

***POSSIBLE LESSONS FOR CEER-GOM
FROM EMAP***

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CONTEXT FOR COMMENTS

◆ SPACE-TIME AQUATIC RESOURCES MODELING AND ANALYSIS PROGRAM = STARMAP

- FUNDED BY EPA'S STAR PROGRAM, AS IS
CEER-GOM (==> "SIBLING" PROGRAMS)**
- STARMAP IS TO USE EMAP AS A DATA SOURCE
AND CONTEXT**
- NSU = STARMAP PROGRAM DIRECTOR @ CSU**
 - *10 YEARS OF COLLABORATION WITH EMAP***
 - *40 YEARS AS STATISTICIAN WORKING WITH ECOLOGISTS***

LESSONS - A FEW

- ◆ **1. STATISTICS DOES NOT HAVE ALL OF THE TOOLS YOU NEED.**
- ◆ **2. A USEFUL INDICATOR SHOULD APPLY ACROSS A WIDE RANGE OF CONDITIONS**
- ◆ **3. YOU DO NOT KNOW WHAT YOUR DATA WILL BE USED FOR 20 YEARS FROM NOW**

LESSON 1:
***STATISTICS DOES NOT HAVE ALL OF
THE TOOLS YOU NEED***

**→ ECOLOGICAL/ENVIRONMENTAL RESEARCH
PRODUCES SITUATIONS FOR WHICH
APPROPRIATE STATISTICAL PROCEDURES
DO NOT EXIST**

**● *IF A STATISTICAL APPROACH DOES NOT “MAKE
SENSE” CHALLENGE YOUR STATISTICIANS TO
FIND SOMETHING WHICH FITS YOUR
SITUATION.***

**■ EX: CLASSICAL SAMPLING THEORY IS BASED ON A LIST; IT
LEADS TO ANSWERS OF LIMITED VALUE WHEN APPLIED TO
SAMPLING STREAMS. OUTGROWTH: THIS HAS LED TO AN
EXTENSION OF SAMPLING THEORY TO COVER CONTINUOUS
SAMPLING FRAMES.**

***LESSON 1:
STATISTICS DOES NOT HAVE ALL OF THE
TOOLS YOU NEED
CONTINUED***

◆ EPA HAS RECOGNIZED THIS!

**→ EPA's STAR PROGRAM INVESTS ~\$2.5M/YEAR
TOWARD DEVELOPMENT OF SOLUTIONS TO
THIS LIMITATION**

- ***COLORADO STATE UNIVERSITY: SPACE-TIME AQUATIC RESOURCE MODELING AND ANALYSIS PROGRAM (STARMAP). DIRECTOR = NSU***
- ***OREGON STATE UNIVERSITY: DESIGN-BASED/ MODEL-ASSISTED SURVEY METHODOLOGY FOR AQUATIC RESOURCES. DIRECTOR = DON STEVENS***

LESSON 1:
STATISTICS DOES NOT HAVE ALL OF
THE TOOLS YOU NEED
CONTINUED II

◆ **EPA HAS RECOGNIZED THIS!**

➔ **EPA's STAR PROGRAM INVESTS ~\$2.5M/YEAR
TOWARD DEVELOPMENT OF SOLUTIONS TO
THIS LIMITATION**

- ...
- ***UNIVERSITY OF CHICAGO. DIRECTOR: CENTER FOR
INTEGRATING STATISTICAL AND ENVIRONMENTAL
SCIENCE. DIRECTOR = MICHAEL STEIN***

EPA's REQUEST FOR APPLICATIONS (RFA)

◆ CONTENT REQUIREMENTS

→ RESEARCH IN STATISTICS

- *DIRECTED TOWARD USING, IN PART, DATA GATHERED BY PROBABILITY SURVEYS OF THE "EMAP-SORT."*

→ TRAINING OF "FUTURE GENERATIONS" OF ENVIRONMENTAL STATISTICIANS

→ OUTREACH TO THE STATES and TRIBES

◆ ADMINISTRATIVE REQUIREMENT

EPA's REQUEST FOR APPLICATIONS ***(RFA) - continued***

◆ MAJOR ADMINISTRATIVE REQUIREMENT

- “... EACH OF THE TWO PROGRAMS ESTABLISHED WILL INVOLVE COLLABORATIVE RESEARCH AT MULTIPLE, GEOGRAPHICALLY DIVERSE SITES.”**
- CLOSE COOPERATION BETWEEN TWO PROGRAMS**
- CSU and OSU SUBMITTED A PAIR OF COORDINATED PROPOSALS**

EPA's REQUEST FOR APPLICATIONS ***(RFA) - continued III***

◆ THE TWO PROGRAMS:

**→ DESIGN-BASED/MODEL ASSISTED SURVEY
METHODOLOGY - @ OSU**

**→ SPATIAL AND TEMPORAL MODELING,
INCORPORATING HIERARCHICAL SURVEY
DESIGN, DATA ANALYSIS, MODELING - @ CSU**

◆ CHECK ON THE RFA @

→ <http://es.epa.gov/ncerqa/rfa/aquastat01.html>

RESPONSE to RFA from CSU

◆ INSTITUTIONS:

→ COLORADO STATE UNIVERSITY

- *STATISTICS*
- *NATURAL RESOURCES ECOLOGY LAB*
- *FOREST SCIENCE*
- *BIORESOURCE AND AGRICULTURAL ENGINEERING*

→ OREGON STATE UNIVERSITY (PROGRAM 1, too)

→ SOUTHERN CALIFORNIA COASTAL WATER RESEARCH PROJECT

→ WATER QUALITY TECHNOLOGY, INC

CSU PROPOSAL - CONTENT

- ◆ **1. COMBINING ENVIRONMENTAL DATA**
- ◆ **2. LOCAL INFERENCE**
- ◆ **3. DEVELOPING AQUATIC INDICATORS**
- ◆ **4. OUTREACH**
- ◆ **5. ADMINISTRATION/COORDINATION**

CSU PROPOSAL - APPROACH

◆ TAKE EXISTING SETS OF

→ PROBABILITY &

→ NON-PROBABILITY DATA

**→ START WORKING WITH THE DATA WITH A
PERSPECTIVE OF DRAWING INFERENCES**

- *IDENTIFY ISSUES WE DON'T KNOW HOW TO HANDLE***
- *HAVE POST-DOCS AND PRE-DOCTORAL STUDENTS
CONDUCT RESEARCH ON THESE TOPICS***

WHAT IS DISTINCTIVE ABOUT “AQUATIC RESOURCES”?

◆ THEY ARE THINGS LIKE

→ STREAMS

→ RIVERS

→ WETLANDS

→ LAKES & PONDS

→ ESTUARIES

→ PRAIRIE POTHOLE

→ NEAR COASTAL OCEANIC WATERS

***WHAT IS DISTINCTIVE ABOUT
“AQUATIC RESOURCES”?
CONTINUED***

- ◆ **FOR MOST AQUATIC RESOURCES,**
 - **THERE ARE MANY “SMALL” ONES**
 - **PROGRESSIVELY FEWER AS THEY GET BIGGER**
 - **INTEREST, BIOLOGICAL & SOCIETAL, TENDS TO STAY CONSTANT OR EVEN INCREASE WITH SIZE**
 - **SIMPLE RANDOM SAMPLING WOULD SELECT MOSTLY “SMALL” ONES, FEW “BIG” ONES.**
 - **IMPLICATION:**
 - ***UNEQUAL PROBABILITY SAMPLING***

***WHAT IS DISTINCTIVE ABOUT
“AQUATIC RESOURCES”?
CONTINUED II***

- SPATIAL STATISTICS TENDS TO FOCUS ON TWO-DIMENSIONAL SPACE**
- STREAMS AND RIVERS ESSENTIALLY AMOUNT TO ONE-DIMENSIONAL OBJECTS IN TWO-SPACE**
- BUT MUCH LANDSCAPE INFORMATION IS COMPLETE COVERAGE IN TWO-SPACE**

◆ CHALLENGE:

- MERGE THESE PERSPECTIVES**

- *SOME RELATION TO CEER-GOM ON THIS APPROACH***

DISTINCTIVE EMAP PERSPECTIVE

◆ DEFINE THE POPULATION OF INTEREST

→ CONDUCT A PROBABILITY SURVEY OF IT

- ***CAREFULLY DEFINE THE SAMPLING FRAME***
- ***VARIABLE PROBABILITY SELECTION OF SITES, BUT WITH SPATIAL BALANCE***
- ***CAREFULLY DEFINE RESPONSES TO BE EVALUATED***
- ***TRAIN FIELD CREWS WELL***
- ***MANAGE DATA WITH CARE AND AN “AUDIT TRAIL”***
- ***LEARN FROM PAST MISTAKES, THROUGHOUT***

FUTURE NEEDS - STATES & TRIBES

- ◆ **STATES AND TRIBES MUST REPORT ON THE CONDITION OF ALL “WATERS” UNDER THEIR JURISDICTION**
 - ➔ **A REQUIREMENT OF SECTION 305b OF THE CLEAN WATER ACT**
 - ➔ **RESULTS IN BIENNIAL REPORT TO CONGRESS**
- ◆ **STARTING IN 2004 THE RECOMMENDED STANDARDS WILL CHANGE TO BEING BASED ON PROBABILITY SAMPLING**
- ◆ **OUTREACH PROJECT OPPORTUNITY!**

Lesson 2:

***A USEFUL INDICATOR SHOULD APPLY
ACROSS A WIDE RANGE OF CONDITIONS***

◆ **CONDITIONS SHOULD INCLUDE**

→ **SPACE**

→ **TIME**

● *IDENTIFY ITS APPROPRIATE TIME WINDOW, IF LIMITED*

→ **PHYSICAL/BIOLOGICAL CONDITIONS**

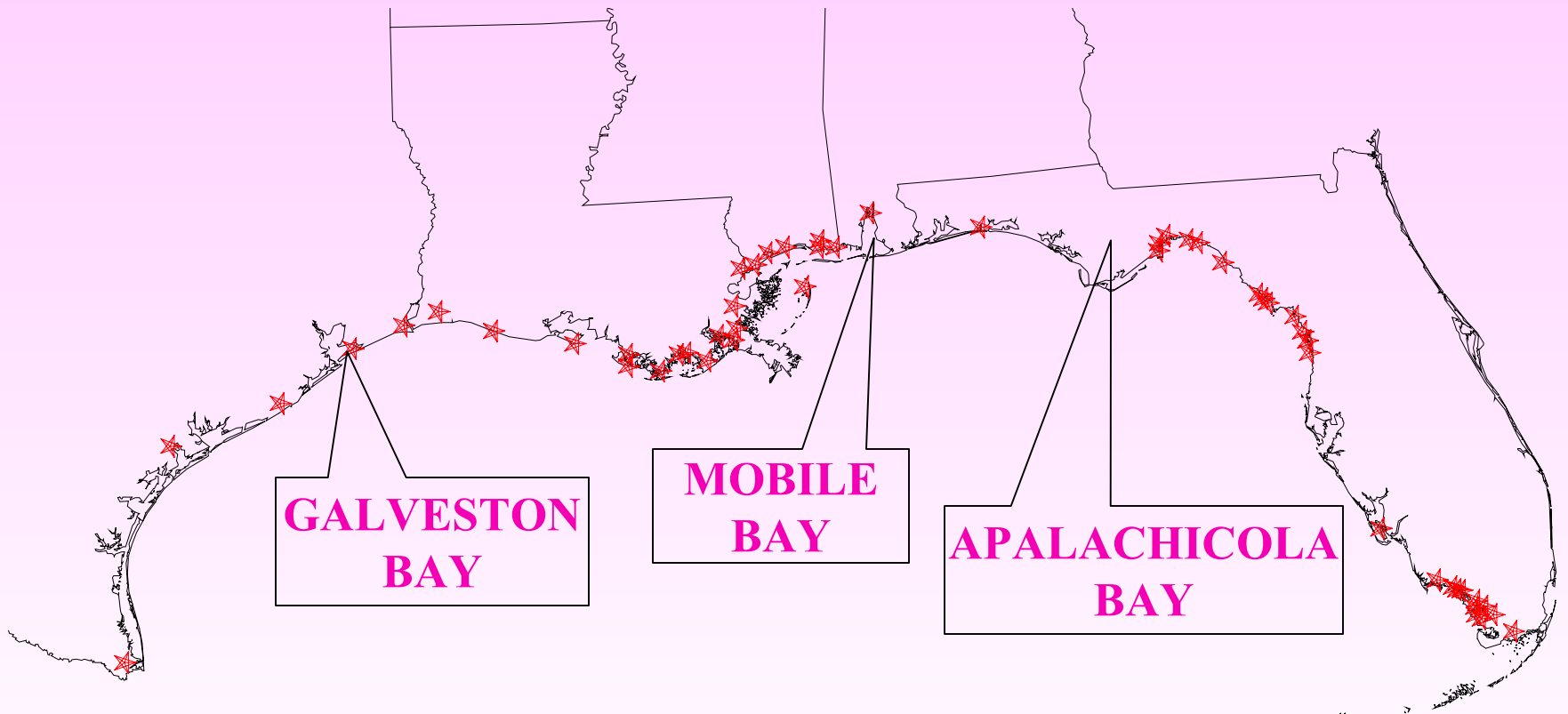
→ **ENVIRONMENTAL QUALITY**

◆ **EVALUATION SITES SHOULD NOT BE IN A
“CORNER” RELATIVE TO SUCH FEATURES**

***INDICATORS SHOULD APPLY ACROSS A
WIDE RANGE OF CONDITIONS***

- ◆ FROM YOUR PROPOSAL IT ***APPEARS*** THAT MOST OF YOUR STUDIES WILL BE CONDUCTED IN
 - GALVESTON BAY
 - MOBILE BAY
 - APALACHICOLA BAY
- ◆ THESE DIFFER PRIMARILY (?) AS A CONSEQUENCE OF FRESHWATER INPUT

POSSIBLE SPATIAL LIMITATIONS of CEER-GOM



***EVALUATION SITES SHOULD NOT BE IN A
“CORNER” RELATIVE TO IMPORTANT
FEATURES***

◆ OBSERVATIONS:

**→ HAVE YOU CONFOUNDED HIGH POLLUTION
WITH LOW FRESHWATER INPUT?**

**→ CONSIDER EVALUATING PROMISING
INDICATORS OVER A WIDER SPATIAL DOMAIN
IN THE LATTER YEARS OF THE PROGRAM**

DEALING WITH LOCAL VARIATION

◆ IN THE PRESENCE OF SUBSTANTIAL LOCAL VARIATION

→ MANY SCIENTISTS CONCENTRATE ON GETTING PRECISE LOCAL DETERMINATIONS

→ INSTEAD, CONSIDER COLLECTING MATERIAL OVER SOME SPACE

- ***THEN MIX (COMPOSITE) THE LOCALLY COLLECTED MATERIAL***

- ***DO LABORATORY EVALUATIONS ON A SUBSAMPLE FROM THE WELL MIXED COMPOSITE***

- ***THIS USES PHYSICAL AVERAGING***

Lesson 3:

***YOU DO NOT KNOW WHAT YOUR DATA
WILL BE USED FOR 20 YEARS FROM NOW***

- ◆ **POPULAR PRESPECTIVE - WE “KNOW” LOTS ABOUT THE “ENVIRONMENT”**
- ◆ **REALITY: GOOD AQUATIC DATA IS SCARCE**
 - **SPATIALLY EXTENSIVE**
 - **OVER A REASONABLE TIME SPAN**
 - **WELL DOCUMENTED PROCEDURES**
 - **WELL TRAINED CREWS**
 - **CAREFULLY EXECUTED STUDIES**
 - **DATA PUBLICALLY AVAILABLE**

THE VALUE OF “METADATA”

◆ DATA

→ WITHOUT CONTEXT ARE NUMBERS

- *NEARLY WORTHLESS TO OTHERS*

→ DATA WITH CONTEXT IS INFORMATION

- *CAN BE VALUABLE TO OTHERS*

◆ CONTEXT IS CALLED METADATA

ASSOCIATE METADATA WITH ALL DATA

◆ USE IT TO DOCUMENT

→ SITE SELECTION AND LOCATION

→ FIELD PROTOCOLS FOR GATHERING

● ***DATA & MATERIAL***

→ LABORATORY METHODS

→ QUALITY ASSURANCE/QUALITY CONTROL

→ METHODS USED TO DEAL WITH

● ***NONDETECTS, MISSING OR LOST DATA, ETC***

THANK YOU FOR YOUR ATTENTION