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Recent Modeling in the Maumee Watershed and the Western Basin of Lake Erie

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Outline of Presentation

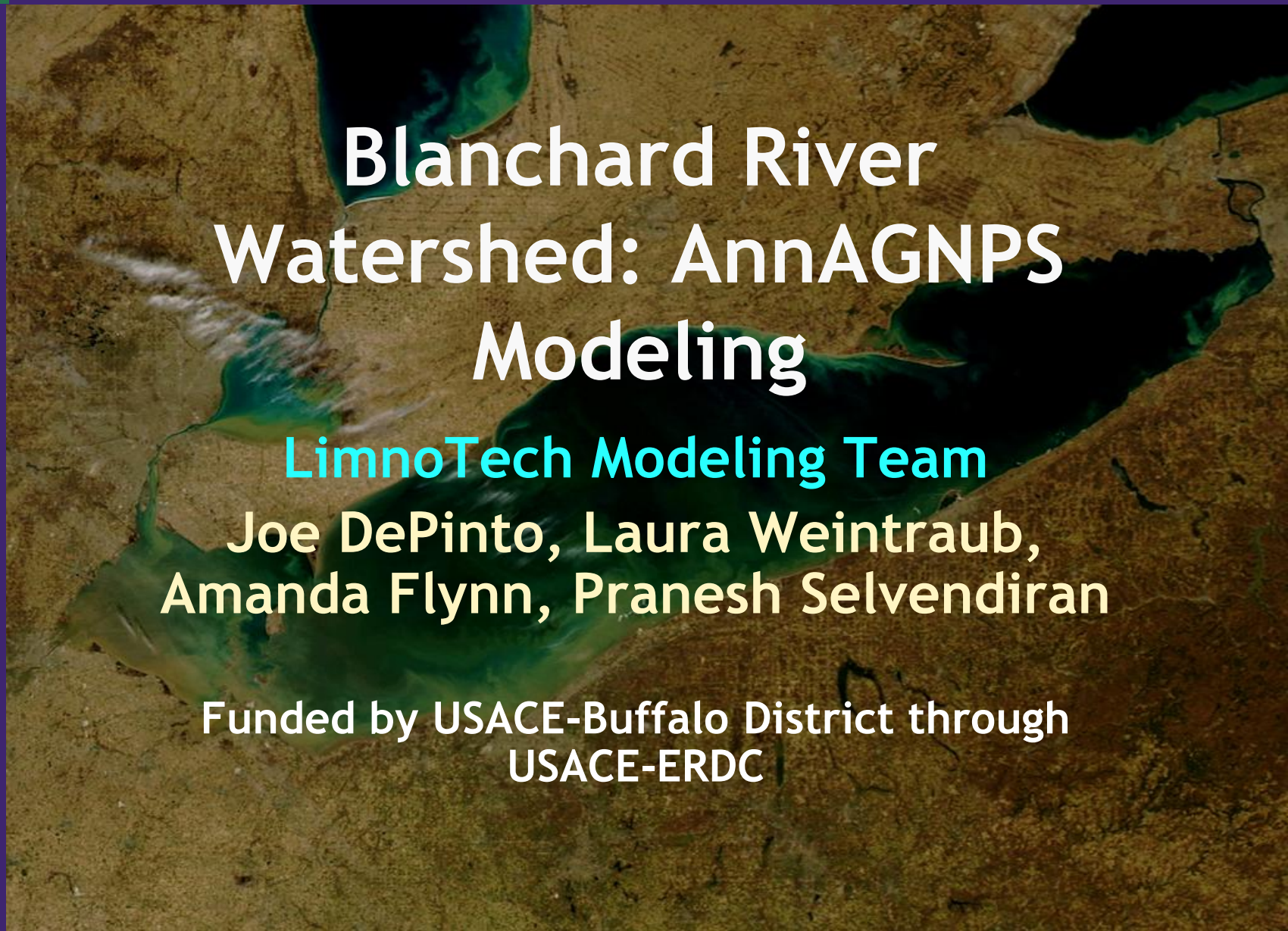
- General value of models
- The problem
  - Harmful and Nuisance algal blooms
  - Excessive sedimentation
- Brief overview of two Lake Erie modeling programs
  - Blanchard River Watershed Modeling
  - Lower Maumee River - Western Basin Modeling (LMRM)
- How these models can be used to support WLEB management decisions

Models Aid in Assessment and Management

- Provide a means of understanding and forecasting system behavior under existing conditions
  - Organizing and explaining field observations
  - Formulating and Quantifying “Conceptual Model”
- Provide a means of comparison of system response to Remediation or Restoration actions with reference to “current conditions”
- Provide a means to forecast the impact of extreme events for which there is no actual experience (e.g., climate change)
- Provide a means to evaluate and measure the success of implemented regulatory or restoration programs (Post-audit)

Western Basin of Lake Erie - 2005 Loads

Western Basin 2005 Data and Flow	TP Metric Tons	TP %	SRP Metric Tons	SRP %	TSS Metric Tons	TSS %	Flow cfs
Detroit	2,965	43.0%	884	52.1%	277,585	15.9%	180,000
Huron	25	0.4%	12	0.7%	6,485	0.4%	447
Stony and Swan	23	0.3%	6	0.3%	10,004	0.6%	
Raisin	124	1.8%	39	2.3%	44,271	2.5%	652
Ottawa and Portage	95	1.4%	30	1.8%	14,963	0.9%	
Maumee	3,565	51.7%	706	41.6%	1,358,534	78.0%	6,718
Atmospheric	100	1.4%	20	1.2%	28,867	1.7%	
Total	**6,897.58**		**1,696.09**		**1,740,707.71**		



Blanchard River Watershed: AnnAGNPS Modeling

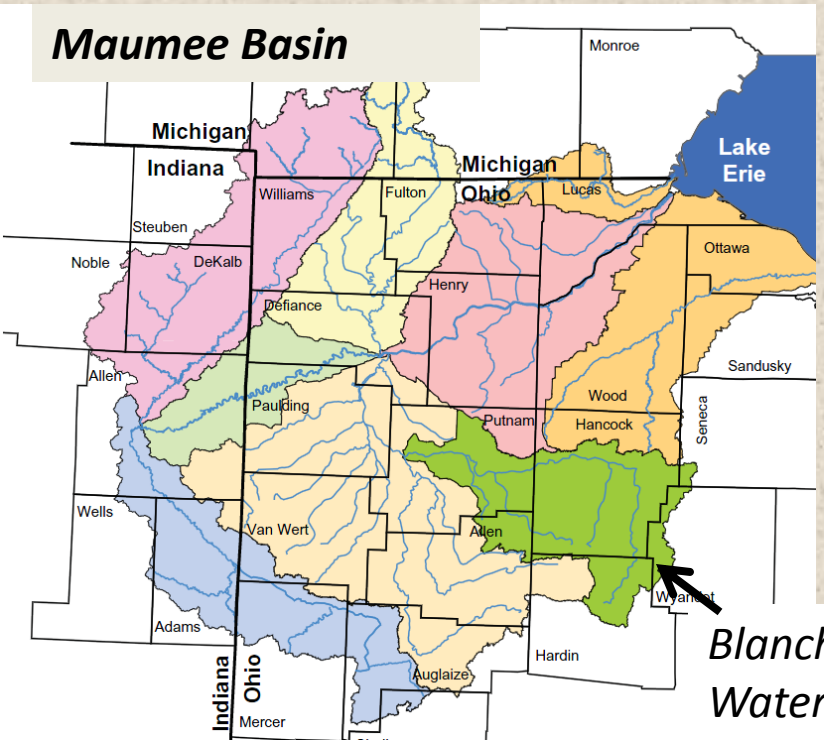
LimnoTech Modeling Team

Joe DePinto, Laura Weintraub, Amanda Flynn, Pranesh Selvendiran

Funded by USACE-Buffalo District through USACE-ERDC

Blanchard River Watershed: AnnAGNPS Modeling

- ***Funding:*** 516(e) Program – USACE Buffalo District / ERDC
- ***Project partners:*** LimnoTech, USDA-NRCS, USDA-ARS, USGS, University of Toledo, Heidelberg University
- ***Goals:***
  - Identify high priority areas for sediment and nutrient loading
  - Compute export from watershed in response to management actions

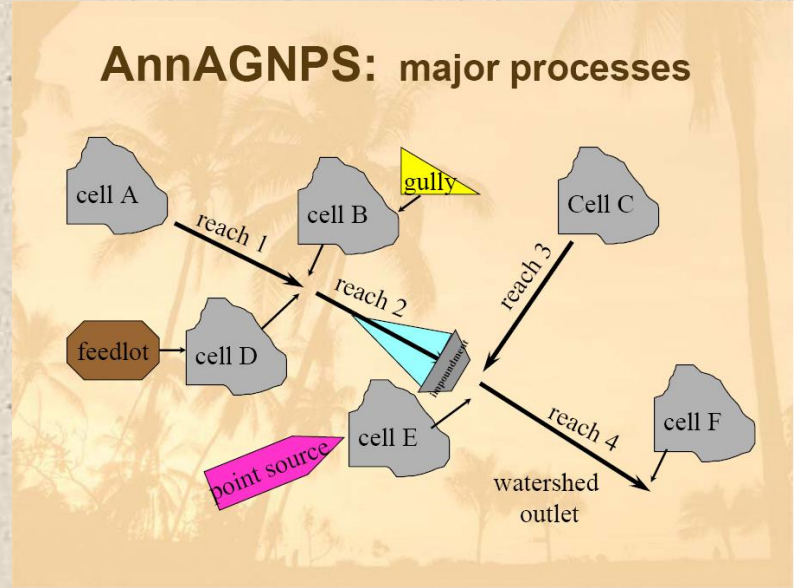


Blanchard Watershed Characteristics

- 771 miles^2
- Maumee Basin is largest tributary sediment source to Lake Erie
- Cropland > 80% (Beans, Corn, Wheat)
- Low slope (typically < 2%)
- Poorly drained soils (42% hydric)

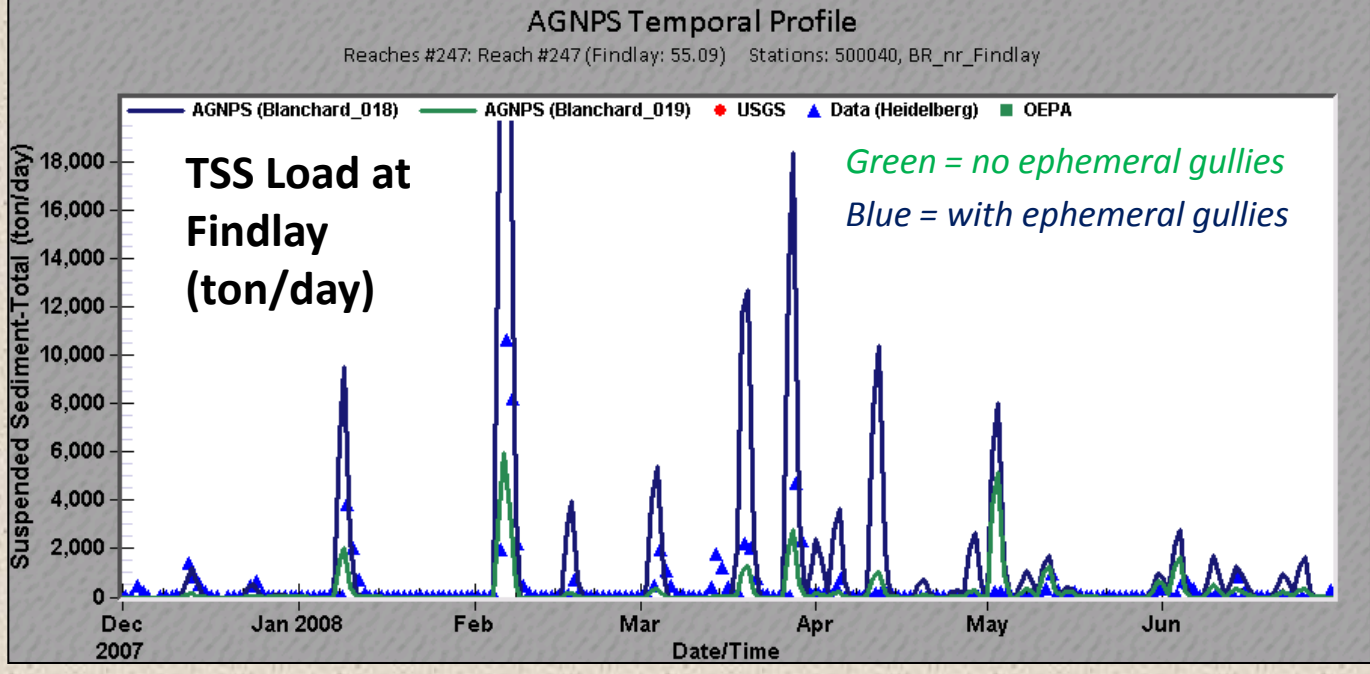
AnnAGNPS Background

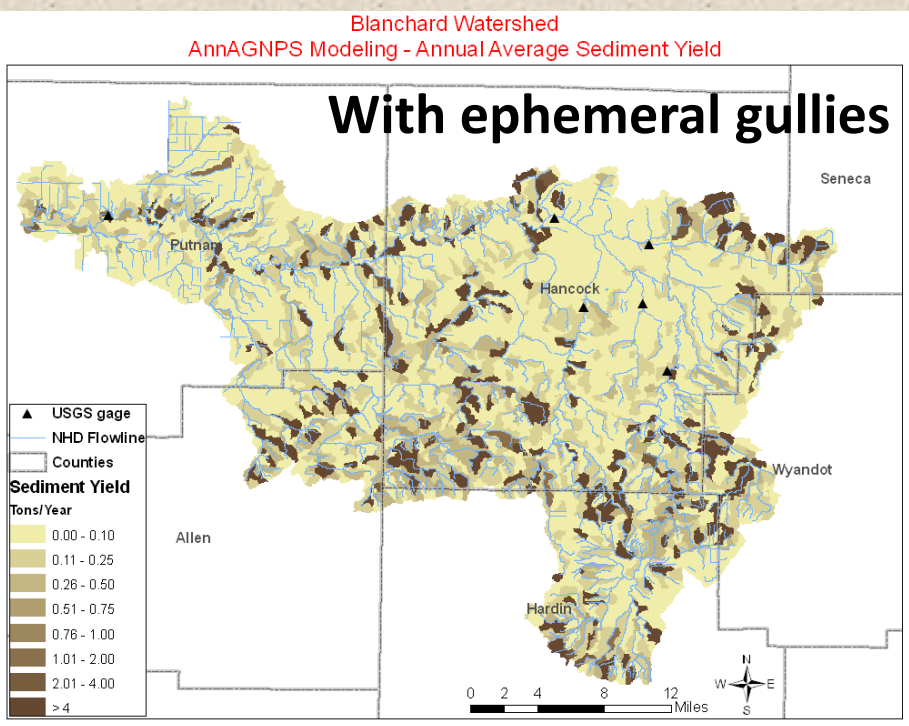
- Developed by USDA-ARS
  - Continuous simulation of surface runoff and pollutant loading
  - Incorporates revised universal soil loss equation (RUSLE)
- Models flow, suspended solids, and nutrients*
- Distinguishes between erosion forms:
  - Sheet and rill, ephemeral gully, bank and bed
- GIS-based tool:
  - Input development / Output visualization
  - LTI developed additional capabilities within WinModel interface

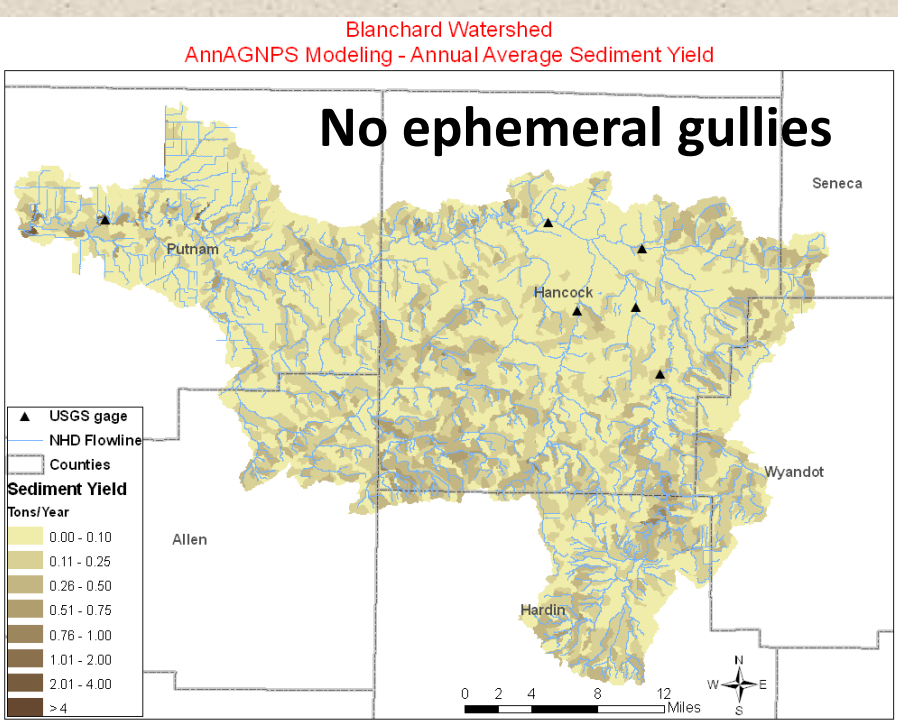


** Nutrient algorithms currently under revision*

Preliminary AnnAGNPS Results







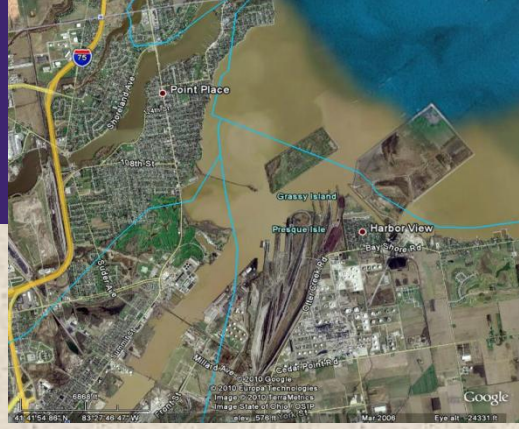
Linked Hydrodynamic – Sediment Transport – Eutrophication Model for Lower Maumee River – Lake Erie western basin (LMRM)

LimnoTech Modeling Team

Joe DePinto, Todd Redder, Ed Verhamme, Jeremy Grush, Ric McCulloch

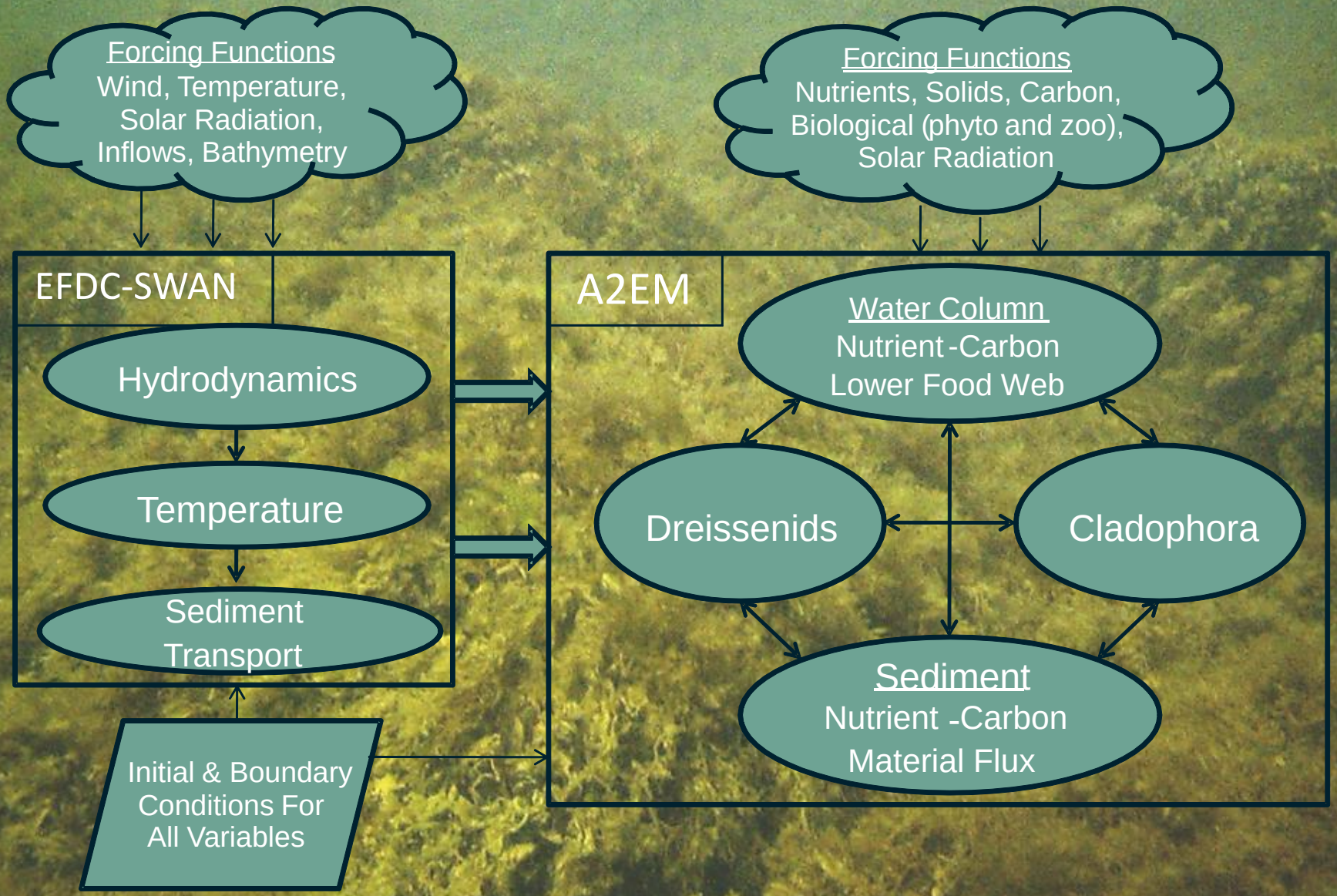
Funded by USACE-Buffalo District through sub-contract to Ecological & Environment, Buffalo, NY

Goals of Lower Maumee River Model – Western Lake Erie (LMRM)

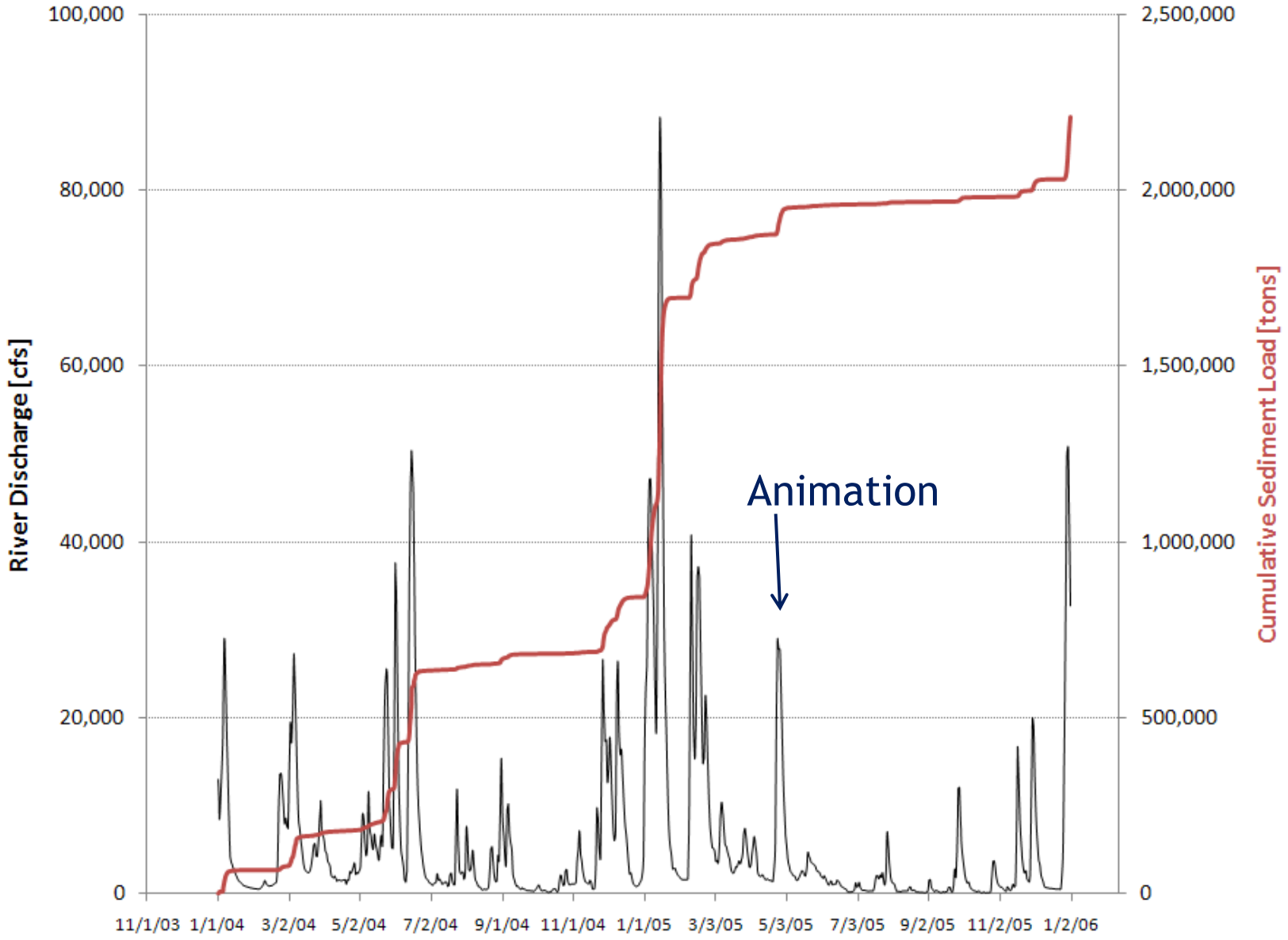


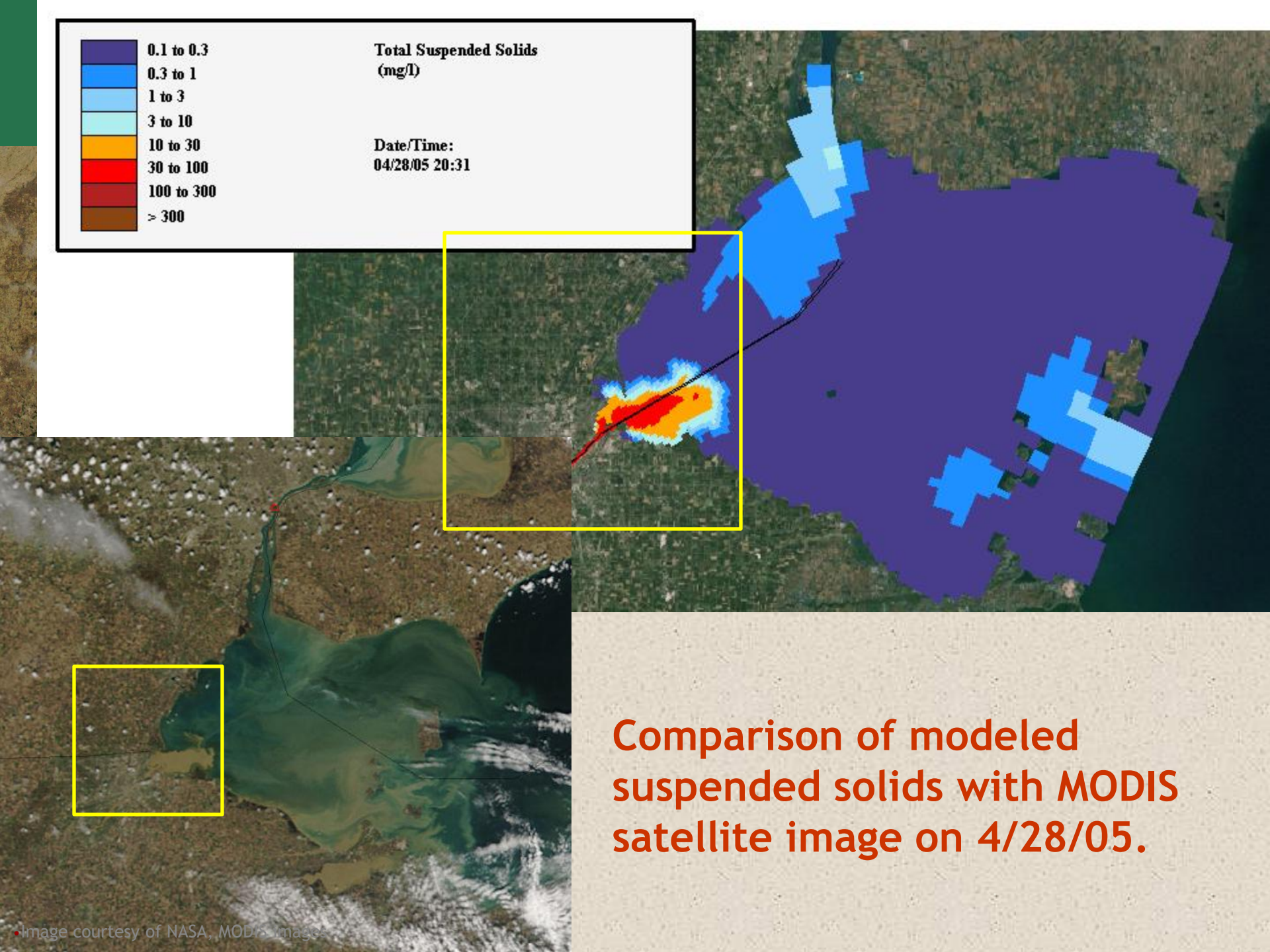
- Quantify relationship between sediment and nutrients loading to the system and aquatic ecosystem endpoints of concern
  - Sedimentation in Toledo Harbor and navigational channel
  - Microcystis blooms
  - Nearshore benthic algal blooms
  - Relative contribution of all sources to suspended solids concentrations
- Support USACE with sediment management planning, including selection of new dredged material disposal areas
- Support WLEB Partnership in establishing informed management goals for the system

LMRM Modeling Framework



Flow and cumulative sediment load at Waterville during calibration period

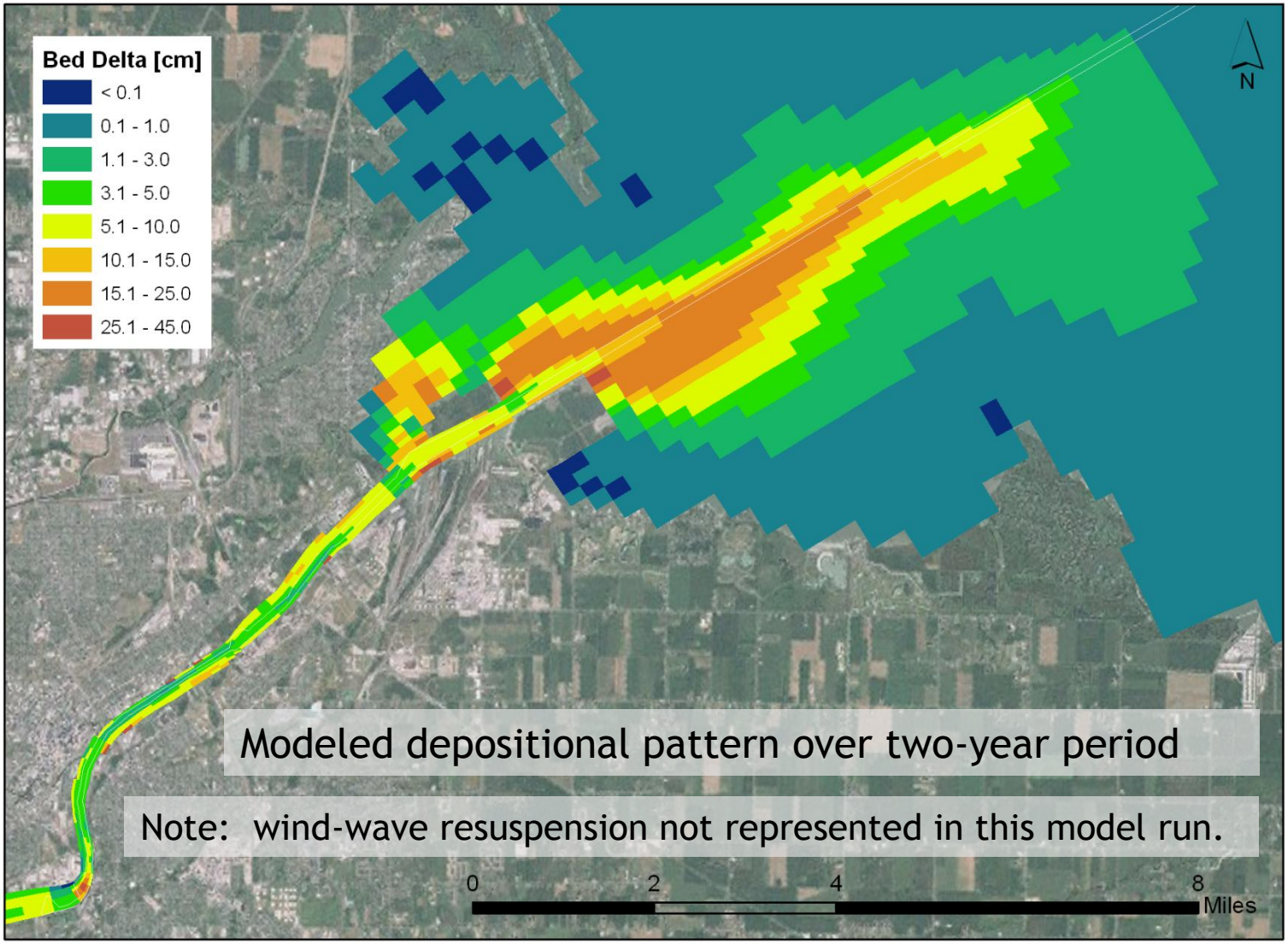




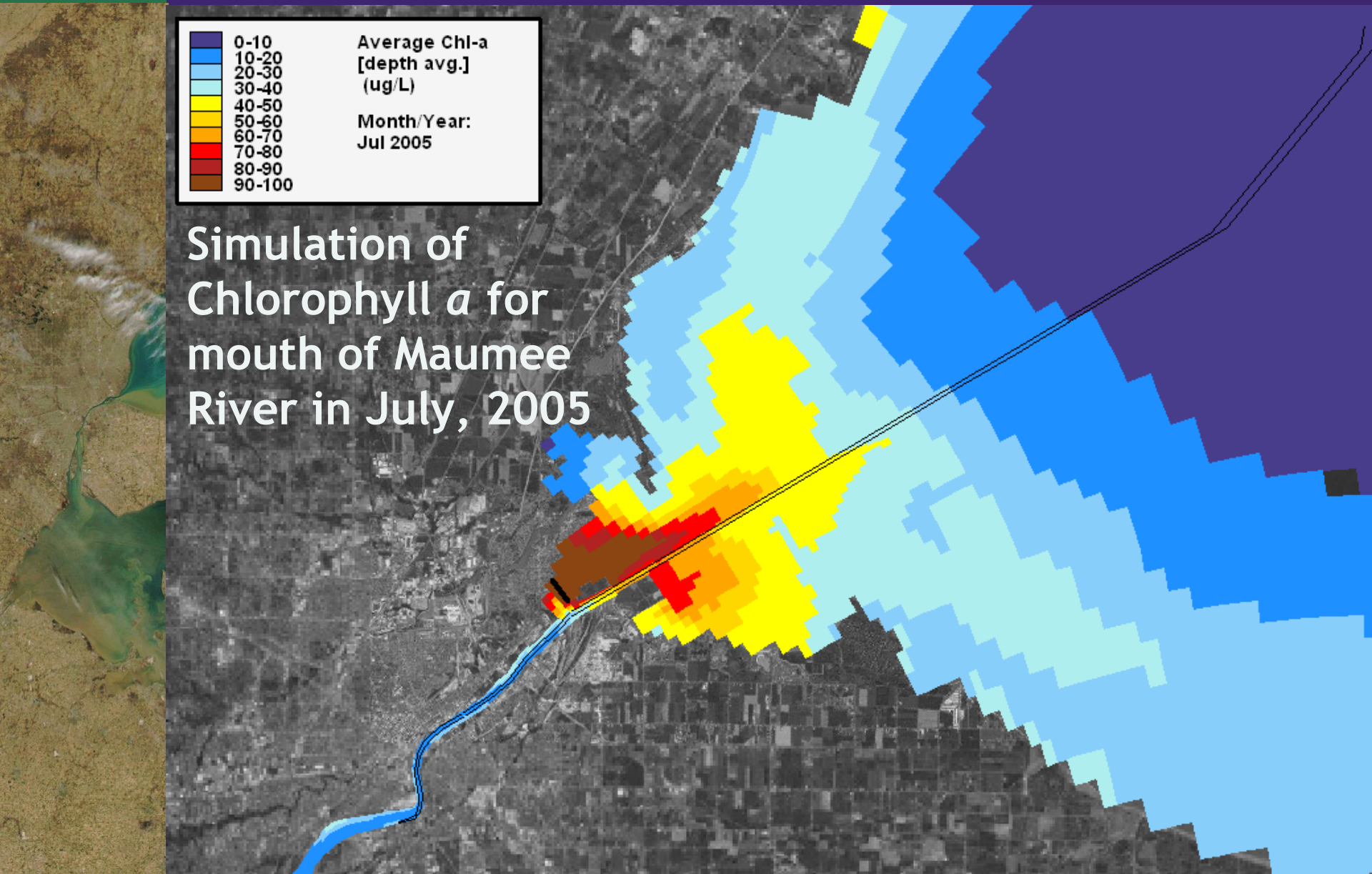
Comparison of modeled suspended solids with MODIS satellite image on 4/28/05.

Image courtesy of NASA, MODIS Images

Preliminary Sediment Model Results (deposition patterns for 2004-05)



Preliminary Water Quality Model Results



Simulation of Chlorophyll *a* for mouth of Maumee River in July, 2005

Management Questions Supported by Models

1. What is the relative contribution of various sources (tributaries, Detroit River, bottom and shoreline resuspension, dredged material disposal) to sediments and nutrients in Maumee Bay and western basin?
2. How much and what form of phosphorus load reduction from the Maumee Watershed is necessary to eliminate harmful and nuisance algal blooms in Maumee Bay and the western basin?
3. What combination of management actions in the Maumee watershed are necessary to achieve targeted phosphorus load reduction?

Management Questions Supported by Models

4. How can models assist with sediment and flood management planning for Maumee system?
    1. Impact of new features on general circulation and sediment deposition patterns (e.g., remove causeway, create islands)
    2. Potential for erosion of submerged features
    3. Transport and fate of dredged material releases from various proposed disposal areas
    4. What is the relationship between land management actions in the watershed and dredging requirements in the Maumee navigation channel?
    5. How can a watershed model be used for evaluation and planning of flood mitigation efforts
        1. Quantify spatial-specific runoff as a function of precipitation
        2. Estimate benefits of flood-related BMPs
        3. Identify best areas for increased infiltration or flood retention areas
        4. Assist with evaluation and design of flood control structures in the watershed.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