

# Living in a sea of images: discovering and exploring our world from space



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# SEMINAR OUTLINE

- **What uses?** – to track environmental changes, military activities, migrations, natural disasters, human activity, etc. Case studies involving artists, activists & journalists.
- **Available tools & resources**  
Different platforms (databases) contain different imagery, taken at different times in different resolutions.
- **Google Maps & Google Earth Pro**  
Pros & cons, latitude & longitude
- **Seeing & recording changes on earth**
  - with Google Earth
  - with [Google Earth Engine's Timelapse](http://earthengine.google.com/timelapse) - [earthengine.google.com/timelapse](http://earthengine.google.com/timelapse)
- **Key concepts & exercises**  
Acquisition, spatial resolution, spectral resolution, temporal resolution, positional accuracy
- **How to tell stories with satellite imagery**
  - Verifying images with Google Earth & StreetView
  - Comparing satellite imagery over time
  - Finding and importing KML and KMZ files into Google Earth
  - Creating video with Google Earth

<https://www.nytimes.com/video/world/middleeast/100000005738262/turkey-drone-attack-kurds-syria.html>

# The Blue Marble

**One of the most reproduced images in human history.**

Taken on Dec 7 1972 by the crew of Apollo 17, the last manned lunar mission.

**It became a symbol of the environmental movement, as a depiction of Earth's frailty, vulnerability, and isolation amid the vast expanse of space.**






**The Pale Blue Dot**

Until 2005, the only ones who could observe the earth from space were astronauts...

Today, we can all do it from the comfort of our homes and for free.


**The entire planet is just a mouse-click away!**




 **DSCOVER: EPIC**  
Earth Polychromatic Imaging Camera


Science ▾ Images ▾ Galleries About ▾ Publications


**Image Information** ▾


[epic\\_1b\\_20180930003634](#) 


Processing Version: 02

Distance to Earth: 888,671 miles 

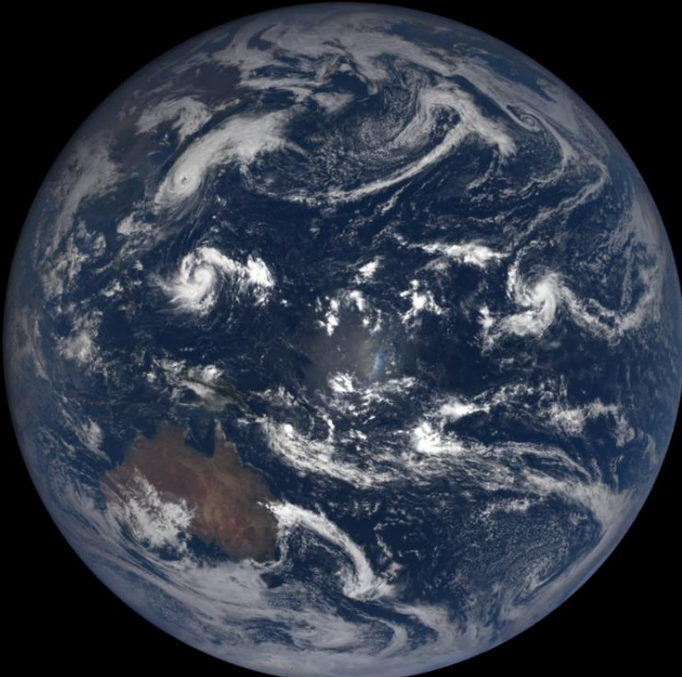
Distance to Sun: 92,210,438 miles 

Sun to Earth: 93,092,115 miles 

SEV Angle: 7.16° 



**Slideshow Controls** ▾



[epic.gsfc.nasa.gov](http://epic.gsfc.nasa.gov)



# PLANET.COM...

The entire planet is now photographed every day with...

+ 200 micro-satellites put into orbit thanks to...

21 rocket launches

30 radio receivers on the ground

1,5 million images of 29 Mb each (6 Tb every day)

planet.

CONTACT SALES SIGN UP LOG IN

PRODUCTS MARKETS DEVELOPERS COMPANY BLOG

planet.

2018.05.10

Monitor. Discover. Take action.  
Planet's daily monitoring enables detection of deforestation and changes in land use. Gain valuable insight into single events, understand what's happening on the ground, and take action when you detect a trend.

LEARN MORE

PlanetScope data reveals development of a plantation in the Brazilian Amazon.  
By Will Marshall

in f t

LATEST NEWS Planet Launches Planet Analytics Beta to Transform Imagery into Insights Read more

Monitor Daily  
Monitor change on the ground with a one-of-a-kind dataset to make informed decisions

Discover Trends  
Model solutions to understand trends, predict change, and extract more actionable information

Deliver Insights  
Deliver results at the speed of change with a fully-automated platform and scalable APIs and web tools.

# STARLINK: SPACEX'S SATELLITE CONSTELLATION

**12,000 satellites...**  
the size of a **pizza box!**...  
launched by SpaceX,  
Elon Musk's company...

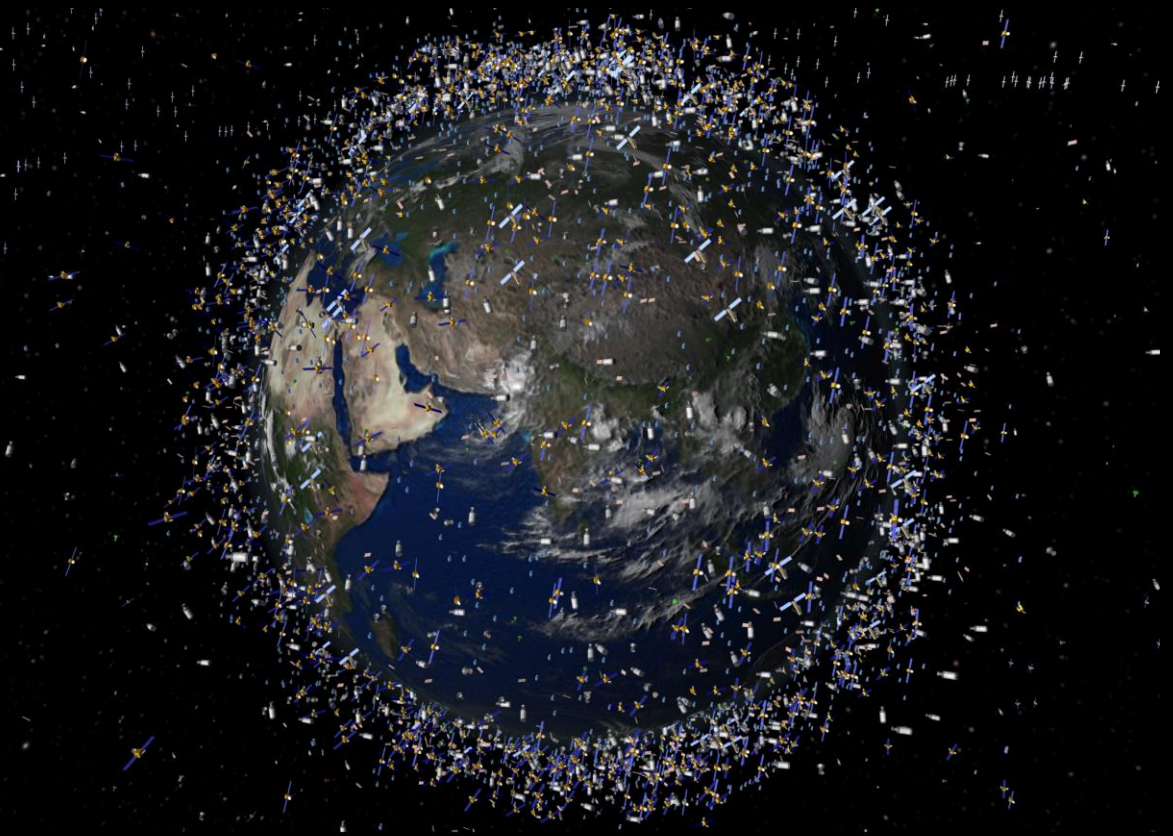
The 2<sup>nd</sup> of 200 launches  
took place last week with  
the deployment of 60  
satellites...

SpaceX has wants to  
deploy an **additional**  
**30,000 satellites** in the  
coming years.





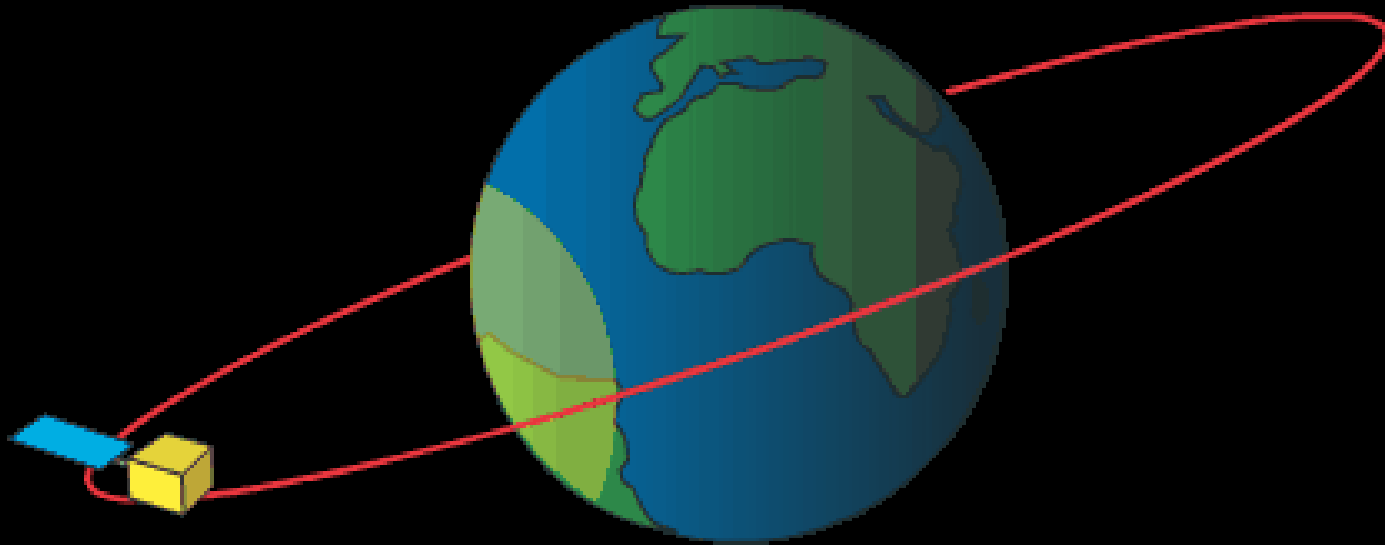
# Space: a crowded place...



The derelict Russian satellite **Cosmos 2251** had been spinning around Earth for nearly 15 years when, **in 2009**, it **slammed into a functional Iridium telecommunication satellite** at **26,000 miles per hour**.

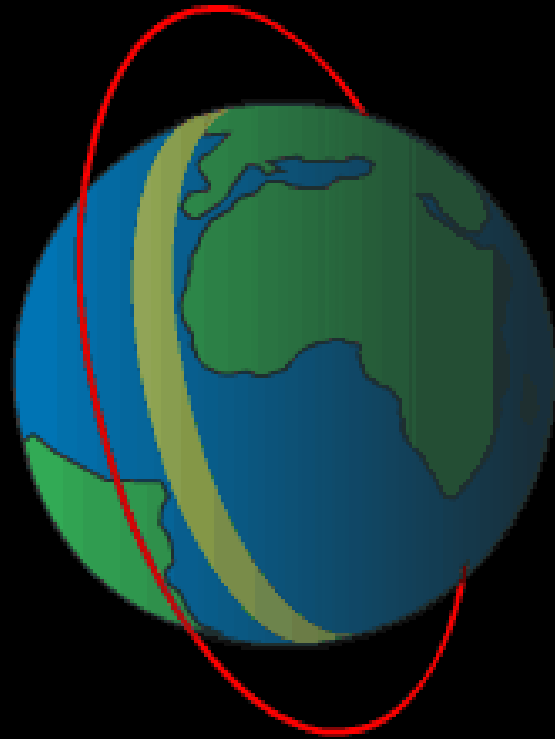
This collision sprayed about **200,000 centimeter-sized bits of debris** into orbit around Earth. **Another 3,200 broken pieces from the crash were much larger, at 10 centimeters or greater in size**. Each of these objects now threaten to pierce, damage, or destroy any other satellites unlucky enough to be in their way.

Note: Artist's impression; size of debris exaggerated as compared to the Earth



# Satellites géostationnaires

Altitude: 36000 km



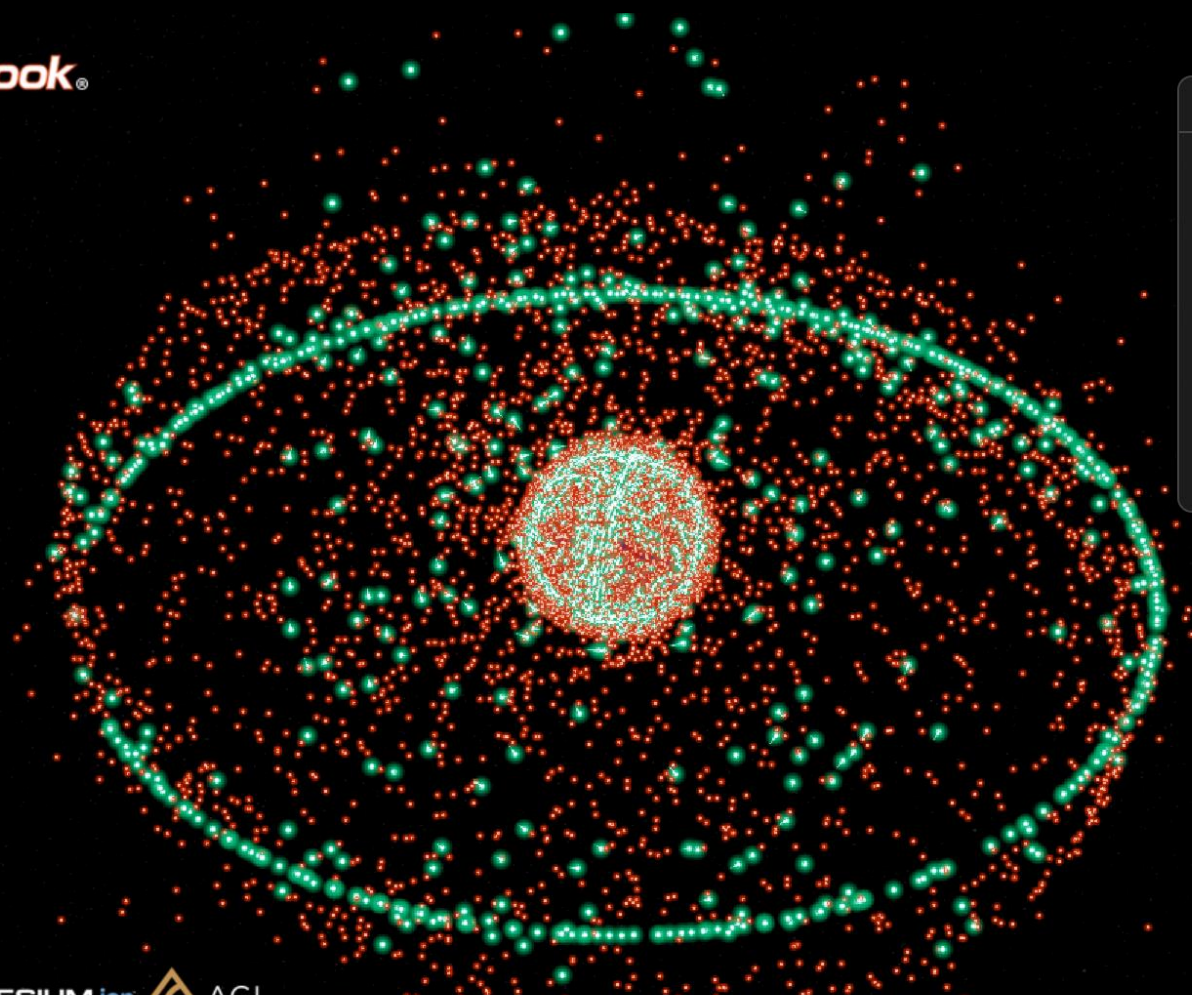
## Satellites en orbite basse

Orbites circulaires par rapport à la Terre (polaires ou non-polaires)

# Space: a crowded place...



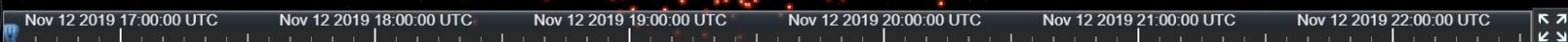
- Active
- Debris
- Name
- SSC Number
- Status
- Orbit
- Mission
- Owner



Mouse Touch

- Detail view**  
Left click on any object for more info
- Pan view**  
Left click + drag
- Zoom view**  
Right click + drag, or Mouse wheel scroll
- Rotate view**  
Middle click + drag, or CTRL + Left/Right click + drag

1x  
Nov 12 2019  
16:33:50 UTC



Objects: 17801  
Showing: 17801  
[Privacy Policy](#) ✕

[apps.agi.com/SatelliteViewer](https://apps.agi.com/SatelliteViewer)

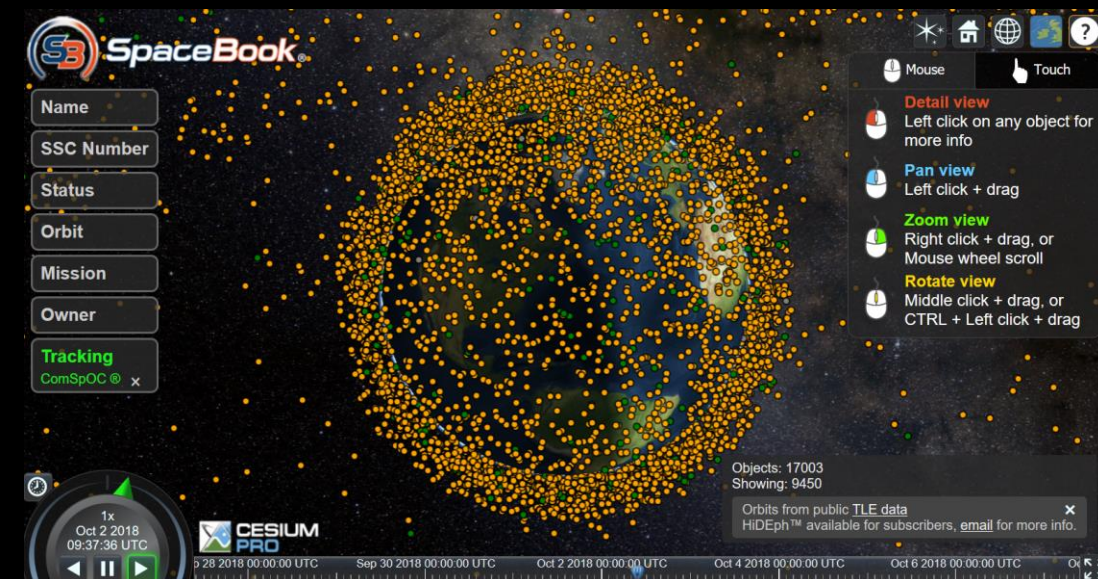
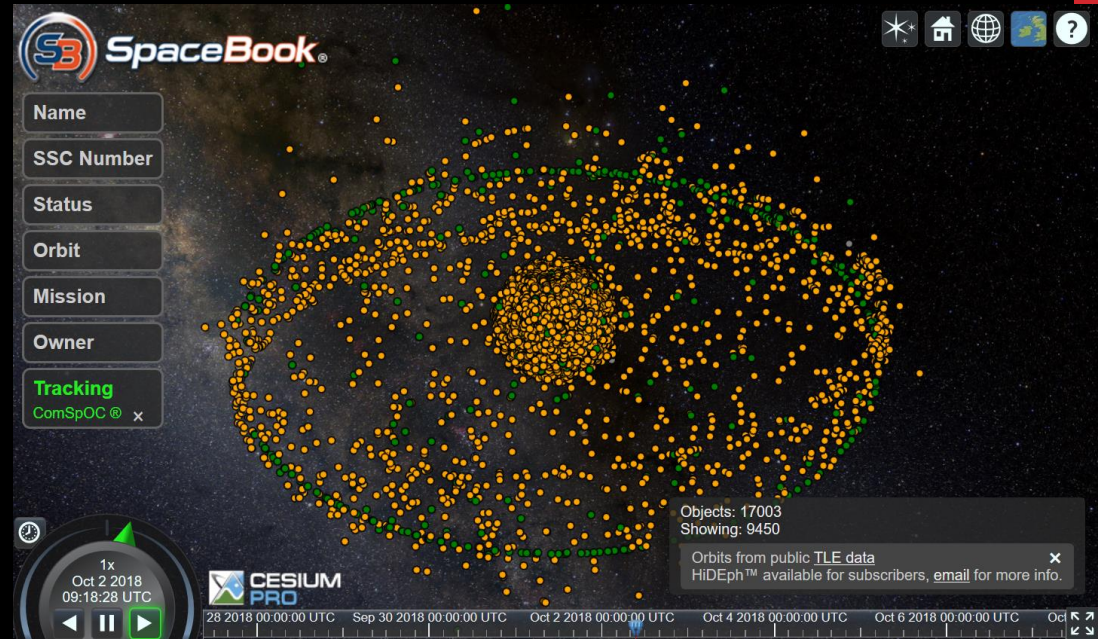
# Space: a crowded place...

About 5000 satellites in orbit (1900 are operational, the other ones are space debris).  
+ 40,000 pieces of space junk

453 objects launched in 2017 alone, most of which 'cubesats', miniature shoebox-size satellites.

Video: **Return of the Blue Marble - Planet Earth - Science at NASA (1:07-**

[apps.agi.com/SatelliteViewer](https://apps.agi.com/SatelliteViewer)



# Satellite captures space junk for the first time

[money.cnn.com/2018/09/20/technology/space-debris-capture/index.html](https://money.cnn.com/2018/09/20/technology/space-debris-capture/index.html)



**Video:** [RemoveDebris executes first successful capture of space junk](#) (1:11)

**LINKS...**

**[bourgoing.com/satellite](http://bourgoing.com/satellite)**

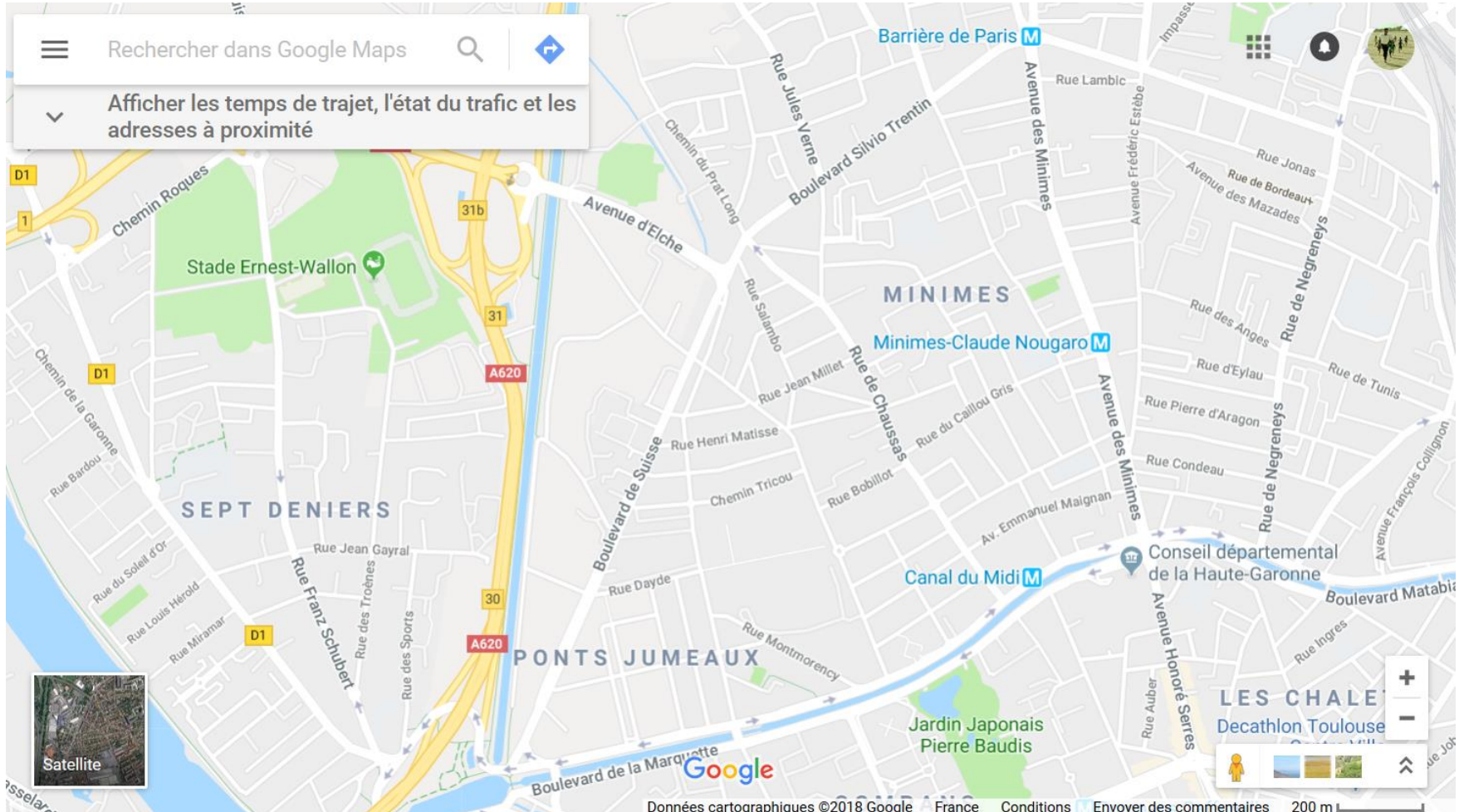
# TOOLS & RESOURCES





# GOOGLE MAPS

[google.fr/maps](https://google.fr/maps)



# GOOGLE MAPS

[google.fr/maps](https://google.fr/maps)

- Search Bar
- Satellite view versus Earth view
- 3d view
- Street view
- Historic Street View
- Distance measurement
- GPS coordinates (latitude & longitude)

# OTHER MAPPING TOOLS

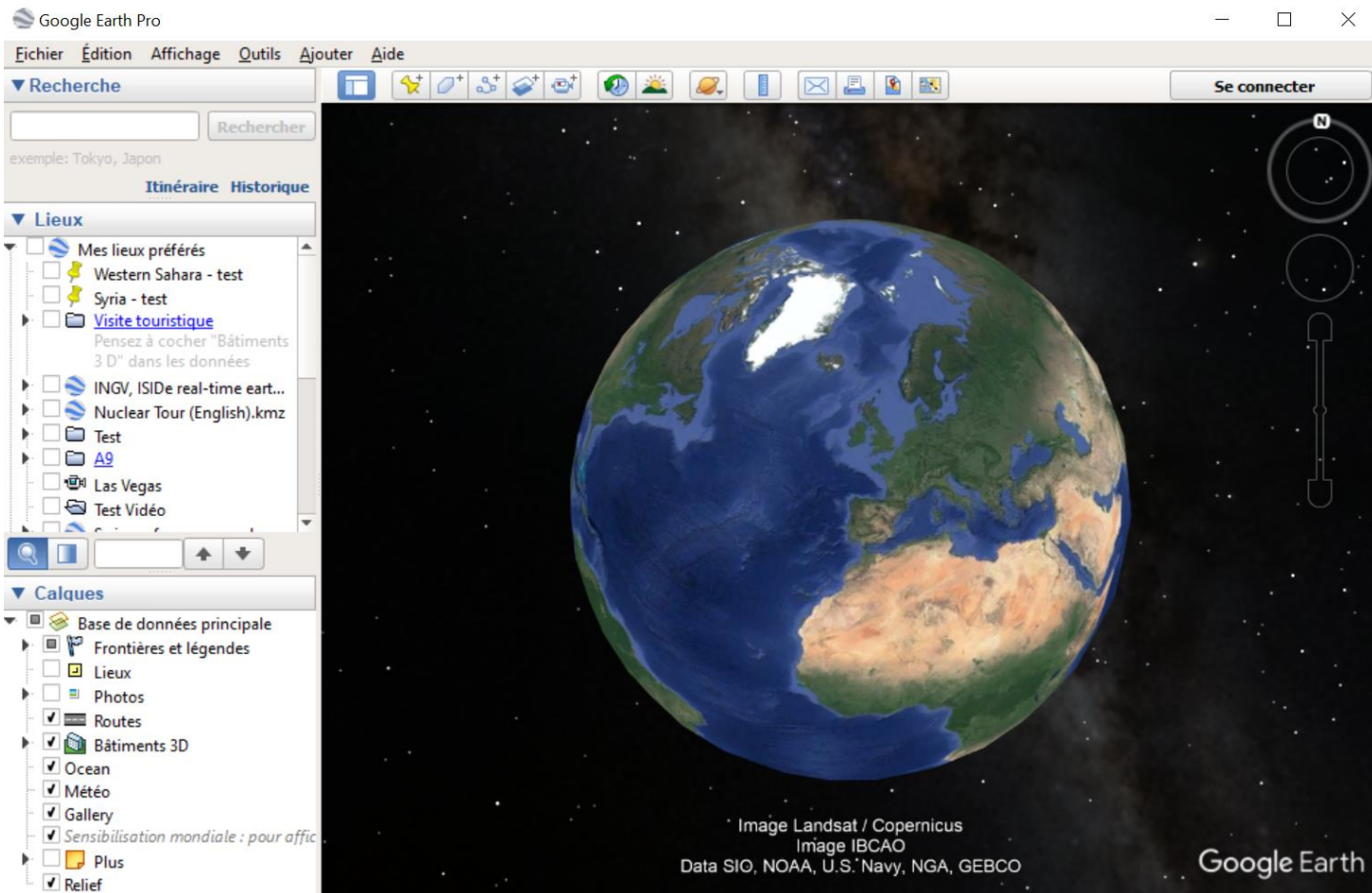
➤ Bing Maps: [bing.com/maps](http://bing.com/maps)

➤ Dual Maps:  
[data.mashedworld.com/dualmaps/map.htm](http://data.mashedworld.com/dualmaps/map.htm)

# GOOGLE EARTH

online version: <http://www.g.co/earth> or [earth.google.com](http://earth.google.com)

software version: [google.com/earth/download/gep/agree.html](http://google.com/earth/download/gep/agree.html)



Video: [Google Earth's Incredible 3D Imagery, Explained](#) (8:08)

# SEEING FROM ABOVE

A SERIES OF RESOURCES ON COLLECTING, ANALYSING AND SHOWING VISUAL EVIDENCE FROM ABOVE

SEEING THE WORLD THROUGH GOOGLE'S EYES



Uncovering hidden infrastructure and landscapes

MIKEL MARON



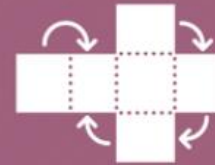
Crowdsourcing satellite imagery of deforestation

FLIGHTRADAR24



Tool review for tracking flights in real time

STARTING SATELLITE INVESTIGATIONS



A how-to on getting started with satellites

LEA SCHAFFNER



Switching Perspectives

JAMES BRIDLE



Hidden in Plane Sight

# GOOGLE IMAGES: FOR ARTISTS





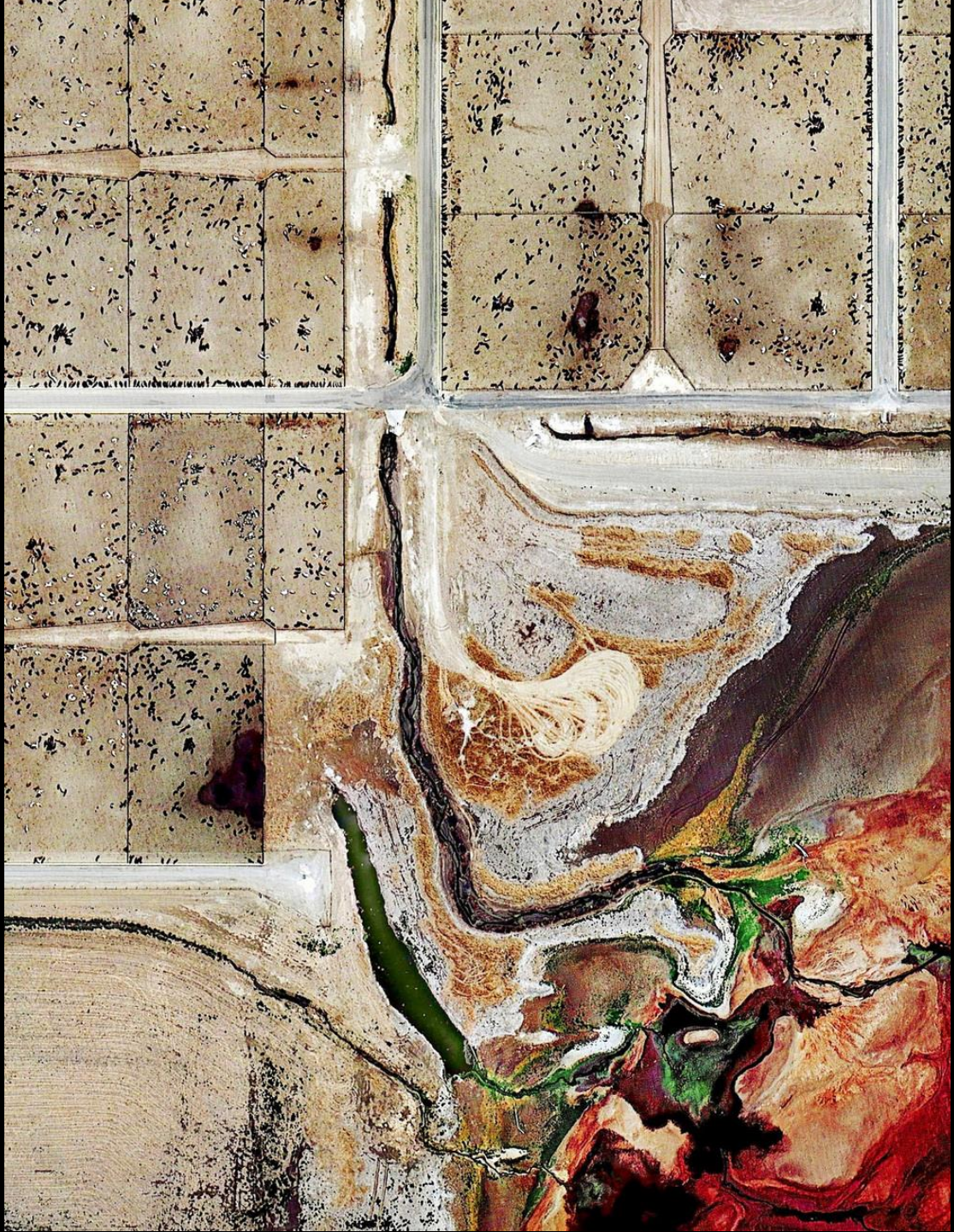
























# MISHKA HENNER

[mishkahenner.com/feedlots](http://mishkahenner.com/feedlots)



***“I first came across these feedlots on Google Earth and had no idea what I was seeing.***

*The mass and density of the black and white dots seemed almost microbial. To understand what they were I had to learn about the meat industry and its methods for maximizing yield in the minimum amount of time for the highest profit.”*

**To produce 1 kilo of meat, it takes 13000 to 15000 litres of water.**

***“It used to take five years for a cow to reach its mature weight, ready for slaughter and processing. Today, since the structures and processes of feed yards have been perfected, that has been reduced to less than 18 months.***

***Such speed requires growth hormones and antibiotics in cows' diets, and efficient feedlot architecture. Farmers can turn to reports to help calculate the maximum number of cattle that can fit in each pen, the minimum size of run-off channels that carry away thousands of tons of urine and manure, and the composition of chemicals needed to break down the waste as it collects in lagoons and drains into the soil. Different chemical mixes explain the varying toxic hues of each lagoon.***

*These pictures were made by stitching together hundreds of high-resolution screen shots from publicly accessible satellite imaging software. The results are prints of great clarity and detail that capture the effects of feedlots on the land.*

*The meat industry is a subject loaded with a moral and ethical charge. But when I think of these pictures, I don't just see gigantic farms, I see an attitude toward life and death that exists throughout contemporary culture. These images reflect a blueprint and a horror that lie at the heart of the way we live.” — [Op-Ed, LA Times](#)*

# FOR ACTIVISTS: TO ILLUSTRATE OUR CONSUMERIST SOCIETY...

“Feedlots”

Where are hamburgers are produced...



<https://mishkahenner.com/Feedlots>

**Video:** [Precious Commodities - Feedlots - Google Earth](#)

**Video:** [Drones Expose Massive Beef Feedlots \(1:45\)](#)

# EXERCISE

**With Google Earth, fly to different feedlot locations in the USA and try to see how they have increased in size over time.**

1. Randall County Feedyard, Amarillo, Texas
2. Tascosa Feedyard, Bushland, Texas
3. Coronado Feeders, Dalhart, Texas
4. Centerfire Feedyard, Ulysses, Kansas
5. Friona Feedyard, Parmer County, Texas
6. Wrangler Feedyard, Tulia, Texas
7. Black Diamond Feedyard, Harrington, Texas

# FOR ACTIVISTS: TO ILLUSTRATE OUR CONSUMERIST SOCIETY...



Photo: George Steinmetz – Big Food

# SEEING CHANGE OVER TIME...

☰ Google Earth Engine

The screenshot displays the Google Earth Engine interface. At the top left, there are navigation controls: a compass, a zoom-in (+) and zoom-out (-) button, and a scale bar showing 5 km and 5 mi. A search bar with the text "Search for places..." and a magnifying glass icon is located at the top center. The main map area shows a satellite view of Miami, Florida, with a timeline at the bottom. The timeline starts at 1984 and ends at 2016, with a "Fast" button and a play/pause icon. A thumbnail strip at the bottom shows various locations: Miami (selected), Brisbane, Australia, Shirase Glacier, Polarforschung, San Francisco, and Lassen Volcanic Park. An inset map in the top right corner shows the location of Miami relative to Hialeah and Doral, with road numbers 826 and 836. The Google logo is visible in the bottom right corner of the map area.

Timelapse

[earthengine.google.com/timelapse](https://earthengine.google.com/timelapse)

🔗 Share or Embed

# FOR ACTIVISTS: TO ILLUSTRATE DEFORESTATION...

With Google Earth, zoom in on any part of Western Brasil and use the historic view to see the forest disappear...

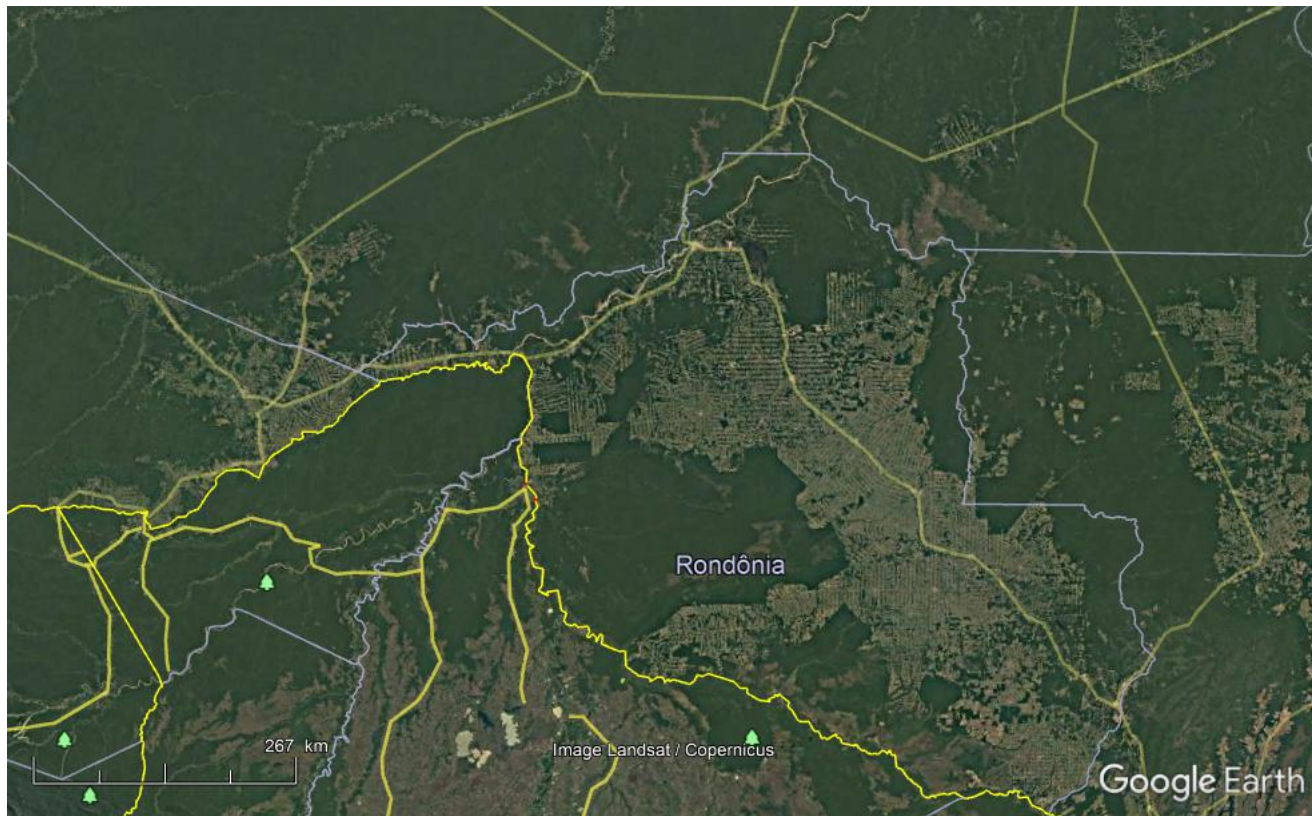




Image Landsat / Copernicus

Google Earth



# FOR ACTIVISTS: TO ADVOCATE AGAINST SOCIAL INJUSTICE...



**This is Malkiyya.**

**How many times of  
Malkiyya's population  
can this area  
accommodate?**

**But sorry... Not for sale!**

**Owned by a ruling family  
member!**

**Legal?!!**

**malkiyya, bahrain (ou Al-Mālikīyah, Bahreïn)**

[exposingtheinvisible.org/resources/starting-satellite-investigations](http://exposingtheinvisible.org/resources/starting-satellite-investigations)

# FOR ACTIVISTS: TO ADVOCATE AGAINST SOCIAL INJUSTICE...

*In 2006, a group of Bahraini activists used Google Earth to view palaces and land owned by the elite that was situated next to overcrowded cities. This exploration revealed vast stretches of unused open spaces along with luxury properties and golf courses all owned by the ruling minority. The group compared these big, empty spaces with the crowded, built up areas that the majority of people lived in.*

*In response the Bahraini government blocked Google Earth in order to prevent further dissemination. The group circumvented this by distributing emails containing an anonymous PDF of these satellite images which contributed to growing unrest about the lack of affordable housing.*

*Without this view from above many of these properties were hidden behind walls and 'no trespassing' signs. They were out of sight, subject to the phenomenon of not being able to see the forest through the trees, something which an aerial perspective overcomes, moving the viewer above the trees to make observations and comparisons not possible on the ground.*

*Or as Mahmood Yousif, who is known as the grandfather of the Bahraini blogging community stated to the [Financial Times](#), "Some palaces take up more space than three or four villages nearby and block access to the sea for fishermen. People knew this already. But they never saw it. All they saw were the surrounding walls."*

**malkiyya, bahrain (ou Al-Mālikīyah, Bahreïn)**

**[exposingtheinvisible.org/resources/starting-satellite-investigations](http://exposingtheinvisible.org/resources/starting-satellite-investigations)**

# KEY CONCEPTS

How/where to find GPS coordinates in Earth & Maps

Longitudes & latitudes: **decimal** versus **sexagecimal** system

KML: **K**eyhole **M**arkup **L**anguage

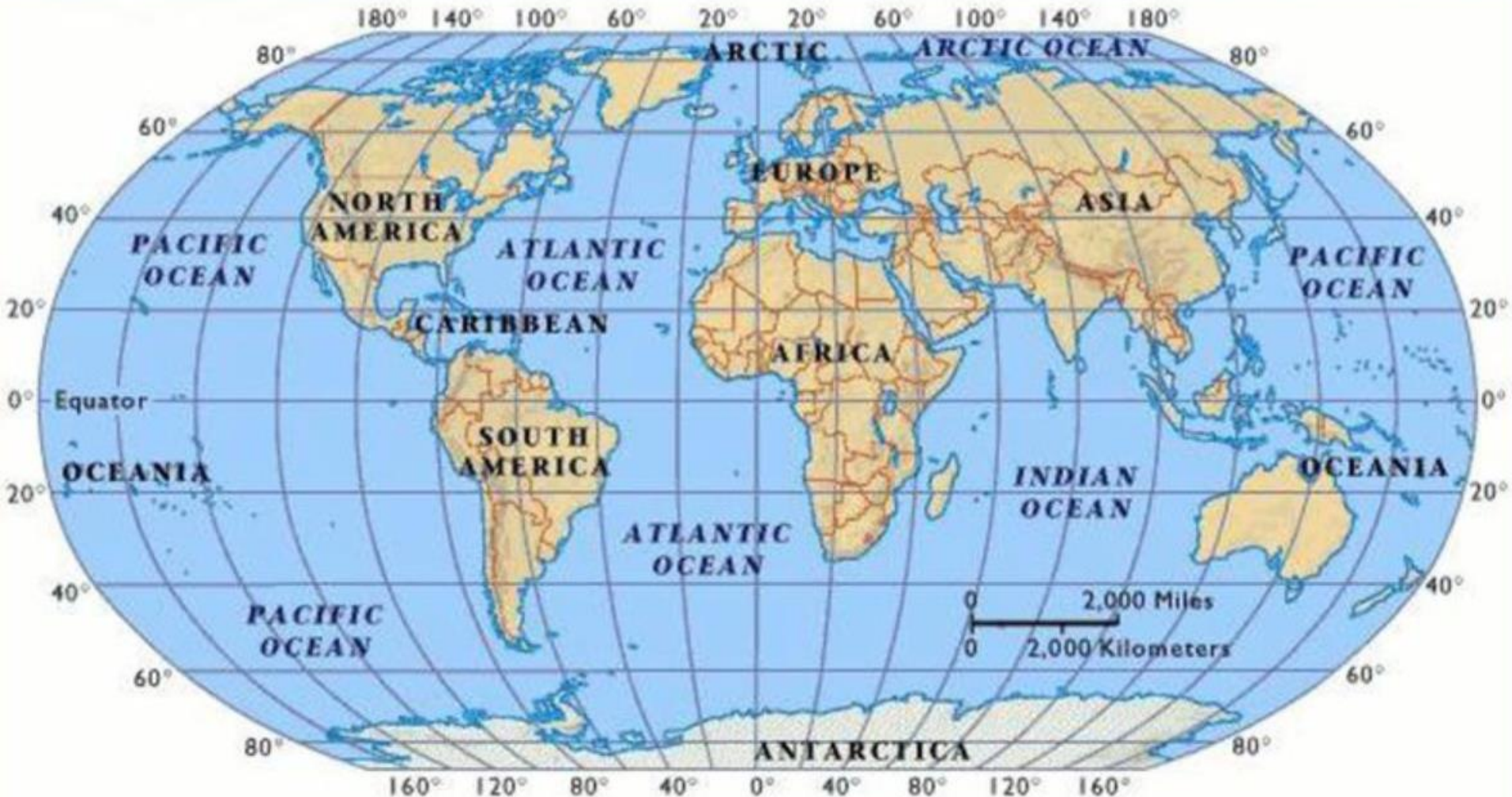
KMZ files: **K**eyhole **M**arkup language **Z**ipped

Google Earth layers

# LONGITUDES & LATITUDES

360 degrees **longitude** (vertical lines)

180 degrees **latitude** (horizontal lines – parallel to the equator)



# KEY CONCEPTS:

## SPATIAL VS SPECTRAL VS TEMPORAL RESOLUTION & ACCURACY

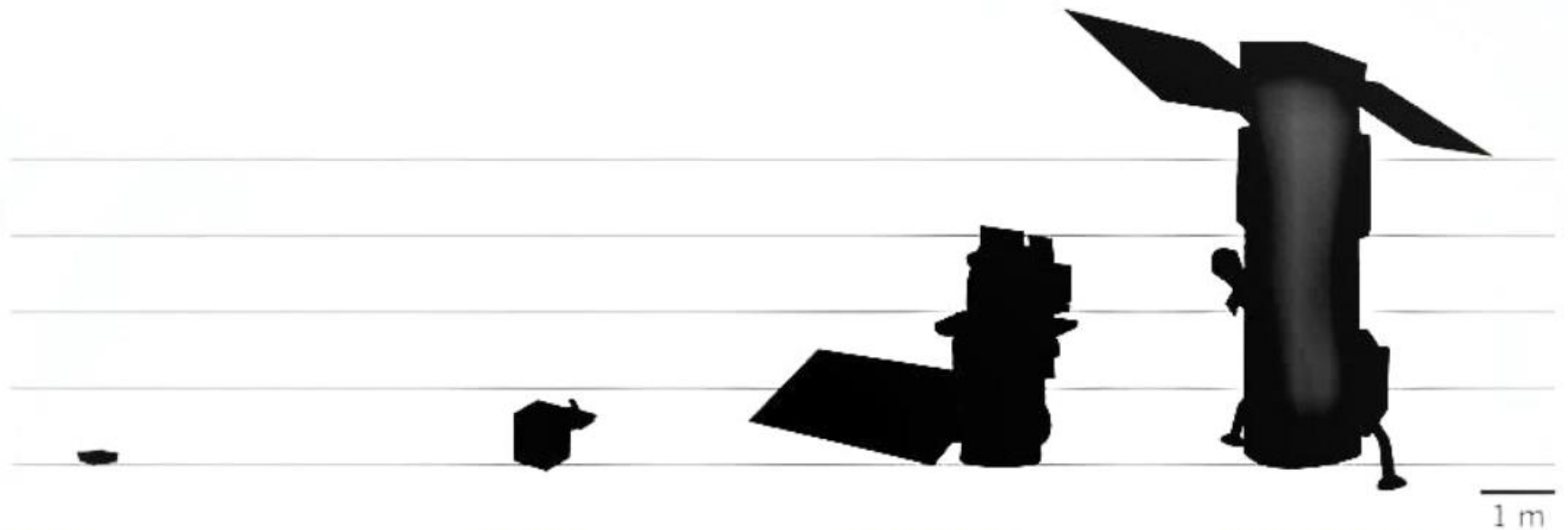
### Acquisition

Video: [Earth Imaging - Episode I – Acquisition](#) (from 0:45)

### Spatial resolution (see next slides first)

Video: [Earth Imaging - Episode II – Resolution](#)

# CONSTELLATIONS DE SATELLITES & RÉOLUTION SPATIALE



## DOVE

**Operator:** Planet Labs

**Weight:** ~5 kg

**Instruments:** Optical and near-infrared spectral bands

**Spatial resolution:** 3–5 m

## SKYSAT

~100 kg

Optical and near-infrared spectral bands

~1 m

## LANDSAT 8

NASA

2,071 kg<sup>†</sup>

Multiple spectral bands

15–100 m<sup>‡</sup>

## WORLDVIEW-3

DigitalGlobe

2,800 kg

Multiple spectral bands

0.3–30 m<sup>‡</sup>

<sup>†</sup> Without instruments    <sup>‡</sup> Depending on spectral frequency

# CONSTELLATIONS DE SATELLITES & RÉOLUTION SPATIALE



The DigitalGlobe constellation. Each satellite costs “several hundred million dollars” to build and launch  
(Images – DigitalGlobe)

# CONSTELLATIONS DE SATELLITES & RÉOLUTION SPATIALE



## WorldView-4

Introducing WorldView-4, a multispectral, high-resolution commercial satellite. Operating at an expected altitude of 617 km, WorldView-4 provides 31 cm panchromatic resolution, and 1.23 m multispectral resolution. WorldView-4 has an average revisit time of <1 day and is capable of collecting up to 680,000 sq km per day, further enhancing the DigitalGlobe collection capacity for more rapid and reliable collection.

(Images and infographic – DigitalGlobe)



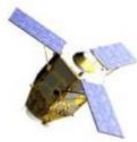
# CONSTELLATIONS DE SATELLITES & RÉSOLUTION

DigitalGlobe



**WorldView-4**  
Launch Mass 2,485kg

AIRBUS



**Pleiades**  
Launch Mass 970kg

planet.



**PlanetScope (Dove)**  
Launch Mass 4kg

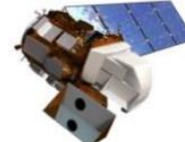
esa



**Sentinel-2**  
Launch Mass 1,130kg

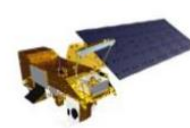
NASA

USGS

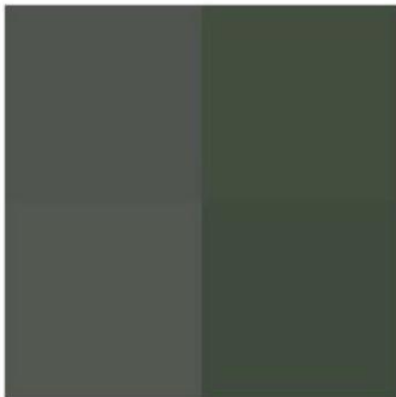


**Landsat-8**  
Launch Mass 2,780kg

NASA



**Aqua (MODIS)**  
Launch Mass 2,934kg



**Aqua (MODIS)**  
250m Resolution



**Landsat-8**  
30m Resolution



**Sentinel-2**  
10m Resolution



**PlanetScope (Dove)**  
3m Resolution



**Pleiades**  
0.5m Resolution



**Worldview-4**  
0.3m Resolution

# FOR JOURNALISTS & ACTIVISTS: TO SPOT MILITARY ACTIVITIES...



# Strava Global Heatmap : [strava.com/heatmap](https://strava.com/heatmap)

- Doesn't explain what you see
- Uses outdated satellite imagery
- But shows where to look and what area to investigate further using other satellite imagery and tools

STRAVA | LABS

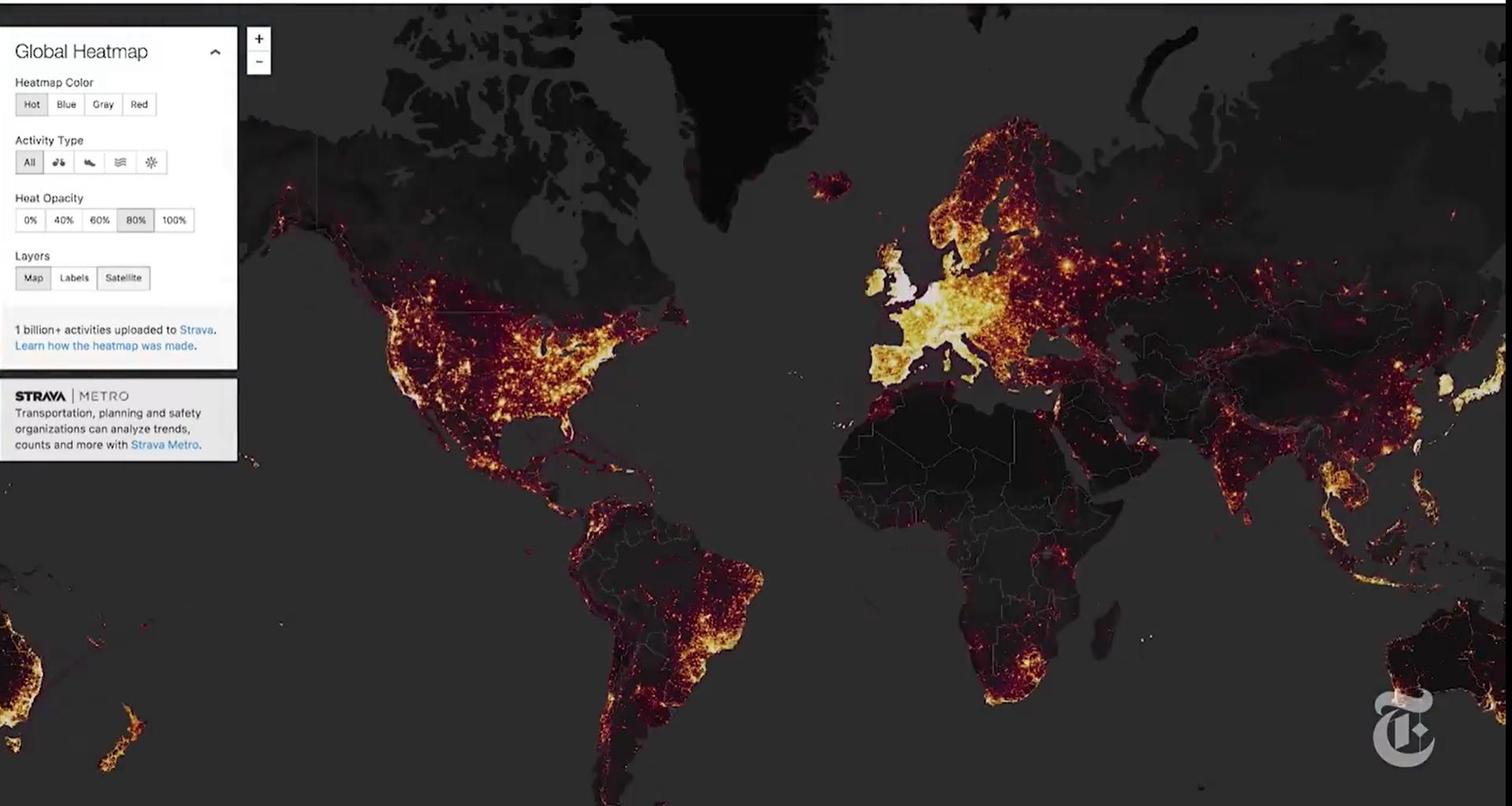
[Projects](#)

[Blog](#)

[Developers](#)

[Strava.com](#)

[Careers](#)



# FOR JOURNALISTS & ACTIVISTS: TO SPOT MILITARY ACTIVITIES...

## Videos:

How a Fitness App's Heat Map UnCOVERS Military Bases NYT (3:57)

Satellite Images Reveal the Birth of a Drone Base (2:14)

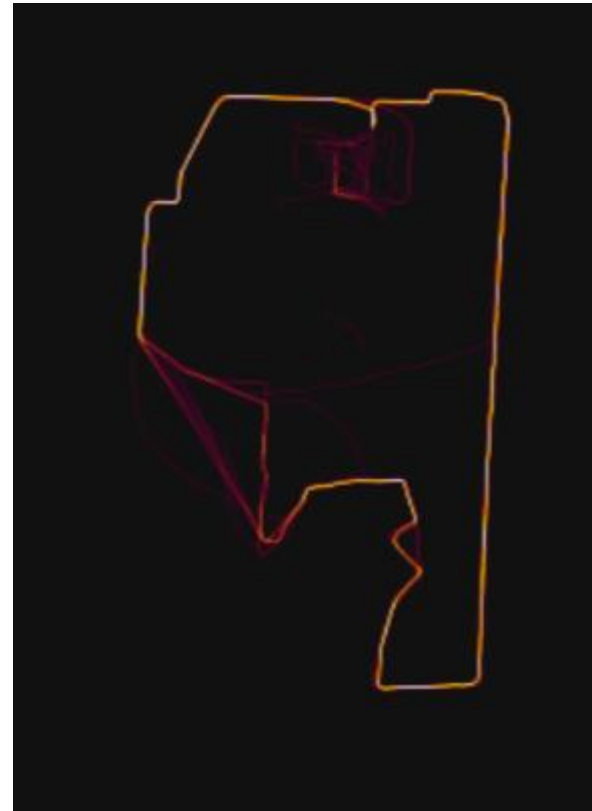


# EXERCISE

## Exercice d'investigation avec des images satellitaires...

A l'aide de l'outil Strava Global Heatmap, vous détectez **dans le nord du Niger** une activité inhabituelle.

A l'aide du web, de Strava, Google Earth et de tout autre outil pertinent, déterminez à quoi correspond ce lieu et en quoi les activités qui y ont cours ont changé depuis quelques années.



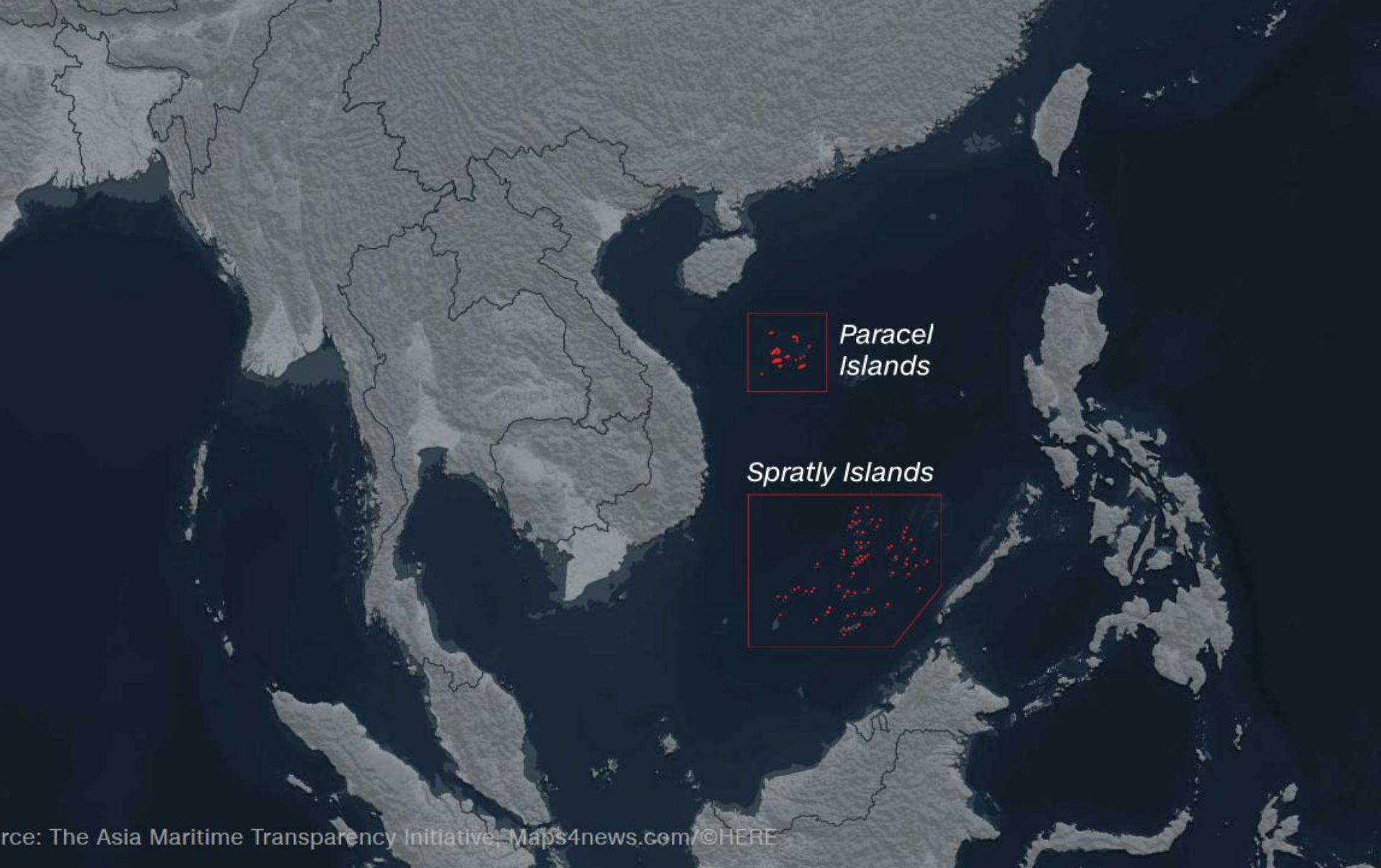


# TO SPOT MILITARY ACTIVITY...

## Exercice d'investigation avec des images satellitaires...

A l'aide de Google Earth, vérifiez comment la Chine s'emploie à militariser les archipels coralliens des Spratleys et des Paracels en mer de Chine méridionale.

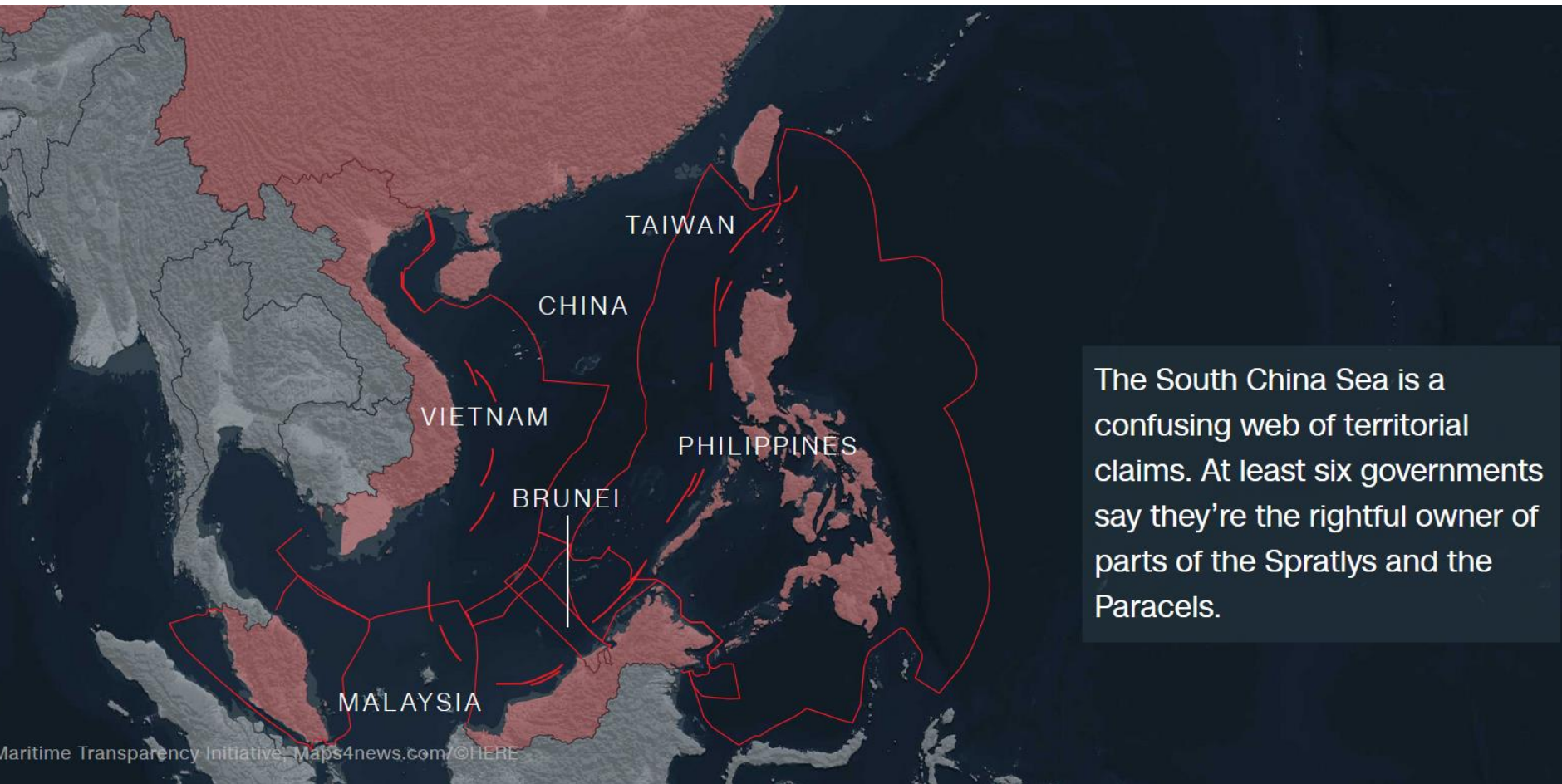
Ex: **Subi, Mischief et Fiery Cross Reefs**



Source: The Asia Maritime Transparency Initiative, Maps4news.com/©HERE

The **Paracel et Spratly islands**: sand islets and coral reefs that have been transformed by China into airstrips and naval bases in the middle of the sea.





The South China Sea is a confusing web of territorial claims. At least six governments say they're the rightful owner of parts of the Spratlys and the Paracels.



The Chinese government claims an enormous area under what is known as the “nine-dash line.” Beijing maintains the area has been under Chinese rule since “ancient times” -- many disagree.

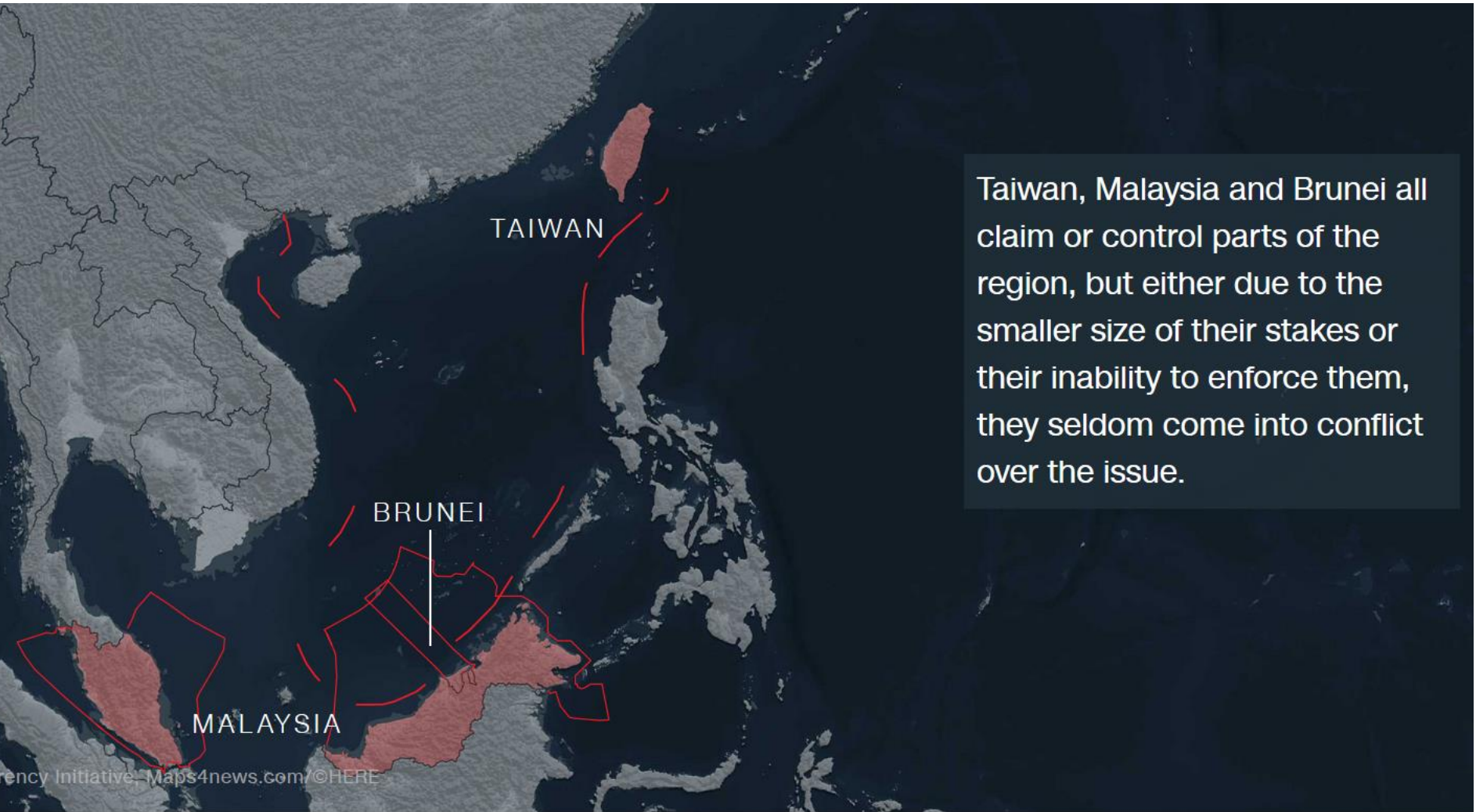


The Philippines government also claims the majority of the Spratly chain, which lies off their shores. But so far, President Rodrigo Duterte has wanted warmer relations with China, rather than conflict.



Vietnam claims the Paracel chain and parts of the Spratlys, saying they fall under Hanoi's control. The Chinese government has repeatedly blocked Hanoi's attempts to explore for oil inside what both regard as their territory.

Agency Initiative, Maps4news.com ©HERE



Taiwan, Malaysia and Brunei all claim or control parts of the region, but either due to the smaller size of their stakes or their inability to enforce them, they seldom come into conflict over the issue.

# South China Sea: Who Occupies What in the Spratlys?

[thediplomat.com/2016/05/south-china-sea-who-claims-what-in-the-spratlys](http://thediplomat.com/2016/05/south-china-sea-who-claims-what-in-the-spratlys)

Subi Reef

Gaven Reef

Hughes Reef

Johnson South Reef

Fiery Cross Reef

Cuarteron Reef

Mischief Reef

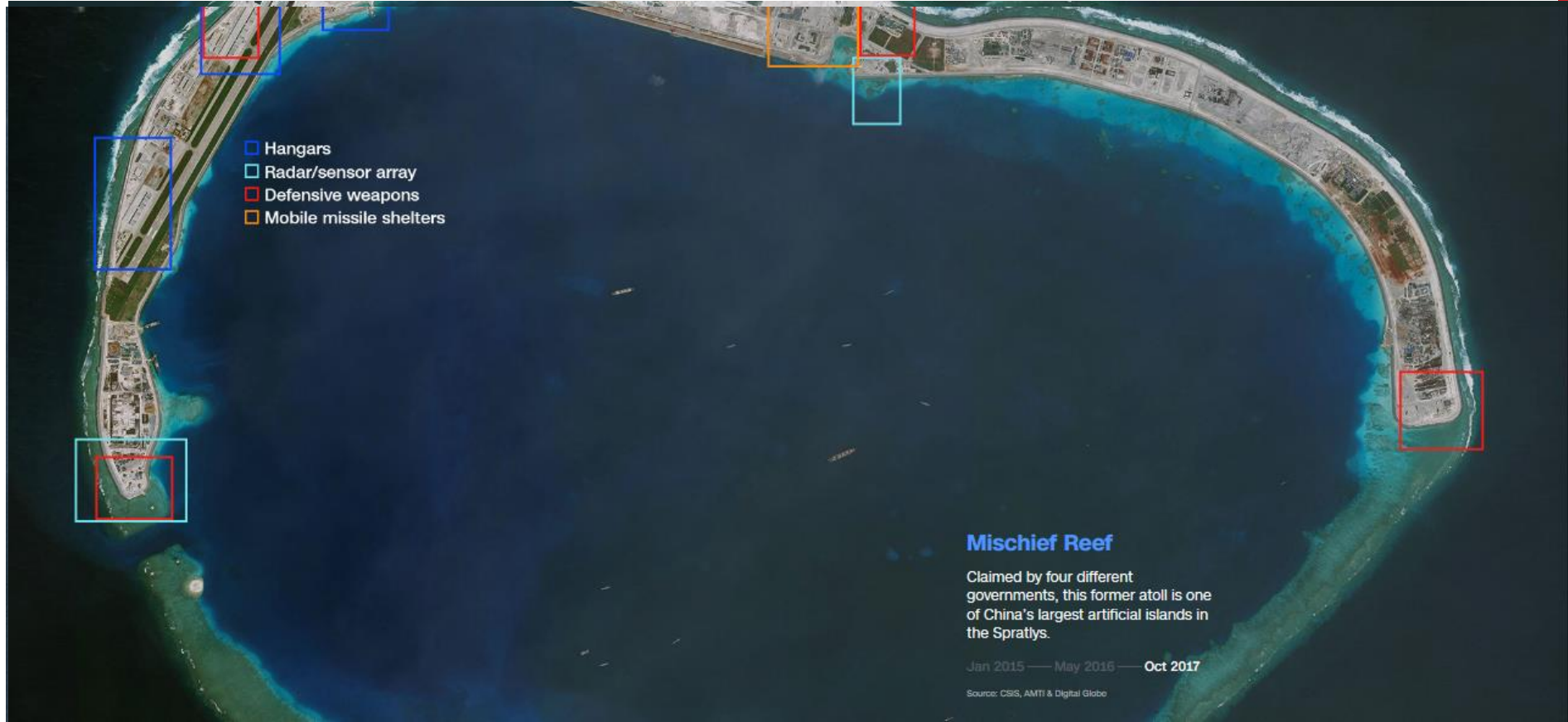
- Hangars
- Radar/sensor array
- Defensive weapons
- Mobile missile shelters

### Fiery Cross Reef

In five years, China has erected multiple-story buildings on the former shoal, as well as a long airstrip suitable for military aircraft.

Jan 2015 — Sep 2015 — Jan 2018

Source: CSIS, AMTI & Digital Globe



- Hangars
- Radar/sensor array
- Defensive weapons
- Mobile missile shelters

### Mischief Reef

Claimed by four different governments, this former atoll is one of China's largest artificial islands in the Spratlys.

Jan 2015 — May 2016 — Oct 2017

Source: CSIS, AMTI & Digital Globe



- Hangars
- Radar/sensor array
- Defensive weapons
- Mobile missile shelters

### Subi Reef

In 2014, China began building up and reinforcing this small strip of land. Now it features radar stations and aircraft hangars.

Mar 2014    May 2016    Dec 2017

Source: CSIS, AMTI & Digital Globe

# EXERCISE

I find what seems to be a factory in the middle of the desert.

Its precise location is :

**26.313030° -12.866703°**

With Google Earth and the web...

- find out what this place and activity are about and why the satellite image seems to be overexposed
- find out what is the straight white line (**red arrow**) that seems to run parallel to a road
- find photos of this place and of the white line taken on the ground





© 2018 Google  
Image © 2018 DigitalGlobe  
Image © 2018 CNES / Airbus

Google Earth



# LES LIMITES DES BASES DE DONNÉES D'IMAGES SATELLITAIRES...

- **La mise à jour des images:**  
souvent irrégulière et trop espacée dans le temps
- **La résolution des images:**  
généralement faible pour les images gratuites
- **Une capture d'écran:**  
souvent une mosaïque d'images prises à des moments différents

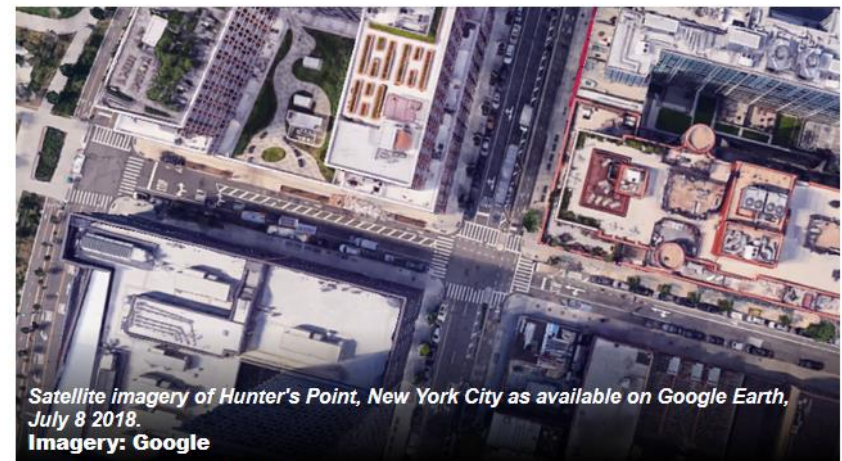
# LES LIMITES DES BASES DE DONNÉES D'IMAGES SATELLITAIRES...

Images floutées, manquantes, masquées de certaines régions/installations sensibles

[en.wikipedia.org/wiki/Satellite\\_map\\_images\\_with\\_missing\\_or\\_unclear\\_data](https://en.wikipedia.org/wiki/Satellite_map_images_with_missing_or_unclear_data)

Israël: tout un pays flouté...

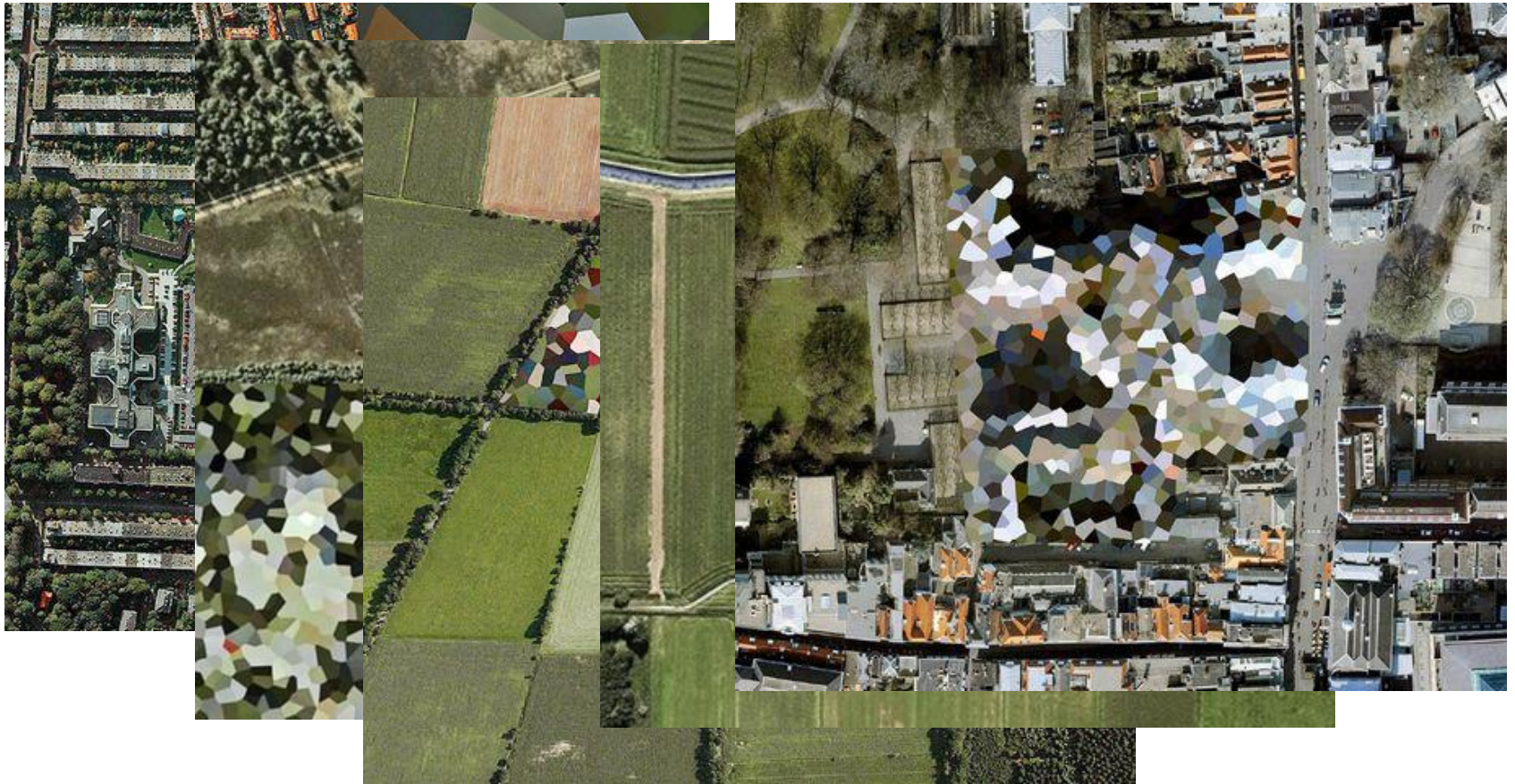
[Israel could soon be 'unblurred' on Google Earth](#)



Sensitive sites unmasked?

# LES LIMITES DES BASES DE DONNÉES D'IMAGES SATELLITAIRES...

## The Dutch Have the Weirdest Google Maps Censorship



Mishka Henner's Dutch Landscapes - When online censorship is beautiful (CNN)

# LES LIMITES DES BASES DE DONNÉES D'IMAGES SATELLITAIRES...

- **La mise à jour des images:** souvent irrégulière et trop espacée dans le temps
- **La résolution des images:** généralement faible pour les images gratuites
- **Une capture d'écran:** souvent une mosaïque d'images prises à des moments différents



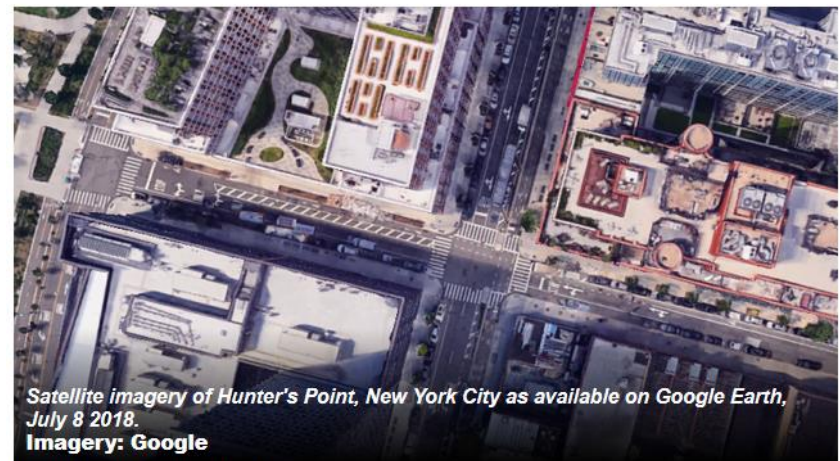
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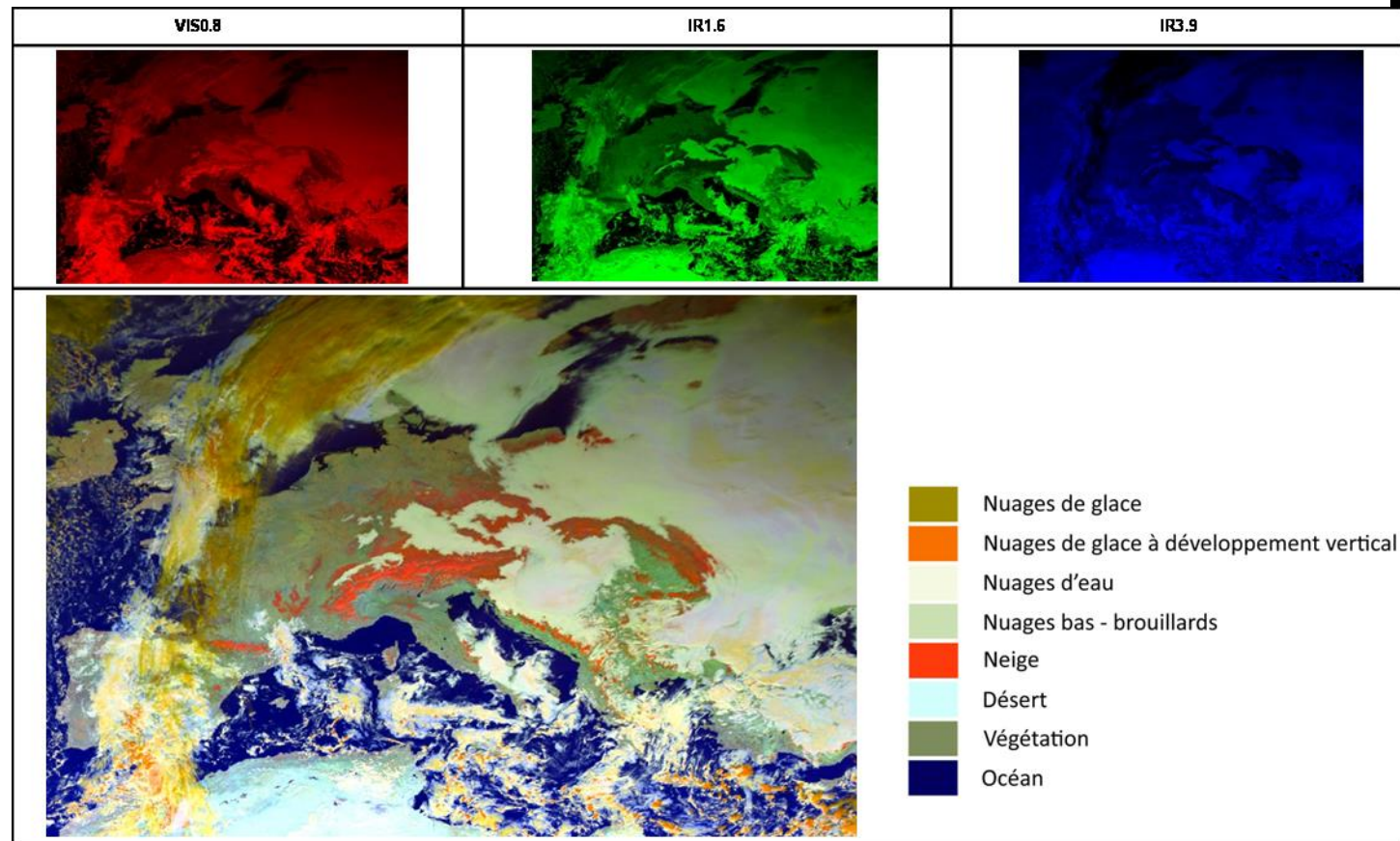
# AU-DELÀ DE GOOGLE EARTH...

- Google Earth ne gère que les images visibles pour l'œil humain, le rouge, le vert et le bleu (format **jpeg**).
- Des formats comme GeoTIFF gèrent aussi l'infra-rouge et l'**ultra-violet**.

# AU-DELÀ DE GOOGLE EARTH...

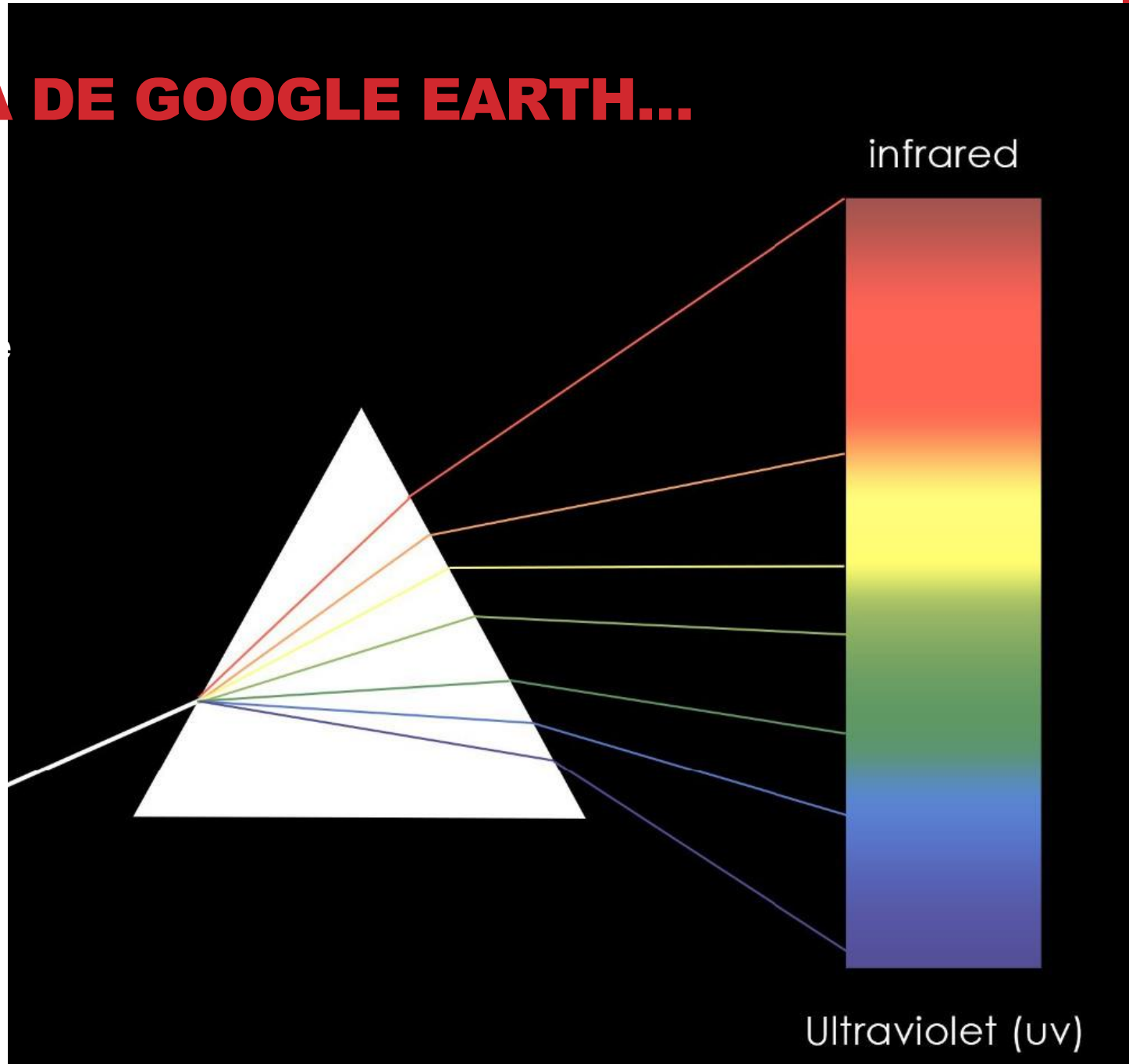
Les images des satellites de télédétection contiennent plus d'infos que de simples photos prises depuis l'espace (comme Google Earth).

Ces infos décrivent la quantité d'énergie qui est reflétée dans différentes longueurs d'ondes de lumière (les **'bandes spectrales'** ou **'canaux'**) provenant de la surface terrestre.

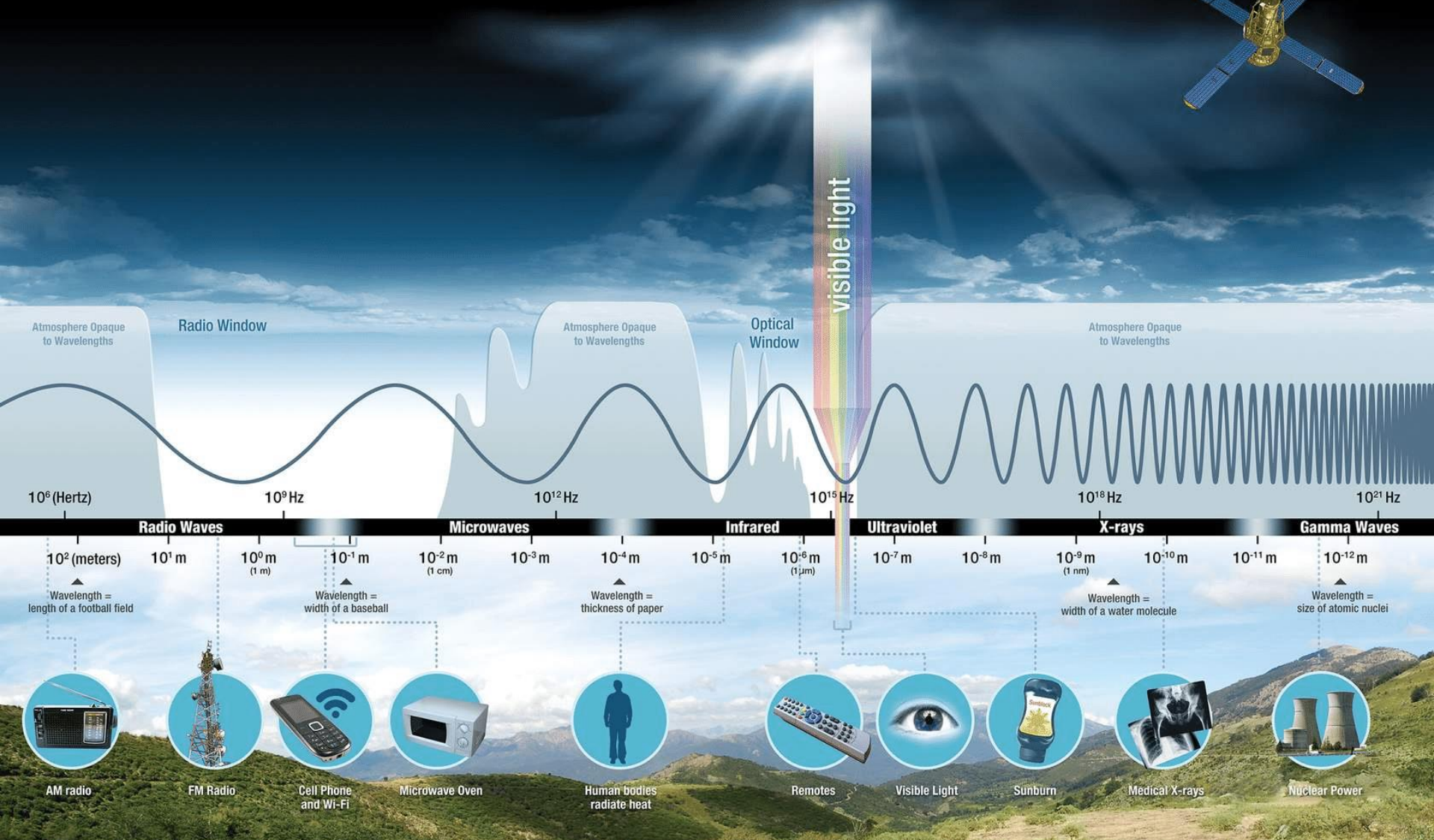


# AU-DELÀ DE GOOGLE EARTH...

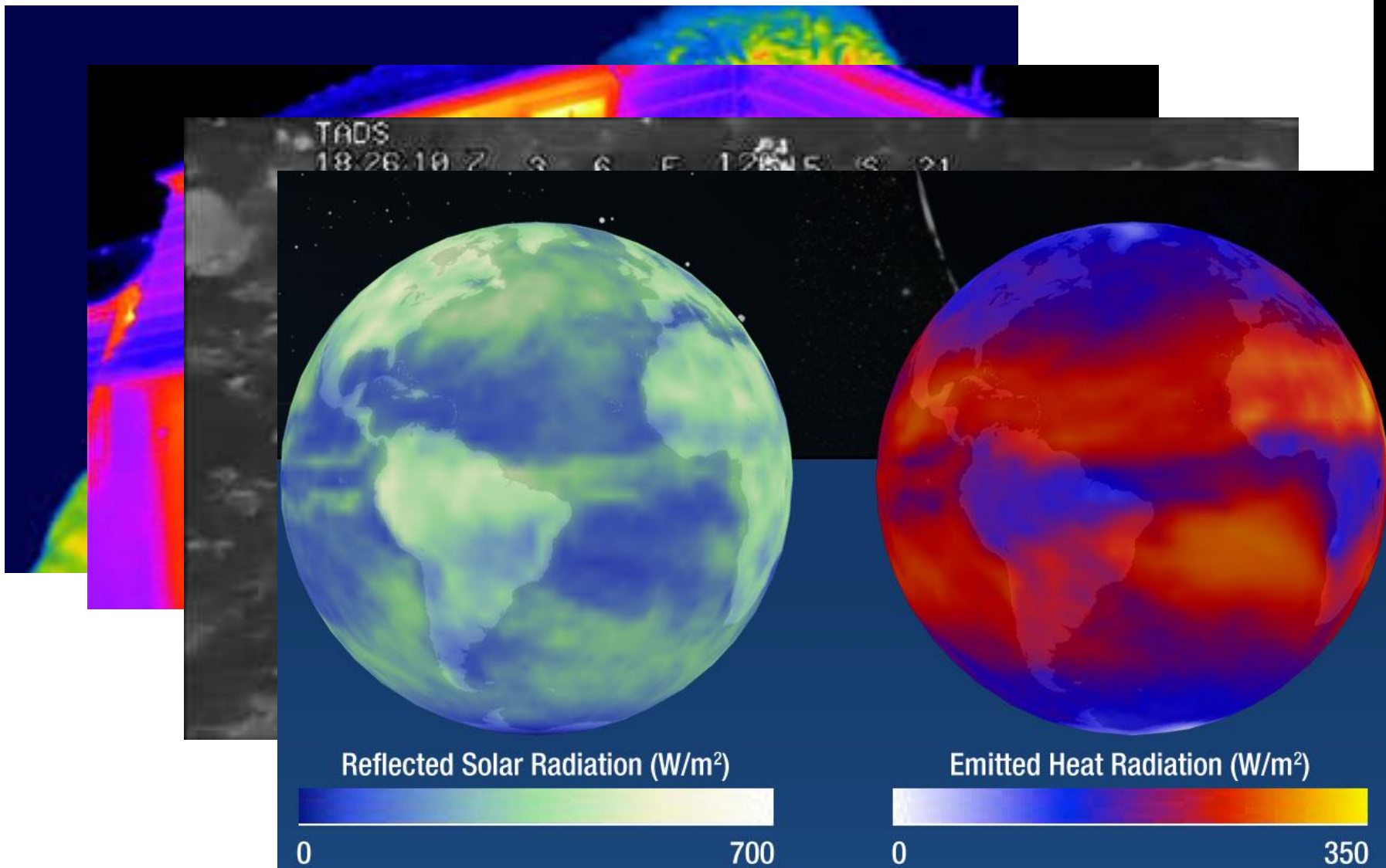
infra-rouge  
ultra-violet

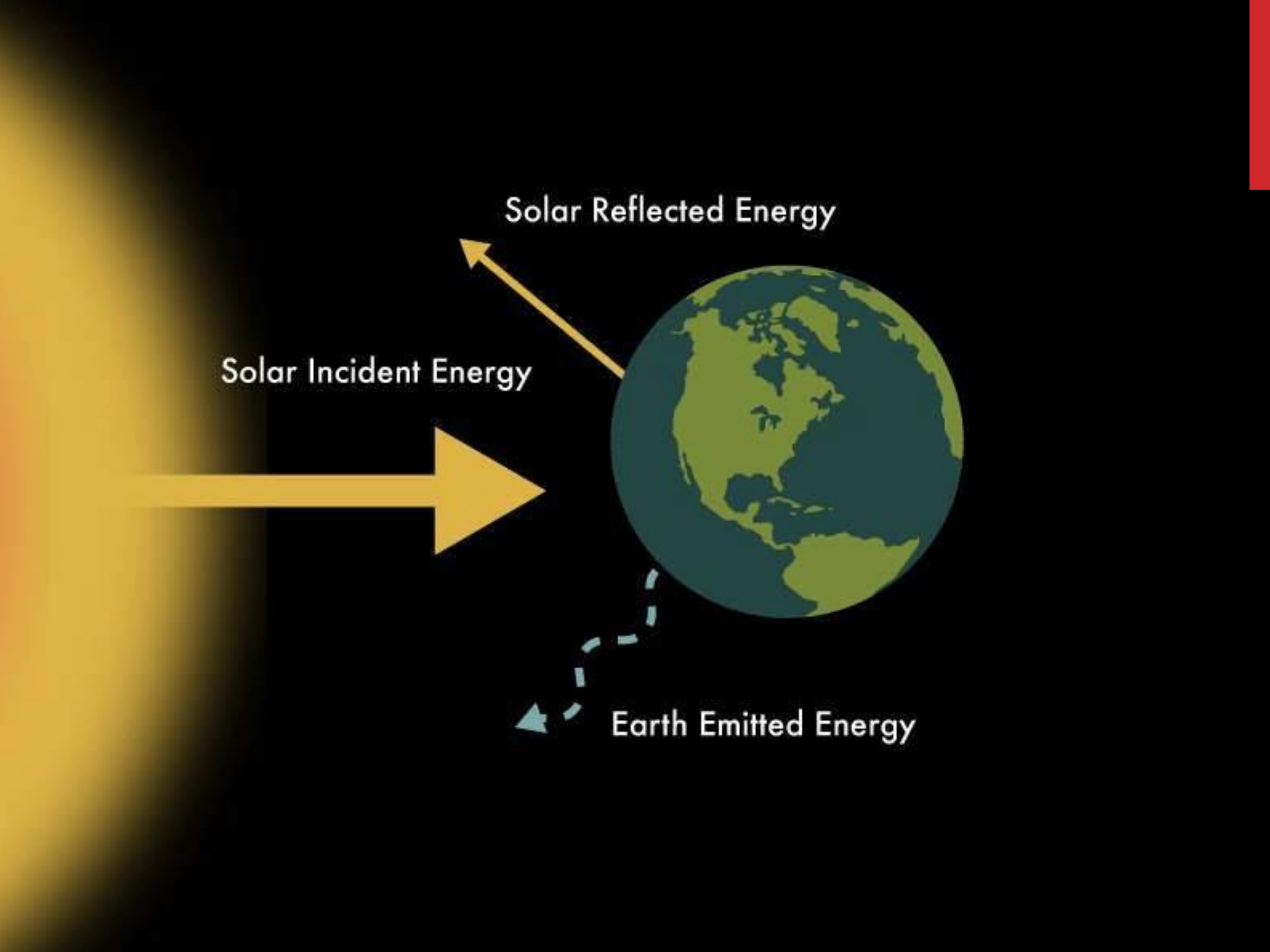


Ultraviolet (uv)



# VOIR L'INVISIBLE AVEC... L'INFRA-ROUGE

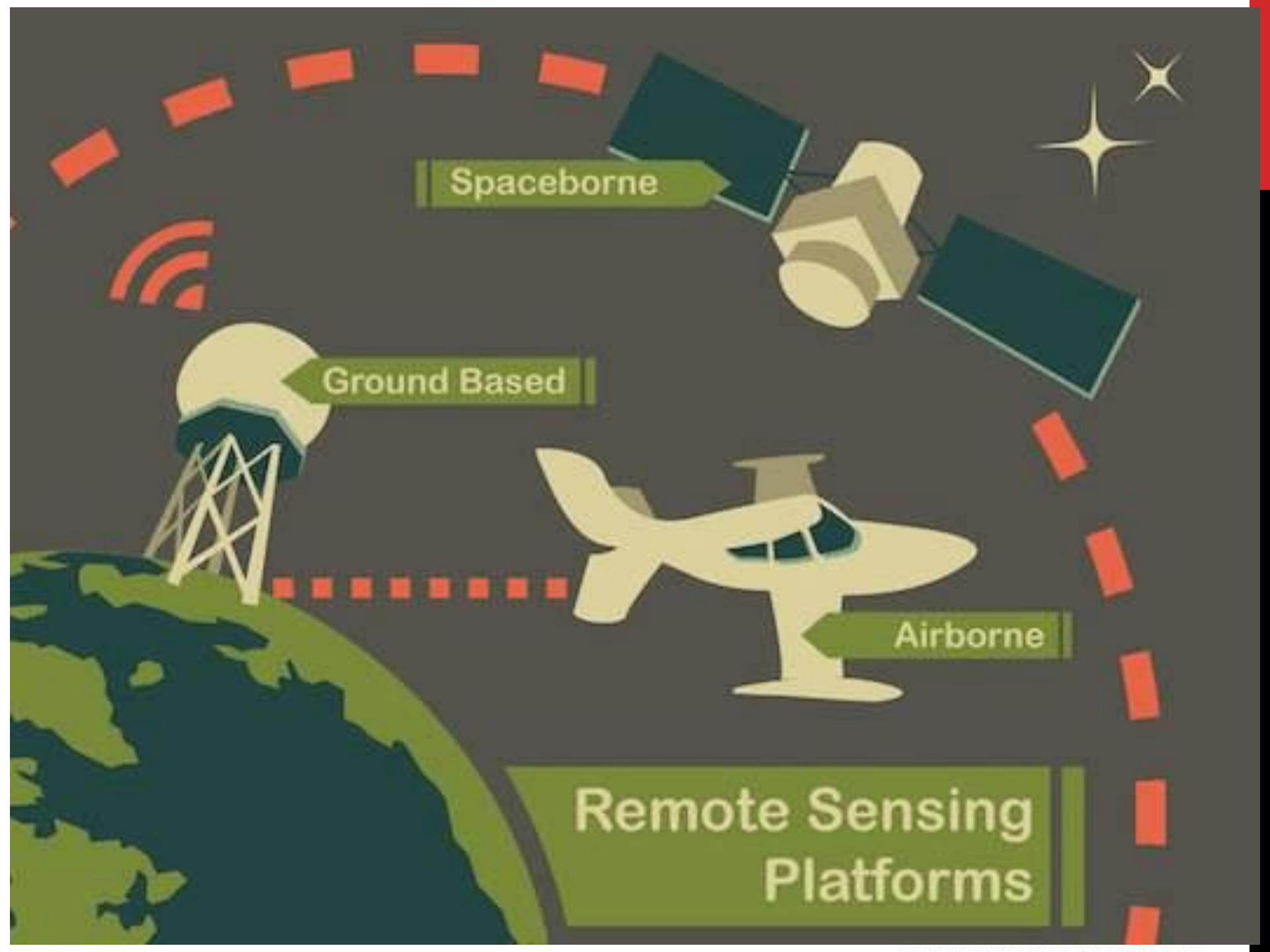




Solar Reflected Energy

Solar Incident Energy

Earth Emitted Energy



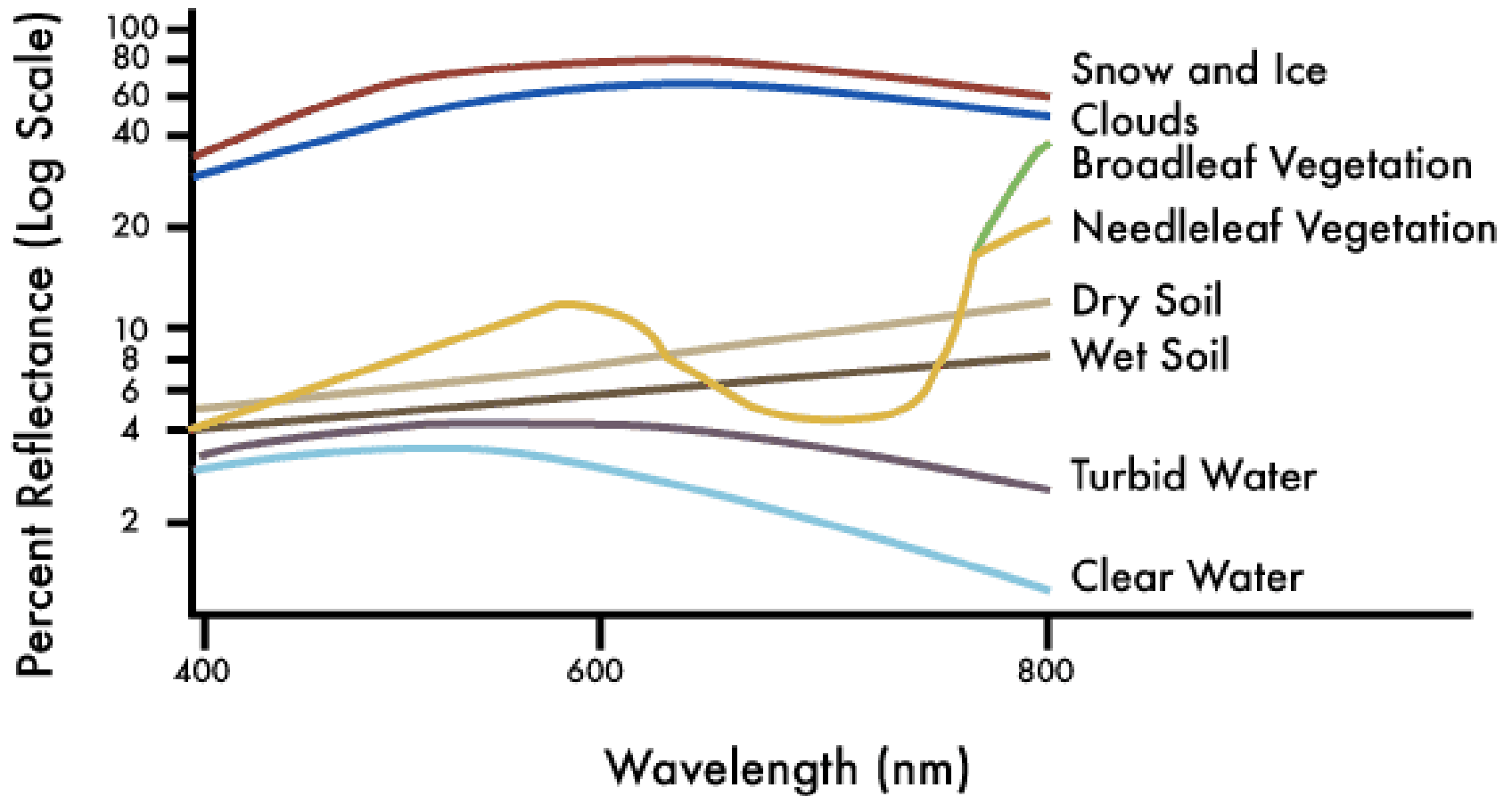
Spaceborne

Ground Based

Airborne

Remote Sensing  
Platforms





# KEY CONCEPTS:

## SPATIAL VS SPECTRAL VS TEMPORAL RESOLUTION & ACCURACY

### Spectral resolution

Video: [Earth Imaging - Episode III - Spectral Resolution](#)

### Positional accuracy

Video: [Earth Imaging - Episode V - Positional Accuracy](#)



**ARSET** (APPLIED REMOTE SENSING TRAINING)

## PROGRAMME DE FORMATION À LA TÉLÉDÉTECTION DE LA NASA

Désastres naturels,  
qualité de l'air,  
qualité des sols et  
ressources en eau.

[arset.gsfc.nasa.gov/webinars/fundamentals-remote-sensing](https://arset.gsfc.nasa.gov/webinars/fundamentals-remote-sensing)

# QUELLES UTILITÉS EN JOURNALISME?

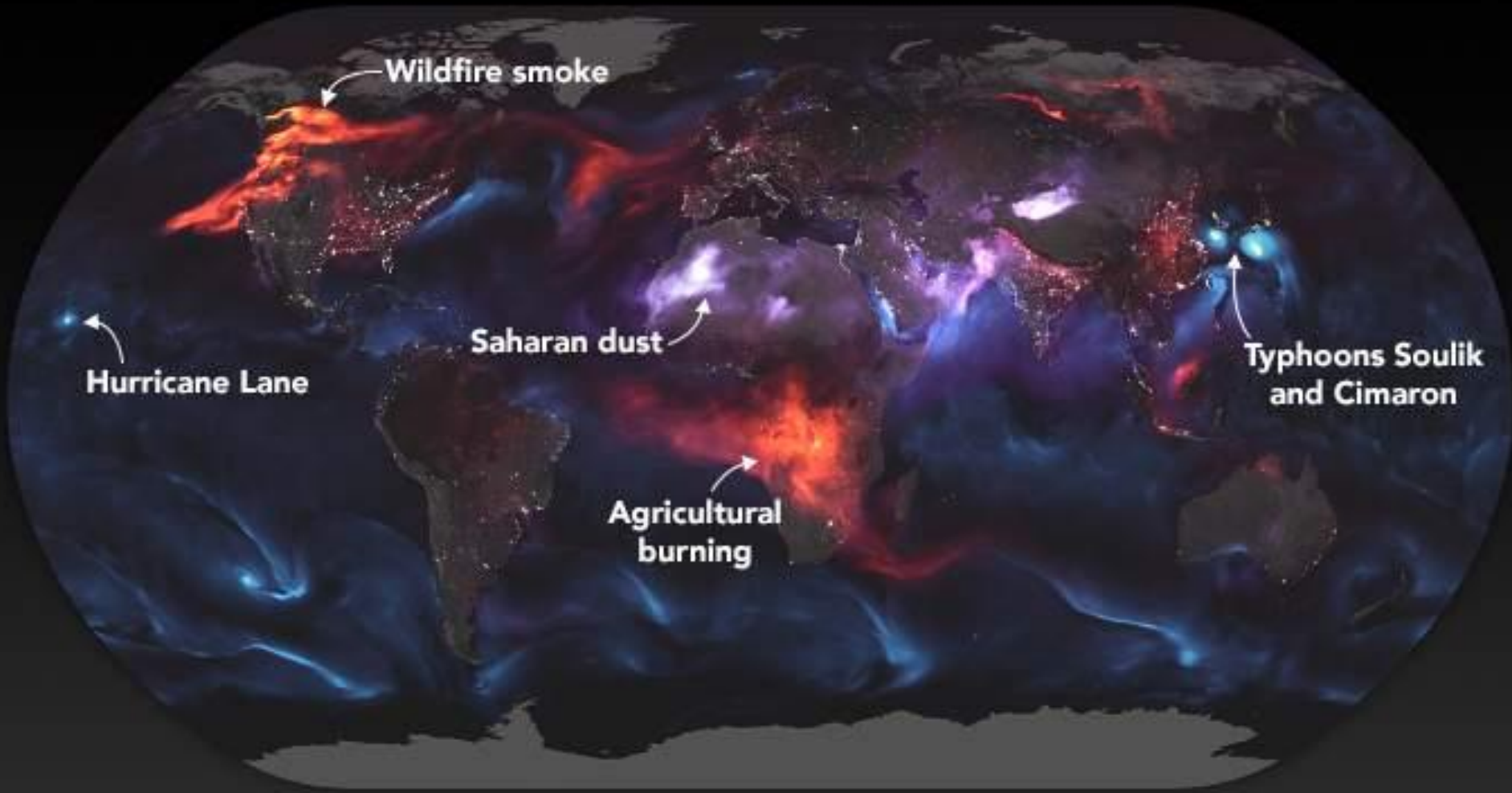
## Désastres environnementaux

- Précipitations extrêmes
- Inondations
- Sécheresse
- Eboulements
- Ouragans
- Tremblements de terre
- Marées noires
- Feux de brousse / de forêt

# QUELLES UTILITÉS EN JOURNALISME?

## Qualité de l'air et santé

- **Aérosols** (fines particules, solides ou liquides, d'une substance chimique ou d'un mélange de substances chimiques, en suspension dans un milieu gazeux. Émis par les activités humaines ou naturelles - volcans, incendies de forêt -, les aérosols interviennent aussi à l'échelle planétaire et locale dans les phénomènes de pollution de l'air et d'allergies) et **traces de gaz** (autres que les gaz naturels)
- Transport sur de longues distances d'aérosols dans l'atmosphère
- Détection de fumée et de poussière
- Tendances à long terme dans la qualité de l'air
- Cartographie des maladies à transmission vectorielle comme le paludisme, l'onchocercose, la fièvre jaune et la bilharziose (les vecteurs sont des organismes qui transmettent des agents pathogènes ou des parasites d'un sujet - ou d'un animal - infecté à un autre, causant de graves maladies dans les populations humaines)
- Surveillance de la pollution



Wildfire smoke

Hurricane Lane

Saharan dust

Agricultural burning

Typhoons Soulik and Cimaron

Black Carbon

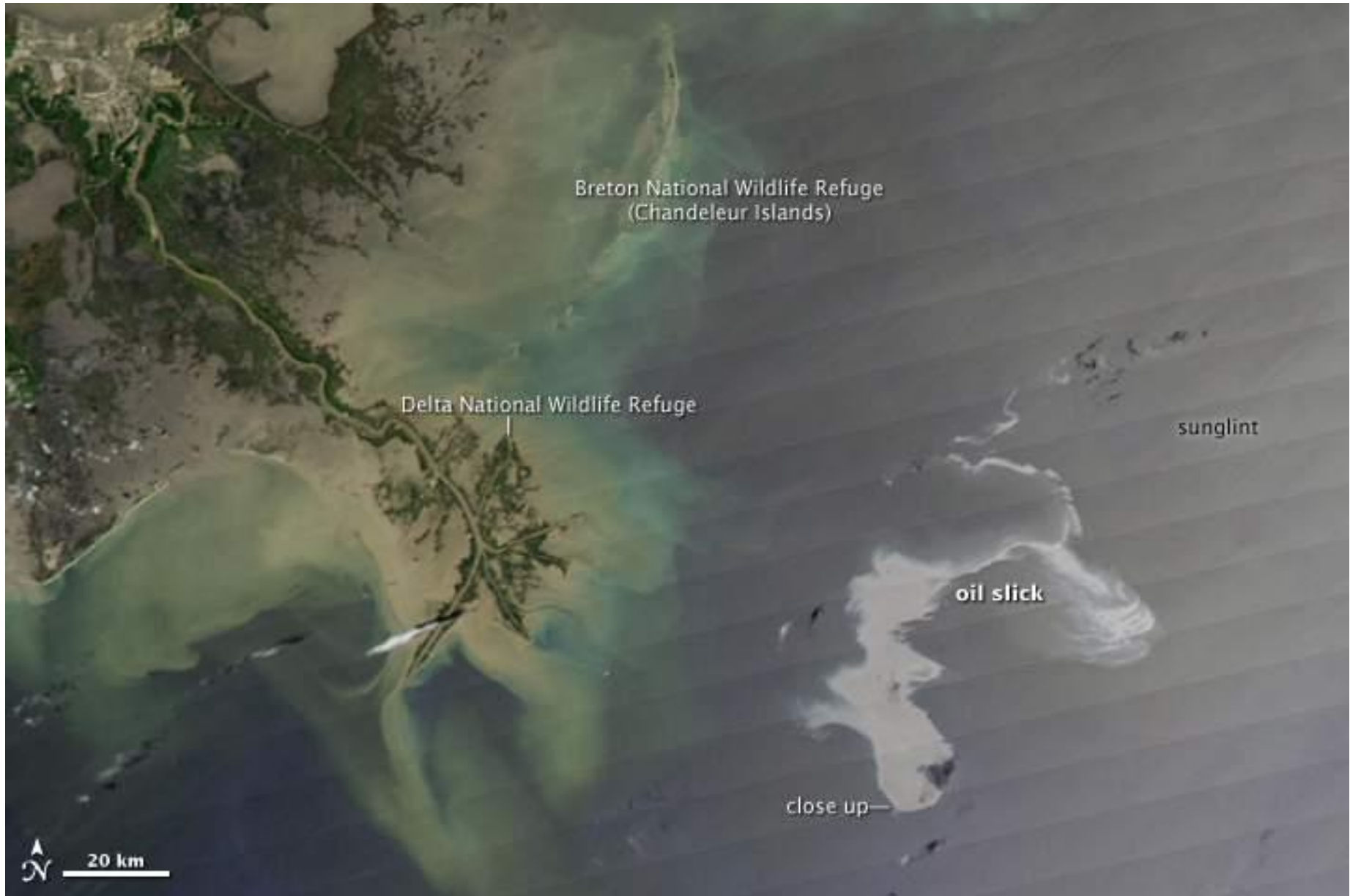
Sea Salt



Dust

Aerosols on August 23, 2018

# QUELLES UTILITÉS EN JOURNALISME?



# LE NAVIGATEUR EN LIGNE EO

Le navigateur EO (**EO Browser**)...

[apps.sentinel-hub.com/eo-browser](https://apps.sentinel-hub.com/eo-browser)

réunit les archives complètes et permet de visualiser et comparer les images en pleine résolution de ces sources...

- Sentinel-1, Sentinel-2, Sentinel-3, Sentinel-5P
- Landsat 5, 7 and 8 (Agence spatiale européenne - ESA)
- Envisat Meris, Proba-V, MODIS GIBS

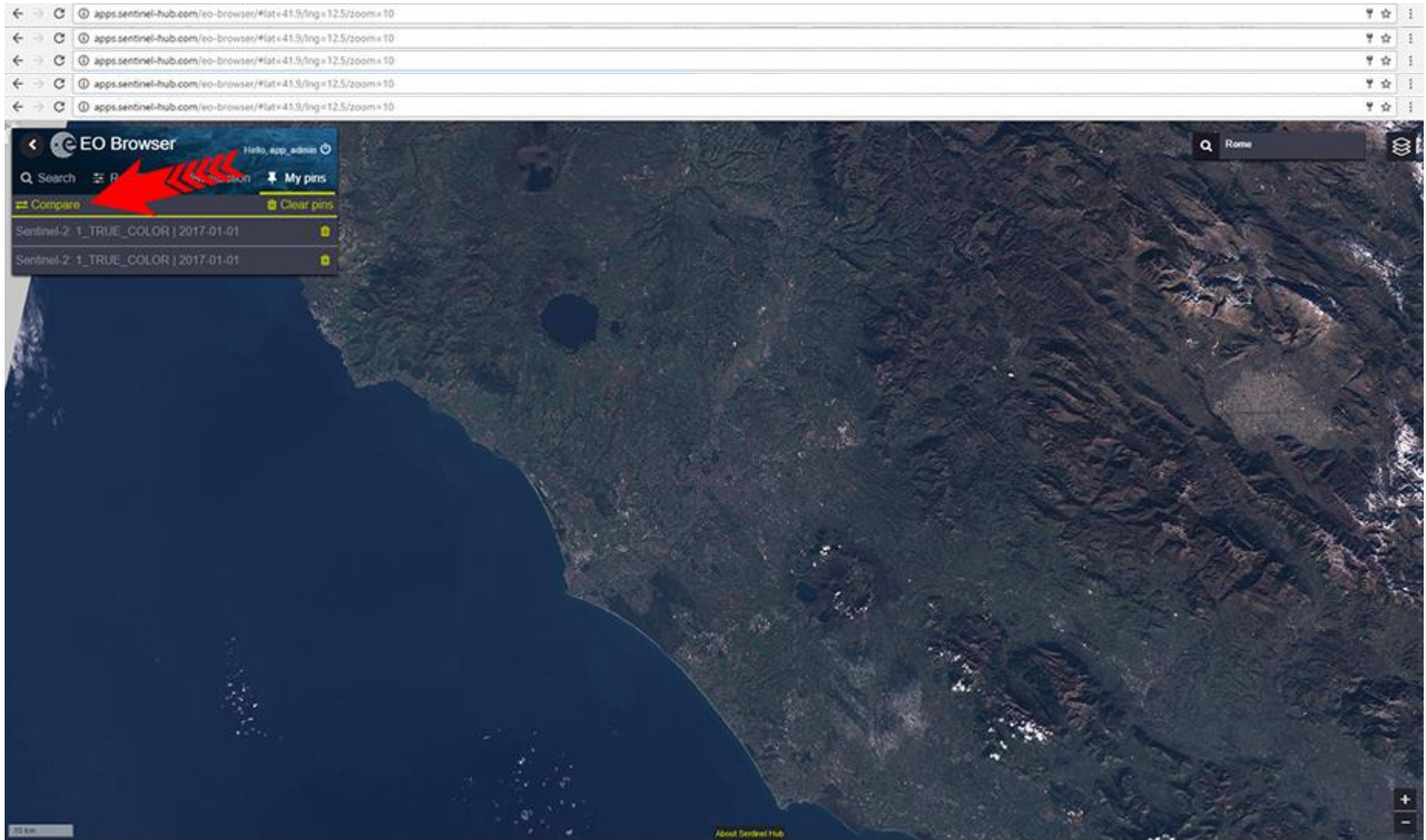
Il suffit de choisir...

- un lieu
- une ou des sources d'images
- la période de prise de vue
- la couverture nuageuse





# EO (EARTH OBSERVATION) BROWSER (NAVIGATEUR D'IMAGES SATELLITAIRES)



NEWS / BOKO HARAM

## Nigeria: 'Villages totally burned' in deadly Boko Haram attacks

*Boko Haram fighters attacked two villages on outskirts of Maiduguri as well as a camp for internally displaced people.*

1 Nov 2018



A man reacts as dead bodies are brought to a hospital after a suspected Boko Haram attack on Maiduguri's inner city in Nigeria [File: Reuters]

At least 12 civilians have been killed in multiple [Boko Haram](#) attacks targeting two villages and a camp for those displaced by fighting in northeastern [Nigeria](#), according to residents and civilian militia.

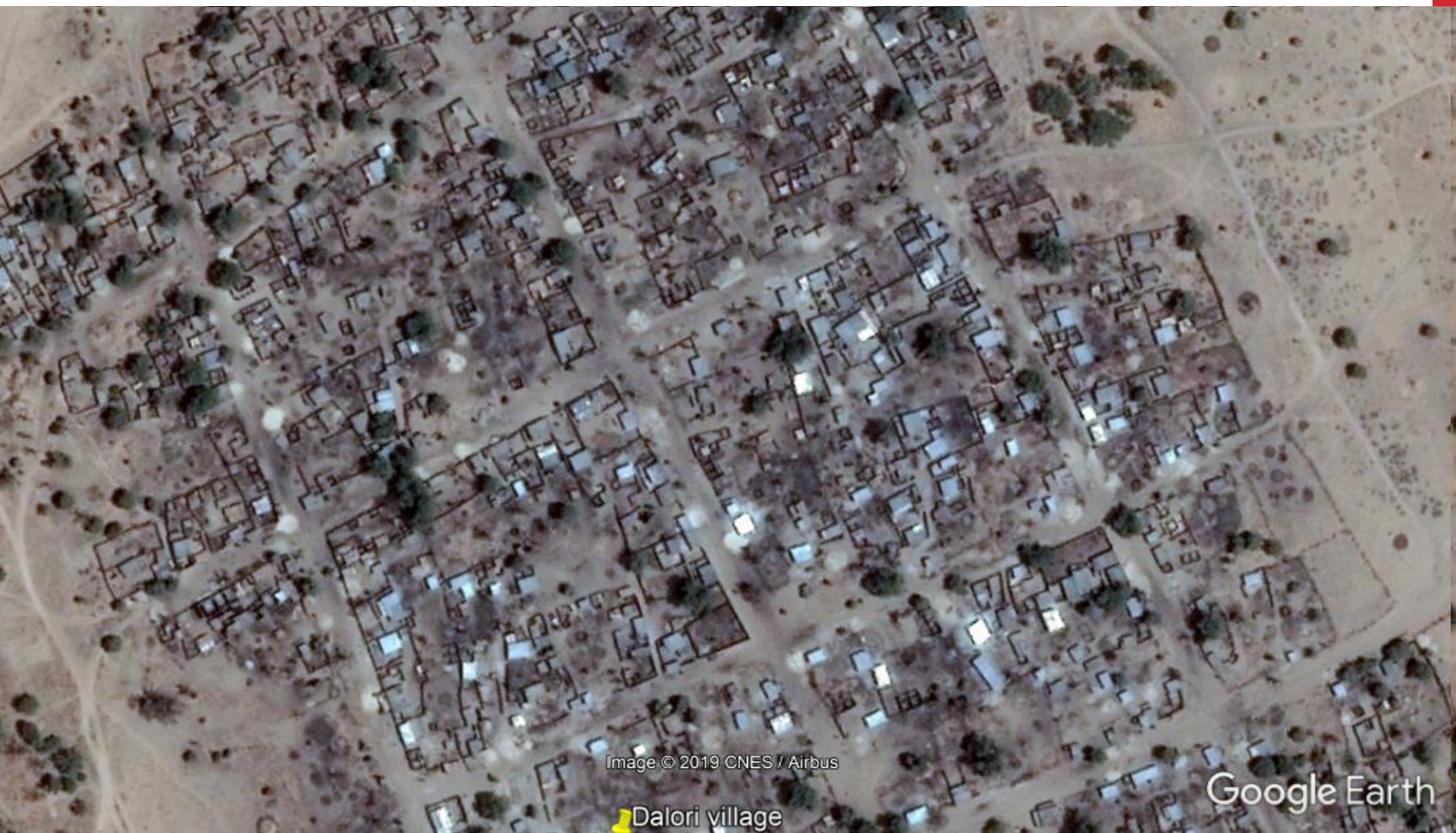
### MORE ON AFRICA

Studio B, Unscripted: With Elif Shafak and Wole Soyinka

today

**11.759765° 13.263558°**

# **VRAIES COULEURS (VISIBLES À L'ŒIL NU)**




**Avant l'attaque (29/12/2015)**

**Après l'attaque (13/04/2016)**



Image © 2019 CNES / Airbus

 Dalori village

Google Earth

# FAUSSES COULEURS (INFRA-ROUGE)

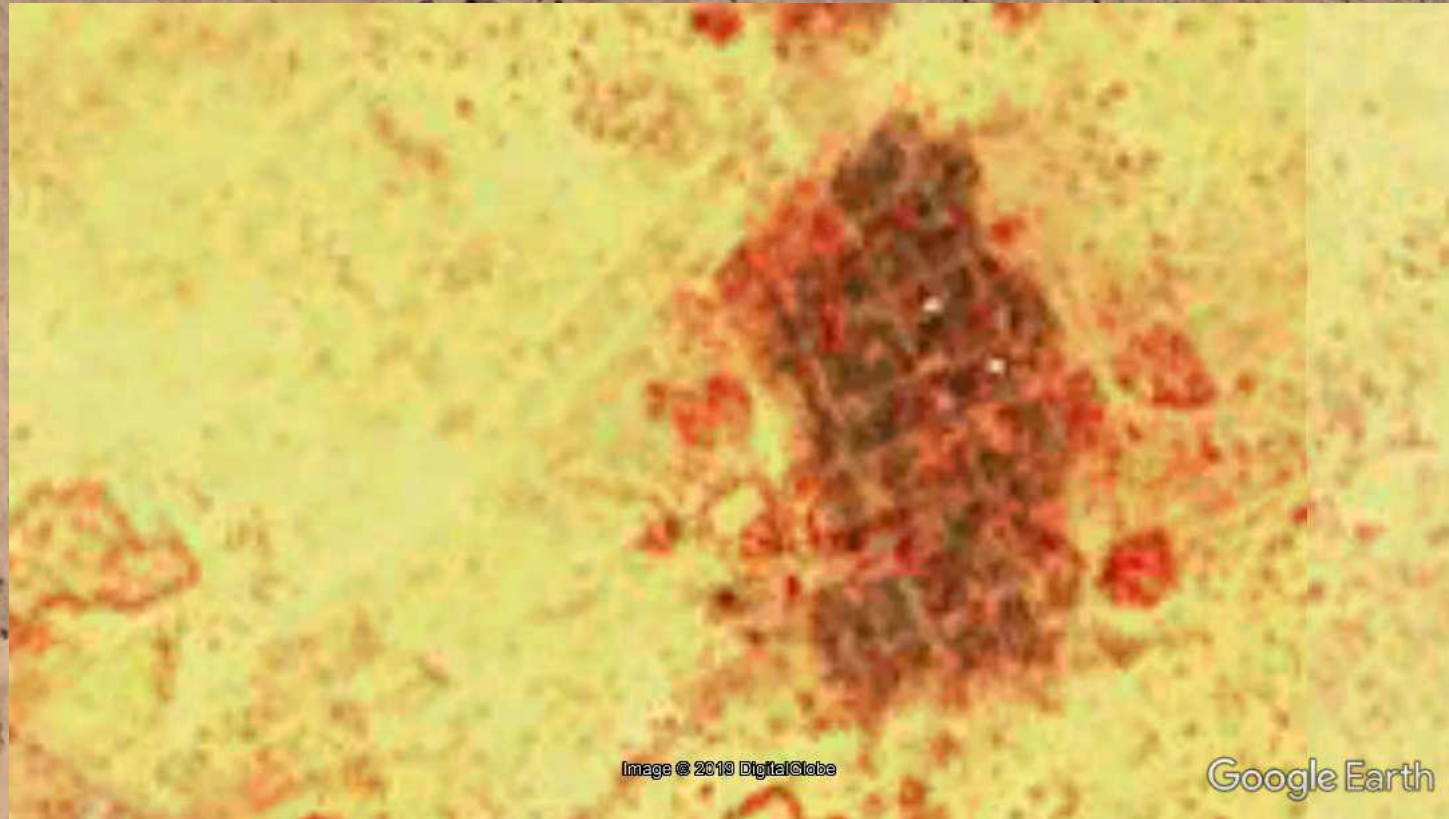


Image © 2019 DigitalGlobe

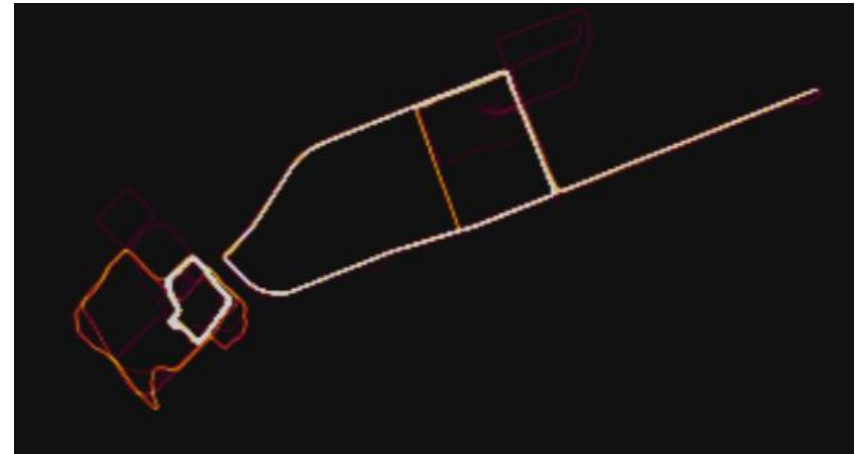
Google Earth

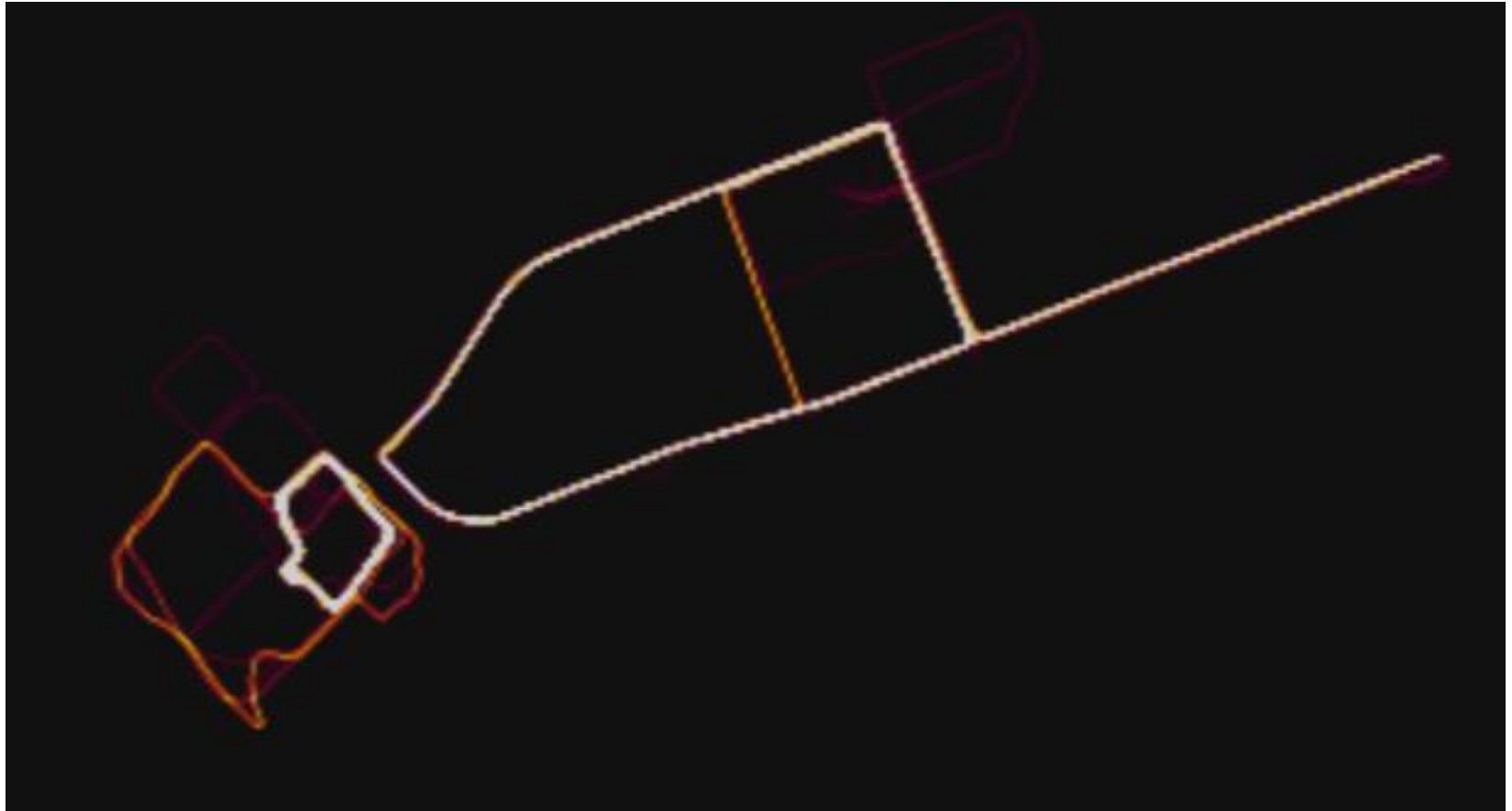
# EXERCICE

## Exercice d'investigation avec des images satellitaires...

A l'aide de l'outil Strava Global Heatmap, vous détectez à Agadez, au Niger, le tracé de cette activité.

A l'aide du web, de Strava, Google Earth et de tout autre outil pertinent, déterminez à quoi correspond ce lieu et en quoi les activités qui y ont cours ont changé depuis quelques années.







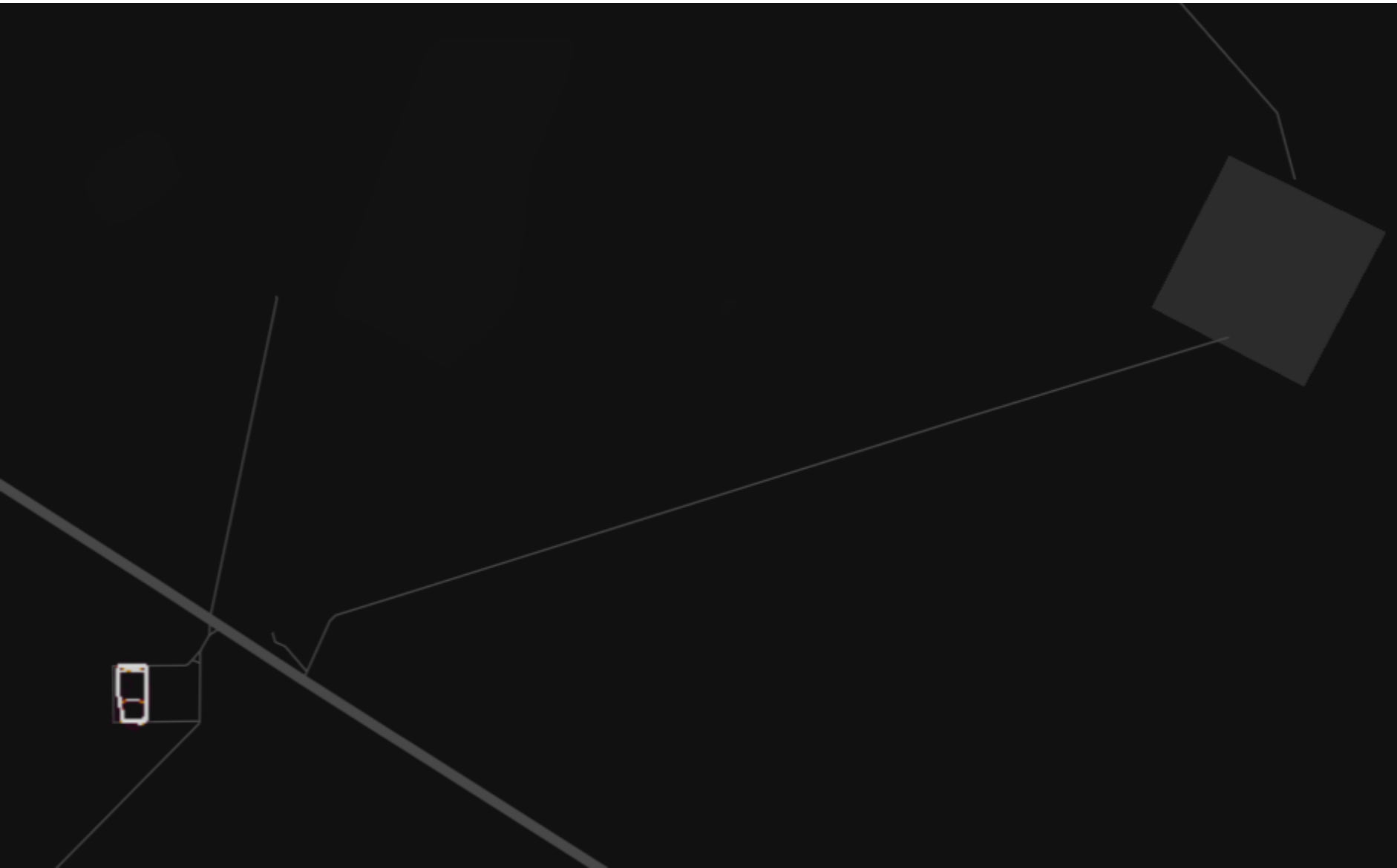
# EXERCICE

## Exercice d'investigation avec des images satellitaires...

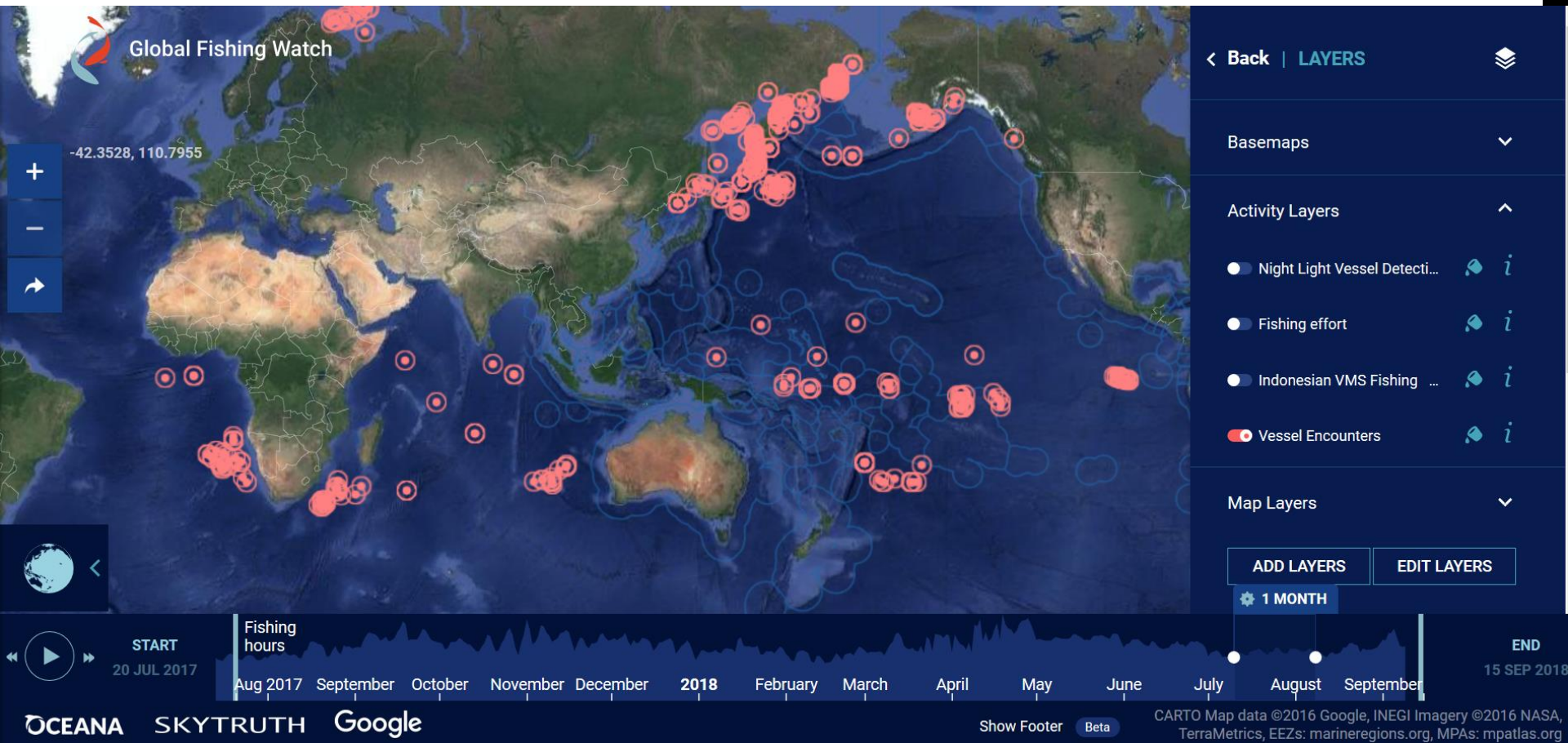
A l'aide de l'outil Strava Global Heatmap, vous détectez dans le sud de la Syrie, près de la frontière de l'Irak, le tracé de cette activité.

A l'aide du web, de Strava, Google Earth et de tout autre outil pertinent, déterminez à quoi correspond ce lieu et en quoi les activités qui y ont cours ont changé depuis quelques années.





# FOR ACTIVISTS: TO ILLUSTRATE & ADVOCATE AGAINST OVERFISHING...



[globalfishingwatch.org/map/](http://globalfishingwatch.org/map/)

# TO TRACK AIRPLANES IN REAL TIME...

[flightradar24.com](http://flightradar24.com)

The screenshot displays the Flightradar24 website interface. At the top, the navigation menu includes: Apps, Add coverage, Data / History, Social, Press, About, Commercial services, Log in, and UTC 16:39. The main content area features a global map with live air traffic data. The map is populated with numerous yellow airplane icons representing aircraft in flight, and blue location pins indicating specific airports or points of interest. The map shows a high density of aircraft in the North Atlantic, Europe, and Asia.

On the left side, there is a sidebar with the following sections:

- AIRCRAFT** 1,500 / 17,258
- AIRPORT DELAYS**
- AIRPORT** table with columns ARR and DEP:

AIRPORT	ARR	DEP
Manila (MNL)	4.3	5.0
Nanjing (NKG)	2.3	5.0
Shenzhen (SZX)	3.6	2.5
London (LGW)	1.5	3.5
Guangzhou (CAN)	3.0	1.9

Below the table is a link: [Go to delay map](#)

At the bottom of the sidebar, there are links to download the Flightradar24 Flight Tracker app on the App Store and Google Play, along with social media icons for Facebook Like and Google+.

On the right side of the map, there is a search bar and a dropdown menu for map view (default). Below these are several icons for map interaction: a gear for settings, a full-screen icon, a filter icon, a star for favorites, and a refresh icon. At the bottom right, there is a scale bar (2000 km) and a link to Terms of Use.

# HOW IT WORKS...

FlightRadar24 regroupe les données **ADS-B** (Automatic Dependent Surveillance-Broadcast) fournies par plusieurs milliers de récepteurs répartis à la surface du globe. Ces récepteurs sont mis en œuvre par des personnes qui participent ainsi au fonctionnement de ce système international. D'ailleurs FlightRadar24 fournit des systèmes de réception à ceux qui en font la demande et qui sont éligibles du fait de leur position géographique dans une zone encore mal couverte.

La technologie que FlightRadar24 utilise pour recevoir des informations de vol est appelée ADS-B. Cette technologie est illustrée sur l'image ci-dessus.

- L'avion récupère sa localisation à partir d'un récepteur GPS
- Le transpondeur ADS-B installé sur l'avion transmet un signal à 1090 MHz contenant cette information de position ainsi que d'autres données (N° du vol et indicatif, altitude, vitesse, vitesse ascensionnelle...)
- Le signal du transpondeur ADS-B est capté par un récepteur au sol, connecté aux serveurs de FlightRadar24
- Le récepteur envoie les données reçues à FlightRadar24
- Les données s'affichent sur [www.flightradar24.com](http://www.flightradar24.com) et les applications FlightRadar24



# TO TRACK AIRPLANES IN REAL TIME...

[flightaware.com](https://flightaware.com)

FlightAware Tous ▾  Suivre

SUIVI DE VOLS    PRODUITS    ADS-B    PHOTOS    INFOS    FORUM DE DISCUSSION    A PRO

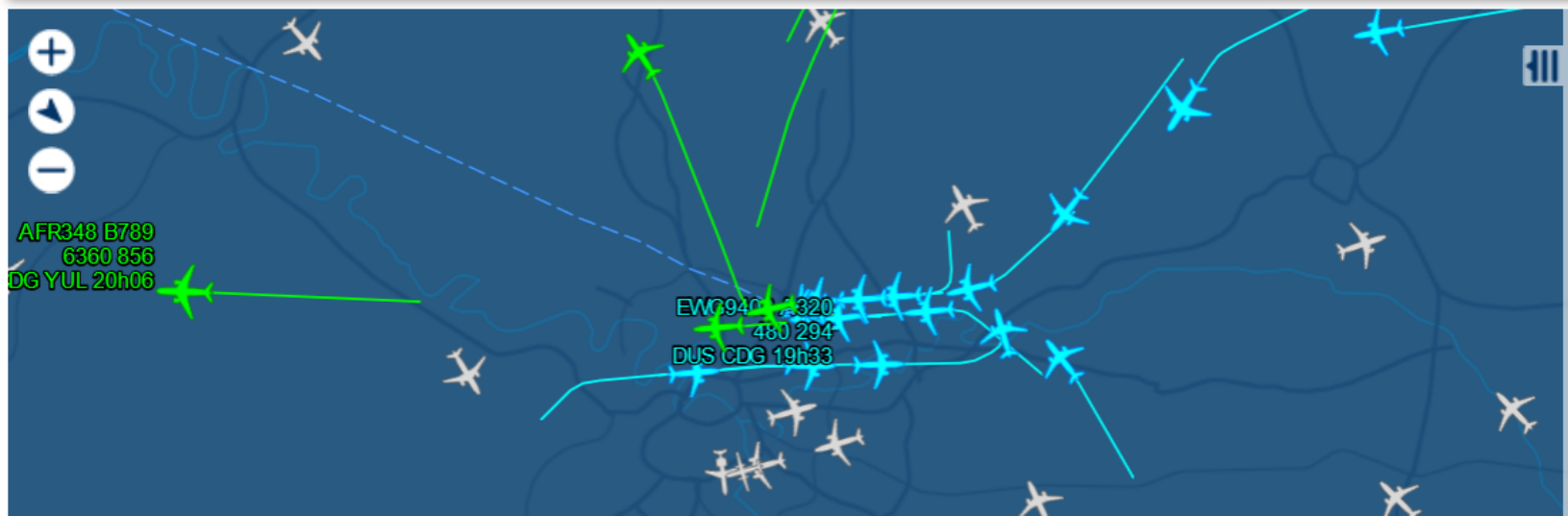
SUIVI DE VOLS

CONDITIONS MÉTÉOROLOGIQUES

CARTE ET DIAGRAMME

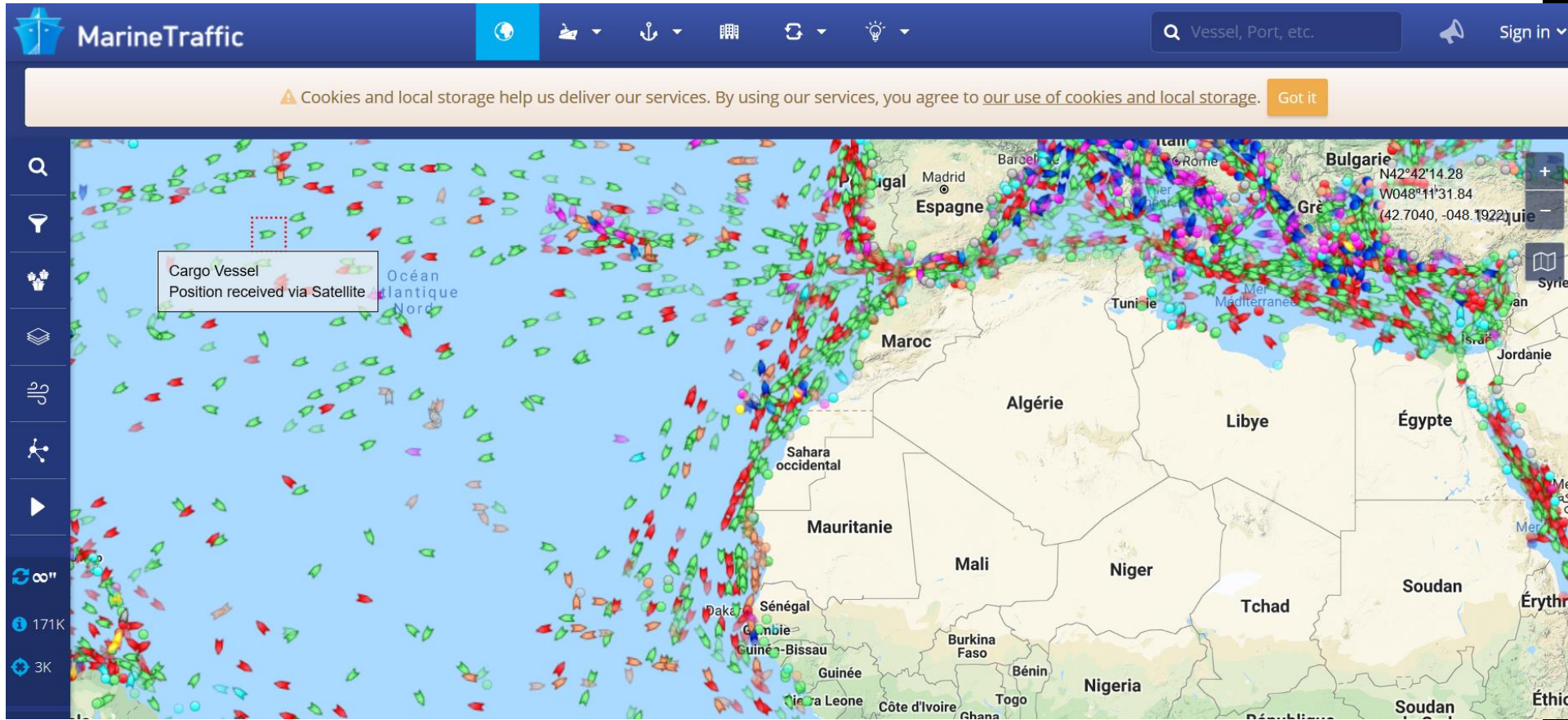
HISTORICAL DATA

PARIS-CHARLES-DE-GAULLE AIRPORT (PARIS) CDG



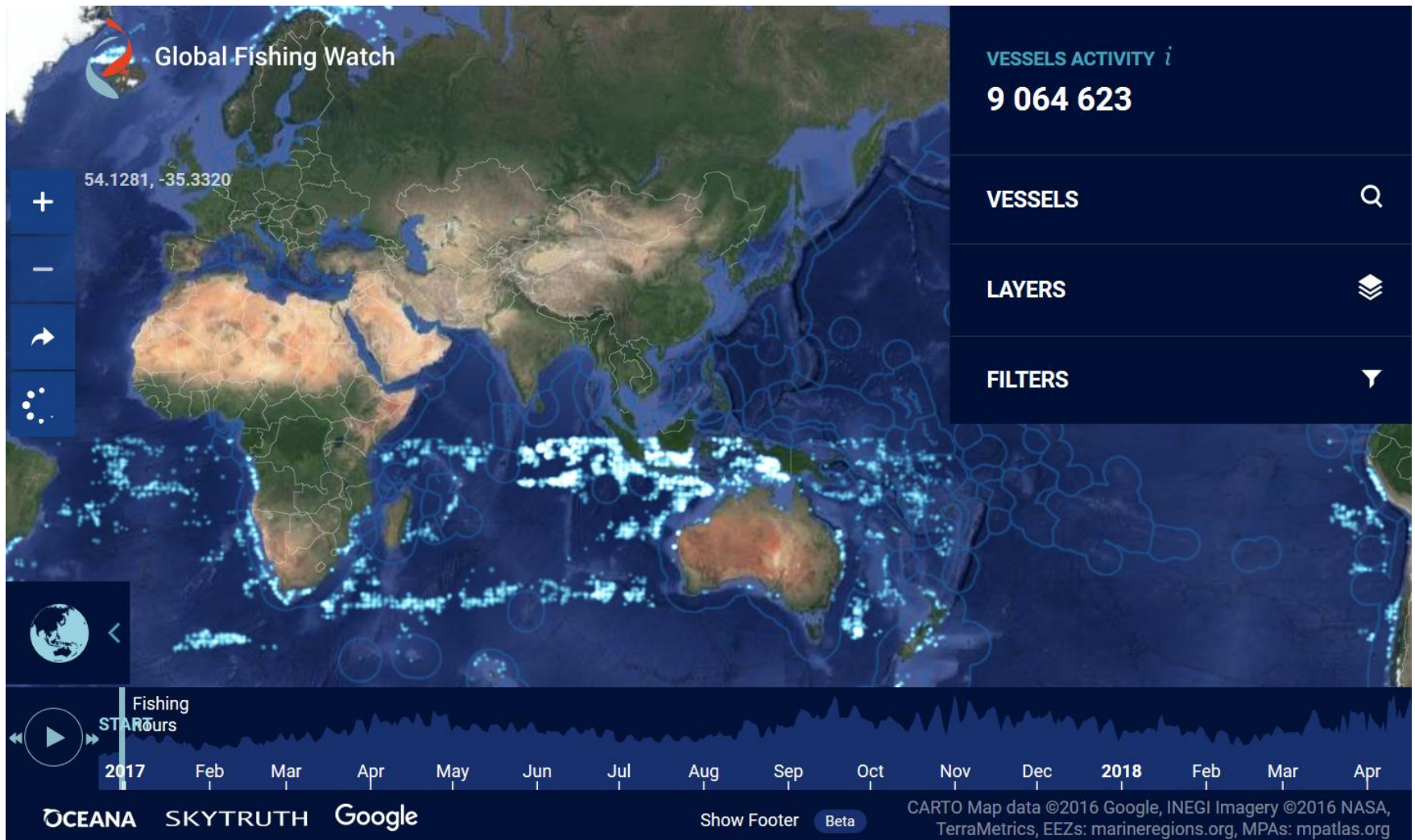
# TO TRACK SHIPS IN REAL TIME...

[marinetraffic.com](https://www.marinetraffic.com)



# TO SPOT AND FIGHT OVERFISHING ...

[globalfishingwatch.org/map/](http://globalfishingwatch.org/map/)





# FOR ACTIVISTS: TO ILLUSTRATE & ADVOCATE AGAINST DEFORESTATION...



<https://loggingroads.org/en/map>

# DM...

Robert Bourgoing  
Au-delà des frontières



A propos

## Test/DM – Investigation par satellite

Chaque personne a deux exercices à compléter.

Remettre **votre DM** dans un fichier **PDF** qui inclut vos prénom et nom. Envoyez votre fichier **avant 18h le vendredi 6 décembre**, dernier délai, à [robert@bourgoing.com](mailto:robert@bourgoing.com).

### Instructions

A l'aide de Strava, du web, de Google Earth, Google Maps et tout autre outil pertinent, donnez...

1. les coordonnées géographiques (latitude et longitude) exactes de cette activité aux formats décimal et sexagésimal
2. une description précise des activités qui se déroulent ou se sont déroulées à cet endroit (expliquez pas à pas le processus que vous avez suivi pour trouver vos infos)
3. une description des changements (s'il y en a eu) qui ont eu lieu à cet endroit au fil des années (expliquez quels outils vous avez utilisés et utilisez des captures d'écran ou tout autre visuel qui montre les changements qui ont eu lieu).

Etudiant 1 (ouest de la Mauritanie) :



[bourgoing.com/dm-satellite](http://bourgoing.com/dm-satellite)

# PLAN

- **Intro**
- **Quelles utilités?** – pour pister les changements environnementaux, activités militaires, etc. artistes, militants (environmental disasters, changing landscape due to war, etc.), journalistes ([Strava](#)), archéologues (Sarah Parcak)
- **Les outils/ressources disponibles**  
What tools to use? Different platforms do contain different imagery, taken at different points in time For example the earlier Saudi Arabia image of a possible drone base was only visible through Bing Maps
- **Concepts clés**  
Acquisition, Résolution, Résolution spectrale, Résolution temporelle, Précision / Lat. & Long.
- **Comment enrichir vos reportages avec les images satellite**
  - Vérification d'images avec Google Earth & StreetView
  - Visualiser l'évolution de la planète au fil du temps
  - Trouver et importer des fichiers d'infos géolocalisées (KML & KMZ) dans Google Earth
  - Créer des vidéos avec Google Earth
  - <https://www.nytimes.com/video/world/middleeast/100000005738262/turkey-drone-attack-kurds-syria.html>