



NATIONAL WATER QUALITY MONITORING COUNCIL

Working Together for Clean Water

Better Access to Water Quality Statistical and Assessment Methods: Developing a New Component of the National Environmental Methods Index (NEMI)

Douglas McLaughlin, National Council for Air & Stream Improvement

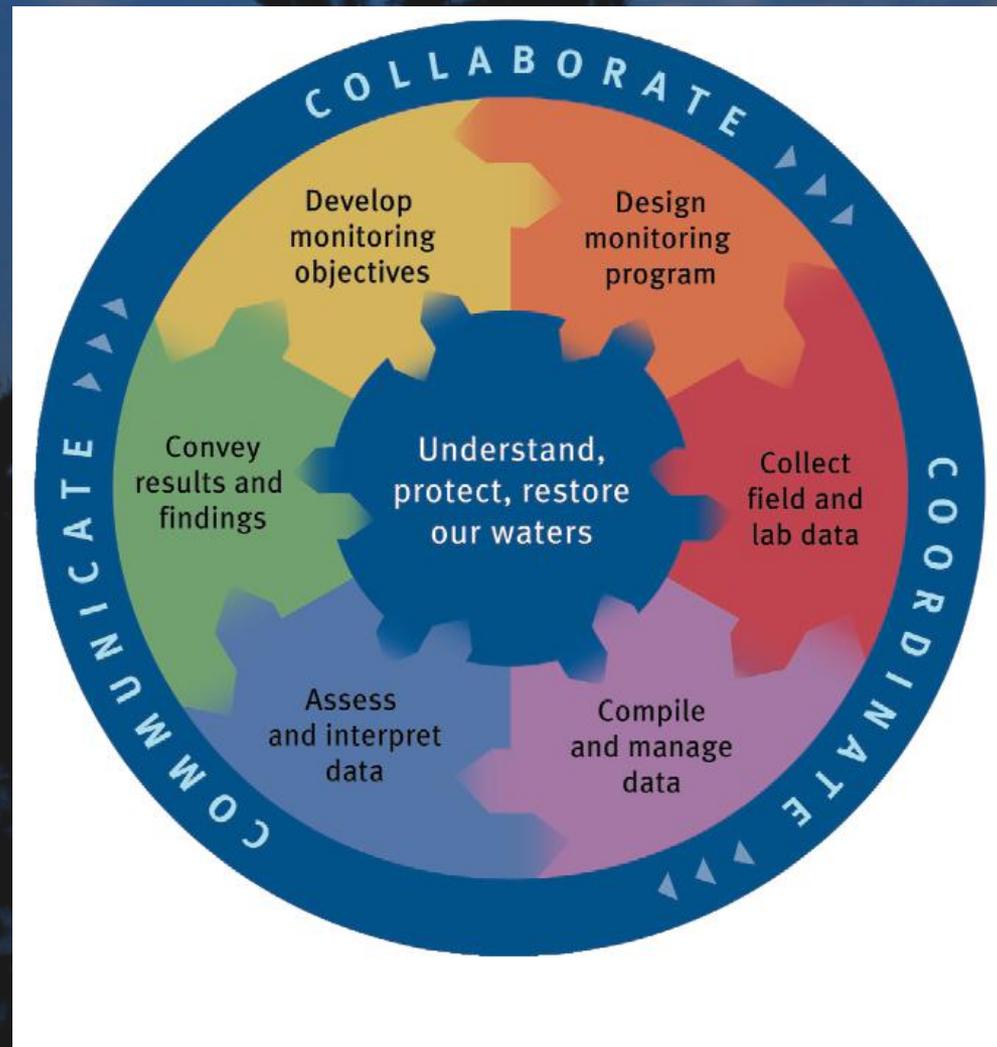
Daniel Sullivan, US Geological Survey

Leslie McGeorge, NJ Dept. of Environmental Protection

Presentation to ACWI, July 11, 2012

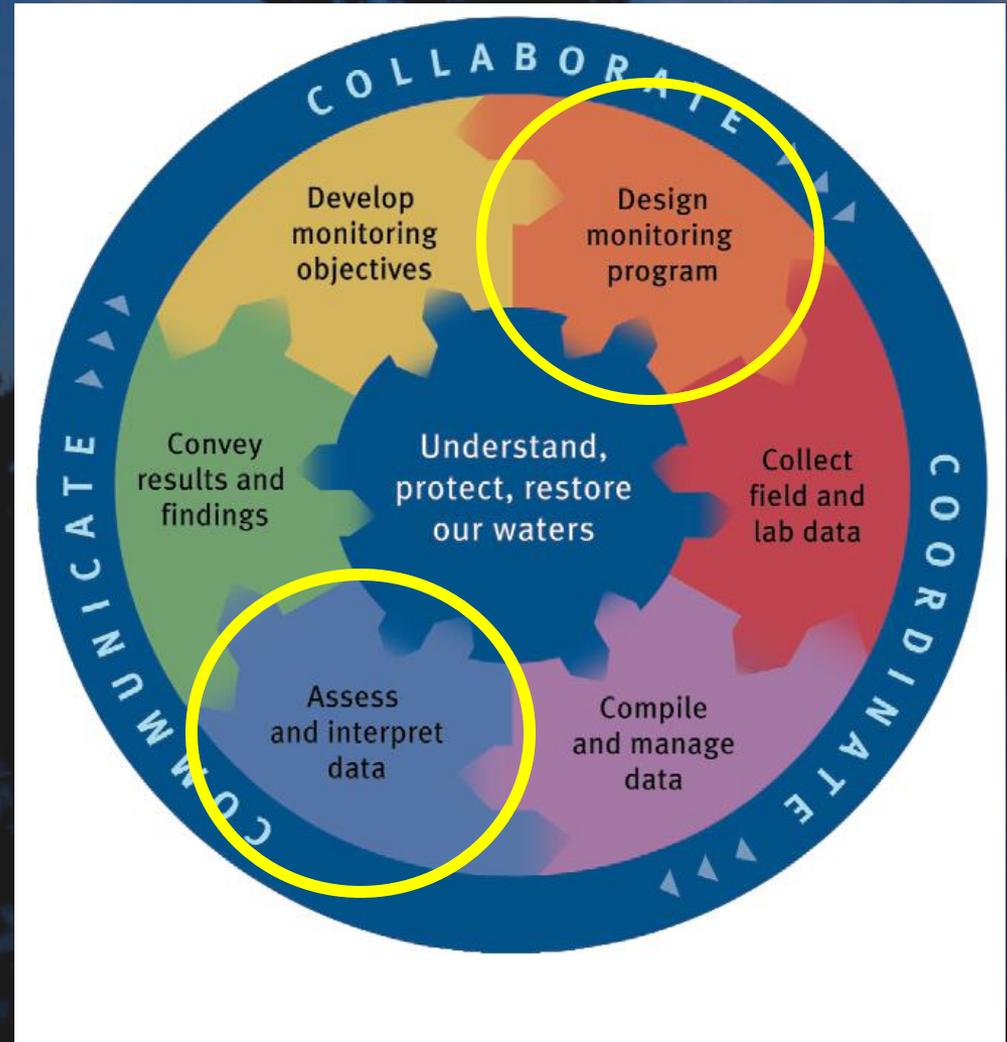
National Water Quality Monitoring Council Monitoring Wheel

- Communicate, Collaborate, Coordinate
- 6 elements central to successful WQ monitoring ...



Need Identified by National Water Quality Monitoring Council

- Develop toolbox to support assessment & interpretation of data
- Link to various monitoring designs



Communicate, Collaborate,
Coordinate on
data analysis & monitoring
design too!

Response to Need

- Water Quality Statistics and Assessments (WQSA) workgroup
 - Council formed WQSA in 2009
 - White paper:
(http://acwi.gov/monitoring/workgroups/wis/wqsa/white_paper_Stats_WorkGroup_draft3.pdf)
 - Participants have represented state and federal government organizations, interstate agencies, private interests, & others
 - Conference calls in September and December 2009, April 2010, Jan 2011

Discussions Shaped WQSA Workgroup Objectives/Responses

- Focus on developing a “statistical NEMI” as a resource for information on data analysis and monitoring design methods/tools
 - No existing equivalent tool found
- “Strawman” methods database entry form (spreadsheet format) developed and circulated fall 2011 to vet a proposed information structure
- Online **prototype** similar to existing NEMI interface now available for evaluation
 - **NEMI – Statistical and Assessment Methods Search (NEMI_SAMS)**

Existing NEMI

Searchable database of the Methods and Data Comparability Board of the NWQMC

- Currently contains chemical, microbiological, biological, toxicity, and physical methods.
- <http://www.nemi.gov>

NEMI
National Environmental Methods Index

Keyword Search **Go**

Browse all Methods in NEMI

Milestones **Go**

MyNEMI

Go to MyNEMI (Requires Login)

General Information

- Links of Interest
- Green Chemistry
- Background
- Disclaimer
- Send us Feedback

Quick Links

- ACWI
- NWQMC
- MDCB
- How to Submit a Method

Beta Welcome Chemical Microbiological Biological Toxicity Physical Regulatory

Search for a method in NEMI:

Use the links below to search all chemical, microbiological, biological, toxicity, and physical methods in NEMI, or follow the tabs to the right to narrow your search

- Analyte Search
- General Search
- Multi-Analyte Search
- Find a Sample Collection, Preparation or Processing Method
- Browse all Methods in NEMI

Statistics and Assessments (beta)

The Council's **Water Quality and Assessments (WQSA)** workgroup announces the beta release of an [online database of statistical methods](#). Please take a look at the beta test version and provide [feedback](#).

MEMO: Methods for Environmental Measurements and Observations (beta)

MEMO is a portal that links sensor technologies in NOAA's **Alliance for Coastal Technologies (ACT)** database to NEMI. Additional information that links sensor technologies with applications, QA guidance, and more will be added. >> [More on MEMO...](#)

NEMI is maintained under the direction of the Methods and Data Comparability Board, a partnership of water-quality experts from Federal agencies, States, municipalities, industry, and private organizations. The Methods Board is chartered under the National Water Quality Monitoring Council, whose mission since its charter in May 1997 is to coordinate and provide guidance on implementation of a voluntary, integrated, nationwide monitoring strategy.

Questions?

- FAQs
- Contact Us
- Help for IE8 Users

USGS
Water Resources Discipline

EPA
EPA Office of Water

CIDA

Some Considerations for Adding Stat/Assessment Methods to NEMI

- Audience/User Community:
 - Target a wide range of users, primarily water quality practitioners
- Query results should be more than just a list (read “Google search”) of statistical and assessment methods
 - Provide several types of queries to tailor responses to specific needs of the water resource community
 - Provide information on key attributes via citation, abstract, TOC, level of complexity, internet link, etc.

Other Concerns

- Will candidate methods be reviewed?
- What's missing from the user interface?
- If NEMI-SAMS proves useful, is there support (\$) within the sponsoring organization to assist new users?
- Do the entries truly represent available methods?
- Are the entries accurate?
- Is there an interactive component, i.e., opportunity for online discussion of methods, user needs?
- Finding the right balance of entry detail, time required and accuracy of entries, utility of query results

By Adding to Existing NEMI:

- Can capitalize on
 - Similar database structure
 - Sizeable current NEMI user community
 - Experience in addressing several broad concerns, e.g., review of candidate methods, representativeness of entries, method input procedures, user responsibility for method application, etc.
 - Council view that including statistical/assessment methods extends the objectives of NEMI previously applied to field/lab methods

NEMI-SAMS Prototype

- Types of queries
 - Can be based on main interest/study question, special topics, others
 - Eventually, a keyword search option as is now available for other NEMI methods
 - Narrowing the list with additional filters (item type, sponsoring agency, etc.)
- Query results
 - “View” entry details
 - Links to documents/tools/document access

The Prototype – SAMS Main Page



NEMI

National Environmental Methods Index

Provisional - Site in review



Home | Statistical Methods

Statistical And Assessment Methods Search

Note: Query results are intended to help users discover and obtain statistical and assessment methods information that MAY be useful. Whether a method is appropriate for a specific use requires careful review of the items that the query returns. Please see the [Water Quality Statistics and Assessment Workgroup white paper](#) for more information about this database tool.

Select Search Criteria



Select criteria from the drop down menus below and press 'Search NEMI' to perform a search.

What are you interested in:

Item type:

Complexity:

Analysis type:

Publication source type:

Media emphasized:

Special topic:



The Prototype – SAMS Main Page



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What are you interested in:

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Complexity:

Analysis type:

Publication source type:

Media emphasized:

Special topic:



A caution for users

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Select Search Criteria

-

Select criteria from the drop down menus below and press 'Search NEMI' to perform a search.

What are you interested in:

Item type:

Complexity:

Analysis type:

Publication source type:

Media emphasized:

Special topic:

Several search criteria/filters



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Select Search Criteria



Select criteria from the drop down menus below and press 'Search NEMI' to perform

What are you interested in: **Any**

Item type: Any

Complexity: Any

Analysis type: Any

Publication source type: Any

Media emphasized: Any

Special topic: Any

Search NEMI

- Any
- Bioassays & toxicity tests
- Communities & populations
- Compare locations
- Compare treatments
- Compliance with a threshold
- Continuous (sensor) data
- Derive thresholds
- Exploring/summarizing data
- Flow statistics
- Flow-adjusted concentrations
- Interpolate concentrations
- Loads & fluxes
- Probability survey
- Relationships & correlations
- Source identification
- Spatial trends
- Temporal trends
- Volume calculations



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Select Search Criteria



Select criteria from the drop down menus below and press 'Search NEMI' to perform

What are you interested in:

Item type:

Complexity:

Analysis type:

Publication source type:

Media emphasized:

Special topic:

- Any
- Book
- Book Chapter / Section
- Downloadable Software
- Journal Article
- Online Calculator
- Other
- Report / Guidance Document
- Website



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What are you interested in:

Item type:

Complexity:

Analysis type:

Publication source type:

Media emphasized:

Special topic:



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Select Search Criteria



Select criteria from the drop down menus below and press 'Search NEMI' to perform a search.

What are you interested in:	Any
Item type:	Any
Complexity:	Any
Analysis type:	Any
Publication source type:	Any
Media emphasized:	Any
Special topic:	Any
<input type="button" value="Search NEMI"/>	

Any
Data analysis
Monitoring program design



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Statistical And Assessment Methods Search

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Select Search Criteria



Select criteria from the drop down menus below and press 'Search NEMI' to perform a search.

What are you interested in:

Item type:

Complexity:

Analysis type:

Publication source type:

Media emphasized:

Special topic:

Search NEMI

Any

Academic Institution

Government Agency (Federal, USA)

Government Agency (State, USA)

Government Agency (Tribal, NA)

Industry

International Government Agency

Journal

Nongovernmental Organization

Other

Regional Organization



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Statistical And Assessment Methods Search

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Select Search Criteria



Select criteria from the drop down menus below and press 'Search NEMI' to perform a

What are you interested in:

Item type:

Complexity:

Analysis type:

Publication source type:

Media emphasized:

Special topic:

Search NEMI

Any

Agricultural Products

Air

Animal Tissue

Biological

Dredged Material

Groundwater

Other

Soils/Sediment

Surface Water



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NEMI

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Statistical And Assessment Methods Search

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Select Search Criteria

Select criteria from the drop down menus below and press 'Search NEMI' to perform a search.

What are you interested in:	Any
Item type:	Any
Complexity:	Any
Analysis type:	Any
Publication source type:	Any
Media emphasized:	Any
Special topic:	Any

Any

- Assessing and managing autocorrelation
- Characterizing the uncertainty of an estimated value
- Evaluating whether data follow a certain (e.g., normal) distribution
- Handling nondetects
- Identifying outliers
- Measurements taken using a water quality sensor



The Prototype – SAMS Current Contents



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Statistical And Assessment Methods Search

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Select Search Criteria

-

Select criteria from the drop down menus below and press 'Search NEMI' to perform a search.

What are you interested in:

Item type:

Complexity:

Analysis type:

Publication source type:

Media emphasized:

Special topic:



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Statistical And Assessment Methods Search

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Select Search Criteria

Total records found: 40

Criteria summary:

	Author	Title	Source Organization	Link
<input type="button" value="View"/>	Bales, J.D., and Nardi, M.R.	Automated Routines for Calculating Whole-Stream Metabolism: Theoretical Background and User's Guide	USGS	http://pubs.usgs.gov/tm/tm4c2/
<input type="button" value="View"/>	Bales, J.D., and Nardi, M.R.	Stream Metabolism Program	USGS	http://wa.water.usgs.gov/need/metabolism.zip
<input type="button" value="View"/>	Barbour, M.T., Gerritsen, J., Snyder, B., and Stribling, J.B.	Rapid Bioassessment Protocols for Use in Wadeable Streams and Rivers: Periphyton, Benthic Macroinvertebrates, and Fish	EPA	http://water.epa.gov/scitech/monitoring/rs/bioassessment/index.cfm
<input type="button" value="View"/>	Barnett, Vic	Environmental Statistics: Methods	NTU UK	http://www.wiley.com/WileyCDA/WileyTitle/productCd-0471489719.html

The Prototype – An Example Query



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Statistical And Assessment Methods Search

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Select Search Criteria

Select criteria from the drop down menus below and press 'Search NEMI' to perform a search.

What are you interested in: **Temporal trends**

Item type: Any

Complexity: Any

Analysis type: **Data analysis**

Publication source type: Any

Media emphasized: **Surface Water**

Special topic: **Handling nondetects**

Search NEMI

The Prototype – Results

Total records found: 5

Criteria summary:

- What you are interested in is Temporal trends
- Analysis type is Data analysis
- Media emphasized is Surface Water
- Special topic is Handling nondetects

	Author	Title	Source Organization	Link	Country
View	Helsel, D.R. and Hirsch, R.M.	Statistical Methods in Water Resources	USGS	http://pubs.usgs.gov/twri/twri4a3/	USA
	Helsel, Dennis R.	Nondetects and Data Analysis: Statistics for Censored Environmental Data	USGS	http://www.amazon.com/Nondetects-Data-Analysis-Statistics-Environmental/dp/0471671738	USA
View	Helsel, Dennis R.	Statistics for Censored Environmental Data Using Minitab and R	None	http://www.wiley.com/WileyCDA/WileyTitle/productCd-0470479884.html	USA
View	Manly, Bryan F.J.	Statistics for Environmental Science and Management	WEST Inc	http://www.amazon.com/Statistics-Environmental-Science-Management-Edition/dp/142006147X/	USA
View	McBride, Graham B.	Using Statistical Methods for Water Quality Management	NWA	http://www.amazon.com/Using-Statistical-Methods-Quality-Management/dp/0471470163/	New Zealand

Link to item or more info

To see full record

“View” An Item

Statistical Source Details

Title	Statistical Methods in Water Resources
Author	Helsel, D.R. and Hirsch, R.M.
Abstract/Summary Statement	<p>This book began as class notes for a course we teach on applied statistical methods to hydrologists of the Water Resources Division, U. S. Geological Survey (USGS). It reflects our attempts to teach statistical methods which are appropriate for analysis of water resources data. As interest in this course has grown outside of the USGS, incentive grew to develop the material into a textbook. The topics covered are those we feel are of greatest usefulness to the practicing water resources scientist. Yet all topics can be directly applied to many other types of environmental data.</p> <p>This book is not a stand-alone text on statistics, or a text on statistical hydrology. For example, in addition to this material we use a textbook on introductory statistics in the USGS training course. As a consequence, discussions of topics such as probability theory required in a general statistics textbook will not be found here. Derivations of most equations are not presented. Important tables included in all general statistics texts, such as quantiles of the normal distribution, are not found here. Neither are details of how statistical distributions should be fitted to flood data -- these are adequately covered in numerous books on statistical hydrology.</p> <p>We have instead chosen to emphasize topics not always found in introductory statistics textbooks, and often not adequately covered in statistical textbooks for scientists and engineers. Tables included here, for example, are those found more often in books on nonparametric statistics than in books likely to have been used in college courses for engineers. This book points the environmental and water resources scientist to robust and nonparametric statistics, and to exploratory data analysis. We believe that the characteristics of environmental (and perhaps most other 'real') data drive analysis methods towards use of robust and nonparametric methods.</p>

“View” An Item

Statistical Source Details

Title	Table of Contents	Chapters:
Author		1. Summarizing data
		2. Graphical data analysis
		3. Describing uncertainty
		4. Hypothetical tests
	5. Differences between two independent groups	
	6. Matched-pair tests	
	7. Comparing several independent groups	
	8. Correlation	
	9. Simple linear regression	
	10. Alternative methods to regression	
	11. Multiple regression	
	12. Trend analysis	
Abstract		13. Methods for data below the reporting limit
		14. Discrete relationships
		15. Regression for discrete responses
		16. Presentation graphics
		References
		Appendices
Citation		Helsel, D.R. and Hirsch, R. M., 2002. Statistical Methods in Water Resources Techniques of Water Resources Investigations, Book 4, chapter A3 (Hydrologic Analysis and Interpretation). U.S. Geological Survey. September 2002. 522 pp.
Source Organization		USGS
Source Organization Country		USA
Publication Year		2002
Link		http://pubs.usgs.gov/twri/twri4a3/
Special notes		This book is available only as an electronic publication and is not for sale. This electronic book reference is intended to give more robust information for analysis of water resources data. This book is not a stand-alone text on statistics, or a text on statistical hydrology. There is an errata sheet for this report. Data sets for Appendix C area available in both ASCII and Excel formats.

“View” An Item

Statistical Source Details

Title	Statistical Methods in Water Resources	
Author	Chapters: 1. Summarizing data	
	Item Type	Book
	Publication Source Type	Government Agency (Federal, USA)
	Purpose	Data analysis
Table of Contents	Design or Data Analysis Objectives	<ul style="list-style-type: none"> Communities & populations Compare locations Compare treatments Compliance with a threshold Continuous (sensor) data Exploring/summarizing data Flow statistics Flow-adjusted concentrations Loads & fluxes Source identification Spatial trends Temporal trends
Abstract	Complexity	Medium
Citation	Media Emphasized	<ul style="list-style-type: none"> Biological Groundwater Sediment Surface Water
Source Organization	Subcategory	
Source Organization	Special Topics	<ul style="list-style-type: none"> Assessing and managing autocorrelation Characterizing the uncertainty of an estimated value Evaluating whether data follow a certain (e.g., normal) distribution Handling nondetects Identifying outliers Measurements taken using a water quality sensor
Publication Link		
Special notes		

Online Entry Form



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NEMI

National Environmental Methods Index



Home | Statistical Methods

Statistical Methods Search

Search by criteria

Add methods

Note: Query [Update methods](#) help users discover and obtain statistical and assessment methods information that MAY be useful. Whether a method is appropriate for a specific use requires careful review of the items that the query returns. Please see the [Water Quality Statistics and Assessment Workgroup white paper](#) for more information about this database tool.

Select Search Criteria



Online Entry Form



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NEMI

National Environmental Methods Index



Home | Statistical Methods

Add Statistical Method

Enter information to create a statistical method

A * by a field's label indicates the field is required.

Username:	Doug McLaughlin - dmclaughlin
Source abbreviation*:	<input type="text"/>
Title:	<input type="text"/>
Source organization:	<input type="text"/>
Country:	<input type="text"/>
Author:	<input type="text"/>
Abstract/summary statement:	<input type="text"/>
Table of contents:	<input type="text"/>

Home | Statist

Statist Search

Add met

Note: Query Update appropriate for a paper for more informa

Select Search



ful. Whether a method is Assessment Workgroup white

Online Entry Form

NEMI National Environmental Methods Institute

Home | Statistical Methods | **Add Statistical Method**

Enter information to create a statistical method

A * by a field's label indicates the field is required.

Username: Doug McLaughlin - dmclaughlin
Source abbreviation*:
Title*:
Source organization: _____
Country*:
Author*:
Abstract/summary statement:
Table of contents:

Publication source type*:

- Academic Institution
- Government Agency (Federal, USA)
- Government Agency (State, USA)
- Government Agency (Tribal, NA)
- Industry
- International Government Agency
- Journal
- Nongovernmental Organization
- Other
- Regional Organization

If other source selected, please describe:

Analysis types*:

- Data analysis
- Monitoring program design

Design objectives*:

- Bioassays & toxicity tests
- Communities & populations
- Compare locations
- Compare treatments
- Compliance with a threshold
- Continuous (sensor) data
- Derive thresholds
- Exploring/summarizing data
- Flow statistics
- Flow-adjusted concentrations
- Interpolate concentrations
- Loads & fluxes
- Probability survey
- Relationships & correlations
- Revisit
- Source identification
- Spatial trends
- Temporal trends
- Volume calculations

Complexity*: _____

Note: Query Update appropriate for a specific paper for more information

Select Search

The Prototype Is Not...

- ...the method, or an “expert system”.
 - Query results are intended to help users discover/obtain a more focused set of items that MAY be useful. Whether the method is appropriate for a specific use requires review of the items that the query returns.
- ...a typical Google search.
 - It’s intended to be more helpful by focusing on specific water resources questions/topics, and is informed by water resources experts (should have less “junk” to sort through).

Requesting Input from ACWI Member Organizations

- Does the query format work for you?
- Are the results useful to you?
- Does the entry form work for you?
- Can you review candidate methods?
- Would you like to participate on the WQSA workgroup?

Things ACWI Member Organizations Can Do

- Try the Prototype
 - To Conduct a Query:
 - Go to www.nemi.gov and click the link under “Statistics and Assessments (beta)” or click:
http://cida.usgs.gov/nemi/search/statistic_search/
 - To **Add a Method**:
 - Contact Doug, Dan, or Leslie
- Become Involved in Developing/Implementing NEMI-SAMS
 - Contact Doug, Dan, or Leslie

Conclusions/Next Steps

- “Communicate, Collaborate, Coordinate” applies to WQ statistical and assessment methods too
- NEMI-SAMS prototype is an opportunity to fill this gap
- Full implementation will ultimately depend on user interest and participation

Many thanks to WQSA participants, Mary Bucknell, Cheryl Buchwald, and Kathy Shoephoester of the USGS Center for Integrated Data Analytics (CIDA).

Contacts

- Doug McLaughlin
douglas.mclaughlin@wmich.edu or
dmclaughlin@ncasi.org
- Dan Sullivan
djsulliv@usgs.gov
- Leslie McGeorge
Leslie.McGeorge@dep.state.nj.us