

SWMPrats: A community of practice for NERRS data analysis

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- The genesis of SWMPrats
- Features of SWMPrats.net
 - ▶ SWMP_r
 - ▶ widgets
 - ▶ forum
- Continuing work and engaging the larger community



As of April 29th, > 58 million SWMP data records available on CDMO

An invaluable data source but...

- No recent comparative analyses between systems
- No simple tools for trend analysis at individual sites

These needs were identified in 2013 annual meeting, led to a workshop at the 2014 meeting to focus on time series analysis



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 R And Time Series

SWMPrats.net is our base of operations...



A time series and data analysis information and tool resource




SWMPPrats.net

- ★ **SWMPPrats.net**
- ★ **SWMP Widgets**
 - Trends Maps
 - Summary Plots
- ★ **All about SWMP**
- ★ **2014 Workshop**
- ★ **Forum**

SWMPPrats.net

The SWMPPrats.net web pages serve as a time series and data analysis information and tool resource for the National Estuarine Research Reserve System (NERRS) System-wide Monitoring Program (SWMP).



Trends in SWMP parameters

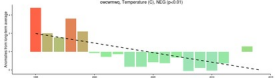
Created by Marcus W. Beck, beck.marcus@epa.gov, Todd O'Brien, todd.obrien@noaa.gov

This widget is an interactive tool to evaluate trends in SWMP data. Trends are described by an increase or decrease in values over time using a simple linear regression of summarized data. The regression for each station can be viewed by clicking on a map location. Trends at each station are plotted as circles that identify the direction and significance of the trend. The trend direction is blue for decreasing and red for increasing. The significance is indicated by the radius of the circle and color shading where larger points with darker colors indicate a strong trend. Original data are available from <http://nerrs.beacons.noaa.gov>. The map is centered at 34.44, -93.96 with a zoom level of 8.

Select parameter:
eq. Temperature (C)

Summarize by:
Years, anomalies

Select date range:
1980 - 2015





SWMPPrats.net: The SWMPPr package



SWMPPr is an open-source R package, v2.0.0 is now available

```
> # install/load from R  
> install.packages('SWMPPr')  
> library(SWMPPr)
```

Currently working on a manuscript to describe the package in detail



SWMPPrats.net: The SWMPPr package

SWMPPr functions are grouped into three categories that describe their use in the ‘data workflow’

Retrieve

all_params
all_params_dtrng
import_local
import_remote
single_param
site_codes
site_codes_ind

Organize

comb
qaqc
qaqcchk
rem_reps
setstep
subset

Analyze

aggreswmp
aggrementab
ecometab
decomp
decomp_cj
hist
lines
na.approx
plot
plot_metalab
plot_summary
smoother



SWMPPrats.net: The SWMPPr package

The software addresses the tedious 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



Proof of concept, import and combine wq and weather data from Apalachicola Bay

```
> # import data
> met <- import_remote('apaebmet')
> wq <- import_remote('apacpwq')
>
> # combine, two hours time step
> # only overlapping date ranges
> dat <- comb(met, wq, timestep = 120,
+   method = 'intersect')
```

Try this with excel...



SWMPPrats.net: The SWMPPr package

```
> head(dat, 4)
```

```
##          datetimestamp temp spcond sal do_pct do_mgl depth
## 1 2001-12-31 23:00:00   NA     NA  NA     NA     NA    NA
## 2 2002-01-01 01:00:00   12    37  24    104    10     2
## 3 2002-01-01 03:00:00   12    40  26     99     9     2
## 4 2002-01-01 05:00:00   11    42  26     98     9     2
##   cdepth level clevel ph turb chlfluor atemp rh   bp wspd
## 1     NA   NA     NA NA   NA     NA    4 69 1017    4
## 2     NA   NA     NA NA   3     NA    3 75 1017    3
## 3     NA   NA     NA NA   4     NA    2 77 1018    3
## 4     NA   NA     NA NA   5     NA    1 82 1019    4
##   maxwspd wdir sdwdir totpar totprcp totsorad
## 1     NA  347     NA     0     NA     NA
## 2     NA   9     NA     0     NA     NA
## 3     NA 331     NA     0     NA     NA
## 4     NA   0     NA     0     NA     NA
```



Time series analysis can range from very general to very specific

SWMP_r functions include...

General

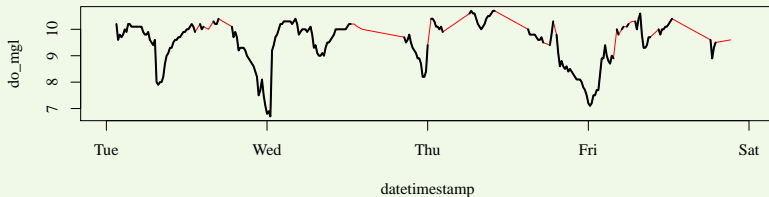
- `na.approx`
- `smoother`
- `aggreswmp`
- `plot`
- `hist`
- `lines`

Specific

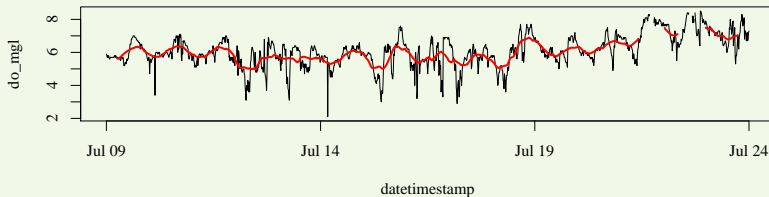
- `decomp`
- `decomp_cj`
- `ecometab`
- `aggremetab`
- `plot_metab`
- `plot_summary`



Fill missing data with `na.approx`

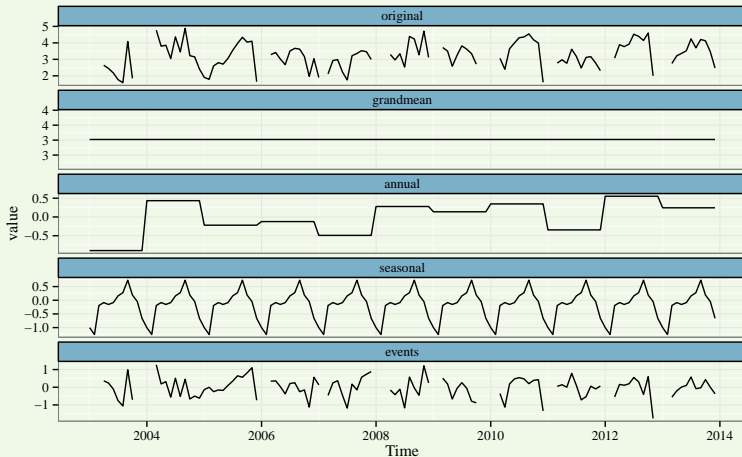


Smooth data with `smoother`



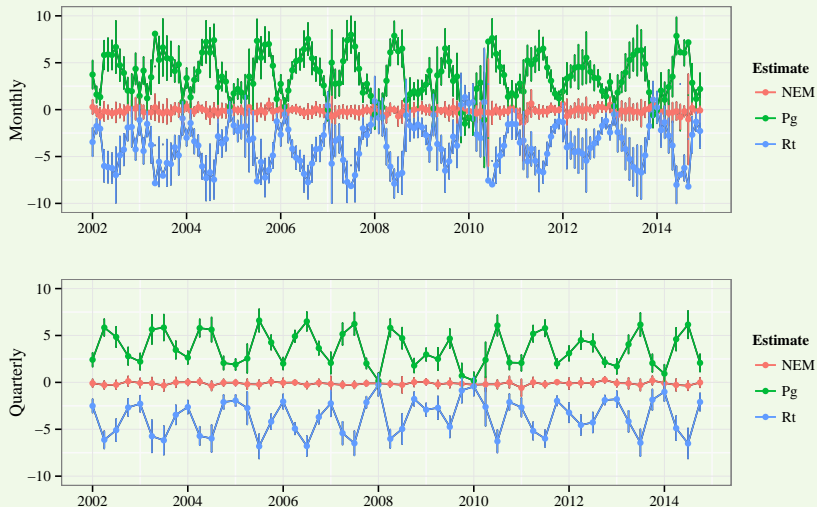


Time series decomposition with `decomp_cj` (chl-a at cbmocnut)





Estimate ecosystem metabolism with ecometab (apadbwq)



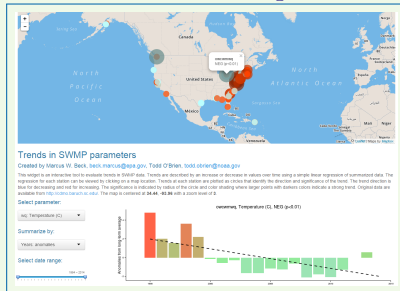


The most common question - what is the change over time at my site?

The functions in SWMP_r can help, but it's easier to interact!

Two apps on SWMPrats.net can help visualize trends

Summary plots





Last but not least, a discussion forum for all things analytical

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Continuing work and engagement

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

- SWMPPr downloaded 289 times from R network (as of April 29)
- Apps have been used 345 hours (as of April 29)

Continuing development of packages/apps - submit suggestions/bug reports via email or on [GitHub](#) (preferred)

Plan for greater engagement with the forum - soliciting moderators, suggested topics

Additional training workshops??

Continuing work and engagement



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

Summary app: <http://swmprats.net/swmp-widgets/summary-plots>

Trends map app: <http://swmprats.net/swmp-widgets/trends-maps>

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