

# System-Wide Science Integration for Adaptive Management

Working Group/Science Coordination Group  
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# Effective Use of Science in South Florida

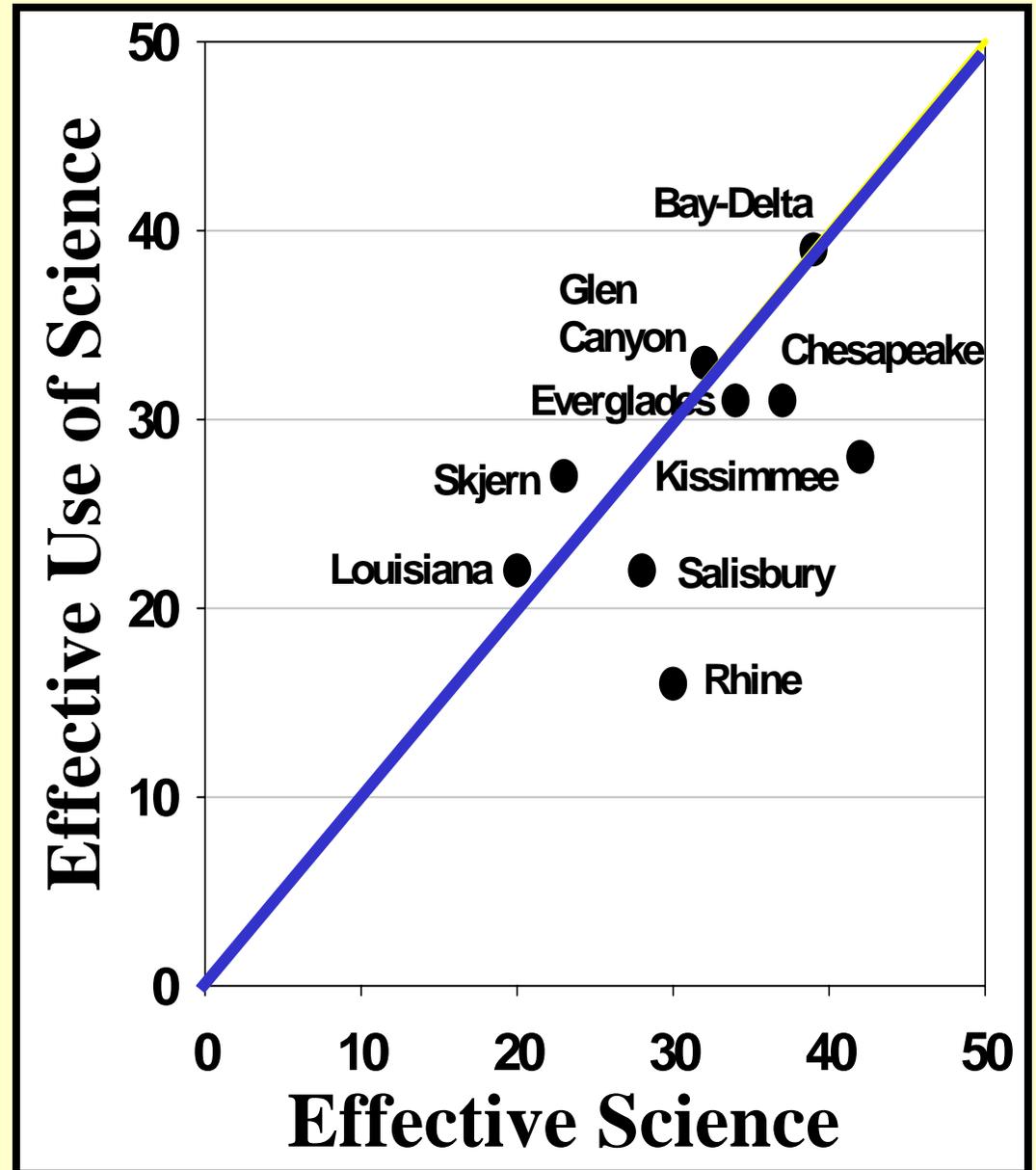
## Effective Science

- Content
- Quality

## Effective Use of Science

Institutional process  
where science is:

- Generated
- Evaluated
- Applied



From: Van Cleve et al. (2006)  
Environ. Manage. 37:367-379

# Topics and Themes Covered

- Overview of the Monitoring and Assessment Plan (MAP)
- System-wide monitoring and assessment for AM
- Integrating Science: multiple scales and opportunities
- Lessons-learned
- Long-term monitoring, sustainability, and thresholds
- Synthesis of key messages for managers

# **Overview of the Monitoring and Assessment Plan**

2008 CISRERP Report:

Ensure that PMs have adequate supporting monitoring  
data to be useful

# Purpose of the MAP

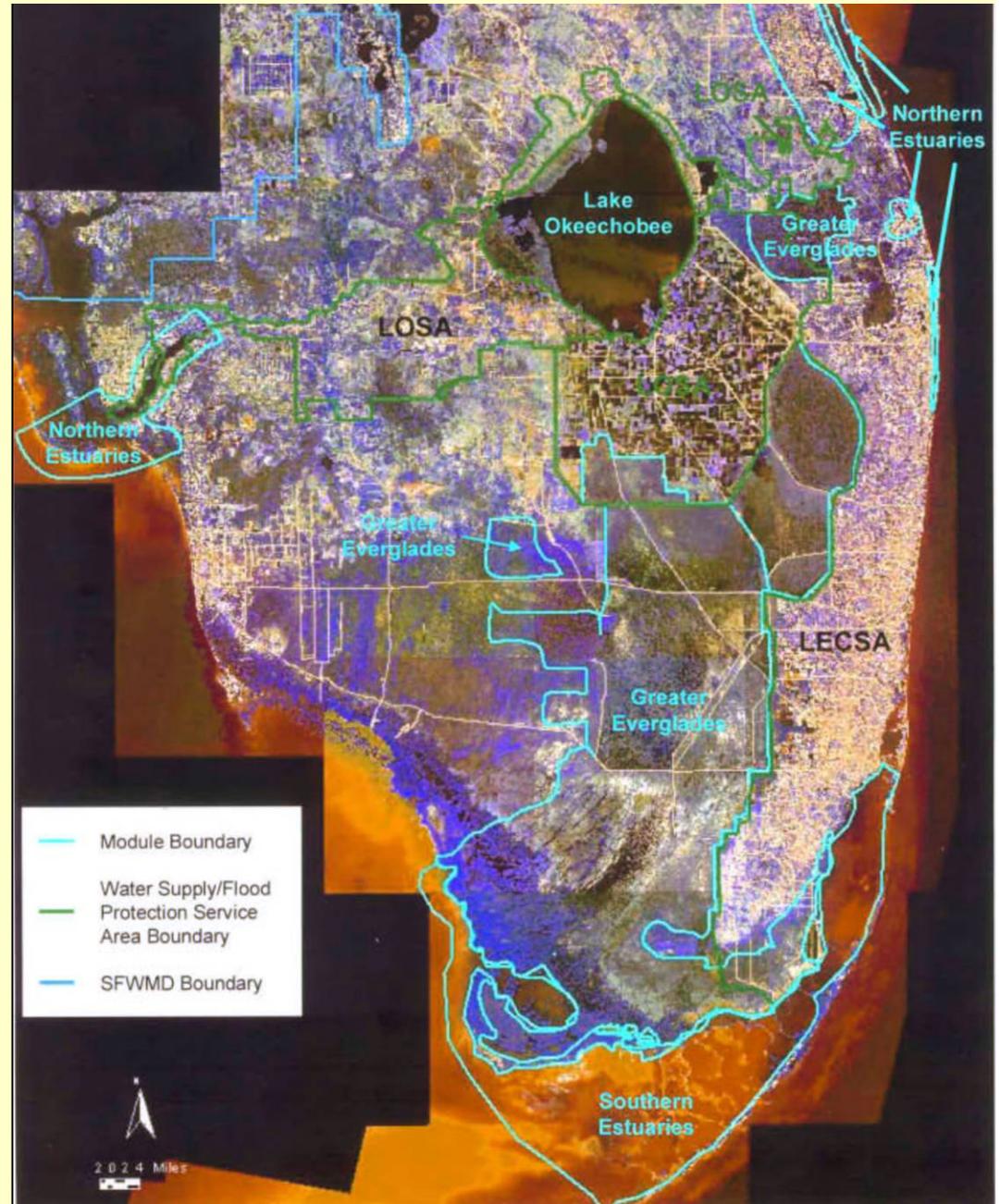
- **Document restoration-induced change and status of system**
  - Measure hydrology, water quality, ecology responses
- **Confirm/develop scientific information**
- **Feedback loop integrating science and management**
- **Informed decision-making**
  - Provide science to guide implementation, operation, and maximize benefits, i.e., Adaptive Management
  - Sound science to reduce risk and uncertainty

# **MAP Implementation**

- **Capture baseline info for monitoring components that do not have adequate existing information**
- **Fill gaps in existing networks**
  - hydrology
  - water quality
  - ecology responses
- **Initiate high priority new biological monitoring**
- **Initiate priority supporting ecological research**
- **Develop guidance for assessment protocols**

# Conceptual Ecological Models

Ridge & Slough  
Marl Prairies  
Mangrove Estuaries  
Big Cypress  
Florida Bay  
Biscayne Bay  
Caloosahatchee Estuary  
St. Lucie Estuary/IRL  
Lake Okeechobee  
Loxahatchee R.  
Lake Worth Lagoon  
  
Total System Model



# Metrics for Assessment

- Was  $\gg$  than 100 PMs
- Combined across CEMs
- Distilled CEMs
  - 17 major organizing hypothesis clusters

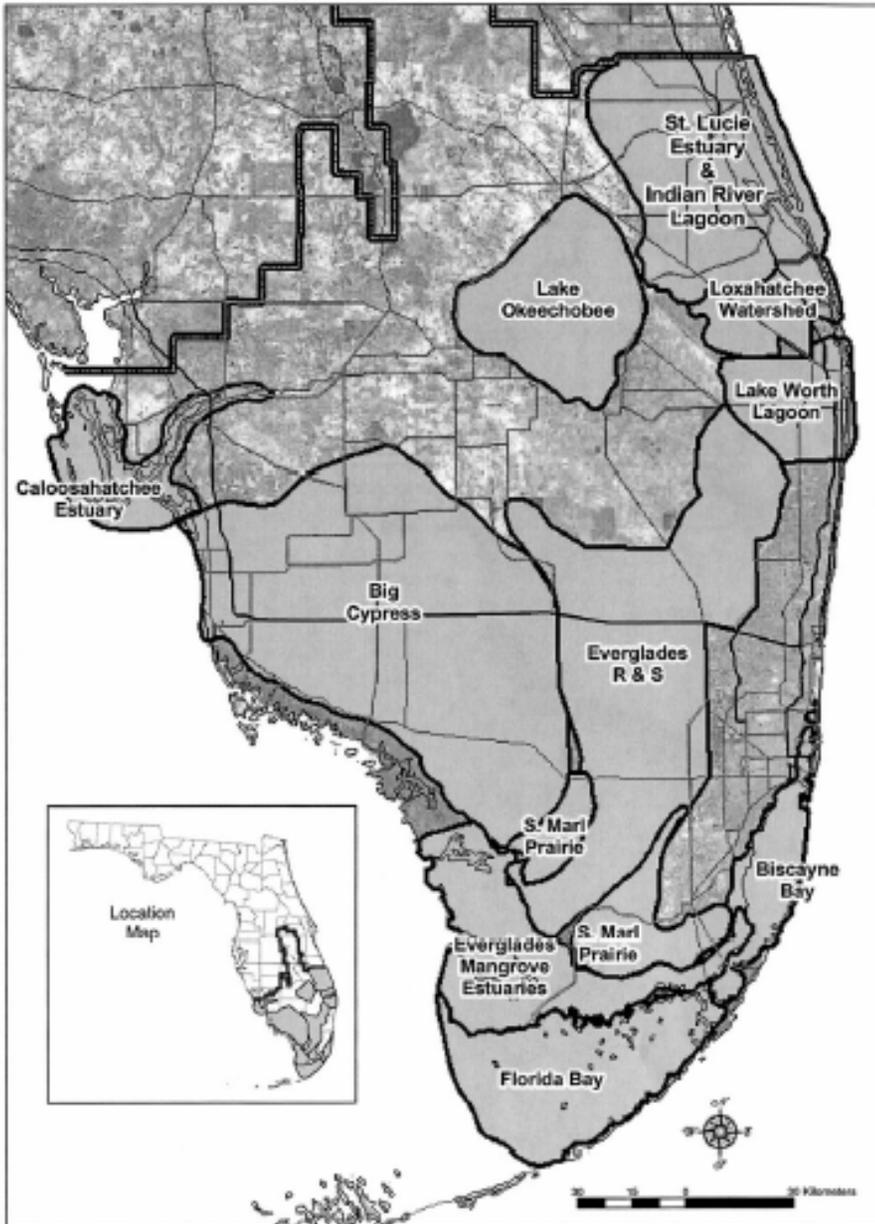


Figure 1. The total South Florida ecosystem has 11 regions for which conceptual ecological models have been developed. These regions combined form the boundary of the Total System Conceptual Ecological Model.

# Conceptual Ecological Models

**Drivers  
&  
Sources**



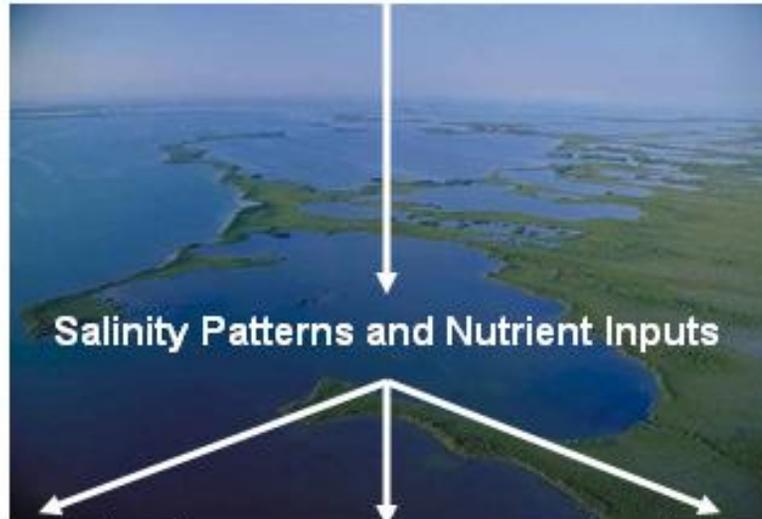
*Reservoir pump station*

**WATER STORAGE and WATER QUALITY**



*Storm water treatment area*

**Stressors**



*Florida Bay salinity transition zone*

**Algal Blooms**

**Seagrass**

**Pink Shrimp**

**Attributes**



**Ability to  
Detect Change**

**Performance  
measure**

**Establish  
Reference**

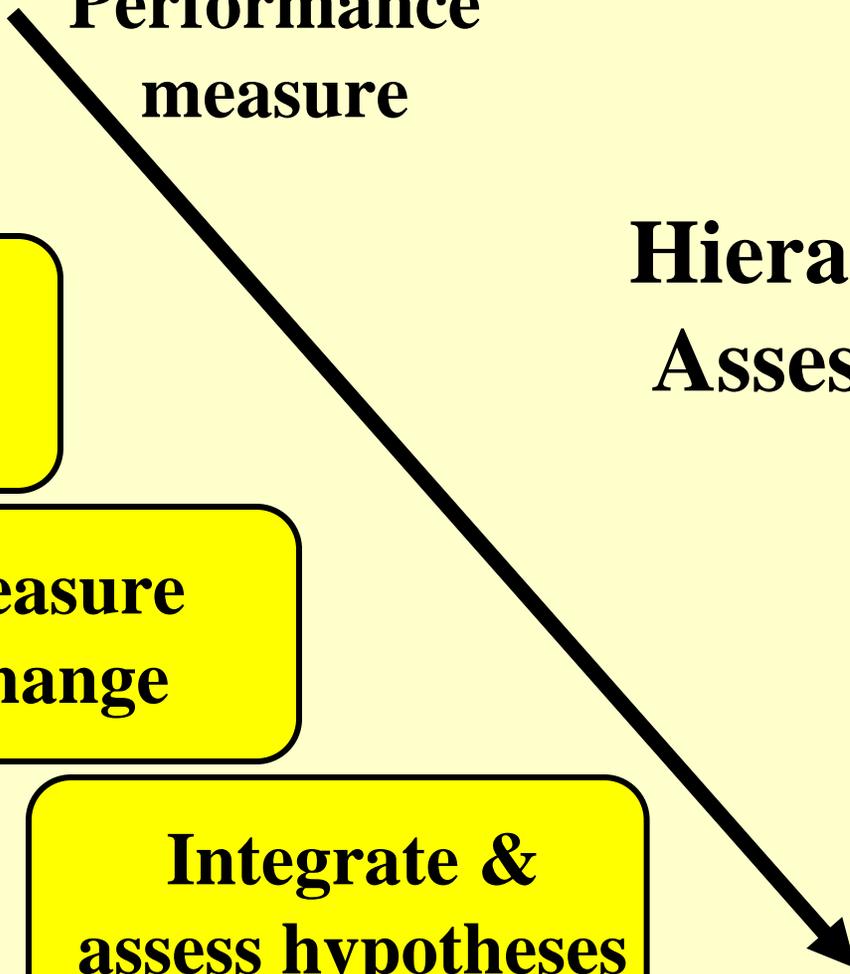
**Hierarchical  
Assessment**

**Measure  
Change**

**Integrate &  
assess hypotheses**

**Integrate  
& Scale Up**

**Ecosystem**



# System-wide Assessments

<b>Hypothesis Cluster</b>	<b>Oysters</b>	<b>SAV</b>	<b>Wading Birds</b>	<b>Crocodiles</b>
<b>Data Status</b>				
<b>Ability to Detect Change</b>				
<b>Reference Condition</b>				
<b>Measure / Assess Change</b>				
<b>Apply to AM</b>				
<b>Lessons Learned</b>				

# System-wide Assessments

GEER 2008 System-wide Assessment workshop

<b>Components</b>	<b>N. Estuaries</b>	<b>L. Okeechobee</b>	<b>G. Everglades</b>	<b>S. Estuaries</b>
<b>Data Status</b>				
<b>Ability to Detect Change</b>				
<b>Reference Condition</b>				
<b>Measure / Assess Change</b>				
<b>Apply to AM</b>				
<b>Lessons Learned</b>				

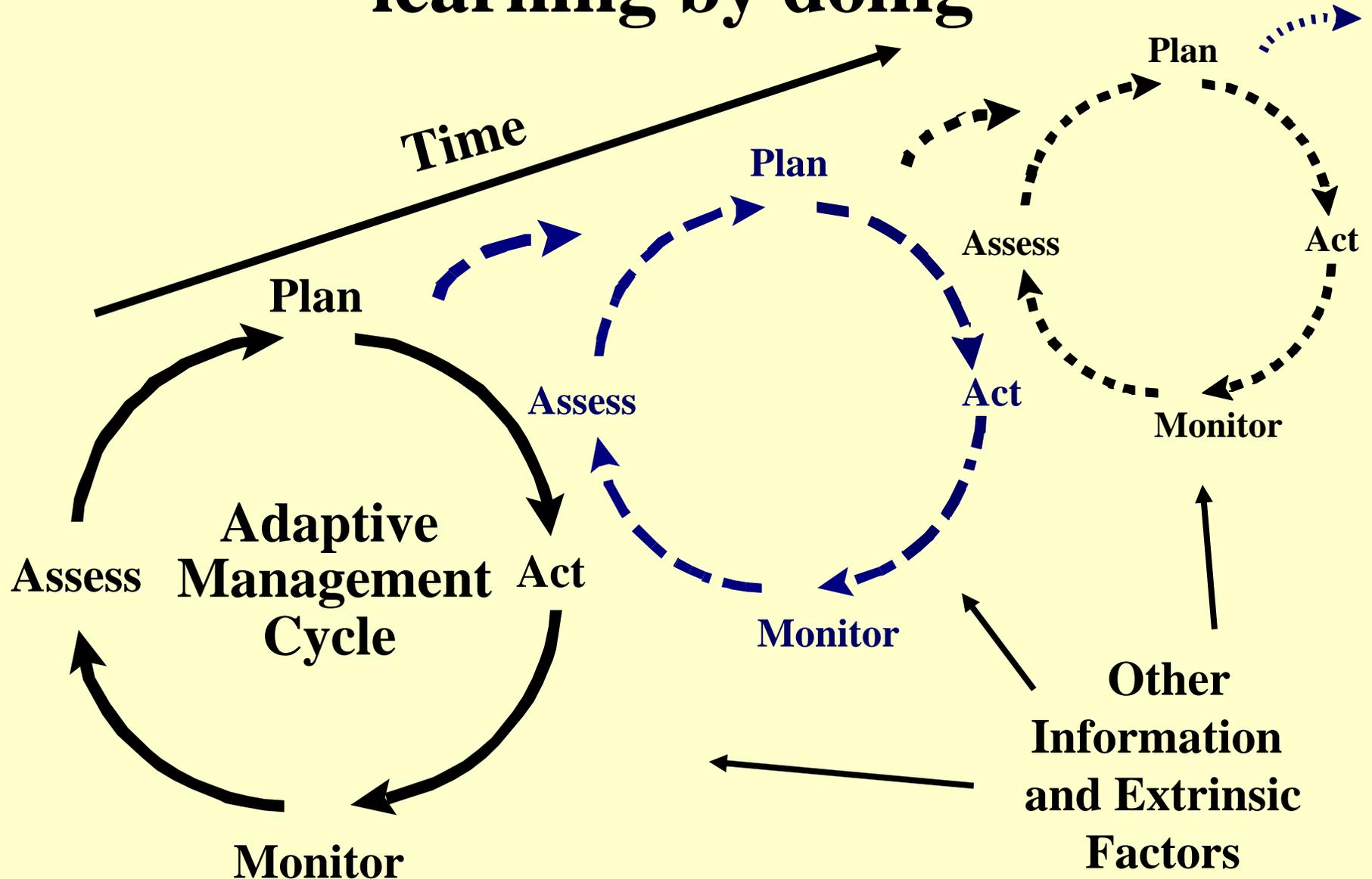
**System-Wide  
Monitoring and Assessment  
for  
Adaptive Management**

## **CERP AM Definition**

**“Adaptive management is a science- and performance-based approach to ecosystem management in situations where predicted outcomes have a high level of uncertainty. Under such conditions, management anticipates actions to be taken as testable explanations, or propositions so the best course of action can be discerned through rigorous monitoring, integrative assessment, and synthesis. Adaptive management advances desired goals by reducing uncertainty, incorporating robustness into project design, and incorporating new information about ecosystem interactions and processes as our understanding of these relationships is augmented and refined. Overall system performance is enhanced as AM reconciles project-level actions within the context of ecosystem-level responses.”**

**- *CERP AM Strategy, 2006***

# AM is a structured process of learning by doing



# Nine Activities in CERP AM

**Plan Formulation**

**Design/Construction**

**Operations**

**Activity 1: *Engage Stakeholders and Collaborate***

**Activity 2:**

*Establish or Verify  
Program Goals and  
Objectives*

**Activity 3:**

*Identify and Prioritize  
Unanswered Questions*

**Activity 4:**

*Use Conceptual Models,  
Hypotheses, and  
Performance Measures*

**Activity 5:**

*AM Integration into  
Restoration Plan*

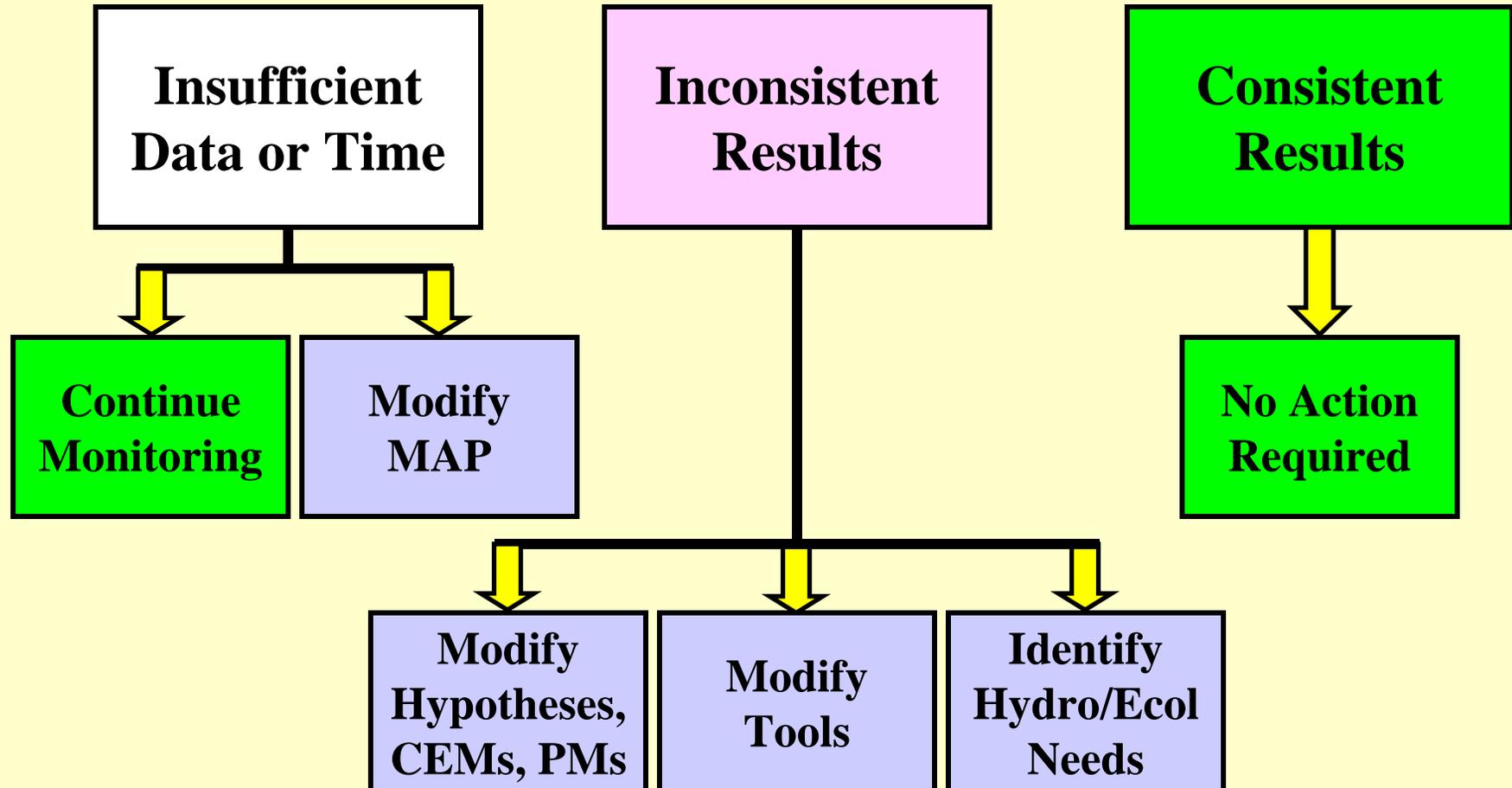
**Activity 6: *Monitoring***

**Activity 7:  
*Assess***

**Activity 8:  
*Decision-  
Making***

**Activity 9:  
*Implement  
and Refine***

# Framework for Synthesis and Interpretation



# **Integrating Science: multiple scales and opportunities**

2008 CISRERP Report:

Communication efforts need to satisfy the need of project managers and decision makers as well as scientists.

# Northern Estuaries

## Water Management

## Water Treatment

## Habitat Alterations

Reservoirs



Stormwater Treatment Areas



Muck Removal



Wetlands  
Rehydration

Improve salinity patterns,  
water quality and habitat



Artificial  
Habitat



Seagrass



Oysters



to restore

# Oyster hypothesis cluster example

- **Monitoring**
  - Simple monitoring; established program; high quality science
- **Project Planning**
  - HSI based on science
  - Used for evaluating restoration alternatives
- **Project-level AM Opportunities**
  - Project-level tweaks
- **Project Sequencing – Regional Scale**
  - Utilizing AM entry points to identify tradeoffs; risk assessment
- **System-wide Integration**
  - System Operating Manual; identifying bottlenecks, tradeoffs

# Oyster Example – Monitoring

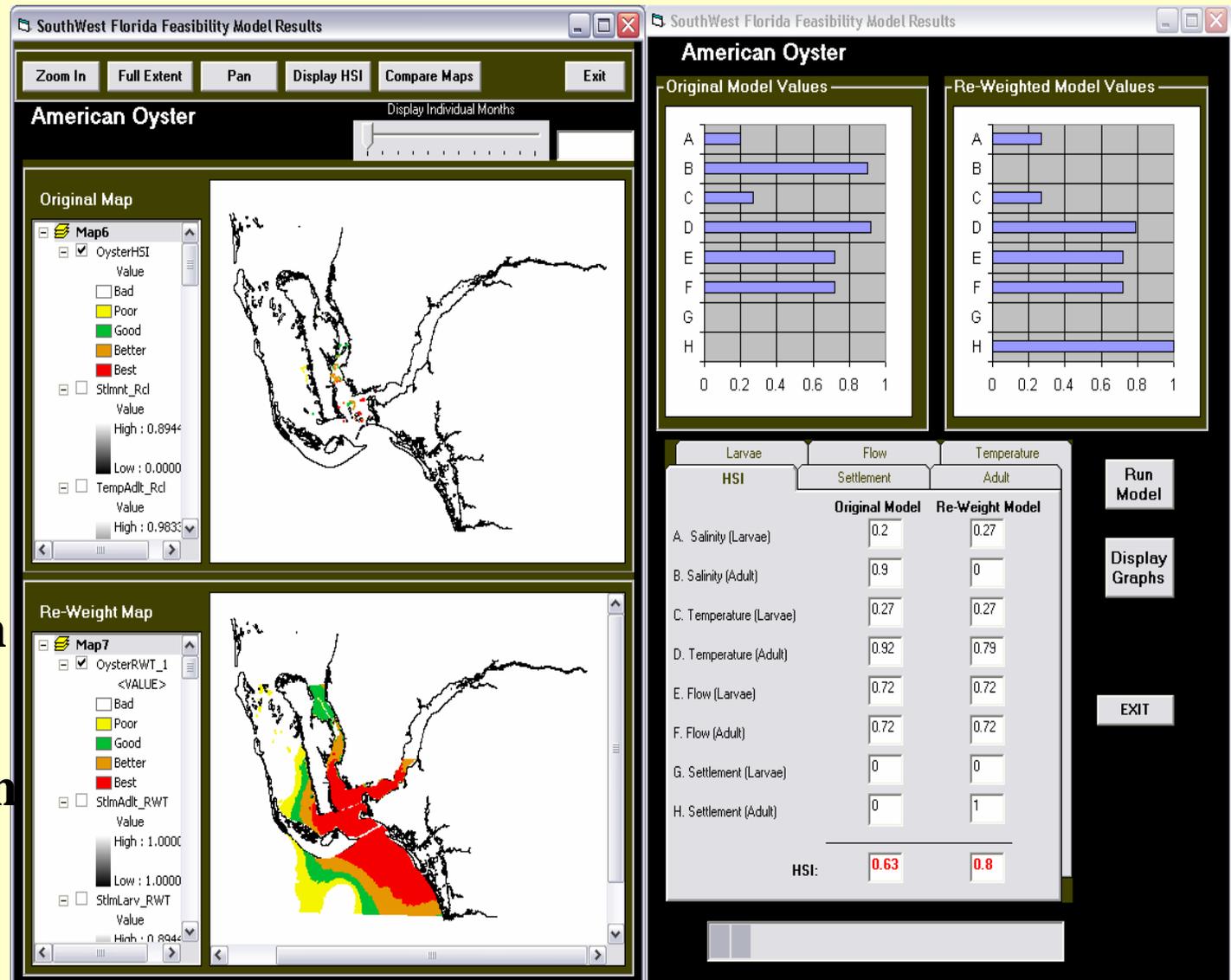
Simple monitoring; established program; high quality science

- Salinity
- Recruitment
- Juvenile growth and mortality
- Disease
- Substrate
- Oyster reef development



# Oyster Example – Project Planning

HSI to predict suitable Oyster Habitat based on differing flow/salinity scenarios that will occur as an outcome of Implementation



Evaluation of restoration alternatives

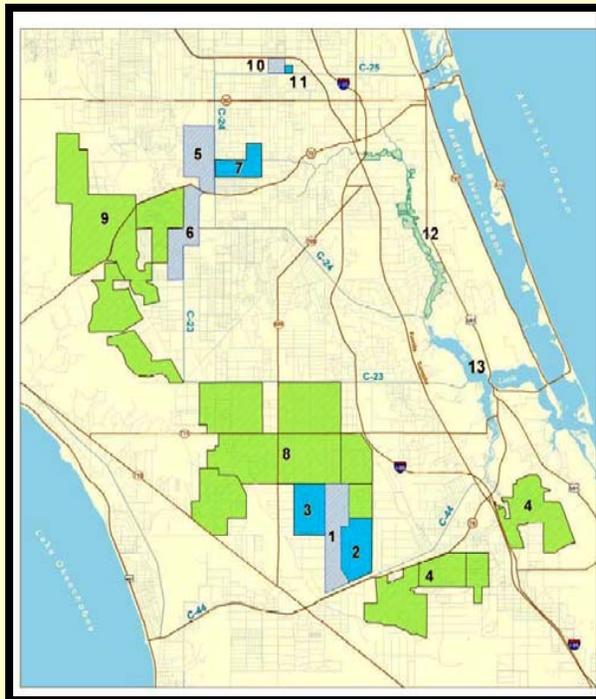
# Linkage of oyster HSI metrics to management actions

<b>Stressor metric</b>	<b>Target</b>	<b>Management Action OPTION 1</b>	<b>Management Action OPTION 2</b>	<b>Management Action OPTION 3</b>
<b>Salinity</b>	<b>Salinity range of 10-25 ppt</b>	<b>Change operations to meet flows</b>		
<b>Recruitment</b>	<b>Presence Absence adults and larvae</b>	<b>Stock larvae</b>	<b>Stock adults</b>	<b>Operations to avoid too much or too little flow in key months</b>
<b>Substrate</b>	<b>Acres of Suitable habitat</b>	<b>Add oyster shell cultch</b>	<b>Try different substrate e.g., concrete</b>	<b>Dredge muck</b>

# Linkage of oyster HSI metrics to management actions

<b>Stressor metric</b>	<b>Target</b>	<b>Management Action OPTION 1</b>	<b>Management Action OPTION 2</b>	<b>Management Action OPTION 3</b>
<b>Oyster reef development</b>	<b>Presence / absence of 1 m<sup>2</sup> reefs</b>	<b>Add additional cultch</b>		
<b>Juvenile growth and mortality</b>	<b>Attain natural levels of growth and mortality</b>	<b>Adjust operations to eliminate or minimize events</b>	<b>Adjust flows to attain salinities similar to creeks where oyster growth is optimal</b>	<b>Excessive predation may require salinity adjustments through operations</b>
<b>Disease</b>	<b>Elimination</b>	<b>Operate flows to maintain salinity below maximum threshold</b>	<b>Lower salinity threshold and adjust operations</b>	

# Oyster Example – Sequencing Projects



**IRL-S Implementation**

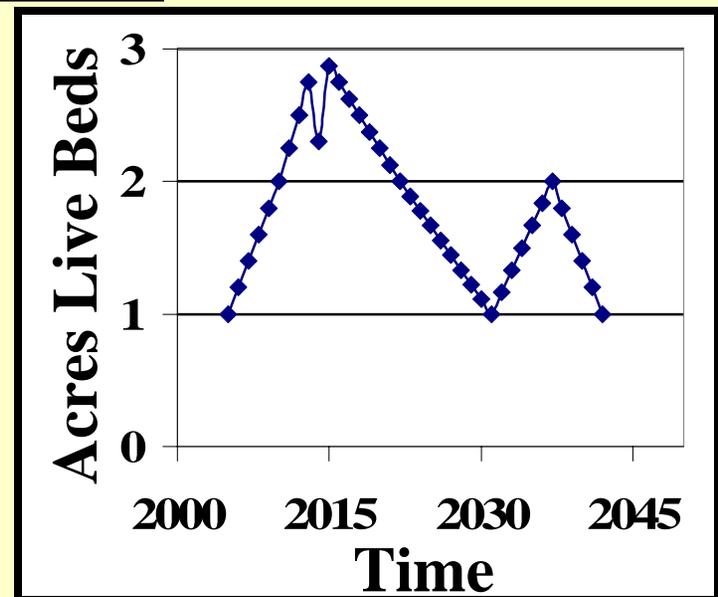
**Adaptive Management  
Entry Points**

**Substrate  
Suitability**

**Nutrient  
Reductions**

**Flow/Salinity  
Envelope**

**Oyster  
Distribution,  
Quantity and  
Health**



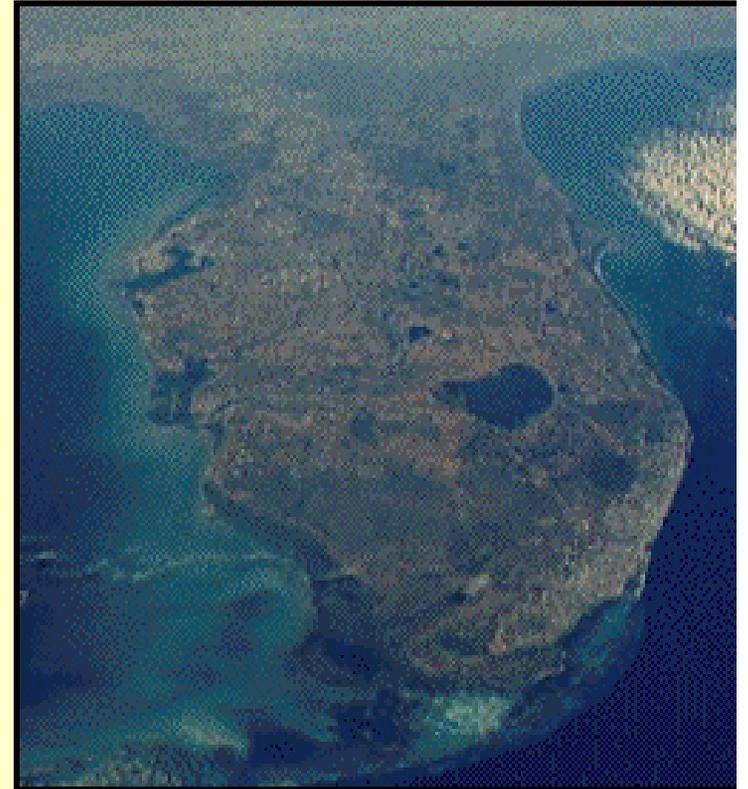
**Utilizing AM entry points to  
identify tradeoffs; risk assessment**

# Oyster Example – System-wide Integration

Identifying bottlenecks, tradeoffs

## System Operating Manual

- System-wide
- Kiss. River-Lake Istokpoga
- L. Okeechobee and EAA
- ARMLNWR, WCAs, ENP,  
and ENP-South Dade Conveyance
- East Coast Canals
- Upper St. Johns River Basin
- Southwest Florida



[PalmBeachPost.com](http://PalmBeachPost.com)

**The world is not their oyster**

By Sally Swartz

Sunday, October 12, 2008

*Palm Beach Post Columnist*

# **Application of lessons-learned to better aid managers' efforts to maximize restoration**

2008 CISRERP Report:

Lessons learned will be invaluable for:  
refinement of the monitoring plan; refinement of the CEMs;  
refinement of models; prioritization efforts

# Lessons Learned – Science and Assessment

- **Science**

- Specific to monitoring components

- **e.g., network efficacy**

- Applicable among systems

- **sampling protocols**

- **Assessment**

- Collaboration among scientists and agencies critical

- Data Management:

- **Additional structure and integration**
- **Improved efficiency through automation**

# **Lessons Learned – Science and Assessment**

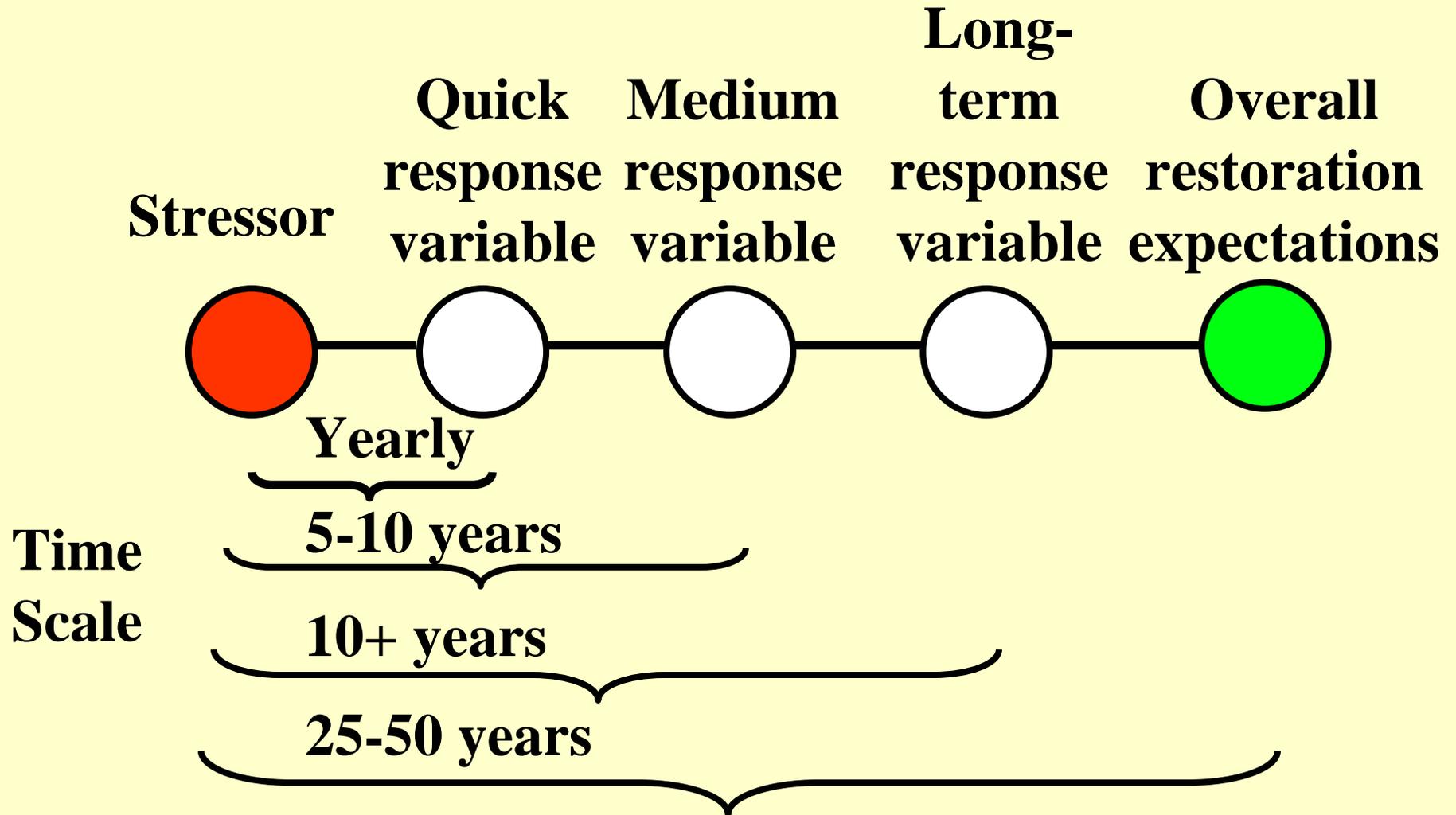
- **Integration of science for AM**
  - Continued efforts needed to develop structured process to integrate science and management decisions
- **Application of system-wide perspectives to project planning and implementation**
  - Communication
  - System-wide science should be expressed as:
    - **A means of reducing risk**
    - **A means of reducing uncertainty**

# **Long-term monitoring, sustainability, and thresholds**

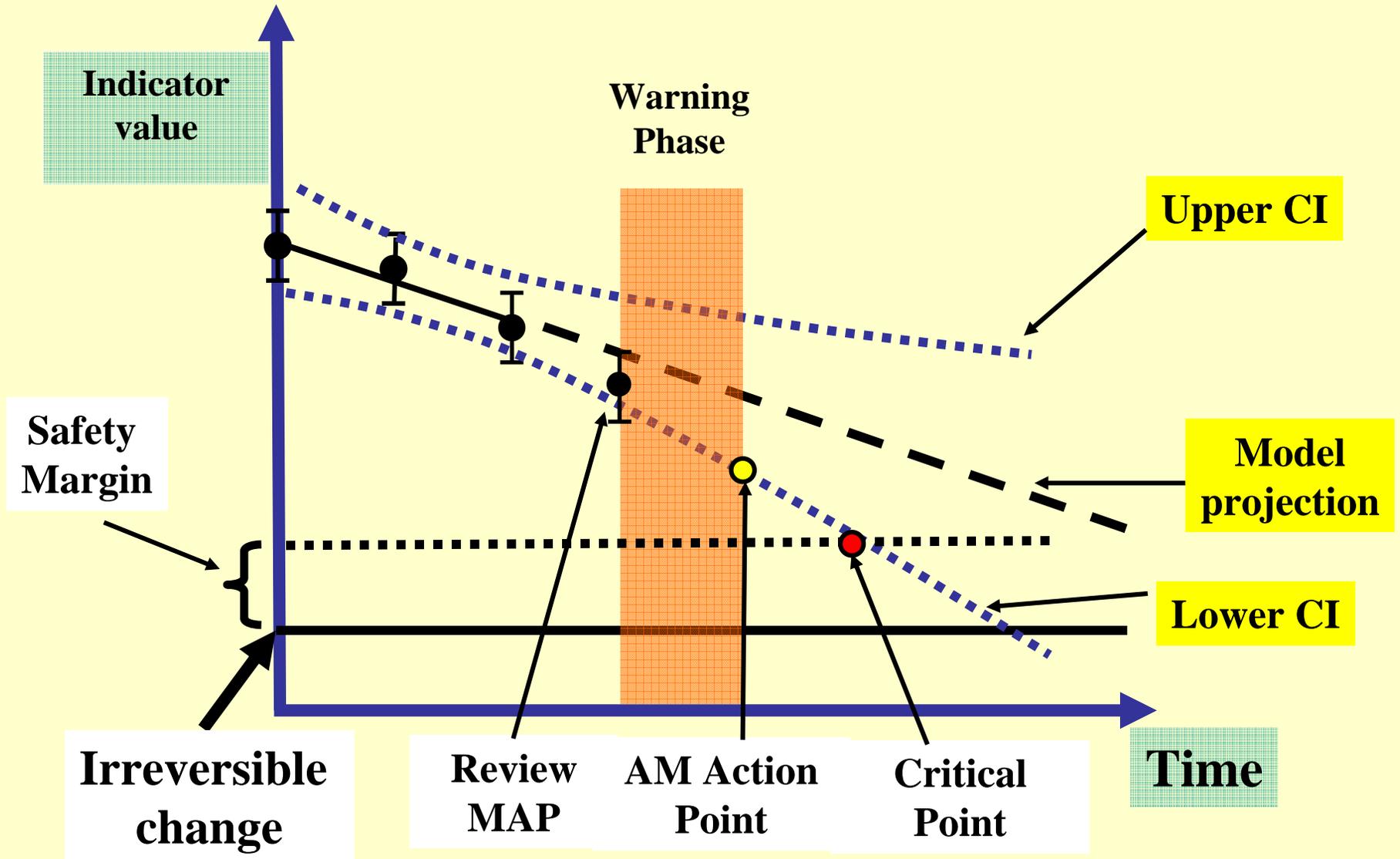
2008 CISRERP Report:

Match the frequency of monitoring with the speed of change of the variables that are being monitored.

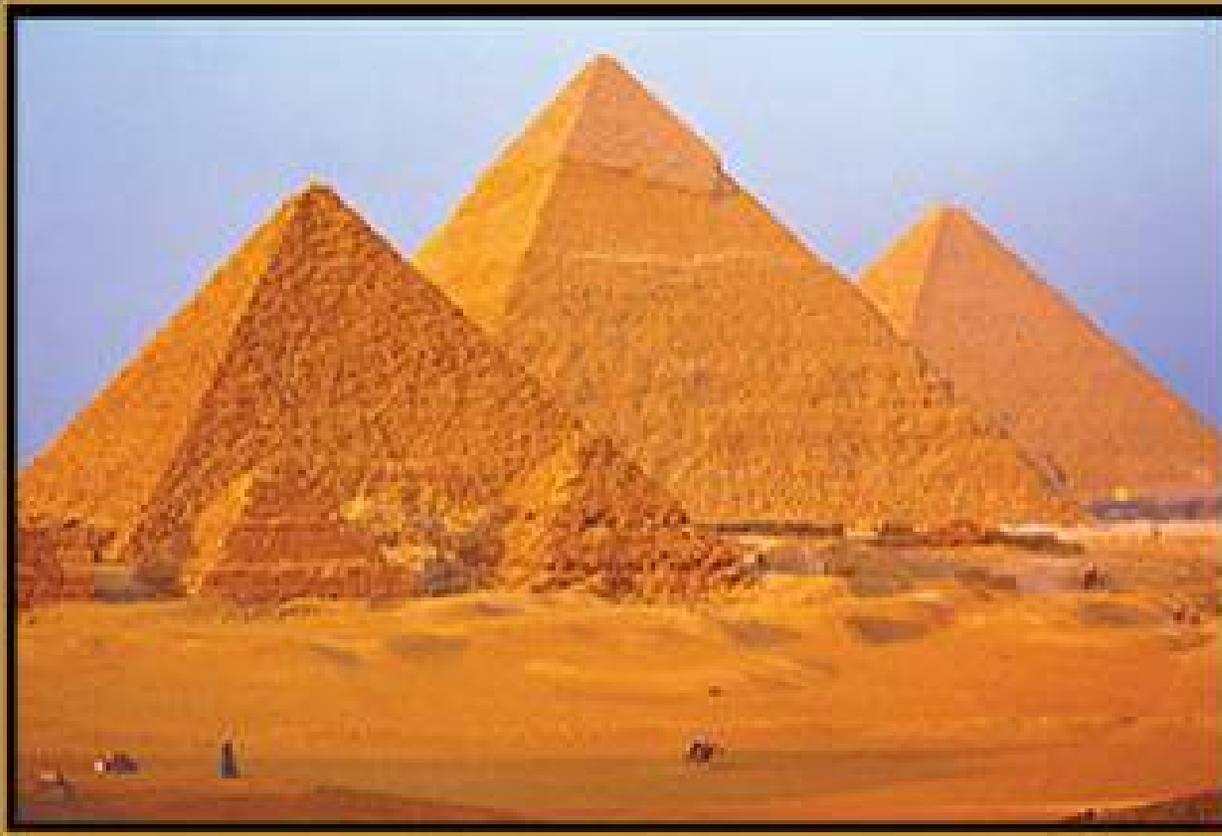
# Ecosystem Response



# From Thresholds to Action



# Sustainability



**ACHIEVEMENT**

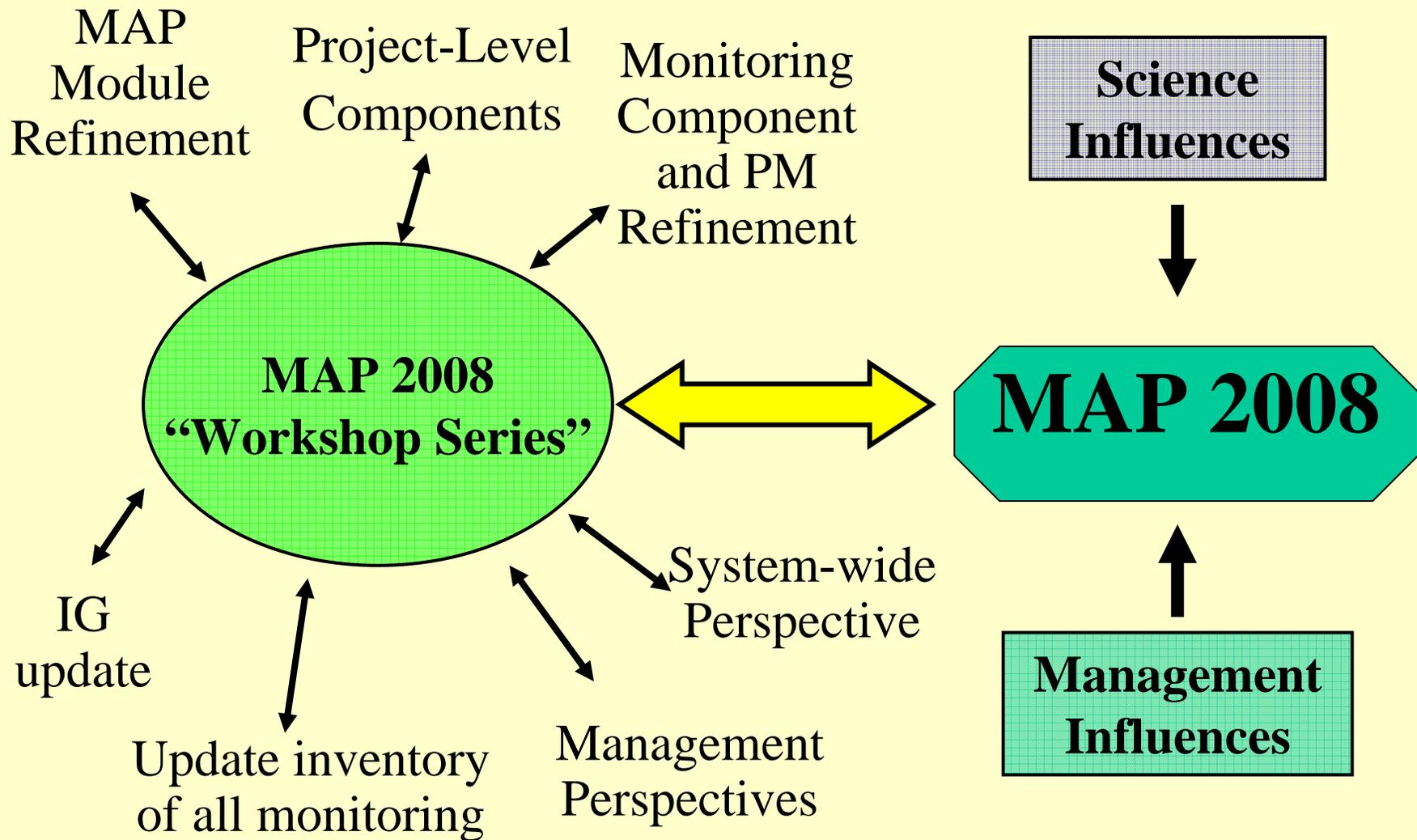
YOU CAN DO ANYTHING YOU SET YOUR MIND TO WHEN YOU HAVE VISION,  
DETERMINATION, AND AN **ENDLESS SUPPLY OF EXPENDABLE LABOR.**

- \$\$\$
- Resources
- Expectations Management

Most needs  
are resource  
related



# MAP 2008 Implementation Process



# Topics and Themes Covered

- Overview of the Monitoring and Assessment Plan (MAP)
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# Key Messages

## Science $\leftrightarrow$ Management/Policy Connections

- Focus on linkages between science and CERP AM program
- System-wide science directed to output relevant for managers

## Decision Support

- Translating science into management decision options

## Scaling up from small-scale to big picture

- Multiple scales & multiple entry points
- Project-level (planning; operations)
- Regional sequencing
- System-wide Integration – System Operating Manual



E. BUCKNER