

激光雷达专辑

微脉冲米散射激光雷达系统的产品化研发及实验观测研究

闫庆, 华灯鑫, 李仕春, 艾宇

西安理工大学机械与精密仪器工程学院, 陕西 西安 710048

摘要:

采用模拟探测技术研发了具有三维扫描功能的微脉冲米散射激光雷达产品, 用于高密度气溶胶聚集地区的大气气溶胶光学特性及云的精确探测。详细的介绍了该系统的整体结构、系统控制和数据采集处理软件。利用该系统对西安地区气溶胶及城市边界层特性进行观测研究, 实验结果表明: 在激光脉冲能量为50μJ, 望远镜接收孔径为254mm, 信号平均时间40s及距离分辨率为7.5m的条件下, 系统测量气溶胶的有效距离可达到白天5公里左右, 夜晚15公里。系统可以为研究大气变化, 特别是为研究颗粒污染物的产生, 传输和扩散的特性提供科学的测量数据。

关键词: 微脉冲米散射激光雷达 模拟探测 气溶胶 云 城市边界层 混合层厚度

Observation and productization of the micro-pulsed Mie scattering lidar system

YAN Qing, HUA Deng-xin, LI Shi-chun, AI Yu

School of Mechanical & Instrument Engineering, Xi'an University of Technology, Xi'an 710048, China

Abstract:

A Micro-pulsed Mie scattering lidar system operated in analog detection mode was designed and built for routine observations of aerosol optical properties and cloud in the lower troposphere, particularly in the high intense aerosol gathered atmospheric area. The configuration of lidar and its design methods including the hardware and automatic control and data acquisition software were described in details. The experimental results in Xi'an area illustrate that the system can measure the atmospheric aerosols up to the range of near 5 km at daytime and up to 15 km at nighttime under the measurement conditions of laser energy of 50μJ, signal averaging time of 40 s, a receiving aperture 254 mm, range resolution of 7.5 m and analog detection model. It can provide scientific measurement data for studying the atmospheric environment change, particularly for resolving the particulate pollutant generation, transmission and diffusion characteristics.

Keywords: micro-pulsed Mie scattering lidar analog detection mode atmospheric aerosol cloudurban boundary layer mixed-layer depth

收稿日期 修回日期 网络版发布日期

DOI:

基金项目:

国家自然科学基金项目(41027004) 教育部博士学科点专项基金(博导类)(20106118110005)

通讯作者: 华灯鑫(1964-) 浙江省萧山市人, 博士, 教授, 博导, 从事激光雷达大气检测技术及光电检测技术研究。

作者简介: 闫庆(1985-) 内蒙古呼和浩特人, 博士生, 从事激光雷达精细探测气溶胶及边界层技术研究Email: yanqing_lidar@163.com

作者Email: dengxinhua@xaut.edu.cn

参考文献:

[1] He, Q.S., Mao, J.T., Chen, J.Y., Hu, Y.Y.. Observational and modeling studies of urban atmospheric boundary-layer height and its evolution mechanisms [J]. Atmospheric Environment, 2006, 40:1064-1077 .

[2] Zhang, Ning, Chen, Yan, Zhao, Wenjing. Lidar and microwave radiometer observations of planetary

扩展功能

本文信息

Supporting info

PDF(1730KB)

[HTML全文]

参考文献[PDF]

参考文献

服务与反馈

把本文推荐给朋友

加入我的书架

加入引用管理器

引用本文

Email Alert

文章反馈

浏览反馈信息

本文关键词相关文章

微脉冲米散射激光雷达

模拟探测

气溶胶

云

城市边界层

混合层厚度

本文作者相关文章

PubMed

boundary layer structure under light wind weather
[J]. Journal of Applied Remote Sensing. 2012,6:8.

[3] Dubey, P.K., Jain, S.L., Arya, B.C., Ahammed, Y.N., Kumar, Arun, Shukla, D.K., Kulkarni, Pavan S. Indigenous design and development of a micro-pulse lidar for atmospheric studies
[J]. International Journal of Remote Sensing, 2011, 32(2): 337-351.

[4] Hu Shunxing, Wang Zhenzhu, Xu Qingshan, Zhou Jun, Hu Huanlin. Studies on methods for aerosol optical depth measurements by lidar
[J]. Chinese Journal of Quantum Electronics (量子电子学报)2006,23(3) (in Chinese)

[5] Zhong zhiqing, Zhou Jun.Simulated Signal Calculation for Micro Pulse Lidar
[J] Chinese Journal of Quantum Electronics (量子电子学报), 2003, 20(5) (in Chinese)

[6] Mao Jiandong, Hua Dengxin, He Tingyao, Wang Ming. Lidar observations of atmospheric aerosol optical properties over Yinchuan area
[J]. Spectroscopy and Spectral Analysis (光谱学与光谱分析), 2010, 07: 2006-2010(in Chinese).

[7] Gao, F., Bergant, K. A. Filipc \check{c} , B. Forte, et al. Observations of the atmospheric boundary layer across the land - sea transition zone using a scanning Mie lidar
[J]. Journal of Quantitative Spectroscopy & Radiative Transfer, 2011, 112(2): 182-188.

[8] Klett, J.D. Stable analytical inversion solution for processing lidar returns
[J].Applied Optics, 1981, 20:211.

[9] Sicard, M., Pérez, C., Rocaadenbosch, F., Baldasano, J.M., García-Vizcaino, D. mixed-layer depth determination in the Barcelona coastal area from regular lidar measurements: Methods, results and limitations
[J].Boundary-Layer Meteorology, 2006, 119:135-157.

[10] Wang Lin, Xie Chenbo, Han Yong, Liu Dong, Wei Heli. Comparison of retrieval methods of planetary boundary layer height from lidar data
[J]. Journal of Atmospheric and Environmental Optics(大气与环境光学学报). 2012,04:241-247.

本刊中的类似文章

1. 王莉萍 赵凤生 李占清.用MFRSR仪器观测气溶胶光学厚度[J]. 量子电子学报, 0,(): 234-241
2. 王莉萍 赵凤生 李占清.用MFRSR仪器观测气溶胶光学厚度[J]. 量子电子学报, 2010,27(2): 234-241
3. 靳磊, 吴松华, 陈玉宝, 闫宝东, 宋小全, 刘秉义, 刘智深.基于多普勒激光雷达的2011年春季北京地区气溶胶探测实验分析[J]. 量子电子学报, 2013,30(1): 46-51
4. 王瑾, 张镭, 王宏斌, 刘瑞金, 周碧, 黄忠伟, 闭建荣, 张北斗, 张武.西北半干旱区激光雷达探测卷云几何特征和光学厚度[J]. 量子电子学报, 2013,30(1): 66-72
5. 张子良 提汝芳 黄腾 王颖萍 丁蕾 郑海洋 方黎.气溶胶单粒子光谱的PLS聚类分析[J]. 量子电子学报, 2012,29(1): 106-113
6. 黄兴友, 夏俊荣, 卜令兵, 张雪芬, 雷勇, 黄建松, 王巍巍, 吴迪, 蒋昌华, 胡汉峰.云底高度的激光云高仪、红外测云仪以及云雷达观测比对分析[J]. 量子电子学报, 2013,30(1): 73-78
7. 杜立彬, 王章军, 陈超, 曲君乐, 吕斌, 刘杰, 吴承璇.微脉冲激光雷达系统实验观测及应用[J]. 量子电子学报, 2013,30(1): 84-88
8. 范广强, 刘建国, 刘文清, 陆亦怀, 张天舒, 赵雪松, 董云升.差分吸收激光雷达几何因子实验确定方法[J]. 量子电子学报, 2013,30(1): 93-97
9. 汤佳沅, 吴东.基于星载激光雷达的AOD与海面风速关系研究[J]. 量子电子学报, 2013,30(1): 25-28
10. 魏书晓, 吴东.利用星载激光雷达研究云层垂直结构及其分布[J]. 量子电子学报, 2013,30(1): 36-41