

Satellite Imagery Resources and Usage for the Farm Service Agency

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Introduction

Many imagery users in the Farm Service Agency (FSA) are familiar with satellite imagery, however most FSA user's interaction with aerial imagery comes via the National Agriculture Imagery Program (NAIP). Satellite imagery from various platforms is available for free usage in many cases as well. The imagery comes in various pixel sizes (ground sample distance) and band combinations. The variety and amount of data could be of great use to FSA users. These uses include vegetation analysis, disaster preparedness, post-disaster evaluation, field assessments, etc. The goal of this paper is to present some of the satellite imagery options, how these options could be used with FSA programs, and how the data could be integrated with FSA policies. Also, there will be some discussion of how the USDA-FSA-Aerial Photography Field Office (APFO) can be used as a resource for assistance with satellite imagery. This paper is intended to be a brief overview of satellite imagery resources and usage.

Satellite Imagery Resources

There are many online sources where users may obtain satellite imagery for free; several of them will be discussed here but keep in mind there are a vast amount of resources available. Most of the imagery that may meet FSA needs can be found on the USGS Earth Explorer website, Digital Globe's My DigitalGlobe website, and the USGS Hazards Data Distribution System (HDDS) where disaster response satellite imagery may be downloaded. Each of these portals host imagery from various sensors including LANDSAT, SPOT, and Worldview (these will be discussed in more detail later). Earth Explorer (<http://earthexplorer.usgs.gov/>) is a client/server interface that provides access to the USGS EROS (Earth Resources Observation and Science) data center archive. The EROS archive is a comprehensive collection of land remote-sensing data that spans more than 70 years for national coverage. Current data collections include aerial photography, satellite imagery, elevation data, land cover products, and digitized maps. Much of the satellite imagery archive is LANDSAT or SPOT. With a login and password (provided by EROS through a request), users can access even more data such as unclassified commercial satellite imagery. The Earth Explorer interface is very user-friendly (figure 1). It allows for searches by an area of interest, address/place name, zip code, or by utilizing the interactive map to specify a geographic point, rectangle or multiple point polygons. Data searches also can be made for specific date ranges and specific data sets. Downloading the imagery along with any associated vector and metadata files is very straightforward. USGS also offers a bulk downloader tool for downloading larger quantities of imagery.

MyDigitalGlobe (<https://rdog.digitalglobe.com/myDigitalGlobe/Console.html#LOGIN>) uses the EnhancedView Web Hosting Service (EV WHS) which is a web-based application that enables you to quickly and easily view and download imagery. The service requires a subscription that can be obtained by requesting access through DigitalGlobe. In the request, you will need to provide a detailed reason for needing access to the imagery archive. The imagery is all licensed through the Nextview license and most of the available satellite imagery is Worldview-1, Worldview-2, or Quickbird. The MyDigitalGlobe interface is also very user-friendly (figure 2). There are several filters such as date range, image

resolution, satellite platform, etc. that can be edited to meet the user's preferences. Accessing the interface to download imagery is simple to do, but the actual download process can take some time depending on user bandwidth. Keep in mind this satellite imagery is licensed, so care must be taken with usage and distribution.

The USGS HDDS (<https://hdds.usgs.gov/hdds2/>) is mainly a resource for retrieving satellite data to support disaster response/recovery efforts. Data queries are built based on disaster events. To begin a search for data, the user must select a specific disaster as identified by the USGS from a dropdown menu. The user interface is very similar to EarthExplorer (figure 3). Only imagery relevant to a particular disaster will be available. Like EarthExplorer, a request can be made to access certain imagery not available to the general public; FSA users should have no trouble accessing this imagery.

There are other resources for free satellite imagery besides the three previously described. This includes WARP (<https://warp.nga.mil/>) which is a site hosted by the National Geospatial Intelligence Agency (NGA). WARP hosts an extensive archive of declassified satellite imagery but users must first register and justify a need to access the archive. The Foreign Agriculture Service (FAS) hosts the USDA satellite imagery archive (http://www.pecad.fas.usda.gov/archive_explorer/). The archive is similar to other satellite imagery repositories and requires a USDA login.

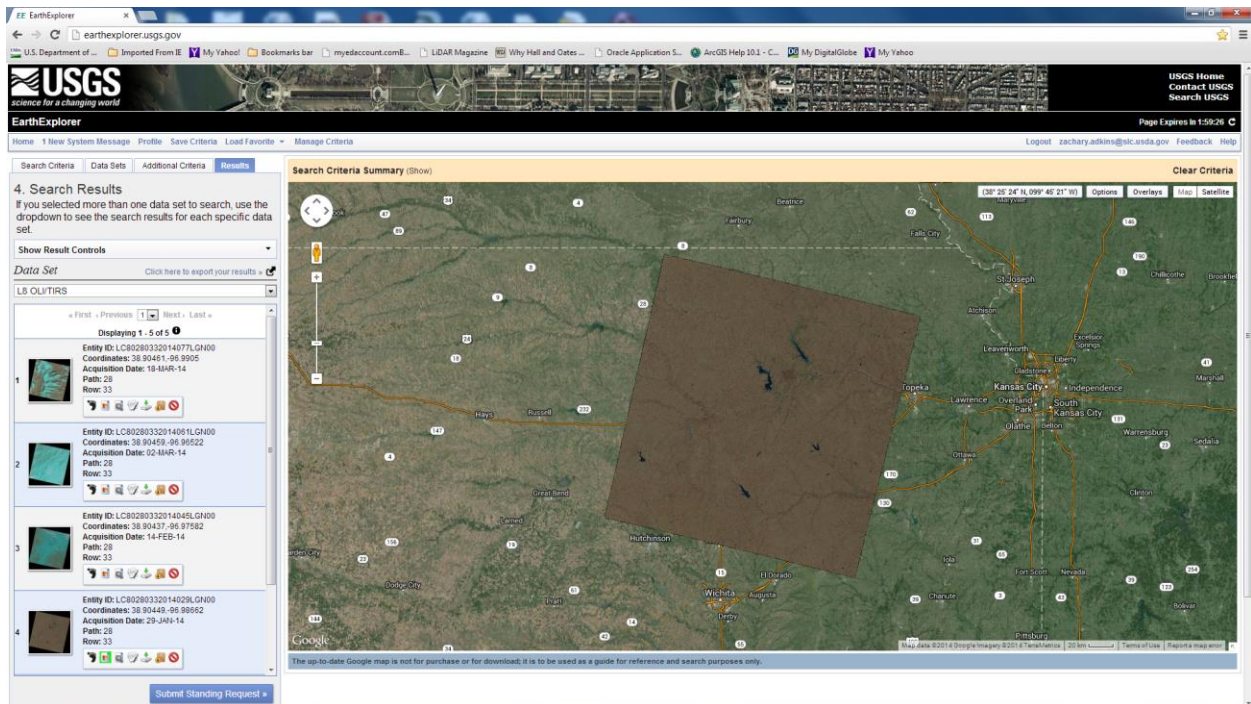


Figure 1: EarthExplorer Interface

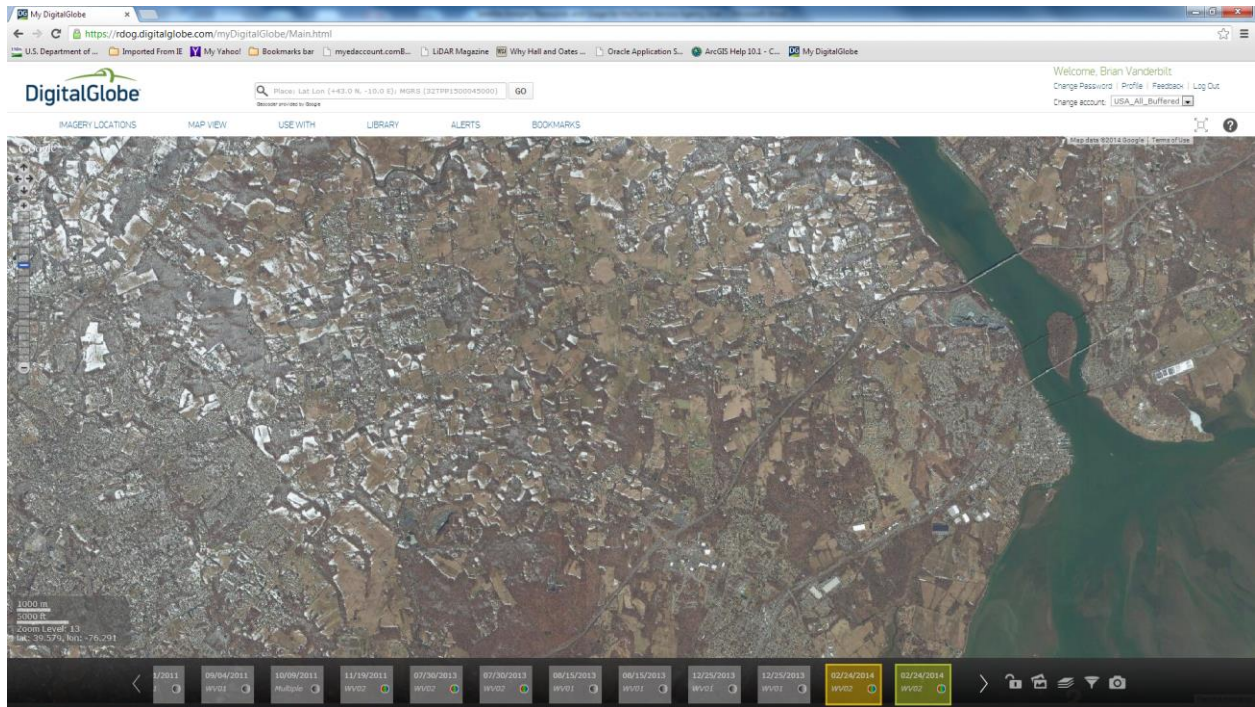


Figure 2: MyDigitalGlobe Interface

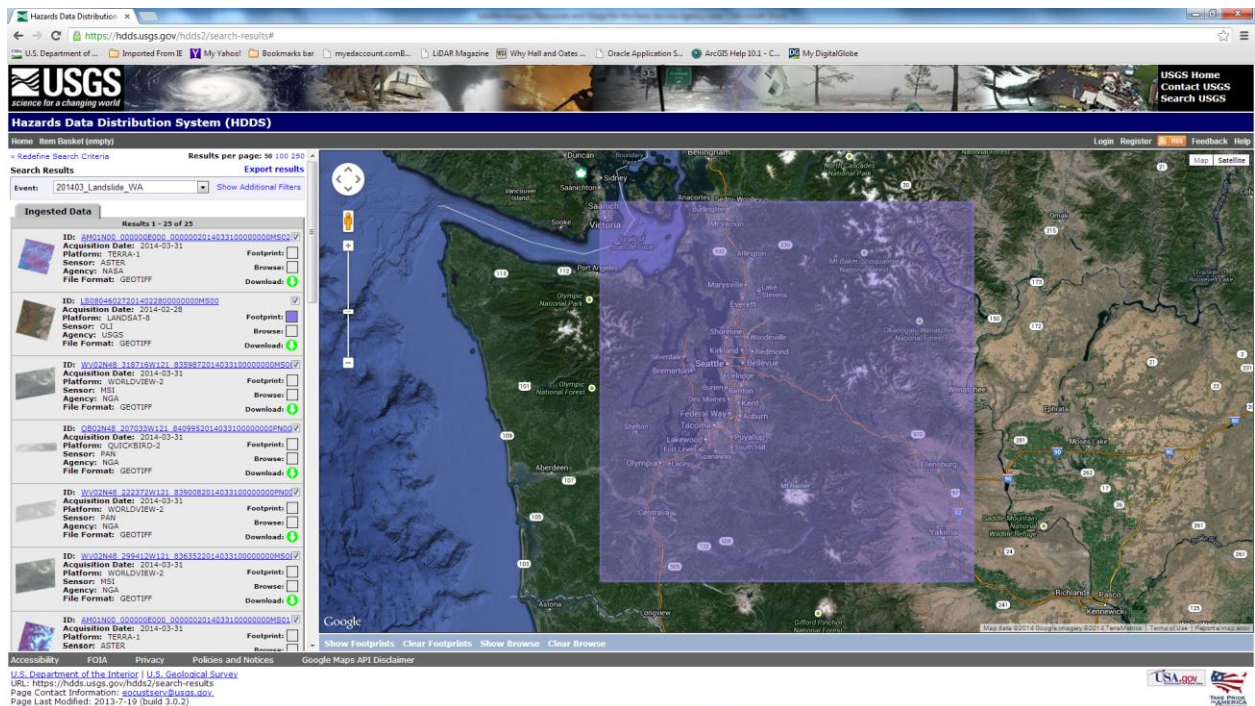


Figure 3: USGS HDDS Interface

Satellite Imagery Platforms and Sensors

The following is a list of some of the satellite platforms and sensors that acquire imagery that FSA users can download and use for free. Keep in mind this is just a partial list of available data.

ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer)

Footprint Width – 60 km

Spectral Resolution – 4 bands

Spatial Resolution – 15 m

ASTER is a sensor that is onboard the TERRA satellite. ASTER data is used to create detailed maps of land surface temperature and reflectance. APFO has used ASTER scenes to identify flooded croplands.

AWiFS (Advanced Wide Field Sensor)

Footprint Width – 370 km

Spectral Resolution – 3 or 4 bands

Spatial Resolution – 56 m

Due to the large area that an AWiFS scene covers, it is ideal for use in vegetation assessments for areas such as counties or even states. In the past, APFO has used AWiFS data to detect areas where native sod has been cultivated out in test scenarios.

GeoEye-1

Footprint Width – 15 km

Spectral Resolution – 4 bands plus pan

Spatial Resolution – 50 cm pan/2 m multispectral

GeoEye-1 is a commercial satellite owned by the DigitalGlobe Corporation. With a higher spatial resolution, the imagery can be ideal for field based assessments.

IKONOS

Footprint Width – 11 km

Spectral Resolution – 4 bands plus pan

Spatial Resolution – 80 cm pan/4 m multispectral

IKONOS is a commercial satellite owned by the DigitalGlobe Corporation.

Landsat-8 (Operational Land Imager (OLI))

Footprint Width – 185 km

Spectral Resolution – 8 bands plus pan

Spatial Resolution – 15 m pan/30 m multispectral

Most of the free satellite imagery available will be from the Landsat program. The program has been running since the early 1970's and has a vast archive of imagery. The most recent satellite, Landsat-8, launched in 2013. The imagery is very useful for land use change detection in larger areas.

Quickbird

Footprint Width – 18 km

Spectral Resolution – 4 bands

Spatial Resolution – 60 cm pan/2.4 m multispectral

Quickbird is a commercial satellite owned by DigitalGlobe.

SPOT (Satellite Pour l'Observation de la Terre)

Footprint Width – 60 km

Spectral Resolution – 4 bands

Spatial Resolution – 2.5 m or 5 m pan/10 m multispectral

SPOT is a commercial satellite owned by Airbus Defence & Space. The imagery is part of the North American Data Buy which can be accessed for free through EarthExplorer. APFO has used SPOT extensively to analyze flooding and other post-disaster situations.

WorldView (1 and 2)

Footprint Width – Worldview-1: 17 km

Worldview-2: 16 km

Spectral Resolution – Worldview-1: pan only

Worldview-2: 8 multispectral bands/1 pan band

Spatial Resolution – Worldview-1: 50 cm

Worldview-2: 50 cm pan/2 m multispectral

The WorldView satellites are commercial and owned by DigitalGlobe. With 8 bands of multispectral data (WorldView-2), there are many possibilities for using the imagery as a base layer for FSA work. This could include land cover classification, land use change, identifying drought stricken areas, disaster recovery, etc.

Using Satellite Imagery With Regards to FSA Policies

Per FSA policy, satellite (or other types of non-NAIP imagery) may be used for unofficial or reference purposes unless otherwise specified. This includes image classification, land use change detection, disaster support, and other types of geospatial work that require imagery. For satellite imagery to be used as an official base layer for common land unit maintenance work, a request must be made to APFO in concordance with policies outlined in FSA Handbooks 8-CM (Common Land Unit) and 1-AP (Aerial Photography). The process includes a formal review by the APFO Geospatial Services Branch (GSB) and the FSA GIS Program Manager. After review, a response is sent to the requestor. If approved, if needed, and depending on use, the satellite imagery can be reformatted at APFO and built into web services. To use satellite imagery for disaster support and needs, policies outlined in the FSA Handbook 1-SEM (Security and Emergency Management) should be followed. This includes coordination with the FSA GIS Program Manager and requesting imagery resources through the USDA Remote Sensing Advisor.

Using APFO as a Technical Resource

The APFO Geospatial Services Branch provides support and technical knowledge regarding satellite imagery. GSB has experience working with satellite data in numerous respects. This includes, but not limited to, downloading data, modifying or editing imagery to meet end user requirements, and building web services to support FSA efforts and programs.

APFO also acts as a provider of satellite imagery for post-disaster circumstances. This includes building web services for disaster recovery operations when imagery is available to support those operations. APFO also provides the administrative oversight to initiate disaster imagery requests (new acquisitions) through the USGS disaster coordinator and a variety of mechanisms to obtain imagery for disasters.

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