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UNIVERSITY OF LISBON  
INTERDISCIPLINARY STUDIES  
ON SUSTAINABLE ENVIRONMENT AND SEAS



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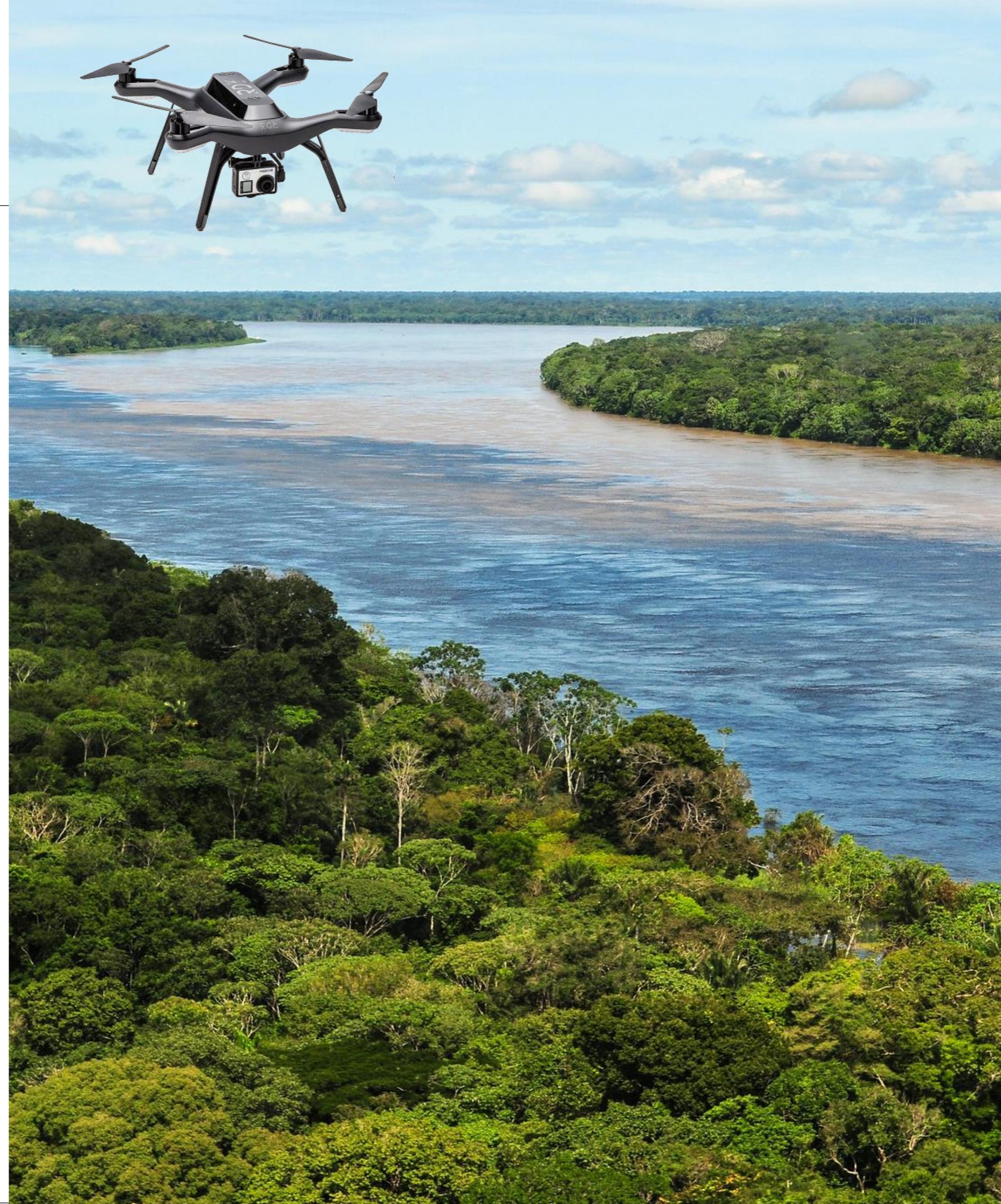
# Unmanned Aerial Vehicles for Environmental Monitoring

**Alexandra Moutinho**

Control, Automation and Industrial Informatics  
Mechanical Engineering Department  
Instituto Superior Técnico, Universidade de Lisboa

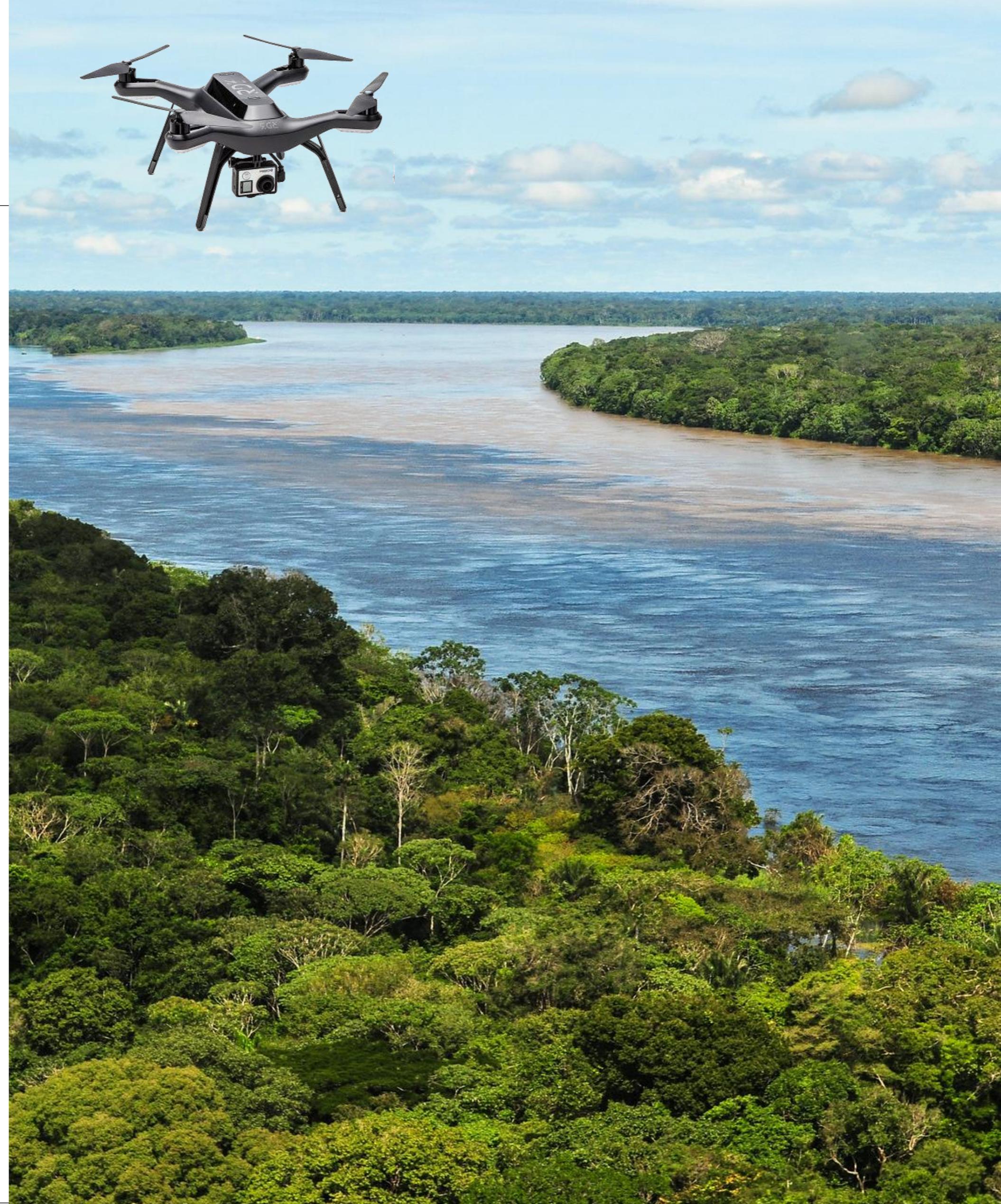
# Module contents

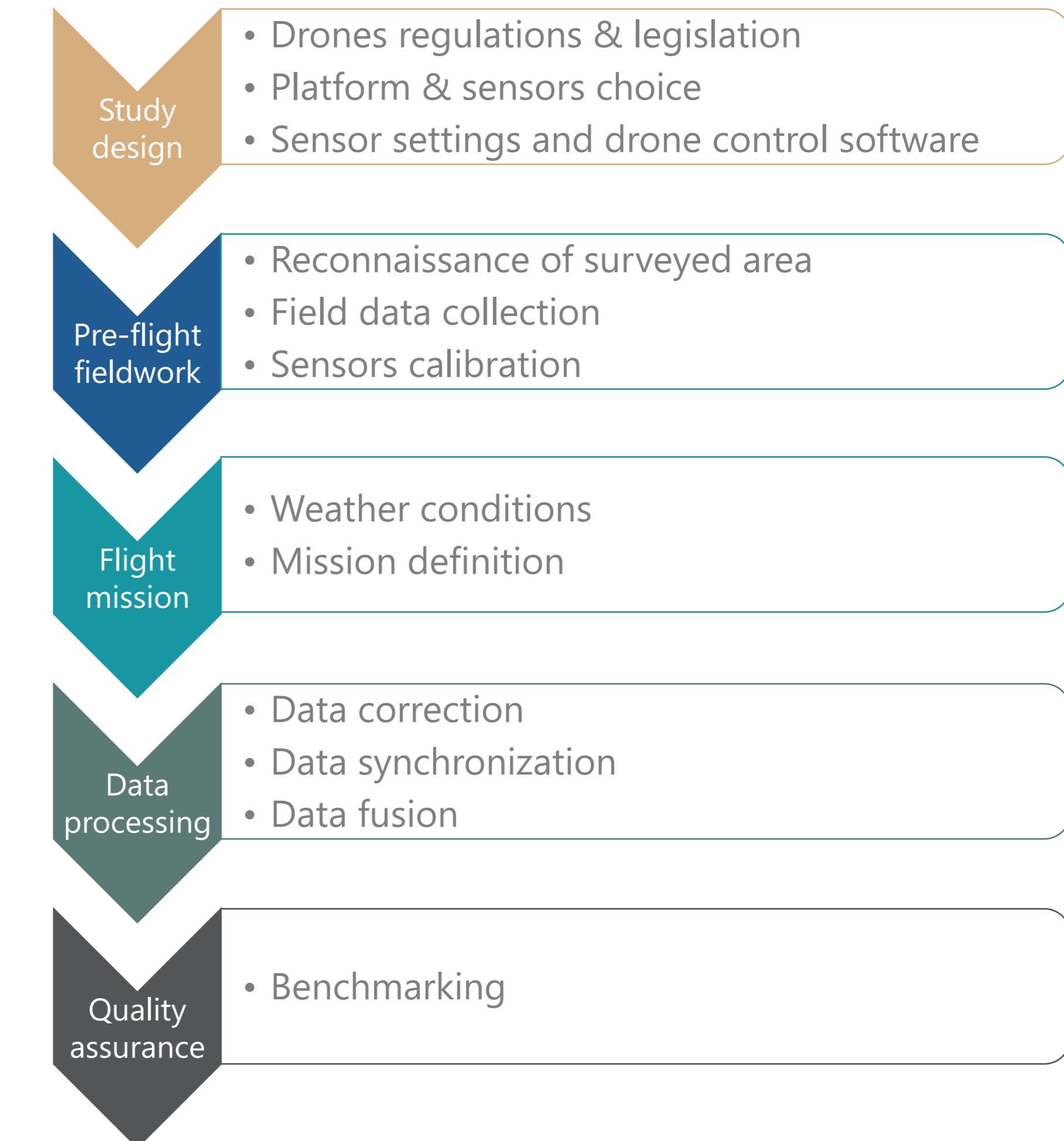
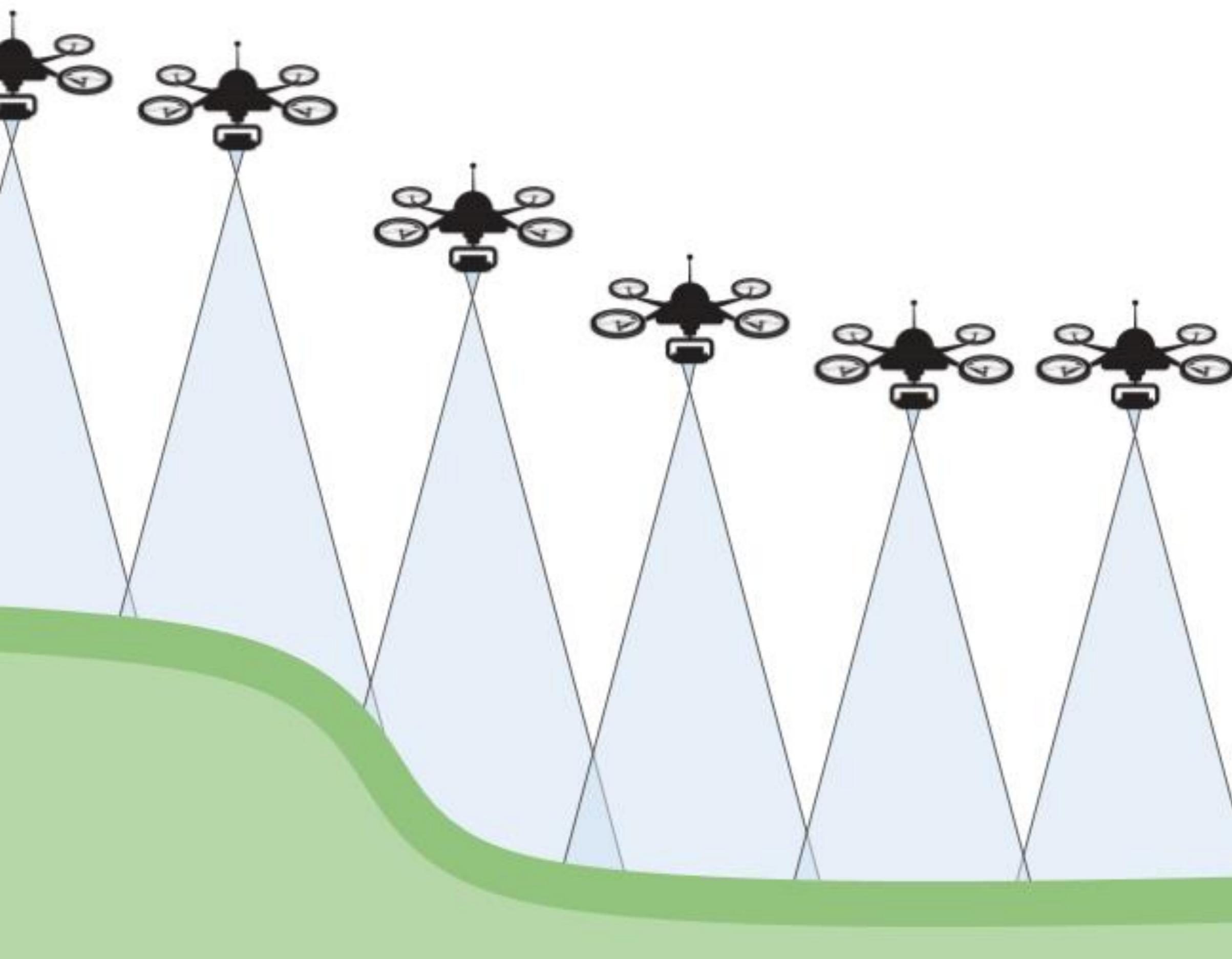
1. Introduction to Unmanned Aerial Systems
2. UAVs payload: sensors for environmental monitoring
3. UAVs operation
4. Examples of application of UAVs for environmental monitoring



# Module contents

1. Introduction to Unmanned Aerial Systems
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# Drones regulations and legislation

**Aviation safety pillars: rules needed for operating drones**

**Open operations LOW RISK**

**DRONES**

- Flying own drone / Photography and filming / Industrial operations.
- Example: a farmer using drones over his own property

**Specific operations RISK DEPENDING ON TYPE OF OPERATIONS**

**AVIATION**

- Private planning and aerial work by small aircraft, amateur aviation.

**DRONES**

- Mailing / Infrastructure inspections / commercial or industrial operations.
- Example: filming of sport events
- Rules adapted to the level and nature of risk

**Certified operations CERTIFIED RISK**

**AVIATION**

- Passenger and cargo transportation

**DRONES**

- Remoted pilot license
- Certification of drones
- Operation manual

**No aviation specific rules**  
Enforcement by police

**Aviation specific rules**  
Enforcement of rules by aviation authorities

**Aviation specific rules**  
Enforcement of rules by aviation authorities

**REGULATIONS RELATED TO FLYING DRONES ARE CHANGING**

On 31st December 2020, the new EU drone regulation will come into effect

You must register your drone if it is more than 250g or has a camera or a sensor

These new regulations require you to register as a drone operator. It is no longer necessary to register the drone

By registering with the IAA, you will automatically meet the new EU requirements

Learn what you need to do with the IAA and how you can do it on the IAA's digital platform MySRS

Register your drone before 31st January 2021 for the discounted of €5. Registrations after this date will cost €30

**IAA**

Icelandic Transport Authority

# Use of Drones in Iceland

## FOR LEISURE

### MANDATORY RULES:

Mark the drone with name, address & phone number.

Total weight may not exceed 3 kg within urban areas & 25 kg in rural areas.

A drone with a total weight of 20 kg or more shall be insured.

Do not fly over crowds of people.

Do not fly higher than 120 m above ground or sea.

Keep the drone in sight at all times.

Please follow the general rules on the protection of property & privacy.

It is forbidden to fly within 2 km from international airports & 1.5 km from other airports.

Do not fly within 150 m from public buildings.

Do not fly closer to residential buildings or premises than 50 m within urban areas & 150 m in rural areas without approval by the owner.

Check all flight regulations & restrictions for the flying area before flying.

The operator is responsible for damages that may arise from the use of the drone.

Drone flights may not interfere with air traffic, ship or vehicle traffic. Stay far away from manned aircraft.

### RECOMMENDATIONS:

Read carefully the instructions before use. Plan your flight in advance, check the flight area, your drone safety & condition.

Check regulation No. 990/2017 on the operation of remotely piloted aircraft.

The operating area shall be defined to ensure sufficient distance from people, animals and property.

Use the drone with caution and fly safely.

15/01/2018

Enjoy the flight & show responsibility

www.ictra.is

COMMERCIAL  
or back pack

# KNOW BEFORE YOU GO!

# DRONES LESS THAN 250 G

DRONES THAT WEIGH LESS THAN 250 GRAMS ARE ALSO KNOWN AS **MICRODRONES**.

IF YOU FLY A **MICRODRONE**, YOU **MUST**:

- Fly safely—don't put people or other aircraft in danger
- Avoid emergency sites and restricted airspace (forest fires, first responder perimeters)
- Follow provincial, territorial or municipal rules that may also apply, including rules about privacy and trespassing: [canada.ca/safe-legal-drones](http://canada.ca/safe-legal-drones)

**YOU SHOULD:**

- Keep your drone below 122 metres (400 feet) in the air—approximately a 30-storey building
- Keep your drone where you can see it
- Avoid advertised events
- Avoid airports
- Use [this map](#) to find a safe site to fly your drone: [nrc.ca/en/uav-site-selection](http://nrc.ca/en/uav-site-selection)

**YOU DON'T NEED TO:**

- Register your drone
- Get a drone pilot certificate

**MAXIMUM TAKE-OFF WEIGHT**

If the take-off weight of your drone is 250 g or more, it isn't a microdrone. You must register it and get a drone pilot certificate.

The maximum take-off weight of your drone includes batteries or anything you attach to it, like:

- communications equipment
- sensors
- cameras
- lights

**IF YOU BREAK THE RULES, YOU COULD BE FINED \$1,000 (FOR AN INDIVIDUAL) OR \$5,000 (FOR A CORPORATION)**

[Canada.ca/drone-safety](http://Canada.ca/drone-safety)

**The use of your drone determines the class of operation!**

**LOW RISK**

- Class 1b** Max 150 kg
- Max height 90m
- License 18+

**MODERATE RISK**

- Class 1b** Max 150 kg
- Max height 45m
- License 18+
- Class 2** Max 5 kg
- Certificate 16
- Max height 10m
- Recreational use Max 1 kg Private area only
- Keep a safe distance!
- Class 2: Distance > 50 m from buildings, persons etc.
- All classes: appropriate distance from obstacles > 30 m (unless acceptable risk in class 2)

**HIGH RISK**

- Class 1a** Max 150 kg
- Max height 10m
- License 18+

NON-BINDING ILLUSTRATION. CHECK THE APPLICABLE LEGISLATION FOR COMPLETE INFORMATION.

**Transport Canada** **Canada**

[www.mobilit.belgium.be](http://www.mobilit.belgium.be)

**DRONE CODE**

**You are legally responsible for the conduct of your flights**

**FLY** Make sure you can see your drone at all times and can avoid collisions

**FLY** Do not fly your drone in any way that could endanger people or property

**FLY** Don't fly higher than 400ft (122m) or within 2 nautical miles of the airport without the permission of Air Traffic Control

**SAFE** Use your common sense and fly safely; You could be prosecuted if you don't

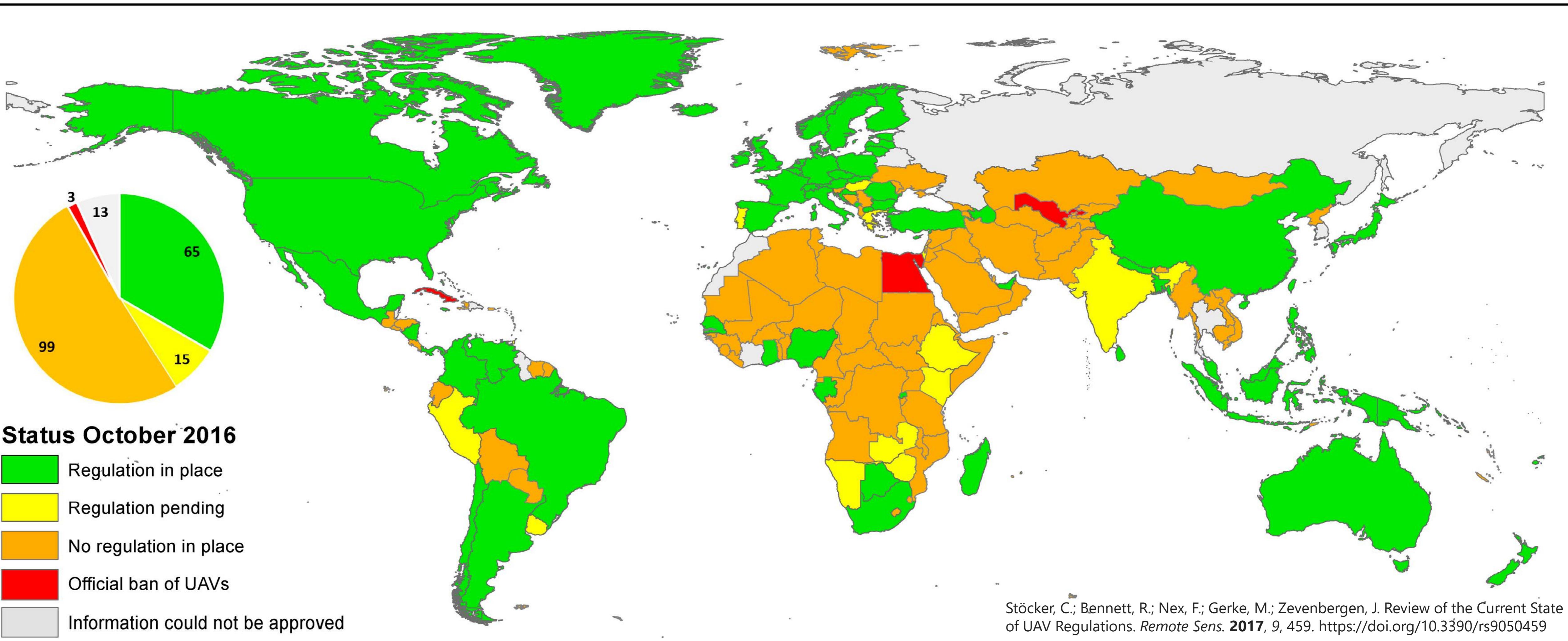
**SAFE** DRONES FITTED WITH CAMERAS MUST NOT BE FLOWN:-

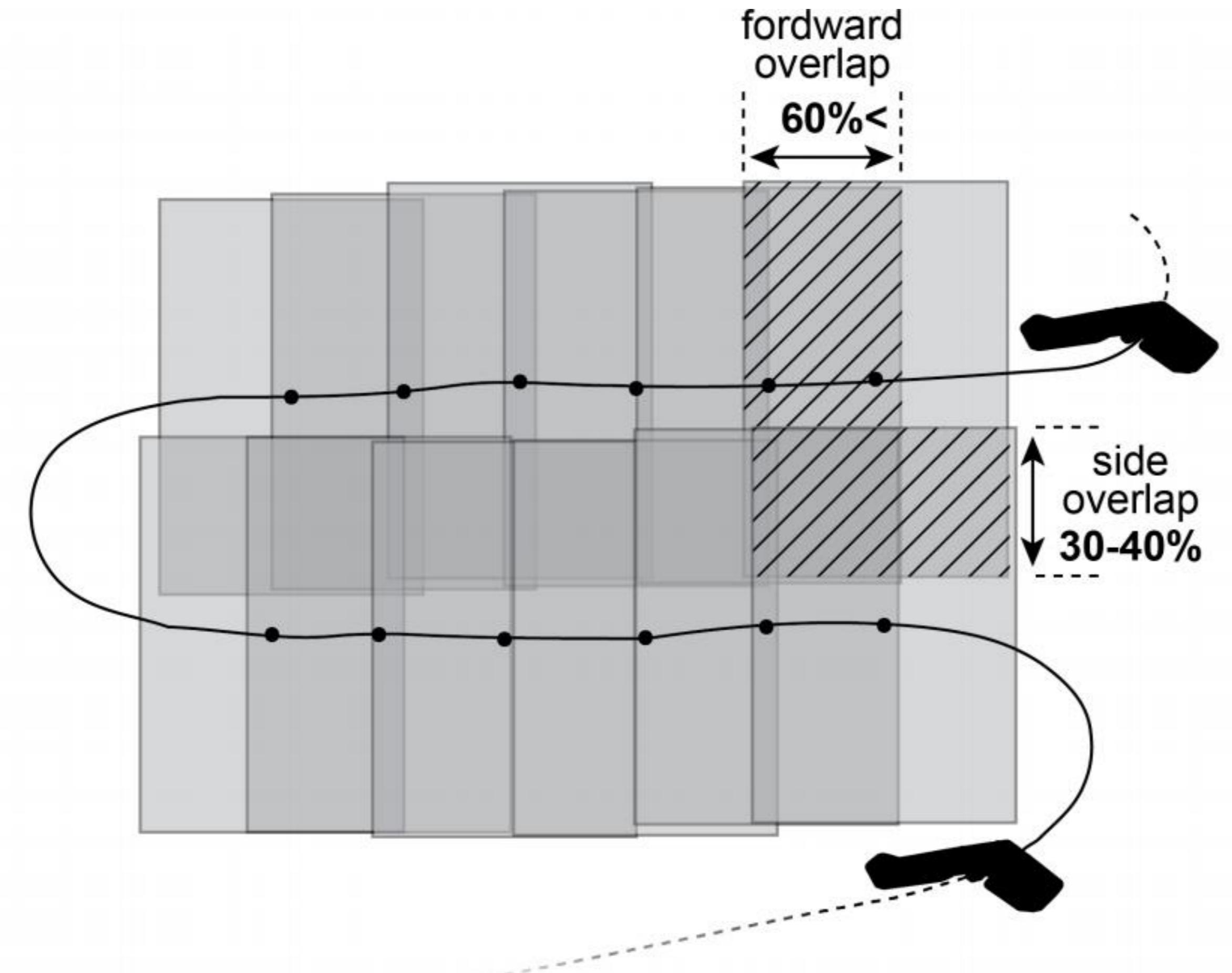
- within 50m of people, vehicles or structures
- or
- over or within 150m of congested areas (towns, villages etc) or large outdoor gatherings such as beaches, concerts and sports events

**SAFE** NO OVERFLY

**LEGAL** You need a 'Permission for Aerial Work' to use a drone commercially

# Drones regulations and legislation





Goran Tmušić, Salvatore Manfreda, Helge Aasen, et al., Current Practices in UAS-based Environmental Monitoring, *Remote Sensing*, 2020, 12, 1001; doi:10.3390/rs12061001



unite!

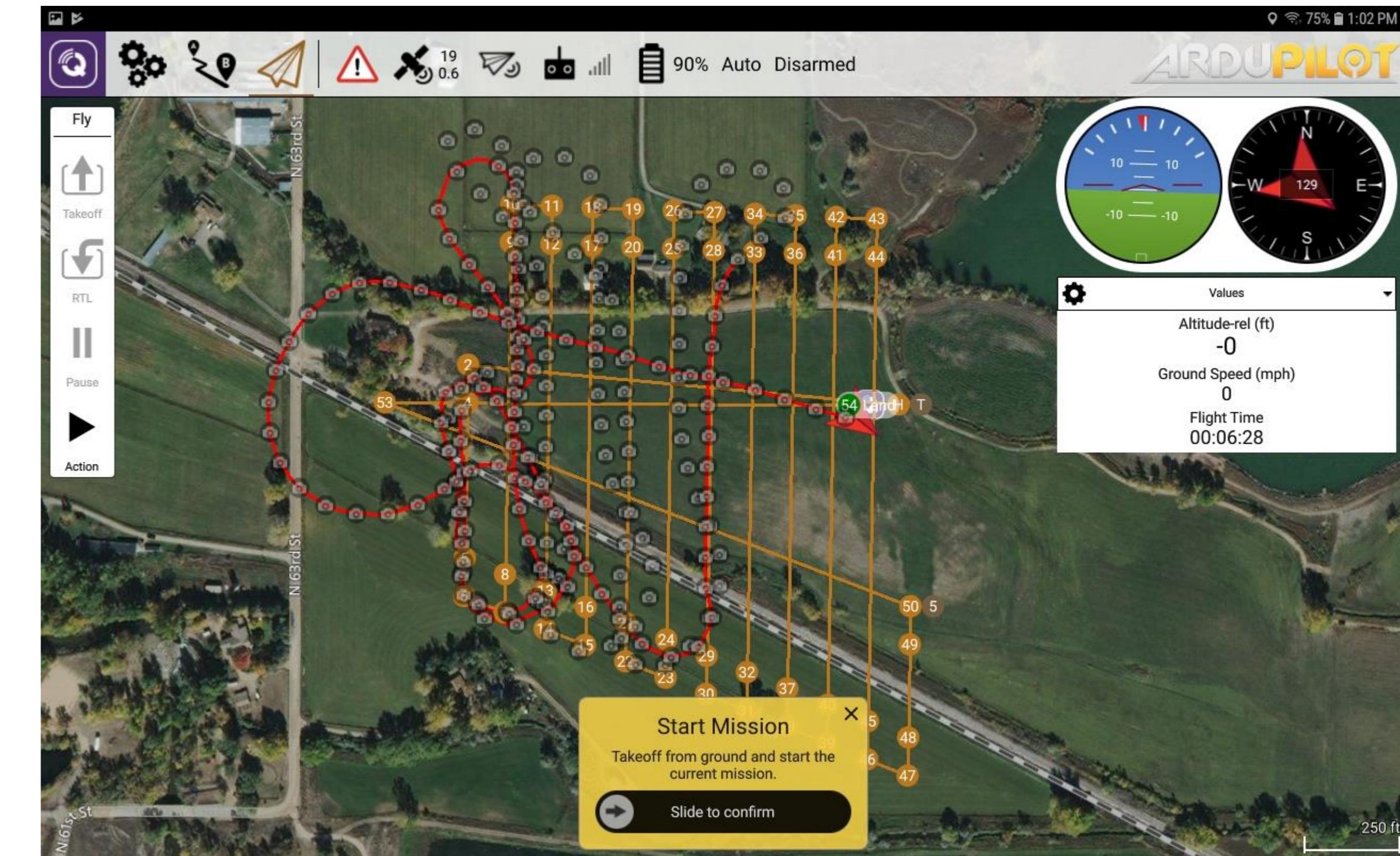
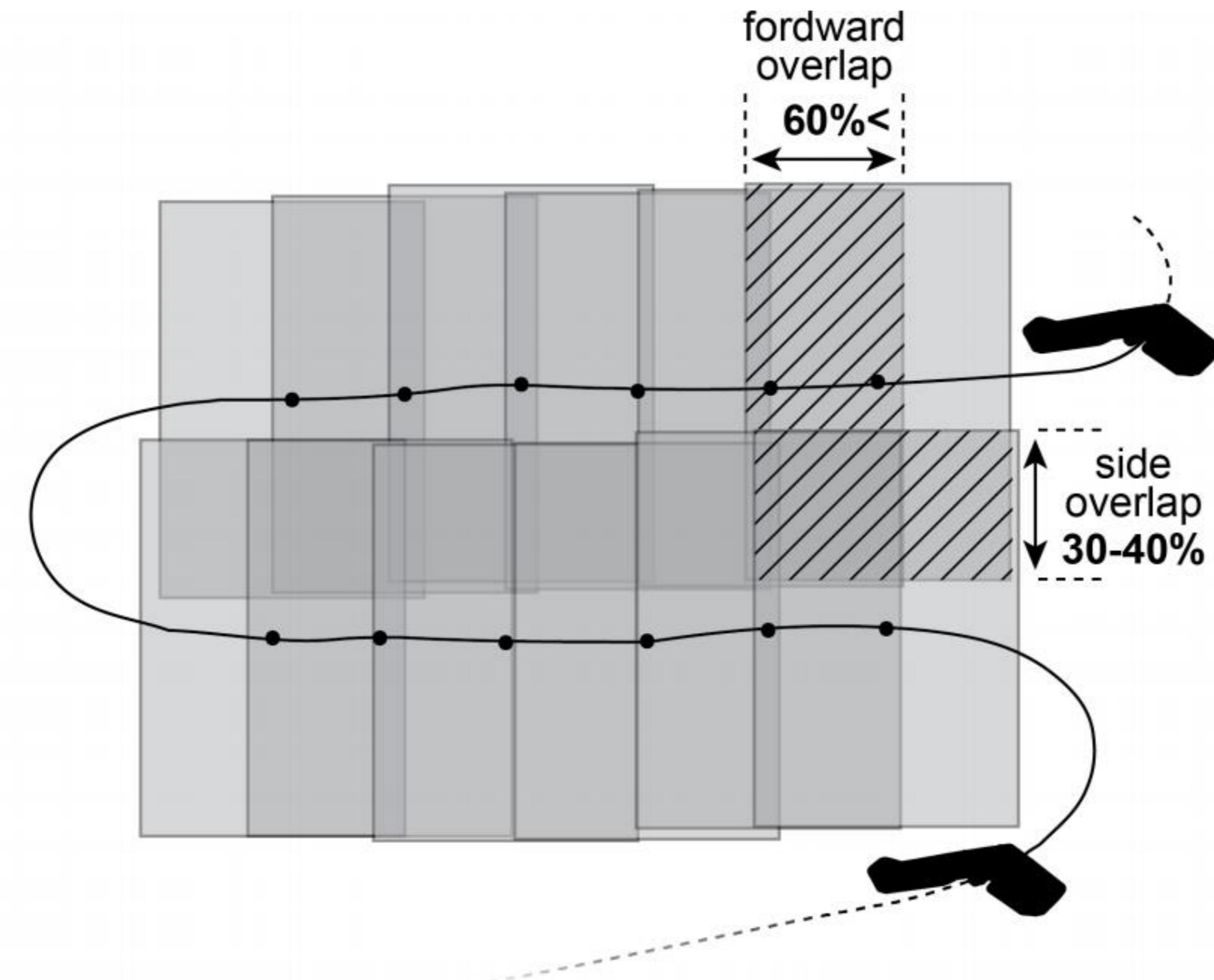
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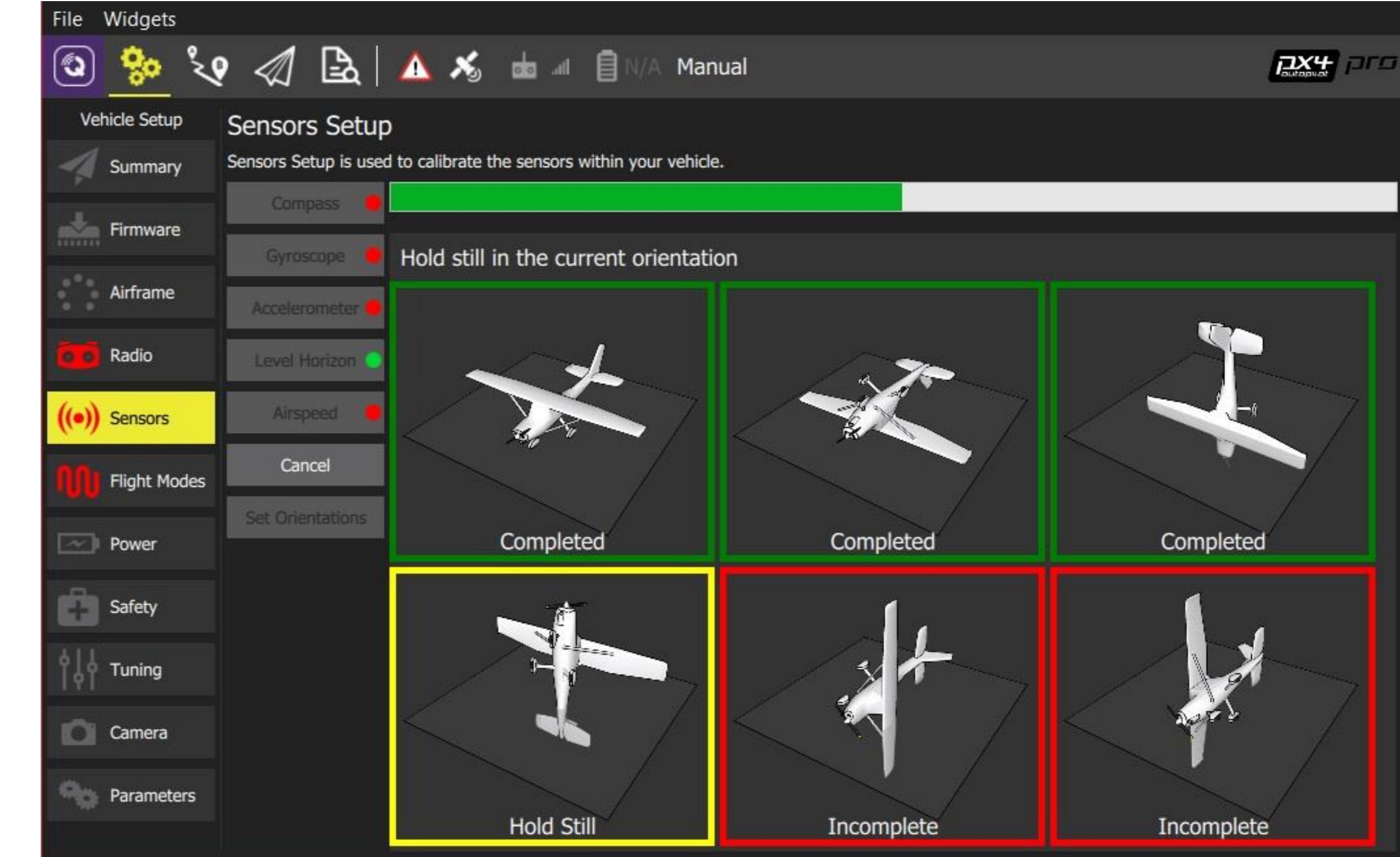
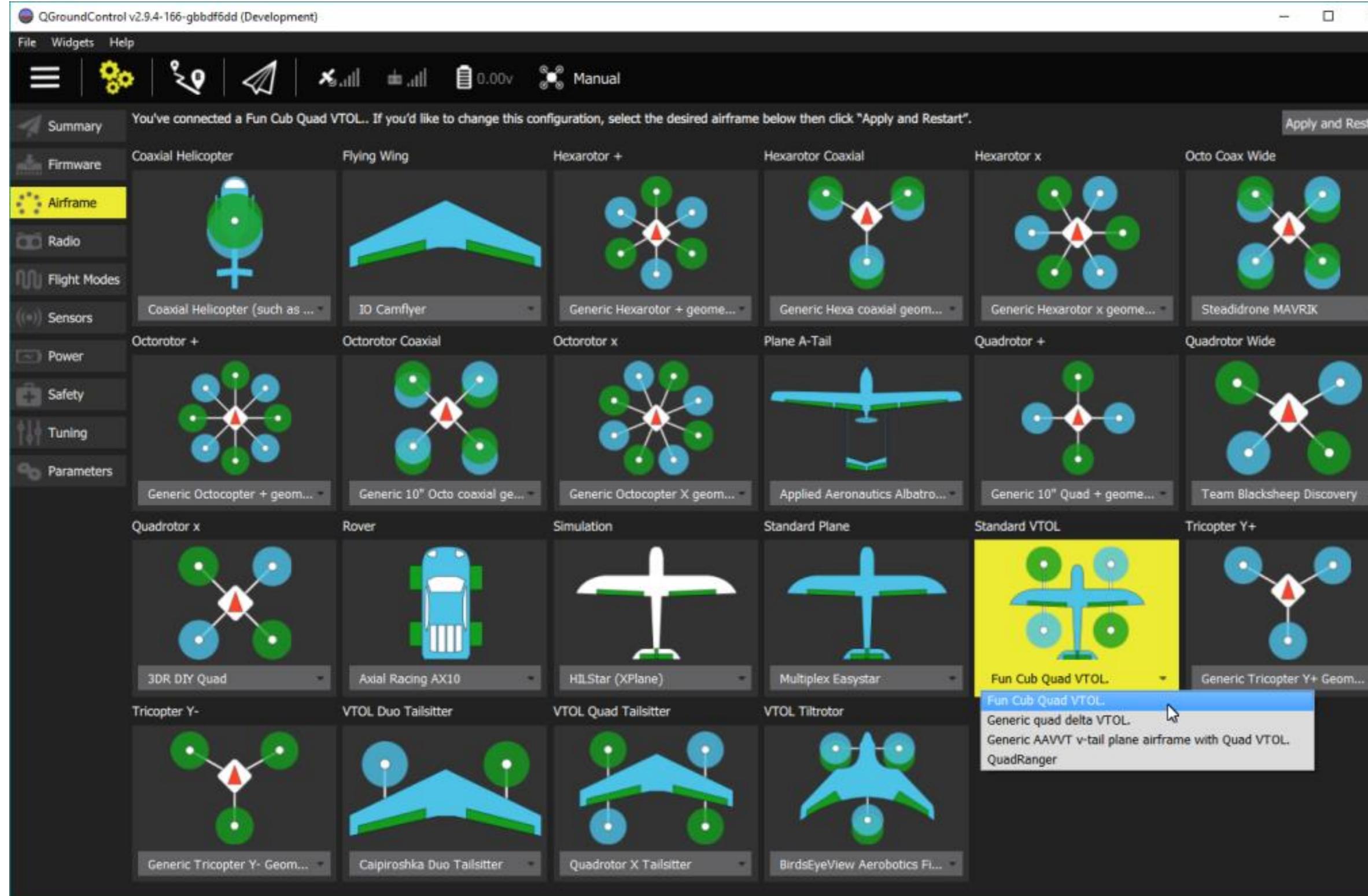
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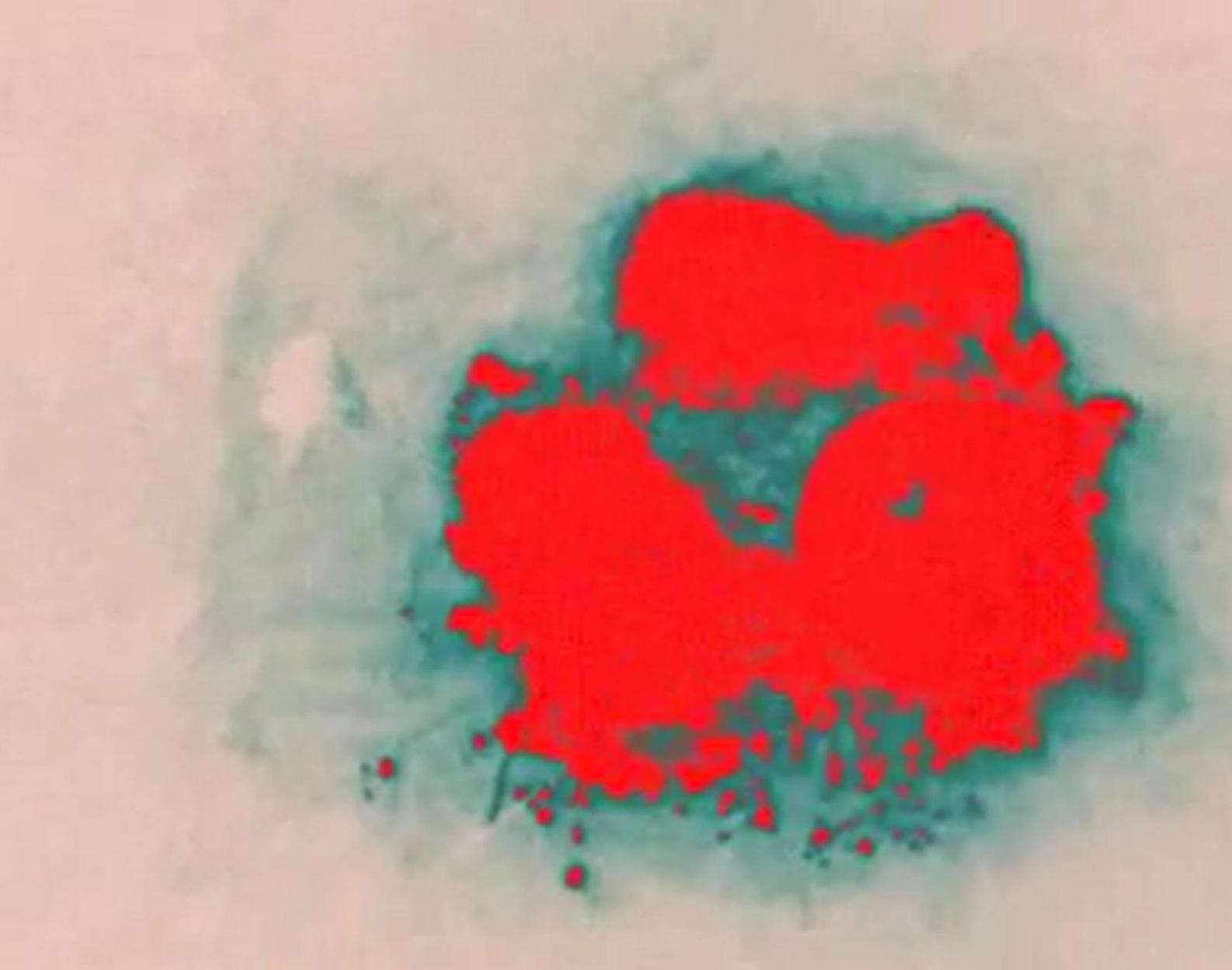
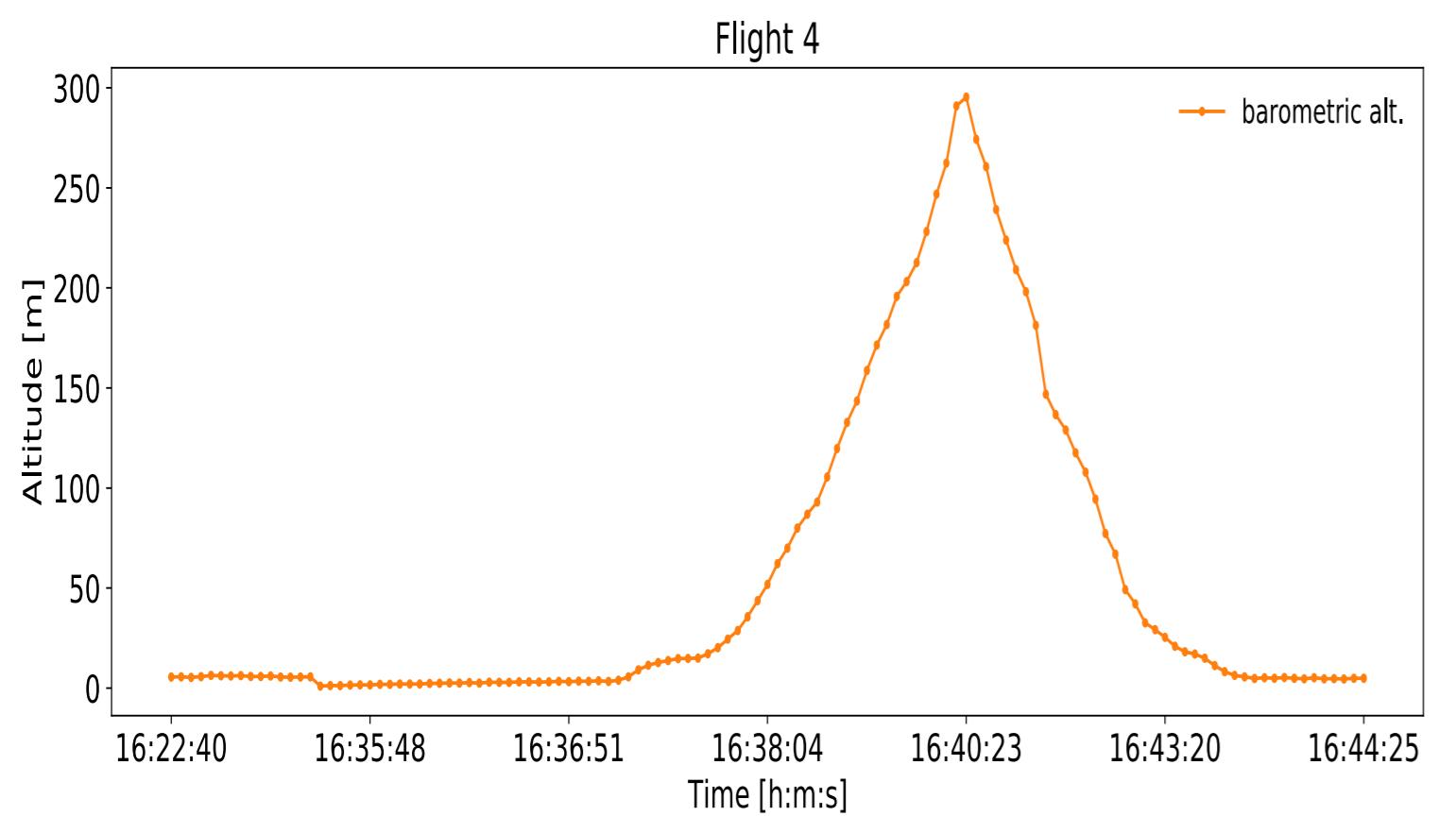
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	Name	Software (SW) Options	Operating System	Home Page	Type of License
Flight planning app	Pix4Dcapture	Planar flights; Double gridded flights; Circular Flights.	Android/iOS/Windows	<a href="http://pix4d.com/product/pix4dcapture">http://pix4d.com/product/pix4dcapture</a>	Free to use
	DJI GS Pro	3D mapping	iOS	<a href="http://dji.com/ground-station-pro">http://dji.com/ground-station-pro</a>	Free to use
	Precision flight free	Resume interrupted flights.	Android	<a href="http://precisionhawk.com/precisionflight">http://precisionhawk.com/precisionflight</a>	Free to use
	DroneDeploy	Planar flights; Cloud-based orthomosaics.	Android/iOS	<a href="https://www.dronedeploy.com/">https://www.dronedeploy.com/</a>	Free to use
	Litchi	Art computer vision algorithms; the gimbal and the drone's yaw axis.	Android/iOS	<a href="https://flylitchi.com/">https://flylitchi.com/</a>	Proprietary SW
Ground station software	Phenofly Planning tool	Photographic properties, GCP placement, Viewing angle estimation	JavaScript browser	<a href="http://www.phenofly.net/PhenoFlyPlanningTool">http://www.phenofly.net/PhenoFlyPlanningTool</a>	Free to use & modify
	MAVProxy	Loadable modules.	Portable Operating System (POSIX)	<a href="https://ardupilot.github.io/MAVProxy/html/index.html">https://ardupilot.github.io/MAVProxy/html/index.html</a>	Free to use
	Mission Planner	Hardware-in-the-loop UAV simulator.	Windows	<a href="http://ardupilot.org/planner">http://ardupilot.org/planner</a>	Free to use
	APM Planner 2/Mission Planner	Live data; Initiate commands in flight.	Linux/OS X/Windows	<a href="http://ardupilot.org/planner">http://ardupilot.org/planner</a>	Free to use
	QGroundControl GCS	Multiple vehicles.	Android/iOS/Linux/OS X/Windows	<a href="http://www.qgroundcontrol.org/">http://www.qgroundcontrol.org/</a>	Free to use & modify
	UgCS	Photogrammetry; Custom elevation data import; battery change option.	OS X/Linux/Windows	<a href="https://www.ugcs.com/">https://www.ugcs.com/</a>	Proprietary SW
	mdCOCKPIT	Real-time telemetric data; Flight analytics Module.	Android	<a href="http://microdrones.com/en/maircraft/software/mdcockpit">http://microdrones.com/en/maircraft/software/mdcockpit</a>	Proprietary SW
	UAV Toolbox	Telemetry data conversion.	Android	<a href="http://uavtoolbox.com/">http://uavtoolbox.com/</a>	Proprietary SW
	eMotion 3	Supports both fixed-wing and multirotor operations; Full 3D environment for flight management.	Windows	<a href="http://sensefly.com/software/emotion-3.html">http://sensefly.com/software/emotion-3.html</a>	Proprietary SW

Goran Tmušić, Salvatore Manfreda, Helge Aasen, et al., Current Practices in UAS-based Environmental Monitoring, Remote Sensing, 2020, 12, 1001; doi:10.3390/rs12061001



## Data processing, synchronization, and fusion



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The background of the entire image is a photograph of an underwater environment. A large green sea turtle is the central figure, swimming towards the left. Its head is above the water, and it has a white tag attached to its front flipper. The water is a vibrant turquoise color. At the surface, there is a significant amount of plastic waste, including several plastic bottles and a plastic bag, floating among the fish. In the background, there are icebergs and a city skyline visible through the water. The overall theme is the impact of plastic pollution on marine life.

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