Assessing Land Cover Changes in the Chesapeake Bay Area

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Introduction

- Why the Chesapeake Bay Region?
  - America's largest estuary
  - Contains Washington, DC, and Baltimore, two major (and growing) metropolitan areas
  - It's tied closely to Maryland's identity
  - As part of the anthropogenic impact, we have a responsibility to be aware of the changes occuring in this ecosystem.

https://www.chesapeakebay.net/discover/watershed

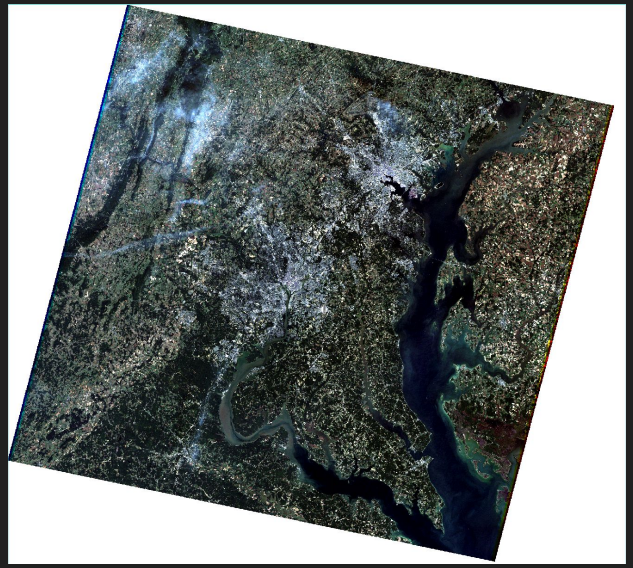
Our Questions

- How has land cover in the Chesapeake Bay area changed over the last 30 years?
- How has the Chesapeake Bay's health changed over the last 30 years?
- Is the Chesapeake Bay region's land cover correlated with the Bay's health?

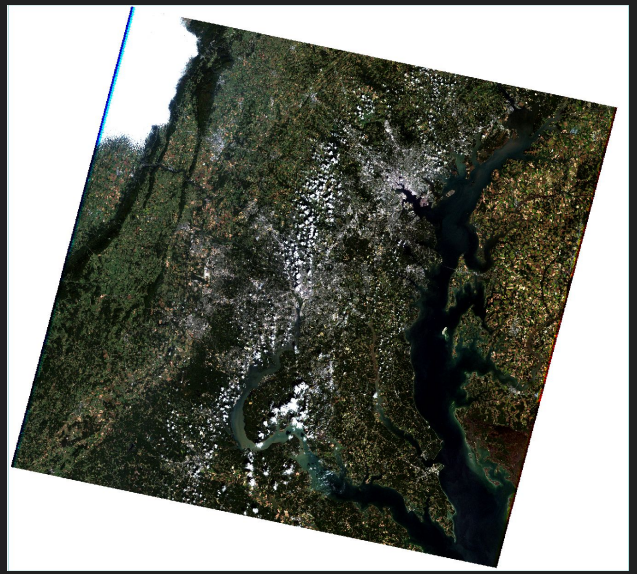
Data Used

- Landsat imagery (30 m spatial resolution, 16-day temporal resolution) of Chesapeake Bay region (WRS Path 15 Row 33)
  - 1985 - Landsat 4-5 (7 spectral bands)
  - 2000 - Landsat 7 (7 bands + 1 panchromatic band)
  - 2015 - Landsat 8 (10 bands + 1 panchromatic band)

Data Used



09 - 15 - 1985



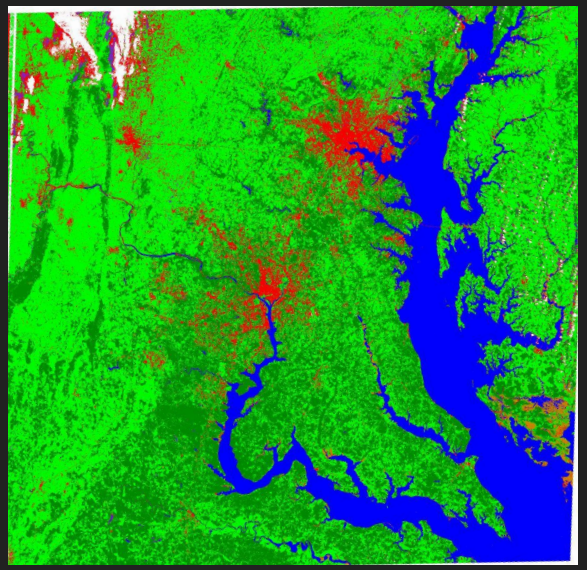
10 - 02 - 2000

08 - 17 - 2015

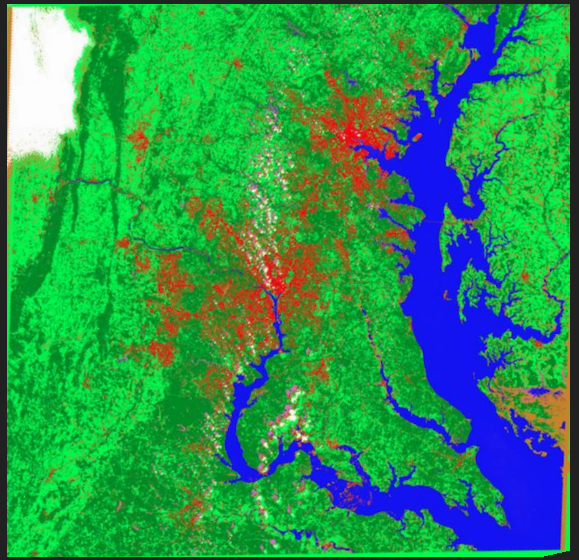
Data Processing Steps / Methods

- Land cover maps
  - Maximum Likelihood Classification with 7 classes
    - Forests
    - Other Vegetation
    - Built Areas
    - Water
    - Wetlands
    - Clouds
    - Cloud Shadows
- Confusion Matrix to determine accuracy of land cover maps
- Calculate percentages of each land cover class for each year and compare to see change over time.

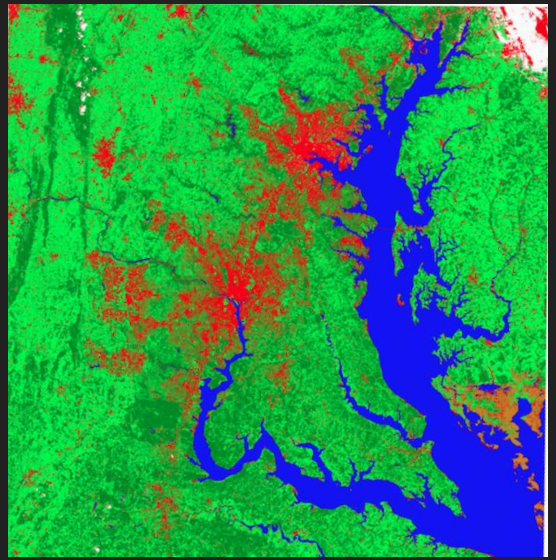
Land Cover Maps



09 - 15 - 1985



10 - 02 - 2000



08 - 17 - 2015

Confusion Matrices - 1985

1985									
0	Forest Ref	Urban Ref	Cloud Ref	Wetland Ref	Water Ref	Other Veg	Cloud Shadow Ref	Map Total	User's Accuracy
Forest Map	4	0	0	0	0	0	0	4	100%
Urban Map	0	0	0	0	0	0	0	0	0
Cloud Map	0	0	0	0	0	0	0	0	0
Wetland Map	0	0	0	0	0	1	0	1	0%
Water Map	0	0	0	0	2	1	0	3	67%
Other Veg Map	2	0	0	0	0	10	0	12	83%
Cloud Shadow Map	0	0	0	0	0	0	0	0	0%
Row total	6	0	0	0	2	12	0	**20**	
Producer's Acc	**67%**	**0**	**0**	**0**	**100%**	**83%**	**0**		
Overall Acc	**80%**								

Commission Error :

Forest - **33%**
Other Vegetation - **17%**

Omission Error:

Water - **33%**
Other Vegetation - **17%**

Confusion Matrices - 2000

2000									
0	Forest Ref	Urban Ref	Cloud Ref	Wetland Ref	Water Ref	Other Veg	Cloud Shadow Ref	Map Total	User's Accuracy
Forest Map	8	0	0	0	0	0	0	8	100%
Urban Map	0	0	0	0	0	0	0	0	0
Cloud Map	0	0	0	0	0	0	0	0	0
Wetland Map	0	0	0	0	0	2	0	2	0%
Water Map	0	0	0	0	2	1	0	3	67%
Other Veg Map	0	0	0	0	0	7	0	7	100%
Cloud Shadow Map	0	0	0	0	0	0	0	0	0
Row total	8	0	0	0	2	10	0	**20**	
Producer's Acc	**100%**	**0**	**0**	**0**	**100%**	**70%**	**0**		
Overall Acc	**85%**								

Commission Error:

Other Vegetation - **30%**

Omission Error:

Water - **33%**

Confusion Matrices - 2015

2015									
0	Forest Ref	Urban Ref	Cloud Ref	Wetland Ref	Water Ref	Other Veg	Cloud Shadow Ref	Map Total	User's Accuracy
Forest Map	4	0	0	0	0	0	0	4	100%
Urban Map	0	0	0	0	0	0	0	0	0
Cloud Map	0	0	0	0	0	0	0	0	0
Wetland Map	0	0	0	0	0	0	0	0	0
Water Map	0	0	0	0	2	1	0	3	67%
Other Veg Map	3	1	0	0	0	9	0	13	69%
Cloud Shadow Map	0	0	0	0	0	0	0	0	0
Row total	7	1	0	0	2	10	0	**20**	
Producer's Acc	**57%**	**0**	**0**	**0**	**100%**	**90%**	**0**		
Overall Acc	**75%**								

Commission Error:

Forest - **43%**
Other Vegetation - **10%**

Omission Error:

Water - **33%**
Other Vegetation - **31%**

Calculating the Percents

1985

Class Summary	Pixel Count
Wetland	395663
Wetland	
Basic Stats	Min
Band 1	3
Histogram	DN
Band 1	3
Binsize=1	

Wetland	395663	1.059%
Other Veg	16798682	44.958%
Water	6045355	16.179%
Forest	11266264	30.152%
Urban	2859247	7.652%
Total:	37365211	100.000%

2000

Class Summary	Pixel Count
Wetlands 2000	4163788
Wetlands 2000	
Basic Stats	Min
Band 1	4
Histogram	DN
Band 1	4
Binsize=1	

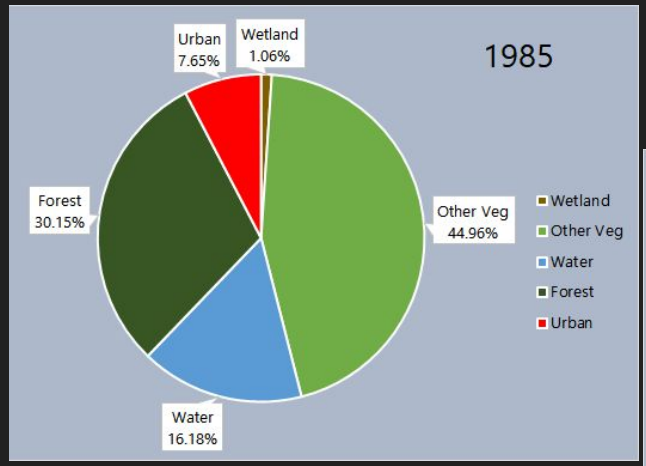
Wetland	4163788	7.341%
Other Veg	31054440	54.747%
Water	5537762	9.763%
Forest	13876828	24.464%
Urban	2090381	3.685%
Total:	56723199	37.912%

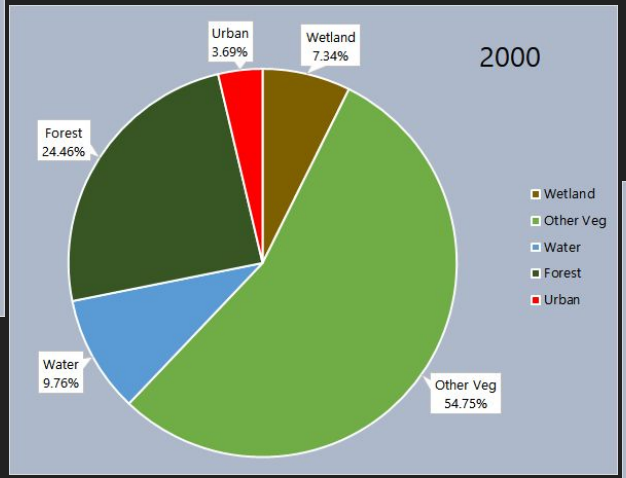
2015

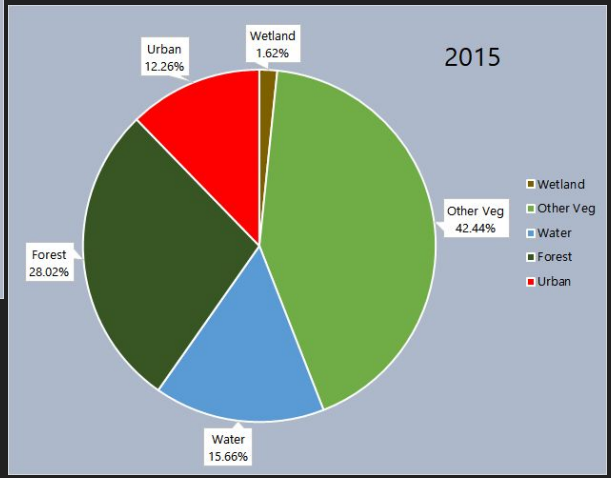
Class Summary	Pixel Count
Wetlands	665922
Wetlands	
Basic Stats	Min
Band 1	1
Histogram	DN
Band 1	1
Binsize=1	

Wetland	665922	1.624%
Other Veg	17404872	42.444%
Water	6420325	15.657%
Forest	11488198	28.016%
Urban	5027241	12.260%
Total:	41006558	100.000%

Percent Change Over Time



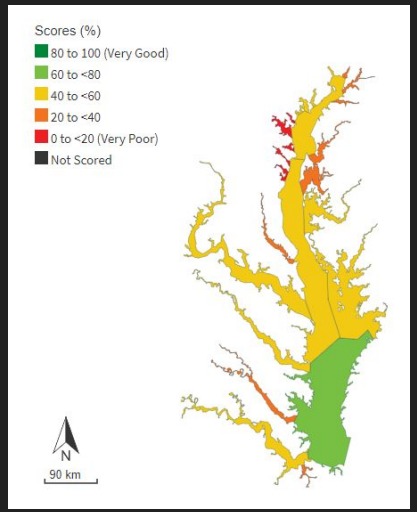




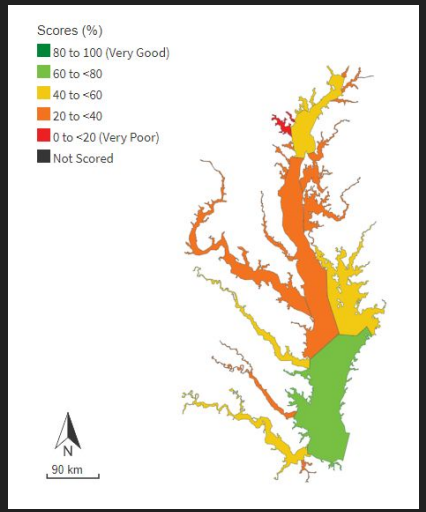
Has the Bay reflected these changes?

- Chesapeake Bay Report Card - compares 11 indicators of health combined into percent score

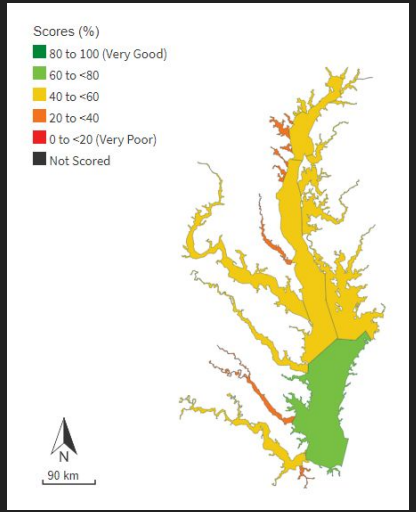
1986 - 48%



2000 - 44%

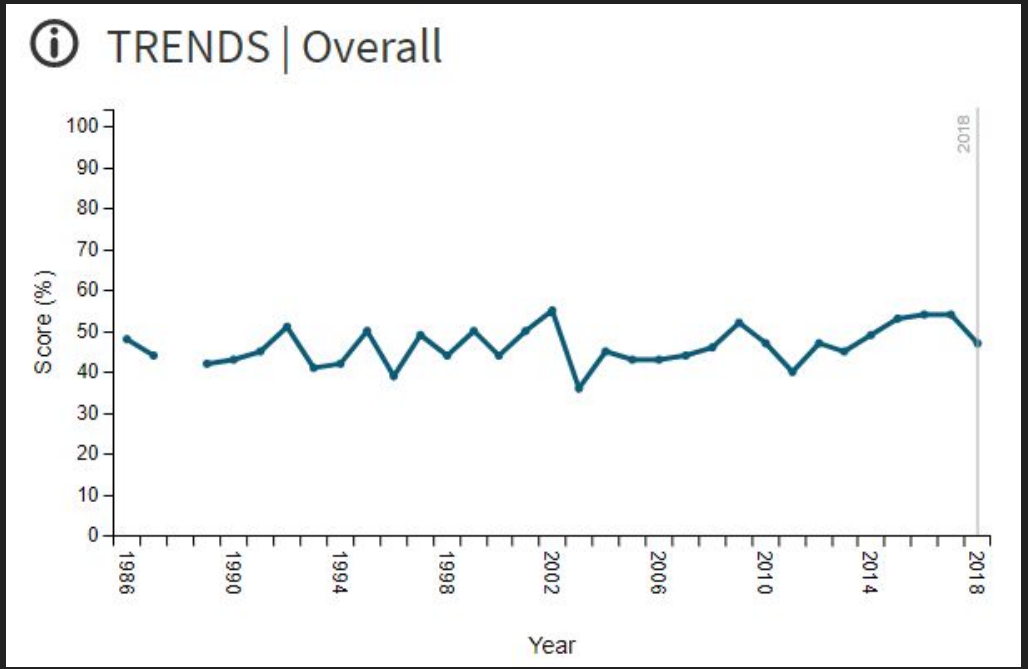


2015 - 53%



Has the Bay reflected these changes?

- Chesapeake Bay Report Card scores have fluctuated
- Some trends over certain years, but no apparent trends overall



Conclusions

- How has land cover in the Chesapeake Bay area changed over the last 30 years?
  - Increased urbanization, deforestation and increased agriculture
- How has the Chesapeake Bay's health changed over the last 30 years?
  - It has fluctuated, most likely influenced by policy, change in land cover, and natural reasons
- Is the Chesapeake Bay region's land cover correlated with the Bay's health?
  - There are many factors that affect the Bay's health
  - Land cover is definitely one of those factors

In Review...

- Land Cover Maps
  - Cloud Mask
- Confusion Matrix
  - More random points in reference layer that covered all of our classes
- More Focused Topic
  - Changed topic at last minute because of problems with original proposal

References

Claggett, Peter. Irani, Frederick. Thompson, Renee. *Methods for Estimating Past, Present, and Future Developed Land Uses in the Chesapeake Bay Watershed.* U.S. Geological Survey.

Robinson, Caleb. et. al. *Large Scale High-Resolution Land Cover Mapping with Multi-Resolution Data.* https://www.cais.usc.edu/wp-content/uploads/2019/04/cvpr2019-land-cover-mapping.pdf