

NECSC Stream Temperature Updates



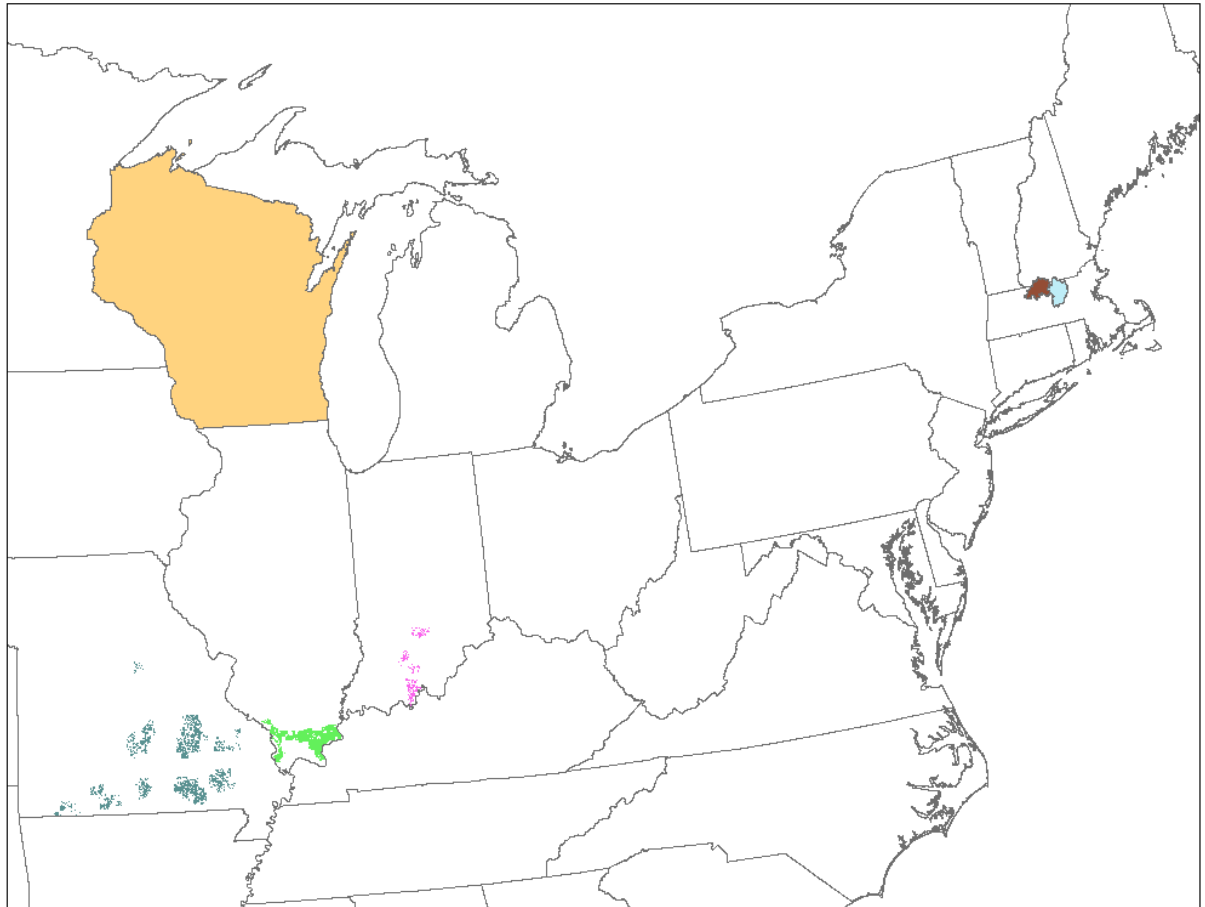
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Outline

- Lots to cover!
- Monitoring/Logger Deployment
- Stream Temperature Survey
- Model Applications and Evaluation
 - Hydrology
 - Thermal Metrics
- Brief R demo!

Stream Temperature Sites and Sampling

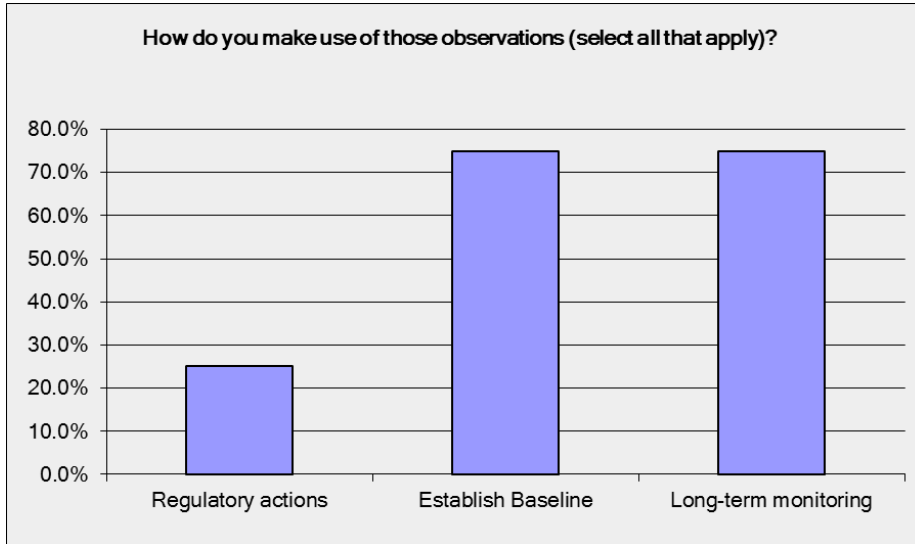
WI DNR	117
USFS Shawnee	34
USFS Hoosier	10
USFS Mark Twain	30
UMO	25
Nashua Basin/Trout Unlimited	30
NRWA	20
Millers	22
CT River Watershed Council	4
U Saint Joseph	12
Maybe you?	X?



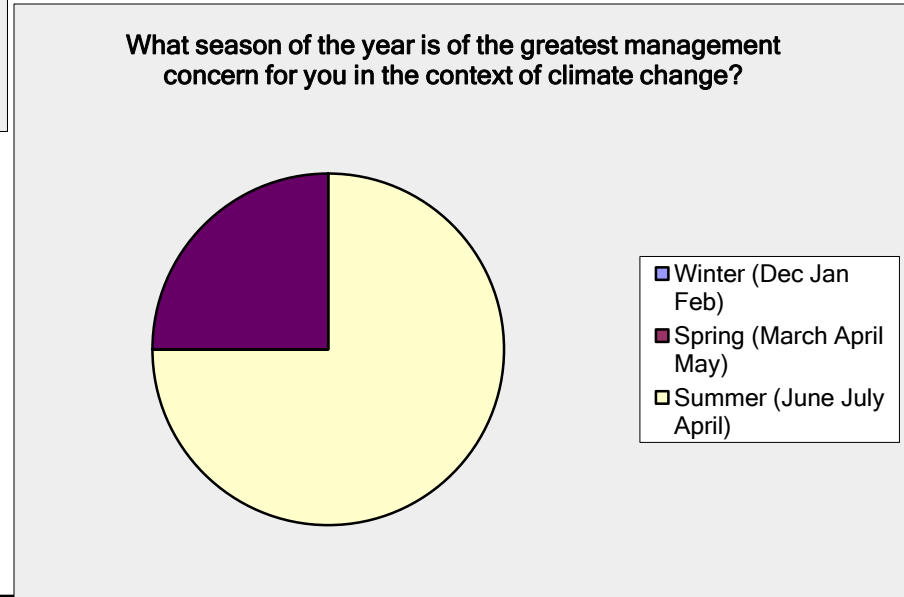
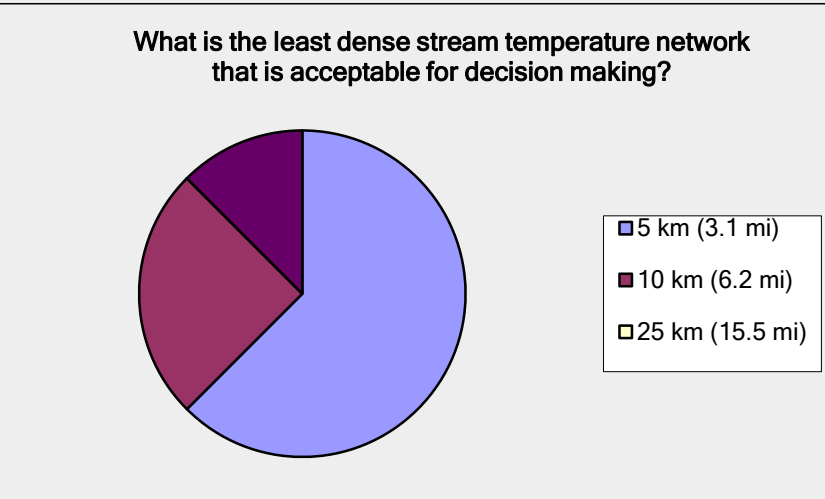
Identifying Manager Needs

- Different management concerns may require different data
 - Temporal resolution
 - Daily, seasonal, annual temps
 - Mean, max, or min temps
 - Spatial resolution
 - Continental
 - Watershed
 - Reach
- Manager Needs Survey in progress
 - Please take at [Streamtemperature.com!](http://Streamtemperature.com)

Sample Survey Results



Example: We Need Stream Temperature Time Series at Specific Points!



Stream Temperature Models

- **Mohseni et al. (1998) model**
 - S-shaped non-linear regression
 - 4 parameters: est. max & min stream temps, air temp @ inflection pt., steepest slope of function
- **VIC-RBM model**
 - Coupled hydrology – stream temp model
 - “Continental”- scale
 - Grid-based
- **SWAT-Ficklin et al. (2012) model**
 - Coupled hydrology – stream temp model
 - USDA developed for sediment transport
 - ArcGIS Interface

Model Needs Comparison

	VIC RBM	SWAT	Mohseni
Scale	Continental/Large Rivers	Typically Medium Size	Any – Typically Medium to Small
Spatial	1/8 th degree grid	HRU - Any	Any
Temporal	Daily	Daily/Hourly	Monthly/Daily
Met Inputs	Gridded T/P/Others	Any – T/P/Others	Any - Just T
Other Inputs	GIS!	GIS!	None
Ease of Use	Not Easy	Semi-Easy	Easy

Spatial Resolution

- Mohseni: per-point, single locations
- VIC-RBM: 1/8 deg.
 - 1 temp per $\sim 140\text{km}^2$
 - 1/16 deg.?
- SWAT-Ficklin: watershed-specific
 - Westfield
 - 113 Stream Reaches, ~ 451 km of river
 - Average of 1 temp per 4 km (or 1 per 12km^2)
 - Milwaukee
 - 123 Stream Reaches, ~ 679 km of river
 - Average of 1 temp per 5.5 km (or 1 per 18km^2)

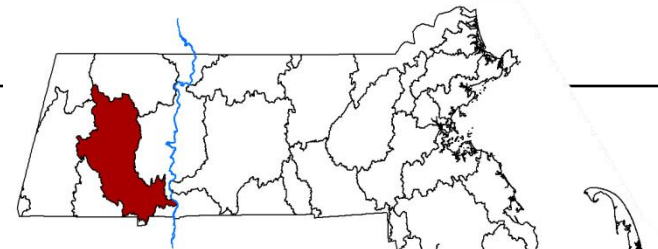
Evaluation Framework

- Evaluation criteria
 - Spatial resolution
 - Temporal resolution
 - Prediction skill
 - Nash-Sutcliffe Efficiency (NSE)
 - Root Mean Square Error (RMSE)

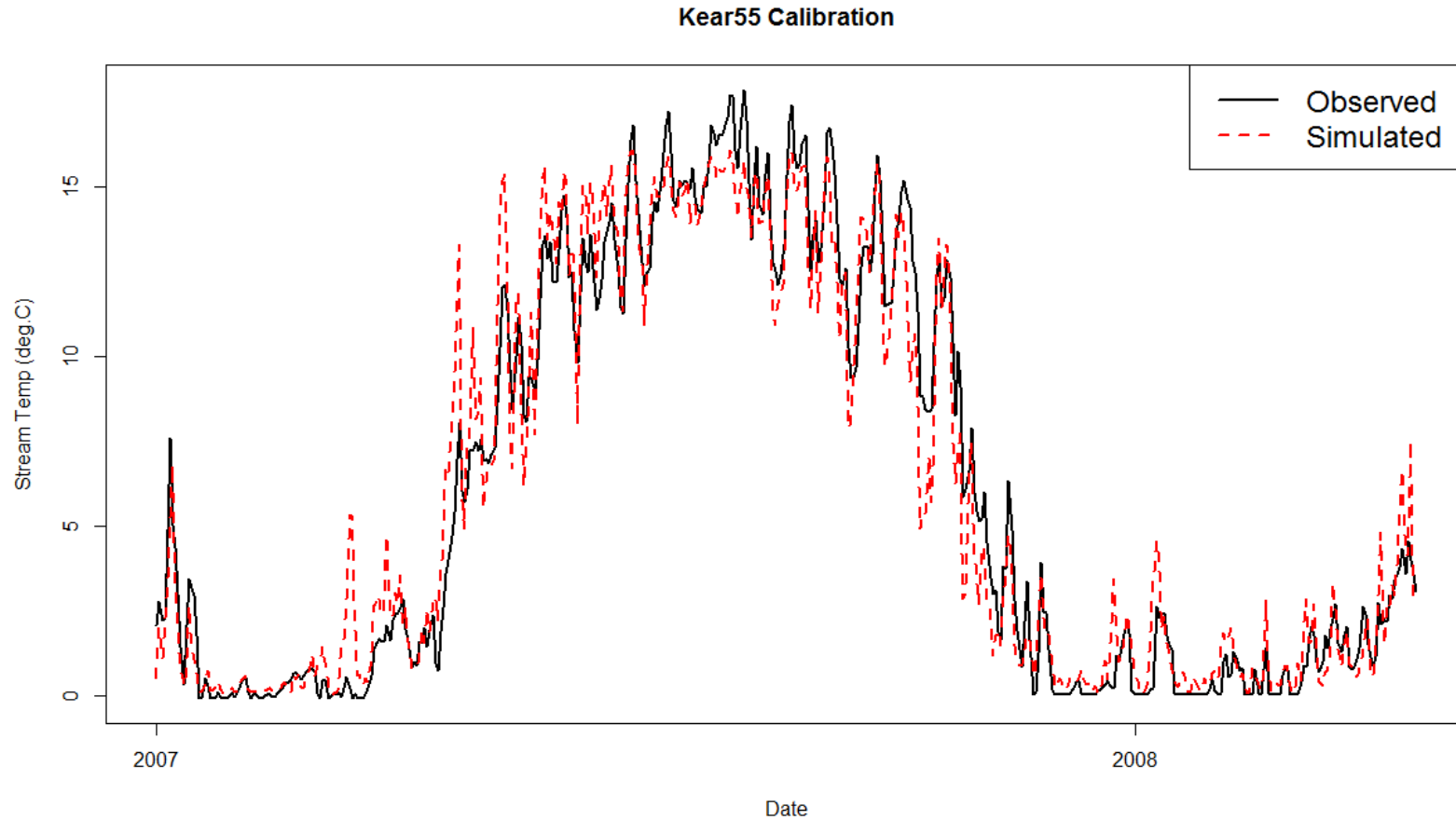
Study Basins

- Westfield, Western MA
 - 1,344 km²
 - 7% Ag
 - 79% Forest
 - 10% Urban/Residential
 - 4% Wetlands

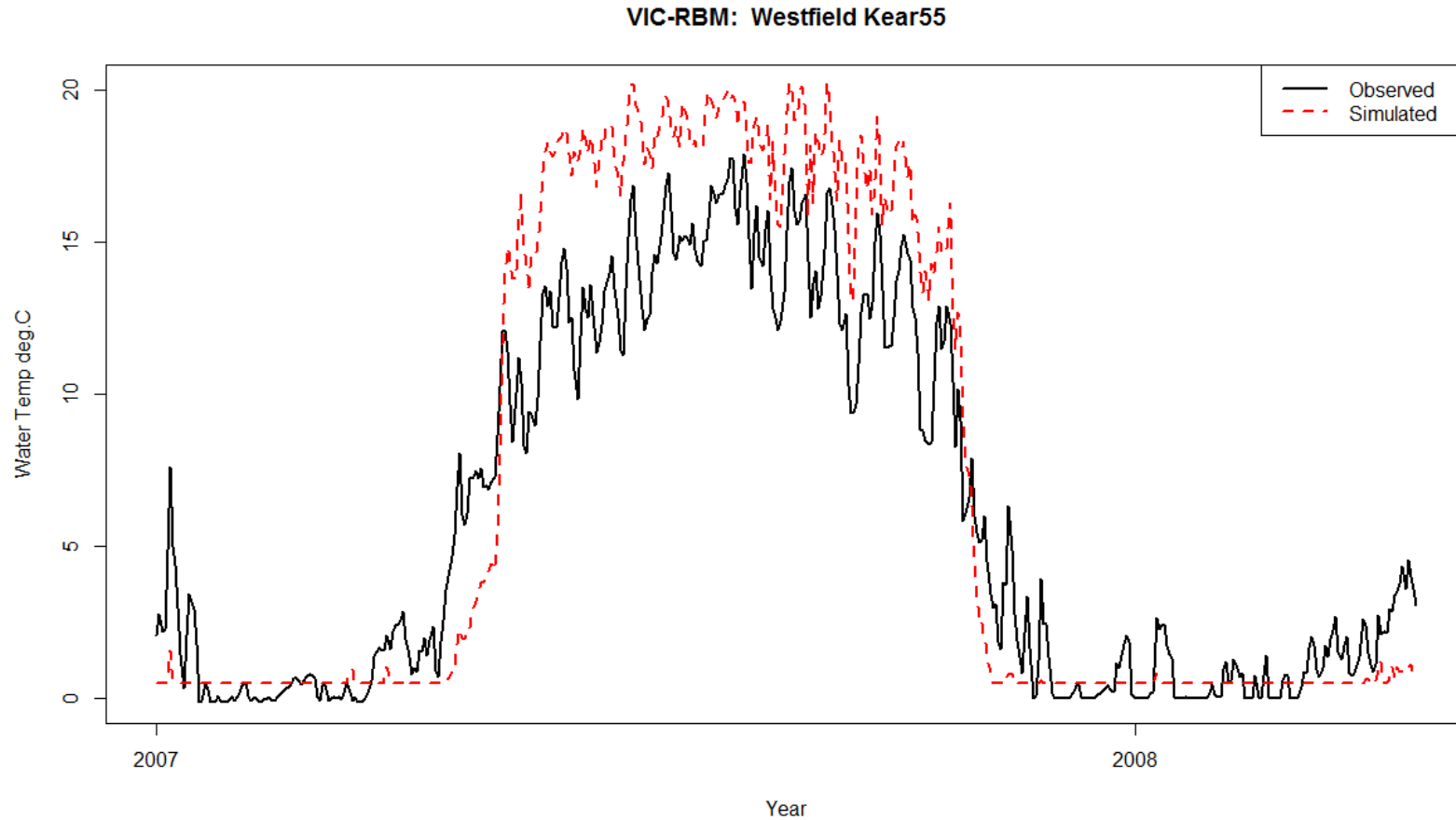
- Milwaukee, SE WI
 - 2,220 km²
 - 51% Ag
 - 17% Forest
 - 26% Urban/Residential
 - 6% Wetlands/Water



Mohseni et al.

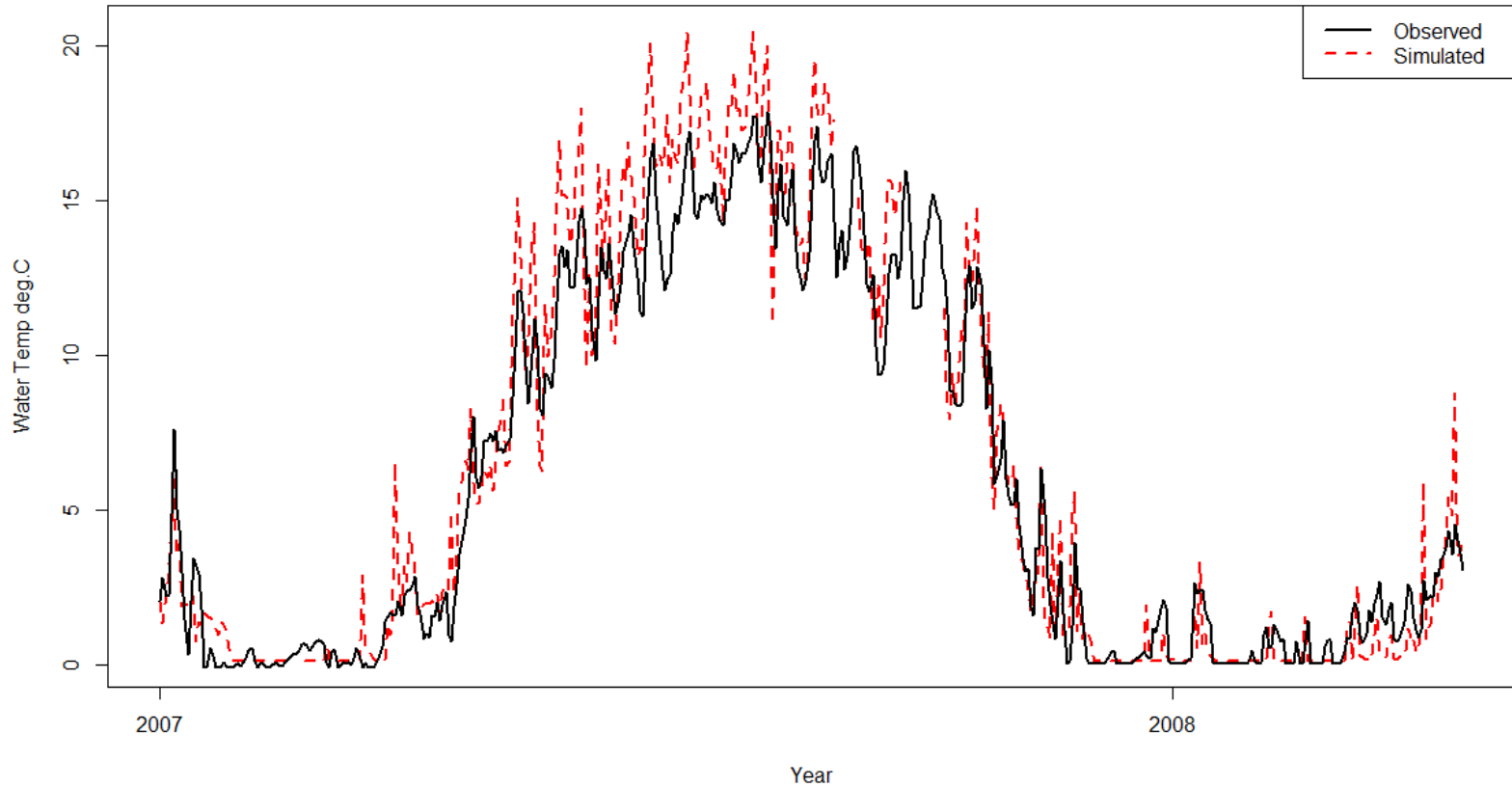


VIC-RBM



SWAT-Ficklin et al.

SWAT: Westfield Kear55

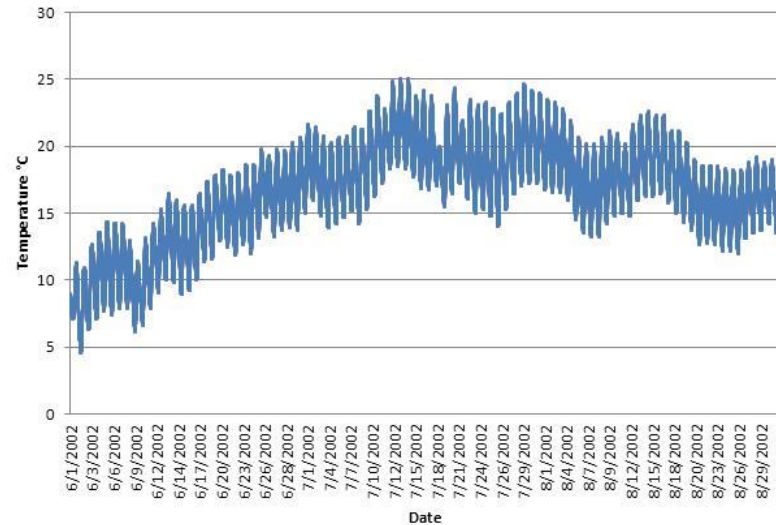
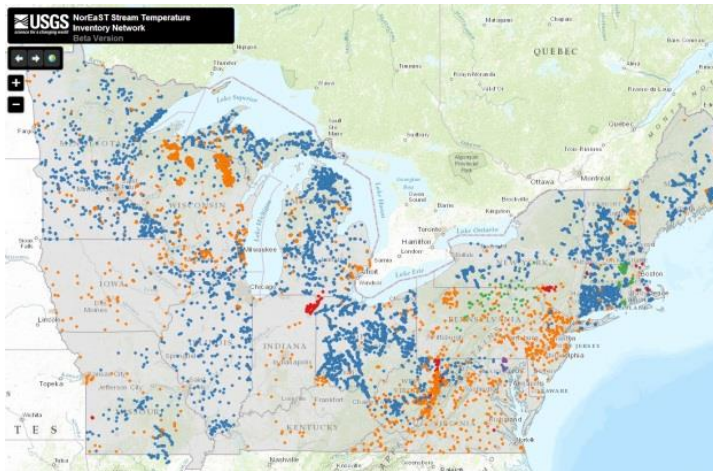


Prediction Skill

	Calibration		Validation	
	NSE	RMSE	NSE	RMSE
Mohseni	0.956	1.269 °C	0.930	1.546 °C
VIC-RBM	0.772	2.894 °C	0.429	4.435 °C
SWAT-Ficklin	0.932	1.550 °C	0.642	3.349 °C

Thermal Habitats for Fish in the Northeast

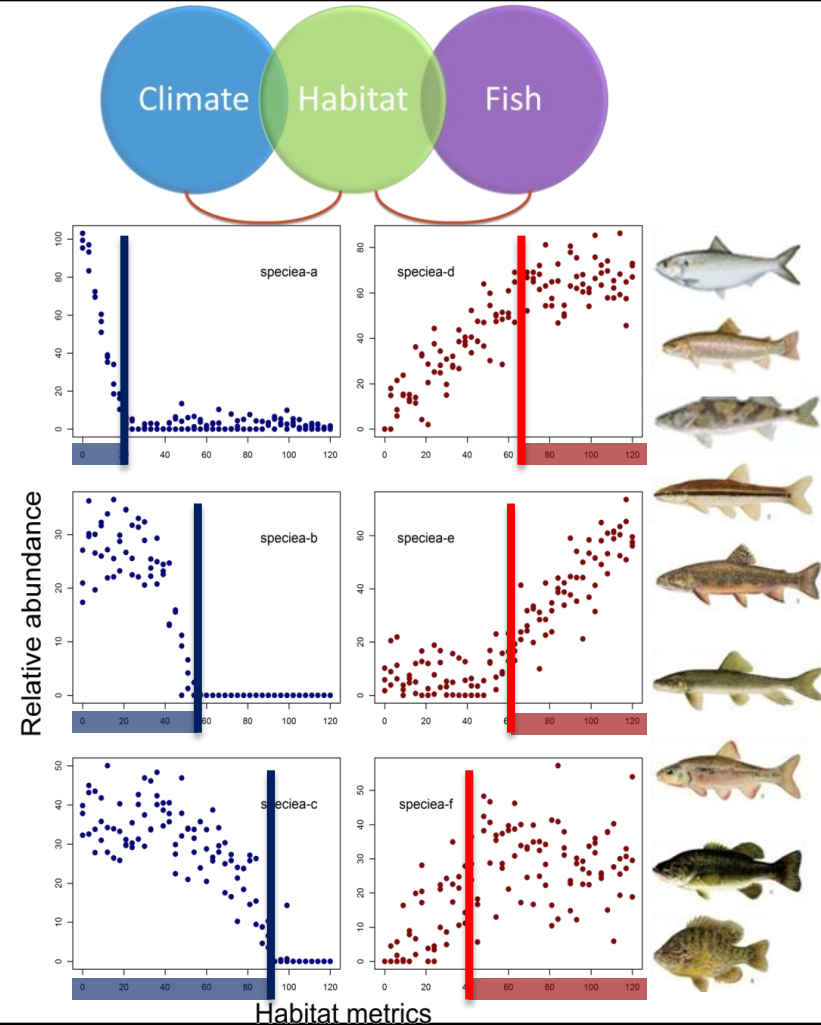
■ Yin-Phan Tsang and Dana Infante, Michigan State University



1. Summarize regional stream temperature trends (for loggers with data that meet criteria)
2. Calculate 141 thermal metrics characterizing thermal regimes for a given stream reach (e.g. seasonal average, Julian day of maximum temperature, daily rate of change in spring, 7 days moving average)

Thermal Habitats for Fish in the Northeast

- Characterize species' associations with extremes in thermal metrics using indicator species analysis
 - Identifies fish that respond to extremes in thermal conditions
 - Identifies thermal metrics important to multiple species
- Knowledge of how individual species may be responding to stream thermal characteristics is essential for understanding their potential response to temperature changes that may occur with climate change



R Demo!

- Example site: MD-BC-BC-05
- Duration: 1990-08-01 to 2013-08-02
- `install.packages(c("zoo", "XML", "RCurl", "plyr", "reshape2"))`
- `install.packages("dataRetrieval", repos="http://usgs-r.github.com")`
- `library(dataRetrieval)`
- `getWaterML2Data('http://cida.usgs.gov/noreast-sos/simple?request=GetObservation&featureID=MD-BC-BC-05&offering=RAW&observedProperty=WATER&beginPosition=1990-08-01T00:00:00&endPosition=2013-08-02T00:00:00')`

To Be Continued

- Finish model comparison for the Milwaukee
- Apply models to more basins in the NECSC region
 - Scale?
- Incorporate climate change analysis with the suite of models
- Use existing resource management decision framework (SDM) to provide a guide for aquatic resource managers planning to model stream temperature
- All by December!

Thanks to:

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 - Hannah Pothier

