ESM 232 Assignment 6

Madeline Oliver, Ruben Sanchez, Atefeh Mohseni

5/5/2021

Model of forest growth (where forest size in measured in units of carbon (C))

- dC/dt = r*C for forests where carbon is below a canopy closure threshold
- dC/dt = g for forests where carbon is at or above the threshold canopy closure
- dC/dt = 0 once a carrying capacity (K) is reached.

The size of the forest (C), Canopy closure threshold and carrying capacity are all in units of carbon

Canopy closure threshold: the size of the forest at which growth rates change from exponential to linear

r: early exponential growth rate

g: linear growth rate once canopy closure has been reached

Run model for 300 years (using the ODE solver) starting with an initial forest size of 10 kg/C and using the following parameters:

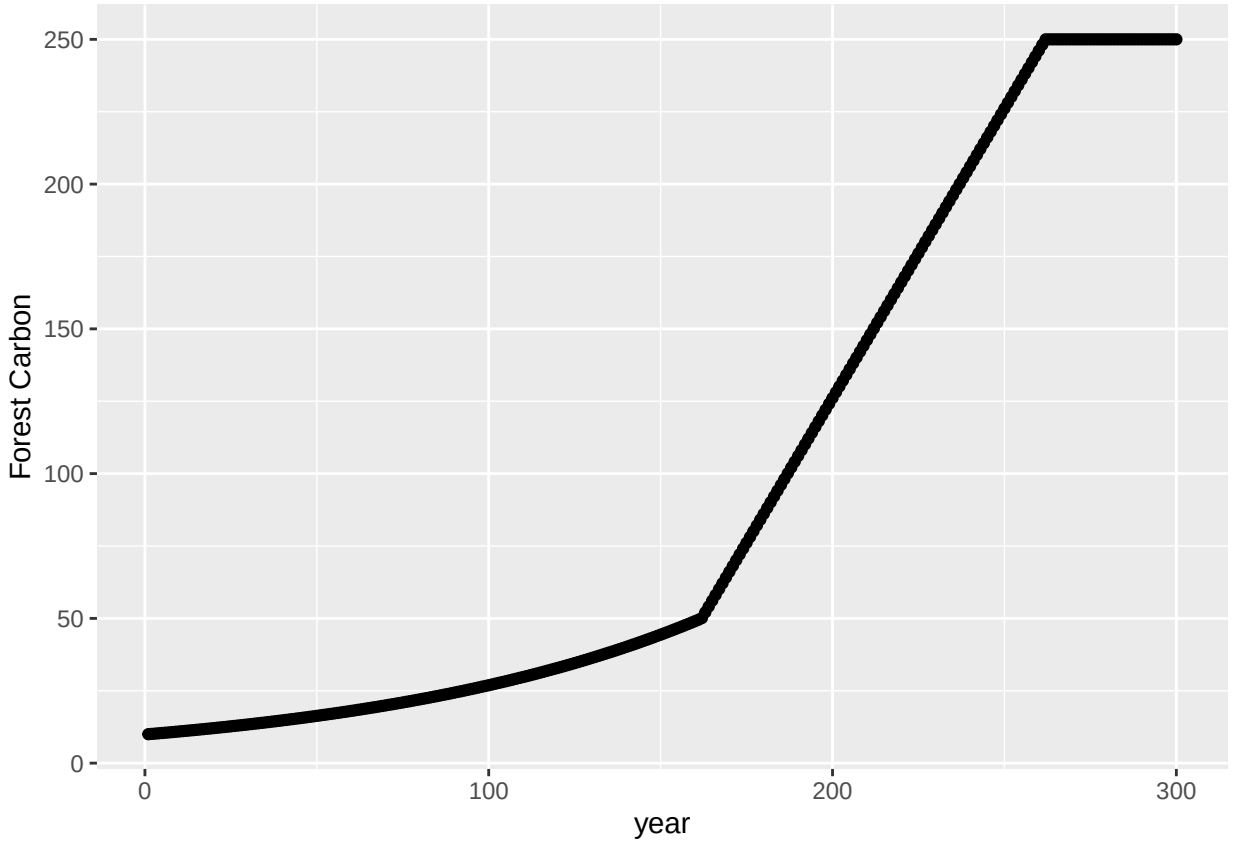
- canopy closure threshold = 50 kgC
- K = 250 kg C (carrying capacity)
- r= 0.01 (exponential growth rate before before canopy closure)
- g = 2 kg/year (linear growth rate after canopy closure)

```
# source model
source("forest_growth.R")

# set parameters

years = seq(from=1, to=300, by=1)
initial_forest = 10
thresh = 50
K = 250
r = 0.01
g = 2

# create parameter list
```

```
parms = list(thresh = thresh, K=K, r=r, g=g)

# run ODE
results = ode(y=initial_forest,
              time=years,
              func=forest_growth,
              parms=parms)

results = as.data.frame(results)

colnames(results)=c("year","forest_size")
head(results)
```

```
##   year forest_size
## 1    1    10.00000
## 2    2    10.10050
## 3    3    10.20202
## 4    4    10.30455
## 5    5    10.40811
## 6    6    10.51271
```

```
# graph results
ggplot(results, aes(year,forest_size))+
  geom_point()+
  labs(y="Forest Carbon", "Years")
```



Sobol sensitivity analysis

Our sobol sensitivity analysis explores how estimated max and mean forest size (C) varies with the:

- pre canopy closure growth rate(C)
- post-canopy closure growth rate (g)
- canopy closure threshols and carrying capacity

```
# Run sobol sensitivity analysis
```