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Version

NASA Making Earth System Data Records for Use in Research Environments (MEaSUREs) Global Food Security-support Analysis Data (GFSAD) @ 30-m for Europe, Middle-east, Russia and Central Asia: Cropland Extent Product (GFSAD30EUCEARU-MECE).

User Guide

Document History

Document Version	Publication Date	Description
1.0	September, 2017	Original
1.1		Modification made according to USGS reviewer comments

Contents

1.0 Dataset Overview

The goal of the Global Food Security-support Analysis Data @ 30-m (GFSAD30) is to provide highest resolution, objective cropland datasets to assist and address global food and water security issues of the twenty-first century. The project proposed developing cropland products using time-series Landsat and Sentinel satellite sensor data, machine learning algorithms, and cloud 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 user guide provides guidelines of the GFSAD30 cropland extent product for the countries of Europe, Middle-east, Russia and Central Asia (GFSAD30EUCEARUMECE) at nominal 30m in 2015. The Coordinate Reference System (CRS) used for the GFSAD30EUCEARUMECEis a geographic coordinate system (GCS) based on the World Geodetic System 84 (WGS84) reference ellipsoid. The legend is presented in Section 2. Datasets are provided in 10^o x 10^o raster grid (GeoTIFF) format. The year, resolution, tiling, and file name convention details are provided in section 2.0 and its sub-section of this document.

1.1 Background

Monitoring global croplands (GCs) is imperative for ensuring sustainable water and food security to the people of the world in the twenty-first century. However, the currently available cropland products suffer from major limitations such as: (a) Absence of precise spatial location of the cropped areas; (b) Coarse resolution nature of the map products with significant uncertainties in areas, locations, and detail; (c) Uncertainties in differentiating irrigated areas from rainfed areas; (d) Absence of crop types and cropping intensities; and (e) Absence of a dedicated web\data portal for the dissemination of cropland products. Therefore, our project aims to close these gaps through a Global food security support-analysis data @ 30-m (GFSAD30).

Satellite-derived cropland extent map at high spatial resolution are necessary for food and water security analysis. Thereby, GFSAD30EUCEARUMECE cropland extent products were produced at a resolution of 30-m for the countries of Europe, Middle-east, Russia and Central Asia for the nominal year 2015 using Landsat time-series data. These data are part of a global data release; thereby each region will be made publically available. Global cropland extent maps, indicating cropland and non-cropland areas, provides a working baseline data to develop high-level products such as crop watering method (irrigated or rainfed), cropping intensities (e.g., single, double, or continuous cropping), crop type mapping, cropland fallows, as well as assessment of cropland productivity (productivity per unit of land), and crop water productivity (productivity per unit of water or “crop per drop”). Uncertainties associated with cropland extent maps have a cascading effect on all higher-level cropland products.

Cloud-based geo-spatial computing platforms and satellite image inventory offer opportunities for producing precise and accurate maps of cropland extent and area that meet the spatial and temporal requirements of broad applications. Such maps can be a significant improvement compared to existing products, which tend to be coarser resolution, are often not representative of regions with highly dynamic change, and have a fixed set of cover classes. Cloud-based computing platform such as Google Earth Engine and new earth-observing satellites like Landsat 8 have brought significant improvements to LULC mapping and agriculture monitoring. Specifically, the production of standard static maps of the past will be shifted to dynamic creation maps from massively large volumes of big data, crowd souring of training and validation samples, and implementing machine-learning algorithms on the cloud to serve better specific applications.

For a very detailed description of the satellite and reference data, processing scheme, approaches, methods, results, and conclusions please refer to algorithm theoretical basis document (ATBD) of GFSAD30EUCEARUMECE.

2.0 Dataset Characteristics

Global food security-support analysis data @ 30-m cropland extent for Europe, Middle-east, Russia and Central Asia (GFSAD30EUCEARUMECE) datasets and characteristics described below.

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

2.1.1 Collection Level

Short name	GFSAD30EUCEARUMECE
Temporal Granularity	Static
Temporal Extent	2015, nominal
Spatial Extent	Europe, Middle-east, Russia and Central Asia
File size	~ 800MB
Coordinate System	Geographic
Datum	WGS84
File Format	GeoTIFF

2.1.2 Granule Level

Number of Layers	1
Columns/Rows	307053x 272312
Pixel Size	~30 m

2.1.3 Data Layers Classification

Class Label	Class Name	Description
0	Non-Cropland	Non-Cropland areas
1	Cropland	Cropland and Fallow-land
2	Water	Water Bodies

2.1.4 Filename Convention

GFSAD30EUCEARUMECE_2015_N00W000_001_20162741122.tif
GFSAD30EUCEARUMECE= Product Short name
30 = 30 m Resolution
EUCEARUME = Europe, Central Asia, Russia, Middle East
CE = Crop Extent
2015 = Nominal Year
N10W20 = 10 x 10 degree grid, starting at (N10, W20)
001 = Version
2016 = Processing Year in YYYY

3.0 Dataset Knowledge

The following questions addresses the user information regarding the **GFSAD30EUCEARU-MECE** collection.

3.1 Frequently Asked Questions

What is the accuracy of the GFSAD30EUCEARUMECE product?
For the entire study area, the weighted overall accuracy was 93.8% with producer's accuracy of 86.5% and user's accuracy of 85.7%. When considering all twelve zones, the overall accuracies ranged between 76-100%, producer's accuracies ranged between 64-92%, and user's accuracies ranged between 54-95% These results clearly imply the high level of confidence in differentiating croplands from non-croplands for Europe, Middle-east, Russia and Central Asia.

What do GFSAD30EUCEARUMECE product contain?

They provide cropland extent product for the Europe, Middle-east, Russia and Central Asia at nominal 30-m.

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) 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 other than croplands and cropland fallows.

How to access the dataset?

All the GFSAD30 products will be downloadable through the Land Processes Distributed Active Archive Center (LP DAAC). **GFSAD30EUCEARUMECE** product divided into 10x10 grids, are among them.

You can also visualize this data @ https://croplands.org by going to "products" drop-down menu there.

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

No. At this time LP DAAC is the single source. In future, we may release the data through GEE, but this will be decided by Prasad S. Thenkabail, PI of the GFSAD30 project.

4.0 Dataset Access (Applicable Data Tools)

The **GFSAD30EUCEARUMECE** dataset is available through the LP DAAC Data Pool and NASA Earthdata Search. GFSAD data visualization and information are also made available at our Global Croplands Website: https://croplands.org

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
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More details about the GFSAD30 project and products are available @

https://croplands.org

6.0 Citations

6.1 GFSAD30EUCEARUMECE

Phalke, A., Ozdogan, M., Thenkabail, P.S., Congalton, R.G., Yadav, K., Massey, R., Teluguntla, P., Poehnelt, J., Smith, C. (2017). *NASA Making Earth System Data Records for Use in Research Environments (MEaSUREs) Global Food Security-support Analysis Data (GFSAD) Cropland Extent 2015 Europe, Central Asia, Russia, Middle East 30 m V001* [Data set]. NASA EOSDIS Land Processes DAAC. doi: 10.5067/MEaSUREs/GFSAD/GFSAD30EUCEARUMECE.001

7.0 Publications

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

7.1 Peer-reviewed publications within GFSAD project

Congalton, R.G., Gu, J., Yadav, K., Thenkabail, P.S., and Ozdogan, M. 2014. Global Land Cover Mapping: A Review and Uncertainty Analysis. Remote Sensing Open Access Journal. Remote Sens. 2014, 6, 12070-12093; http://dx.doi.org/10.3390/rs61212070.

Congalton, R.G, 2015. Assessing Positional and Thematic Accuracies of Maps Generated from Remotely Sensed Data. Chapter 29, In Thenkabail, P.S., (Editor-in-Chief), 2015. "Remote Sensing Handbook" Volume I: Volume I: Data Characterization, Classification, and Accuracies: Advances of Last 50 Years and a Vision for the Future. Taylor and Francis Inc.\CRC Press, Boca Raton, London, New York. Pp. 900+. In Thenkabail, P.S., (Editor-in-Chief), 2015. "Remote Sensing Handbook" Volume I: **): Remotely Sensed Data Characterization, Classification, and Accuracies**. Taylor and Francis Inc.\CRC Press, Boca Raton, London, New York. ISBN 9781482217865 - CAT# K22125. Print ISBN: 978-1-4822-1786-5; eBook ISBN: 978-1-4822-1787-2. Pp. 678.

Gumma, M.K., Thenkabail, P.S.,Teluguntla, P., Rao, M.N., Mohammed, I.A., and Whitbread, A.M. 2016. Mapping rice-fallow cropland areas for short-season grain legumes intensification in South Asia using MODIS 250 m time-series data. International Journal of Digital Earth, http://dx.doi.org/10.1080/17538947.2016.1168489

Massey, R., Sankey, T.T., Congalton, R.G., Yadav, K., Thenkabail, P.S., Ozdogan, M., Sánchez Meador, A.J. 2017. MODIS phenology-derived, multi-year distribution of conterminous U.S. crop types, Remote Sensing of Environment, Volume 198, 1 September 2017, Pages 490-503, ISSN 0034-4257, https://doi.org/10.1016/j.rse.2017.06.033.

Phalke, A. R., Ozdogan, M., Thenkabail, P. S., Congalton, R. G., Yadav, K., & Massey, R. et al. (2017). A Nominal 30-m Cropland Extent and Areas of Europe, Middle-east, Russia and Central Asia for the Year 2015 by Landsat Data using Random Forest Algorithms on Google Earth Engine Cloud. (in preparation).

Teluguntla, P., Thenkabail, P.S., Xiong, J., Gumma, M.K., Congalton, R.G., Oliphant, A., Poehnelt, J., Yadav, K., Rao, M., and Massey, R. 2017. Spectral matching techniques (SMTs) and automated cropland classification algorithms (ACCAs) for mapping croplands of Australia using MODIS 250-m time-series (2000–2015) data, International Journal of Digital Earth. DOI:10.1080/17538947.2016.1267269.IP-074181, http://dx.doi.org/10.1080/17538947.2016.1267269.

Teluguntla, P., Thenkabail, P., Xiong, J., Gumma, M.K., Giri, C., Milesi, C., Ozdogan, M., Congalton, R., Yadav, K., 2015. CHAPTER 6 - Global Food Security Support Analysis Data at Nominal 1 km (GFSAD1km) Derived from Remote Sensing in Support of Food Security in the Twenty-First Century: Current Achievements and Future Possibilities, in: Thenkabail, P.S. (Ed.), Remote Sensing Handbook (Volume II): Land Resources Monitoring, Modeling, and Mapping with Remote Sensing. CRC Press, Boca Raton, London, New York., pp. 131–160. Link.

Xiong, J., Thenkabail, P.S., Tilton, J.C., Gumma, M.K., Teluguntla, P., Oliphant, A., Congalton, R.G., Yadav, K. 2017. A Nominal 30-m Cropland Extent and Areas of Continental Africa for the Year 2015 by Integrating Sentinel-2 and Landsat-8 Data using Random Forest, Support Vector Machines and Hierarchical Segmentation Algorithms on Google Earth Engine Cloud. Remote Sensing Open Access Journal (in review).

Xiong, J., Thenkabail, P.S., Gumma, M.K., Teluguntla, P., Poehnelt, J., Congalton, R.G., Yadav, K., Thau, D. 2017. Automated cropland mapping of continental Africa using Google Earth Engine cloud computing, ISPRS Journal of Photogrammetry and Remote Sensing, Volume 126, April 2017, Pages 225-244, ISSN 0924-2716, https://doi.org/10.1016/j.isprsjprs.2017.01.019.

7.2 Web sites and Data portals:

http://croplands.org (30-m global croplands visualization tool)
http://geography.wr.usgs.gov/science/croplands/index.html (GFSAD30 web portal and dissemination)
http://geography.wr.usgs.gov/science/croplands/products.html#LPDAAC (dissemination on LP DAAC)
http://geography.wr.usgs.gov/science/croplands/products.html (global croplands on Google Earth Engine)
croplands.org (crowdsourcing global croplands data)

7.2 Other relevant past publications prior to GFSAD project

Biggs, T., Thenkabail, P.S., Krishna, M., GangadharaRao Rao, P., and Turral, H., 2006. Vegetation phenology and irrigated area mapping using combined MODIS time-series, ground surveys, and agricultural census data in Krishna River Basin, India. International Journal of Remote Sensing. 27(19):4245-4266.

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Dheeravath, V., Thenkabail, P.S., Chandrakantha, G, Noojipady, P., Biradar, C.B., Turral. H., Gumma, M.1, Reddy, G.P.O., Velpuri, M. 2010. Irrigated areas of India derived using MODIS 500m data for years 2001-2003. ISPRS Journal of Photogrammetry and Remote Sensing. http://dx.doi.org/10.1016/j.isprsjprs.2009.08.004. 65(1): 42-59.

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Thenkabail, P.S., Biradar C.M., Noojipady, P., Dheeravath, V., Li, Y.J., Velpuri, M., Gumma, M., Reddy, G.P.O., Turral, H., Cai, X. L., Vithanage, J., Schull, M., and Dutta, R. 2009a. Global irrigated area map (GIAM), derived from remote sensing, for the end of the last millennium. International Journal of Remote Sensing. 30(14): 3679-3733. July, 20, 2009.

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Thenkabail, P. S.; Dheeravath, V.; Biradar, C. M.; Gangalakunta, O. P.; Noojipady, P.; Gurappa, C.; Velpuri, M.; Gumma, M.; Li, Y. 2009b. Irrigated Area Maps and Statistics of India Using Remote Sensing and National Statistics. Journal Remote Sensing. 1:50-67. http://www.mdpi.com/2072-4292/1/2/50.

Thenkabail, P.S., GangadharaRao, P., Biggs, T., Krishna, M., and Turral, H., 2007b. Spectral Matching Techniques to Determine Historical Land use/Land cover (LULC) and Irrigated Areas using Time-series AVHRR Pathfinder Datasets in the Krishna River Basin, India. Photogrammetric Engineering and Remote Sensing. 73(9): 1029-1040. (Second Place Recipients of the 2008 John I. Davidson ASPRS President's Award for Practical papers).

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Velpuri, M., Thenkabail, P.S., Gumma, M.K., Biradar, C.B., Dheeravath, V., Noojipady, P., Yuanjie, L.,2009. Influence of Resolution or Scale in Irrigated Area Mapping and Area Estimations. Photogrammetric Engineering and Remote Sensing (PE&RS). 75(12): December 2009 issue.

7.4 Books and Book Chapters

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Biradar, C.M., Thenkabail. P.S., Noojipady, P., Li, Y.J., Dheeravath, V., Velpuri, M., Turral, H., Cai, X.L., Gumma, M., Gangalakunta, O.R.P., Schull, M., Alankara, R.D., Gunasinghe, S., and Xiao, X. 2009. Book Chapter 15: Global map of rainfed cropland areas (GMRCA) and stastistics using remote sensing. Pp. 357-392. In the book entitled: "Remote Sensing of Global Croplands for Food Security" (CRC Press- Taylor and Francis group, Boca Raton, London, New York. Pp.

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Turral, H., Thenkabail, P.S., Lyon, J.G., and Biradar, C.M. 2009. Book Chapter 1: Context, need: The need and scope for mapping global irrigated and rain-fed areas. Pp. 3-12. In the book entitled: "Remote Sensing of Global Croplands for Food Security" (CRC Press- Taylor and Francis group, Boca Raton, London, New York. Pp. 475. Published in June, 2009. (Editors: Thenkabail. P., Lyon, G.J., Biradar, C.M., and Turral, H.).