LFPL's MyLibraryU Short Course
September 21, 2023

Humans and the Environment

An Investigation of Land Cover and Land Use – Southeast Asia

Andrea E Gaughan
Department of Geographical and Environmental Sciences
University of Louisville

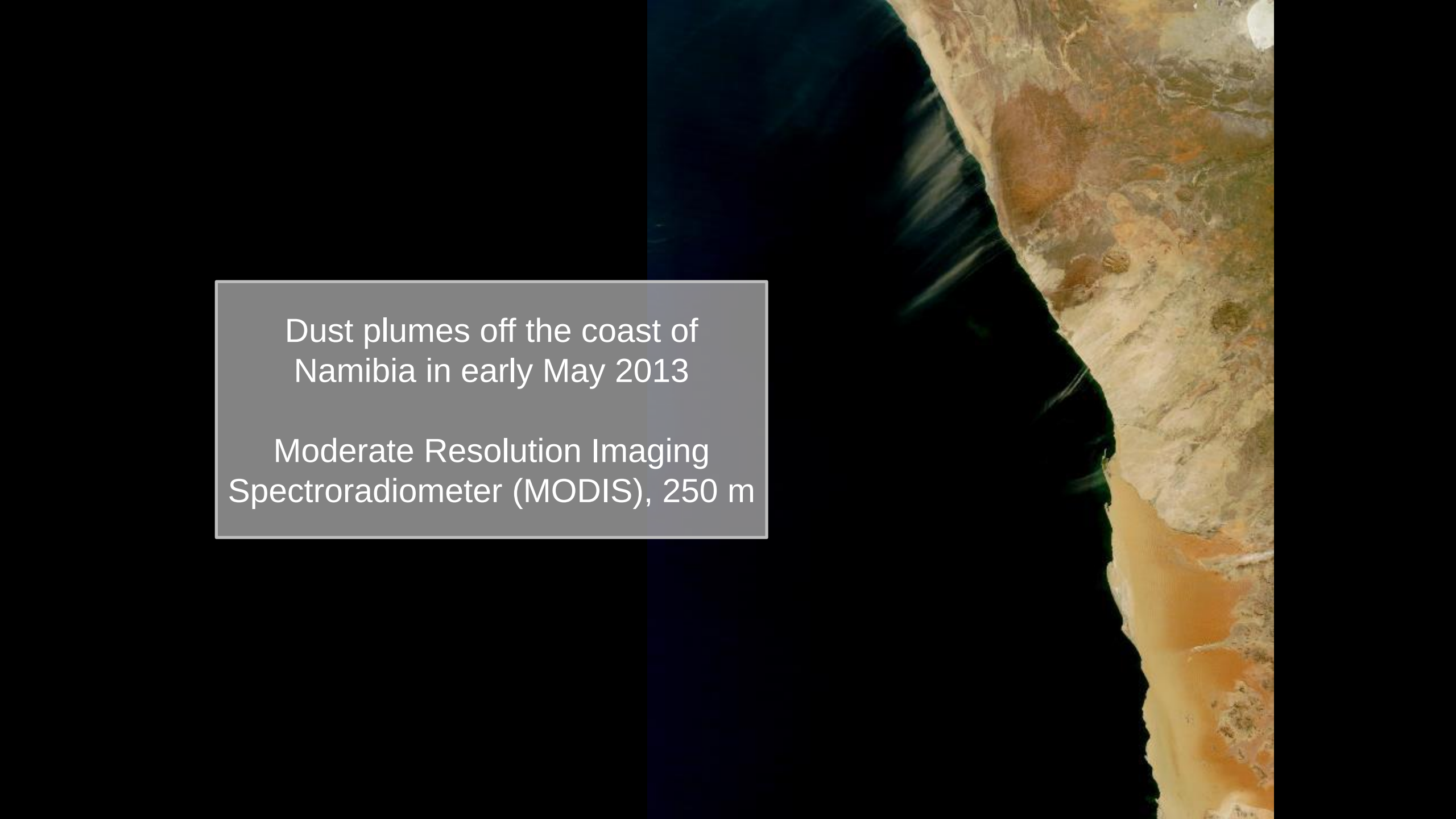
NASA's Night Lights Data

Remote Sensing – A Primer

Remote Sensing – defined

"Remote sensing is the science and art of obtaining information about an object, area, or phenomenon through the analysis of data acquired by a device that is not in contact with the object, area, or phenomenon under investigation."

- Lillesand et al., 2008



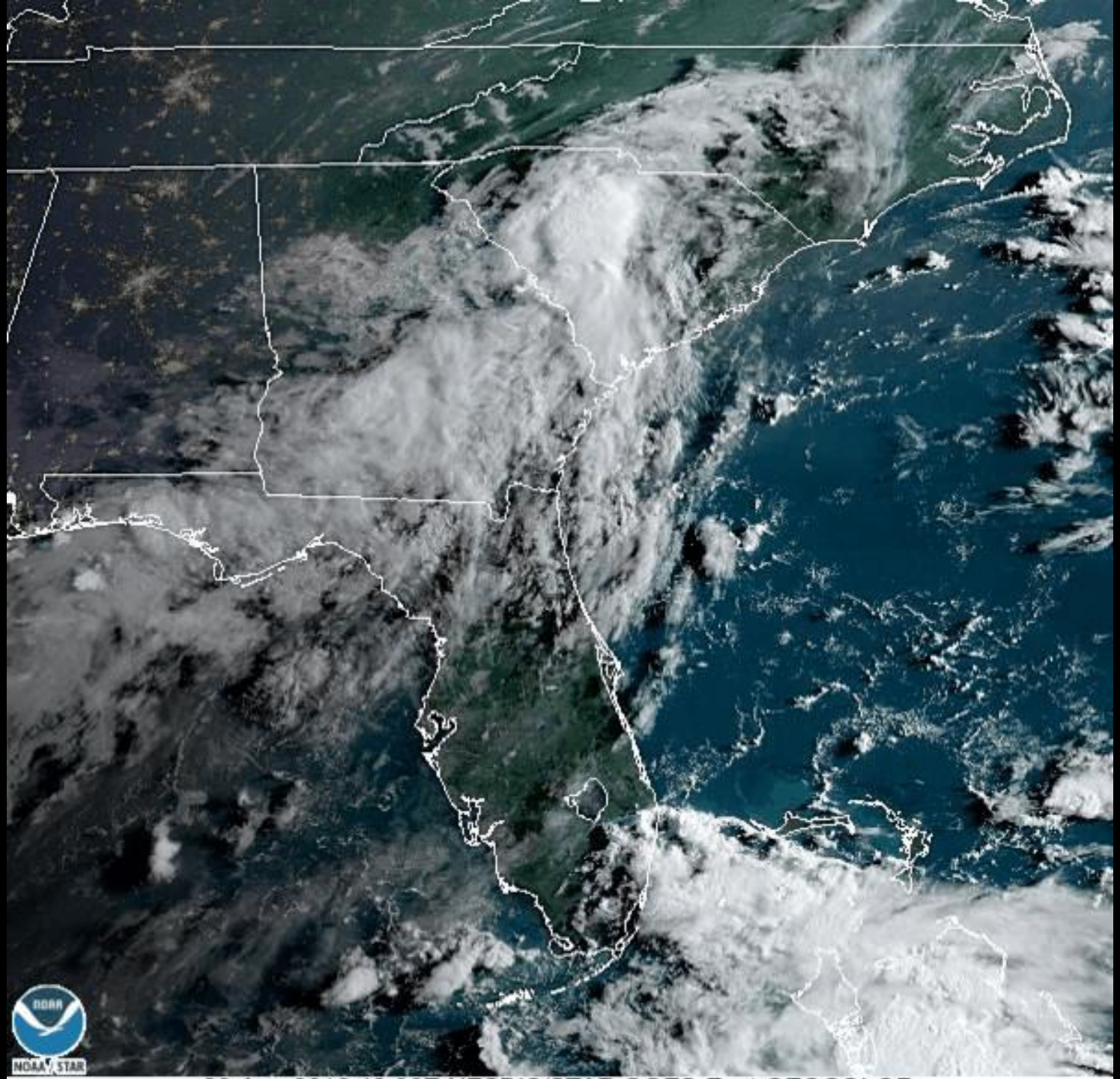
Dust plumes off the coast of Namibia in early May 2013

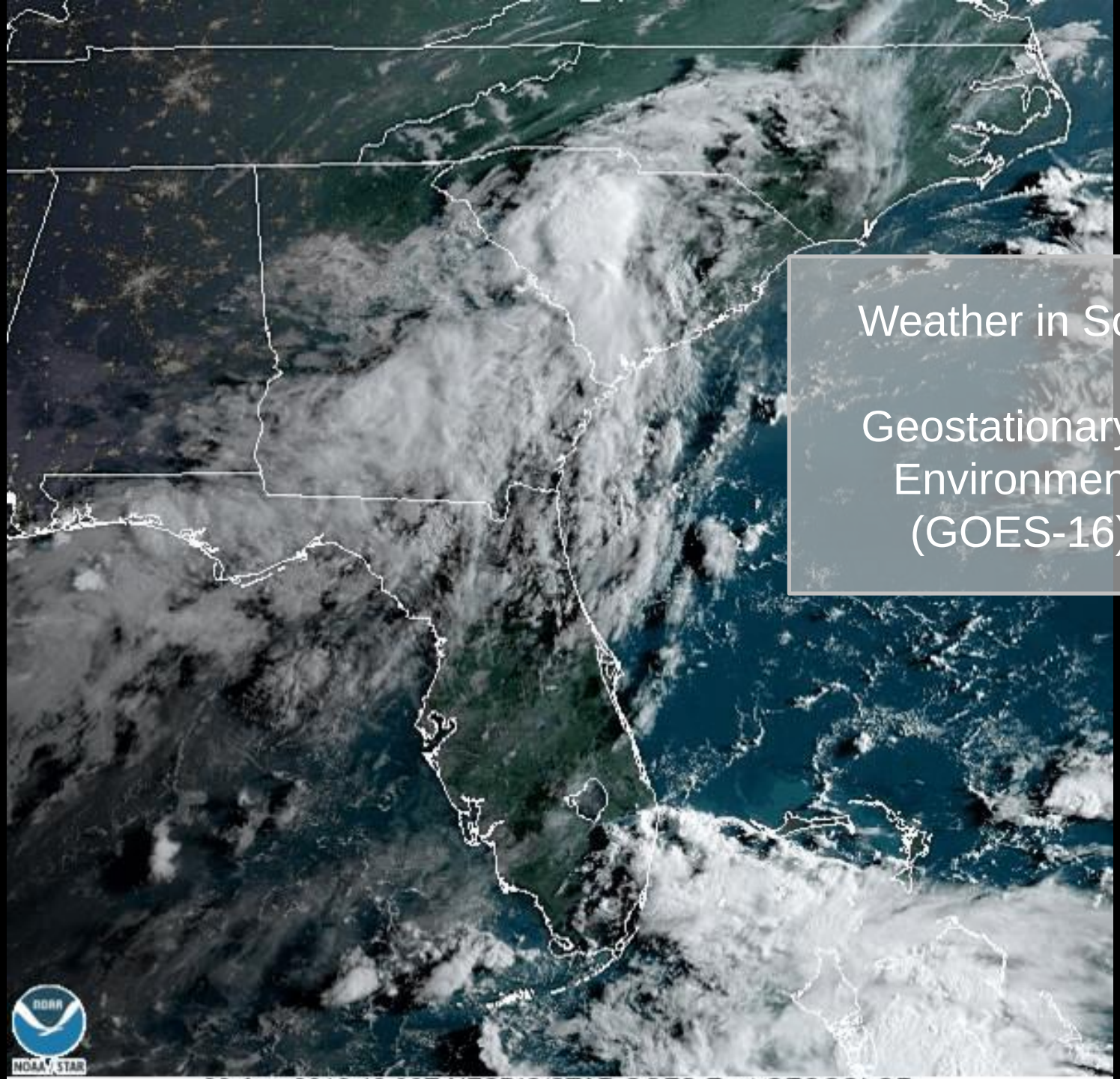
Moderate Resolution Imaging Spectroradiometer (MODIS), 250 m


1 km
N

Urbanization in Dubai

Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), 30 m

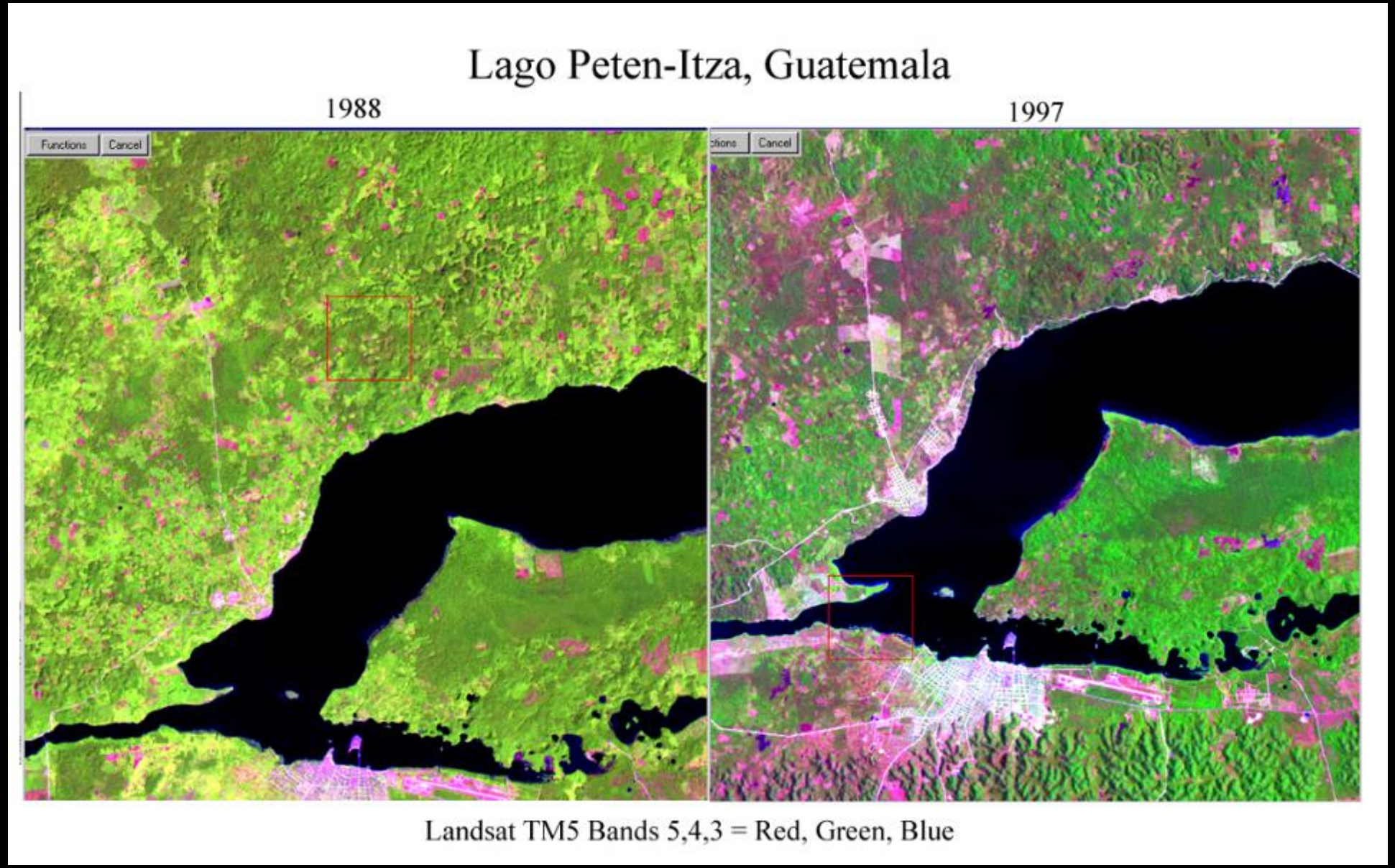

NOAA
STAR



Weather in Southeast U.S.

Geostationary Operational Environmental Satellite (GOES-16), 0.5-2 km

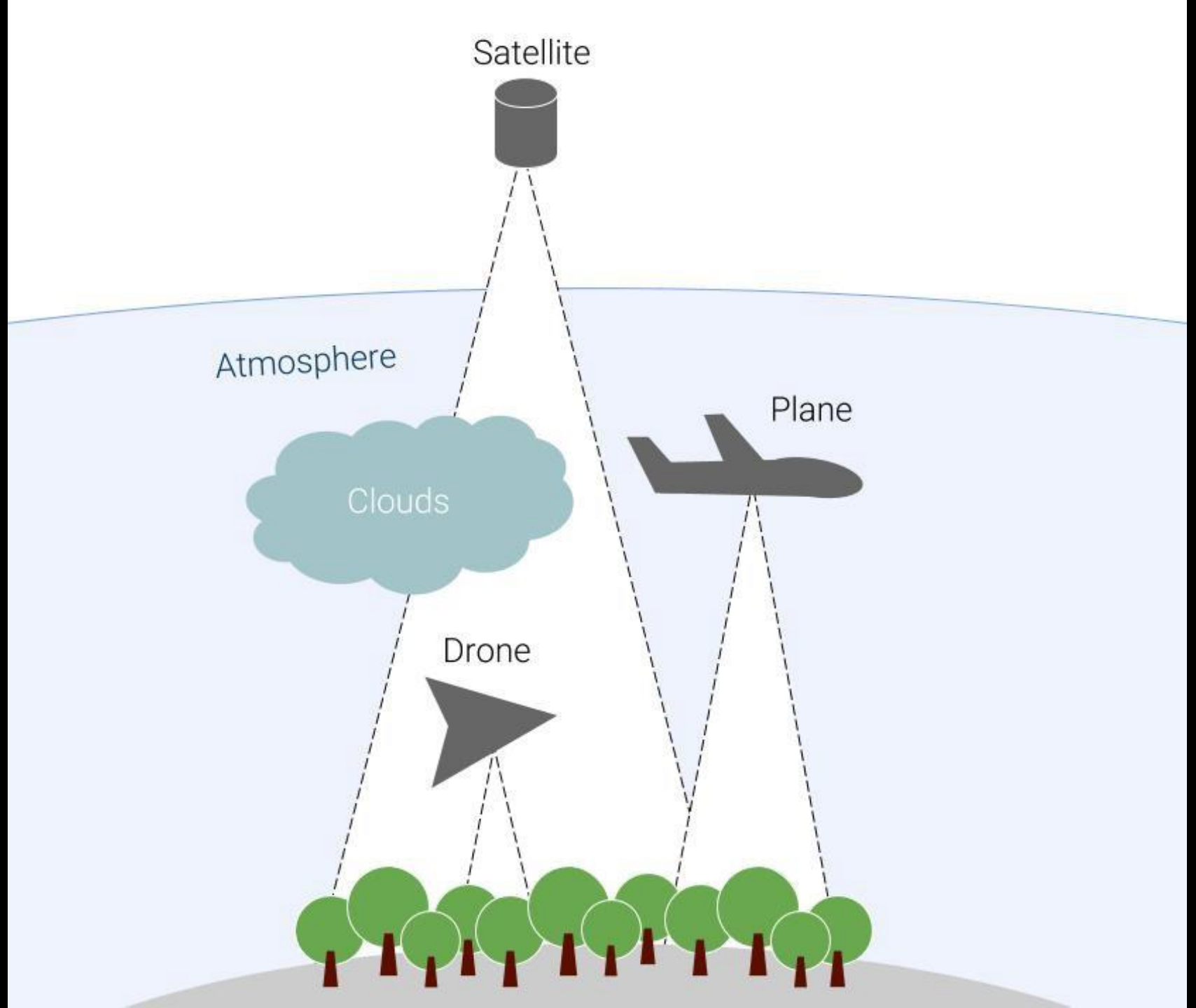
Landscape Change



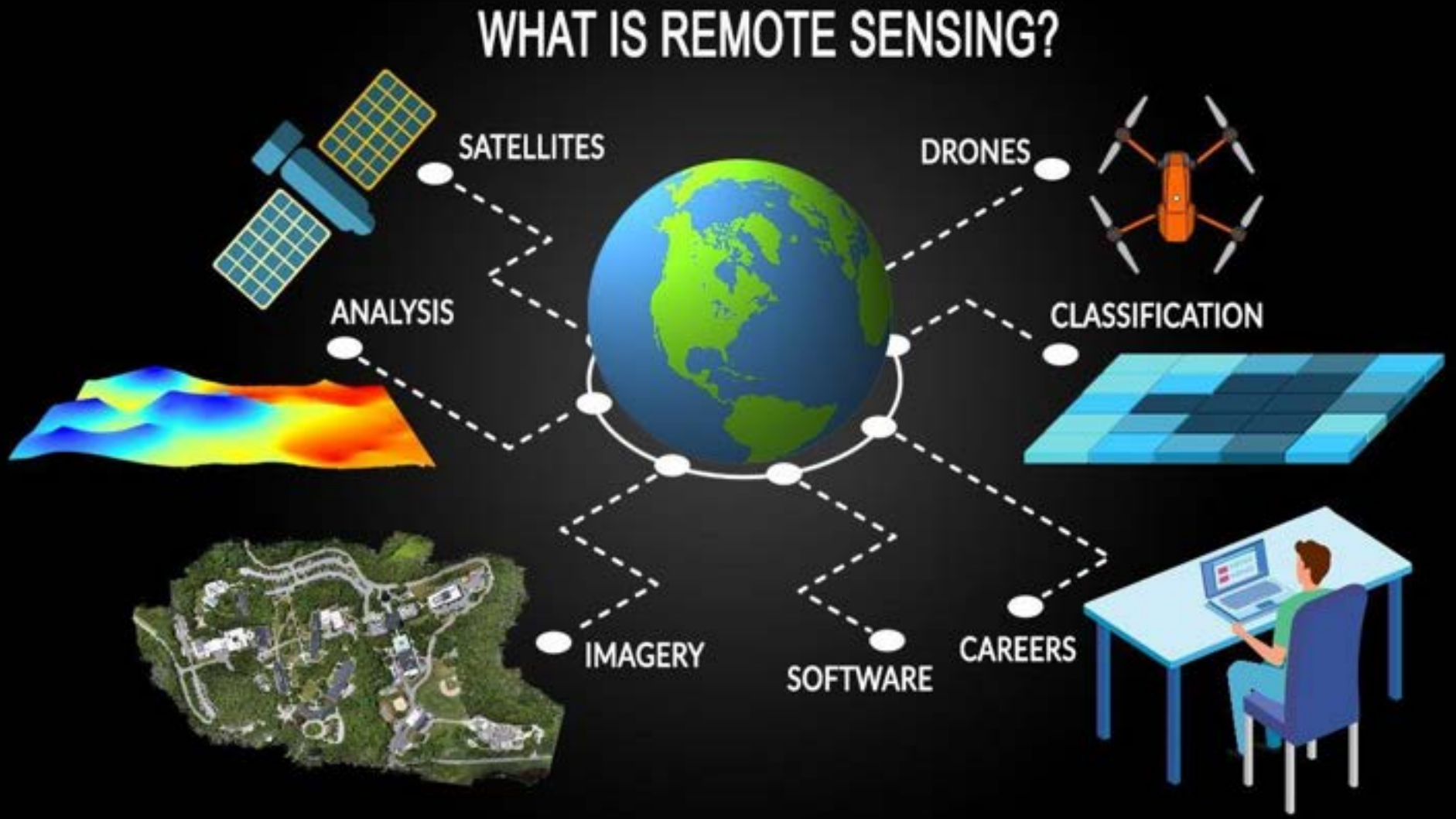
Remote Sensing – A Primer

Many platforms, many applications

Sensor altitude plays a role in determining purpose



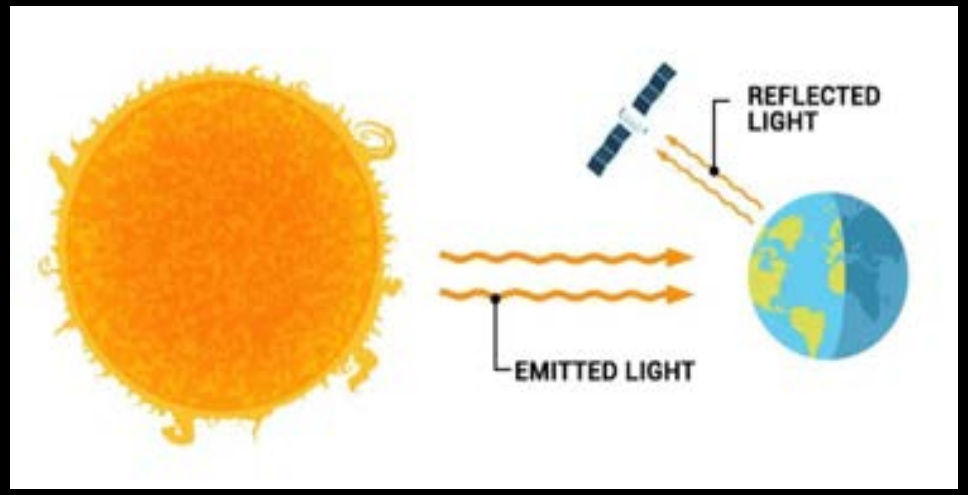
Source


WHAT IS REMOTE SENSING?
SATELLITES
DRONES
ANALYSIS
CLASSIFICATION
IMAGERY
SOFTWARE
CAREERS

Source

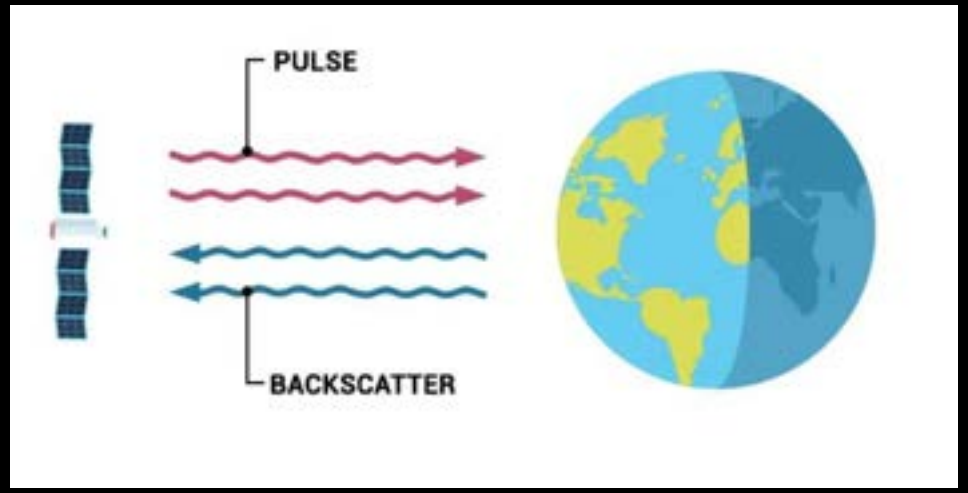
Sensor Types

Systems that rely on the sun to generate all the EM energy needed to image earth's atmosphere and land surfaces are called *passive sensors*



Remote Sensing

Sensors that generate their own energy, called *active sensors*, transmits energy in a certain direction and records the portion reflected back by features within the signal path



Electromagnetic Energy

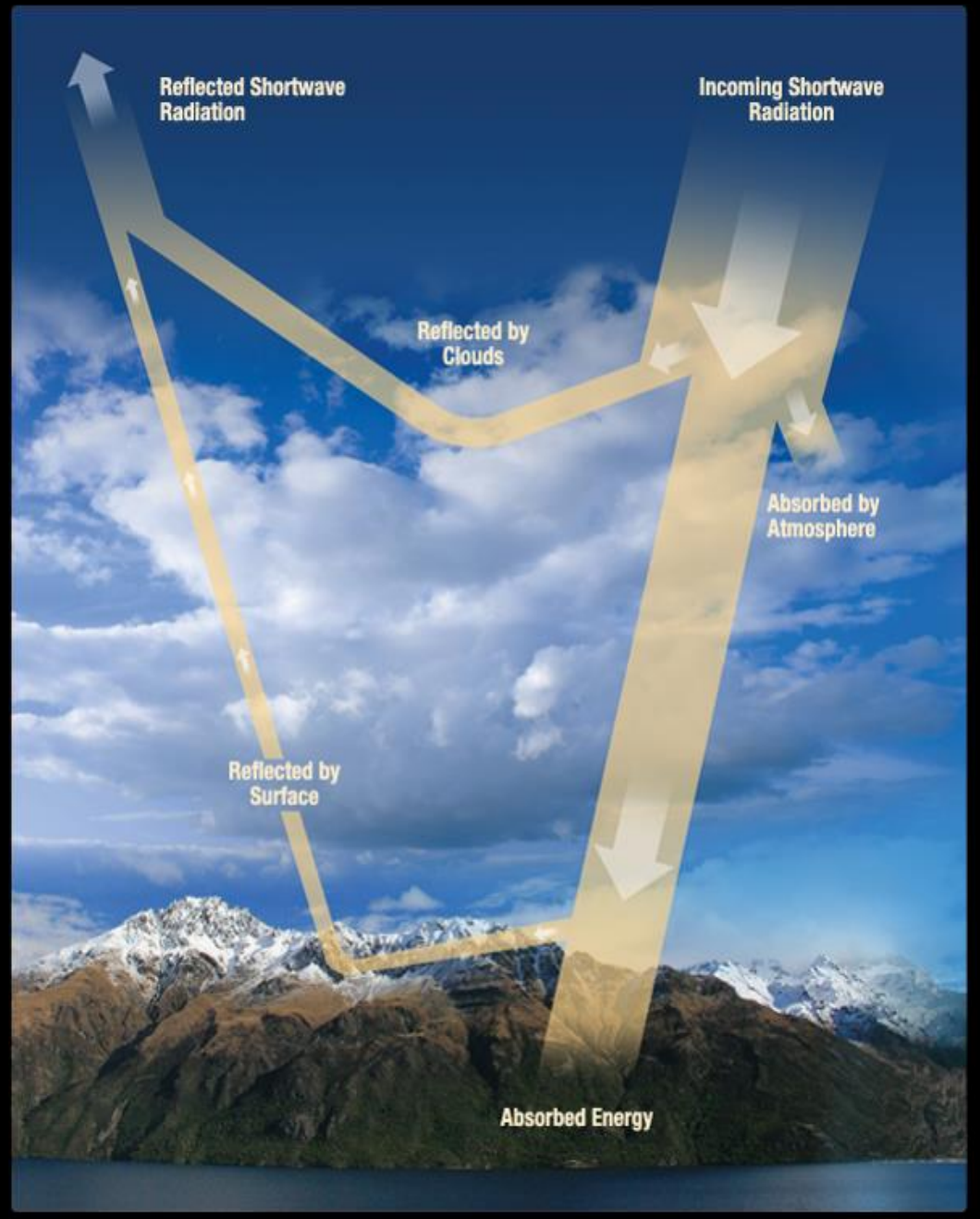


Photo Source

Electromagnetic Spectrum

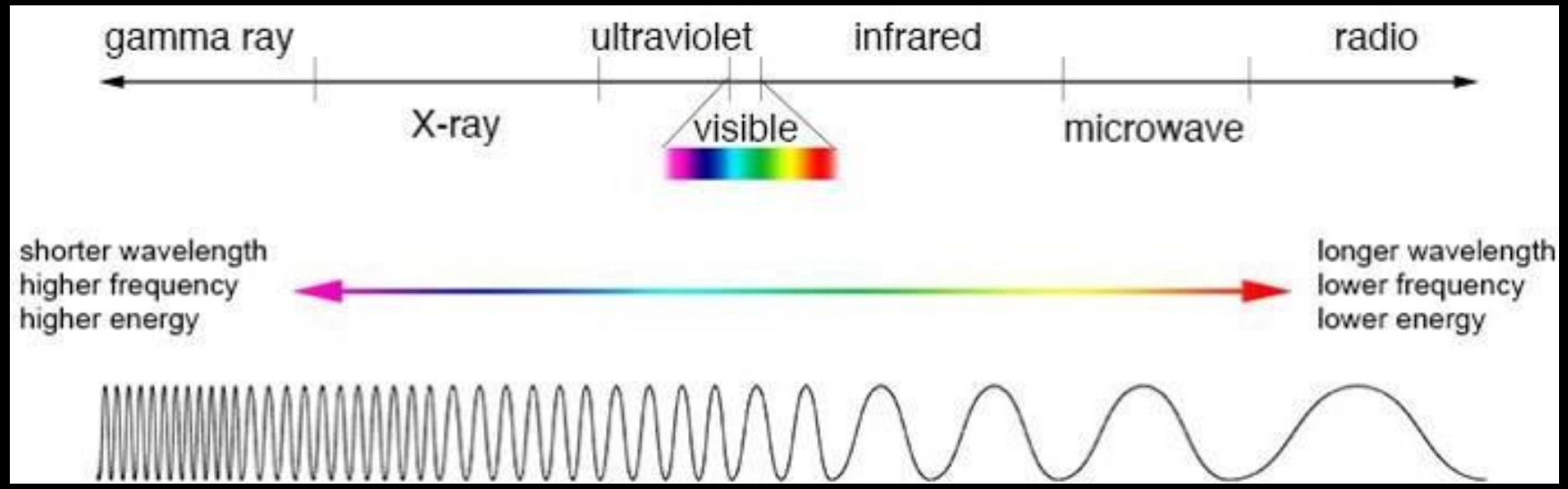
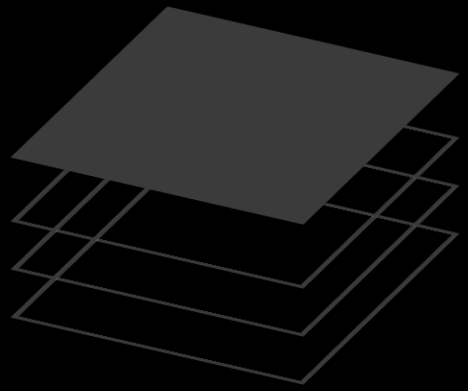


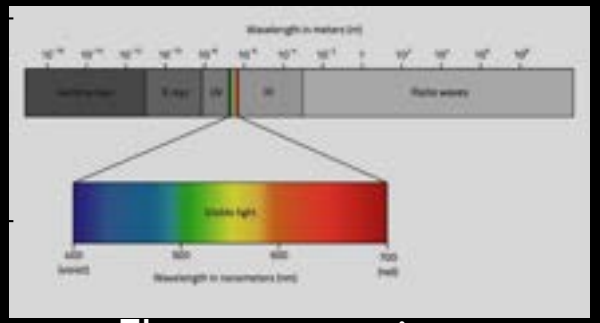
Photo Source

Color, Data, Light

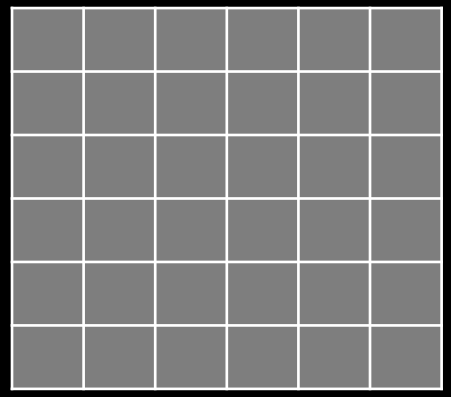
Our eyes are sensitive in the *visible* spectrum (390-700 nm)

Remote Sensing Data





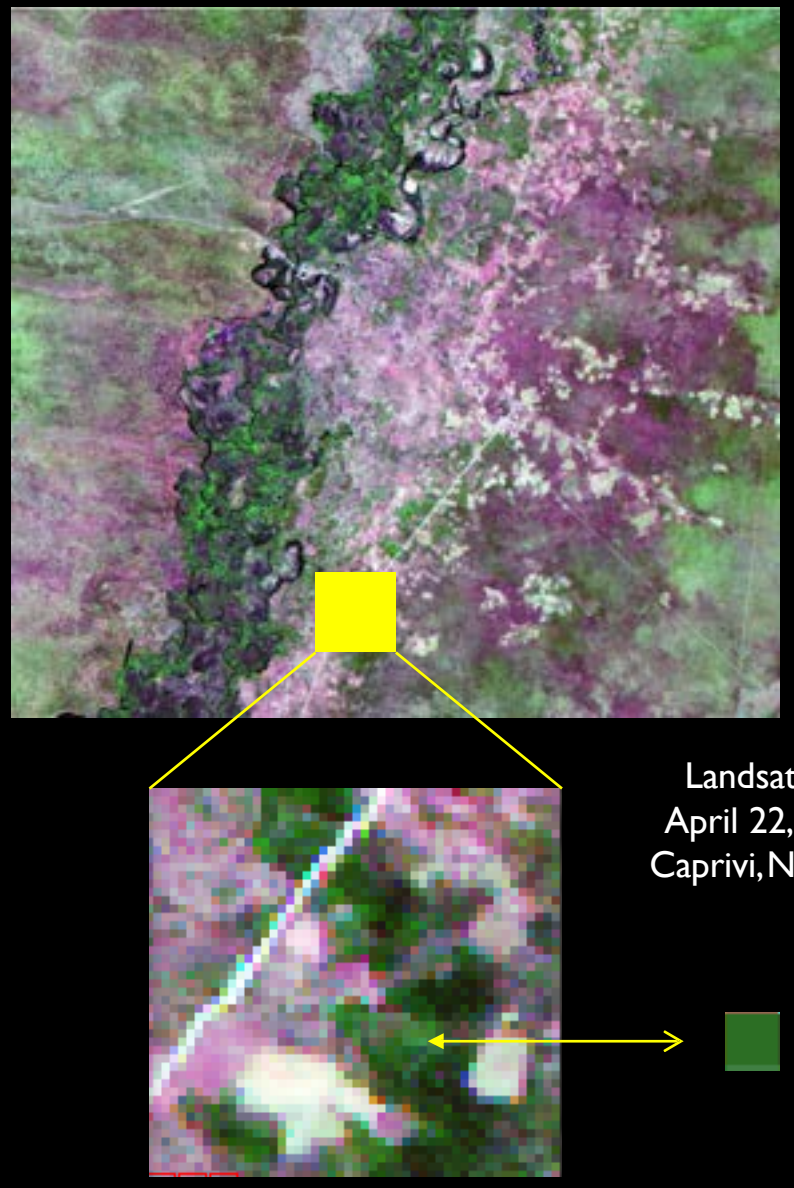
Electromagnetic Spectrum



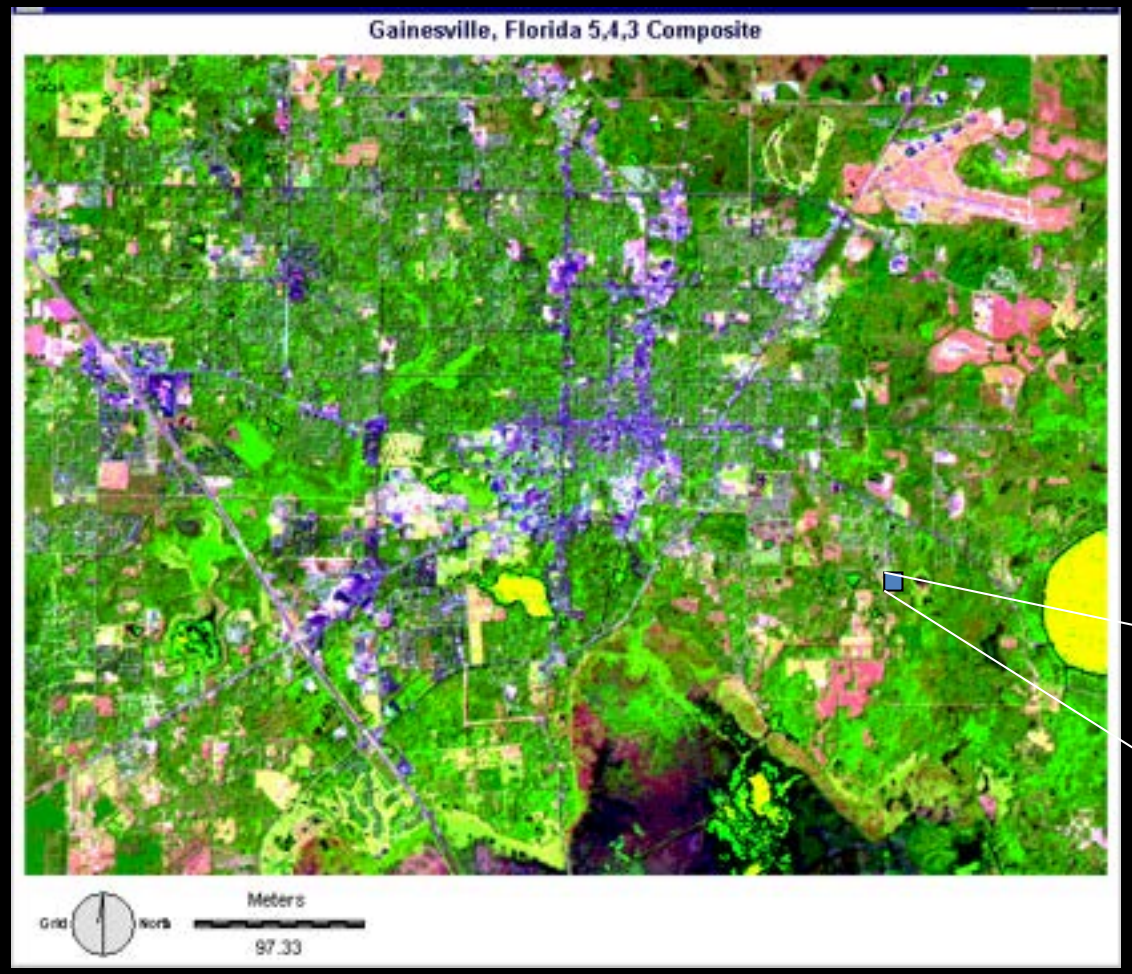
Columns and Rows

Pixel

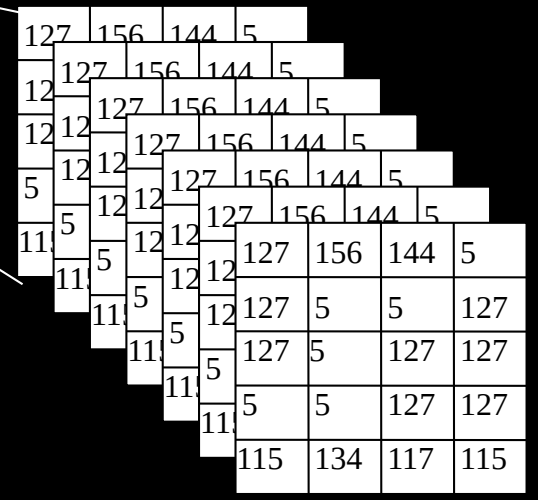
Biophysical/Remote Sensing Protocol



Landsat TM
April 22, 2007
Caprivi, Namibia



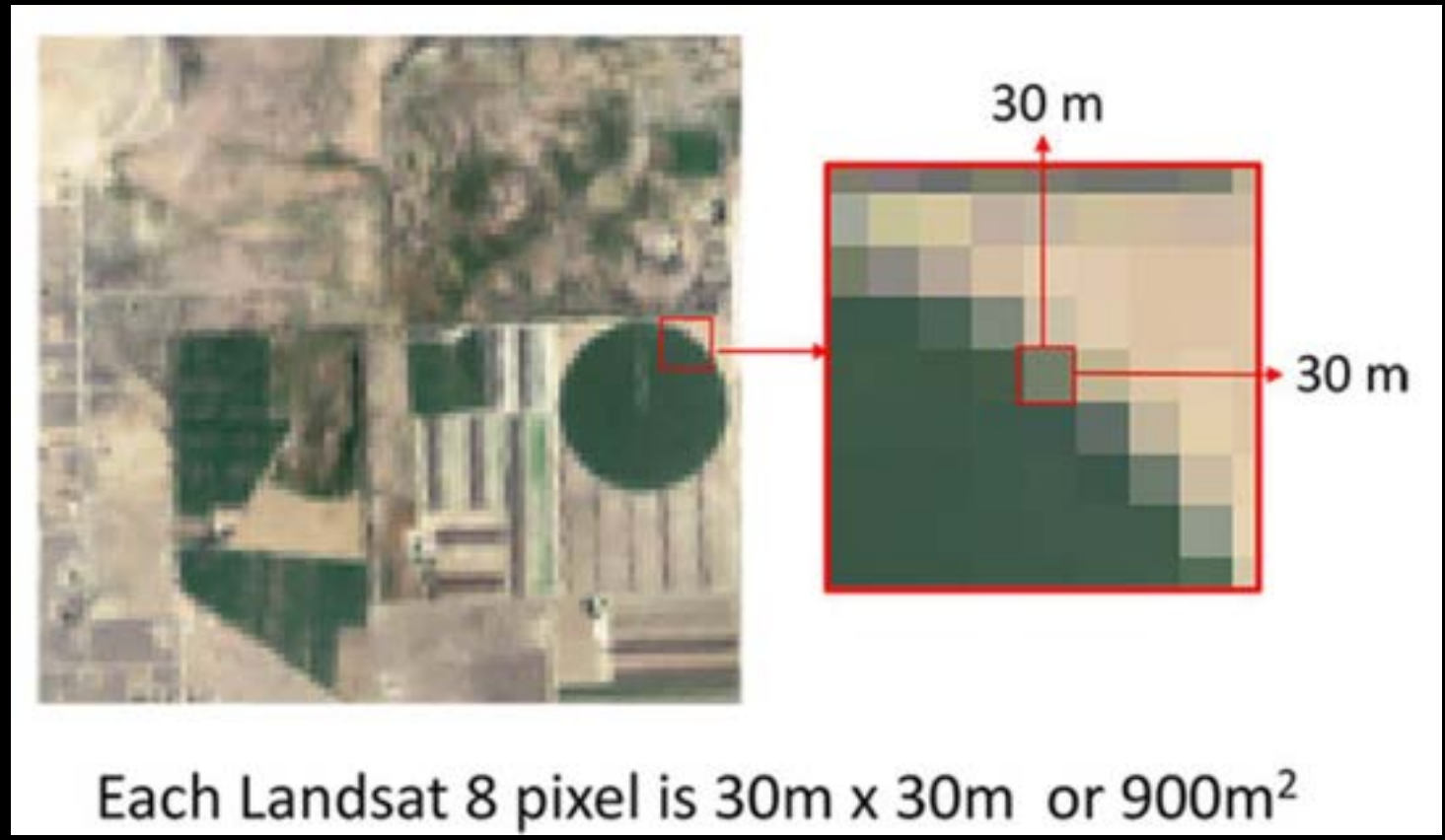
Quantized grid of small areas on the Earth's surface. The energy of reflected electromagnetic radiation in each grid cell is a function of the characteristics of the objects in that cell.



7 Landsat Bands – Individual Data Files

Nature of RS Data

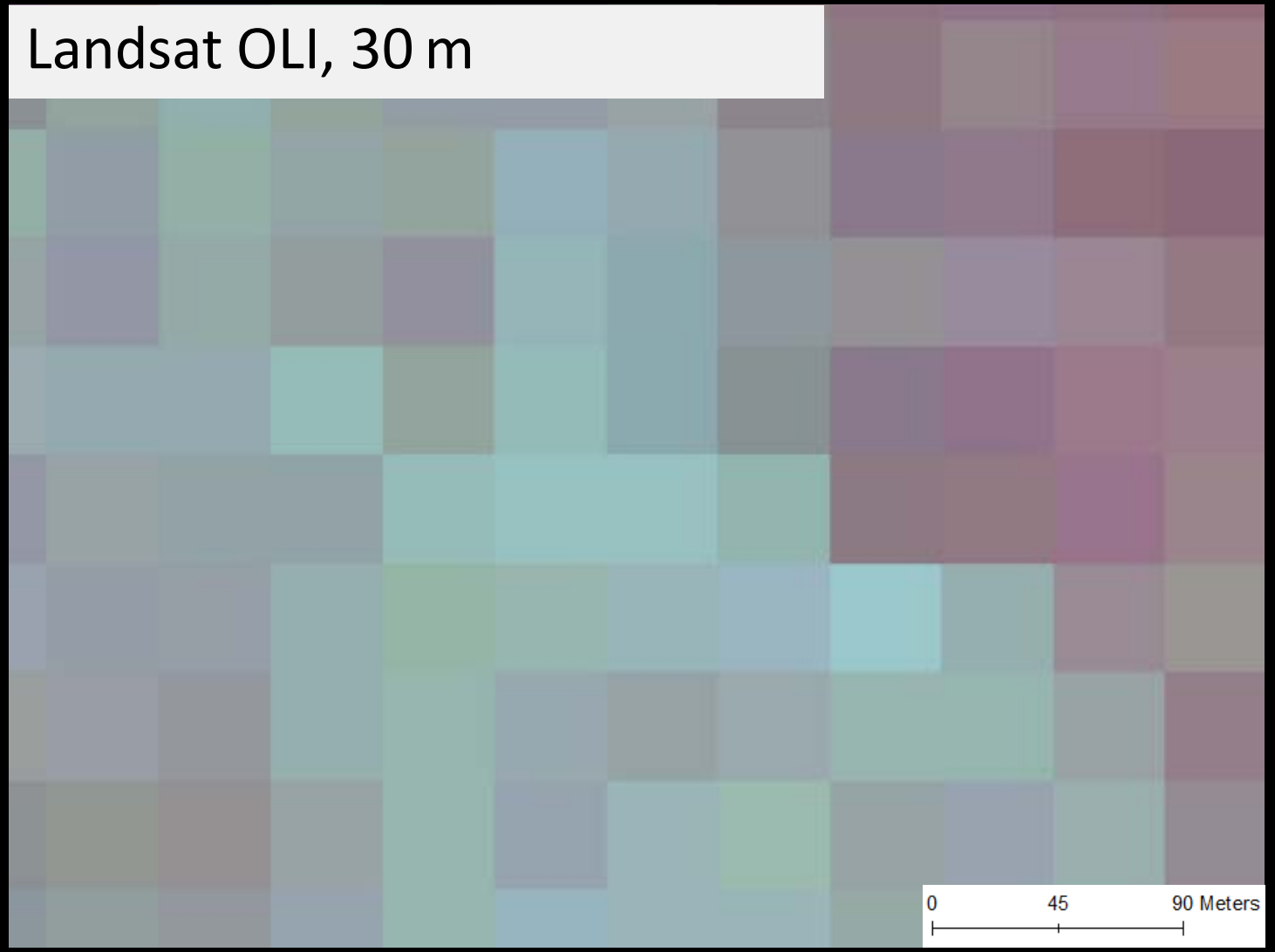
Remote Sensing Resolutions - Spatial



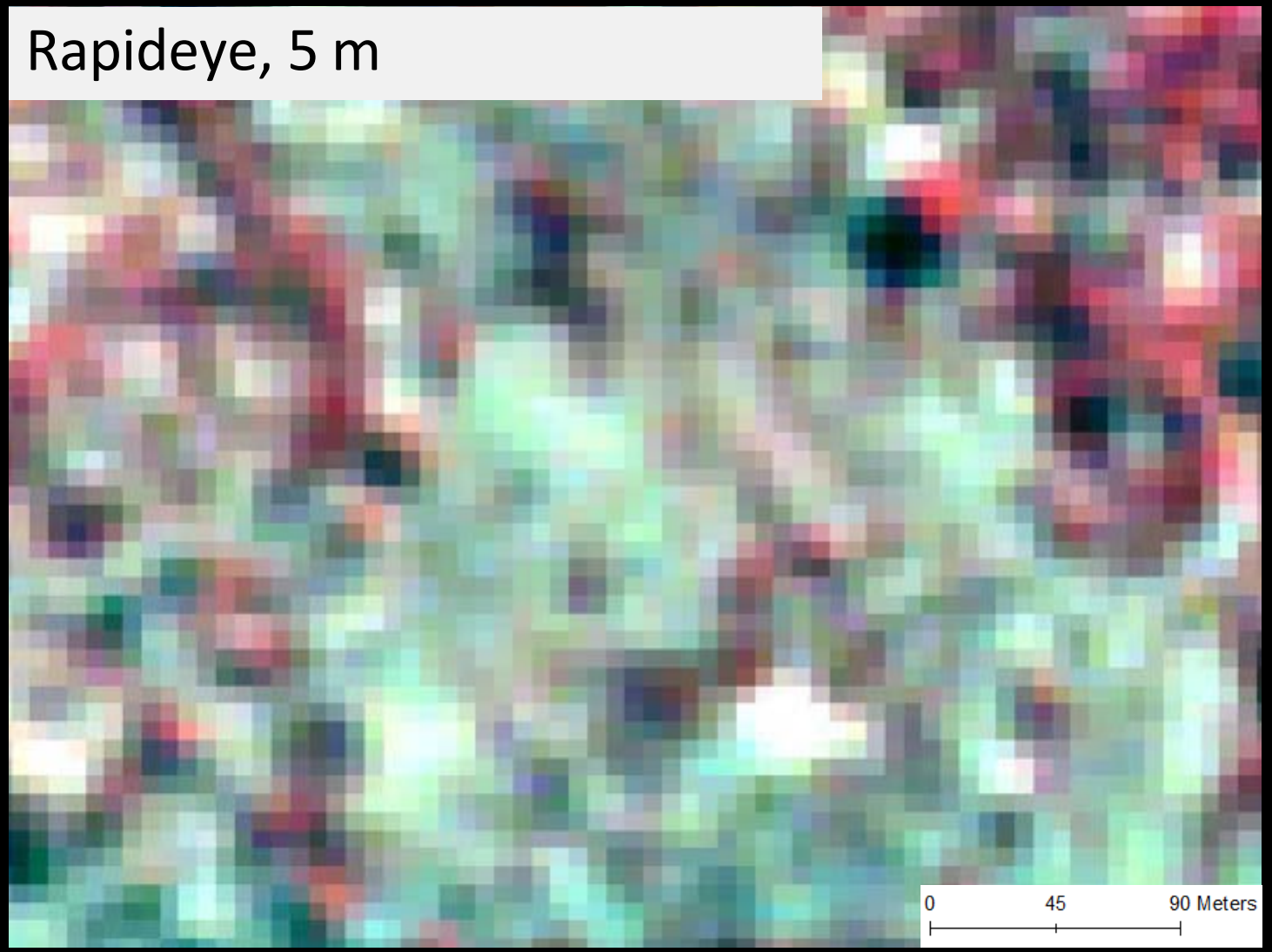
Source

Remote Sensing Resolutions - Spatial

Remote Sensing Resolutions - Spatial

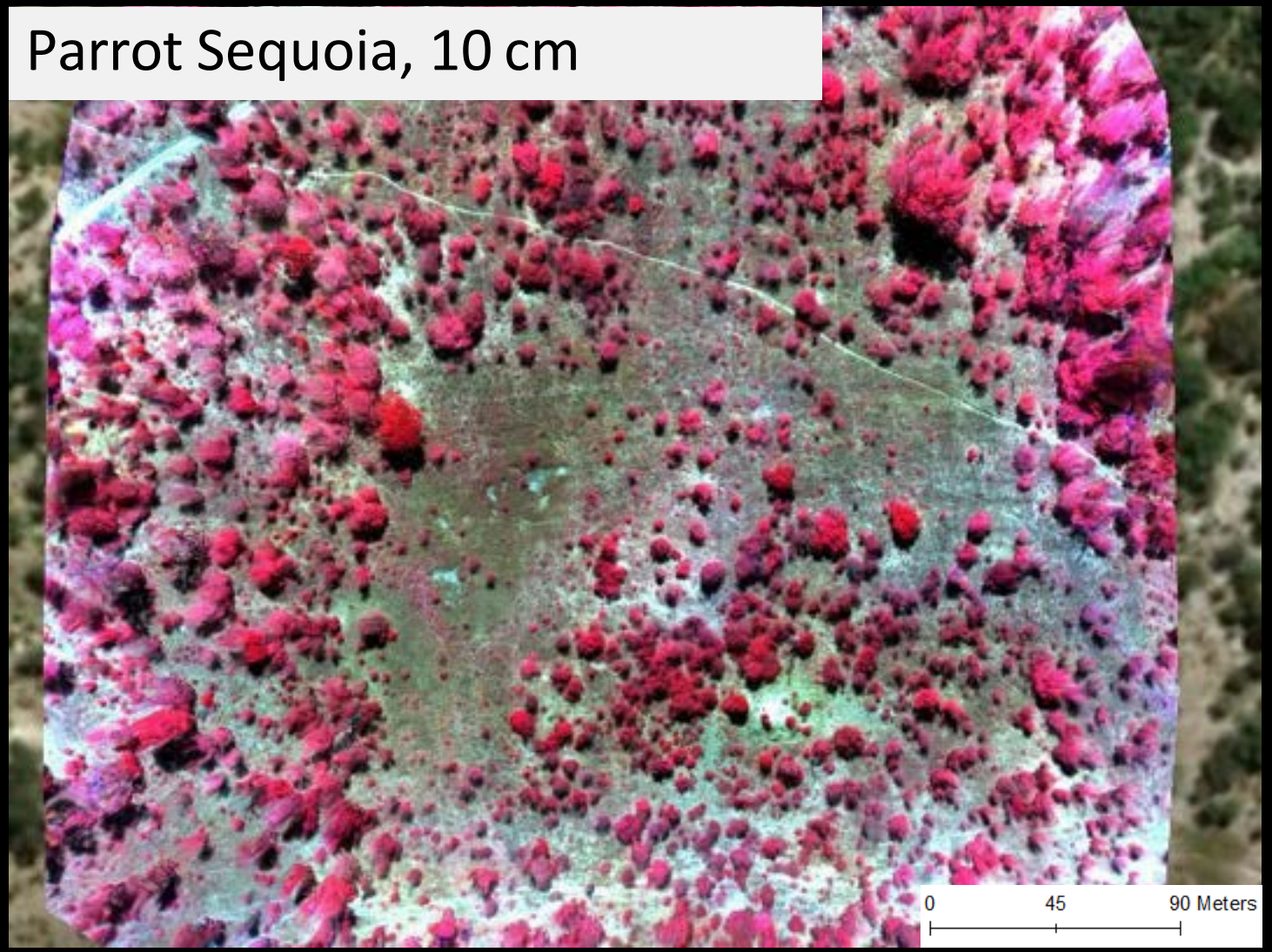


Remote Sensing Resolutions - Spatial



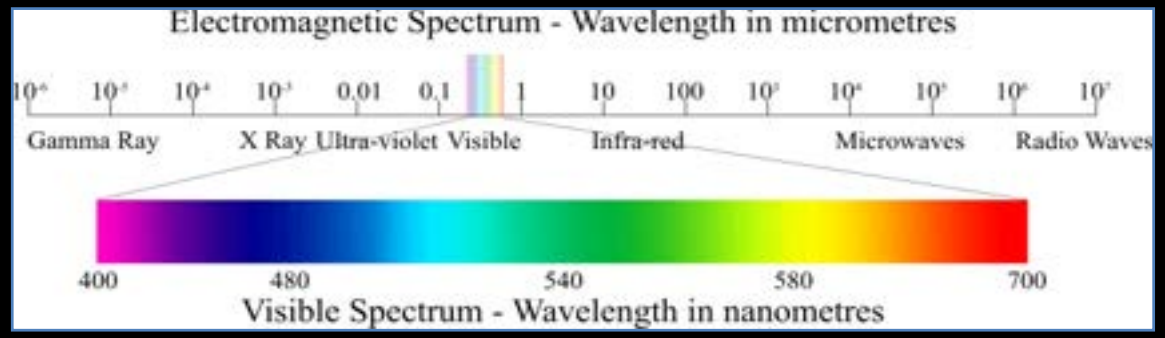
Remote Sensing Resolutions - Spatial

Remote Sensing Resolutions - Spatial

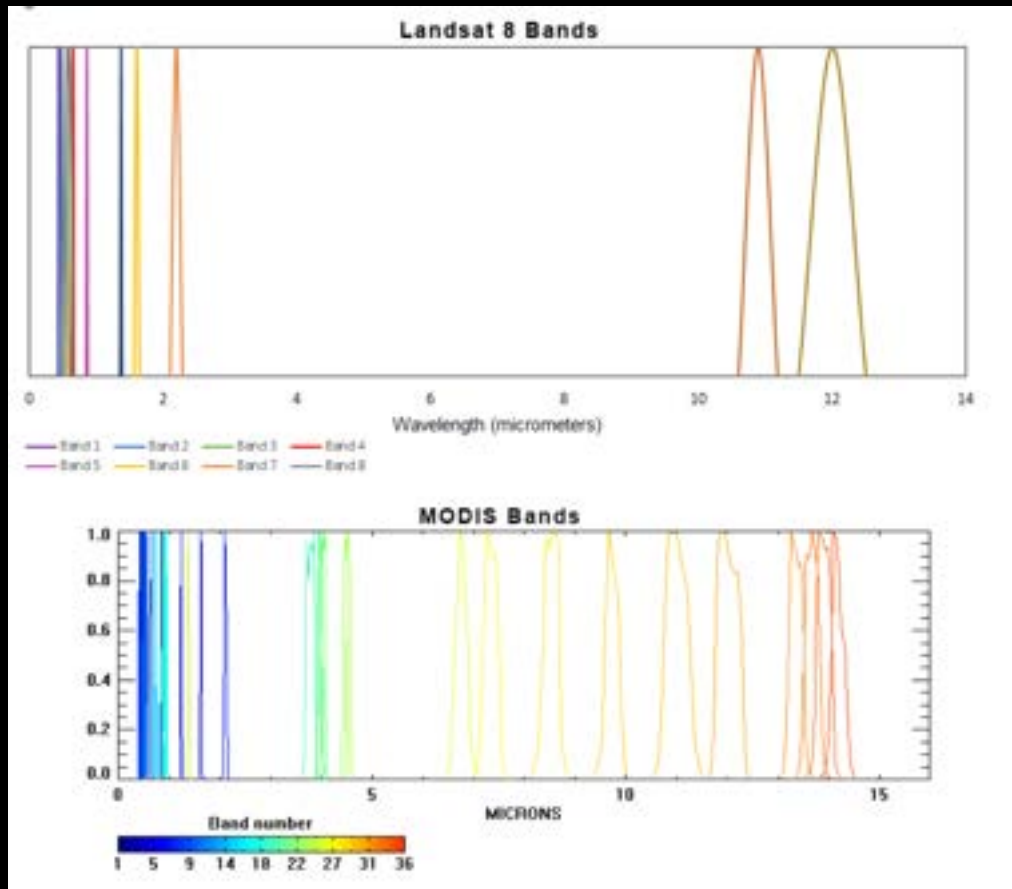


Remote Sensing Resolutions - Spectral

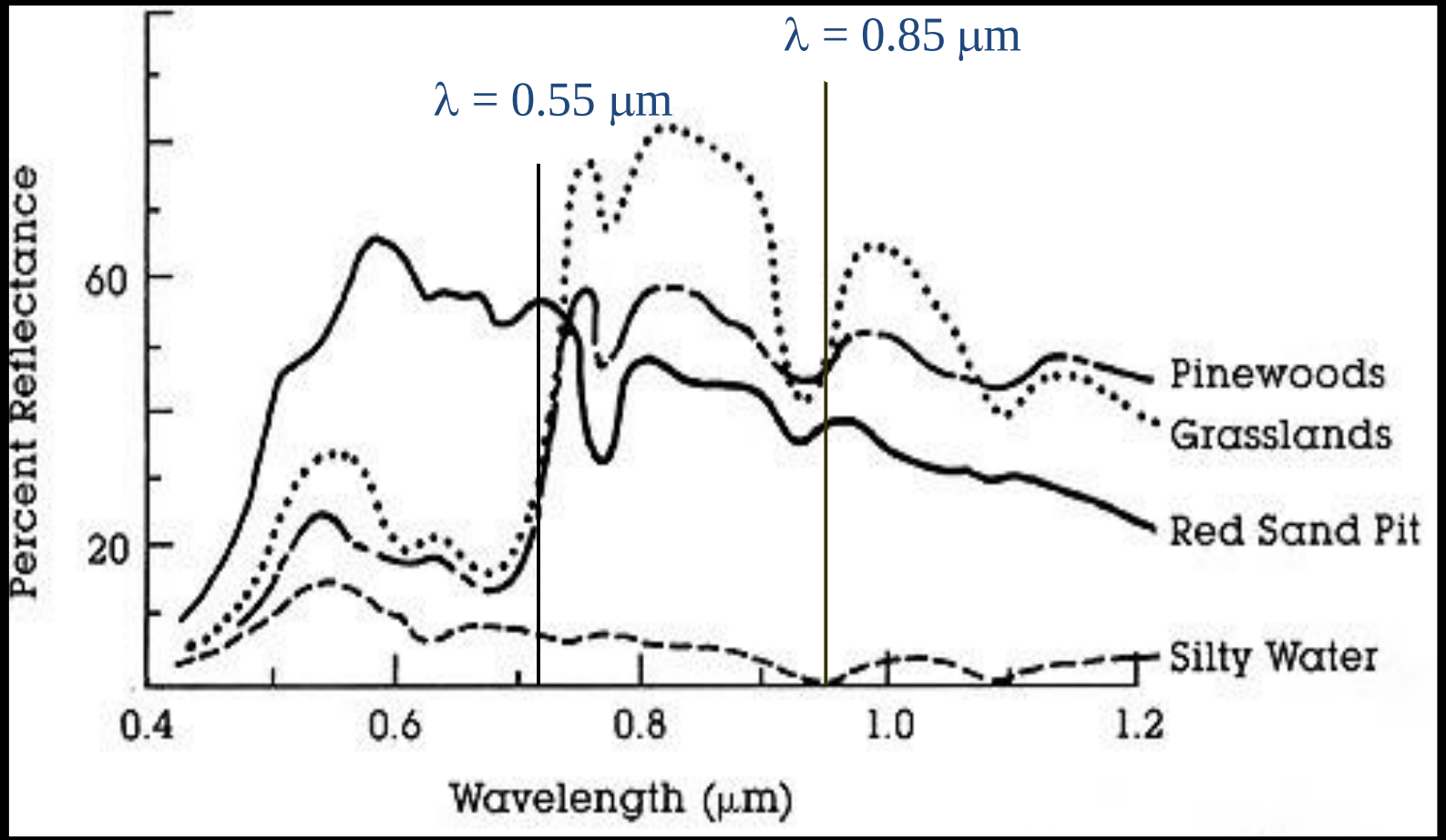
Short Wavelength
High Frequency
High Energy



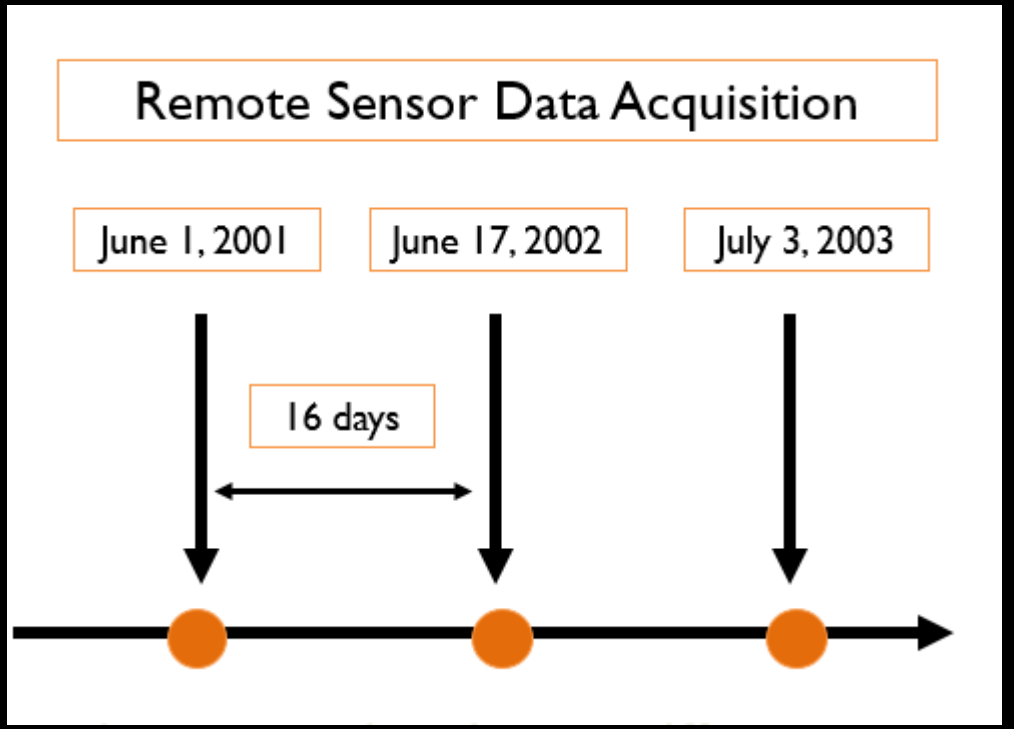
Long Wavelength
Low Frequency
Low Energy



Remote Sensing Resolutions - Spectral



Remote Sensing Resolutions - Temporal



NDVI Anomalies in the southwestern United States. Image Credit: NASA/Goddard Space Flight Center Scientific Visualization Studio.

Vietnam-Cambodia-Laos Regional Applications

Collaborators in this study:

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  Lamont-Doherty Earth Observatory, Columbia University Earth Institute, Palisades, New York, U.S.A.
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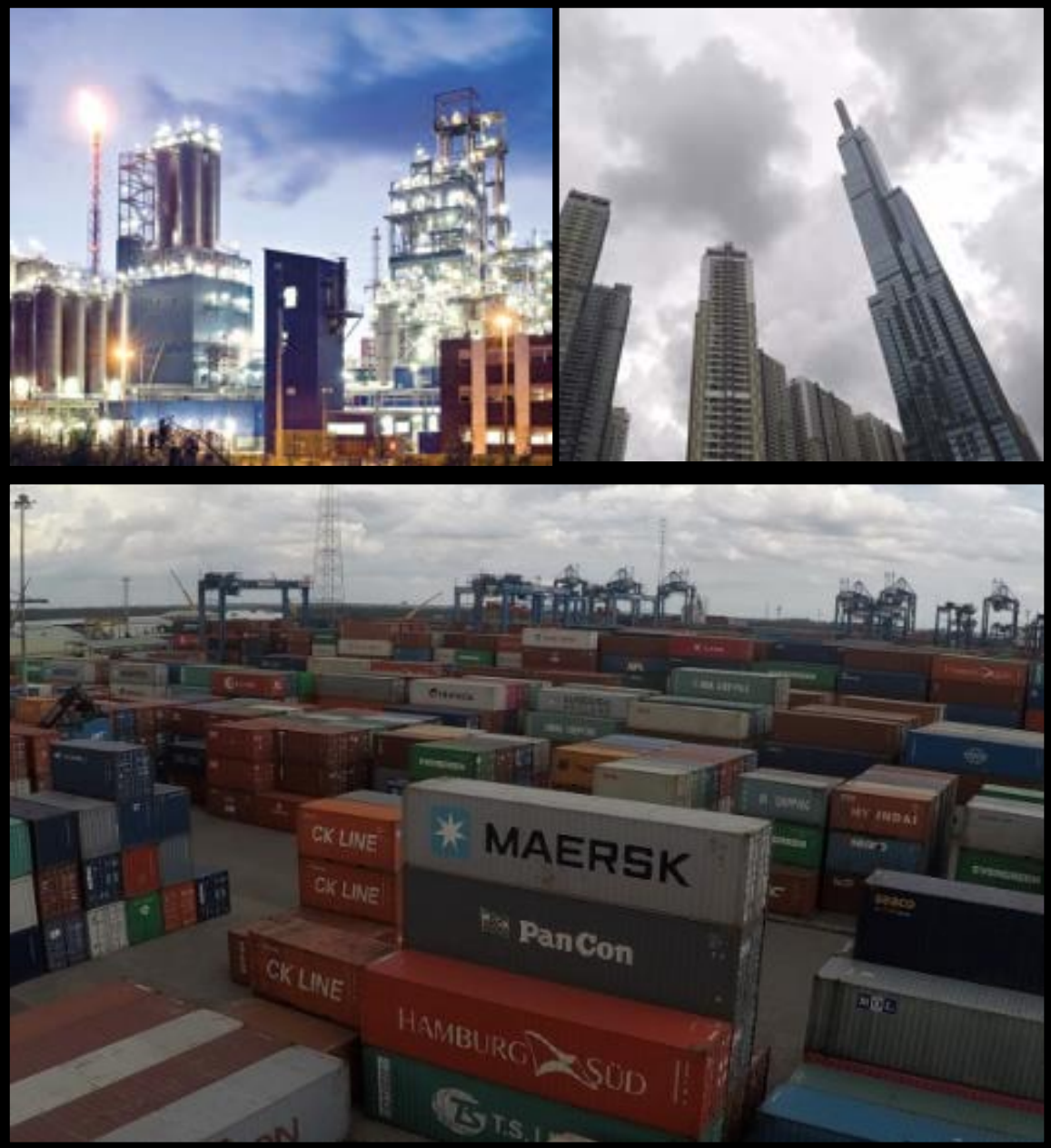
Introduction

- Agricultural transition represents an essential component of land use and land cover change
- Southeast Asia:
  - economic globalization
  - rapid urbanization
  - sociopolitical stabilization
- Vietnam's *Doi Moi* and globalized, market-oriented economy



Agriculture - Dragonfruit

- Dragon fruit: perennial, epiphytic cactus plant with jointed green stems
- Large pink fruits with white or red flesh
- Origins in Central America

The basis of “lighticulture” or “agrilighting” to grow dragon fruit using nighttime light

Photo by Nghiem, Feb. 2020

Let There Be Light

From the Bình Thuận Province

Agricultural Technology Leading to Socioeconomic Changes

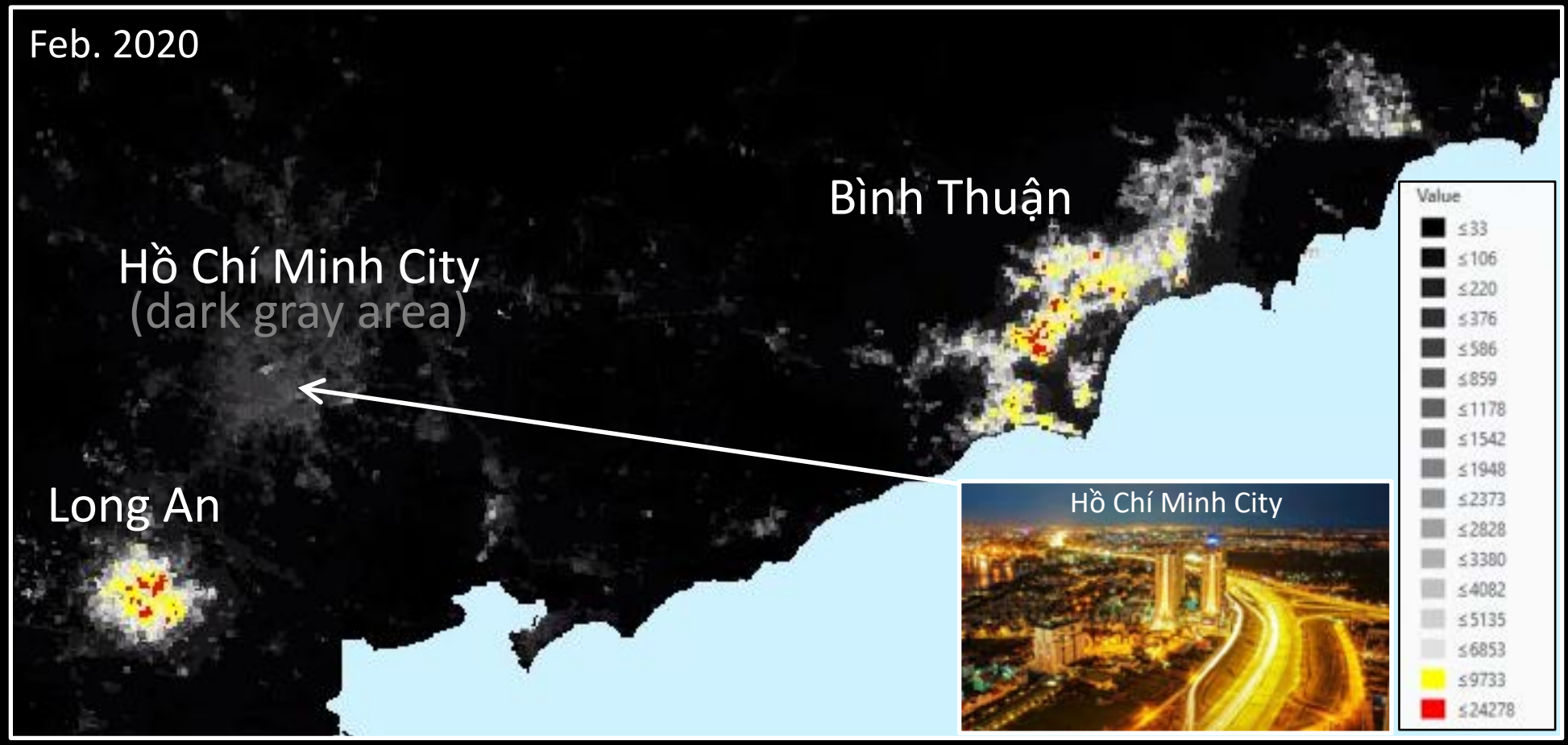
Agricultural Conversion

Land Use Conversion-Induced Migration

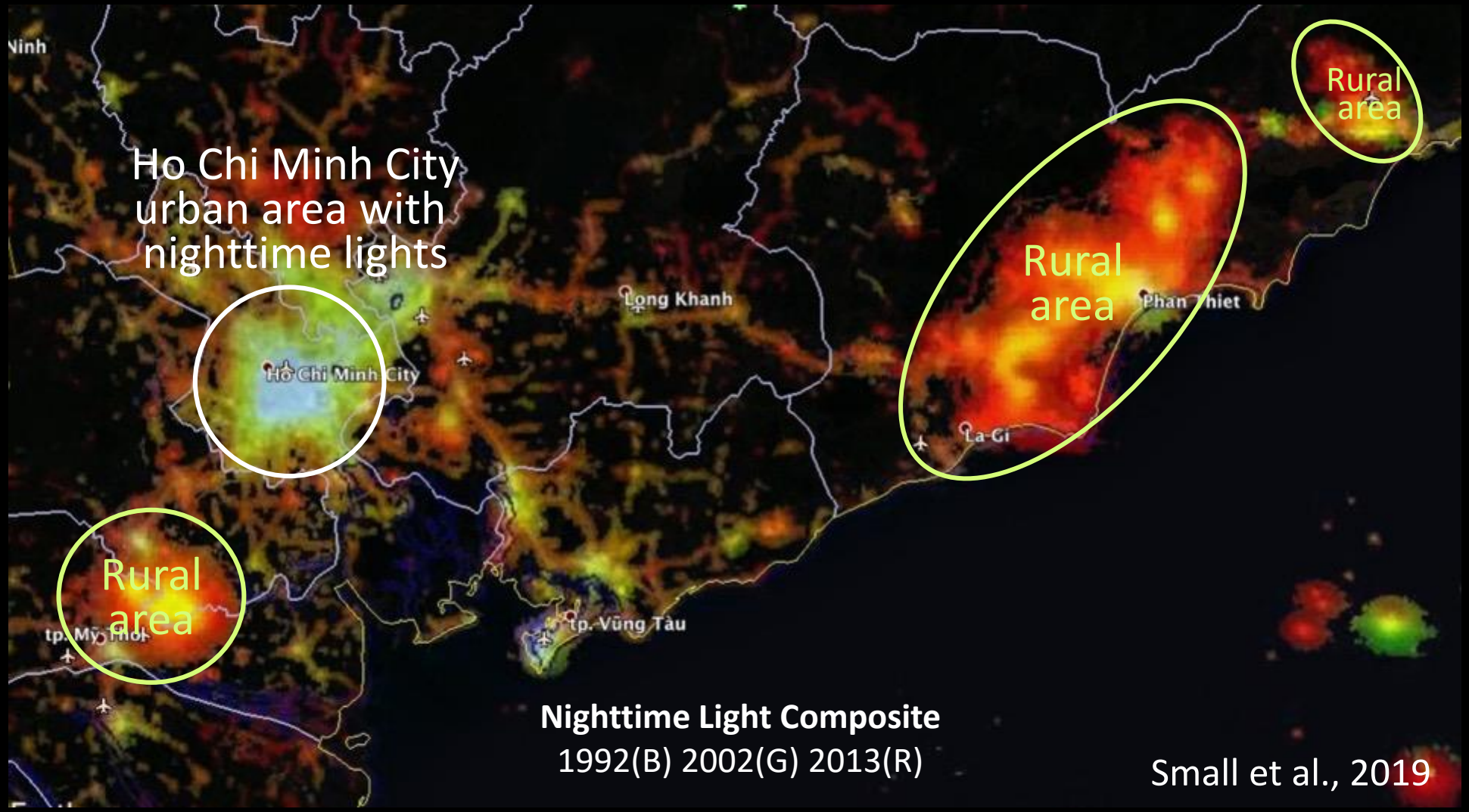
Lighting is the Key

Processing and Distribution

“Lighticulture” is much more extensive and far brighter than nighttime lights from the Mega-, Ho Chi Minh City



Nighttime Light Composite from OLS 1992(B)-2002(G)-2013(R)



Enhanced Vegetation Index
EVI from MODIS Terra

Nighttime Light Sensor/Product

The Visible Infrared Imaging Radiometer Suite Day-Night Band (VIIRS DNB)

- One of the 5 instruments onboard the Suomi National Polar-orbiting Partnership (Suomi-NPP) and Joint Polar Satellite System (JPSS) satellite platform operational since 2012.
- Joint partnership between NASA and NOAA.
- Sun-synchronous orbit the Earth in ~102 mins, providing global coverage at ~14 orbits per day at 824 km orbital altitude.

Suomi-NPP Satellite

Krauser et al., 2021

Source NASA

Study Area

Sensor: VIIRS Day/Night Band

Time Period: 2012 – 2018, monthly

Ms. Laura Krauser
GIS Research Coordinator
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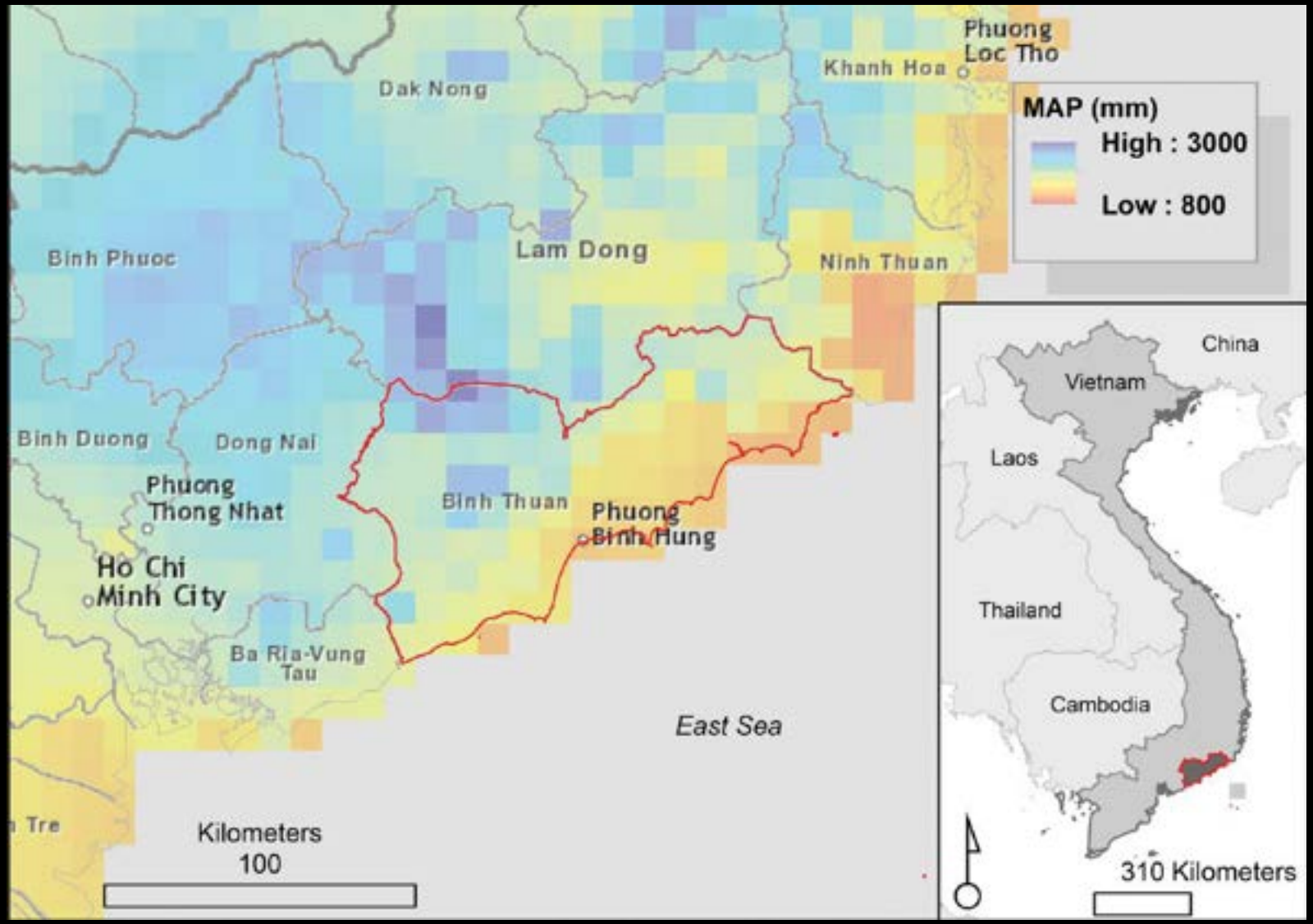
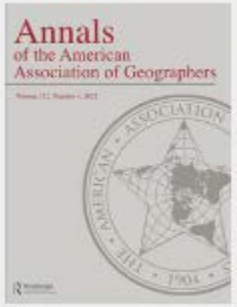


Krauser et al., 2021

Reference



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Articles

Shedding Light on Agricultural Transitions, Dragon Fruit Cultivation, and Electrification in Southern Vietnam Using Mixed Methods

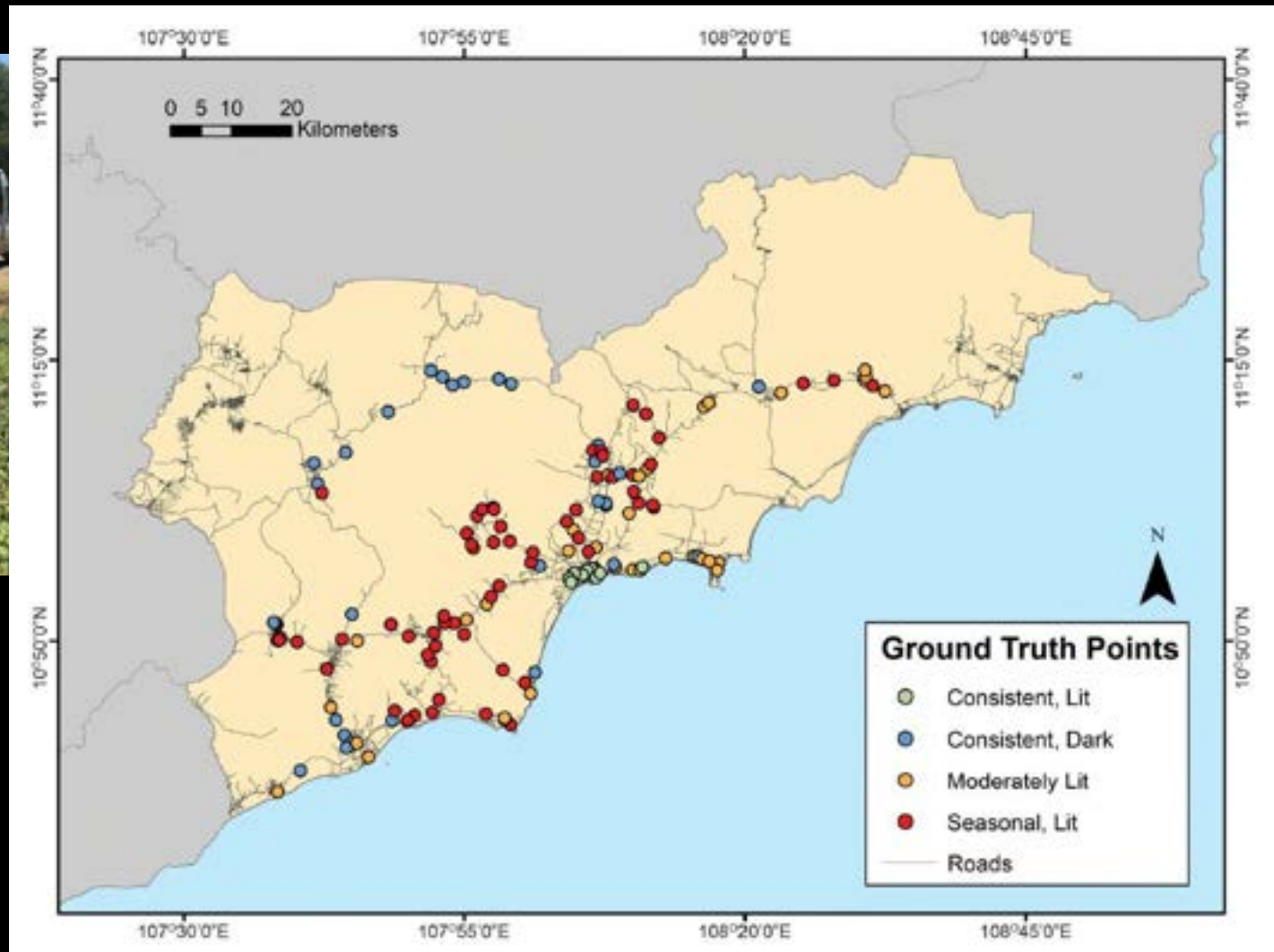
Laura Egan Krauser, Forrest R. Stevens, Andrea E. Gaughan, Son V. Nghiem, Pham Thi Mai Thy, Pham Tran Nhat Duy & ...show all

Pages 1139-1158 | Received 04 Jan 2021, Accepted 13 Apr 2021, Published online: 13 Sep 2021

Cite this article | https://doi.org/10.1080/24694452.2021.1940825 | Check for updates

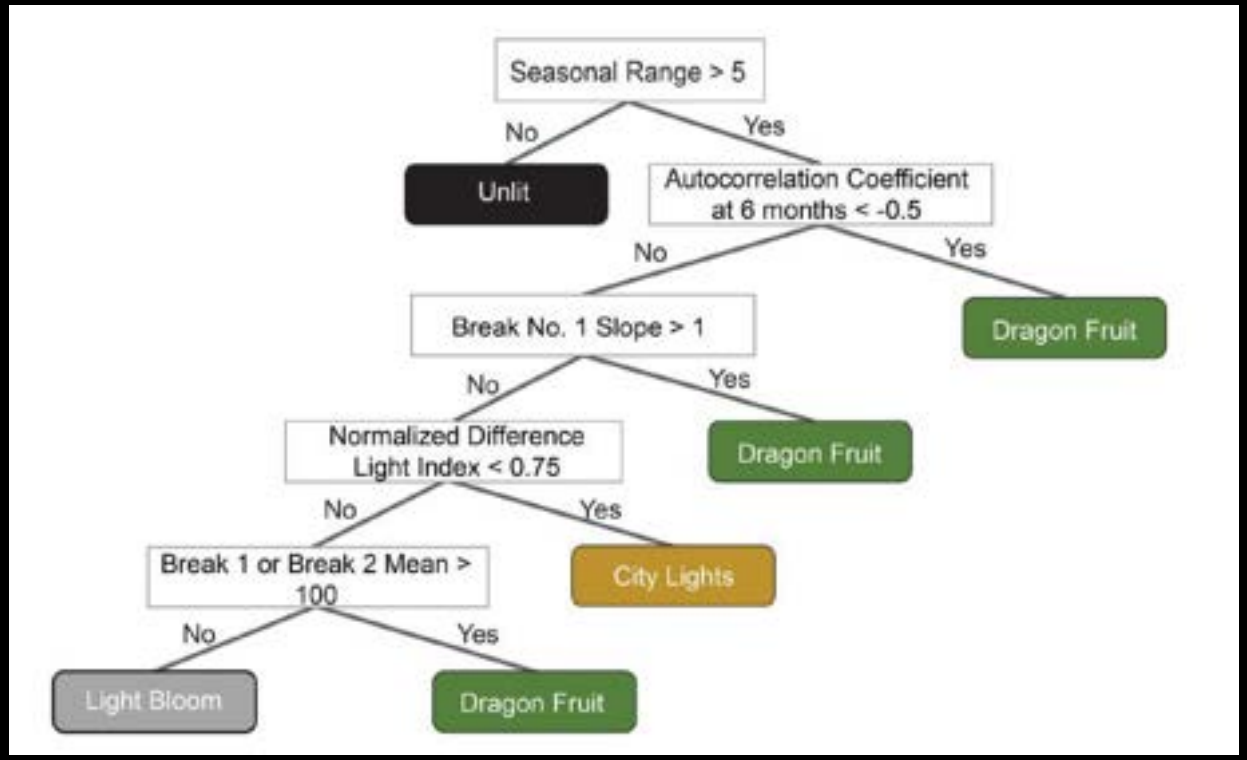
Krauser et al., 2021

Krauser et al., 2021



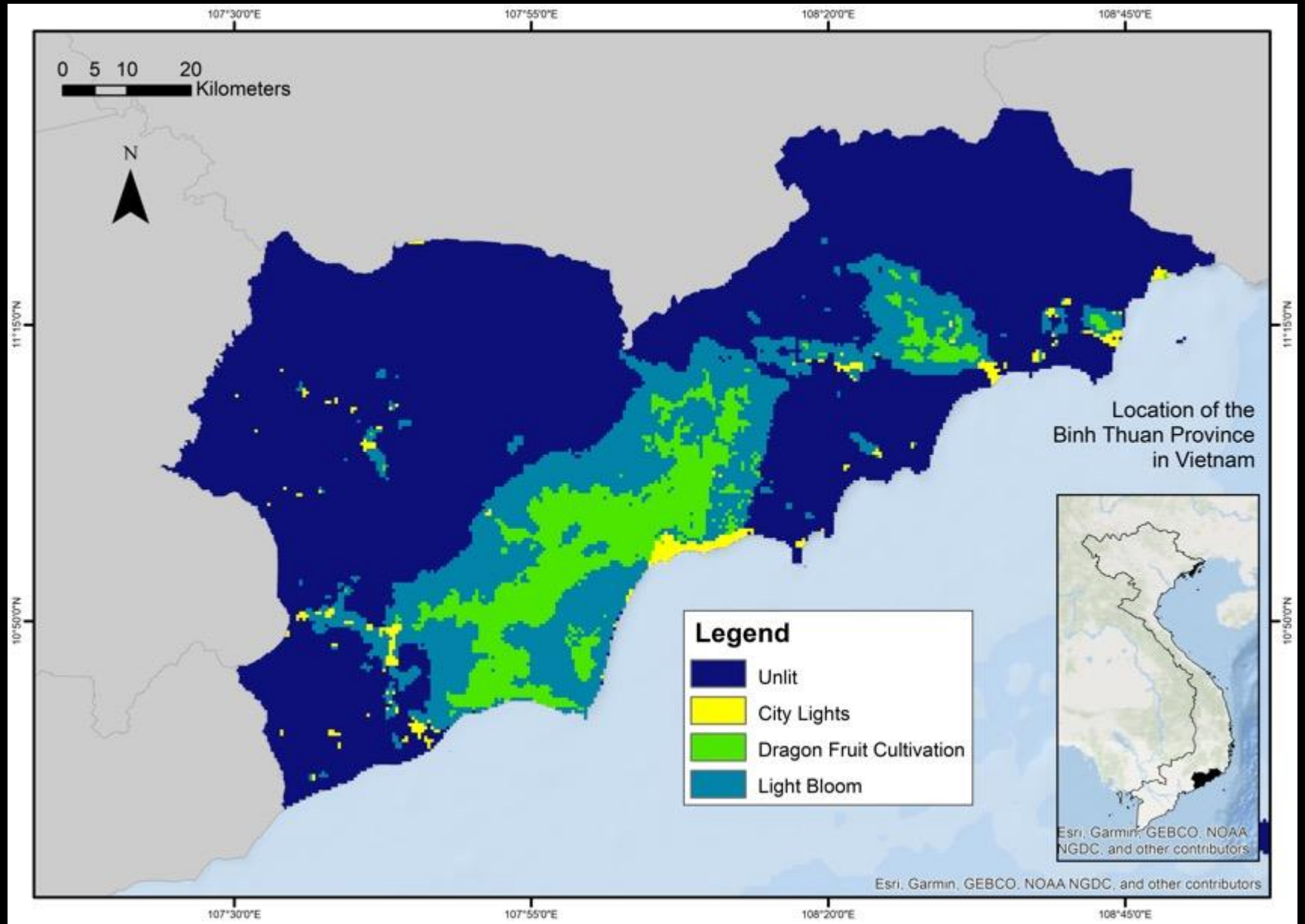
Analysis Approach

- Decision tree classifier
  - Nonparametric
- Ideal for exploratory analysis
  - Direct and intuitive nature
  - Easily informed by expert knowledge
- Class separability based on known seasonal pattern



Krauser et al., 2021

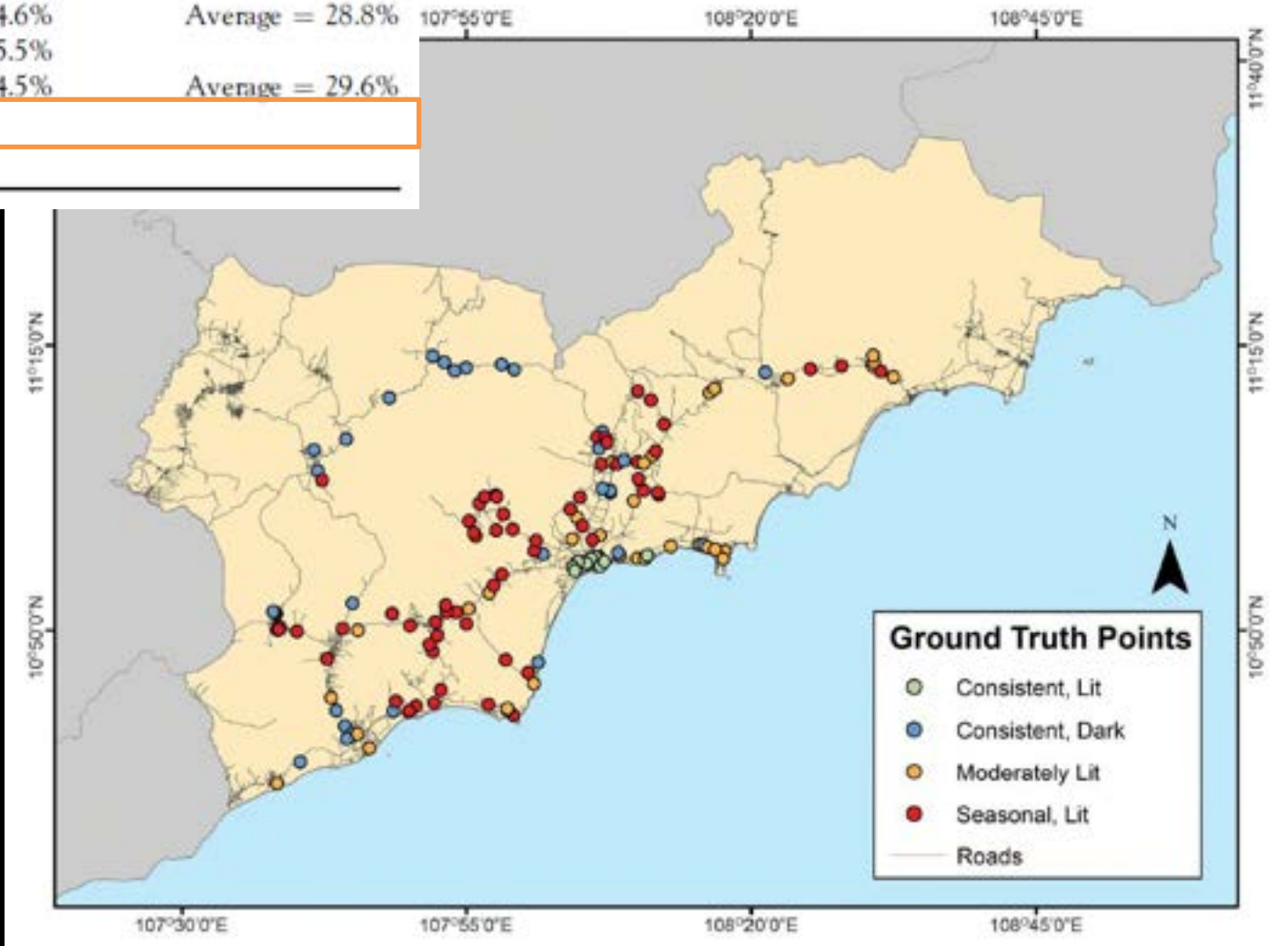
Mapping of Dragon Fruit Region from Satellite Nighttime Light Data



Krauser et al., 2021

	Classification				
Reference	Unlit	City lights	Dragon fruit	Light bloom	Total
Unlit	16	0	1	3	20
City lights	1	14	0	2	17
Dragon fruit	1	3	48	13	65
Light bloom	0	1	17	15	33
Total	18	18	66	33	135
User's accuracy	80.0%	82.4%	73.9%	45.5%	
Error of commission	20.0%	17.7%	26.2%	54.6%	Average = 28.8%
Producer's accuracy	88.9%	77.8%	72.7%	45.5%	
Error of omission	11.1%	22.2%	27.3%	54.5%	Average = 29.6%
Overall statistic	68.9%				
Kappa statistic	53.5%				

Night light classification assessment

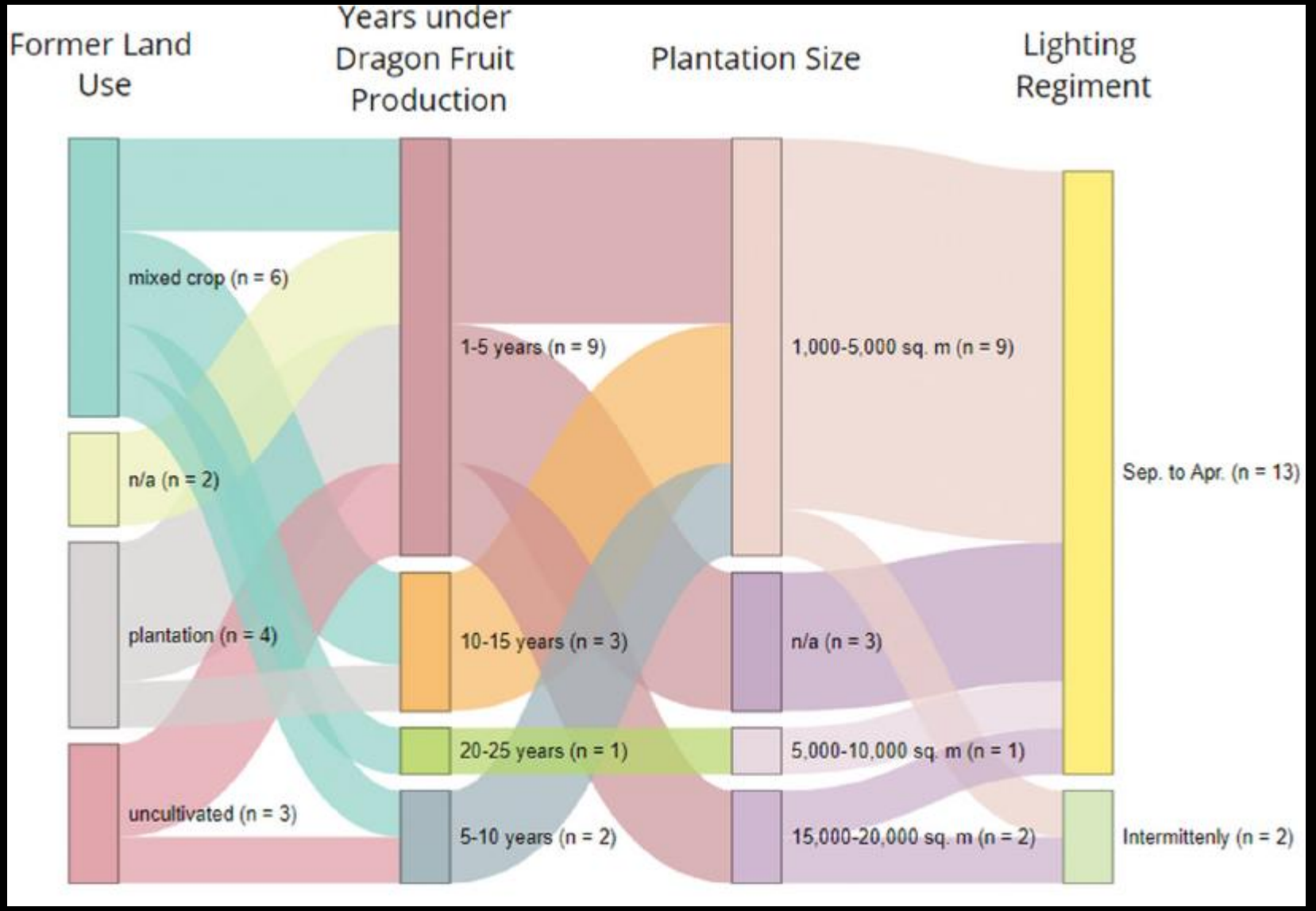


Krauser et al., 2021

Data: Social Context

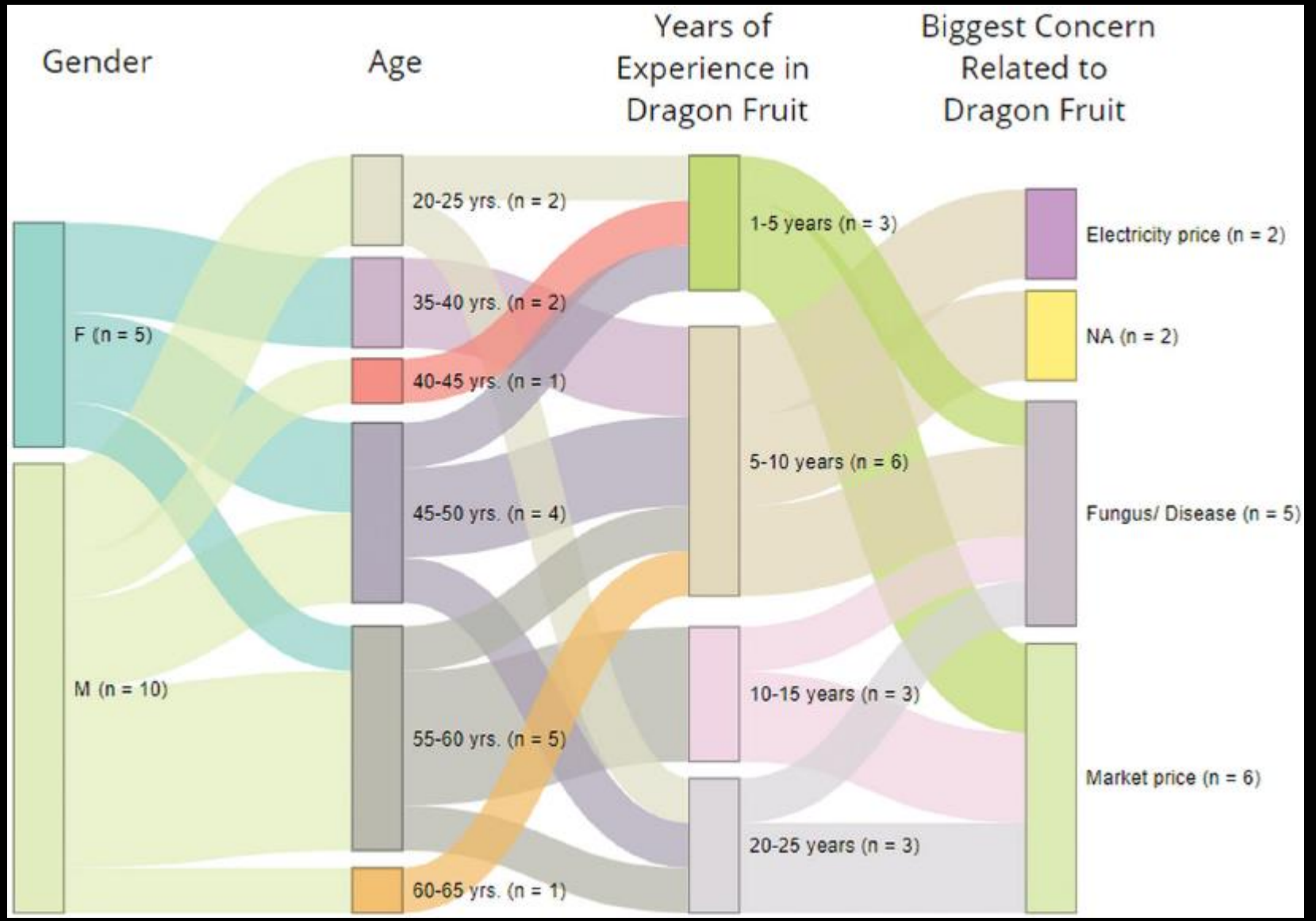
- Qualitative research on perception of changes
- Two translators, (n=4, 11)
- 15 semi-structured interviews through random and snowball sampling (Raymond et al. 2015).
- Provide lived, experiential elements of landscape transition

Alluvial Diagram modeling land change at the site of each interview based on participants' knowledge



Krauser et al., 2021

Alluvial Diagram modeling land change at the site of each interview based on participants' knowledge



Krauser et al., 2021

What happened: Effects of COVID-19 isolation or not and why?

- **Early Feb. 2020**: Price drop due to restriction of transportation across Vietnam-China border and decrease in demand due to COVID-19 restriction -> reduce NTL to decrease fruit yield and lighting cost.
- **Late Feb. 2020**: Efforts to rescue market price (pink burger, pink bread, etc.) and increase shipping by sea =≫ increase NTL to increase fruit yield for more shipping at higher price.

Further Information

Southeast Asia Project

Krauser et al., 2021, Annals

Jia et al., 2022, Dragon Fruit and LCLUC

LCLUC
Land-Cover / Land-Use Change Program

https://lcluc.umd.edu/projects/land-use-status-change-and-impacts-vietnam-cambodia-and-laos

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UNIVERSITY OF LOUISVILLE.