Drones in GIS

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Objectives:

By the end of this presentation you will be able to:

1. Briefly explain what a Drone/UAV/UAS is, how the technology works, and what it currently costs
2. Clarify the Drone mapping system components
3. Discuss Drone mapping workflow
4. Describe Drone mapping applications in GIS
5. Briefly describe the projected market for Drone technology
6. Discuss Challenges faced in Drone mapping
1. Drone/UAV/UAS Technology → Definition

**Definition**: A Drone/UAV is defined as a "powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload".

The Reaper military drone. A military drone recently flew for 82 hours non-stop.

Nano drones are just a few centimeters across and cost ~$40.
1. Drone/UAV/UAS Technology → Controversy
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1. Drone/UAV/UAS Technology → GIS Benefits
1. Drone/UAV/UAS Technology → How it Works

1. Last 15 years Radio Controlled (RC) airplanes have changed; drones now utilize RC technology

2. GPS enables autonomous flight with Drones

3. Wifi → First Person View (FPV) streams real time video to smartphones/tablets; also, no visual contact is even needed now

4. Technology allows pilot to alter flight path, further inspections, build new waypoint sets, etc.
1. Drone/UAV Technology → The DJI Phantom 2 Plus

System includes:

1. Aircraft
2. Sensor (camera)
3. GPS
4. RC + Wifi
2. Drone/UAV/UAS Components

1. Multi-rotor copter
   - Aircraft + RC
   - Payload
   - Gimbal system

2. Fixed wing Drone
   - Aircraft + RC
   - Payload
   - No gimbal required

3. More on Payload Sensors
   Payload gathers data; Drones make it cheaper, more accessible
   Sensors can include:
   - Visible
   - Infrared (NIR/SWIR, MIR, TIR)
   - Multispectral/hyperspectral
   - LiDAR
   - Other
3. Typical Workflow

1. Drone Acquisition and Generation of Raster Data
   - Flight planning
   - Flight(s)
   - Image downloading and processing
   - Generation of orthophotos/digital surface models

2. Extraction of Vector Data
   - GPS recording
   - Geodatabases
   - Manual data collection
   - Digitization
   - Web services
   - Drone point cloud

3. Import and Layering of Vector and Raster Data
   - GIS software

4. Analysis and decision-making
   - Flood simulation
   - Hazard analysis
   - Progress tracking
   - Feature identification
   - Project planning
   - Etc.
3. Typical Workflow

Drone2Map ESRI Tool
4. Drone Mapping Applications

1. Remote sensing
2. Surveying
3. Precision agriculture
4. Terrain mapping/modeling
5. 2D and 3D image analysis
6. 3D topographic image analysis
7. Ortho-mosaicking
8. Weather monitoring
9. Oil and Gas exploration
10. Mining
11. Transmission line monitoring
12. Filmmaking
13. Disaster response and relief
14. Other
4. Drone Mapping Applications

Columbia College Student Drone Mapping Projects

Finding Pine Bark Beetle Infestations on the Columbia College Campus, Sonora, CA
By Connor Beatty

Medusahead Severity Survey on Orvis Ranch Stanislaus County, California, USA
By Parker Donnelley, Robert Peffer, & Donnie Escamilla
4. Drone Mapping Applications

Columbia College Student-Generated Stereo Photos
4. Drone Mapping Applications
5. The Market

● 80-100,000 new jobs projected by the Department of Labor in 5-10 years
● ~$82 billion in economic benefit by 2025
● Training and certification program growth
  ○ Columbia College GIS Program
    ■ Geospatial Microcredential
    ■ Geodatabase Microcredential
    ■ GIS in Emergency Response Microcredential
    ■ GIS Drone Mapping Microcredential
      (Proposed for Fall 2017)

http://tolhurstj.faculty.gocolumbia.edu/ESGIS/Geographic_Information_Systems/GIS_Program.htm
6. Challenges

● Regulatory Concerns
  ○ FAA Regulations issued at end of 2015 for hobby use
    ■ All Drones 0.55 to 55 lbs must be registered ($5 fee that lasts 3 years)
    ■ 13 years old to operate
    ■ 400 foot vertical flight limit
    ■ Line of sight at all times
    ■ Airport zone restrictions = 5 miles
    ■ Travel restrictions (challenges in taking equipment through airport security)
  ○ Commercial regulations still being worked on
    ■ Exemptions can be applied for (Section 333 → COW or COA)

● Technical Challenges
  ○ Limited range for multi-rotor drones (~20-25 minute flight time per battery)
  ○ Fixed wing may require catapult or runway for larger models
  ○ Pilots needed for both types of drones

● Weather limits
  ○ Rain, wind, fog, etc.
6. Challenges

“The FAA doesn’t really have everything in place yet as far as commercial use, so in order to implement a UAS program at our company, I actually started a completely separate company, Reality Capture Systems, to take responsibility for it,” Lopez said. “I went through the whole process for insurance, 333, etc. The reason I did that is because Hensel Phelps doesn’t want to be liable until everything is settled under the FAA. It’s been complicated, but I saw and believed in the technology, and it’s why I took this approach.”
Summary

- Inexpensive Drones and sensors will collect and consume GIS data
- Once Drone technology and autonomous flights prove reliable we will see a dramatic increase in the use of Drones for GIS mapping applications
- This will disrupt the existing GIS data collection process
- Collateral industries will also be affected (drone and sensor manufacture, sales, repair, etc.)
- Software industry will adapt (Drone2Map from ESRI, AgiSoft, etc.)
- Training programs will evolve and adapt (Columbia College GIS Drone Mapping Microcredential)