

# COMEX: AVIRIS-NG Facility Instrument Associated Flights and Information, 2014

## Get Data

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Dataset Version: 1

## Summary

This dataset lists flight lines and provides data access links and contextual flight information for a subset of the AVIRIS-NG Facility Instrument Collection that are associated with the CO2 and Methane eXperiment (COMEX) Project. The COMEX Project was carried out May through September, 2014. AVIRIS-NG Facility Instrument data are otherwise not replicated in this dataset. The COMEX Project utilized several measurement capabilities including the AVIRIS-NG airborne facility instrument data to demonstrate that methane emissions associated with fossil fuel production activities in the Los Angeles, California area were of sufficient magnitude and size for space-based observations. These lists of the associated COMEX flights from the AVIRIS-NG Facility Instrument provide flight lines and access information for the Level 1B Calibrated Radiance data and the Level 2 Calibrated Reflectance data.

The NASA AVIRIS-NG is a nadir-viewing pushbroom spectral mapping system with high signal-to-noise ratio (SNR), designed and toleranced for high performance spectroscopy. AVIRIS-NG measures reflected radiance at 5-nm intervals in the Visible to Shortwave Infrared (VSWIR) spectral range from 380-2510 nm. The AVIRIS-NG sensor has a 1 milliradian instantaneous field of view, providing altitude dependent ground sampling distances from 20 m to sub-meter range. Data from AVIRIS-NG have been applied to a wide range of studies in the fields of terrestrial and coastal aquatic plant physiology, atmospheric and aerosol studies, environmental science, snow hydrology, geology, volcanology, oceanography, soil and land management, agriculture, and limnology. In the COMEX project, data from AVIRIS-NG were combined with ground-based in situ measurements to study techniques for mapping methane plumes using airborne and satellite sensors.

The COMEX-related flights by AVIRIS-NG occurred on 2014-06-03, 2014-06-12, 2014-06-13, 2014-09-01, 2014-09-02, 2014-09-03, and 2014-09-04.

There are 3 files associated with this dataset. One file holds information for COMEX-related flights that has been subsetted from the [AVIRIS Facility Instrument collection](#) archived at the ORNL DAAC including basic metadata for each flight line, such as date, site name, and comments about atmospheric conditions. A separate file lists the L1B and L2 data files for each flight available for download through the ORNL DAAC and NASA's Earthdata Search. Download links and Common Metadata Repository (CMR) query text are provided for these files. For convenience, a map of flight line footprints in Keyhole Markup Language (KML) is also included. These tabular data are provided in comma separated values (CSV) format.

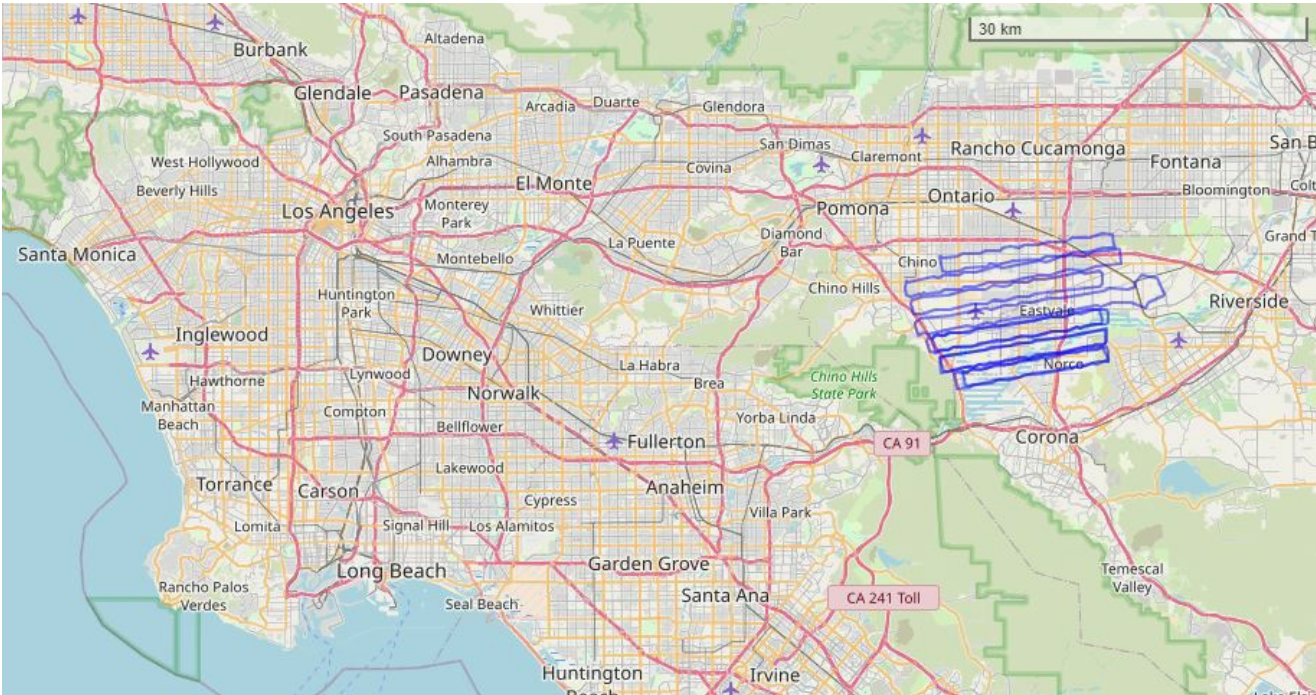


Figure 1. Footprints of COMEX-related flight lines for the AVIRIS-NG instrument shown as blue rectangles. Area depicted in vicinity of Los Angeles, California, U.S.

## Citation

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## 1. Dataset Overview

This dataset lists flight lines and provides data access links and contextual flight information for a subset of the Airborne Visible / Infrared Imaging Spectrometer-Next Generation (AVIRIS-NG) Facility Instrument Collection that are associated with the CO<sub>2</sub> and Methane eXperiment (COMEX) Project. The COMEX Project was carried out May through September in 2014. AVIRIS-NG Facility Instrument data are otherwise not replicated in this dataset. The COMEX Project utilized several measurement capabilities including the AVIRIS-NG airborne facility instrument data to demonstrate that methane emissions associated with fossil fuel production activities in the Los Angeles, California area were of sufficient magnitude and size for space-based observations. These lists of the associated COMEX flights from the AVIRIS-NG Facility Instrument provide flight lines and access information for the Level 1B Calibrated Radiance data and the Level 2 Calibrated Reflectance data.

This dataset holds information for COMEX-related flights that has been subsetted from the [AVIRIS Facility Instrument collection](#) archived at the ORNL DAAC.

**Project:** COMEX (CO<sub>2</sub> and Methane eXperiment)

The CO<sub>2</sub> and Methane eXperiment (COMEX) campaign, funded bilaterally by NASA and ESA, supported the mission definition of CarbonSat and HypSIRI by providing representative airborne remote sensing data as well as ground-based and airborne in situ data. The objectives were addressed by a unique combination of VIS/NIR/SWIR hyperspectral remote sensing airborne instrumentation (AVIRIS-C, AVIRIS-NG), TIR hyperspectral remote sensing airborne instrumentation (Mako), NIR/SWIR spectroscopic remote sensing airborne instrumentation (MAMAP) as well as in situ airborne (Picarro GHG sensor/analyzer and CIRPAS atmospheric measurements suite) and ground based (AMOG - AutoMObile greenhouse Gas surveyor) measurements for validation and interpretation support. COMEX demonstrated that methane emissions associated with fossil fuel production activities in the Los Angeles area were of sufficient magnitude and size for space-based observations. COMEX was executed between May and September 2014 around the Southern California, USA, area.

### Related Publications

Gerilowski, K., S. Krautwurst, D.R. Thompson, A.K. Thorpe, R.W. Kolyer, H. Jonsson, T. Krings, C. Frankenberg, M. Horstjann, I. Leifer, M. Eastwood, R.O. Green, S. Vigil, M. Fladeland, D. Schüttemeyer, J.P. Burrows, and H. Bovensmann. 2016. Passive remote sensing of large-scale methane emissions from Oil Fields in California's San Joaquin Valley and validation by airborne in-situ measurements - Results from COMEX. EGU General Assembly 2016, 17-22 April 2016 in Vienna Austria. ID EPSC2016-15799. <https://meetingorganizer.copernicus.org/EGU2016/EGU2016-15799-1.pdf>

Krautwurst, S., K. Gerilowski, T. Krings, J. Borchard, and H. Bovensmann. 2016. COMEX - Final Report. University of Bremen; Germany. <https://earth.esa.int/eogateway/documents/20142/37627/COMEX-Final-Report.pdf>

Thompson, D.R., I. Leifer, H. Bovensmann, M. Eastwood, M. Fladeland, C. Frankenberg, K. Gerilowski, R.O. Green, S. Krautwurst, T. Krings, B. Luna, and A.K. Thorpe. 2015. Real-time remote detection and measurement for airborne imaging spectroscopy: a case study with methane. Atmospheric Measurement Techniques 8:4383–4397. <https://doi.org/10.5194/amt-8-4383-2015>

Tratt, D.M., K.N. Buckland, J.L. Hall, P.D. Johnson, E.R. Keim, I. Leifer, K. Westberg, and S.J. Young. 2014. Airborne visualization and quantification of discrete methane sources in the environment. Remote Sensing of Environment 154:74–88. <https://doi.org/10.1016/j.rse.2014.08.011>

### Related Datasets

Green, R.O., P.G. Brodrick, J.W. Chapman, M. Eastwood, S. Geier, M. Helmlinger, S.R. Lundeen, W. Olson-Duvall, R. Pavlick, L.M. Rios, D.R. Thompson, and A.K. Thorpe. 2023a. AVIRIS Facility Instruments: Flight Line Geospatial and Contextual Data. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2140>

Green, R.O., P.G. Brodrick, J.W. Chapman, M. Eastwood, S. Geier, M. Helmlinger, S.R. Lundeen, W. Olson-Duvall, R. Pavlick, L.M. Rios, D.R. Thompson, and A.K. Thorpe. 2023b. AVIRIS-NG L1B Calibrated Radiance, Facility Instrument Collection, V1. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2095>

Green, R.O., P.G. Brodrick, J.W. Chapman, M. Eastwood, S. Geier, M. Helmlinger, S.R. Lundeen, W. Olson-Duvall, R. Pavlick, L.M. Rios, D.R. Thompson, and A.K. Thorpe. 2023c. AVIRIS-NG L2 Surface Reflectance, Facility Instrument Collection, V1. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2110>

- These three collections provide information about additional AVIRIS-NG flights and resulting data products. The tables in the current dataset refer to files in these collections.

Green, R.O., D.K. Thompson, J.W. Boardman, J.W. Chapman, M. Eastwood, M. Helmlinger, S.R. Lundeen, and W. Olson-Duvall. 2024. COMEX: AVIRIS-Classic Facility Instrument Associated Flights and Information, 2014. ORNL DAAC, Oak Ridge, Tennessee, USA. <https://doi.org/10.3334/ORNLDAAC/2343>

- This collection provides information about COMEX-related flights by a similar airborne spectrometer, AVIRIS-Classic.

### Acknowledgement

The COMEX project received funding support from NASA (grants NNX13AM07G, NNX13AM21G) and from the European Space Agency.

## 2. Data Characteristics

**Spatial Coverage:** Portion of California east of Los Angeles, U.S.

**Spatial Resolution:** Flight lines of approximately 10 km in length

**Temporal Coverage:** 2014-06-03 to 2014-09-04

**Temporal Resolution:** One-time estimates

**Study Area:** Latitude and longitude are given in decimal degrees.

Site	Northernmost Latitude	Southernmost Latitude	Easternmost Longitude	Westernmost Longitude
California	34.036	33.913	-117.455	-117.702

### Data File Information

This dataset holds two files in comma separated values (.csv) format and one map in compressed Keyhole Markup Language (.kmz).

- **COMEX\_AVIRIS-NG\_info.csv** : A list of AVIRIS-NG flight lines (scenes) associated with COMEX project (Table 1)
- **COMEX\_AVIRIS-NG\_files.csv** : Level 1B and Level 2 data files available for each flight line (Table 2).
- **COMEX\_AVIRIS-NG.kmz** : provides a map of the flight line footprints in compressed Keyhole Markup Language.

The AVIRIS-NG flight line identifier is formatted as *angYYMMDDthmmss*, which encodes the date and time by year ( *YYYY* ), month ( *MM* ), day ( *DD* ), hour ( *hh* ), minute ( *mm* ), and second ( *ss* ) of the flight (e.g., "ang20200708t192518"). Date-time is in UTC.

**Table 1.** Variables in *COMEX\_AVIRIS-NG\_info.csv*.

Variable	Description
Sensor	"AVIRIS-NG"
Date	Date of flight in YYYY-MM-DD
Flight_line	Flight line (scene) identifier (e.g., "ang20140903t214929")
Flight_scene	Flight line with suffix to denote a separate scene if available. Usually, Flight_scene = Flight_line
Site_name	Location name from NASA flight log
NASA_Log	NASA flight log ID
Investigator	Person/researcher/investigator associated with flight
Comments	Notes about flight such as aircraft altitude , speed on ground (SOG), flight track azimuth, and haze/cloud cover.
KMZ_download	URL for downloading a polygon of imagery footprint from ORNL DAAC in compressed Keyhole Markup Language format. If NA, no KMZ file is available.

**Table 2.** Variables in *COMEX\_AVIRIS-NG\_files.csv*.

Variable	Description
Sensor	"AVIRIS-NG"
Product	Data product: "L1B_Radiance" or "L2_Reflectance"
Flight_line	Flight line (scene) label (e.g., "ang20140903t214929")
Date	Date of flight in YYYY-MM-DD
Filename	Name of L1B or L2 file available from ORNL DAAC.
File_size_mb	File size in megabytes
Checksum_sha256	SHA-256 checksum value for file.
Download_url	URL for downloading file from ORNL DAAC
CMR_query	URL for obtaining most up-to-date information about file from NASA Earthdata's Common Metadata Record (CMR) system. Information is returned in JSON format.

### User Notes:

- An active [Earthdata login](https://urs.earthdata.nasa.gov/) is required for accessing files and CMR information using the provided URLs. Earthdata accounts are available free of charge at <https://urs.earthdata.nasa.gov/>.
- L1B radiance data files are provided in ENVI format. There are multiple files per flight line, which includes quicklook images (JPEG). See the [AVIRIS-NG L1B Calibrated Radiance, Facility Instrument Collection](#) for more details about these files.
- For L2 surface reflectance data, see the [AVIRIS-NG L2 Surface Reflectance, Facility Instrument Collection](#) for more details about these files.
- Users should cite both this dataset and the corresponding Facility Instrument Collection datasets above when accessing and using the underlying Facility Instrument data in publications, in accordance with the [EOSDIS Data Use Policy](#). See our [Data Use and Citation Policy](#) for more information.
- Additional information about AVIRIS-NG flights is available in the [AVIRIS Facility Instruments: Flight Line Geospatial and Contextual Data](#) collection.

### 3. Application and Derivation

These resources assist researchers in accessing AVIRIS-NG imagery data associated with the COMEX project.

The objectives of the COMEX campaign activities include:

- Investigate spatial/spectral resolution trade-offs for CH<sub>4</sub> anomaly detection and flux inversion by comparison of MAMAP-derived emission estimates with AVIRIS/AVIRIS-NG derived data.
- Evaluate sun-glint observation geometry on CH<sub>4</sub> retrievals for marine sources.
- Characterise the effect of Surface Spectral Reflectance (SSR) heterogeneity on trace gas retrievals of CO<sub>2</sub> and CH<sub>4</sub> for medium and low-resolution spectrometry.
- Identify benefits from joint SWIR/TIR data for trace gas detection and retrieval by comparison of MAMAP and AVIRIS/AVIRIS-NG NIR/SWIR data with MAKO TIR data.

Further information about the COMEX project is available from Krautwurst, et al. (2016) and ESA (2024).

Results from COMEX research on methane source mapping are available from Thompson et al. (2015) and Tratt et al. (2014).

### 4. Quality Assessment

None conducted.

### 5. Data Acquisition, Materials, and Methods

These resources assist researchers in accessing AVIRIS-NG imagery data associated with the COMEX project. This project was conducted June to September in 2014 in southern California, U.S. The AVIRIS-NG flights covered a region east of Los Angeles and west of Riverside, California (Figure 1) and occurred on 2014-06-03, 2014-06-12, 2014-06-13, 2014-09-01, 2014-09-02, 2014-09-03, and 2014-09-04.

The AVIRIS-NG is a pushbroom spectral mapping system with high signal-to-noise ratio (SNR), designed and toleranced for high performance spectroscopy. AVIRIS-NG measures reflected radiance at 5-nm intervals in the Visible to Shortwave Infrared (VSWIR) spectral range from 380-2510 nm. The AVIRIS-NG sensor has a 1 milliradian instantaneous field of view, providing altitude dependent ground sampling distances from 20 m to sub-meter range. For COMEX, AVIRIS-NG was flown on the Twin Otter aircraft.

A list of COMEX-related flights was compared to data available in the ORNL DAAC's AVIRIS Project collections. Flight information was compiled from Green et al. (2023a). The original sources of this information includes NASA flight logs and metadata provided by the AVIRIS-NG team at NASA's Jet Propulsion Laboratory (see <https://avirisng.jpl.nasa.gov/>).

A list of data files from the L1B (Green et al., 2023b) and L2 (Green et al., 2023c) was developed. The L1B and L2 files are available for flights on 2014-09-03 only.

#### Further information about L1B and L2 files

For L1B radiance, there are six file types for each flight line: orthorectified calibrated radiance image (img) files, geometric lookup table (glt) and orthorectified observation geometry and illumination (obs\_ort) files. Also included are unprojected files of input geometry (igm), parameters relating to the geometry of observation and illumination (obs), and orthorectified locations of each pixel (loc). In addition, ancillary files for the flight line are provided, including quick look images and polygon outlines of imagery footprints. The AVIRIS-NG L1B data are provided in ENVI binary format, which includes a flat binary file accompanied by a header (.hdr) file holding metadata in text format. The ancillary files include JPEG images and maps in Keyhole Markup Language (KML).

For L2 surface reflectance, two types of data files may be included: (a) calibrated surface reflectance and (b) water vapor and optical absorption paths for liquid water and ice. The L2 data are also provided in ENVI format.

### 6. Data Access

These data are available through the Oak Ridge National Laboratory (ORNL) Distributed Active Archive Center (DAAC).

[COMEX: AVIRIS-NG Facility Instrument Associated Flights and Information, 2014](#)

Contact for Data Center Access Information:

- E-mail: [uso@daac.ornl.gov](mailto:uso@daac.ornl.gov)
- Telephone: +1 (865) 241-3952

### 7. References

Bradley, E.S., I. Leifer, D.A. Roberts, P.E. Dennison, and L. Washburn. 2011. Detection of marine methane emissions with AVIRIS band ratios. *Geophysical Research Letters* 38:L10702. <https://doi.org/10.1029/2011GL046729>

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