Area Impact Assessment of Sea-level Rise on Wetlands of the Oregon Coast and the Salmon River Estuary

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As sea levels are projected to rise at an accelerated rate in the 21st century coastal managers are increasingly questioning whether estuarine wetlands are able to maintain their elevation with respect to rising water levels. The purpose of this study was to calculate the submersion area (mi^2) of estuarine and marine wetlands and freshwater emergent wetlands of the Salmon River Estuary Wetland and the entire Oregon's coast using a GIS bathtub modelling approach. This study used 10m digital elevation models (DEM) of western Oregon to calculate the submersion area with projected sea-level rises of 0.75 ft. by 2030, 1.6 ft. by 2050, and 4.6 ft. by 2100. Results showed that over double the area of wetlands along the Oregon coast would be submerged by 2075. Limitations to this study showed that for large-scale study cites, high resolution DEMs are needed to for accurate calculations. At the Salmon River Estuary scale a 10m DEM could only provide a 3 ft. SLR projection. Environmental management and planning for sea-level rise should be directed towards facilitating wetland adaptation by promoting tidal exchange to saltmarsh and providing land for wetland migration.

Key words: sea-level rise, coastal wetlands, GIS, digital elevation models, environmental management

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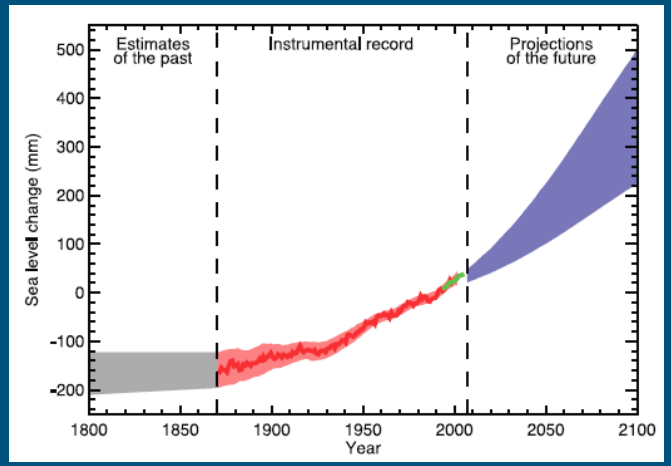
Introduction

Sea Level Rise (SLR) is regarded as the most certain consequence of global warming

SLR has serious physical impacts on coastal areas, mainly characterized by inundation risk and displacement of lowlands and wetlands



Introduction

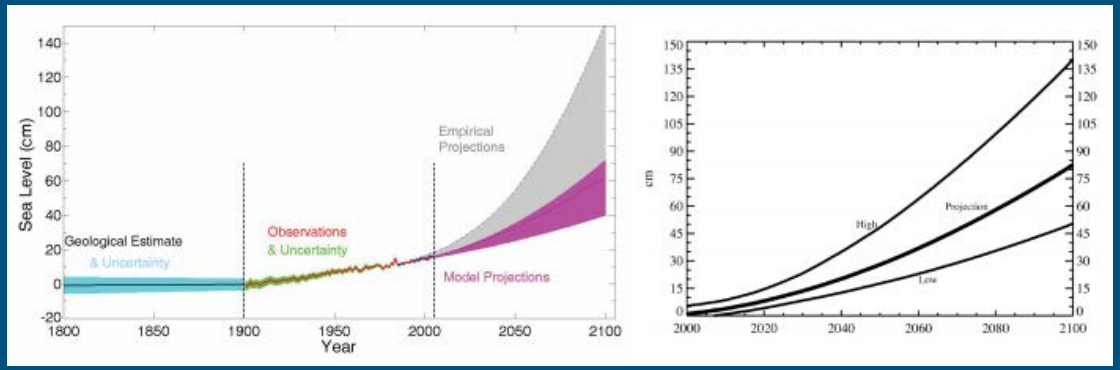
According to the National Research Council

SLR Projections for Oregon

2030 - 0.75 feet

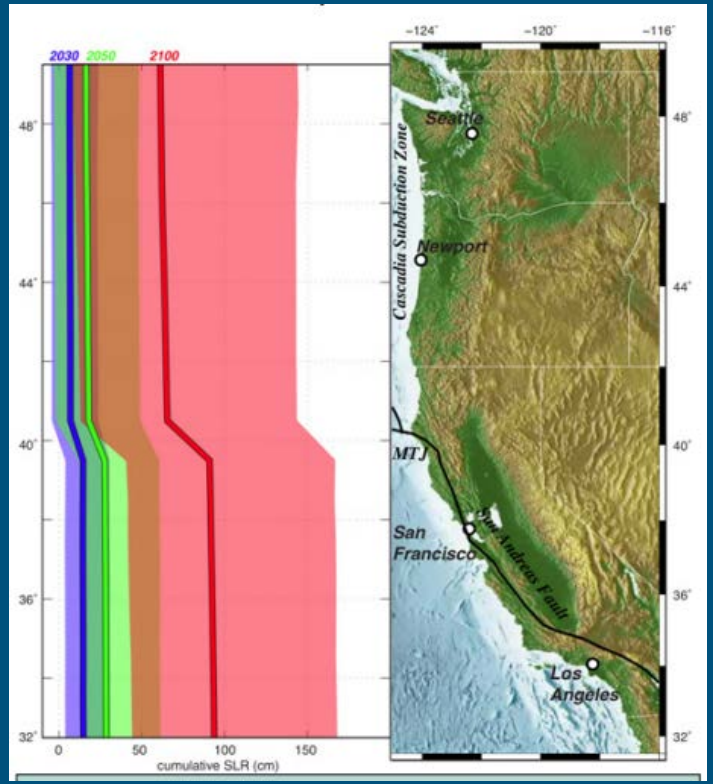
2050 - 1.6 feet

2100 - 4.6 feet



Purpose

The purpose of this study was to assess the total area of wetlands that will be at risk of submersion for 2030, 2050, and 2100 using GIS digital terrain analysis.



http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/sea-level-rise-brief-final.pdf

Methods

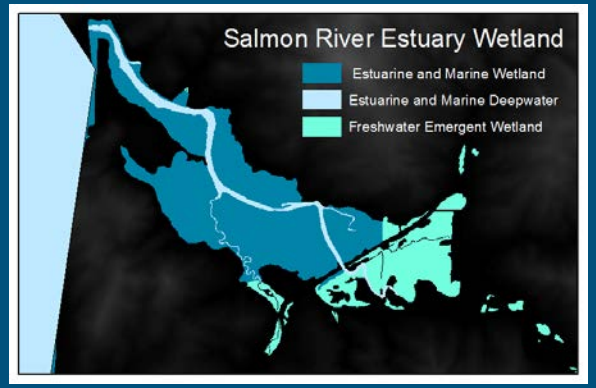
Study Area: Oregon Coast

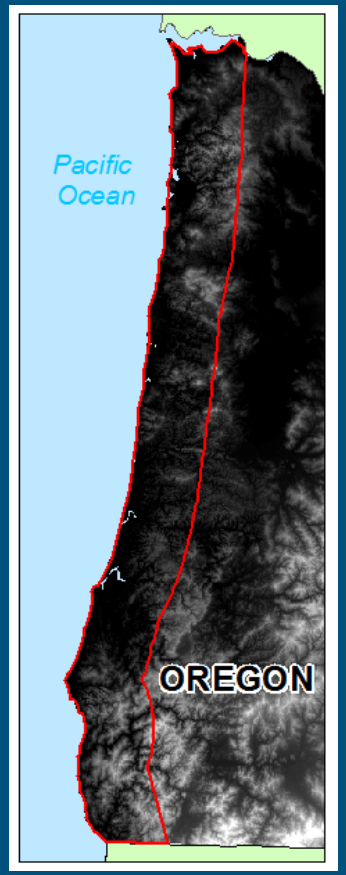
- Washington to California
- 25 miles inland

Wetlands

- Estuarine and Marine Wetlands
- Freshwater Emergent Wetlands

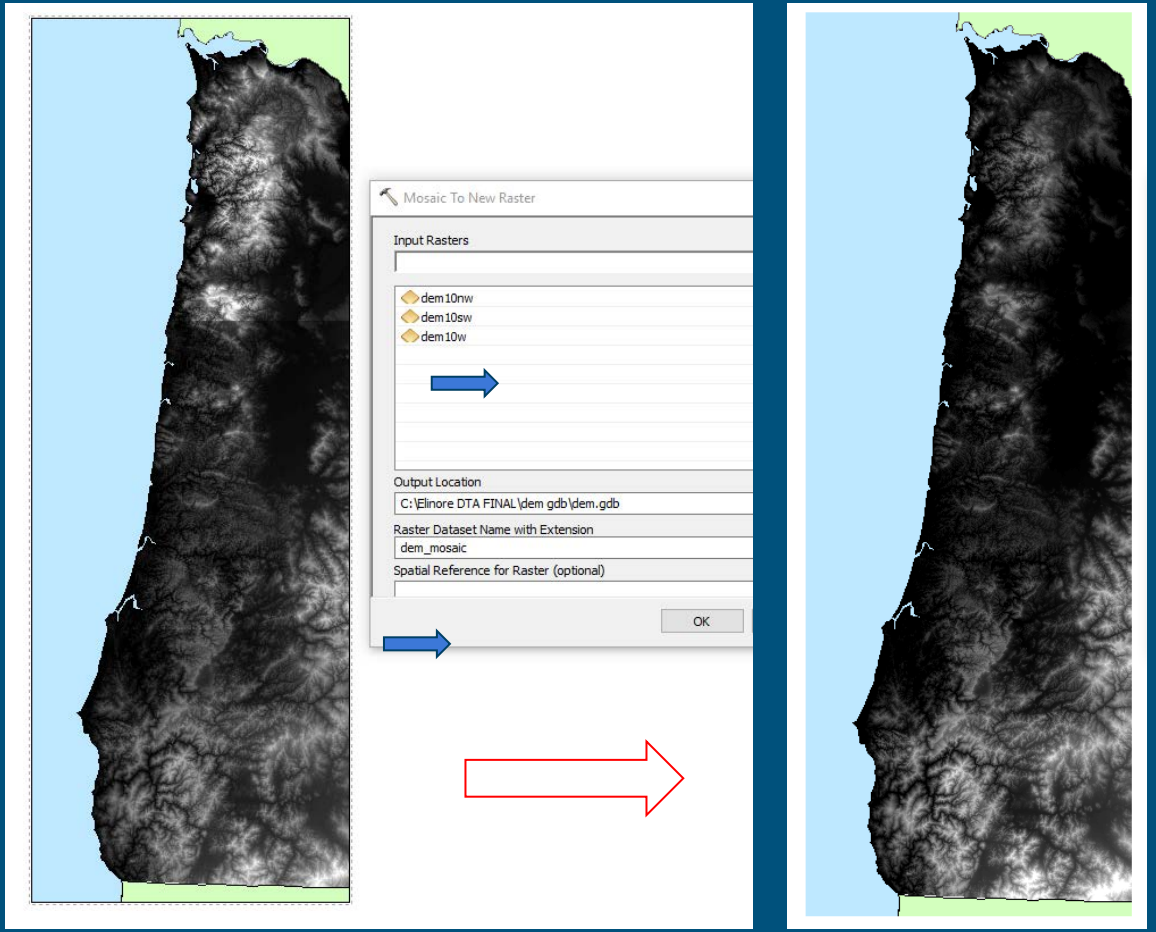
Study Cite: Salmon River Estuary Wetland





Methods

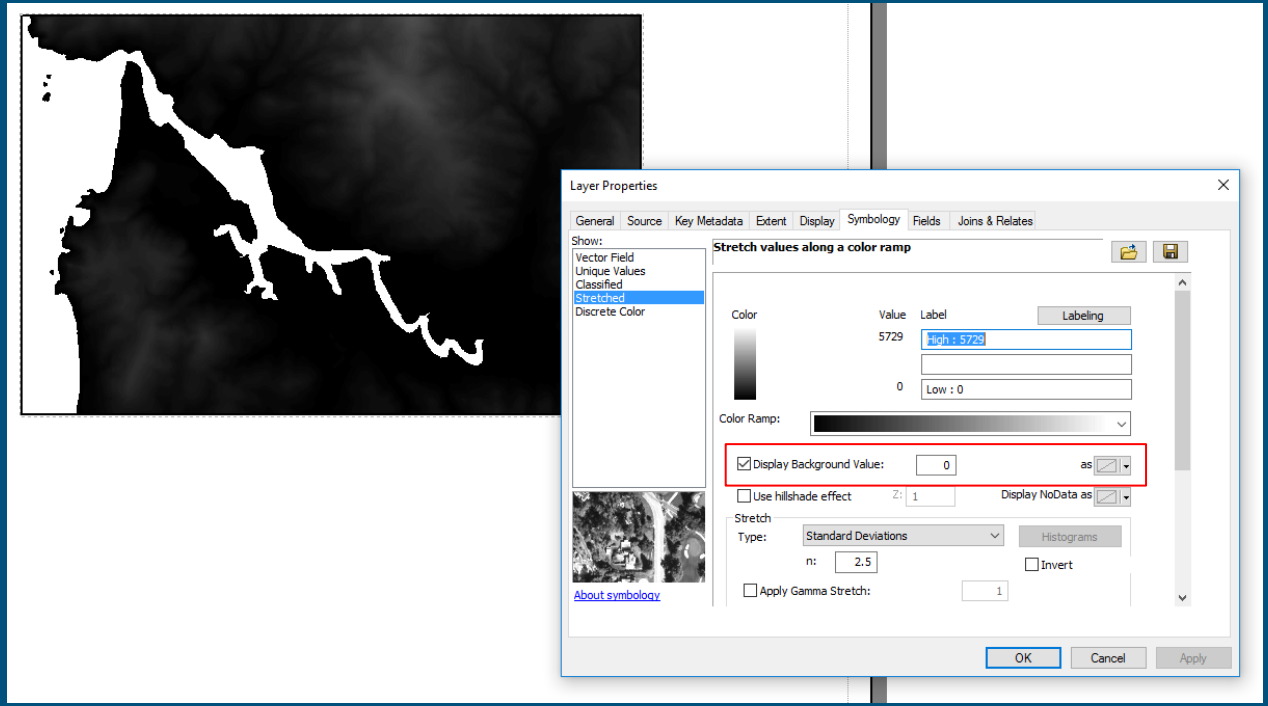
Stitched together 3 the DEMs of Western Oregon with the Mosaic to New Raster Tool



Methods

Set 0 elevation values to No Color

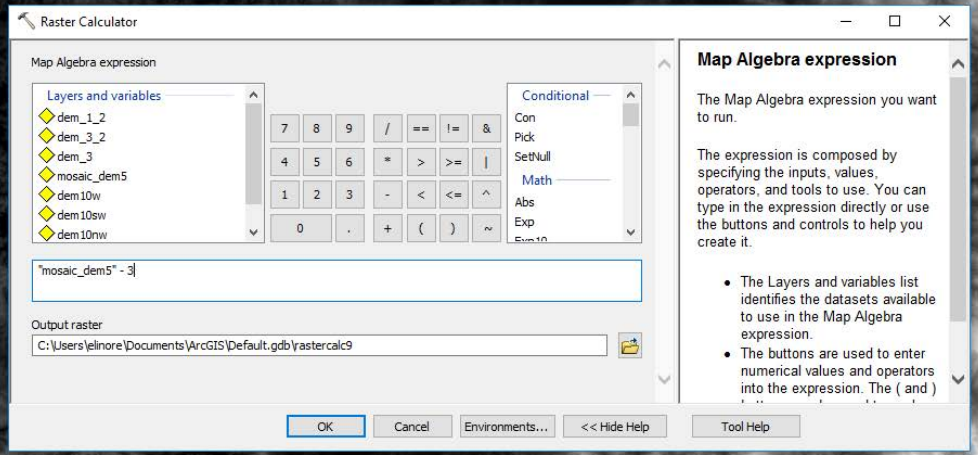
Shows current Mean Sea Level



Methods

Ran Raster Calculator Tool to subtract DEM by 3ft (1m)

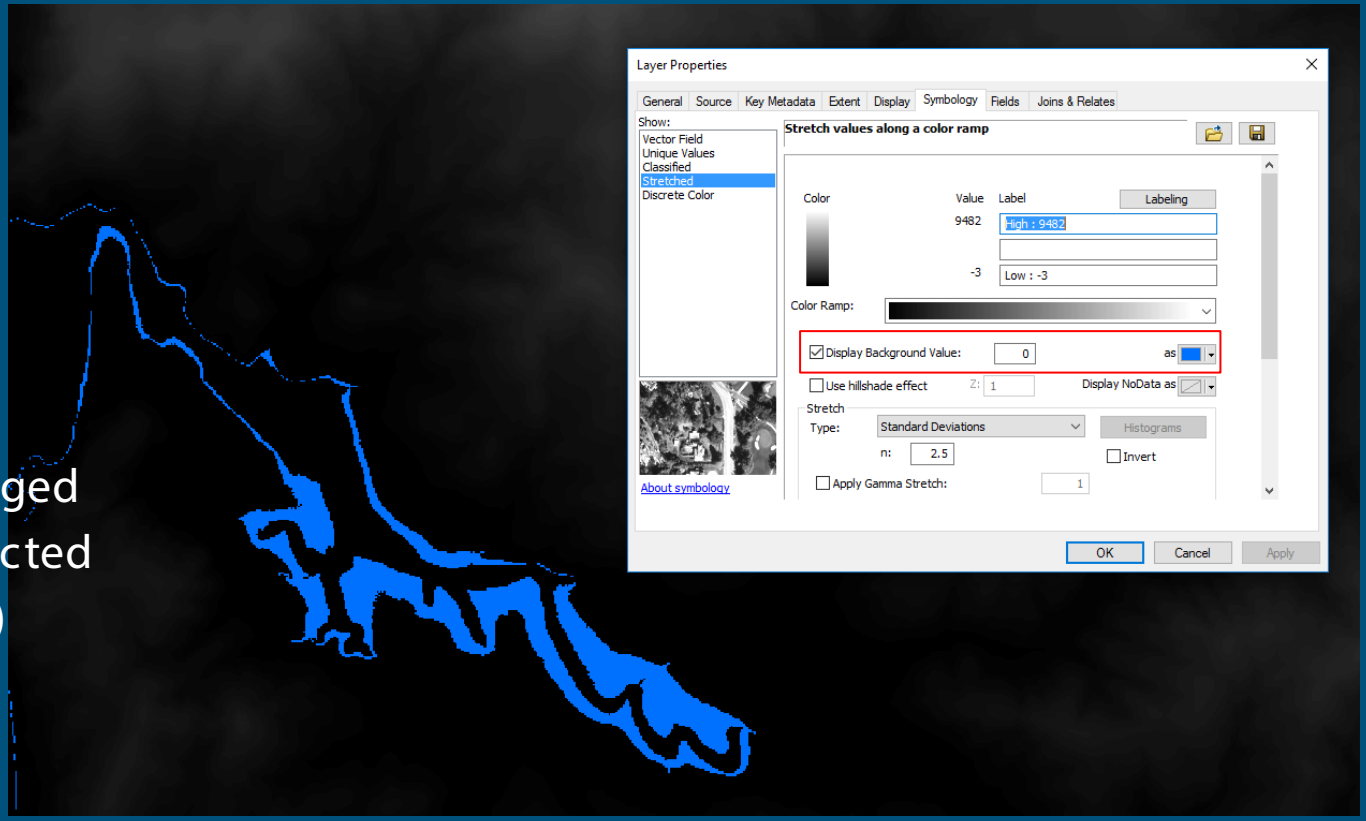
Emulating an increase in MSL



Methods

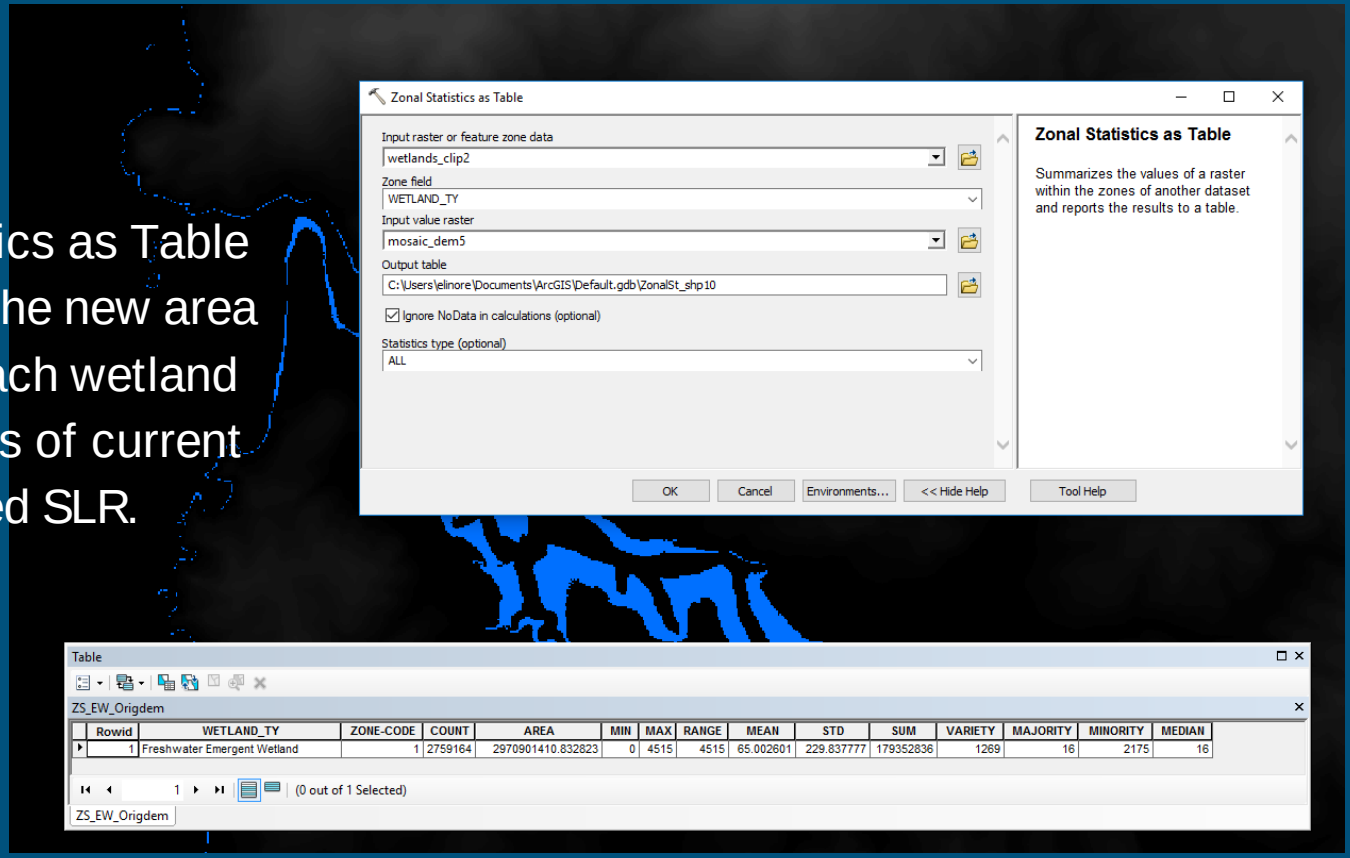
Set 0 elevation values to blue

Shows submerged area with projected SLR of 3ft (1m)



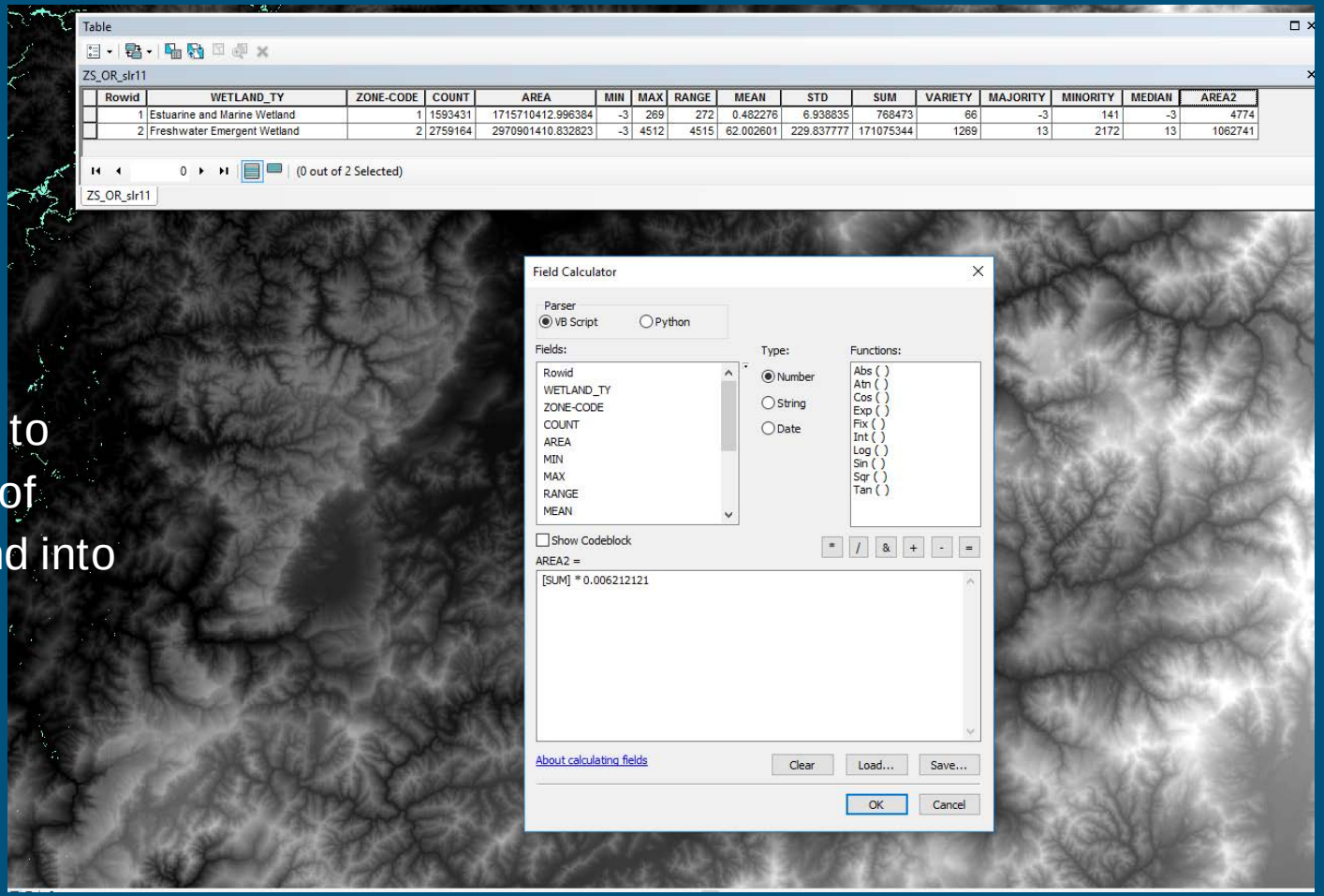
Methods

Ran Zonal Statistics as Table tool to calculate the new area underwater for each wetland type and the dems of current MSL and projected SLR.



Methods

Used Field Calculator tool to calculate area of submerged land into square miles



Results for All Oregon Coastal Wetlands

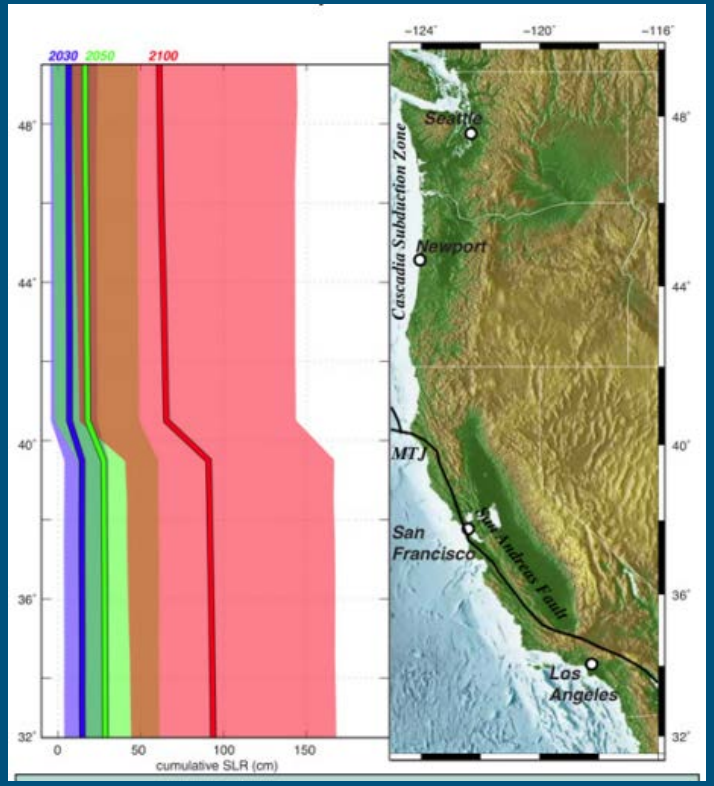
Current Conditions	Wetland Type	COUNT	MIN elevation (ft)	MAX elevation (ft)	MEAN elevation (ft)	AREA (mi^2)	Total Area (mi^2) submerged
	Estuarine and Marine Wetland	1593431	0	272	3.482276	25,281	
	Freshwater Emergent Wetland	2759164	0	4515	65.0026	76,176	
Projected Conditions	Estuarine and Marine Wetland	1593431	-3	269	0.482276	88,209	62,928
	Freshwater Emergent Wetland	2759164	-3	4512	62.0026	264,196	188,020

Results for Salmon River Estuary Wetland

	WETLAND TYPE	MIN elevation (ft)	MAX elevation (ft)	MEAN eleveation (ft)	STD	SUM	AREA (sq mi)	PERCENT OF NEW AREA SUBMERGED
Current Conditions	Estuarine and Marine Wetland	0	66	6.313763	6.221859	188952	1225	
	Freshwater Emergent Wetland	0	98	15.026313	12.06912	152472	784	
Projected Conditions	Estuarine and Marine Wetland	-3	63	3.313763	6.221859	99171	324	26.45%
	Freshwater Emergent Wetland	-3	95	12.026313	12.06912	122031	529	67.47%

Discussion

Over double of Oregon's current area considered Estuary and Marine Wetlands and Freshwater Emergent Wetlands will be submerged by roughly 2075.



http://dels.nas.edu/resources/static-assets/materials-based-on-reports/reports-in-brief/sea-level-rise-brief-final.pdf

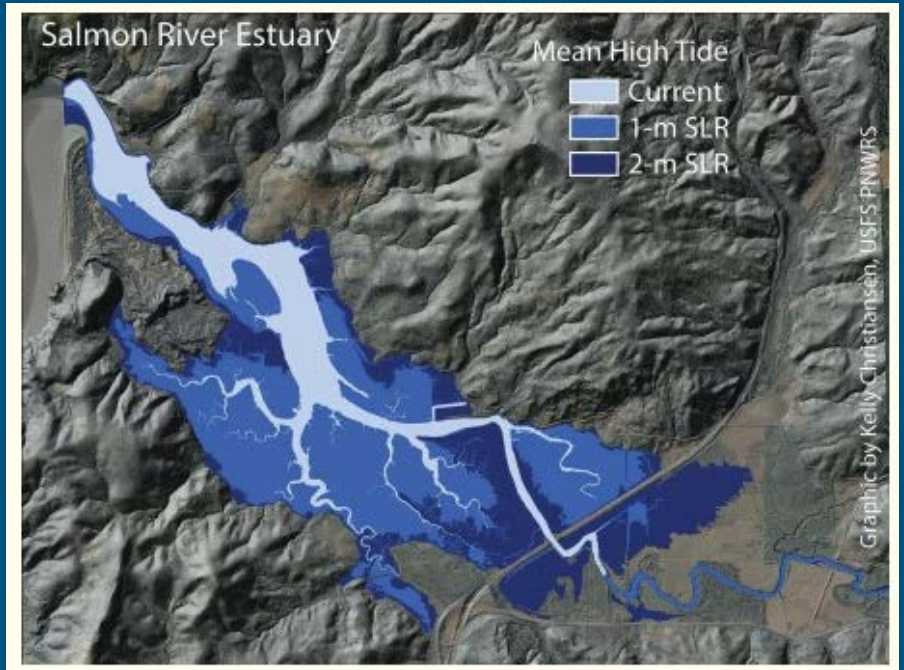
Discussion

Limitations and Further Directions:

Too large of a resolution DEM for large scale analysis.

Small elevation changes (under 5ft) need a finer resolution DEM.

Calculations for SLR projections other than 1m were unsuccessful and inconclusive because of the limitations listed above.



Mapped elevations that can inform predictions of sea-level rise at the Salmon River Estuary, Oregon. Rebecca Flitcroft, USDA Forest Service

http://www.fs.fed.us/research/highlights/highlights_display.php?in_high_id=670

Conclusion

Sea-level rise will flood currently productive salt-marsh habitats, with limited potential for these habitats to shift upstream or into floodplains.

Need more wetland mapping to provide environmental managers with data to help protect wetlands and mitigate SLR.

Environmental management and planning for sea-level rise should be directed towards facilitating wetland adaptation by promoting tidal exchange to saltmarsh and providing land for wetland migration.

Works Cited

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