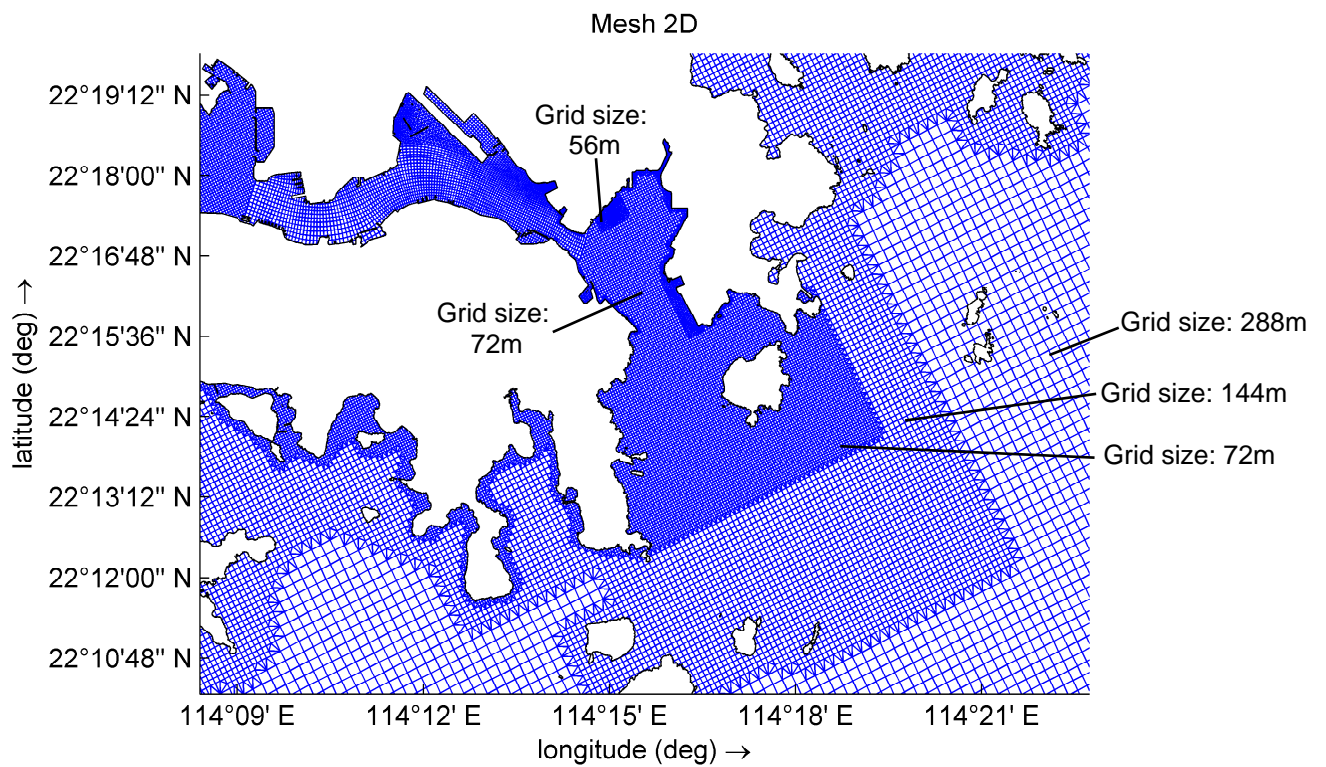
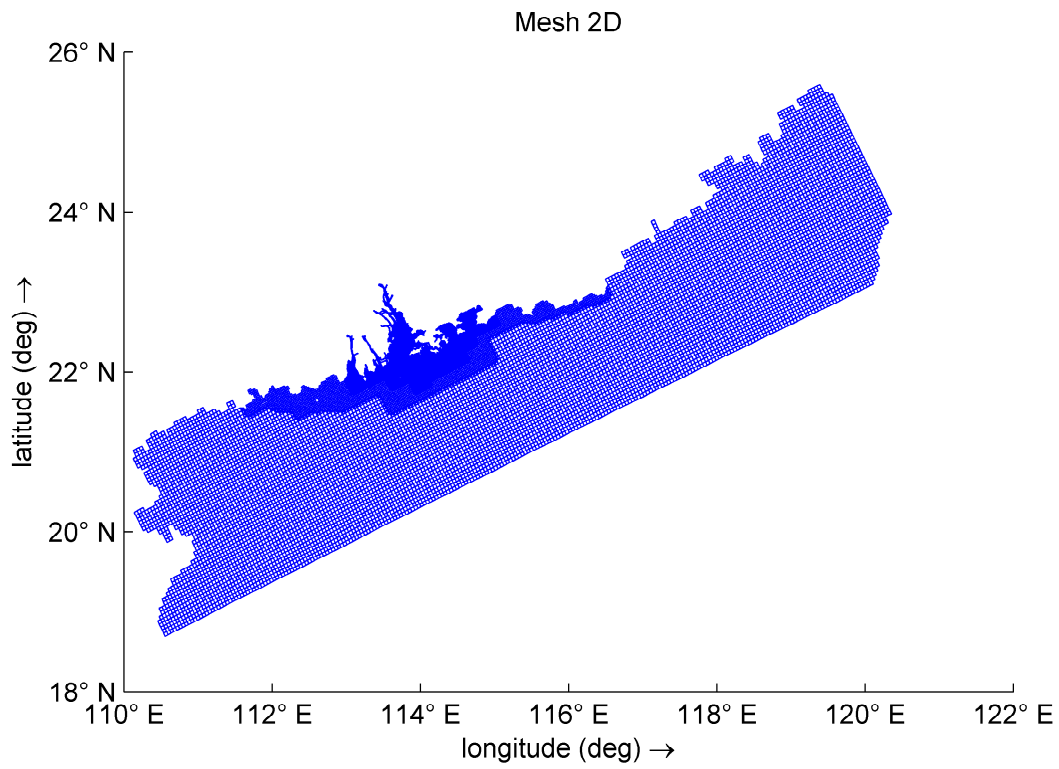


Appendix 5.4

Refined Model Grid Layout, Properties and Performance Verifications

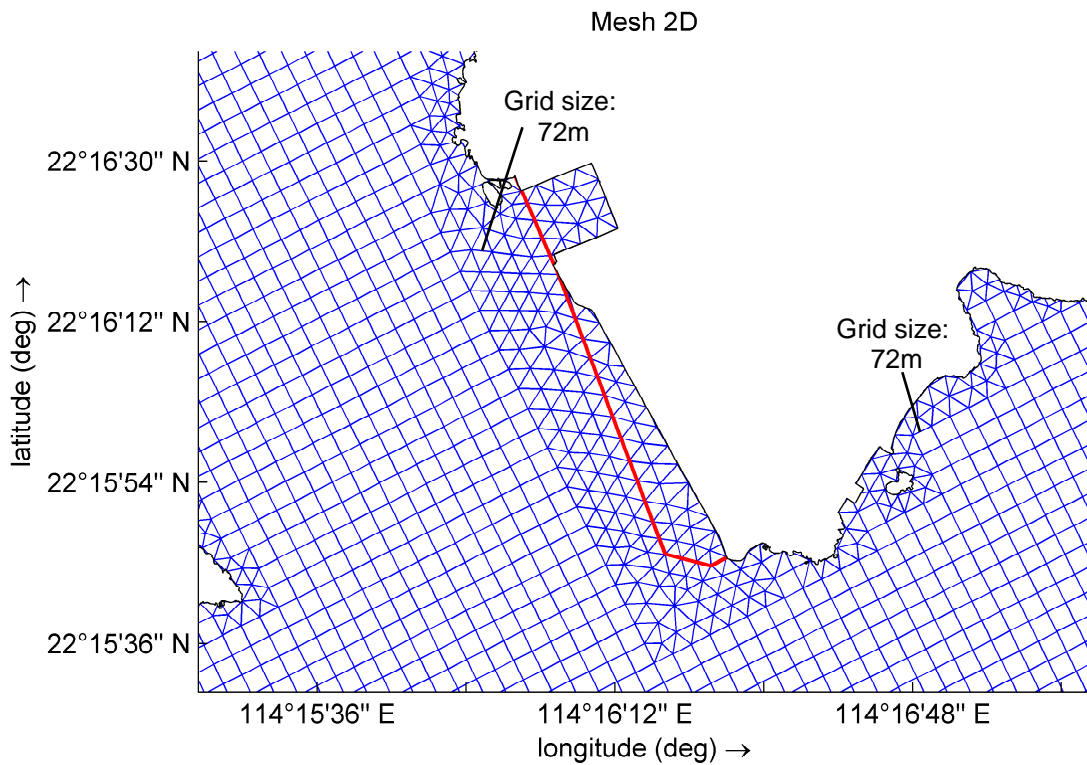
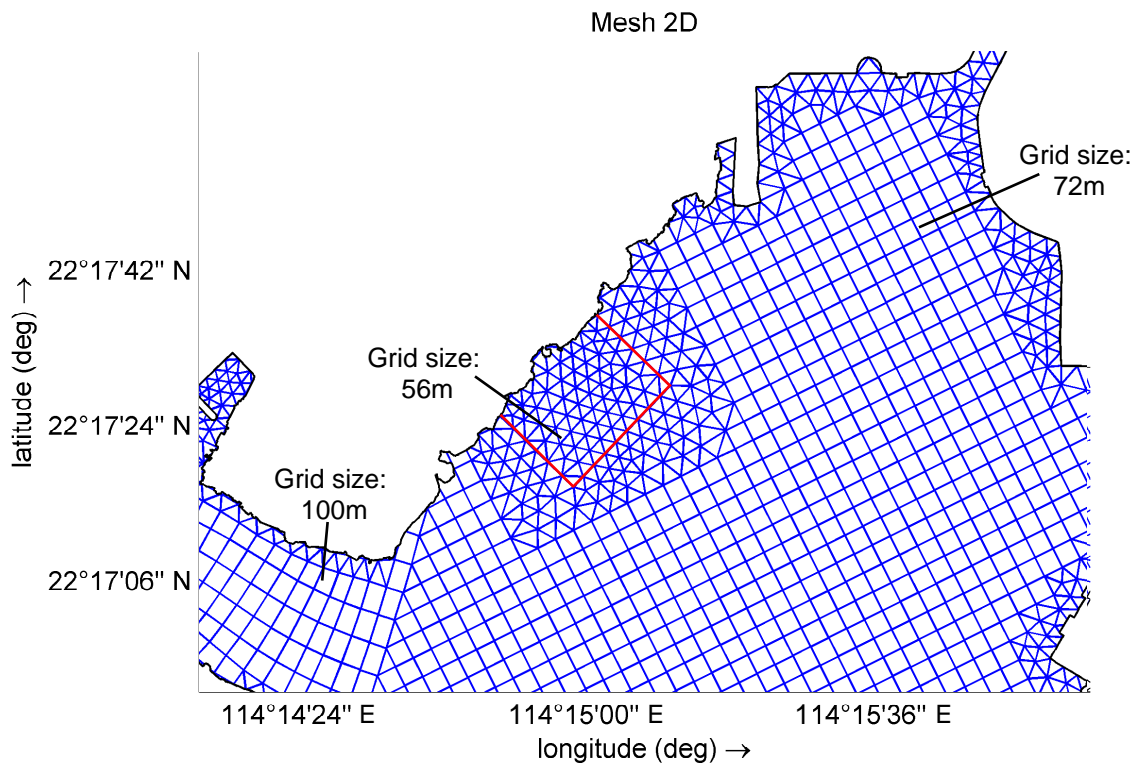


Refined Model Grid Layout and Coverage
Upper - Overview; Lower - Assessment Area

CE 40/2023 (CE)

Binnies

01

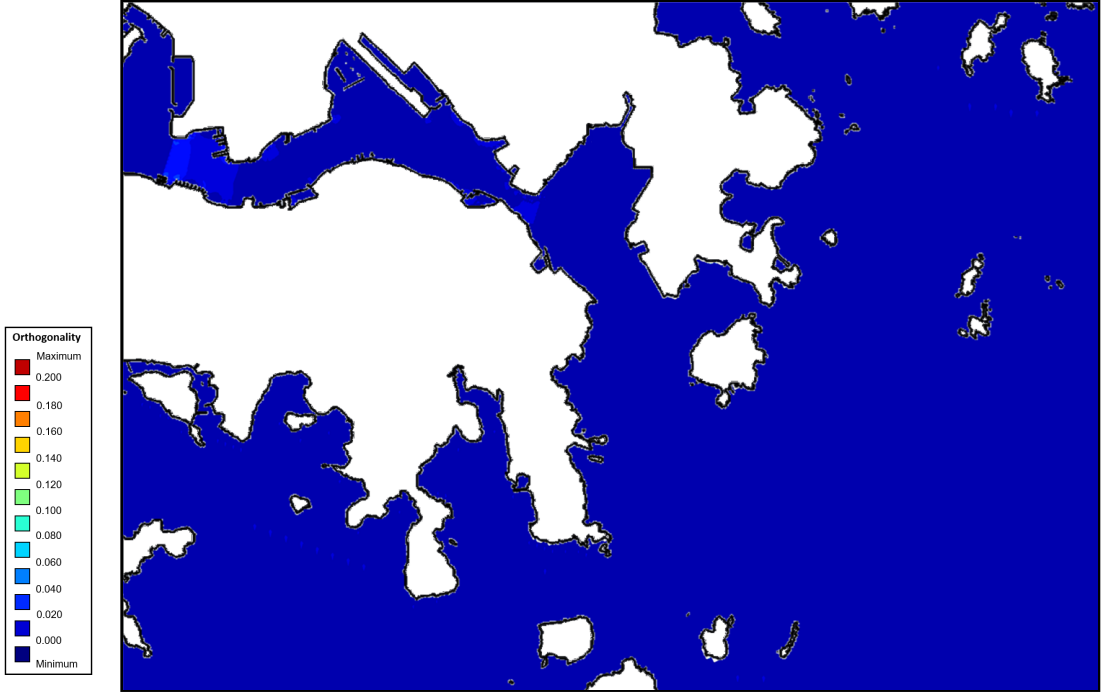


Refined Model Grid Layout and Coverage
Upper - Zoom-in at TKO 132 ; Lower - Zoom-in at TKO 137

CE 40/2023 (CE)

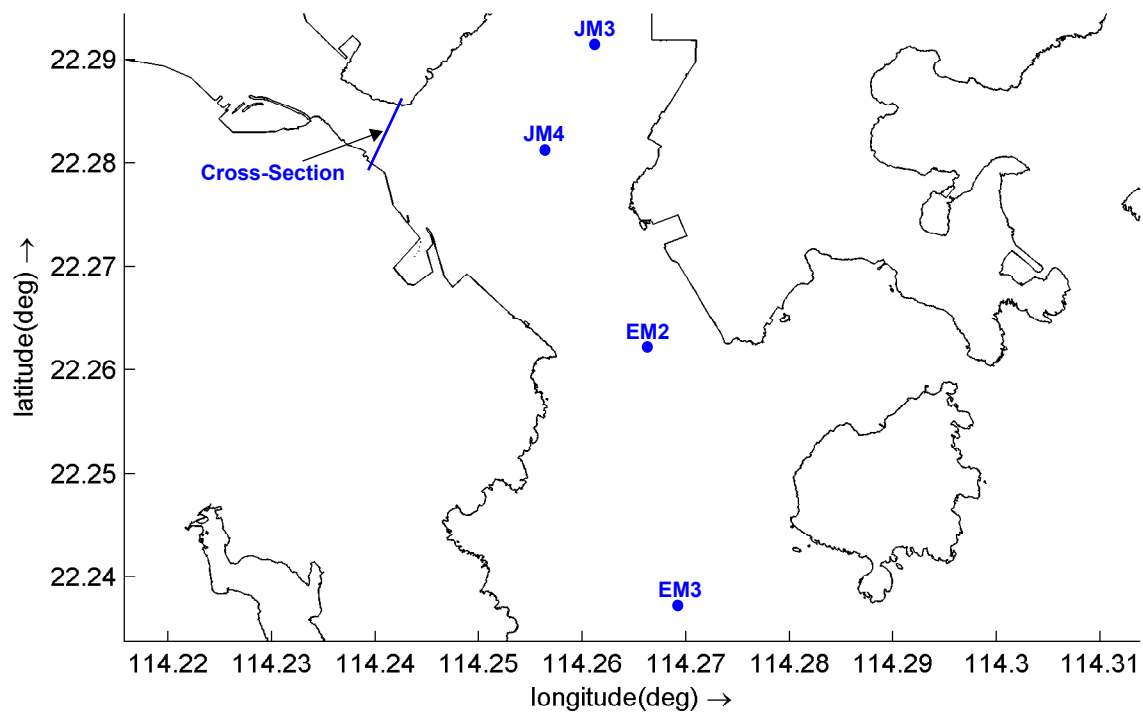
Binnies

02



Orthogonality

Model Grid Properties - Orthogonality		
	CE 40/2023 (CE)	
Binnies		03

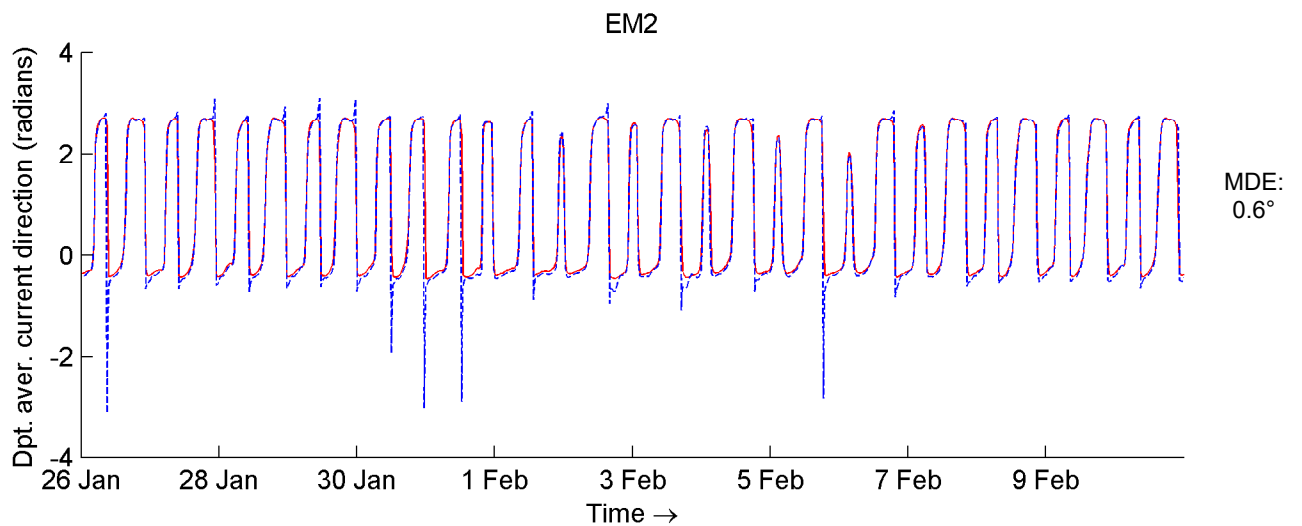
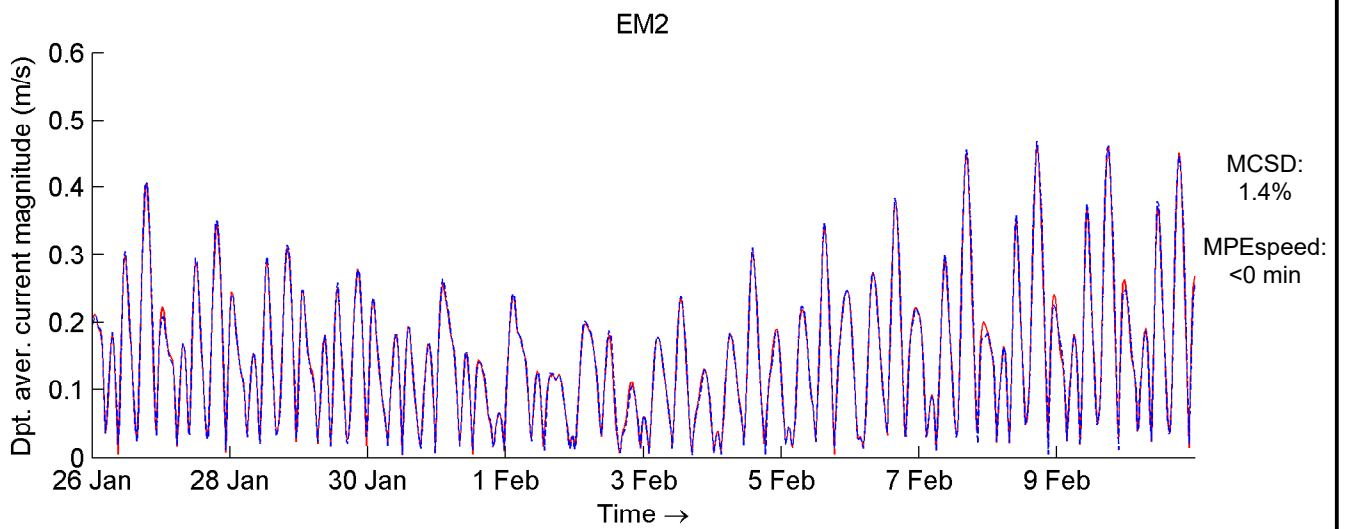
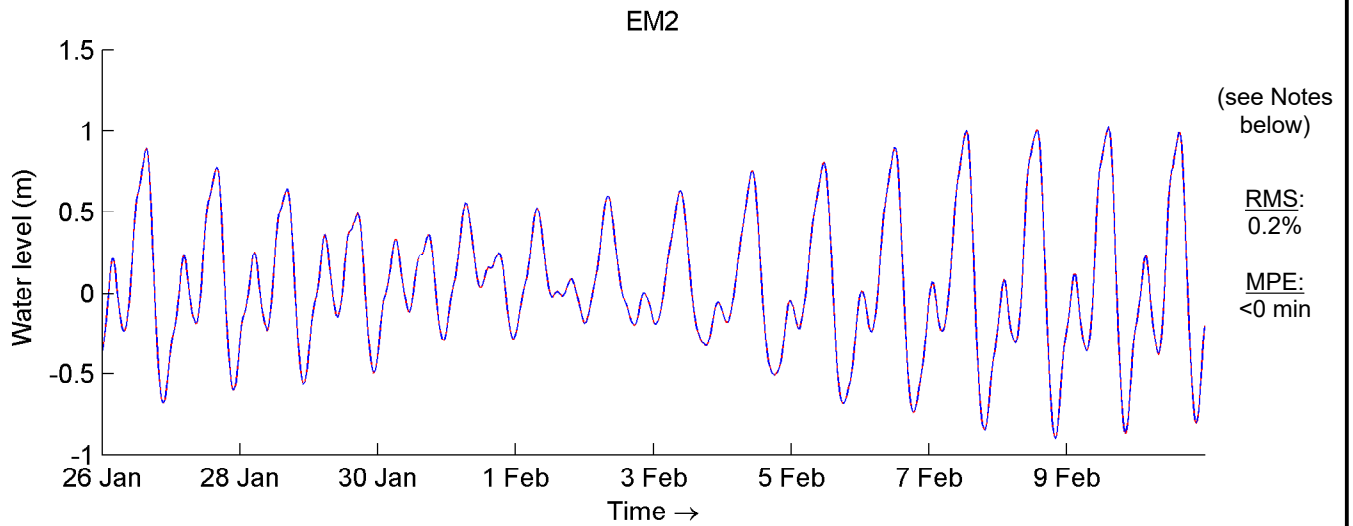


Locations of Indicator Points and Cross-Section

CE 40/2023 (CE)

Binnies

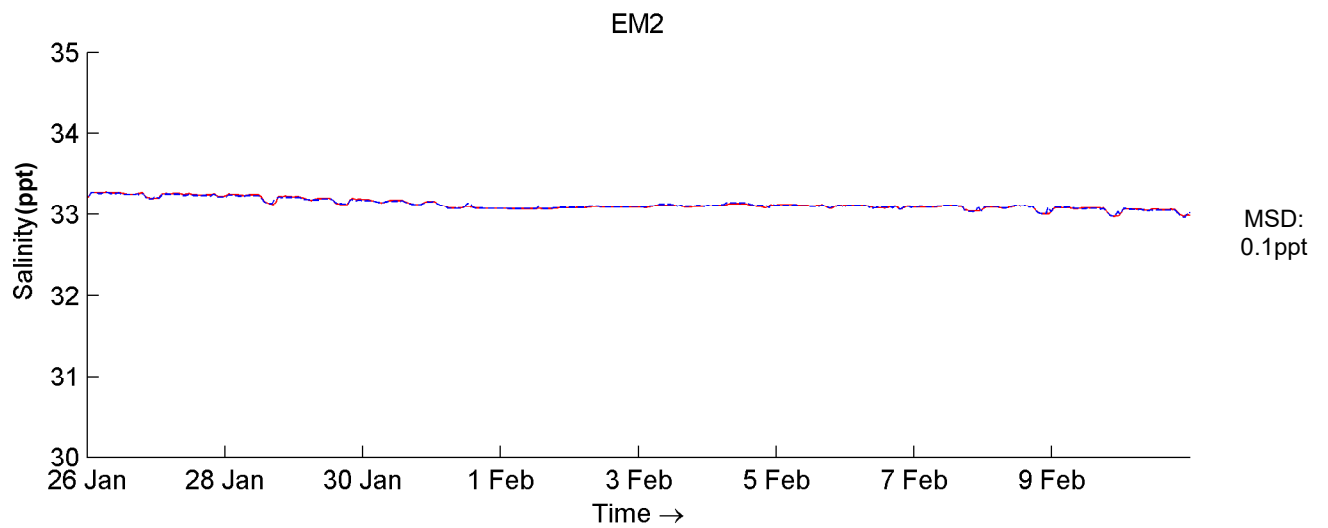
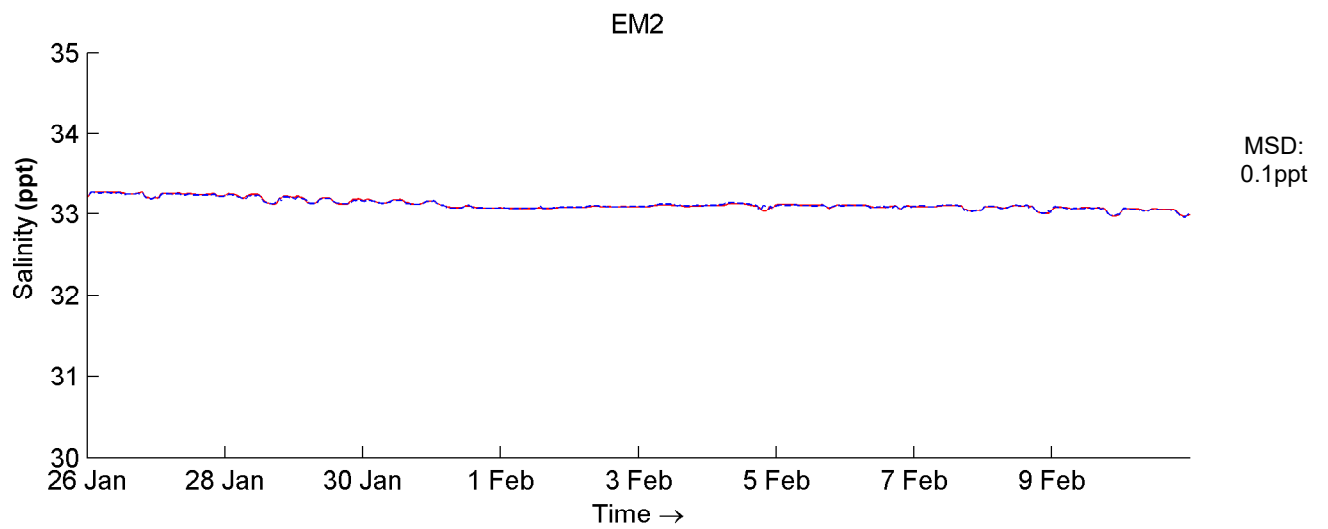
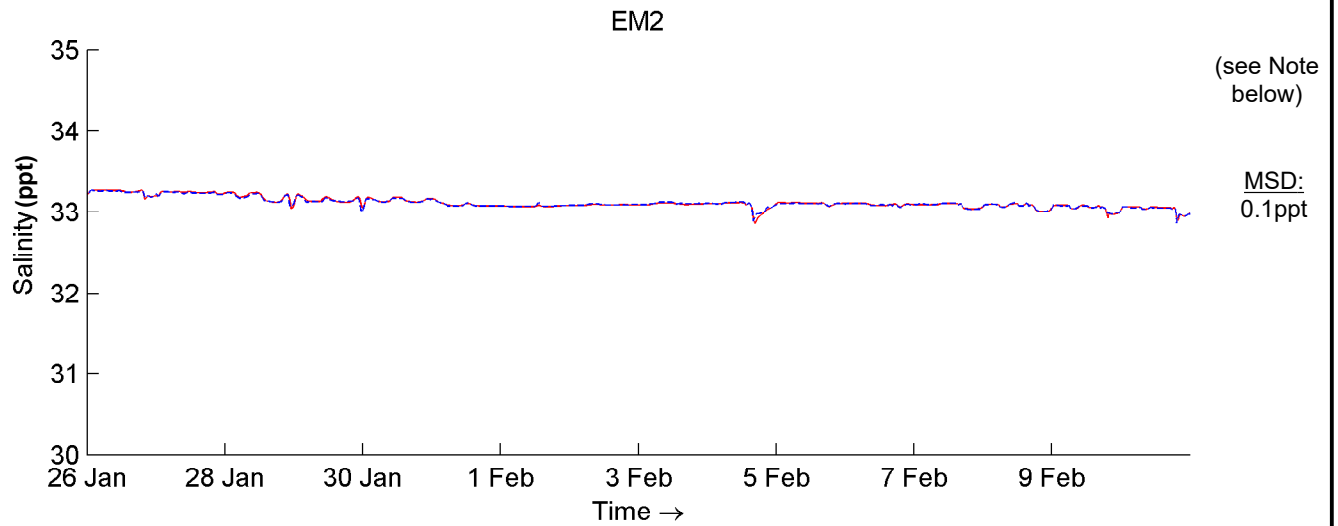
04



Notes:

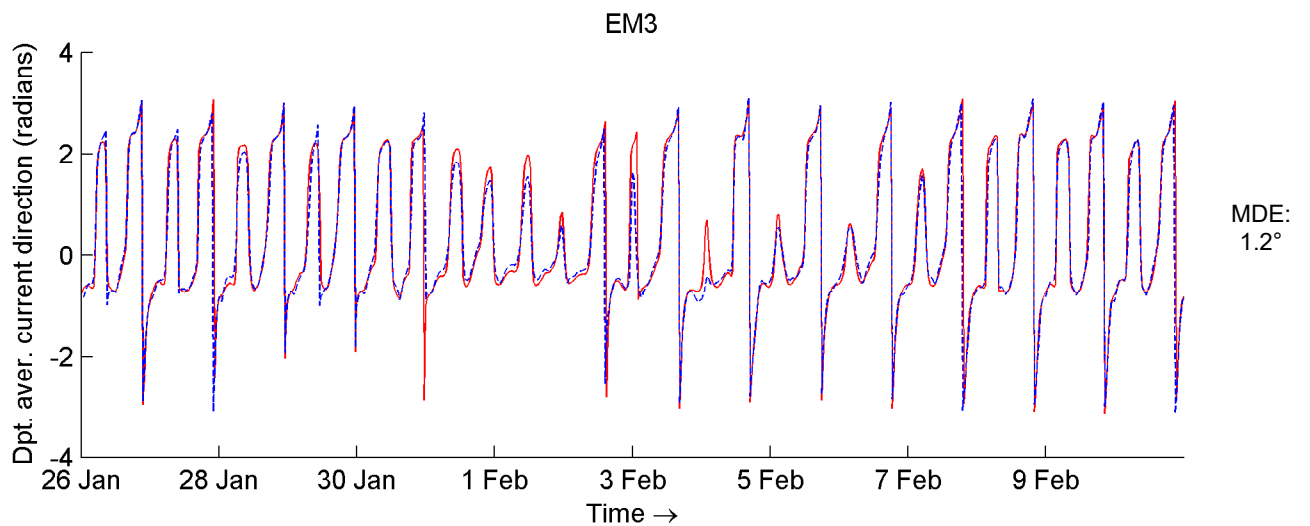
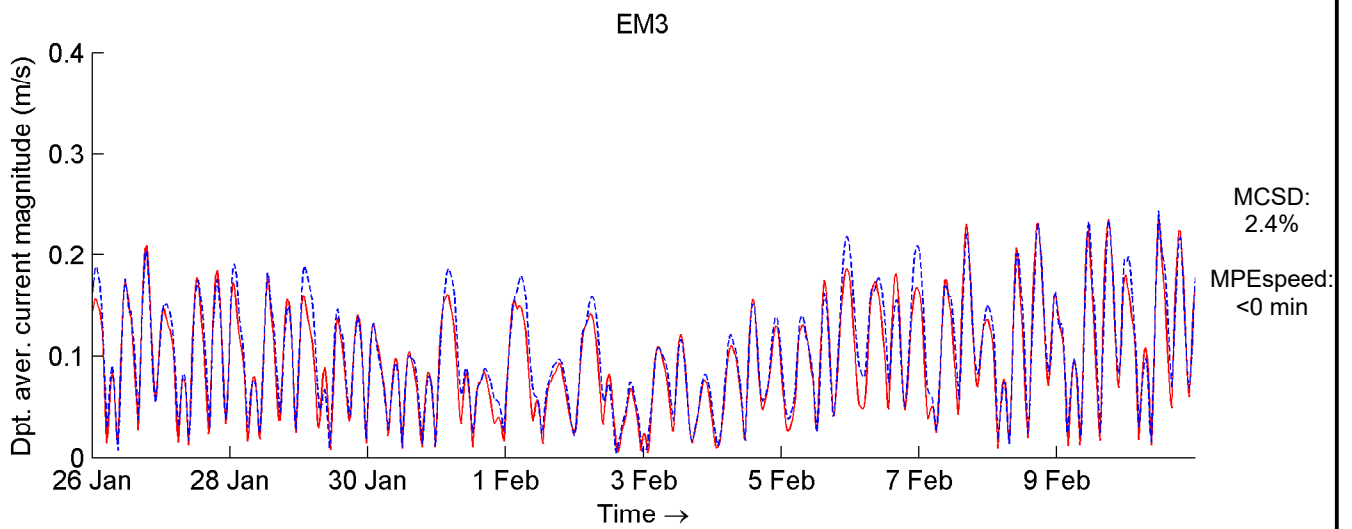
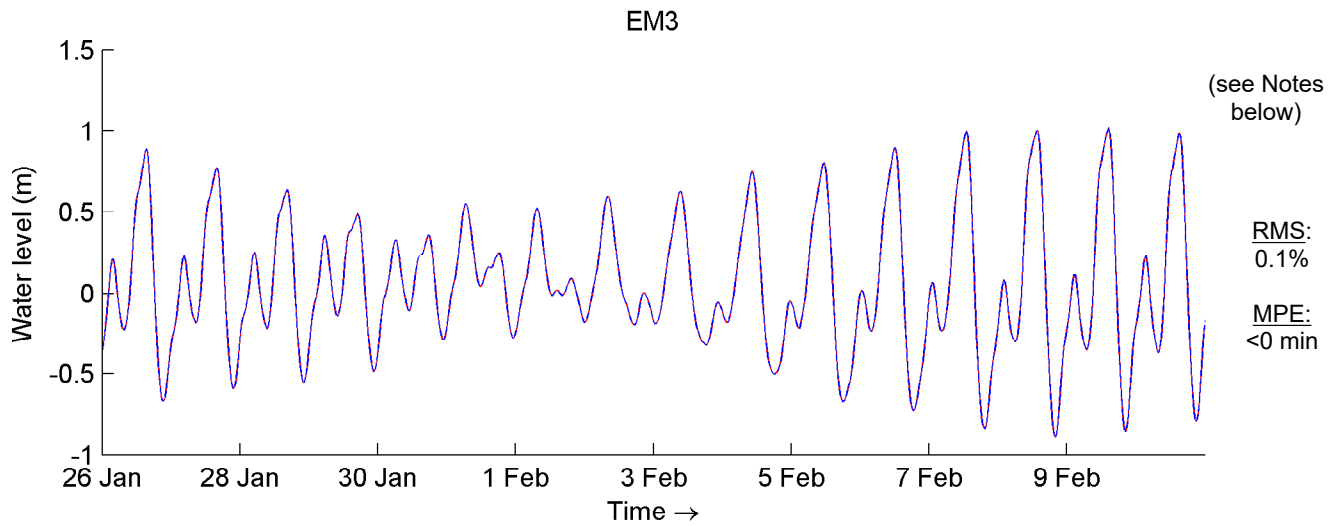
RMSE - Root mean square error; MPE - Maximum phase error at high water and low water; MCSD - Maximum current speed deviation, MPESpeed: Maximum phase error at peak speed, MDE: Maximum direction error at peak speed

Water Level, Depth Averaged Current Velocity and Direction at EM2		Dry Season
Dry Season		
Red : Original Model ; Blue : Refined Model		CE 40/2023 (CE)
Binnies		05



Note: MSD - Maximum Salinity Deviation

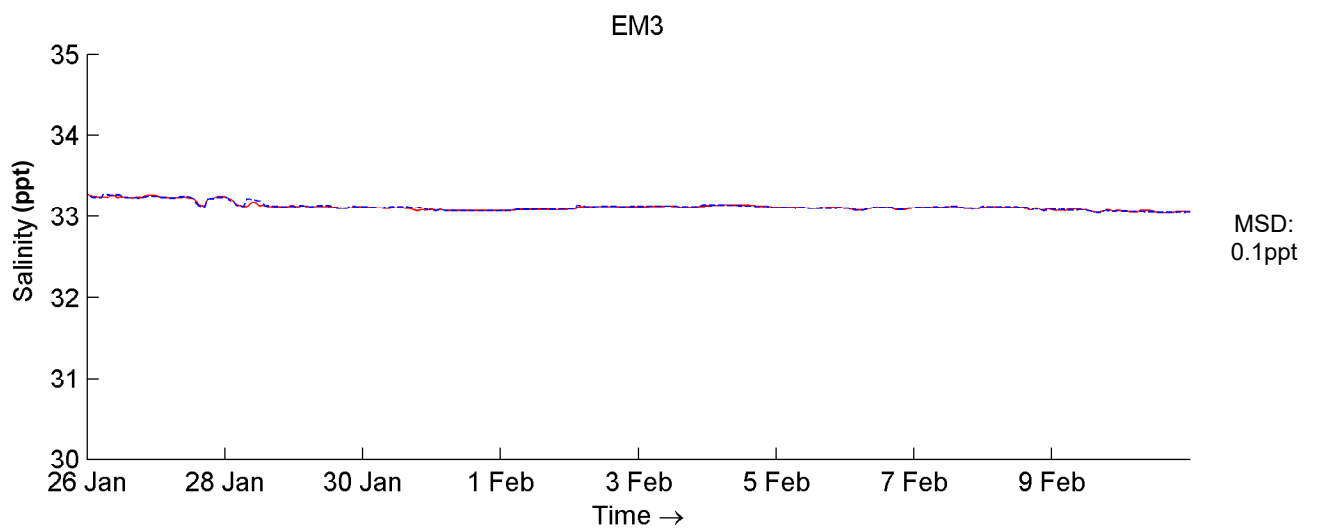
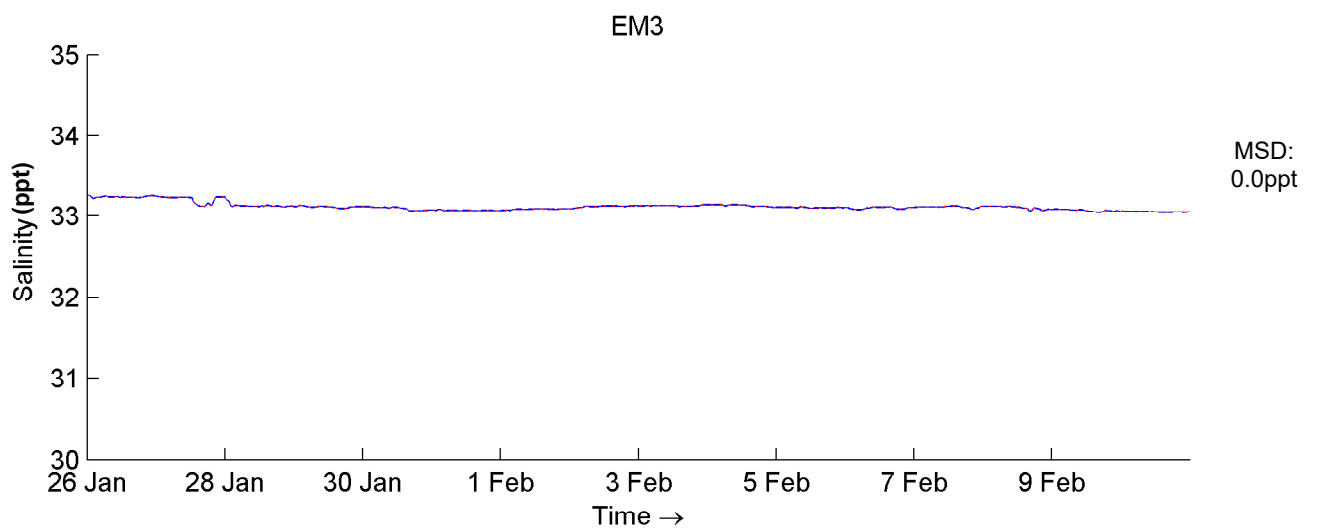
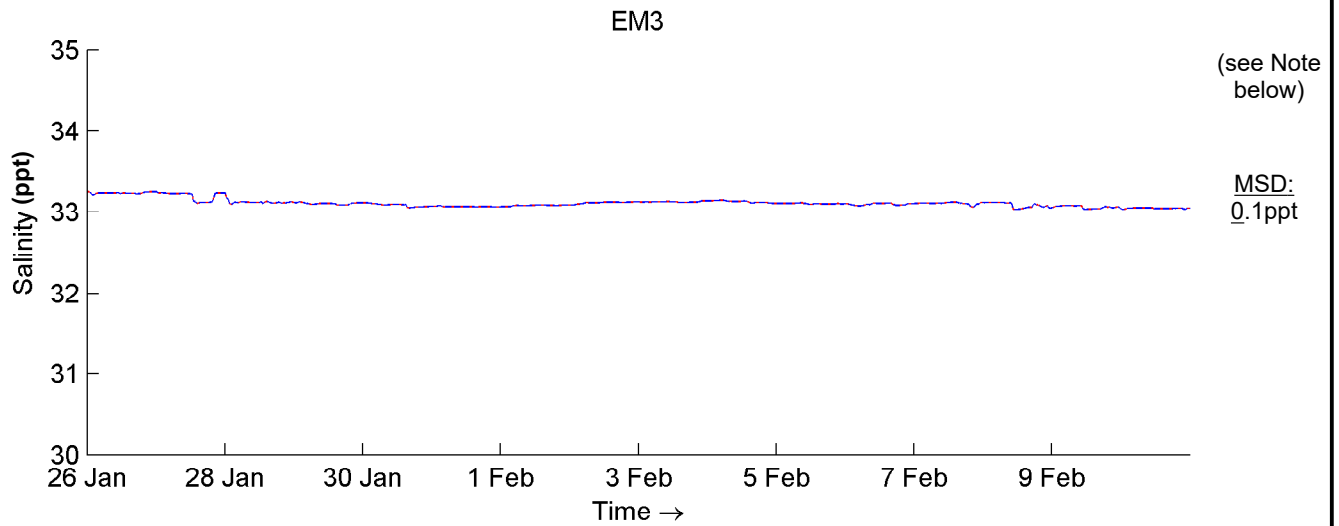
Surface, Mid-Depth and Bottom Salinity at EM2 Dry Season Red : Original Model ; Blue : Refined Model		Dry Season
		CE 40/2023 (CE)
Binnies		06



Notes:

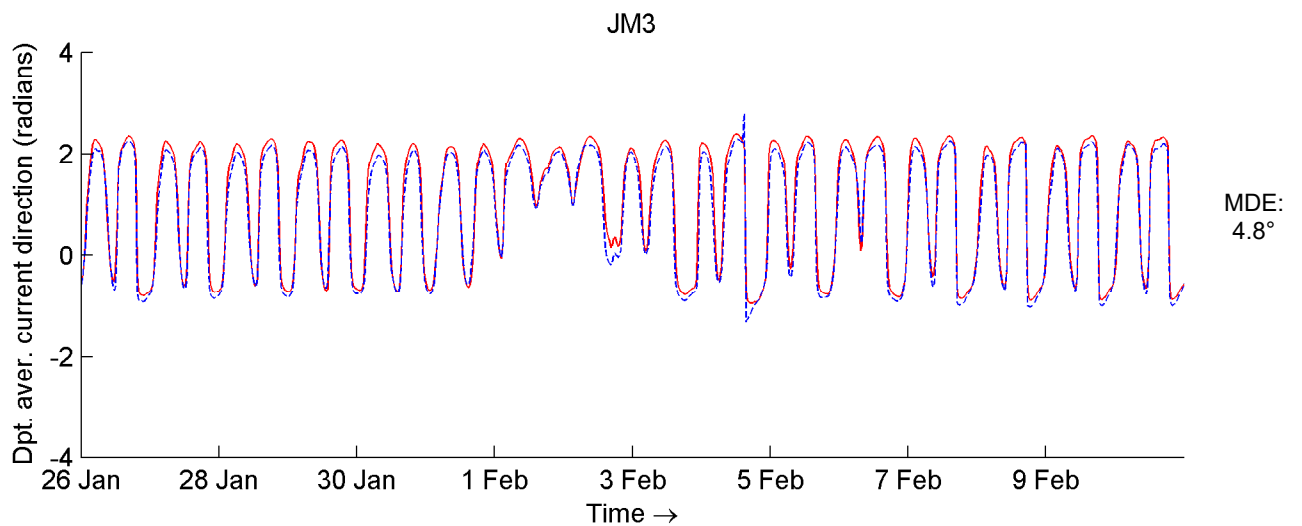
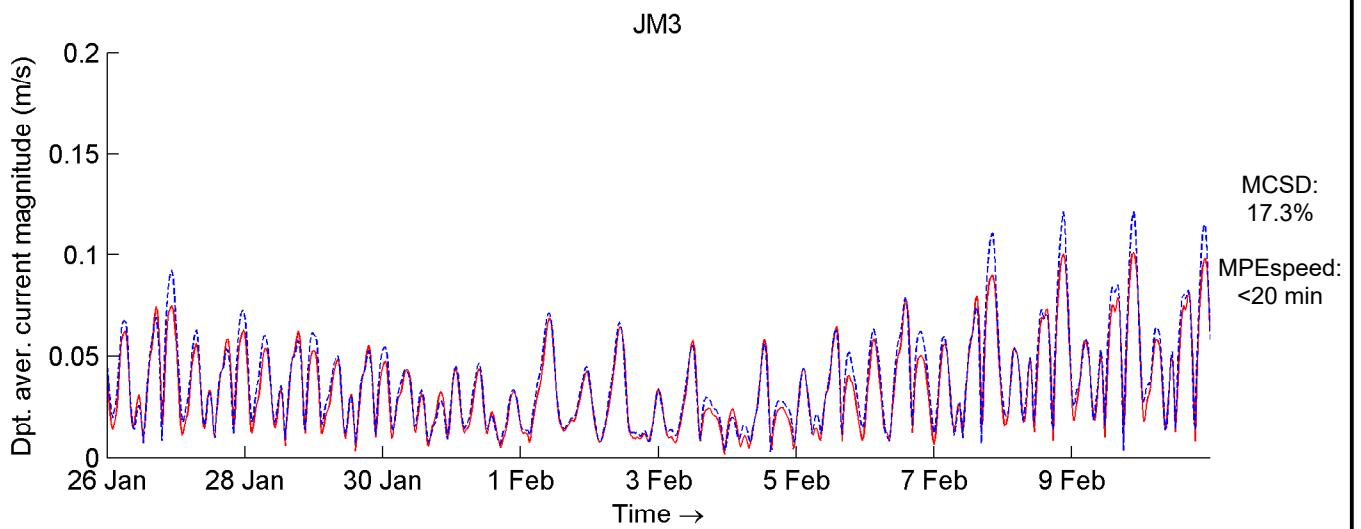
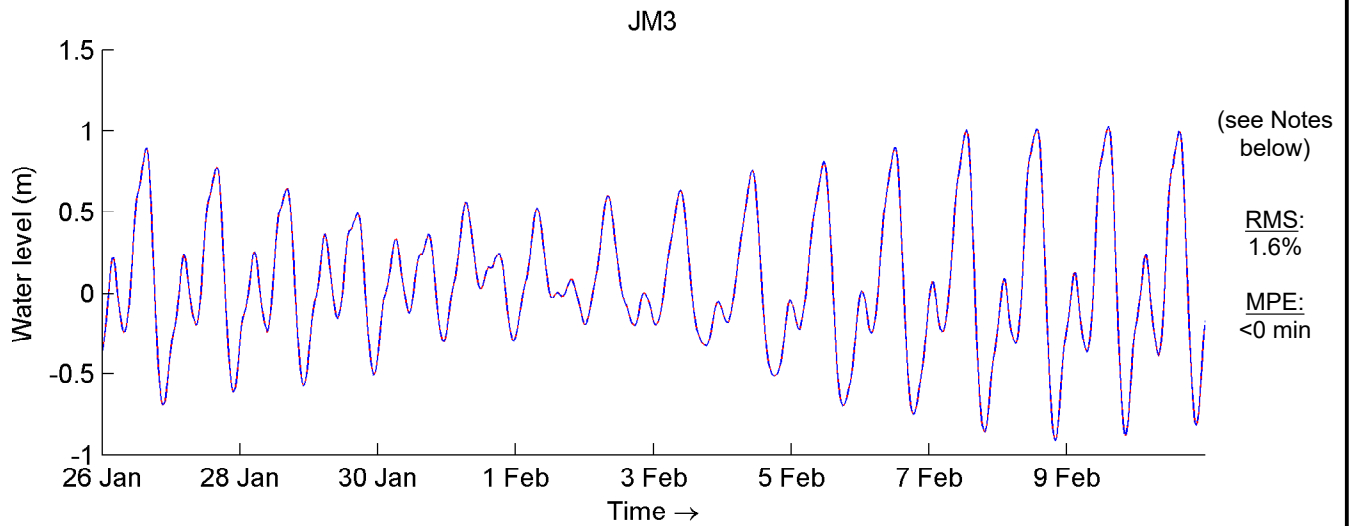
RMSE - Root mean square error; MPE - Maximum phase error at high water and low water; MCSD - Maximum current speed deviation, MPESpeed: Maximum phase error at peak speed, MDE: Maximum direction error at peak speed

Water Level, Depth Averaged Current Velocity and Direction at EM3 Dry Season Red : Original Model ; Blue : Refined Model		Dry Season
	CE 40/2023 (CE)	
Binnies		07



Note: MSD - Maximum Salinity Deviation

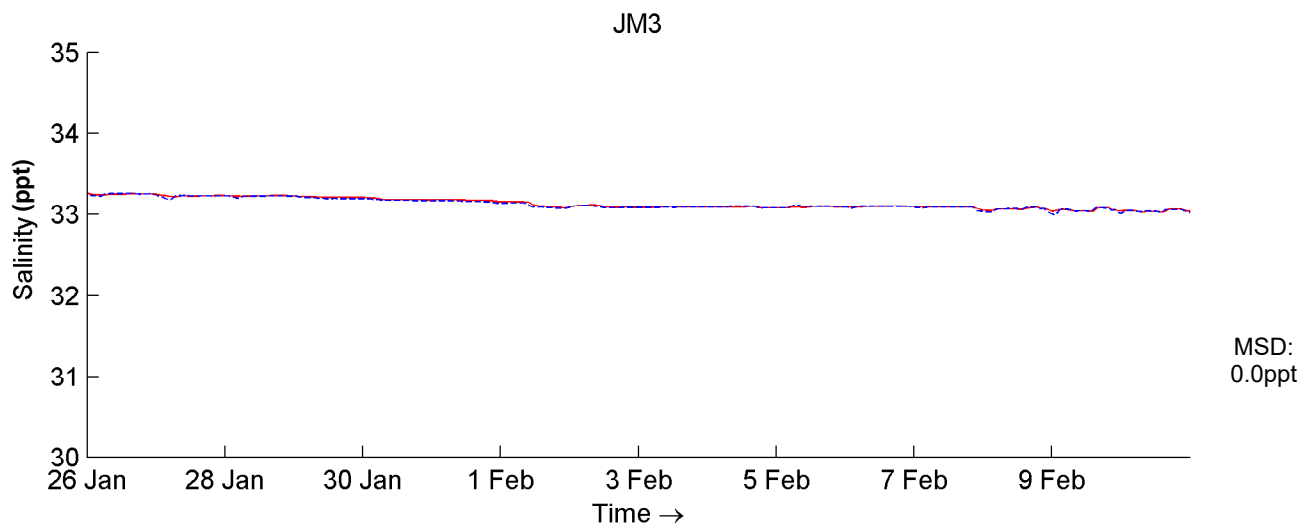
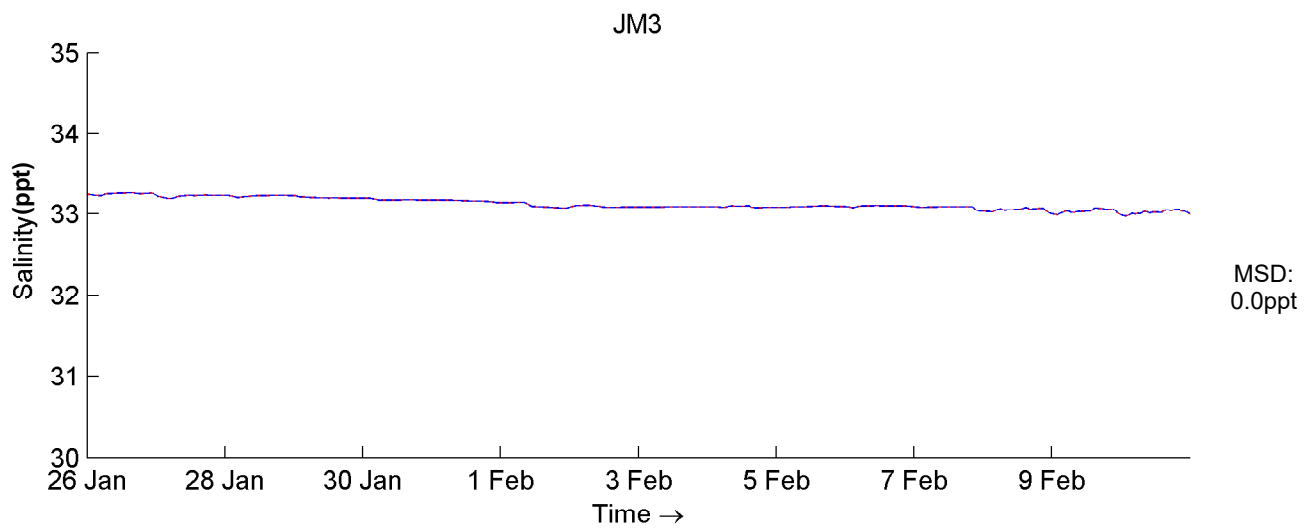
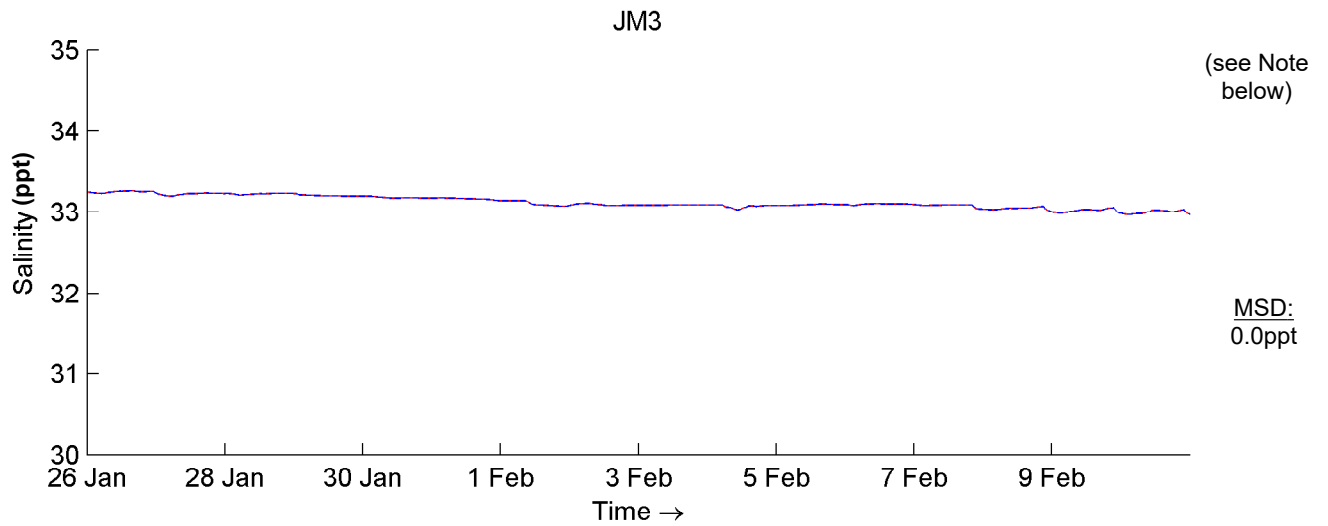
Surface, Mid-Depth and Bottom Salinity at EM3 Dry Season Red : Original Model ; Blue : Refined Model		Dry Season
		CE 40/2023 (CE)
Binnies		08



Notes:

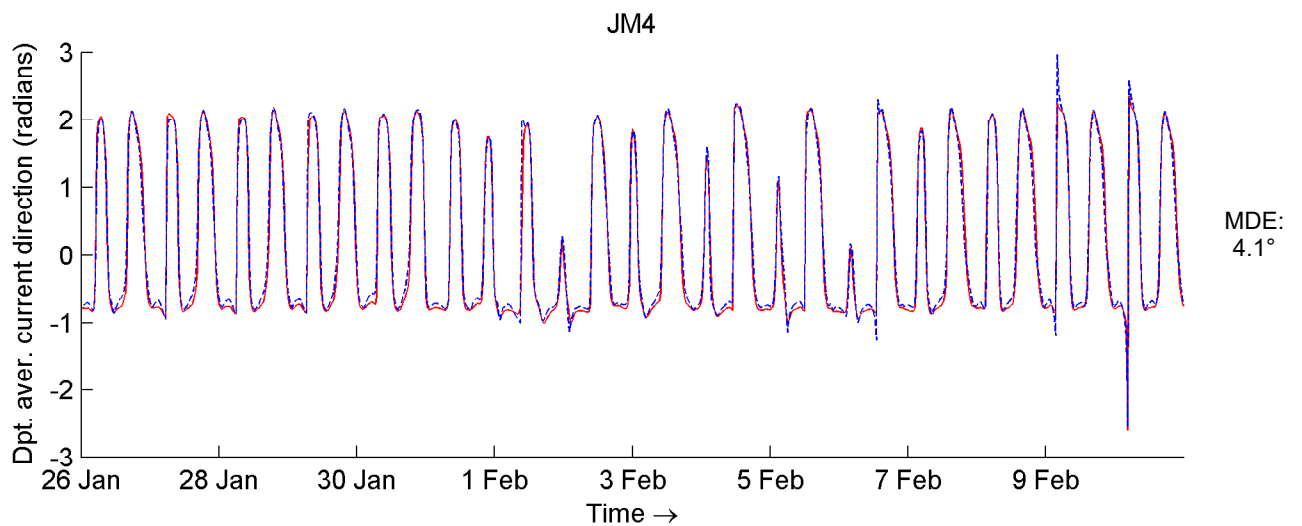
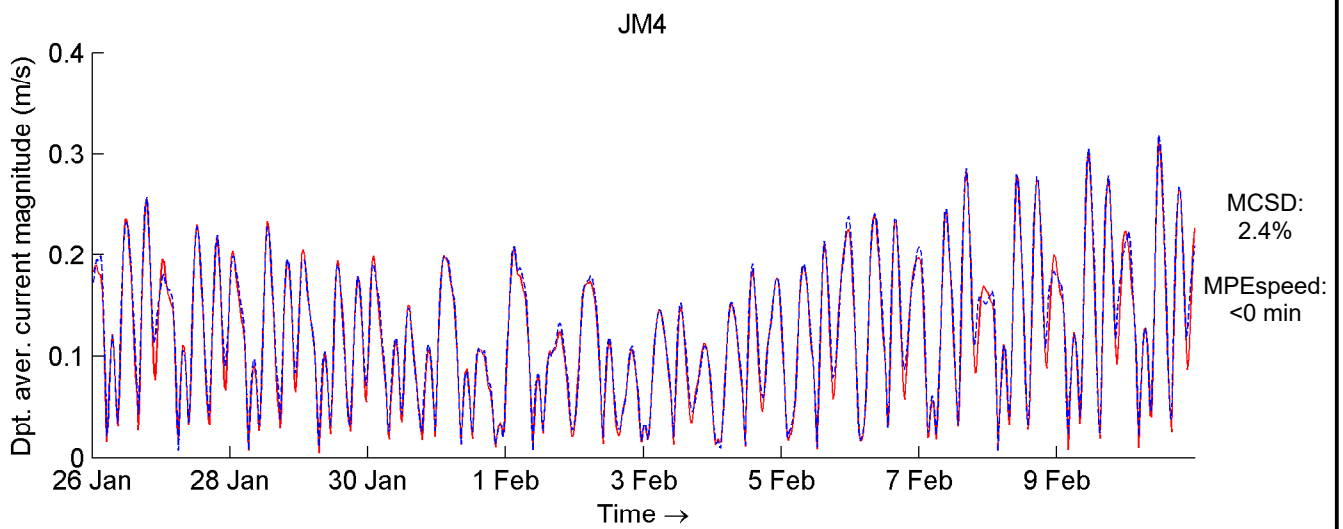
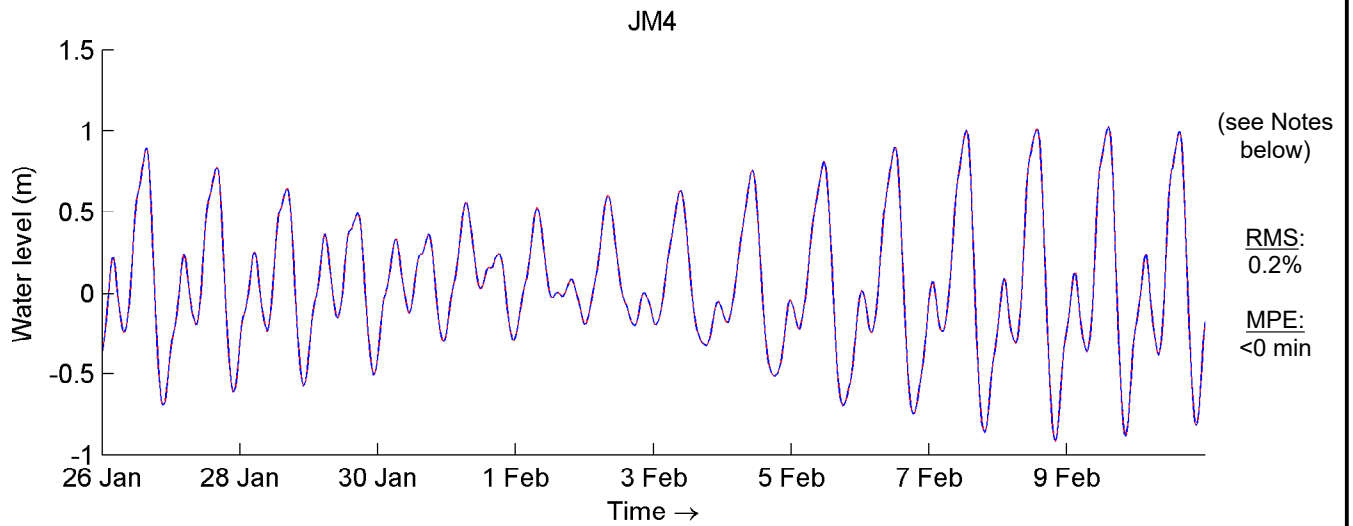
RMSE - Root mean square error; MPE - Maximum phase error at high water and low water; MCSD - Maximum current speed deviation, MPEspeed: Maximum phase error at peak speed, MDE: Maximum direction error at peak speed

Water Level, Depth Averaged Current Velocity and Direction at JM3 Dry Season Red : Original Model ; Blue : Refined Model		Dry Season
		CE 40/2023 (CE)
Binnies		09



Note: MSD - Maximum Salinity Deviation

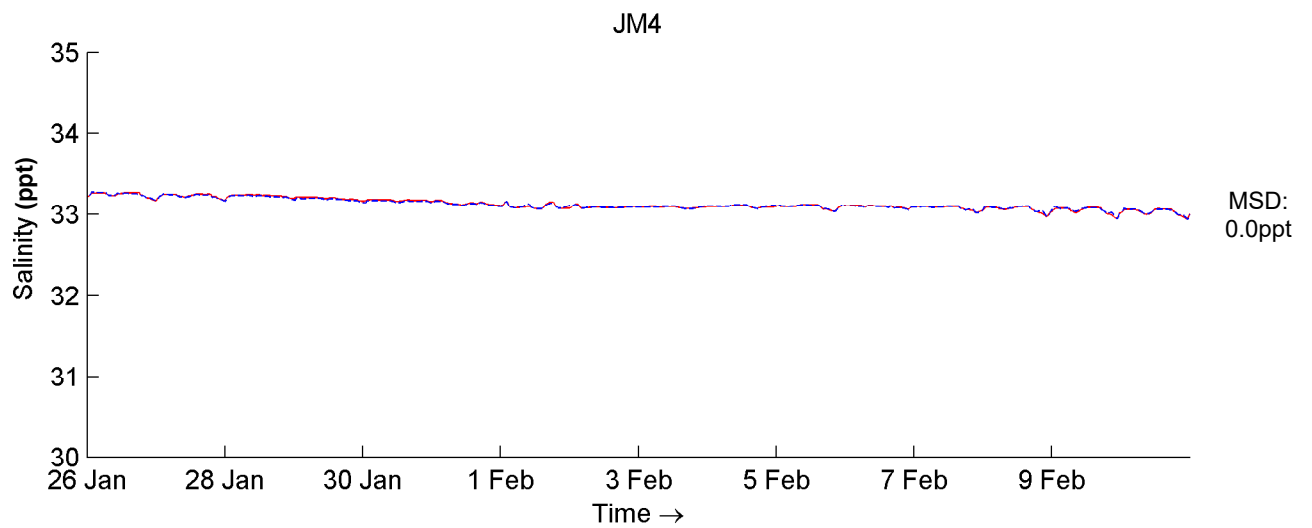
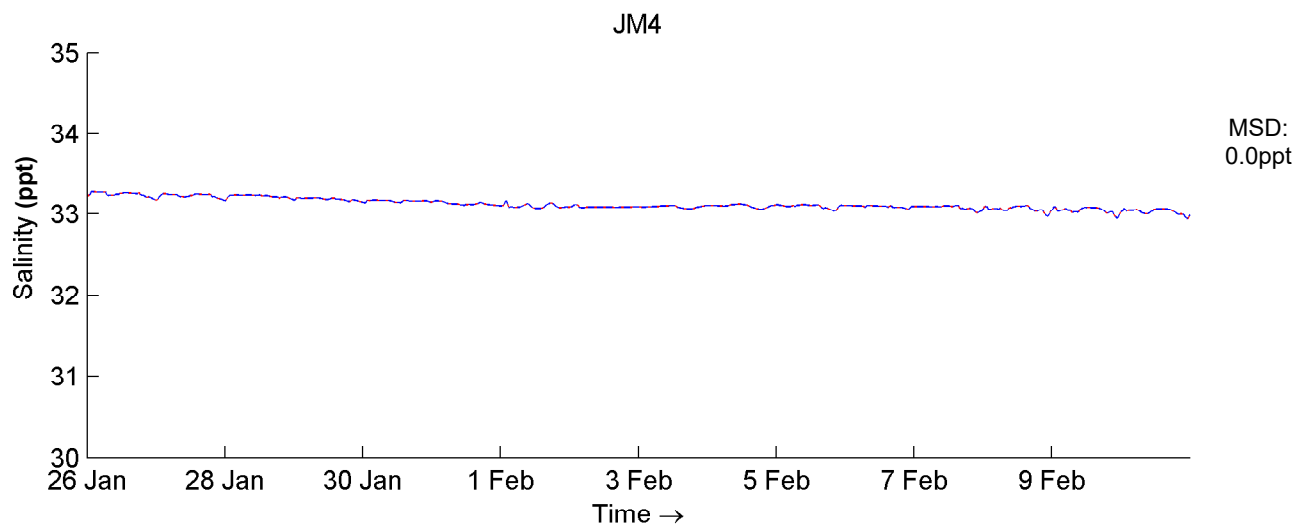
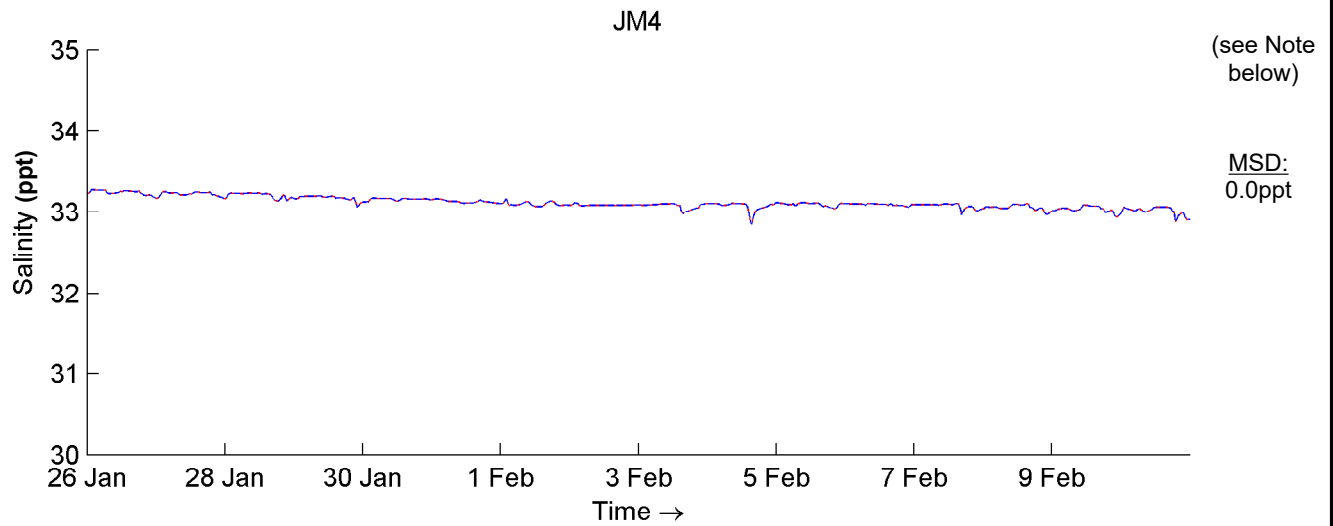
Surface, Mid-Depth and Bottom Salinity at JM3 Dry Season Red : Original Model ; Blue : Refined Model		Dry Season
		CE 40/2023 (CE)
Binnies		10



Notes:

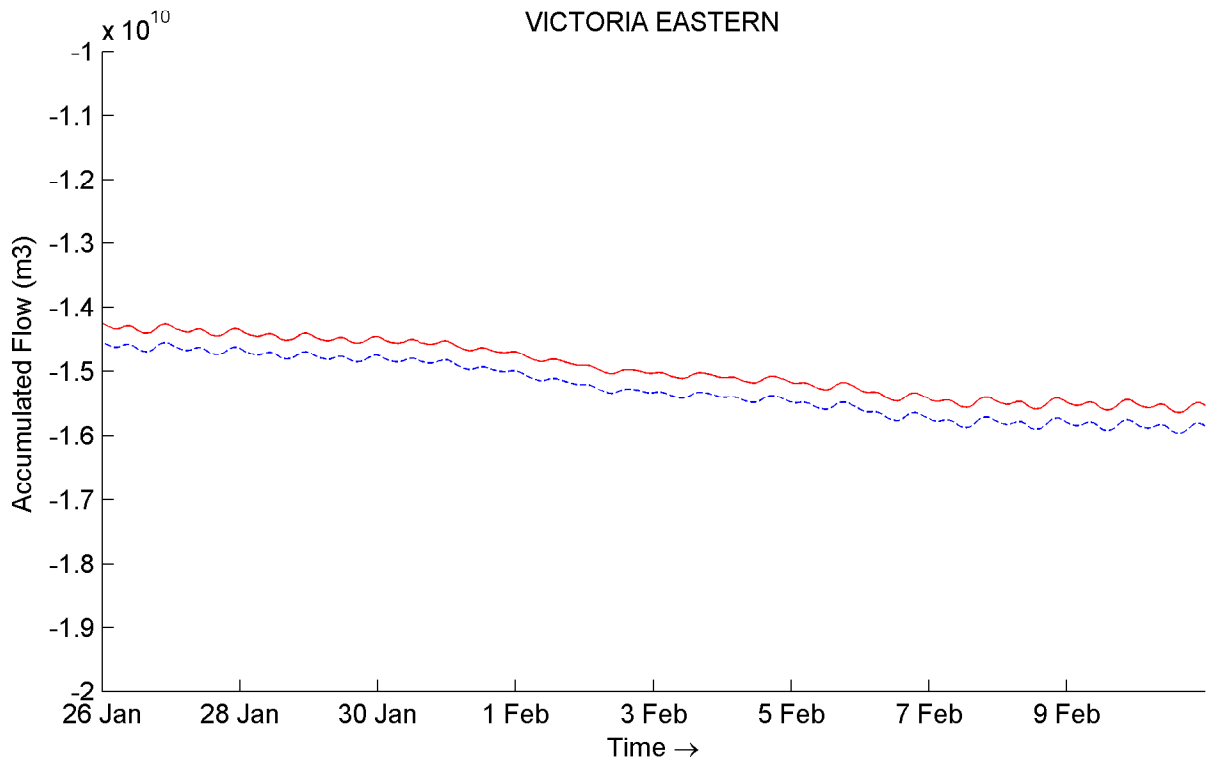
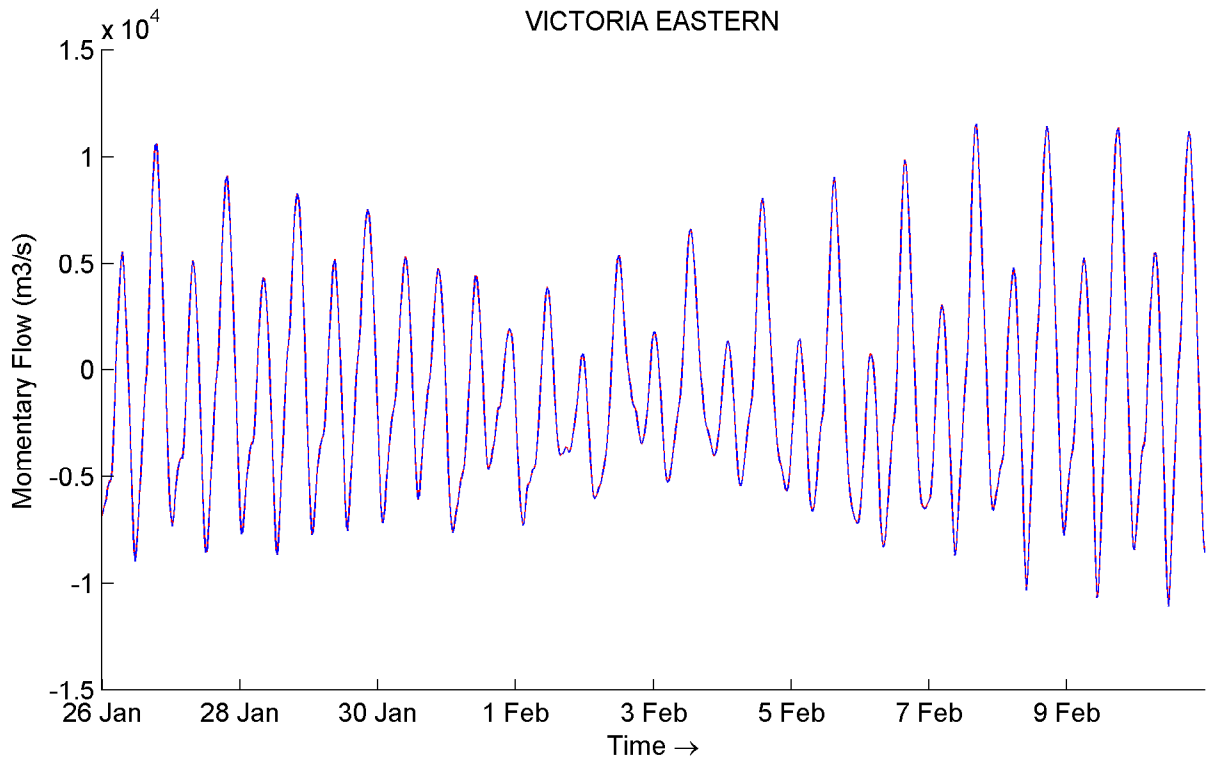
RMSE - Root mean square error; MPE - Maximum phase error at high water and low water; MCSD - Maximum current speed deviation, MPEspeed: Maximum phase error at peak speed, MDE: Maximum direction error at peak speed

Water Level, Depth Averaged Current Velocity and Direction at JM4 Dry Season Red : Original Model ; Blue : Refined Model		Dry Season
	CE 40/2023 (CE)	
Binnies		11

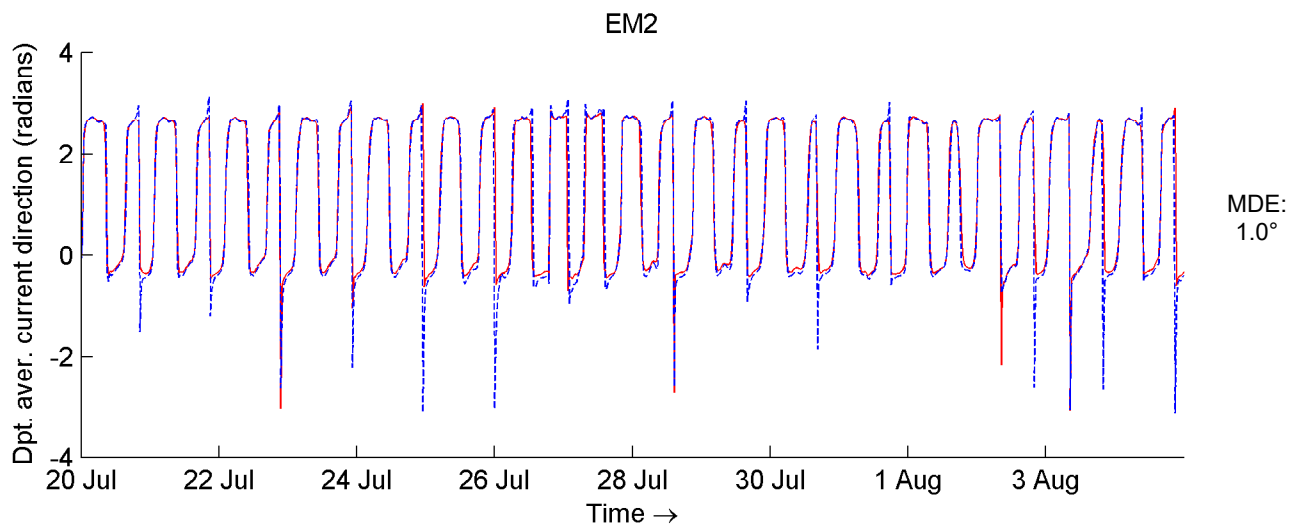
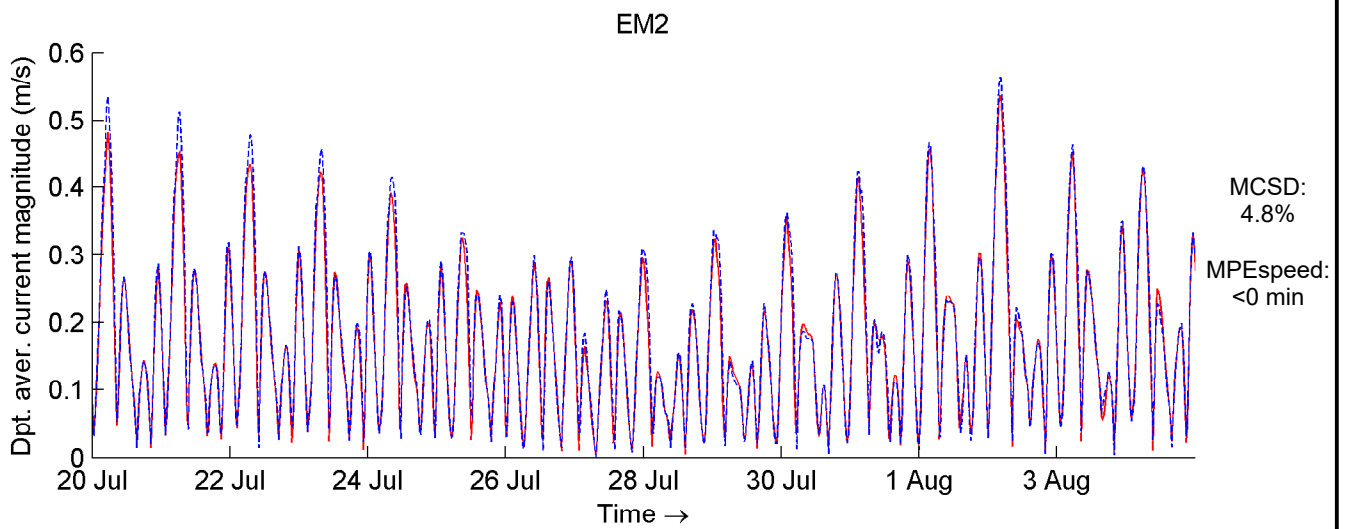
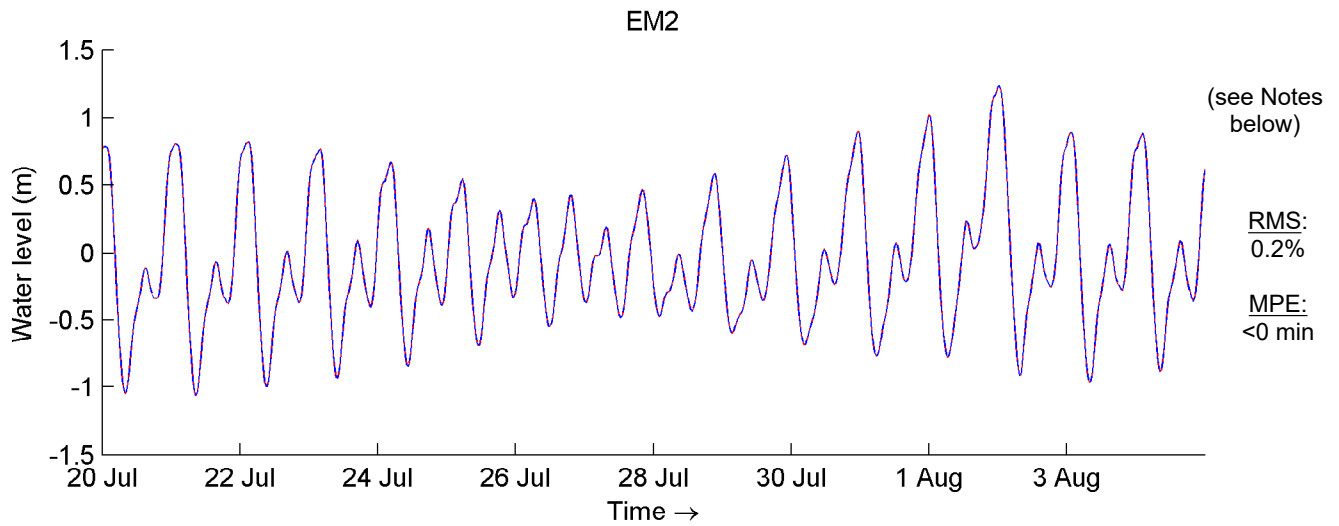


Note: MSD - Maximum Salinity Deviation

Surface, Mid-Depth and Bottom Salinity at JM4 Dry Season Red : Original Model ; Blue : Refined Model		Dry Season
		CE 40/2023 (CE)
Binnies		12



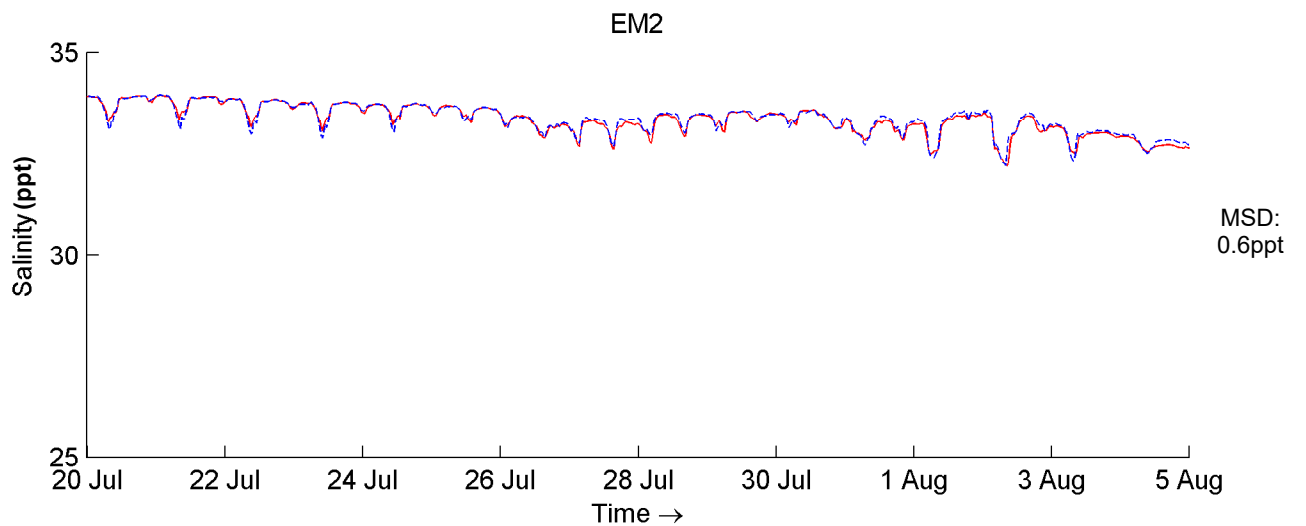
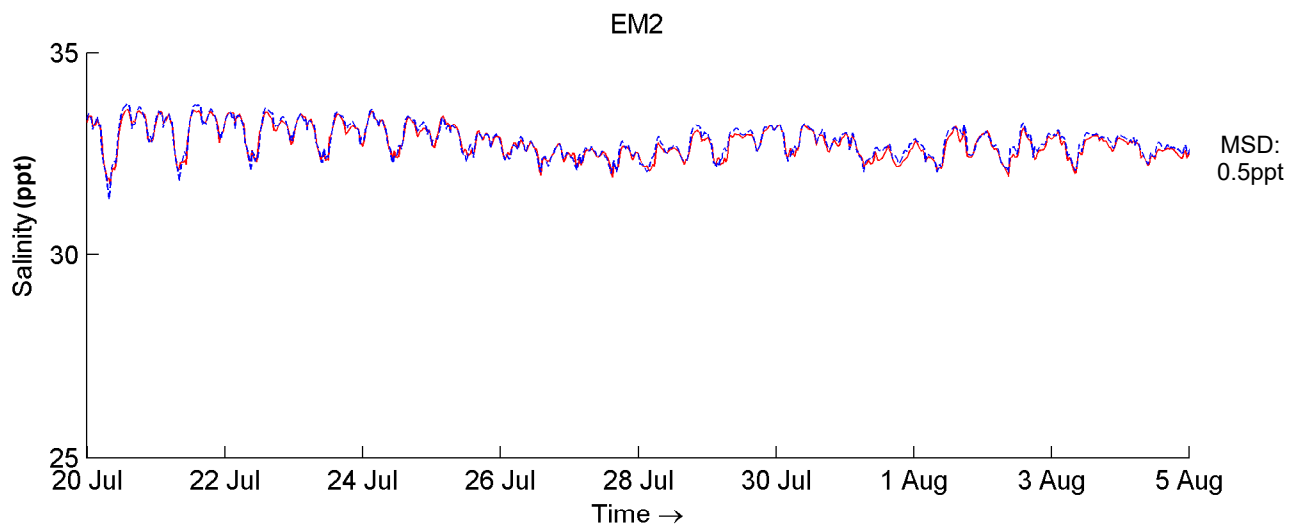
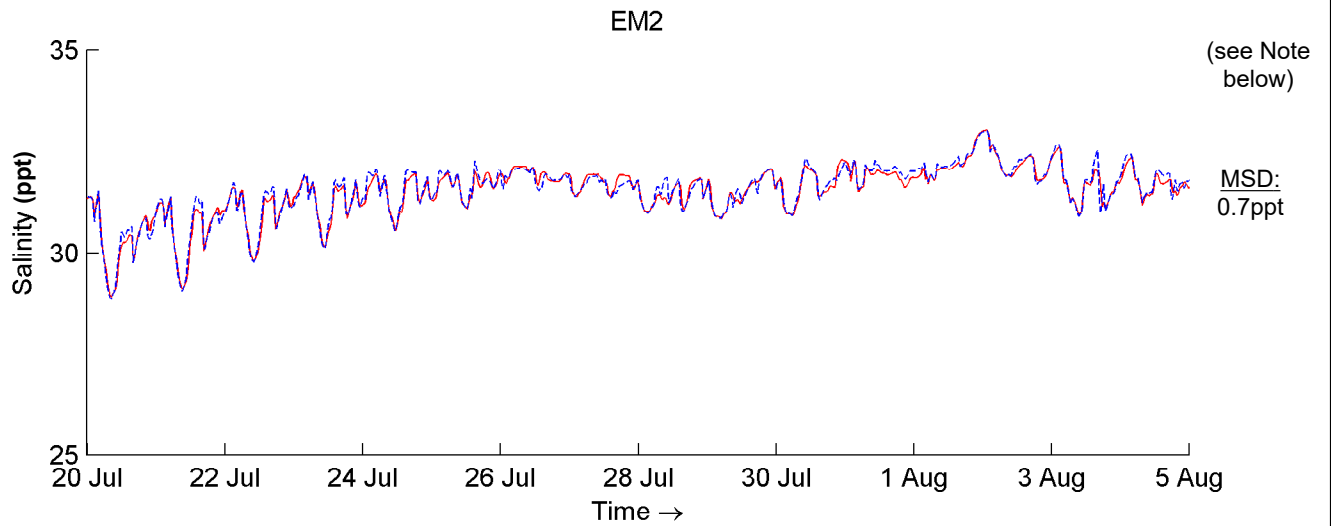
Momentary Flow and Accumulated Flow through Cross Section Red : Original Model ; Blue : Refined Model		Dry Season
	CE 40/2023 (CE)	
Binnies		13



Notes:

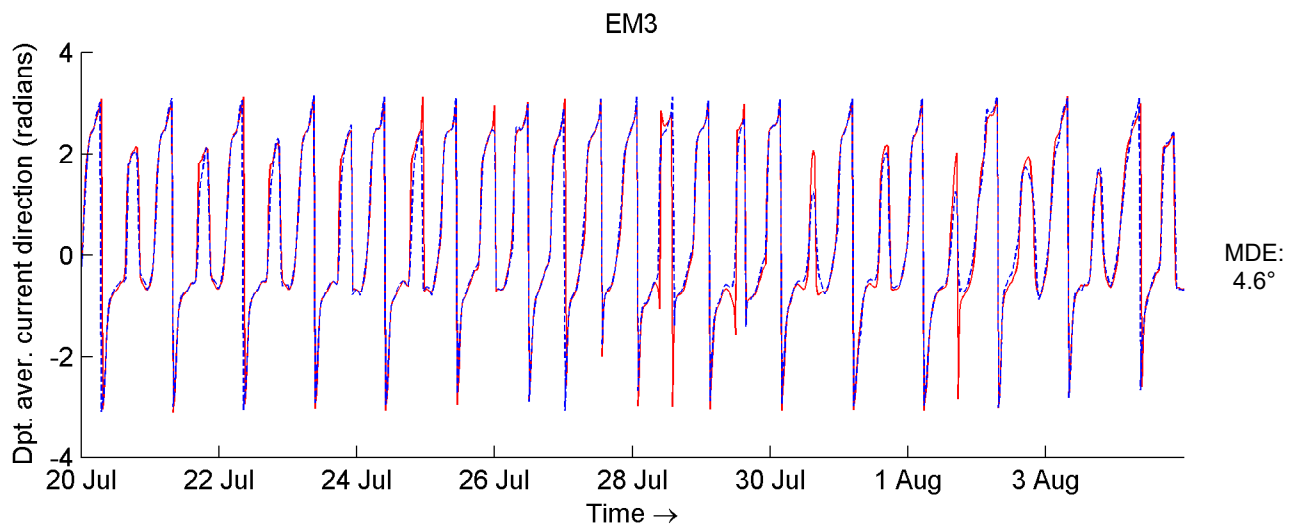
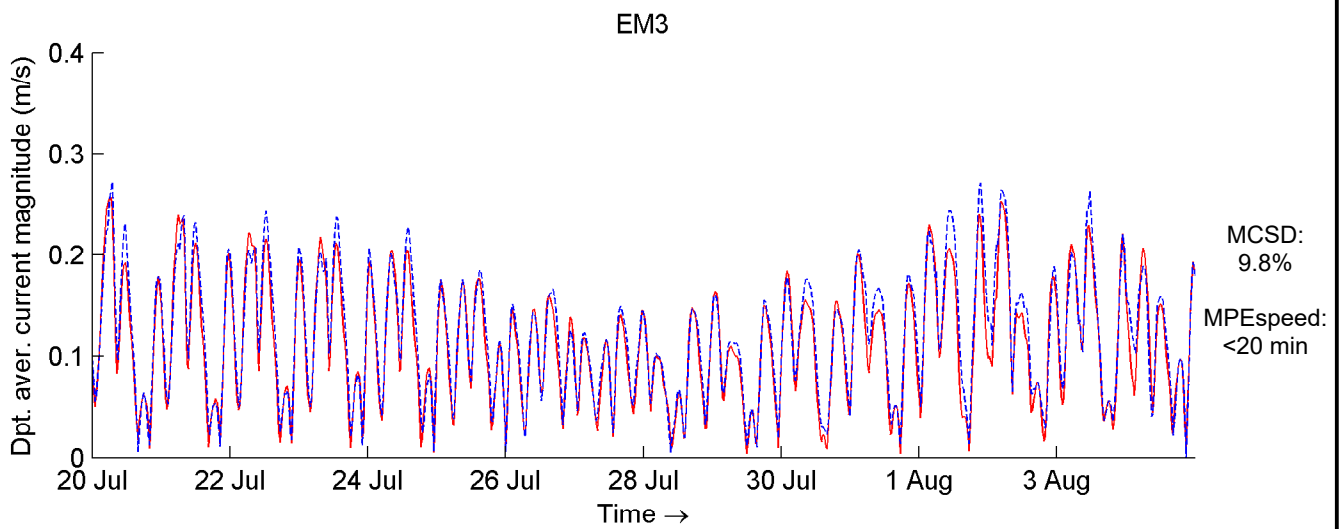
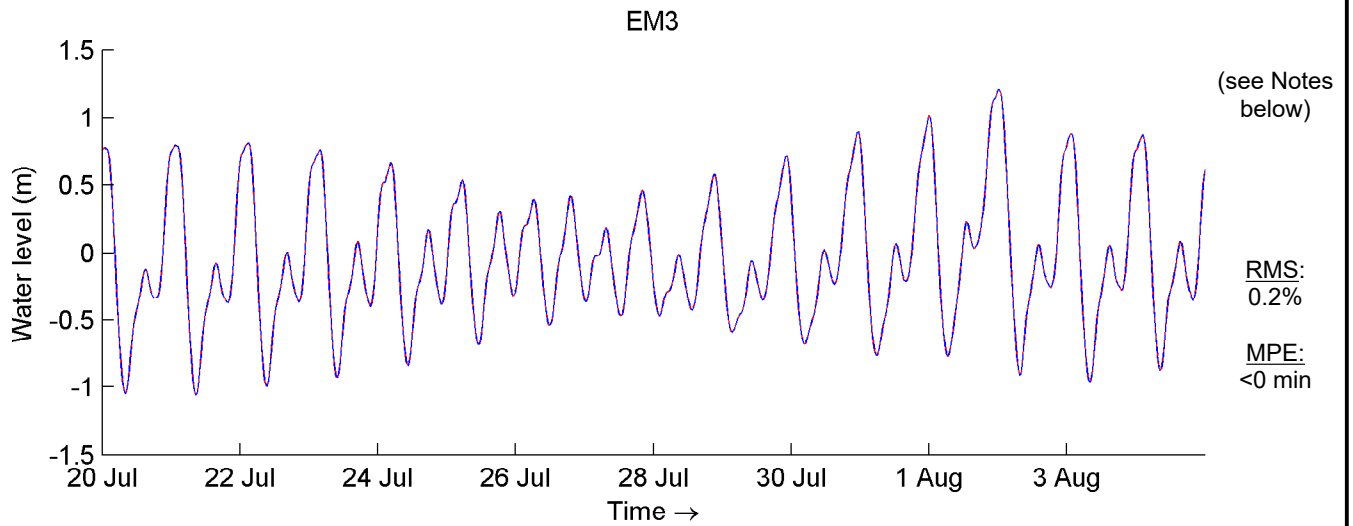
RMSE - Root mean square error; MPE - Maximum phase error at high water and low water; MCSD - Maximum current speed deviation, MPESpeed: Maximum phase error at peak speed, MDE: Maximum direction error at peak speed

Water Level, Depth Averaged Current Velocity and Direction at EM2 Dry Season Red : Original Model ; Blue : Refined Model		Wet Season
	CE 40/2023 (CE)	
Binnies		14



Note: MSD - Maximum Salinity Deviation

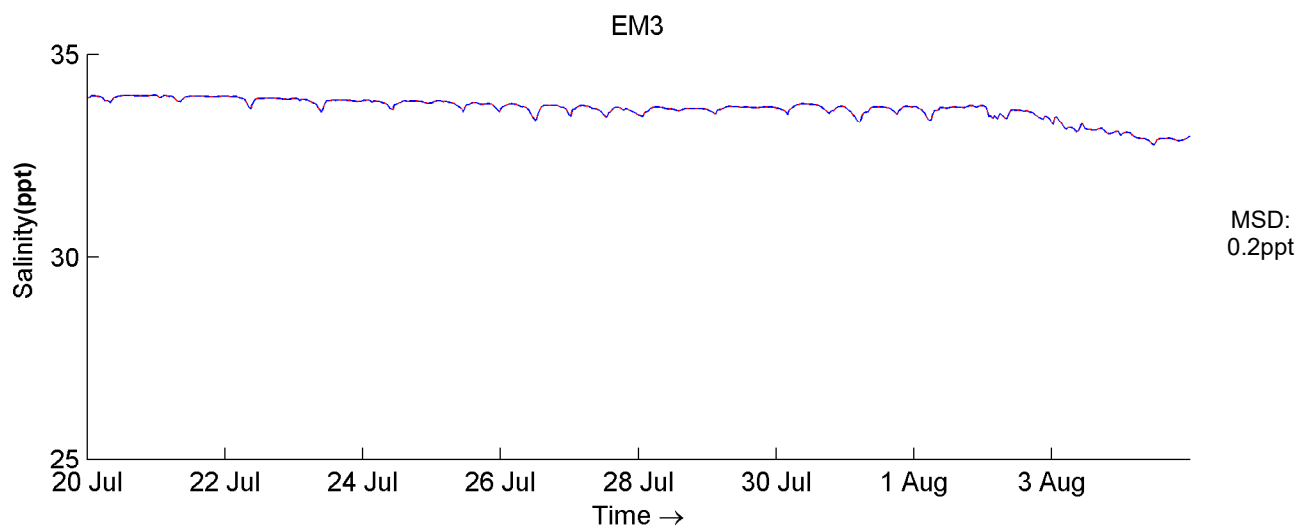
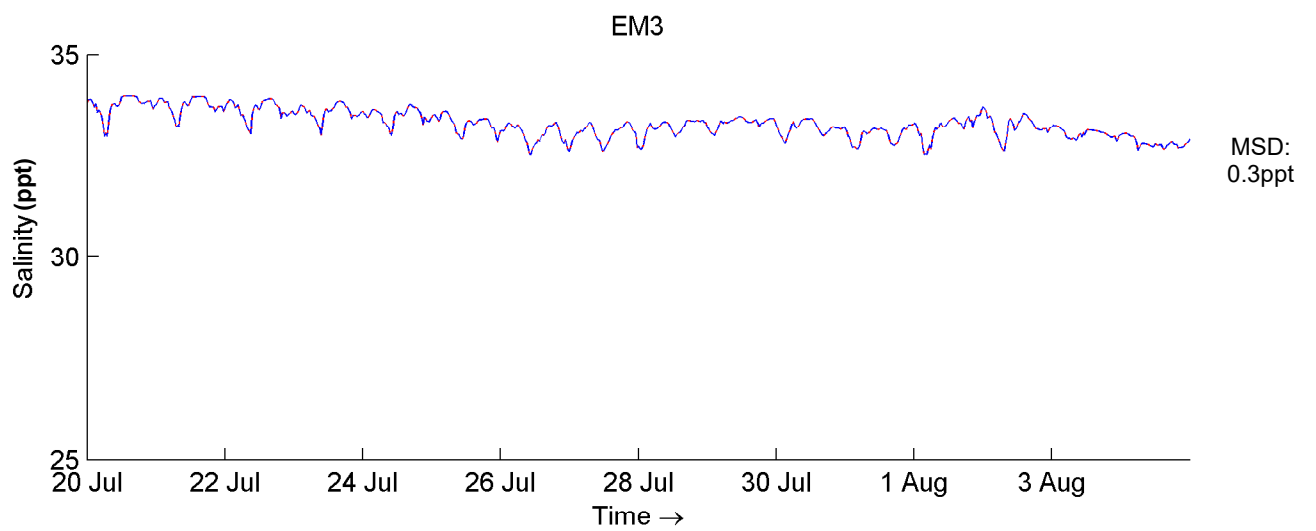
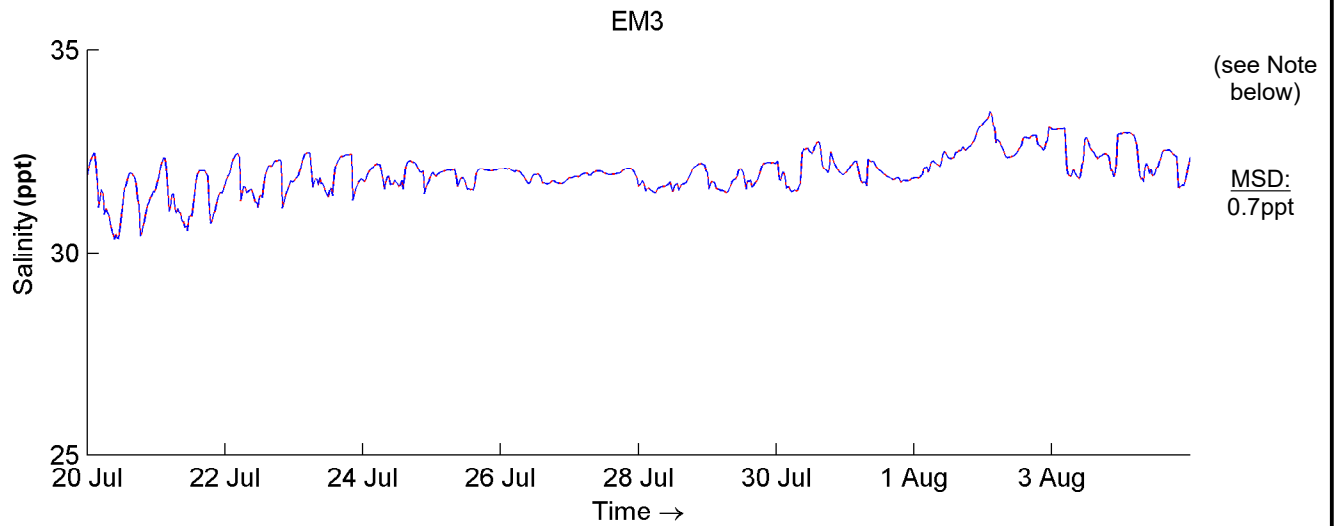
Surface, Mid-Depth and Bottom Salinity at EM2 Dry Season Red : Original Model ; Blue : Refined Model		Wet Season
	CE 40/2023 (CE)	
Binnies		15



Notes:

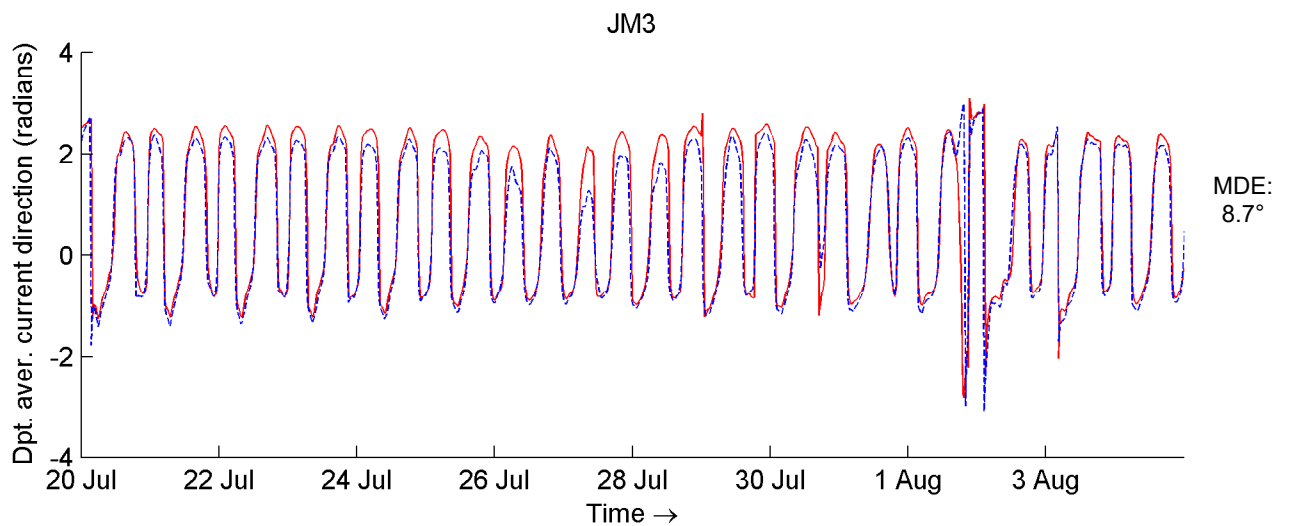
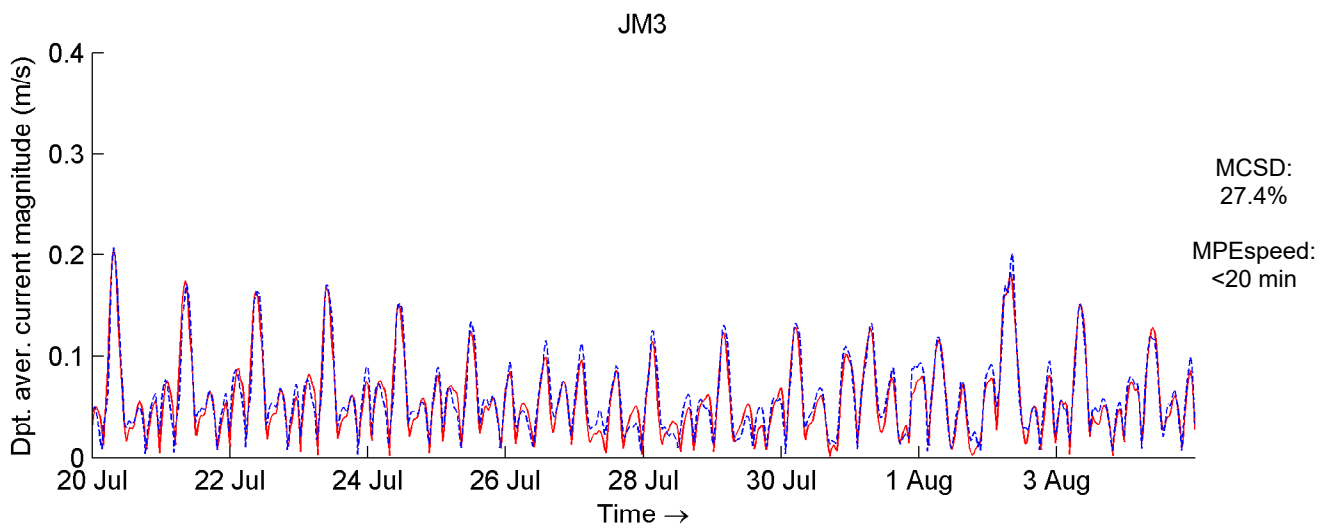
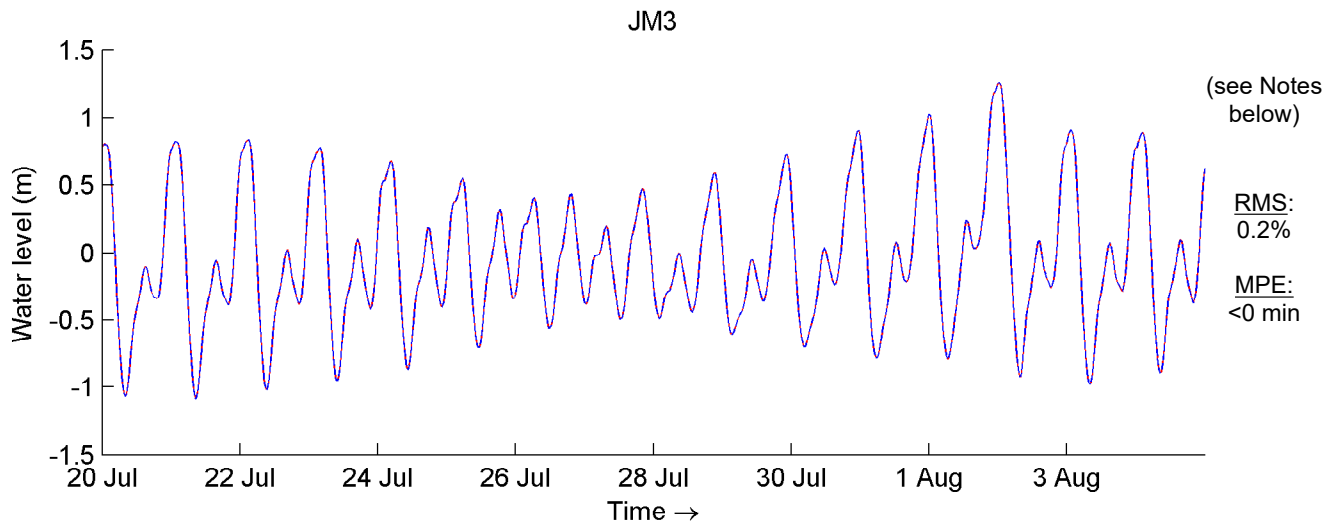
RMSE - Root mean square error; MPE - Maximum phase error at high water and low water; MCSD - Maximum current speed deviation, MPEspeed: Maximum phase error at peak speed, MDE: Maximum direction error at peak speed

Water Level, Depth Averaged Current Velocity and Direction at EM3 Dry Season Red : Original Model ; Blue : Refined Model		Wet Season
		CE 40/2023 (CE)
Binnies		16



Note: MSD - Maximum Salinity Deviation

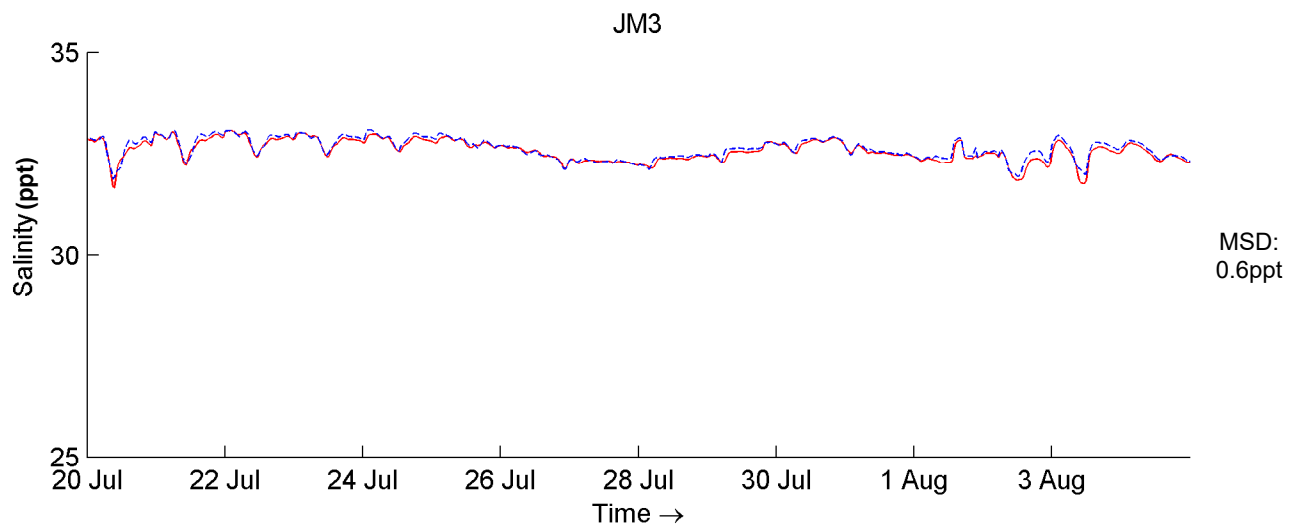
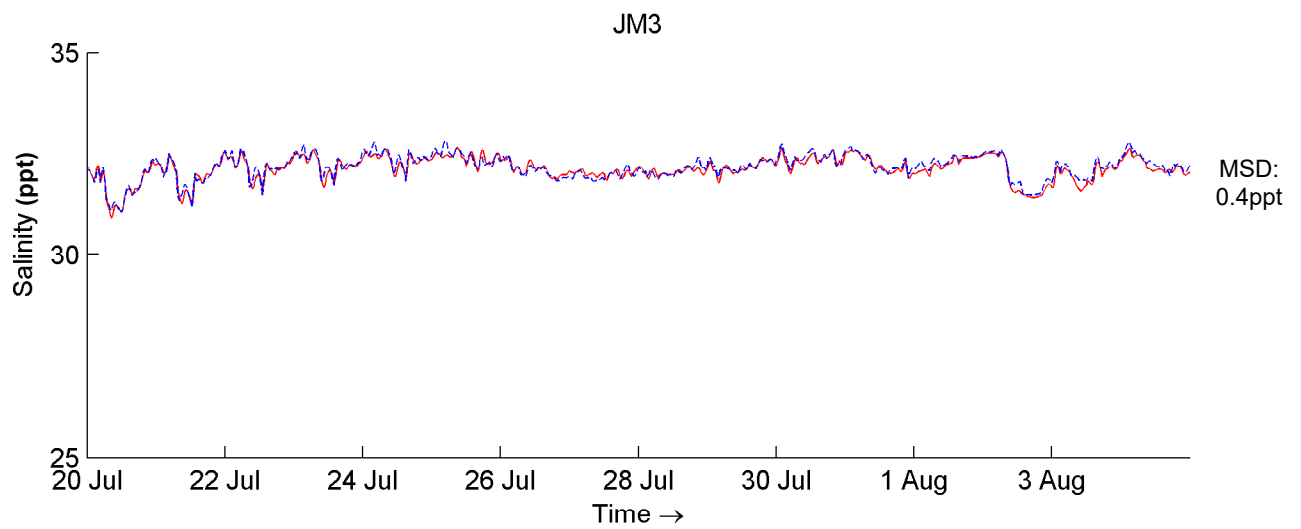
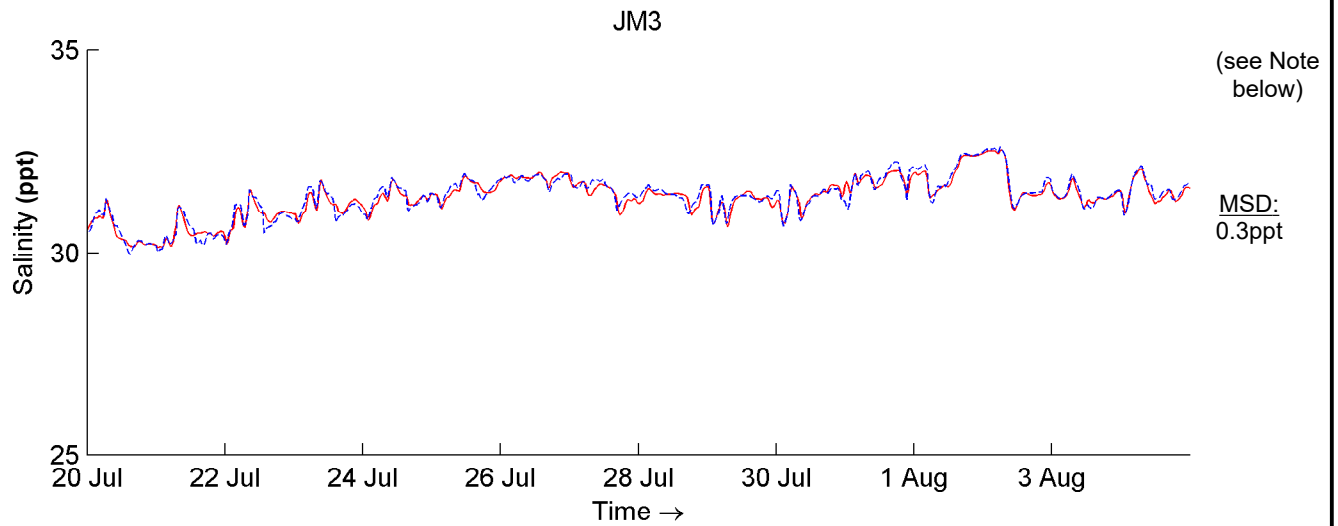
Surface, Mid-Depth and Bottom Salinity at EM3 Dry Season Red : Original Model ; Blue : Refined Model		Wet Season
		CE 40/2023 (CE)
Binnies		17



Notes:

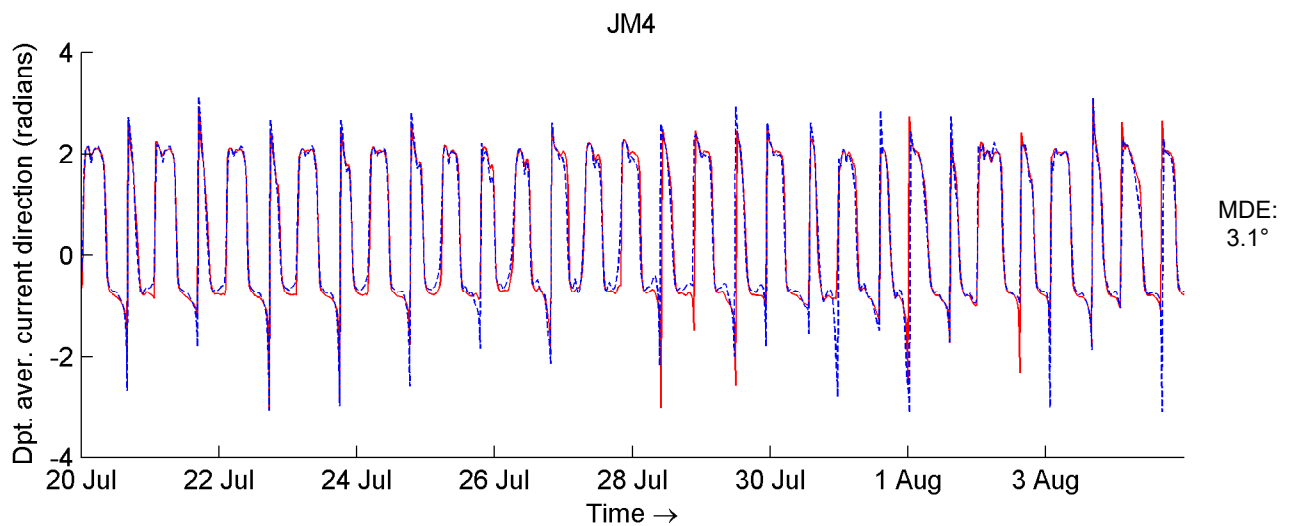
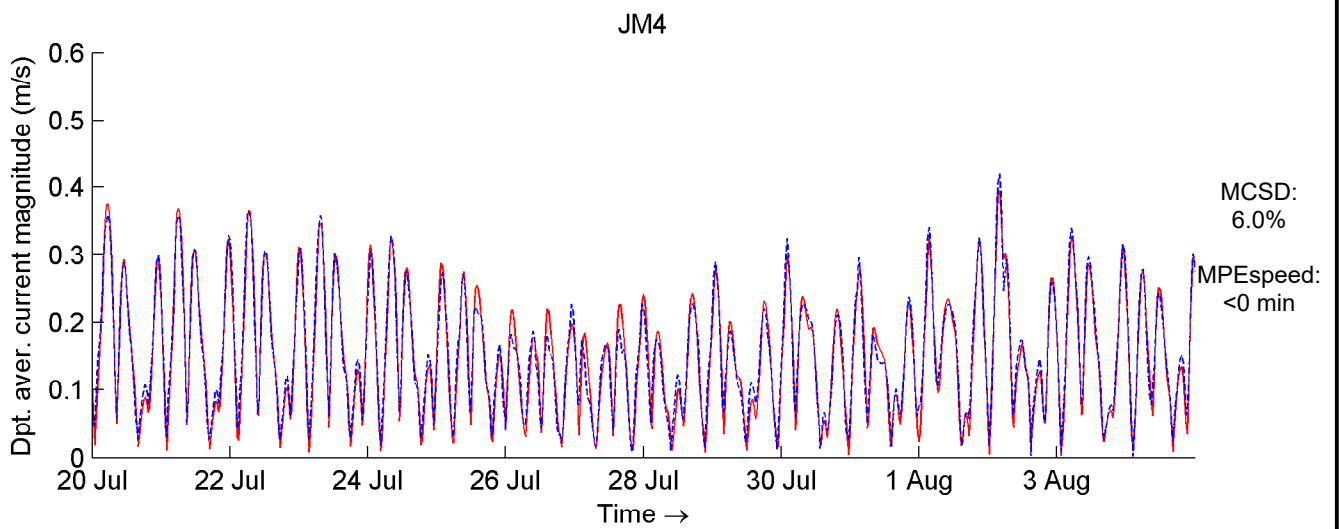
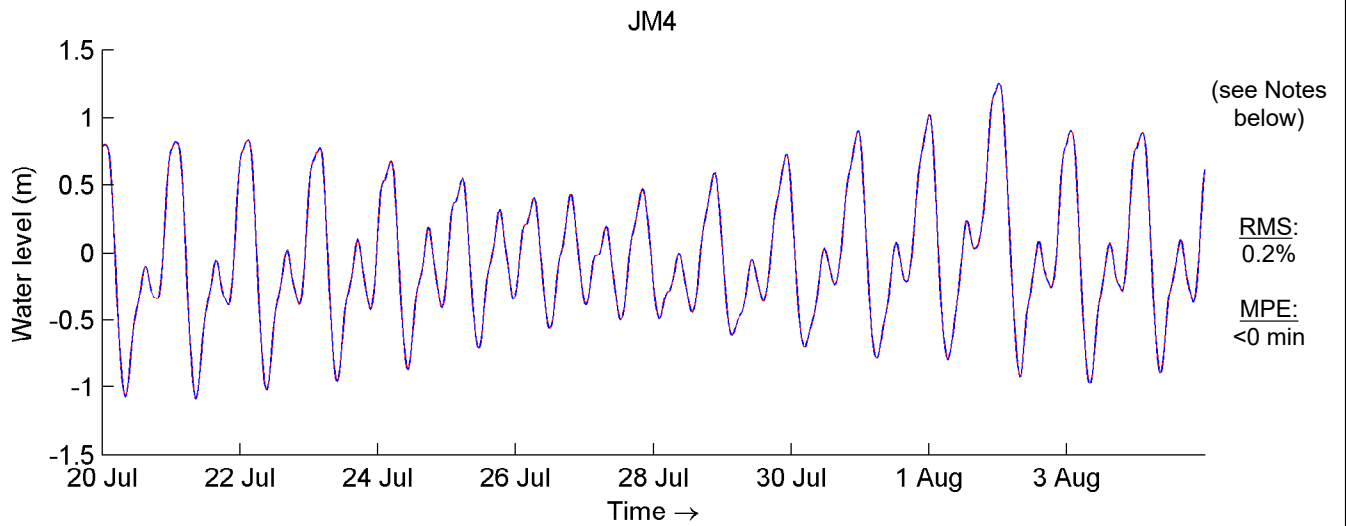
RMSE - Root mean square error; MPE - Maximum phase error at high water and low water; MCSD - Maximum current speed deviation, MPEspeed: Maximum phase error at peak speed, MDE: Maximum direction error at peak speed

Water Level, Depth Averaged Current Velocity and Direction at JM3 Dry Season Red : Original Model ; Blue : Refined Model		Wet Season
	CE 40/2023 (CE)	
Binnies		18



Note: MSD - Maximum Salinity Deviation

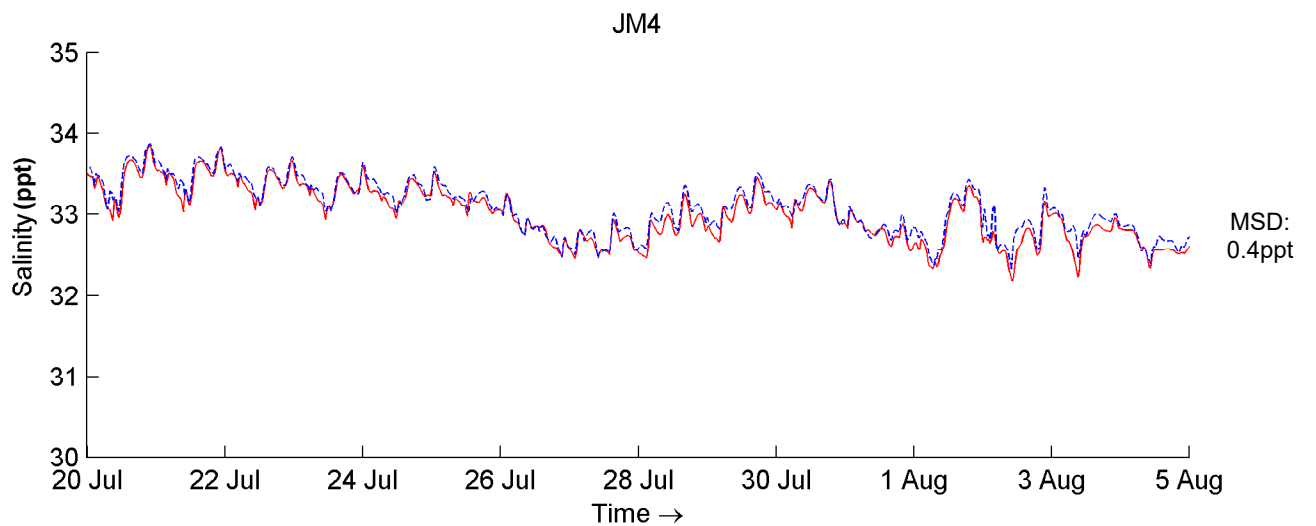
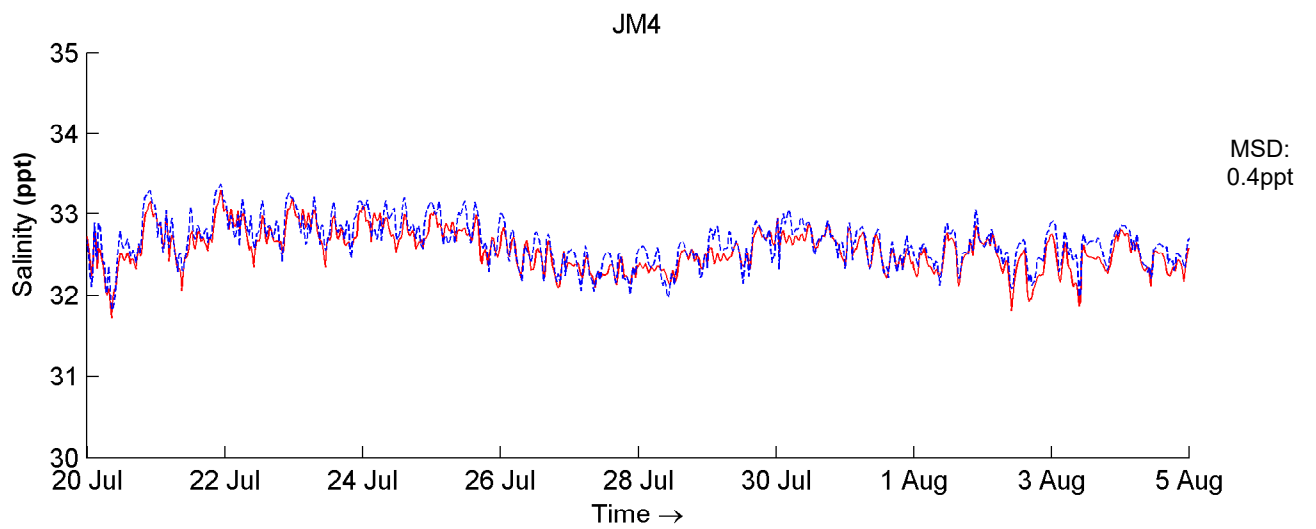
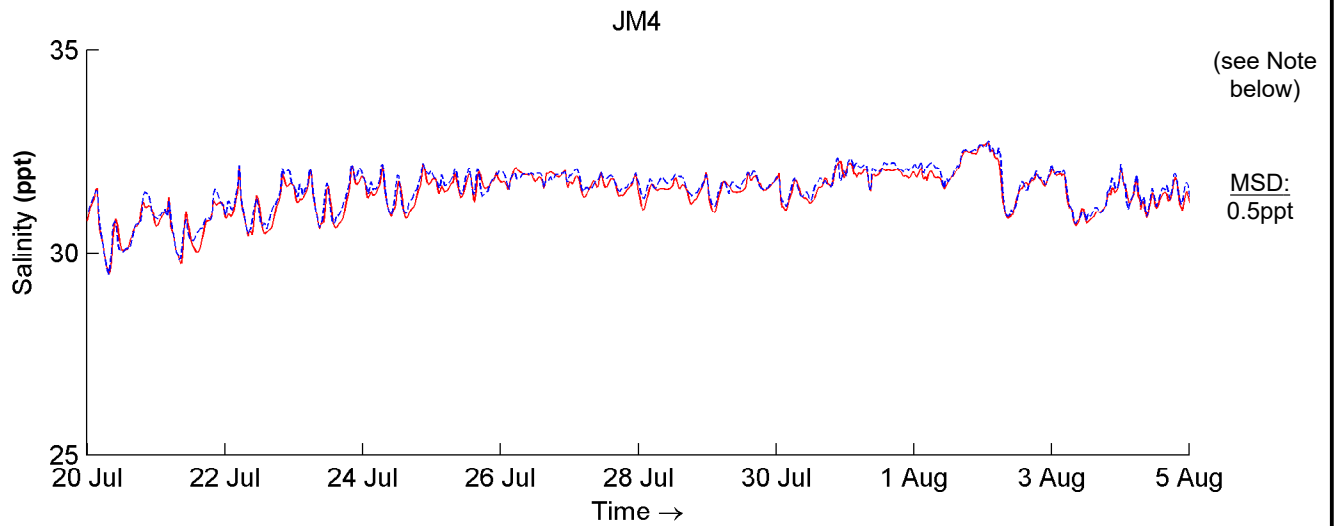
Surface, Mid-Depth and Bottom Salinity at JM3 Dry Season Red : Original Model ; Blue : Refined Model		Wet Season
		CE 40/2023 (CE)
Binnies		19



Notes:

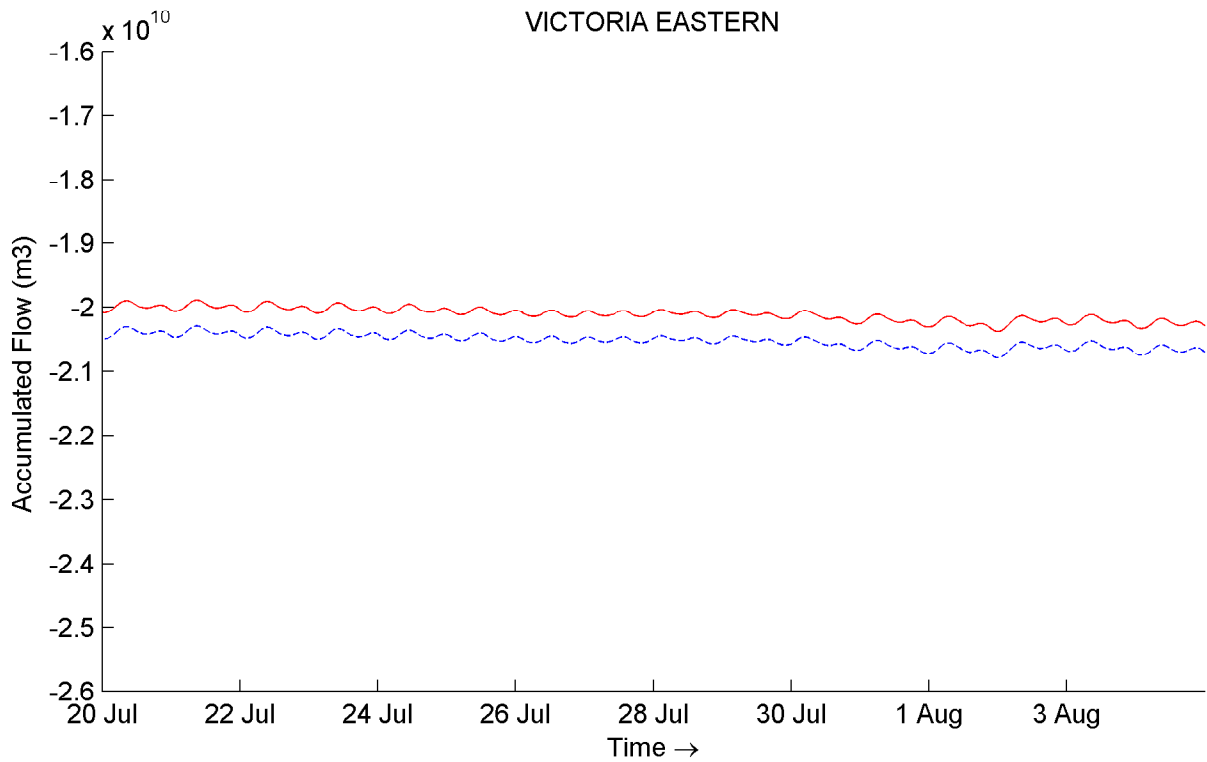
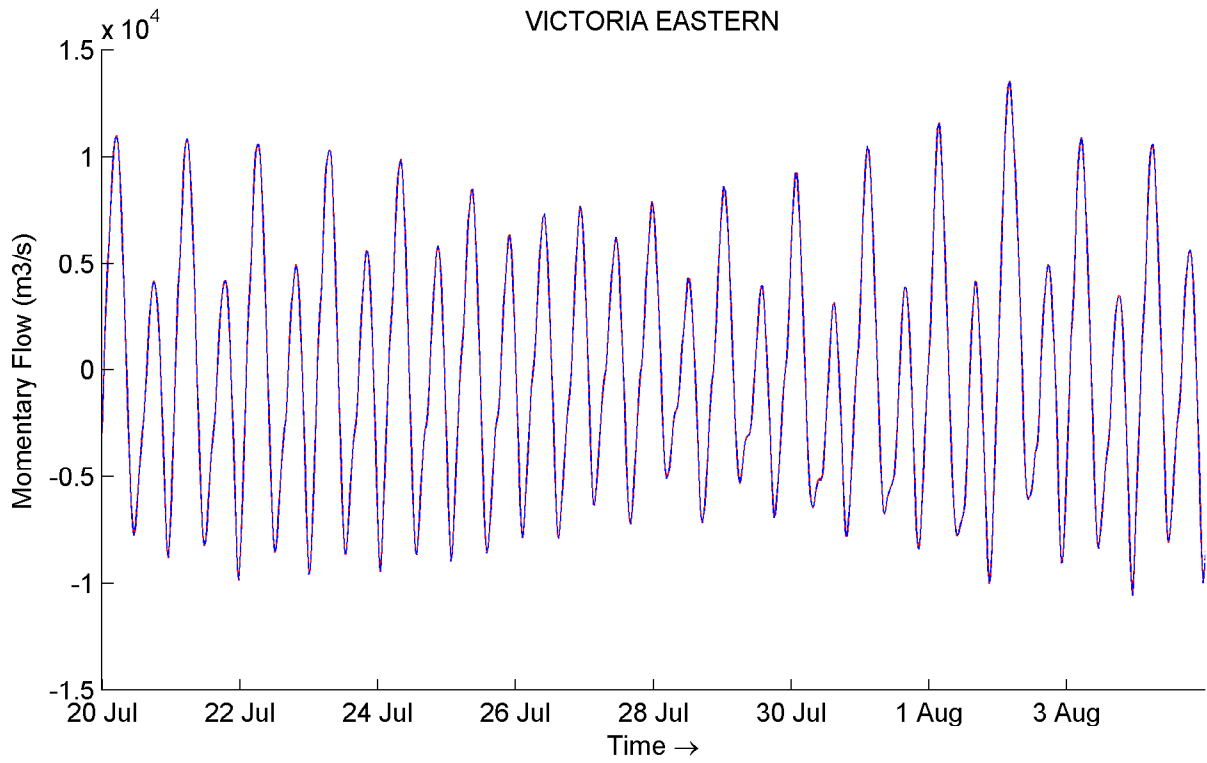
RMSE - Root mean square error; MPE - Maximum phase error at high water and low water; MCSD - Maximum current speed deviation, MPEspeed: Maximum phase error at peak speed, MDE: Maximum direction error at peak speed

Water Level, Depth Averaged Current Velocity and Direction at JM4 Dry Season Red : Original Model ; Blue : Refined Model	Wet Season
	CE 40/2023 (CE)
Binnies	20



Note: MSD - Maximum Salinity Deviation

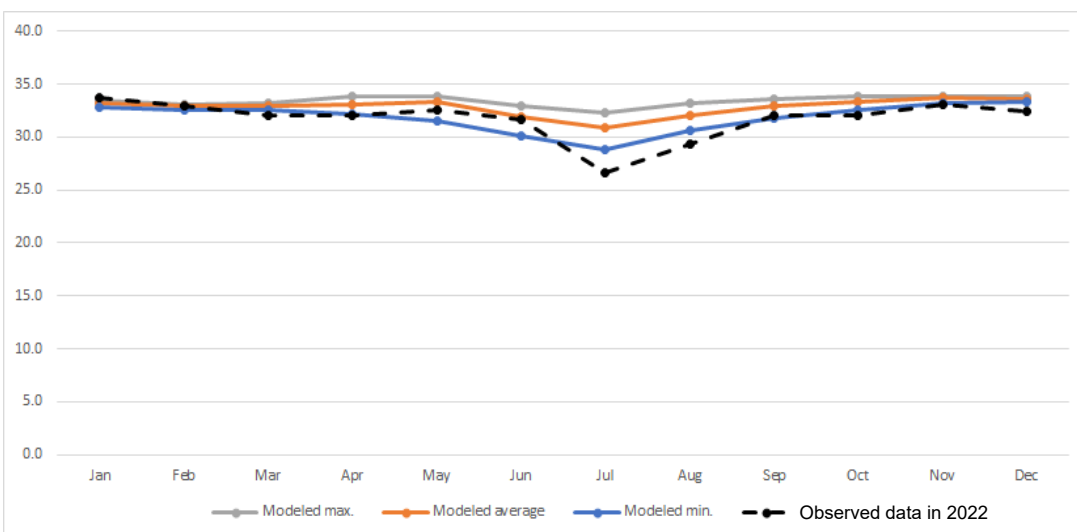
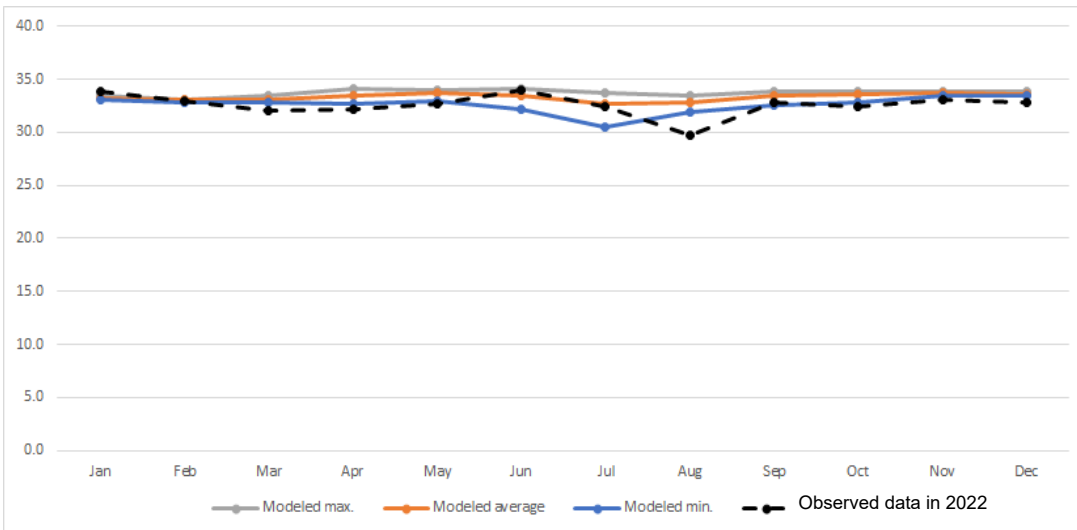
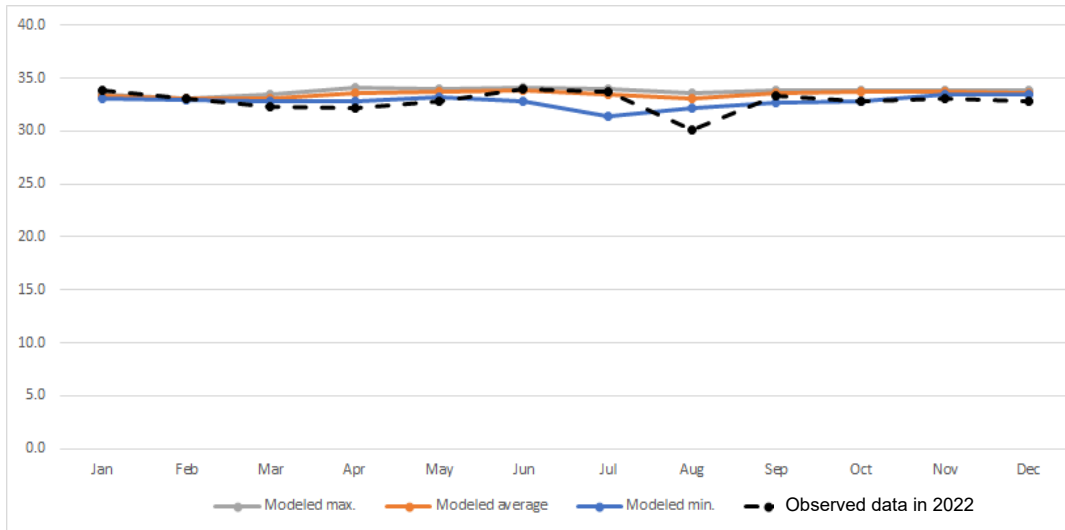
Surface, Mid-Depth and Bottom Salinity at JM4 Dry Season Red : Original Model ; Blue : Refined Model		Wet Season
	CE 40/2023 (CE)	
Binnies		21



Momentary Flow and Accumulated Flow through Cross Section Red : Original Model ; Blue : Refined Model		Wet Season
	CE 40/2023 (CE)	
Binnies		22

Data Interpretation

The observed data are within similar range of modelled data. The model performance is considered reasonable in terms of salinity prediction.



Modeled and Observed Salinity at EM2
Upper - Surface; Middle - Mid-Depth; Lower - Bottom

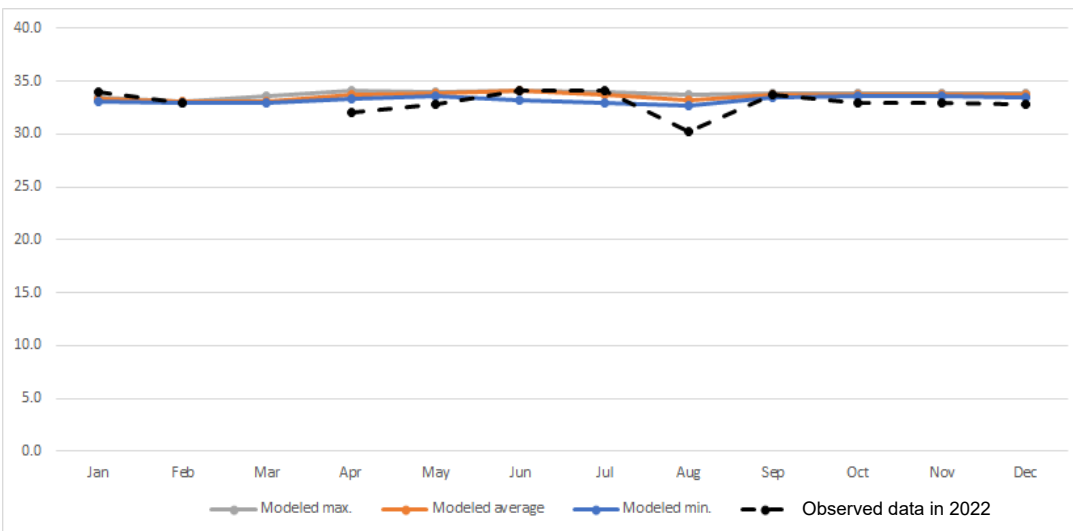
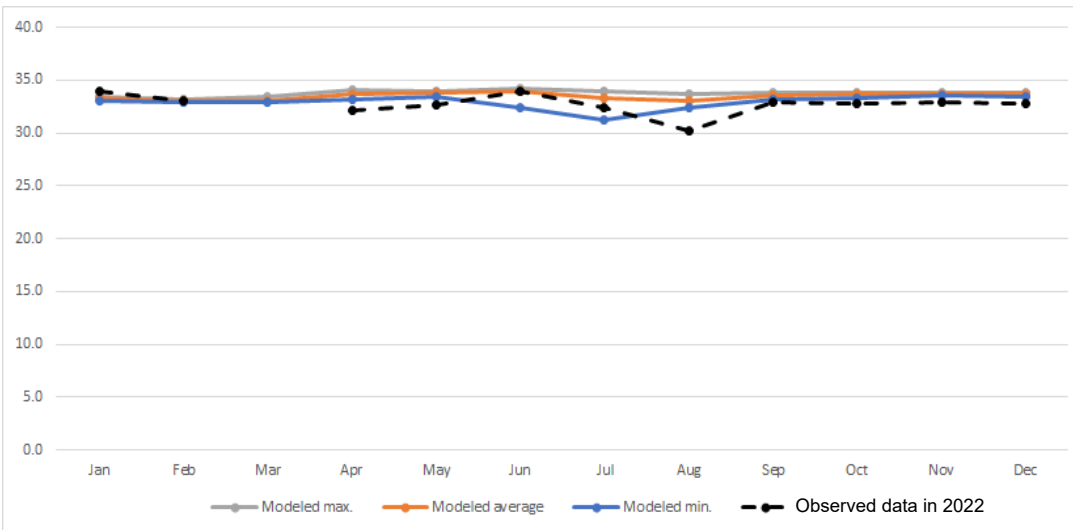
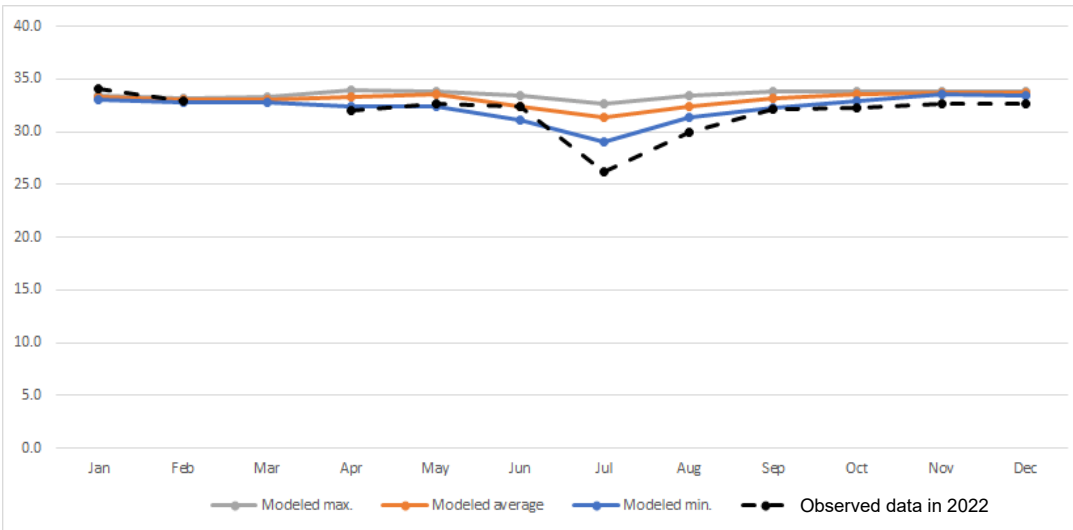
CE 40/2023 (CE)

Binnies

23

Data Interpretation

The observed data are within similar range of modelled data. The model performance is considered reasonable in terms of salinity prediction.



Modeled and Observed Salinity at EM3
Upper - Surface; Middle - Mid-Depth; Lower - Bottom

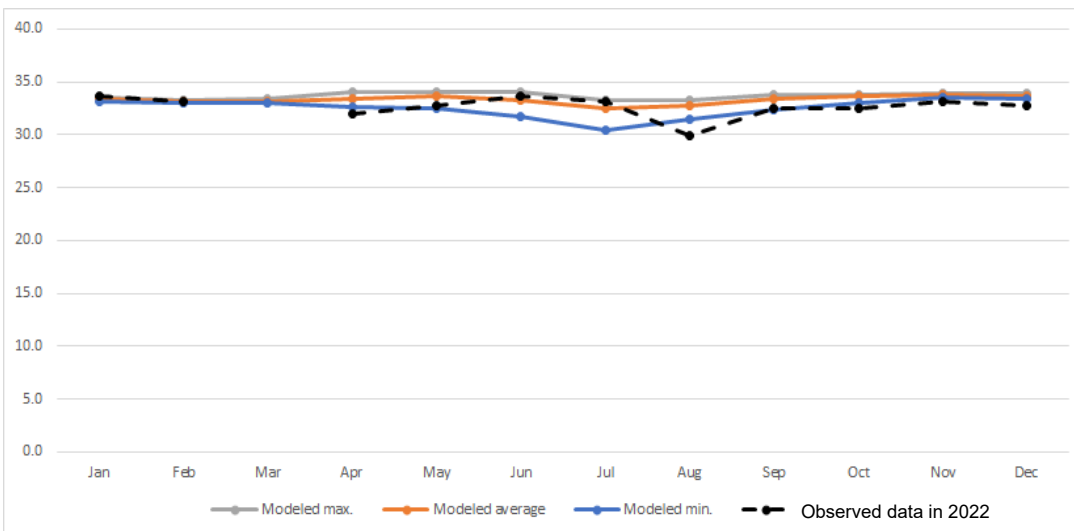
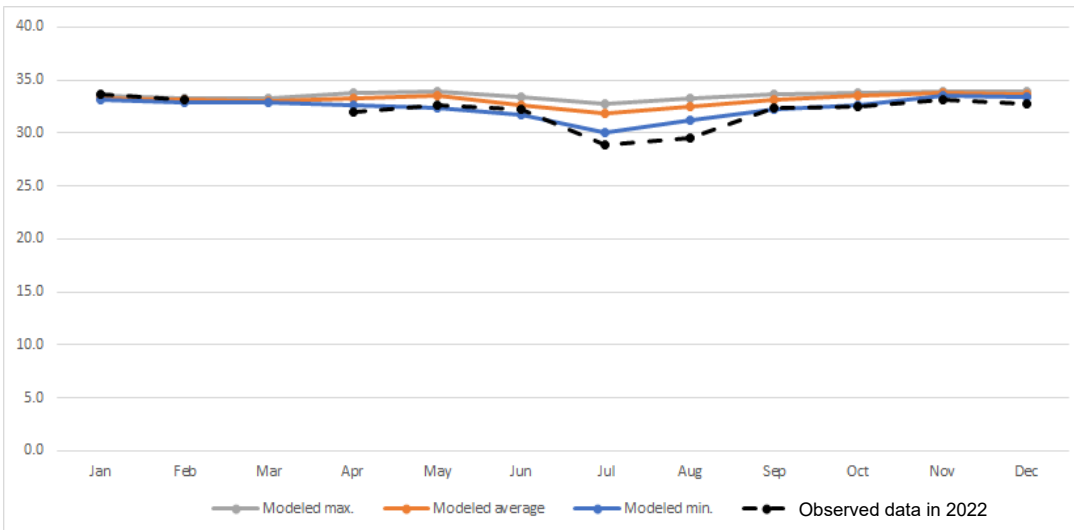
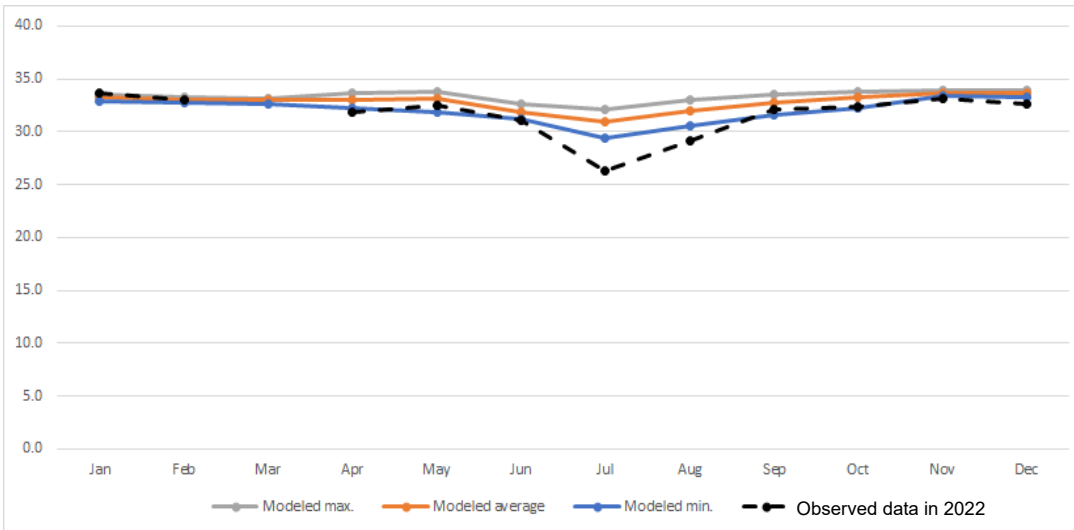
CE 40/2023 (CE)

Binnies

24

Data Interpretation

The observed data are within similar range of modelled data. The model performance is considered reasonable in terms of salinity prediction.



Modeled and Observed Salinity at JM3
Upper - Surface; Middle - Mid-Depth; Lower - Bottom

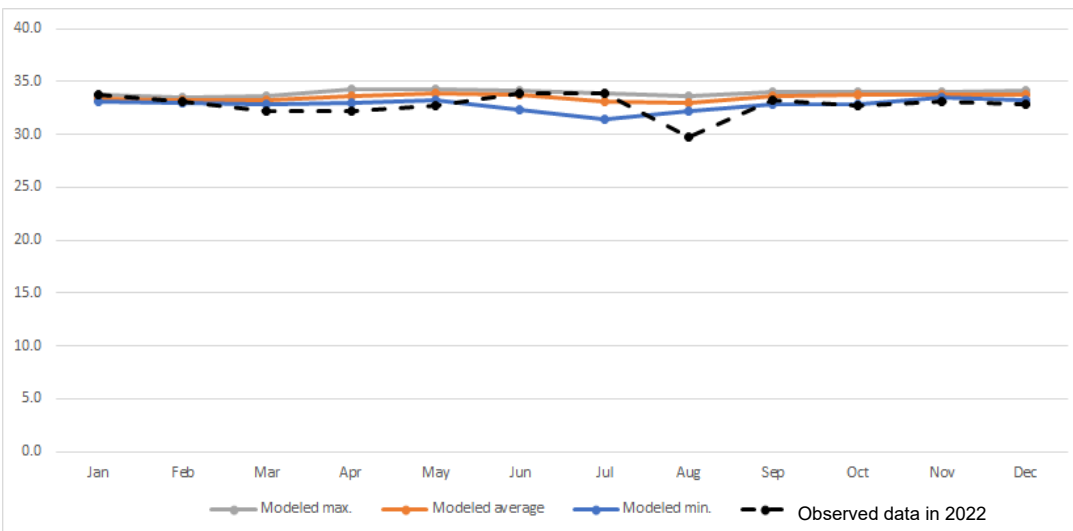
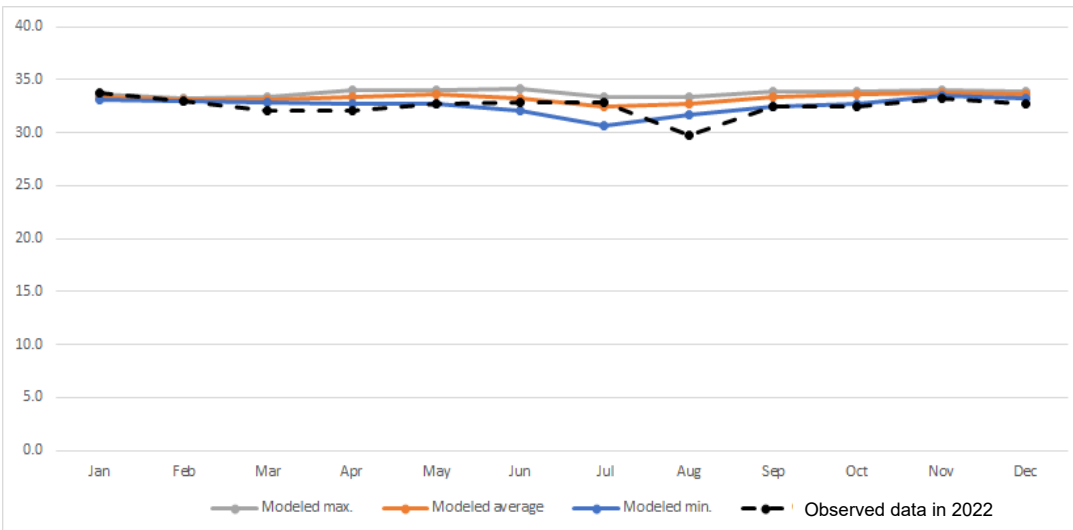
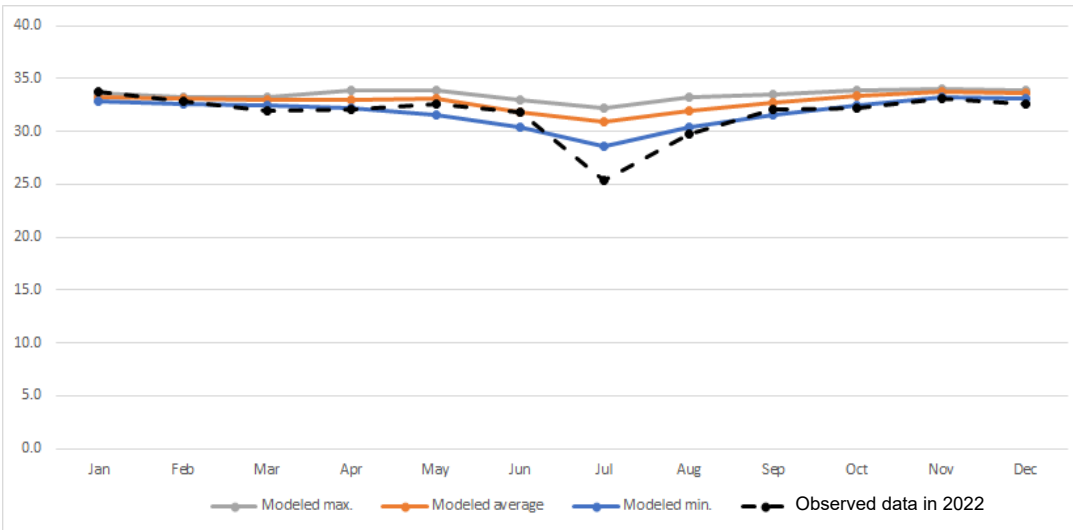
CE 40/2023 (CE)

Binnies

25

Data Interpretation

The observed data are within similar range of modelled data. The model performance is considered reasonable in terms of salinity prediction.



Modeled and Observed Salinity at JM4
Upper - Surface; Middle - Mid-Depth; Lower - Bottom

CE 40/2023 (CE)

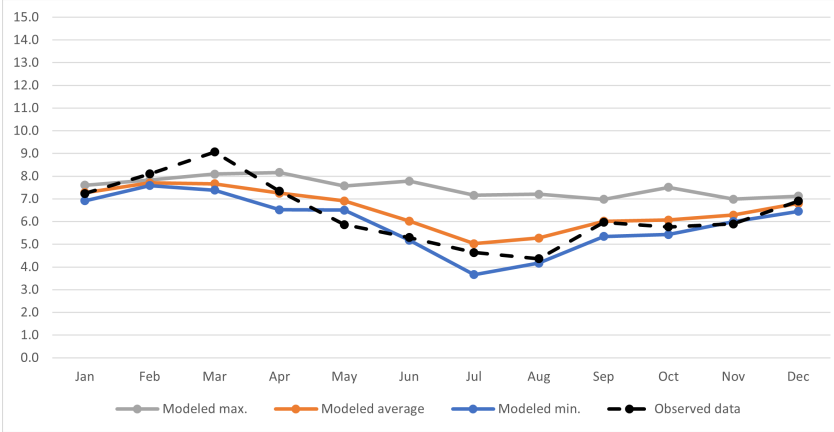
Binnies

26

Dissolved oxygen (DO)

Depth-averaged

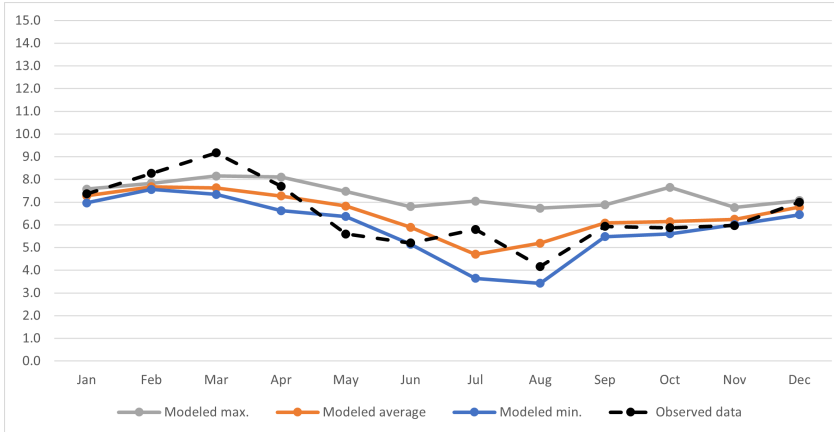
EM2



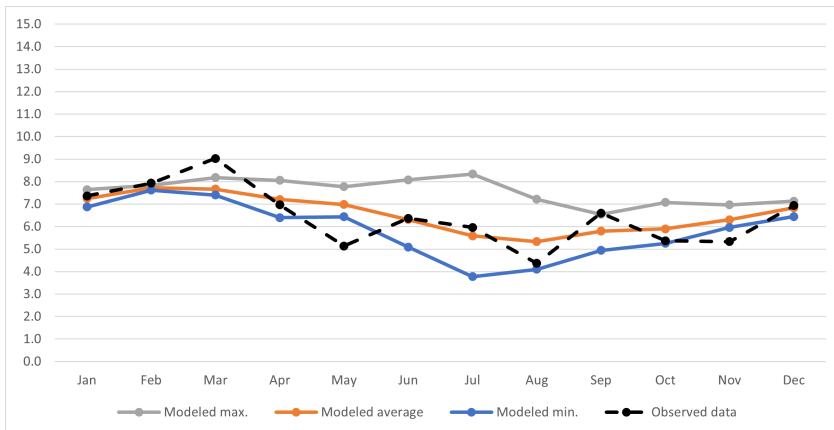
Data Interpretation

The measured data are within the same range of modelled data. The model performance is considered reasonable in terms of DO prediction.

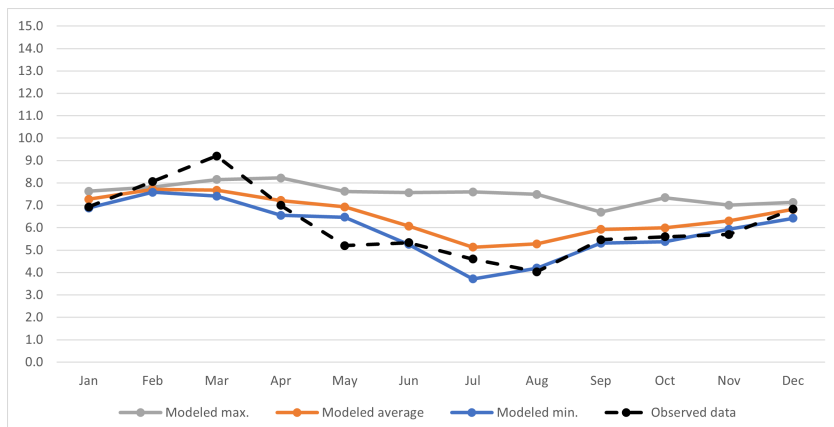
EM3



JM3



JM4



Modeled and Observed Depth Averaged Dissolved Oxygen at EM2, EM3, JM3 and JM4

CE 40/2023 (CE)

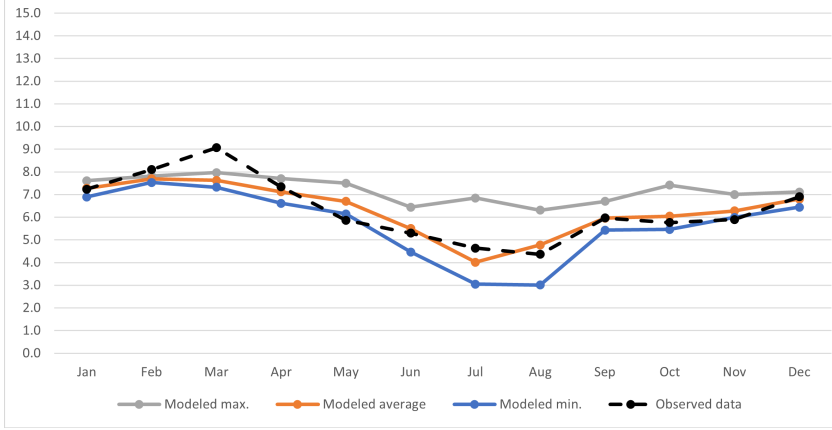
Binnies

27

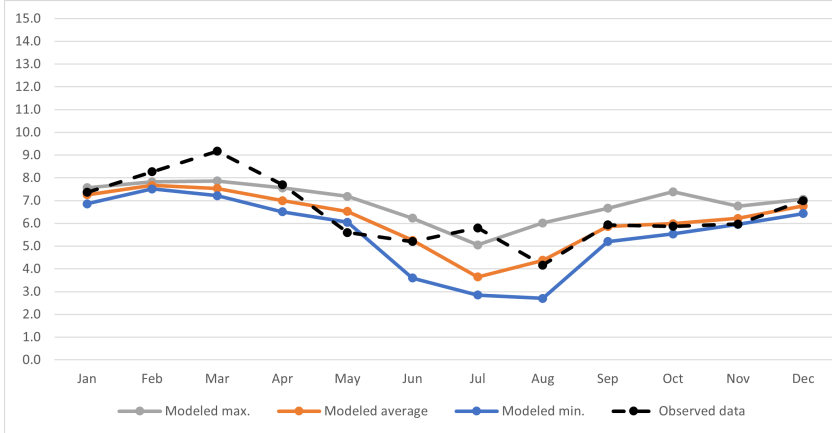
Dissolved oxygen (DO)

Bottom

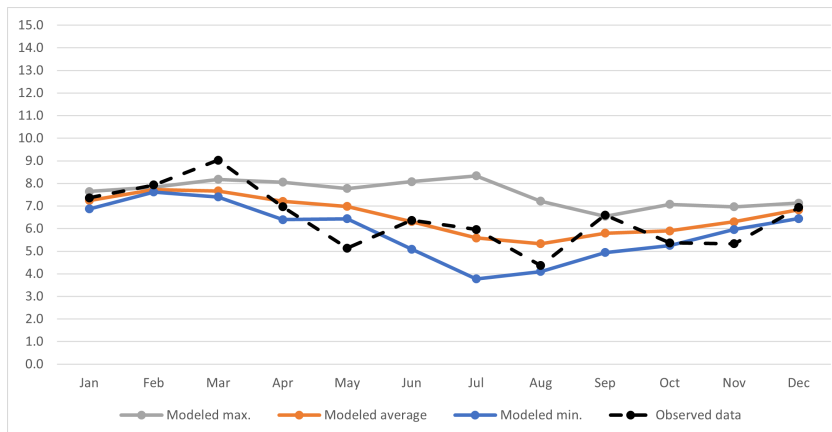
EM2



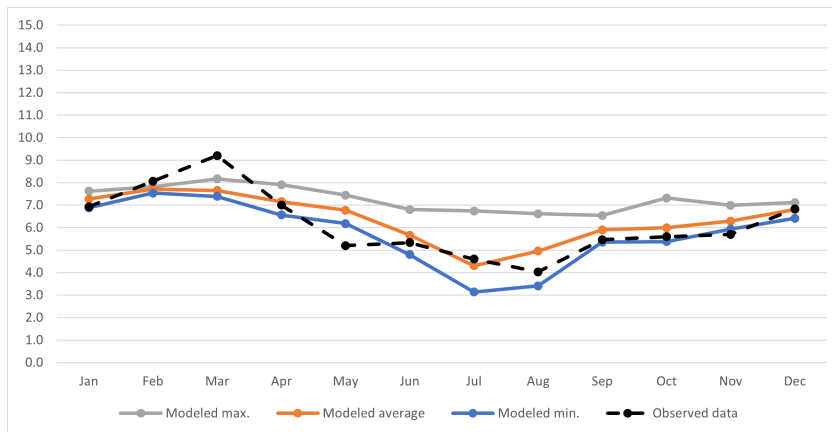
EM3



JM3



JM4



Data Interpretation

The measured data are within the same range of modelled data. The model performance is considered reasonable in terms of DO prediction.

Modeled and Observe Bottom Dissolved Oxygen at EM2, EM3, JM3 and JM4

CE 40/2023 (CE)

Binnies

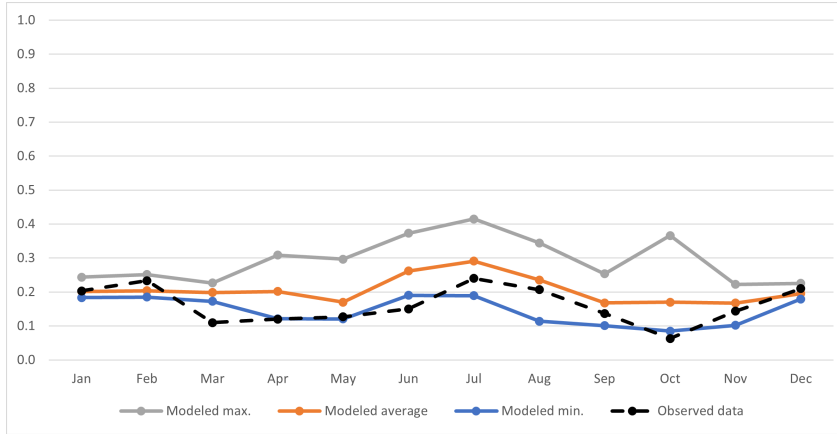
28

Total inorganic nitrogen (TIN)
Depth-averaged

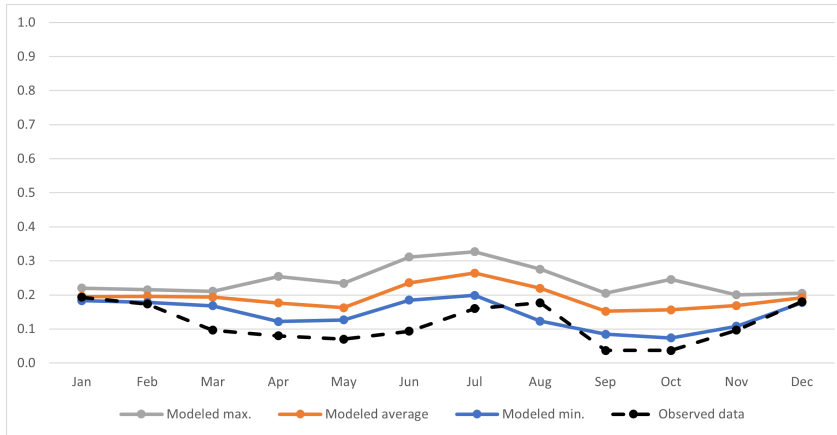
Data Interpretation

The measured data are in similar range of modelled data. The model performance is considered reasonable in terms of TIN prediction.

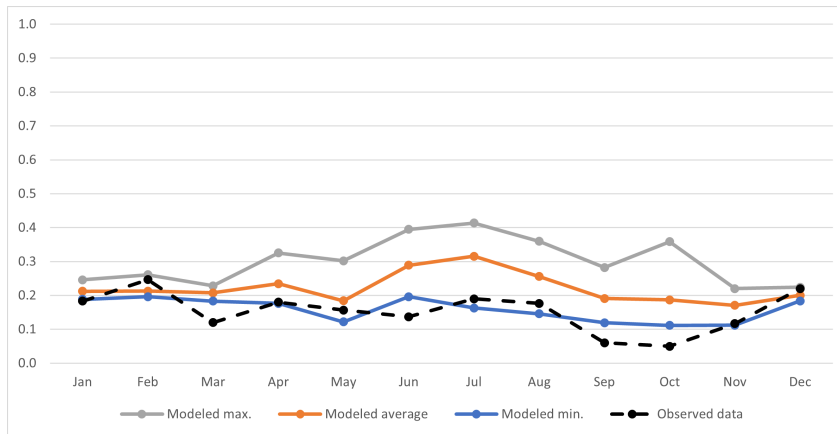
EM2



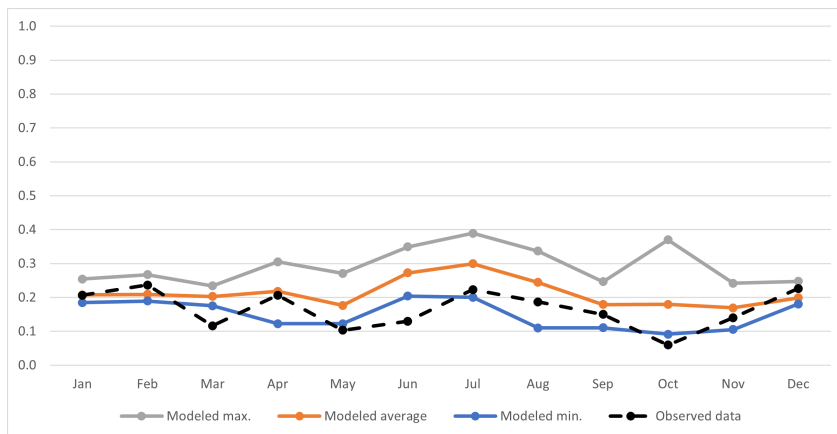
EM3



JM3



JM4



Modeled and Observe Depth Averaged Total Inorganic Nitrogen at EM2, EM3, JM3 and JM4

CE 40/2023 (CE)

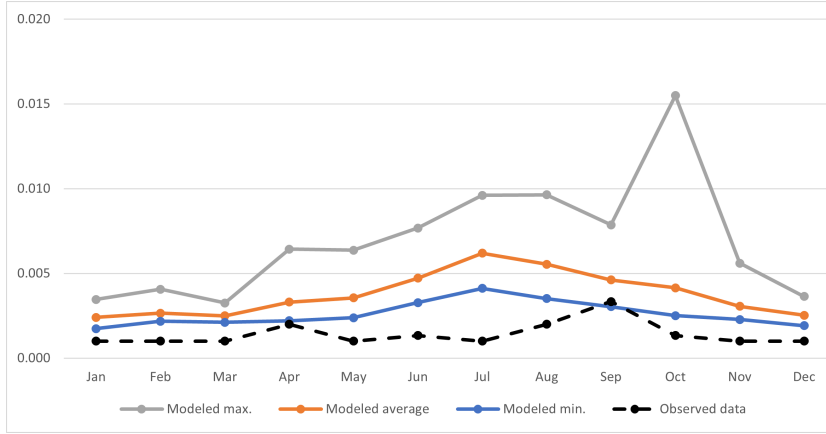
Binnies

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Unionised Ammonia (UIA)

Depth-averaged

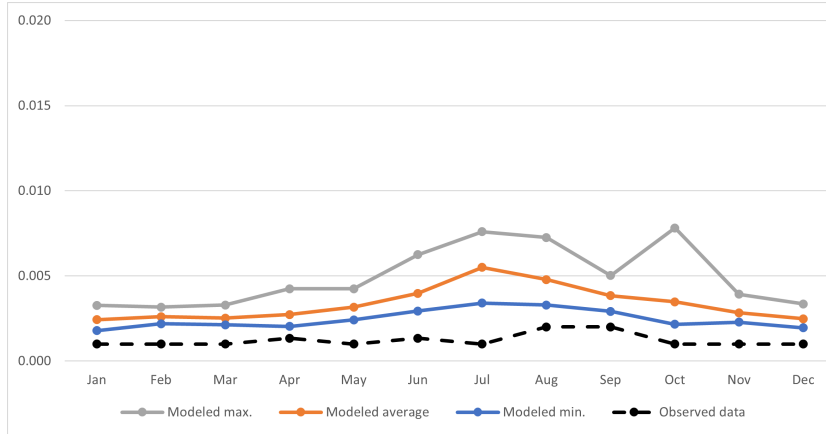
EM2



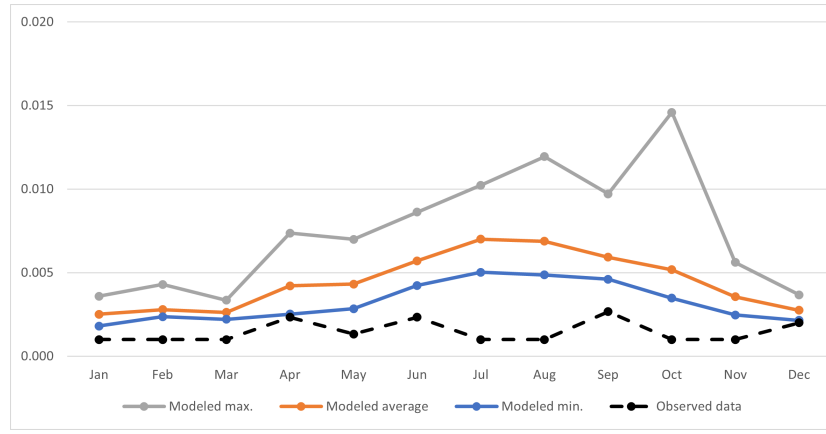
Data Interpretation

The measured levels and majority of the model data are below 0.01 mg/L, which is considered low and well below the WQO of 0.021 mg/L. The measured data and modelled data are considered within the same order of magnitude. The model performance is considered reasonable in terms of the UIA prediction

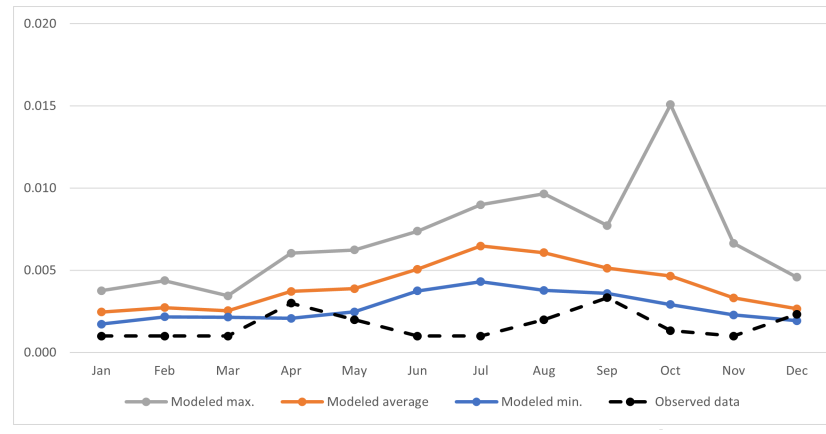
EM3



JM3



JM4



Modeled and Observe Depth Averaged Unionized Ammonia at EM2, EM3, JM3 and JM4

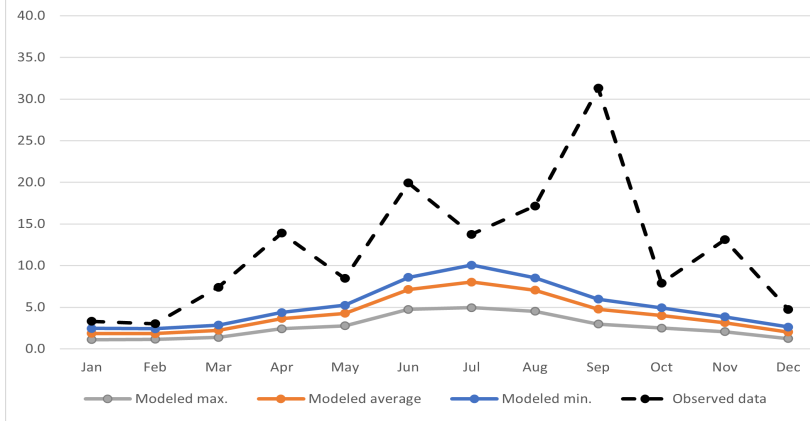
CE 40/2023 (CE)

Binnies

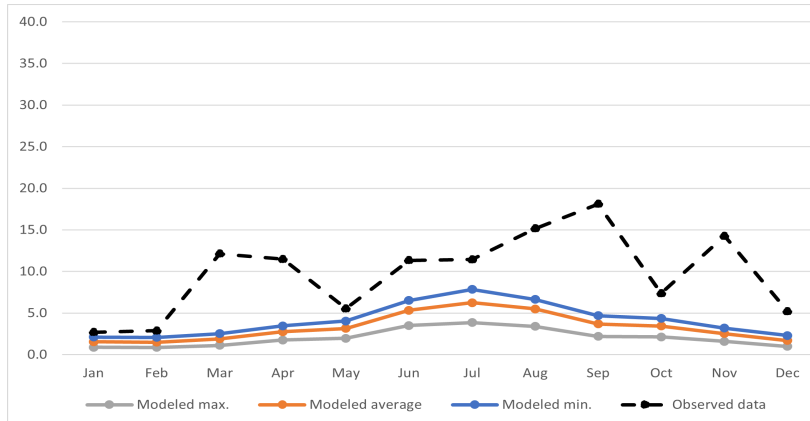
30

Suspended Solids
Depth-averaged

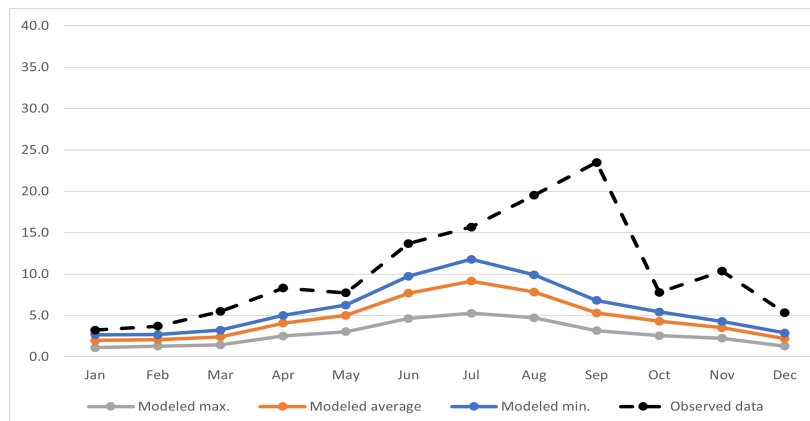
EM2



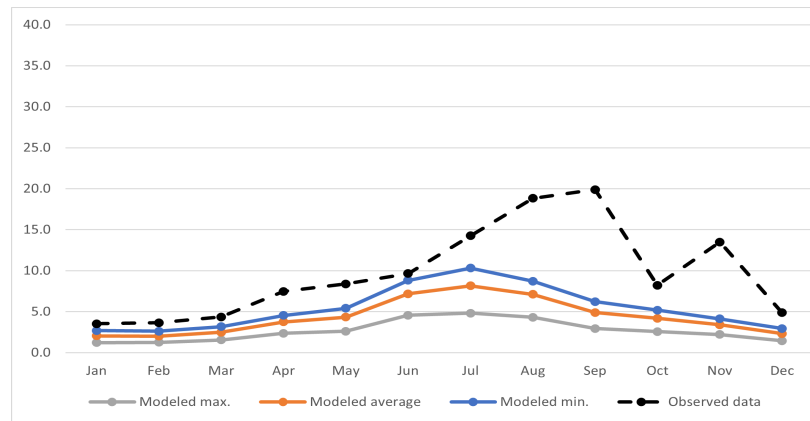
EM3



JM3



JM4



Data Interpretation

The actual SS in marine water is sensitive to the storm or rainfall related loading where more SS would be flushed into the sea in case of heavy rain. The mean pollution loading based on theoretical calculation was adopted for modelling and therefore the model results are more stable and thus deviated from the measured data during the wet season. Large fluctuation of measured data is observed in the wet season. The model results for the dry season is within the same range of measured data. The model performance in terms of SS prediction is considered reasonable. Since the WQO for SS is defined as a percentage increase from the ambient level. The significance of SS impact will be assessed by reviewing the relative change from the baseline level. Use of the model results is considered acceptable for impact assessment. No further adjustment of the SS loading set up of the model is performed.

Modeled and Observe Depth Averaged Suspended Solids at EM2, EM3, JM3 and JM4

CE 40/2023 (CE)

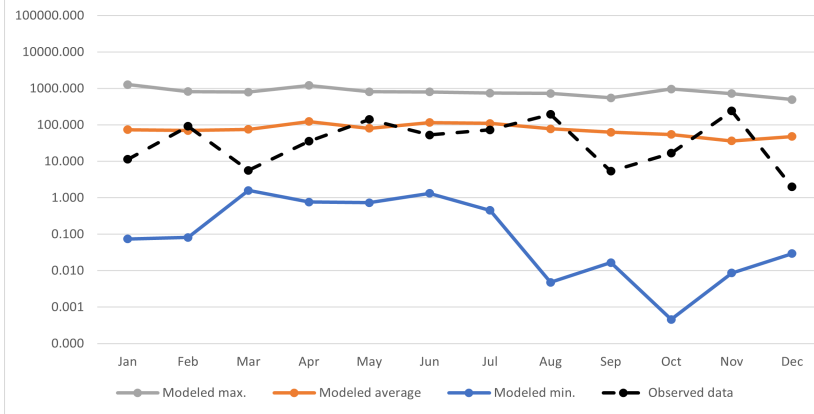
Binnies

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E.coli
(cfu/100ml)

Depth-averaged

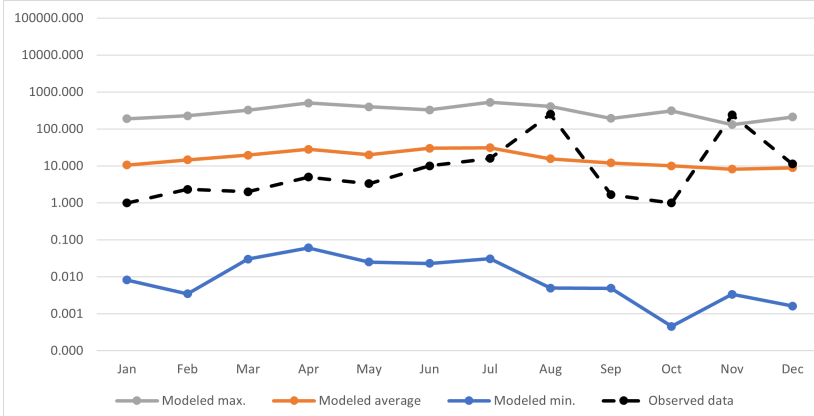
EM2



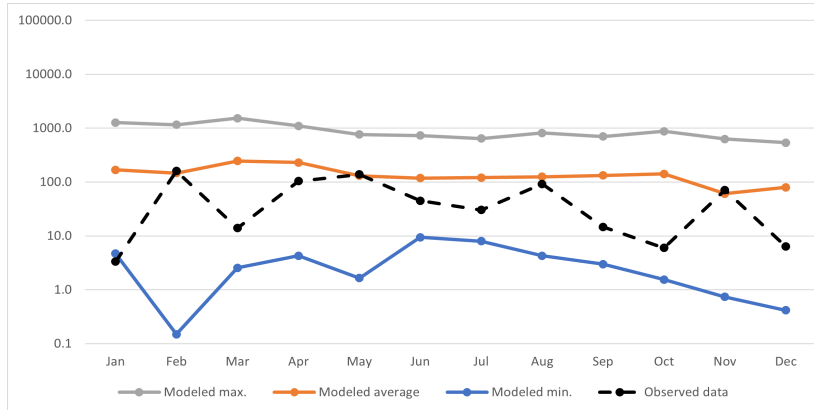
Data Interpretation

The measured data are within the same range of modelled data. The model performance is considered reasonable in terms of *E. coli* prediction.

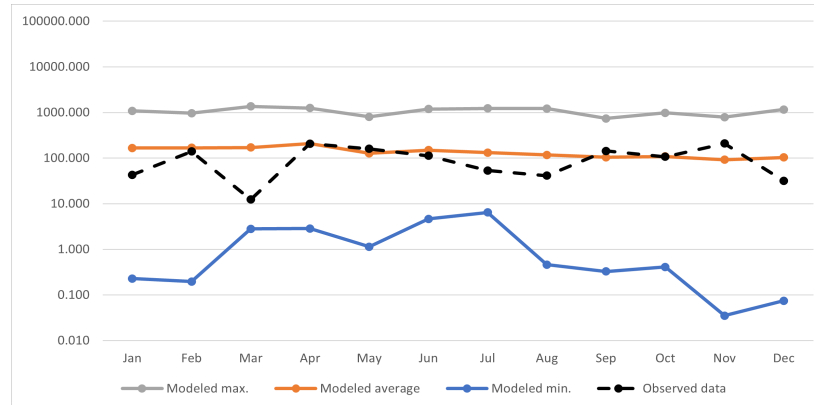
EM3



JM3



JM4

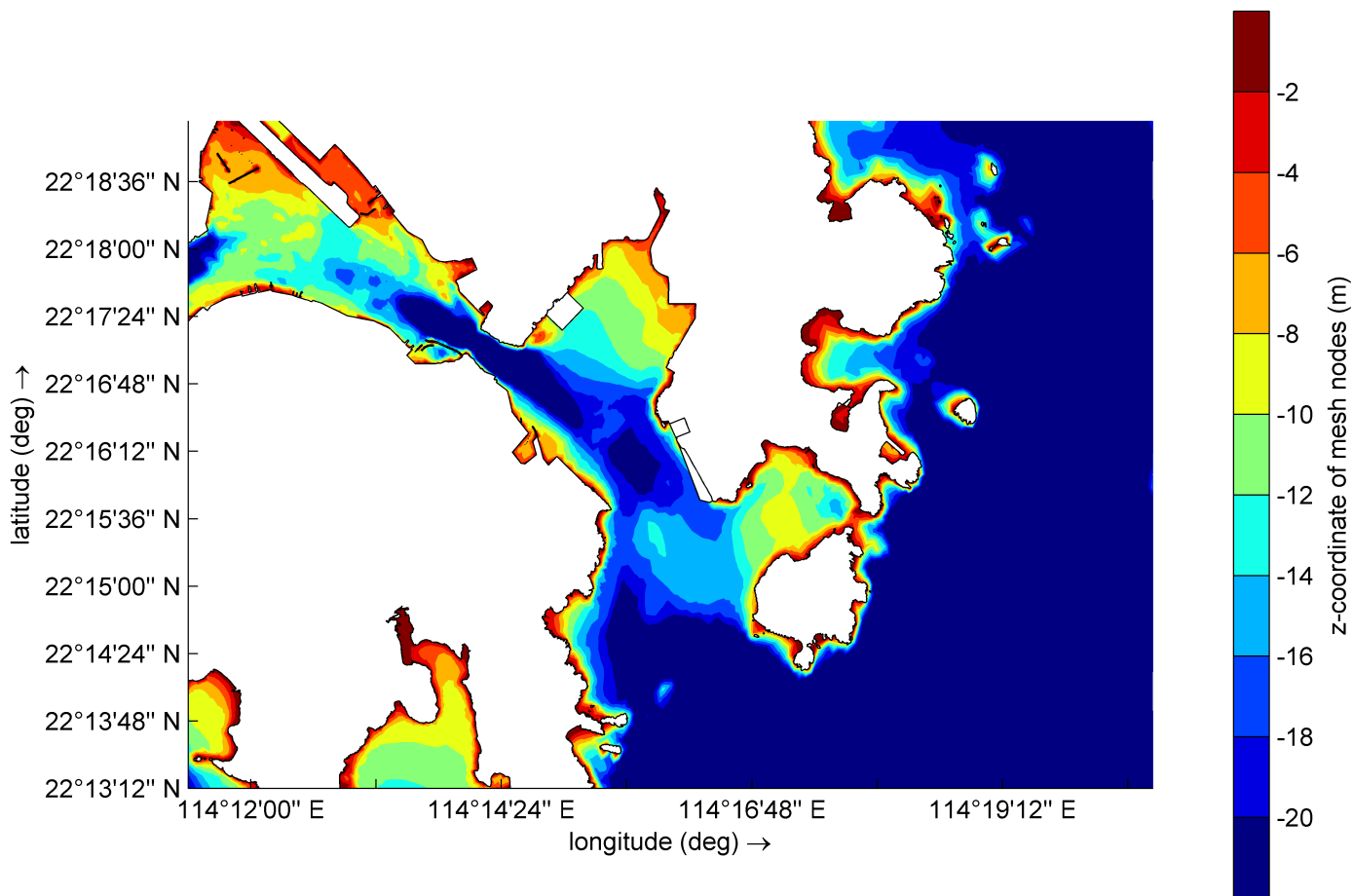


Modeled and Observe Depth Averaged *E. coli*
at EM2, EM3, JM3 and JM4

CE 40/2023 (CE)

Binnies

32



Model Bathymetry

CE 40/2023 (CE)

Binnies

Appendix A

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