NAU’s New UAV Instrumentation

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• Remote Sensing Ecology
• Land Use and Land Cover Change
• Studies at local, regional, and global scales
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• Studies at regional and global scales:
  • Global cropland mapping project: NA continent
  • Regional forest restoration project: Northern AZ
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- Satellite data
  - MODIS (250 m resolution)
  - Landsat 5, 7, 8 (30 m resolution)
High Resolution Data

• Expensive
  • WorldView 2 and 3 (2 m resolution)
  • Airborne imagery
  • Repeat data and timing of imagery??

• UAV as an alternative
NAU UAV

- Remote controlled with waypoints
- Payload: 8 lbs
- Flight time: 25 min
- Area coverage: 30 ha/hr
Hyperspectral Sensor

- Hyperspectral: 400-1650nm
- Measures reflectance in ~300 narrow bands in 5 cm
- Allows us to detect different plants, soils, and rocks
Hyperspectral Sensor: Plant and Soil Moisture
Lidar scanner

- Lidar: 32 pts/m² @ 80m and 6 mph
- GNSS: ~6 cm accuracy
Lidar data

- 3D vegetation and topography
- Point cloud data
- Height and DEM
- Can be rasterized
Tree height, canopy volume, and biomass

\[ y = -0.14 + 0.82X \]

\[ R^2 = 0.84 \]

\[ p < 0.001 \]

\[ \text{RMSE} = 4.9 \]
Forest Stand Biomass

Y = 0.85 + 0.77*X

R² = 0.77

p < 0.001

RMSE = 0.5
Juniper tree age and height

\[ y = 10.7 + 10.6X \]

\[ R^2 = 0.60 \]
Individual shrub characterization

- Shrub height and canopy area
- Shrub volume and biomass
Sagebrush Height - Lidar

Vegetation height (cm)

- Herb
- ARAR
- ARTR
- PUTR
- Other

Lidar measurement
Field measurement

a b c d
Sagebrush Height - Lidar
4FRI Objectives

• Promote snowpack accumulation to increase groundwater recharge

• Little quantitative information on the effects of thinning/burning on snow accumulation
  • Snow water equivalence
  • Soil moisture
Research sites
Landsat results: NDSI Feb 18, 2010

Study Sites:
- GPNA
- Rudd's
- PL
- CF-B
- CF-A

Bars represent different treatments:
- Control
- Thin
- Thin & Burn
Grand Canyon and Colorado River Sediment

• Sand dune measurements in 3D
• Sediment volume and weight
• Sand dune migration rates
Current Status

- System engineering is a challenge
- Smaller, ready-to-go systems are available
- FAA regulations are another challenge
- COA is a long process
Thank you.

Questions?