UAV data management handbook

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NERC Environmental Data Service

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

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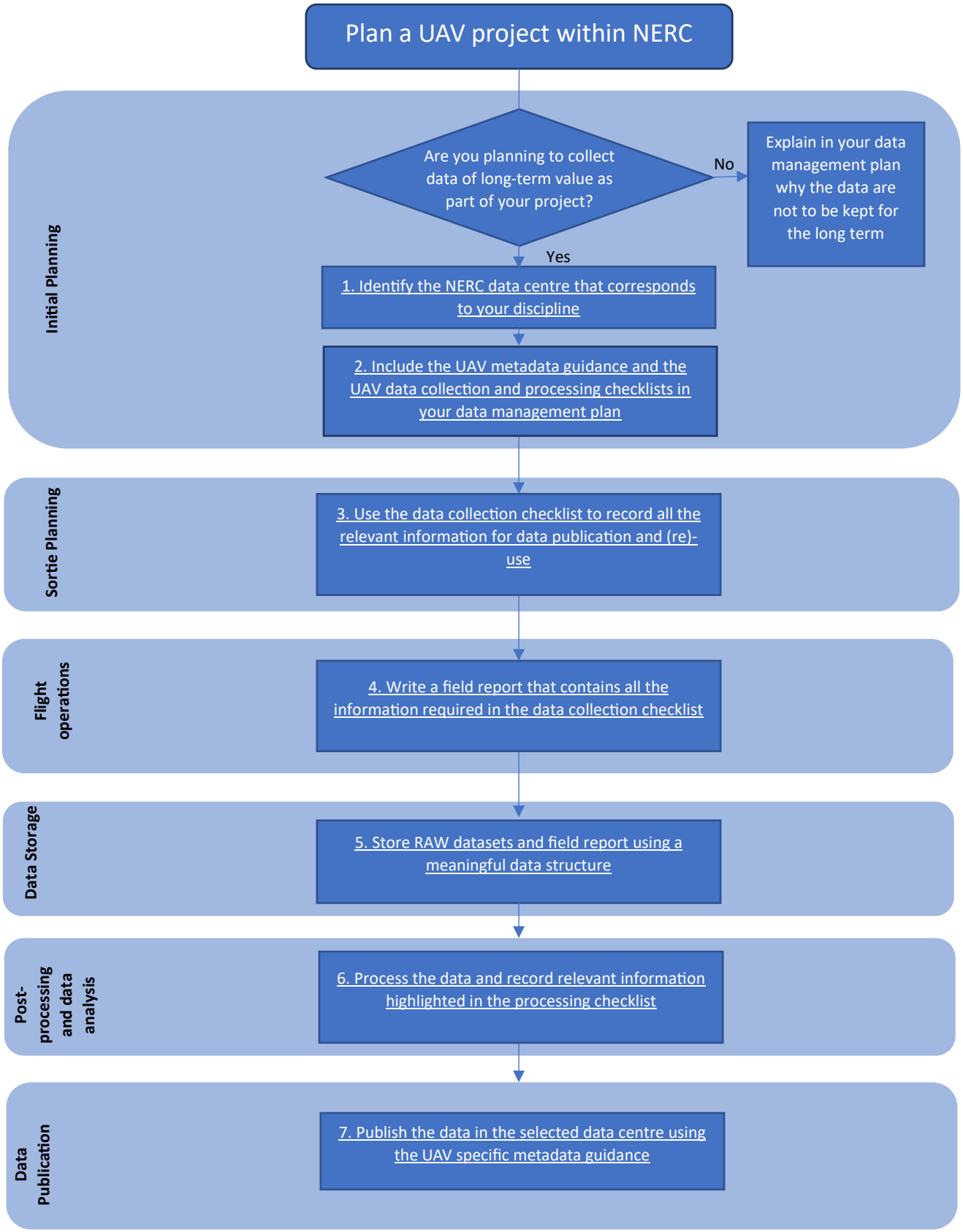
Introduction

This document gives relevant information related to the management of remotely piloted or uncrewed airborne vehicles (commonly referenced as UAV in this document) data collected as part of NERC-funded research.

From project planning to data publication, this document will guide you through the different steps for the publication of Findable, Accessible, Interoperable and Reusable (FAIR, Wilkinson, 2016) UAV data.

The flowchart

The workflow presented below introduces the different steps to manage UAV data in NERC-funded research. Click on the links to find further guidance and information about each step.



1. Finding the NERC data centre for your data

As highlighted in the NERC data policy (https://www.ukri.org/about-us/nerc/our-policies-and-standards/nerc-data-policy/), all data of long-term value collected as part of a NERC-funded research should be deposited in a NERC data centre. The NERC data environmental data service is composed of 5 data centres each with a theme and data managers with specific expertise for your data:

- BODC – British Oceanographic Data Centre (marine)
- CEDA – Centre for Environmental Data Analysis (Atmospheric, Earth Observation, and Solar and space physics)
- EIDC – Environmental Information Data Centre (hydrology)
- NGDC - National Geoscience Data Centre (geoscience)
- UKPDC - UK Polar Data Centre (polar and cryosphere)

Depending on your subject of study, you can select the data centre that will best suit your data.

2. Write your data management plan

Each NERC-funded project must be associated with its own data management plan that states how the data will be handled during and after the end of the project. General recommendations on how to best write your data management plan are given on UKRI website: https://www.ukri.org/publications/outline-data-management-plan-template-and-guidance and within the digital stewardship wizard. If you have any queries, do not hesitate to contact a data manager of the NERC data centre of your choice.

If your project involves data derived from UAV, please provide the following information to the data management plan:

- In project management plan section: “To ensure that all the metadata are collected from the field, the UAV data collection checklist will be used and a specific field report will document the UAV survey campaign. Throughout the project it is expected that data (where they are in electronic format) will be backed up on secure systems so that hardware failure and/or malicious attack on the data and/or systems will not cause a permanent loss. As part of the processing, the UAV data processing checklist will be used.”
- Metadata and documentation section: “To facilitate reuse of UAV data, the necessary metadata to enable their use and re-use will be recorded to the best of the scientist's abilities and should document what, where, when, how, why and who generated the data (including analysis and processing steps). In particular, a field report for each UAV campaign and UAV-specific metadata will be provided as described in the drone data management handbook.”

3. Data collection

Most of the relevant information needs to be recorded as part of the data collection. We propose here a checklist that provides a list of required information to record when collecting data derived from autonomous or remotely piloted aerial systems. To capture the information, it is recommended to use a log sheet for each flight and write a summary data collection document.

Log information for each flight:

☐ Flight ID

☐ Date

☐ Start time flight

☐ End time flight

☐ Latitude start

☐ Longitude start

☐ Latitude end

☐ Longitude end

☐ Operator

☐ Weather information

☐ List of sensors

☐ Log of events including time, comments, cause, effects of events

☐ Specific configuration notes (are all the sensors on, different location of sensors on the platform)

☐ GNSS on

☐ Recording data

☐ Calibration done/calibration flight

Summary data collection document

☐ project

☐ survey name

☐ Start date/time of first flight for the survey

☐ End date/time of last flight for the survey

☐ Geographic extent of the survey

☐ Total number of flights

☐ Platform make and model

☐ Mission planning software

☐ List of sensors make and model and possible configurations. For each sensor, metadata should include if relevant: make and model, sampling rate, resolution, measurement capability and accuracy, their locations on the drone (including mount and orientation), firmware and version

☐ Calibration information

☐ General comments

We propose in the Appendix, an example of a log sheet and summary data document that can be used as part of your survey.

4. Field report

After each survey, it is highly recommended to write a field report that documents how the survey was undertaken. The report gives a general summary of the survey and initial results. The flight logs and summary data collection documents can be added as appendix to facilitate the processing and re-use of the data.

5. Storage of data

As soon as the flight is finished, it is important to make a copy of the data. In remote environment with limited internet connection, it is recommended to use hard drives, but as soon a better internet connection is found, the best is to save the data on your institutional data server which usually has higher backup facilities. To facilitate reuse of the data, using a specific data structure and file naming conventions are recommended. In particular, the raw and processed data should be stored separately.

It can also be useful to make the raw data folder read-only to avoid mistakes. For naming conventions, you might want to consider including in the file name: the platform name especially if different platforms are used within a same survey, the name of the sensor, the flight ID and a date. In addition, some considerations regarding the file format might need to be considered. Please note that for publication, only open file formats will be accepted by the NERC data repositories. Example of accepted file formats include but are not limited to CSV for tabular data, NetCDF for gridded data, TIFF, JPEG or PNG for images.

6. Data processing checklist

To facilitate data publication, the following information are to be documented as part of the processing:

☐ Processing software and version

☐ Methodology

☐ Output format and coordinate system if applicable

☐ type of data (gridded, orthomosaic imagery, triangulated mesh, digital elevation model, dense point cloud, tabular)

☐ Data processor

7. Publishing UAV data

As per the NERC data policy (https://www.ukri.org/about-us/nerc/our-policies-and-standards/nerc-data-policy/), the data should be published in the **two years** after the date of collection. When publishing UAV data, it is crucial to provide the following document to the data centre of your choice:

- Data in an open format
- metadata that documents how, where, when the data have been collected and processed.
- A Data Transfer Agreement that outlines the responsibilities of the data depositor and data centre

Data

The data should be provided in an open format. To identify which data should be considered for accession, data depositors are invited to check if there data complies with the NERC Data Value Checklist: https://www.ukri.org/publications/nerc-data-value-checklist/

Metadata

UAV metadata should include generic metadata that complies with the UK Gemini standard but also more specific metadata linked to the use of UAV. Additional metadata related to the domain of study should be added to comply with the requirement of the community. In this document, we only provide information related to the generic UK Gemini metadata and the specific UAV metadata. To know more about the specific domain requirements, please contact your data centre.

UK Gemini metadata

"GEMINI" is the UK geographic metadata standard. It provides guidance on how to publish geographic metadata in a way that conforms to UK government guidelines and the relevant ISO standards. This standard is used across the Environmental Data Service (EDS), and documents how to describe any (geo-)spatial dataset. It comprises a title, an abstract, authors and contributors, lineage, references, dates, license and spatial information.

The list of recommended fields is provided online on EIDC or UK PDC website:

- https://eidc.ac.uk/deposit/metadata/guidance
- https://www.bas.ac.uk/data/uk-pdc/metadata-guidance/

Common UAV metadata

In addition to the UK Gemini metadata, specific information related to the UAV platform, sensor and survey will need to be provided. The table below gives the metadata recommendations specific to UAV data.

Table 1 Metadata recommendations specific to UAV datasets (M – Mandatory, C – Conditional, R – recommended, O – optional)

The UAV platform and its sensor type	
RPAS type (e.g. fixed wing vs multirotor)	R
RPAS make and model	R
RPAS payload type(s)	R
Camera type and model	C - R
Sensor type and model	C - M
Sensor calibration specification	C - R
Sensor sampling rate	R
Sensor measurement capability	R
Sensor location on drone	R
Sensor mount and orientation	R
Sensor firmware and version	R
The UAV survey	
Geographic extent (size of area covered)	M
Flight pattern type (e.g., grid, vertical profile, z-formation, forward lap)	R
Weather report	O
Flight date and time	M
Sensing target	R
Mission planning software	O
Imagery data	
Image type (e.g. raw, georeferenced, composite)	C - R
Processed image output format (e.g., orthomosaic imagery, triangulated mesh, digital elevation model, dense point cloud)	C - R
Image file format (e.g., TIFF, JPEG, etc)	C - R
Coordinate reference system	C - M
Image processing software and version (e.g., Agisoft Photoscan)	C - R
Image processing algorithm/function used	C - R
Image processor (person)	C - O
Image processing date	C - R
Image resolution	C - M
Non-imaging sensor data	
Observed property (e.g., temperature, wind speed)	C - M
Sensor data output type (e.g., time series, alerts, acoustic)	C - M
Data processing status	C - R
Sensor data processing software	C - R
Sensor data processing method (e.g., adjustment for sensor angle or heat/air flow)	C - M

Data processor (person)	C - O
Processing date(s)	C - R
Data file format (e.g., csv, txt, netcdf)	C -R
Coordinate reference system	C - M
The sortie	
Flight log - duration	R
Flight log – coordinates (x, y)	M
Flight log - altitude	M
Flight log - attitude or orientation (pitch, roll, and yaw)	R

Data transfer Agreement

Depending on which data centre you are depositing your data with, you might be asked to fill in a Data Transfer Agreement or similar document that outline NERC data centre and the data depositor's responsibilities with regards to transferring, sharing and distributing data.

Publishing the data

When all the documents are received by a data centre, a data manager will be assigned to check and publish your data. A Digital Object Identifier (DOI) will be provided to easily cite your data. This process can be quite long (~2 weeks), it is thus recommended to communicate as soon as possible with your data centre to arrange for the publication of the data. Please note that embargo period can also be proposed for reviewers to check your data before final publication.

References

Wilkinson, M. D., Dumontier, M., Aalbersberg, I. J., Appleton, G., Axton, M., Baak, A., ... & Mons, B. (2016). The FAIR Guiding Principles for scientific data management and stewardship. *Scientific data*, *3*(1), 1-9. https://doi.org/10.1038/sdata.2016.18.

APPENDIX

UAV summary data collection

Project	
Survey name	
Date and time of first flight	
Date and time of last flight	
Total number of flights	

Geographic extent

Latitude min	
Latitude max	
Longitude min	
Longitude max	

Insert map here

Summary of the survey

……
……
……
……
……

Description of platform:

Name: ……
Make and model:……
Payload:……
Mission planning software:……

Description of sensors:

☐ Sensor 1

- Name:……
- Make and model:……
- Sampling rate:……
- Resolution/accuracy:……
- Location on drone:……
- Mount and orientation:…… (here several configurations can be mentioned) ……
- Firmware and version:……
- Calibration:……

☐ Sensor 2

- Name:……
- Make and model:……
- Sampling rate:……
- Resolution/accuracy:……
- Location on drone:……
- Mount and orientation:…… (here several configurations can be mentioned) ……
- Firmware and version:……
- Calibration:……

☐ Sensor 3

- Name:……
- Make and model:……
- Sampling rate:……
- Resolution/accuracy:……
- Location on drone:……
- Mount and orientation:…… (here several configurations can be mentioned) ……
- Firmware and version:……
- Calibration:……

☐ Sensor 4

- Name:……
- Make and model:……
- Sampling rate:……
- Resolution/accuracy:……
- Location on drone:……
- Mount and orientation:…… (here several configurations can be mentioned) ……
- Firmware and version:……
- Calibration:……

Calibration information:

……
……
……
……
……
……

UAV survey log sheet

Flight ID:	**Operator:**
Date start:	**Date end:**
Time start:	**Time end:**
Latitude start:	**Latitude end:**
Longitude start:	**Longitude end:**

GNSS ON	YES/NO
Calibration information	
Recording data	YES/NO

List of sensors in use:

☐ **Sensor 1** ☐ **Sensor 2** ☐ **Sensor 3** ☐ **Sensor 4 …**

Time	**Comment / Cause / Effect**
Notes :	