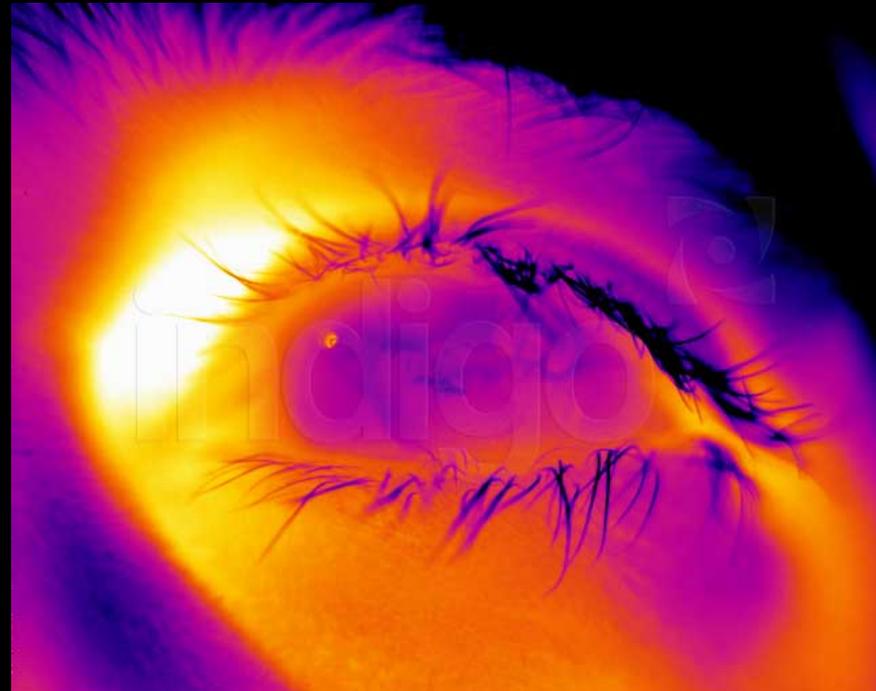


# Seeing Our World in a Different Light

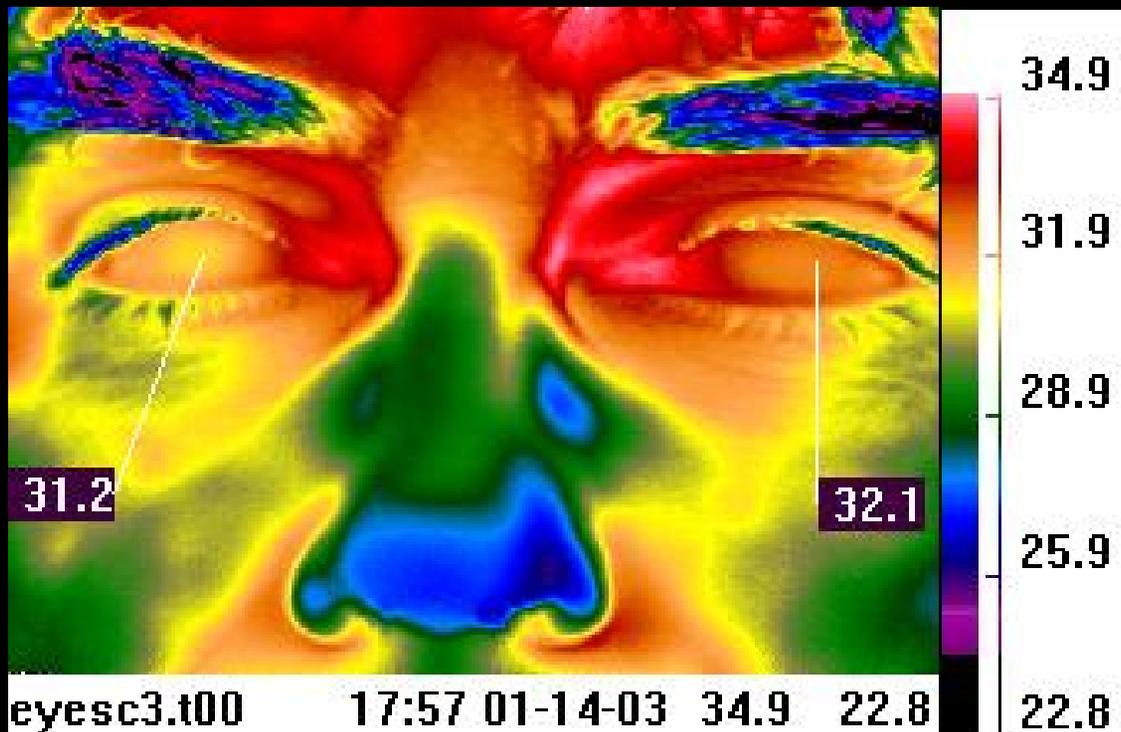
## Thermal Infrared Imaging

There's more to it  
than meets the eye

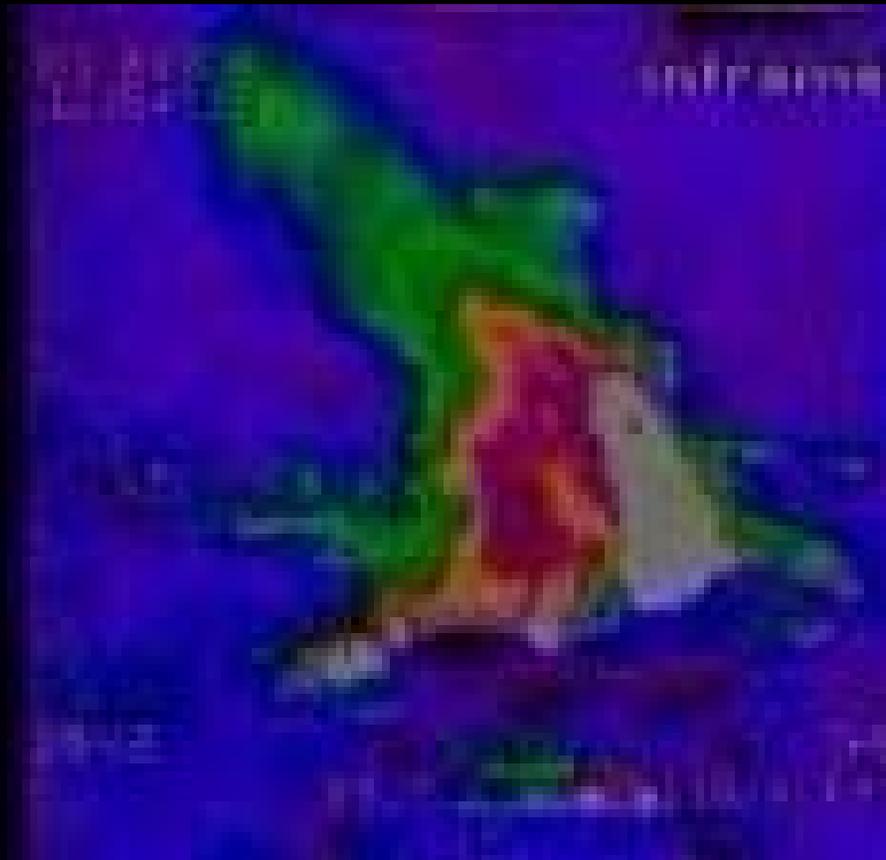


# What is Thermal Imaging?

**Thermography:** A diagnostic technique in which an infrared camera is used to measure temperature variations.

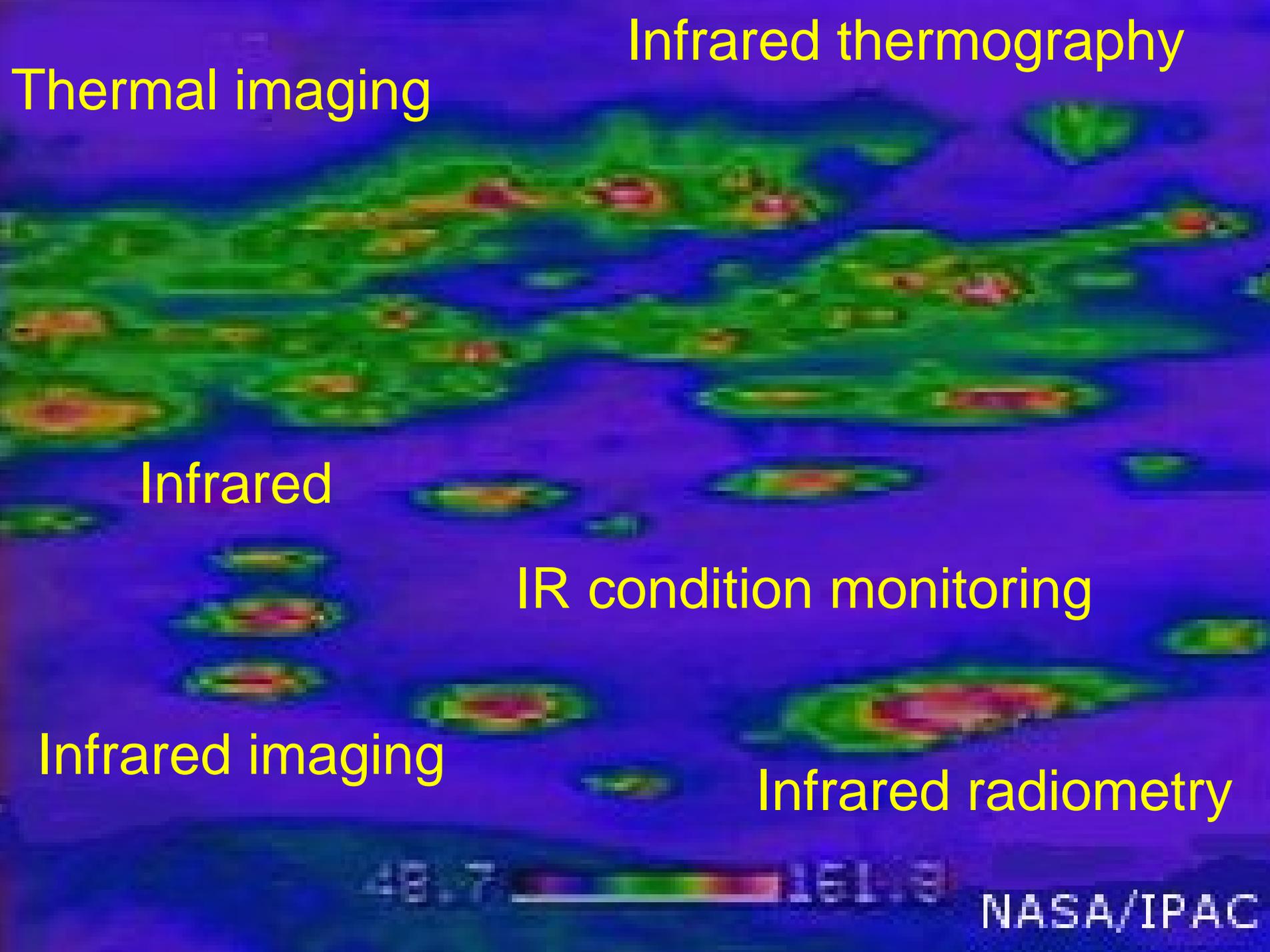


**Thermography:** A technique for visualizing heat given off by all objects. Part of the heat lost by an object is in the form of long-wavelength or infrared light. Invisible to human eyes with higher temperatures as bright areas



Infrared thermography

Thermal imaging



Infrared

IR condition monitoring

Infrared imaging

Infrared radiometry



NASA/IPAC

# Uses of Thermography

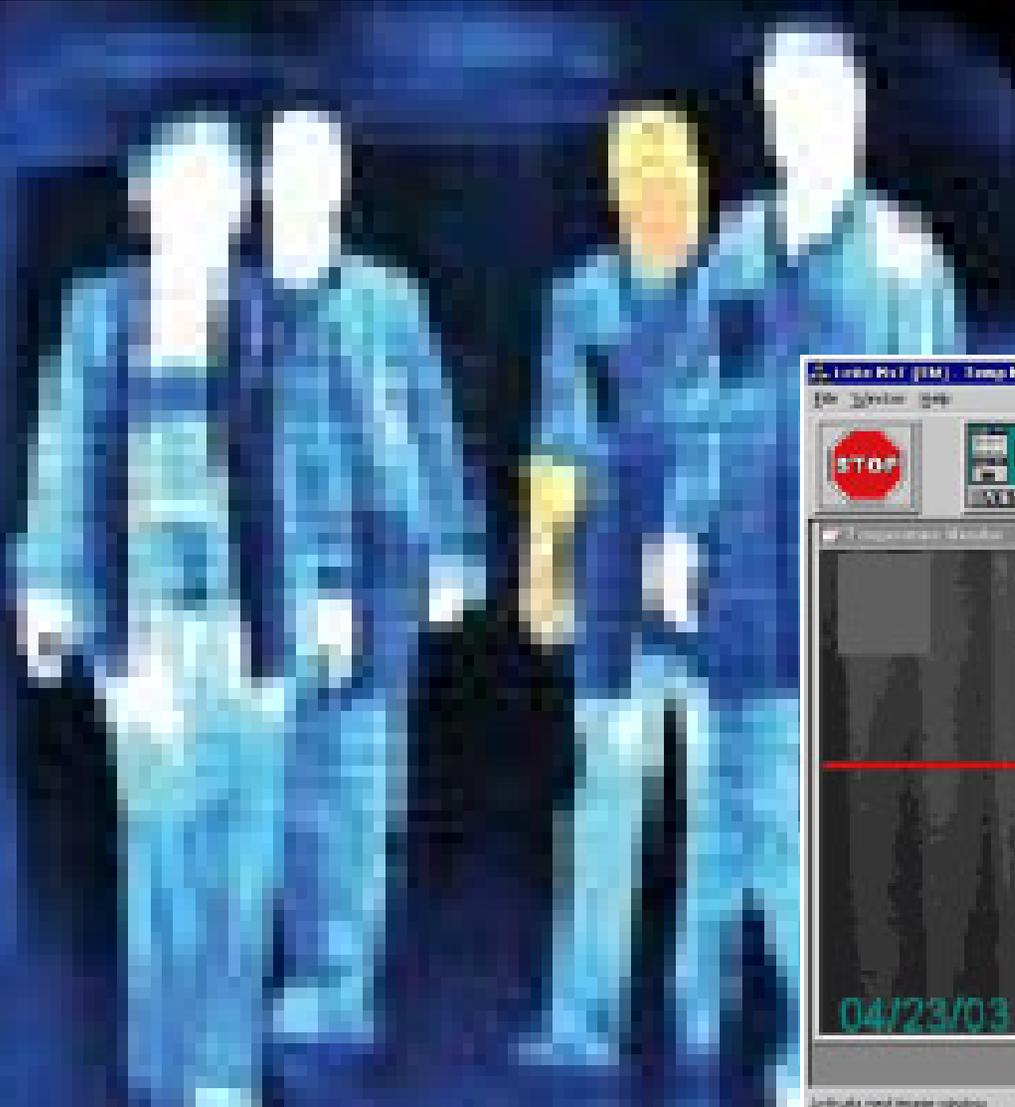


Movie Industry



# Uses of Thermography

## Infectious Disease Control



# Thermal Infrared Technology Mining Applications

Location of:

Underground coal seam fires (inactive vents)

Active vents from coal seam fires

Spoil fires

# Final Pit Closure Spoil Fire



Mychal Yellowman  
Civil Engineer - OSM

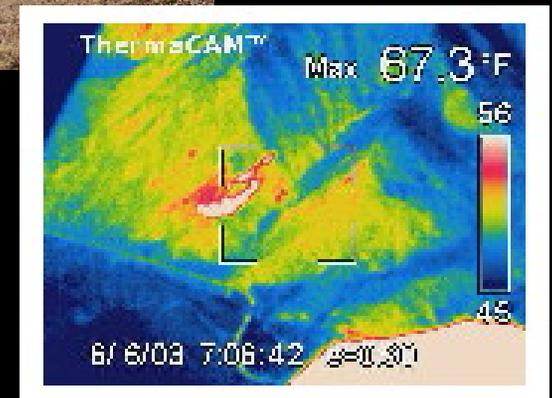
# Thermal Imaging

## Find Something:

Coal seam fire

## Diagnose a Condition:

Temperature and extent of a coal seam fire



Kyle Bohnensiehl  
TIPS - 2003

# Thermal Infrared Technology Mining Applications

Monitor:

Temporal temperature variation in venting activity

Indication of fire behavior underground



THE GLOBAL LEADER IN INFRARED CAMERA TECHNOLOGY

## ThermaCAM™ E4

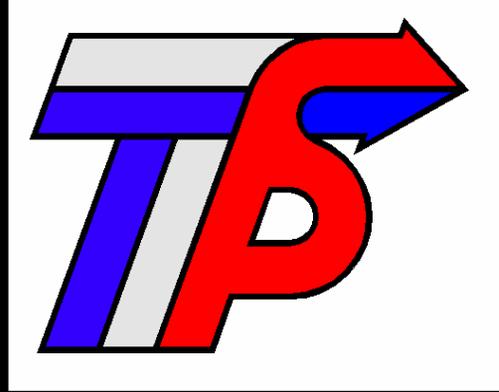
Designs  
Manufactures  
Markets

> 30,000 in use worldwide





ThermaCAM™ E4



WRCC  
Denver

ARCC  
Pittsburg

# ThermaCAM™ E4

Compact

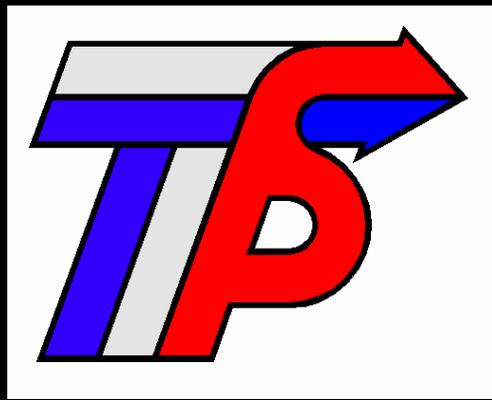
Rugged

Lightweight – 1.5 lbs.

Interchangeable optics - 25° lens  
(25° - 80° IFOV)

Temperature range -4° to +482°F  
(+482°F to +1,652°F option)





ThermaCAM™ E4

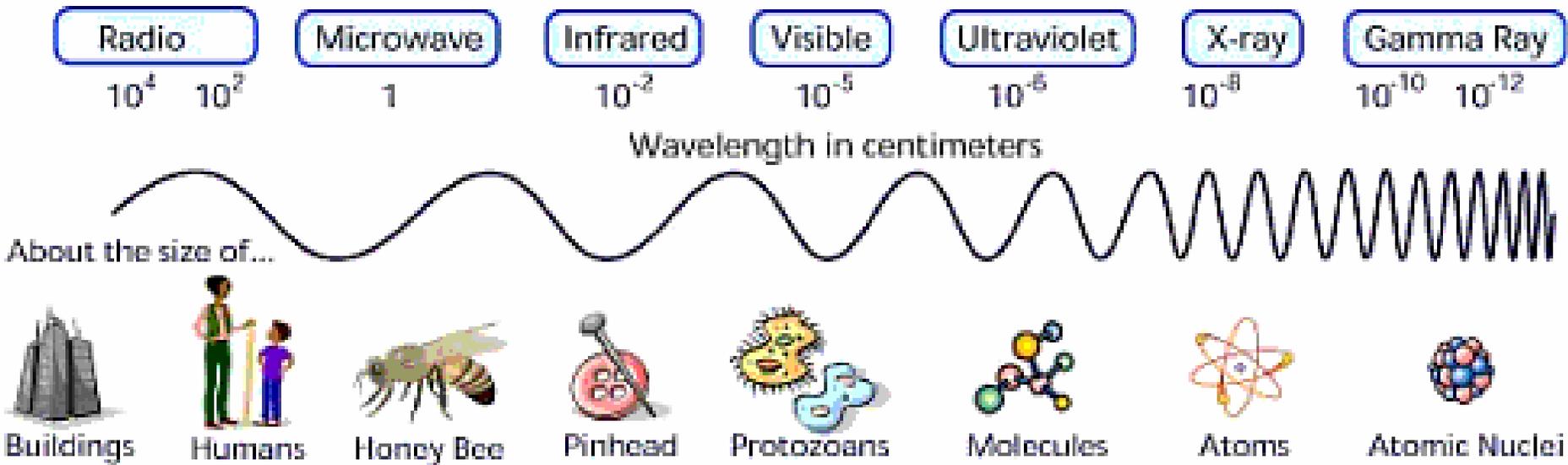
WRCC  
Denver



ThermaCAM™ E2

ARCC  
Pittsburg

# ThermaCAM™ E4



**Spectral range 7.5 to 13 microns**

# Coal Seam Outcrop Fires on USFS

## Little Missouri National Grasslands



Hart Draw

Little Missouri National Grasslands





Hart Draw

Little Missouri National Grasslands

 **FLIR**

Min 29.1 °F

112



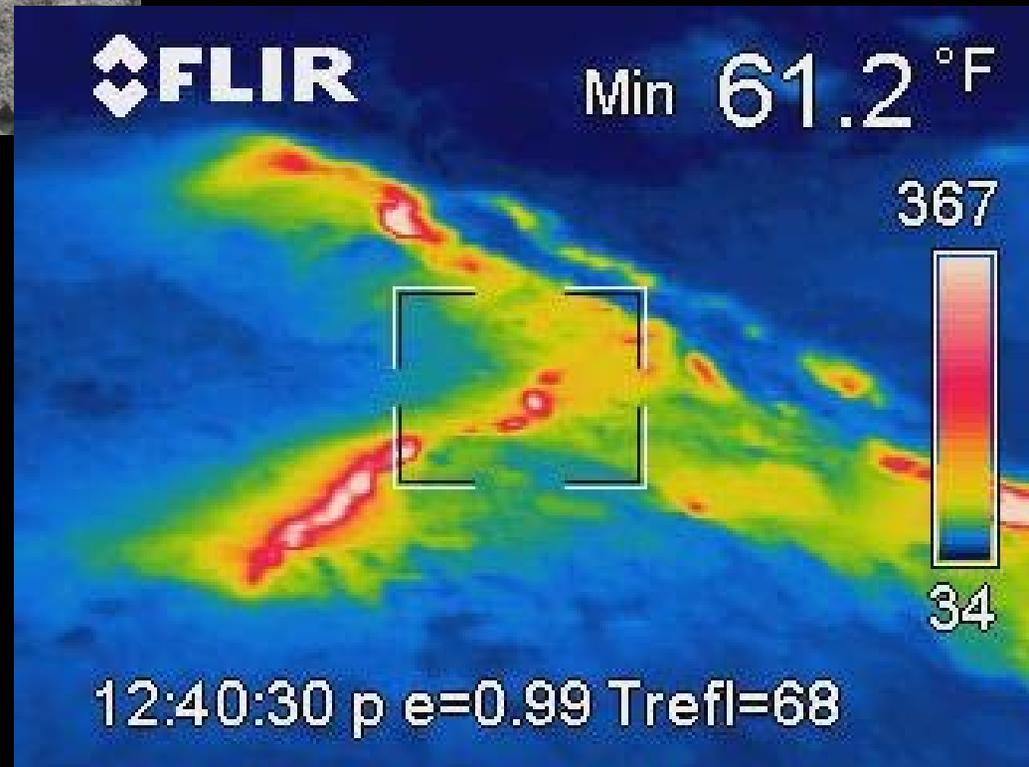
24

12:53:46 p e=0.99 Trefl=68



Hart Draw

Little Missouri National Grasslands



# Limitations of ThermoCAM™

Designed for small scale use

Object or site specific intent

Close to object - 10 ft. for accurate  
temperature reading

Aerial Overview Difficult –

Positional accuracy

Precise location and scale can  
not be determined



# USFS Firewatch STAR Safire III



# Benefits of STAR Safire III

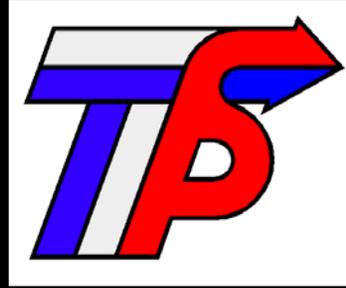
Inventory – Aerial overview entire site

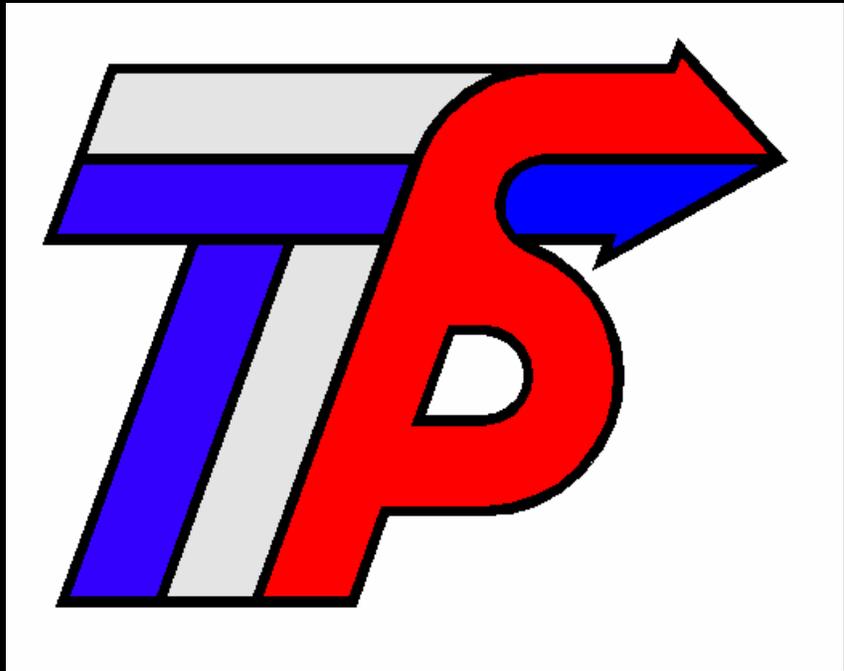
Geometrically corrects on the fly - precise locations can be mapped

Monitor – Identify change over time

Assess – Map and quantify change in fire

Collect imagery at various scales

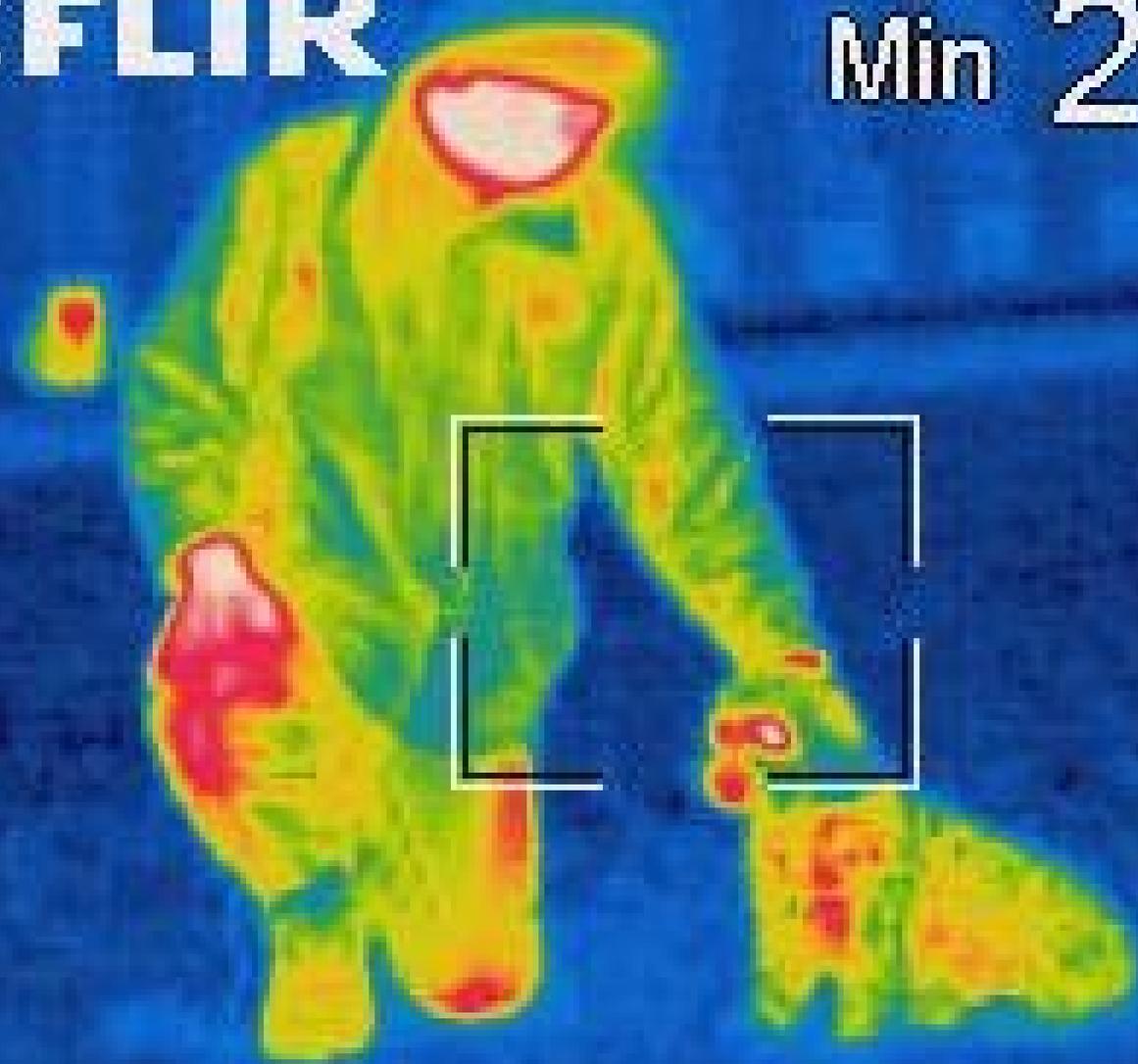






 FLIR

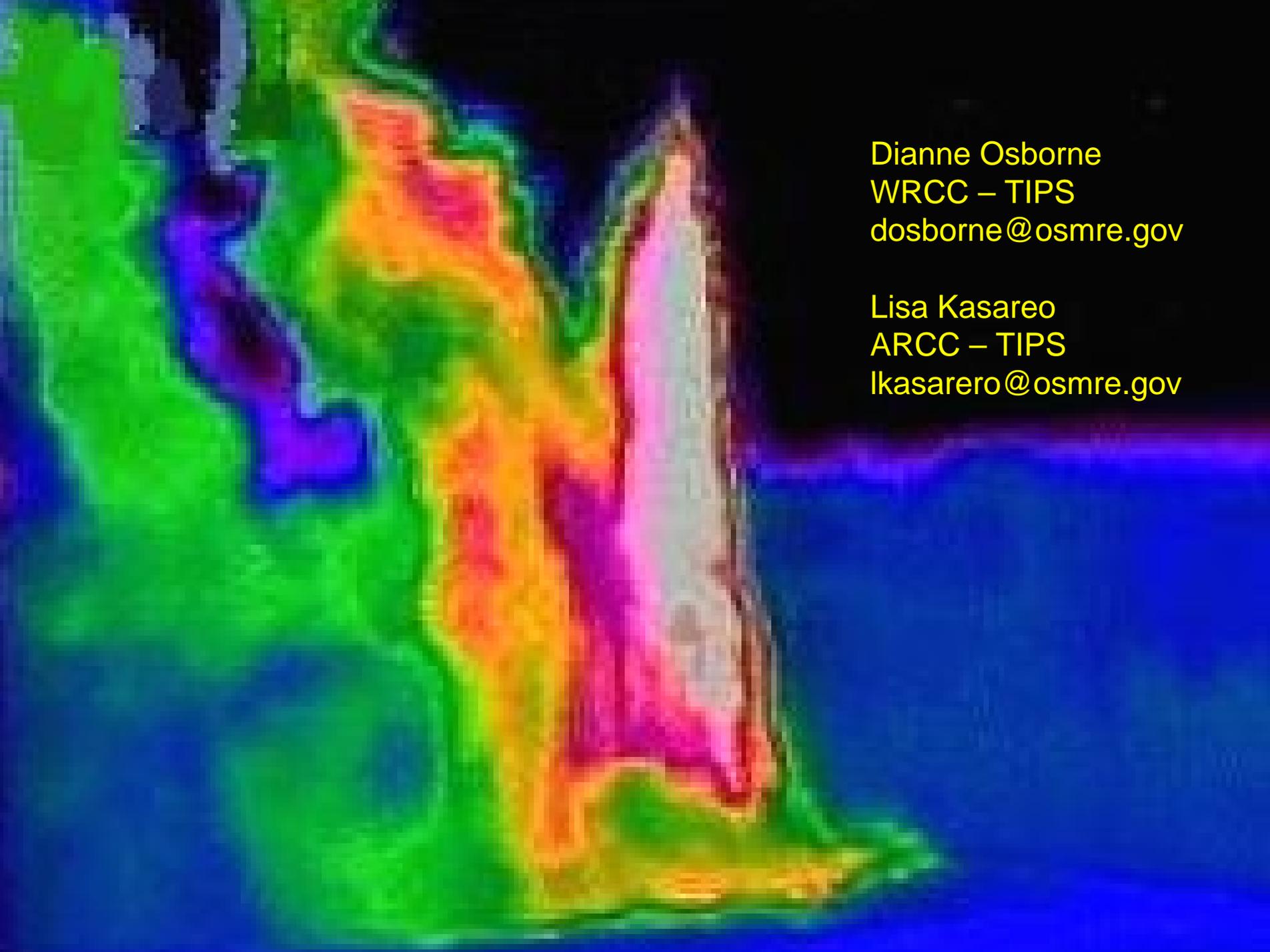
Min 20.3 °F



75

20

6:08:17 p e=0.99 Trefl=68



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