

## WINBUGS CODE

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```
# model_mvparpool is the multilevel regression
# By varying the alpha and beta and tau (variance) within each site with non informative priors, Bugs fits
regression on Y using X
# Further, the betas are informed from a common multivariate mean (mu.beta) called the hyper
parameter. At level 3, the hyper parameter is informed from non-informative prior. The shrinkage on the
# betas will allow partial pooling across sites. Only betas are partially pooled. alpha which represents the
mean flows is not shrunk.
```

```
model
{

for (i in 1:nsites)
{
for (t in 1:ntimes)
{
predictand[t,i] ~ dnorm(mu.predictand.pp[t,i],tau.predictand.pp[i,1])
mu.predictand.pp[t,i] <- alpha.pp[i,1] + inprod(betas.pp[i,],predictor[t,])

predictand.rep.pp[t,i] ~ dnorm(mu.predictand.pp[t,i],tau.predictand.pp[i,1])

}
}

for (i in 1:nsites)
{
alpha.pp[i,1] ~ dnorm(0, 0.0001)

tau.predictand.pp[i,1] <- pow(sigma.predictand.pp[i,1],-2)
sigma.predictand.pp[i,1] ~ dunif(0,100)
}

for (i in 1:nsites)
{
betas.pp[i,1:npred] ~ dnorm(mu.betas.pp[i,], tau.betas.pp[i,])
}
}
```

```
for (j in 1:npred)
{
mu.betas.pp[j] ~ dnorm(0, 0.0001)

}

tau.betas.pp[1:npred,1:npred] ~ dwish(Wp[,,],df.p)
df.p <- npred + 1
sigma.betas.pp[1:npred,1:npred] <- inverse(tau.betas.pp[,,])

for (j in 1:npred)
{
for (j.prime in 1:npred)
{
rho.betas.pp[j,j,prime] <- sigma.betas.pp[j,j,prime]/sqrt(sigma.betas.pp[j,j,prime]*sigma.betas.pp[j.prime,j.prime])
}
}
}
```