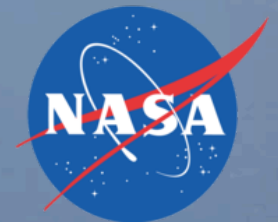


Recent NASA Dryden COA Experience



Brent Cobleigh
NASA Dryden Flight Research Center
April 29, 2008





Recent NASA Dryden COA's



- 2005 Altair NOAA Mission
 - 6 missions in NAS, up to 18.5 hrs
 - Goal: Atmospheric Science, remote sensing, mapping, wildlife monitoring, maritime surveillance demo



2006 Altair Western States Fire Mission

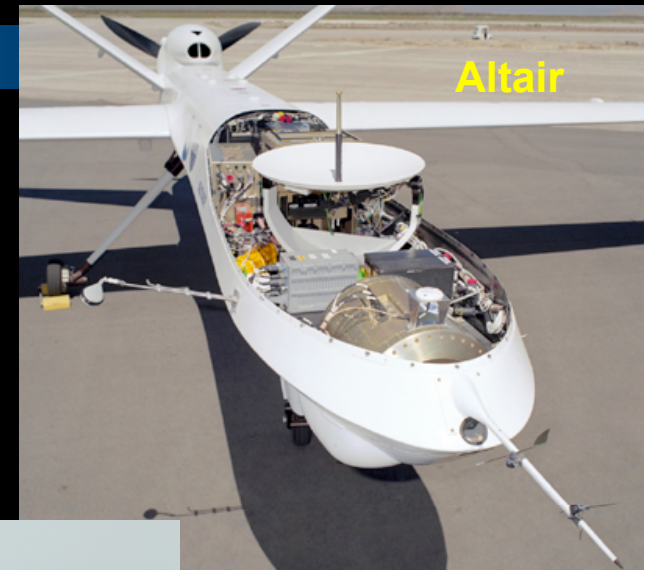
- 2 flights in NAS
- Goal: Wildfire Mapping

- 2007 Ikhana Local Area
 - > 30 flights in NAS
 - Goal: Pilot Training



2007 Ikhana Western States Fire Mission

- 8 flights in NAS, up to 20 hrs
- Goal: Wildfire Mapping



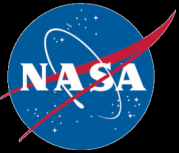
Altair



Altair



Ikhana



NASA Dryden UAS Safety Process

- Priority
 1. Protect public (ground and flying)
 2. Protect high value ground assets
 3. Protect UAS
 4. Accomplish Mission
- Detailed hazard analysis accomplished for each mission
 - Assessment of probability and severity
 - Fault tree used to estimate overall reliability
 - Analysis results in changes to system design, mission plan, contingency plans, mission rules
- Independent Range Safety Analysis
 - Statistical analysis based on vehicle reliability, route, and population density
- Airworthiness and Flight Safety Review
 - Detailed review of project objectives, vehicle modifications, flight plan, operations plan, risks, mitigations
- Tech Briefs
 - Periodic review of past flights, operations planning, configuration changes, hazards, mission rules, go/nogo



Typical UAS Hazards

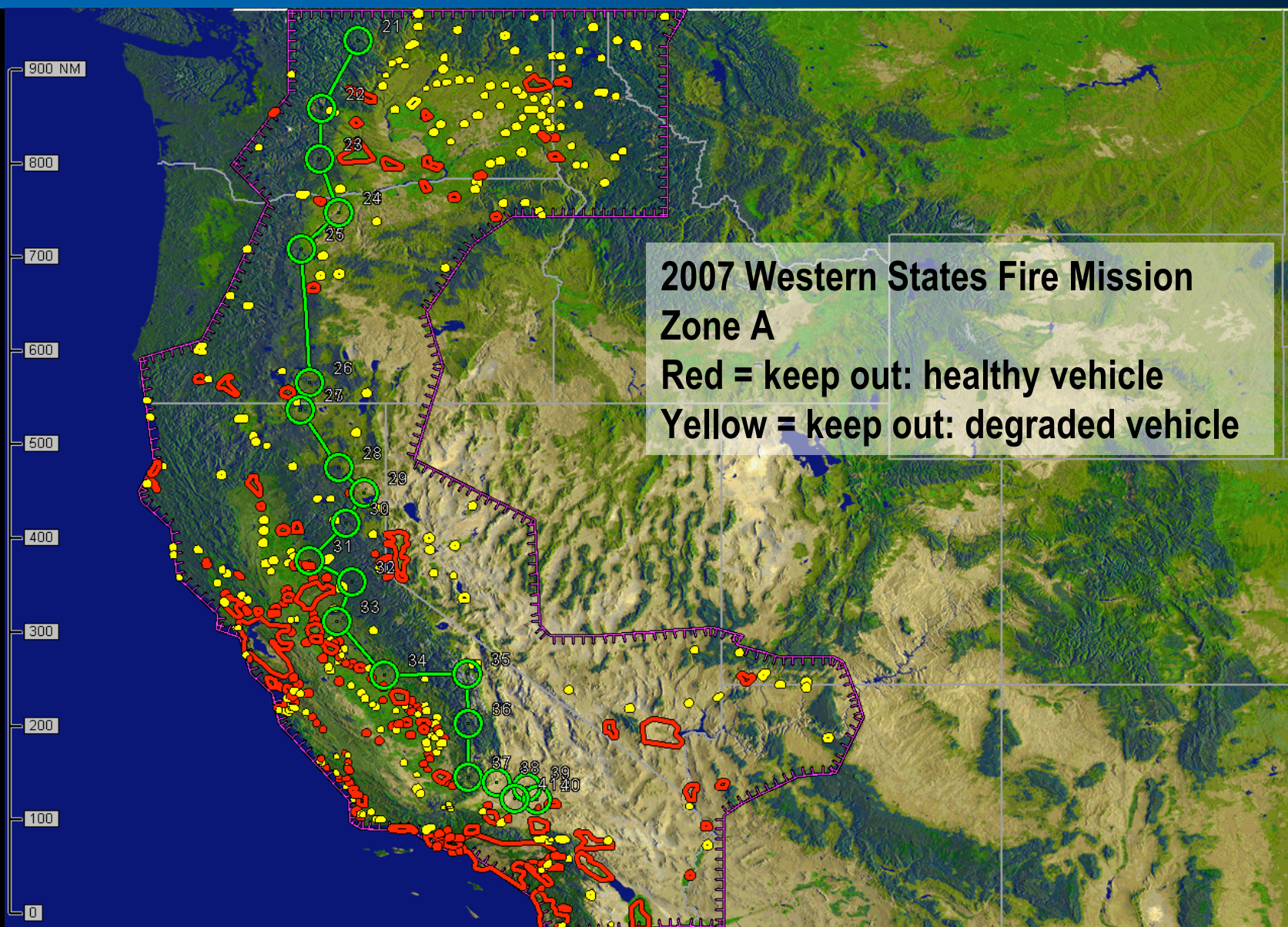
- Mid-air Collision
- Engine failure
- Power failure
- Aircraft flyaway
- Loss of datalink
- Network failure
- Control system failure
- Loss of ATC communication
- GCS failure
- Loss of GCS/antenna power
- Structural Failure
- Explosion/fire
- Controlled flight into terrain
- GCS evacuation
- Airdata failure
- Icing
- Landing Gear/Brake failure
- Nose camera failure

Each hazard is evaluated for

- Cause(s)
- Effect(s)
- Mitigations
- Probability
- Severity



Range Safety Zones





Common COA Provisions

- Navigation and strobe anti-collision lights
- Mode C transponder
- Fully operational redundant flights controls, navigation
- Chase aircraft below class A when outside segregated airspace
- 2-way radio communication with ATC
 - Telephone back-up with ground station
 - Immediate notification following lost-link
- Visual Meteorological Conditions (VMC) & clear of clouds
- Visual Observer when outside Class A or segregated airspace
- Pilot and Observer qualifications
- Reportable events
 - Deviations from special provisions
 - Lost link
 - Incidents/accidents

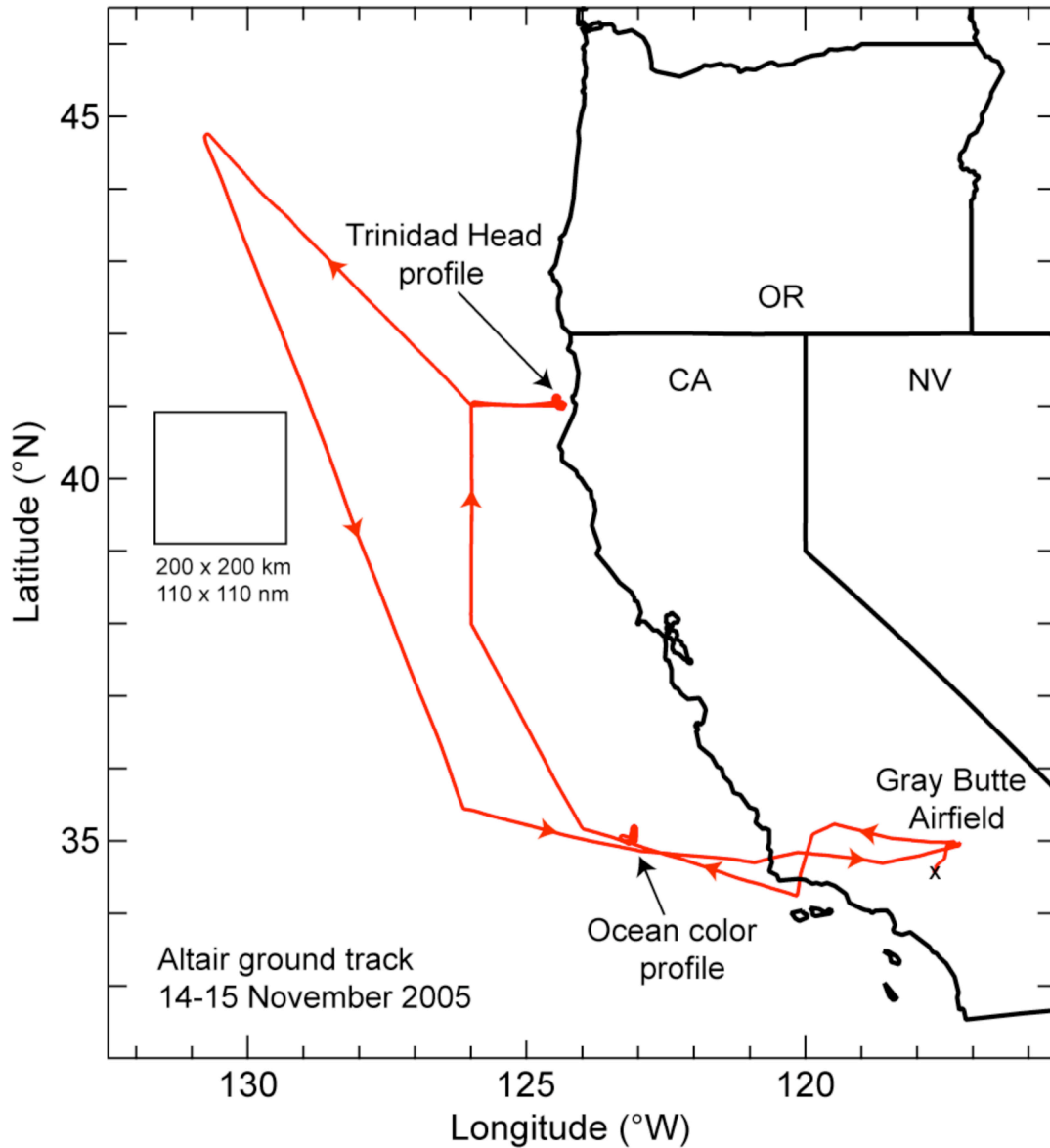


UAS Lessons / Best Practices

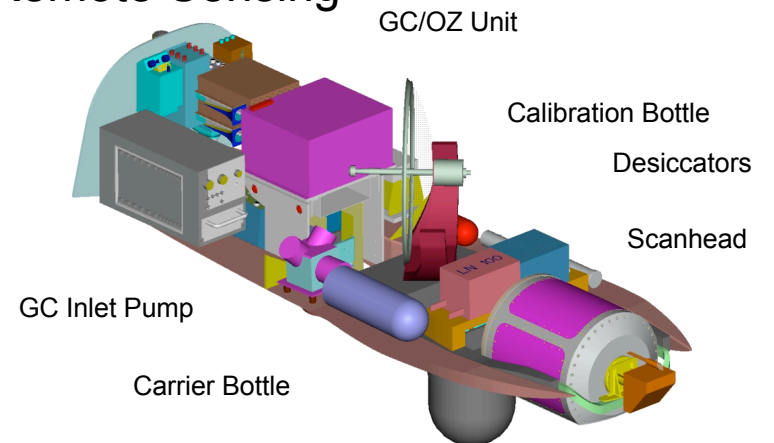
- Communicate early and often (face-to-face where possible)
 - FAA
 - Get Flight Safety & Air Traffic Controller Feedback
 - Segregated Airspace owners
 - Contingency landing sites
 - Frequency owners
- Contingency Planning requires significant time investment
 - Decision flow diagram
 - Predetermined landing sites
- Expect the unexpected
 - GPS jamming
 - Weather



2005 NOAA/NASA Science Demonstration Flights



Atmospheric Science Remote Sensing





2006 Esperanza Fire Emergency

First use of emergency COA process for civilian emergency

FAA indicates willingness to issue COA amendment within one hour of request & issues COA within 11 hours

~16 hr mission delivered near real-time imagery to fire incident command



2007 Fire Missions

Provided near real-time imagery to incident commands

8 Flights lasting up to 20 hours and imaging up to 10 wildfires per flight

One-hour loiters over fires

Excellent coordination with ATC

