```
clear
clc
% cell model 2 cells with concentration

% number of cells in the basin
 N=2;

%cell parameters-
a=[5.92 4.61]; %cell area
l=[3.01 2.34]; %channel length
TA=1.8;
KA=2.5;
DA=0.2;

%rain, time step and d from Ostfeld and Pries (2002)
I=[0 4 1 3 2 1 1 0 0 0 0 0 0 0 0 0 0 0 0]; %rain data
t=[0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18]; %time step
d=I/1;

%rainfall graph
bar(t,I,1)
title("Rain intensity for storm event")
ylabel("I [mm/hr]")
xlabel("t [hr]")
ylim([0 5])
xlim([0 10])

% model parameters

tdif=t(2)-t(1);
n=length(d);
A=mean(a);
L=mean(l);
KC=KA*sqrt(a/A);
DC=DA*(l/L);
TC=TA*(l/L);

%water quality
k=0.2;
C0=[0.5 0.5]; % NH3 cocentration

% runoff from rainfall excess Qr[m3/sec]
h=zeros(N,n);
dh=zeros(n,n,N);
for j=1:N
 h(j,:)=(exp(-t/KC(j))-exp((-10*t)/KC(j)))/(0.9*KC(j));
 dh(:,:,j)=d'*h(j,:);
 qr(:,j)=sum(spdiags(rot90(dh(:,:,j))));
end
qr=qr(1:n-1,:);
```

```
Qr=zeros(n,N);
Vr=zeros(n,N);
for j=1:N
Qr(2:n,j)=(a(j)/3.6)*qr(1:n-1,j);
end
Qr;

%Concentration from rainfall excess Cr[mg/l]

Cr=zeros(n,N);
%d=d' %
for j=1:N
for i=1:n
    Cr(i,j)=C0(j)*exp(-k*t(i));
end
end
Cr;
Nr_mass=Qr.*Cr;

% shock reaction (gt) flow from nearby cells [1/hr]
gt=zeros(n-1,1);
 for i=1:n-1
    for j=1:N
if t(i)>=DC
gt(i,j)=(exp(-(t(i)-DC(j))/TC(j)))/TC(j);
else
    gt(i,j)=0;
end
    end
 end
gt;
gt=gt';

% volume (Vt) flow from nearby cells [m3]
Vt=zeros(n-1,N);
for j=1:n-1
    for i=1:N
    Vt(j,i)=3600*tdif*0.5*(Qr(j,i)+Qr(j+1,i));
    end
end
Vt;

% runoff from cell 1 to 2 Q12[m3/s]
Vg=Vt(:,1)*gt(2,:);
Vg;
Q12=(sum(spdiags(rot90(Vg))))';
Q12=(1/3600)*Q12(1:n-1);

% pollutant (NH3) C from cell 1 to 2 Cf[mg/l]
```

```
Cf=zeros(n-1,N);
for i=1:n-1
    Cf(i,2)=Cr(i,1)-(exp((-Q12(i)/Vt(i,1))*t(i))*(Cr(i,1)-C0(1)));
    %Cf(i,2)=Cr(i,1)-(exp((-Q12(i)/Vt(i,1)))*(Cr(i,1)-C0(1)));
end
Cf;
Nf_mass=Q12.*Cf;
Nr_mass;
N_mass=zeros(n,1);
N_mass(2:n)=Nr_mass(2:n,2)+Nf_mass(:,2);

% runoff and concentration at cell 2 (outlet)
Qout=zeros(n,1);
Q2=Q12+Qr(2:n,2);
Qout(2:n)=Q2
```

```
Qout = 19×1
         0
    1.8964
    2.2775
    3.3662
    3.8295
    3.6439
    3.3760
    2.6460
    1.9825
    1.4443
      ⋮
```

```
Cout=N_mass./Qout
```

```
Cout = 19×1
       NaN
    0.4258
    0.3970
    0.3594
    0.3446
    0.3430
    0.3370
    0.3528
    0.3641
    0.3725
      ⋮
```

```
% graphs
tiledlayout(2,2)

%runoff from rain cell 1
nexttile
scatter (t,Qr(:,1),"filled")
title('Runoff from rain cell 1')
xlabel('t [hr]')
ylabel('Q [m3/s]')
ylim([0 5])
```

```
%Concentration from rain cell 1
nexttile
scatter (t,Cr(:,1),"filled")
title('Concentration from rain cell 1')
xlabel('t [hr]')
ylabel('C [mg/l]')
ylim([0 1.5])

%runoff from cell 2
nexttile
scatter(t,Qout,"filled")
title('Runoff from cell 2')
xlabel('t [hr]')
ylabel('Q [m3/s]')
ylim([0 5])

%Concentration from cell 2
nexttile
scatter(t,Cout,"filled")
title('Concentration from cell 2')
xlabel('t [hr]')
ylabel('C [mg/l]')
ylim([0 1.5])
```

