

Marine Shipping and Air Quality

Santa Barbara County

Our Interest in Vessel Speed Reduction



**Santa Barbara County
Air Pollution Control District**

**Mary Byrd | Marine Shipping Working Group
May 5, 2015**

Marine Shipping Notes

- Most efficient mode of transporting goods
- Air emissions not controlled as much as onshore air emissions sources – until recently
- Recently:
 - State, federal, and international rules
 - Ports measures to control air pollution



Air Pollution from Shipping

- Particle pollution, known as particulate matter (PM)
- Air toxics (carried on particles)
- Sulfur oxides (SO_x), carbon monoxide (CO)
- Smog-forming (ozone-forming) pollution:
 - Nitrogen Oxides (NO_x)
 - Reactive Organic Compounds
- Greenhouse gases



Air Pollution Regulations

- California Fuel Rule
- International Maritime Organization: North American Emissions Control Area (ECA)



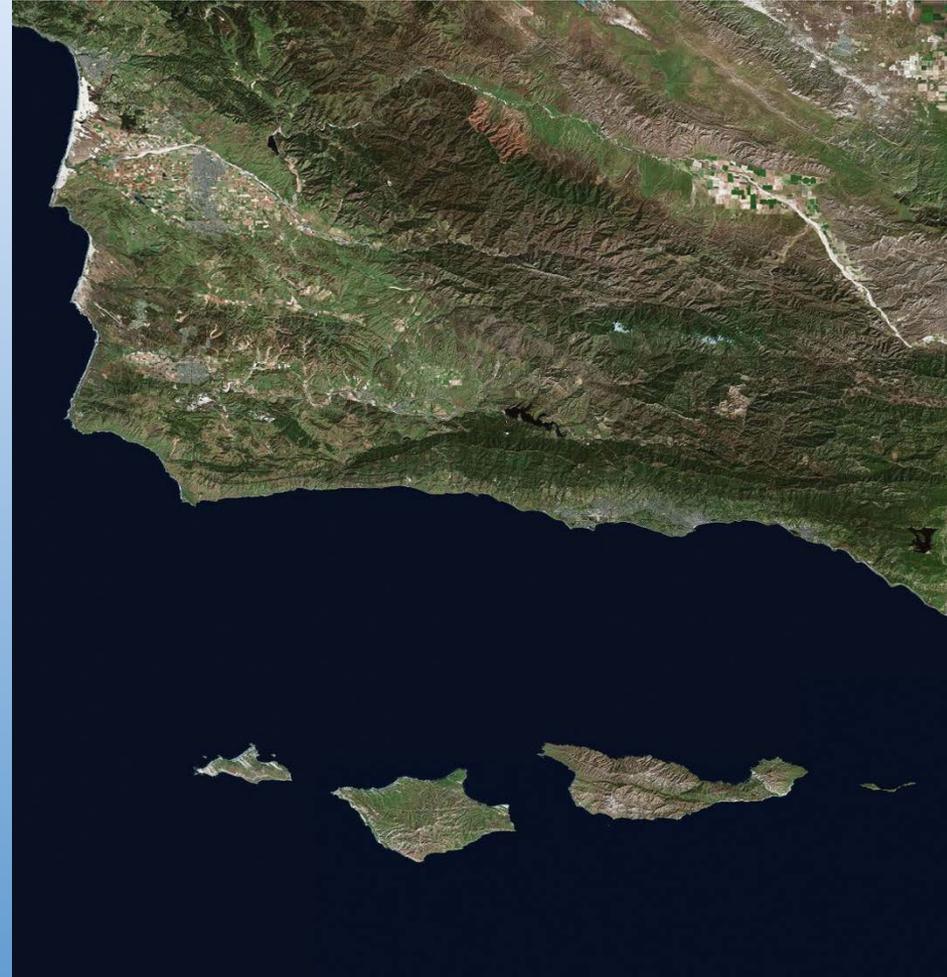
Air Pollution Regulations



- ECA/California lower sulfur fuels produce significant reductions of: particulate, toxics, sulfur emissions
 - Only small reductions in NO_x
 - No reductions in greenhouse gases
- Cleaner engine rules part of ECA
 - Apply starting 2016
 - Only apply to new engines at start
 - Will reduce NO_x, but only over long term as engines are replaced in the fleet

Santa Barbara County

- 130 miles of coastline
- Does not meet the state ozone (smog) standard
- Meets the federal ozone standard (just barely)
 - Federal standard may be tightened
- Need to reduce ozone-forming emissions (NO_x)
especially in peak ozone season (late spring – fall)



Sources of NO_x Santa Barbara County

- Marine shipping
- Off-road mobile sources
- On-road mobile sources
- Stationary sources (under our direct regulatory control)
- Area-wide sources

Note: while we are refining our emissions estimates,

Marine shipping is still a major source of NO_x

Why a Vessel Speed Reduction Strategy

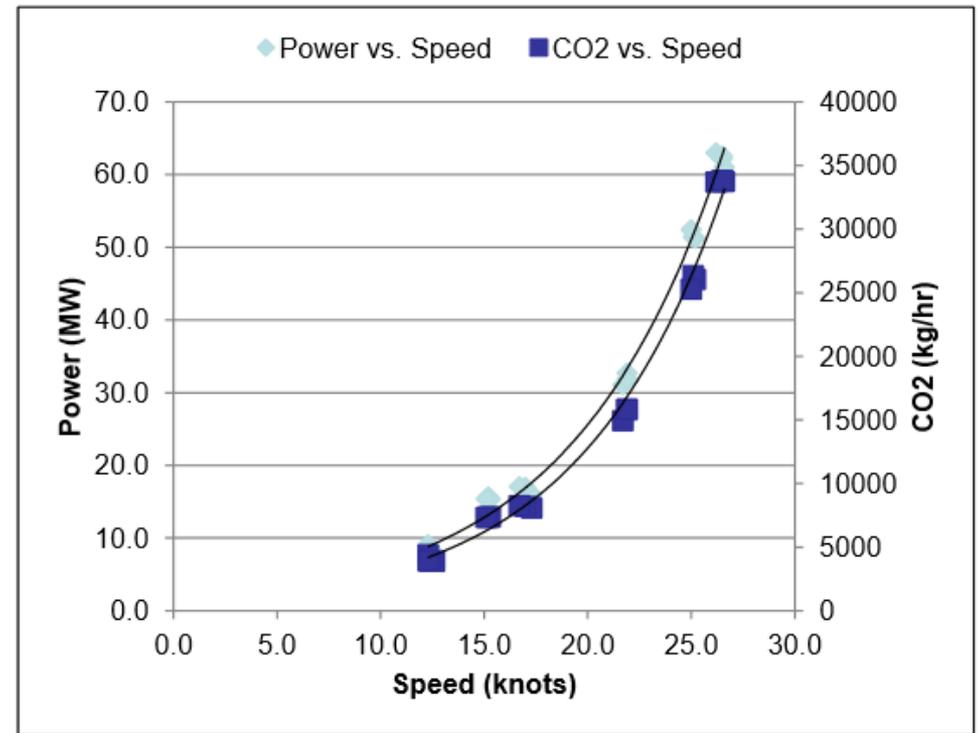
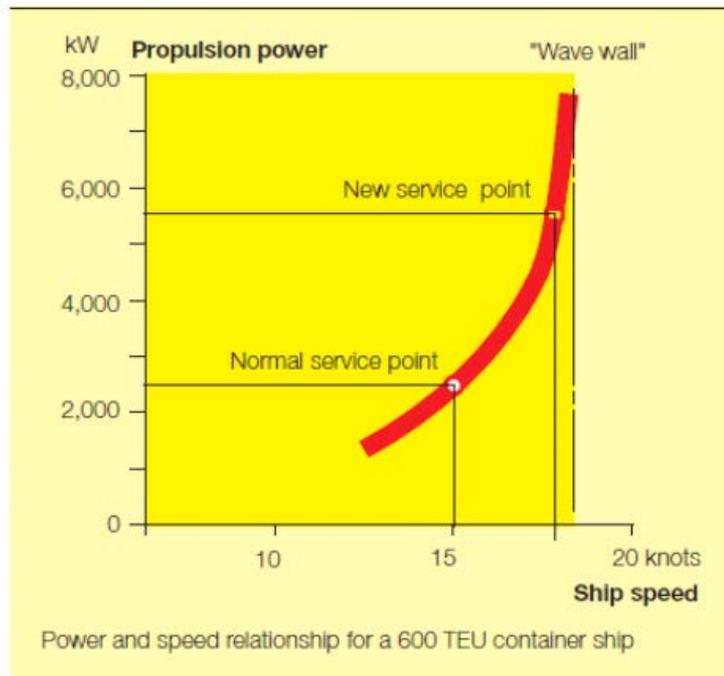
- Operating engine at higher efficiency reduces air emissions, **including NOx**
- Increases fuel efficiency, **decreasing greenhouse gas emissions**
- Documented in “Greenhouse Gas and Criteria Emission Benefits through Reduction of Vessel Speed at Sea” (Khan, Miller, et. al. Environ. Sci. Technol. 2012, 46, 126000-12607)



Study (J. Wayne Miller at 2014 Forum)

- Container ships at sea
- Stack emissions before/after speed reduced to 12 knots

Theory vs Data



(Ref: : Appendix E from MANN B&W Technical Report, *Basic Principles of Ship Propulsion*)

Study Results (Miller cont.)

- Stack emission results- speed reduction to 12 knots:
 - Reduced greenhouse gas (CO₂) emissions by 61 %
 - Reduced NO_x emissions by 56%
 - See presentation at www.OurAir.org

UCR | College of Engineering - Center for
Environmental Research & Technology



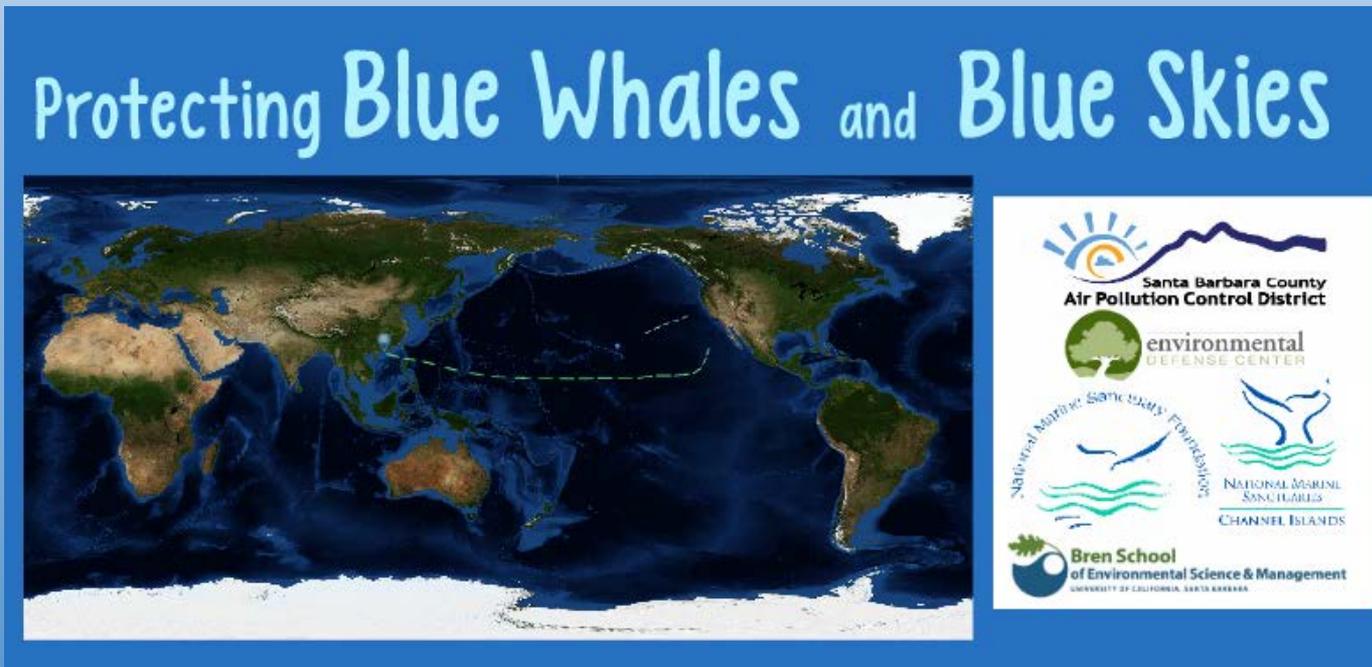
Vessel Speed Reduction Lowers Emissions

Research funded by US EPA and California Air Resources Board

Protecting Blue Whales and Blue Skies
Community Forum
Wednesday, September 10, 2014 3-5 PM
Cabrillo Pavilion Arts Center, 1118 E. Cabrillo Blvd
Santa Barbara, CA 93103

Results from VSR Trial 2014

- Similar to Study
- Emission reductions approx. 50 percent from baseline
 - 16 tons NOx reduced
 - 500 metric tons of greenhouse gases reduced



Data Input to Sea Sketch

Assume Vessel Speed(knots)	Average Ship Emissions (Pounds per Nautical Mile)							Metric Tons CO ₂ e (per nautical mile)
	NO _x	ROG	SOX	CO	PM ₁₀	CO ₂	CH ₄	
10	7.40	0.34	0.16	0.48	0.11	255.90	0.03	0.12
12	10.65	0.49	0.23	0.69	0.16	368.50	0.04	0.17
14	14.50	0.67	0.31	0.94	0.21	501.56	0.06	0.23
16	18.94	0.87	0.40	1.23	0.28	655.11	0.08	0.30
18	23.97	1.10	0.51	1.55	0.35	829.12	0.10	0.38

- Emissions based on 2013 transits through Santa Barbara Channel; container ships that serviced POLA/POLB
- Routing and ship-specific maximum speed data provided by Marine Exchange of Southern California
- Main Engines Only; emissions calculated for each container ship then averaged for each speed class
- Average power of container ship (37,265 kW) and emission factors from California Air Resources Board Emissions Estimation for Ocean-Going Vessels, May, 2011
- Will continue to refine numbers

VSR Emission-Reduction Challenges



- Speeding up cancels the benefit
- Difficult to produce verifiable greenhouse gas emission reductions (global pollutant)
- Reducing below 12 knots may create inefficiencies
 - Especially for larger ships and engines
 - Industry trend towards bigger ships

Additional Perspectives

- Moving emissions outside the Islands versus in the Channel
 - Could impact areas to the south of us (San Diego)
- Other emission-reduction strategies
 - Potential to reduce NO_x
 - May be longer term options; investments
- VSR appeal
 - Near-term reductions without capital investments
 - Potential for GHG reductions
 - Common ground with whale protection



Questions

More info at <http://www.ourair.org/air-pollution-marine-shipping/>

ByrdM@sbcapcd.org

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