DCN
Version 1.0

August 2019
Version

Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA)
Area of Study: Conterminous United States (CONUS)

User Guide

Document History

Document Version	Publication Date	Description
1.0	July 2019	Original
2.0	August 2019	1st Revision

Contents

1.0 Dataset Overview

The overarching goal of the Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA) is to build a comprehensive hyperspectral library of the world's major agricultural crops (e.g., wheat, rice, corn, soybeans, cotton) based on hyperspectral data acquired from multiple platforms (e.g. spaceborne, airborne, drone-based, ground-based). The GHISA data are collected, organized, analyzed, and distributed for different parts of the world systematically by providing user guides, Algorithm Theoretical Basis documents (ATBDs), associated code used in processing the data, and the GHISA hyperspectral library data.

This user guide provides information for the GHISA hyperspectral library of dominant crops (winter wheat, rice, corn, soybeans, and cotton) of the conterminous United States (CONUS), which was developed using Earth Observing-1 (EO-1) Hyperion hyperspectral data acquired for the 2008 to 2015 time-period. The dominant crop data were acquired for various agroecological zones throughout the CONUS. The data were acquired for these crops in different growth stages and years using EO-1 Hyperion data (available in Google Earth Engine (GEE) and through EarthExplorer- https://earthexplorer.usgs.gov/) backed by reference data from the United States Department of Agriculture (USDA) Cropland Data Layer (CDL- https://nassgeodata.gmu.edu/CropScape/).

The project is funded by the Mendenhall Postdoctoral Fellowship through the United States Geological Survey (USGS), the USGS Land Resources Mission Area (LRMA), and the National Land Imaging (NLI) and Land Change Science (LCS) programs.

This user guide provides the background, dataset characteristics, dataset access information, and contact information for the GHISA product of the CONUS. For details on the algorithms and code used to generate the product, please refer to the ATBD.

1.1 Background

Agricultural crop studies are crucial for global food and water security. Remote sensing data are widely used in cropland studies that include characterization, modeling, mapping, and monitoring cropland extent, areas, watering methods (e.g., irrigated, rainfed, supplemental irrigation), cropping intensities, crop types, crop productivities, crop yields, and crop water productivities. All of this is crucial in food security assessments and management. Croplands account for 80-90% of all human water use. As a result, cropland studies are very important for water security. It is increasingly accepted that hyperspectral data provide a real opportunity to advance cropland studies with significant increases in modeling, mapping, and classification accuracies. Hyperspectral narrowband data also provide "spectral crop signatures" rather than the few spectral data points available from multispectral broadband data. This capability of hyperspectral data provides an opportunity to automate crop signatures for identifying, modeling, and mapping various crop characteristics and their biophysical and biochemical quantities. However, a big drawback is the lack of adequate well-organized hyperspectral libraries of agricultural crops.

As a result, the overarching goal of this effort is to compose a comprehensive global hyperspectral imaging spectral library of agricultural crops (GHISA). This is a user guide for GHISA composed for the conterminous United States (CONUS). This GHISA for CONUS is developed based on leading crops of the USA (e.g., winter wheat, corn, rice, soybeans, cotton) from various agroecological zones acquired for 2008 to 2015 from EO-1, Hyperion hyperspectral data (available in Google Earth Engine and through EarthExplorer- https://earthexplorer.usgs.gov/) with reference data from the USDA Cropland Data Layer (CDL, https://nassgeodata.gmu.edu/CropScape/). In addition, GHISA crop growth stage hyperspectral library data were also derived based on reference data from the Center for Sustainability and the Global Environment (SAGE) (https://nelson.wisc.edu/sage/data-and-models/crop-calendar-dataset/index.php).

2.0 Dataset Characteristics

The Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA) for the conterminous United States (CONUS) dataset characteristics are described below.

2.1 Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA) for the US V001

2.1.1 Collection Level

Short name	GHISA of CONUS
Temporal Granularity	Varied during 2008-2015
Temporal Extent	2008-2015
Spatial Extent	Conterminous United States of America
File size	~20 MB
Coordinate System	Geographic Latitude and Longitude
Datum	None
File Format	Excel Spreadsheet

3.0 Dataset Knowledge

The following questions address the user information regarding the GHISA dataset.

3.1 Frequently Asked Questions

What does the GHISA product contain?

The Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA) is a comprehensive compilation of hyperspectral signatures of agricultural crops of the world. The GHISA is composed for different regions of the world. This user guide provides GHISA for major crops (winter wheat, rice, corn, soybeans, cotton) of the conterminous United States (CONUS) developed from Earth Observing-1 (EO-1) Hyperion from seven agroecological zones (AEZs) throughout the US from 2008 to 2015 in six different growth stages (1. emergence and very early vegetative (Emerge VEarly), 2. early and mid-vegetative (Early Mid), 3. late vegetative (Late), 4. critical, 5. maturing and senescence (Mature Senesc), and 6. harvest) where present.

How can I access the dataset?

The GHISA hyperspectral library database of CONUS, EO-1 Hyperion code used to process Hyperion data and derive GHISA hyperspectral libraries, ATBD documents, and user guides are all downloadable through LP DAAC.

4.0 Dataset Access

The GHISA dataset is available through the Land Processes Distributed Active Archive Center (LP DAAC).

5.0 Contact Information

LP DAAC User Services
U.S. Geological Survey (USGS)
Center for Earth Resources Observation and Science (EROS)
47914 252nd Street
Sioux Falls, SD 57198-0001

Phone Number: 605-594-6116
Toll Free: 866-573-3222 (866-LPE-DAAC)
Fax: 605-594-6963

Email: lpdaac@usgs.gov
Web: https://lpdaac.usgs.gov

For the Principal Investigators, feel free to write to:

Prasad S. Thenkabail at pthenkabail@usgs.gov
Itiya Aneece at ianeece@usgs.gov

6.0 Citations

6.1 GHISA for CONUS

Aneece, I. and Thenkabail, P. 2019. Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA) for the Conterminous United States (CONUS). User Guide. NASA Land Processes Distributed Active Archive Center (LP DAAC). IP-110217.

7.0 Publications

7.1 Peer-reviewed publications

Aneece, I.P. and Thenkabail, P.S. 2018. Accuracies achieved in classifying five leading world crop types and their growth stages using optimal Earth Observing-1 Hyperion hyperspectral narrowbands on Google Earth Engine. Remote Sensing Open Access Journal of MDPI. 10(12), 2027. Available at: https://pubs.er.usgs.gov/publication/70201462

7.2 Books and Book Chapters

Aneece, I., and Thenkabail, P.S. 2018. Chapter 9 (of Volume I of Four-Volume Book): Spaceborne Hyperspectral EO-1 Hyperion Data Pre-Processing: Methods, Approaches, and Algorithms. Volume I Title: Fundamentals, Sensor Systems, Spectral Libraries, and Data Mining for Vegetation. Pp. 251-271. Book Title: "Hyperspectral Remote Sensing of Vegetation" (Second Edition, 4 Volume Set). Publisher: CRC Press- Taylor and Francis group, Boca Raton, London, New York. Pp. 450. (Editors: Thenkabail, P.S., Lyon, G.J., and Huete, A.). (Editors: Thenkabail, P.S., Lyon, G.J., and Huete, A.). IP-091722. Available at: https://www.routledge.com/Hyperspectral-Remote-Sensing-of-Vegetation-Second-Edition-FourVolume/Thenkabail-Lyon-Huete/p/book/9781138066250

8.0 References

USDA. 2019. Cropscape- Cropland Data Layer. Available at: https://nassgeodata.gmu.edu/CropScape/

USGS. 2019. EarthExplorer. Available at: https://earthexplorer.usgs.gov/

SAGE. 2019. Crop Calendar Dataset. Available at: https://nelson.wisc.edu/sage/data-and-models/crop-calendar-dataset/index.php