Nighttime VIIRS Processing at NOAA/NCEI/EOG

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EOG Nighttime VIIRS Product Lines

Earth Observation Group Nighttime VIIRS Product Generation System

GRAVITE
~2 hour latency

DNB and I bands
Data volume = 250GB/day

VIIRS Boat Detection (VBD)
- Detects offshore DNB spikes
- Four hour latency

Output csv and kmz posted at NCEI web site
http://www.ngdc.noaa.gov/eog/viirs/download_total_boat.html

Email alert service for detections in Marine Protected Areas, fishery closures and restricted waters.

US Ground Stations
~30 minute latency

DNB and M bands
Data volume = 25GB/day

- VIIRS NightFire (VNF)
- Geolocated DNB mosaics
- for North America with ~1hr latency

Output VNF csv and kmz files and DNB geotiffs posted at NCEI web site.
http://www.ngdc.noaa.gov/eog/index.html

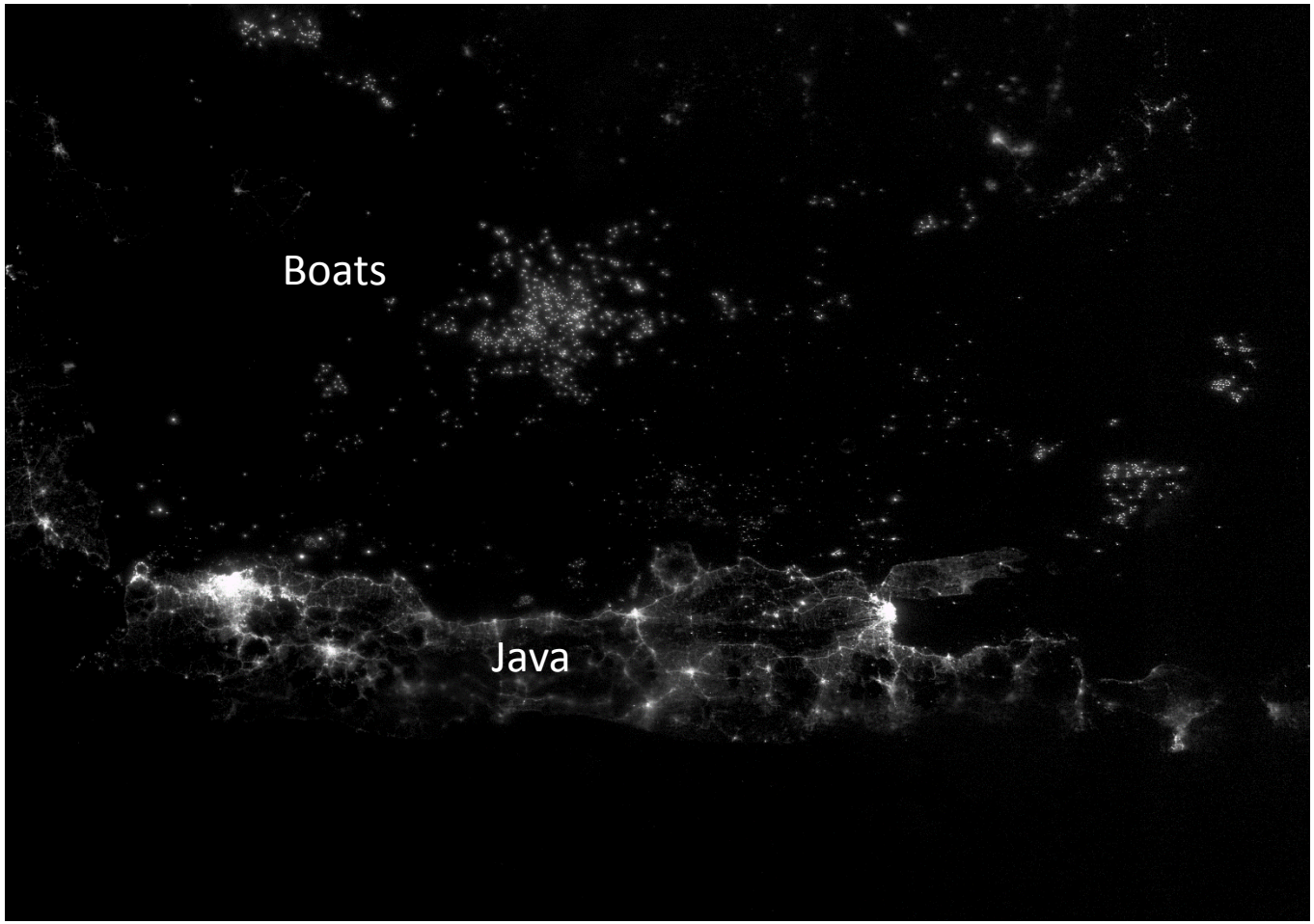
CLASS
~7 hour latency

DNB and M bands
Viirs Cloud Mask
Data volume = 100GB/day

- Nightly global VIIRS NightFire (VNF)
- Monthly DNB cloud-free composites
- Geoloated DNB nightly mosaics

Output VNF csv and kmz files and DNB geotiffs posted at NCEI web site.
http://www.ngdc.noaa.gov/eog/viirs/download_ut_mos.html
http://www.ngdc.noaa.gov/eog/viirs/download_monthly.html
http://www.ngdc.noaa.gov/eog/viirs/download_viirs_fire.html

VIIRS Boat Detection (VBD) Product



Java Sea, Indonesia September 28, 2014

- The Visible Infrared Imaging Radiometer suite has a unique capability to detect lights at the earth's surface. This includes heavily lit boats.

- NCEI has been working on algorithms for reporting boat detections since September 2014.

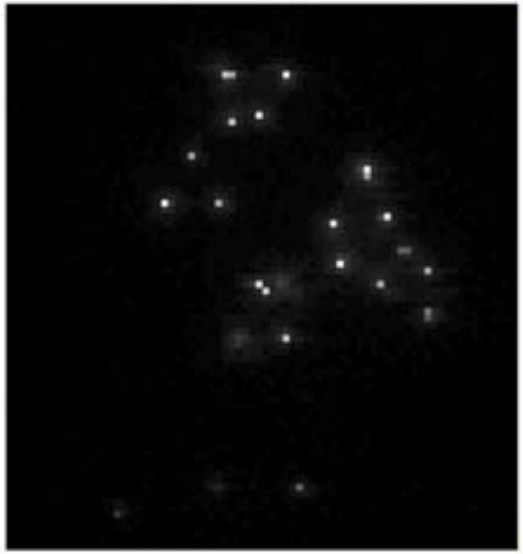
- Supported by the JPSS program office and USAID.

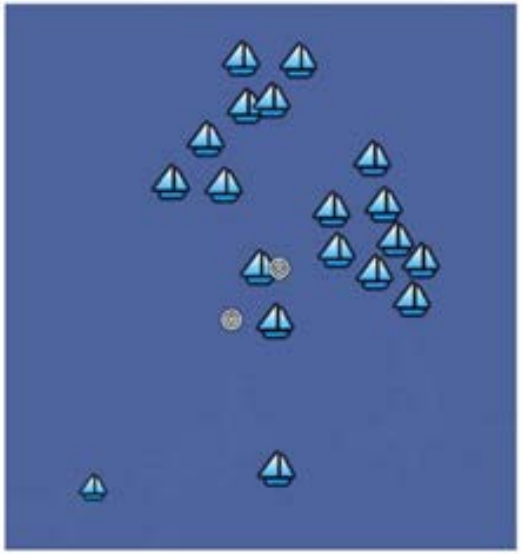
- Files available by 06:00 local time.

VIIRS Boat Detection (VBD) Product

VIIRS day/night band (DNB) nighttime image data

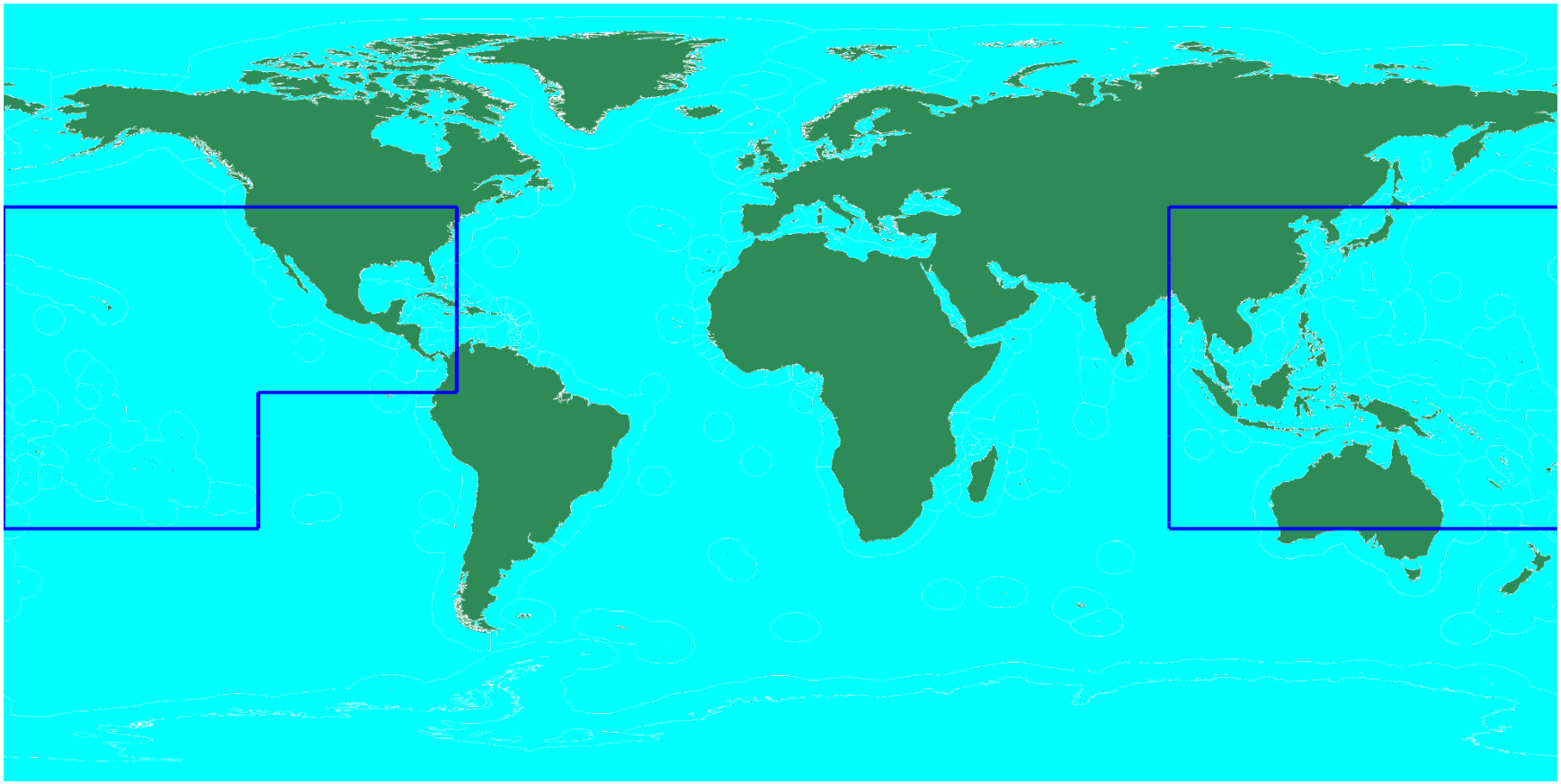
Boat detection data (points)





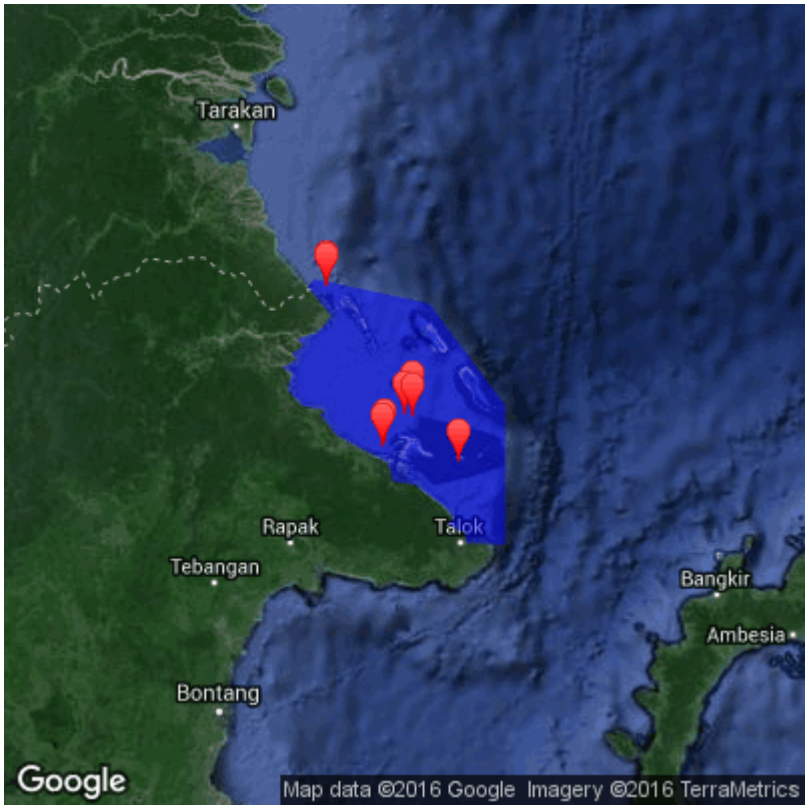
VBD algorithms run on DNB/I5 SDR files, output points, vast data volume reduction

Current VBD Processing Area



VBD alert service example for an Indonesian MPA

Derawan Marine Conservation Area



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1 / 8
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Latitude: 2.456135
Longitude: 118.069016
Color: red
Quality flag= 2 (Medium)

+===
2 / 8
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+===
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Longitude: 118.382790
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Quality flag= 1 (Strong)

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Quality flag= 1 (Strong)

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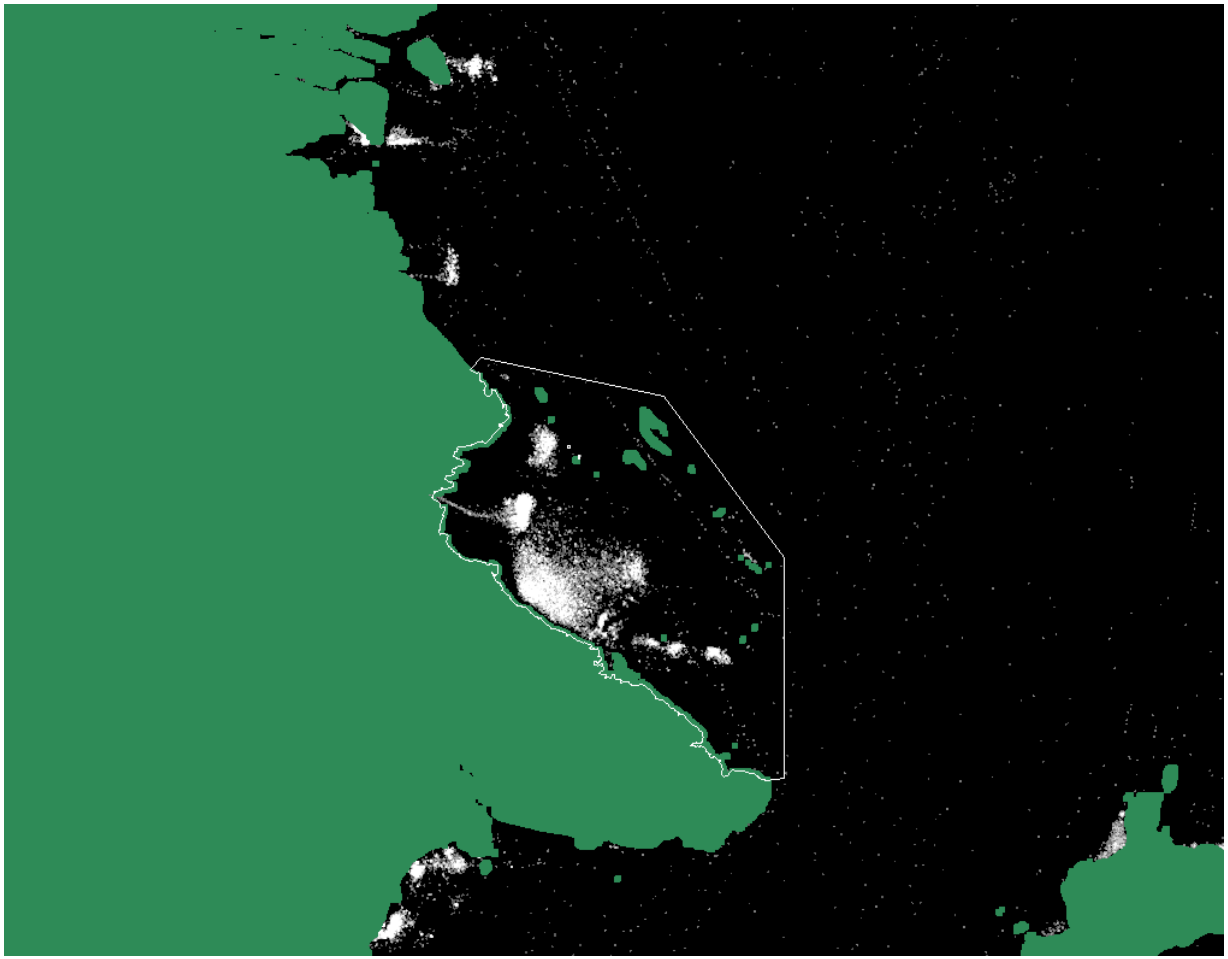
Annual VBD summary grids reveal spatial patterns of fishing boat activity



Derawan Marine Conservation Area

25 Countries Show Clusters of VIIRS Boat Detections

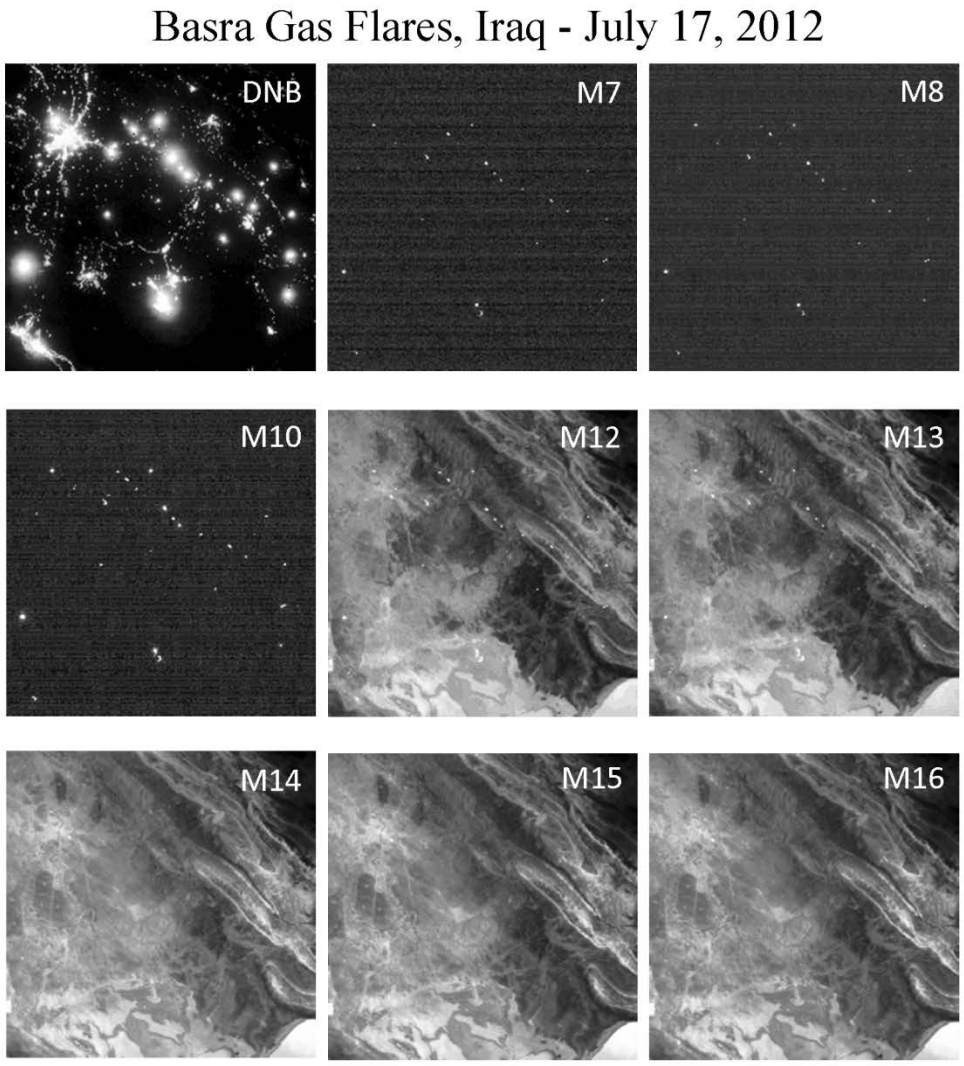
- **Asia:** Russia, Japan, Korea, China, China Taipei, Vietnam, Cambodia, Thailand, Myanmar, Malaysia, Indonesia, Philippines, India
- **Oceania:** Australia, New Zealand, Papua New Guinea
- **Europe, Middle East and Africa:** Egypt, United Arab Emirates, Iran, Oman, South Africa, Malta
- **Americas:** Argentina, Peru, Ecuador

Current VBD Products/Services

- Nightly VBD files for Asia and Pacific available at: http://www.ngdc.noaa.gov/eog/viirs/download_boat.html
- Country level products are running for: Indonesia, Philippines, Thailand-Cambodia, Vietnam, Fiji, Papua New Guinea, Guam.
- Email alert services for:
  - 86 MPAs in Indonesia
  - Four seasonal fishery closures in the Philippines
  - Restricted municipal waters (out 15 km from shore) in the Philippines. Commercial fishing boats are banned from this zone.

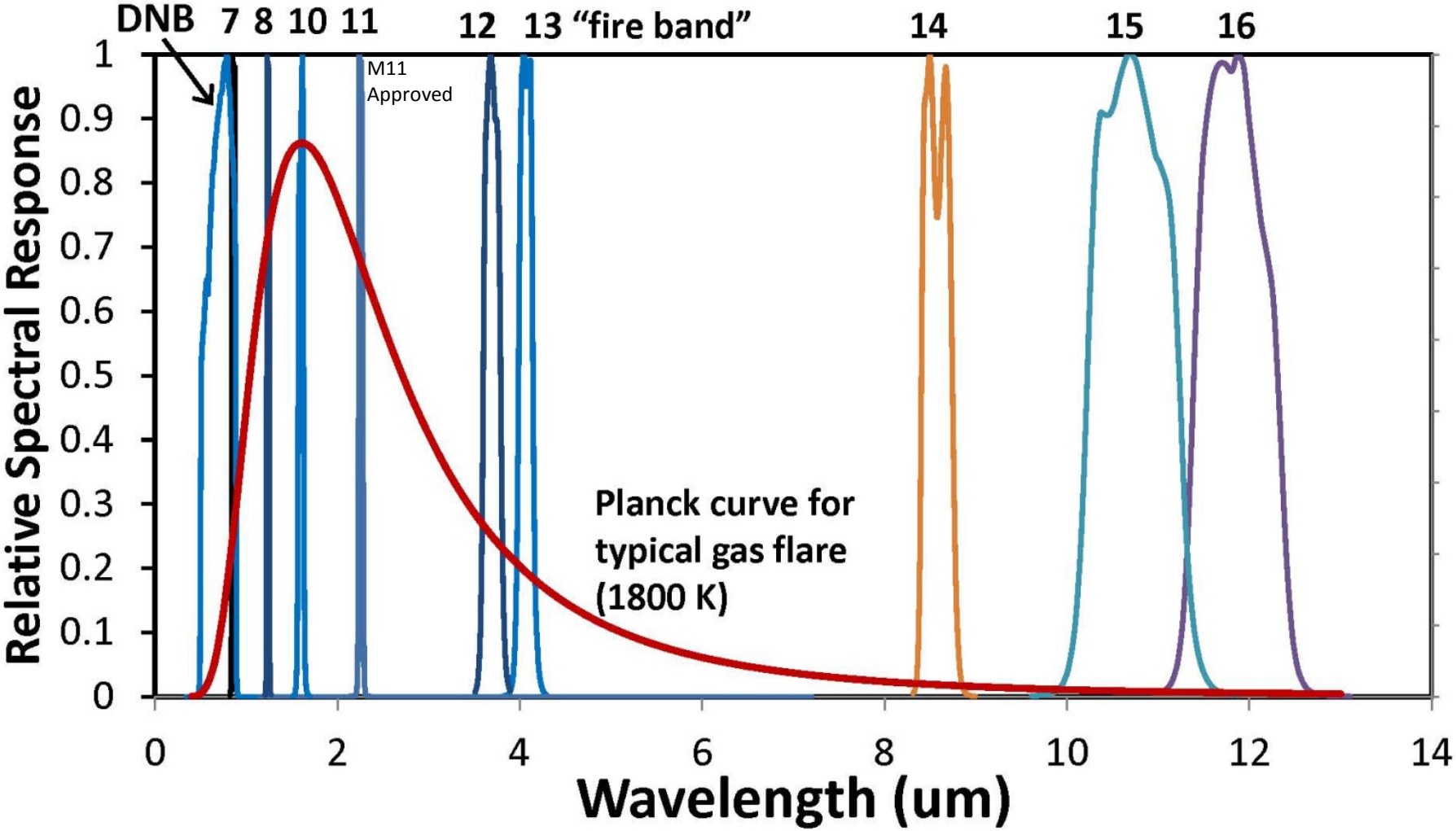
VIIRS Nightfire (VNF)

- A multispectral “fire product” developed by the NOAA Earth Observation Group.
- Makes use of two near infrared (NIR), a short-wave infrared (SWIR), two mid-wave and three long-wave infrared bands.
- The NIR and SWIR bands were designed for daytime imaging of reflected sunlight. IR emitters can be readily identified at night in these spectral bands.
- Daily files are in csv and kmz formats available at: http://ngdc.noaa.gov/eog/viirs/download_viirs_fire.html
- Publications: http://www.mdpi.com/2072-4292/5/9/4423 http://www.mdpi.com/1996-1073/9/1/14



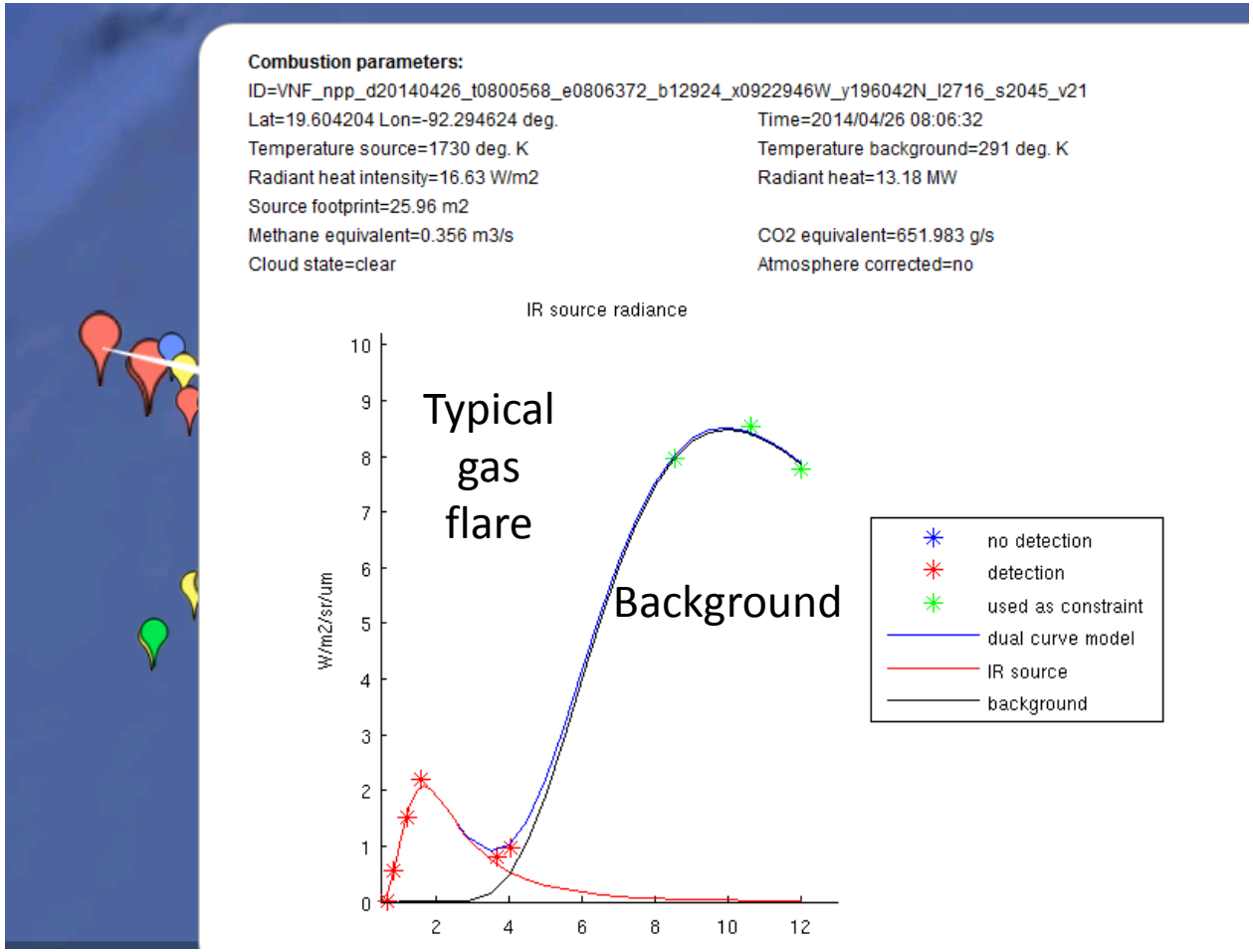
Gas flares are readily detected in the VIIRS M10 spectral band

VIIRS Nightfire (VNF): A global multispectral fire product
Nine channels of data are collected at night



Nighttime collection of channel 11 is expected to start in 2016

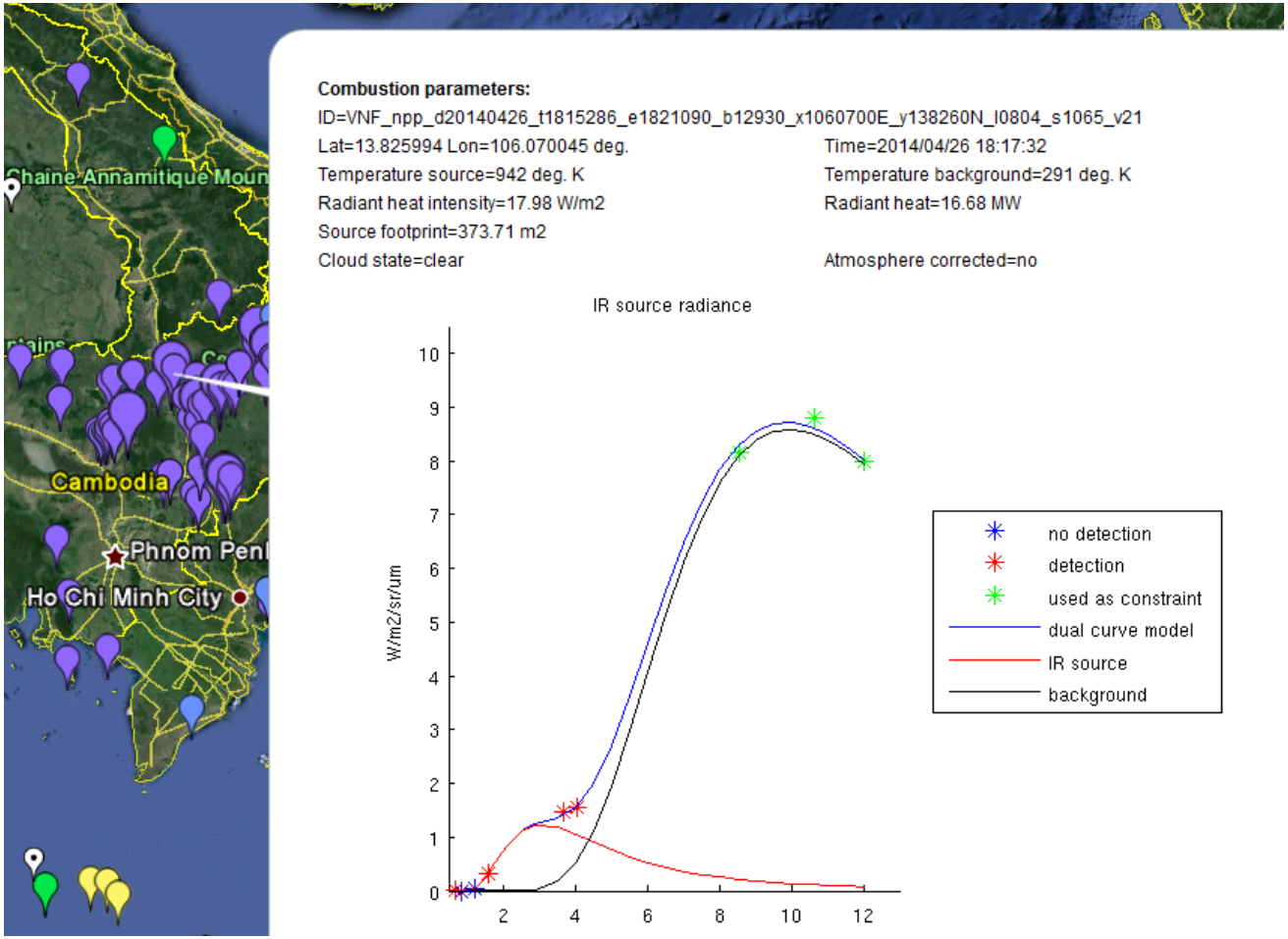
VNF Gas Flare Detection



Planck curve fitting is used to estimate temperature, source size and radiant heat.

Daily files are in csv and kmz formats

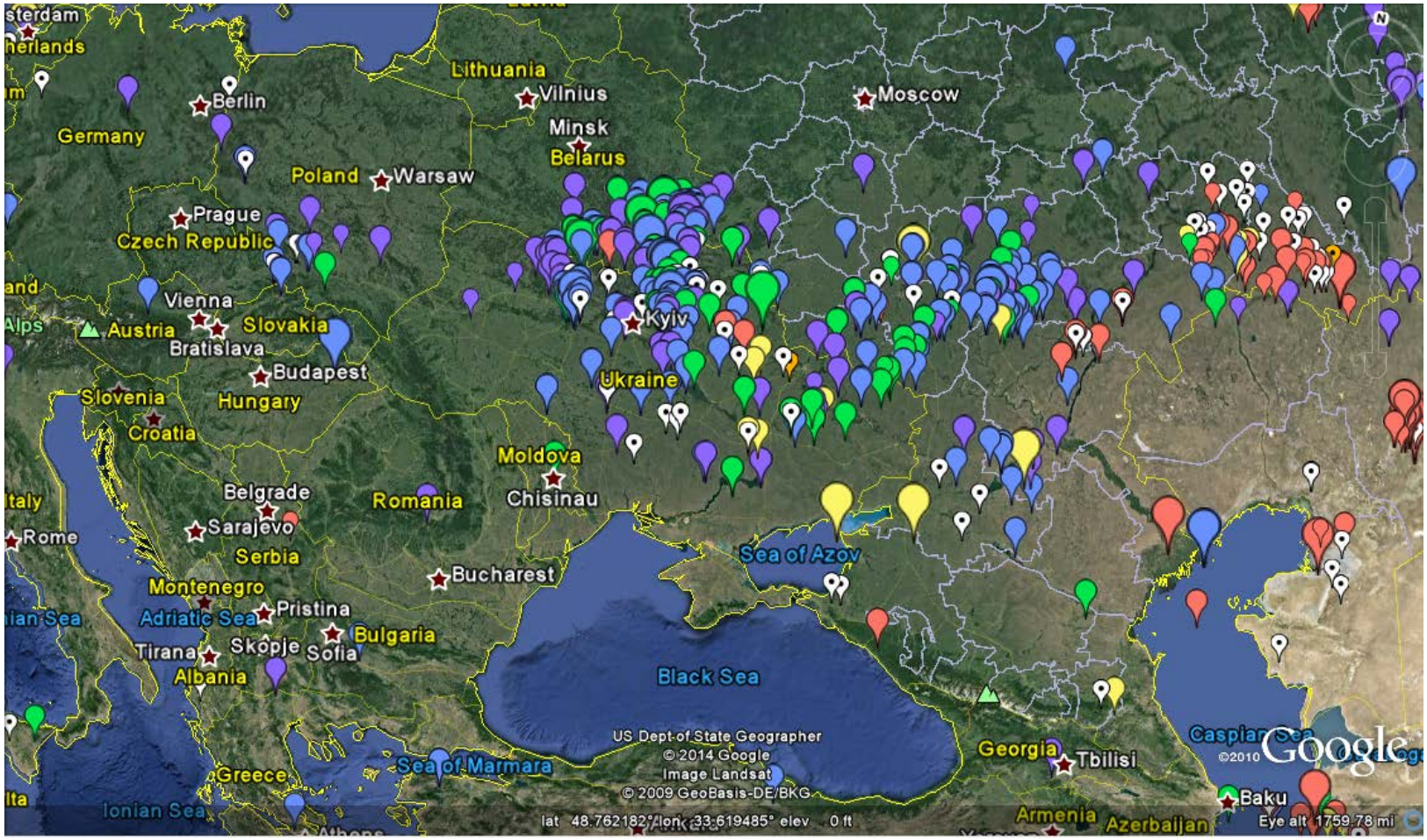
VNF Biomass Burning Detection



Lower temperature than gas flaring. Often these have larger source size than gas flares.

Daily VNF data are available at:

http://ngdc.noaa.gov/eog/viirs/download_viirs_fire.html



Current global processing typically runs with a nine hour delay. This will reduce to a 4 hour latency when M-bands are available through GRAVITE.

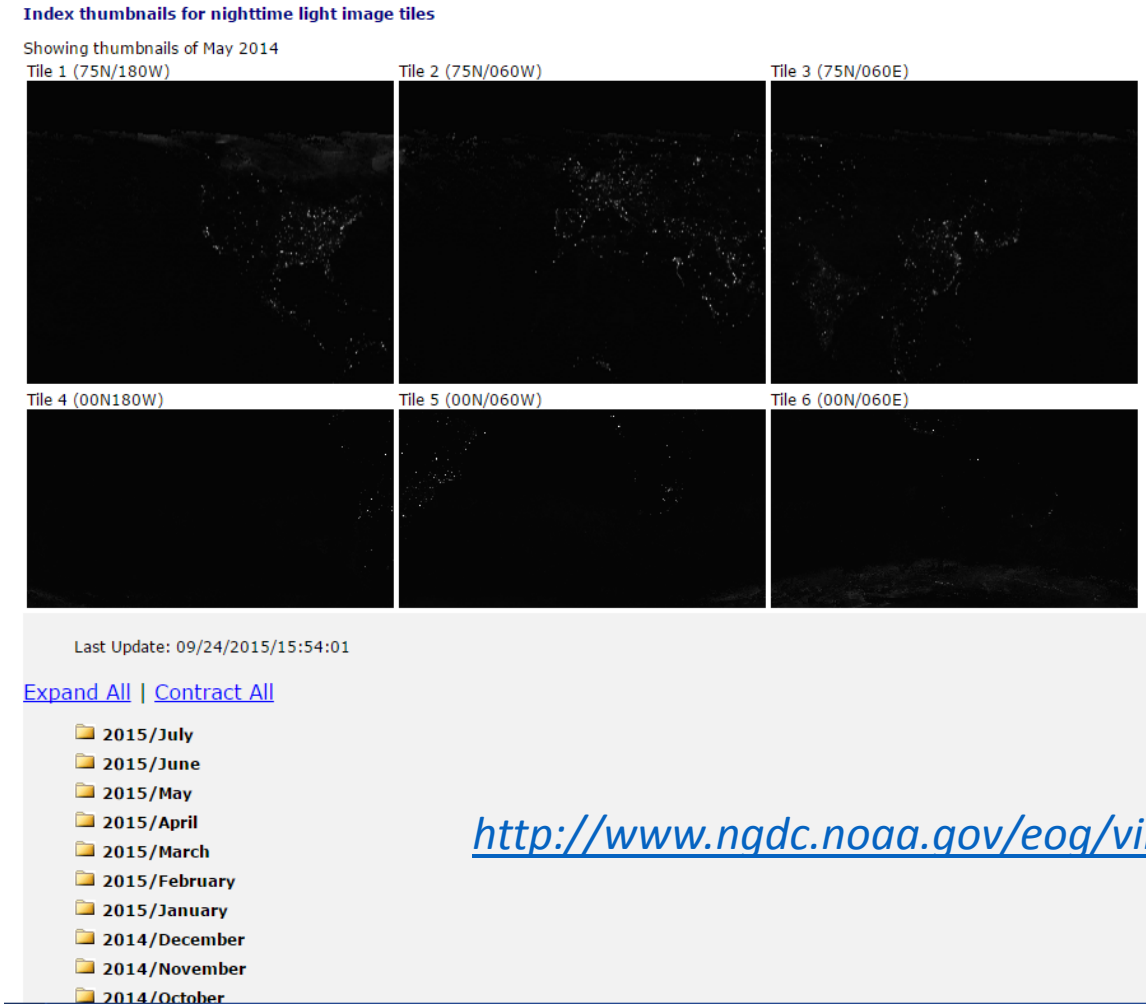
Nighttime Lights Composites

- A nighttime lights composite is made to serve as a baseline of persistent light sources.
- Composites are made as an average of the highest quality nighttime lights imagery over desired time period – usually monthly or annually.
- “Stable Lights” composites have ephemeral light sources and non-light (background) areas are removed from a composite.
- EOG group is producing current monthly cloud-free/no-moon DNB nighttime lights composites and is doing algorithm development to turn these in to Stable Lights composites.

Nighttime Lights Composites
What goes in?

- Only the “highest quality” nighttime data gets averaged into a composite
- Currently this is defined as DNB data that is:
  - Cloud-free (using the VIIRS cloud-mask (VCM) product)
  - Nighttime with solar zenith angles greater than 101
  - Not affected by moonlight (lunar illuminance < 0.0005 lux)
  - Middle of swath (DNB has increased noise at edge of scan)
  - Free of lights from lightning
  - Free of “lights” from South Atlantic Anomaly

Nighttime Lights Composites
(Monthly DNB Products)



- Monthly DNB nighttime lights composites are available online
- Globe is cut into 6 tiles to reduce individual file sizes
- These products still contain ephemeral lights and non-lights (background).

http://www.ngdc.noaa.gov/eog/viirs/download_monthly.html

VIIRS Nighttime Lights Composite – 2015/01

Excluding Stray Light Corrected Areas

VIIRS Nighttime Lights Composite – 2015/01

Including Stray Light Corrected Areas

Questions?

Backup Slides

Superlights

Boats operating with large number of bare high intensity lights

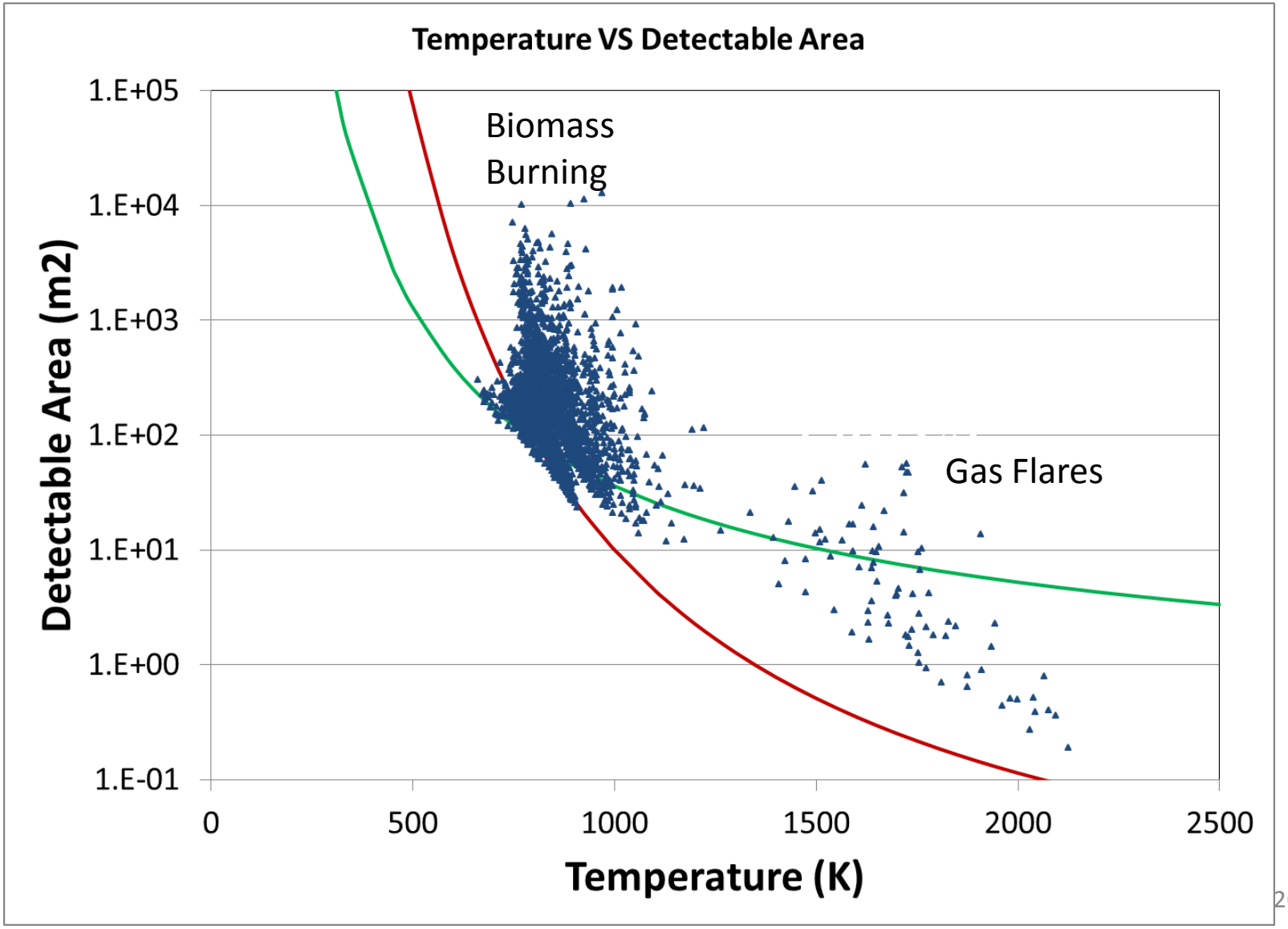
Superlights

Strings of 1500 Watt metal halide bulbs

30-80 bulbs are common - 45,000 to 120,000 Watts of bare bulbs on individual boats!

Detection Limits

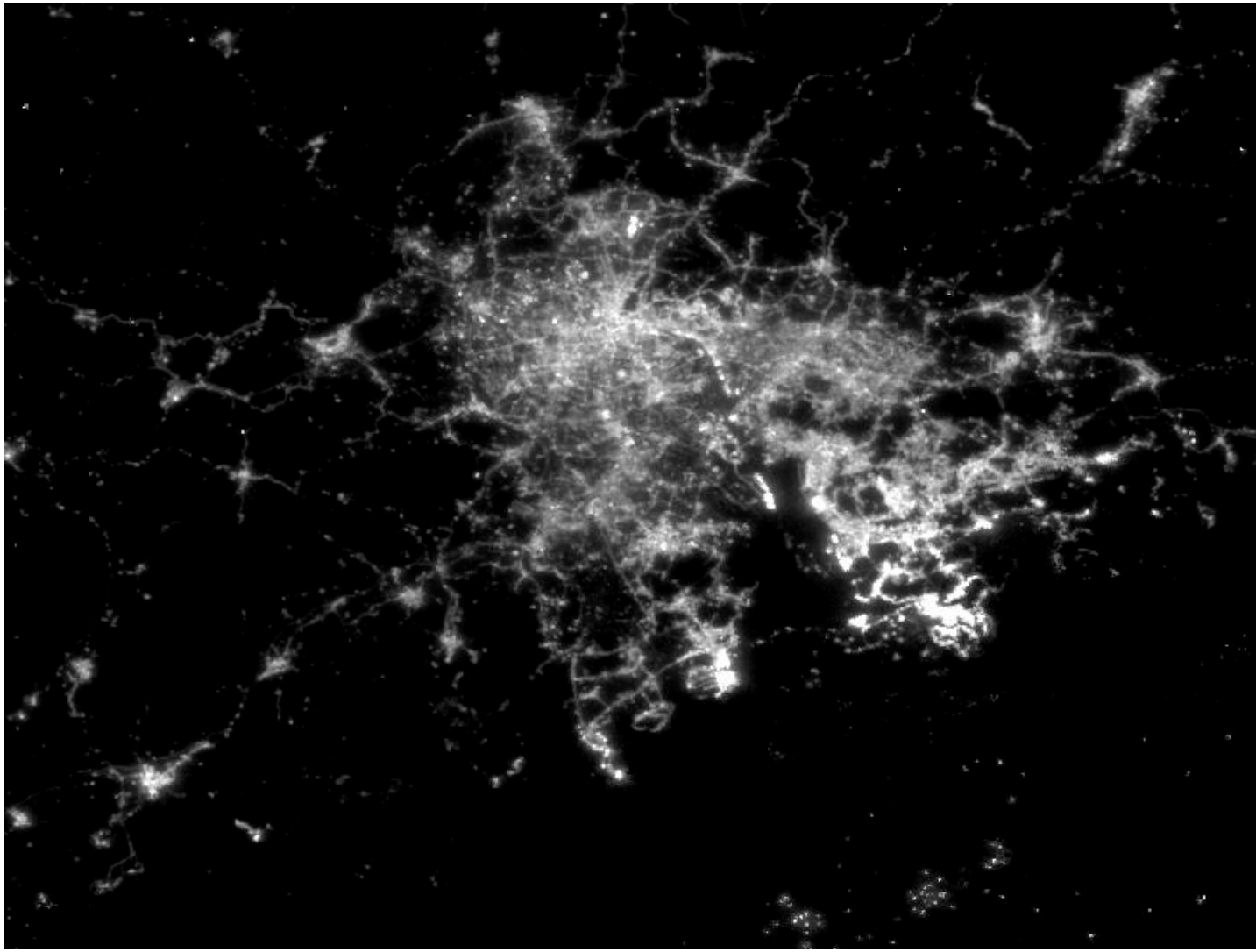
At 1800 K flares as small as 0.25 m^2 are detectable



VIIRS Nighttime Lights Composite

October 2014

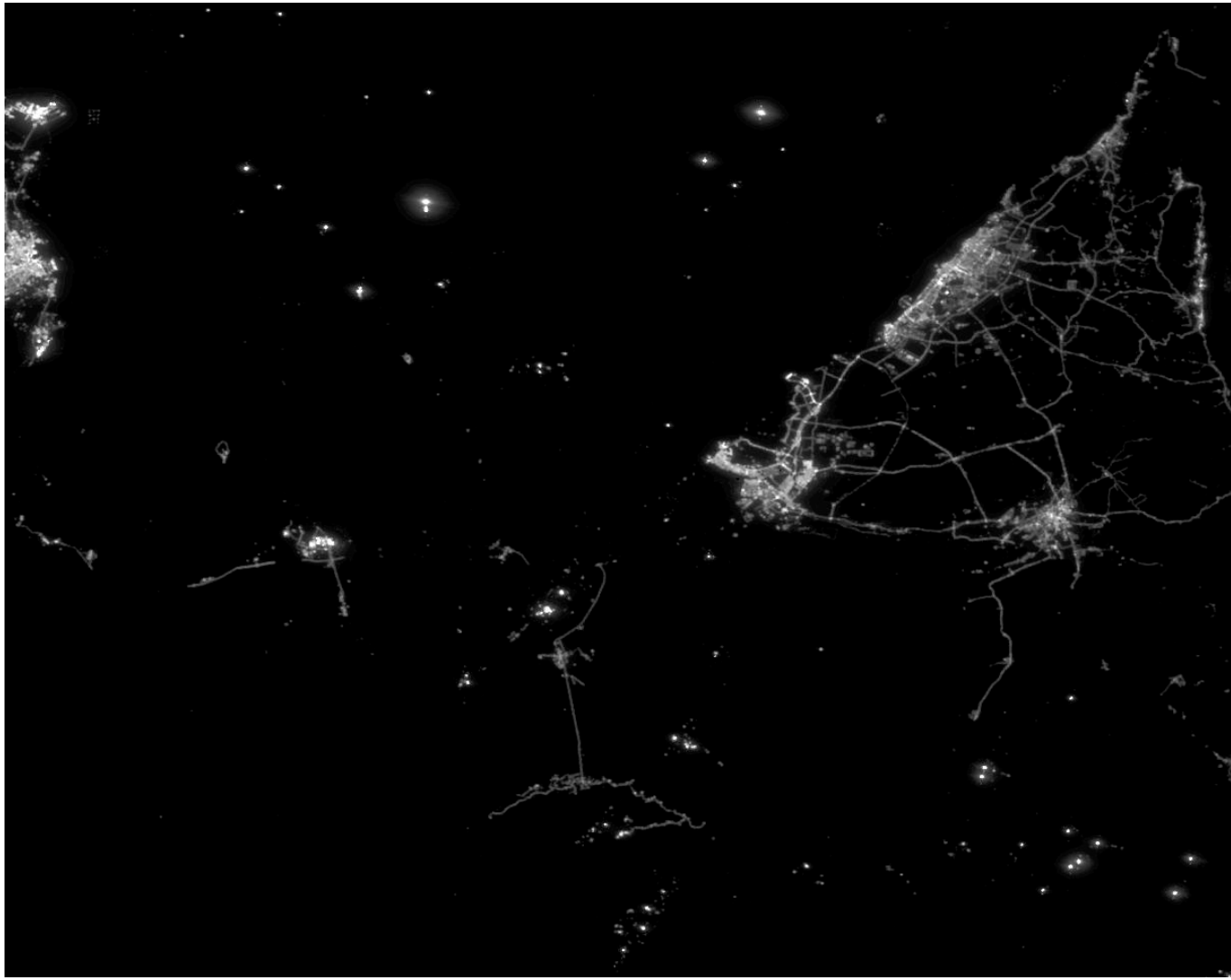
Hong Kong



VIIRS Nighttime Lights Composite

October 2014

United Arab Emirates



VIIRS Nighttime Lights Composite

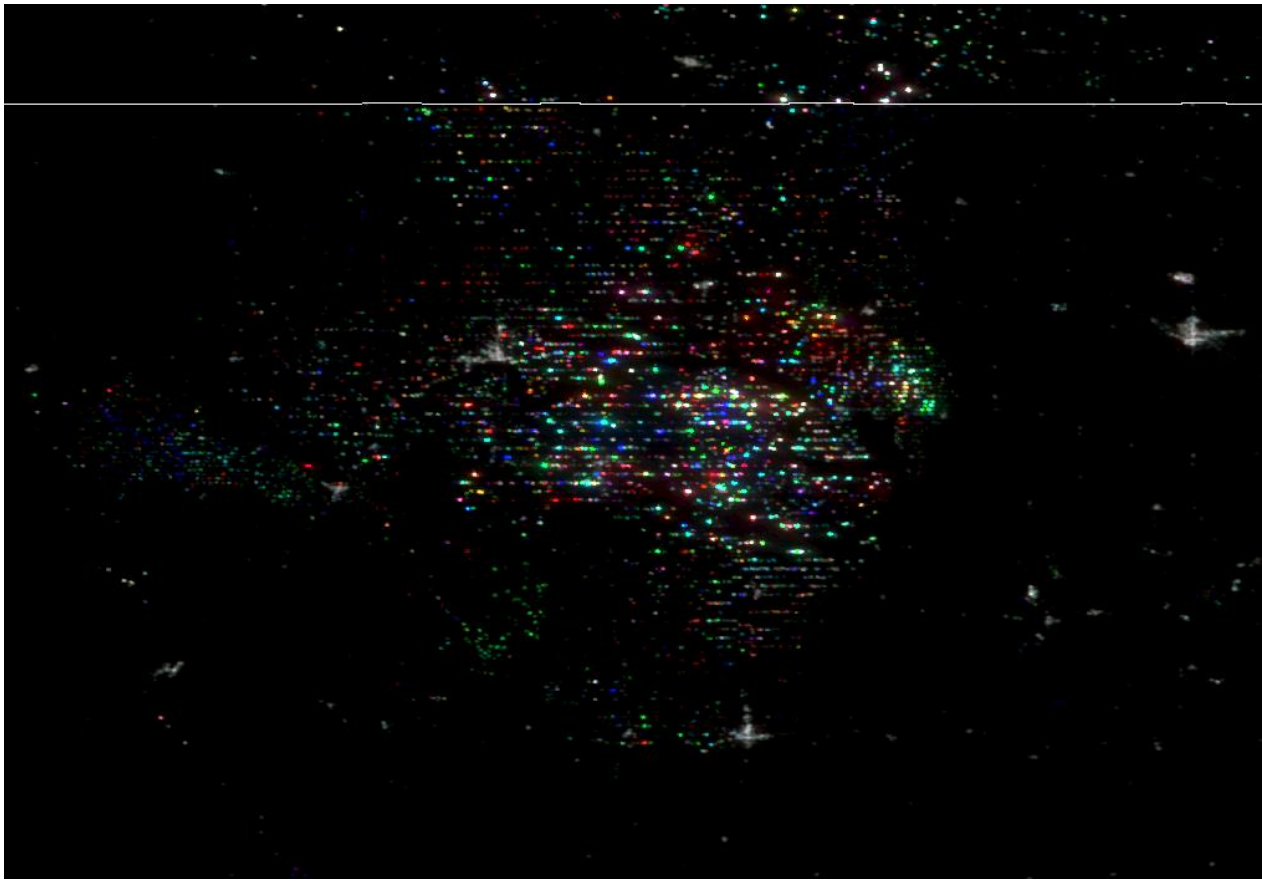
October 2014

Nile Delta (right)
Los Angeles->San Diego (below)

Temporal Change in VIIRS Nighttime Lights Composites

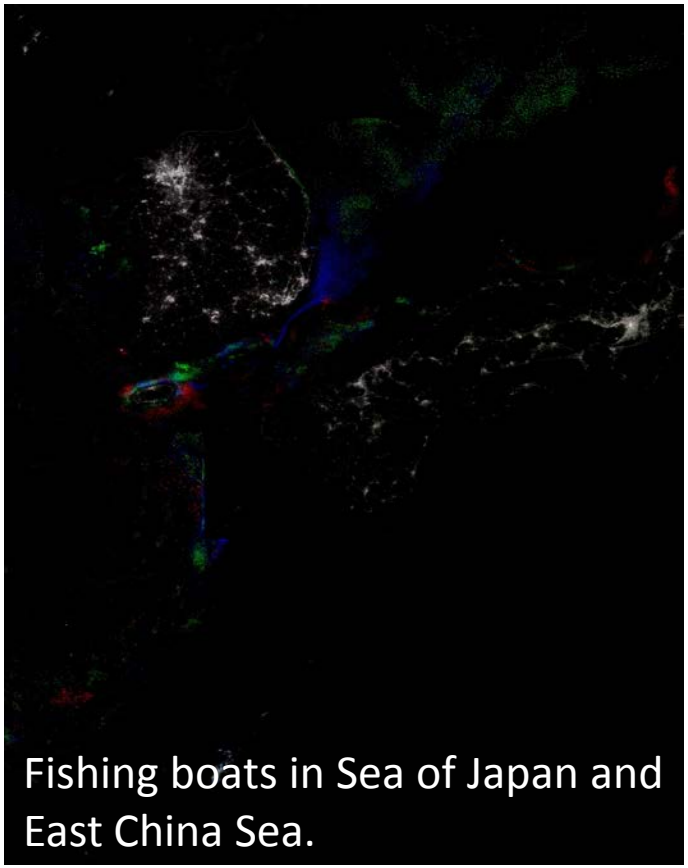
Red = May 2014, Green = September 2014, Blue = October 2014

Bakken gas flares in North Dakota, USA, are a mix of permanent and ephemeral sites.

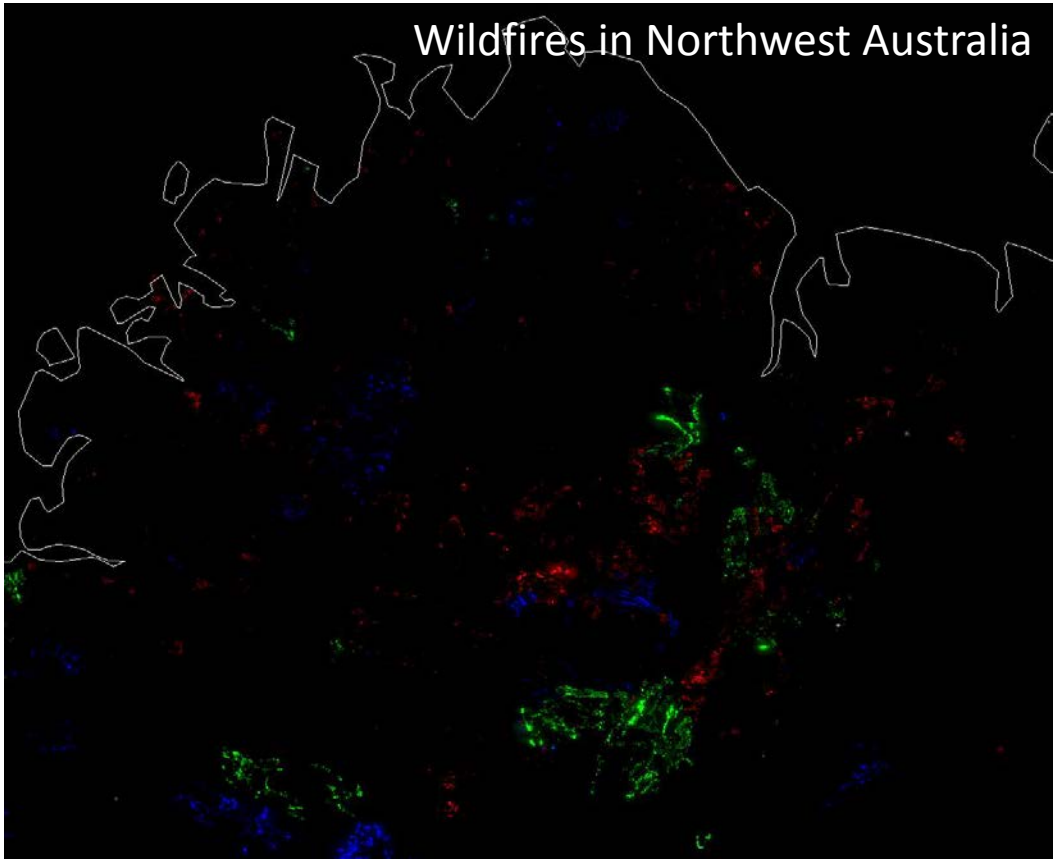


Temporal Change in VIIRS Nighttime Lights Composites

Red = May 2014, Green = September 2014, Blue = October 2014



Fishing boats in Sea of Japan and East China Sea.



Temporal Change in VIIRS Nighttime Lights Composites

Red = May 2014, Green = September 2014, Blue = October 2014

Lights in northern Iraq are present in May 2014, and have been greatly reduced in the September and October 2014 composites.