Lower Cost Observing Technology: Drones

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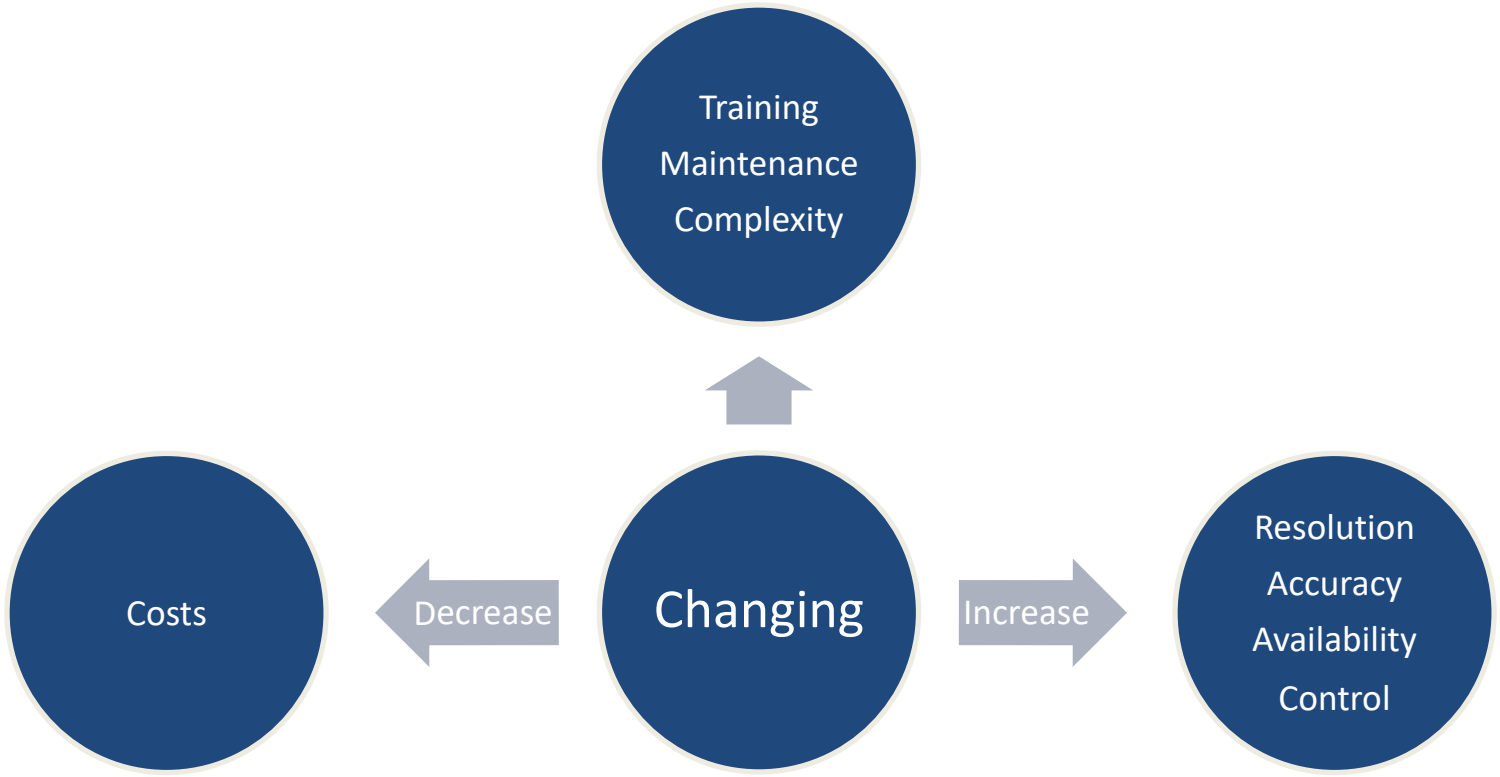
Outline

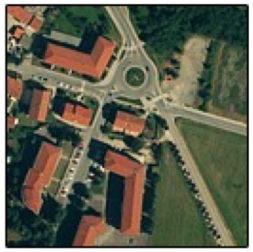
- Trends in remote sensing
- Compare and contrast
- Community of Practice

Trends in Remote Sensing



Resolution

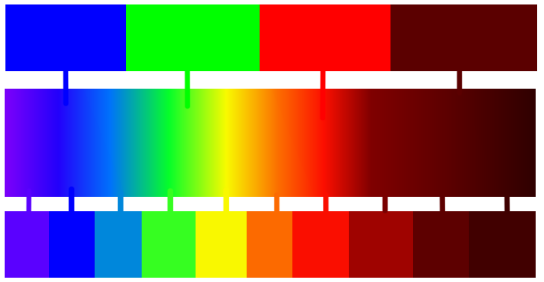
- UXS generally provide for great flexibility, but can come at a cost



High Spatial Resolution

Medium Spatial Resolution

Low Spatial Resolution



4-band

10 band

https://i.redd.it/liirufoc5j811.jpg https://www.eagleview.com/newsroom/2018/09/eagleview-activates-post-event-drone-capture-following-hurricane-florence/ https://www.mdpi.com/2072-4292/10/4/491/htm https://gisgeography.com/spatial-resolution-vs-spectral-resolution/

Accuracy

- Horizontal and vertical
- Absolute and relative
- Spectral
- Sensor, GPS, IMU, flying parameters, topography, ground control
- UXS accuracy may vary depending on many factors, but if you are willing to pay the cost, they can be very accurate

Availability

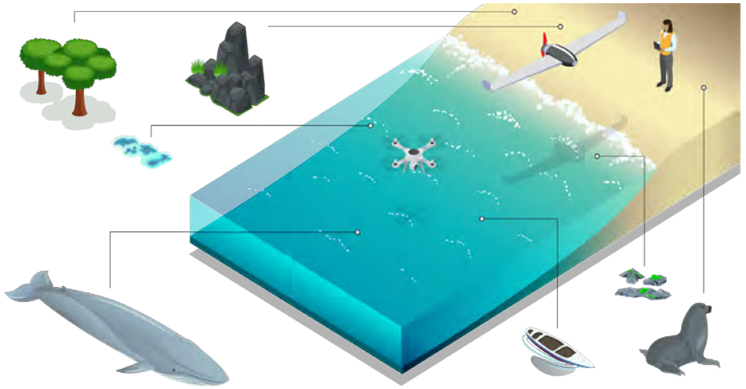
	Consumer	Prosumer	Research/Survey-Grade
			
Capabilities	One sensor option and low customization capabilities	May have several sensor options and more flexible with customization and flight planning	Several sensor options (more high end) with better integration of custom payloads Transitional or hybrid airframes combine rotary and fixed-wing mechanics
Weight	Lightweight (<1 kg)	Lightweight (1–2 kg)	Rotary: Moderate to Heavy (5–20 kg) Fixed: Lightweight (<3 kg)
Flight time	Approximately 20 minutes	25–30 minutes	Rotary: 10–30 minutes Fixed-wing: 45–90 minutes
Cost	Low cost (<$2k)	Can be more costly with extra options (RTK, multispectral sensor) $2–7k	Higher cost $10–20k with standard sensors
Pilot skill	Beginner	Beginner to Intermediate	Intermediate to Advanced
Optimal data type	Video	Photos	Video and Photos
Optimal application	Inspection/surveillance and basic mapping	Precision mapping	Rotary: High end cinematography, multisensory rigs and specialized payloads (lidar, hyperspectral) Fixed-wing: Precision mapping

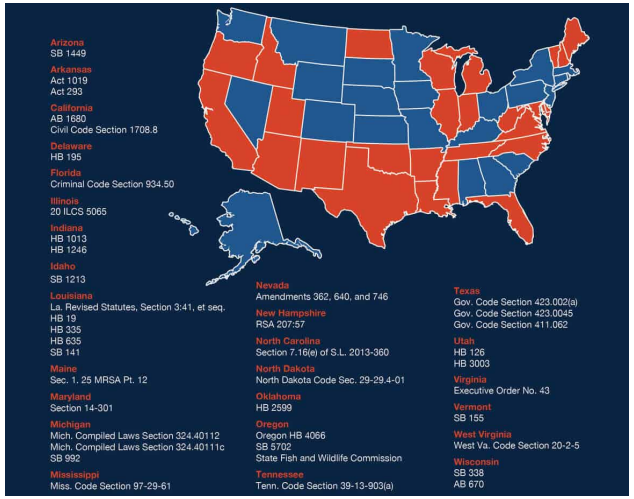
Note: Images obtained from the manufacturers website: https://www.dji.com/; https://freeflysystems.com/; https://www.sensefly.com/

http://secoora.org/wp-content/uploads/2022/01/0-Final-Report-Drone-Workshop-2020.pdf

Training

- Federal Aviation Administration Small UAS Rule (Part 107)
- Recertification
- State/local regulations
- Mission specific
- Software (mission planning/processing)

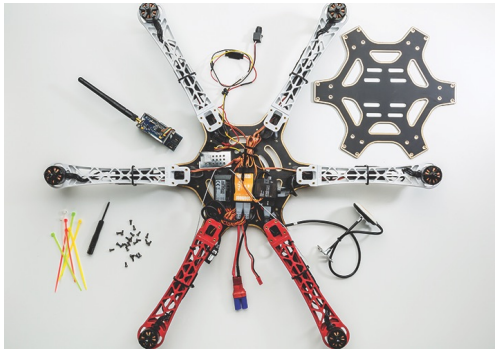




https://www.faa.gov/uas/commercial_operators/become_a_drone_pilot/ https://drone-registration.net/state-drone-regulations/ http://secoora.org/wp-content/uploads/2022/01/0-Final-Report-Drone-Workshop-2020.pdf

Operation and Maintenance

- You own it, you upkeep
- Safety
- Technology
  - Constantly improving
  - Upgrade capabilities
- Pre/post flight – checks and logging
- Data storage, discovery, archive



UNMANNED AIRCRAFT SYSTEMS

SAFETY TIPS *FOR* **FLYING YOUR DRONE**

When you fly your drone, follow the key safety tips below to keep the airspace safe.

1) **Register your drone** on the FAA's Drone Zone Portal (faadronezone.faa.gov) and display the FAA-issued registration number on an outside surface of the aircraft and carry your proof of registration with you.

2) **Follow FAA's** operating requirements and certificate requirements:

> **To fly for fun or recreation only**, follow FAA-approved safety guidelines of a model aircraft community-based organization (CBO) AND comply with any aeronautical knowledge and safety test requirements.
>
> *-OR-*
>
> **Meet the requirements** to become an FAA Certificated Remote Pilot and operate under Part 107 (the Small UAS Rule).

3) **Fly your drone** at or below 400 feet when in uncontrolled or "Class G" airspace, which is airspace where the FAA is not controlling manned air traffic.

4) **Do NOT fly** in controlled airspace (around and above many airports) unless:
   a. **You have received** authorization from the FAA. *(See our website to learn about how to obtain authorization.)*

5) **Do NOT fly** in airspace where drones are prohibited. *(See our website for information on airspace restrictions.)*

6) **Keep your drone within your line of sight**, or within the visual line-of-sight of a visual observer who is co-located and in direct communication with you.

7) **Never fly near other aircraft**, especially near airports.

8) **Never fly over groups of people**, public events, or stadiums full of people.

9) **Never fly near emergencies** such as any type of accident response, law enforcement activities, firefighting, or hurricane recovery efforts.

10) **Never fly under the influence** of drugs or alcohol.

11) **Respect others' privacy** and abide by local privacy requirements.

Learn more about FAA UAS/drone rules, regulations, and guidance at www.faa.gov/uas.

UNMANNED AIRCRAFT SYSTEMS

Federal Aviation Administration

PUBLISHED MARCH 2019

https://sn.astm.org/?q=features/training-drone-operation-and-maintenance-nd18.html
https://www.faa.gov/uas/programs_partnerships/manufacturers_toolkit/

Standards

US Southeast and Caribbean Regional Workshop

Drones in the Coastal Zone Workshop

Drones are rapidly growing components of research, assessment, and monitoring of coastal regions within the U.S. Southeast and the Caribbean.

The *Drones in the Coastal Zone* virtual workshop series was held in October 2020. This series covered aspects of drone technology including governmental policy and procedures, mission planning, data management, demonstrations on emerging drone technologies, and more. There were over 250 participants from Florida, Georgia, South Carolina, North Carolina, and the Caribbean.

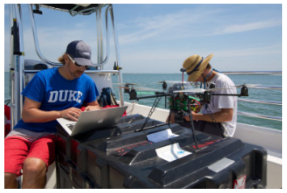
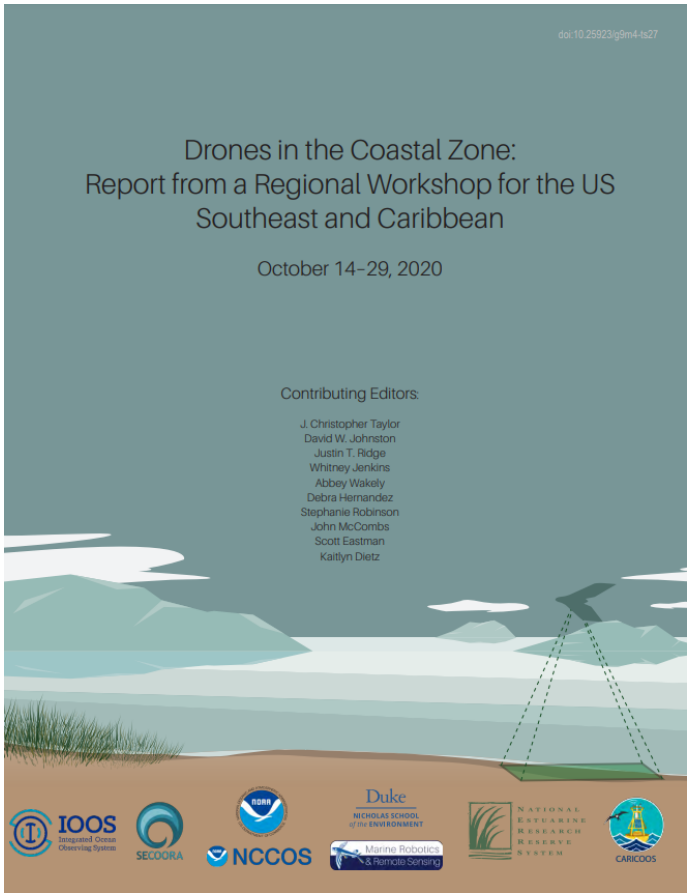


Image Credit: Duke University Marine Robotics and Remote Sensing

The objectives for the workshop were to:

- Identify information gaps in coastal ecosystem management that could be addressed by drones
- Assess UAS expertise and experiences across the coastal southeast US and Caribbean regions
- Discuss regulatory, policy and ethical concerns in drone applications
- Demonstrate emerging techniques and technologies in UAS



https://secoora.org/drones-in-the-coastal-zone-workshop/

Community of Practice

Chapter 5: Calling for a Southeast and US Caribbean Drone Community of Practice

The workshop highlighted a diversity of expertise in UAS operations applied to coastal management issues. Many of the coastal management concerns were shared across the southeast continental US as well as among US Caribbean partners.

5.1 Benefits of Regional Collaboration in UAS

The webinar series lightning talks and breakout groups/panels highlighted emerging technologies or approaches addressing a wide range of coastal science and management challenges, from water quality to several aspects of enumerating or assessing wildlife population on land and over water. New machine learning and artificial intelligence methods are available to conduct automated counting of organisms or even to identify individuals using marks as natural tags detected from images. New sensors and photogrammetric techniques are providing novel measures of body condition for individual animals. Mapping coastal habitat conditions using drones is significantly improving the efficiency in mapping remote areas or conducting repeated mapping to detect change. Participants learned about new methods for estimating biomass of vegetation using high-resolution point clouds to estimate canopy and shoot densities. They also learned about surveys conducted in remote areas in Puerto Rico and surprising recovery of mangrove habitats following significant hurricane damage. UAS have also been used to successfully detect and map ocean currents in nearshore environments to better understand sediment dynamics and beach erosion or accretion processes.

While inspiring, this range of new equipment and applications, and the varied ways in which people are using drones in the coastal zone, highlights a key foundational challenge for widespread use of UAS in coastal science and management: the lack of organization amongst labs and researchers using this technology. This issue is leading to deficits in essential standardization, calibration, and validation work and reinforcing a large interoperability gap that limits comparative work across space and time. It became clear that guiding principles and best practices are needed for data collection with these sensors, including independent validation of their performance across a range of locations, operational protocols, and environmental conditions. Although efforts are underway (e.g., Slocum et al. 2019), a regional network will help overcome these challenges and allow for robust and efficient collaborations amongst coastal researchers and managers.

During the webinar series, experienced UAS practitioners shared several best practices in developing a drone program as part of an agency or institution. From these presentations and discussions, it became clear that regional coordination would help researchers develop a program that is: 1) robust scientifically, 2) rooted in legal and ethical best practices, 3) accounts for other social dimensions including issues of social and environmental justice, and 4) addresses program governance and accountability. At present there are no comprehensive best practices for the use of drones in environmental science, and a regional effort will help to collectively develop them.

- Support state/territory nodes by facilitating exchange of information and best practices from federal government agencies
- Facilitate training through academic and industry partnerships
- Encourage data sharing through data assembly centers and interactive visualization tools
- Assemble members and stakeholders to update gaps and needs for UAS applications, technological advances and areas for potential collaboration
- Connect partners within southeast and across US Caribbean organizations

Community of Practice

MISSION STATEMENT

The Drones in the Coastal Zone Community of Practice (DITCZ CoP) connects academic, research, commercial, governmental and non-governmental sectors with common interests in coastal and ocean management to share resources, strategies, and innovations. Our goal is to support the transmission and expansion of knowledge and expertise for leaders, learners and professionals across the U.S. Southeast and Caribbean.

SECOORA
Southeast Coastal Ocean Observing Regional Association

CARICOOS

SCiDUC
SC INTERAGENCY DRONE USERS CONSORTIUM

Marine Robotics & Remote Sensing

Questions?

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