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Development of the Dual-wavelength Mie-Raman Lidar for Weather Modification Application

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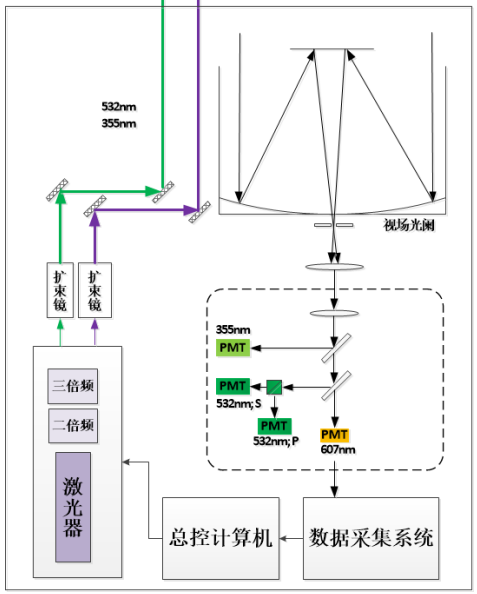
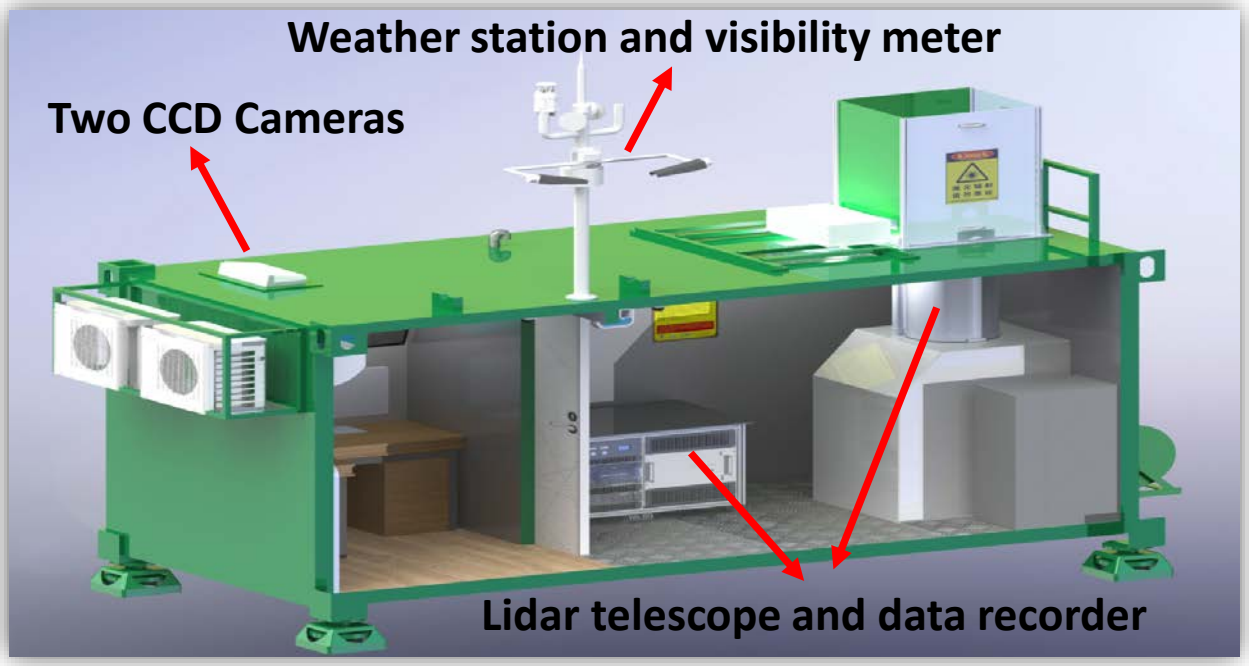
Lidar system development



Lidar photo and diagram



- **Dual-wavelength Mie-Raman lidar**
  - 355/532nm – two wavelengths transmitting
  - 355,532p,532s,607nm – four receiving channels
- **Two CCD Cameras**
  - 355nm/532nm - overlap function correction
- **Weather station and visibility meter**
  - Temperature, humidity, visibility - near-end calibration

Lidar main specifications

Laser transition unit：

- ✓ type：Inlite II-20
- ✓ wavelength：355nm&532nm
- ✓ energy ： ≥ 80mJ （ 532nm ） ， ≥ 25mJ （355nm）
- ✓ Pulse duration：<8ns
- ✓ repetition：20Hz
- ✓ divergance：<0.5mrad(after expansion)

Receiving unit：

- ✓ telescope：Cassegrain（16 inch）
- ✓ channels：355nm，532nm (p, s)， 607nm
- ✓ detectors：PMT
- ✓ Data acquisition: AD 16bit
- ✓ Vertical resolution：7.5-300m (adjustable)
- ✓ Time resolution:1-30min（ adjustable ）

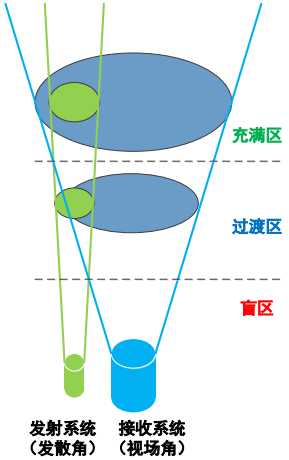
Auxiliary equipment:

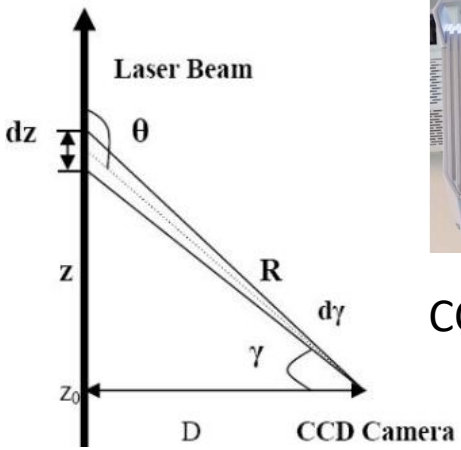
- ✓ CCD side-scattering Camera: 355nm， 532nm
- ✓ Weather station： wind, humidity, temperature, pressure
- ✓ Visibility meter： visibility

Data products：

- ✓ Max range: 20km(nightime); 4km(daytime,Mie); 1.5km(daytime, Raman)
- ✓ Five profiles: extinction coefficient, backscattering coefficient, lidar ratio, size distribution(effective radius), depolarization ratio
- ✓ Two heights: cloud base height; atmosphere boundary layer height

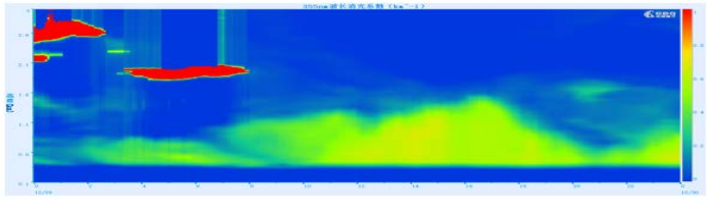
Overlap function correction



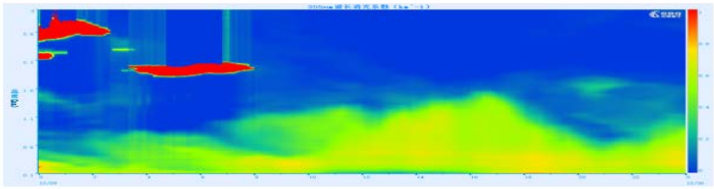


CCD Cameras

355nm

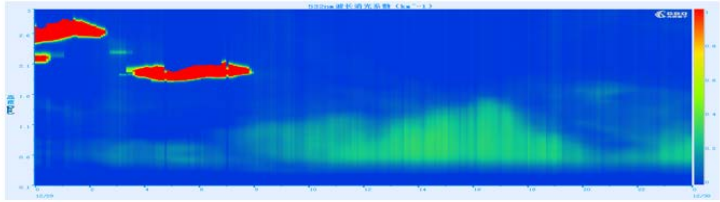


355nm 波长消光系数（近地面修正和填充前）

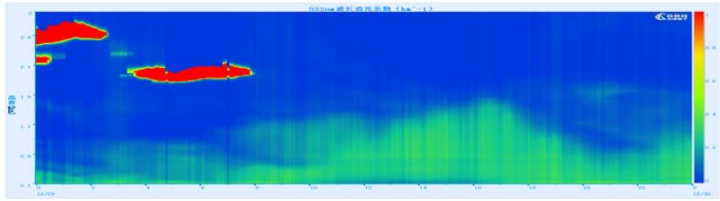


355nm 波长消光系数（近地面修正和填充后）

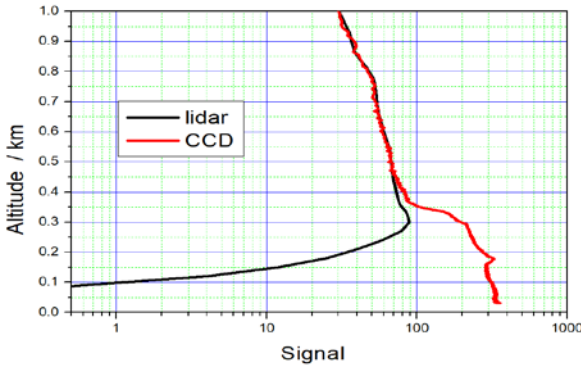
532nm

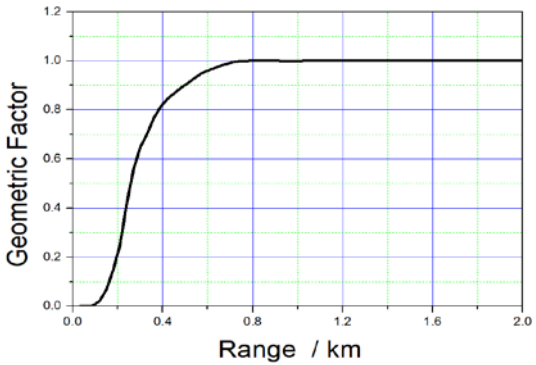


532nm 波长消光系数（近地面修正和填充前）



532nm 波长消光系数（近地面修正和填充后）



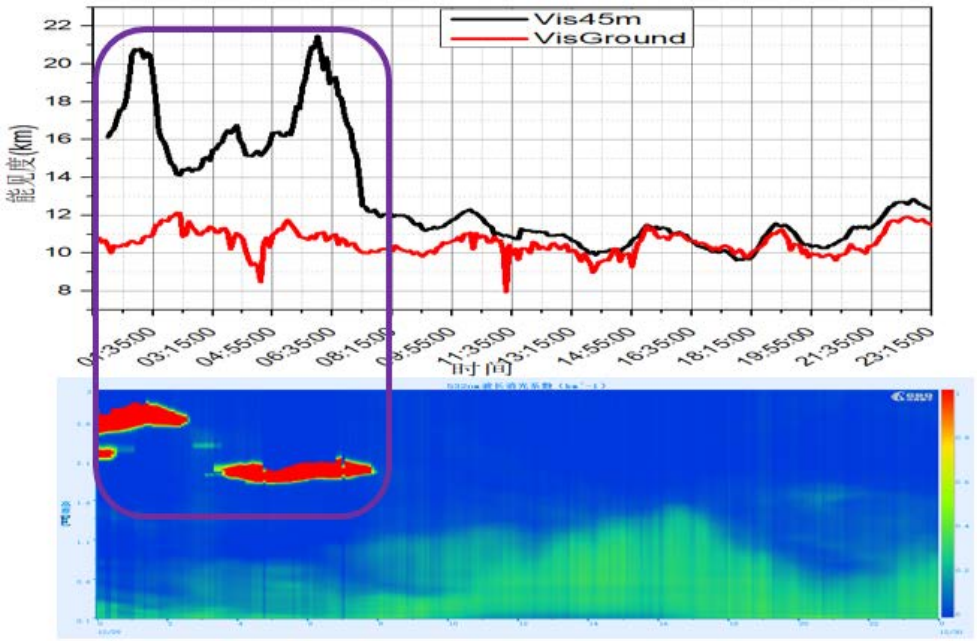


CCD side scattering technique

Near-end calibration can be applied after Overlap function correction

Extinction coefficient retrieval before(up) and after (down) overlap function correction, respectively

Near-end retrieval case

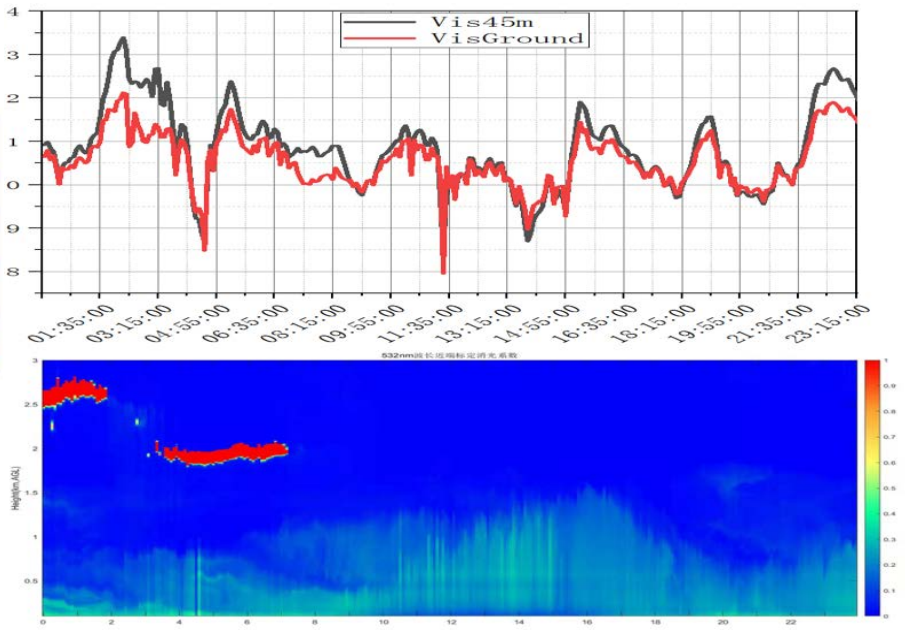


Far-end retrieval, affected by clouds

Two problems: Far-end calibration and cloud lidar ratio

Vis45m: visibility convert from lidar retrieved extinction coefficient at 45m height

VisGround: directly measured visibility

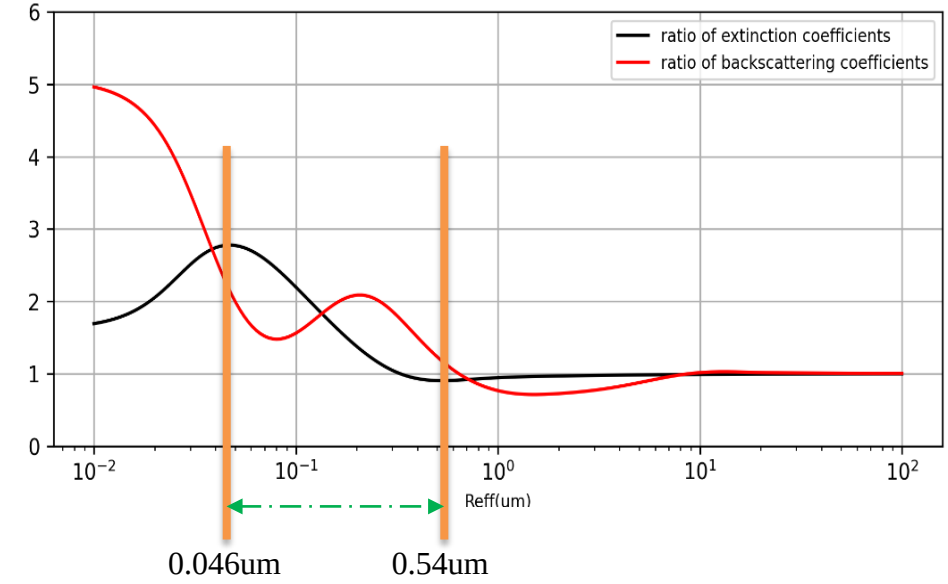


Near-end retrieval, good performance under clouds

Effective radius retrieval

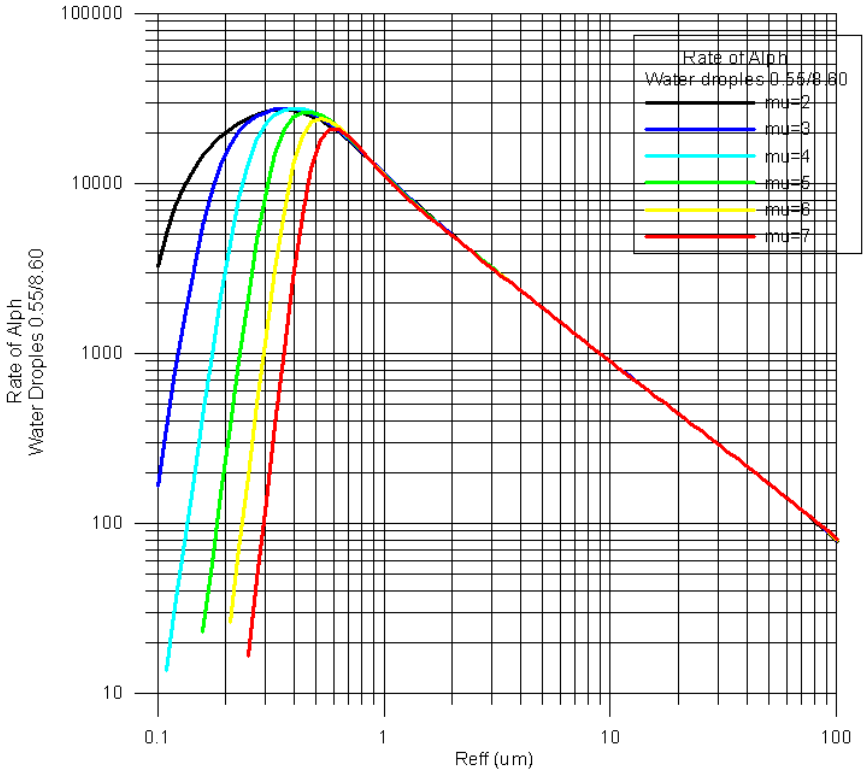
Two-wavelength retrieval technique

Urban-type(from OPAC) 355/532



Taking the advantage of the linear relationship between effective radius(x-axis) and the rate of extinction/backscattering coefficient (y-axis) of the two wavelengths

550nm/8.6mm



The protentional of cloud droplet radius retrieval combined lidar and millimeter radar(x-axis: water droplet effective radius; y-axis: the rate of extinction coefficient of 550nm and 8.6mm)

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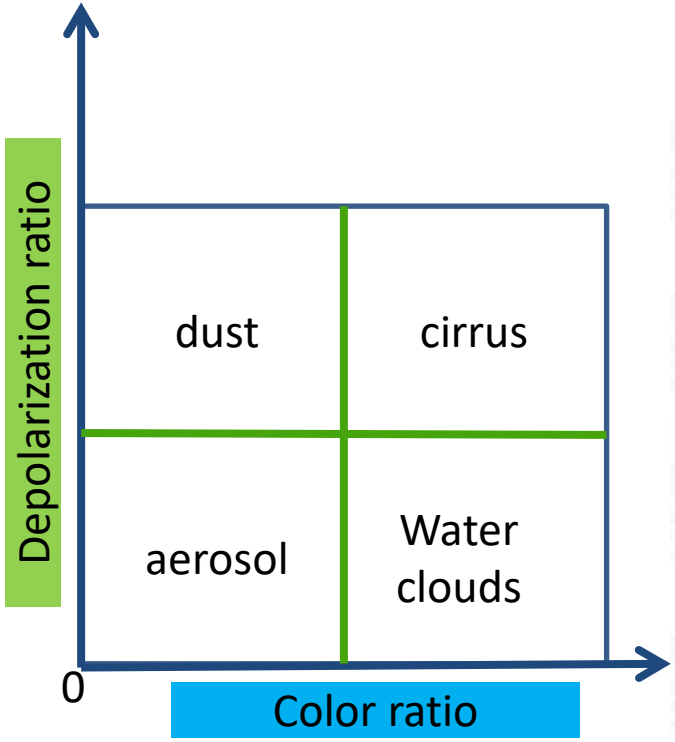
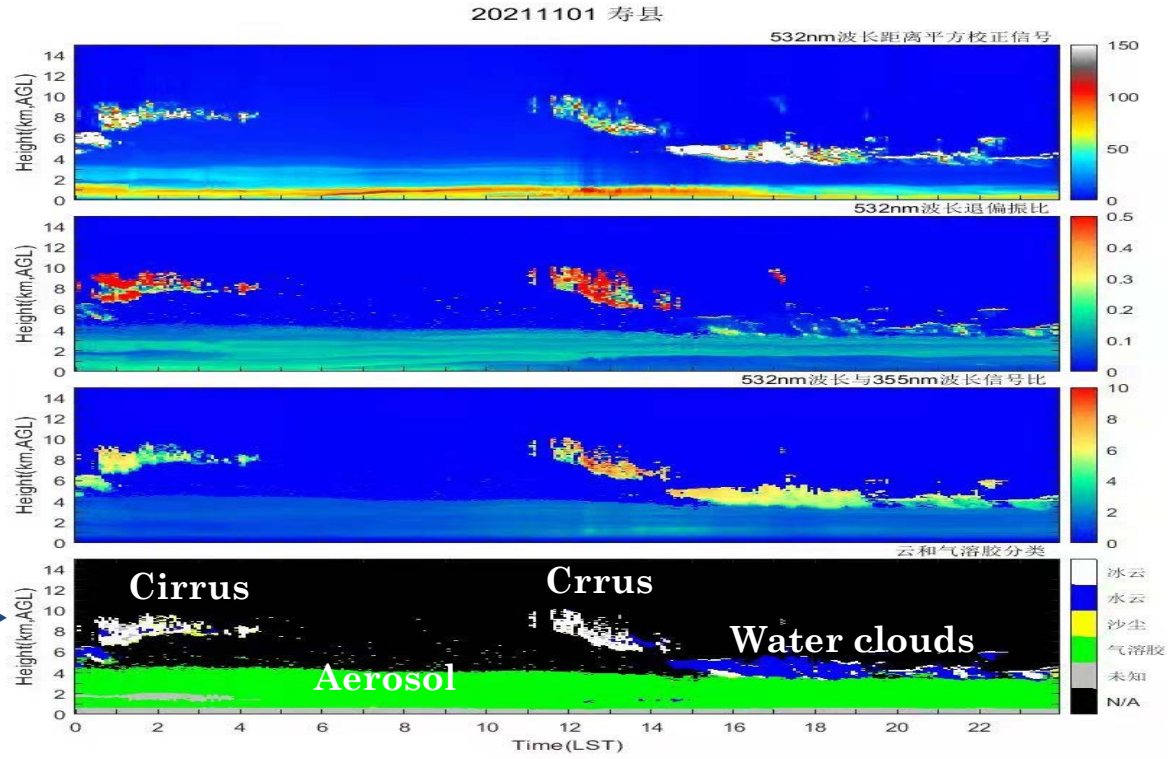
Aerosol and cloud classification





A simple scheme for lidar operators to fast distinguish the aerosol and cloud type.

Three lidar systems have been built and deployed in different sites. More data will be investigated.

Thanks for your attention!