NASA Dryden Flight Research Center

Ikhana MIZOPEX and Alaska Fire Missions

2011 Alaska UAS Conference

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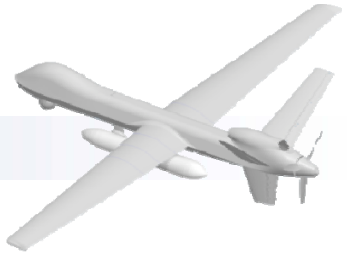
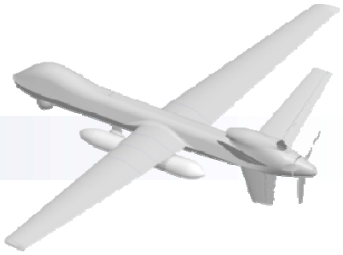
September 2011

Agenda

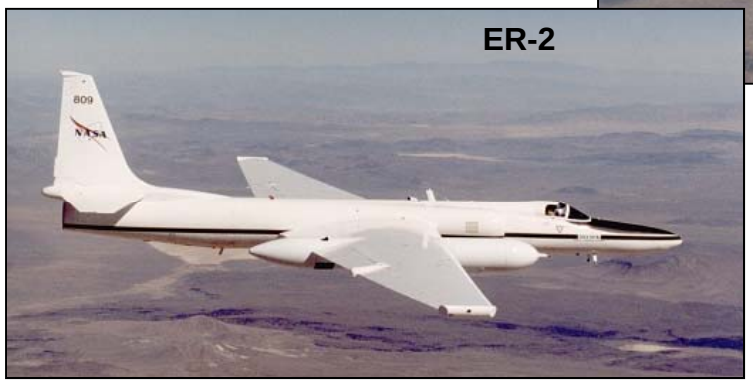


- Introductions
- Science Missions
  - MIZOPEX
  - Alaska Fire Mission
- Eielson AFB: Ikhana Base of Operation
  - COA
  - Concept of Ops
  - Safety Considerations
- Questions

Introductions



- NASA, Dryden Flight Research Center
  - Tenant at Edwards AFB, CA
  - Aeronautics
  - Earth Science
  - Space Exploration



Introductions

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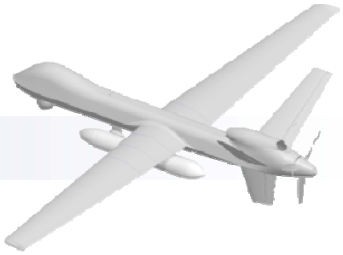


- Ikhana Team Members
  - Project Management
  - Air Crew, Ground Crew, Ops Engineers
  - Aeronautical Engineers, Scientists

MIZOPEX Missions Description

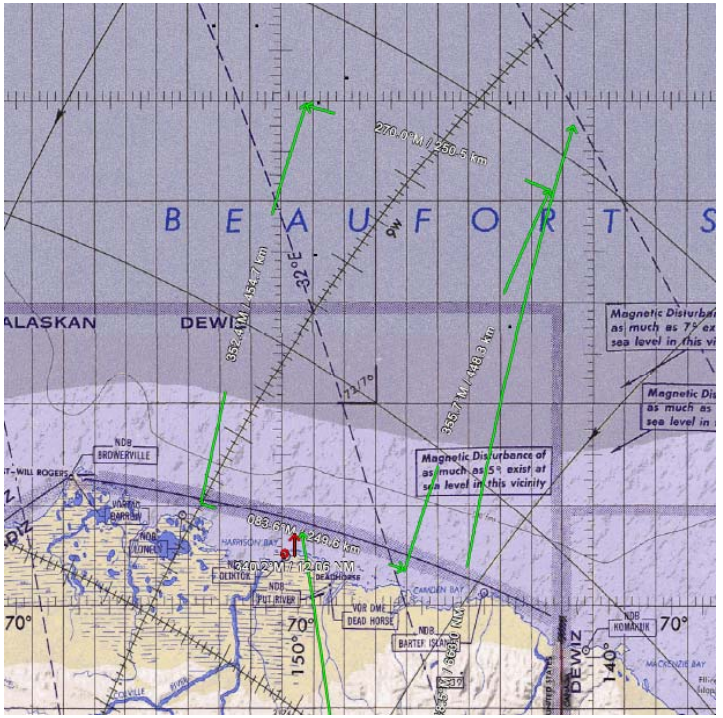
Marginal Ice Zone Observations and Processes EXperiment

An interdisciplinary effort that brings together oceanographers, cryospheric scientists, aeronautical engineers, UAS operators and database/data systems experts.

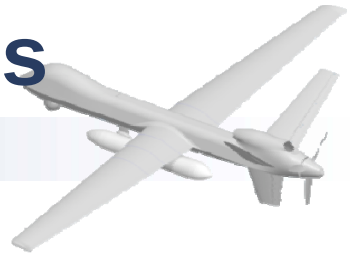
-How much is the warming of the MIZ in the Arctic Ocean under or over estimated by satellite measurements?

-How does this warming affect sea ice melt in the MIZ?

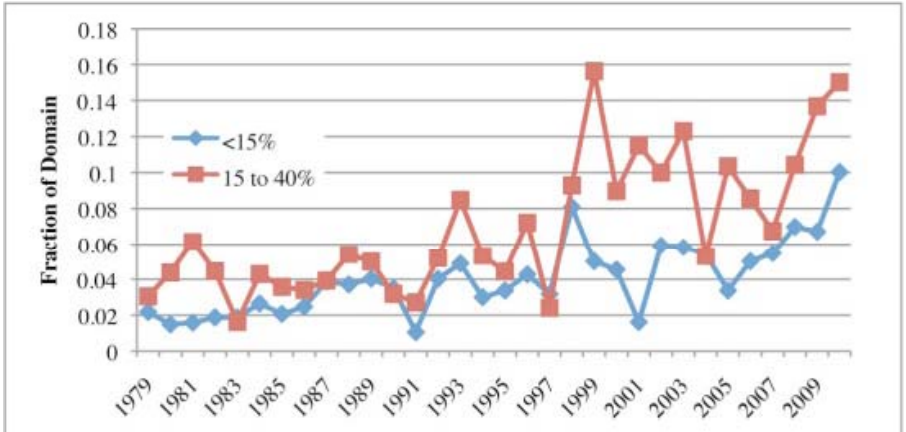
- Can we better characterize sea ice survival rates in the transition zone between open ocean and permanent ice through improved data input to ice forecasting and climate models?



MIZOPEX Missions Objectives



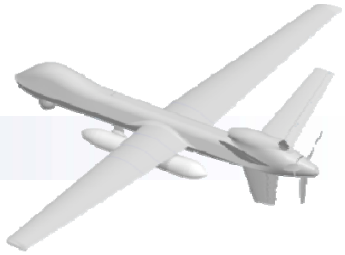
– Science
- Quantify the variability of sea surface temperature and salinity, ice conditions in and near the marginal ice zone
- Determine the accuracy of satellite-derived data
- Investigate how well measurements represent subsurface temperatures
- Assess ice-ocean interactions
- Identify variations in ice thickness and surface characteristics
- Investigate what types of ice survive summer melt



Fraction of Beaufort Sea and Canada Basin Containing Sea Ice by Year

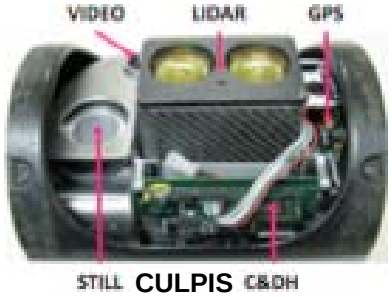
– Aeronautical:
- Demonstrate coordinated operation of multiple classes of UAS
- Long-duration, repeated UAS missions in the NAS
- Deployment of unique combinations of remote sensing instrumentation

MIZOPEX Sensors



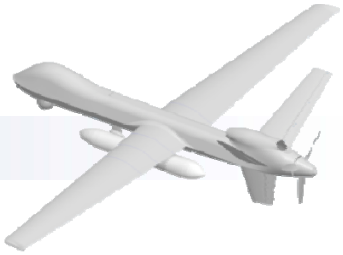
The MIZOPEX suite of sensors provides a comprehensive set of data targeting surface temperature, salinity, ice topography, and surface reflectance.

- **Ball Experimental SST Radiometer (BESST):** A microbolometer radiometer providing real-time calibration
- **CU Laser Profiler and Imaging System (CULPIS):** A Lidar, IMU, GPS and digital still and video camera sensor suite to map ice sheet and sea ice topography including roughness, elevation, and surface features



- **Synthetic Aperture Radar Imaging:** C and X band SAR providing sea ice small-scale roughness and large-scale morphographic imagery
- **Airborne Automatic Identification System (AIS) Reciever:** AIS is a marine vessel transponder. The AIS receiver enables airborne tracing of vessels and maritime surveillance.

MIZOPEX Sensors (cont.)



- **ATOM miniature thermal camera:** Providing thermal data
- **Riegl Q240i-80 laser scanner**

- **IR thermometers/spectrometers:** Multiple instruments that include two spectrometers; two pyrometer/thermometers each providing different degrees of atmospheric penetration; and a pyrometer

- **Airborne RadIomEter at L-band (ARIEL):** A single polarization nadir-looking radiometer for SSS and soil moisture measurements

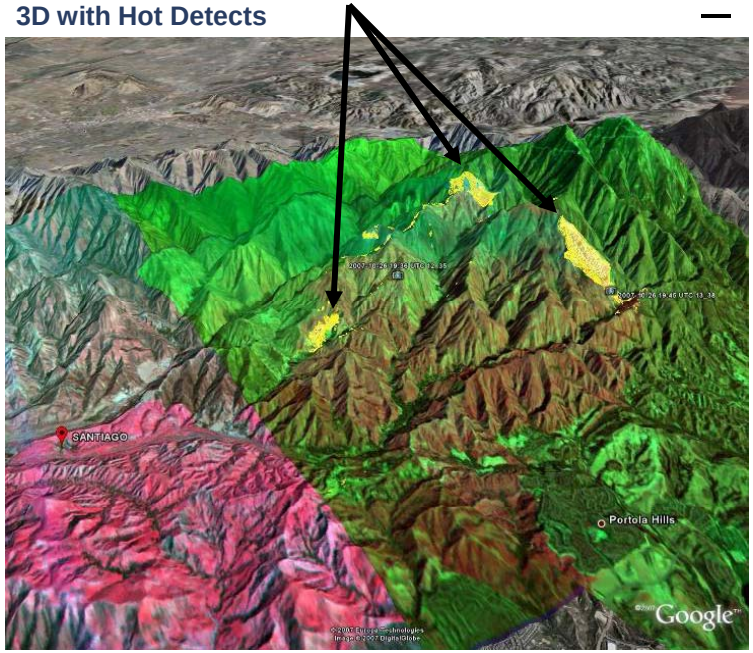
- **Hyperspectral and standard electro-optical (EO) cameras:** A hyperspectral camera providing spectral data, and electro-optical still and video cameras

Alaska Fire Missions Description

A joint project in cooperation with the National Interagency Fire Center (NIFC), and NASA's Ames Research Center (ARC) and DFRC to demonstrate technology that will increase capabilities for locating and monitoring wild fires, and distributing to the wild fire community the "near real-time" data collected.

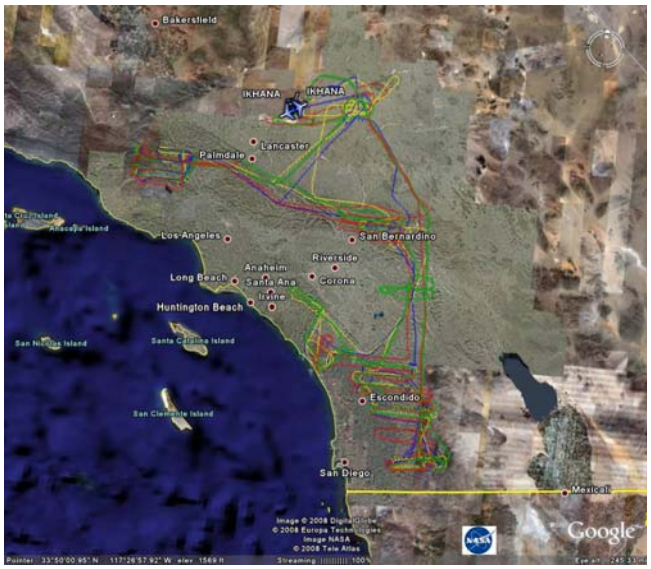
Alaska Fire Missions Objectives

WSFM 7: Santiago Fire – 3D with Hot Detects



– Technology
  - High altitude identification/imagery of wildfires, emerging wildfires and hotspots that are both within and outside of the primary burn area
  - Near real time data transfer to national fire personnel and incident commanders
  - Multiple wildfire incidents per mission
  - Lengthy Loiters up to “several” hours

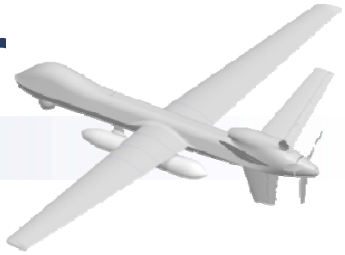
– Operational
  - UAS operations in the NAS approximating “file and fly”
  - UAS capabilities to collect sensor data on widespread wildfires for long durations



2007 WSFM

WSFM 5: Oct. 24
11 Fires,
~1350 nm, 9.0 hrs
WSFM 6: Oct. 25
8 Fires,
~1350 nm, 7.8 hrs
WSFM 7: Oct. 26
8 Fires,
~1350 nm, 7.8 hrs
WSFM 8: Oct. 28
8 Fires,
~1350 nm, 7.1 hrs

Alaska Fire Missions Sensor



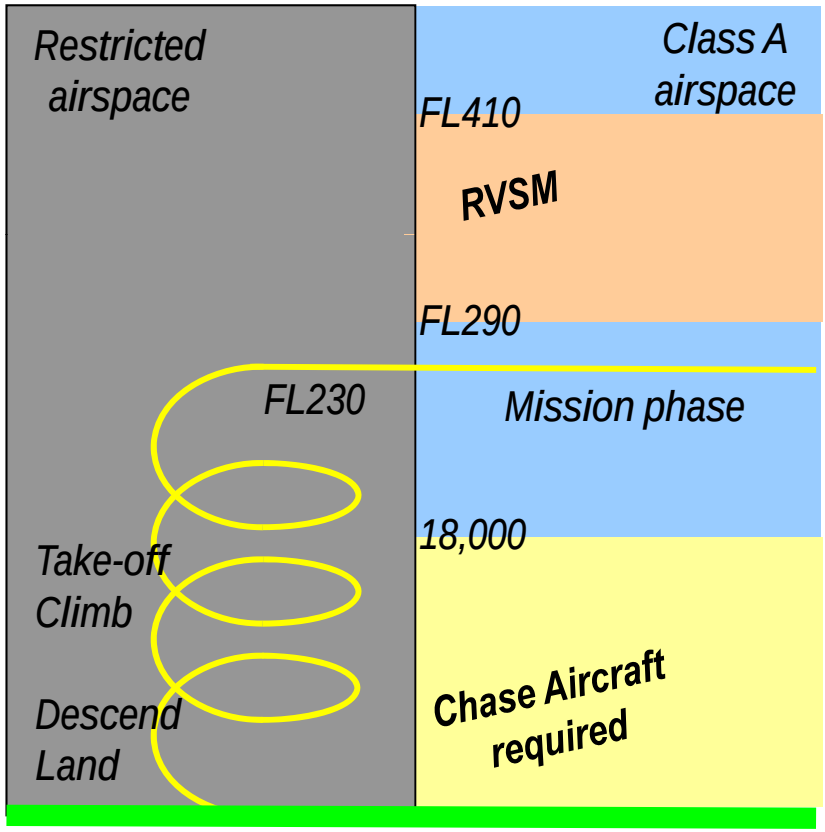
– NASA ARC Autonomous Modular Sensor (AMS)

- Airborne scanning spectrometer, passive IR line scanning
- Onboard science data recording and processing
- Approx. 6nm swath at FL200

NASA ARC AMS "Fire" Sensor

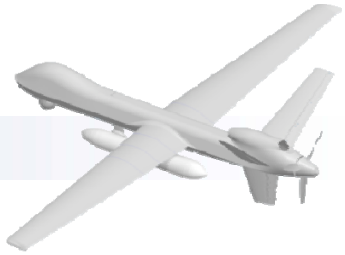
Ikhana with the Fire Sensor Pod

EDW AFB NAS Flight Operation

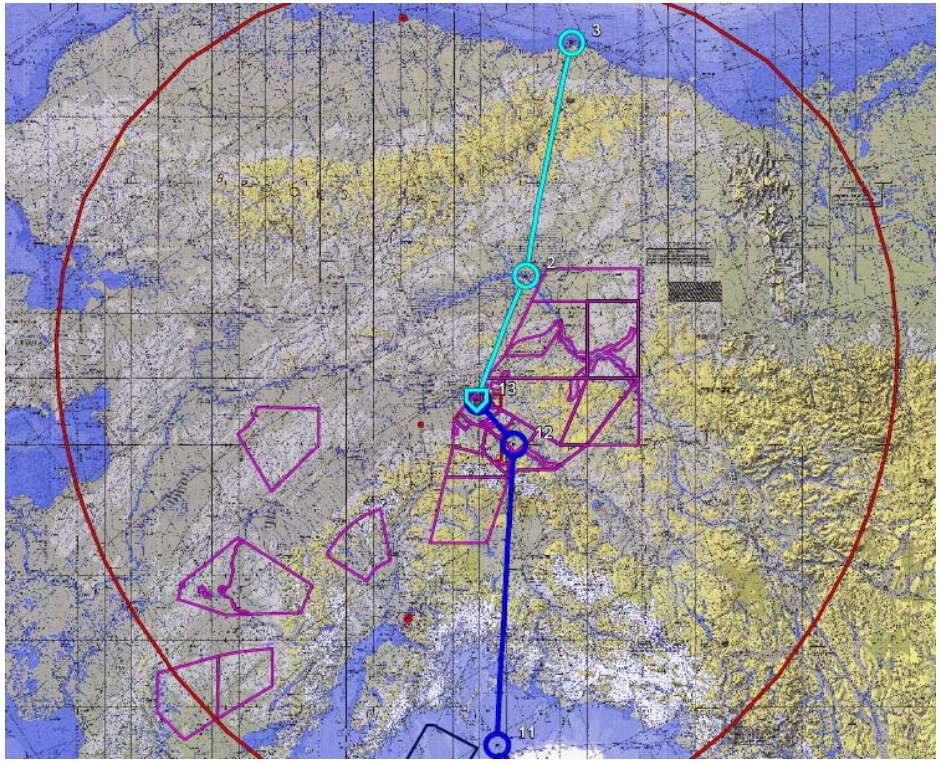


- COAs (WSFM /TRACER)
  - WSFM :Western US
  - TRACER: route Specific
- OTH Communication
  - C-band w/Transition to Ku (Commercial provider)
  - Exploring Irridium
- R2508/R2515 Surface to Unltd
  - Climb and Descent into/from the NAS
- Lost Link – Hold over appropriate area near base of operation
- Emergency Landing Sites

Ikhana Eielson AFB COA



- History
  - 2011-WSA-XXX not yet submitted
  - Effective ?? To ??
- General Information
  - Jul – Aug 2012 or ??
  - Ikhana relocation route
  - MIZOPEX mission route to the Beaufort Sea
    - Loiter up to ~8 hours
    - Low and high altitudes
    - ??? Number of flights
  - Alaska Fire Mission route
    - File point to point with ATC, 24-48 hours prior
    - 12-14 hour missions
    - Loiter, as appropriate to the fire (generally 30 minutes to 2 hours)
    - 23,000 MSL or altitude preferred by ATC
    - ??? Number of flights



Eielson AFB Concept of Operation

- Initial Arrival at Eielson AFB: Stage
  - GCS
  - SMURF/PGDT Antennas
  - Ku Dish
- GDT at Deadhorse (science missions)
- Fly Ikhana to Eielson AFB
  - Use GCS, SMURF/PGDT and Ku Dish
  - Beyond ~100 nm Ku SATCOM C2
  - Within ~100 nm C-Band LOS C2
    - Descend from Class A Airspace
      - Use nearby Restricted Area
    - Land at Eielson Class D Airspace
      - Use nearby UAS Corridors
      - UAS Chase, as required

Eielson AFB Concept of Operation

- Mission flight preparation from Eielson AFB
  - Processes similar to Edwards AFB
  - Per Eielson Processes make the following requests:
    - C-band flight set
    - Airspace, Pad
    - After hours, if required
  - Prepare UAS (Several days to the day before)
    - Load Mission files
    - Top Charge 6 - 14 Batteries in hangar (prior to PMA mod)
    - Position Equipment
    - Notify FAA and file flight plan per the COA
  - Flight Day
    - UAS Pre-Flight
    - Aircraft Tow
    - Pre-Flight Brief
    - Flight

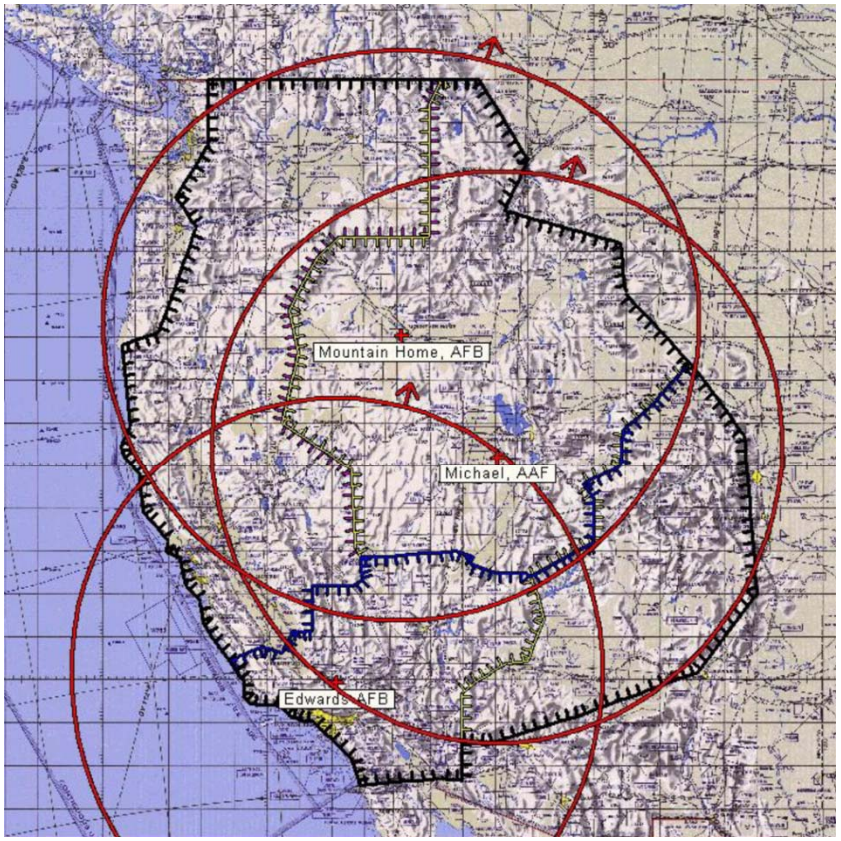
Eielson AFB Concept of Operation

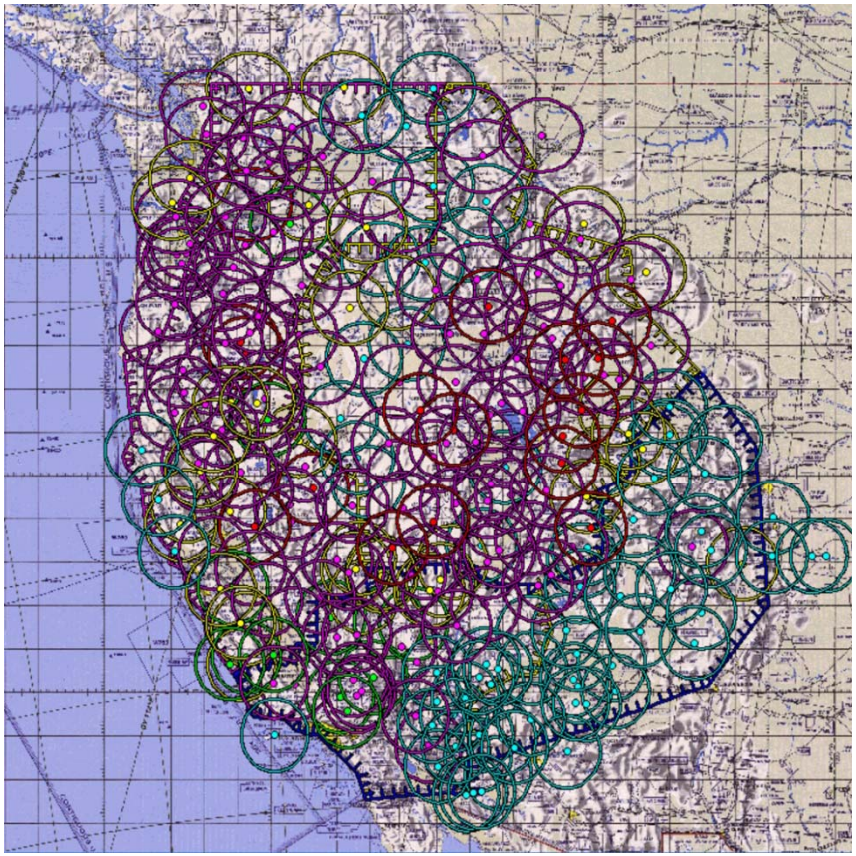
- Eielson Safety Considerations
  - Eielson Population Keep Out Zones (PopKOZ)
  - Eielson “Keep-out” and “No Fly” areas
  - Preferred approaches / approach corridors
  - Recommended / preferred runway(s)
  - Nominal Lost Link Mission
    - Aircraft will fly a pre-programmed RTB route to Eielson AFB
    - HOLD As Designated By Eielson AFB
      - Until link is re-established
      - OR Until out of fuel

Eielson AFB Concept of Operation

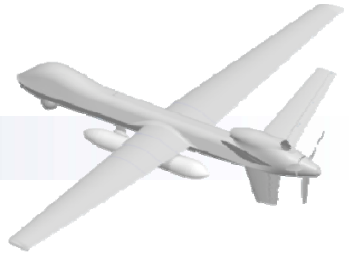
WSFM Emergency Landing Sites

- Primary ELS (prior to PMA mod)
  - Generator / Electrical Failure
  - 400 nm radius at 20K AGL





- Secondary ELS
  - Engine Failure
  - 50 nm radius at 20K AGL
  - No Comm Aviation Presence



THANK YOU!!!!