

# LMM\_NvS

Created January 28, 2025

## Changes

- 1/28/25: loading data

```
library(lme4)
```

```
## Loading required package: Matrix
```

```
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(ggplot2)
```

## Load Data

```
# File from github
filepath = "https://raw.githubusercontent.com/shabanm2/Utqiagvik/pca-25/Analysis_Ready_Data/"
df <- read.csv(paste0(filepath, "daily_2022_2024.csv"))
df <- df %>% select(-X) %>% select(-X.1)
df$Date <- as.POSIXct(df$date, format="%Y-%m-%d")
df <- df %>% filter(windspeed != -888.88) %>% filter(winddir != -888.88)
```

## Select and Transform Data

North vs South

TNHA:

North = TNHA-SC

South = TNHA-SA

SSMH:

North = SSMH-SB

South = SSMH-SA

BEO (Control): does not have different aspects

```
nvs <- df %>% filter(fullname == "TNHA-SA" | fullname == "TNHA-SC" | fullname == "SSMH-SB" | fullname == "SSMH-SA")

# filter out data from before data collection
# filter to get only depth of 10cm for now
df_10cm <- nvs %>% filter(grounddepth == 8) %>% filter(Date >= "2022-06-19")
```

## Fit LMM

```
lmm0 <- lmer(groundtemp ~ airtemp + vwc + solar + windspeed + aspect + (1|site), data = df_10cm)
summary(lmm0)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: groundtemp ~ airtemp + vwc + solar + windspeed + aspect + (1 |
##      site)
##      Data: df_10cm
##
## REML criterion at convergence: 10927.7
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.7941 -0.4783  0.0118  0.5160  7.8222
##
## Random effects:
##      Groups   Name      Variance Std.Dev.
##      site     (Intercept) 0.05909  0.2431
##      Residual              6.46800  2.5432
## Number of obs: 2317, groups: site, 2
##
## Fixed effects:
##              Estimate Std. Error t value
## (Intercept) -0.3345152  0.2573161  -1.300
## airtemp      0.6739394  0.0087078  77.394
## vwc          3.6543524  0.5076261   7.199
## solar       -0.0051227  0.0009276  -5.523
## windspeed    0.1069898  0.0632437   1.692
## aspectSouth  1.1278163  0.1159095   9.730
##
## Correlation of Fixed Effects:
##              (Intr) airtmp vwc      solar  wndspd
## airtemp      0.494
## vwc          -0.586 -0.664
## solar        -0.306 -0.287  0.130
```

```
## windspeed    -0.355 -0.123  0.151  0.076
## aspectSouth -0.368 -0.177  0.296 -0.160  0.233
```

```
lmm1 <- lmer(groundtemp ~ airtemp + vwc + solar + aspect + (1|site), data = df_10cm)
summary(lmm1)
```

```
## Linear mixed model fit by REML ['lmerMod']
## Formula: groundtemp ~ airtemp + vwc + solar + aspect + (1 | site)
## Data: df_10cm
##
## REML criterion at convergence: 10926.9
##
## Scaled residuals:
##      Min       1Q   Median       3Q      Max
## -3.8346 -0.4751  0.0114  0.5207  7.8056
##
## Random effects:
## Groups Name Variance Std.Dev.
## site (Intercept) 0.05317 0.2306
## Residual 6.47347 2.5443
## Number of obs: 2317, groups: site, 2
##
## Fixed effects:
## Estimate Std. Error t value
## (Intercept) -0.1796726 0.2343280 -0.767
## airtemp 0.6758010 0.0086438 78.183
## vwc 3.5232102 0.5019738 7.019
## solar -0.0052399 0.0009253 -5.663
## aspectSouth 1.0820043 0.1127689 9.595
##
## Correlation of Fixed Effects:
## (Intr) airtmp vwc solar
## airtemp 0.499
## vwc -0.592 -0.658
## solar -0.307 -0.281 0.121
## aspectSouth -0.322 -0.154 0.271 -0.183
```

```
coef(lmm1)
```

```
## $site
## (Intercept) airtemp vwc solar aspectSouth
## SSMH -0.02520229 0.675801 3.52321 -0.00523987 1.082004
## TNHA -0.33414284 0.675801 3.52321 -0.00523987 1.082004
##
## attr(,"class")
## [1] "coef.mer"
```

It seems like there is not too much of a difference between the two sites, but there is still presence of a difference as shown by the two different intercepts for SSMH vs TNHA.

Graphing linear models: Random effects have different intercepts, and the fixed effects have different slopes

```
coeffs = coef(lmm1)$site
```

## Table Output

```
library(stargazer)
```

```
##
```

```
## Please cite as:
```

```
## Hlavac, Marek (2022). stargazer: Well-Formatted Regression and Summary Statistics Tables.
```

```
## R package version 5.2.3. https://CRAN.R-project.org/package=stargazer
```

```
stargazer(lmm1, type = "html",
  digits = 3,
  star.cutoffs = c(0.05, 0.01, 0.001),
  digit.separator = "")
```

```
##
```

```
## <table style="text-align:center"><tr><td colspan="2" style="border-bottom: 1px solid black"></td></tr>
## <tr><td></td><td colspan="1" style="border-bottom: 1px solid black"></td></tr>
## <tr><td style="text-align:left"></td><td>groundtemp</td></tr>
## <tr><td colspan="2" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-align:left">
## <tr><td style="text-align:left"></td><td>(0.009)</td></tr>
## <tr><td style="text-align:left"></td><td></td></tr>
## <tr><td style="text-align:left">vwc</td><td>3.523<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td>(0.502)</td></tr>
## <tr><td style="text-align:left"></td><td></td></tr>
## <tr><td style="text-align:left">solar</td><td>-0.005<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td>(0.001)</td></tr>
## <tr><td style="text-align:left"></td><td></td></tr>
## <tr><td style="text-align:left">aspectSouth</td><td>1.082<sup>***</sup></td></tr>
## <tr><td style="text-align:left"></td><td>(0.113)</td></tr>
## <tr><td style="text-align:left"></td><td></td></tr>
## <tr><td style="text-align:left">Constant</td><td>-0.180</td></tr>
## <tr><td style="text-align:left"></td><td>(0.234)</td></tr>
## <tr><td style="text-align:left"></td><td></td></tr>
## <tr><td colspan="2" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-align:left">
## <tr><td style="text-align:left">Log Likelihood</td><td>-5463.442</td></tr>
## <tr><td style="text-align:left">Akaike Inf. Crit.</td><td>10940.880</td></tr>
## <tr><td style="text-align:left">Bayesian Inf. Crit.</td><td>10981.120</td></tr>
## <tr><td colspan="2" style="border-bottom: 1px solid black"></td></tr><tr><td style="text-align:left">
## </table>
```