

# **Drones for Surveying and other purposes**

Dan Farrell and Glenn Anderson  
September 9, 2015

# Bio- Glenn Anderson

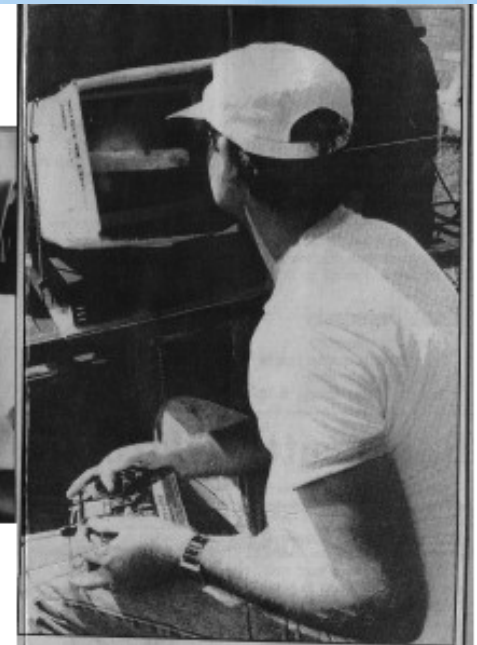
KYTC Traffic Operations, PE (Electrical)

Flying Radio Controlled airplanes for 39 years

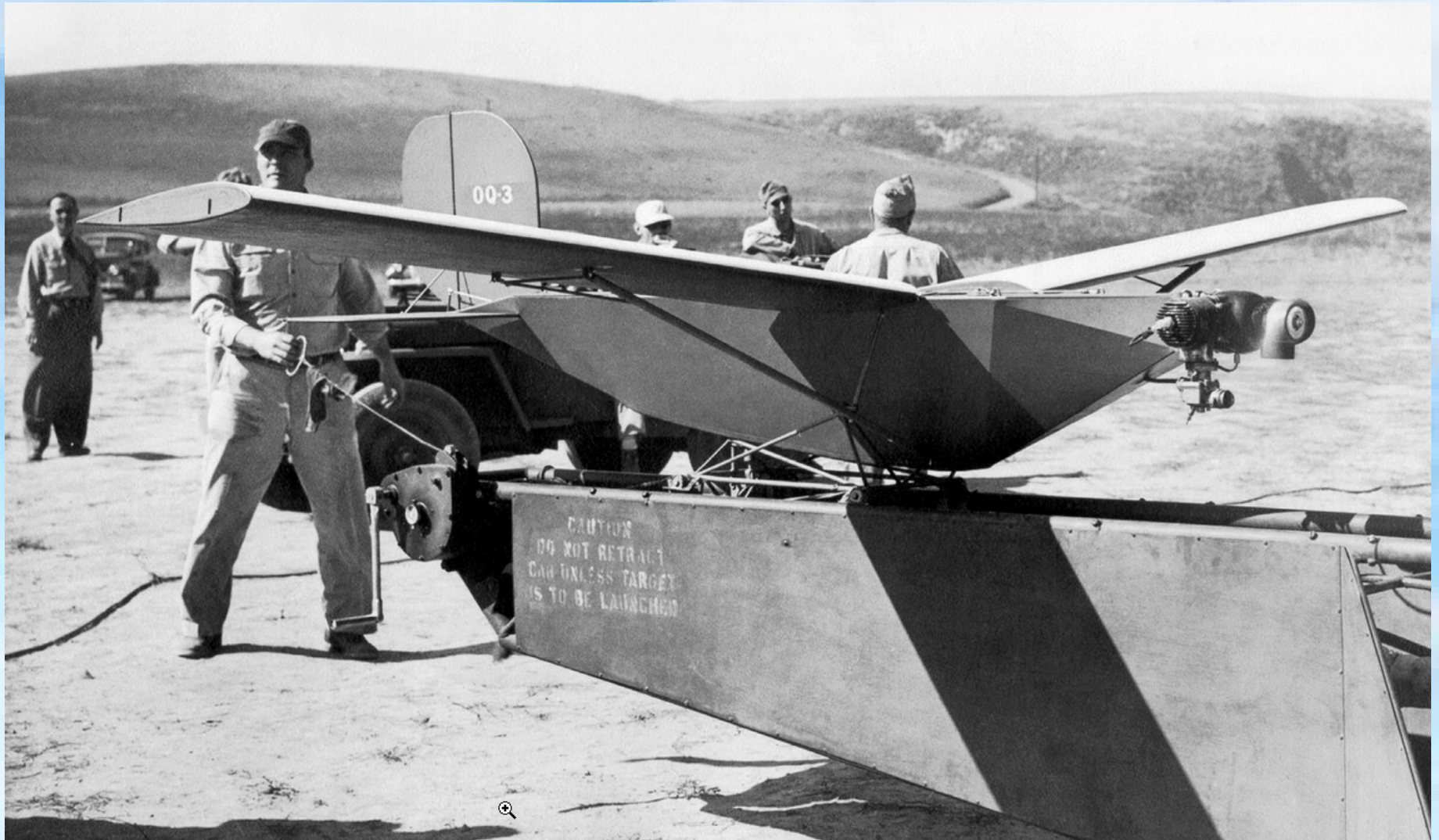
Flying with video for 26 years (possibly first in KY in 1989)

Operated New Perspective Aerial Photography from 1994-2009

[www.aerialrobotics.com](http://www.aerialrobotics.com)



# What is a drone?



# Terminology

RPV – Remotely Piloted Vehicle (obsolete)

UAV – Unmanned Aerial Vehicle (almost obsolete)

FAA language:

UAS – Unmanned Aircraft Systems

sUAS – Small Unmanned Aircraft Systems

However, the term “Drone” is here to stay

# Large UAS



# Small UAS or sUAS



Fixed Wing:

Longer flight time

Requires an unobstructed area for launch and recovery

Multi Rotor:

Shorter flight time

Can fly almost anywhere



# Seems like everyone has a drone



# What caused this drone revolution?

- Acceleration/gyro sensors – car airbags
- Better batteries – cell phones
- Powerful microcomputers
- Improved GPS precision
- Software
  - Flight control software
  - Image processing software
- Chinese manufacturing
- Internet and Amazon etc.
- FAA – Lack of rules has created a “wild west” situation



# Drones: making news daily

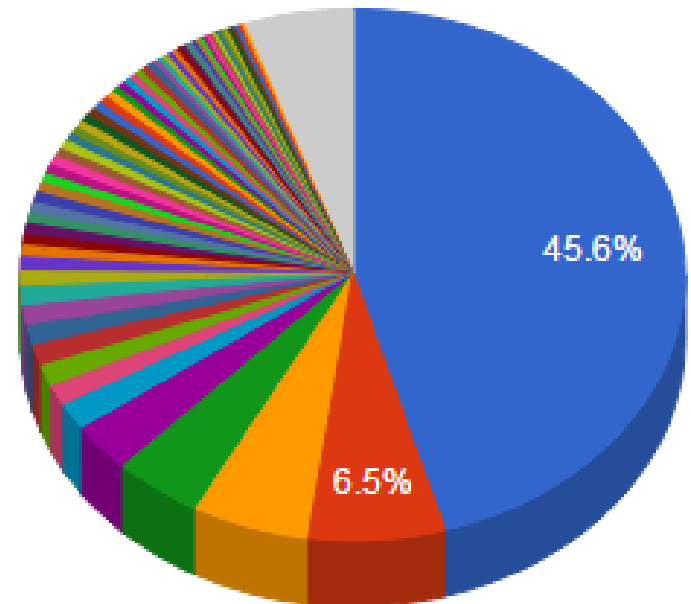


# DJI - The drone any idiot can fly



FAA Approved  
commercial use  
by type

- DJI (China)
- 3D Robotics (USA)
- AeroVironment
- Precisionhawk
- AshFloyd LLC
- Sensefly
- Physical Science...
- Aeryon Flight Labs
- Yuneec
- Altavian
- Trimble Navigati...
- ▲ 1/6 ▼



careless operators & misunderstood capabilities



# Drones will be another tool in the KYTC surveying tool box

We currently have:



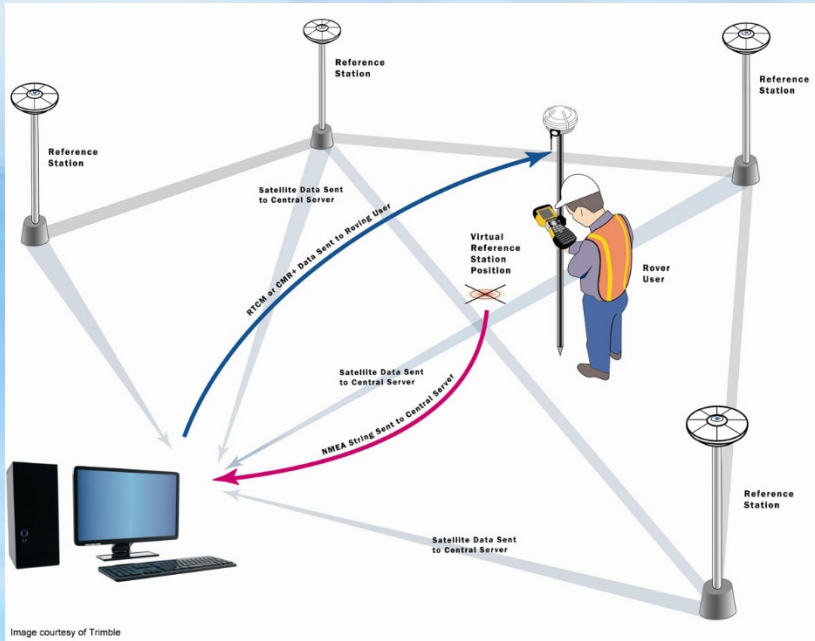
Robotic Total Stations

GPS RTK Base Station Setup



# Survey Tools continued

## KYCORS Network



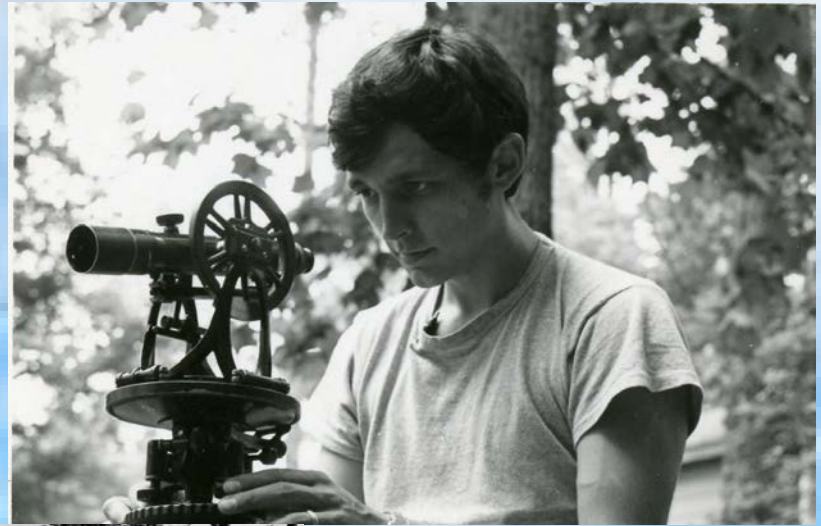
## Stationary Scanners



## Aerial Photography, Mapping, LiDAR, and Mobile Mapping by our Consultants

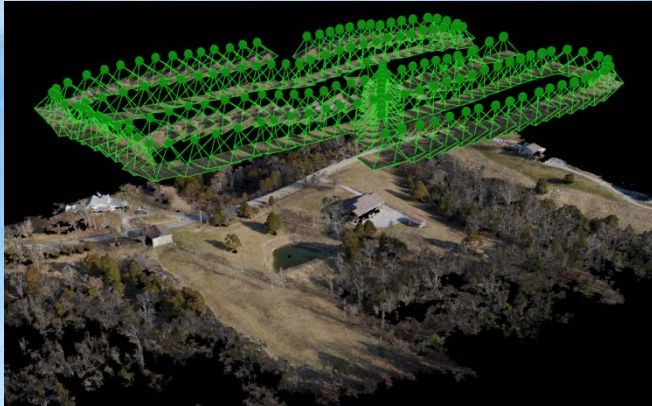


Just in case of an EMP attack...We're back to the good old days



# Drones can be useful and they are changing the way people collect data

## Surveying



## Bridge Inspection (from KTC quad)



- Accident reconstruction

- Oblique photos have many uses

# Benefits

## ▶ Efficient

- Survey 2 acres per minute with two people
  - Interim construction surveys
  - As-built surveys

## ▶ Safe

- Styrofoam or frangible construction
- Light weight, 4–8 lbs
- Slow Flying, 0–50 mph
- Flies below 200'
- No people on board
- Geofenced flight boundaries

## ▶ Quick Response

- Accident reconstruction
- Surveying
- Bridge inspections



# Benefits

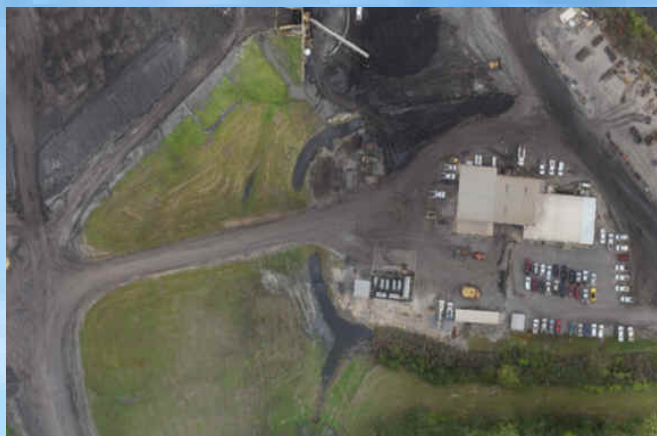
- ▶ **Low Cost**
  - UAV  $\approx$  \$2,600
  - Manned aircraft and camera  $\approx$  \$2,000,000?
- ▶ **Better Images**
  - Flies close to the subject
  - Shoots through less atmospheric interference

# Low altitude images

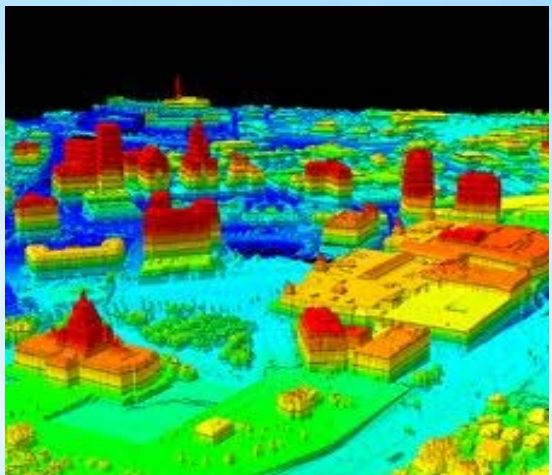
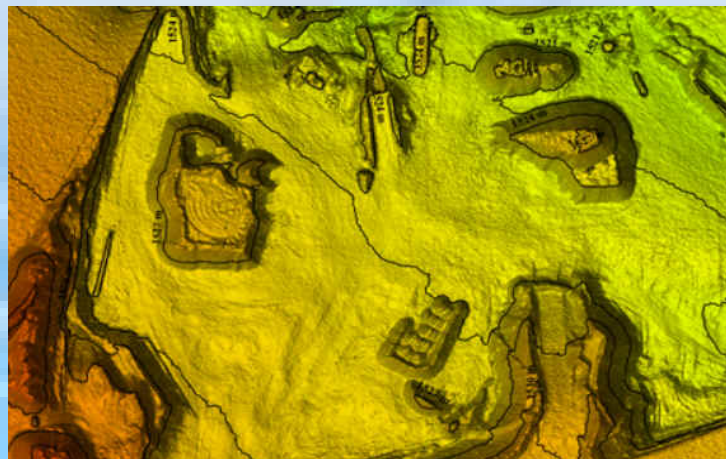


# Just a few Deliverables from a Drone Mission

Orthomosaic

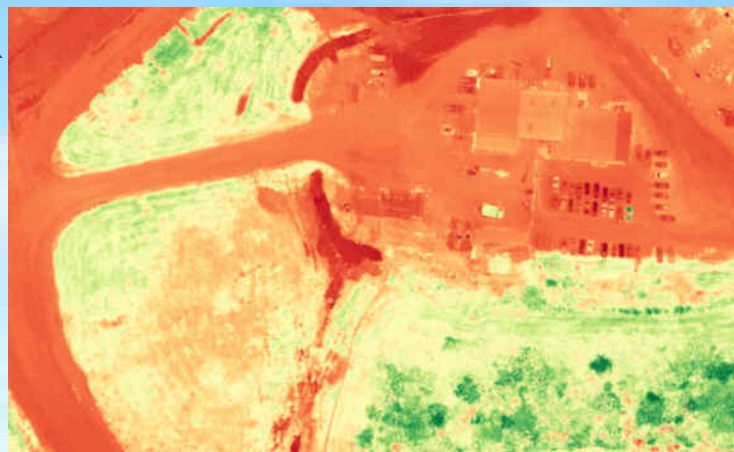


DEM



DSM

NIR

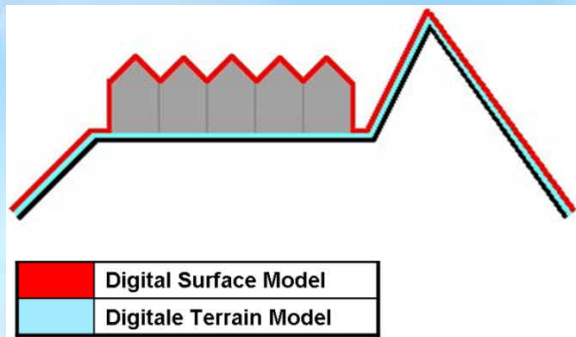


# DTM, DSM, Or DEM What's the difference?

DEM – digital elevation model is a 3-D representation of a terrain's surface created from terrain elevation data.

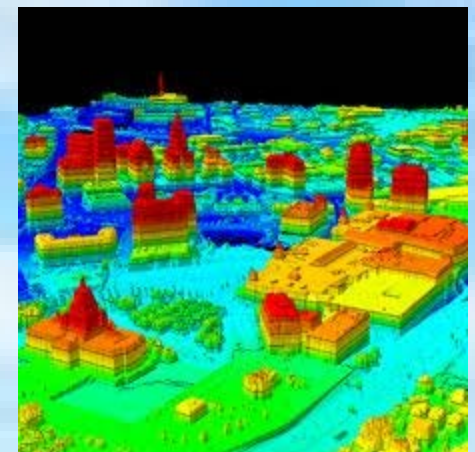
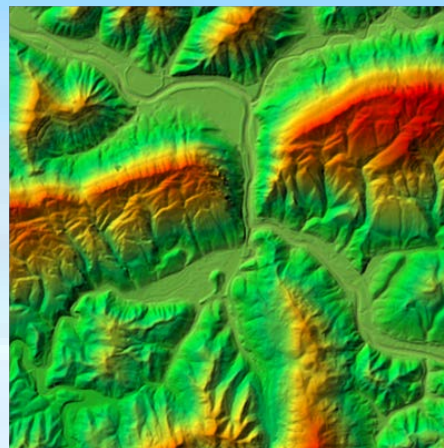
DTM – digital terrain model represents the bare ground surface without any objects such as plants or buildings.

DSM – digital surface model represents the earth's surface and all objects on it



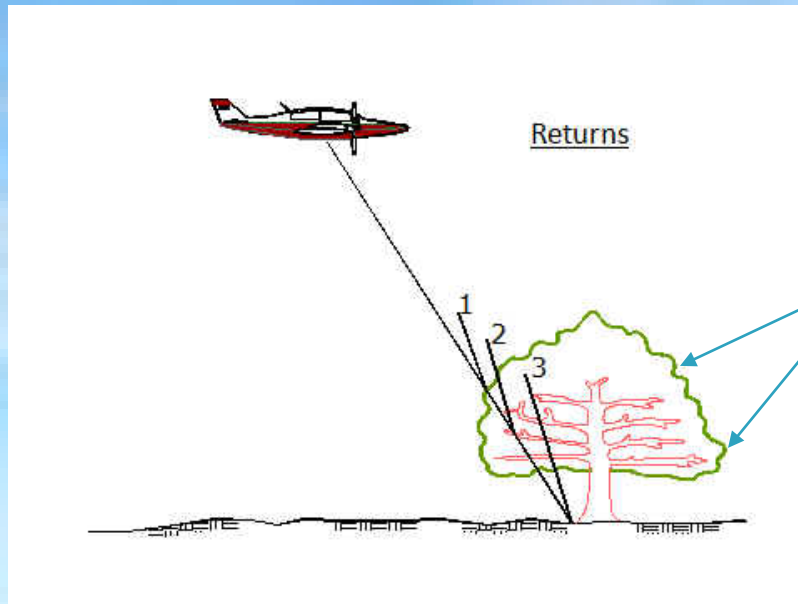
Digital Elevation Model

Digital Surface Model



# What about the DTM data?

With Airborne LiDAR, Yes. Because it delivers better elevation data in vegetated areas



With Orthomosaics, No. Because the camera can't penetrate the vegetation. It records what it sees

However, the DTM can be created by merging or fusing the data sets

# Drones with LiDAR?



# Surveying with drones

- ▶ Identify the Mission location
- ▶ Plan Mission Boundary
- ▶ Identify and address any potential safety issues
- ▶ Notify property owners of the mission
- ▶ Layout Ground Control Points to give the project a Geospatial identity
- ▶ Fly the mission after complete systems check
- ▶ Check the data on site for any deficiencies. Refly if necessary.
- ▶ Do final processing in the office
- ▶ Deliver final product or products

# A few words about Photography

Photogrammetry is the art and science of obtaining precise mathematical measurements and three-dimensional (3D) data from two or more photographs.

Photogrammetric techniques can be applied to virtually any source of imagery, whether it comes from 35-mm digital cameras or an earth-orbiting satellite. As long as the images are captured with stereoscopic overlap, one can derive accurate 3D data at a very wide range of scales.



# Pix4D demo

# How to legally fly



FAA Modernization and Reform act of 2012

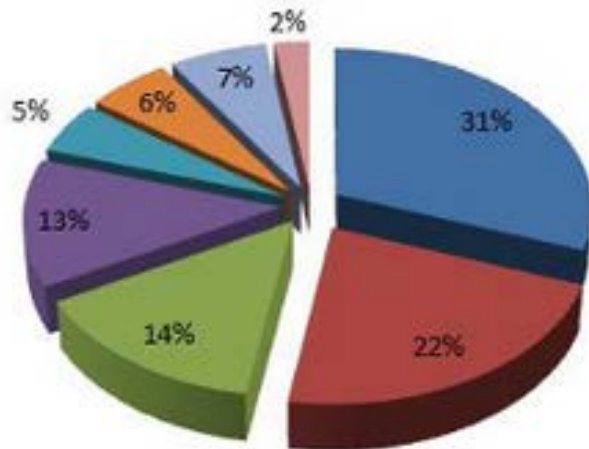
Congressional mandate – Achieve safe integration of UAS into the national air space (NAS) by September 30, 2015

This is probably not going to happen

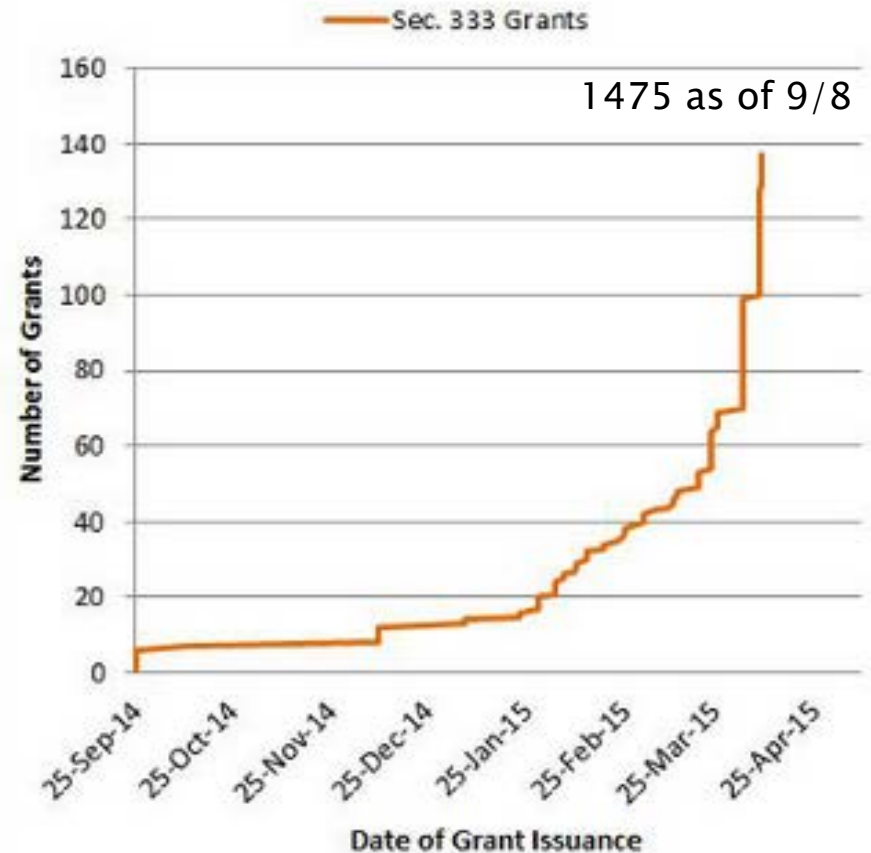
# For now – the section 333 exemption is a band-aid

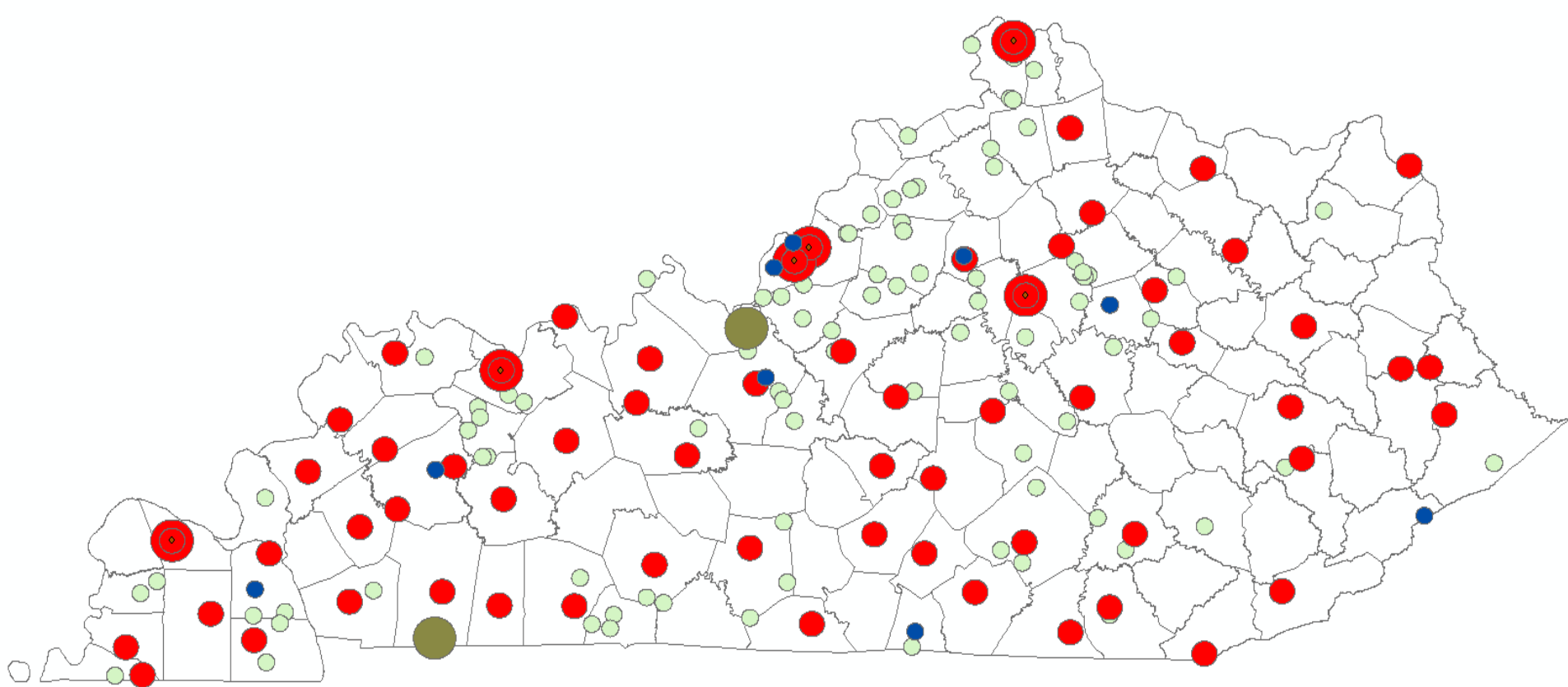
## Exemption Grants by Use

- Aerial photography, videography, filmmaking
- Industrial/utility applications and inspections
- Aerial surveying, mapping
- Precision agricultural uses
- Construction
- Miscellaneous (including Amazon Prime Air, wildlife conservation uses, search and rescue operations)
- Education, training, research
- Insurance



## Issue of Sec. 333 Exemption Grants over Time





**“Blanket COA” for 333 exemption holders**  
**Below 200’ AGL**  
**5 nm from towered airports**  
**3 nm smaller airports**  
**2 nm from heliports**

# Airspace terminology

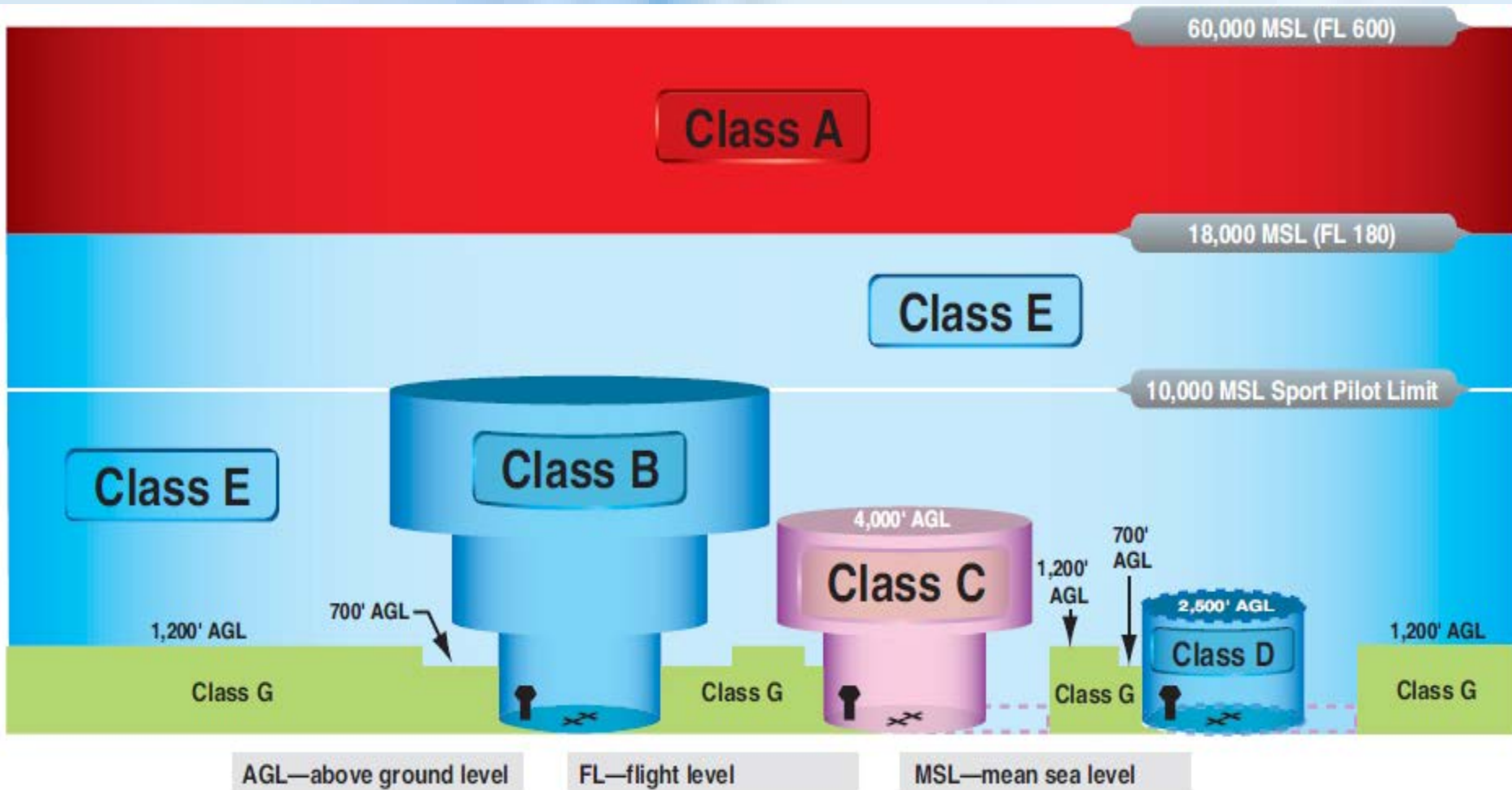


Figure 8-3. Class G airspace extends from the surface to the base of controlled airspace (Class B, C, D, and E).

KYTC 333 exemption submittal approaching 3.5 months

Peter Sachs's paper airplane took 3.5 months to approve so perhaps we are getting close

## Lawyer gets FAA to approve paper airplane



September 2, 2015 | By Alton K. Marsh



# sUAS future? FAA NPRM Part 107

- ▶ Aircraft less than 55 lbs
- ▶ VLOS only
- ▶ Daytime only
- ▶ <100 mph <500' agl
- ▶ UA Operator Certificate
- ▶ Aeronautical knowledge test
- ▶ Minimum 17 years old
- ▶ No airworthiness certificate
- ▶ Aircraft N# required

**Comments closed 4/24/15**  
**Likely 2017 before final rule**

# Questions

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