

# EGM310: GIS and Remote Sensing

Week 10, Part 7: Using Digital Imagery

## What is the purpose of this “red room” in Stranger Things?

Asked 1 year, 2 months ago Active 1 year, 2 months ago Viewed 38k times



68



9



In *Stranger Things*, we frequently see Jonathan go inside this to "refine" his photos or something. I don't quite understand what happens here.

He puts the photo in water, and somehow this makes it more clear?

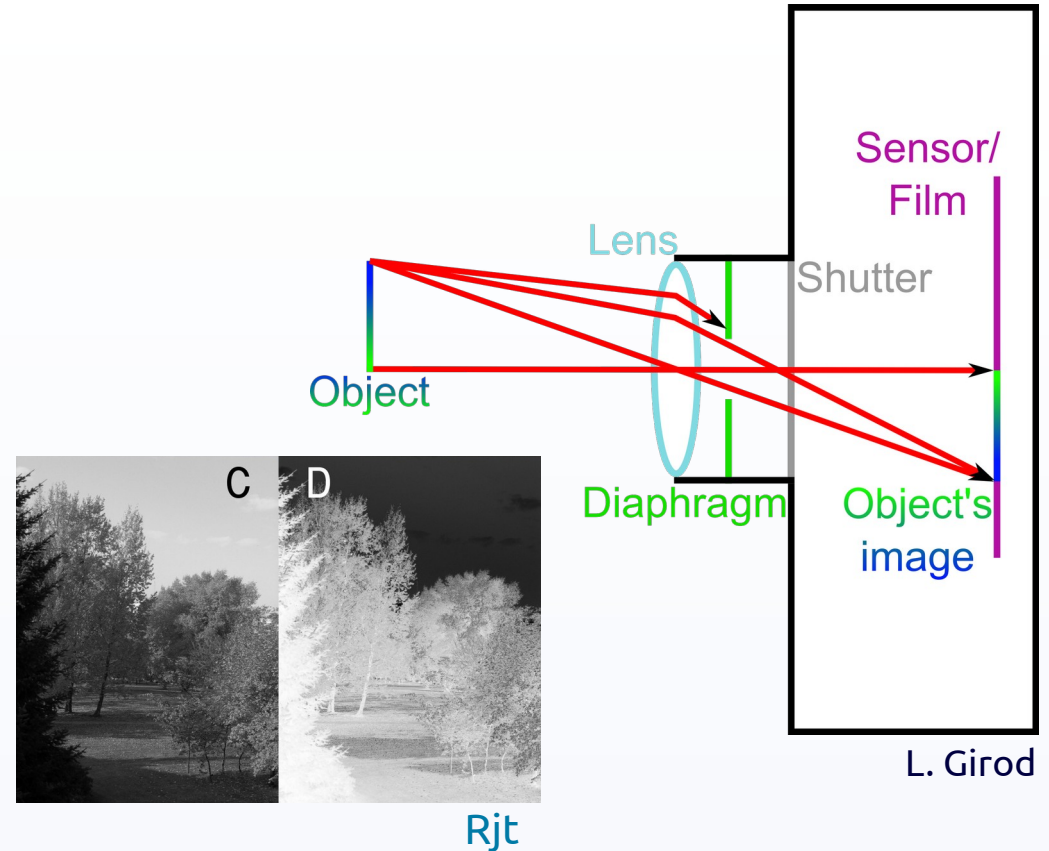
Is this an old film technique, and if so, what is it called?



[movies.stackexchange.com](https://movies.stackexchange.com)

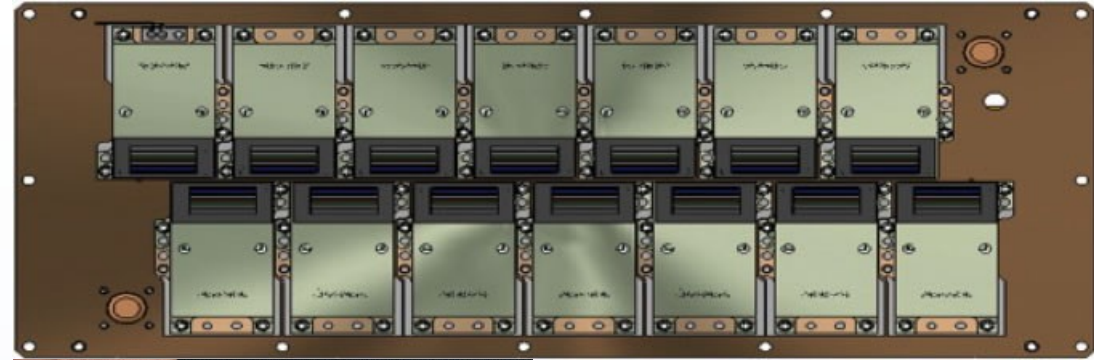
# In the before times...

- Cameras recorded photographs on **film**:
  - Plastic or paper coated with silver halide crystals
- After “developing” the film, have a **negative** image
- Can then project the film onto light-sensitive paper:
  - Bright areas: more light/energy
  - Dark areas: less light/energy

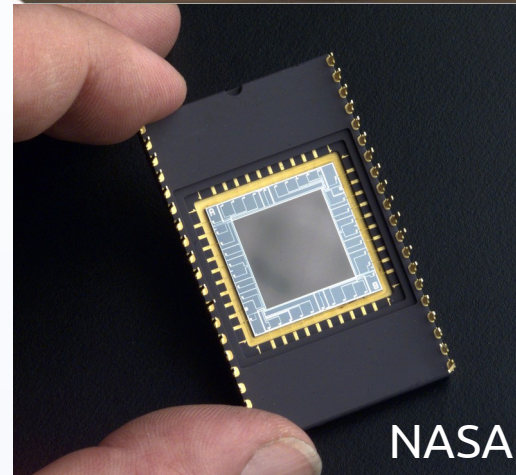


L. Girod

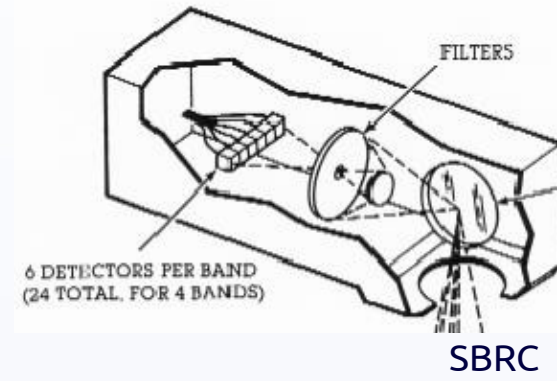
- Still measure intensity of electromagnetic radiation:
  - Charge-coupled device (CCD)
  - Complementary metal-oxide semiconductor (CMOS)
- EMR strikes detector, produces electrical charge → voltage → brightness value
  - Proportional to intensity of energy
- Monochromatic
  - Need to filter/split incoming radiation



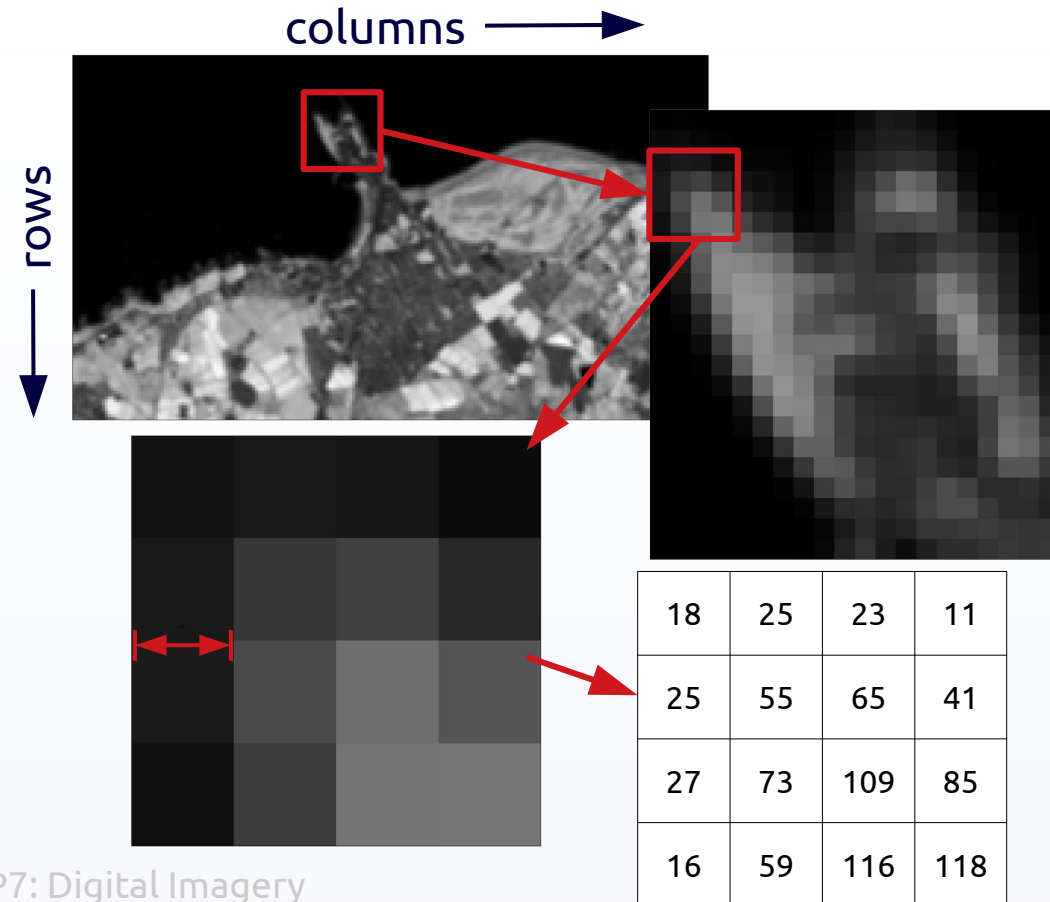
Ball Aerospace/NASA



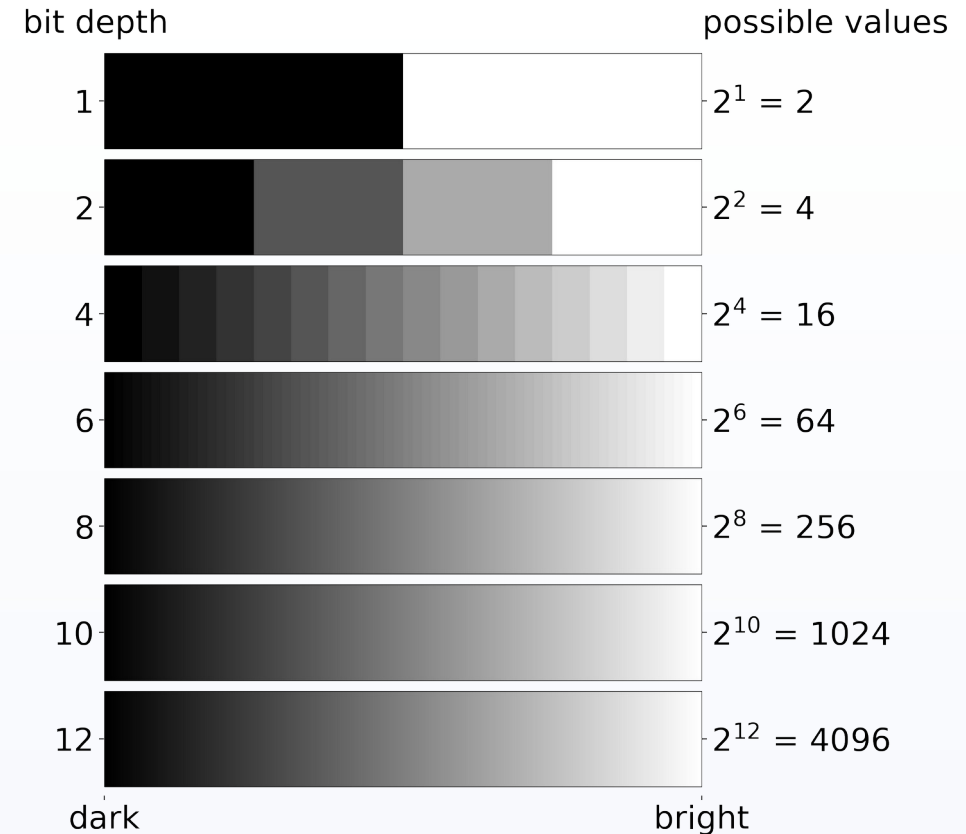
NASA



- Typically stored as **arrays**
  - Rows (lines)
  - Columns (pixels)
- Each cell (**pixel**) has a **digital number (DN)**
  - Represents brightness value
- Ground sample distance:** the ground distance each pixel covers
  - Measured in both column (y) and row (x) direction



- For images, we typically use **unsigned integer** values:
  - i.e., non-negative integers 0, 1, 2, ...
- Colour/bit depth**: how many different values we can use
- Expressed as  $2^n$  ( $n$ -bit)
  - 1-bit:  $2^1$  values
  - 2-bit:  $2^2 = 4$  values
  - 8-bit:  $2^8 = 256$  values
  - 16-bit:  $2^{16} = 65,536$  values
  - 24-bit:  $2^{24} = 16,777,216$  values (!)
- In general, the more values, the better the **radiometric resolution**
  - also, bigger images/more storage space needed

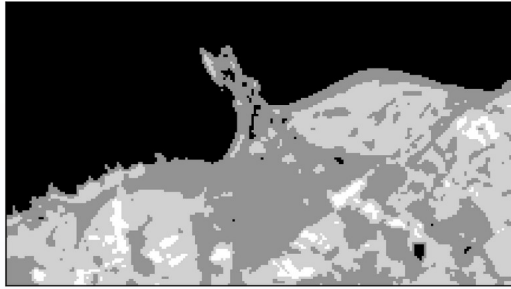


# Comparing colour depths

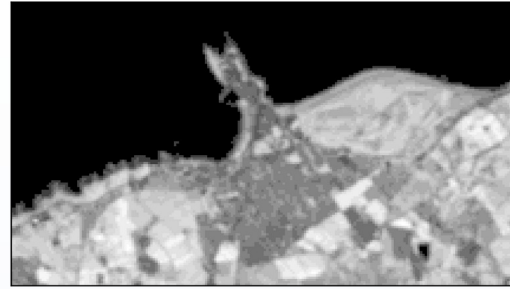
1-bit



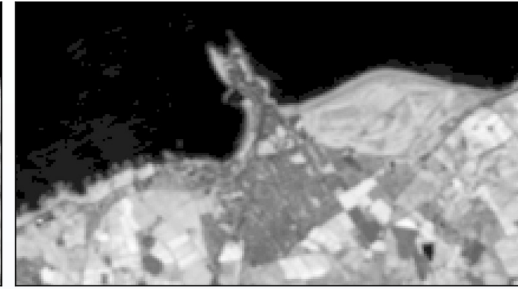
2-bit



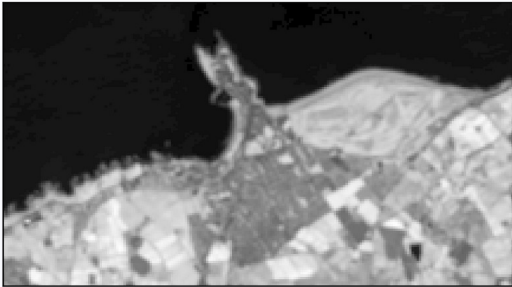
4-bit



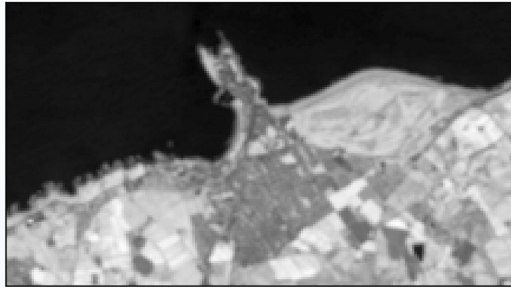
6-bit



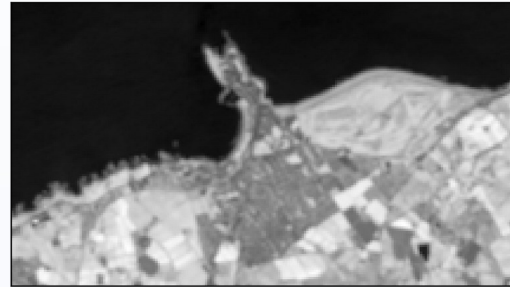
8-bit



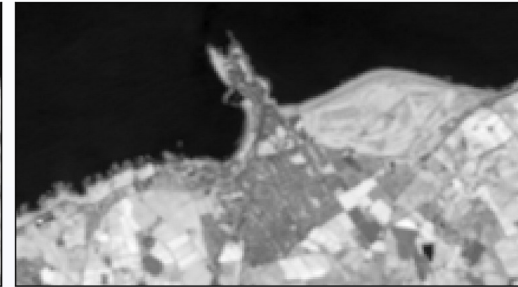
10-bit



12-bit



16-bit





- Similar to vector files, images (rasters) need information to locate the image on Earth\*
- Typically includes:
  - Size of pixels (ground sample distance)
  - Location
  - How to flatten/project image (spatial reference system)
- Pixel coordinates can be referenced to pixel centers or corners
- Many (not all!) images you will work with use Universal Transverse Mercator (UTM)



Stamen Design



- Images acquired by sensors represent the amount of energy “seen” by the sensor
- Sensor, how image is stored determines properties
- Most images we will use are stored as arrays of “unsigned” integers (0, 1, 2, 3, ...)
- For use in GIS, other applications, we also need spatial information

- Lillesand, Kiefer & Chipman – Chapter 7
- Campbell & Wynne – Chapter 4
- How does a photon become a film photo? [[SciShow](#)]
- How do digital cameras work? [[BBC Earth Lab](#)]
- Digital Images [[computerphile](#)]