Drones

Jan 30 ,2024

GEOG 457/657

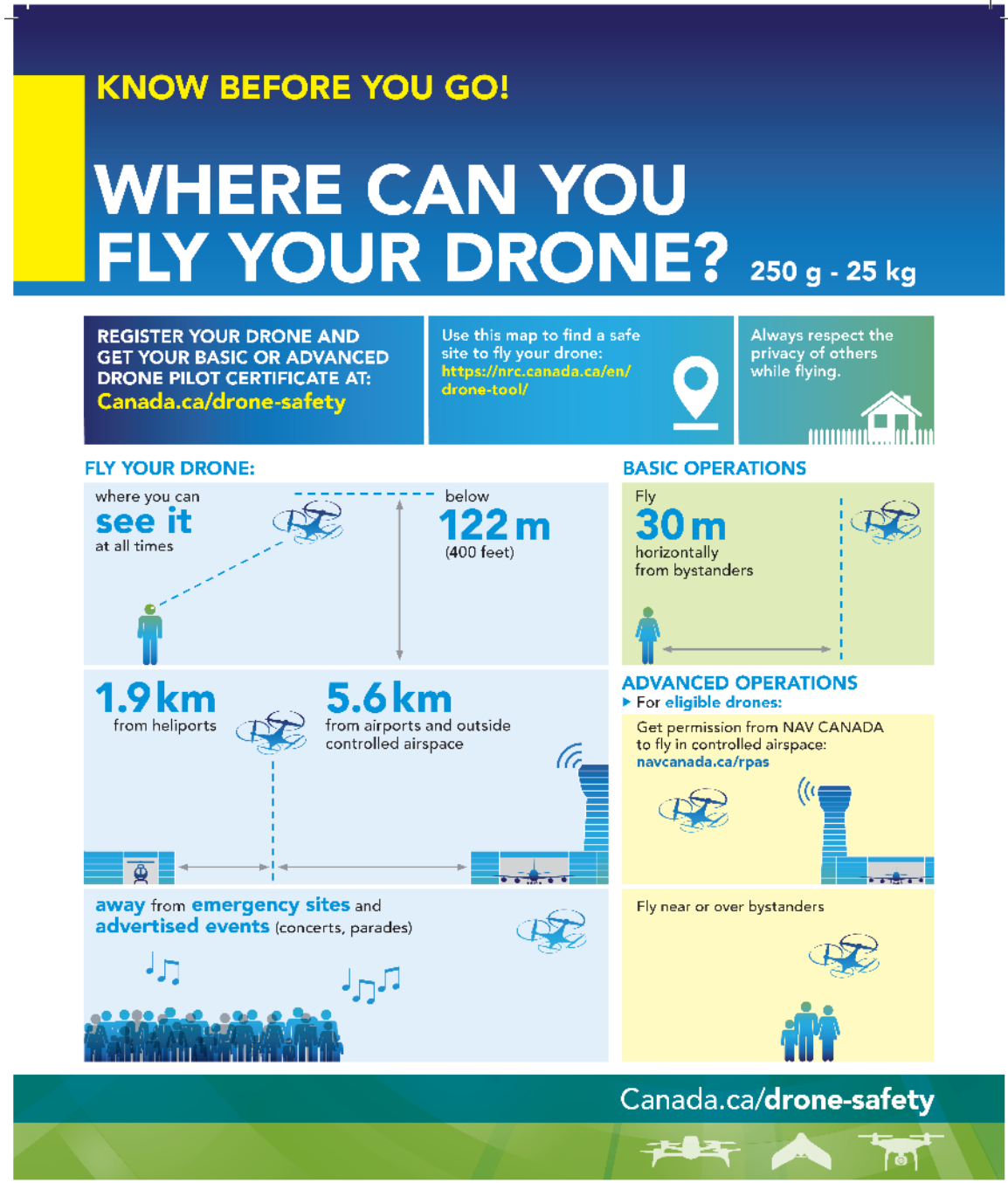
Alexandre Bevington

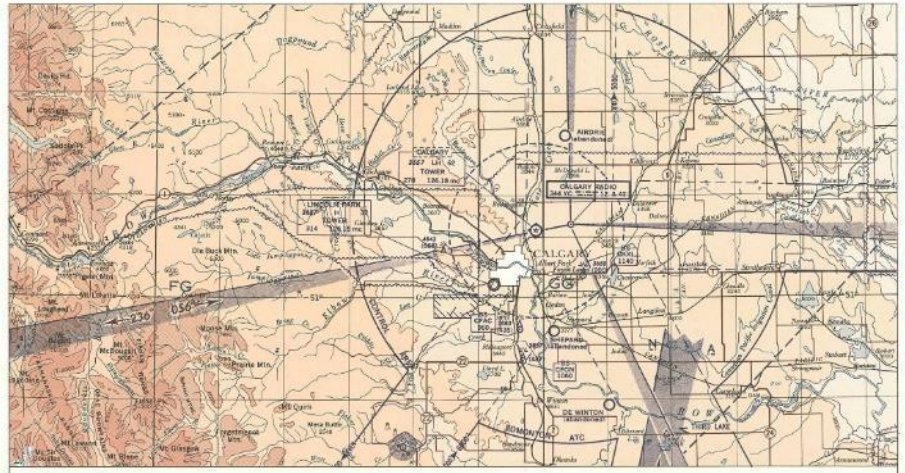
Remotely Piloted Aircraft System (RPAS)

- An unmanned aircraft which is piloted from a remote pilot station.
- System includes: Aircraft, remote pilot station(s), command and control links, and other specified components.
- Why use drones? High spatial resolution, access unsafe locations, increase efficiency in the field, generate valuable products, and they are fun!

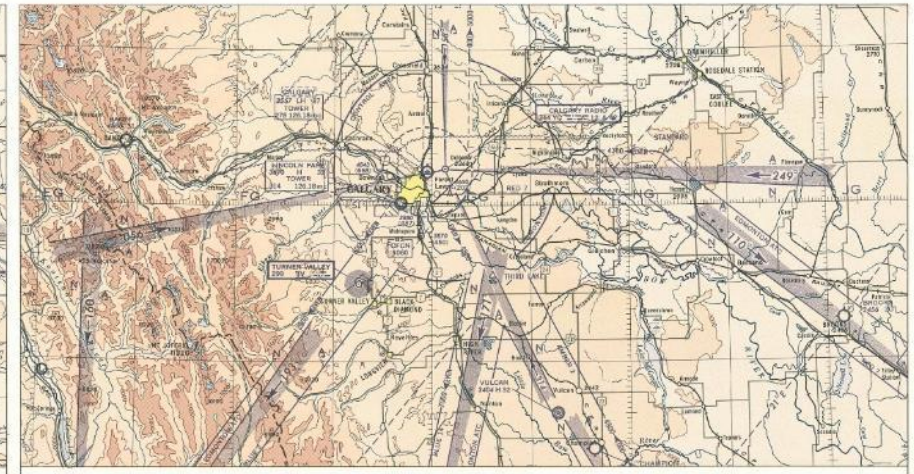
Rules and regulations

- Transport Canada regulates RPAS in Canada
- Pilots must be aware of the law
- Pilot certification program and drone registration
- Special Flight Operations Certificate (SFOC) for special circumstances

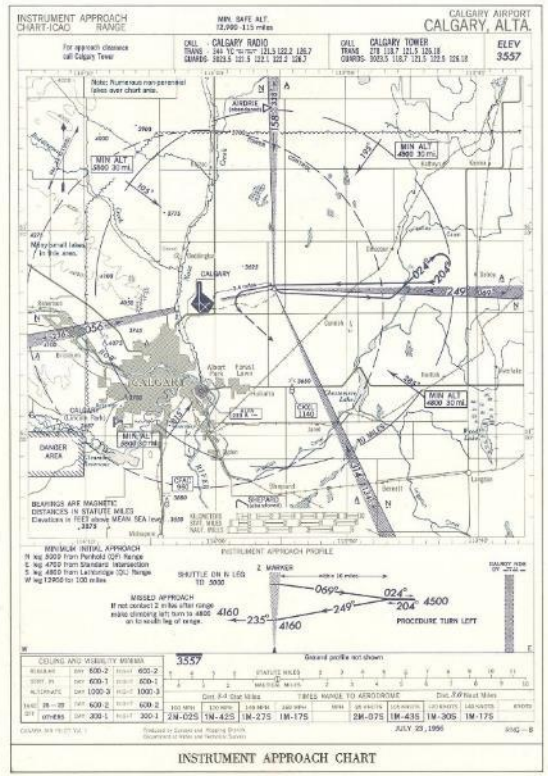




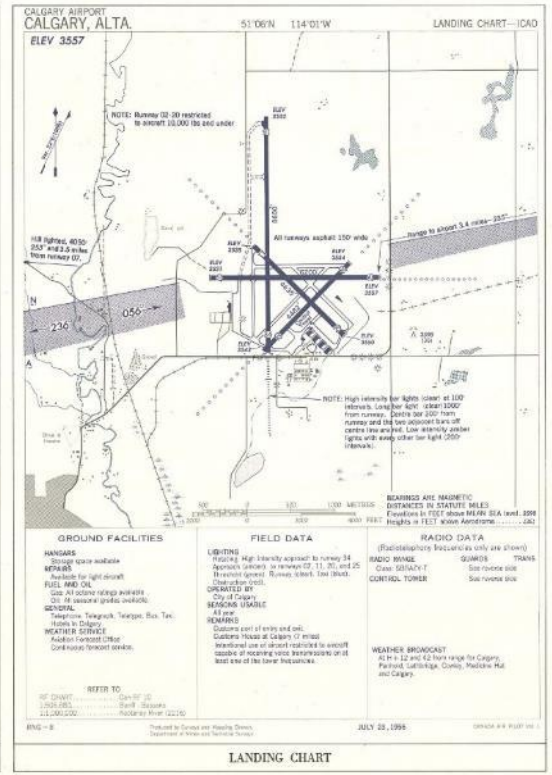
AERONAUTICAL CHART
SCALE 8 MILES to 1 INCH



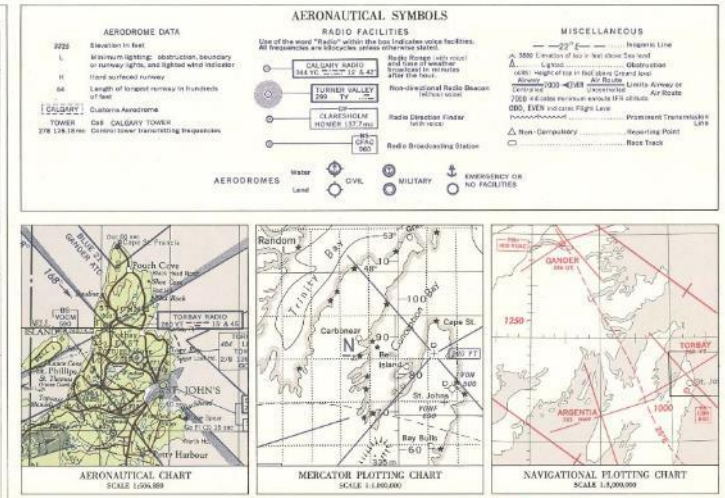
AERONAUTICAL CHART
SCALE 16 MILES to 1 INCH



INSTRUMENT APPROACH CHART



LANDING CHART



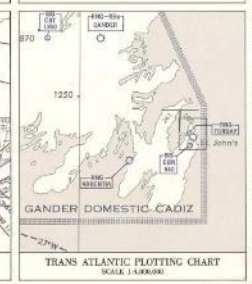
AERONAUTICAL SYMBOLS

AERONAUTICAL CHART
SCALE 1:506,880

MERCATOR PLOTTING CHART
SCALE 1:1,000,000

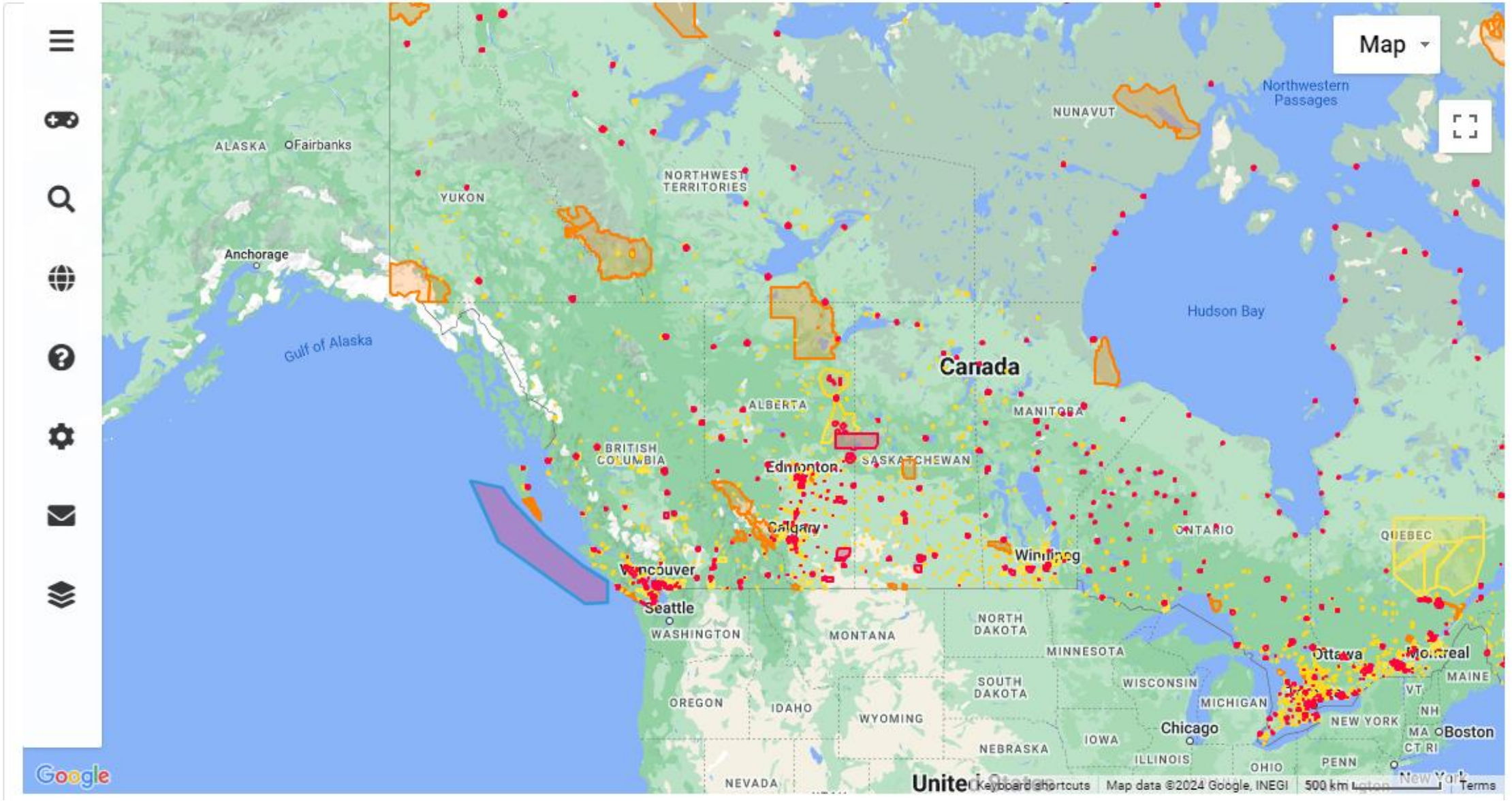
NAVIGATIONAL PLOTTING CHART
SCALE 1:1,000,000

RADIO FACILITY CHART
SCALE 1:5,506,400



TRANS ATLANTIC PLOTTING CHART
SCALE 1:4,000,000

AERONAUTICAL PLANNING CHART
SCALE 1:6,000,000



https://nrc.canada.ca/en/drone-tool/

Many areas encourage extra caution
Parks (National and Provincial, some Regional) require permission
Around military bases, prisons, else…
Does not include temporary restricted airspace

Privacy

- Risk of photographs containing private property, private spaces, or peoples faces.

How we use drones

- Situational awareness
- Photos / Videos
- Mapping
- Other

Common RPAS Types

- *Fixed Wing*:
  - Suitable for longer distances, heavier payloads, and extended flight times
  - Complicated takeoff / landing, less agile
- *Quadcopter/Octocopter*:
  - Agile and versatile for various application, easy take-off /landing
  - Lighter payloads
- *Balloons/Kites*:
  - Less common, well suited for specific operations.

Payloads

- *Sensor Types*
  - Multispectral
  - Hyperspectral
  - LiDAR
- *Gimbal Systems*
  - Stabilization for precise data capture
- *Other*:
  - Adaptation for specific applications

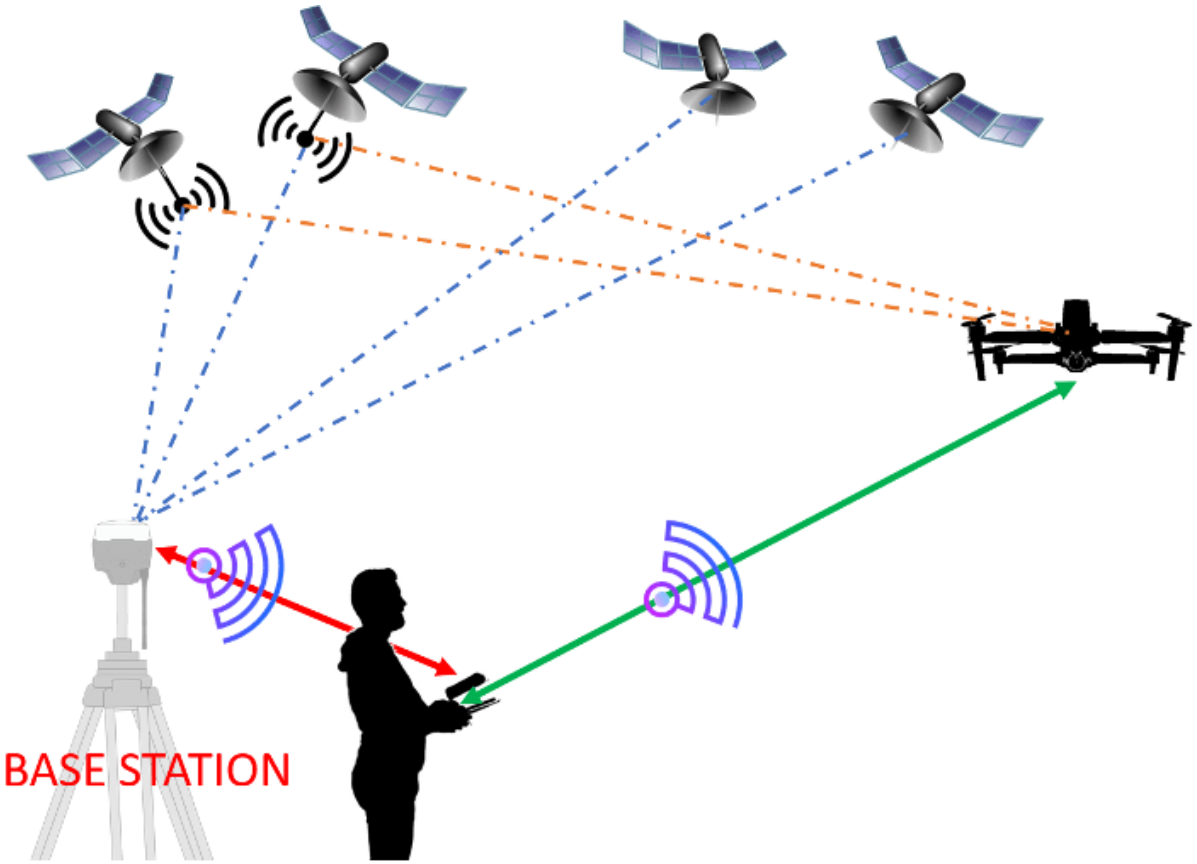
Weight Class Considerations

- *Microdrones*: Under 250g
  - Minimal regulations.
- *Small Drones*: 250g to 25kg
  - Standard RPAS regulations.
- *Large Drones*: Over 25kg
  - Special permissions and stricter regulations.

- Pros/Cons?

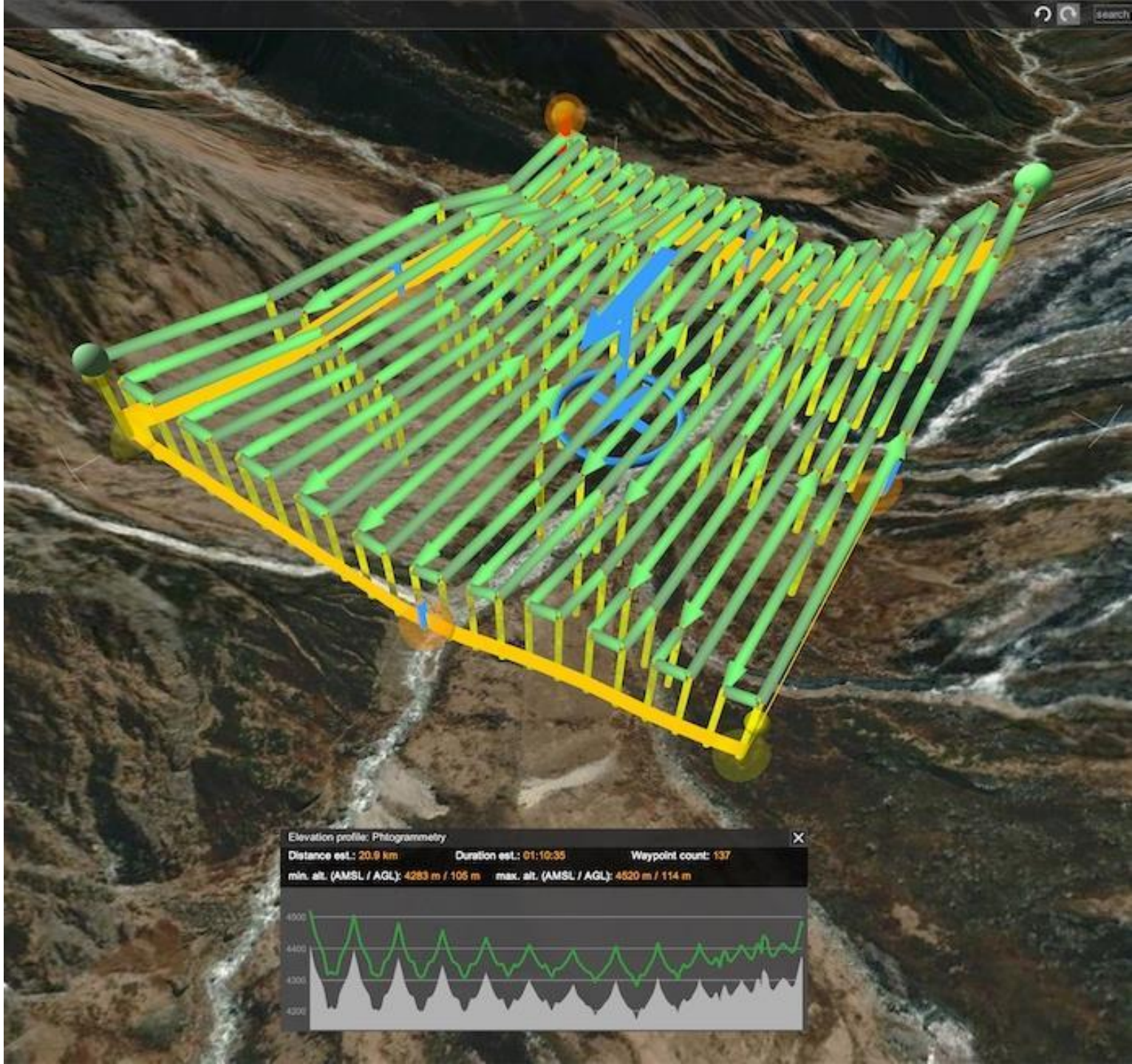
GPS and Targets

- ***Onboard GPS***:
  - Integrated GPS for positioning (typically ~5m accuracy)
  - Newer RTK systems onboard ($) (typically ~1cm accuracy with base station)
- ***Ground Targets***:
  - Points on the ground for that you can survey with an RTK system and then correct the ortho.



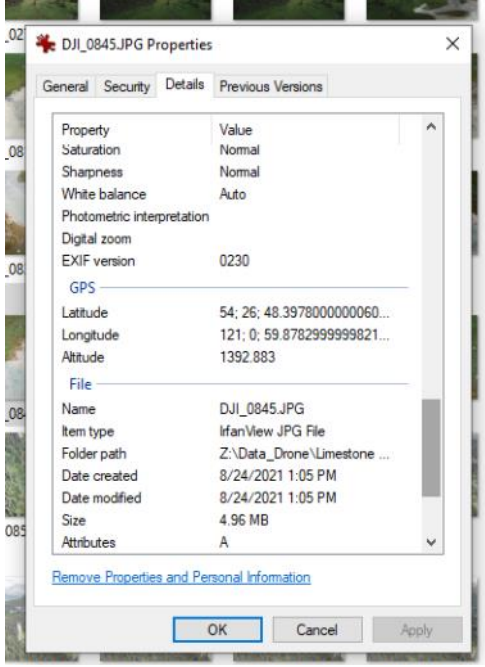
Flight control options

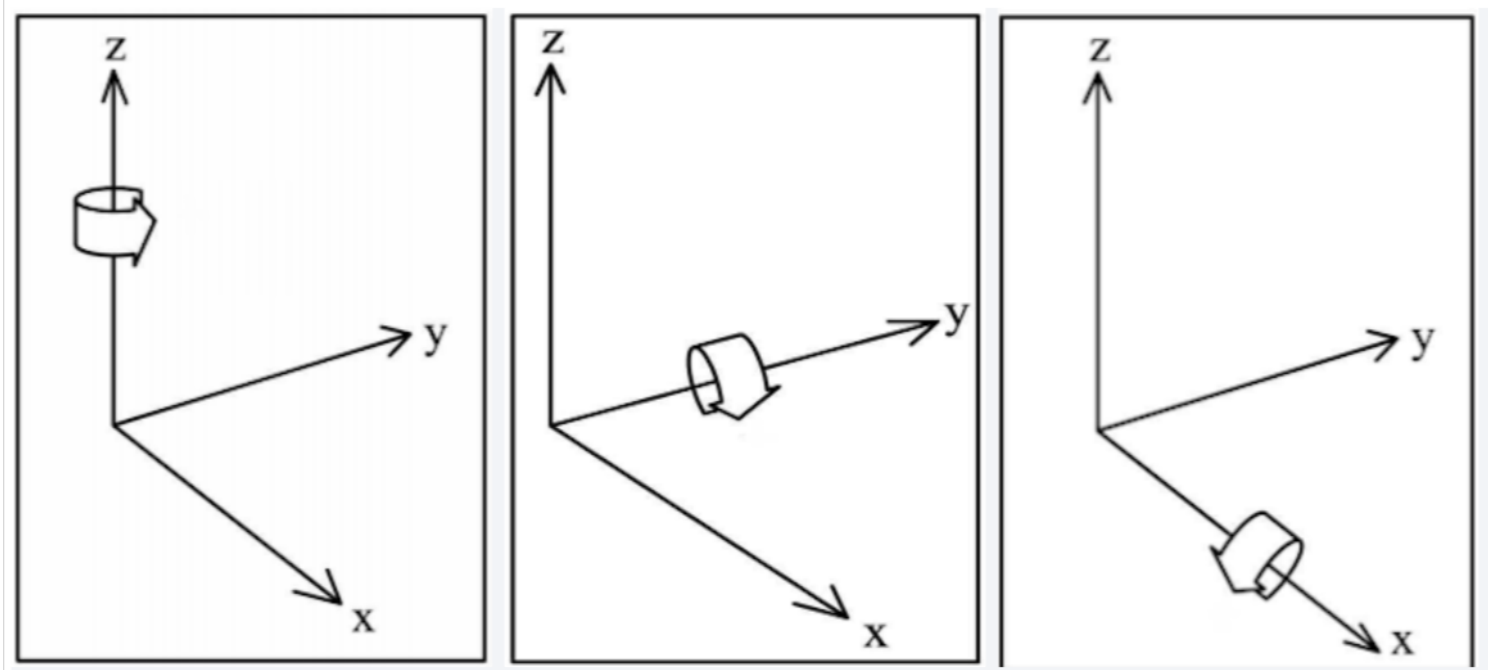
- Manual Flight
- ‘Follow-me’
- 3D Building
- Survey Grid
- DEM Adjusted Survey Grid



Exif attributes

- Metadata recorded in images themselves using the exchangeable image file format (Exif) standar. Exif typically includes:
  - Latitude,
  - Longitude
  - Elevation
  - Roll - Kappa
  - Pitch - Phi
  - Yaw - Omega



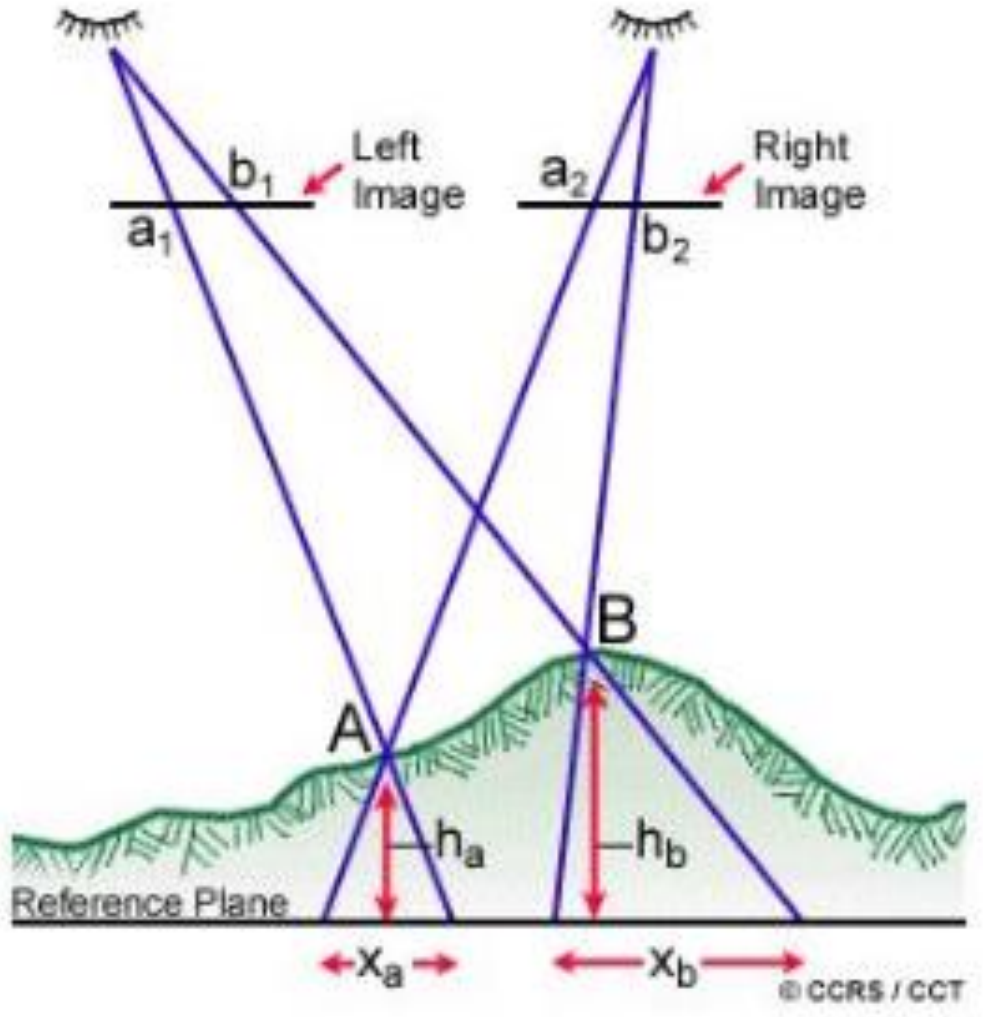


Rotation around the Z-axis (Kappa) Rotation around the Y-axis (Phi) Rotation around the X-axis (Omega)

Exterior orientation rotations/angles.

Principles of Photogrammetry

- By capturing the same location in multiple images from different locations, we can calculate elevation
- Must first match points for image alignment
- *Software options*: Agisoft, Pix4D, Spexi, OpenDroneMap
- Generally creates a DSM and an Ortho. Can also make a DTM if the canopy is sparse.
- % overlap is user specified, more overlap = more matches



Untitled* — Agisoft Metashape Professional (30 days left)

File Edit View Workflow Model Photo Ortho Tools Help

Workspace

Workspace (1 chunks, 790 images)

Chunk 1 (790 images)

Model Ortho

Perspective 40°

Snap: Axis, 3D

Z

Y X

Property	Value
Chunk 1	
Cameras	790
Aligned cameras	0
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

Workspace Reference

Animation

Speed (%) X Y

Photos

DJI_0017 DJI_0018 DJI_0019 DJI_0020 DJI_0021 DJI_0022 DJI_0023 DJI_0024 DJI_0025 DJI_0026 DJI_0027 DJI_0028 DJI_0029 DJI_0030

DJI_0031 DJI_0032 DJI_0033 DJI_0034 DJI_0035 DJI_0036 DJI_0037 DJI_0038 DJI_0039 DJI_0040 DJI_0041 DJI_0042 DJI_0043 DJI_0044

Photos Console Jobs

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File Edit View Workflow Model Photo Ortho Tools Help

Workspace

Workspace (1 chunks, 790 images)

Chunk 1 (790 images, 41,921 tie points) [R]

Property	Value
Chunk 1	
Cameras	790
Aligned cameras	0
Coordinate system	WGS 84 (EPSG::4326)
Rotation angles	Yaw, Pitch, Roll

Workspace Reference

Animation

Speed (%) X Y

Model Ortho

Perspective 40°

Snap: Axis, 3D

41,921 points

Photos

DJI_0017 DJI_0018 DJI_0019 DJI_0020 DJI_0021 DJI_0022 DJI_0023 DJI_0024 DJI_0025 DJI_0026 DJI_0027 DJI_0028 DJI_0029 DJI_0030

DJI_0031 DJI_0032 DJI_0033 DJI_0034 DJI_0035 DJI_0036 DJI_0037 DJI_0038 DJI_0039 DJI_0040 DJI_0041 DJI_0042 DJI_0043 DJI_0044

Photos Console Jobs

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