Session 8: Image Analysis and Remote Sensing

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Class Schedule

Monday	Tuesday	Wednesday	Thursday	Friday
08/05/19 **Introduction to Geographical Information Systems** 10:45 am–12:15 am	08/06/19 **Cartography and Spatial Data Display** 8:30am – 11:00pm	08/07/19 **Querying Data for Spatial & Attribute Selections** 8:30am – 11:00pm	08/08/19 **Data Formats and Open-Source GIS** 8:30am – 11:00pm	08/09/19 **Map Projections and Coordinate Systems** 8:30am – 11:00pm
08/12/19 **Spatial Analysis Tools** 8:30am – 11:00pm	08/13/19 **Raster and Terrain Analysis** 8:30 am – 10:00 am **Scripps Institution of Oceanography** 1:00pm – 4:00pm	08/14/19 **Image Analysis & Remote Sensing** 8:30am – 11:00pm	08/15/19 **Editing Spatial Data and Geocoding** 8:30am – 11:00pm	08/16/19 **Web Mapping/ Wrap up** 8:30am – 11:30am

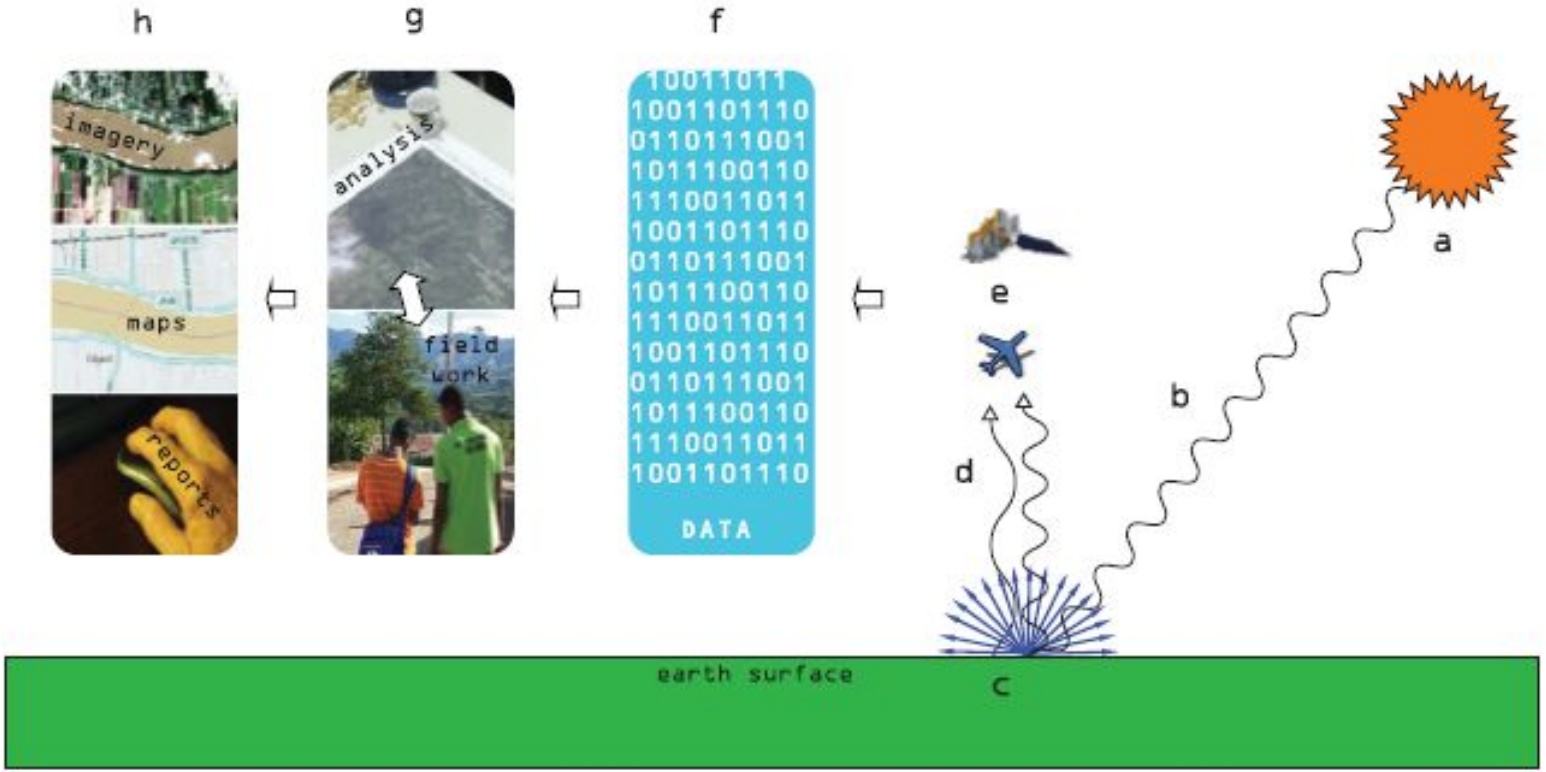
Outline: Imagery and Remote Sensing

- Introduction
- Available Imagery
- ArcGIS Pro Tools
- Displaying Image Data
- Demonstration

Introduction

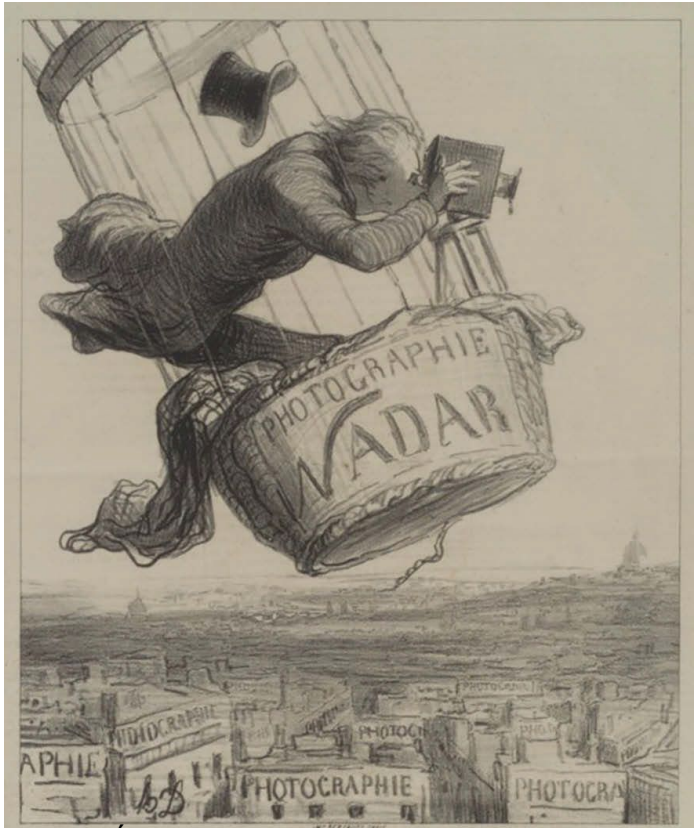
- Remote sensing:
  - data collected using devices not in contact with target
- Many different types of remote sensing
  - Aerial Imagery
  - Satellite Imagery
  - Radar Imagery
- Used in multiple applications

Remote Sensing



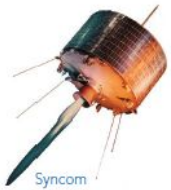
Types of Remote Sensing

- Aerial photography
- Satellite imagery
- Multispectral imagery
- Radar
- LiDAR



Nadar Élevant la Photographie à la Hauteur de l'Art, Daumier, Honoré-Victorin Daumier, 25 May 1862

Many Platforms



Geosynchronous — 22,236 miles

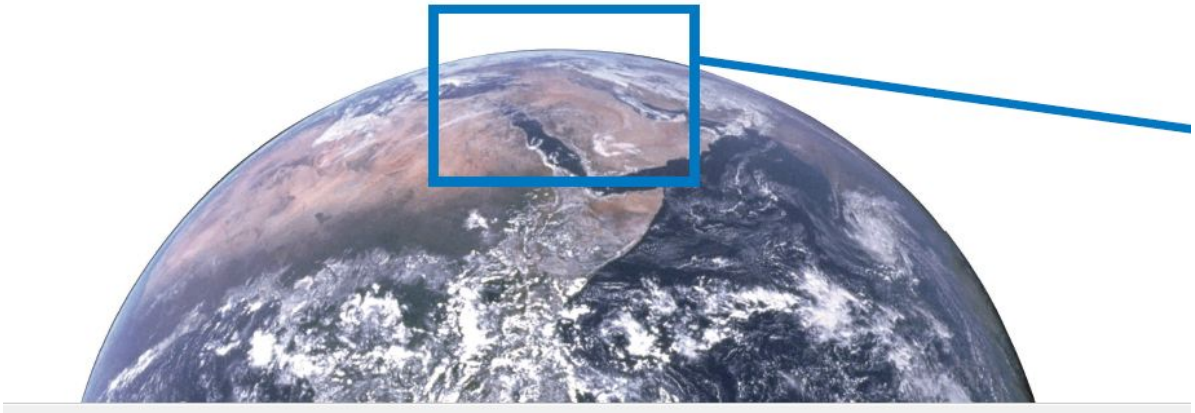
Satellites that match Earth's rotation appear stationary in the sky to ground observers. While most commonly used for communications, geosynchronous orbiting satellites like the hyperspectral *GIFTS* imager are also useful for monitoring changing phenomena such as weather conditions. NASA's Syncom, launched in the early 1960s, was the first successful "high flyer."

Sun synchronous — 375–500 miles

Satellites in this orbit keep the angle of sunlight on the surface of the earth as consistent as possible, which means that scientists can compare images from the same season over several years, as with Landsat imagery. This is the bread-and-butter zone for earth observing sensors.

Atmospheric satellite — 100,000 feet

Also known as pseudo-satellites, these unmanned vehicles skim the highest edges of detectable atmosphere. NASA's experimental Helios craft measured solar flares before crashing in the Pacific Ocean near Kauai.



SR71 Blackbird

Jet aircraft — 90,000–30,000 feet

Jet aircraft flying at 30,000 feet and higher can be flown over disaster areas in a very short time, making them a good platform for certain types of optical and multispectral image applications.

Cessna

General aviation aircraft — 100–10,000 feet

Small aircraft able to fly at low speed and low altitude have long been the sweet spot for high-quality aerial and orthophotography. From Cessnas to ultralights to helicopters, these are the workhorses of urban optical imagery.

Ultralight

Helicopter

US Navy Silver Fox

Drones — 100–500 feet

Drones are the new kids on the block. Their ability to fly low, hover, and be remotely controlled offer attractive advantages for aerial photography, with resolution down to sub-1 inch. Military UAVs can be either smaller drones or actual airplanes.

3DR Solo private drone

Handheld spectrometer

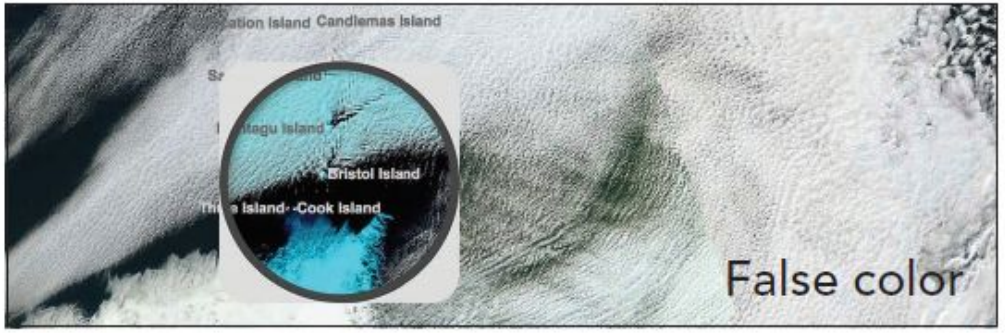
Smartphone

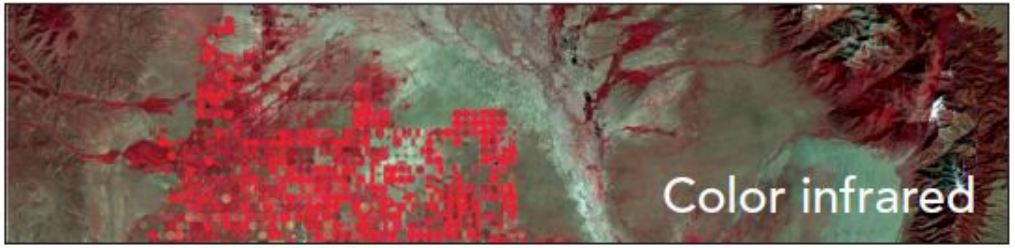
Street-level mapping car

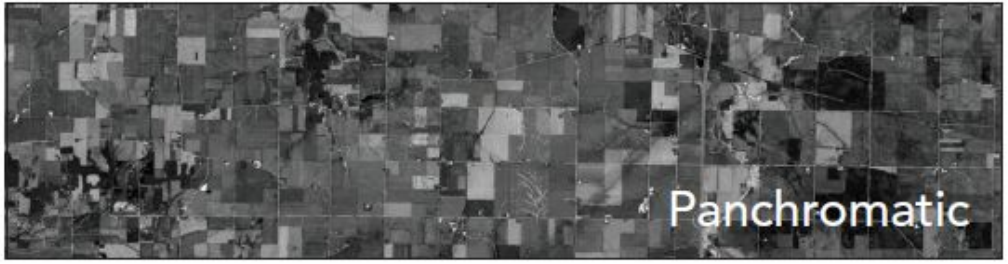
Ground based/handheld — Ground level

Increasingly, imagery taken at ground level is finding its way into GIS workflows. Things like Google Street View, HERE streel-level imagery, and Mapillary; handheld multispectral imagers; and other terrestrial sensors are finding applications in areas like pipelines, security, tourism, real estate, natural resources, and entertainment.

Imagery Types



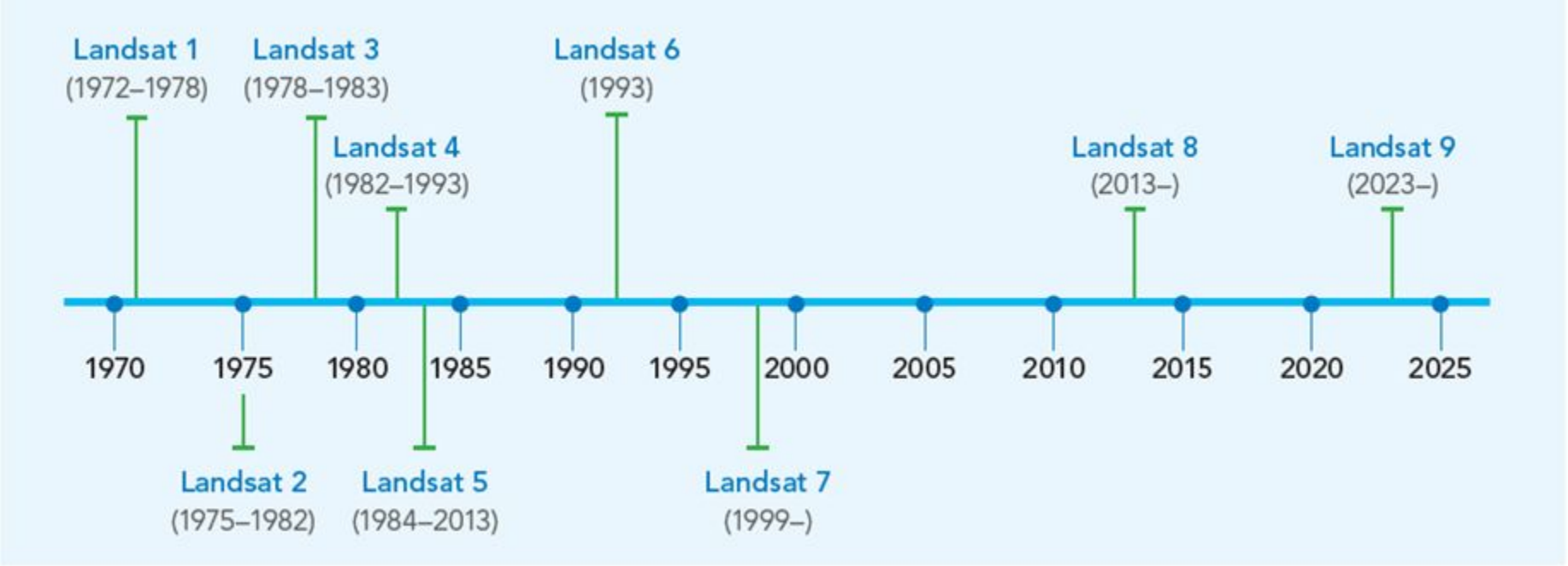




Source: The ArcGIS Imagery Book

Landsat Satellite Data

First satellites to provide continuous global observation



Source: The ArcGIS Imagery Book

Multispectral Imagery

Band 1	Coastal Aerosol
Band 2	Blue
Band 3	Green

Band 4	Red
Band 5	Near Infrared
Band 6	Shortwave Infrared 1

Band 7	Shortwave Infrared 2
Band 8	Panchromatic
Band 9	Cirrus

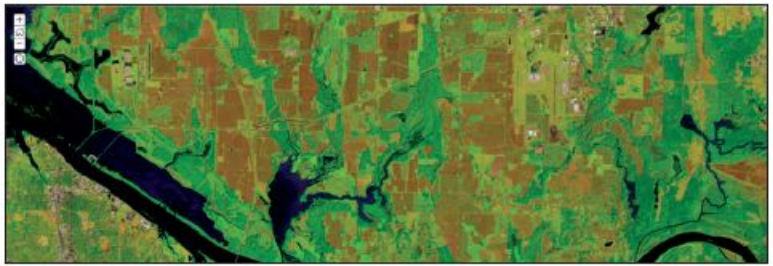
Band 10	Thermal Infrared
Band 11	Thermal Infrared

Natural color

Color infrared

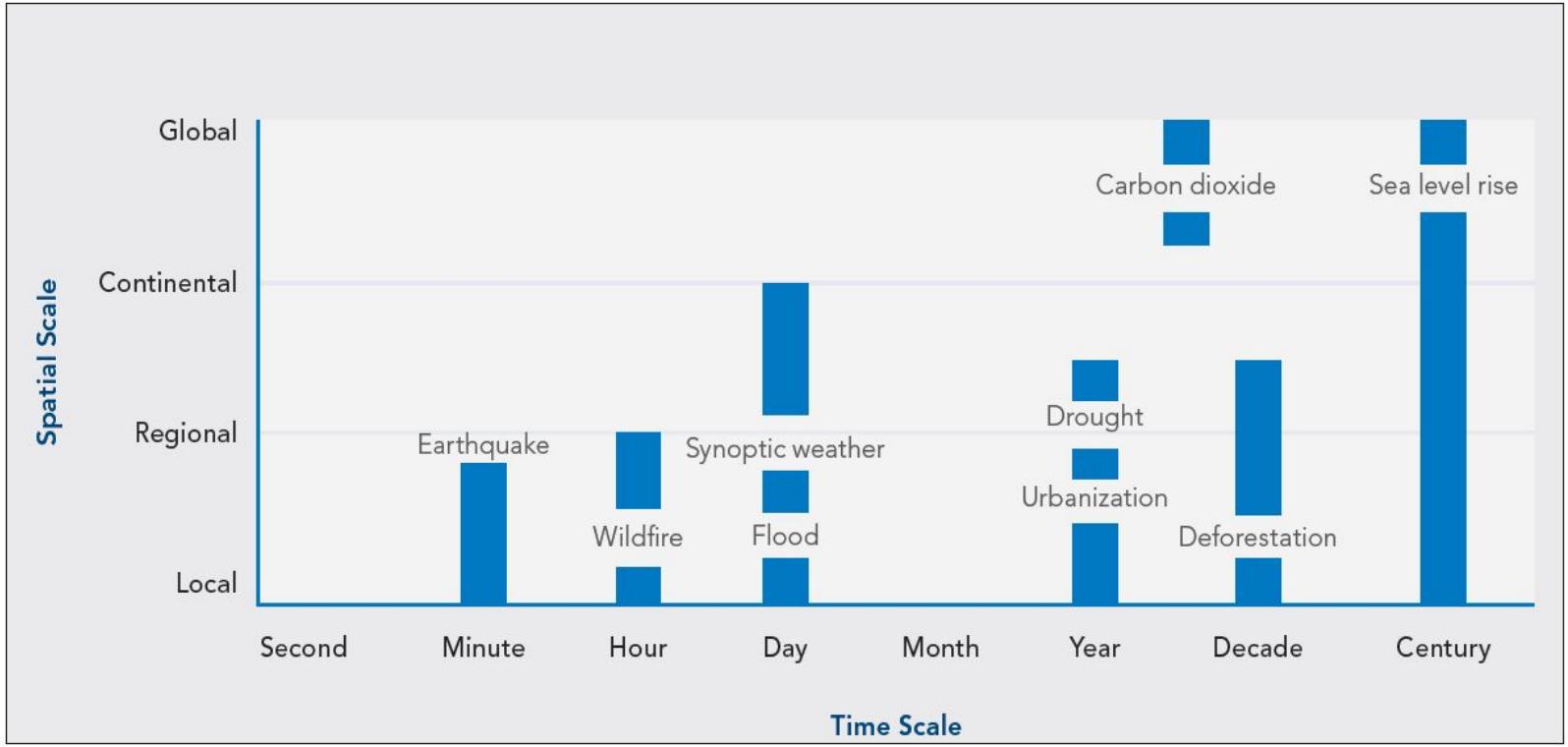
Land and water interface

Vegetation analysis



Source: The ArcGIS Imagery Book

Space-Time Scales

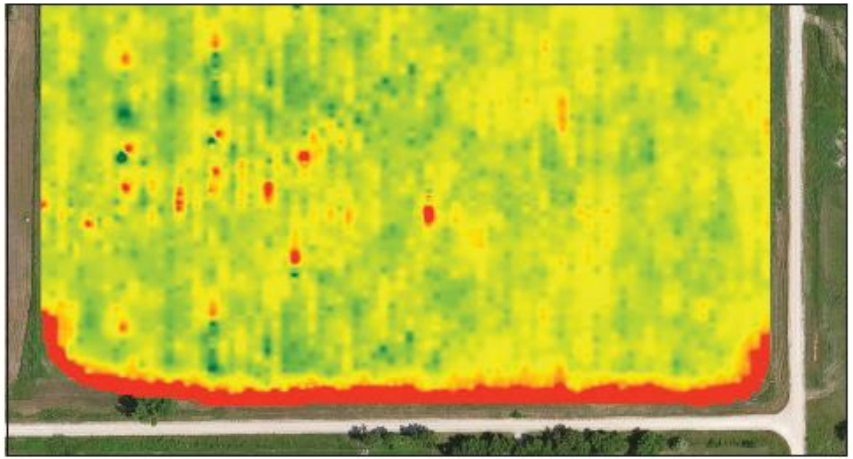


Critical challenges to our planet occur at various space-time scales.

Source: The ArcGIS Imagery Book

Applications

Precision agriculture



Information gathered during harvest, including yield at any given location, helps growers track their results and provides valuable input for calculating seeding and soil amendment rates for the following year.

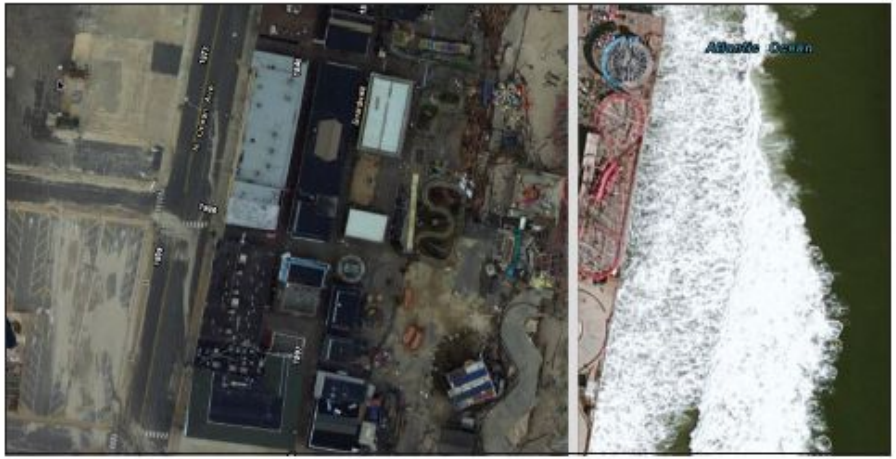
Humanitarian aid

Access to up-to-date imagery shows the creation of the Zaatari refugee camp over a nine-day period in July 2012. Designed to hold over 60,000 people, its population skyrocketed to over 150,000 before new camps relieved some of the pressure. The story map The Uprooted tells the tale.

Source: The ArcGIS Imagery Book

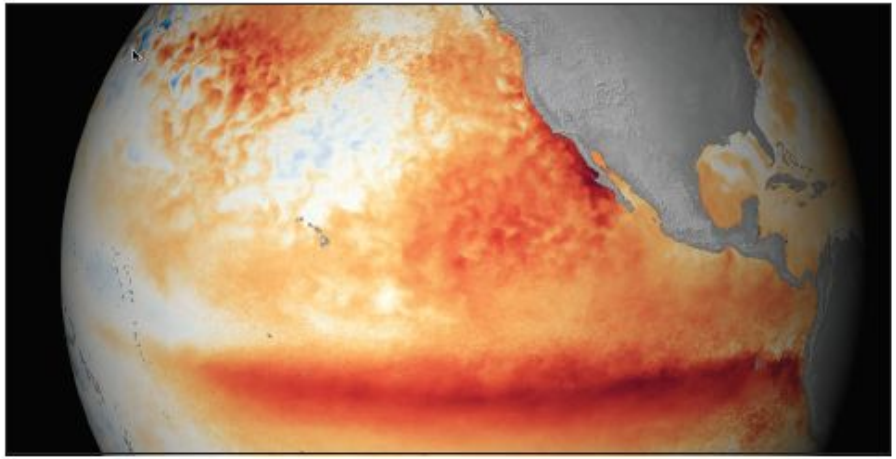
Applications

Natural disaster assessment



This scene shows the destruction of Hurricane Sandy's storm surge in Seaside, New Jersey. The active swipe map compares pre- and postevent imagery from the National Oceanic and Atmospheric Administration (NOAA).

Climate and weather study

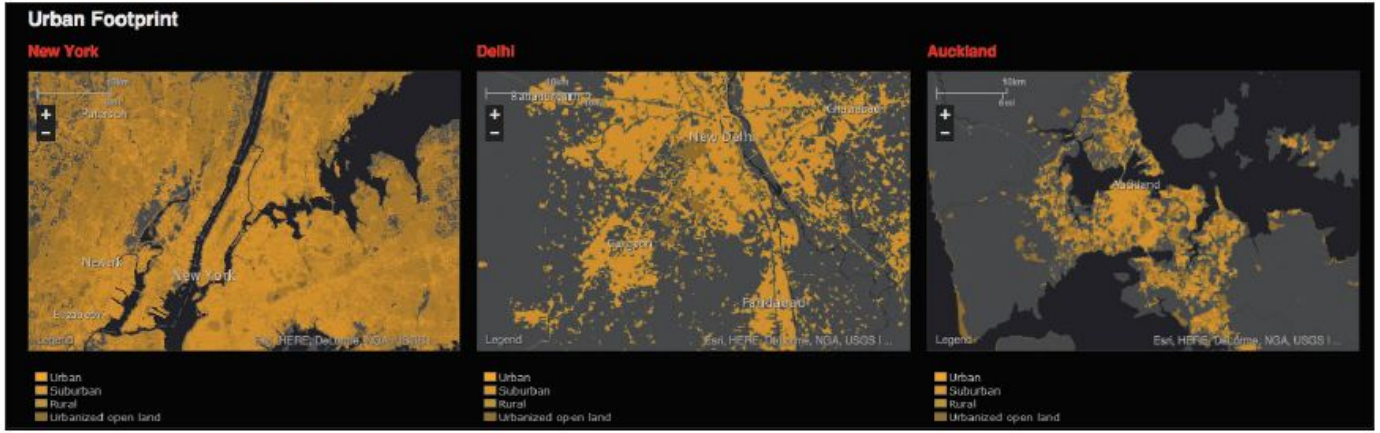


This short map presentation from NOAA answers many of the questions about the effects of El Niño. Scroll down to learn more about this climate feature and its characteristics.

Source: The ArcGIS Imagery Book

Applications

Urban Planning: Urban Observatory



The Urban Observatory is an ambitious project led by TED founder Richard Saul Wurman to compile data that allows comparision of metro areas at common scales.

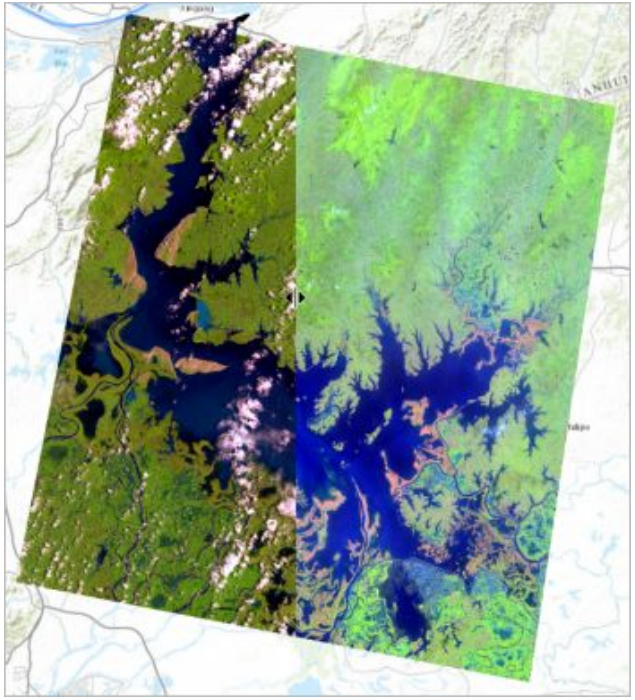
Source: The ArcGIS Imagery Book

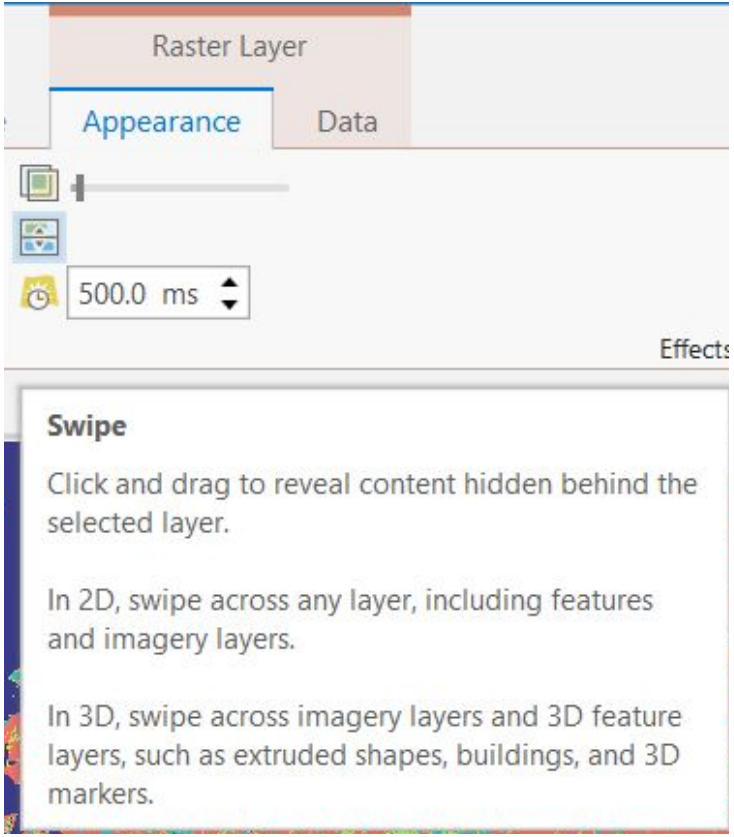
ArcGIS Pro Imagery Tools

- Swipe tool
- Classification
  - Unsupervised
  - Supervised
- Majority Filter
- Boundary Clean

Swipe Tool

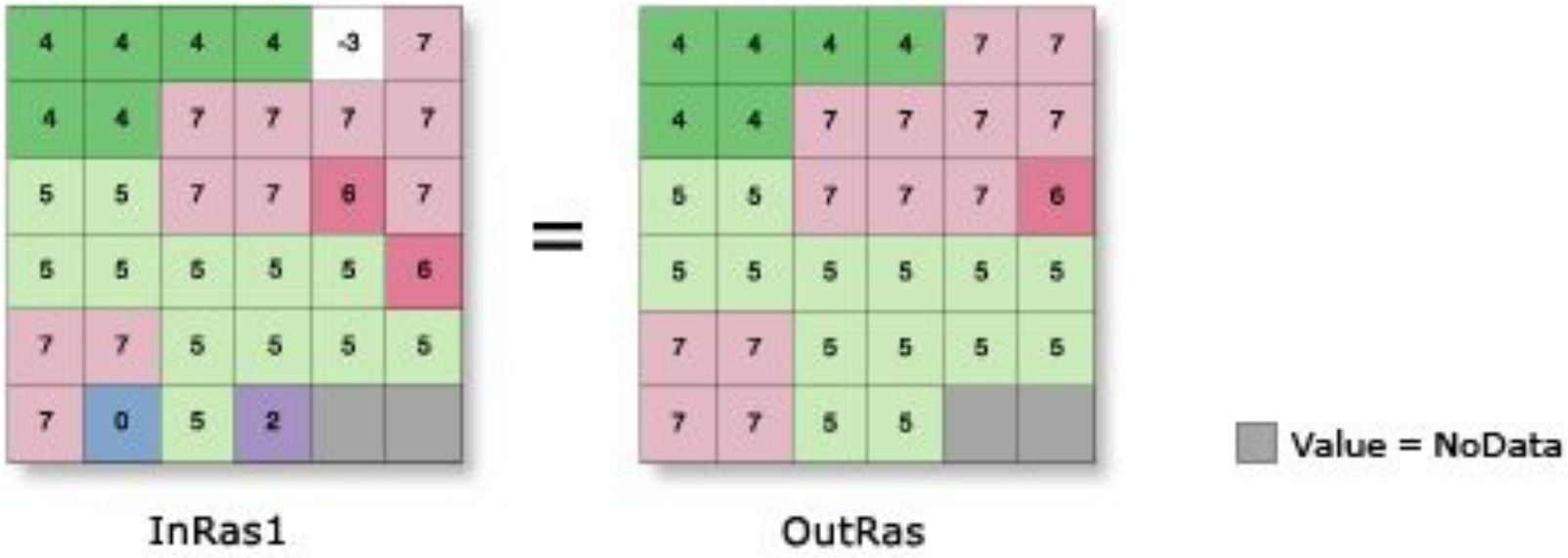
- Select Layer
- Appearance > Effects > Swipe





Majority Filter

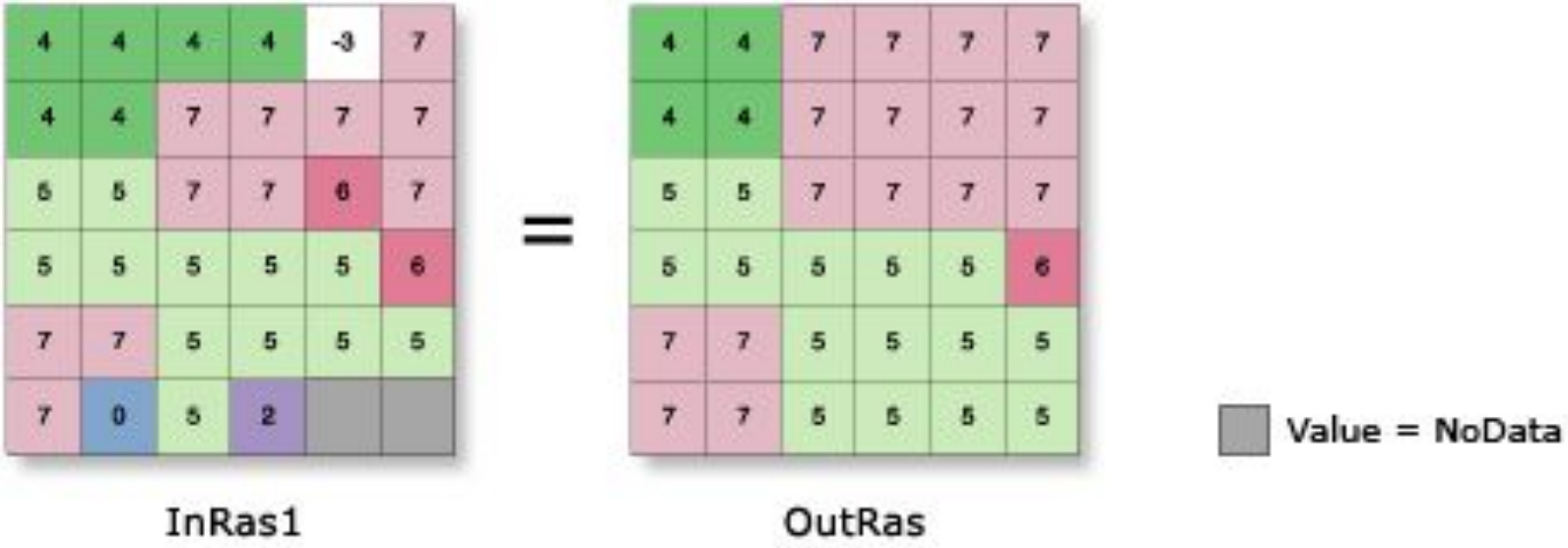
- Data generalization tool
- Replaces cells with value of majority of neighbors



Source: [Smoothing zone edges with boundary clean and majority filter]

Boundary Clean

- Cleaning ragged edges between zones
- Uses an expand and shrink method



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