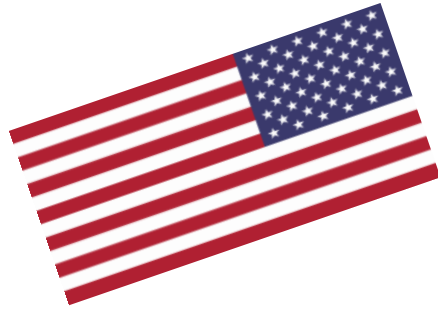




Fusion Center Workshop and Table Top Exercise

Sulawesi, Indonesia

31 July – 3 August 2018





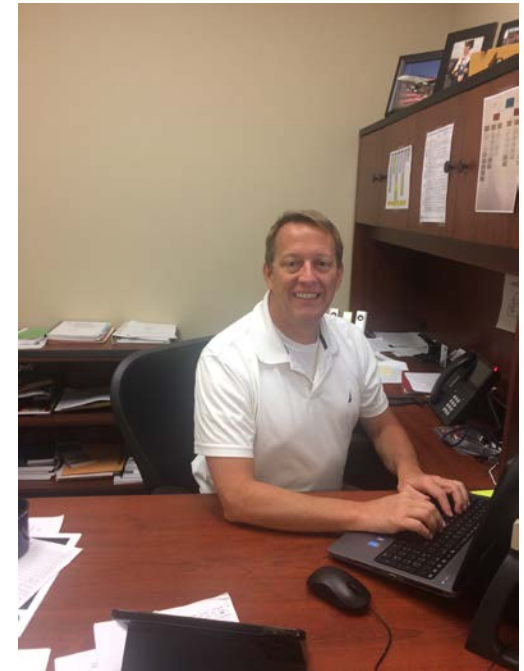
VIIRS

LCDR Kirk Baldin
US Navy



Officer

Gentleman



Government Employee
Aviation Safety Inspector –
Federal Aviation Administration



Not VIIRS

Office





This is the VIIRS Expert



Mad Scientist



Really Smart Guy

Dr. Chris Elvidge

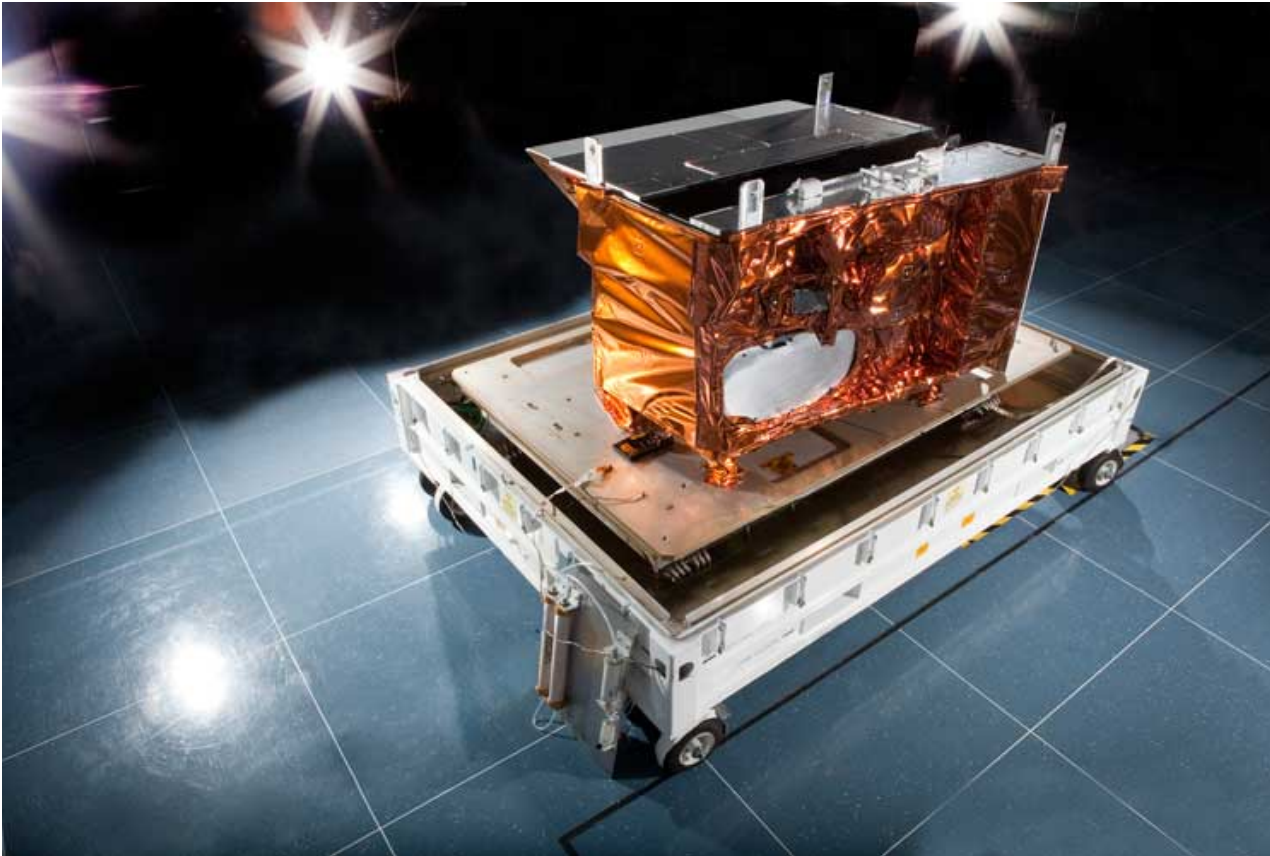
National Oceanographic and Atmospheric Administration -
Earth Observation Group (EOG)

Boulder, Colorado





Visible Infrared Imaging Radiometer Suite VIIRS



VIIRS, a scanning radiometer, collects visible and infrared imagery and radiometric measurements of the land, atmosphere, cryosphere, and oceans.



Visible Infrared Imaging Radiometer Suite VIIRS



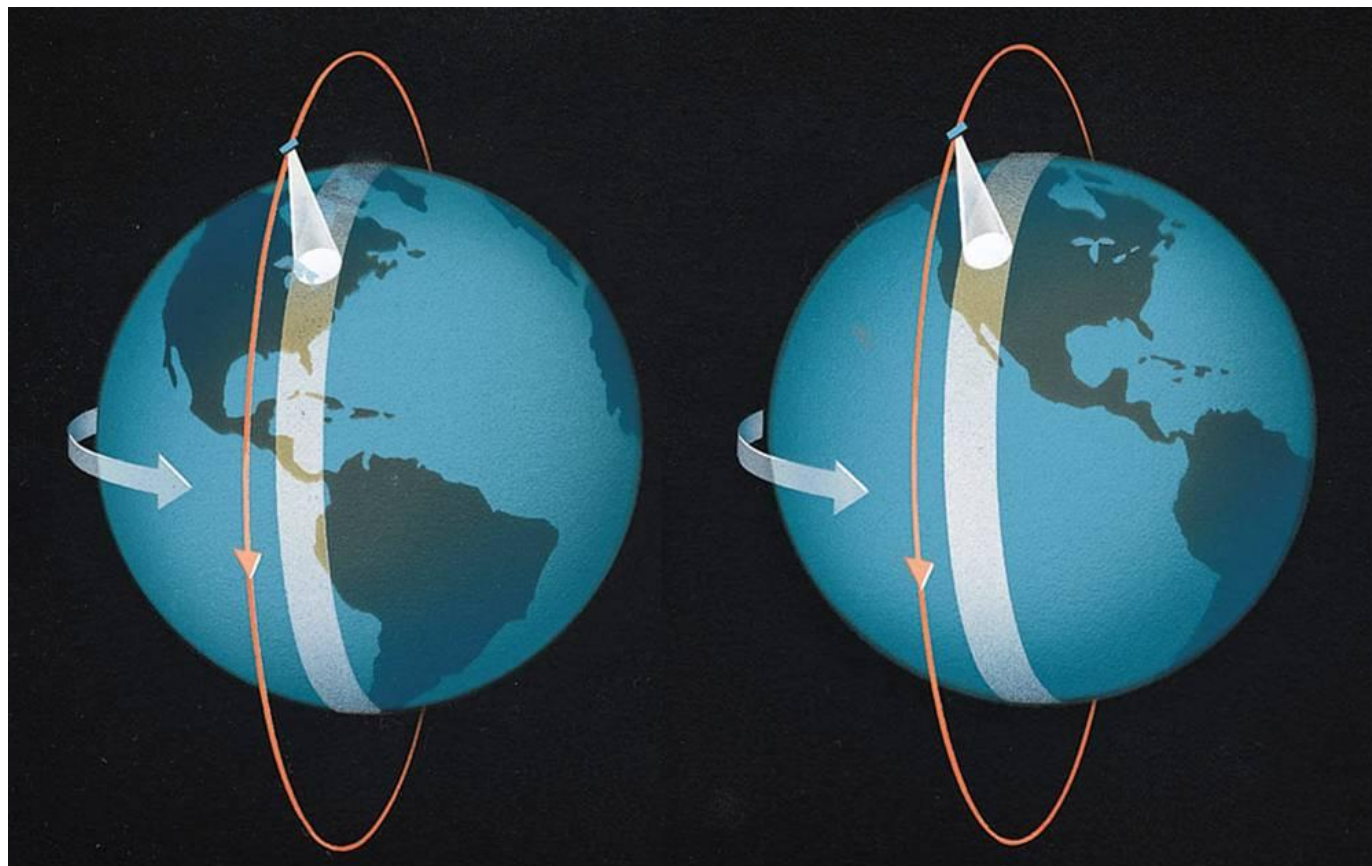
Purpose: To collect measurements of clouds, aerosols, ocean color, surface temperature, fires, and earth light reflection.

VIIRS

Suomi Polar Satellite



Visible Infrared Imaging Radiometer Suite VIIRS



Polar Orbit –
nightly data
across the
globe. **2 hour
window
between
12am and
2am.** Not
always the
same time of
night due to
orbital
patterns. 14
orbits a day.

© 2007 Thomson Higher Education



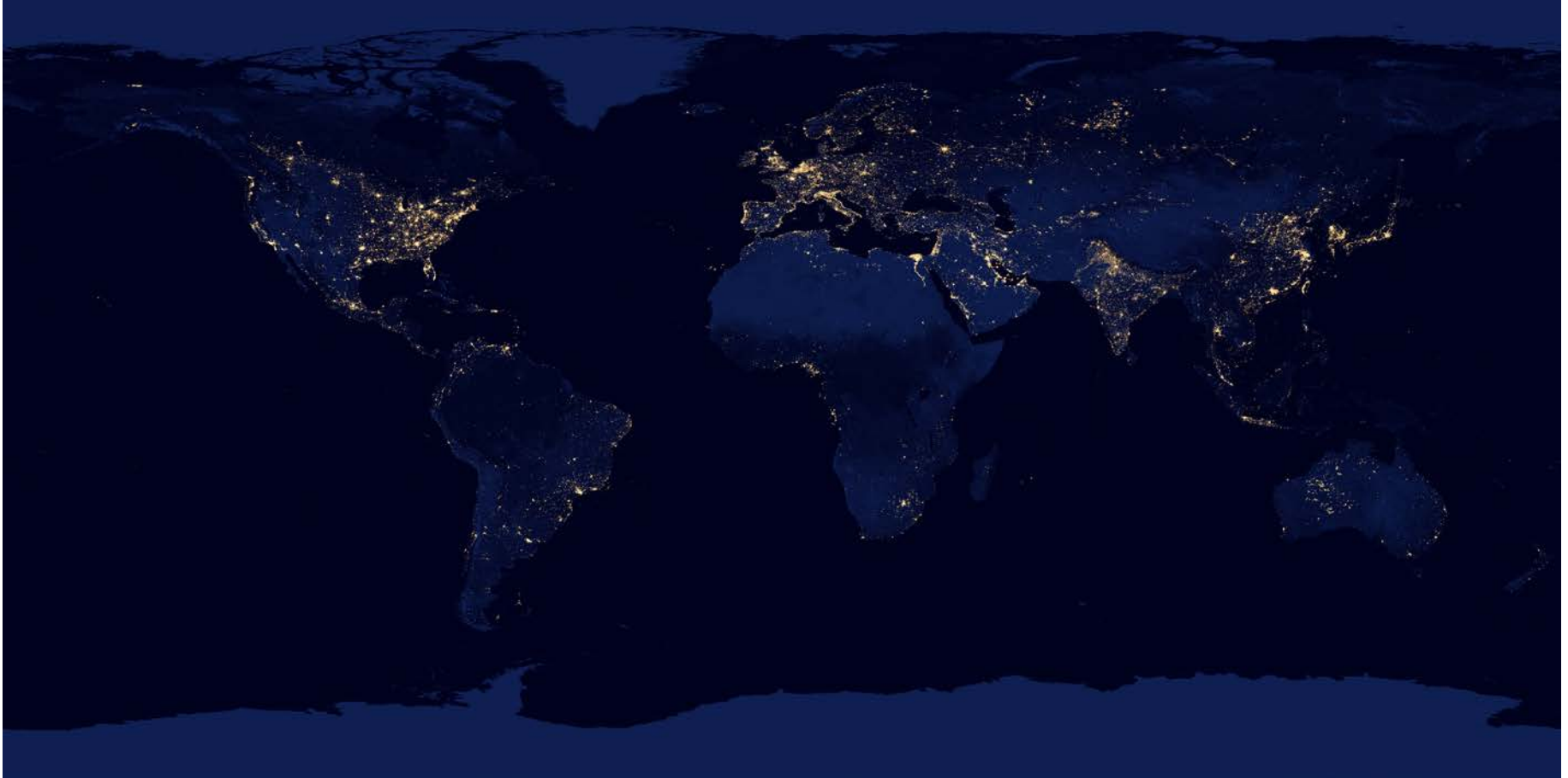
Visible Infrared Imaging Radiometer Suite VIIRS



...downloaded
to Norway,
transmitted to
Maryland for
processing,
analyzed in
Boulder, CO,
and then...



You Get This Beautiful Picture





Who are the Primary Audiences?

- Fishery Management Agencies
- Coastal Enforcement Agencies



Current Users and Participants

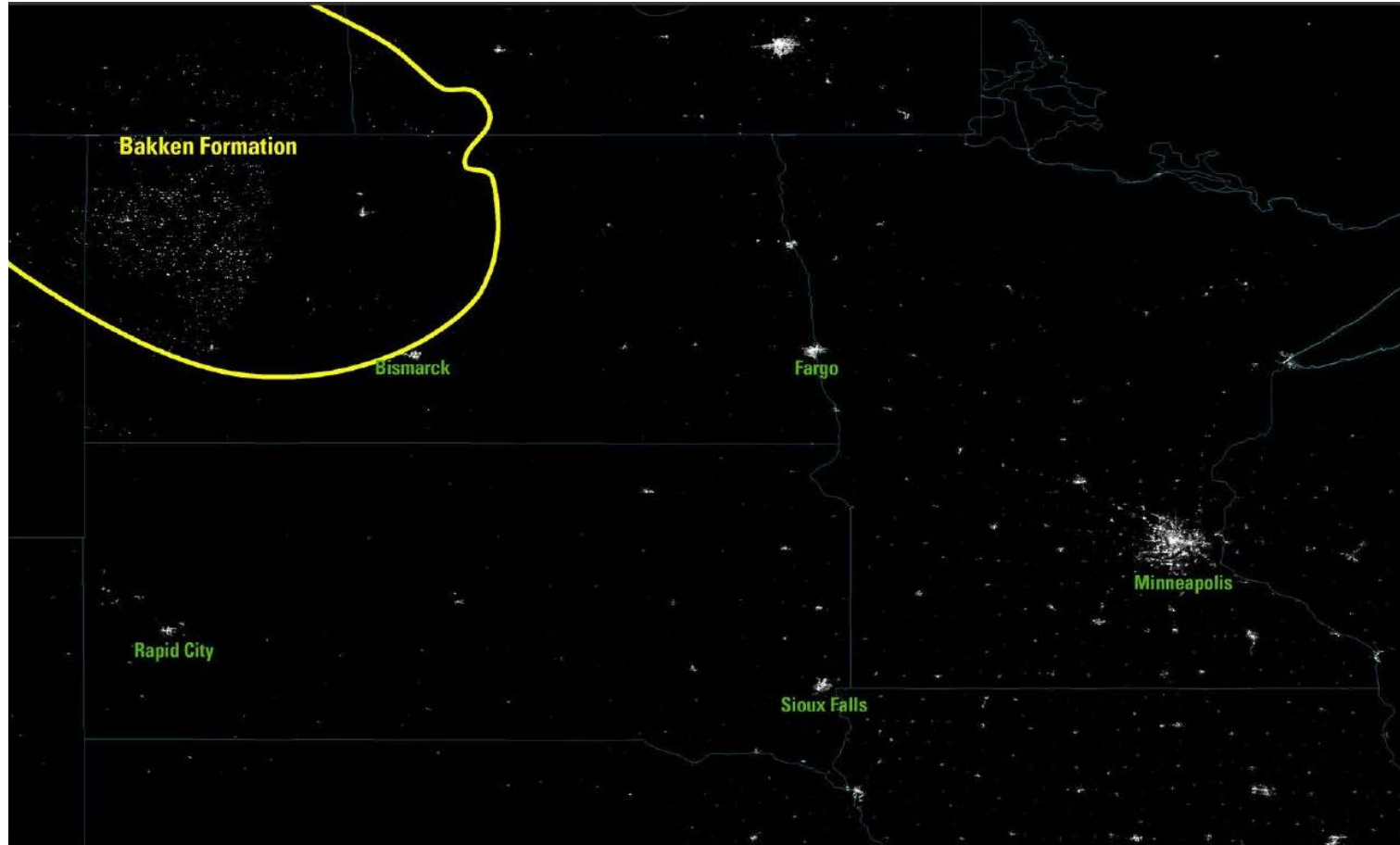
- Indonesia - (2014) Partner with Fisheries and USAID
- Philippines – (2015) Daily Basis (Local Government Units)
- Thailand –Department of Fisheries, Southeast Asia Development Center for Fisheries, and some Universities.
- Cambodia – (2017) Received 2 day training
- Also - Japan, South Korea, United States

Right Now you are asking yourself,

What does it detect?



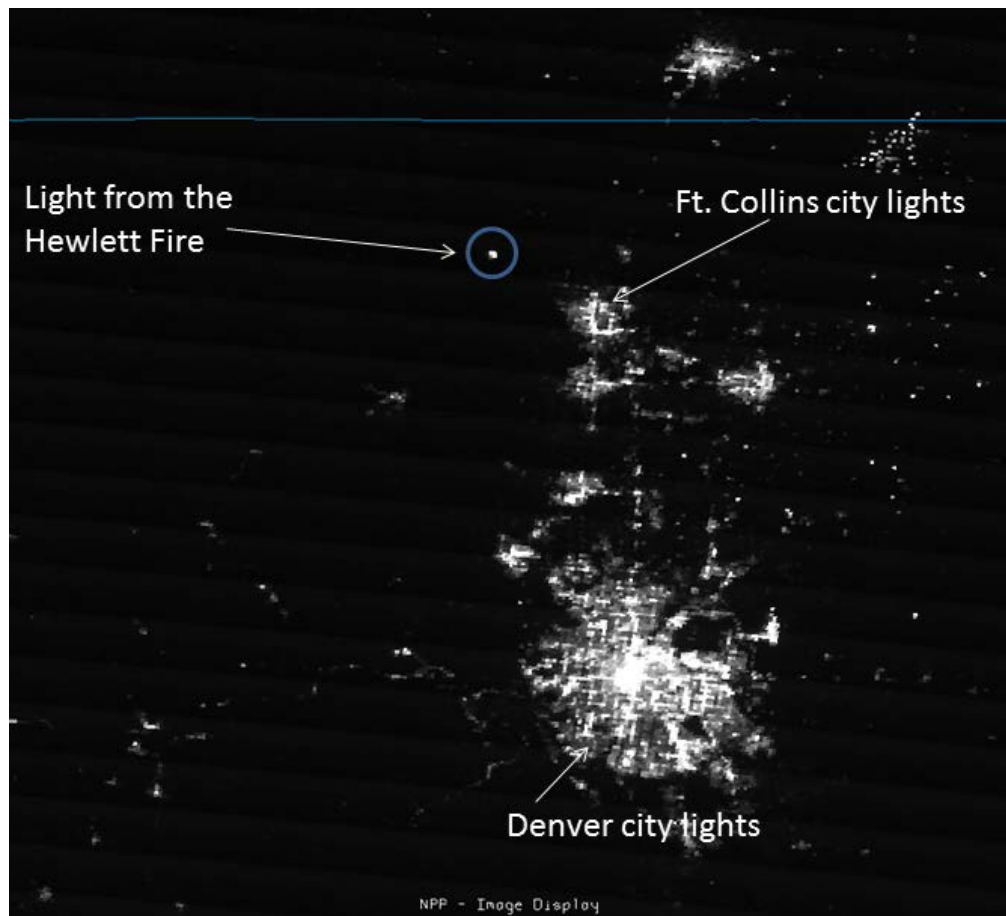
Can it detect Gas Flares from oil wells?





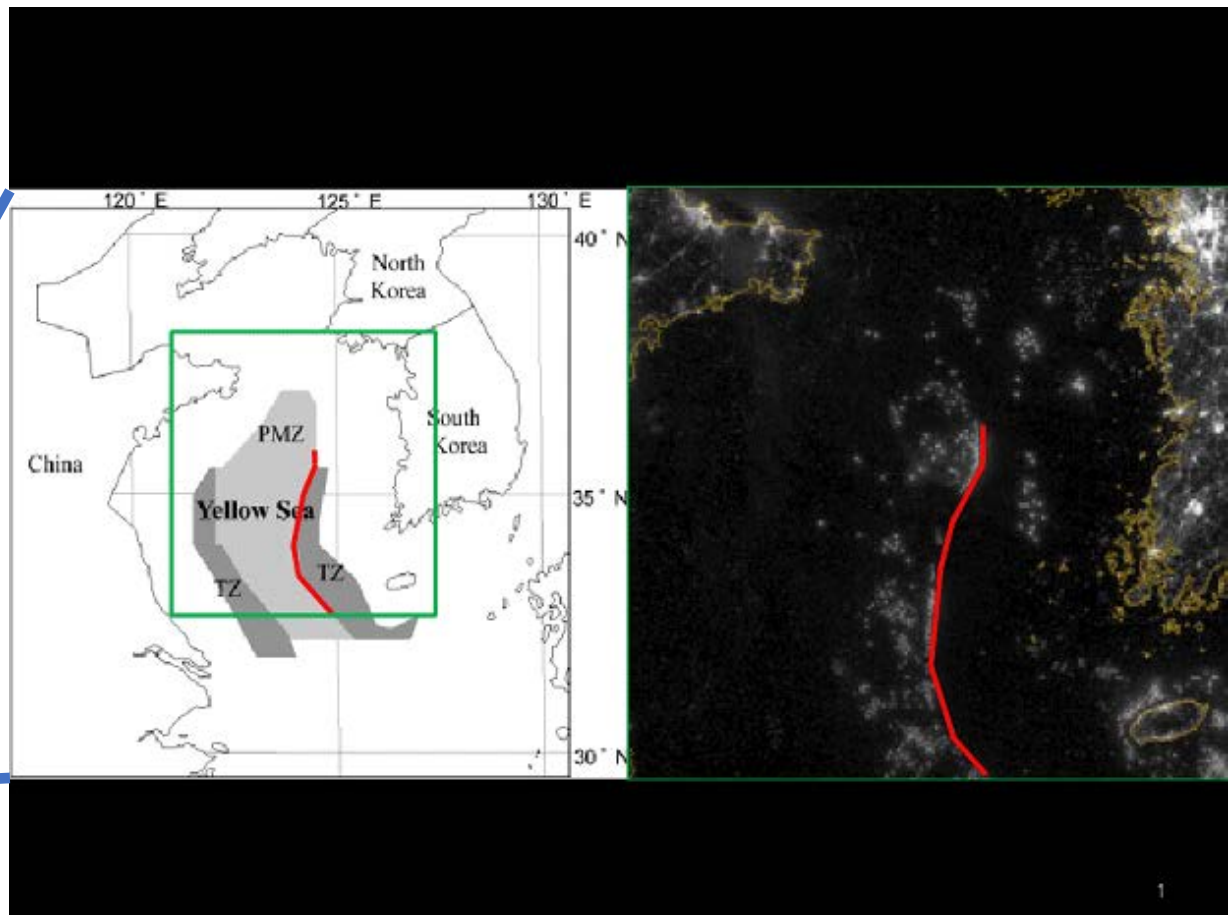
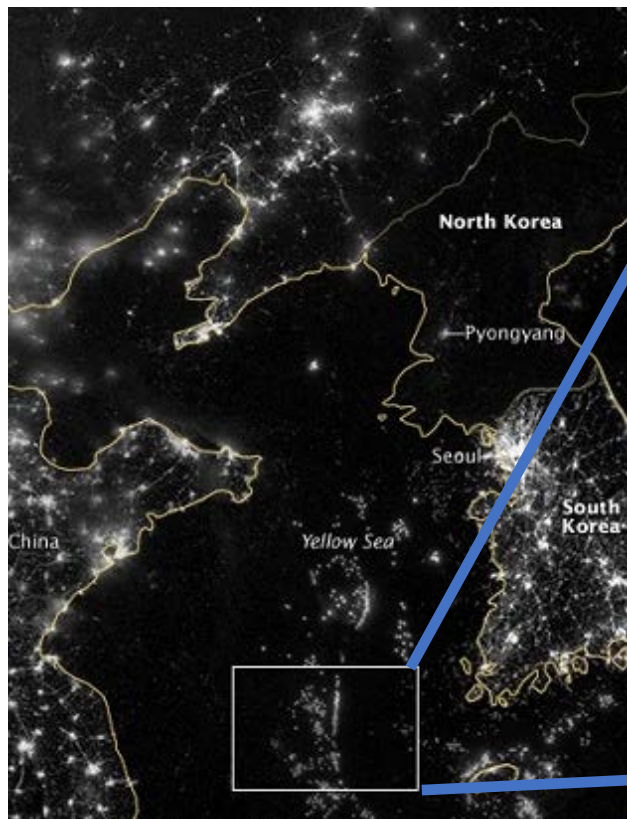
Can it detect Fires?

Day-Night Band Image over north-central Colorado on 15 May 2012





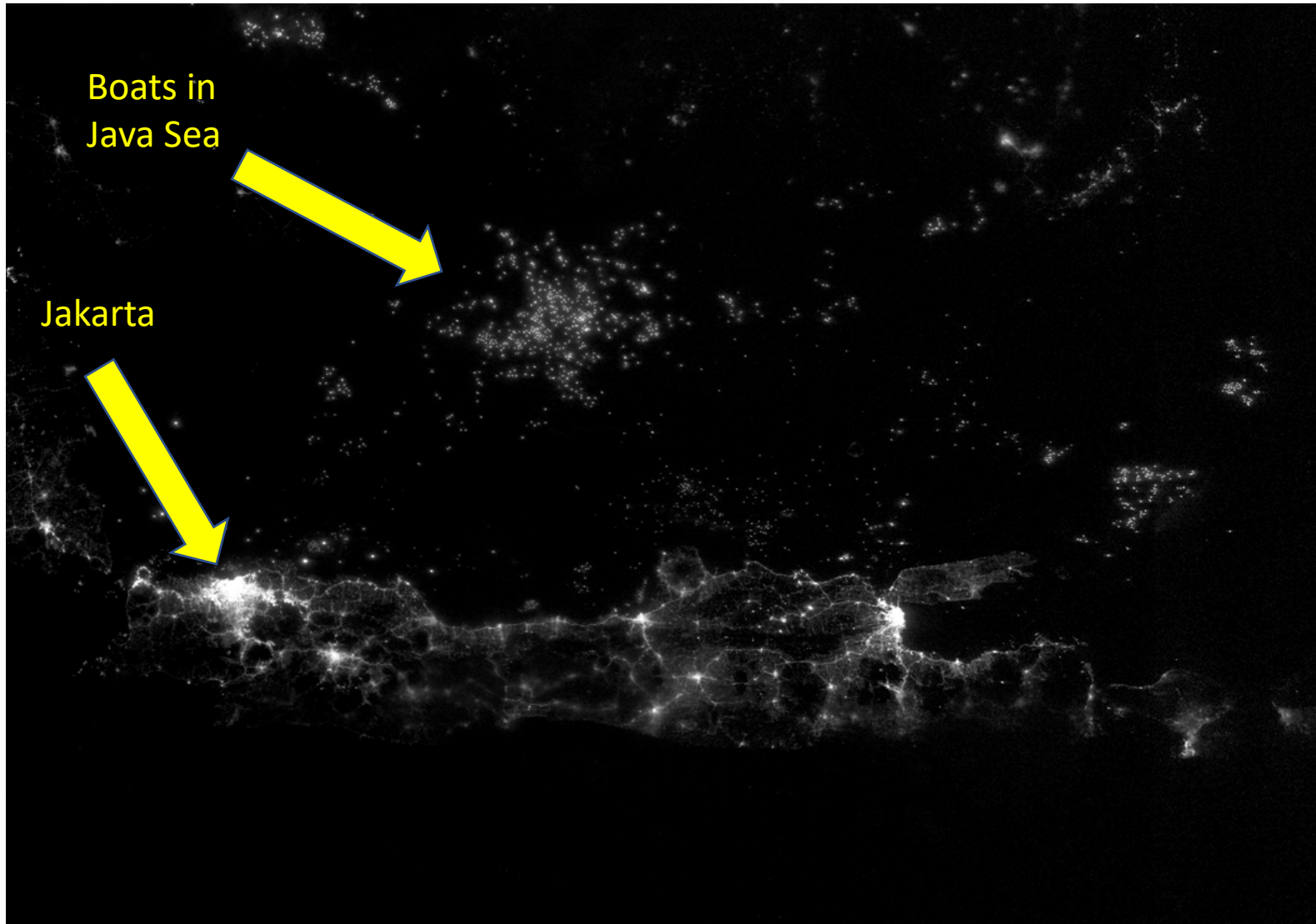
Can it detect Fishing Boats?





How does all this work?

The VIIRS day/night band (DNB) sensor detects lights present at the Earth's surface, including those from boats.

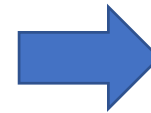




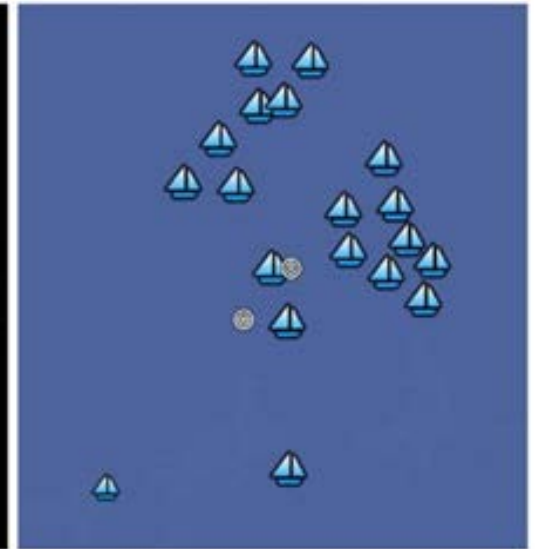
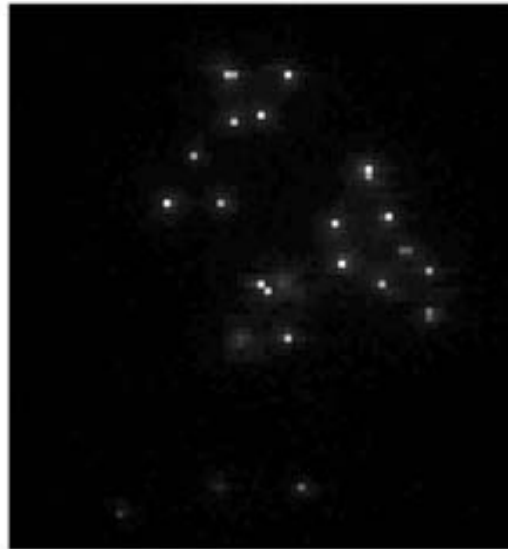
The VIIRS data is processed through Algorithms, output points are generated, and a vast data volume reduction occurs.



VIIRS day/night
band (DNB)
nighttime
image data

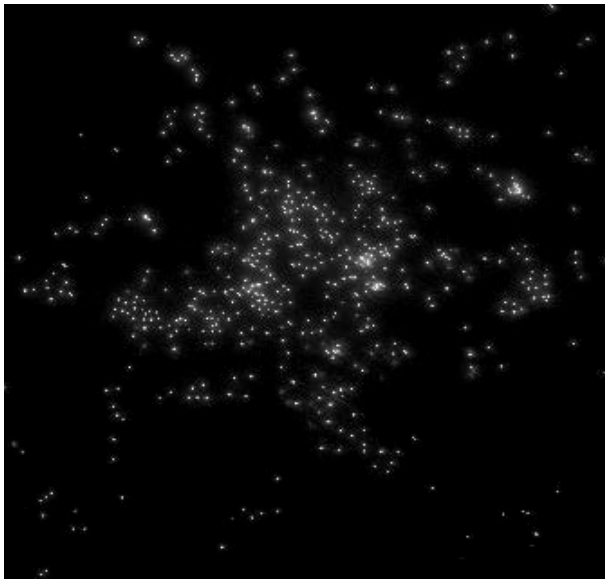


VIIRS Boat Detection
data (points)

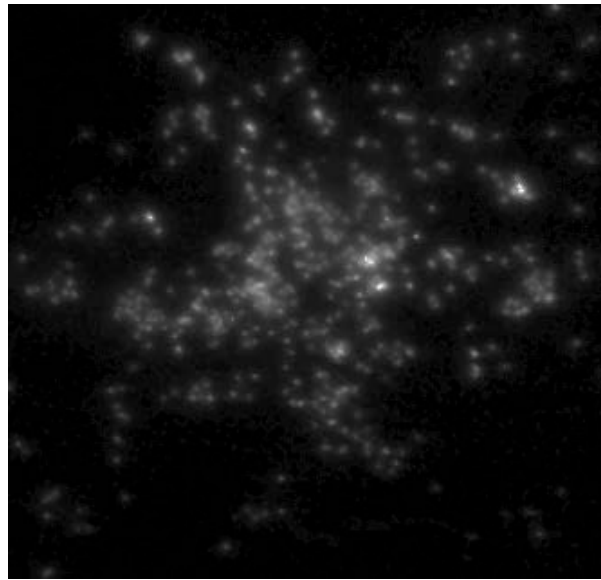




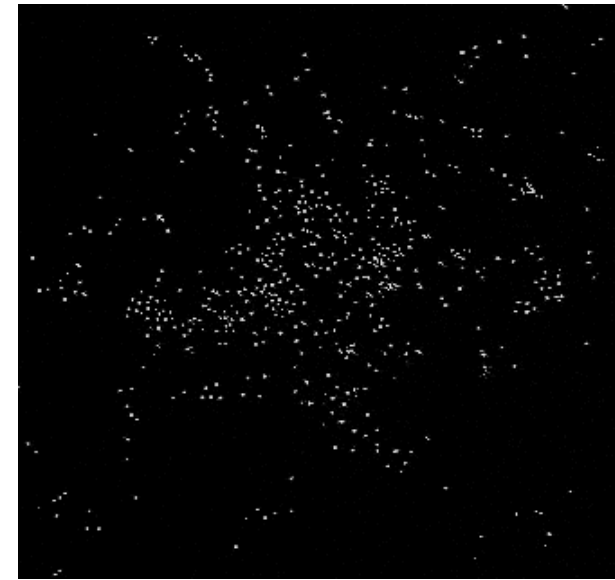
Example Algorithm – Day/Night Band (DNB) Spike Detector



DNB



Median
Filtered DNB
(De-spiked)



DNB minus De-spiked
with background
suppressed a threshold is
used to detect the spikes

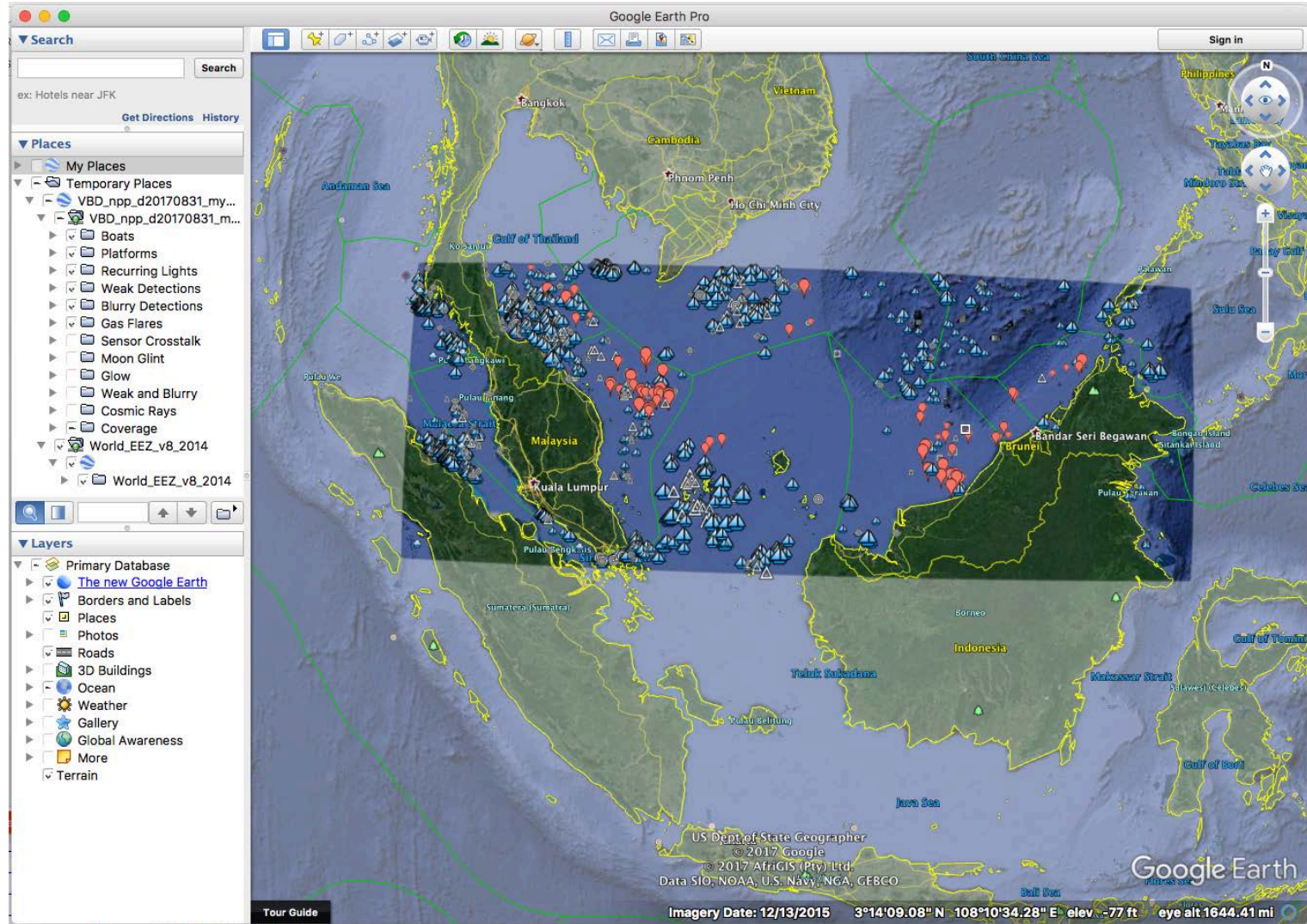


Another Example Algorithm – Remove detections on land



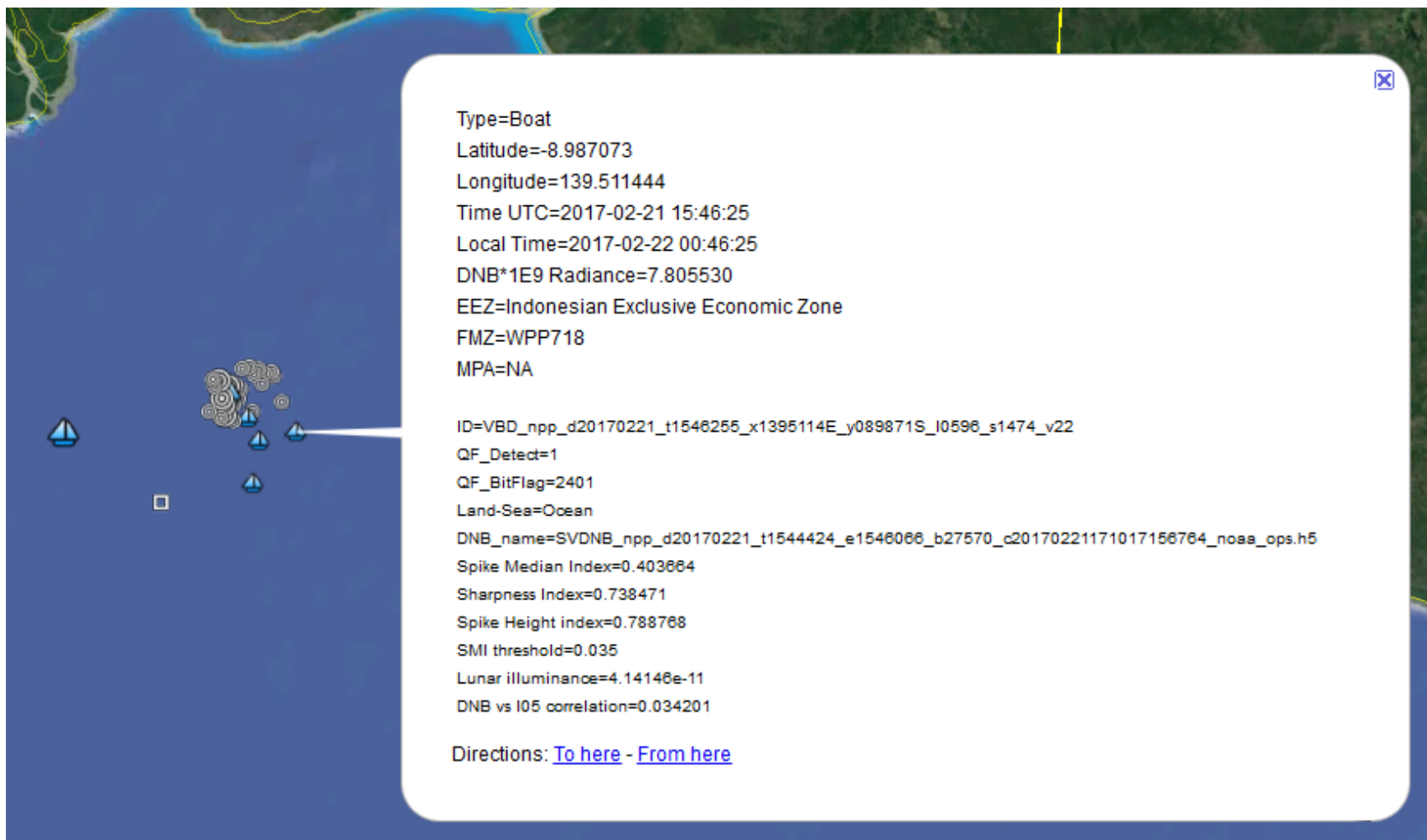


And, Turn It Into Easy To Read Visuals





Easy to Read Visuals





What Can You Do With This Information?

- Monitor Fishing Activity – Daily, Weekly, Monthly, and Annually
- Provide Education down at the Wharf
- Monitor Regulatory Compliance (**alerting** feature)
 - Fish Management Zones
 - Marine Protected Areas – Thailand, Philippines, Indonesia
 - Restricted Coastal Water Zones
 - Local Government Units (LGUs) – Philippines (10.1 and 15 km restrictions)
- Match VMS to VBD



What Else?

Annual Summaries –

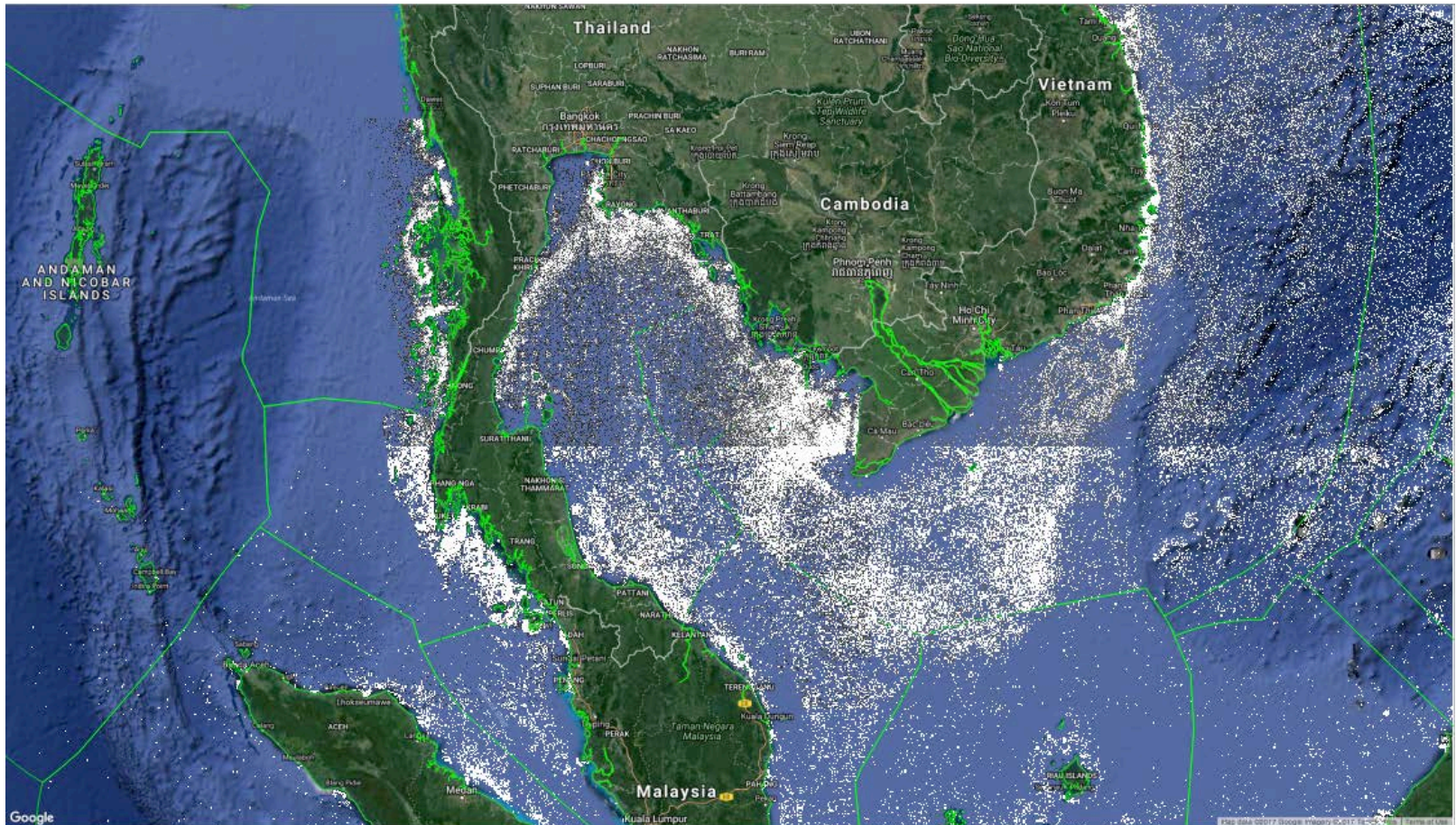
Reveal distinct fishing grounds. These are available from 2012-2016.



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

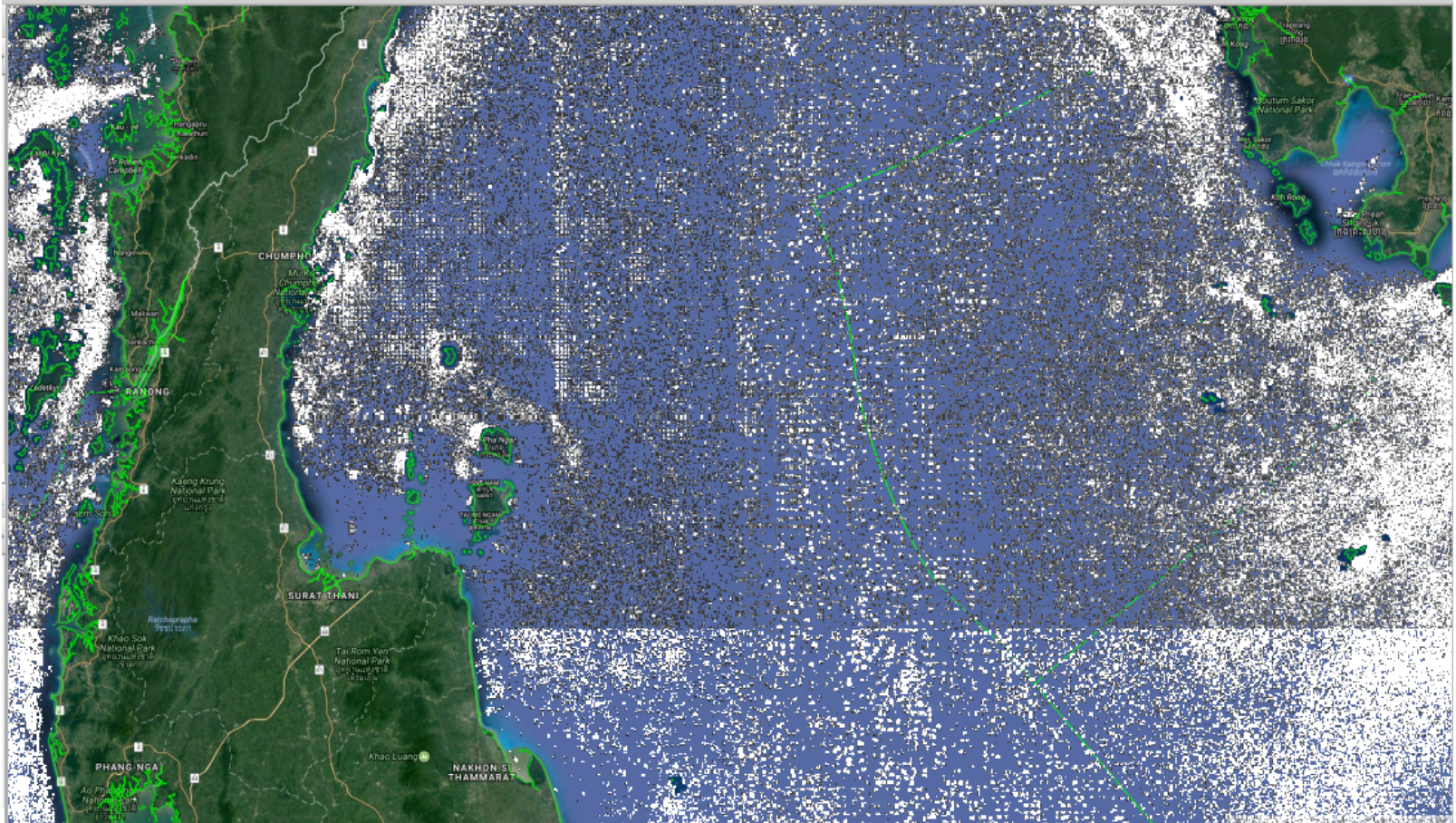


Annual Fishing Activity



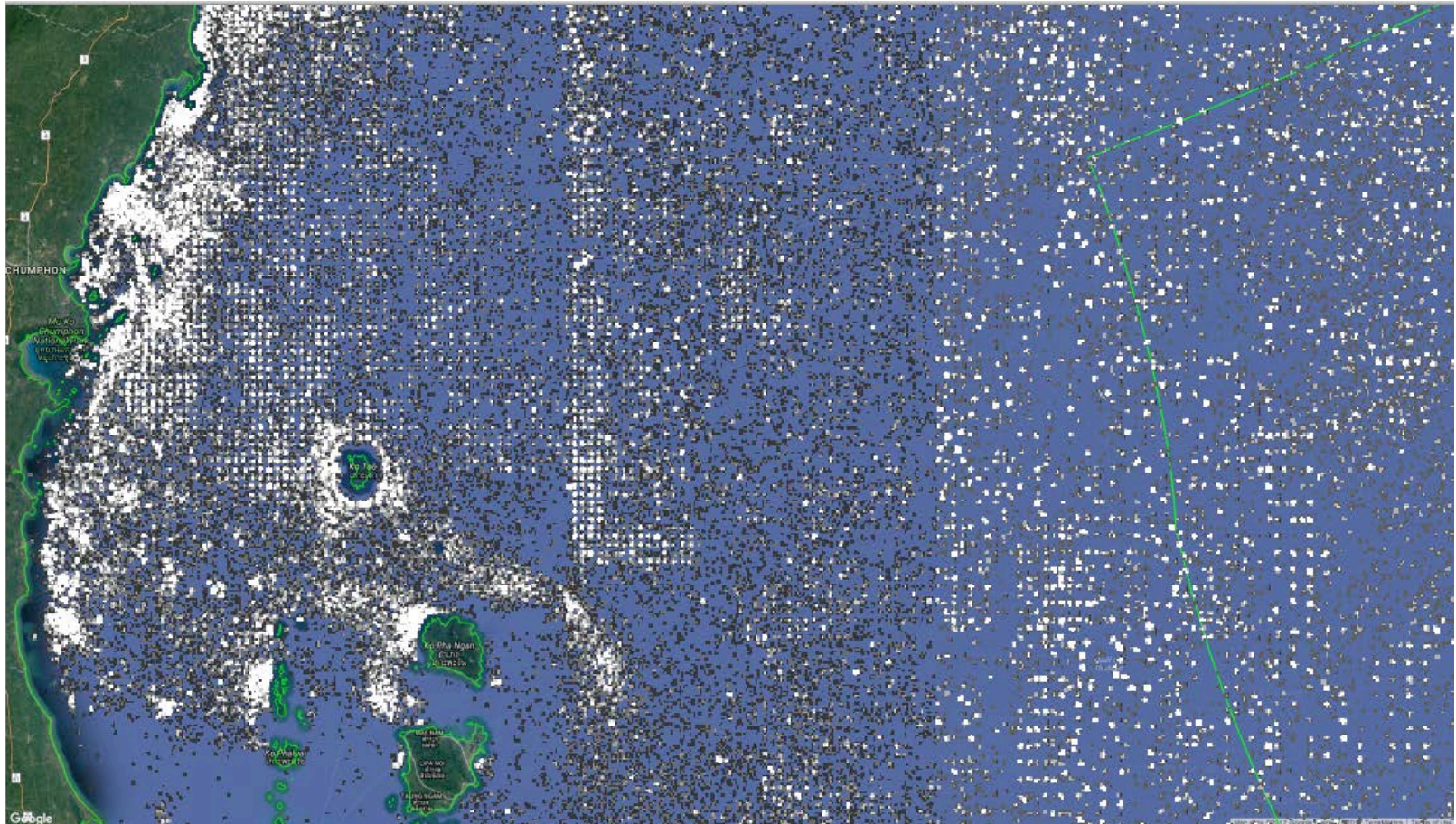


Looks like a grid pattern





It is a grid pattern





Alerting Features – What should we be alerted to?

- Seasonal Fishing Waters – Restricted Fisheries
- Local Fishing Areas
- Protected Areas
- National Parks



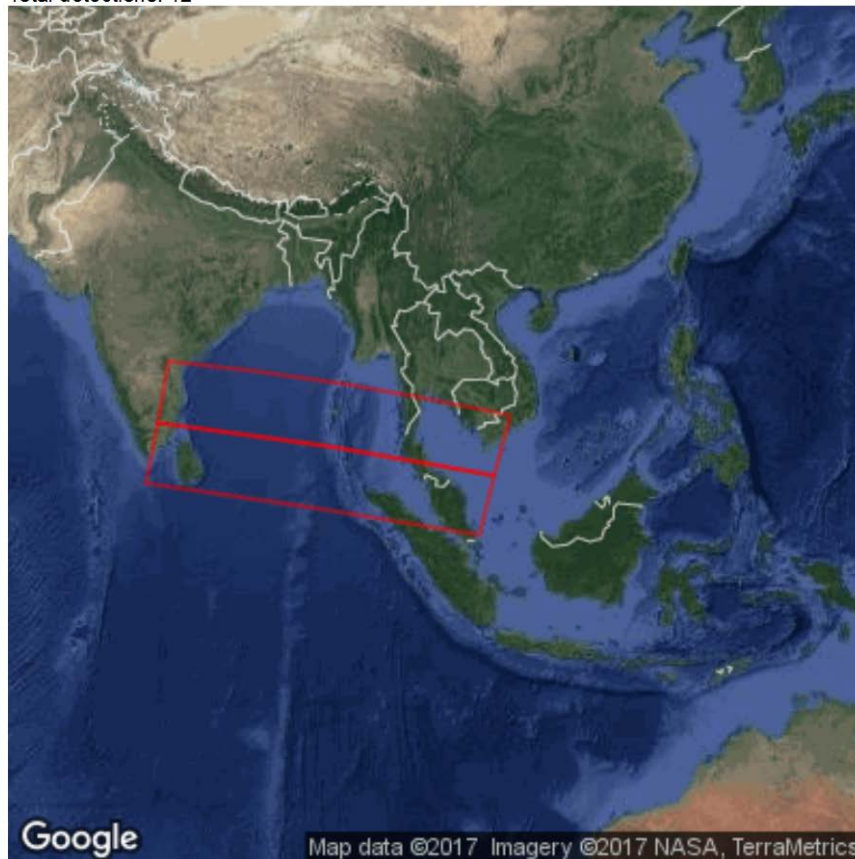
Alert by email

From: NCEI@barnacle.ngdc.noaa.gov [✉](#)
Subject: Thailand Marine National Parks Daily Summary
Date: August 31, 2017 at 4:51 PM
To: Undisclosed_Recipient@barnacle.ngdc.noaa.gov

VIIRS Boat Detections Inside Park Boundaries 2017-09-01

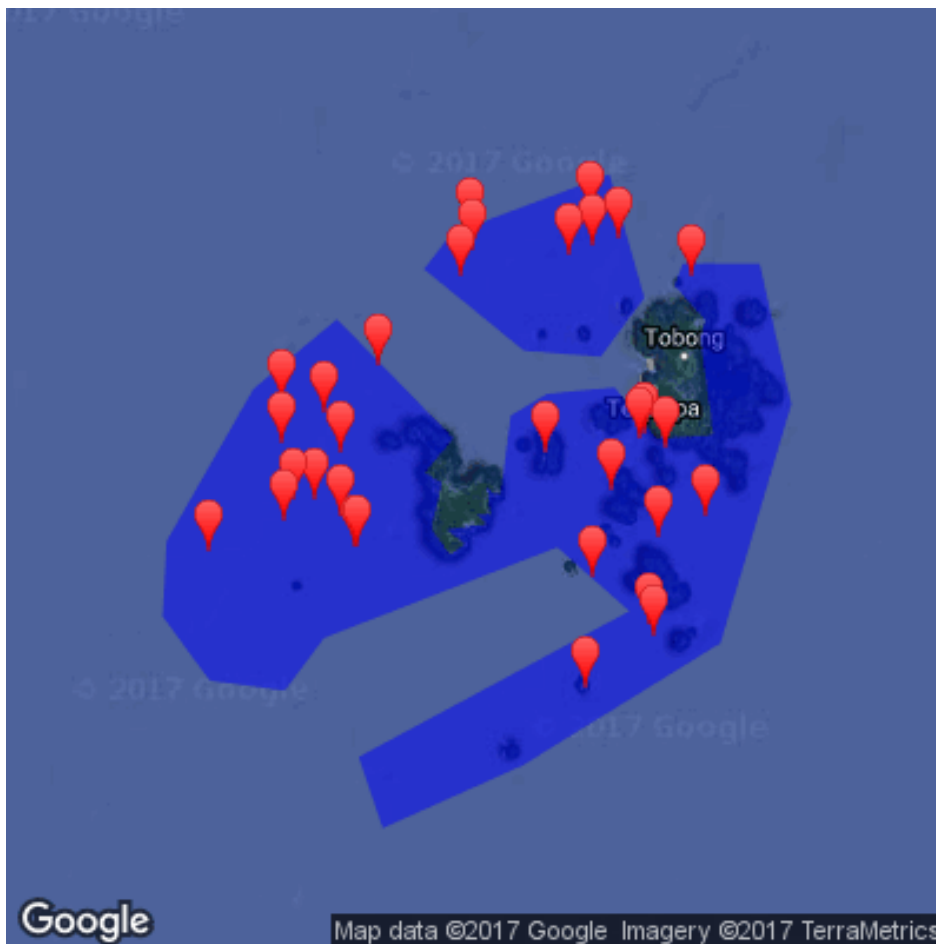
[\[CSV\]](#)[\[KML\]](#)

Total detections: 12





Indonesia has Alerts running for 86 Marine Protected Areas



Kepulauan Anambas
Marine Conservation Area
Boat Detection Alert
2017-05-04

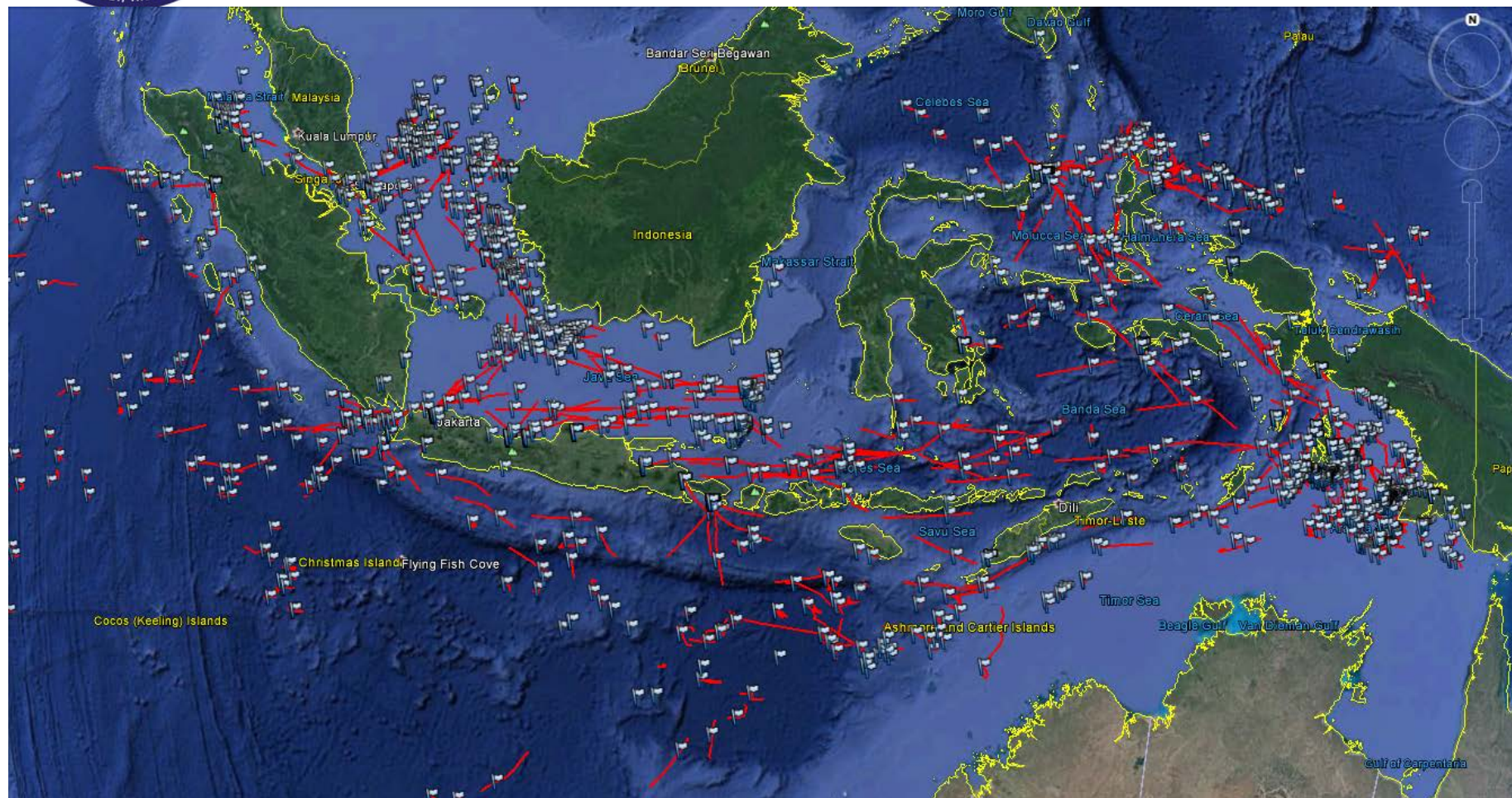


VMS – VBD Cross Matching

(VMS required for 30 Gross Tons or more in Indonesia)



Indonesia has 5000 boats equipped with Vessel Monitoring Systems (VMS)



VMS tracks from a 24 hour period – November 1, 2014 (VMS data provided by Global Fishing Watch)



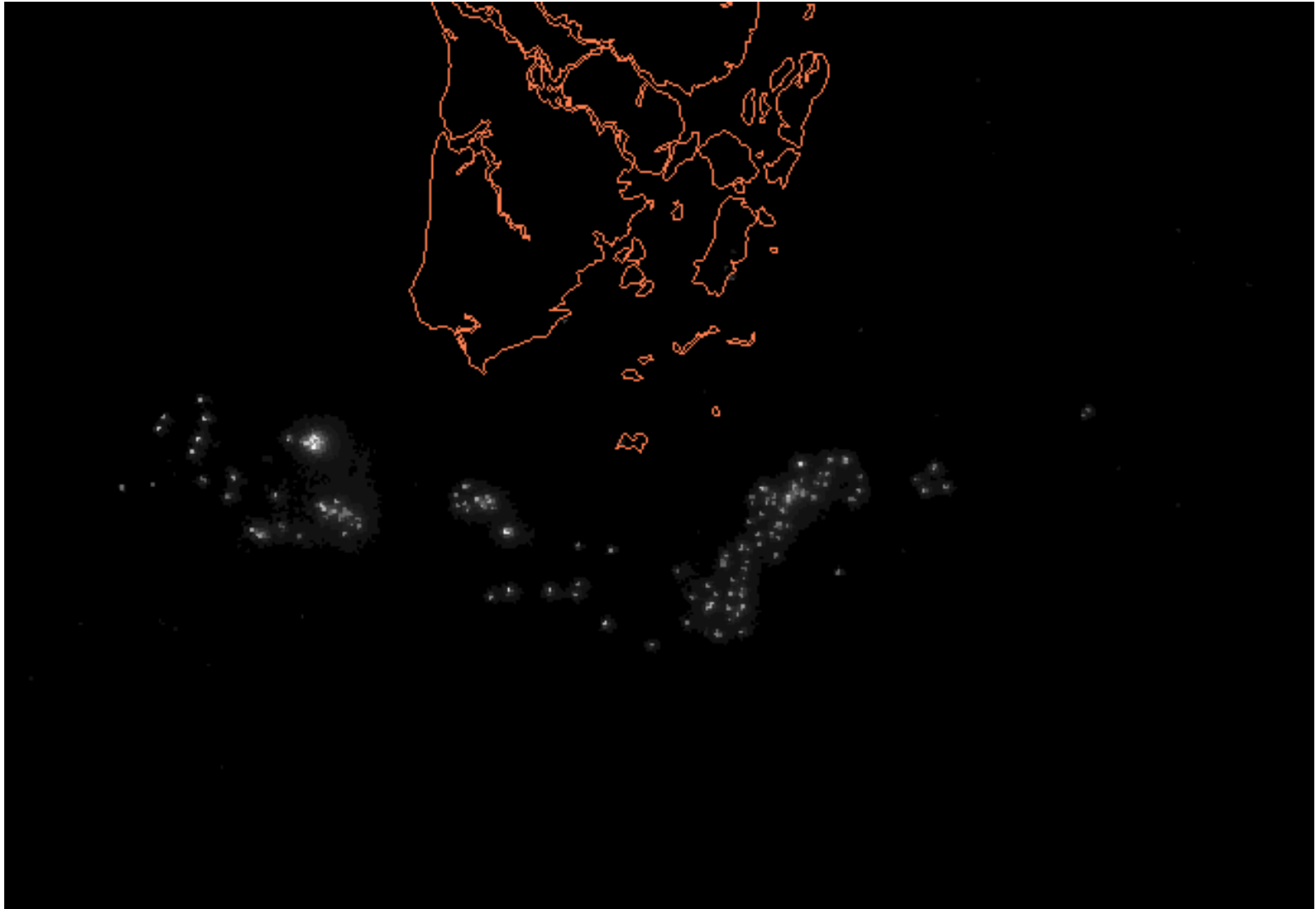
How does VMS and VBD matching work?

- Ingest VMS into VDB data.
- Predict the location of VMS boats at the time of the VIIRS overpass.
- Identify three categories:
 - VMS plus VBD
 - VMS only
 - VBD only



Aru Island VIIRS Boat Detections

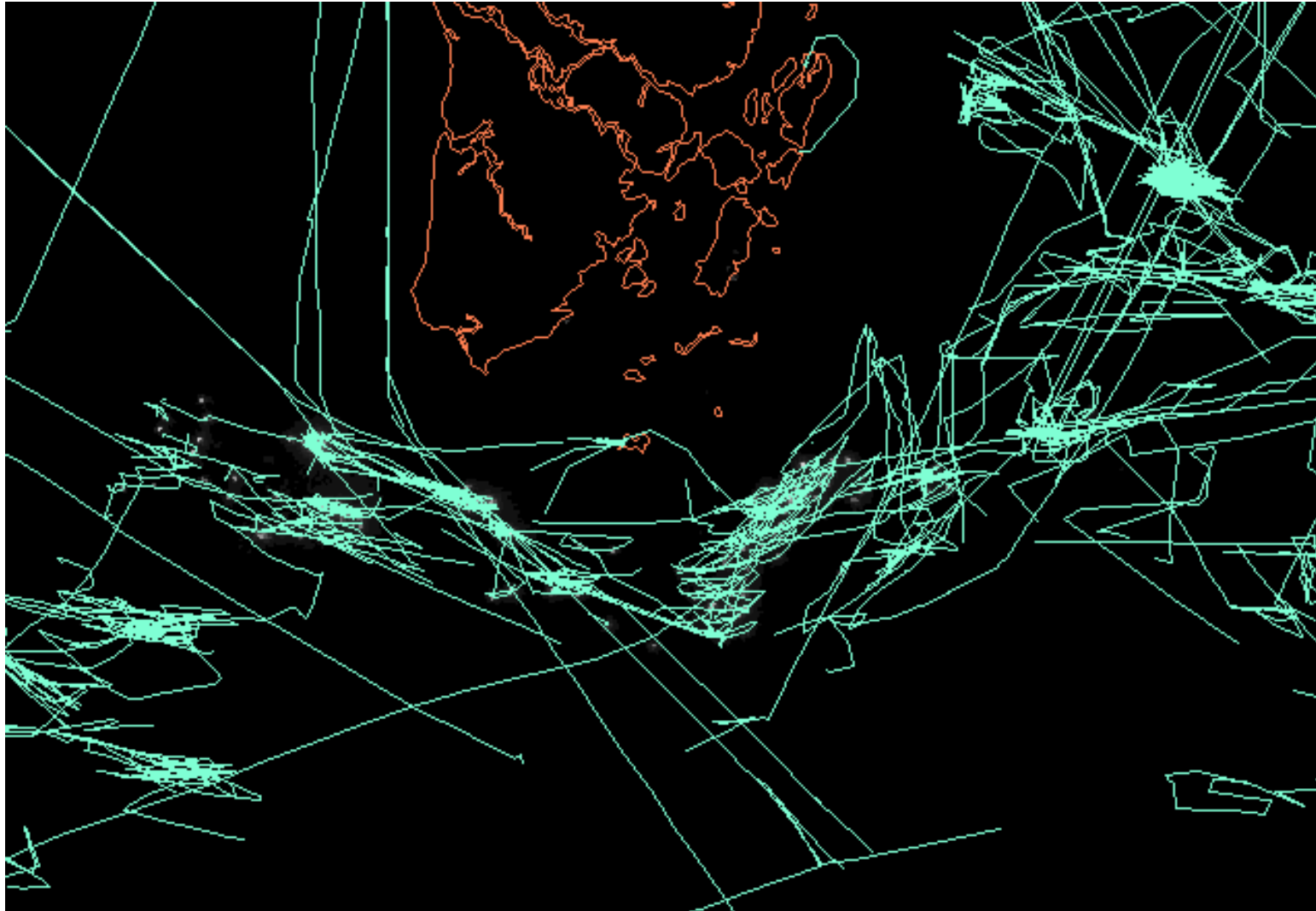
October 31, 2014





Aru Island VMS Tracks

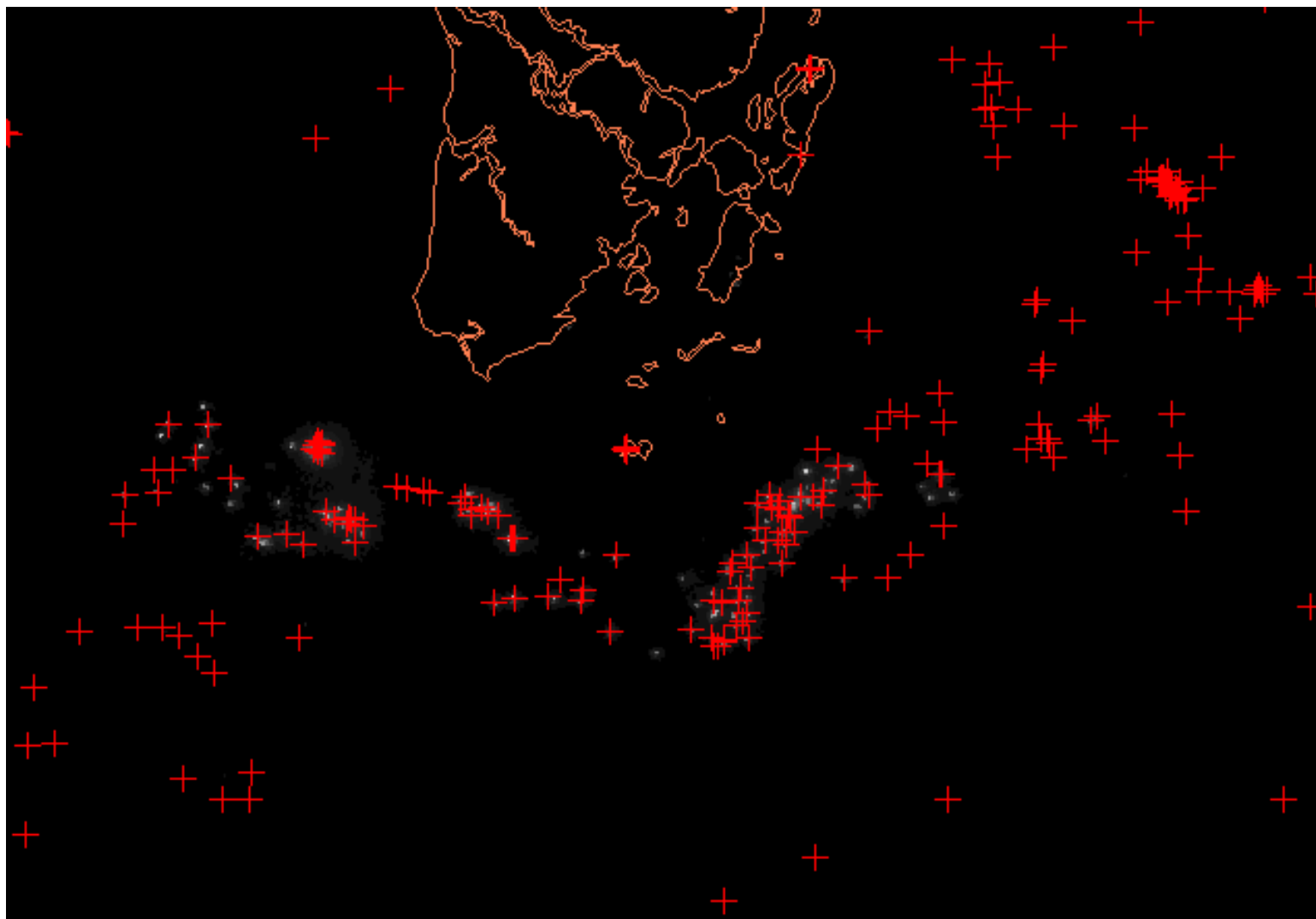
From October 31, 2014





Aru Island predicted VMS boat locations

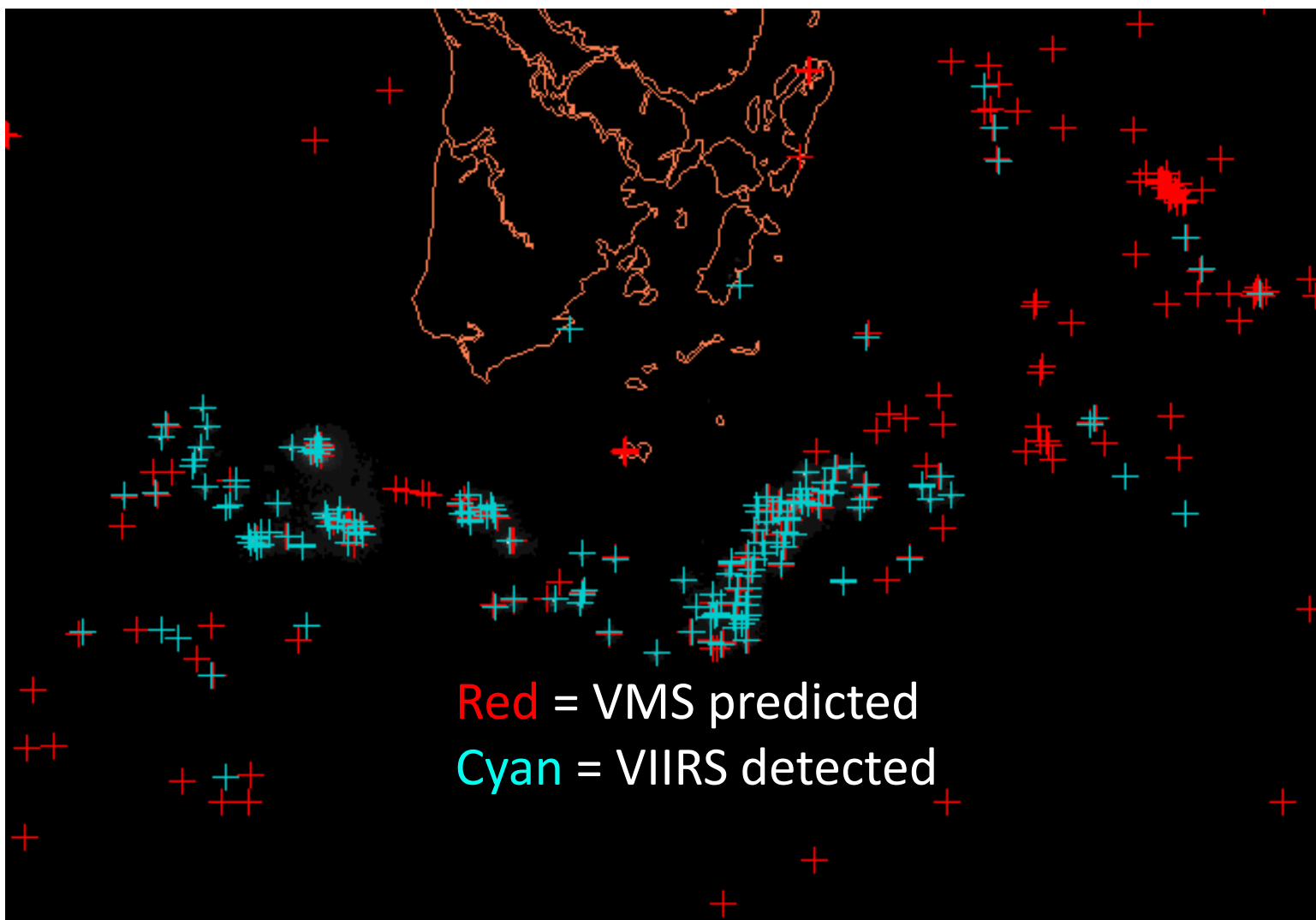
October 31, 2014





Matching to find VMS + VBD, VMS only, and VBD only

October 31, 2014





What's the point?

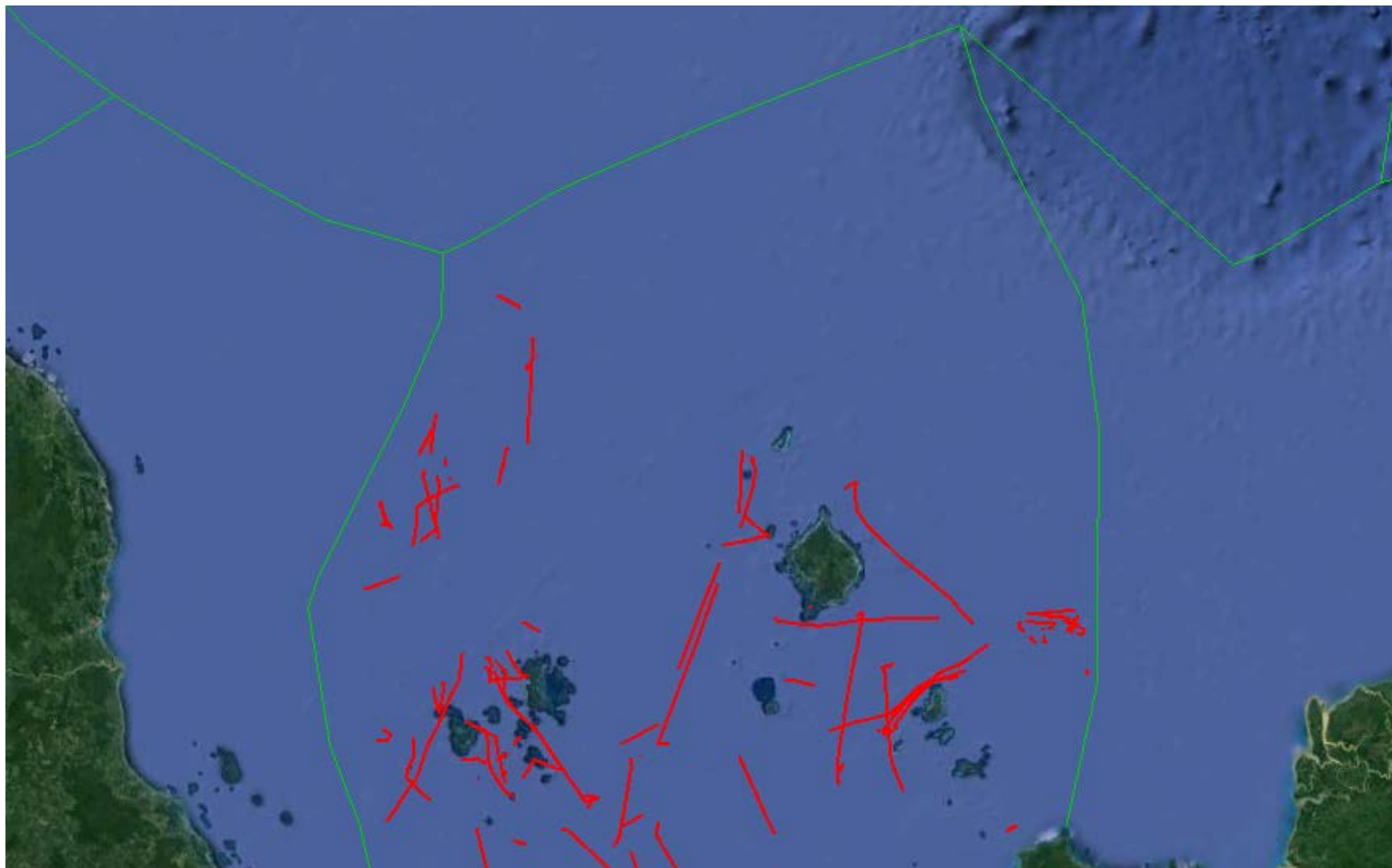
VMS & VBD can ID possible illegal fishing

- Most small boats stay relatively close to major landing sites.
- Only larger boats are able to reach the farther flung areas of the Indonesia EEZ.
- In areas such as the Northern Natuna Sea and Eastern Arufura Sea it is possible to identify potentially illegal boats by combining the VMS with VBD.
- The suspect boats are detected by VIIRS, but lack VMS.



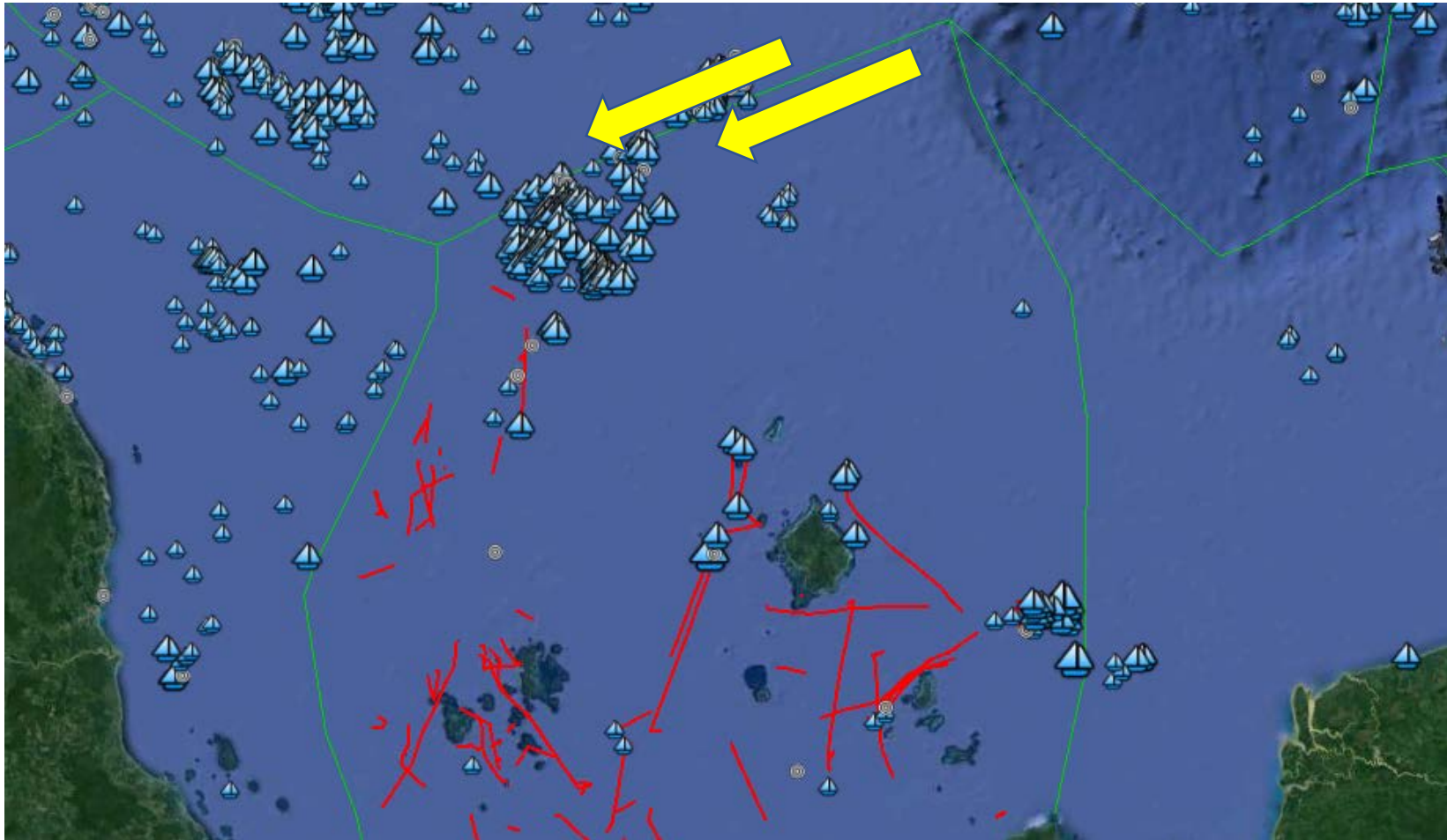
VMS Tracks in Natuna Sea

October 1, 2016





Boats detected by VIIRS but lacking VMS are ?





Significant new results

Indonesia VMS / VBD cross-matching by gear type (2014-16)

Matches	Predictions	Rate (%)	Count	Gear
43452	100175	43.37	190	Pancing Cumi (squid jigging)
52997	158445	33.44	535	Bouke ami
219	677	32.34	3	Pancing Ulur (Fishing Pole)
8094	28788	28.11	75	Hand Line Tuna
76127	368156	20.67	1149	Purse Seine (Pukat Cincin) Pelagis Kecil
20496	175238	11.69	417	Pukat cincin Pelagis Besar dengan satu kapal (Pelagic small trawler big pelagic ring with one ship)
				(A large Pelagis net with one Ship)
1795	32123	5.58	216	Pukat Ikan (fishing nets)
837	19786	4.23	144	Jaring liong bun Pukat cincin grup pelagis besar
132	4251	3.1	12	Pukat cincin grup pelagis besar (Trawler ring big pelagic group)
2065	68167	3.02	185	Jaring insang oseanik (Oceanic gill net)
305	11533	2.64	45	Pukat Udang (Shrimp Trawler)
3871	161593	2.39	402	Pengangkut (Carrier)
3514	154045	2.28	433	Rawai Tuna
6	329	1.82	2	Bubu
884	68910	1.28	126	Rawai dasar (bottomline)
159	17672	0.89	77	Huhate
25	4159	0.6	15	Pukat cincin grup pelagis kecil (Trawler ring small pelagic group)
			4026	



Questions to Ask

- Are fishing fleets using lights in accordance to local regulations?
- Are they exceeding wattage? (16,000 watts in Indonesia)
- What type of fishing is occurring and where?



Fishery Monitoring Options

- Set up email alerts for detections in:
 - Marine Protected Areas (MPAs)
 - No take zones
 - Seasonal fishery closures
 - Restricted coast waters
- Detect boats exceeding wattage limits.
- Detect fishing boat clusters straddling EEZ boundaries.
- Cross reference VMS and AIS tracks to identify “dark” vessels.



Plans for the coming year

- A second VIIRS will be launched this year. For some period of time two will operate, with a 50 minute offset. This could be used to ID stationary boats vs. drifters.
- Calibration testing to define detection limits and estimate wattage:
 - Based on long term records of VMS boats with known installed lighting. 51 surveyed boats.
 - The same approach could be applied to GPS & AIS tracks.
 - How? Collect VIIRS data on string of lights deployed at isolated locations.
- Improve the definition of recurring detections and validate the causes (FADs? Platforms? Fishing boat villages? Trans-shipment?).
- Define and characterize fishing grounds based on annual VMS & VBD data.
- Implement near-real time VMS / VBD cross matching.
- Integrate into SeaVision.



Limitations

- Not all fishing boats are lit sufficiently for detection.
- Some of the detected boats are not fishing boats.
- These data provide no direct information on the ownership of the detected boats.
- Detection is in a single spectral band. Therefore it is not possible to distinguish different types of lighting based on spectral signatures.
- In general, it is not possible to track individual boats through time.
- The current algorithm works best under low lunar illuminance. Detection thresholds rise under moonlit conditions.



How to access the data

- <https://ngdc.noaa.gov/eog/>



Want to learn more?

chris.elvidge@noaa.gov



kirk.baldin@navy.mil

kirk.baldin@gmail.com

Mobile and WhatsApp: +1 678 360 4305