



CARGO CATASTROPHE RISK

NEW ANALYTICS FOR THE WORLD'S OLDEST LINE

Chris Folkman, Senior Director, Product Management

Agenda

- **Why build catastrophe models for the marine cargo line of business?**
- **What are the drivers of natural catastrophe risk for cargo?**
- **How can we better understand accumulations of value at ports?**
- **Big data and analytics in the cargo industry: where do we go from here?**

Superstorm Sandy: \$3 billion loss to marine lines



16,000 cars at ports destroyed
65,000 watercraft damaged
15,000 TEU of loaded containers damaged
\$100 million single fine art loss claim

Just the latest in a series of large marine cat losses from:

- Tianjin (2015)
- Tohoku EQ (2011)
- Typhoon Maemi (2003)
- Kobe EQ (1995)



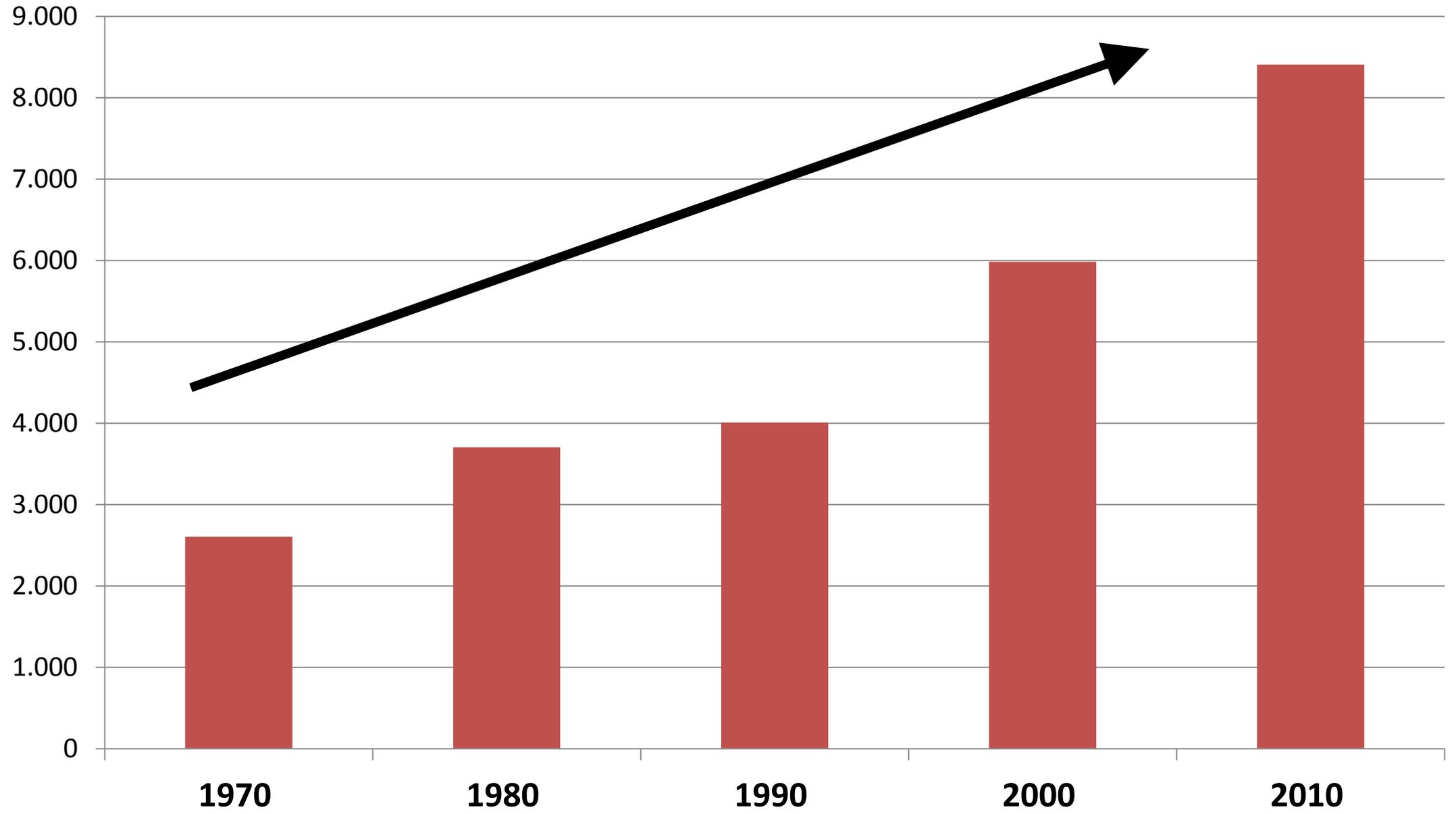
Port of Tianjin Explosions

August 12, 2015

- **21 ton TNT equivalence.**
- **170 dead. 800 injured. 3,500 homeless.**
- **Insurance loss of \$3-5 billion.**

**INCREASING
EXPOSURE**

International Seaborne Trade (MM tons)



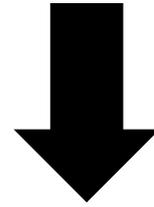
INCREASING ACCUMULATIONS OF VALUE



Standard Cargo Accumulation Clause

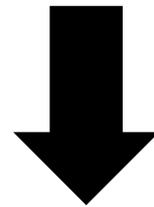
Should there be an accumulation of the subject matter insured whilst in transit beyond the conveyance limits expressed in this insurance by reason of any interruption of the transit **beyond the control of the insured** and/or by reason of any casualty and/or at a trans-shipping point and/or on a connecting vessel or conveyance it is agreed that this insurance shall attach for the full amount at risk subject to insurers' liability being limited to a maximum of **200% of the relevant conveyance limit** provided notice is given to insurers as soon as practicable by the insured of such accumulation.

Standard Cargo Insurance: “in due course of transit”



All of the above, with:

- + Endorsement 1: Warehouse A (storage facility)
- + Endorsement 2: Warehouse B (storage facility)
- + Endorsement 3: Warehouse C (storage facility)
- + Endorsement 4: Distribution Center



Stock Throughput (“Cradle to Grave Contents Coverage”)

- Raw materials
- Finished Products
- In Transit
- In storage – 1st or 3rd party warehouse
- At final retail destination

**Broadening of
cargo coverage
in today’s soft
market**

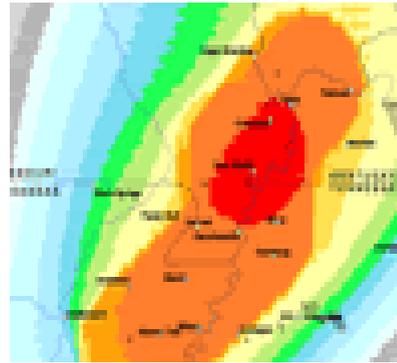
CALCULATION STEPS OF A CAT MODEL



Apply Exposure

Cargo Storage Address → lat long

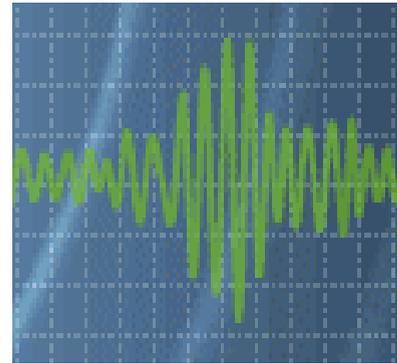
Value of cargo



Generate Events

Which events in the catalog affect the exposure?

Hundreds of thousands of cat events, high resolution hazard.



Assess Hazard

Wind Speed

Surge Height

Ground shaking Intensity



Calculate Damage

Damage to each location

Uncertainty in damage (standard deviation)



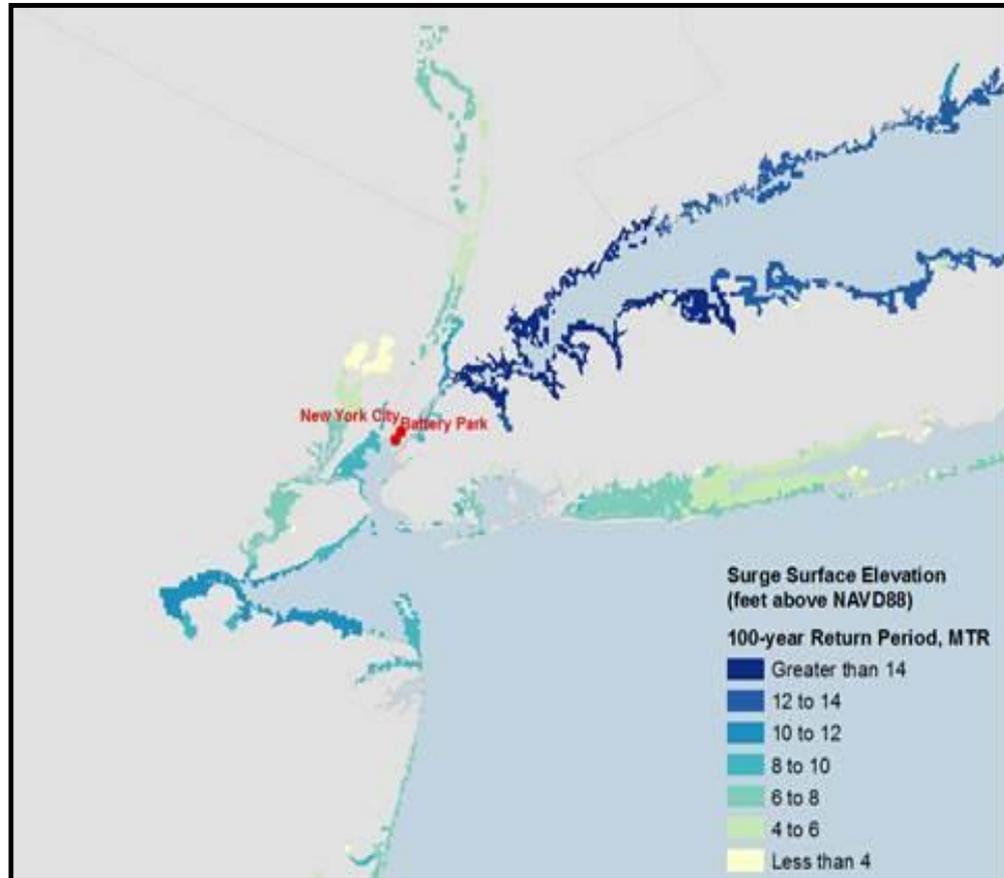
Quantify Financial Loss

Exceedance probability (1-in-100, 1-in-250)

Average Annual Loss (Pure Premium)

Apply Limits, Deductibles, Treaty Terms

What are the outputs of a model and how are they used?



100 year storm surge elevation

Simulated Event	Description	Loss (\$)	Std. Deviation
1	Cat 4, NE	\$241m	\$21m
2	Sandy	\$21m	\$55m
3	Ike	\$665m	\$280m
4	Cat 3, SW	\$4.8m	\$0.9m
... Thousands of simulated events			

Event Loss Table

What's are the worst events that my book of business faces?

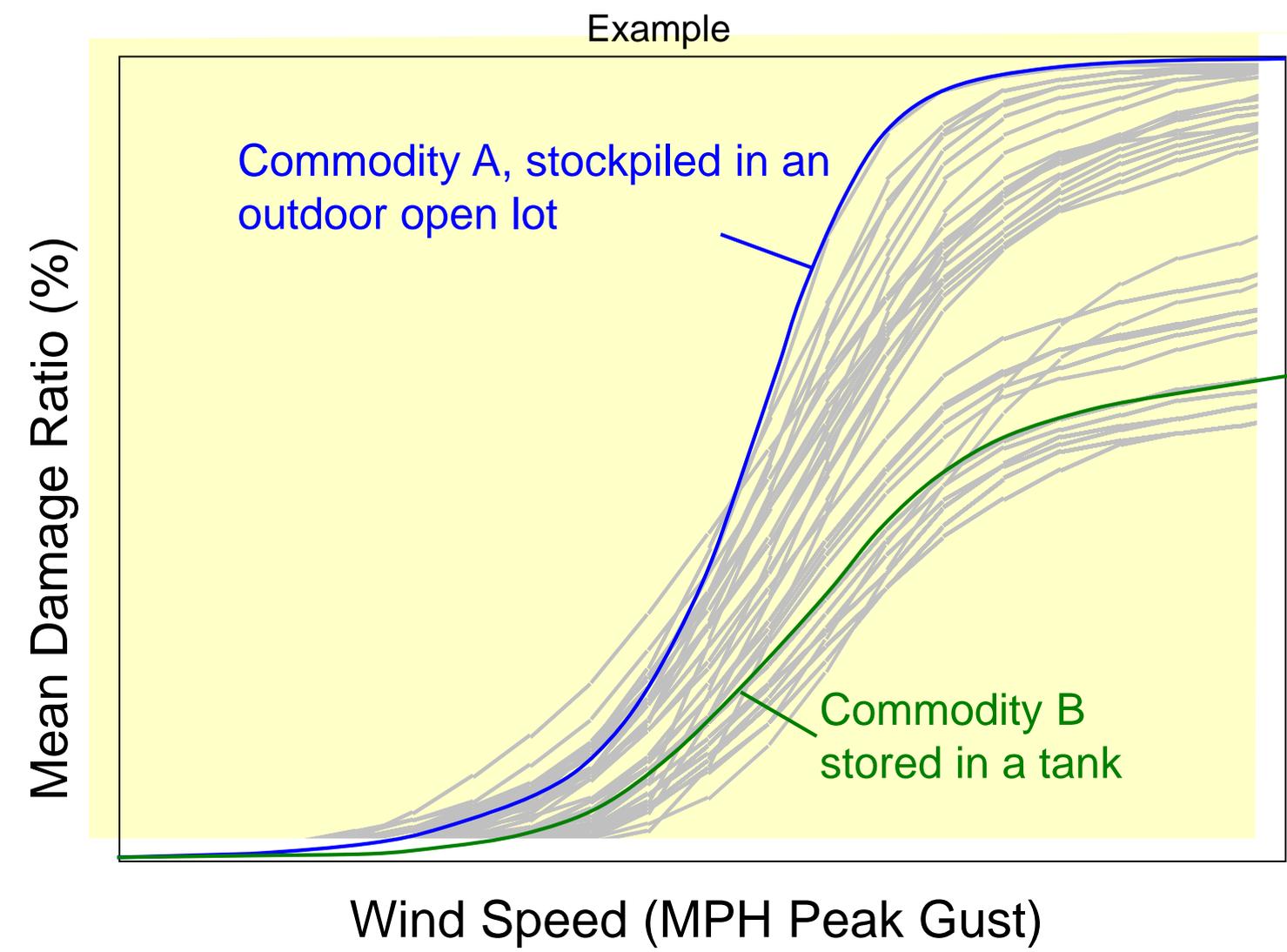
Return Period	Loss (\$)
100 year	\$125.1m
250 year	\$210.5m
500 year	\$665m
Avg. Annual Loss	\$4.8m

Exceedance Probability

- How do I price for cat?
- How much exposure can I afford to accumulate?
- How much reinsurance should I buy?

CARGO VULNERABILITY

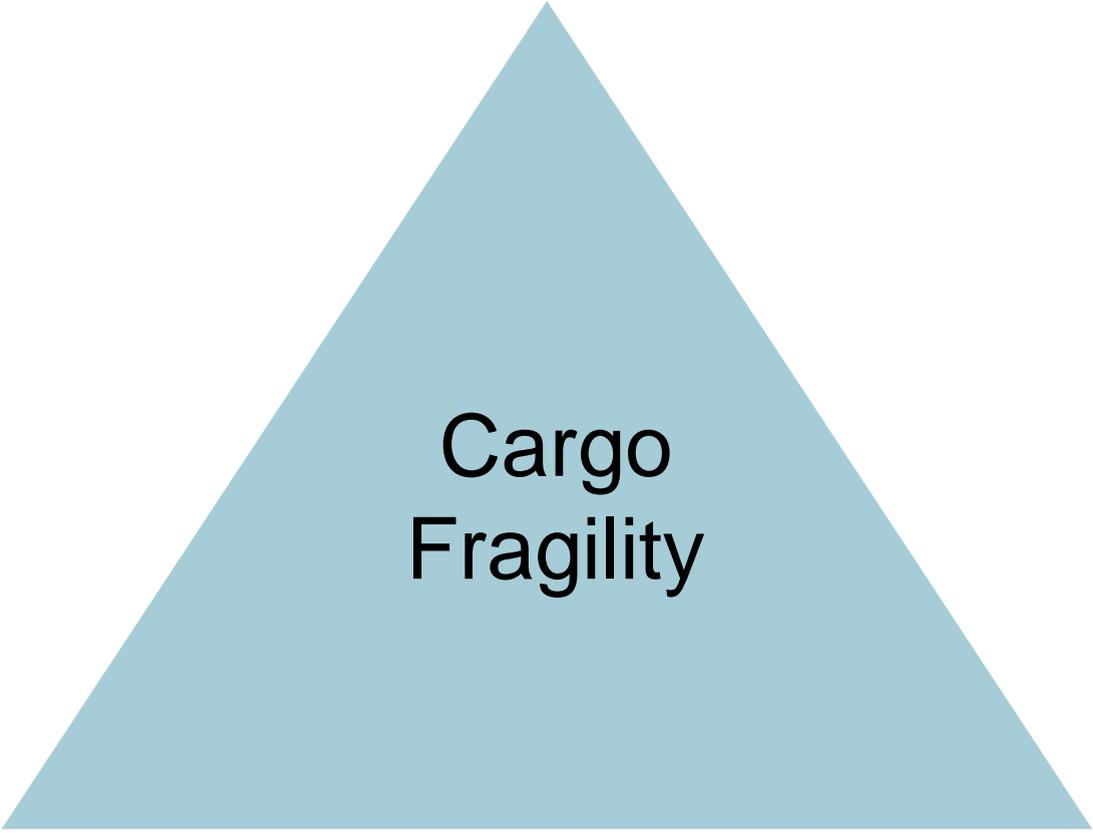
Given that cargo is subject to a certain hazard (wind speed, flood depth, etc), what will be its damage?



Drivers of Cargo Vulnerability

Material

- General Cargo
- Petroleum
- Consumables
- Temperature Controlled, etc.



Cargo Fragility

Storage Configuration

- Warehouse
- Tank
- Museum
- Outdoors in open lot

Packaging and Protection

- Packaging Measures
- Pre-loss protection
- Salvage protocol
- Transport protocol

MODELING EXAMPLE



Refrigerated Containers
("Reefers")

Model Inputs

Product Category: Temperature Controlled

Storage Options:

- Liquid Tanks
- Inside Warehouse at Port
- Containerized ←
- At destination warehouse
- At destination – retail

Other model inputs:

- Brand clause (salvage-worthy?)
- Extra protection?
- Special packaging?

SPECIE: A UNIQUE LINE WITH MANY MODELING CONSIDERATIONS

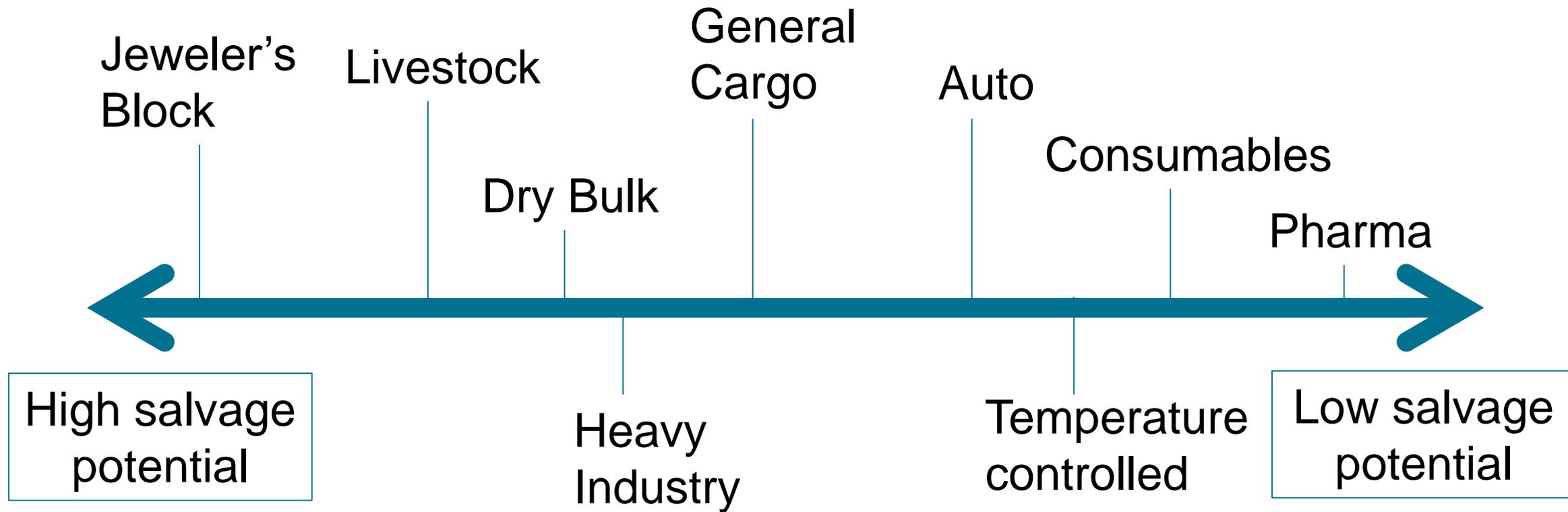
Commodity Types
Cash in Transit
General Specie
Fine Art & Collectibles
Jeweler's Block



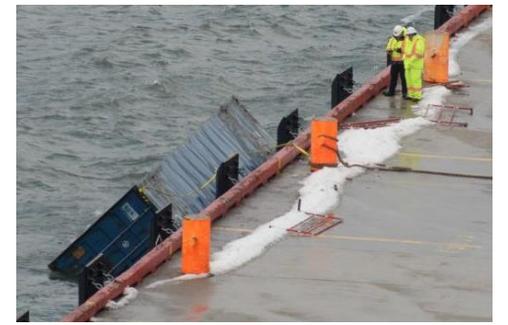
Storage Options
Museum
Residence
Warehouse
Display Case
Vault
Container

- Specie is well protected and packaged.
- Valuation is complex.
- Salvage potential & values can vary dramatically.
- Underwriting is very specific.
- Many modeling options are needed to accommodate this type of exposure.

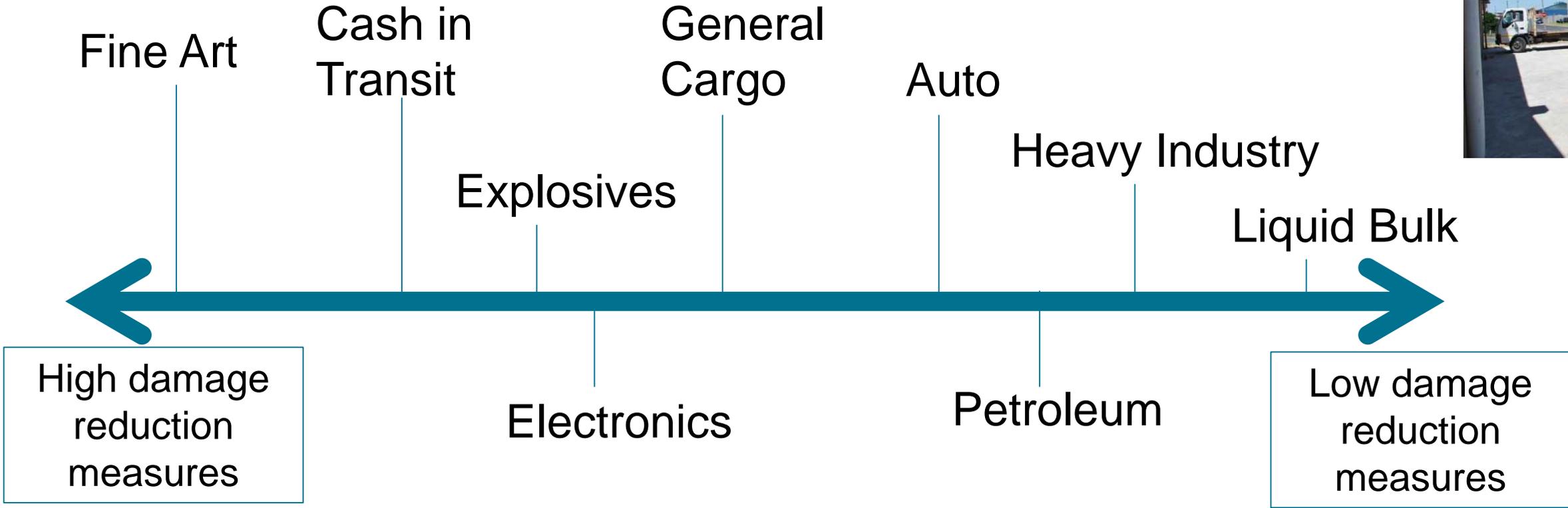
SALVAGE POTENTIAL VARIES BY PRODUCT



This can change with contract provisions (i.e. brand protection clauses).



DAMAGE REDUCTION MEASURES VARY BY PRODUCT, STORAGE CONFIGURATION



- Certain product classes are more susceptible to damage during transit
- Some cargo will be moved out of storm path (fine art)

DAMAGE MECHANISMS OF CARGO

1. Damage if moved/knocked down
2. Loss if packaging damaged
3. Volume loss (leaks, spills, lost) if configuration disturbed
4. Wind-borne debris damage
5. Rain water damage
6. Damage if delay since perishable/time sensitive
7. Loss if Contaminated
8. Damage if Power loss since refrigerated or temp. controlled
9. Loss amplified from severe environmental consequence
10. Damage if ignited since Volatile



Property vs. Cargo Exposure

Building “Contents”	Marine Cargo
At risk 365 days per year	At risk only when at insured premises
Heterogeneous products, for everyday use.	Homogeneous products, sale-ready
Rarely packaged	Carefully packaged
Minimal salvage efforts	Extensive salvage efforts
Stored inside structure	Stored in many different configurations (containers, silos, warehouses, pallets).

Prior to cargo cat models, cargo exposure was lumped in with traditional property (building/content) exposure.

Problems with this:

- Cargo is diverse (thousands of products / storages).
- Coverages are different.
- Claims adjustment is different.
- Salvage values influence claim costs.
- Risk is different. Models should be different too.

Why not just model cargo risk as standard “property contents”?

ACCUMULATIONS OF VALUE AT PORTS

Considerations
in measuring
values at risk
in ports.

- Time in Port (“Dwell Time”)
- Converting tonnage to value
- Data quality - varies by region
- Trade Seasonality
- Geographic distribution of exposure between terminals.
- Accounting for storage structures within ports and terminals (warehouses, tanks, silos, open lots).

PORT EXPOSURE AT RISK (AT ANY TIME)

$$\sum_{i=1}^n \frac{Imports_i + Exports_i}{365} * DT_i$$

n = number of cargo types at port. (18 in schema)

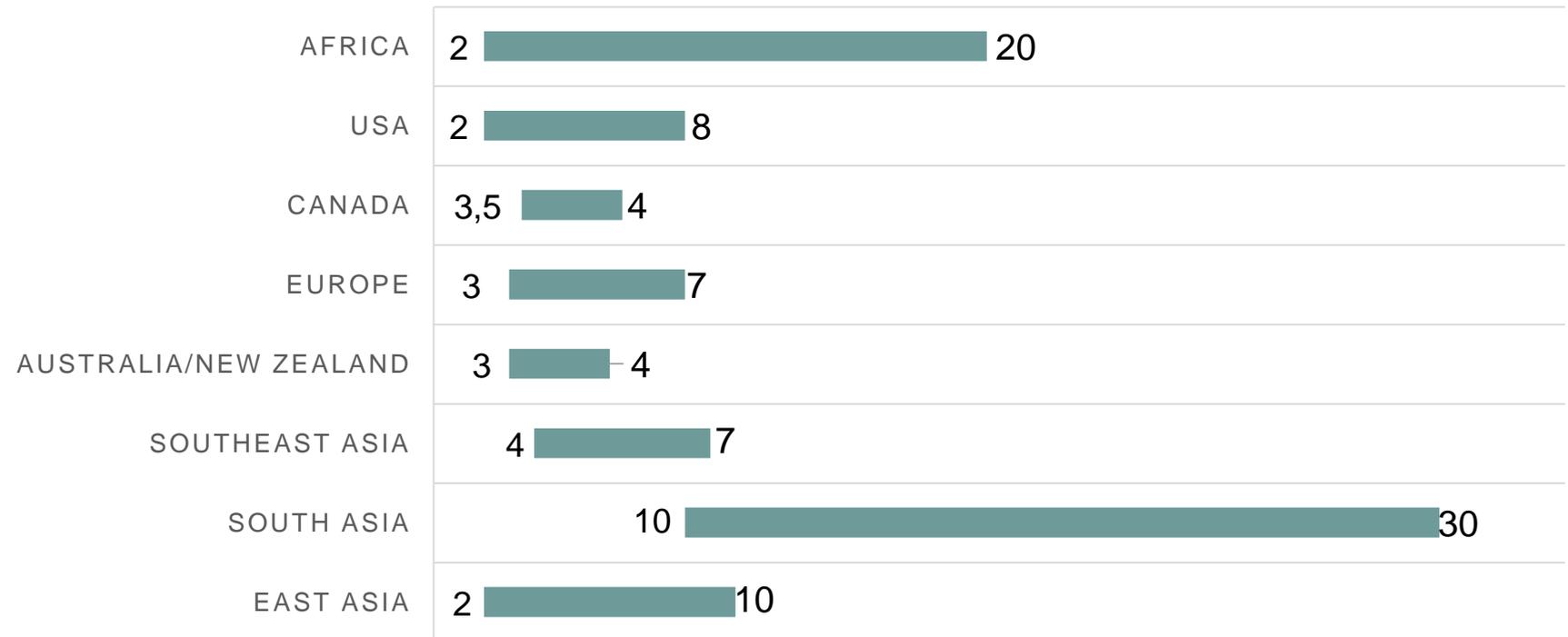
DT = dwell time

Seasonal considerations apply

WHAT INFLUENCES DWELL TIMES?

- Region
- Import / Export Ratio
- Weather
- Labor practices
- Demurrage
- Dominant Commodity Types
- Terminal automation

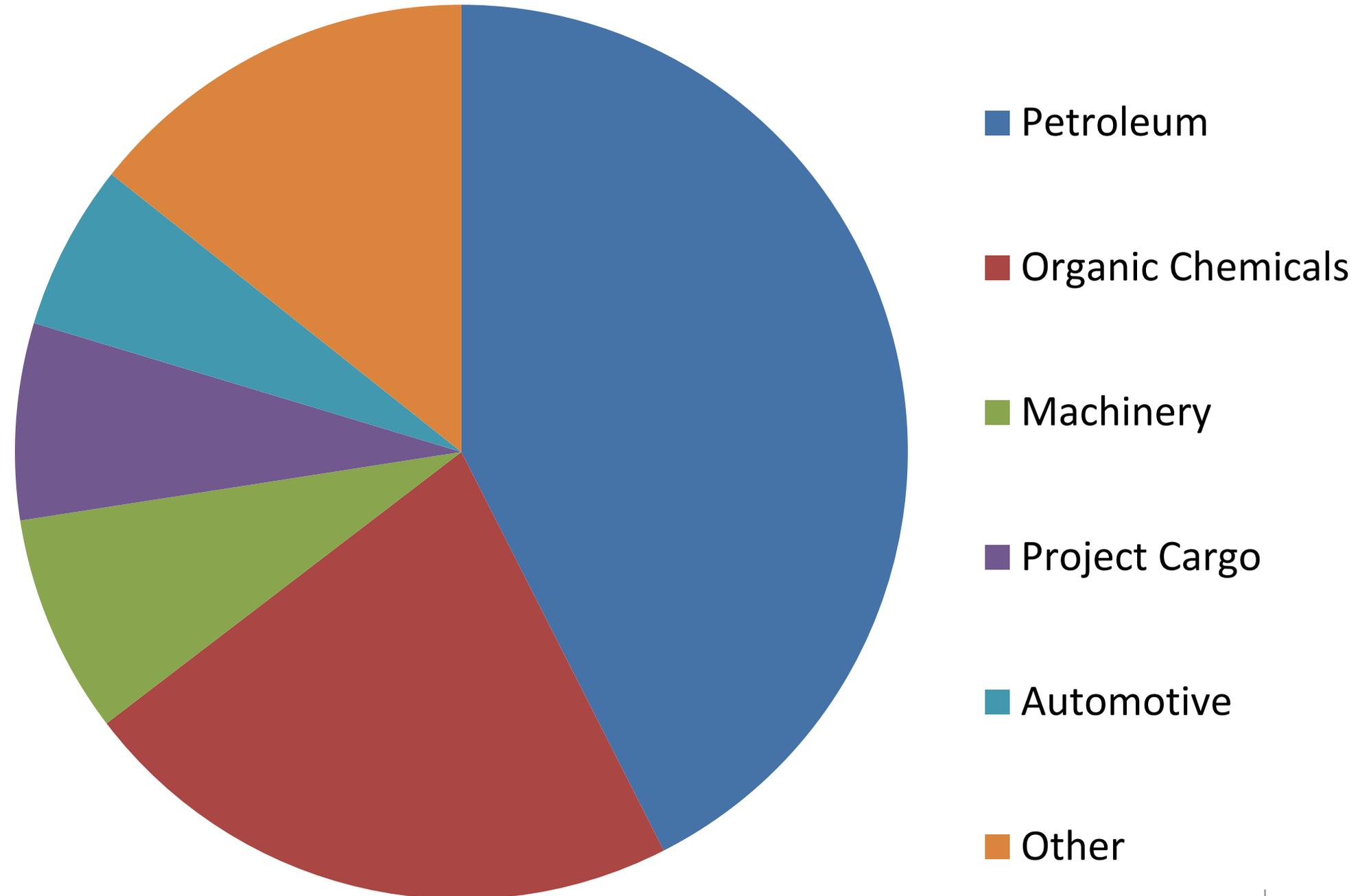
REGION WIDE DWELL-TIME RANGE



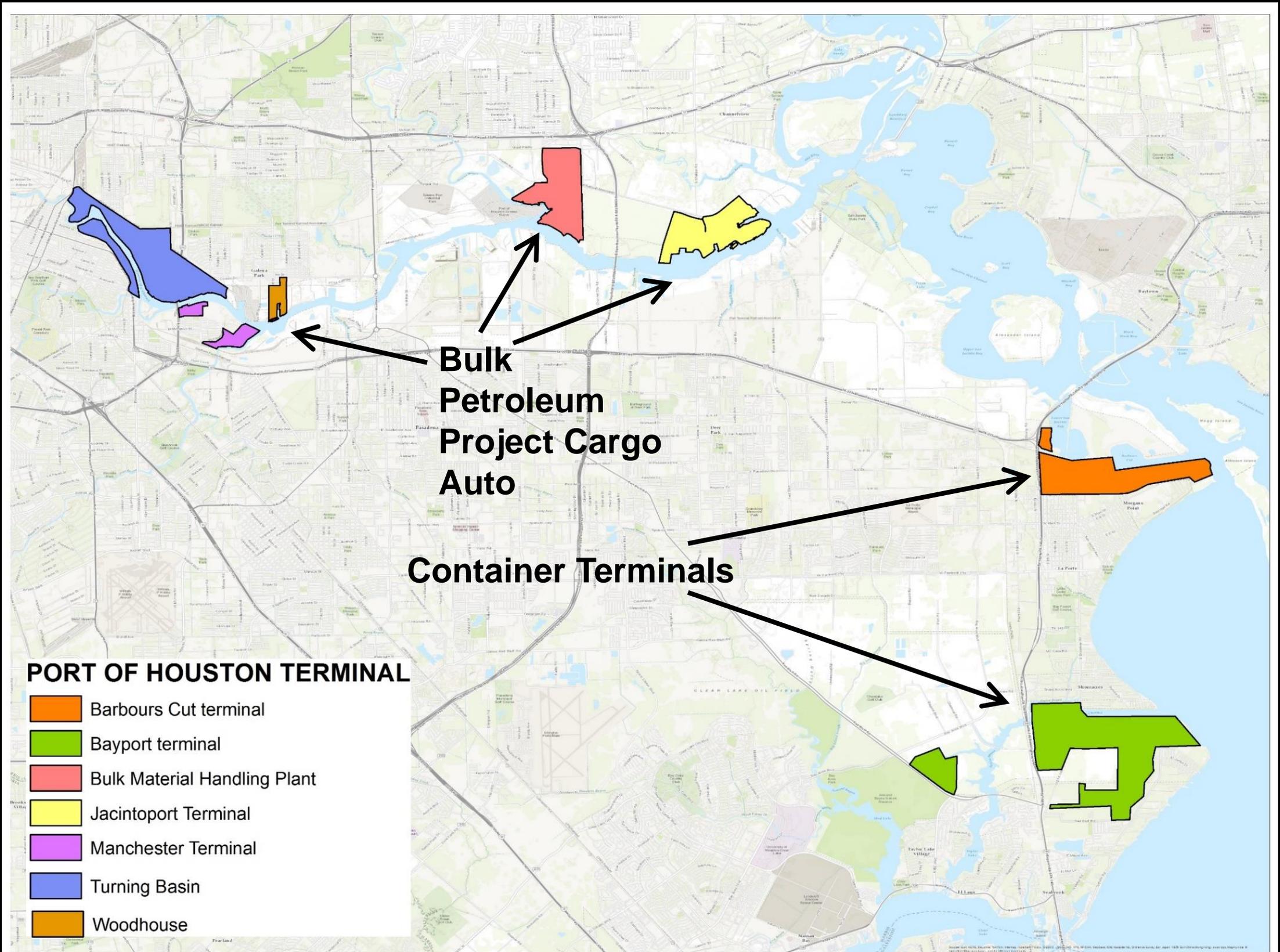
	East Asia	South Asia	SouthEast Asia	Australia/Ne w Zealand	Europe	Canada	USA	Africa
Min	2	10	4	3	3	3,5	2	2
Max	10	30	7	4	7	4	8	20

Port of Houston: ~\$250 billion of annual trade

Key Facts
#1 port in North America for petroleum
#1 port on U.S. Gulf Coast by tonnage
#13 in the world for total tonnage
#73 in the world by TEU throughput (containers)

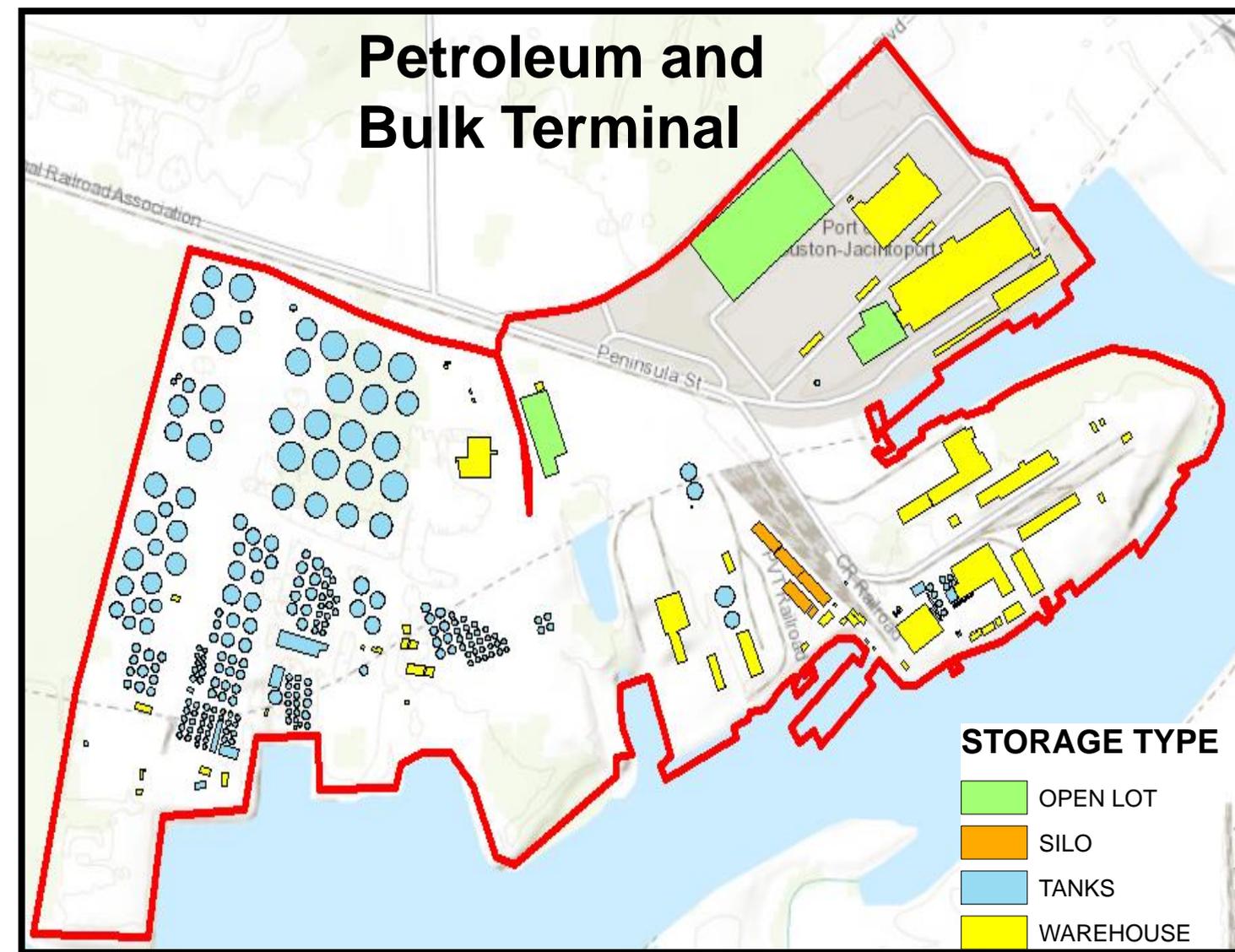
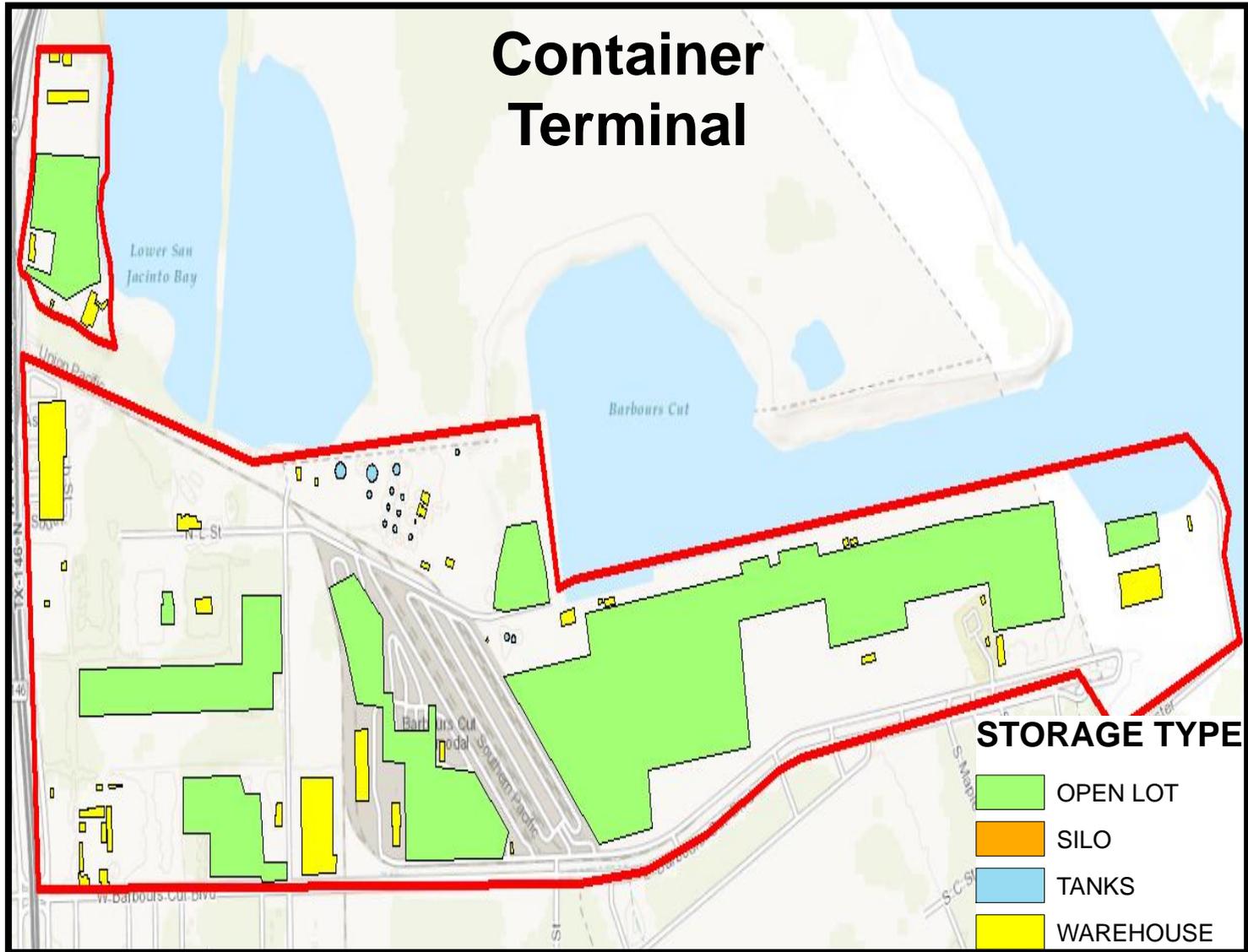


Port of Houston Terminal Layout

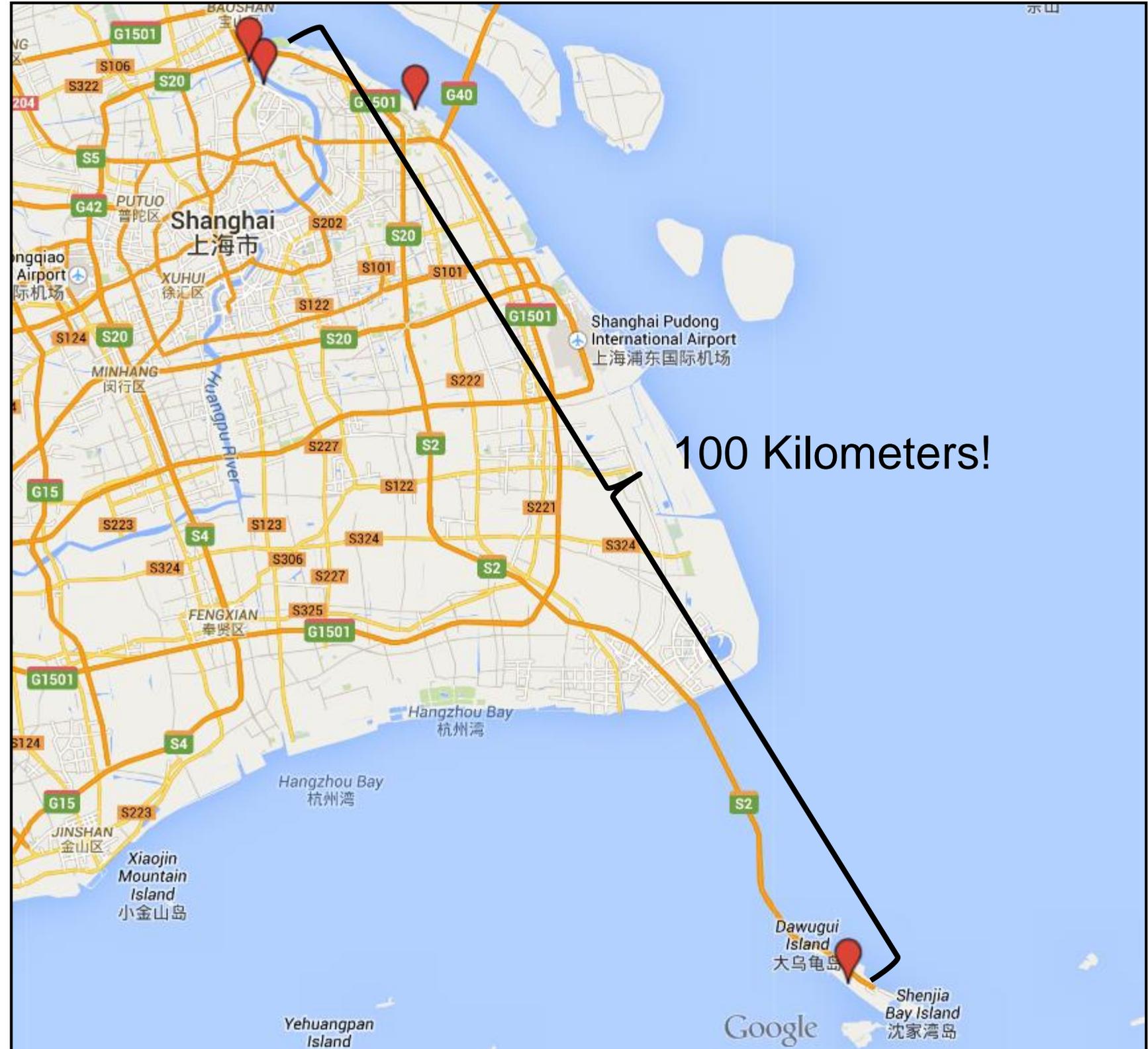


Geospatial Analysis

Allocating cargo exposure to storage structures

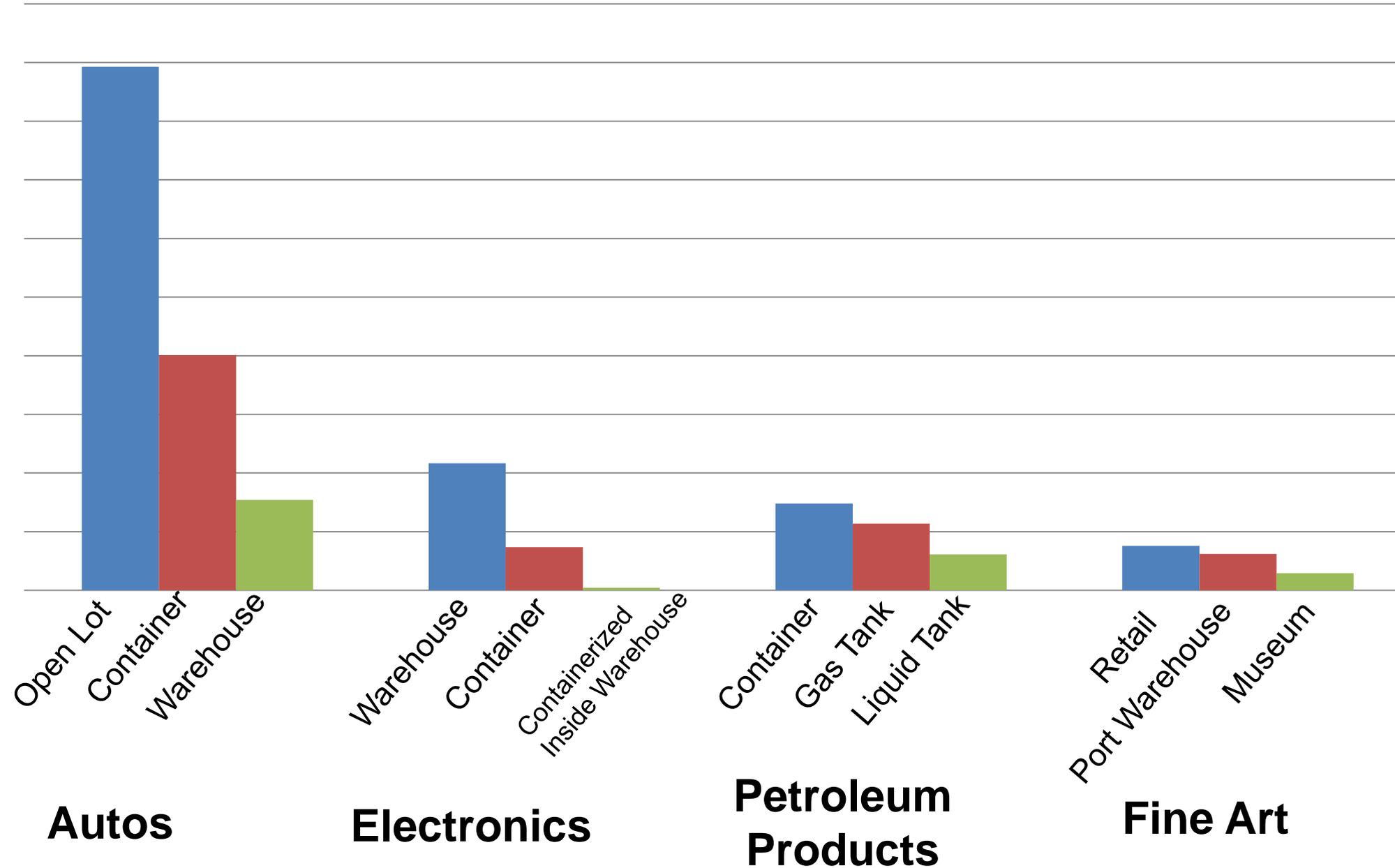


Key Terminals, Shanghai Port



Relative Risk of Cargo & Storage Type

Wind & Surge Risk: Miami



MARINE CATASTROPHE ANALYTICS – WHERE WILL WE BE IN 5-10 YEARS?

- 1. Port interconnectivity.** Port disruptions and their downstream effects.
- 2. Accumulation beyond ports.** Airport facilities, free ports, shipyards, storage yards, bonded warehouses.
- 3. Dynamic accumulation.** Ship-level bills of lading are increasingly available. Can this data provide better intelligence on accumulation?
- 4. And other non-cargo marine analytics**
 - *Offshore Energy:* Global modeling and exposure accumulation for all 20+ offshore coverages.
 - *Builders' Risk* - improved value ramp-up, phased vulnerability, incorporating regional differences in construction
 - *Marine Hull* – Leverage traffic data for underwriting?

Global Traffic Visualization



Conclusions

- Cargo is diverse and must be addressed with specific modeling practices.
- Given recent cat experience, using approximations and work-arounds are no longer acceptable.
- Port exposure accumulation is a growing challenge. It will continue to be so for the foreseeable future.
- Trade is an ever growing part of world economic growth. Data and modeling advancements must keep pace.

Q & A