Evaluating the Impacts of Future Land Use and Climate Change on Highly Developed Coastal Basin

Yvanna Serra[1], Enrique Orozco López[1], David Kaplan[1]
University of Florida, Engineering School of Sustainable Infrastructure and Environment[1]

INTRODUCTION

- **Coastal watershed** are critical for supplying water, sediments, and nutrients to near-shore environments like estuaries, beaches, and marine habitats.
- Anthropogenic activities like **mining**, **agriculture** and **urban expansion** affect coastal watersheds, and therefore the coast.
- Excess nutrients in coastal watersheds can cause an **increase** in the **algae population** of coastal areas.

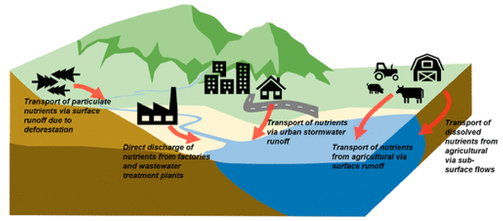


Figure 1. Key sources and transport pathways of nutrients in watersheds (Environ. Sci. Technol. 2020, 54, 15, 9159–9174).

METHODS

- A hydrologic model of the Peace River basin was developed using the Soil and Water Assessment Tool (SWAT).
- SWAT uses information about watershed soils, topography, land use, and climate to calculate river flow and nutrient flux.
- The Peace River model, derived from a DEM, comprises 82 subbasins and 8 Flow Calibration Stations.

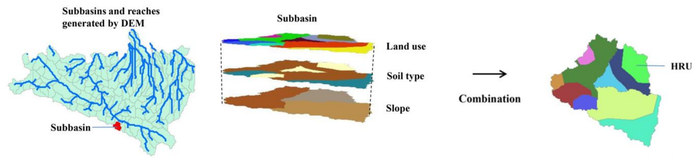


Figure 2. SWAT input layer and processing (Zhang et al. 2017).

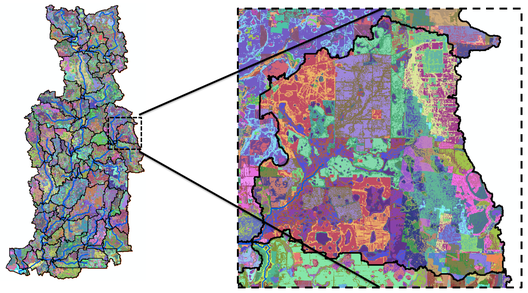
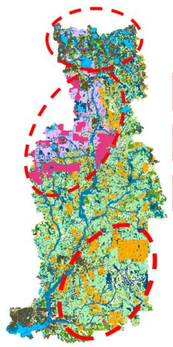


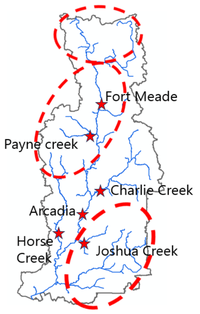
Figure 3. Peace River calibration stations and SWAT "Hydrological Response Units" (n=7926). .

DATA

Land use

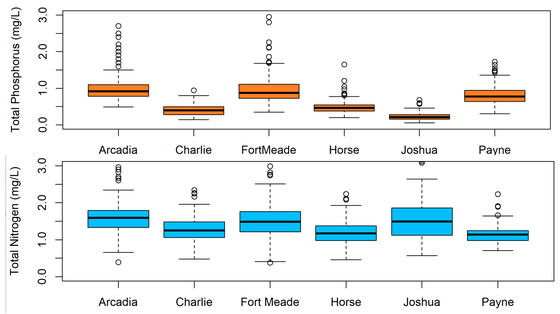


Land Use	(%)
Residential low density	9
Residential high density	2.9
Industrial	0.6
Mining	5
Reclaimed	5.4
Bermudagrass	7.3
Pasture	27.9
Oranges	12.1
Forest-evergreen	3.9
Forest deciduous	2.2
Water	4.6
Wetland-forested	9.6
Wetland-Non-Forested	9.4



The dominant land cover is agricultural activities (40%).

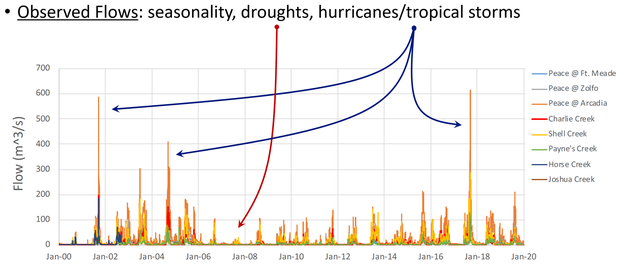
Nutrients



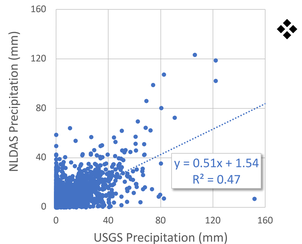
- Relationship between land use and nutrients concentration can be notice.

Streamflow

- Observed Flows: seasonality, droughts, hurricanes/tropical storms

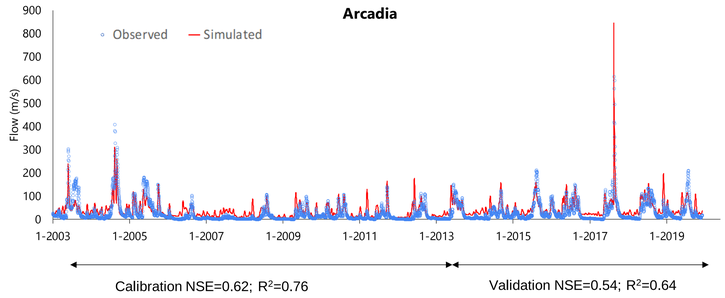


Weather

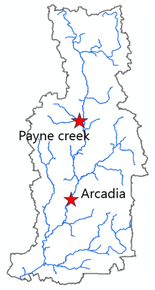


- Weather data was extracted from NLDAS. and compare with weather station data.

RESULTS



- Initial calibration and validation of the streamflow at Arcadia is the lowest point in the main channel.
- Variation could be due to using NLDAS weather.



SCENARIOS

Different scenarios were proposed:

- Base: Actual state
- RCP 4.5 & 8.5 wettest: GCM with highest precipitation.
- RCP 4.5 & 8.5: GCM with lowest precipitation.
- BMP: Best Management Practices on citrus and grazing.
- FDACS 2070 Trend: Increase in urban areas.
- FDACS 2070 Alternative: Protected areas and more compacted population.
- FSAID 2045: Irrigation increases.
- No septic tanks.

Scenarios	IPCC Scenarios	Land Use	Flow	Nutrients concentration
1	Base	No change	**No change**	**No change**
2	RCP 4.5 wettest	No change	**Increase**	**Decrease**
3	RCP 4.5 driest	No change	**Decrease**	**Increase**
4	Base	FDACS 2070 Trend	**Decrease**	**Increase**
5	Base	FDACS 2070 Alternative	**Decrease**	**Increase**
6	Base	FSAID 2045	**No change**	**No change**
7	Base	BMPs	**No change**	**Decrease**
8	Base	No septic	**No change**	**Decrease**
19	RCP 8.5 wettest	No change	**Increase**	**Decrease**
10	RCP 8.5 driest	No change	**Decrease**	**Increase**
11	Base	FDACS 2070 Trend	**Decrease**	**Increase**
12	Base	FDACS 2070 Alternative	**Decrease**	**Increase**
13	Base	FSAID 2045	**Decrease**	**Increase**
14	Base	BMPs	**Decrease**	**Decrease**
15	Base	No septic	**Decrease**	**Decrease**

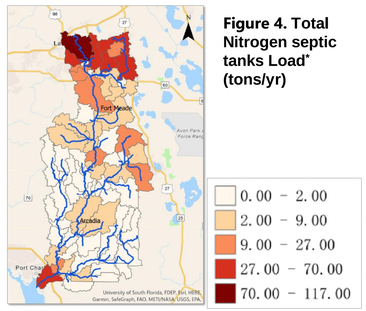


Figure 4. Total Nitrogen septic tanks Load* (tons/yr)

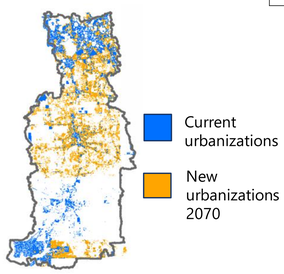


Figure 5. FDACS 2070 Trend

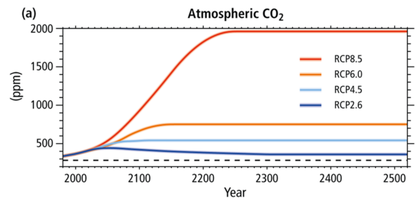


Figure 6. FDACS 2070 Trend

NEXT STEPS

Fig 7. The upper Peace River (FDEP 2022)

- Estimates of nutrient load sources, including the septic tank, agriculture and mining nutrients loads.
- Apply the calibrated model to understand how different land-use and climate change scenarios affect Peace River flow and nutrient fluxes.
- Connect simulated flows and loads to coastal model.

ACKNOWLEDGMENTS & REFERENCES

This work is funded by the Florida Department of Environmental Protection under AGREEMENT NO. LPR0017

Southwest Florida Water Management District. (2022). Peace River Watershed Excursion. Retrieved from Southwest Florida Water Management District, Florida Department of Environmental Protection. (2022). Explore Peace River. Retrieved from Florida State Parks: