Modeling of sand bar response to fluctuating flows

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Processes that build and erode sand bars

-- wind
-- slumping
-- sapping
-- interaction with flow and sediment in transport

Model application

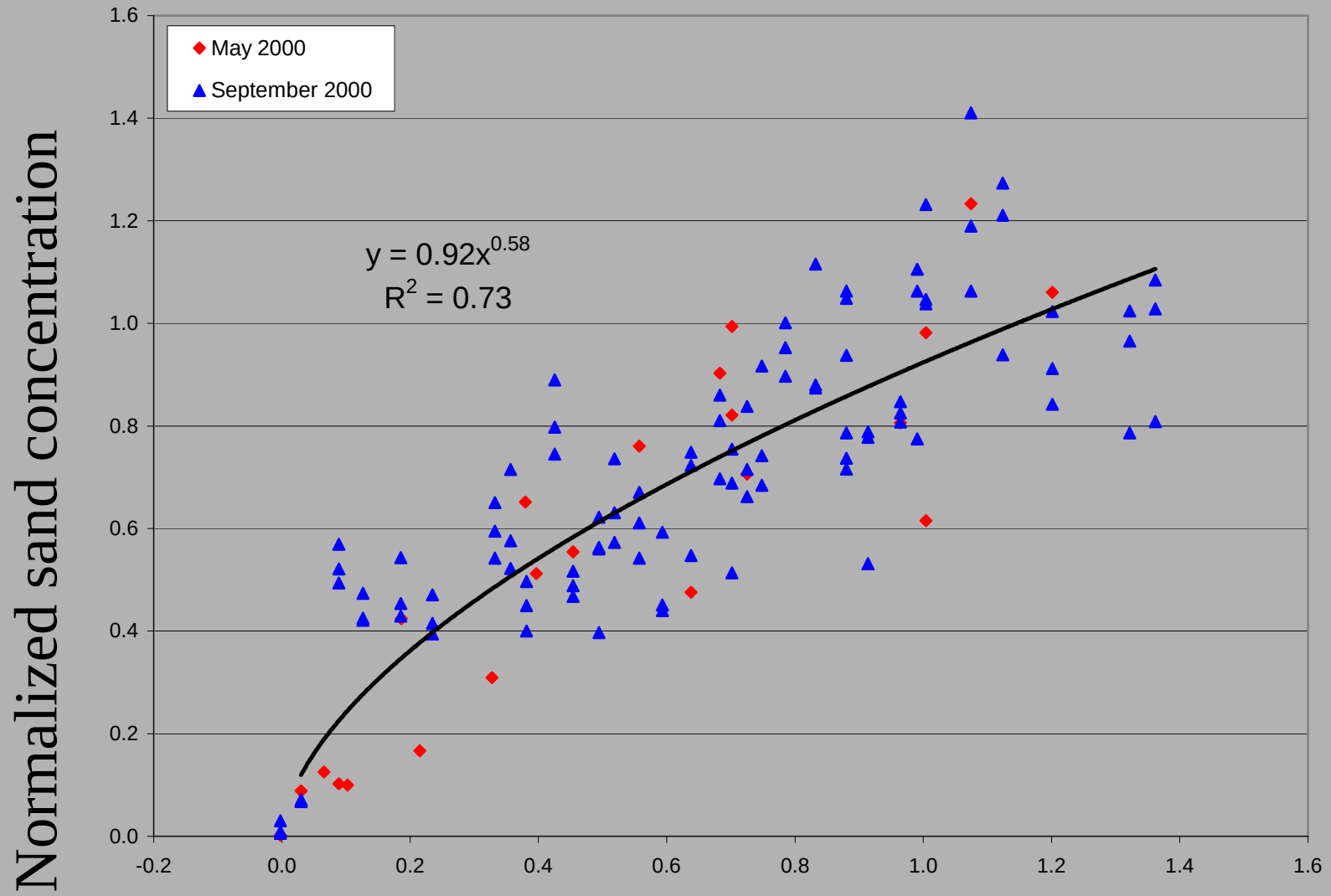
5-20k and 5-25k cfs fluctuating flows following steady

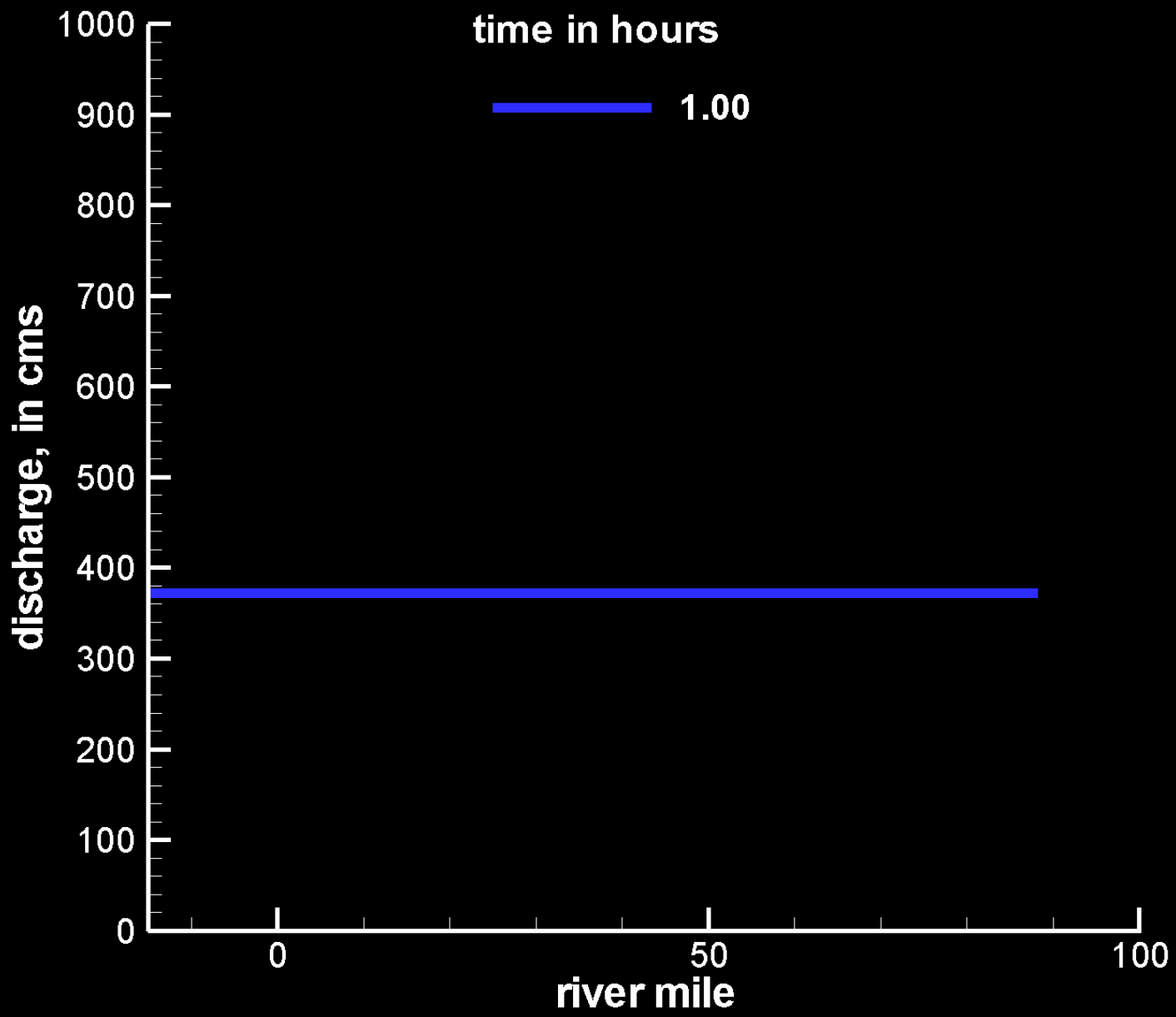
flow of 16,800 cfs

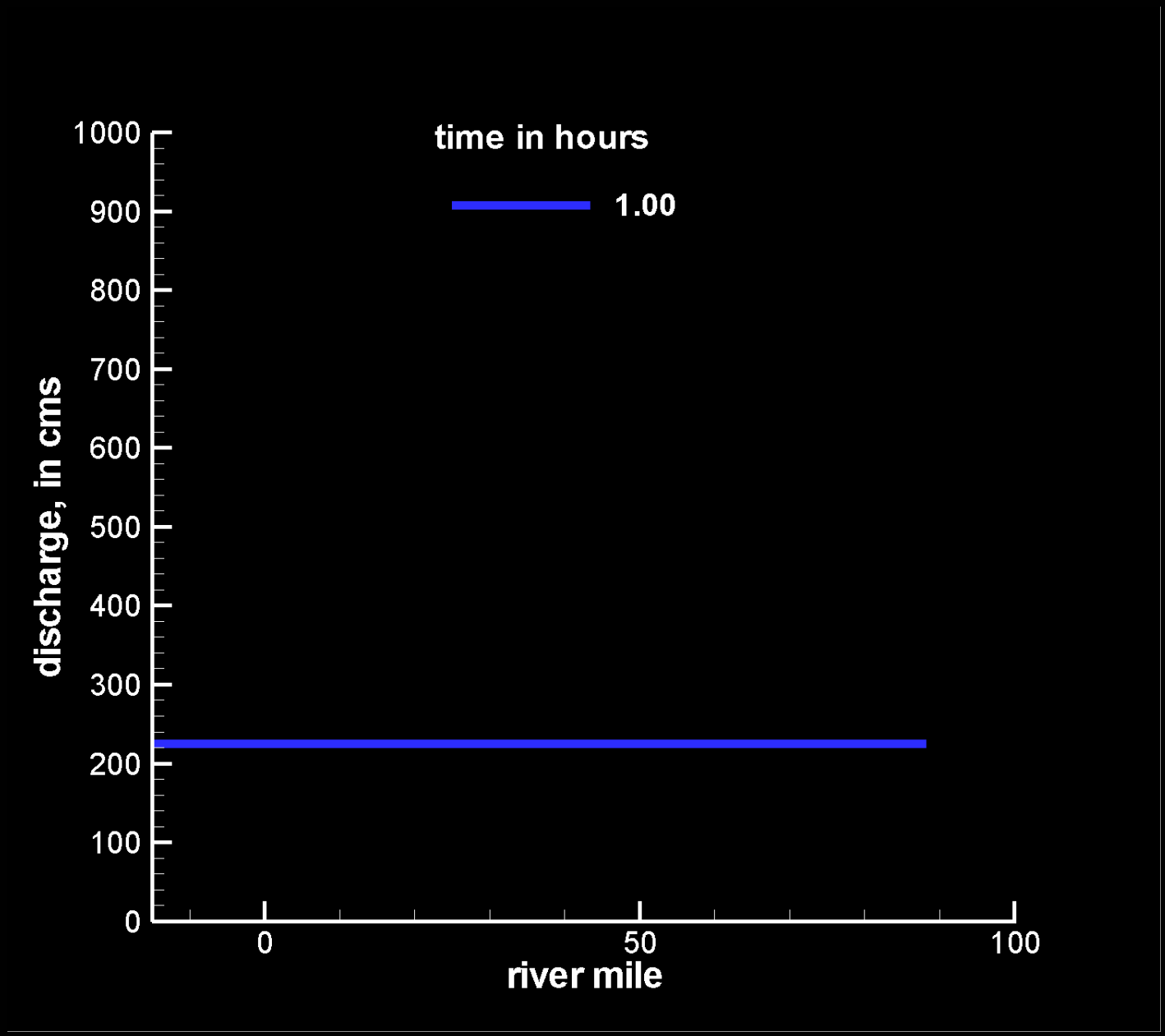
Model inputs:

- Channel shape – NAU and GCMRC
- Stage-discharge relations – NAU
- Sand boundary condition – Topping, Melis, and Wright
- Hydrograph – Clark Burbidge

data – Topping and Melis; function – Wright




time in hours
1.00
1000
900
800
700
600
500
400
300
200
100
0
discharge, in cms
0
50
100
river mile


time in hours
1.00
1000
900
800
700
600
500
400
300
200
100
0
discharge, in cms
0
50
100
river mile

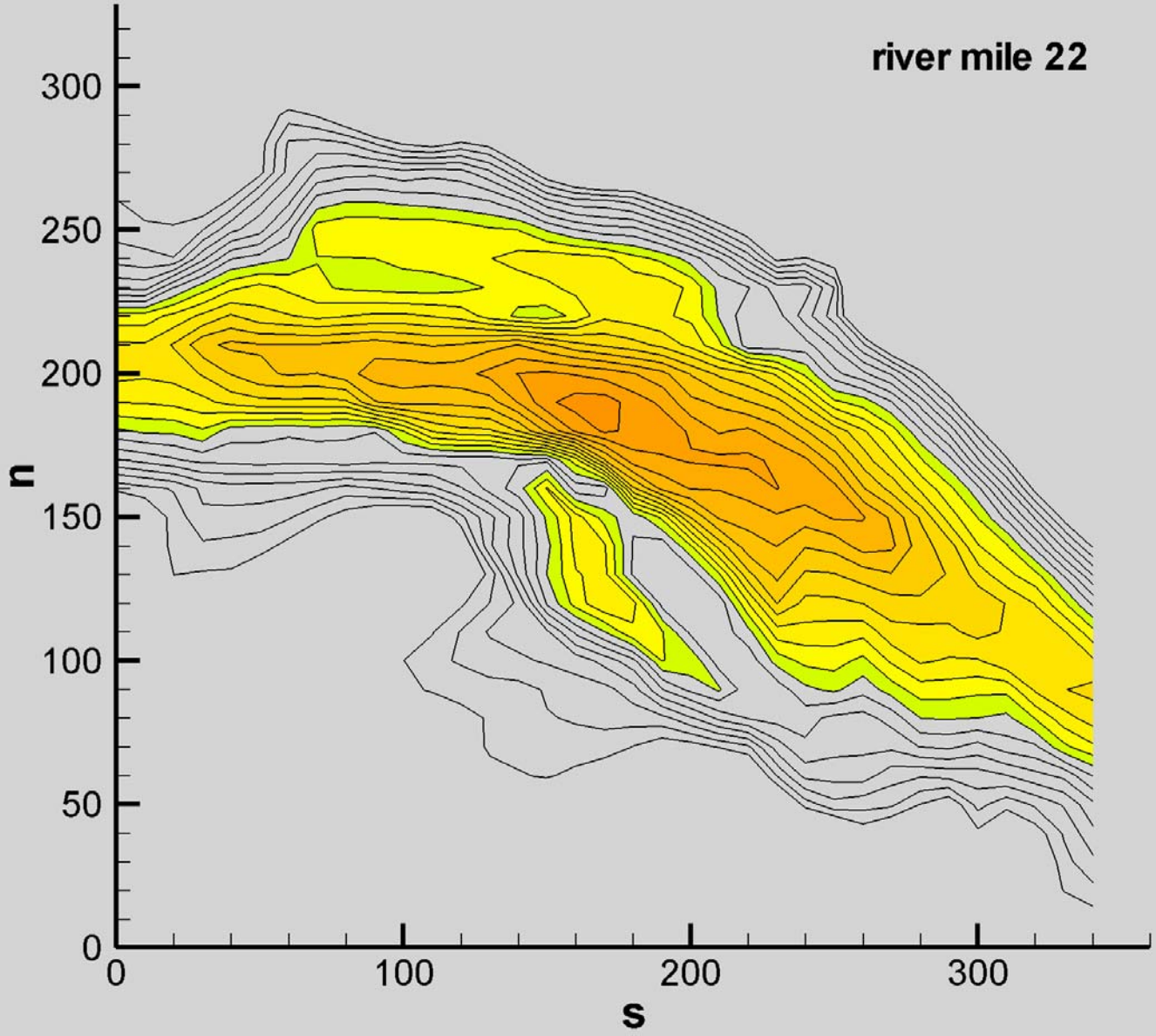
2d model of flow, sand transport, and bed evolution

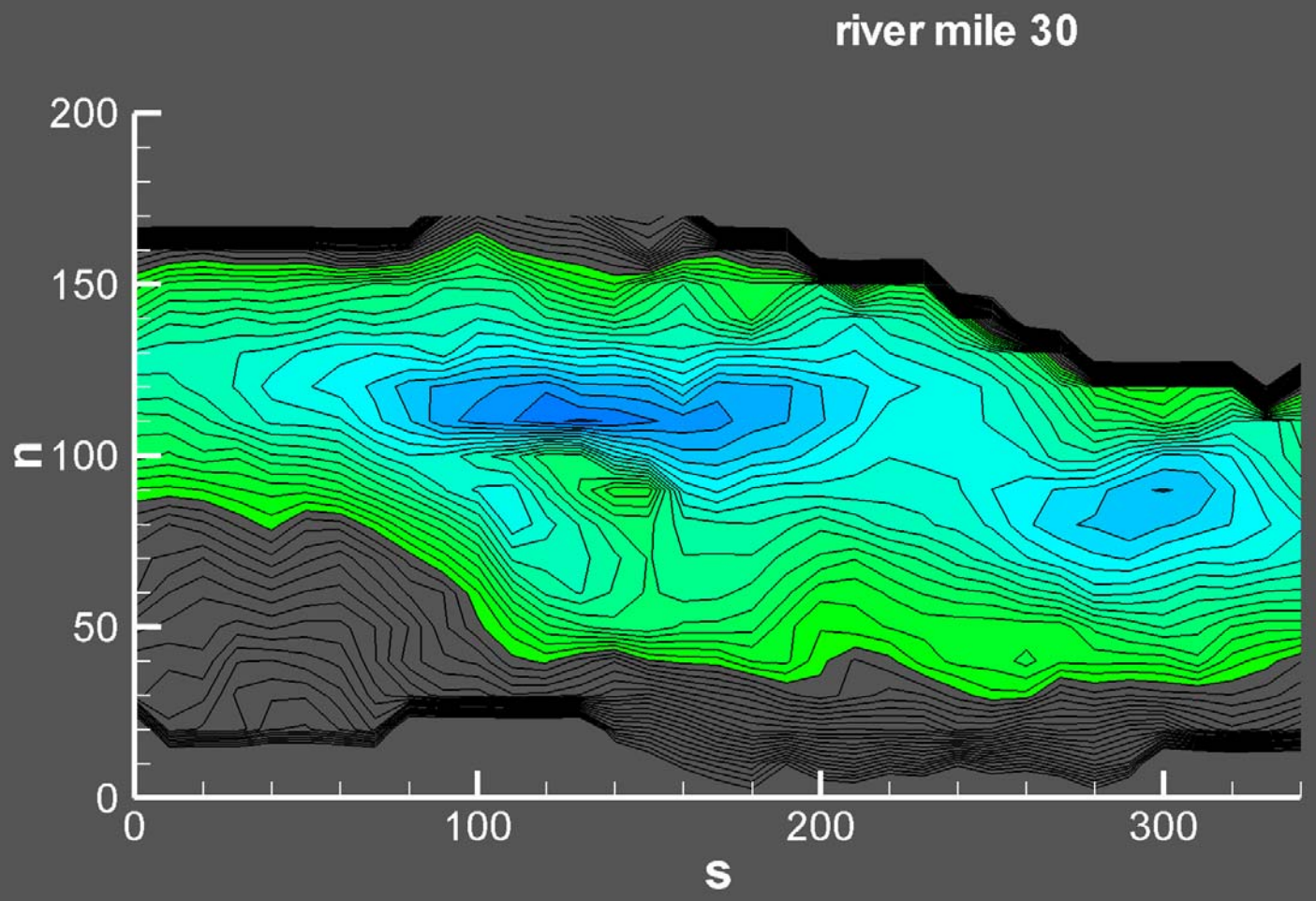
-- calculate vertically averaged flow field

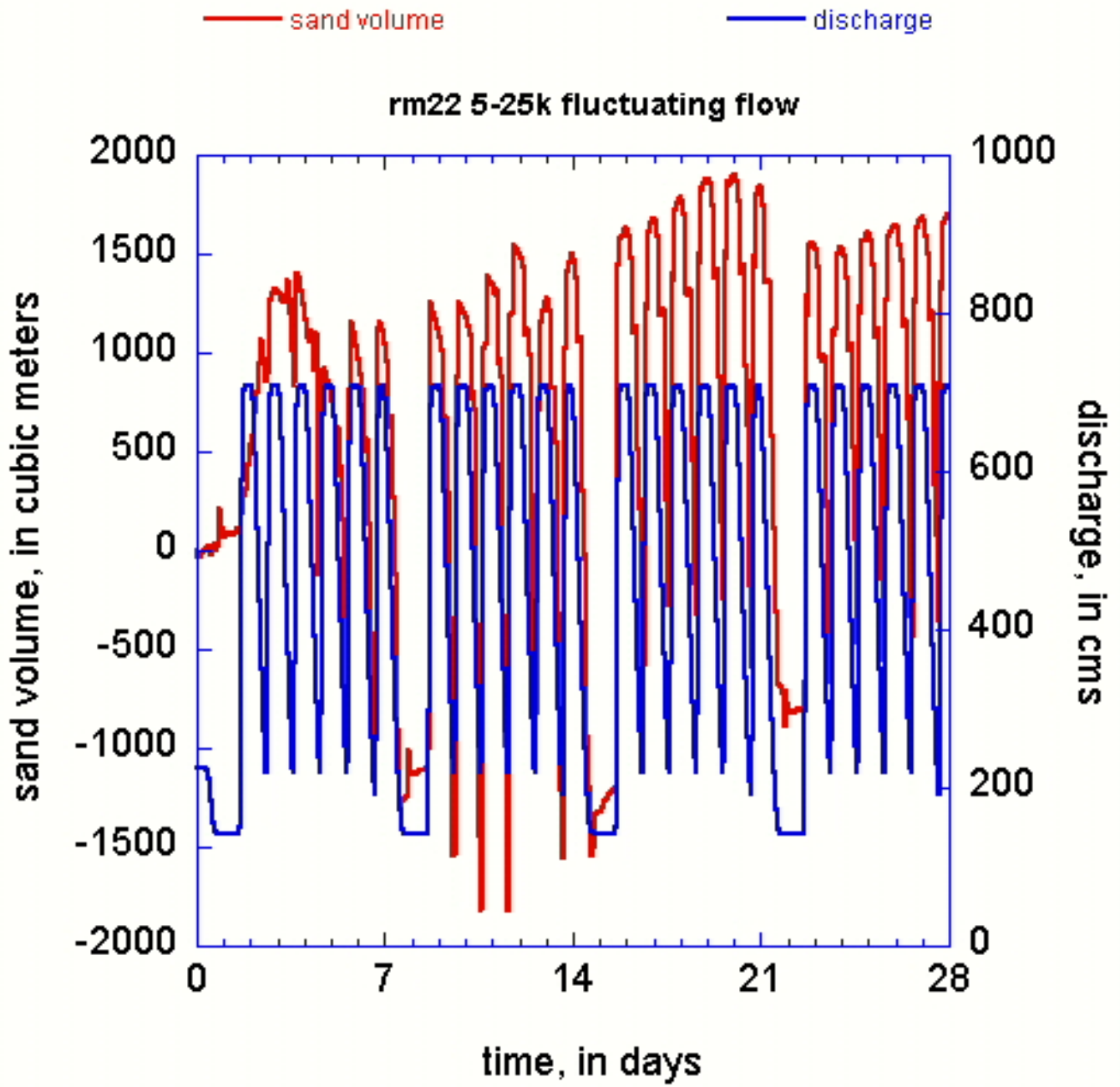
-- calculate 3d suspended sand field

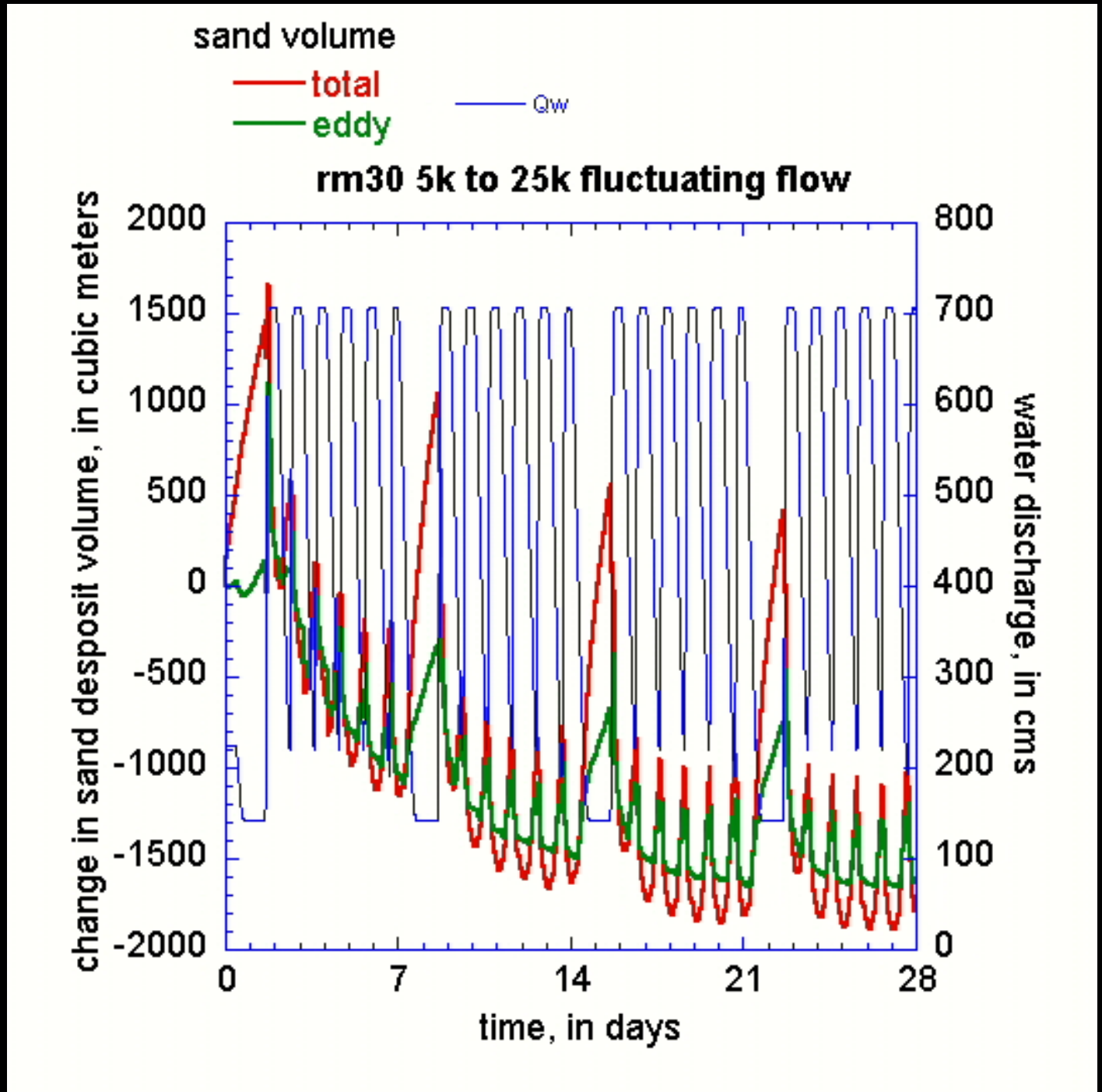
-- calculate local sand discharge

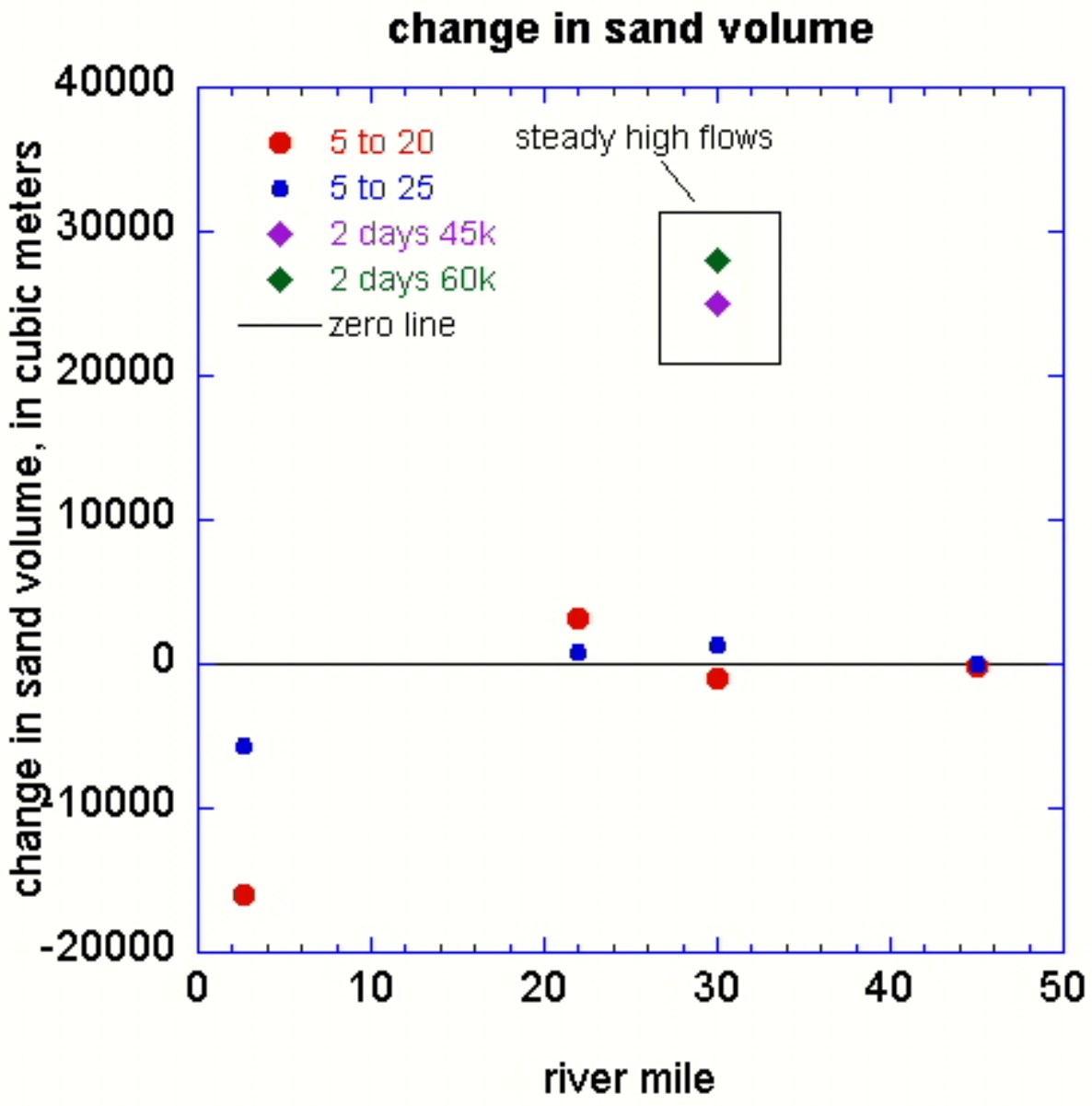
-- calculate change in bed elevation over a small time step


river mile 22
300
250
200
150
100
50
0
n
0
100
200
300
s

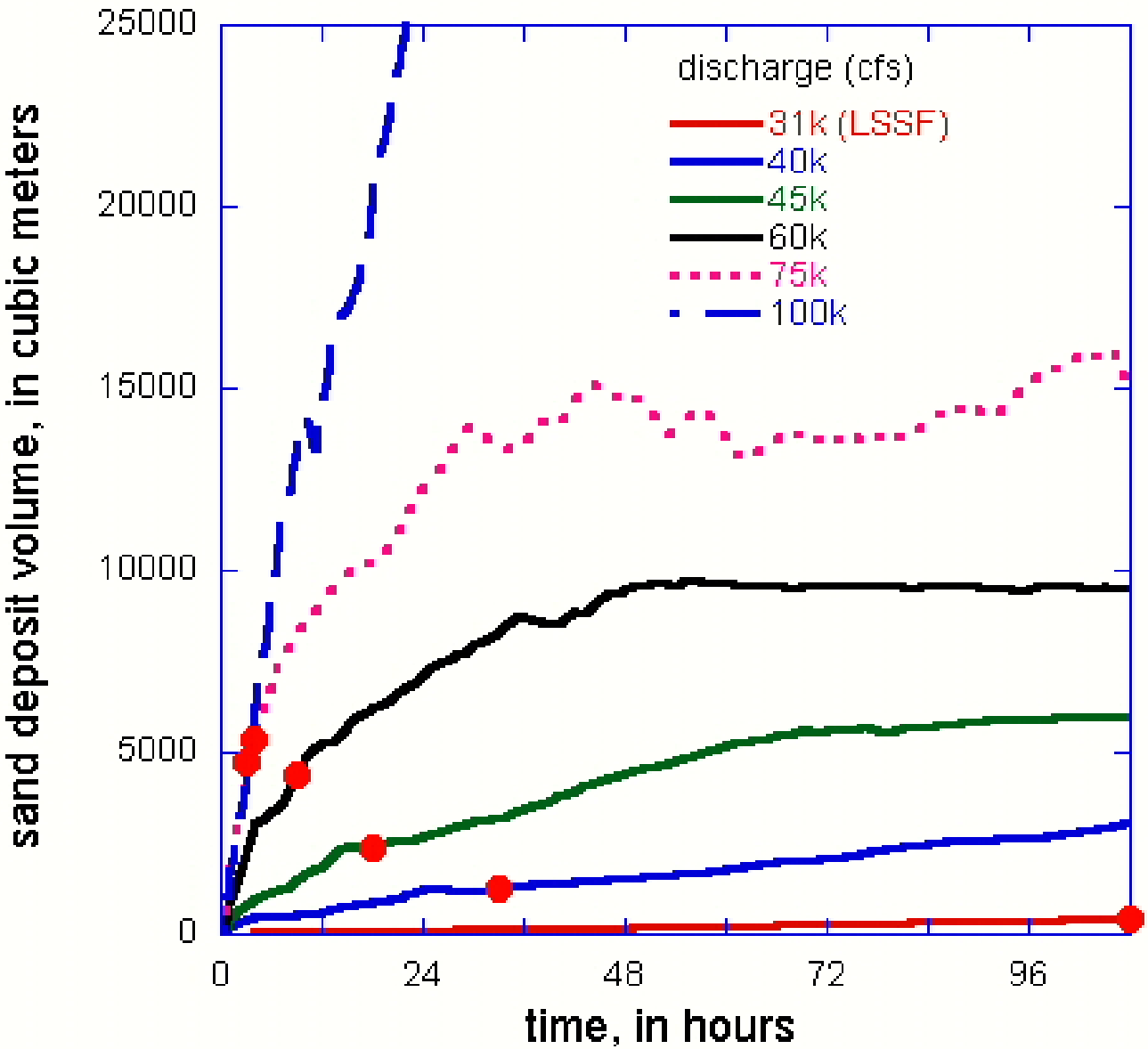

river mile 30
200
150
100
50
0
n
0
100
200
300
s


sand volume
discharge
rm22 5-25k fluctuating flow
2000
1500
1000
500
0
-500
-1000
-1500
-2000
1000
800
600
400
200
0
0
7
14
21
28
sand volume, in cubic meters
discharge, in cms
time, in days


sand volume
total
eddy
Qw
rm30 5k to 25k fluctuating flow
change in sand desposit volume, in cubic meters
water discharge, in cms
time, in days
2000
1500
1000
500
0
-500
-1000
-1500
-2000
800
700
600
500
400
300
200
100
0
0
7
14
21
28


change in sand volume
change in sand volume, in cubic meters
river mile
5 to 20
5 to 25
2 days 45k
2 days 60k
zero line
steady high flows
40000
30000
20000
10000
0
-10000
-20000
0
10
20
30
40
50

Net change in sand volume above 25k cfs stage



Conclusions

- short term response to fluctuating flows – variable and small
- export of sand will increase
- long term response – ongoing decline of sand bars accelerated without replenishment