

Hurricane Activities in Gulf of Mexico Lead to Conversion of Forested Land: Implications for Water Quantity/Quality

Dr. Latif Kalin, Dongjun Lee

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The National Academies of SCIENCES
ENGINEERING
MEDICINE

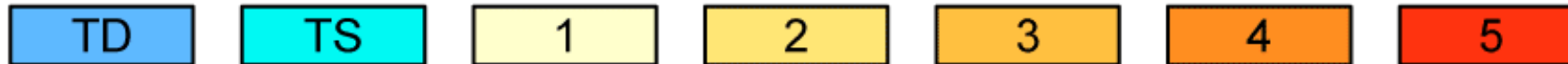
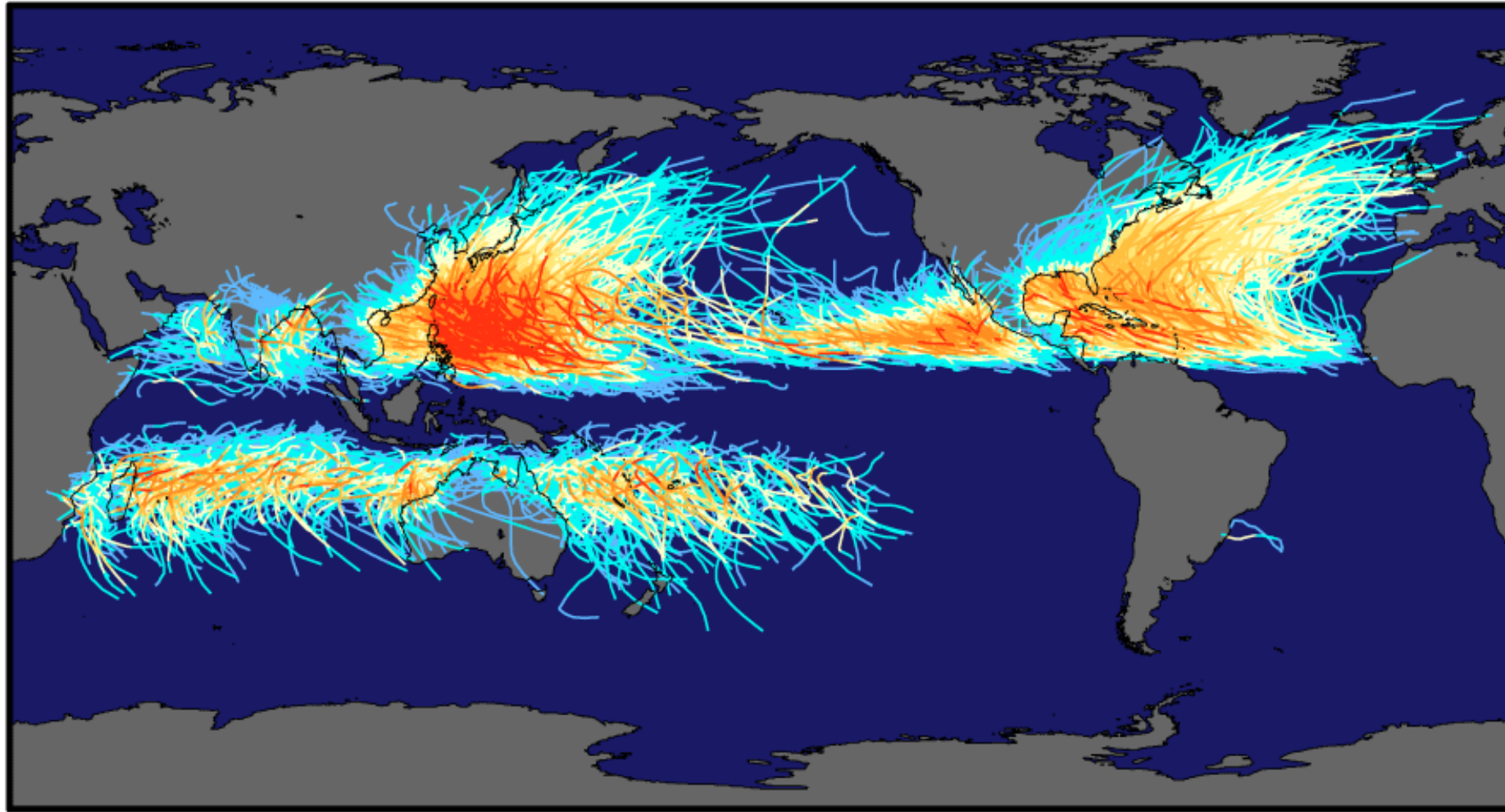


GULF RESEARCH PROGRAM



AUBURN UNIVERSITY
College of Forestry, Wildlife and Environment

Tracks and Intensity of All Tropical Storms



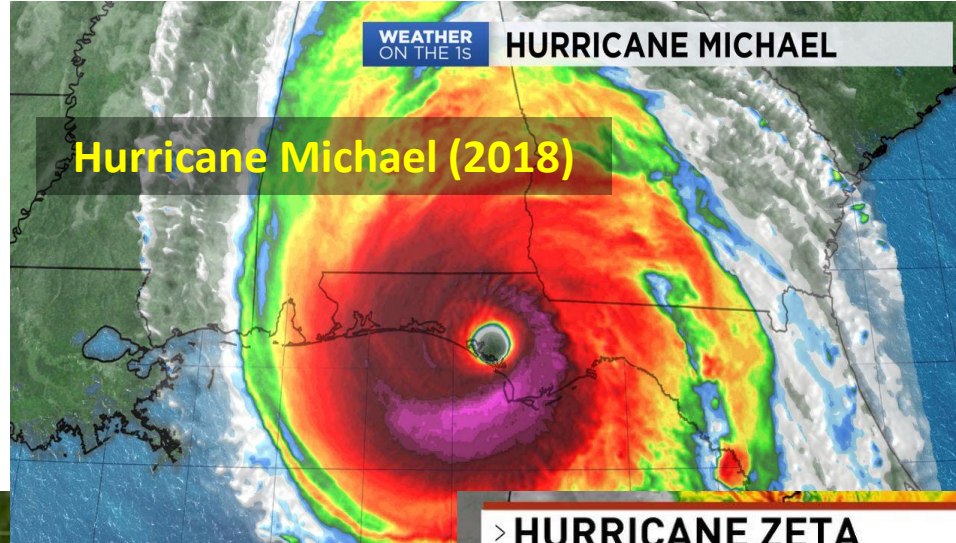
Saffir-Simpson Hurricane Intensity Scale

CATEGORY	mph	km/h
1	74 -95 mph	119-153 km/h
2	96-110 mph	154-177 km/h
3	111-129 mph	178-208 km/h
4	130-156 mph	209-251 km/h
5	≥157 mph	≥252 km/h

Northern Gulf of Mexico



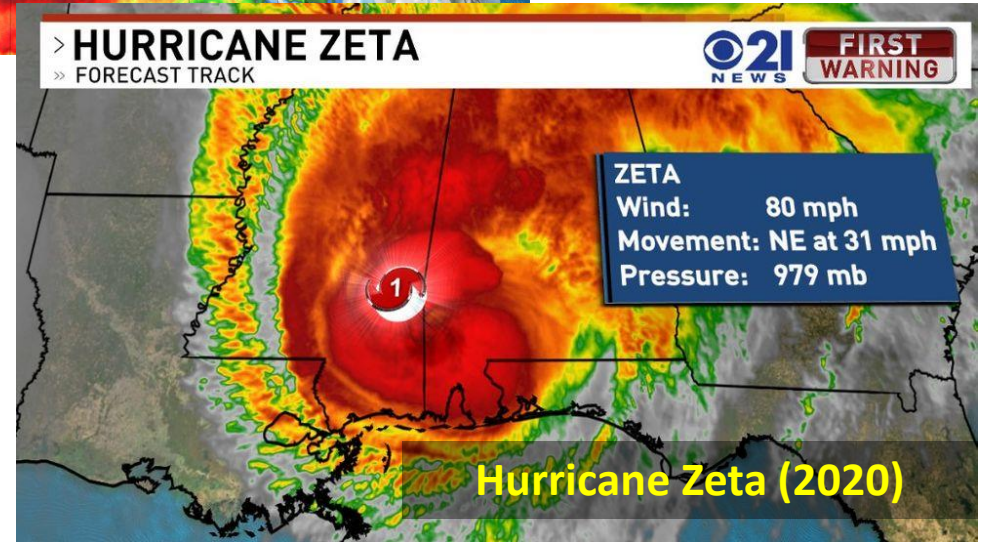
Hurricane Ivan (2004)



Hurricane Michael (2018)



Hurricane Katrina (2005)



Hurricane Zeta (2020)

Hurricane Impacts



Damage to forests



Damage to crops

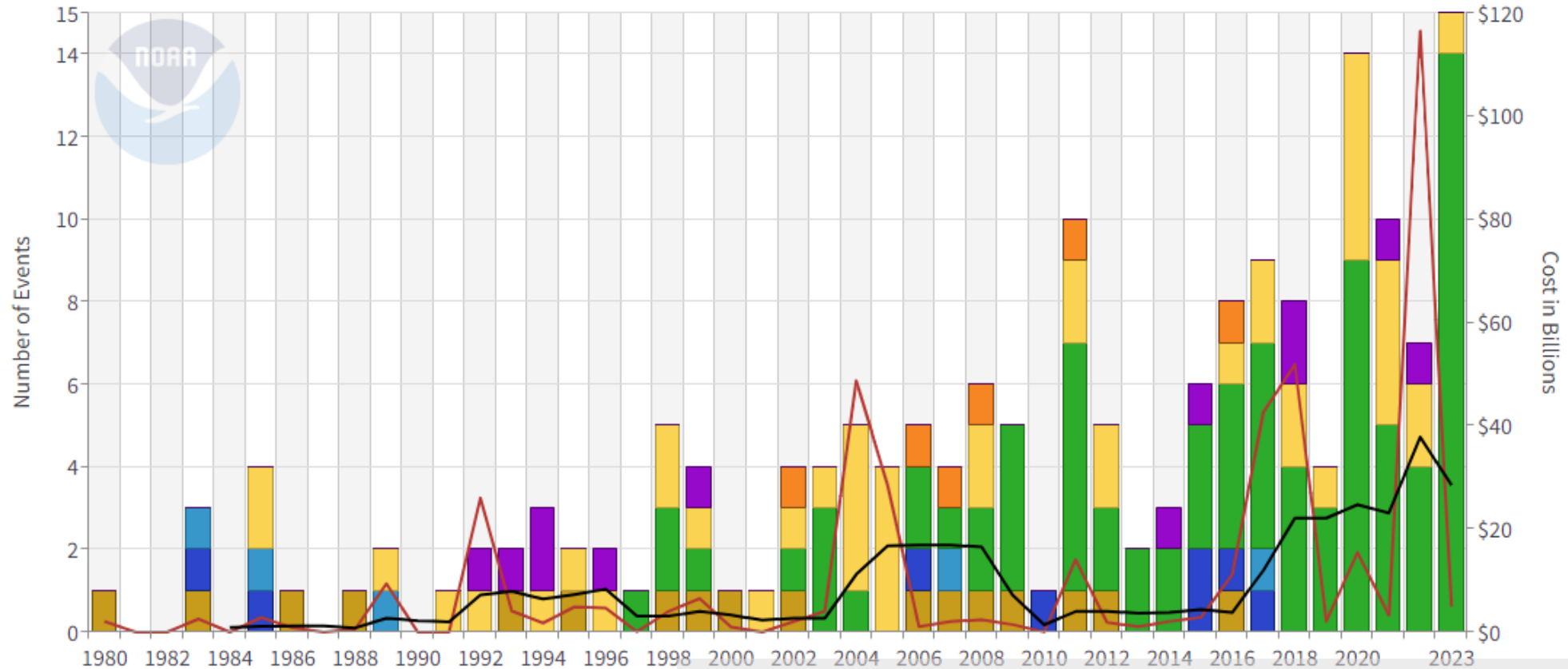


Damage to resident area

Southeast Billion-Dollar Disaster Events 1980-2023 (Unadjusted)

AL, FL, GA, NC, SC, VA

- Drought Count
- Flooding Count
- Freeze Count
- Severe Storm Count
- Tropical Cyclone Count
- Wildfire Count
- Winter Storm Count
- Combined Disaster Cost
- 5-Year Avg Costs



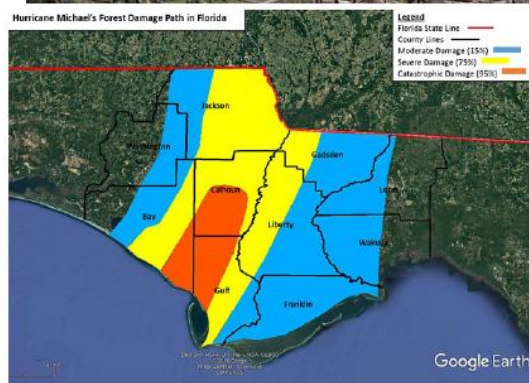
Updated: October 10, 2023

(NOAA, <https://www.ncei.noaa.gov/access/billions/time-series/SECR>)

Hurricane Impacts

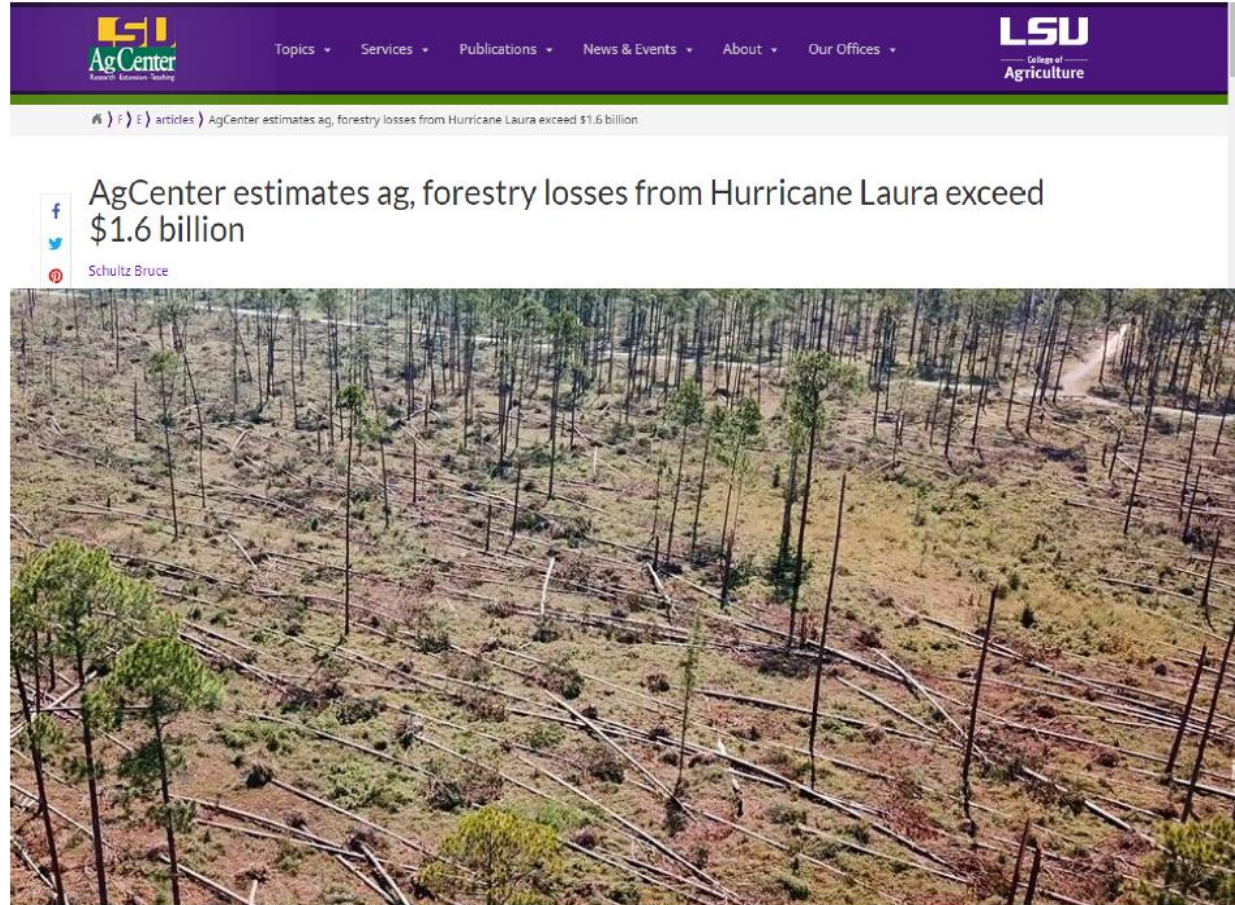


Hurricane impacts and conversion of managed forests



October 12, 2018 Tyndall AF Base near Mexico Beach (Source: AP)

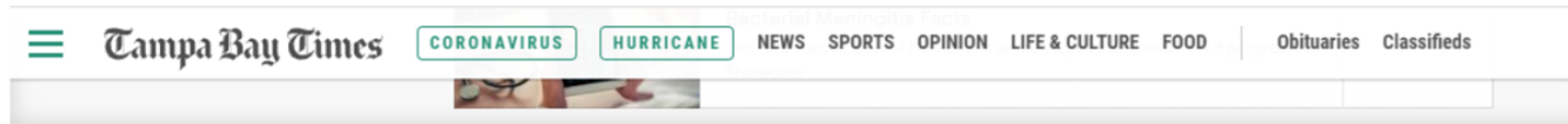
Hurricane impacts and conversion of managed forests



The screenshot shows the top navigation bar of the AgCenter website, including the AgCenter logo and the LSU College of Agriculture logo. Below the navigation bar, the article title is displayed: "AgCenter estimates ag, forestry losses from Hurricane Laura exceed \$1.6 billion". The article is attributed to "Schultz Bruce". The main image of the article is a drone photograph of a forest with many trees that have been knocked down or are leaning precariously, with a dirt road visible in the background.

A photo taken with a drone shows downed trees in the Vernon Unit of the Kisatchie National Forest. Photo by U.S. Department of Agriculture Forest Service

Hurricane impacts and conversion of managed forests



FLORIDA POLITICS / THE BUZZ

After Hurricane Michael, Florida considers new crops

Alternative crops include hemp, hops, olives, some hardier citrus varieties, such as satsuma, and lupines, which produce an oil that can be converted to biodiesel and a high protein meal.

By News Service of Florida

Published Feb. 5, 2019

TALLAHASSEE -- Hemp and hops are being promoted among alternatives for crops wiped out by Hurricane Michael in the eastern Panhandle.

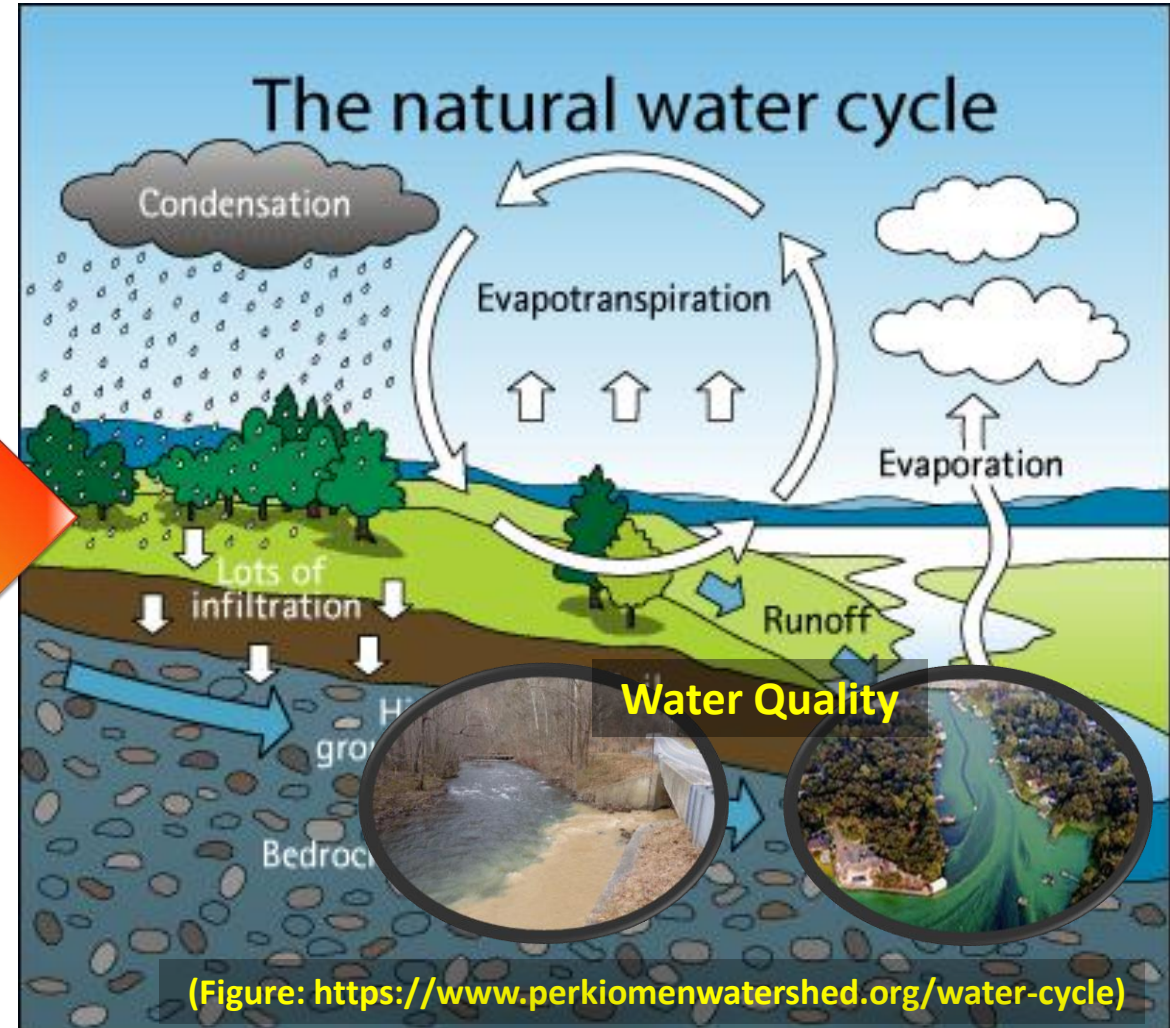
Land Use + Climate Change



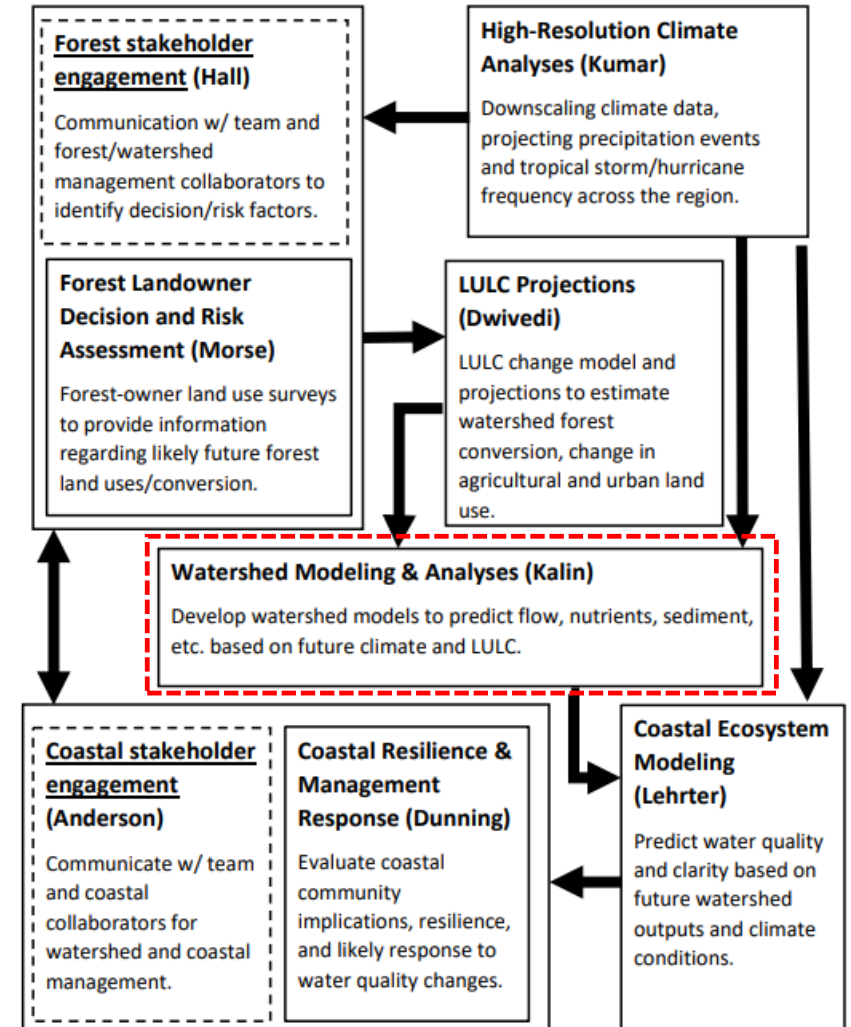
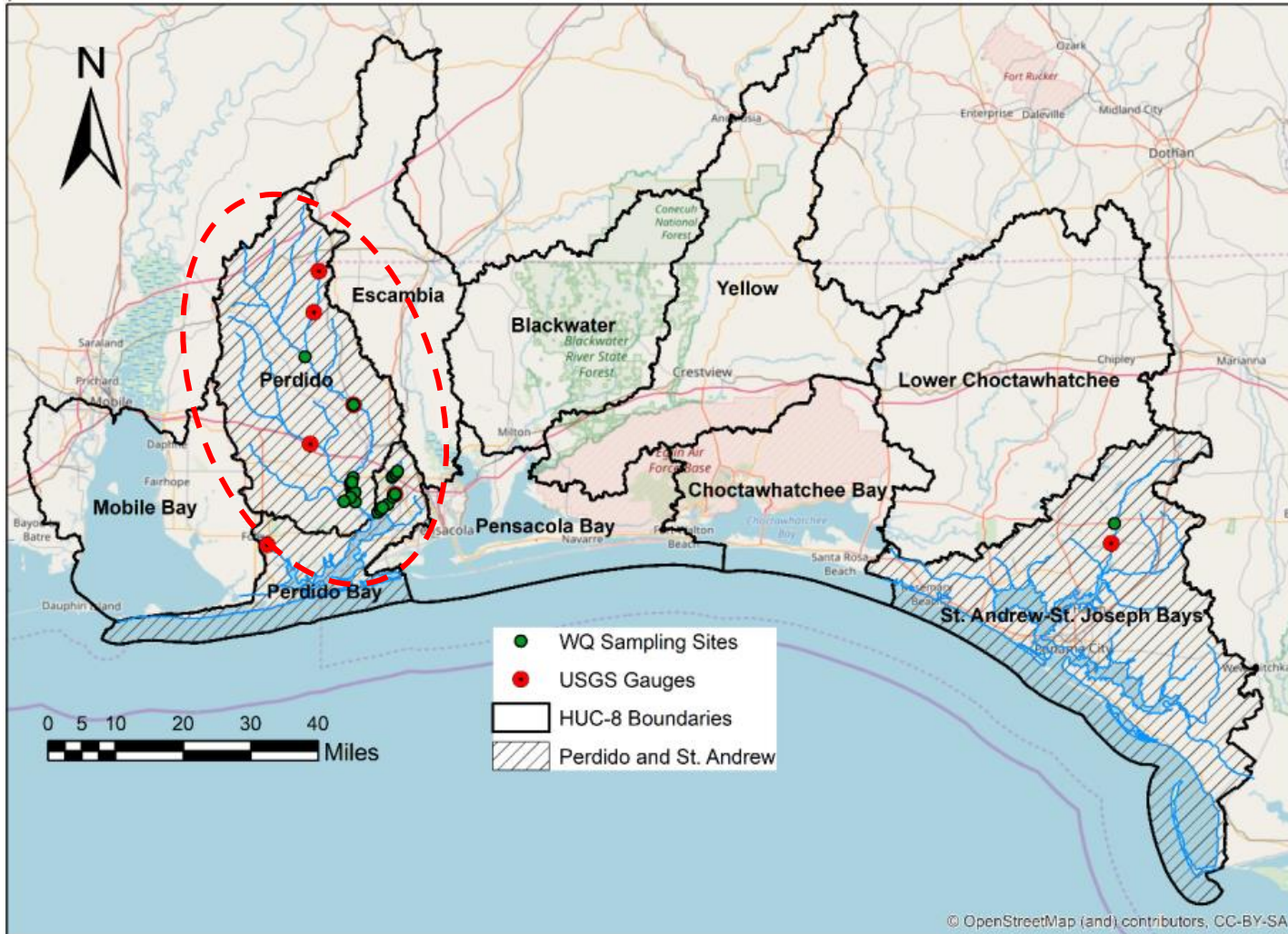
Land Use/Cover conversion



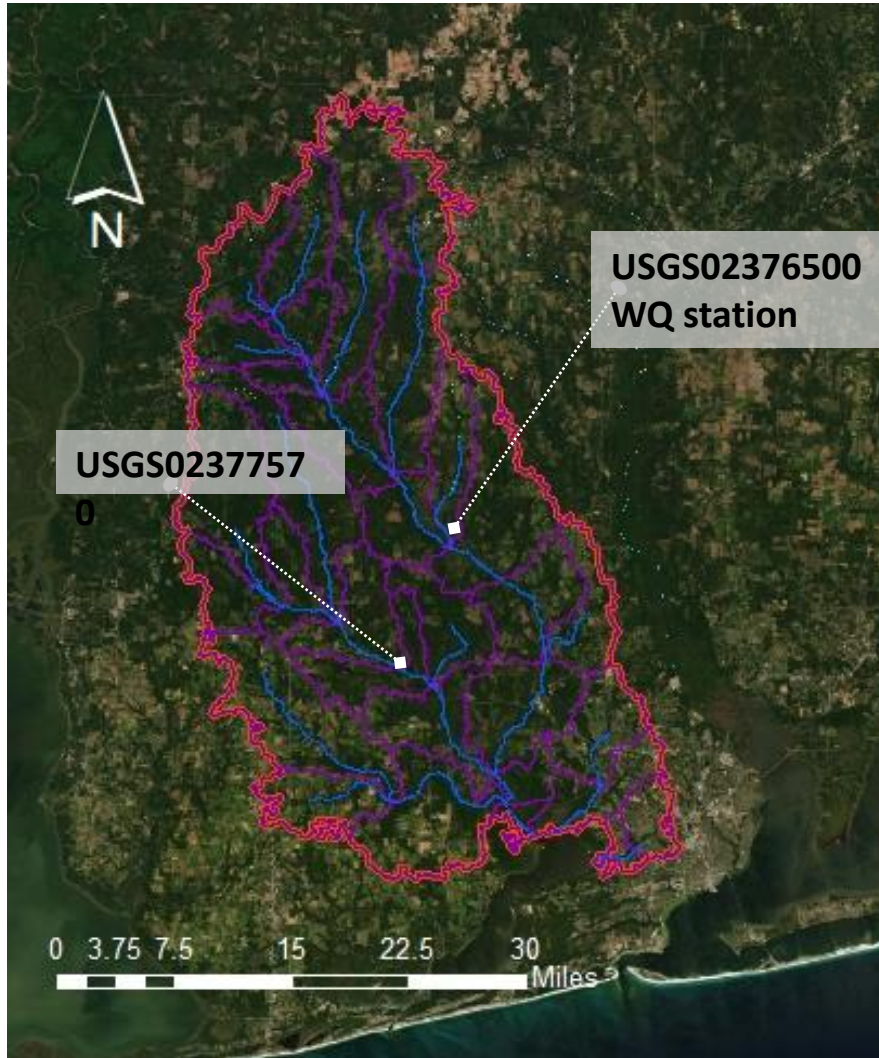
Climate Changes



Coastal Human-Natural (CHN) Framework



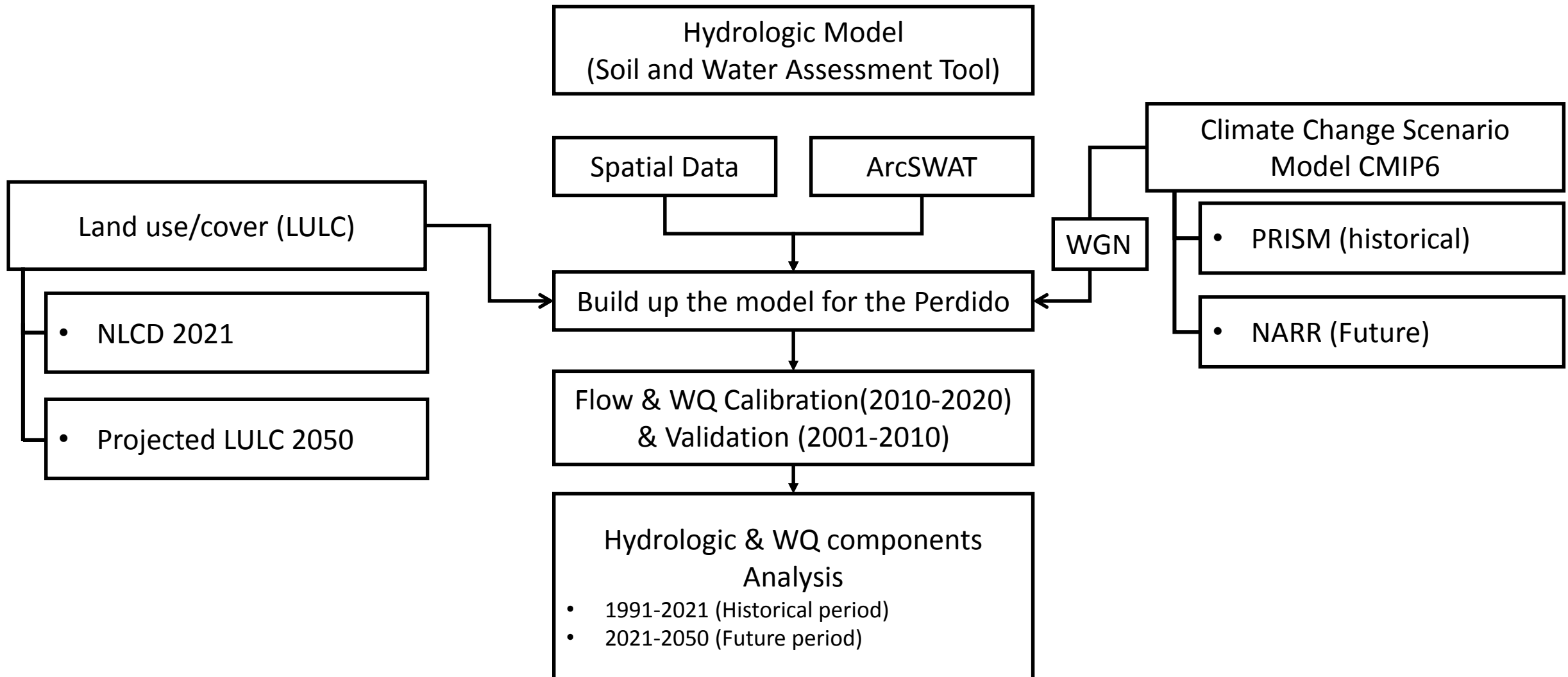
Perdido Bay Watershed



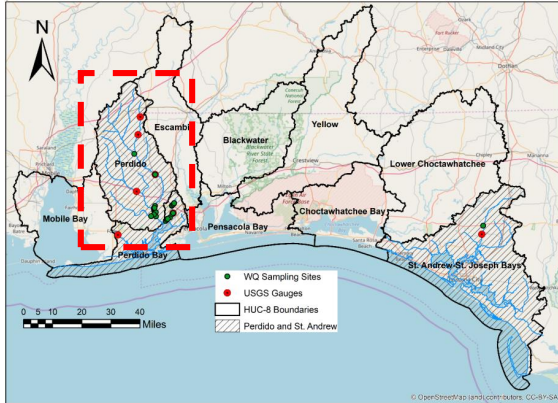
- The Perdido watershed
- Area: 2,529 km²
- Land use/cover (based on NLCD2021)



Modeling Framework



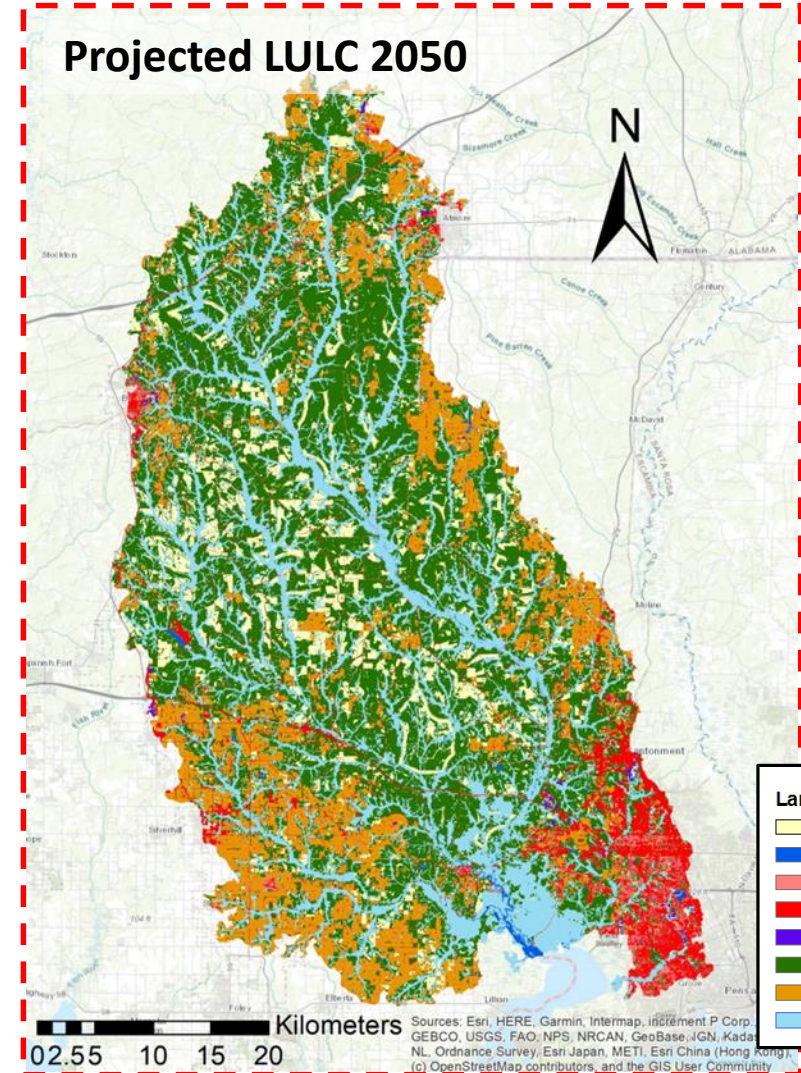
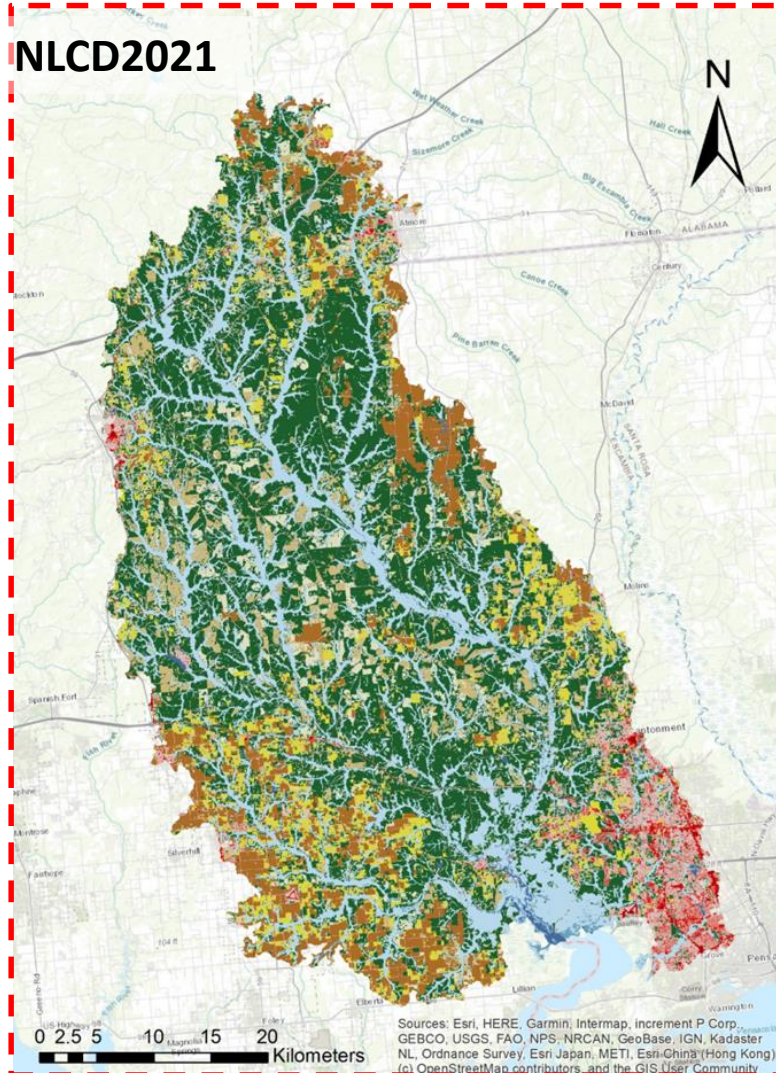
LULC Change



NLCD Land Cover Classification Legend

- 11 Open Water
- 12 Perennial Ice/ Snow
- 21 Developed, Open Space
- 22 Developed, Low Intensity
- 23 Developed, Medium Intensity
- 24 Developed, High Intensity
- 31 Barren Land (Rock/Sand/Clay)
- 41 Deciduous Forest
- 42 Evergreen Forest
- 43 Mixed Forest
- 51 Dwarf Scrub*
- 52 Shrub/Scrub
- 71 Grassland/Herbaceous
- 72 Sedge/Herbaceous*
- 73 Lichens*
- 74 Moss*
- 81 Pasture/Hay
- 82 Cultivated Crops
- 90 Woody Wetlands
- 95 Emergent Herbaceous Wetlands

* Alaska only



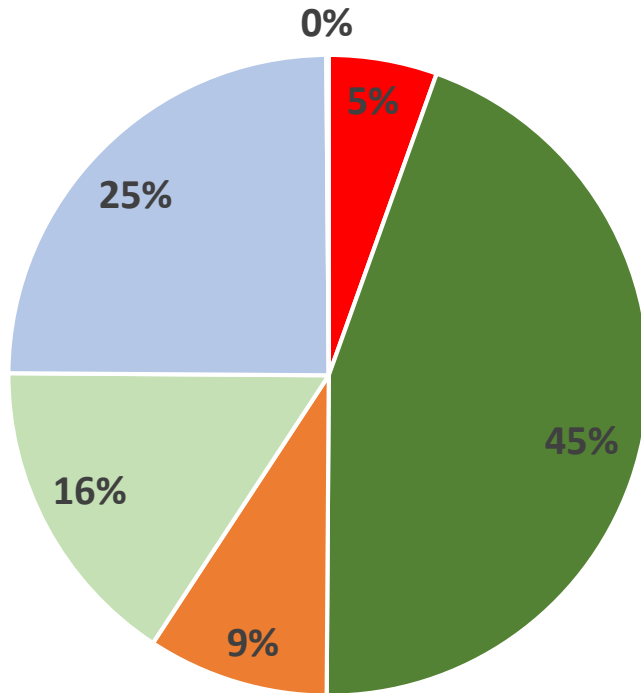
LandUse

- Grassland
- Open Water
- Developed, Medium
- Developed, High
- Barren Land
- Forest
- Cultivated Crops
- Wetlands

LULC change

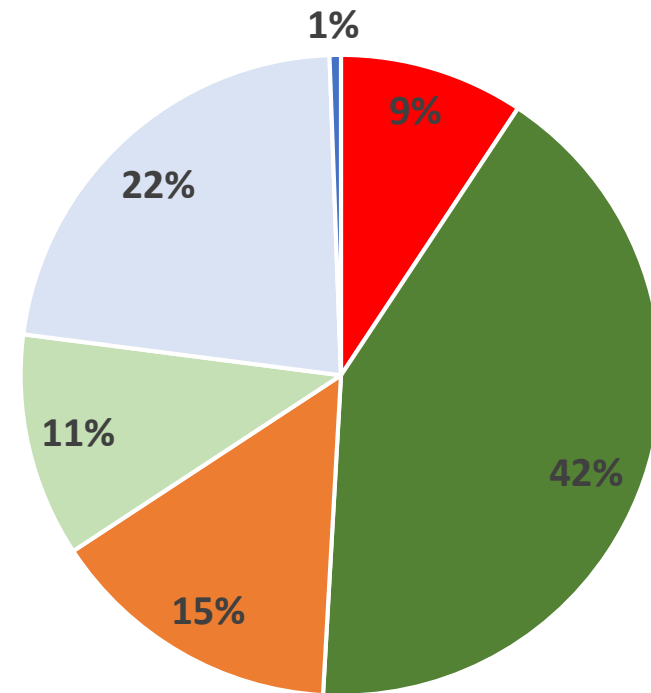


NLCD2021



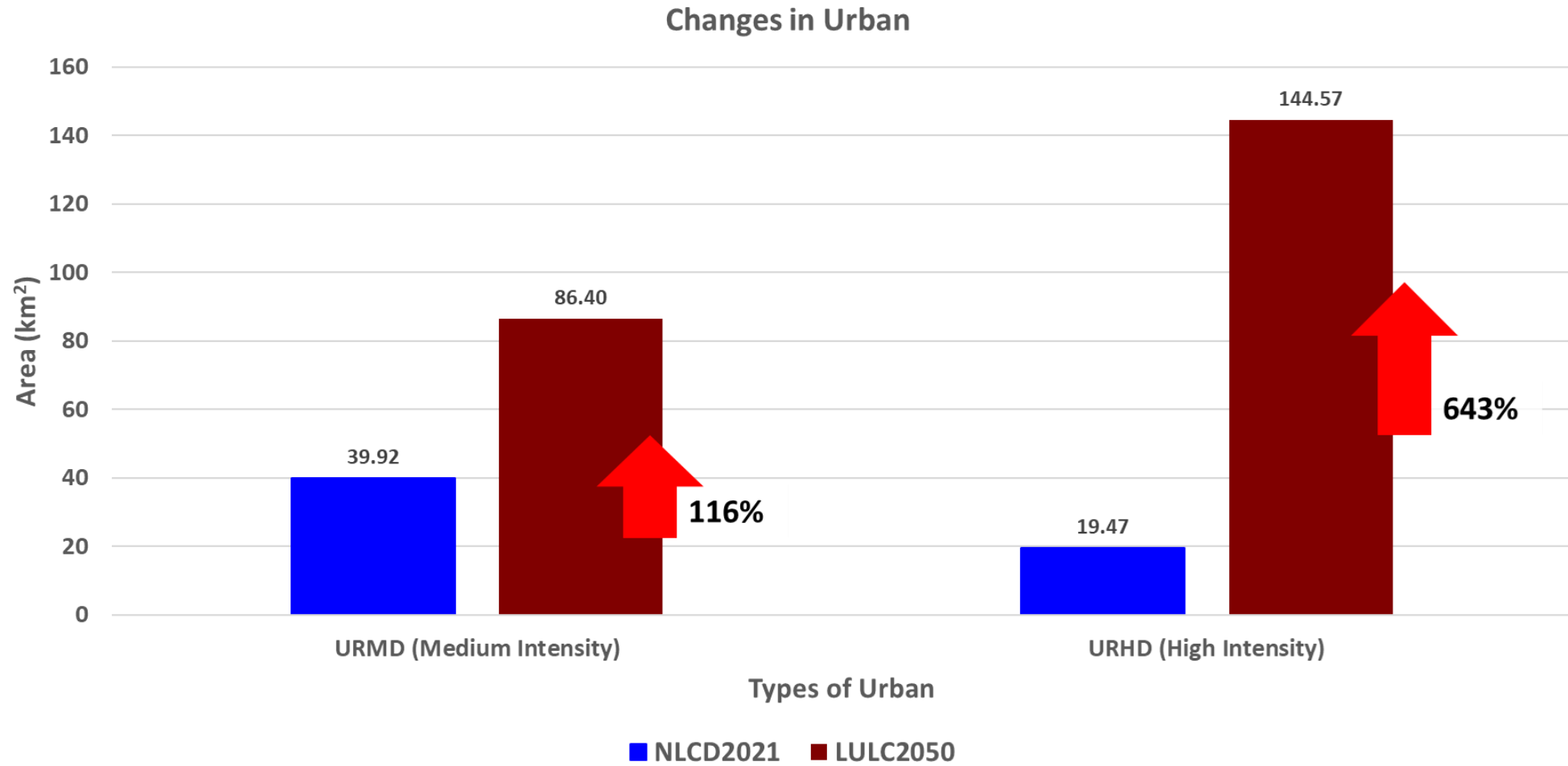
- Urban
- Forest
- Agriculture
- Pasture
- Wetland
- Water

LULC2050



- Urban
- Forest
- Agriculture
- Pasture
- Wetland
- Water

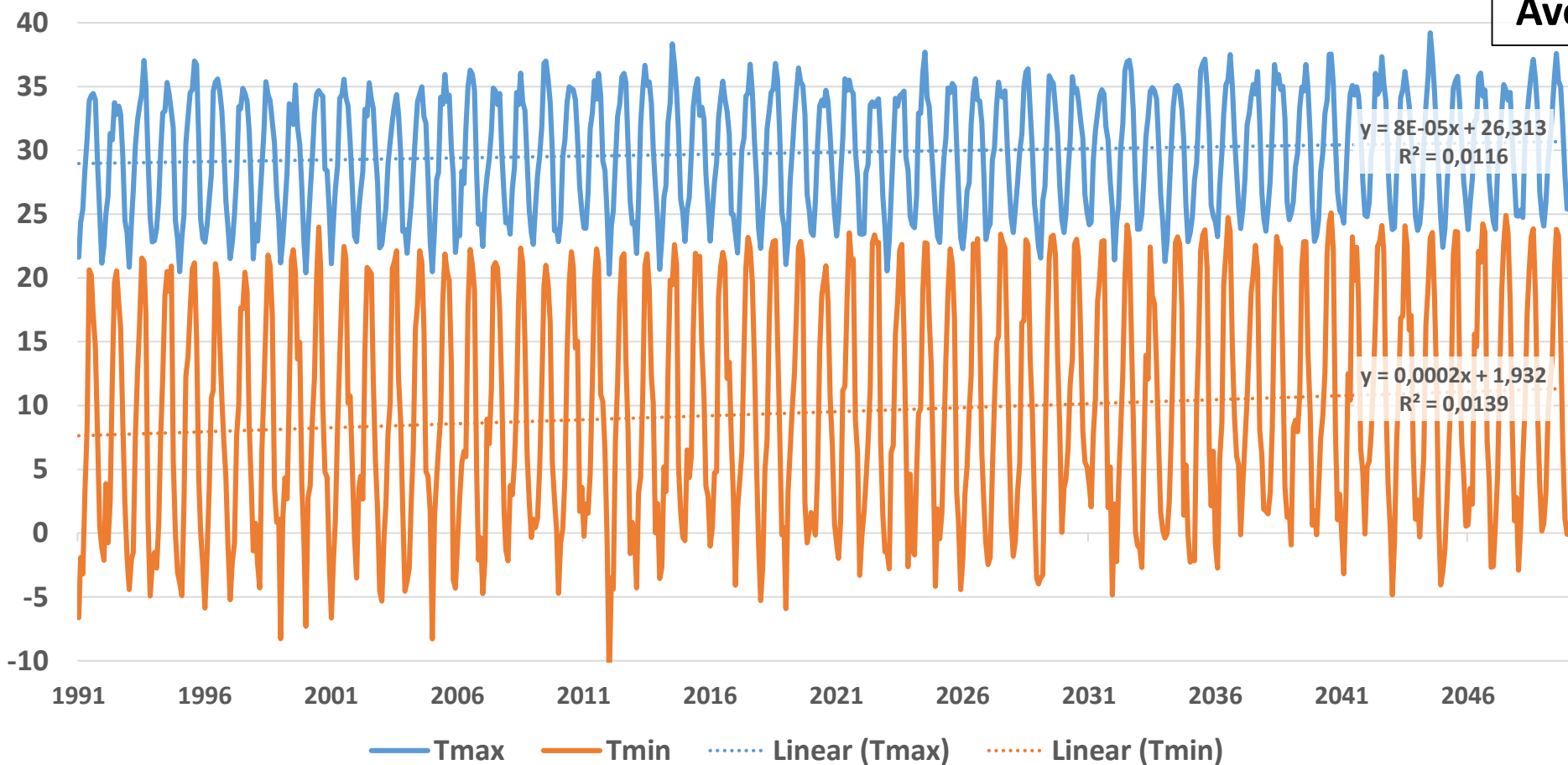
Urban Density



Temperature and Climate



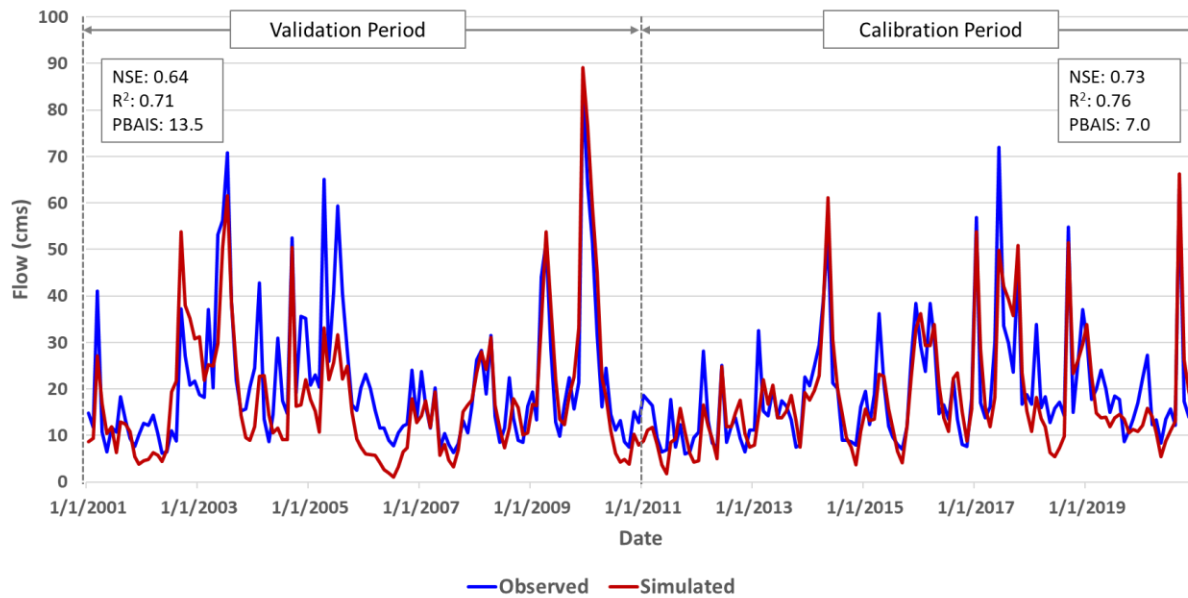
Temperature (degree C)



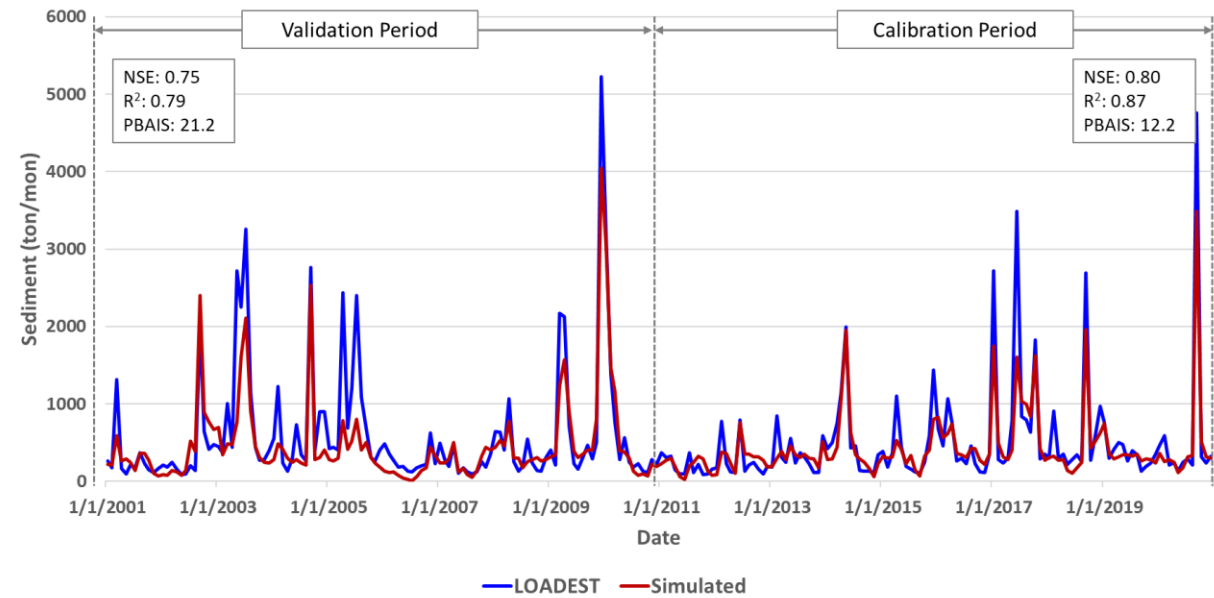
Average Annual PCP: +107 mm

Historical Period		Future Period	
Tmax (degreeC)	Tmin (degreeC)	Tmax (degreeC)	Tmin (degreeC)
25.35	15.38	26.24	16.98
0.89 ↑		1.60 ↑	

Model Calibration

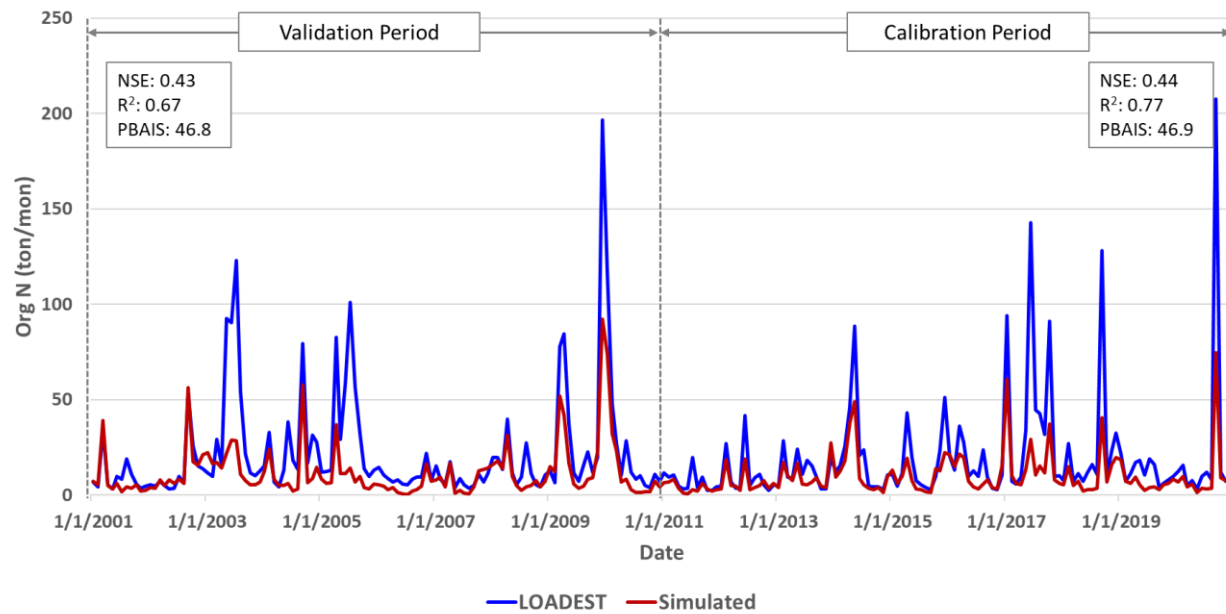


Flow

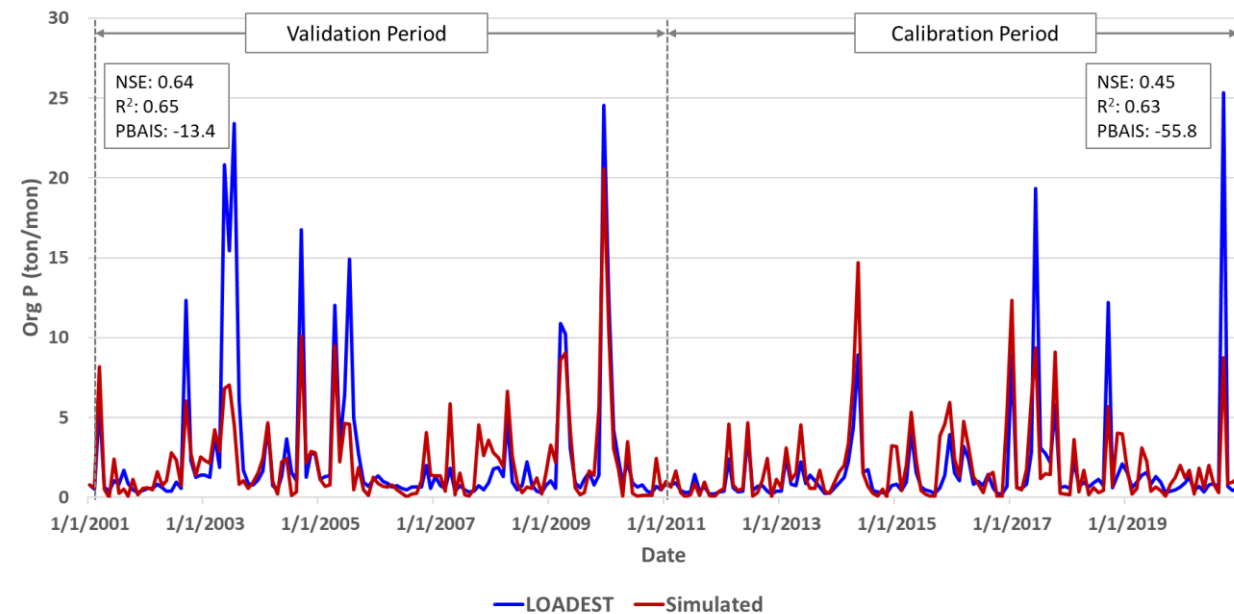


Sediment

Model Calibration

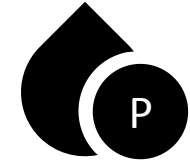
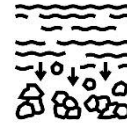


Organic N



Organic P


Water Quantity & Quality Changes




	Flow (m ³ /s)	Sediment (mg/l)	T-N (mg/l)	T-P (mg/l)
Historical Period (1991 – 2020)	41.6	5.6	0.59	0.11
Future Period (2021 – 2050)	47.5	23.9	1.00	0.64
Increase rate	14%	329%	70%	476%

Conclusion



 Stakeholders prefer to sell their land to developers rather than converting to pasture

 We did not find increase in number of hurricanes but found increase in hurricane related precip.

 Future climate and projected LULC changes significantly impact water quality and water quantity

 Future efforts will extend this work to the whole the Northern Gulf of Mexico