Department of the Interior
U.S. Geological Survey

USGS UNMANNED AIRCRAFT SYSTEMS

DATA MANAGEMENT PLAN

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USGS
science for a changing world

UNMANNED AIRCRAFT SYSTEMS
DATA MANAGEMENT PLAN

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INTRODUCTION

The U.S. Geological Survey (USGS) National Unmanned Aircraft Systems (UAS) Project Office is leading the implementation of UAS technology in anticipation of transforming the Department of the Interior (DOI) approach for collecting remote sensing data. UAS technology is being made available to monitor environmental conditions, respond to natural hazards, understand landscape change rates, recognize the consequences and benefits of land and climate change, conduct wildlife inventories, and support related land management missions. The USGS is teaming with all the DOI bureaus, academia, industry, state, tribal, and local agencies under guidance from the Federal Aviation Administration (FAA) and the DOI Office of Aviation Services (OAS) to lead the safe, efficient, cost-effective and leading-edge adoption of UAS technology into the scientific research and operational activities of the Department.

Data collected during UAS projects are used to produce various derived- data products. These products are generated by the USGS to help answer scientific and natural resource questions.

Certain UAS data and derived products may include:

Raw data collections – The raw data are the original imagery collected from the sensors aboard the aircraft.

Point cloud – Point cloud data may be derived from sensor data collected during UAS collections.

Digital Elevation Models - A Digital Elevation Model (DEM) or Digital Surface Model (DSM) is a digital geographic map dataset representing surface elevations with horizontal and vertical (xyz) coordinates. A DEM may include elevations of natural terrain features in addition to vegetation and cultural features, such as buildings and roads.

Orthophotography - An orthophoto is an undistorted aerial photograph with a completely uniform scale that allows it to function as a map. A significant amount of geometric correction, known as orthorectification, is required to bring about this high level of uniformity.

Keyhole Markup Language (KML) – KML files or KML zipped (KMZ) may include a set of features (place marks, images, polygons, 3-D models, textual descriptions, etc.) for display in Google Earth or any other geospatial software implementing the KML encoding.

Shape Files – Shape files may be created from certain layers and features derived from acquired sensor data.

Derivative Products – Derived products may include, but not limited to: Normalized Difference Vegetation Index (NDVI) calculations, seismic data, band ratio or mosaicked products.

Video – Movie segments are recorded and retained for observing certain landscape features.

Reports – Documents are retained regarding specific project details, such as the purpose, area of interest, collect information, and mission-related activities.

As the UAS project data are collected, the USGS Earth Resources Observation and Science (EROS) Center will be responsible for the archive of the collections and provide data distribution to the user community through the USGS tool called EarthExplorer.

UAS DATA MANAGEMENT FLOW

Figure 1 illustrates the end-to-end data flow from the initial acquisition of data to the final archival and distribution of products to the end user community.

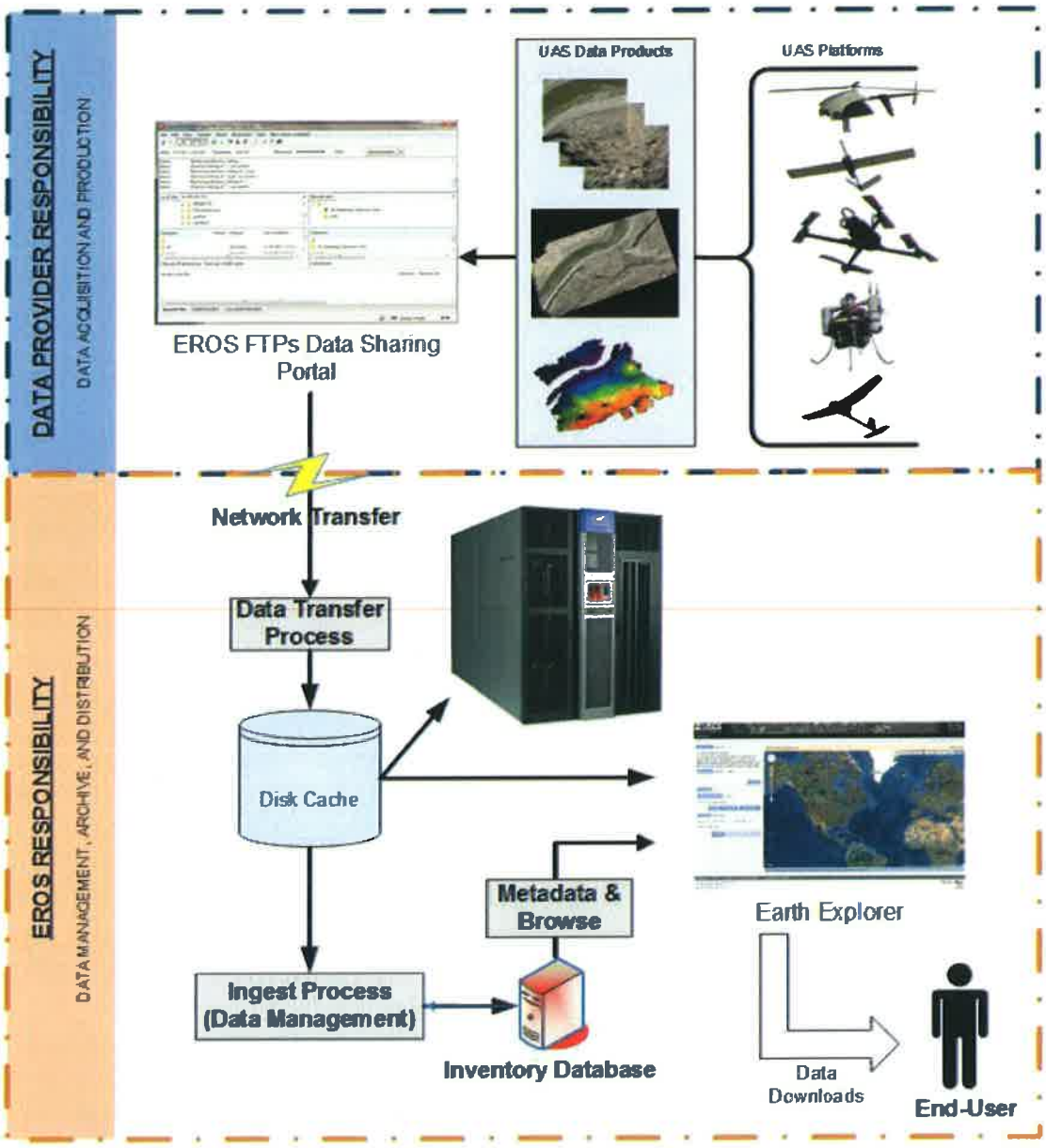

Figure 1 Data Flow Overview

UAS activities will be project or program driven. Projects may schedule several UAS missions to capture the required data. Missions are normally over different geographic areas. Each mission may include a single or multiple UAS collects. A UAS collect is defined as the specific collect (or flight) that is flown for its data collection. The data

acquired within a project and its missions will be transferred to the USGS EROS Center and placed in a managed state and archived. The UAS products will be offered to the general user community through the online USGS EarthExplorer tool.

The UAS data transferred to the USGS EROS Center will include the raw original data collections (single frames or videos), and final- data products, such as DEM data, derived orthorectified imagery, and KML files. Intermediate products will not be transferred.

The directory structure for a project and its mission will be labelled specifically for ease in automation of transfer and archiving of imagery.

Directory names will include: RAW, PTCLOUD, DEM, ORTHO, VIDEO and SUPPORTFILES. Projects, missions, and collects will vary on the product types and number of created directories, and all product types may not be present.

Data that contains GPS or georeferencing, such as projection and corner information, will be managed based on these coordinates. Data not provided with georeferencing will use the planned mission or collect boundaries for their geographic coordinates.

2.1 Data Generation and Documentation Requirements

Along with the raw collection data and data files that are generated, the UAS project will provide documentation detailing the project, mission and collect information.

The primary goals of the documentation are to facilitate users' understanding and use of data. This documentation should consist of details of the planned project and the imagery collected along with a history of the value-added products.

2.2 UAS Directory Structure and Metadata Requirements

UAS projects will be delivered in a uniform directory structure for ease of ingest and providing data to the general user community.

Directories and file names may be alphanumeric, lower and/or upper case. There are no naming conventions required for project, mission, or collect directories or for file names. However, there is a 50- character limit on the names, and no spaces or special characters such as -, +, =, !, @, #, $, %, ^, &, *, ?,/, \ or apostrophes will be allowed. Note: underscores are acceptable.

Specific metadata files will be required for a project and when applicable for mission(s) and collect(s) within the project. Whether mission- or collect-level directories are present will depend on the nature of the project requirements.

Product type directories may be present at project-, mission-, and/or collect-levels and this will also depend on the specific project requirements.

2.2.1 UAS Directory Structure

The directory structure will require a project name directory and may include mission-level directories, if applicable, as well as specific collect-level directories. This will depend on the requirements of the project.

Each project may include one or all product types and will have uniform directory names such as: RAW, PTCLOUD, DEM, ORTHO, VIDEO and SUPPORTFILES. The directory structure will be dynamic and allow new product types to be included at any given time.

The directory structure is shown below in figure 2 and is in upper case, although lower and/or upper case will be acceptable for directories and file names. The structure and information regarding the metadata specifications are included in 2.2.2.1.

PROJECT *(name given to each project)*
- *project.meta*
- *projectfiles*
- MISSION1 *(name given each mission)*
  - *mission1.meta*
  - *missionfiles*
  - COLLECT1 (name given each collect)
  - *>collect1.meta*
  - *collectfiles*
    - *SENSOR*
      - RAW
        - *datafiles*
      - PTCLOUD
        - *datafiles*
      - DEM
        - *datafiles*
      - ORTHO
        - *datafiles*
      - VIDEO
        - *datafiles*
      - SUPPORTFILES
        - *files*
  - COLLECT2 (name given each collect)
  - *>collect2.meta*
  - *collectfiles*
    - *SENSOR*
      - RAW
        - *datafiles*
      - PTCLOUD
        - *datafiles*
      - DEM
        - *datafiles*
      - ORTHO

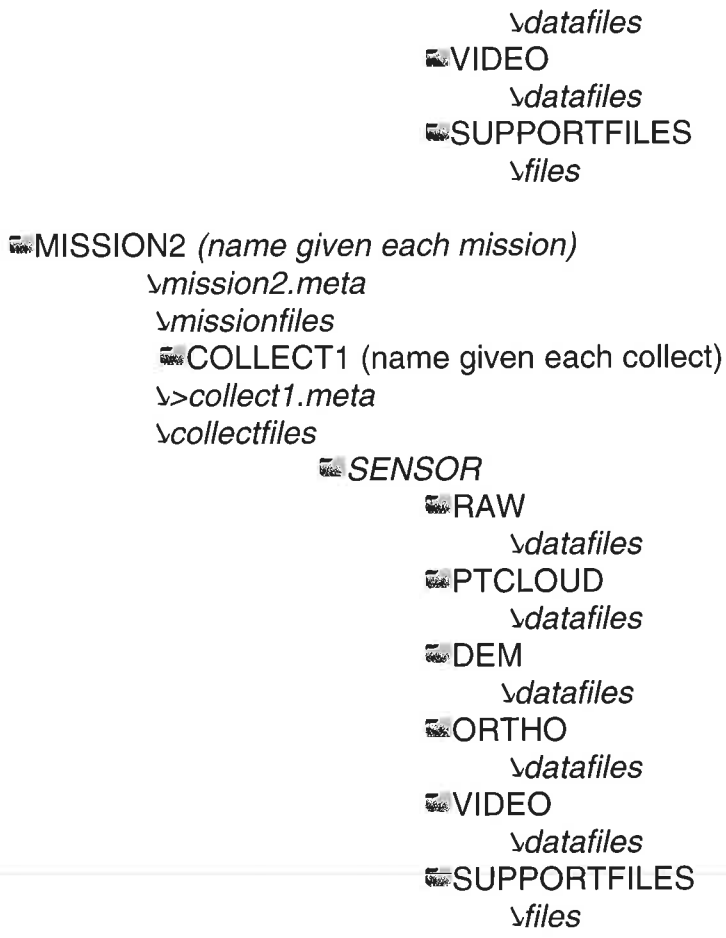

Figure 2 Directory Structure

The PROJECT directory will be the name given to each project and will have a 50-character limit. The directory will include a metadata file and documents regarding the project.

The MISSION directory will be the name given to the mission and will have a 50-character limit. The directory will include a metadata file and documents specific to the mission. There may be multiple missions (including a metadata file for every mission) within a project.

The COLLECT directory will be the name given to a collect and will have a 50-character limit. The directory will include a metadata file and documents specific to the collect. There may be multiple collects (including a metadata file for every collect) within a mission.

The SENSOR directory will be relevant to the sensor acquiring the data product types.

The RAW, PTCLOUD, DEM, ORTHO, and VIDEO will be product-type directories containing the relevant data files. The presence of certain product types will vary depending on the project's requirements.

The SENSOR directories along with product- type directories may be present at the project, mission, or collect levels depending on the project's requirements. Note: no required naming convention is necessary for SENSOR.

The SUPPORTFILES directory may include reports, documents, shape files, KMLs and other derived value-added files. The directory may be present at project, mission, and/or at the collect levels.

The UAS data file formats may include Joint Photographic Experts Group (JPEG), Geospatial Tagged Image File Format (GeoTIFF), KML(Z), shape files, and video Moving Pictures Experts Group (MPEG) files.

In the case of multiple missions, there may be multiple-mission directories under the main-project directory along with a mission metadata file for each mission that is included.

In the case of multiple collects, there may be multiple collect directories along with a collect metadata file for each collect that is included.

There will be metadata files accompanying the transfer of each set of project data. The metadata files will include information such as the agency, project, mission, collects, and acquisition dates.

The metadata files will be included at the correct level alongside the relevant project, mission(s) or collect(s) directories.

Figure 3 illustrates an example of the specific directory structure for the landslide in the DeBeque Canyon of Colorado.

DeBequeCO_Landslide *(name given to each project)*
↘*DeBequeCO_Landslide.meta*
SUPPORTFILES
↘ *landslide_clipped_print.ply*
↘ *landslide_clipped_print.obj*
↘ *landslide_clipped_print.mtl*
DeBequeCO_201306 *(name given each mission)*
↘ *DeBequeCO_201306.meta*
CANON
RAW
↘img_0001 through img_XXXX
ORTHO
↘*ortho_8bit_201306.tif*

↘*ortho_8bit_201306.tfw*
↘*ortho_8bit_201306.pdf*
DeBequeCO_201310 *(name given each mission)*
↘ *DeBequeCO_201310.meta*
CANON
RAW
↘*img_0001 through img_XXXX*
ORTHO
↘*ortho_8bit_201310.tif*
↘*ortho_8bit_201310.tfw*
↘*ortho_8bit_201310.pdf*
DeBequeCO_201403 *(name given each mission)*
↘ *DeBequeCO_201403.meta*
GO_PRO
VIDEO
↘*imgclip.mp4*
SONY
RAW
↘*img_0001 through img_XXXX*
PTCLOUD
↘*sage_brush_clipped_cloud_dense_lowest.las*
↘*sage_brush_sparse_pts_for_compare.las*
ORTHO
↘*ortho_8bit_201403.tif*
↘*ortho_8bit_201403.tfw*
↘*ortho_8bit_201403.pdf*

Figure 3 Debeque Canyon Colorado project directory structure

2.2.2 UAS Metadata Format Specifications

There will be specific metadata files for a given project, mission(s) and/or collect(s) within the project. Information regarding the metadata specifications included in 2.2.1.1.

2.2.2.1 Project Metadata File Format

The metadata file will be a text file called *project.meta* for each project.
**Agency=USGS*
**Project=name (50-character limit)*
ProjectDesc=freeform (100-character limit, 1 line)
**StartDate=mm/dd/yyyy*
**EndDate=mm/dd/yyyy*
**ULLat=latitude (in degrees)*
**ULLon=longitude (in degrees)*
**LRLat=latitude (in degrees)*
**LRLon=longitude (in degrees)*
Restrictions=Restricted (if applicable)

AgencyFieldCenter=
POCName=
POCEmail=

2.2.2.2 Mission Metadata File Format

The metadata file will be a text file called *mission.meta* for each mission.
**Mission=name (50-character limit)*
MissionDesc=freeform (100-character limit, 1 line)
**CollectFlag=Y or N*
**StartDate=mm/dd/yyyy*
**EndDate=mm/dd/yyyy*
**ULLat=latitude (in degrees)*
**ULLon=longitude (in degrees)*
**LRLat=latitude (in degrees)*
**LRLon=longitude (in degrees)*
Restrictions=Restricted (if applicable)

2.2.2.3 Collect Metadata File Format

The metadata file will be a text file called *collect.meta* for each collect.
**Collect=name (50-character limit)*
CollectDesc=freeform (100-character limit, 1 line)
**StartDate=mm/dd/yyyy*
**EndDate=mm/dd/yyyy*
**StartLat=latitude (in degrees)*
**StartLon=longitude (in degrees)*
**EndLat=latitude (in degrees)*
**EndLon=longitude (in degrees)*
Restrictions=Restricted (if applicable)
**PlatformName=*
PlotformClass=
PlatformType=
Platform-n=

**Denotes required metadata field; Restrictions field is not required unless data are restricted.*

2.2.3 UAS Data Files Metadata Management

UAS data files with internal tags identifying the sensor, acquisition dates, and coordinates will be used for the records managed in the UAS database. If there are no acquisition date tags, collect or mission dates will be used for record management. If there are no coordinates, collect or mission coordinates will be used for record management. The sensor information will be retrieved from the relevant SENSOR directory name.

2.3 UAS Data Delivery and Ingest

Following UAS project data collections, the data will be transferred and archived at the USGS EROS Center by media or through electronic transfer using FTPS on the USGS server, datasharingportal-incoming.cr.usgs.gov (DSP). Electronic transfers will require user registration on the DSP. Requests for accounts and set up information may be sent to lta@usgs.gov.

Media delivery specifications include external drives of 1 terabyte capacity or greater and support USB 2.0 and USB 3.0.interface. For media deliveries and information, the point of contact will be lta@usgs.gov (or LTA@usgs.gov).

A check list form (see Appendix A) is available for data providers. The check list will ensure verification of the required directory structure and metadata.

A data release form (see Appendix B) must be provided with each delivery. The data release form describes the access/distribution restrictions, if any, on the data.

2.4 UAS Data Archive and Distribution

Data will be ingested and stored on the Robotic Tape Library System (RTLS) located at the USGS EROS Center. The USGS EROS data collections also are backed up to digital media that are shipped off-site for safe keeping in conformance with National Archive and Records Administration (NARA) regulations.

Projects will be uniform in directory structure on the RTLS. As projects are ingested and archived on the RTLS, they will be stored in specific project, mission, mission sensor, and product- type directories with volume sub-directories of 1,000 data files per directory for uniformity. Each data file will be zipped along with a formatted metadata *xml.*

All data managed and archived at the USGS EROS Center will be provided to the user community for searching and ordering through the USGS EarthExplorer (EE).

EE will be the tool used by users to search, access the metadata, and browse data products for the UAS collections. EE customers are allowed to search and view data collections 24/7. EE uses a profile registration service to provide other customer support services that can be catered to each user for accessing license- restricted data or other special collections, if required. All data collections will conform to standard Federal Geographic Data Committee (FGDC) standards in defining and supporting access to these unique data sets.

APPENDIX A CHECK LIST

Check List for UAS Project Delivery

☐ Naming conventions with no spaces or special characters such as ! @ # $ % ^ & * ( ) - = + { } [ ] | : “, . / \. Note: underscores are acceptable.

☐ Naming conventions limited to 50 characters

☐ Directory structure includes project name and appropriate metadata file(s)

☐ Directory structure includes mission(s) name and appropriate metadata file(s)

☐ Directory structure includes collect(s) name and appropriate metadata file(s)

☐ SupportFiles directory included at the project level

☐ SupportFiles directory included at the mission level

☐ SupportFiles directory included at the collect level

☐ Sensor directories and product types at project level

☐ Sensor directories and product types at mission level

☐ Sensor directories and product types at collect level

☐ Signed UAS Project Release Form

APPENDIX B RELEASE FORM

UAS Project Release Form Date _____

Agency _____

Name_____

Email Address_____

UAS Project Name _____

UAS Products being delivered/released (please indicate below)

_raw data _Point cloud _DEM/DSM _Orthophoto _Derivatives _KML _Shape Files _Video _Report

If the project data is considered available for public distribution, please skip to the bottom and sign form.

If certain project data is considered sensitive, at what level are the data restricted such as for federal government only, USGS only, or completely hidden?

_____

_____

Please provide details on the specific directories that are restricted.

Project and product types

_____

_____

Mission(s) and product types

_____

_____

Collect(s) and product types

_____

_____

Signature_____

**Principal Investigator or appropriate manager

APPENDIX C ACRONYMS

Acronym	Description
DOI	Department of the Interior
DEM	Digital Elevation Model
DSM	Digital Surface Model
DSP	datasharingportal-incoming.cr.usgs.gov
EE	USGS EarthExplorer
EROS	Earth Resources Observation and Science
XML	Extensible Markup Language
FAA	Federal Aviation Administration
FGDC	Federal Geographic Data Committee
JPEG	Joint Photographic Experts Group
KML	Keyhole Markup Language
KMZ	Keyhole Markup language Zipped
MPEG	Moving Picture Experts Group
NDVI	Normalized Difference Vegetation Index
OAS	Office of Aviation Services
RTLS	Robotic Tape Library System
UAS	Unmanned Aircraft Systems
USGS	United States Geological Survey