James River PCB TMDL

Model Calibration
Phase I: Hydrodynamic Model

Jian Shen, Rico Wang, & Mac Sisson
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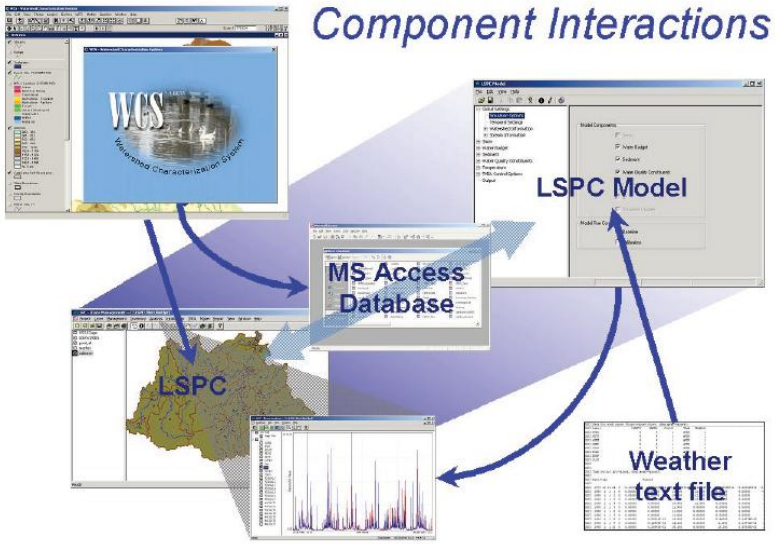
Virginia Institute of Marine Science
College of William & Mary

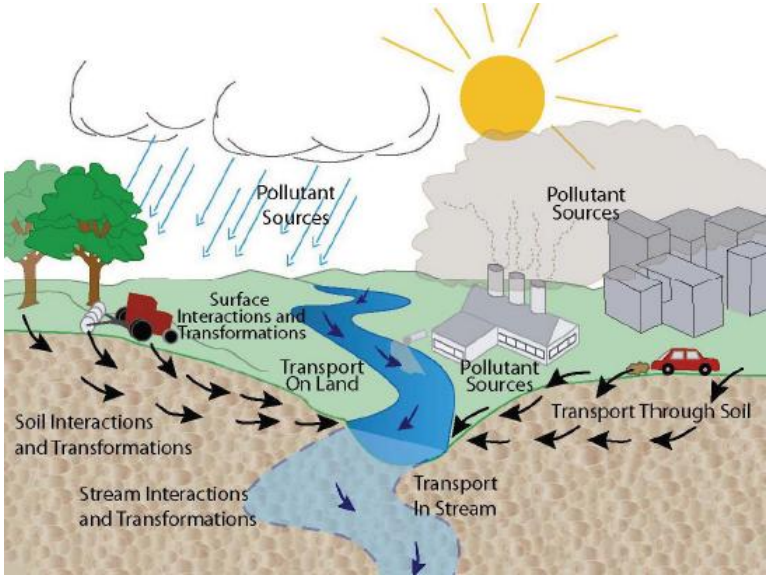
Model Development

- Watershed model
  - Flow (surface runoff, interflow, and groundwater)
  - Organic carbon, sediment
  - Nutrients (ON, DON, NH_4, NO_3, OP, DOP, PO_4)
- Hydrodynamic model
  - Surface elevation and current
  - Salinity
  - Temperature
- Eutrophication Model
  - Organic carbon, dissolved organic carbon, and algae
- PCB model
  - PCB transport and fate

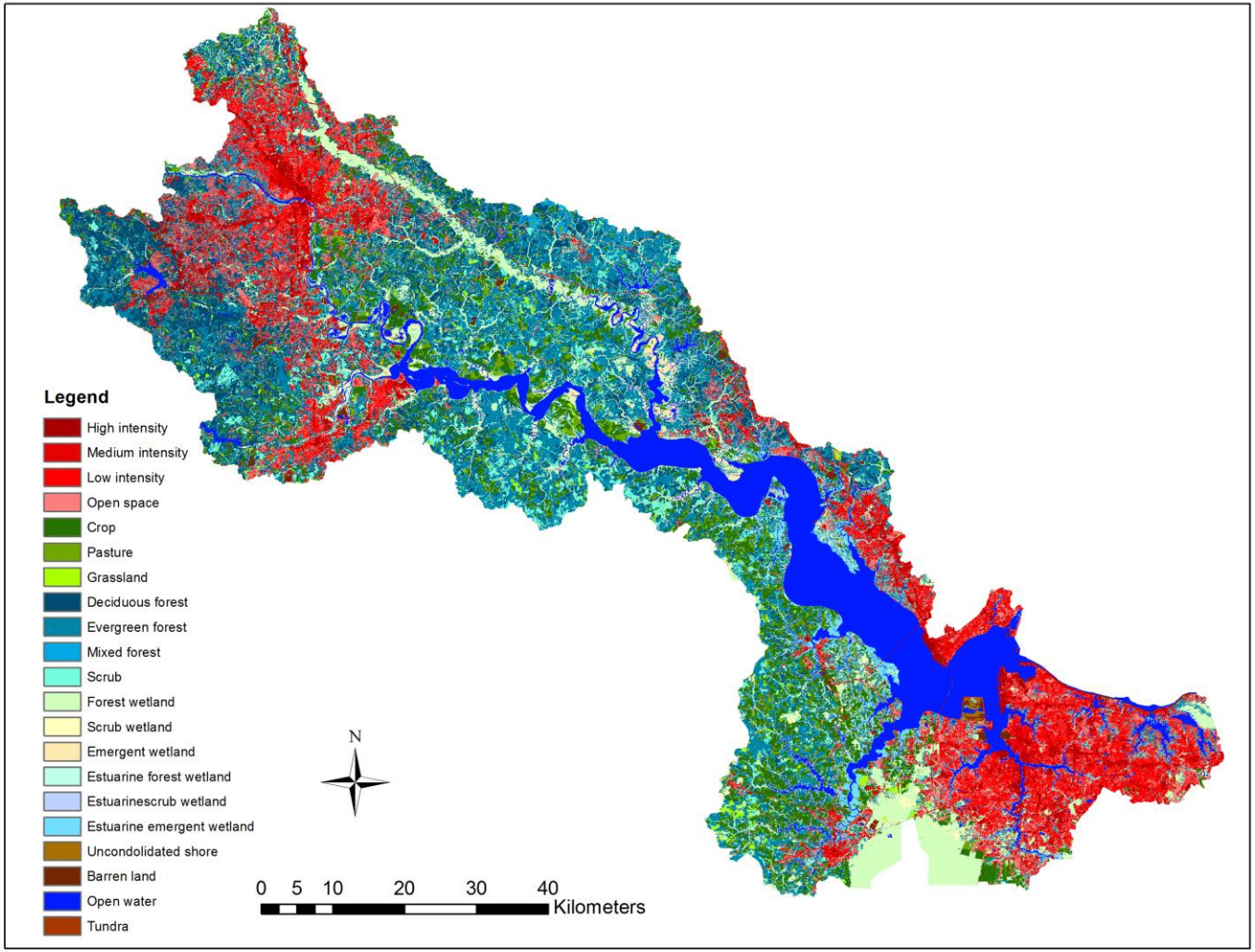
Watershed Model

- Watershed model was developed by TetraTech, Inc. for the James River eutrophication model project
- The Loading Simulation Program in C++ is being used for the simulation (http://www.epa.gov/athens/wwqtsc/html/lspc.html)

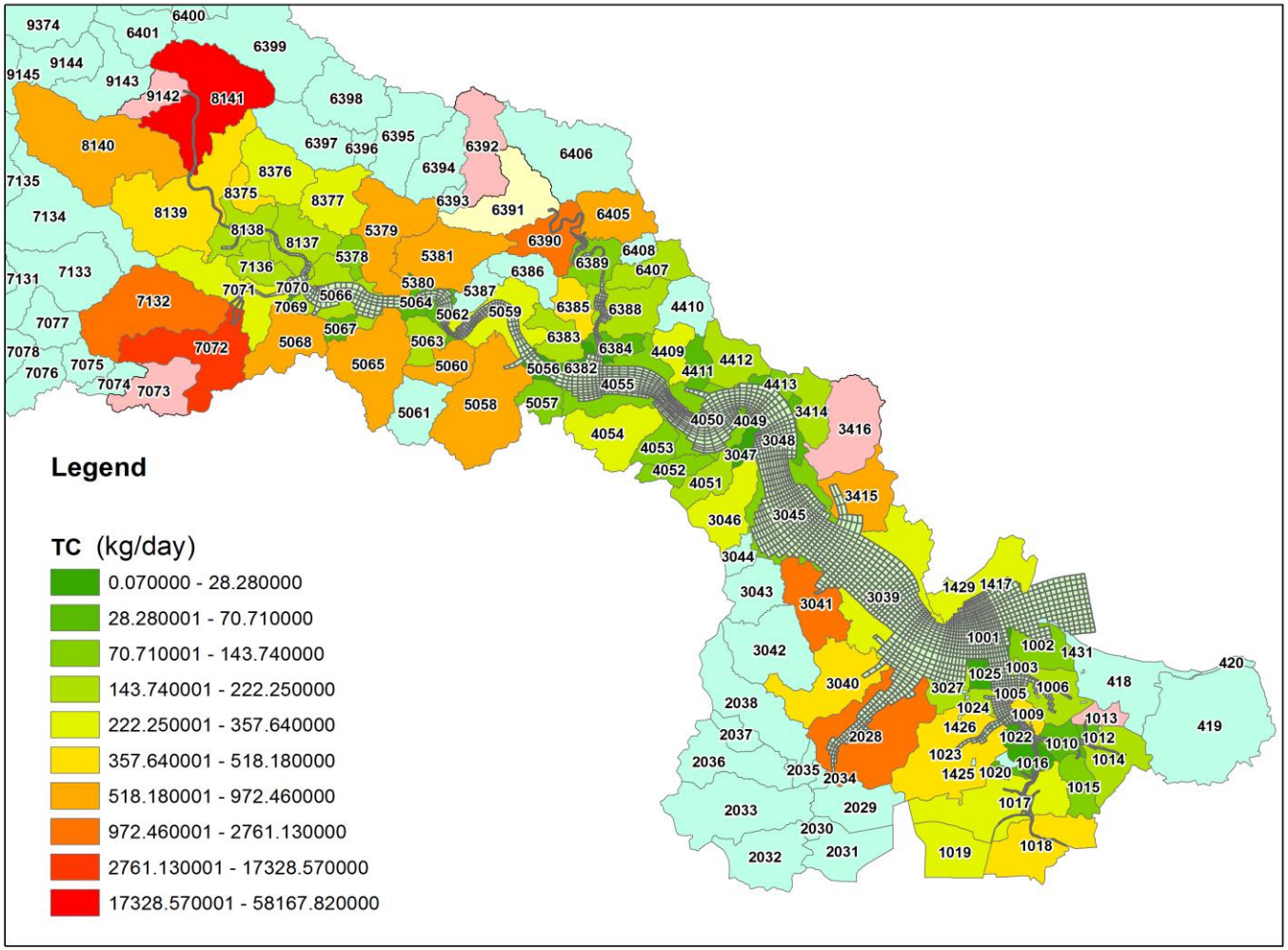




Land Use Distribution

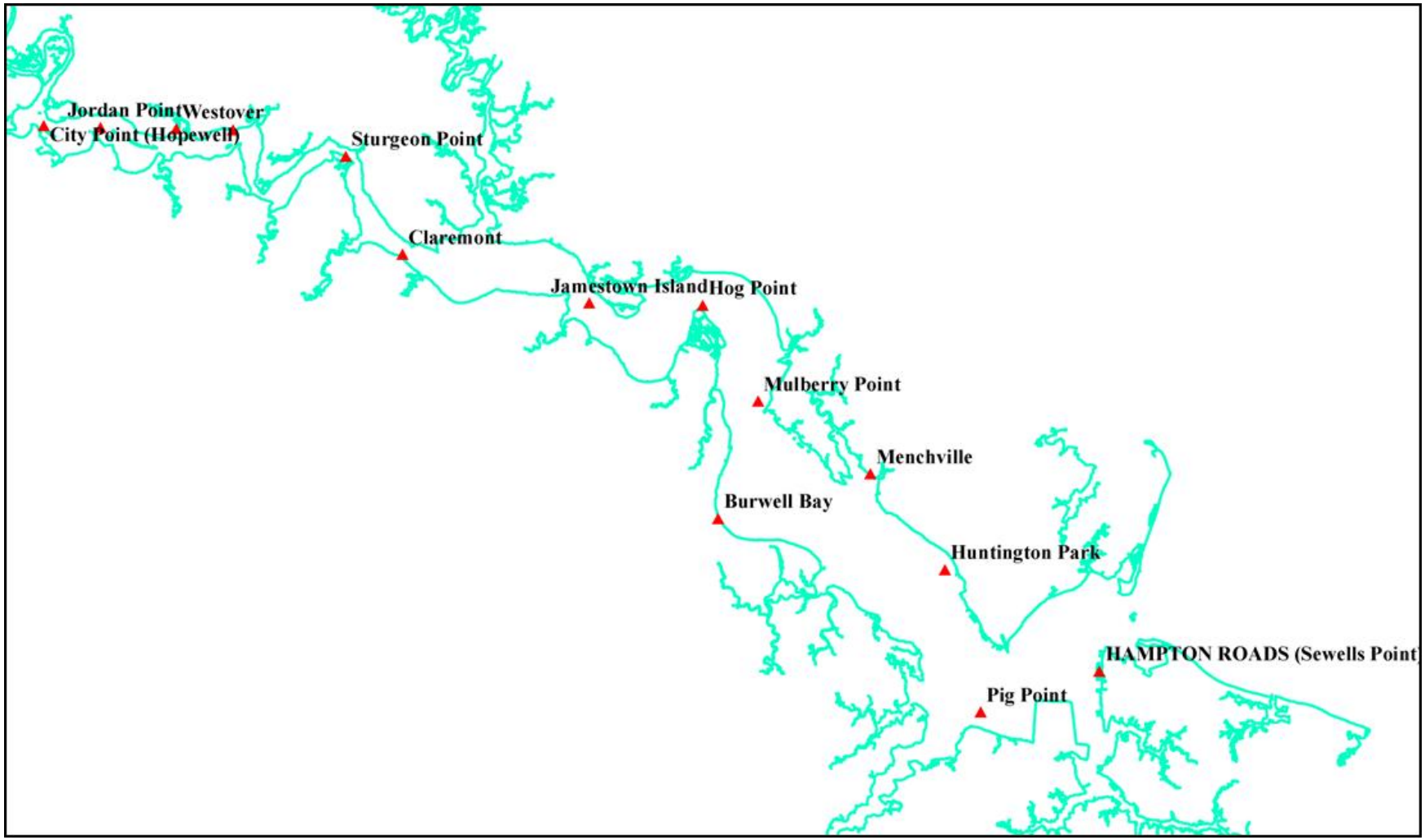


Watershed Segmentation and Total Organic Carbon Distribution



Observation Stations

Locations of NOAA Tidal Range Prediction

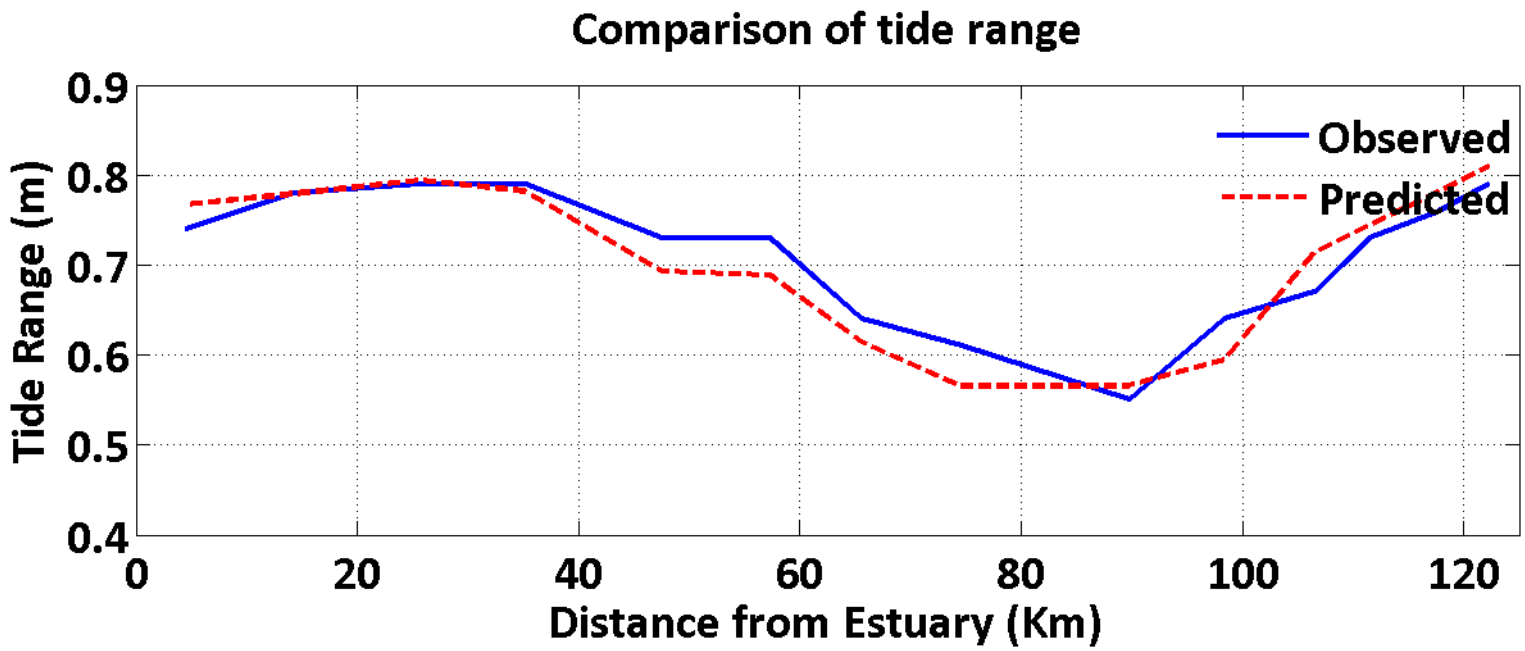


Dynamics Model Setup

- Use Chesapeake Bay Model outputs (surface elevation, salinity, and temperature) as open boundary conditions
- Use USGS freshwater discharge at Richmond, Appomattox River, and Chickahominy River.
- Use watershed model output for downstream discharge
- Use observed wind and heat fluxes as surface forcings.

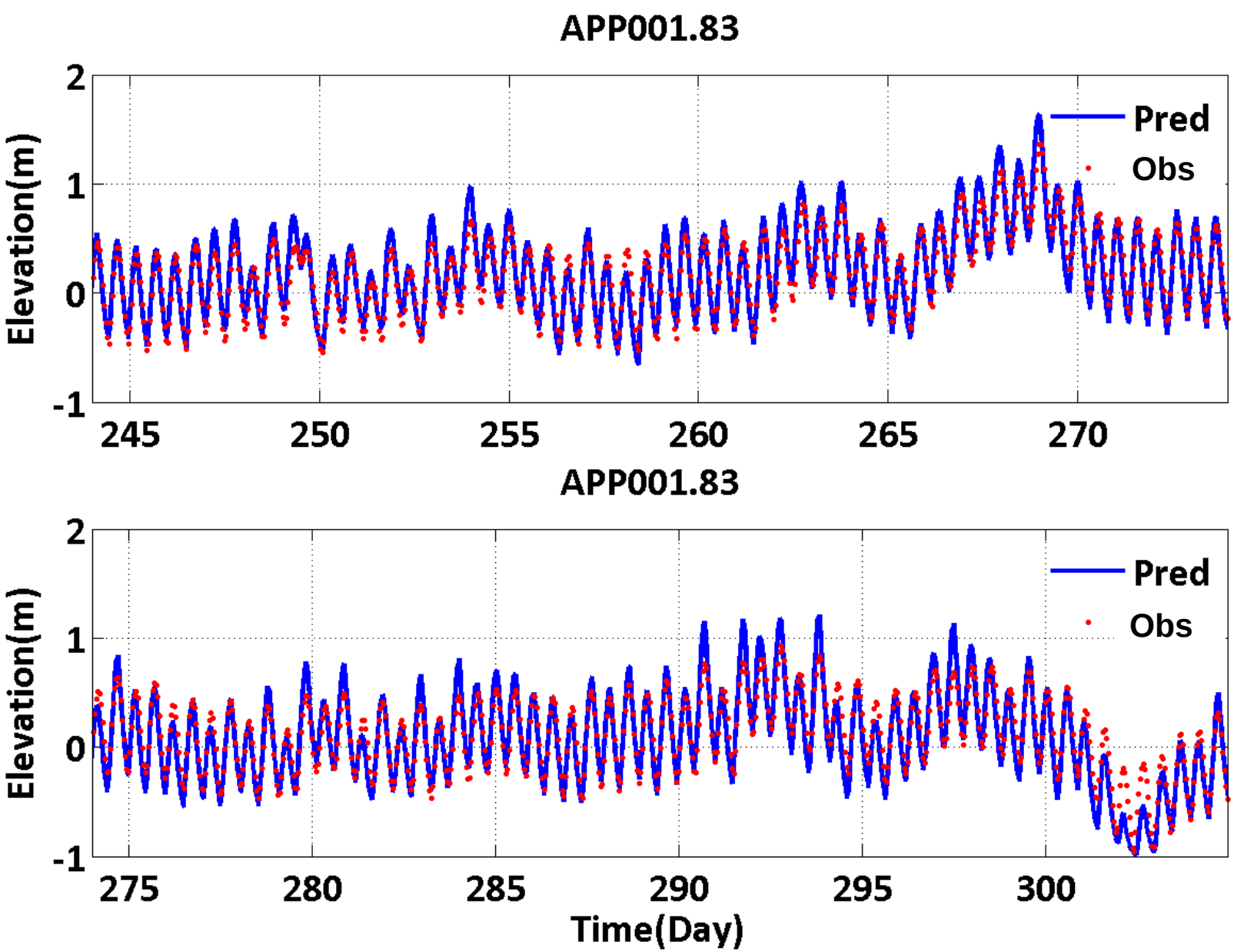
Surface Elevation

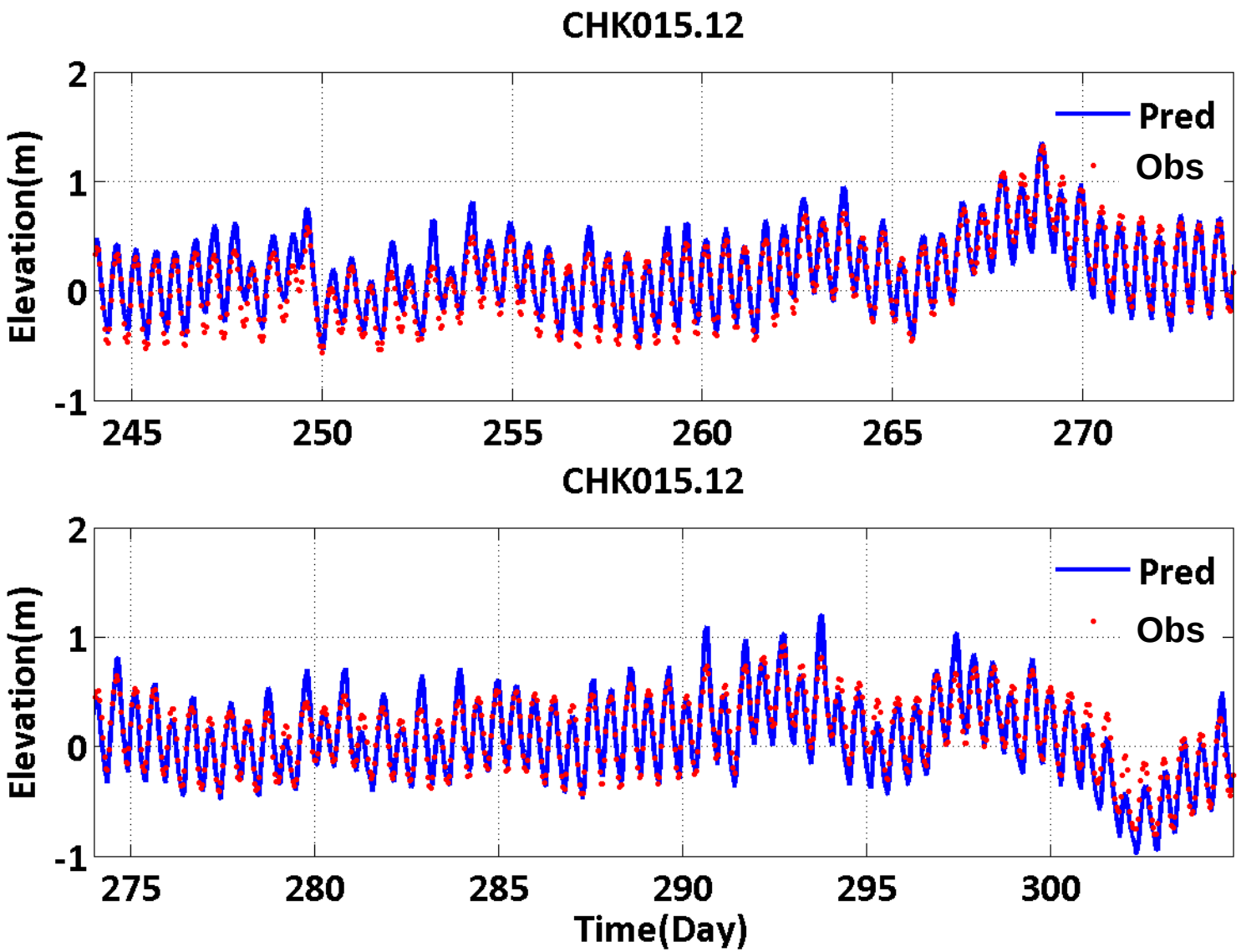
- Mean calibration of tidal range (compare model results against NOAA tidal table)



Model skill SS=0.8424

$$SS = 1 - \frac{\sum \left(A_{model} - A_{measured} \right)^2}{\sum \left(A_{measured} - \overline{A_{measured}} \right)^2}$$


APP001.83
Elevation(m)
2
1
0
-1
245
250
255
260
265
270
Pred
Obs
APP001.83
Elevation(m)
2
1
0
-1
275
280
285
290
295
300
Time(Day)
Pred
Obs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-1
245
250
255
260
265
270
Pred
Obs
CHK015.12
Elevation(m)
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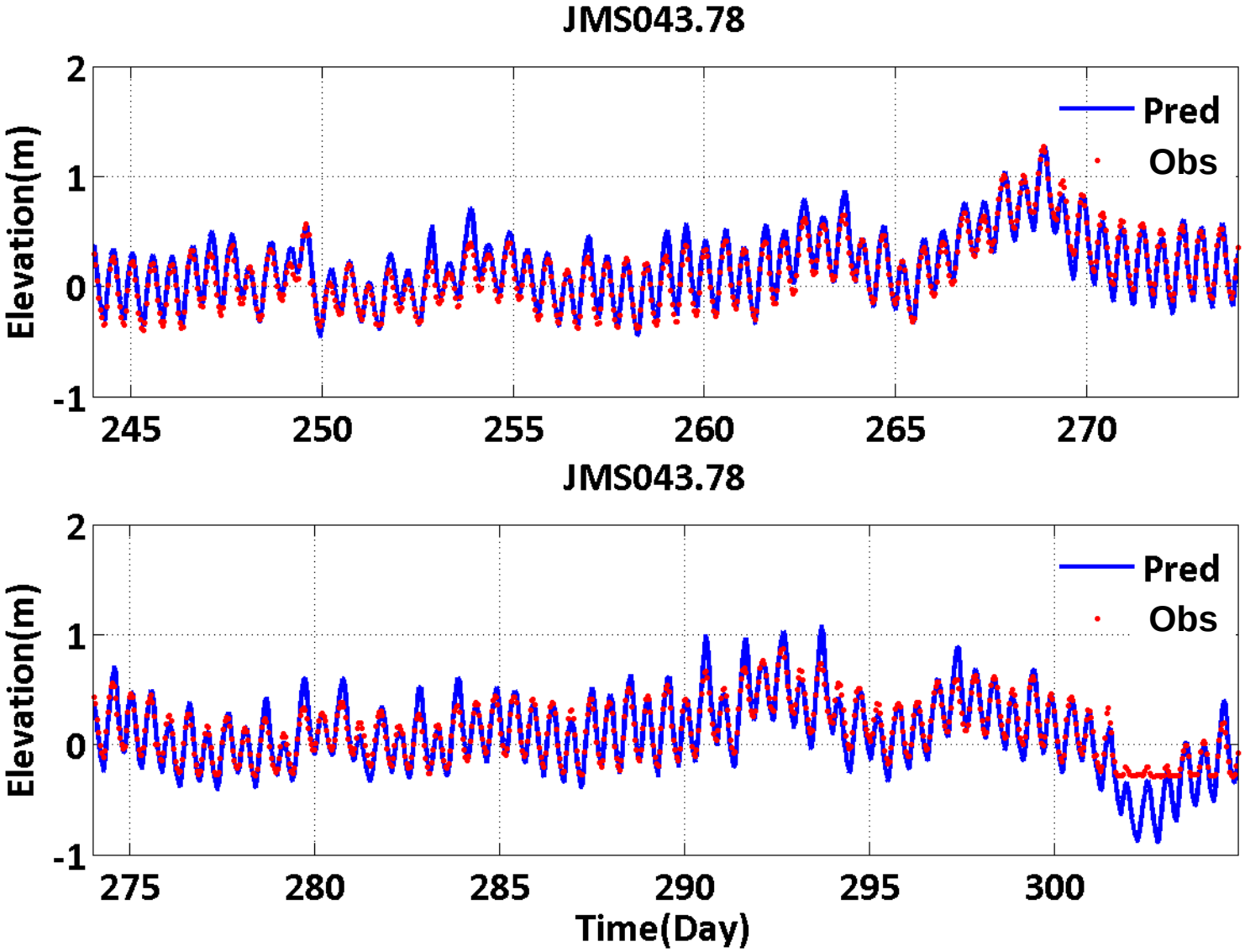
1
0
-1
275
280
285
290
295
300
Time(Day)
Pred
Obs


JMS043.78
Elevation(m)
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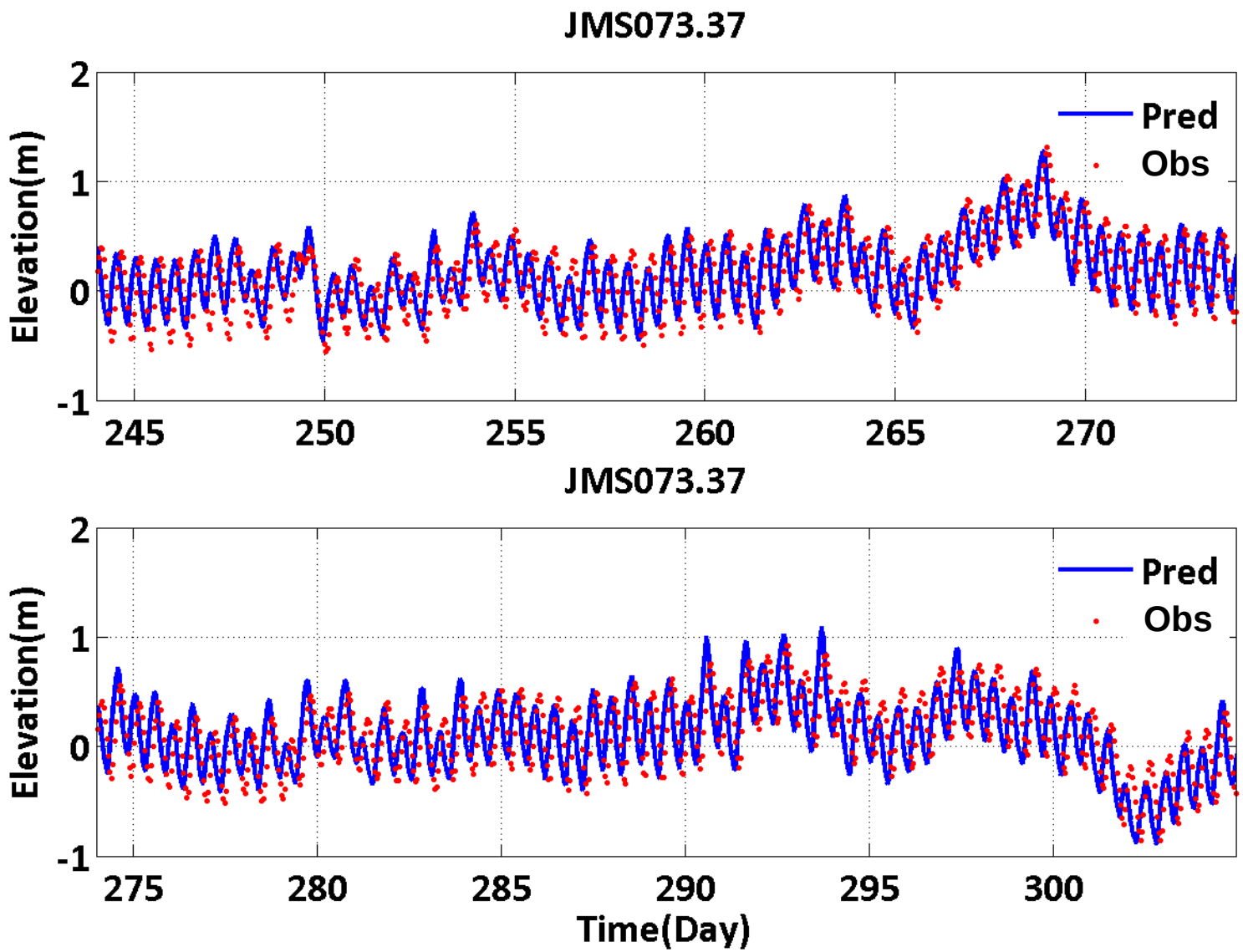
1
0
-1
245
250
255
260
265
270
Pred
Obs
JMS043.78
Elevation(m)
2
1
0
-1
275
280
285
290
295
300
Time(Day)
Pred
Obs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-1
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255
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265
270
Pred
Obs
JMS073.37
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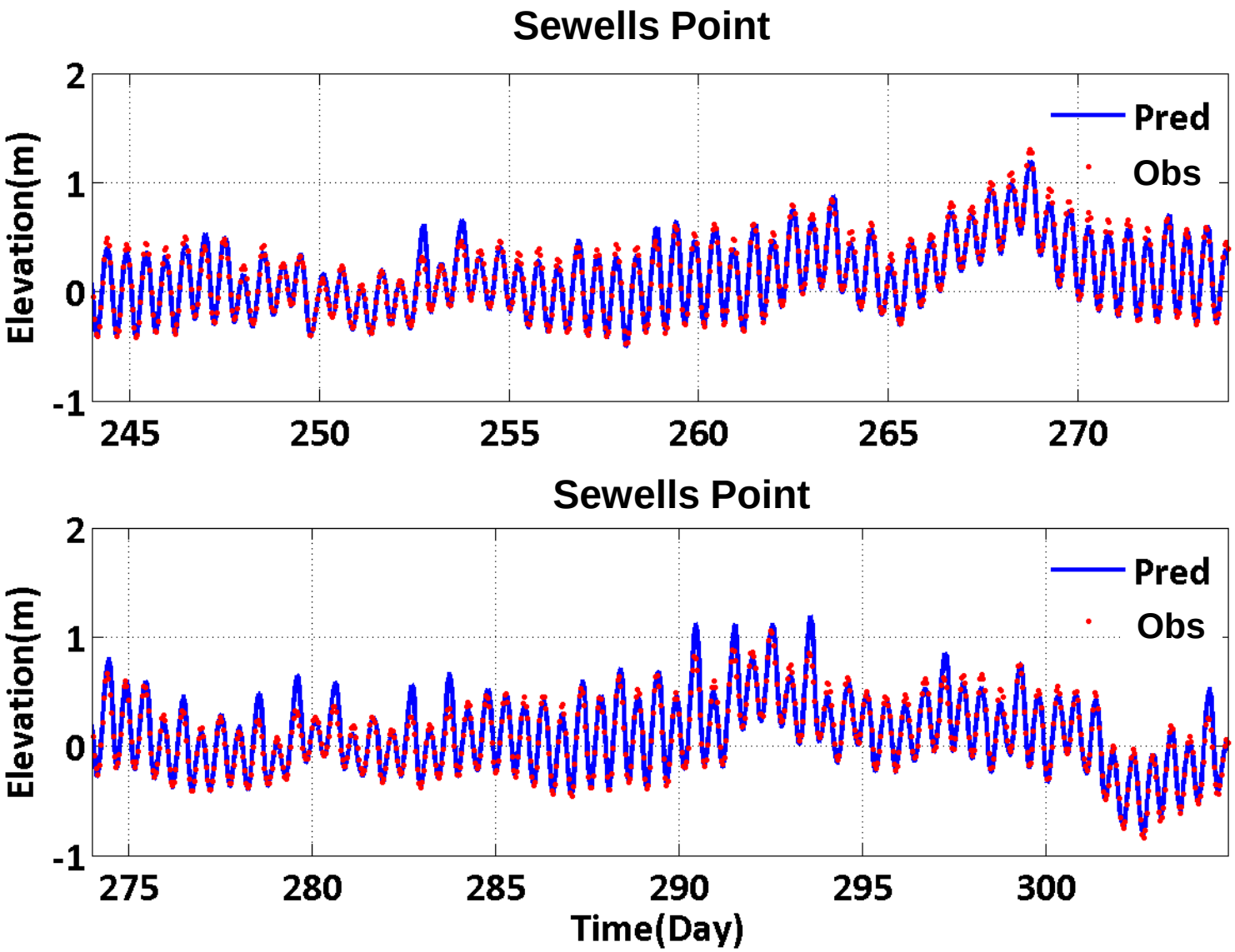
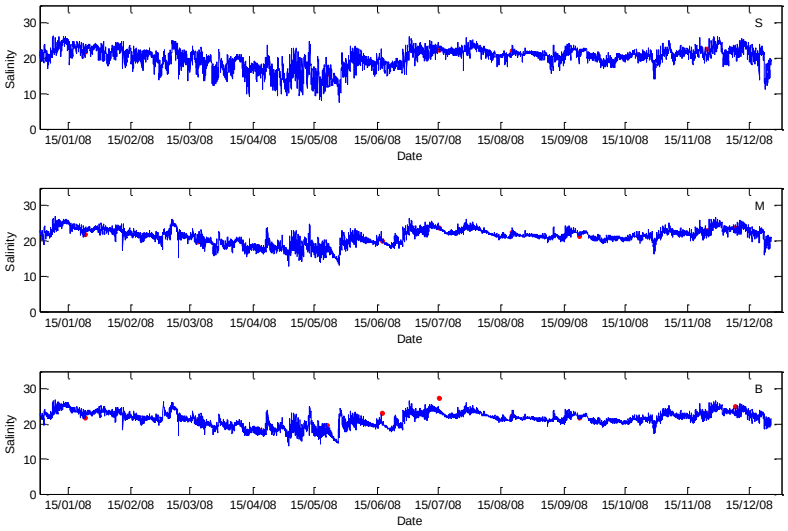
0
-1
275
280
285
290
295
300
Time(Day)
Pred
Obs


Sewells Point
Elevation(m)
2
1
0
-1
245
250
255
260
265
270
Pred
Obs
Sewells Point
Elevation(m)
2
1
0
-1
275
280
285
290
295
300
Time(Day)
Pred
Obs

Salinity

LE5.4



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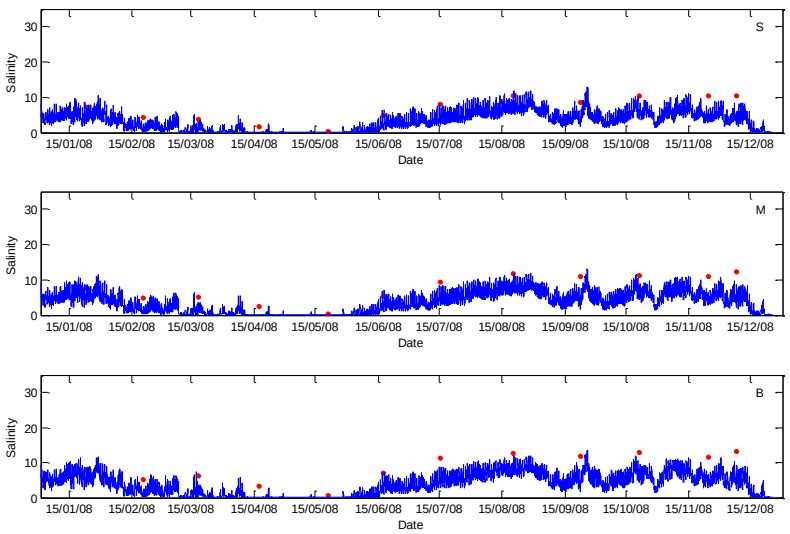
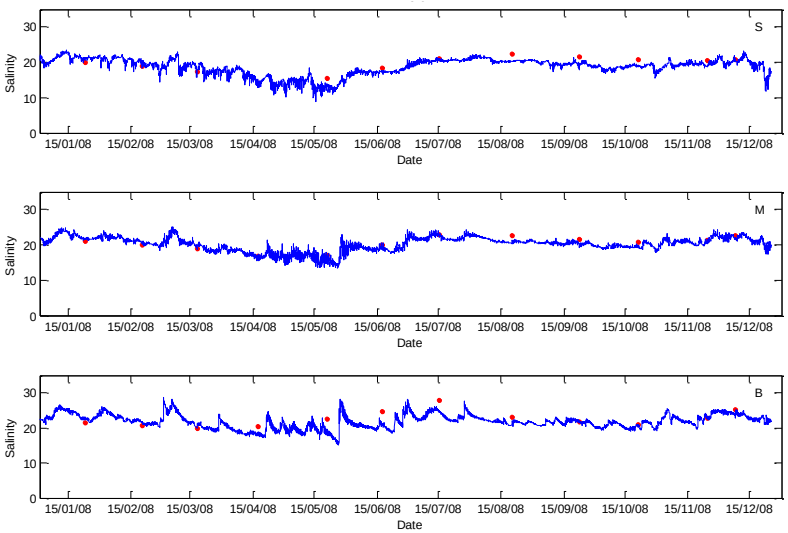


LE5.6



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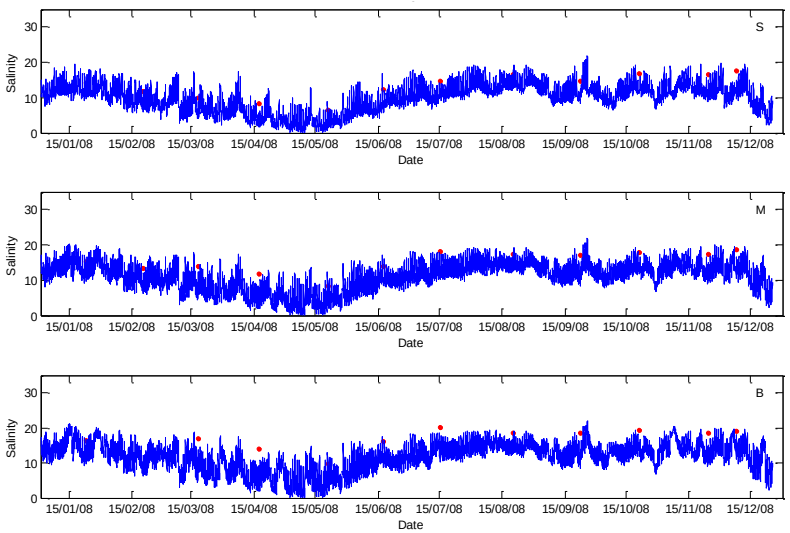

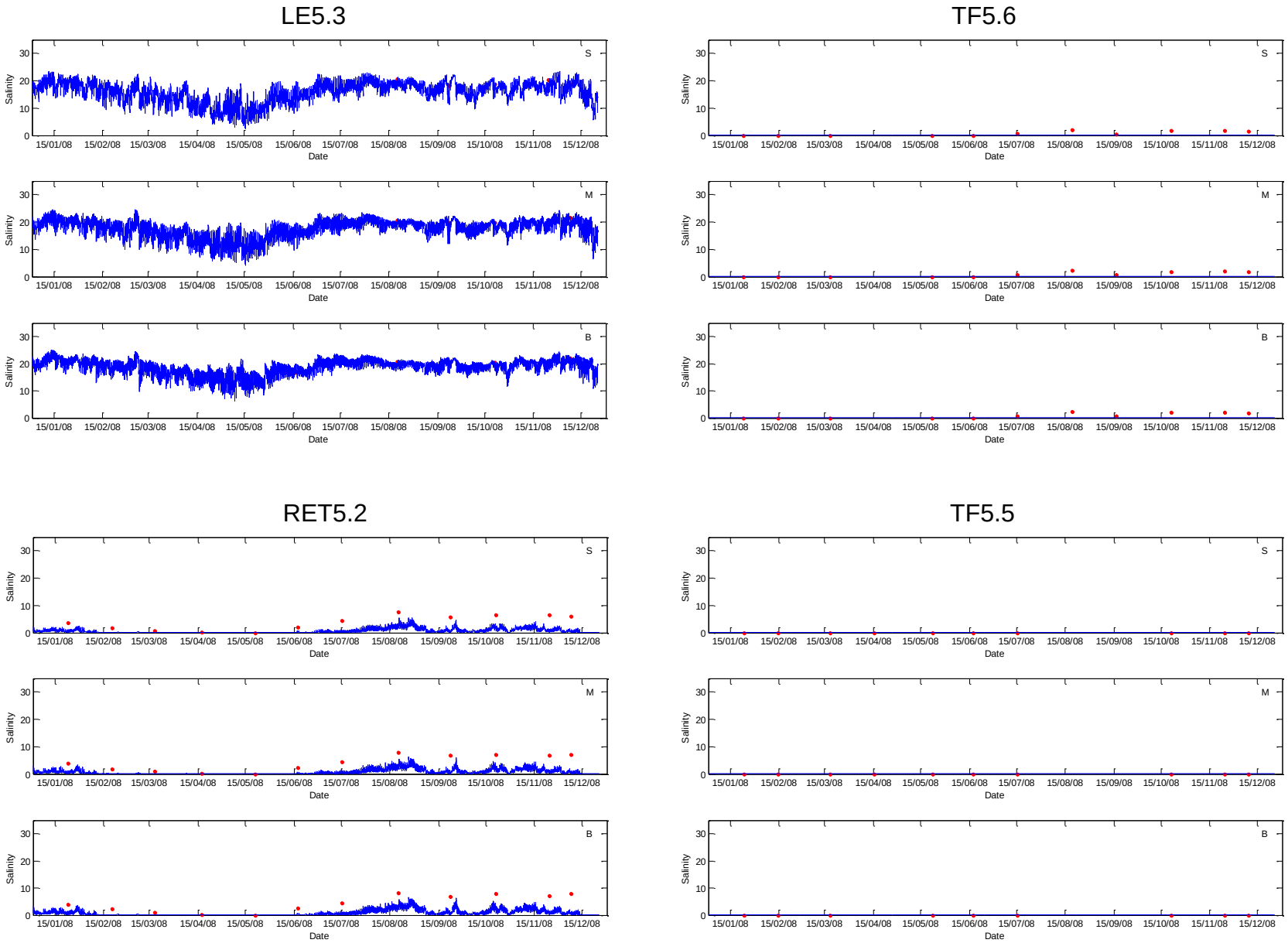
LE5.3
TF5.6
RET5.2
TF5.5
S
M
B
Salinity
Date
0
10
20
30
15/01/08
15/02/08
15/03/08
15/04/08
15/05/08
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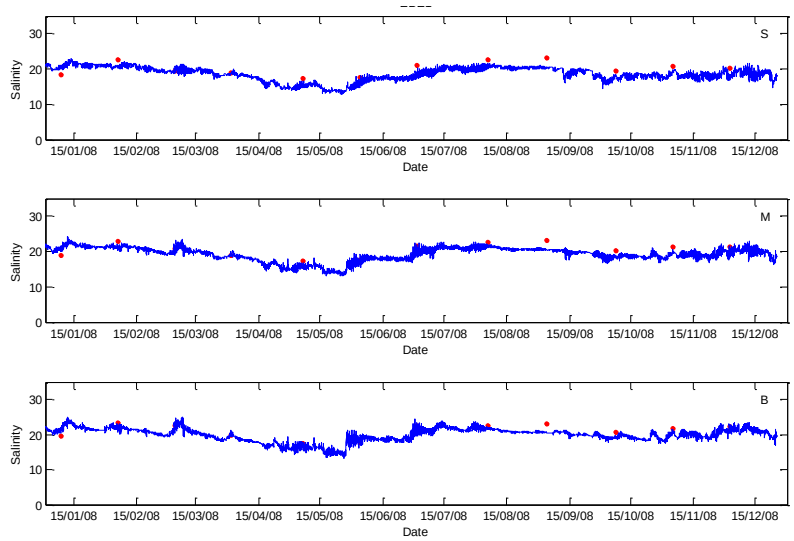
15/12/08

EBE5.1



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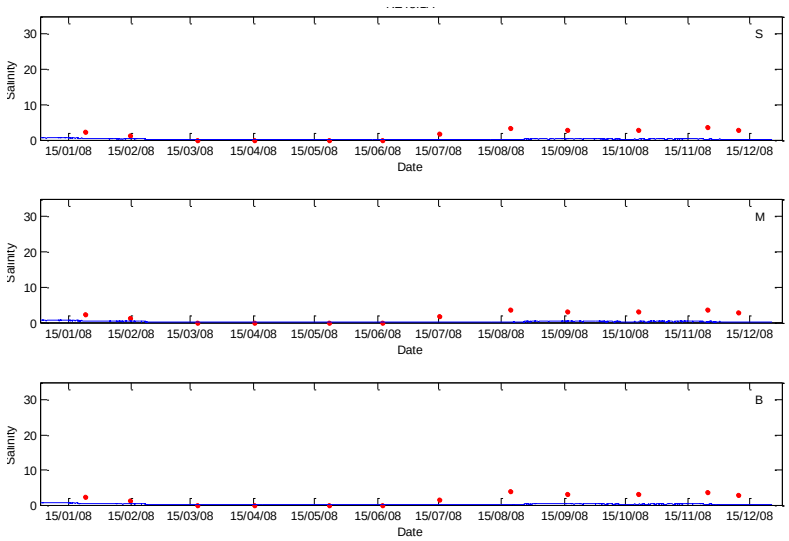

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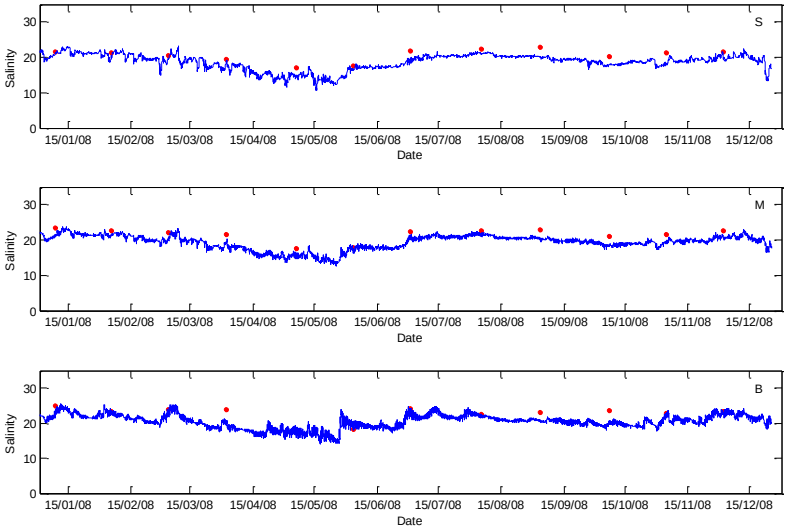

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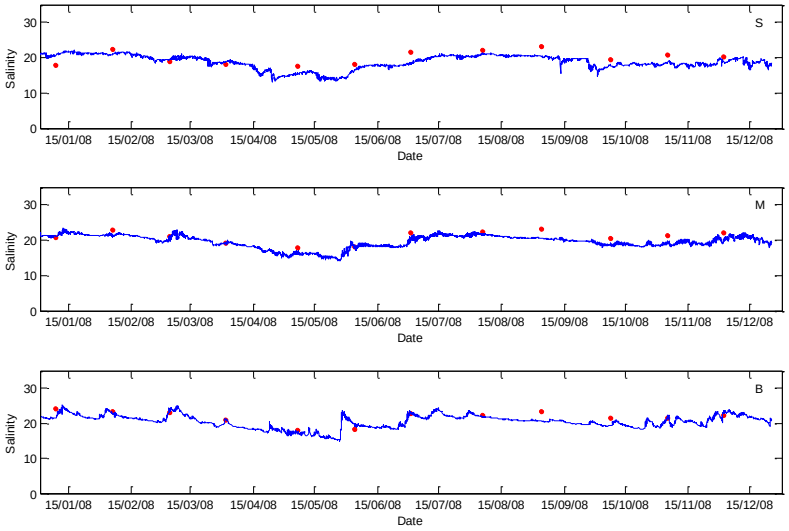

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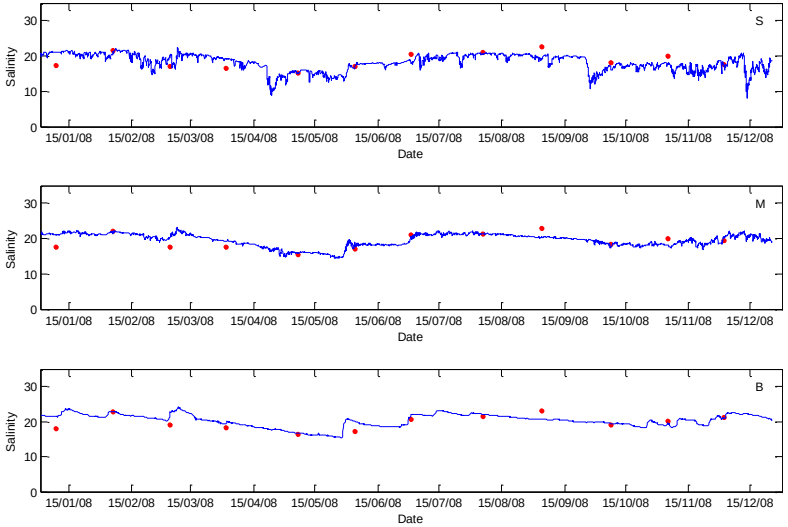

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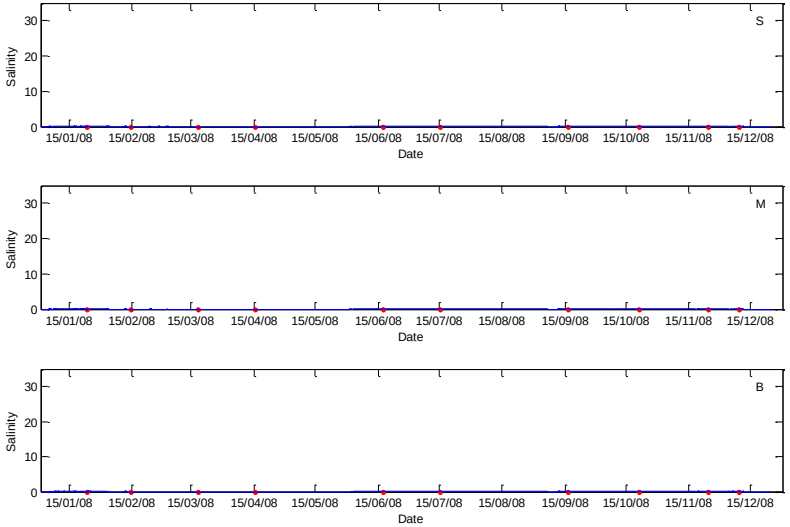

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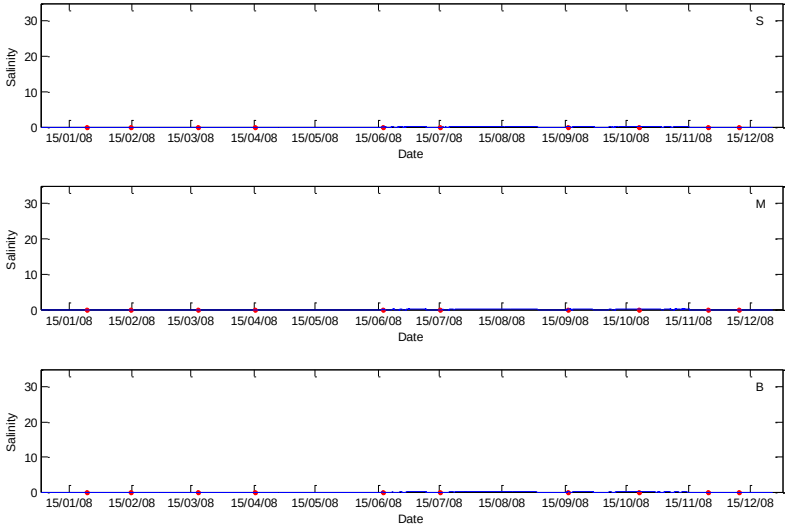

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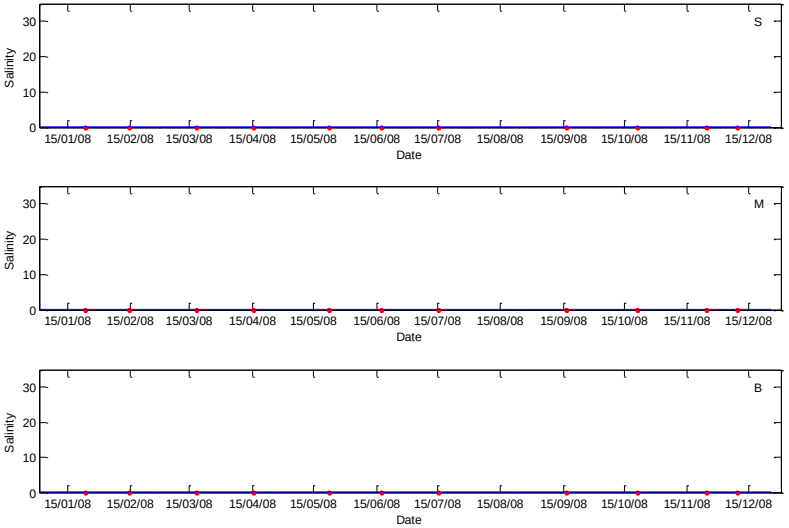
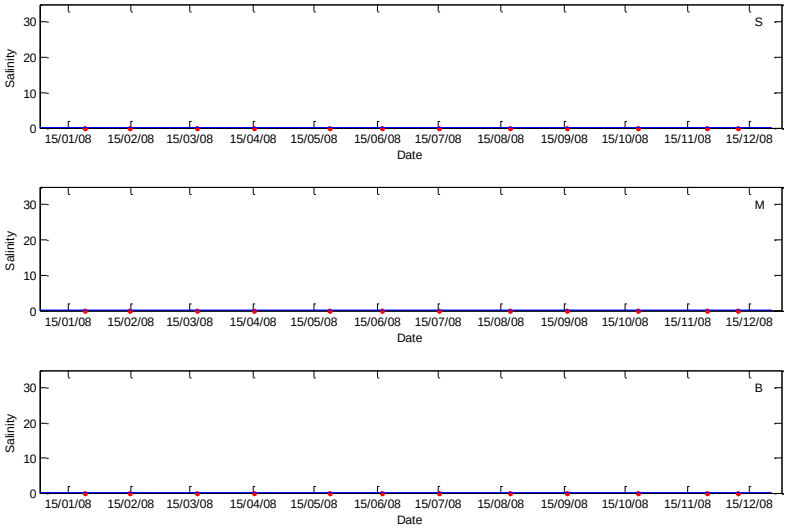


TF5.5A


S
M
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Salinity
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15/04/08
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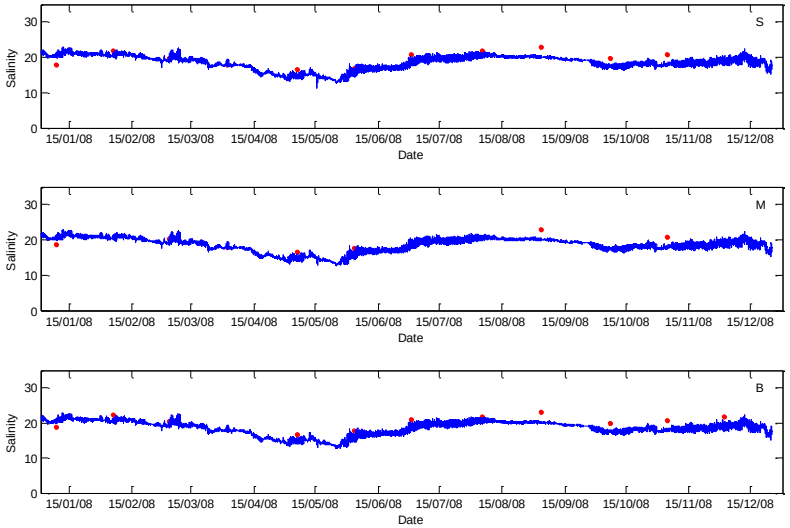
15/11/08
15/12/08
Date

WEB1


S
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Salinity
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15/05/08
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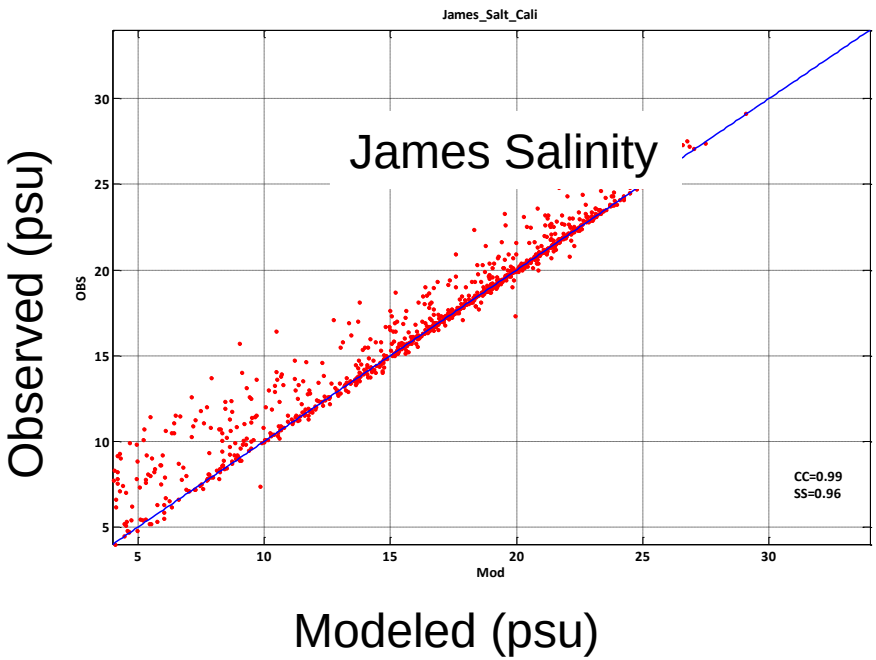
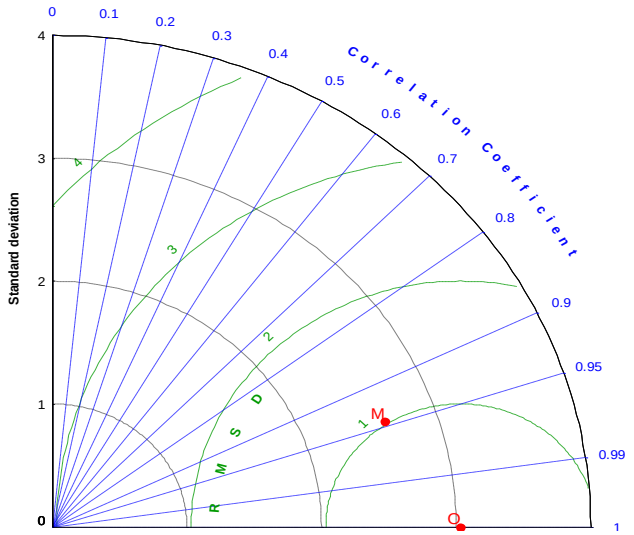
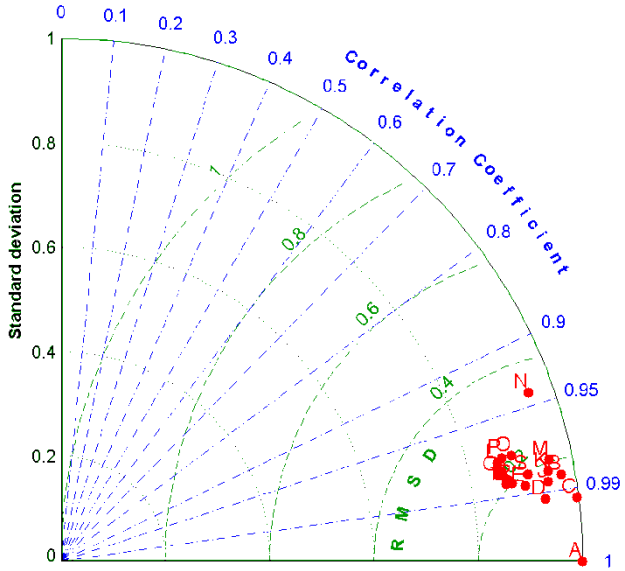
15/12/08
Date

Model Skill

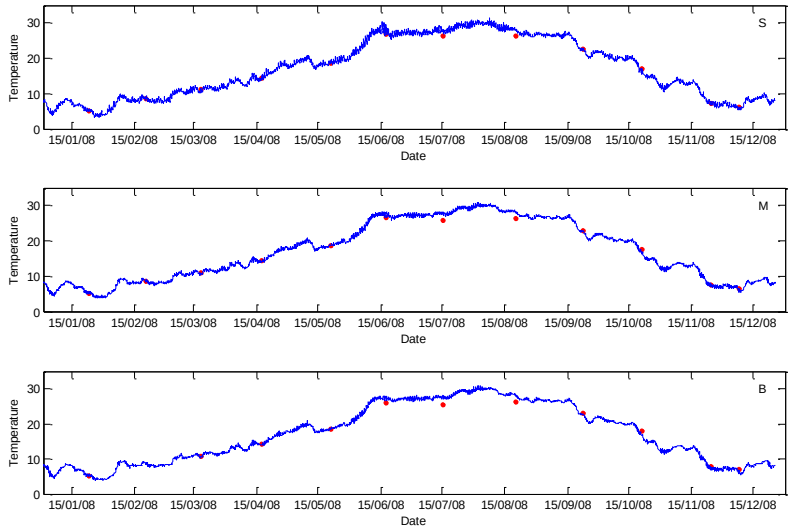

James_Salt_Cali
James Salinity
CC=0.99
SS=0.96
OBS
Mod
Observed (psu)
Modeled (psu)


Correlation Coefficient
Standard deviation
R M S D
M
O

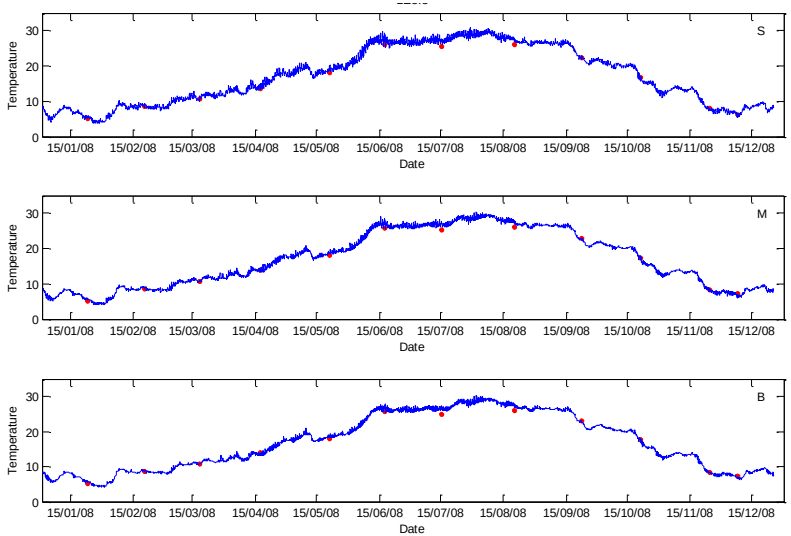

Correlation Coefficient
Standard deviation
R M S D
N
A
Reference

Temperature

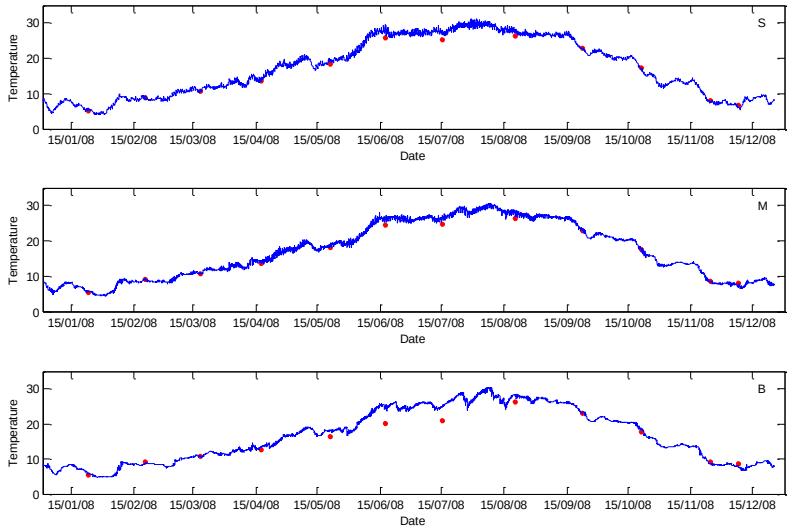
LE5.2



LE5.3



LE5.6



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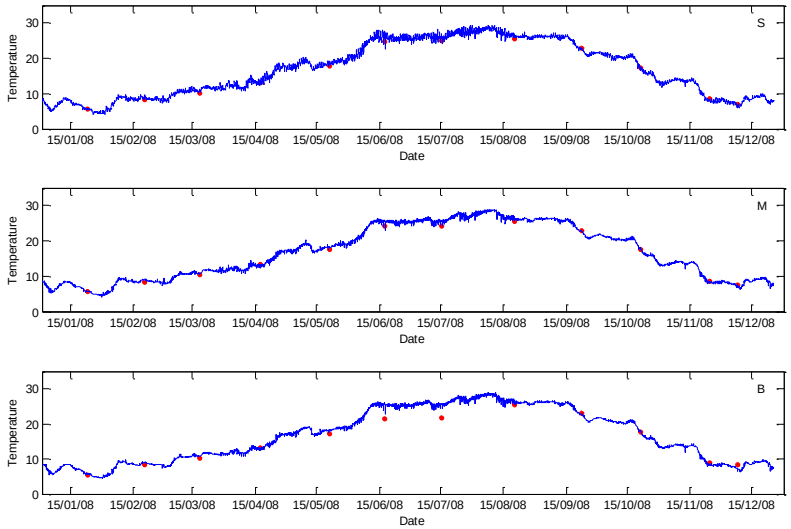
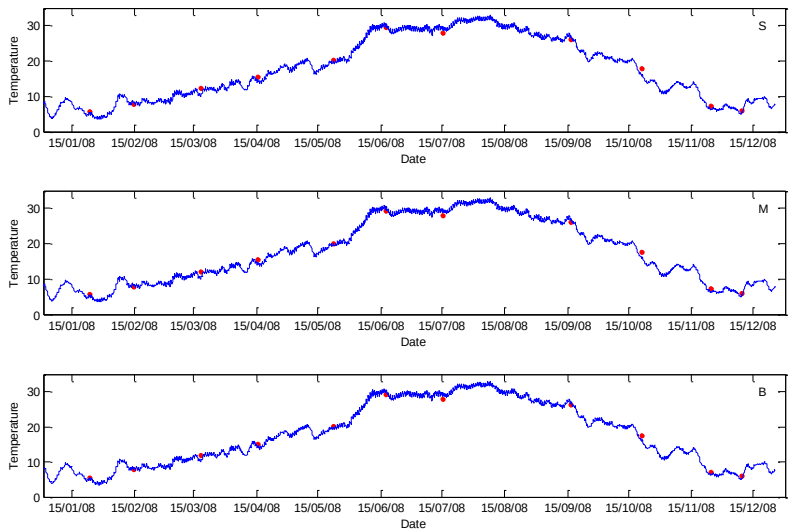


TF5.5



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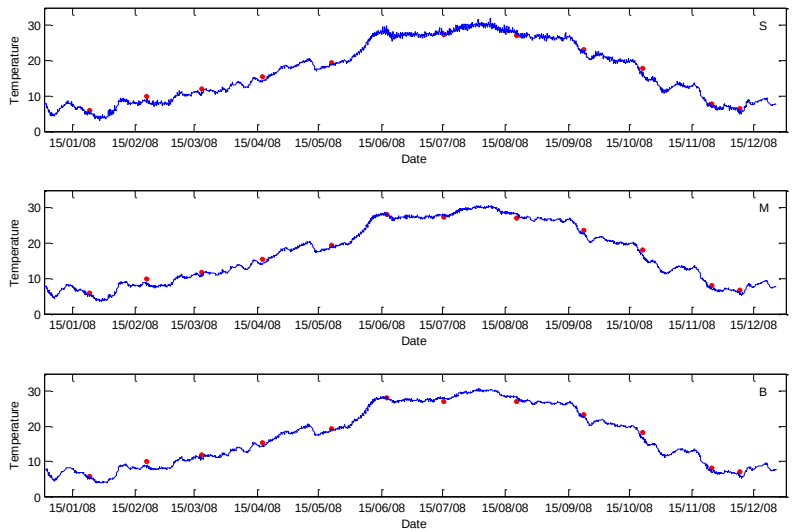

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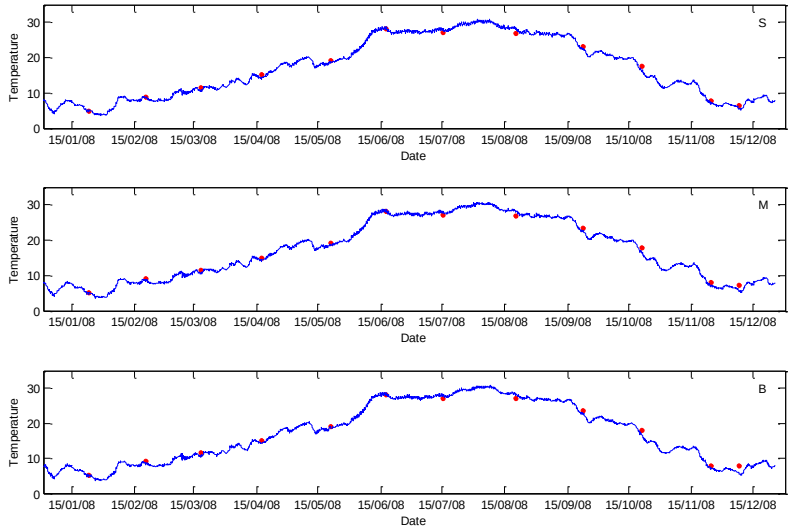

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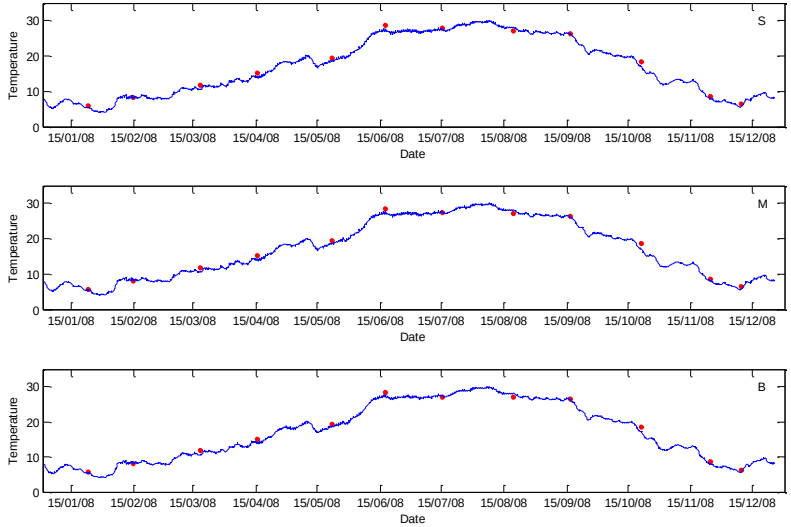

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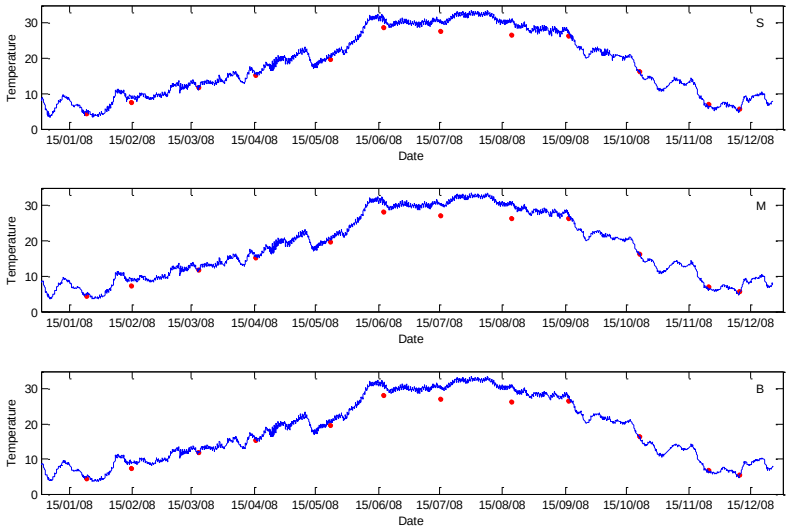

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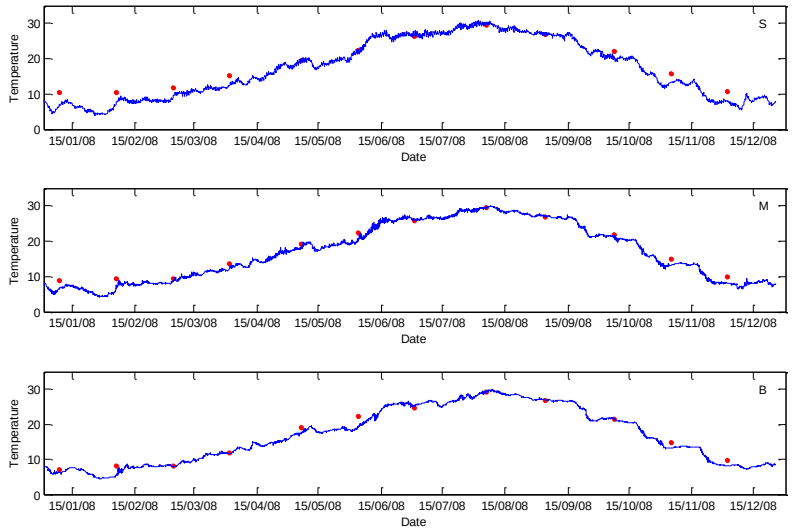

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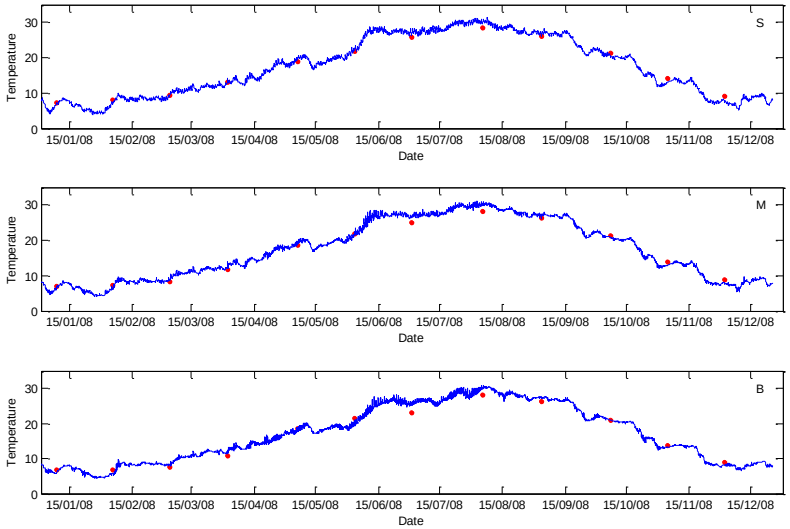
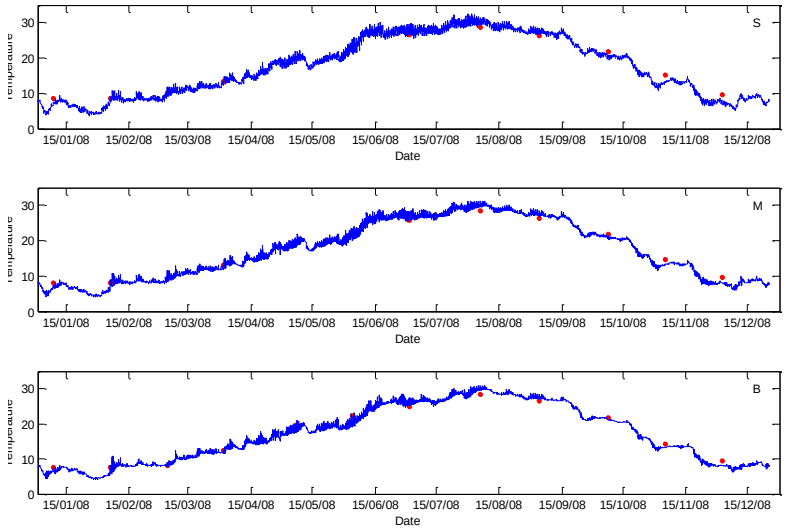
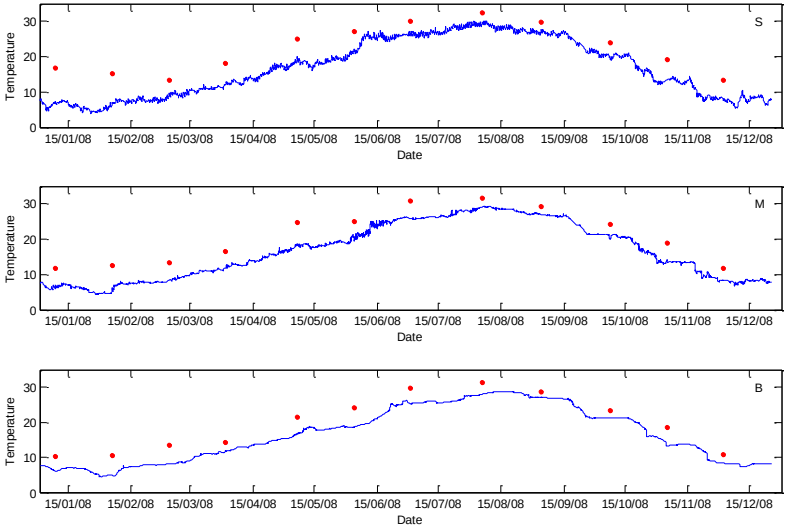


EBE1



EBE5



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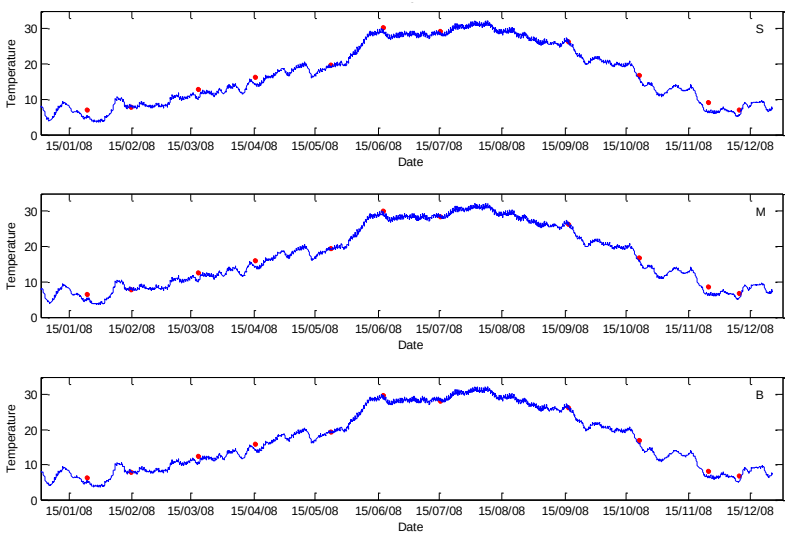

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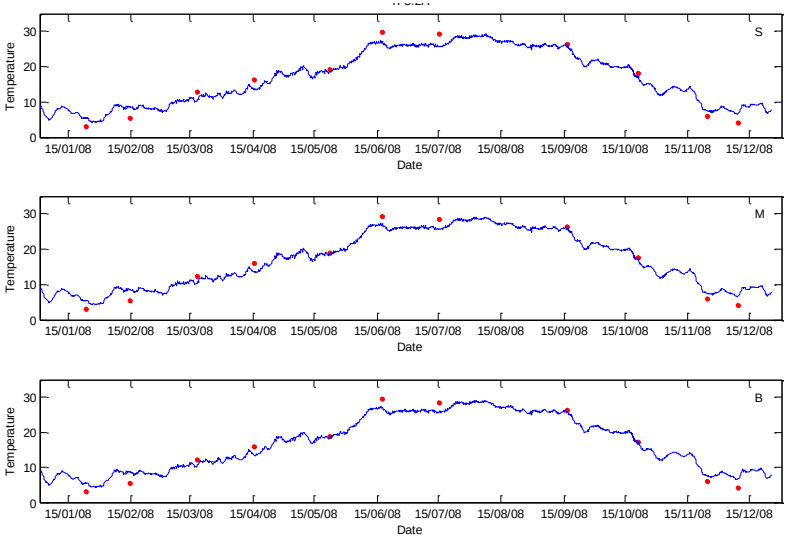

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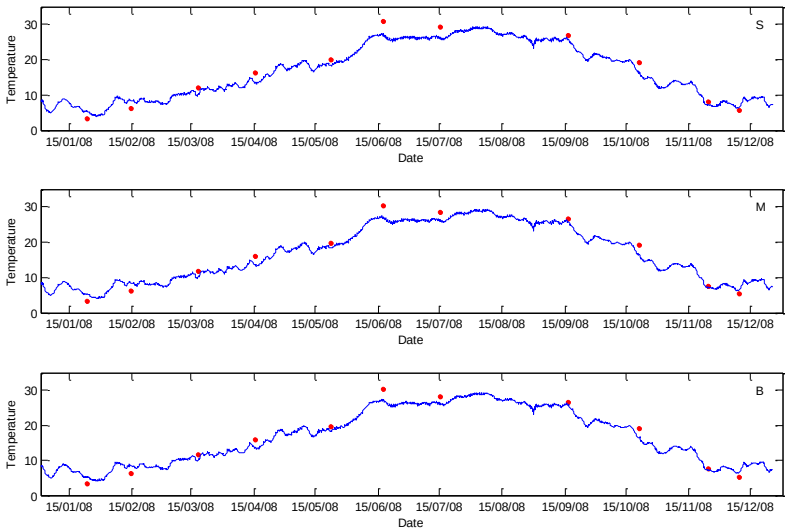
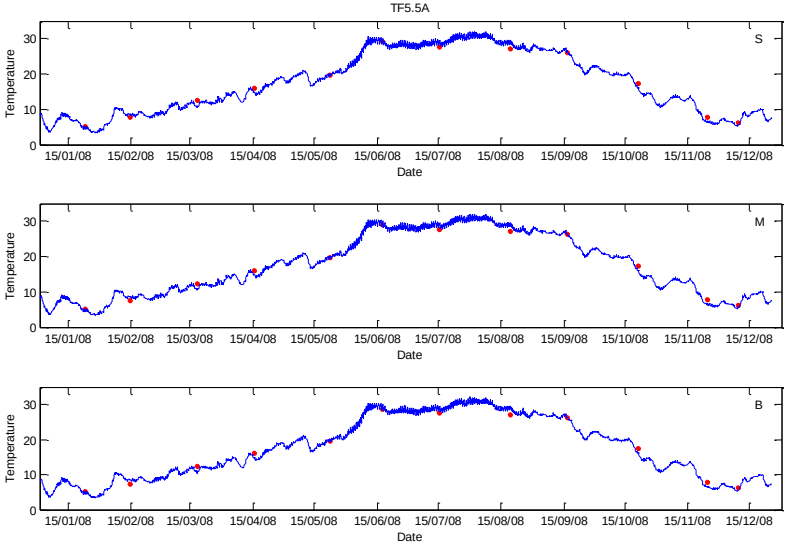


TF5.5A


TF5.5A
S
M
B
Temperature
0
10
20
30
15/01/08
15/02/08
15/03/08
15/04/08
15/05/08
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15/07/08
15/08/08
15/09/08
15/10/08
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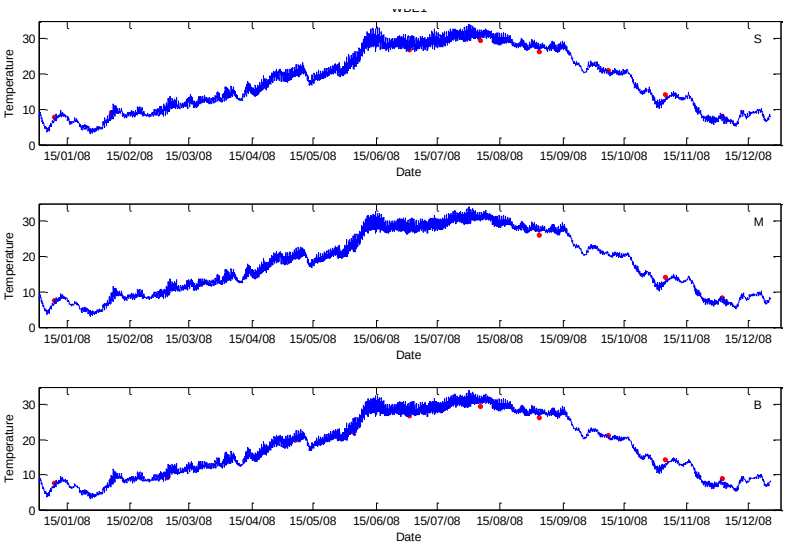
15/12/08
Date

WEB1


S
M
B
Temperature
0
10
20
30
15/01/08
15/02/08
15/03/08
15/04/08
15/05/08
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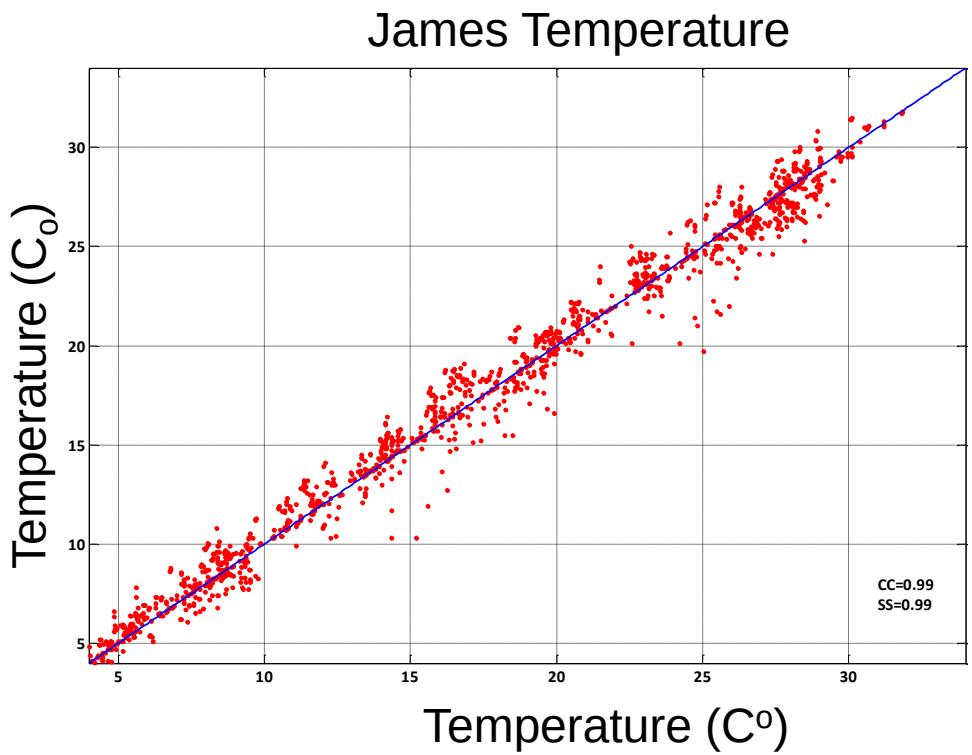
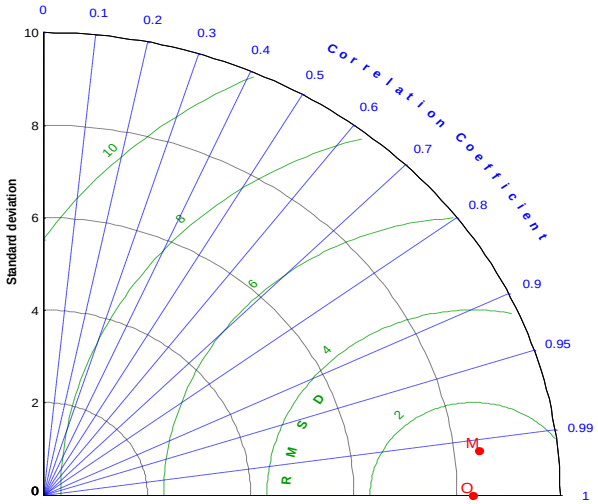
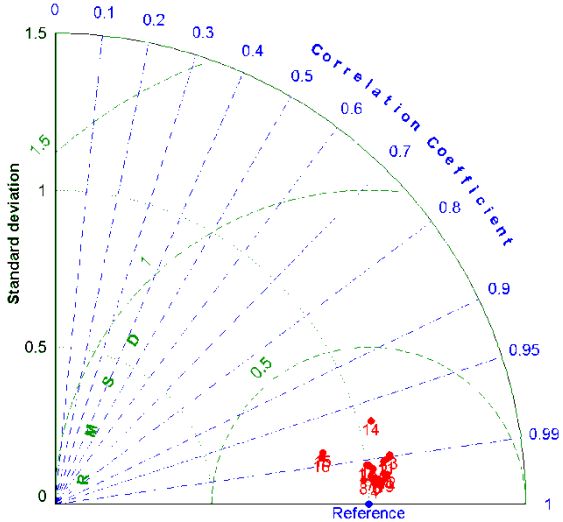
15/11/08
15/12/08
Date

Model Skill







Reference

Conclusion

- Preliminary dynamic model calibration yields good model prediction skill
- Refinement of model calibration will be conducted to further improve model results