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Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA)
Area of Study: Central Asia

User Guide

Document History

Document Version	Publication Date	Description
1.0		Original

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 (wheat, rice, corn, alfalfa, and cotton) of Central Asia, which was developed using Earth Observing-1 (EO-1) and ASD Spectroradiometer data. Hyperion hyperspectral data were acquired in 2007. ASD spectroradiometer hyperspectral data were acquired for the 2006 and 2007 time-period. The dominant crop data were acquired in two irrigated farms in Uzbekistan. 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/).

The project was funded by the NASA ROSES HyspIRI research grant, NASA Science Mission Directorate's Earth Science Division.

The project was also funded by 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 Central Asia. 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 Central Asia. This GHISA for Central Asia is developed based on leading crops (e.g., wheat, corn, rice, alfalfa, cotton) from two irrigated farms acquired in 2007 from EO-1, Hyperion hyperspectral data (available in Google Earth Engine and through EarthExplorer- https://earthexplorer.usgs.gov/); and acquired in 2006 and 2007 from ASD Spectroradiometer hyperspectral data.

2.0 Dataset Characteristics

The Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA) for Central Asia dataset characteristics are described below.

2.1 Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA) for Central Asia V001

2.1.1 Collection Level

Short name	GHISA of CENTRAL ASIA
Temporal Granularity	Hyperion: ~ 3 months; ASD Spectroradiometer: 15-20 days
Temporal Extent	Hyperion: 2007 ASD Spectroradiometer: 2006-2007
Spatial Extent	Galaba and Kuva farms, Uzbekistan
File size	~5 MB
Coordinate System	UTM
Datum	WGS84
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 detailed 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 (wheat, rice, corn, alfalfa, cotton) of Central Asia developed from Earth Observing-1 (EO-1) Hyperion and ASD Spectroradiometer data from two irrigated farms in Uzbekistan in 2006 and 2007 in different growth stages.

How can I access the dataset?

The GHISA hyperspectral library database of Central Asia, Excel spreadsheet of Hyperion and ASD Spectroradiometer spectral data to derive GHISA spectral library, SAS codes to determine optimal bands to detect crops, 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

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Itiya Aneece at ianeece@usgs.gov

6.0 Citations

6.1 GHISA for Central Asia

Mariotto, I., Thenkabail, P., and Aneece, I. 2020. Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA) Area of Study: Central Asia. Algorithm Theoretical

Basis Document (ATBD). NASA Land Processes Distributed Active Archive Center (LP DAAC). IP-116254. https://doi.org/10.5067/Community/GHISA/GHISACASIA.001

Mariotto, I., Thenkabail, P., and Aneece, I. 2020. Global Hyperspectral Imaging Spectral-library of Agricultural crops (GHISA) Area of Study: Central Asia. User Guide. NASA Land Processes Distributed Active Archive Center (LP DAAC). IP-116254. https://doi.org/10.5067/Community/GHISA/GHISACASIA.001

7.0 Publications

7.1 Peer-reviewed publications

Mariotto, I., Thenkabail, P., Huete, A., Slonecker, T., and Platonov, A. 2013. Hyperspectral versus multispectral crop-productivity modeling and type discrimination for the HyspIRI mission. Remote Sensing of Environment, 139, 291–305. doi: 10.1016/j.rse.2013.08.002

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

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