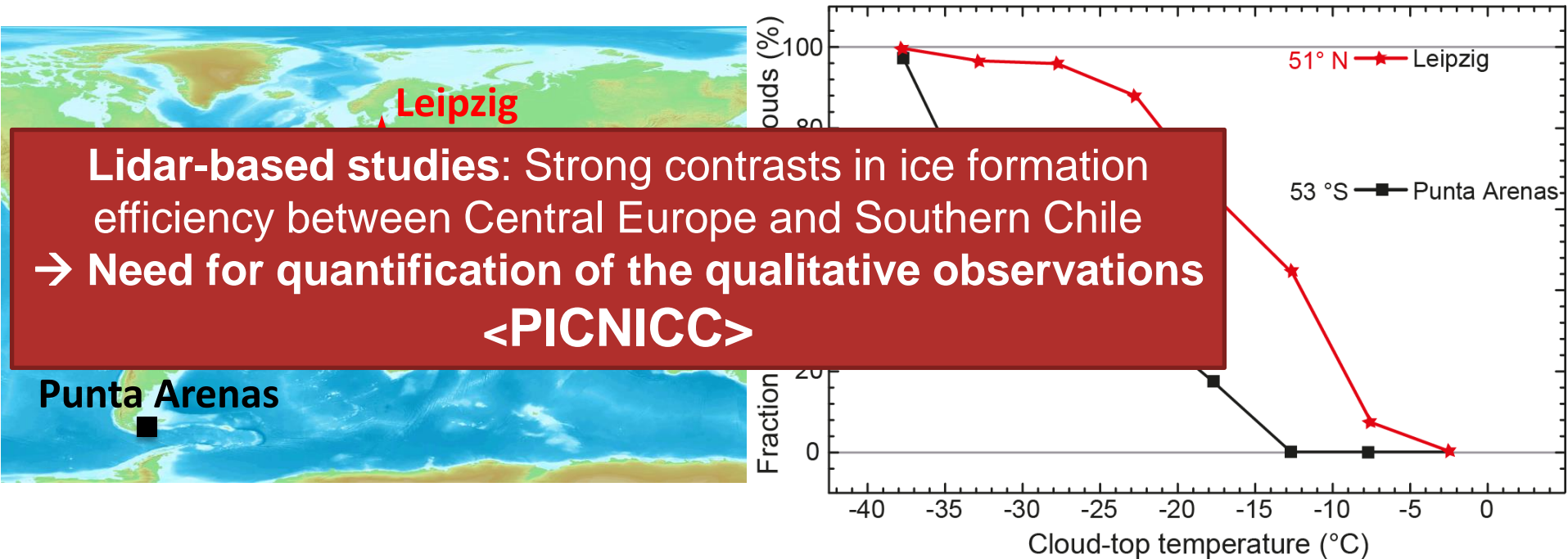
UNIVERSITÄT
LEIPZIG
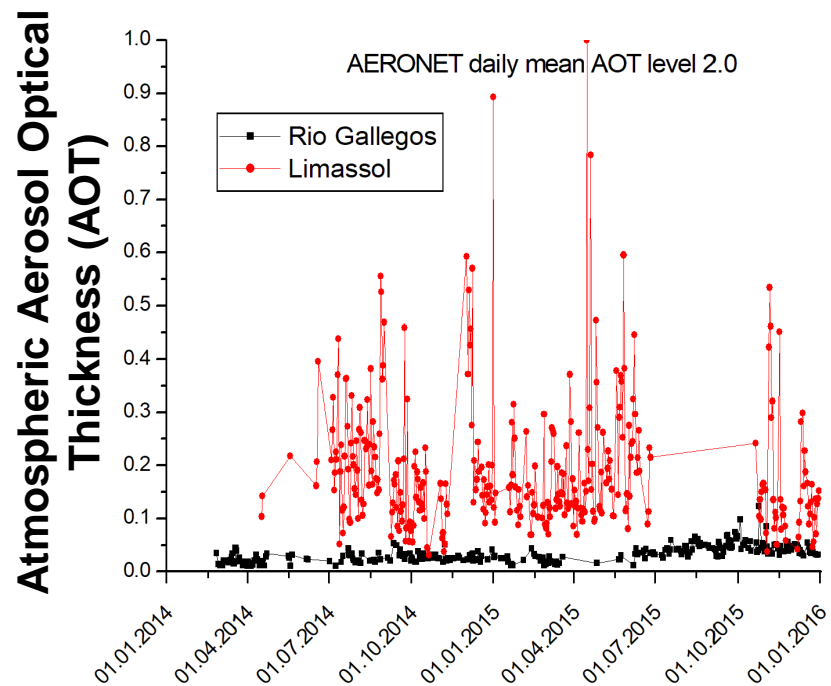
MOTIVATION

- Clouds and aerosols are inseparably coupled
- There is a **strong spatio-temporal variability in** aerosol and **cloud properties**

MOTIVATION

- Clouds and aerosols are inseparably coupled
- There is a **strong spatio-temporal variability in** aerosol and **cloud properties**

Leipzig

Punta Arenas

Lidar-based studies: Strong contrasts in ice formation efficiency between Central Europe and Southern Chile
→ **Need for quantification of the qualitative observations**
<PICNICC>

Teresa Vogl, Heike Kalesse, Patric Seifert, Audrey Teissiere, Johannes Quaas   Kick-off meeting, Bonn, 17 October 2018   5

UNIVERSITÄT
LEIPZIG

MOTIVATION

Microphysical growth processes in mixed-phase clouds:

– Water vapor depositional growth

– <u>Aggregation</u>: snow crystals collide and clump together

– <u>Riming</u>: supercooled droplets are collected on a falling ice crystal

Tim Garrett, University of Utah, 2013

How do strong contrasts in aerosol burden influence the ratio between aggregation and riming?

To what extent are the expected differences observable with polarimetric spectrally resolved multi-wavelength cloud radar techniques?

Tim Garrett, University of Utah, 2013

http://www.inscc.utah.edu/~tgarrett/
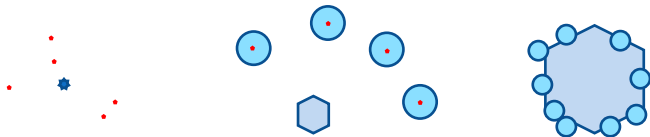Snowflakes/Gallery/
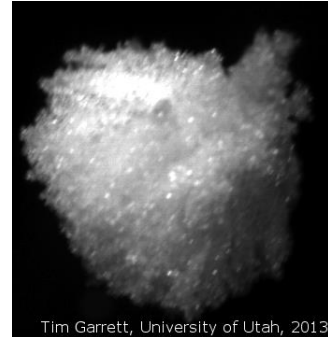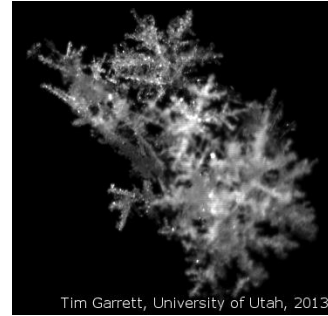
HYPOTHESIS: MIXED-PHASE CLOUD PROCESSES ARE SUSCEPTIBLE TO AEROSOL PERTURBATIONS.

1. High aerosol loads and high INP concentrations → higher ice crystal concentrations → more aggregation
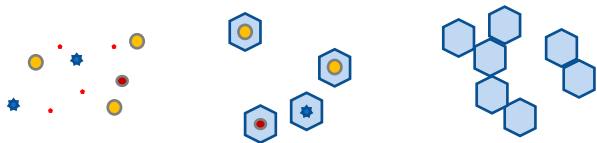
2. Low aerosol loads and scarcity of INP → thicker/ more persistent supercooled liquid layers → more riming

Teresa Vogl, Heike Kalesse, Patric Seifert, Audrey Teissiere, Johannes Quaas   Kick-off meeting, Bonn, 17 October 2018

FIELD CAMPAIGNS

DACAPO-PESO
Dynamics, Aerosol, Cloud And Precipitation Observations in the Pristine Environment of the Southern Ocean

CyCARE
Cyprus Cloud Aerosol and pRecipitation Experiment

Collocated ground-based aerosol and cloud profiling observations (sum of months per gridbox)

Map courtesy Martin Radenz

Courtesy A.Foth

Contrast Northern /Southern hemisphere (NH and SH)

UNIVERSITÄT LEIPZIG

Teresa Vogl, Heike Kalesse, Patric Seifert, Audrey Teissiere, Johannes Quaas   Kick-off meeting, Bonn, 17 October 2018   8

INSTRUMENTATION

LACROS-Suite (Limassol):

DACAPO-PESO only:

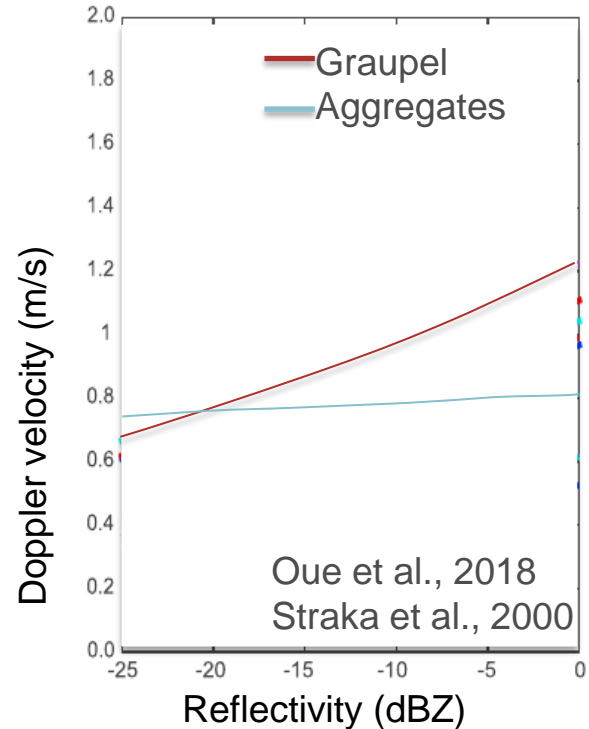+ 94 GHz RPG FMCW Radar (LIM)

+ 24 GHz K-band Micro Rain Radar

+ UMAG LIDAR system

https://www.tropos.de/en/institute/departments/remote-sensing-of-atmospheric-processes-new/ground-based-remote-sensing/cyprus-clouds-aerosol-and-rain-experiment-cycare/
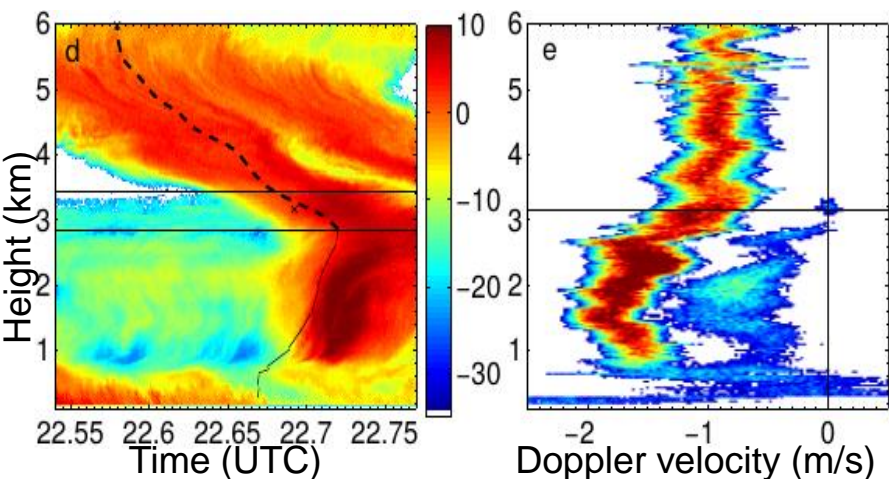
WORK PACKAGE 1 (PHD 1): ANALYSIS OF BULK MOMENTS FOR MICROPHYSICAL FINGERPRINTING

- Analysis of radar moments: Ze, V_D,σ, LDR, skewness

- Gradients of moments

- Determination of V_D-Ze power relations and comparison to existing relations for aggregation and riming (Straka et al., 2000)

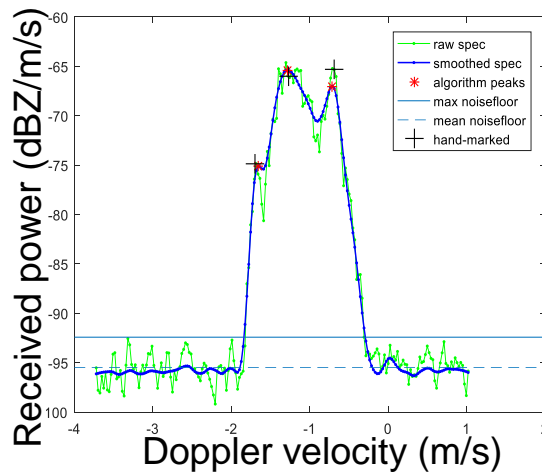- Multi-frequency analysis (Dual-wavelength-ratio Ka/W)

Oue et al., 2018
Straka et al., 2000

Teresa Vogl, Heike Kalesse, Patric Seifert, Audrey Teissiere, Johannes Quaas   Kick-off meeting, Bonn, 17 October 2018   10
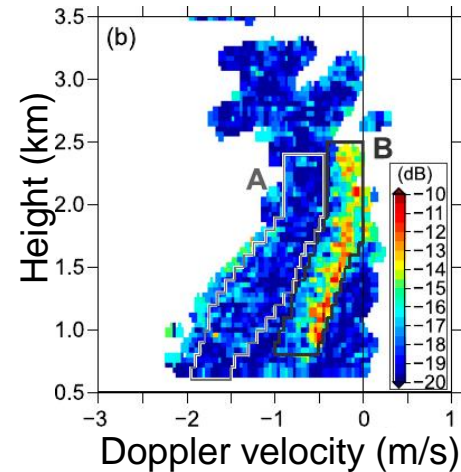
WORK PACKAGE 2 (PHD 1): DOPPLER SPECTRA ANALYSIS

– Exploration of spectral observations (Doppler velocity spectra of reflectivity and LDR), peak separation

– Identification of supercooled liquid layers

– Determination of moments for each found peak


Kalesse et al., 2016   PEAKO algorithm, work in progess   Oue et al., 2018

Teresa Vogl, Heike Kalesse, Patric Seifert, Audrey Teissiere, Johannes Quaas

UNIVERSITÄT
LEIPZIG

# WORK PACKAGE 3 (PHD 1): CLOUD-RESOLVING MODELLING

– Cloud-resolving modelling with ICON-NWP
  – case studies
  – sensitivity study (variation of empirical parameters)
  – simulation of full observation periods with varying CCN/ INP concentrations

– Attribution of observations in NH and SH to differences in INP/ CCN
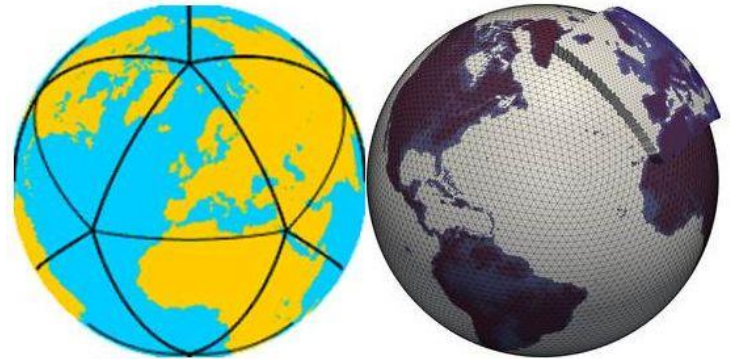
https://www.dwd.de/EN/research/weatherforecasting/num_modelling/01_num_weather_prediction_modells/icon_description.html

WORK PACKAGE 3 (PHD 1):

MODELLING DOMAINS
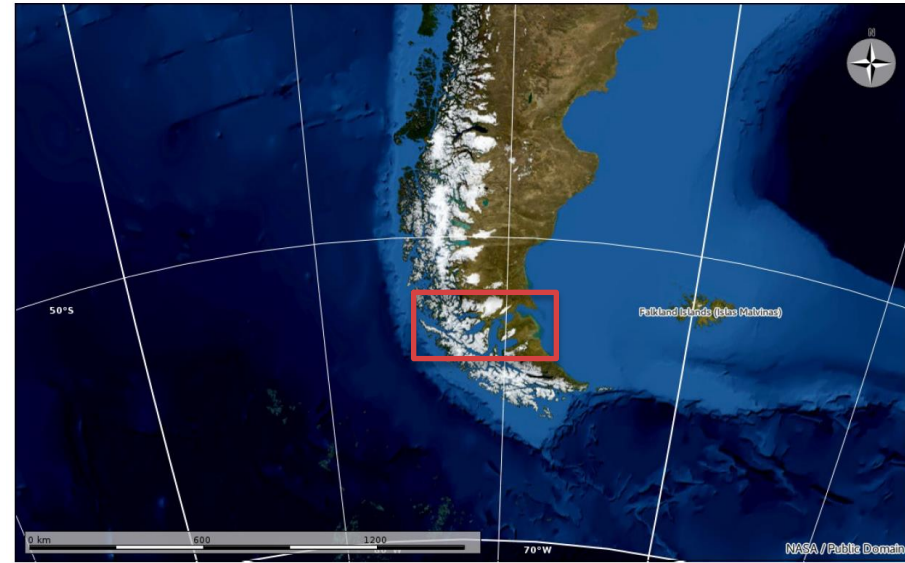
https://dacapo.tropos.de/images/slideshow/DACAPO-PESO-AC-16_9_resized.jpg

THANK YOU!

Teresa Vogl

Uni Leipzig

teresa.vogl@uni-leipzig.de

https://home.uni-leipzig.de/remsensarctic/

https://dacapo.tropos.de