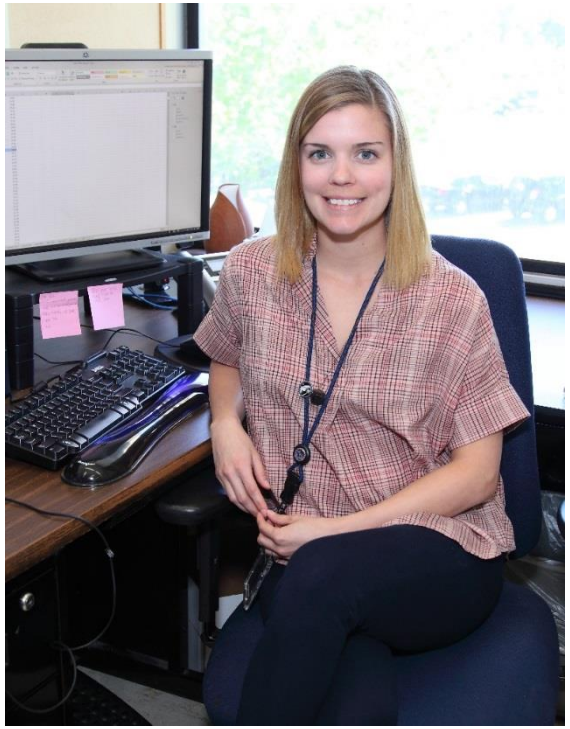
CEO, Research with Astronaut Photography, and Tips for GIS Students

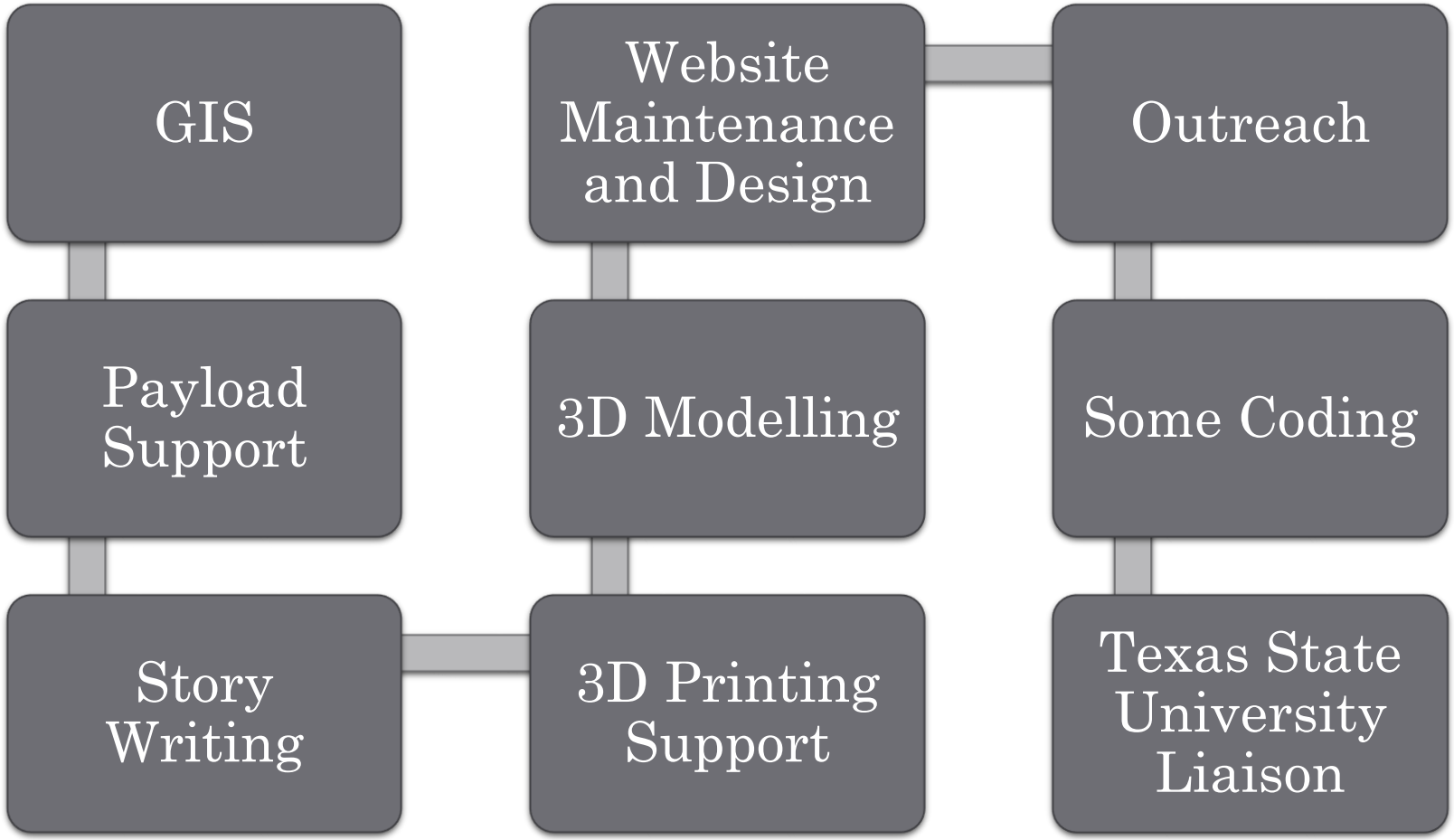
Andi Hollier (Thomas), Earth Science and Remote Sensing Unit, JSC

Background



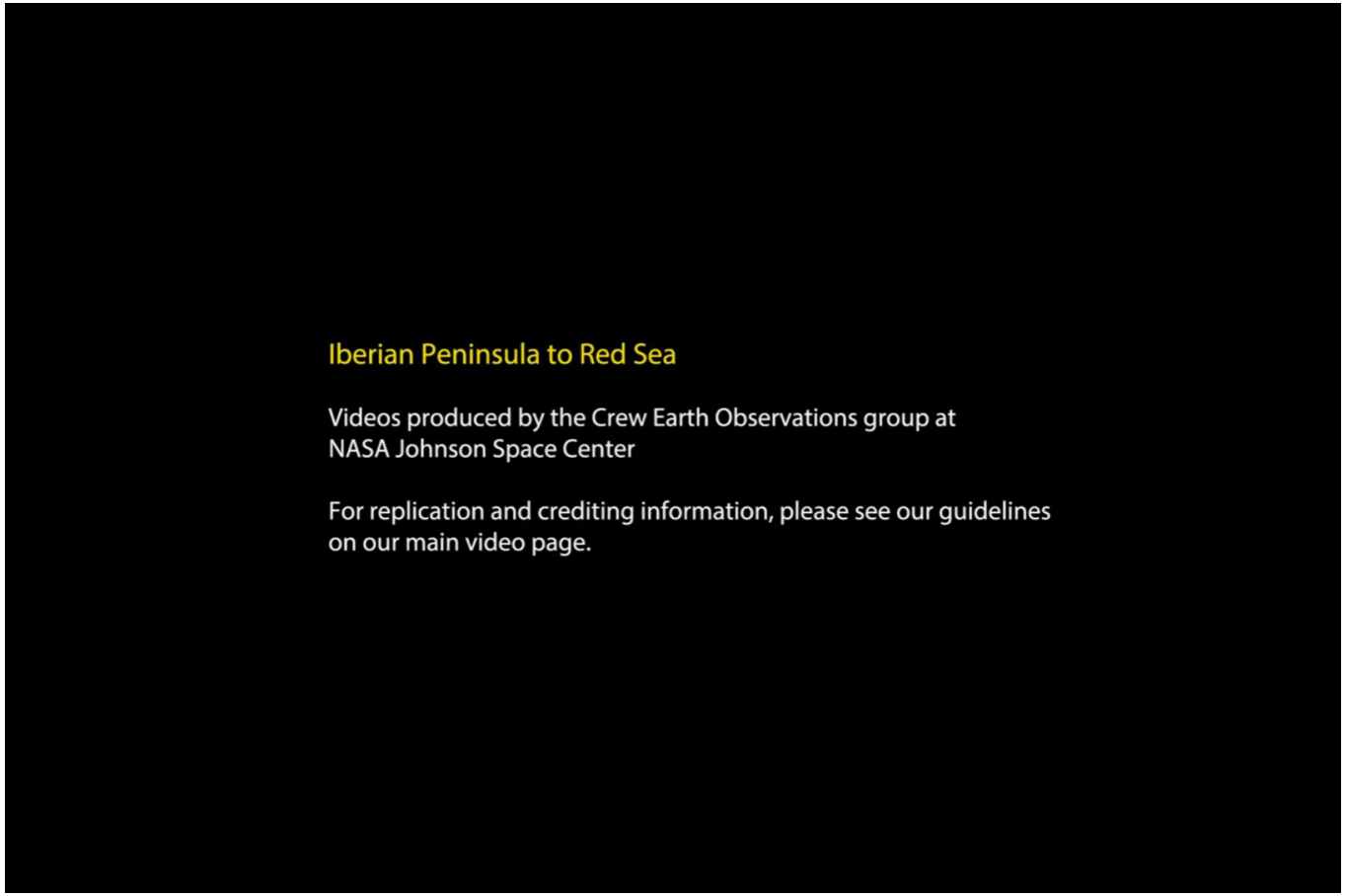
- BS Geography, Resource and Environmental Studies
- Minor: Geology
- Certificates:
  - Water Resources Policy
  - GIS
- Former GTU Secretary and Vice President
- Astronaut Photography Cataloger (thank you Dr. Currit and Dr. Jensen)
- Jacobs Internship, Earth Science and Remote Sensing (thank you Dr. Currit and Dr. Jensen)
- Hired with Hx5 as a Scientist 1 at Johnson Space Center, August 2016

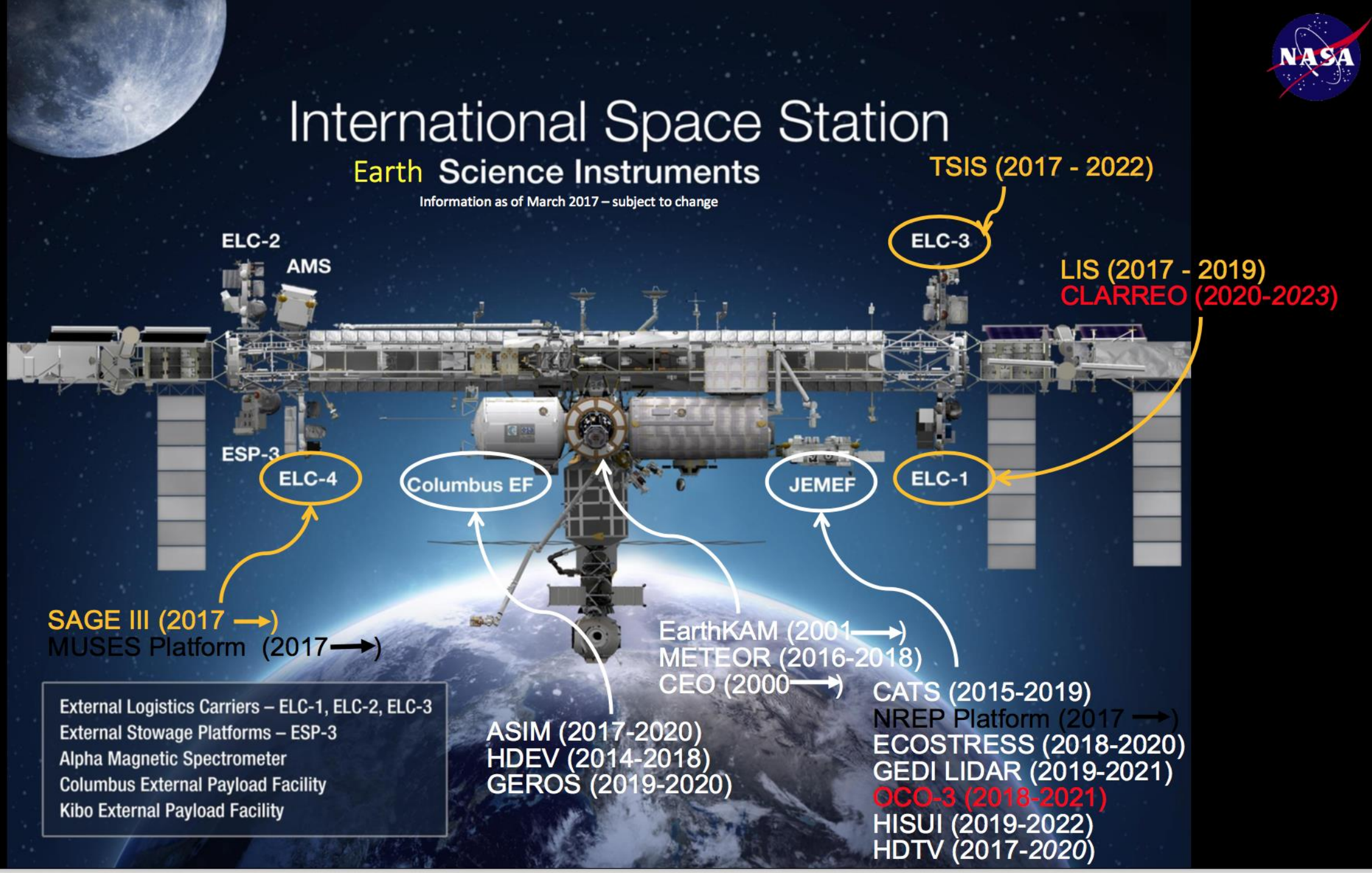
What I do as an Earth Scientist

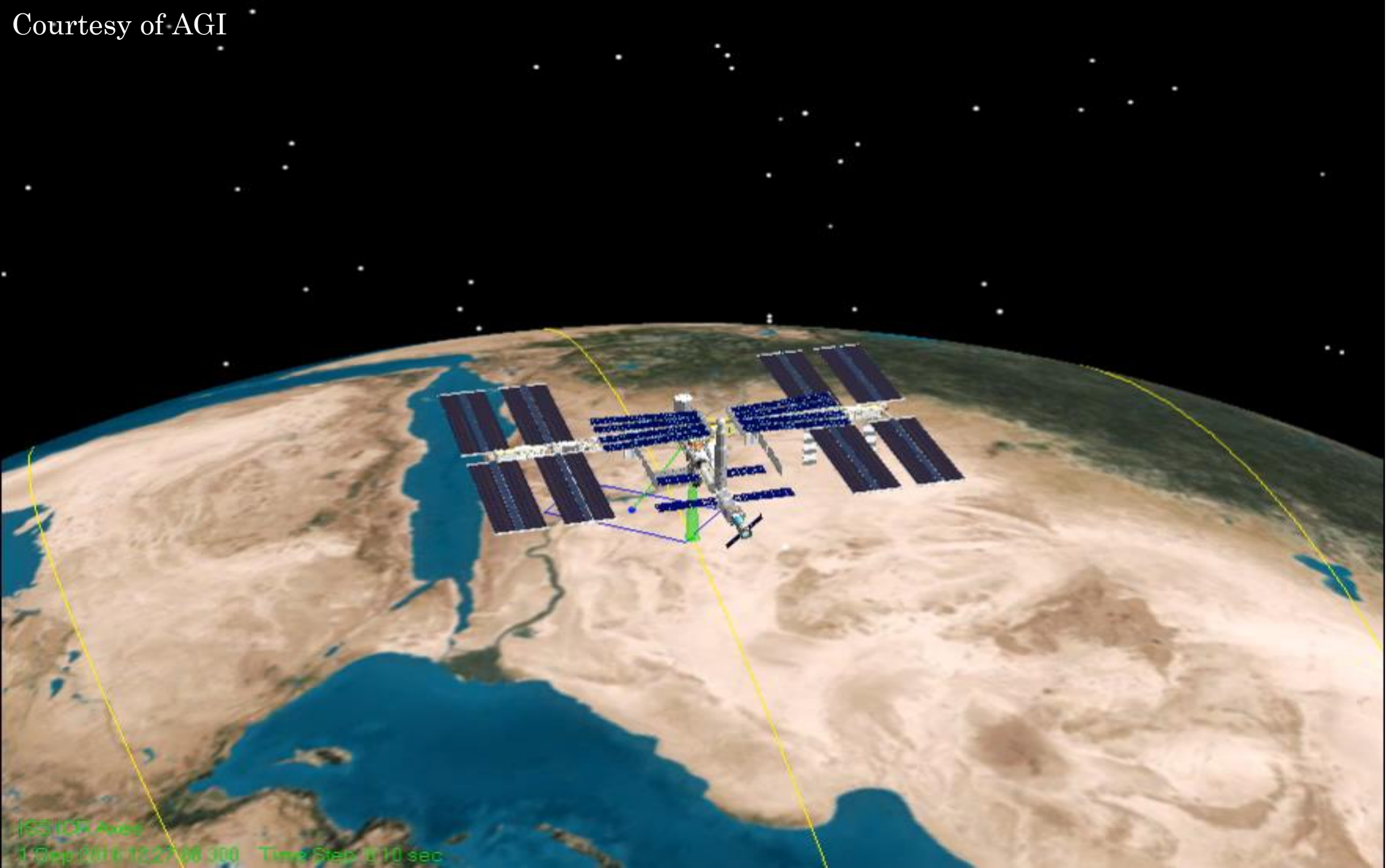


The Earth Science and Remote Sensing Unit

eol.jsc.nasa.gov/ESRS




International Space Station
Earth Science Instruments
Information as of March 2017 – subject to change
TSIS (2017 - 2022)
ELC-3
ELC-2
AMS
LIS (2017 - 2019)
CLARREO (2020-2023)
ESP-3
ELC-4
Columbus EF
JEMEF
ELC-1
SAGE III (2017 →)
MUSES Platform (2017→)
EarthKAM (2001→)
METEOR (2016-2018)
CEO (2000→)
CATS (2015-2019)
NREP Platform (2017 →)
ECOSTRESS (2018-2020)
GEDI LIDAR (2019-2021)
OCO-3 (2018-2021)
HISUI (2019-2022)
HDTV (2017-2020)
ASIM (2017-2020)
HDEV (2014-2018)
GEROS (2019-2020)
External Logistics Carriers – ELC-1, ELC-2, ELC-3
External Stowage Platforms – ESP-3
Alpha Magnetic Spectrometer
Columbus External Payload Facility
Kibo External Payload Facility



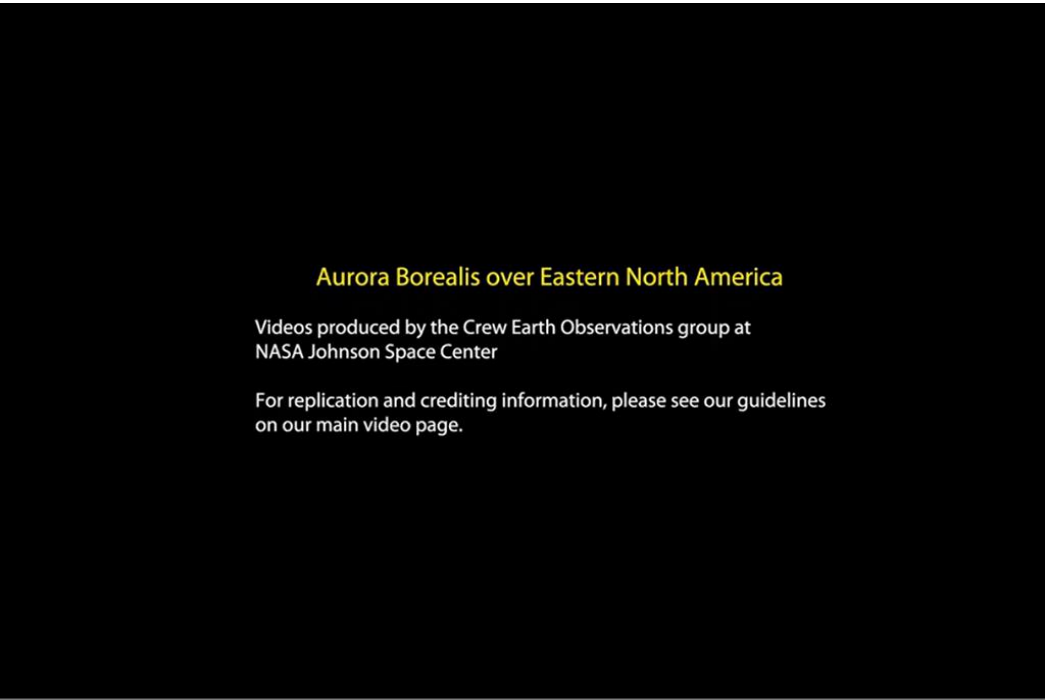
Crew Earth Observations

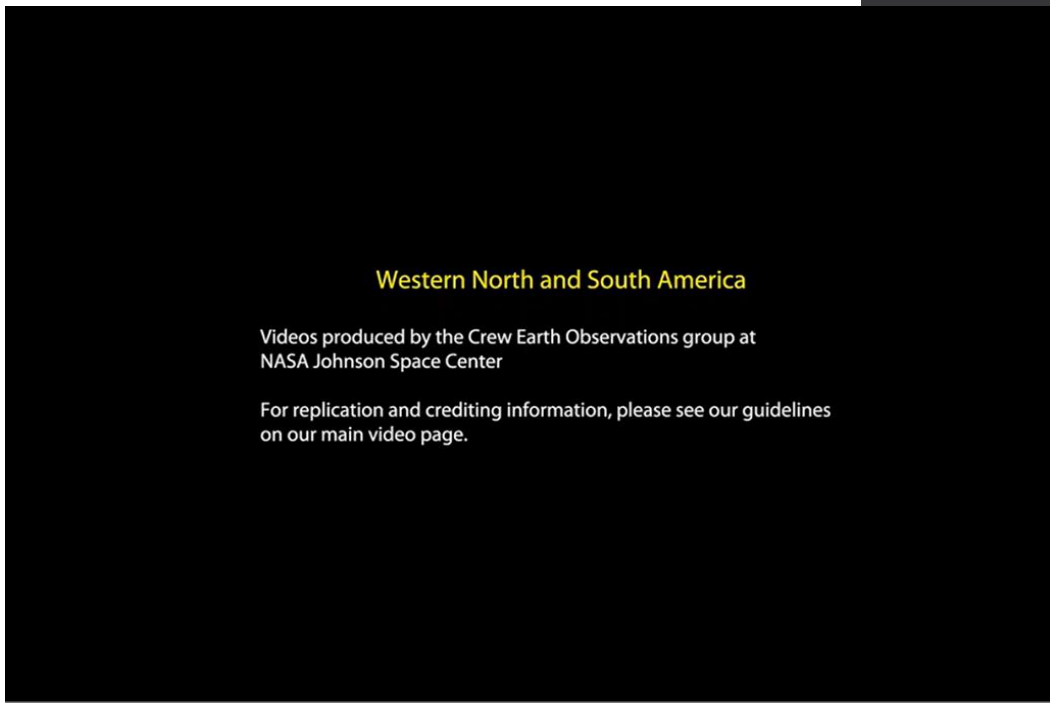
Astronaut Photography

OVER 1.5 MILLION IMAGES AVAILABLE FOR DOWNLOAD FREE!!

Night

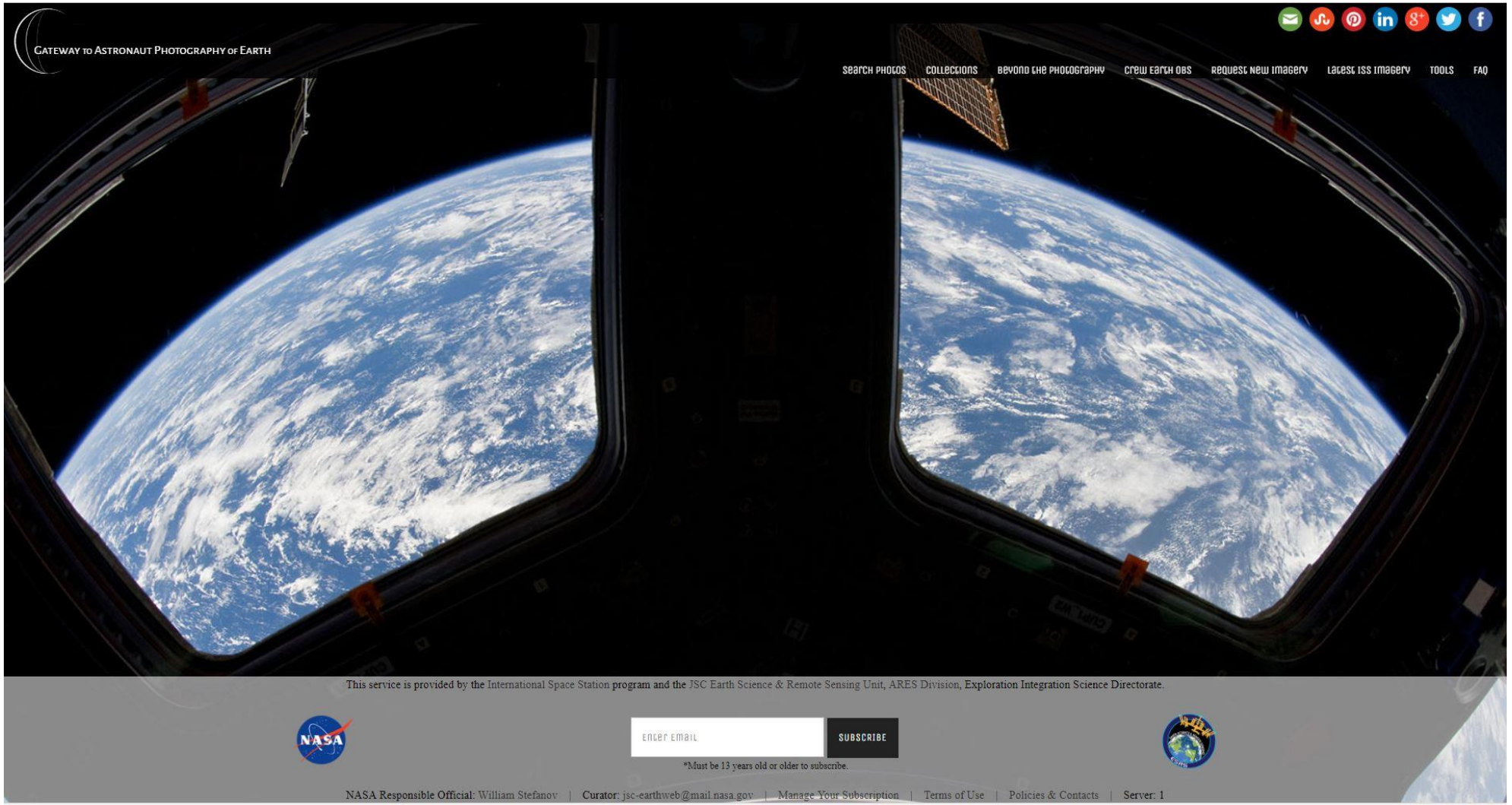
Day





eol.jsc.nasa.gov

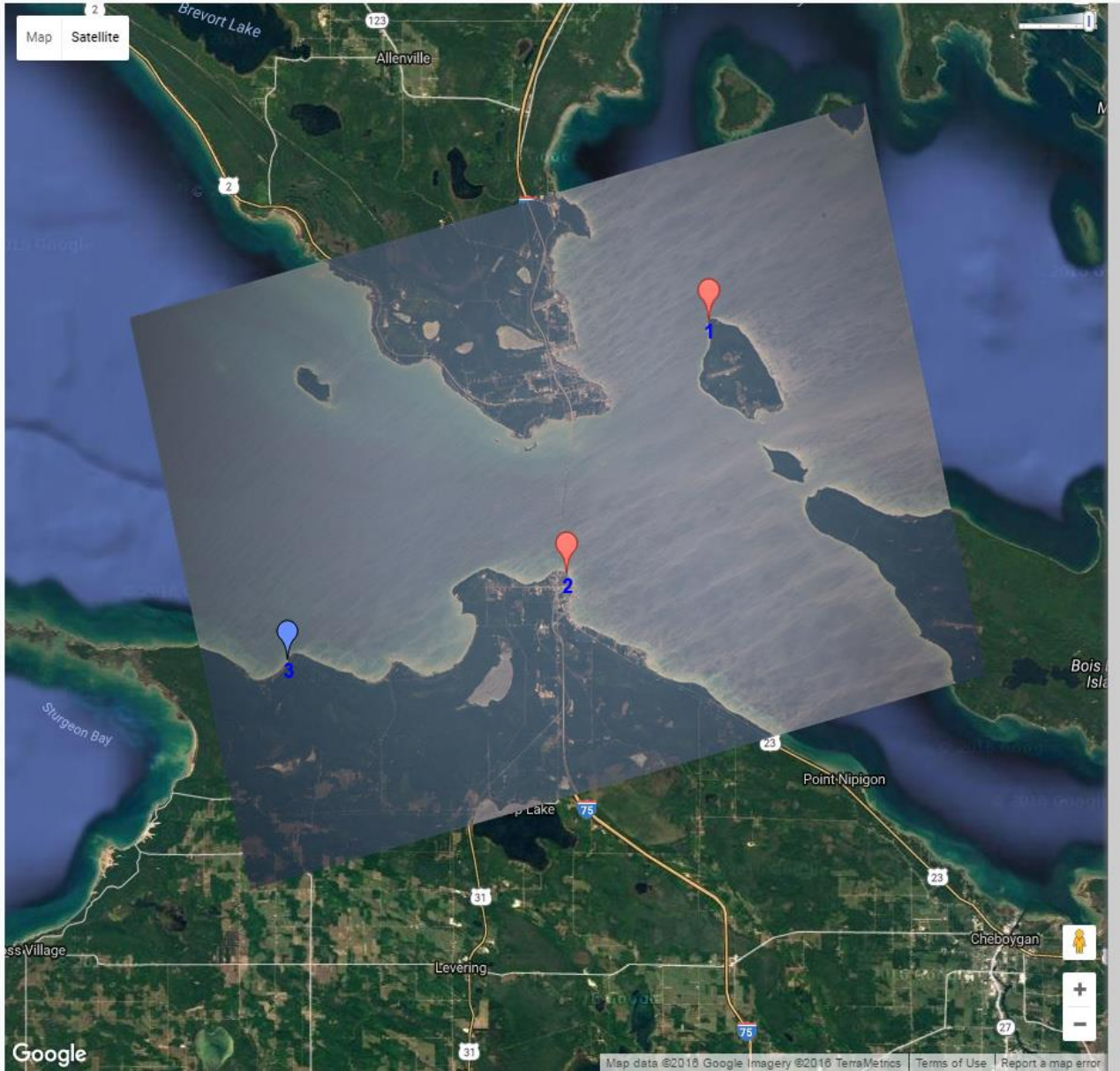
Gateway to Astronaut Photography of Earth

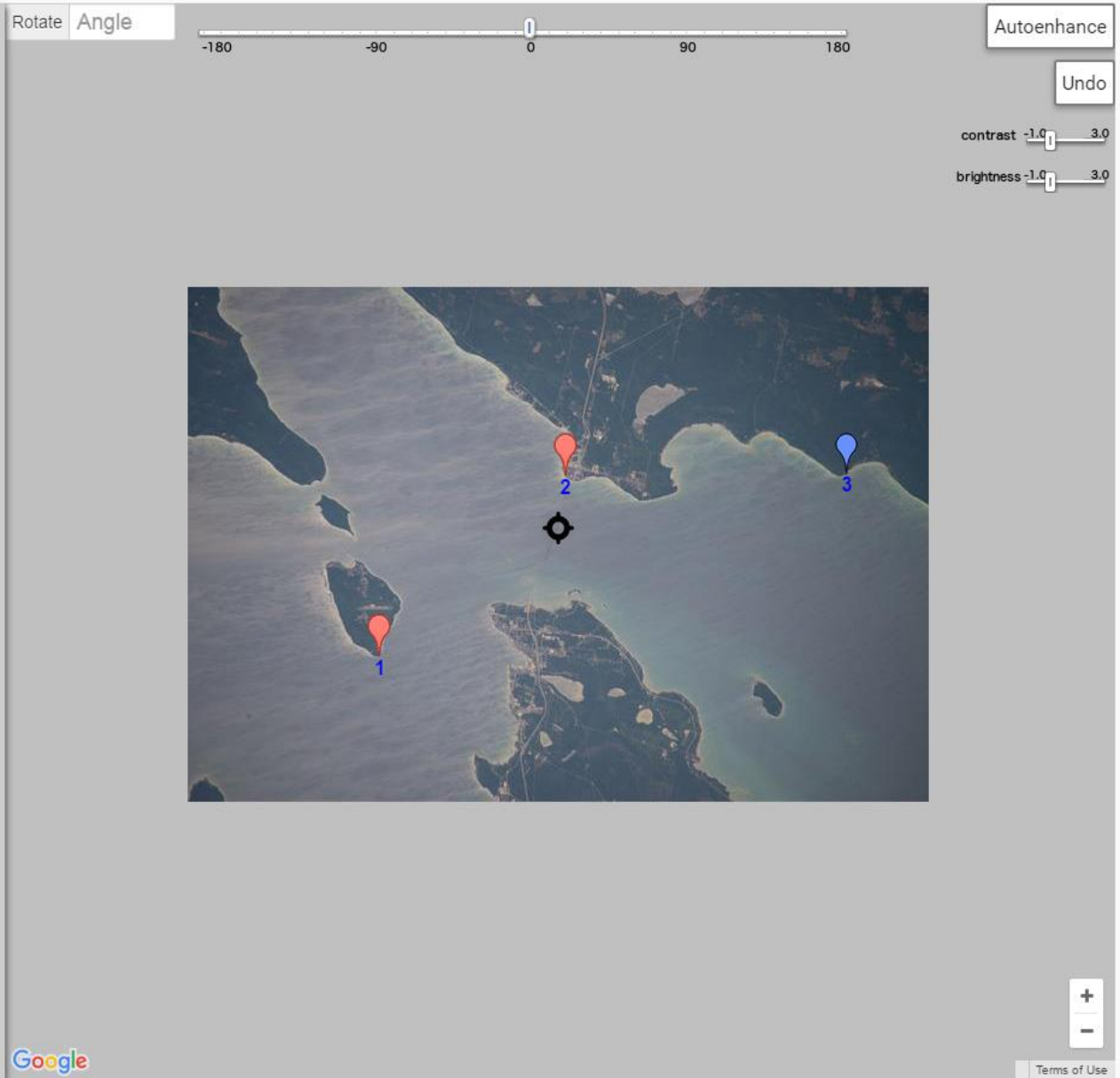


GeoRef List Overlays Logout

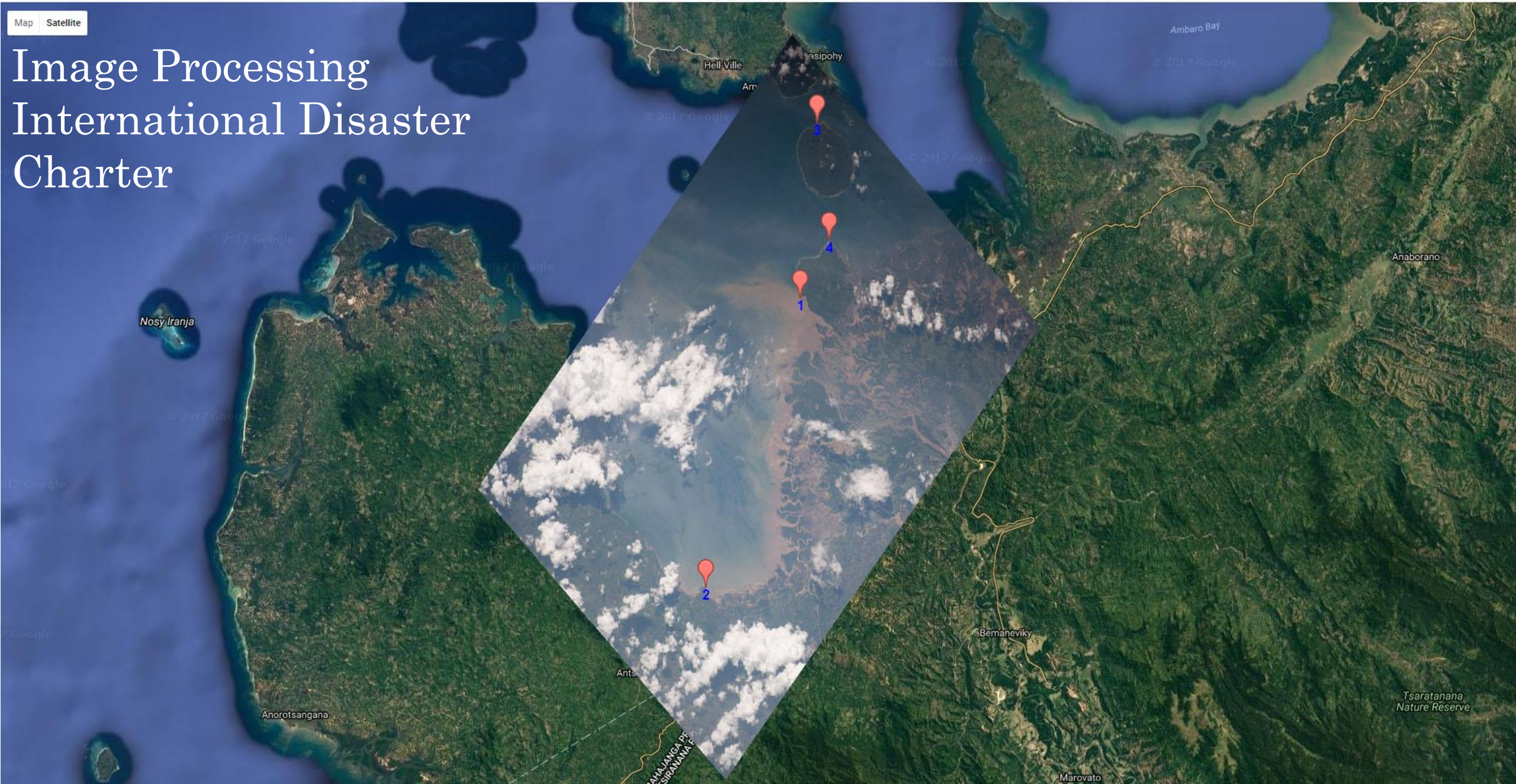
ISS048-E-65427

Help | Undo | Redo | Delete | Zoom Max | Zoom Fit | Show Preview | Save | Saved. | Done

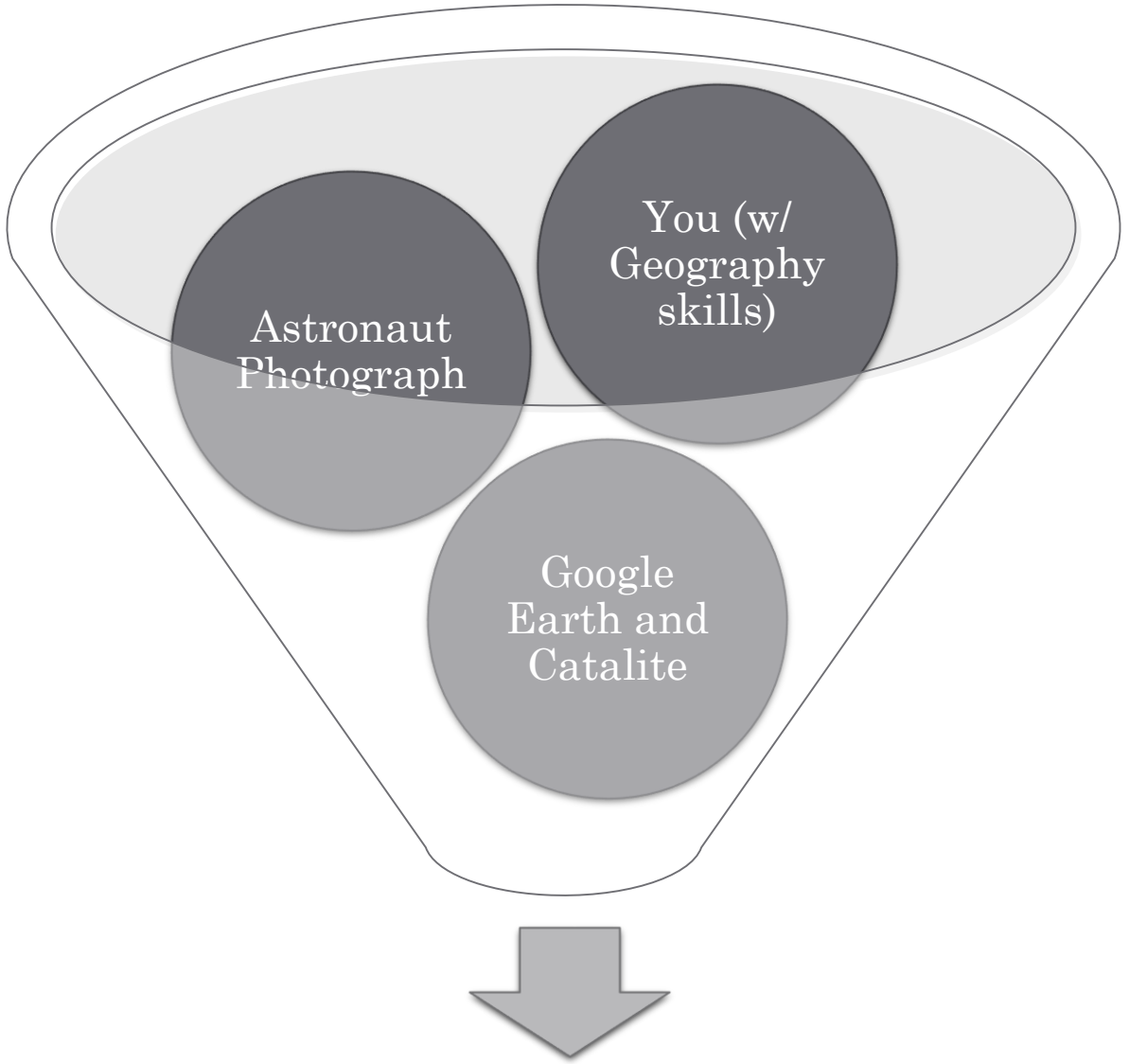




GeoRef Overview List Overlays



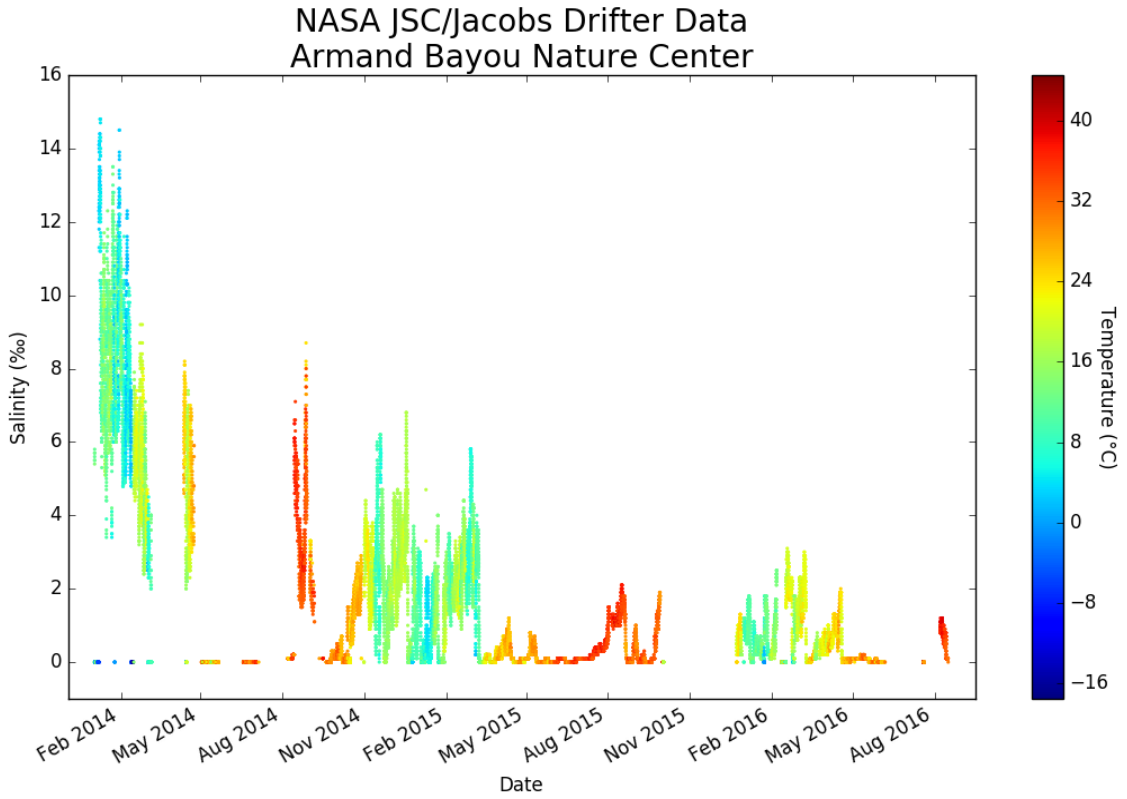
Part 2 – Texas State University Projects



Astronaut Photography Cataloging

Drifter

https://eol.jsc.nasa.gov/ESRS/Regional_Remote_Sensing/Drifter/



Tweets by @jscdrifter2

Jacobs @jscdrifter2

Date:160816,Time:123032.383,Lat:2935.4977N,Long:09504.7585W,Conductivity (uS/cm2):84.9240,Temp (Celsius):30.7369

16 Aug

Jacobs @jscdrifter2

Date:160816,Time:073620.230,Lat:2935.4983N,Long:09504.7556W,Conductivity (uS/cm2):148.5960,Temp (Celsius):31.4502

16 Aug

Jacobs @jscdrifter2

Date:160816,Time:072225.890,Lat:2935.4976N,Long:09504.7593W,Conductivity (uS/cm2):148.5960,Temp (Celsius):31.4502

16 Aug

Jacobs @jscdrifter2

Part 3- Related Projects

Andi Hollier (Thomas) & Amy Jagge

ESRS Presentation Map with Web AppBuilder for ArcGIS

Esri World Geocoder

Select the layer you want to swipe

JohnsonSpaceCenter_Veg_2015

Layer List

Operational Layers

- JohnsonSpaceCenter_2015
- JohnsonSpaceCenter_Veg_2015
- JohnsonSpaceCenter_NDVI_2015

29.581 -95.090 Degrees

0.3mi

City of Houston, Texas Parks & Wildlife, Esri, HERE, Garmin, INCREMENT P, USGS, METI/NASA, EPA, USDA

Geographic Object-Based Image Analysis (GEOBIA)

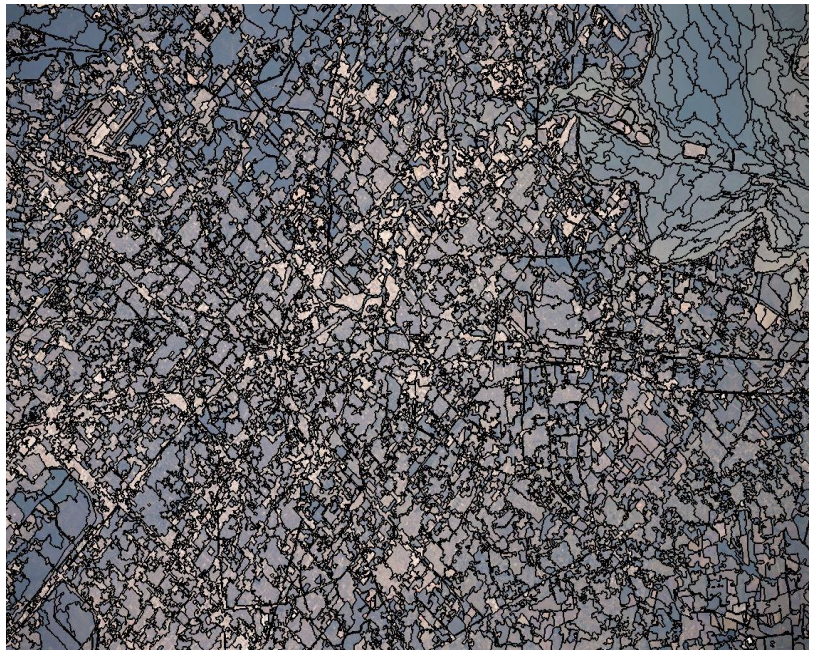
"…a sub-discipline of Geographic Information Science (GIScience) devoted to developing automated methods to partition remote sensing imagery into meaningful image-objects, and assessing their characteristics through spatial, spectral and temporal scales, so as to generate new geographic information in GIS-ready format."

-G.J. Hay, G. Castilla

1. Computer algorithms segment images into image-objects based on image features (texture, geometry, spectral properties, and spatial relationships)

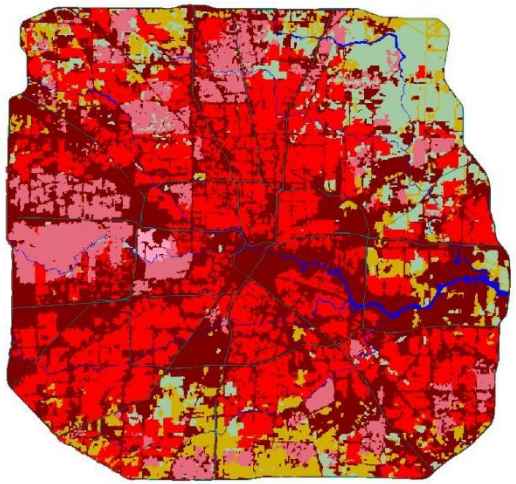
2. Assign image-objects to categories or classes of interest based on expert knowledge, unique image-object features, and supervised algorithms.

3. Image-objects are the basic unit of analysis

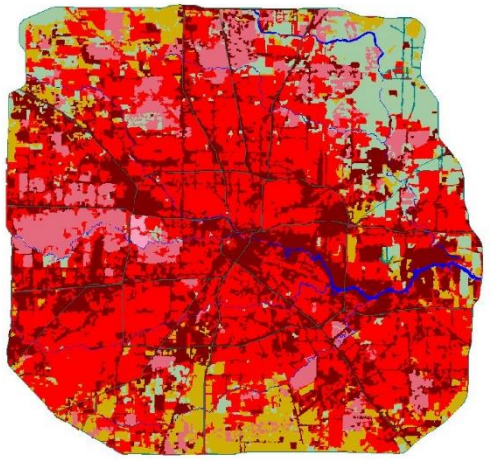


GEOBIA

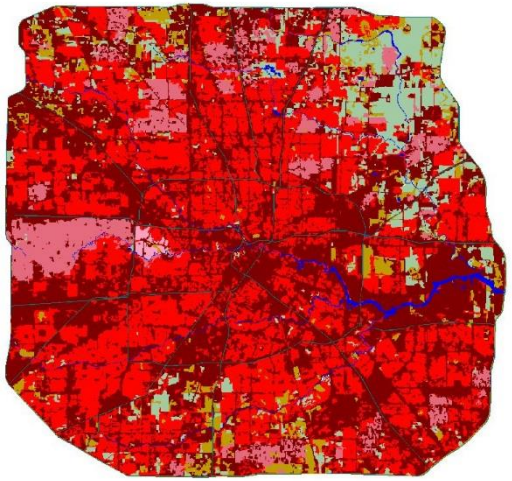
1985



2002

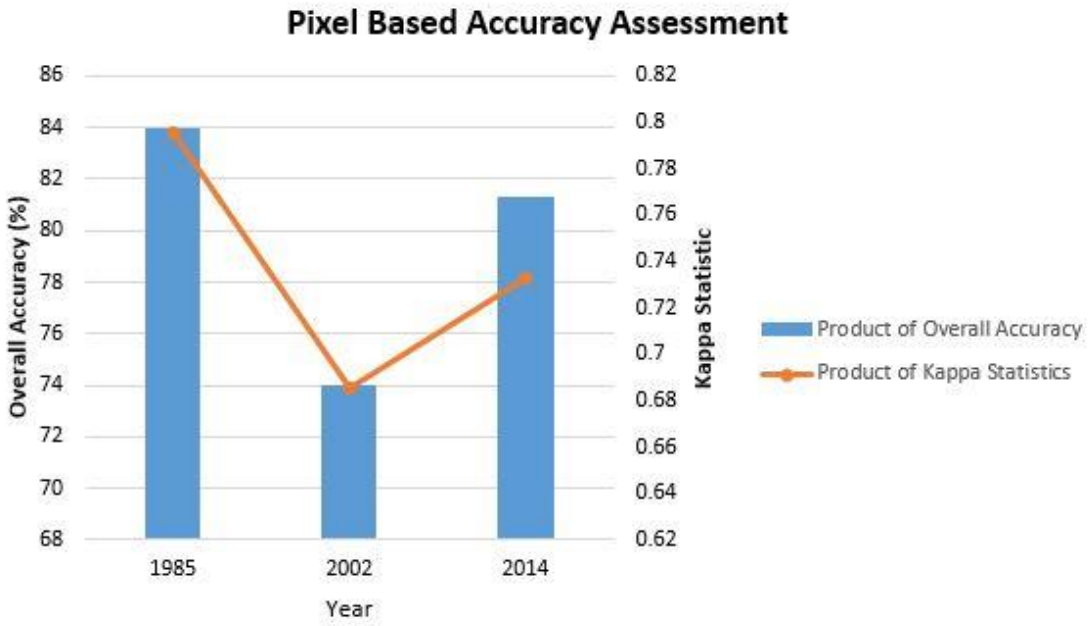


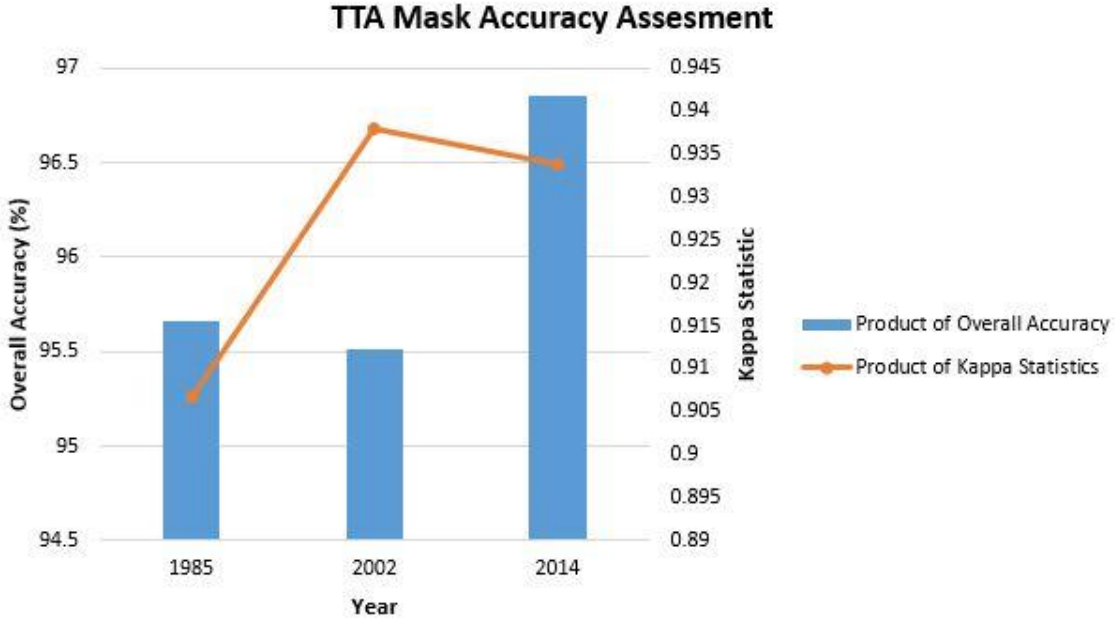
2014



Accuracy Assessment

- Perform two types of accuracy assessments on classified images for comparison
- Overall accuracy > 80% and kappa statistic > 0.71



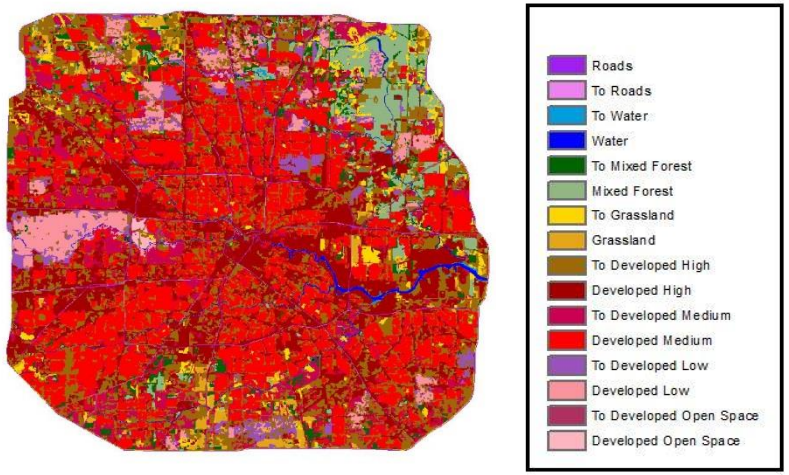


ERDAS: Generate 150 randomly stratified points and assign classes to points using the unclassified digital image as reference. Assess accuracy using confusion matrix and statistical report.

Ecogniton: Select >5 samples for each class and create TTA mask based off samples. Assess accuracy using confusion matrix and statistical report.

Change Detection

- Perform change detection between classified images for years 1985 and 2014.
- Generate Matrix Union output image quantifying change between two images.



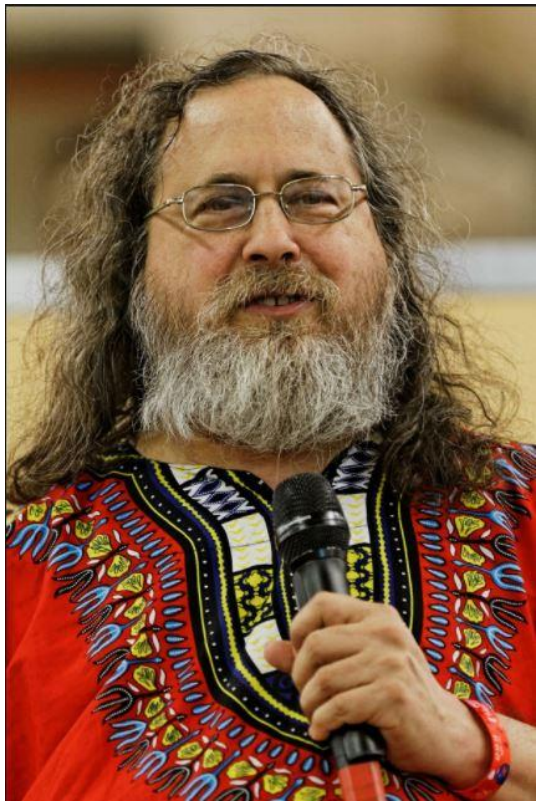
		2014 "To" Class							
		Unchanged							
		Roads	Water	Mixed Forest	Grassland	Developed - High	Developed - Medium	Developed - Low	Developed - Open Space
1985 "From" Class	**Hectares (%)**	1823.67(83.73)	1197.06(77.86)	6090.06(58.72)	2725.17(41.35)	27070.8 (42.30)	5150.7 (27.28)	5887.13 (62.14)	243.384 (74.82)
	Roads		1.75495(1.75)	14.8709(4.19)	14.6862(4.14)	185.471(52.34)	123.493(34.85)	12.6541(3.57)	1.38549(0.39)
	Water	2.03205 (0.59)		111.855(32.86)	13.6702(4.01)	52.8211(15.51)	128.112(37.64)	30.8502(9.06)	1.01603(0.29)
	Mixed Forest	130.236(3.04)	85.7156(2.00)		1505.66(35.17)	395.881(9.24)	1364.43(31.87)	796.978(18.61)	2.12442(0.04)
	Grassland	118.413(3.06)	37.7777(0.97)	1334.13(34.51)		755.646(19.54)	1143.12(29.57)	474.484(12.27)	2.03205(0.05)
	Developed - High	339.6391(1.19)	102.279(0.33)	3602.09(11.87)	5472.13(18.04)		18158.4(59.86)	2627.9(8.66)	31.035(0.10)
	Developed - Medium	78.6034(0.57)	71.8607(0.52)	1864.68(13.57)	2887.45(21.02)	5150.7(37.50)		3654.5(26.61)	23.9228(0.17)
	Developed - Low	4.0641(0.11)	38.609(1.07)	647.763(18.05)	657.461(18.32)	437.168(12.18)	1802.24(50.32)		0.184732(0.005)
	Developed Open Space	0	0.646562(0.78)	50.43189(61.55)	0	0	18.7503(22.88)	12.0999(14.76)	

Part 4 – Free and Open Source GIS Tools

Free and Open Source?

Free

"…the users have the freedom to run, copy, distribute, study, change and improve the software"
-Richard Stallman



Open Source

- Some licenses are restrictive
  - Can't make a modified version

QGIS

- Free and Open Source GIS software supporting raster, vector, database formats and functions
- Licensed under GNU
- Windows, Mac, Linux, BSD, and Android

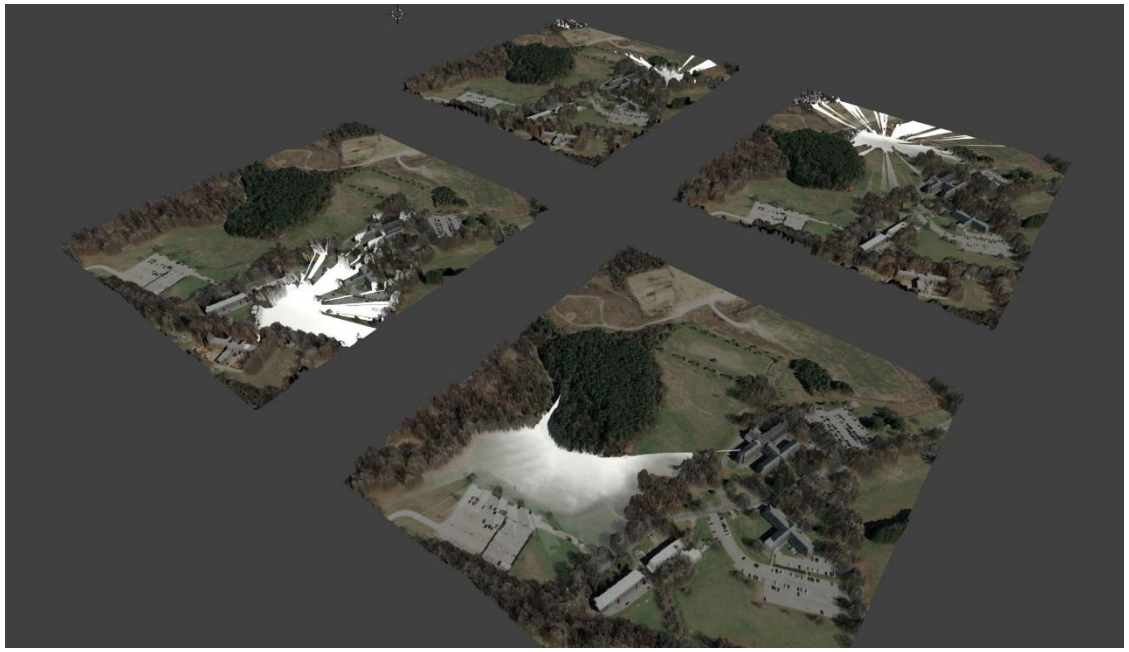
Automating GIS Tasks – GDAL/OGR

- Geospatial Data Abstraction Library – Translating and processing raster and vector data
- GDAL – Raster
- OGR – Vector
- GDAL/OGR: Has both raster and vector tools
- Free and open-source
- Command line interface
- Can translate 142 raster formats and 84 vector formats
- Explore, manipulate, convert data on the fly.
- Check out Sara Safavi and Sasha Hart's workshop: http://slides.sarasafavi.com/gdal/#/

Credit: Sara Safavi and Sasha Hart

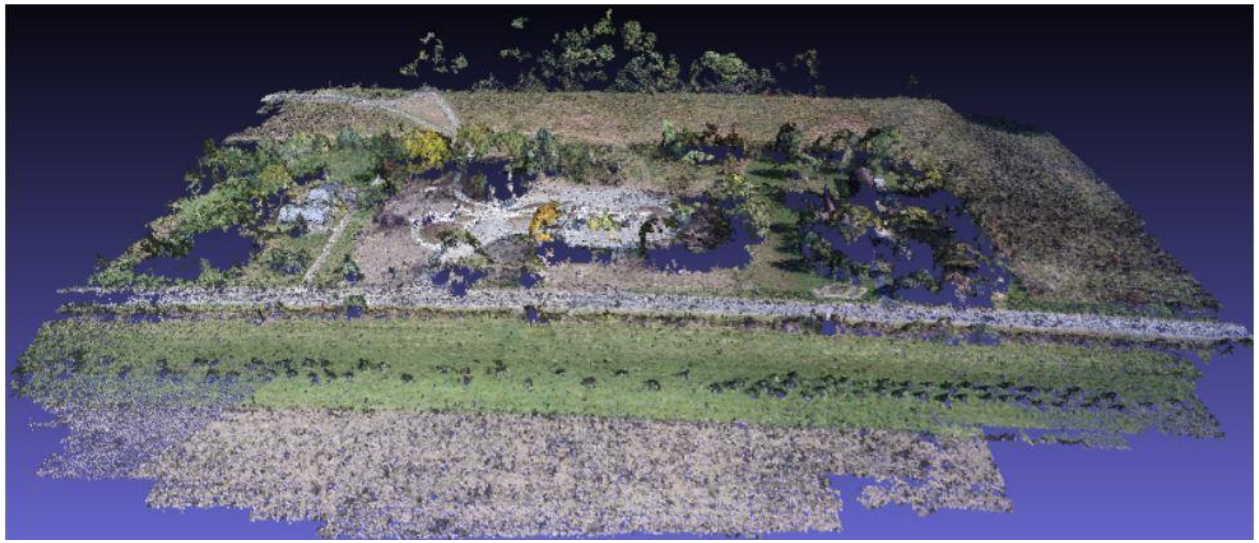
Real-time 3D visualization of geospatial data using Blender

- 3D modeling with a powerful open-source rendering and game engine software
  - Can import various georeferenced data with BlenderGIS addon
  - Almost every operation can be scripted in a Python environment
  - Can publish with Blender4Web or sketchfab addons.
    - Sample geospatial model in Sketchfab



Open Drone Map

- Open source toolkit
- Supports aerial drone image processing
- Can process to:
  - Point clouds
  - DSMs
  - Textured DSMs
  - Orthorectified imagery
  - Classified point clouds
  - DEMs



Recommended Coursework

- Technical Writing
- Maps and Map Making
- All GIS and Remote Sensing classes
- As much math as possible
- Python or R course (tons of free online options)

Questions?