Example R code for the most complex model used in this study

```
#set your directory
setwd("E:/shalegasstudies")

#read in data from a CSV file
groundcond <- read.csv('eacondgroundwater.csv')

#load the necessary R library
library(R2jags)

#set data types in data frame
groundcond[,'SiteNo']<-factor(groundcond[,'SiteNo'])

#jags model with trend set as the Year and two factors (month and Site)
# this code includes a simulation routine that allows for posterior prediction analysis
#there is no prediction routine
jags_code = '
model{
# Likelihood
for(i in 1:N){
y[i] ~ dnorm(intercept[SiteNo[i], Month[i]] + slope[SiteNo[i],Month[i]]*(Year[i] - mean(Year)),
residual_sd^-2)
y_sim[i] ~ dnorm(intercept[SiteNo[i],Month[i]] + slope[SiteNo[i],Month[i]]*(Year[i] - mean(Year)),
residual_sd^-2)
}

# Priors
for(j in 1:N_SiteNo) {
for(k in 1:N_month) {
intercept[j,k] ~ dnorm(mu_intercept, sigma_intercept^-2)
slope[j,k] ~ dnorm(mu_SiteNo, sigma_SiteNo^-2)
}
}
mu_intercept ~ dnorm(6, 2^-2)
mu_SiteNo ~ dnorm(0, 0.1^-2)
residual_sd ~ dt(0, 5,1)T(0,)
sigma_intercept ~ dt(0, 5,1)T(0,)
sigma_SiteNo ~ dt(0, 5,1)T(0,)
}
'
#Jags code ends here and it needs the quote marks

#R2Jags commands that operate the Jags code
jags_run = jags(data = list(N = nrow(groundcond),
                y = log(groundcond$result),
                Month=groundcond$Month,
                SiteNo = groundcond$SiteNo,
                N_SiteNo=length(unique(groundcond$SiteNo)),
                N_month=length(unique(groundcond$Month)),
                Year = groundcond$Year),
        parameters.to.save = c('intercept',
```

```
                    'slope',
                    'residual_sd',
                    'mu_intercept',
                    'mu_SiteNo',
                    'sigma_intercept',
                    'sigma_SiteNo',
                    'y_sim'),
         model.file = textConnection(jags_code))

#this svaes the klist item from the jags run
jags_run_year__month_siteno_normal<-jags_run
save(jags_run_year__month_siteno_normal,file="jags_run_year_month_siteno_normal.Rda")


#plots prior vs posterior estimates
pars = jags_run$BUGSoutput$sims.list
par(mfrow=c(1,3))
dens = density(pars$intercept)
curve(dnorm(x, mean = 6, sd = 2), 0, 12, xlab = 'intercept', ylab = '', ylim = range(dens$y))
lines(dens, col='red')
dens = density(pars$slope)
curve(dnorm(x, mean = 0, sd = 0.1), -0.5, 0.5, xlab = 'slope', ylab = '', ylim = range(dens$y))
lines(dens, col='red')
dens = density(pars$residual_sd)
curve(dunif(x, 0, 5), 0, 5, xlab = 'residual_sd', ylab = '', ylim = range(dens$y))
lines(dens, col='red')

#plots predcited vs modelled with a dashed black line
dev.off()
pred = pars$y_sim
y_sim_summary = apply(pred, 2, 'quantile',
              probs = c(0.025, 0.5, 0.975))
plot(log(groundcond$result), y_sim_summary[2,],
    xlab = 'Observed log(specific conductance)',
    ylab = 'Posterior Predicted value')
abline(a=0, b=1, col = 'black', lwd=3, lty=2)
abline(lm(log(groundcond$result) ~ y_sim_summary[2,], data=groundcond))
```