

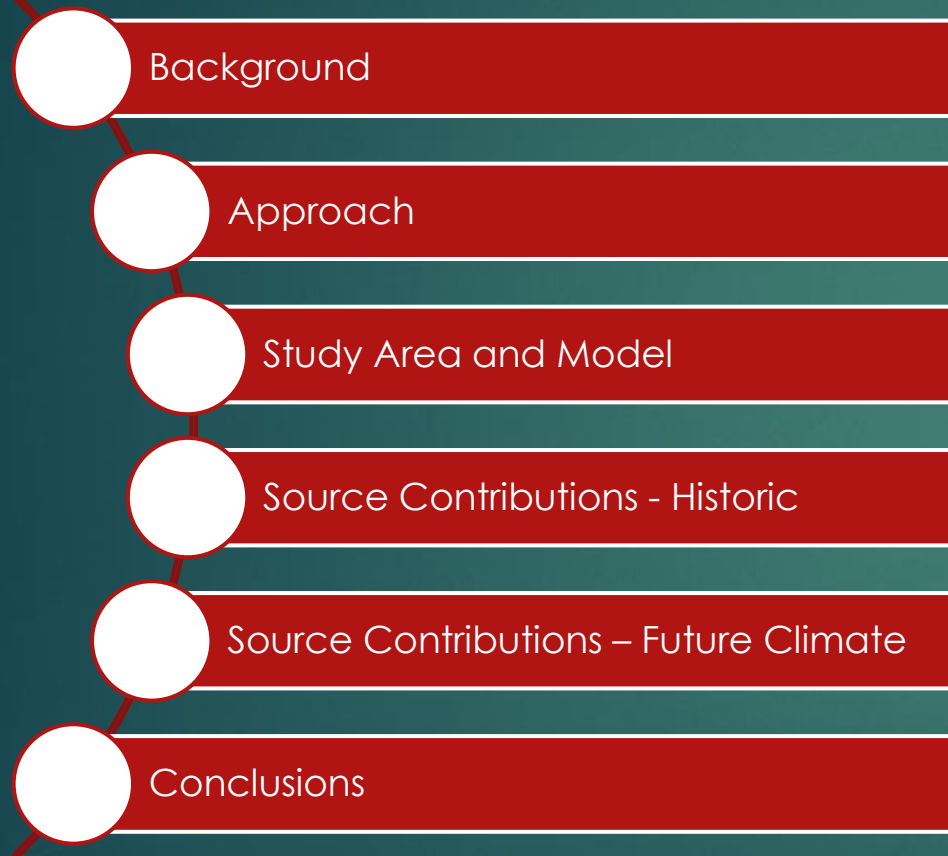


PHOSPHORUS SOURCE CONTRIBUTIONS UNDER CURRENT AND FUTURE CLIMATE IN A LAKE OKEECHOBEE SUBWATERSHED

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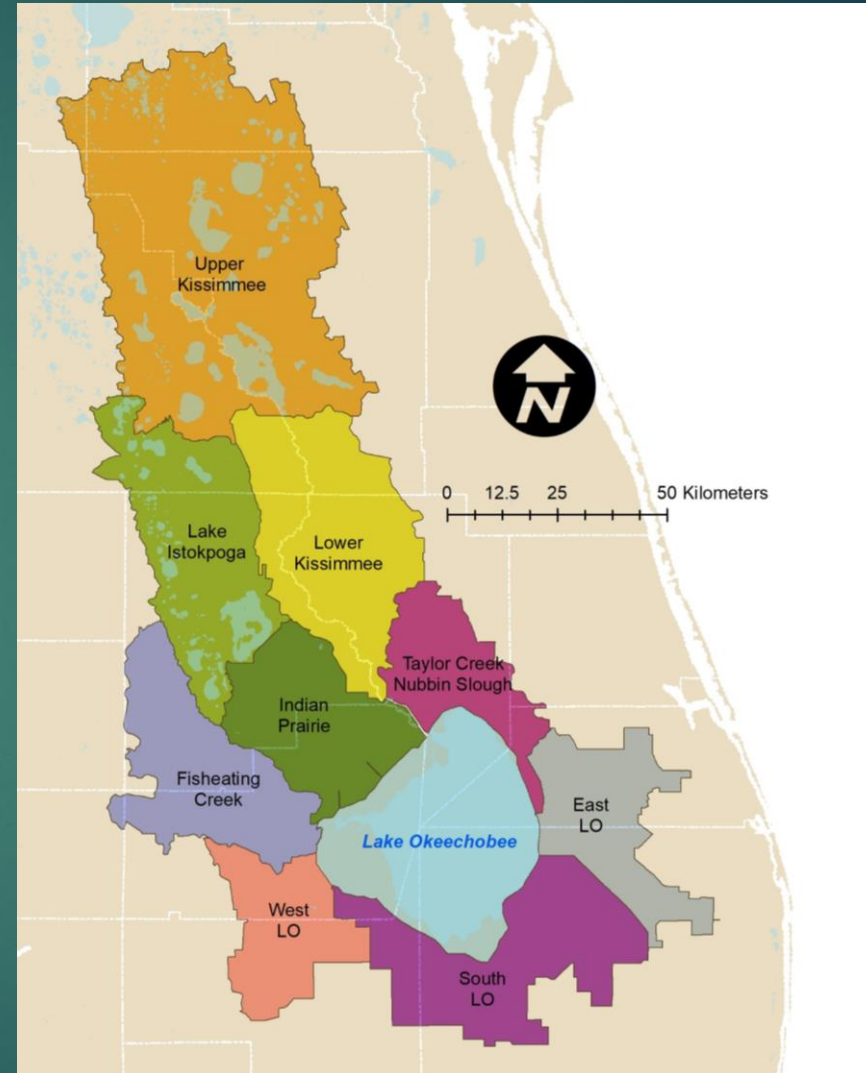
Outline



- Legacy P is a global problem, which may become worse with climate change
- Large lag times for water quality improvement
- Watershed simulation models need development
- Legacy P: A big component of TP loads to Lake Okeechobee

Background

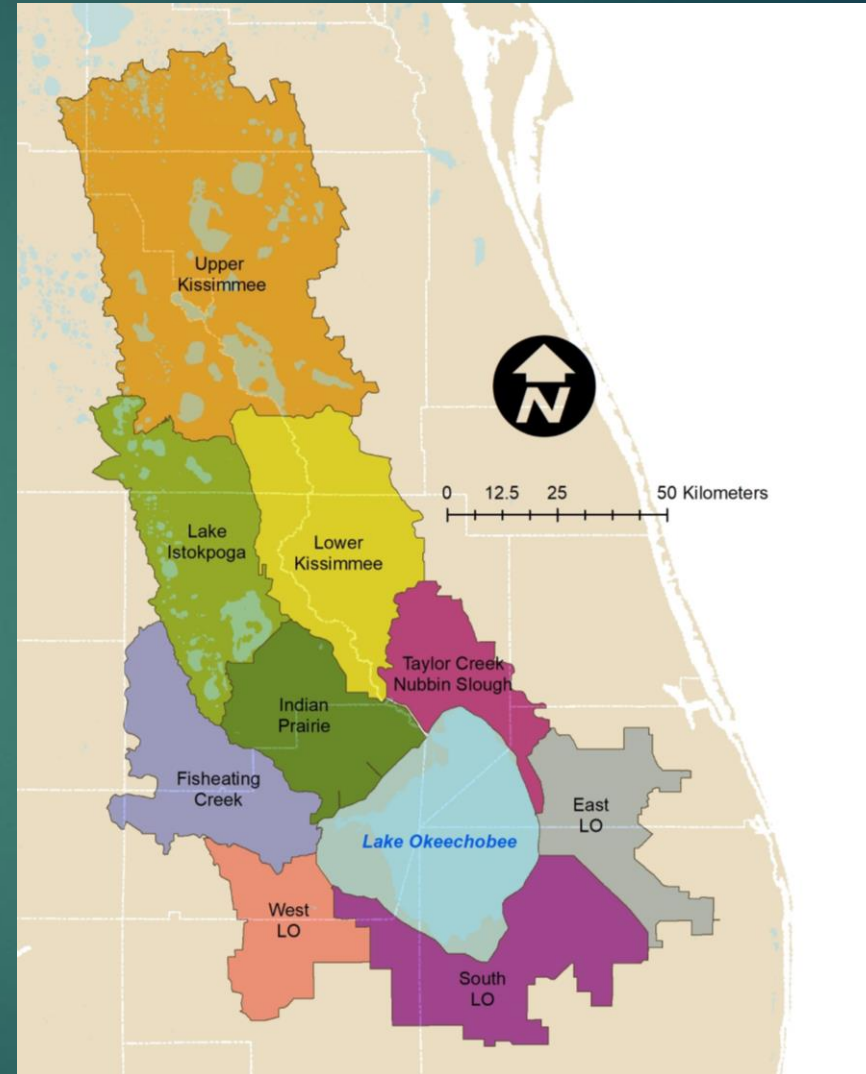
- ▶ Lake Okeechobee Watershed TP TMDL
 - ▶ 105 mt/y TP Load
 - ▶ Current loads: ~4 times
- ▶ Lake Okeechobee BMAP
 - ▶ Focus on identification and effectiveness of projects
- ▶ Legacy P
 - ▶ LO Watershed ~ 180,000 ± 30% mt (SWET and JGH, 2008)



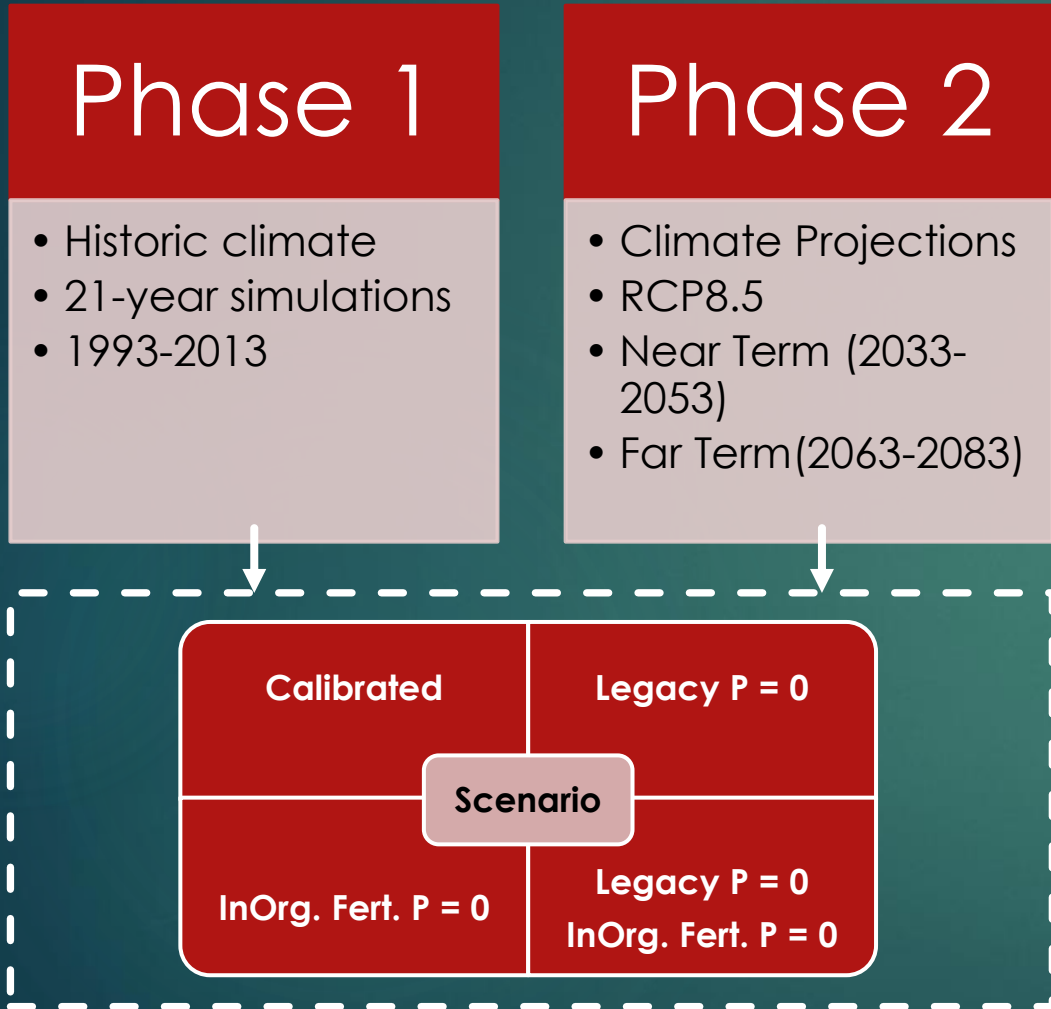
Background

Objectives

1. Quantify contribution of legacy, inorganic fertilizer, and other P sources to existing TP loads
2. Estimate potential impact of climate change on source contributions



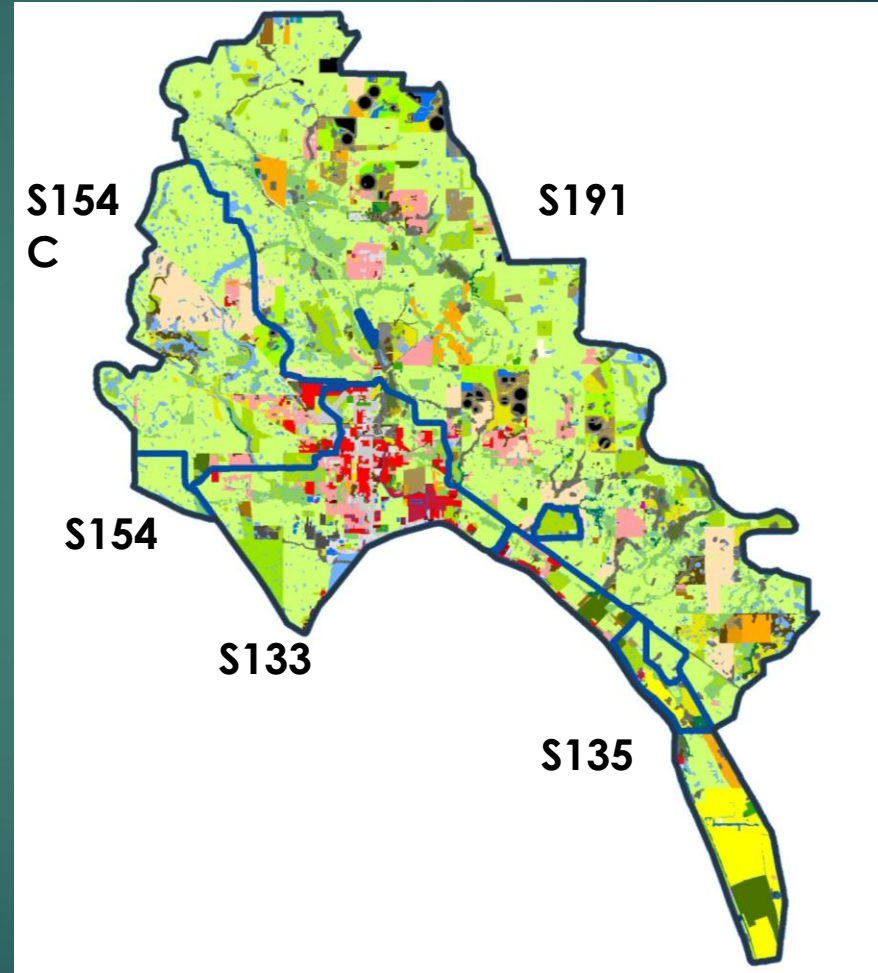
Approach



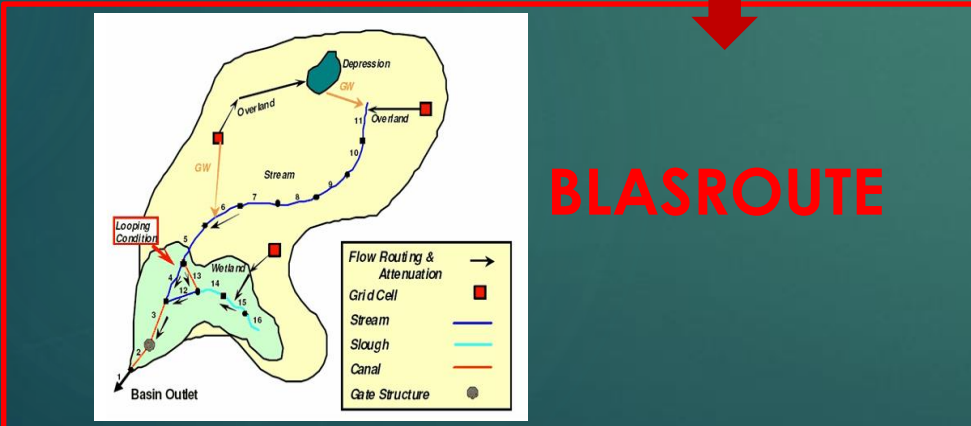
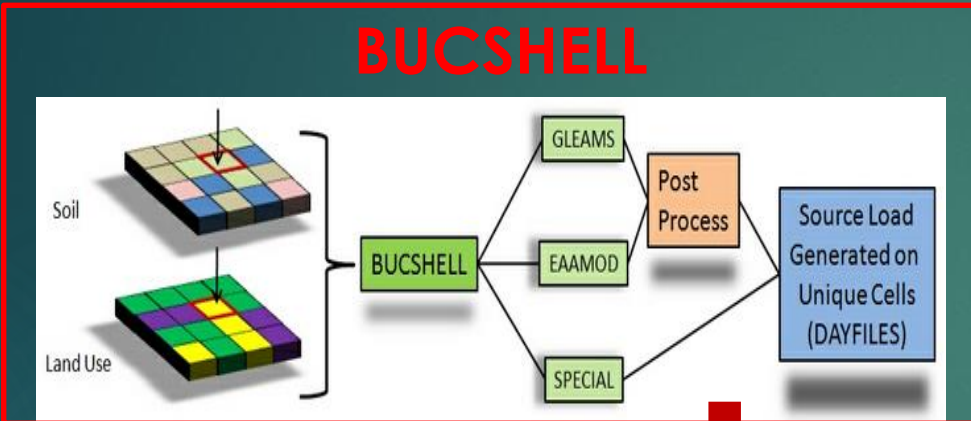
- ▶ Watershed Assessment Model (WAM)
- ▶ Scenario analysis approach to apportion TP loads to source types
 - ▶ Legacy P, inorganic fertilizer P, other sources
- ▶ Test Case: Taylor Creek Nubbin Slough

Study Area

- ▶ Drainage Area ~ 800 sq. km (7% of LOW)
- ▶ TP Hotspot (WY1991-2018)
 - ▶ TP FWMC: 525 $\mu\text{g/L}$
 - ▶ TP Load: 107 mt/y
 - ▶ UAL: 1.33 kg/ha/y
- ▶ LU/LC
 - ▶ Pastures (60%), other Ag. (16%)
 - ▶ Natural (14%)
 - ▶ Urban and built-up (9%)
- ▶ Soils
 - ▶ Immokalee, Myakka, Floridana, Basinger
 - ▶ Sandy, poorly drained



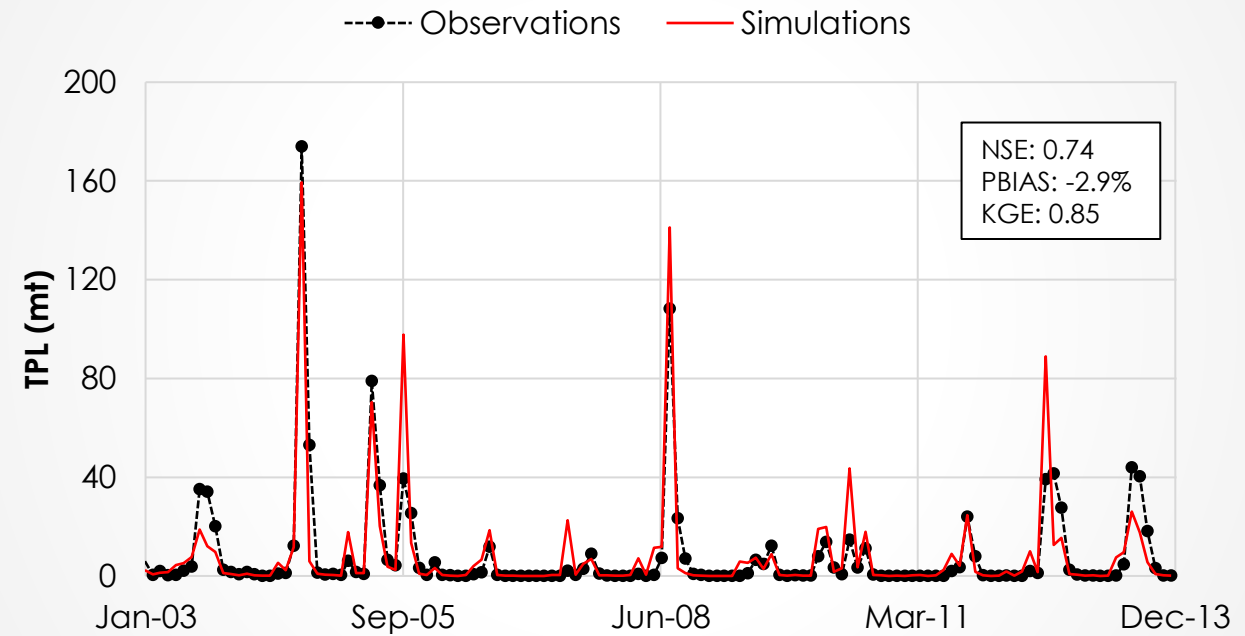
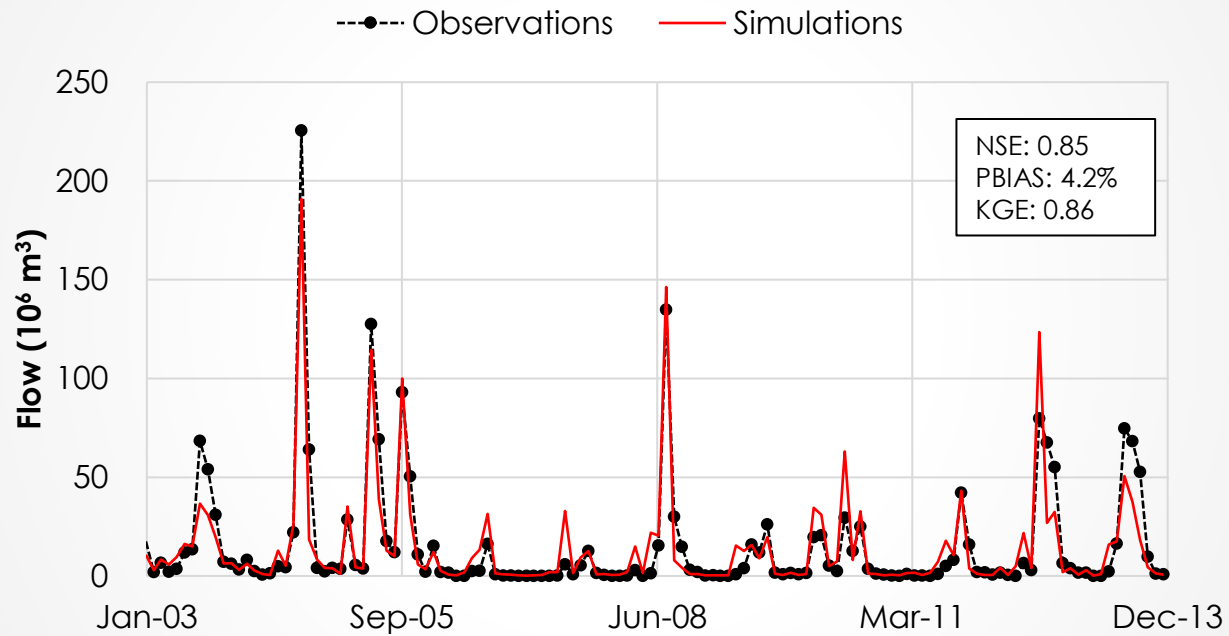
WAM Overview



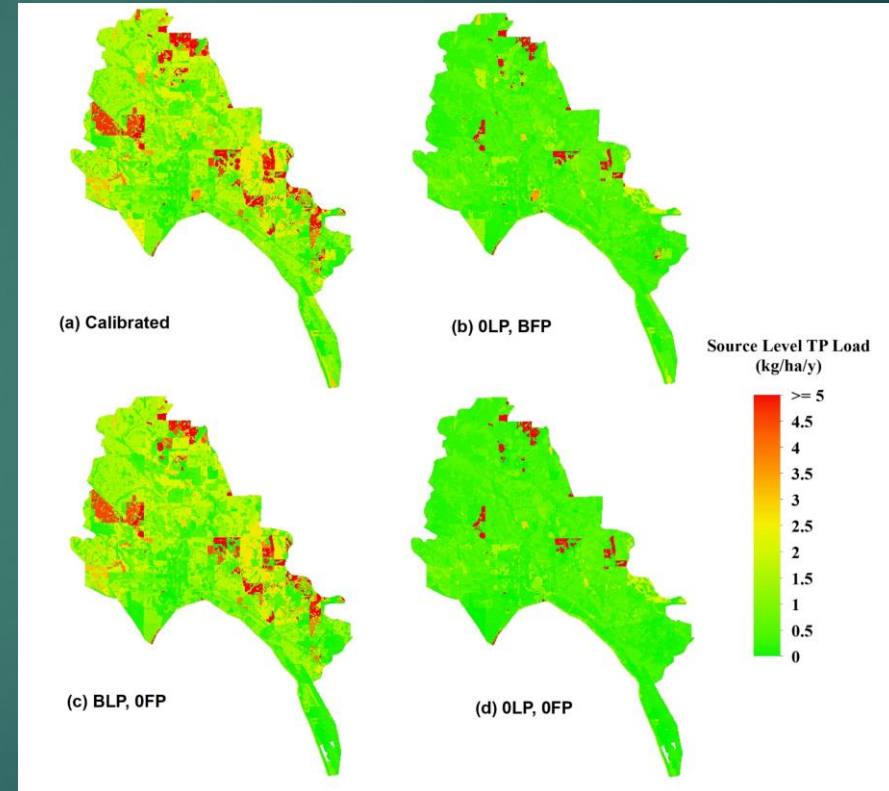
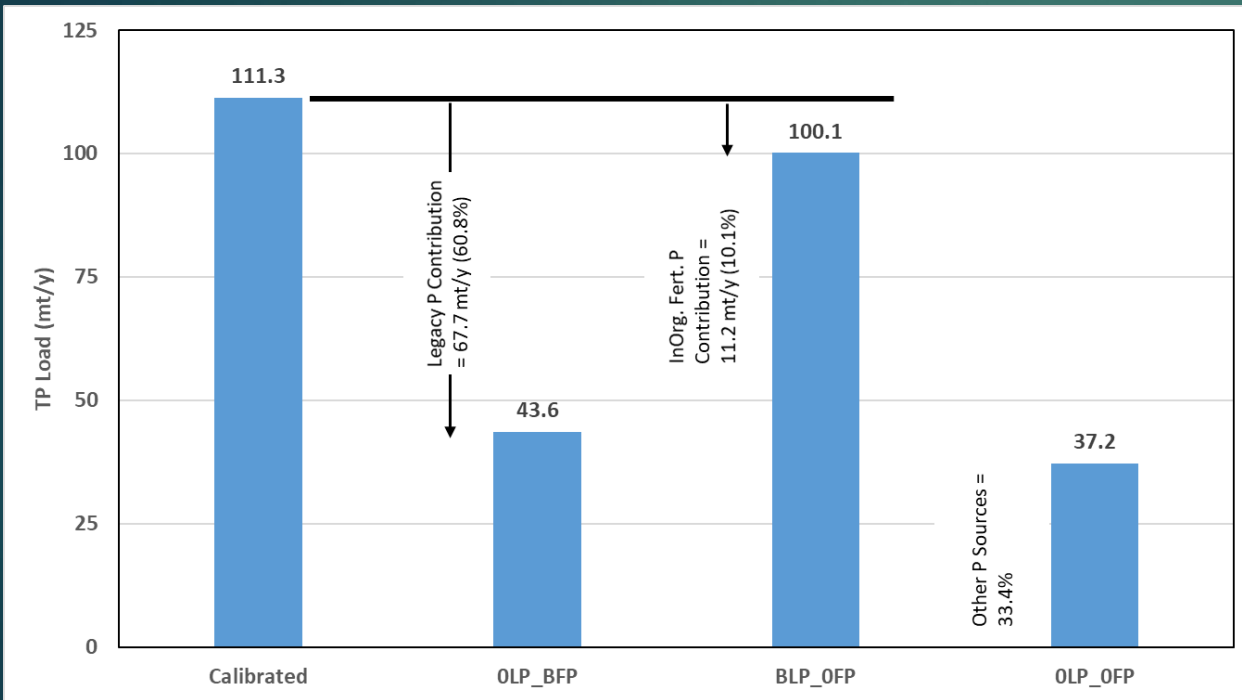
- ▶ Physically-based, spatially distributed, watershed scale
- ▶ Inputs: Soil, LU/LC, Topography, Streams, Rainfall, Weather
- ▶ Source loads: BUCSHELL {GLEAMS, EAAMOD, Special-case}
- ▶ Routing: BLASROUTE
- ▶ TCNS
 - ▶ EAAMOD – 86.4% of model domain
 - ▶ Legacy P
 - ▶ Initial application
 - ▶ Land use based typical values
 - ▶ InOrg. Fert. P and Org. Fert. P
 - ▶ management calendar

Model Performance

Minor re-calibration



Phase 1: P Source Contributions

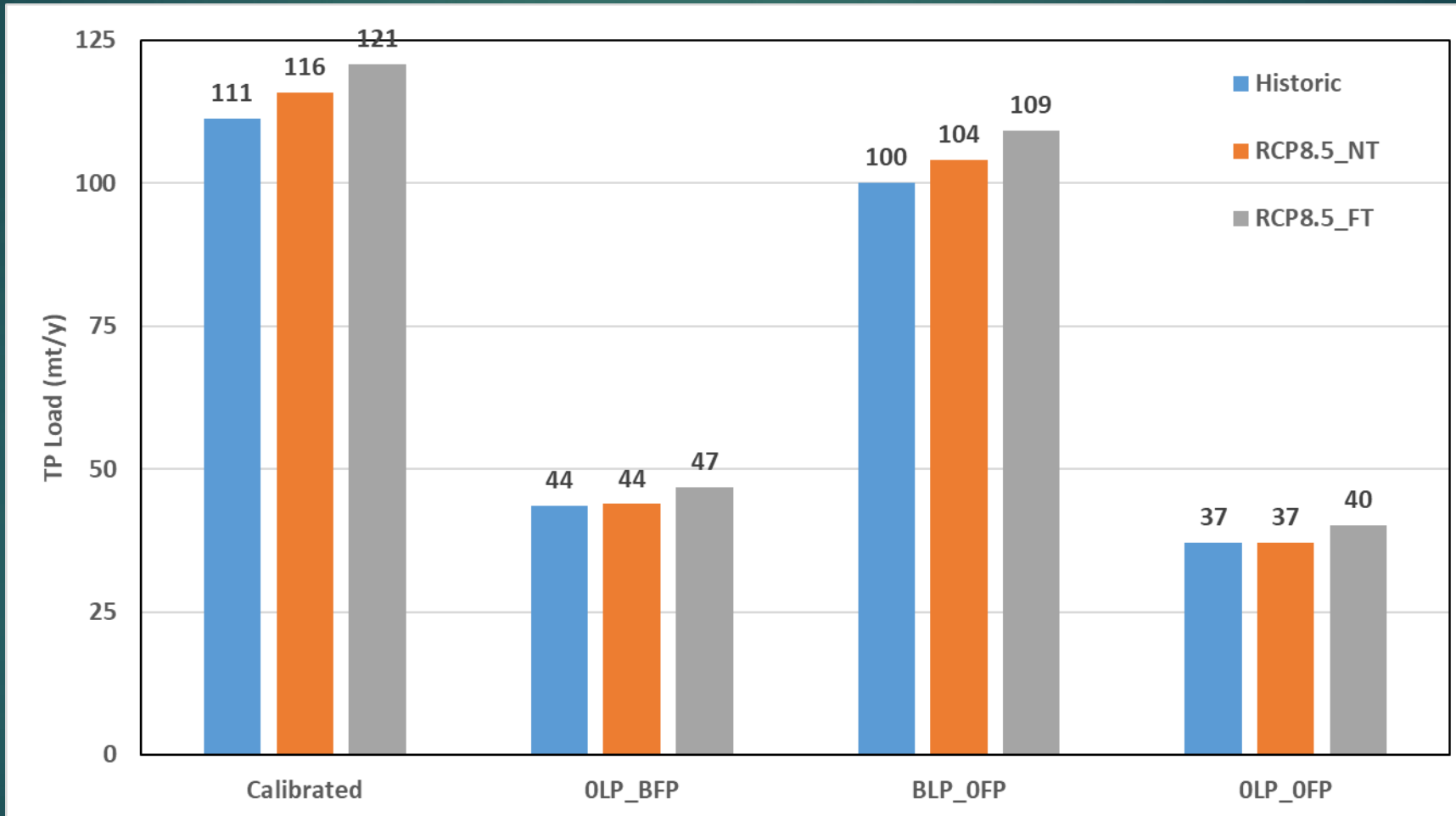


Phase 2: Climate Projections

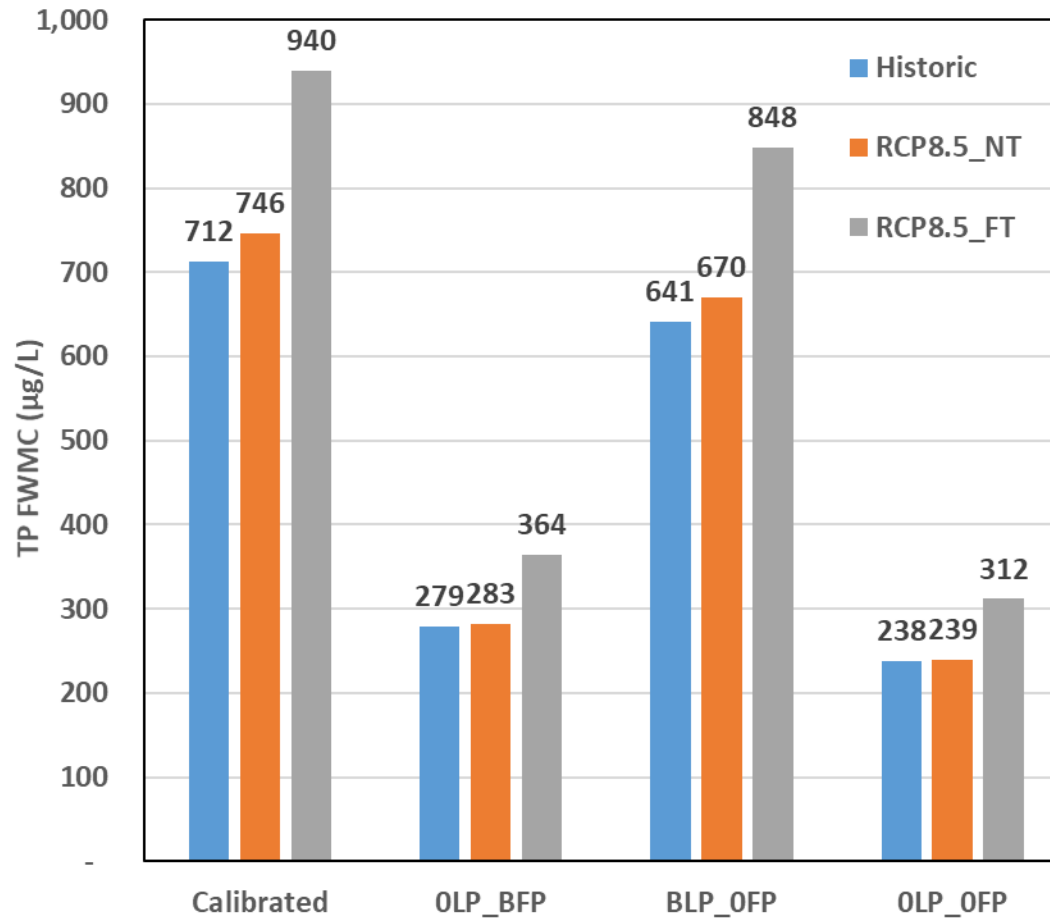
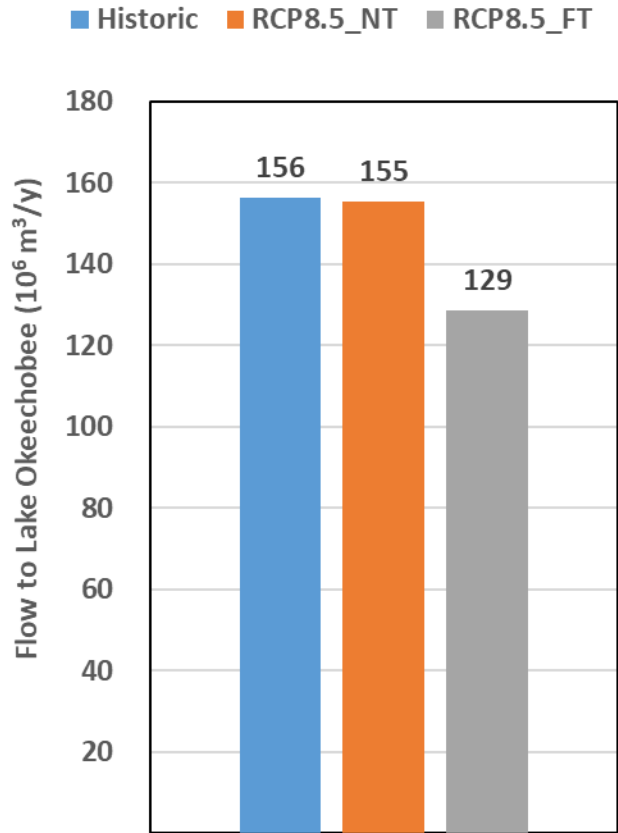
- ▶ Precipitation and Temperature Projections (RCP8.5)
 - ▶ Near Term Future (NT): 2030-2053
 - ▶ Far Term Future (FT): 2060-2084
- ▶ Rainfall and drought characteristics based GCM evaluation methodology (Song et al., 2020)
- ▶ 4 Rainfall GCMs:
 - ▶ Bcc-csm1-1-m
 - ▶ CMCC-CMS
 - ▶ FGLOALS-g2
 - ▶ FGLOALS-s2

	Rainfall	Temperature
Historic (1990-2013)	1173 mm	24.13 °C
NT	896 mm (-23.6 %)	26.16 °C (+2.03 °C)
FT	837 mm (-28.6 %)	28.18 °C (+4.04 °C)

Phase 2: TP Loads



Phase 2: Flows and FWMC



Conclusions

- ▶ Legacy P contributed as much as 60.8% of the TP Load from TCNS
- ▶ GCM projections indicate
 - ▶ Drier and hotter conditions
 - ▶ less flow, but similar TP loads and high concentrations
- ▶ Future investigations
 - ▶ Performing continuous long-term simulations
 - ▶ Legacy P model



Khare, Y.P.; Paudel, R.; Wiederholt, R.; Abiy, A.Z.; Van Lent, T.; Davis, S.E.; Her, Y. Watershed Response to Legacy Phosphorus and Best Management Practices in an Impacted Agricultural Watershed in Florida, U.S.A. *Land* 2021, 10, 977. <https://doi.org/10.3390/land10090977>

Thank You!

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