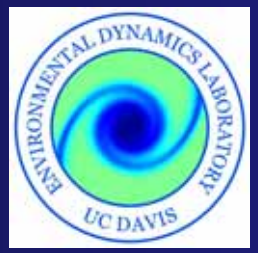
Hydrodynamic and Oxygen Modeling of the Stockton Deep Water Ship Channel ERP–02D–P51



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Collaborators

UC Davis (lead & water quality)
- Geoff Schladow
- Bill Fleenor
- Laura DiPalmero

Stanford (hydrodynamics)
- Stephen Monismith
- Jim Hench
- Derek Fong
- Nick Nidzieko

USGS (modeling and field support)
- Pete Smith
- Jay Cuetara

Field Personnel

UC Davis

Bill Fleenor
Geoff Schladow
Laura Di Palermo
Fabian Bombardelli
Bill Sluis
Daret Kehlet
David Jassby
Raffi Moughamian
Eu Gene Chung
Marlene Relja
Wendy Trowbridge
Warren Jordan

Stanford

Stephen Monismith
Jim Hench
Derek Fong
Nick Nidzieko
Kristen Davis
Johanna Rosman
Cameron McDonald
Sandy Chang
Alyson Santoro
Jonah Steinbuck
Ryan Lowe
Nicole Jones

USGS

Jay Cuetara
Dan Doctor
Cecily Chang
Curt Battenfeld
Jon Yokomizo

Questions

1) What is the 3D structure of circulation in SDWSC?

2) How does the circulation change over semi-diurnal, diel, and spring-neap cycles?

3) How do circulation and stratification affect DO?

4) Can we model the system to determine fundamental mechanisms, and predict conditions under different natural forcings and management scenarios?

Semi-implicit 3D (Si3D) Model

Developed by USGS (Pete Smith) as part of the Interagency Ecological Program for San Francisco Bay/Delta

Support provided by:

- U.S. Geological Survey
- CA Dept. of Water Resources
- U.S. Bureau of Reclamation

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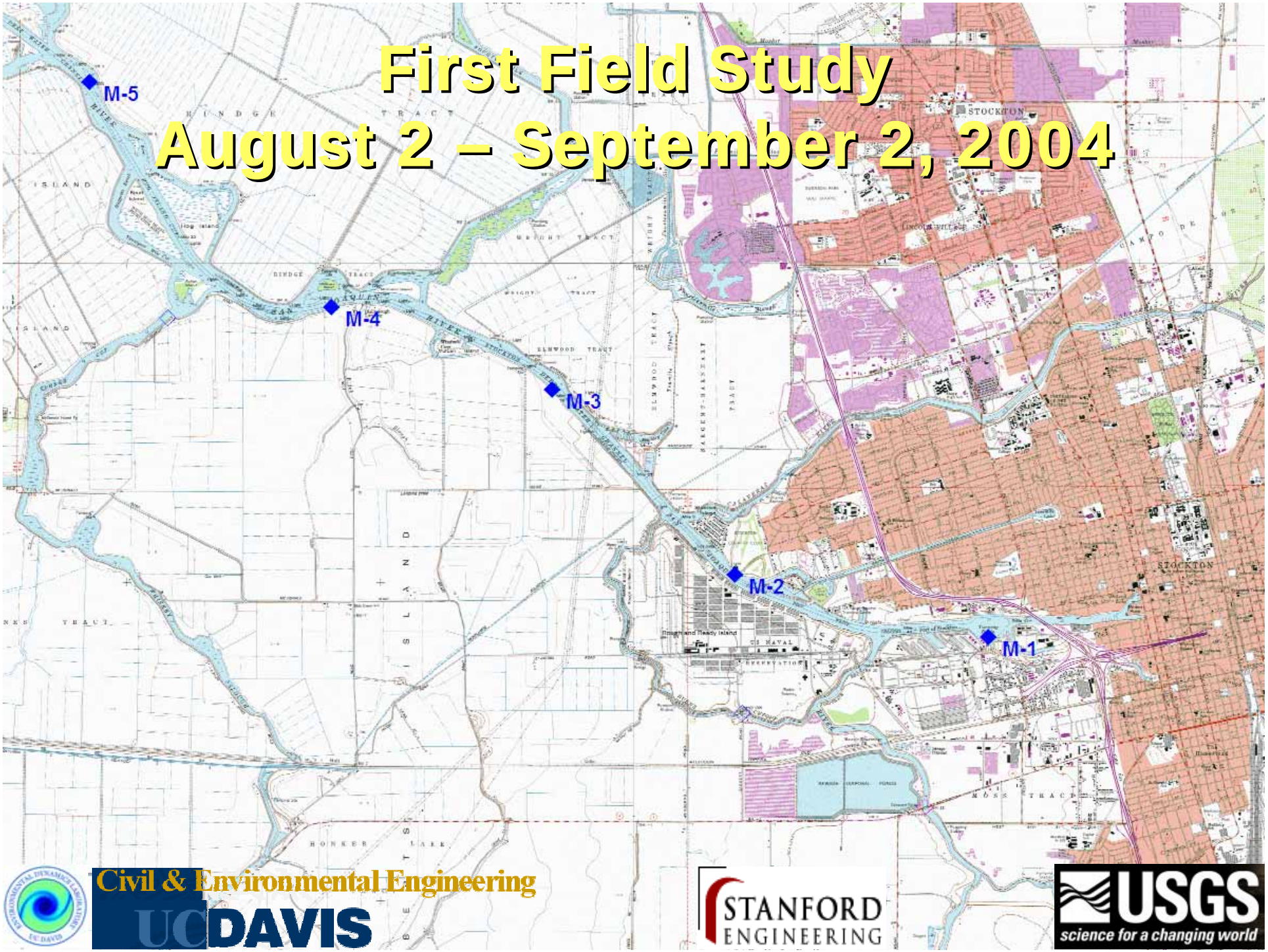
Field Data Collection

- Up to three 1-month studies
- 2-days of concentrated transects of velocity and water quality during each month
- 2 tracer studies


First Field Study
August 2 – September 2, 2004
M-5
M-4
M-3
M-2
M-1
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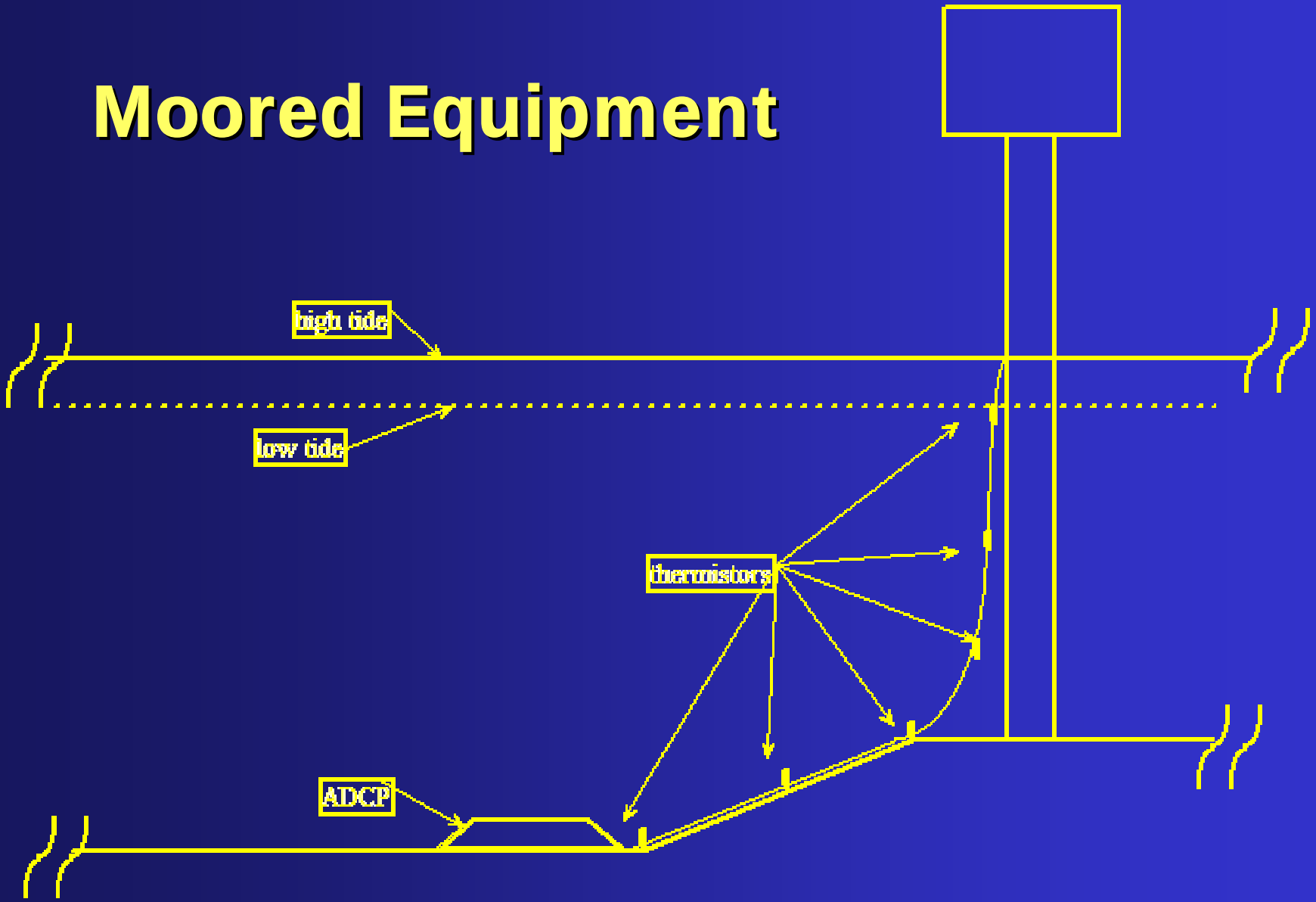
Moored Equipment



Starting in the parking lot

Assembled instrument packages

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Programmed instruments

Programmed instruments

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Placed instrument packages

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Dove on instruments for verification of orientation

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Great Visibility
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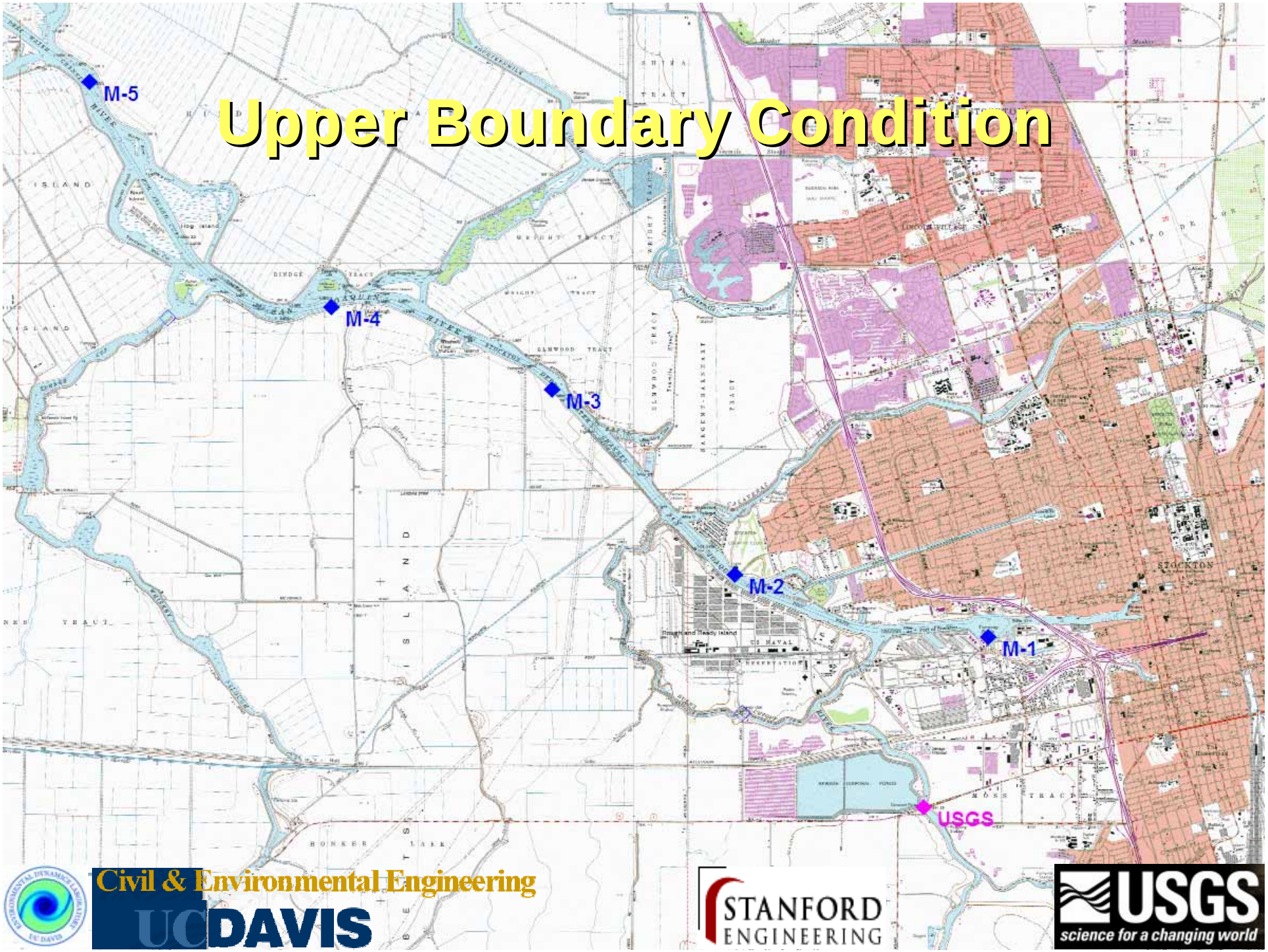
Upper Boundary Condition
M-5
M-4
M-3
M-2
M-1
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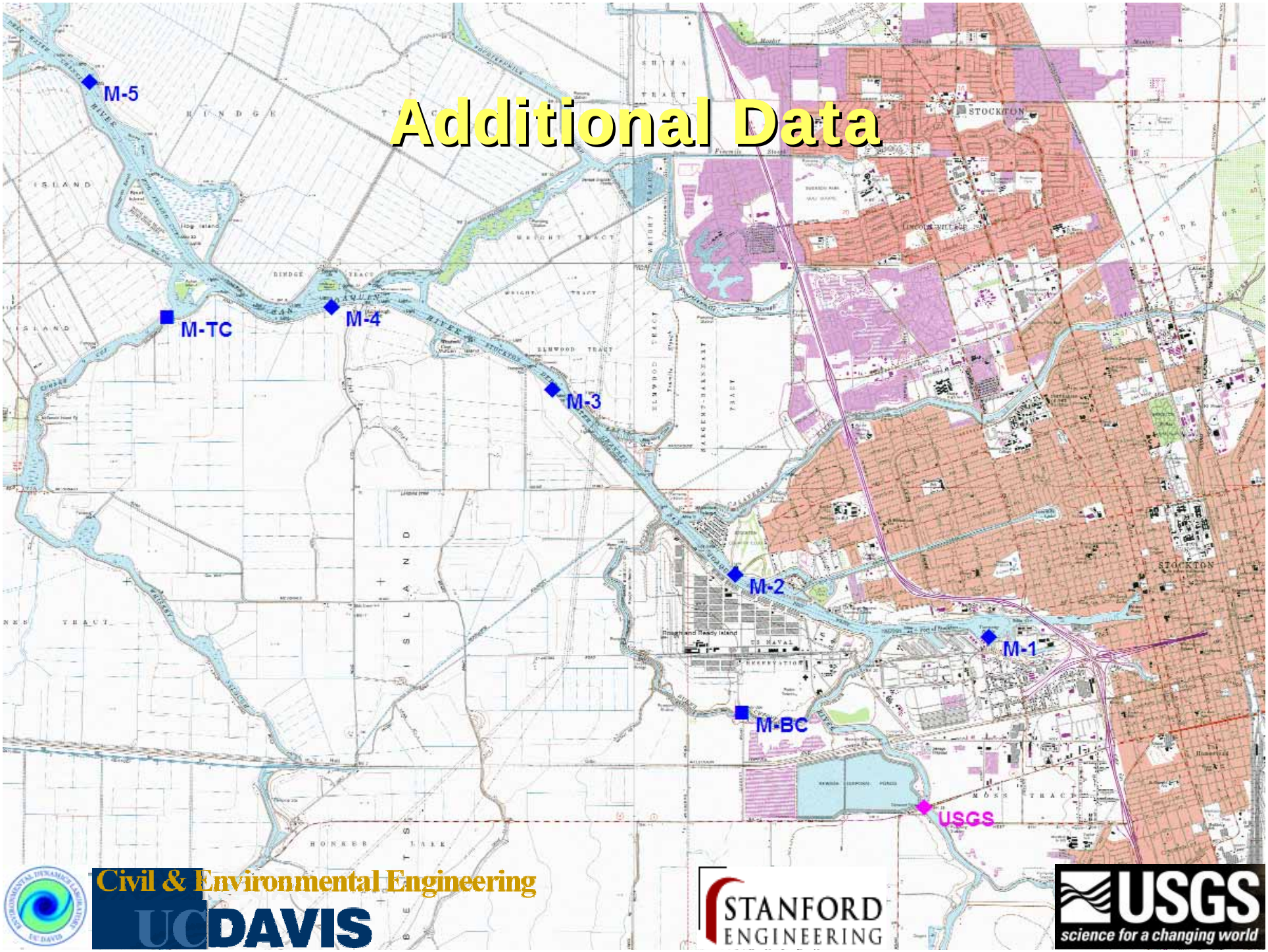
Additional Data
M-5
M-TC
M-4
M-3
M-2
M-1
M-BC
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Concentrated Transects
August 9 & August 16, 2004

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30-hour single site study
August 9 & August 16, 2004

M-2

USGS

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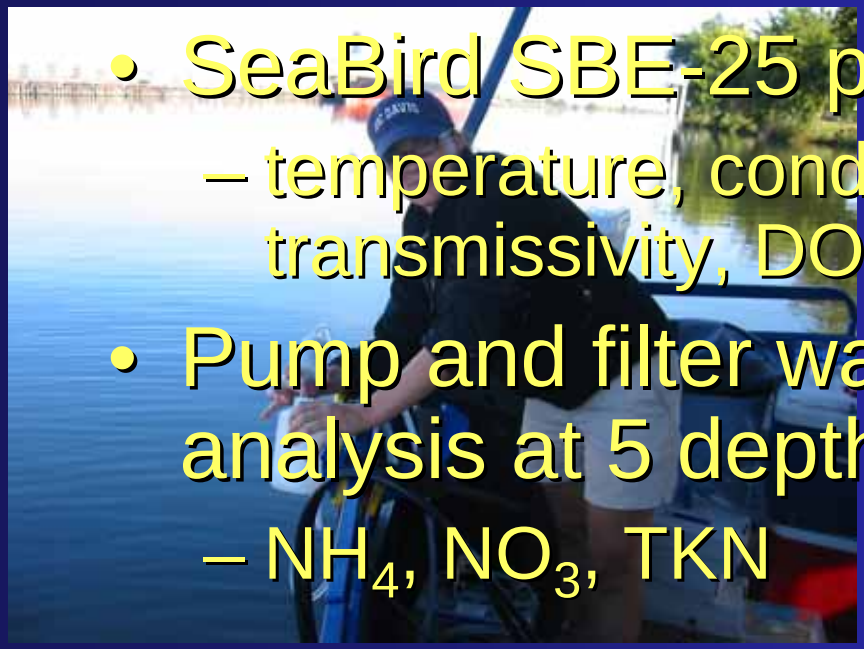
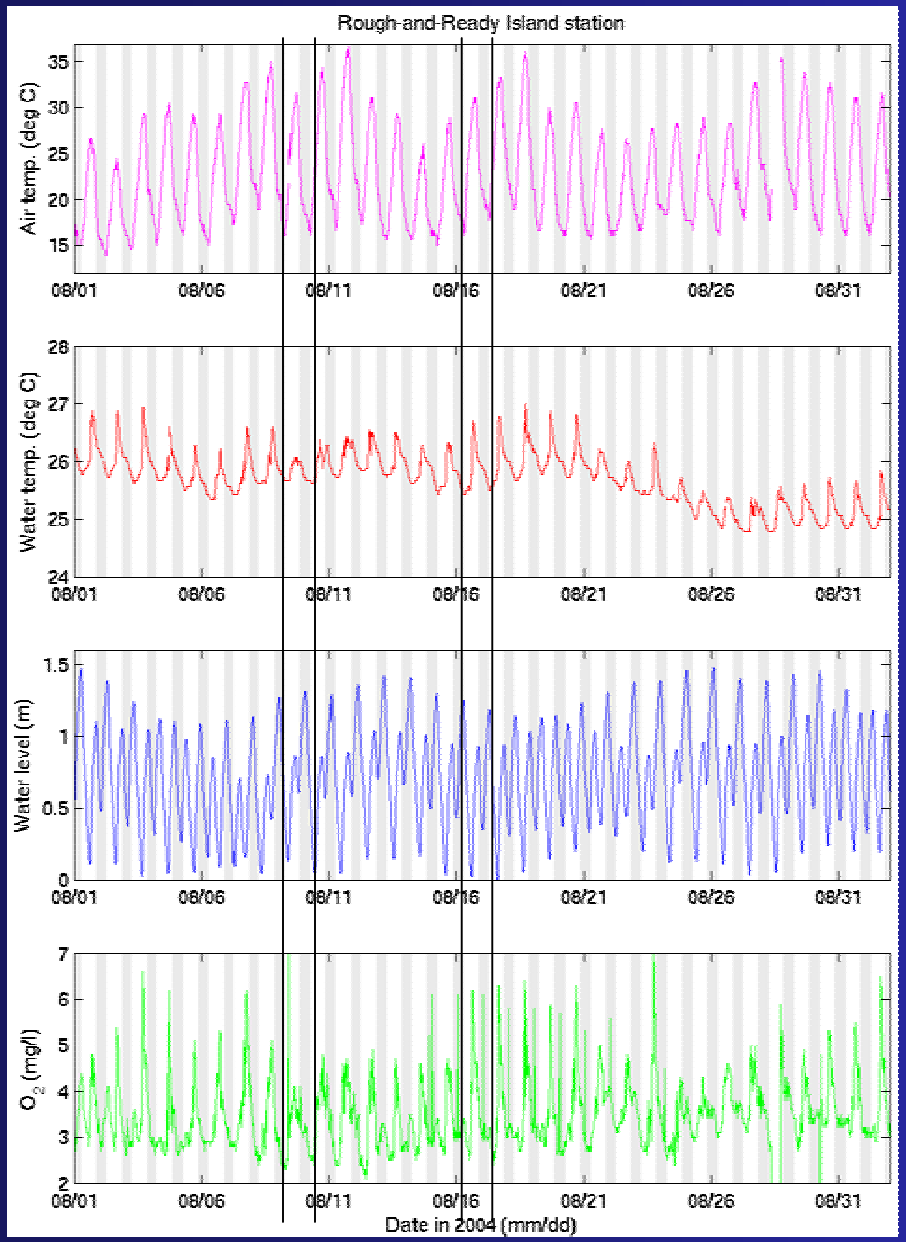
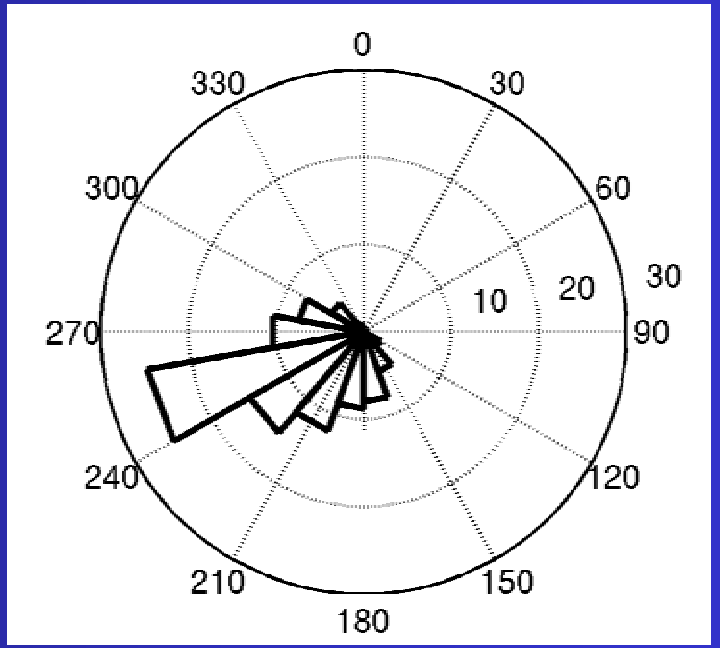
30-hour single site study
August 9 & August 16, 2004

- SCAMP microstructure profiler:
  - vertical turbulent mixing rates
- SeaBird SBE-25 profiles:
  - temperature, conductivity, Chl-a, obs, transmissivity, DO, PAR
- Pump and filter water for laboratory analysis at 5 depths every 2-hours:
  - NH_4, NO_3, TKN



Conditions





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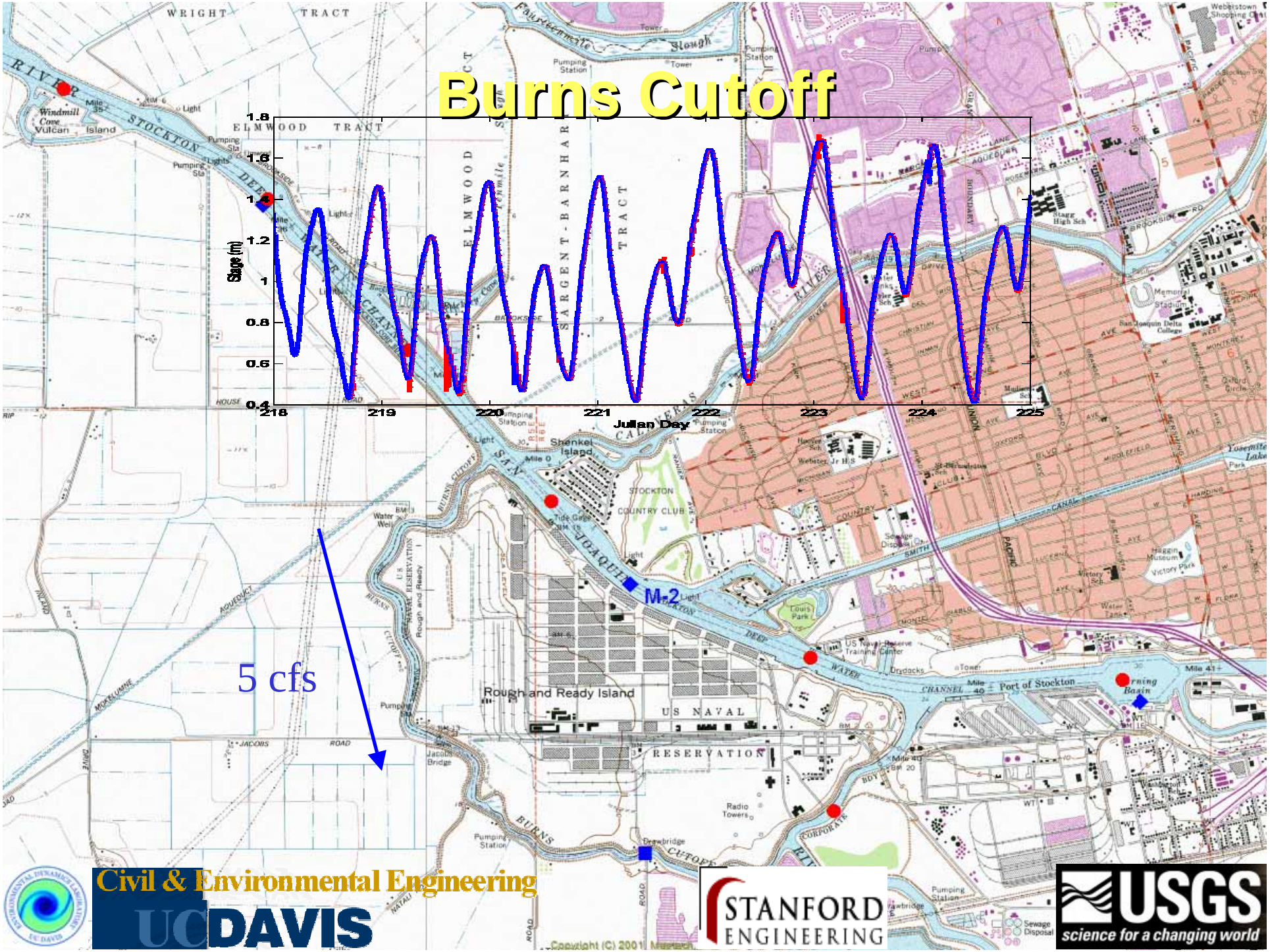
Burns Cutoff
Stage (m)
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
218
219
220
221
222
223
224
225
Julian Day
M-2
5 cfs
Rough and Ready Island
US NAVAL
RESERVATION
Port of Stockton
Civil & Environmental Engineering
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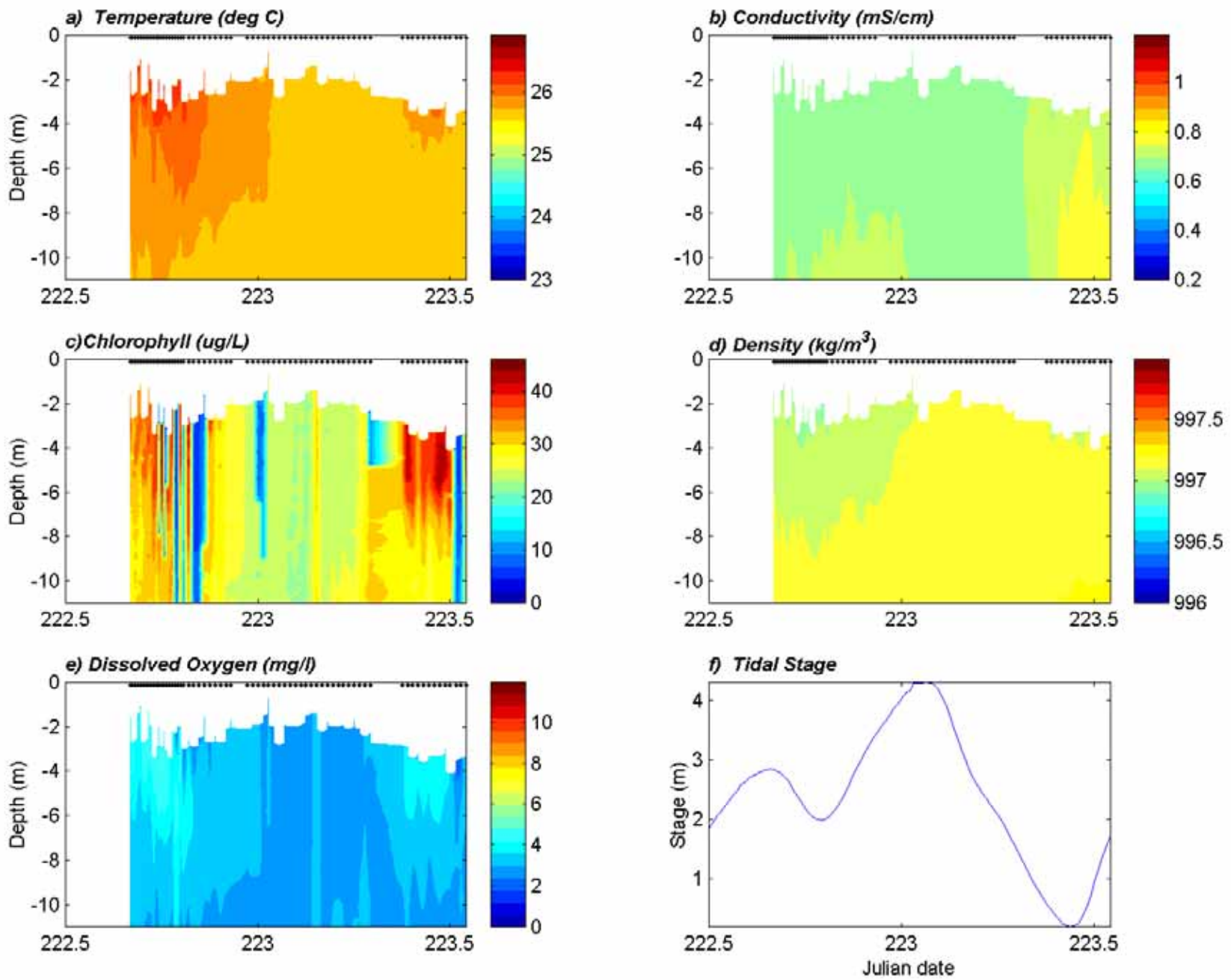
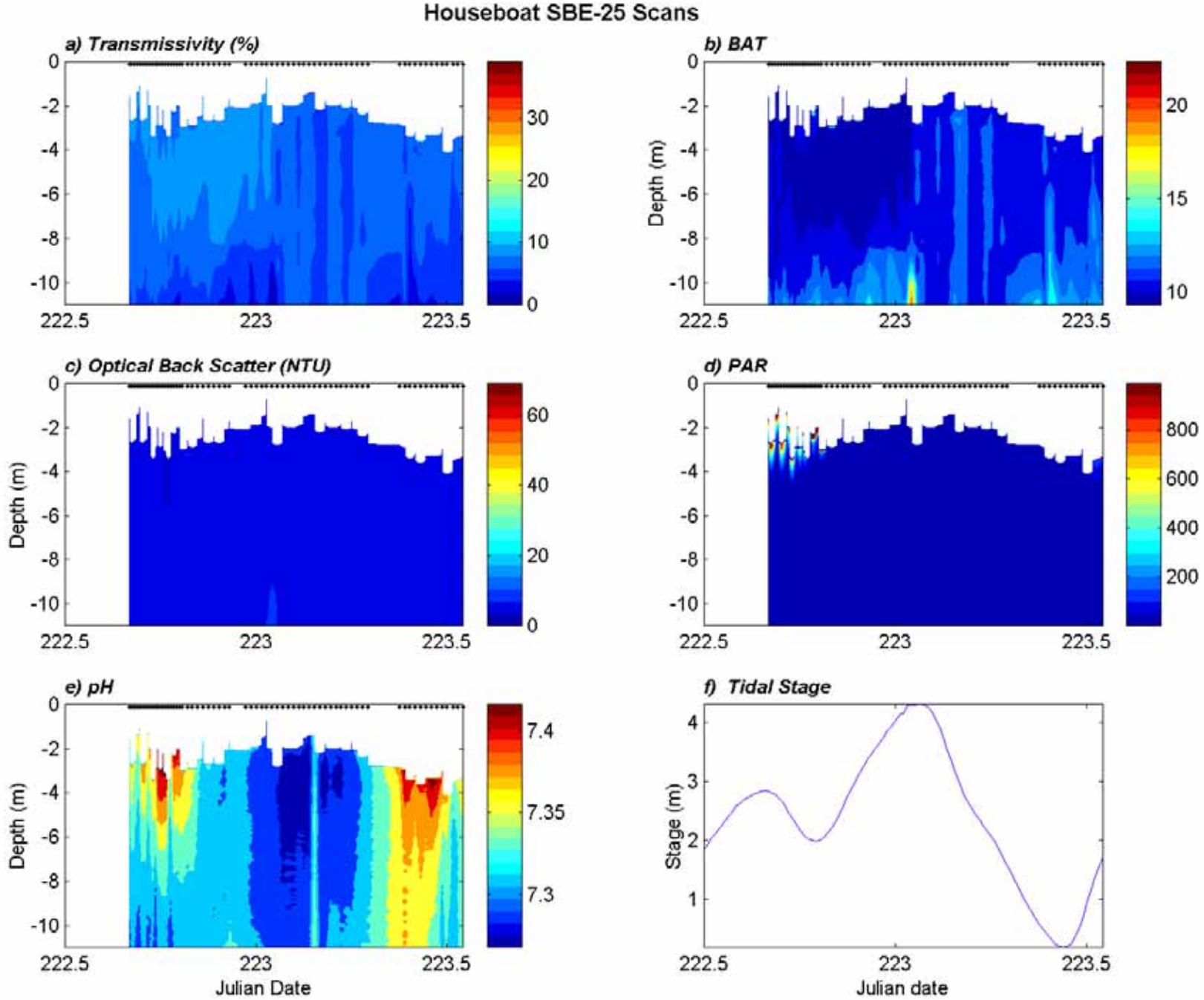
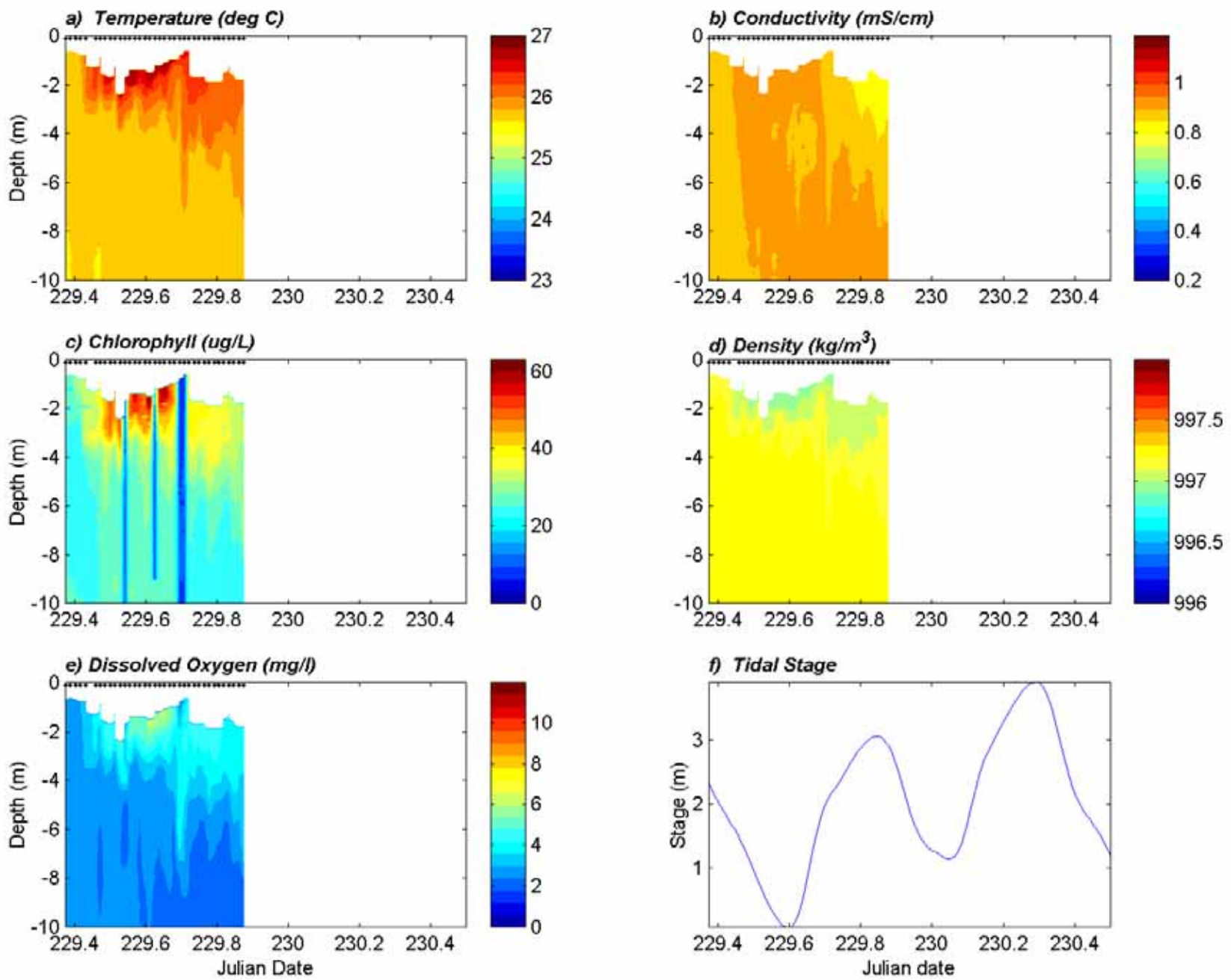

Houseboat SBE-25 Scans
a) Temperature (deg C)
b) Conductivity (mS/cm)
c)Chlorophyll (ug/L)
d) Density (kg/m3)
e) Dissolved Oxygen (mg/l)
f) Tidal Stage
Depth (m)
Stage (m)
Julian date
222.5
223
223.5


Houseboat SBE-25 Scans
a) Transmissivity (%)
b) BAT
c) Optical Back Scatter (NTU)
d) PAR
e) pH
f) Tidal Stage
Depth (m)
Stage (m)
Julian Date
Julian date
222.5
223
223.5


Houseboat SBE-25 Scans
a) Temperature (deg C)
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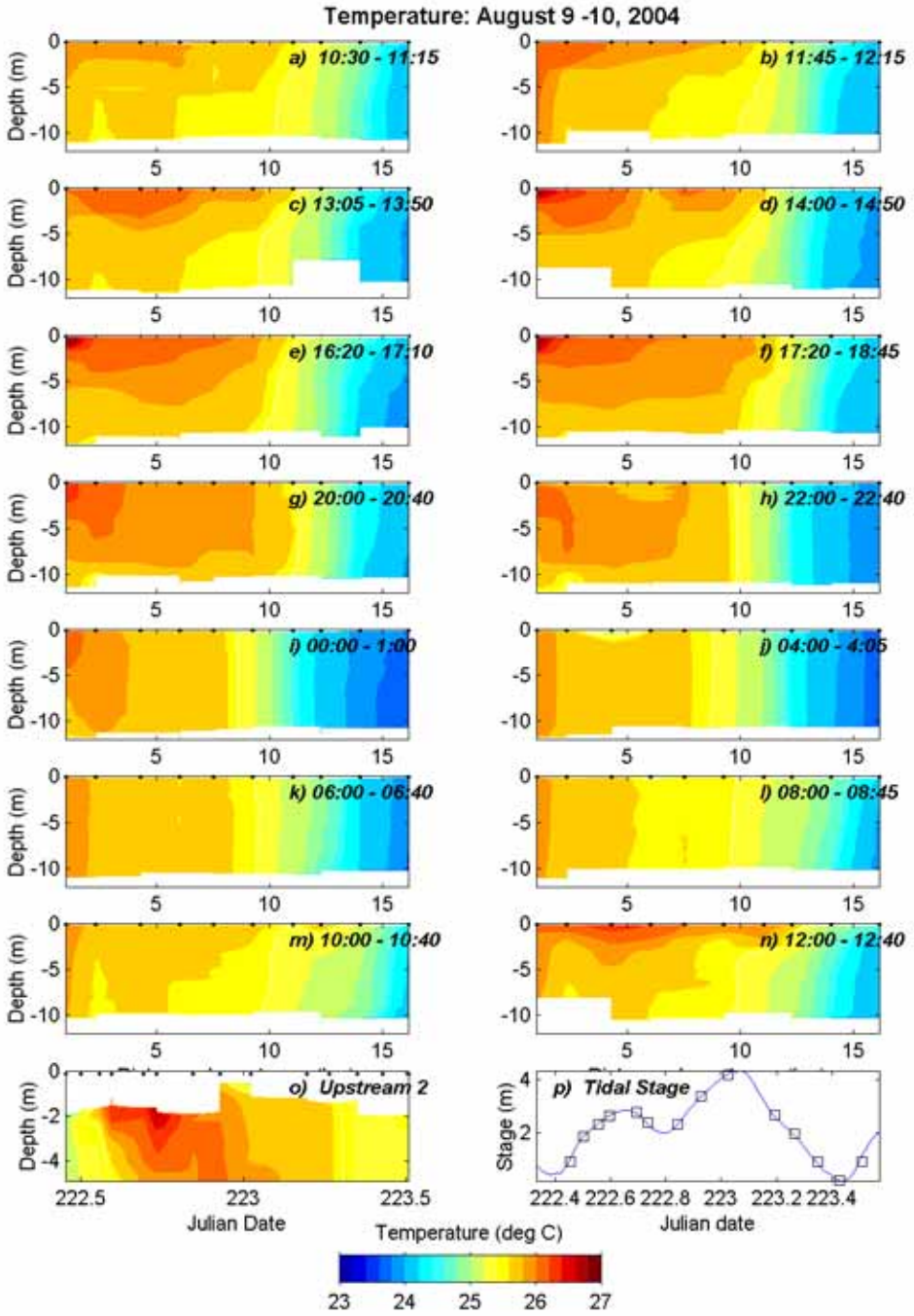
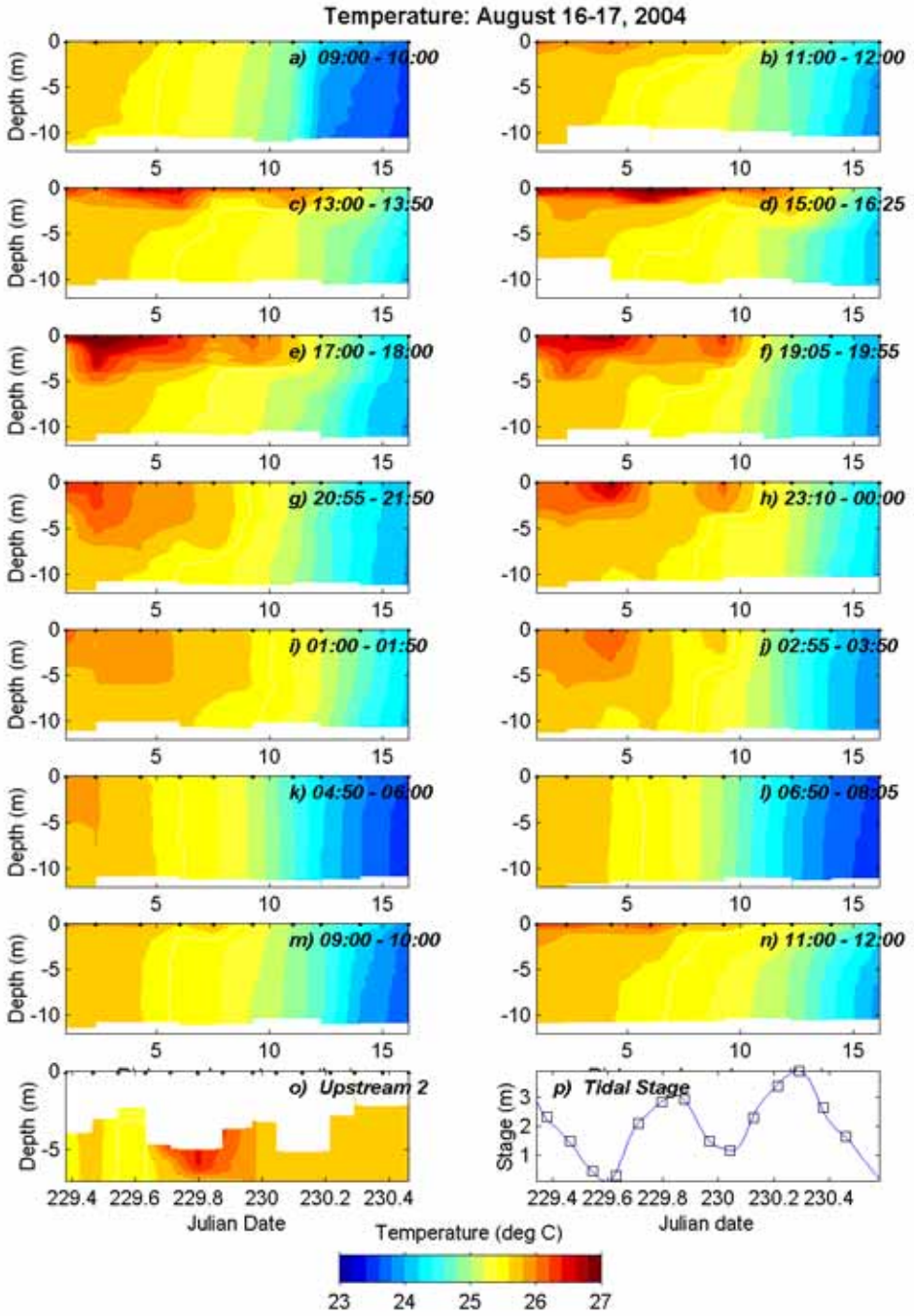
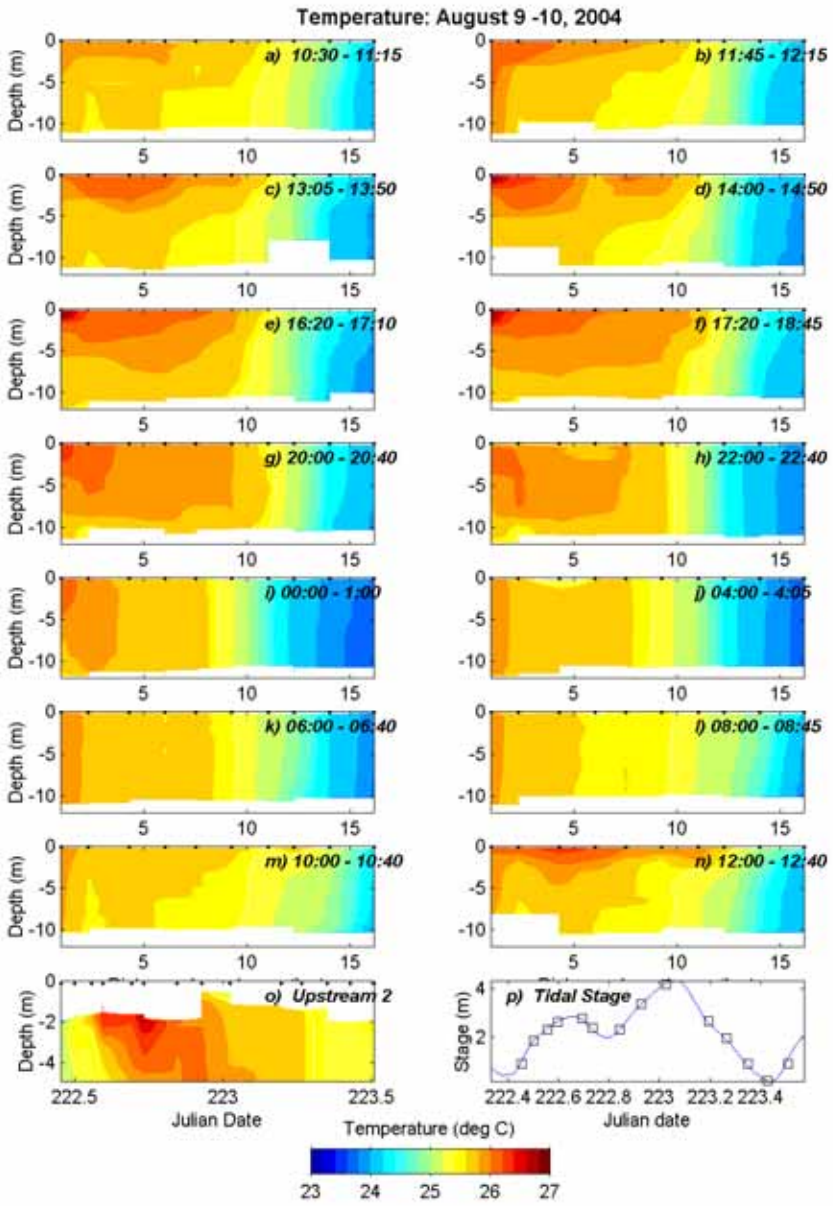
c) Chlorophyll (ug/L)
d) Density (kg/m3)
e) Dissolved Oxygen (mg/l)
f) Tidal Stage
Depth (m)
Stage (m)
Julian Date
Julian date
0
-2
-4
-6
-8
-10
229.4
229.6
229.8
230
230.2
230.4
27
26
25
24
23
1
0.8
0.6
0.4
0.2
60
40
20
0
997.5
997
996.5
996
10
8
6
4
2
0
3
2
1

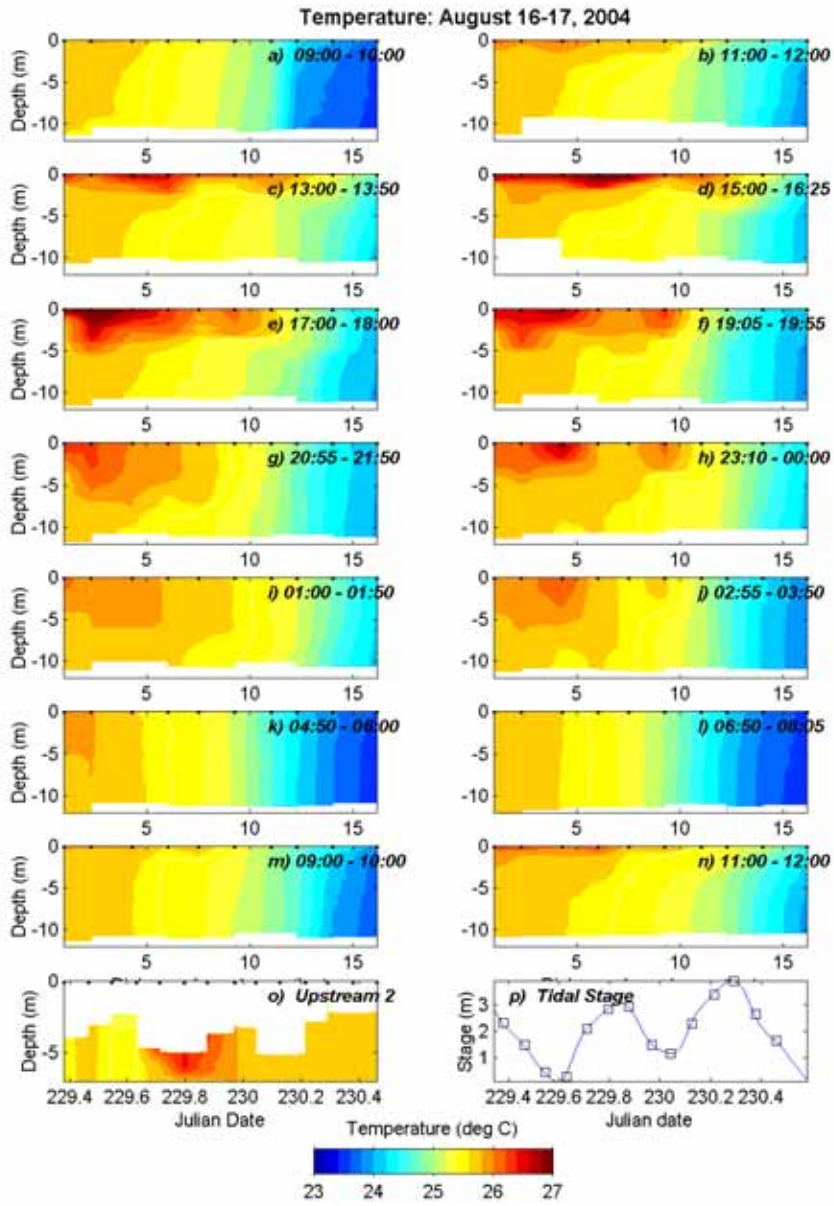
Aug 9th Tidal Cycle Longitudinal Transects

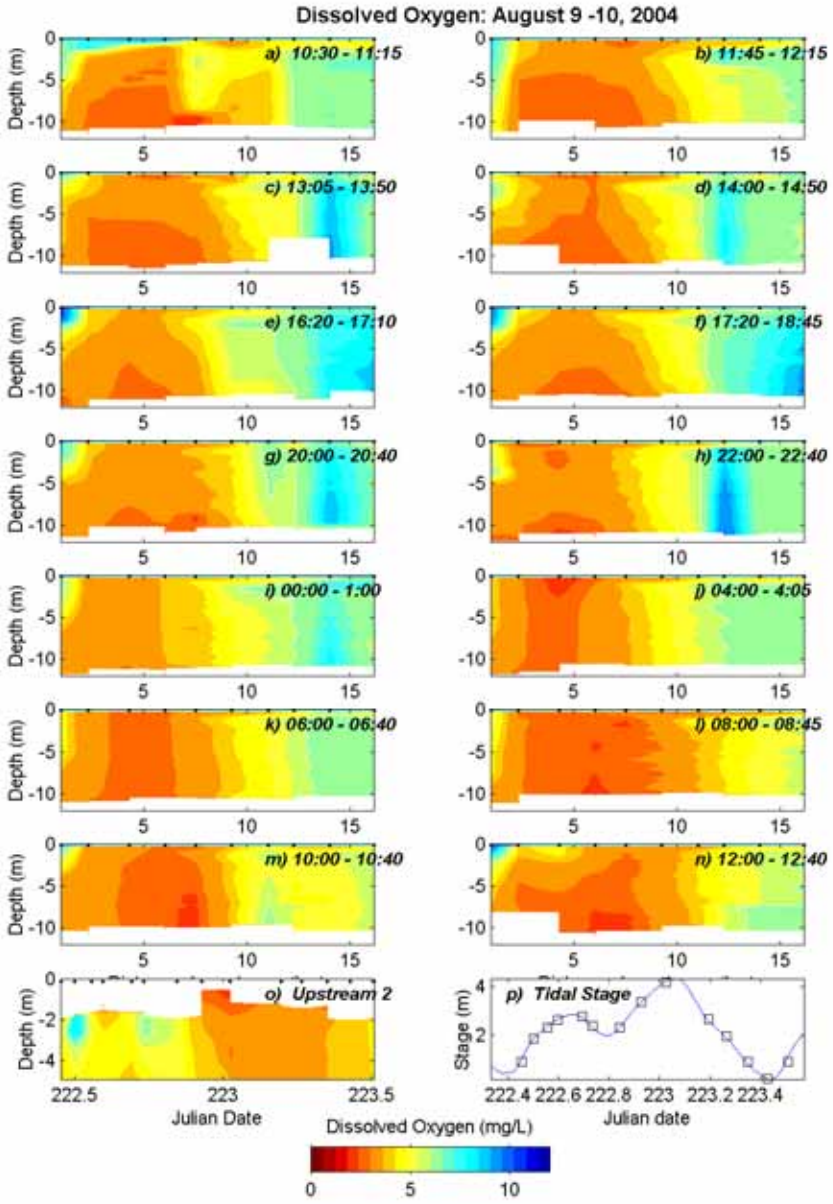


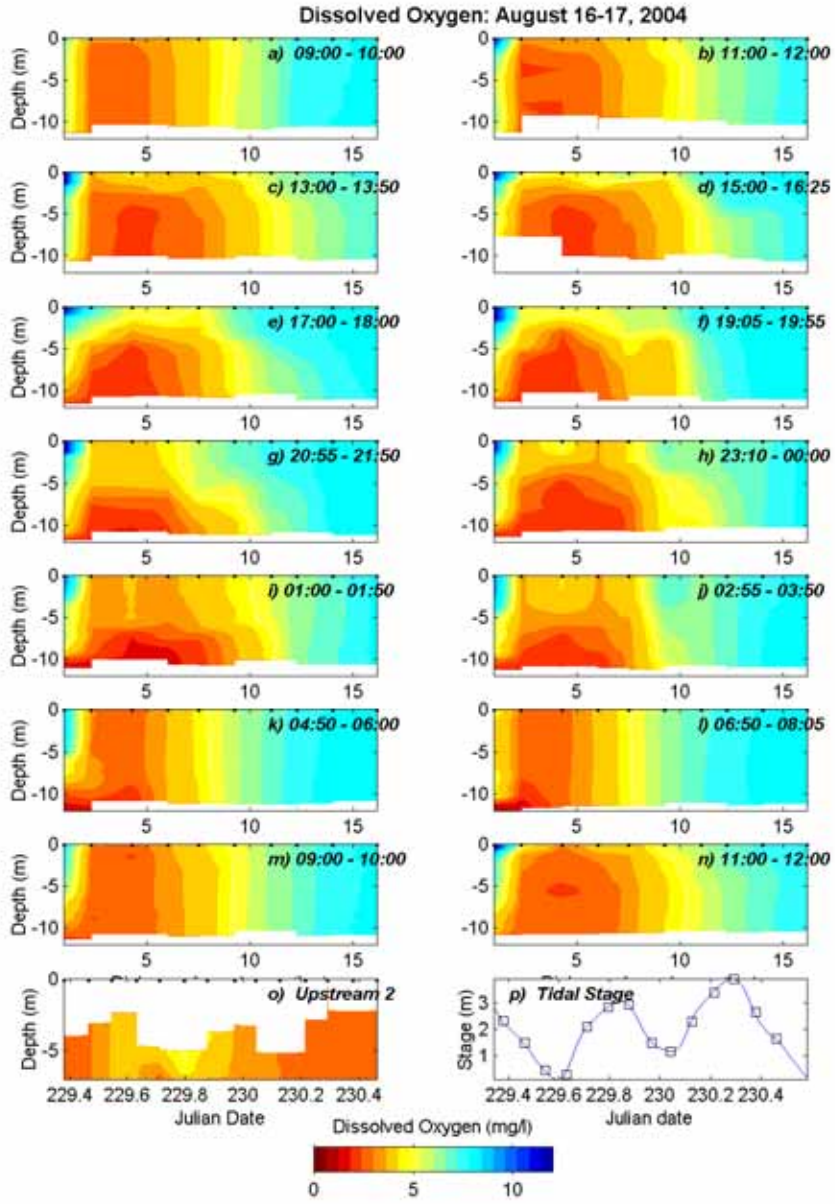
Aug 16th Tidal Cycle Longitudinal Transects




Temperature: August 9 -10, 2004
a) 10:30 - 11:15
b) 11:45 - 12:15
c) 13:05 - 13:50
d) 14:00 - 14:50
e) 16:20 - 17:10
f) 17:20 - 18:45
g) 20:00 - 20:40
h) 22:00 - 22:40
i) 00:00 - 1:00
j) 04:00 - 4:05
k) 06:00 - 06:40
l) 08:00 - 08:45
m) 10:00 - 10:40
n) 12:00 - 12:40
o) Upstream 2
p) Tidal Stage
Depth (m)
Stage (m)
Julian Date
Julian date
Temperature (deg C)
23 24 25 26 27


Temperature: August 16-17, 2004
a) 09:00 - 10:00
b) 11:00 - 12:00
c) 13:00 - 13:50
d) 15:00 - 16:25
e) 17:00 - 18:00
f) 19:05 - 19:55
g) 20:55 - 21:50
h) 23:10 - 00:00
i) 01:00 - 01:50
j) 02:55 - 03:50
k) 04:50 - 06:00
l) 06:50 - 08:05
m) 09:00 - 10:00
n) 11:00 - 12:00
o) Upstream 2
p) Tidal Stage
Depth (m)
Stage (m)
Julian Date
Julian date
Temperature (deg C)
23 24 25 26 27

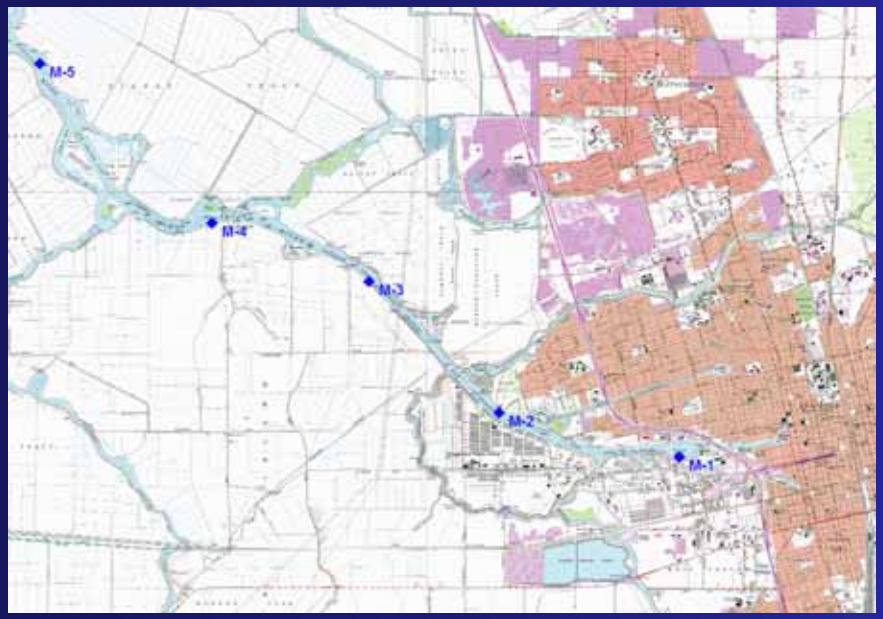


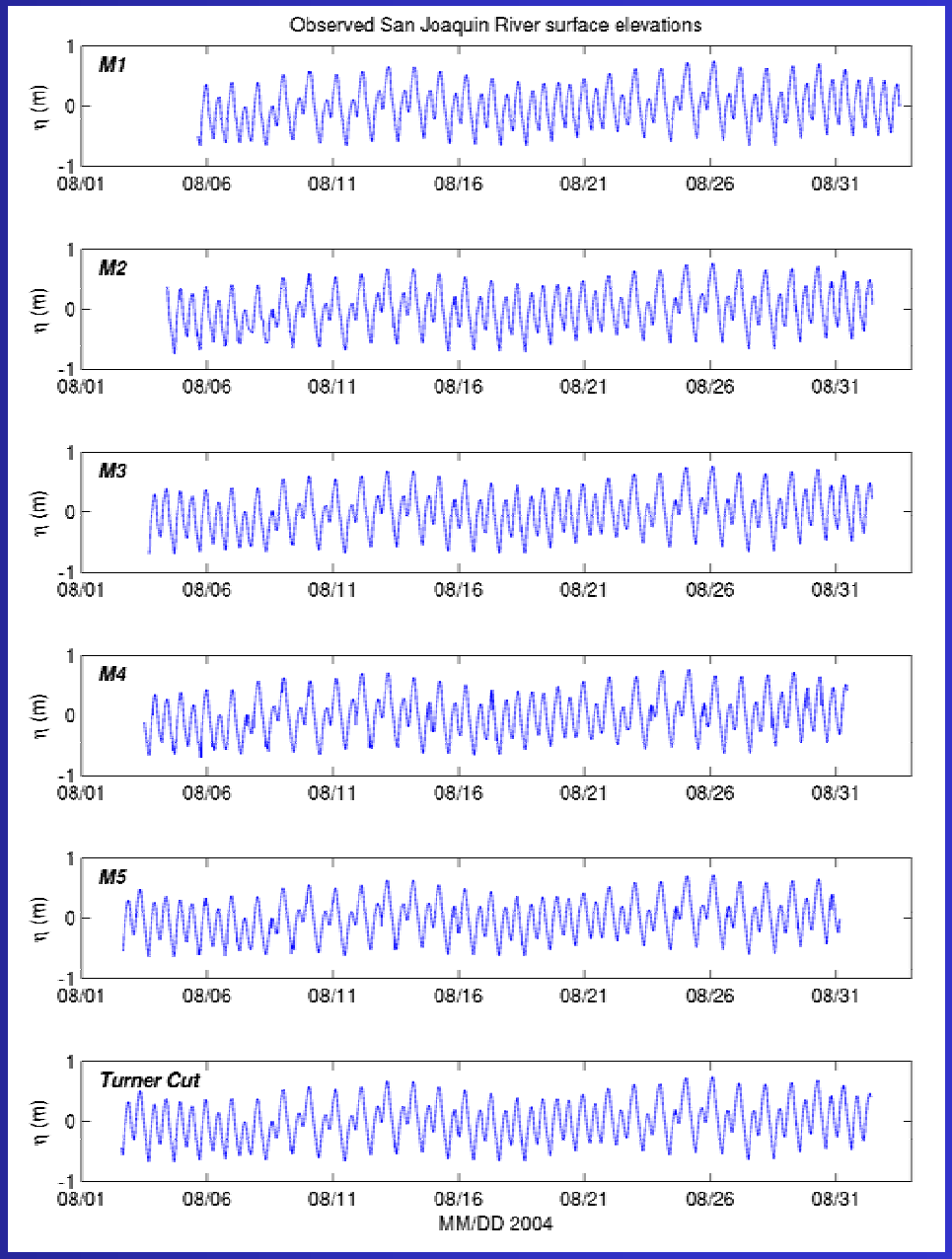


Neap Tide

Spring Tide

Moorings





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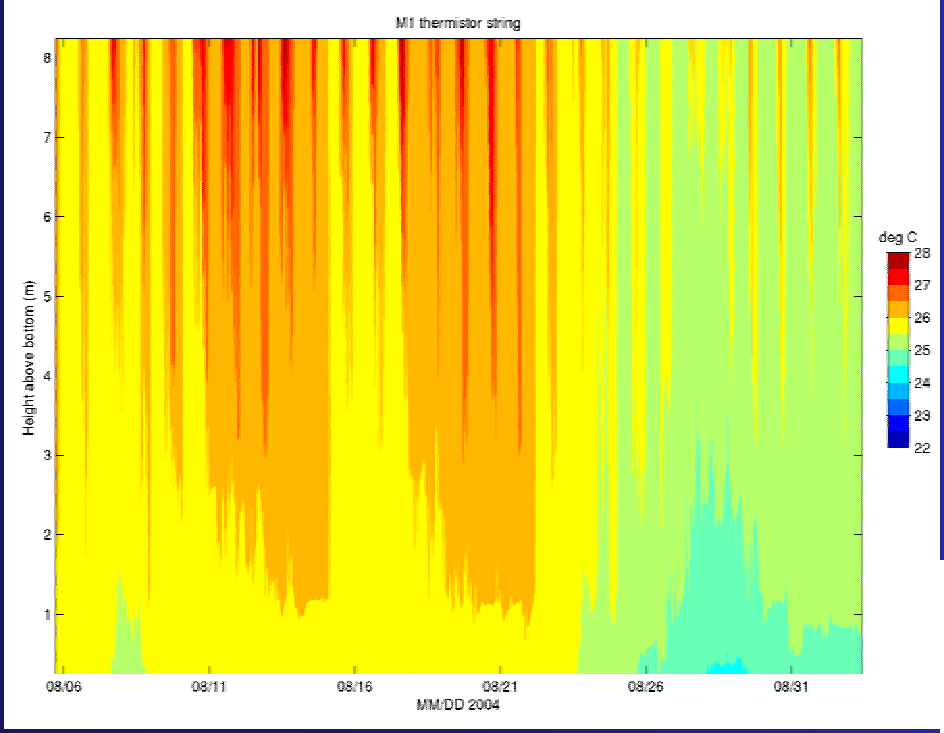
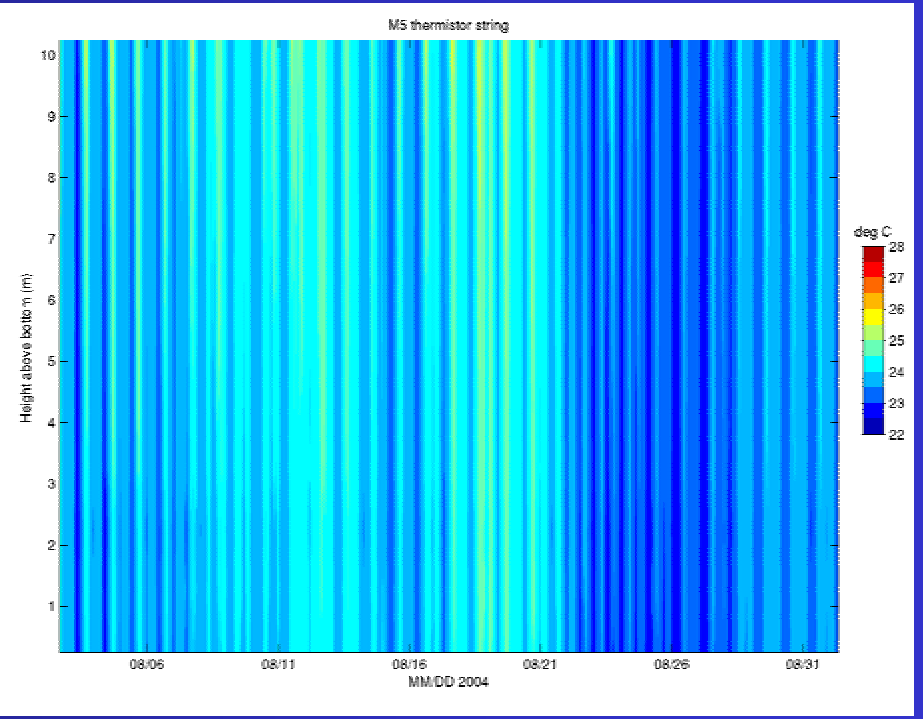
Moorings





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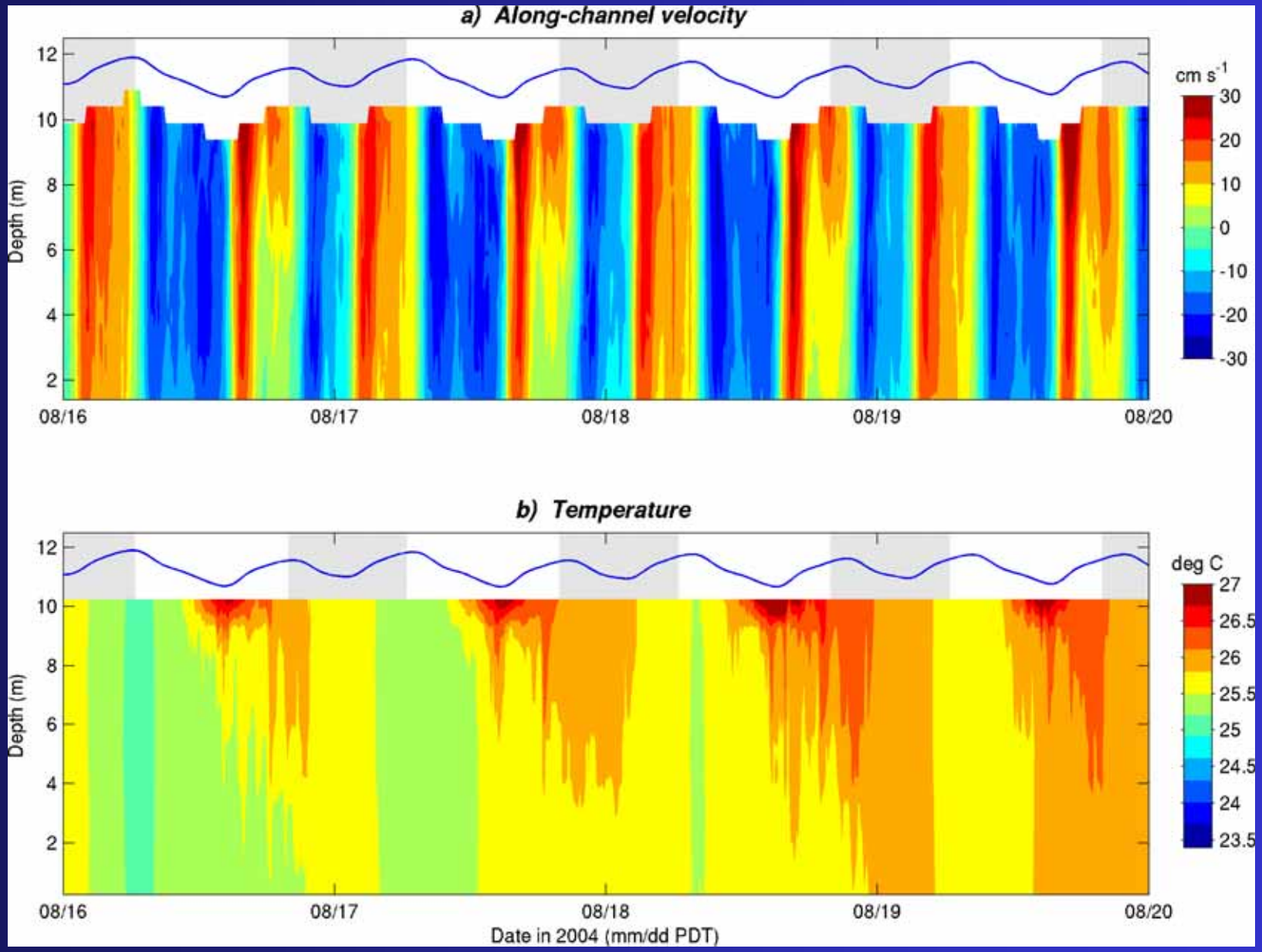

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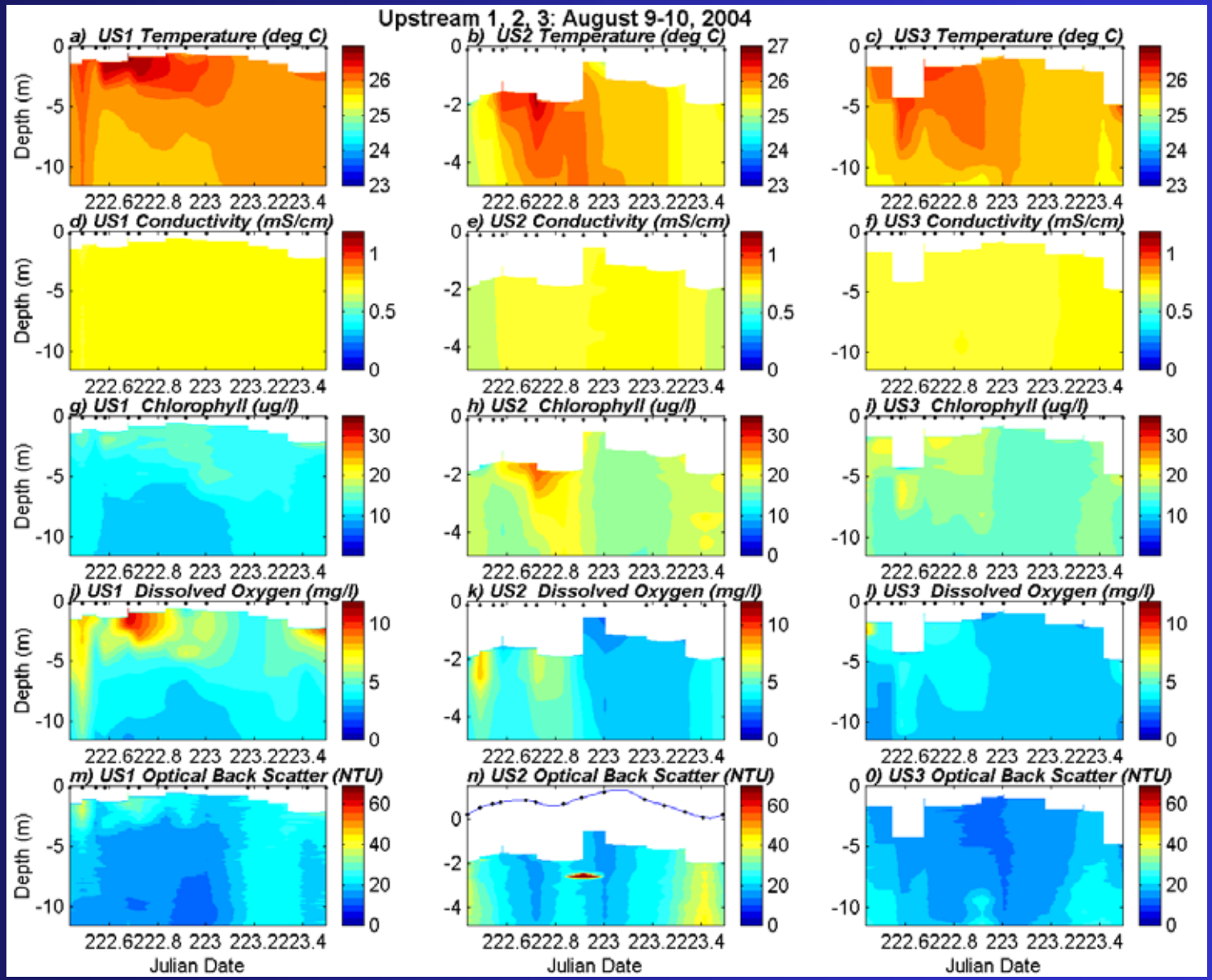

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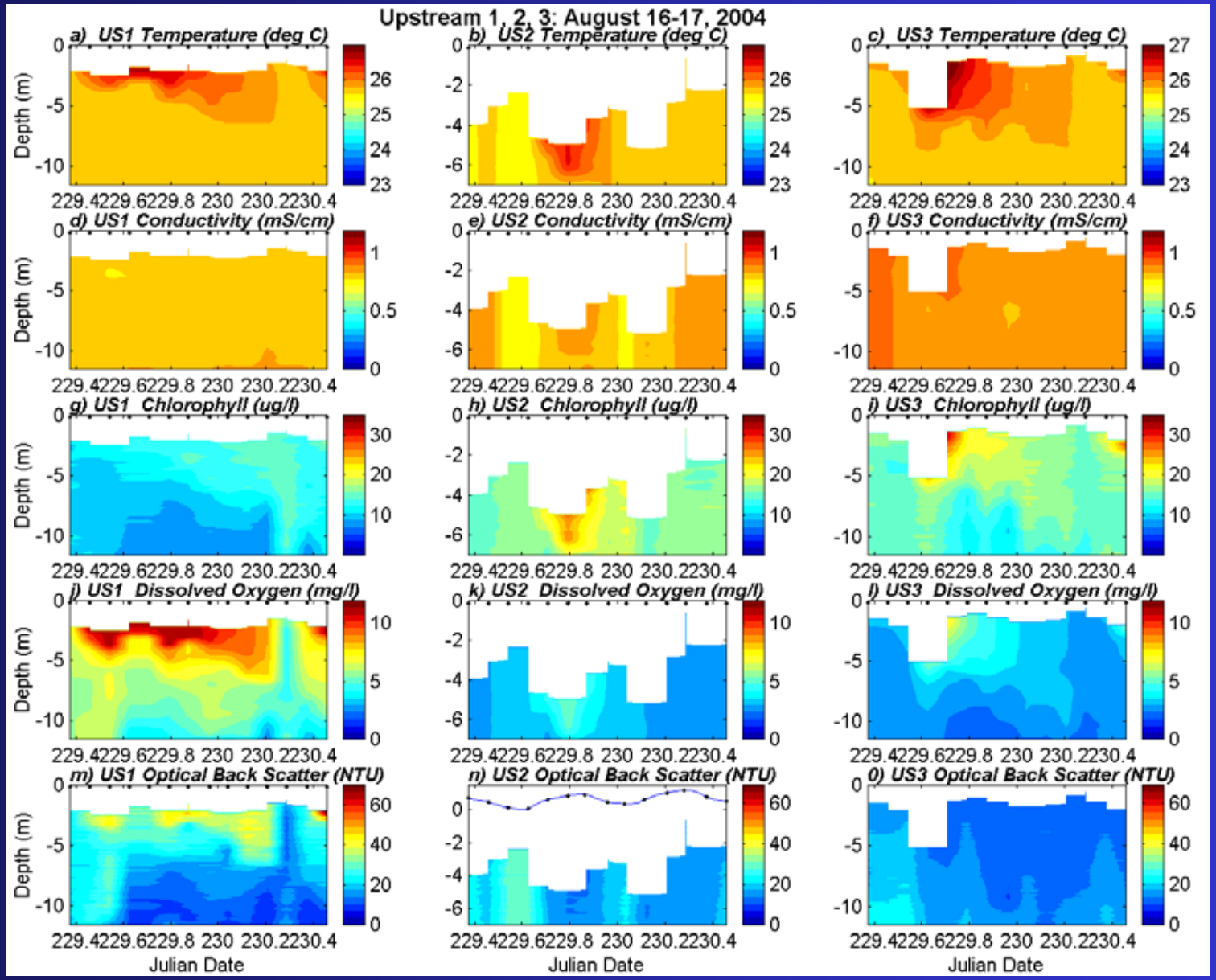

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Next step

Finish velocity data from fixed ADCPs

Finish temperature string data

Incorporate water quality data analysis

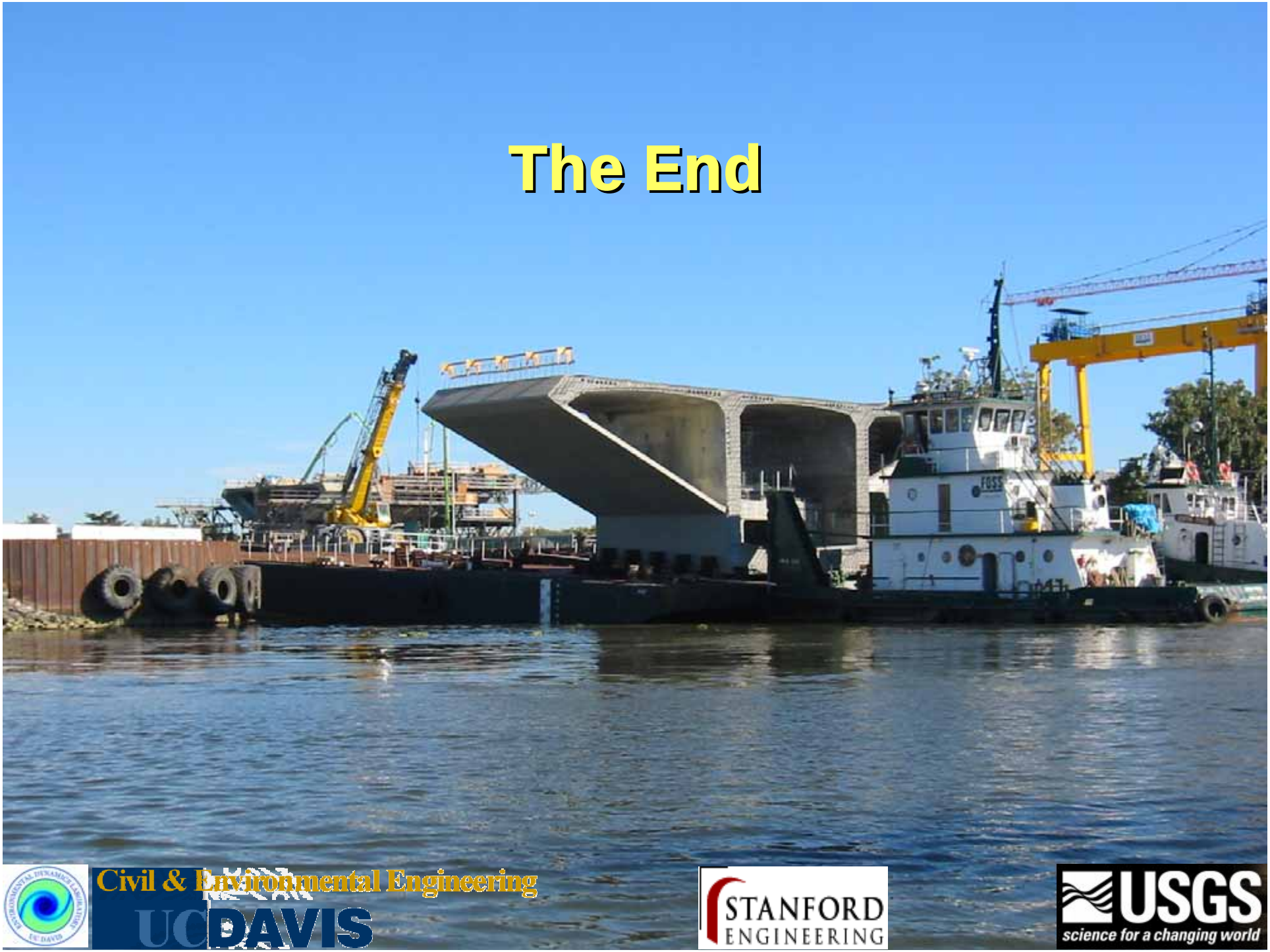
Concentrate on the junction

Move upstream boundary condition

Need improved resolution on grid

Plan next field investigation effort

The End



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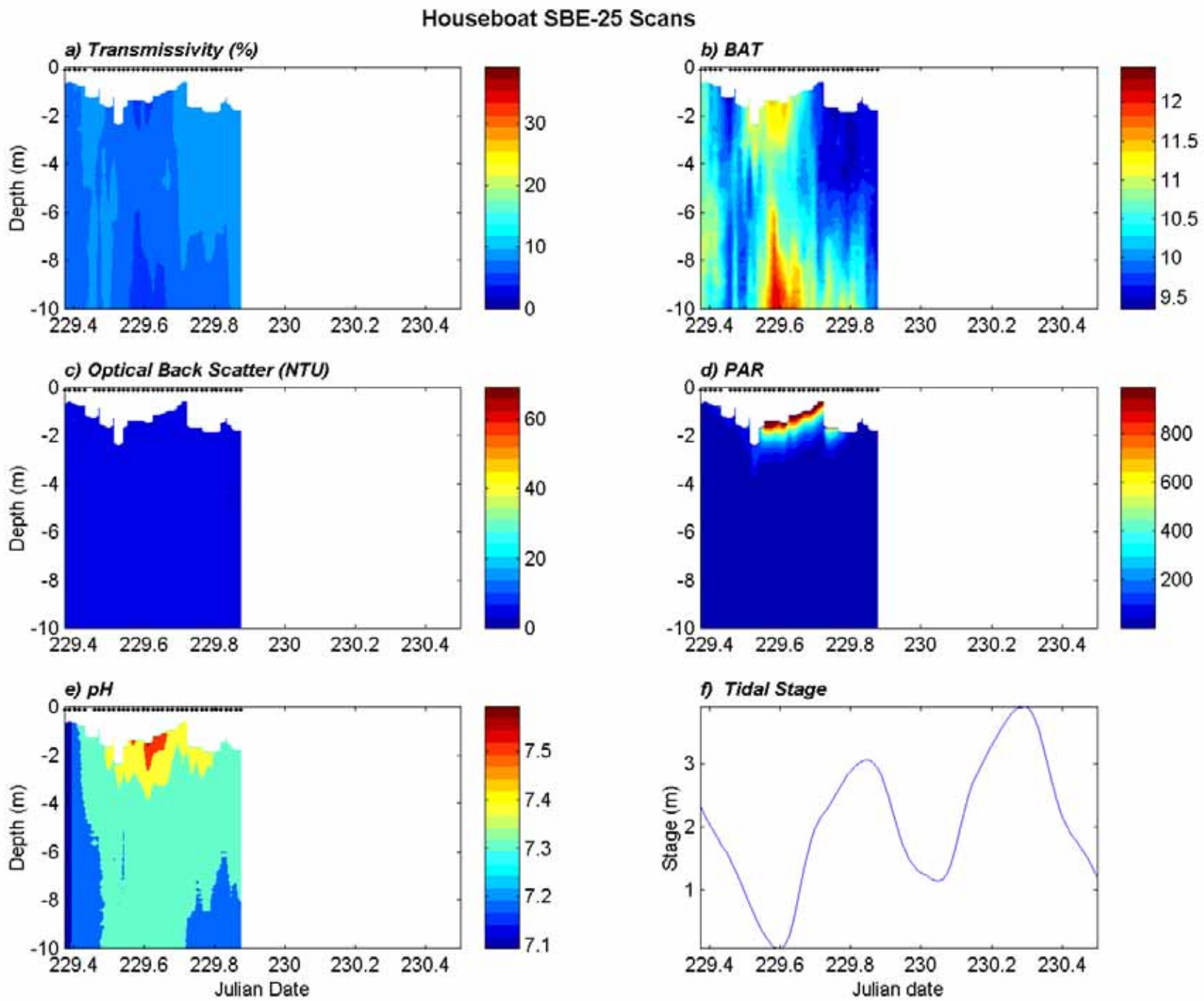
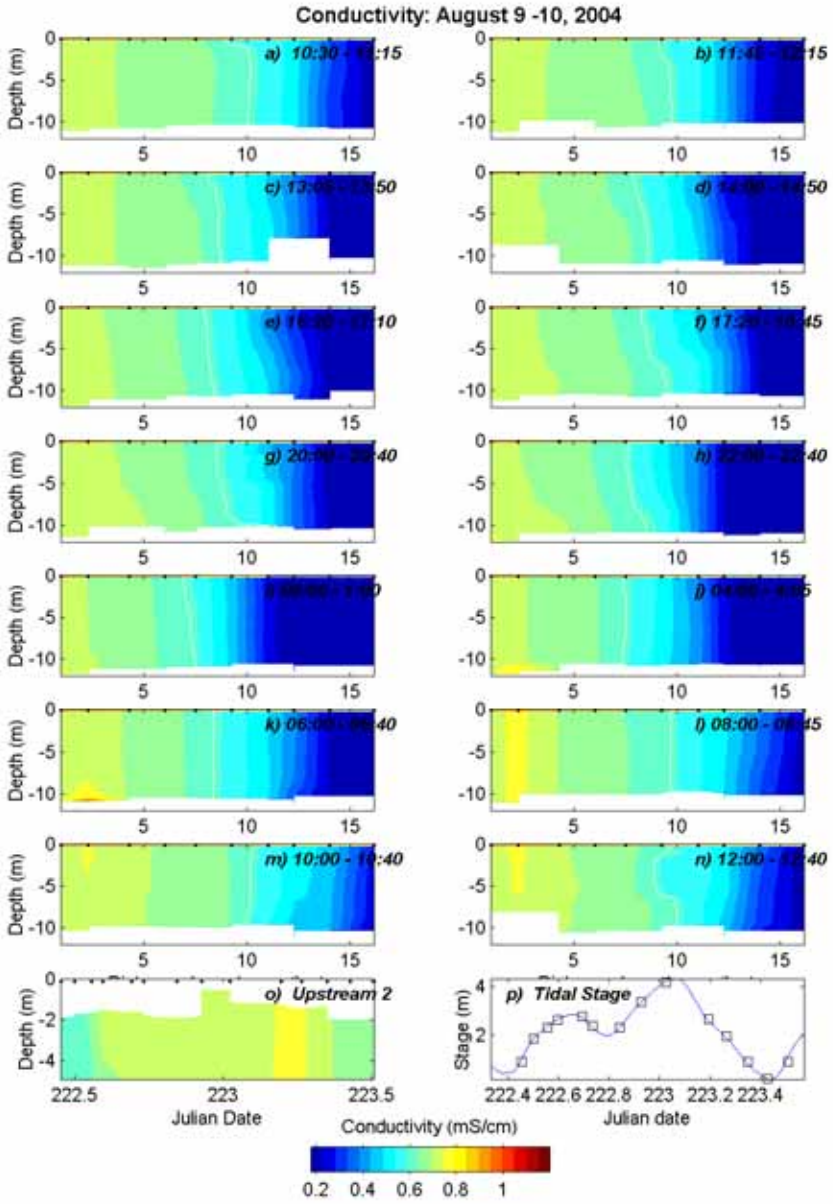
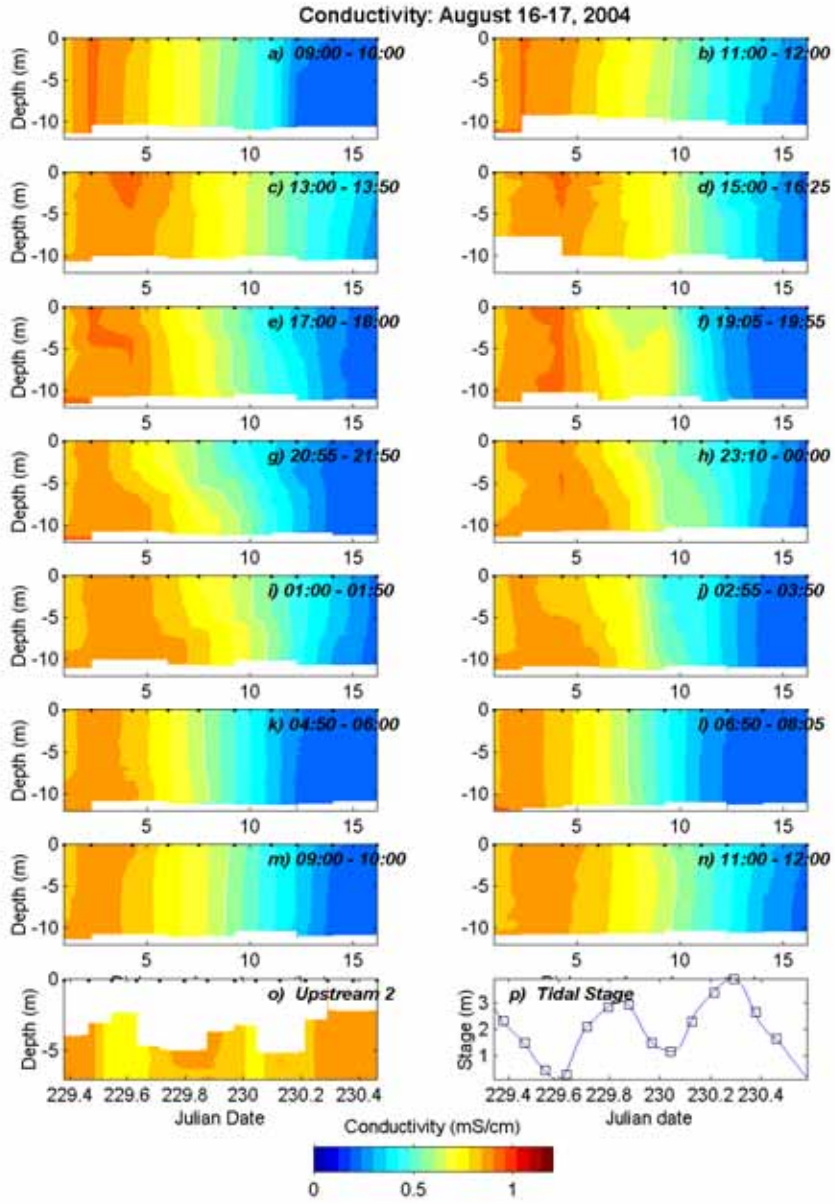
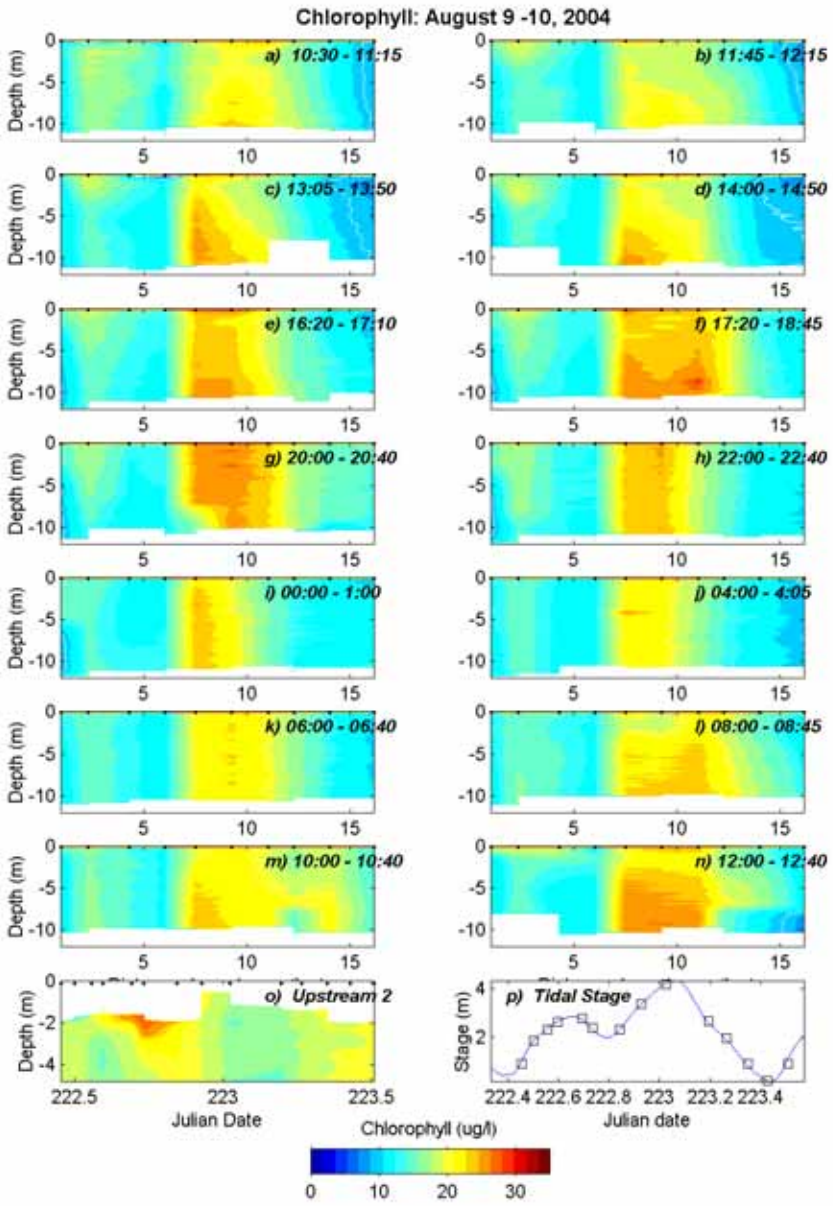

Houseboat SBE-25 Scans
a) Transmissivity (%)
b) BAT
c) Optical Back Scatter (NTU)
d) PAR
e) pH
f) Tidal Stage
Depth (m)
Stage (m)
Julian Date
Julian date
0
-2
-4
-6
-8
-10
229.4
229.6
229.8
230
230.2
230.4
30
20
10
0
12
11.5
11
10.5
10
9.5
60
40
20
0
800
600
400
200
7.5
7.4
7.3
7.2
7.1
3
2
1

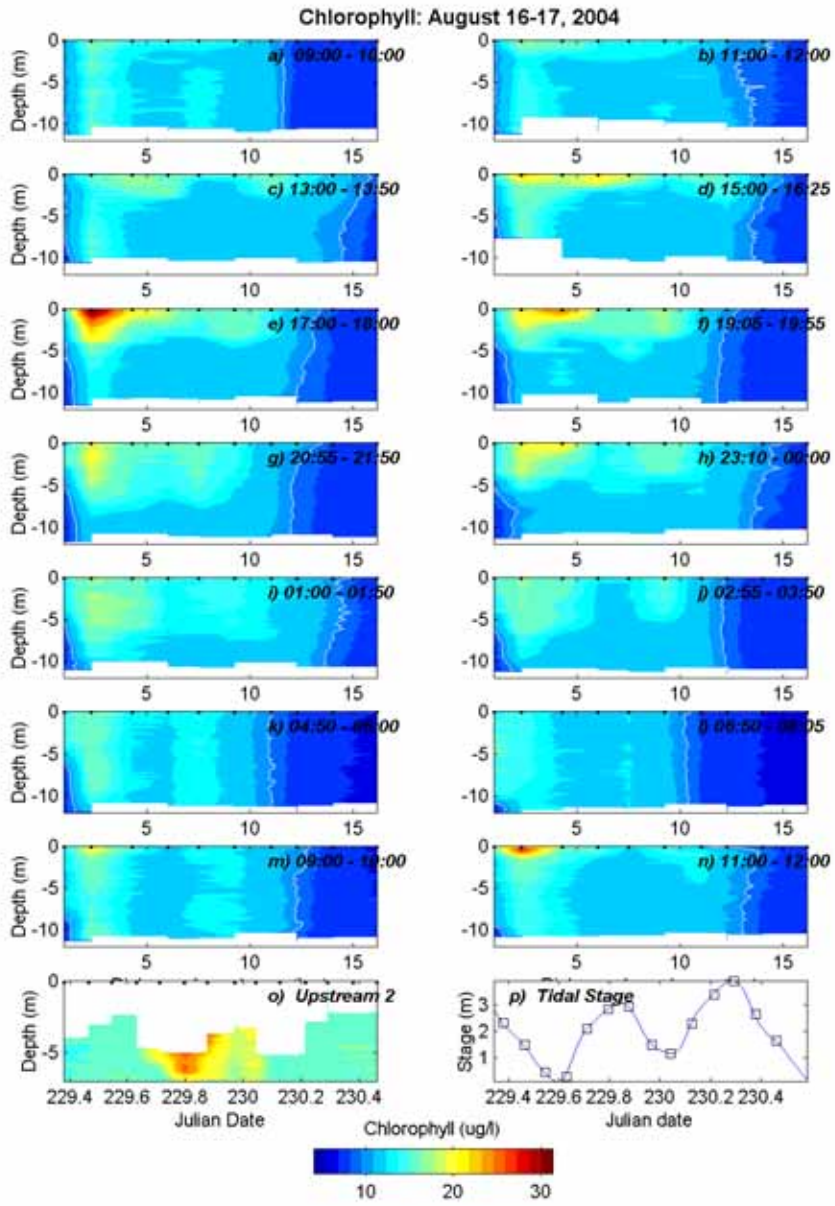




Neap Tide

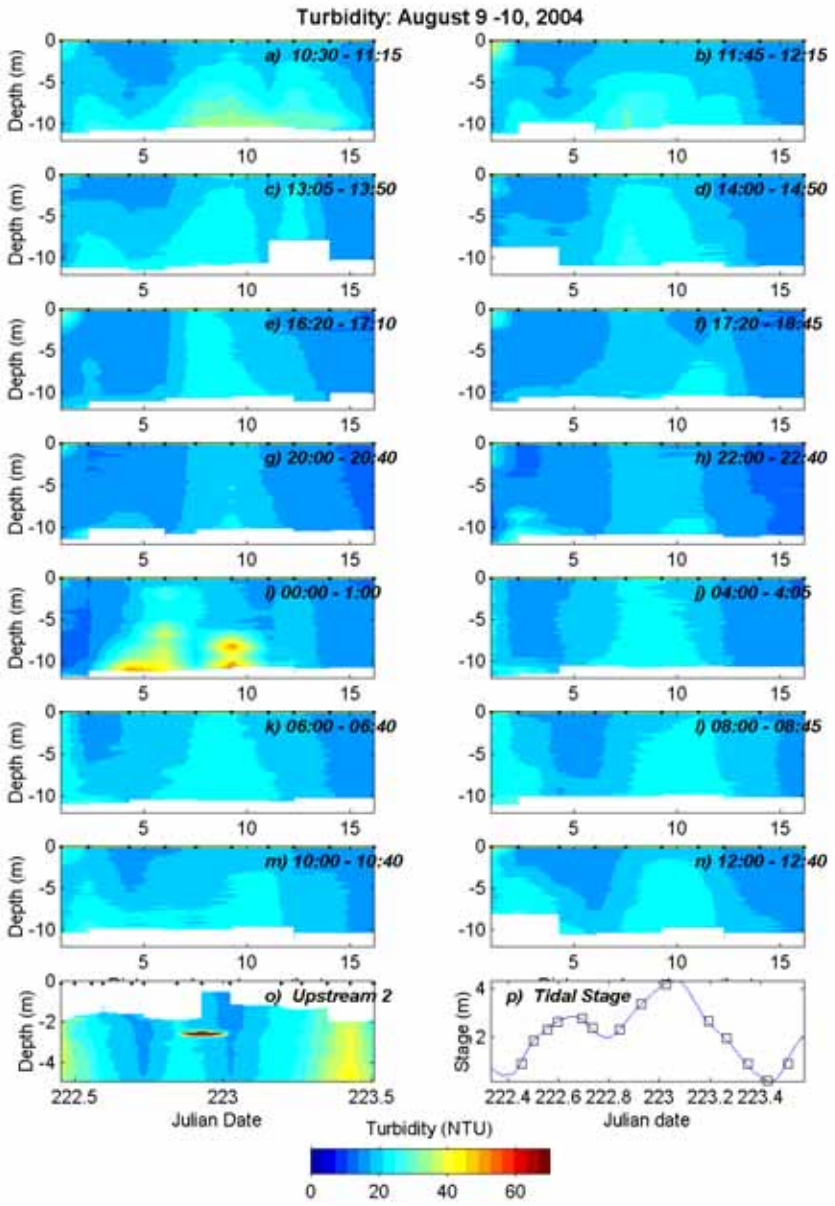
Spring Tide

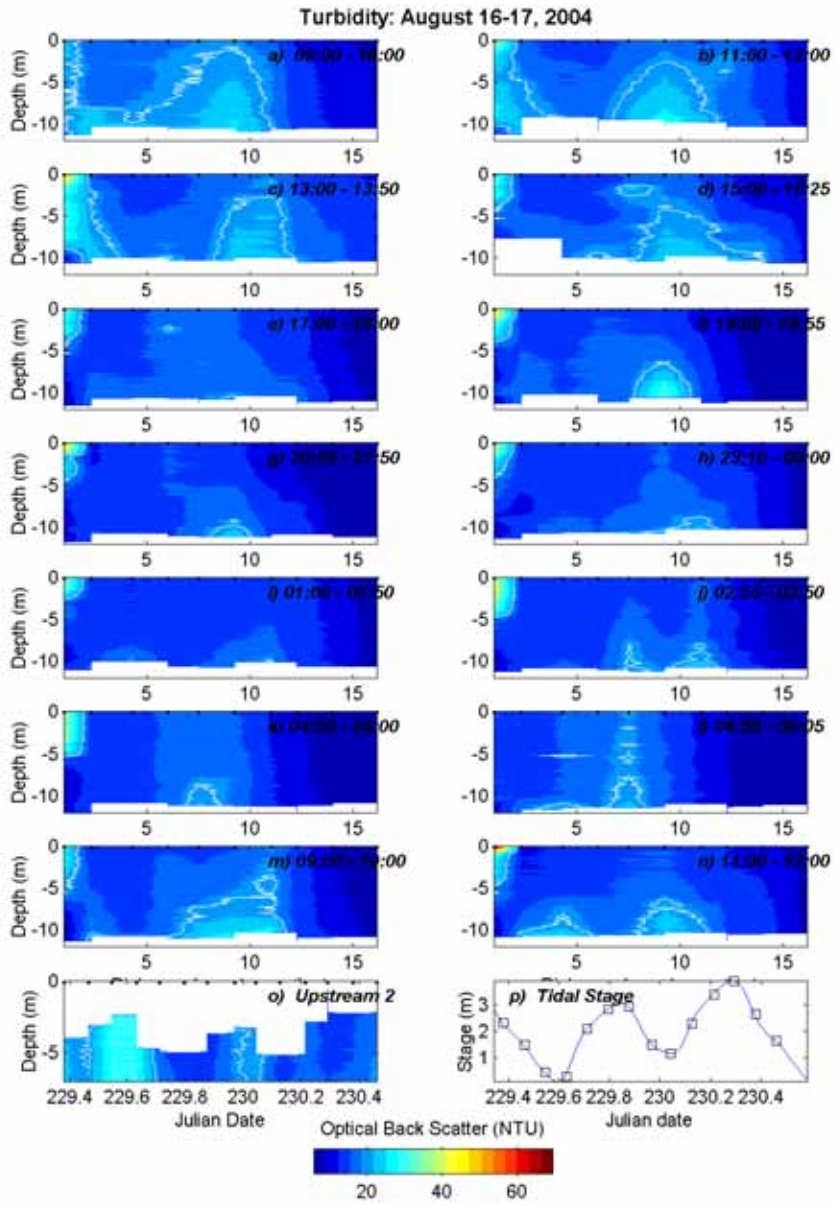




Neap Tide

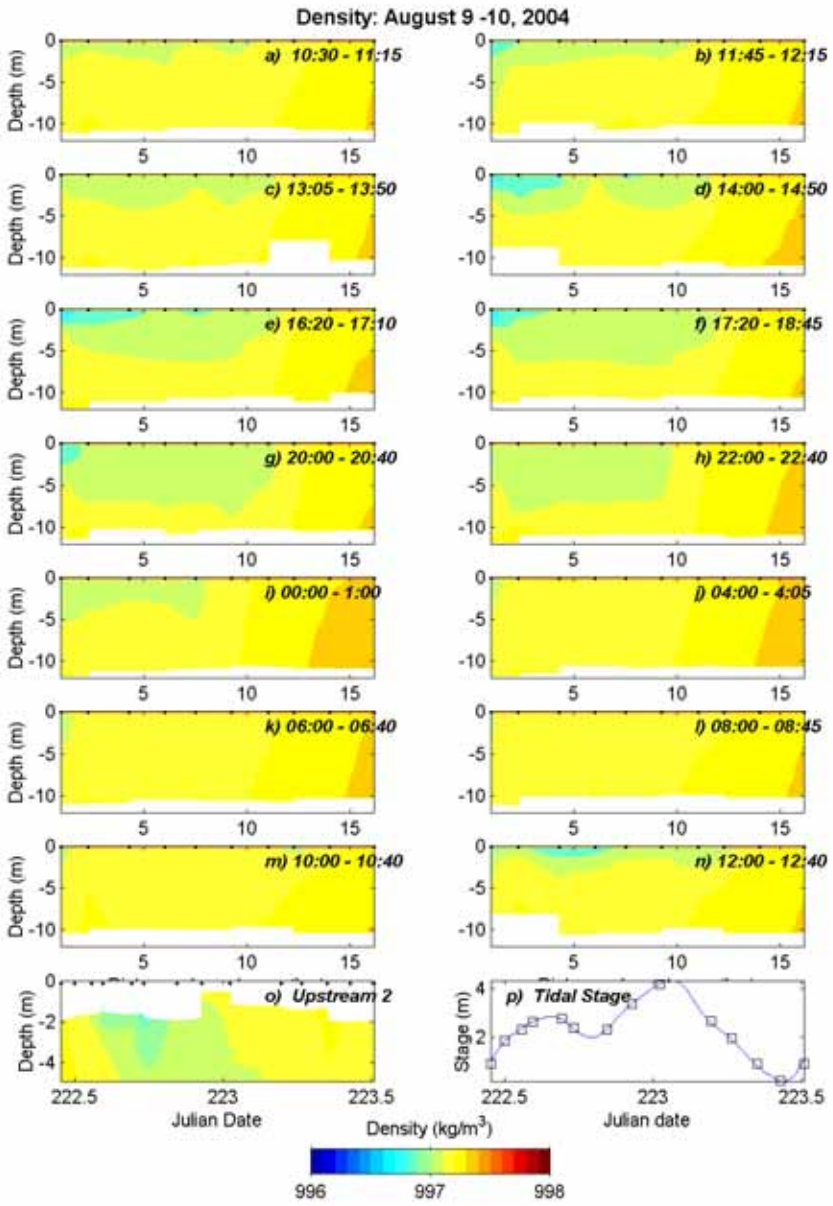
Spring Tide

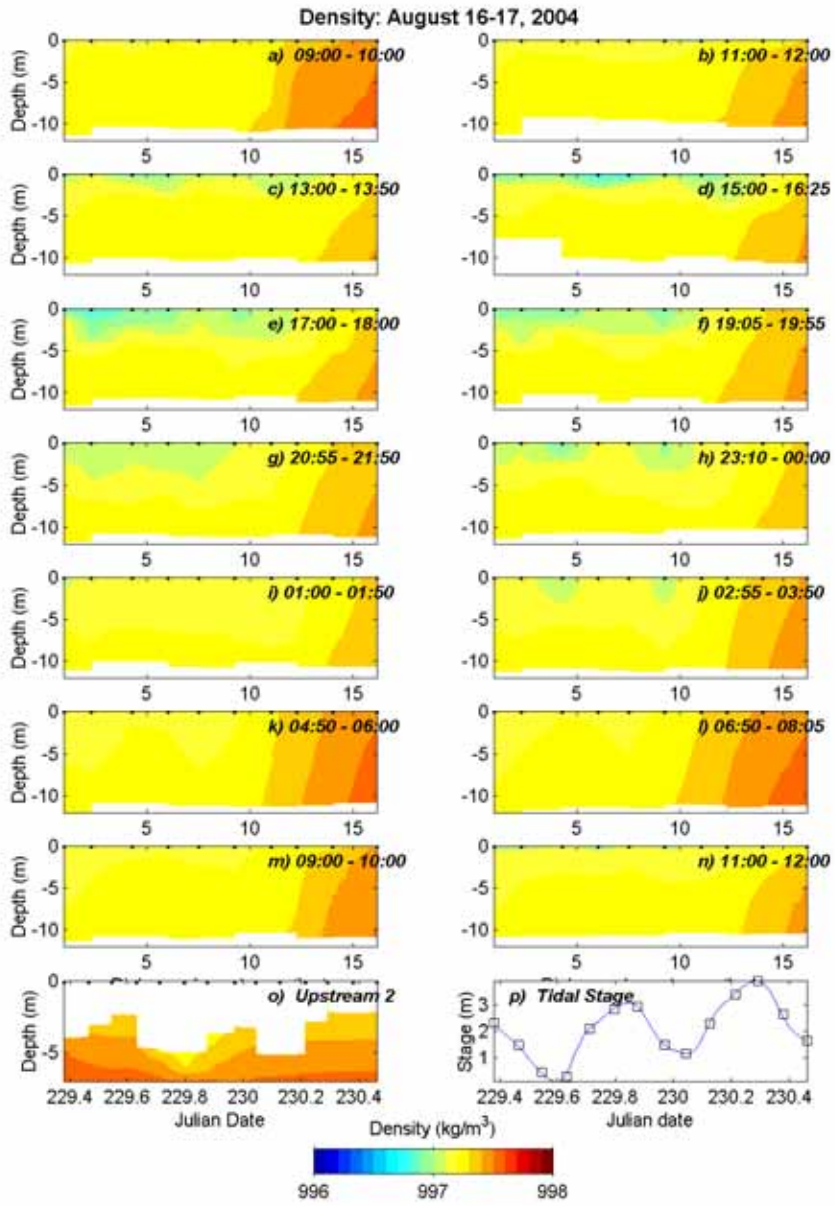




Neap Tide

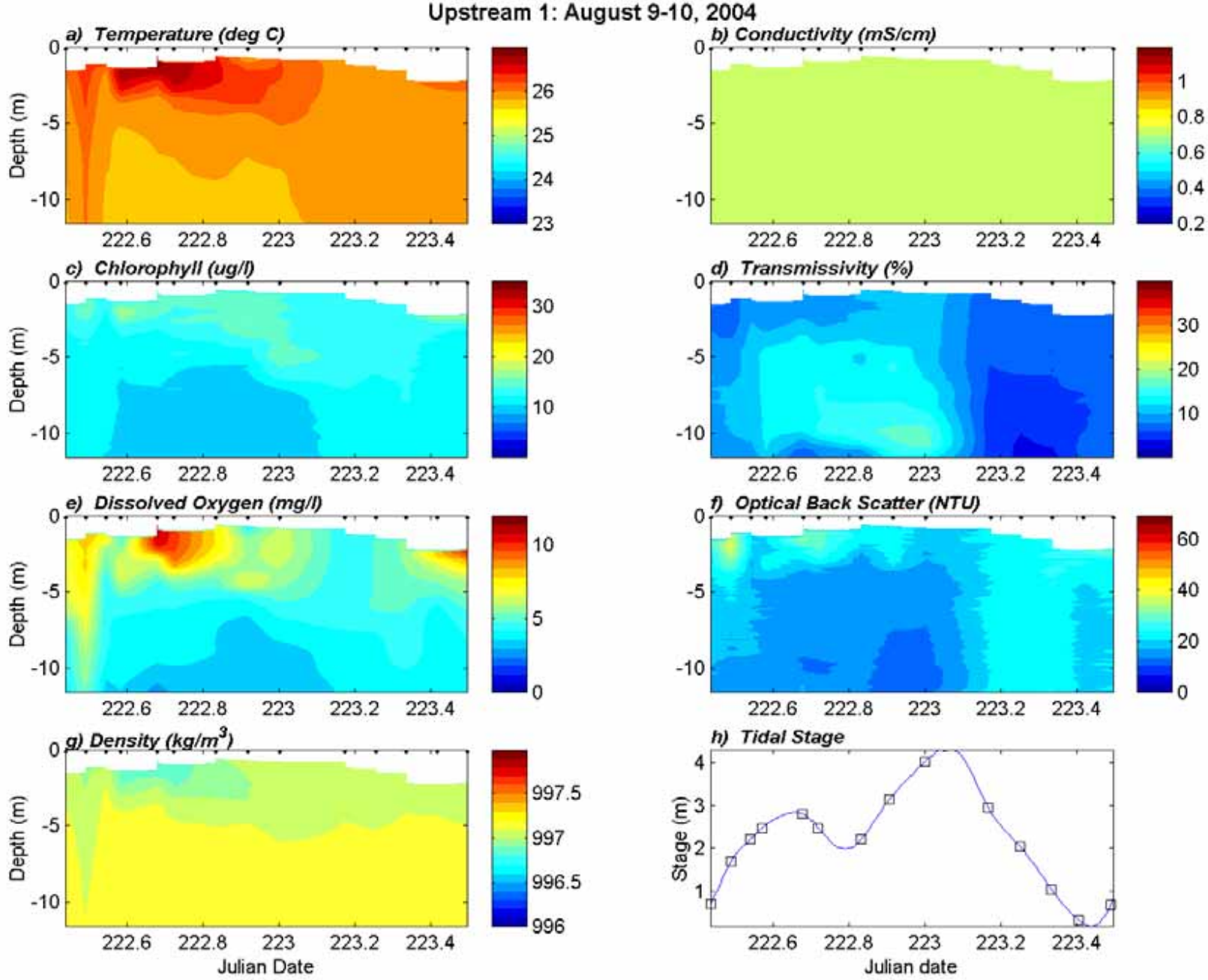
Spring Tide





Neap Tide

Spring Tide


Upstream 1: August 9-10, 2004
a) Temperature (deg C)
b) Conductivity (mS/cm)
c) Chlorophyll (ug/l)
d) Transmissivity (%)
e) Dissolved Oxygen (mg/l)
f) Optical Back Scatter (NTU)
g) Density (kg/m3)
h) Tidal Stage
Depth (m)
Stage (m)
Julian Date
Julian date
222.6
222.8
223
223.2
223.4