

Danaos Management Consultants

"CMA CGM NERVAL"

Tuesday 7th December, 2021

Vessel Basic Info:

IMO: 9406623

Vessel Type: Container

Min Draft: 11.0 m

Max Draft: 14.0 m

Max Speed: Sea speed Ballast 21.5. Laden 20.8

1 Model Performance Overview

Table 1: Neural Network model accuracy based on the weather observed by the sensors

Neural Net	Info per leg				
	Total Act FOC (MT)	Total Pred FOC (MT)	FOC Perc Diff	Mean STW (kt)	Mean Draft (m)
ALIAGA - MARSAXLOKK	109.94	106.26	3.40 %	15.12	12.78
MARSAXLOKK - VALENCIA	203.44	199.63	1.89 %	20.62	12.46
VALENCIA - TANGER MED	59.04	61.02	3.30 %	14.58	12.40
TANGER MED - FELIXSTOWE	269.58	259.13	3.95 %	16.00	11.29
ANTWERP - MARSAXLOKK	520.88	534.56	2.59 %	15.54	13.25
MARSAXLOKK - PIRAEUS	118.36	122.20	3.19 %	17.96	12.97
PIRAEUS - GEBZE	75.75	78.18	3.16 %	17.20	12.28
Total	1,356.99	1,360.98	0.29 %	16.7 (Avg)	12.5 (Avg)

Overall Accuracy

- Total records: **24,928 instances**
- Total Sailing Time: **421 hours**
- Total Distance Travelled: **4,459.98 n mi**

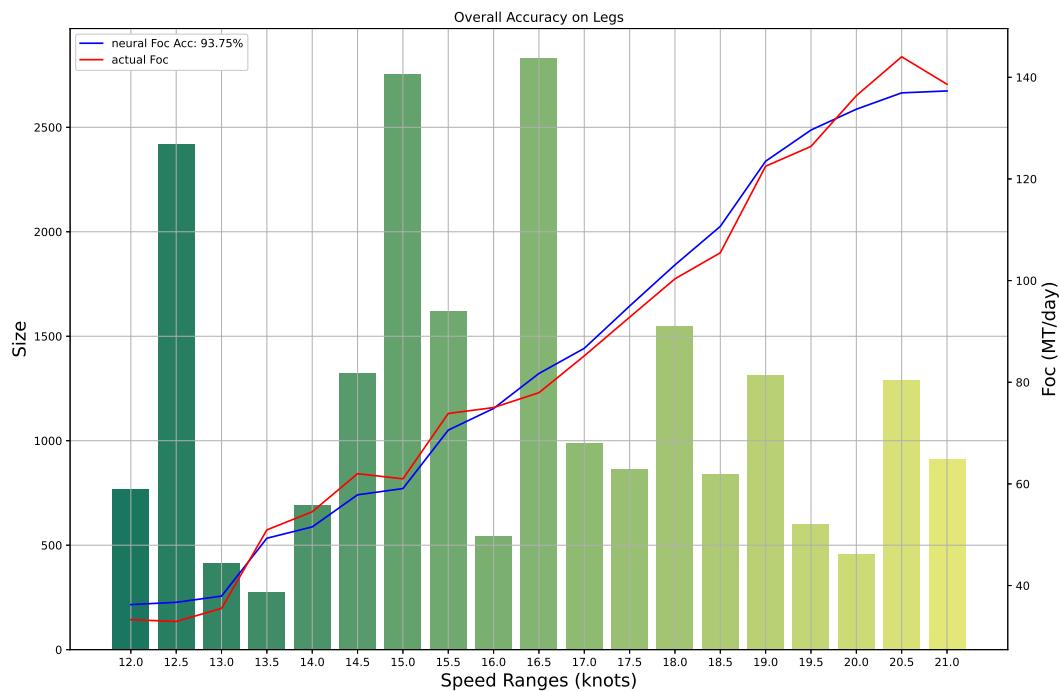


Figure 1: FOC Actual vs Predicted / Speed Ranges, Overall on Legs

2 ALIAGA - MARSAXLOKK

- Total Actual FOC : **109.94 MT**
 - Total Predicted FOC (Neural Net): **106.26 MT**
 - FOC Perc Diff (Neural Net): **3.40 %**
- Departure Port : **ALIAGA / 2019-11-23 18:18:00**
- Arrival Port : **MARSAXLOKK / 2019-11-25 14:00:00**
- Total Sailing Time: **44 hours**
- Distance Travelled: **569.75 n mi**
- Draft: **12.8 m**

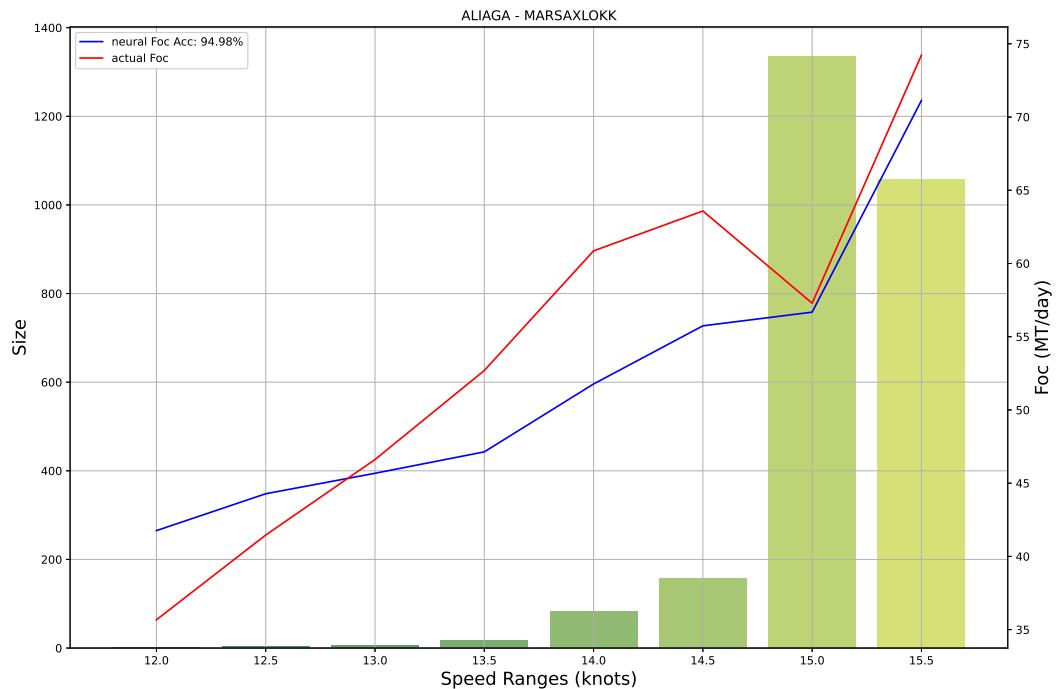


Figure 2: FOC Actual vs Predicted / Speed Ranges, ALIAGA - MARSAXLOKK

Weather Comparison - Sensor / Weather Service (NOA)

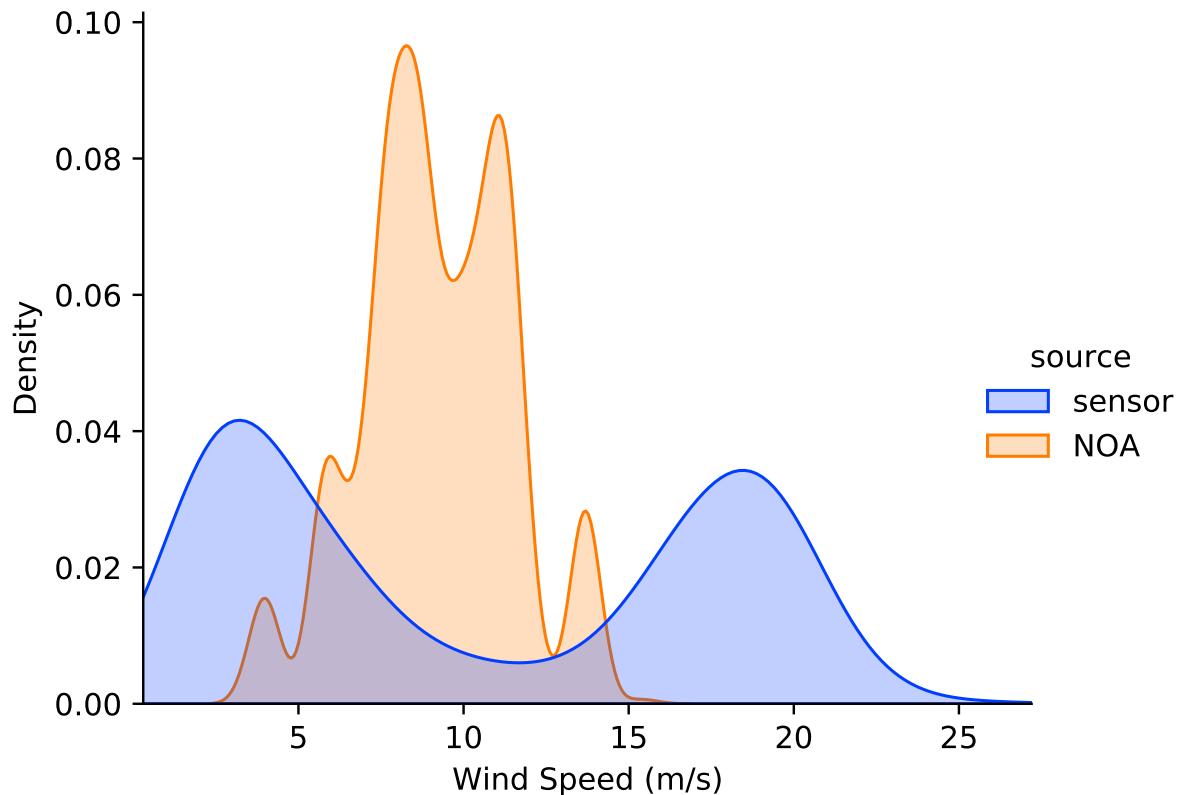


Figure 3: Wind Speed Sensor VS NOA Distributions comparison

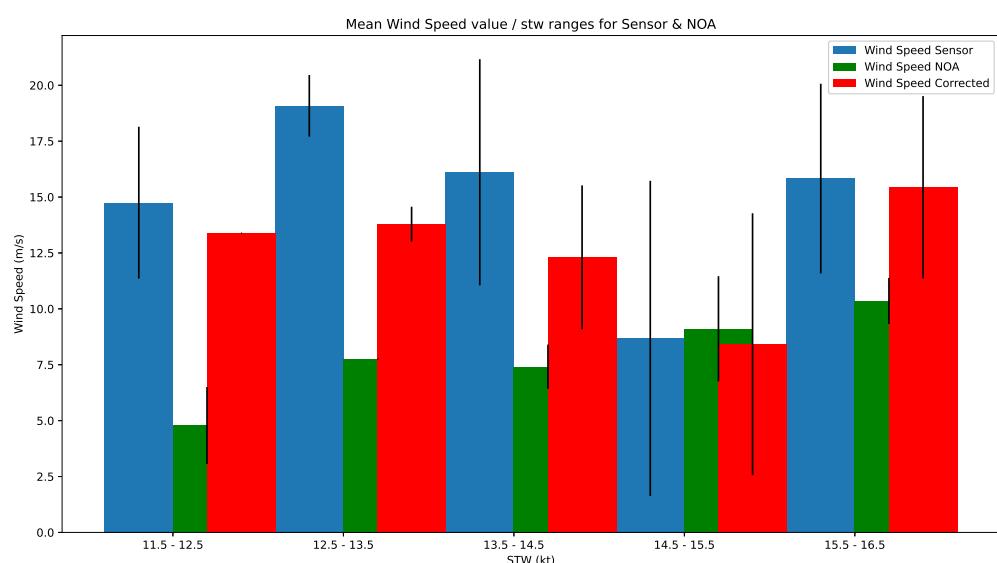


Figure 4: Initial / Weather Features Comparison per Speed Range

Routing Optimization Info : ALIAGA - MARSAXLOKK



Figure 5: Initial / Optimized Route, ALIAGA - MARSAXLOKK

Voyage	Date	Latitude	Longitude
Departure	2019-11-23 18:18:00	38.0° 41.0' N	25.0° 58.0' E
Arrival	2019-11-25 14:00:00	35.0° 46.0' S	14.0° 38.0' E
<hr/>			
BASIC COMPARISON	Actual route estimation	Optimized route estimation	
Distance (nm)	651.81	611.16	
Time (hours)	43.70	43.03	
Avg Speed (kt)	14.92	13.94	
Total FOC (MT)	105.88	84.09	

Table 2: Estimation based on Weather Service data (NOA)

Weather comparison optimization / initial:

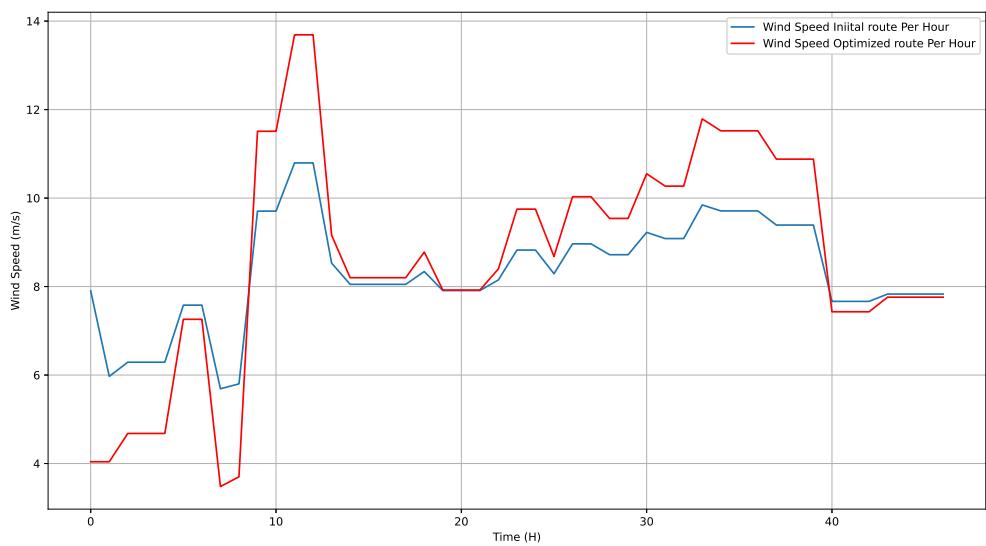


Figure 6: Wind Speed comparison Initial / Optimized Route, ALIAGA - MARSAXLOKK

3 MARSAXLOKK - VALENCIA

- Total Actual FOC : **203.44 MT**
 - Total Predicted FOC (Neural Net): **199.63 MT**
 - FOC Perc Diff (Neural Net): **1.89 %**
- Departure Port : **MARSAXLOKK / 2019-11-26 12:00:00**
- Arrival Port : **VALENCIA / 2019-11-28 00:30:00**
- Total Sailing Time: **36 hours**
- Distance Travelled: **727.27 n mi**
- Draft: **12.5 m**

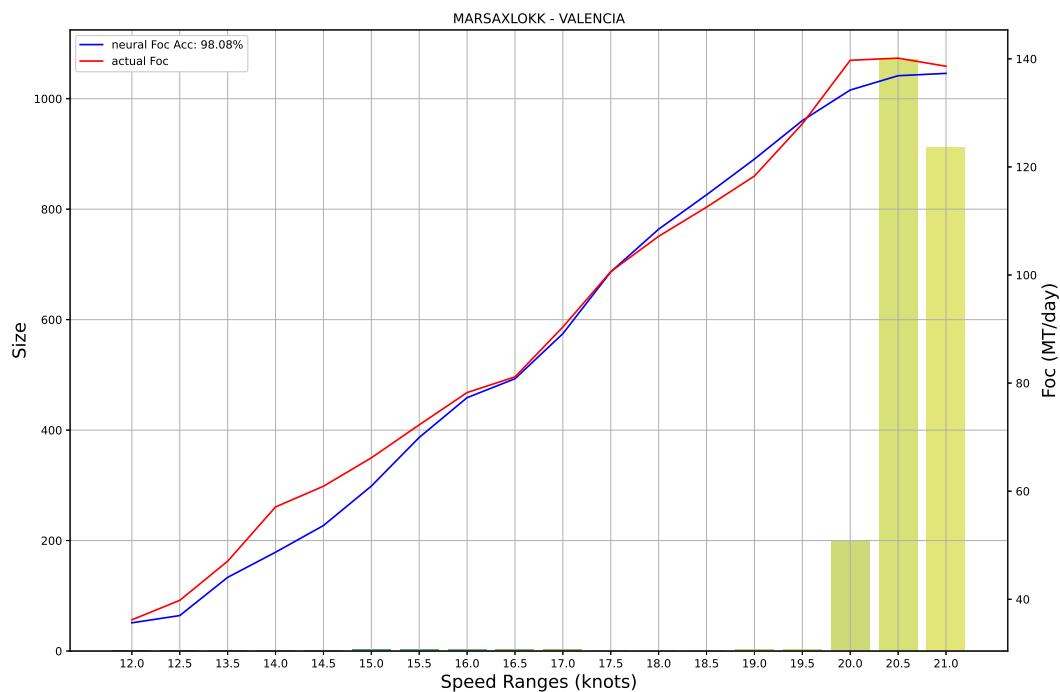


Figure 7: FOC Actual vs Predicted / Speed Ranges, MARSAXLOKK - VALENCIA

Weather Comparison - Sensor / Weather Service (NOA)

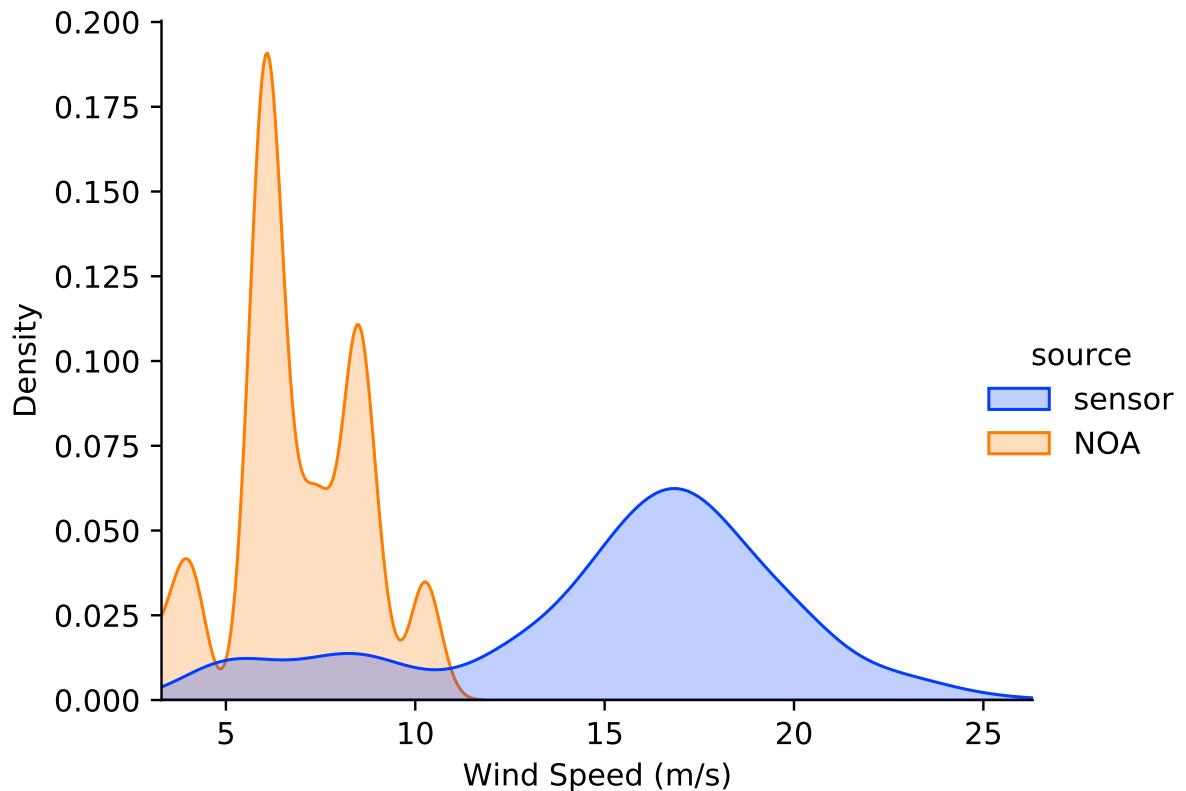


Figure 8: Wind Speed Sensor VS NOA Distributions comparison

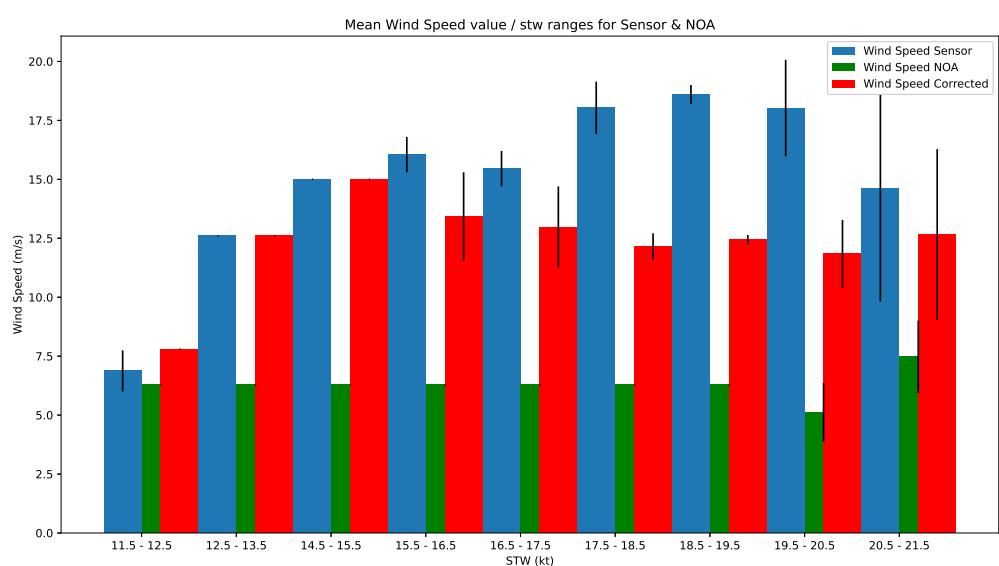


Figure 9: Initial / Weather Features Comparison per Speed Range

Routing Optimization Info : MARSAXLOKK - VALENCIA

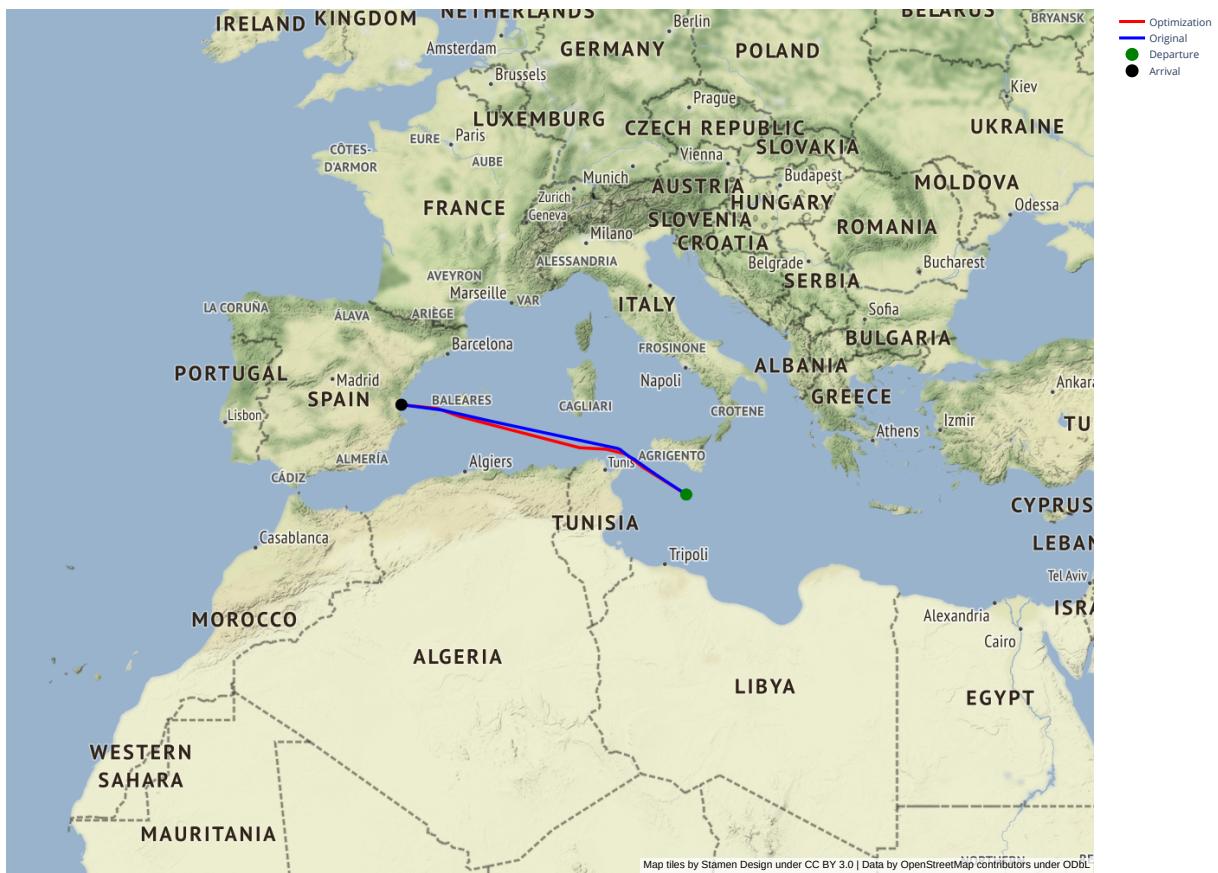


Figure 10: Initial / Optimized Route, MARSAXLOKK - VALENCIA

Voyage	Date	Latitude	Longitude
Departure	2019-11-26 12:00:00	35.0° 48.0' N	14.0° 17.0' E
Arrival	2019-11-28 00:30:00	39.0° 25.0' S	1.0° 42.0' E
<hr/>			
BASIC COMPARISON	Actual route estimation	Optimized route estimation	
Distance (nm)	741.97	730.23	
Time (hours)	36.50	35.10	
Avg Speed (kt)	20.33	20.59	
Total FOC (MT)	198.50	192.74	

Table 3: Estimation based on Weather Service data (NOA)

Weather comparison optimization / initial:

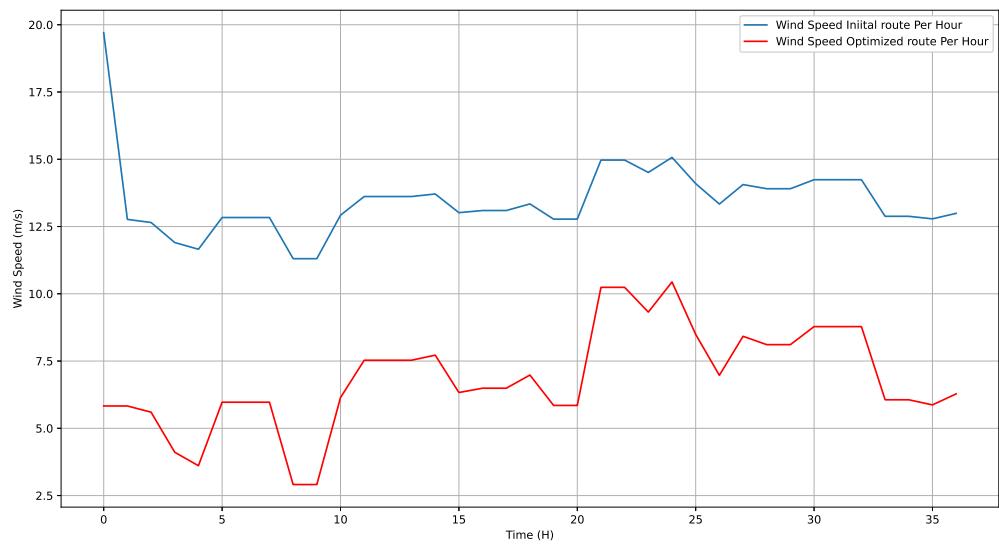


Figure 11: Wind Speed comparison Initial / Optimized Route, MARSAXLOKK - VALENCIA

4 VALENCIA - TANGER MED

- Total Actual FOC : **59.04 MT**
 - Total Predicted FOC (Neural Net): **61.02 MT**
 - FOC Perc Diff (Neural Net): **3.30 %**
- Departure Port : **VALENCIA / 2019-11-28 15:00:00**
- Arrival Port : **TANGER MED / 2019-11-29 19:00:00**
- Total Sailing Time: **28 hours**
- Distance Travelled: **330.00 n mi**
- Draft: **12.4 m**

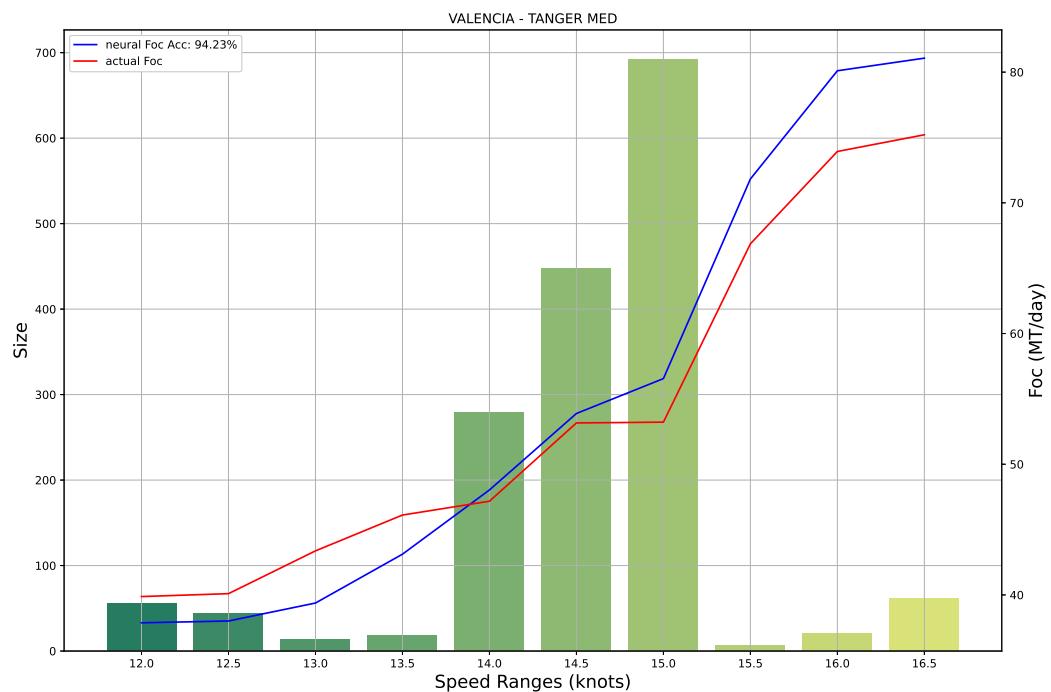


Figure 12: FOC Actual vs Predicted / Speed Ranges, VALENCIA - TANGER MED

Weather Comparison - Sensor / Weather Service (NOA)

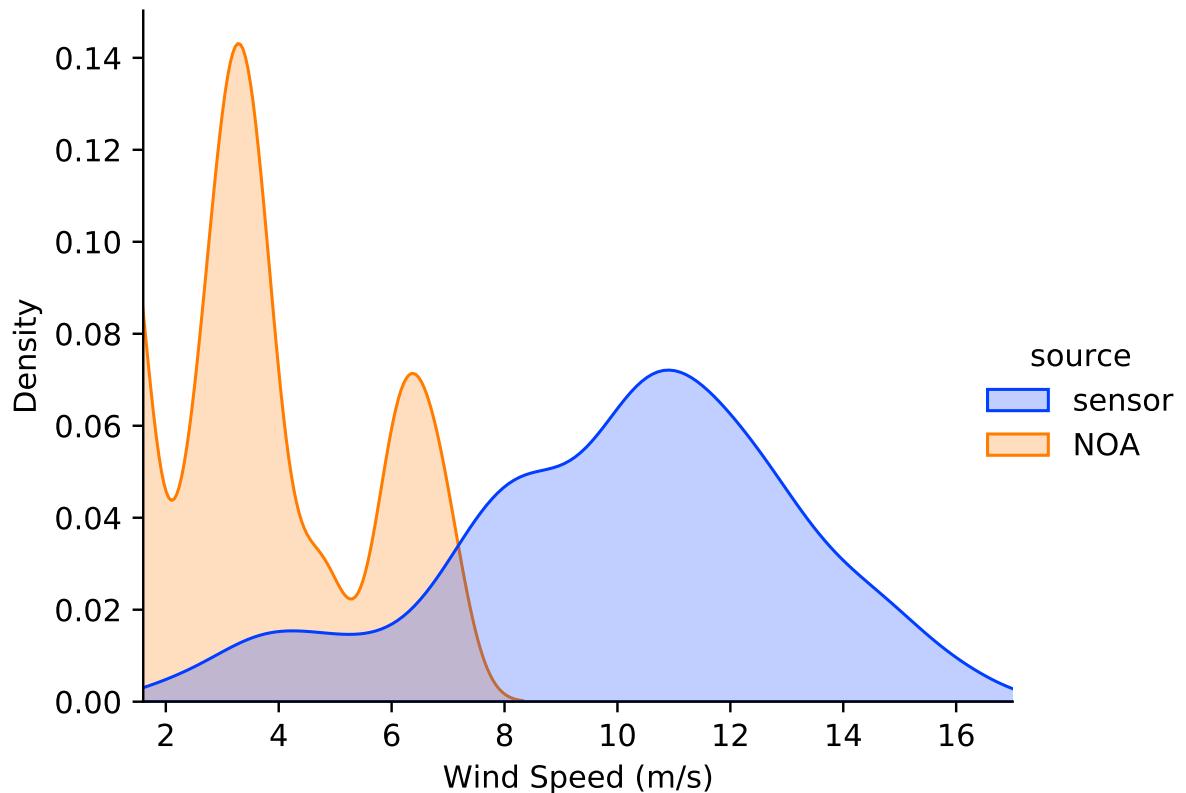


Figure 13: Wind Speed Sensor VS NOA Distributions comparison

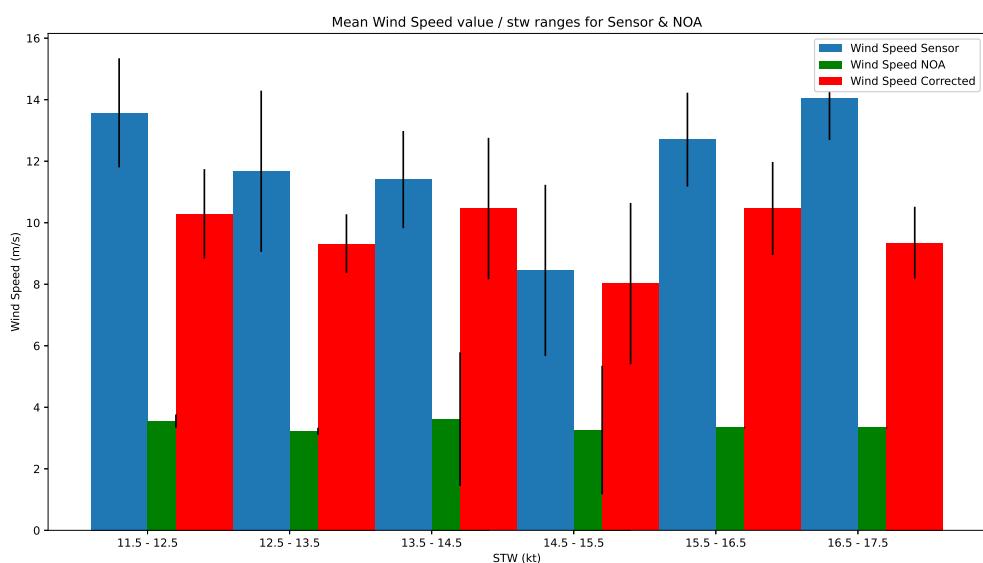


Figure 14: Initial / Weather Features Comparison per Speed Range

Routing Optimization Info : VALENCIA - TANGER MED



Figure 15: Initial / Optimized Route, VALENCIA - TANGER MED

Voyage	Date	Latitude	Longitude
Departure	2019-11-28 15:00:00	39.0° 13.0' N	1.0° 57.0' E
Arrival	2019-11-29 19:00:00	35.0° 53.0' S	6.0° 26.0' E
<hr/>			
BASIC COMPARISON	Actual route estimation	Optimized route estimation	
Distance (nm)	397.99	421.00	
Time (hours)	28.00	27.87	
Avg Speed (kt)	14.21	14.93	
Total FOC (MT)	58.41	61.96	

Table 4: Estimation based on Weather Service data (NOA)

Weather comparison optimization / initial:

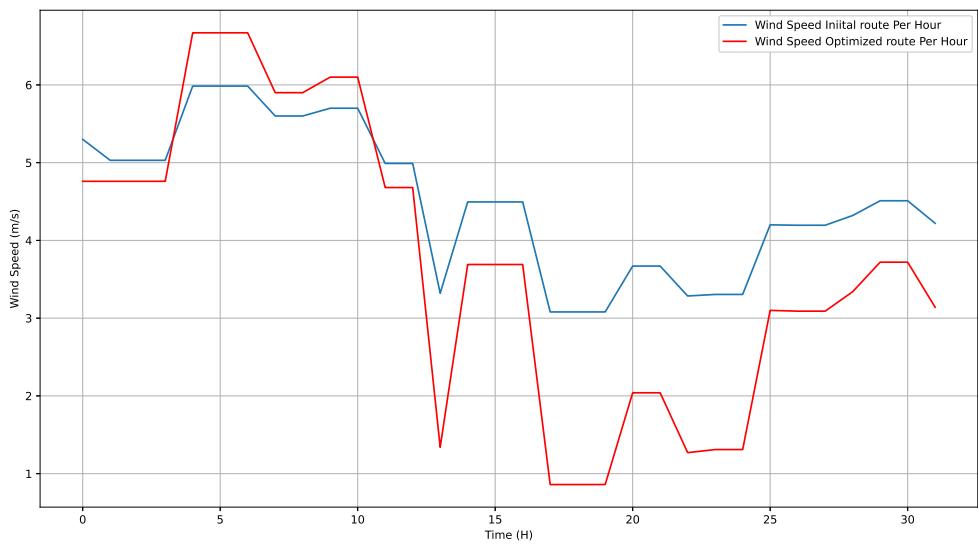


Figure 16: Wind Speed comparison Initial / Optimized Route, VALENCIA - TANGER MED

5 TANGER MED - FELIXSTOWE

- Total Actual FOC : **269.58 MT**
 - Total Predicted FOC (Neural Net): **259.13 MT**
 - FOC Perc Diff (Neural Net): **3.95 %**
- Departure Port : **TANGER MED / 2019-11-30 15:42:00**
- Arrival Port : **FELIXSTOWE / 2019-12-04 04:30:00**
- Total Sailing Time: **85 hours**
- Distance Travelled: **1,004.29 n mi**
- Draft: **11.3 m**

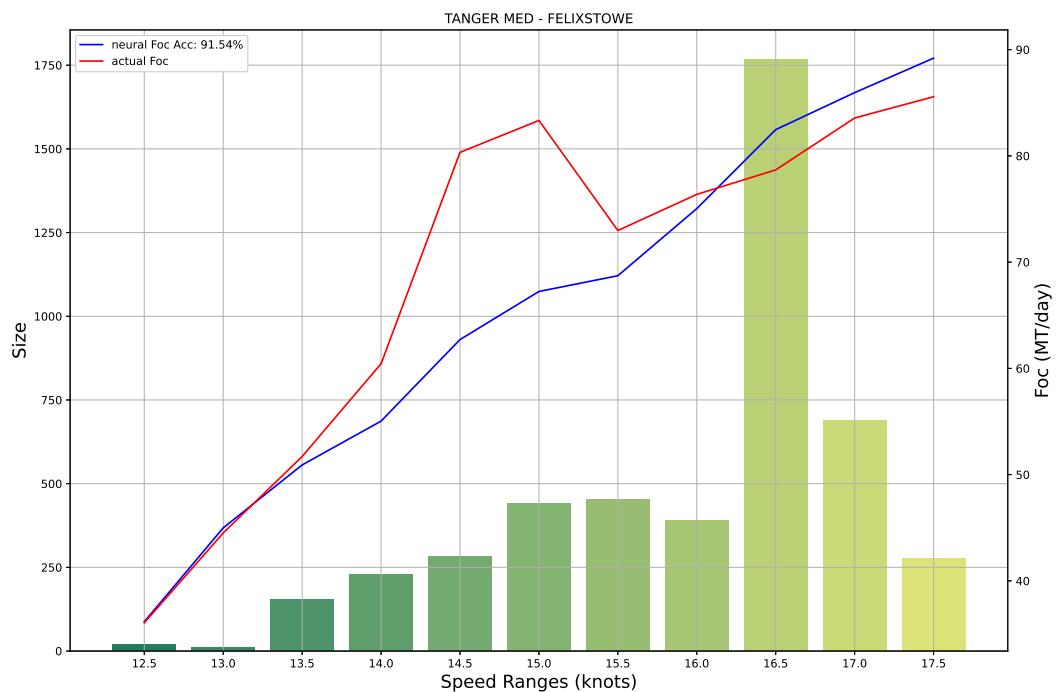


Figure 17: FOC Actual vs Predicted / Speed Ranges, TANGER MED - FELIXSTOWE

Weather Comparison - Sensor / Weather Service (NOA)

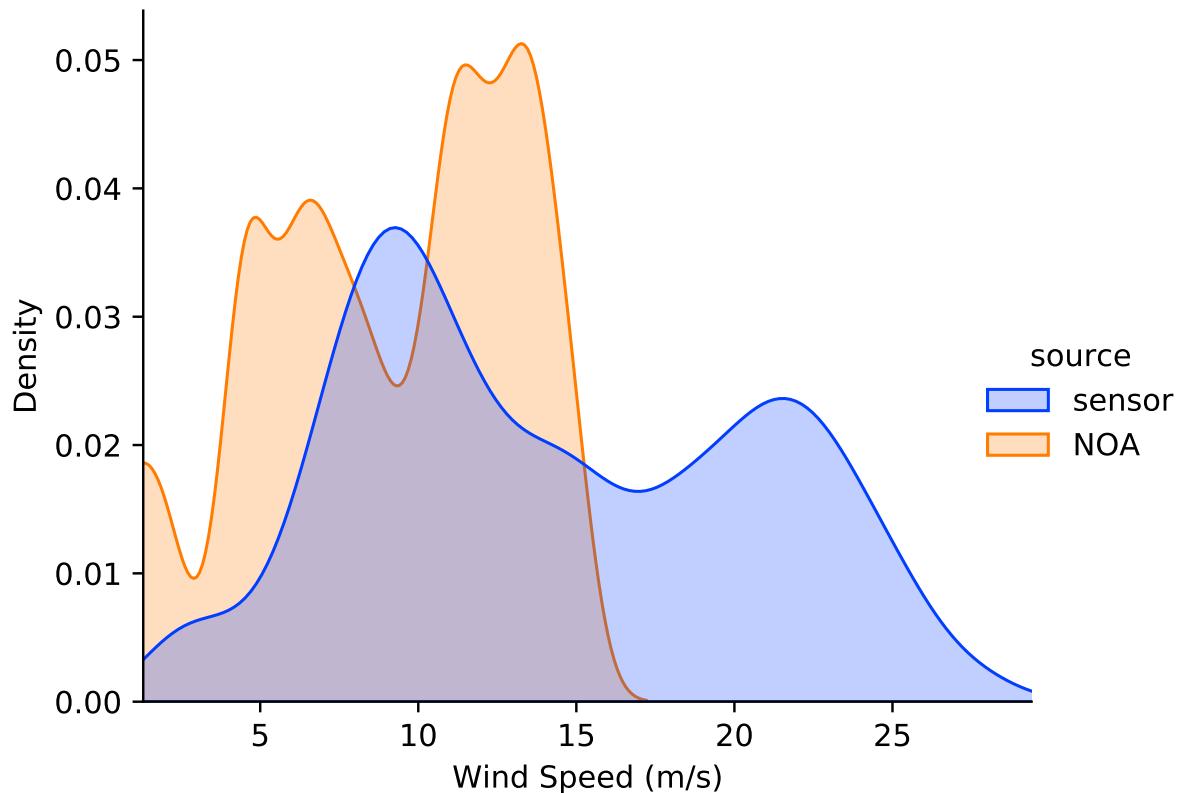


Figure 18: Wind Speed Sensor VS NOA Distributions comparison

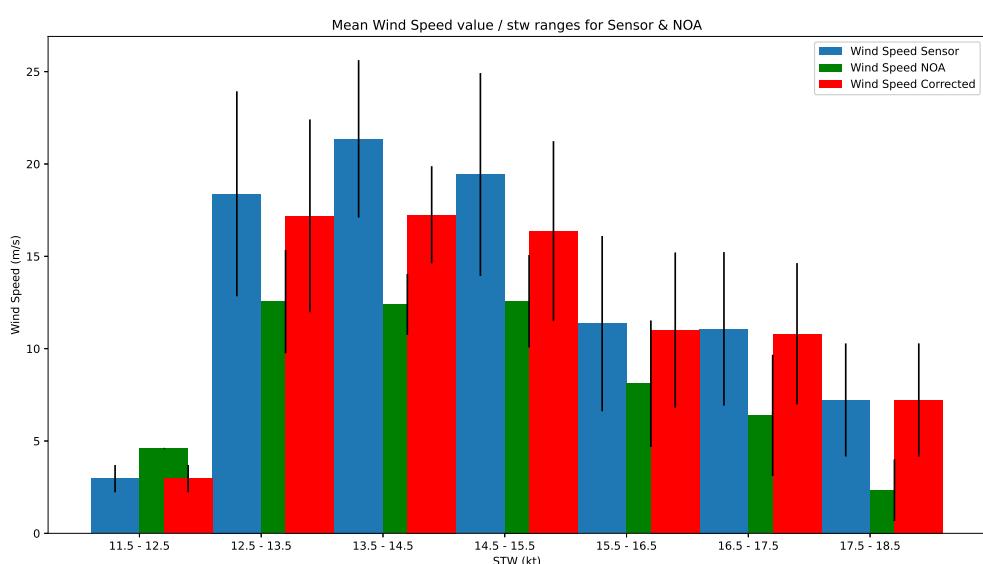


Figure 19: Initial / Weather Features Comparison per Speed Range

Routing Optimization Info : TANGER MED - FELIXSTOWE

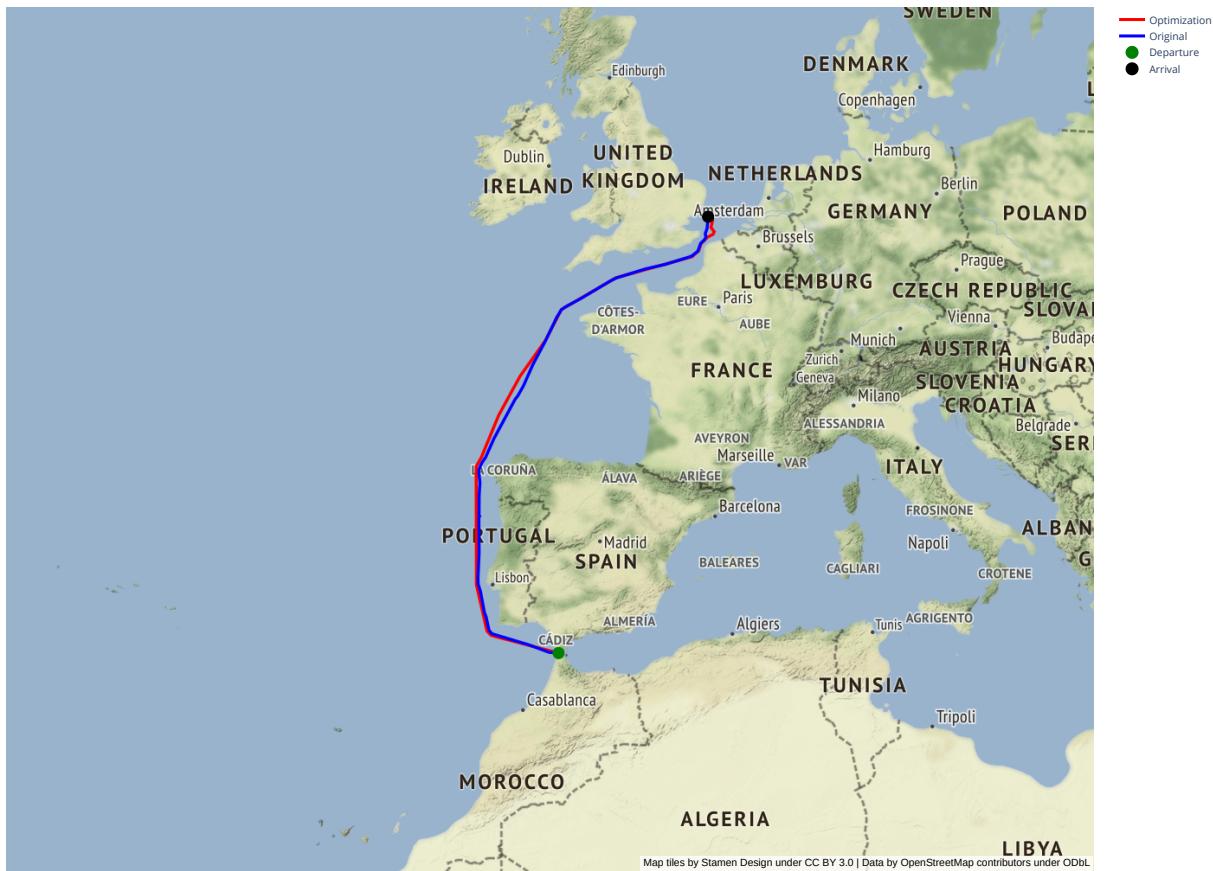


Figure 20: Initial / Optimized Route, TANGER MED - FELIXSTOWE

Voyage	Date	Latitude	Longitude
Departure	2019-11-30 15:42:00	35.0° 57.0' N	6.0° 13.0' E
Arrival	2019-12-04 04:30:00	51.0° 47.0' S	1.0° 49.0' E
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BASIC COMPARISON	Actual route estimation	Optimized route estimation	
Distance (nm)	1,319.31	1,333.24	
Time (hours)	84.80	84.83	
Avg Speed (kt)	15.56	15.62	
Total FOC (MT)	246.94	245.32	

Table 5: Estimation based on Weather Service data (NOA)

Weather comparison optimization / initial:

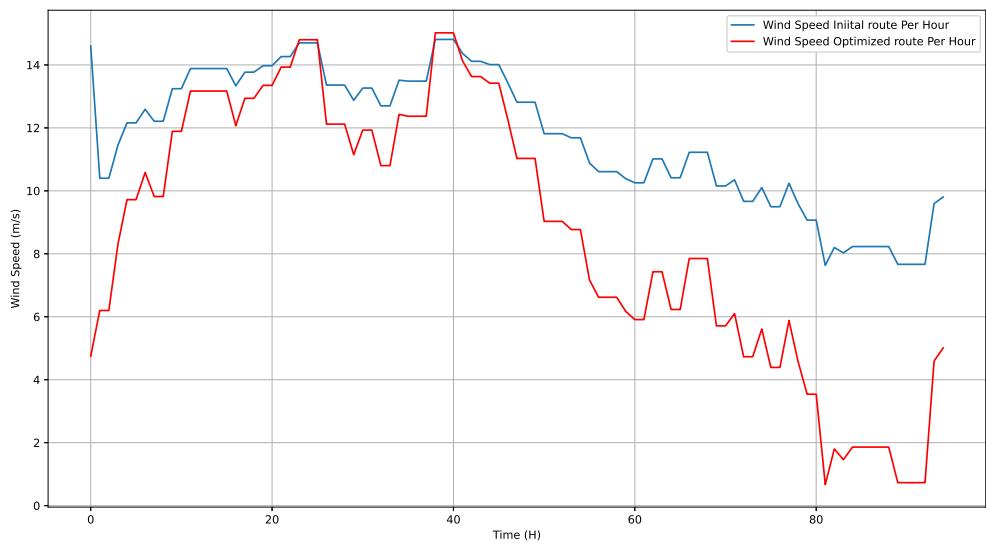


Figure 21: Wind Speed comparison Initial / Optimized Route, TANGER MED - FELIXSTOWE

6 ANTWERP - MARSAXLOKK

- Total Actual FOC : **520.88 MT**
 - Total Predicted FOC (Neural Net): **534.56 MT**
 - FOC Perc Diff (Neural Net): **2.59 %**
- Departure Port : **ANTWERP / 2019-12-12 10:00:00**
- Arrival Port : **MARSAXLOKK / 2019-12-19 18:00:00**
- Total Sailing Time: **176 hours**
- Distance Travelled: **1,077.24 n mi**
- Draft: **13.3 m**

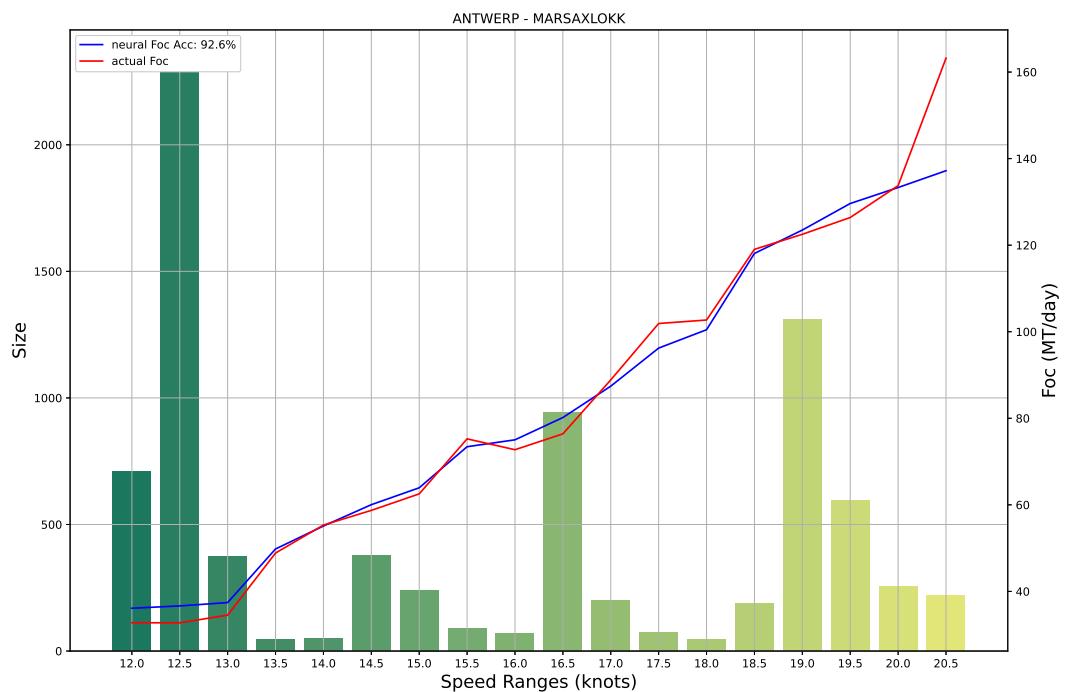


Figure 22: FOC Actual vs Predicted / Speed Ranges, ANTWERP - MARSAXLOKK

Weather Comparison - Sensor / Weather Service (NOA)

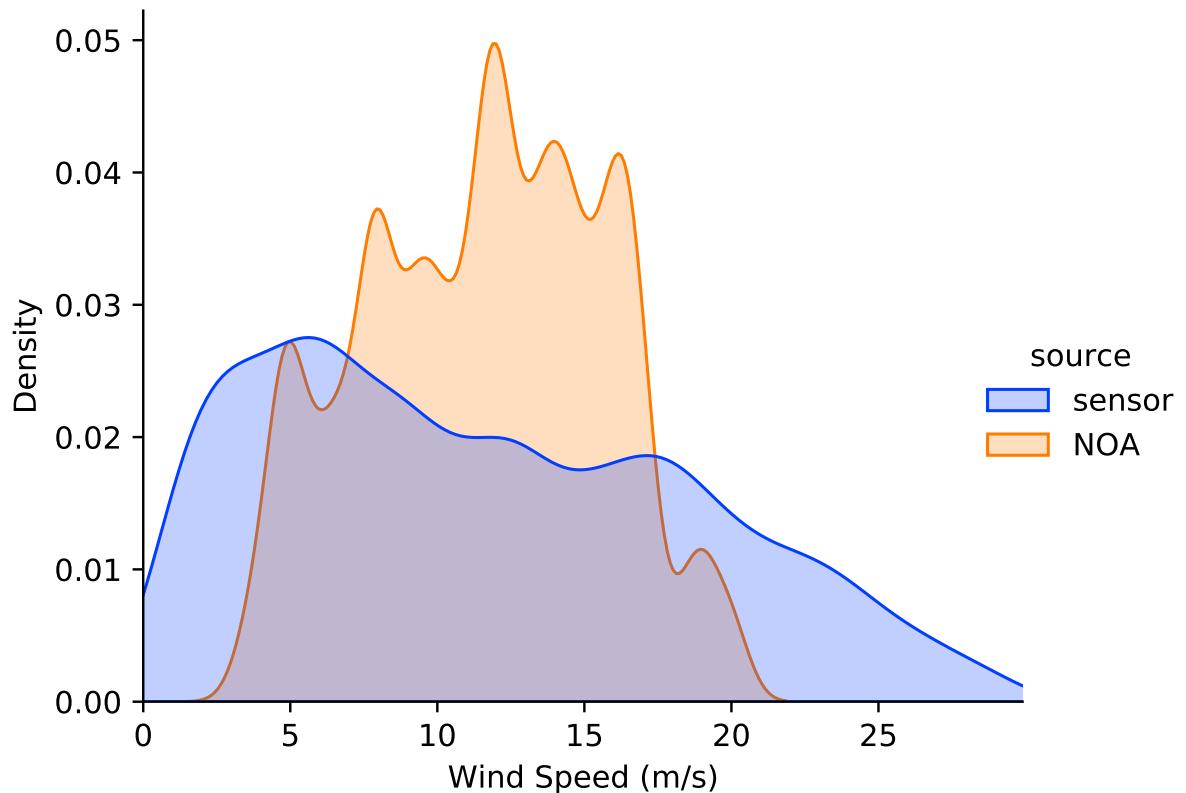


Figure 23: Wind Speed Sensor VS NOA Distributions comparison

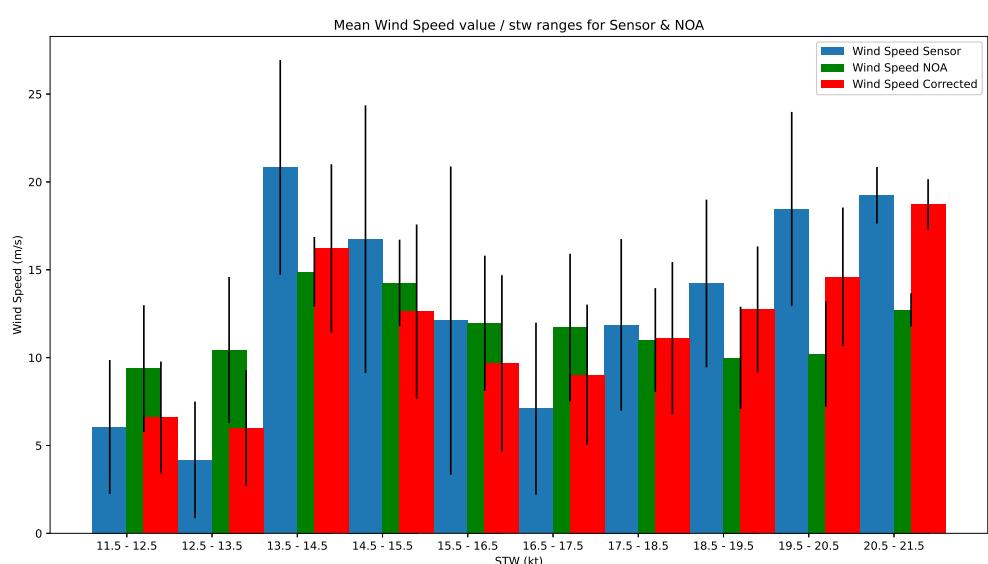


Figure 24: Initial / Weather Features Comparison per Speed Range

Routing Optimization Info : ANTWERP - MARSAXLOKK



Figure 25: Initial / Optimized Route, ANTWERP - MARSAXLOKK

Voyage	Date	Latitude	Longitude
Departure	2019-12-12 10:00:00	51.0° 20.0' N	2.0° 17.0' E
Arrival	2019-12-19 18:00:00	35.0° 43.0' S	14.0° 38.0' E
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BASIC COMPARISON	Actual route estimation	Optimized route estimation	
Distance (nm)	2,760.47	2,338.81	
Time (hours)	176.00	174.70	
Avg Speed (kt)	15.68	13.16	
Total FOC (MT)	495.46	316.48	

Table 6: Estimation based on Weather Service data (NOA)

Weather comparison optimization / initial:

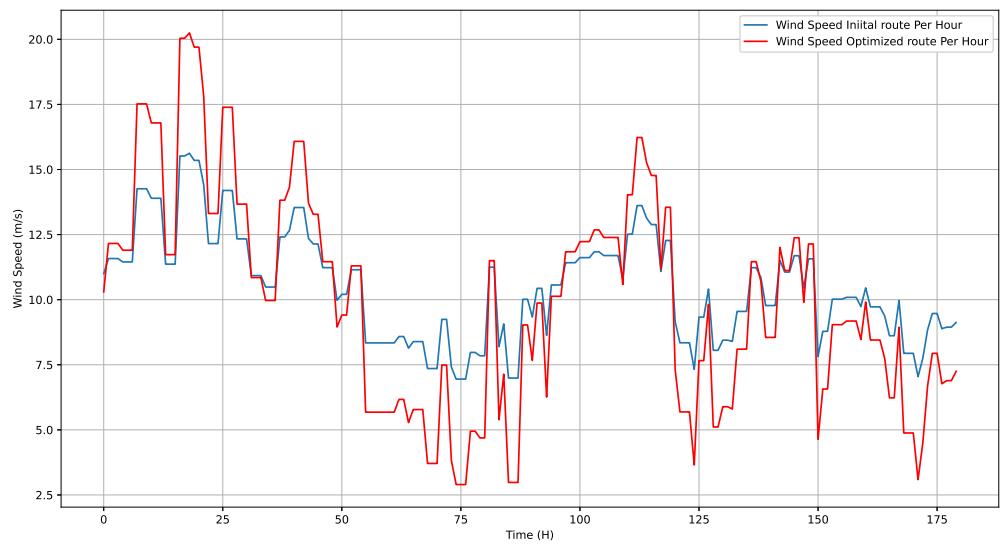


Figure 26: Wind Speed comparison Initial / Optimized Route, ANTWERP - MARSAXLOKK

7 MARSAXLOKK - PIRAEUS

- Total Actual FOC : **118.36 MT**
 - Total Predicted FOC (Neural Net): **122.20 MT**
 - FOC Perc Diff (Neural Net): **3.19 %**
- Departure Port : **MARSAXLOKK / 2019-12-22 16:00:00**
- Arrival Port : **PIRAEUS / 2019-12-23 21:32:00**
- Total Sailing Time: **30 hours**
- Distance Travelled: **430.90 n mi**
- Draft: **13.0 m**

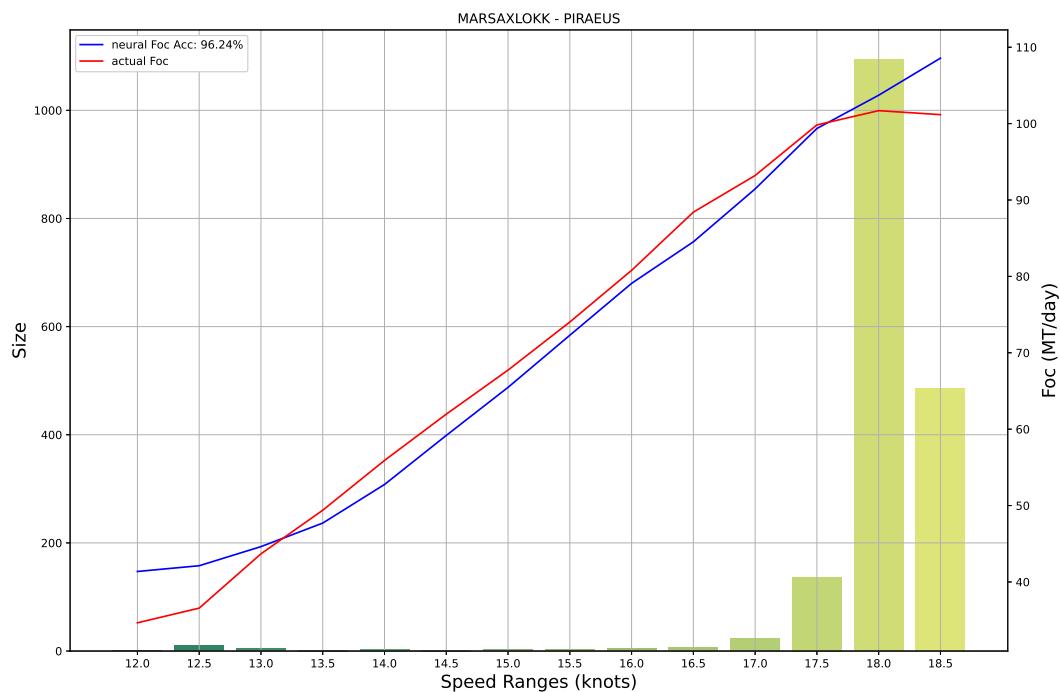


Figure 27: FOC Actual vs Predicted / Speed Ranges, MARSAXLOKK - PIRAEUS

Weather Comparison - Sensor / Weather Service (NOA)

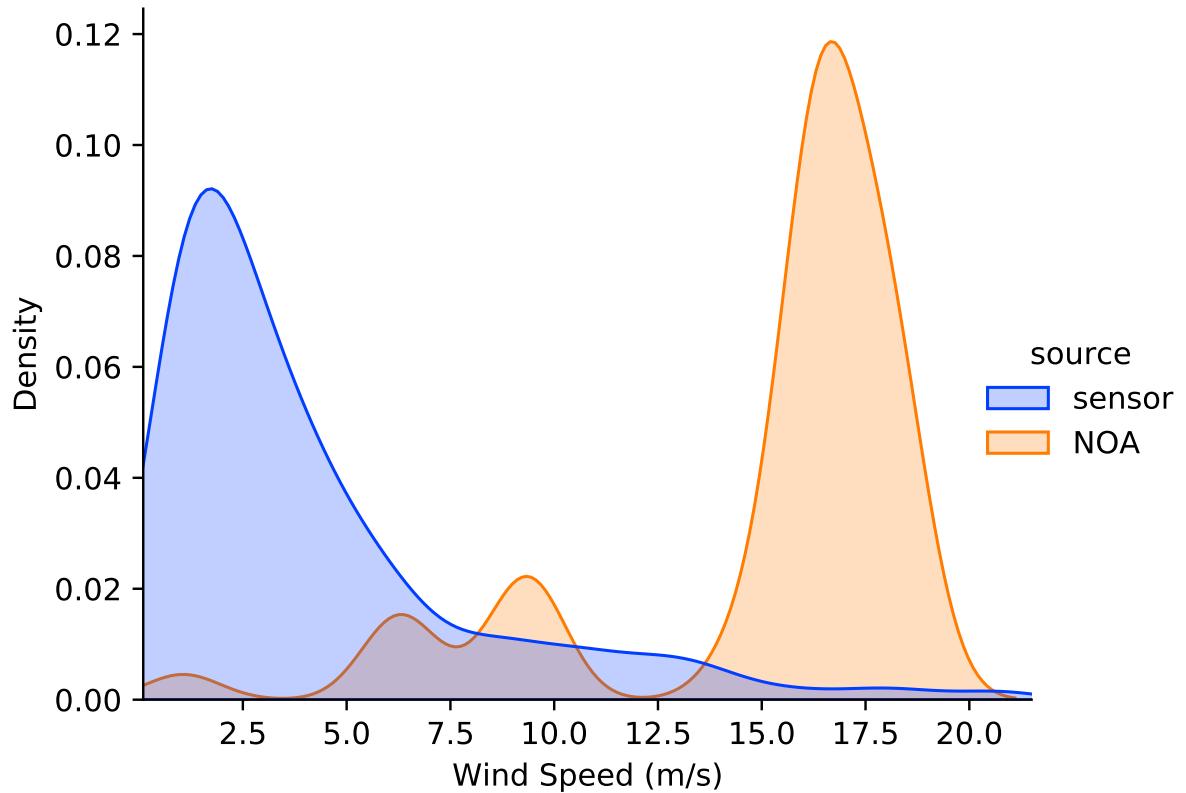


Figure 28: Wind Speed Sensor VS NOA Distributions comparison

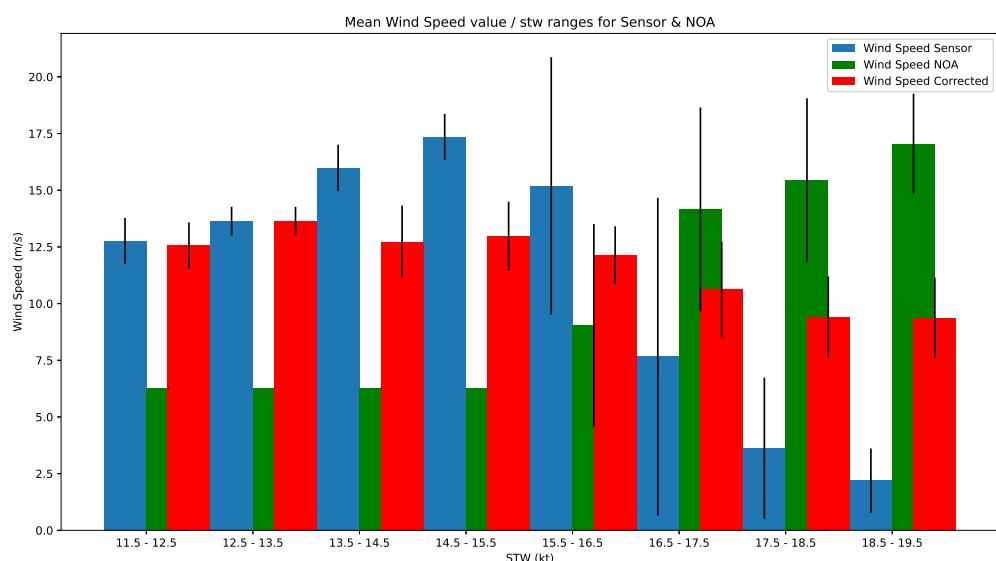


Figure 29: Initial / Weather Features Comparison per Speed Range

Routing Optimization Info : MARSAXLOKK - PIRAEUS



Figure 30: Initial / Optimized Route, MARSAXLOKK - PIRAEUS

Voyage	Date	Latitude	Longitude
Departure	2019-12-22 16:00:00	35.0° 46.0' N	14.0° 58.0' E
Arrival	2019-12-23 21:32:00	37.0° 52.0' S	23.0° 31.0' E
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BASIC COMPARISON	Actual route estimation	Optimized route estimation	
Distance (nm)	527.44	499.58	
Time (hours)	29.53	29.03	
Avg Speed (kt)	17.86	17.10	
Total FOC (MT)	118.38	110.79	

Table 7: Estimation based on Weather Service data (NOA)

Weather comparison optimization / initial:

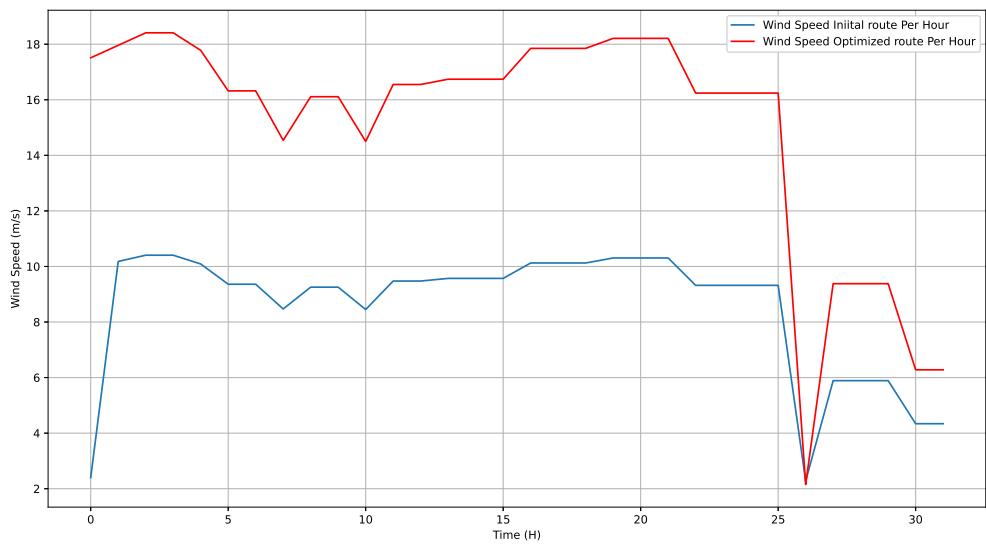


Figure 31: Wind Speed comparison Initial / Optimized Route, MARSAXLOKK - PIRAEUS

8 PIRAEUS - GEBZE

- Total Actual FOC : **75.75 MT**
 - Total Predicted FOC (Neural Net): **78.18 MT**
 - FOC Perc Diff (Neural Net): **3.16 %**
- Departure Port : **PIRAEUS / 2019-12-24 21:18:00**
- Arrival Port : **GEBZE / 2019-12-25 19:25:00**
- Total Sailing Time: **22 hours**
- Distance Travelled: **320.53 n mi**
- Draft: **12.3 m**

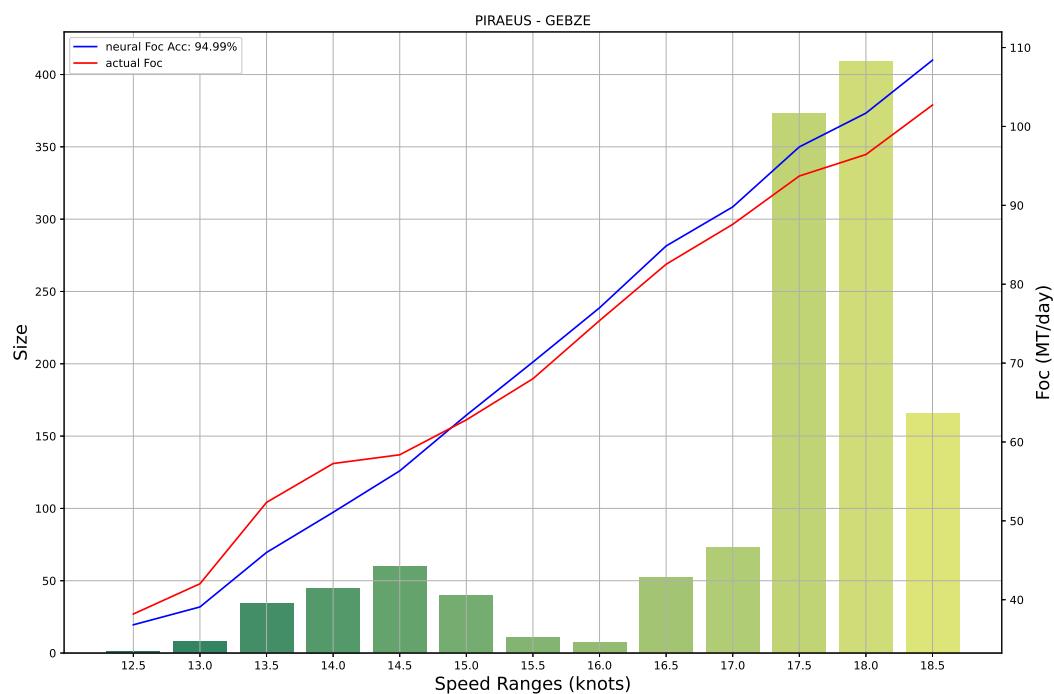


Figure 32: FOC Actual vs Predicted / Speed Ranges, PIRAEUS - GEBZE

Weather Comparison - Sensor / Weather Service (NOA)

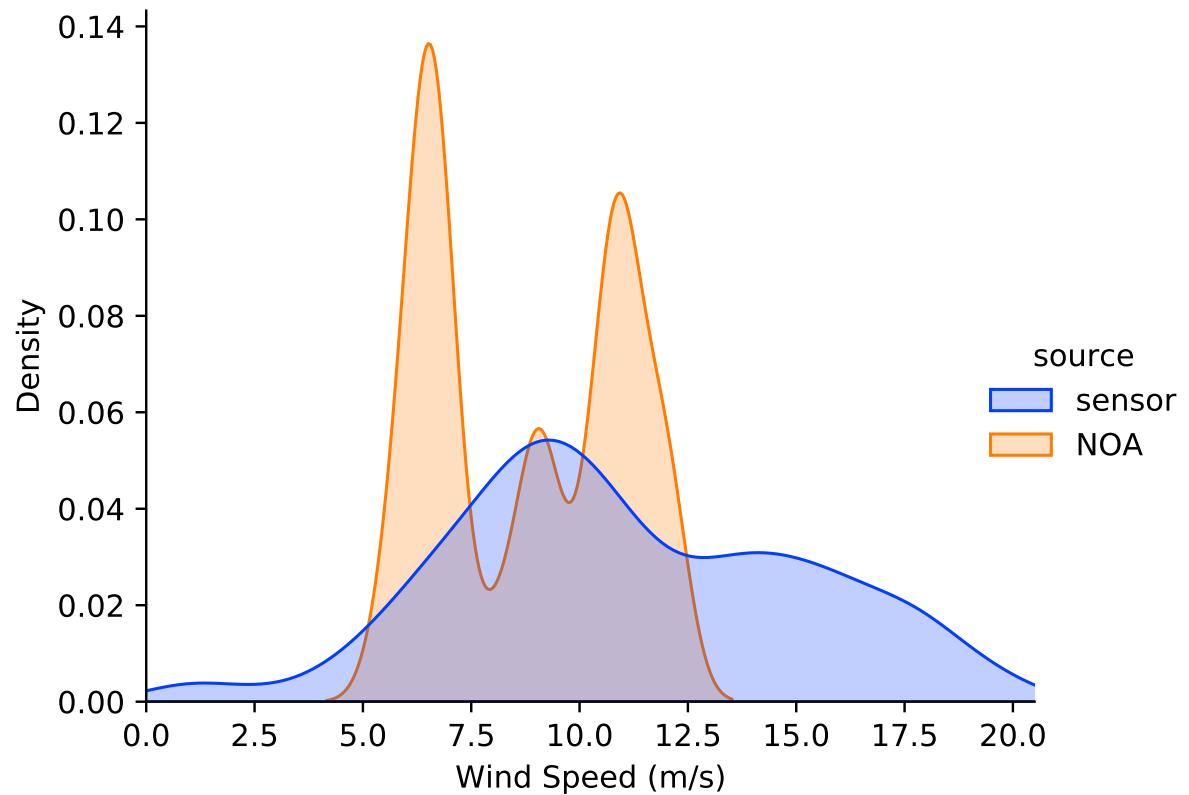


Figure 33: Wind Speed Sensor VS NOA Distributions comparison

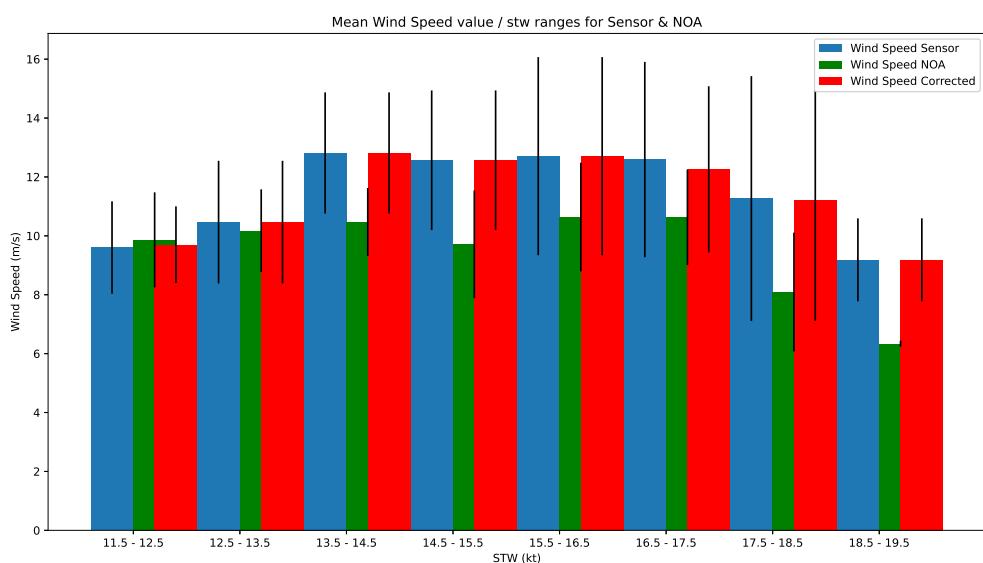


Figure 34: Initial / Weather Features Comparison per Speed Range

Routing Optimization Info : PIRAEUS - GEBZE



Figure 35: Initial / Optimized Route, PIRAEUS - GEBZE

Voyage	Date	Latitude	Longitude
Departure	2019-12-24 21:18:00	37.0° 34.0' N	24.0° 1.0' E
Arrival	2019-12-25 19:25:00	40.0° 45.0' S	29.0° 32.0' E
<hr/>			
BASIC COMPARISON	Actual route estimation	Optimized route estimation	
Distance (nm)	374.95	349.94	
Time (hours)	22.12	21.33	
Avg Speed (kt)	16.95	16.54	
Total FOC (MT)	77.18	70.36	

Table 8: Estimation based on Weather Service data (NOA)

Weather comparison optimization / initial:

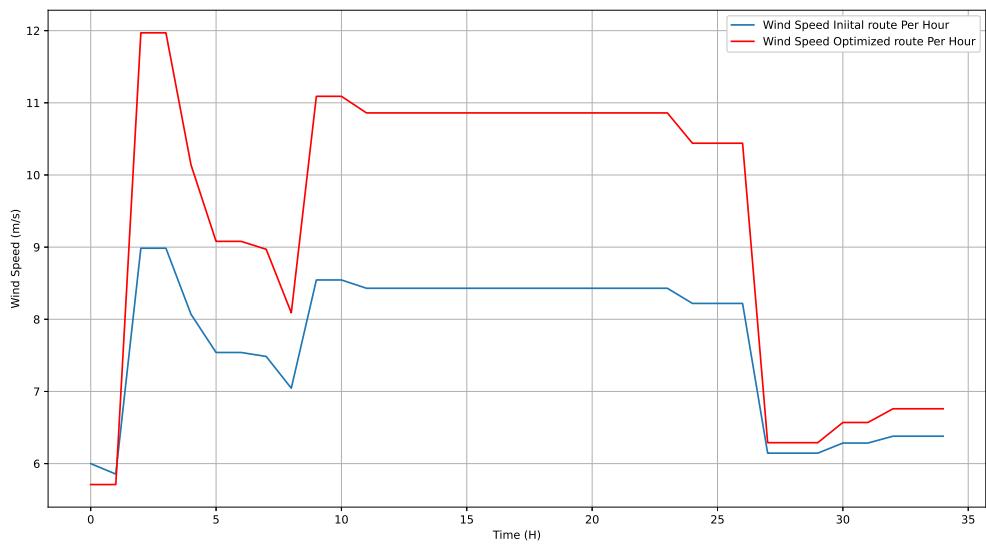


Figure 36: Wind Speed comparison Initial / Optimized Route, PIRAEUS - GEBZE