

Oxygen mass transfer sensitivity in ABM

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```
library(ABM)
```

Default simulation

```
out1 <- abm()
```

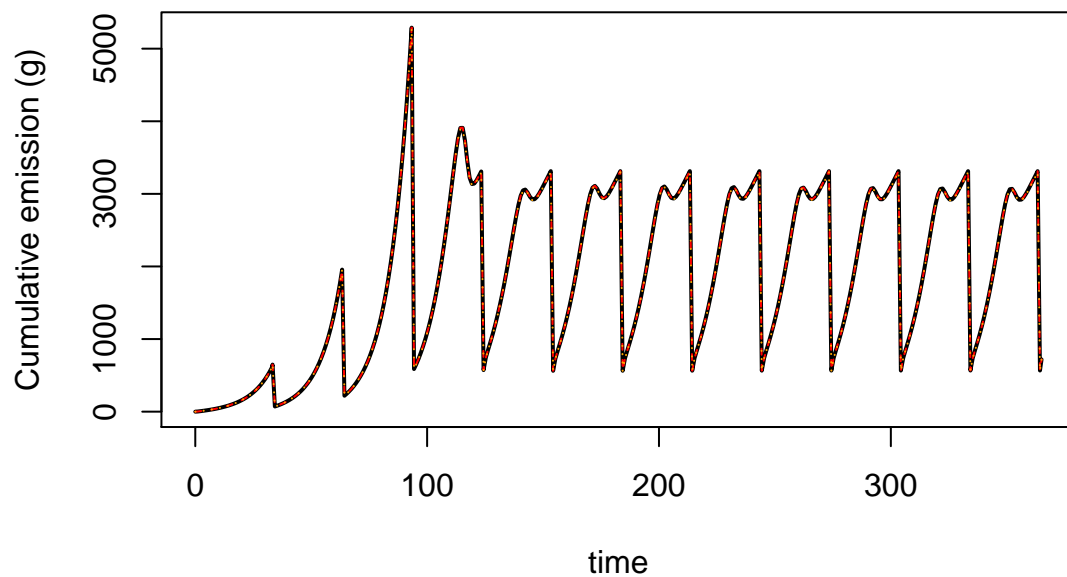
Total cumulative emission (g) and emission rate (g/d) are plotted below.

Completely shut off respiration, and also increase mass transfer coefficient by a factor of 10.

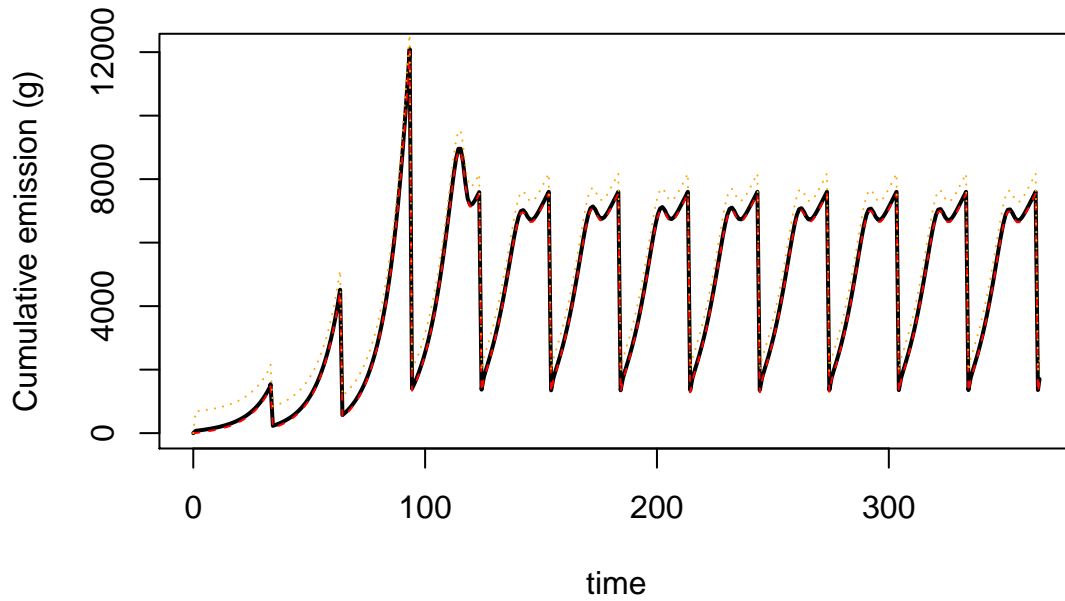
```
out2 <- abm(add_pars = list(kl.oxygen = 0))
```

```
out3 <- abm(add_pars = list(kl.oxygen = 5))
```

```
plot(CH4_emis_rate ~ time, data = out1, type = 'l', ylab = 'Cumulative emission (g)', lwd = 2)  
lines(CH4_emis_rate ~ time, data = out2, col = 'red', lty = 2)  
lines(CH4_emis_rate ~ time, data = out3, col = 'orange', lty = 3)
```

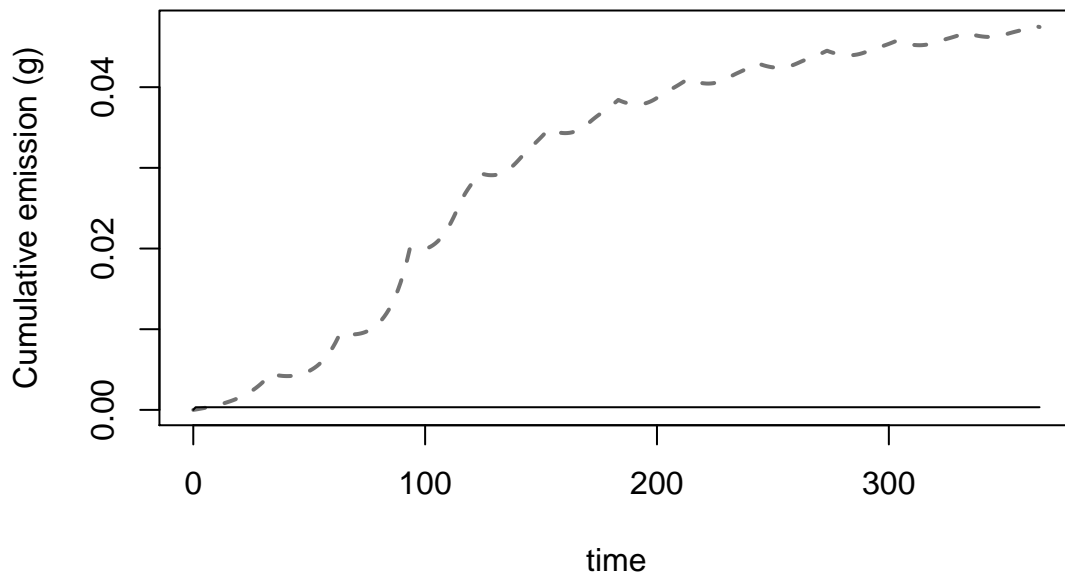


```
plot(CO2_emis_rate ~ time, data = out1, type = 'l', ylab = 'Cumulative emission (g)', lwd = 2)  
lines(CO2_emis_rate ~ time, data = out2, col = 'red', lty = 2)  
lines(CO2_emis_rate ~ time, data = out3, col = 'orange', lty = 3)
```



Conclude that respiration is minor sink for substrate, and uncertainty is not important. Compare CH₄/respiration COD consumption:

```
plot(f_COD_CH4_cum ~ time, data = out3, type = 'l', col = 'gray45', lty = 2, ylab = 'Cumulative emission')
lines(f_COD_respir_cum ~ time, data = out1, lwd = 1)
```



```
tail(out3[, c(1, which(grepl('^f_COD', names(out3))))])
```

##	time	f_COD_CH4_rate	f_COD_CH4_cum	f_COD_respir_cum	f_COD_sr_cum
## 362	360.3300	0.07750056	0.04732569	0.003268801	0
## 363	361.3300	0.07905528	0.04741351	0.003268801	0
## 364	362.3300	0.08062059	0.04750516	0.003268801	0
## 365	363.3297	0.08218735	0.04760058	0.003268801	0
## 366	364.3297	0.01407087	0.04750855	0.003268801	0
## 367	365.0000	0.01787083	0.04745413	0.003268801	0

Try increasing k_L 10x and decreasing the maximum depth. To do that we will increase surface area from 11 m² to 333 m², for a maximum depth of 1 cm.

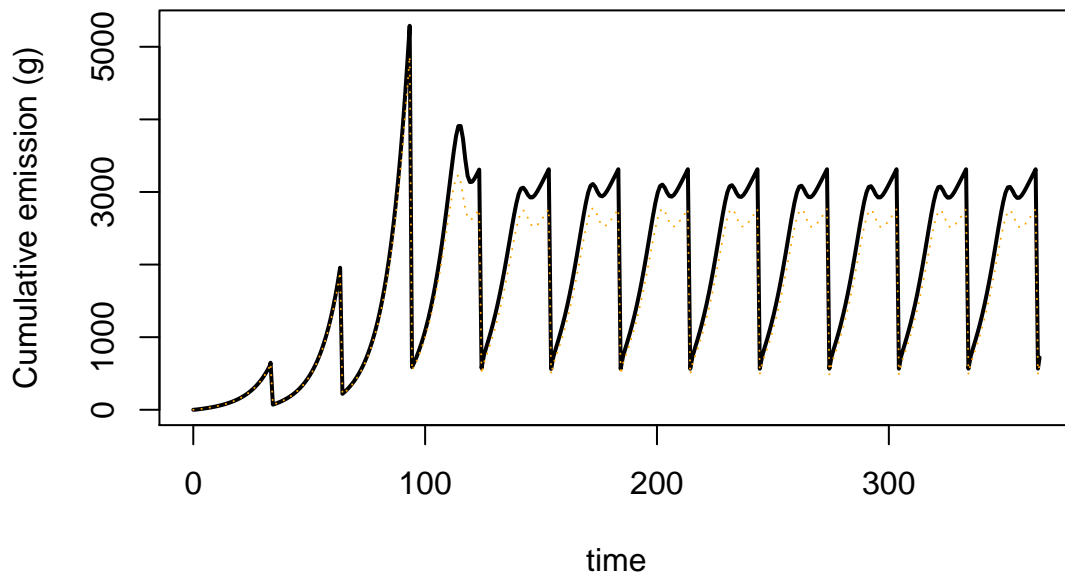
```
out4 <- abm(add_pars = list(kl.oxygen = 5, area = 333))
```

```
tail(out4[, c(1, which(grepl('^f_COD', names(out4)))))]
```

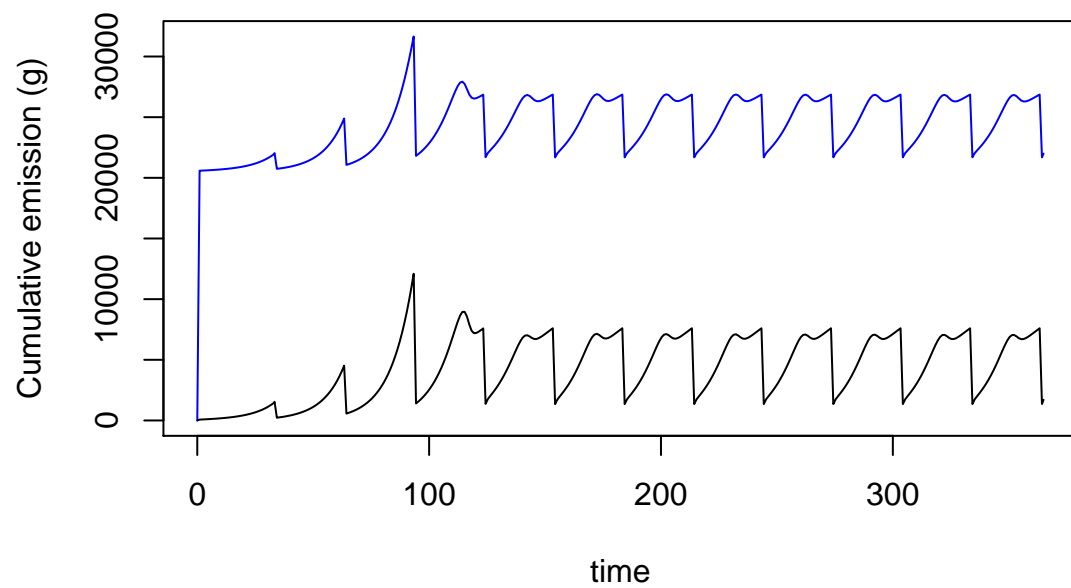
```
##      time f_COD_CH4_rate f_COD_CH4_cum f_COD_respir_cum f_COD_sr_cum
## 362 360.3300      0.06536290      0.04156057      0.09895553          0
## 363 361.3300      0.06652123      0.04162965      0.09895553          0
## 364 362.3300      0.06770262      0.04170161      0.09895553          0
## 365 363.3297      0.06889125      0.04177642      0.09895553          0
## 366 364.3297      0.01216247      0.04169514      0.09895553          0
## 367 365.0000      0.01553775      0.04164710      0.09895553          0
```

Now respiration becomes more important.

```
plot(CH4_emis_rate ~ time, data = out1, type = 'l', ylab = 'Cumulative emission (g)', lwd = 2)
lines(CH4_emis_rate ~ time, data = out4, col = 'orange', lty = 3)
```



```
plot(CO2_emis_rate ~ time, data = out4, type = 'l', ylab = 'Cumulative emission (g)', col = 'blue')
lines(CO2_emis_rate ~ time, data = out1)
```



But even so, for default conditions CH₄ emission is not affected.