

# CLM-CNP: Reaction Sandbox for General Litter and Organic Matter Decomposition

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# General Decomposition Reaction

Upstream pool  $\rightarrow$  Downstream pools

- ▶ Pool can be litter, soil organic matter, microbial mass, enzyme, ...
- ▶ Each pool has C, N and P are optional (e.g., Lit1 can have Lit1C, Lit1N, Lit1P)
- ▶ Fixed or variable CN or CP ratio

# General Decomposition Rate

$$R = k \prod f(C_i) f_E$$

$$\text{First order} \quad f(C_i) = C_i$$

$$\text{Monod} \quad f(C_i) = \frac{C_i}{K_{C_i} + C_i}$$

$$\text{Inhibition} \quad f(C_i) = \frac{I_{C_i}}{I_{C_i} + C_i}$$

$$f_E = f(T)f(\psi)f(N)f(\text{pH})$$

## Example 1. First Order

$$\text{Lit1} \rightarrow 0.61 \text{ SOM1} + 0.39 \text{ C}$$

IMMOBILE\_SPECIES

C

SOM1

Lit1

/

REACTION\_SANDBOX

CLM-CNP

UPSTREAM

CPOOL Lit1

/

DOWNSTREAM

CPOOL SOM1 0.61

/

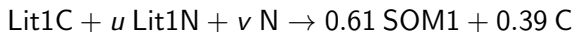
FIRSTORDER Lit1

RATE\_CONSTANT 0.7 1/d

/

/

## Example 2. First Order with N



```
IMMOBILE_SPECIES
C
N
Lit1C
Lit1N
SOM1
/
REACTION_SANDBOX
CLM-CNP
  UPSTREAM
    CPOOL Lit1C
    NPOOL Lit1N
  /
  DOWNSTREAM
    CPOOL SOM1 0.61
    CNRATIO 12.d0
  /
  FIRSTORDER Lit1C
  RATE_CONSTANT 0.7 1/d
/
```

## Example 3. First Order with N and P



```
IMMOBILE_SPECIES
C
N
P
Lit1C
Lit1N
Lit1P
SOM1
/
REACTION_SANDBOX
CLM-CNP
  UPSTREAM
    CPOOL Lit1C
    NPOOL Lit1N
    PPOOL Lit1P
  /
  DOWNSTREAM
    CPOOL SOM1 0.61
    CNRATIO 12.d0
    CPRATIO 350.d0
  /
  FIRSTORDER Lit1C
  RATE_CONSTANT 0.7 1/d
/
```

## Example 4. Monod



```
IMMOBILE_SPECIES
C
SOM1
Lit1
MBC
/
REACTION_SANDBOX
CLM-CNP
  UPSTREAM
    CPOOL Lit1
  /
  DOWNSTREAM
    CPOOL SOM1 0.56
  /
  DOWNSTREAM
    CPOOL MBC 0.05
  /
  FIRSTORDER MBC
  MONOD Lit1 1.0d-4
  RATE_CONSTANT 7.0 1/d
/
```

## Example 5. Michaelis-Menten



```
IMMOBILE_SPECIES
C
SOM1
Lit1
MBC
Enzyme
/
REACTION_SANDBOX
CLM-CNP
UPSTREAM
CPPOOL Lit1
/
DOWNSTREAM
CPPOOL SOM1 0.56
/
DOWNSTREAM
CPPOOL MBC 0.04
/
DOWNSTREAM
CPPOOL Enzyme 0.01
/
FIRSTORDER Enzyme
MONOD Lit1 1.0d-4
RATE_CONSTANT 7.0 1/d
/
/
```



## Example 6. CLM-CN without N

```

IMMOBILE_SPECIES
C
Lit1
Lit2
Lit3
SOM1
SOM2
SOM3
SOM4
SOMD
/
REACTION_SANDBOX
: Lit1 -> 0.61 SOM1 + 0.39 CO2
  CLM-CNP
    UPSTREAM
      CPOOL Lit1
    /
    DOWNSTREAM
      CPOOL SOM1 0.61
    /
    FIRSTORDER Lit1
      RATE_CONSTANT 0.7 1/d
  /
: Lit2 -> 0.45 SOM2 + 0.55 CO2
  CLM-CNP
    UPSTREAM
      CPOOL Lit2
    /
    DOWNSTREAM
      CPOOL SOM2 0.45
    /
    FIRSTORDER Lit2
      RATE_CONSTANT 0.07 1/d
  /
: Lit3 -> 0.71 SOM3 + 0.29 CO2
  CLM-CNP
    UPSTREAM
      CPOOL Lit3
    /
    DOWNSTREAM
      CPOOL SOM3 0.71
    /
    FIRSTORDER Lit3
      RATE_CONSTANT 0.014 1/d
  /
: SOM1 -> 0.72 SOM2 + 0.28 CO2
  CLM-CNP
    UPSTREAM
      CPOOL SOM1
    /
    DOWNSTREAM
      CPOOL SOM2 0.72
    /
    FIRSTORDER SOM1
      RATE_CONSTANT 0.07 1/d
  /
: SOM2 -> 0.54 SOM3 + 0.46 CO2
  CLM-CNP
    UPSTREAM
      CPOOL SOM2
    /
    DOWNSTREAM
      CPOOL SOM3 0.54
    /
    FIRSTORDER SOM2
      RATE_CONSTANT 0.014 1/d
  /
: SOM3 -> 0.45 SOM4 + 0.55 CO2
  CLM-CNP
    UPSTREAM
      CPOOL SOM3
    /
    DOWNSTREAM
      CPOOL SOM4 0.45
    /
    FIRSTORDER SOM3
      RATE_CONSTANT 0.0014 1/d
  /
: SOM4 -> 0.39 CO2
  CLM-CNP
    UPSTREAM
      CPOOL SOM4
    /
    DOWNSTREAM
      CPOOL SOMD 0.0d0
    /
    FIRSTORDER SOM4
      RATE_CONSTANT 0.0001 1/d
  /

```

## Example 7. CLM-CN

```
IMMOBILE_SPECIES
C
N
Lit1C
Lit1N
Lit2C
Lit2N
Lit3C
Lit3N
SOM1
SOM2
SOM3
SOM4
SOMD
/
REACTION_SANDBOX
: Lit1 -> 0.61 SOM1 + 0.39 CO2
  CLM-CNP
    UPSTREAM
      CPOOL Lit1C
      NPOOL Lit1N
    /
    DOWNSTREAM
      CPOOL SOM1 0.61
      CNRATIO 12.d0
    /
    FIRSTORDER Lit1C
    RATE_CONSTANT 0.7 1/d
  /
  .....
```

```
: SOM1 -> 0.72 SOM2 + 0.28 CO2
  CLM-CNP
    UPSTREAM
      CPOOL SOM1
      CNRATIO 12.d0
    /
    DOWNSTREAM
      CPOOL SOM2 0.72
      CNRATIO 12.d0
    /
    FIRSTORDER SOM1
    RATE_CONSTANT 0.07 1/d
  /
  .....
```

```
: SOM4 -> 0.39 CO2
  CLM-CNP
    UPSTREAM
      CPOOL SOM4
      CNRATIO 10.d0
    /
    DOWNSTREAM
      CPOOL SOMD 0.0d0
      CNRATIO 10.d0
    /
    FIRSTORDER SOM4
    RATE_CONSTANT 0.0001 1/d
  /
  .....
```