

Profiling-plots 2022

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Introduction

The following plots are Thermoclines from the ponds used for the Stickleback- experiments in 2022. For some of the ponds, the profiling was not done in 2022, and data from 2021 was subsequently taken. 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

B3P3

This is the code for B3P3, the other ponds were analysed equivalently:

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

setwd("~/ZIVI_EAWAG/project_22")

source("~/ZIVI_EAWAG/project_22/Moritz_Luehrig_paper_stuff/methods_packages.R")
library(GGally)

prof <- fread("~/ZIVI_EAWAG/project_22/sonde_profiling/B3P3 June 21 22.csv", sep = ";")

# Choose columns of interest
prof <- prof[,c("V8", "V23")]

# 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
```

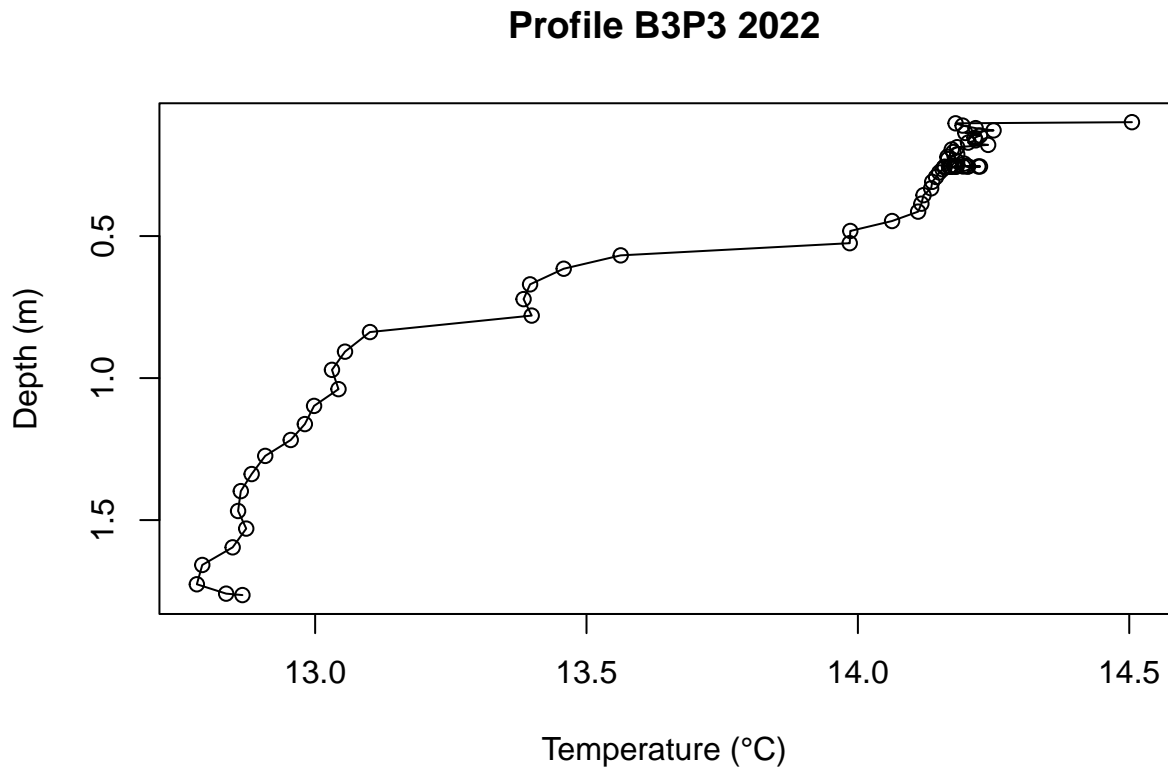
```
prof$Temp_C <- as.numeric(prof$Temp_C)
```

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

```
# Choose rows 464-555, where the profiling was done
prof <- prof[c(464:531),]
```

```
# Create the thermocline plot
```

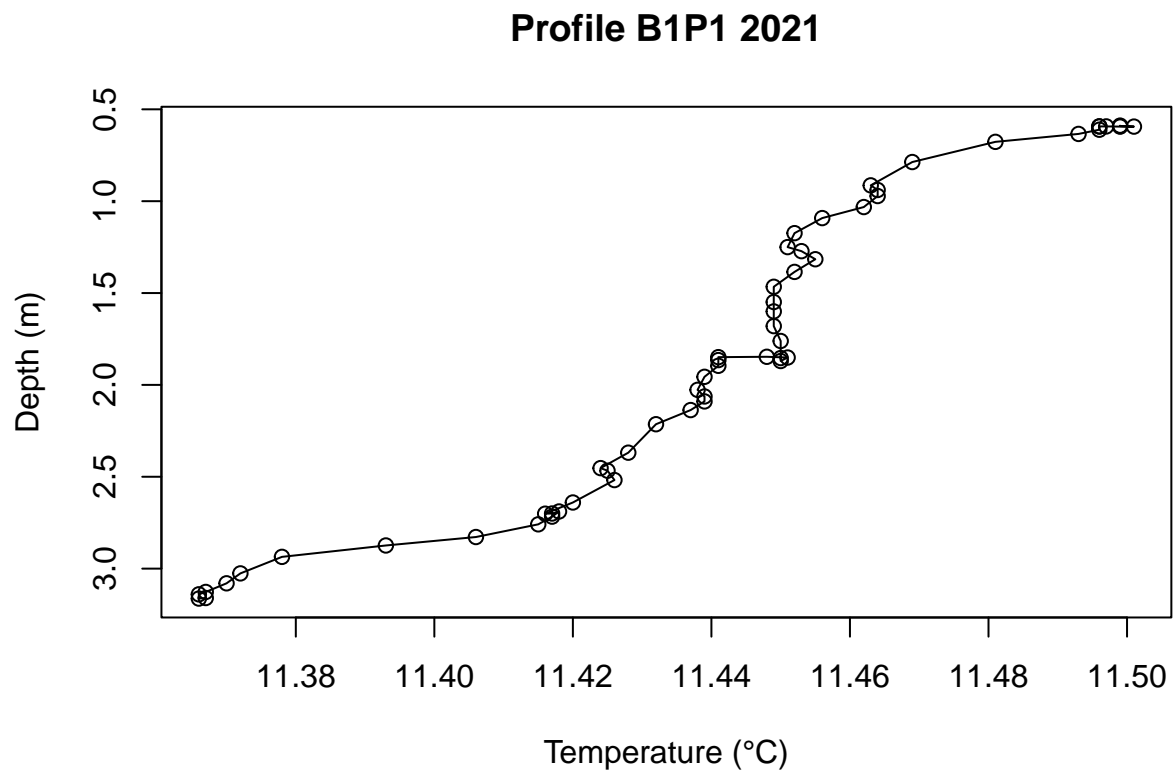
```
plot(prof$Temp_C, prof$Depth_m, type = "o", xlab = "Temperature (°C)",
      ylim = c(max(prof$Depth_m), min(prof$Depth_m)), ylab = "Depth (m)",
      main = "Profile B3P3 2022")
```



```
# I interpret that the mixed layer depth is only about 0.5 meters deep, since
# Temperature starts to decline rapidly after 0.5 meters from about 14.25 down to 13.00
# at 1.75 meters.
# -> mixed layer depth = 0.5m
```

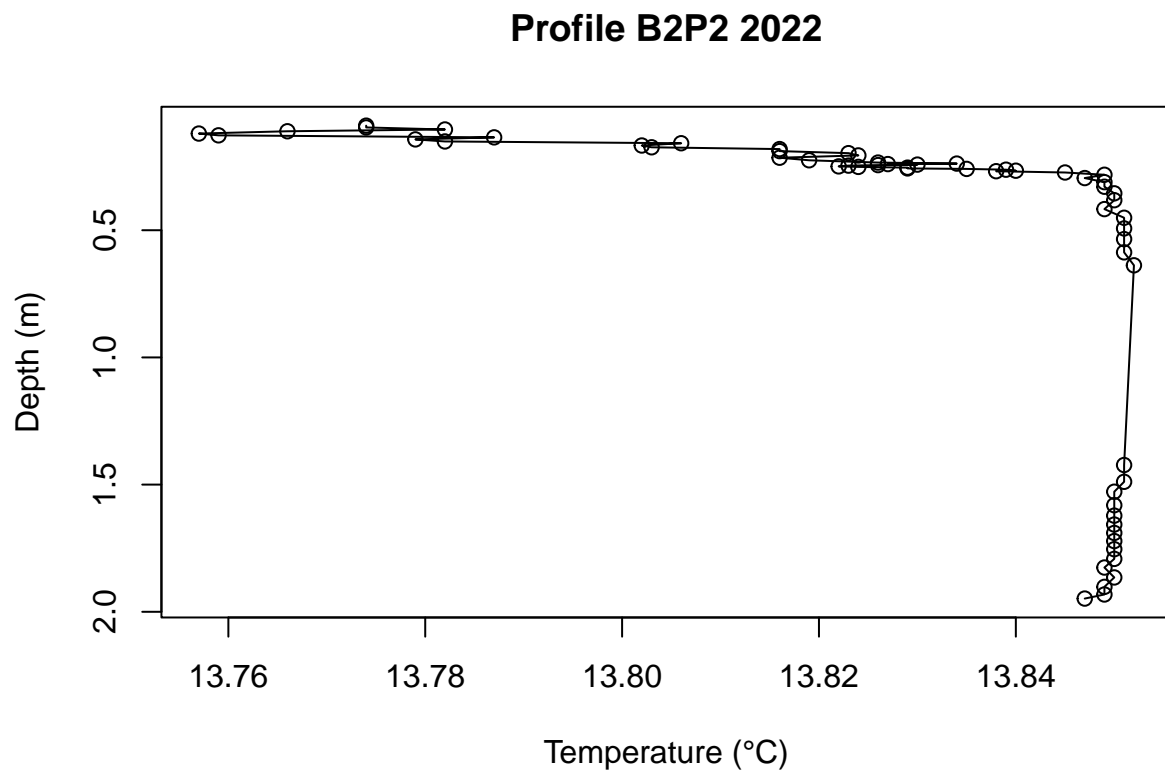
I interpret that the mixed layer depth is only about 0.5 meters deep, since Temperature starts to decline rapidly after 0.5 meters from about 14.25 down to 13.00 at 1.75 meters. -> mixed layer depth = 0.5m

B1P1



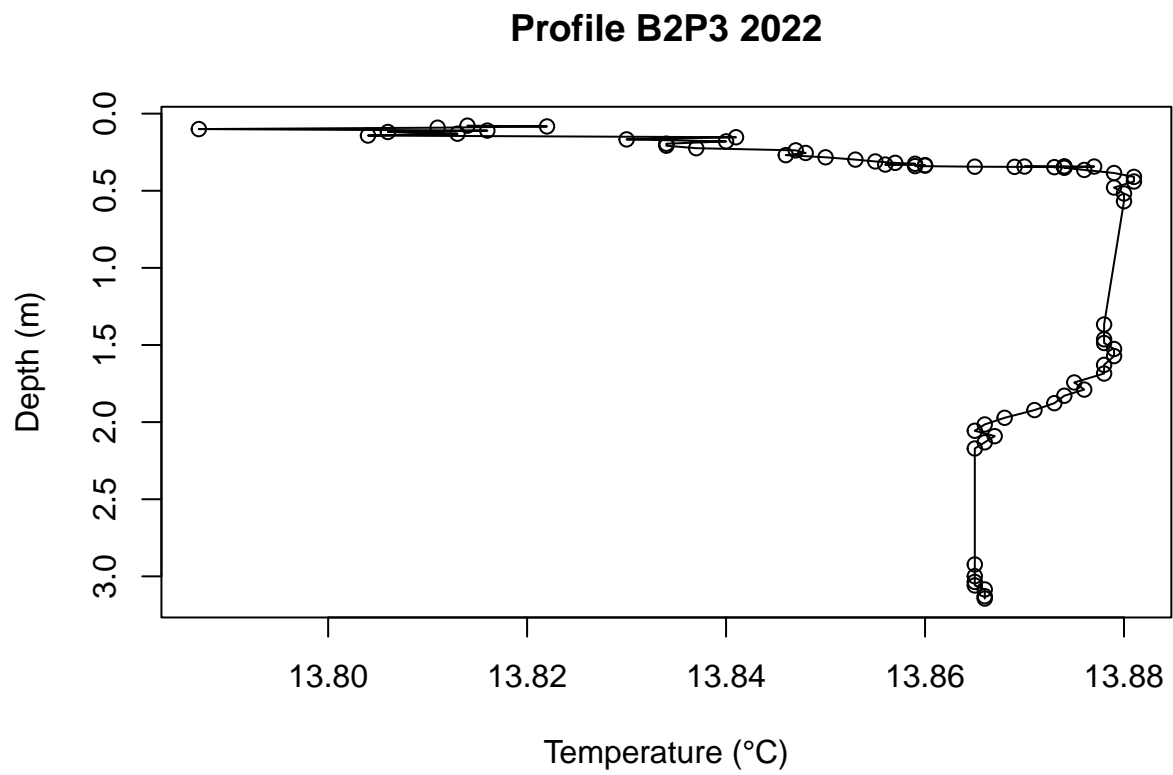
The drop in temperature is very small ($<0.5^{\circ}\text{C}$) and I therefore conclude that the actively mixed layer depth at that time was at least 3 meters. -> set mixed layer depth to maximum profiling depth (3.163m)

B2P2



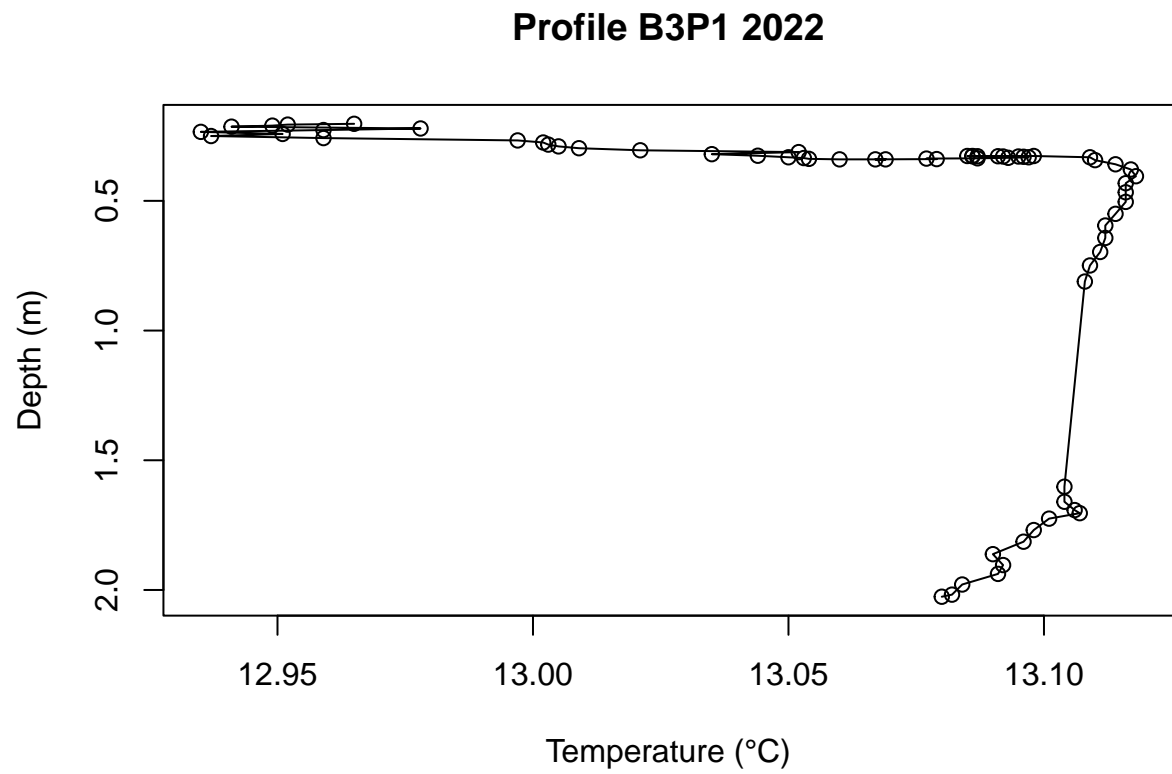
Same temperature across all depths. -> set mixed layer depth to maximum profiling depth (1.948m)

B2P3



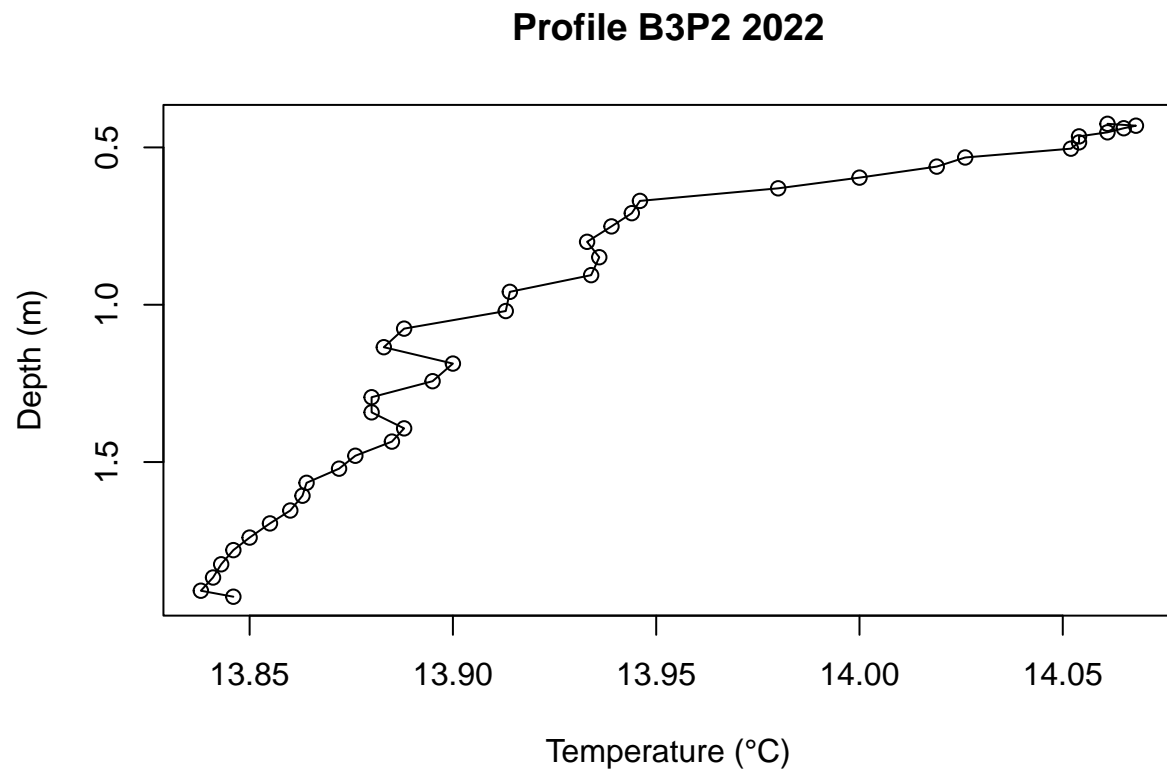
Same temperature across all depths. -> set mixed layer depth to maximum profiling depth (3.144m)

B3P1



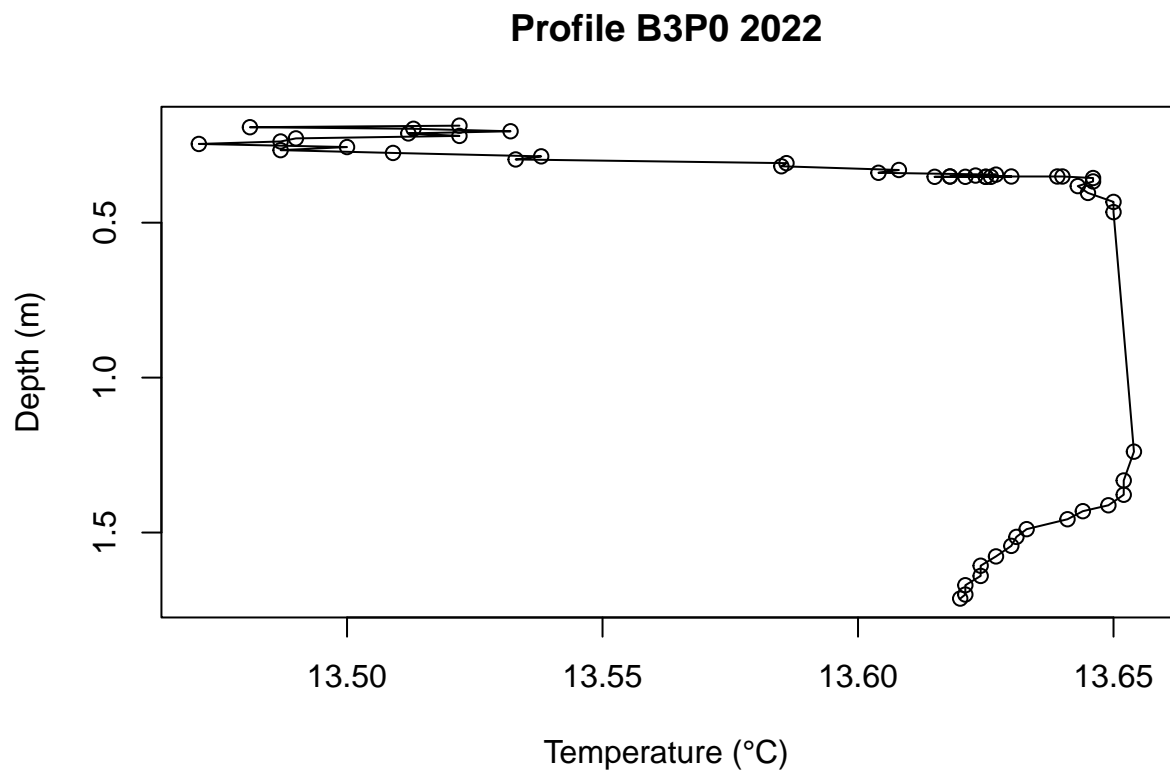
Same temperature across all depths. -> set mixed layer depth to maximum profiling depth (2.026m)

B3P2



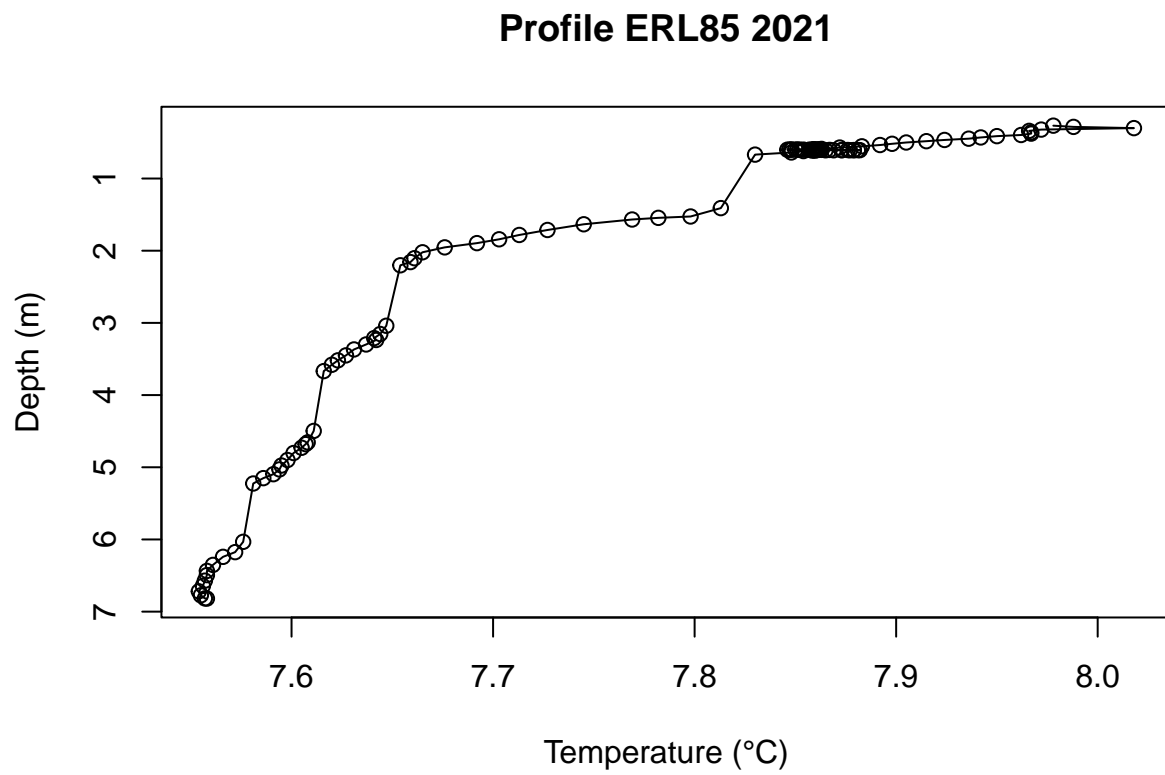
Same temperature across all depths (difference < 0.5°C). -> set mixed layer depth to maximum profiling depth (1.928m)

B3P0



Same temperature across all depths (difference $< 0.5^{\circ}\text{C}$). -> set mixed layer depth to maximum profiling depth (1.713m)

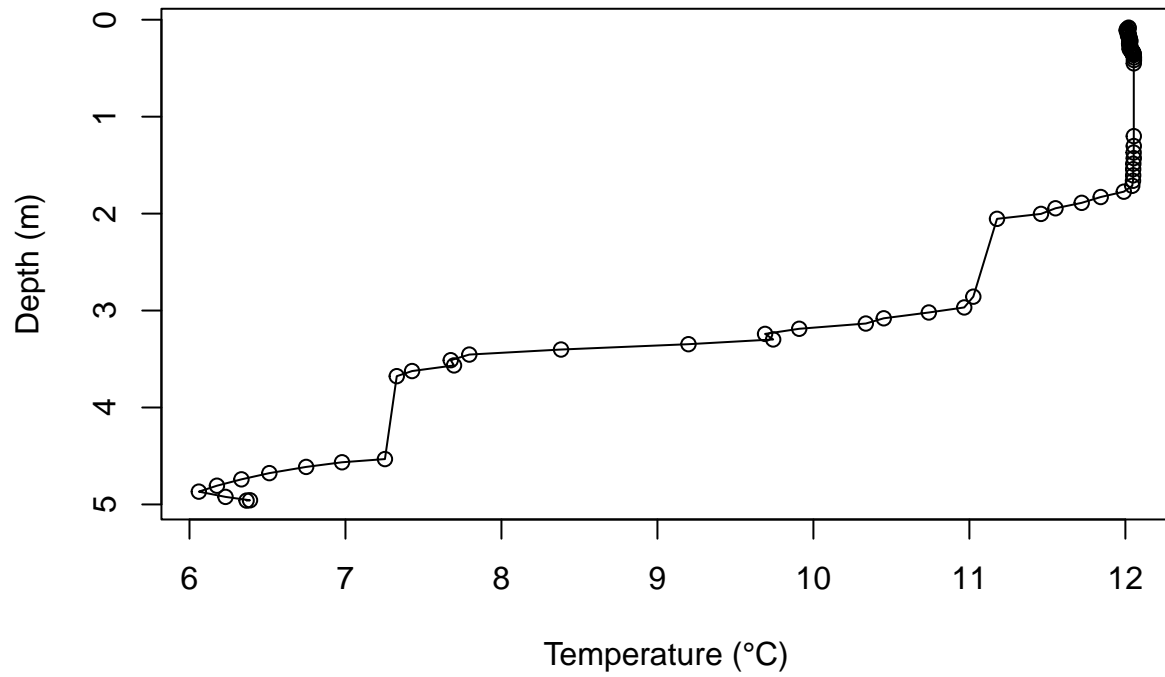
ERL85



Same temperature across all depths (difference < 0.5°C). -> set mixed layer depth to maximum profiling depth (1.713m)

B2P4

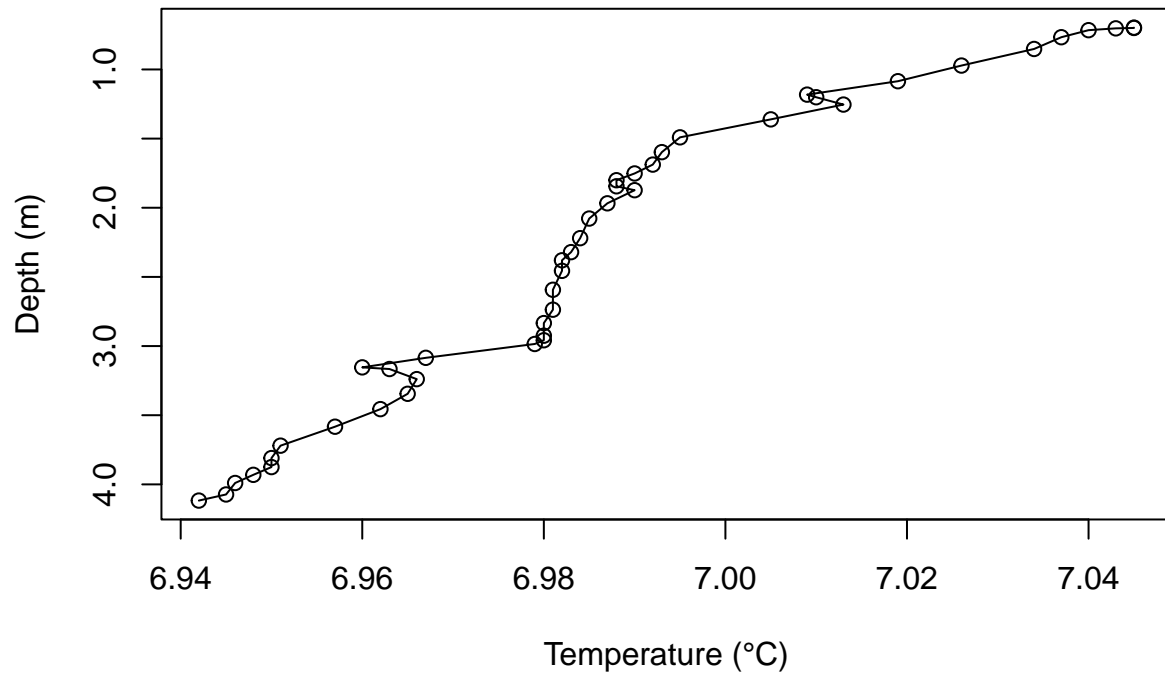
Profile B2P4 2022



Quite a steep thermocline from 2m downwards. -> set mixed layer depth to 2m

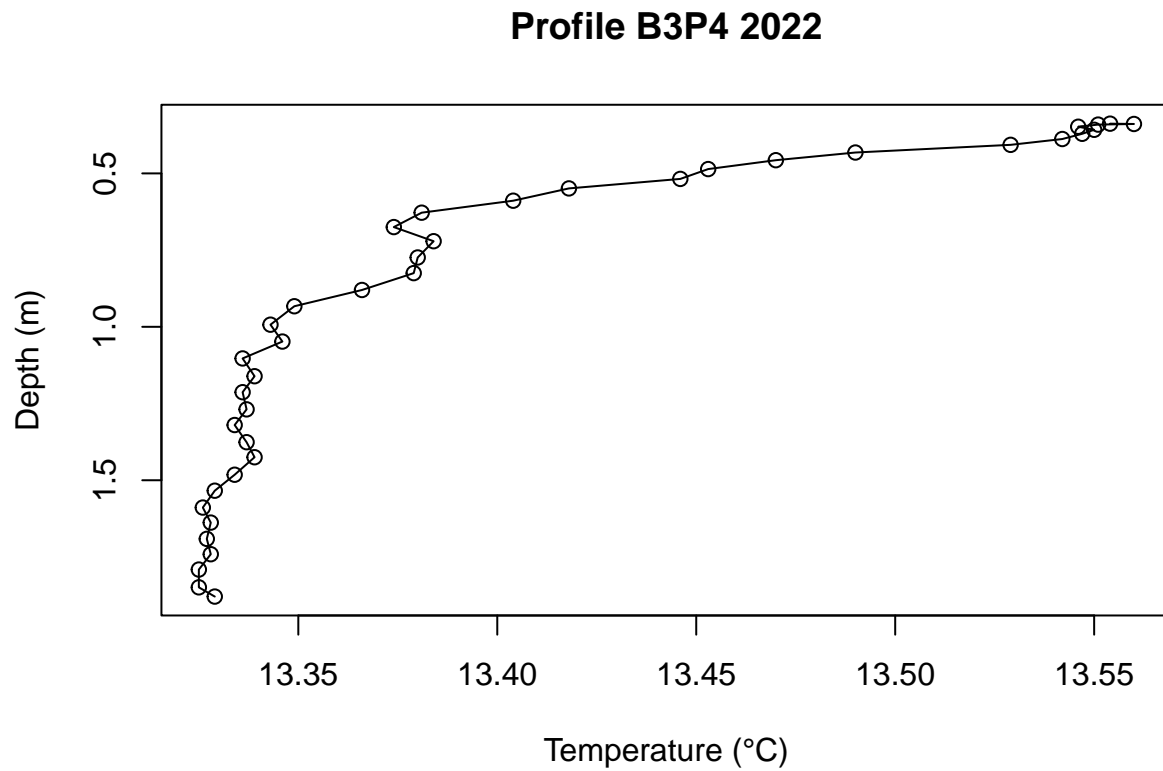
ERL152

Profile ERL152 2021



Same temperature across all depths (difference < 0.5°C). -> set mixed layer depth to maximum profiling depth (4.117m)

B3P4



Same temperature across all depths (difference < 0.5°C). -> set mixed layer depth to maximum profiling depth (1.879)

Appendix

Version and packages used to generate this report:

```
## 2023-08-03 09:35:48.61355 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:

```
# Profile B1P1 -----

#####
# This is the profile from 2021, since for 2022, it was not available
#####
prof <- fread("~/ZIVI_EAWAG/project_22/sonde_profiling/B1P1Sept10_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 756-813, where the profiling was done
prof <- prof[c(756:813),]

# 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")

# The drop in temperature is very small (<0.5°C) and I therefore conclude that the
# actively mixed layer depth at that time was at least 3 meters.
```

```

# -> set mixed layer depth to maximum profiling depth (3.163m)

# Profile B2P2 -----

prof <- fread("~/ZIVI_EAWAG/project_22/sonde_profiling/B2P2 June 19 22.txt", sep = "\t")

# Choose columns of interest
prof <- prof[,c("V8", "V23")]
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 219-278, where the profiling was done
prof <- prof[c(219:278),]

# 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 2022")

# Same temperature across all depths

# -> set mixed layer depth to maximum profiling depth (1.948m)

# Profile B2P3 -----

prof <- fread("~/ZIVI_EAWAG/project_22/sonde_profiling/B2P3 June 19 22.txt", sep = "\t")

# Choose columns of interest
prof <- prof[,c("V8", "V23")]
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 216-283, where the profiling was done
prof <- prof[c(216:283),]

# 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 2022")

# Same temperature across all depths

# -> set mixed layer depth to maximum profiling depth (3.144m)

# Profile B3P1 -----

prof <- fread("~/ZIVI_EAWAG/project_22/sonde_profiling/B3P1 June 20 22.txt", sep = "\t")

# Choose columns of interest

```

```

prof <- prof[,c("V8", "V23")]
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 173-238, where the profiling was done
prof <- prof[c(173:238),]

# 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 2022")

# Same temperature across all depths

# -> set mixed layer depth to maximum profiling depth (2.026m)

# Profile B3P2 -----
prof <- fread("~/ZIVI_EAWAG/project_22/sonde_profiling/B3P2 June 20 22.txt", sep = "\t")

# Choose columns of interest
prof <- prof[,c("V8", "V23")]
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 150-188, where the profiling was done
prof <- prof[c(150:188),]

# 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 2022")

# Same temperature across all depths (difference < 0.5°C)

# -> set mixed layer depth to maximum profiling depth (1.928m)

# Profile B3P0 -----
prof <- fread("~/ZIVI_EAWAG/project_22/sonde_profiling/B3P0 June 20 22.txt", sep = "\t")

# Choose columns of interest
prof <- prof[,c("V8", "V23")]
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 257-307, where the profiling was done
prof <- prof[c(257:307),]

# 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 2022")

# Same temperature across all depths (difference < 0.5°C)

# -> set mixed layer depth to maximum profiling depth (1.713m)

# Profile ERL85 -----

#####
# This is the profile from 2021, since for 2022, it was not available
#####
prof <- fread("~/ZIVI_EAWAG/project_22/sonde_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 992-1108, 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")

# Same temperature across all depths (difference < 0.5°C)

# -> set mixed layer depth to maximum profiling depth (1.713m)

# Profile B2P4 -----
prof <- fread("~/ZIVI_EAWAG/project_22/sonde_profiling/B2P4 June 19 22.txt", sep = "\t")

# Choose columns of interest
prof <- prof[,c("V8", "V23")]
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 789-869, where the profiling was done
prof <- prof[c(789:869),]

```



```

# 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 2022")

# Quite a steep thermocline from 2m downwards

# -> set mixed layer depth to 2m

# Profile ERL152 -----

#####
# This is the profile from 2021, since for 2022, it was not available
#####
prof <- fread("~/ZIVI_EAWAG/project_22/sonde_profiling/ERL152_Sept16_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 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")

# Same temperature across all depths (difference < 0.5°C)

# -> set mixed layer depth to maximum profiling depth (4.117m)

# Profile B3P4 -----

prof <- fread("~/ZIVI_EAWAG/project_22/sonde_profiling/B3P4_June_21_22.txt", sep = "\t")

# Choose columns of interest
prof <- prof[,c("V8", "V23")]
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 505-543, where the profiling was done
prof <- prof[c(505:543),]

# 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 B3P4 2022")  
  
# Same temperature across all depths (difference < 0.5°C)  
  
# -> set mixed layer depth to maximum profiling depth (1.879)
```