

An aerial photograph of a river valley with agricultural fields. A white unmanned aircraft is flying in the center of the image. The text is overlaid on the image.

New Mexico State University/ Physical Science Laboratory Technical Analysis and Applications Center

RDT&E to Advance UAS Access to the
National Airspace System

Steve Hottman

February 28, 2008

24th Annual National Test & Evaluation Conference

NMSU/Physical Science Laboratory Overview

- Established in 1946 to support missile testing of V-2/Aerobee rocket testing at WSPG
- Multi-disciplined, aerospace- and defense-oriented scientific and technical organization
- A TOP SECRET cleared facility

30 Dec. 1946

George,

When you have a little time I should like to enquire as to your interest in (a) establishing + manning an elementary electronics + mechanical shop on the grounds at W.S.P.S. for APH.

(b) Telemetering trucks + service for Aerobee.

(c) Handling, fueling, taking, launching + supervision of Aerobee.

(d) General headquarters for receipt + shipment of data equipment in connection with V-2 and Aerobee program.

(e) etc.

John Van Allen



UAS Demonstrations and T&E

Las Cruces

T&E

WSMR

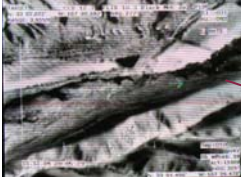
Denied GPS Environment



OSD-LEWK



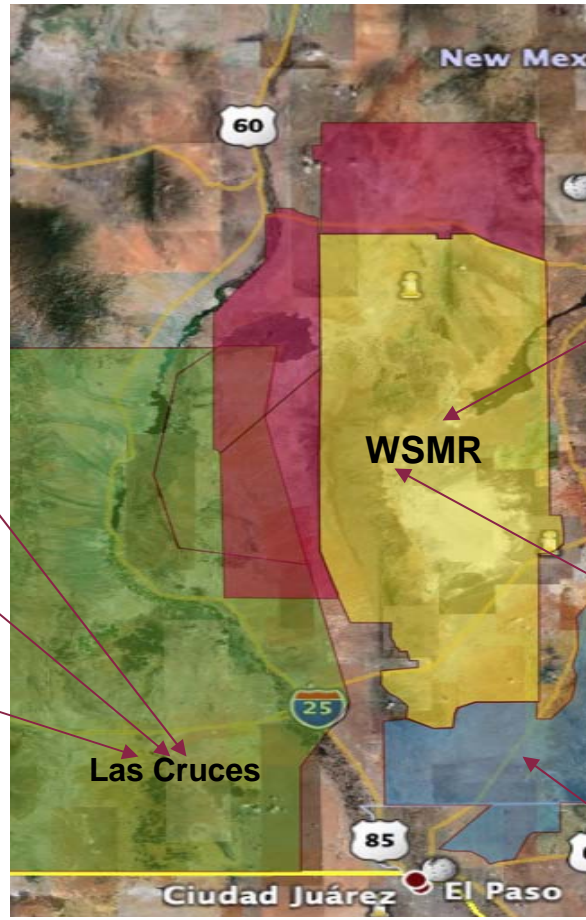
DHS/Border



Combat Search & Rescue



Playas



Asymmetric Threat

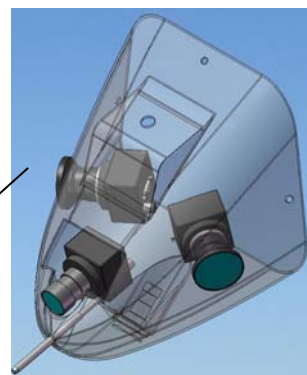
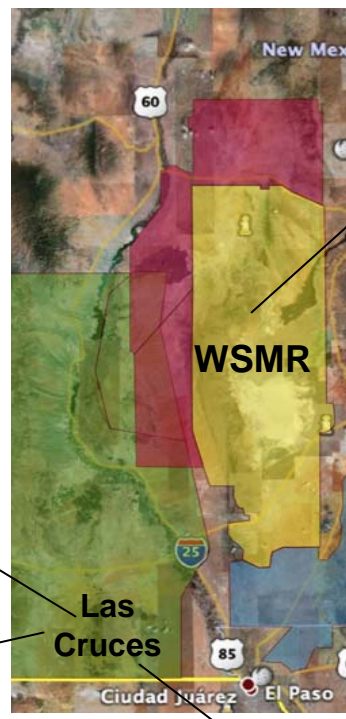
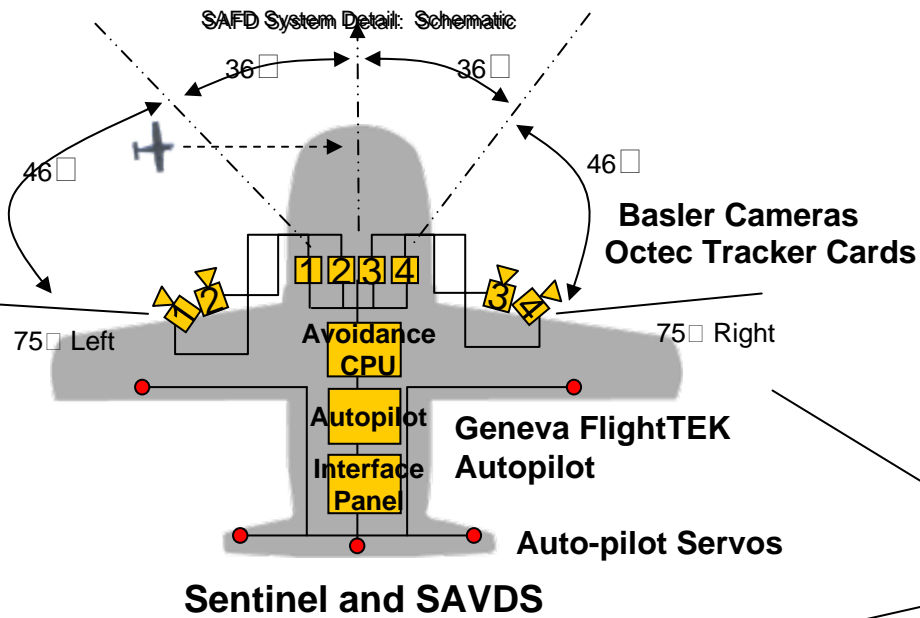


IED Demo

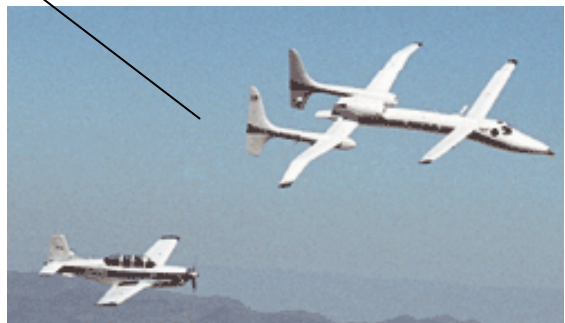
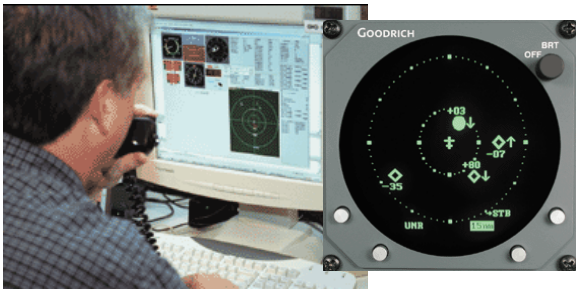


Orbiter

Detect, Sense, and Avoid



ERAST



Alaska



Trans Alaskan Pipeline Flight Route



Bering Sea Maritime Boundary Flight Route



Trans Alaskan Pipeline Flight Route

UAS Research

Air Traffic Control Research

Approach

Field evaluation of UAS symbology at FAA Air Traffic Control locations

- Aircraft call sign

Participants

- Seattle, Albuquerque, Fort Worth, Denver, New York En Route Centers and New Orleans, Denver, High Desert (Edwards AFB), Tucson, Albuquerque TRACONs
- 53 ARTCC controllers, 46 TRACON controllers

Potential UAS Symbology

- Aircraft call signs are used by air traffic controllers to identify individual aircraft:
 - **UAV173**
 - **UM9417**
 - **UIN237** (uses aircraft registration number)
 - **UN4237** (uses aircraft registration number)
- The data block (right) appears on the controller's radar scope. Flight progress strips (below) are printed on pieces of paper.



UAV173
180C
426 223

UM9417	SSO	00 ³¹	370		SNA./DR EWM J4 INK JEN5 DFW	6722
T/PRED/G	360					
T454 G499	017					
89	0012				o UAV TYPE 2 PREDATOR	
425 04/1		EWM				

UAS Operator Requirements



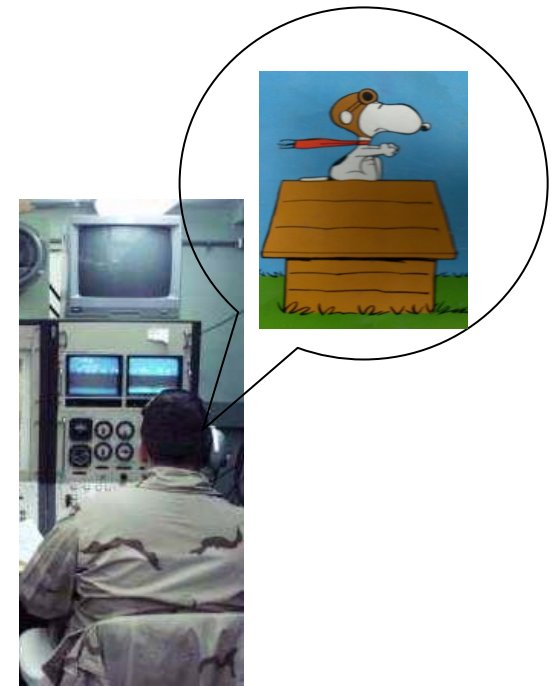
- Landing task description
 - ➔ 3 miles from airport
 - ➔ Lined up on centerline
 - ➔ 500' AGL
 - ➔ Substantial crosswind
 - ➔ Runway – 200' width; 7000' long
 - ➔ Acceptable landing parameters
 - Runway location
 - Heading
 - Vertical velocity

Results

- Data included as part of book chapter “Required Attributes and Skills of UAV Operators” for the future Human Factors of Remotely Piloted Vehicles volume of the Advances in Human Performance and Cognitive Engineering Research series.

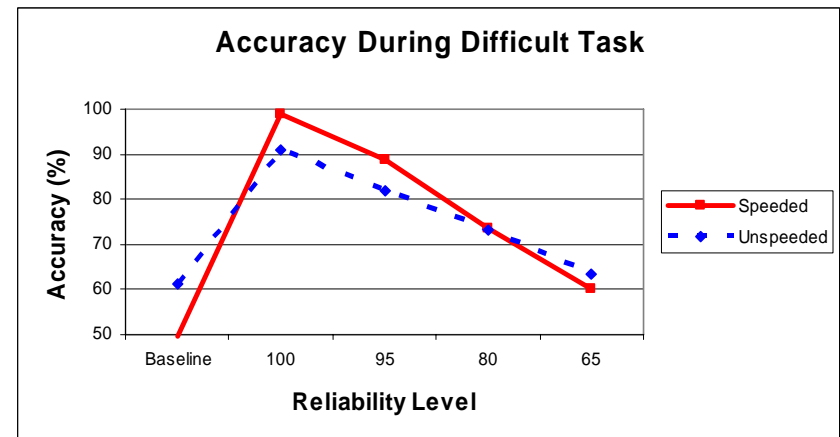
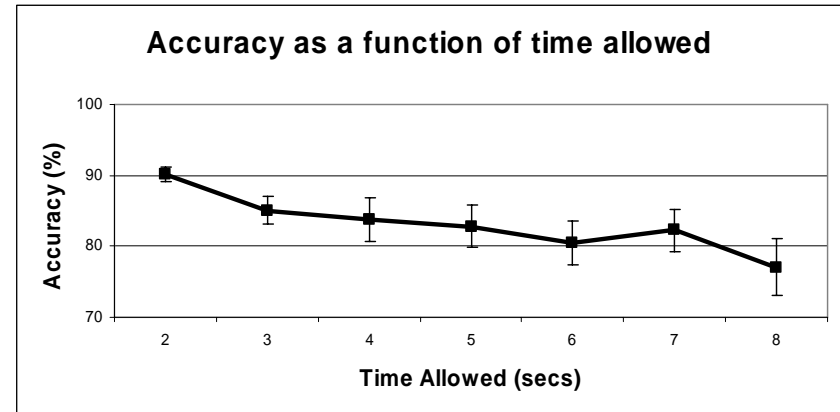
Handling Qualities

- Developing an assessment scale for UAS handling qualities. Derived from the Cooper-Harper aircraft handling qualities scale
- The UAS handling qualities scale will be multidimensional (unlike Cooper-Harper), non-intrusive, and will not compromise flight safety.
- The development of the UAS handling qualities scale will involve two empirical phases: dimension identification and validation. After scale construction, both content validity and inter-rater reliability will be empirically evaluated.



Trust in Automation

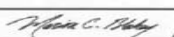
- Conducted an experiment that found time pressure increased trust and compliance in automation. This is beneficial to overall human-automation performance when the automation is highly reliable.
- Second experiment indicated that this increase in trust carries over to second session even when time pressure is removed.
- Third experiment indicated that time pressure is only effective when task is difficult and participants feel that the automation is doing a good job.
- Fourth experiment reveals a function by which the more time given to complete the task, the less compliance participants have in the automation.

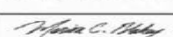


UAS Flight Test Center

UAS Regulatory Status

- No regulations exist for UAS; only guidance
- No empirical data exists to help drive regulatory development
- Access to airspace
- Civil – Experimental Airworthiness Certificate

REGISTRATION NOT TRANSFERABLE	
UNITED STATES OF AMERICA DEPARTMENT OF TRANSPORTATION - FEDERAL AVIATION ADMINISTRATION CERTIFICATE OF AIRCRAFT REGISTRATION	
NATIONALITY AND REGISTRATION MARKS N 617NM	AIRCRAFT SERIAL NO. 617
MANUFACTURER AND MANUFACTURER'S DESIGNATION OF AIRCRAFT AERONAUTICS DEFENSE SYSTEMS LT AEROSTAR ICAO Aircraft Address Code: 52004767	
I S S U E D T O	REGENTS OF NEW MEXICO STATE UNIVERSITY PO BOX 30002 LAS CRUCES NM 88003-8002
	This certificate is issued for registration purposes only and is not a certificate of title. The Federal Aviation Administration does not determine rights of ownership as between private persons.
GOVERNMENT It is certified that the above described aircraft has been entered on the register of the Federal Aviation Administration, United States of America, in accordance with the Convention on International Civil Aviation dated December 7, 1944, and with Title 49, United States Code, and regulations issued thereunder.	
DATE OF ISSUE December 14, 2007	 ADMINISTRATOR
U.S. Department of Transportation Federal Aviation Administration	
<small>AC Form 8050-3(10/2003) Supersedes previous editions</small>	

REGISTRATION NOT TRANSFERABLE	
UNITED STATES OF AMERICA DEPARTMENT OF TRANSPORTATION - FEDERAL AVIATION ADMINISTRATION CERTIFICATE OF AIRCRAFT REGISTRATION	
NATIONALITY AND REGISTRATION MARKS N 650NM	AIRCRAFT SERIAL NO. 250
MANUFACTURER AND MANUFACTURER'S DESIGNATION OF AIRCRAFT AERONAUTICS DEFENSE SYSTEMS LT AEROLIGHT ICAO Aircraft Address Code: 52106762	
I S S U E D T O	REGENTS OF NEW MEXICO STATE UNIVERSITY PO BOX 30002 LAS CRUCES NM 88003-8002
	This certificate is issued for registration purposes only and is not a certificate of title. The Federal Aviation Administration does not determine rights of ownership as between private persons.
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- Public – Certificate of Authorization

Need for UAS Flight Test Center

- COA process used for public aircraft operators
- Experimental airworthiness certificates required for commercial operators
 - Data must be generated to substantial airworthiness
 - To generate data, you must be able to fly
 - To fly in the NAS, you must have an experimental airworthiness certificate
 - To obtain an airworthiness certificate, flight data are required
- No authorized flight areas exist for UAS
- FAA needs data for development of regulations

Why A Test Center?

- UAS are Different
 - Manned Aircraft under testing and development can comply with 14 CFR Part 91
 - Private Industry needs a place to do basic Research and Development
 - Many are not ready for the FAA Experimental Certification process
 - Not just for aircraft.....payloads
 - UAS are still very immature

Why NMSU?

- Experience with UAS
 - Foundational SOP's in place and exercised
 - Ability to collect and process significant data
 - Solid and credible safety record
 - Over 8 years operational experience
 - Experienced UAS personnel
- Location –
 - “It’s not the end of the world, but you can see it from there.....”
 - Very sparsely populated
 - Low density Air Traffic
 - Climate is favorable

How?

- Establishing a Cooperative Research and Development Agreement (CRDA)
 - Outlines the risk management process similar to that being applied by FAA today
- FAA will require data on a routine basis
- NMSU is a Public Organization and thus qualifies for a COA
 - All testing/R&D will be conducted as directed by FAA under the COA
- Provides for a controlled testing environment while minimizing impact to other NAS users as well as people/property on the ground

TAAC 2007

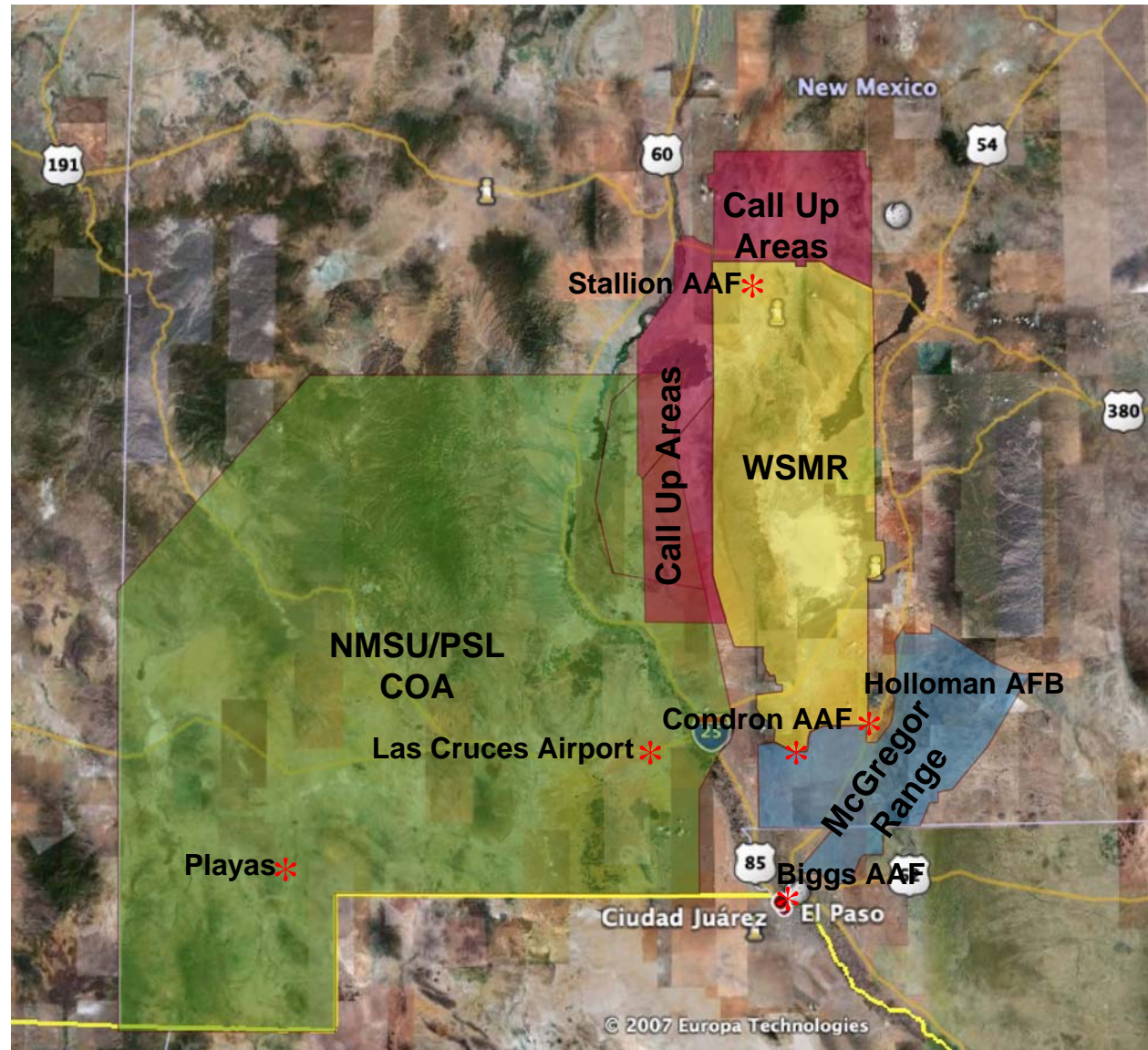


Federal Aviation
Administration

QuickTime™ and a
TIFF (LZW) decompressor
are needed to see this picture.

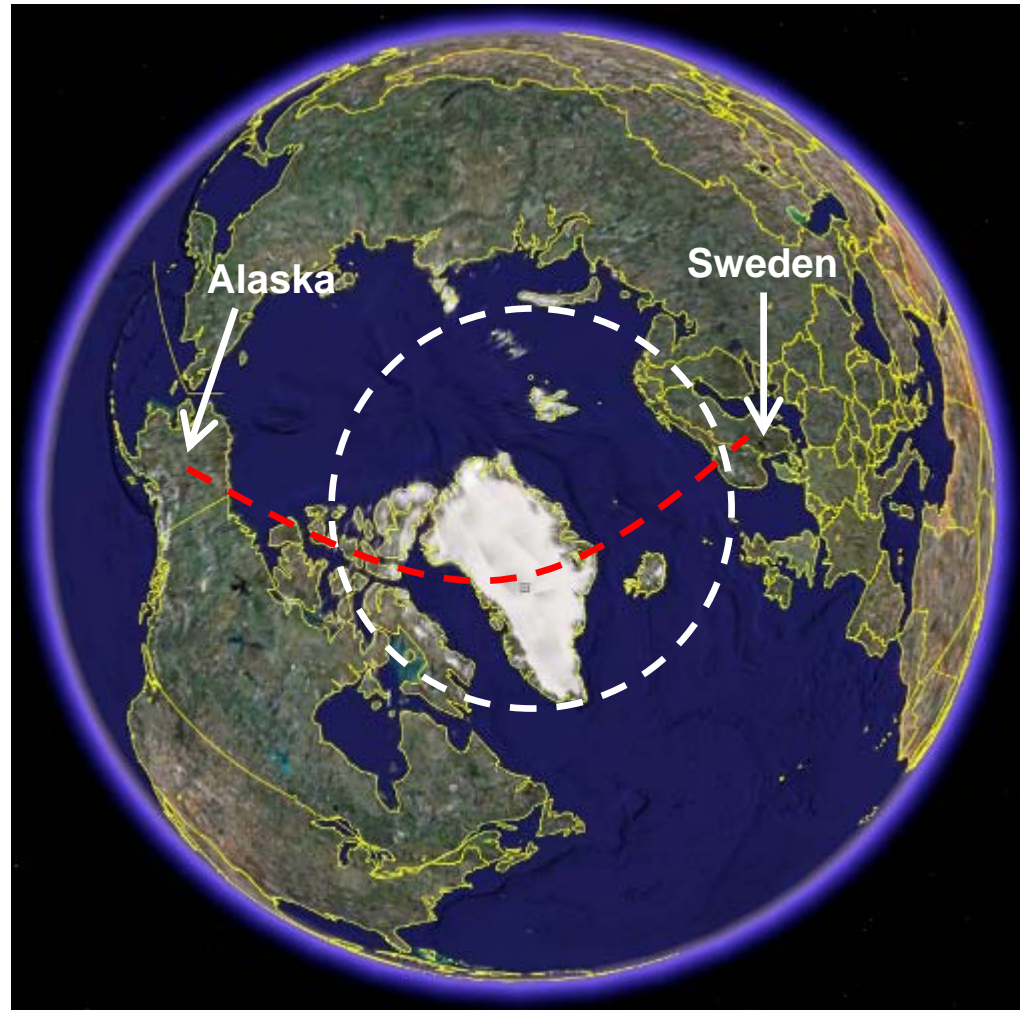
Southwest New Mexico Airspace

- Largest DoD-controlled air and ground space in the U.S.
- Slightly smaller than Connecticut – 7,105 sq mi
- USAF air traffic control from “surface to space”
- NMSU/PSL COA
>12,000 sq mi



Sweden/Arctic

- Currently performing Arctic airspace study with FAA UAPO
- Arctic overflights proposed since 2003
- CY05 USA/Sweden Space Exploration Agreement and International Polar Year with Swedish Space Corporation
- High-altitude balloon experience



Summary

- Routine access to the NAS is not yet available
- The regulatory body for UAS requires development
- Significant RDT&E is required before realistic “file and fly” in the NAS exists
- Formal studies with resulting empirical data will assist with FAA certification issues

UAS Flight Test Center provides NAS access and a T&E environment

