ISCN3 visualization and report

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Contents

The International Soil Carbon Network version 3 data base (ISCN3) is available here. Currently the Layers data is ingestion and summarized below (work is underway to also bring in profile level data). Much of the data is from NRCS (Sept 2014 version of the soil characterization data base) and methods can be refered to in SSL (SoiL Survey Manual, R Burt) manual.

```
library(SoilDataR) #library(devtools); install_github("ktoddbrown/soilDataR")
library(ggplot2) #make pretty plots
library(plyr) #data management
library(knitr)

#mapping librarys to help with global/regional plots
library(ggmap)
library(maps)
```

```
##
## Attaching package: 'maps'
```

```
## The following object is masked from 'package:plyr':
##
##     ozone
```

```
library(mapdata)
library(fiftystater)
```

```
ISCN3 <- SoilDataR::processData_ISCN3(dir='../repoData/ISCN_3/')
```

```
## Warning: ISCN3 is a large data set and will take some time...
```

```
## Warning in processWorksheet(csvFile = sprintf("%s/Layers/
## ISCN_ALL_DATA_LAYER_C1_1-1.csv", : NAs introduced by coercion
```

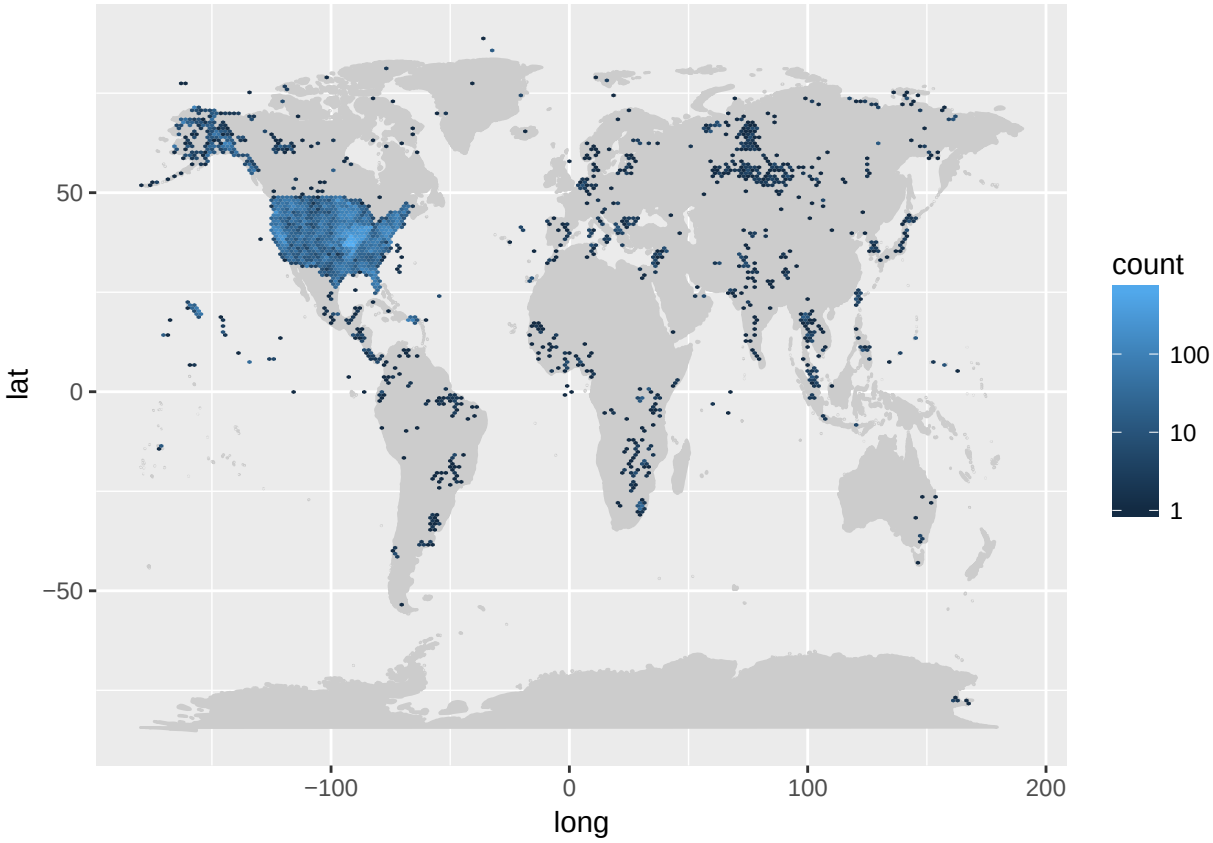
```
##  done!
```

Site locations

Lat-lon map

```
mapWorld <- borders("world", colour="gray80", fill="gray80") # create a layer of borders
#ggplot() + mapWorld
ggplot(unique(ISCN3$field[, c('lat', 'long')])) +
  mapWorld +
  geom_hex(aes(x=long, y=lat), bins=200) +
  scale_fill_gradient(trans='log10')
```

```
## Warning: Removed 1 rows containing non-finite values (stat_binhex).
```



Sites with states but no lat-lon

```
noLatLon <- unique(subset(ISCN3$field, is.na(lat+long))$fieldID)

stateCounts <- ddply(subset(ISCN3$field, is.na(lat+long)), c('state'),
                     summarize, count=length(unique(fieldID)))
```

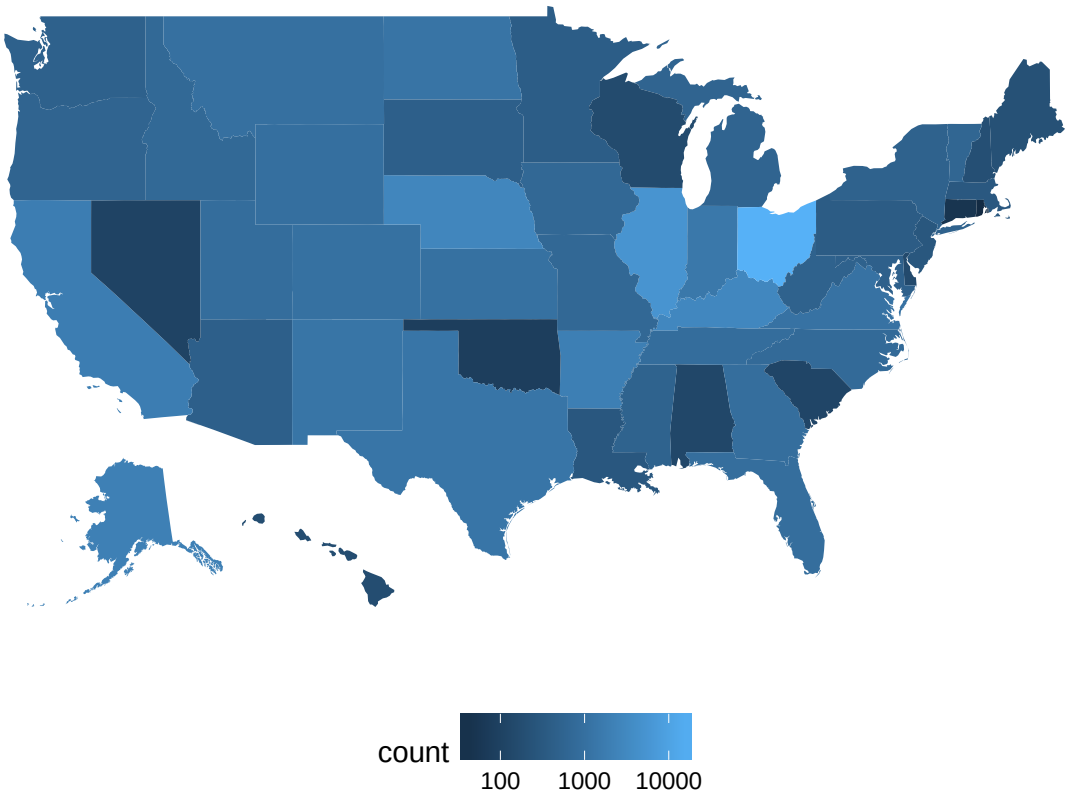
```
stateCounts$state <- tolower(stateCounts$state)

cat('Following are not considered states:\n')
```

```
## Following are not considered states:
```

```
kable(subset(stateCounts, ! state %in% fifty_states$id))
```

	state	count
1		4720
10	guam	6
15	kosrae	3
17	manicaland	17
18	midlands	6
24	northern mariana islands	14
26	pohnpei	2
27	puerto rico	404
31	unknown	3745
33	virgin islands	25
46	cataluna	2
62	'ajman	13
63	chiapas	6
64	national lab	748
65	tsumeb	29

```
stateCounts <- subset(stateCounts, state %in% fifty_states$id)

ggplot(stateCounts, aes(map_id = state)) +
  geom_map(aes(fill=count), map=fifty_states) +
  expand_limits(x = fifty_states$long, y = fifty_states$lat) +
  coord_map() +
  scale_x_continuous(breaks = NULL) +
  scale_y_continuous(breaks = NULL) +
  scale_fill_gradient(trans='log10') +
  labs(x = "", y = "") +
  theme(legend.position = "bottom",
        panel.background = element_blank())
```



Sites with country but no lat-lon

```
countryCounts <- ddply(subset(ISCN3$field, is.na(lat+long)), 'country',  summarize, count=length(unique
names(countryCounts)[1] <- 'region'
countryCounts$region <- as.character(countryCounts$region)
countryCounts$region[grepl('United States', countryCounts$region)] <- 'USA'

map.world <- map_data(map="world")

cat('These countries are unknown to the map\n')
```

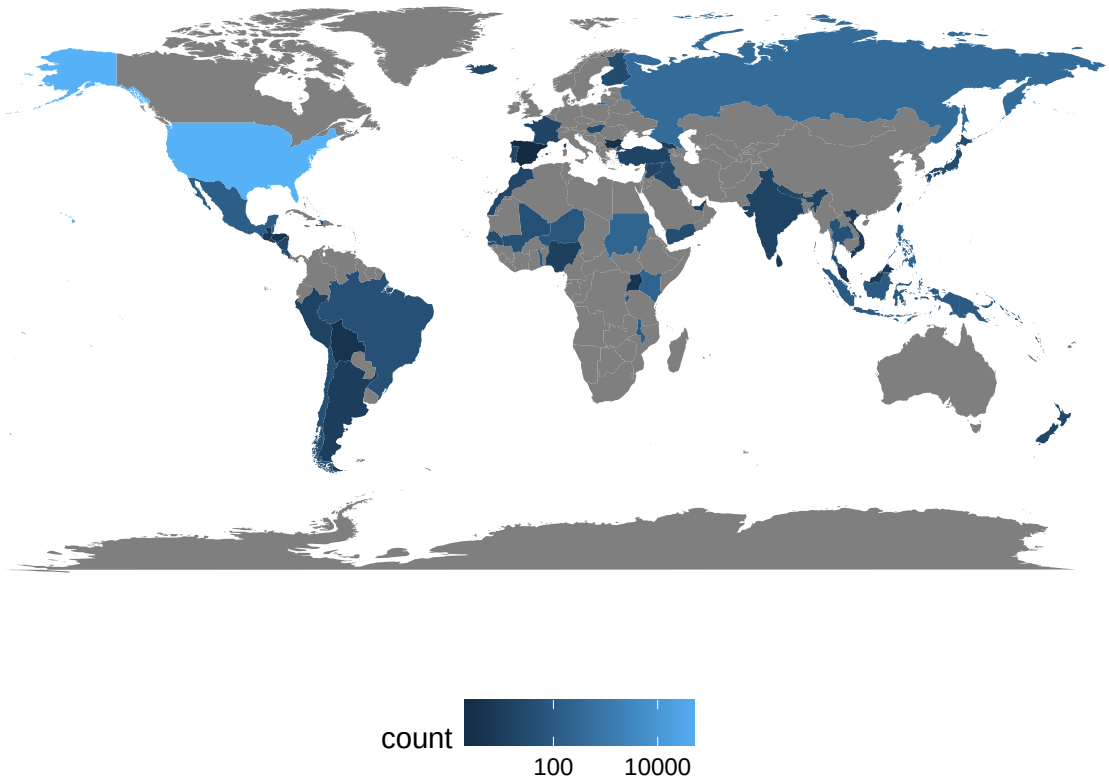
```
## These countries are unknown to the map
```

```
kable(subset(countryCounts, ! region %in% map.world$region))
```

	region	count
1		4720
6	Congo (Democratic Republic of the)	11
9	Federated States of Micronesia	11
17	Korea, Republic of	4
37	Unknown	2596
50	Korea, Democratic People's Republic of	67

```
missingCountries <- data.frame(region=setdiff(map.world$region, countryCounts$value), count=NA)
countryCounts <- rbind(countryCounts, missingCountries)
#map.world <- merge(map.world, countryCounts, all=TRUE)
```

```
ggplot(countryCounts, aes(map_id = region)) +
  geom_map(aes(fill=count), map=map.world) +
  expand_limits(x = map.world$long, y = map.world$lat) +
  coord_cartesian(xlim=c(-180,180), ylim=c(-90,90)) +
  scale_x_continuous(breaks = NULL) +
  scale_y_continuous(breaks = NULL) +
  scale_fill_gradient(trans='log10') +
  labs(x = "", y = "") +
  theme(legend.position = "bottom",
        panel.background = element_blank())
```



7316 sites with no known country nor lat-lon.

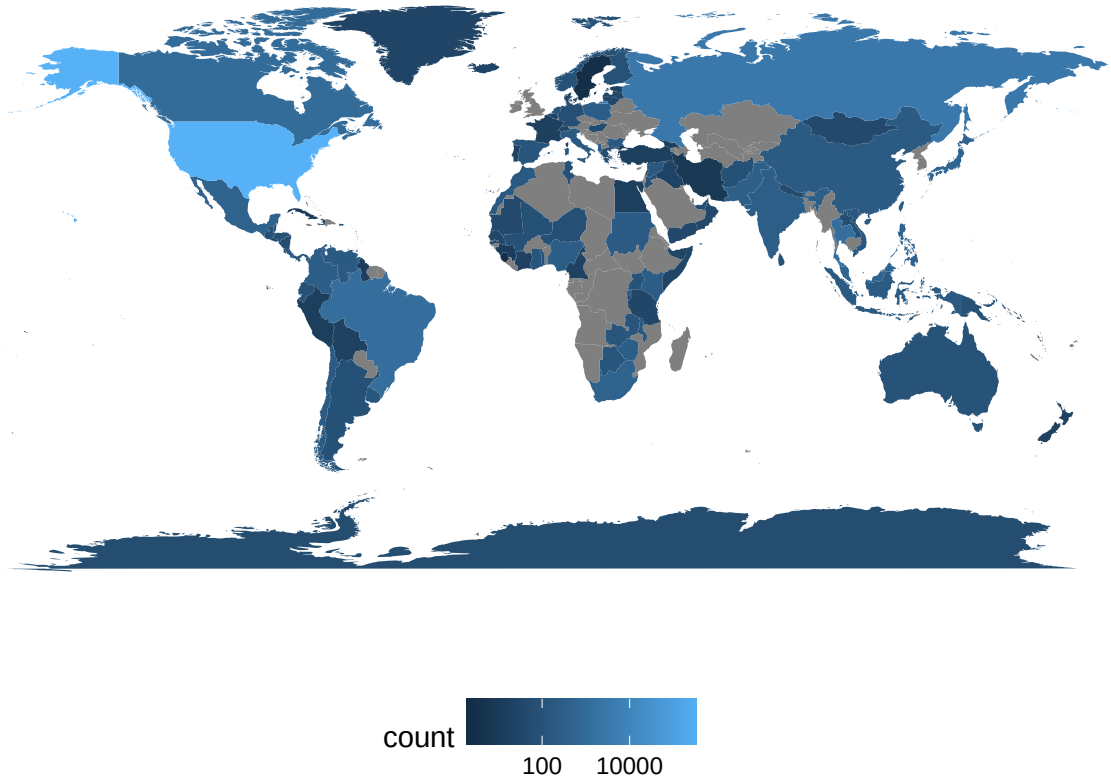
Site count by country map (include sites w/ lat-lon)

```
countryCounts <- ddply(ISCN3$field, 'country', summarize, count=length(unique(fieldID)))
names(countryCounts)[1] <- 'region'
countryCounts$region <- as.character(countryCounts$region)
countryCounts$region[grepl('United States', countryCounts$region)] <- 'USA'

map.world <- map_data(map="world")

missingCountries <- data.frame(region=setdiff(map.world$region, countryCounts$region), count=NA)
setdiff(countryCounts$region, map.world$region)
```

```
##  [1] ""
##  [2] "Congo (Democratic Republic of the)"
##  [3] "Dahomey"
```

```
##  [4] "Federated States of Micronesia"
##  [5] "Korea, Republic of"
##  [6] "Portuguese Guinea"
##  [7] "Tasmania"
##  [8] "Unknown"
##  [9] "Yugoslavia"
## [10] "Korea, Democratic People's Republic of"
```

```
countryCounts <- rbind(countryCounts, missingCountries)
#map.world <- merge(map.world, countryCounts, all=TRUE)
ggplot(countryCounts, aes(map_id = region)) +
  geom_map(aes(fill=count), map=map.world) +
  expand_limits(x = map.world$long, y = map.world$lat) +
  coord_cartesian(xlim=c(-180,180), ylim=c(-90,90)) +
  scale_x_continuous(breaks = NULL) +
  scale_y_continuous(breaks = NULL) +
  scale_fill_gradient(trans='log10') +
  labs(x = "", y = "") +
  theme(legend.position = "bottom",
        panel.background = element_blank())
```



Summary of measurements

The following variables are listed in

```
table(ISCN3$measurement$type)
```

```
##
```

```
##          13c          14c          15n           al     base_sum
##            1            1            1            3            1
##           bd           bs       bs_sum        c_tot           ca
##           27            1            1           59            1
##        caco3     cat_exch      cec_sum clay_tot_psa         ecec
##            1            1            1            1            1
##           fe            k          loi           mg           mn
##            3            1            9            1            3
##        n_tot           na           oc            p           ph
##            1            1           20            3            8
## sand_tot_psa silt_tot_psa          soc         wpg2
##            1            1          130            6
```

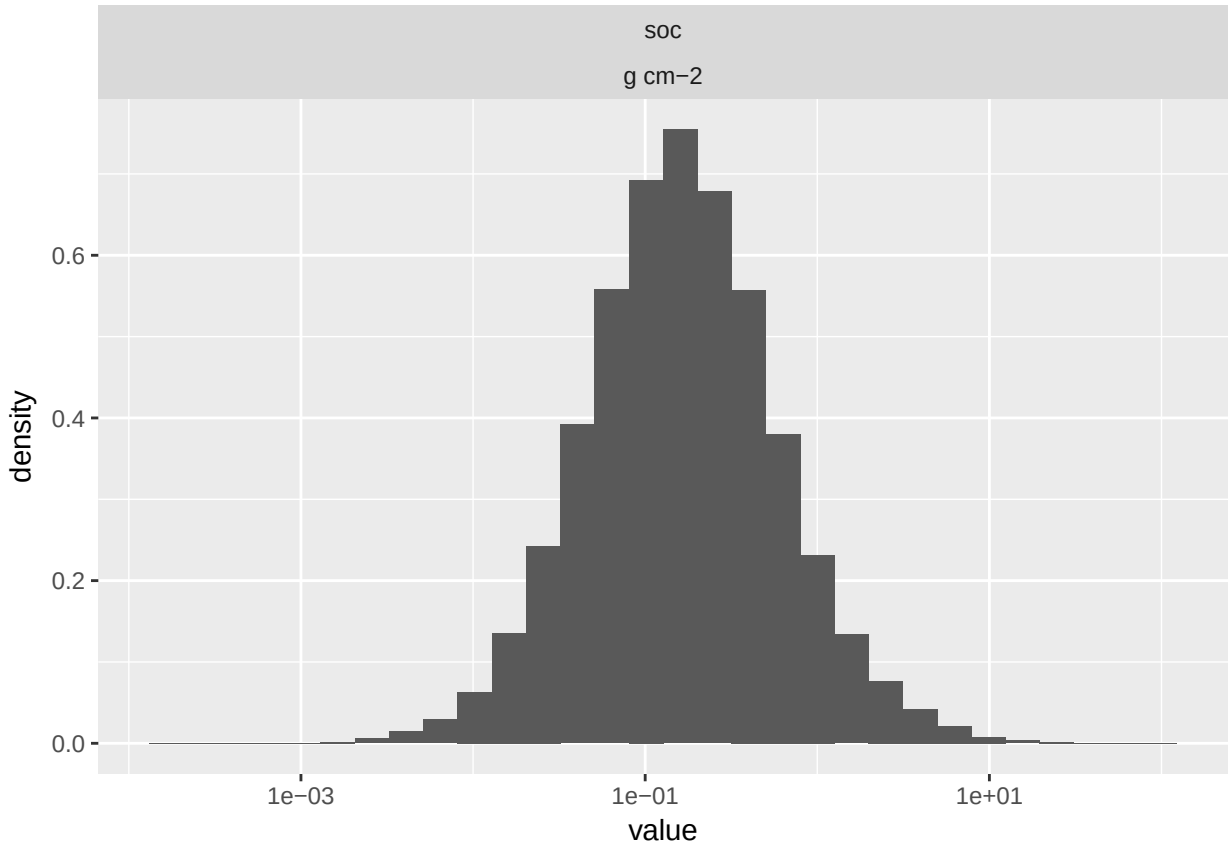
All measurements are on oven dry soils and in mass percent where percent noted.

Soil organic carbon stock

- *soc* calculated soil carbon stock of layer/profile

```
ggplot(merge(subset(ISCN3$sample, grepl('^soc', measurementID) & value > 0),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
  scale_x_log10() +
  facet_wrap(type~unit)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



```
summary(subset(ISCN3$sample, grepl('^soc', measurementID) & (value < 0)))
```

```
##               fieldID  measurementID     value                unit
##  GCPU* 5.Orge,abm :1   soc_01 :2     Min.   :-998   g cm-2       :2
##  GCPU* 5.Orgi,abm :1   13c_01 :0     1st Qu.:-998   %            :0
##  00015-1-1        :0   14c_01 :0     Median :-998   cmol H+ kg-1:0
##  00015-1-2        :0   15n_01 :0     Mean   :-998   g cm-3       :0
##  00015-1-3        :0   al_01  :0     3rd Qu.:-998   meq 100g-1   :0
##  00015-1-4        :0   al_02  :0     Max.   :-998   percent      :0
##  (Other)          :0   (Other):0                    (Other)      :0
```

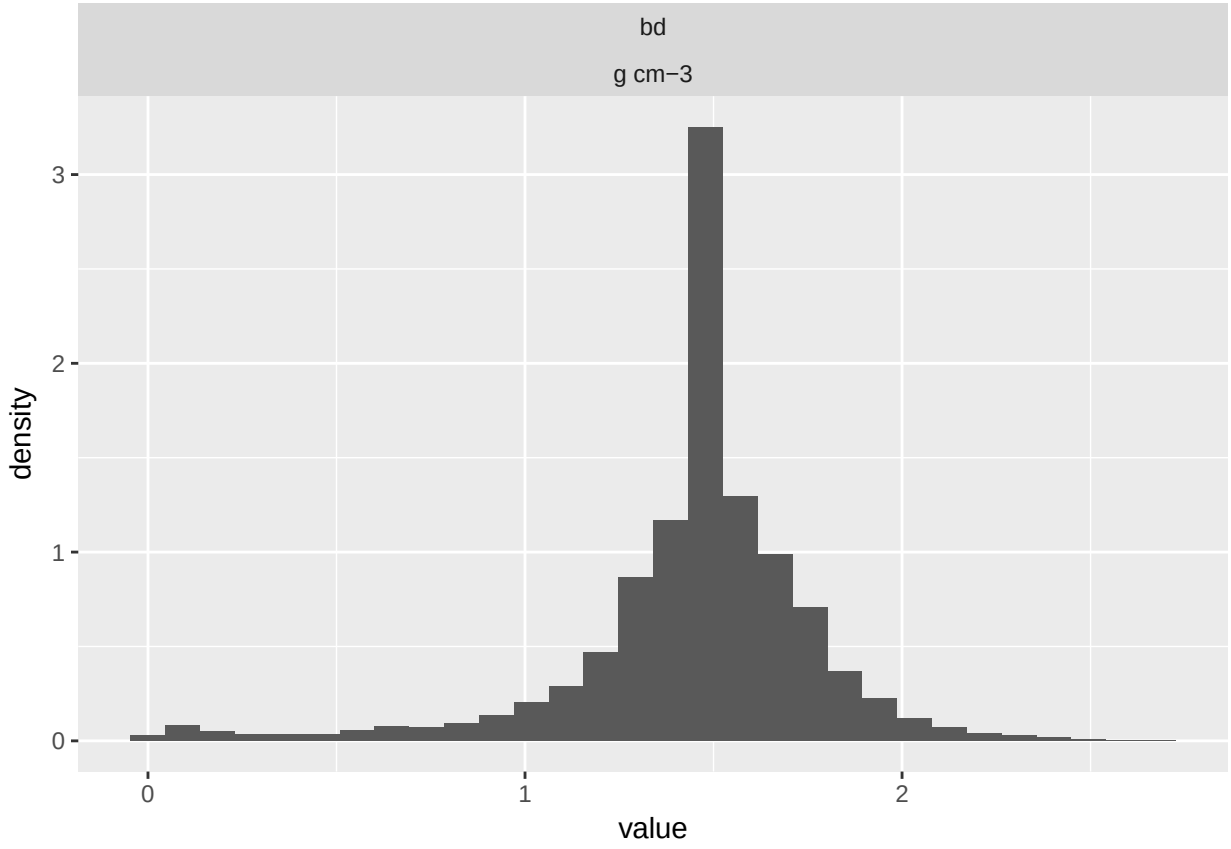
Bulk density

- *bd_samp* is the bulk density of the <2mm (fine earth) fraction, in which the mass is expressed on an oven-dry (105 deg) basis. This is the best form of Db for the most uses.
- *bd_tot* is the whole soil bulk density, includes fine earth fraction and rocks.
- *bd_whole* is the bulk density of the whole soil (coarse frags, if present, included), expressed on a 1/3 bar moisture content (a little drier than typical field moist, but not oven-dry). It is collected by the clod method. For a variety of reasons, including the presence of water, possible coarse frags, and the tendency of clods to cleave along pore spaces, this will overestimate Db relative to bd_samp. The SSL standard method here is 4A1d if you want to look it up.
- *bd_other* is, for data contributed by NRCS SSL, the bulk density of the fine earth fraction, but expressed on a field moist condition. It is collected by a volumetric core, but given the presence of some water, will probably usually be an overestimate relative to the bd_samp. This corresponds to the SSL standard method 4A3a. For datasets contributed by sources other than NRCS, bd_other is anyone's guess. Hopefully specified in the associated bd_method variable, or the metadata sheet for that dataset.

Reasonable BD minimum 0.03 or lower and maximum 2.7 g cm-3.

```
plot.df <- merge(subset(ISCN3$sample, grepl('^bd_', measurementID) &
                        value > 0 & value < 2.7), ISCN3$measurement)
ggplot(plot.df) +
  geom_histogram(aes(x=value, y=..density..)) +
  #scale_x_log10() +
  facet_wrap(type~unit)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
summary(subset(ISCN3$sample, grepl('^bd_', measurementID) &
                         (value <= 0 | value > 2.7)))
```

```
##       fieldID   measurementID     value                   unit
##  00P02751 : 2   bd_20  :17    Min.   :-998.00   g cm-3      :48
##  BF84-1-F : 2   bd_21  :10    1st Qu.:   0.00   %           : 0
##  FP3C_4_17: 2   bd_27  : 8    Median :   0.00   cmol H+ kg-1: 0
##  HCCN 5.47: 2   bd_15  : 5    Mean   : -12.85   g cm-2      : 0
##  TFBC 6.9 : 2   bd_07  : 2    3rd Qu.:   3.62   meq 100g-1  : 0
##  TFBC 7.7 : 2   bd_25  : 2    Max.   :1230.00   percent     : 0
##  (Other)  :36   (Other): 4                      (Other)     : 0
```

```
nrow(plot.df)
```

```
## [1] 413921
```

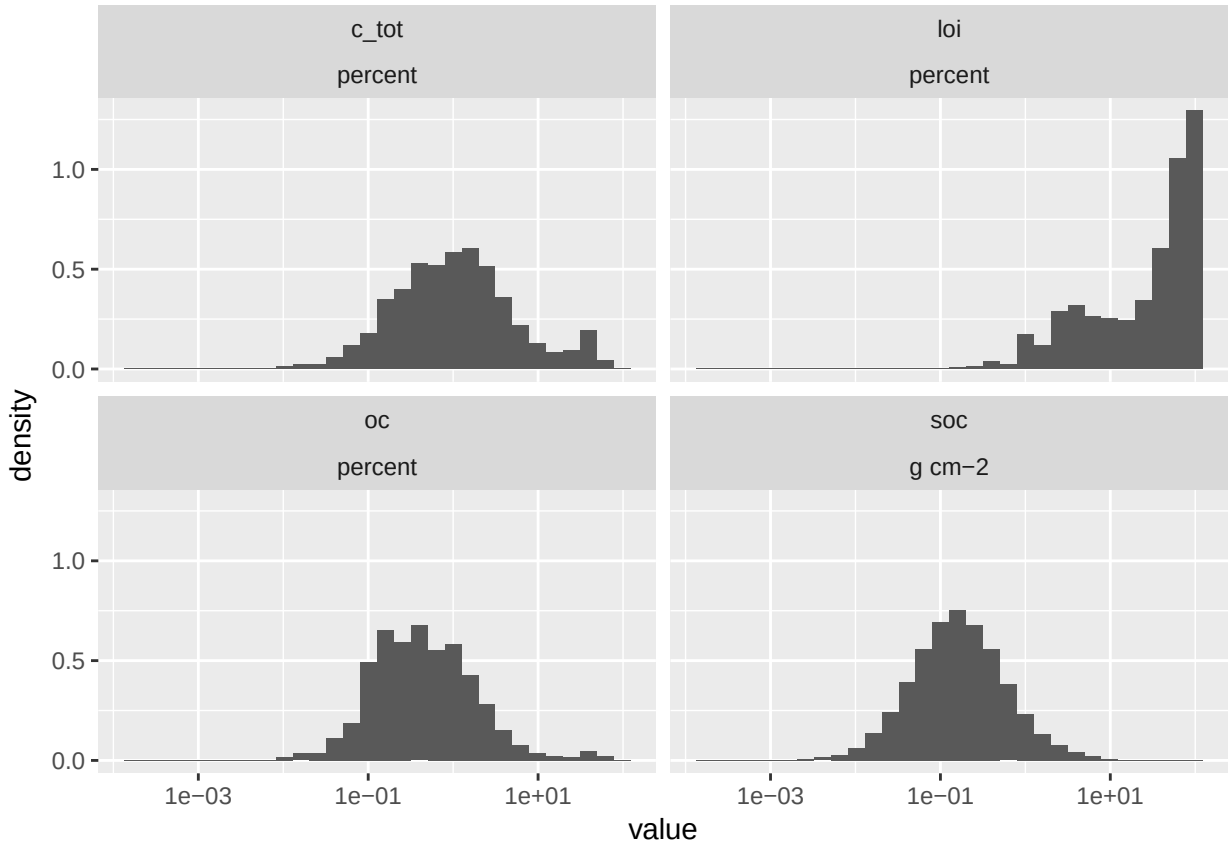
Number of samples for BD 413921.

Carbon (mostly organic)

- *c_tot* carbon concentration in a dry combustion analysis, sometimes include inorganic carbon
- *oc* organic carbon concentration from either acidified (to remove carbonates) and then ran on dry combustion analyizer, or (more common) wet oxidation 'Walkly-Black' dicromate oxidation, chemical digest for organic carbon; old methods 1930-1990s tends to over estimate it in certain soils. pH below 7 c_tot generally == oc otherwise you might have carbonates
- *loi* loss on ignition uncorrected for C:organics, generally close to half for O-horizon, C about a third of the LOI for lower horizons.

```
ggplot(merge(subset(ISCN3$sample, grepl('^(c_|oc|loi|soc)', measurementID) & value > 0),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
  scale_x_log10() +
  facet_wrap(type~unit)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
summary(subset(ISCN3$sample, grepl('^(c_|oc|loi)', measurementID) & (value < 0)))
```

```
##       fieldID  measurementID     value                  unit
##  02N05882 :1   loi_08 :1     Min.   :-102.00   percent     :2
##  72C00098 :1   oc_19  :1     1st Qu.: -76.53   %           :0
##  00015-1-1:0   13c_01 :0     Median : -51.07   cmol H+ kg-1:0
##  00015-1-2:0   14c_01 :0     Mean   : -51.07   g cm-2      :0
##  00015-1-3:0   15n_01 :0     3rd Qu.: -25.61   g cm-3      :0
##  00015-1-4:0   al_01  :0     Max.   :  -0.14   meq 100g-1  :0
##  (Other)  :0   (Other):0                       (Other)     :0
```

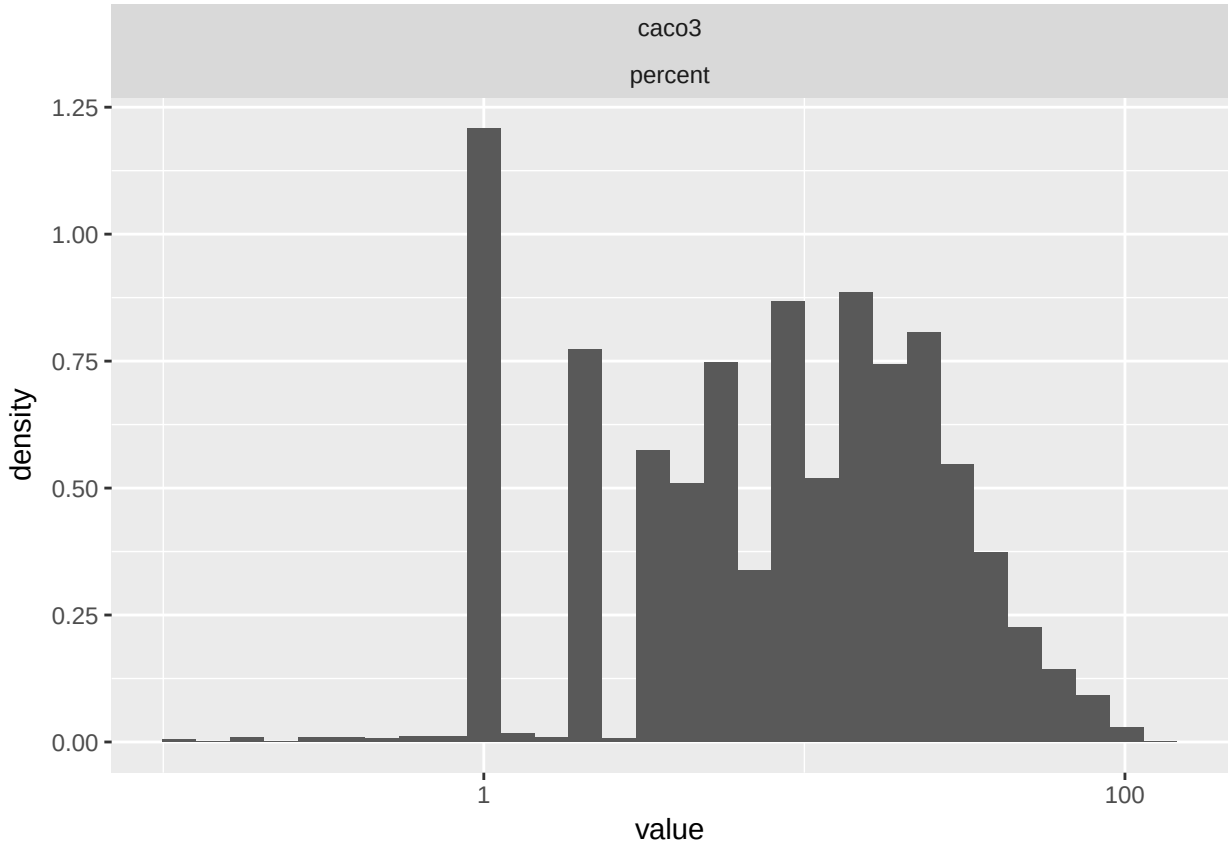
Carbon (inorganic)

Percent inorganic carbon in a sample.

```
ggplot(merge(subset(ISCN3$sample, grepl('^caco3', measurementID) & value > 0),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
```

```
  scale_x_log10() +
  facet_wrap(type~unit)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
summary(subset(ISCN3$sample, grepl('^caco3', measurementID) & (value <= 0)))
```

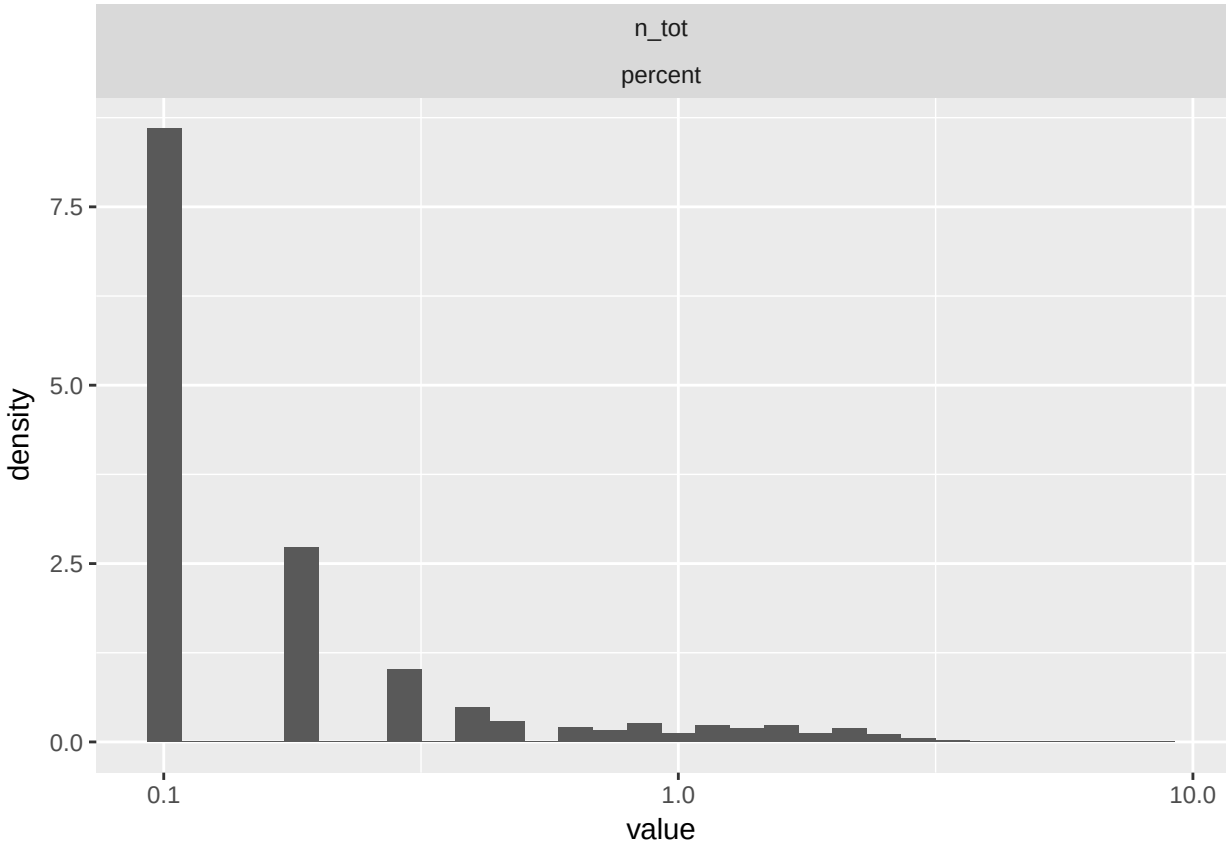
```
##      fieldID       measurementID       value             unit
##  00P00005:    1   caco3_01:25036   Min.   :0   percent     :25036
##  00P00006:    1   13c_01  :    0   1st Qu.:0   %           :    0
##  00P00007:    1   14c_01  :    0   Median :0   cmol H+ kg-1:    0
##  00P00014:    1   15n_01  :    0   Mean   :0   g cm-2      :    0
##  00P00015:    1   al_01   :    0   3rd Qu.:0   g cm-3      :    0
##  00P00016:    1   al_02   :    0   Max.   :0   meq 100g-1  :    0
##  (Other) :25030   (Other) :    0               (Other)     :    0
```

Nitrogen

- *n_tot* most N is organic mass percent dry weight, probably estimated by dry combustion (Dumas methods), sometimes also Kjeldahl digestion converts N to nitrate and then measures nitrate.

```
ggplot(merge(subset(ISCN3$sample, grepl('^n_', measurementID) & value > 0),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
  scale_x_log10() +
  facet_wrap(type~unit)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

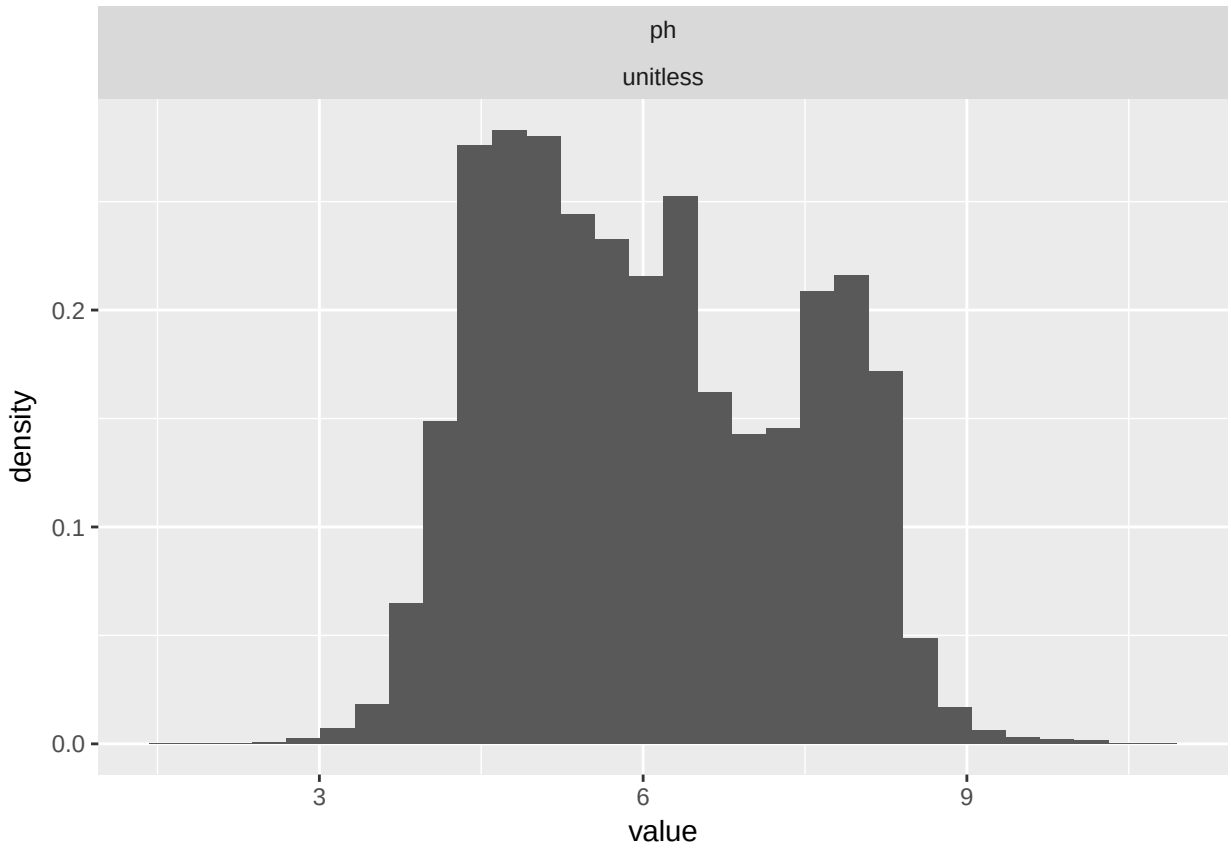


pH

- *ph_cacl* 1:2 Soil-CaCl2 suspension
- *ph_h2o* 1:1 Soil-water suspension
- *ph_other* non-standard catch all

```
ggplot(merge(subset(ISCN3$sample, grepl('^ph_', measurementID) &
                      value > 1.5 & value < 11),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
  #scale_x_log10() +
  facet_wrap(type~unit)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
summary(subset(ISCN3$sample, grepl('^ph_', measurementID) & (value <= 1.5 | value > 11)))
```

```
##       fieldID   measurementID     value                  unit
##  MU002991 : 2   ph_03  :23    Min.   :-7.700   unitless    :40
##  MU008274 : 2   ph_07  : 7    1st Qu.: 0.000   %           : 0
##  4010002.1: 1   ph_04  : 6    Median : 0.100   cmol H+ kg-1: 0
##  4010002.2: 1   ph_01  : 4    Mean   : 5.303   g cm-2      : 0
##  4010002.3: 1   13c_01 : 0    3rd Qu.: 0.700   g cm-3      : 0
##  4010002.4: 1   14c_01 : 0    Max.   :87.100   meq 100g-1  : 0
##  (Other)  :32   (Other): 0                     (Other)     : 0
```

```
#d_ply(subset(ISCN3$sample, grepl('^ph_', measurementID) & (value <= 1.5 | value > 11)),
#      'measurementID', function(xx){print(summary(xx))})
```

Sand, clay, slit, and percent coarse fragement content

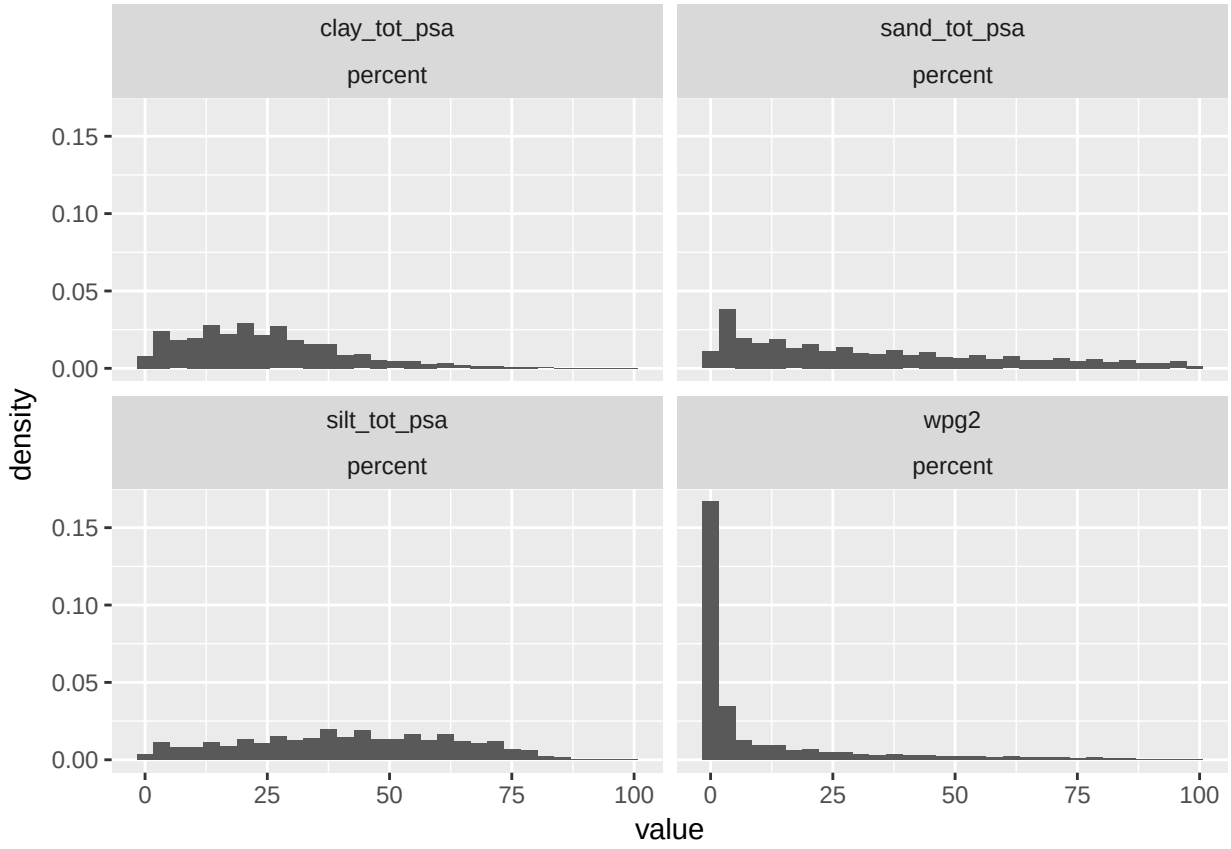
Partical size analysis. Methods might not be completely annotated.

- *wpg2* coarse fragment (>2mm) content by weight
- *sand_tot_psa* percentage of sand
- *clay_tot_psa* percentage of clay
- *silt_tot_psa* percentage of silt

```
ggplot(merge(subset(ISCN3$sample, grepl('(wpg|tot_psa)', measurementID) &
                      value < 100 & value >= 0 ),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
```

```
  #scale_x_log10() +
  facet_wrap(type~unit)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
summary(subset(ISCN3$sample, grepl('(wpg|tot_psa)', measurementID) &
                 (value < 0 | value > 100)))
```

```
##      fieldID          measurementID     value                  unit
##  40A40506: 2   wpg2_01        :21   Min.   : -62.0   percent     :42
##  04N00472: 1   silt_tot_psa_01:11   1st Qu.:  -2.0   %           : 0
##  04N00476: 1   clay_tot_psa_01: 9   Median : 101.0   cmol H+ kg-1: 0
##  06N00201: 1   sand_tot_psa_01: 1   Mean   : 318.0   g cm-2      : 0
##  06N04190: 1   13c_01         : 0   3rd Qu.: 121.2   g cm-3      : 0
##  06N04193: 1   14c_01         : 0   Max.   :4229.0   meq 100g-1  : 0
##  (Other) :35   (Other)        : 0                    (Other)     : 0
```

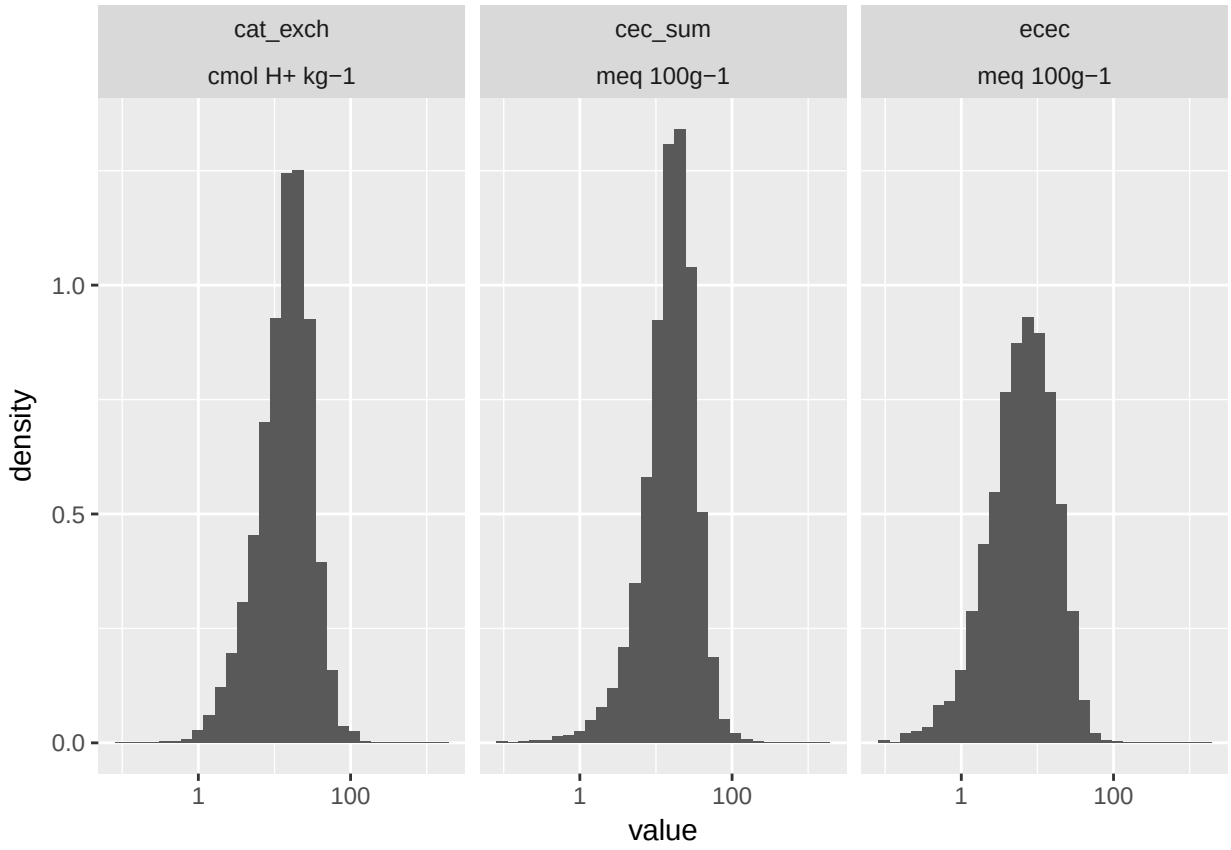
Cation exchange capasity and base saturation

- *cat_exch* cation exchange capasity [[TODO: Ask Luke N about this variable]]
- *cec_sum* cation exchange capsity (sum of cations)
- *ecec* effective cation exchange capsity
- *bs* base saturation (NH4OAc at pH 7.0)
- *bs_sum* base saturation (sum of cations at pH 8.2)

```
ggplot(merge(subset(ISCN3$sample, grepl('(cat_exch|cec_sum|ecec)', measurementID)& (value > 0)),
             ISCN3$measurement)) +
```

```
  geom_histogram(aes(x=value, y=..density..)) +
  scale_x_log10() +
  facet_wrap(type~unit)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

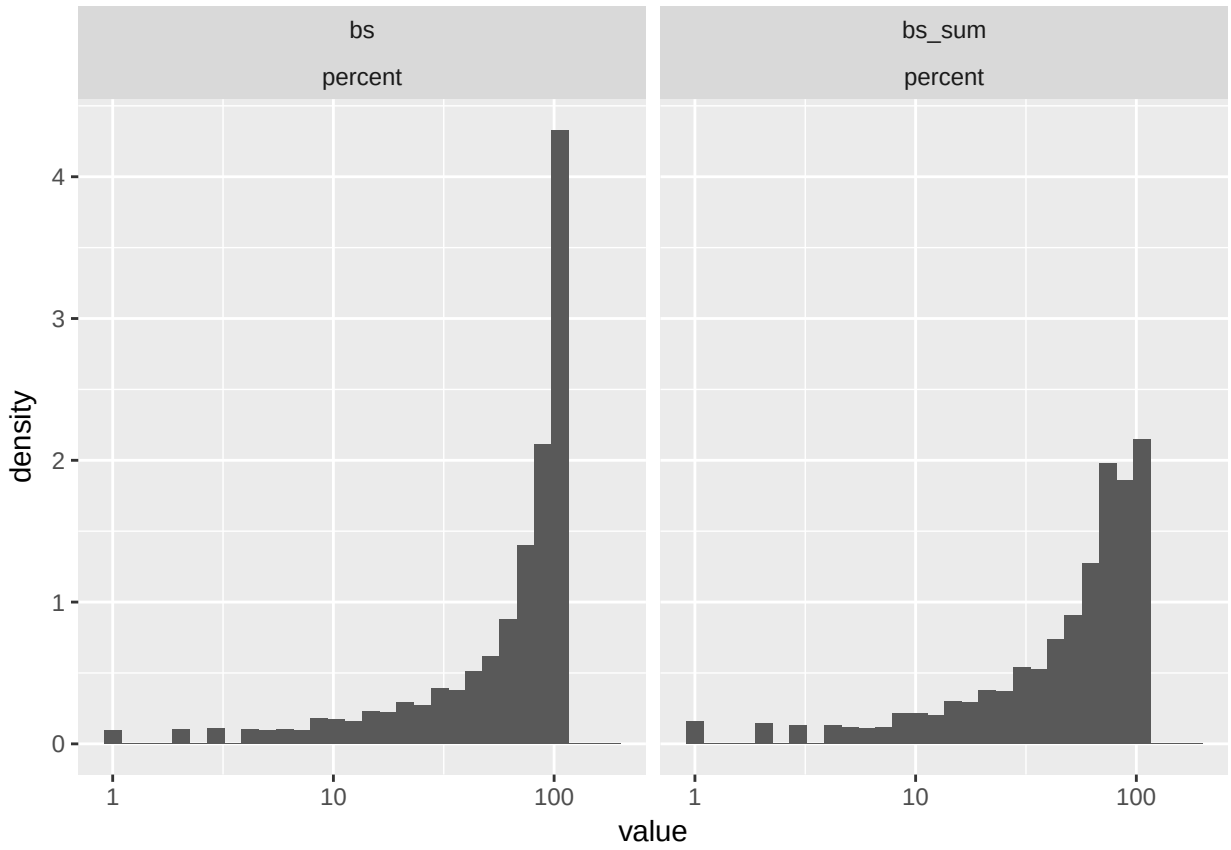



```
summary(subset(ISCN3$sample, grepl('(cat_exch|cec_sum|ecec)', measurementID) & (value <= 0)))
```

```
##      fieldID        measurementID     value             unit
##  MU000161:  2   ecec_01    :382   Min.   :0   meq 100g-1  :649
##  MU000162:  2   cec_sum_01 :267   1st Qu.:0   cmol H+ kg-1:  1
##  MU000163:  2   cat_exch_01:  1   Median :0   %           :  0
##  MU000502:  2   13c_01     :  0   Mean   :0   g cm-2      :  0
##  MU000599:  2   14c_01     :  0   3rd Qu.:0   g cm-3      :  0
##  MU001641:  2   15n_01     :  0   Max.   :0   percent     :  0
##  (Other) :638   (Other)    :  0               (Other)     :  0
```

```
ggplot(merge(subset(ISCN3$sample, grepl('(bs|bs_sum)', measurementID)& (value > 0)),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
  scale_x_log10() +
  facet_wrap(type~unit)
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
summary(subset(ISCN3$sample, grepl('(bs|bs_sum)', measurementID) & (value <= 0)))
```

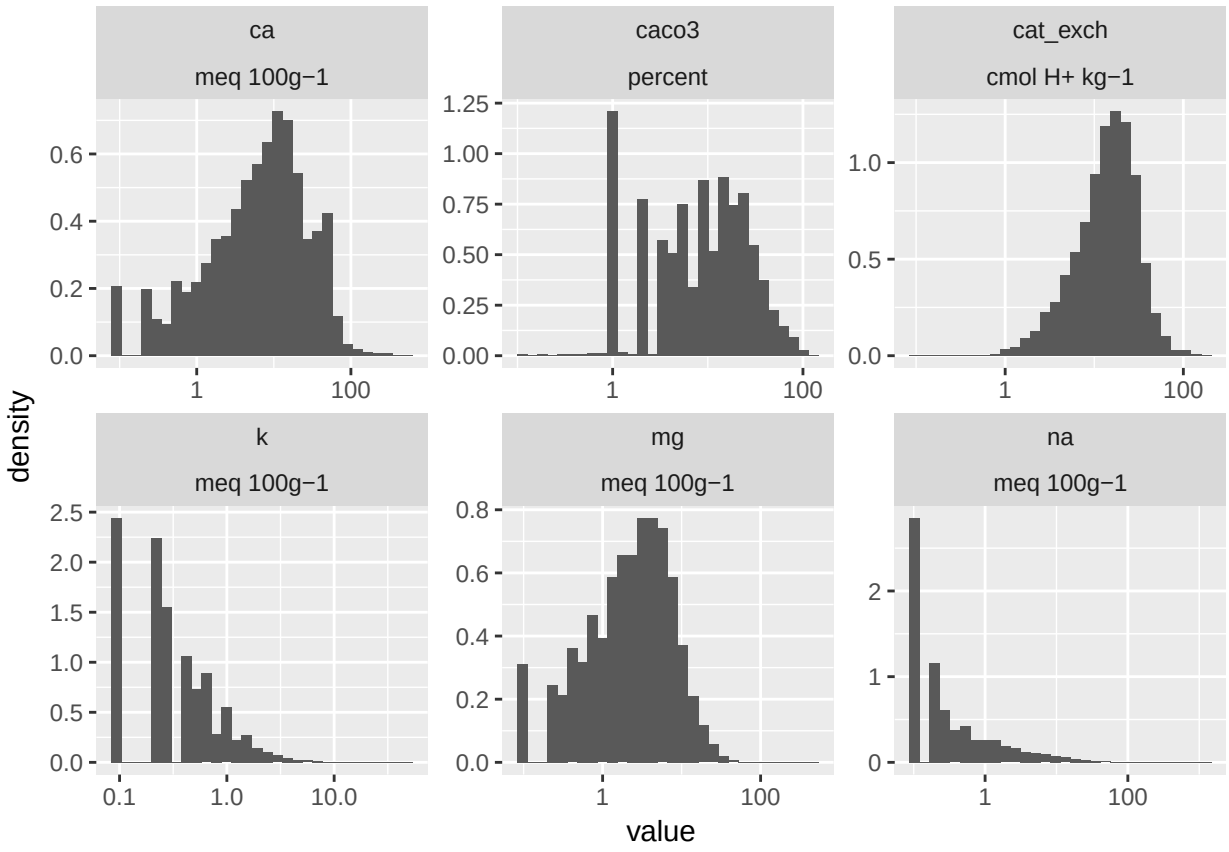
```
##      fieldID       measurementID      value             unit
##  00P07181:   2   bs_sum_01:1609   Min.   :0   percent     :2212
##  00P07182:   2   bs_01    : 603   1st Qu.:0   %           :   0
##  00P07831:   2   13c_01   :   0   Median :0   cmol H+ kg-1:   0
##  01N05842:   2   14c_01   :   0   Mean   :0   g cm-2      :   0
##  01N05843:   2   15n_01   :   0   3rd Qu.:0   g cm-3      :   0
##  01N05844:   2   al_01    :   0   Max.   :0   meq 100g-1  :   0
##  (Other) :2200   (Other)  :   0               (Other)     :   0
```

Extractable bases

- *ca_al* TODO Luke N, what is this??
- *ca_ext* calcium extractable (SSL: NH4OAc extractable)
- *k_ext* potassium extractable (SSL: NH4OAc extractable)
- *mg_ext* magnesium extractable (SSL: NH4OAc extractable)
- *na_ext* sodium extractable (SSL: NH4OAc extractable)
- *base_sum* sum of NH4OAc extractable bases

```
ggplot(merge(subset(ISCN3$sample, grepl('(ca|k|mg|na)', measurementID) & value > 0),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
  scale_x_log10() +
  facet_wrap(type~unit, scales='free')
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
summary(subset(ISCN3$sample, grepl('(ca|k|mg|na)', measurementID) & (value <= 0)))
```

```
##      fieldID           measurementID       value
##  05N04528:     5   na_01      :87848   Min.   :-7.0e-01
##  06N03497:     5   k_01       :27763   1st Qu.: 0.0e+00
##  07N01837:     5   caco3_01   :25036   Median : 0.0e+00
##  07N01843:     5   mg_01      :12471   Mean   :-4.9e-06
##  08N00509:     5   ca_01      : 8912   3rd Qu.: 0.0e+00
##  08N01184:     5   cat_exch_01:    1   Max.   : 0.0e+00
##  (Other) :162001   (Other)    :    0
##            unit
##  meq 100g-1  :136994
##  percent     : 25036
##  cmol H+ kg-1:     1
##  %           :     0
##  g cm-2      :     0
##  g cm-3      :     0
##  (Other)     :     0
```

Metal (Al, Fe, Mn) extracts

For ISCN3 this is only for NRCS data.

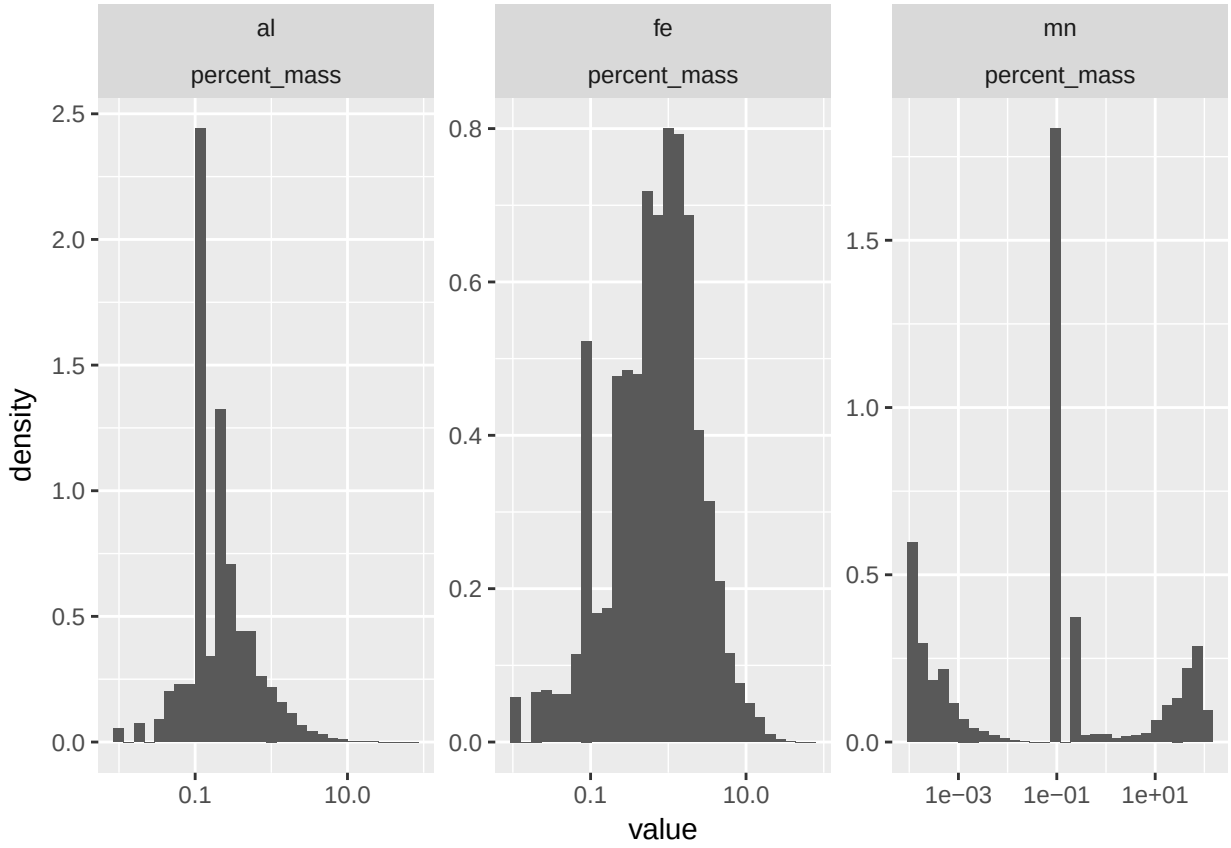
- *_dith* Dithionite citrate extractable
- *_ox* Oxalate extractable
- *al_other* and *fe_other* Sodium phyrophospate extractable
- *mn_other* KCl extractable

```
ggplot(merge(subset(ISCN3$sample,
                    grepl('^(al|fe|mn)_', measurementID) &
                      (value <= 100 & value >= 0)),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
  scale_x_log10() +
  facet_wrap(type~unit, scales='free')
```

```
## Warning: Transformation introduced infinite values in continuous x-axis
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
## Warning: Removed 101203 rows containing non-finite values (stat_bin).
```




```
summary(subset(ISCN3$sample, grepl('^(al|fe|mn)_', measurementID) &
                      !grepl('ext', measurementID) & (value < 0 | value > 100)))
```

```
##      fieldID      measurementID       value                 unit
##  95Z01392:    3   mn_03  :27180   Min.   :  100.1   percent_mass:27210
##  95Z01393:    3   al_03  :   14   1st Qu.:  209.5   %           :    0
##  95Z01395:    3   fe_03  :   14   Median :  372.7   cmol H+ kg-1:    0
##  95Z01396:    3   fe_01  :    2   Mean   :  590.1   g cm-2      :    0
##  95Z01397:    3   13c_01 :    0   3rd Qu.:  678.4   g cm-3      :    0
##  95Z01398:    3   14c_01 :    0   Max.   :35481.6   meq 100g-1  :    0
##  (Other) :27192   (Other):    0                     (Other)     :    0
```

Phosphorus

- *p_bray* bray-1 extractable
- *p_ox* oxalate extractable
- *p_other* mehlich3 extractable

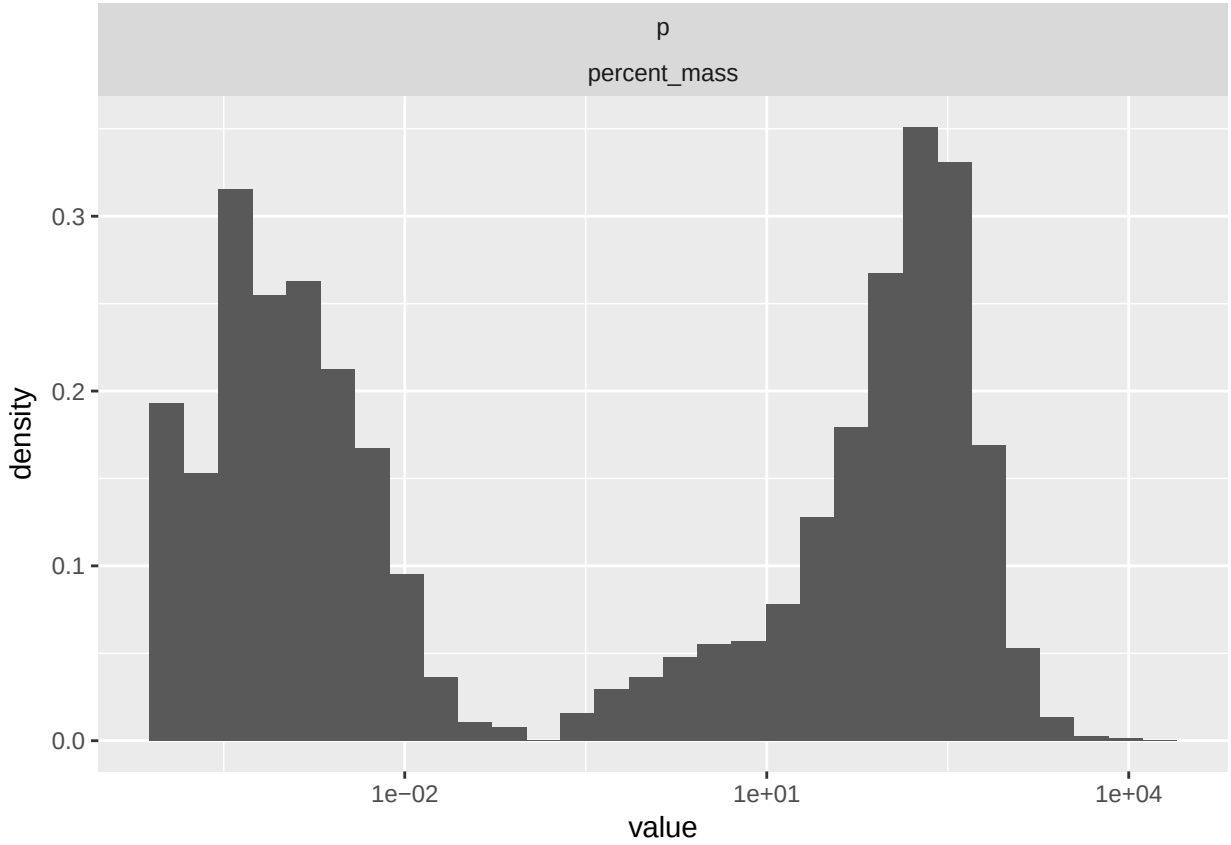
```
ggplot(merge(subset(ISCN3$sample, grepl('^p_', measurementID)),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
  scale_x_log10() +
  facet_wrap(type~unit, scales='free')
```

```
## Warning in self$trans$transform(x): NaNs produced
```

```
## Warning: Transformation introduced infinite values in continuous x-axis
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

```
## Warning: Removed 7887 rows containing non-finite values (stat_bin).
```



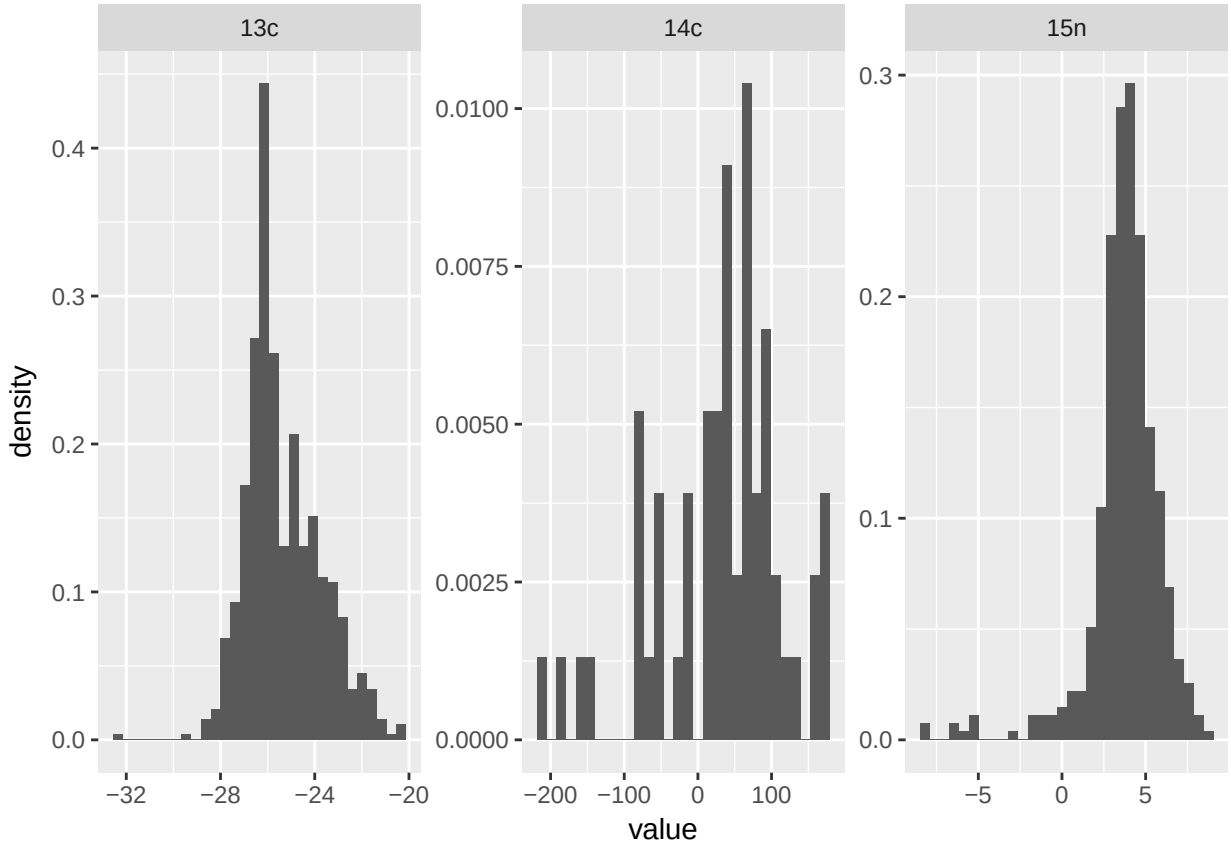

```
summary(subset(ISCN3$sample, grepl('^p_', measurementID) & (value > 100 | value < 0)))
```

```
##      fieldID      measurementID       value                 unit
##  02N00030:    2   p_03   :18254   Min.   :   -0.2   percent_mass:18544
##  02N00031:    2   p_02   :  290   1st Qu.:  176.8   %           :    0
##  02N01473:    2   13c_01 :    0   Median :  277.4   cmol H+ kg-1:    0
##  02N03345:    2   14c_01 :    0   Mean   :  418.2   g cm-2      :    0
##  02N03354:    2   15n_01 :    0   3rd Qu.:  468.6   g cm-3      :    0
##  03N02430:    2   al_01  :    0   Max.   :16926.4   meq 100g-1  :    0
##  (Other) :18532   (Other):    0                     (Other)     :    0
```

Isotope

```
#15n          13c          14c
ggplot(merge(subset(ISCN3$sample, grepl('^1[345]', measurementID)),
             ISCN3$measurement)) +
  geom_histogram(aes(x=value, y=..density..)) +
  #scale_x_log10() +
  facet_wrap(~type, scales='free')
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
summary(subset(ISCN3$sample, grepl('^1[345]', measurementID)))
```

```
##              fieldID     measurementID     value
##  BCPR 1.10 m,ab  :   3   13c_01 :701   Min.   :-208.90
##  BCPR 1.100 m,ab :   3   15n_01 :474   1st Qu.: -26.00
##  BCPR 1.20 m,ab  :   3   14c_01 : 58   Median : -23.46
##  BCPR 1.40 m,ab  :   3   al_01  :  0   Mean   : -11.53
##  BCPR 1.5 m, ab  :   3   al_02  :  0   3rd Qu.:   3.68
##  BCPR 1.60 m,ab  :   3   al_03  :  0   Max.   : 175.90
##  (Other)         :1215   (Other):  0
##             unit
##  %           :1233
##  cmol H+ kg-1:   0
##  g cm-2      :   0
##  g cm-3      :   0
##  meq 100g-1  :   0
```

```
##  percent     :   0
##  (Other)     :   0
```