Hydrological Analysis and Modeling of Mississippian Watersheds

Yi Jiang

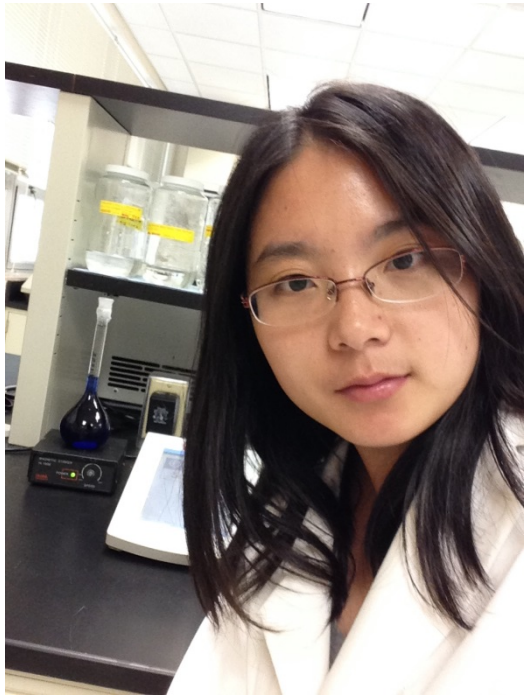
Mentor: Dr John J. Ramirez-Avila

Civil and Environmental Engineering Department
Mississippi State University

About me

- Second-year MS and PhD dual degree student
- Civil and Environmental Engineering Department,

  Mississippi State University
- Field of Study:
- Environmental Engineering
- Wastewater treatment
- Water quality modeling



My Mentor

- Dr John J. Ramirez-Avila
- Assistant Research Professor in CEE department at Mississippi State University.
- Former Postdoctoral Associate at the Geosystems Research Institute
- Area of Study:
  - Soil and Water Quality;
  - Watershed Modeling;
  - Nutrient management;
  - Soil and Streambank erosion

Background Information:

Task I

refine and regionalize nutrient assessment tools based on validation and state priorities

- Region: Yazoo river basin and Big Black River basin
- Software: APEX

  Agricultural Policy/ Environmental eXtender

Task II

determine changes in regional rainfall frequency for Mississippian river basins

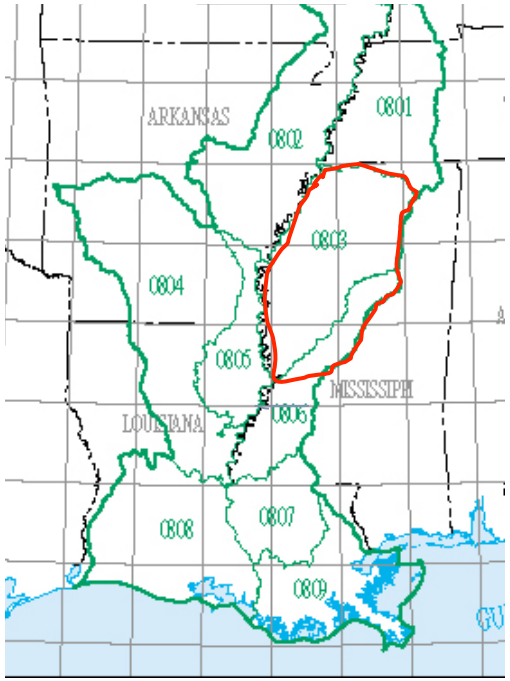
- Region: Yazoo river basin and Tombigbee river basin
- Tool: ICI-RAFT model and Excel Spreadsheet

Task III

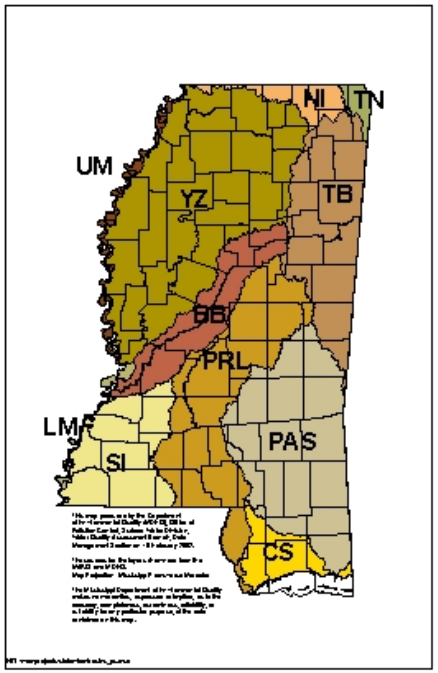
determine potential contributions of phosphorus to streams from streambanks in the Town Creek Watershed in Mississippi

- Lab work
- Soil test P method: Mehlich III

Background Information:



Yazoo+ Big Black



Yazoo+Tombigbeee

represents approximately 50% of the upper Tombigbee River basin area

Severe streambank erosion within the Town Creek Watershed reduces downstream water quality and threatens agricultural land.

Reference:

http://water.usgs.gov/wsc/reg/08.html
http://opc.deq.state.ms.us/faq.aspx#01
http://nitcnrcsbase-www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_025567.pdf

My Work--- Task I:
refine and regionalize nutrient assessment tools

- Study Area:

HUC	Watershed name	State	station number
08030201	Little Tallahatchie	MS	20
08030202	Tallahatchie	MS	8
08030203	Yocona	MS	7
08030204	Coldwater	TN	27
08030205	Yalobusha	MS	22
08030206	Upper Yazoo	MS	10
08030207	Big Sunflower	MS	19
08030208	Lower Yazoo	LA,MS	7
08030209	Deer-Steele	LA,MS	16
08060201	Upper Big Black	MS	15
08060202	Lower Big Black	LA,MS	22

- APEX: Agricultural Policy/Environmental eXtender

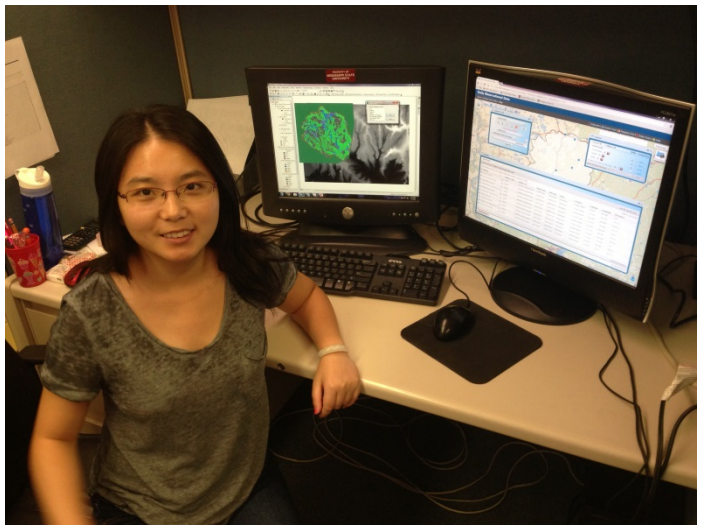
evaluate various land management strategies considering sustainability, erosion (wind, sheet, and channel), economics, water supply and quality, soil quality, plant competition, weather and pests.

- ArcAPEX version:

My Work--- Task I:
refine and regionalize nutrient assessment tools

- Daily weather data to build weather station data for MS
- Download Data from NOAA

Type: Evaporation, Precipitation, Soil Temperature, Snow Depth,
Average Wind Speed



- Organize data in Excel

Put the data of one station in each sheet.

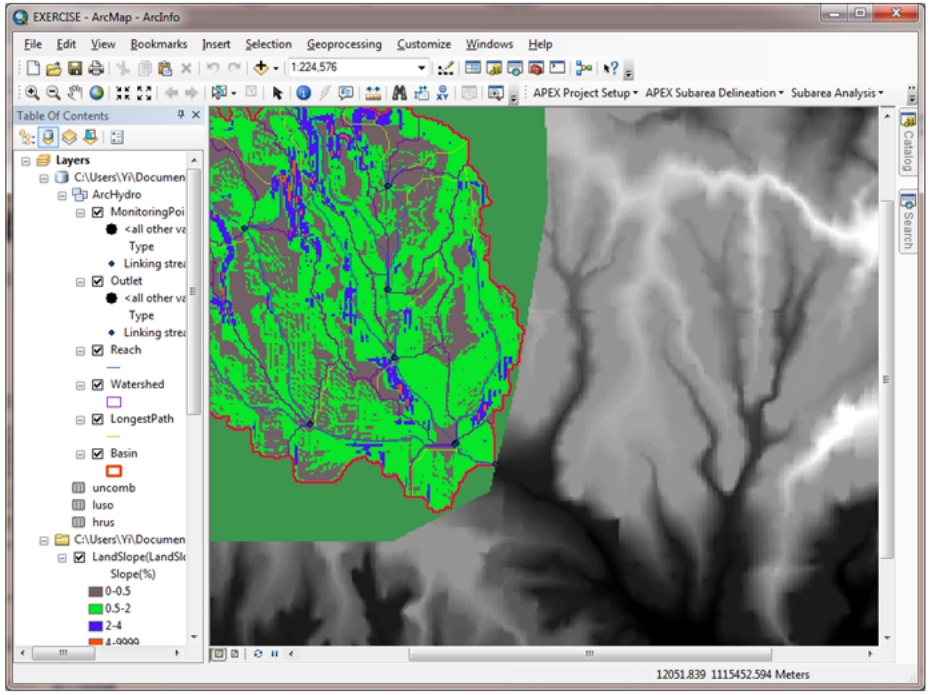
Record data begin date and end date.

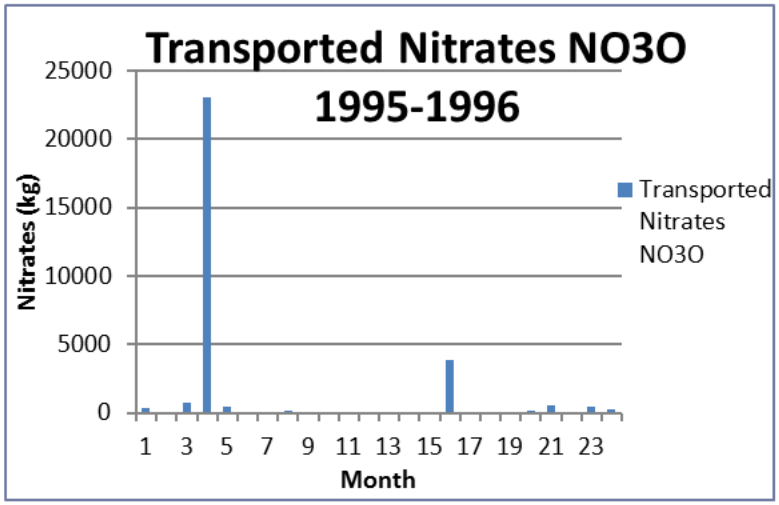
- Run Exercise example:
- Build up APEX project;
- Input: weather data, operation schedule, soil, land cover, slope …
- Get output data

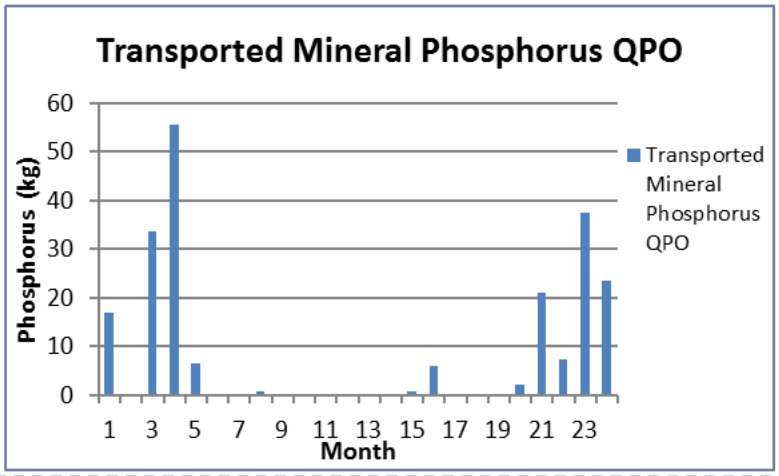
Result

Task I: refine and regionalize nutrient assessment tools

Get familiar with the APEX software package; prepare for future dissertation







My Work--- Task II:
determine regional rainfall frequency changes

Area: Yazoo river basin and Tombigbee river basin

Original data: Precipitation and Temperature from 1981-2010

Analysis 1
- ✓ 10 year and 5 year interval

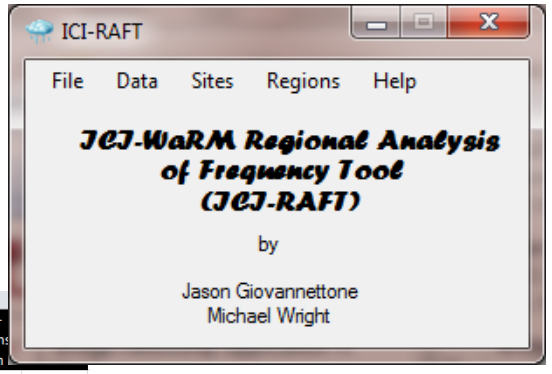
1. 1981-1990; 1991-2000;2001-2010
2. 1981-1985;1986-1990;1991-1995; 1996-2000;2001-2005; 2006-2010

Analysis 2
- ✓ Extreme event

1981-2010; 1982-2010; 1983-2010; 1984-2010…1997-2010;1998-2010; 1999-2010, 2000-2010

- Organize data to fit ICI-RAFT software input format

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	Site	Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
2	USC00229(	1981	11.9685	35.98425	56.49606	18.22835	51.14173	20.59055	70.7874	10.94488	13.11024	28.8189	18.07087	27.71654	
3	USC00229(	1982	52.08661	44.56693	13.14961	85.27559	19.40945	55.90551	38.70079	68.07087	37.55906	103.622	50.62992	199.2913	
4	USC00229(	1983	35.03937	52.99213	46.14173	103.622	106.5748	29.13386	15.62992	7.322835	45.07874	37.59843	102.1654	105.7087	
5	USC00229(	1984	24.01575	33.8189	54.05512	48.30709	93.70079	2.165354	25.31496	28.62205	7.125984	129.4094	66.5748	20.31496	

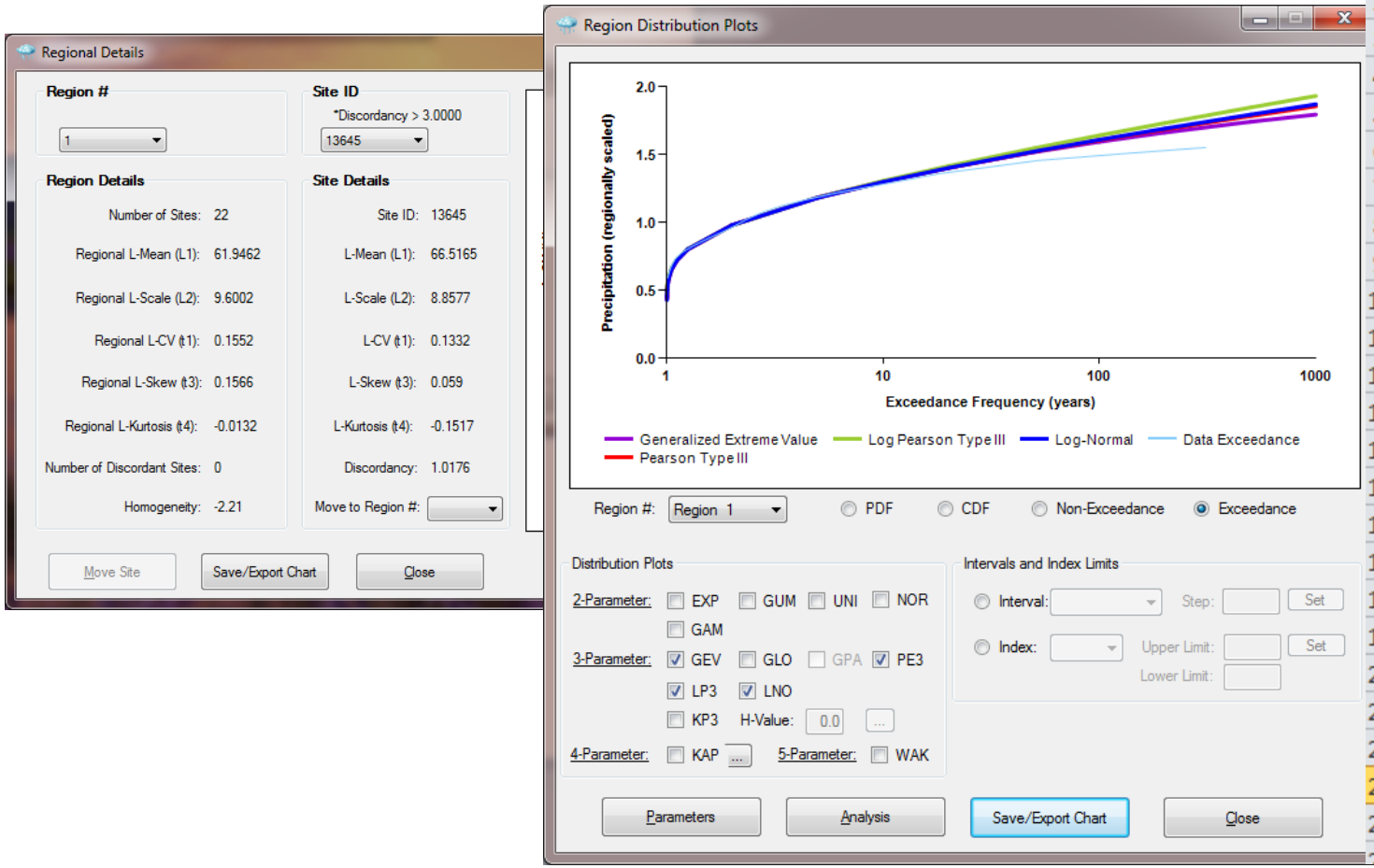


	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Site ID	Latitude	Longitude	Elevation	Annual Mean Temperatur	Annual Mean Precipitatio	Mean Julian Day	Seasonality Index	Mean Precipitation (Winter)	Mean Precipitation (Spring)	Mean Precipitation (Summer)	Mean Precipitation (Autumn)	Other Site Characteristic (1)	Other Site Character	Other Site Character	Eco-Regions Own
2	USC00229(	34.3725	-89.5308	124.4	16.331	571.19			165.88	148.72	113.22	143.36				
3	USC00220(	34.50111	-89.5008	123.7	-999	431.53			127.94	138.03	100.14	125.62				
4	USC00227(	34.74111	-88.9381	160	15.22798	570.54			151.70	161.04	127.30	130.50				

- Run ICI-RAFT, Screen data for annual and seasonal (winter, spring, summer, autumn)

My Work--- Task II:
determine regional rainfall frequency changes

Data from ICI-RAFT

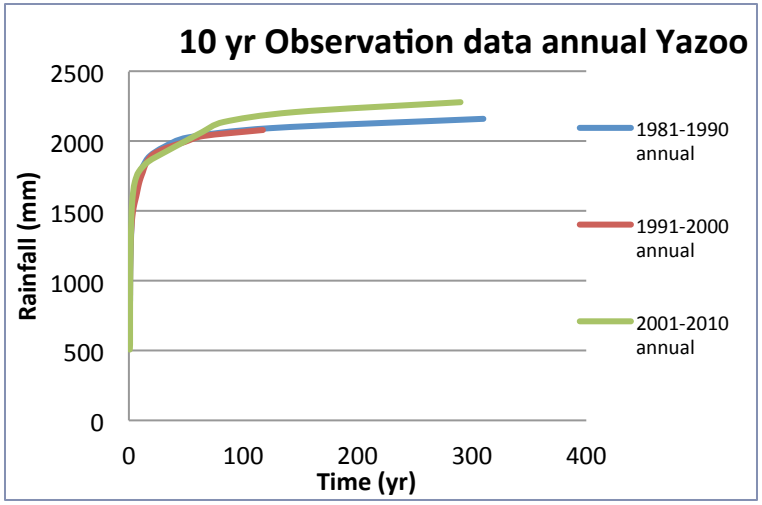


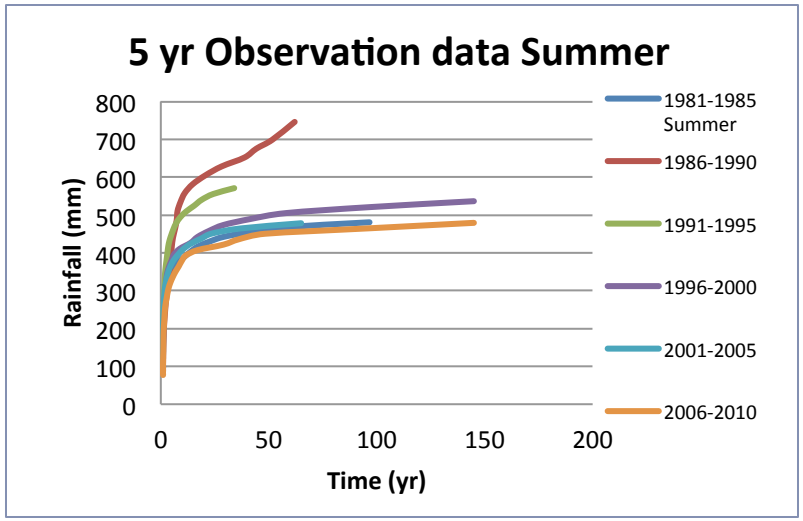
	A	B
1	Region #: 1	Exceedance
2	Frequency	Rainfall (in)
3	1.0081301	0.593516
4	1.0281924	0.641563
5	1.0544218	0.689611
6	1.0973451	0.737658
7	1.1854685	0.785706
8	1.3362069	0.833753
9	1.5384615	0.8818
10	1.7919075	0.929848
11	2.0666667	0.977895
12	2.3396226	1.025942
13	2.7312775	1.07399
14	3.3513514	1.122037
15	4.3971631	1.170084
16	6.0194175	1.218132
17	8.7323944	1.266179
18	12.653061	1.314227
19	18.235294	1.362274
20	31	1.410321
21	51.666667	1.458369
22	124	1.506416
23	310	1.554463
24		

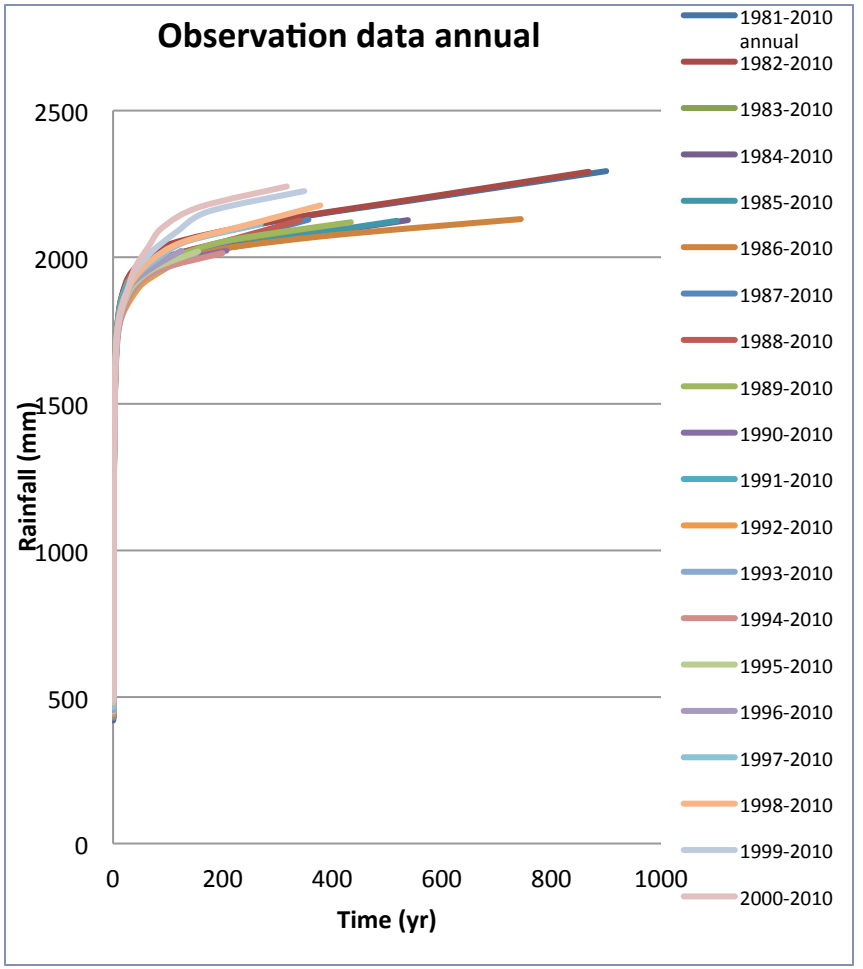
Result

Task II: determine regional rainfall frequency changes

- Yazoo



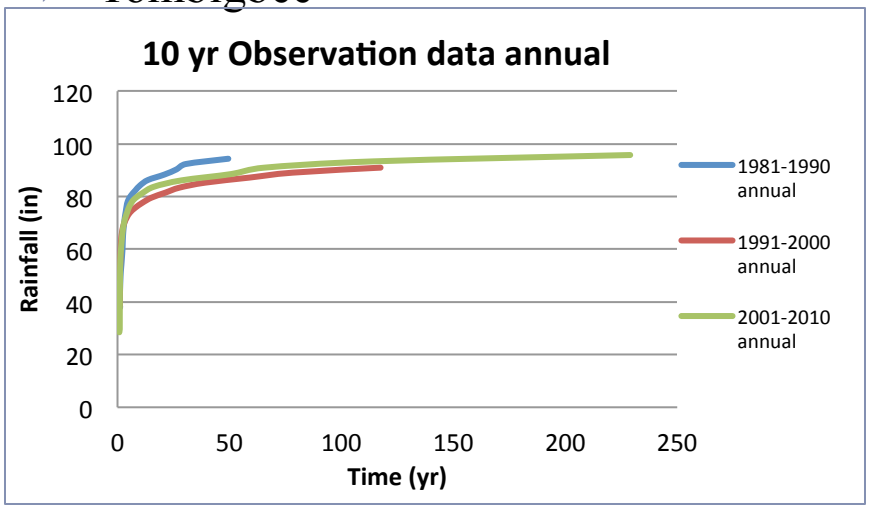


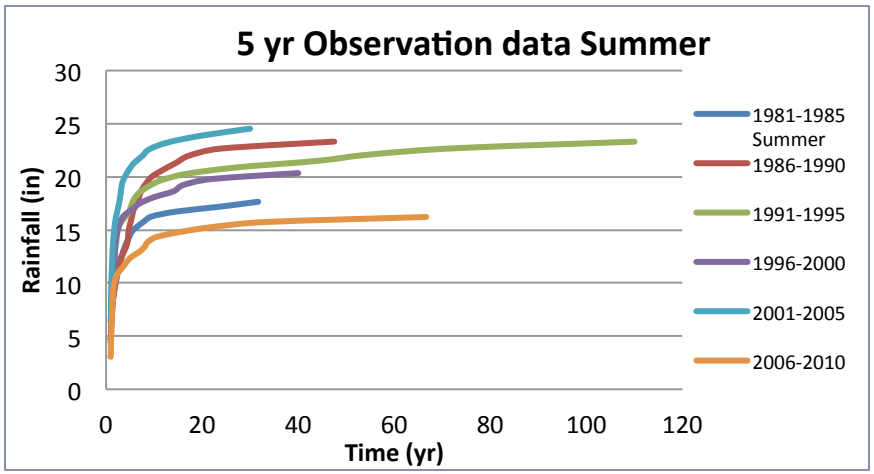


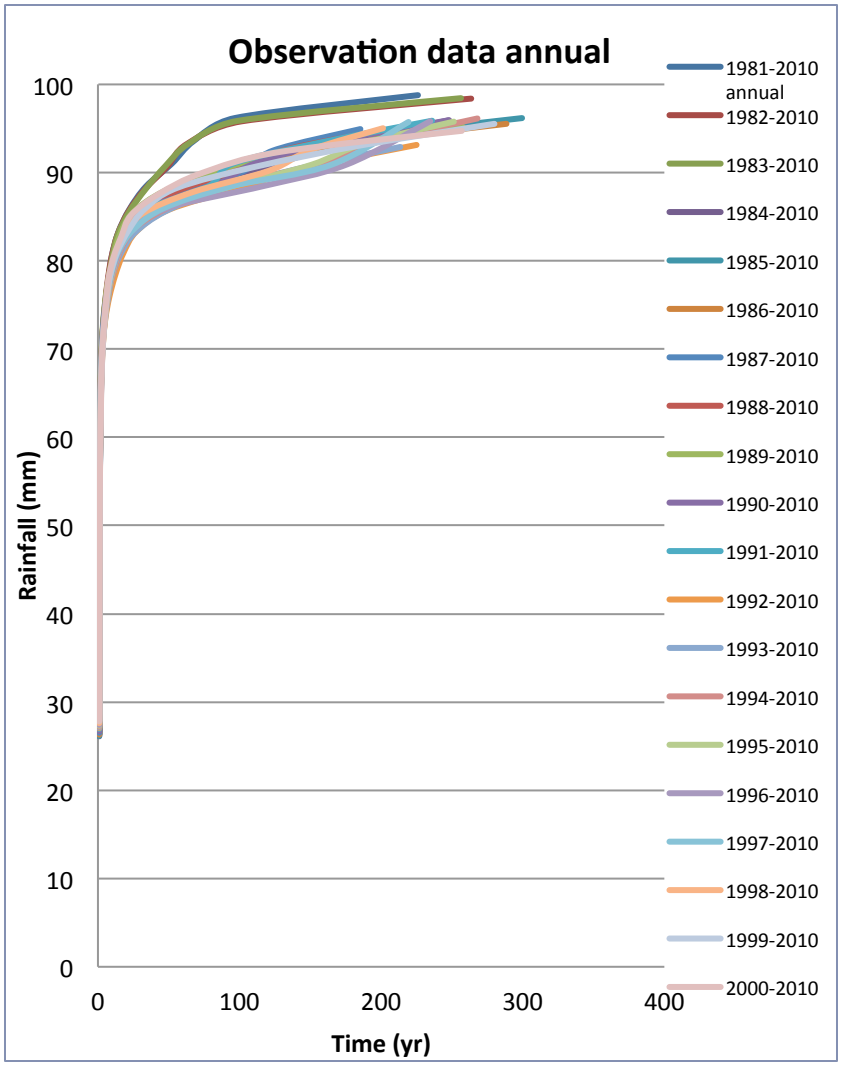
Result

Task II: determine regional rainfall frequency changes

- Tombigbee







My Work--- Task III:

Soil test P Analysis for streambanks from Town Creek Watershed

- Weight 2.0 grams of each soil sample: 36 samples
- Prepare solutions

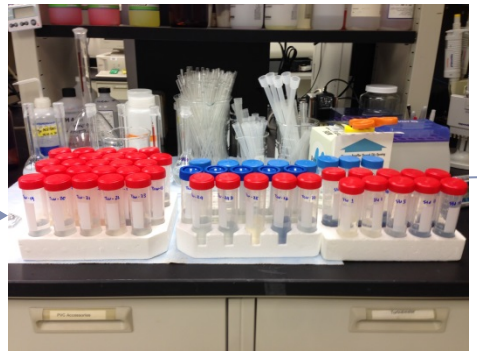
Extraction solution; Working solution;

Phosphorus standard solution series: for standard curve

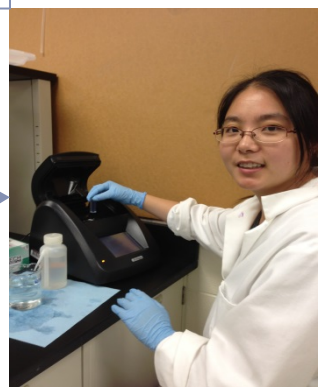
Mehlich III

Extraction
Shake
Filter

Color development



Colorimetry

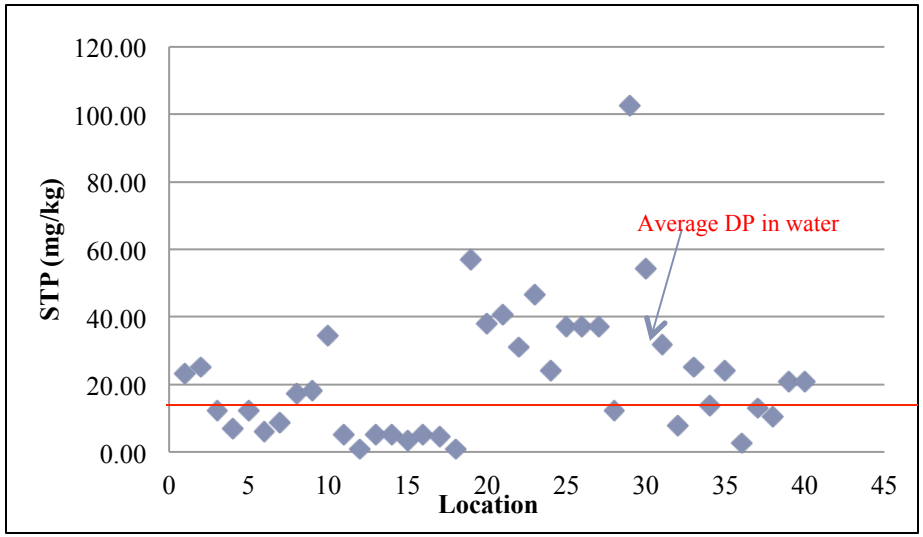


UV-VIS
Spectrophotometer
Set at 880 nm

Result

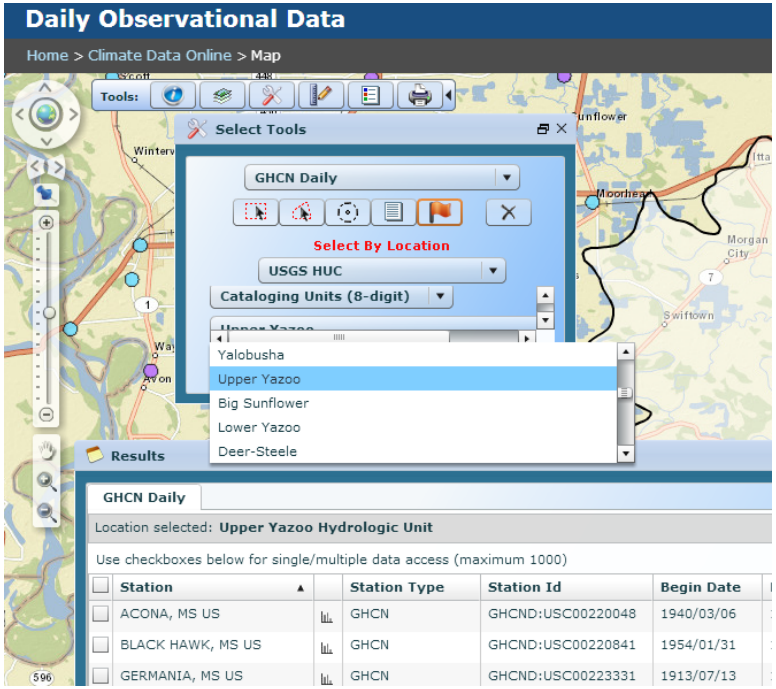
Part III: Soil test P for streambanks in Town Creek watershed

Soil ID	Mehlich III Extractable P (mgP/kg)	Mehlich III Extractable P (Kg / ha)	Critical P levels proposed by Mehlich 1984
TCW-1	23.27	34.91	Very low
TCW-1D	25.00	37.50	Very low
TCW-2	12.07	18.10	Very low
TCW-3	6.90	10.34	Very low
TCW-4	12.07	18.11	Very low
TCW-5	6.03	9.05	Very low
TCW-6	8.62	12.93	Very low
TCW-7	17.24	25.86	Very low
TCW-8	18.10	27.16	Very low
TCW-9	34.48	51.72	Low
TCW-10	5.17	7.76	Very low
TCW-11	0.86	1.29	Very low
TCW-12	5.17	7.76	Very low
TCW-12D	5.17	7.76	Very low
TCW-13	3.45	5.17	Very low
TCW-14	5.17	7.76	Very low
TCW-15	4.31	6.46	Very low
TCW-16	0.86	1.29	Very low
TCW-17	56.89	85.33	Medium
TCW-18	37.94	56.91	Low
TCW-19	40.52	60.77	Low
TCW-20	31.03	46.54	Low
TCW-21	46.56	69.84	Medium
TCW-22	24.14	36.21	Very low
TCW-23	37.07	55.61	Low
TCW-24	37.07	55.60	Low
TCW-24D	37.06	55.59	Low
TCW-25	12.07	18.11	Very low
TCW-26	102.58	153.87	High
TCW-27	54.30	81.45	Medium
TCW-28	31.89	47.84	Low
TCW-29	7.76	11.64	Very low
TCW-30	25.00	37.50	Very low
TCW-31	13.79	20.69	Very low
TCW-32	24.14	36.21	Very low
TCW-33	2.59	3.88	Very low
TCW-34	12.93	19.40	Very low
TCW-35	10.34	15.52	Very low
TCW-36	20.69	31.03	Very low
TCW-36D	20.69	31.03	Very low



https://elibrary.asabe.org/azdez.asp?JID=5&AID=29829&CID=pitt2010&T=2

Metadata usage



Station Detail & Data Flag Options

Additional output options such as data flags (attributes), station names, and geographic location are also available.

- [x] Station name
- [x] Geographic location
- [ ] Include data flags
- [ ] Date Filter

Select data types for custom output

The items below are data types that can be added to the output. Expand the data type category headers to view the categorized data type names and descriptions.

Show All / Hide All | Select All / Deselect All

- [ ] Precipitation
  - [ ] Multiday precipitation total (tenths of mm; use with DAPR and DWPR, if available) (MDPR)
  - [ ] Number of days included in the multiday precipitation total (MDPR) (DAPR)
  - [x] Precipitation (tenths of mm) (PRCP)
  - [x] Snow depth (mm) (SNWD)
  - [ ] Snowfall (mm) (SNOW)
- [ ] Sunshine
- [x] Air Temperature
  - [x] Maximum temperature (tenths of degrees C) (TMAX)
  - [x] Minimum temperature (tenths of degrees C) (TMIN)
  - [x] Temperature at the time of observation (tenths of degrees C) (TOBS)
- [ ] Wind
  - [x] Average daily wind speed (tenths of meters per second) (AWND)
  - [ ] Direction of fastest 2-minute wind (degrees) (WDF2)
  - [ ] Direction of fastest 5-second wind (degrees) (WDF5)
  - [ ] Fastest 2-minute wind speed (tenths of meters per second) (WSF2)
  - [ ] Fastest 5-second wind speed (tenths of meters per second) (WSF5)
  - [ ] Peak guest wind speed (tenths of meters per second) (WSFG)
  - [ ] Peak gust time (hours and minutes, i.e., HHMM) (PGTM)
  - [ ] Time of fastest mile or fastest 1-minute wind (hours and minutes, i.e, HHMM) (FMTM)
- [ ] Weather Type

Conclusion

What I learned…

- Data collection
- APEX model application
- Nutrient loss assessment
- Interpret data

Value of the internship

- An opportunity to get professional training
- New experience
- Expand knowledge

Acknowledgements

- NOAA, NGI, Dauphin island sea lab, Diversity Internship Program

- Dr. Tina Miller-Way and Ms Natalie Ortell
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