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Geoscientific Instrumentation Methods and Data Systems Discussions

Interactive comment on "A new mobile and portable scanning lidar for profiling lower troposphere" *by* C.-W. Chiang et al.

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Comment: Reviewer #2: General Comments The paper describes a new system that comprises state-of-the-art parts. To my knowledge, there are several scanning lidars already published in the literature as well lidar systems with Raman shifters for aerosols, clouds, and trace gases. For me, the paper doesn't contain neither new information about the quantities to be measured nor the technical realizations that are used.

Response: We would like to sincerely thank anonymous referees for their critical examination and constructive comments/suggestions on the manuscript. We went through all the referee comments and suggestions, and implemented the same in the revised manuscript. Point-to-point clarifications for referee's comments and how we have ad-

dressed each recommendation are given below.

We agree with the reviewer that there are several scanning lidars published literature, however we have overcome with few drawbacks which are reported in earlier scanning lidar. For example: (1) we used rotating filters, which allows us to use lidar system as a multi-wavelength lidar. The rotating filters are automatically controlled via computer. (2) In the receiver there is an iris, which can adjust the FOV of telescope to reduce the impact of multiple scatting. (3) The transmitter (laser) is kept steady while performing the scanning. (4) The Raman cell technique is used for generating multi-wavelength signal. The automatic switching of Raman cell is through piezoelectric drivers. (5) Lidar system can be automatically switched ON depending upon the air quality. This is done by following certain steps: (a) set scan strategy of the lidar system (e.g., scan angle, scan speed, laser power, temporal and spatial resolution, etc., as shown in below Fig. 1)

Fig. 1

(b) We use rotating zoom camera image recognition system (shown as Fig. 2) as an early warning (whether to switch ON or not) for lidar system. The camera takes photo and identifies smoke area (shown as Fig. 3). If the intensity of smoke over the set threshold value, then the lidar transmitter can be trigger and lidar system will switch ON. The lidar will continue to operate until the air quality improve (intensity comes below the set threshold value). All the operations are auto-controlled by using computer. The discussed overall features make our lidar system unique from other scanning lidar system and the author's believe that this could be publishable in the esteemed "Geoscientific Instrumentation, Methods and Data Systems" journal.

Fig. 2

Fig. 3 Comment: I'm wondering that the system can measure the mobility? Please, take into account that the mobility is a fixed physical term.

Response: Thanks for valuable suggestion. There were some typo errors and therefore the relative sentence has been rewritten in the revised manuscript.

Comment: I missed essential technical details of the system as for instance - power consumption of the whole system, - laser details (type, manufacture, : : :), - size of laser power supply, - size of cooling system, - size of FOV : : :

Response: Power consumption of the whole system (full power):total:1328W Orientation system: 150 W Laser power (included cooling system): 660 W Data processing system (included: multi-channel Scaler, and PC: 518 W We use two types of laser (a) New wave Polaris (Nd:YAG Laser at 266/355/532 nm) (b) Indigenous developed laser (Nd:YAG Laser at 266/355/532 nm) Size of laser power supply with cooling system (a) New wave Polaris (37 cm*20cm*28cm) (b) Indigenous developed laser (50 cm*35cm*20cm)

A Schmidt-Cassegrain telescope having a field-of-view (FOV) of 0.5 mrad is used as receiver.

Comment: The reader thinks that Fig. 1 shows the whole system. But I did't see neither the Raman cells nor the power supply or other supporting parts (cooling system, : : :) there?

Response: The lidar system shown in the manuscript as Figure 1 is for the aerosol and cloud measurement. However, for SO2 measurement, we have used another high power indigenously developed laser. The laser is allowed to pass through the Raman active gas enclosed in a cell to pump the gas at different atmospheric pressure level (Fig. 4a) through Raman cell (shown as below Fig.a) to pump the gas. The developed laser is shown in Fig. 4b. The laser power supply and cooling system is shown in Fig. 4c. The size of laser power supply and cooling system is 50 cm*35cm*20cm.

Fig. 4a: Lidar system with the Raman cell

Fig. 4b: The indigenously developed laser (500 mJ @ 532 nm)

Fig. 4c: The laser power supply and cooling system and size is about 50 cm*35cm*20cm

Comment: The reader thinks that the system is auto-controlled : : : I'm asking: - Does the system really run automatically without any touch of an operator? - Is there really nobody necessary? Does the measurement program start autonomously including starting all subunits according a measurement schedule? - What is "auto-controlled" by the software?

Response: The system is auto controlled with computer. Before starting the lidar system the operator has to define the scan strategy (stored scan strategy can also be used). The measurement can be started automatically according a measurement schedule. We use rotating zoom camera image recognition system as an early warning (whether to switch ON or not) for lidar system. The camera takes photo and identifies smoke area (shown above as Fig. 3). If the intensity of smoke over the set threshold value, then the lidar transmitter can be trigger and lidar system will switch ON. The lidar will continue to operate until the air quality improve (intensity comes below the set threshold value). All the operations are auto-controlled by using computer.

Comment: The formulas can also be found in text books (that could be cited). I agree that basic formulas need to be named.

Response: The reference "Sasano et al., 1979" and "Campbell et al. 2002" has been added in the revised manuscript.

Comment: The error analysis is much too short.

Response: Errors and uncertainties in the measurement are discussed in Nee et al., (2007) and Chiang et al., (2008).

Comment: What is the difference between the overlapping function (page 173, 7) and the overlap function (page 171, 14)?

Response: Sorry for the discrepancy, the overlapping function in page 173, line 7 has been corrected as overlap function.

Comment: Why don't the authors show a profile of beta_particle? How is the system used in cloud research? Do the authors have a example for cloud research?

Response: In this work, we used backscattered lidar signal (photon counts) to show the intensity of plume. We use Fernald backward integration method to derive the aerosol backscattering coefficient by using constant extinction-to-backscatter ratio (Chiang et al., 2008). However, the use of aerosol backscattering coefficient will not change the conclusion of the paper. The developed scanning lidar system is capable of providing high quality data to do cloud research. One specific example is given below:

An intense cloud layer is observed between 3.5 and 5.5 km and the growth is confined up to 3 km height.

Comment: Why do the authors show only a range-integrated value of SO_2 concentration and don't show a profile of SO_2 concentration?

Response: We want to compare the lidar derive SO2 with CEMS measured SO2 concentration. As reviewer suggested, the SO2 profile for one case is shown below:

Also, the SO2 concentration as a function of range retrieved from the DIAL measurement is shown in Figure 6b 9refer manuscript).

Comment: The English must be improved.

Response: Thanks for your valuable suggestion. The authors have tried their best to reduce the acronyms, typos error and correct the English.

References:

(1) CW Chiang, SK Das and JB Nee (2008), An iterative calculation to derive extinction-to-backscatter ratio based on lidar measurements, Journal of Quantitative Spectroscopy and Radiative Transfer 109 (7), 1187-1195. (2) (3) JB Nee, CW Chiang, H Hu, S Hu and JY Yu (2007), Lidar measurements of Asian dust storms and dust cloud

interactions, Journal of Geophysical Research: Atmospheres (1984–2012) 112 (D15).

Interactive comment on Geosci. Instrum. Method. Data Syst. Discuss., 4, 165, 2014.

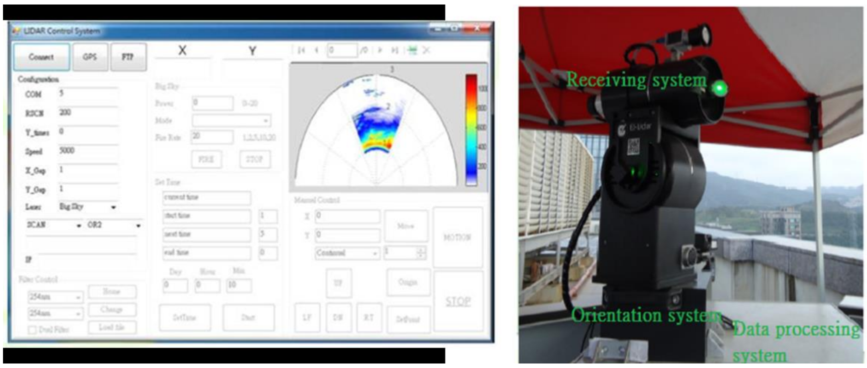

LIDAR Control System
Connect
GPS
FTP
X
Y
Receiving system
Orientation system
Data processing system

Fig. 1.

Fig. 2.

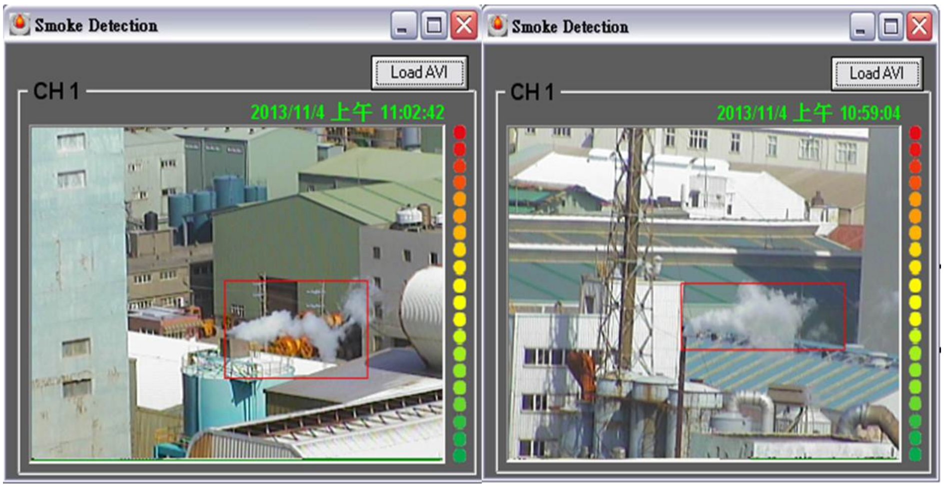

Smoke Detection
Load AVI
CH 1
2013/11/4 上午 11:02:42
Smoke Detection
Load AVI
CH 1
2013/11/4 上午 10:59:04

Fig. 3.


Raman
Cell

Fig. 4.

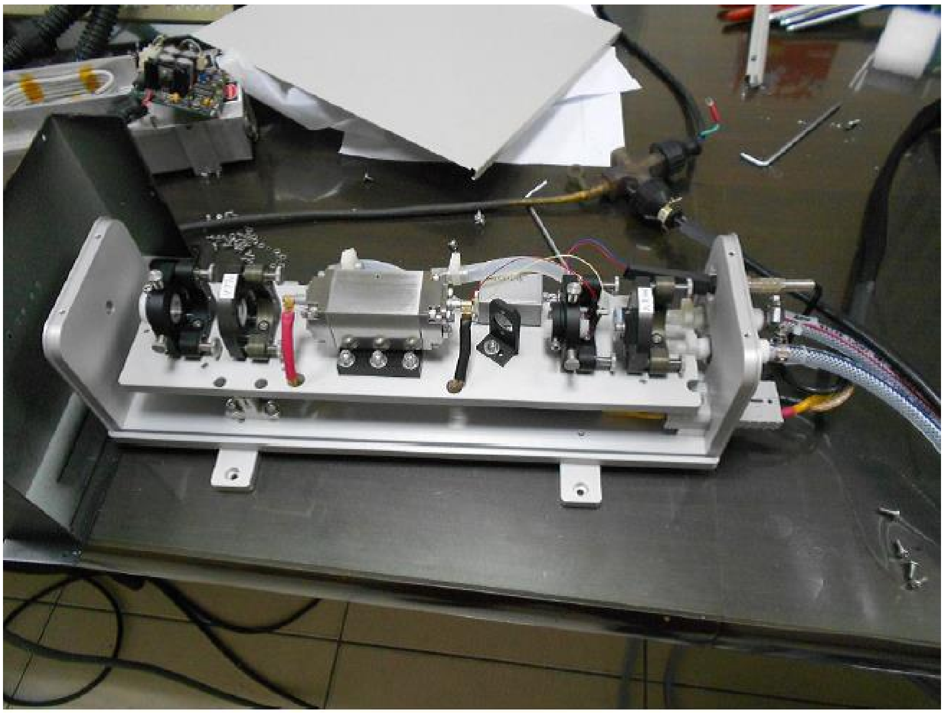


Fig. 5.

C151

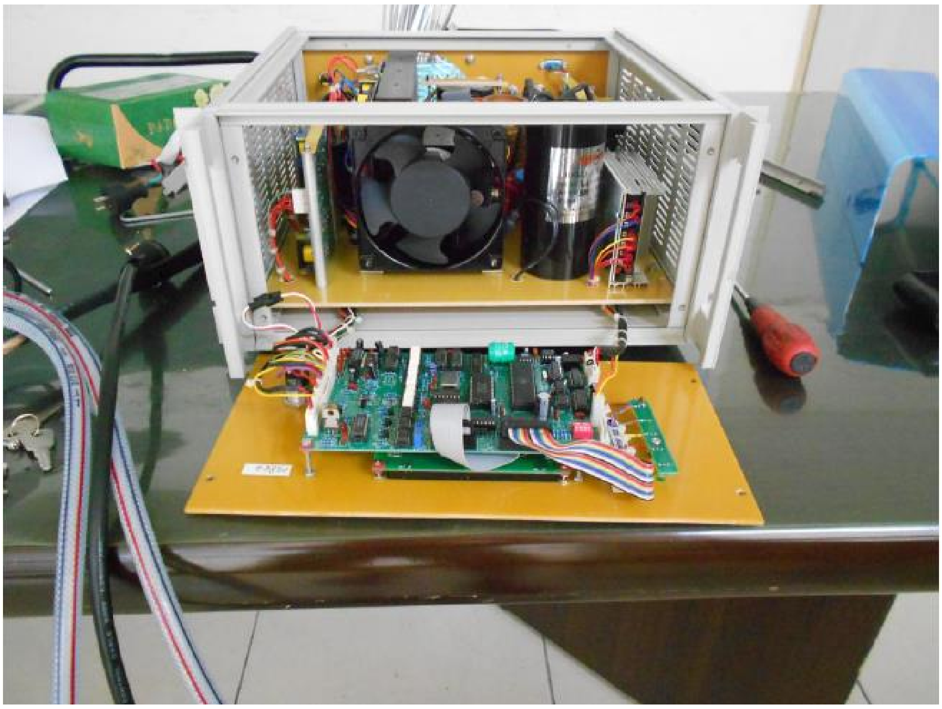
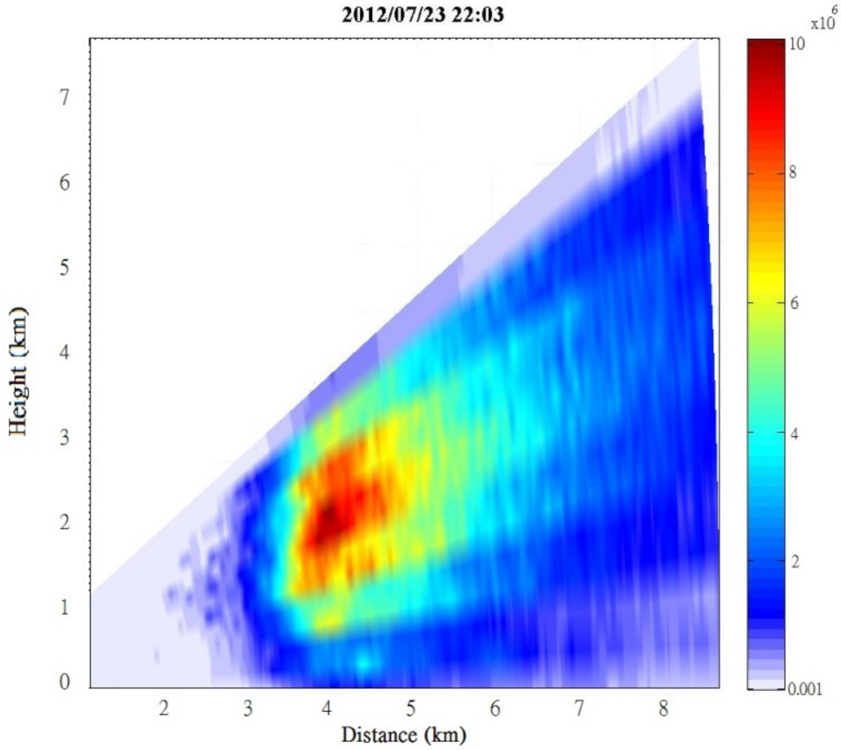
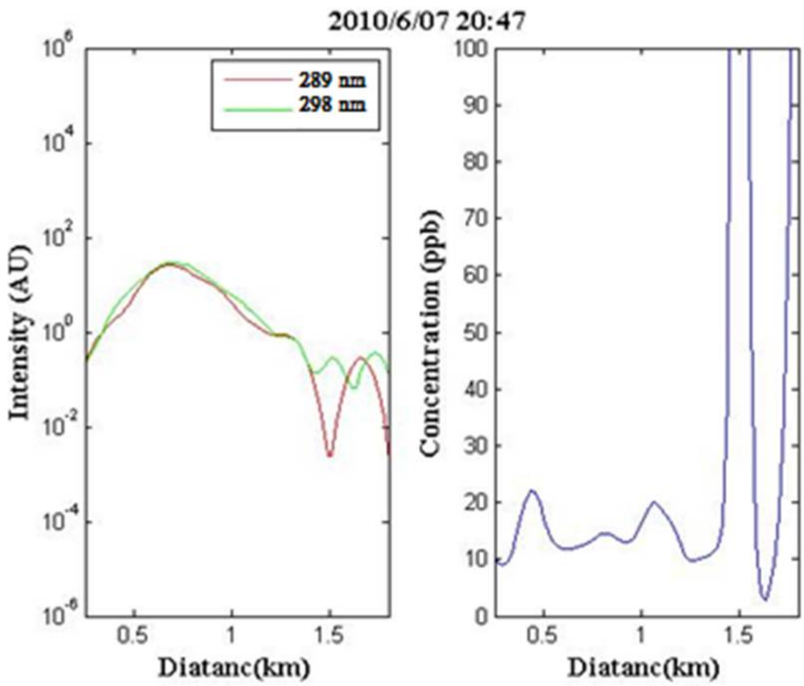


Fig. 6.



2012/07/23 22:03
Height (km)
Distance (km)
x10^6
10
8
6
4
2
0.001

Fig. 7.



2010/6/07 20:47
289 nm
298 nm
Intensity (AU)
Diatanc(km)
Concentration (ppb)
Diatanc(km)

Fig. 8.