How Cities Breathe: Ground-Referenced, Airborne Hyperspectral Ira Leifer^{1,2}, David Tratt³, Dale Quattrochi⁴, Heinrich Bovensmann⁵, Imaging Precursor Measurements To Space-Based Monitoring Konstantin Gerilowski⁵, Michael Buchwitz⁵, John Burrows⁵

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Approach considerations

ission Derivation (Plume Inversion Modeling)

Hyperspectral Imaging: Land Use and Strong Trace Gas Sources High Resolution Remote Sensing: Trace Gas Column Abundance Key urban considerations receive around 1 Amopheric corrections including hand temporally and spatially variable aerosol loads, atmospheric heterogeneity terms of profiles of almospheric parameters, and 2. high and varied levels surface spectral dutter, often at sub-pied scales.

Underlying Spectroscopy





Mobile Measurement Trace Gas Remote Sensing Surface Reference Measurements









Airborne Shortwave Infrared (AVIRIS) and Thermal Infrared (SEBASS) Methane Imaging Spectroscopy in the LA Basin



idell, D.T., Faluvegi, G., Koch, D.M., Schmidt, G.A., Unger, I ng to emissions. Science 326, 716-718.



Abstract: Methane's (CH₄) large global warming potential (<u>Shindell et al. 2012</u>) and likely increasing future emissions due to global warming feetbocks emphasition its requisition has far greater near-ferm climate change milingation potential versus carbon dioxide CD₂, the Other major anthropogenic Greenhouse Gas (GHG) (<u>Shindell et al. 2012</u>). Uncircatanes in CH₂ budgets are from the poor state of knowledge of CH₁ spatial emissions and controlling factors of highly variable anthropogenic and natural flux surface (the CH₂ 2020) and the lack of global-cacle (satelline) data at surfacently high spatial resolution to resolve sources.

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 Contribution of Working Group I to the Fourth Assessment Report of the intergovernmental Panel on thange, in: Solomon, S., Qin, D., Manning, M., Chen, Z., Marquis, M., Averyt, K.B., Tignor, M., Miller, H.L. CC df. Cambridge, p. 996.

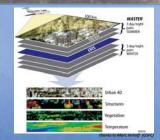






Landuse





CO₂ and Methane EXperiment "COMEX"













Generalized COMEX flight pattern for source investigation.



COMEX will calibrate / validate plume inversemodel 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

Wave Inflacted absorption of the control of the con

arge localized anthropogenic and natural GHG (mainly CH₄) emitting

- California fossil fuel and gas extraction areas near Bakersfield, oil an natural gas refineries (Carson Refinery...), natural marine geologic CH4 emissions from the Coal Oil Point ar terrestrial geologic emissions from the La Brea Tar Pits in Los



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

Complementary Satellites

HyspIRI

- Imaging spectrometer measuring from the visible to short wave infrared (VSWIR: 380 nm > 2500 nm) in 0 nm contiguous bands
 Multispectral imager measuring from 3 to 12 um in the mid and thermal infrared (TIR).
 VSWIR and TIR instruments have 60-m spatial receiption.



- High performance on-board calibration sources (diffusers, lamp, LED, etc.)

Main Points

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

Combined airborne and surface reference data are richer for source identification and characterizing the complex urban metaconlorus.