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

Ira Leifer1,2, David Tratt3, Dale Quattrochi4, Heinrich Bovensmann5, Konstantin Gerilowski6, Michael Buchwitz2, John Burrows7

1 NASA Marshall Flight Center, Huntsville, AL, 2 Institute of Physical Optics, University of Bremen, Germany

Abstract: Hyperspectral airborne remote sensing for urban surfaces is fraught with complications, including the need to resolve spatial, temporal, and radiometric scales that are often unknown or poorly constrained. This work combines airborne and ground reference measurements in key urban environments to test the utility of the Earth Observing System (EOS) HyspIRI mission for measuring urban trace gas emissions. A multispectral and thermal infrared sensor imaged Puente Hills Landfill, the second largest landfill in California, to assess the capability of EOS HyspIRI to measure urban trace gas emissions from a variety of sources.

CO2 and Methane Experiment “COMEX”

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

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.

Underlying Spectroscopy

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.

Underlying Spectroscopy

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.

Underlying Spectroscopy

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.

Underlying Spectroscopy

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.

Underlying Spectroscopy

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.

Underlying Spectroscopy

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.

Underlying Spectroscopy

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.

Underlying Spectroscopy

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.

Underlying Spectroscopy

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.

Underlying Spectroscopy

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

Landuse

HyspIRI Hyperspectral and VIRWIR Level II Product (top) for Puente Hills. Topography, urban surfaces, and vegetation shown. Surface spectral features are broad and gentle at the thermal (TIR). These features are useful for vegetation classification and CH4 CTMF scores (f). From Thorpe et al. (2013).

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

Generalized COMEX flight pattern for source investigation.