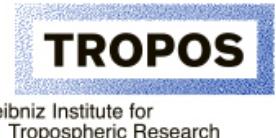


# Validation of Aeolus aerosol and wind products with sophisticated ground-based instruments in the Northern and Southern Hemisphere

Holger Baars, Alina Herzog, Ronny Engelmann, Johannes Bühl, Martin Radenz, Patric Seifert, Albert Ansmann, Dietrich Althausen, Birgit Heese, Julian Hofer, Kevin Ohneiser, Karsten Hanbuch, Elizaveta Basharova, Tülin Gülbas, Alexandra Chudnovsky, Boris Barja, Maria Filioglou, Mika Komppula, and Ulla Wandiger



Leibniz Institute for  
Tropospheric Research

Thanks to ESA for proving data and especially to T. Kanitz and S. Bley for support



# EVAA:

## Experimental Validation and Assimilation of Aeolus observations

- Validate the wind and aerosol products of Aeolus with
  - Radar wind profiler network of DWD
  - Aerosol lidars at different locations (Leipzig, PollyNet stations)
  - Doppler cloud radar (LACROS mobile facility)
  - Wind lidar (Leipzig, LACROS)
- Support validation campaigns with airborne demonstrator performed by DLR
- Quantify the benefits for weather forecasting by assimilation experiments



Deutscher Wetterdienst  
Wetter und Klima aus einer Hand



Gefördert durch:  
 Bundesministerium  
für Wirtschaft  
und Energie  
aufgrund eines Beschlusses  
des Deutschen Bundestages



# TROPOS contribution to Aeolus Cal/Val



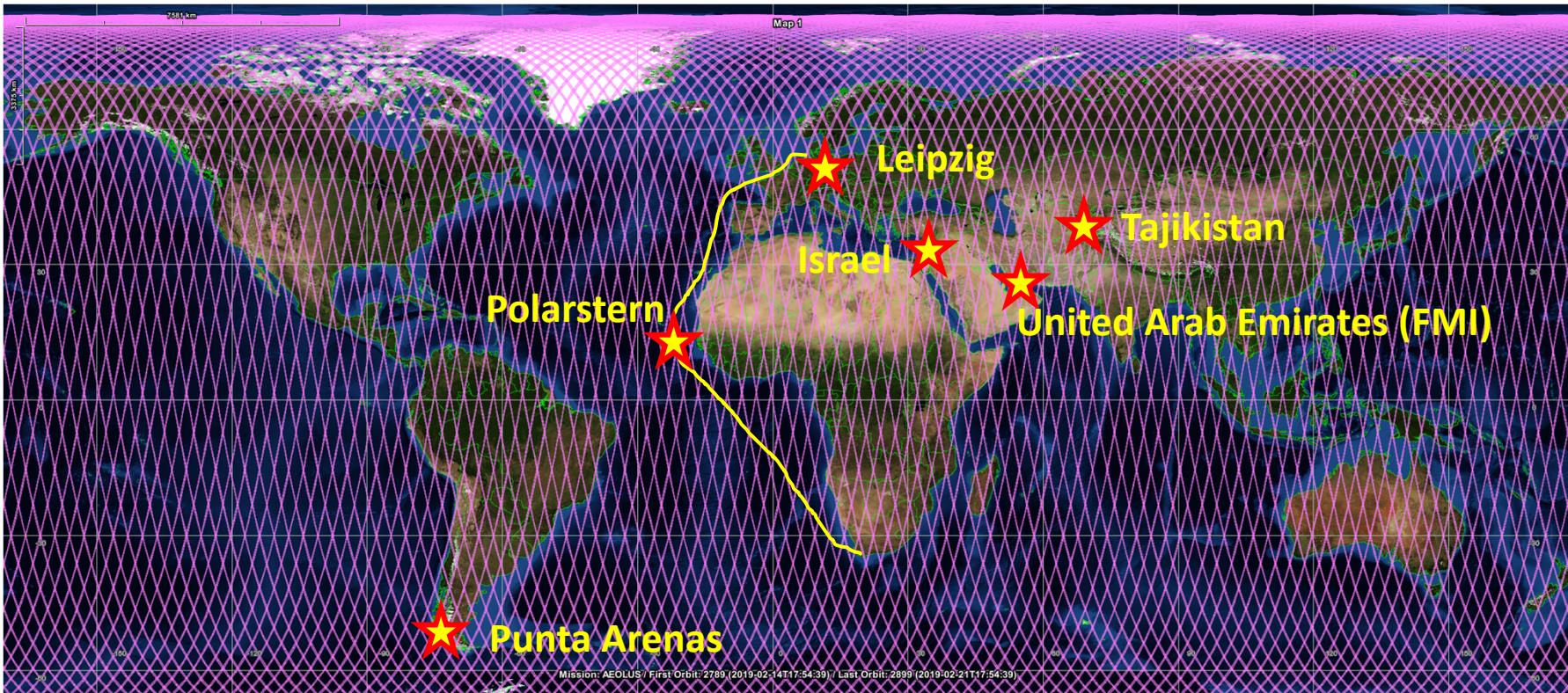
aufgrund eines Beschlusses  
des Deutschen Bundestages

## Project in EVAA:

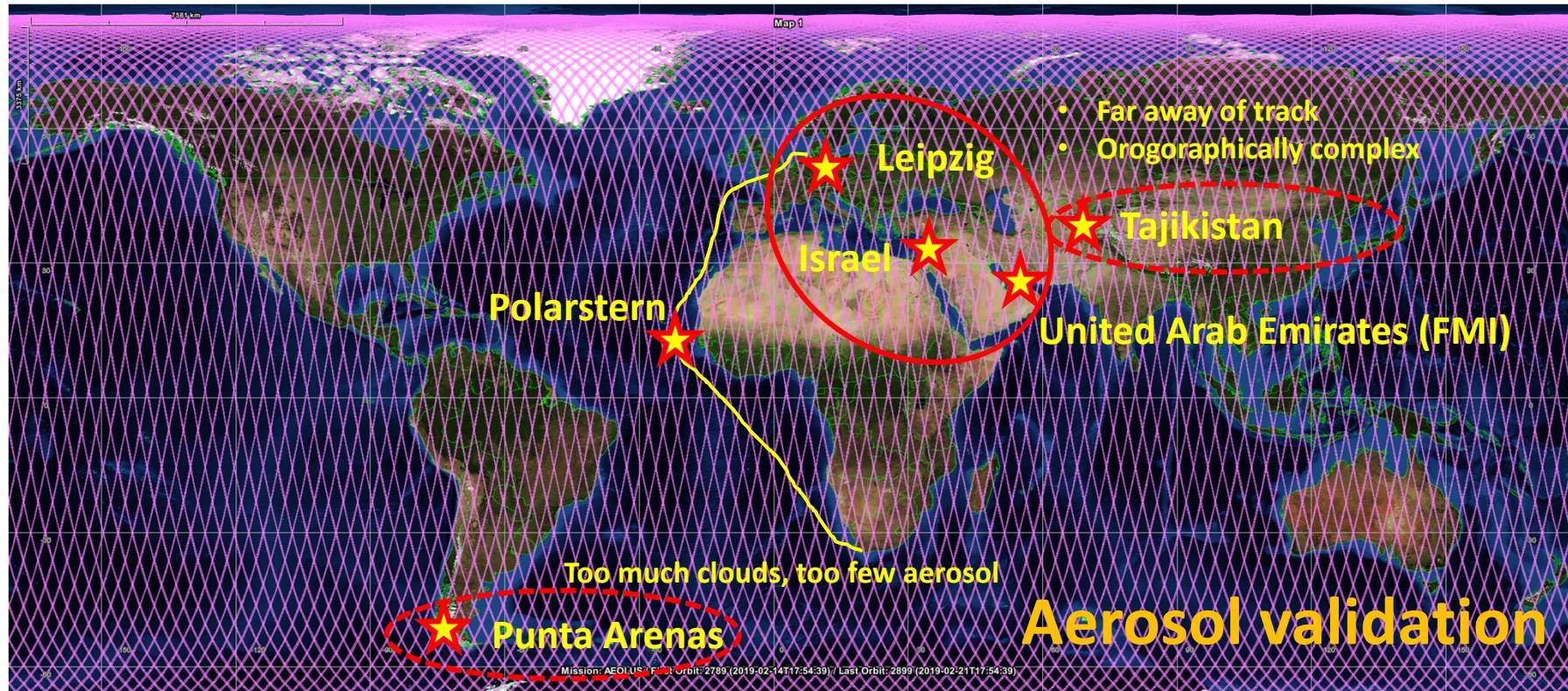
*Validation of aerosol and wind products with ground-based instruments of TROPOS*

- Apply TROPOS instrumentation for Aeolus Cal/Val
  - Network of multiwavelength polarization lidars (PollyNet)
  - Mobile Doppler lidar, Doppler radar, AERONET photometer, ...
- **Intensive campaign-based measurements** at Leipzig during aircraft campaigns
  - Quality analysis of L1 and L2 data of Aeolus
  - Horizontal homogeneity (error of representativeness)
- **Long-term measurements** at Leipzig and LACROS location (currently Punta Arenas)
  - Identify systematic differences and trends
- **Opportunity** measurements during campaigns (e.g. shipborne OCEANET facility, tropical campaign)

# Locations of TROPOS ground-based Aeolus Cal/Val activities



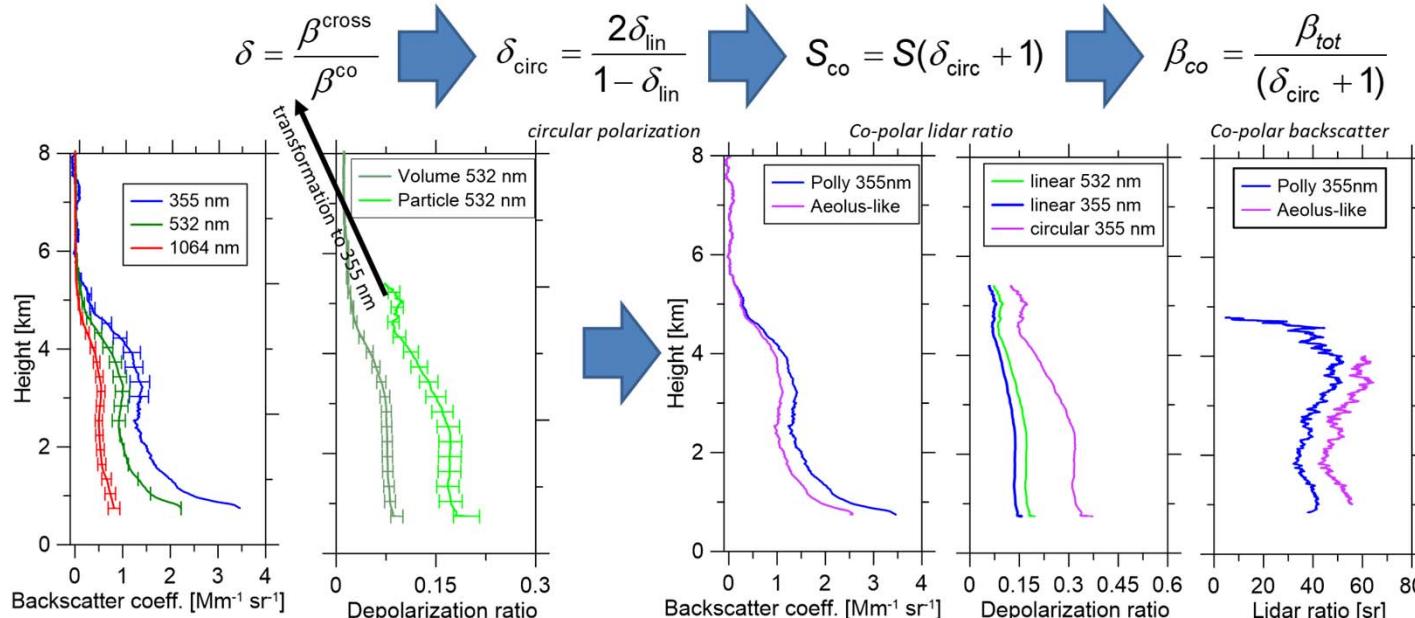
# Locations of TROPOS ground-based Aeolus Cal/Val activities



# Aeolus aerosol spin-off products

ALADIN emits circular-polarized and detects the co-polar component of the backscattered light only

## Transformation of Polly products to Aeolus co-polar products



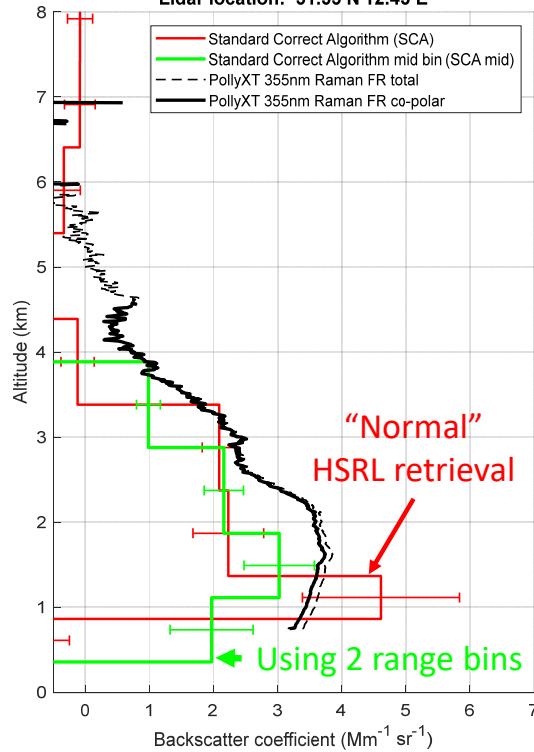
- 30%–70% of the backscattered light gets lost
- backscatter is underestimated
- lidar ratio is overestimated

# A perfect day in Leipzig: 25 Aug 2019

Leipzig, Germany, 2019-08-25 05:28:35.226399

Orbit location: 50.9071 N 12.7914 E

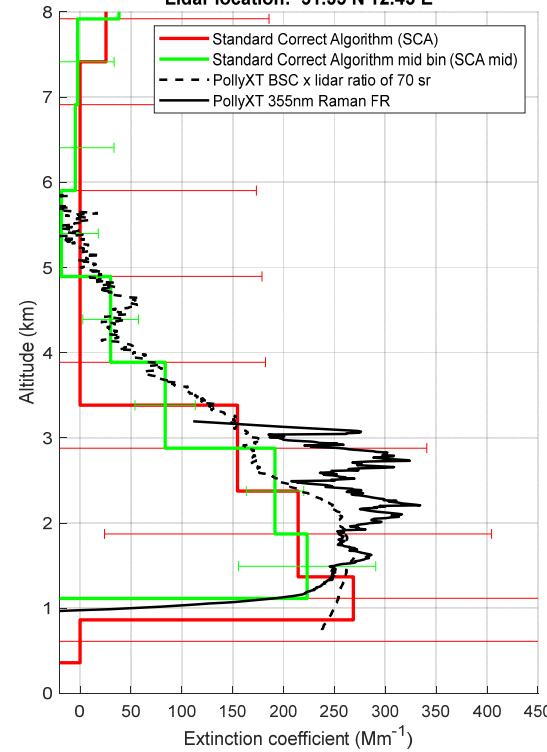
Lidar location: 51.35 N 12.43 E



Leipzig, Germany, 2019-08-25 05:28:35.226399

Orbit location: 50.9071 N 12.7914 E

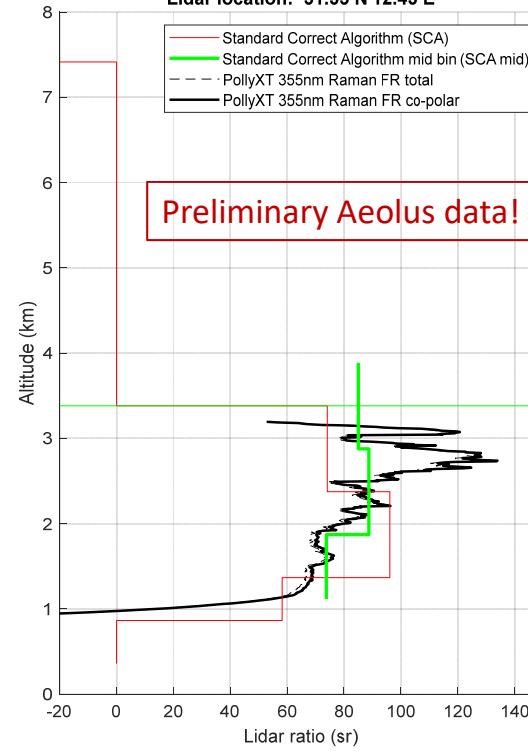
Lidar location: 51.35 N 12.43 E



Leipzig, Germany, 2019-08-25 05:28:35.226399

Orbit location: 50.9071 N 12.7914 E

Lidar location: 51.35 N 12.43 E



Good results for well dedicated scenes (homogenous, cloud free)

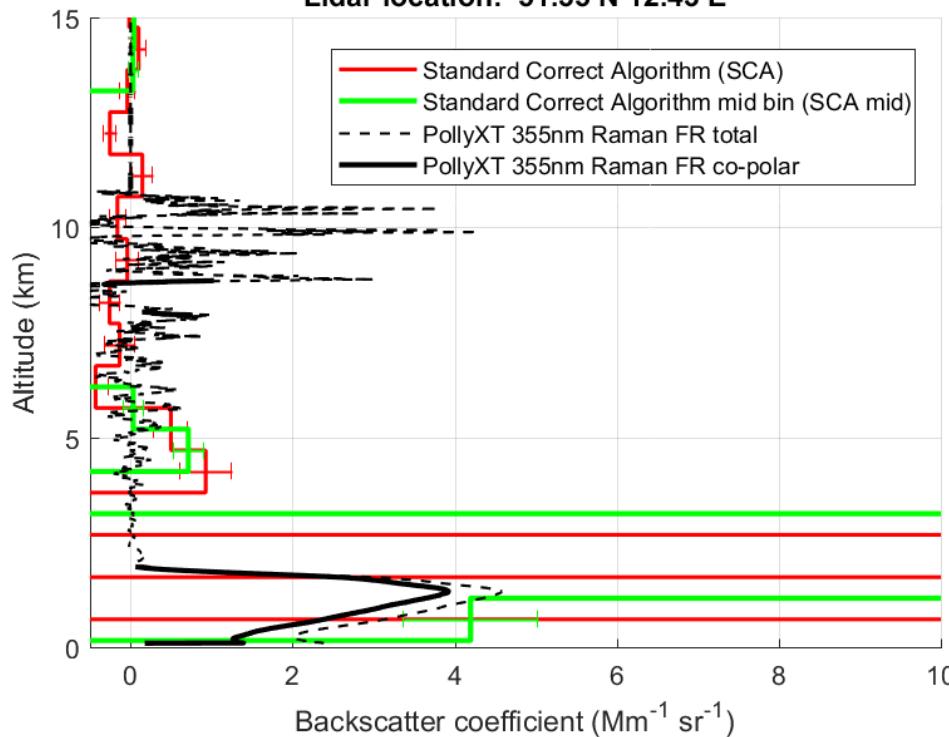


# Aerosol comparison 17 May 2019 on Leipzig

Leipzig, Germany, 2019-05-17 16:49:53.222539

Orbit location: 51.442 N 12.0891 E

Lidar location: 51.35 N 12.43 E

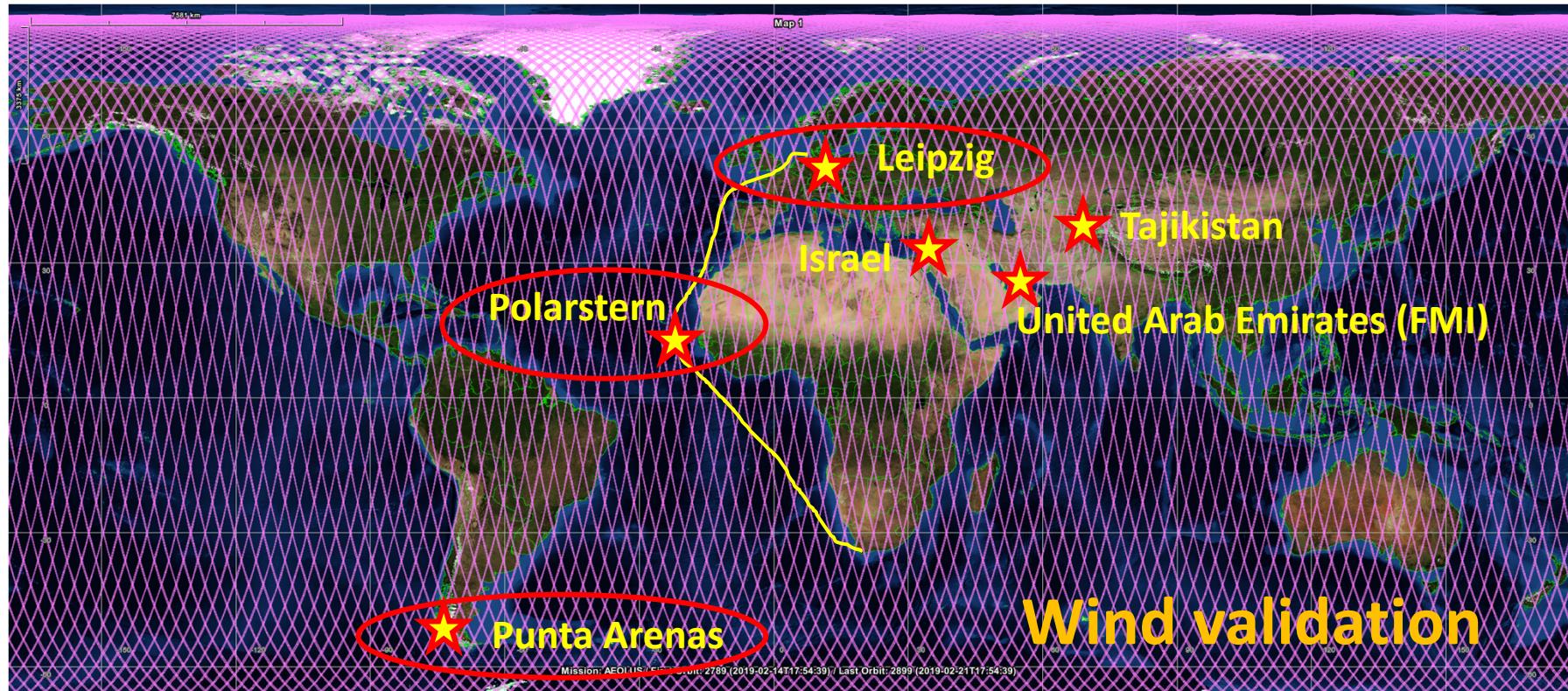


Aeolus profiles are cloud contaminated  
→ And these cloudy profiles are not flagged  
→ no valid comparison possible concerning aerosol properties

## L2A products:

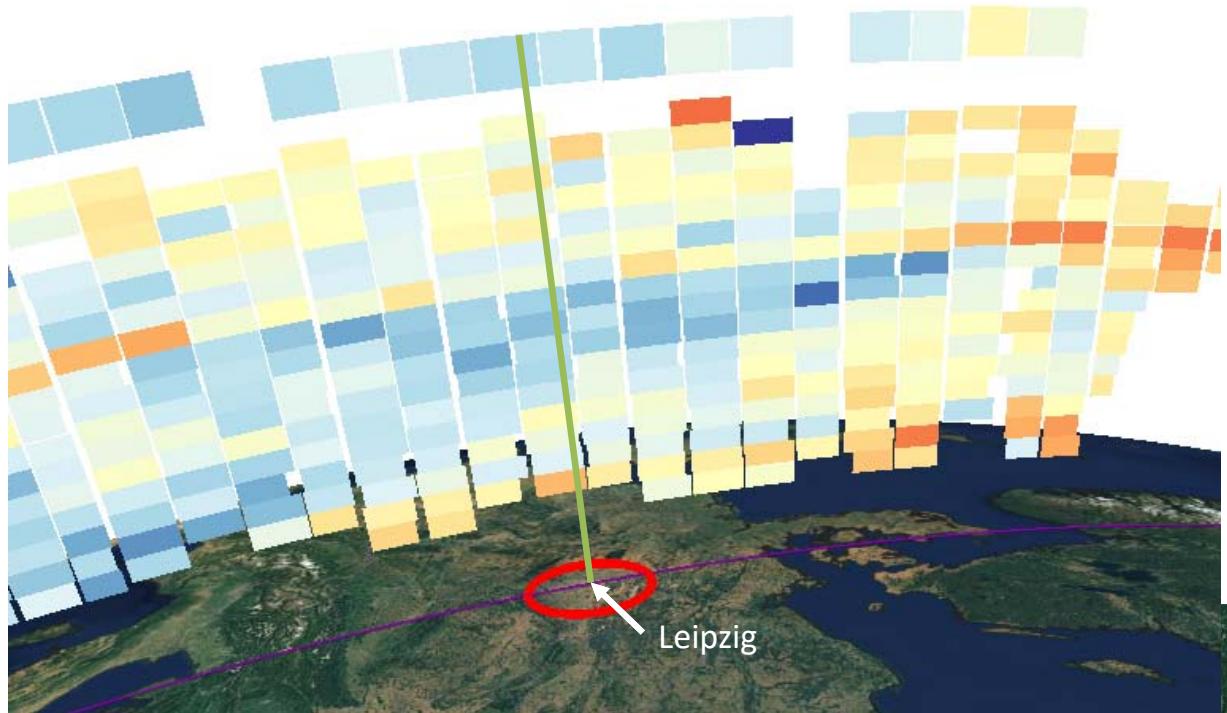
- Proof of concept have been done!
- Good results for well dedicated scenes.
- But strong observation to observation variation partly due to horizontal averaging of 87 km
- For L2A, there is not something like a constant bias, but features which have to be analyzed and discussed case by case

# Locations of TROPOS ground-based Aeolus Cal/Val activities



# Aeolus Cal/Val

Rayleigh winds (87 km horizontal resolution)

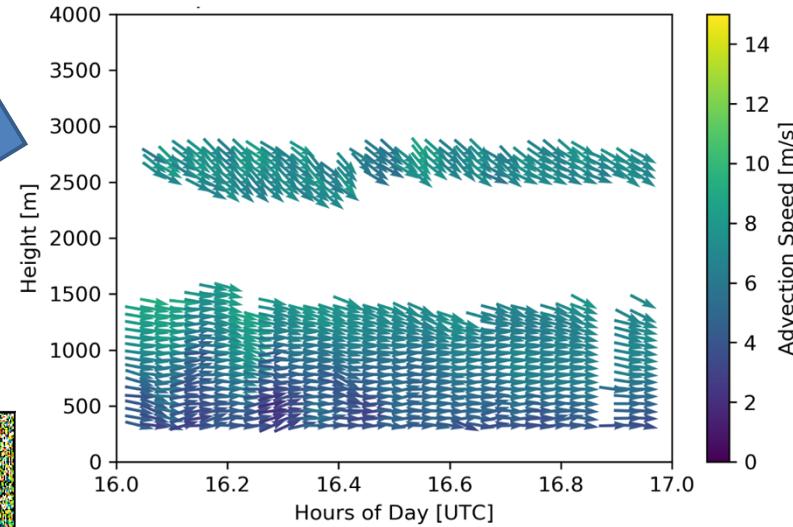
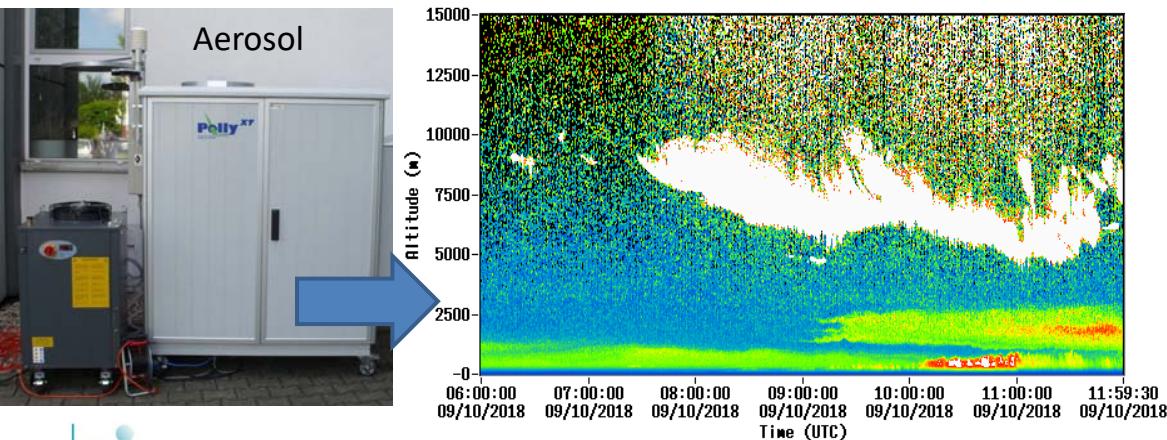


Compare  
measurements  
within 100 km  
around ground site

Blueish: Westerly winds  
Reddish: Easterly winds

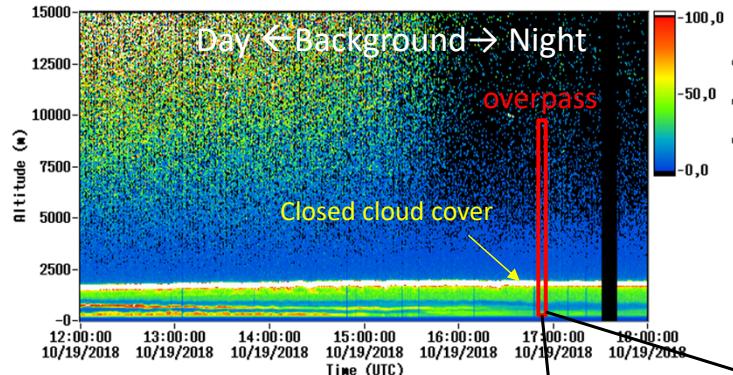
WiLi always scanning at 60° off zenith

# Polly<sup>XT</sup> and WiLi @ Leipzig

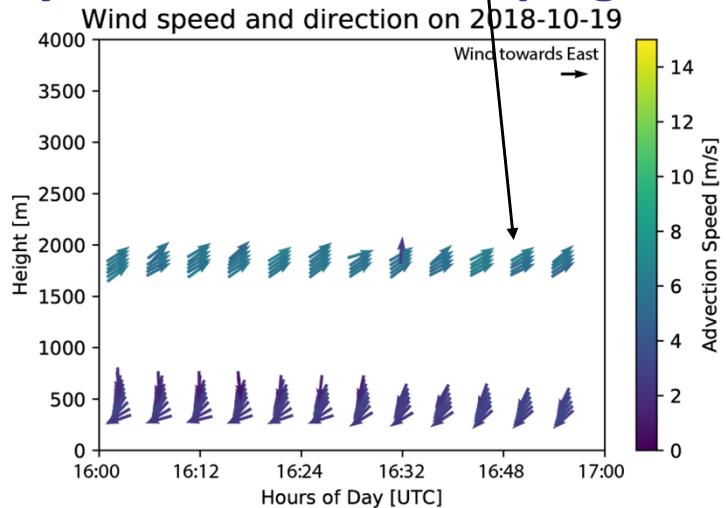


Doppler wind lidar sensible to particles →  
PBL winds and cloud bottom winds

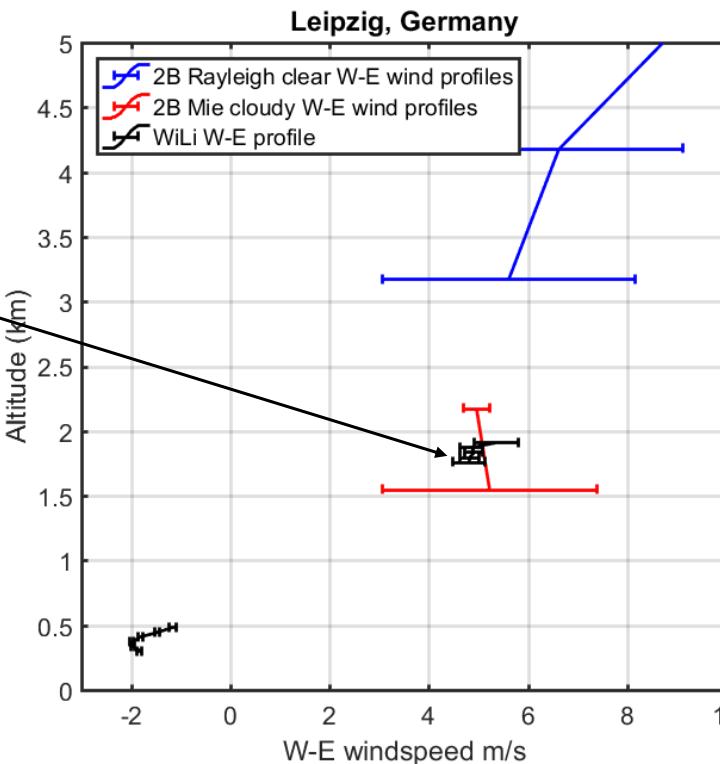
**Verification of  
Aeolus  
Level 1B, 2A, 2B, 2C**



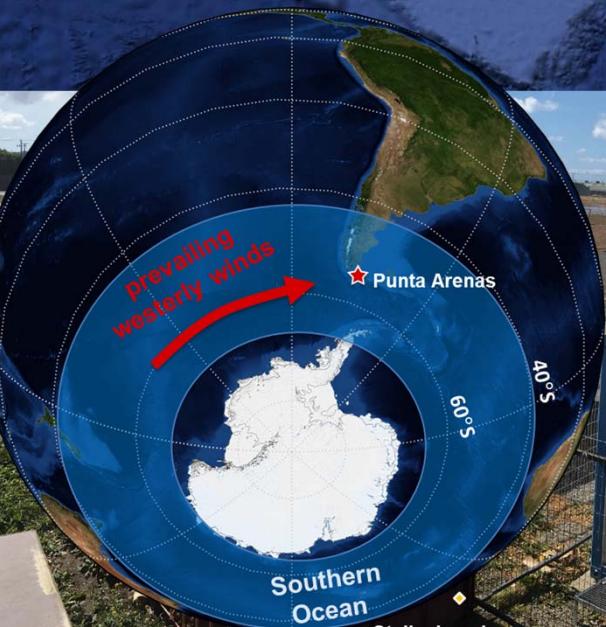
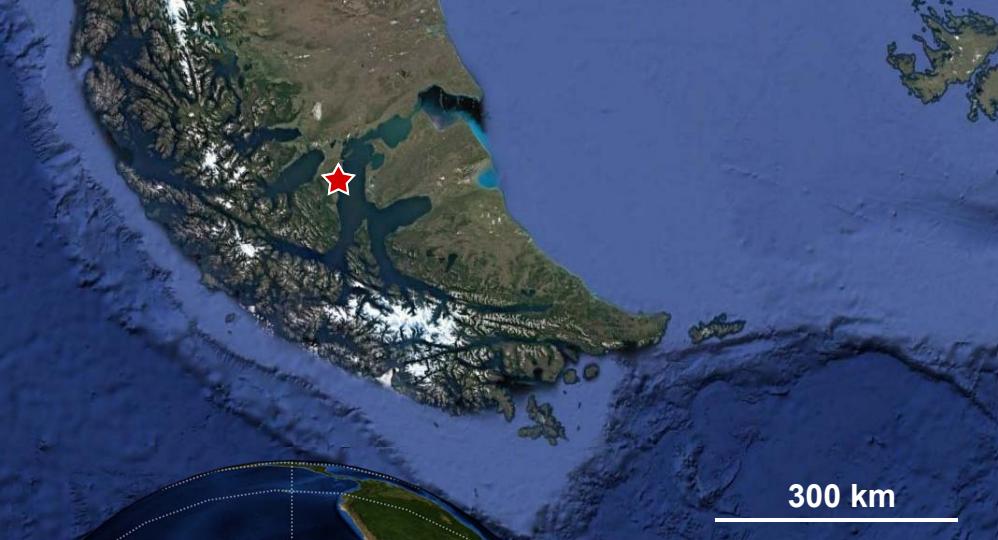
## Polly<sup>XT</sup> and WiLi @ Leipzig



# Comparison Leipzig, 19 October 2018



Data Filter:  
<8m/s error  
<5m/s error



**DACAPO  
PESO** Dynamics, Aerosol, Cloud and Precipitation Observations in the Pristine Environment of the Southern Ocean

LACROS at Punta Arenas since Nov 2018 and serves for Cal/Val:

Low aerosol load and bad Aeolus performance below 2 km  
→ Doppler lidar mostly not usable  
→ Use of Cloud radar to obtain horizontal wind speed  
(algorithm development still ongoing)



Leipzig Aerosol and Cloud Remote Observations System