How Cities Breathe: Ground-Referenced, Airborne Hyperspectral Imaging Precursor Measurements To Space-Based Monitoring

Abstract: Airborne hyperspectral imaging has been used to measure urban pollution including greenhouse gases. However, this technique is limited in that the land use reference data required for assigning urban pollution to specific activity sources. This paper describes a new extreme hyperspectral imaging method of the Los Angeles basin to measure the temporal and spatial distribution of greenhouse and trace gases. The method employs a combination of a regional land use reference database, a mobile trace gas sensor, and an airborne hyperspectral sensor. This new method allows the measurement of urban pollution that is not currently available through traditional methods.

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CO2 and Methane Experiment “COMEX”

COMEX will calibrate / validate plume inverse-model derivation of greenhouse gas source emissions for future remote sensing satellite missions (HyspIRI and CarbonSat) that use Short Wave InfraRed absorption features for trace gas retrievals.

HyspIRI is a joint NASA-EU project that will use both AVIRIS-like and thermal infrared (TIR) sensors to produce global maps of key greenhouse gases. The project includes two main goals:

1. Measurement of CO2, CH4, N2O, O3, SO2, NOx, CO, and aerosols using AVIRIS-like sensors
2. Measurement of CO2, CH4, N2O, CO, and aerosols using TIR sensors

Landuse

Hypermapping will also use data from the MODIS instrument on the Terra and Aqua spacecrafts, which provide global coverage of land use from 1984 to present. The MODIS data will be used to derive land use maps that will be used to validate the COMEX results.

COMEX has applications for remote sensing space-borne TIR and SWIR Sensors (e.g., VIRS, IASI, AIRS, etc.)

Complementary Satellites

The HyspIRI sensor includes two instruments mounted on a satellite in low Earth orbit:

- Imaging spectrometer measuring from the visible to shortwave infrared (SWIR: 380-2350 nm)
- TIR (3.7-11.2 µm) and SWIR (1.5-2.5 µm) bands

Main Points

COMEX will combine airborne, surface, TIR and SWIR imaging spectroscopy and high spectral resolution spectroscopy for greenhouse gas source derivation from a network of 50 California sites as part of the HyspIRI campaign, with a focus on the Los Angeles megacity.

1. Combined airborne and surface reference data are richer for source identification and characterizing the complex urban environment.
2. Source and emissions could be derived from analyzing hyperspectral imaging data for Los Angeles land use during the COMEX campaign.
3. Combined TIR and SWIR provides improved land use characterization.