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sUAS Data Sharing Guidelines

Lindsay Barbieri, Brian Wee, Bill Teng

Lindsay Barbieri
PhD Natural Resources, University of Vermont
ESIP Agriculture and Climate Information Fellow

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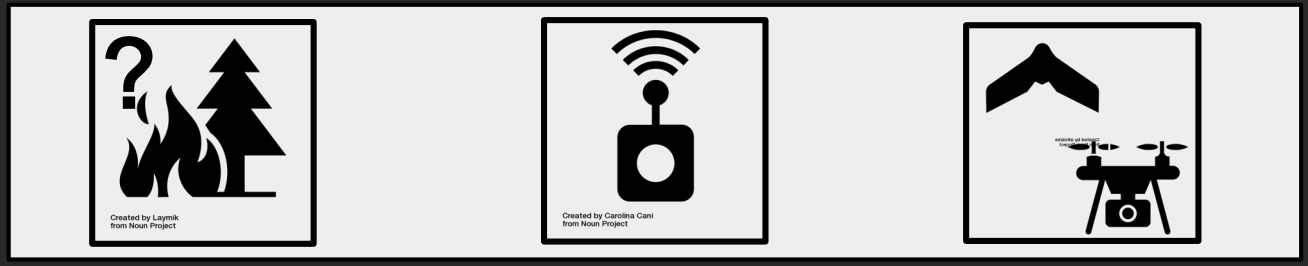

Pre Flight

Flight

Post Flight

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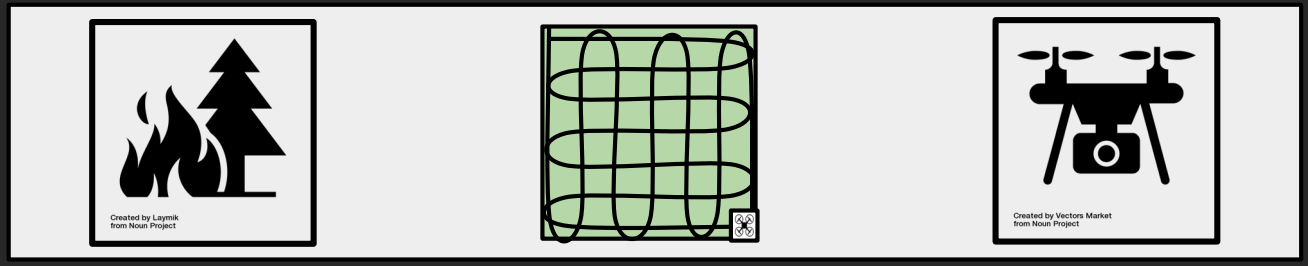

Pre Flight

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Pre Flight

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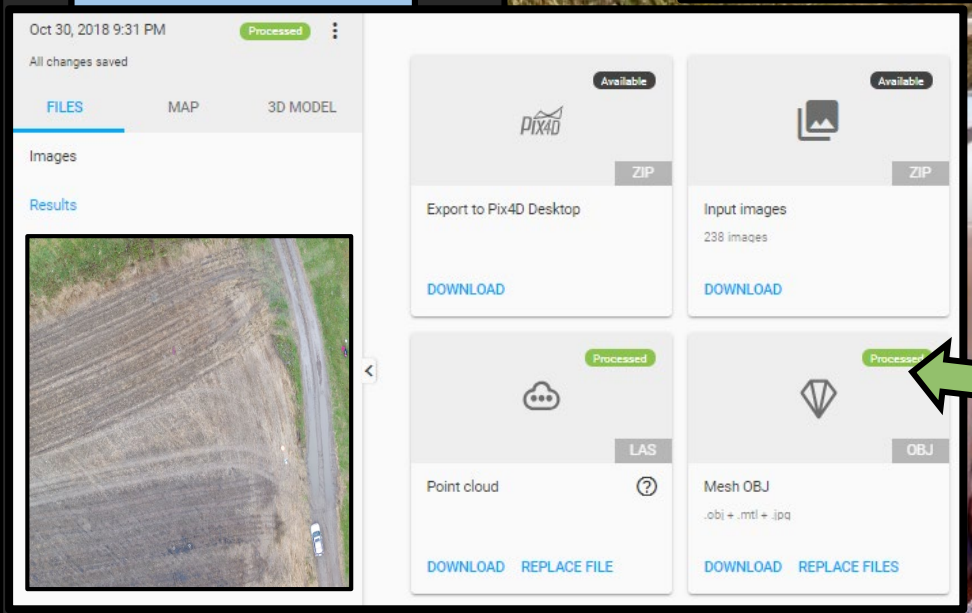
A	B	C	D	E	F	G
Time	COM Elapse	XQ-iMet-XQ Pres	XQ-iMet-XQ Air T	XQ-iMet-XQ Hun	XQ-iMet-XQ Hun	XQ-iMet-XQ Date
09:58.5	0	990.2	23.62	48.3	24.32	10/18/2015
09:59.2	0.734	1018.83	23.22	39.8	25.02	10/18/2015
09:59.3	0.765	1018.81	23.22	41.1	24.89	10/18/2015
09:59.3	0.781	1018.78	23.2	41.1	24.9	10/18/2015
09:59.3	0.812	1018.78	23.2	41.1	24.9	10/18/2015
09:59.3	0.844	1018.74	23.24	41	24.89	10/18/2015
09:59.3	0.859	1018.73	23.24	41	24.92	10/18/2015



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Data Challenges

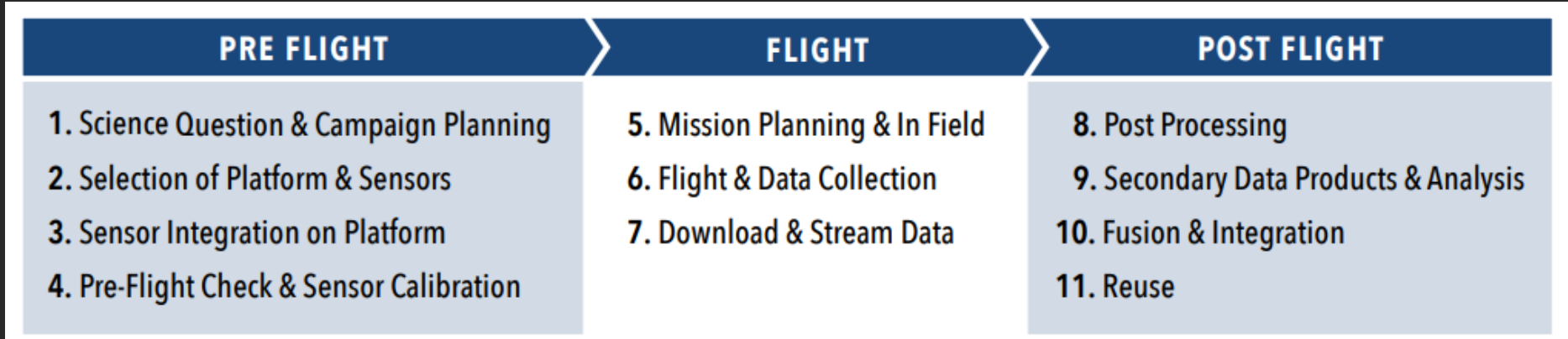

Figure 1. A high-level drone research workflow

Thomer, A.K.,Barbieri, L. K., Swanz, S.,Wyngaard, J., (2021). A Minimum Information Framework for capturing FAIR data with small Uncrewed Aircraft Systems,https://doi.org/10.31223/X5Z338

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Data Challenges

1. What **sensor calibration and use procedures** need to be defined and articulated?

1. What is the **minimum information** that needs to be collected about a scientific sUAS data capture flight?

1. What **data processing best practices** and **error analysis methodology** need to be outlined?

1. Which **data and metadata formats** should be used?

1. Which **ontologies** should be applied-- or need to be developed -- for sUAS (meta)data?

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Data Sharing Guidelines

Why Care?

- **Good Science!** Understand & reduce uncertainty, important for science outcomes
- **Sharing!** Reproducible and reusable
- **Quicker, Better Science!** Increased learning and more rapid “best practices” science development

Why Now?

- **Urgent!** sUAS are an increasingly used sensor platform for the sciences
- **Momentum and support!** Open science and FAIR data practices
- **Possible!** Maturing of the technologies to enable and implement practices

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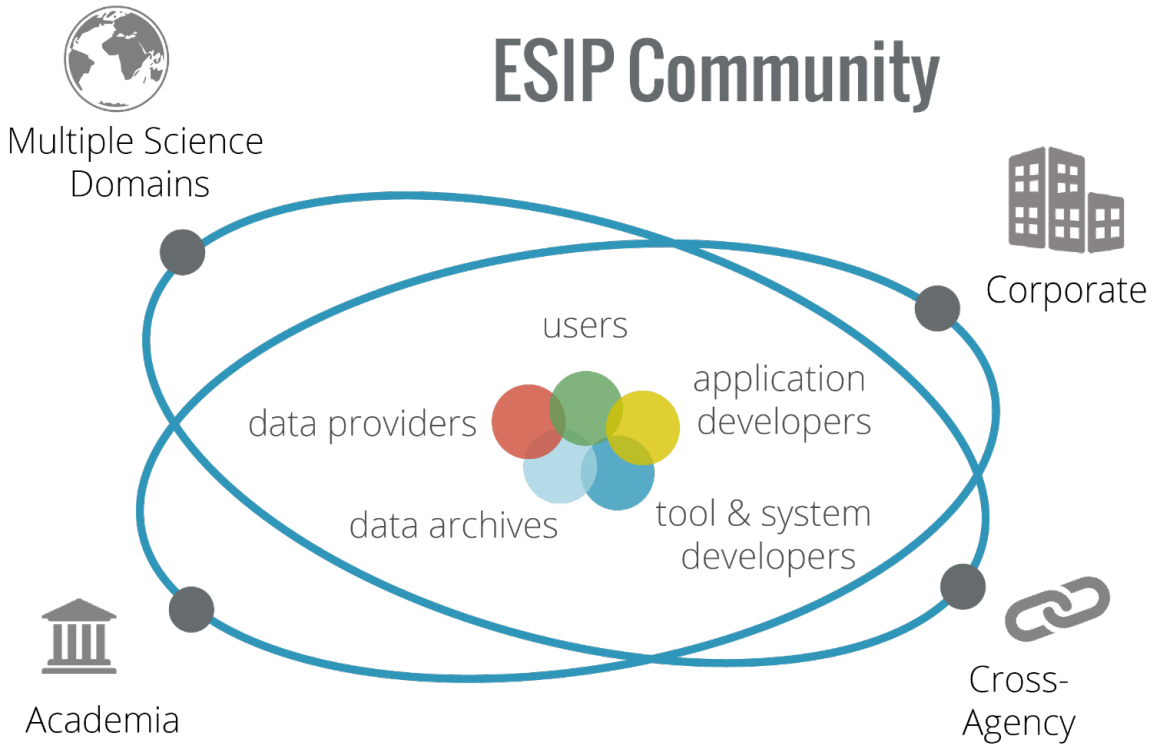
ESIP | supported by: NASA NOAA USGS



ESIP is a leader in promoting the **collection, stewardship, (re)purposing and (re)use** of Earth science data, information, and knowledge that is responsive to societal needs.

COLLABORATION AREAS

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STANDING COMMITTEES:

- Data Stewardship
- Education
- Information Technology and Interoperability (IT&I)
- Semantic Technologies

CLUSTERS:

- Ag & Climate
- Air Quality
- Biological Data Standards
- Cloud Computing
- Community Data
- Community Resilience
- COPDESS
- Community Ontology Repository (COR)
- Data Readiness
- Disaster Lifecycle
- Discovery
- Drones
- E2SIP
- EnviroSensing
- Information Quality
- IM Code Registry
- Machine Learning
- Marine Data
- Physical Sample Curation
- Public-Private Partnerships
- Research Object Citation
- Schema.org
- Semantic Harmonization
- Soil Ontology & Informatics
- Sustainable Data Mgmt

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Ag and Climate and Semantic Harmonization coorganized ESIP July 2021 session:
Identifying technology capabilities that meet wildfire science and practitioner requirements.

https://esip.figshare.com/articles/poster/Wildfire_data_and_information_interoperability_across_fire_management_phases/14974266

Wildfire data and information interoperability across fire management phases

Brian Wee[1], William Teng[2], Dave Zader[3]

Wildfire data and information should ideally be reusable and repurposable across different fire management phases.

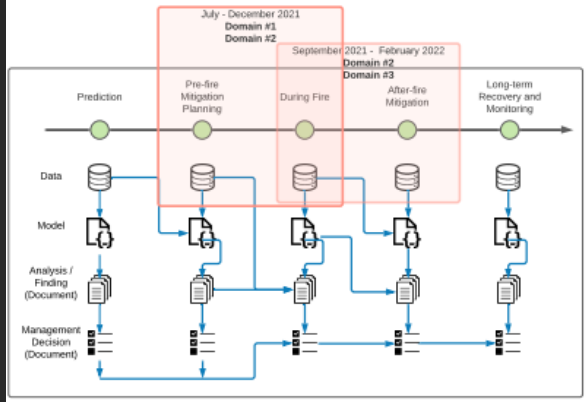
For example, infrastructure that is vulnerable to wildfire-induced floods identified during the active-fire fighting phase should be easily discoverable to city managers weeks or even months later, when heavy rains on burn areas may trigger catastrophic debris-flows that threaten lives.

The Agriculture and Climate Cluster and the Semantic Harmonization Cluster are examining how formally encoded knowledge about disasters like wildfires can be used to enable applications that result in wildfire data and information interoperability across fire management phases.

Knowledge Domains to be captured as machine-readable representations

Domain #1: Planning Polygons	Domain #2: Values-at-Risk	Domain #3: Flood Hazards
Knowledge Domain: What are the types of natural features (e.g. ridgelines, lakes), civil infrastructure (e.g. roads), and other features (e.g. animal trails) that can be used to generate polygons used for planning (pre-fire) activities? Are the polygons used for planning the same as polygons used for fire-fighting activities?	**Knowledge Domain:** What are considered "values-at-risk " (e.g. critical infrastructure, cultural resources, biodiversity hotspots) vulnerable to wildfire and wildfire impacts (e.g. flood, debris flow)? Are values-at-risk identified in planning activities the same entities considered during the active fire-fighting phase?	**Knowledge Domain:** What are the different types of hydrometeorological flood hazards (e.g. water flows, hyperconcentrated flows, debris flows) threatening values-at-risk that affect how you would issue warnings to the public? How are data relevant to these hazards that are identified during the active fire-fighting phase shared with the after-fire risk-mitigation team (e.g. BAER* team)?

* BAER stands for "Burned Area Emergency Response"



To enable applications like

App1: Candidate polygon identification	
Data Science Areas	AI/ML Image analysis Spatial topology algebra Graph data science Semantic technology
Wildfire Phase	Pre-fire, During Fire
Narrative	Semi-automated identification, extraction, and labeling of features from high-resolution imagery that can be combined with existing geospatial data into candidate planning polygons.

App2: Semantic-enabled data discovery	
Data Science Areas	AI/ML Natural language processing Semantic technology
Wildfire Phase	All phases
Narrative	Use semantic-enabled search to identify values-at-risk relevant to a specified geographical extent (e.g. within a given planning polygon).

App3: Crowd-sourced values prioritization	
Data Science Areas	Visualization Multivariate analytics
Wildfire Phase	Pre-fire, During Fire
Narrative	Provide a web-based tool for communities to prioritize and visualize geospatial data on values-at-risk as they prepare community wildfire mitigation plans. These community-augmented geospatial data will be discoverable (see "App2") to fire incident managers so that they can allocate appropriate resources for fire management.

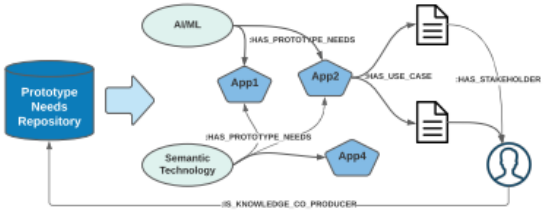
App4: BAER* information management	
Data Science Areas	Natural language processing Semantic technology Graph data science
Wildfire Phase	All phases
Narrative	BAER* reports contain a rich trove of information that can be mined to summarize information about how fires have evolved, and how managers have correspondingly evolved post-fire mitigation measures. Ingesting BAER report information for visualization and analysis may reveal spatial and temporal patterns that are useful in informing future fire management strategies.

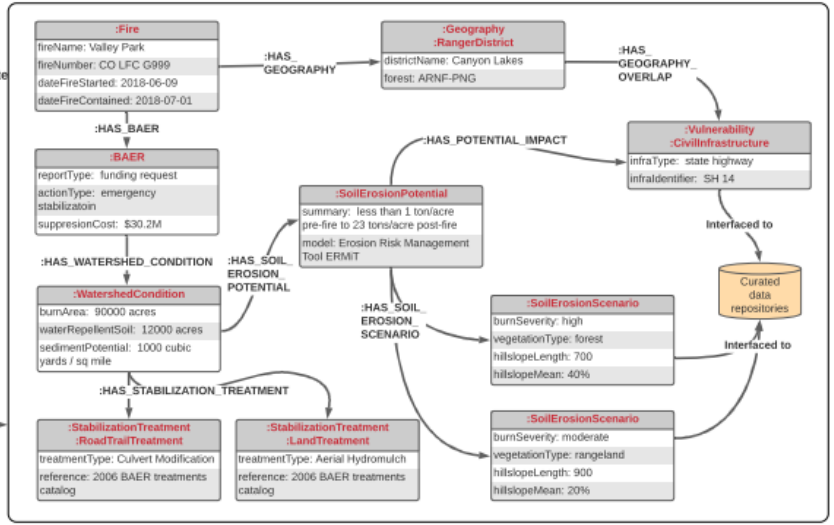
To populate a repo

To generate graphs like

A "Prototype Needs Repository" can be used to:

- Foster project ideas for ESIP FUNding Friday, ESIP Lab, USGS Community for Data Integration, etc. by connecting stakeholders to parties interested in developing experimental prototypes.
- Enable the visualization of how informatics capabilities may help fulfill stakeholder needs via experimental prototypes.





[1] Massive Connections, LLC | [2] NASA Goddard Space Flight Center (ADNET Systems) | [3] Boulder, CO Fire Department (retired)

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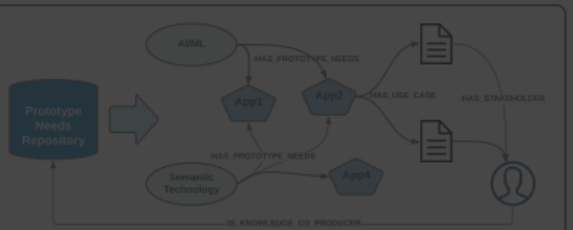

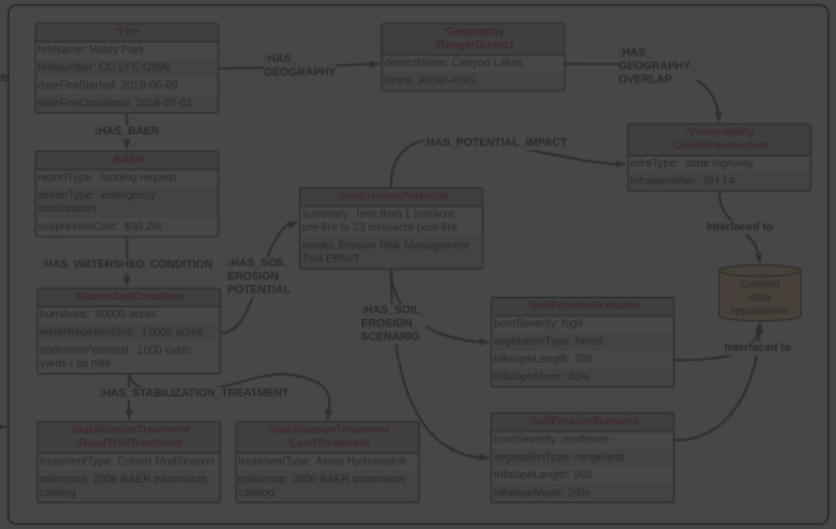

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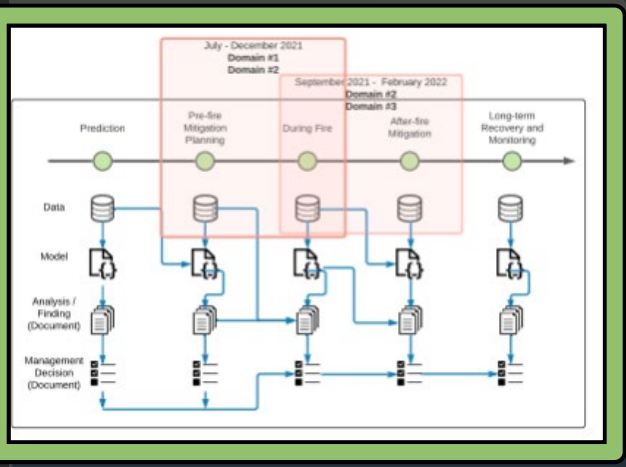

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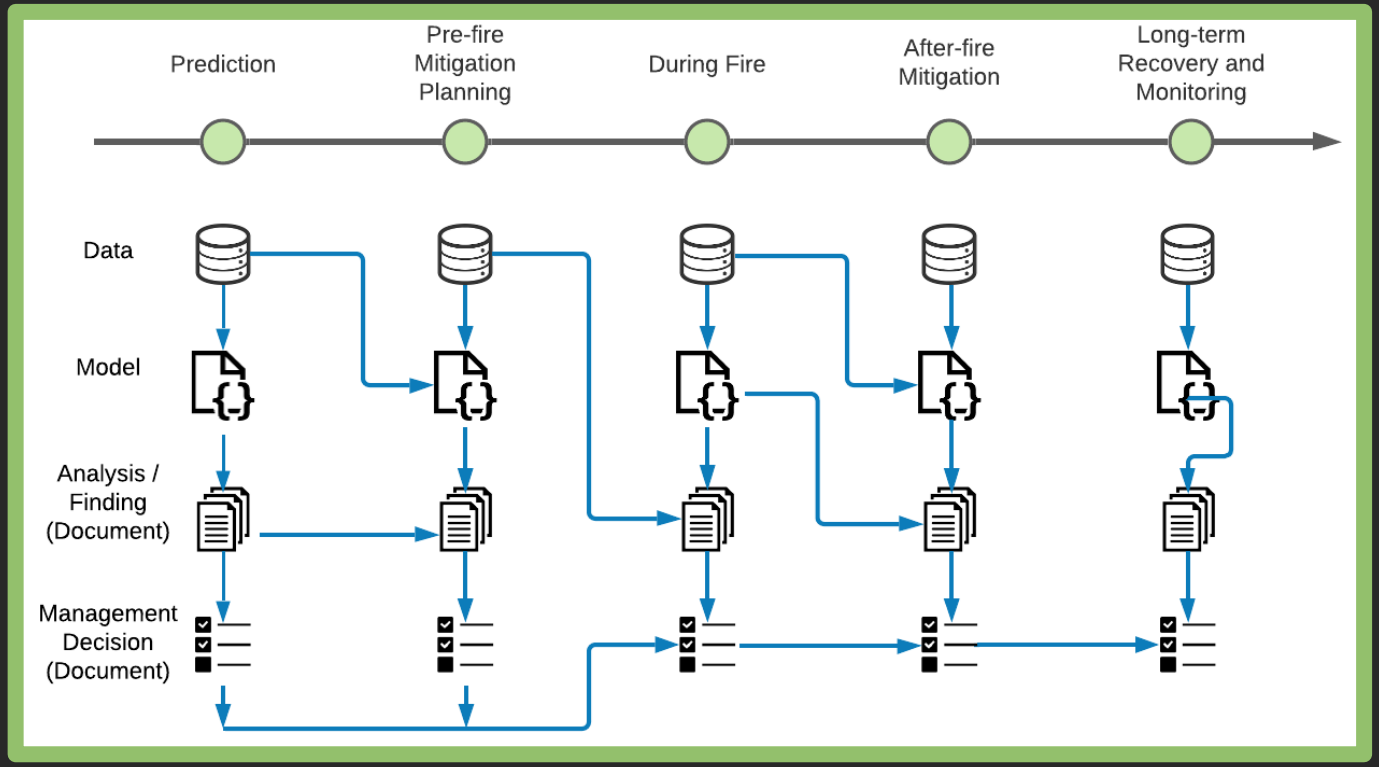
Ag & Climate: Wildfires



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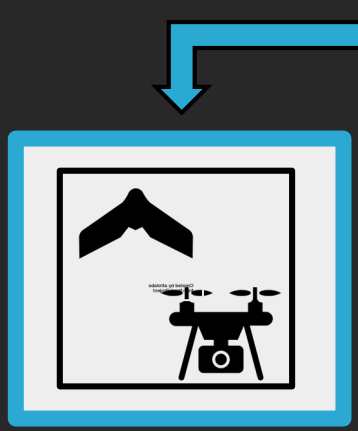

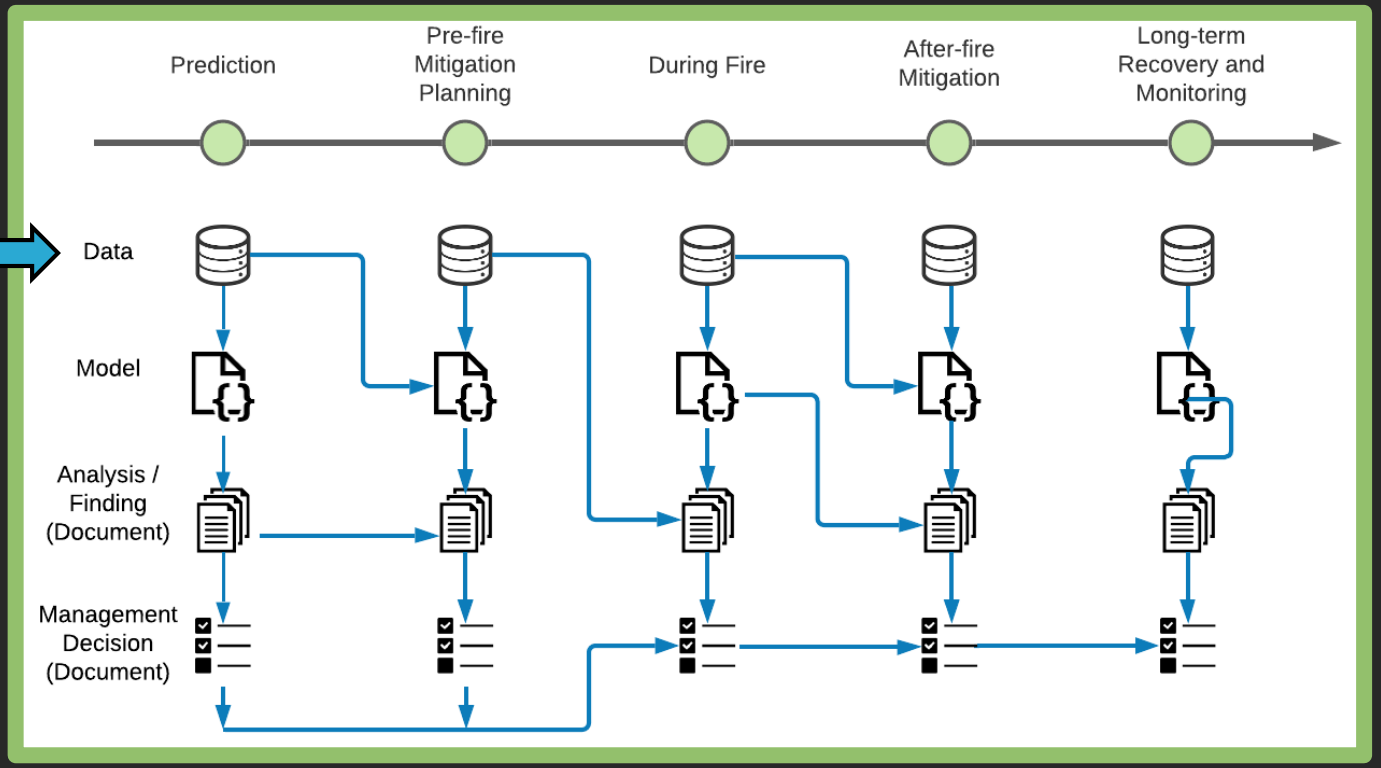

Drone Cluster

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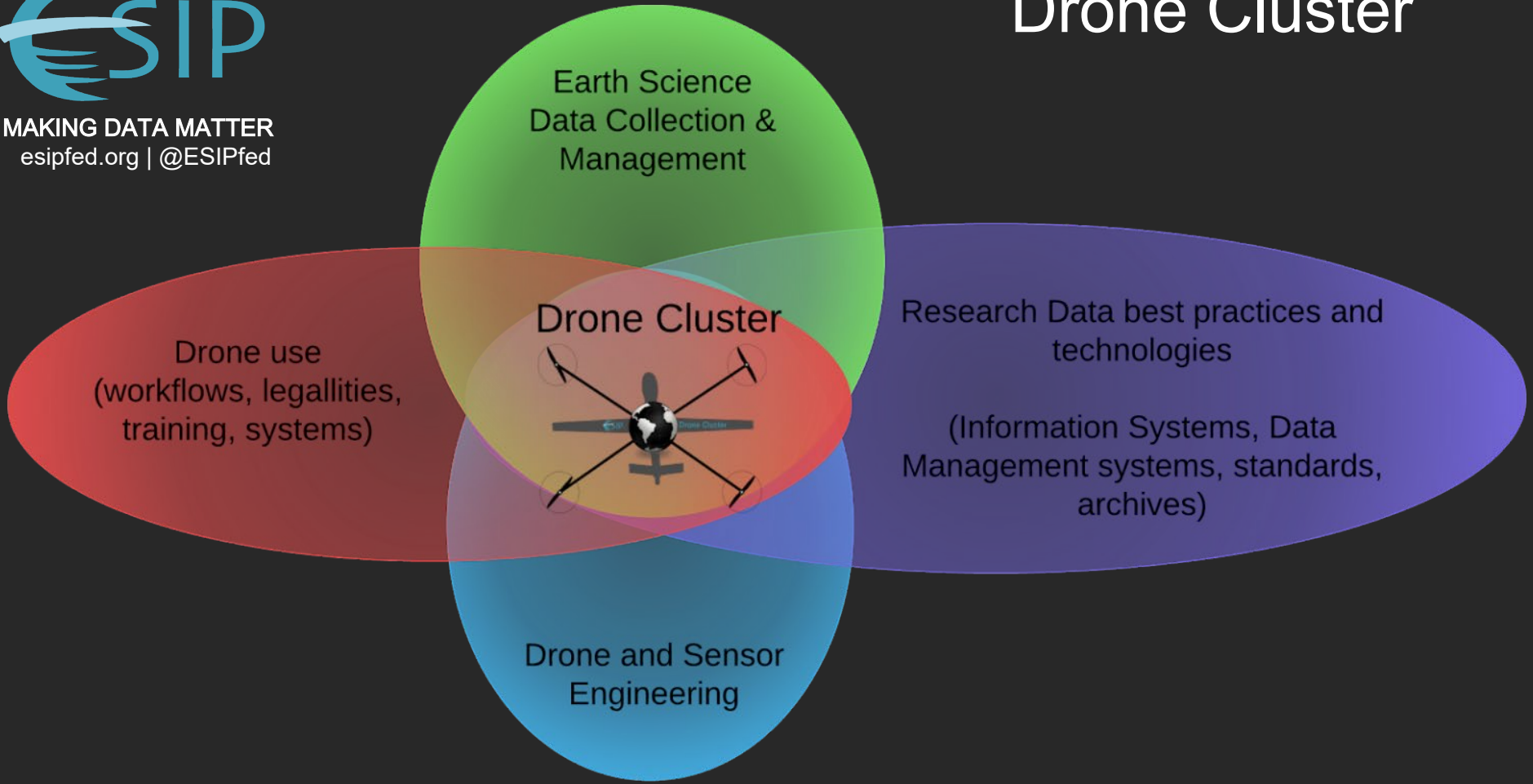

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Minimum Information Framework

Minimum information framework: a list* of data and metadata attributes necessary for sharing and reuse.

What do you need to know about this image to make it useful to you??

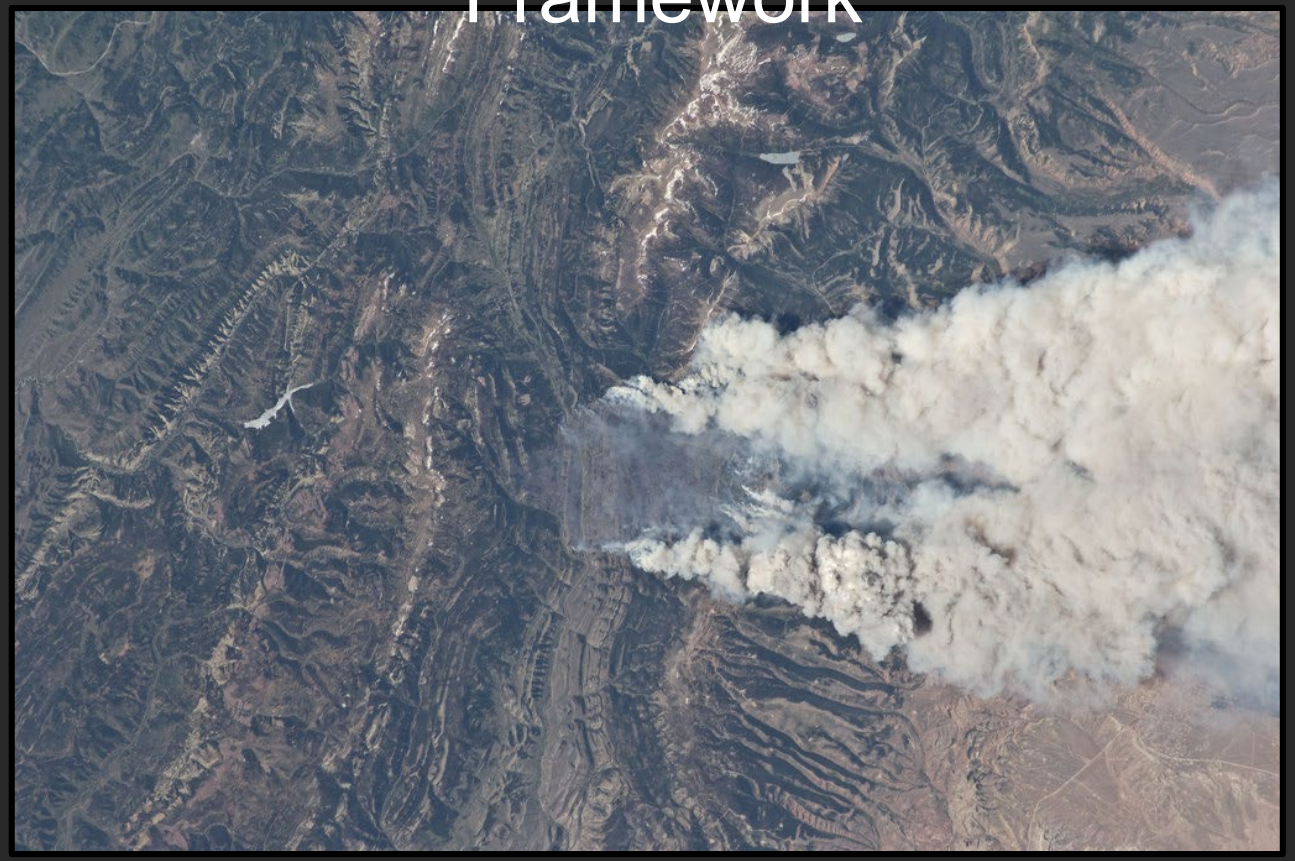

Image credit: NASA/JSC

Approach

1) Work with drone data collectors to document their:
   - Workflows
   - Data products
   - Data needs

2) Create a Minimum Information Framework (a high level information model) of key data classes necessary for reuse

3) Refine via community feedback

4) Use as basis of ontologies, data standard.

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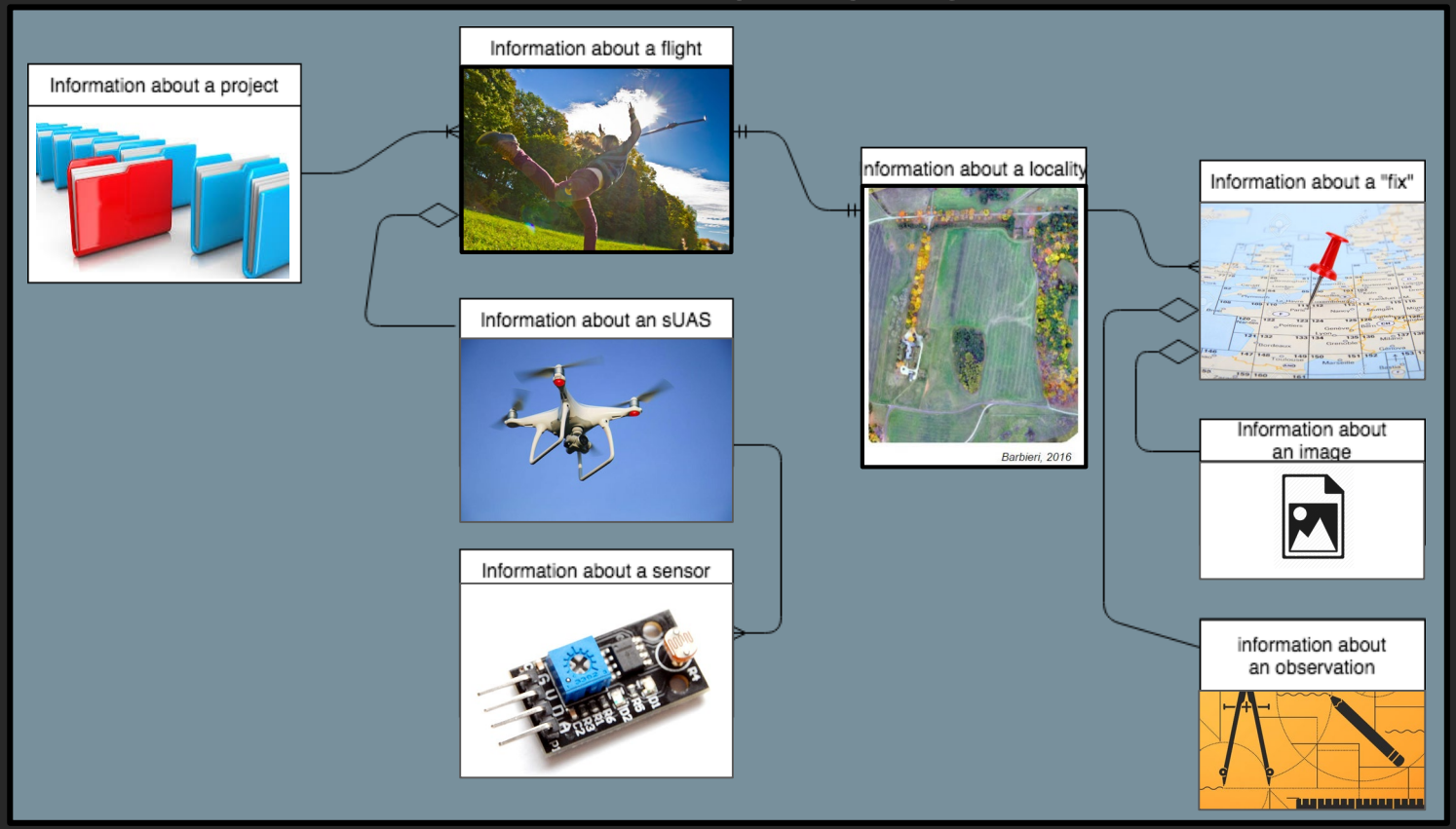
Minimum Information Framework

A high level model of key **information classes** and **parameters**;

and the **relationships between** those information classes



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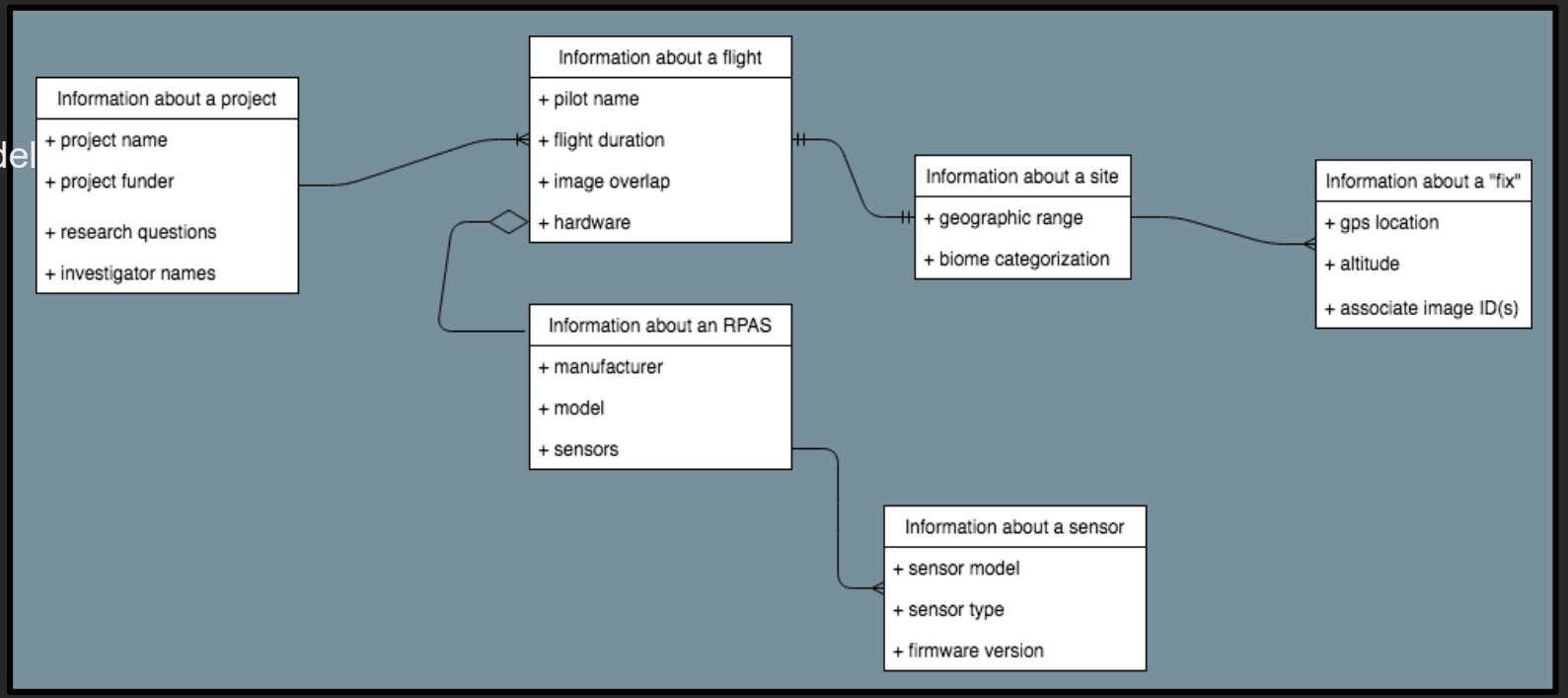

Wyngaard, J., Barbieri, L. K., Vardeman II, C., Leahy, B., Swanz, S., Thomer, A.K. (2018). Minimal Information Framework for Scientific Data Collection from Remotely Piloted Aircraft Systems (RPAS). Poster presented at 11th plenary of the Research Data Alliance. Berlin. doi:10.6084/m9.figshare.6145739

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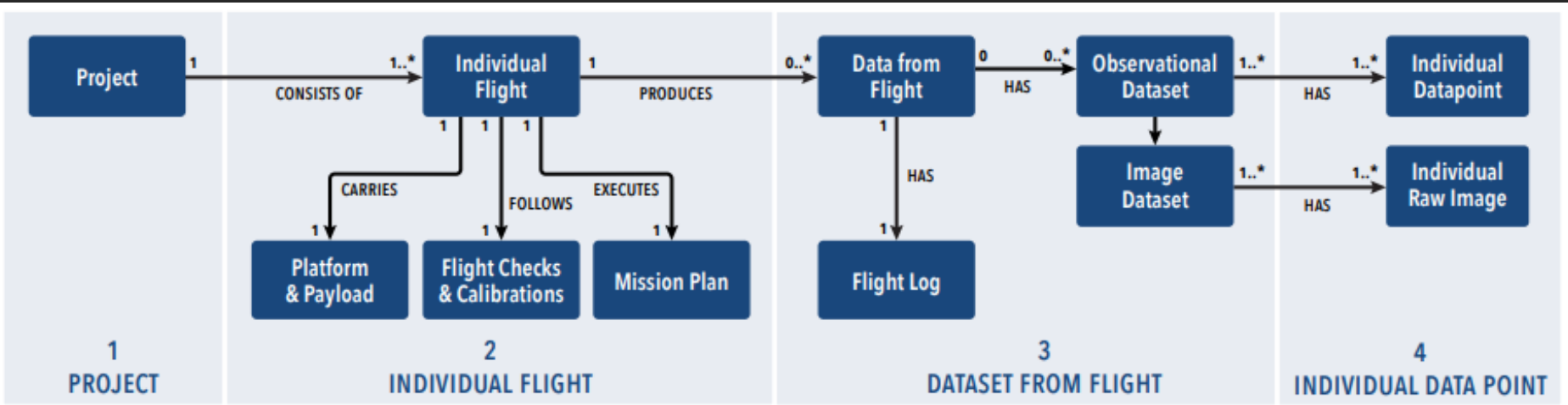
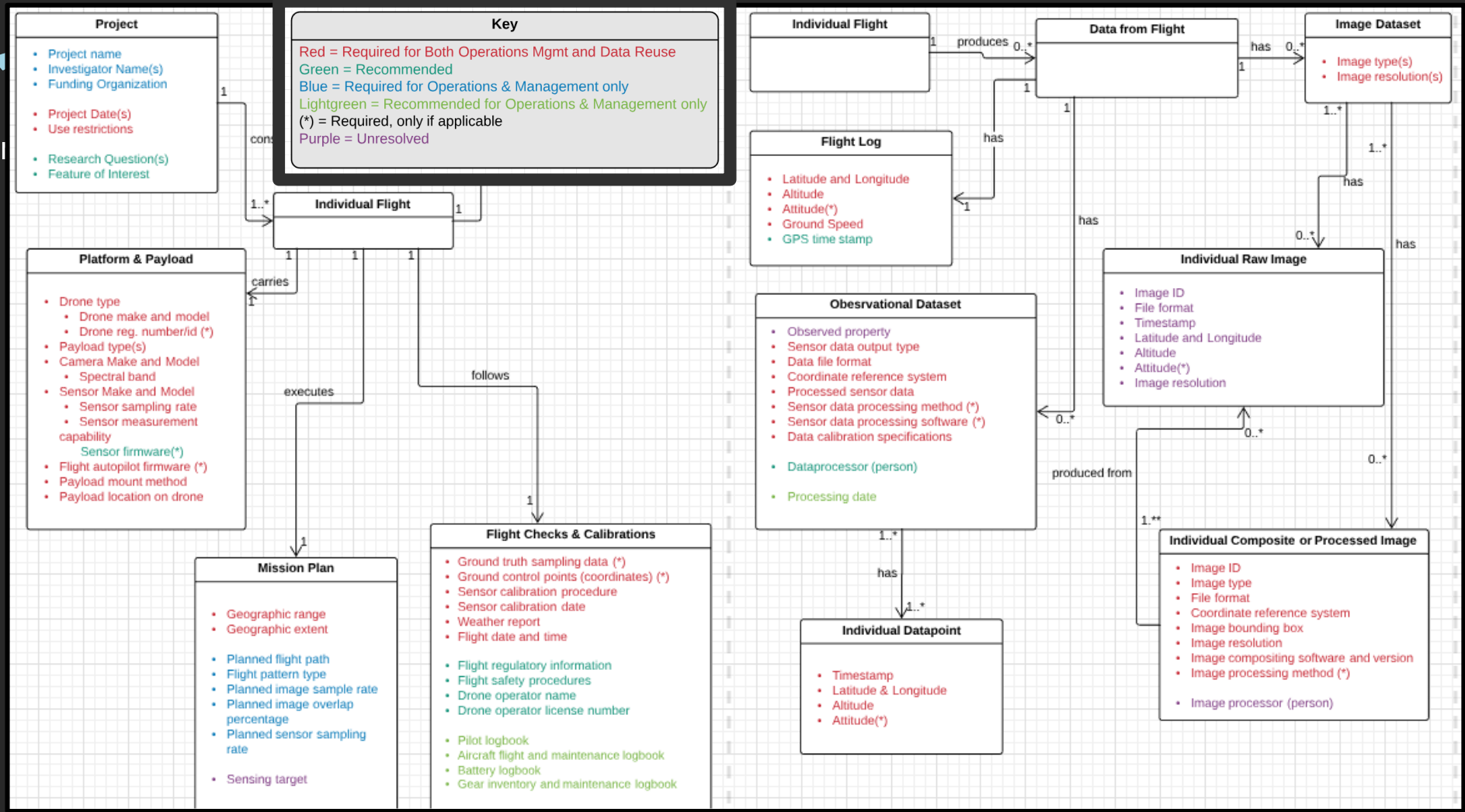
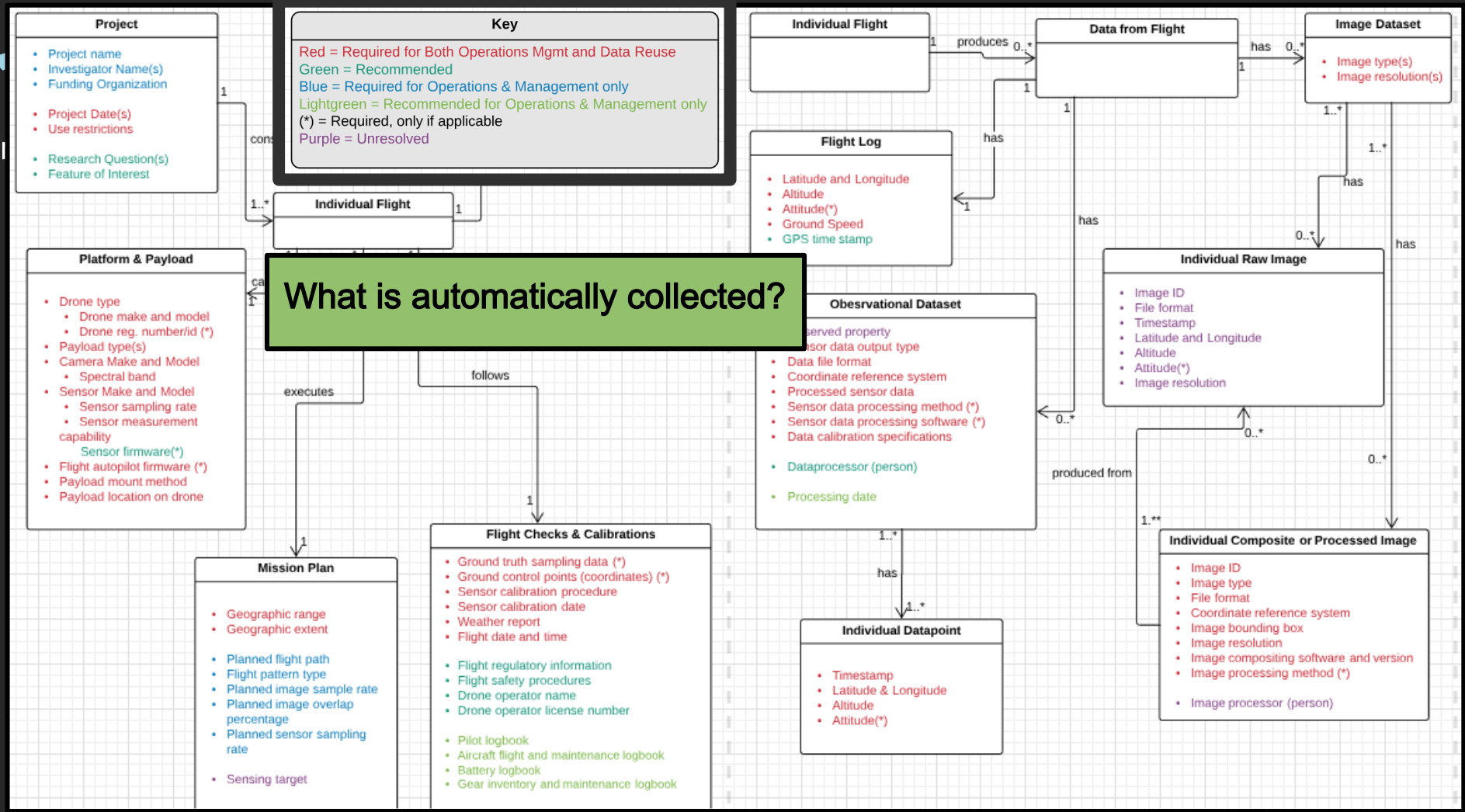


Figure 2. Core Classes of The Minimum Information Framework for sUAS datasets

Thomer, A.K.,Barbieri, L. K., Swanz, S.,Wyngaard, J., (2021). A Minimum Information Framework for capturing FAIR data with small Uncrewed Aircraft Systems,https://doi.org/10.31223/X5Z338


Key
Red = Required for Both Operations Mgmt and Data Reuse
Green = Recommended
Blue = Required for Operations & Management only
Lightgreen = Recommended for Operations & Management only
(*) = Required, only if applicable
Purple = Unresolved
Project
Project name
Investigator Name(s)
Funding Organization
Project Date(s)
Use restrictions
Research Question(s)
Feature of Interest
Individual Flight
Platform & Payload
Drone type
Drone make and model
Drone reg. number/id (*)
Payload type(s)
Camera Make and Model
Spectral band
Sensor Make and Model
Sensor sampling rate
Sensor measurement capability
Sensor firmware(*)
Flight autopilot firmware (*)
Payload mount method
Payload location on drone
Mission Plan
Geographic range
Geographic extent
Planned flight path
Flight pattern type
Planned image sample rate
Planned image overlap percentage
Planned sensor sampling rate
Sensing target
Flight Checks & Calibrations
Ground truth sampling data (*)
Ground control points (coordinates) (*)
Sensor calibration procedure
Sensor calibration date
Weather report
Flight date and time
Flight regulatory information
Flight safety procedures
Drone operator name
Drone operator license number
Pilot logbook
Aircraft flight and maintenance logbook
Battery logbook
Gear inventory and maintenance logbook
Individual Flight
Data from Flight
Image Dataset
Image type(s)
Image resolution(s)
Flight Log
Latitude and Longitude
Altitude
Attitude(*)
Ground Speed
GPS time stamp
Obesrvational Dataset
Observed property
Sensor data output type
Data file format
Coordinate reference system
Processed sensor data
Sensor data processing method (*)
Sensor data processing software (*)
Data calibration specifications
Dataprocessor (person)
Processing date
Individual Datapoint
Timestamp
Latitude & Longitude
Altitude
Attitude(*)
Individual Raw Image
Image ID
File format
Timestamp
Latitude and Longitude
Altitude
Attitude(*)
Image resolution
Individual Composite or Processed Image
Image ID
Image type
File format
Coordinate reference system
Image bounding box
Image resolution
Image compositing software and version
Image processing method (*)
Image processor (person)
produces
has
carries
executes
follows
produced from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Drone make and model
Drone reg. number/id (*)
Payload type(s)
Camera Make and Model
Spectral band
Sensor Make and Model
Sensor sampling rate
Sensor measurement capability
Sensor firmware(*)
Flight autopilot firmware (*)
Payload mount method
Payload location on drone
What is automatically collected?
executes
follows
Mission Plan
Geographic range
Geographic extent
Planned flight path
Flight pattern type
Planned image sample rate
Planned image overlap percentage
Planned sensor sampling rate
Sensing target
Flight Checks & Calibrations
Ground truth sampling data (*)
Ground control points (coordinates) (*)
Sensor calibration procedure
Sensor calibration date
Weather report
Flight date and time
Flight regulatory information
Flight safety procedures
Drone operator name
Drone operator license number
Pilot logbook
Aircraft flight and maintenance logbook
Battery logbook
Gear inventory and maintenance logbook
Individual Flight
produces
Data from Flight
has
Image Dataset
Image type(s)
Image resolution(s)
Flight Log
Latitude and Longitude
Altitude
Attitude(*)
Ground Speed
GPS time stamp
Obesrvational Dataset
served property
sor data output type
Data file format
Coordinate reference system
Processed sensor data
Sensor data processing method (*)
Sensor data processing software (*)
Data calibration specifications
Dataprocessor (person)
Processing date
Individual Raw Image
Image ID
File format
Timestamp
Latitude and Longitude
Altitude
Attitude(*)
Image resolution
produced from
Individual Composite or Processed Image
Image ID
Image type
File format
Coordinate reference system
Image bounding box
Image resolution
Image compositing software and version
Image processing method (*)
Image processor (person)
Individual Datapoint
Timestamp
Latitude & Longitude
Altitude
Attitude(*)

Minimum Information Framework

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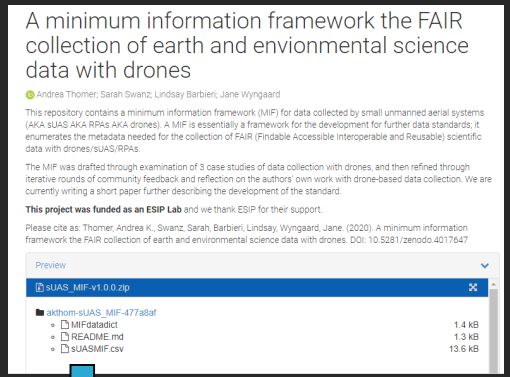
A minimum information framework the FAIR collection of earth and envionmental science data with drones

Andrea Thomer; Sarah Swanz; Lindsay Barbieri; Jane Wyngaard

This repository contains a minimum information framework (MIF) for data collected by small unmanned aerial systems (AKA sUAS AKA RPAs AKA drones). A MIF is essentially a framework for the development for further data standards; it enumerates the metadata needed for the collection of FAIR (Findable Accessible Interoperable and Reusable) scientific data with drones/sUAS/RPAs.

The MIF was drafted through examination of 3 case studies of data collection with drones, and then refined through iterative rounds of community feedback and reflection on the authors' own work with drone-based data collection. We are currently writing a short paper further describing the development of the standard.

This project was funded as an ESIP Lab and we thank ESIP for their support.

Please cite as: Thomer, Andrea K., Swanz, Sarah, Barbieri, Lindsay, Wyngaard, Jane. (2020). A minimum information framework the FAIR collection of earth and environmental science data with drones. DOI: 10.5281/zenodo.4017647

Preview

sUAS_MIF-v1.0.0.zip

akthom-sUAS_MIF-477a8af

MIFdatadict	1.4 kB
README.md	1.3 kB
sUASMIF.csv	13.6 kB

Thomer, A.K.,Barbieri, L. K., Swanz, S.,Wyngaard, J., (2021). A Minimum Information Framework for capturing FAIR data with small Uncrewed Aircraft Systems, https://doi.org/10.31223/X5Z338

Attribute ID	MIF Class	Subclass: specific types of data within a broader class	Attribute: The specific characteristic being captured in a given field/term	Attribute definitions	Discovery: Is this metadata important for data discovery / to facilitate search discovery	Discovery Level of Importance: quantitative score of importance of this metadata for discovery. 1-5 1 == not useful 2 == may be useful but non essential 3 == useful but non essential 4 == useful and may be essential 5 == essential	Fit For Use: Is this metadata important for determining if data is worth downloading.	Fit For Use Level of Importance: quantitative score of importance of this metadata for discovery. 1-5 1 == not useful 2 == may be useful but non essential 3 == useful but non essential 4 == useful and may be essential 5 == essential	Reuse: Is this metadata important for determining if data is sufficiently appropriate for use in a given usecase.	Reuse Level of Importance: quantitative score of importance of this metadata for discovery. 1-5 1 == not useful 2 == may be useful but non essential 3 == useful but non essential 4 == useful and may be essential 5 == essential
1	Project	n/a	Investigators	name of primary inves	Yes	2	Yes	2	No	1
2	Project	n/a	Sponsering organiza	name and description	Yes	2	Yes	2	No	1
3	Project	n/a	Project name	name of research pro	Yes	3	Yes	2	No	1
4	Project	n/a	Dates	date range of the ove	Yes	3	Yes	3	Yes	4
5	Project	n/a	Research question(s	description of researc	Yes	3	Yes	3	Yes	4
6	Project	n/a	Feature of interest	description of enviror	Yes	4	Yes	4	Yes	3
7	Project	n/a	Use restrictions	description of who ou	No	1	Yes	4	Yes	4
8	Project	n/a	Access restrictions	description of any res	Yes	2	Yes	5	Yes	5
9	Individual Flight	Flight Checks & Ca	Drone operator iden	name / license numbe	No	1	Yes	2	Yes	2
10	Individual Flight	Flight Checks & Ca	Flight regulatory info	description of relevar	No	1	Yes	2	Yes	2
11	Individual Flight	Flight Checks & Ca	Flight safety proced	record of pre-flight sa	No	1	No	1	No	1
12	Individual Flight	Flight Checks & Ca	Flight date and time	date and time of day c	Yes	4	Yes	4	Yes	5
13	Individual Flight	Flight Checks & Ca	Weather	description of weathe	No	1	Yes	3	Yes	4
14	Individual Flight	Flight Checks & Ca	Sensor calibration pr	description of sensor	No	1	Yes	4	Yes	5
15	Individual Flight	Flight Checks & Ca	Sensor calibration d	most recent date of s	No	1	Yes	4	Yes	4
16	Individual Flight	Flight Checks & Ca	Ground truth samplir	description and date c	No	1	Yes	4	Yes	4
17	Individual Flight	Flight Checks & Ca	Ground truth control	description of ground	No	1	Yes	4	Yes	4
18	Individual Flight	Mission Plan	Mission planning so	name of mission plan	No	1	No	1	Yes	3
19	Individual Flight	Mission Plan	Planned flight path	a log or data file of th	No	1	Yes	2	Yes	2
20	Individual Flight	Mission Plan	Flight pattern type	description of flight p	Yes	3	Yes	3	Yes	3
21	Individual Flight	Mission Plan	Set image overlap pe	the set percentage an	No	1	Yes	3	Yes	3
22	Individual Flight	Mission Plan	Geographic extent	size of area covered	Yes	4	Yes	3	Yes	3
23	Individual Flight	Mission Plan	Geographic range	the bounded geograp	Yes	5	Yes	3	Yes	5
24	Individual Flight	Mission Plan	Sensing target	name of the paramet	Yes	4	Yes	3	Yes	3
25	Individual Flight	Mission Plan	Sensor trigger rate	the rate at which sens	No	1	Yes	3	Yes	4
26	Individual Flight	Platform & Payloac	Drone identification	drone registration nur	No	1	No	1	No	1
27	Individual Flight	Platform & Payloac	Drone type	type of drone (e.g. fixe	Yes	2	Yes	4	Yes	4
28	Individual Flight	Platform & Payloac	Drone make and mo	name of drone manuf	Yes	2	Yes	3	Yes	4
29	Individual Flight	Platform & Payloac	Modifications to har	description of any cha	No	1	Yes	3	Yes	4
30	Individual Flight	Platform & Payloac	Autopilot make and	name of autopilot and	No	1	No	1	Yes	2
31	Individual Flight	Platform & Payloac	Flight autopilot firmv	name of autopilot ma	No	1	Yes	2	Yes	2
32	Individual Flight	Platform & Payloac	Payload type(s)	general name and des	Yes	4	Yes	5	Yes	4
33	Individual Flight	Platform & Payloac	Companion comput	onboard companian c	No	1	Yes	2	Yes	2
34	Individual Flight	Platform & Payloac	Sensor location on c	description of placem	No	1	Yes	4	Yes	4
35	Individual Flight	Platform & Payloac	Sensor mount and o	description of sensor	No	1	Yes	4	Yes	4
36	Individual Flight	Platform & Payloac	Sensor make and m	name of sensor, man	Yes	3	Yes	4	Yes	5
37	Individual Flight	Platform & Payloac	Sensor firmware and	name and version nur	No	1	Yes	4	Yes	4
38	Individual Flight	Platform & Payloac	Sensor measuremer	description of measu	Yes	2	Yes	4	Yes	4
39	Individual Flight	Platform & Payloac	Sensor sampling rat	the rate at which sens	No	1	Yes	4	Yes	4
40	Dataset From Flight	Flight Log	Flight ID	unique identifier for a	Yes	2	No	1	No	1
41	Dataset From Flight	Flight Log	Flight path of drone	the coordinates of th	Yes	4	Yes	4	Yes	4
42	Dataset From Flight	Flight Log	GPS time stamp cha	in what units and with	Yes	4	Yes	4	Yes	4
43	Dataset From Flight	Flight Log	Altitude characterist	in what units and with	No	1	Yes	4	Yes	4
44	Dataset From Flight	Flight Log	Ground speed chara	in what units and with	No	1	Yes	3	Yes	3
45	Dataset From Flight	Flight Log	Air speed characteri	in what units and with	No	1	Yes	3	Yes	3
46	Dataset From Flight	Flight Log	Wind speed characte	in what units and with	No	1	Yes	3	Yes	3
47	Dataset From Flight	Flight Log	Pitch characteristics	in what units and with	No	1	Yes	3	Yes	4
48	Dataset From Flight	Flight Log	Yaw characteristics	in what units and with	No	1	Yes	3	Yes	4
49	Dataset From Flight	Flight Log	Roll characteristics	in what units and with	No	1	Yes	3	Yes	4
50	Dataset From Flight	Observational Data	Data file format	the file format of the	Yes	2	Yes	4	Yes	2
51	Dataset From Flight	Observational Data	Observed property	description of all prop	Yes	4	Yes	4	Yes	5
52	Dataset From Flight	Observational Data	Sensor identification	identification of the s	No	1	Yes	3	Yes	4
53	Dataset From Flight	Observational Data	Sensor specification	description of sensiti	No	1	Yes	3	Yes	3
54	Dataset From Flight	Observational Data	Sensor data output t	description of type of	Yes	5	Yes	4	Yes	4
55	Dataset From Flight	Observational Data	Sensor sampling dur	the duration of time th	Yes	2	Yes	3	Yes	3

https://zenodo.org/record/4124167#.YZKdZ2DMId
U

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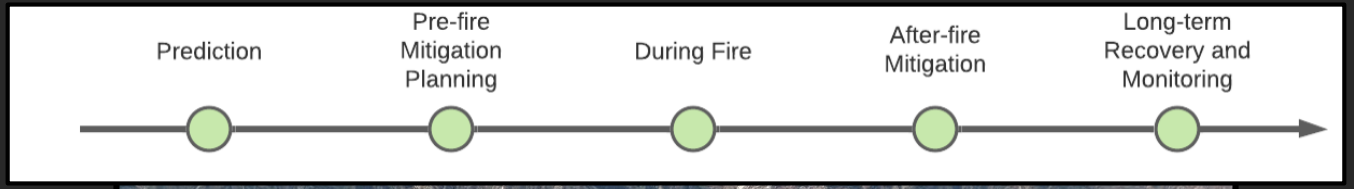
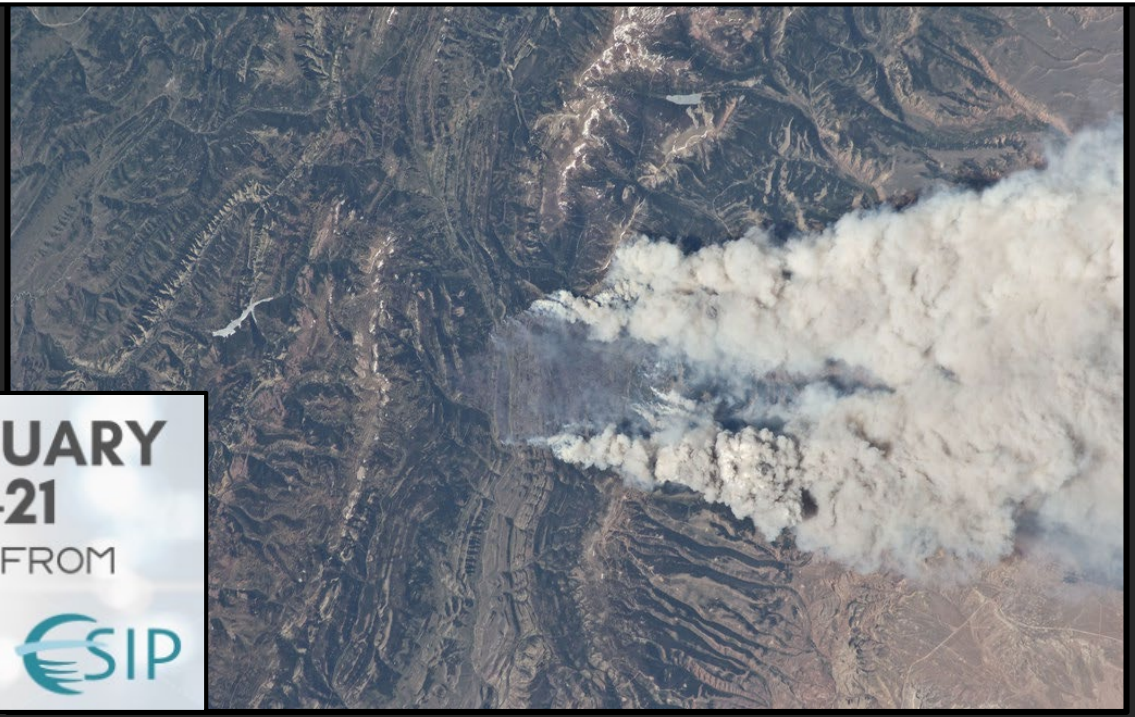
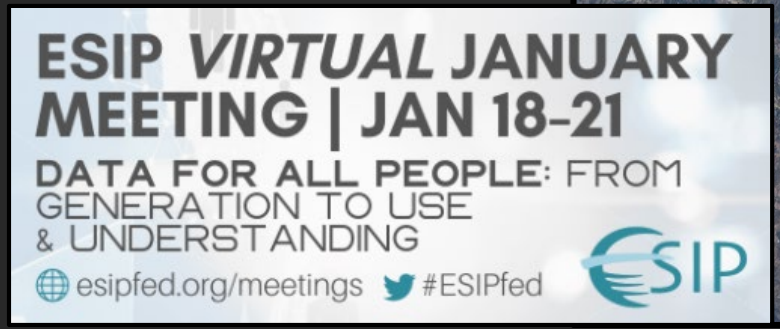
Data Sharing Guidelines, Important for Wildfires



ESIP January Meeting:
https://2022esipjanuary_meeting.sched.com/info





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Questions?
barbieri@esipfed.org

Join the Monday Update Mailing List: eepurl.com/cFmghz

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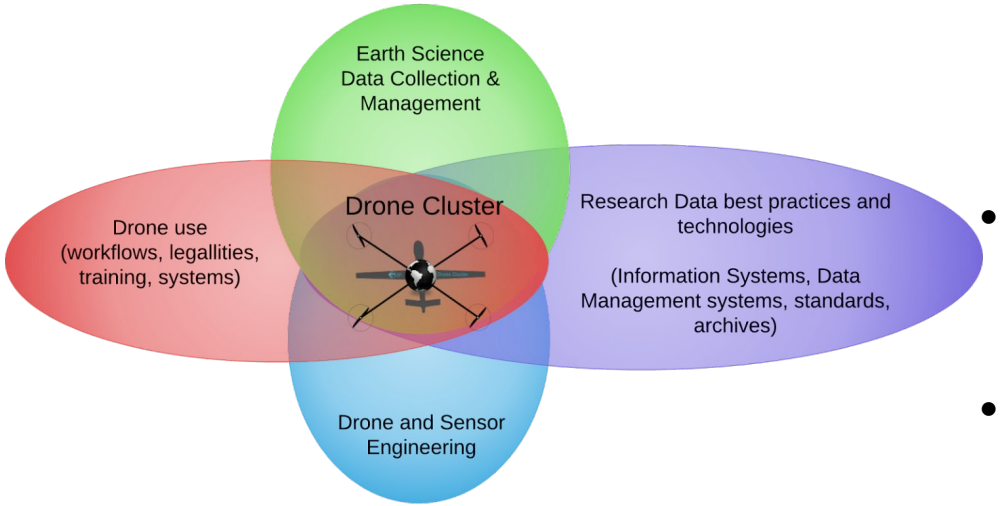
Summary!

Drone Cluster

Working to make scientific data collected with drones FAIR and science drones easier to use.



Tags:

Drones, FAIR Data, Semantic Tech, IoT

NEW AND NOTEWORTHY

- ESIP Laboratories grant outcomes: ***Minimal Information Framework for Science Drone Data Workflows***
  - OSF: https://osf.io/n6t9b/
  - Take our survey! contribute to the FAIRness of drone data: http://bit.ly/droneDataSurvey
- **Drone Sensor Data Collections** (Sphex and Shongololo) Snaps (Single board computer Ubuntu applications)
  - https://gitlab.com/r4space/VTAgMonitoring
- **International Data Week Novembe**r 2018
  - Science Drone Flight Week
  - Drone datathon
  - SciDataCon
  - https://rpasdm.github.io/

Want to learn more? esip-drone@lists.esipfed.org

Outline

1. sUAS scientific data challenges
    a. sUAS data is unique
    b. 10 challenges

2. ESIP Minimal Information Framework project
    a. Case Studies
    b. Ontologies
    c. MIF

sUAS Scientific Data Challenges

1. What **standard sensor calibration** and use procedures need to be defined and articulated?

1. What **best practices regarding data post processing** and error analysis methodology need to be outlined?

1. **What is the minimum information** that needs to be collected about a scientific sUAS data capture flight?

1. Which **formats** should be used to store (meta)data in?

1. Which **ontologies** should be applied -- or need to be developed -- for sUAS (meta)data? (what we began addressing at the VOCamp)

sUAS Scientific Data Challenges

Why Care?

Why Now?

sUAS Scientific Data Challenges

Why Care?

- **Good Science!** Understand & reduce uncertainty, important for science outcomes
- **Sharing!** Reproducible and reusable
- **Quicker, Better Science!** Increased learning and more rapid “best practices” science development

sUAS Scientific Data Challenges

Why Care?

- **Good Science!** Understand & reduce uncertainty, important for science outcomes
- **Sharing!** Reproducible and reusable
- **Quicker, Better Science!** Increased learning and more rapid “best practices” science development

Why Now?

- **Urgent!** sUAS are an increasingly used sensor platform for the sciences
- **Momentum and support!** Open science and FAIR data practices
- **Possible!** Maturing of the technologies to enable and implement practices

ESIP Minimal Information Framework project

Minimum information framework: a list* of data and metadata attributes necessary for sharing and reuse

Project goals:

1. Define a high-level minimum information framework (MIF) for drone data based on case studies

1. Use MIF as backbone/testbed for preliminary drone data ontology

A first step towards achieving FAIRness is to both augment them with machine-readable, semantically-rich metadata, and to annotate them in ways that make their provenance (the record of the processes that created the data) explicit.

Approach

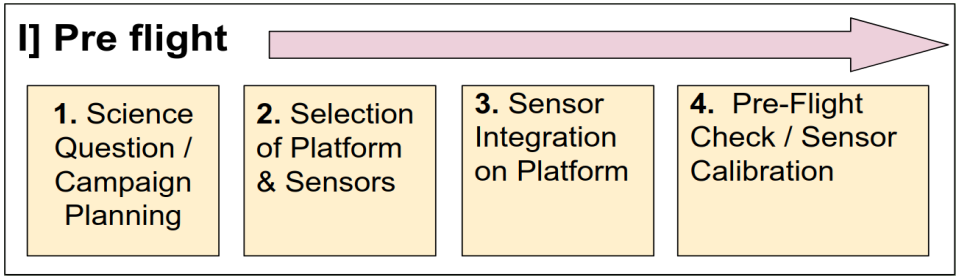
1) Work with drone data collectors to document their:
    - Workflows
    - Data products
    - Data needs

2) Create a Minimum Information Framework (a high level information model) of key data classes necessary for reuse

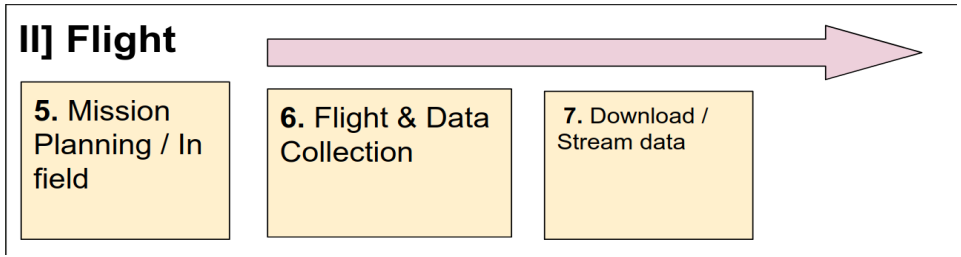
3) Refine via community feedback

4) Use as basis of ontologies, data standard.

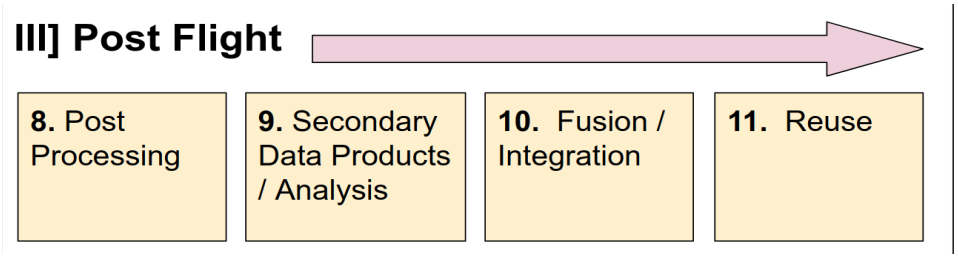
Collecting and analyzing scientific RPAS workflows



Collecting and analyzing scientific RPAS workflows



Collecting and analyzing scientific RPAS workflows

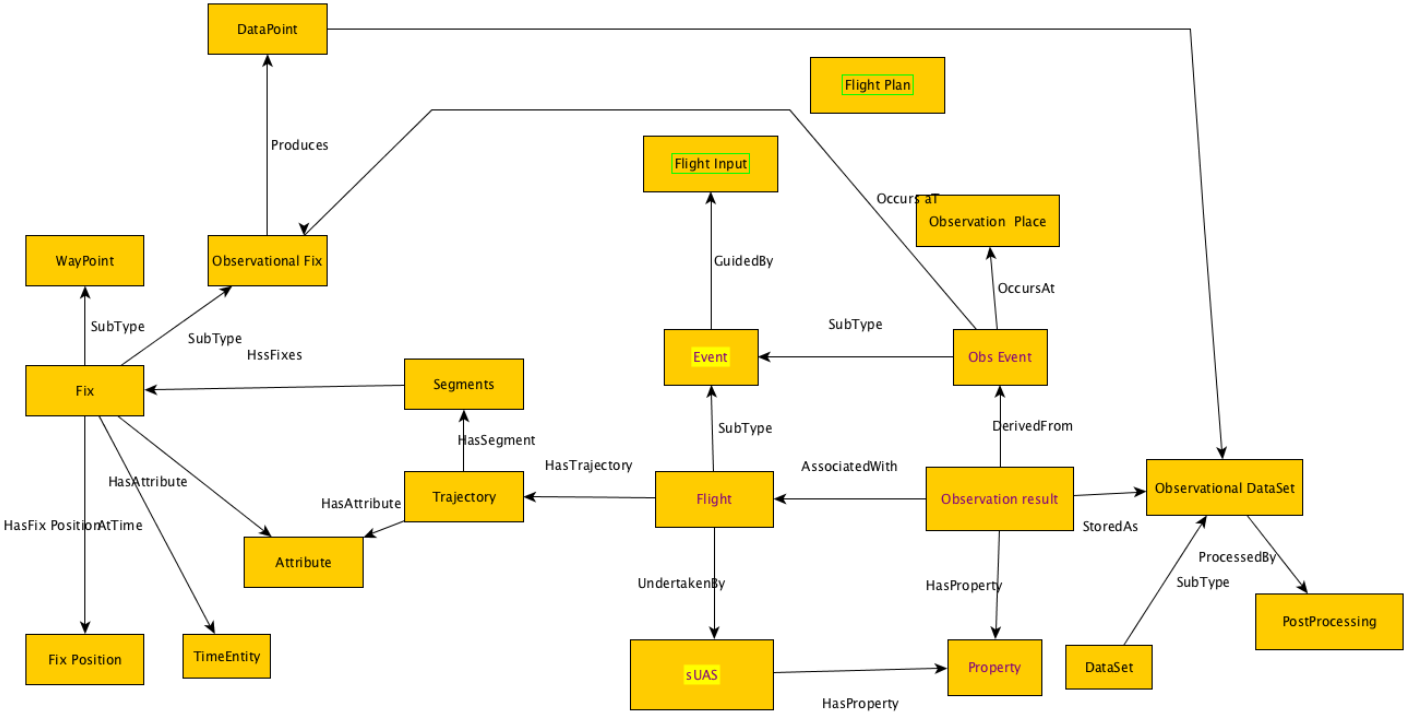


VOCamp: https://github.com/Vocamp/dronedata

- Ontologies to build on
  - Geolink (ontology design pattern) http://daselab.cs.wright.edu/pub/2015-geolink-ontology.pdf
  - W3C SOSA
  - Various IEEE UAV/Robot ontologies

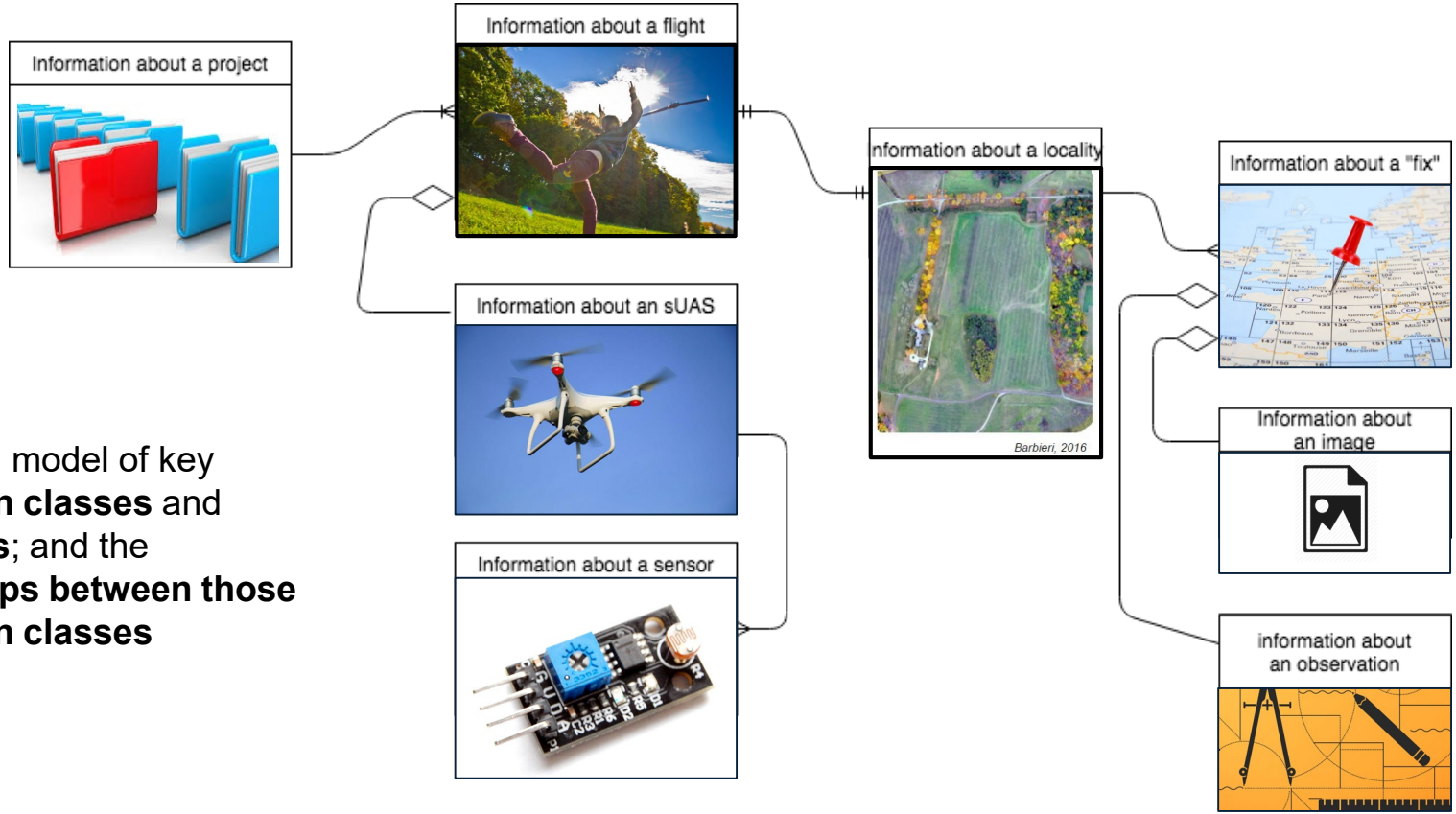
- Format candidates
  - Onboard, web accessible: CoverageJSON
  - Archive: NetCDF

Results: Ontology Design patterns



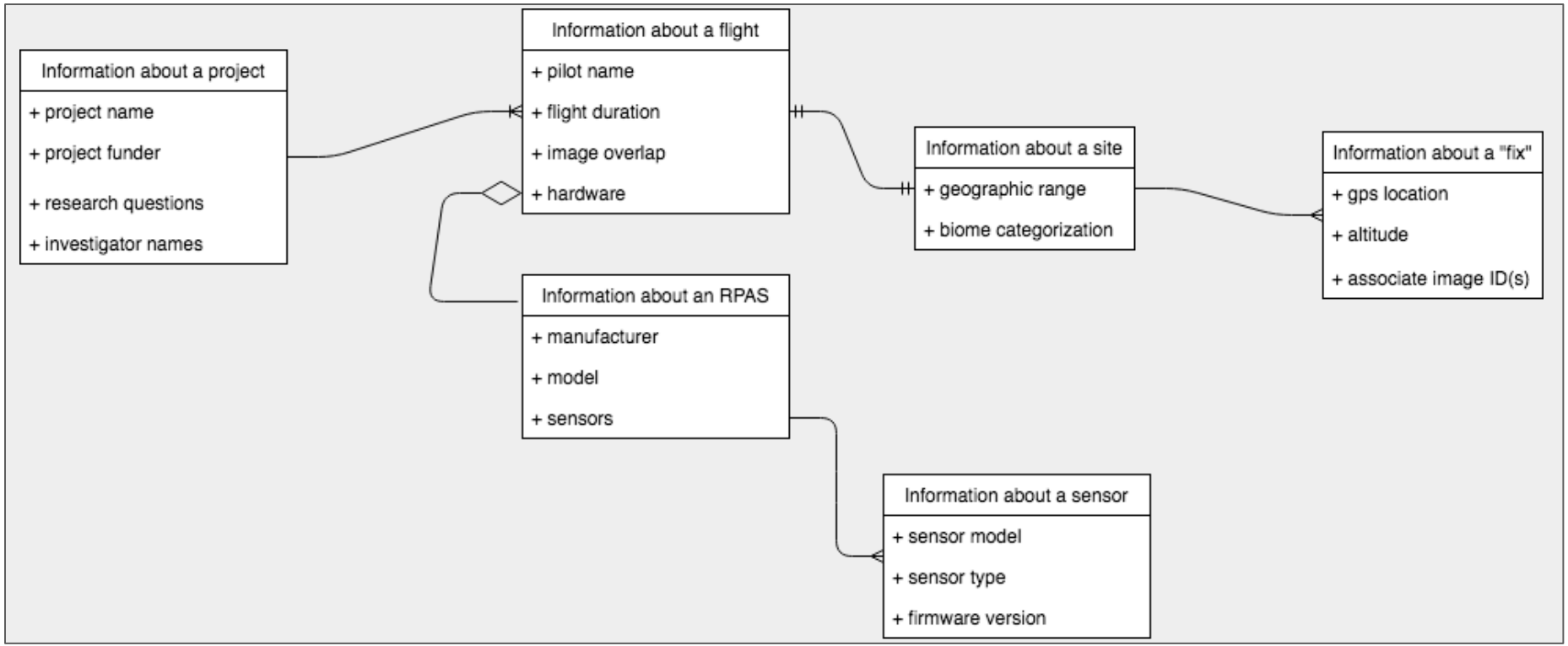
https://github.com/Vocamp/dronedata/tree/master/concept_maps

Results: Minimum Information Framework



A high level model of key **information classes** and **parameters**; and the **relationships between those information classes**

Minimum information framework (so far)



Wyngaard, J., Barbieri, L. K., Vardeman II, C., Leahy, B., Swanz, S., Thomer, A.K. (2018). Minimal Information Framework for Scientific Data Collection from Remotely Piloted Aircraft Systems (RPAS). Poster presented at 11th plenary of the Research Data Alliance. Berlin. doi:10.6084/m9.figshare.6145739

*not a list

On-going: Drone Data Survey

Do you use drones in your research or teaching? We need your feedback!

http://bit.ly/droneDataSurvey

Enviro-sensing <-> Drone Cluster

- Ontology design pattern(s) needs more community driven work (need funding)
  - By Scientific or System Domain?
- Community discussion around:
  - Best sampling practices
  - Best standard sensor calibration processes
  - What is the minimum information necessary to be FAIR
  - FAIR archives for “small” data/time series
  - Formats… (meta)data...