

SARE water holding capacity calcs

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3/17/2020

Data processing

NOTE: Calcs are loosely based on Agron479 lab, although I found that lab hard to follow.

I have my plot-treatment key (called *key*):

```
head(key)
```

```
## # A tibble: 6 x 8
##   site_name site_desc      sys_trt crop_trt cc_trt   rep plot code
##   <chr>      <chr>      <chr>   <chr>   <chr> <dbl> <dbl> <chr>
## 1 Boyd42    Boyd Farm, soybean plots sil    soy    no      1     2 B42-p2
## 2 Boyd42    Boyd Farm, soybean plots sil    soy    no      2    11 B42-p11
## 3 Boyd42    Boyd Farm, soybean plots sil    soy    no      3    16 B42-p16
## 4 Boyd42    Boyd Farm, soybean plots sil    soy    no      4    20 B42-p20
## 5 Boyd42    Boyd Farm, soybean plots sil    soy    no      5    28 B42-p28
## 6 Boyd42    Boyd Farm, soybean plots sil    soy    cc       1     7 B42-p7
```

I have my raw data (called *datraw*):

```
head(datraw)
```

```
## # A tibble: 6 x 23
##   code satsamp_g satwater_g cell_nu cylinder_g atm `10_cm` `25_cm` `50_cm`
##   <chr>   <dbl>    <dbl> <chr>      <dbl> <dbl>   <dbl>   <dbl>   <dbl>
## 1 St-1~    859.    4.39 1a         46.1  48.9   48.5   53.8   49.2
## 2 St-3~    880.    4.68 2a         46.1  50.7   51.6   57.4   49.3
## 3 St-5~    848.    3.26 3a         46.1  50.2   50.6   56.9   49.6
## 4 St-7~    842.    6.49 4a         46.1  50.2   52.0   59.0   50.7
## 5 St-2~    856.    3.92 5a         46.2  50.4   51.8   55.5   48.9
## 6 St-4~    846.    19.3 6a         46.2  51.9   55.0   63.1   51.8
## # ... with 14 more variables: `100_cm` <dbl>, `200_cm` <dbl>, `500_cm` <dbl>,
## #   sampafter500_g <dbl>, drysoil_g <dbl>, ringpluscrap_g <dbl>, ring_g <dbl>,
## #   site_name <chr>, site_desc <chr>, sys_trt <chr>, crop_trt <chr>,
## #   cc_trt <chr>, rep <dbl>, plot <dbl>
```

1. Calculate the bulk density

```
dat1 <- datraw %>%
  # assume volume of soil sample is 347.50 cm3
  mutate(soilvol_cm3 = 347.5) %>%
  # calc bulk density based on dry weight of soil
  mutate(bulkden_gcm3 = drysoil_g / soilvol_cm3) %>%
  select(code, drysoil_g, bulkden_gcm3)

head(dat1)
```

```
## # A tibble: 6 x 3
##   code  drysoil_g bulkden_gcm3
```

```
##   <chr>      <dbl>      <dbl>
## 1 St-1no    526        1.51
## 2 St-3no    532        1.53
## 3 St-5no    512        1.47
## 4 St-7no    498        1.43
## 5 St-2cc    520        1.50
## 6 St-4cc    482        1.39
```

2. Calculate actual amount of water released at each pressure.

Note that pressure of 999 refers to the amount of water remaining in the soil after the 500 cm pressure was applied. This was determined by weighing the soil, drying it, then reweighing it.

```
dat2 <-
  datraw %>%
  mutate(
    w_0cm_g = satwater_g,
    w_2.5cm_g = atm - cylinder_g,
    w_10cm_g = `10_cm` - cylinder_g,
    w_25cm_g = `25_cm` - cylinder_g,
    w_50cm_g = `50_cm` - cylinder_g,
    w_100cm_g = `100_cm` - cylinder_g,
    w_200cm_g = `200_cm` - cylinder_g,
    w_500cm_g = `500_cm` - cylinder_g,
    w_999cm_g = sampafter500_g - ringpluscrap_g - drysoil_g
  ) %>%
  select(code, starts_with("w_"))

head(dat2)
```

```
## # A tibble: 6 x 10
##   code w_0cm_g w_2.5cm_g w_10cm_g w_25cm_g w_50cm_g w_100cm_g w_200cm_g
##   <chr>   <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>    <dbl>
## 1 St-1~  4.39      2.73     2.35     7.63     3.08     4.08     4.68
## 2 St-3~  4.68      4.59     5.46    11.2     3.15     3.07     3.92
## 3 St-5~  3.26      4.12     4.53    10.8     3.5      3.26     3.92
## 4 St-7~  6.49      4.1      5.89    12.8     4.57     4.62     5.45
## 5 St-2~  3.92      4.2      5.67     9.34     2.76     3.73     4.46
## 6 St-4~ 19.3      5.70     8.79    16.9     5.55     3.63     3.89
## # ... with 2 more variables: w_500cm_g <dbl>, w_999cm_g <dbl>
```

3. Gather into long form to get cumulatives.

```
dat3 <-
  dat2 %>%
  gather(w_0cm_g:w_999cm_g, key = press_cm, value = water_g) %>%
  separate(press_cm, into = c("water", "press_cm", "grams"), sep = "_") %>%
  select(-water, -grams) %>%
  # get pressure as a numeric value
  mutate(press_cm = parse_number(press_cm)) %>%
  # arrange within a sample
  group_by(code) %>%
  arrange(code, -press_cm) %>%
```

```
# get cumulative water retained in soil at that pressure point (is this right?)
mutate(cumwater_g = cumsum(water_g))

head(dat3)
```

```
## # A tibble: 6 x 4
## # Groups:   code [1]
##   code   press_cm water_g cumwater_g
##   <chr>    <dbl>   <dbl>    <dbl>
## 1 B42-p10      999    110.      110.
## 2 B42-p10      500     4.56     115.
## 3 B42-p10      200    12.6     128.
## 4 B42-p10      100     5.93     134.
## 5 B42-p10       50     8.03     142.
## 6 B42-p10       25     9.82     151.
```

4. Calculate water content of soil.

Divide the cumulative water released at each pressure by the weight of the dry soil (gravimetric water content). The gravimetric water content is converted to volumetric using the bulk density.

```
dat4 <-
  dat3 %>%
  left_join(dat1) %>%
  mutate(gtheta = cumwater_g / drysoil_g,
         vtheta = gtheta * bulkden_gcm3) %>%
  ungroup() %>%
  mutate_if(is.numeric, round, 3)

head(dat4)
```

```
## # A tibble: 6 x 8
##   code   press_cm water_g cumwater_g drysoil_g bulkden_gcm3 gtheta vtheta
##   <chr>    <dbl>   <dbl>    <dbl>    <dbl>    <dbl> <dbl> <dbl>
## 1 B42-p10      999    110.      110.     541.      1.56 0.204 0.318
## 2 B42-p10      500     4.56     115.     541.      1.56 0.213 0.331
## 3 B42-p10      200    12.6     128.     541.      1.56 0.236 0.367
## 4 B42-p10      100     5.93     134.     541.      1.56 0.247 0.384
## 5 B42-p10       50     8.03     142.     541.      1.56 0.262 0.407
## 6 B42-p10       25     9.82     151.     541.      1.56 0.28  0.436
```

5. Join the data with the key so I have treatment info.

```
dat5 <-
  dat4 %>%
  left_join(key) %>%
  select(code, site_name, sys_trt, cc_trt, rep,
         bulkden_gcm3, press_cm, gtheta, vtheta)

head(dat5)
```

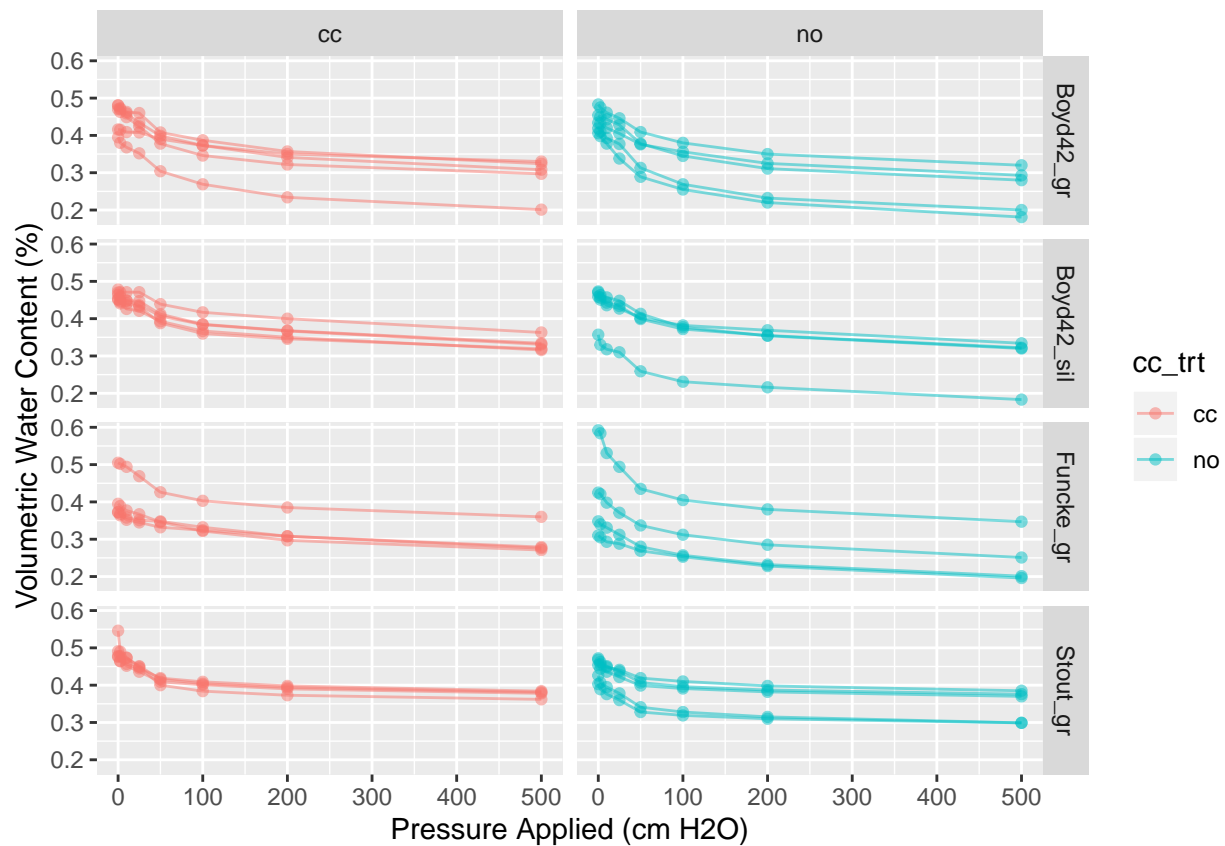
```
## # A tibble: 6 x 9
##   code   site_name sys_trt cc_trt   rep bulkden_gcm3 press_cm gtheta vtheta
##   <chr>   <chr>    <chr>  <chr> <dbl>    <dbl>    <dbl> <dbl> <dbl>
```

## 1	B42-p10	Boyd42	sil	cc	2	1.56	999	0.204	0.318
## 2	B42-p10	Boyd42	sil	cc	2	1.56	500	0.213	0.331
## 3	B42-p10	Boyd42	sil	cc	2	1.56	200	0.236	0.367
## 4	B42-p10	Boyd42	sil	cc	2	1.56	100	0.247	0.384
## 5	B42-p10	Boyd42	sil	cc	2	1.56	50	0.262	0.407
## 6	B42-p10	Boyd42	sil	cc	2	1.56	25	0.28	0.436

Figures

Data for each cell, no transformation

```
dat5 %>%
  # I don't think the water left after 500 cm ever comes into play (?)
  filter(press_cm != 999) %>%
  unite(site_name, sys_trt, col = "site_name") %>%
  ggplot(aes(press_cm, vtheta, color = cc_trt)) +
  geom_point(alpha = 0.5) +
  geom_line(alpha = 0.5, aes(group = code)) +
  #stat_summary(fun.y = mean, geom="line", size = 2) +
  #stat_summary(fun.data = "mean_se", size = 1) +
  facet_grid(site_name ~ cc_trt) +
  labs(x = "Pressure Applied (cm H2O)",
       y = "Volumetric Water Content (%)")
```

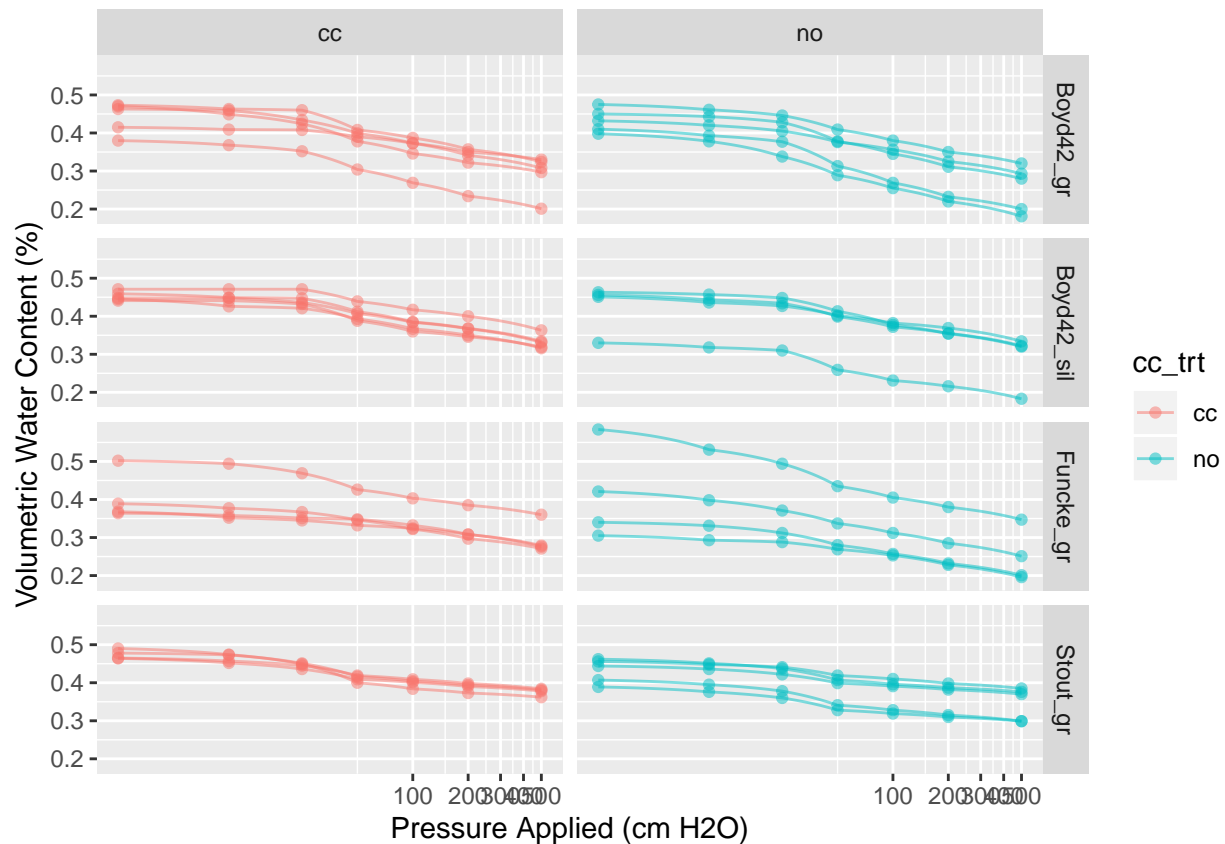


Data for each cell, log-scale

```

dat5 %>%
  # I don't think the water left after 500 cm ever comes into play (?)
  filter(press_cm != 999,
         press_cm != 0) %>%
  #mutate(press_cm2 = press_cm + 0.1) %>% #--add atmospheric pressure to every value so there isn't a 0
  unite(site_name, sys_trt, col = "site_name") %>%
  ggplot(aes(press_cm, vtheta, color = cc_trt)) +
  geom_point(alpha = 0.5) +
  geom_line(alpha = 0.5, aes(group = code)) +
  facet_grid(site_name ~ cc_trt) +
  labs(x = "Pressure Applied (cm H2O)",
       y = "Volumetric Water Content (%)") +
  coord_trans(x = "log10")

```



Data averaged for each treatment, no transformation

```

dat5 %>%
  # I don't think the water left after 500 cm ever comes into play (?)
  filter(press_cm != 999) %>%
  unite(site_name, sys_trt, col = "site_name") %>%
  ggplot(aes(press_cm, vtheta, color = cc_trt)) +
  stat_summary(fun.y = mean, geom="line", size = 2) +
  stat_summary(fun.data = "mean_se", size = 1) +
  facet_grid(. ~ site_name) +
  labs(x = "Pressure Applied (cm H2O)",
       y = "Volumetric Water Content (%)")

```

