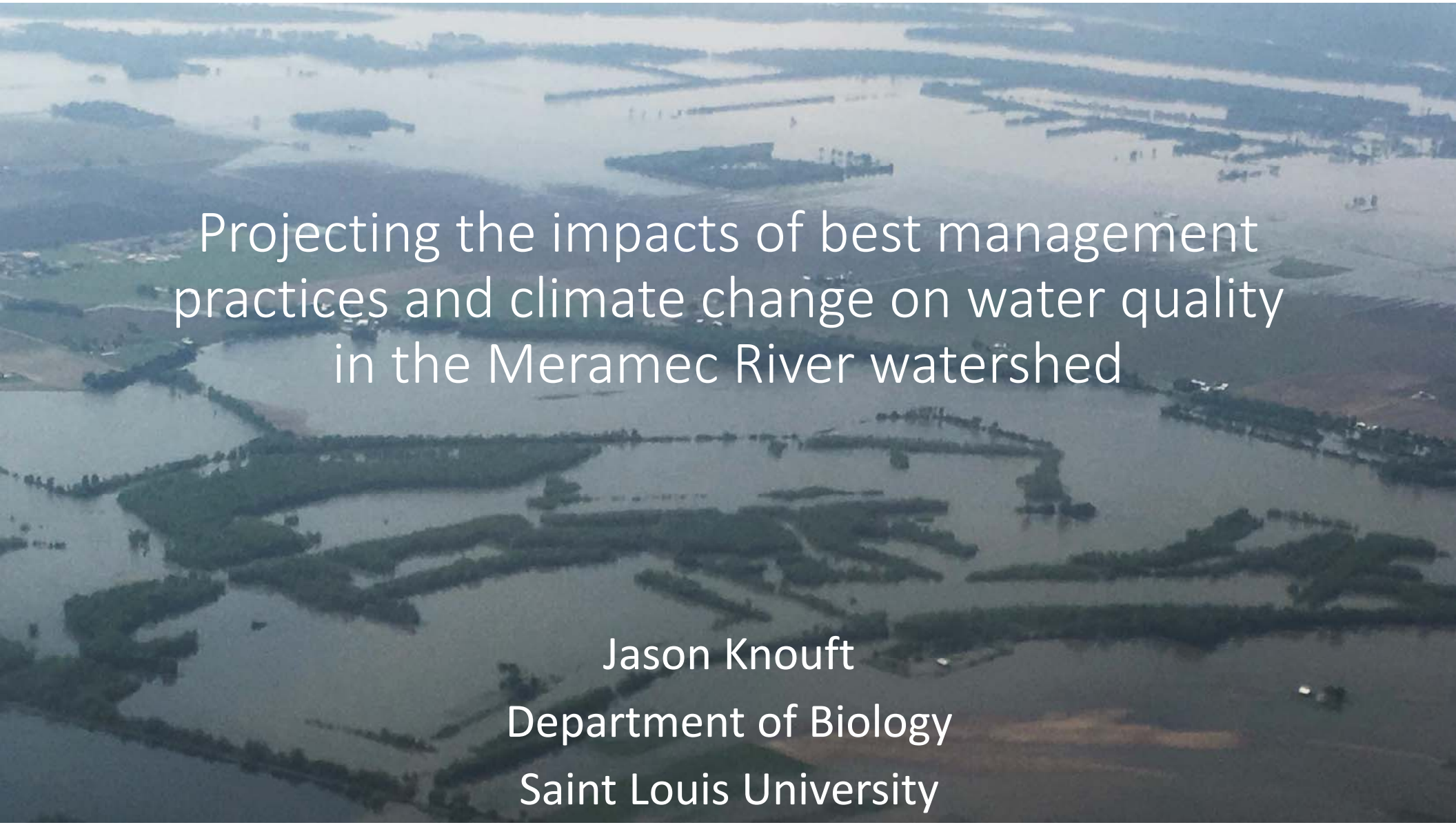

Projecting the impacts of best management practices and climate change on water quality in the Meramec River watershed

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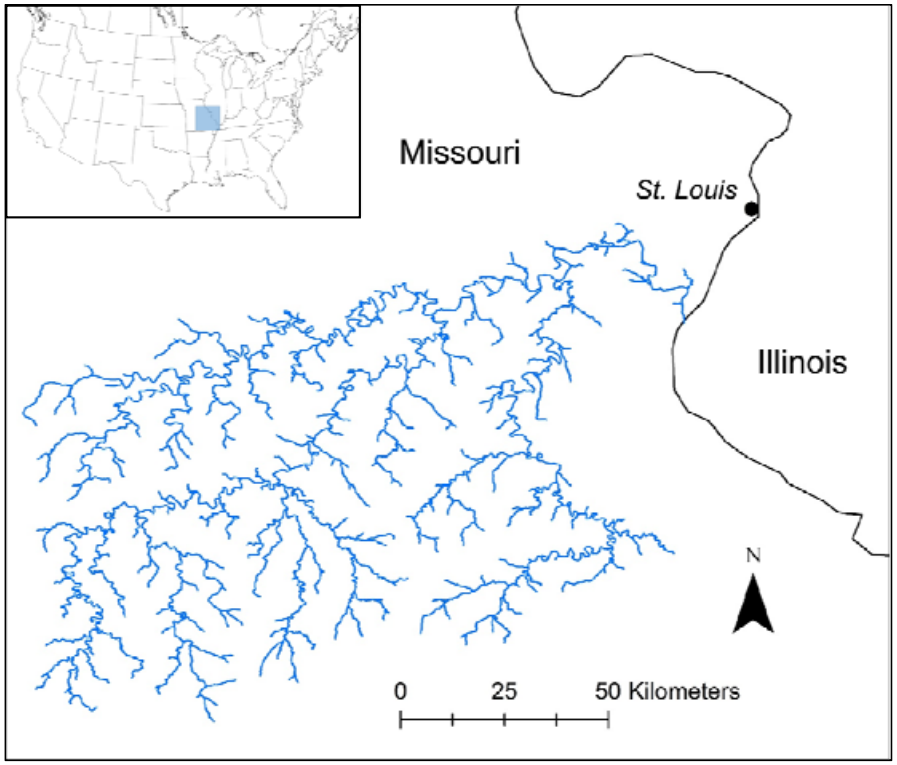
The Meramec River Watershed

- Meramec River, Bourbeuse River and Big River
- Supplies drinking water for ~250,000 people in region
- Economic and recreational importance
- Major Land Use
  - Forest (68%), Pasture (19%), Urban (8%) Agriculture (4%)
- Biologically diverse



Overview

- Goal is to understand how best management practices (BMPs) applied to agricultural and urban areas will impact water quality.

- Will benefits from BMPs be sustained as climate changes?

- How will biodiversity be impacted by changes in physical habitat?

Soil and Water Assessment Tool (SWAT)

- SWAT is a distributed watershed-scale hydrological model

- SWAT predicts the impact of changes in climate, land use and land cover, and agricultural management on water, sediment, and agricultural chemical yields

- Readily available input
  - weather, soils, land use, and topography
  - Precipitation data (10 Stations) and Temperature data (4 stations)

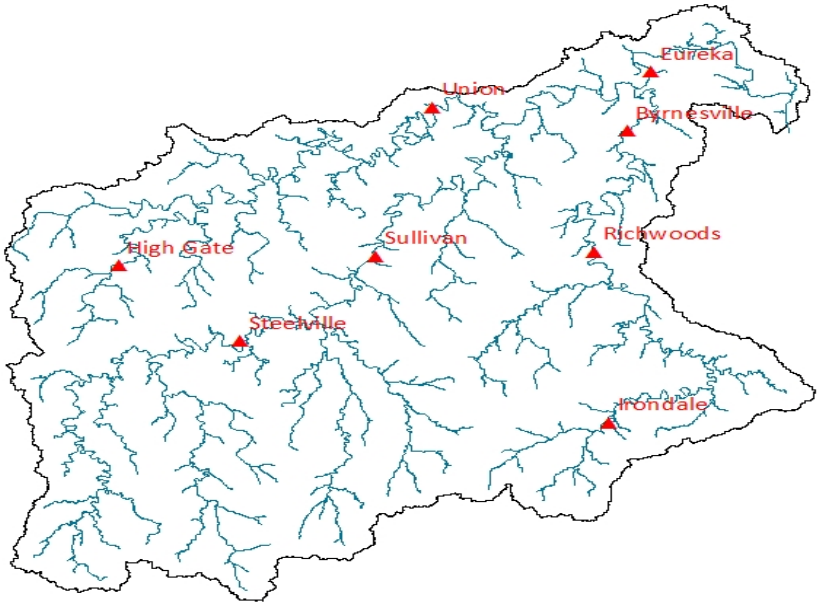
- Long-term simulations

Model Development (cont.)

- Entire basin is divided into 470 subbasins

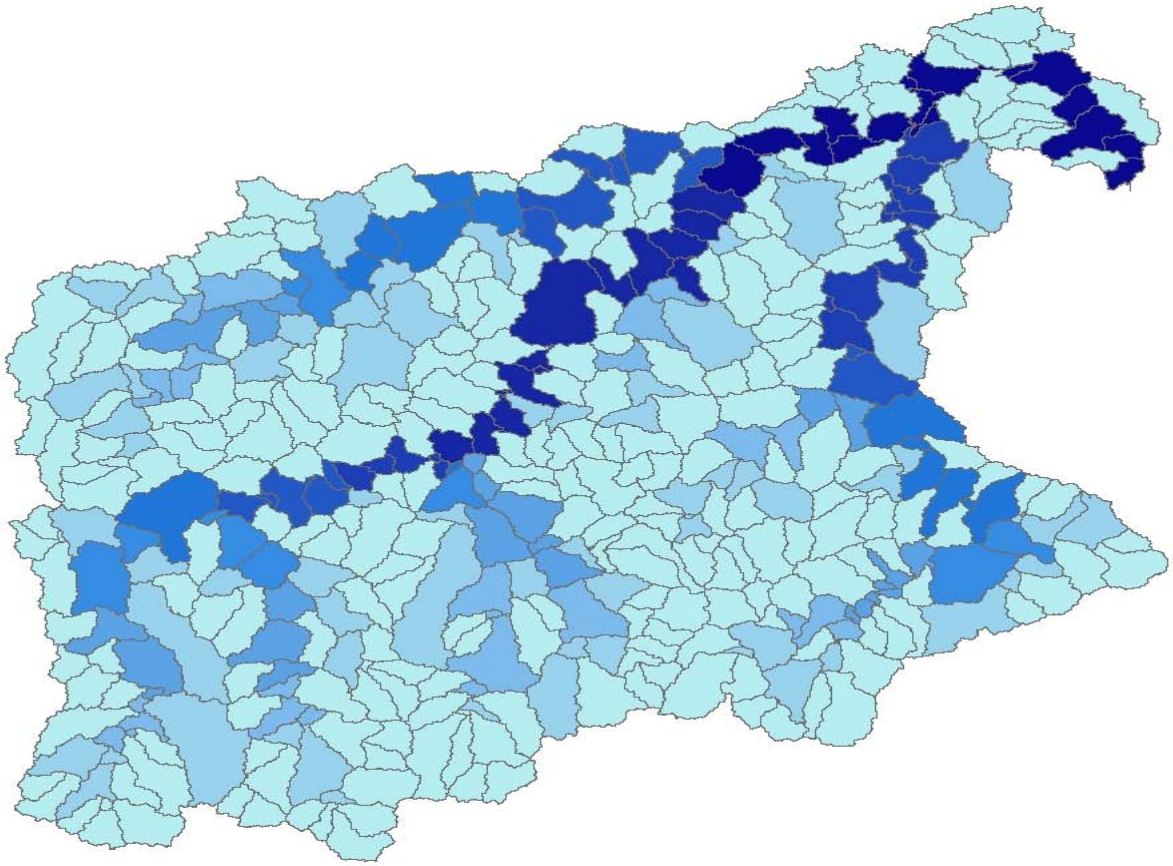
- Calibration Period
  Stream flow: Jan 1996-Dec 2012, Sediment load: Nov 2011-Dec 2012

- Validation Period
  Stream flow : Jan 1981-Dec 1995, Jan 2013-Dec 2014
  Sediment load: Jan 2013-Sep 2013

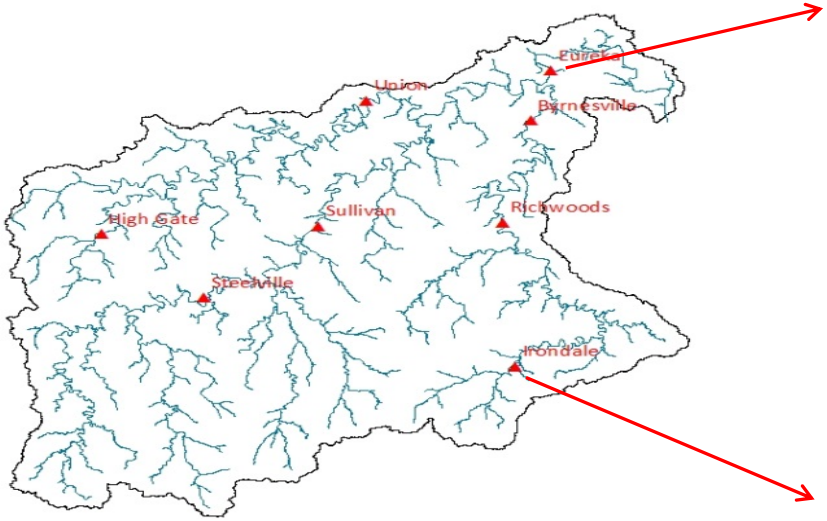


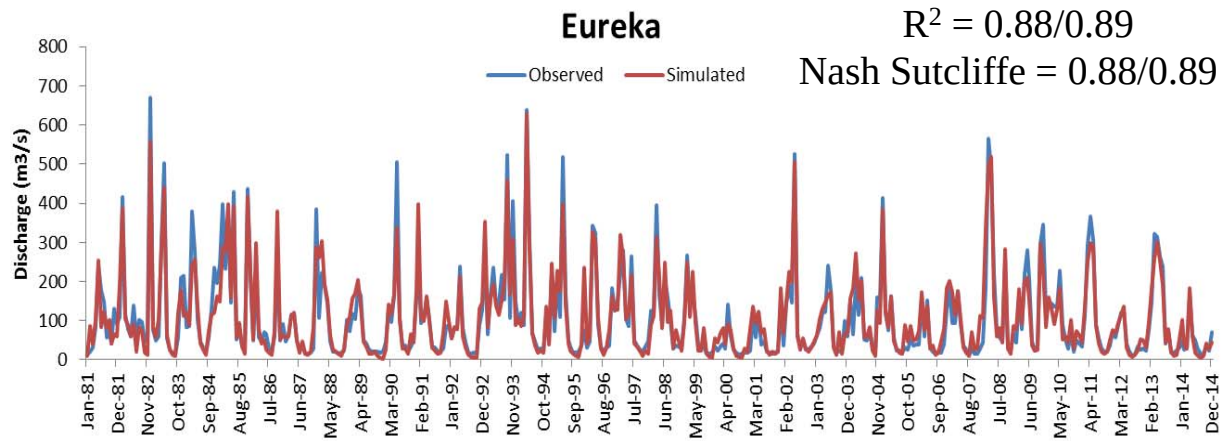
The Meramec River Watershed

Discharge from SWAT
(1981 – 2014)

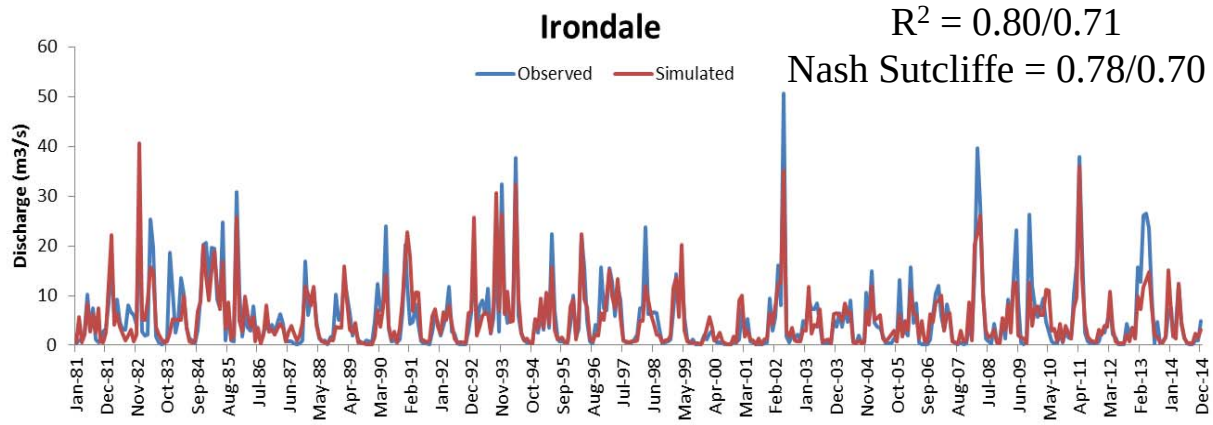


Results – Discharge (Stream Flow)



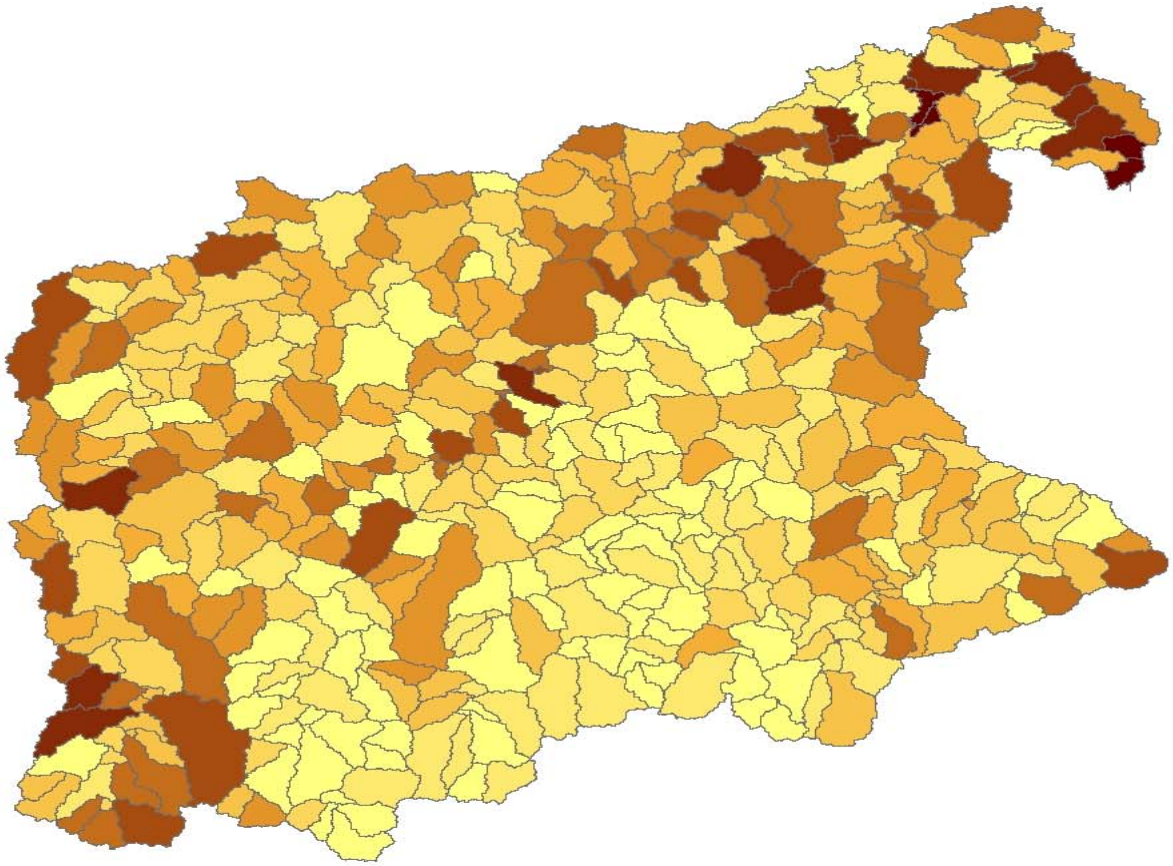


R^2 = 0.88/0.89
Nash Sutcliffe = 0.88/0.89

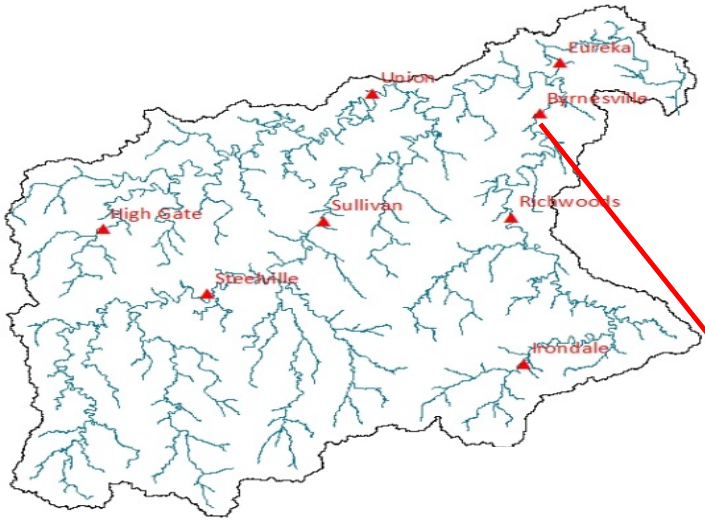


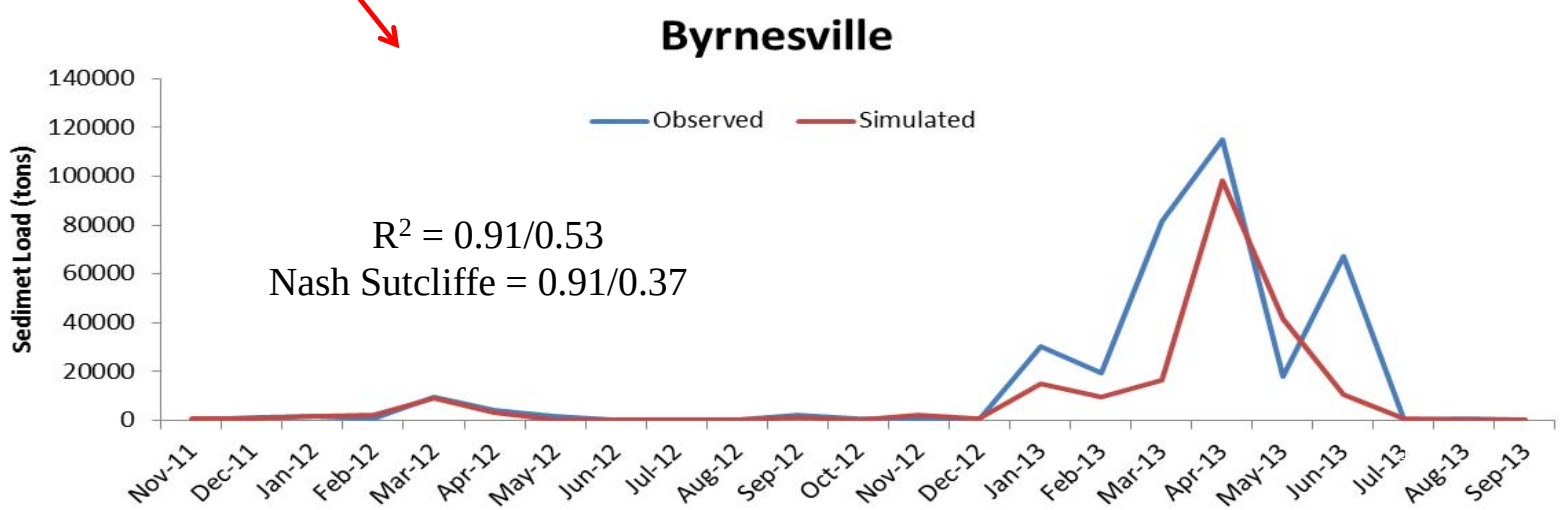
R^2 = 0.80/0.71
Nash Sutcliffe = 0.78/0.70

Total annual sediment from SWAT
(1981 – 2014)



Results – Total Sediment

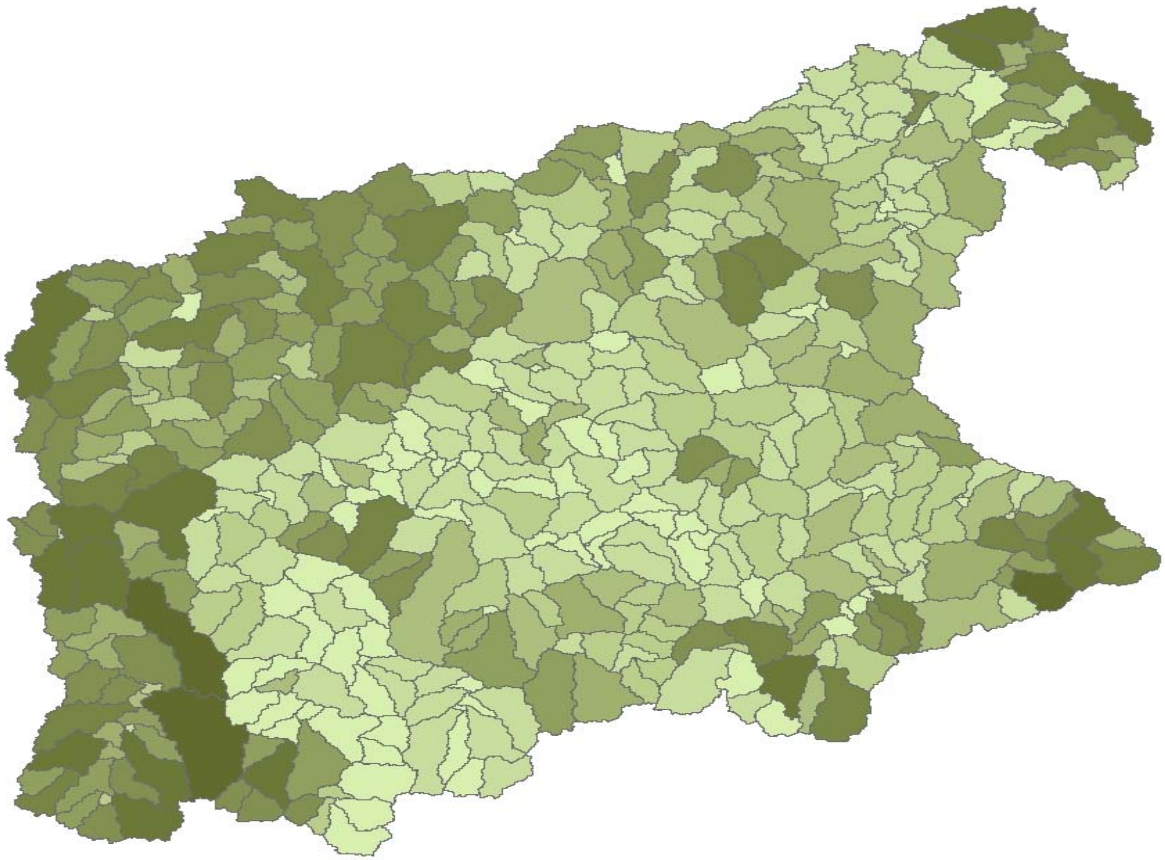




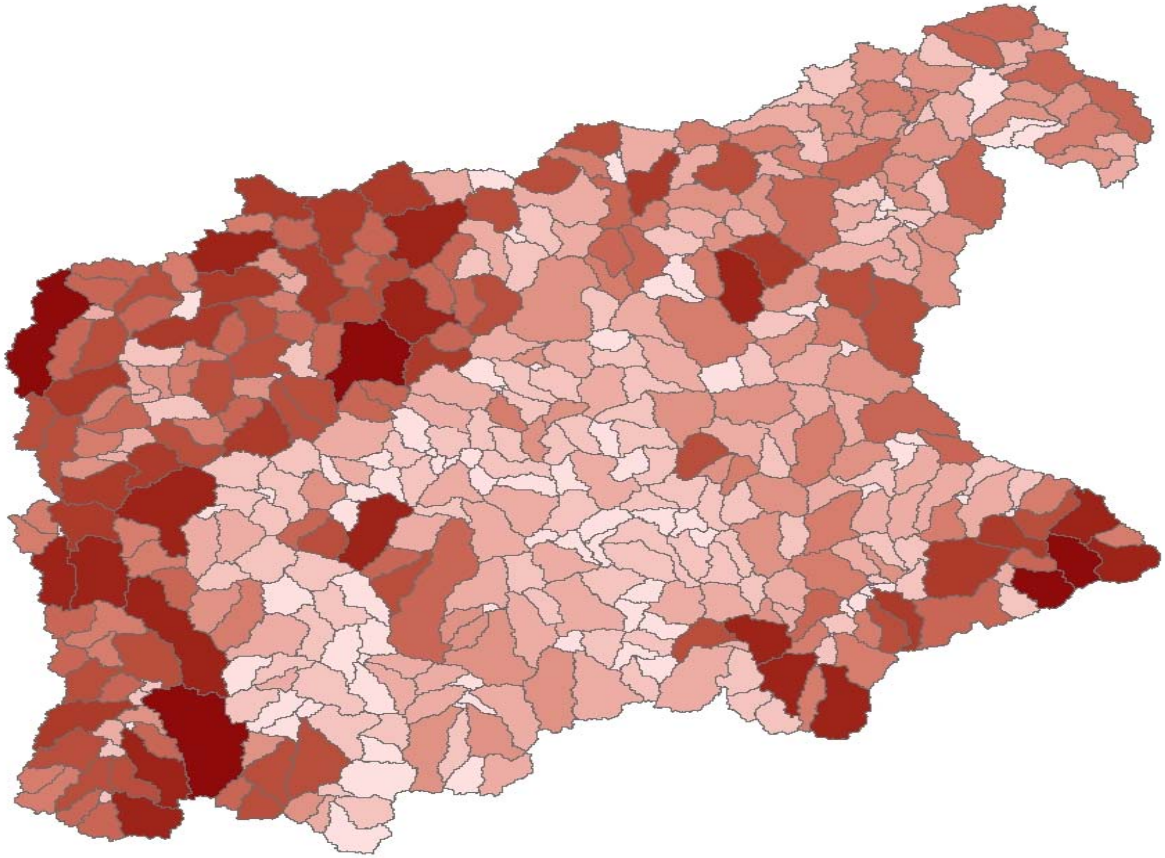
R^2 = 0.91/0.53

Nash Sutcliffe = 0.91/0.37

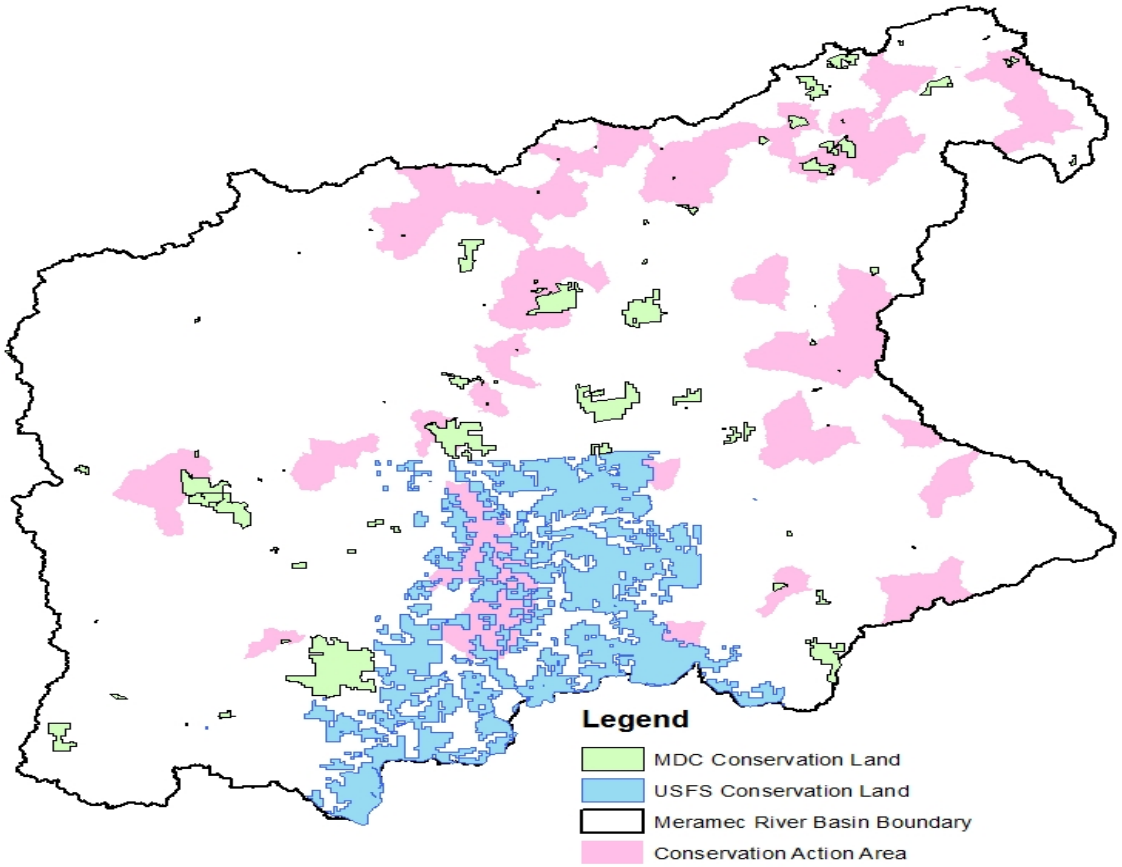
Nitrogen Load from Subbasin from SWAT (1981 – 2014)



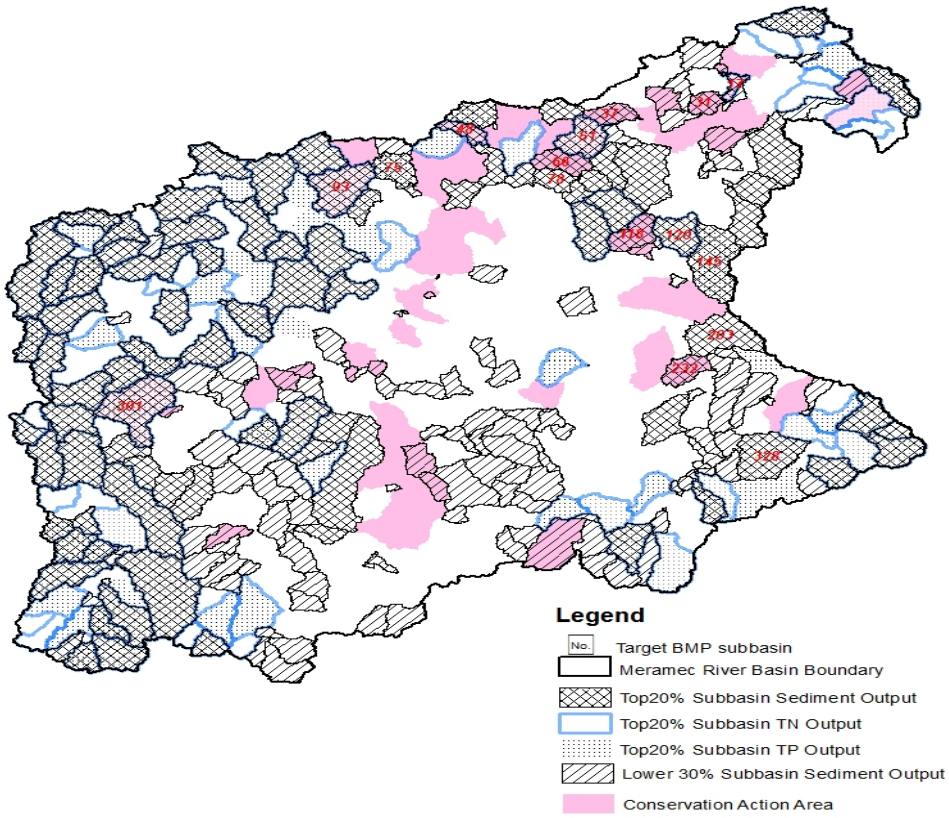
Phosphorus Load from Subbasin from SWAT (1981 – 2014)



Conservation Action Areas & Conservation Land



Biodiversity Hotspots & BMP Subbasins



Subbasin No.	Stream Name	County
17	Meramec River	St Louis
31	Meramec River	St Louis
37	Meramec River	Franklin
48	Bourbeuse River	Franklin
51	Meramec River	Franklin
66	Meramec River	Franklin
75	Bourbeuse River	Franklin
78	Meramec River	Franklin
93	Bourbeuse River	Franklin
118	Maupin Creek	Franklin, Jefferson
120	Big River	Jefferson
145	Dry Creek	Jefferson
203	Big River	Jefferson, Washington
232	Shibboleth Branch	Washington
301	Dry Fork	Crawford, Phelps
328	Big River	St Francois

Best Management Practices (BMPs)

- Riparian Buffer – 100 feet and 300 feet (all)
- Filter Strip (all)
- Grassed Waterway (croplands)
- Terrace (croplands)
- No-Till (croplands)

Results of adding 300 foot riparian buffer

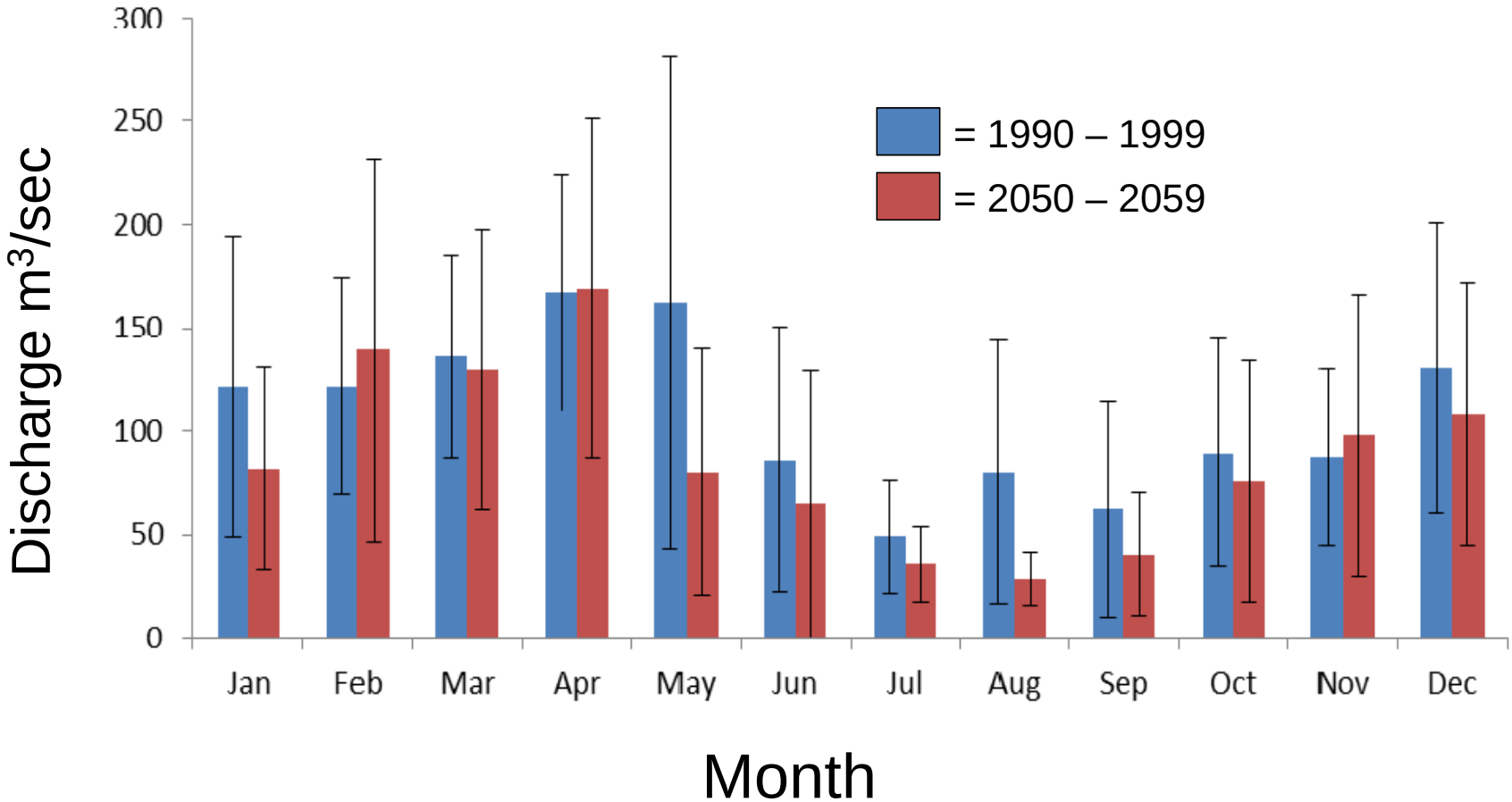
Subbasin	Sediment (%)	Nitrogen (%)	Phosphorus (%)
17	-2.4	-0.7	-1.0
31	-47.0	-11.4	-14.6
37	-69.3	-39.9	-62.4
48	-38.0	-4.3	-9.1
51	-39.1	-3.1	-10.6
66	-61.1	-16.8	-27.1
75	-56.0	-2.0	-15.7
78	-61.7	-18.5	-28.3
93	-40.3	-9.0	-21.1
118	4.5	0.8	1.1
120	-77.4	-68.6	-76.5
145	3.5	0.5	1.2
203	-18.9	-2.6	-4.8
232	26.6	1.2	4.4
301	-76.0	-83.9	-69.5
328	-32.7	-6.6	-9.3

What happens as climate changes?

- Temperature and precipitation regimes change
- Greater seasonality in precipitation and evapotranspiration
- Hydrologic cycle is altered
- Altered runoff patterns

Climate change and streamflows

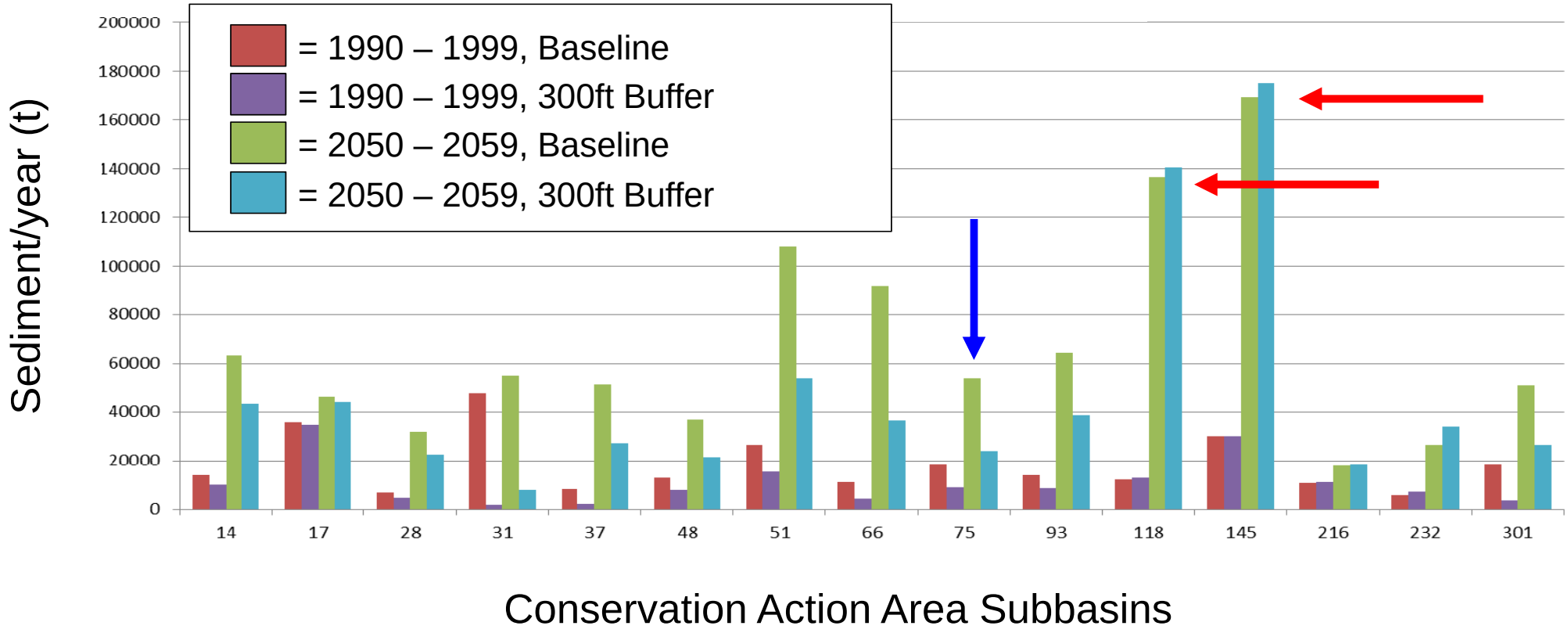
(MIROC5 RCP6.0)



* at mouth of Meramec

Climate change and sediment inputs

(MIROC5 RCP6.0)



Conclusions

- Sediment and nutrient inputs vary across the Meramec watershed
- BMPs likely reduce these inputs, but results vary among subbasins
- Projected changes in climate will intensify sediment and nutrient inputs and BMPs may buffer these impacts, but only in some cases
- Changes in temperature, discharge and sediment will likely impact the ecosystem characteristics across the watershed