# <u>Autonomous Modular Sensor</u> (AMS) Update

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Tactical Fire Remote Sensing Advisory Committee (TFRSAC) Boise, Idaho November 3, 2016



### Autonomous Modular Sensor (AMS)

IFOV:

Altitude:

2.5mrad 25000'

Spatial Resolution: 20m (at sea level)

- 16 band multispectral ightarrowscanner
- Multi-mission capability igodol
- Developed by NASA Ames ightarrowand UC Santa Cruz
- Used extensively since ullet2006 for wildfire mapping & Cal/Val activities
  - Western States Fire Missions \_\_\_\_
  - Targeted active fire/post-fire incident support
  - USFS tactical fire support operations

NAS	X NATIONAL AERONAUTICS		RTH OBSERVING SYSTEM	NASA AIRBORN	
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- HOM	respon	d to natural disasters.	on in environmental conditions.	, assess global change, and	
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No.		GALLERY		SPECIFICATIONS	
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1.1		+ Click to view in	nages	in detail the various AMS characteristics.	
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		Monterey Bay an		data interfaces, cabling diagrams, mounting har	
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192		+ Click to view in	hages	Fire Mapping	
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	1.55- 1.75 (TM5)				
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### **AMS Timeline**



### 2014-2015 AMS Testing/Integration Activities

- Collaborative effort on a limited budget!!!
  - NIFC/NIICD IR Branch, R4 F&AM, NASA Ames, RSAC
- Schedule
  - Typically conduct annual test flights from March through late May
- Missions
  - 15 target areas flown
    - Rx fires
    - Post-fire areas
    - Forest areas affected by pests/pathogens
  - Two 2014 wildfire incidents (multiple days)
- Significant test objectives/goals
  - Forest Service IR technician training
  - Refinement of onboard processing (OBP) system for NRT data production/delivery
  - Remote command and control of sensor from the ground

2016 AMS Testing/Integration Activities

- No testing/integration missions conducted
  - 144Z not available due to upgrade/maintenance schedule
  - AMS readiness after "overhaul"



### AMS Integration Support Contract

- 5 year IDIQ Contract
  - One base and four option years; August 2015 2020
- Year 1 Tasks (primarily OBP enhancements & technical support activities)
  - Provide AMS Testing/Integration Mission Support
  - Implement AMS Algorithm Refinements/Updates
  - Implement Improved Histogram Matching/Tone Balancing for Mosaic Products
  - Enhance/Support AMS System & FS AirCell Integration
  - Implement AMS System Navigation/Flight Data Display
  - Develop and Implement AMS Boresight Process Automation
  - Develop/Maintain AMS Technical/Software Documentation
  - Provide Consultation and Technology Transfer
- Year 2 Tasks
  - Post mission processing system development

### Identifying a USFS Platform for AMS

- 3<sup>rd</sup> Aircraft Proposal (N182Z)
  - Submitted to F&AM in 2015
    - Coordination with R8 and WO F&AM
  - FS Fire Imaging Technology Working Group developing requirements to ensure multimission capability
    - Sensor port/pod installation
    - AirCell system installation
  - Potential mission scope
    - Tactical fire support "surge" aircraft; daytime fire missions
    - Post-fire/post-storm assessment
    - Forest health monitoring
    - Cal/Val of satellite products

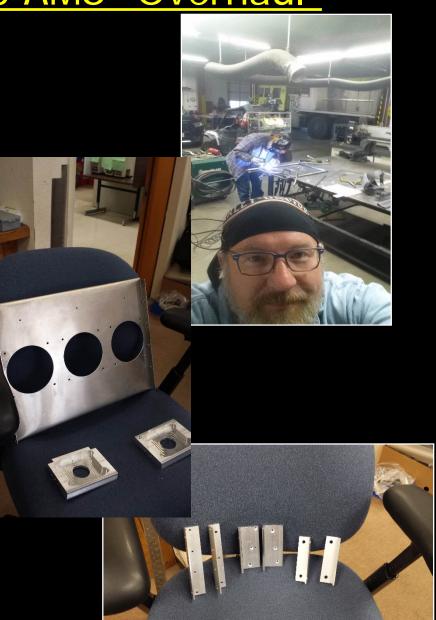




## AMS "Overhaul" & Current Status

### Winter 2015/2016 AMS "Overhaul"

- NIFC/NIICD IR
   Branch Redesign
  - Designed and manufactured 19" rack/operator console
  - Built new fan cooling system



## Winter 2015/2016 AMS "Overhaul" (cont.)

loondy:

- Collaboration between NIFC/NIICD IR Branch and NASA Ames
  - New 19" rack/operator console
  - New UAVSys and LinkMod computers
  - New 12V rack mounted power supply
  - New WiFi router
  - New card cage for data acquisition unit, new computers, CPU power supply & related equipment
  - New cooling system for rack equipment





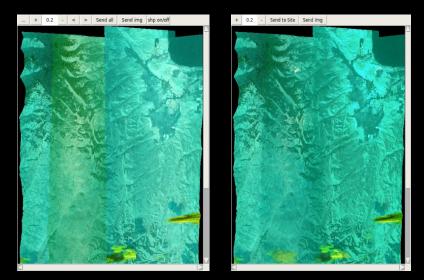
- Etc., etc.

# <u>AMS Software, Algorithm &</u> <u>Processing Updates</u>

### Histogram Matching

Standard Algorithm overlap or full image no masking or edge treatment

Right: bands 10,11,12 rgb Below: Lick Fire bands 7,5,3 rgb

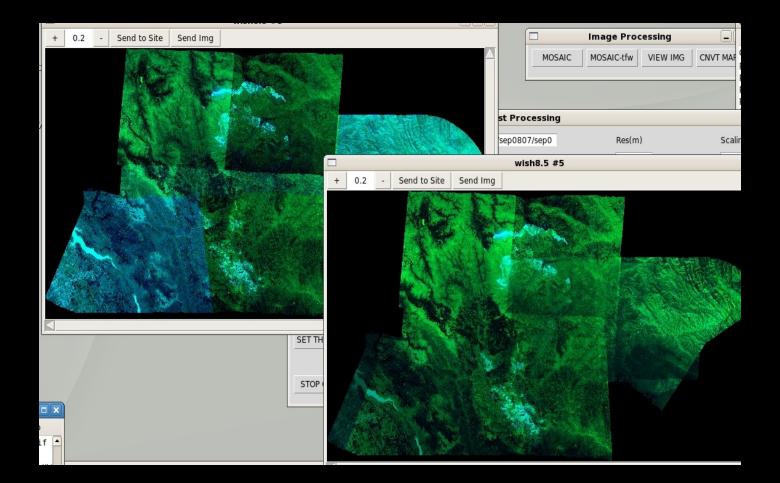






### Histogram Matching

### Example of real-time segment mismatch corrected Lick Fire Night Product

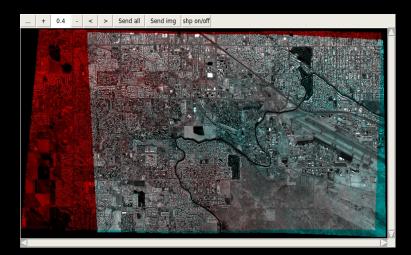


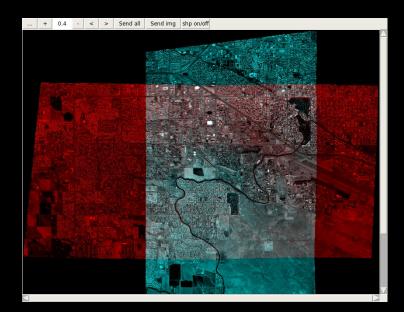
### Automated Boresighting

Relative point selection between E/W and E/N lines:

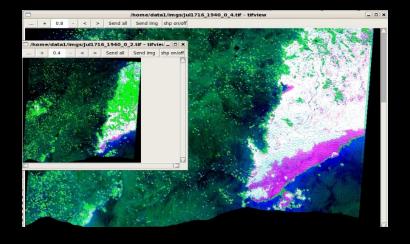
cross correlation (u,v) =  $\sum x \sum y \{ [B(x,y) - \mu \text{ base }] [S(x-u,y-v) - \mu \text{ shift }] \}$ 

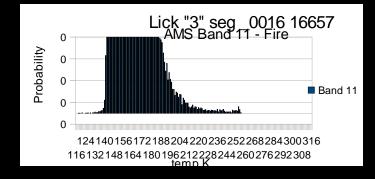
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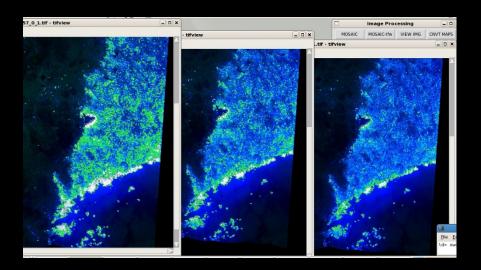


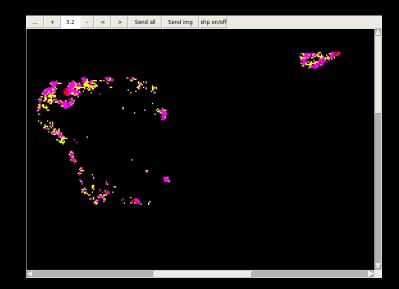


### **Threshold Selection for Active Fire**









### **Threshold Selection for Active Fire**

### Moonlight Fire

