PM Composition in Rural Yunnan Province China

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Objectives

To produce a reviewable document containing R code for KH Xuanwei Thesis

Setup

Java is required for package "XLConnect". Make sure Java is installed.

```
if (system2("java","-version")) {
    stop("Java not found. Install Java first. https://java.com/en/download/")
}
```

Load the required R packages.

```
for (pkg in c("knitr", "RCurl", "doBy", "psych", "beeswarm", "ggplot2",
              "reshape2", "scales", "shiny")) {
    if (! suppressWarnings(require(pkg, character.only=TRUE)) ) {
        install.packages(pkg, repos="http://cran.fhcrc.org", dependencies=TRUE)
        if (! suppressWarnings(require(pkg, character.only=TRUE)) ) {
            stop(paste0(c("Can't load package: ", pkg, "!"), collapse = ""))
        }
    }
}
```

Configure `knitr` options.

```
opts_chunk$set(tidy=FALSE, cache=FALSE)
```

Load, subset data to exclude Xuanwei City.

```
file_PC <- c("C:/Users/KGH/OneDrive/Documents/Xuanwei/air-comp/Xuanwei_ForAnalysis_Test.csv")
X <- subset(read.csv(file_PC),village != "Xuanwei")
```

Summary of Concentrations

By site and compartment.

```
mass.site <- droplevels(
    summaryBy(conc ~ sitenum + location + village, data=X,id = NULL,
              keep.names=TRUE, FUN=mean, na.rm = TRUE))
mass.site.table <- mass.site
mass.site.table[,4] <- round(mass.site.table[,4],0)
colnames(mass.site.table) <- c("Site Number", "Compartment", "Village",
                               "Mass Conc")
mass.site.table
```

```
##    Site Number Compartment   Village Mass Conc
## 1            1     Ambient   Jiu Bao        25
## 2            1        Home   Jiu Bao        50
## 3            2     Ambient   Jiu Bao        25
## 4            2        Home   Jiu Bao      2264
## 5            3     Ambient   Jiu Bao        23
## 6            3        Home   Jiu Bao        51
## 7            4     Ambient   Qi Long        20
## 8            4        Home   Qi Long        33
## 9            5     Ambient   Qi Long        16
## 10           5        Home   Qi Long        23
## 11           6     Ambient   Qi Long        17
## 12           6        Home   Qi Long        27
## 13           7     Ambient Tang Tang        30
## 14           7        Home Tang Tang        38
## 15           8     Ambient Tang Tang        41
## 16           8        Home Tang Tang       362
## 17           9     Ambient Tang Tang        29
## 18           9        Home Tang Tang        27
```

```
levo.site <- droplevels(
    summaryBy( Levo_ugV ~ sitenum + location + village, data=X, id = NULL,
               keep.names=TRUE, FUN=mean, na.rm = TRUE))
levo.site.table <- levo.site
levo.site.table[,4] <- round(levo.site.table[,4],5)
colnames(levo.site.table) <- c("Site Number", "Compartment", "Village",
                               "Levo Conc")
levo.site.table
```

```
##    Site Number Compartment   Village Levo Conc
## 1            1     Ambient   Jiu Bao   0.00010
## 2            1        Home   Jiu Bao   0.00017
## 3            2     Ambient   Jiu Bao   0.00018
## 4            2        Home   Jiu Bao   0.15150
## 5            3     Ambient   Jiu Bao   0.00010
## 6            3        Home   Jiu Bao   0.00012
## 7            4     Ambient   Qi Long   0.00012
## 8            4        Home   Qi Long   0.00020
## 9            5     Ambient   Qi Long   0.00006
## 10           5        Home   Qi Long   0.00007
## 11           6     Ambient   Qi Long   0.00005
## 12           6        Home   Qi Long   0.00009
## 13           7     Ambient Tang Tang   0.00008
## 14           7        Home Tang Tang   0.00045
```

```
## 15           8     Ambient Tang Tang   0.00020
## 16           8        Home Tang Tang   0.00881
## 17           9     Ambient Tang Tang   0.00005
## 18           9        Home Tang Tang   0.00005
```

```
nitro.site <- droplevels(
    summaryBy( X1NP_ugV + X2NP_ugV + X2NFL_ugV ~ sitenum + location + village,
               data=X, id = NULL, keep.names=TRUE, FUN=mean, na.rm = TRUE))
nitro.site.table <- nitro.site
nitro.site.table[,4:6] <- round(nitro.site.table[,4:6],6)
colnames(nitro.site.table) <- c("Site Number", "Compartment", "Village",
                                "1NP Conc", "2NP Conc", "2NFL Conc")
nitro.site.table
```

```
##    Site Number Compartment   Village 1NP Conc 2NP Conc 2NFL Conc
## 1            1     Ambient   Jiu Bao 0.000095 0.000158  0.000221
## 2            1        Home   Jiu Bao 0.000240 0.000360  0.000390
## 3            2     Ambient   Jiu Bao 0.000038 0.000072  0.000116
## 4            2        Home   Jiu Bao 0.012602 0.004458  0.006932
## 5            3     Ambient   Jiu Bao 0.000031 0.000071  0.000135
## 6            3        Home   Jiu Bao 0.000053 0.000124  0.000109
## 7            4     Ambient   Qi Long 0.000049 0.000073  0.000116
## 8            4        Home   Qi Long 0.000037 0.000100  0.000122
## 9            5     Ambient   Qi Long 0.000035 0.000065  0.000099
## 10           5        Home   Qi Long 0.000017 0.000072  0.000102
## 11           6     Ambient   Qi Long 0.000033 0.000071  0.000099
## 12           6        Home   Qi Long 0.000024 0.000133  0.000165
## 13           7     Ambient Tang Tang 0.000031 0.000061  0.000068
## 14           7        Home Tang Tang 0.000033 0.000088  0.000105
## 15           8     Ambient Tang Tang 0.000119 0.000169  0.000171
## 16           8        Home Tang Tang 0.005352 0.002049  0.001740
## 17           9     Ambient Tang Tang 0.000073 0.000091  0.000111
## 18           9        Home Tang Tang 0.000021 0.000049  0.000075
```

```
BaP.site <- droplevels(
    summaryBy( Benzo.a.pyrene_ugV  ~ sitenum + location + village,
               data=X, id = NULL, keep.names=TRUE, FUN=mean, na.rm = TRUE))
BaP.site.table <- BaP.site
BaP.site.table[,4] <- round(BaP.site.table[,4],4)
colnames(BaP.site.table) <- c("Site Number", "Compartment", "Village",
                              "BaP Conc")
BaP.site.table
```

```
##    Site Number Compartment   Village BaP Conc
## 1            1     Ambient   Jiu Bao   0.0027
## 2            1        Home   Jiu Bao   0.0081
## 3            2     Ambient   Jiu Bao   0.0013
## 4            2        Home   Jiu Bao   0.1523
## 5            3     Ambient   Jiu Bao   0.0019
## 6            3        Home   Jiu Bao   0.0014
## 7            4     Ambient   Qi Long   0.0014
## 8            4        Home   Qi Long   0.0011
## 9            5     Ambient   Qi Long   0.0010
```

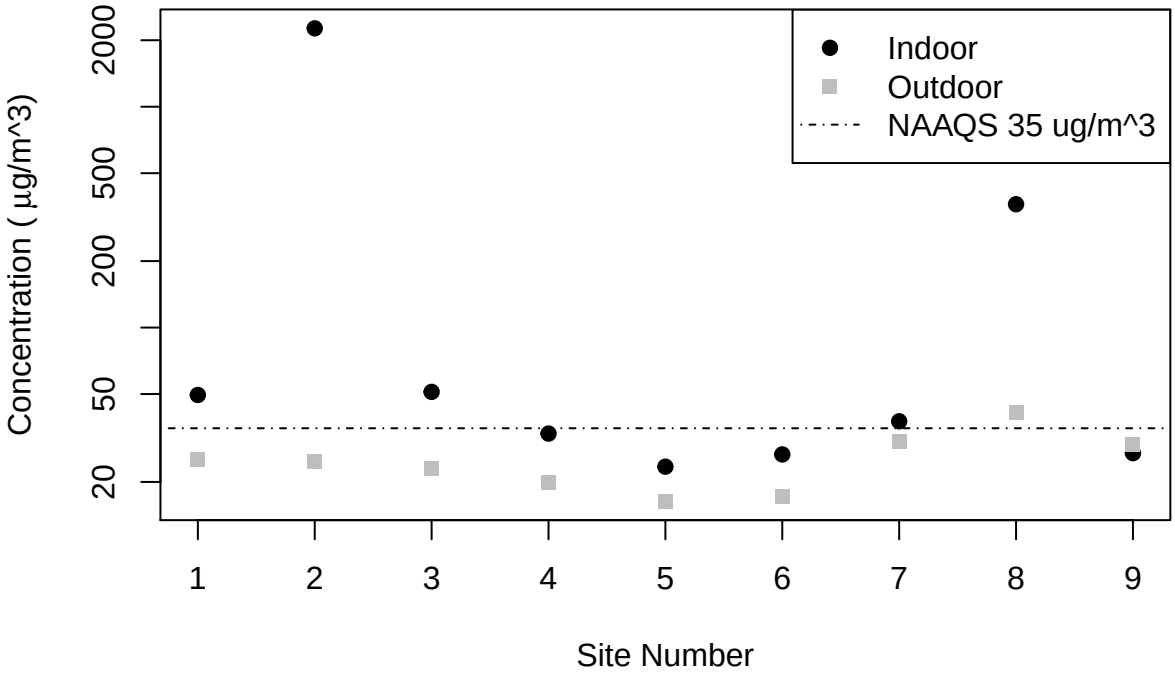
```
## 10           5        Home   Qi Long   0.0008
## 11           6     Ambient   Qi Long   0.0010
## 12           6        Home   Qi Long   0.0011
## 13           7     Ambient Tang Tang   0.0018
## 14           7        Home Tang Tang   0.0012
## 15           8     Ambient Tang Tang   0.0063
## 16           8        Home Tang Tang   0.1441
## 17           9     Ambient Tang Tang   0.0018
## 18           9        Home Tang Tang   0.0014
```

```
metals <- droplevels(
    summaryBy( PbConcV + AsConcV + SeConcV  ~ sitenum + location, data=X,
               id = NULL, keep.names=TRUE, FUN=mean, na.rm = TRUE))
```

Scatter Plots

Visualize mass concentrations by village.

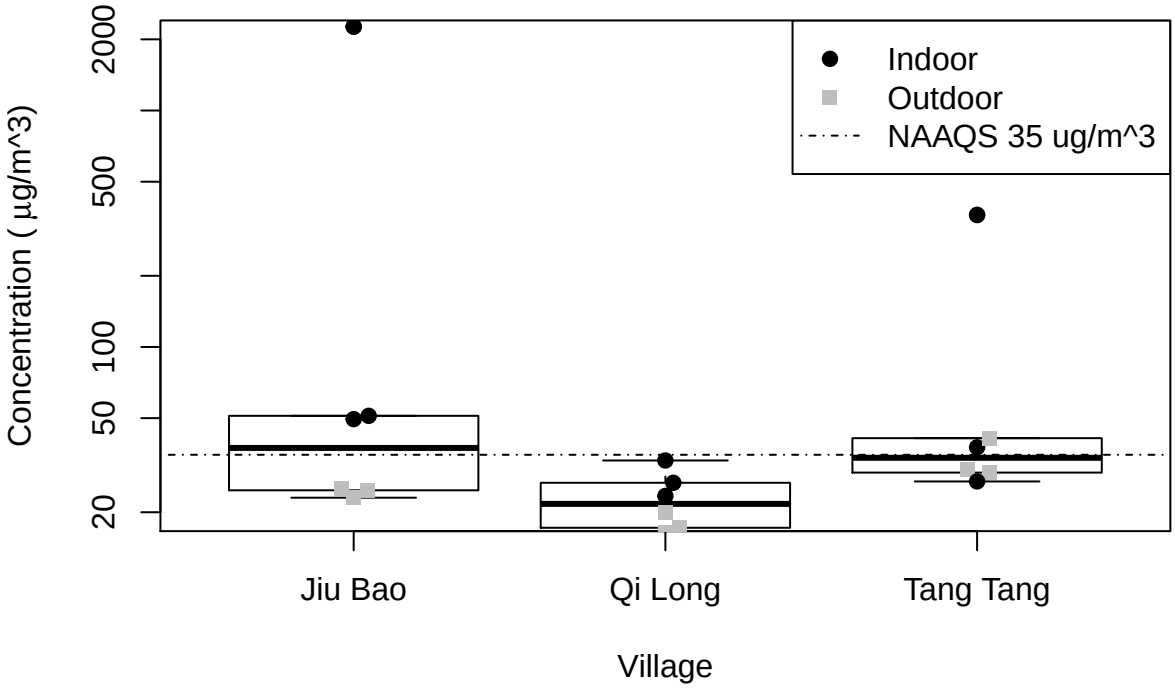
```
plot(conc ~ sitenum, data = mass.site, type = "n", log="y",axes = FALSE,
     frame.plot=TRUE,ylab =
         expression(paste("Concentration ( ",mu,"g/m^3",")",sep ="")),
     xlab="Site Number",main="")
points(conc ~ sitenum,data = subset(mass.site, location == "Home"), col=1,pch=19)
points(conc ~ sitenum,data = subset(mass.site, location == "Ambient"), col=8,pch=15)
Axis(side=1, at = 1:9, labels=c(1:9))
Axis(side=2, labels=TRUE)
abline(h=35, lty=4, col=1)
legend("topright", c("Indoor","Outdoor","NAAQS 35 ug/m^3"),col=c(1,8,1),
       pch=c(19,15,NA),lty=c(NA,NA,4))
```



Box Plots

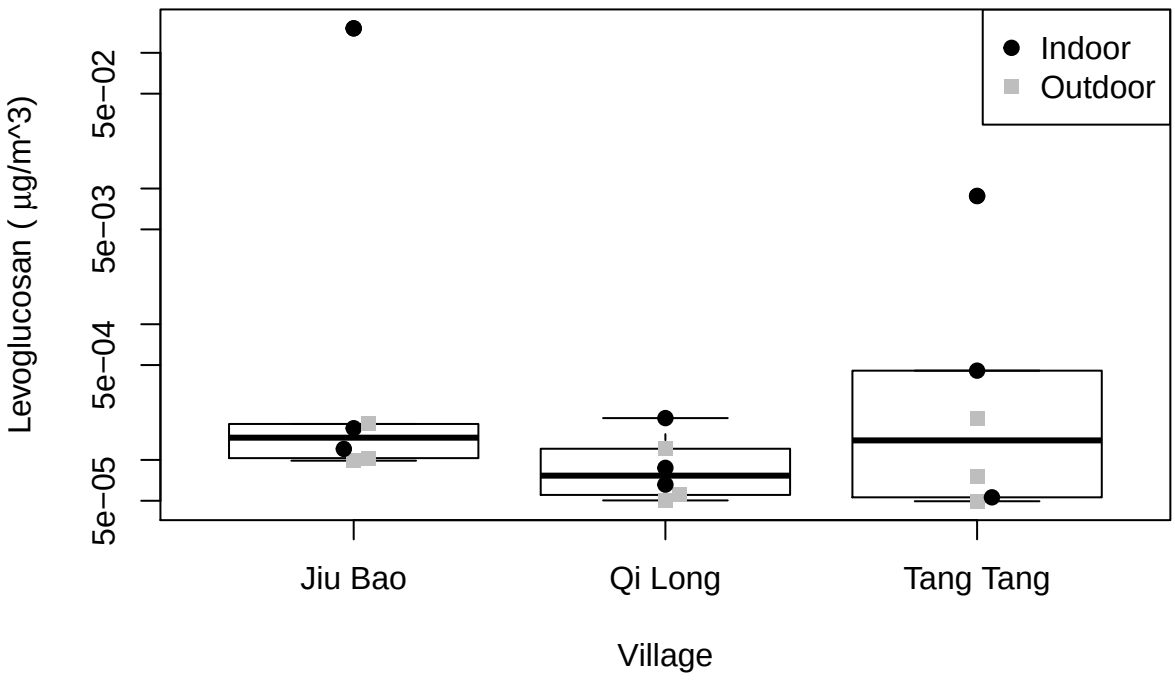
Mass concentration by village.

```
boxplot(conc~village, data=mass.site, pch=19,
        ylab=expression(paste("Concentration ( ",mu,"g/m^3",")",sep ="")),
        main="",xlab = "Village", log="y", ylim=c(20,2000))
beeswarm(conc~village, data=mass.site, pwpch=ifelse(location=="Home",19,15),
         pwcol=ifelse(location=="Home",1,8),log="TRUE", add=TRUE,
         ylim=c(20,2000))
abline(h=35, lty=4, col=1)
legend("topright", c("Indoor", "Outdoor","NAAQS 35 ug/m^3"),
       col=c(1,8), pch=c(19,15,NA),lty=c(NA,NA,4))
```



Levoglucosan concentration by village.

```
boxplot(Levo_ugV ~ village, data=levo.site, pch=19,
        ylab=expression(paste("Levoglucosan ( ",mu,"g/m^3",")",sep ="")),
        main="",xlab = "Village", log="y")
beeswarm(Levo_ugV~village, data=levo.site, pwpch=ifelse(location=="Home",19,15),
         pwcol=ifelse(location=="Home",1,8),log="TRUE", add=TRUE)
legend("topright", c("Indoor", "Outdoor"),
       col=c(1,8), pch=c(19,15))
```



Nitro-PAH concentration by village.

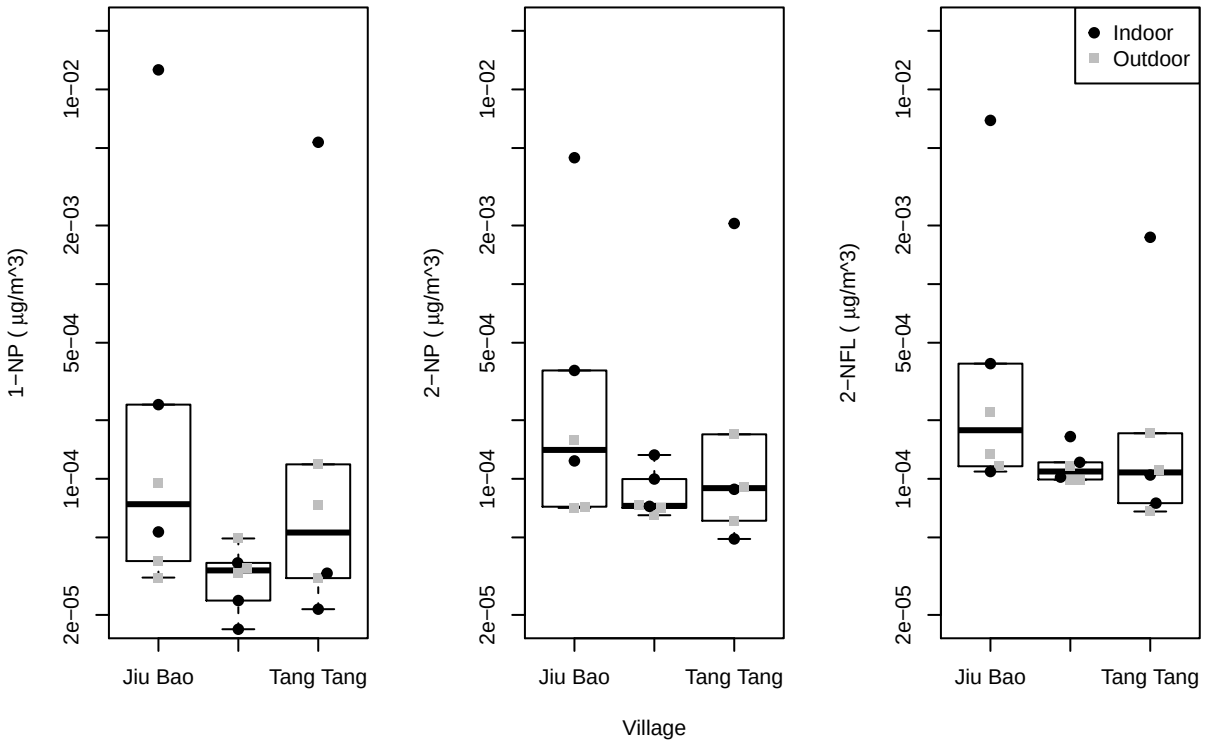
```
par(mfrow=c(1,3))

boxplot(X1NP_ugV ~ village, data=nitro.site, pch=19,
        ylab=expression(paste("1-NP ( ",mu,"g/m^3",")",sep ="")),
        main="", log="y", ylim=c(2e-05,2e-02))
beeswarm(X1NP_ugV ~ village, data=nitro.site,
         pwpch=ifelse(location=="Home",19,15),
         pwcol=ifelse(location=="Home",1,8),log="TRUE", add=TRUE,
         ylim=c(2e-05,2e-02))

boxplot(X2NP_ugV ~ village, data=nitro.site, pch=19,
        ylab=expression(paste("2-NP ( ",mu,"g/m^3",")",sep ="")),
        main="",xlab = "Village", log="y", ylim=c(2e-05,2e-02))
beeswarm(X2NP_ugV ~ village, data=nitro.site,
         pwpch=ifelse(location=="Home",19,15),
         pwcol=ifelse(location=="Home",1,8),log="TRUE", add=TRUE,
         ylim=c(2e-05,2e-02))

boxplot(X2NFL_ugV ~ village, data=nitro.site, pch=19,
        ylab=expression(paste("2-NFL ( ",mu,"g/m^3",")",sep ="")),
        main="", log="y", ylim=c(2e-05,2e-02))
beeswarm(X2NFL_ugV ~ village, data=nitro.site,
         pwpch=ifelse(location=="Home",19,15),
         pwcol=ifelse(location=="Home",1,8),log="TRUE", add=TRUE,
```

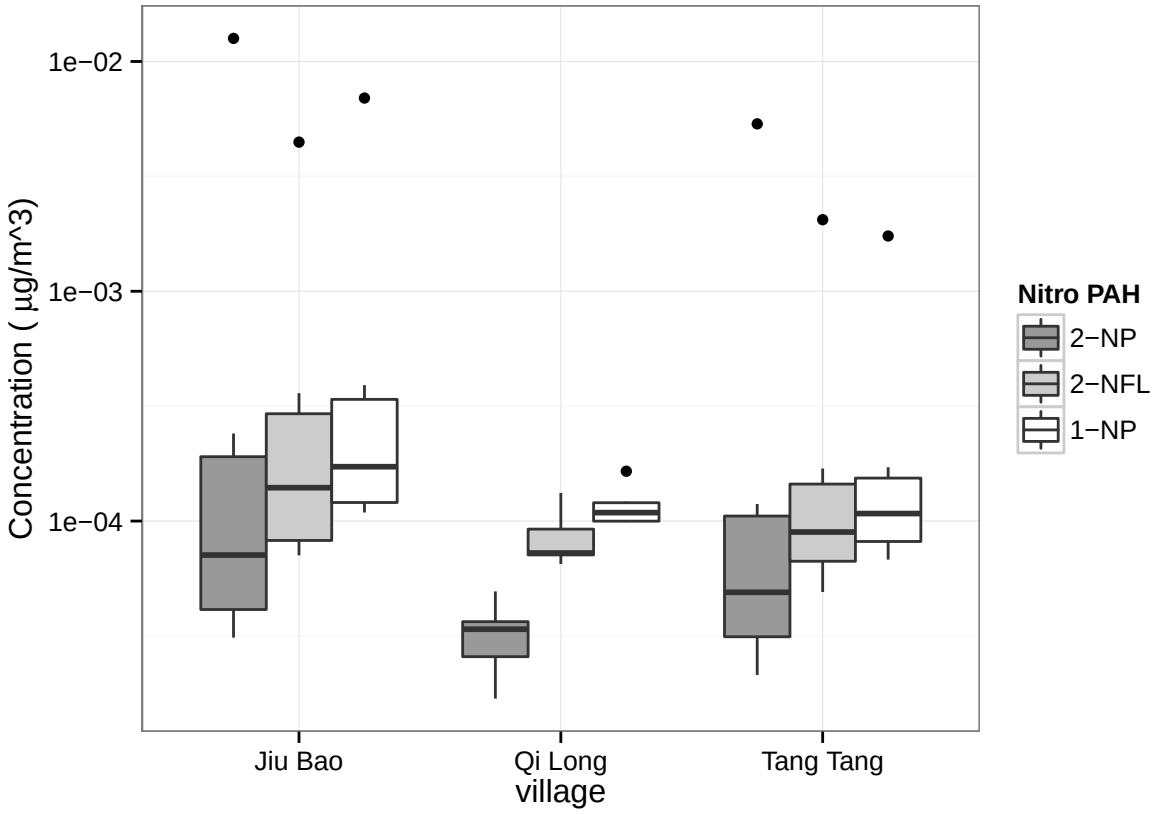
```
         ylim=c(2e-05,2e-02))
legend("topright", c("Indoor", "Outdoor"),
       col=c(1,8), pch=c(19,15))
```



Nitro-PAH by Village, GG Plot

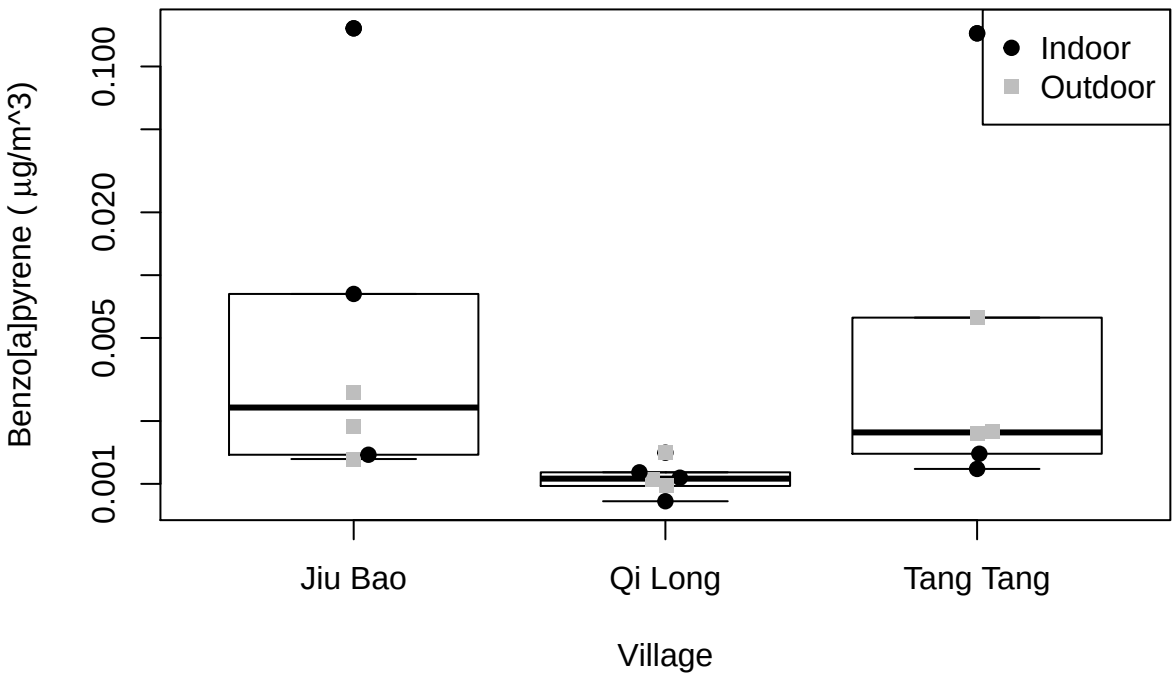
```
am.nitro.m <- melt(nitro.site, id.vars = c("sitenum", "location", "village"))
bxp.NP <- ggplot(am.nitro.m, aes(x=village, y=value))
bwPalette <- c("#999999", "#CCCCCC", "#FFFFFF")

bxp.NP + scale_y_continuous(trans=log10_trans()) + ylab(expression(
    paste("Concentration ( ",mu,"g/m^3",")",sep ="""))) +
    geom_boxplot(aes(fill = variable)) + theme_bw() +
    scale_fill_manual(values=bwPalette, name = "Nitro PAH",
                      labels = c("2-NP", "2-NFL","1-NP"))
```



Benzo[a]pyrene

```
boxplot(Benzo.a.pyrene_ugV ~ village, data=BaP.site, pch=19,
        ylab=expression(paste("Benzo[a]pyrene ( ",mu,"g/m^3",")",sep ="")),
        main="",xlab = "Village", log="y")
beeswarm(Benzo.a.pyrene_ugV ~ village, data=BaP.site, pwpch=ifelse(
    location=="Home",19,15), pwcol=ifelse(location=="Home",1,8),
    log="TRUE", add=TRUE)
legend("topright", c("Indoor", "Outdoor"),
       col=c(1,8), pch=c(19,15))
```


Benzo[a]pyrene (µg/m^3)
0.001
0.005
0.020
0.100
Indoor
Outdoor
Jiu Bao
Qi Long
Tang Tang
Village