# Science Breakout Room Overriding Questions

Participant:

Ecologists, geomorphologists, scientist, and UAS system developers that have experience with UAS to no experience with UAS.

Why they are interested in UAS?

Ecology: High resolution data for ecosystem management, change detection, fire research, and Satellite, airborne data calibration

To characterize vegetation that is not capable f capturing with high altitude sensor data such as airborne or satellite (shrubs and grass structure)

Geomorphology:

Change detection – remove vegetation

Fly frequently

Small changes

Signal processing

Vegetation restoration

Have used ground based hyperspectral – interested in seeing drone based – Work for UNAVCO

Interested in What post processing techniques are needed

UNAVCO - Structure from motion

What works as advertised - lidar UAV

IVAN Clark – experienced with lidar UAV

Credible mapping - multischemes of data

Geometric aspects of calibration

Life and habitat – monitoring

Use a RGB camera and want to apply hyperspectral and lidar for habitat work

## With no limitations, what would you like to achieve with a UAS in the next 5-10 years?

* What is the end goal of UAS development?
  + Integrate into national airspace – increase site capability and accessibility
  + small institutions
  + Be able to use high payloads and improve coordination with groups
  + 2000-2001 – no requirement in marketplace at the time for Ipods but increased the usage and accessibility with time. That is now same with the UAS
  + UAS in open pit mines – to calculate volume (airborne platform- expensive)
    - UAS is being used (with lidar and or camera)
    - Time and cost effective
    - Have higher accessibility
* Geomorphological study – change over time

## What is preventing you from achieving this and are UAS essential for its accomplishment?

* What are the top community needs for UAS that can’t be met by manned aircraft?

cheap (cost effectiveness of getting the measurements)

much higher resolution (cm or half inch resolution)

fly inaccessible areas (e.g. over fires) - difficult with manned aircrafts (e.g. safety reasons)

surrogate for field observations

hyperspectral - phase of the water in runway (water/ice)

NASA AboVE –high latitude research (e.g. AVIRIS airborne sensor– calibration of airborne sensors)

* What unique capabilities do UAS provide that are critical to your research?
* What are the costs and access limitations of UAS?

Flying restrictions over some areas

GPS – e.g over a canyon – accuracy of your measuring location

Lidar + high precision camera -: $ 250,000 – most expensive lidar (Riegl ) - ~ 3000 pts per km2

Camera : ground sampling – 6 mm

GNU :

All high quality sensors to get high quality data, hence expensive (the Most expensive and highest quality for today)

* What framework would need to be established for a new investigator to use these instruments properly?

Cost – (half million dollars)

Getting permission to fly

Need to have both the UAV and the measuring instrument

Institute for coordination flying and giving permission

Accessibility to DGPS (UNAVCO) – Getting quality location information

Data processing

Need standard workflows and processing steps – data acquisition, processing and preprocessing, calibration, quality assurance: credible scientific investigation based on scientific facts based on others finding

Can sharable open

* What are the observation gaps that are unique to UAS?

Medium to large UAS – payload size (lidar and hyperspectral)

Selection of cameras

Even Medium do not provide enough electricity to power lidar

## How can NASA help to remove these limitations?

* Where are the gaps in funding and attention? What aspects haven’t been addressed by other groups?

funding some researchers and equipment’s with the UAS

calibration and validation are important – concurrent acquisition of data

UAS hyperspectral – as field observations to calibrate DESIS, PRISMA, AVIRIS

* How does this new observation fit into the larger observation scheme found in NASA?
* Why can’t this be done by universities or centers on their own? Why is this a NASA issue and not NSF?

Multitemporal data

High latitude drone ecology network

* Are there examples of existing projects that would be improved with NASA involvement? How? Be specific.

High resolution – (talked Brian Yanites) – use UAS data with machine learning algorithms for coarser lidar systems

Multiscale observations

UAV – Difference in data collection timescales (compared to a scene from coarse resolution)

Needs better batteries and better platforms – can fly longer, at different altitudes.

Considerations or thoughts of using UAV ---- (Satellite data – one block – but UAV takes longer to cover that)

Mohamad Mostafa : UAS footage by camera or lidar: consider as a close range sensor- thus introduce lot of variation to the data :

Are there models that consider those issues? yes, There are models – refer Researchgate : methods and algorithms for UAS

* Are there Decadal Survey observables that will need a UAV component to meet associated science objectives?

“Questions for Science”

• Why UAS vs the plethora of other aircraft?

• Where do you want to fly?

• How high, how long, in what conditions?

• How big are the instruments you want to fly?

• How much power do you need?

• What environments do your instruments require to survive (temp, vibration, clean air, etc.) and take data?

Vibrations are not higher

Use UAS stabilize mounts – isolate vibrations

End user

– data collection temperature consideration – maximize the coverage – don’t trust when fly below 40 Degrees

Elevations above MSL – factor to consider - Thin air, battery life (crashing within 5 min – Mexican city –

GPS + IMU + sensors : Zero degree temp – challenging

RTK – calibration and validation

• What’s the real airborne “truck” requirement?