

NATIONAL INFRARED OPERATIONS

The U.S. Forest Service National Infrared Operations (NIROPS) Program:

2016 NIROPs Closeout

November 02, 2016





 NIROPS aircraft are considered national resources and are dispatched from the Aircraft Desk at NICC



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National resources are those which have national utilization, high demand, limited availability, and unique status reporting requirements

OPERATIONS

Air Tankers Type 1 & 2 helicopters Lead Planes Smokejumpers & Aircraft ANG MAFFS Infrared Aircraft Firehawk Support



Aircraft: Main function: IR use from April-November



N144Z Cessna Citation Bravo



N149Z Beechcraft 200
 Super King Air



WHY IR LINE SCANNERS?

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- Cover extremely large areas in a very short period of time
- Line scanners are extremely accurate (depending on processing system +/- 1 meter)
- Can detect very small fires

(While simultaneously)

- Mapping very large areas
- Timely delivery



PHOENIX System Specifications

Two channel thermal IR line scanner

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- 3-5 µm band for intense heat
- 8-12 µm band for background terrain
- 1.25 milliradian IFOV 3.8 meter (12.5 Feet) pixel at nadir, 10,000 feet AGL
- I20º FOV 6.55 mile swath at 10,000 feet AGL
- 256 gray scale (256th pixel is colored red)
- 1680 pixels per scan line
- 40 to 200 scan lines per second



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AIRCELL System

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- Imagery delivered to NIFC ftp site via AIRCELL system
- AirCell is the company that provides in-flight Internet for commercial airlines ("GoGo").
- N149Z and N144Z have the business aviation systems; a Wi-Fi hotspot in the sky
- FreeArc compressed archive (.exe)





PHOENIX System Installation – N144Z











NIROPS History

- 1964 Research begins with DoD, Civil Air Patrol, NASA, USFS
- 1969 First full system deployment
- Ø Deliverable Products:
- 1969-1972 "stitched" Polaroids
- 1972-1993 5" continuous dry silver film
- 1993-2005 8½" continuous thermal paper
- 2004-present orthorectified imagery in GeoTiff format

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Ø Delivery Methods:

- 1969 2005 hand delivered/drop tubes
- 1996 2003 hand delivered imagery/drop tubes
- 2004 2005 ground ortho processing
- 2006 2008 Ortho files uploaded to ftp site ("land and upload")
- 2009-present AirCell to ftp site



IR Data delivered from plane



Orthocorrected tiff w/ fire detects

"raw" tiff



Orthocorrected color tiff

Waldo Canyon Fire June 25, 2012, 2253 hrs



IR Data delivered from plane (cont.)



"dumb" reduced resolution jpeg mosaic of all runs



Heat detect point shapefile

Waldo Canyon Fire June 25, 2012, 2253 hrs



Some Points To Remember About Phoenix Imagery

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What is captured in the imagery is the relative variation in heat across the fire area

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- No one-to-one correspondence between pixel values and ground temperature
- The technician can adjust the heat "threshold" value during runs across the fire area.
 - Doesn't allow for automated extraction of heat areas
- There is more heat in the imagery than just the red (DN = 255) pixels!
 - Requires an Infrared Interpreter (IRIN) to derive products





OPERATIONS



Phoenix Line Scanner

- # 1950's Technology Made New
 - Omplete upgrade to:
 - Mirrors

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- Preamps
- Signal Sample and Hold Circuit
- Navigation System
- Processing Systems
- Operator Interface







Phoenix Line Scanner (cont)









Phoenix Line Scanner Ops Diagram



COLLECTION — (linescanner, detector, preamps)





PROCESSING (A/D conversion, software, fire detection, image processing)

NAVIGATION (Applanix or Ekinox GPS attitude correction control)



DELIVERABLES (ortho tiff, color tiff, ortho'd mosaic, .shp files)





N149Z Phoenix Sensitivity Tests 2015

Test Flight over 6", 9", 12" Targets

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- Test Results at:
 - 8,000 Ft AGL: 9" 12"
 - 10,000 Ft AGL: 6" 9" 12"
 - 12,000 Ft AGL: 6" 9" 12"
 - 14,000 Ft AGL: 6" 9" 12"
 - 16,000 Ft AGL: 9" 12"
 - 18,000 Ft AGL: 9" 12"



OPERATIONS



Recent accomplishments

- Nearly perfect AB curve match
- Nearly complete 3D Solidworks CAD model of RS-25
- AMS has new state of the art computers, processing enhancements, operator interface, and new lighter ergonomic packaging of the operator terminal.
- We also provide support to NIICD engineering.



Recent accomplishments

We make our own precision CNC mechanical parts, circuits/boards and enclosures.







Recent accomplishments (cont.)



NATIONAL INFRARED OPERATIONS



Recent accomplishments (cont.)



NATIONAL INFRATED OPERATIONS



Recent accomplishments (cont.)





Future developments

Integration of AMS on FS plane

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Autonomous Modular Sensor transferred to FS by NASA

AMS Wildfire Sensor		
Band	Wavelength μι	<u>m</u>
1	0.42-0.45	
2	0.45-0.52	(TM1)
3	0.52-0.60	(TM2)
4	0.60-0.62	
5	0.63-0.69	(TM3)
6	0.69-0.75	
7	0.76-0.90	(TM4)
8	0.91-1.05	
9	1.55-1.75	(TM5)
10	2.08-2.35	(TM7)
11	3.60-3.79	(VIIRS M12)
12	10.26-11.26	(VIIRS M15)





2017 plans

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- New Ekinox nav system integration almost ready for testing
- Update DSP/ADC w/4 channel capability
- Port Phoenix to 64 bit and make some processing enhancements.
- Implement digital noise filtering