NASA Making Earth System Data Records for Use in Research Environments (MEaSUREs) Global Food Security-support Analysis Data (GFSAD) @ 30-m for North America: Cropland Extent Product (GFSAD30NACE)

User Guide

USGS EROS
Sioux Falls, South Dakota
### Document History

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<tbody>
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1 Dataset Overview

The goal of the Global Food Security-support Analysis Data @ 30-m (GFSAD30) project is to provide the highest resolution, objective cropland datasets to assist and address global food and water security issues in the twenty-first century. The project proposed developing cropland products using time-series Landsat and Sentinel satellite sensor data, machine learning algorithms, and cloud-based computing. The project is funded by the National Aeronautics and Space Administration (NASA) with supplemental funding from the United States Geological Survey (USGS). The project is led by USGS and carried out in collaboration with NASA AMES, University of New Hampshire (UNH), California State University Monterey Bay (CSUMB), University of Wisconsin (UW), NASA GSFC, and Northern Arizona University (NAU). There were a number of International partners, including The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT).

This document provides data characteristics and user guidelines for the GFSAD30 cropland extent product for the North American continent (GFSAD30NACE). The Coordinate Reference System (CRS) used for the GFSAD30NACE is a geographic coordinate system (GCS) based on the World Geodetic System 1984 (WGS84) reference ellipsoid. The cropland extent data are provided in GeoTIFF raster tiles.

1.1 Background

Accurate spatial information on croplands is critical for global food security research, agricultural planning, and land-cover change studies (Foley et al. 2011; Thenkabail et al. 2010). Satellite image-based cropland maps provide spatially explicit, economic, and efficient methods and opportunities for cropland monitoring (Yu et al., 2013, Foley et al., 2011; Fritz et al., 2015; Wardlow and Egbert, 2008). North America provides much of the global crop production in the world at approximately 30%. It is the largest producer of maize, and the third largest producer of wheat (Cerquiglini et al., 2016). A fundamental description of food production and food security as well as an indicator of the food supply system health are achieved by mapping and quantifying the spatial extent of croplands and can be used for economic and policy decision making (Foley et al., 2011; Thenkabail et al., 2009).

The current cropland maps and extents for North America, including the Central American countries, the Caribbean, and Hawaii, however, have significant shortcomings including: 1) coarse spatial resolution (250m pixels or larger), 2) low overall accuracies, and 3) large inconsistencies in spatial distribution of croplands among current maps at various international level in North America. We address these shortcomings in this study by providing a comprehensive and consistent cropland extent map across the entire North American continent using 30m spatial resolution for the nominal year 2010.

We leveraged the computing capacity of Google’s Earth Engine (GEE - Gorelick et al., 2017) in conjunction with the Landsat 5 Thematic Mapper (TM) and Landsat 7 Enhanced Thematic Mapper (ETM+) data archive in this study to classify cropland extent at the North American
continental scale. We used a random forest classification on GEE to develop a pixel-based classification of the North American continental cropland extent. We then fused the pixel-based classification with crop field boundaries across the North American continent identified using recursive hierarchical segmentation (RHSeg) (Tilton et al., 2012), an object-based classification method on Northern Arizona University (NAU)’s high performance computing cluster Monsoon. The fusion approach removed spatial uncertainties such as the ‘salt and pepper’ effect noise and partially classified crop fields. This fusion of the two approaches resulted in an unprecedented cropland extent map at 30 m spatial resolution for the North American continent for the nominal year 2010. We validated the final fusion-based cropland extent map using United States Department of Agriculture (USDA) Cropland Data Layer (CDL) for the United States, Agriculture and Agri-food Canada (AAFC) Annual Crop Inventory (ACI) in Canada, Servicio de Información Agroalimentaria y Pesquera (SIAP)’s digitized agricultural boundaries in Mexico, and high-resolution images from GEE’s application programming interface (API). Additionally, we validated the cropland extent map using USDA county crop statistics data, AAFC agricultural census data, and agricultural statistics from other countries in North America.

Detailed description of the satellite and reference data, processing scheme, approaches, methods, results, and conclusions is provided in the algorithm theoretical basis document (ATBD) for GFSAD30NACE.

2 Dataset Characteristics

Global food security-support analysis data at 30m cropland extent for the North American continent (GFSAD30NACE) V001 data and characteristics are described below:

2.1 Global Food Security Support Analysis Data (GFSAD) 30-m V001

2.1.1 Collection Level

<table>
<thead>
<tr>
<th>Short name</th>
<th>GFSAD30NACE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temporal Granularity</td>
<td>Static</td>
</tr>
<tr>
<td>Temporal Extent</td>
<td>2010, nominal</td>
</tr>
<tr>
<td>Spatial Extent</td>
<td>North America</td>
</tr>
<tr>
<td>File size</td>
<td>~800 MB</td>
</tr>
<tr>
<td>Coordinate System</td>
<td>Geographic</td>
</tr>
<tr>
<td>Datum</td>
<td>WGS84</td>
</tr>
<tr>
<td>File Format</td>
<td>GeoTIFF</td>
</tr>
</tbody>
</table>

2.1.2 Granule Level
Number of Layers | 1  
Columns/Rows | $307053 \times 272312$  
Pixel Size | $\sim 30\text{m}$

### 2.1.3 Data Layer Characteristics

<table>
<thead>
<tr>
<th>SDS Layer Name</th>
<th>Description</th>
<th>Units</th>
<th>Data Type</th>
<th>Fill Value</th>
<th>Valid Range</th>
<th>Scale Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Band 1</td>
<td>Crop Extent for North America</td>
<td>N/A</td>
<td>8-bit unsigned integer</td>
<td>N/A</td>
<td>0,1,2</td>
<td>N/A</td>
</tr>
</tbody>
</table>

### 2.1.4 Data Layers Classification

<table>
<thead>
<tr>
<th>Class Label</th>
<th>Class Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Water</td>
<td>Water bodies / no-data</td>
</tr>
<tr>
<td>1</td>
<td>Non-Cropland</td>
<td>Non-Cropland areas *</td>
</tr>
<tr>
<td>2</td>
<td>Cropland</td>
<td>Cropland areas #</td>
</tr>
</tbody>
</table>

* Non-cropland areas include classes such as bare ground, forest, etc.

### 2.1.5 Filename Convention

**GFSAD30NACE_2010_N20E10_001_2017001121526.tif**

GFSAD30NACE = Product short name  
30 = 30m Resolution  
NA = North America  
CE = Crop Extent  
2010 = Nominal Year  
N20W10 = $10 \times 10$ degree grid, starting at (N70, W180)
3 Dataset knowledge

3.1 Frequently Asked Questions

What does the GFSAD30NACE product contain?

This product provides cropland extent for the continental North America at nominal 30m. It covers all North American countries and 11 independent territories. The countries and regions include Canada, the US, Mexico, Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Antigua & Barbuda, Bahamas, Barbados, Cuba, Dominica, Dominican Republic, Grenada, Haiti, Jamaica, Saint Kitts & Nevis, Saint Lucia, Saint Vincent & the Grenadines. The dependent territories in the Caribbean include: Anguilla, British Virgin Islands, Montserrat, Puerto Rico, United States Virgin Islands, Guadeloupe, Saba, Saint Barthelemy, Saint Martin, Sint Eustatius, and Sint Marteen.

What is the accuracy of the cropland extent product?

For the entire North American continent, the overall weighted accuracy of the cropland extent is 93.4% with weighted producer’s accuracy of 85.4% (errors of omissions 14.6%) and weighted user’s accuracy of 74.5% (errors of commissions 25.5%) for the cropland class. See the ATBD for further detailed, zone by zone discussions on accuracies.

What is the definition of the crop extent?

For the entire Global Food Security-Support Analysis Data project at 30-m (GFSAD30) project, cropland extent was defined as: “lands cultivated with plants harvested for food, feed, and fiber, include both seasonal crops (e.g., wheat, rice, corn, soybeans, cotton, alfalfa, other hay) and continuous plantations (e.g., coffee, tea, rubber, cocoa, oil palms). Cropland fallows are lands uncultivated during a season or a year but are farmlands and are equipped for cultivation, including plantations (e.g., orchards, vineyards, coffee, tea, rubber” (Teluguntla et al., 2015). Cropland extent includes all planted crops and fallowed lands. Non-croplands include all other land cover classes (such as bare ground, forest, water, etc.).

How to access the dataset?

All the GFSAD30 products will be downloadable through Land Processes Distributed Active Archive Center (LP DAAC). GFSAD30NACE, divided into 10 degree × 10 degree grids, is among them.

Can I access the dataset through Google Earth Engine (GEE)?

No. Not at this time. PI (Prasad S. Thenkabail) will determine this later.
4 Dataset Access (Applicable data tools)

The GFSAD30NACE dataset is available through the LP DAAC Data Pool and NASA Earthdata Search. GFSAD data visualization and information can also be found at Global Croplands website: Croplands.org.

5 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

For North America cropland extent, feel free to write to:
Richard Massey rm885@nau.edu
Temuulen Sankey Temuulen.Sankey@nau.edu

More details about the GFSAD project and products can be found at: globalcroplands.org

6 Citations

6.1 GFSAD30NACE


7 Publications

The following publications are related to the development of the above croplands products:

7.1 Peer-reviewed publications specific to this study


7.2 Peer-reviewed publications within GFSAD project


7.3 Web sites and Data portals:

http://croplands.org (30-m global croplands visualization tool)
http://geography.wr.usgs.gov/science/croplands/products.html#LPDAAC (dissemination on LP DAAC)
croplands.org (crowdsourcing global croplands data)

7.4 Other relevant past publications prior to GFSAD project


Photogrammetric Engineering and Remote Sensing, August 2012 Special Issue on Global Croplands: Highlight Article. 78(8): 773-782.


7.5 Books and Book Chapters


