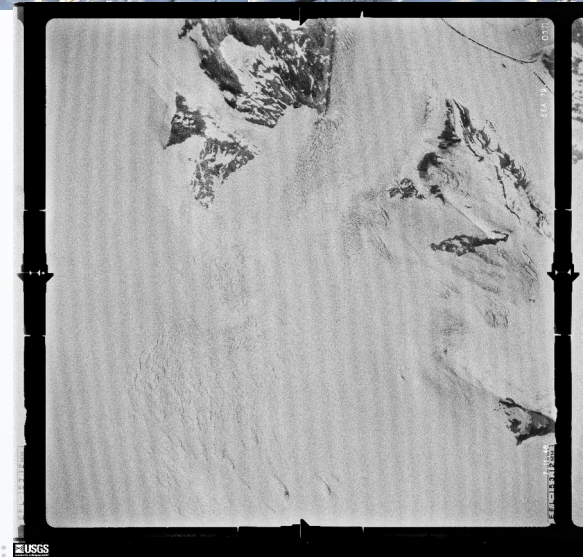


# EGM310: GIS and Remote Sensing

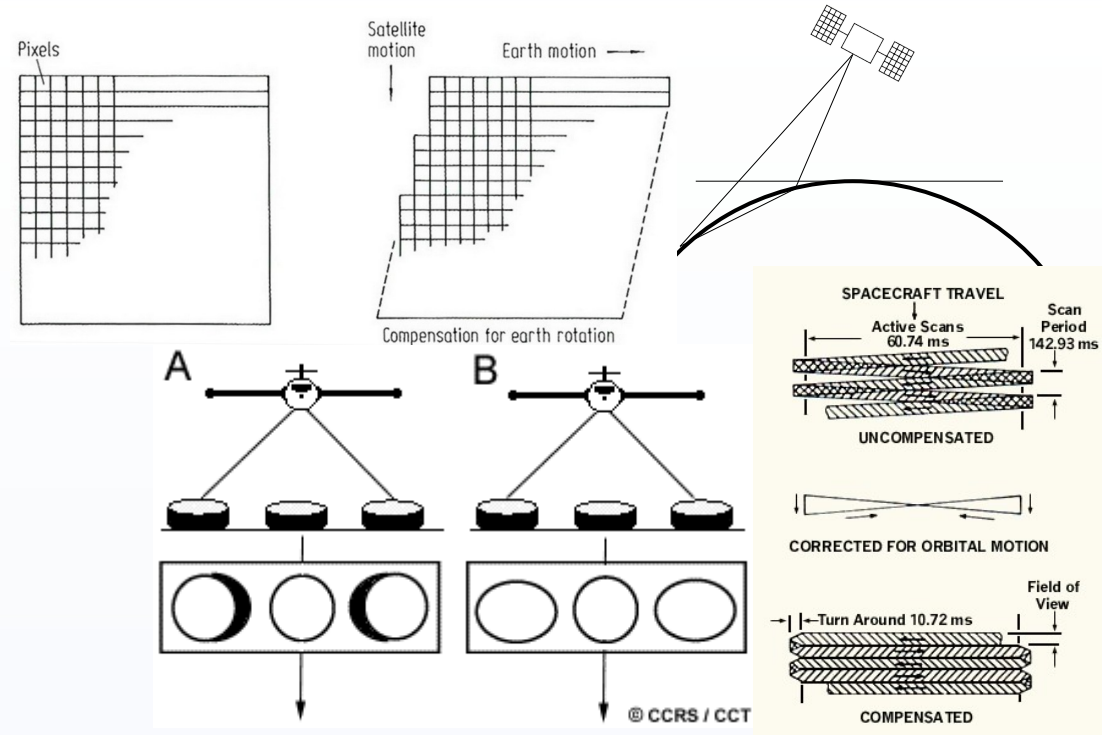
Week 10, Part 4: Sensor Distortions and Corrections

# From sensor to image

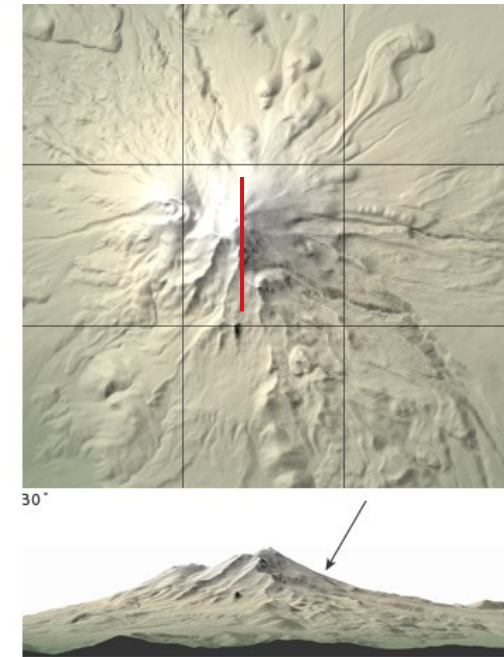
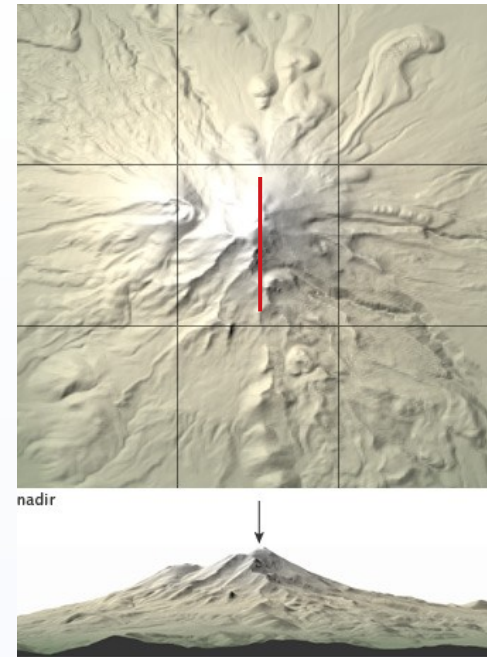
- Images will have distortion
  - Geometric
  - Radiometric
- Causes:
  - Systematic
  - Non-systematic
- Most applications need:
  - Consistent geometry
  - Consistent radiometry



- Sources:
  - Earth curvature
  - Earth rotation (skew)
  - Satellite orbit variation
  - Sensor
  - Atmosphere (refraction)
  - Terrain (relief displacement)

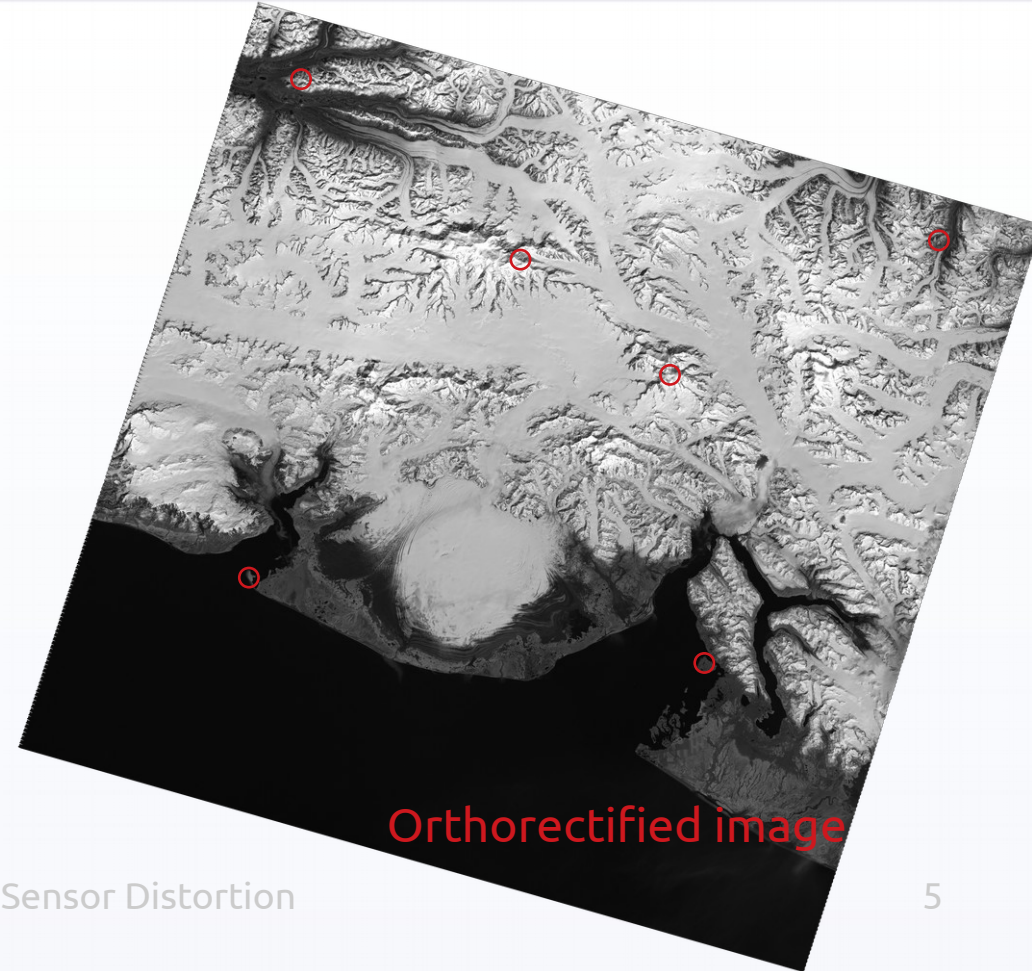
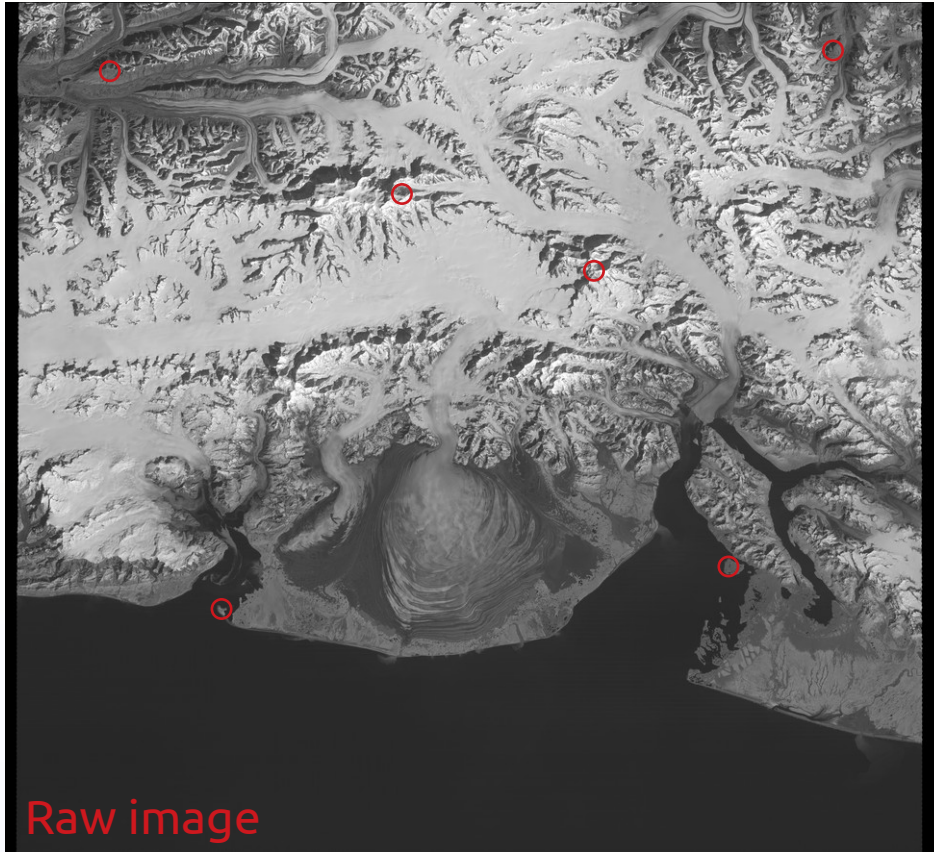


- At nadir, sensor sees the top of an object
- Objects away from nadir appear to lean outward
- Depends on:
  - Height of object
  - Distance from nadir
- Can be corrected if we know the height of the objects (**orthorectification**)



NASA Earth Observatory

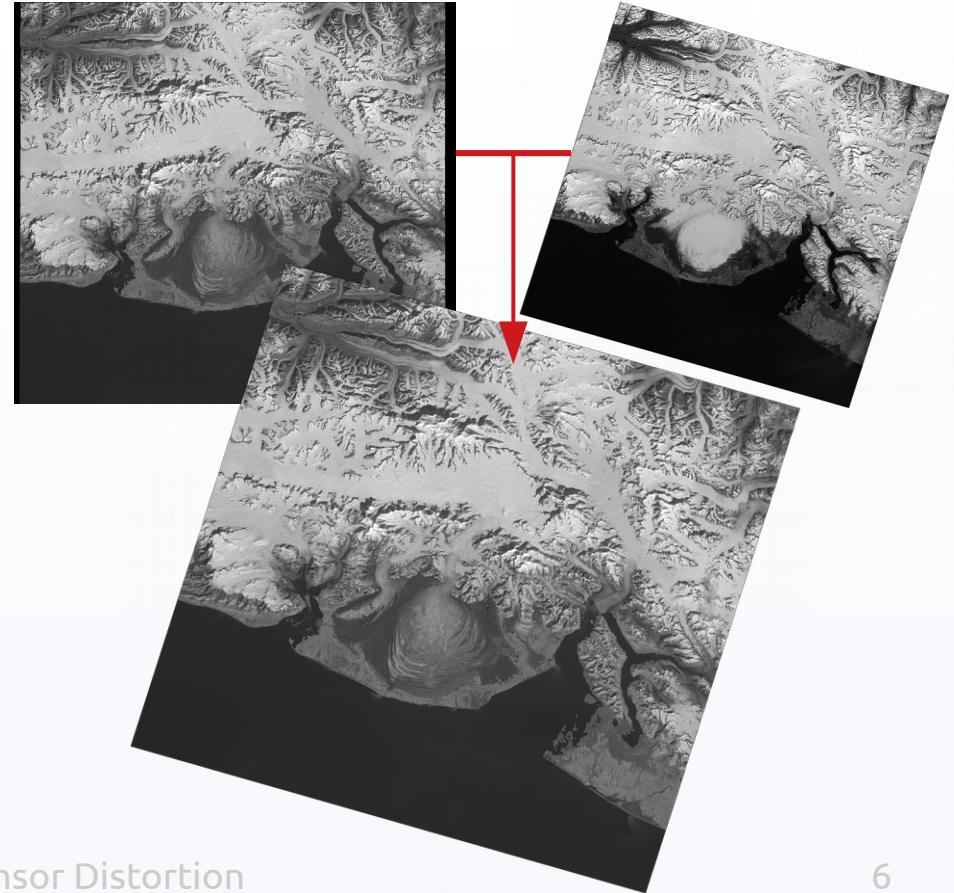




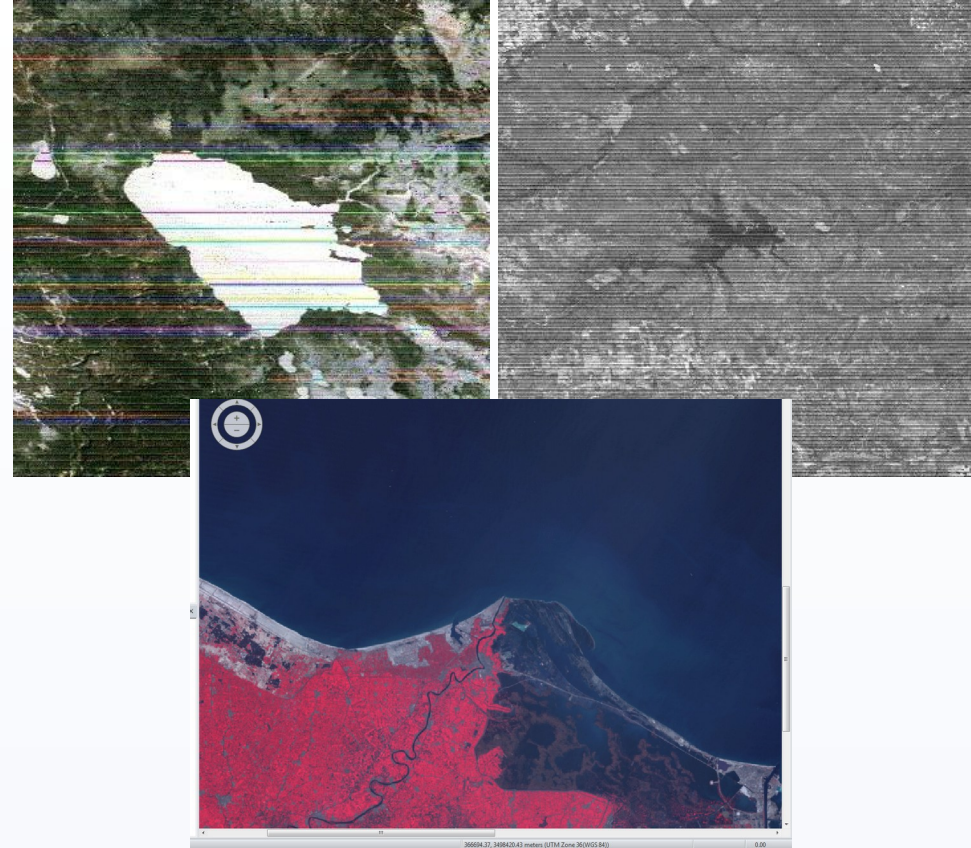
24/11/2020

EGM310: W10, P4: Sensor Distortion

- With ground control points (GCPs):
  - Calculate mathematical transformation between image, map geometry
  - Re-sample (interpolate) image into the corrected geometry
- If necessary, correct for terrain displacement, other distortion

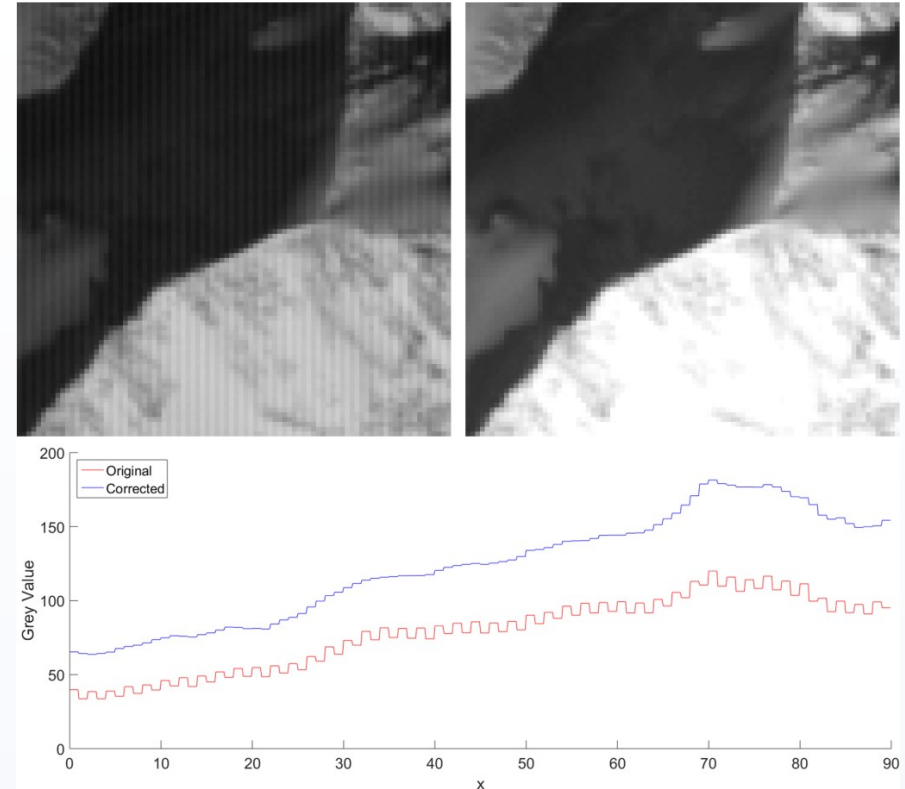


- Causes:
  - Sensor degradation/failure
  - Sensor differences
  - Variation in illumination
  - Atmospheric conditions
  - Topography





- Detectors may have different responses
  - Response changes over time
- Some sensors (e.g., ASTER) provide calibration data for correction
- Filtering/image processing techniques can help, too

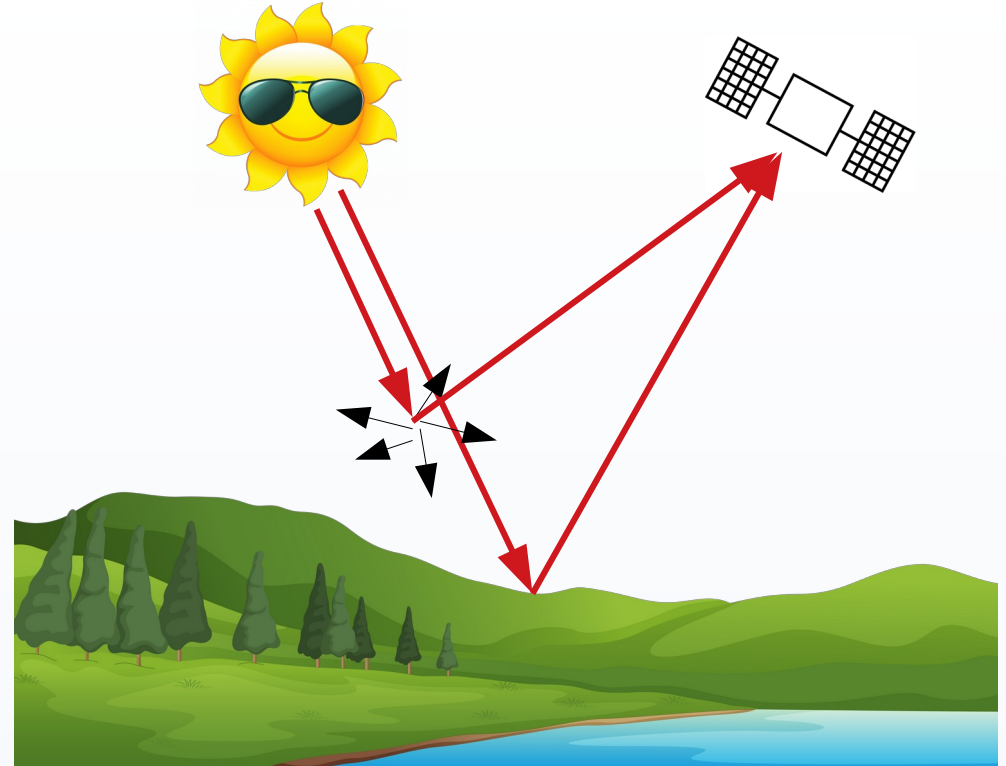


Girod et al., 2017



# Atmospheric correction

- Atmospheric scattering → some EMR is sent back to sensor
  - Gives **at-sensor radiance**, or **Top of Atmosphere reflectance**
  - Often, we want **surface reflectance**
- Need to model/estimate, then remove atmospheric component



- Images will have distortion
  - Radiometric (differences in brightness), geometric
- In order to compare images at different times/places, have to correct these
- Different distortions have different causes
  - Systematic vs. non-systematic
- Many satellite data come already corrected\*

- Lillesand, Kiefer & Chipman – Chapter 7.2
- Campbell & Wynne – Chapter 11
- Natural Resources Canada [Remote Sensing Tutorials](#)
- What is lens distortion? [[Photography Life](#)]