Soil texture class transforms

This R notebook provides the code used to transform the soil textural class data presented in the following two studies from their national textural class systems (ASNIE and AU) to the USDA system.

> Richer-de-Forges, A. C., Arrouays, D., Chen, S., Dobarco, M. R., Libohova, Z., Roudier, P., ... & Bourennane, H. (2022). Hand-feel soil texture and particle-size distribution in central France. Relationships and implications. Catena, 213, 106155.
>
> Minasny, B., McBratney, A. B., Field, D. J., Tranter, G., McKenzie, N. J., & Brough, D. M. (2007). Relationships between field texture and particle-size distribution in Australia and their implications. Soil Research, 45(6), 428-437.

Load packages

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
##
##     filter, lag
```

```
## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(soiltexture)
```

Create point grid within soil textural triangle. This creates a point for every possible particle size class combination (e.g., [sand=22,silt=10,clay=68])

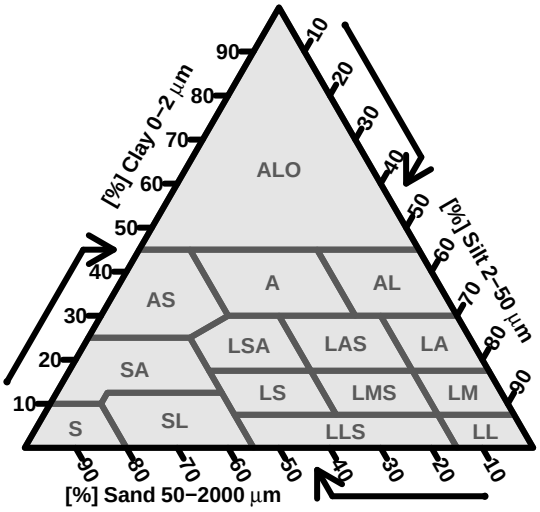
```
sand <- seq(0, 100, 1)
clay <- seq(0, 100, 1)
txt <-  expand.grid(x = sand, y = clay)
txt <- txt %>% rowwise() %>% mutate(silt = (100 - (x + y))) %>% ungroup() %>% purrr::set_names("SAND",
```

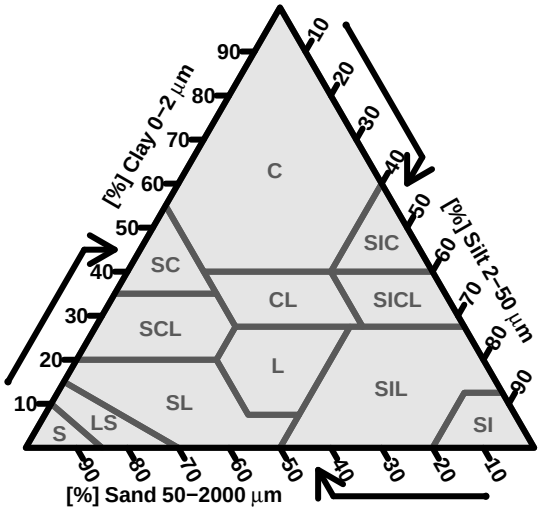
Transform AISNE textural class data to USDA textural class data

Plot Aisne and USDA texture triangles

```
old.par <- par(no.readonly=T)
par("mfcol" = c(1,2),"mfrow"=c(1,2))
TT.plot(class.sys = "FR.AISNE.TT",main = "Texture triangle: Aisne (FR)", cex=0.5,cex.axis = 0.7, cex.la
TT.plot(class.sys = "USDA-NCSS.TT",main = "Texture triangle: USDA", cex=0.5,cex.axis = 0.7, cex.lab = 0
```

Texture triangle: Aisne (FR) Texture triangle: USDA

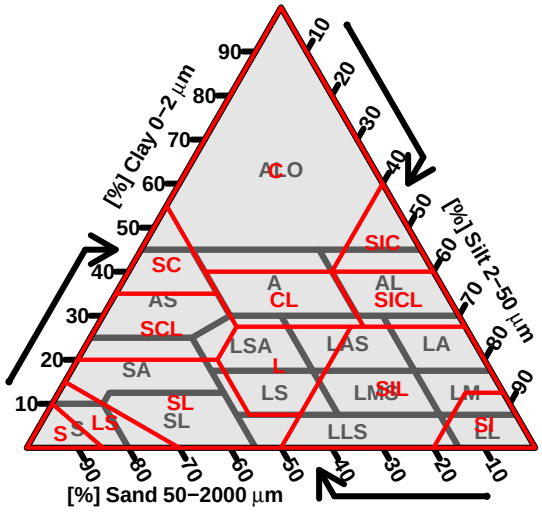




Overlay AISNE and USDA

```
geo <- TT.plot(class.sys = "FR.AISNE.TT",main = "Soil texture data", cex=0.5,cex.axis = 0.7, cex.lab = 0
TT.classes(
geo = geo,
class.sys = "USDA-NCSS.TT",
# Additional "graphical" options
class.line.col = "red",
class.lab.col = "red",
lwd.axis = 2, cex.lab = 0.7
)
```

Soil texture data



Assign each point to its corresponding AISNE class and USDA class

```
AISNE <-  txt %>% rowwise() %>% mutate(txt = TT.points.in.classes(
tri.data = data.frame(SAND, CLAY, SILT),
class.sys = "FR.AISNE.TT", PiC.type = "t", collapse=",")) %>% ungroup()
#extract only first texture label
AISNE <-  AISNE %>% rowwise() %>% mutate(AISNE = strsplit(txt, "[,]")[[1]][1]) %>% ungroup() %>% as.data
AISNE <-  AISNE %>% rowwise() %>% mutate(txt = TT.points.in.classes(
tri.data = data.frame(SAND, CLAY, SILT),
class.sys = "USDA-NCSS.TT", PiC.type = "t", collapse=",")) %>% ungroup()
#extract only first texture label
AISNE <-  AISNE %>% rowwise() %>% mutate(USDA = strsplit(txt, "[,]")[[1]][1]) %>% ungroup() %>% as.data
AISNE <-  AISNE %>% dplyr::select(-c(txt))
```

Load in Producer accuracies for each AISNE class from Richer-de-Forges et al. 2022, join to our texture grid, and summarize by USDA texture class

```
AISNE_PA <- data.frame(c("A","AL","ALO","AS","LA","LAS","LL","LLS","LM","LMS","LS","LSA","S","SA","SL")
c(69, 64, 83, 74, 76, 66, 100, 30, 84, 72, 54, 64, 95, 73, 70)) %>% purrr::set_names("AISNE", "PA")
AISNE_PA_adj <- data.frame(c("A","AL","ALO","AS","LA","LAS","LL","LLS","LM","LMS","LS","LSA","S","SA","S
c(96, 97, 99, 98, 94, 94, 100, 100, 97, 95, 92, 91, 100, 98, 99)) %>% purrr::set_names("AISNE", "PA_adj
AISNE <-  AISNE %>% left_join(AISNE_PA, by="AISNE") %>% left_join(AISNE_PA_adj, by="AISNE")

# This effectively gives us an area weighed average for each USDA texture class based on the relative a
USDA_AISNE_txt_class_PA <- AISNE %>% group_by(USDA) %>% summarise(PA = mean(PA) %>% round(digits = 0))
USDA_AISNE_txt_class_PA_adj <- AISNE %>% group_by(USDA) %>% summarise(PA_adj = mean(PA_adj) %>% round(di
```

Aproximate the number of AISNE texture class samples that would fall into USDA texture classes

```
# Calculates the area of each AISNE texture class that falls within a USDA texture class
USDA_AISNE_class_count <- AISNE %>% group_by(USDA) %>% count(AISNE)

# Calculate the gridded area of the textural triangle occupied by each AISNE texture class
AISNE_class_count <- AISNE %>% group_by(AISNE) %>% count(AISNE) %>% ungroup() %>% purrr::set_names("AISN

# Add the number of samples analyzed for each AISNE texture class
AISNE_class_count$txt_samples <- c(1723, 2270, 2487, 870, 1723, 1331, 3, 10, 346, 532, 815, 1315, 1210,

# Join table of AISNE texture class area and corresponding sample numbers per class
USDA_AISNE_class_count <- USDA_AISNE_class_count %>% left_join(AISNE_class_count, by="AISNE")

# For each intersection area of an AISNE class that falls within a USDA texture class, calculate the re

#For example, the USDA CL-Clay Loam texture class intersects three AISNE textural classes (A-clay, AL-s

USDA_AISNE_class_count <- USDA_AISNE_class_count %>% rowwise() %>% mutate(prop_samp = (n/txt_tri_area)*

USDA_AISNE_samp_count <- USDA_AISNE_class_count  %>% group_by(USDA) %>% summarise(USDA_samp = sum(prop_s

#combine PA, PAadj, and USDA_samp

USDA_AISNE_summary <- USDA_AISNE_samp_count %>% left_join(USDA_AISNE_txt_class_PA, by="USDA") %>% left_j
```

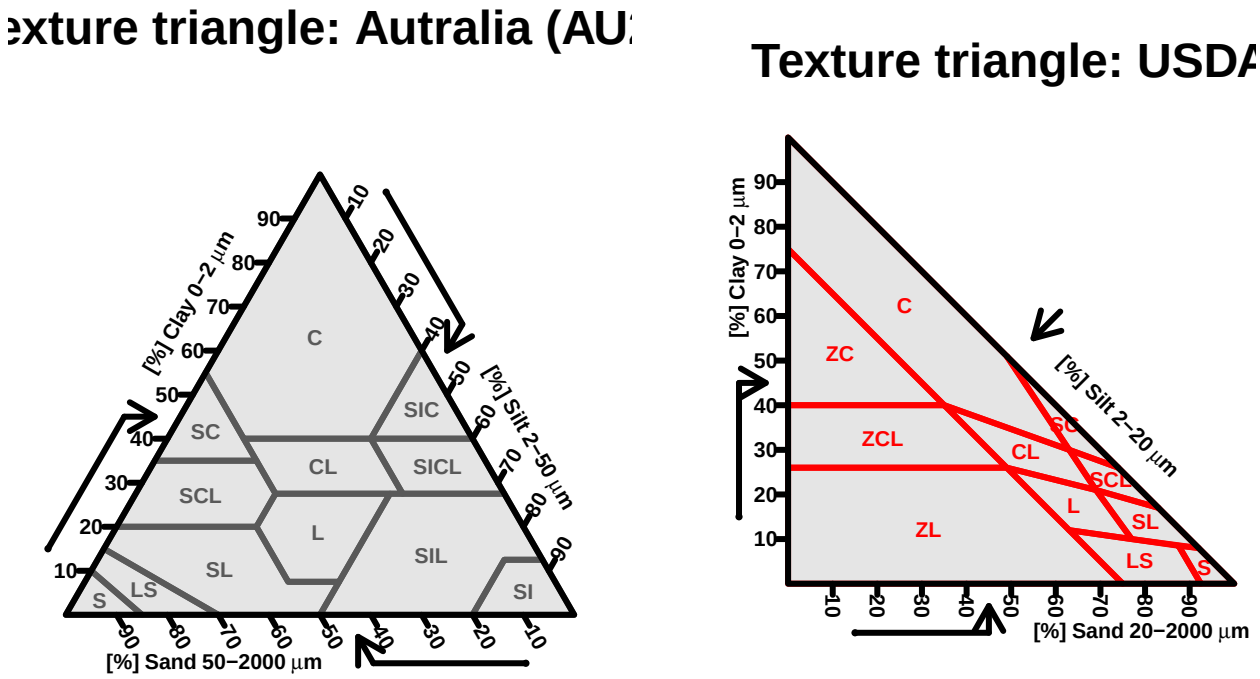
```
knitr::kable(USDA_AISNE_summary, align = "lccrr")
```

USDA	n	PA (%)	PA-adj (%)
C	2829	82	99
CL	1387	68	95
L	1985	61	92
LS	876	82	99
S	664	95	100
SC	493	76	98
SCL	1336	73	97
SI	111	92	99
SIC	868	75	98
SICL	1853	66	96
SIL	2946	61	96
SL	2039	66	98

Transform Australian (AU) textural class data to USDA textural class data

Plot Australian and USDA texture triangles

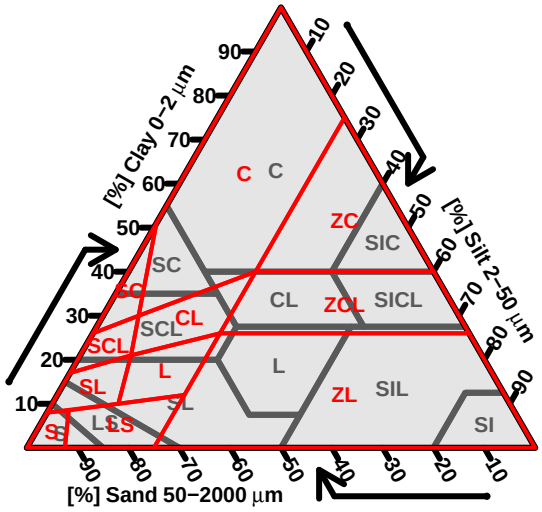
```
old.par <- par(no.readonly=T)
par("mfcol" = c(1,2),"mfrow"=c(1,2))
TT.plot(class.sys = "USDA-NCSS.TT",main = "Texture triangle: Autralia (AU2)", cex=0.5,cex.axis = 0.7, c
TT.plot(class.sys = "AU2.TT",main = "Texture triangle: USDA", cex=0.5,cex.axis = 0.7, cex.lab = 0.7, gr
```



Overlay AU and USDA

```
geo <- TT.plot(class.sys = "USDA-NCSS.TT",main = "Soil texture data", cex=0.5,cex.axis = 0.7, cex.lab =
TT.classes(
geo = geo,
class.sys = "AU2.TT",
# Additional "graphical" options
class.line.col = "red",
class.lab.col = "red",
lwd.axis = 2, cex.lab = 0.7
)
```

Soil texture data



Assign each point to its corresponding Australian class and USDA class

```
AU <-  txt %>% rowwise() %>% mutate(txt = TT.points.in.classes(
tri.data = data.frame(SAND, CLAY, SILT),
class.sys = "AU2.TT", PiC.type = "t", collapse=",")) %>% ungroup()
#extract only first texture label
AU <-  AU %>% rowwise() %>% mutate(AU = strsplit(txt, "[,]")[[1]][1]) %>% ungroup() %>% as.data.frame()
AU <-  AU %>% rowwise() %>% mutate(txt = TT.points.in.classes(
tri.data = data.frame(SAND, CLAY, SILT),
class.sys = "USDA-NCSS.TT", PiC.type = "t", collapse=",")) %>% ungroup()
#extract only first texture label
AU <-  AU %>% rowwise() %>% mutate(USDA = strsplit(txt, "[,]")[[1]][1]) %>% ungroup() %>% as.data.frame
AU <-  AU %>% dplyr::select(-c(txt))
```

Load in Producer accuracies for each Australian class from Minasny et al., 2007, join to our texture grid, and summarize by USDA texture class

```
AU_PA <- data.frame(c('S', 'LS', 'SL', 'L', 'ZL', 'SCL', 'CL', 'ZCL', 'SC', 'ZC', 'C'),
c(78, 32, 40, 35, 14, 37, 15, 6, 40, 6, 86)) %>% purrr::set_names("AU", "PA")
AU_PA_adj <- data.frame(c('S', 'LS', 'SL', 'L', 'ZL', 'SCL', 'CL', 'ZCL', 'SC', 'ZC', 'C'),
c(94, 94, 92, 63, 55, 77, 66, 24, 86, 84, 96)) %>% purrr::set_names("AU", "PA_adj")
AU <-  AU %>% left_join(AU_PA, by="AU") %>% left_join(AU_PA_adj, by="AU")

# This effectively gives us an area weighed average for each USDA texture class based on the relative a
USDA_AU_txt_class_PA <- AU %>% group_by(USDA) %>% summarise(PA = mean(PA) %>% round(digits = 0))
USDA_AU_txt_class_PA_adj <- AU %>% group_by(USDA) %>% summarise(PA = mean(PA_adj) %>% round(digits = 0))
```

Aproximate the number of Australian texture class samples that would fall into USDA texture classes

```
# Calculates the area of each AU texture class that falls within a USDA texture class
USDA_AU_class_count <- AU %>% group_by(USDA) %>% count(AU)

# Calculate the gridded area of the textural triangle occupied by each AU texture class
AU_class_count <- AU %>% group_by(AU) %>% count(AU) %>% ungroup() %>% purrr::set_names("AU", "txt_tri_a

# Add the number of samples analyzed for each AU texture class
AU_class_count$txt_samples <- c(1278, 1060, 1748, 1339, 557, 858, 1745, 635, 456, 704, 7599)


# Join table of AU texture class area and corresponding sample numbers per class
USDA_AU_class_count <- USDA_AU_class_count %>% left_join(AU_class_count, by="AU")

# For each intersection area of an AU class that falls within a USDA texture class, calculate the relat

#For example, the USDA C-Clay Loam texture class intersects two AU textural classes (C-clay and ZC-silt

USDA_AU_class_count <- USDA_AU_class_count %>% rowwise() %>% mutate(prop_samp = (n/txt_tri_area)*txt_sa

USDA_AU_samp_count <- USDA_AU_class_count  %>% group_by(USDA) %>% summarise(USDA_samp = sum(prop_samp) %

USDA_AU_summary <- USDA_AU_samp_count %>% left_join(USDA_AU_txt_class_PA, by="USDA") %>% left_join(USDA_

knitr::kable(USDA_AU_summary, align = "lccrr")
```

USDA	n	PA (%)	PA-adj (%)
C	1388	64	93
CL	451	10	30
L	1600	13	51
LS	957	33	91
S	726	62	94
SC	662	73	93
SCL	3609	29	70
SI	838	14	55
SIC	152	6	84
SICL	277	6	24
SIL	3741	14	53
SL	3577	24	67