```
require(phydynR)
```

```
Warning:  package 'ape' was built under R version 3.3.2
Warning:  package 'expm' was built under R version 3.3.2
Warning:  package 'phytools' was built under R version 3.3.2
Warning:  package 'maps' was built under R version 3.3.2
Warning:  package 'phangorn' was built under R version 3.3.2
Warning:  package 'ggplot2' was built under R version 3.3.2
Warning:  package 'BH' was built under R version 3.3.2
Warning:  package 'Rcpp' was built under R version 3.3.2
Warning:  package 'RcppArmadillo' was built under R version 3.3.2
```

```
source('model1.R')

MH <- 20
PID <- Sys.getpid()

# counterfactuals sim'ed separately, eg:
#~ nh_wtransm <- c(
#~  nh1 = 1
#~  ,nh2 = 1
#~  ,nh3 = 1
#~  ,nh4 = 1
#~  ,nh5 = 1
#~ )

#~ o <- ode(y=y0, times=times_day, func=dydt, parms=list()  , method = 'adams')
o <- ode(y=y0, times=times_day, func=dydt, parms=list()  , method = 'rk4')
tfgy <- .tfgy( o )

############################
#~ incidence and prevalence
yfin <- tfgy[[4]][[length(times_day)]]
ffin <- tfgy[[2]][[length(times_day)]]
newinf <- sum(ffin[1:120, 1:120] ) * 365
plwhiv <- sum( yfin[-length(yfin)] )

#~  sample time and states
sampleTimes <- scan( file = 'sampleTimes' )
ss  <- matrix( scan( file = 'sampleStates' ) , byrow=TRUE, ncol = m)
colnames(ss) <- DEMES
# regularise
ss <- ss + 1e-4
ss = sampleStates <- ss / rowSums(ss)

# modify sample times so max corredsponds to 2013
```

```
sampleTimes <- sampleTimes + (years2days(2013) - max(sampleTimes) )

# test by downsampling
if (F)
{
n <- length( sampleTimes )
keep <- sample.int( n, size = 2e3, replace=F)
sampleTimes <- sampleTimes[keep]
sampleStates <- sampleStates[keep, ]
}


## sim tree

print('sim tree')
```

```
[1] "sim tree"
```

```
print(date())
```

```
[1] "Wed Jun 21 18:48:10 2017"
```

```
st.tree <- system.time( {
#~  daytree <- sim.co.tree.fgy(tfgy,  sampleTimes, sampleStates)
        daytree <- rcolgem::sim.co.tree.fgy(tfgy,  sampleTimes, sampleStates)
})
```

```
Warning in rcolgem::sim.co.tree.fgy(tfgy, sampleTimes, sampleStates):
Estimated number of extant lineages at earliest time on time axis is
20.3646096708416, and sampled lineages are not likely to have a single
common ancestor.  Root of returned tree will have daughter clades corresponding
to simulated trees.
```

```
print(date())
```

```
[1] "Wed Jun 21 18:50:18 2017"
```

```
# rescale tree
tree <- daytree
sampleTimes <- days2years( tree$sampleTimes )
tree$edge.length <- tree$edge.length / 365
bdt <- DatedTree(  tree, sampleTimes, tree$sampleStates, tol = Inf)

D <-  cophenetic.phylo( bdt )
cat( 'mean genetic divergence if rate = .0015\n' )
```

```
mean genetic divergence if rate = .0015
```

```r
print( mean(D ) * .0015 )
```

```
[1] 0.1489217
```

```r
n<- bdt$n

treeSampleStates <- tree$sampleStates
cd4s <- setNames( sapply( 1:nrow(treeSampleStates), function(k){
        deme <- DEMES[ which.max(treeSampleStates[k,] )  ]
        stage <- strsplit( deme, '.' , fixed=T)[[1]][1]
        stage <- as.numeric( tail( strsplit(stage, '')[[1]], 1 ) )
        if (stage==1) return(1e3)
        if (stage==2) return(750)
        if (stage==3) return(400)
        if (stage==4) return(300)
        if (stage==5) return(100)
}), tree$tip.label)
ehis <-  setNames( sapply( 1:nrow( treeSampleStates), function(k){
        deme <- DEMES[ which.max(treeSampleStates[k,] )  ]
        stage <- strsplit( deme, '.' , fixed=T)[[1]][1]
        stage <- as.numeric( tail( strsplit(stage, '')[[1]], 1 ) )
        ifelse( stage==1, TRUE, FALSE)
}), tree$tip.label)
sampleDemes <- setNames( sapply( 1:n, function(u) DEMES[which.max( treeSampleStates[u,])] ),

system.time(
  W <- phylo.source.attribution.hiv.msm( bdt
                                         , bdt$sampleTimes # must use years
                                         , cd4s = cd4s[bdt$tip.label] # named numeric vecto
                                         , ehi = ehis[bdt$tip.label] # named logical vector
                                         , numberPeopleLivingWithHIV  = plwhiv# scalar
                                         , numberNewInfectionsPerYear = newinf # scalar
                                         , maxHeight = MH
                                         #, res = 1e3
                                         #, treeErrorTol = Inf
                                         #, minEdgeLength = 1/52
  )
)
```

```
[1] "NOTE : sample times must be in units of years"
[1] "start source attrib"
[1] "Wed Jun 21 18:51:40 2017"
```

```
Error in sourceAttribMultiDemeCpp2(heights, Fs[fgyi], Gs[fgyi], Ys[fgyi],
:  c++ exception (unknown reason)
```

```
Timing stopped at: 19.304 8.026 27.421
```