

Delaware State Inventory of Ocean Going Vessels (OGV)

Shane Cone

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Delaware Department of Natural
Resources and Environmental Control



Blue Skies Delaware; Clean Air for Life

Otherwise titled:

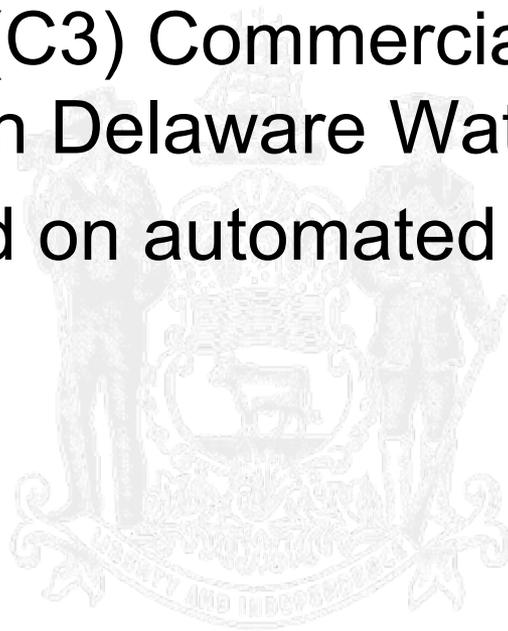
***A RETROSPECTIVE ON STATE
WORK TO ESTIMATE
EMISSIONS FROM OCEAN
GOING VESSELS***



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Background

- Delaware has, since 2005, created an inventory for Category 3 (C3) Commercial Marine Vessel (CMV) activity in Delaware Waters
- Inventory based on automated identification system (AIS)



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Activity Data

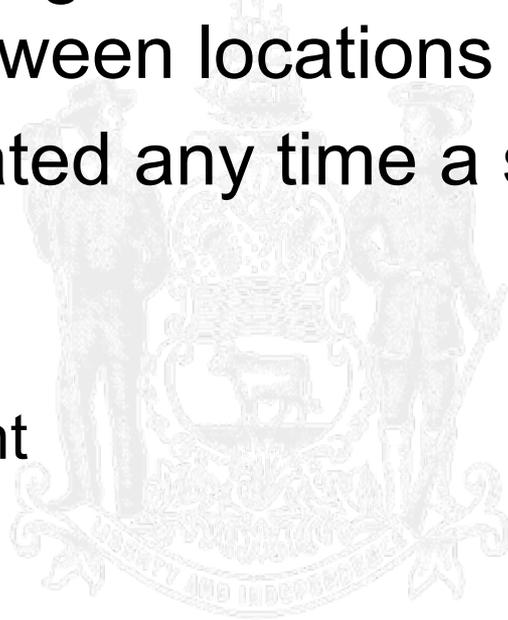
- AIS data with a catch
- Data export from partnership with local trade association, Maritime Exchange
- Maritime Exchange pre-processes the data, so it is easy to work with



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AIS Data - Processed

- Maritime Exchange has data of C3 ship movements between locations
- A record is created any time a ship enters/leaves:
 - DE waters
 - anchorage point
 - Port
 - Canal



AIS Data – Processed 2

- Using this data source, we have a dataset of all ship movements in tabular format
- DE Created a list of all locations on the Maritime Exchange dataset, then created a table with every distance between them measured using Google Earth
 - Significant time, but only had to do this once



AIS - Dataset Fields

Legend:

Data element as export

Computed data element

Primary	Database ID (created)
Vessel Name	
IMO Number	Unique IMO Number
Flag	Country
Rig Type	Vessel type code
Year of build	Year that vessel was built
GRT	
DWT	Deadweight Tonnage (size of ship)
NRT	
Length	
Breadth	
ADA	Actual Date of Arrival
ATA	Actual Time of Arrival
Arrival Timestamp	Concatenated field for full timestamp
Draft	Size (many missing records)
Location Name	Location of AIS ping
Location Code	Created Field
Trip Code	This row's Location code appended to the last row's location code
ADD	Actual Date of Departure
ADT	Actual Time of Departure. Problem: Many missing records
Departure Timestamp	ADD and ADT concatenated for full timestamp
Agent	Misc. Info
Trip Location Time Duration	How long did the ship stay at that location
Trip Time	How long did it take the ship to get here from its last stop. Problem: Many missing departure times
Trip Speed (mi/hr)	Trip distance / trip time. Problem: Many missing departure times



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Tables

- Average Propulsion Engine Power and the 1996 Number of Calls for OGVs Calling on the Delaware River Area (DE, NJ and PA) (Deep Sea Ports, EPA, 1999)
- Trip Distances and County Allocation Factors (6 x 119) All trip distances, and the percent of each trip in each county, including whether or not it is in DE
- EPA Marine Engine Category by Vessel Type (14 x 3) – Vessel type, and category of Propulsion and Auxiliary engines
- Emission Factors for propulsion engines (9 x 13) – engine category/tier/year, and EF by pollutant
- Emission Factors for Auxiliary engines (9 x 13) – engine category/tier/year, and EF by pollutant
- Age Distribution by Vessel Type*



Calculating Trips

- Using the AIS-informed tabular dataset, we were able to calculate the total distance of all trips
- We could also sum the amount of time each vessel hotelled at any one location
- Trips summed by vessel type, by engine type (2/4-stroke), by deadweight tonnage (DWT) by transect



Vessel Type	DWT Range	DWT Min	DWT Max	Engine Type	Transit RT	Transit RT	Transit RT	Transit RT	Transit RT
					Breakwater to PA/DE Line	Breakwater to Oceanport	Breakwater to Wilmington	Breakwater to Magellan	Breakwater to DC Refinery
BU (BG, OR)	<25,000	-1	25000	2-stroke	105.5	11.2	26.0	0.0	0.0
BU (BG, OR)	<25,000	-1	25000	4-stroke	16.5	1.8	4.0	0.0	0.0
BU (BG, OR)	25,000 - 35,000	24999	35000	2-stroke	69.0	2.0	26.0	0.0	0.0
BU (BG, OR)	35,000 - 45,000	34999	45000	2-stroke	412.0	5.0	40.0	0.0	0.0
BU (BG, OR)	>45,000	44999	1000000	2-stroke	0.0	0.0	1.0	0.0	0.0
CC (CB, PC)	<25,000	-1	25000	2-stroke	317.7	0.0	132.4	0.0	0.0
CC (CB, PC)	<25,000	-1	25000	4-stroke	169.3	0.0	70.6	0.0	0.0
CC (CB, PC)	25,000 - 35,000	24999	35000	2-stroke	790.0	0.0	113.0	0.0	0.0
CC (CB, PC)	35,000 - 45,000	34999	45000	2-stroke	95.0	1.0	2.0	0.0	0.0
CC (CB, PC)	>45,000	44999	1000000	2-stroke	44.0	0.0	0.0	0.0	1.0
GC	<15,000	-1	15000	2-stroke	2.7	0.0	0.9	0.0	0.0
GC	<15,000	-1	15000	4-stroke	3.3	0.0	1.1	0.0	0.0
GC	15,000 - 30,000	14999	30000	2-stroke	4.2	0.0	0.0	0.0	0.0
GC	15,000 - 30,000	14999	30000	4-stroke	0.8	0.0	0.0	0.0	0.0
GC	30,000 - 45,000	29999	45000	2-stroke	6.0	0.0	0.0	0.0	0.0
MS (CL, LV, HL)	<10,000	-1	10000	2-stroke	88.7	0.0	2.7	0.0	0.0
MS (CL, LV, HL)	<10,000	-1	10000	4-stroke	44.3	0.0	1.3	0.0	0.0
PR	<5,000	-1	5000	4-stroke	0.0	0.0	0.0	0.0	0.0
PR	5,000 - 10,000	4999	10000	4-stroke	0.4	0.0	0.0	0.0	0.0
PR	5,000 - 10,000	4999	10000	Steam	0.6	0.0	0.0	0.0	0.0
RF (CR)	5,000 - 10,000	4999	10000	2-stroke	58.9	0.0	51.2	0.0	0.0
RF (CR)	5,000 - 10,000	4999	10000	4-stroke	10.1	0.0	8.8	0.0	0.0
RF (CR)	10,000 - 15,000	9999	15000	2-stroke	52.0	0.0	4.9	0.0	2.9
RF (CR)	10,000 - 15,000	9999	15000	4-stroke	1.0	0.0	0.1	0.0	0.1
RF (CR)	>15,000	14999	1000000	2-stroke	32.0	0.0	2.0	0.0	0.0
RR (RC)	<15,000	-1	15000	2-stroke	2.5	0.0	1.0	0.0	0.0
RR (RC)	<15,000	-1	15000	4-stroke	2.5	0.0	1.0	0.0	0.0
RR (RC)	15,000 - 30,000	14999	30000	2-stroke	34.0	0.0	14.0	0.0	0.0
RR (RC)	>30,000	29999	1000000	2-stroke	194.0	0.0	18.0	0.0	17.0
TA (AS, BO, CH, CO, NP, PD, PG)	<30,000	-1	30000	2-stroke	108.1	0.0	3.0	0.0	11.9
TA (AS, BO, CH, CO, NP, PD, PG)	<30,000	-1	30000	4-stroke	26.0	0.0	0.7	0.0	2.9
TA (AS, BO, CH, CO, NP, PD, PG)	<30,000	-1	30000	Steam	10.9	0.0	0.3	0.0	1.2
TA (AS, BO, CH, CO, NP, PD, PG)	30,000 - 60,000	29999	60000	2-stroke	252.8	0.0	5.1	0.0	18.8
TA (AS, BO, CH, CO, NP, PD, PG)	30,000 - 60,000	29999	60000	4-stroke	16.2	0.0	0.3	0.0	1.2
TA (AS, BO, CH, CO, NP, PD, PG)	30,000 - 60,000	29999	60000	Steam	175.0	0.0	3.5	0.0	13.0
TA (AS, BO, CH, CO, NP, PD, PG)	60,000 - 90,000	59999	90000	2-stroke	6.9	0.0	0.0	0.0	0.9
TA (AS, BO, CH, CO, NP, PD, PG)	60,000 - 90,000	59999	90000	4-stroke	1.1	0.0	0.0	0.0	0.1
TA (AS, BO, CH, CO, NP, PD, PG)	90,000 - 120,000	89999	120000	2-stroke	145.8	0.0	6.8	0.0	3.9
TA (AS, BO, CH, CO, NP, PD, PG)	90,000 - 120,000	89999	120000	Steam	3.2	0.0	0.2	0.0	0.1
TA (AS, BO, CH, CO, NP, PD, PG)	120,000 - 150,000	119000	150000	2-stroke	4.0	0.0	0.0	0.0	0.0
TA (AS, BO, CH, CO, NP, PD, PG)	>150,000	149999	1000000	2-stroke	6.9	0.0	2.3	0.0	0.0
TA (AS, BO, CH, CO, NP, PD, PG)	>150,000	149999	1000000	Steam	2.1	0.0	0.7	0.0	0.0



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New SCCs

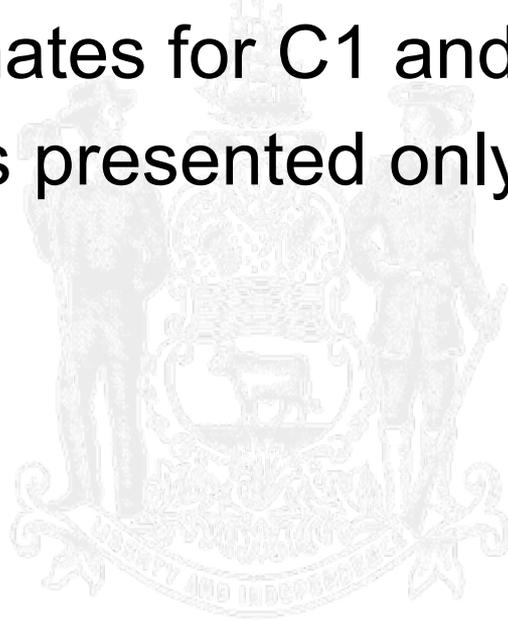
- Change in SCCs from 2014 to 2017
 - 2017
 - Category of ship (C1/C2 or C3)
 - Propulsion or Auxiliary engines
 - Port or underway emissions
 - These changes will be very valuable in future efforts



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EPA and DE comparison (2014)

- EPA CMV values are for whole CMV sector (including estimates for C1 and C2)
- DE CMV values presented only for OGV



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EPA and DE comparison (2014)

	NH ₃	CO	Lead	NO _x	PM10 Pri	PM2.5 Pri	SO ₂	VOC	
2014DEDNR	1	292		2,894	240	221	1,711	101	
2280002100	0	11		127	5	5	7	4	
2280002200	0	89		730	21	20	77	16	OGV
2280003100	0	13		141	15	14	119	5	
2280003200	1	179		1,896	198	183	1,508	76	
2014NEIV2	1	320	20	3,189	249	230	1,785	114	
2280002100	0	11	1	127	5	5	7	4	
2280002200	0	89	6	733	21	20	77	16	CMV
2280003100	0	16	2	176	16	15	128	7	
2280003200	1	204	11	2,153	206	190	1,572	87	



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Going Forward (1 of 3)

■ Activity Data

- <https://marinecadastre.gov/ais/>
- 1-minute interval for all AIS-equipped vessel
- National data split into zones
- One zone, for one month, is several GB CSV file

■ Emission Factors

- Need detailed ship data, including
 - Engine specs
 - Stack height
 - Auxiliary engine specs

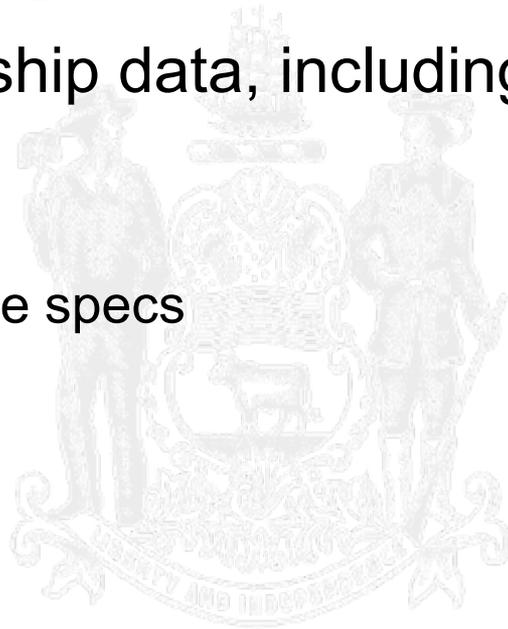


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Going Forward (2 of 3)

■ Emission Factors

- Need detailed ship data, including
 - Engine specs
 - Stack height
 - Auxiliary engine specs



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Going Forward (3 of 3)

- EPA will be producing CMV inventory using same activity data
- For inventory to be useful for states, we need it at its original resolution
 - If estimates are summed, will have limited use to states



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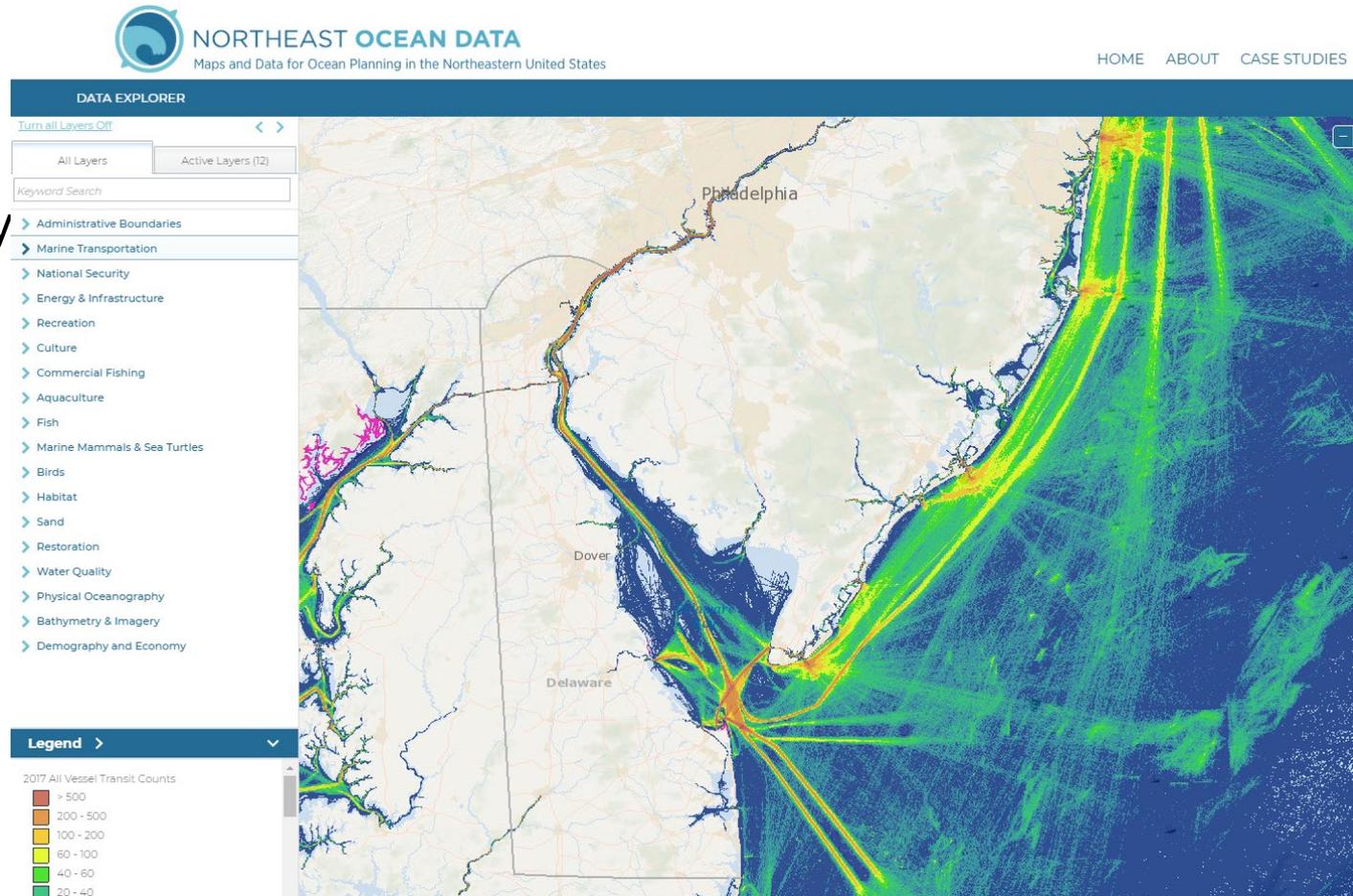
Ideal needs for further work

- What is really needed
 - Vessel Parameters that are
 - 1. Public
 - 2. Not behind a paywall
 - Collaborative work and code sharing for big data
 - MARAMA workgroup recently started
 - Previous LADCO work
 - C1/C2 may be a large part of the inventory as well



Viewing AIS Data

- Several websites out there already have nice maps of annual data



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Acknowledgements

- Dave Fees
 - DAQ Director
 - Began this work years ago
- Scott Anderson
 - Maritime Exchange
- EPA
 - Leadership on developing new CMV methodologies



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Thank You for Listening

- My Contact info:

Shane Cone

Shane.Cone@Delaware.Gov



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Finding other maritime organizations

- MISNA: Maritime Information Services of North America
 - Host list of member maritime organizations (including maritime exchange)

