



IMPACTS OF CLIMATE CHANGE AND SEA-LEVEL RISE ON SOUTHEAST FLORIDA'S GROUNDWATER RESOURCES: PRELIMINARY RESULTS

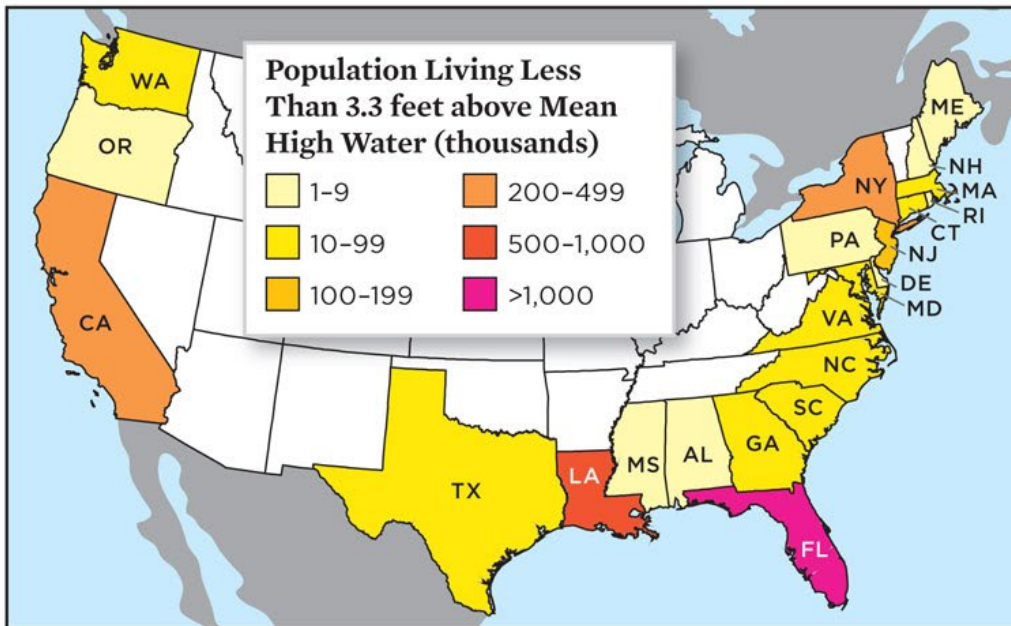
Young Gu Her, Assistant Professor

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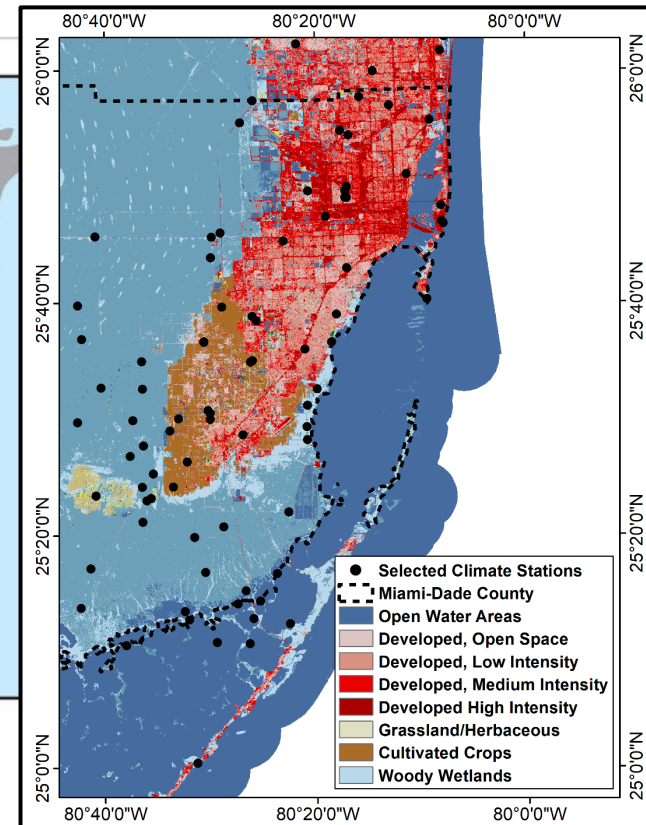
Groundwater Dynamic Modeling

□ Sea level rise In Florida

FIGURE 2. Coastal States at Risk from Global Sea Level Rise

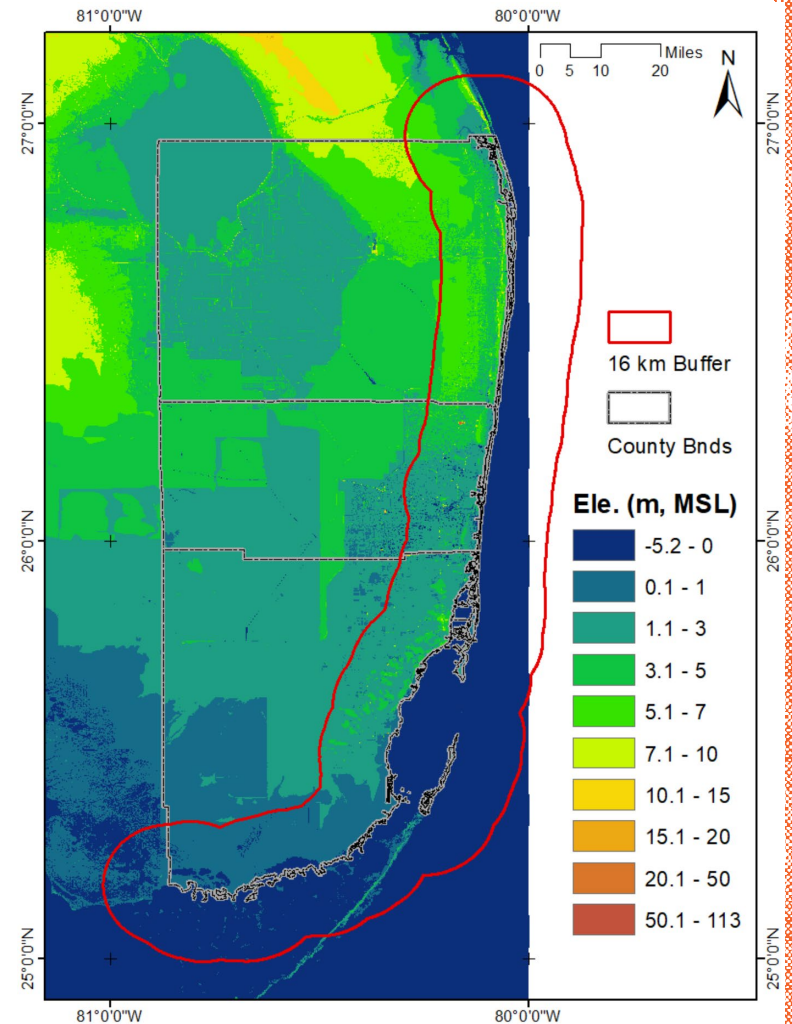
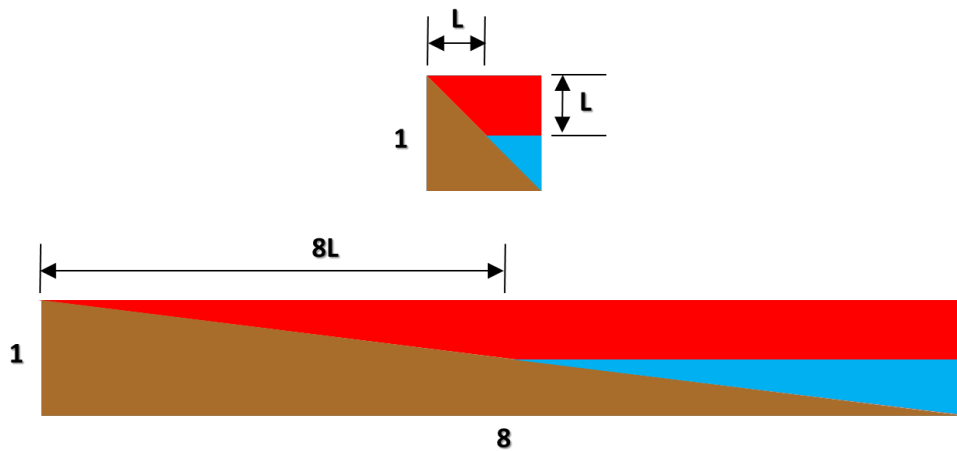


Strauss, B.H., Ziemiński, R., Weiss, J.L. and Overpeck, J.T., 2012. Tidally adjusted estimates of topographic vulnerability to sea level rise and flooding for the contiguous United States. *Environmental Research Letters*, 7(1), p.014033.



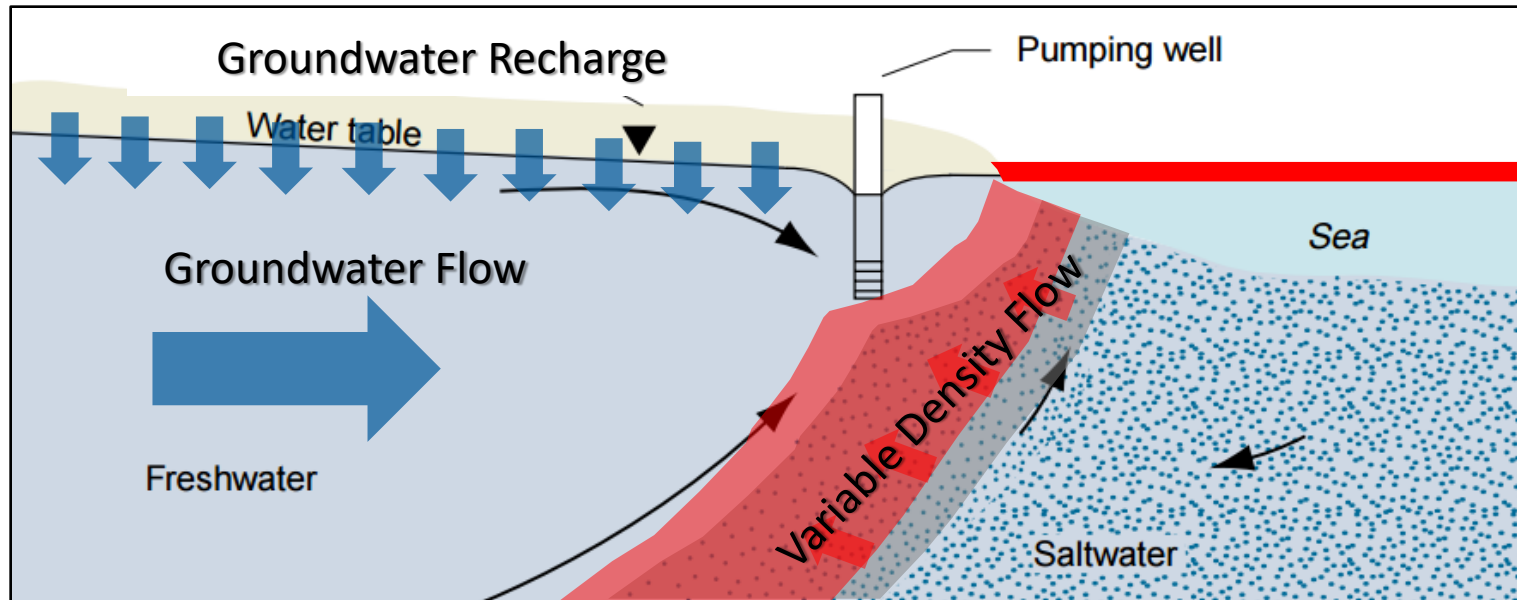
Groundwater Dynamic Modeling

- ❑ 4.8 M within 16 km
- ❑ 2.8 M under 5 m
- ❑ Average slope is only 0.25%
- ❑ 0.5-m increase is equivalent to 200-m inland intrusion



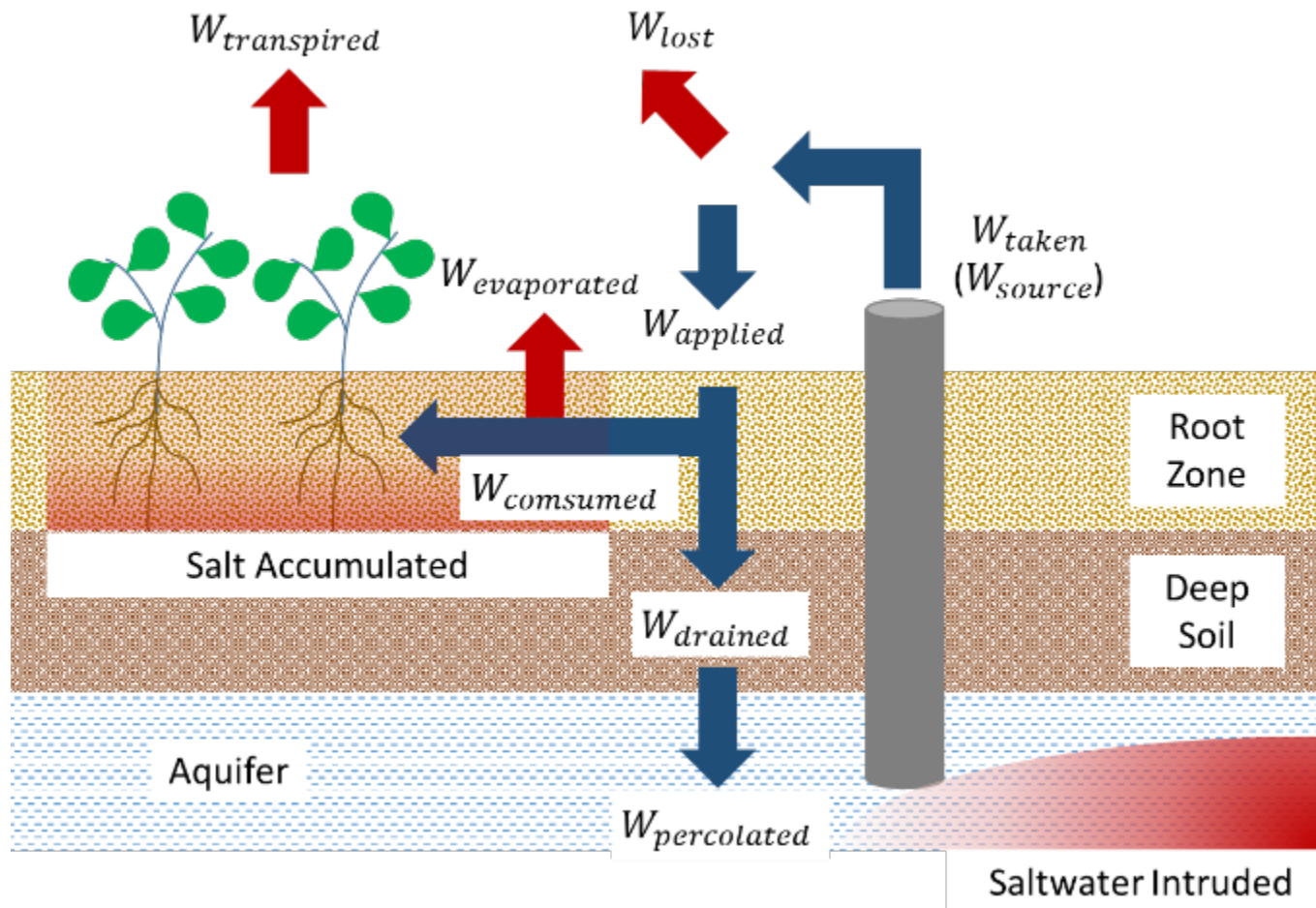
Groundwater Dynamic Modeling

□ Sea level rise In Florida



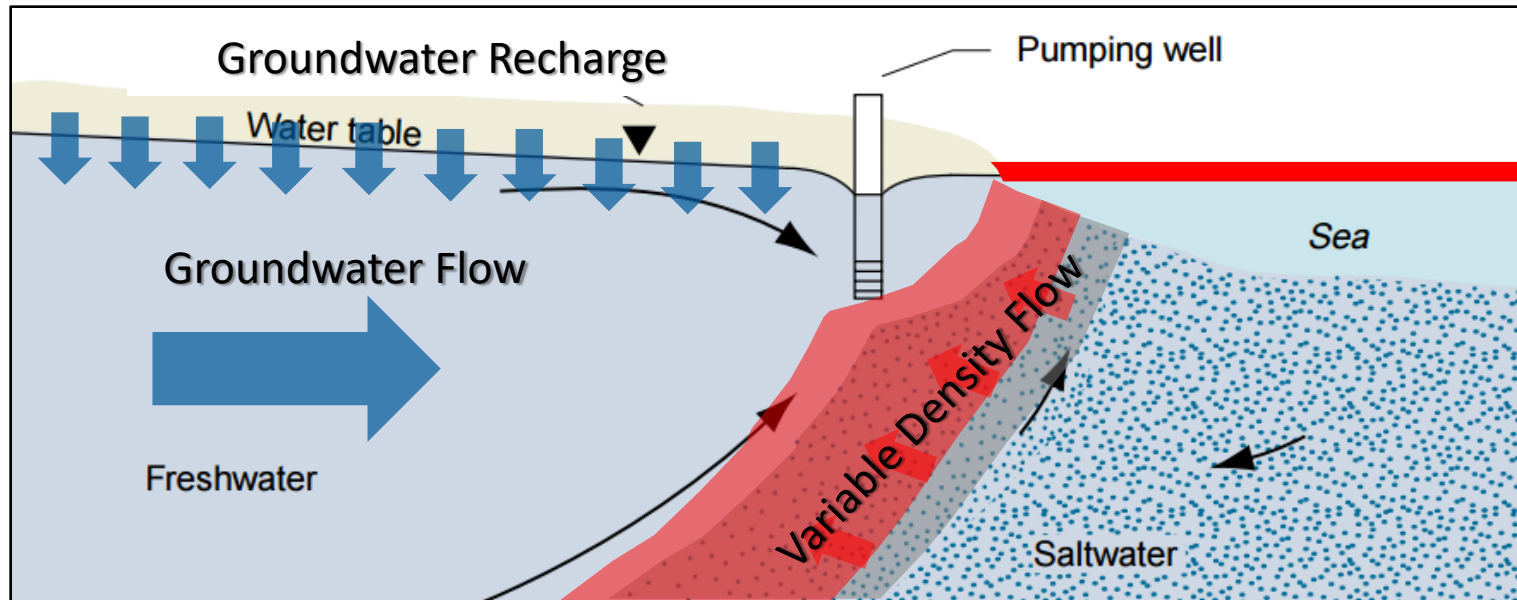
Groundwater Dynamic Modeling

□ Sea level rise In Florida



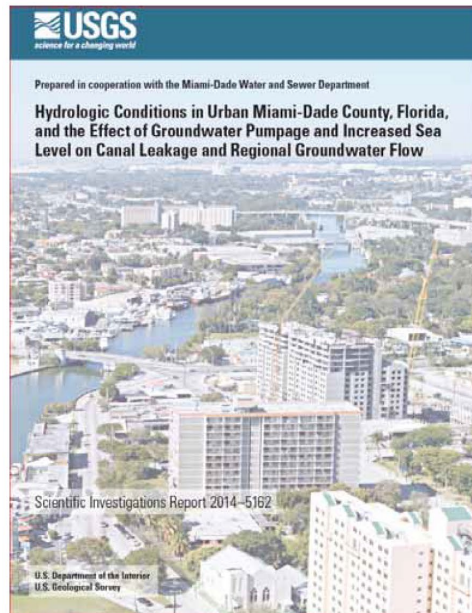
Groundwater Dynamic Modeling

- Sea level rise In Florida



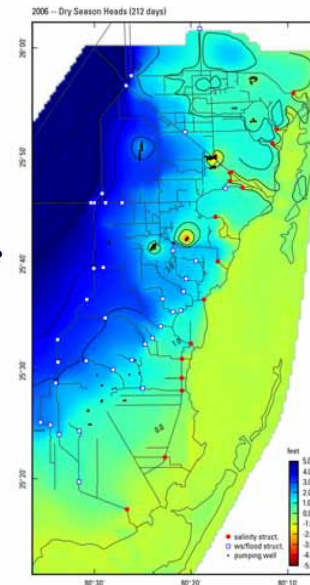
Groundwater Dynamic Modeling

- ❑ UMD groundwater model of USGS
- ❑ Scenarios
 - ❑ Sea level, land cover (groundwater recharge, pumping rates (municipal water and irrigation), and climate change (rainfall patterns))



<http://pubs.er.usgs.gov/publication/sir20145162>

*Scientifically defensible
at this point in time
with available SLR and
climate change data
available*



Sea Level Rise Projections

Scenario	Base	Scenario 1	Scenario 2	Scenario 3
Sea-level Rise	1996 – 2010	IPCC Median (2 inch)	NOAA Inter. High (4 inch)	NOAA High (5 inch)
Increased Pumping	1996 – 2010	10% increase	20% increase	-
Urbanization (increase in impervious areas)	1996 – 2010	10% increase	20% increase	-

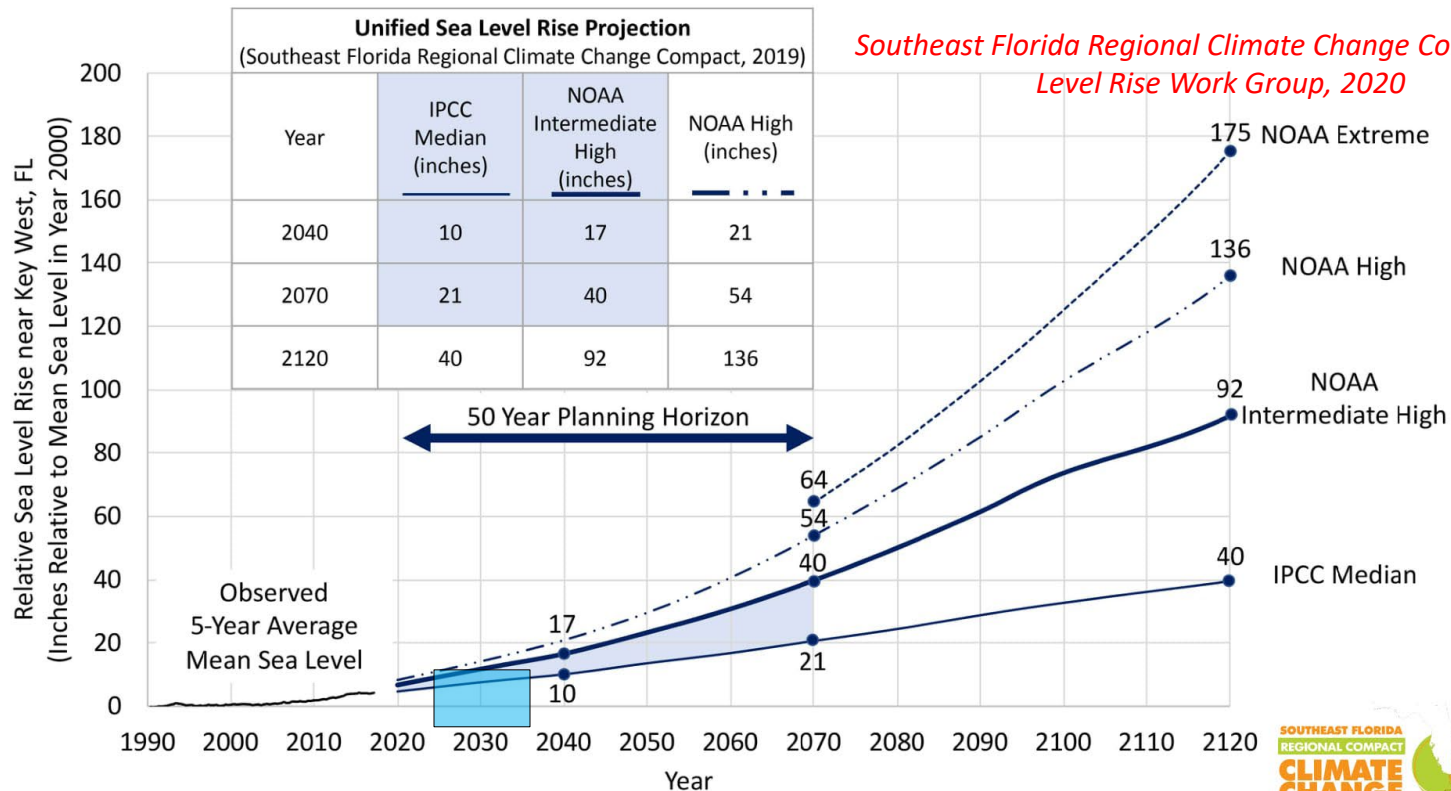
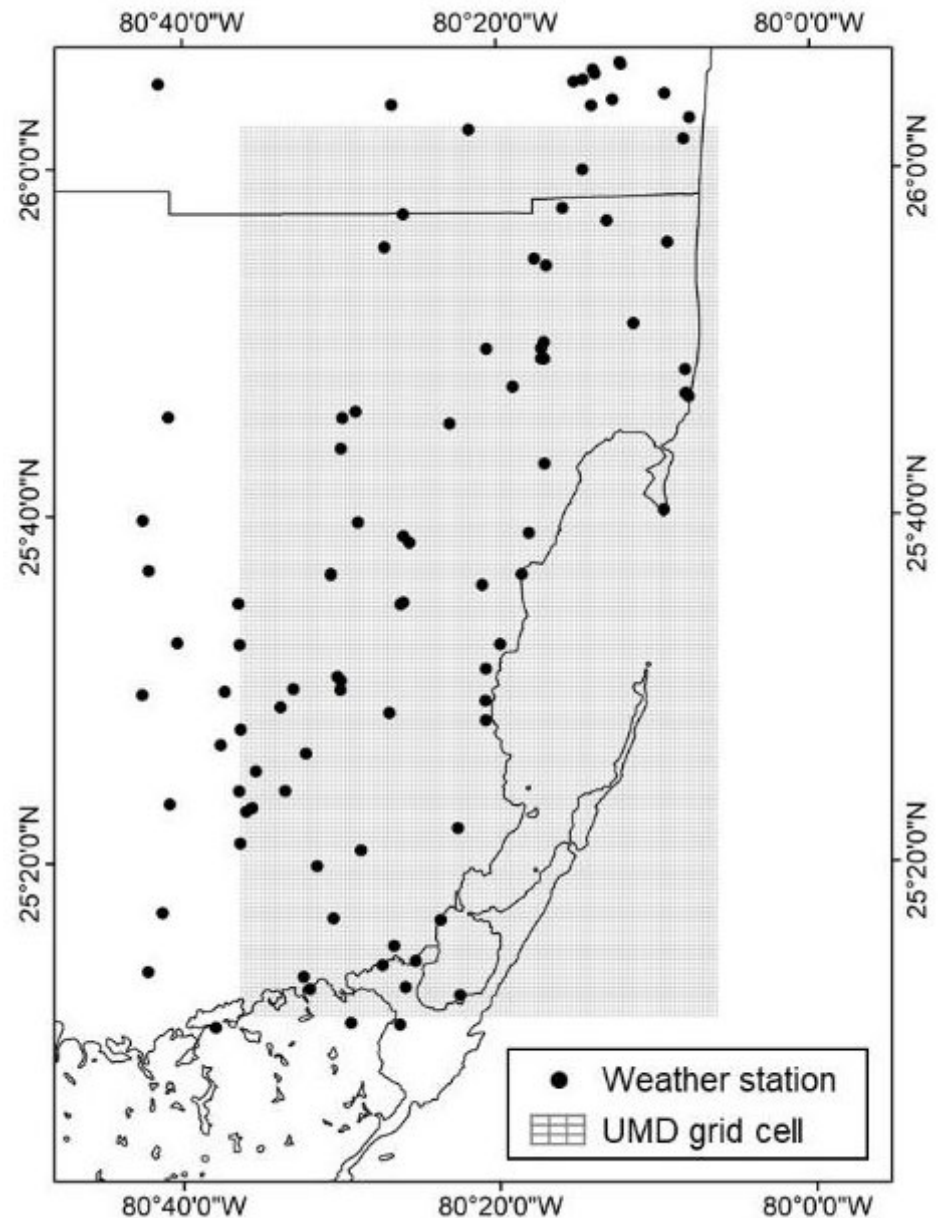
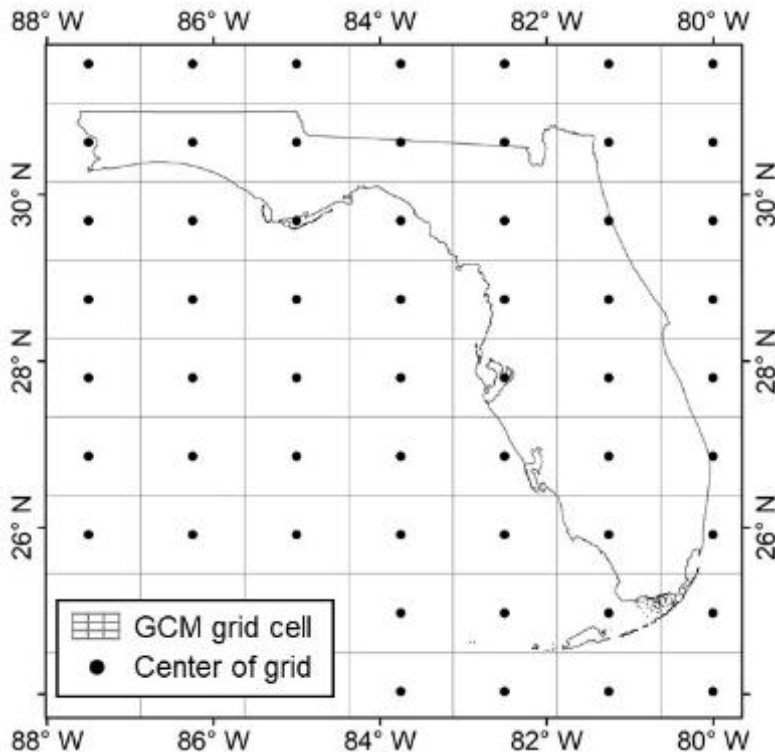


FIGURE 1: Unified Sea Level Rise Projection



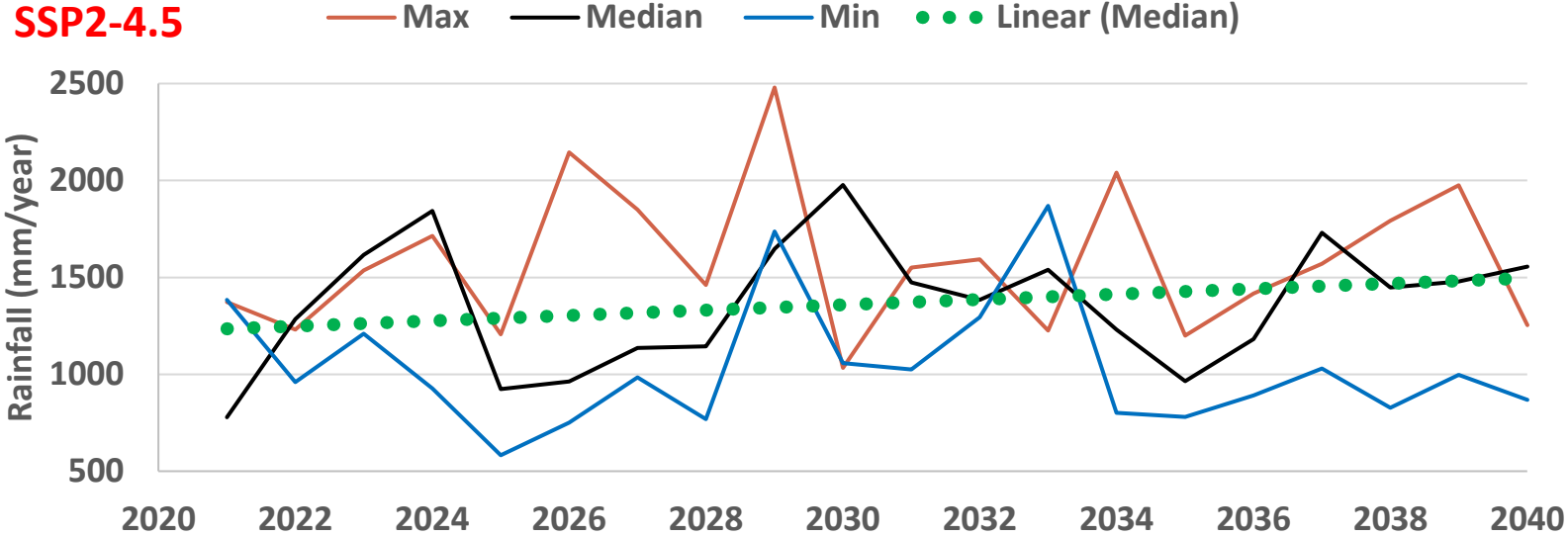
Climate Projections

- ☐ 29 GCMs
- ☐ SSP2-4.5/SSP5-8.5
- ☐ Quantile Mapping

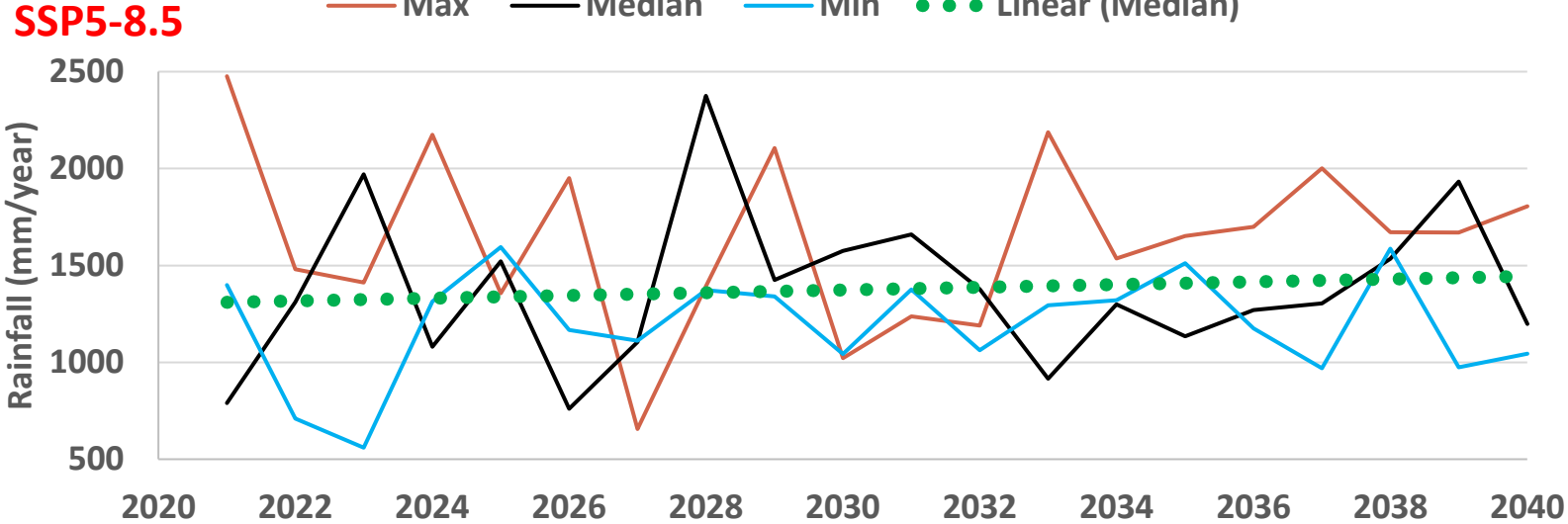


Climate Projections

SSP2-4.5



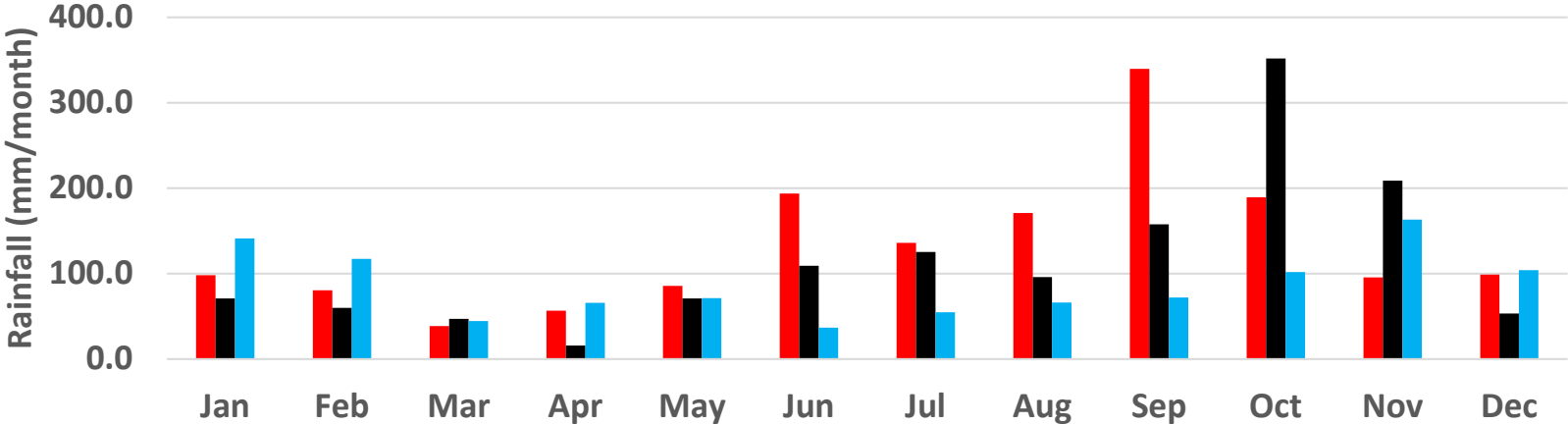
SSP5-8.5



Climate Projections

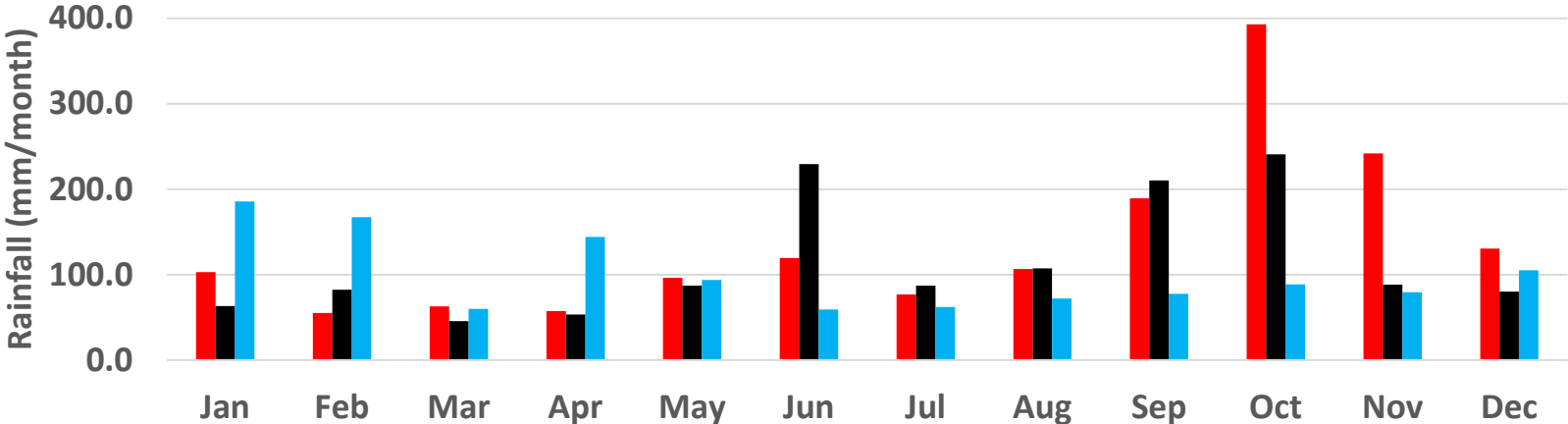
SSP2-4.5

■ Max ■ Median ■ Min

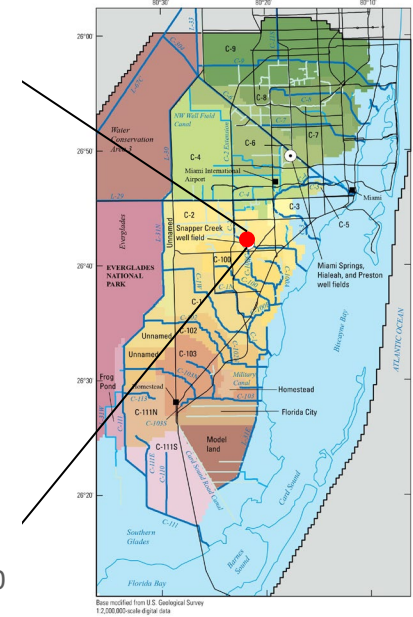
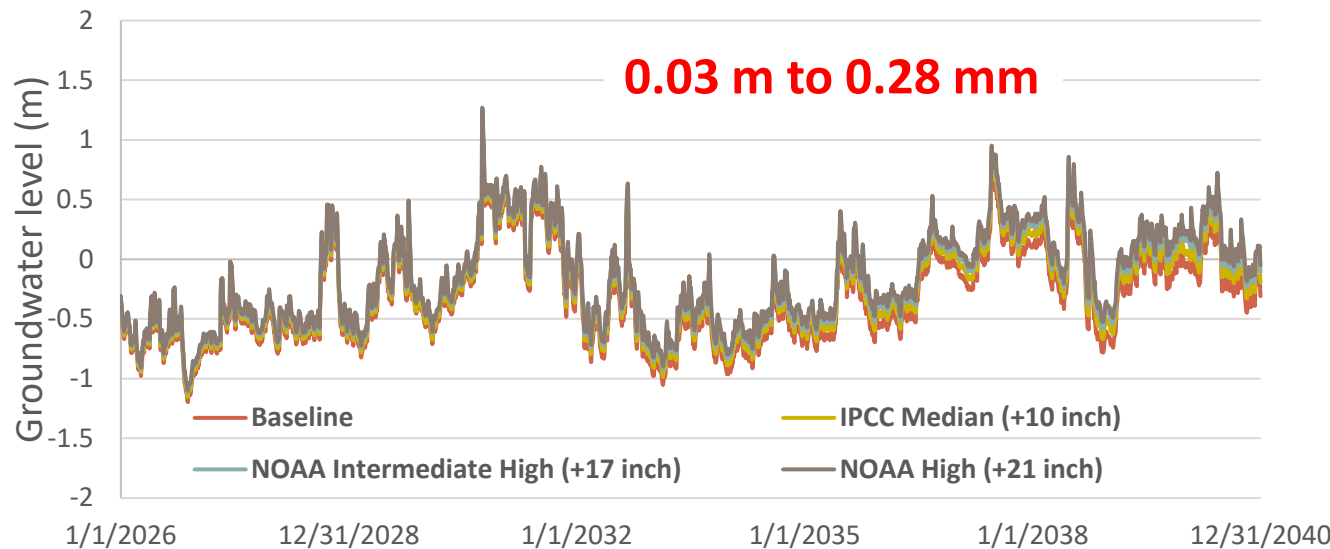
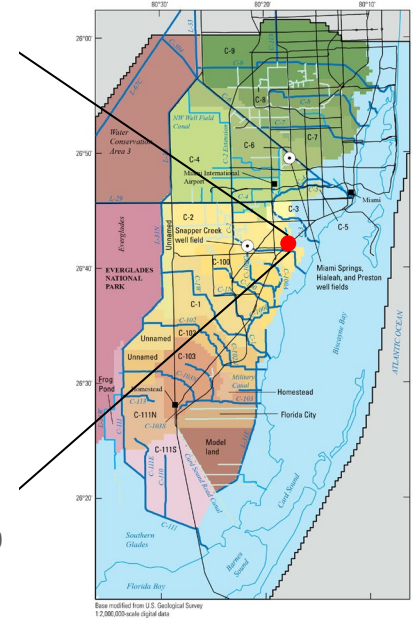
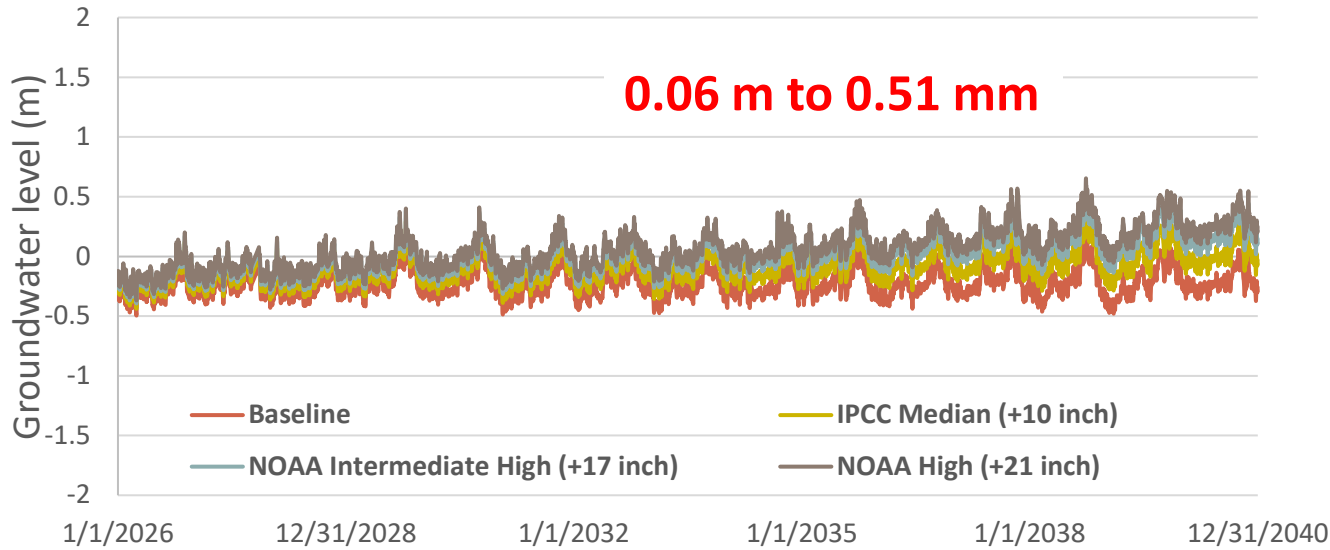


SSP5-8.5

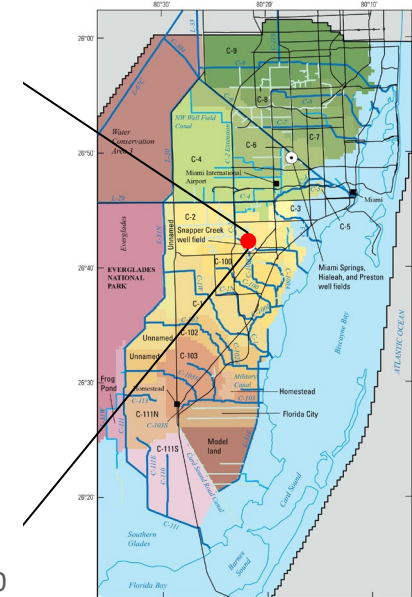
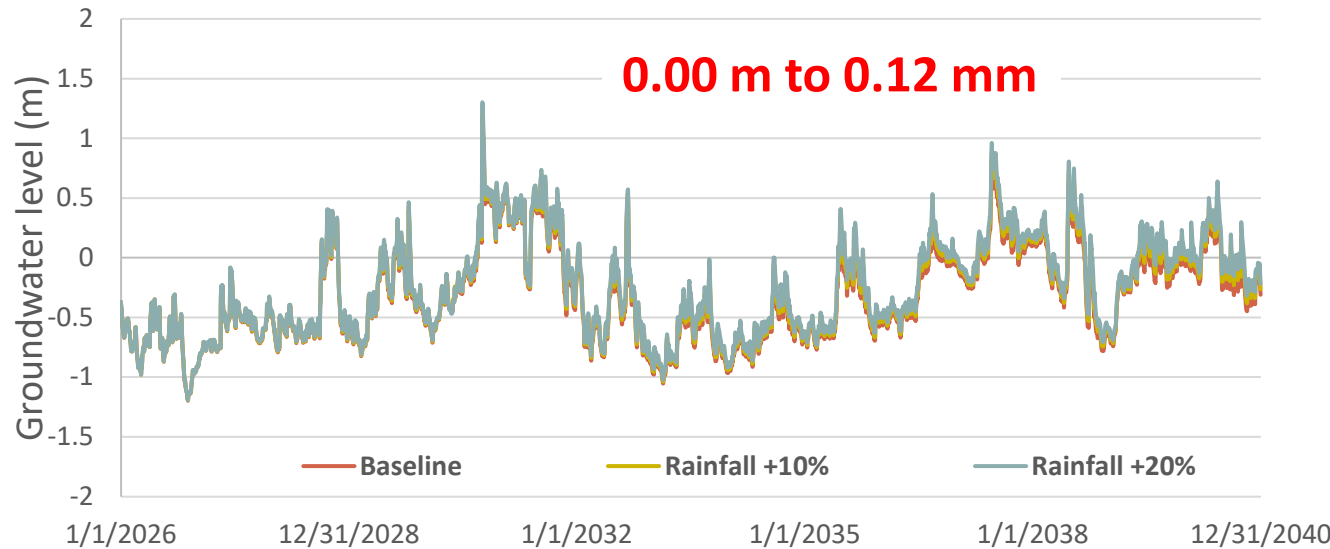
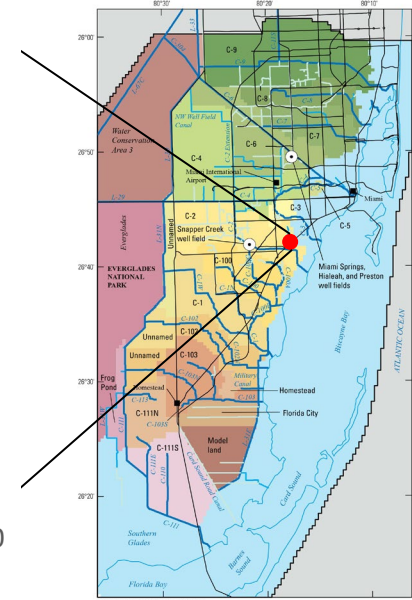
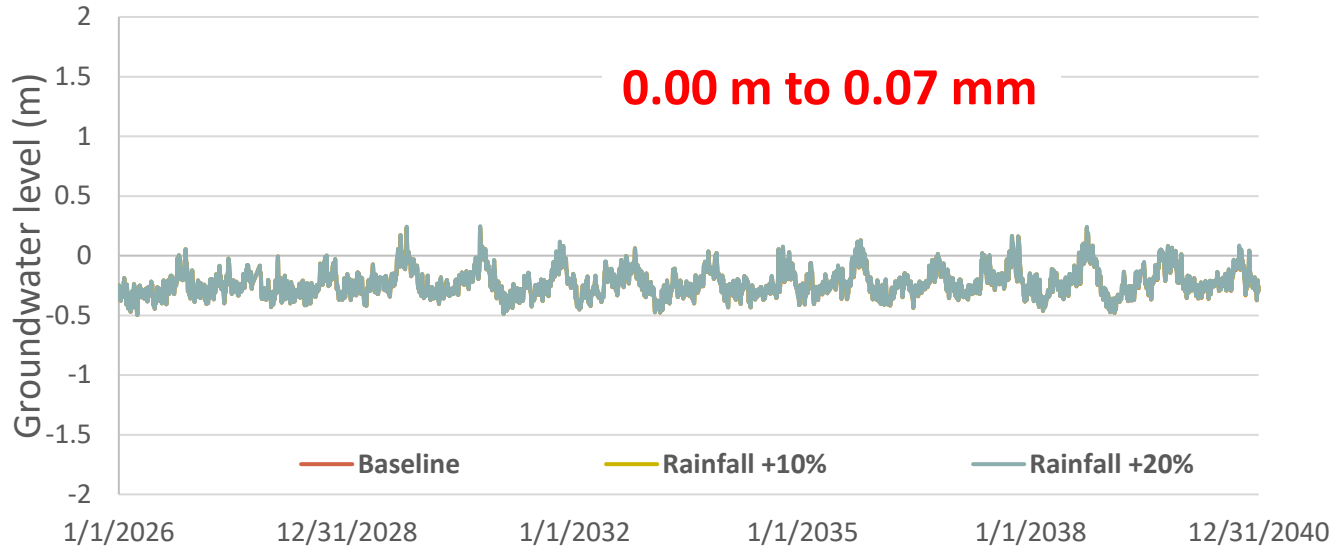
■ Max ■ Median ■ Min



Scenario: Sea-Level Rise



Scenario: Increased Rainfall (10%)



Scenario: SSP 4.5 + SLR Scenarios

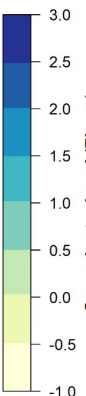
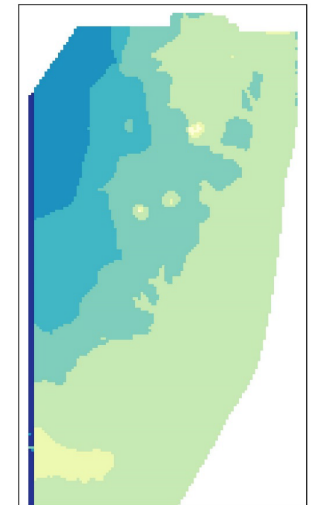
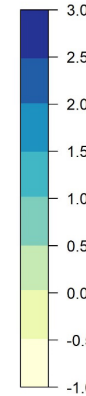
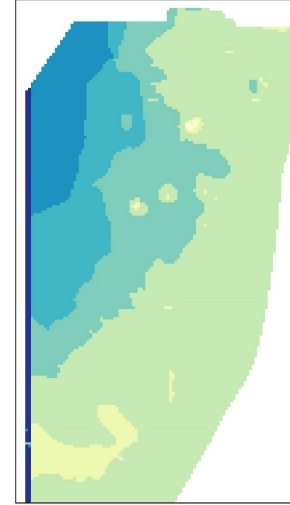
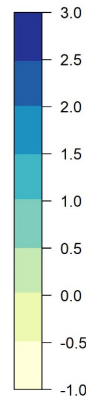
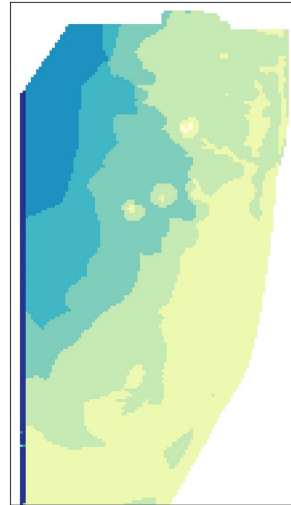
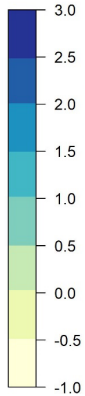
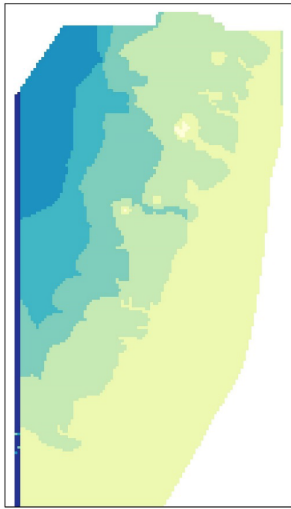
April 1, 2040

SSP 4.5: Median + Sea-Level Rise: Baseline

SSP 4.5: Median + Sea-Level Rise: IPCC-Median

SSP 4.5: Median + Sea-Level Rise: NOAA Int. High

SSP 4.5: Median + Sea-Level Rise: NOAA High



Groundwater Level (EL., m)

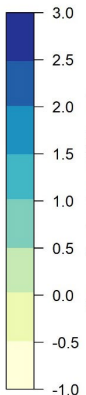
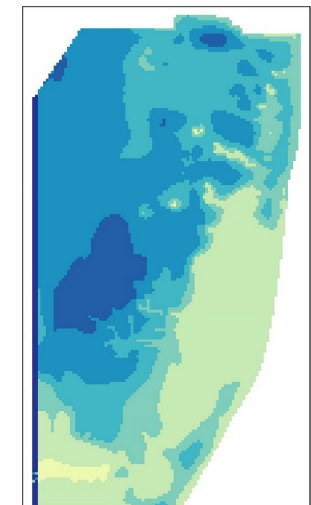
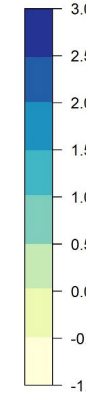
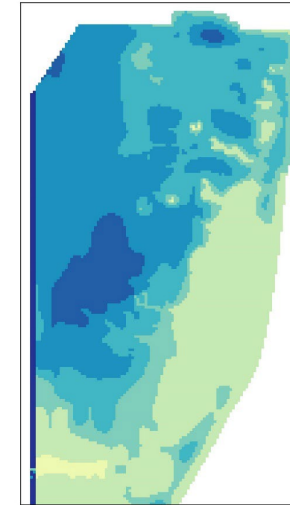
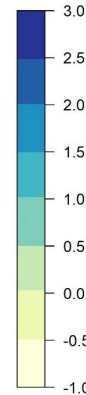
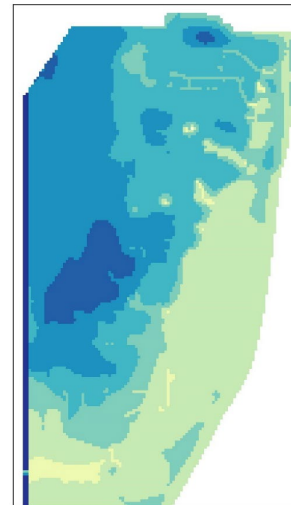
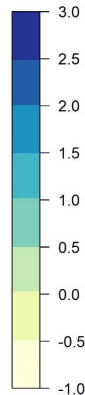
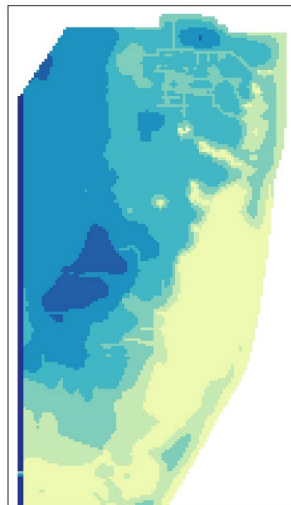
October 1, 2040

SSP 4.5: Median + Sea-Level Rise: Baseline

SSP 4.5: Median + Sea-Level Rise: IPCC-Median

SSP 4.5: Median + Sea-Level Rise: NOAA Int. High

SSP 4.5: Median + Sea-Level Rise: NOAA High



Groundwater Level (EL., m)

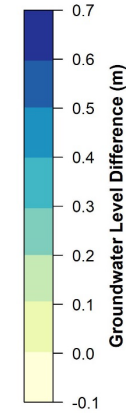
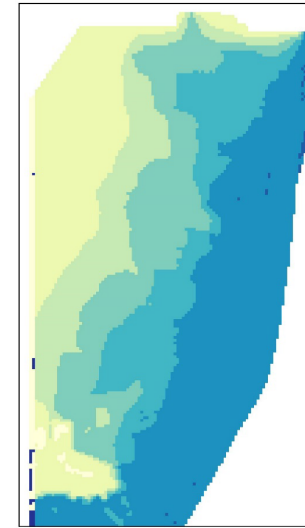
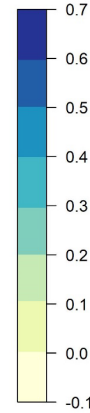
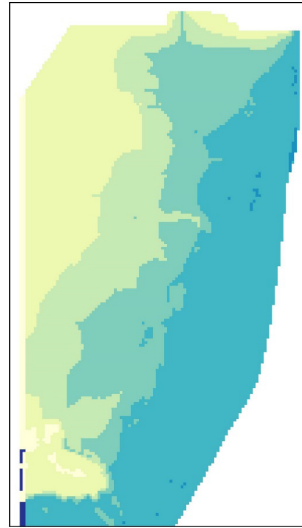
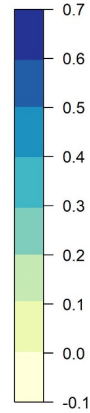
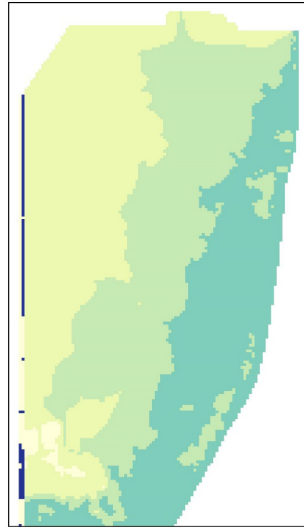
Scenario: SSP 4.5 + SLR Scenarios

April 1, 2040

SSP 4.5: Median + Sea-Level Rise: IPCC Median

SSP 4.5: Median + Sea-Level Rise: NOAA Int. High

SSP 4.5: Median + Sea-Level Rise: NOAA High

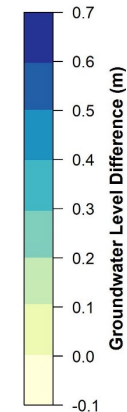
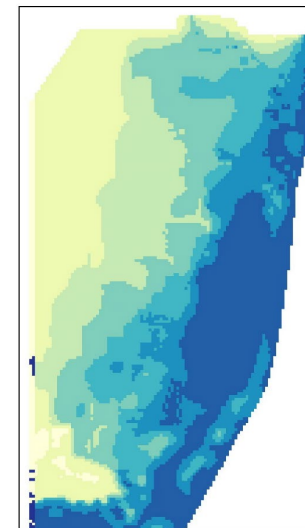
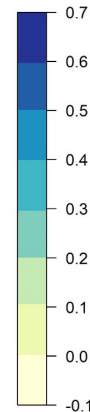
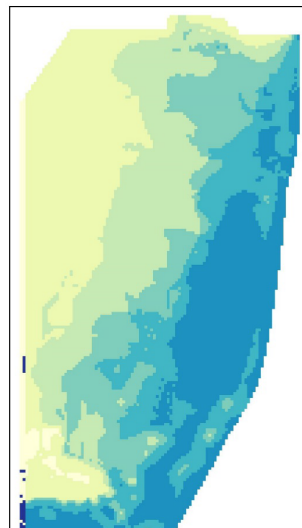
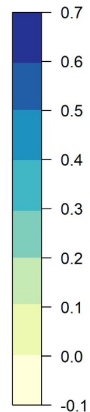
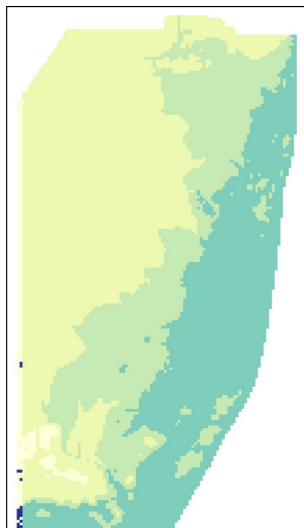


October 1, 2040

SSP 4.5: Median + Sea-Level Rise: IPCC Median

SSP 4.5: Median + Sea-Level Rise: NOAA Int. High

SSP 4.5: Median + Sea-Level Rise: NOAA High



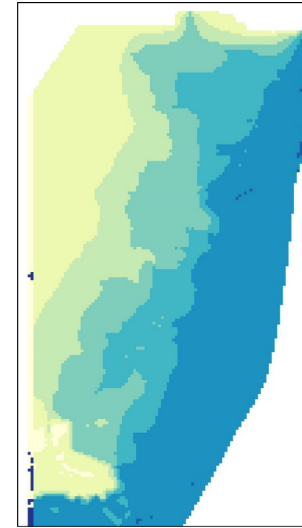
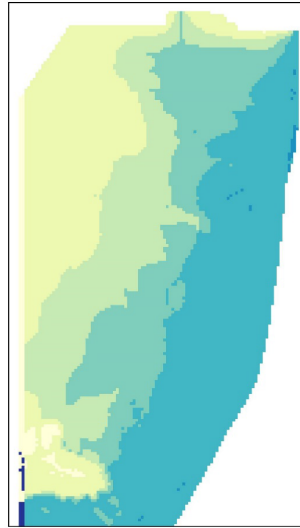
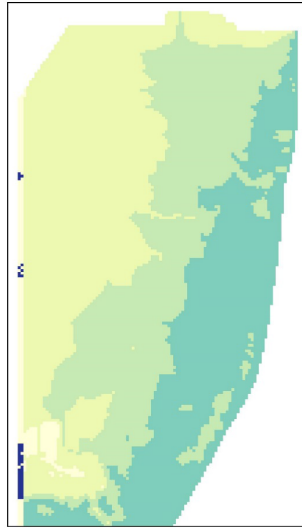
Scenario: SSP 8.5 + SLR Scenarios

April 1, 2040

SSP 8.5: Median + Sea-Level Rise: IPCC Median

SSP 8.5: Median + Sea-Level Rise: NOAA Int. High

SSP 8.5: Median + Sea-Level Rise: NOAA High

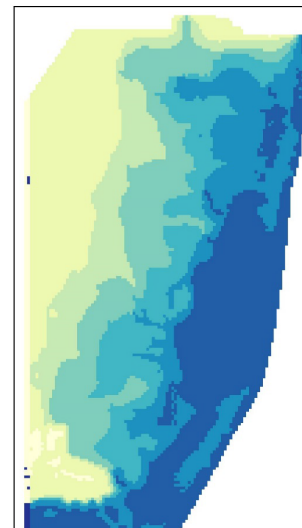
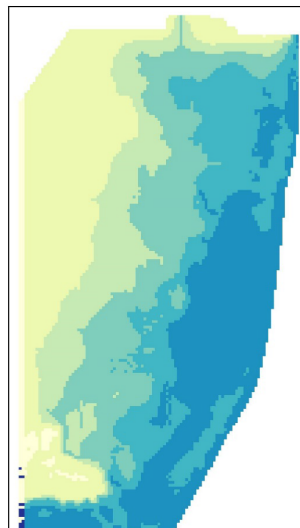
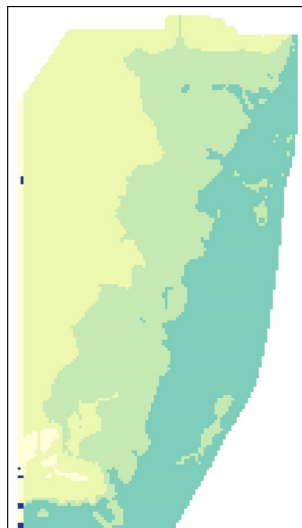


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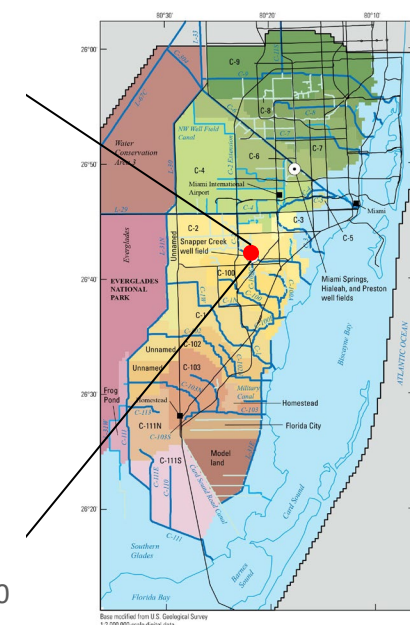
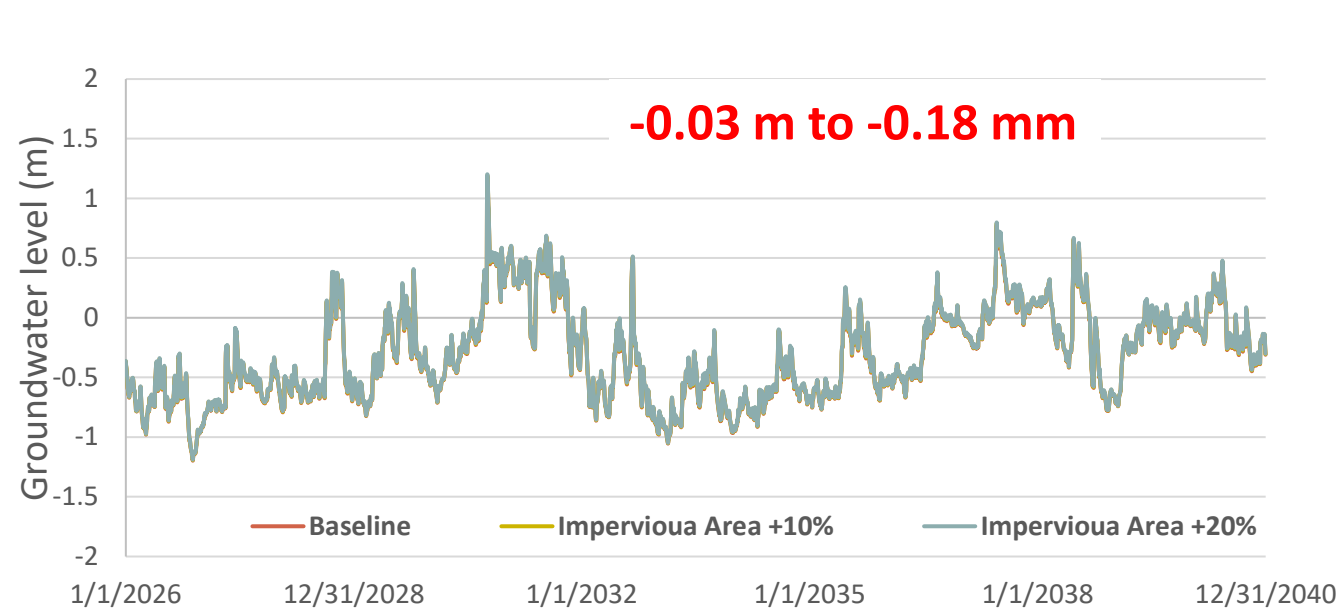
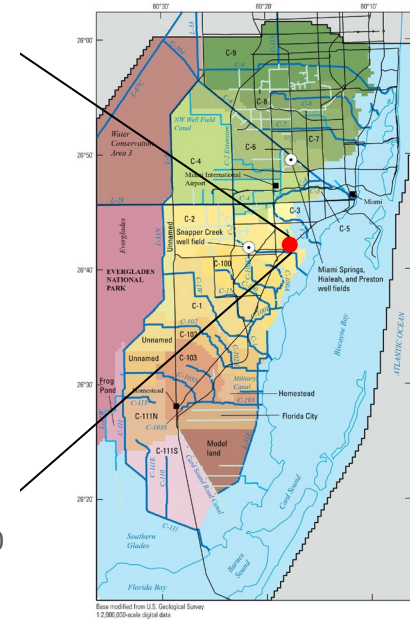
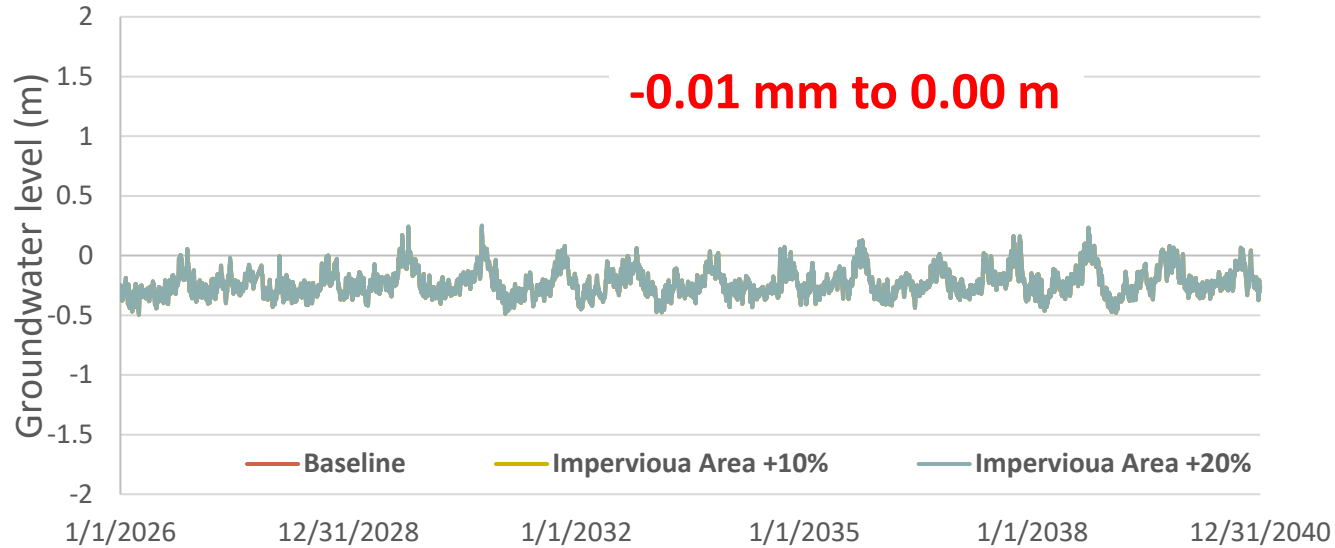
SSP 8.5: Median + Sea-Level Rise: IPCC Median

SSP 8.5: Median + Sea-Level Rise: NOAA Int. High

SSP 8.5: Median + Sea-Level Rise: NOAA High



Scenario: Land use Change



Conclusions

- ❑ Overall, GW levels are the most sensitive to sea level rise projections (cf. climate change, urbanization, and pumping rate increase)
- ❑ Sea level rise and climate change may increase groundwater level, but pumping rate increase and urbanization may decrease groundwater level
- ❑ GW levels in the costal areas are more sensitive to sea level rise than those of the inland areas
- ❑ GW levels in the inland areas are more responsive to climate change and pumping rate increase than those of coastal areas

Future Work

- ❑ Expanding the projections up to 2100
- ❑ Projecting the future populations (and pumping rates) and land uses (and groundwater recharge)
 - ❑ Do increases in pumping rate and urbanization can help decrease groundwater level?
- ❑ Groundwater recharge injection
- ❑ Comprehensive Everglades Restoration Plans
- ❑ Agricultural consequences of projected groundwater level changes (excess soil water / soil water flooding)
- ❑ Quantifying uncertainty in the projections
 - ❑ 29 climate change scenarios/3 sea level scenarios