

Terra helps fight fires

Toward Operational Use of Terra Data



Yoram Kaufman, David Herring, Ed Masuoka, Vanessa Griffin

MODIS science, Terra information, MODIS data, EOSDIS

Collaboration with Wei-Min Hao USDA Forest Service Fire lab.

- **Events in the fire activity**
- **Normal processing of Terra-bits of data from Terra**
- **Expedite processing**
- **Plans for the future**

Toward Operational Use of Terra Data



SCIENCE

Yoram Kaufman (Terra PSO)
David Herring
Reto Stockli
Rong Rong Li (MODIS)
Brian Montgomery

MODIS SDST

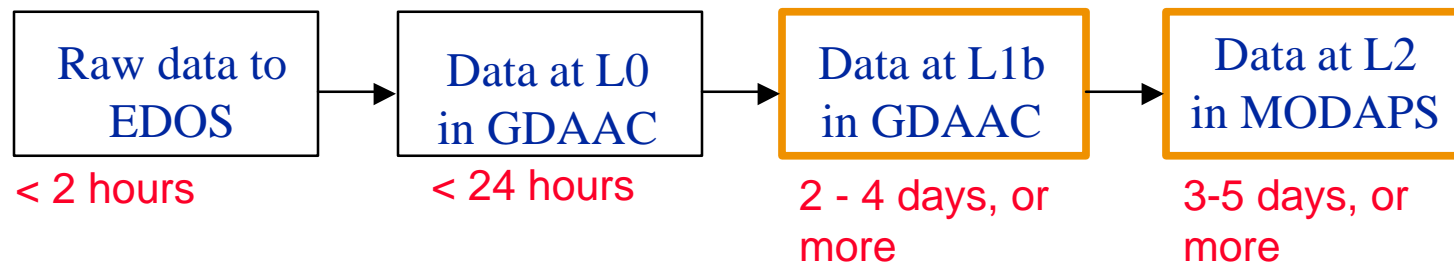
Ed Masuoka (SDST)
Nazmi El Saleous
Jack Shol

EOSDIS/GDAAC

Vanessa Griffin (DAACs)
Steve Kempler (GDAAC)
Chris Lynnes (GDAAC)
Kay Spreitzer (NOAA)

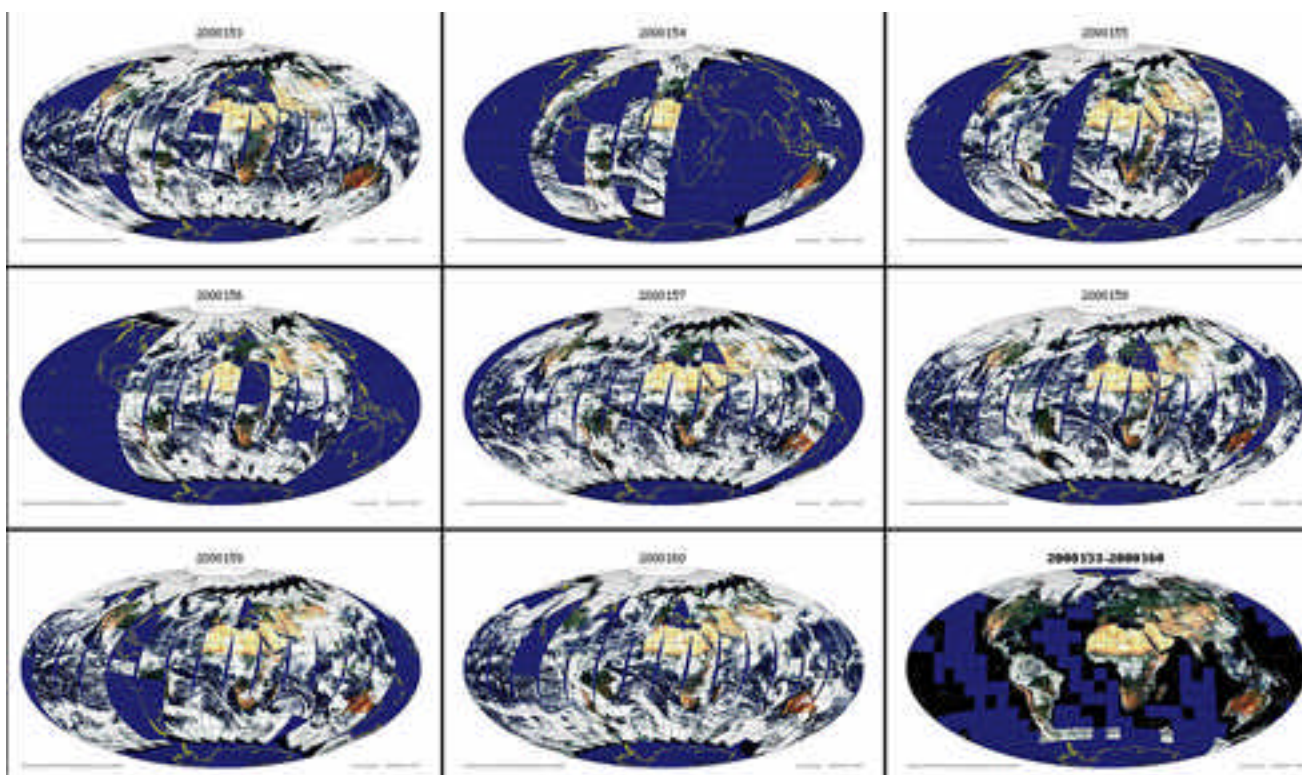
- **On Aug. 28, there were 26 wildfires in Montana, 23 in Idaho**
 - Several fires converged into one very large fire
 - Wei Min Hao predicted fires will burn another 3 weeks
 - Clinton declares parts of those states 'disaster areas' on Aug. 29-30
- **On Aug. 29, we asks EOSDIS for operational turnaround of MODIS images over those states**
 - Goal is to push images to Forest Service by 12 noon the day after acquisition
- **Pursued 5 paths to Level 1b, 5 paths to making images**

MODIS Data System Performance (mid-August)



On average, data takes a day in EDOS, a day in GDAAC, and a day in MODAPS to reach L2 or higher. But this depends upon the granule of data. Some granules are missing from EDOS, which are eventually available but move more slowly through the system. The process for making images for public release was taking 7 to 10 days.

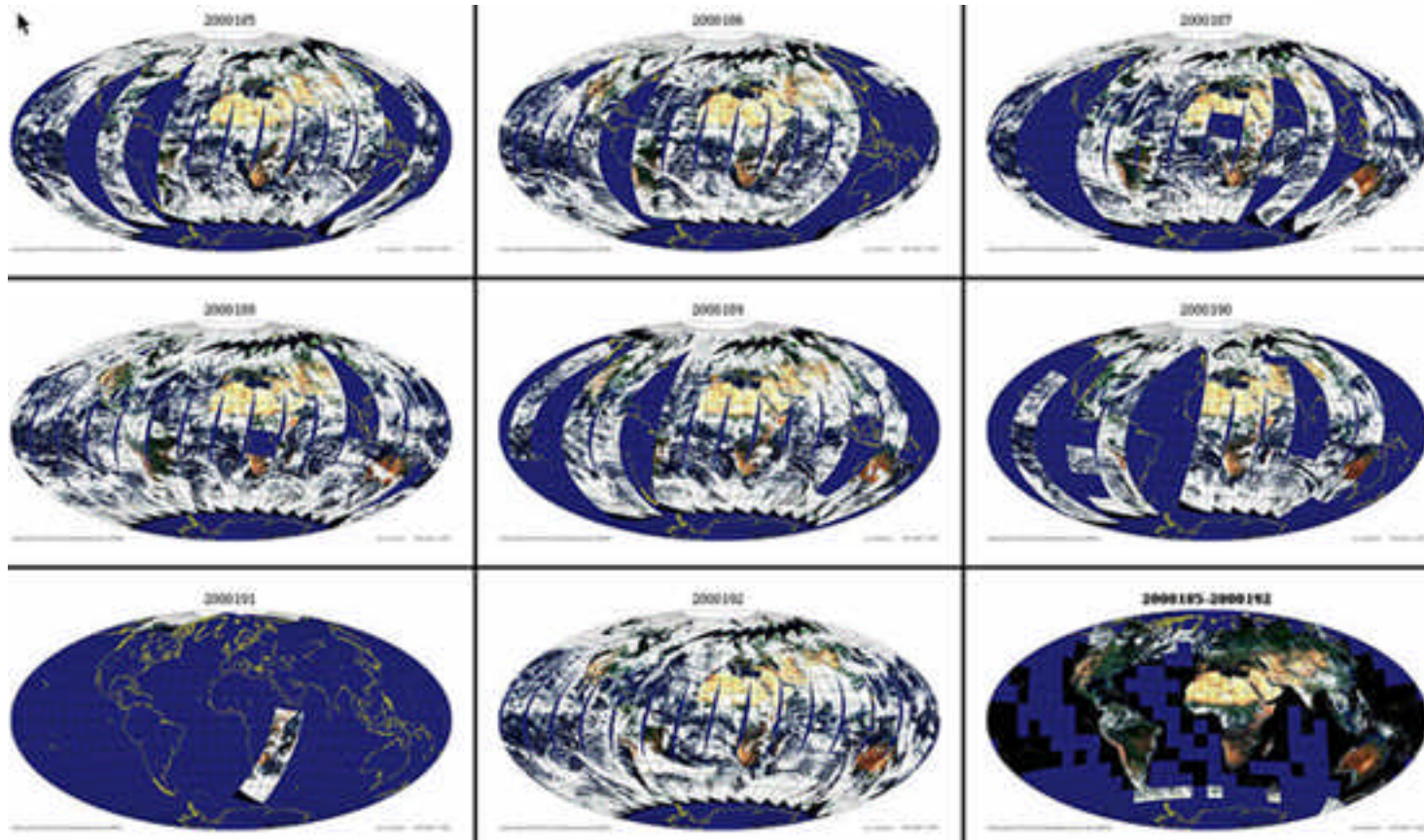
Days 153 - 160 (June 8-15)



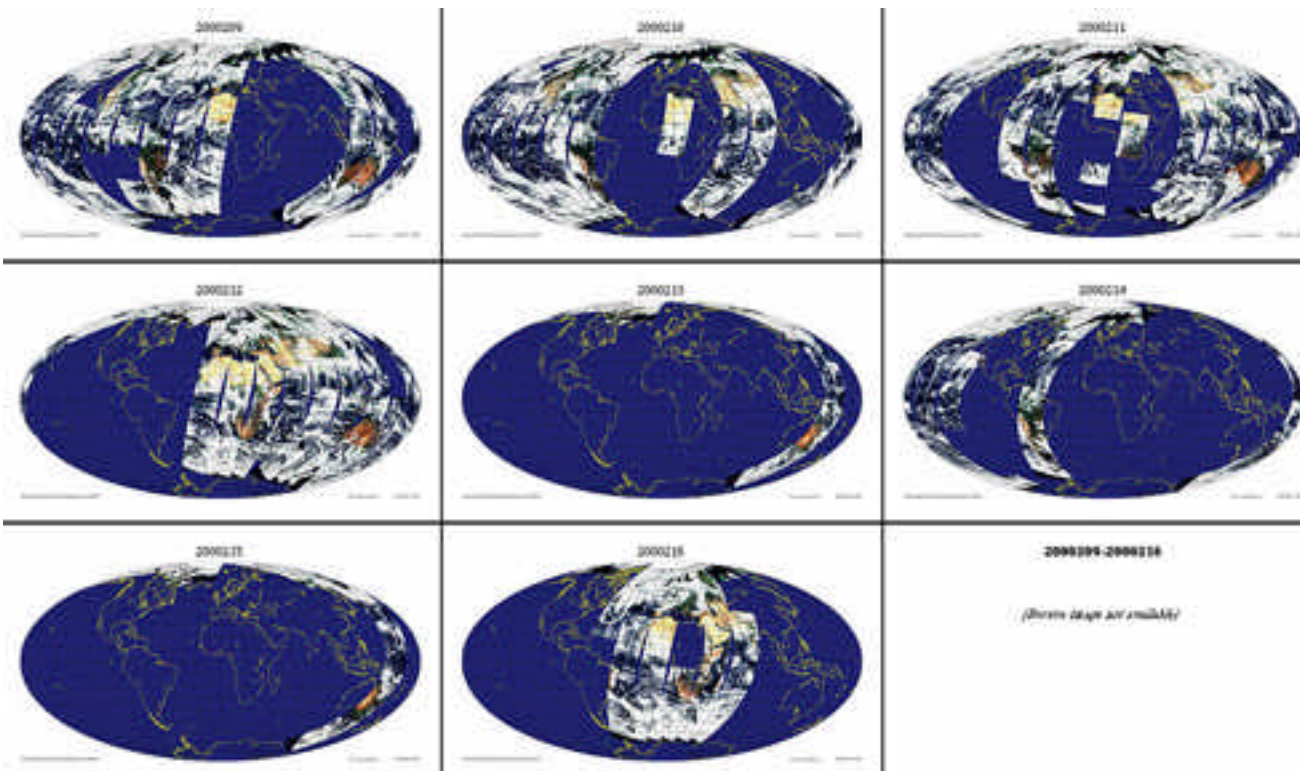
Incomplete data coverage hampers the ability to produce 8-day, 16-day, & 30-day composites. This hampers ability to detect large climate & change trends.

By MODIS SDST

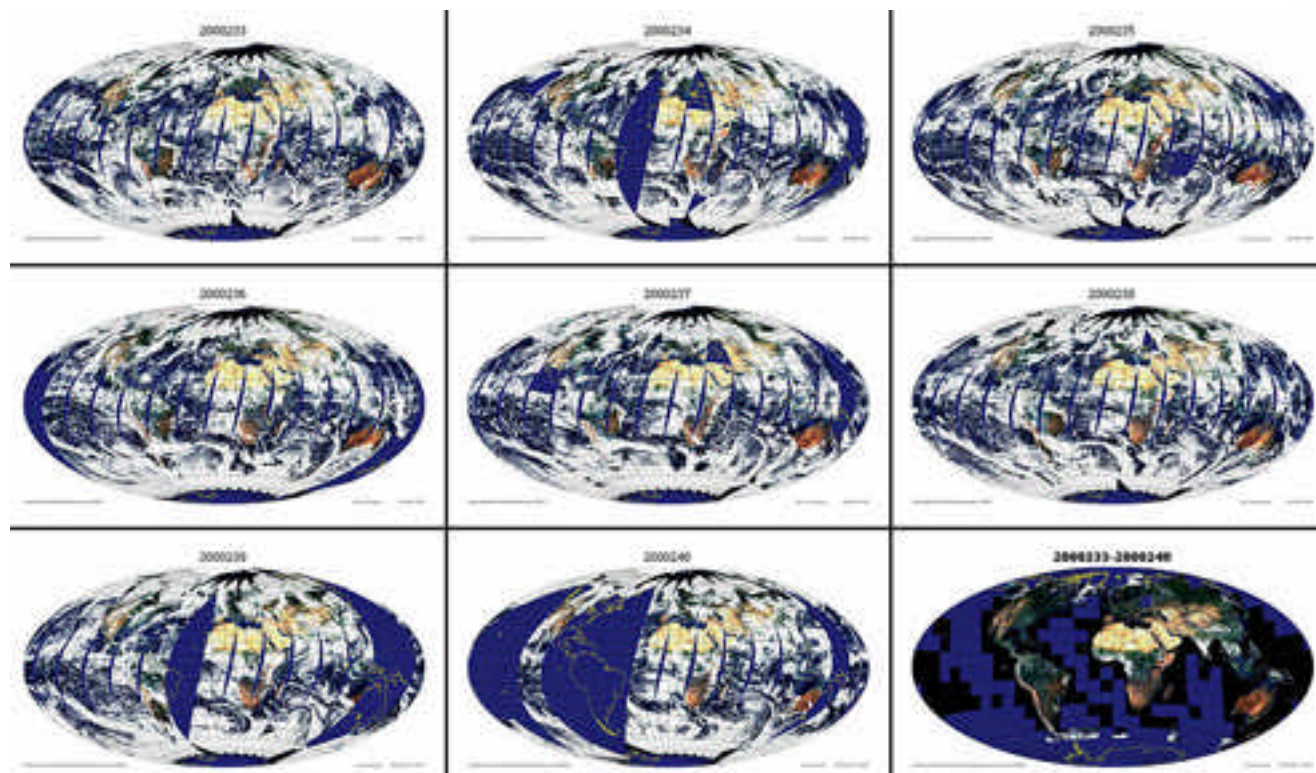
Days 185 - 191 (July 10-17)



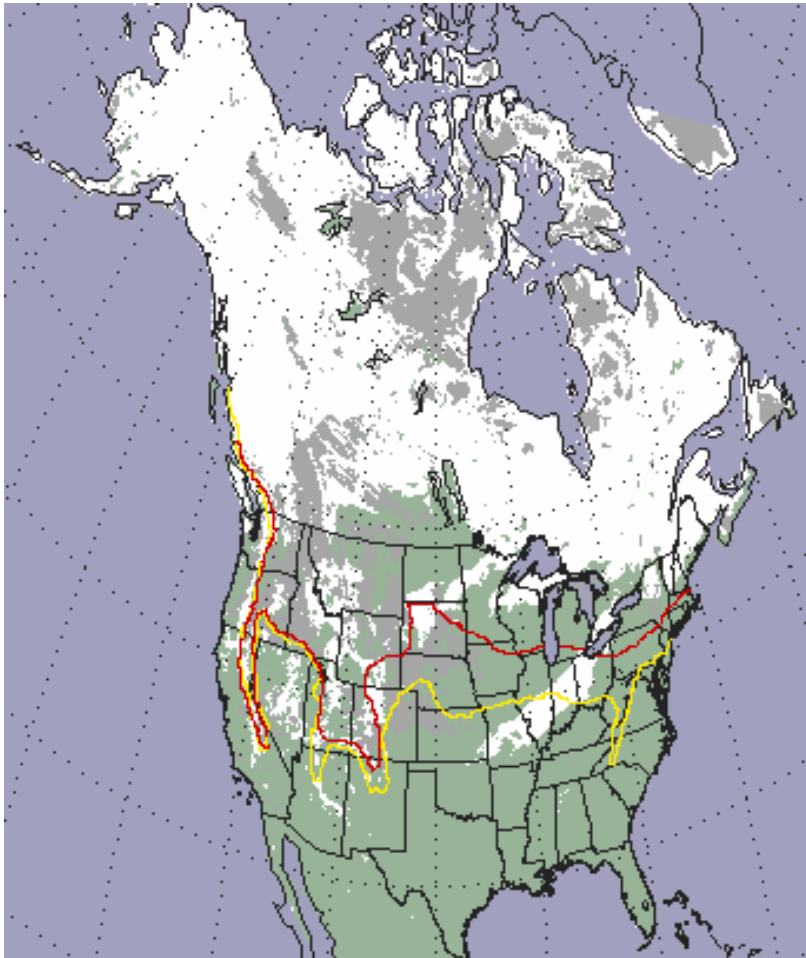
Days 209 - 216



Smoother operation lately: Days 233 - 240



Relatively Little Springtime Snow cover in N. America



This early MODIS 8-day composite from March 5-12 shows much less snow cover when compared to the averages for February (yellow line) and March (red line).

The lack of snow contributed to near-record low water levels in the Great Lakes and dry soils, a precursor for an active wildfire season,

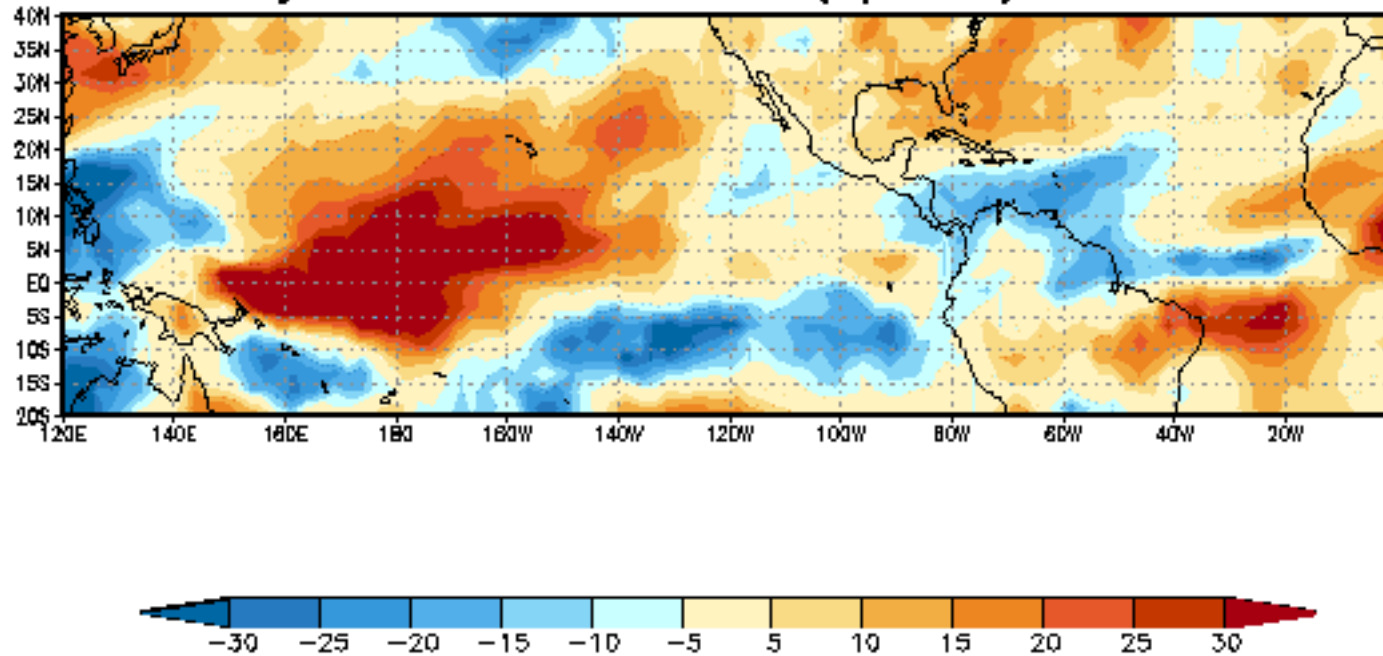
Posted mid-April on the earthobservatory.nasa.gov.

By Dorothy Hall, et al.

TRMM CERES Outgoing Longwave Rad. Anomalies



Monthly-mean OLR Anomalies (W/m^2), March 2000

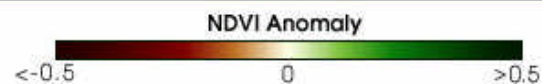


Is OLR Anomaly a 10-day precursor to the drought?

Note the low values off west coast & high values over Gulf of Mexico & southeastern U.S.

By Tak Wong

Drought in the Rockies



NDVI anomaly for July 2000 in North America, (NOAA AVHRR).

Dry conditions in the western U.S. Western Montana & eastern Idaho appear darker brown.

By Jim Tucker and Rob Simmon

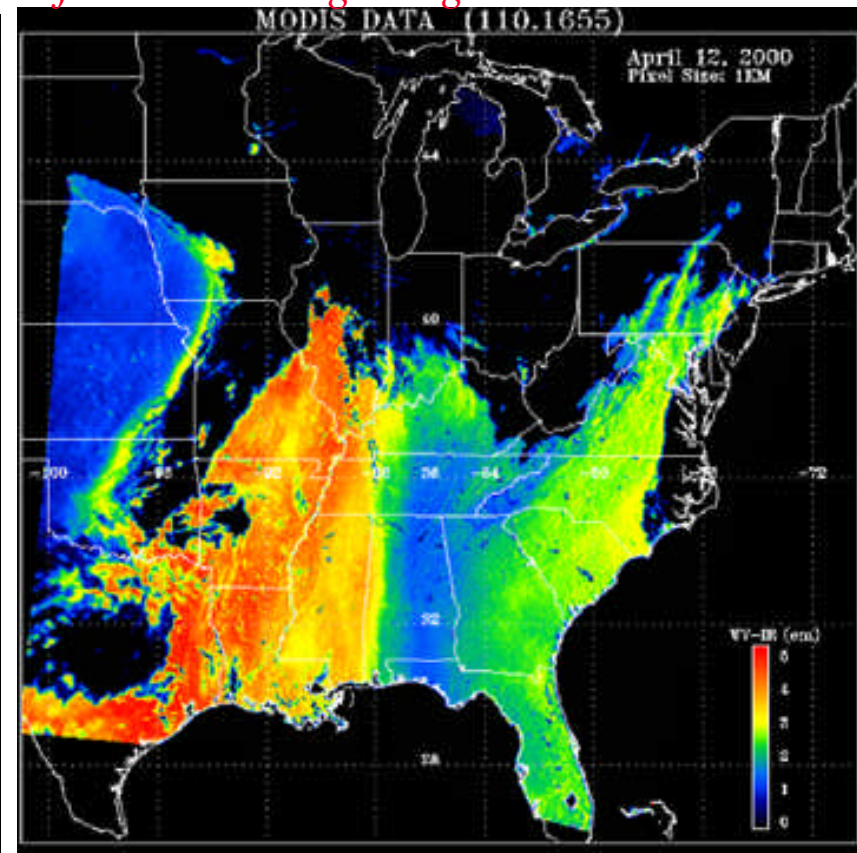
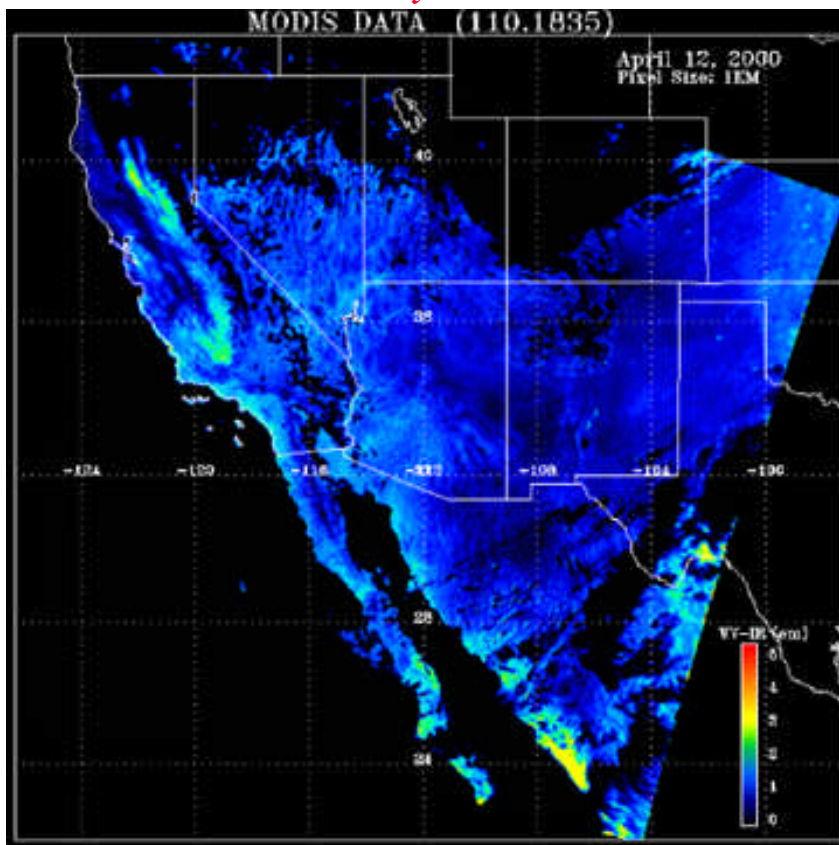
MODIS' Enhance Vegetation Index product will be superior to AVHRR's NDVI, both in terms of spatial and spectral information, but there are currently too many gaps in the data archive to derive monthly composites.

September 18, 2000

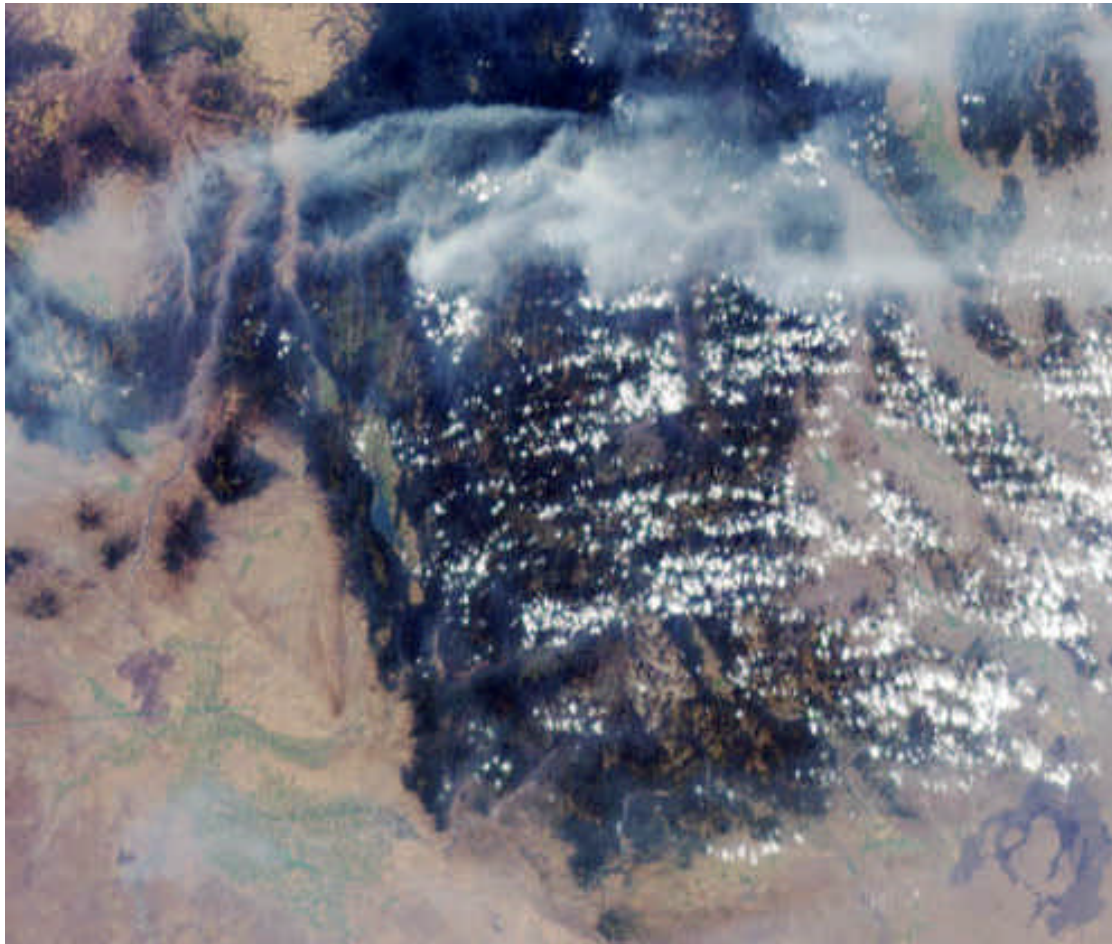
MODIS Water Vapor over N. America- Day 110 (April 12) (blue - dry; red - wet)



By Bo-Cai Gao Yoram Kaufman and Rong Rong Li



MISR Smoke Plumes



Day 218

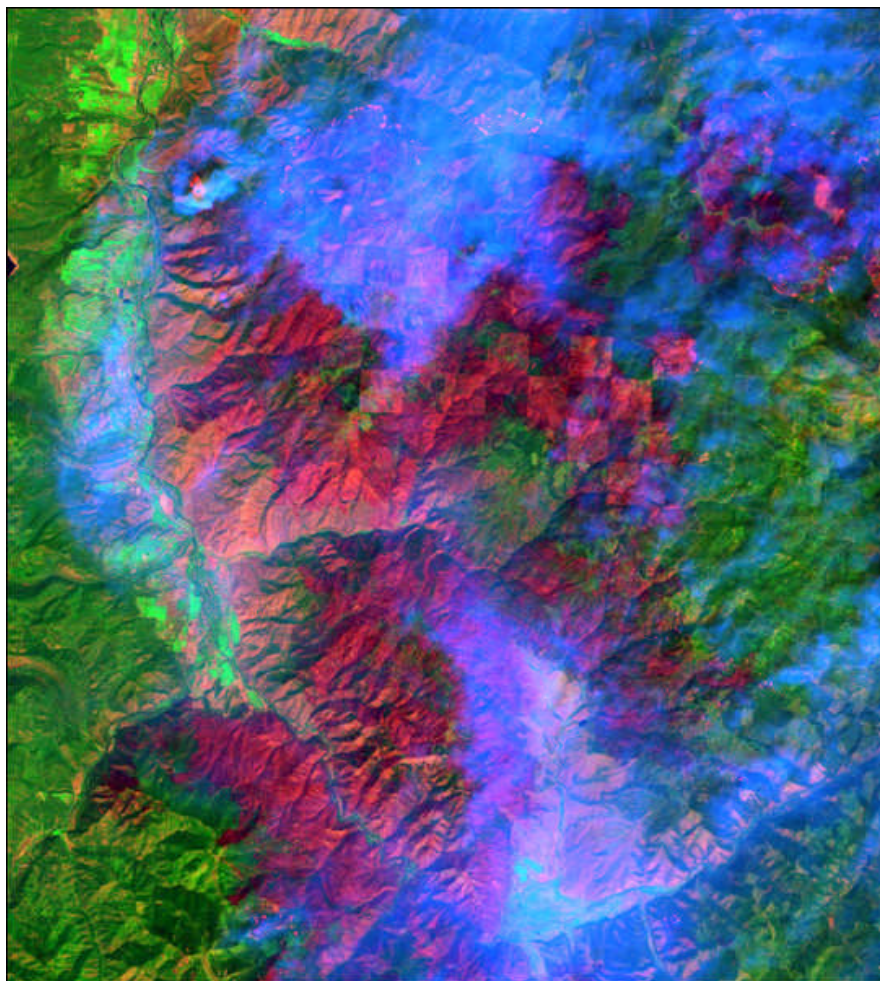
Acquired Aug. 5,

Released Aug. 16

MISR true-color
image of land
surface and smoke
over Montana &
Idaho

By MISR Science Team

Image by Landsat 7



Day 227

Acquired Aug. 14, 2000

Released Aug. 20

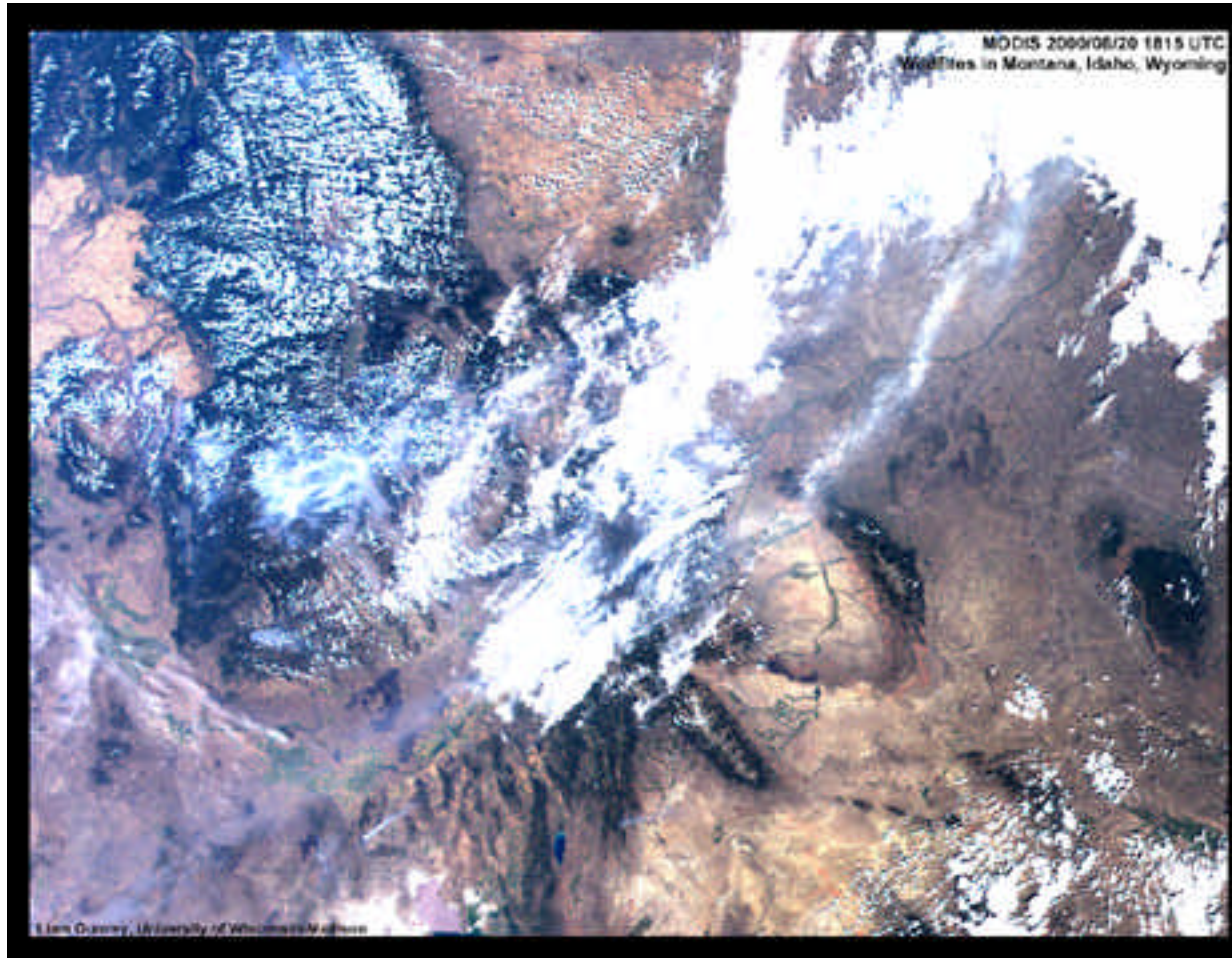
Bitterroot National Forest, Montana,

About 30 large blazes across Montana had burned more than 600,000 acres (937 square miles).

Dark red - recent burn scars,
bright red - flaming fires,
Blue- smoke

By Rich Irish, Landsat 7 Team

MODIS Direct Broadcast



Day 233

Acquired Aug. 20

Produced Aug. 21

MODIS direct
broadcast data over
fires in Montana &
Idaho

*By Liam Gumley,
U. of Wisconsin*

Rapid Response Team's First MODIS Image over Montana using EOSDIS



Day 234

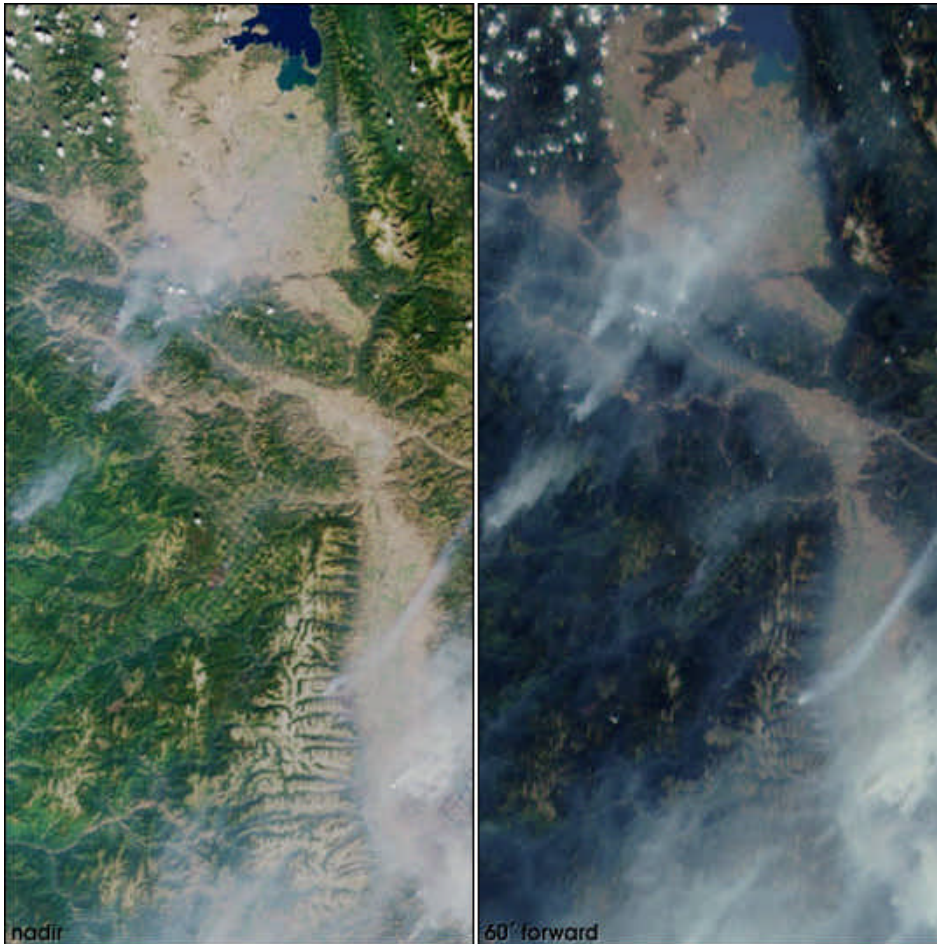
Acquired Aug. 21

Produced Aug. 29

57 fires were burning; true-color image of wide-spread smoke over Montana (thermal channel were watching the moon - calibration)

By Reto Stockli

Two MISR Perspectives on the Smoke Plumes in Montana



Acquired August 14

Released August 30

left - view from MISR nadir camera
right - view from 60° forward angle,
showing better the smoke location
and extent.

A brown burn scar is located nearly
in the exact center of the nadir
image, while in the high-angle view
it is shrouded in smoke.

By MISR Science Team

MODIS detects *Fires!*



Day 236

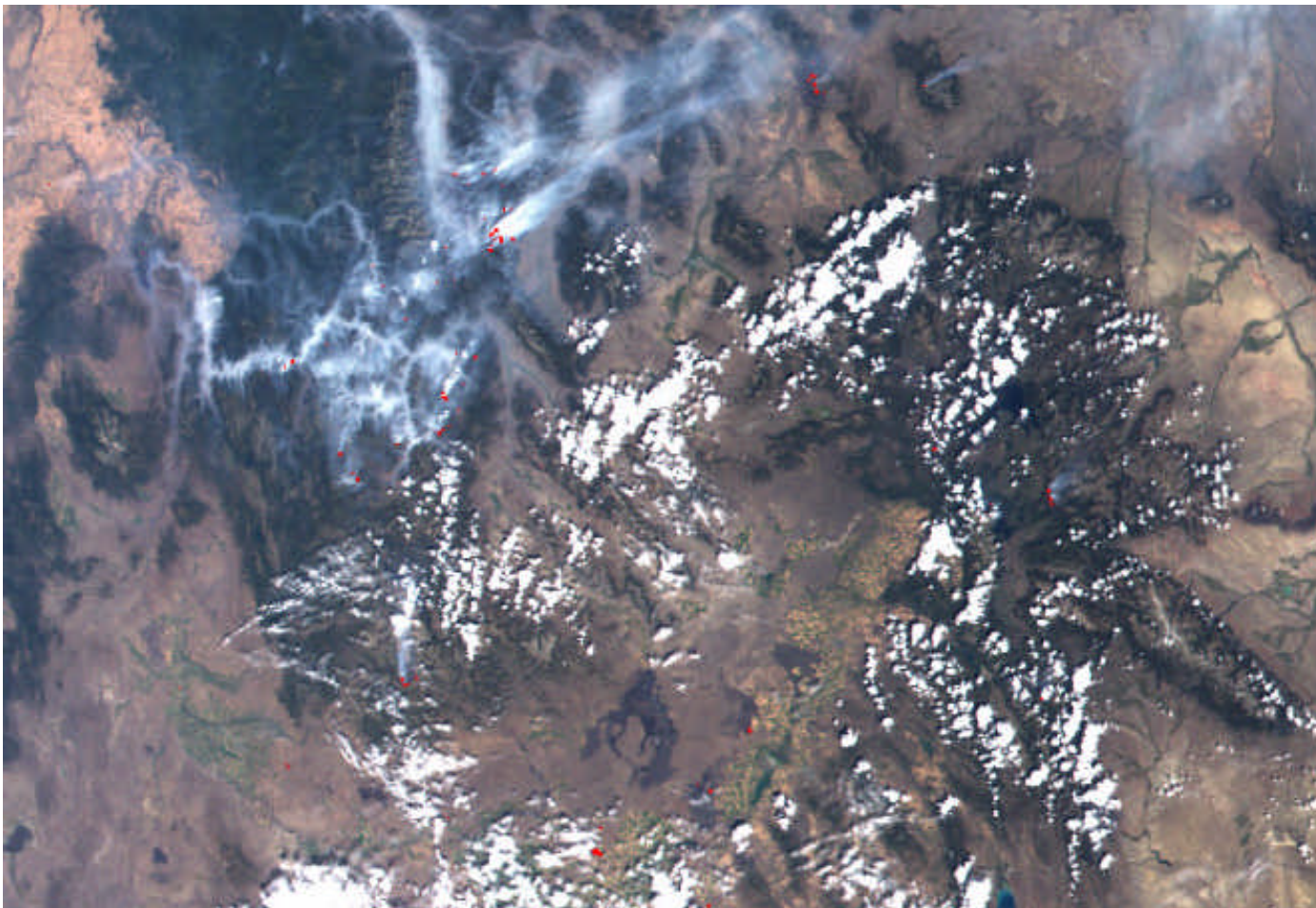
Acquired Aug. 23

Produced Aug. 30

True-color image
of smoke & burn
scars over
Montana

fire pixels added
using 3.75 μm
channel

By Rong Rong Li

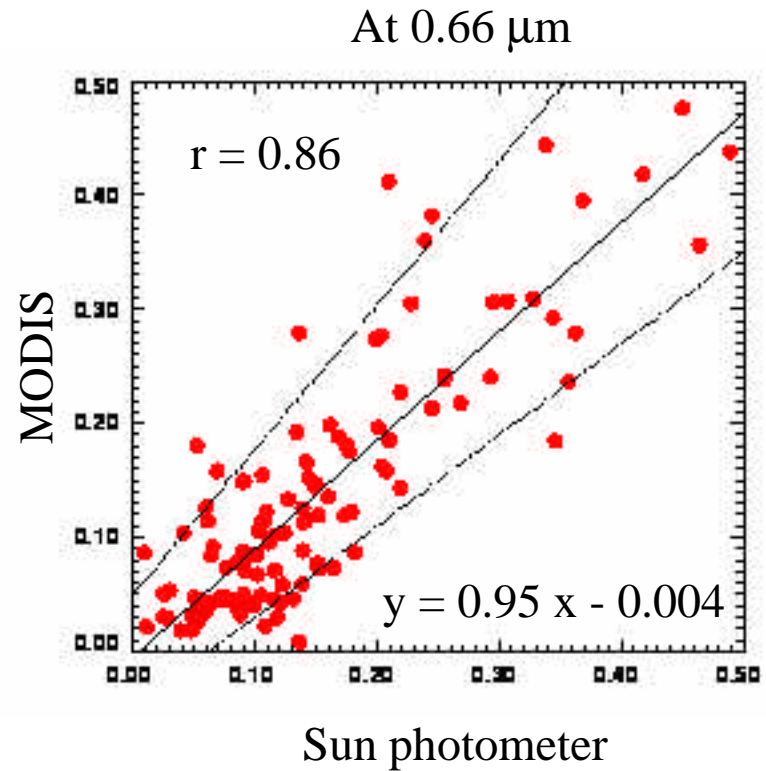
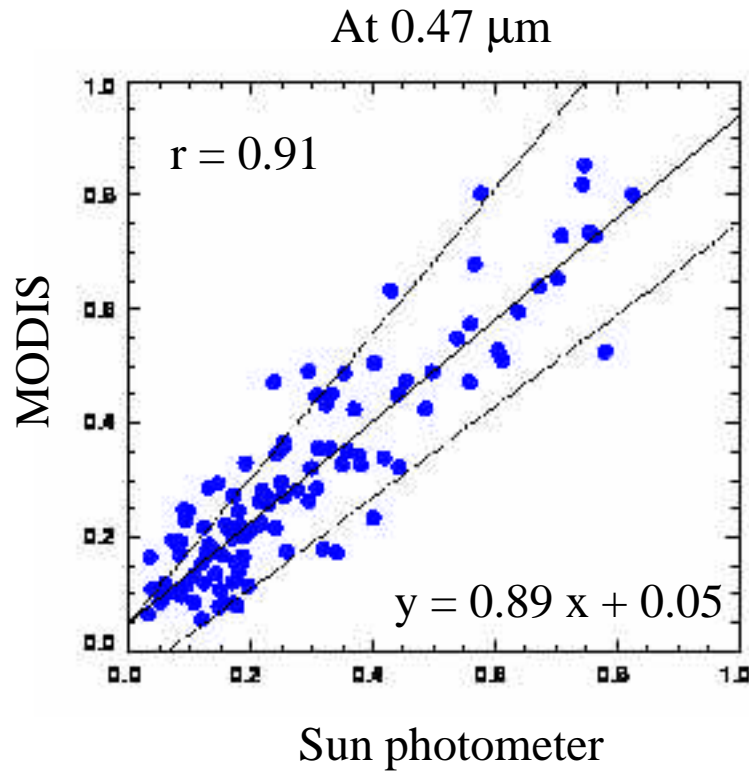


Yoram Kaufman, Terra Project Science Office

September 18, 2000

MODIS can quantify the smoke concentration

MODIS vs. AERONET Aerosol Optical Thickness - land



Total points = 115

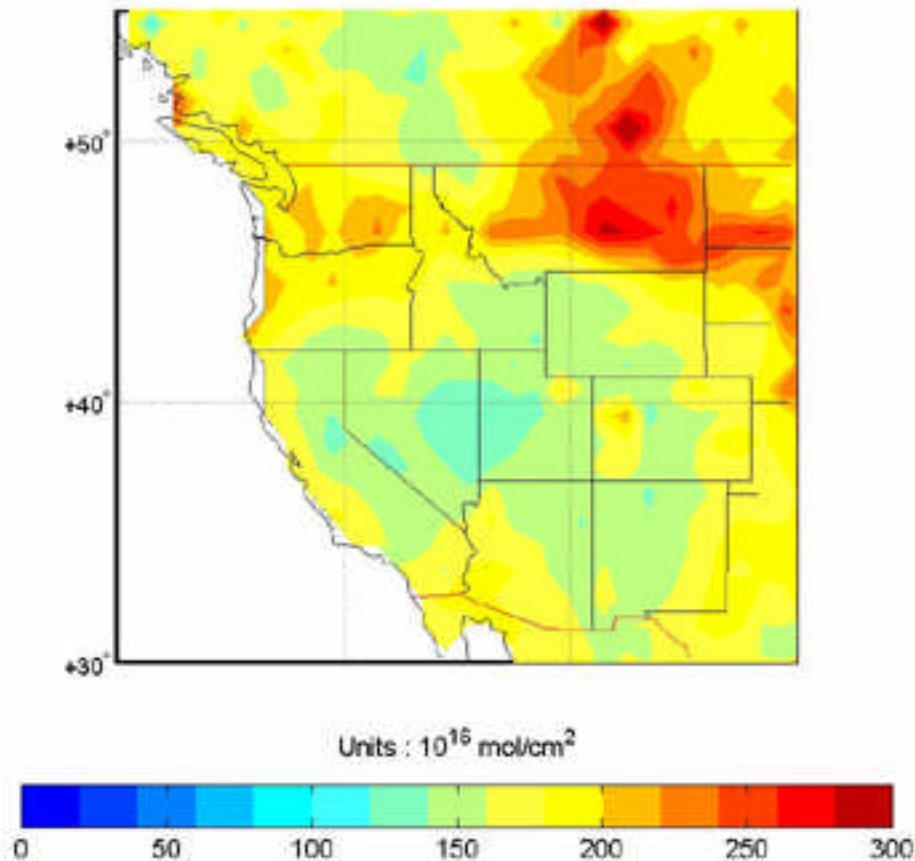
Note: excluding Venice, El Arenosillo, Wallaps, MD Science Center, GSFC sites

Allen Chu and Yoram Kaufman

MOPITT Carbon Monoxide



MOPITT continental CO total column retrieval,
averaged for Aug.22-Aug.27 2000

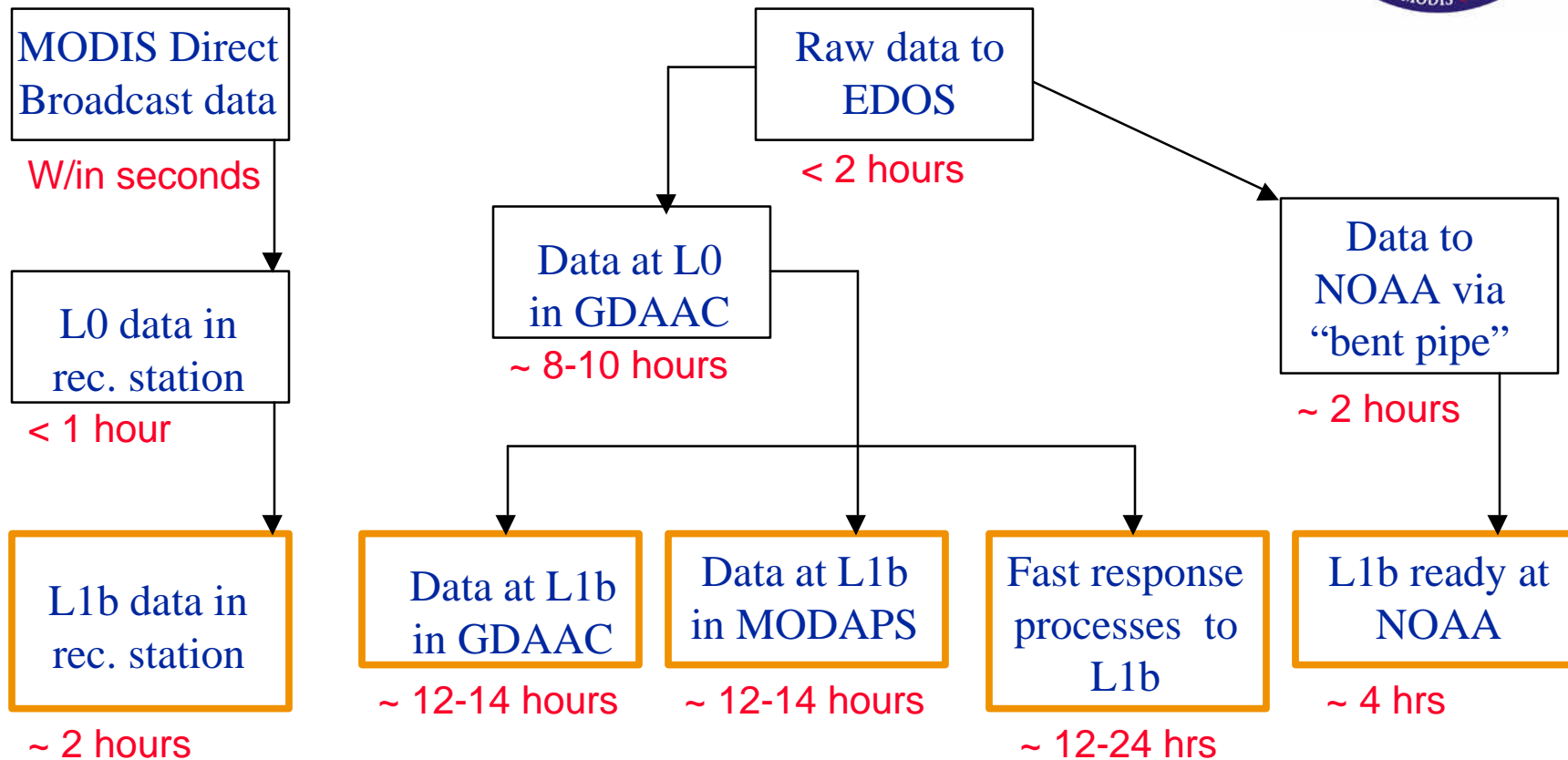


Aug. 22-27, 2000

Composite image showing
unvalidated levels of
carbon monoxide over
Montana & Idaho.

By David Edwards, NCAR

Five Paths to Operational MODIS Level 1b Data



5 Paths to Images

- **Nazmi El Saleous, MODLAND Group**
- **Rong Rong Li, Atmosphere Group**
- **Reto Stockli, Earth Observatory Team**
 - Based in Switzerland, 6 hours ahead
- **Rob Simmon, Earth Observatory Team**
- **Brian Montgomery, Rapid Response**



Fires in Idaho - MODIS



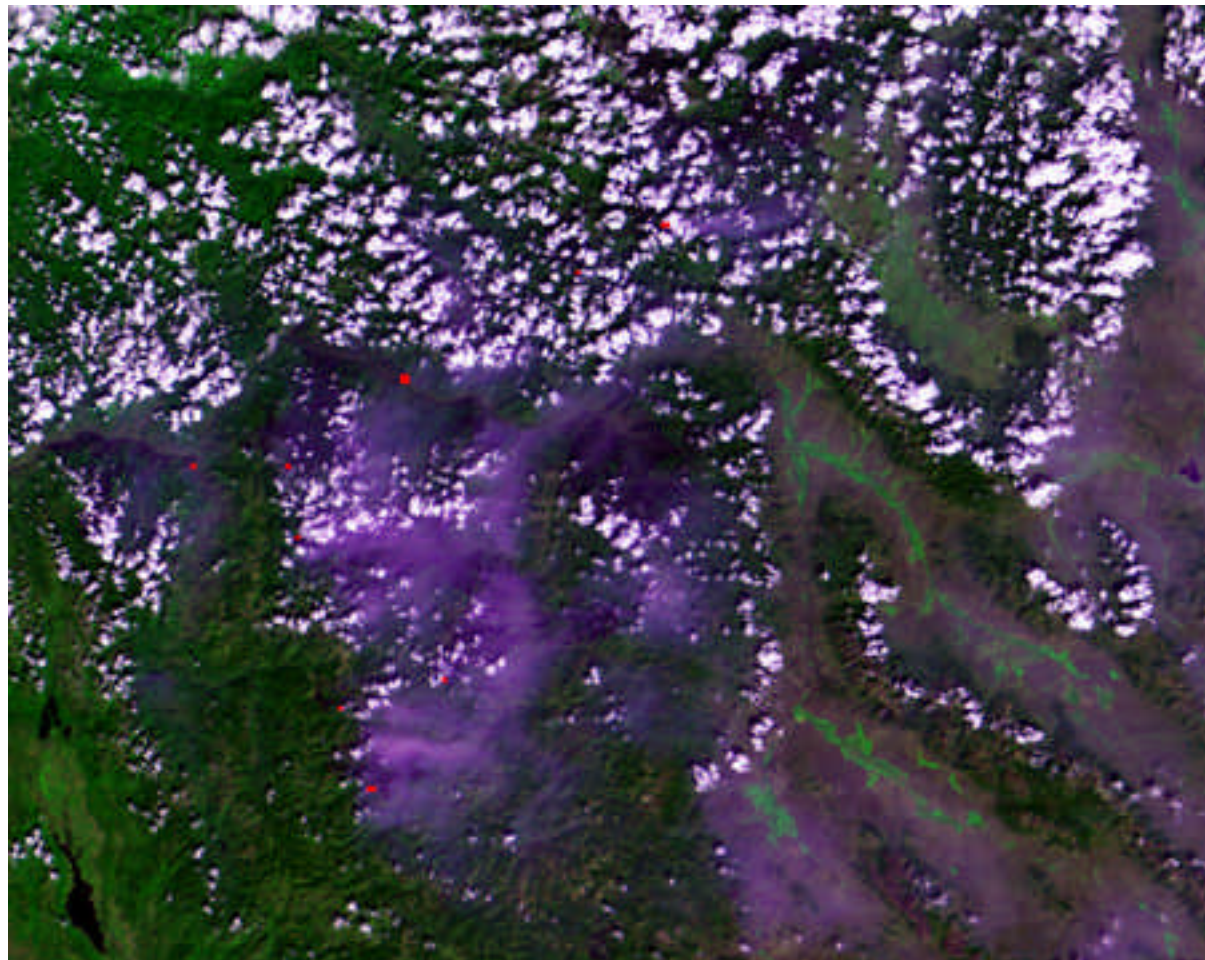
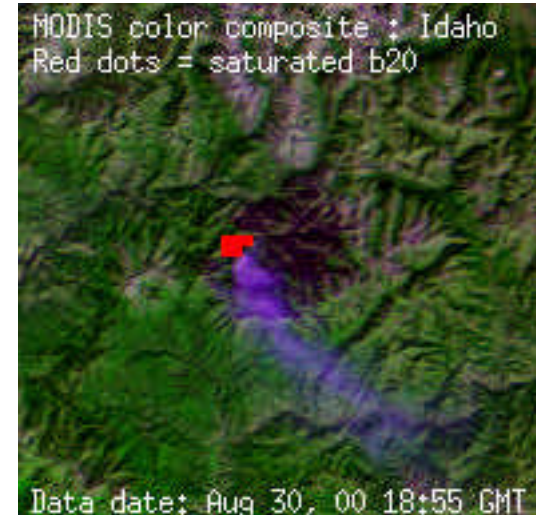
Day 243

Acquired Aug. 30

Produced Aug. 31

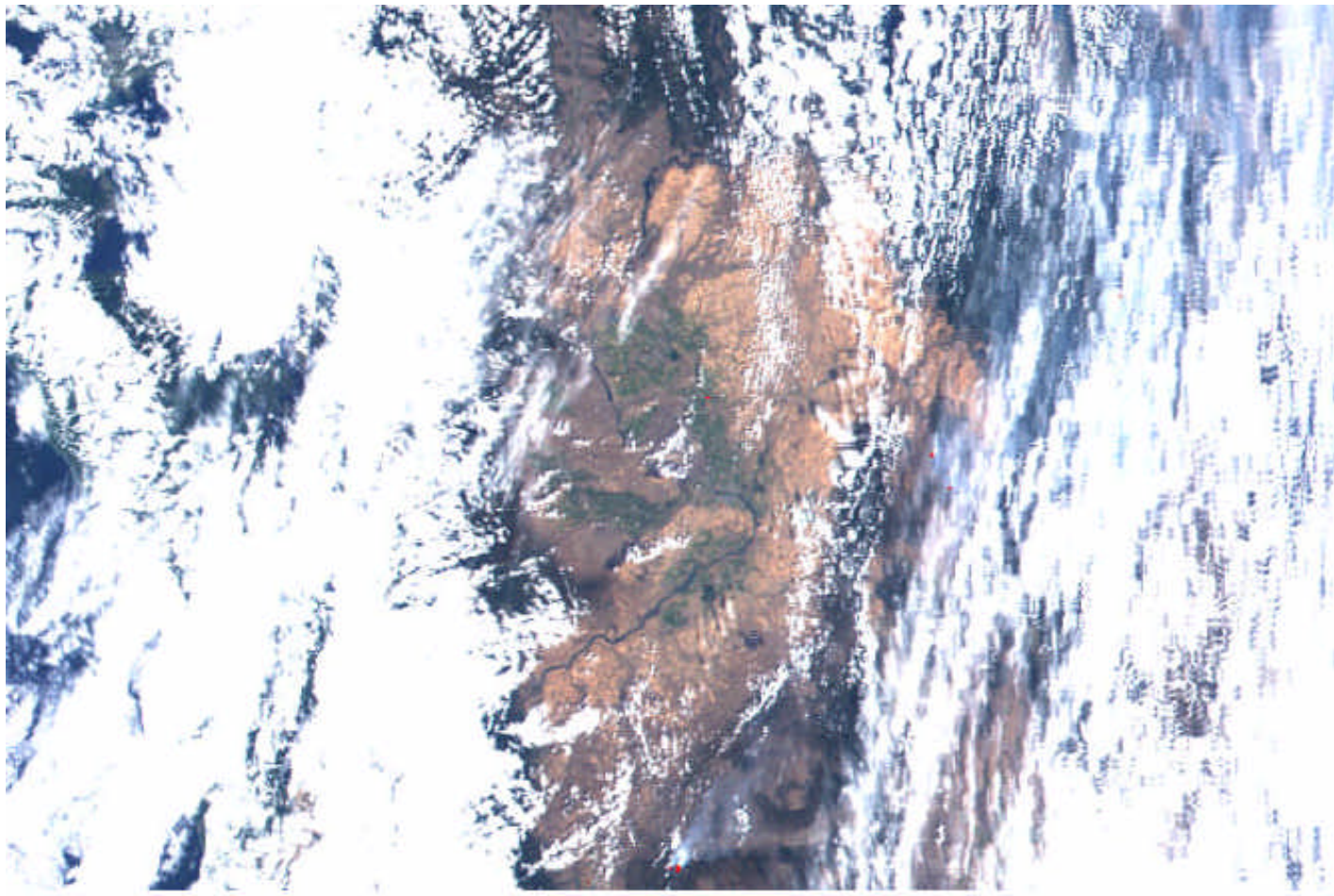
Fire pixels, smoke,
clouds, & land
surface in Idaho

By Nazmi El Saleous



Yoram Kaufman, Terra Project Science Office

Clouds! (& fires) - MODIS



Day 244

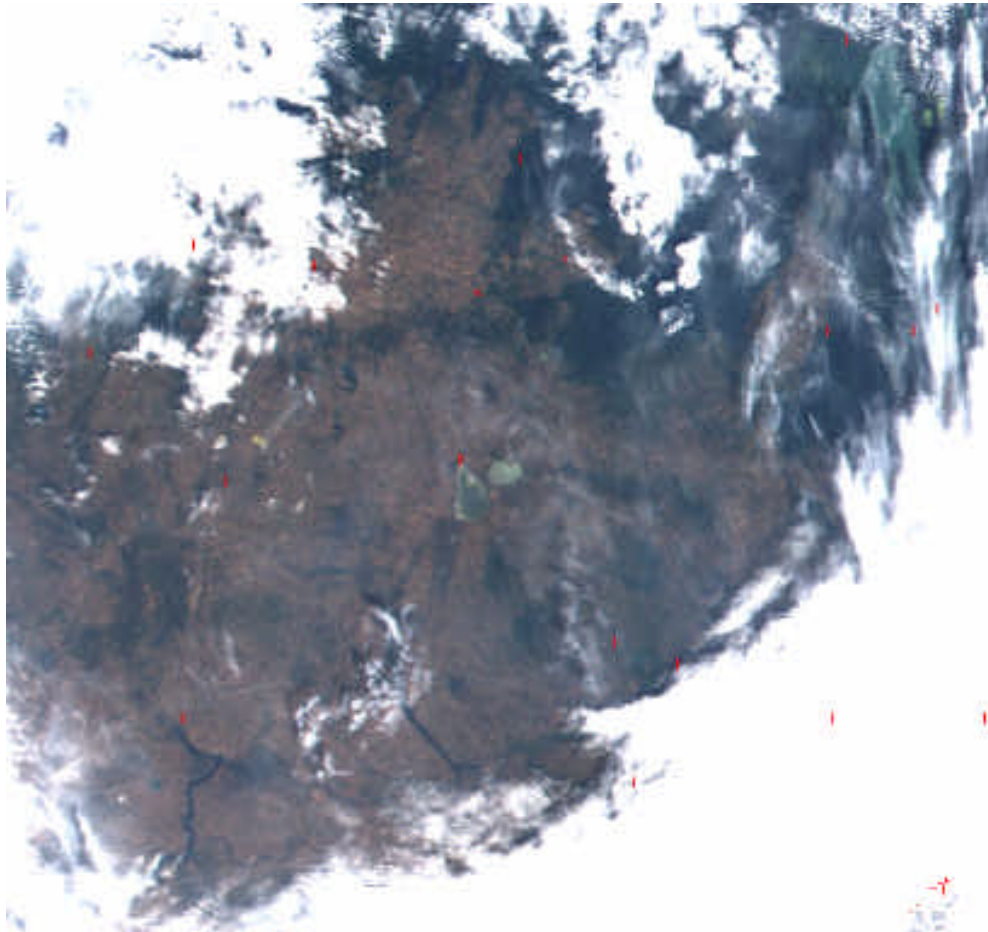
Acquired
Aug. 31

Produced
Sept. 1

True-color
image of clouds,
smoke, fires, &
burn scars over
Montana

By Rong Rong Li

Break in the Clouds, few fires



Day 245

Acquired
Sept. 1

Produced
Sept. 2

True-color
image of clouds,
smoke, & fires
over Montana

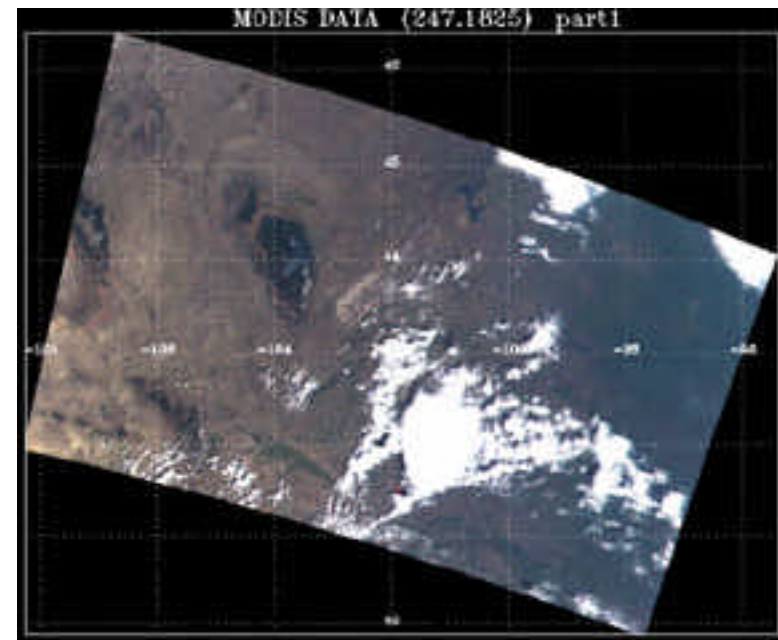
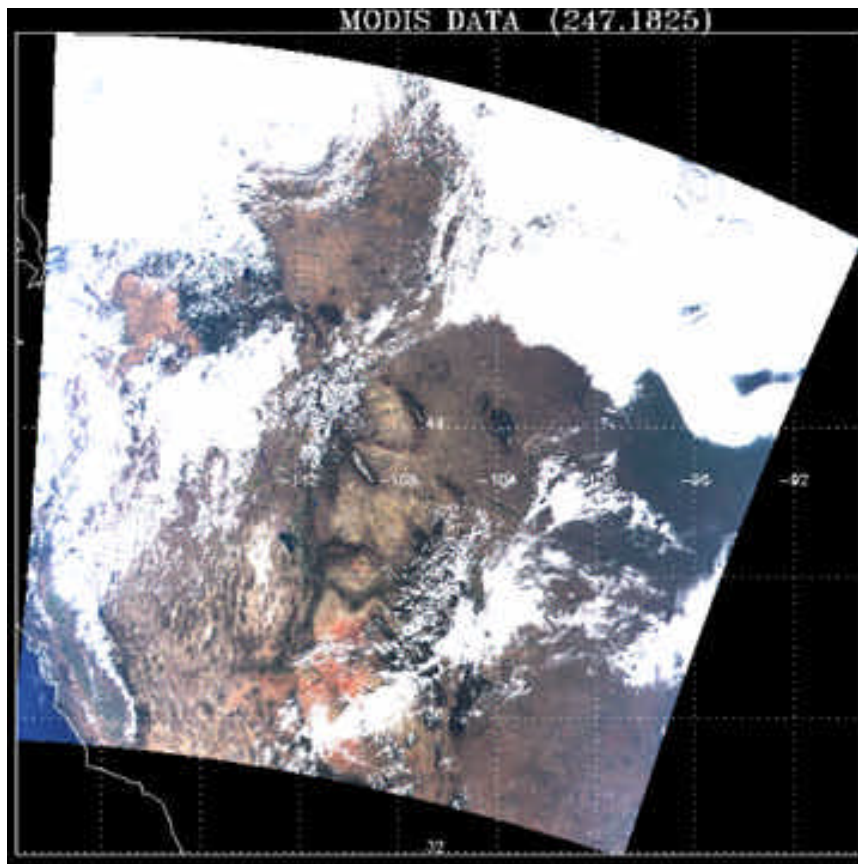
By Rong Rong Li

Day 247 - Small Fires Visible

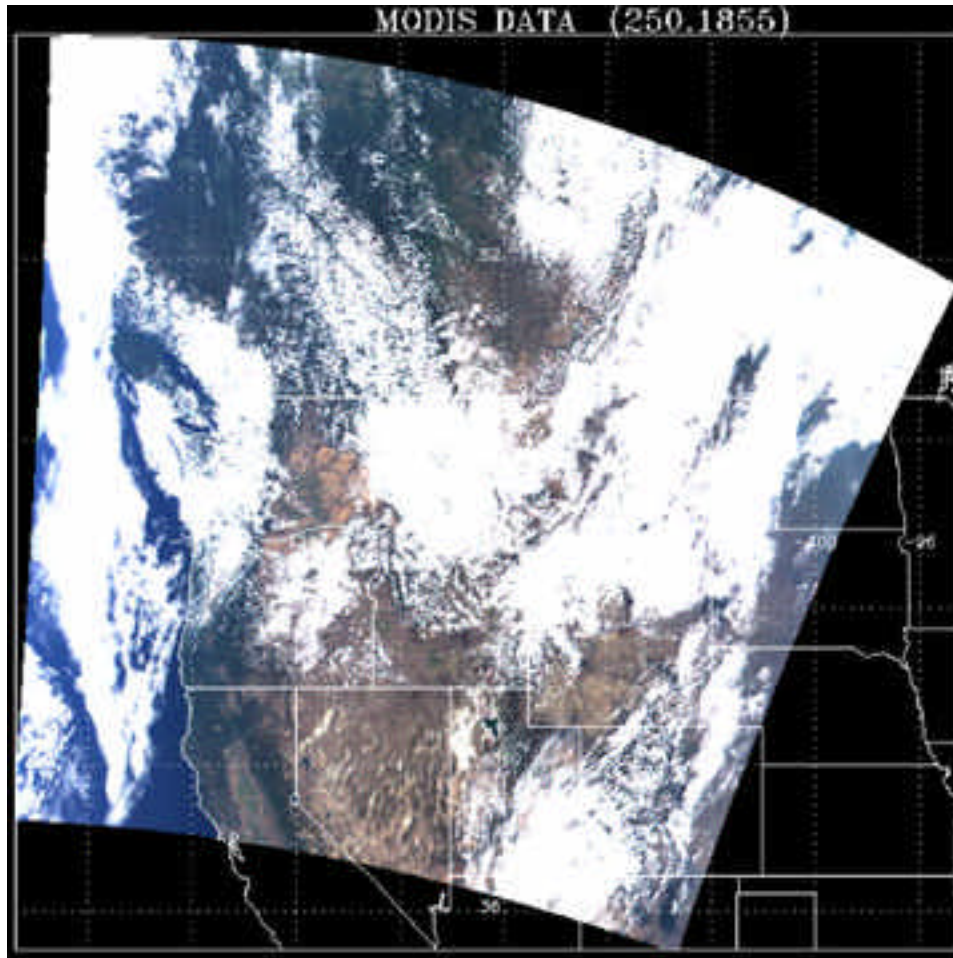


Acquired Sept. 3
Produced Sept. 4

By Rong Rong Li



Clouds, No Fires



Day 250

Acquired Sept. 6

Produced Sept. 7

True-color land and
clouds over western
North America, with
state boundaries

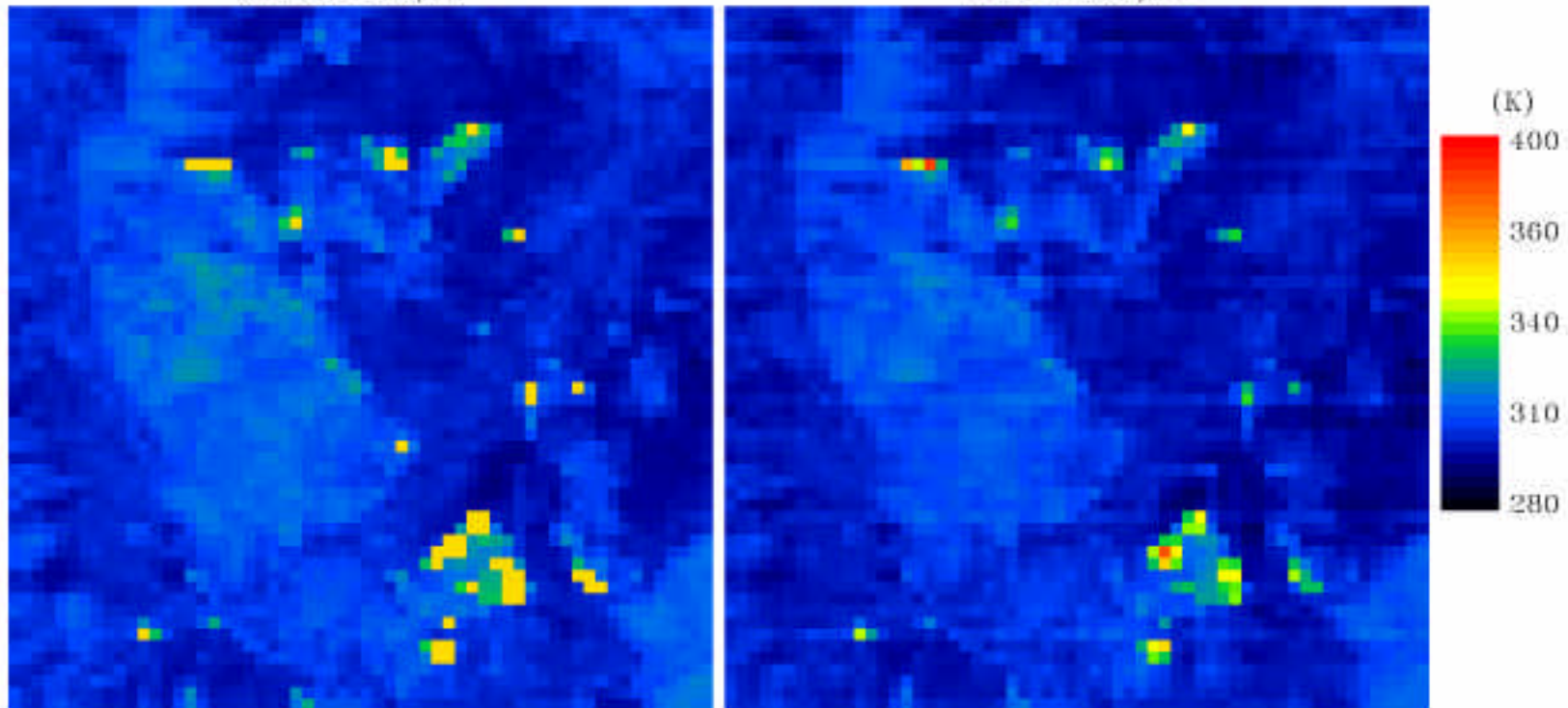
By Rong Rong Li

MODIS vs. AVHRR fires in Idaho

Ch 20 saturates at 330K, Ch 21 saturates at 450K
thus shows the location of the fire fronts (red)



MODIS DATA 8/23/2000 18:45 UTC (236.1845)
Ch 20, 3.70 μ m Ch 21, 3.90 μ m



By Rong Rong Li and Yoram Kaufman

MODIS vs. AVHRR fires in Idaho



The MODIS images in the previous slide were acquired on Aug. 23 over Montana and Idaho. Each image is 60 by 60 pixels and a single pixel is 1 square kilometer. The image on the left was made using MODIS' channel 20 (centered at 3.7 μm); this image approximates the capability of the NOAA Advanced Very High Resolution Radiometer (AVHRR) to detect fires and measure their intensities. The image on the right uses MODIS' channel 21 (centered at 3.90 μm). Notice how MODIS channel 21 shows greater sensitivity to the temperatures of the fires, which can help fire scientists pinpoint where there are active flaming fires and where fires are less intense or smoldering. This is important because large smoldering fires can contribute heavy amounts of pollutants into the atmosphere, while active flaming fires are often where firefighters concentrate their efforts for containment and suppression.

Burn Scars

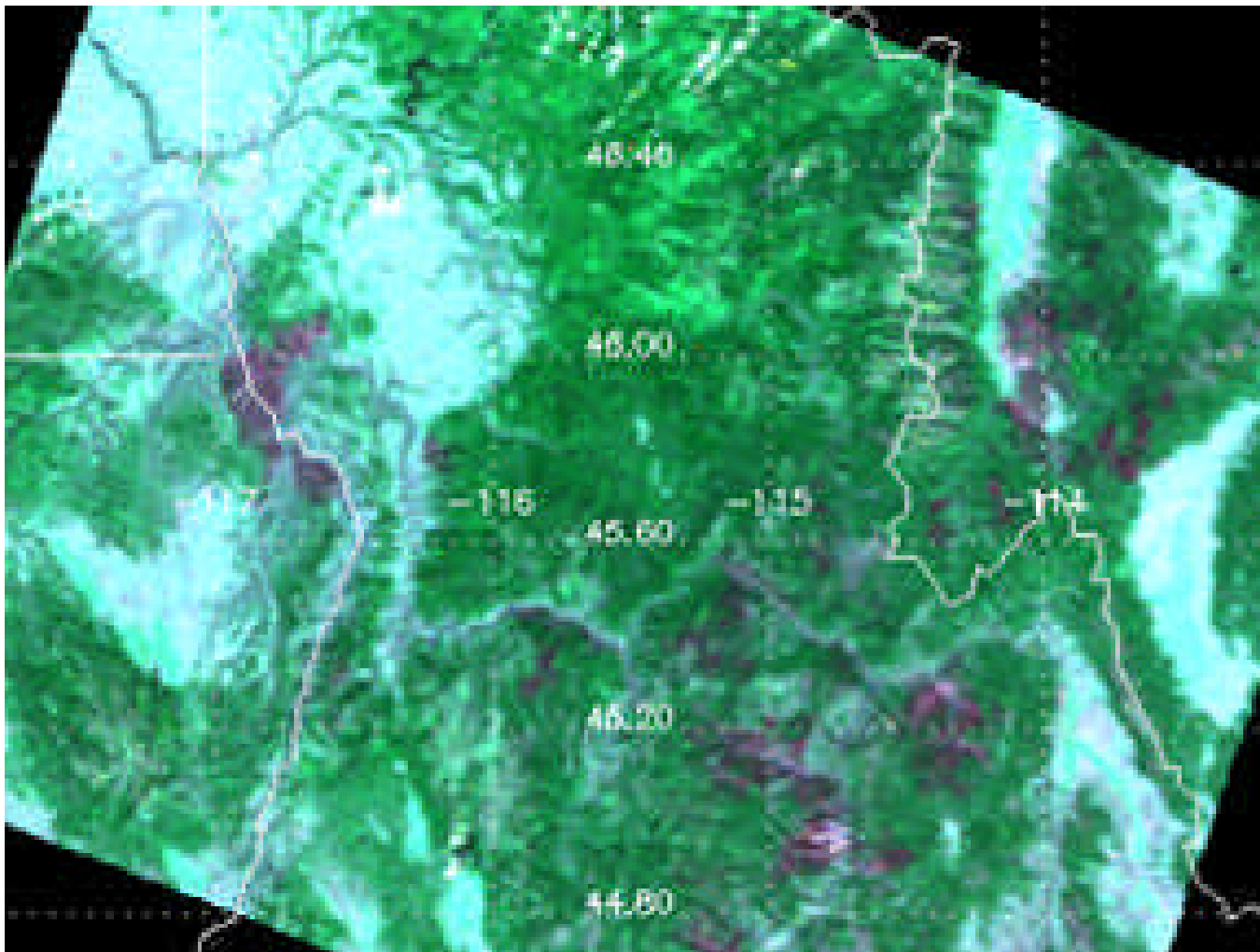


Day 251

Produced Sept.
7 -- 24-hour
turnaround

False-color
image over
Montana &
Idaho. Burn
scars appear as
dark purple
splotches.

By Rong Rong Li



Yoram Kaufman, Terra Project Science Office

Conclusions



- The Terra Rapid Response Team succeeded in outputting useful products to the Forest Service
- The goal of 24-hour turnaround was achieved
- The potential for operational use of MODIS direct broadcast was demonstrated
- Wei Min Hao submitted 5-year, \$.5 million per year proposal to Forest Service for MODIS DB station for fire monitoring
- The Rapid Response Team will continue to explore working relationships for operational use of data:
 - USDA Forest Service
 - U.S. Army Corps of Engineers
 - World Health Organization
 - NOAA