Python Resources for working with EMIT Imaging Spectroscopy Data

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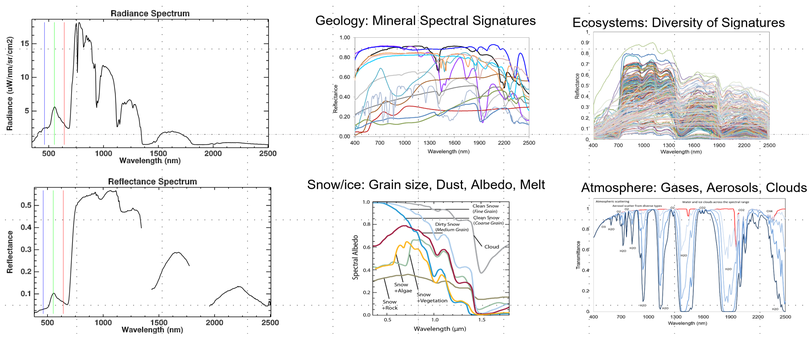
Overview

Imaging Spectroscopy has become a crucial tool for understanding Earth's surface and atmospheric properties. There are currently several orbital and airborne instruments, including the Earth Mineral dust source InvesTigation (EMIT) providing multiple data products to NASA Earthdata Distributed Active Archive Centers (DAACs). These information rich datasets support mapping applications ranging from biology and geology to greenhouse gases, but working with them can be a challenging task for new users. The EMIT-Data-Resources repository maintained by the Land Process (LP) DAAC contains several learning-oriented Python workflows and Jupyter Notebooks designed to support scientists interested in capitalizing on EMIT imaging spectroscopy data, as well as transforming their analyses into more transparent and reproducible workflows. The notebooks in the repository provide examples of how to find, open, and convert data formats, as well as enabling cloud access and conducting geospatial analyses. Contributions to the repository are welcome! Please follow the instructions in our contributing guide.

EMIT

The EMIT instrument is an imaging spectrometer on the International Space Station that measures light in visible and infrared wavelengths for each pixel in an image. These measurements display unique spectral signatures that correspond to the chemical composition and physical properties within each pixel of an image. The EMIT mission focuses specifically on mapping the surface composition of minerals to better understand the effects of mineral dust throughout the Earth system and human populations now and in the future. In addition, EMIT is being used to map greenhouse gas point source emission plumes. More broadly, EMIT imaging spectroscopy data can be used in several mapping applications including terrestrial and aquatic ecosystem diversity, and properties of snow and ice.

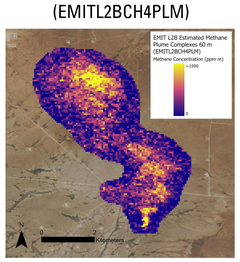


Data

The LP DAAC ingests and manages products from the EMIT mission. All EMIT data are stored in the Earthdata Cloud and are available at no cost. There are currently 9 EMIT products available, which are listed in the table below. Data can be accessed via a graphical user interface (GUI) using NASA's Earthdata Search or Jet Propulsion Laboratory's VISIONS Data Portal, or accessed programmatically using NASA's Common Metadata Repository (CMR) Application Programming Interface (API), the CMR-SpatioTemporal Asset Catalog (STAC) API, or the earthaccess Python Library.

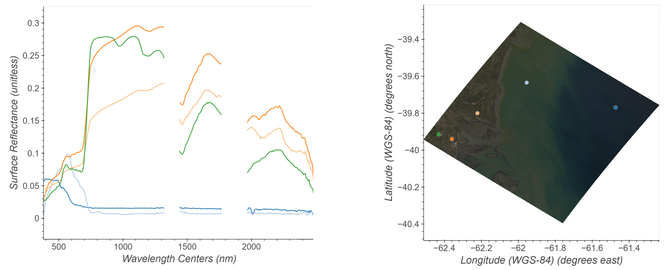
Level	Product Description	Shortname
0	Telemetry and Compressed Raw Instrument Data	EMITL0
1A	Reassembled Raw Image Cube	EMITL1ARAW
1B	Corrected Spacecraft Attitude and Ephemeris	EMITL1BATT
1B	At-Sensor Calibrated Radiance and Geolocation	EMITL1BRAD
2A	Estimated Surface Reflectance and Uncertainty	EMITL2ARFL
2B	Estimated Mineral Identification and Band Depth	EMITL2BMIN
2B	Estimated Methane Enhancement Data	EMITL2BCH4ENH
2B	Estimated Methane Plume Complexes	EMITL2BCH4PLM
3	Aggregated Mineral Spectral Abundance	EMITL3ASA

EMIT L2B Methane 60 m (EMITL2BCH4PLM)

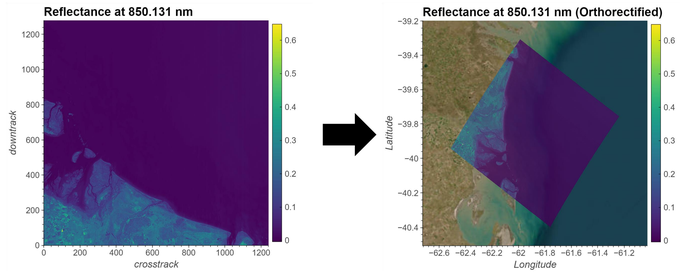


Jupyter Notebook Resources

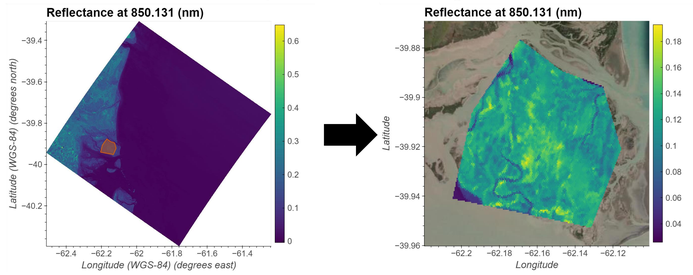
Interactive Plots



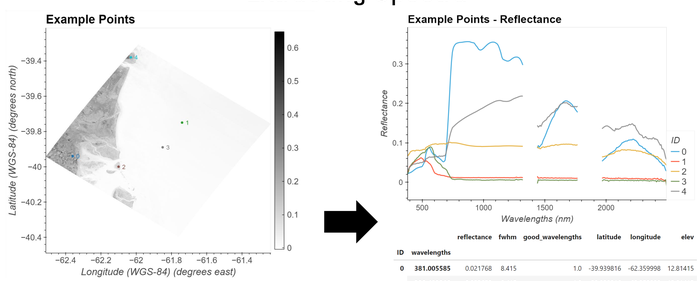
Orthorectification



Spatial Subsetting

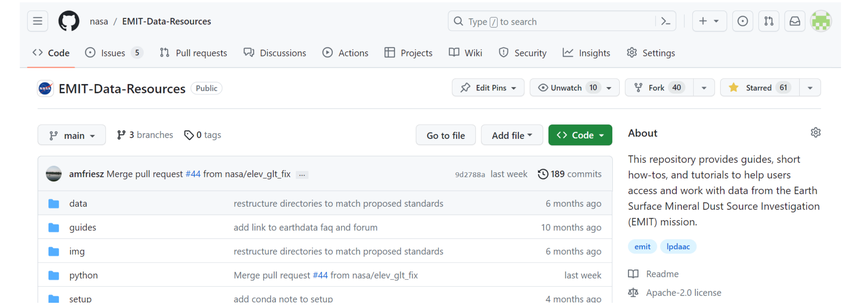


Extracting Spectra



	ID	Category	Latitude	Longitude
0	0	1	-39.94	-62.36
1	1	1	-39.75	-61.74
2	2	3	-40.00	-62.10

ID	wavelengths	reflectance	fwhm	good_wavelengths	latitude	longitude	elev
0	**381.005585**	0.021768	8.415	1.0	-39.939816	-62.359998	12.81415
	388.409210	0.022659	8.415	1.0	-39.939816	-62.359998	12.81415
	395.815826	0.023554	8.415	1.0	-39.939816	-62.359998	12.81415
	403.225403	0.024465	8.415	1.0	-39.939816	-62.359998	12.81415
	410.638000	0.025633	8.417	1.0	-39.939816	-62.359998	12.81415
...	...	...	...	...	...	...	...
4	**2463.381592**	0.084580	8.803	1.0	-39.380232	-62.029779	13.63026
	2470.767822	0.081152	8.804	1.0	-39.380232	-62.029779	13.63026
	2478.153076	0.072722	8.806	1.0	-39.380232	-62.029779	13.63026
	2485.538574	0.061968	8.807	1.0	-39.380232	-62.029779	13.63026
	2492.923828	0.057322	8.809	1.0	-39.380232	-62.029779	13.63026



Resource Name	Contents Summary
Getting EMIT Data using EarthData Search	A thorough walkthrough for using Earthdata Search to find and download EMIT data
Exploring EMIT L2A Reflectance	Explore EMIT L2A Reflectance data using interactive plots
How to find and access EMIT data	Use the earthaccess Python library to find and download or stream EMIT data
How to Convert to ENVI Format	Convert from downloaded netCDF4 (.nc) format to .envi format
How to Orthorectify	Use the geometry lookup table (GLT) included with the EMIT netCDF4 file to project on a geospatial grid
How to Extract Point Data	Extract spectra using lat/lon coordinates from a .csv and build a dataframe and .csv output
How to Extract Area Data	Subset to an area defined by a .geojson or shapefile
How to use EMIT Quality Data	Build a mask using an EMIT L2A Mask file and apply it to an L2A Reflectance file
How to use Direct S3 Access with EMIT	Use S3 from inside AWS us-west-2 to access EMIT Data
How to find EMIT Data using NASA's CMR API	Use NASA's CMR API to programmatically find EMIT Data
Exploring EMIT L2B Mineralogy Data (COMING SOON)	Explore mineralogy data, select the 10 minerals that are the focus of the EMIT mission, and calculate spectral abundance from band depth.
Exploring EMIT L2B Greenhouse Gas Products (COMING SOON)	Explore the methane enhancement product and create maps with the methane plume product.

More Info and Additional Resources

EMIT Data Resources Repository

EMIT Tutorial Series Videos

VISIONS Data Portal

EMIT Webpage

EMIT Product Pages (LP DAAC)

Join EMIT Slack

U.S. Department of the Interior
U.S. Geological Survey

December 2023