SWMPr overview, retrieve, and organize

Marcus W. Beck[1] Todd D. O'Brien[2]

[1]ORISE, USEPA NHEERL Gulf Ecology Division
Email: beck.marcus@epa.gov

[2]NOAA/NMFS COPEPOD Project
Email: todd.obrien@noaa.gov

Objectives and agenda

- Objectives
  - What are the various ways data are obtained from SWMP?
  - What are some issues that need to be addressed before importing into a statistical program for time series analysis?

Objectives and agenda

- Objectives
  - What are the various ways data are obtained from SWMP?
  - What are some issues that need to be addressed before importing into a statistical program for time series analysis?
- Agenda
  - Brief overview of SWMP network and available data
  - Format and potential issues with output data
  - Retrieving and importing the data

Interactive portion

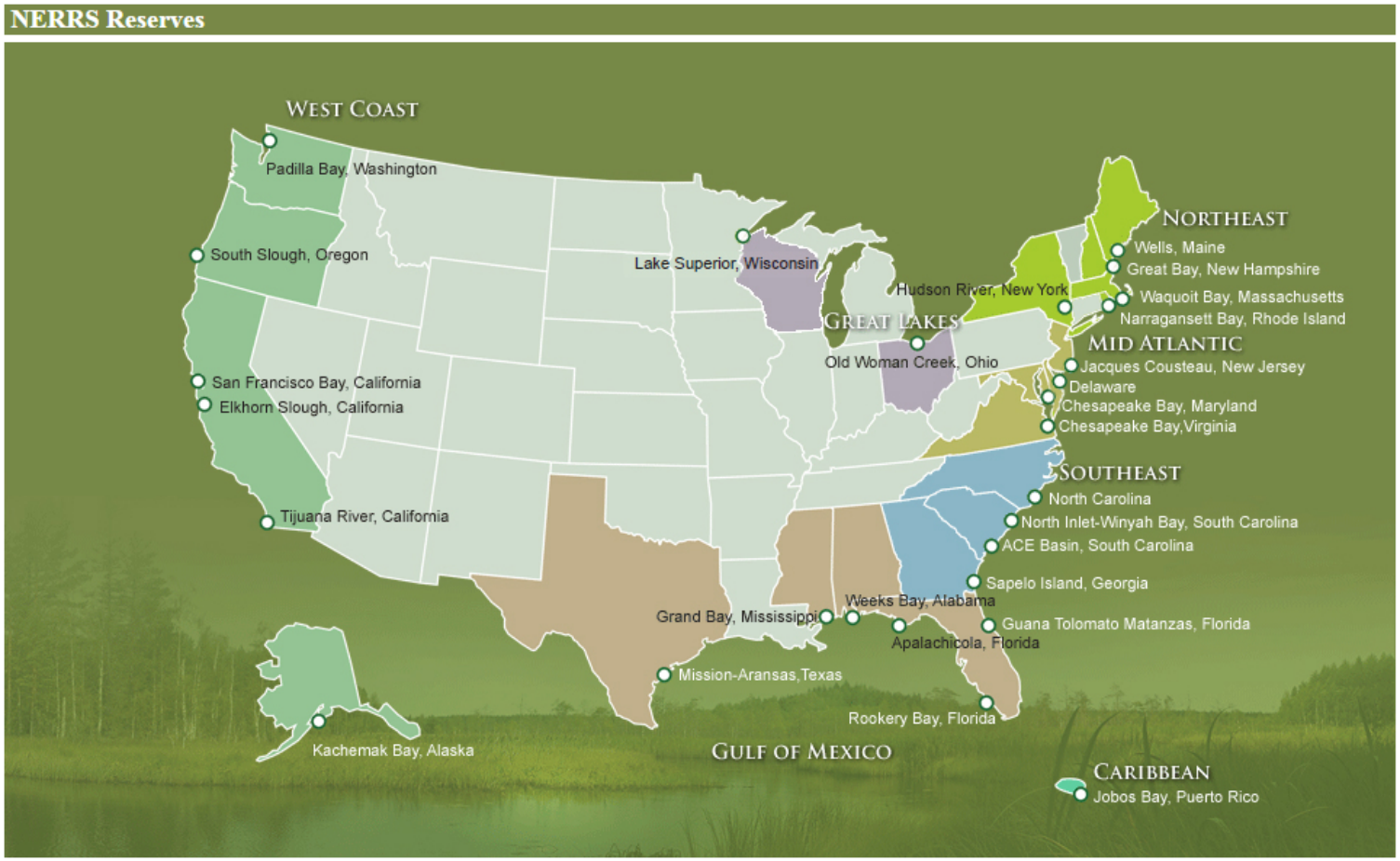
You can follow along later in this module:

- dataset1
- script1

Interactive!

Overview of SWMP and available data

SWMP - System Wide Monitoring Program, initiated in 1995 to provide continuous monitoring data at over 300 stations in 28 US estuaries



http://nerrs.noaa.gov/ReservesMap.aspx

Overview of SWMP and available data

CDMO (link) is your one-stop shop for retrieving SWMP data

Overview of SWMP and available data

A wide range of data can be requested... a few records for one site to all records for multiple sites

Requests can return a lot of data so make sure you have clear objectives

Check the available data before making a request!

- station names
- data types
- date ranges
- parameters

Format and potential issues with output data

To orient yourself, understand the NERRS/SWMP naming convention

Site (reserve), ***station***, and ***parameter type*** are identified by a 7 or 8 character name

Format and potential issues with output data

To orient yourself, understand the NERRS/SWMP naming convention

Site (reserve), ***station***, and ***parameter type*** are identified by a 7 or 8 character name

E.g., elkcwmet

Format and potential issues with output data

To orient yourself, understand the NERRS/SWMP naming convention

Site (reserve), ***station***, and ***parameter type*** are identified by a 7 or 8 character name

E.g., elkcwmet

- elk: site, Elkhorn Slough
- cw: station, Caspian Weather Station
- met: parameter type (weather)

Format and potential issues with output data

The fundamental unit of data is the ‘station’ defined by a parameter type

The parameters for a station are specific to the parameter type

Format and potential issues with output data

The fundamental unit of data is the 'station' defined by a parameter type

The parameters for a station are specific to the parameter type

Nutrients	***Water quality***	***Meteorology***
po4f, chla_n, no3f, no2f, nh4f, no23f, ke_n, urea	temp, spcond, sal, do_pct, do_mgl, depth, cdepth, level, clevel, ph, turb, chlfluor	atemp, rh, bp, wspd, maxwspd, wdir, sdwdir, totpar, totprcp, cumprcp, totsorad

Format and potential issues with output data

The raw data will look like this...

	A	B	C	D	E	F	G	H	I	J	K	L
1	StationCo	isSWMP	DateTimeStamp	Historical	Provisiona	CollMetho	REP	F_Record	PO4F	F_PO4F	NH4F	F_NH4F
2	apacpnut	P	1/10/2012 10:20	0	1	1	1		0.003	<-4> [SBL]	0.03	<0>
3	apacpnut	P	2/7/2012 11:41	0	1	1	1		0.005	<0>	0.019	<0>
4	apacpnut	P	3/5/2012 11:51	0	1	1	1		0.003	<-4> [SBL]	0.041	<0>
5	apacpnut	P	4/4/2012 10:30	0	1	1	1		0.003	<-4> [SBL]	0.043	<0>
6	apacpnut	P	5/9/2012 10:12	0	1	1	1		0.003	<0>	0.053	<0>
7	apacpnut	P	5/9/2012 10:15	0	1	1	2		0.003	<-4> [SBL]	0.022	<0>
8	apacpnut	P	5/9/2012 10:20	0	1	1	3		0.003	<0>	0.016	<0>
9	apacpnut	P	6/5/2012 8:30	0	1	1	1		0.003	<-4> [SBL]	0.04	<0>
10	apacpnut	P	7/3/2012 9:58	0	1	1	1	{CSM}	0.004	<0>	0.094	<0>
11	apacpnut	P	7/3/2012 9:59	0	1	1	2	{CSM}	0.004	<0>	0.066	<0>
12	apacpnut	P	7/3/2012 10:01	0	1	1	3	{CSM}	0.005	<0>	0.069	<0>
13	apacpnut	P	8/7/2012 9:53	0	1	1	1	{CSM}	0.003	<-4> [SBL]	0.05	<0>
14	apacpnut	P	9/5/2012 10:56	0	1	1	1		0.003	<-4> [SBL]	0.026	<0>
15	apacpnut	P	10/2/2012 9:22	0	1	1	1		0.003	<-4> [SBL]	0.042	<0>
16	apacpnut	P	10/2/2012 9:27	0	1	1	2		0.003	<-4> [SBL]	0.024	<0>
17	apacpnut	P	10/2/2012 9:32	0	1	1	3		0.003	<0>	0.042	<0>
18	apacpnut	P	11/6/2012 10:30	0	1	1	1		0.003	<-4> [SBL]	0.07	<0>
19	apacpnut	P	11/26/2012 11:39	0	1	1	1		0.003	<-4> [SBL]	0.041	<0>

Format and potential issues with output data

What are the challenges for evaluating SWMP data??

Format and potential issues with output data

What are the challenges for evaluating SWMP data??

- Knowing what we want (I can't help with this)

Format and potential issues with output data

What are the challenges for evaluating SWMP data??

- Knowing what we want (I can't help with this)
- Dealing with QAQC columns and removing 'bad' observations

Format and potential issues with output data

What are the challenges for evaluating SWMP data??

- Knowing what we want (I can't help with this)
- Dealing with QAQC columns and removing 'bad' observations
- Data we don't want... extra columns or irrelevant parameters

Format and potential issues with output data

What are the challenges for evaluating SWMP data??

- Knowing what we want (I can't help with this)
- Dealing with QAQC columns and removing 'bad' observations
- Data we don't want... extra columns or irrelevant parameters
- Combining data for comparison

Format and potential issues with output data

What are the challenges for evaluating SWMP data??

- Knowing what we want (I can't help with this)
- Dealing with QAQC columns and removing 'bad' observations
- Data we don't want... extra columns or irrelevant parameters
- Combining data for comparison
- Issues inherent with time series, e.g., missing data

Format and potential issues with output data

What are the challenges for evaluating SWMP data??

- Knowing what we want (I can't help with this)
- Dealing with QAQC columns and removing 'bad' observations
- Data we don't want... extra columns or irrelevant parameters
- Combining data for comparison
- Issues inherent with time series, e.g., missing data

We will learn how to handle most of these challenges!

Overview of the SWMPr package

What: An R package for retrieving, organizing and analyzing SWMP data

Overview of the SWMPr package

What: An R package for retrieving, organizing and analyzing SWMP data

Why: There are many challenges for working with SWMP data... a toolkit for addressing these challenges will be useful (I hope!)

Overview of the SWMPr package

What: An R package for retrieving, organizing and analyzing SWMP data

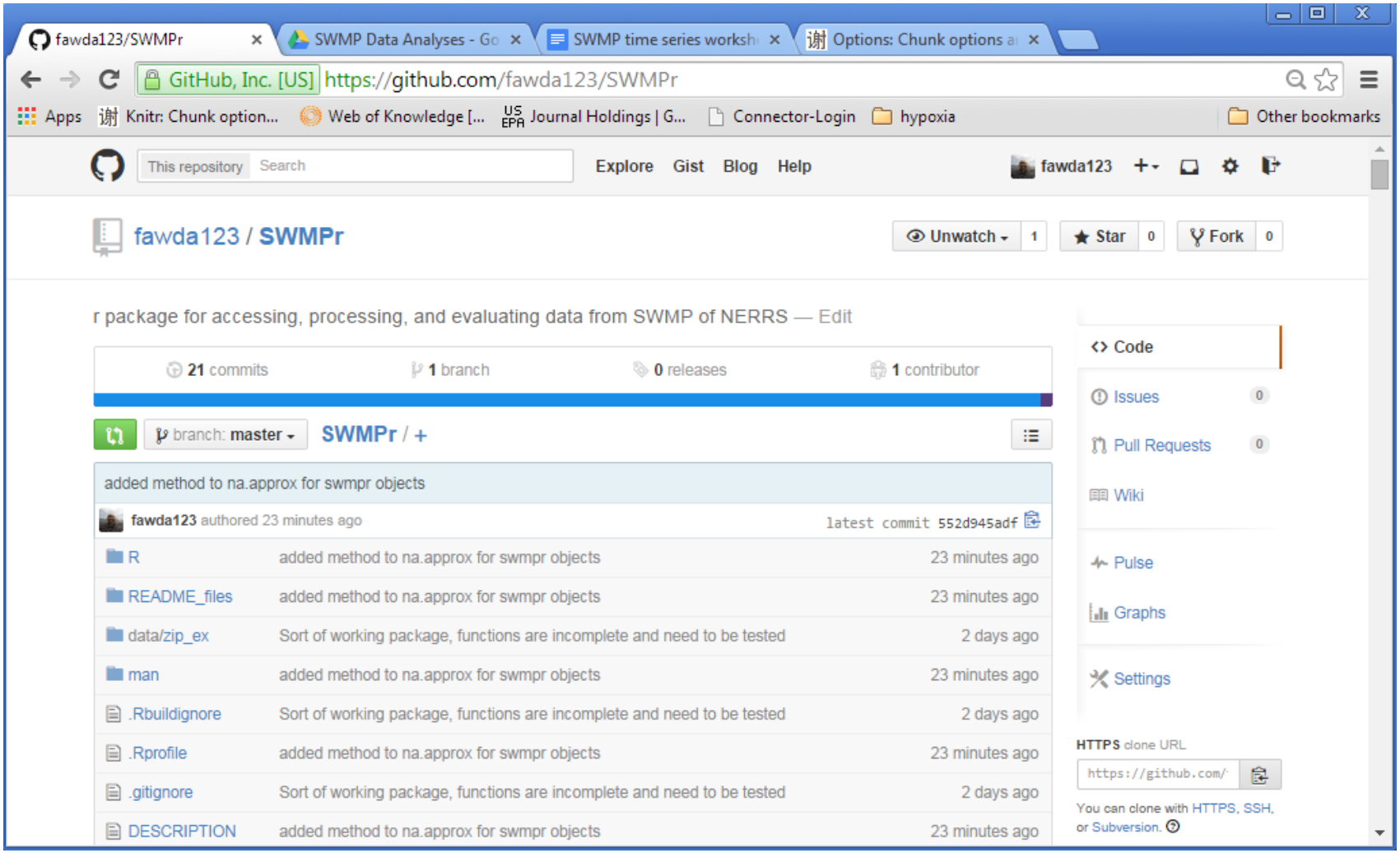
Why: There are many challenges for working with SWMP data... a toolkit for addressing these challenges will be useful (I hope!)

How:

- Install R/RStudio on your computer (done already!)
- Install the SWMPr package (dont already!)
- Use the SWMPr functions to ***retrieve***, ***organize***, and ***analyze*** SWMP data

Overview of the SWMPr package

This is where SWMPr lives - https://github.com/fawda123/SWMPr



Overview of the SWMPr package

What is provided in the SWMPr package?

Retrieve

```
all_params
all_params_dtrng
single_param
import_local
```

Organize

```
qaqc.swmpr
qaqcchk.swmpr
subset.swmpr
setstep.swmpr
comb.swmpr
```

Analyze

```
aggregate.swmpr
smoother.swmpr
na.approx.swmpr
plot.swmpr
hist.swmpr
lines.swmpr
decomp.swmpr
map_reserve
```

Built around the concept of ***object-oriented programming*** - retrieval functions return a data type with specific methods to organize and analyze

Overview of the SWMPr package

To view the help file for any function (including examples for most):

```
?all_params
```

all_params {SWMPr} R Documentation

Import current station records from the CDMO

Description

Import current station records from the CDMO starting with the most current date, CDMO equivalent of `exportAllParamsXMLNew`

Usage

```
all_params(station_code, Max = 100)
```

Arguments

`station_code`	chr string of station, 7 or 8 characters
`Max`	numeric value for number of records to obtain from the current date, maximum of 100

Value

Returns a swmpr object, all available parameters including QAQC columns

Overview of the SWMPr package

Let's get some data into R!

The ***retrieval*** functions do two things:

Import data directly from the CDMO:

```
all_params
all_params_dtrng
single_param
```

These functions require registering your IP address with CDMO

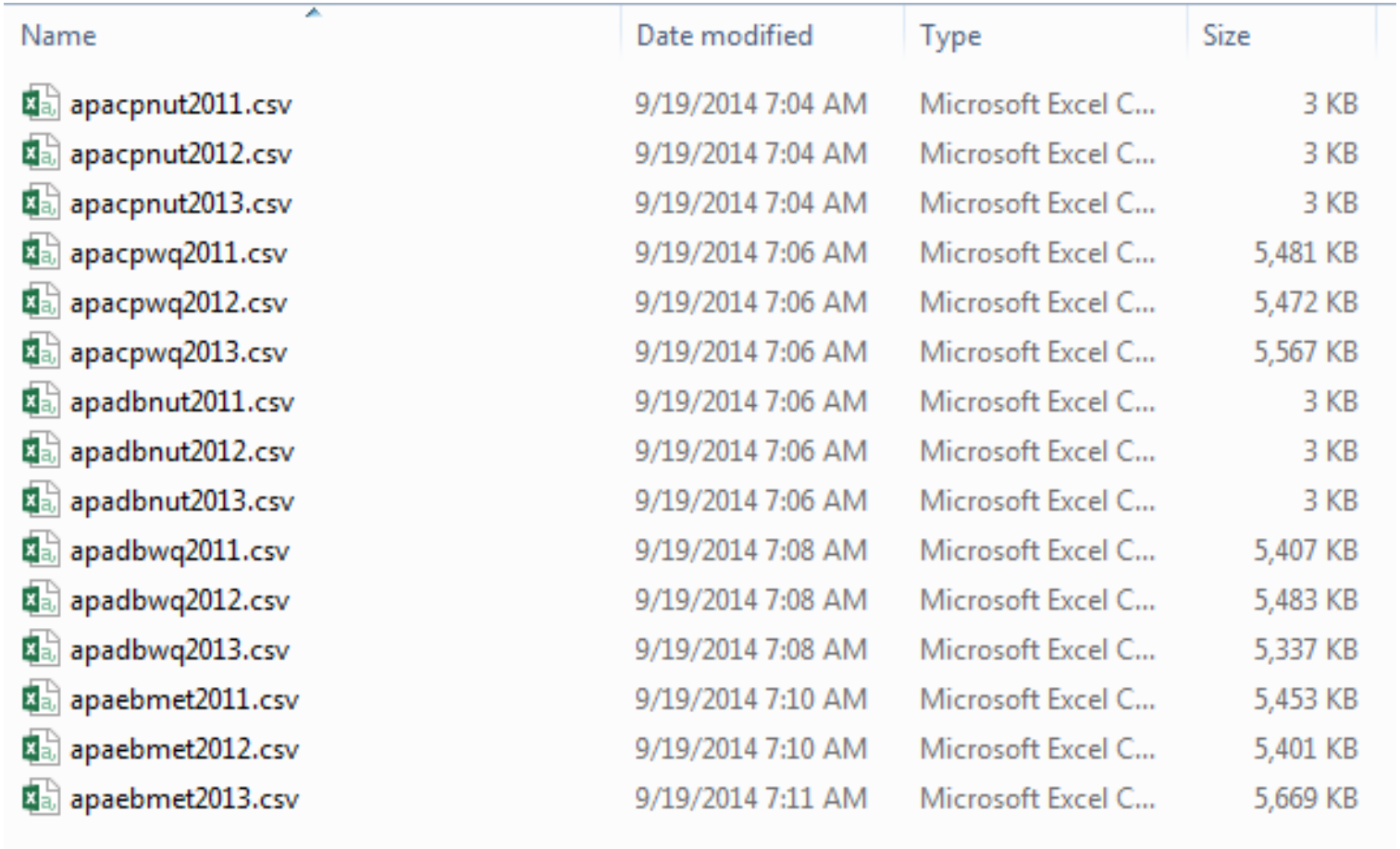
Import data from a local path:

```
import_local
```

Allows import of data obtained from (and only from) the zip downloads feature

Overview of the SWMPr package

After unzipping, data from zip downloads will have separate .csv files for each station and year



Name	Date modified	Type	Size
apacpnut2011.csv	9/19/2014 7:04 AM	Microsoft Excel C...	3 KB
apacpnut2012.csv	9/19/2014 7:04 AM	Microsoft Excel C...	3 KB
apacpnut2013.csv	9/19/2014 7:04 AM	Microsoft Excel C...	3 KB
apacpwq2011.csv	9/19/2014 7:06 AM	Microsoft Excel C...	5,481 KB
apacpwq2012.csv	9/19/2014 7:06 AM	Microsoft Excel C...	5,472 KB
apacpwq2013.csv	9/19/2014 7:06 AM	Microsoft Excel C...	5,567 KB
apadbnut2011.csv	9/19/2014 7:06 AM	Microsoft Excel C...	3 KB
apadbnut2012.csv	9/19/2014 7:06 AM	Microsoft Excel C...	3 KB
apadbnut2013.csv	9/19/2014 7:06 AM	Microsoft Excel C...	3 KB
apadbwq2011.csv	9/19/2014 7:08 AM	Microsoft Excel C...	5,407 KB
apadbwq2012.csv	9/19/2014 7:08 AM	Microsoft Excel C...	5,483 KB
apadbwq2013.csv	9/19/2014 7:08 AM	Microsoft Excel C...	5,337 KB
apaebmet2011.csv	9/19/2014 7:10 AM	Microsoft Excel C...	5,453 KB
apaebmet2012.csv	9/19/2014 7:10 AM	Microsoft Excel C...	5,401 KB
apaebmet2013.csv	9/19/2014 7:11 AM	Microsoft Excel C...	5,669 KB

Overview of the SWMPr package

Use the following to import some data into R...

Open script1.R, change the path to where you have the folder 'dataset1'

```
# get data for apacpwq, all years

# location of data
mypath <- 'C:/data/dataset1'

# import and assign to 'dat'
dat <- import_local(mypath, 'apacpwq', trace = T)
```

The console will return some informative text...

Overview of the SWMPr package

Now we have data in our 'workspace' that we can organize/analyze

```
head(dat)
```

```
##         datetimestamp temp f_temp spcond f_spcond sal f_sal do_pct f_do_pct
## 1 2011-01-01 00:00:00   11   <0>      44     <0>   28  <0>      68     <0>
## 2 2011-01-01 00:15:00   11   <0>      44     <0>   28  <0>      68     <0>
## 3 2011-01-01 00:30:00   11   <0>      44     <0>   28  <0>      68     <0>
## 4 2011-01-01 00:45:00   11   <0>      44     <0>   28  <0>      68     <0>
## 5 2011-01-01 01:00:00   11   <0>      44     <0>   29  <0>      68     <0>
## 6 2011-01-01 01:15:00   11   <0>      44     <0>   29  <0>      67     <0>
##   do_mgl f_do_mgl depth f_depth cdepth f_cdepth level f_level clevel f_clevel
## 1      6     <0>      2    <0>       2     <3>     NA   <-1>      NA        NA
## 2      6     <0>      2    <0>       2     <3>     NA   <-1>      NA        NA
## 3      6     <0>      2    <0>       2     <3>     NA   <-1>      NA        NA
## 4      6     <0>      2    <0>       2     <3>     NA   <-1>      NA        NA
## 5      6     <0>      2    <0>       2     <3>     NA   <-1>      NA        NA
## 6      6     <0>      2    <0>       2     <3>     NA   <-1>      NA        NA
##   ph f_ph turb f_turb chlfluor f_chlfluor
## 1  8 <0>     3   <0>        NA      <-1>
## 2  8 <0>     3   <0>        NA      <-1>
## 3  8 <0>     2   <0>        NA      <-1>
## 4  8 <0>     1   <0>        NA      <-1>
## 5  8 <0>     2   <0>        NA      <-1>
## 6  8 <0>     1   <0>        NA      <-1>
```

Questions??