

VIIRS Boat Detection (VBD) data: Illuminating the capture segment of the supply chain

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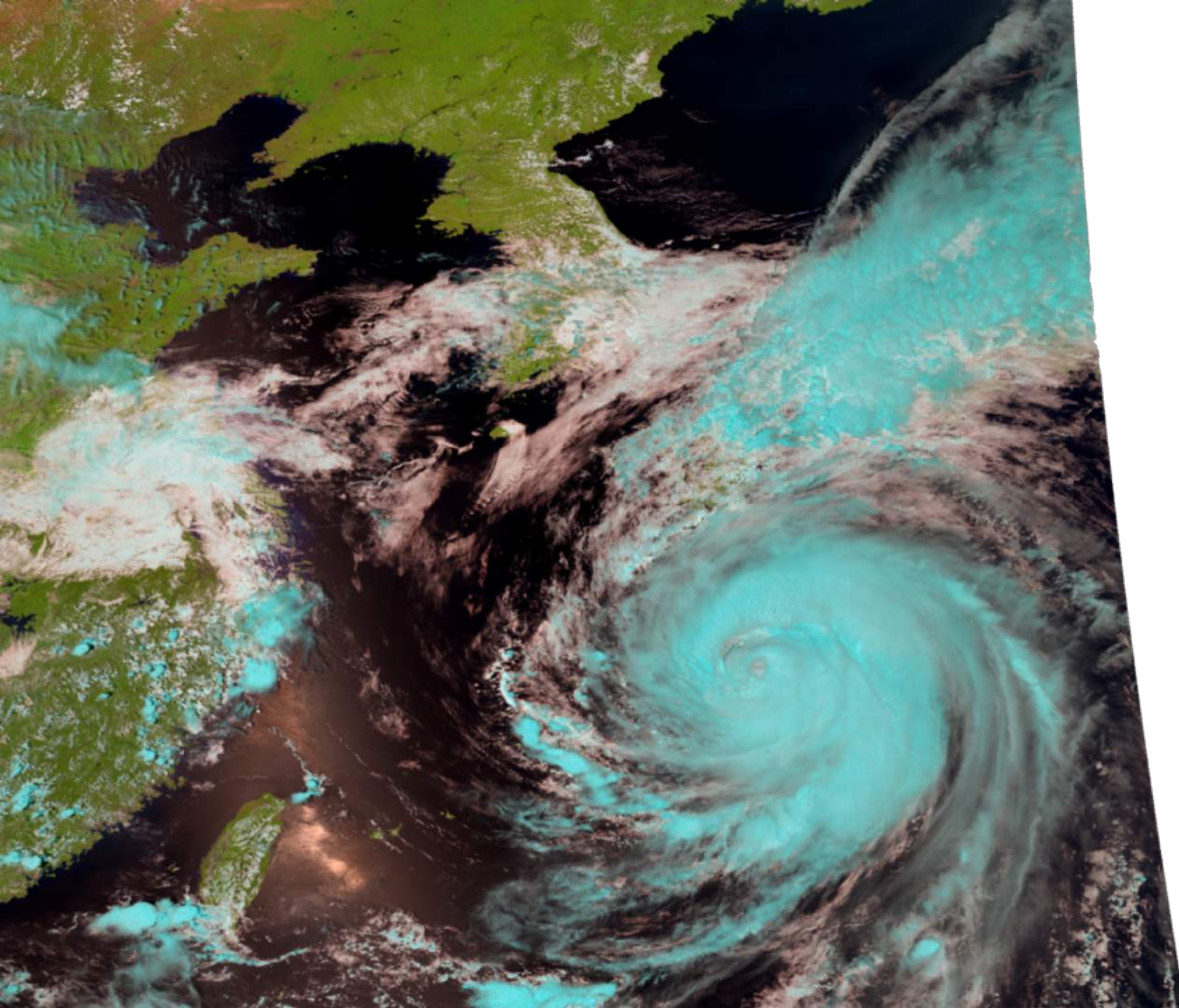
Kimberly Baugh, Mikhail Zhizhin, Feng-Chi Hsu, Tilottama Ghosh

University of Colorado

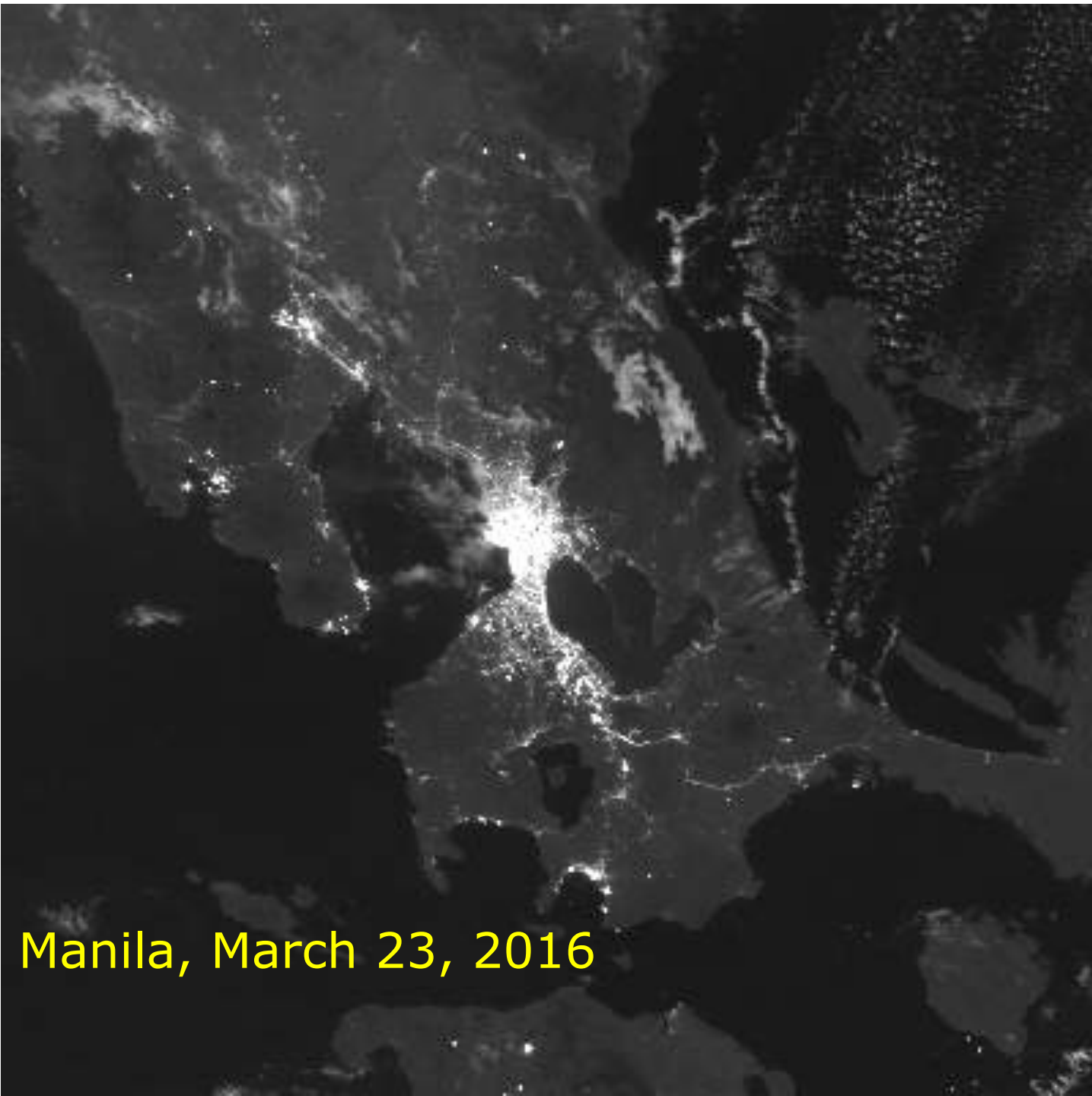
celvidge@mines.edu

February 15, 2019



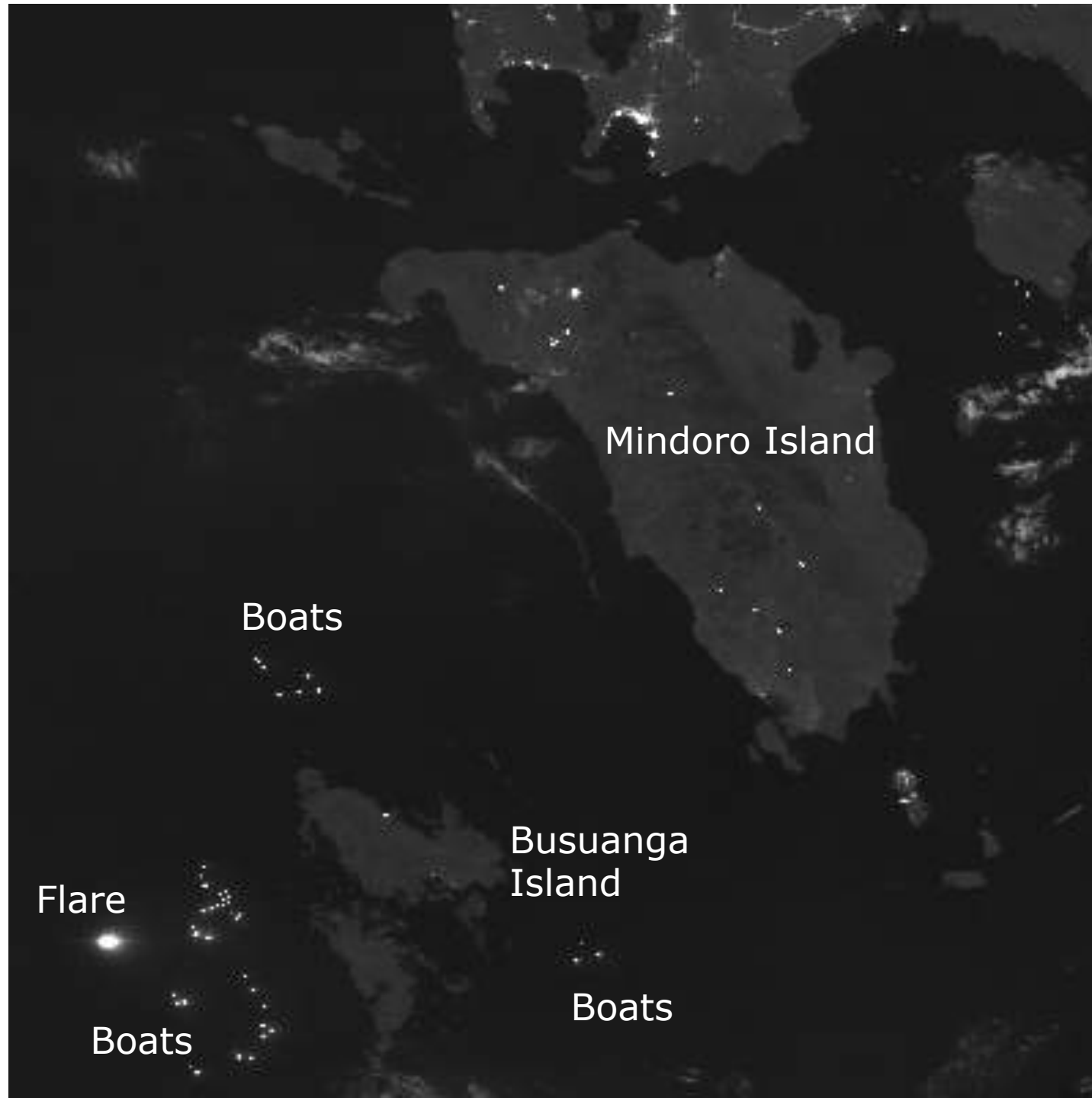


The Visible
Infrared
Imaging
Radiometer
Suite
(VIIRS)
primary
mission is
weather
prediction.

A satellite image of Manila, Philippines, taken at night. The image shows the city's coastline and surrounding areas, with bright white and yellow lights indicating urban development and infrastructure. The clouds are illuminated by moonlight, creating a high-contrast, grainy texture. The overall scene is dark, with the lights providing the primary source of illumination.

Low light
imaging data
are collected
at night to
enable
detection of
moonlit
clouds. Electric
lighting is also
detected.

Manila, March 23, 2016

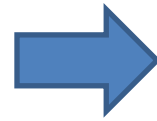


Mindoro
Strait
March 23,
2016
High moon
DNB data.

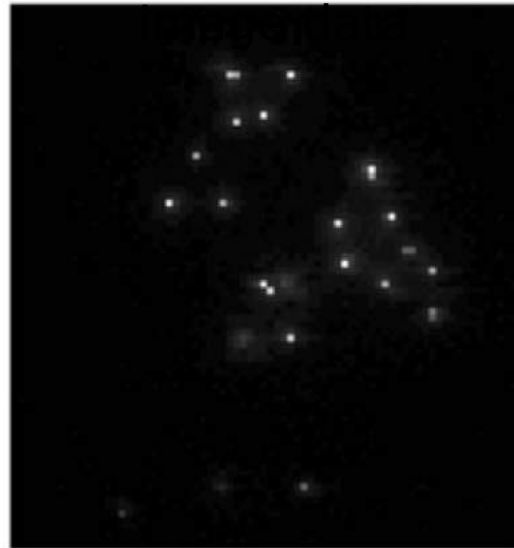
Algorithms run on images, output points, vast data volume reduction



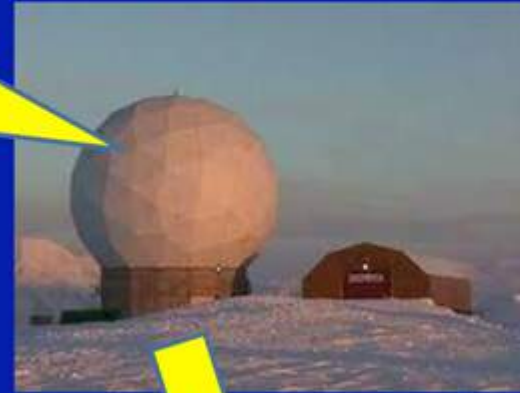
VIIRS
day/night
band (DNB)
nighttime



Boat detection
data (points)



VIIRS Data Flow

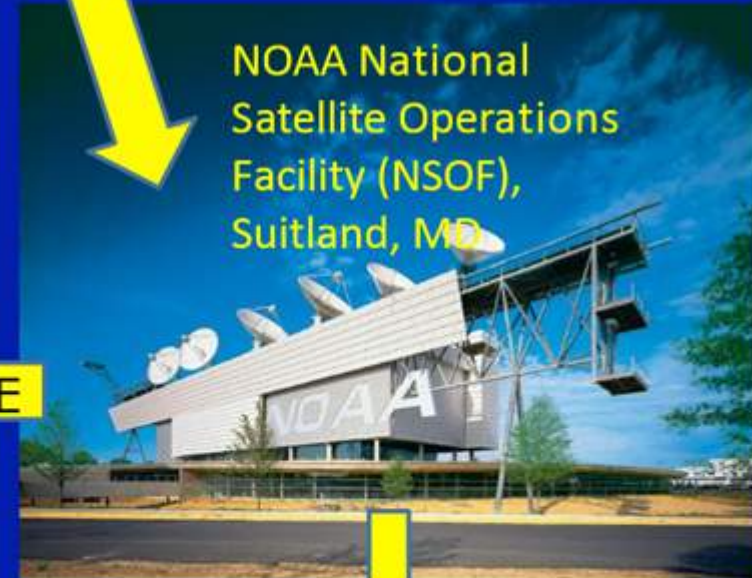


Svalbard
Ground
Station

EOG VBD, VNF, VNL product generation
at NOAA NCEI Boulder, Colorado



Users



NOAA National
Satellite Operations
Facility (NSOF),
Suitland, MD

National Weather Service

GRAVITE

Three temporal aggregations

- Nightly, with individual vessel detections.
- Monthly summary grids of detection tallies and average radiances.
- Annual summary grids of detection tallies and average radiances.

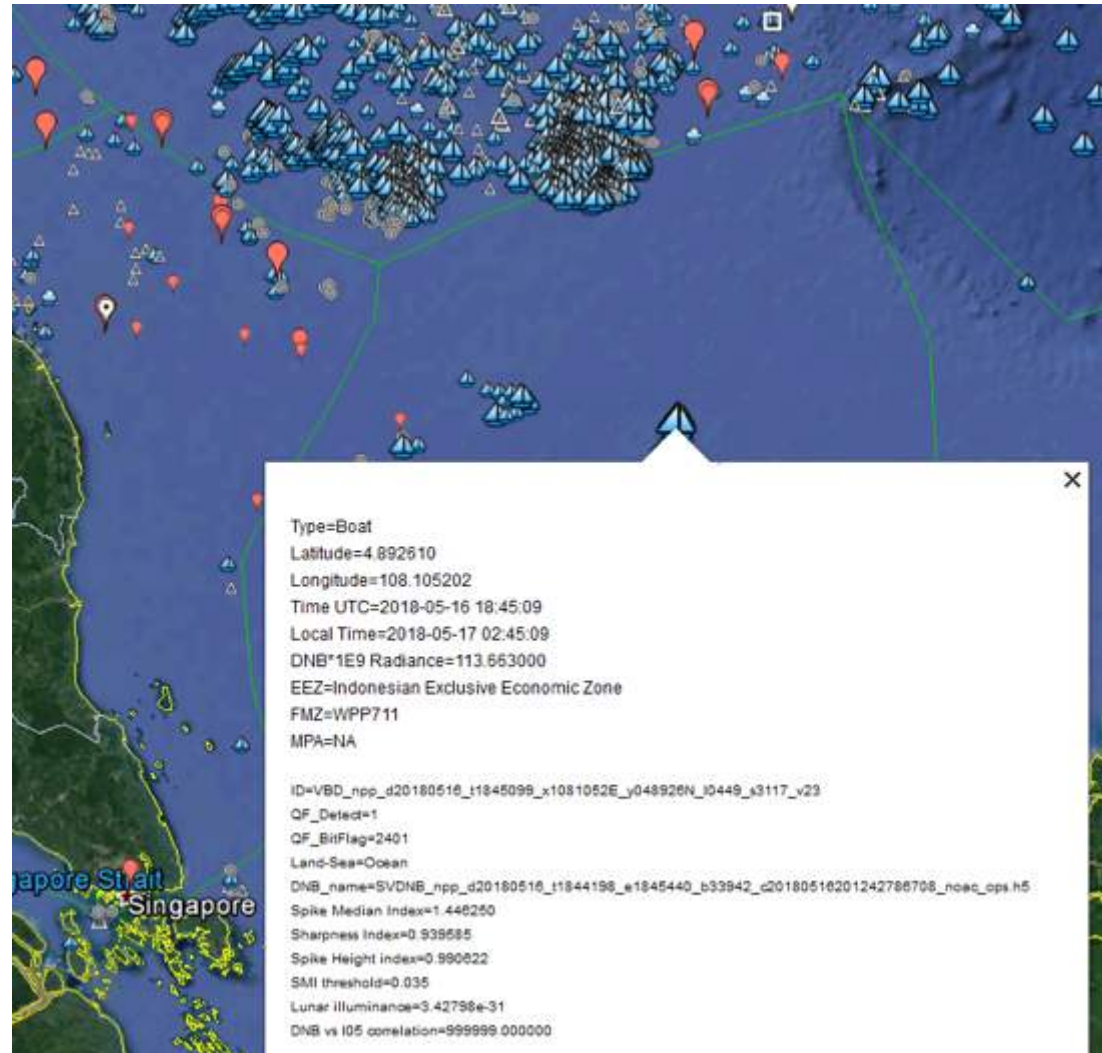
Data Access

- Nightly, monthly and annual data files are available at: <https://eogdata.mines.edu/vbd/>.
- Global annual summary grid for 2017: [https://eogdata.mines.edu/trip the light fantastic/](https://eogdata.mines.edu/trip%20the%20light%20fantastic/)
- Temporal loops of monthly summary grids:
https://www.ngdc.noaa.gov/eog/nighttime_lights_loops.html

Nightly global data with product release target of four hour from observation

Legend for V23 KMZ placemarks

-  Boat (QF=1)
-  Boat near coast (QF=1)
-  Weak (QF=2)
-  Blurry (QF=3)
-  Gas flare (QF=4)
-  Glow (QF=7)
-  Recurring light (QF=8)
-  Weak and blurry (QF=10)
-  Platform (QF=11)



Purse seiner and ring net boats commonly carry string of bare bulbs



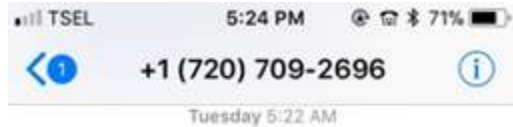
Are small pontoon boats with lights detected?
Probably not, but has not been validated



Twelve shielded 24 W
compact fluorescent
bulbs = 288 watts



VBD alerts sent by email, SMS, and Telegram



Negros Occidental Daily
Summary 2018-02-13
Total detections: 7
goo.gl/cdWBN8

Indonesia WPP715 Daily
Summary 2018-02-13
Total detections: 27
goo.gl/Hd7n1u

Kepulauan Anambas
Marine Conservation
Area - Boat Detection
Alert 2018-02-13
Total detections: 12
goo.gl/iQSpRb

Negros Occidental Daily Summary

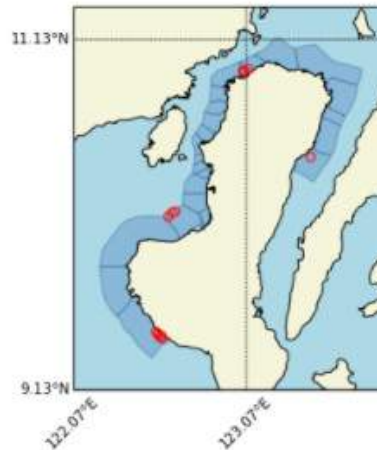
NCEI <ngdc.eognrt@noaa.gov>
to

Negros Occidental Daily Summary 2019-02-09

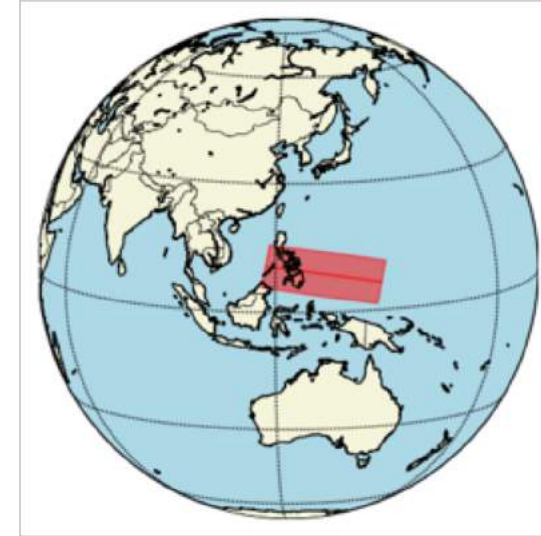
[CSV][KML] Note: These links are valid for 14 days.

Total detections: 12

There are new data in this alert.



Coverage map



====

1 / 12

UTC_Time: 2019-02-08 16:37:33

Local_Time: 2019-02-09 00:37:33

Latitude: 10.946325

Longitude: 123.054108

Color: red

Quality flag= 2 (Medium)

====

2 / 12

UTC_Time: 2019-02-08 16:37:33

Local_Time: 2019-02-09 00:37:33

Latitude: 10.952414

Longitude: 123.061989

Color: red

Quality flag= 1 (Strong)

Summary of VBD detections in MPAs

Countries	Number of units	Area in sq. km.	VBD counts- 2017	VBD counts- 2018
Philippine-LGU Municipal waters	814	311,853	52,745	59,703
Philippine-NIPAS MPAs	28	16,132	589	743
Philippine-Seasonal Closures	4	82,733	1395	1171
Indonesia	192	252,242	24,458	28,460
Cambodia	4	8,758	4	1
Myanmar	2	3,290	59	41
Malaysia	48	11,801	100	111
Thailand	49	13,733	8,530	8,857
Vietnam	30	8,106	41,918	46,454
TOTALS	1171	708,649	129,798	145,541

The alerts are being used by Philippines BFAR to plan enforcement patrols for commercial fishing boats operating illegally in municipal waters. BFAR reported more than 20 apprehensions credited to VIIRS in 2018.



VIIRS Continuity

- The first VIIRS was launched in 2011.
- The second in 2017.
- Third is built and is slated to fly circa 2022.
- Fourth and fifth are under construction.
- Each has a five year design life, which is usually exceeded.
- It is anticipated that NASA and NOAA will design, build and fly an even more advanced instrument series prior to the end of VIIRS data collections.
- Bottom line is – there are excellent prospects for the product lines to continue to 2030 and beyond.

Limitations

- VBD only provides locations, date/time, and radiance. None of the detailed metadata of AIS or VMS.
- Not all fishing boats are lit sufficiently for detection.
- Some of the detected boats are not fishing 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.

Summary

- VIIRS detects boats using light at night.
- The product is global every night.
- File sizes are modest, readily downloaded.
- Alerts can be sent for individual zones of interest, such as MPAs.
- In Asia, VIIRS detects vastly more numbers of vessels than AIS or VMS.
- Temporal records extending back to 2012, making it possible to monitor trends, outline fishing grounds, and assess the effectiveness of enforcement and management efforts.