Tropospheric CO Observed with NAST-I: Retrieval Algorithm, First Results, and Validation

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ABSTRACT A methodology of retrieving tropospheric carbon monoxide from IR-spectra data has been developed. Tropospheric CO profiles, together with thermodynamic properties, are determined using a three-stage approach that combines the algorithms of physical-based statistical regression inversion, simultaneous non-linear radiance inversion, and CO enhanced physical retrieval. The NPOESS Advanced Scatterometer Testbed-Instrument (NAST-I) observed a high altitude aircraft with a spectral coverage of 895-250 cm⁻¹ and a spectral resolution of 0.25 cm⁻¹ has been successfully collecting data throughout many flight campaigns. The retrieval methodology is described and demonstrated by simulations. Detailed CO retrieval error analysis based on the NAST-I instrument and retrieval accuracy of the other parameters are discussed. Results from several NAST-I flight campaigns are presented including those flown over the western Pacific Ocean in conjunction with airborne atmospheric chemistry profiles. Retrieved radiative and inverse concentration distributions that tropospheric CO profiles can be obtained from remotely sensed IR spectral data (such as NAST-I data) with accurate thermodynamic properties.

1. Flow Diagram for NAST-I Data

2. NAST-I Regression Inversion Methodology

3. NAST-I Simultaneous Matrix Inversion

4. CO Physical Enhancement Iteration

5. CO Retrieval Simulation (50% enlarged CO)

6. CO Retrieval Simulation (nominal CO)

7. CO Retrieval Error Simulation

8. NAST-I Retrieval Sample (July 14, 2001)

9. NAST-I Retrieval Sample (July 14, 2001)

10. Retrieval Validation – Radiance (July 14, 2001)

11. Retrieval Validation - Profile (March 12, 2001)

12. CO Summer Column Density on US East Coast

SUMMARY An inversion algorithm for tropospheric CO profile retrieval from IR-spectra data has been developed. Tropospheric CO profiles, together with thermodynamic properties, are determined using a three-stage approach that combines the algorithms of physical-based statistical regression inversion, simultaneous non-linear radiance inversion, and CO enhanced physical retrieval. The NPOESS Advanced Scatterometer Testbed-Instrument (NAST-I) observed a high altitude aircraft with a spectral coverage of 895-250 cm⁻¹ and a spectral resolution of 0.25 cm⁻¹ has been successfully collecting data throughout many flight campaigns. The retrieval methodology is described and demonstrated by simulations. Detailed CO retrieval error analysis based on the NAST-I instrument and retrieval accuracy of the other parameters are discussed. Results from several NAST-I flight campaigns are presented including those flown over the western Pacific Ocean in conjunction with airborne atmospheric chemistry profiles. Retrieved radiative and inverse concentration distributions that tropospheric CO profiles can be obtained from remotely sensed IR spectral data (such as NAST-I data) with accurate thermodynamic properties.