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MASTER: Student Airborne Research Program (SARP) campaign, California, 2018

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Summary

This dataset includes Level 1B (L1B) data products from the MODIS/ASTER Airborne Simulator (MASTER) instrument collected and developed by the Student Airborne Research Program (SARP). The spectral data were collected from flights flown on 2018-06-20 to 2018-06-28 over the Channel Islands and coastline near Santa Barbara, California, U.S., in a NASA ER-2 aircraft. SARP was an eight-week summer program for junior and senior undergraduate students to acquire hands-on research experience in all aspects of a scientific campaign using airborne science laboratories. The SARP 2018 deployment included two flights with 13 flight tracks. Data products include L1B georeferenced multispectral imagery of calibrated radiance in 50 bands covering wavelengths of 0.460 to 12.879 micrometers at approximately 50-meter spatial resolution, and the L1B file format is HDF-4. In addition, the dataset includes flight paths, spectral band information, instrument configuration, ancillary notes, and summary information for each flight, and browse images derived from each L1B data file.

The MASTER instrument is a modified Daedalus Wildfire scanning spectrometer that flies on a variety of multi-altitude research aircraft and provides spectral information similar to that provided by the Moderate Resolution Imaging Spectroradiometer (MODIS) and the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), which are aboard two NASA Earth Observing System satellites: Terra and Aqua.

This dataset includes a total of 38 data files: 13 files in Hierarchical Data Format (HDF-4; *.hdf) format, 8 text (*.txt) files, 2 archives of text files that are zipped (*.zip), 2 flight maps as GIF (*.gif) images, and 13 browse images in JPEG (*.jpg) format.

ASTER/MODIS Airborne Simulator Browse Imagery
HyspIRL SumFall2018 Campaign – 27 Jun 2018
Santa Barbara Channel, CA
Flight #18-661-00 Track #7

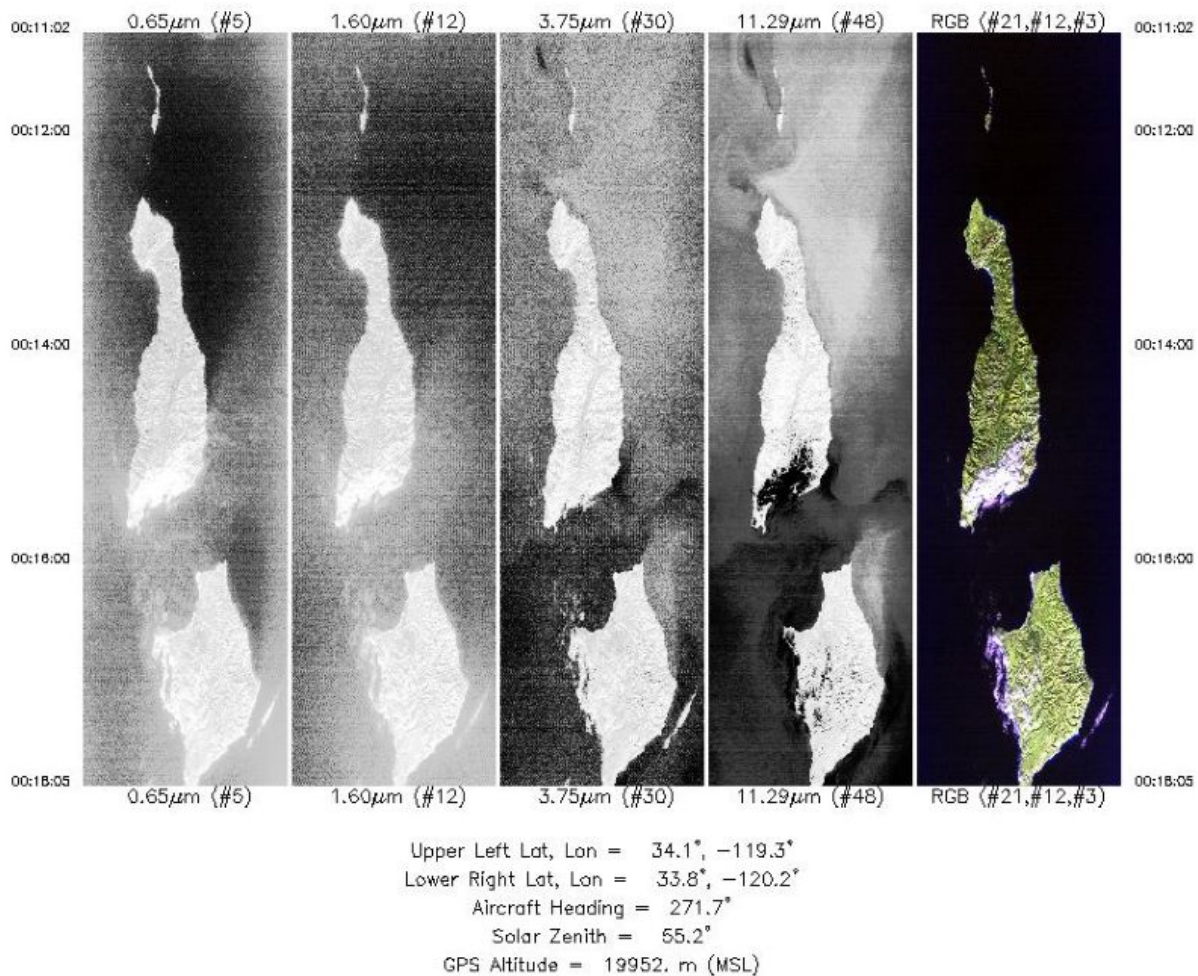


Figure 1. Single band images and an RGB composite image from flight track 07 acquired on 27 June 2018 over the Channel Islands south of Santa Barbara, California, U.S. Source: MASTERL1B_1866100_07_20180628_0011_0018_V02.jpg

Citation

Hook, S.J., J.S. Myers, K.J. Thome, M. Fitzgerald, A.B. Kahle, Airborne Sensor Facility NASA Ames Research Center, D.A. Roberts, and R. Kudela. 2022. MASTER: Student Airborne Research Program (SARP) campaign, California, 2018. ORNL DAAC, Oak Ridge, Tennessee, USA.
<https://doi.org/10.3334/ORNLDAAC/1946>

Table of Contents

1. Dataset Overview
2. Data Characteristics
3. Application and Derivation
4. Quality Assessment
5. Data Acquisition, Materials, and Methods
6. Data Access
7. References

1. Dataset Overview

This dataset includes Level 1B (L1B) data products from the MODIS/ASTER Airborne Simulator (MASTER) instrument collected and developed by the Student Airborne Research Program (SARP). The spectral data were collected from flights flown on 2018-06-20 to 2018-06-28 over the Channel Islands and coastline near Santa Barbara, California, U.S., in a NASA ER-2 aircraft. SARP was an eight-week summer program for junior and senior undergraduate students to acquire hands-on research experience in all aspects of a scientific campaign using airborne science laboratories. The SARP 2018 deployment included two flights with 13 flight tracks. Data products include L1B georeferenced multispectral imagery of calibrated radiance in 50 bands covering wavelengths of 0.460 to 12.879 micrometers at approximately 50-meter spatial resolution, and the L1B file format is HDF-4. In addition, the dataset includes flight paths, spectral band information, instrument configuration, ancillary notes, and summary information for each flight, and browse images derived from each L1B data file.

The MASTER instrument is a modified Daedalus Wildfire scanning spectrometer that flies on a variety of multi-altitude research aircraft and provides spectral information similar to that provided by the Moderate Resolution Imaging Spectroradiometer (MODIS) and the Advanced Spaceborne Thermal

Emission and Reflection Radiometer (ASTER), which are aboard two NASA Earth Observing System satellites: Terra and Aqua.

Related Publication

Hook, S.J. Myers, J.J., Thome, K.J., Fitzgerald, M. and A.B. Kahle. 2001. The MODIS/ASTER airborne simulator (MASTER) - a new instrument for earth science studies. Remote Sensing of Environment 76:93–102. [https://doi.org/10.1016/S0034-4257\(00\)00195-4](https://doi.org/10.1016/S0034-4257(00)00195-4)

Related Dataset

Additional MASTER datasets are available on the ORNL DAAC [MASTER](#) project page.

Acknowledgments

The MASTER instrument is maintained and operated by the Airborne Sensor Facility (ASF) at NASA Ames Research Center in Mountain View, California, under the oversight of the EOS Project Science Office at NASA Goddard. Data processing was conducted at NASA Ames Research Center and the Jet Propulsion Laboratory at the California Institute of Technology in Pasadena, California.

2. Data Characteristics

Spatial Coverage: Channel Islands and coastal regions near Santa Barbara, California, U.S.

Spatial Resolution: 21 to 50 m

Temporal Coverage: 2018-06-20 to 2018-06-28

Temporal Resolution: One-time estimate

Study Area: All latitudes and longitudes given in decimal degrees.

Site	Westernmost Longitude	Easternmost Longitude	Northernmost Latitude	Southernmost Latitude
Santa Barbara, California	-120.4785	-118.8457	34.8734	33.7538

This dataset includes a total of 38 data files: 13 files in Hierarchical Data Format (HDF-4; *.hdf) format, 8 text (*.txt) files, 2 archives of text files that are zipped (*.zip), 2 flight maps as GIF (*.gif) images, and 13 browse images in JPEG (*.jpg) format. (Table 1)

There are different numbers of each type of file, which corresponds to the number of "flights" and "flight tracks". A "flight" is a deployment flown on a single day, and a "flight track" refers to a segment of a given flight. The number of flight tracks varies among flights (Table 2).

- There are 2 flights with 13 flight tracks (Table 2).
- For each of 13 flight tracks, there is one L1B data file in HDF format and one auxiliary browse image (*.jpg).
- For each flight, there is a collection of auxiliary files providing information about the flight and instrument configuration.

The primary data files are named MASTERLAA_BBBBBBBB_CC_YYYYMMDD_EEFF_GGHH_V0J.hdf (e.g., MASTERL1B_1865700_01_20180620_1917_1932_V02.hdf).

The flight track-level browse images are named MASTERLAA_BBBBBBBB_CC_YYYYMMDD_EEFF_GGHH_V0J.jpg (e.g., MASTERL1B_1865700_01_20180620_1917_1932_V02.jpg).

The deployment-level auxiliary files are named MASTER_BBBBBBBB_YYYYMMDD_X.ext (e.g., MASTER_1865700_20180620_config.txt).

Elements of file names are described as:

AA = "1B", indicates L1B data level,
BBBBBBBB = "1865700" or "1866100", indicating the flight number,
CC = flight track,
YYYYMMDD = date of sampling,
EEFF = starting time at EE hour and FF minute,
GGHH = ending time at GG hour and HH minute,
J = version number for file,
X = the file content (see Table 1), and
ext = ".hdf", ".kmz", ".gif", ".jpg", ".txt", or ".zip", indicating the file extension.

Table 1. File names and descriptions.

File Name	Level	File Type	Total Files	Description
Primary Data Files				
MASTERL1B_BBBBBBBB_CC_YYYYmmDD_EEFF_GGHH_V0J.hdf	L1B	HDF-4	13	Multispectral radiance in 50 bands, pixel coordinates, sensor configuration, aircraft platform data, analysis parameters. The "CalibratedData" variable provides estimates of radiance in units of W m ⁻² sr ⁻¹ per micron.
Auxiliary Files				
MASTERLAA_BBBBBBBB_CC_YYYYMMDD_EEFF_GGHH_V0J.jpg	L1B	JPEG	13	Browse figures; one per flight track, multiple tracks per flight.
MASTER_BBBBBBBB_YYYYMMDD_ancillary.txt	-	Text	2	Ancillary information about flight including notes on aircraft platform, mission objective, and data evaluation.

File Name	Level	File Type	Total Files	Description
MASTER_BBBBBBBB_YYYYMMDD_config.txt	-	Text	2	Instrument configuration information for flight.
MASTER_BBBBBBBB_YYYYMMDD_flightpath.gif	-	GIF	2	Map showing flight paths.
MASTER_BBBBBBBB_YYYYMMDD_spectral_band_info.txt	-	Text	2	Spectral band information.
MASTER_BBBBBBBB_YYYYMMDD_spectral_response_table.zip	-	Text	2	Spectral response tables by band (ZIP archive of 50 text files).
MASTER_BBBBBBBB_YYYYMMDD_summary.txt	-	Text	2	Time and coordinates for start and end of flight tracks along with the number of scan lines, solar and instrument angles, and aircraft altitude. FTLT = flight track number.

Data File Details

The HDF-4 files contain swath trajectory data using longitude and latitude coordinates. The spatial resolution ranges from 1 m to 20 m and is a function of aircraft altitude.

Table 2. Number of flight tracks for each MASTER flight during this 2020 deployment over California.

Date	Flight Number	Locations (U.S.)	Flight Tracks
2018-06-20	1865700	Santa Barbara region and coast	5
2019-07-27	1866100	Santa Barbara Channel	8
Total			13

3. Application and Derivation

The primary objective of MASTER is to: (a) collect ASTER-like and MODIS-like land datasets to support the validation of the ASTER and MODIS geophysical retrieval algorithms; (b) collect these datasets at a higher resolution than the spaceborne datasets to permit scaling studies and comparisons with in-situ measurements; and (c) under fly the EOS-AM1 ASTER and MODIS sensors to provide an additional radiometric calibration to assist with in-flight instrument performance characterization. Calibration is particularly important for ASTER where on-board calibration is dependent on a single black body in the TIR and only partial aperture illumination in the VNIR.

A secondary objective of MASTER is to: (a) provide both a backup instrument and backup modules for the current MODIS Airborne simulator, which is committed to a program of atmospheric and oceanic measurements; and (b) provide a wider spectral and dynamic range alternative to the use of the Thematic Mapper (TM) airborne simulator and Thermal Infrared Multispectral Scanner (TIMS) airborne scanners (JPL, 2021b).

MASTER imagery has been used for mapping wildfires and their impacts (Veraverbeke et al., 2011), land covers (Li and Moon, 2004), coral reefs (Capolsini et al., 2003), and urban heat islands (Zhao and Wentz, 2016).

4. Quality Assessment

The MASTER instrument channels are calibrated spectrally and radiometrically in the laboratory preflight and postflight. The mid-infrared and thermal infrared channels (26–50) are also radiometrically calibrated in-flight by viewing an internal hot and cold blackbody with each scanline (Hook et al., 2001). Three calibration and validation experiments were conducted in 1998–2001 (Hook et al., 2001; JPL, 2021a). Spectral response information for this deployment is included in the files named MASTER_BBBBBBBB_YYYYMMDD_spectral_response_table.zip.

5. Data Acquisition, Materials, and Methods

The MASTER instrument was developed by the NASA Ames Research Center in conjunction with the Jet Propulsion Laboratory. The instrument consists of three key components: the scanning spectrometer, the digitizer, and the storage system. The scanning unit was built by Sensys Technology (formerly Daedalus Enterprises) and the digitizer was a collaborative effort between Berkeley Camera Engineering and the Ames Airborne Sensor Facility (ASF). The data storage system and overall system integration were also provided by the ASF.

The MASTER instrument is similar to the MODIS Airborne Simulator (MAS) developed by the MODIS project (King et al., 1996). However, it has two key differences. First, MASTER supports a variety of scan speeds allowing it to acquire contiguous imagery from a variety of altitudes with different pixel sizes. Second, the channel positions are configured to closely match those of ASTER and MODIS. A detailed description of the instrument and optical system are provided by Hook et al. (2001) and King et al. (1996), respectively.

NASA's Student Airborne Research Program (SARP) is an eight-week summer internship program for rising senior undergraduate students to acquire hands-on research experience in all aspects of a scientific campaign using one or more NASA Airborne Science Program flying science laboratories (aircraft used for SARP have included the DC-8, P-3B, C-23, UC-12B, and ER-2).

For this deployment, the MASTER instrument was flown on NASA's ER-2 aircraft at altitudes of 9031–19,972 m above sea level. The study area included the coastline of Santa Barbara, the Channel Islands, and the Santa Barbara Channel in the Pacific Ocean (Fig. 2–3).

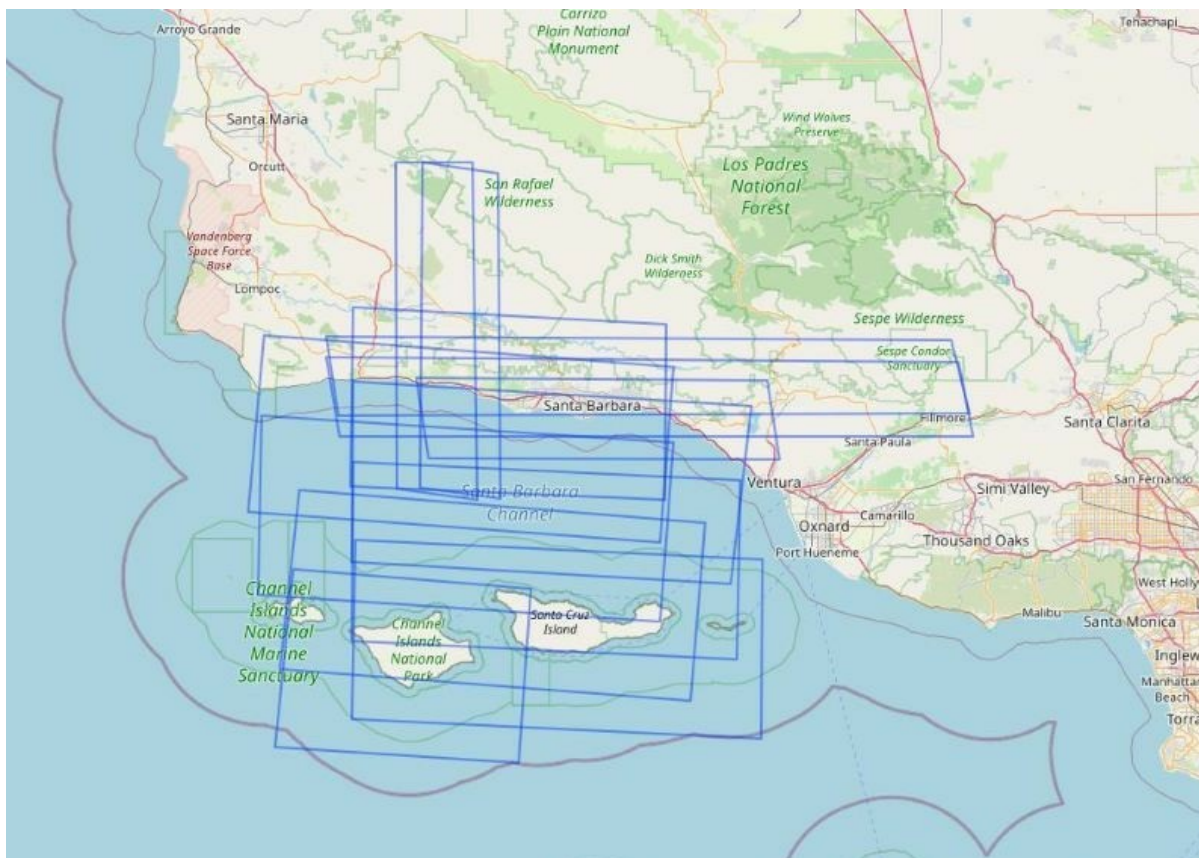


Figure 2. Flight tracks in this dataset represented as rectangular polygons. Map shows a portion of coastal California in the vicinity of Santa Barbara and the Channel Islands. Basemap: © [OpenStreetMap](#) contributors.

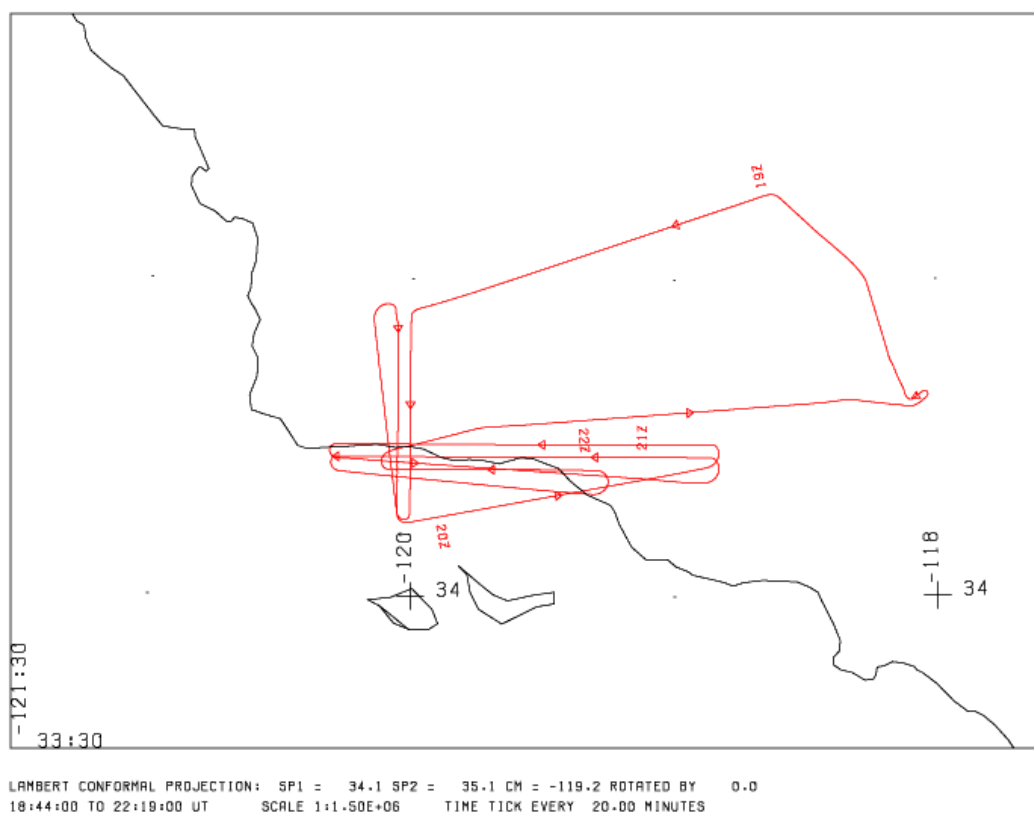


Figure 3. Typical flight path is shown for 27-28 June 2018. Flight 1866100 and 8 flight tracks occurred over the Pacific Ocean and coastline south of Santa Barbara, California, U.S. Source: MASTER_1866100_20180627_flightpath.gif

6. Data Access

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

[MASTER: Student Airborne Research Program \(SARP\) campaign, California, 2018](#)

Contact for Data Center Access Information:

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

7. References

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All Datasets

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Data Scope and
Acceptance
Data Authorship Policy
Data Publication Timeline
Detailed Submission
Guidelines

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