

Profiling plots 2021

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Introduction

The following plots are Thermoclines from the ponds used for the Stickleback- experiments in 2021. This profiles are used to estimate the actively mixed layer depth of the ponds, which are subsequently used to model metabolism (GPP, R, NEP).

Pond-profiles

B1P1

This is the code for B1P1, the other ponds were analysed equivalently:

```
# Step 0: set up R-script -----
rm(list= ls())

setwd("~/ZIVI_EAWAG/project_21")

source("~/ZIVI_EAWAG/project_21/Moritz_Luehrig_paper_stuff/methods_packages.R")
library(GGally)

# Profile B1P1 -----

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/B1P1Sept10_2021.csv", sep = ";")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]

# Rename columns
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)

## Warning: NAs durch Umwandlung erzeugt

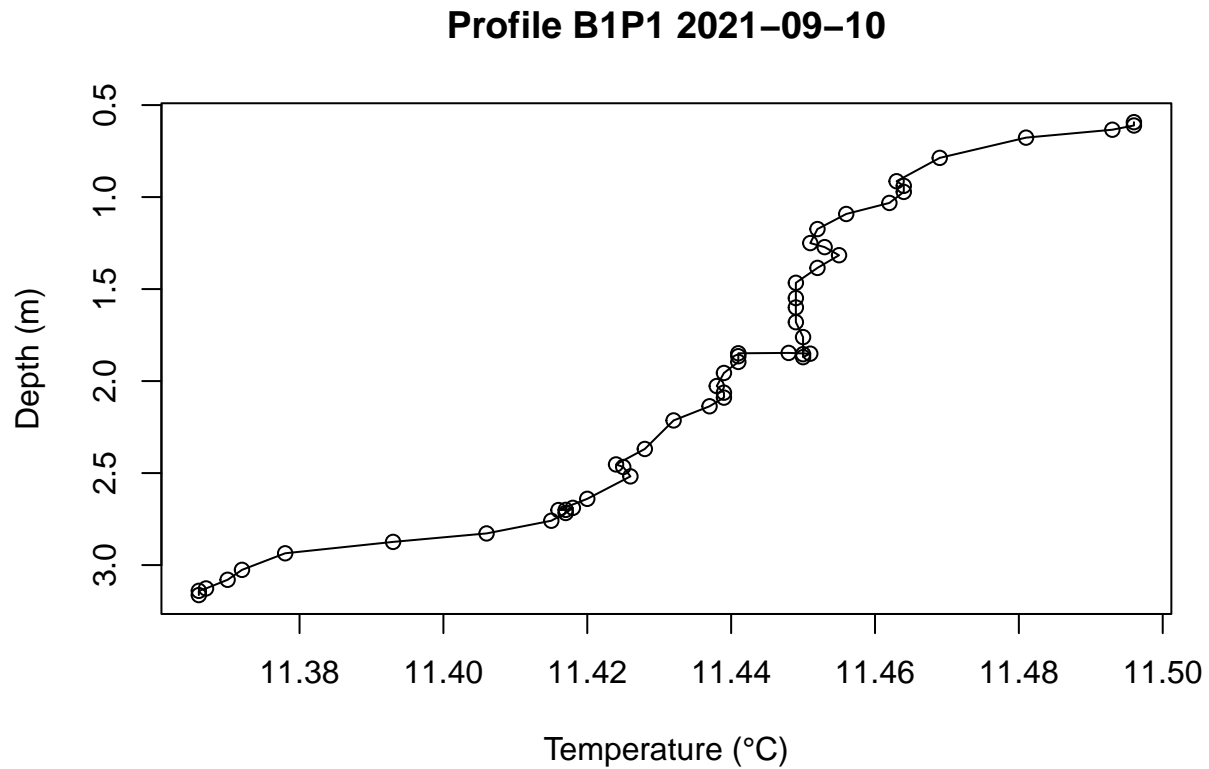
prof$Temp_C <- as.numeric(prof$Temp_C)
```

```
## Warning: NAs durch Umwandlung erzeugt
```

```
# Choose rows 762:812, where the profiling was done
prof <- prof[c(762:812),]
```

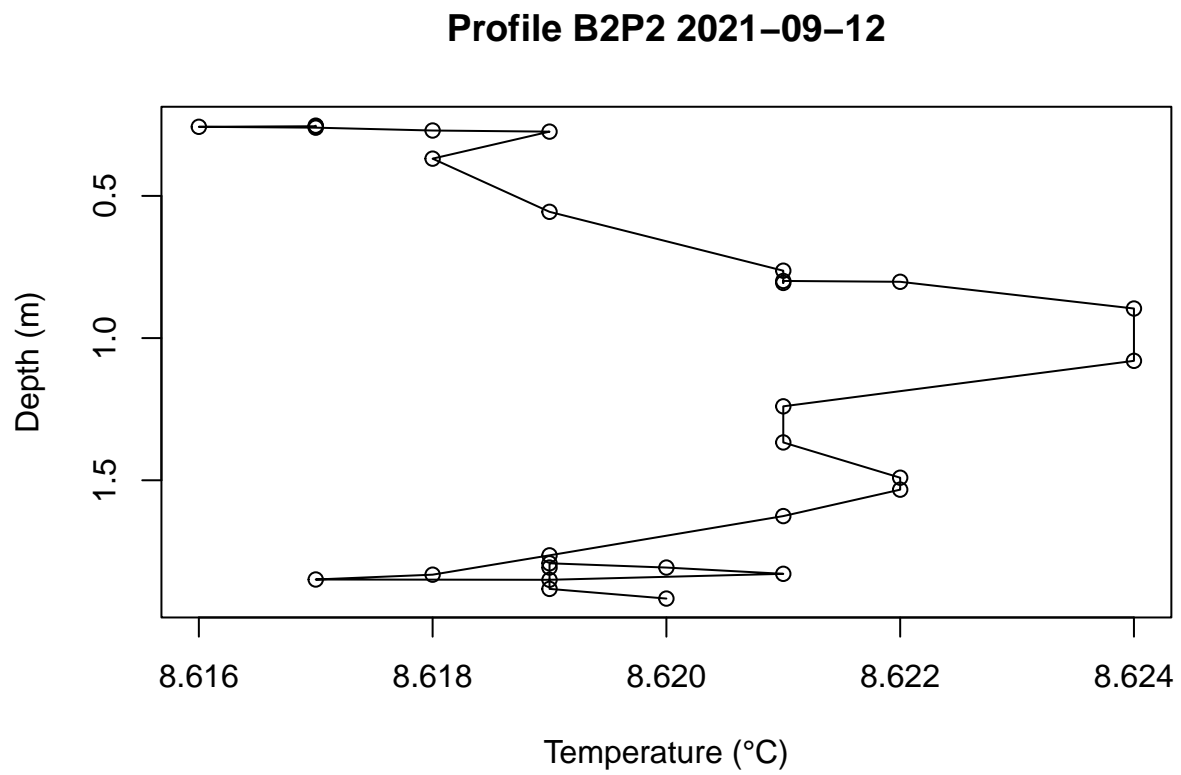
```
# Create the thermocline plot
```

```
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
     ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
     main = "Profile B1P1 2021-09-10")
```



I interpret that the mixed layer depth in B1P1 was at least 3.163m on Sept 10 2021, since the demperature differences from top to bottom are only minimal ($< 0.5^{\circ}\text{C}$).

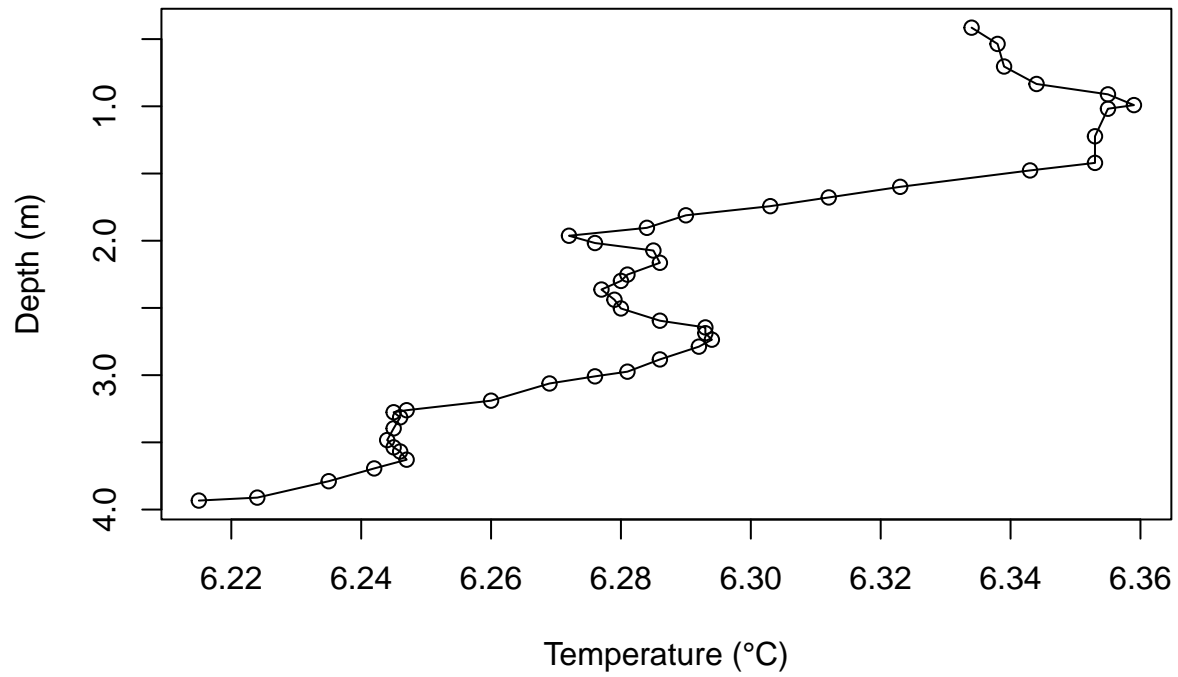
B2P2



I interpret that the mixed layer depth in B2P2 was at least 1.916m on Sept 12 2021, since the temperature differences from top to bottom are only minimal ($< 0.1^{\circ}\text{C}$)

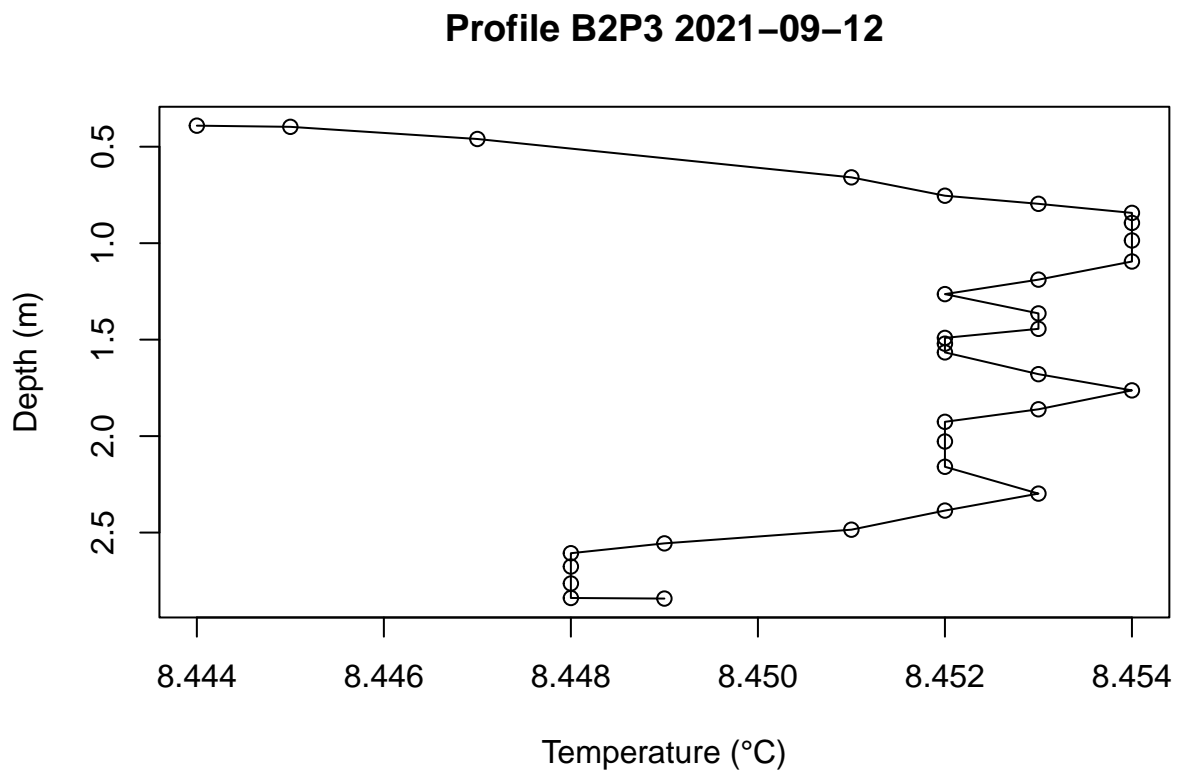
B3P3

Profile B3P3 2021-09-13



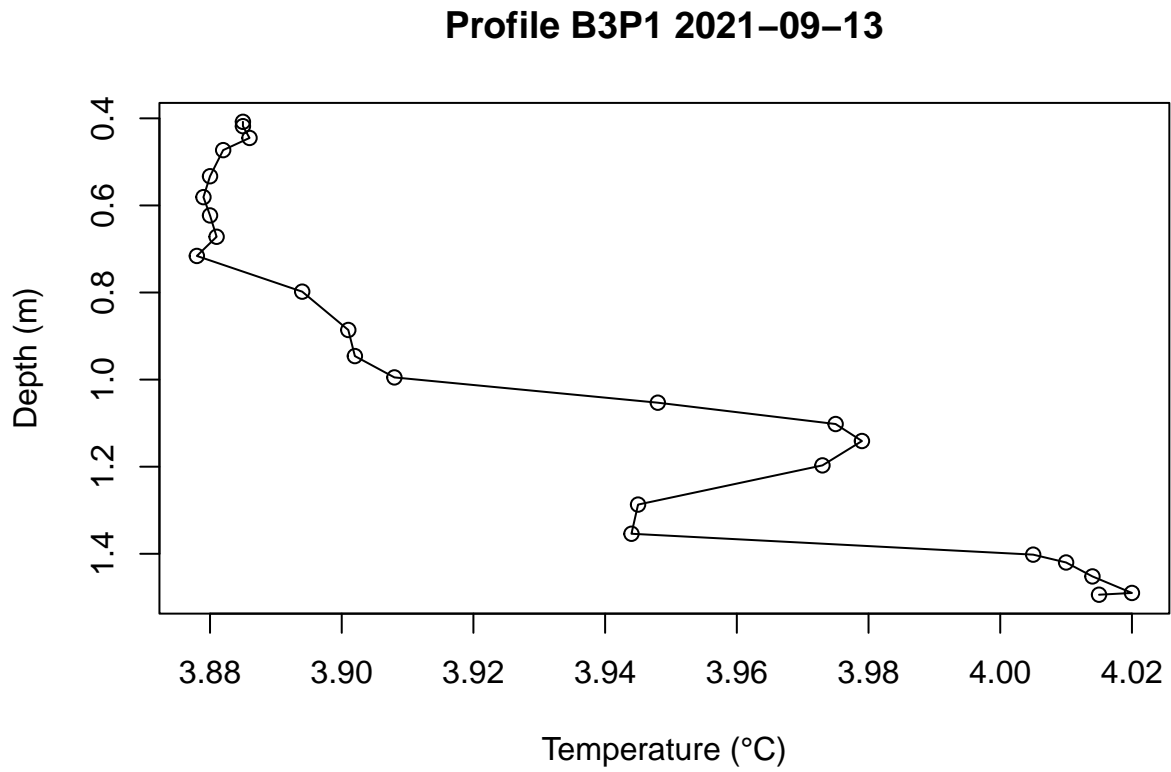
I interpret that the mixed layer depth in B3P3 was at least 3.933m on Sept 13 2021, since the temperature differences from top to bottom are only minimal ($< 0.2^{\circ}\text{C}$)

B2P3



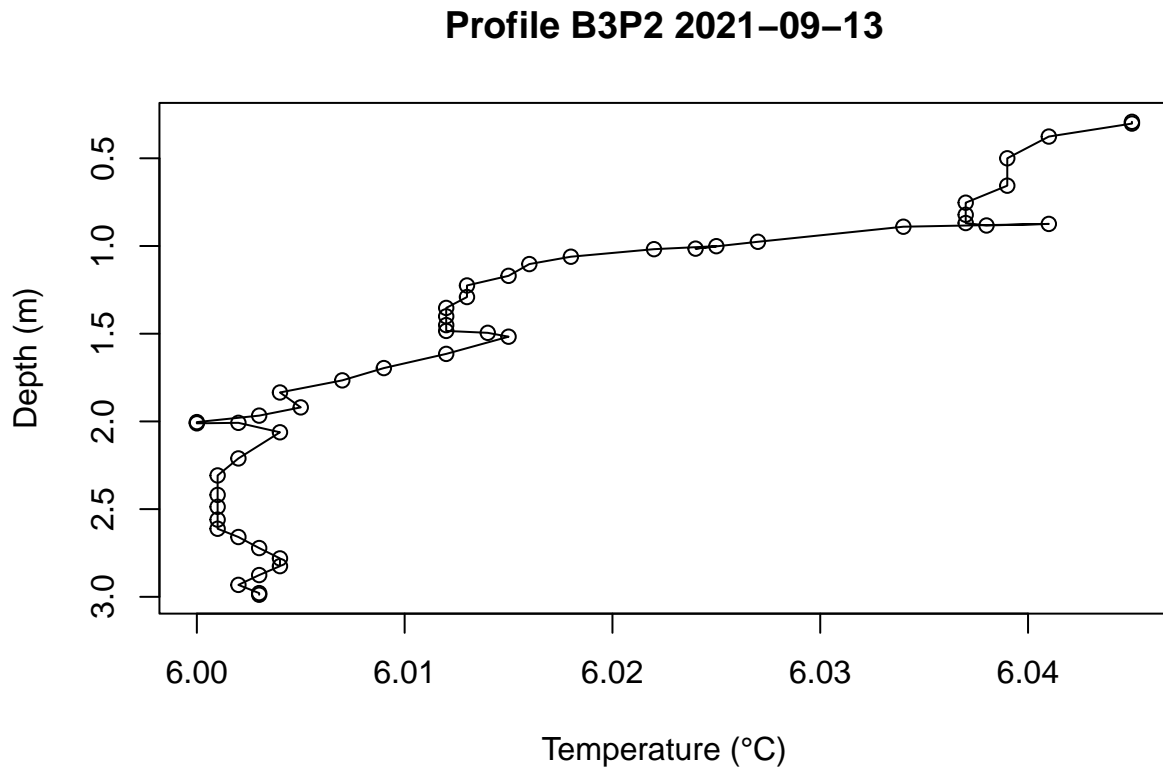
I interpret that the mixed layer depth in B2P3 was at least 2.842 on Sept 12 2021, since the temperature differences from top to bottom are only minimal ($< 0.1^{\circ}\text{C}$)

B3P1



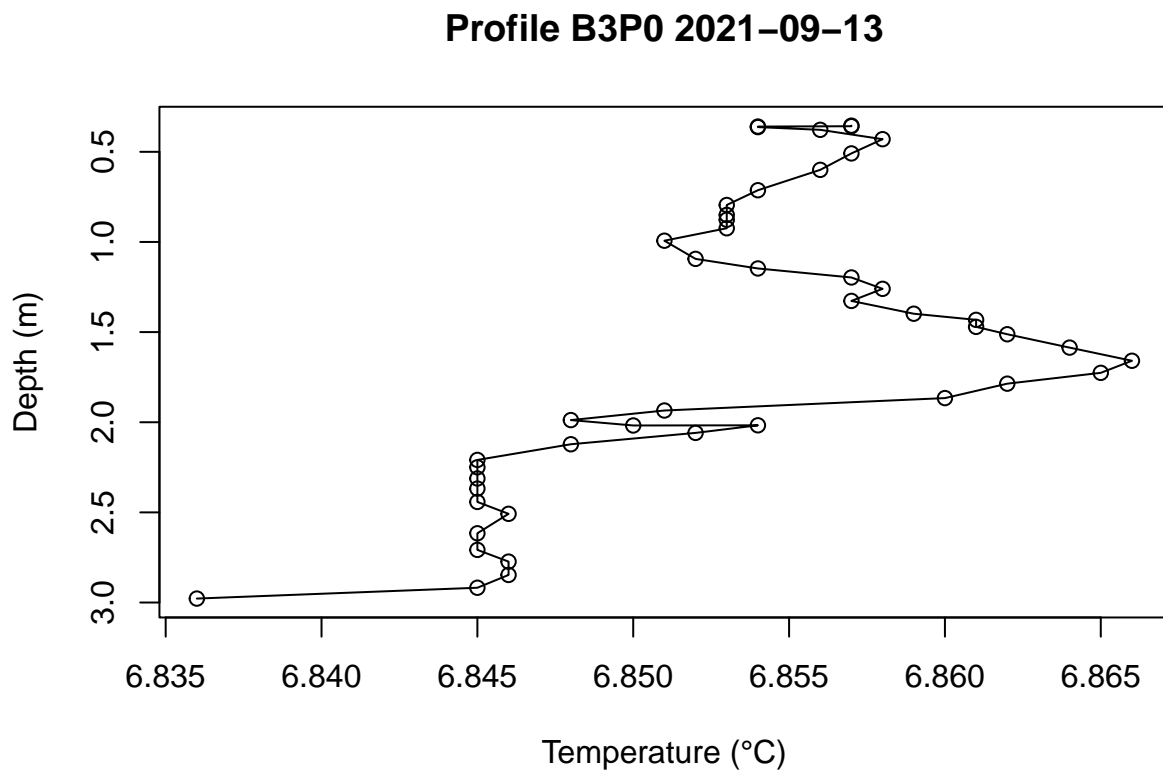
I interpret that the mixed layer depth in B3P1 was at least 1.494m on Sept 13 2021, since the temperature differences from top to bottom are only minimal ($< 0.2^{\circ}\text{C}$).

B3P2



I interpret that the mixed layer depth in B3P2 was at least 2.988m on Sept 13 2021, since the temperature differences from top to bottom are only minimal ($< 0.1^{\circ}\text{C}$).

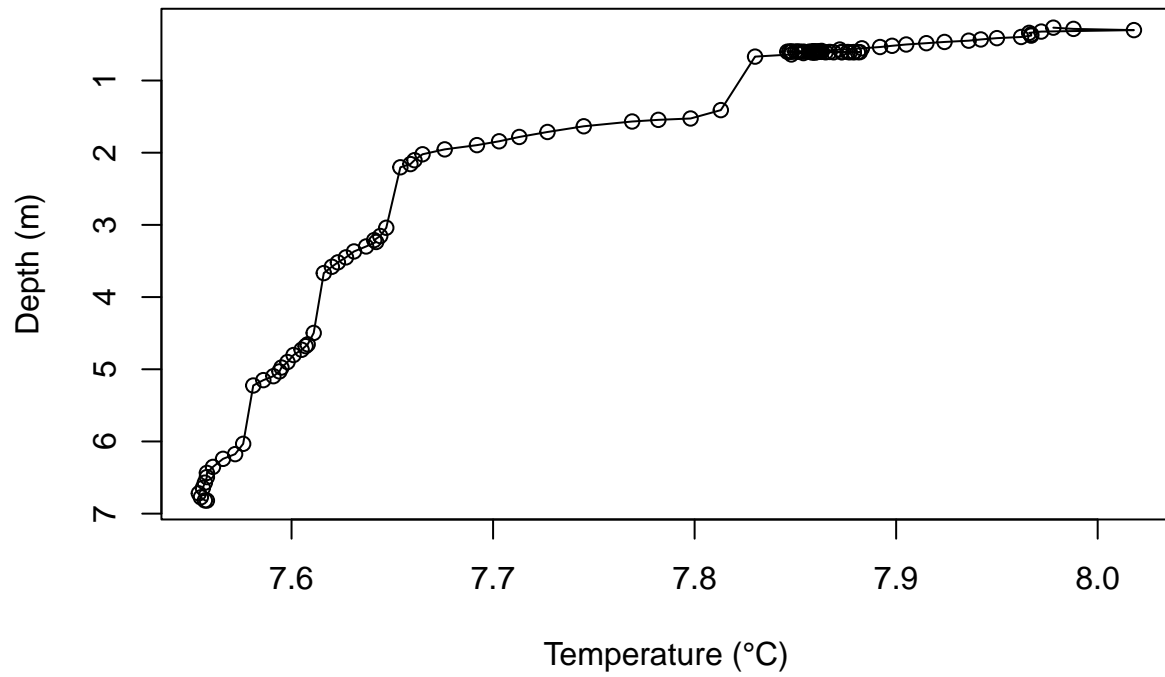
B3P0



I interpret that the mixed layer depth in B3P0 was at least 2.978m on Sept 13 2021, since the temperature differences from top to bottom are only minimal ($< 0.1^{\circ}\text{C}$).

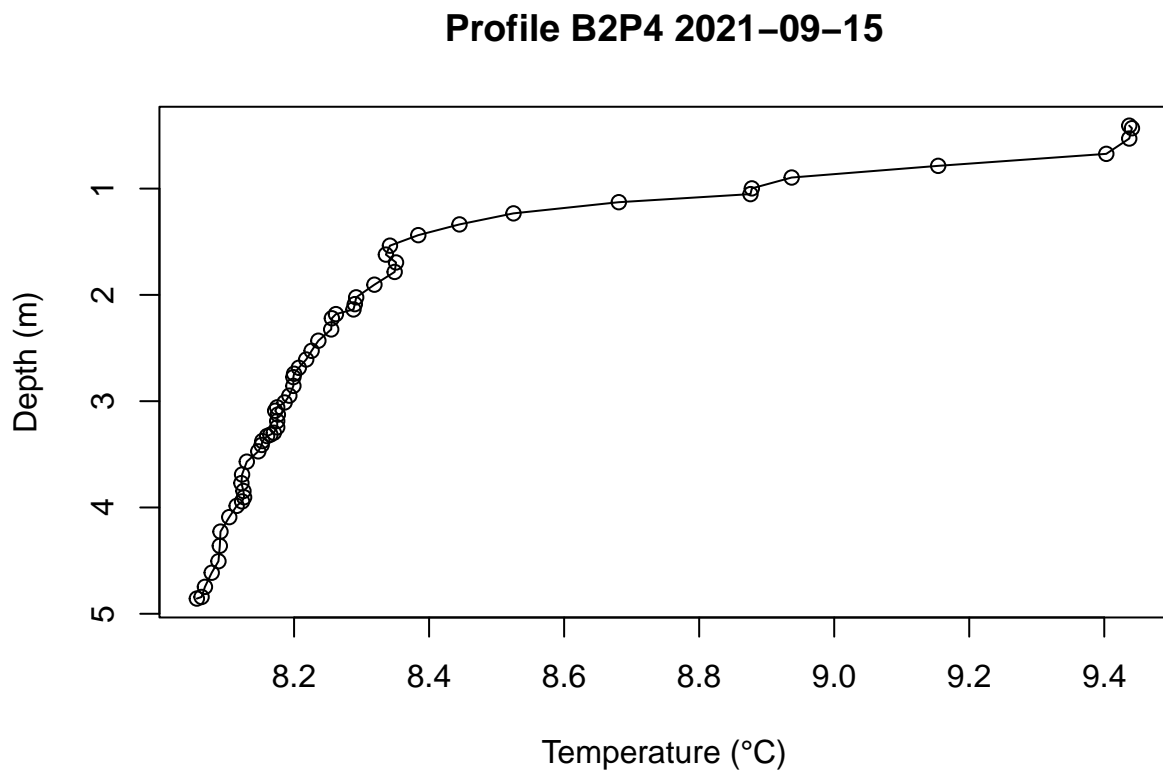
ERL85

Profile ERL85 2021-09-21



I interpret that the mixed layer depth in ERL85 was at least 6.819m on Sept 21 2021, since the temperature differences from top to bottom are only minor ($< 0.6^{\circ}\text{C}$).

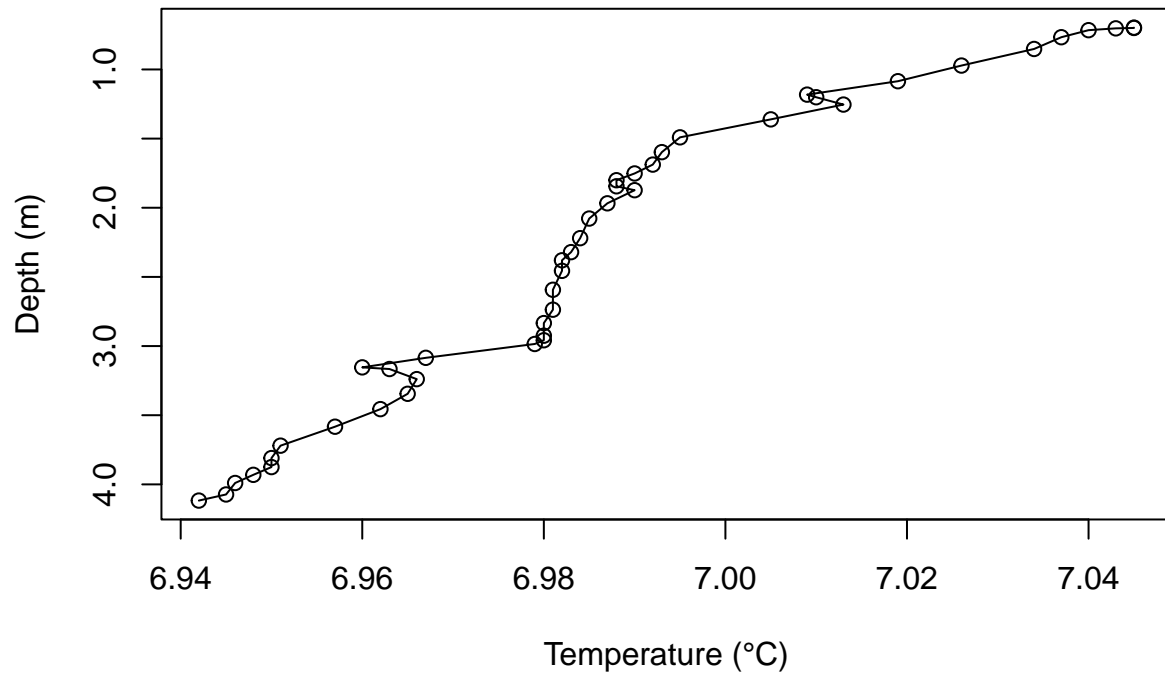
B2P4



Even though the temperature difference from top to bottom is about 1.4°C, I would say that the mixed layer depth of B2P4 on Sept 15 2021 was at least 4.857m.

ERL152

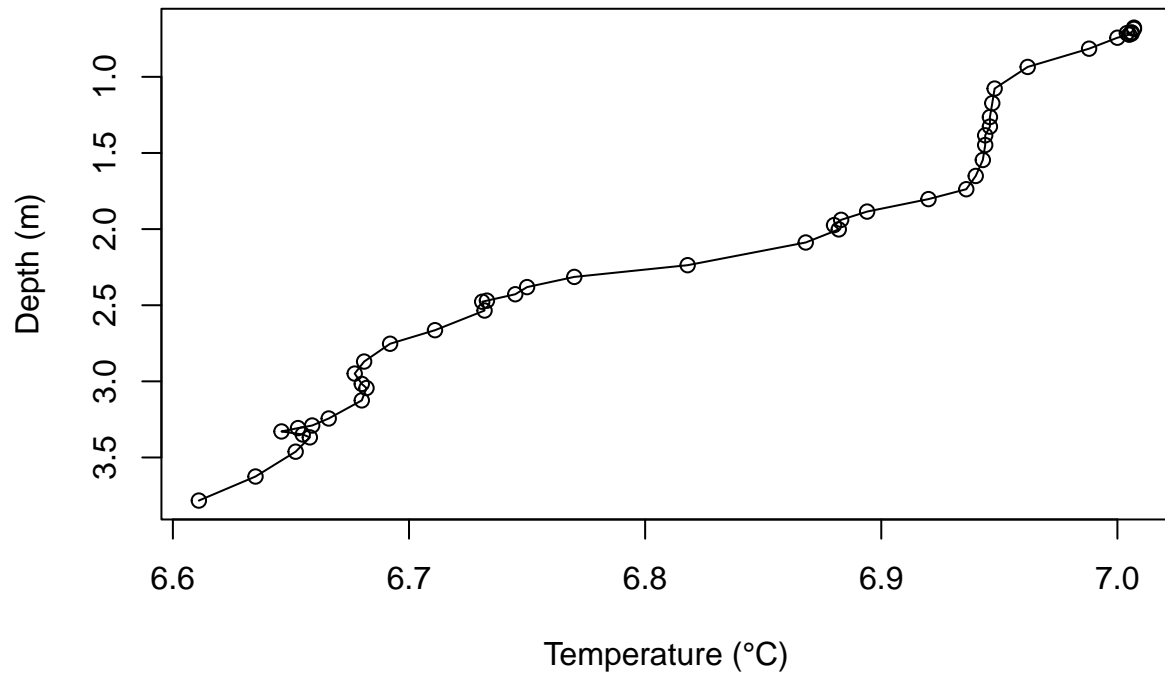
Profile ERL152 2021-09-16



I interpret that the mixed layer depth in ERL152 was at least 4.117m on Sept 16 2021, since the temperature differences from top to bottom are only minor ($< 0.2^{\circ}\text{C}$)

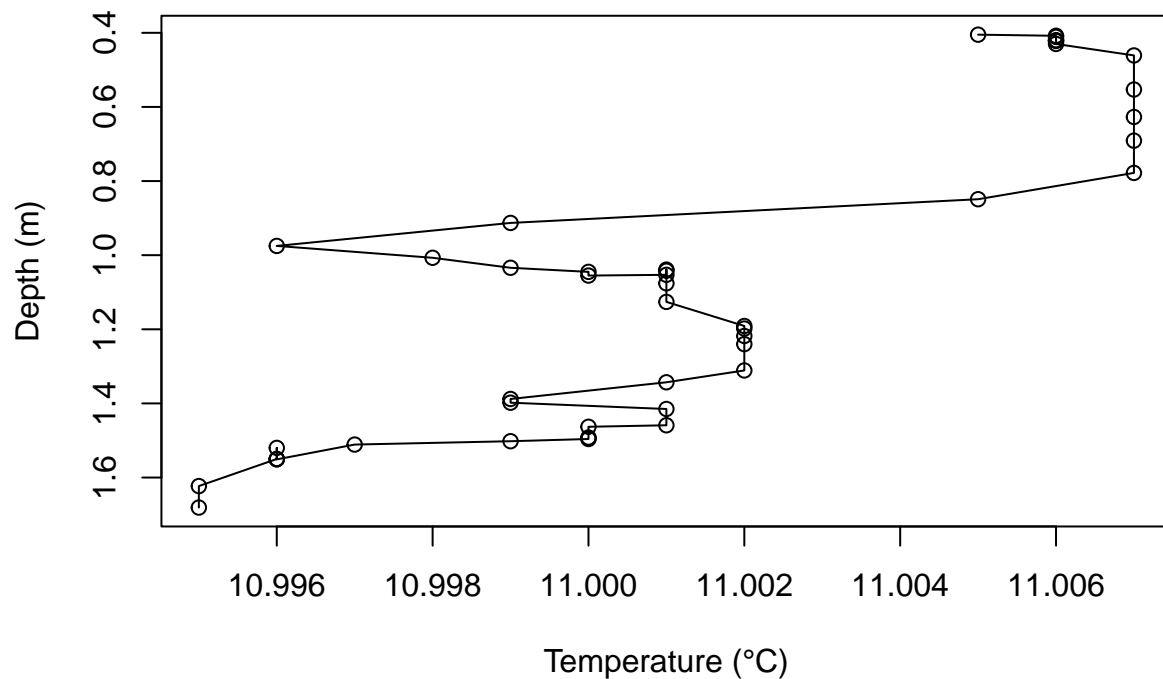
ERL122

Profile ERL122 2021-09-16



I interpret that the mixed layer depth in ERL122 was at least 3.783m on Sept 16 2021, since the temperature differences from top to bottom are only minor ($< 0.4^{\circ}\text{C}$)

B1P4

Profile B1P4 2021-09-11

I interpret that the mixed layer depth in B1P4 was at least 1.681m on Sept 11 2021, since the temperature differences from top to bottom are only minimal ($< 0.1^{\circ}\text{C}$).

Appendix

Version and packages used to generate this report:

```
## 2023-08-10 14:11:00.557536 Europe/Zurich

## R version 4.3.1 (2023-06-16 ucrt)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 19045)
##
## Matrix products: default
##
##
## locale:
## [1] LC_COLLATE=German_Switzerland.utf8  LC_CTYPE=German_Switzerland.utf8
## [3] LC_MONETARY=German_Switzerland.utf8 LC_NUMERIC=C
## [5] LC_TIME=German_Switzerland.utf8
##
## time zone: Europe/Zurich
## tzcode source: internal
```

```
##
## attached base packages:
## [1] stats      graphics  grDevices  utils      datasets  methods   base
##
## other attached packages:
## [1] GGally_2.1.2      zoo_1.8-12      viridis_0.6.3    viridisLite_0.4.2
## [5] forcats_1.0.0     stringr_1.5.0   dplyr_1.1.2      purrr_1.0.1
## [9] readr_2.1.4       tidyr_1.3.0     tibble_3.2.1     ggplot2_3.4.2
## [13] tidyverse_2.0.0   lubridate_1.9.2 data.table_1.14.8 cowplot_1.1.1
## [17] bit64_4.0.5       bit_4.0.5       pacman_0.5.1
##
## loaded via a namespace (and not attached):
## [1] utf8_1.2.3        generics_0.1.3   stringi_1.7.12    lattice_0.21-8
## [5] hms_1.1.3         digest_0.6.32    magrittr_2.0.3    RColorBrewer_1.1-3
## [9] evaluate_0.21     grid_4.3.1       timechange_0.2.0  fastmap_1.1.1
## [13] plyr_1.8.8        reshape_0.8.9    gridExtra_2.3     fansi_1.0.4
## [17] scales_1.2.1      cli_3.6.1        rlang_1.1.1       munsell_0.5.0
## [21] withr_2.5.0       yaml_2.3.7       tools_4.3.1       tzdb_0.4.0
## [25] colorspace_2.1-0  vctrs_0.6.3      R6_2.5.1          lifecycle_1.0.3
## [29] pkgconfig_2.0.3   pillar_1.9.0     gtable_0.3.3      Rcpp_1.0.10
## [33] glue_1.6.2        highr_0.10       xfun_0.39         tidyselect_1.2.0
## [37] rstudioapi_0.14   knitr_1.43       htmltools_0.5.5   rmarkdown_2.23
## [41] compiler_4.3.1
```

Code used to generate the plots:

```
#####
# This is a code to plot the sondes profiles of 2021 to determine a reasonable
# actively mixed layer depth for the metabolism models of the different ponds
#####

# Step 0: set up R-script -----
rm(list= ls())

setwd("~/ZIVI_EAWAG/project_21")

source("~/ZIVI_EAWAG/project_21/Moritz_Luehrig_paper_stuff/methods_packages.R")
library(GGally)

# Profile B1P1 -----

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/B1P1Sept10_2021.csv", sep = ";")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]

# Rename columns
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)
```

```

# Choose rows 762:812, where the profiling was done
prof <- prof[c(762:812),]

# Create the thermocline plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile B1P1 2021-09-10")

# I interpret that the mixed layer depth in B1P1 was at least 3.163m on Sept 10 2021,
# since the demperature differences from top to bottom are only minimal (< 0.5°C)

# Profile B2P2 -----

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/B2P2_Sept12_2021.csv", sep = ";")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 936-964, where the profiling was done
prof <- prof[c(936:964),]

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile B2P2 2021-09-12")

# I interpret that the mixed layer depth in B2P2 was at least 1.916m on Sept 12 2021,
# since the demperature differences from top to bottom are only minimal (< 0.1°C)

# Profile B3P3 -----

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/B3P3_Sept13_2021.txt", sep = "\t")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 811:856, where the profiling was done
prof <- prof[c(811:856),]

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",

```

```

    main = "Profile B3P3 2021-09-13")

# I interpret that the mixed layer depth in B3P3 was at least 3.933m on Sept 13 2021,
# since the temperature differences from top to bottom are only minimal (< 0.2°C)

# Profile B2P3 -----

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/B2P3_Sept12_2021.csv", sep = ";")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 588:619, where the profiling was done
prof <- prof[c(588:619),]

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile B2P3 2021-09-12")

# I interpret that the mixed layer depth in B2P3 was at least 2.842 on Sept 12 2021,
# since the temperature differences from top to bottom are only minimal (< 0.1°C)

# Profile B3P1 -----

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/B3P1_Sept13_2021.csv", sep = ";")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 943:966, where the profiling was done
prof <- prof[c(943:966),]

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile B3P1 2021-09-13")

# I interpret that the mixed layer depth in B3P1 was at least 1.494m on Sept 13 2021,
# since the temperature differences from top to bottom are only minimal (< 0.2°C)

# Profile B3P2 -----

```



```

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/B3P2_Sept13_2021.txt", sep = "\t")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 979:1028, where the profiling was done
prof <- prof[c(979:1028),]

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile B3P2 2021-09-13")

# I interpret that the mixed layer depth in B3P2 was at least 2.988m on Sept 13 2021,
# since the temperature differences from top to bottom are only minimal (< 0.1°C)

# Profile B3P0 -----
prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/B3P0_Sept13_2021.csv", sep = ";")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 649:694, where the profiling was done
prof <- prof[c(649:694),]

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile B3P0 2021-09-13")

# I interpret that the mixed layer depth in B3P0 was at least 2.978m on Sept 13 2021,
# since the temperature differences from top to bottom are only minimal (< 0.1°C)

# Profile ERL85 -----
prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/ERL85_Sept21_2021.csv", sep = ",")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric

```

```

prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 991:1108, where the profiling was done
prof <- prof[c(992:1108),]

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile ERL85 2021-09-21")

# I interpret that the mixed layer depth in ERL85 was at least 6.819m on Sept 21 2021,
# since the temperature differences from top to bottom are only minor (< 0.6°C)

# Profile B2P4 -----

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/B2P4_Sept15_2021.csv", sep = ";")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 912:969, where the profiling was done
prof <- prof[c(912:969),]

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile B2P4 2021-09-15")

# Even though the temperature difference from top to bottom is about 1.4°C,
# I would say that the mixed layer depth of B2P4 on Sept 15 2021 was at least
# 4.857m.

# Profile ERL152 -----

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/ERL152_Sept16_2021.csv", sep = ";")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 521:565, where the profiling was done
prof <- prof[c(521:565),]

```

```

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile ERL152 2021-09-16")
# I interpret that the mixed layer depth in ERL152 was at least 4.117m on Sept 16 2021,
# since the temperature differences from top to bottom are only minor (< 0.2°C)

# Profile ERL122 -----

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/ERL122_Sept16_2021.csv", sep = ";")
# In lake ERL122, the profile dataset seems to be cut right about at the moment the sondes
# reaches its deepest point

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 515:561, where the profiling was done
prof <- prof[c(515:561),]

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile ERL122 2021-09-16")
# I interpret that the mixed layer depth in ERL122 was at least 3.783m on Sept 16 2021,
# since the temperature differences from top to bottom are only minor (< 0.4°C)

# Profile B1P4 -----

prof <- fread("~/ZIVI_EAWAG/project_21/sondes_profiling/B1P4_Sept11_2021.txt", sep = "\t")

# Choose columns of interest
prof <- prof[,c("V10", "V29")]
prof <- setnames(prof, c("Depth_m", "Temp_C"))

# As numeric
prof$Depth_m <- as.numeric(prof$Depth_m)
prof$Temp_C <- as.numeric(prof$Temp_C)

# Choose rows 1148:1193, where the profiling was done
prof <- prof[c(1148:1193),]

# plot
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile B1P4 2021-09-11")
# I interpret that the mixed layer depth in B1P4 was at least 1.681m on Sept 11 2021,
# since the temperature differences from top to bottom are only minimal (< 0.1°C)

```