```
clear
clc
% cell model 5 cells with concentration

% %number of cells in the basin
 N=5;


%cell parameters-
a=[5.92 5.92 4.61 5.02 6.58]; %cell area
l=[3.01 3.01 2.34 3.81 3.35]; %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 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 19 20 21 22]; %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 0.5 0.5 0.5];%NH3

% %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);
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);

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 3 Q13[m3/s]
% Q
Vg=Vt(:,1)*gt(3,:);
Vg;
Q13=(sum(spdiags(rot90(Vg))))';
Q13=(1/3600)*Q13(1:n-1);
% pollutant (NH3) C from cell 1 to 3 Cf13[mg/l]
% C
```

```
Cf13=zeros(n-1,N);
for i=1:n-1
    Cf13(i,3)=Cr(i,1)-(exp((-Q13(i)/Vt(i,1))*t(i))*(Cr(i,1)-C0(1)));
end
Cf13;
Nf_mass13=Q13.*Cf13  ;

%% % runoff from cell 2 to 3 Q23[m3/s]
% Q
Vg=Vt(:,2)*gt(3,:);
Vg;
Q23=(sum(spdiags(rot90(Vg))))';
Q23=(1/3600)*Q23(1:n-1);
% pollutant (NH3) C from cell 2 to 3 Cf23[mg/l]
% C
Cf23=zeros(n-1,N);
for i=1:n-1
    Cf23(i,3)=Cr(i,2)-(exp((-Q23(i)/Vt(i,2))*t(i))*(Cr(i,2)-C0(2)));
end
Cf23;
Nf_mass23=Q23.*Cf23 ;

%% Total runoff and C for cell 3
Q3tot=zeros(n,1) ;
Q3tot(2:n)=Q13+Q23+Qr(2:n,3) ;
Qtot=Qr ;
Qtot(:,3)=Q3tot ;
N3_mass=zeros(n,1) ;
N3_mass(2:n)=Nf_mass23(:,3)+Nf_mass13(:,3)+Nr_mass(2:n,3) ;
C3tot=N3_mass./Q3tot ;

% new vt after cell 3
Vt=zeros(n-1,N);
for j=1:n-1
    for i=1:N
    Vt(j,i)=3600*tdif*0.5*(Qtot(j,i)+Qtot(j+1,i));
    end
end
Vt;

%% % runoff from cell 3 to 5 Q35[m3/s]
% Q
Vg=Vt(:,3)*gt(5,:);
Vg;
Q35=(sum(spdiags(rot90(Vg))))';
Q35=(1/3600)*Q35(1:n-1);
% pollutant (NH3) C from cell 3 to 5 Cf35[mg/l]
% C
Cf35=zeros(n-1,N);
for i=1:n-1
```

```
    Cf35(i,5)=Cr(i,3)-(exp((-Q35(i)/Vt(i,3))*t(i))*(Cr(i,3)-C0(3)));
end
Cf35;
Nf_mass35=Q35.*Cf35  ;

%% % runoff from cell 4 to 5 Q45[m3/s]
% Q
Vg=Vt(:,4)*gt(5,:);
Vg;
Q45=(sum(spdiags(rot90(Vg))))';
Q45=(1/3600)*Q45(1:n-1);
% pollutant (NH3) C from cell 3 to 5 Cf35[mg/l]
Cf45=zeros(n-1,N);
for i=1:n-1
    Cf45(i,5)=Cr(i,4)-(exp((-Q45(i)/Vt(i,4))*t(i))*(Cr(i,4)-C0(4)));
end
Cf45;
Nf_mass45=Q45.*Cf45 ;

%% Total runoff and C for cell 5
Q5tot=zeros(n,1) ;
Q5tot(2:n)=Q35+Q45+Qr(2:n,5) ;
Qtot(:,5)=Q5tot ;
N5_mass=zeros(n,1) ;
N5_mass(2:n)=Nf_mass35(:,5)+Nf_mass45(:,5)+Nr_mass(2:n,5);
C5tot=N5_mass./Q5tot  ;

%%%%%%%%%%%%%%

%% Total runoff and C for outlet
Qout=Q5tot
```

```
Qout = 23×1
         0
    2.6869
    3.8495
    6.0134
    7.4488
    7.8775
    7.8896
    6.9894
    5.8630
    4.7148
      ⋮
```

```
Cout=C5tot
```

```
Cout = 23×1
       NaN
    0.4326
    0.4173
    0.3931
    0.3888
    0.3954
```

```
    0.3974
    0.4128
    0.4236
    0.4309
     ⋮
     ⋮
```

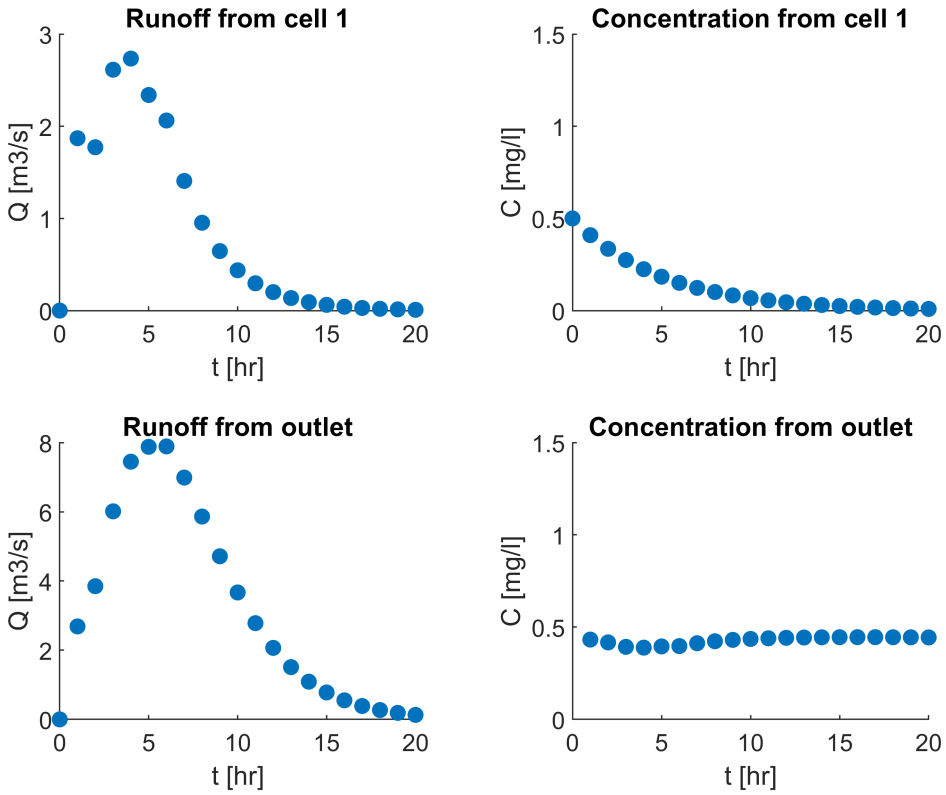
```
%graphs
tiledlayout(2,2)

%cell 1 Q
nexttile
scatter(t(1:n-1),Qtot(1:n-1,1),'filled')
title('Runoff from cell 1')
xlabel('t [hr]')
ylabel('Q [m3/s]')
xlim([0 20])

%cell 1 C
nexttile
scatter(t(1:n-1),Cr(1:n-1,1),'filled')
title('Concentration from cell 1')
xlabel('t [hr]')
ylabel('C [mg/l]')
ylim([0 1.5])
xlim([0 20])

%runoff from watershed outlet
nexttile
scatter(t,Qout,'filled')
title('Runoff from outlet')
xlabel('t [hr]')
ylabel('Q [m3/s]')
xlim([0 20])

%Concentration from watershed outlet
nexttile
scatter(t,Cout,'filled')
title('Concentration from outlet')
xlabel('t [hr]')
ylabel('C [mg/l]')
ylim([0 1.5])
xlim([0 20])
```


Runoff from cell 1
Q [m3/s]
t [hr]
Concentration from cell 1
C [mg/l]
t [hr]
Runoff from outlet
Q [m3/s]
t [hr]
Concentration from outlet
C [mg/l]
t [hr]