

# **SAFARI 2000 ER-2 Color-IR Aerial Photography, Dry Season 2000**

## **Abstract**

Aerial photography from the NASA ER-2 high altitude aircraft was collected to provide detailed and spatially extensive documentation over parts of the SAFARI study area. The ER-2 aerial photography consists of 3,046 color-infrared (IR) transparencies collected during the SAFARI 2000 Dry Season Aircraft Campaign in August and September of 2000. ORNL DAAC has archived 52 scanned images of the ER-2 aerial photography.

The original color-IR aerial photography the SAFARI 2000 Dry Season Aircraft Campaign is located at NASA Ames Research Center (ARC) Aircraft Data and Sensor Facilities. Copies can be ordered from the U.S. Geological Survey's EROS Data Center (EDC) in Sioux Falls, South Dakota, USA. In addition, 515 image frames have been scanned from copies of the original level-0 ER-2 aerial photography by the University of the Witwatersrand (Wits), in Pretoria, South Africa.

ORNL DAAC has archived scanned subsets of the available imagery from ARC and Wits. This documentation file describes the scanned imagery subsets archived at the ORNL DAAC and provides information about the original color-IR aerial photography at ARC and the scanned imagery at Wits.

## **Background Information**

### **Investigators:**

Jeffrey S. Myers (jmyers@mail.arc.nasa.gov)

**Project:** SAFARI 2000

**Data Set Title:** SAFARI 2000 ER-2 Color-IR Aerial Photography, Dry Season 2000

**Site:** Southern Africa

**Westernmost Longitude:** 15° E

**Easternmost Longitude:** 43° E

**Northernmost Latitude:** 12° S

**Southernmost Latitude:** 30° S

### **Data Set Citation:**

Myers, J. S. 2004. SAFARI 2000 ER-2 Color-IR Aerial Photography, Dry Season 2000. Data set. Available on-line [<http://daac.ornl.gov/>] from Oak Ridge National Laboratory Distributed Active Archive Center, Oak Ridge, Tennessee, U.S.A.

**Web Site:** <http://www.dfrc.nasa.gov/>

### **Data File Information**

The original ER-2 aerial photographs are color-IR transparencies. The 9-inch x 9-inch (229-mm x 229-mm) photographs from single or multiple flight lines are contained on a large film roll. Standard photographic processing of the original positives to duplicate positive transparencies was performed according to the manufacturer's film developing specifications.

Imagery was acquired each time the aircraft was deployed for a mission during the field campaign. The dates and flight numbers of missions flown during the SAFARI 2000 Dry Season Aircraft Campaign are listed in the table below.

## SAFARI 2000 ER-2 Missions

Flight	Date	Country of Overflight
00-146	13-Aug-2000	Republic of South Africa
00-147	17-Aug-2000	Republic of South Africa
00-148	20-Aug-2000	Republic of South Africa, Botswana
00-149	22-Aug-2000	Republic of South Africa, Mozambique
00-150	24-Aug-2000	Republic of South Africa, Mozambique, Malawi
00-151	25-Aug-2000	Botswana, Zambia
00-152	27-Aug-2000	Botswana
00-153	29-Aug-2000	Republic of South Africa, Mozambique
00-155	1-Sep-2000	Zambia (Night Flight)
00-156	4-Sep-2000	Republic of South Africa, Botswana
00-157	6-Sep-2000	Zambia
00-158	7-Sep-2000	Republic of South Africa
00-160	11-Sep-2000	Republic of South Africa Namibia Botswana
00-175	13-Sep-2000	Namibia, Botswana
00-176	14-Sep-2000	Namibia, Botswana
00-177	17-Sep-2000	Republic of South Africa, Namibia, Botswana
00-178	21-Sep-2000	Mozambique Channel
00-179	23-Sep-2000	Republic of South Africa, Mozambique, Lesotho
00-180	25-Sep-2000	Republic of South Africa, Mozambique, Malawi

No film was acquired during the 1-Sep-2000 night flight mission.

## NASA ARC Scanned Photographs

ORNL DAAC has archived 42 scanned images from the original 3,046 ER-2 color-IR photographs held at the NASA Ames Research Center (ARC) Aircraft Data and Sensor Facilities. The imagery scanned at NASA ARC and archived by ORNL DAAC are listed below. The file names are made up of the Roll and Frame numbers. The sample images are high-quality JPEG images, about 2700x2700 pixels.

## NASA ARC Scaanned SAFARI Frames

Roll	Frame	Date	Site
5542	3512	17-Aug-2000	South African Escarpment
5542	3541	17-Aug-2000	Pietersburg, South Africa
5543	3586	20-Aug-2000	Waterkloof AFB, South Africa
5543	3588	20-Aug-2000	Pretoria, South Africa
5546	4105	24-Aug-2000	Sua Pan, Botswana
5546	4106	24-Aug-2000	Sua Pan, Botswana
5546	4107	24-Aug-2000	Sua Pan, Botswana
5546	4108	24-Aug-2000	Sua Pan, Botswana
5546	4109	24-Aug-2000	Sua Pan, Botswana
5546	4110	24-Aug-2000	Sua Pan, Botswana
5546	4111	24-Aug-2000	Sua Pan, Botswana
5546	4112	24-Aug-2000	Sua Pan, Botswana
5546	4113	24-Aug-2000	Sua Pan, Botswana
5546	4114	24-Aug-2000	Sua Pan, Botswana
5546	4115	24-Aug-2000	Sua Pan, Botswana
5546	4116	24-Aug-2000	Sua Pan, Botswana
5546	4117	24-Aug-2000	Sua Pan, Botswana
5546	4118	24-Aug-2000	Sua Pan, Botswana
5546	4119	24-Aug-2000	Sua Pan, Botswana
5546	4120	24-Aug-2000	Sua Pan, Botswana
5546	4121	24-Aug-2000	Sua Pan, Botswana
5546	4242	24-Aug-2000	Zambezi River, Zambia
5546	4254	24-Aug-2000	Mongu, Zambia
5548	4644	29-Aug-2000	Inhaca Island, Mozambique
5552	5658	11-Sep-2000	Namib Desert, Namibia
5552	5717	11-Sep-2000	Walvis Bay, Namibia
5552	5731	11-Sep-2000	Walvis Bay, Namibia
5552	5732	11-Sep-2000	Walvis Bay, Namibia
5552	5733	11-Sep-2000	Walvis Bay, Namibia
5552	5734	11-Sep-2000	Walvis Bay, Namibia
5552	5735	11-Sep-2000	Walvis Bay, Namibia
5553	5984	13-Sep-2000	Etosha Pan

5553	5985	13-Sep-2000	Etosha Pan
5553	5986	13-Sep-2000	Etosha Pan
5553	5987	13-Sep-2000	Etosha Pan
5553	5988	13-Sep-2000	Etosha Pan
5554	6095	13-Sep-2000	Namib Desert, Namibia
5554	6096	13-Sep-2000	Namib Desert, Namibia
5554	6097	13-Sep-2000	Namib Desert, Namibia
5554	6098	13-Sep-2000	Namib Desert, Namibia
5554	6099	13-Sep-2000	Namib Desert, Namibia
5555	6592	17-Sep-2000	Ramotswa, Botswana

### Wits Scanned Photographs

Ten (10) of the 515 ER-2 aerial images scanned by the University of the Witwatersrand (Wits) are archived at the ORNL DAAC. The file names are made up of the checkpoint name with the frame number appended. The sample images high-quality JPEG images, about 2700x2700 pixels.

Flight	Checkpoint_Frame	
00-151	AB4101	FG4216
	AB4103	FG4218
	FG4214	FG4220
00-149	IJ3720	JK3764
	IJ3718	JK3766

The Wits has prepared a detailed MS Excel spreadsheet of ER-2 flights, checkpoints, and frame numbers, with links to maps showing the flights and links to 362 thumbnails of the 515 scanned images held by Wits. The ORNL DAAC has archived this MS Excel spreadsheet and the 362 imagery thumbnails.

## NASA Aircraft Program

The NASA Earth Resources Aircraft Program at Ames Research Center (ARC) operates the [NASA ER-2 High Altitude Aircraft](#) to acquire data for Earth science research. The aerial photographic cameras used on the ER-2 are equipped with the film, lenses, and filters needed to meet various photographic needs.

The NASA ARC High Altitude Aircraft Branch collected and processed color-IR aerial photography in support of the SAFARI 2000 Dry Season Aircraft Campaign. Maintenance and operation of the cameras were the responsibility of ARC. The ER-2 Experimenter's Handbook [<http://www.dfrc.nasa.gov/airsci/>] produced by the ARC High Altitude Aircraft Branch provides a description of the systems, calibration procedures, and format of platform payload.



NASA's ER-2 in descent. Note the wing superpods.



The Wild-Heerbrugg RC-10 mapping camera.

## Equipment

A Wild-Heerbrugg RC-10 metric mapping camera was used, with the shutter intervalometer set to acquire frames with a 60% forward overlap to provide stereo coverage.

## **Manufacturer of Sensor/Instrument**

Formerly, Wild-Heerbrugg  
LH Systems, LLC USA  
American Sales and Support  
61 Inverness Drive East, Suite 200  
Englewood, CO 80112  
Phone (303)799-9453  
Fax (303)799-4809

## **Sensor/Instrument Measurement Geometry**

The SAFARI 2000 ER-2 flight altitudes ranged from 19,000 to 20,000-m Above Ground Level (AGL). Generally, one camera acquired photographs using a 304.89-mm focal-length lens, which resulted in photography at scales ranging from 1:62,000 to 1:65,000.

The following are the various lens, film, filter, and exposure combinations used:

- Camera Focal Length Film Filter F Stop
- RC-10 034 304.66 mm Aerochrome IR SO-134 Wratten 12 4

The Wild-Heerbrugg RC-10 is a metric mapping camera equipped with a shutter intervalometer set to acquire frames with a 60% forward overlap to produce imagery with stereo coverage. The RC-10 film can be used to produce standard photogrammetric products or scanned to generate digital orthophotos.

Lens: 304.44-mm (12-inch) focal length/f4  
Film Format: 240-mm (9.5-inch) 9-inch x 9-inch image area  
Film Type: Kodak SO-134 Aerochrome IR  
Filtration: Kodak Wratten 12  
Spectral Range: 510-900 nm  
Shutter Speed: 1/200  
Ground Coverage: 15 x 15 km from ER-2 altitude of 19.8 km/65,000 ft  
Scale: 1:65,000

Resolution: 1.5-4 m (nominal)

## **Access to ER-2 Aerial Photography Through EDC EarthExplorer**

Copies of the original level-0 ER-2 aerial photography for SAFARI 2000 can be ordered from the U.S. Geological Survey's EROS Data Center (EDC) in Sioux Falls, South Dakota, USA:

### **U.S. Geological Survey**

EROS Data Center

Sioux Falls, SD 57198

Phone: (605) 594-6151

Fax: (605) 594-6589

EDC Web Site: <http://edc.usgs.gov/>

EarthExplorer Web Site: <http://edcsns17.cr.usgs.gov/EarthExplorer/>

### **Steps for Accessing the SAFARI 2000 Archive via the EDC EarthExplorer**

1. Enter as "**GUEST**"
2. First define **Spatial Coverage**. Define via map interface or enter lat/long coordinates. Note: For specific areas it is best to enter lat/long coordinates.
3. Next, make your **Data Set Selection**. Under the category *Aerial Photography*, select the *Survey Photography* box.
4. Select **Continue**.

At this point you can further restrict search criteria by entering a temporal window or date of interest in the *Acquisition Dates* box. For SAFARI 2000, for instance, ER-2 imagery are only available during the dry season aircraft campaign of August and September of 2000. Also be aware of the 'Results Restrictions' box at the bottom. This is set (default) to retrieve a small number of records. There are thousands of records of photos from the SAFARI 2000 ER-2 missions, so if you do not adjust the default, you may not retrieve all the possible results. When you are



finished with the search criteria, click on the search button at the bottom of the page.

Once results are displayed, click on the ***Survey Photography*** link under Data Set to see actual frame IDs and spatial coverage for each image. At this point you can select images to order. The images can be ordered on film, or on paper at 9, 20, or 40 inches square, for \$16 to \$75 USD each.

**Note:** All of the SAFARI film metadata are at EDC, not the actual film itself. The metadata have been provided to EDC and added to the EarthExplorer database. If a request for film is received, NASA-Ames Research Center (ARC) is notified and the film is sent to EDC for duplication. Once the order is completed, the original film is returned to ARC.

### **Access to Scanned ER-2 Aerial Photography from University of the Witwatersrand (Wits)**

Five hundred and fifteen (515) ER-2 aerial photographs out of the 3,046 images collected during the SAFARI 2000 Dry Season Aircraft Campaign were scanned at Wits. Ten (10) samples of the 515 images scanned by Wits are archived by the ORNL DAAC. For information about availability of images scanned by Wits, contact Melanie Anne Kneen (makneen@netactive.co.za).

### **Additional Sources of Information**

#### **Platform/Sensor/Instrument/Data Processing Documentation**

All of the details of the ER-2 missions flown in support of SAFARI 2000 can be found within the 2 volume Flight Summary Airborne Instrumentation Research Project. SAFARI Flight Summary Report (2 volumes) for Flights No. 00-146 to 00-180 or August 11 2000 to September 27, 2000. NASA Ames Research Center, Airborne Sensor Facility, Moffett Field, California. 94035 USA. The SAFARI Flight Summary Report has been archived by ORNL DAAC: [Volume 1](#) (PDF

format) and [Volume 2](#) (PDF format). The ER-2 Airborne Sensor Facility Web Site is: <http://asapdata.arc.nasa.gov/>.

## **References**

NASA. 1990. ER-2 Earth Resources Aircraft Experimenter's Handbook. National Aeronautics and Space Administration, Ames Research Center, Moffett Field, California, U.S.A.

### **Point of Contact:**

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