Sample Analysis Report

IMO: 1111111

Estimation period: 01/01/2015 to 31/12/2015

By analyzing our satellite and terrestrial AIS data, FUSE Vessel reports deliver detailed estimates of a ship's speed, fuel consumption, CO2/NOx/Sox emissions, activity and operational efficiency.

This report contains a number of variables that have been estimated for an individual ship over a time period. Data on activity (from AIS) and technical specifications are combined in models characterizing ship performance, in order to estimate fuel consumption and emissions. Derived information on the ship's activity (speed and transport work) is included to add detail and explanation of the fuel and emissions results. The estimated emissions and transport work information is also used to estimate the ship's overall operational efficiency during the time period, including through the use of the Energy Efficiency Operational Indicator.

Information is provided in the report about the coverage of the ship's activity that was achieved from the AIS sources, and estimates of the reliability of certain parameters, in order to guide the user in their interpretation and application of the data.

UCL ENERGY INSTITUTE MATRANS exactEarth®

Analysis Report

IMO: 1111111 **November 2017**

Speed

At berth/anchor (days)	Average at sea (SOG/ kts)	Average slow steaming (%)	Average at sea loaded (SOG/ kts)	Average at sea ballast (SOG/ kts)
68.92	10.96	34.57	10.96	-

Days at 0-25% Vref (days)	Av.Speed at 0-25% Vref (kts)	Days at 25-50% Vref (days)	Av.Speed at 25-50% Vref (kts)	Days at 50-75% Vref (days)	Av.Speed at 50-75% Vref (kts)	Days at 75%+ Vref (days)	Av.Speed at 75%+ Vref (kts)
68.96	0.15	11.17	6.17	4.04	9.18	76.83	11.98

Fuel and Emissions

	Berth/anchor, main	Berth/anchor, aux	Berth/anchor, boiler	At Sea, main	At Sea, aux	At Sea, boiler	Total
HFO (t)	0.00	202.48	59.86	1537.76	229.11	20.66	2059.87
MDO/MGO (t)	0.00	290.88	84.56	747.57	80.12	5.11	1228.23
Other (t)	0.00	0.00	0.00	0.00	0.00	0.00	-
Energy (TJ)	0.00	20.96	6.02	60.74	13.49	1.05	135.25
CO2 (t)	0.00	1594.21	457.50	7185.29	1034.42	80.73	10352

Transport and Proxies

Distance, loaded (nm)	Distance, ballast (nm)	Distance, total (nm)	Time at sea (days)	Average loaded cargo mass (t)	Average payload utilisation (average dwt ut.)	Allocative utilisation (average loaded/ ballast ratio)	Mtnm, using est. cargo mass (Mt.nm)	Mtnm, using fleet av. cargo mass (Mt.nm)	MDwtnm using vessel Dwt (MDwt.nm)
27129	0.00	27129	102.08	27991	69.24	100.00	738.42	399466751	1096.71

EEOI / AER

EEOI, using est. cargo mass (gCO2/t.nm)	EEOI, using fleet-av. cargo mass (gCO2/ t.nm)	AER (gCO2/dwt.nm)
14.02	20.74	9.44

Accuracy

Time observed (%)	Observed time with reliable sog observation (%)	Observed time with reliable T observation (%)	Unobserved time where infilling was reliable (%)
61.58	100.00	100.00	100.00

Emissions

	HFO	MDO	Other	Total
CH4 (t)	0.11	0.01	0.00	0.17
N2O (t)	0.31	0.00	0.00	0.49
SOx (t)	96.38	18.87	0.00	50.26
NOx (t)	153.87	80.17	0.00	200.04
CO (t)	6.30	3.38	0.00	9.01
PM (t)	13.00	0.54	0.00	12.37
VOC (t)	5.00	2.13	0.10	8.00

Acronyms and Definitions

Loaded/ballast condition:

The identification of whether the ship is loaded or in ballast, and if loaded the estimate of the quantity (mass) of cargo, is taken from the ship's AIS reported draught parameter. As such the calculations are dependent on the accuracy of this reported draught. Tests are performed to indicate the reliability of the draught indicator and reported as one of the 'accuracy' fields.

Time at sea:

A ship's time is divided between time at sea, and at anchor/in port. The time at sea in these calculations is estimated by summing any period when the ship is travelling above 3 knots.

Speed:

Values for ship speed (all Speed Over Ground (SOG)) are calculated both as an average for time at sea and as an average for the time in the loaded and ballast condition. The slow steaming % represents the ratio of the ship's average at sea speed to the ship's reference/ design speed as reported in vesseltracker. The distribution of time spent in different speed ranges (0-25-50-75-+) is estimated to provide information on how much variability of ship speed there is during the period of the report.

Fuel and CO2:

The information about the ship's activity (time spent at different speeds and draughts) is used in combination with models of ship's performance to estimate fuel consumption. Classifying the ship's activity into time at sea and at berth/anchor enables this to be broken out into these categories. Heuristics about the matching between machinery and fuel consumption, as well as the identification of when the ship is sailing within an ECA area are used to classify between different types of fuel. The default assumption is that the ship uses distillate fuel when sailing in an ECA.

Transport work and proxies:

Estimates of when the ship is loaded, the quantity of cargo when the ship is loaded, and the distance traveled, are used to estimate the utilization. Payload utilization is a % expressing the ratio of the average cargo loaded to the ship's capacity, 100% represents a ship that sails with cargo mass equal to deadweight capacity on every loaded voyage. Allocative utilization represents the ratio of time loaded to time in ballast, a value of 100% represents a ship sailing constantly in the loaded condition.

The uncertainty in the identification of loaded condition and cargo carried, related to the uncertainty in the AIS reported draught condition, means that AIS derived estimates of transport work (t.nm (sum of cargo mass x distance travelled) cannot always be relied upon. For this reason, t.nm is calculated in two different ways: using the values specific to the ship (from its reported draught parameter), and using the average values of utilization obtained from a subset of a fleet of similar ships for which the AIS reported draught meets a minimum reliability criteria. The proxy for transport work, dwt.nm (cargo capacity x distance travelled) is also calculated and included.

Operational energy efficiency

Three different estimates of operational energy efficiency are presented. Different estimates are used because of uncertainty in the estimate of transport work (see Transport work and proxies). The EEOI represented the amount of CO2 emitted per unit of transport work done. It is first estimated using the AIS derived cargo mass and transport work for the individual ship. If there is poor quality draught data transmitted over AIS (see Accuracy), this value will be unreliable, and so the EEOI is also calculated using the fleet's average utilization instead of the individual ship's AIS derived utilisation. The operational energy efficiency is also calculated and presented according to the AER (Annual Efficiency Ratio), which estimates transport work assuming the ship is always loaded and with a cargo mass equivalent to the ship's deadweight.

Accuracy

A number of indicators provide information on the accuracy of the AIS derived calculations. This includes information on the amount of time, over the course of the year, for which an AIS transmission is received and estimated to be of 'high reliability'. Explanations for why an AIS signal has not been received are that the ship's transponder is turned off, or because the ship's transmitted signal could not be received (data collisions, or out of range). Generally, good estimates of fuel, emissions and efficiency can be obtained with coverage greater than 50%, but this can vary if there is poor coverage when the ship is active for long time periods continuously (for example, prolonged periods of time that the transponder is turned off).

A draught reliability indicator shows the percentage of the of the reported draught values that are numeric.

Emissions

Estimates are provided for total annual emissions of a number of GHG and air pollution species. These estimates are provided based on the AIS derived estimate of a ship's activity, as well as assumptions about the fuel type and machinery, and so may differ if the ship's specification and operation are significantly different.

AER	Annual Efficiency Ratio
At sea	any observation of a ship at sea and underway
At berth/anchor	any observation of a ship not underway
CH4	Methane
CO	Carbon Monoxide
Dwt	Deadweight tonnage - how much mass a ship is carrying or can safely carry
ECA	Emission Control Area
EEOI	Energy Efficiency Operational Indicator
HFO	Heavy Fuel Oil (a generic term inclusive of all residual fuels: heavy and intermediate fuel oils e.g. RMG and RMK)
LSFO	Low Sulphur Fuel Oil (1% Sulphur limit compatible)
MDO/MGO	Marine Diesel Oil /Marine Gas Oil (a generic term inclusive of all distillate fuels e.g. DMA and DMB)
NMVOC	Non-Methane Volatile Organic Compounds
NOx	Nitrogen Oxides
N2O	Nitrous Oxide
% slow steaming	Ratio of average observed speed to reference (design) speed
PM	Particulate Matter
SFC	Specific Fuel Consumption
SOG	Speed Over Ground
SOx	Sulphur Oxides
TEU	Twenty foot Equivalent Unit
Tref	Reference, deep displacement, draught
Vref	Reference or design speed

Vessel Characteristics Used

	Value
Ship Type	Chemical tanker
Dwt	42000
teu capacity	-
Vref	13.00
T	11.00
Installed power	9000.00
SFC of main engine	1.00
SFC of aux engine	1.00
Main engine fuel type	HFO
Aux engine and boiler fuel type	HFO
Main engine fuel type (ECA)	MDO/MGO
Aux engine and boiler fuel type (ECA)	MDO/MGO

Notes

This data was generated using model version 0.4.6.post0.dev423+ng6850123 on November 2017. The FUSE Vessel analysis model's total fuel consumption and CO2 emissions outputs have been validated to be accurate for an average ship to within 10% (to 95% confidence interval) and make allowances for average performance impacts due to environmental conditions encountered, and in-service conditions of the hull, propeller and machinery. However, it is possible that larger discrepancies than 10% can be observed for any individual ship. This can be caused by, for example, low AIS coverage, errors in the ship technical specifications used, significant departure from fleet average auxiliary or boiler operation, significant departure from reference specification (e.g. extreme hull fouling, engine wear), and consistent and significant adverse environmental conditions encountered). In addition, all estimates requiring differentiation between the loaded and ballast condition and associated with cargo mass, are dependent on the AIS reported draught parameter; calculations are also performed using fleet average statistics which could be used instead in the event that the AIS reported draught is thought to be unreliable.

The parameters in FUSE Vessel reports are estimates based on analysing terrestrial and satellite AIS data in conjunction with a database of vessel characteristics information. Whilst the analysis model's outputs have been validated to be generally accurate within 10%, we do not claim that the estimates will exactly match actual measurements of the parameters. If you see significant discrepancies in the estimates and/or would like more information on how we calculate any of the parameters contained within the report, then please contact fuse@u-mas.co.uk

FUSE Vessel estimates of Sulphur Oxide (SOx) and Nitrogen Oxide (NOx) emissions, and Heavy Fuel Oil (HFO) and Marine Diesel Oil (MDO) consumption are based on the assumption that a ship has switched to using the correct fuel at the correct time.

UCL ENERGY INSTITUTE

MATRANS

exactEarth®