



ESA-MOST Dragon Cooperation

中国科技部-欧洲空间局“龙计划”合作

2017 DRAGON 4 SYMPOSIUM

2017年“龙计划”四期学术研讨会

26-30 June 2017 | Copenhagen, Denmark

2017年6月26-30日, 丹麦 哥本哈根

Lidar Observations from ADM-Aeolus and EarthCARE-Validation, Study of Long-range Transport of Aerosol and Preparation of a Future Chinese CO₂ Lidar Mission

Topic Nr.	PIs	Title
32296_3	Dietrich Althausen, TROPOS Songhua Wu, OUC	Long-range dust transport and validation using ground-based and satellite lidar observations

TROPOS: Dietrich Althausen, Ulla Wandinger,
OUC-ORSI: Songhua WU, Xiaoquan Song, Bingyi Liu, Guangyao Dai, Xiaochun Zhai,
DLR-IPA: Oliver Reitebuch, Silke Groß
LZU: J. Huang, Z. Huang



➤ Portable Raman Lidar System Polly^{XT}

- Aerosol-backscattering ratio (R_b), aerosol extinction coefficient, extinction-to-backscatter (S_a) ratio, water vapor mixing ratio, depolarization ratio

➤ Multiwavelength-Raman-polarization lidar MARTHA (only in Leipzig)

- Temperature, Humidity, and Aerosol profiling)



➤ BERTHA (only in Leipzig)

- Backscatter Extinction Ratio, Temperature, Humidity, depolarization ratio Lidar

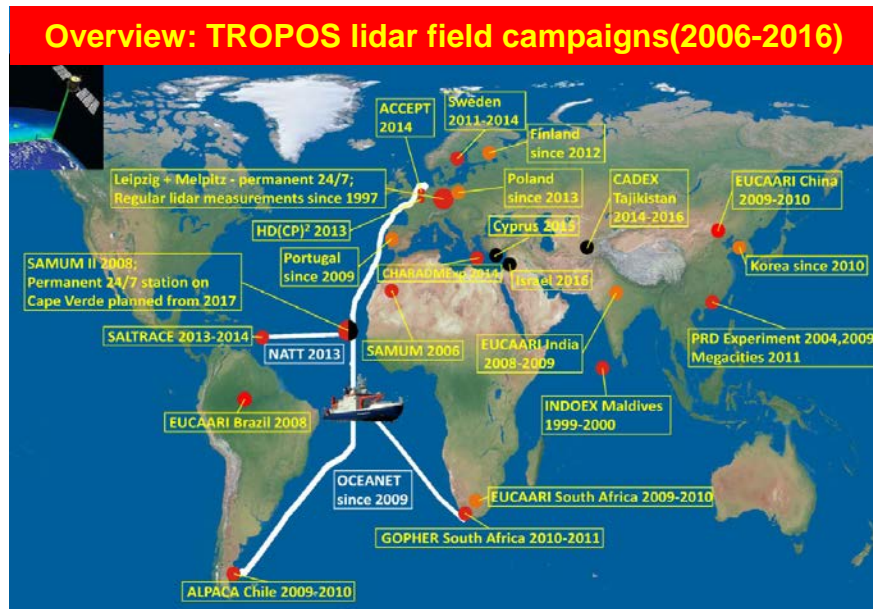
➤ Coherent Doppler lidar

- wind profile , sea surface wind vector



➤ Cloud Radar MIRA-35

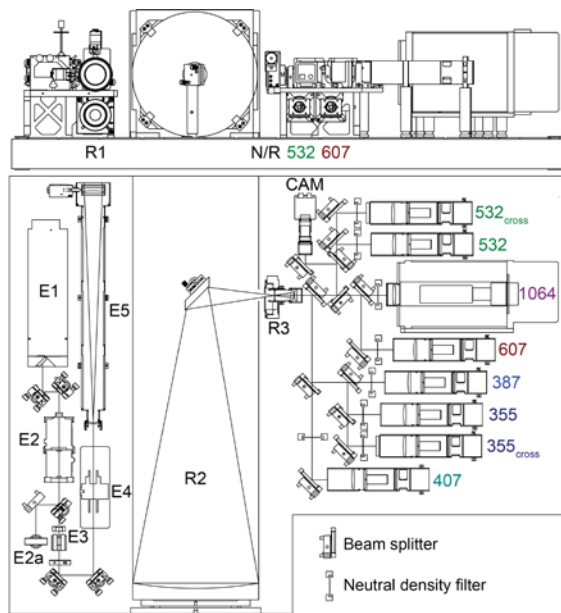
- Backscatter ratio, linear depolarization ratio, Doppler velocity



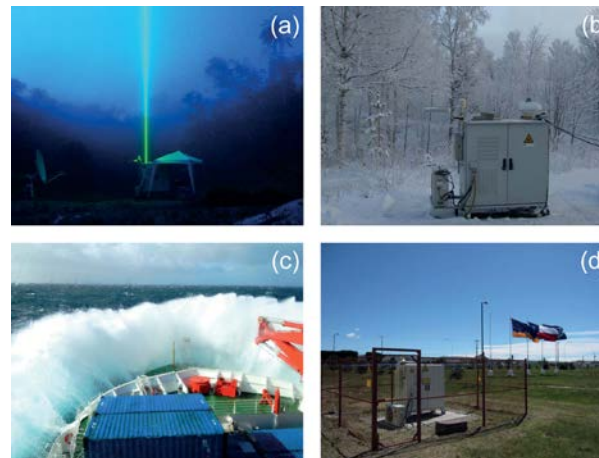
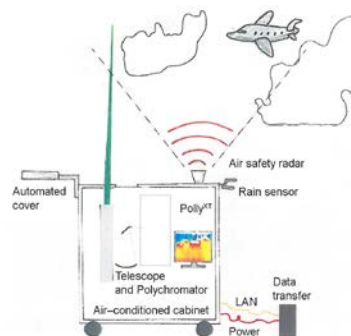
Dietrich, 2015. Qingdao, China

- Saharan mineral dust experiment 1, Morocco 2006 (SAMUM1)
- Convective and orographically-induced precipitation study in the Black Forest, Germany 2007 (COPS)
- Saharan mineral dust experiment 2, Cap Verde 2008 (SAMUM2)
- European Supersites for Atmospheric Aerosol Research 2006 - 2011 (EUSAAR), Leipzig
- Satellite-based aerosol mapping over megacities: Development of methodology and application in health and climate related studies at Leipzig and Guangdong 2007 – 2010 (Megacities)
- Joint experiments with groups in Sweden 2010-2011 (VASA), Chile 2009-2010 (ALPACA), South Africa 2010-2011 (GOPHER)
- OCEANET Autonome Messplattformen zur Bestimmung des Stoff- und Energieaustausches zwischen Ozean und Atmosphäre (Atlantic)
- Saharan Aerosol Long-range Transport and Aerosol-Cloud-Interaction Experiment, Barbados 2013-2014 (SALTRACE)
- Central Asian Dust Experiment 2014-2016 (CADEX)
- Cyprus Clouds Aerosol and Rain Experiment (CyCARE) 2015

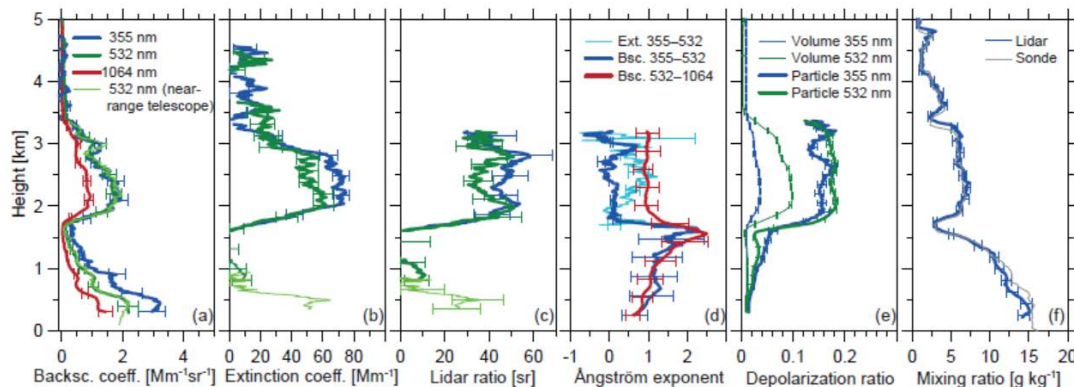
Polly^{XT}



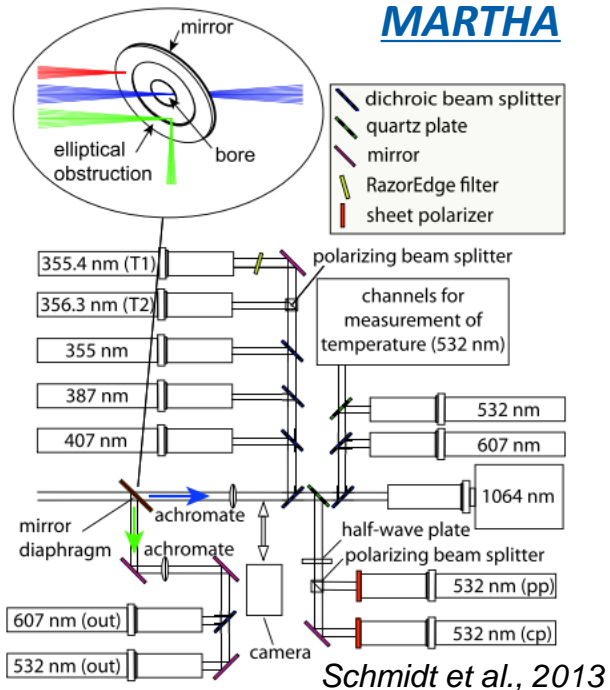
Engelmann et al, 2016



Autonomous measurements of Polly^{XT}



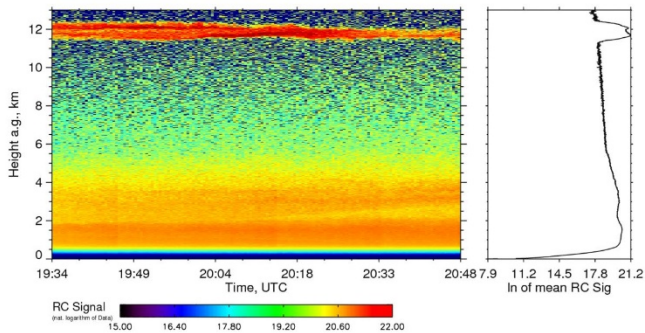
MARTHA



Schematic diagram of MARTHA

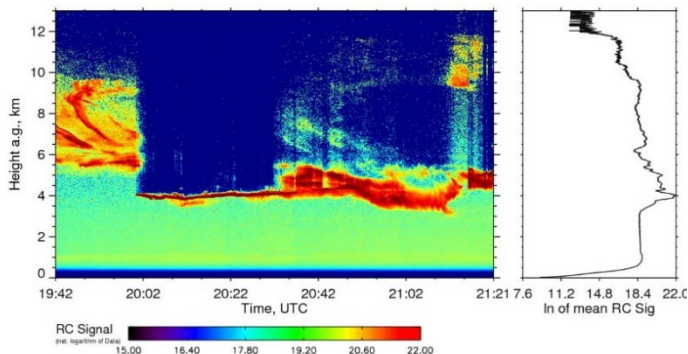
0532nm-FF RC Signal on 20170529

19:34 - 20:48 UTC Res.: 7.50 m - 30 s



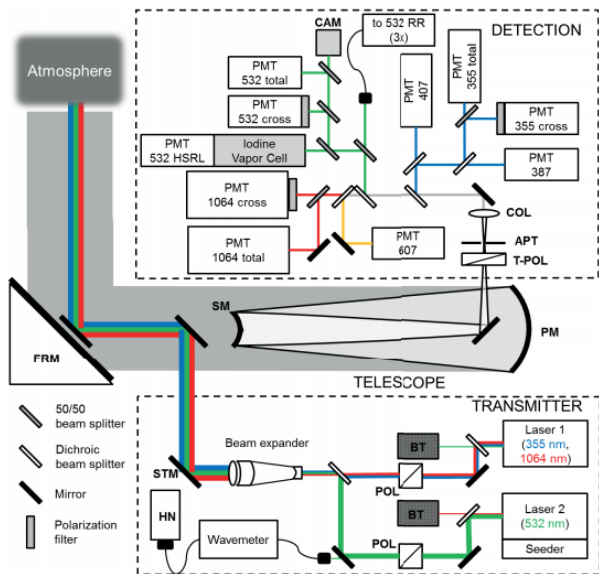
0532nm-FF RC Signal on 20170608

19:42 - 21:21 UTC Res.: 7.50 m - 10 s



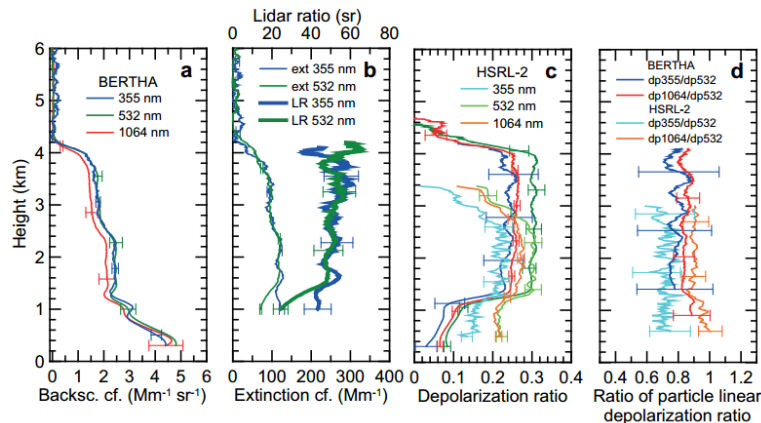
Regular measurement
on 29 May and 08 June
2017.

BERTHA

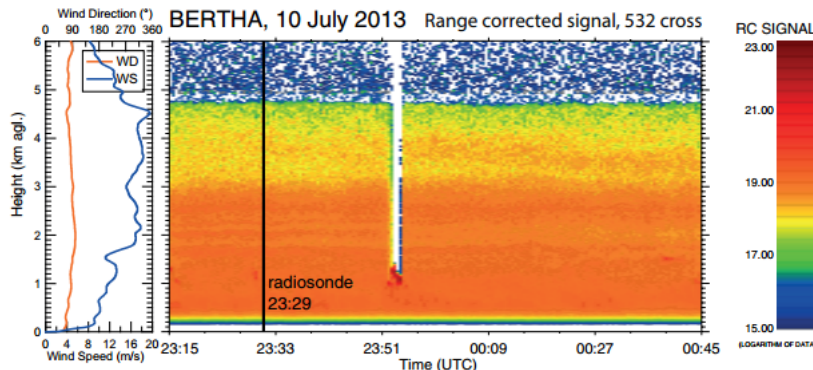


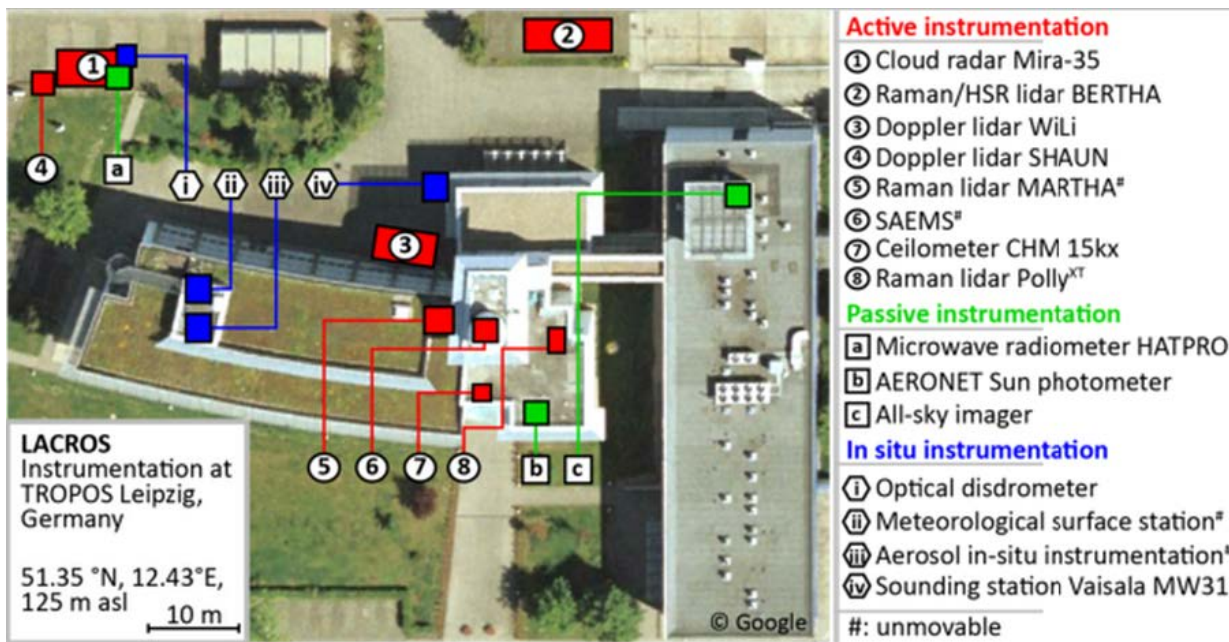
Haarig et al., 2017

Schematic diagram of BERTHA



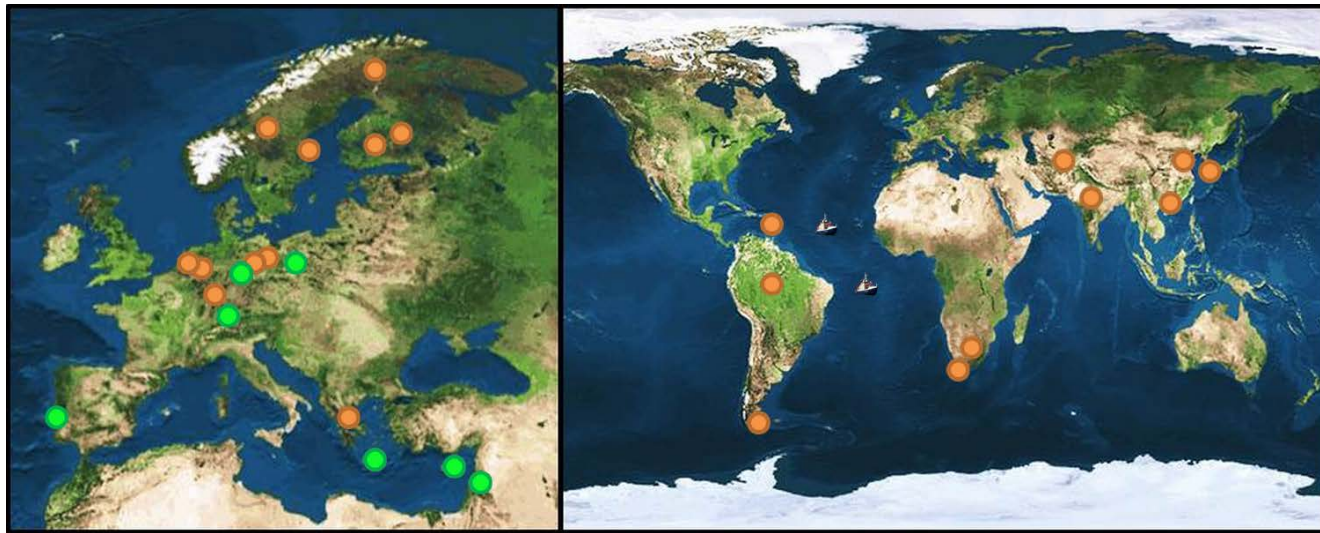
Data products from BERTHA





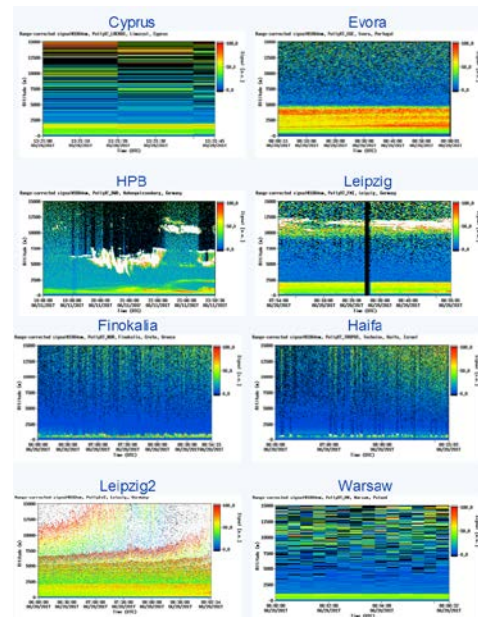
LACROS (The Leipzig Aerosol and Cloud Remote Observations System) comprises a unique set of active and passive remote-sensing instruments which are to a large extent containerized and available for application in field campaigns.

<http://www.tropos.de/en/research/projects-infrastructure-technology/coordinated-observations-and-networks/lacros/>



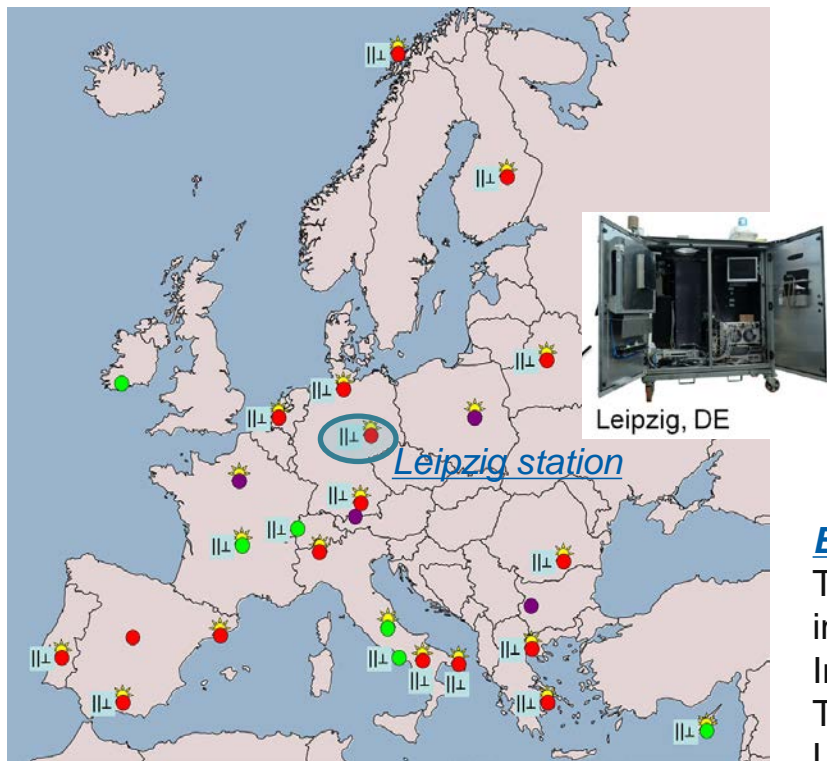
Green dots: on-going measurements

Gray dots: archive measurements

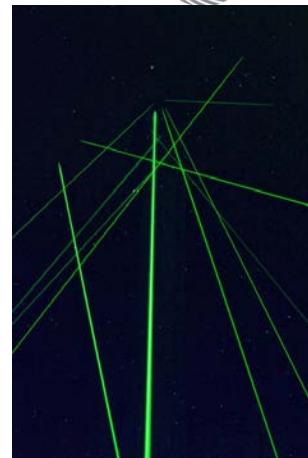
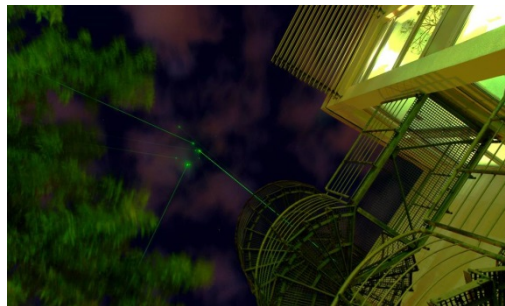


PollyNET (Worldwide observations with the portable Raman lidar systems). This network consists of portable, remote-controlled multiwavelength-polarization-Raman lidars (Polly) for automated and continuous 24/7 observations of clouds and aerosols.

<http://polly.rsd.tropos.de/lidar/?p=home>



Pappalardo et al., 2014



Direct inter-comparison of 11 EARLINET lidars in 2009, at TROPOS

EARLINET/ACTRIS:

The ground-based remote sensing group is a leading group in the international networks ACTRIS (European Research Infrastructure for the observation of Aerosol, Clouds, and Trace gases.) and EARLINET (European Aerosol Research Lidar Network)



➤ **Direct detect Doppler wind lidar / HSRL (High Spectral Resolution Lidar) CHiPSDWiL**

- radial wind speed, wind profile, 3D wind vector, aerosol- backscattering ratio (R_b), aerosol extinction coefficient, extinction-to-backscatter (S_a), sea surface wind vectors

➤ **Coherent Doppler lidar WindPrint**

- wind profile , sea surface wind vector



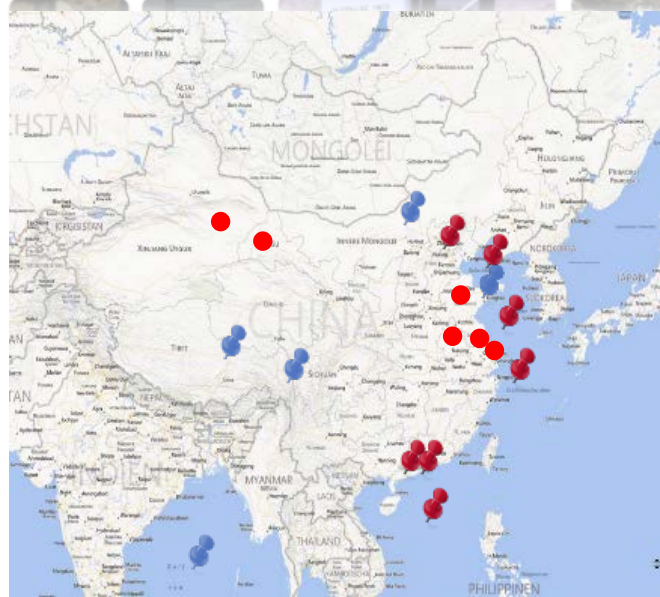
➤ **Multi-wavelength Raman-Polarization lidar WACAL**

- Aerosol-backscattering ratio (R_b), aerosol extinction coefficient, extinction-to-backscatter (S_a) ratio, cloud base height

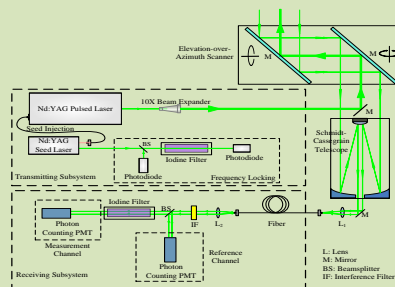
Co-located ground observations by OUC lidar facilities can be compared with the data products of ADM-Aeolus, and we will analyze the comparison results and present assessment reports to ADM-Aeolus community.

Atmospheric lidar campaigns of last 10 yrs

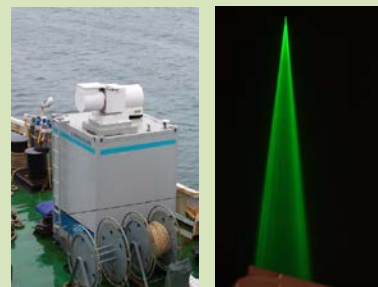
- 2014-2017 MABL dynamics and structure observation by Doppler Lidar
- 2014-2016 Wind turbine wake research
- 2015-2017 UAV wind lidar for MABL and SSW
- 2015-2016 Aviation hazard weather monitoring
- 2013-2017 Tibetan Plateau atmospheric experiment
- 2011-2012 CMA Lidar and radiosonde campaign
- 2010 Sea surface wind observations for Asia Game
- 2013 MABL lidar observation in Indian Ocean
- 2010 WMO radiosonde validation campaign at Yangjiang
- 2009 Storm observation: lidar, radars
- 2008 Spacecraft landing area: wind profile
- 2008 Olympics: operational SSW monitoring
- 2007 International Sailing Games
- 2007 Ground anemometer validation campaign
- 2005~2006: radiosonde validation



Theory



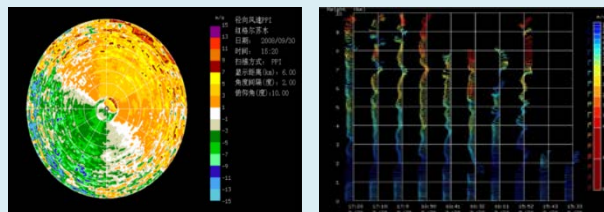
Schematics



CHiPSDWiL

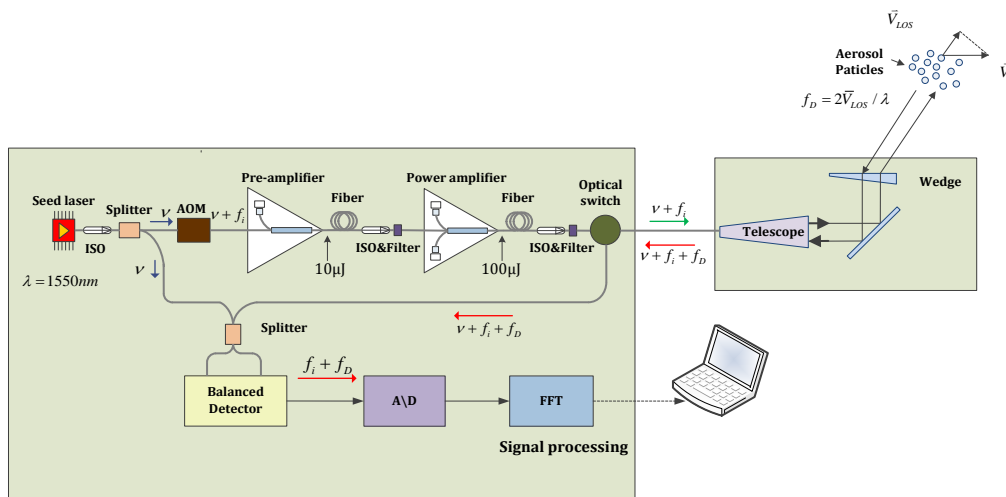


Atomic filter

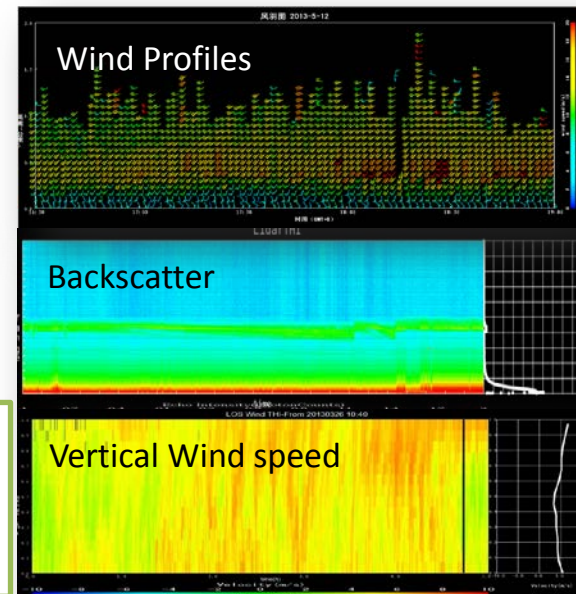


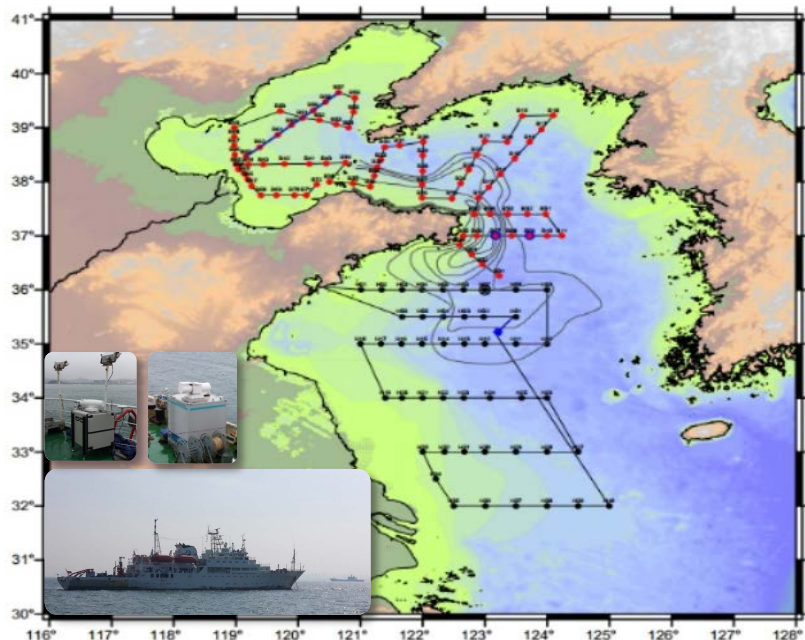
3D wind and wind Profile

High precision scanner enables the observation at specified azimuth and elevation angle pointing to the ADM-Aeolus laser path.

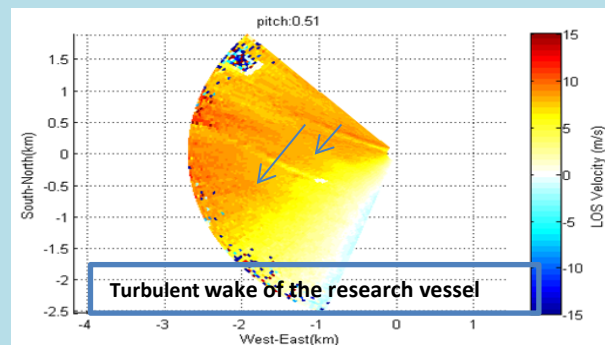
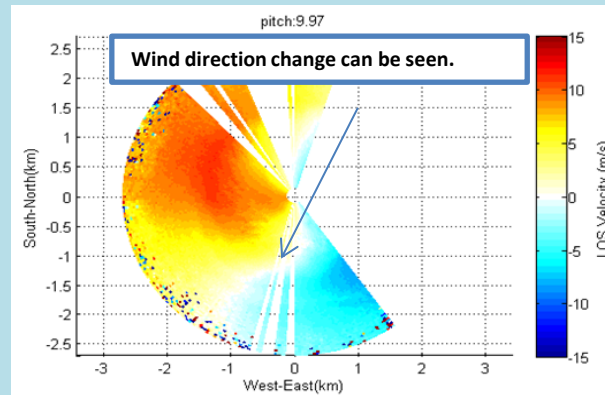


- Boundary layer wind profile measurement with high accuracy of 0.3 m/s.
- Better understanding of the vertical wind under and within clouds.
- Easy to transport for remote area campaign
- Deployed in the Tibetan Plateau campaign.





2013 Cruise, April 27th to May 21th





CMA



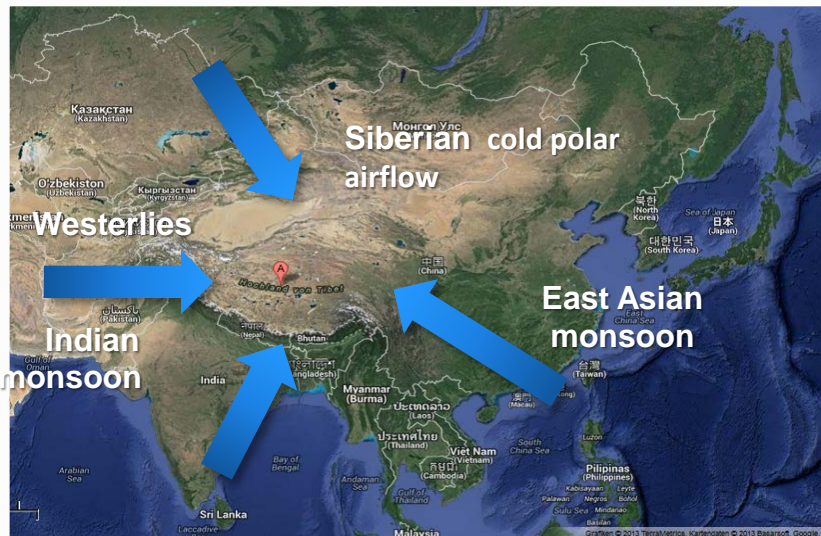
OUC



CAMS



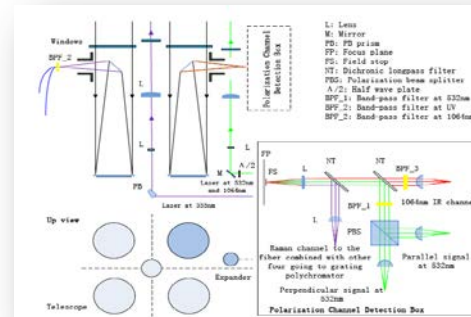
LaSW



The Tibet lidar campaign is a joint experiment organized by OUC/ORSI and CAMS/LAWS (Chinese Academy of Meteorological Sciences/ Laboratory of Severe Weather.



OUC lidar facilities: Wind, Humidity, , Temperature, Aerosol and Cloud profiling



WACAL diagram

Multi-wavelength Raman-Polarization lidar

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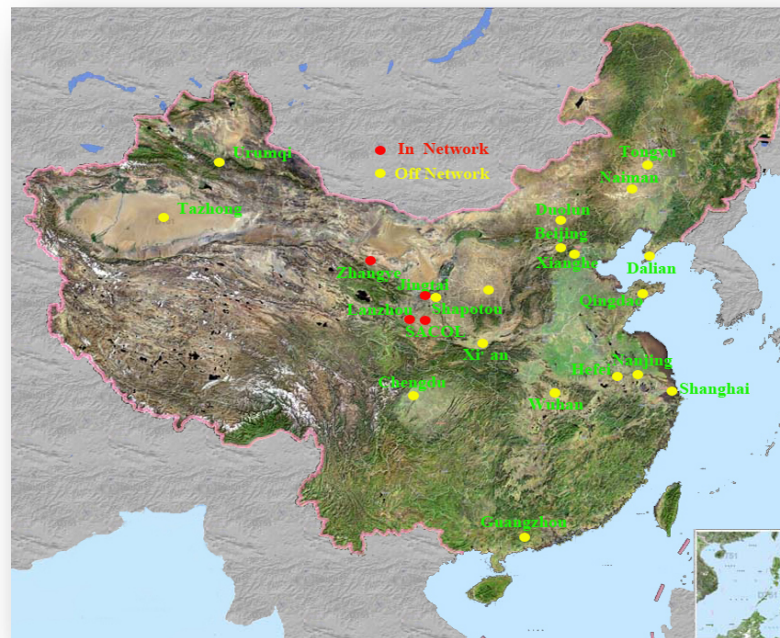
To study cloud/aerosol effect on semi-arid climate, we developed a supper site for cloud/aerosol & climate parameters measurements in 2005.

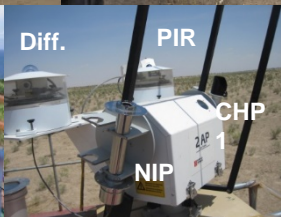
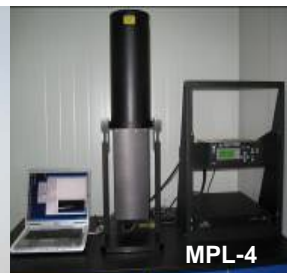
MOTIVATION

Fill the gap of global climate monitoring network.

There is no any international network (such as CEOP,BSRN, Aeronet) site in Loess Plateau yet.

Loess Plateau is a special semi-arid land surface; & part of dust aerosol source and close to the desert.





PSP

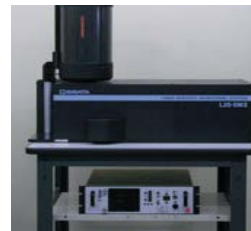
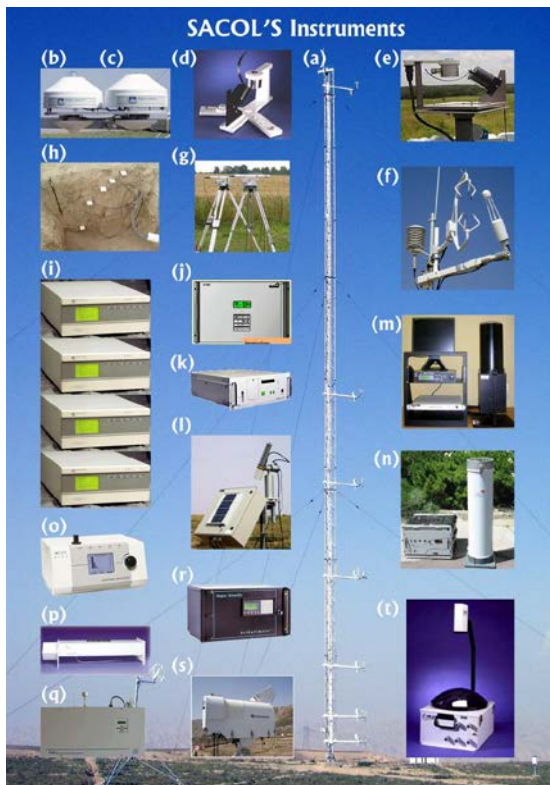
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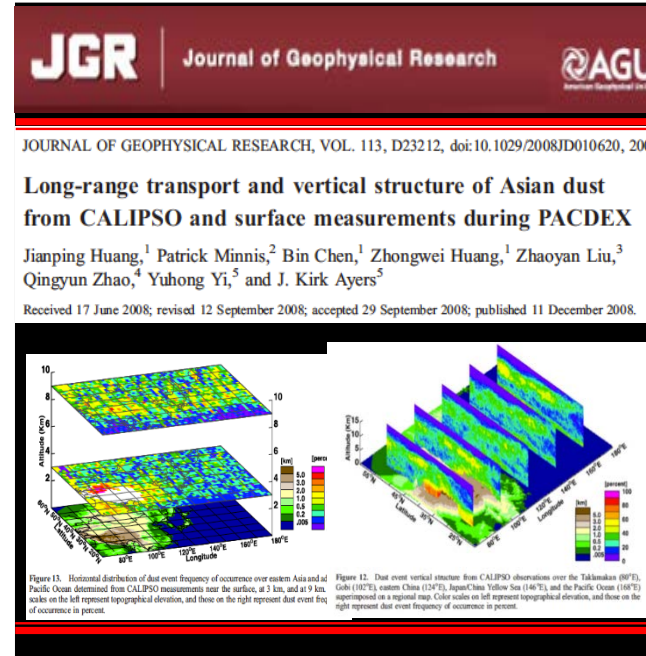
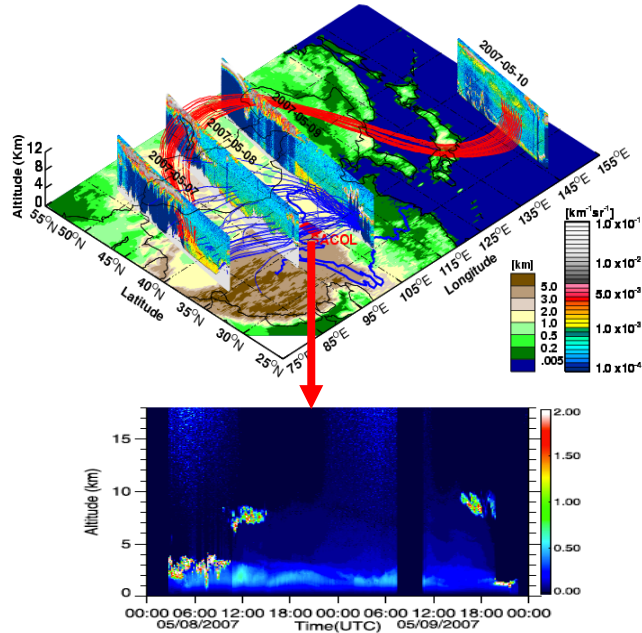
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- Boundary layer
- Surface radiation
- Surface fluxes
- Soil parameters
- Ambient air analyzers
- Aerosol optical properties
- Aerosol vertical profile
- Temperature and water vapor vertical profiles
- Sky condition



Long-range transportation of Asian dust was investigated using ground-based and space borne lidar measurements



Huang et al., JGR, 2008a, 2010.

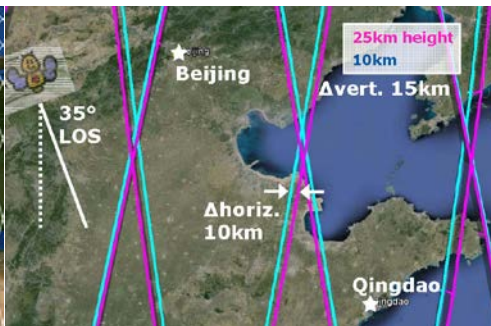
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Summary of ground based measurement for dust long range transportation and Cal/Val



Kanitz, 2015. Frascati, Italy.

Marksteiner et al., 2015. Frascati



OUC lidar facilities



TROPIS Lidars



Lanzhou Univ. SACOL station

Ground-based co-located measurements with lidars during overpasses of Aeolus and EarthCARE are foreseen in China (Costal cities, China Seas, inland cities, Tibetan Plateau, Taklimakan desert) and in Central Europe.

Young scientists contributions

Chinese YS

- Mr. DAI Guangyao
joint-Ph.D student (2016.11-2018.4) working on aerosol and cloud laser remote sensing with TROPOS/Germany and OUC/China.
- Research experience:
 - ✓ Construction of lidar system, calibration and validation;
 - ✓ Water vapor calibration;
 - ✓ Depolarization ratio calibration;
 - ✓ Quality control (QC) and Quality assurance (QA);
 - ✓ Lidar products retrieval.



Photo with Polly^{XT}

Summary on progress and collaboration

Joint proposal to NSFC and DFG for

Lidar Measurements of Atmospheric Mineral Dust and Absorbing Aerosol Profiles for the Determination of Radiative Aerosol Impacts at Eurasian Coastal Zones (IMPACT)

(in review)

联合向中国自然科学基金委与德国科学联合会申请课题：
欧亚海岸带海气边界层气溶胶光学特性激光雷达探测技术研究
(评审中)

