Air Pollution in the Santa Barbara Channel

Shore to Sea Lecture Series

Tom Murphy, Division Manager
Santa Barbara County
Air Pollution Control District
August 11&12, 2009

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Overview

- Air Quality regulatory framework
- Pollutants/Health effects
- Ozone trends/Meteorology/Other sources
- Shipping in the Santa Barbara Channel
  - Our case study
  - Planning process - emission inventories
  - Regulatory efforts
  - Demonstration project
  - Port Hueneme
  - Ship types

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Regulatory Framework

- **IMO** – International Maritime Organization
- **Federal** – U.S. Environmental Protection Agency
- **State** – California Air Resources Board
- **Local** – Air Pollution Control & Air Quality Management Districts

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California Air Districts & Counties

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Pollutants Overview

- Ozone, a.k.a. smog
  - Oxides of Nitrogen (NOx)
  - Reactive Organic Gases (ROG, or VOCs)
- Particle Pollution
  - Inhalable Particulate Matter (PM10)
  - Fine Particulate Matter (PM2.5)
- Toxic Air Contaminants
  - Identified by state or federal government
  - Classified for cancer or non-cancer effects
- Greenhouse Gases
  - State's Global Warming Solutions Act - AB 32

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Pollutants & Health

- Ozone
  - Irritates eyes, nose, throat and lungs
  - Exacerbates and can cause asthma
  - Contributes to heart and lung disease and early death
- Particle Pollution
  - All of the above, and
  - Can have serious effects on those with heart ailments
  - Penetrates lung tissue; small particles cannot be removed by body's defenses, disrupt lung cell function
  - Has additional and very serious adverse effects on children
- Toxic Air Pollution
  - Acute and chronic effects, some cause cancer
  - Some have non-cancer effects, such as causing birth defects, sterility, nerve or brain damage, or damage to eyes, skin, organs and organ systems
- Greenhouse Gases
  - Climate change and a range of related impacts

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Air Pollution and Children

Southern California Children's Health Study showed pollutants from fuel combustion:

- Slow lung growth in children
- Decrease lung function in children
- Increase asthma rates in children
- Produce some effects that can't be reversed (will affect children for life)
- Other effects included increased hospital admissions, more missed school days, and greater care costs for affected children

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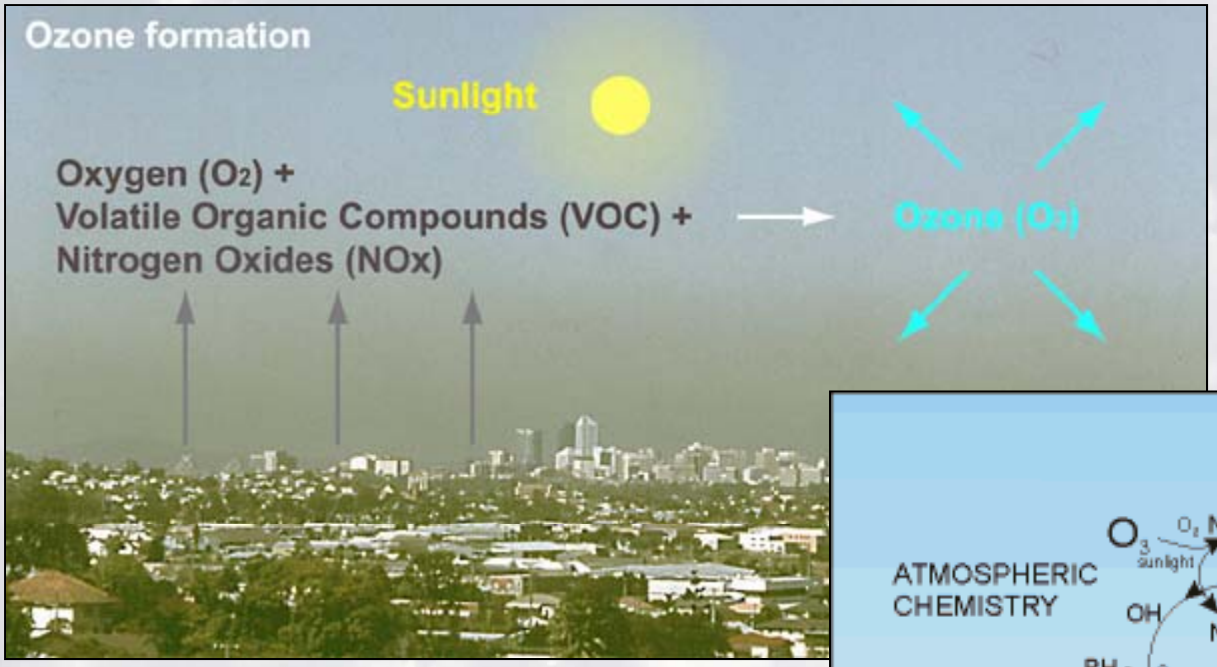
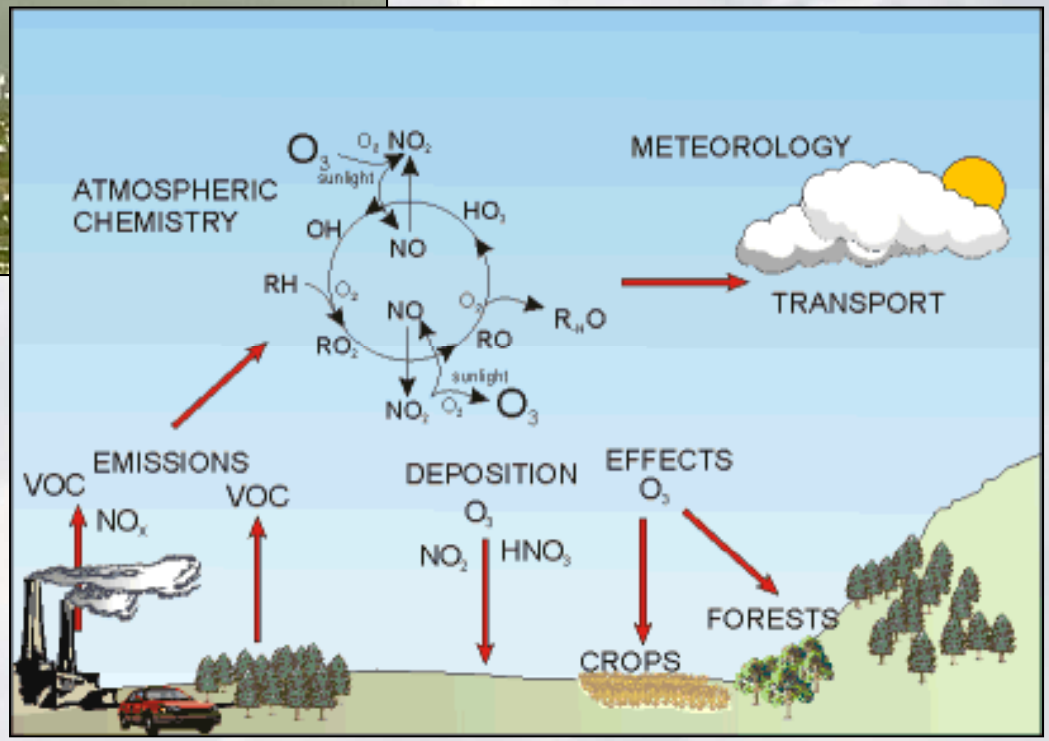
Ozone Formation





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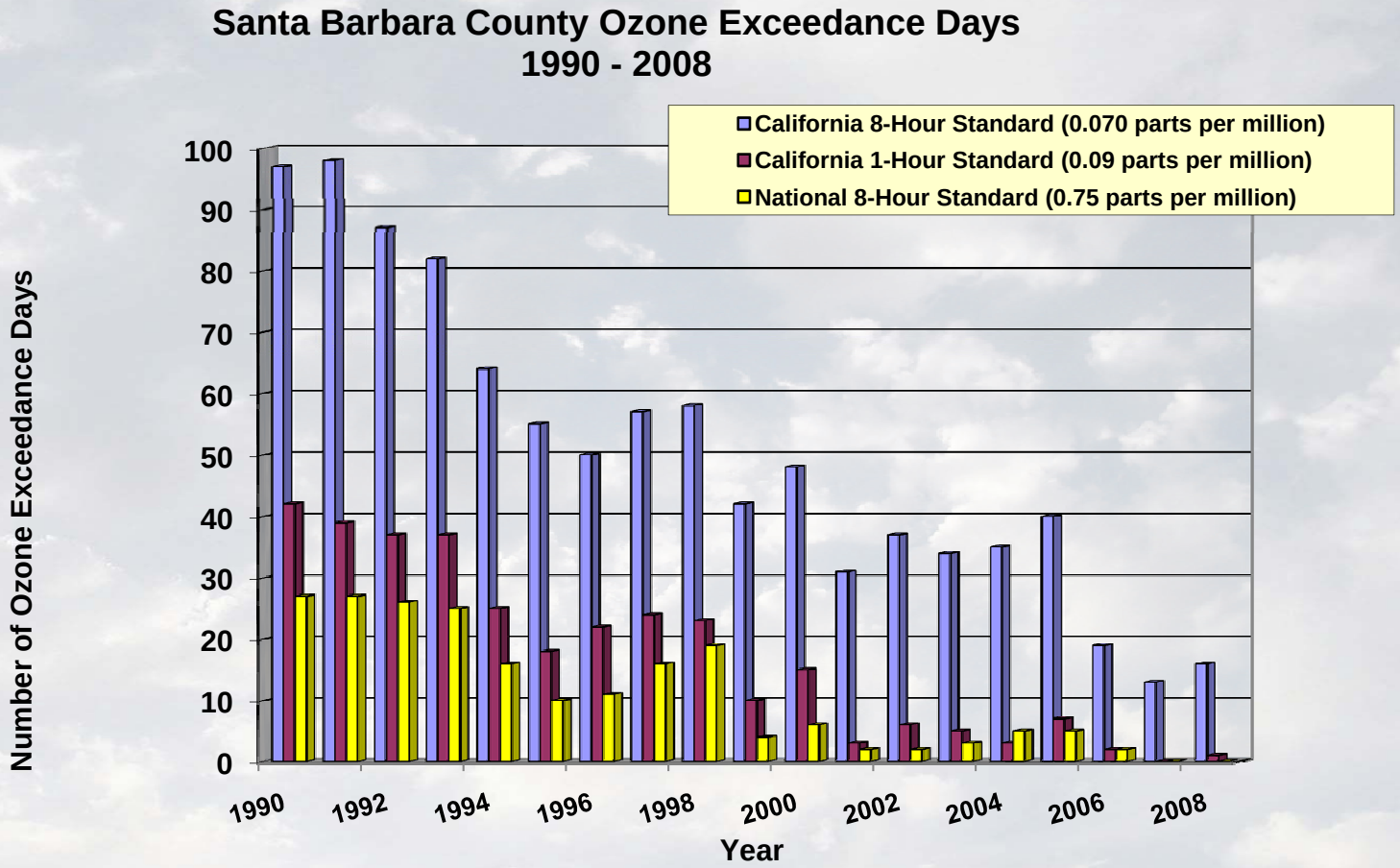
Santa Barbara County Ozone Trends



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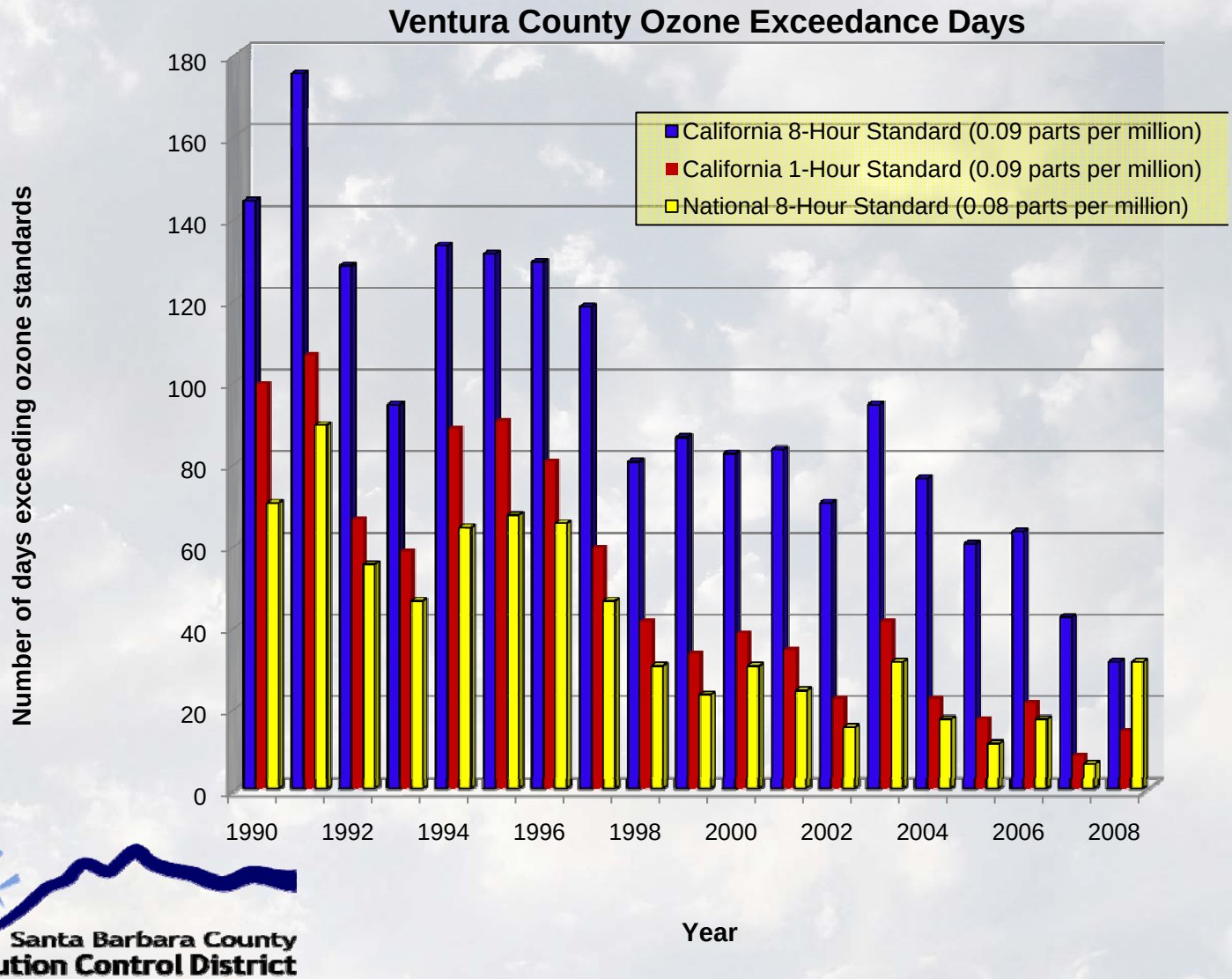
Ventura County Ozone Trends



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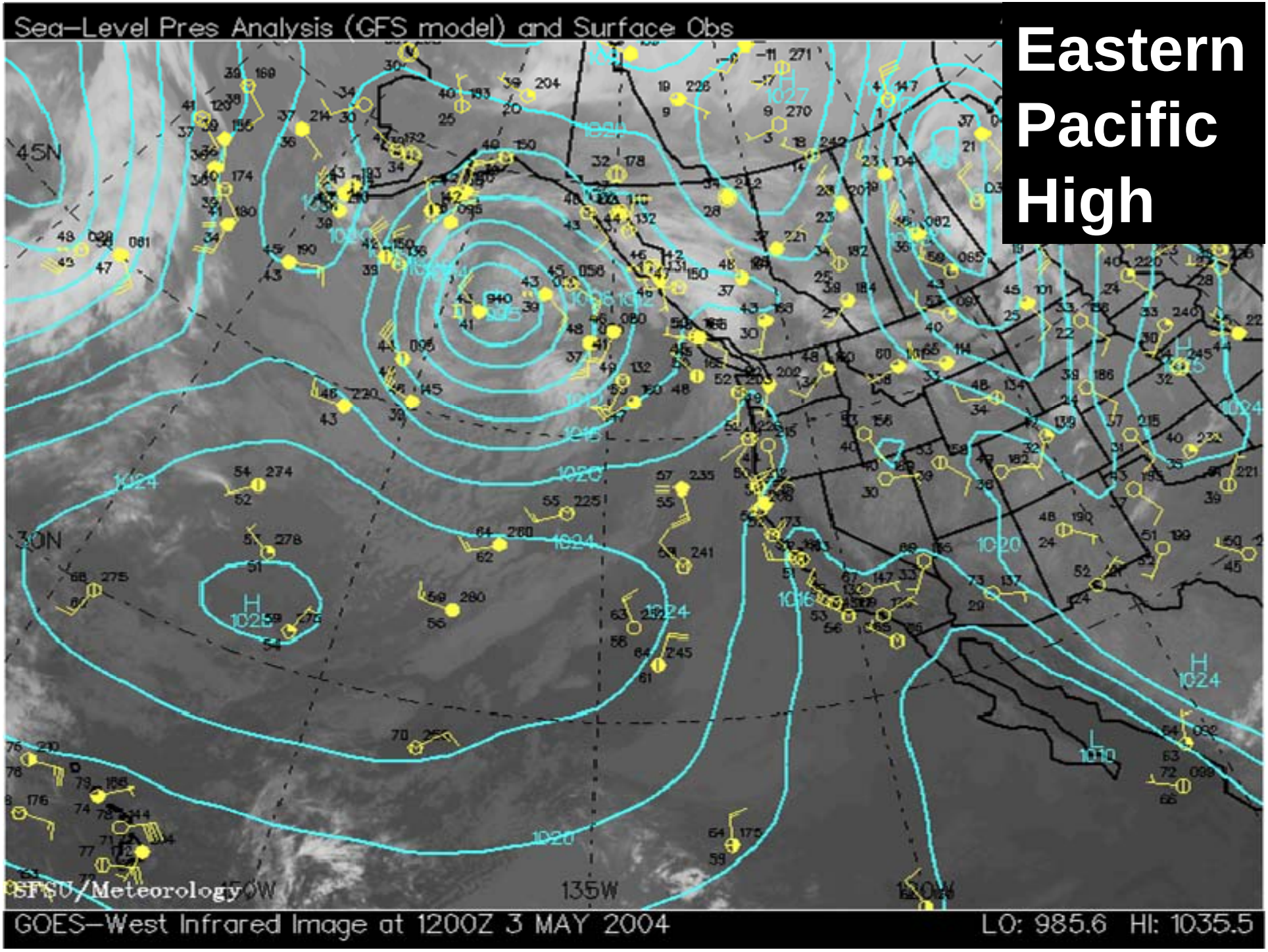
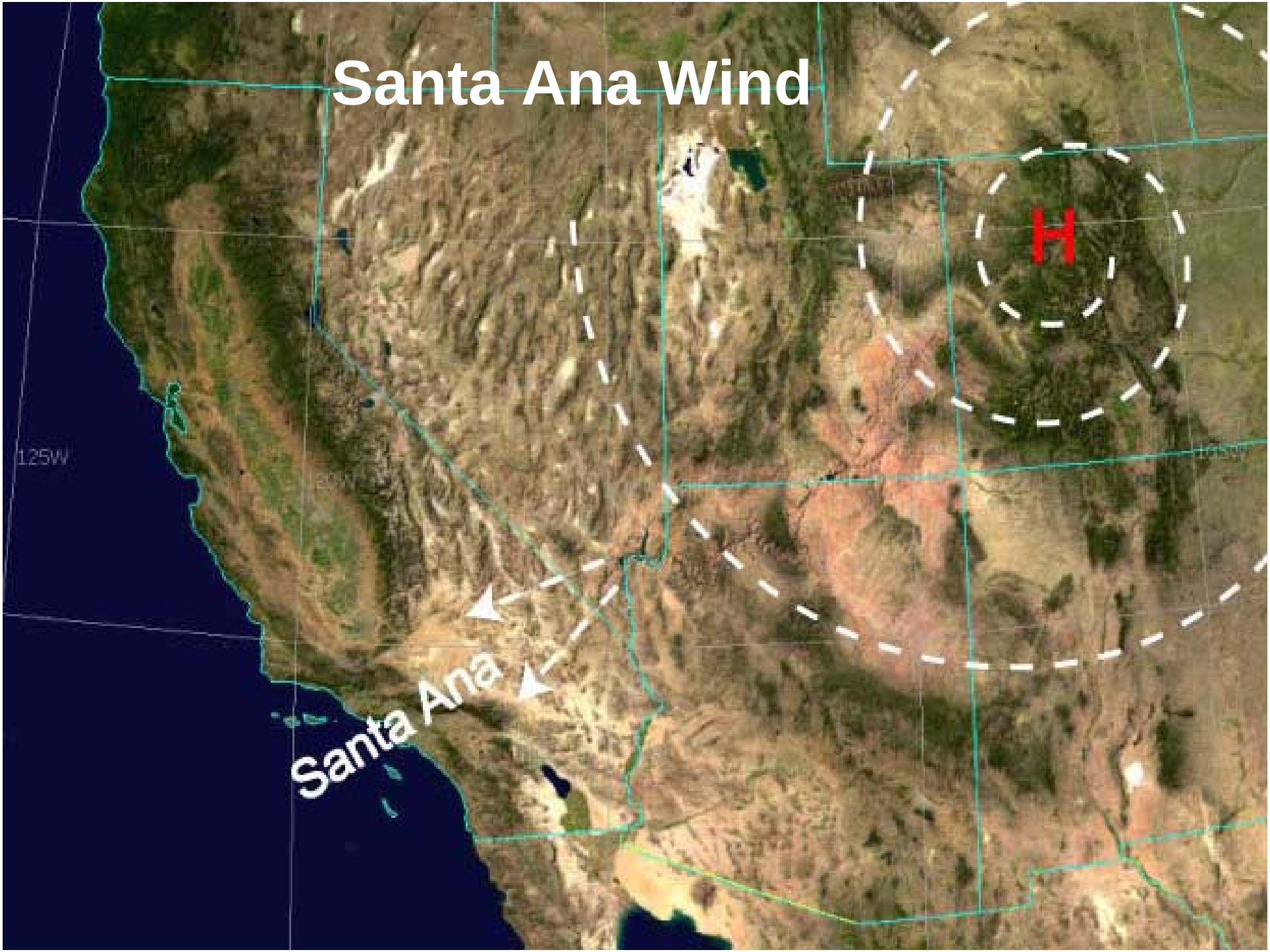
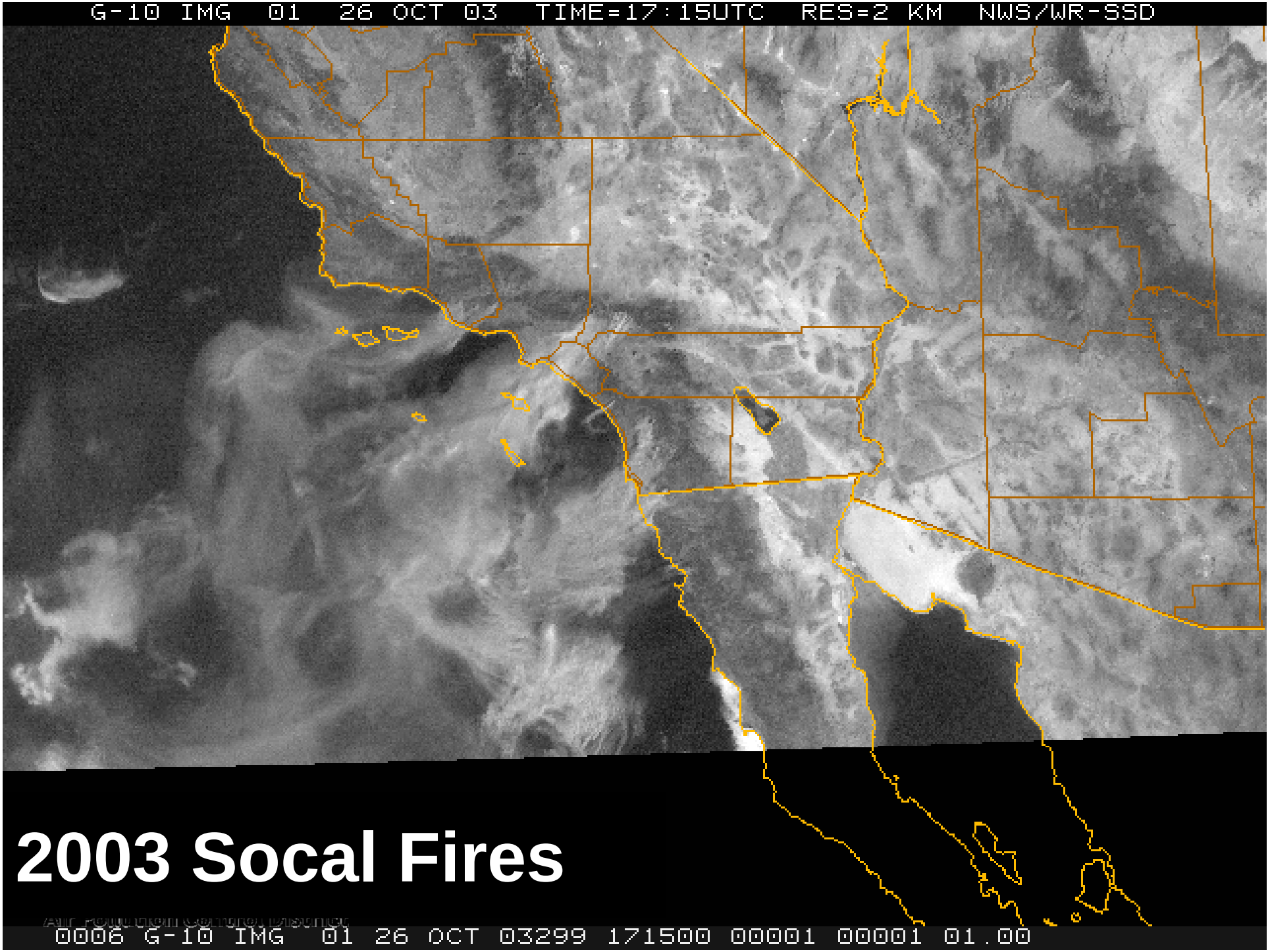

Sea-Level Pres Analysis (GFS model) and Surface Obs
Eastern Pacific High
45N
30N
135W
SFSU/Meteorology
GOES-West Infrared Image at 1200Z 3 MAY 2004
LO: 985.6 HI: 1035.5

Catalina Eddy

.E (CH 01) - 15:03 UTC 06 JUN 2002 - CIMSS


Santa Ana Wind
H
125W
Santa Ana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2003 Socal Fires
0006 G-10 IMG 01 26 OCT 03299 171500 00001 00001 01.00

Ventura County Fire

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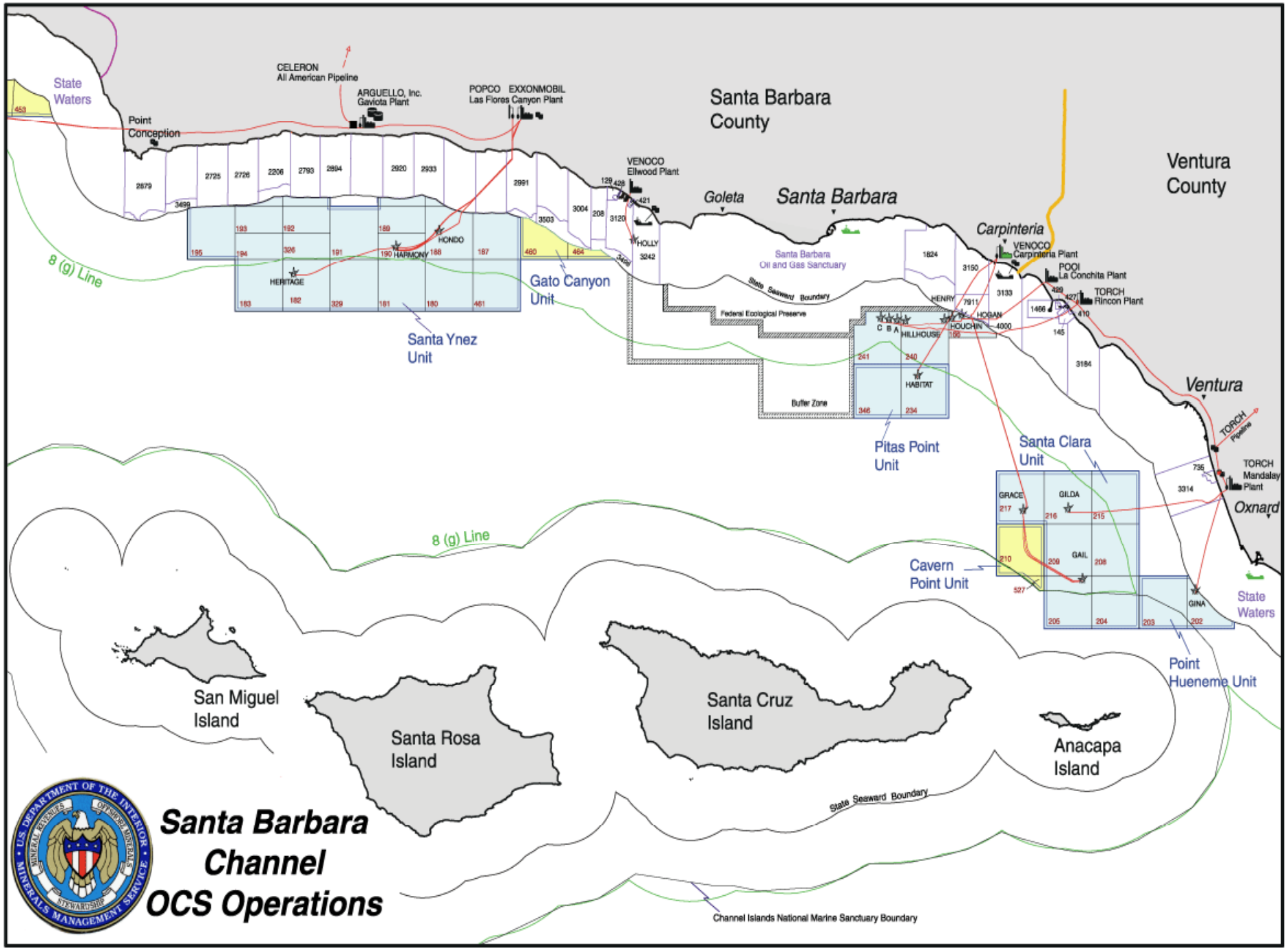
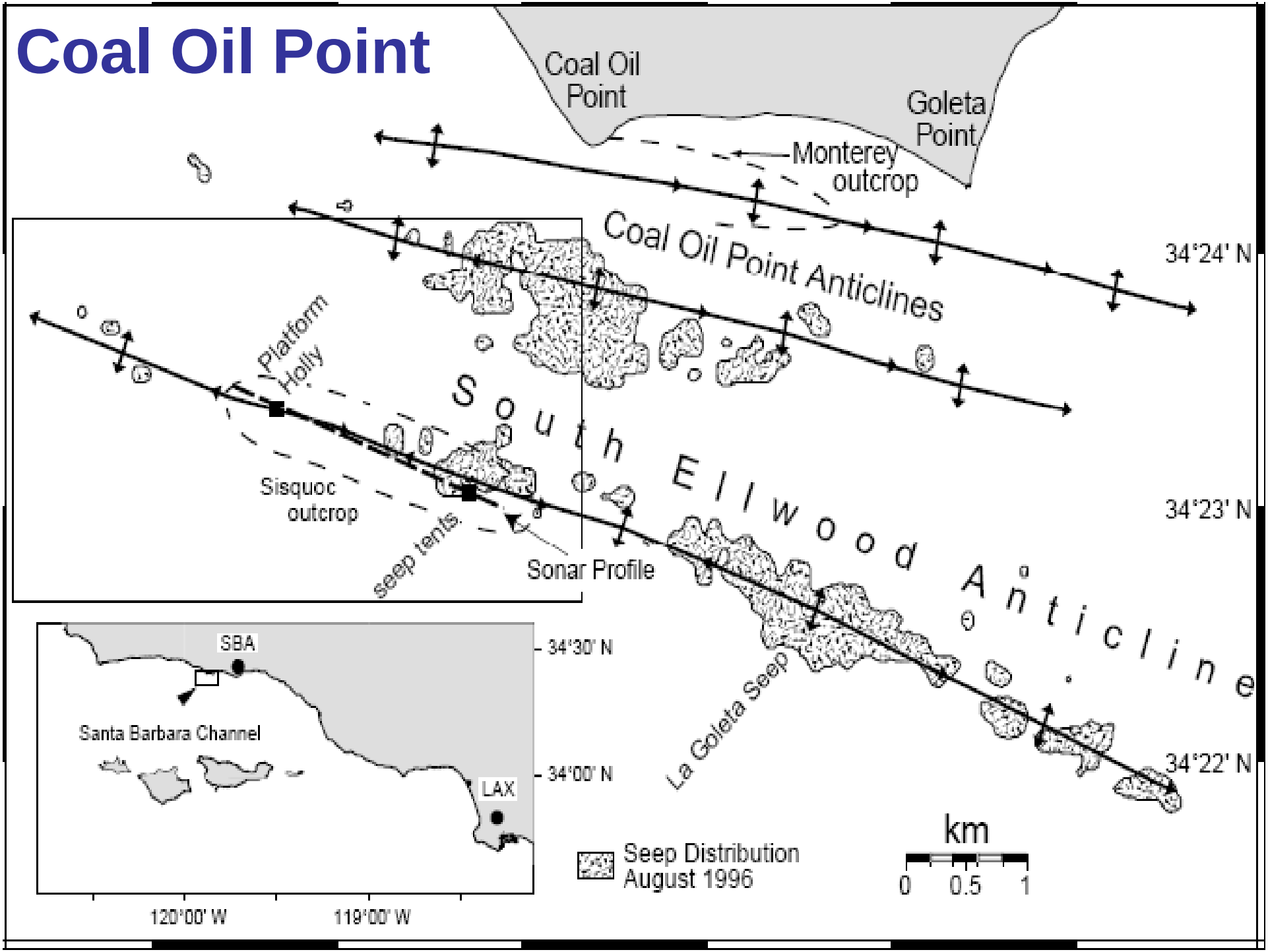
Platform Gilda
DANGER
GILDA


Santa Barbara Channel OCS Operations
State Waters
Point Conception
CELERON
All American Pipeline
ARGUELLO, Inc.
Gaviota Plant
POPCO
Las Flores Canyon Plant
EXXONMOBIL
Santa Barbara County
Ventura County
VENOCO
Ellwood Plant
Goleta
Santa Barbara
Carpinteria
VENOCO
Carpinteria Plant
POOI
La Conchita Plant
TORCH
Rincon Plant
Ventura
Oxnard
TORCH
Mandalay Plant
TORCH
Pipeline
8 (g) Line
Santa Ynez Unit
Gato Canyon Unit
Santa Barbara
Oil and Gas Sanctuary
State Seaward Boundary
Federal Ecological Preserve
Buffer Zone
Pitas Point Unit
Santa Clara Unit
Cavern Point Unit
Point Hueneme Unit
HONDO
HARMONY
HERITAGE
HOLLY
HENRY
HOGAN
HOUCHIN
HILLHOUSE
HABITAT
GRACE
GILDA
GAIL
GINA
San Miguel Island
Santa Rosa Island
Santa Cruz Island
Anacapa Island
Channel Islands National Marine Sanctuary Boundary

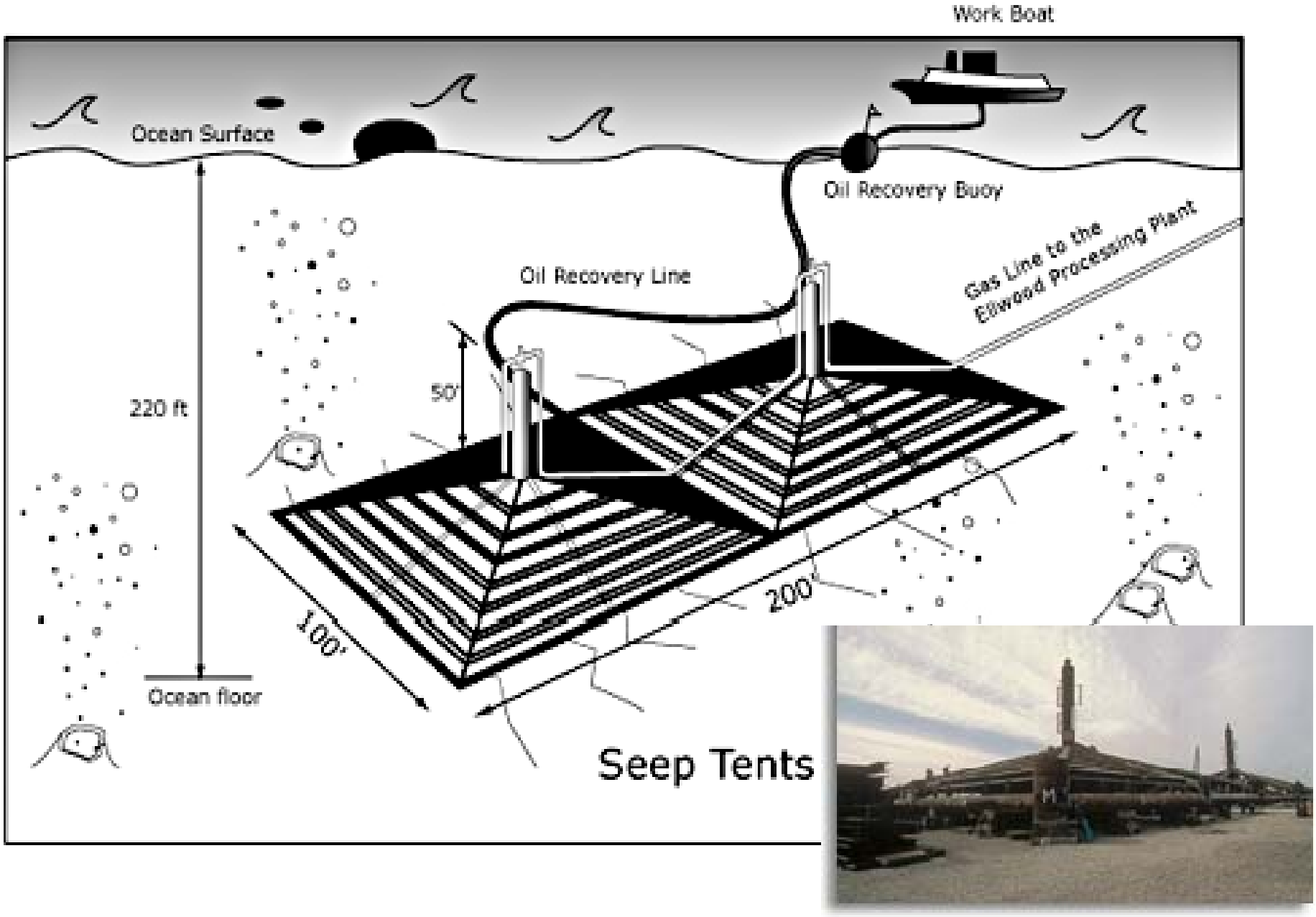

Natural Oil and Gas Seeps

Coal Oil Point



Installation of a Seep Tent

Seep Containment Devices -- 1982



Shipping in the SB Channel

Santa Barbara Case Study

- Over 7,200 annual traverses
- 130 miles of coastline
- Large 2-stroke engines
- Vessels burning heavy bunker fuels
- Slow turnover rates
- Majority of the vessels are foreign flagged
- Trade volumes expected to continue to increase

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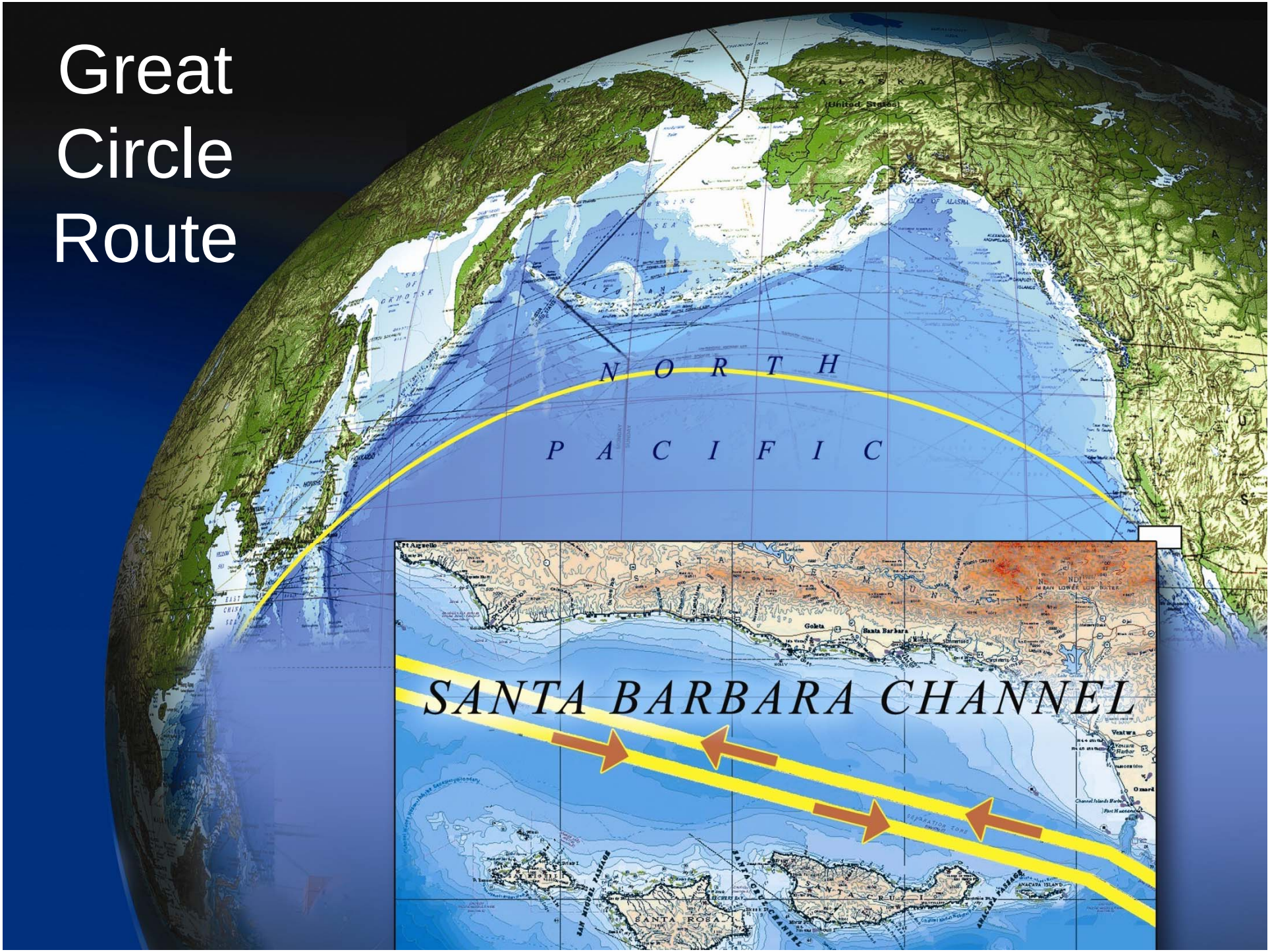
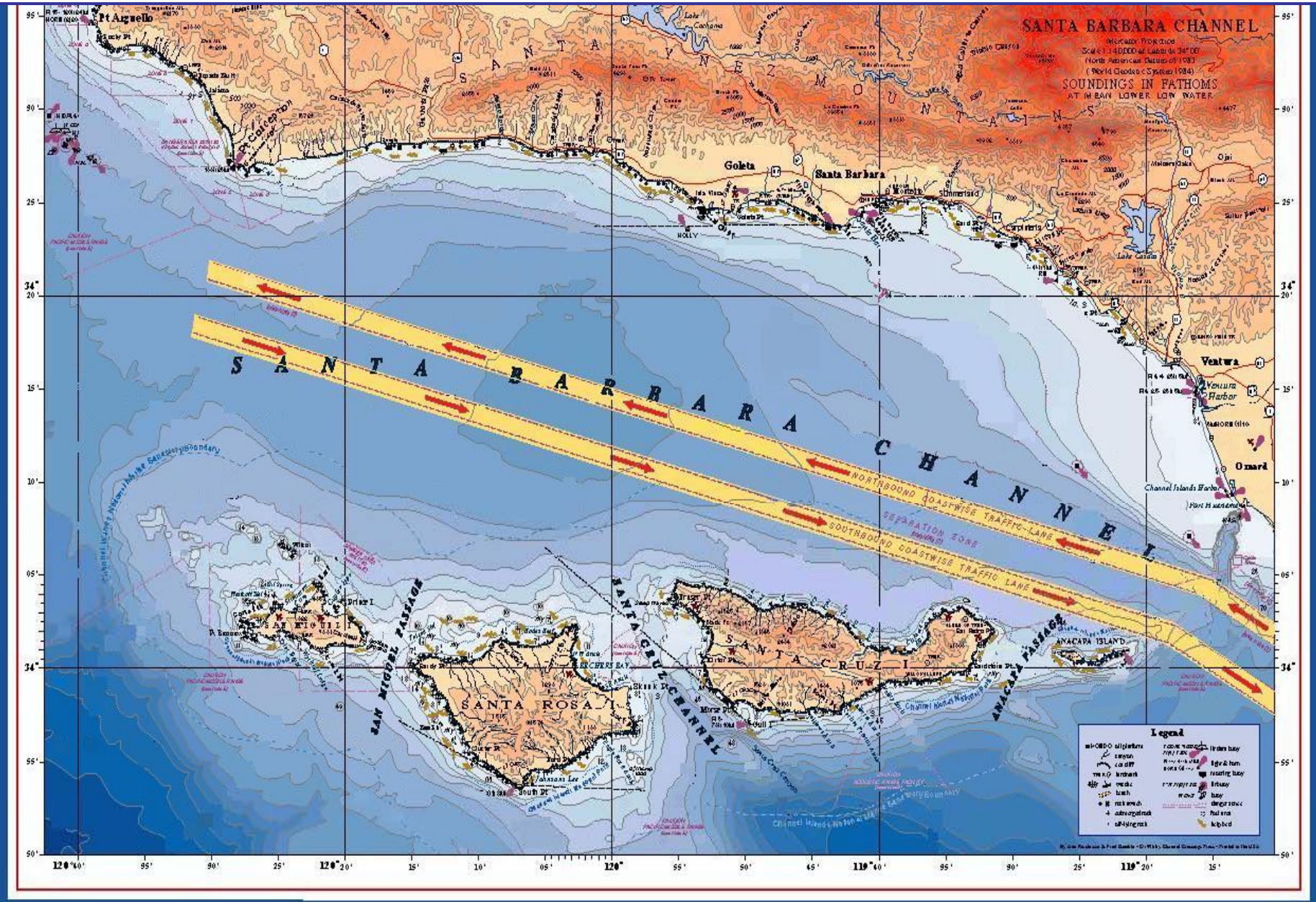
Great Circle Route



Santa Barbara Shipping Lanes



Clean Air Planning Process

Goal: attainment of state and federal standards

- Develop emission inventories
- Evaluate emission control measures
- Forecast emissions
- Marine shipping contribution: large and growing
- 2010 – next Clean Air Plan

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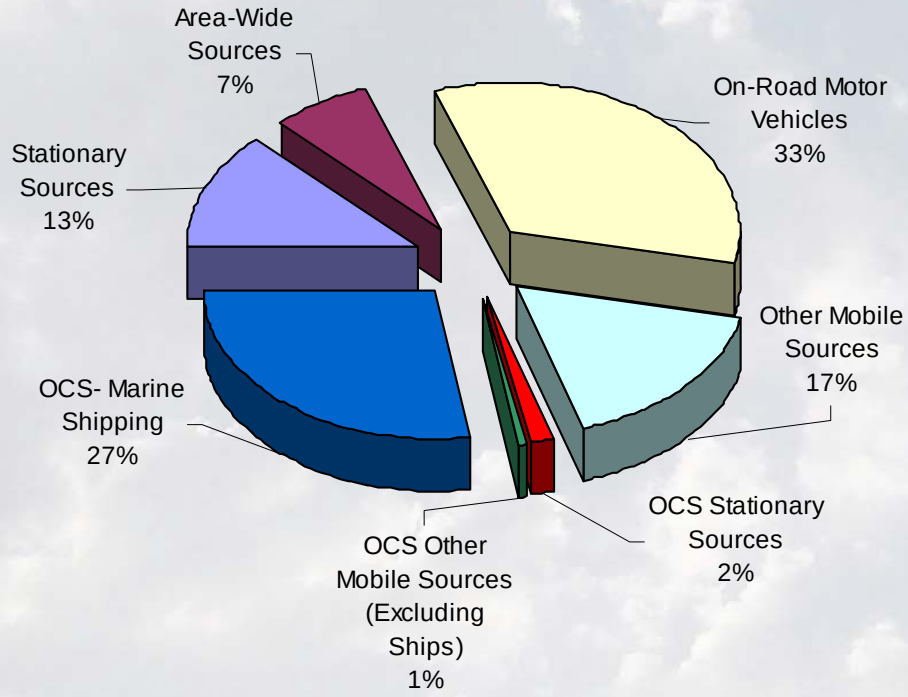
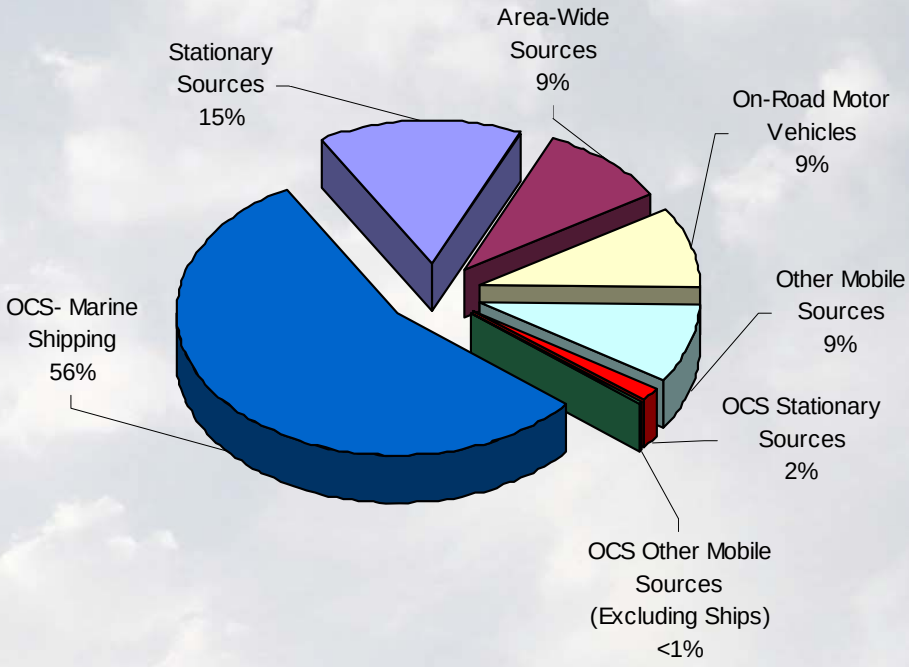
ROC & NOx Emission Sources *

2000 Santa Barbara County ROC & NOx Emissions
122 Tons per day



2020 Santa Barbara County ROC & NOx Emissions
120 Tons per day



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* Includes both Onshore & OCS Emissions

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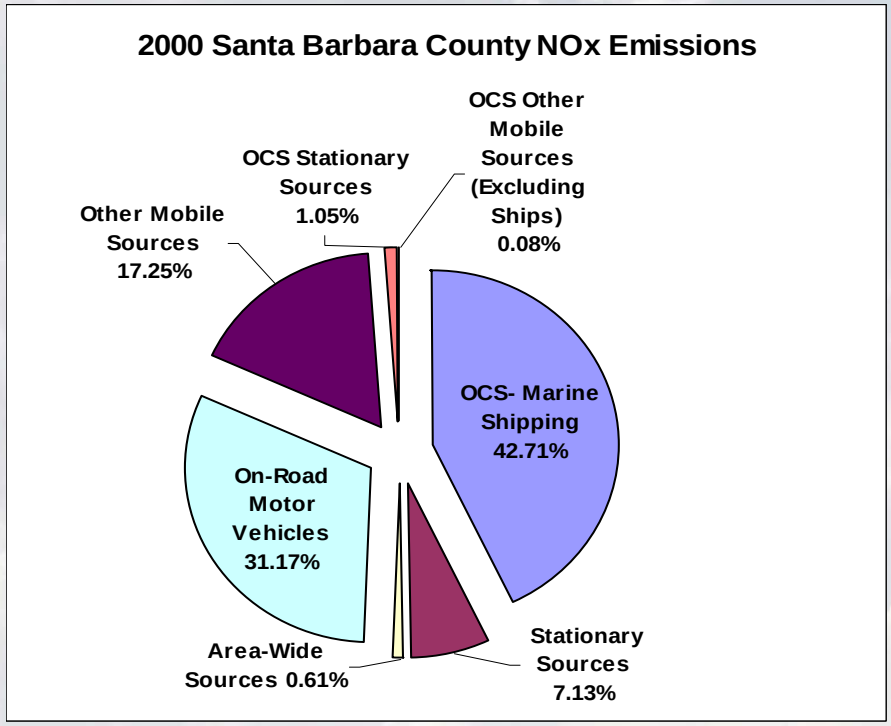
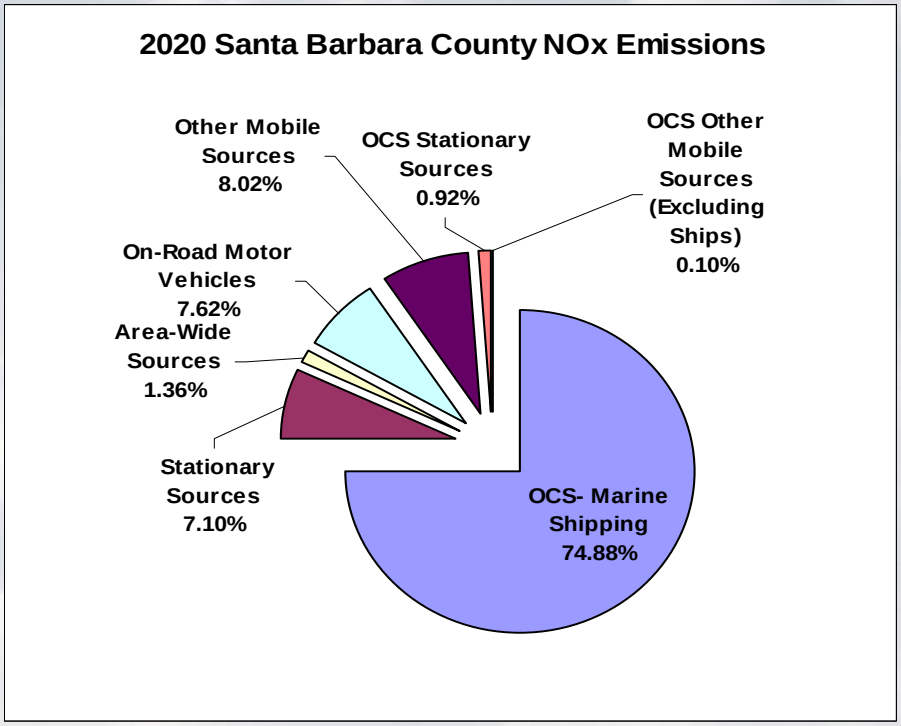
NOx * Emissions Comparison





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* NOx = Onshore + OCS

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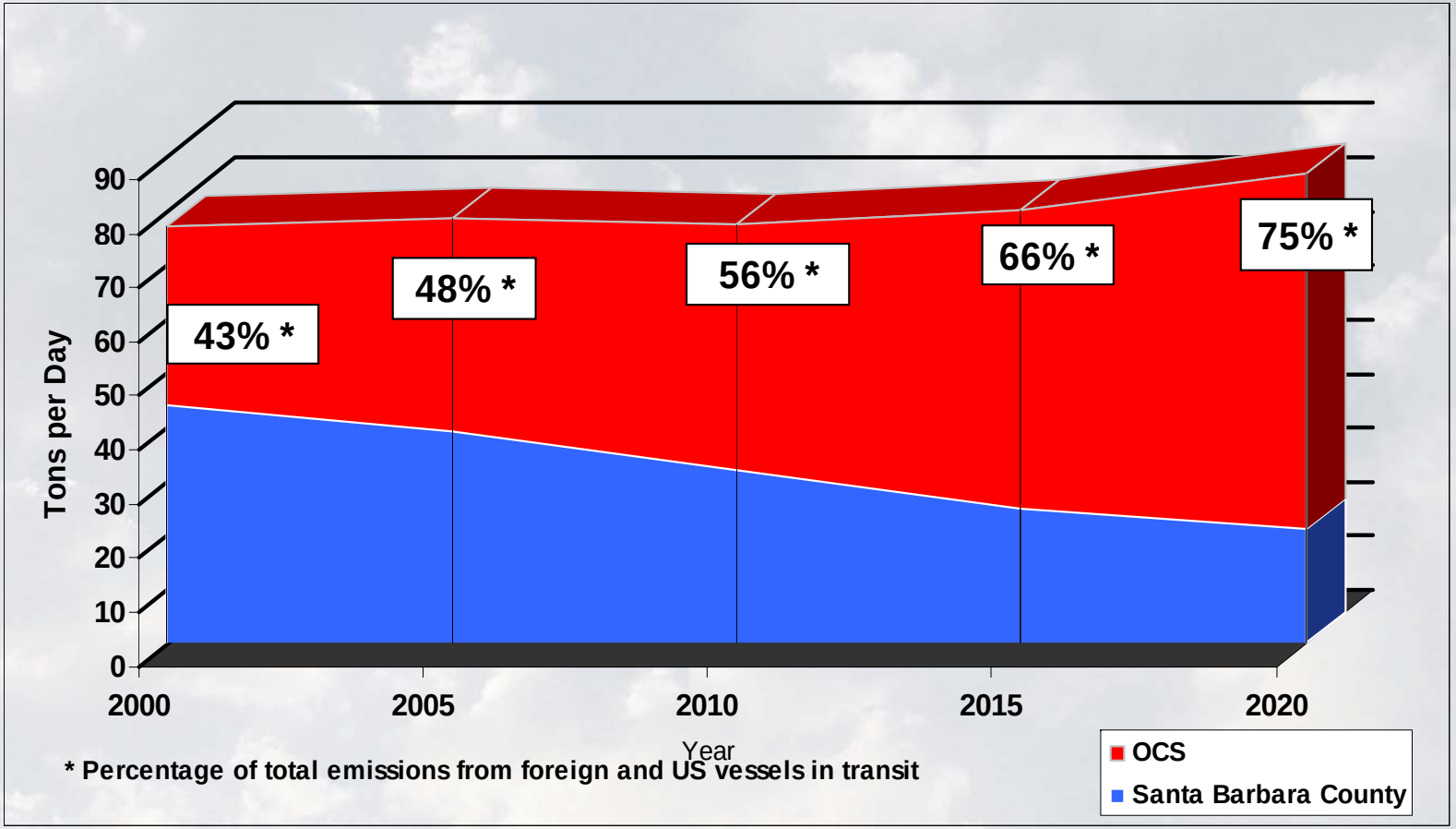
NOx * Emission Forecast



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* NOx = Onshore + OCS

2005 Marine Shipping Inventory

- Over 7,000 transits
- 10% of vessels = 56% NOx emissions
- 76 vessels over 50 tons of NOx
- 92% of NOx from foreign flagged vessels
- About 19 transits per day
- About 40 tons of NOx and 3 tons of PM emitted daily

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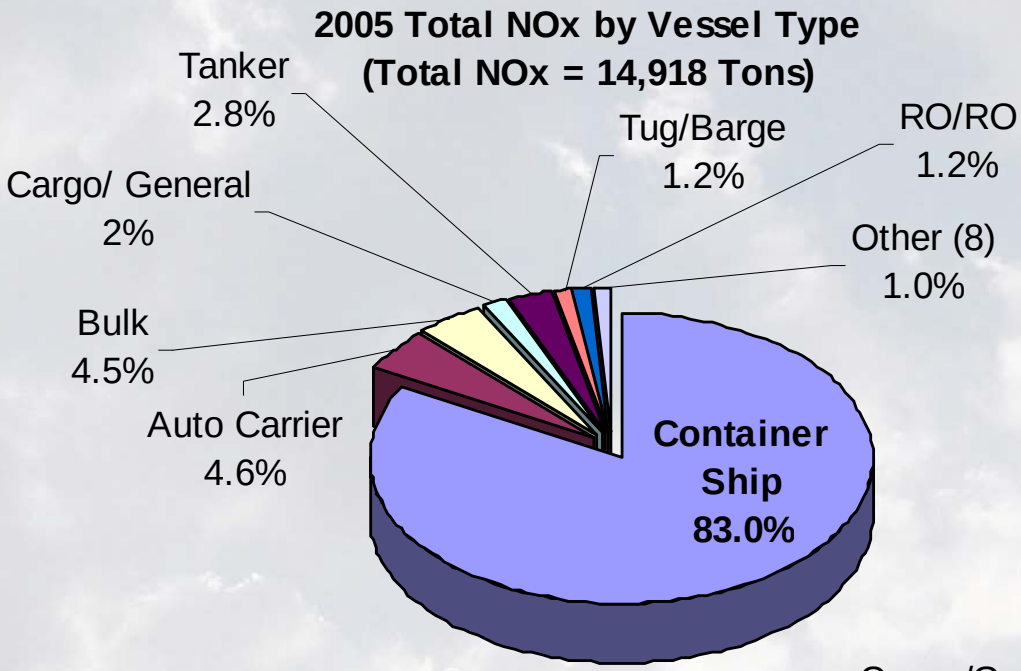
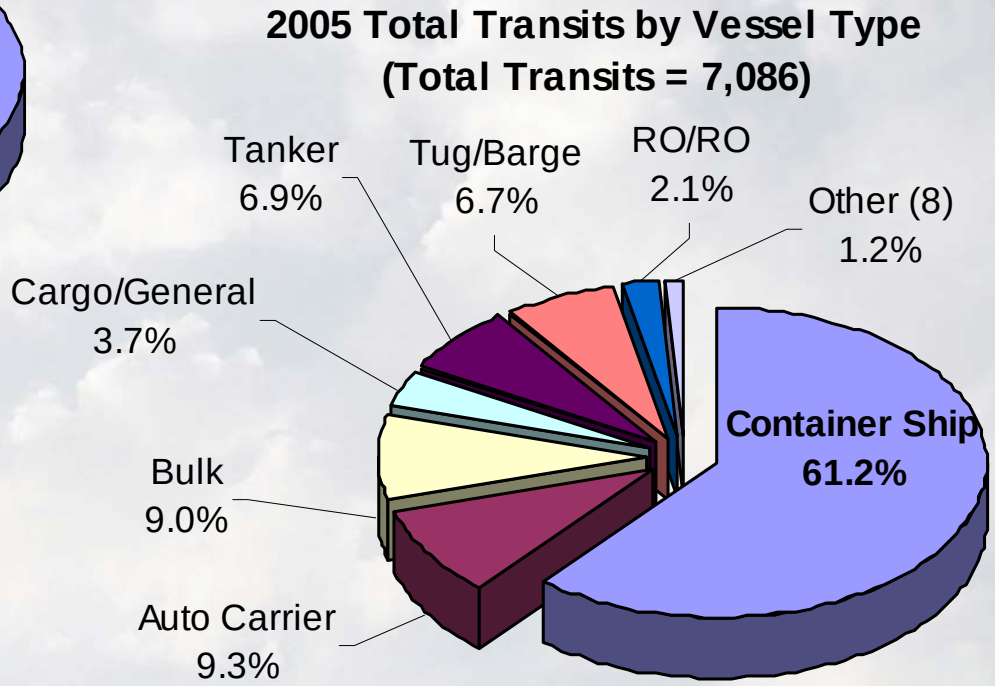
Ship Type Analysis





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Health Impacts

- 1,100 premature deaths
- 31,000 asthma related cases
- 2600 acute bronchitis cases
- 190,000 lost work days
- EPA estimates that new proposed standards would save 8,300 American and Canadian lives by 2020

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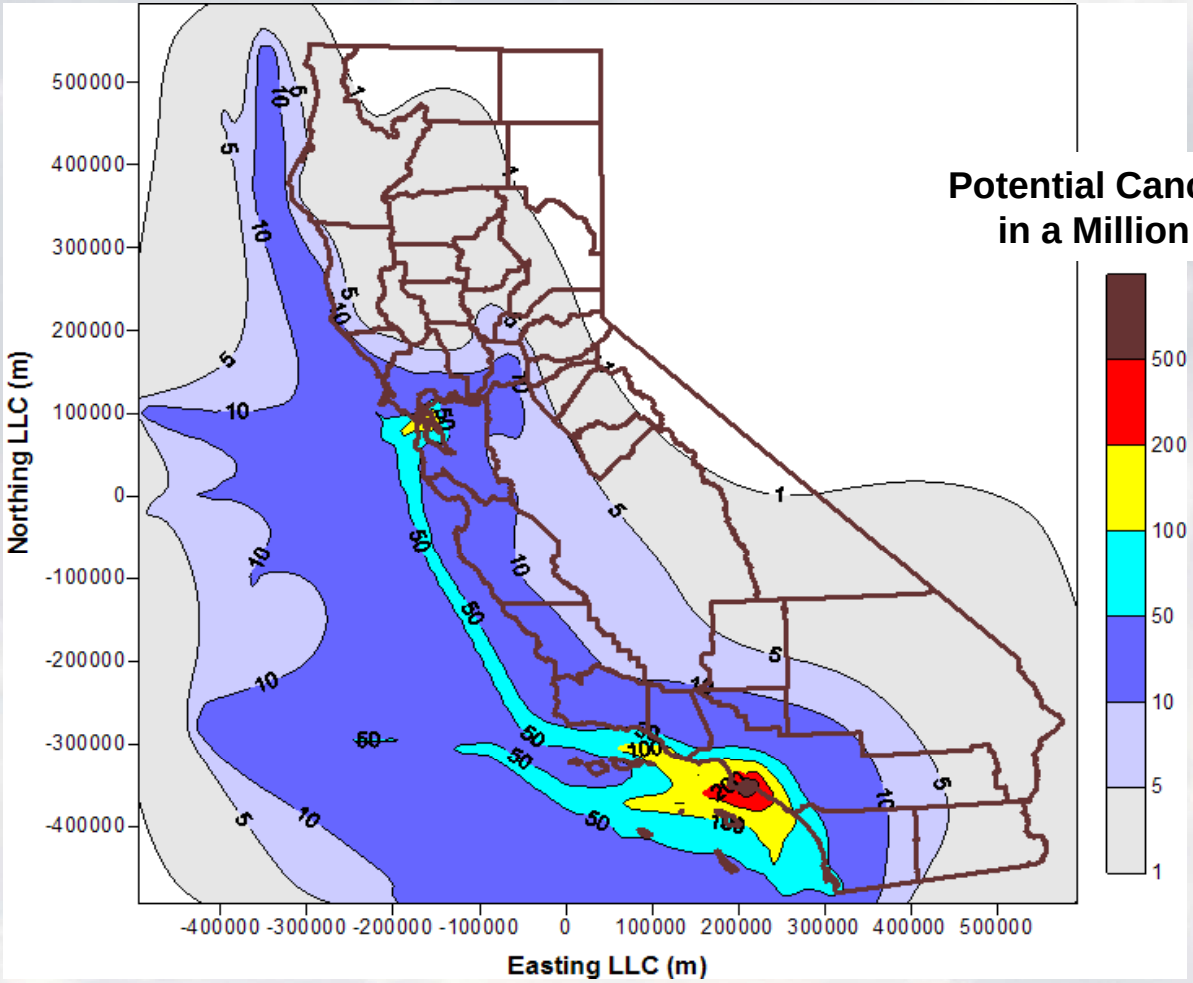
Ocean-Going Vessel Diesel Particulate Exposures and Cancer Risk*



*2005 ARB Statewide Emissions Inventory

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Regulatory Efforts

IMO

- MARPOL Annex VI - entered into force – May 2005
  - Sets NOx limits from vessels built or modified after 1/1/2000. Fuel sulfur limits.
  - Maritime Pollution Protection Act of 2008 – US ratification
  - Amendments to Annex VI for stricter NOx limits and fuel sulfur standards – October 2008
  - Emission Control Areas – Tier 3 NOx standards

US EPA

- Category 3 Engine Rulemaking – June 2009
  - US Flagged Vessels Only – Relies on IMO for foreign
  - Mirrors IMO Annex VI amendments
  - Applying for Emission Control Area designation

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Regulatory Efforts

California Air Resources Board (ARB)

- Onboard Incineration Prohibition (2007)
- Shore Power Rule (2007)
- Main Engine Fuel Rule (2008; Effective July 1st 2009)
- Vessel Speed Reduction Report/Options (Late 2009)
- Green Ships Program (2010 target date)
- Working with EPA on Emission Control Area designation

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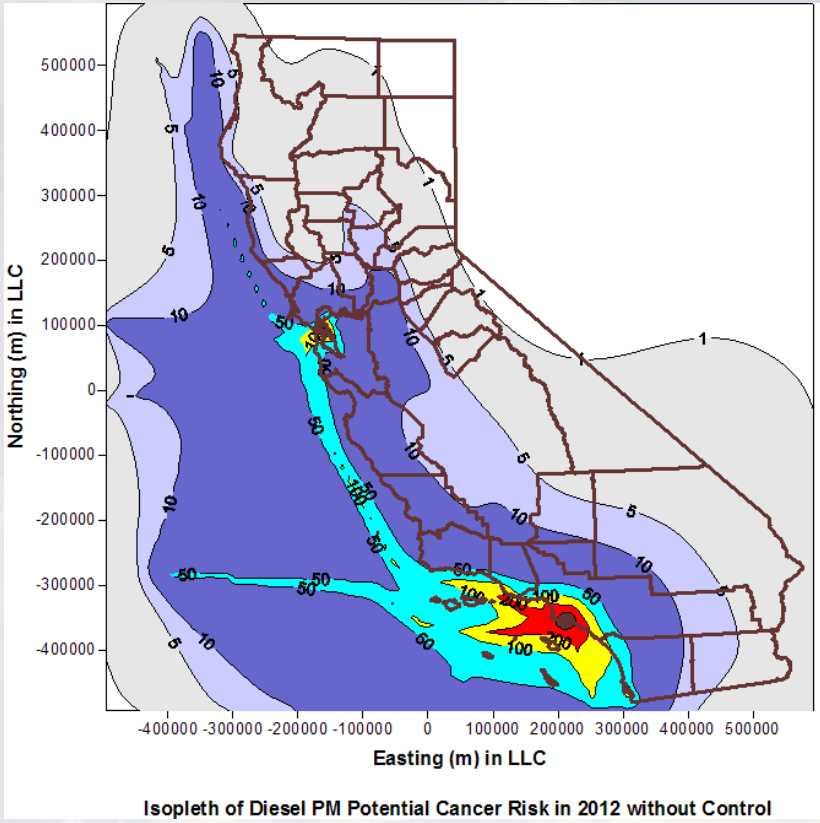
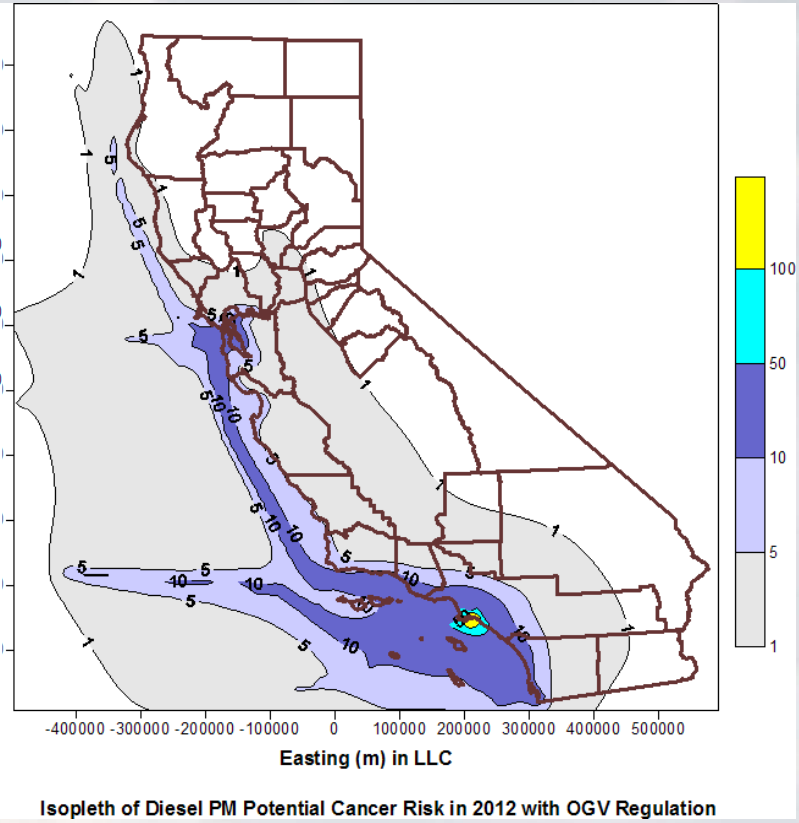
Proposal Reduces Statewide Potential Cancer Risk from Ocean Going Vessels by over 80%*

Without Proposed Regulation



Isopleth of Diesel PM Potential Cancer Risk in 2012 without Control

With Proposed Regulation



Isopleth of Diesel PM Potential Cancer Risk in 2012 with OGV Regulation

*Based on projected statewide 2012 inventory without control and with control

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Our District Efforts

- Santa Barbara case study
- ARB Maritime Working Group
- Commenting on EPA/ARB rulemakings
- Lawsuits to force EPA regulations
- ARB VSR workshop – July 29 in Sacramento
- Concerned about existing fleet turnover rate
- Technology demonstration project

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Demonstration Project

Objectives

- Demonstrate emission controls
- Develop support for potential economic incentive programs
- Develop in-use testing protocol

Participants

- U.S. EPA, MARAD
- ARB, Ports, CA Air districts
- Ship operator -- APL
- Engine manufacturer
- UC Riverside

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Demonstration Project (cont'd)

- **Emission Control Technologies**
  - Fuel-water emulsification
  - Slide valves
- **Detailed Emissions Testing**
- **Project Costs**
  - About $780,000 for hardware
  - About $100,000 for emissions testing
- **Annual Emissions Reductions in CA Waters**
  - 66 tons of NOx
  - 4 tons of PM
- **Challenges**

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Port Hueneme

- "Niche" Port
  - #1 port in nation for citrus exports
  - Top ten in imports of autos & bananas
- Nearly tripled cargo weight and value between 1990 & 2001
- 35' depth limits vessel types
- Vessel types: Reefer, ro-ro, older containerships
- About 340 calls in 2004
- About 7% of total US vehicle carrier port calls and capacity (DWT x calls) in 2004

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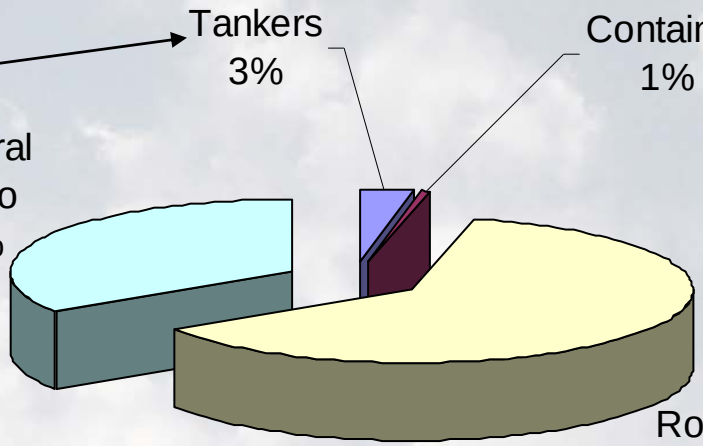
Common Ship Types



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Containership Evolution

	Length	Draft	TEU
First Generation (1956-1970)			
 Converted Cargo Vessel Converted Tanker	135 m 200 m	< 9 m	500 800
Second Generation (1970-1980)			
 Cellular Containership	215 m	10 m	1,000 – 2,500
Third Generation (1980-1988)			
 Panamax Class	250 m 290 m	11-12 m	3,000 4,000
Fourth Generation (1988-2000)			
 Post Panamax	275 – 305 m	11-13 m	4,000 – 5,000
Fifth Generation (2000-?)			
 Post Panamax Plus	335 m	13-14 m	5,000 – 8,000

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Containerships

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General Cargo Ships

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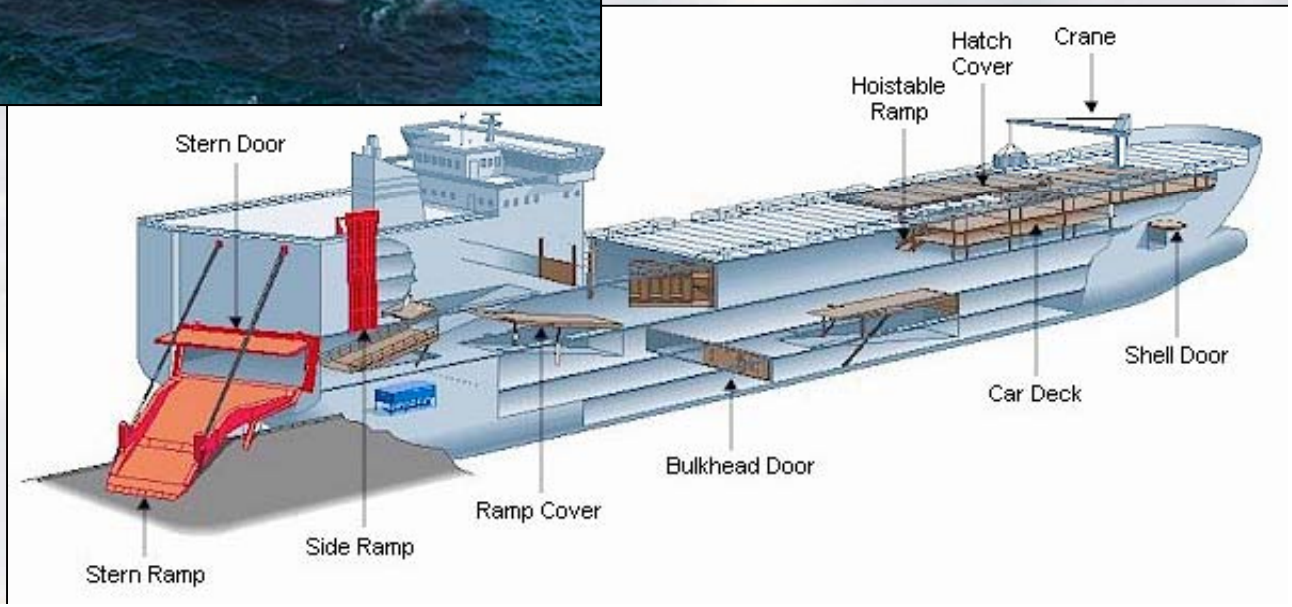
Ro-Ro (Roll On, Roll Off) Ships



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Tankers

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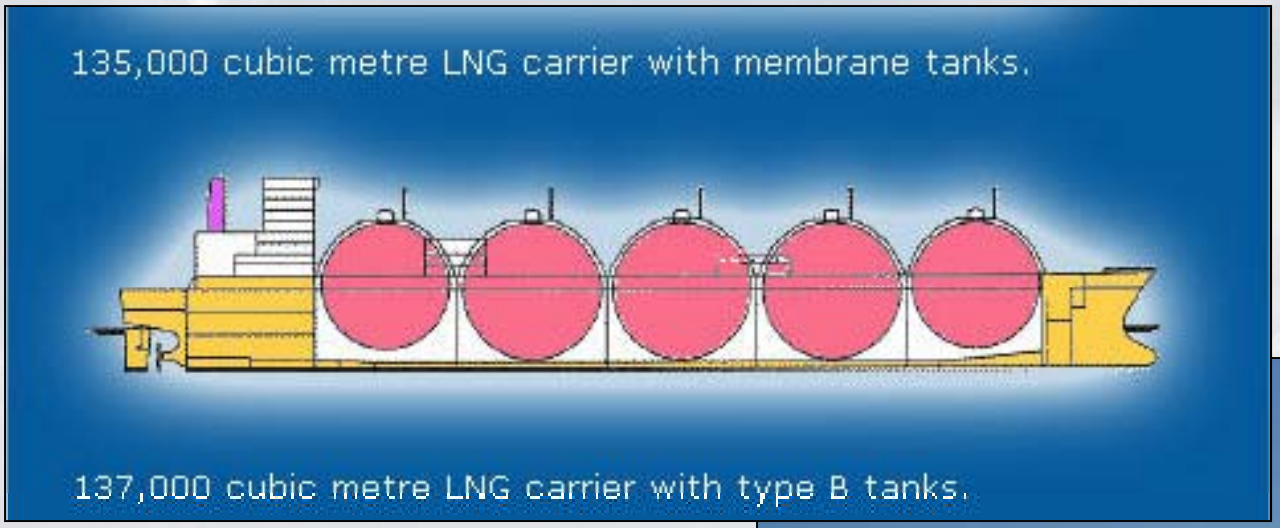
LNG (Liquified Natural Gas) Tankers



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Bulk Carriers

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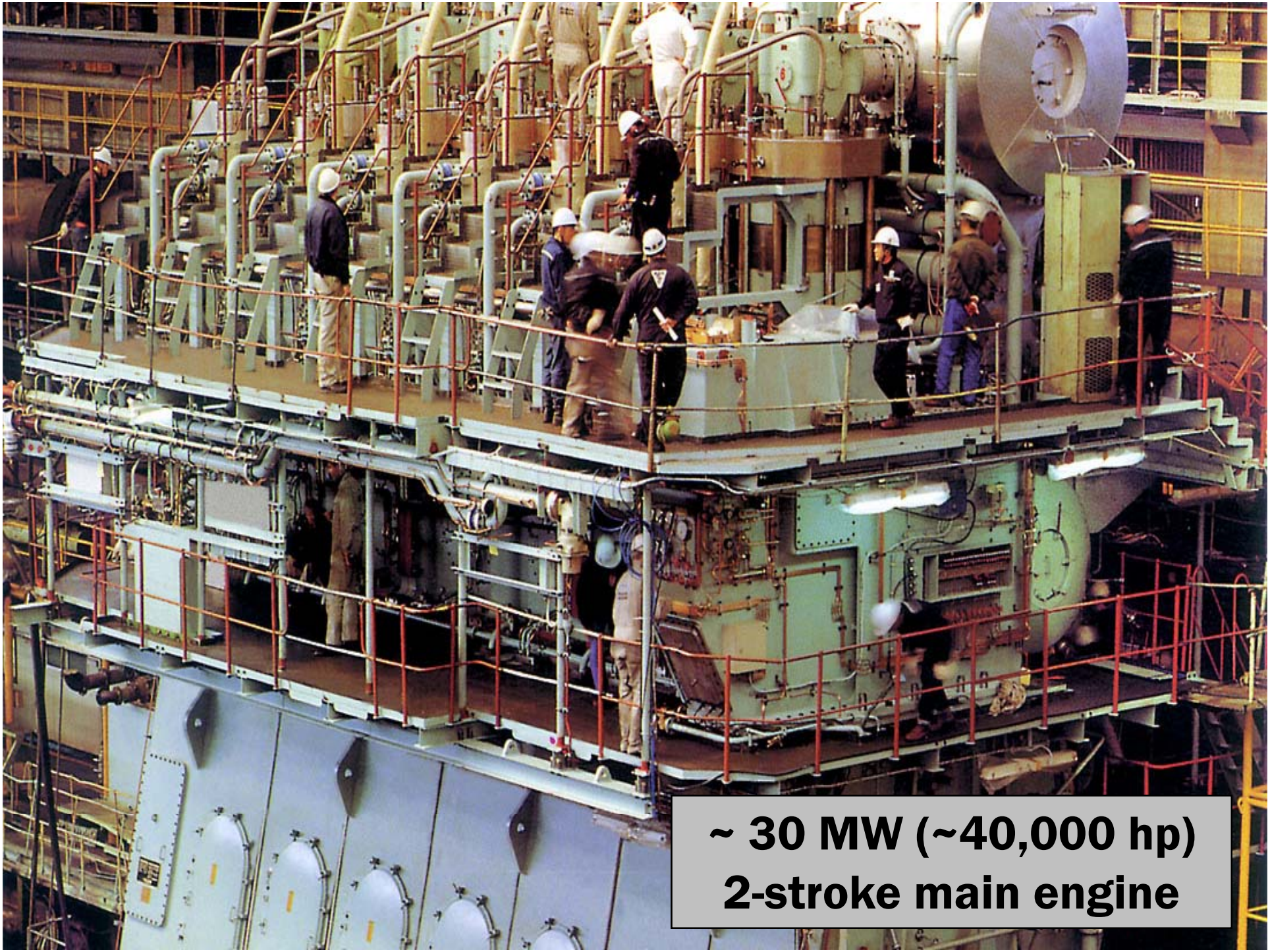
~ 30 MW (~40,000 hp)
2-stroke main engine


Questions ?
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Photo by Steve Ringman, The Seattle Times