US EPA ARCHIVE DOCUMENT

Use of Regional Data to Evaluate and Develop Sediment Quality Guidelines

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Exa Data and Mapping Services

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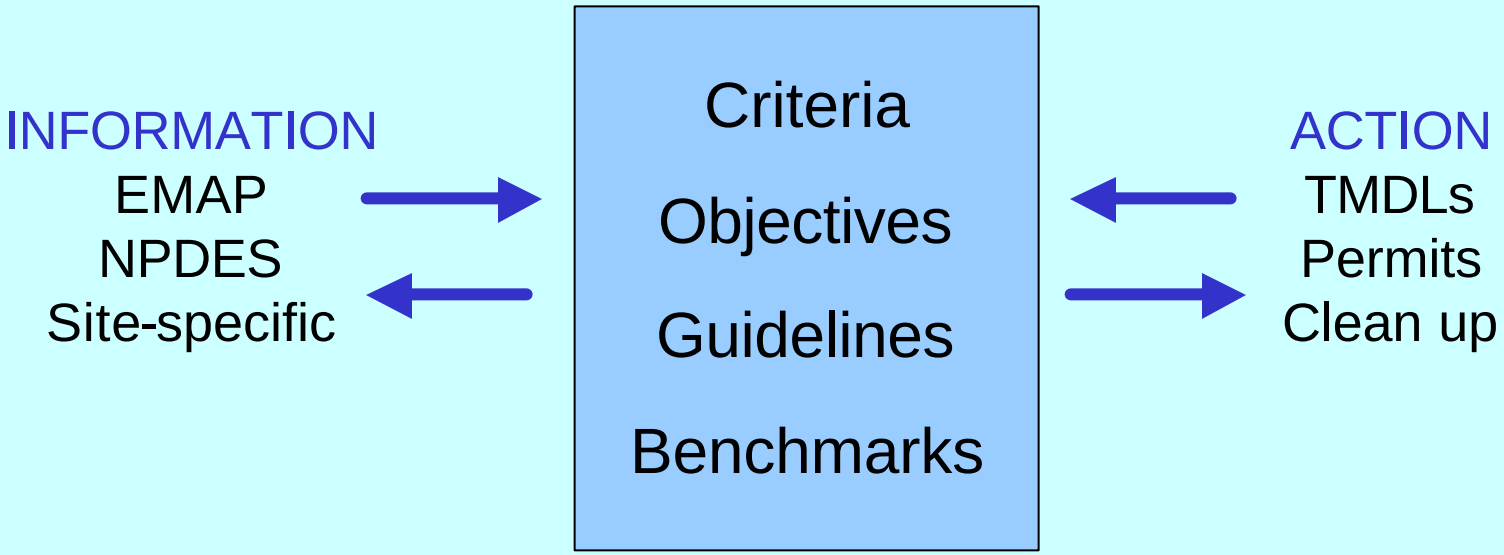
- **LA Contaminated Sediments Task Force**

Sediment Quality Guidelines



- **Diverse types available**
- **Used for different purposes**

Narrow definition: Chemical concentrations associated with an expectation of biological response

SQG Characteristics:
Number of Constituents

SQG Approach	Organics	Metals
ERM Effects Range Median	15	9
AET Apparent Effects Threshold	44	10
EqP Equilibrium Partitioning	43	0
LRM Logistic Regression Model	27	10
Consensus	2 (2)	0 (9)
SQG-Q1	4	5

LA Contaminated Sediments Task Force (CSTF)

- **Agencies involved in sediment dredging in the Los Angeles Area**
  - **Regulators**
  - **Dredgers**
  - **Environmental Groups**
- **Develop long-term management strategy**
  - **Reduce inputs**
  - **Beneficial use**
  - **Better coordination and planning**
- **Address data gaps**

SQG Application Issues

- **Do they work?**
- **What approach is best?**
- **How should they be used for my project?**

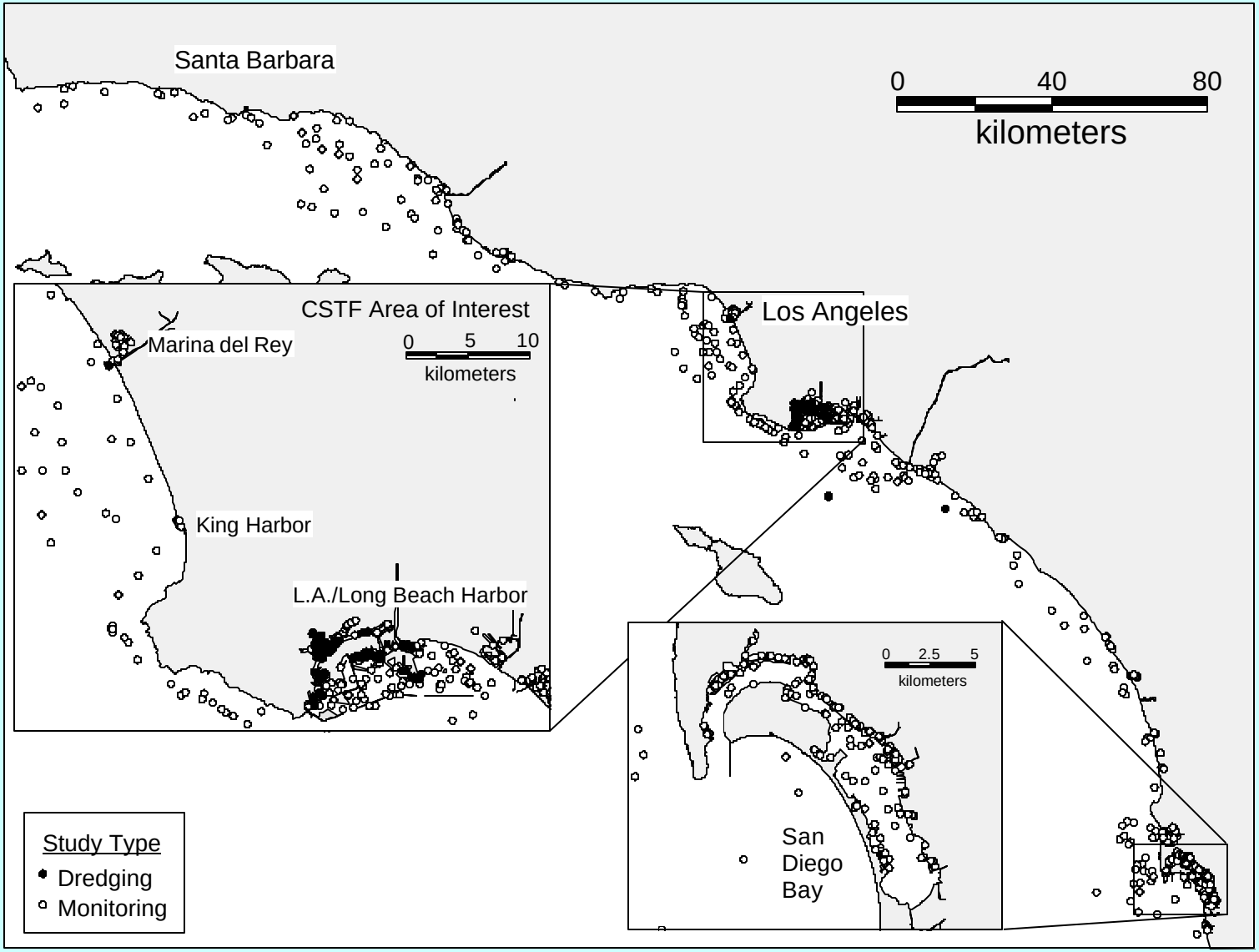
Objectives

- **Use regional monitoring data and other datasets to evaluate the performance of SQG methods**
- **Evaluate the influence of regional factors on SQG performance**
- **Identify optimum SQGs for CSTF use**
  - **Application guidance**
  - **Regional SQGs**

Study Design

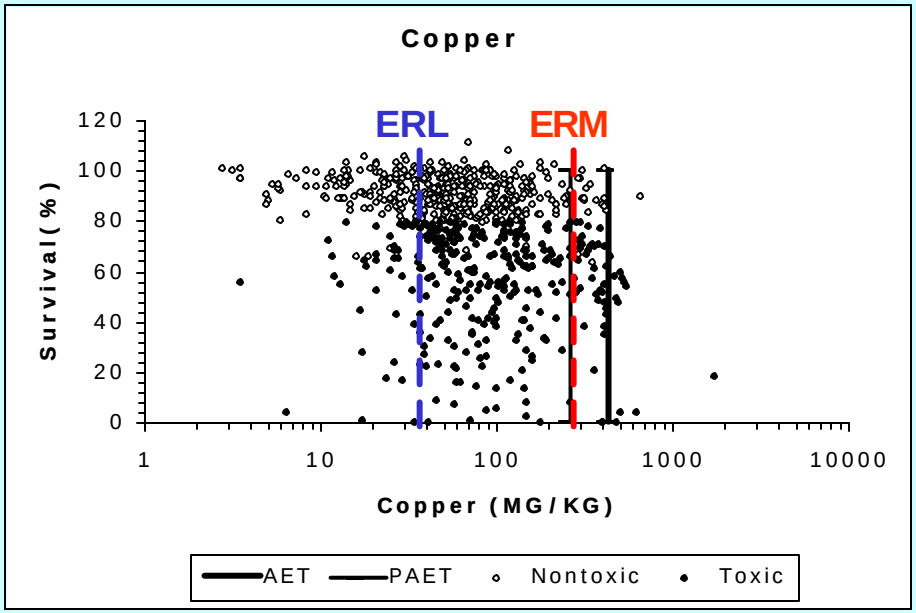
- **Assembled sediment quality database for southern California**
- **Compared performance of selected SQGs**
- **Investigated influence of regional factors**
  - **CSTF vs. NOAA Sedtox database**
- **Developed optimized SQGs for CSTF use**
  - **Quantitative description of performance**
  - **Relate to various applications**

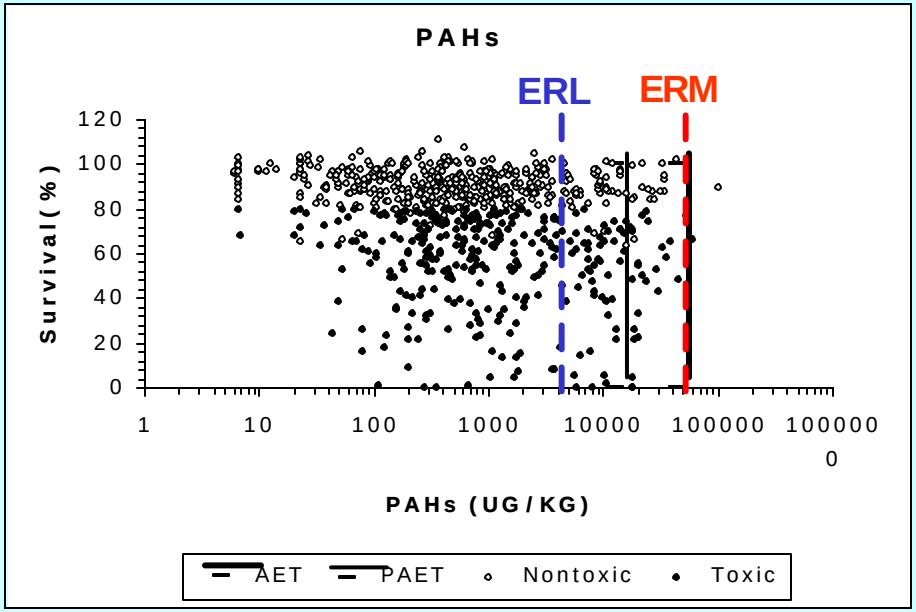
Data Distribution

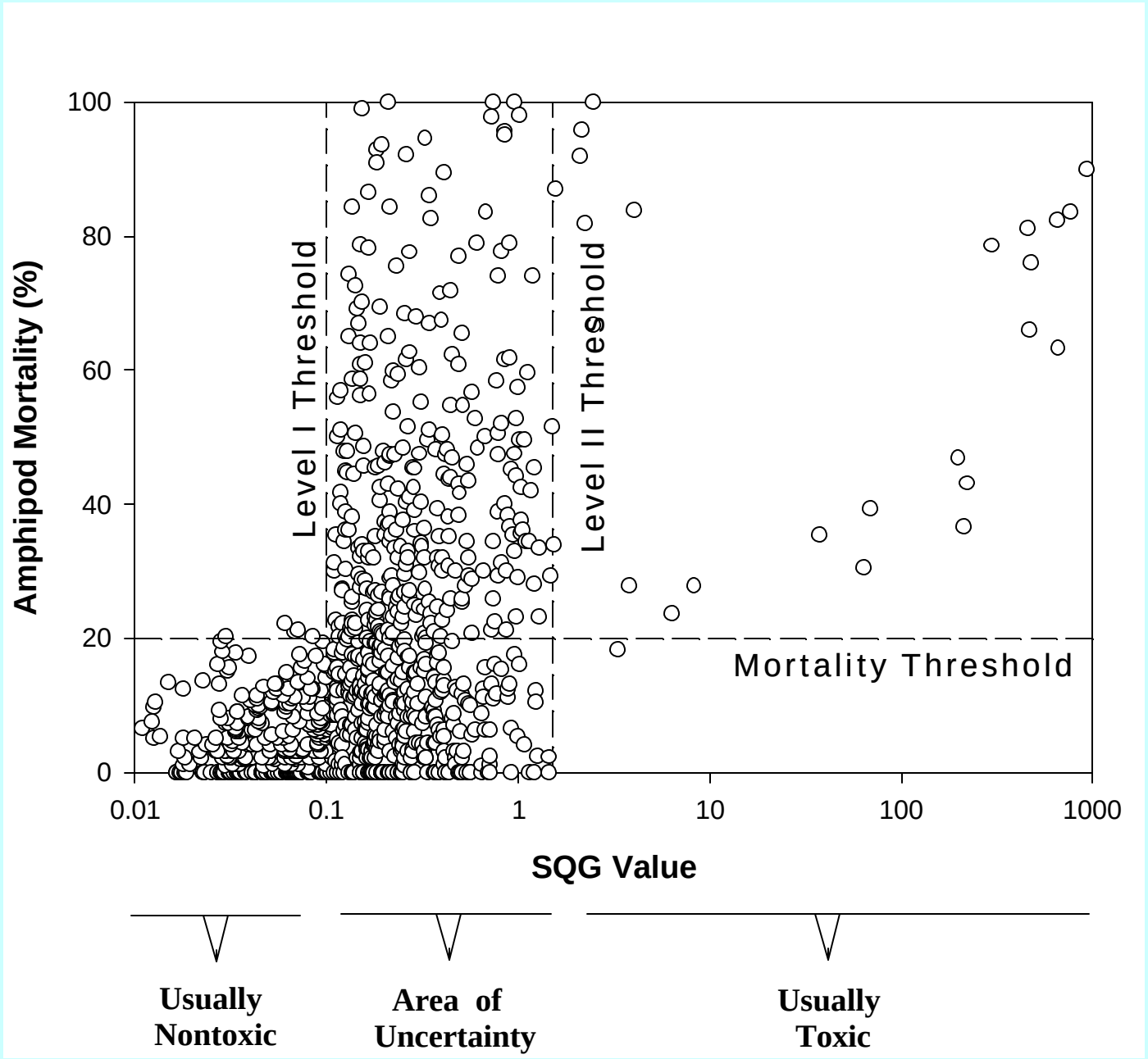


SQG Performance Evaluation

- Screened data for relevance and quality
  - Matched chemistry and toxicity
  - Chemistry detection limits and completeness
- Ability to predict toxicity to amphipods
- Joint chemical effect approaches
- Evaluated specific applications
  - Low probability of toxicity (Level I)
  - High probability of toxicity (Level II)


Copper
ERL
ERM
120
100
80
60
40
20
0
Survival(%)
1
10
100
1000
10000
Copper (MG/KG)
AET
PAET
Nontoxic
Toxic

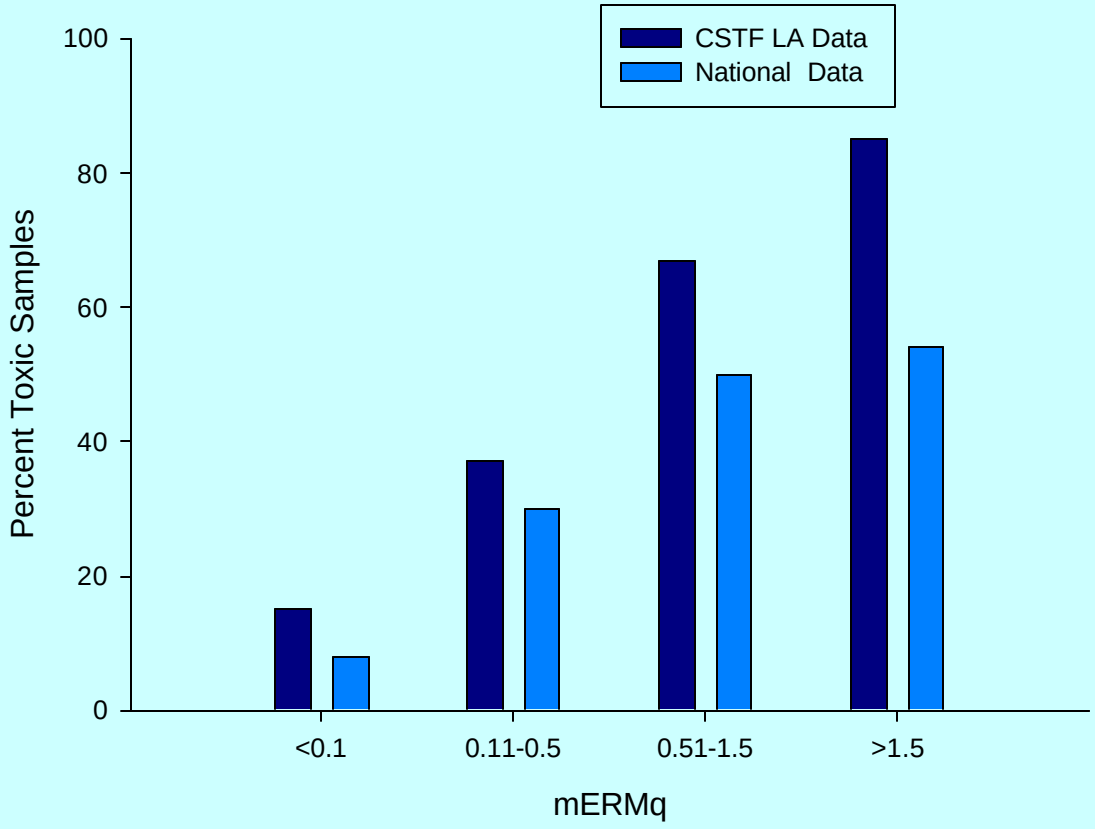

PAHs
ERL
ERM
120
100
80
60
40
20
0
Survival(%)
1
10
100
1000
10000
100000
1000000
PAHs (UG/KG)
AET
PAET
Nontoxic
Toxic

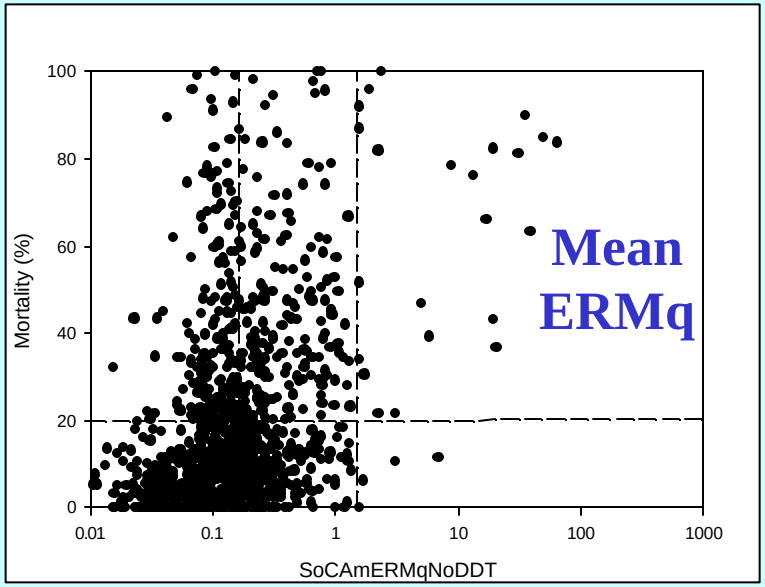

Amphipod Mortality (%)
100
80
60
40
20
0
Level I Threshold
Level II Threshold
Mortality Threshold
0.01
0.1
1
10
100
1000
SQG Value
Usually Nontoxic
Area of Uncertainty
Usually Toxic

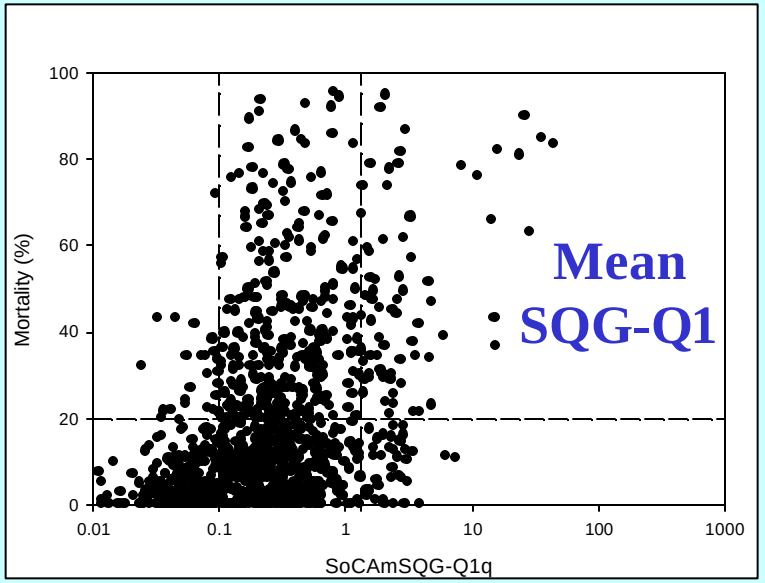
Provisional Application Thresholds
(Based on published/recommended values)

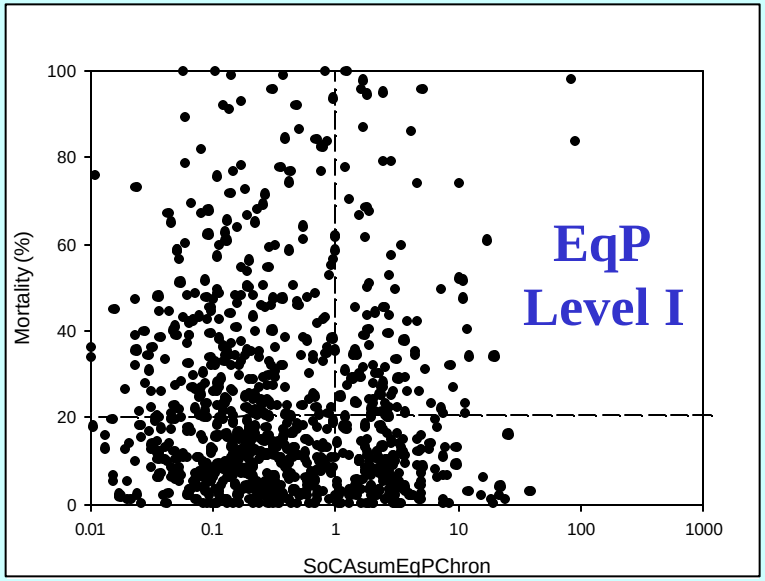
Guideline	Level I	Level II
ERM	Mean ERMq= 0.1	Mean ERMq= 1.5
AET	Exceedance of any LAET	Exceedance of any HAET
EqP org.	Sum Chronic TU= 1	Sum Acute TU= 1
Consensus	Mean MECq= 0.1	Mean MECq= 1.5
SQG-Q1	Mean SQG-Q1q= 0.1	Mean SQG-Q1q= 2.0

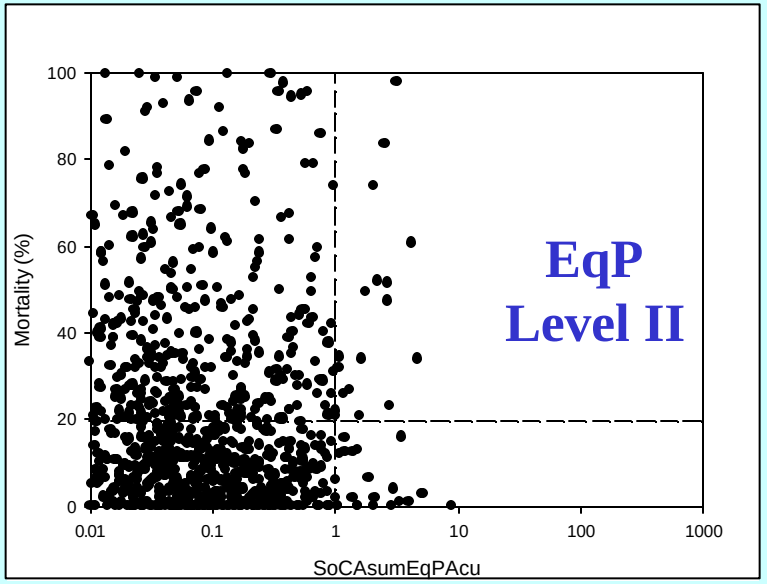
National vs. LA Comparison




Mean
ERMq
Mortality (%)
SoCAmERMqNoDDT
0
20
40
60
80
100
0.01
0.1
1
10
100
1000


Mean
SQG-Q1
Mortality (%)
SoCAmSQG-Q1q
0
20
40
60
80
100
0.01
0.1
1
10
100
1000


EqP
Level I
Mortality (%)
SoCAsumEqPChron
0
20
40
60
80
100
0.01
0.1
1
10
100
1000

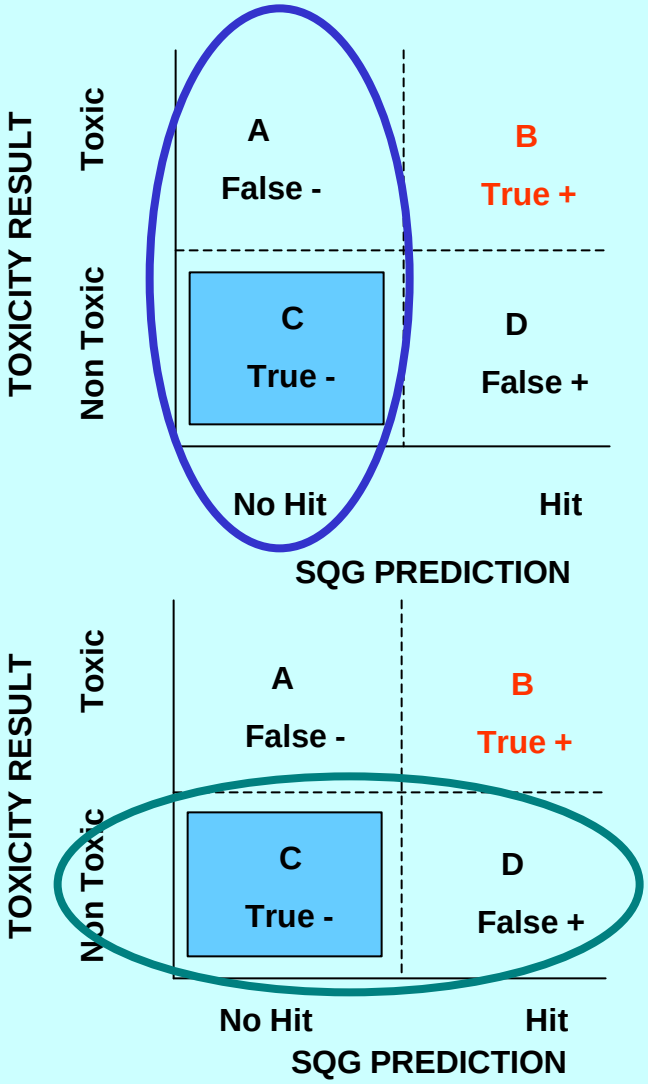

EqP
Level II
Mortality (%)
SoCAsumEqPAcu
0
20
40
60
80
100
0.01
0.1
1
10
100
1000

Performance Measures

Level I

- Nontoxicity Efficiency: percentage of samples below the application threshold that are nontoxic

- Nontoxicity Specificity: percentage of all nontoxic samples that are identified by the application threshold (i.e., below)

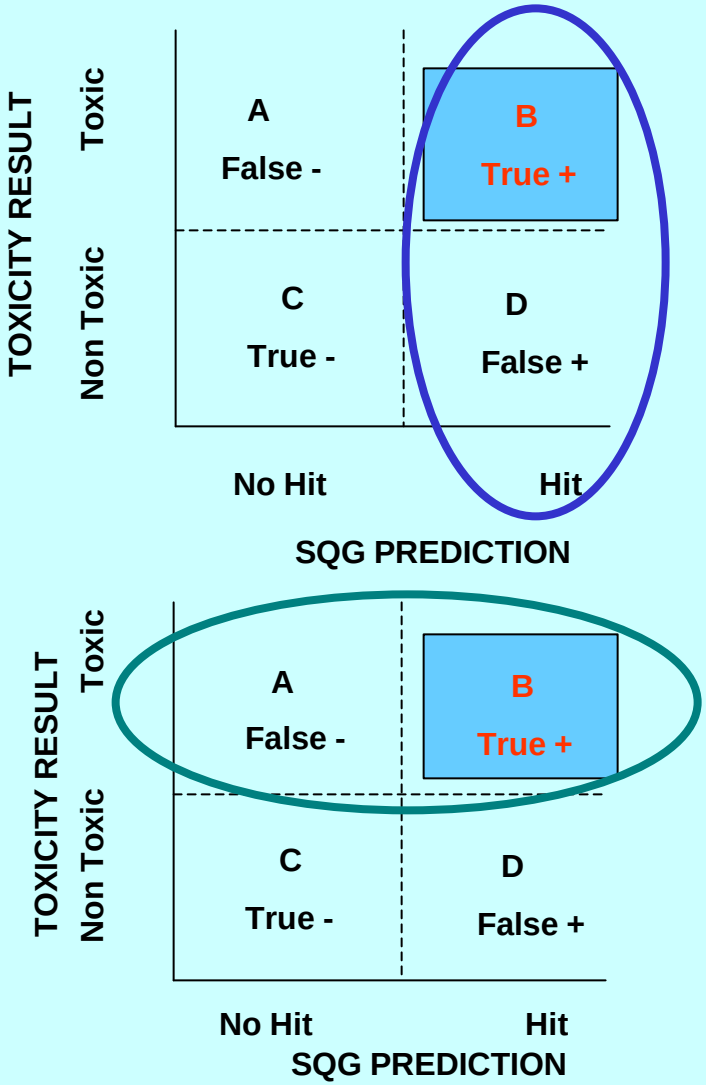


Performance Measures

Level II

- Toxicity Efficiency: percentage of samples above the application threshold that are toxic

- Toxicity Sensitivity: percentage of all toxic samples that are identified by the application threshold (i.e., above)



SoCal Bight Results

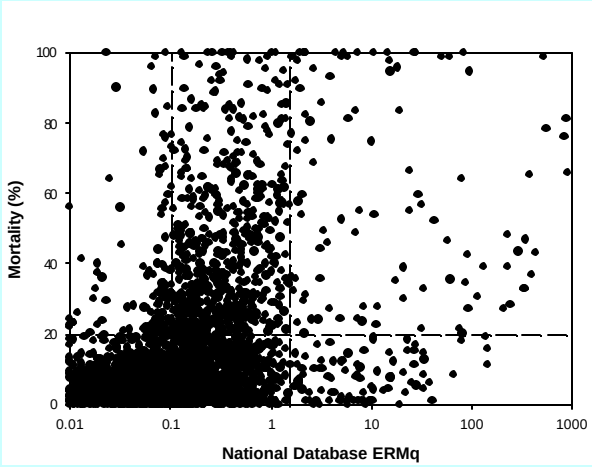
Level I	ERMq	ERMq No DDT	AET	EqP	SQG-Q1	Consensus MEC
Nontoxicity Efficiency	86 %	84 %	76 %	64 %	93 %	95%
Nontoxicity Specificity	40 %	48 %	26 %	69%	34%	24%

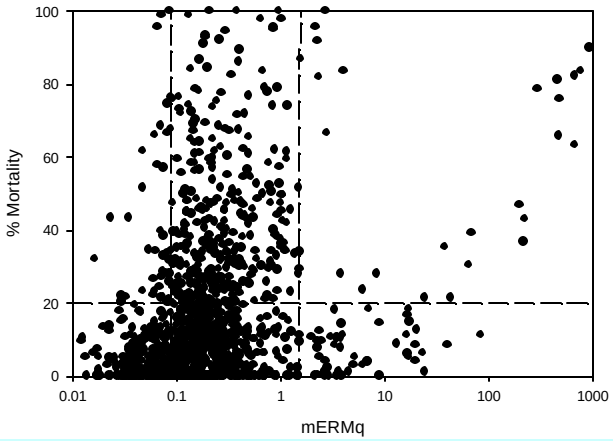
Level II	ERMq	ERMq No DDT	AET	EqP	SQG-Q1	Consensus MEC
Toxicity Efficiency	38 %	85 %	36 %	45 %	64 %	46 %
Toxicity Sensitivity	8 %	6 %	61 %	5%	12 %	13 %

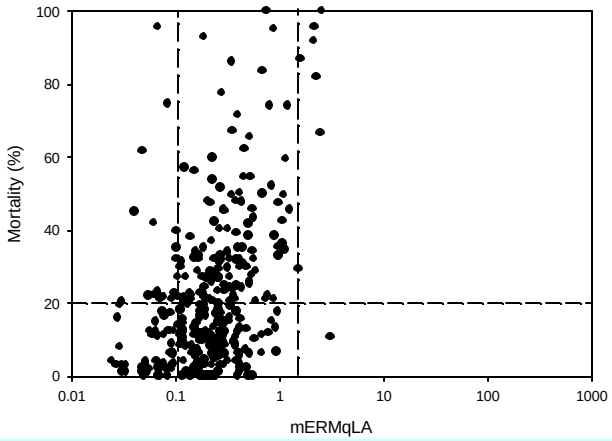
Regional Factors

- **Compared ERMq performance for National and CSTF LA region datasets**
- **Examined regional factors using logistic regression models (LRM)**
  - Fit to models
  - Influence of amphipod test species
  - Predictive accuracy for individual chemicals

Threshold Results: mERMq







National
n=3,220

Southern California
n=1,205

Los Angeles
n=335

Level II Parameter	National	So. Calif	LA
Toxicity Efficiency	54 %	35 %	85 %
Toxicity Sensitivity	14 %	8 %	4 %

SQG Optimization for Regional Use

- **No predetermined performance objective established by CSTF**
  - "Best overall" desired
- **Evaluated performance for range of application thresholds**
  - LA dataset
  - Performance curves
- **Calculated average Level I and II performance**
  - Best overall performer
- **Identified candidate application thresholds for intended use**

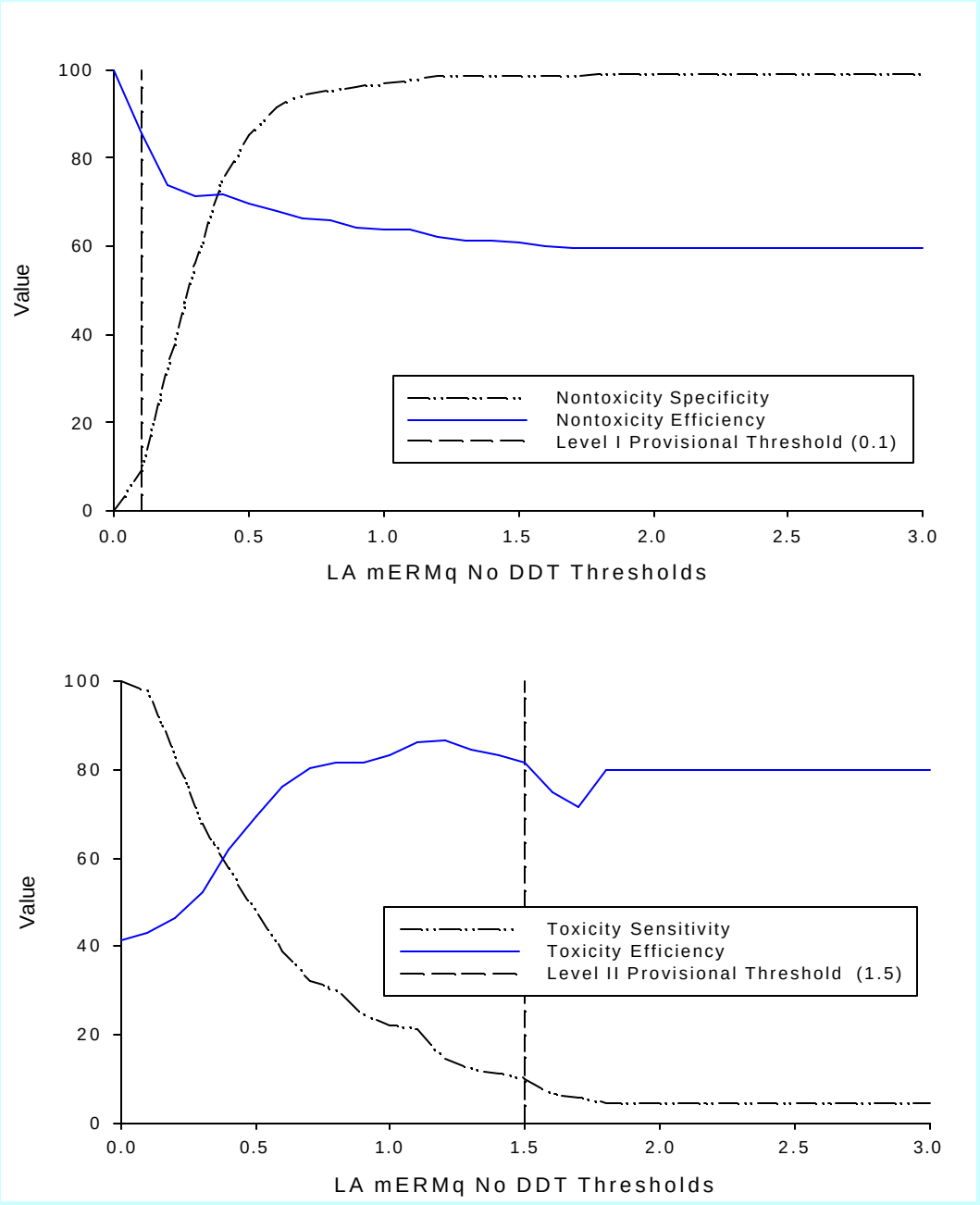
Performance Comparison

No single SQG value is best for all applications

Calculated average specificity or sensitivity within target range of efficiency

Level I target efficiency range =75-90%

Level II target efficiency range =70-85%



Average Performance

Measure	ERMq No DDT	SQG-Q1	Consensus MECq	LRM Pmax
Mean Level I Specificity %	17	25	7	7
Mean Level II Sensitivity %	24	25	19	16

Level I Application Thresholds

	ERMq no DDT		SQG-Q1	
Nontoxicity Efficiency	Specificity	Value	Specificity	Value
90	6	0.04	13	0.08
85	10	0.05	21	0.11
80	20	0.07	28	0.14
75	40	0.11	47	0.23

Level II Application Thresholds

	ERMq no DDT		SQG-Q1	
Toxicity Efficiency	Sensitivity	Value	Sensitivity	Value
85	5	0.93	6	2.00
80	19	0.50	20	1.15
75	32	0.35	29	0.81
70	41	0.27	38	0.54

Development of Regional SQGs AET approach

- **Used So. Calif. bay and harbor data**
  - Screened chemicals for minimum data criterion
- **Calculated CA AETs**
  - Threshold for consistent toxicity
- Calculated performance using validation dataset
  - Subset of bay and harbor data not used in development

CA AET Results

Chemical	CA AET	HAET (WA)
Copper	406	1300
Lead	250	660
Zinc	1600	1600
DDTs	454	69
PCBs	2543	3100
HPAHs	30990	69000

Performance Comparison
Validation Dataset

	Level II %	
	CA AET	HAET
Toxic Efficiency	71	48
Toxic Sensitivity	20	57

Summary and Conclusions

- **EMAP and other regional datasets are a valuable tool for investigating and improving SQG performance at the regional level**
- **The relationship between the bulk sediment concentration of specific contaminants and toxicity is complex and variable**
  - Chemical-specific SQGs are unreliable predictors of toxicity when they are used in isolation
  - SQG applications that incorporate effects from multiple contaminants are reliable, but have a limited range of utility

Summary and Conclusions

- Dataset comparisons demonstrated regional differences in contamination patterns that affected SQG performance
- Regional datasets enable the performance of SQGs to be improved through the use of program-specific application thresholds
- Development of regional SQGs can improve overall performance, but substantial uncertainty is likely to remain