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MSM 215.5

WATER CONSERVATION LABORATORY IMAGE AND GROUND DATA ARCHIVE  
(WIGDA99) FOR ARIZONA AGRICULTURAL AND RANGELAND REGIONS\*

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ABSTRACT

The Water Conservation Laboratory Image and Ground Data Archive produced in 1999 (WIGDA99) is a computer database containing 315 entries for spectral images and 709 entries for associated ground data files. The database contains metadata regarding the images and ground data and allows the user to locate data according to user-specified criteria and to determine easily which images are related to which ground data files, and *vice-versa*. This report provides background information on the collection and archiving of this data set, and contact information for obtaining copies of the image and data files.

1.0 INTRODUCTION

Since 1984, scientists at U.S. Water Conservation Laboratory (WCL) have been conducting extensive, multidisciplinary remote sensing experiments at two Arizona field sites: Maricopa Agricultural Center (MAC; an agricultural region) and the Upper San Pedro Basin (USPB; a wildland region). MAC has been the site of seven multidisciplinary field experiments that focused on studies of multi-spectral remote sensing for evaluation of soil, plant and atmospheric conditions (Jackson, 1990; Moran et al., 1996). MAC is located about 48 km south of Phoenix Arizona in an extensive irrigated agricultural region, and is composed of large fields (up to 0.3 x 1.6 km) used for demonstrating new farming techniques on a production scale. USPB in SE Arizona has been the location of several hydrologic remote sensing experiments (Kustas and Goodrich, 1994; Moran et al., 1994; Goodrich et al., 1998) and encompasses the well-instrumented USDA ARS Walnut Gulch Experimental Watershed (WGEW) (Renard et al., 1993). At low elevations, the vegetation is mixed grass-brush rangeland typical of this region; at higher elevations, the region supports Pinyon-Juniper woodland and Ponderosa Pine forests.

This continuing work has resulted in an accumulation of hundreds of spectral image files from a variety of satellite- and aircraft-based sensors (the "images"), and the association of those images with data files containing high-quality ground-based measurements of soil, plant and atmospheric conditions (the "ground data"). These images and the supporting ground data have been compiled in one location, and transferred in an orderly fashion to compact disks (CD ROM). Each image on CD ROM includes a companion "readme" file containing metadata on the acquisition data and location, processing level, file size and format, and any relevant comments about the image or the archiving procedure. Supporting files of ground, atmospheric and low-altitude aircraft measurements – collectively referred to in

\* Presented at the Second International Conference on Geospatial Information in Agriculture and Forestry, Lake Buena Vista, Florida, 10-12 January 2000.

WIGDA99 as "ground data" – were archived with an internal header describing techniques, instrumentation, location and other relevant information. Metadata on all archived images and ground data were entered into a Microsoft Access database to link the information in the two data sets and to enable easy queries of either image or supporting ground data files. Information about some of the images archived in WIGDA99 is summarized in Table 1. Example images from the Landsat TM sensor for the regions surrounding MAC and USPB are illustrated in Figure 1.

**Table 1. A summary of *some* of the images archived in the WIGDA99 database.**

Location/ Land Use	Platform/ Sensor	Acquisition Dates	No. of images	Notes
Near Phoenix Arizona/ agricultural, desert and urban	Landsat TM	1985-Present	39	<ul style="list-style-type: none"> <li>•Path/Row = 37,37</li> <li>•Landsat satellites 4, 5 and 7</li> <li>•5 pairs of Landsat TM and SPOT HRV XS scenes acquired on the same day</li> </ul>
	SPOT HRV Multi- spectral (XS)	1987-Present	32	<ul style="list-style-type: none"> <li>•K,J = 554,283;554,284;555,283;555,284</li> <li>•SPOT satellites 1,2 and 3</li> <li>•XS View angles = +28° to -28°</li> <li>•Pan View angles = +23° to -22°</li> </ul>
	SPOT HRV Panchro- matic (Pan)	1987-Present	8	<ul style="list-style-type: none"> <li>•6 pairs of XS (and Pan) scenes acquired on consecutive days at different view angles</li> <li>•1 set of XS scenes acquired on 4 consecutive days at 4 view angles</li> </ul>
	ERS SAR	1995-Present	10	<ul style="list-style-type: none"> <li>•6 pairs of Landsat TM and ERS SAR scenes acquired days of each other</li> </ul>
	NASA ATLAS	1998	5	<ul style="list-style-type: none"> <li>•Throughout a single cotton growing season, 15 spectral bands (visible to thermal), 2.5 m ground resolution, 72° field of view</li> </ul>
Near Tucson and Sierra Vista Arizona/ rangeland, mountain, riparian	Landsat TM	1990-Present	47	<ul style="list-style-type: none"> <li>•Path/Row = 35,38</li> <li>•Landsat satellite 5 and 7</li> </ul>
	SPOT HRV Multi- spectral	1992-Present	5	<ul style="list-style-type: none"> <li>•K,J = 559,286</li> <li>•View angles = +5° to -29°</li> <li>•1 pair of XS scenes acquired on consecutive days at different view angles</li> </ul>
	ERS SAR	1992-Present	22	<ul style="list-style-type: none"> <li>•14 pairs of Landsat TM and ERS SAR scenes acquired within days of each other</li> </ul>
	NASA TIMS/ TM simulator	1996, 1997	2 days, multiple sites	<ul style="list-style-type: none"> <li>•High-resolution (5-15m) 6-band thermal and TM simulator</li> <li>•Images acquired during the dry and wet seasons</li> </ul>

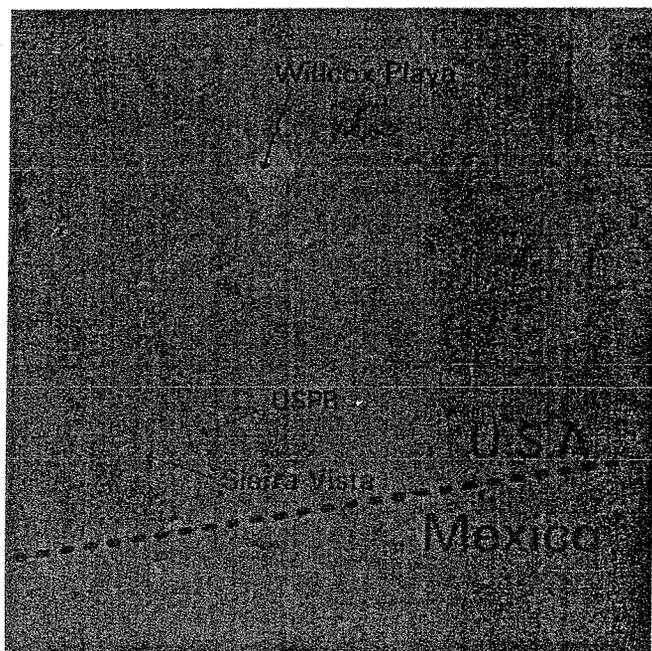
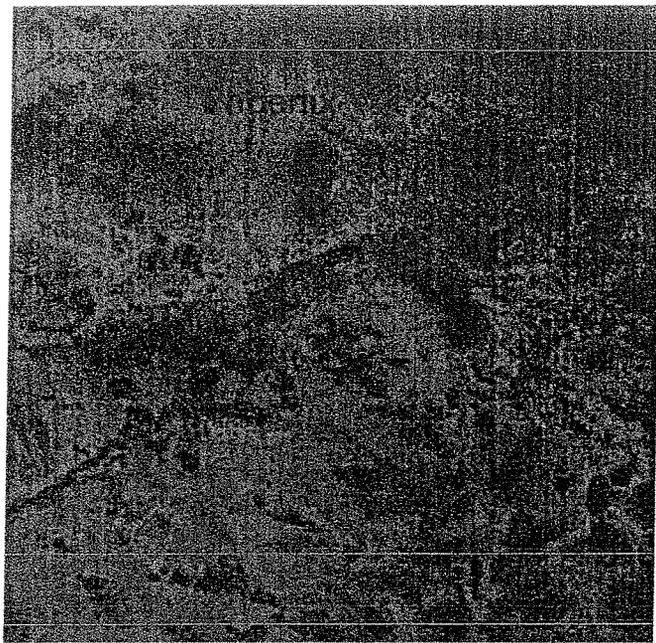


Figure 1. Landsat TM scenes covering two field sites (MAC and USPB) characterized by agricultural (upper image) and wildland (lower image) regions.

## 2.0 ACCESS DATABASE

The schema for the WIGDA99 database (*wigda99.mdb* in Microsoft Access 97) is fairly simple. The image files are represented by rows in one table, the ground data files by rows in another. Logically, these two main tables have what is called a "many-to-many" relationship, which means that a single image file may be related to many ground data files and that a single ground data file may be related to many images. This type of relationship is accomplished through an image-to-ground-file link table, which allows as many relations as one likes for any image or ground data file.

The metadata included in the ImageData and GroundData tables are presented in the ImageData form and GroundData form (Table 2) with abbreviated, yet informative, field names. A longer description for each field appears in the status bar when the focus is on that field, and a more detailed description of the field names is included in Tables 3 and 4. The forms also show which files are linked to the current files.

Users can apply filters to the ImageData and GroundData forms separately based on any field in the table using standard Access 97 filter commands (filter-by-form, filter-by-selection, etc.). When a filter is applied to the Image Data form, it will show only the images matching that filter and, in the link window, the names of the ground data files that are linked to each such image. Similarly, the GroundData form can be filtered to show a subset of the files and their linked images.

The file naming conventions for the images and ground data files were developed to produce an 8-digit filename containing such coded information as location, sensor, and acquisition date. As such, the names are not intuitive, and often the list of linked file names in the link window is not very informative. To alleviate this problem, both the ImageData and GroundData forms allow the user to double-click on a listed filename in the link window to view a form showing the metadata for that file.

## 3.0 SHARING RESTRICTIONS

Images originally purchased by scientists at Water Conservation Laboratory from the SPOT Image, Space Imaging/EOSAT and Eurimage commercial image providers were restricted by the company image license agreements. These included SPOT HRV, Landsat TM and ERS-1/2 SAR images. The three companies have agreed to waive this restriction for the images in WIGDA99, and to authorize WCL to share the images under a set of reasonable conditions defined by each company. In general, the conditions are that

- 1) the images be accompanied by the company's license agreement and a copy of the letter of agreement with WCL;
- 2) the images are used solely by University and Government organizations, for academic and scientific research and not for commercial purposes;
- 3) the facility receiving the images may not receive commercial funding for the research activity involving the use of these images;
- 4) the organization receiving images is not authorized to share the images with additional organizations; and
- 5) the company requests a periodic report from WCL listing organizations that have been furnished a copy of the images, with contact names and phone numbers.

For many aircraft-based images, WCL and the original image provider will consider each request individually. All ground-based data files are available on CD ROM and can be shared without restriction.

Table 2. Examples of the WIGDA99 Image and Ground-based Data Forms.

**Image Data**

Key Number: 147

File Name: mtah173

Platform Type: LANDSAT-5

Sensor Type: TM

Date Acquired: 6/22/97

Overpass Time: 10:34:00 AM

Project Name: MAC-LST

View Angle:

Bands Used: 1,2,3,4,5,6,7

Resolution: 28.5m

Processing Status: a - DN (no Atm. or geo.)

Image Quality:

Cloud Cover:

Weather: clear

Latitude: 33:09:50N

Longitude: 112:27:41W

Vendor Frame: 37,37

File Extension: img

Has Atm Data?

Has Aircraft Data?

Has Yoke Data?

Has RadioSonde?

Has SubScene?

Can Share? Released under the following 4 conditions:

Media Original: 8mm Tape

Media SerNum: 50

Media Location: CD -#[49]

Loaned To:

Archived on CD?  Available in ARIA?

Has Duplicate1?  Has Duplicate2?

File Size: 317 MB

Related Files:

Read.Me File: readme.173

Remarks: subscene mtbh173s on CD #[103]

List of Ground Files linked to this Record

GroundFile
mfuh173_wb1
mbbh173_97v

Record: 1 of

Link this record to Ground Data record

Go to Ground Data form

Add New Record Undo Changes Save Record Delete Record Close Form

Record: 86 of 102 (Filtered)

**Ground Data**

Key Number: 638

File Name: mbbh173\_97v

Experiment Code: m - Maricopa Farm

Exp Code Suffix: b - Bare Soil (MAC)

Measurement Type: b - Exotech - yoke-based

Year Code: h - 1997

Day of Year: 173 Day of Year = 6/22/97

Multiple Data Set: Multiple Data Set Sequences Letter (a,b,c,etc.)

File Extension: 97v File Extension (may include year)

Measurement Notes:

File Location: Mac97

Related Image Files: mtah173

Location Notes: field 13 in bare soil

Has Atm Cor Notes?

Has Field Notes?

Has Air Flight Log?

List of Image Files linked to this Record

ImageFile
mtah173

Record: 1 of

Link this record to Image Data record

Go to Image Data form

Old File Name: vbb173\_97v

Oldest File Name: m97e173.97v

Add New Record Undo Changes Save Record Delete Record Close Form

Record: 1 of 1 (Filtered)

**Table 3. For the WIGDA99 ImageData table, a list of *some* database field names and a description of the information contained in that field.**

<b>FIELD NAME</b>	<b>DESCRIPTION</b>
File Name	A file naming convention was developed to produce 8-digit filenames which are coded for image location, sensor, processing level, acquisition date and time.
Platform Type Sensor Type	The platforms (e.g., Landsat5 or SPOT2) are recorded with each entry. The sensors (e.g., Thematic Mapper) are recorded with each entry.
Date Acquired Overpass Time	These are the date and time of satellite or aircraft overpass supplied by the vendor or recorded by the operator.
Project Name	Many images were acquired in conjunction with on-going ground experiments which provide a rich set of supporting ground-based measurements.
Processing Status	This is the processing level of the image ranging from raw data to atmospherically-corrected to value-added (e.g., converted to leaf area index or soil moisture).
Image Quality	This field is left blank if the image is of good quality; otherwise image quality is designated "poor" or "fair" with an explanation in the remarks field.
Weather	This is a simple description of weather conditions taken from the notes of people on site during the overpass, such as "windy", etc.
Vendor Frame	This is the frame designation given by the vendor (e.g., path/row, orbit/frame, K/J). This provides a universally comparable location ID for each image.
File Extension	Conventional file extensions define the data format (e.g., bin: binary file; gif: graphic interchange file; lan: ERDAS Imagine "lan" format; tar: UNIX tape archive format and tif: tag image file). The most common format used to archive the WIGDA99 images is ERDAS Imagine *.img.
Has Atm Data? Has Aircraft Data? Has Yoke Data? Has Radiosonde Data?	During overpasses of optical sensors, there were often 1) solar radiometers set up to measure atmospheric optical depth for eventual correction of atmospheric effects with a radiative transfer code, 2) associated low-level aircraft overpass to acquire data at the same time with the same spectral bands for validation of satellite-based measurements; 3) yoke-based sensor at ground level to measure surface reflectance and temperature over vegetated and non-vegetated targets; and/or 4) a radiosonde balloon launch at the time of the overpass from the local military base.
Can Share?	The conditions for sharing SPOT Image, Space Imaging and Eurimage images are listed in Section 3.0. For many aircraft-based images, WCL and the image provider will consider each request individually.
Archived On CD? Available in ARIA?	If the image has been archive on CD ROM, it is readily available from WCL to the requestor. If not, sharing may be more difficult. Some images are available on The University of Arizona, Arizona Regional Image Archive (ARIA) at <a href="http://aria.arizona.edu">http://aria.arizona.edu</a> .

**Table 4. For the WIGDA99 GroundData table, a list of *some* database field names and a description of the information contained in that field.**

FIELD NAME	DESCRIPTION
File Name	A file naming convention was developed to produce 8-digit filenames which are coded for experiment, measurement type, and date.
Experiment Code	This designates the general location of the field measurements. More detailed information on measurement location is included in the file header.
Exp Code Suffix	This designates the specific target of the measurement (e.g., crop type, experimental site, or special target).
Measurement Type	This designates the instrument used in the measurement (e.g., Exotech 4-band radiometer) or the measurement type (e.g., soil moisture).
Has Atm Corr Notes? Has Field Notes? Has Air Flight Log?	These flags show if measurements of atmospheric optical depth, hand-written field notes or hardcopy flight logs are archived in a file cabinet at WCL.
Location Notes	These are generally excerpts from the header of the file.

#### 4.0 HOW TO OBTAIN IMAGES

The WIGDA99 Access database and WIGDA99 ground data files (available on a single CD ROM) can be obtained by email request to Dr. Susan Moran at [moran@tucson.ars.ag.gov](mailto:moran@tucson.ars.ag.gov). WIGDA99 images are available under several conditions determined by WCL, and in some cases, determined by the commercial image providers SPOT Image Corp, Space Imaging, and Eurimage (see Section 3.0). When a request is approved, a CD ROM or set of CD ROMs containing the images will be sent to the requestor. The requestor will be asked to make copies of the CD ROMs for personal use and return the original CD ROMs to WCL.

In some cases, the images are available in the Arizona Regional Image Archive (ARIA) at <http://aria.arizona.edu> and the images can be downloaded directly from that web site. The images that are available through ARIA are flagged in the ImageData table in the field "Available in ARIA?". Because ARIA is continually being updated, it is possible that the information in the WIGDA99 database will not correctly reflect the complete ARIA library.

#### 5.0 CONCLUDING REMARKS

This work will allow long term archiving of and easy access to an exceptional remote sensing data set. The primary accomplishments of this work are 1) the archiving and cross-referencing of over 300 spectral images and over 700 ground data files, 2) the unique and liberal sharing agreement with commercial image providers, 3) the renaming of all files into a common 8-character naming convention, and 4) the development of a database to provide detailed metadata on image or ground data files and allow queries by user-specified filters.

## 6.0 ACKNOWLEDGMENTS

This work was funded primarily through a grant from the NASA Landsat7 Science Team (NASA S-41396-F). Though many people cooperated in image acquisitions, several have been particularly helpful with this image archiving process: Robin Marsett, Michael Helfert, U.S. Water Conservation Laboratory; Darrel Williams, NASA Goddard Space Flight Center; Tom Mitchell, Hughes Aircraft; and John Masterson, USDA-ARS Southwest Watershed Research Center. We are particularly grateful to Richard Danbe at SPOT Image, Bill Bare at Space Imaging, and Luciana Di Domenico at Eurimage for working to develop the very unique and liberal sharing policy for SPOT, Landsat and ERS images in WIGDA99. Thanks to Bob Schowengerdt and Eric Pfirman of University of Arizona for making some of our images available in the unique ARIA environment. Though it is really impossible to name all the scientists and technicians that contributed to the image and ground data collections in WIGDA99, there are several scientists who were particularly instrumental in compiling this data set: Ray Jackson, Bob Reginato, Paul Pinter, Tom Clarke, Ed Barnes of the U.S. Water Conservation Laboratory; Dave Goodrich and Bruce Goff of the USDA ARS Southwest Watershed Research Center; Phil Slater and Stuart Biggar of the Univ. of Arizona Optical Sciences Center; and Bill Kustas of the USDA ARS Hydrology Laboratory.

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