

Department of the Interior  
U.S. Geological Survey

# **USGS UNMANNED AIRCRAFT SYSTEMS DATA DELIVERY SPECIFICATION**

**Version 1.2**

**August 22, 2018**



# USGS UNMANNED AIRCRAFT SYSTEMS DATA DELIVERY SPECIFICATION

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## Section 1

### Document History

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Document Number	Document Version	Publication Date	Change Number
Initial	1.0	October 2017	N/A
DCN074-2 MOD1.A5915	1.1	May 2, 2018	N/A
DCN074-2 MOD1.A5915	1.2	August 22, 2018	N/A

# Contents

Document History	3
Contents	4
List of Figures	4
List of Tables	4
INTRODUCTION	5
1.1 Purpose and Scope	5
UAS DATA MANAGEMENT FLOW	5
2.1 UAS Directory Structure	6
2.1.1 Project Directory	7
2.1.2 Mission Directory	7
2.1.3 Support Type Directory	8
2.1.4 Collect Directory	8
2.1.5 Data Type Directory	8
2.1.5.1 Raw	8
2.1.5.2 Point Cloud	9
2.1.5.3 Digital Elevation Model	9
2.1.5.4 Orthorectified	9
2.2 UAS Metadata Requirements	10
2.3 UAS Metadata XML File Format	10
APPENDIX A UAS DATA DELIVERY CHECKLIST	14
APPENDIX B UAS DATA RELEASE FORM	15
APPENDIX C ACRONYMS	16
APPENDIX D UAS Project Directory Structure Example	17
APPENDIX E UAS XML Metadata File Example	18

## List of Figures

Figure 1 UAS Directory Structure	6
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## List of Tables

Table 1 Data Type Directory Names and File Types	9
Table 2 UAS Metadata XML Contents	10

## **INTRODUCTION**

Unmanned Aircraft System (UAS) imagery delivered to the USGS Earth Resources Observation and Science (EROS) Center for inclusion in EarthExplorer (EE) will come from several government agencies (BLM, NOAA, Forest Service, USGS, Fish and Wildlife Service, etc.) This document defines the data delivery and ingest process, by outlining standard specifications for metadata and data formats that the USGS EROS Center will require for ingesting this data. To streamline this process, the USGS EROS Center has created a UAS Data Sharing Portal Metadata Generation Tool (<https://datasharingportal.usgs.gov/uas/upload/export>), which will allow selection of values previously loaded, ensure consistency of metadata and minimize duplication.

As the UAS project data are delivered, the USGS EROS Center will be responsible for the archive of the data files and provide data distribution to the user community through the USGS tool called EarthExplorer (EE).

### **1.1 Purpose and Scope**

The USGS EROS Center intends this specification to define the format of the UAS data delivered to the USGS EROS Center and create consistency across all government agencies providing this UAS data.

This base specification covers the directory structure and metadata requirements for UAS imagery delivered to the USGS EROS Center.

The data provider may send an e-mail to [lta@usgs.gov](mailto:lta@usgs.gov) (or [LTA@usgs.gov](mailto:LTA@usgs.gov)) requesting to allow additional UAS file extensions or data types. The request will be reviewed. If approved, the software and this document will be updated, accordingly.

Personal Identifiable Information (PII) is information that can be used on its own or with other information to identify, contact, or locate a single person, or to identify an individual in context. PII in aerial data is restricted and will not be made available to the public. Identifying PII in the data is the responsibility of the sending agency. The data received by the USGS EROS will be considered free of PII for public download. Other restrictions to the data for public availability are identified in Appendix B UAS Data Release Form.

## **UAS DATA MANAGEMENT FLOW**

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 or over different temporal periods. 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 and is associated with a single sensor. 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 may include the raw data (single frames), final data products (DEM data, point cloud data and derived orthorectified imagery), and UAS metadata xml files containing descriptive information about the project, mission, collect, sensor, platform and data.

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 collect boundaries for their geographic coordinates.

## 2.1 UAS Directory Structure

UAS project data files will be delivered in a uniform directory structure for ease of ingest, archiving of imagery, and providing data to the general user community.

A hierarchical folder structure is required to organize the UAS data files. This hierarchy is structured based on the project, mission, collect and data type for the files being delivered.

Lower and/or upper case alphanumeric characters and underscores will be acceptable for directory names and data file names. However, no spaces or special characters such as -, +, =, !, @, #, \$, %, ^, &, \*, ?, /, \ or apostrophes will be allowed.

The data files will be delivered in the directory structure shown in Figure 1.

### Figure 1 UAS Directory Structure

- *Project1 (directory name to identify Project1)*
  - *Mission1 (directory name to identify 1st mission corresponding to Project1)*
    - *accessible\_support*
      - ↳ *filename\_uasmeta.xml*
      - ↳ *accessible support files*
    - *Collect1 (directory name to identify 1st collect corresponding to Mission1)*
      - *raw*
        - ↳ *filename\_uasmeta.xml*
        - ↳ *raw data files*
      - *ptcloud*
        - ↳ *filename\_uasmeta.xml*
        - ↳ *point cloud data files*
      - *dem*
        - ↳ *filename\_uasmeta.xml*
        - ↳ *DEM data files*

- ortho
        - \filename\_uasmeta.xml
        - \ortho data files
- Collect2 (directory name to identify 2nd collect corresponding to Mission1)
    - raw
        - \filename\_uasmeta.xml
        - \raw data files
      - ptcloud
        - \filename\_uasmeta.xml
        - \point cloud data files
      - dem
        - \filename\_uasmeta.xml
        - \DEM data files
      - ortho
        - \filename\_uasmeta.xml
        - \ortho data files
  - Mission2 (directory name to identify 2nd mission corresponding to Project1)
    - inaccessible\_support
        - \filename\_uasmeta.xml
        - \inaccessiblesupport files
    - Collect3 (directory name to identify collect corresponding to Mission2)
      - raw
          - \filename\_uasmeta.xml
          - \raw data files
        - ptcloud
          - \filename\_uasmeta.xml
          - \point cloud data files
        - dem
          - \filename\_uasmeta.xml
          - \DEM data files
        - ortho
          - \filename\_uasmeta.xml
          - \ortho data files

### 2.1.1 Project Directory

There will be a top-level directory for each project. Each project directory will contain only mission directories. The name of this top-level project directory is user definable.

### 2.1.2 Mission Directory

Below each project directory, there will be one directory for each mission for the project. Each mission directory will contain support type directories and collect directories. The name of each mission directory is user definable.

### **2.1.3 Support Type Directory**

Below each mission directory, there will be one directory for each support type for the mission. The name of the support type directories will correspond to the type of support files in the directories.

- accessible\_support – contains support files that are accessible to the user
- inaccessible\_support – contains support files that are not accessible to the user

Each support type directory will contain:

- one UAS metadata xml files (named \*uasmeta.xml)
- support file(s) corresponding to the support type directory name

### **2.1.4 Collect Directory**

Below each mission directory, there will be one directory for each collect for the mission. Each collect directory will contain only data type directories. The name of each collect directory is user definable.

### **2.1.5 Data Type Directory**

Below each collect directory, there will be one directory for each data type for the collect. The name of the data type directories will correspond to the type of data files in the directories.

- raw - contains the raw data files
- ptcloud - contains the point cloud data files
- dem - contains the DEM data files
- ortho - contains the ortho photo data files

Each data type directory will contain:

- one UAS metadata xml file (named \*uasmeta.xml)
- primary data file(s) corresponding to the data type directory name as listed in Table 1
- optional secondary data file(s) corresponding to the data type directory name as listed in Table 1

#### **2.1.5.1 Raw**

Raw is a file format that captures all information recorded by the sensors when the imagery is captured. A number of file formats are accepted:

- ARW is a file extension for Sony Alpha Raw files created by a Sony digital camera based on the TIF file format.
- CR2 is a file extension for Canon Raw Version 2 files created by a Canon digital camera and based on the TIFF file specification.
- CRW is a file extension for Canon Raw CIFF image files created by a Canon digital camera and structured similar to the TIFF file format. It is not widely used any longer because it has been replaced by the CR2 format.



- DNG is a file extension for Adobe Digital Negative Raw Image files. It is an open standard for RAW imagery.
- TIF and TIFF are file extensions that support lossless compression for high-quality imagery.
- JPG and JPEG files are duplicates provided alongside the RAW image files used to preview the imagery in any image viewer without requiring RAW file support.

This data type also requires a focal length be provided in millimeters.

### 2.1.5.2 Point Cloud

Point Cloud files include a set of data points in a three-dimensional coordinate system used to represent the external surface of an object. The supported file formats are LAS and LAZ.

This data type also requires a European Petroleum Survey Group (EPSG) Number be provided with the data. The ESPG Number is a spatial reference system identifier that can be used to identify a location on Earth. If unknown, 0 can be entered.

### 2.1.5.3 Digital Elevation Model

A digital elevation model (DEM) is a digital model that represents the surface of some terrain in three dimensions using terrain elevation data. The supported file formats are TIF, TFW, XML, and OVR.

### 2.1.5.4 Orthorectified

Orthorectified data has been manipulated to remove optical distortions to produce imagery that is planimetrically correct. The supported file formats are TIF, JPG, JPEG, TFW, XML, OVR, JGW, PRJ, and RRD.

This data type also requires additional metadata be provided describing the start and end date of the orthorectification, as well as the correction model used to process it.

The table “Standard Data Type Directory Names and File Types” lists the file extensions for each allowable data type directory name.

**Table 1 Data Type Directory Names and File Types**

<b>Data Directory name</b>	<b>primary file extensions</b>	<b>secondary file extensions</b>
raw	.jpeg, .jpg, tiff, .tif	.arw, .cr2, .crw, .dng

ptcloud	.las, .laz	
dem	.tif	.tfw, .xml, .ovr
ortho	.tif, .tiff, .jpg, .jpeg	.tfw, .xml, .ovr, .jgw, .prj, .rrd

## 2.2 UAS Metadata Requirements

The metadata xml files may be generated manually or automatically generated via the UAS Data Sharing Portal application. One metadata xml file is required for each data type for each collect for data ingest. The contents of the metadata xml file are documented in section 2.3.

## 2.3 UAS Metadata XML File Format

The UAS metadata will be provided in an xml file named \*uasmeta.xml and located under each data type level directory. This file will contain agency, contact, project, mission, collect, platform and sensor metadata as described in the table “UAS Metadata XML Contents” (table 2). The point of contact information refers to the agency providing the data. All tags are required to be in the metadata xml file, however, some values are optional.

**Table 2 UAS Metadata XML Contents**

Tag	max size/data format	value required
Agency		
name	50 char	Y
shortName	30 char	Y
fieldCenter	45 char	Y
PointOfContact		
name	100 char	N
email	255 char	N
Project		
name	50 char	Y

shortName	8 char	Y
description	200 char	Y
restricted	char 1 1 = project is restricted 0 = project is not restricted	Y
sunsetDate	MM/DD/YYYY	N
Mission		
name	50 char	Y
description	200 char	Y
contractingOffice	50 char	N
vendor	50 char	N
Collect		
name	50 char	Y unless datatype is accessibleSupport or inaccessibleSupport
description	200 char	Y unless datatype is accessibleSupport or inaccessibleSupport
exifIncluded	char 1 1 = exif tags included in data files 0 = exif tags not included in data files	Y unless datatype is accessibleSupport or inaccessibleSupport
northBound	(+/-)DD.DDDDD	N
southBound	(+/-)DD.DDDDD	N
eastBound	(+/-)DDD.DDDDD	N
westBound	(+/-)DDD.DDDDD	N
acquisitionDateStart	MM/DD/YYYY	N
acquisitionDateEnd	MM/DD/YYYY	N
Platform		

name	char 50	Y unless datatype is accessibleSupport or inaccessibleSupport
class	char 20	Y unless datatype is accessibleSupport or inaccessibleSupport
type	char 20	Y unless datatype is accessibleSupport or inaccessibleSupport
serialNumber	char 50	Y unless datatype is accessibleSupport or inaccessibleSupport
faaldNumber	char 30	Y unless datatype is accessibleSupport or inaccessibleSupport
Sensor		
name	char 50	Y unless datatype is accessibleSupport or inaccessibleSupport
type	char 15	Y unless datatype is accessibleSupport or inaccessibleSupport
model	char 20	Y unless datatype is accessibleSupport or inaccessibleSupport
wavelength	char 15	Y unless datatype is accessibleSupport or inaccessibleSupport
imageWidth	integer	Y unless datatype is accessibleSupport or inaccessibleSupport
imageHeight	integer	Y unless datatype is accessibleSupport or inaccessibleSupport
sensorWidth	float	Y unless datatype is accessibleSupport or inaccessibleSupport

sensorHeight	float	Y unless datatype is accessibleSupport or inaccessibleSupport
pixelSizeWidth	float	Y unless datatype is accessibleSupport or inaccessibleSupport
pixelSizeHeight	float	Y unless datatype is accessibleSupport or inaccessibleSupport
Upload		
dataType	raw, ptCloud, ortho, dem, accessibleSupport, inaccessibleSupport	Y
orthoStartDate	MM/DD/YYYY	Y if dataType = ortho
orthoEndDate	MM/DD/YYYY	Y if dataType = ortho
orthoCorrectionModel	values: DSM, DTM, unknown	Y if dataType = ortho
ptCloudEpsgNumber	integer	Y if dataType = ptCloud
rawFocalLength	char 50	N, optionally provided if dataType = raw and no exif tags in the data files

## APPENDIX A UAS DATA DELIVERY CHECKLIST

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### Checklist for UAS Data Delivery

- File and directory names include only alpha numeric characters, in uppercase and lowercase, as well as underscores.
- File and directory names do not include spaces or special characters such as ! @ # \$ % ^ & \* ( ) - = + { } [ ] | : " , . / \.
- File and directory names are limited to 100 characters.
- Directory structure includes project-level directory
- Directory structure includes mission-level directory(s)
- Directory structure includes collect-level directory(s)
- Directory structure includes data-level directory(s)
- Data are evaluated and free from information that contain PII.
- Each data-level directory is named according to data type (raw, ptcloud, dem, ortho)
- Each data-level directory includes a single UAS metadata xml file named: \*uasmeta.xml
- Each data type directory includes 1 or more data files with the appropriate primary file type extensions (see Table 1)
- Data copied to external drive of 1 terabyte capacity or greater and support USB 2.0 and USB 3.0.interface
- Signed UAS Project Release Form

## APPENDIX B UAS DATA RELEASE FORM

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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 \_\_\_ Ortho Photo

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

\_\_\_\_\_  
\_\_\_\_\_

Releasing Official \_\_\_\_\_

Signature \_\_\_\_\_

\*\*Principal Investigator or appropriate manager

## APPENDIX C ACRONYMS

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<b>Acronym</b>	<b><u>Description</u></b>
BLM	Bureau of Land Management
DEM	Digital Elevation Model
DSM	Digital Surface Model
EE	USGS EarthExplorer
EROS	Earth Resources Observation and Science
JPEG	Joint Photographic Experts Group
NOAA	National Oceanic and Atmospheric Administration
UAS	Unmanned Aircraft Systems
USGS	United States Geological Survey
XML	Extensible Markup Language



## APPENDIX D UAS Project Directory Structure Example

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- **CO\_Debeque\_Landslide\_Pilot\_Project**
  - **Debeque\_Landslide\_CO\_201306**
    - **accessible\_support**
      - ↳ asupt\_uasmeta.xml
      - ↳ debeque\_landslide\_201306\_planning.doc
    - **June\_2013\_canon\_sx260\_falcon**
      - **ortho**
        - ↳ 062013\_ortho\_uasmeta.xml
        - ↳ ortho\_cir\_debuque\_landslide\_clip1\_adjust\_utm84.tfw
        - ↳ ortho\_cir\_debuque\_landslide\_clip1\_adjust\_utm84.tif
        - ↳ ortho\_cir\_debuque\_landslide\_clip1\_adjust\_utm84.tif.aux.xml
        - ↳ ortho\_cir\_debuque\_landslide\_clip1\_adjust\_utm84.tif.ovr
        - ↳ ortho\_cir\_debuque\_landslide\_clip1\_dd84.tfw
        - ↳ ortho\_cir\_debuque\_landslide\_clip1\_dd84.tif
        - ↳ ortho\_cir\_debuque\_landslide\_clip1\_dd84.tif.aux.xml
        - ↳ ortho\_cir\_debuque\_landslide\_clip1\_dd84.tif.ovr
      - **raw**
        - ↳ 062013\_raw\_uasmeta.xml
        - ↳ IMG\_0100.JPG to IMG\_0307.JPG
    - **Debeque\_Landslide\_CO\_201310**
      - **october\_2013\_canon\_sx260\_falcon**
        - **dem**
          - ↳ 102013\_dem\_uasmeta.xml
          - ↳ dem\_debuque\_landslide\_clip\_nonadjust\_dd84.tfw
          - ↳ dem\_debuque\_landslide\_clip\_nonadjust\_dd84.tif
          - ↳ dem\_debuque\_landslide\_clip\_nonadjust\_dd84.tif.aux.xml
          - ↳ dem\_debuque\_landslide\_clip\_nonadjust\_dd84.tif.ovr
          - ↳ dem\_debuque\_landslide\_clip\_adjust\_utm84.tfw
          - ↳ dem\_debuque\_landslide\_clip\_adjust\_utm84.tif
          - ↳ dem\_debuque\_landslide\_clip\_adjust\_utm84.tif.aux.xml
        - **raw**
          - ↳ 102013\_raw\_uasmeta.xml
          - ↳ IMG\_1107.JPG through IMG\_1443.JPG
      - **october\_2013\_sony\_nex7**
        - **raw**
          - ↳ 102013\_sony\_raw\_uasmeta.xml
          - ↳ DSC4500.JPG through DSC4622.JPG
    - **Debeque\_Landslide\_CO\_201403**
      - **march\_2014\_sony\_nex7**
        - **raw**
          - ↳ 032014\_raw\_uasmeta.xml
          - ↳ DSC7188.JPG through DSC7253.JPG

## APPENDIX E UAS XML Metadata File Example

---

```
<?xml version="1.0"?>
<uas>
  <Agency>
    <name>United States Geological Survey</name>
    <shortName>USGS</shortName>
    <fieldCenter>Denver, CO</fieldCenter>
  </Agency>
  <PointOfContact>
    <name>John Doe</name>
    <email>johndoe@usgs.gov</email>
  </PointOfContact>
  <Project>
    <name>CO Debeque Landslide Pilot Project</name>
    <shortName>codqlspp</shortName>
    <description>Damage assessment of landslides created from
flooding</description>
    <restricted>1</restricted>
    <sunsetDate/>
  </Project>
  <Mission>
    <name>Debeque Landslide CO 201306</name>
    <description>June 2013 flights</description>
    <contractingOffice>NA</contractingOffice>
    <vendor>NA</vendor>
  </Mission>
  <Collect>
    <name>June 2013 canon sx260 falcon</name>
    <description>June 2013 flights using Falcon fixed wing
aircraft with Canon PowerShot SX260 HS digital
sensor.</description>
    <exifIncluded>1</exifIncluded>
    <northBound>39.21095</northBound>
    <southBound>39.20261</southBound>
    <eastBound>-108.25097</eastBound>
    <westBound>-108.26624</westBound>
    <acquisitionDateStart>06-27-2013</acquisitionDateStart>
    <acquisitionDateEnd>06-27-2013</acquisitionDateEnd>
  </Collect>
  <Platform>
    <name>Falcon Fixed Wing</name>
    <class>NA</class>
    <type>Fixed Wing</type>
    <serialNumber>NA</serialNumber>
```

```
<faaIdNumber>NA</faaIdNumber>
</Platform>
<Sensor>
  <name>Canon PowerShot SX260 HS</name>
  <type>CMOS</type>
  <model>PowerShot SX260 HS</model>
  <wavelength>0</wavelength>
  <imageWidth>0</imageWidth>
  <imageHeight>0</imageHeight>
  <sensorWidth>0</sensorWidth>
  <sensorHeight>0</sensorHeight>
  <pixelSizeWidth>4000</pixelSizeWidth>
  <pixelSizeHeight>3000</pixelSizeHeight>
</Sensor>
<Upload>
  <dataType>raw</dataType>
  <orthoStartDate/>
  <orthoEndDate/>
  <orthoCorrectionModel/>
  <ptCloudEpsgNumber/>
  <rawFocalLength>23</rawFocalLength>
</Upload>
</uas>
```