



# Quantifying Producer Error in the Unsupervised Classification of Reservoirs

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# What is Remote Sensing?

- ▶ Remote Sensing can be defined as the collection of information about an object **without being in direct contact** with that object.
- ▶ Information is often collected from **sensors mounted on satellites or airplanes**.

# How Remote Sensing is used to solve Real-World Problems or Opportunities

- ▶ Process **data** to produce **Images**.
- ▶ Process **Images** to produce **Maps**.
- ▶ Use maps to make decisions about the world.
  
- ▶ Different land covers reflect different wavelengths of light.
- ▶ Remote Sensing can be used to identify land cover types.

# Classification

- ▶ A number of factors can influence the accuracy of the classification of remotely sensed images.
- ▶ Analyst bias is one of the factors that could influence the classification.

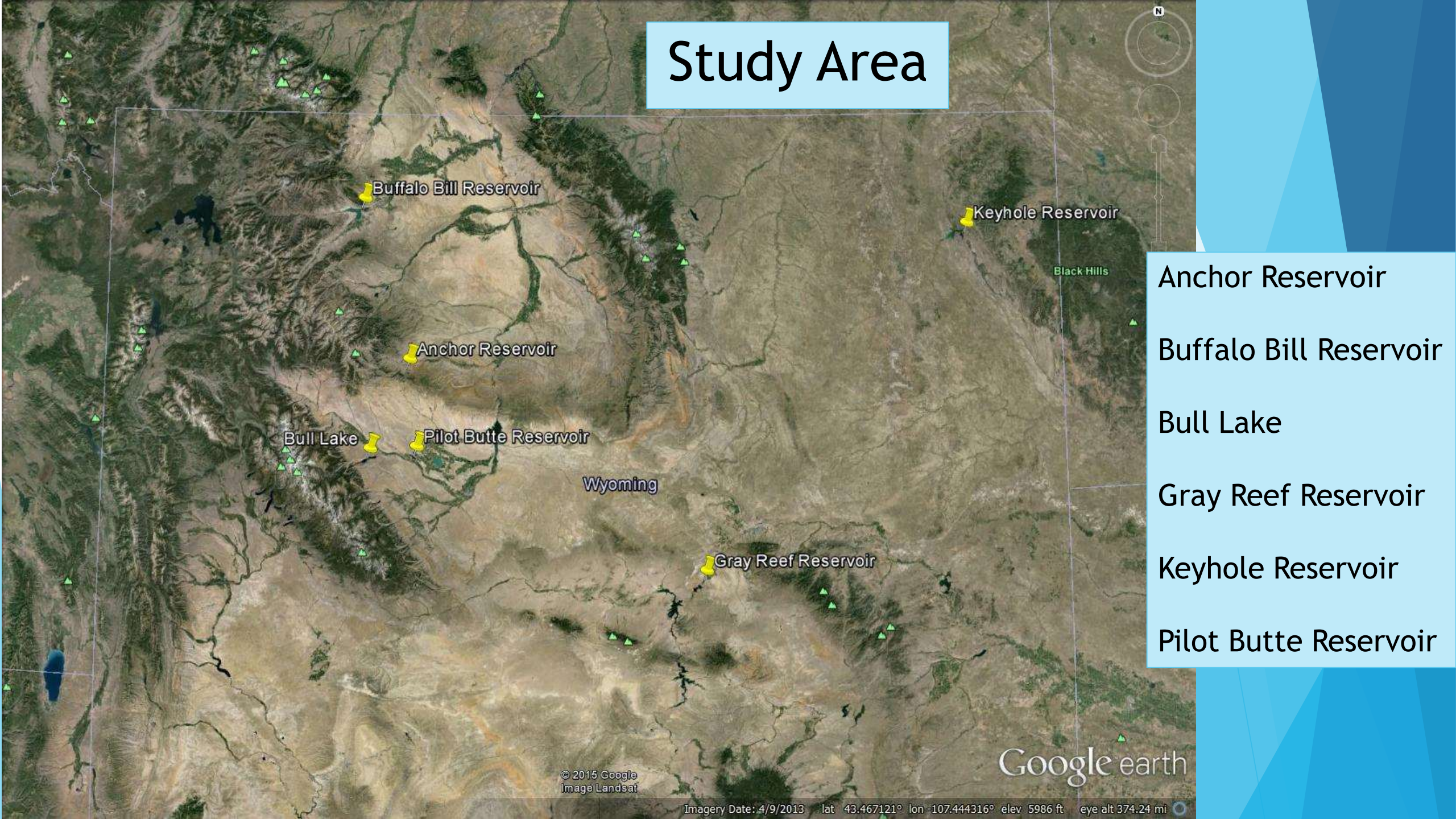
# Objective

- ▶ Quantify the producer error while classifying images.
  - ▶ Four producers independently generated maps from same images.
  - ▶ For six WY reservoirs in five different years.
  - ▶ These maps were compared between producers to determine the amount of agreement or disagreement for an image in a given year.

# Materials and Methods

- ▶ 4 Map Producers
- ▶ 6 Reservoirs
- ▶ Images from 5 Years
  
- ▶ Images were collected by the Landsat 5 Thematic Mapper
- ▶ Images are made available at <http://landsat.usgs.gov>

# Study Area



- Anchor Reservoir
- Buffalo Bill Reservoir
- Bull Lake
- Gray Reef Reservoir
- Keyhole Reservoir
- Pilot Butte Reservoir

Google earth

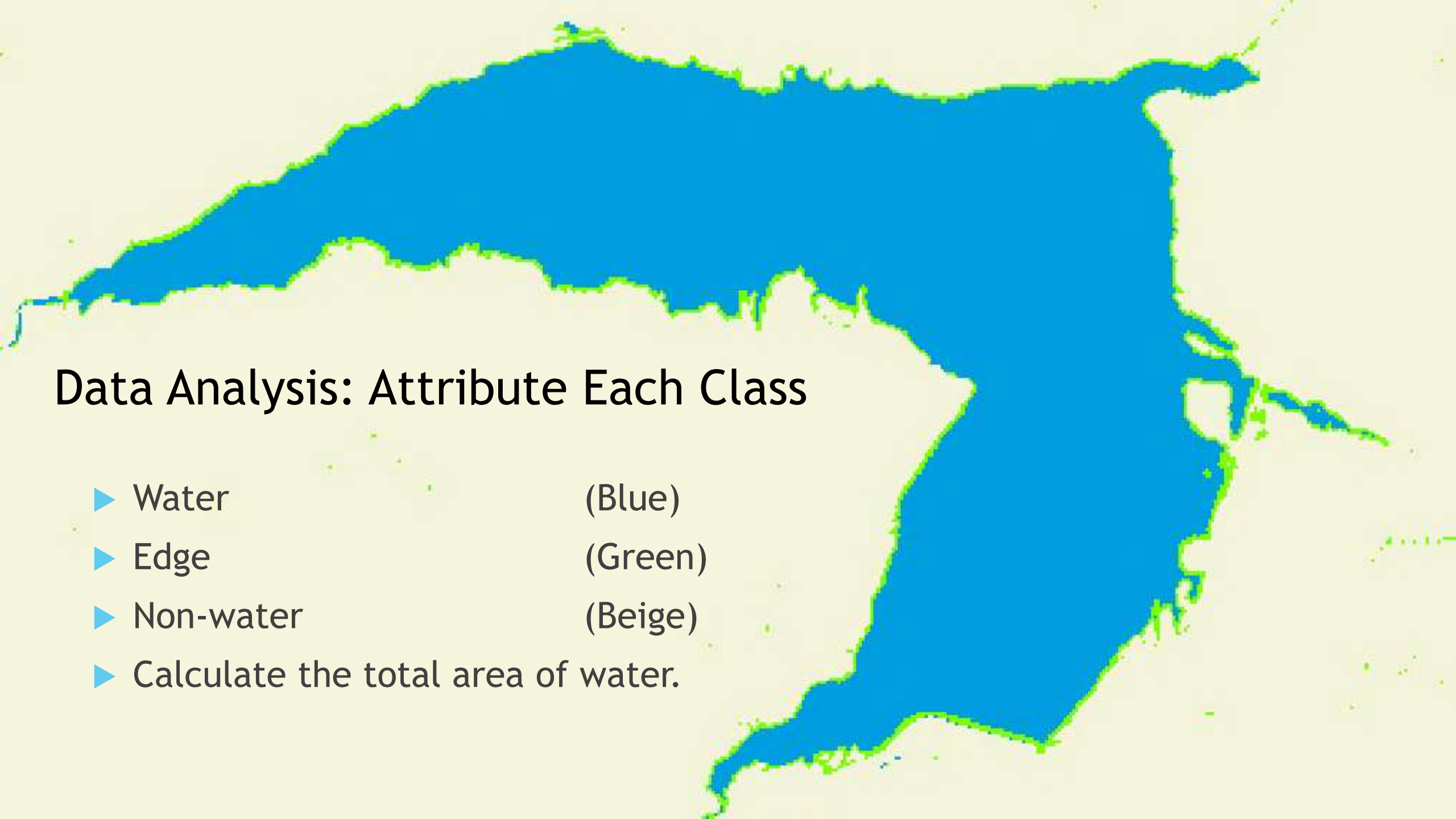
© 2015 Google  
Image Landsat

Imagery Date: 4/9/2013 lat 43.467121° lon -107.444316° elev 5986 ft eye alt 374.24 mi

# Data Analysis

1. Classify each image into 50 clusters using the ISODATA unsupervised classification technique.
2. Attribute each cluster as water or non-water.
3. Each image was attributed by 4 map producers.
4. Each map producer was not aware of the other producers working with the same image. This was a blind-study.
5. Calculate the total area of water for each image.
6. Compare the reservoir's area between different map producers.





## Data Analysis: Attribute Each Class

- ▶ Water (Blue)
- ▶ Edge (Green)
- ▶ Non-water (Beige)
- ▶ Calculate the total area of water.

# Process for Comparing Map Producer Results

Outcome	MP1	MP2	MP3	MP4	Number of Outcomes
All Map Producers Agree	W	W	W	W	1
3/4 Map Producers Agree	W	NW	W	W	4
1/2 Map Producers Agree	W	NW	NW	W	5
1/4 Map Producers Agree	W	NW	NW	NW	4
Total Number of Outcomes					14



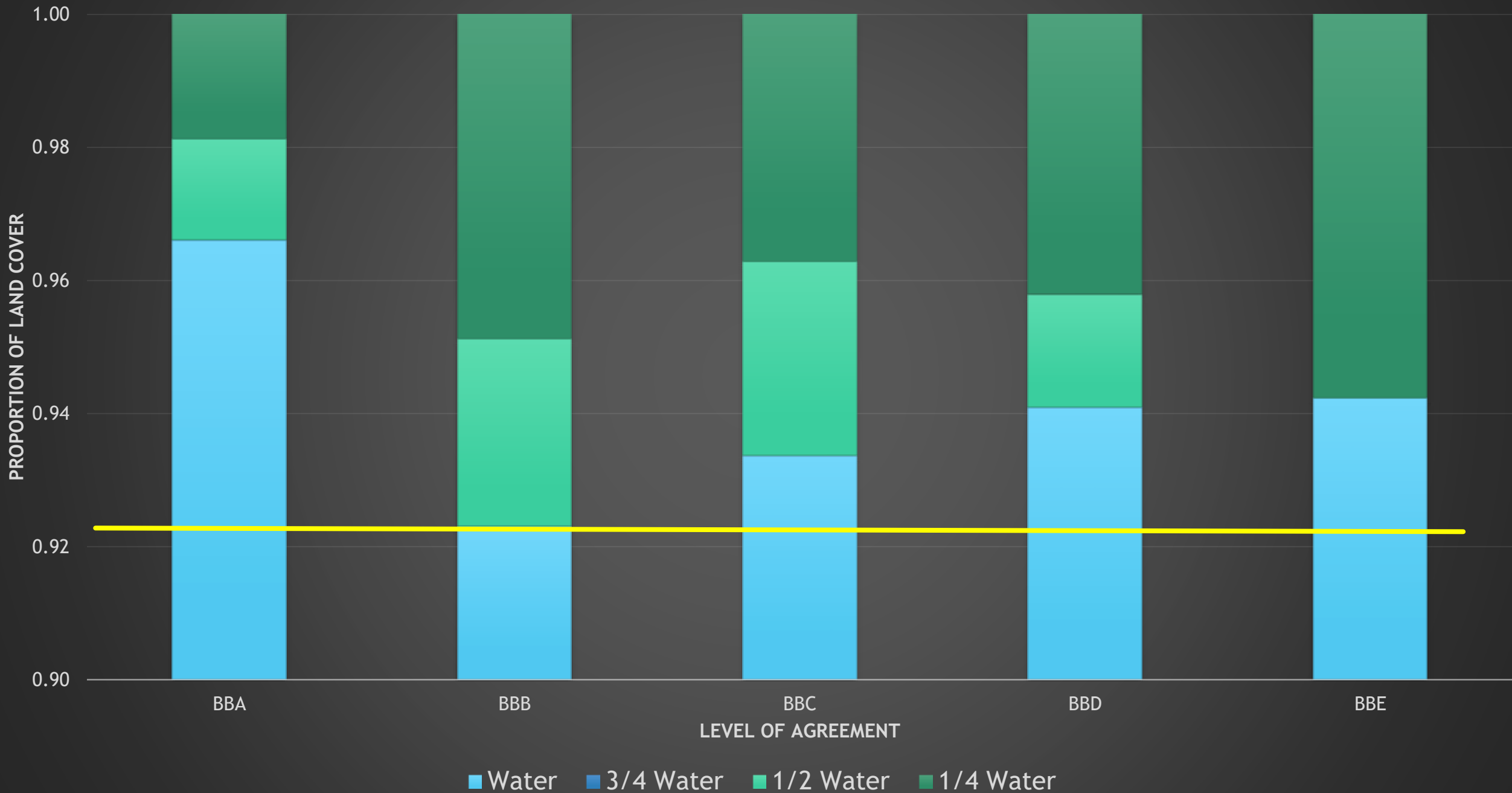
## Results: Highest Agreement

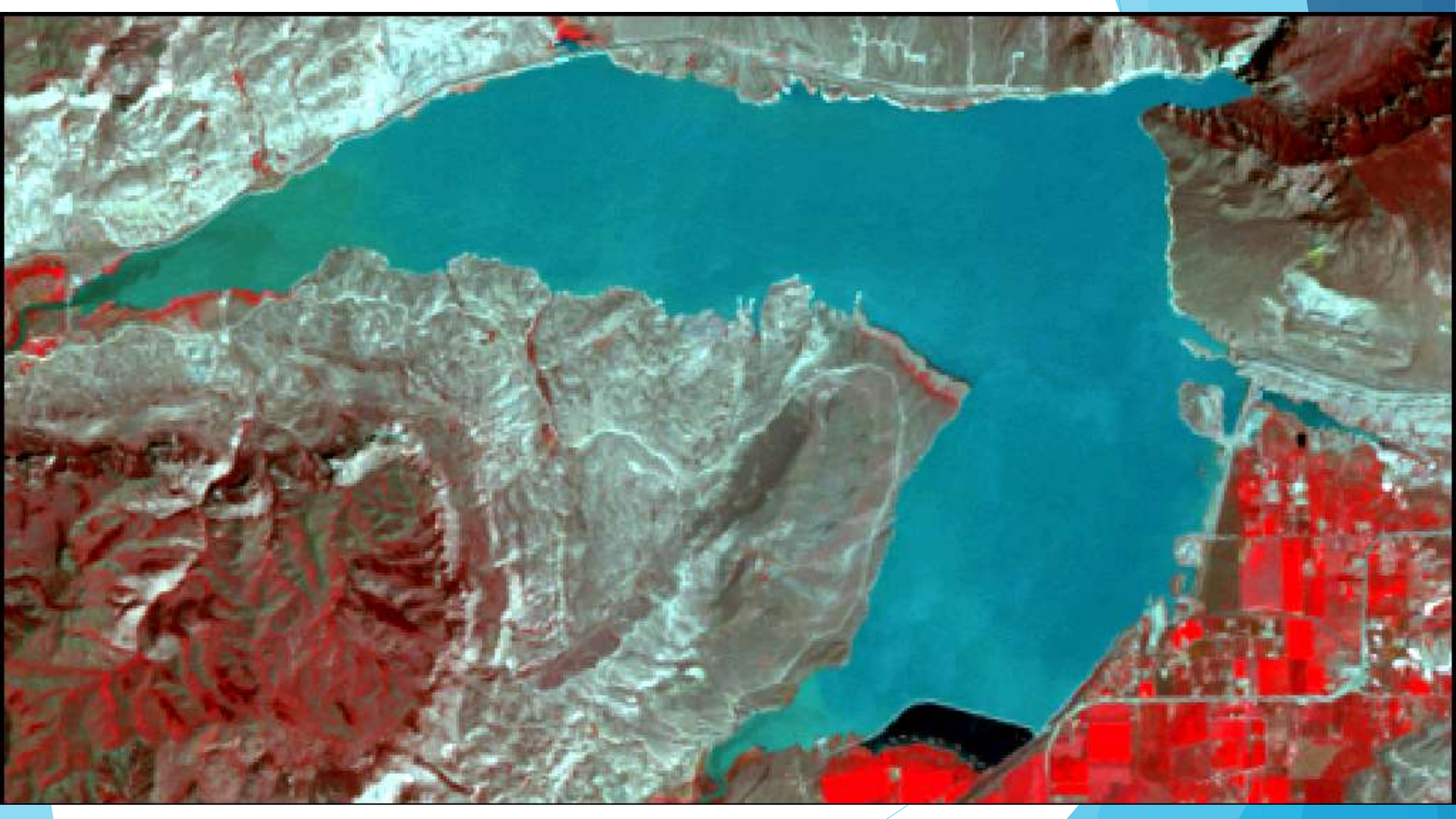
### Levels of Agreement between 4 map producers in the Classification of Buffalo Bill Reservoir in year A (BBA)

- Blue pixels: All 4 map producers agreed.
- Pink pixels: Half the map producers agreed.
- Yellow pixels: One map producer classified as water.

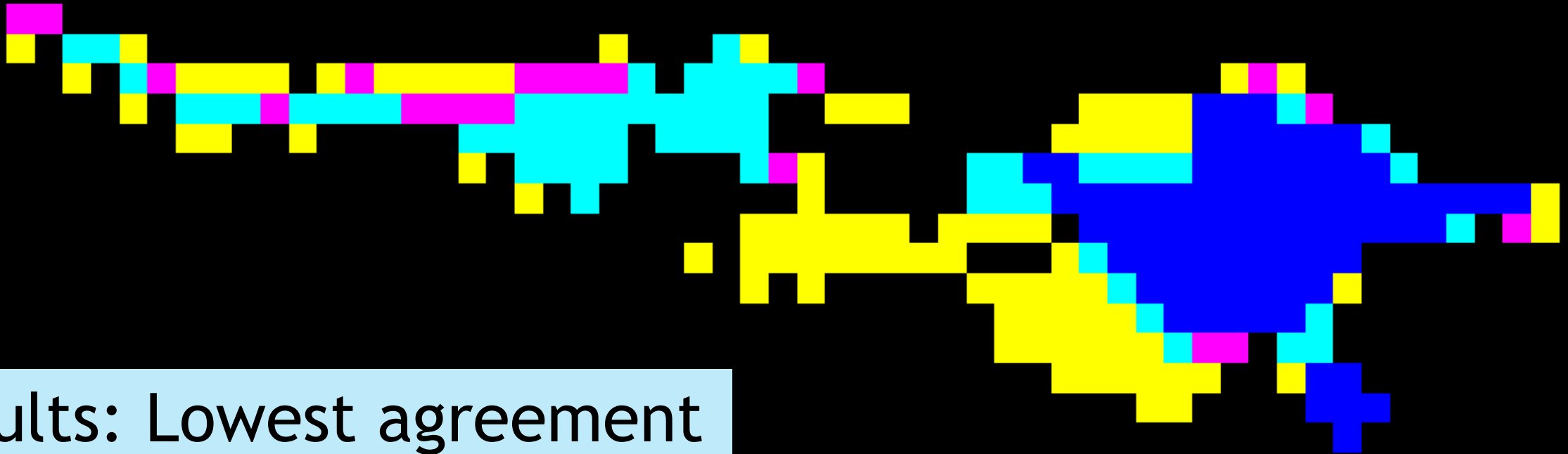
Average Water Area:  
7674 Hectares

# Water Cover Agreement for Buffalo Bill Reservoir





Average water area: 15 Hectares

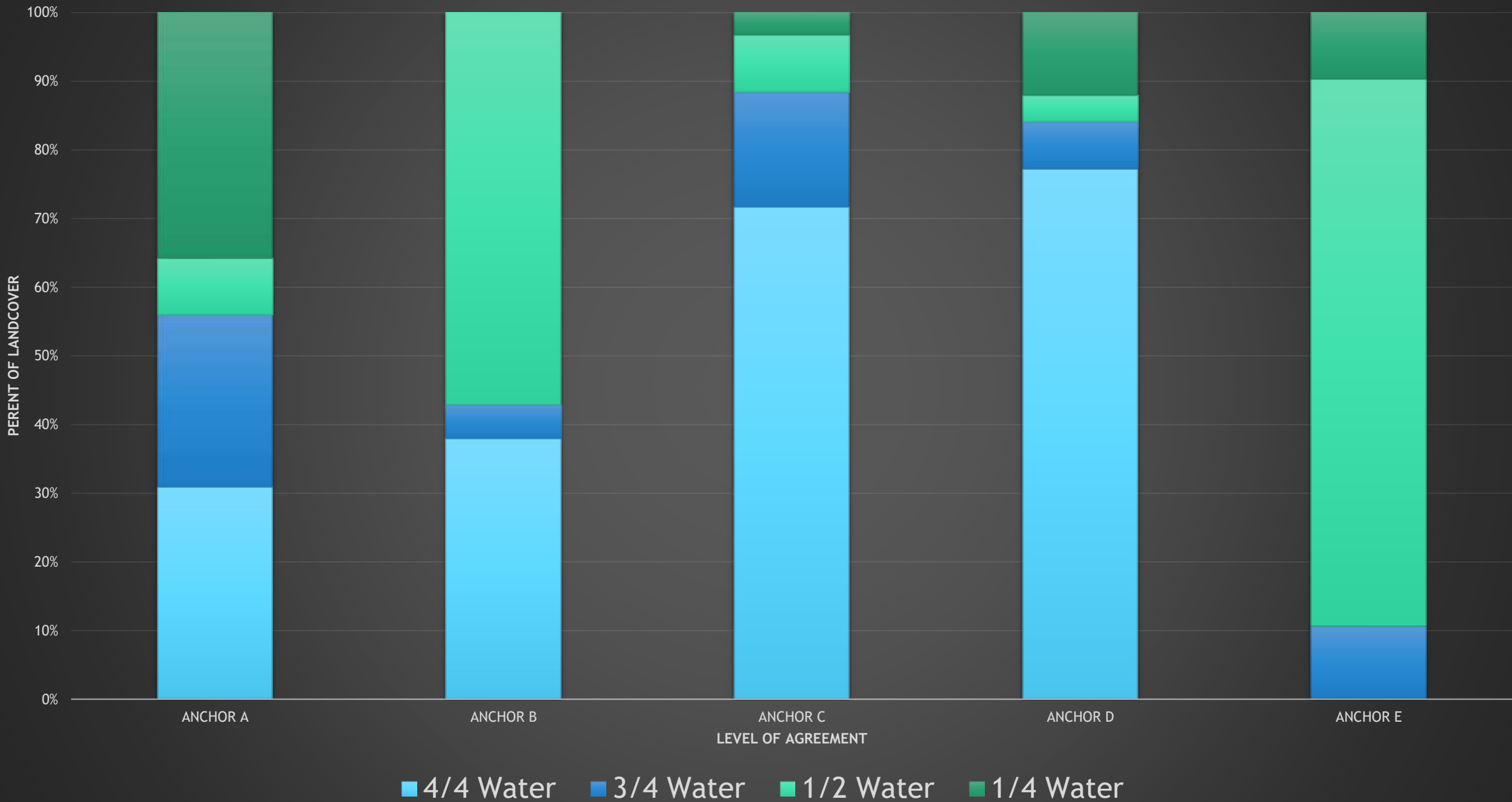


# Results: Lowest agreement

## Levels of Agreement between 4 Map Producers in the Classification of Anchor Reservoir (ARA)

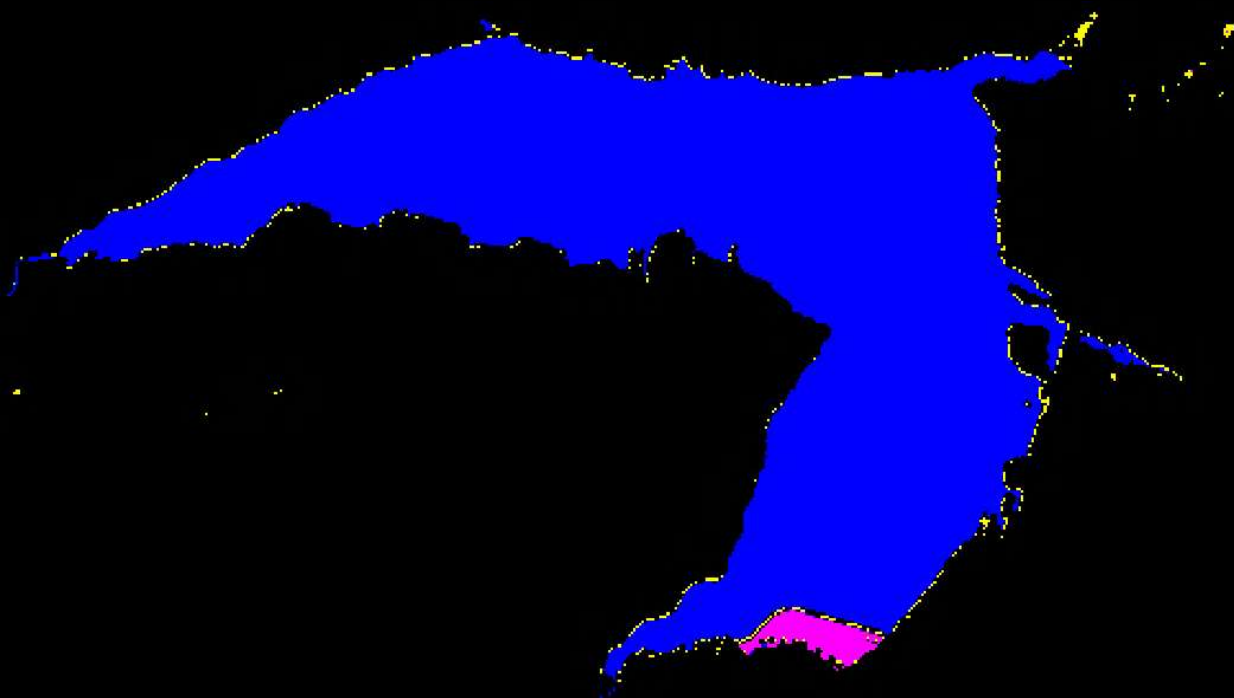
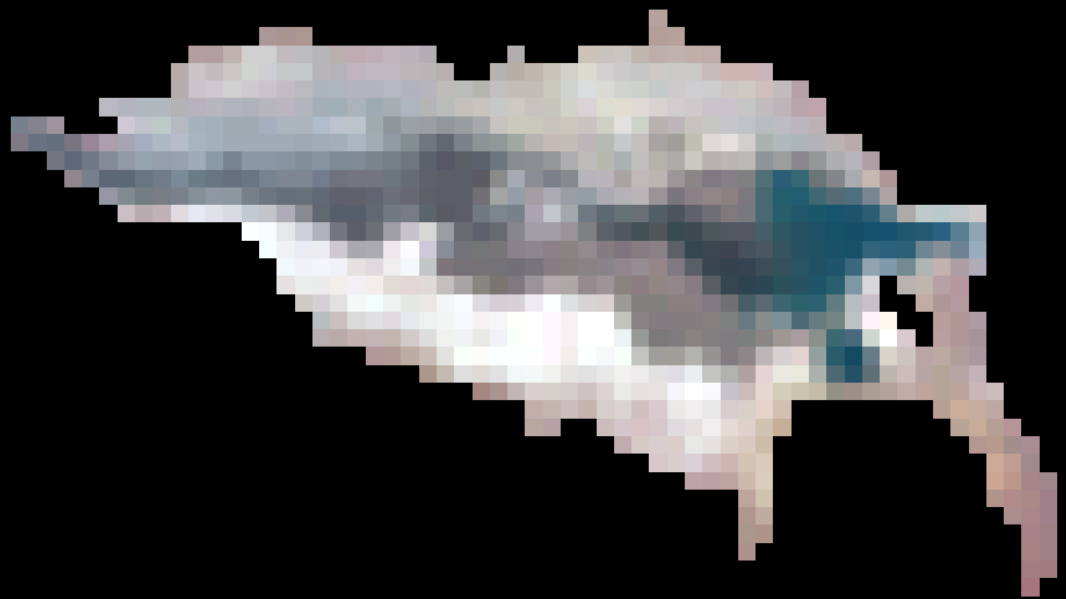
- Blue pixels: All 4 map producers agreed.
- Cyan pixels:  $\frac{3}{4}$  of the map producers agreed.
- Pink pixels: Half the map producers agreed.
- Yellow pixels: One map producer classified as water.

# Water Cover Agreement for AR Reservoir









# Discussion: Sources of Error

- ▶ Reservoir Depth (Shallowness)
- ▶ Wet Sand or Soil
- ▶ Classification of Edges
- ▶ Floating Vegetation
- ▶ Map Producer Expertise

# Discussion: Sources of Agreement

- ▶ Number of Clusters used in the classification of a reservoir (Fewer are better)
- ▶ Reservoir Size and shape
- ▶ Map Producer Expertise

# Conclusions

- ▶ Unsupervised Classification can be applied in many, but not all, circumstances and is dependent on the condition of that reservoir in a given year.
- ▶ Smaller reservoirs with less standing water tend to be more difficult to accurately classify than larger ones.
- ▶ Floating vegetation can significantly decrease the accuracy of Reservoir Classification.

# Acknowledgements



Questions?