

Improvements to the Commercial Marine Vessel Emission Inventory in the Vicinity of Houston, Texas

Prepared for the Houston Advanced Research Center (HARC)
By Eastern Research Group & Starcrest Consulting Group LLC
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Photo: Joyce Kristiansson

Update to the CMV Emissions Inventory in the Vicinity of Houston, Texas

Commonly Used Abbreviations

CO	carbon monoxide
CY	cubic yards
EEZ	Economic Exclusive Zone
EPA	U.S. Environmental Protection Agency
HARC	Houston Advanced Research Center
HGAVEI	Houston-Galveston Vessel Emissions Inventory (Starcrest 2000)
HP	horsepower
HSD	high speed diesel
kW	kilowatts
MDO	marine diesel oil
MGO	marine gas oil
MMS	U.S. Minerals Management Service
MSD	medium speed diesel
NOX	oxides of nitrogen
PM	particulate matter
RO	residual oil
RORO	roll-on roll-off ship
SO ₂	sulfur dioxide
SCC	source category code
SSD	slow speed diesel
TCEQ	Texas Commission on Environmental Quality
ULCC	ultra-large crude carrier
VLCC	very large crude carrier
VOC	volatile organic compounds

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Executive Summary

In terms of mass emissions for ocean-going ships this report is relatively consistent with the previous emissions inventory used in the Houston-Galveston State Implementation Plan for ozone. However, as more clarity is brought into the inventory, we see a dramatic increase in dwelling NOX with a corresponding and proportional reduction in transit emissions. There are several reasons for the increase in dwelling emissions. First, ships must jockey for a limited number of berths, since the harbor is running near capacity. Second, chemical tankers tend to make many deliveries and take on product at the same time (some chemical tankers have up to 60 double-hulled compartments). Third, ships must wait for orders, inspections and other regulatory requirements that cause them to “shift” within the harbor. Aside from tugboats, which are not updated in this report, results for other miscellaneous kinds of ships fall into marginal categories because their mass emissions are small.

It should be noted that dredging emissions are very high compared to the historical record because of Tropical Storm Allison remediation and two large channel deepening projects. As a result, year 2000 dredging emissions should not be projected into the future without using a negative growth rate.

A weakness of this study was a complete lack of information regarding government and military vessels. As mentioned in the proposal and work plan, recent national security issues may have contributed to this lack, in spite of sending Freedom of Information Act (FOIA) letters. Fishing boat emissions were equally difficult to estimate and were not included in our final totals. Findings from the in-port ships study are reported in Table ES-1.

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Table ES-1: Study Findings for In-Port Ships, 2000 Daily Emissions

Emission Type	NOX	VOC	CO
Transit	8.61	1.29	5.56
Dwell	12.12	0.38	1.34
Total HARC	20.73	1.67	6.90
HGAVEI (1997)	20.10	0.60	2.80

This study confirms the previous Starcrest findings regarding ocean-going vessels, updates dredge emissions for the new ozone episodes modeled in the year 2000, and makes some minor recommendations for miscellaneous vessel categories. The VOC and CO emissions were slightly higher than previously estimated, although their impact on ozone models is thought to be miniscule. As the same spatial resolution was used as the last marine vessel update, the new values will be easy to incorporate into the ozone model's pre-processing system. Some additional observations and recommendations follow:

- Dredge emissions are part of the harbor vessel category, so adjustments may be done by (1) removing 0.75 tons of NOX from the former base case and (2) by adding 10.97 tons back in; however, existing base case emissions (e.g., 0.75 tons of NOX) should be used in the 2007 future case
- Beaumont in-port emissions should be updated and added to the emissions inventory because both Houston and Beaumont are modeled as to ozone at the same time, perhaps as a "phase II" effort
- Such a second phase would allow for updates to non-port marine vessel emission estimates, especially in parts of the Gulf of Mexico not addressed in the scope of this report; there are also plans to validate all the emission factors and investigate whether a "ton-mile" method would be a better predictor of at-sea emissions

Reducing uncertainty in the existing emissions inventory for ocean-going ships was perhaps the main benefit of the report. The additional dredge emissions may affect the base case photochemical modeling because the numbers are so large. For selected offshore zones, updating ocean-going emissions was another benefit, since those emissions have not been updated in almost ten years.