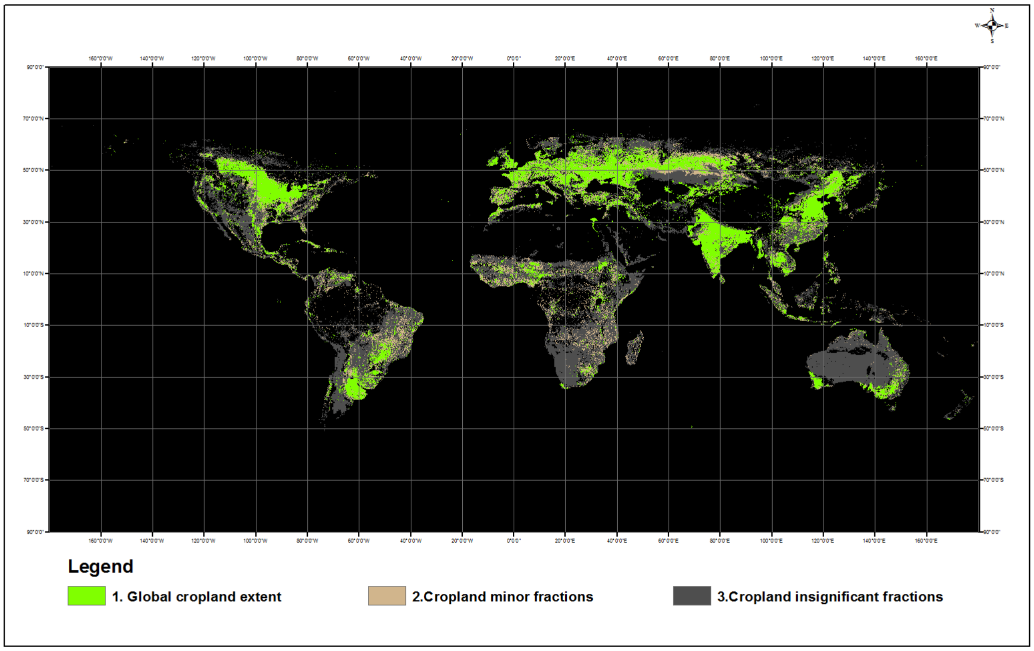
NASA MEaSUREs Project (June 1, 2013-May 31, 2018)

Global Food Security-support Analysis Data @ 30 m (GFSAD30)

Progress Report: June 1, 2013 to November, 30, 2013

PI: Prasad S. Thenkabail (pthenkabail@usgs.gov; thenkabail@gmail.com)



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1.0 Overview

The overarching goal of GFSAD30 project is to produce consistent and unbiased estimates of global agricultural cropland areas, crop types, crop watering method, and cropping intensities (Figure 2) using mature cropland mapping algorithms (CMAs):

There are 6 specific objectives for GFSAD30m project (as in the original proposal):

OBJECTIVE 1: Cropland extent\area,

OBJECTIVE 2: Crop types (focus on 8 crops that occupy 70% of global croplands),

OBJECTIVE 3: Irrigated vs. rainfed croplands,

OBJECTIVE 4: Cropping intensities\phenology (single, double, triple, continuous cropping),

OBJECTIVE 5: Cropped area computation; and

OBJECTIVE 6: In addition, GCAD four decades will produce continuous data streams at monthly frequency (e.g., illustration for 1 year in Figure 1) from 1982-2017 at 8 km from 1982 to 2000 based on AVHRR GIMMS data and at 250 m from 2001 to 2017 based on MODIS data.

This particular report provides the work carried out, and the progress made, in meeting the above defined project objectives during the first 6 months (June-November, 2013) of the project.

2.0 Global Cropland Extent

(**Lead Authors**: **Pardhasaradhi Teluguntla**[1], Jun Xiong[1] , Prasad Thenkabail[1], 1 = U. S. Geological Survey)

2.1 Key goals

The overall goal of this study is to produce an accurate global cropland extent (GCE) map at nominal 30 m resolution. This will be achieved in three steps.

- First, a global cropland extent map will be produced based on the synthesis of best available existing global extent maps. This will be released at nominal 1 km resolution as version 1.0 product;
- Second, MODIS 250 m resolution monthly maximum value composite (MVC) NDVI time-series data will be used to refine the version 1.0 product to produce a more refined nominal 250m resolution as version 2.0 product;
- Third, Landsat 30m resolution NDVI data will be used to refine the version 2.0 product to produce further refined accurate nominal 30 m resolution as version 3.0 product;

Currently, we have produced GCE version 1.0 (GCE V1.0), produced at nominal 1 km resolution and described below.

2.2 Global cropland extent (GCE) at nominal 1 km resolution

GCE version 1.0 (GCE V1.0) is produced at 1 km using 3 existing global cropland products plus taking croplands from an additional global land use\land cover (LULC) product. These products are:

A. Thenkabail et al. (Thenkabail et al., 2009, Biradar et al., 2009, Thenkabail et al., 2011);
B. Pittman et al. (2010);
C. Yu et al., (2013); and;
D. Fried et al (2010)

Thenkabail et al. used combination of AVHRR, SPOT VGT, and numerous secondary data (e.g., precipitation, temperature, and elevation) to produce global irrigated area map (Thenkabail et al., 2009, 2011), global map of rainfed cropland areas (Biradar et al., 2009, Thenkabail et al., 2011). Pittman et al., used MODIS 250 m data to develop cropland extent of the world. More recently, Yu et al. (2013), produced a nominal 30 m resolution cropland extent of the world. These three global cropland extent maps are the best available current state-of-art. Also there is an existing cropland map in the form of Land use land cover by Fried et al.(2010) which used MODIS 500m data.

In this study, we synthesized the croplands from the above 4 global products to produce a unified global cropland extent map at nominal 1 km and released the same as GCE V1.0 (Table 1a, 1b; Figure 1a, 1b). The Figure 1a shows the aggregated global cropland extent map with its statistics in Table 1a. The Figure 1b shows slightly disaggregated global cropland extent map with its statistics in Table 1b.

When these 4 maps are put together, there is fairly good indication of the global cropland extent (Figure 1a, 1b) and their areas (Table 1a, 1b). Class 1 in Figure 1a and Classes 1 to 9 in Figure 1b encompass almost all of the 1.5 to 1.7 billion hectares of global croplands (see Thenkabail et al., 2011). However, the classes in Figure 1a, 1b and Table 1a, 1b need to be assessed taking their sub-pixel areas (SPAs) into account. With the full pixel areas (FPAs) depicted in Figure 1a, 1b and Table 1a, 1b at 1 km resolution, there are, typically, substantial non-croplands within a significant proportion of these pixels. For example, the class 1 in Figure 1a and Table 1a has 23493936 pixels (or approx. 2.4 billion hectares). This are FPAs. The SPAs will be substantially lower.

2.3 Global cropland extent (GCE) at nominal 250 m and 30 m resolution

Going forward, our goal is to improve the uncertainties discussed in previous section through improved spatial resolution. Thereby, we will work towards producing global cropland extent at 250m resolution using MODIS data (GCE V2.0) and 30 m resolution using Landsat data (GCE V3.0). For MODIS, we will use monthly time-series maximum value composites (MVCs) NDVIs. For Landsat we will use the global Land Survey (GLS) data. This work is currently in progress.

Table 1a. Global cropland extent at nominal 1-km based on four major studies: Thenkabail et al. (2009), Pittman et al. (2010), Yu et al. (2013) and Fried et al.(2010). Three class map.

Class#	Class Description	**Pixels**	**Percent**
#	Names	unitless	%
1	1. Global cropland extent	23493936	100
2	2.Cropland minor fractions	13700176	
3	3.Cropland insignificant fractions	44662570	

Note1

1= approximately 2.3 billion hectares Cropland estimated from 4 sources

Table 1b. Global cropland extent at nominal 1-km based on four major studies: Thenkabail et al. (2009), Pittman et al. (2010), Yu et al. (2013) and Fried et al.(2010). Twelve class map.

Class#	Class Description	**Pixels**	**Percent**
#	Names	unitless	%
1	Croplands all 4, irrigated	2802397	12
2	Croplands 3 of 4 , irrigated	289591	1
3	Croplands all 4, rainfed	1942333	8
4	Croplands 3 of 4, rainfed	427731	2
5	Croplands, 2 of 4, irrigation dominance	3220330	14
6	Croplands, 2 of 4, irrigation dominance	1590539	7
7	Croplands, 3 of 4, rainfed dominant	6206419	26
8	Croplands, 2 of 4, rainfed dominance	3156561	13
9	Croplands, minor fragments, 2 of 4	3858035	17
10	Croplands, insignificant fragments, 2 of 4	6825290	
11	Croplands, minor fragments, 1 of 4	6874886	
12	Croplands, insignificant fragments, 1 of 4	44662570	
	Class 1 to 9 total	23493936	100

Note:

1=approximately 2.3 billion hectares
2 = % calculated based on class 1 to 9
3=Class 10,11and 12 are minor cropland fragments

4= all 4 means , all 4 studies agreed

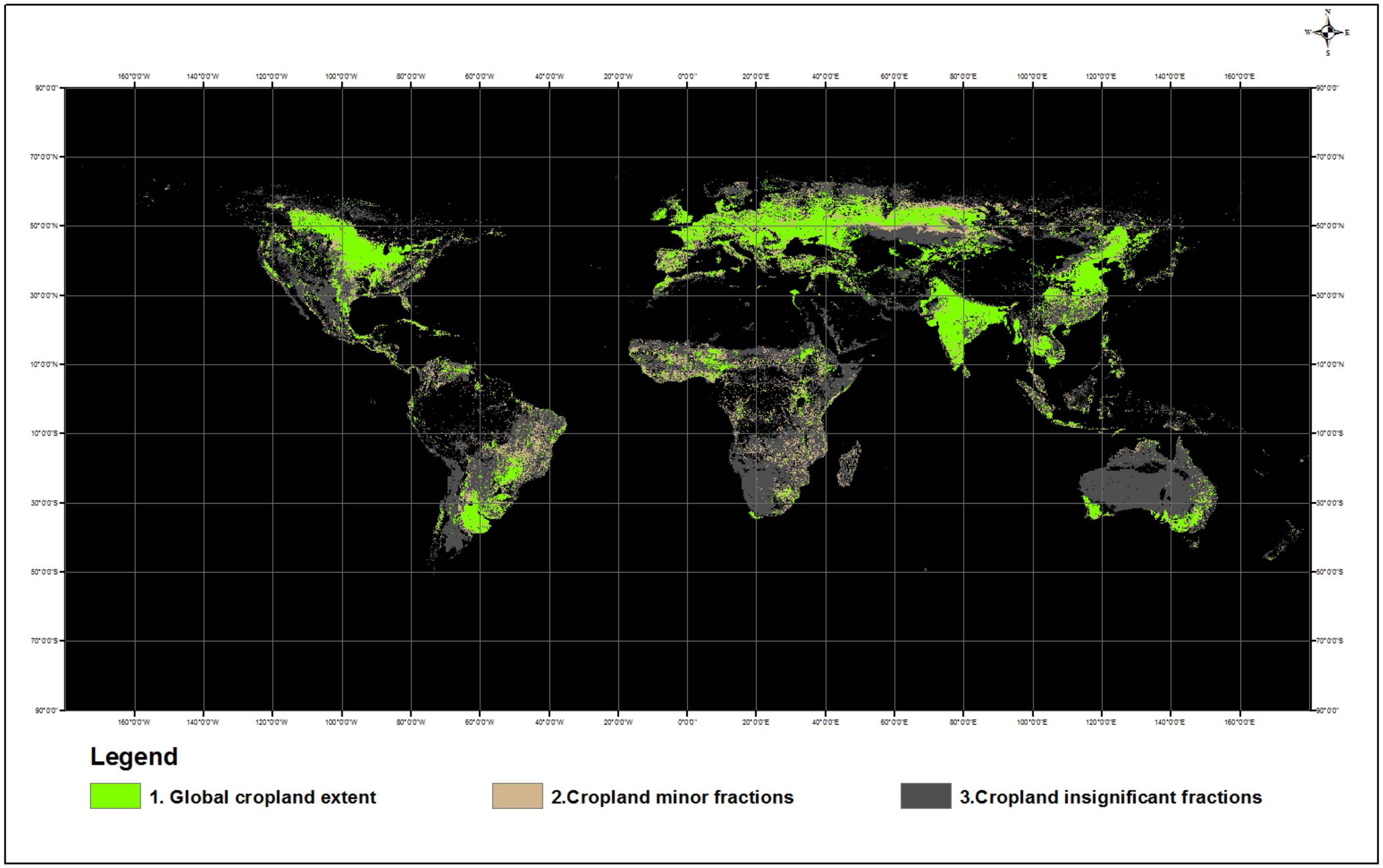

Figure 1a. Global cropland extent at nominal 1-km based on four major studies: Thenkabail et al. (2009), Pittman et al. (2010), Yu et al. (2013) and Fried et al.(2010). Three class map.

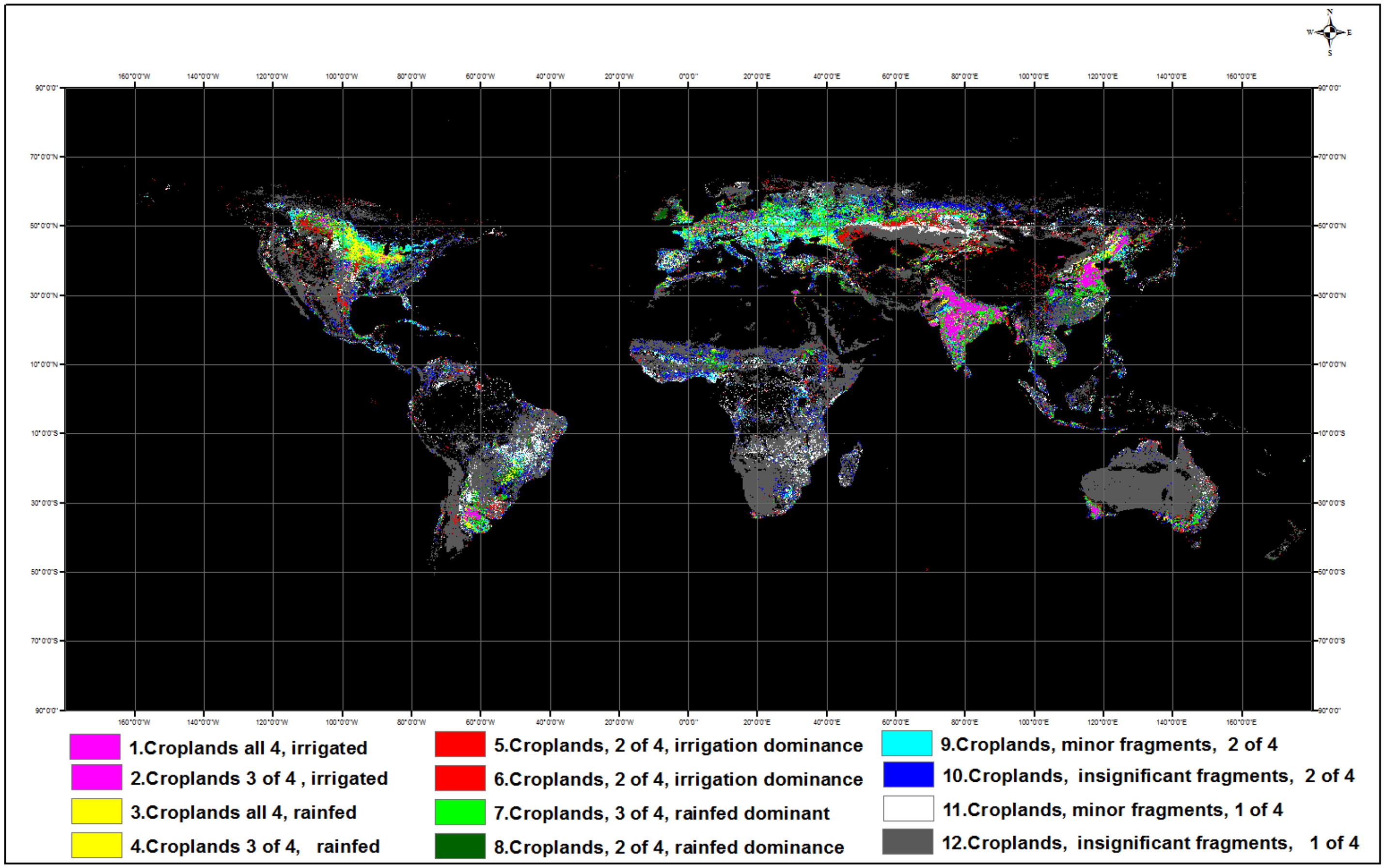

Figure 1b. Global cropland extent at nominal 1-km based on four major studies: Thenkabail et al. (2009), Pittman et al. (2010), Yu et al. (2013) and Fried et al. (2010). Twelve class map.

3.0 Baseline Data Infrastructure

(**Lead Authors**: **Jun Xiong**[1] , Pardhasaradhi Teluguntla[1], and Prasad Thenkabail[1], Cristina Milesi[2], and Chandra Giri[1]; 1 = U. S. Geological Survey; 2 = CSUMB\NASA AMES)

The GFSAD30 project is processing and analyzing massive amounts of data that includes global coverage of Landsat, MODIS, secondary (e.g., elevation, precipitation, temperature), and field data. This effort is collectively termed baseline data infrastructure (BDI). In this section, we have provided an outline the processing steps involved in creating BDI:

- First, we outline the steps involved in creating Landsat global land survey (GLS) data mosaics of the world for the 1975, 1990, 2000, and 2010 epochs. We have included 4 Landsat bands from the thematic mapper (TM) and enhanced thematic mapper (ETM+) sensors of 1990, 2000, 2001. These 4 bands are: red, near-infrared, shortwave infrared, and thermal infrared. For the 1975 multi-spectral scanner (MSS), we have included a red and a near-infrared band. An additional band will be normalized difference vegetation index (NDVI).
- Second, we outline the steps involved in creating MODIS monthly maximum value composite (MVC) normalized difference vegetation index (NDVI) data.
- Third, we outline the creation of mega file data cubes (MFDCs) involving Landsat GLS, MODIS monthly MVC NDVIs, and secondary data for each epoch.
- Fourth, we outline the creation of MFDCs of time series AVHRR GIMMS data for 1982 to 2011.

The above sets of data will be used as primary baseline data infrastructure (BDI) in the GFSAD30 project. In a nutshell, the BDI for a typical epoch (e.g., nominal year 2000), will consist of following data layers:

- **Landsat GLS 2000 data**
    - 30 m, one time for nominal year 2000
- **MODIS NDVI data**
    - 250 m, monthly maximum value composite (MVC) for nominal year 2000 (taken from year 2000-2002)
- **MODIS B1 and B2 data**
    - 250 m, monthly band 1 (red) and band 2 (NIR) for nominal year 2000 (taken from year 2000-2002)
- **Secondary Data**

    Elevation (GDEM, 30 m), precipitation 40 yr average (CRU, 50 km), AVHRR skin temperature (10 km), potential ET based on 100 yr. climate data (100 km). Also, others like Soils slope etc.

3.1 Global Landsat GLS data

Global Landsat BDI for 4 epochs (1975, 1990, 2000, 2005, and 2010) is summarized in Table 1. The Table 1 shows the number of images, sensor from which they are acquired, and the total storage volume required these images will be used in GFSAD30 project. The GLS scenes are band separate, in UTM coordinates, WGS-84 datum, are distributed in GeoTIFF format, and are compressed using tar and gzip / bZip. Collectively, these datasets provide consistent observations of global, orthorectified, leaf-on, “cloud free” data (Gutman, et al., 2008).

Epoch	Scenes	Size*	ETM+	TM	MSS	ALI
2010	8453	1.5TB	3719	4734	n/a	n/a
2005	9375	1.64TB	7087	2288	n/a	n/a
2000	8755	2.18TB	8755	n/a	n/a	n/a
1990	7371	975GB	n/a	7371	n/a	none
1975	7592	250GB	n/a	n/a	7592	n/a

Table 1. Global coverage of the Landsat GLS Data for epoch 2010, 2005, 2000, 1990, 1975. The table shows the sensor from which the data are acquired and the required storage volume.

3.2 Landsat BDI for year 2000 (LBDI 2000)

Here we describe the LBDI for the year 2000 (LBDI 2000). The LBDI 2000 consists of:

- 5 Bands (RED, NIR, MIR, THM, NDVI) will be stored with singed 16 integer. RED, NIR, MIR is top of atmosphere (TOA) reflectance (%) from Band 3, 4, 5. THM is the radiometric temperature (K) from thermal bands. NDVI is a ratio of the red and near infrared reflectance.
- Spatial resolution: 30m pixels or ~0.00026949 degree or 0.09 hectares.
- Projection/datum: Geographic / WGS 84
- Composite is based on data quality and the maximum NDVI for the overlapping area.
- Scene-Selected Map providing geo-location and date-gather information of selected scenes is available.
- Global domain is divided into 7 regions (Table 2 and 3; Figure 3a through 3g): Asia, Africa, South America, North America, Europe, Australia, and Middle East.
- Preview JPEG images, NDVI histogram and resampled-500m data are provided for inspection and experimental use.

Region Name	Sensor	Scenes	Format	Single-Band	Total Size
Africa	ETM	891	Erdas img	144 GB	720 GB
Asia	ETM	1651	Erdas img	366 GB	1830 GB
Australia	ETM	224	Erdas img	39 GB	195 GB
Europe	ETM	640	Erdas img	67 GB	335 GB
Middle-east	ETM	193	Erdas img	37 GB	185 GB
North-America	ETM	900	Erdas img	133 GB	665 GB
South-America	ETM	709	Erdas img	79 GB	395 GB

Table 2. Distribution of Landsat 2000 images in each of the 7 regions in cropland areas.

Sensor	Data Sets	Units	Scale factor	Data Type	Fill Value	Valid Range
TM/ETM+	Band 3 RED	TOA reflectance (-)	0.001	int16	-9999	0 - 1000
	Band 4 NIR	TOA reflectance (-)	0.001	int16	-9999	0 - 1000
	Band 5 SWIR	TOA reflectance (-)	0.001	int16	-9999	0 - 1000
	Band 6 THM*	Radiometric temperature (K)	0.1	int16	-9999	0 - 1000
ALL	NDVI	Normalized Difference Vegetation Index	0.001	int16	-9999	-1000 - 1000

Table 3. Landsat data normalization and scaling.

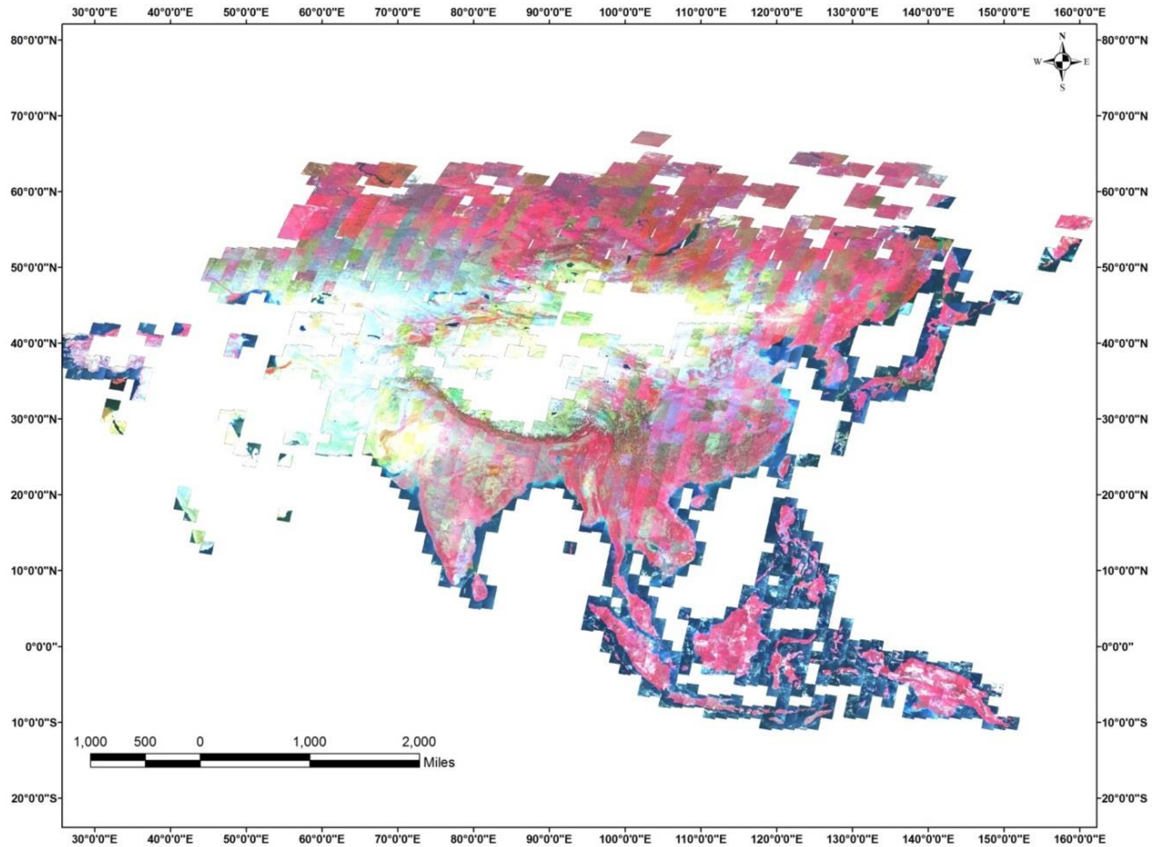

Figure 3a. Landsat Global Land Survey 2000 (GLS2000) mosaic of Asia. A total of 1651 images of croplands or where even a fraction of croplands exist have been mosaicked. Depicted here as False color composite (FCC) RGB bands 4,3,5. These data are in top of the atmosphere reflectance (TOA) expressed in %. The black areas show areas where zero croplands exist and considered sheer waste of time and resources to analyze for cropland characteristics. Data is processed and mosaicked on NASA AMES NEX supercomputer.

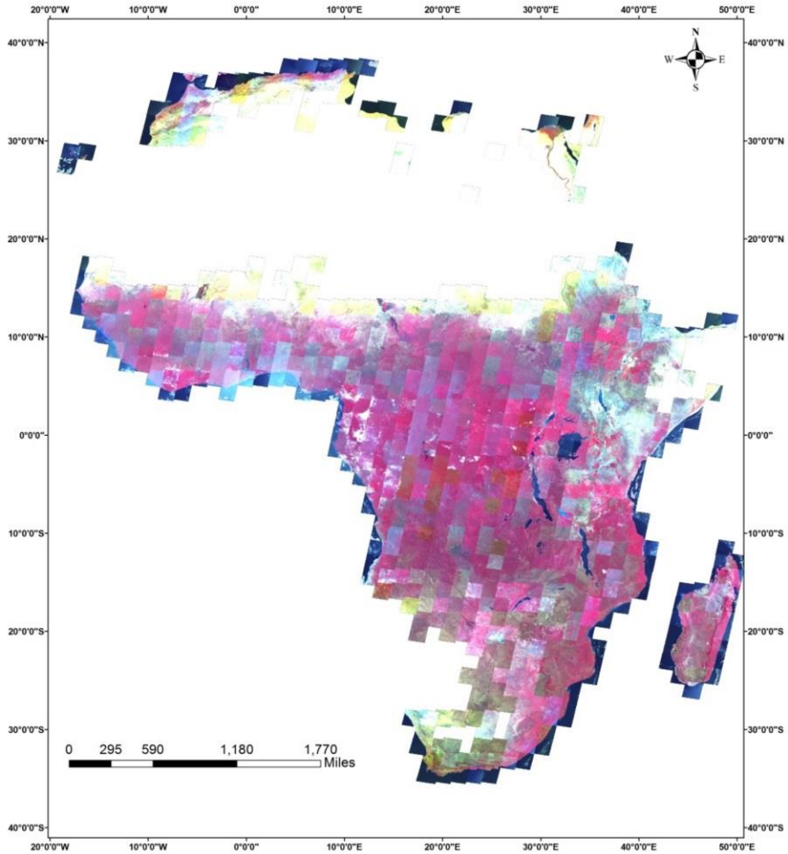

Figure 3b. Landsat Global Land Survey 2000 (GLS2000) mosaic of Africa. A total of 891 images of croplands or where even a fraction of croplands exist have been mosaicked. Depicted here as False color composite (FCC) RGB bands 4,3,5. These data are in top of the atmosphere reflectance (TOA) expressed in %. The black areas show areas where zero croplands exist and considered sheer waste of time and resources to analyze for cropland characteristics. Data is processed and mosaicked on NASA AMES NEX supercomputer.

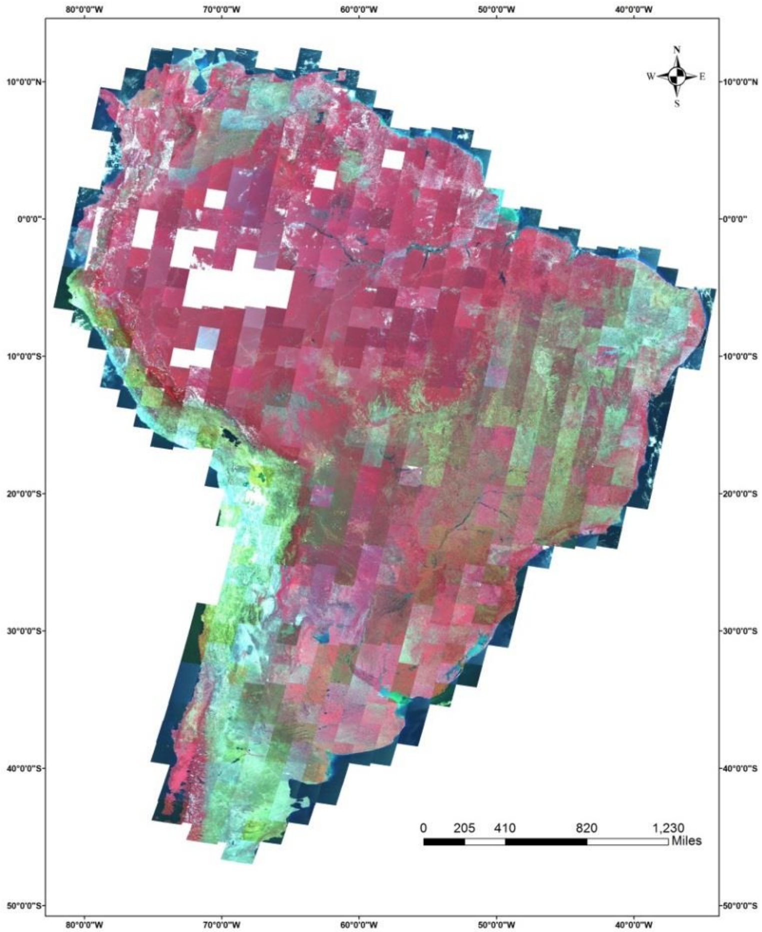

Figure 3c. Landsat Global Land Survey 2000 (GLS2000) mosaic of S. America. A total of 809 images of croplands or where even a fraction of croplands exist have been mosaicked. Depicted here as False color composite (FCC) RGB bands 4,3,5. These data are in top of the atmosphere reflectance (TOA) expressed in %. The black areas show areas where zero croplands exist and considered sheer waste of time and resources to analyze for cropland characteristics. Data is processed and mosaicked on NASA AMES NEX supercomputer.

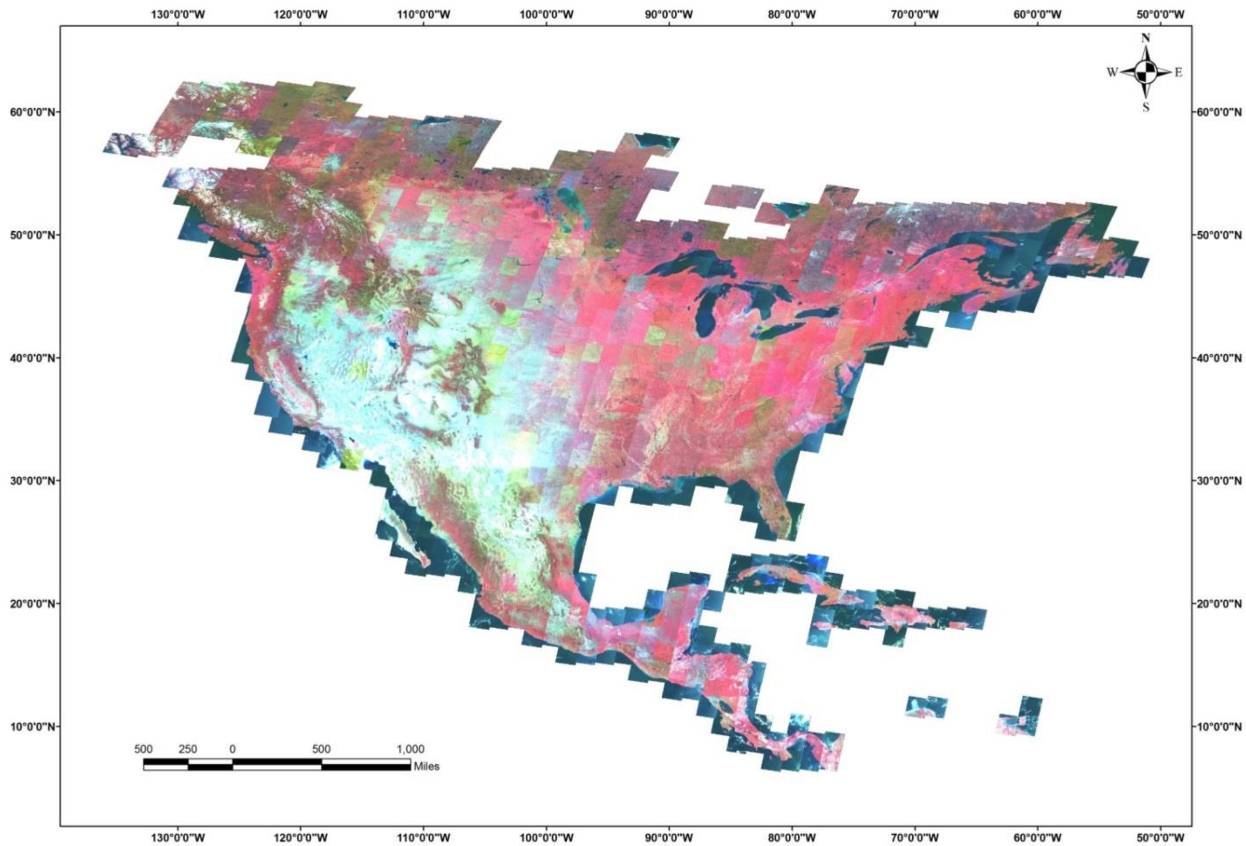

Figure 3d. Landsat Global Land Survey 2000 (GLS2000) mosaic of N. America. A total of 900 images of croplands or where even a fraction of croplands exist have been mosaicked. Depicted here as False color composite (FCC) RGB bands 4,3,5. These data are in top of the atmosphere reflectance (TOA) expressed in %. The black areas show areas where zero croplands exist and considered sheer waste of time and resources to analyze for cropland characteristics. Data is processed and mosaicked on NASA AMES NEX supercomputer.

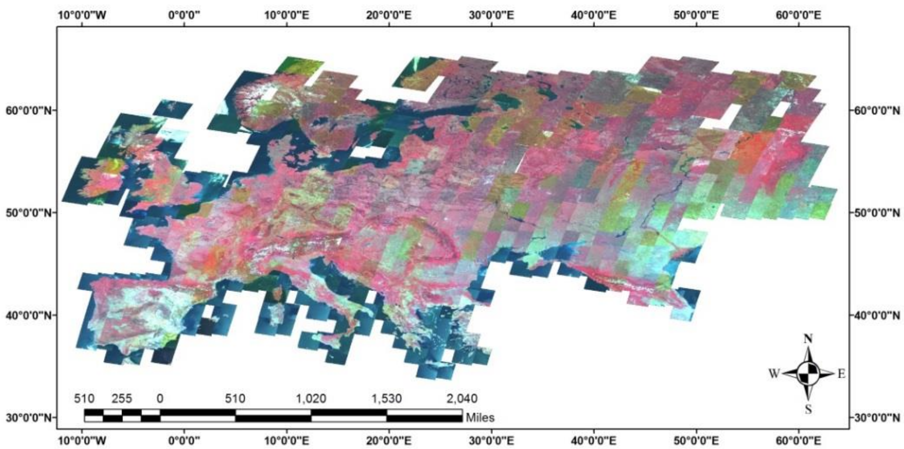

Figure 3e. Landsat Global Land Survey 2000 (GLS2000) mosaic of Europe. A total of 640 images of croplands or where even a fraction of croplands exist have been mosaicked. Depicted here as False color composite (FCC) RGB bands 4,3,5. These data are in top of the atmosphere reflectance (TOA) expressed in %. The black areas show areas where zero croplands exist and considered sheer waste of time and resources to analyze for cropland characteristics. Data is processed and mosaicked on NASA AMES NEX supercomputer.

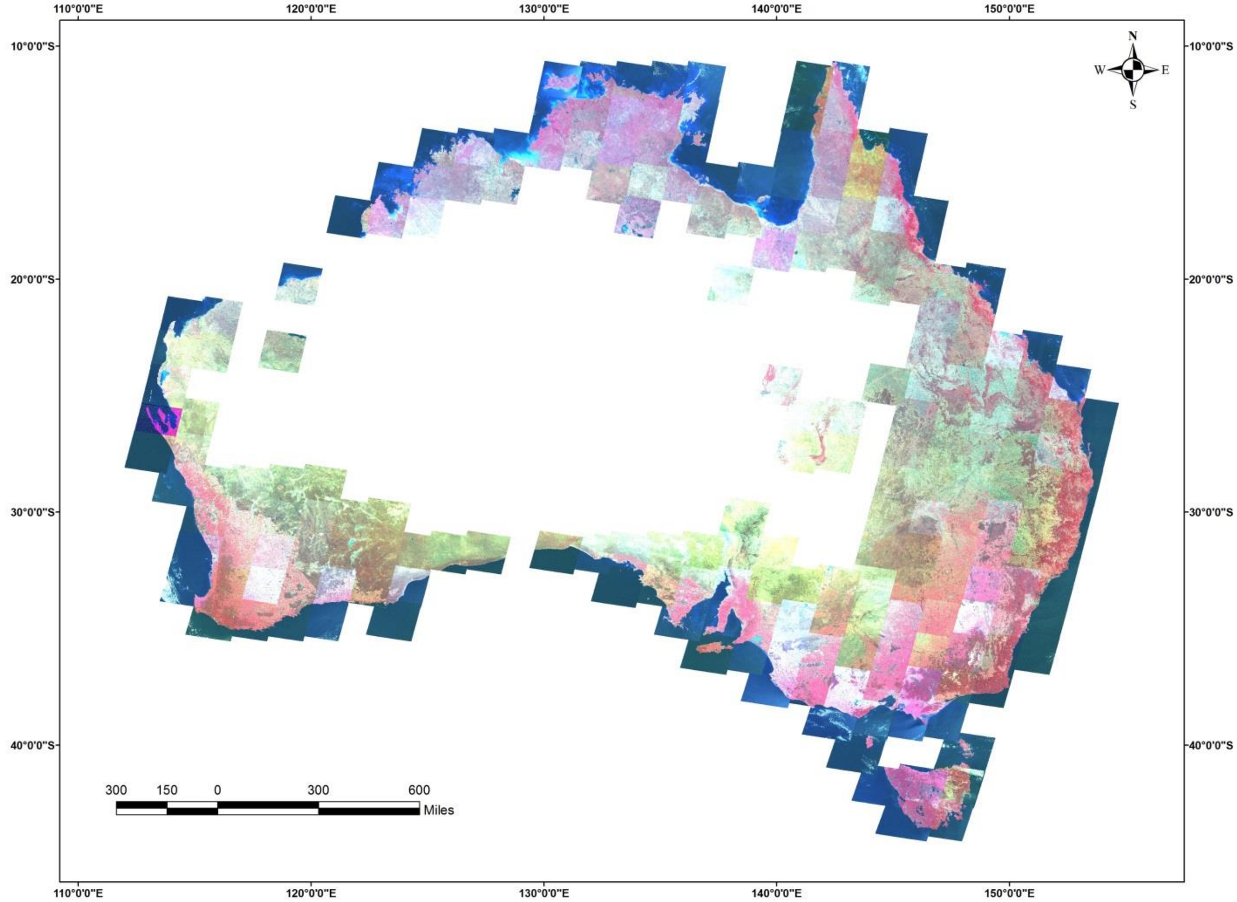

Figure 3f. Landsat Global Land Survey 2000 (GLS2000) mosaic of Australia. A total of 224 images of croplands or where even a fraction of croplands exist have been mosaicked. Depicted here as False color composite (FCC) RGB bands 4,3,5. These data are in top of the atmosphere reflectance (TOA) expressed in %. The black areas show areas where zero croplands exist and considered sheer waste of time and resources to analyze for cropland characteristics. Data is processed and mosaicked on NASA AMES NEX supercomputer.

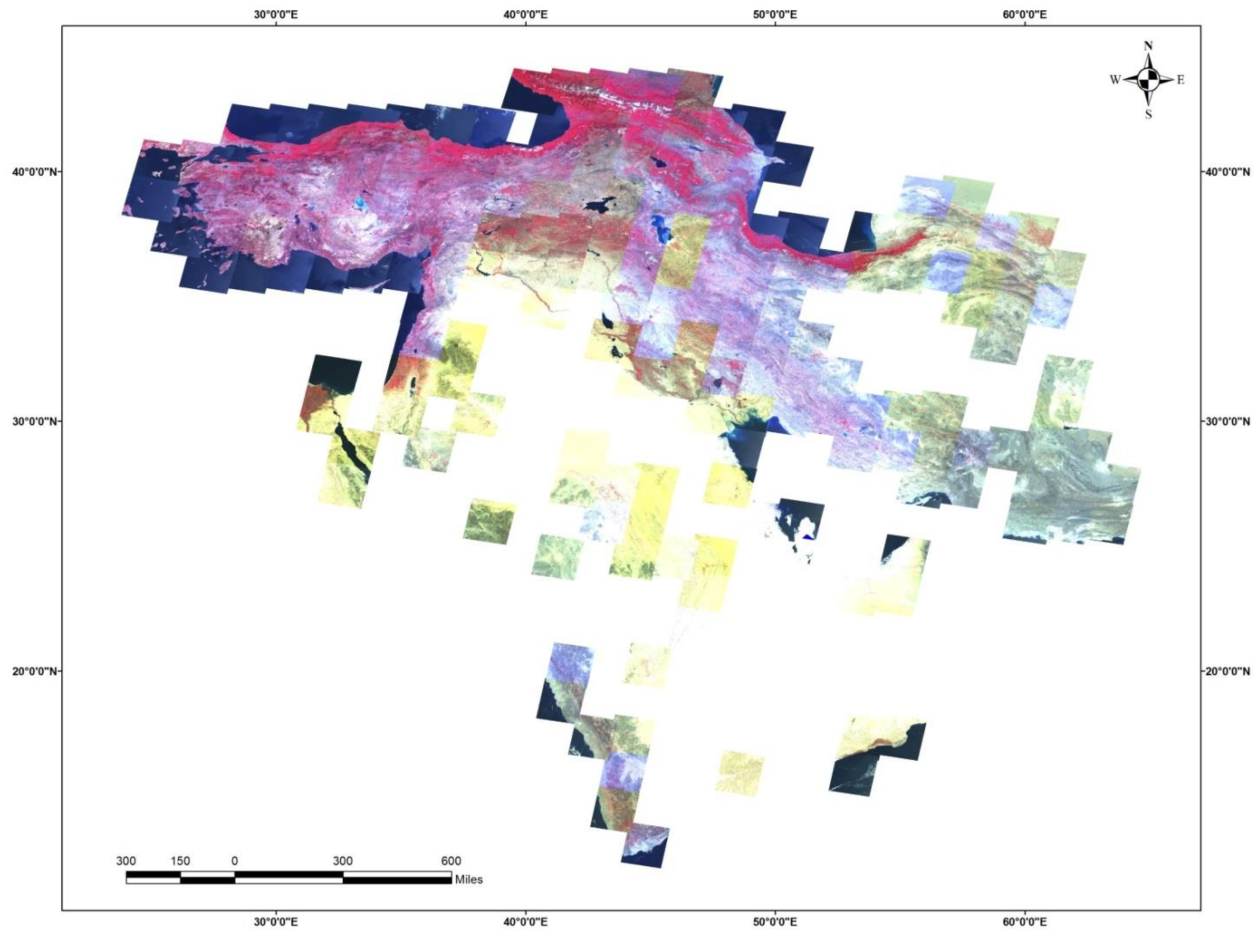

Figure 3g. Landsat Global Land Survey 2000 (GLS2000) mosaic of Middle East. A total of 193 images of croplands or where even a fraction of croplands exist have been mosaicked. Depicted here as False color composite (FCC) RGB bands 4,3,5. These data are in top of the atmosphere reflectance (TOA) expressed in %. The black areas show areas where zero croplands exist and considered sheer waste of time and resources to analyze for cropland characteristics. Data is processed and mosaicked on NASA AMES NEX supercomputer.

4.0 Mega file Data cube (MFDC)

(**Lead Authors**: **Jun Xiong**[1] , Pardhasaradhi Teluguntla[1], and Prasad Thenkabail[1]; 1= U. S. Geological Survey)

The concept of the mega-file data cubes (MFDC's) are described in Thenkabail et al. (2009). MFDC's help visualize as well as analyze data using one harmonious single data file that will consist of any and all type of layer stacks sourced from wide array of primary and secondary data sources over space and time.

Here is an MFDC example of Africa for the nominal year 2000 with 52 data layer stack (Figure 4a and 4b) as listed below:

MODIS: 36 bands

- Band 1 to band 12: MODIS b1 (red) minimum value composite (MVC);
- Band 13 to band 24: MODIS b2 (NIR) maximum value composite (MVC);
- Band 25 to band 36: MODIS NDVI maximum value composite (MVC);

Skin Temperature: 12 bands

- Band 37 to band 48: AVHRR Skin Temperature (in degree kelvin); (based on 20 yr. Aaverage)

DEM: 1 band

- Band 49: ASTER DEM project (resolution: 30m) or GDEM project (resolution: 1km);

Tree Cover (forest cover > 75%; FGT75): 1 band

- Band 50: Tree Cover > 75% (resolution: 8km);
- Precipitation: 1 band
- Band 51: 40-year-annual-mean (CRU) precipitation (resolution: 8km);

Potential Evapotranspiration (PET): 1 band

- Band 52: 40-year-mean from CRU (resolution: 50 km);

The above data layers are harmonized and standardized (i.e., have same projection, datum, pixel size) and are normalized (e.g., reflectance, degree kelvin etc.).

The MFDC can be used in whichever way one deems fit. For example, one can use only MODIS bands in classification, use only secondary climate data for region segmentation, and so on.

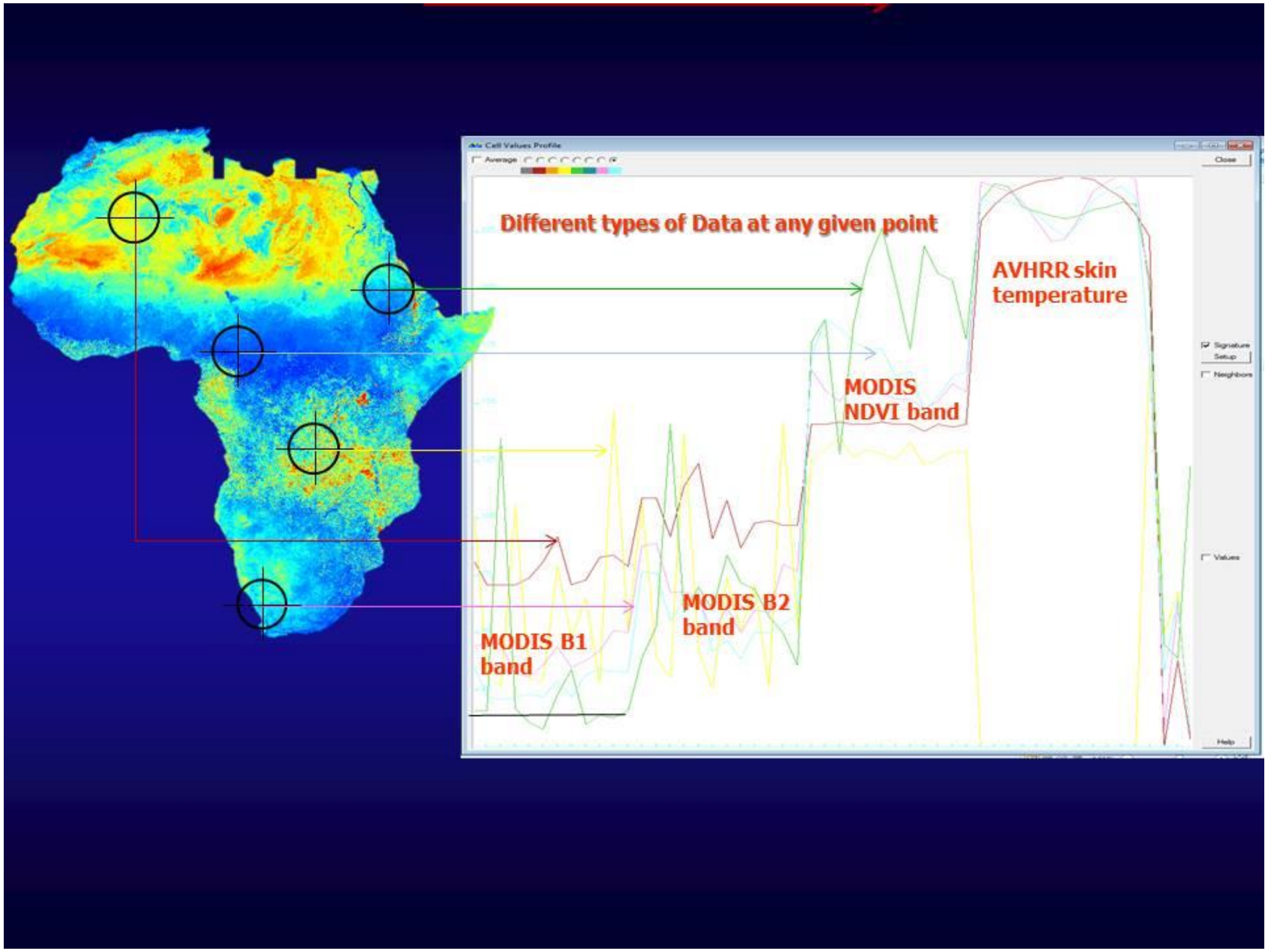

Figure 4a. Mega file data cube (MFDC) of 52 data layer stack at nominal 250 m spatial resolution. A click on any particular pixel will provide complete data characteristics of the stack as shown on the right.

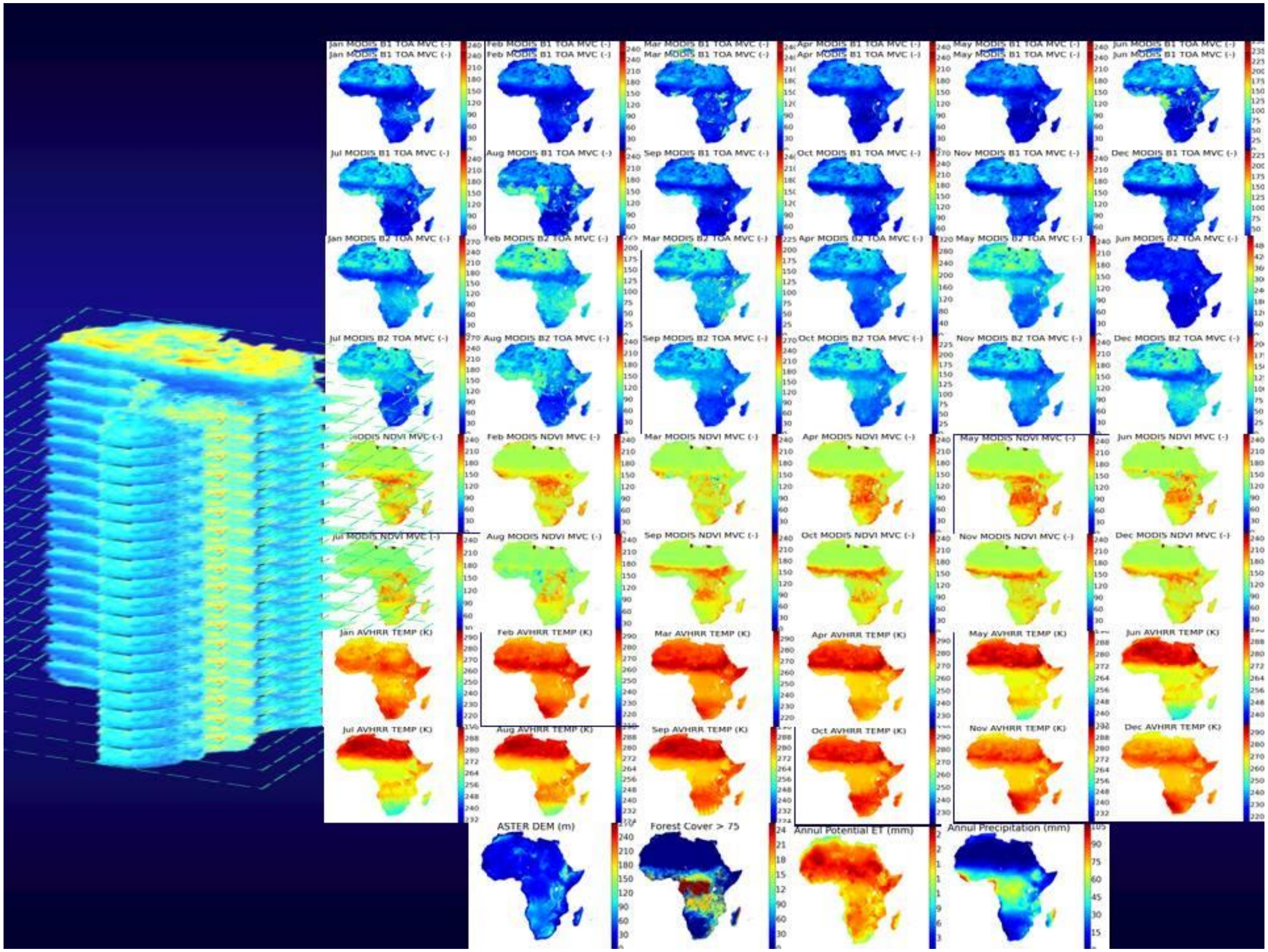

Figure 4b. Mega file data cube (MFDC) of 52 data layer stack at nominal 250 m spatial resolution. A click on any particular pixel will provide complete data characteristics of the stack as shown on the right.

5.0 Study Areas

The project plans to work based on study areas (Figure 5) where different co-Is have expertise and\or interest. Even though there are ~9500 Landsat images covering the terrestrial area, ~50% of these images (see Table 1) are required to cover areas where cropland currently exist and where they can potentially exist in future or where they existed in the past. These images were processed, standardized (Table 2,3) and mosaicked (Figure 3a through 3g).

Figure 5 shows focus region of the world where different sub-groups will work. This plan of action was decided based on the 2 project workshops held so far and agreed by the team members. Each group will then produce the same products outlined in section 1.0 (overview).

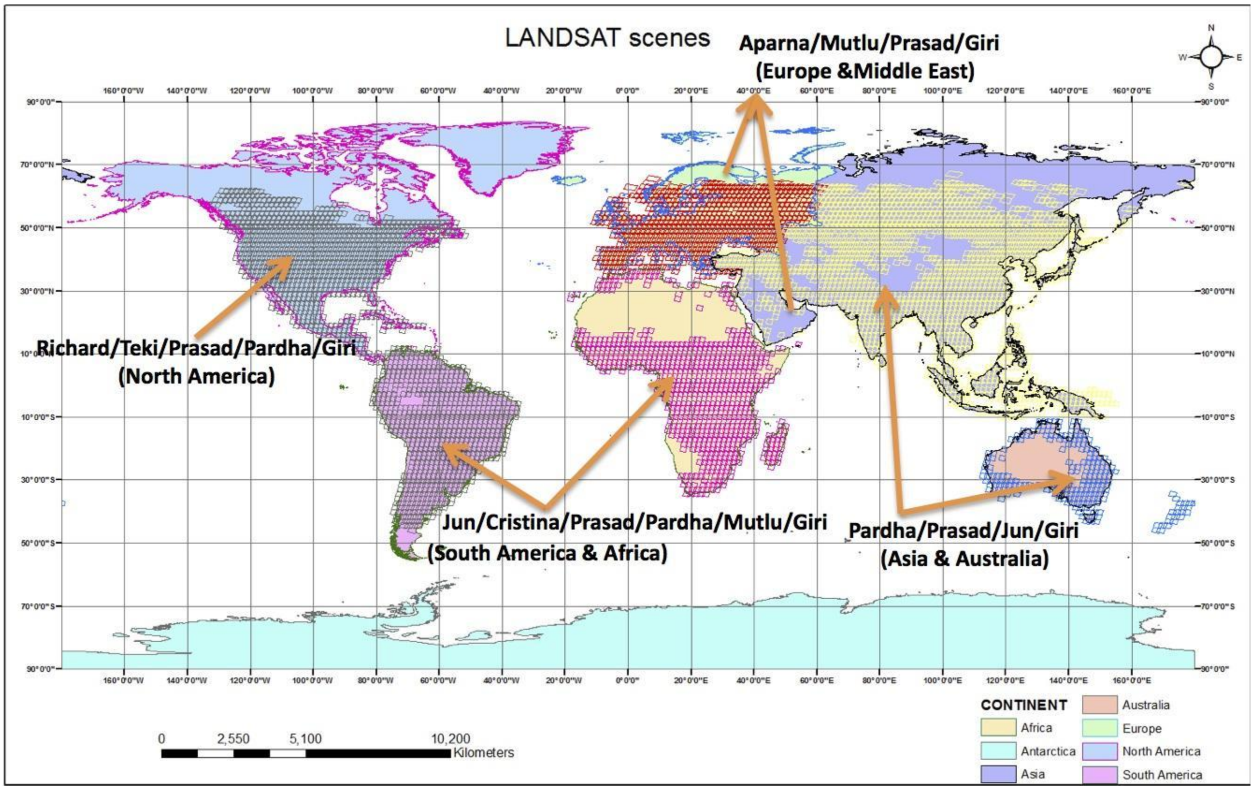

Figure 5. Shows the 7 regions and the Landsat tiles over these regions over cropland areas and\or potential cropland areas. Overall, there are 4990 Landsat tiles over croplands\potential croplands (above figure) of ~9000 Landsat tiles (see Table 1) covering the entire terrestrial Earth. The areas where there is currently zero croplands and\or their chances of occurring in future are about zero (e.g., Sahara desert, Antarctica), no Landsat images are selected to avoid processing unnecessary images for cropland studies.

6.0 GFSAD30 project progress at the University of Wisconsin

(Lead Authors: Mutlu Ozdogan[1] and Aparna Phalke[1]**;** 1= University of Wisconsin**)**

The University of Wisconsin team is responsible for achieving the project goals and objectives (section 1.10) for Europe and Middle East.

They are currently focused on developing the global ground database, which will not only benefit them, but the entire GFSAD30 team.

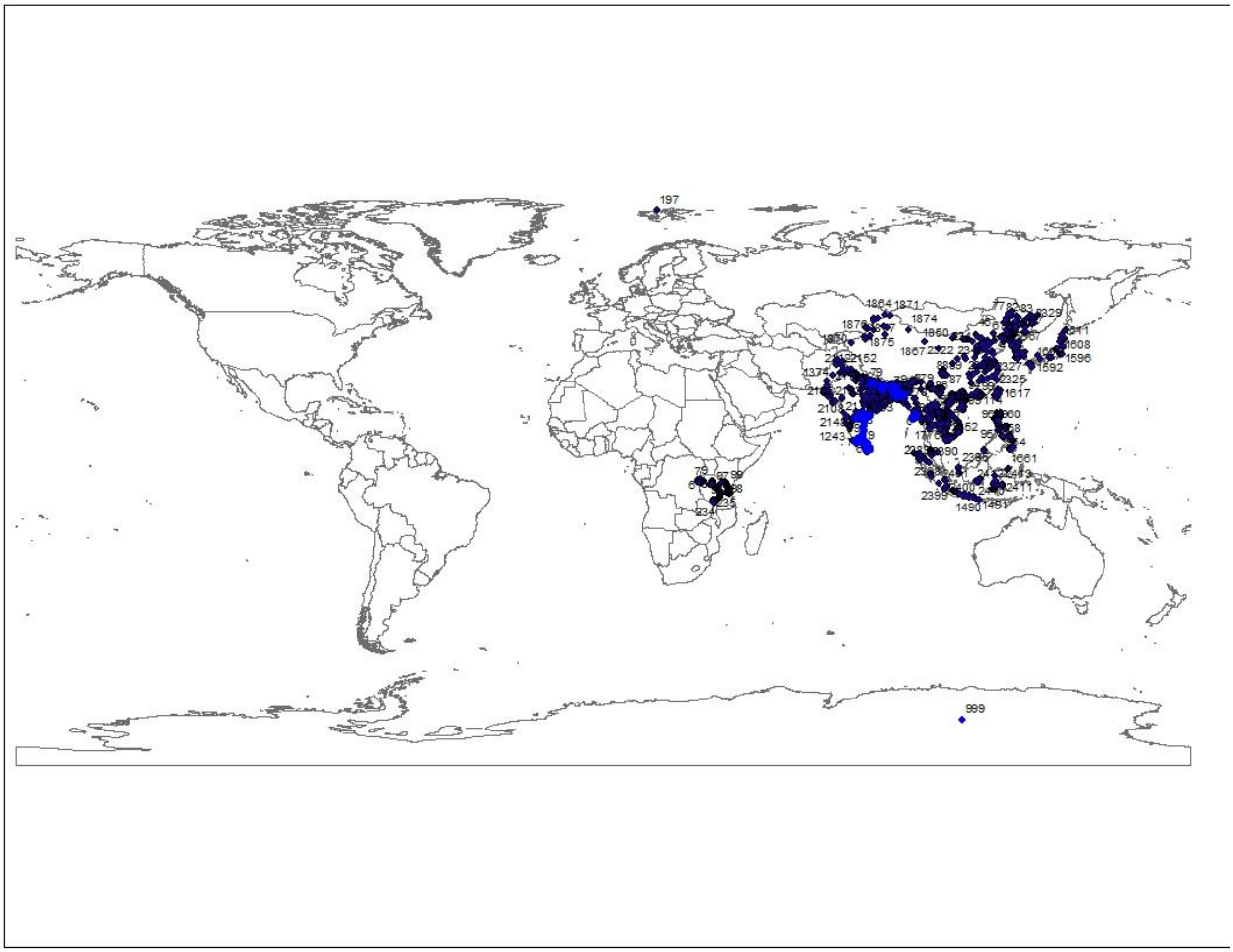

Figure 6. Global ground data base built by University of Wisconsin team. Over 10,000+ data points are available. This is ongoing work and the point so far organized is shown above. Each point has location, digital images\s, and cropland and other land use characteristics. Most of these data is collected by Dr. Murali Krishna Gumma and Prasad Thenkabail’s earlier team at the International Water Management Institute.

7.0 GFSAD30 project progress at the Northern Arizona University

(**Lead authors**: Teki Sankey[1] and Richard Massey[1]; 1= Northern Arizona University)

The research team at NAU is focused on producing the cropland products outlined in section 1.0 for North America. They have started our work with the nominal year 2000. High temporal resolution data is essential to map crop types, irrigated vs. rainfed crops, and cropping intensity over a given year. They have downloaded 8-day composites of MODIS band 1 and band 2 reflectance data (250 m resolution) of entire North America over the nominal year 2000. They have re-projected and mosaicked all of the scenes, which resulted in ~40 images of North America for the nominal year 2000. Using the two bands from each mosaicked composite (Figure 7), they then calculated Normalized Difference Vegetation Index (NDVI). The NDVIs were then stacked together creating a time-series of ~40 dates (~40 mosaicked images) over the entire year. The NDVI time-series data will be used to classify crop types, irrigated vs. rainfed crops, and cropping intensity following Wardlow et al. (2007).

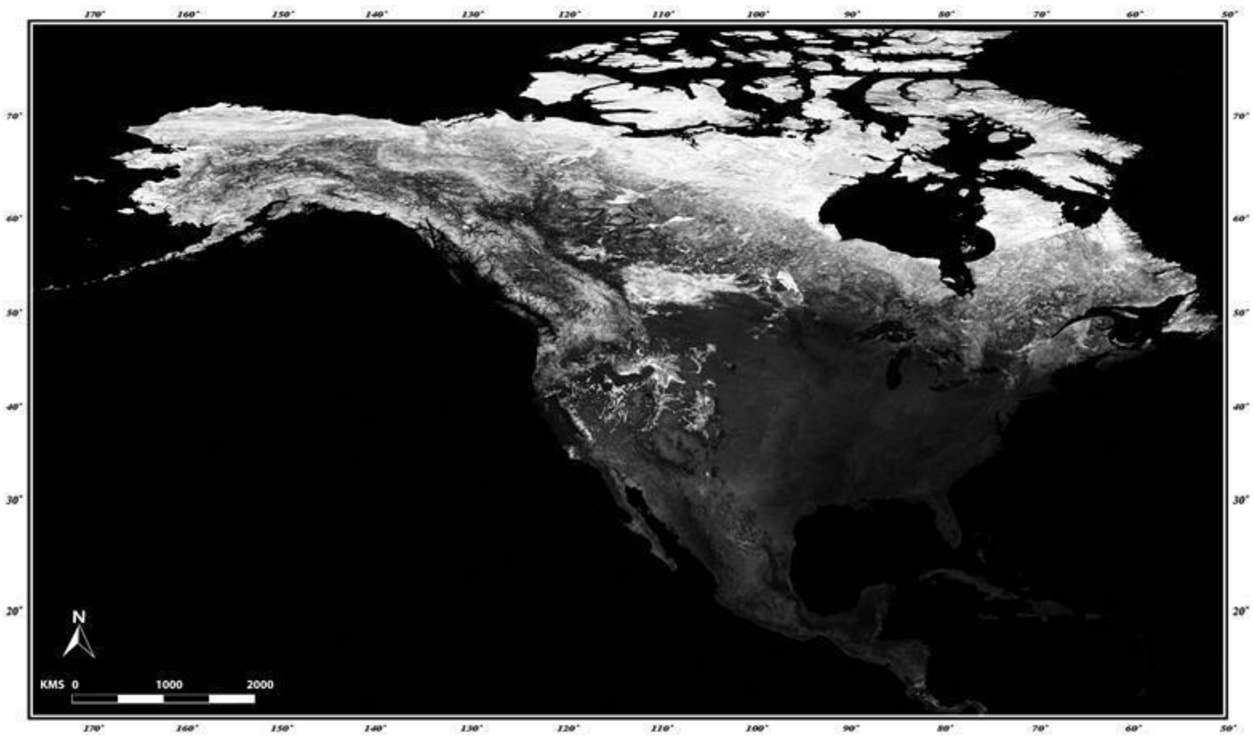

Figure 7. Mosaicked MODIS band 1 example for North America.

High spatial resolution data is also critical for accurately producing the key products. They are currently downloading Landsat data (30 m resolution) for the nominal year 2000 to be able to produce a Landsat NDVI time-series similar to the MODIS NDVI time-series. They will then attempt to combine the Landsat NDVI time-series with the MODIS NDVI time-series to produce a high-resolution time-series, both temporally and spatially, for the nominal year (Gao et al., 2006; Hilker et al., 2009).

8.0 GFSAD30 project progress at the University of New Hampshire

(**Lead authors**: **Russ Congalton**[1] and Kamini Yadav[1]; 1= University of New Hampshire)

The University of New Hampshire team's main role is to assess accuracies of global cropland products listed in section 1.0. Currently this team is conducting the following work:

1- Review of past Global Land Cover Mapping projects to learn from previous mistakes and evaluate uncertainty in these mapping products

2- Working on getting NASA and NGA accounts for access to high-resolution imagery and computer processing.

3- Searching USGS Earth Explorer Data Base for high-resolution imagery for use as reference data and cataloging results.

4- Developing a software program written in R to ingest map and reference data and produce an appropriate error matrix with standard metrics including overall, users, and producer's accuracies and kappa.

9.0 GFSAD30 project progress at the California State University at Monterey Bay (CSUMB)

(**Lead authors**: Cristina Milesi[1]; 1 = California State University at Monterey Bay)

GFSAD30 Website

Initiated planning for GFSAD30 official website in collaboration with USGS in Menlo Park, which will serve as the hosting institution. The website will describe the project and display and serve the cropland data. Functionality of the website will include map server features with layering and zooming, use interaction to collect feedback and validation data, data sub setting and download.

The temporary website for the project is (Figure 8):
https://powellcenter.usgs.gov/globalcroplandwater/

10.0 GFSAD30 project progress at the NASA GSFC

(**Lead authors**: James Tilton[1]; 1=NASA Goddard Space Flight Center)

Co-I Tilton has been refining his RHSeg/HSeg software [1] to better serve the needs of the GFSAD30 project.

A requirement of the GFSAD30 project is to accurately map agricultural fields at the 30m spatial resolution from Landsat TM imagery data. Agricultural field boundaries often exhibit a discontinuity or "edge" that may be helpful in recognizing the field extent. Co-I Tilton has been refining his RHSeg/HSeg software to better identify agricultural fields by modifying it to utilize edge information to influence region object definition.

Edge information can be defined for an image through the use of an edge operator. Of the several edge operators have been defined in the image analysis literature, the most appropriate operator for this application is the Frei-Chen edge difference operator [2]. The Frei-Chen operator is the only operator that is (i) sensitive to diagonal edges as well as vertical and horizontal edges, and (ii) normalized to give numeric results in a consistent range (0.0 to 1.0).

Tilton has successfully modified the RHSeg/HSeg software to track the value of the Frei-Chen edge difference operator, or "edge value," along the boundaries of every region object, and to compute the average of the edge value along the boundaries between pairs of neighboring region objects.

Tilton's initial experiments with a simple modification of the RHSeg/HSeg region merging decision rule have shown some encouraging improvements in the identification of agricultural field extent. He is currently implementing a more complicated, but more flexible and potentially more powerful approach to using the region boundary average edge value to influence the RHSeg/HSeg region object definition process. Results from this new approach are expected to be available later in December 2013.

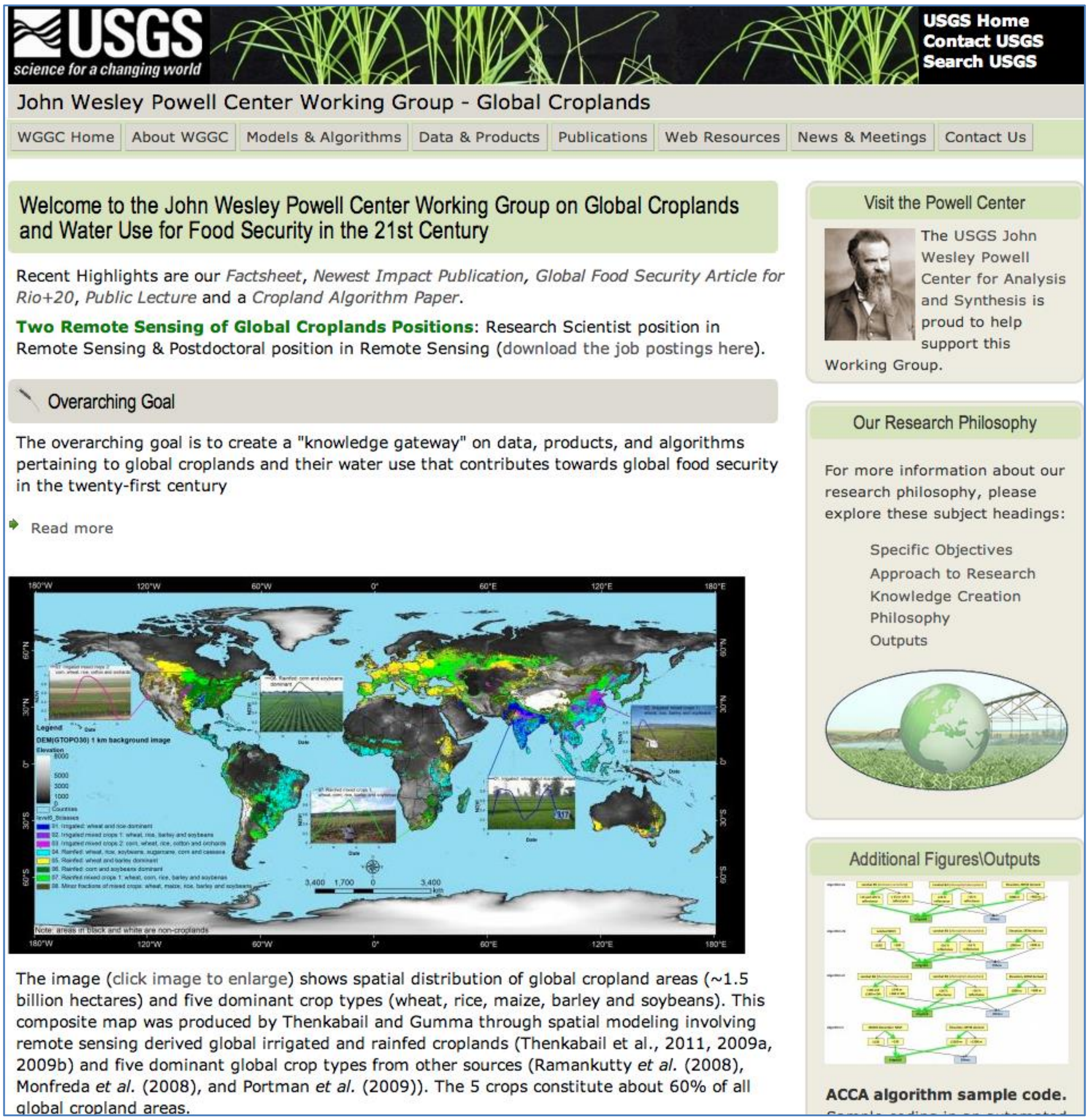

Figure 8. Screenshot of the temporary GFSAD30 website. Information from this temporary website will be migrated to a permanent location at the beginning of the second year of the project.

11.0 GFSAD30 Team composition

<u>GFSAD30 Project Team names and affiliation</u> (Project Team)

Prasad Thenkabail, PI, USGS
Cristina Milesi, co-I, NASA AMES\CSUMB
Mutlu Ozdogan, co-I, UW
Russ Congalton, co-I, UNH
Chandra Giri, co-I, USGS EROS
James Tilton, co-I, NASA GSFC
Temuulen Teki, co-I, NAU
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Richard Massey, PhD student, NAU\USGS
Aparna Phalke, PhD student, UW
Kamini Yadav, PhD student, UNH
Gu Jianyu, PhD student, UNH

<u>LP DAAC</u> (web portal, data portal, web map)

Dave Meyer, U. S. Geological Survey
Stacie Doman Bennett, U. S. Geological Survey

<u>Web Master</u> (web portal, data portal, web map)

Jeff Peters, U. S. Geological Survey

<u>Google Earth Engine</u>: (Python and Java scripts;
Jeanne Jones, U. S. Geological Survey

<u>IT Support</u>

Mr. Miguel Velasco, U. S. Geological Survey
Mr. Rian Bogle, U. S. Geological Survey

12.0 Workshops and Meetings

The GFSAD30 team held two workshops so far. First, a project initiation meeting in Flagstaff, AZ in June 2013 and a follow-up workshop in August, 2013 in Fort Collins, CO. detailed presentations and discussions took place during these workshops. Here, below is the link to all the presentations made during the workshops:
ftp://ftpext.usgs.gov/pub/wr/az/flagstaff/jxiong/GFSAD30/flagstaff/presentations/01-WORKSHOP1-flagstaff/

ftp://ftpext.usgs.gov/pub/wr/az/flagstaff/jxiong/GFSAD30/flagstaff/presentations/02-WORKSHOP2-fort-collins/

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