The Rx-CADRE Integrated Prescribed Fire Measurements Campaign

November 2012

Airborne Measurements with Piloted and Un-Piloted Aircraft

Rx-CADRE Airborne Measurements - overview

- Rx-CADRE (Prescribed Fire Combustion and Atmospheric Dynamic Research) has conducted successful research campaigns at Eglin Air Force Base in 2008 and 2011

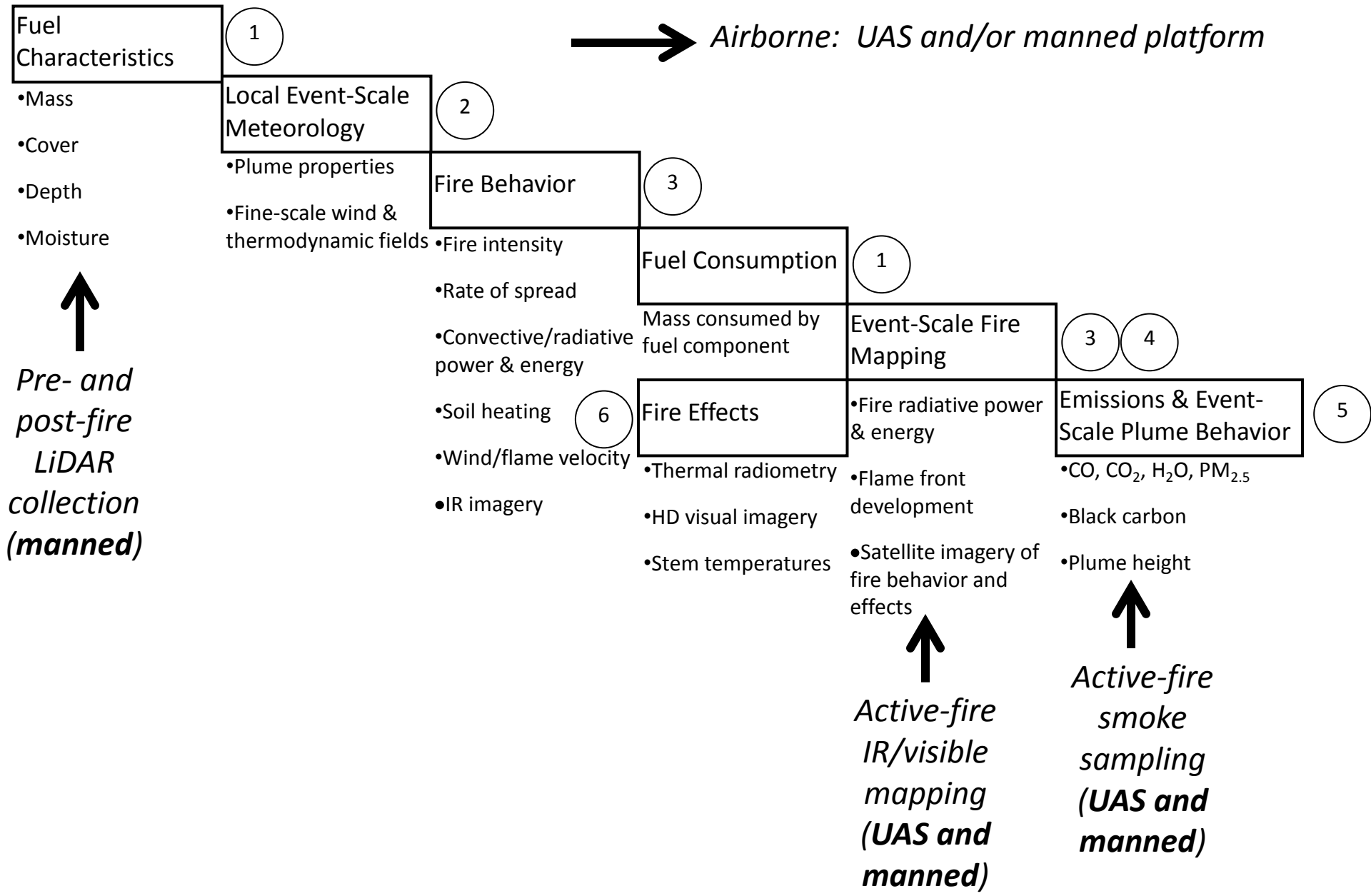
- The Rx-CADRE team is inter-agency (e.g., DoD, USFS, NASA, DoE, Academia) and multidisciplinary (e.g., ecology, remote sensing, meteorology, fire physics)

- The 2011 Campaign integrated Unmanned Aircraft Systems (UAS's) into the research program

- Rx-CADRE funded by the interagency Joint Fire Science Program to conduct a third campaign in non-forested fuels scheduled for November 2012

- Primary objectives of Rx-CADRE 2012
  - Evaluate smoke chemistry and transport models
  - Evaluate fire behavior models

Rx-CADRE Airborne Measurements

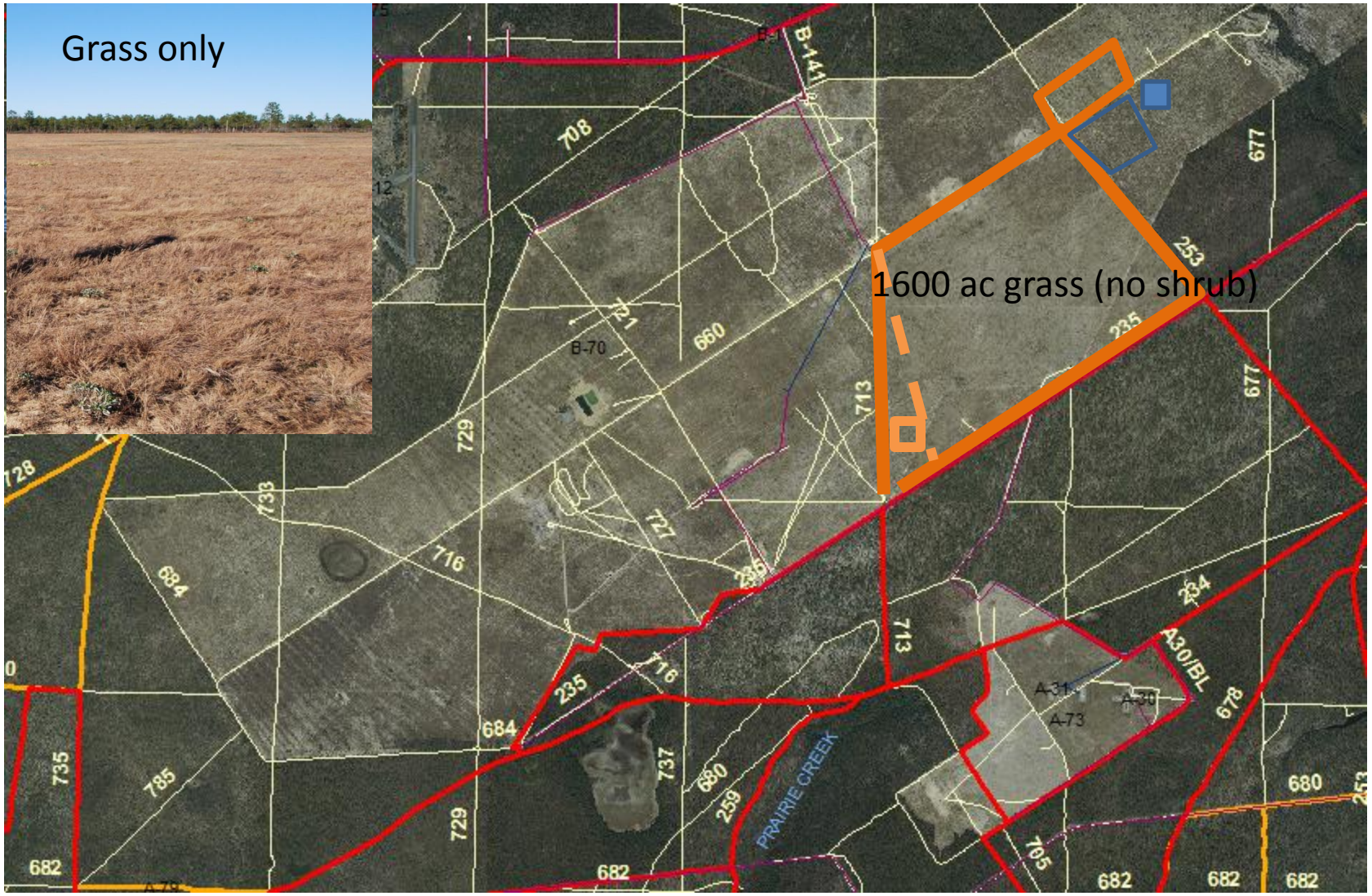


Rx-CADRE Airborne Measurements

- Burns involving aircraft will be conducted on Range B-70

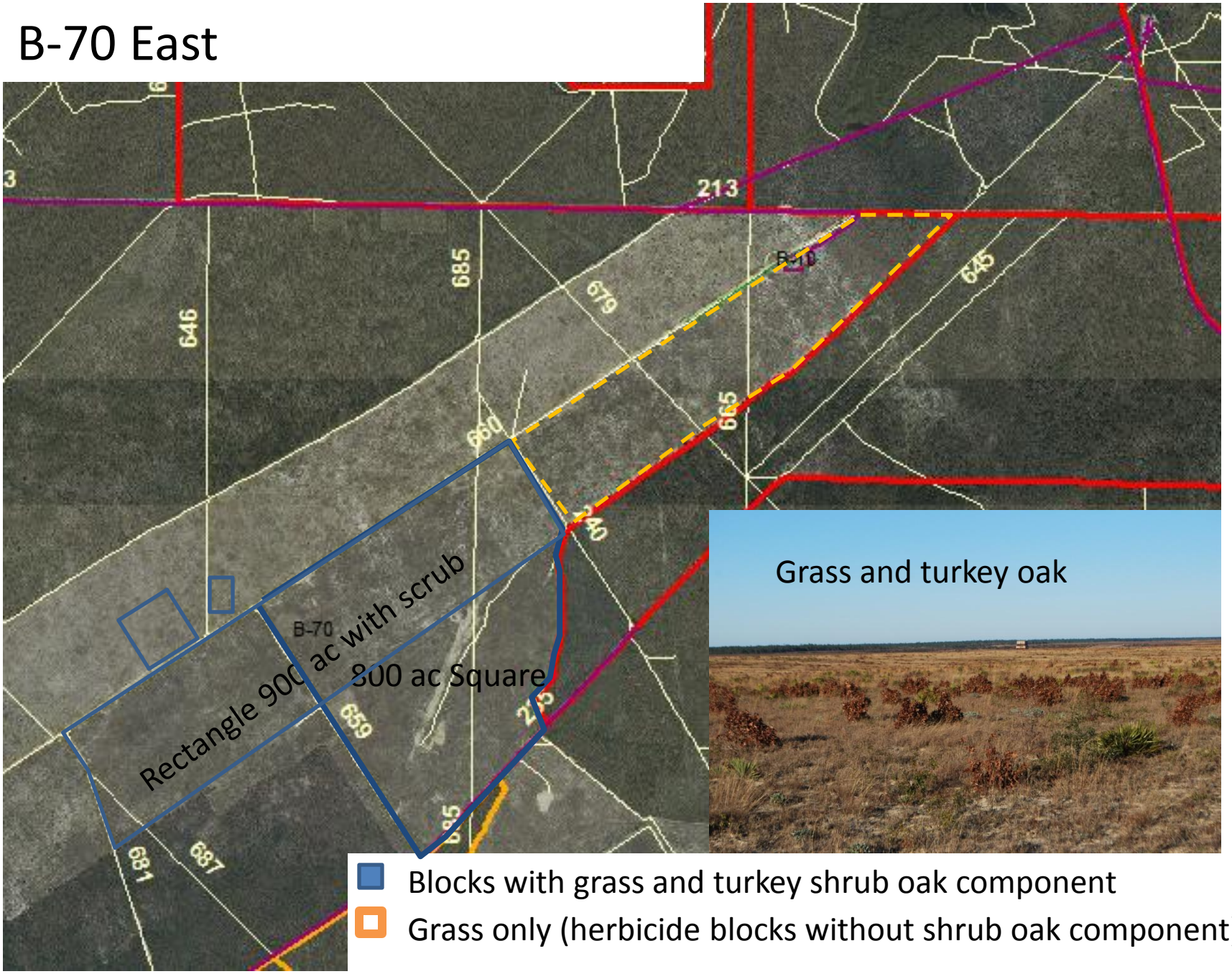
- There will be two kinds of units
  - **Large units** (500-1000 acres, N=2)
    - ✓Grass and turkey oak fuels
    - ✓Objective: evaluate smoke chemistry and transport models
  - **Small units** (~5-10 acres, N=6)
    - ✓Uniform grass fuels
    - ✓Objective: evaluate fire behavior models

B-70 Central and West



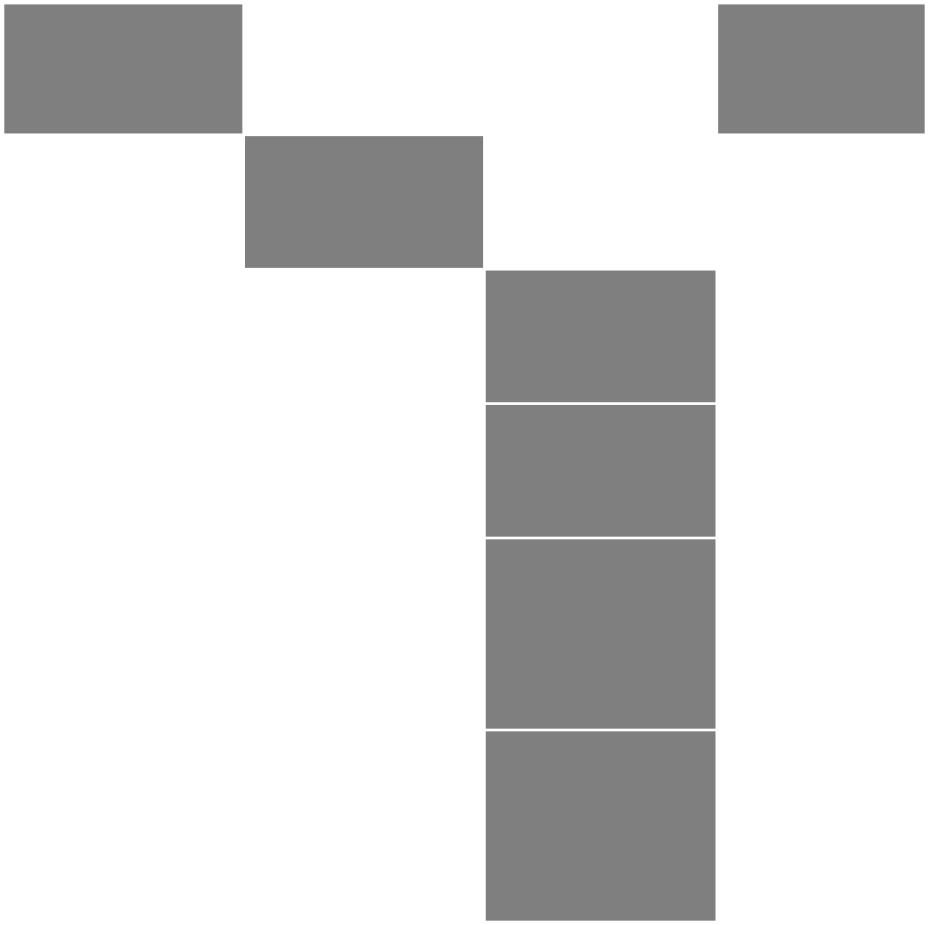
- Blocks with grass and turkey shrub oak component
- Grass only (herbicide blocks without shrub oak component)

B-70 East


213
685
646
679
645
665
660
640
B-70
Rectangle 900 ac with scrub
800 ac Square
659
681
687
Grass and turkey oak
Blocks with grass and turkey shrub oak component
Grass only (herbicide blocks without shrub oak component)

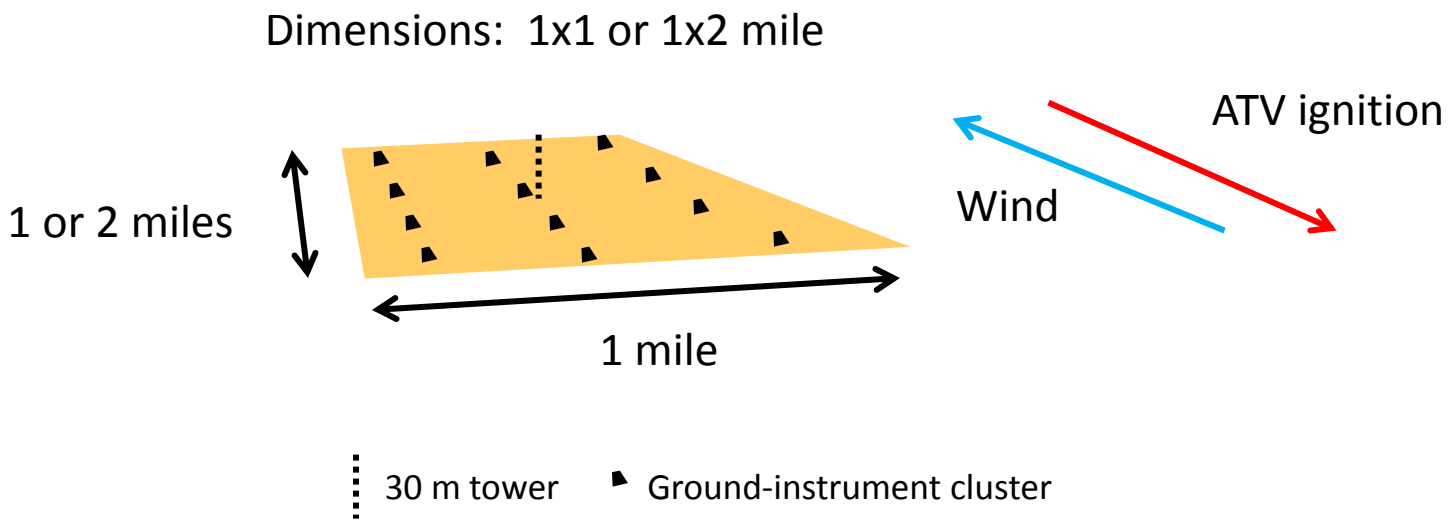
Rx-CADRE Airborne Measurements – Large Units

Measurement	Manned or UAS	Platform	Pre-fire	Pre-ignition	Active-fire	Post-fire
LiDAR fuels mapping	Manned	Cessna 206 or Piper Navajo				
Atmospheric profile	Manned	Twin Otter				
Fire mapping	Manned	Cessna 206 or Piper Navajo				
Fire mapping	UAS	G2R and ScanEagle				
Smoke chemistry and transport	Manned	Twin Otter				
Near-source black carbon, wind, T, and RH	UAS	G2R				



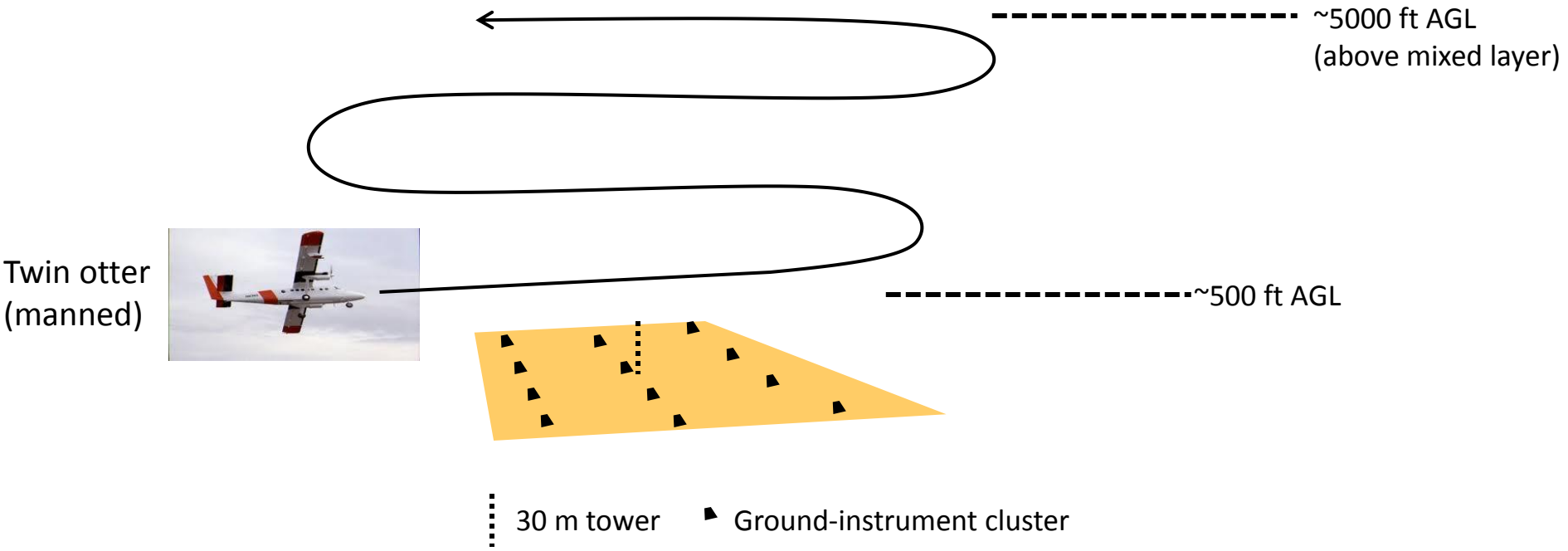
Rx-CADRE Active Fire Measurements – Large Units

Plot layout



Rx-CADRE Active Fire Measurements – Large Units

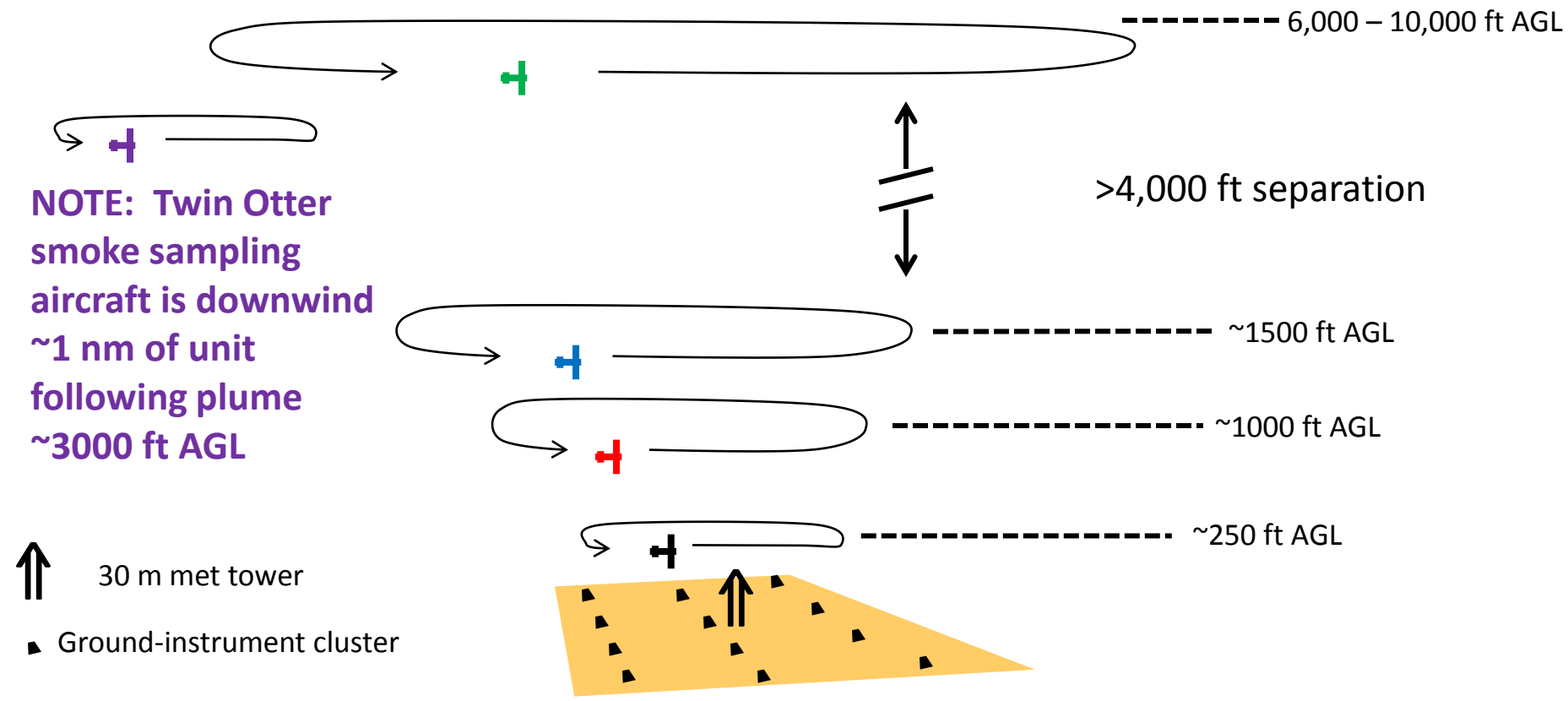
Pre-ignition atmospheric profile measurements



Note: Unmanned aircraft will either remain clear of large fire unit (ScanEagle) or not be launched (G2R) until Twin Otter is above highest UAS operating altitude 1500 ft and is 1 nm downwind of the large fire unit.

Rx-CADRE Active Fire Measurements – Large Units

Active fire measurements



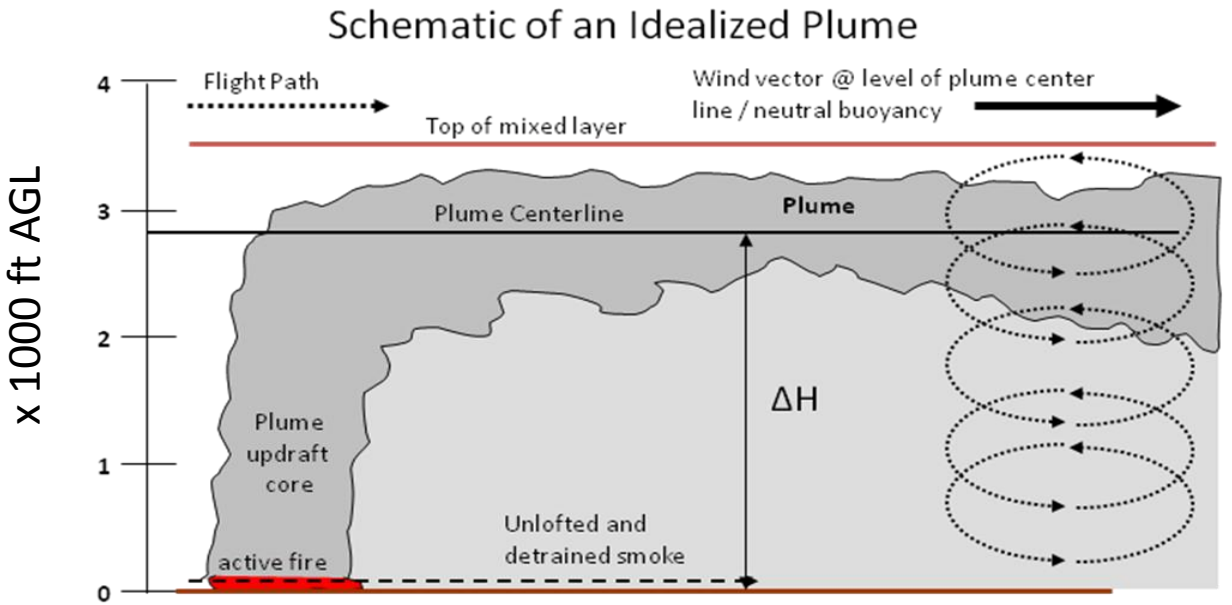
Manned
- Cessna 206 or Piper Navajo – WASP sensor (LWIR/MWIR/SWIR and visible fire mapping at zenith)
- USFS de Havilland Twin Otter – Smoke sampling equipment

UAS
- EAFB Test Wing G2R – black carbon, wind, T, and RH sampler (flies in front of met tower)
- EAFB Test Wing G2R – LWIR and visible fire mapping (oblique/staring – follows ignition)
- U. Alaska ScanEagle – LWIR and visible fire mapping (oblique/staring – follows ignition)

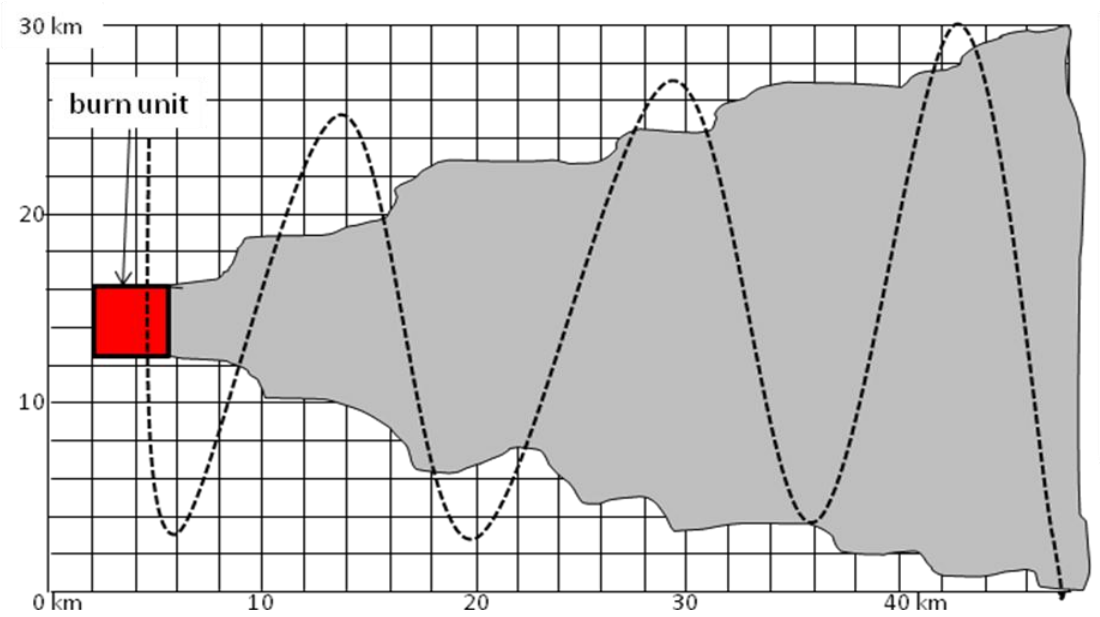
Rx-CADRE Active Fire Measurements – Large Units

Plume chemistry and transport measurements

Twin otter

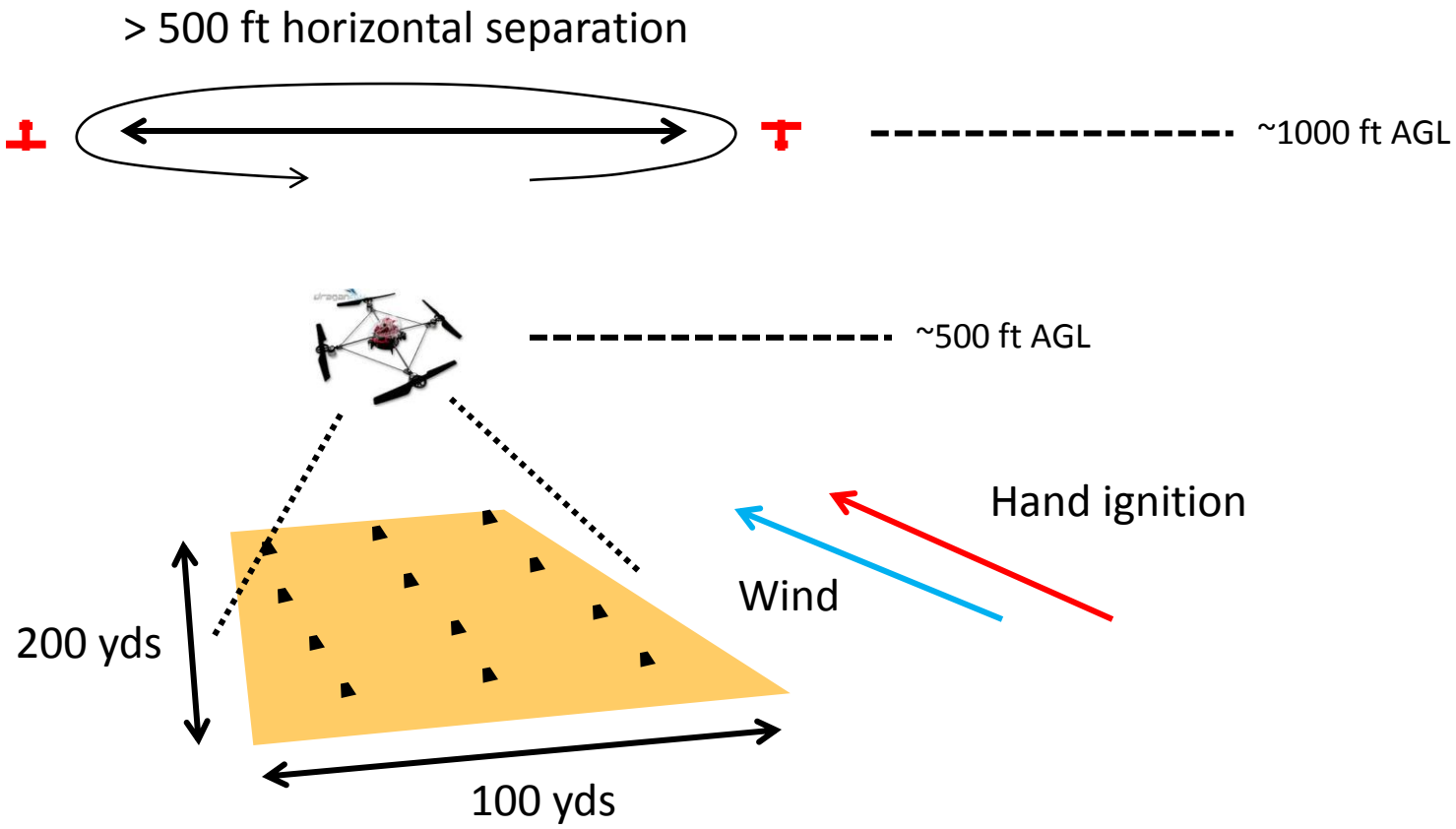


NOTE: Smoke sampling aircraft is downwind of burn units during active-fire period with both vertical and horizontal separation from UAS and other manned aircraft



Rx-CADRE Active Fire Measurements – Small Units

Active fire measurements – UAS only



U. Alaska quadrotor (Dragonflyer X6 or Aeryon Scout) – LWIR fire mapping (stationary with whole-unit FOV at nadir)

EAFB Test Wing G2R – LWIR and visible fire mapping (oblique/staring – whole unit)

Ground-instrument cluster

Rx-CADRE Active Fire Measurements – UAS Specifications

Answers to questionnaire