

ESTABLISHING ACTIVE FIRE DATA CONTINUITY BETWEEN AQUA MODIS AND SUOMI NPP VIIRS

*Ivan Csiszar¹, Wilfrid Schroeder², Louis
Giglio², Christopher O. Justice², Evan
Ellicott²*

¹NOAA/NESDIS Center for Satellite Applications and
Research, Camp Springs, MD

²University of Maryland, College Park, MD

Why do we need MODIS-VIIRS continuity?

- MODIS is the first sensor designed to detect and characterize hot targets (predominantly actively burning fires) on a global and systematic basis
- MODIS fire data have been extensively used for disaster and resource management, air quality applications, ecosystem monitoring, climate studies etc.
- The community expects and society needs the continuation of these high quality observations from VIIRS on NPP (launched on October 28, 2011) and future JPSS satellites

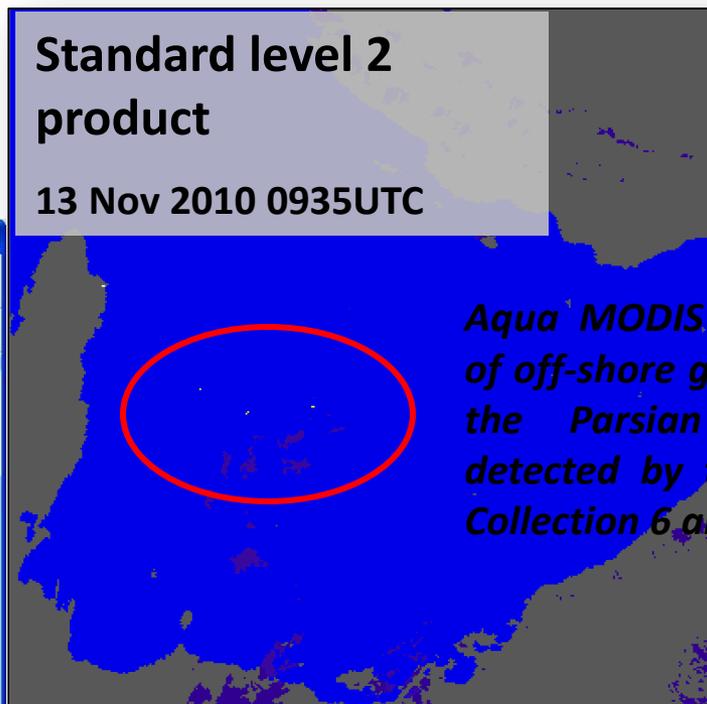
Examples of MODIS fires/thermal anomalies data

Real-time data

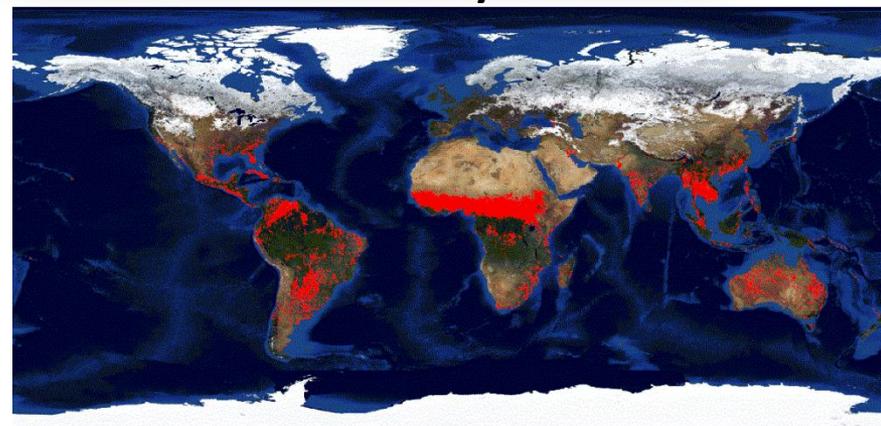
Standard level 2 product

13 Nov 2010 0935UTC

Aqua MODIS detections of off-shore gas flares in the Persian Gulf as detected by the MODIS Collection 6 algorithm



Global dynamics



JANUARY FEBRUARY MARCH APRIL MAY JUNE JULY AUGUST SEPTEMBER OCTOBER NOVEMBER DECEMBER

FIRMS | Fire Information For Resource Management System - Mozilla Firefox

File Edit View History Bookmarks Tools Help

FIRMS | Fire Information For Resource Mana... +

http://maps.geog.umd.edu/firms/

Home
About
Web Mapping Services
Email Alerts
Active Fire Data
Burned Area **New!**
MODIS Subsets
Resources
Publications
FAQs
Links

The Fire Information for Resource Management System (FIRMS) integrates remote sensing and GIS technologies to deliver global MODIS hotspot/fire locations and burned area information to natural resource managers and other stakeholders around the World.

FIRMS is funded by NASA and builds on [Web Fire Mapper](#), a web mapping interface that displays hotspots/fires detected by the [MODIS Rapid Response System](#) and delivers near real-time hotspot/fire information and monthly burned area information to international users and support fire managers around the World.

[Read more...](#)

March 22, 2011 - Fires in Myanmar
Source: [MODIS Rapid Response System](#). [Read More...](#)

FIRMS delivers MODIS fire and burned area information through:

- Email messages: [Global Fire Alerts](#);
- Interactive WebGIS: [Web Fire Mapper](#);
- Monthly [Burned Area](#) images in [Web Fire Mapper](#);
- Latest hotspot/fire data downloads: [Shapefiles/Text Files](#), [KML/Google Earth](#), [WMS](#), [World Wind](#);
- Subsets of [MODIS images](#)

Click on the graphics below to access the different services:

EMAIL ALERTS

WEB FIRE MAPPER

WITH BURNED AREA

ACTIVE FIRE DATA

MODIS SUBSETS

Announcements

MODIS – VIIRS fire continuity: fundamental possible scenarios

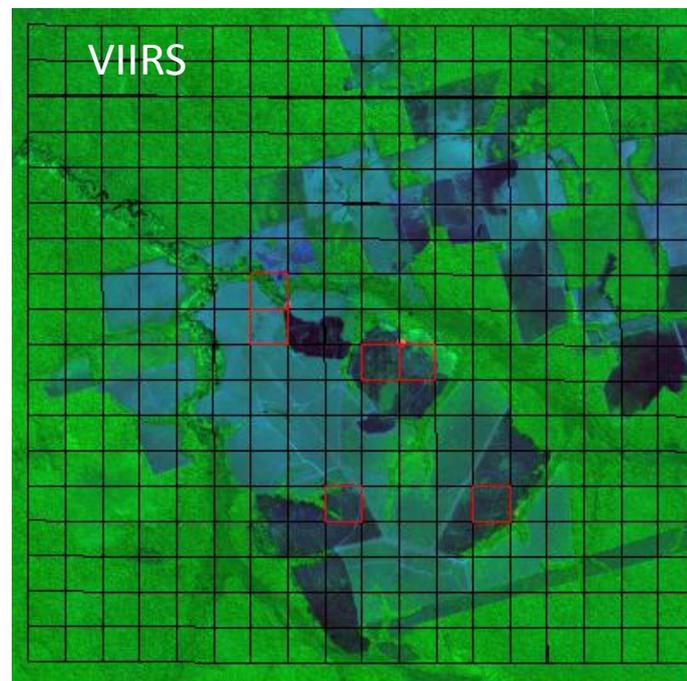
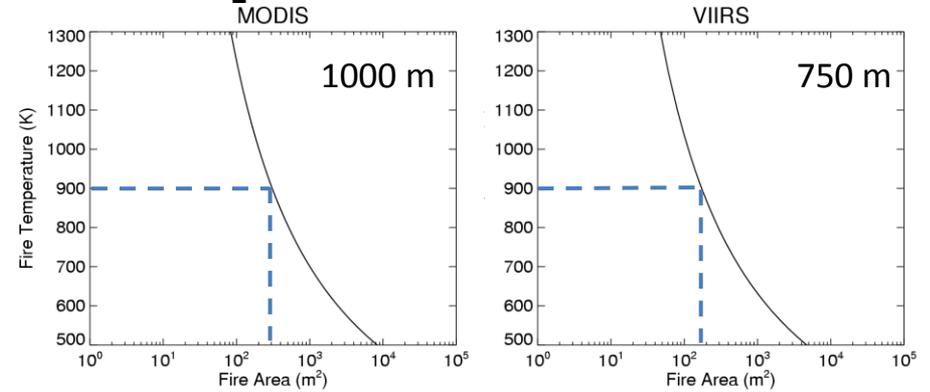
1. Orbital/daily MODIS and VIIRS fire maps are compatible.
2. Spatially and temporally aggregated fire statistics from MODIS and VIIRS are compatible.
3. Not even spatially and temporally aggregated fire statistics from MODIS and VIIRS are compatible, but MODIS and VIIRS provide compatible general patterns and trends of fire dynamics.

Aqua MODIS vs. NPP VIIRS: fundamental features

- Aqua and NPP have similar overpass times (1:30pm)
 - sampling of the diurnal fire cycle is similar
- Saturation levels of the primary bands allow unsaturated radiance measurements for most fires
 - Band 21/22 for MODIS and M13 for VIIRS
- Some differences in spectral placement
- Processing algorithms are compatible
 - Current VIIRS algorithm is based on MODIS, albeit an earlier version
 - Differences can be resolved and the impact can be minimized
- Primary driver of differences is spatial sampling
 - Pixel size
 - Variations along scanline (aggregation schemes)
 - Variations within pixels (line-spread function, aggregation)
 - Differences in swath width (VIIRS has no gaps at low latitudes)

Will orbital/daily MODIS and VIIRS fire maps be compatible?

VIIRS spatial resolution is higher than that of MODIS; in general, VIIRS is expected to detect smaller fires at nadir



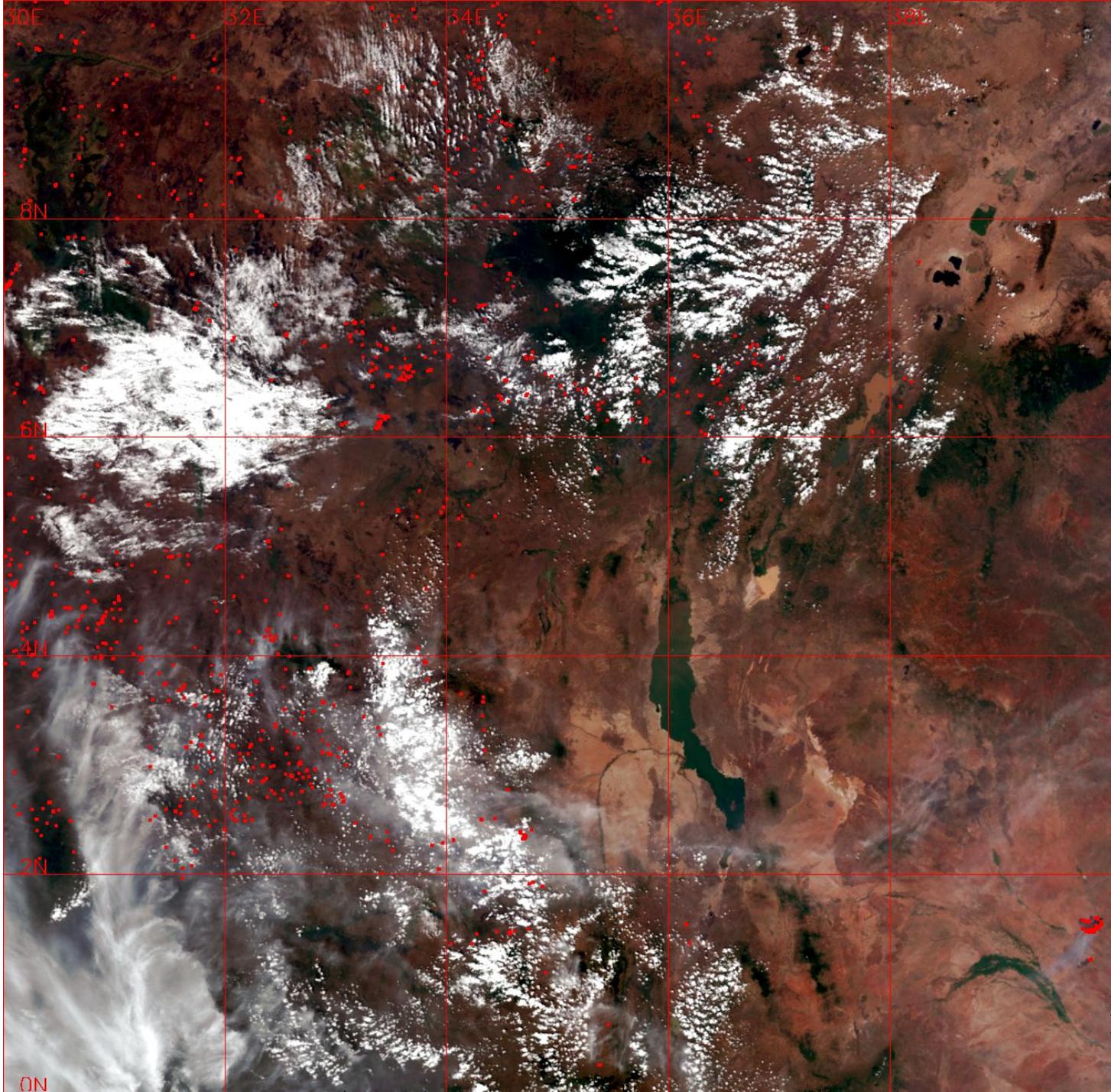
(based on modeling using ASTER fire masks)

7 Aug 2004 1405 UTC ~11.7° S 56.6° W (Brazil)

First light
NPP VIIRS
fire data

M5-M4-M3 RGB
+
IDPS Active Fire ARP

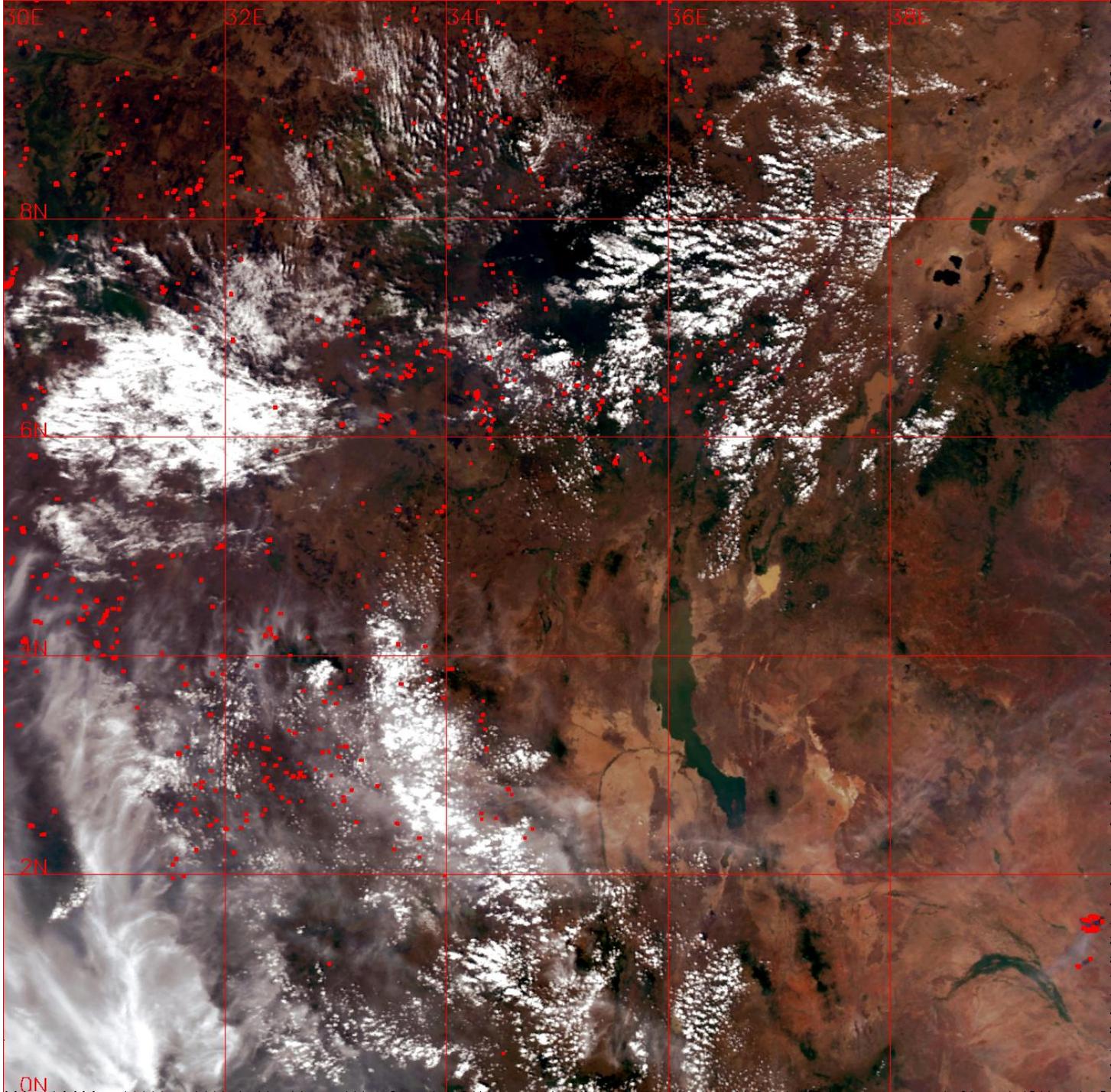
January 19, 2012
~11:05 UTC



...followed
by Aqua
MODIS five
minutes
later

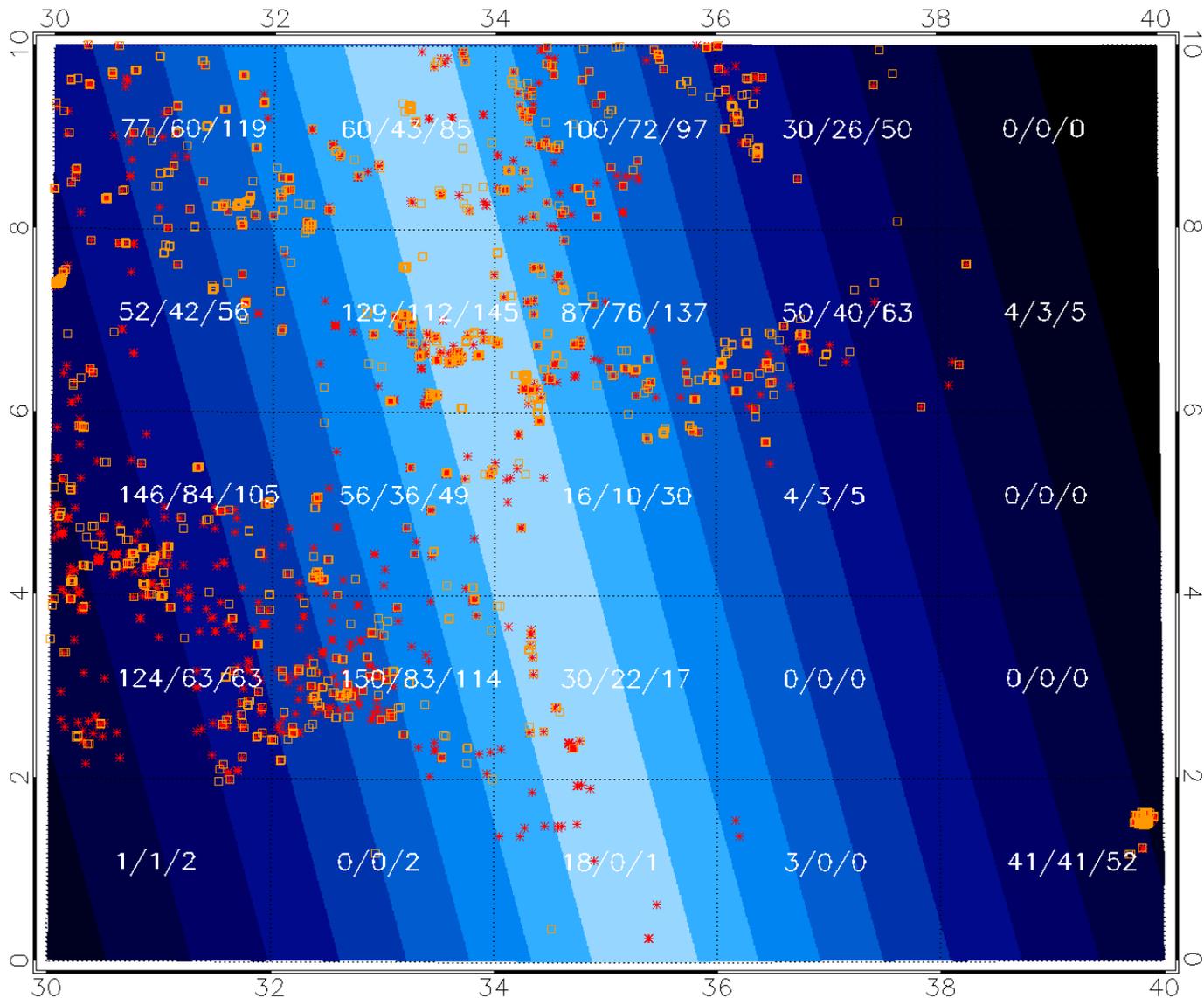
Band 1-4-3 RGB
+
MYD14

January 19, 2012
~11:05 UTC



MODIS vs. VIIRS detections

both near-nadir



January 19, 2012
~11:05 UTC

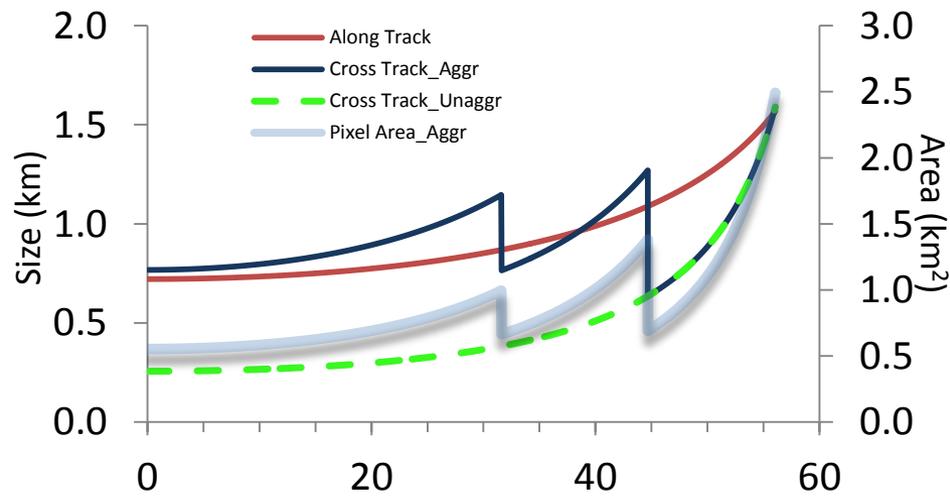
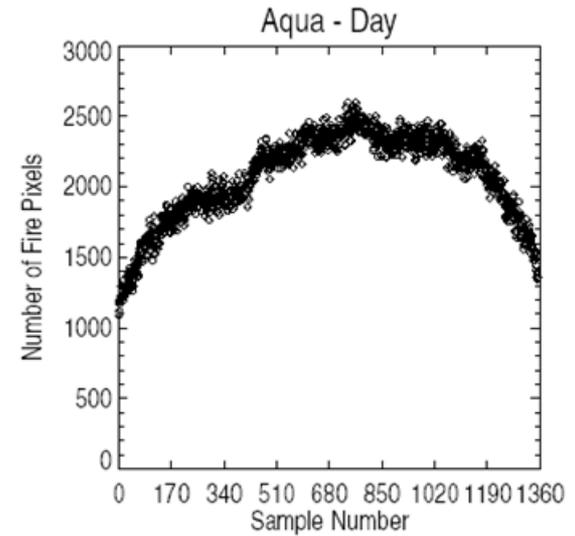
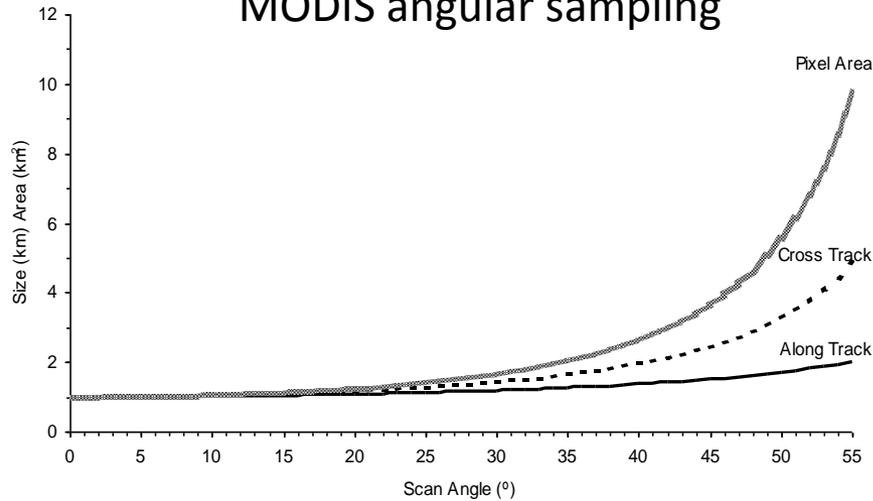
VIIRS Scan Angle (deg)



VIIRS/overlap/MODIS

Angular sampling

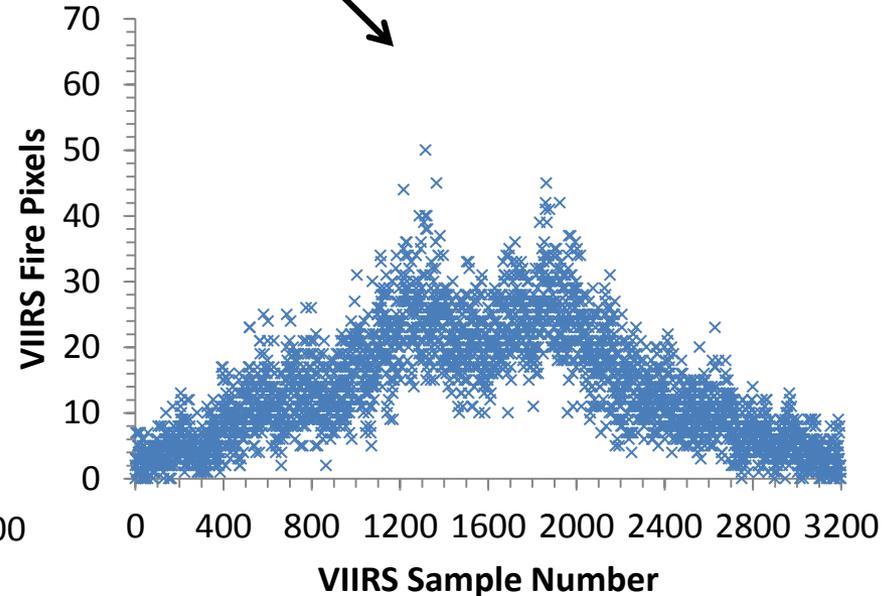
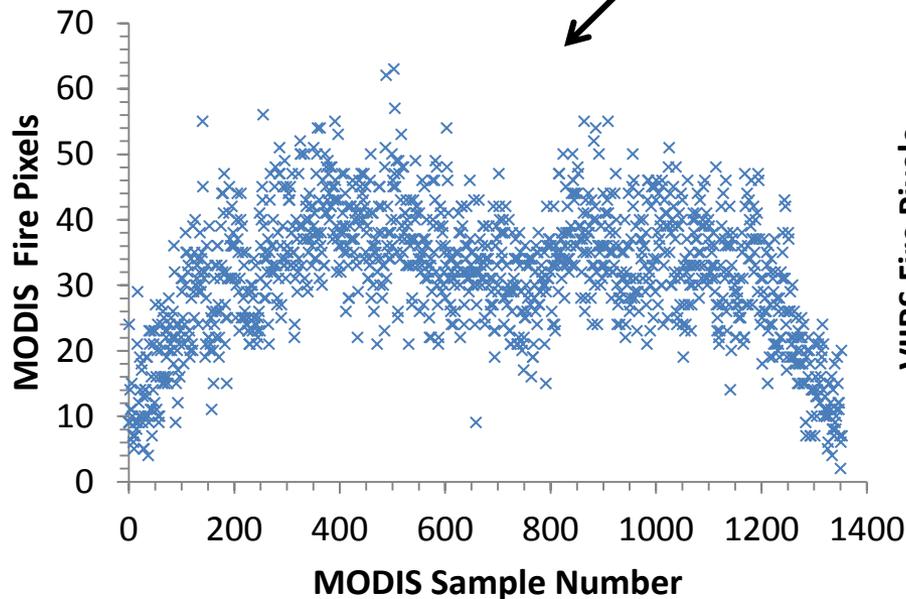
MODIS angular sampling



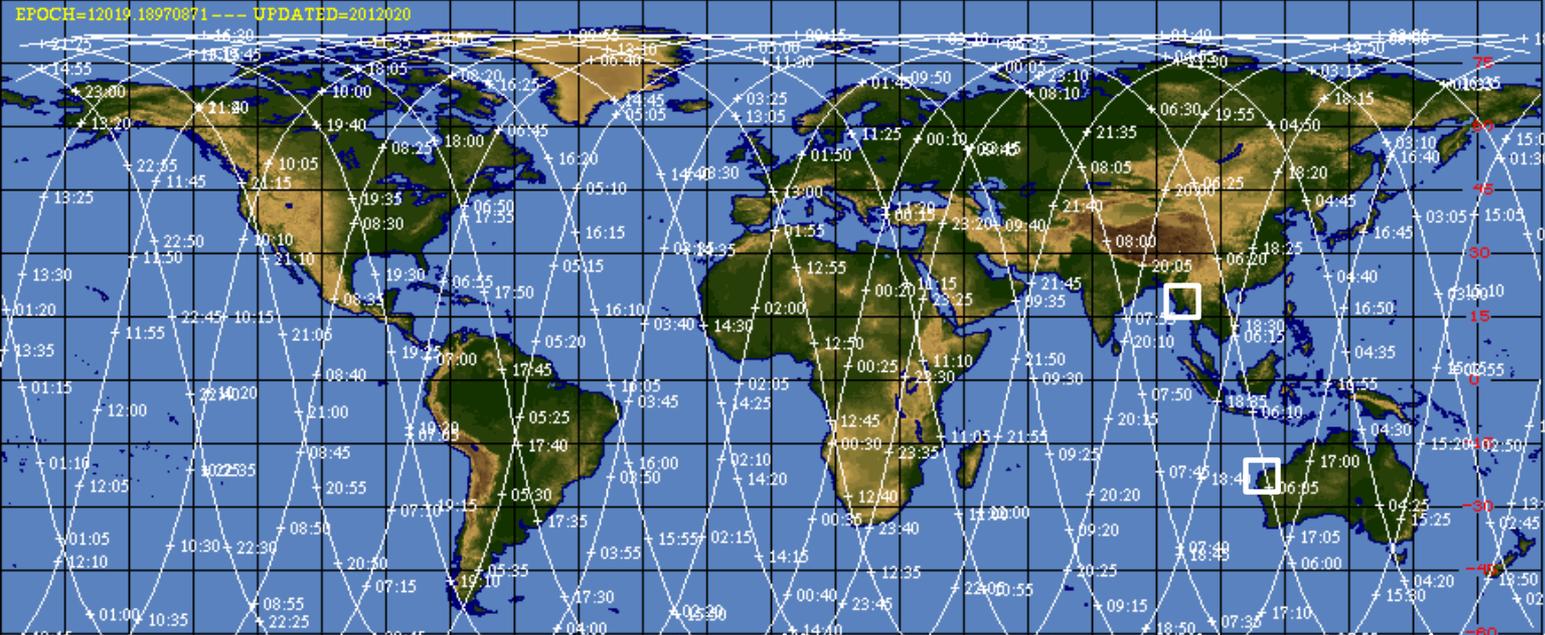
MODIS vs. VIIRS fire counts

Jan 19-24

VIIRS has a wider swath than MODIS



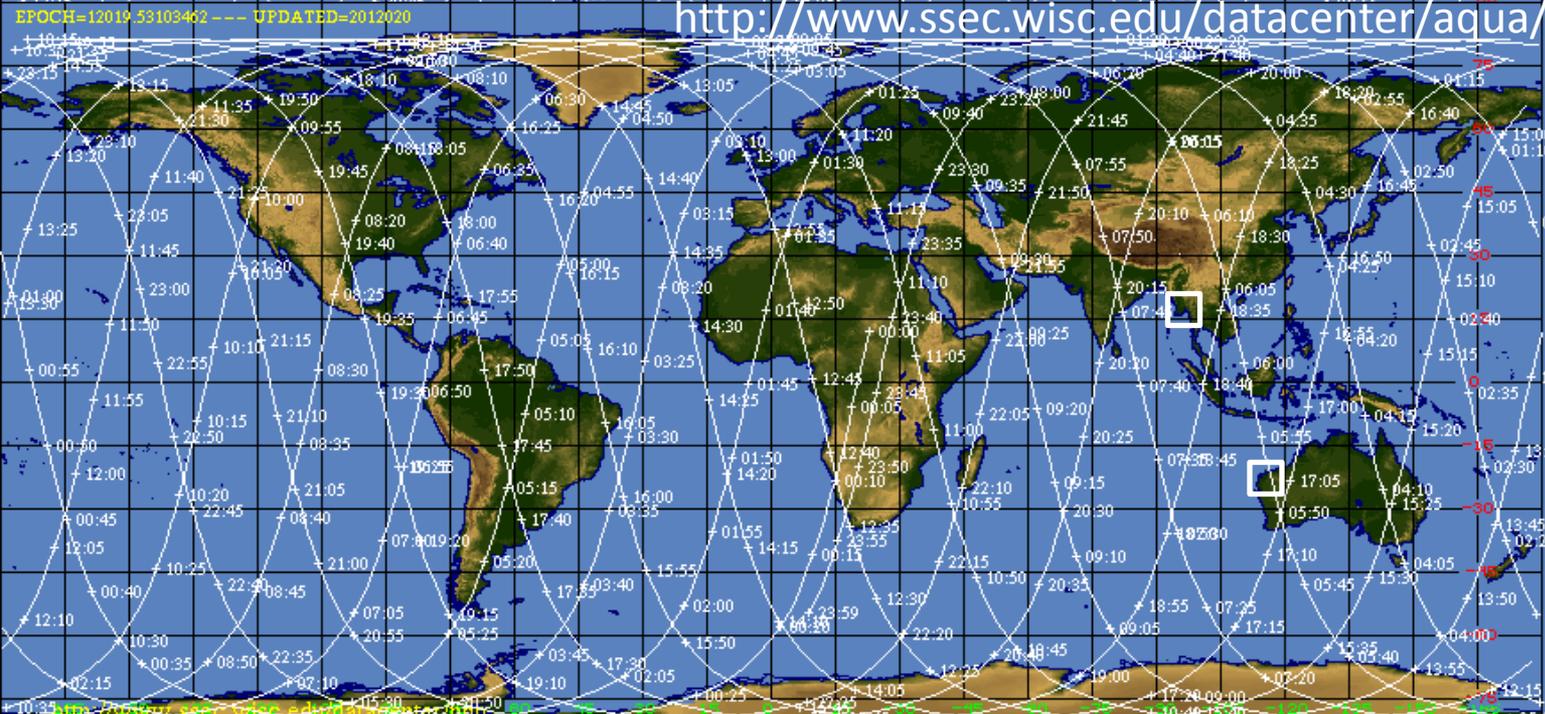
Preliminary, for illustration purposes only!



Aqua

Jan 19
2012

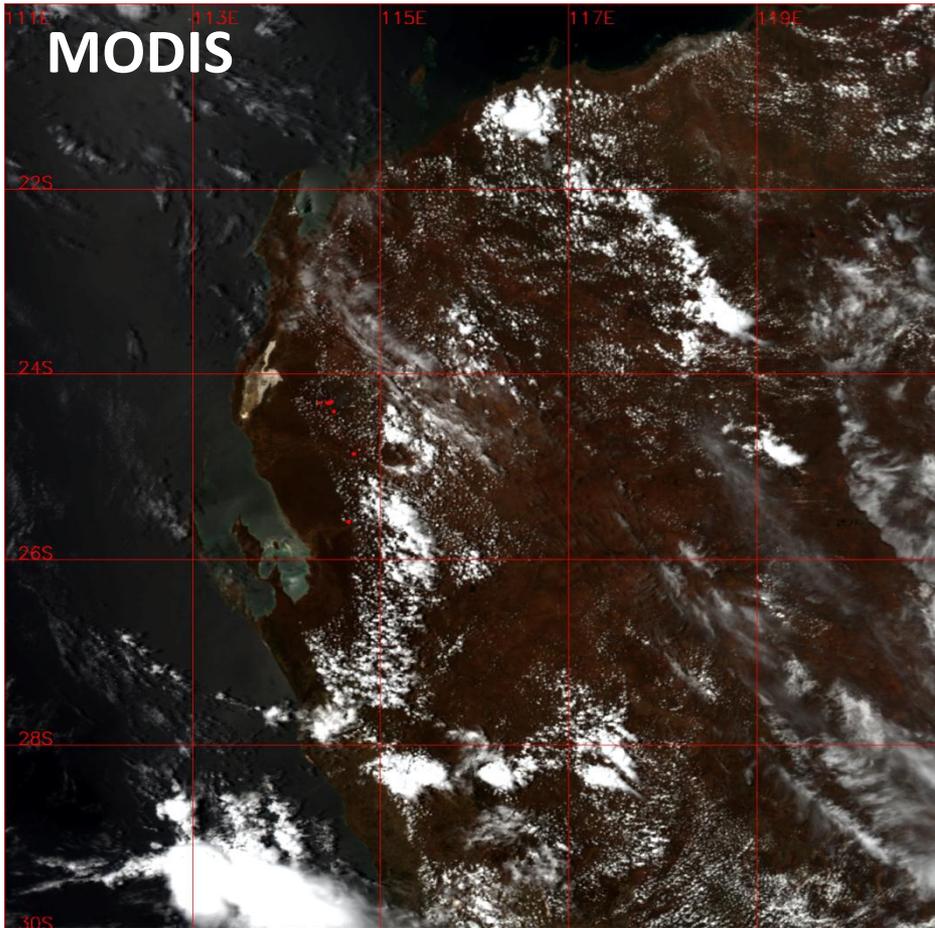
<http://www.ssec.wisc.edu/datacenter/aqua/>



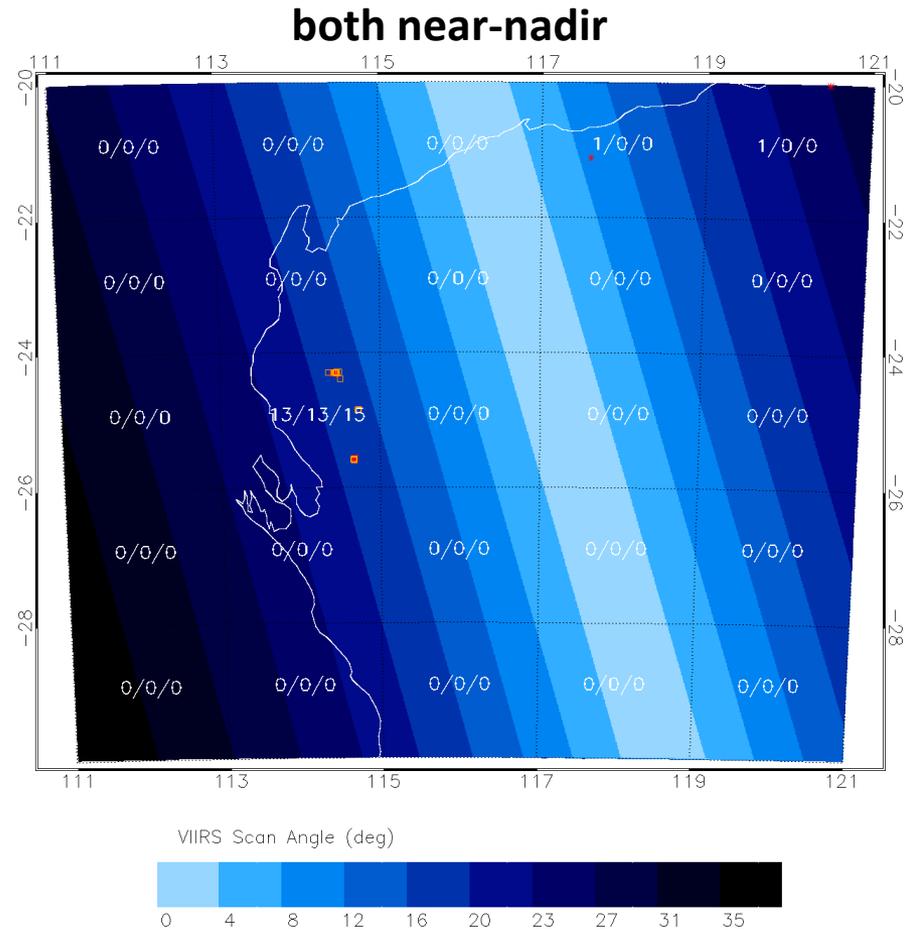
NPP

<http://www.ssec.wisc.edu/datacenter/npp/>

Western Australia

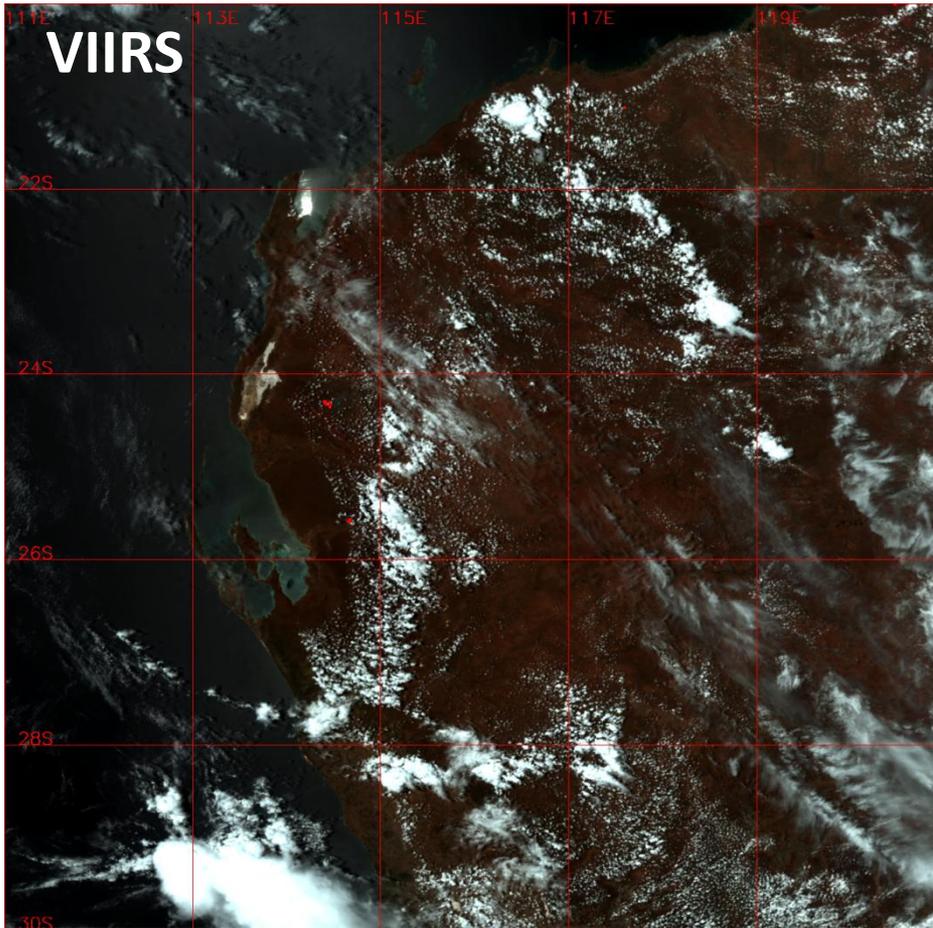


Jan 19 2012 06:00 UTC

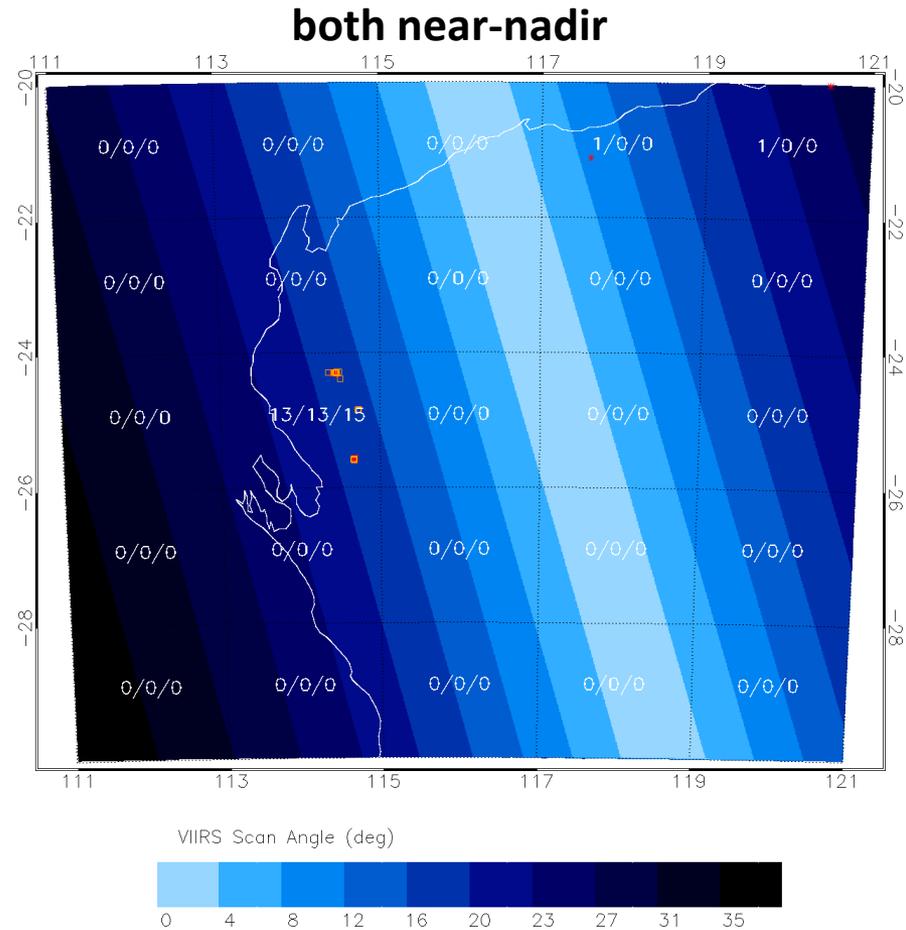


VIIRS/overlap/MODIS

Western Australia

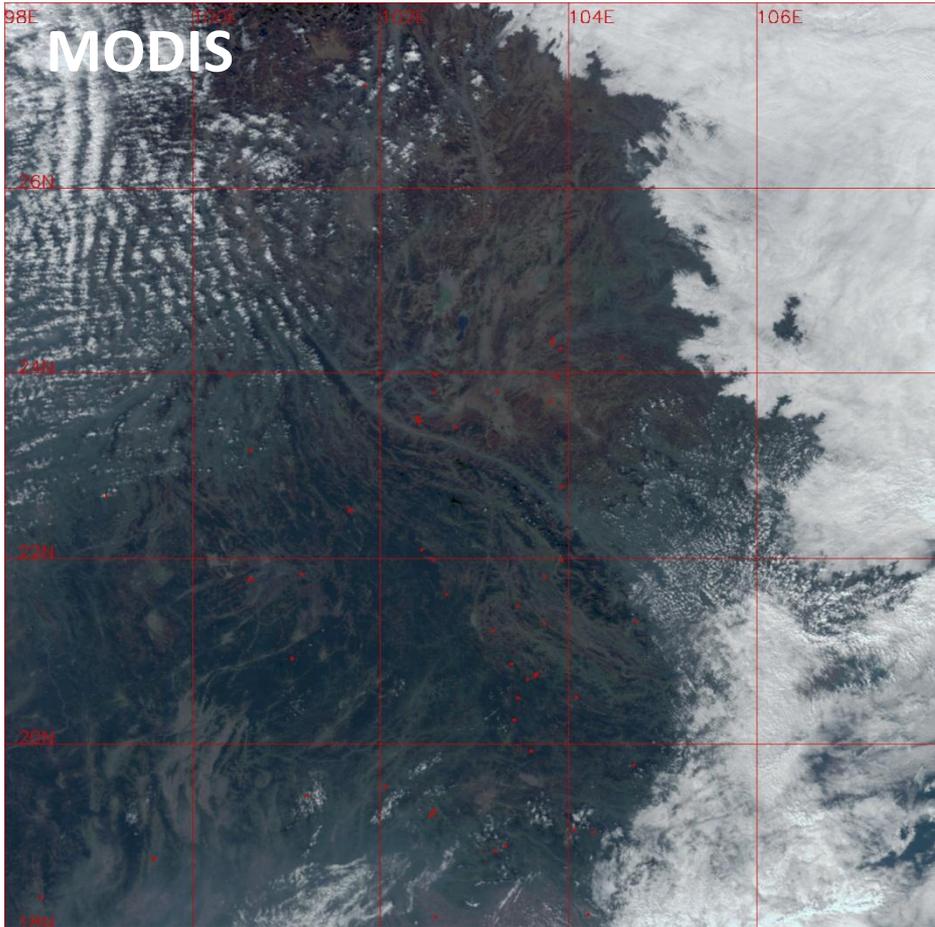


Jan 19 2012 05:45 UTC

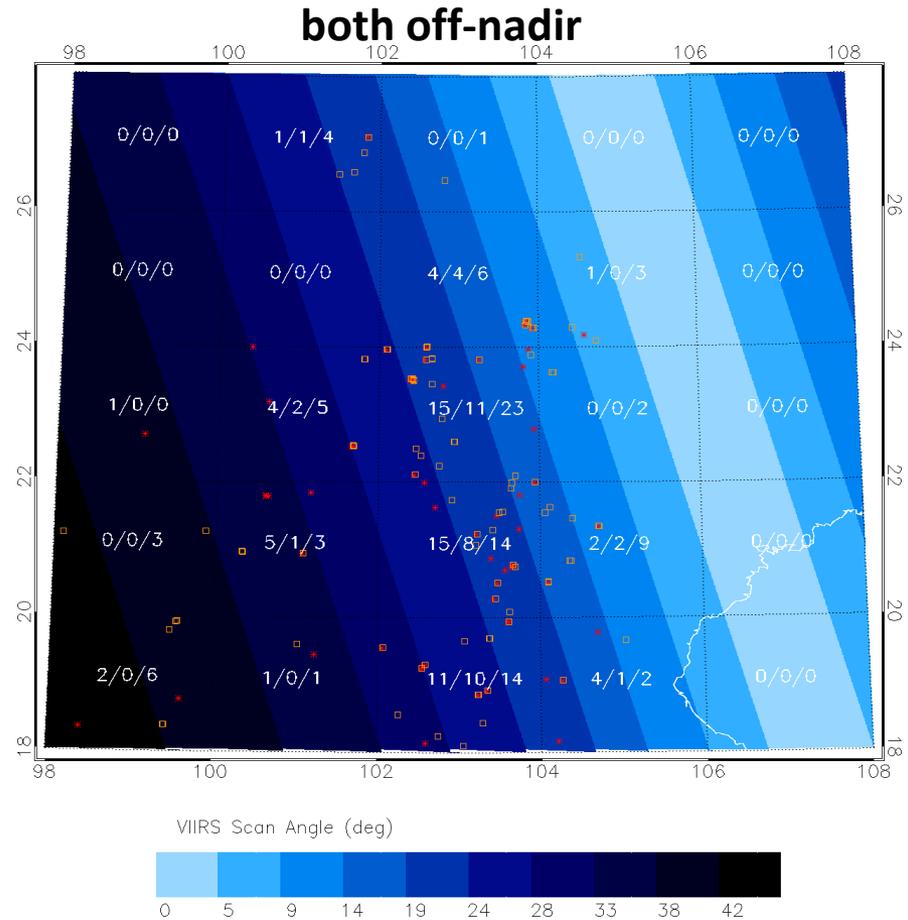


VIIRS/overlap/MODIS

South-East Asia

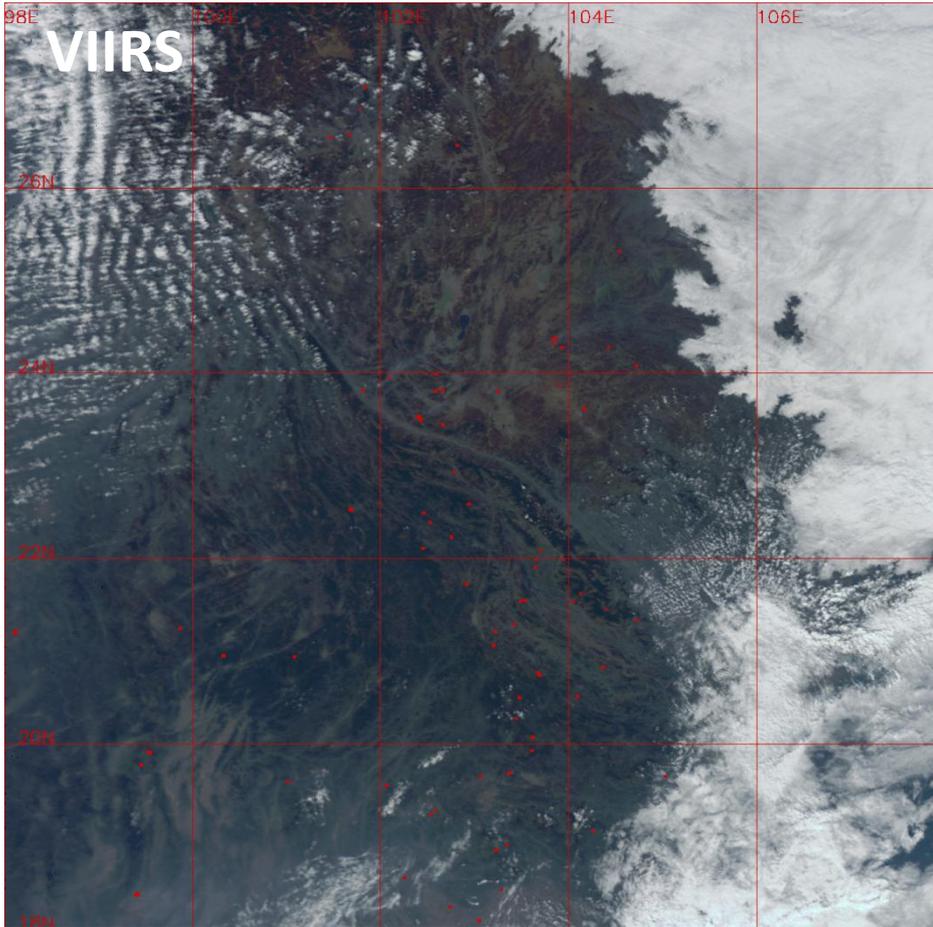


Jan 19 2012 06:15 UTC

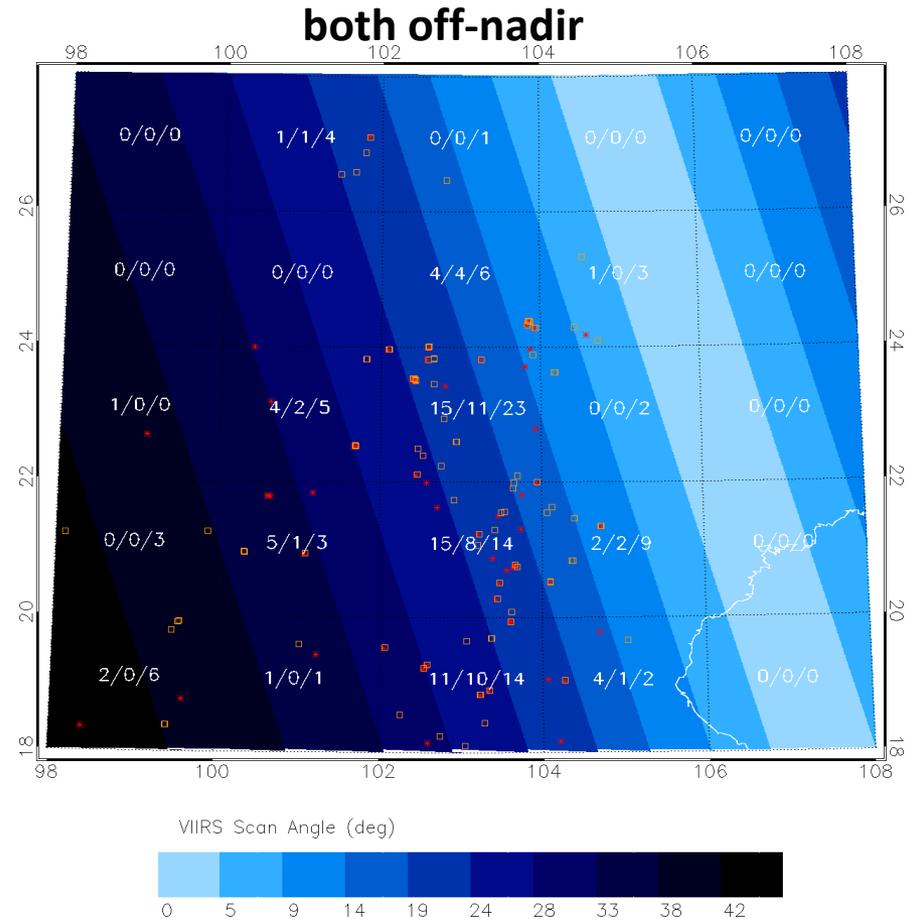


VIIRS/overlap/MODIS

South-East Asia

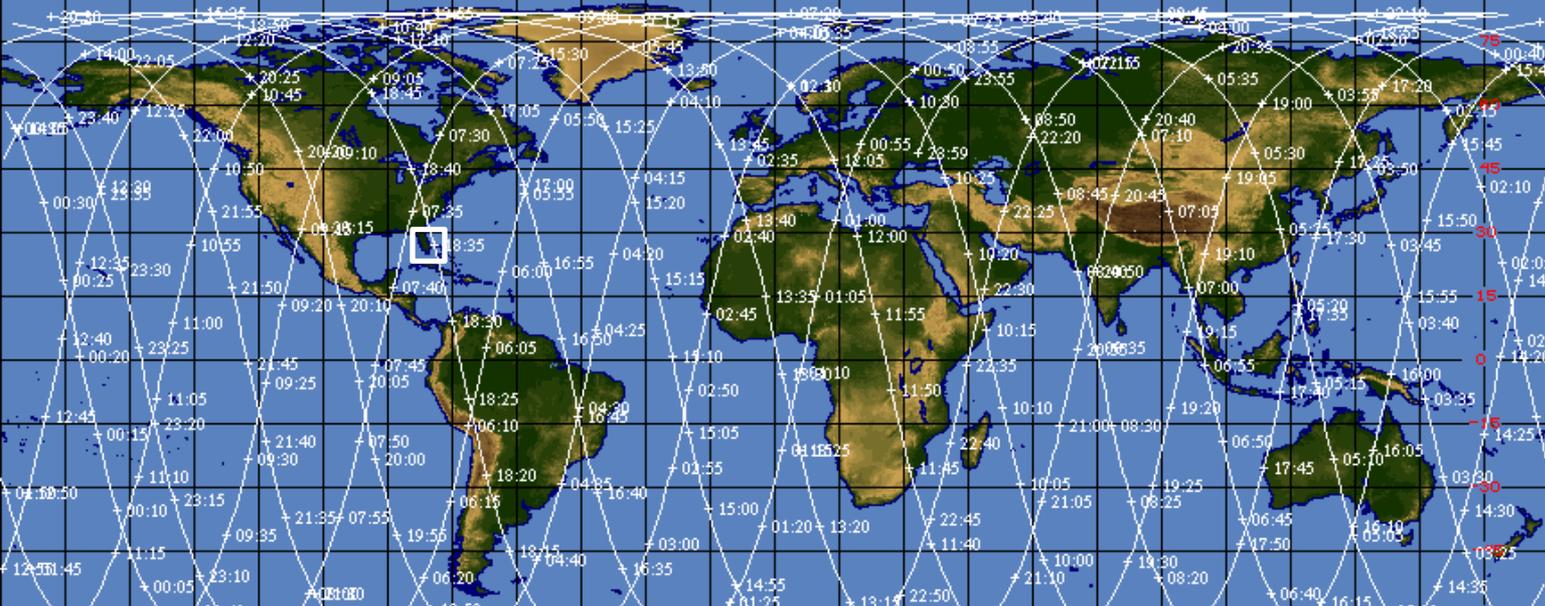


Jan 19 2012 05:57 UTC



VIIRS/overlap/MODIS

EPOCH=12019 18970871 --- UPDATED=2012021

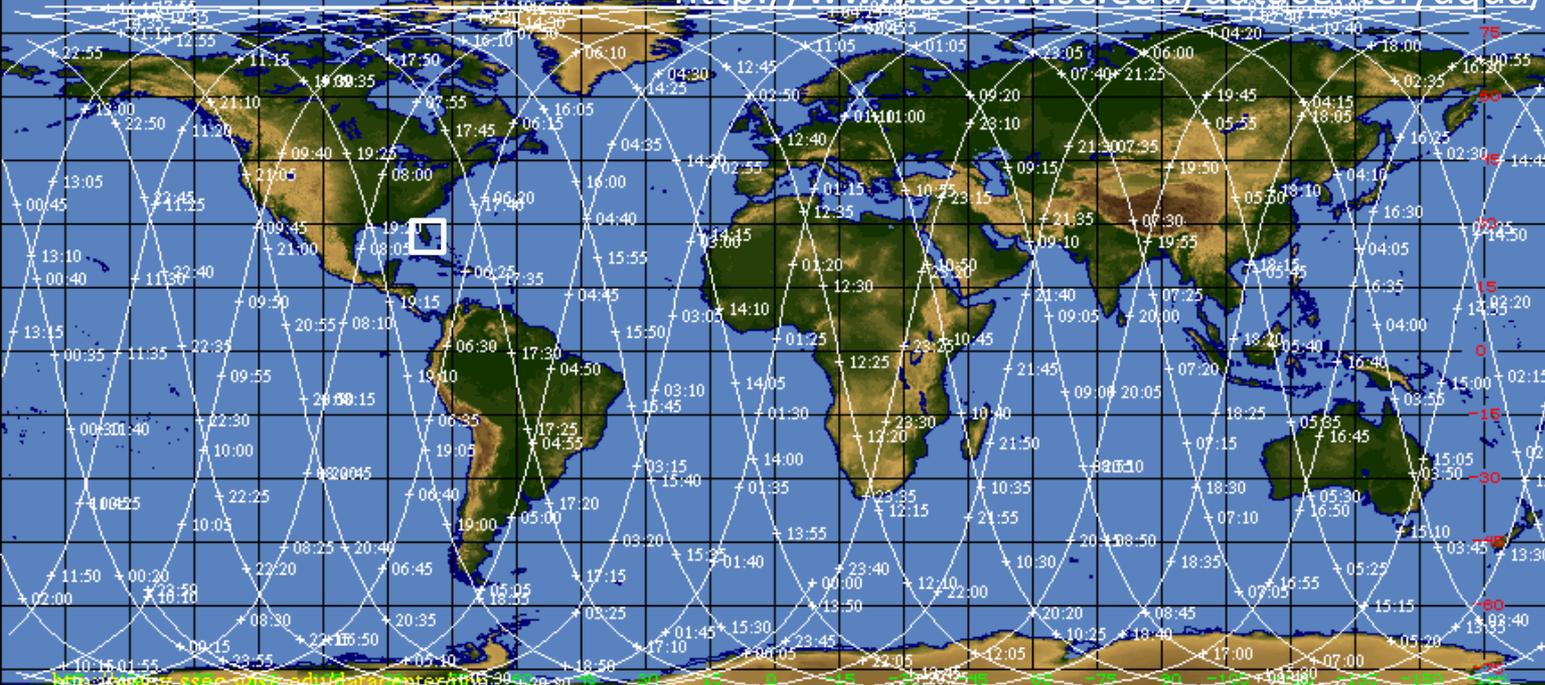


Aqua

Jan 20
2012

EPOCH=12019 88346194 --- UPDATED=2012021

<http://www.ssec.wisc.edu/datacenter/aqua/>

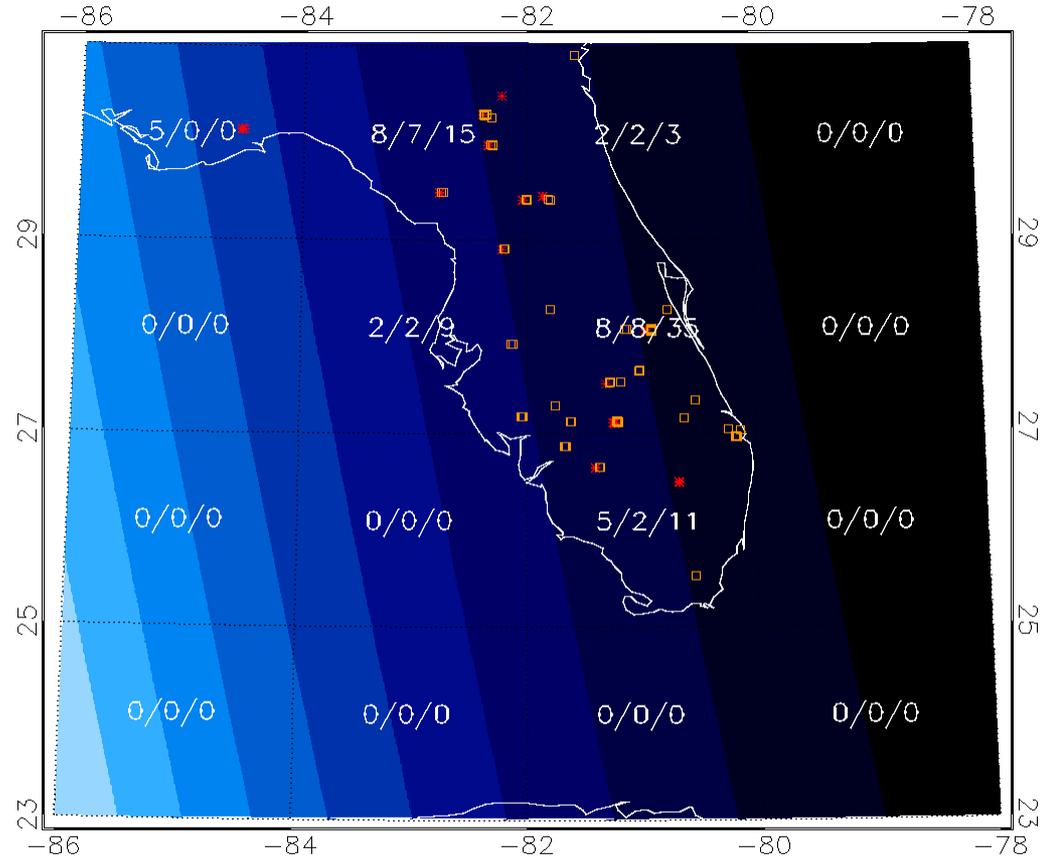
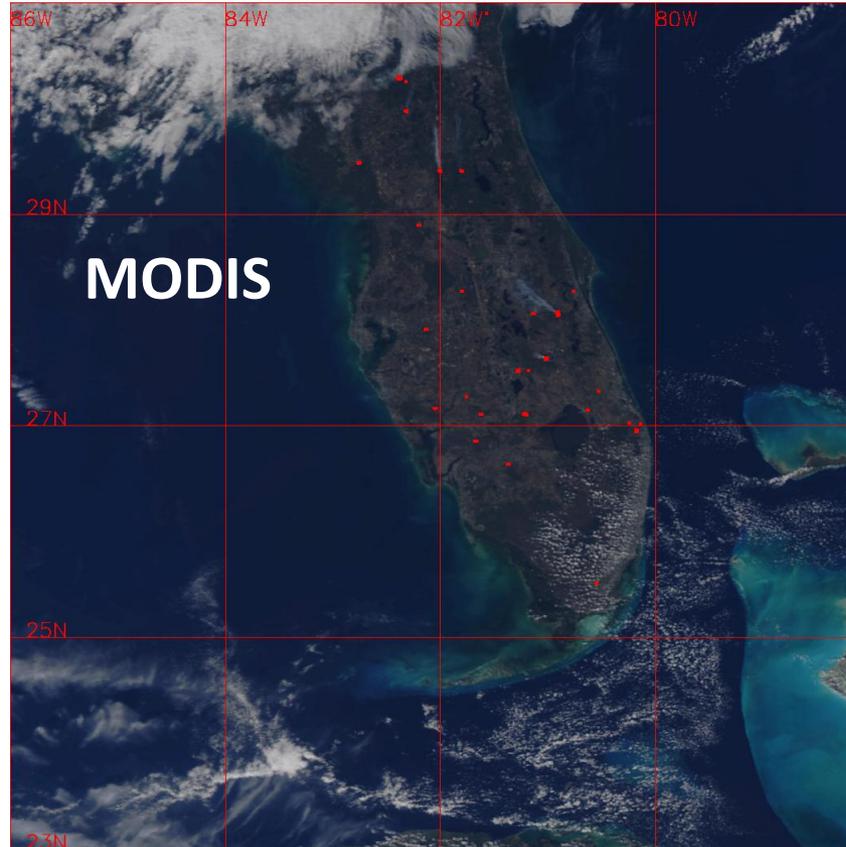


NPP

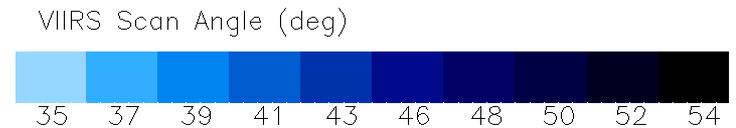
<http://www.ssec.wisc.edu/datacenter/npp/>

Florida

MODIS: near-nadir; VIIRS: off-nadir



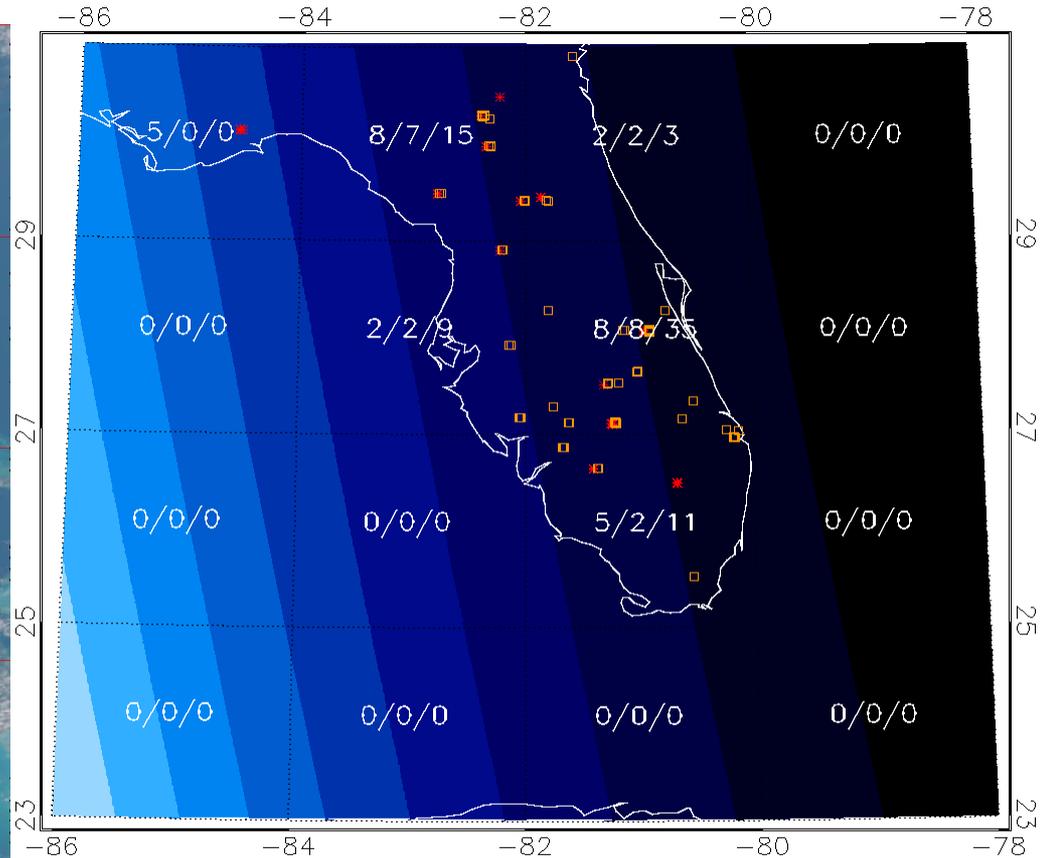
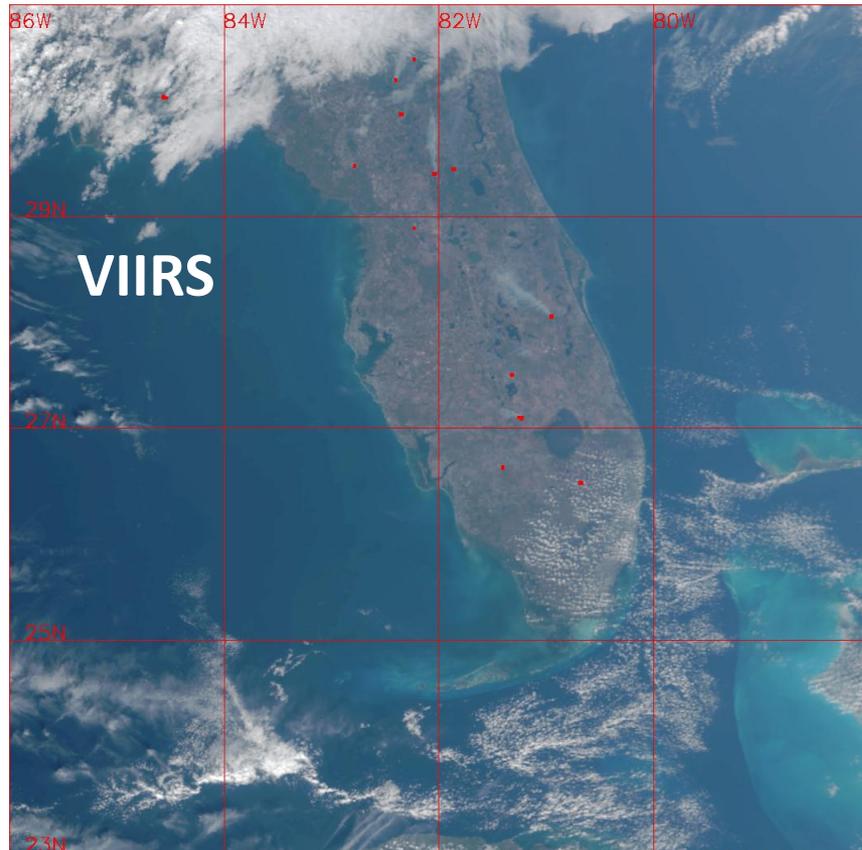
Jan 20 2012 18:33 UTC



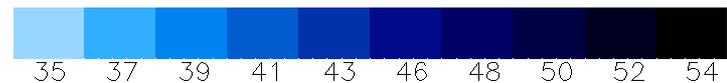
VIIRS/overlap/MODIS

Florida

MODIS: near-nadir; VIIRS: off-nadir



VIIRS Scan Angle (deg)



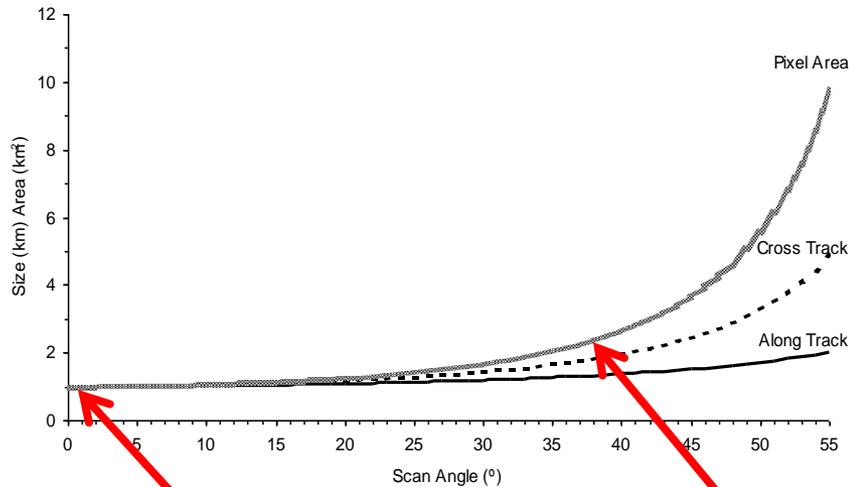
Jan 20 2012 19:15 UTC

VIIRS/overlap/MODIS

Truly compatible spatial sampling for MODIS-VIIRS comparison

- Simultaneous, compatible spatial sampling
 - SNO/SNOx type method for intercalibration
 - primarily driven by sample size
 - angular effects secondary, but potentially non-negligible, especially for off-nadir looks
- Matching swath segments with similar spatial sampling
- Advantage: allows for direct comparison of fire data
- Disadvantage: angular effects are not accounted for

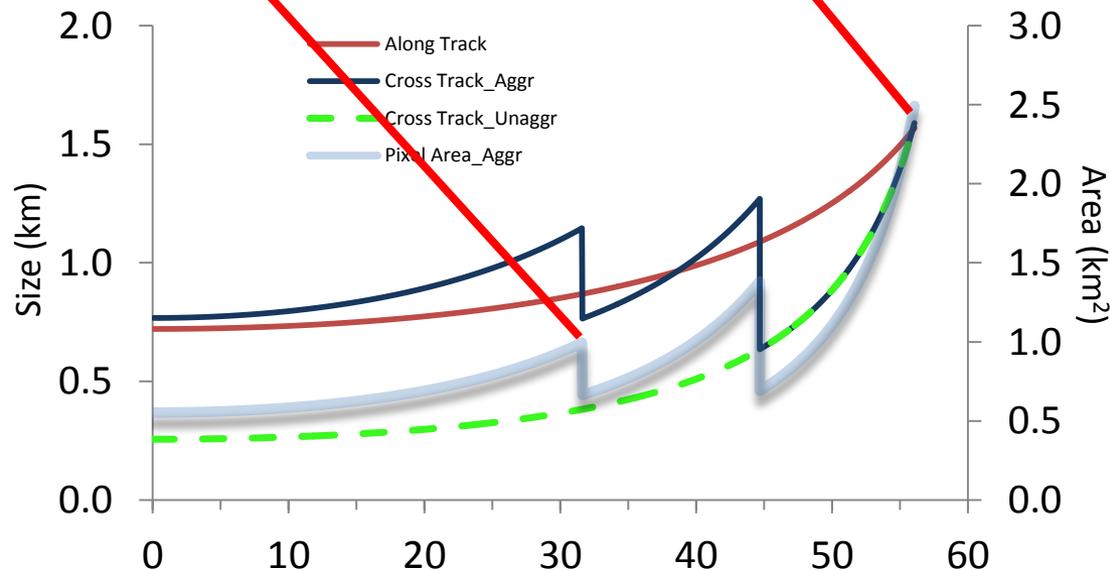
Compatible swath segments



In principle, it is possible to select swath segments with compatible sampling for direct intercomparison

Compatible cloud masks are crucial

(Need for spatially explicit land/water/cloud/fire mask in the VIIRS product!)



Possible scenarios - practicalities

1. Orbital/daily MODIS and VIIRS fire maps are compatible.

- Not crucial for operational users as long as VIIRS is comparable or superior to MODIS

2. Spatially and temporally aggregated fire statistics from MODIS and VIIRS are compatible.

- Useful for evaluating algorithm consistency, data continuity

3. MODIS and VIIRS provide compatible general patterns and trends of fire dynamics.

- Contingent upon the statistical population of fires
- Statistics can be derived from Landsat-class data
- Fire of interest – what is the desired lower limit?

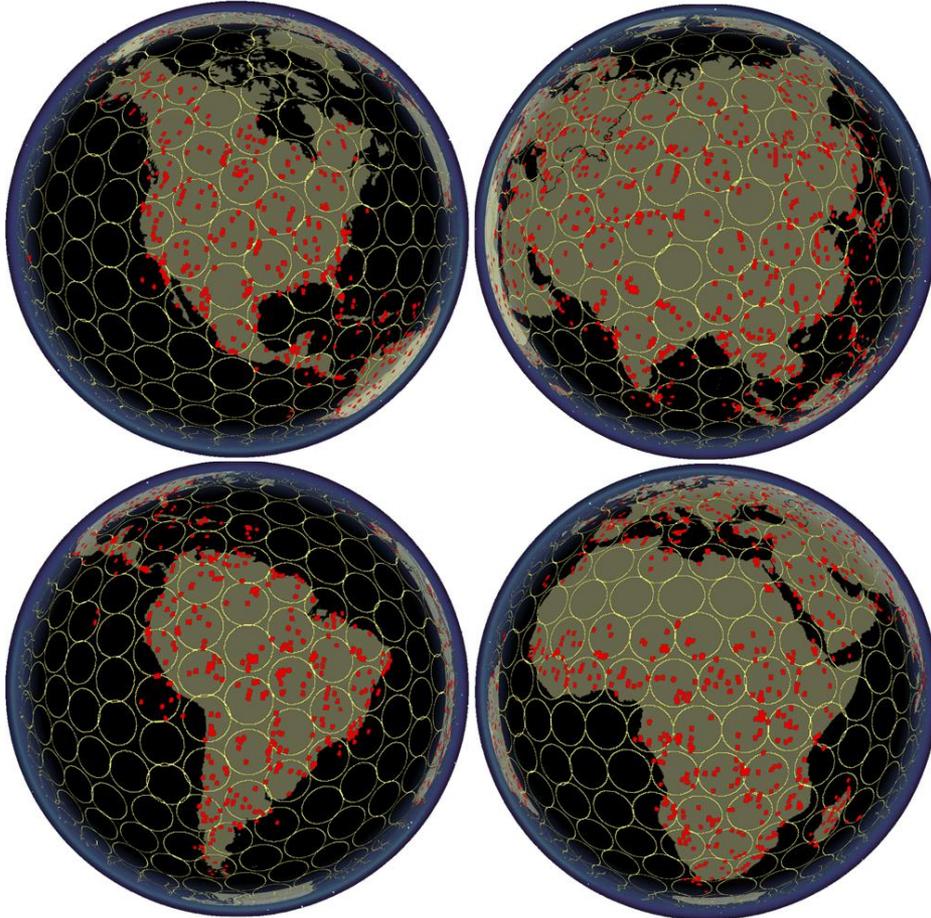
Explicit validation

Near-nadir pixels

(using ~2,500 coincident ASTER scenes)

17K MOD14 pixels sampled

120K MODIS pixels with 1+ ASTER fire pixel

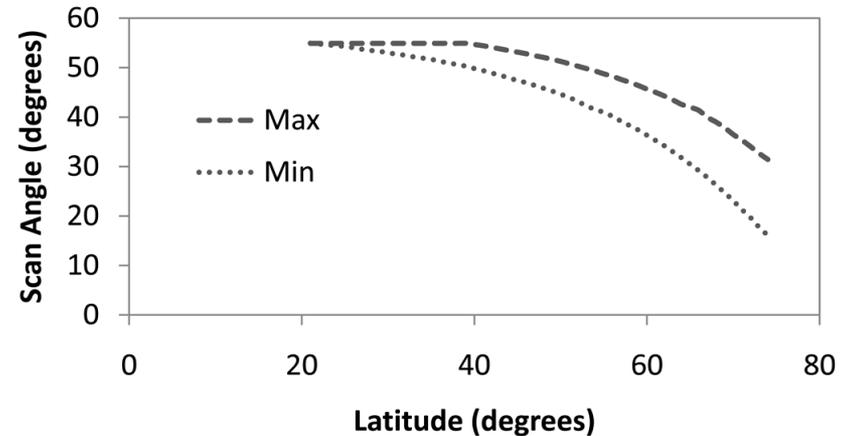
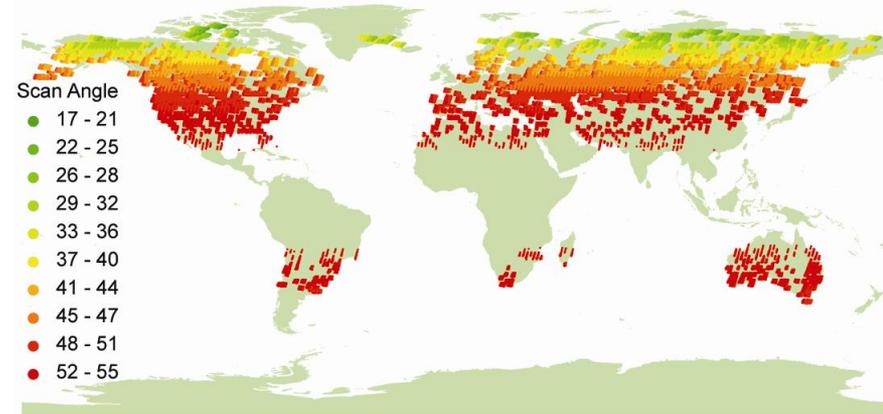


Off-nadir pixels

(using ~3,700 near-coincident TM scenes)

12K MOD14 pixels sampled

270K MODIS pixels with 1+ TM fire pixel



Explicit validation

Near-nadir pixels

(using ~2,500 coincident ASTER scenes)

ASTER 2001-2006

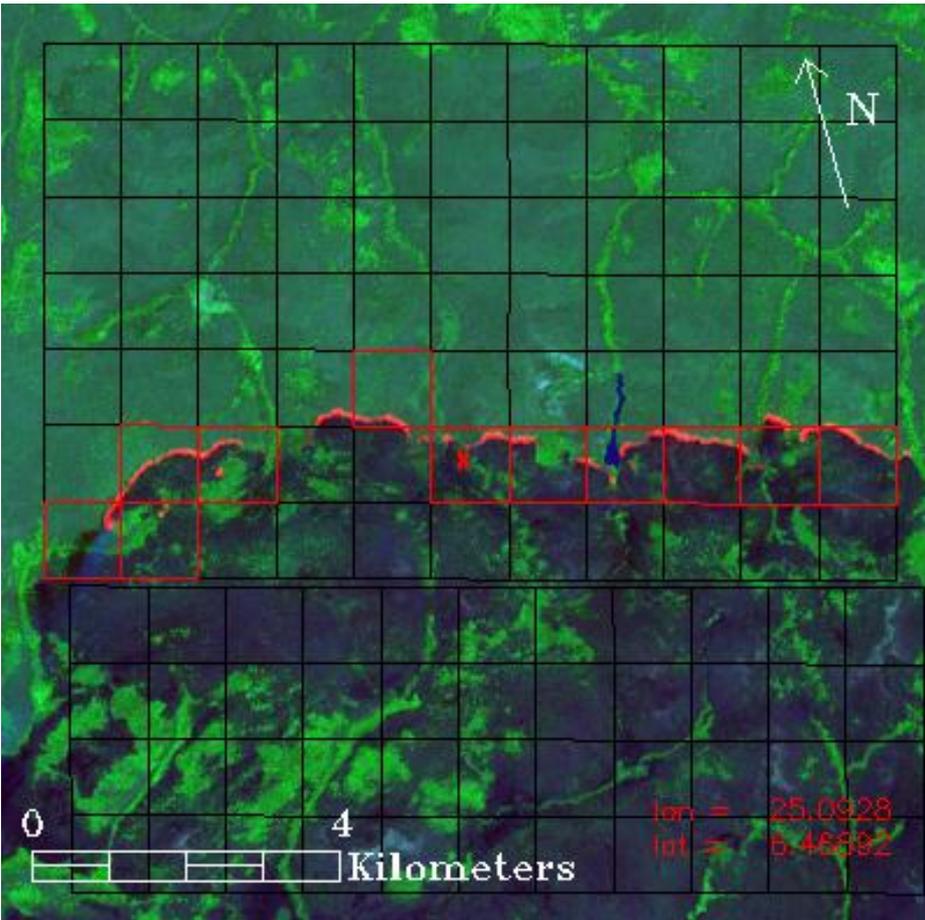
SWIR detector problem > May 2007

Off-nadir pixels

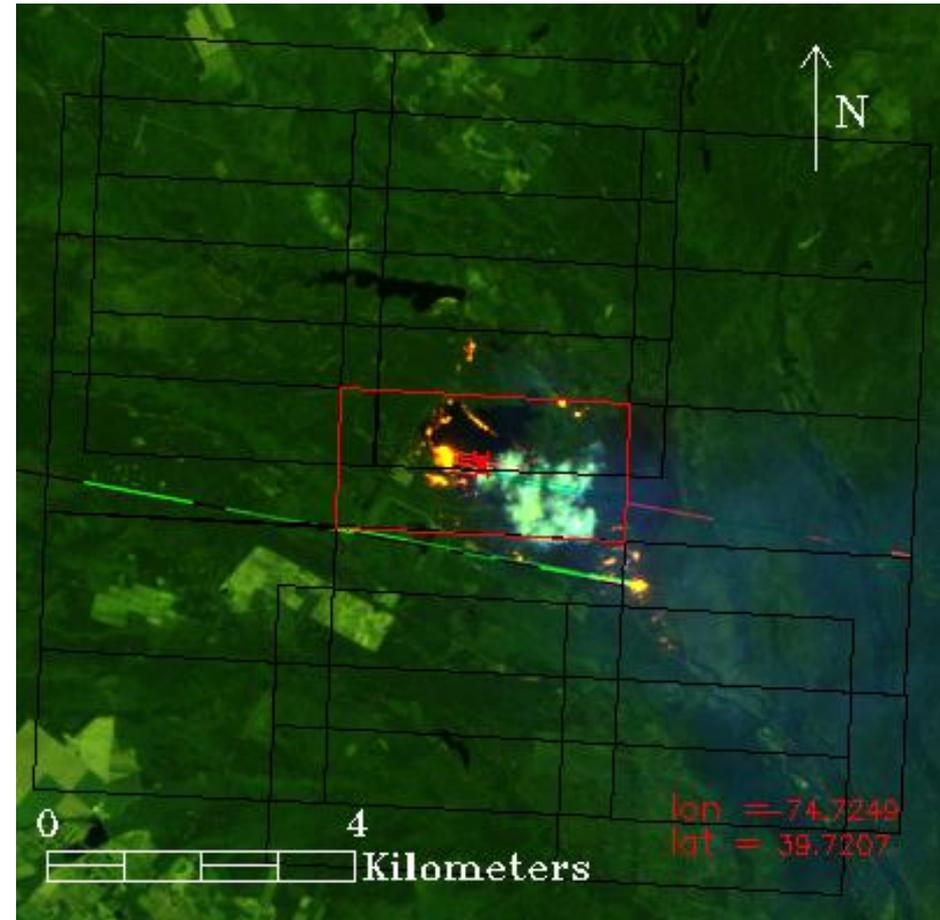
(using ~3,700 near-coincident TM scenes)

Landsat5 TM 2001-2010

Fire-related artifacts – saturation/bleeding



MODIS/ASTER 19 Jan 2006 0852UTC (near nadir)



MODIS/TM 04 Aug 2007 1533UTC (52° scan angle)

Explicit validation

Near-nadir pixels

(using ~2,500 coincident ASTER scenes)

ASTER 2001-2006

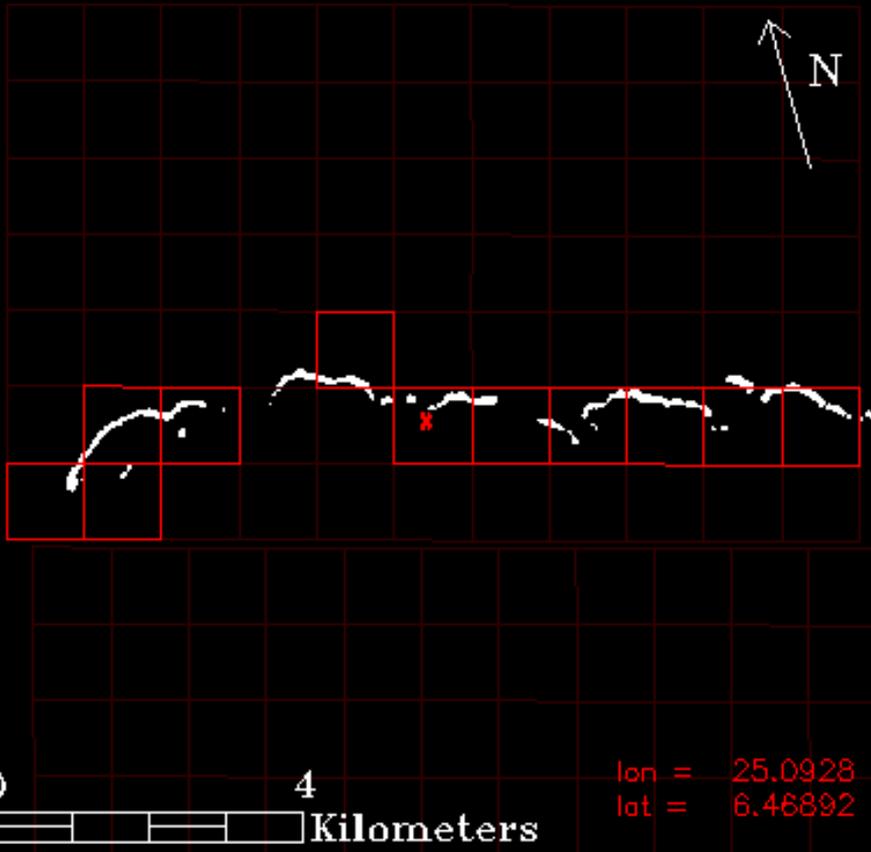
SWIR detector problem > May 2007

Off-nadir pixels

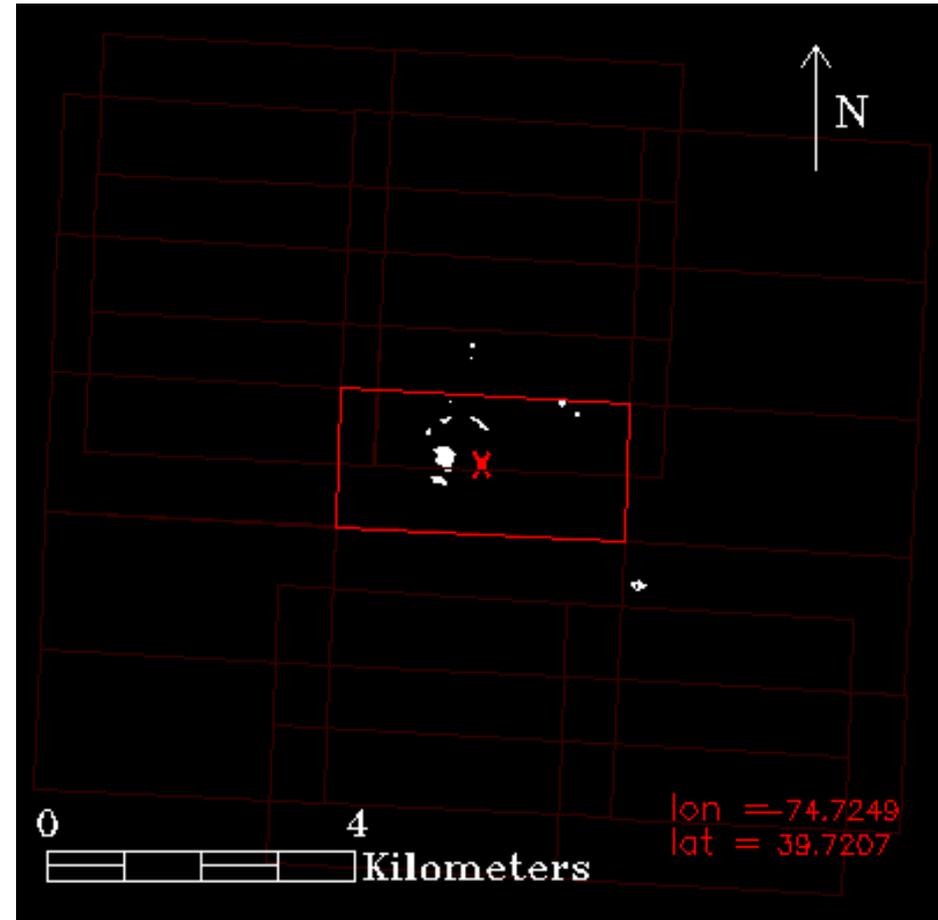
(using ~3,700 near-coincident TM scenes)

Landsat5 TM 2001-2010

Fire-related artifacts – saturation/bleeding



MODIS/ASTER 19 Jan 2006 0852UTC (near nadir)



MODIS/TM 04 Aug 2007 1533UTC (52° scan angle)

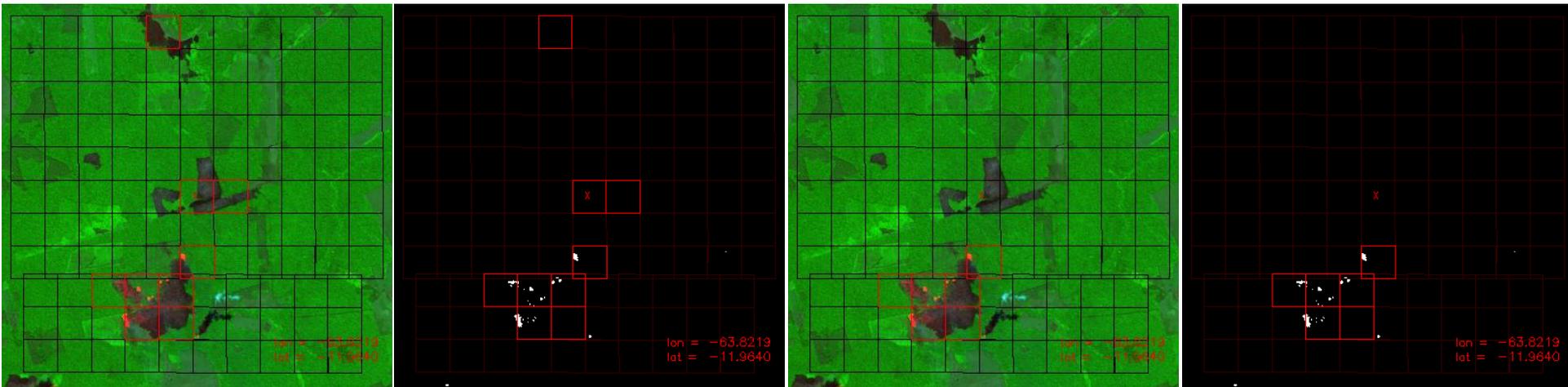
Algorithm continuity: MODIS Collection 6 updates

- Adaptive assignment of potential fire thresholds to better capture small, cool fires and reduce false alarms occurring in hot, arid environments;
- A new rejection test to eliminate persistent false alarms caused by small clearings within Amazonian rainforest
- Extended processing to water pixels to facilitate monitoring of offshore gas flaring
- Improvements to the internal cloud mask to eliminate occasional misclassification of snow and desert as cloud.

Algorithm continuity: MODIS Collection 6 updates

MODIS Collection 5 (and 4)

MODIS Collection 6



True fire detections and false alarms from Terra MODIS over a small-scale cleared area in the Amazon on August 27, 2001, as detected by the MODIS Collection 5 and 6 algorithms. The MODIS Collection 6 algorithm removed the false alarms.

Summary and conclusions

- Initial assessment of the NPP VIIRS fire product is encouraging
- True statistical comparison is possible using proper matching of similar sampling conditions
- Implementation of new MODIS algorithm components and sensor-specific tuning are necessary
- Need for spatially explicit fire mask and Fire Radiative Power in the VIIRS product
- Explicit validation is crucial
- Continuity of the MODIS Climate Modeling Grid (CMG) product is necessary for long-term and large-scale monitoring