



INDIANA
GEOLOGICAL SURVEY



CENTER FOR GEOSPATIAL
DATA ANALYSIS

INDIANA UNIVERSITY

Introduction to the Indiana Water Balance Network – a new NGWMN data provider

Bob Autio

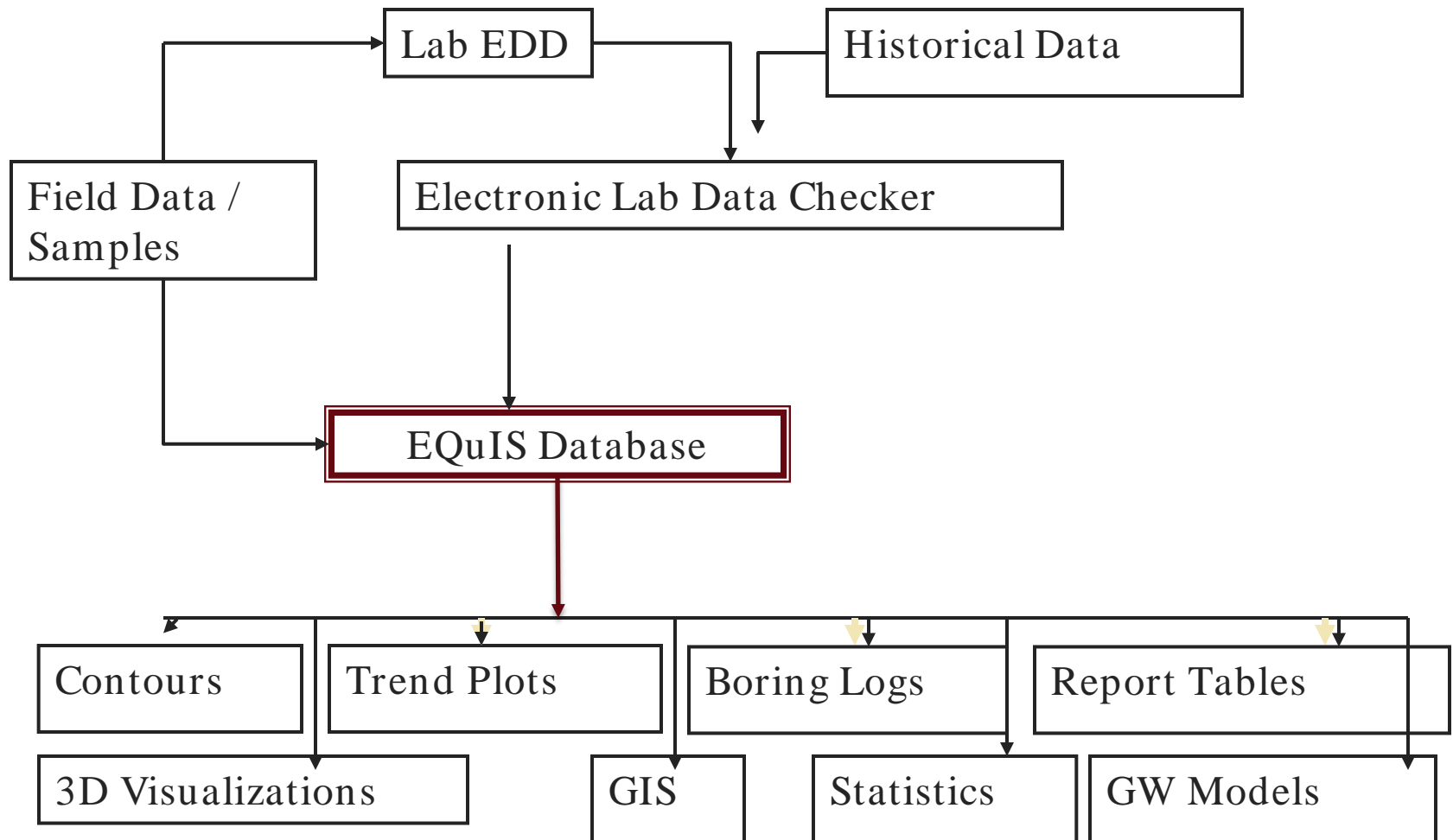
Research Geologist

December 7, 2016

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My data management background - EQuIS

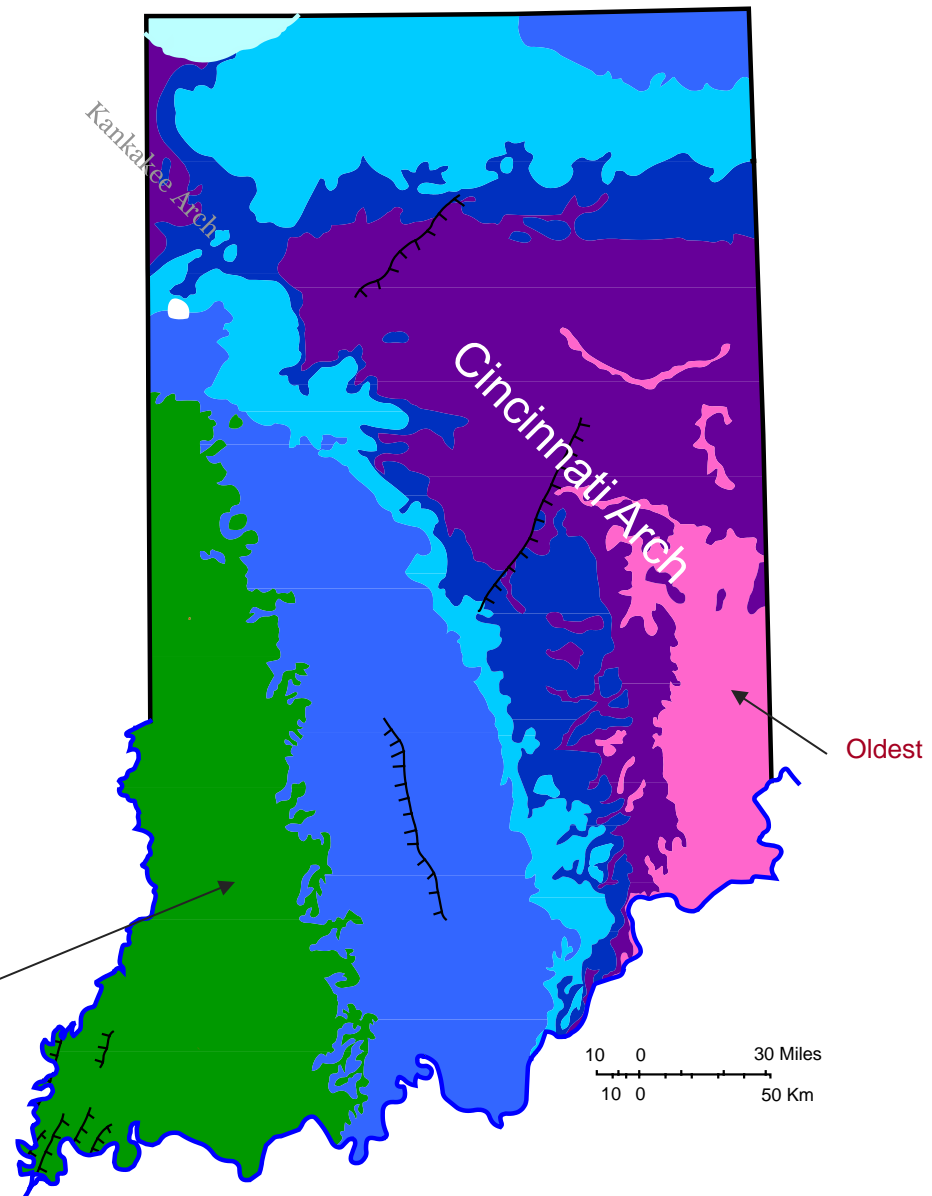
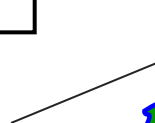


BEDROCK GEOLOGY

EON	ERA	PERIOD	Millions of Years Ago	
PHANEROZOIC	CENOZOIC	QUATERNARY	1.75 ± 0.05	
		TERTIARY ***		
			65 ± 0.5	
	MESOZOIC		CRETACEOUS **	
			JURASSIC **	135 ± 5
			TRIASSIC **	203 ± 3
			PERMIAN **	250 ± 3
			PENNSYLVANIAN	295 ± 5
	PALEOZOIC		MISSISSIPPIAN	325
			DEVONIAN	355 ± 5
			SILURIAN	410 ± 8
			ORDOVICIAN	435 ± 6
			CAMBRIAN *	500
PROTEROZOIC	PRECAMBRIAN *		540 ± 5	
ARCHEAN			4,600	

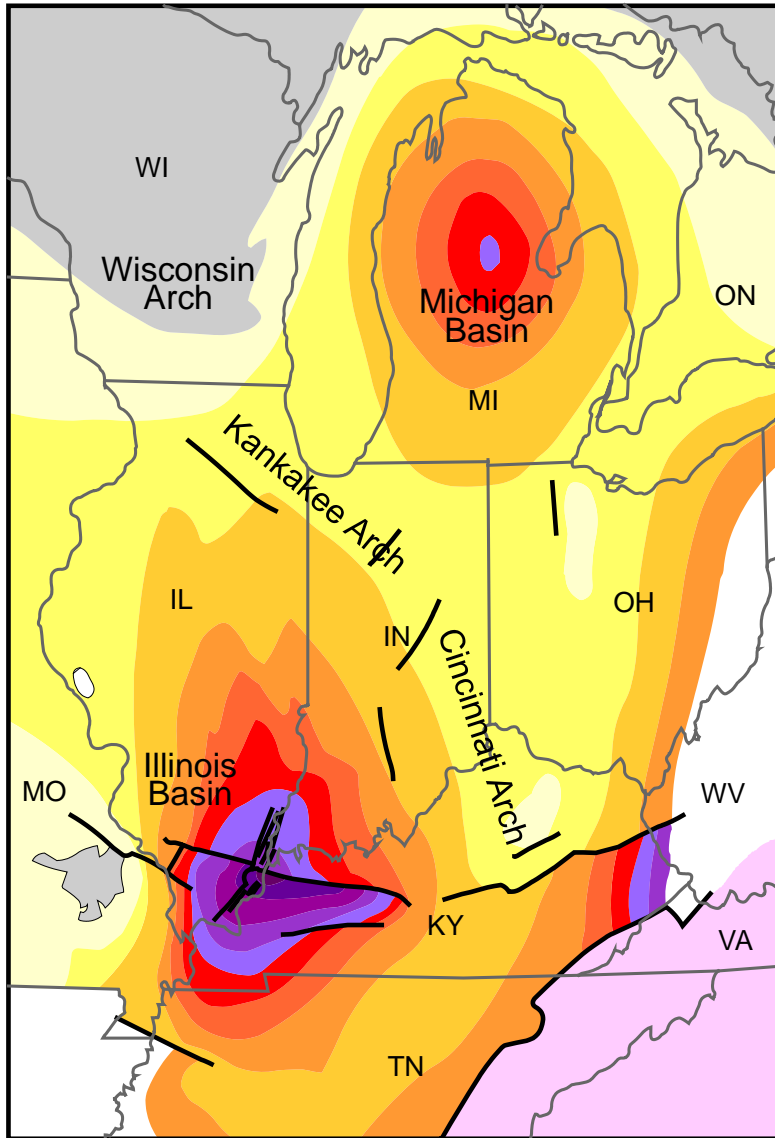
* Not exposed at the surface ** Not present *** Scattered deposits

Youngest



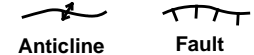
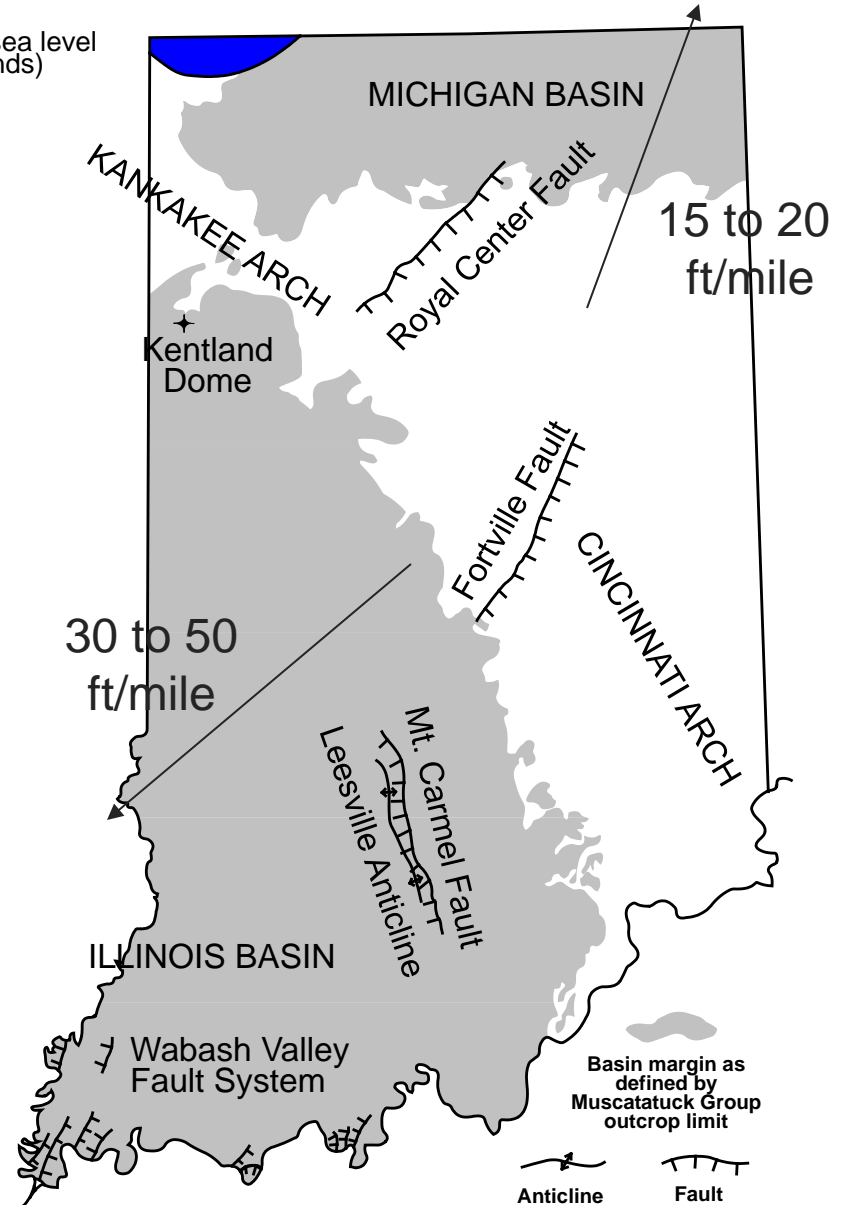
Oldest

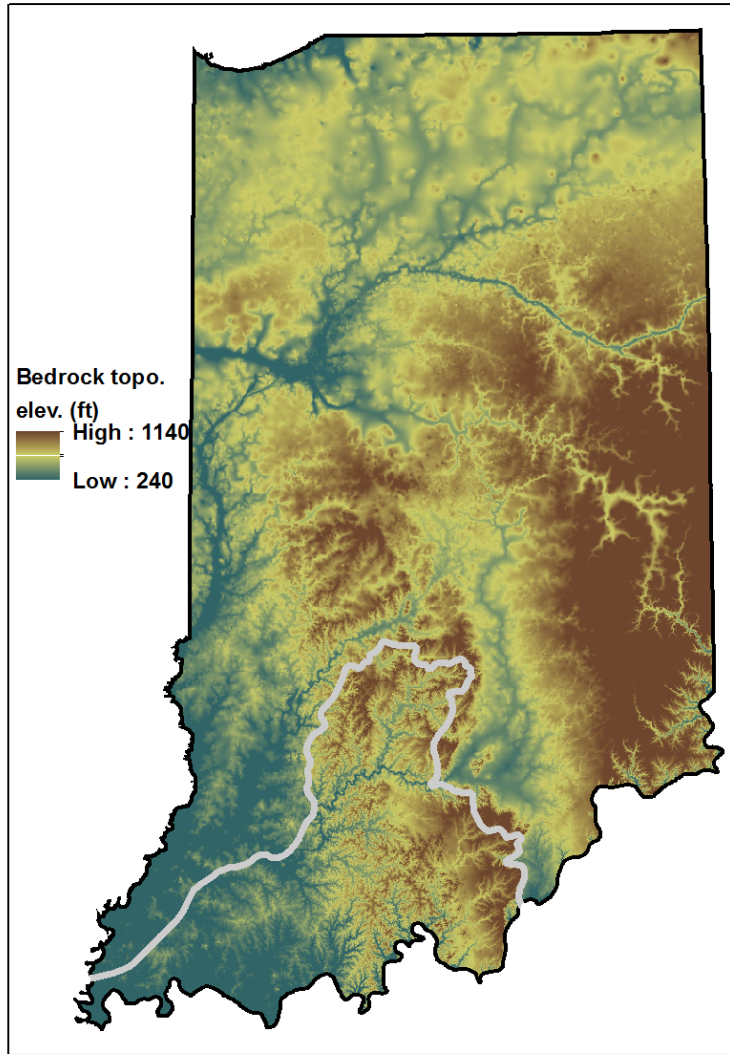
Arches and Basins



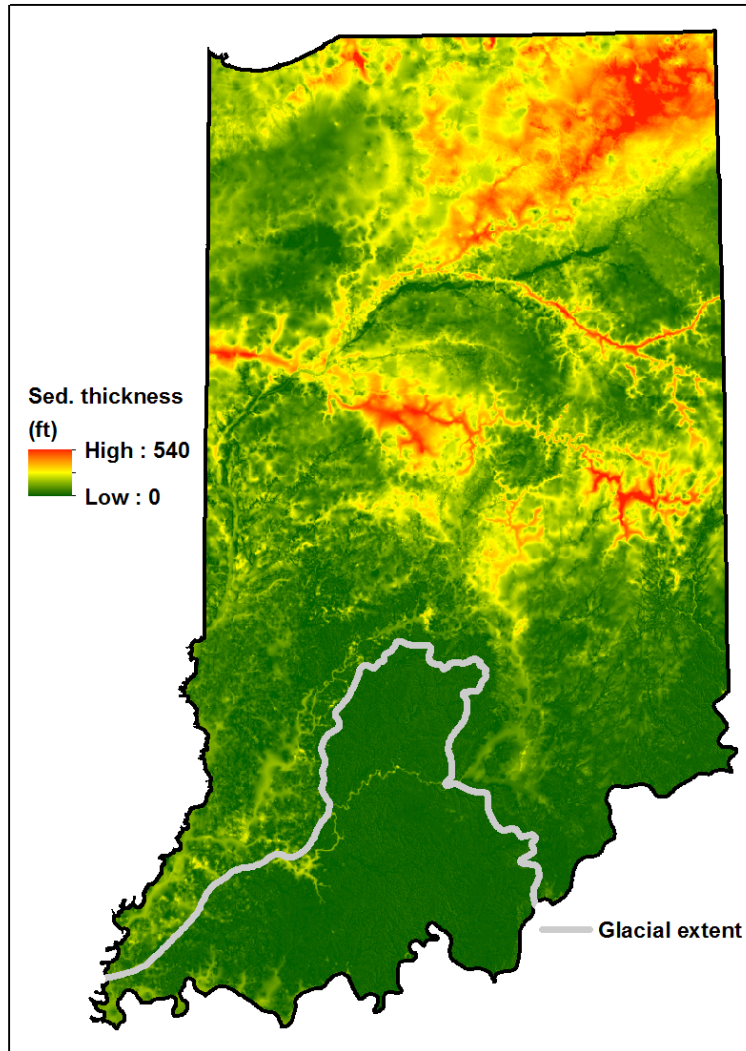
EXPLANATION

Feet below sea level
(thousands)



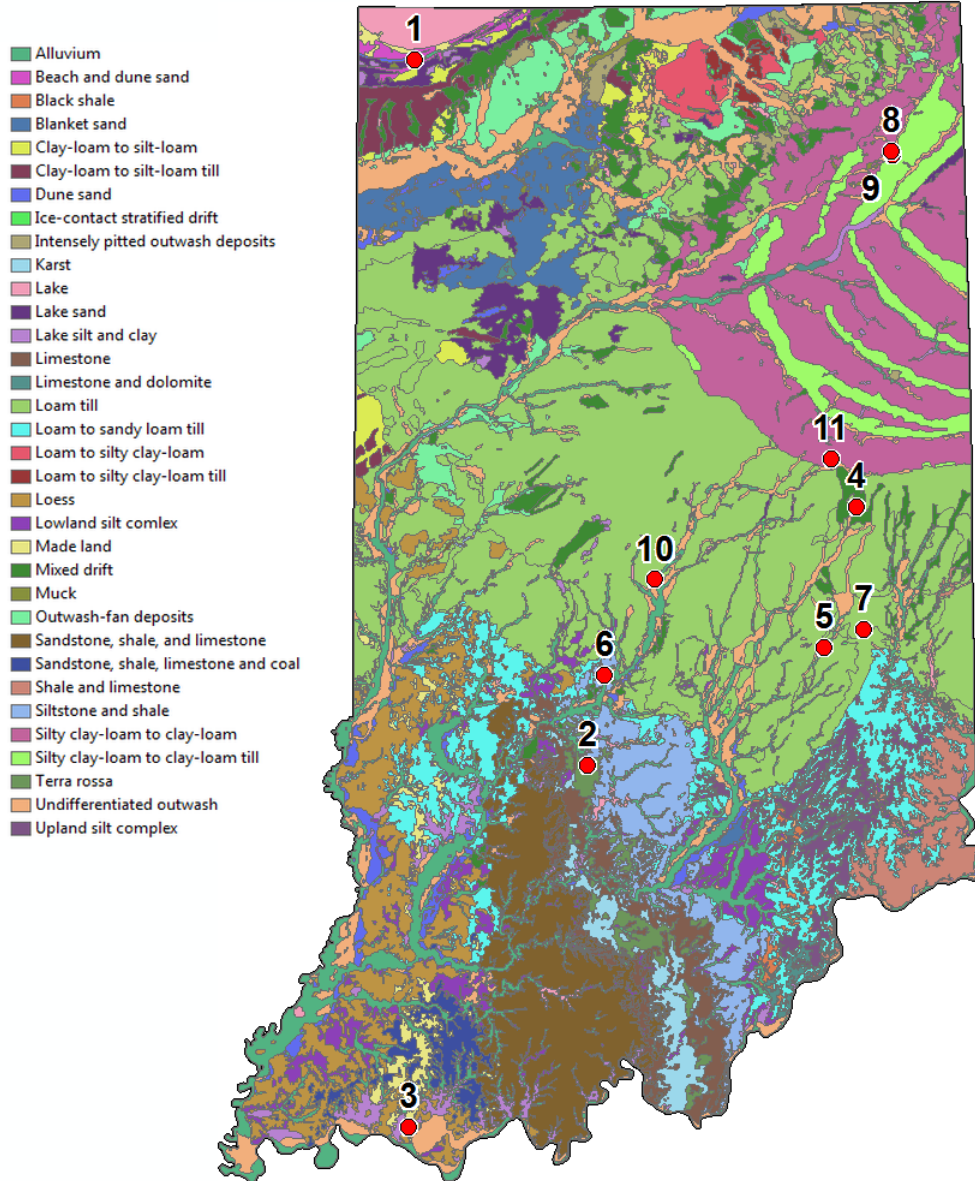


Bedrock topography



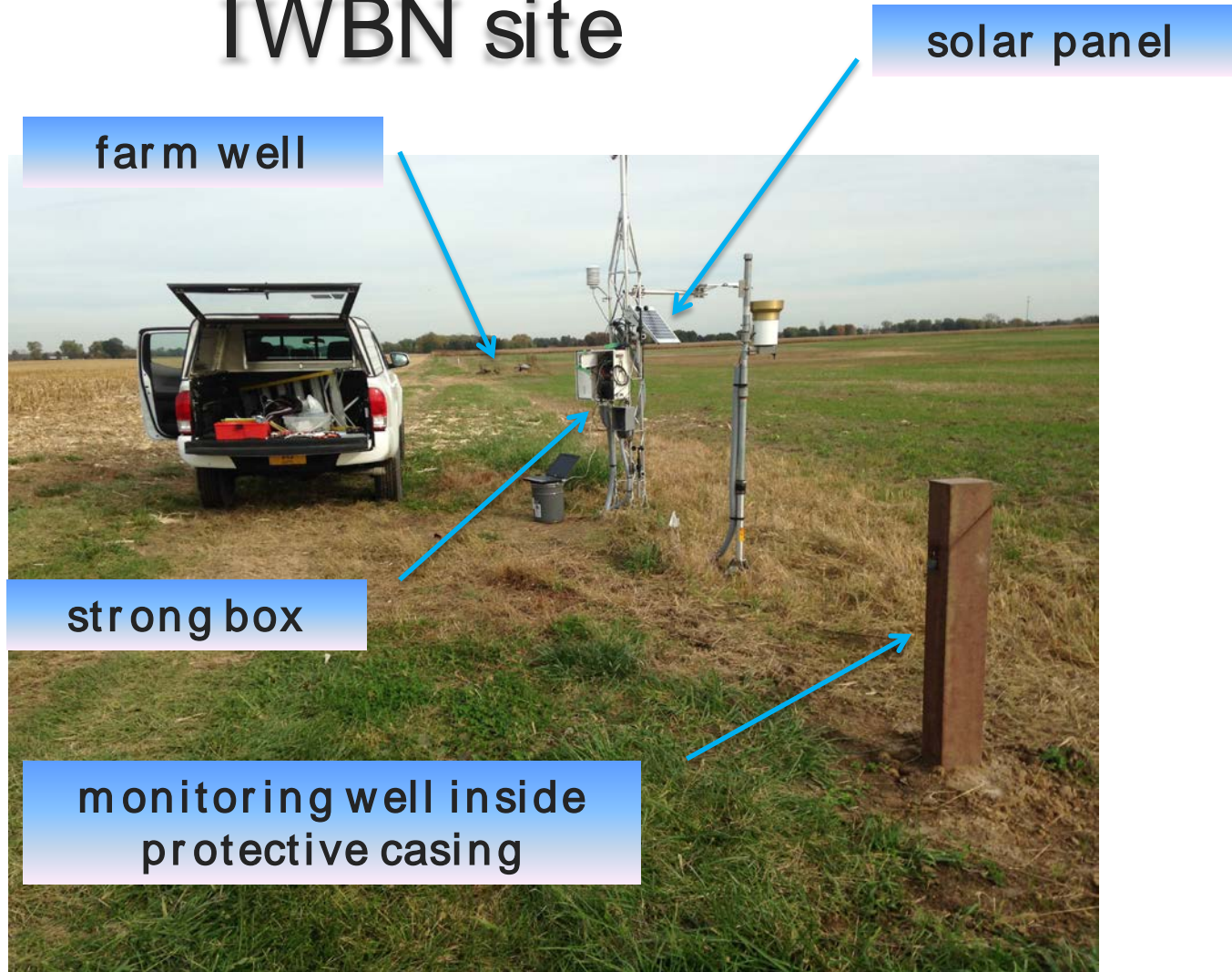
Sediment thickness

Site locations and diversity of hydrogeologic settings in Indiana ...we're not capturing everything but you've gotta start somewhere

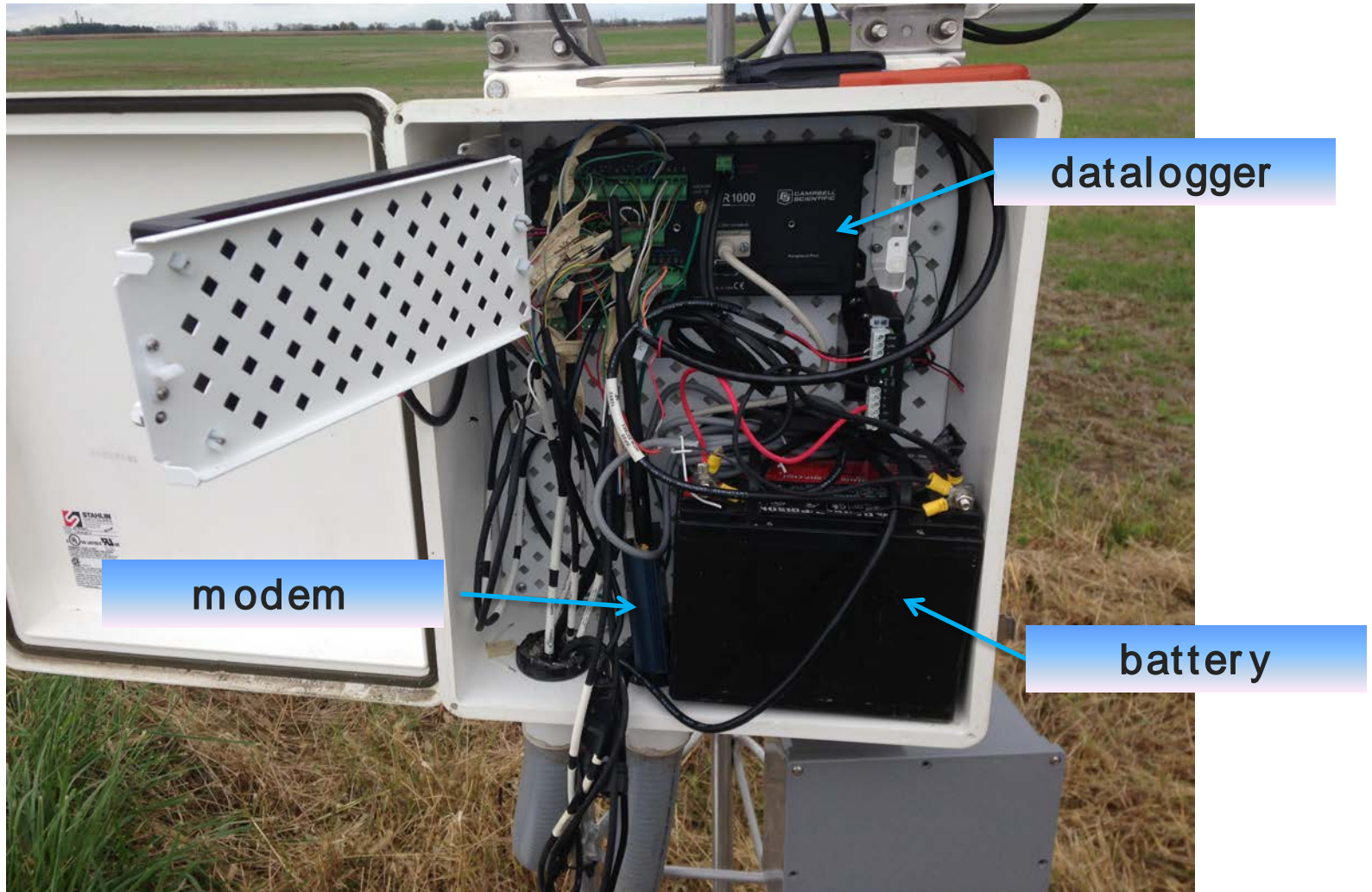


Surficial geology of Indiana by Gray (1989)

IWBN site

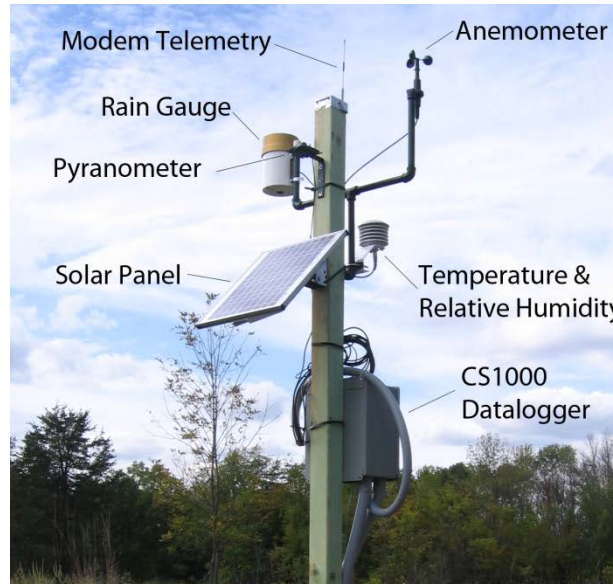


Campbell Scientific dataloggers and sensors

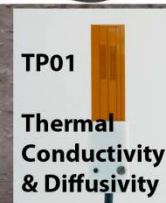


Monitoring approach

Potential evapotranspiration



DEPTH	INSTRUMENTS
0.5'	253-L, T107
1'	CS650, 253-L
2'	CS650, 253-L
3'	CS650
4'	CS650, 253-L, T107, TP01
5'	CS650
6'	CS650, T107



Soil moisture ,
matric potential,
thermal properties,
and temperature

Vented pressure transducer installation



Drill&Drop soil moisture probe installation



Instrumentation (groundwater monitoring)

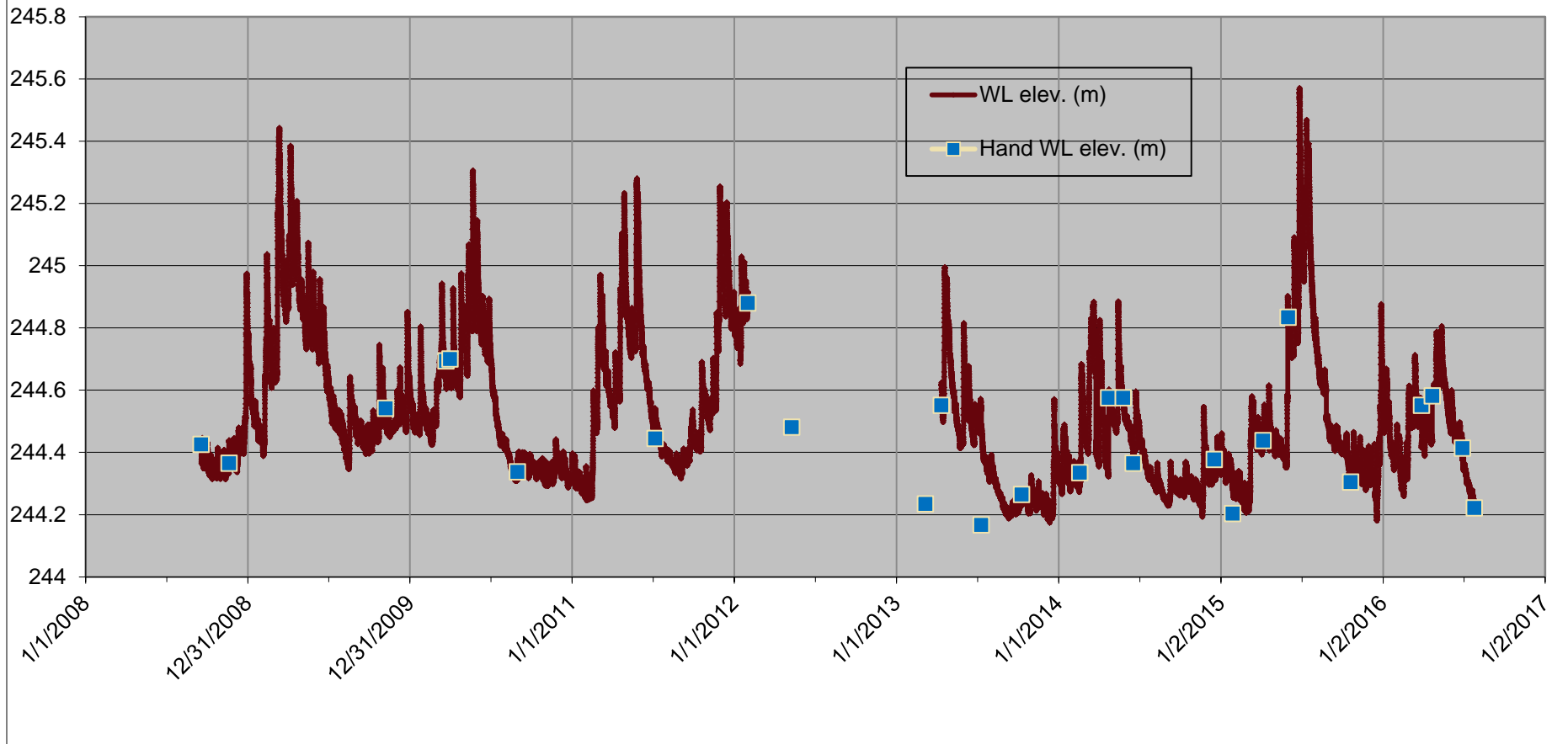
$$P = Q + E + \Delta S_S + \Delta S_G$$

	Site name	Aquifer type	DTW (ft)	Record start	Temp .
north	Eel River Valley	Unconfined	34-36'	11/2009	Y
	Wabash Moraine	Confined	70-75'	9/2008	Y
central	Lake Station	Unconfined / wetland	0-3'	8/2007	N
	Flat Rock River	Unconfined	7-8'	8/2012	Y
	Summit Lake	Unconfined / wetland	0-3'	3/2010	N
	EcoLab	Unconfined	1-3'	9/2012	Y
south	Ball State	Semiconfined	10-15'	4/2013	Y
	Ohio River	Unconfined	30-40'	12/2007	N

Data are collected at hourly intervals with pressure transducers connected to a datalogger

Groundwater elevations versus time

Wabash Moraine (Dustin) WL - all dates



Provisional data on the Web

Indiana Water Balance Network -

<http://igs.indiana.edu/CGDA/waterBalanceNetwork.cfm>

Indiana Geological Survey x
igs.indiana.edu/CGDA/waterBalanceNetwork.cfm

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A research institute of the OVPR
Center for Geospatial Data Analysis

HOME | General Geology | Energy & Mineral Resources | Water and Environment

CGDA

- > CGDA Homepage
- > Field Operations
- > Facilities
- > Personnel
- > CGDA Projects

Highlighted Projects

- > Indiana Water Balance Network
- > Reconnaissance of Coal Slurry Deposits
- > Riparian Buffer Zones
- > Agricultural BMP
- > Predictive Model for Beach Closings in Indiana
- > Mine Spoil Used for Septic Drain Fields
- > Potential Contaminants in Soils at a Confined Feeding Operation

Indiana Geological Survey x
igs.indiana.edu/CGDA/waterBalanceNetwork.cfm

ft to 6 ft below the ground surface at 1-ft intervals.

Groundwater recharge/discharge (ΔS_G)

Groundwater recharge and discharge are dependent upon the geology of an area, but groundwater recharge generally occurs near watershed boundaries, while discharge occurs in valleys near streams (fig. 2). It is important to identify areas of focused recharge, because these are settings where aquifers are particularly sensitive to contamination. Current research at the CGDA/IGS is focused on using groundwater flow models to determine locations and rates of groundwater recharge. Furthermore, two IWBN monitoring sites are currently collecting matric potential (measure of how tightly water is held in pore spaces), soil moisture, and groundwater level data such that wetting/drying conditions, water fluxes, and water-table rise can be determined respectively.

Overview

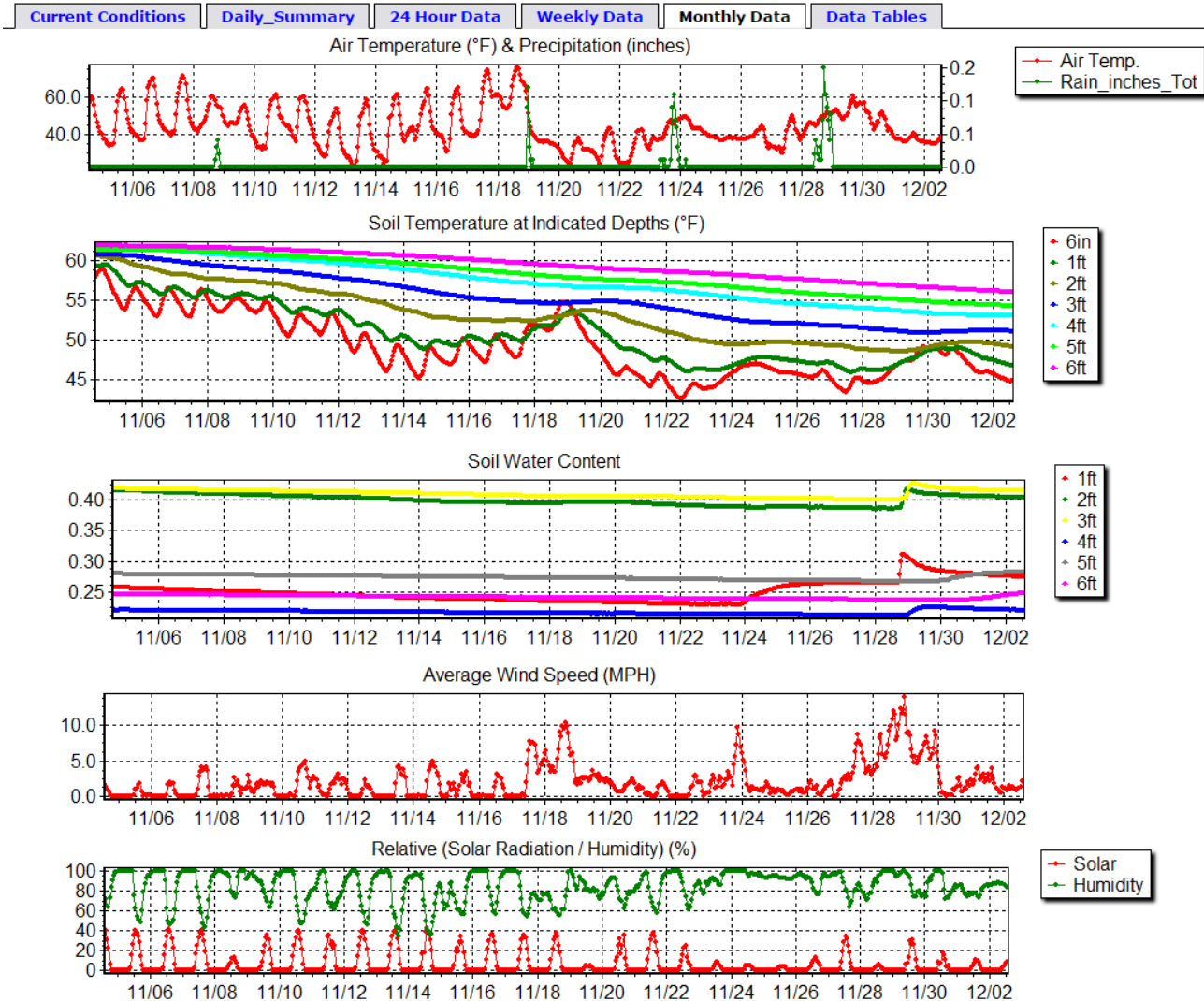
Several projects undertaken at the CGDA/IGS resulted in the collection of continuous data related to the water balance (Table 1). Seven sites have data that can be viewed online; and you can contact Shawn Naylor (snaylor@indiana.edu) to obtain data for the remaining sites.

Table 1. Site locations geologic setting and water-balance parameters measured and calculated (click here for map, or see fig. 3)

Site Name	Data Link (click name)	County	Geologic Setting	P	E	ΔS_S	ΔS_G
Flat Rock River	Y	Rush	Alluvial terrace	Y	Y	Y	Y
Bradford Woods	Y	Morgan	Alluvial terrace	Y	Y	Y	
Shelbyville Moraine	Y	Fayette	Moraine crest	Y	Y	Y	
Eel River Valley	Y	Allen	Outwash terrace	Y	Y	Y	
Wabash Moraine	Y	Allen	Moraine crest	Y	Y	Y	
Ball State Univ.	Y	Delaware	Till plain	Y	Y	Y	
Griffy Woods	Y	Monroe	Unglaciaded highland	Y	Y	Y	
Marian Univ. EcoLab	NA	Marion	Outwash terrace	Y	Y	Y	Y
Lake Station	NA	Lake	Wetland near L. Michigan	Y	Y	Y	
Ohio River	NA	Warrick	Reclaimed mine land	Y	Y	Y	
Summit Lake	NA	Henry	Till plain	Y	Y	Y	Y

Figure 3. Locations of IWBN monitoring sites. The sites are numbered in the order that they were installed. Click on this link to zoom to each site location.

Meteorological and soil data served to web site



Collaborators

Research cohorts



Sally Letsinger



Kevin Ellett



Darren Ficklin



Greg Olyphant



The Yoder Farm LLC



Aurora Vista Farms



Property access



INDIANA
GEOLOGICAL SURVEY

Questions

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Field sampling and soil characterization

Samples collected at 0.3m intervals (0.3-1.8m below ground surface)

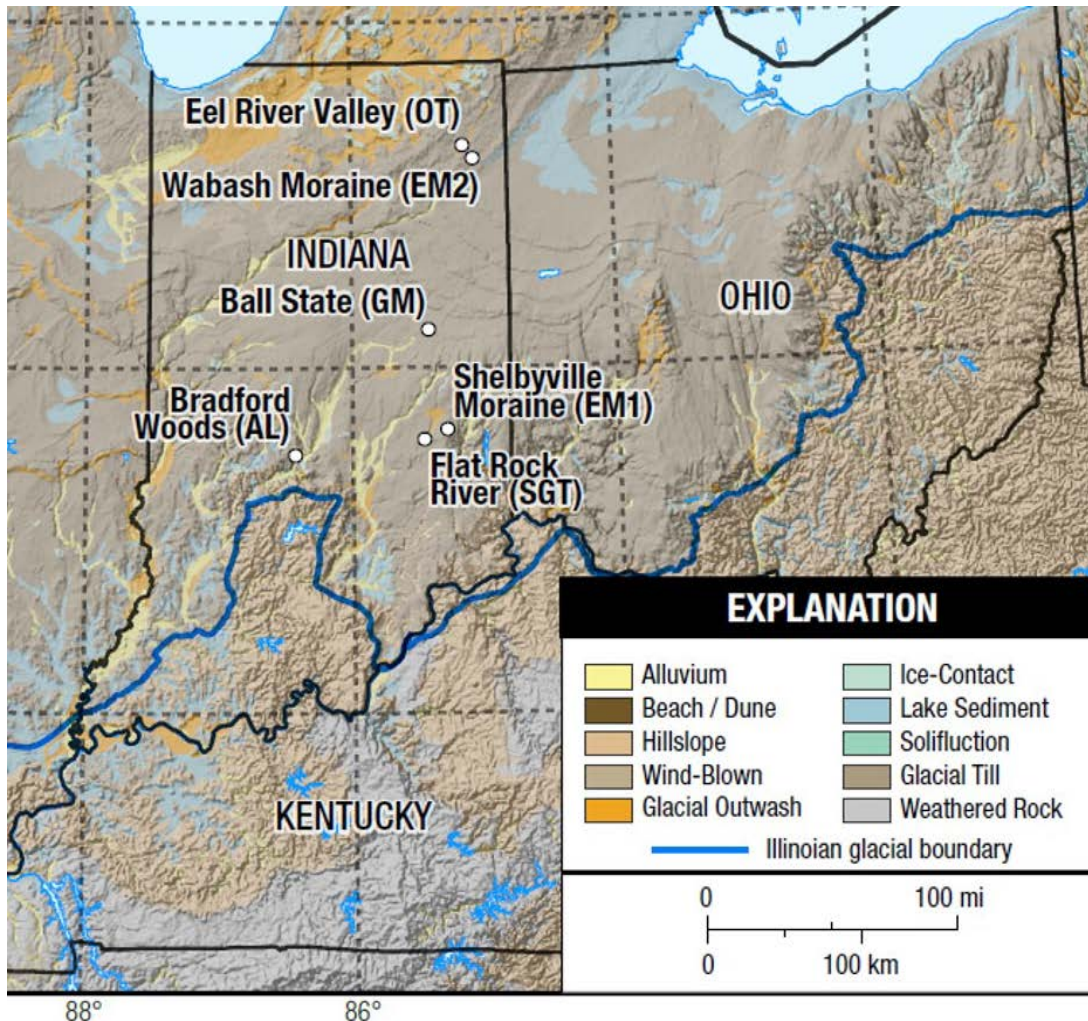
brass core liners used to collect samples for:

- *bulk density* determination
- field *gravimetric water content*
- soil *moisture retention characteristics*
- *grain size* analysis

Bulk density data and grain size distributions are used to estimate hydraulic parameters (e.g., K_{sat}) used in model development



Monitoring locations



6 sites represent common hydrogeologic settings and soil parent materials in the glaciated GLR