SWAT Output Post-Processing (Part 1)

1. Overview

Now that we have done all this work to set-up, calibrate, and validate SWAT, we can explore our results. However, before we jump into data analysis, there are a few things we need to do. First, we need to make sure we understand the purpose of each of the 10 SWAT output files. Next, we might want to reformat these raw SWAT output files so they are easier to work with (i.e., tidy them up). Last, we have to save these reformatted outputs so we can use them for data analysis. This act of taking raw SWAT outputs, reformatting them, and saving this reformatted version is called *post-processing*.

The overall goal of this workshop session is to provide you with some tools to make your post-processing of SWAT outputs easy and reproducible.

By the end of this workshop session you will be able to:

1. *explain* different SWAT output files and their contents

2. *identify* key features of RStudio

3. *describe* key tidy data principles

2. SWAT Output Files

Activity 1:

1. Navigate to the `TxtInOut` directory on your computer (C drive > SWAT > SWATRuns > Scenarios > Default > TxtInOut) and, using the search bar, type in 'output'. Pull out a piece of paper and jot down the names of the different plain text files you see that start with 'output' (hint: they should only differ by their file extensions).

2. *(5 min on your own)* Now that you have a list of the output.* files, head over to chapter 32 of the SWAT help manual here: http://swat.tamu.edu/media/69395/ch32_output.pdf (http://swat.tamu.edu /media/69395/ch32_output.pdf). Read through the SWAT documentaiton and jot down a short summary of the informaiton contained in each file you listed in #1.

3. *(5 min with a partner)* Share what you found with a partner.

4. *(5 min class discussion)* Share what you and your partner found with the class.

3. A Whirlwind Tour of RStudio

RStudio is an integrated development environment (IDE) for `R` that you can install only after you've installed `R`. Basically, RStudio makes coding in `R` easier. There are some aspects of RStudio we'll

explore now.

- Editor window (for viewing and running scripts)
- Console window (for viewing outputs/code errors)
- Environment window (see variables in memory and history)
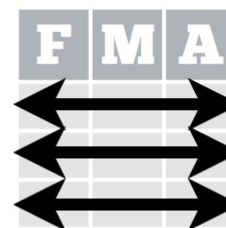- File direcory window (see file path and plots, ask for help)

4. What is tidy data?

According to the RStudio Data Wrangling Cheatsheet (click for link)… (https://www.rstudio.com/wp-content/uploads/2015/02/data-wrangling-cheatsheet.pdf)
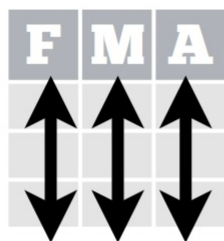
What should tidy SWAT outputs look like? Each row would be a day/month/year and each column would be a different variable of interest (e.g., streamflow).

There are other key features that make data easier for others to use:

- Clear column headers
- Clear units are given
- Clear representation of missing data
- Metadata is included
- Anything else?

Activity 2:

1. *(5 min on your own)* Open up the `output.rch` file in your favorite text editor. How is it organized? Is it tidy? Why or why not? Write down some things you notice on a piece of paper.

2. *(5 min with a partner)* Share what you found with a partner.

3. *(5 min class discussion)* Share what you and your partner found with the class.

5. Importing Data into R/RStudio

Let's try to import some of our SWAT data into R/RStudio.

First we use `library()` to load the `tidyverse` package that has functions to help us import our data.

```
# install and load some packages with functions that we'll need
install.packages("tidyverse") # only do this once!
library(tidyverse) # do this each time you open a new script and need it
```

Next we check where RStudio is currently looking for our data.

```
# check what working directory you are in
getwd()
```

```
## [1] "/Users/ssaia/Documents/GitHub/ecohydro-modeling-workshop-mar2018"
```

You will need to use the code below to set your working directory to point to the directory where the
 output.rch file is stored.

```
setwd('/Users/ssaia/Documents/GitHub/ecohydro-modeling-workshop-mar2018/data/swat_
output_data')
# copy/paste the path to the data directory inside the function setwd()
# windows users may have to change /'s to \\'s when copy/pasting
```

Now let's import the output.rch file.

```
# You will need to change what's between the 's here. It should be output.rch.
rch_data_raw = read_table('/Users/ssaia/Documents/GitHub/ecohydro-modeling-worksho
p-mar2018/data/swat_output_data/output.rch')
```

Now let's look at it. You can click on it in the Environment window, or type View(rch_data_raw) into the
Console window You can also use head() like this to view the first 20 lines…

```
head(rch_data_raw, n = 20)
```

```
## # A tibble: 20 x 1
##                                                              `1`
##                                                              <chr>
##  1                       SWAT Dec 23 2016    VER 2016/Rev 664
##  2                                                           <NA>
##  3                   General Input/Output section (file.cio):
##  4               1/28/2018 12:00:00 AM ARCGIS-SWAT interface AV
##  5
##  6                                                           <NA>
##  7                                                           <NA>
##  8           RCH      GIS    MON    AREAkm2   FLOW_INcms FLOW_OUTcms
##  9 REACH      1        0      1   0.1575E+03  0.3712E+01  0.3706E+01
## 10 REACH      2        0      1   0.1917E+03  0.4410E+01  0.4404E+01
## 11 REACH      3        0      1   0.6200E+02  0.1620E+01  0.1620E+01
## 12 REACH      4        0      1   0.5271E+03  0.1263E+02  0.1261E+02
## 13 REACH      5        0      1   0.1804E+03  0.4689E+01  0.4680E+01
## 14 REACH      6        0      1   0.7987E+02  0.1936E+01  0.1936E+01
## 15 REACH      7        0      1   0.1031E+03  0.2758E+01  0.2756E+01
## 16 REACH      8        0      1   0.6996E+03  0.1683E+02  0.1682E+02
## 17 REACH      9        0      1   0.2614E+03  0.6217E+01  0.6214E+01
## 18 REACH     10        0      1   0.1006E+04  0.2382E+02  0.2381E+02
## 19 REACH     11        0      1   0.3249E+03  0.8206E+01  0.8201E+01
## 20 REACH     12        0      1   0.1026E+03  0.2457E+01  0.2455E+01
```

Hmm…it's coming in as one big column. Why do you think this is happening here? (Hint: Think back to our tidy data critique of the file.) We might have to do some reformatting…

(Image credit: http://www.doctorwhotv.co.uk/ (http://www.doctorwhotv.co.uk/))