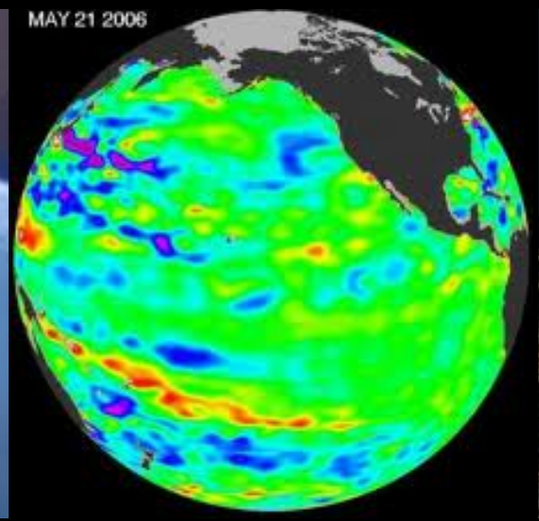




Introduction to Remote Sensing

Xi Yang
Department of Environmental Sciences
University of Virginia
xiyang@virginia.edu
390 Clark Hall

EVSC 4010/7010 Week 1

Zoom Etiquette

- Use the chat to ask questions, report problems, or whenever directed as part of a class activity. Keep chat messages respectful, concise, and relevant.

- Use the 'reactions' buttons (clapping, thumbs up) if appropriate!

- Use the 'raise hand' button whenever you need to ask a question during lecture. I also encourage you to speak directly if you have questions, just like in a normal classroom.

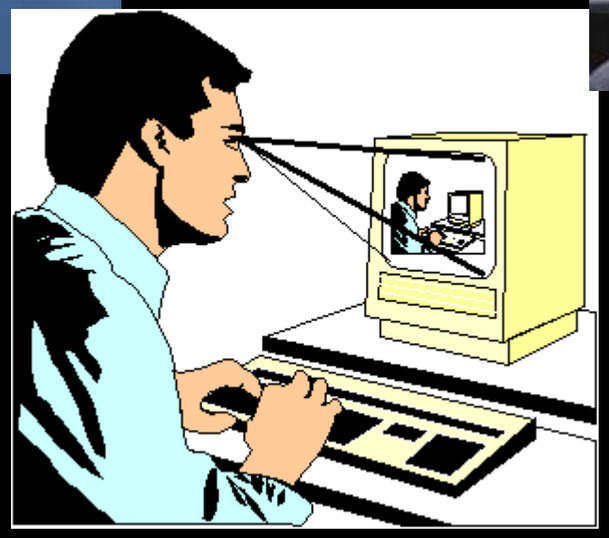
- In this online environment, I will probably 'cold call' students more often than I would in the classroom. It can be hard for me to know who is ready to speak, so I may call on you when you're not expecting it. If you need to 'pass' on a question once or twice, that's OK.

- In every lecture, I have short surveys for you (also accounts for participation). You will need to write down the most memorable slide/ concept in that class, and the concept you have not fully grasped yet (and I can explain during the next class)

Syllabus & 5 min break

What is remote sensing?

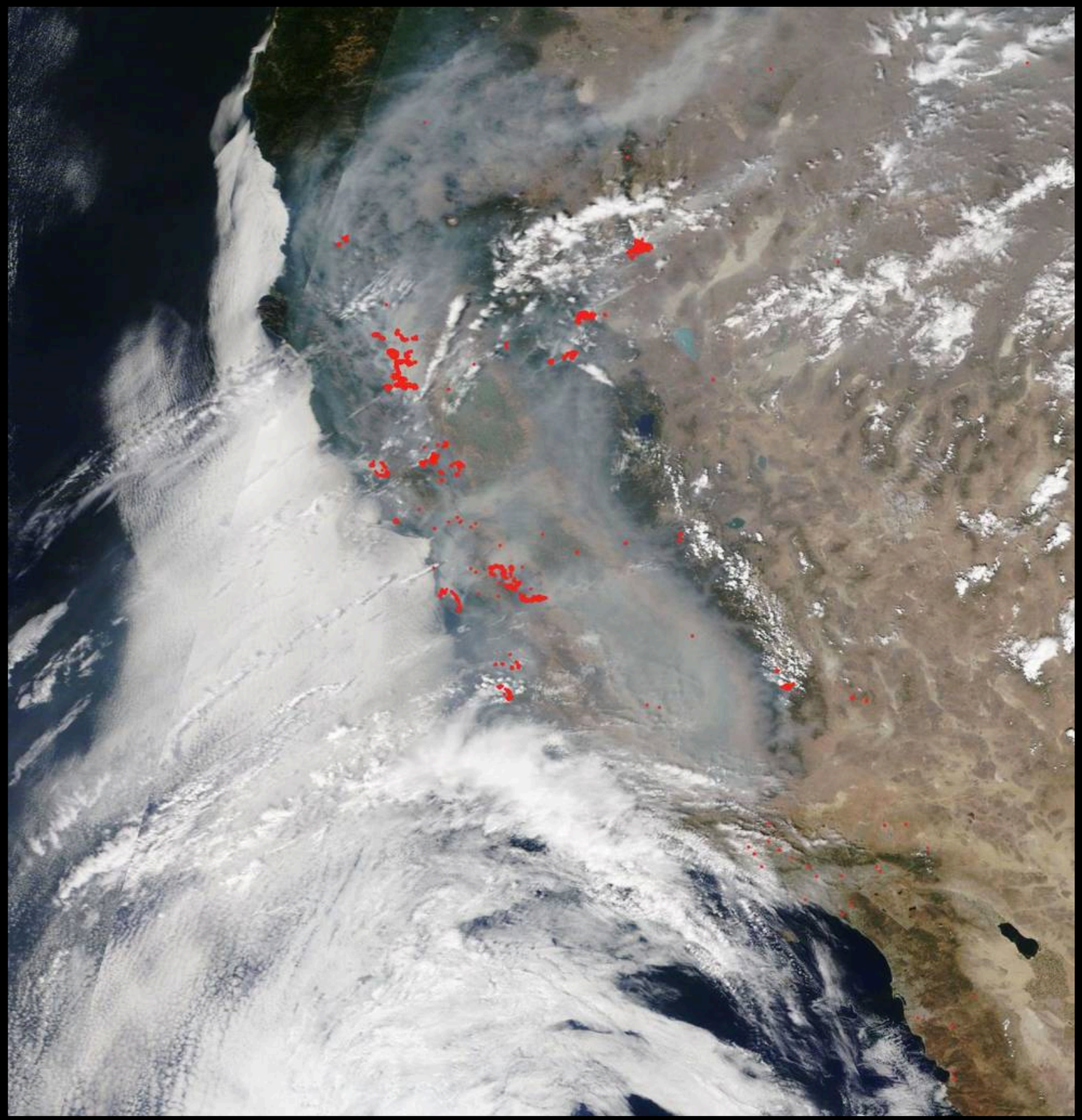
- Remote sensing: the acquisition of information about an object without making physical contact with the objects.



Wikipedia

- What is remote sensing to you (your recent experience with remote sensing)?

California Fire

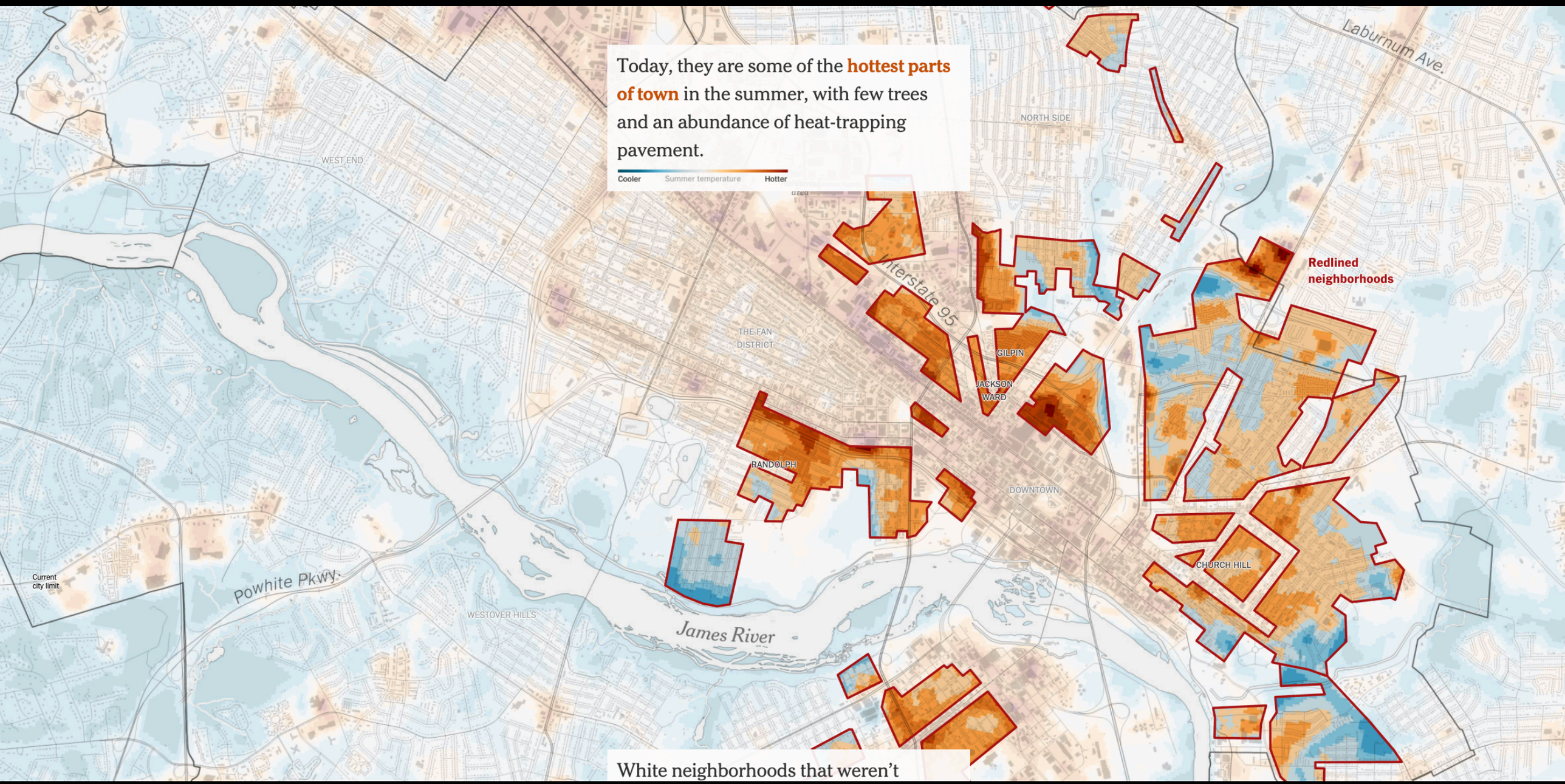


Link

Beirut explosion
May 31, 2020

Beirut explosion
Aug 5, 2020

Environmental Justice
New York Times



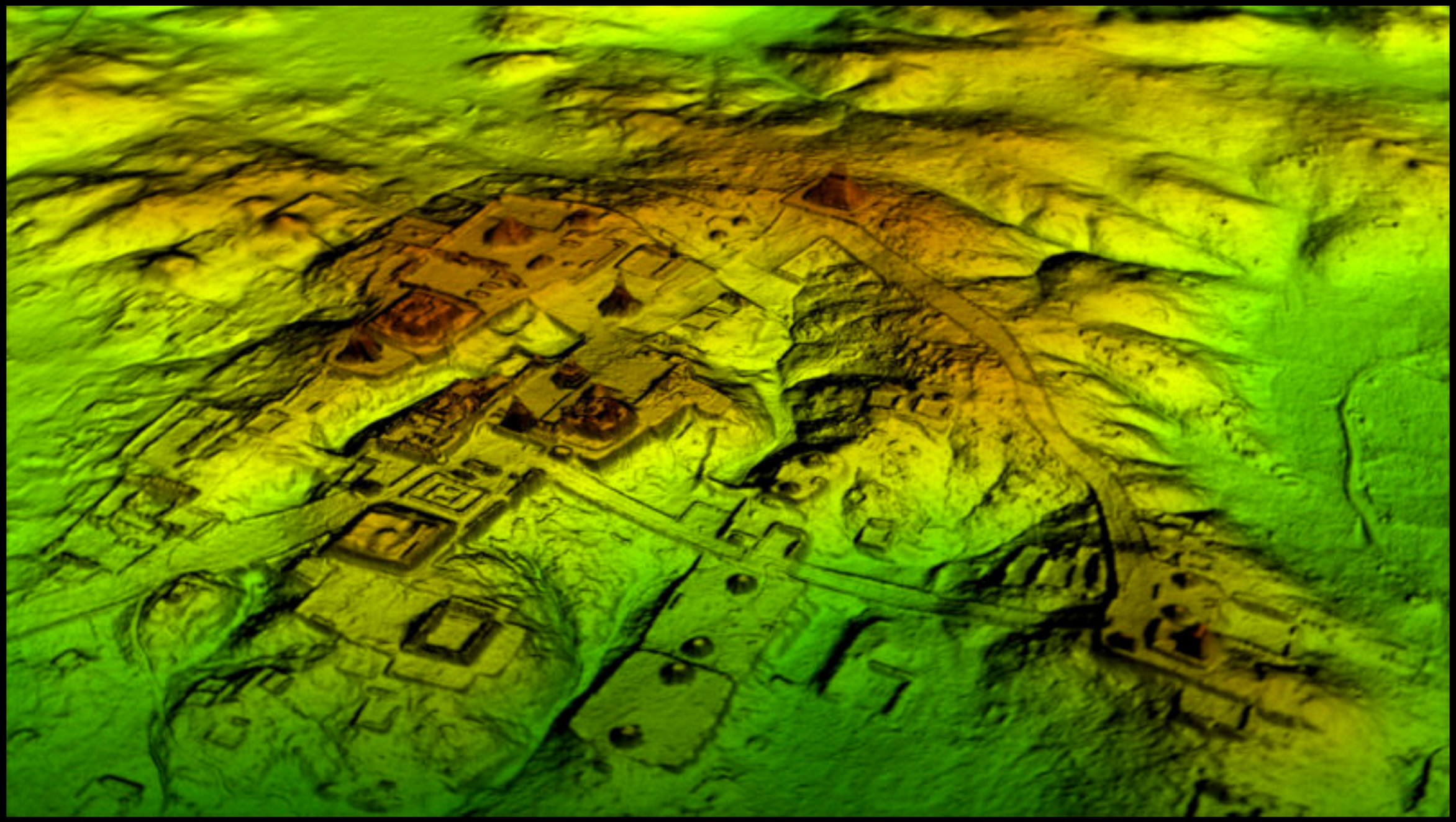
Glowing plants

Credit: Joanna Joiner & Joe Berry

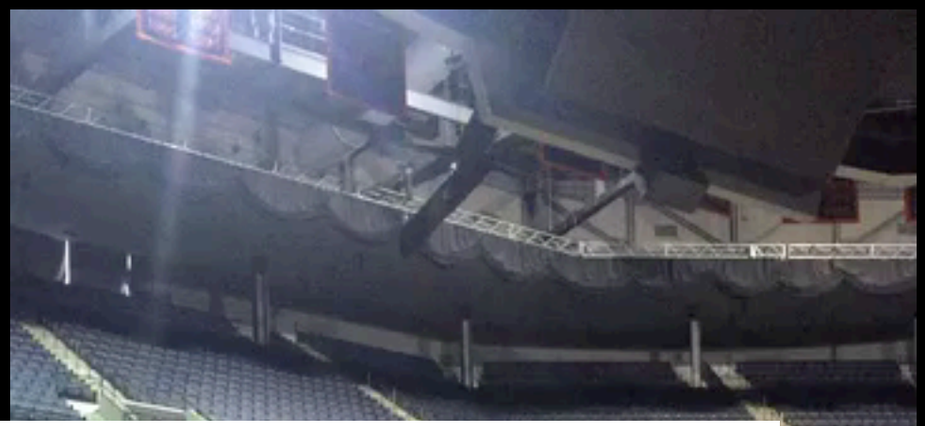
3D reconstruction

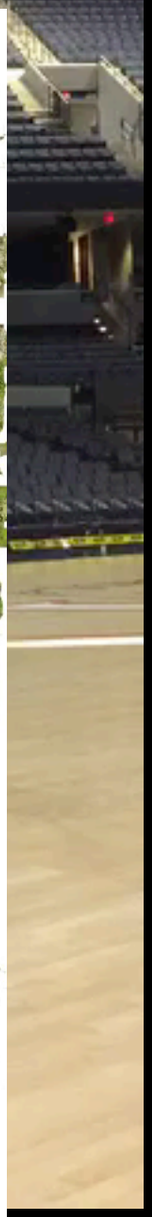
https://www.youtube.com/watch?v=XRTFY3q2d3o

Archeological Remote Sensing



Drones





Global challenges and the role of remote sensing

- Energy and the Environment
- Global Health
- Water Resources
- Agriculture and Food Security
- International Security
- Population
- Human Rights

Remote Sensing is an important and cool tool

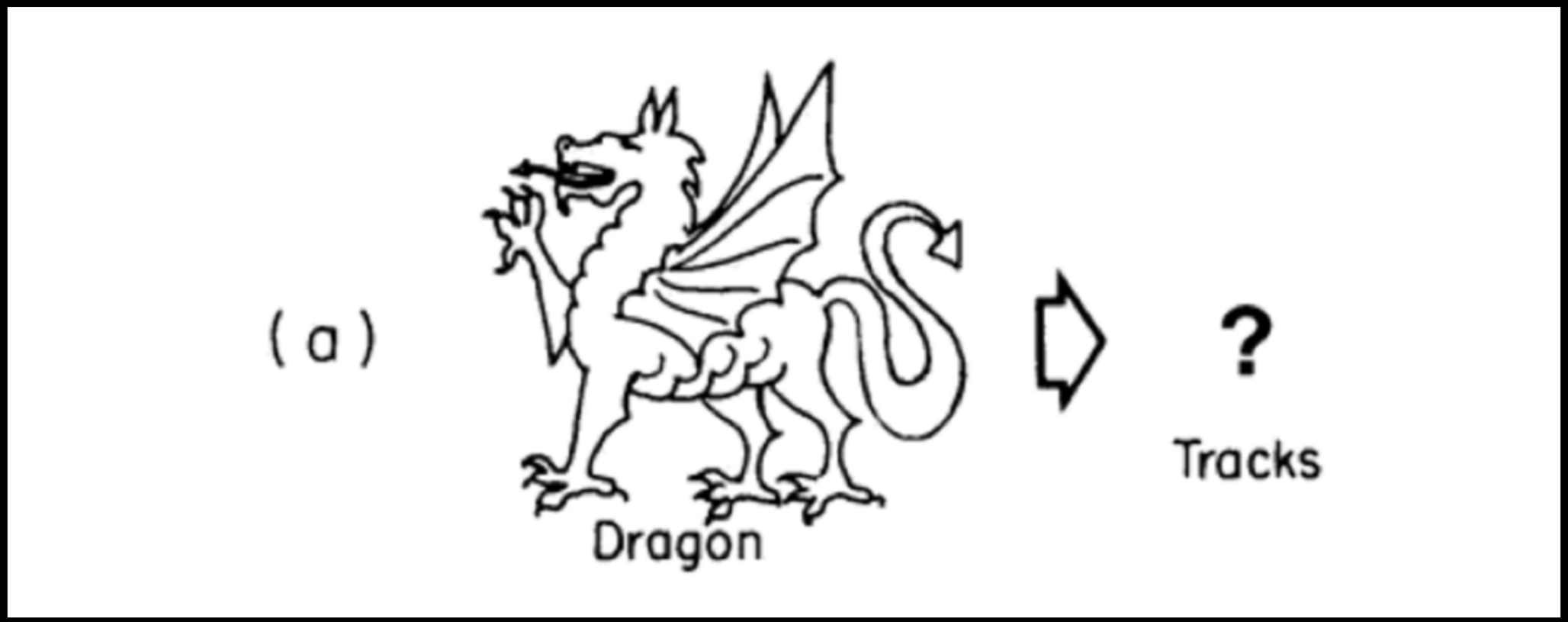
https://earthengine.google.com/timelapse/

https://earth.nullschool.net

Survey Time (~10 min)

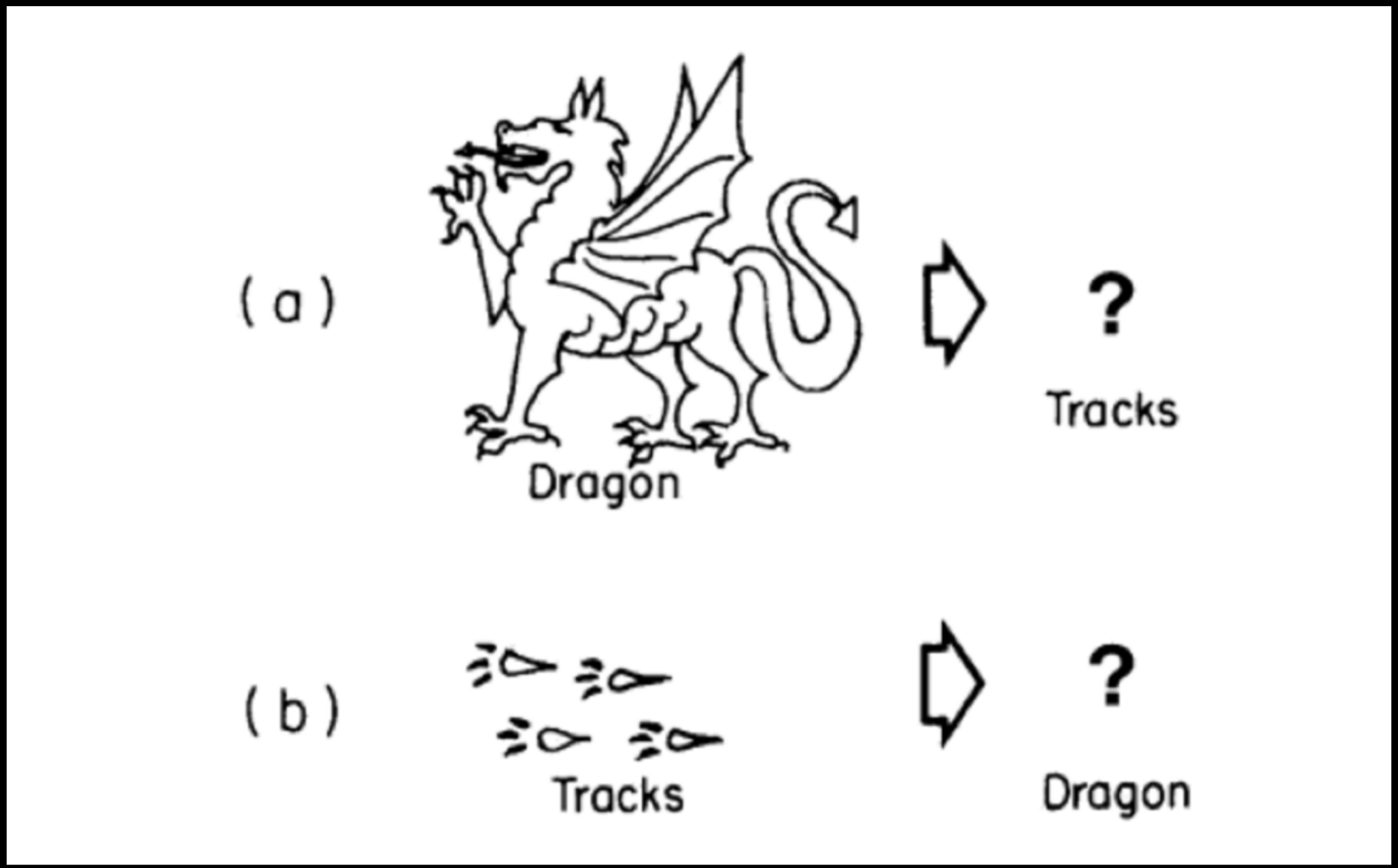
link

Remote sensing solves an inverse problem



Bohren and Huffman, 1983

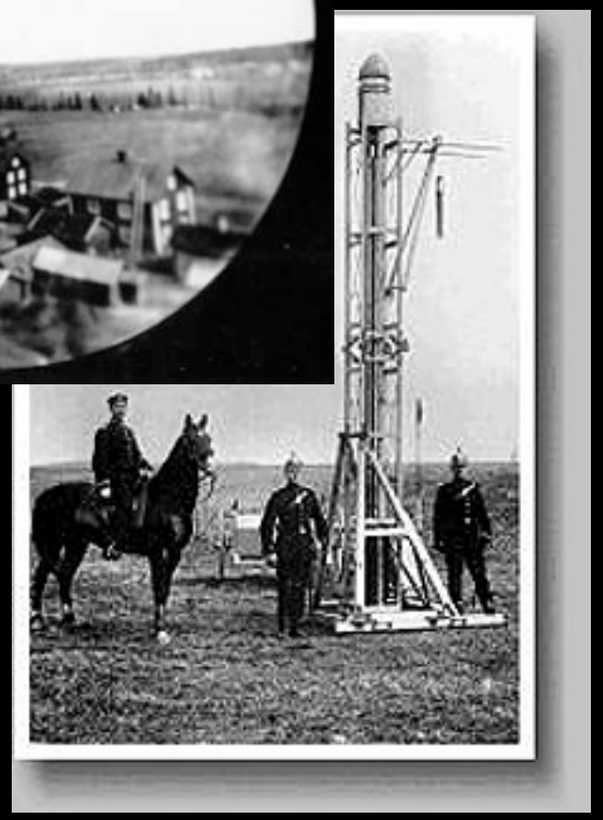
Remote sensing solves an inverse problem



Bohren and Huffman, 1983

A brief history of remote sensing (1)

Balloon (Nadar)



Nobel's Rocket

Recon Pigeon

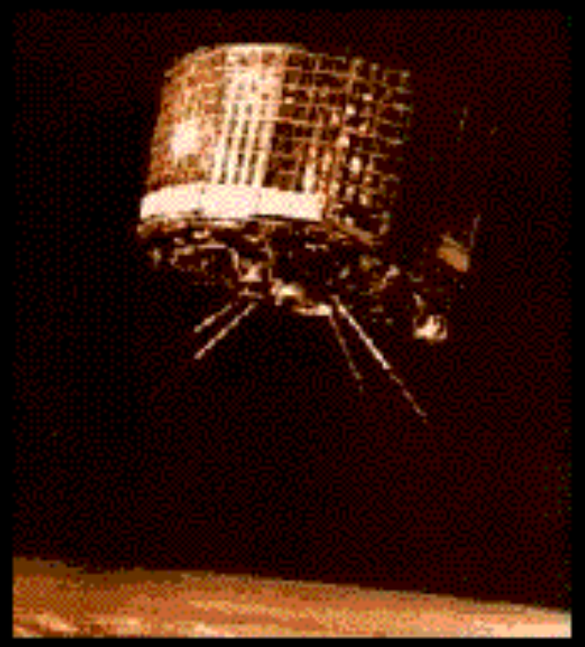
A brief history of remote sensing (II)

First photo of Earth from space

View of Earth from a camera on a V-2 missile. 1946

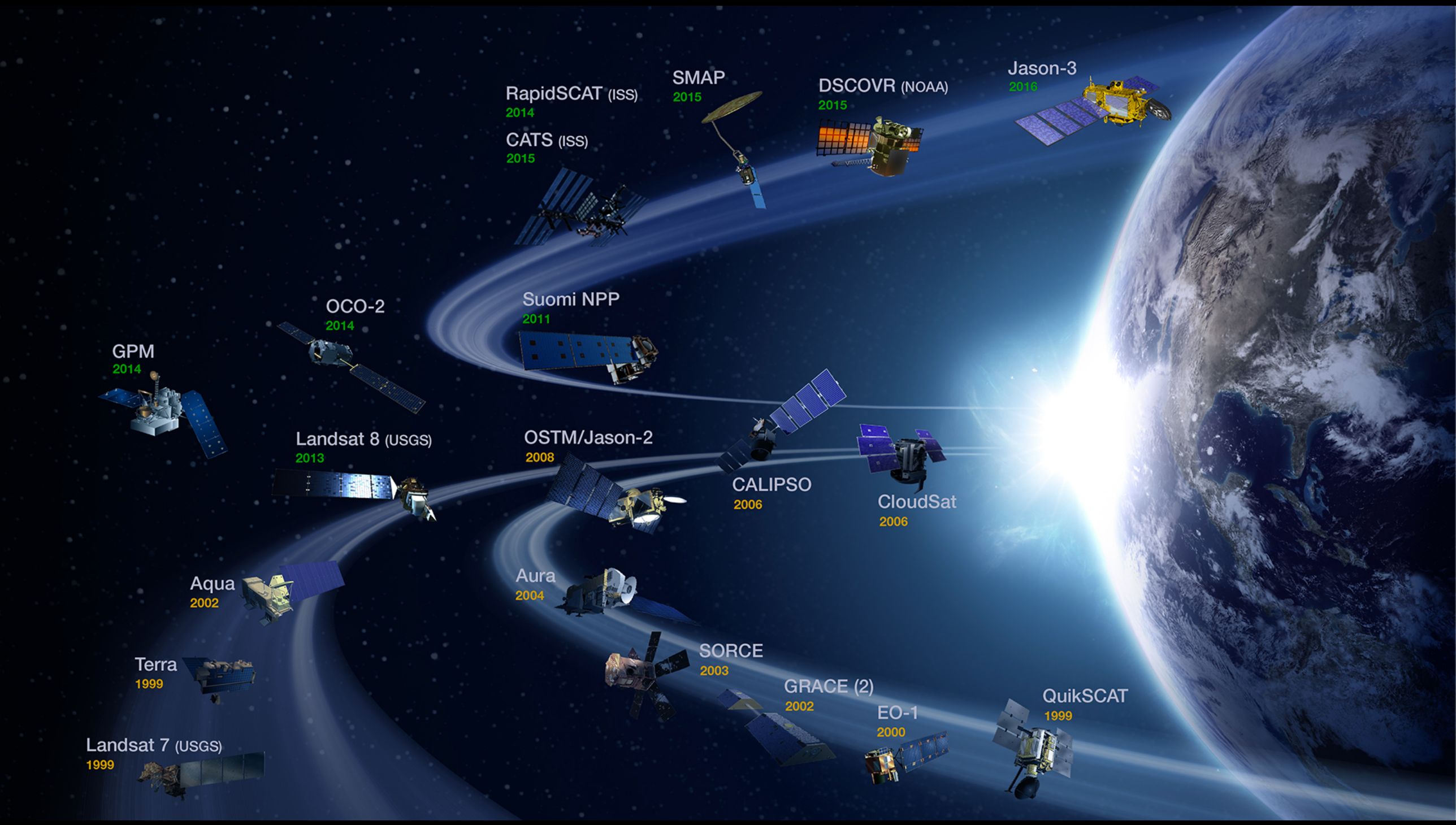
Remote sensing in the satellite era

- TIROS-1: **T**elevision **I**nfra**R**ed **O**bservation **S**ystem 1



- TIROS-N/NOAA satellites since 1978

Spaceborne Remote Sensing



NASA

Remote sensing in the satellite era

Quiz: how many manmade satellite are currently in orbit?

Why Remote Sensing???

Pros

- Spatial coverage
- Temporal frequency
- Cheap and efficient
- Remote

Cons

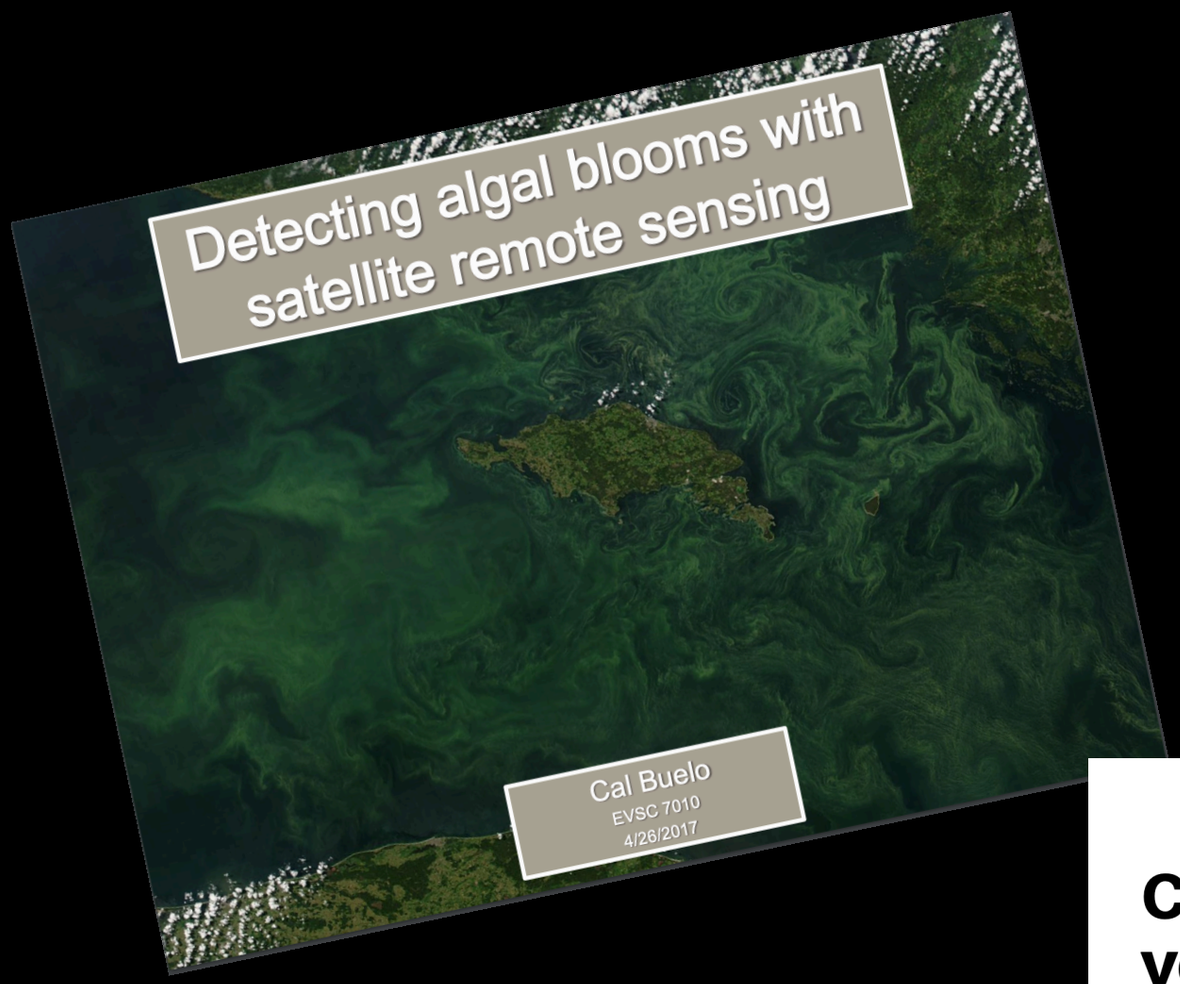
- Spatial resolution can sometimes be too coarse
- Clouds

Class Structure

- Lecture + Lab; Lab assignments + Readings (and discussions);

  Discussion lead sign-up: https://docs.google.com/spreadsheets/d/1jSJkrAmHEKxTsWEM7NILEa4rO3tse3xjnmfrU-MBU1M/edit?usp=sharing

- Evaluation: Final Project + Lab + Mid-term + Class Participation.



Qualitative Changes in Urban Land Cover in Vail and Denver, Colorado and a brief exploration of Classification Accuracy Between Software

EVSC 4010: Introduction to Remote Sensing
Filip Kawka

A Sticky Situation

Remotely Sensing the 2013 Honolulu Harbor Molasses Spill

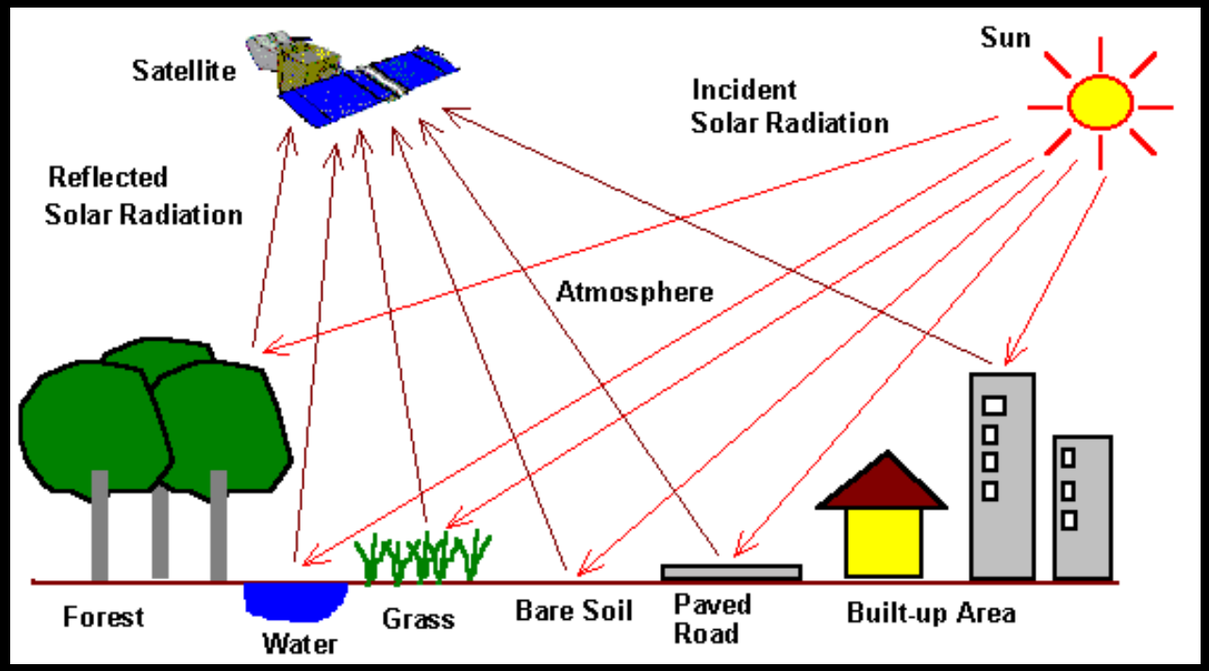
Zane Havens
Spring, 2018

Characterizing changes in vegetation from 1990 to 2010 in Metropolitan Manila, Philippines

Dom Ong

Lecture and discussion topics

Week 1: Introduction to Remote Sensing
Week 2: Basic Physical Principles of Remote Sensing
Week 3: Remote Sensing Systems
Week 4: Radiative Transfer Theory
Week 5: Reflectance Spectroscopy of Materials
Week 6: Image Interpretation and Data Analysis (I)
Week 7: Image Interpretation and Data Analysis (II)
Week 8: Mid-term
Week 9: Thermal Remote Sensing
Week 10: Hyperspectral Remote Sensing
Week 11: Microwave Remote Sensing
Week 12: Ground and Airborne Remote Sensing
Week 13: Advanced Remote Sensing Topics (I)
Week 14: Advanced Remote Sensing Topics (II)



Labs

Lab 1: Introduction to Digital Images and Course Software (ENVI)
Lab 2: Atmospheric Correction and Radiometric Correction
Lab 3: Reflectance, Band Ratio, and Vegetation Indices
Lab 4: Hyperspectral Images
Lab 5: Image Interpretation
Lab 6: Thermal Imageries: Estimating Fire Extent
Lab 7: Land Use Classification

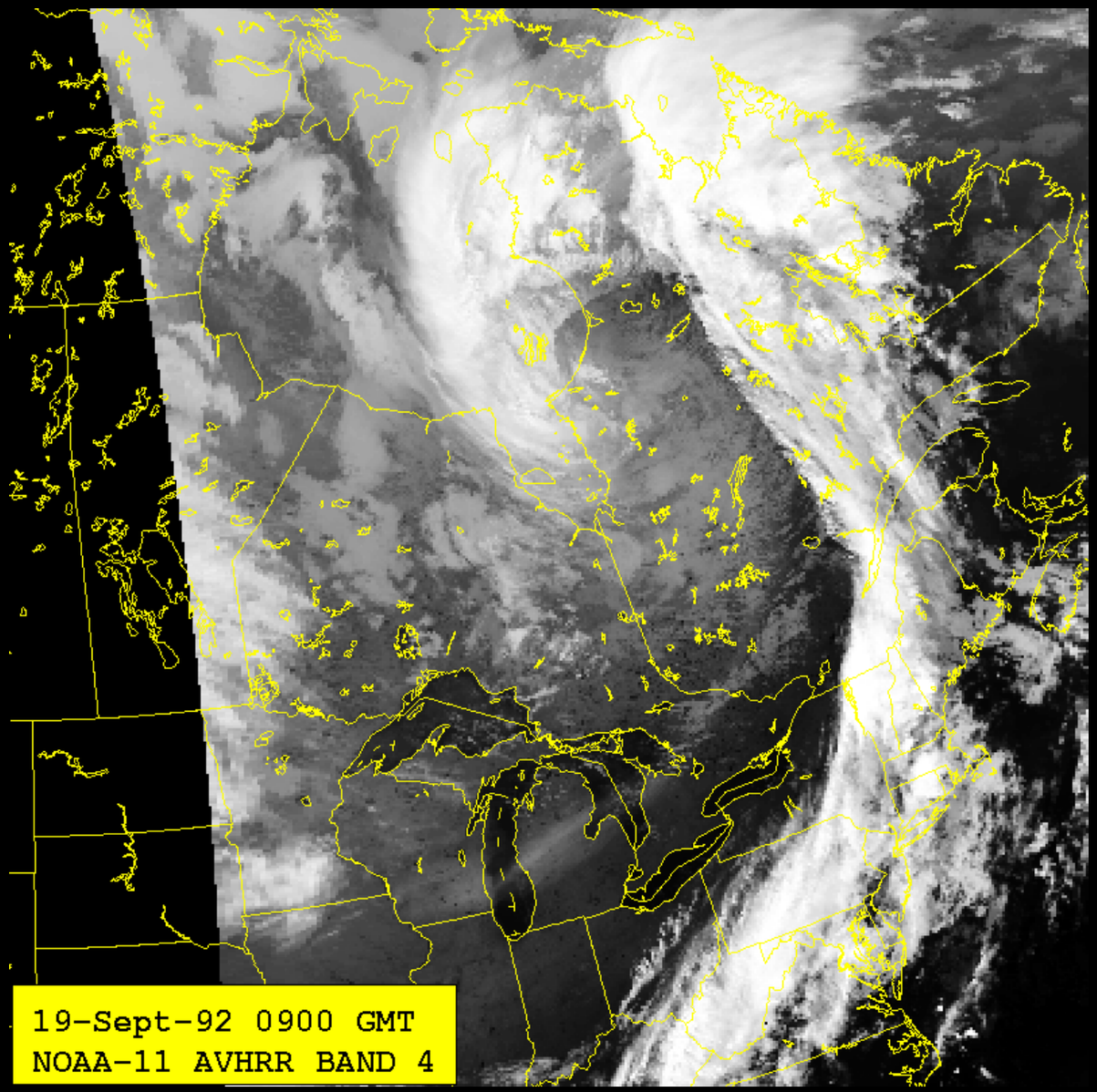
Expected outcomes

- Explain basic concepts in remote sensing;
- Explain how remote sensing instruments works;
- Know how to find remote sensing datasets for your projects;
- Know how to use one or two software that processes remote sensing data;
- Discuss advantages and caveats of remote sensing;
- Explain how remote sensing can solve real-world problems;
- Use remote sensing to solve real-world problems.

Case studies

- Vegetation Remote Sensing — an area of happy accidents
- Urban Remote Sensing

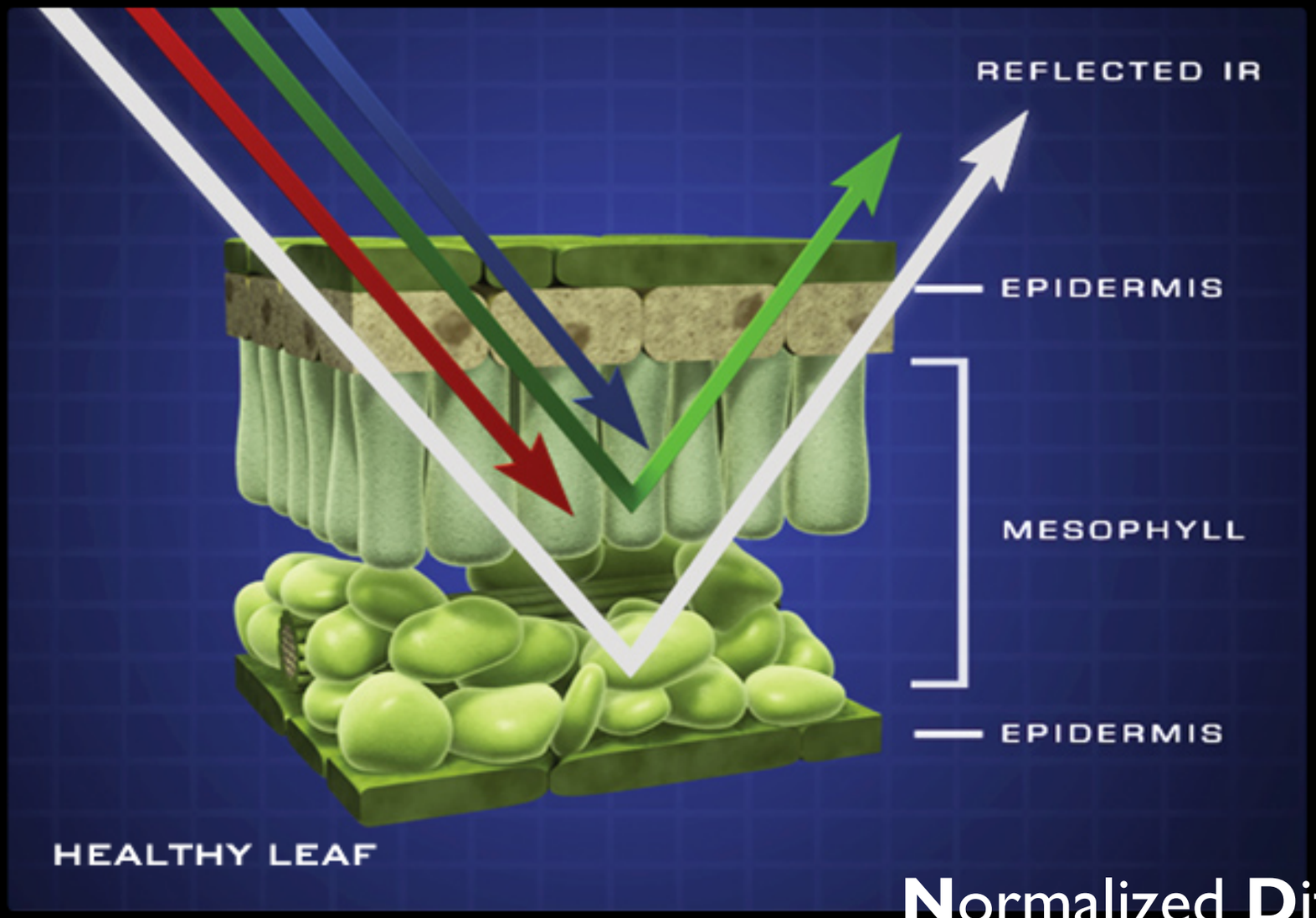
A weather satellite for vegetation studies

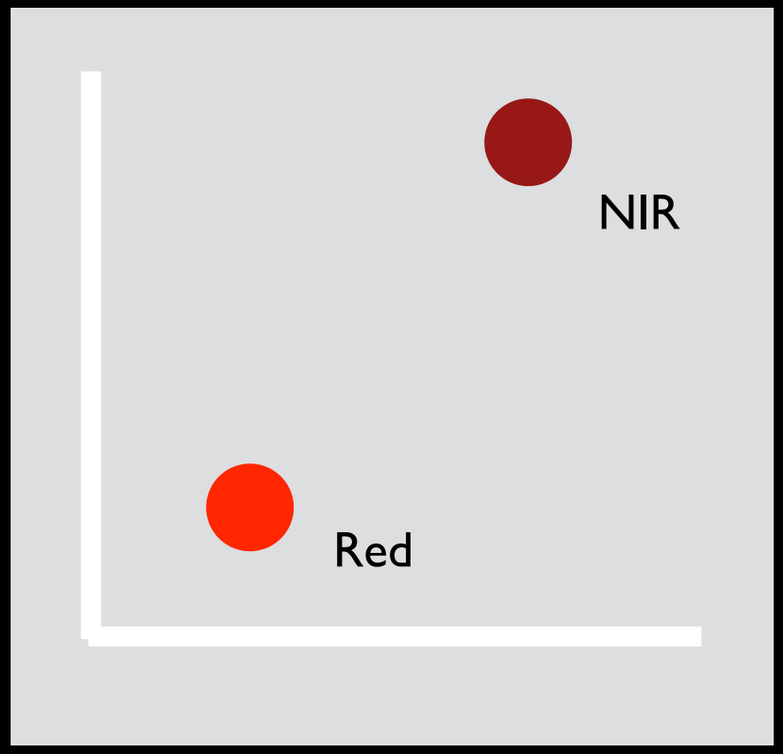


- TIROS-N

NOAA

Vegetation index

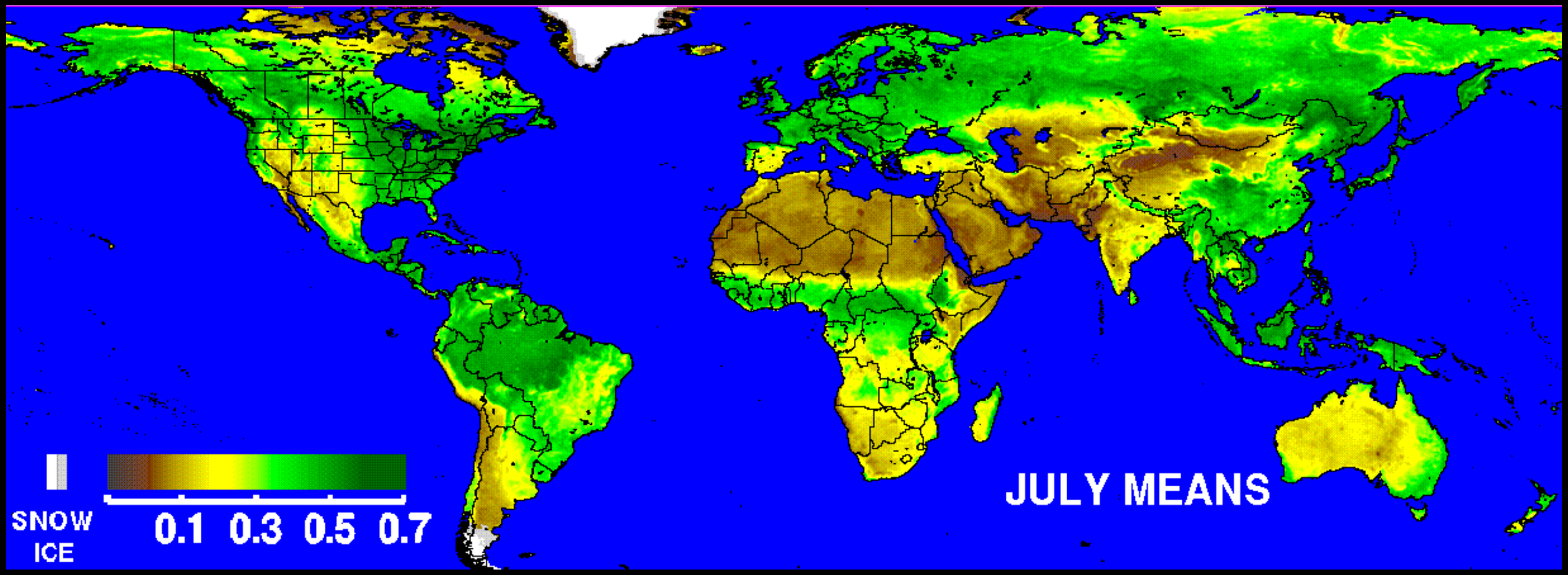




Normalized **D**ifference **V**egetation **I**ndex
= (NIR-R)/(NIR+R)

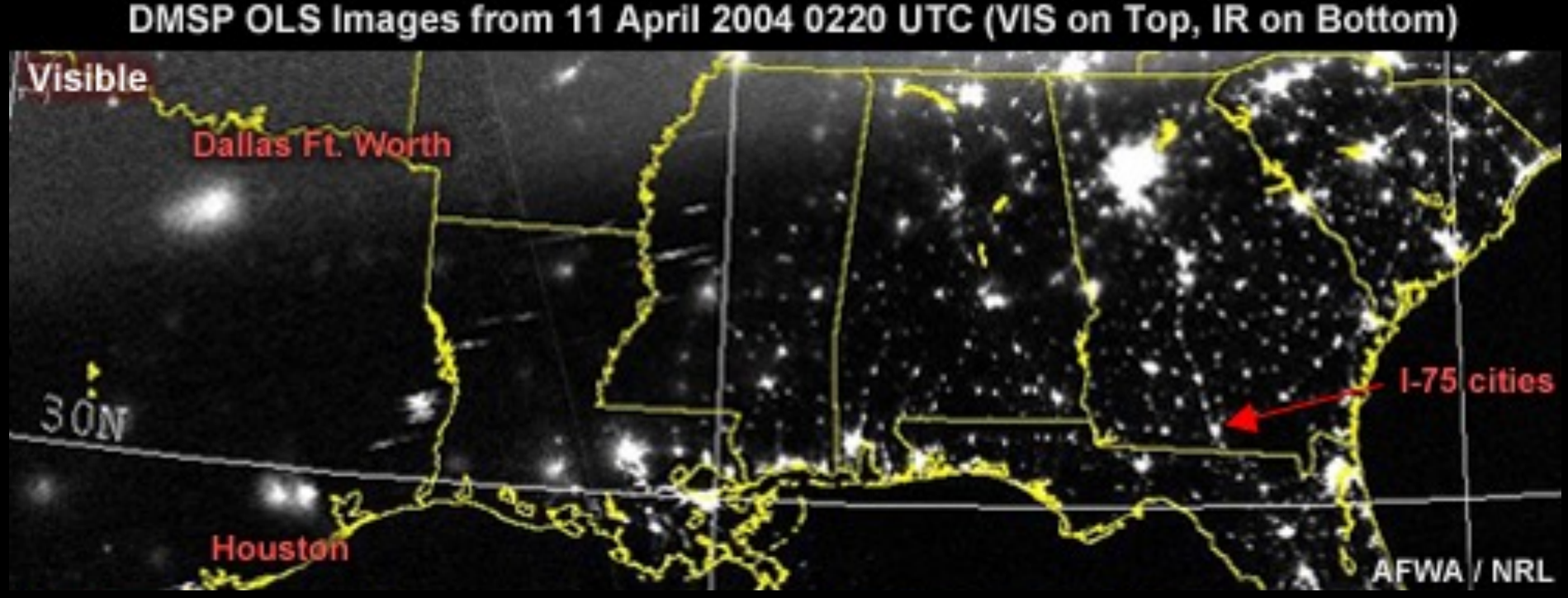
NASA

A weather satellite for vegetation studies



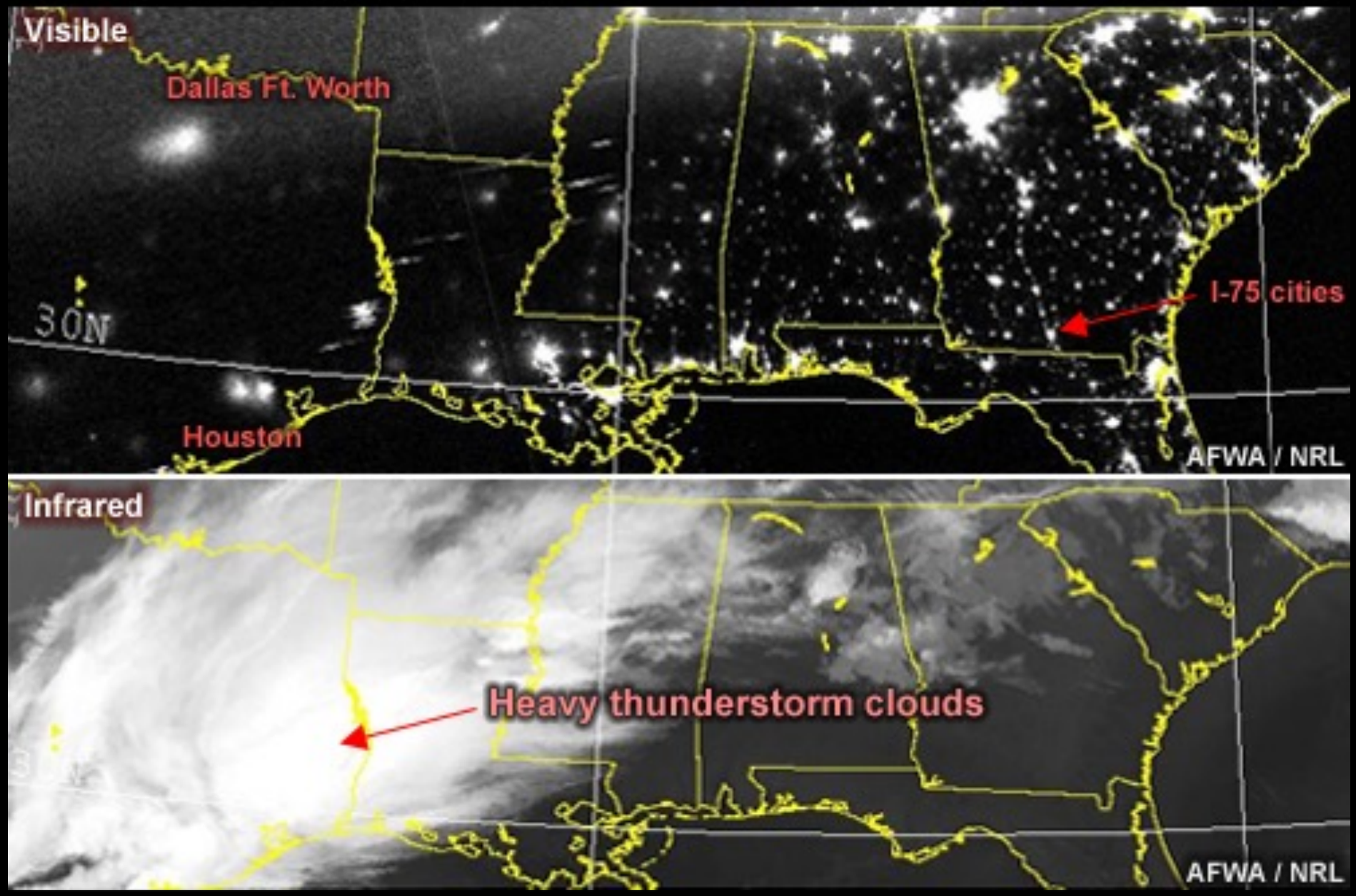
NOAA

A weather satellite for urban studies

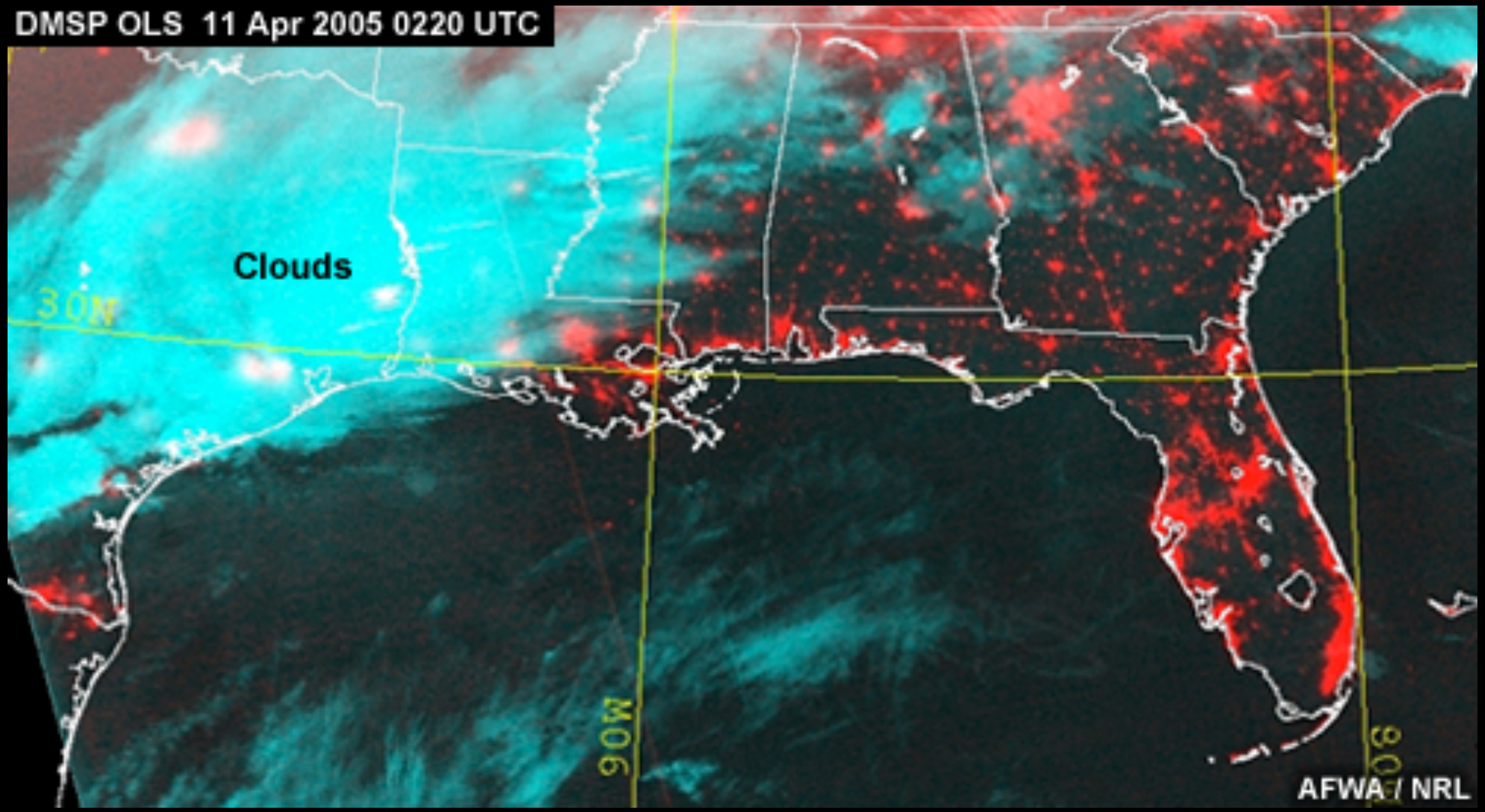


DMSP OLS: Defense Meteorological Satellite Program, Operational Linescan System

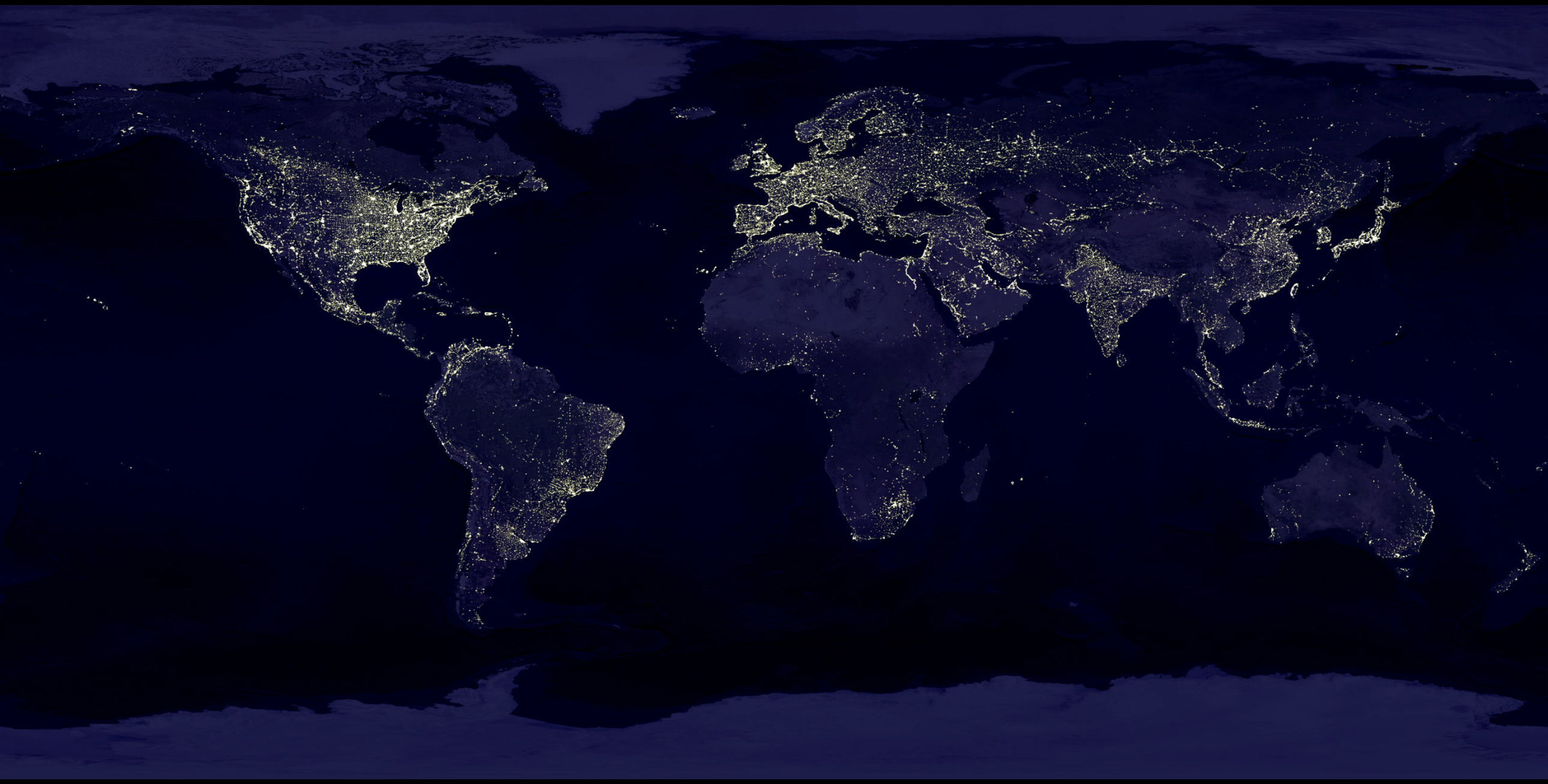
A weather satellite for urban studies



DMSP OLS: Defense Meteorological Satellite Program, Operational Linescan System


DMSP OLS 11 Apr 2005 0220 UTC
Clouds
30N
90W
80W
AFWA / NRL

A weather satellite for urban studies



DMSP OLS