报告

国产卫星大气成分遥感探测研究进展
Research Progress on Remote Sensing Detection of Atmospheric Composition with Chinese Satellites

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讲者介绍 Biography

李正强，中国科学院空天信息创新研究院研究员，博导，国家杰出青年基金获得者，遥感卫星应用国家工程实验室执行主任，兼任国家环境保护卫星遥感重点实验室副主任。主要从事遥感和大气环境研究，主持和完成了国家重点研发计划、国家高分重大专项、基金委优青基金、中德科学基金等项目 20 余项，发表论文 250 余篇，专著 2 本，获发明专利 10 余项。担任《Atmospheric Environment》副主编、《遥感学报》编委、《大气与环境光学学报》编委、国际气候变化空间观测台（SCO）执委、国际偏振观测进展系列研讨会（APOLO）主席、大气环境遥感与协同分析学术论坛主席、中国环境科学学会环境信息系统与遥感专委会秘书长、全国卫星气象和空间天气标准化技术委员会副主任委员。获环境保护科学技术奖、北京市自然科学奖各 1 项。

Prof. Zhengqiang Li, Ph. D. in Atmospheric Optics, Program Leader of the National Science Fund for Distinguished Young Scholars, works as the Executive Director of National Engineering Laboratory for Remote Sensing Satellite Applications (NELRS), Institute of Aerospace Information Innovation, Chinese Academy of Sciences. He also serves as the Deputy Director of the National Environmental Protection Satellite Remote Sensing Key Laboratory. Professor Li mainly engages in remote sensing and atmospheric environment research. He is responsible for more than 20 major programs, including National Key R&D Program of China, Chinese High-resolution Earth Observation System (CHEOS) Program, Excellent Youth Scholars Program and Sino-German Research Project from NSFC. Prof. Li has published more than 250 peer-reviewed papers and two monographs, obtained more than 10 authorized national invention patents. He serves as an Associate Editor of the journal of Atmospheric Environment, and an editorial board member of the journal of National Remote Sensing Bulletin and the Journal of Atmospheric and Environmental Optics. He acts as a Steering Committee Member of Space Climate Observatory (SCO), the co-Chair of the international workshops of Advancement of Polarimetric Observation (APOLO series), the Chair of the Youth Forum on Remote Sensing and Collaborative Analysis of Atmospheric Environment, the Secretary General of the Professional Committee of Environmental Information System and Remote Sensing of the Chinese Society For Environmental Sciences (CSES), and the Vice-Director-Member of the National Technical Committee on Satellite Meteorology and Space Weather Monitoring of Standardization Administration of China. He has won the Environmental Protection Science and Technology Award and the Beijing Natural Science Award.

报告摘要 Abstract

面向国家“碳达峰、碳中和”重大战略目标，以及气候变化应对重大需求，大气成分卫星遥感综合探测是获取全球温室气体、气溶胶颗粒物、污染气体的空间覆盖数据，实现大气重要成分动态监测以及人为排放源识别的重要观测手段。系统梳理了国际和国产卫星大气成分遥感探测研究的发展历程，从卫星平台（极轨卫星、静止卫星、国际空间站）、传感器探测技术（多光谱、多角度、偏振、高光谱、主被动）、大气参数反演算法（差分吸收气体反演、最优化估计气溶胶反演）、真实性检验观测网络（温室气体 TCCON、气溶胶 AERONET、SONET 等）多个方面分析和总结了卫星遥感大气成分产品的发展趋势。在此基础上，以GF-5、GF-5(02)等先进卫星为代表，介绍国产大气多成分卫星遥感综合探测。一方面，多角度偏振、偏振交火等新型卫星观测技术能够获取准确的气溶胶和云参数，为温室气体、污染气体的高精度反演提供必需的散射校正数据，有效改善现有卫星反演精度不足、产品有效率低等瓶颈问题。另一方面，多类大气成分协同观测是突破温室气体、污染气体和颗粒物人为排放源识别与定量监测的重要技术途径，能够大幅提升国产卫星气候变化应用能力。

To achieve the national strategic goals of "Carbon Peak and Carbon Neutrality" and meet the major needs of climate change adaption, joint (synthetized) detection of satellite remote sensing of atmospheric composition is an effective approach to obtain spatial distribution of global greenhouse gases, aerosol particulate matters and pollution gases. It is also proved to be a significant way to identify and dynamically monitor anthropogenic emission sources of atmospheric pollutants. In our presentation, satellite remote sensing of atmospheric composition and its developments are systematically reviewed, analyzed and summarized from various aspects: satellite platform (e.g., polar orbit satellite, stationary satellite and international space station), sensor (e.g., multiple-band, multiple-angle, polarization, hyperspectral, active and passive measurement), inversion algorithm (e.g., differential optical absorption spectroscopy algorithm for gases, optimal estimation algorithm for aerosol), and validation observation network (e.g., TCCON for greenhouse gases, AERONET and SONET for aerosol). Then, taking one of the advanced Chinese satellites, GF-5 (GF-5(02)), as example, we introduce the joint remote sensing detection of multiple atmospheric components with one satellite platform. On the one hand, new observing technologies such as multi-angular intensity plus polarization and “polarization cross-fire (PCF)”, allow us to obtain more accurate aerosol and cloud parameters, thus provide necessary scattering correction for high-precision inversion of greenhouse gases and pollution gases, which could break through the limits of current inversion accuracy and data availability. On the other hand, the joint observation is an important technical way to improve the identification and quantitative monitoring of anthropogenic emissions of greenhouse gases, pollution gases and particulate matter, which can greatly enhance the capacity of the application of Chinese satellites in the field of climate change.

有兴趣合作之项目 Interested topics for future collaboration

（1）国产卫星数据检验和验证

Verification and validation of Chinese satellite data and products

（2）国家航天局气候变化空间观测台（SCO）示范项目合作

Demonstrative project cooperation of Space Climate Observatory (SCO) of China National Space Administration