Integrated Analysis Tools for the NERRS System-Wide Monitoring Program Data

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Overview

- Background of National Estuarine Research Reserves (NERRS) System-Wide Monitoring Program (SWMP)

- Genesis of SWMPPrats.net community of practice

- Features of SWMPPrats.net
  - SWMPPr
  - widgets
  - forum

- Continuing work, training, and engagement
**NERRS**
National Estuarine Research Reserve System, established by Coastal Zone Management Act of 1972. Focus on *long-term research, monitoring, education,* and *stewardship* for more effective coastal management.

**SWMP**
System Wide Monitoring Program, initiated in 1995 to provide *continuous monitoring* data at over 140 stations in each of the 28 NERRS reserves
What is NERRS/SWMP?

[Map of NERRS Reserves]

http://nerrs.noaa.gov/ReservesMap.aspx
Each reserve has fixed, continuous monitoring stations for *water quality* (15 min), *meteorology* (15 min), and *nutrients* (monthly)

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<th><strong>Water quality</strong></th>
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<th><strong>Nutrients</strong></th>
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<td>dissolved oxygen, depth, pH, turbidity,</td>
<td>wind speed, wind direction, PAR,</td>
<td>chlorophyll, nitrate, nitrite, ammonium,</td>
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<td>fluorescence</td>
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What is NERRS/SWMP?

Data maintained by the Centralized Data Management Office (CDMO)
What is NERRS/SWMP?

As of last month, > 63 million SWMP data records available

Raw data will look like this...

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What are the needs?

NERRS researchers, managers, and technicians need more tools for trend analysis:

- Understand regional and national trends while retaining the ability to determine local trends
- Train users
- Maintain a versatile and evolving data analysis approach
- Create a community of practice
One-day training workshop at 2014 annual meeting

- Attended by over 70 NERRS staff, representing 19 of 28 reserves
- General focus on time series analysis, simple applications with SWMP data
- Pre/post workshop materials, including an R package for SWMP
Genesis of SWMPRats

A working group was formed from this meeting

**System-Wide Monitoring Program
Resources for the Analysis of Time Series**

SWMPRats.net is our base of operations...
A website with information and tools for SWMP data analysis
SWMPr is an open-source R package described on the website, v2.1.5 is now available

> # install/load from R
> install.packages('SWMPr')
> library(SWMPR)
The software addresses the unglamorous but necessary challenges of analyzing time series, specific to SWMP

What are some challenges?

- Dealing with ‘bad’ data
- Subsetting by date ranges, parameters
- Combining data from different sites
- Standardizing time steps
- ...and analysis
SWMPPrats.net: The SWMPPr package

Package description published in The R Journal this year

SWMPPr: An R Package for Retrieving, Organizing, and Analyzing Environmental Data for Estuaries

by Marcus W Beck

Abstract The System-Wide Monitoring Program (SWMP) was implemented in 1995 by the US National Estuarine Research Reserve System. This program has provided two decades of continuous monitoring data at over 140 fixed stations in 28 estuaries. However, the increasing quantity of data provided by the monitoring network has complicated broad-scale comparisons between systems and, in some cases, prevented simple trend analysis of water quality parameters at individual sites. This article describes the SWMPPr package that provides several functions to facilitate data retrieval, organization, and analysis of time series data in the reserve estuaries. Previously unavailable functions for estuaries are also provided to estimate rates of ecosystem metabolism using the open-water method. The SWMPPr package has facilitated a cross-reserve comparison of water quality trends and links quantitative information with analysis tools that has use for more generic applications to environmental time series.
Example: fill missing data with `na.approx`

![Graph showing filled missing data using `na.approx`]

Example: smooth data with `smoother`

![Graph showing smooth data using `smoother`]

M. Beck, T. O’Brien, M. Bundy

NERRS Analysis Tools

May 5, 2016
Example: time series decomposition with `decomp_cj` (chl-a at cbmocnut)
Example: estimate ecosystem metabolism with `ecometab (apadbwq)`
The most common question - has there been a change over time at my site (long-term trends)?

Three Shiny applications allow users to visualize trends in SWMP data

These apps allow ‘reactive’ use of SWMPr functions
Last but not least, a discussion forum for all things analytical
Continuing work and engagement

SWMPrats.net is in its infancy but already seeing heavy use

- Over 4000 visits to the website this year
- 3140 downloads of SWMPr to date
- Apps have been used 160 hours in the last three months

Additional training workshops Oct. 2015, planned for 2016
Continuing work and engagement

SWMPrats is an ad hoc group formed organically from the NERRS community

Success depends on:

- Healthy discourse between the creators and users
- In-person training workshops
- Benefits of open-source resources
Continuing work and engagement

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To get this presentation: https://github.com/fawda123/NWQMC_16


Visit the development site for the most recent version of SWMPr: https://github.com/fawda123/SWMPr