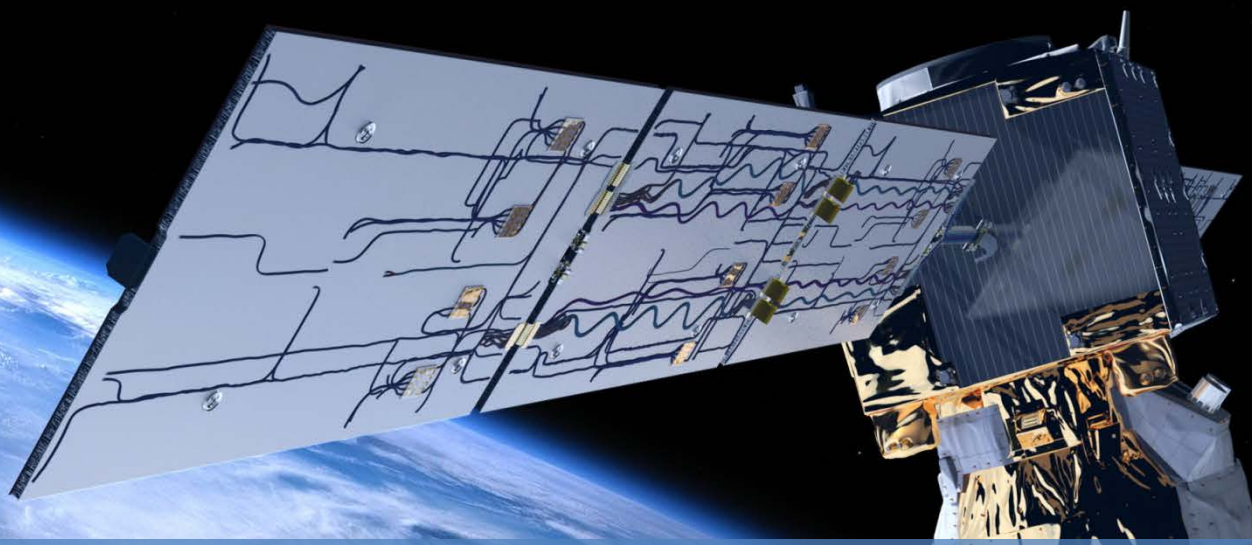

Calibration/Validation Experiments for the ADM-Aeolus using the OUC lidar facilities

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ADM-Aeolus CAL/VAL Rehearsal Workshop, Toulouse, France, 28-30 March 2017

Outline

1. **Proposal objectives**
2. **Description of CAL/VAL techniques applied**

   OUC-ORSI lidar facilities: Mobile Doppler wind lidars / HSRL , coherent Doppler wind lidar, Multi-wavelength Raman-Polarization lidar
3. **Cal/Val activities with ESA-MOST Dragon 4 program**
4. **Summary: contribution to Aeolus CAL/VAL requirements**

Proposal objectives

- **Direct detect Doppler wind lidar / HSRL (High Spectral Resolution Lidar) CHiPSDWiL**
  - radial wind speed, wind profile, 3D wind vector, aerosol-backscattering ratio (Rb), aerosol extinction coefficient, extinction-to-backscatter (Sa), sea surface wind vectors

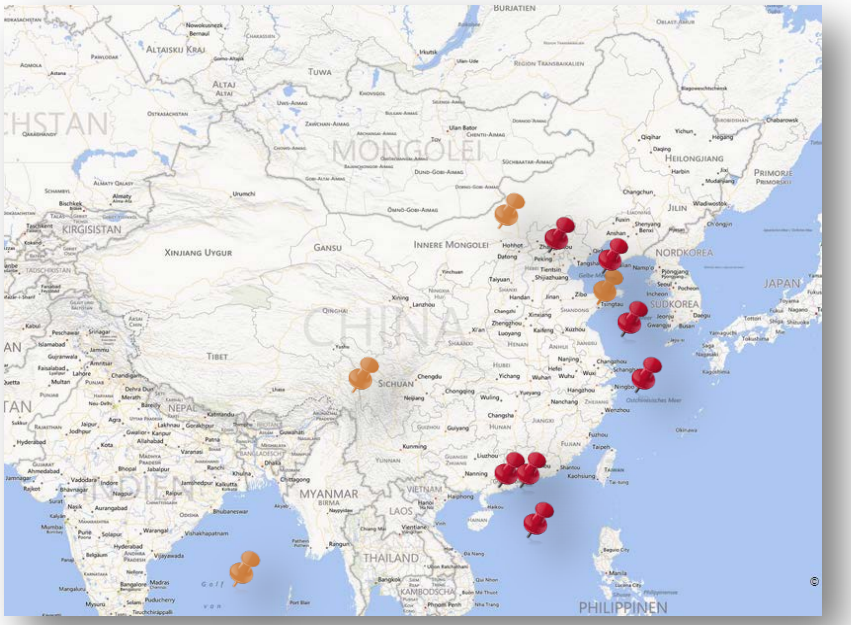
- **Coherent Doppler lidar WindPrint**
  - wind profile , sea surface wind vector

- **Multi-wavelength Raman-Polarization lidar WACAL**
  - Aerosol-backscattering ratio (Rb), aerosol extinction coefficient, extinction-to-backscatter (Sa) 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.

Description of CAL/VAL techniques applied

Atmospheric lidar campaigns of last 10 yrs

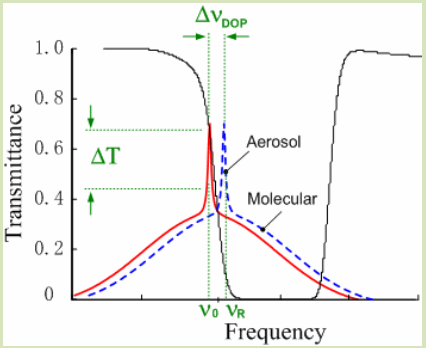


- ✓ 2011-2012 CMA Lidar and radiosonde campaign in Beijing
- ✓ 2013 Atmospheric lidar observation in Indian Ocean
- ✓ 2013-2017 CMA the 3rd Tibetan Plateau atmosphere scientific campaign

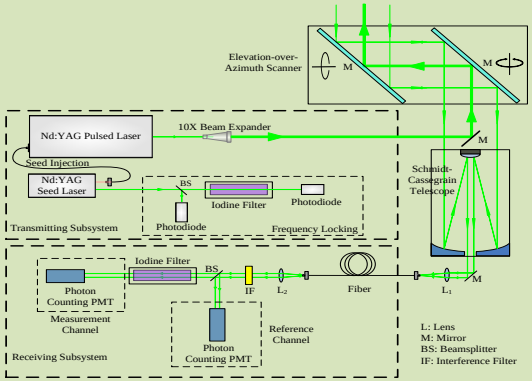
- ✓ 2005~2006：radiosonde validation
- ✓ 2006 International Sailing Games：wind profiler
- ✓ 2007 International Sailing Games：wind profiler, buoys
- ✓ 2007 Ground anemometer validation campaign
- ✓ 2008 Olympics: operational sea surface wind monitoring
- ✓ 2008 Spacecraft landing area：wind profile monitoring
- ✓ 2009 Storm observation：lidar, radars
- ✓ 2010 WMO radiosonde validation campaign at Yangjiang
- ✓ 2010 Sea surface wind observations for Asia Game

Description of CAL/VAL techniques applied

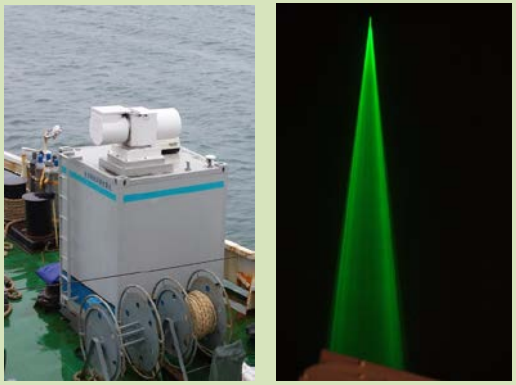
Direct detect Doppler wind lidar / HSRL (High Spectral Resolution Lidar)



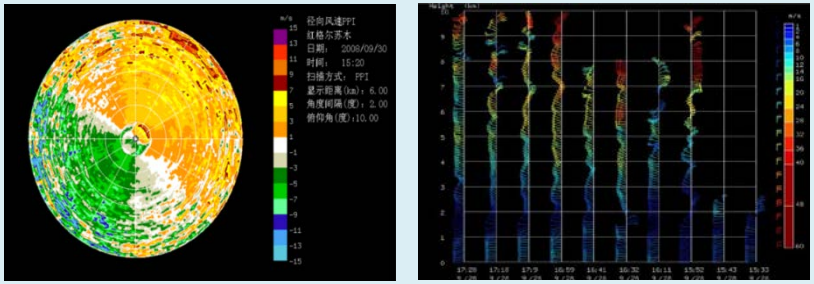
Theory



Schematics



CHiPSDWiL



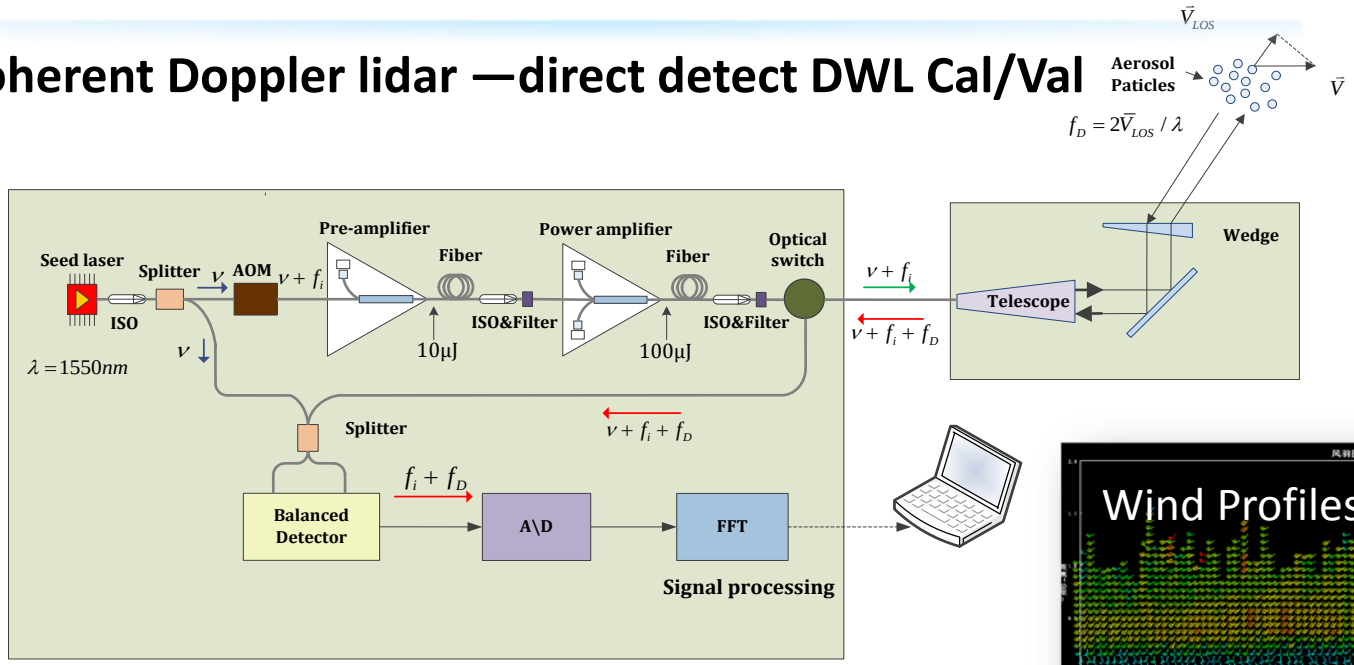
3D wind and wind Profile

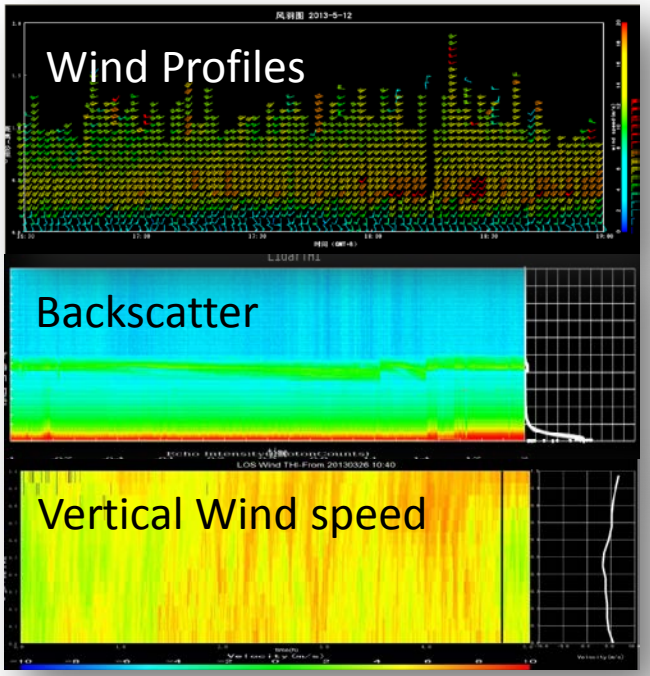
High precision scanner enables the observation at specified azimuth and elevation angle pointing to the ADM-Aeolus laser path.

Z. Liu, S. Wu, B. Liu, Z. Li, et.al. 2003,2006,2007,2008, 2014, 2016

Description of CAL/VAL techniques applied

Coherent Doppler lidar —direct detect DWL Cal/Val



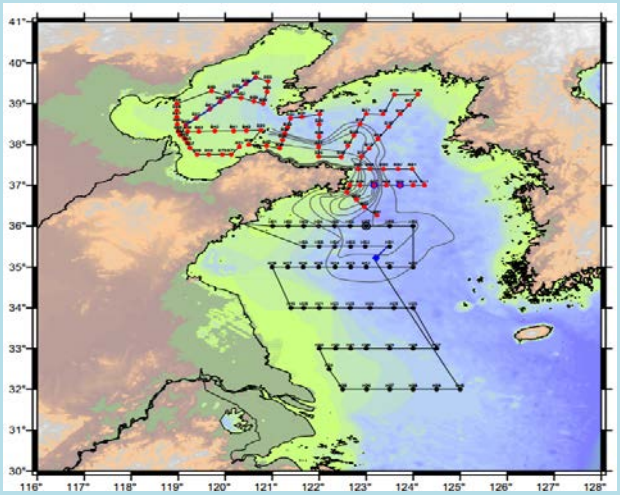


- Boundary layer wind profile measurement with high accuracy of 0.3 m/s.
- Better understanding of the vertical wind under and within clouds.
- Easy to transport for remote area campaign
- Deployed in the Tibetan Plateau campaign.

S. Wu, et. al. 2012

Description of CAL/VAL techniques applied

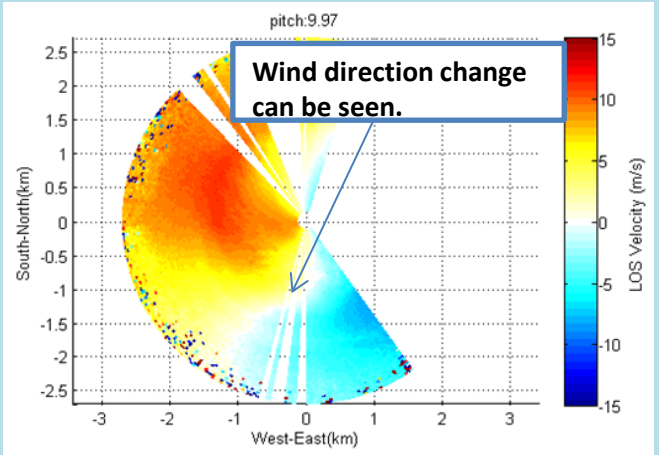
Coherent Doppler lidar —Sea Surface Wind

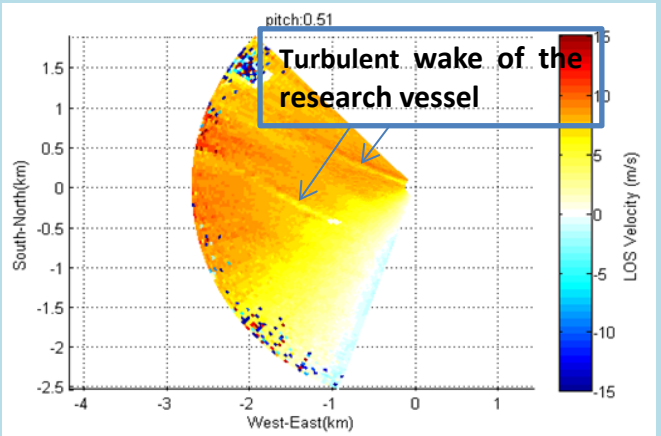


Experiment

2013 Cruise
April 27th to May 21th

Data

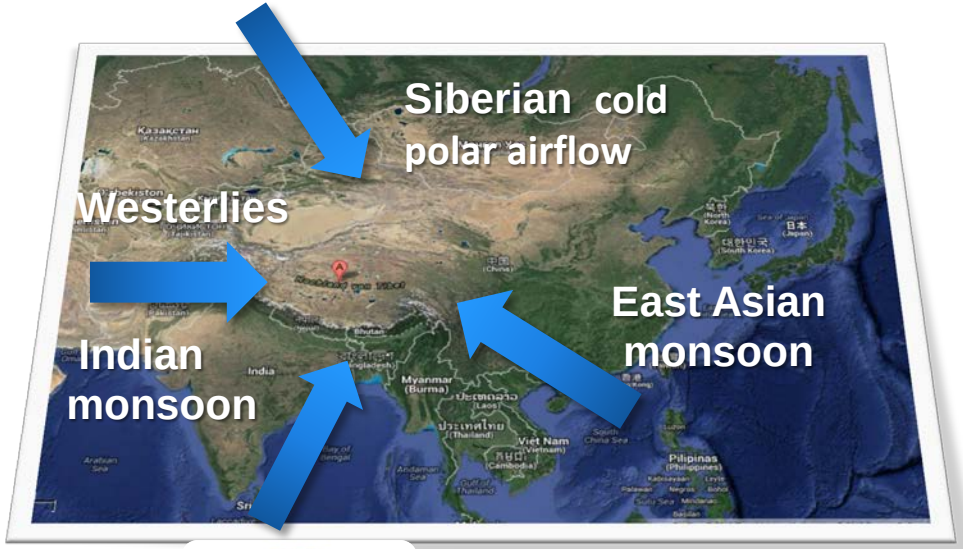




S. Wu, et. al. 2012

Description of CAL/VAL techniques applied

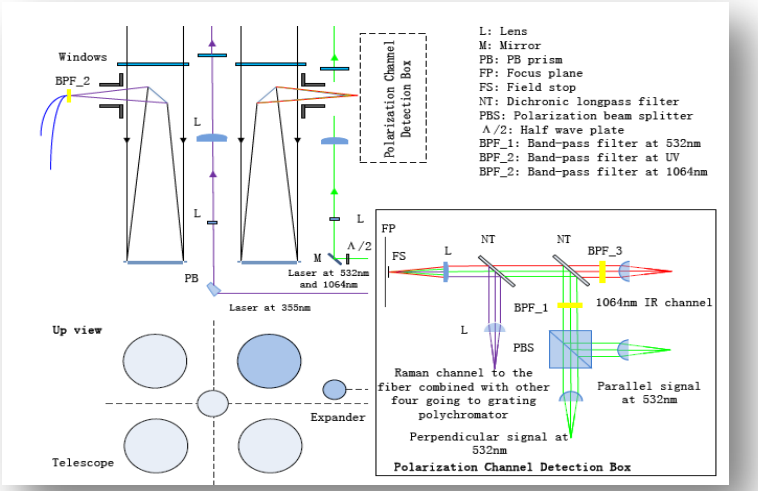
Multi-wavelength Raman-Polarization lidar



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



WACAL diagram

Status of manpower, tools and funding

Team

- PI: Songhua WU
- Co-PIs: Xiaoquan SONG, Bingyi LIU
- Team:
  Guaoyao DAI (OUC/TROPOS),
  Xiaochun ZHAI (OUC/DLR-IPA, 2018-2019),
  Changzhong FENG, Hongwei ZHANG,

Tools

- Direct detection Doppler lidar / HSRL
- Coherent Doppler lidar
- Raman-polarization lidar

Funding

The RD & field campaigns are supported by **National Natural Science Foundations of China (NSFC) project** "Marine atmospheric boundary layer structure and three dimensional wind observation by Doppler lidar" and **China Meteorological Administration projects** "Raman-polarization lidar for water vapor, cloud and aerosol measurement".

OUC projects are going to be closed at the end of 2017. Ground observations for Cal/Val at OUC campus can be ensured. But the field campaigns (Mobile/shipborne) outside of OUC are not assured yet, and travel grant for young participants (postdoc, Ph. D. student) are needed.

Outline

1. Proposal objectives
2. Description of CAL/VAL techniques applied

   Mobile Doppler wind lidars / HSRL , coherent Doppler wind lidar, Multi-wavelength Raman-Polarization lidar
3. Contribution to Aeolus CAL/VAL requirements
4. **Cal/Val activities with ESA-MOST Dragon 4 program**

Lidar Observations from ADM-Aeolus and EarthCARE-Validation, Study of Long-range Transport of Aerosol and Preparation of a Future Chinese CO_2 Lidar Mission

European Leader Investigator	Chinese Leader Investigator
Oliver Reitebuch	**Songhua Wu**
DLR-IPA, GERMANY	**OUC-ORSI, CHINA**

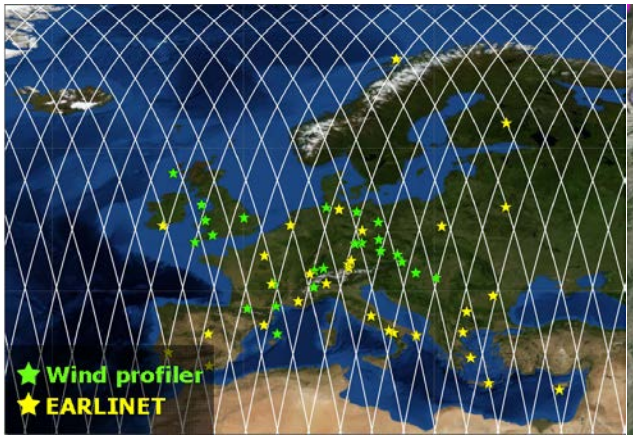
Topic Nr.	PIs	Title
32296_1	O. Reitebuch, DLR W. Chen, CAS-SIOM	Preparation of Cal/Val of spaceborne **Aerosol** and **Carbon dioxide Detection Lidar (ACDL)** by ground-based and airborne sounding instruments observations
32296_2	O. Reitebuch, DLR S. Wu, OUC	Validation of **ADM-Aeolus** by airborne and ground-based wind lidar observations
32296_3	D. Althausen, TROPOS S. Wu, OUC	Long-range **dust transport** and validation using ground-based and satellite lidar observations

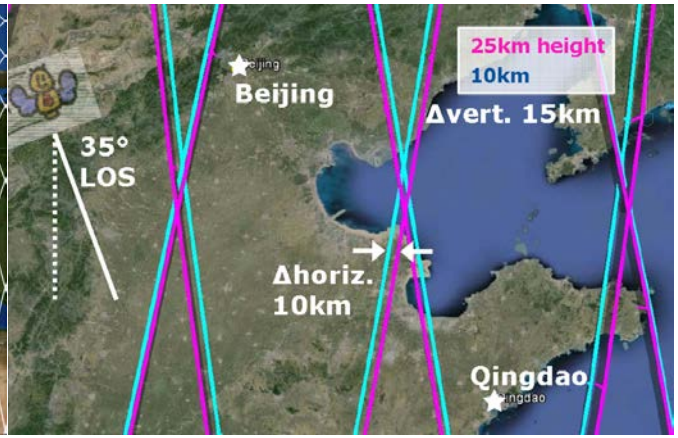
Participants from 8 institutes from EU & China:

DLR-IPA: *O. Reitebuch, G. Ehret, A. Fix, B. Witschas, U. Marksteiner, C. Lemmerz, S. Groß, O. Lux*
OUC-ORSI: *S. WU, X. Song, B. Liu, G. Dai, X. Zhai,*
TROPOS: *D. Althausen, U. Wandinger,*
CAS-SIOM: *W. Chen, J. Liu;* ***CAS-AIOFM:*** *D. Liu;* ***USTC:*** *D. Sun, W.Xu;* ***LZU:*** *J. Huang, Z. Huang*
CMA: *J. ShangAn wind lidar and atmophreric environment measurement lidar.*

Research contents:

Validation using ground-based and satellite lidar observations





Kanitz , 2015. Frascati, Italy.

Marksteiner et al., 2015. Frascati

OUC lidar facilities

TROPOS 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.

Summary of Cal/Val opportunities

Instruments & Data products

OUC will carry out measurements of radial wind speed, wind profile, 3D wind vector, aerosol-backscattering ratio, aerosol extinction coefficient, extinction to backscatter ratio, etc., during ADM-Aeolus overpass the OUC lidar facilities (E120.4956°, N36.165°).

A: **Direct-detect technique** but with **the different laser wavelength** and Doppler frequency discriminator which makes validation effective on the independent technological background. The validation lidars cover most of the data products of ADM-Aeolus such as **LOS wind speed**, **aerosol extinction coefficient** and **backscattering**. Moreover, **aerosol backscattering ratio** and **lidar ratio** can be provided which is essential to calibrate the atmospheric parameter used for aerosol extinction coefficient and wind velocity retrieval in the ADM-Aeolus algorithm.

B: **The mobile Doppler lidar/HSRL CHiPSDWiL** is operated by the State Oceanic Administration **SOA and OUC**. The QA/QC and experiment opportunity should be further considered.

D: **Coherent Doppler lidar** can **validate the direct detect Doppler lidar** in PBL. It is practical and efficient to characterize and monitor **sea surface wind vectors**.

E: **Multi-wavelength Raman-polarization lidar WACAL** is operated by **CMA and OUC** and will be deployed at different campaigns at Guangzhou/Qingdao/Tibetan Plateau to observe optical profiles of **aerosol and cloud**.

Summary of Cal/Val opportunities

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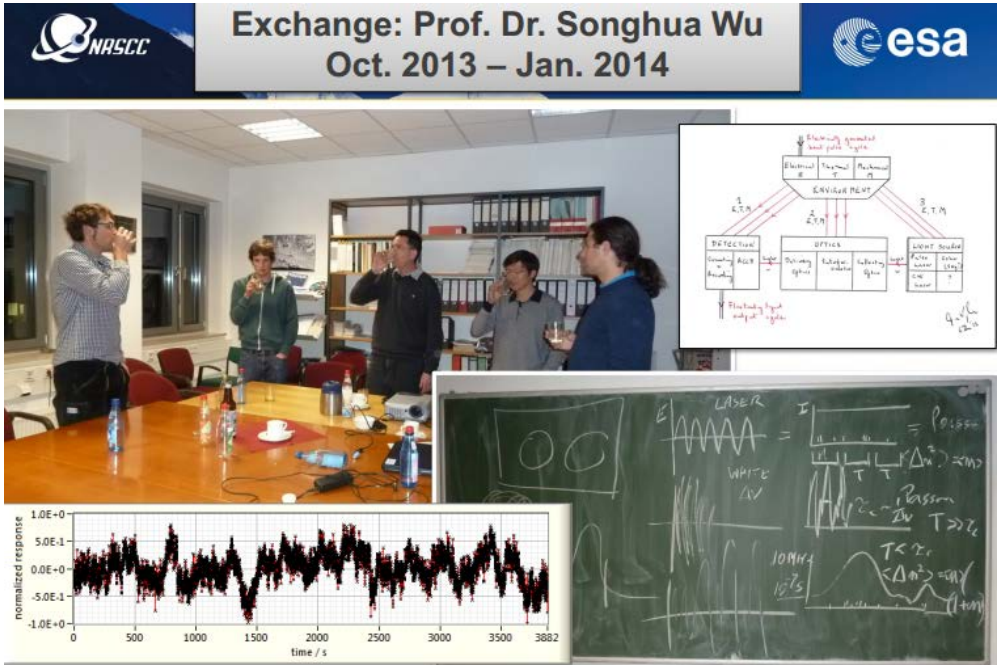
OUC will carry out measurements of radial wind speed, wind profile, 3D wind vector, aerosol-backscattering ratio, aerosol extinction coefficient, extinction to backscatter ratio, etc., during ADM-Aeolus overpass the OUC lidar facilities (E120.4956°, N36.165°).

More findings
More Fun.



Courtesy of *U. Marksteiner*