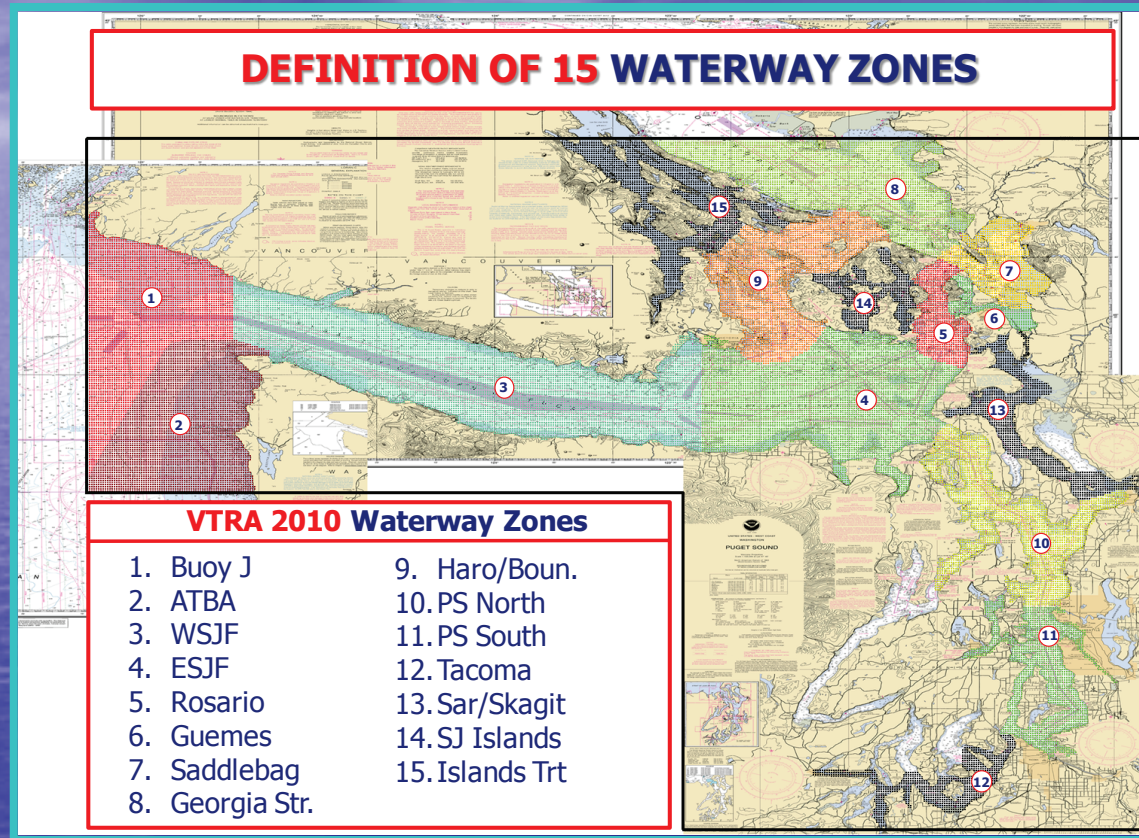


VTRA 2010 – SYNOPSIS OF RMM SCENARIO COMPARISON APPLIED TO CASE P: BASE CASE



GWU Personnel: Dr. J. Rene van Dorp

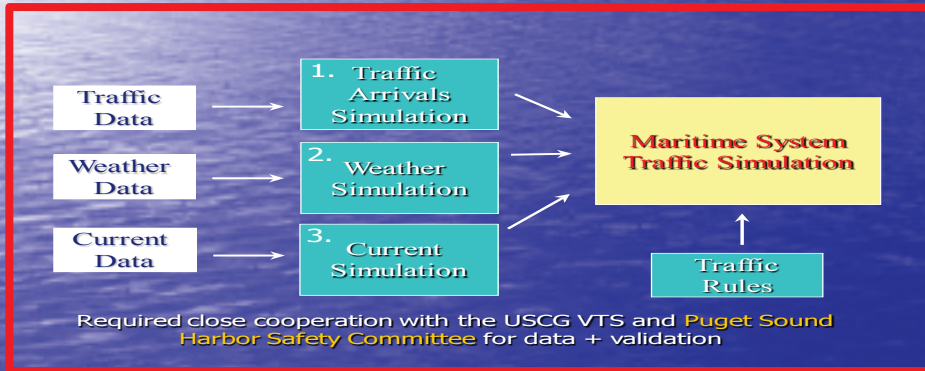
VCU Personnel: Dr. Jason R. W. Merrick

FOCUS VESSELS TRAVEL THROUGH VTRA STUDY AREA

Focus Vessels: Tanker, ATB, Chem. Carrier, Oil Barge, Bulk Carrier, Container Vessel and Other Cargo Vessels

We developed a vessel traffic movement modeled largely based on VTOSS 2010 data validated using AIS 2010 data. We consider the 2010 traffic model a base case year and denote it scenario **P – BASE CASE**.

SNAPSHOTS OF KEY VTRA MODEL COMPONENTS



Generating Accident Scenarios:

- Counting Collision Accident Scenario's
- Counting Drift Grounding Accident Scenario's
- Counting Powered Grounding Accident Scenario's

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Conduct Expert Judgment Elicitations via Questionnaires

Q30

Situation 1	TANKER DESCRIPTION	Situation 2
Straits of Juan de Fuca East	Location	
Inbound	Direction	
Laden	Cargo	
1 Escort	Escorts	
Untethered	Tethering	
	INTERACTING VESSEL	
Shallow Draft Pass - Vessel	Vessel Type	
Crossing the Bow	Traffic Scenario	
Less than 1 mile	Traffic Proximity	
	WATERWAY CONDITIONS	
More than 0.5 mile Visibility	Visibility	Less than 0.5 mile Visibility
Along Vessel	Wind Direction	
Less than 10 knots	Wind Speed	
Almost Slack	Current	
Along Vessel - Opposite Direction	Current Direction	
More? :	9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9	: More?
Situation 1 is worse		Situation 2 is worse

Example of potential experts: USCG VTS Operators, Puget Sound Pilots, Tanker Captains and First Mates, Tug Captains and First Mates, etc.

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Step 1 Damage calculation

A SR 259 Collision Scenario

- struck ship
 - velocity
 - displacement
 - hull type
- collision
 - location
 - angle
- striking ship
 - velocity
 - displacement
 - bow angle

Perpendicular Kinetic Energy

Tangential Kinetic Energy

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IMPORTANT:

THE OPERATIVE WORD IN PRESENTING THESE ANALYSIS RESULTS IS THE USE OF THE WORD

POTENTIAL

TO INDICATE THAT THESE ANALYSIS RESULTS DO NOT FOLLOW FROM AN HISTORICAL DATA ANALYSIS, BUT THROUGH THE USE OF AN ANALYSIS TOOL THAT EVALUATES SUCH **POTENTIAL**.

THE 2010 YEAR IS CONSIDERED **THE BASE CASE YEAR** AND A BASE CASE YEAR POTENTIAL IS EVALUATED.

NEXT, **WHAT-IF SCENARIOS** ARE DEVELOPED FROM THE BASE CASE BY ADDING ADDITIONAL HYPOTHETICAL TRAFFIC AND A WHAT-IF POTENTIAL IS EVALUATED AND COMPARED **RELATIVE TO THE BASE CASE** TO INFORM **RISK MANAGEMENT**.

RISK MITIGATION MEASURES (RMM) SCENARIOS CONSIDERED IN THIS PRESENTATION

P: BC & Cont. 17 Knots

VTRA 2010 Base Case and Max Speed
Container Vessels @ 17 knots

P: BC & HE50

VTRA 2010 Base Case and Human Error Incident
On Oil Barges reduced by 50%

P: BC & HE00

VTRA 2010 Base Case and Human Error Incident
On Oil Barges reduced by 100%

P: BC & DH100

VTRA 2010 Base Case and Double Hull Fuel Tank
Protection for all Deep Draft Vessels (up from 40% in BC)

EXPOSURE DEFINITIONS

VESSEL TIME EXPOSURE:

TOTAL AMOUNT OF ANNUAL TIME A FOCUS VESSEL IS MOVING THROUGH THE VTRA STUDY AREA

FUEL OIL TIME EXPOSURE:

TOTAL AMOUNT OF ANNUAL TIME A CUBIC METER OF FOCUS VESSEL FUEL OIL IS MOVING THROUGH THE VTRA STUDY AREA

CARGO OIL TIME EXPOSURE:

TOTAL AMOUNT OF ANNUAL TIME A CUBIC METER OF FOCUS VESSEL CARGO (CRUDE + PRODUCT) OIL IS MOVING THROUGH THE VTRA STUDY AREA

FOCUS VESSELS MOVE OIL: Crude, Product and Fuel

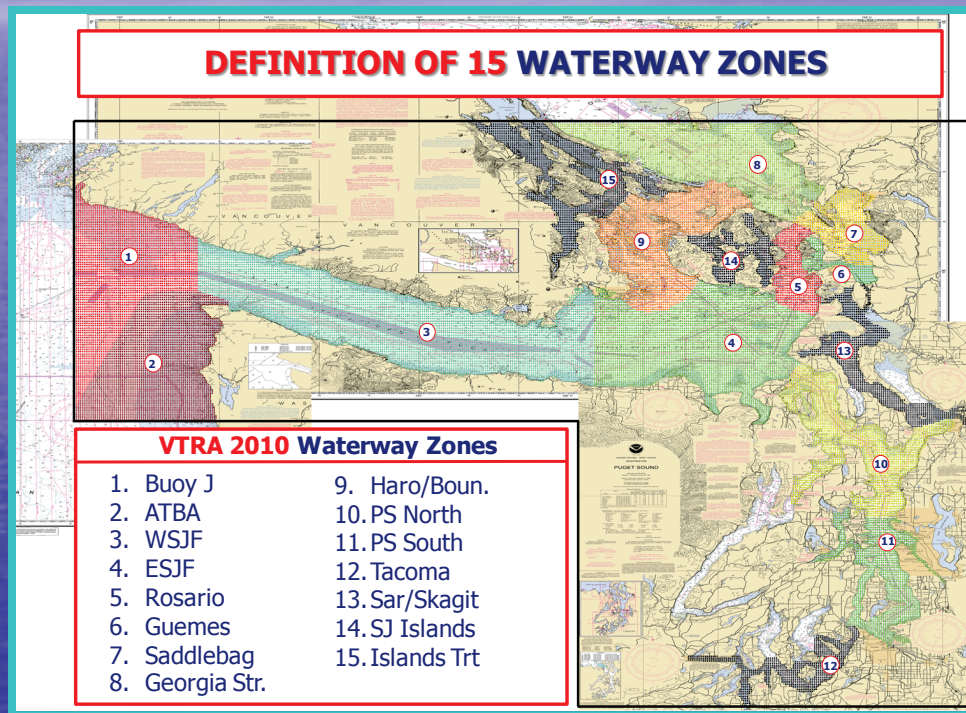
Disclaimer: No information is available on volume of oil or type of oil on board a vessel and we have to rely on overarching assumptions regarding movement of amount and type of oil as focus vessels move through the study area.

- Assumption 1 : Tankers are classified as crude or product carriers by name
- Assumption 2 : Chemical carriers transport product.
- Assumption 3 : Oil barges are assumed to transport product.
- Assumption 4 : All Focus Vessels fuel tanks are 50% full
- Assumption 5 : US bound crude tankers are assumed fully laden as they arrive in study area, drop of equal amounts at their stops and leave empty.
- Assumption 6 : Canadian bound crude tankers are assumed empty as they arrive and fully laden as they depart.
- Assumption 7 : Product Tankers and ATB's are assumed fully laden as they depart study area, empty as they arrive.
- Assumption 8 : Chemical carriers are assumed fully laden as they arrive in the study area, empty when they leave the study area.
- Assumption 9 : When ATB's go back and forth between two destinations within the study area they are assumed 50% full
- Assumption 10: Oil barges are assumed fully laden as they travel through study area.
- Assumption 11: Tank Focus Vessels not covered by 1-10 are assumed fully laden.

VTRA 2010 – SYNOPSIS OF 3D SCENARIO COMPARISON

VESSEL TIME EXPOSURE

By What-if Focus Vessels and Base Case Focus Vessels

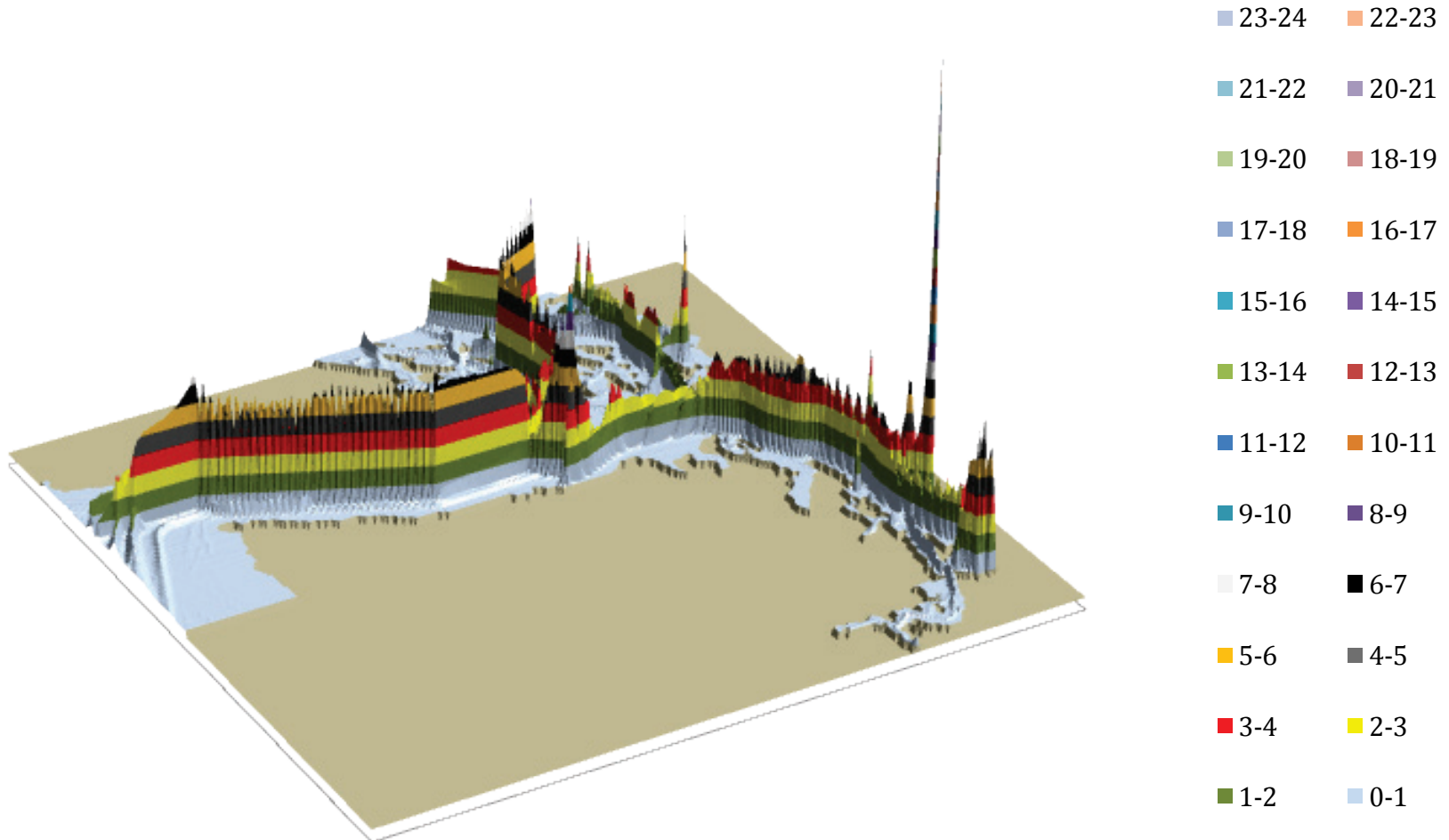


GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

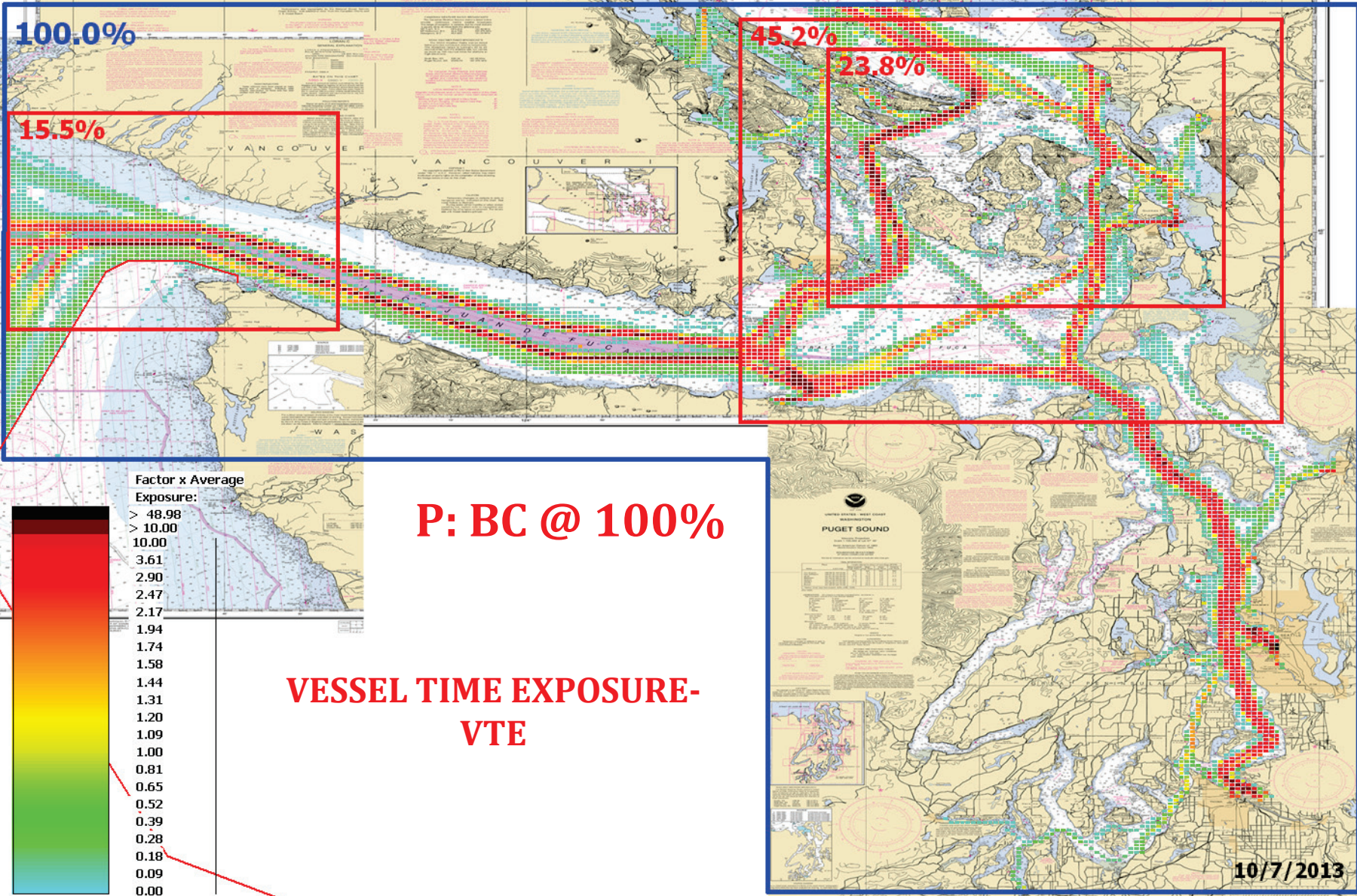
VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

P: Base Case 3D Risk Profile All FV - Vessel Time Exposure: 100% of Base Case VTE



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

P: VTRA 2010 - BASE CASE - All FV

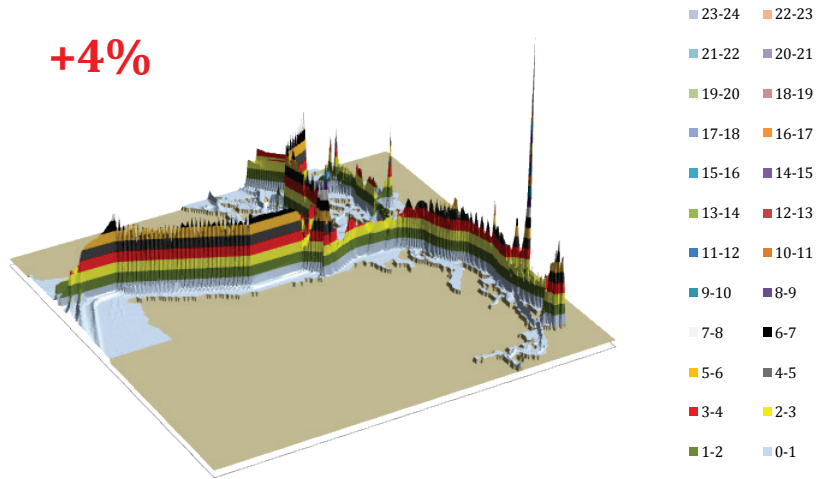


10/7/2013

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

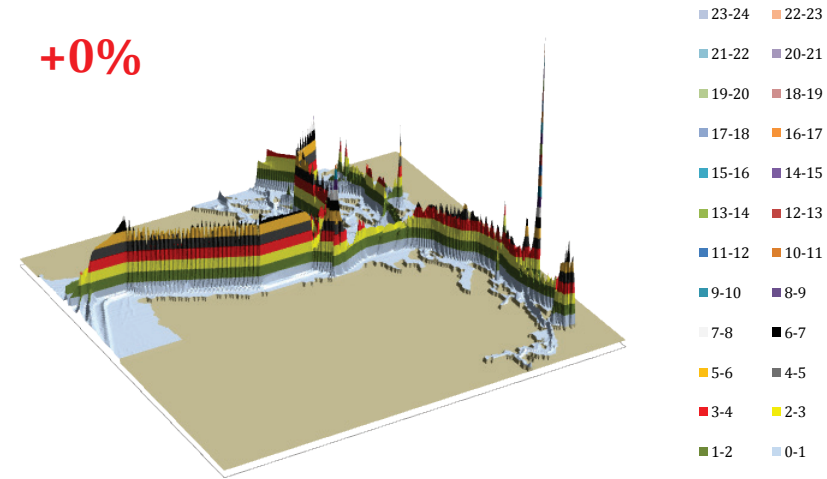
P: BC & CONT 17KNTS 3D Risk Profile
All FV - Vessel Time Exposure: 104% of Base Case VTE

+4%



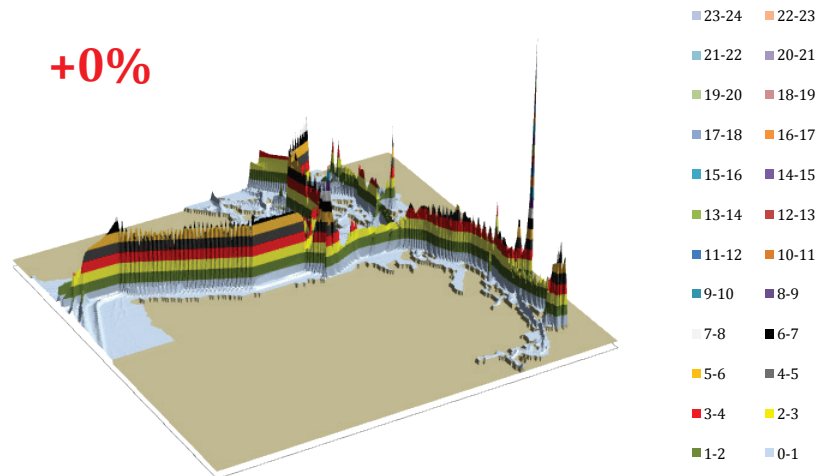
P: BC & OB HE50 3D Risk Profile
All FV - Vessel Time Exposure: 100% of Base Case VTE

+0%



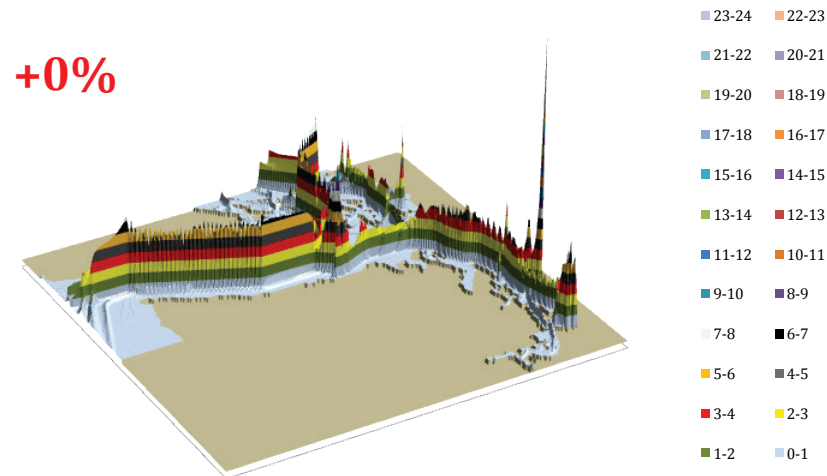
P: BC & OB HE100 3D Risk Profile
All FV - Vessel Time Exposure: 100% of Base Case VTE

+0%



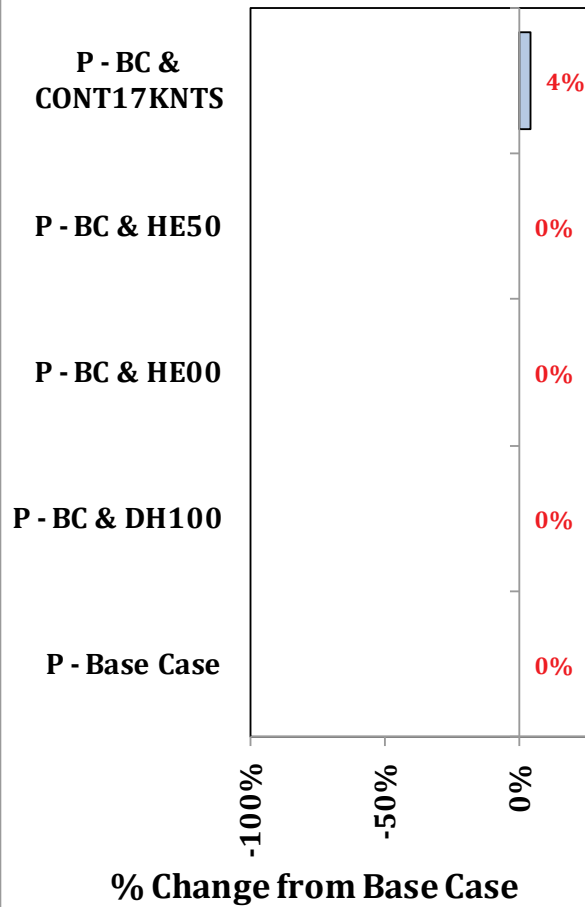
P: BC & DH100 3D Risk Profile
All FV - Vessel Time Exposure: 100% of Base Case VTE

+0%



VTRA 2010 : OIL (C + F) TIME EXPOSURE AND POTENTIAL OIL (C+F) LOSS COMPARISON BASE CASE VESSELS

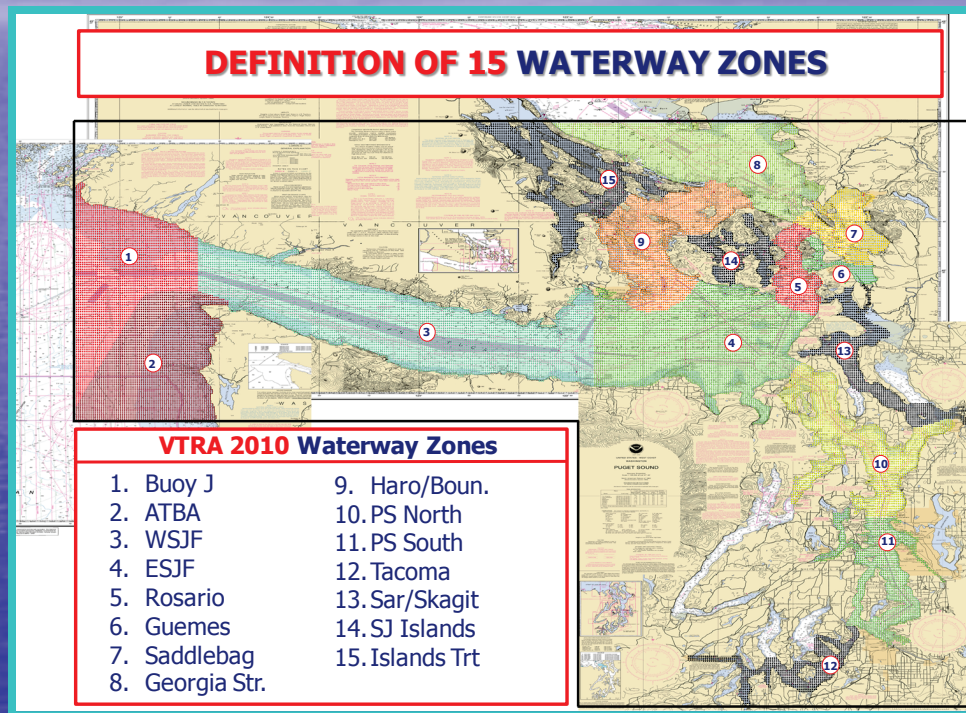
Annual Vessel Time Exposure (BC Vessels Only)



VTRA 2010 – SYNOPSIS OF 3D SCENARIO COMPARISON

POTENTIAL ACCIDENT FREQUENCY

By What-if Focus Vessels and Base Case Focus Vessels

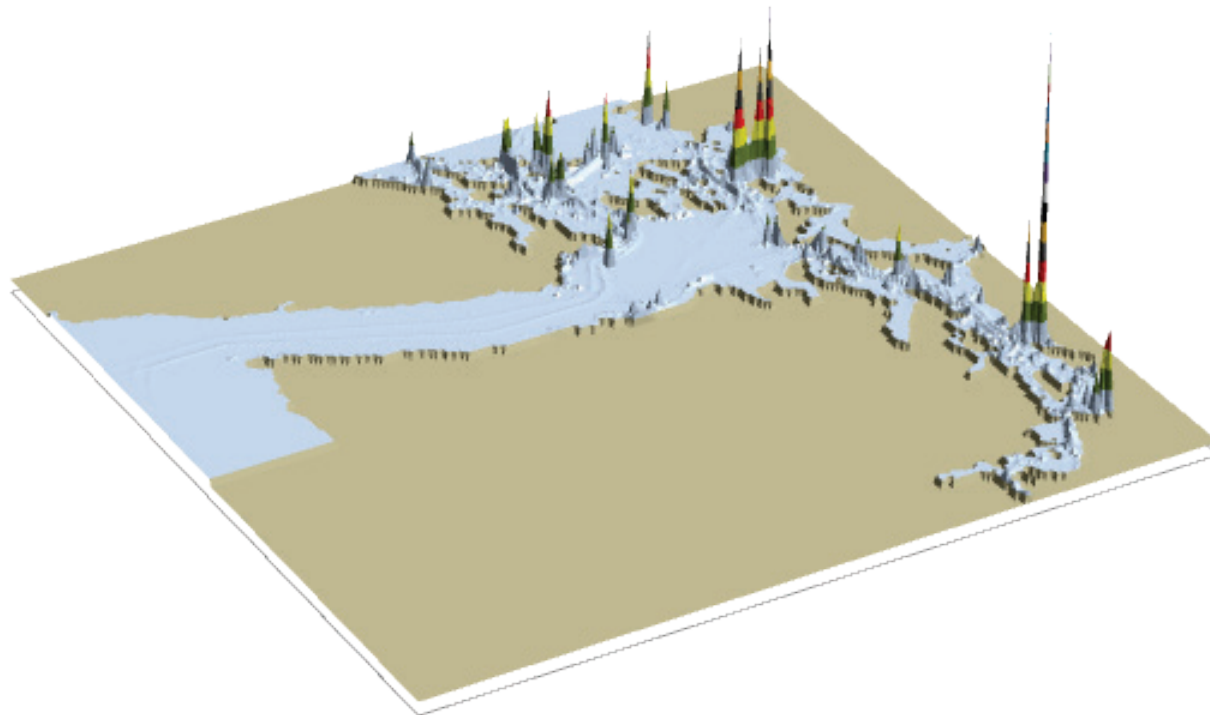


GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

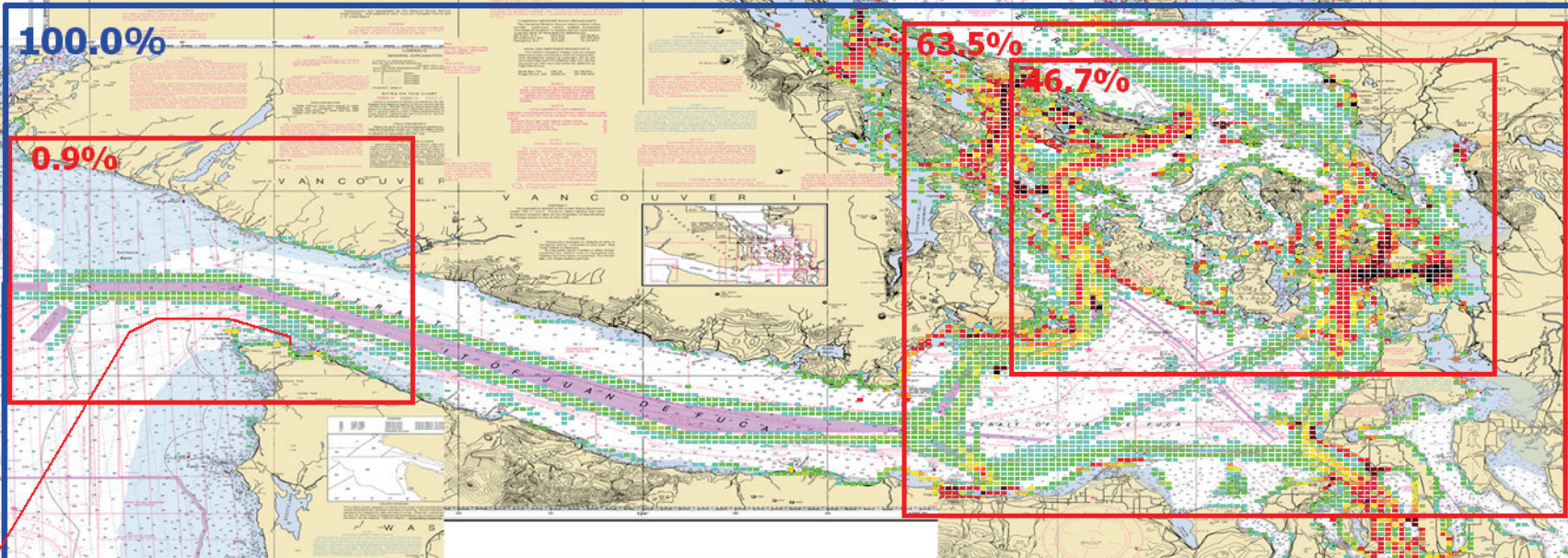
VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

P: Base Case 3D Risk Profile All FV - Pot.Grou+Coll.Acc.Freq.: 100% of Base Case PCF



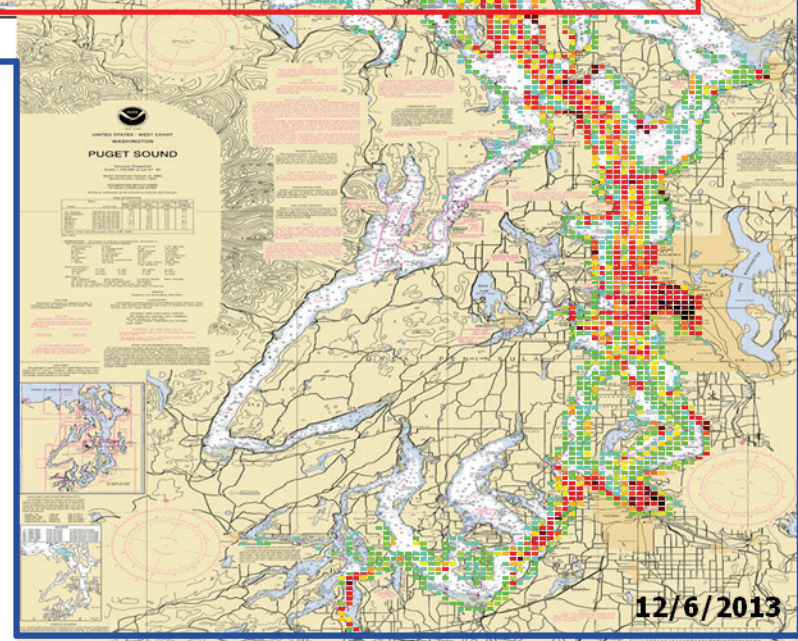
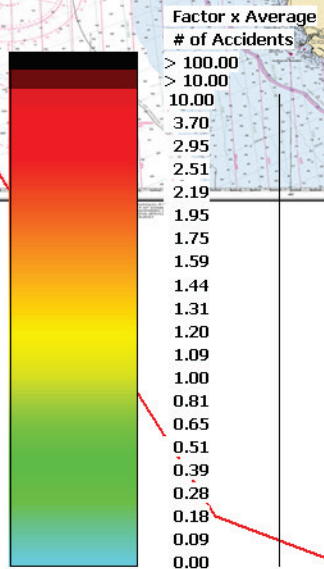
VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

P: VTRA 2010 - BASE CASE - ALL FV



P: BC @ 100%

POTENTIAL ACCIDENT FREQUENCY - PAF

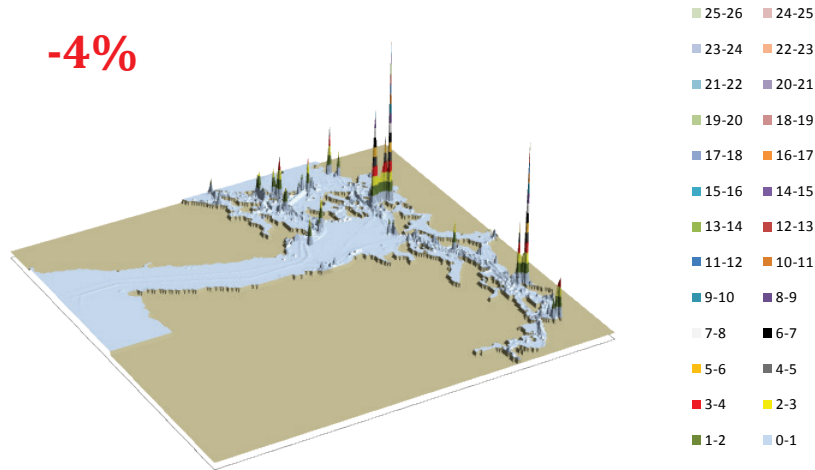


12/6/2013

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

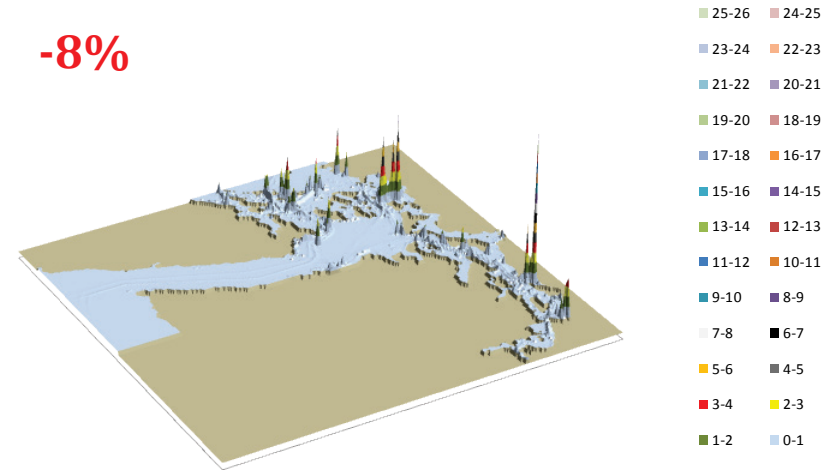
P: BC & CONT 17KNTS 3D Risk Profile
All FV - Pot.Grou+Coll.Acc.Freq.: 96% of Base Case PCF

-4%



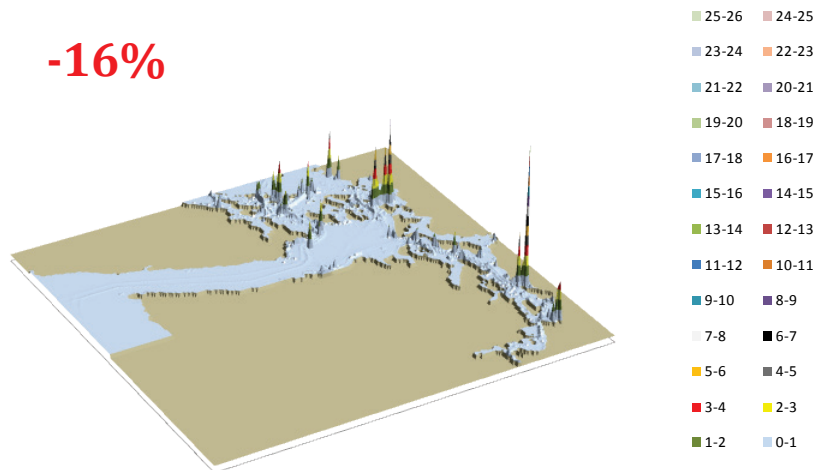
P: BC & OB HE50 3D Risk Profile
All FV - Pot.Grou+Coll.Acc.Freq.: 92% of Base Case PCF

-8%



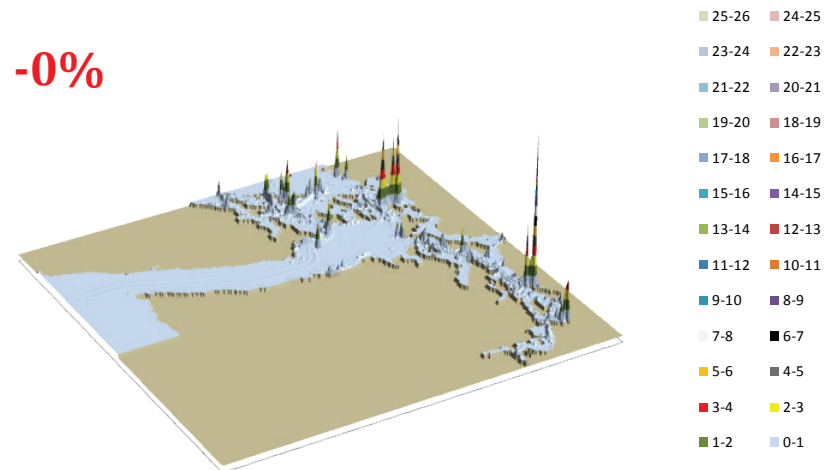
P: BC & OB HE100 3D Risk Profile
All FV - Pot.Grou+Coll.Acc.Freq.: 84% of Base Case PCF

-16%

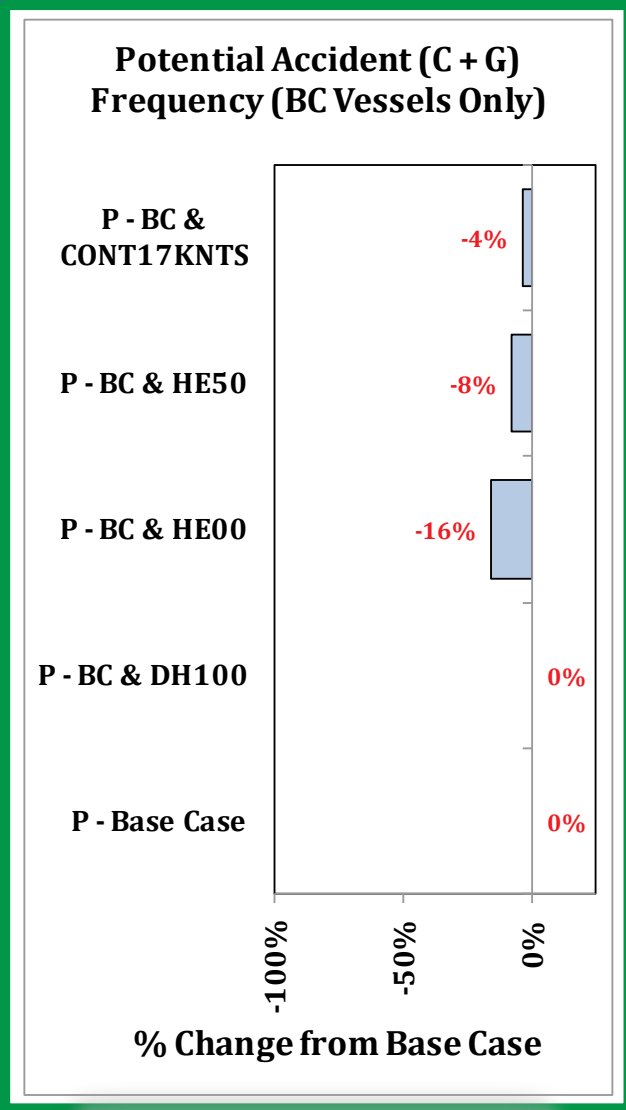
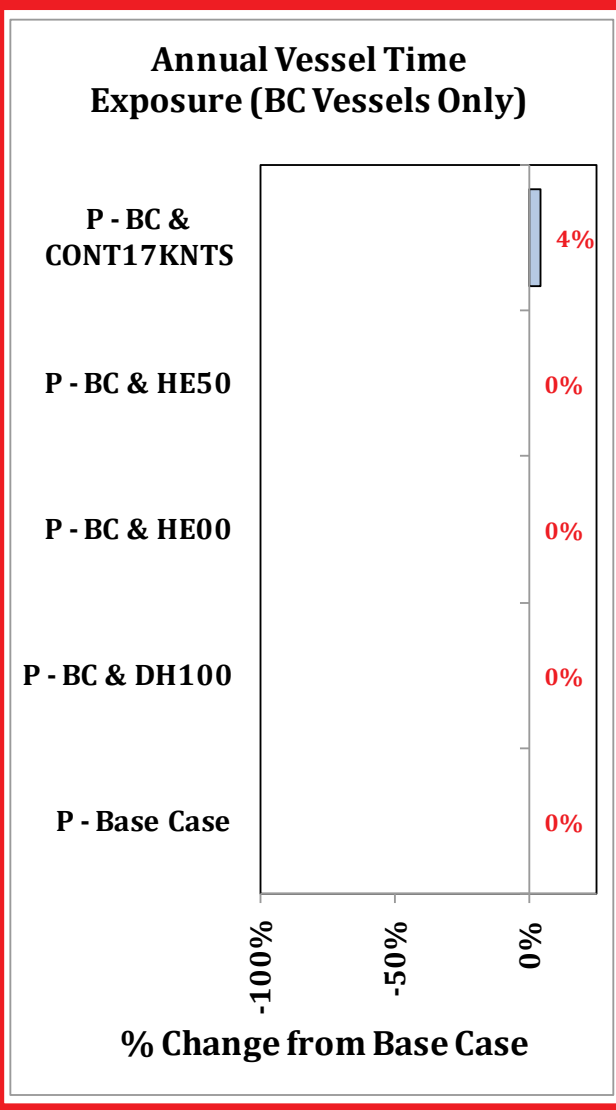


P: BC & DH100 3D Risk Profile
All FV - Pot.Grou+Coll.Acc.Freq.: 100% of Base Case PCF

-0%



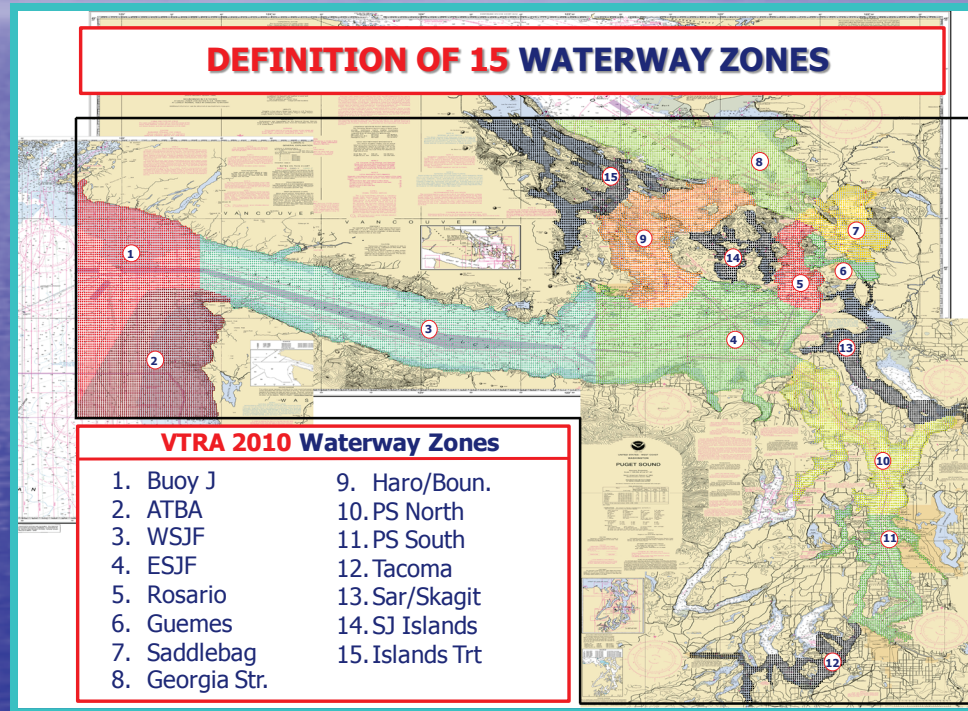
VTRA 2010 : OIL (C + F) TIME EXPOSURE AND POTENTIAL OIL (C+F) LOSS COMPARISON BASE CASE VESSELS



VTRA 2010 – SYNOPSIS OF 3D SCENARIO COMPARISON

POTENTIAL OIL LOSS

By What-if Focus Vessels and Base Case Focus Vessels

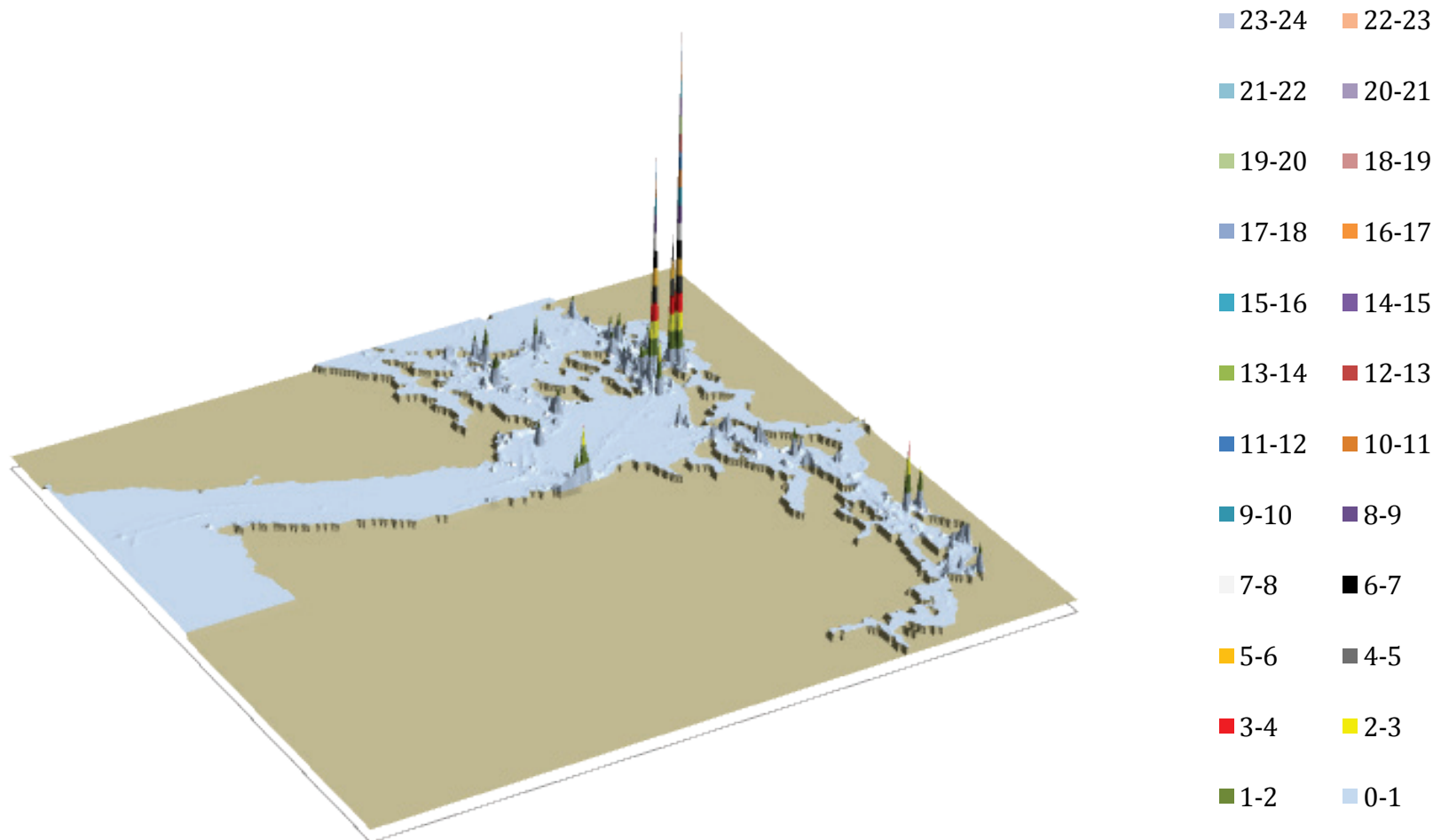


GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

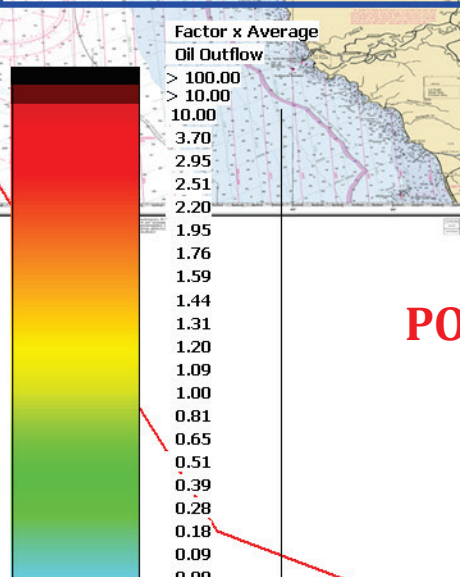
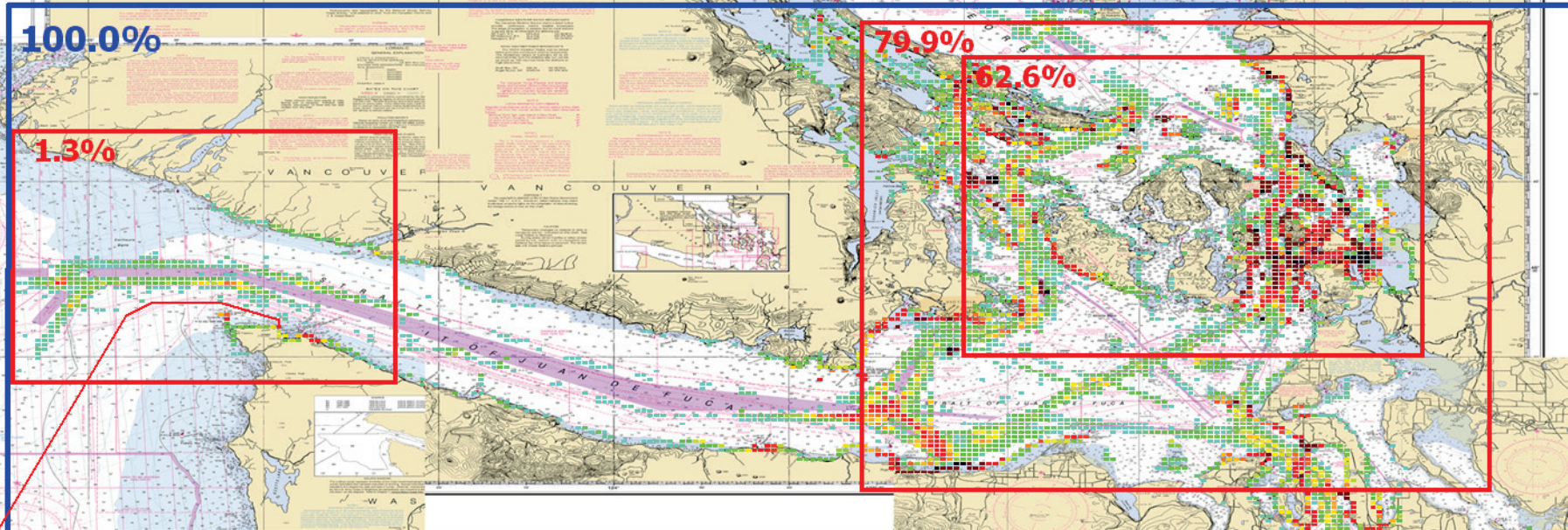
VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

P: Base Case 3D Risk Profile All FV - Pot. Grou+Coll.Oil Loss: 100% of Base Case PCO



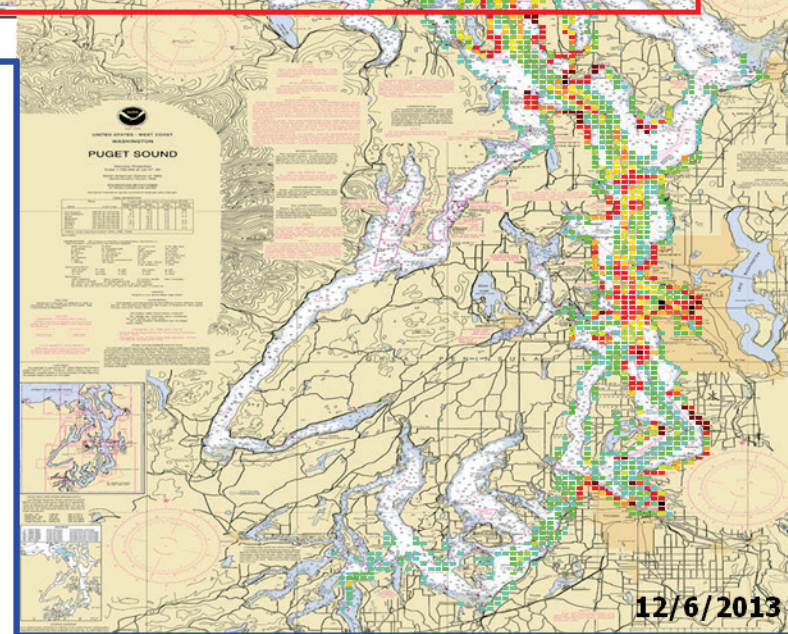
VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

P: VTRA 2010 - BASE CASE - ALL FV



P: BC @ 100%

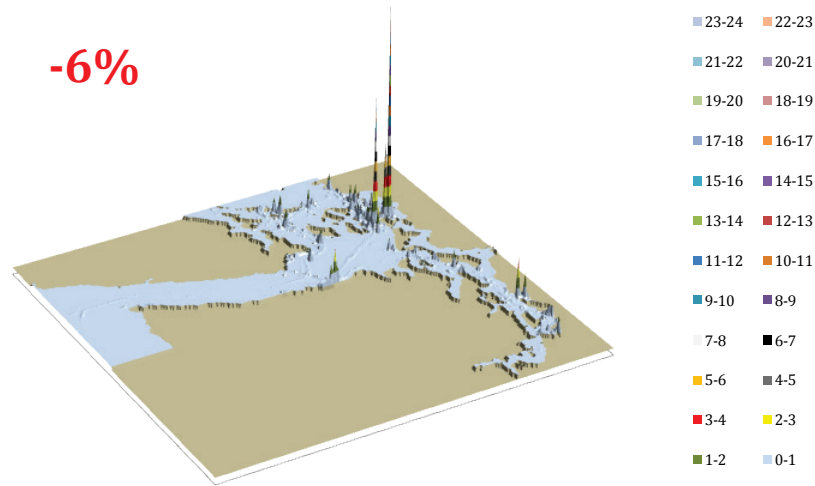
POTENTIAL ACCIDENT OIL LOSS - POL



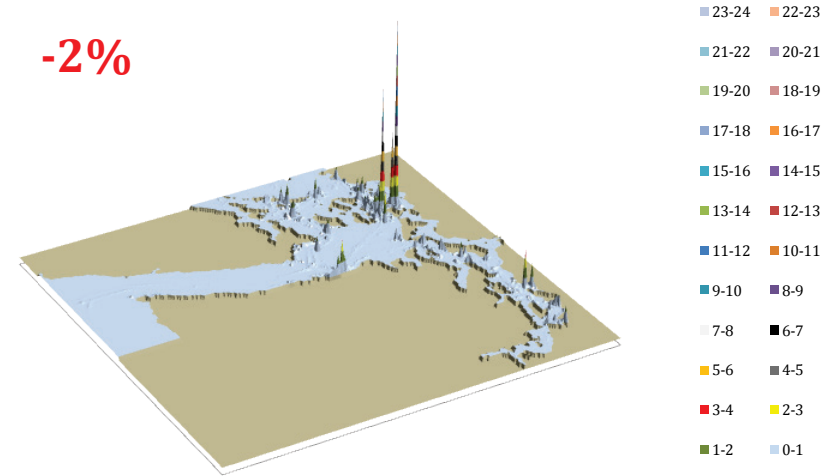
12/6/2013

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

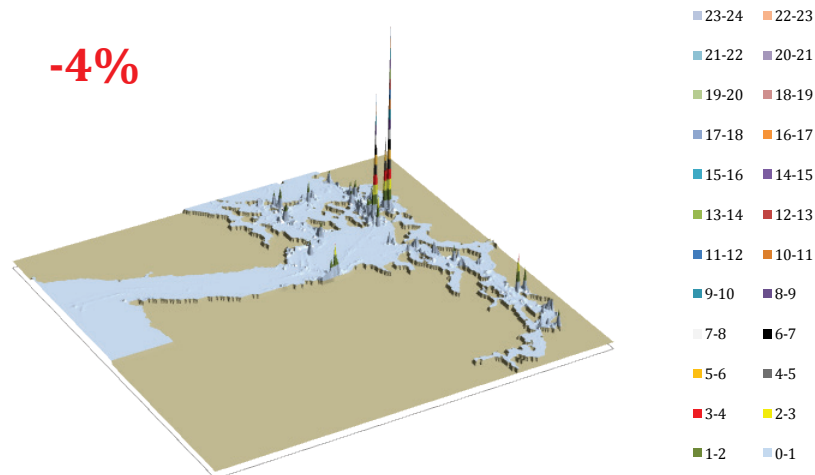
P: BC & CONT 17KNTS 3D Risk Profile
All FV - Pot. Grou+Coll.Oil Loss: 94% of Base Case PCO



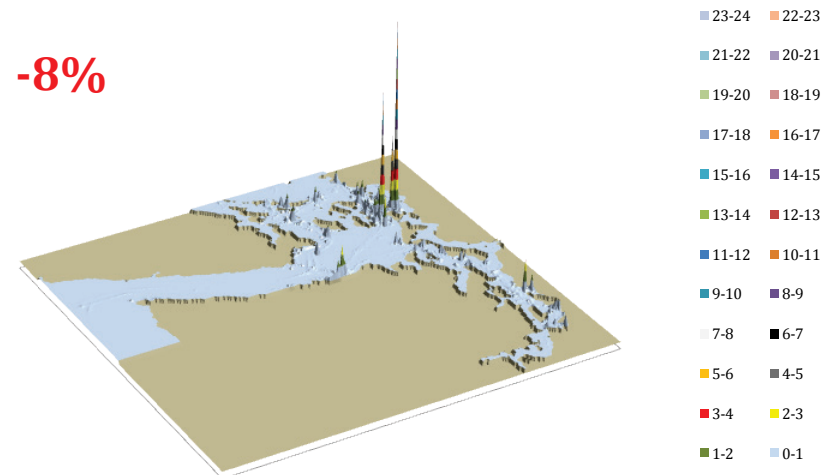
P: BC & OB HE50 3D Risk Profile
All FV - Pot. Grou+Coll.Oil Loss: 98% of Base Case PCO



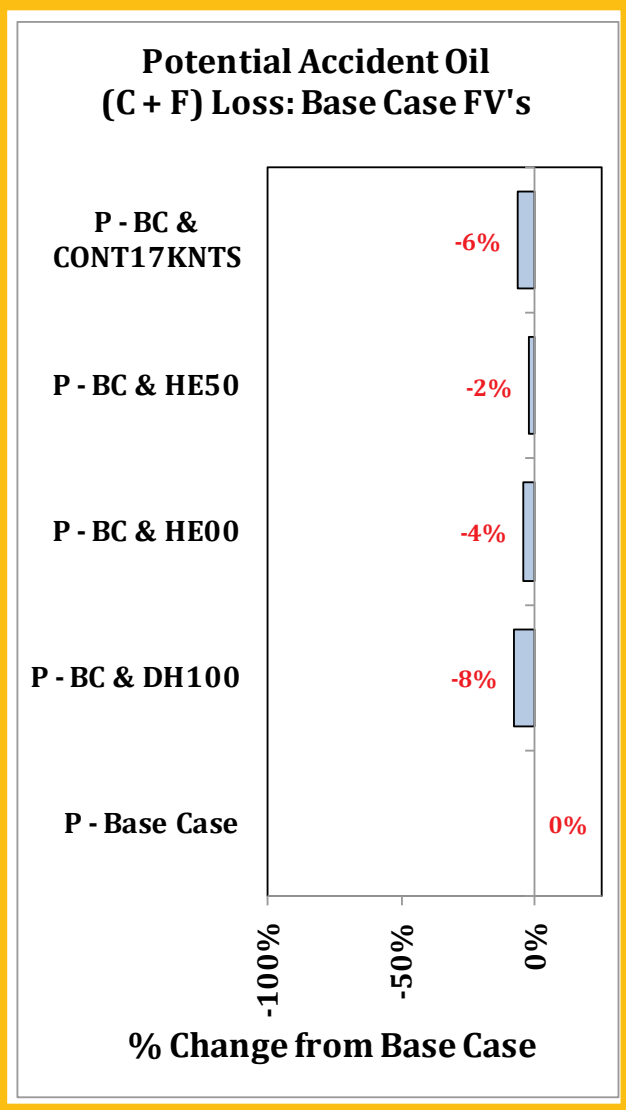
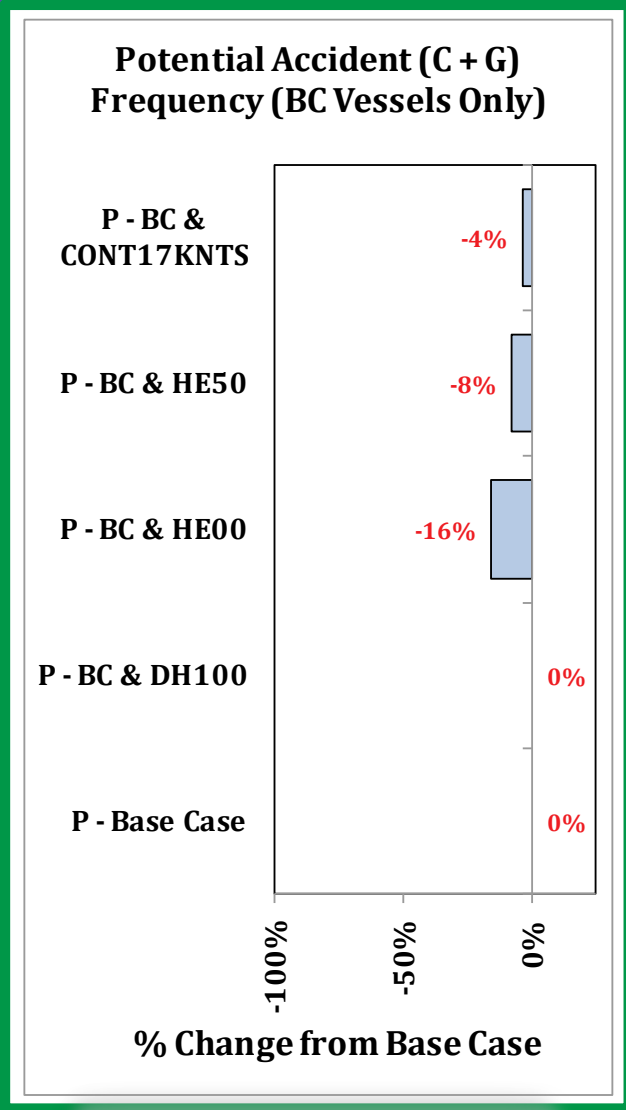
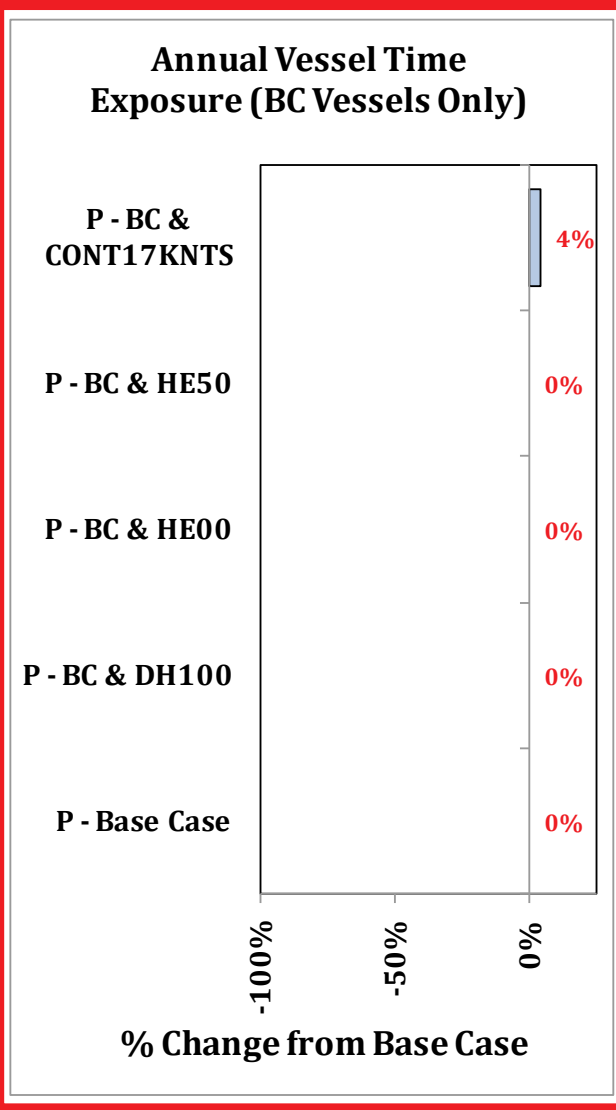
P: BC & OB HE100 3D Risk Profile
All FV - Pot. Grou+Coll.Oil Loss: 96% of Base Case PCO



P: BC & DH100 3D Risk Profile
All FV - Pot. Grou+Coll.Oil Loss: 92% of Base Case PCO

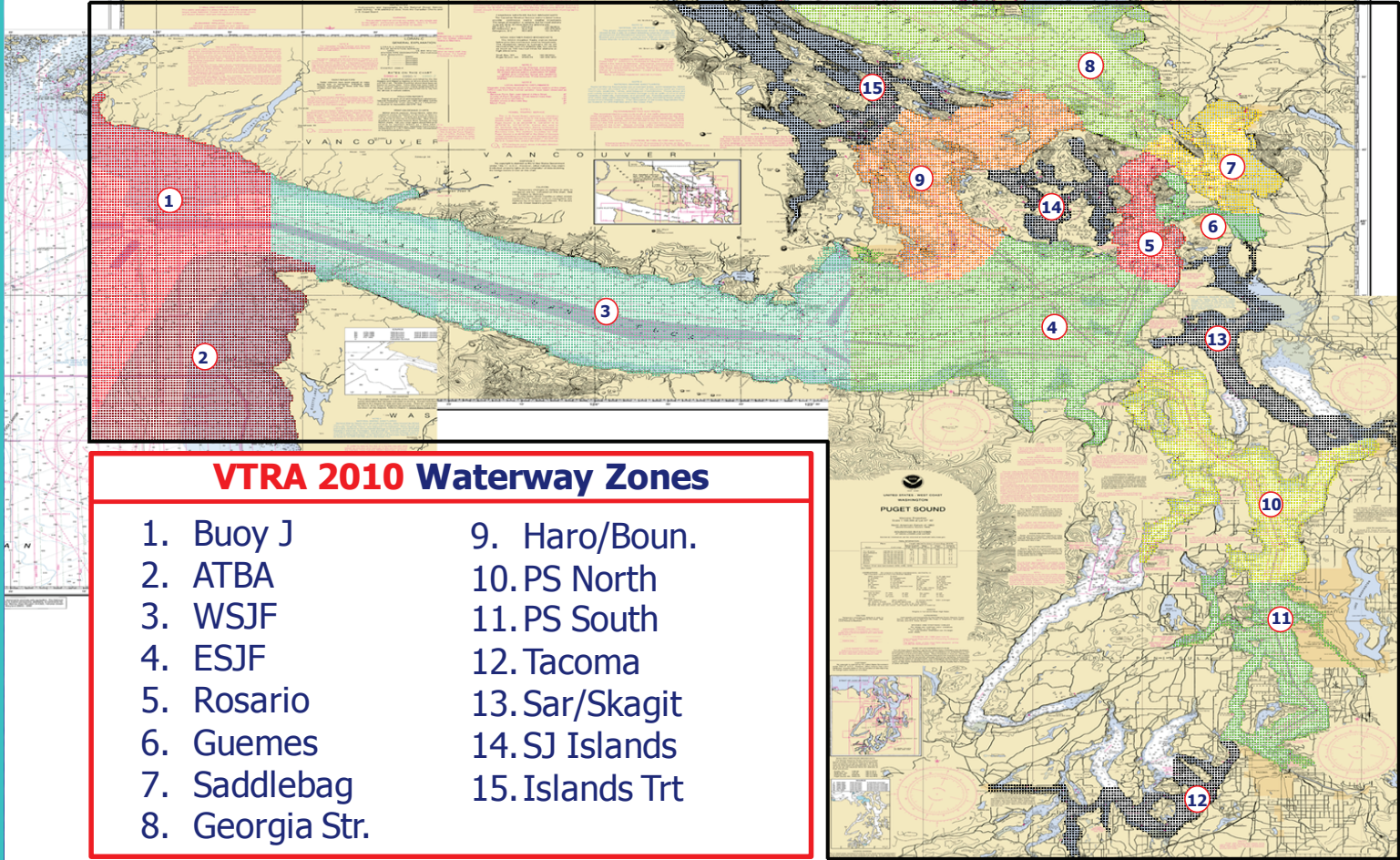


VTRA 2010 : OIL (C + F) TIME EXPOSURE AND POTENTIAL OIL (C+F) LOSS COMPARISON BASE CASE VESSELS



VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

DEFINITION OF 15 WATERWAY ZONES



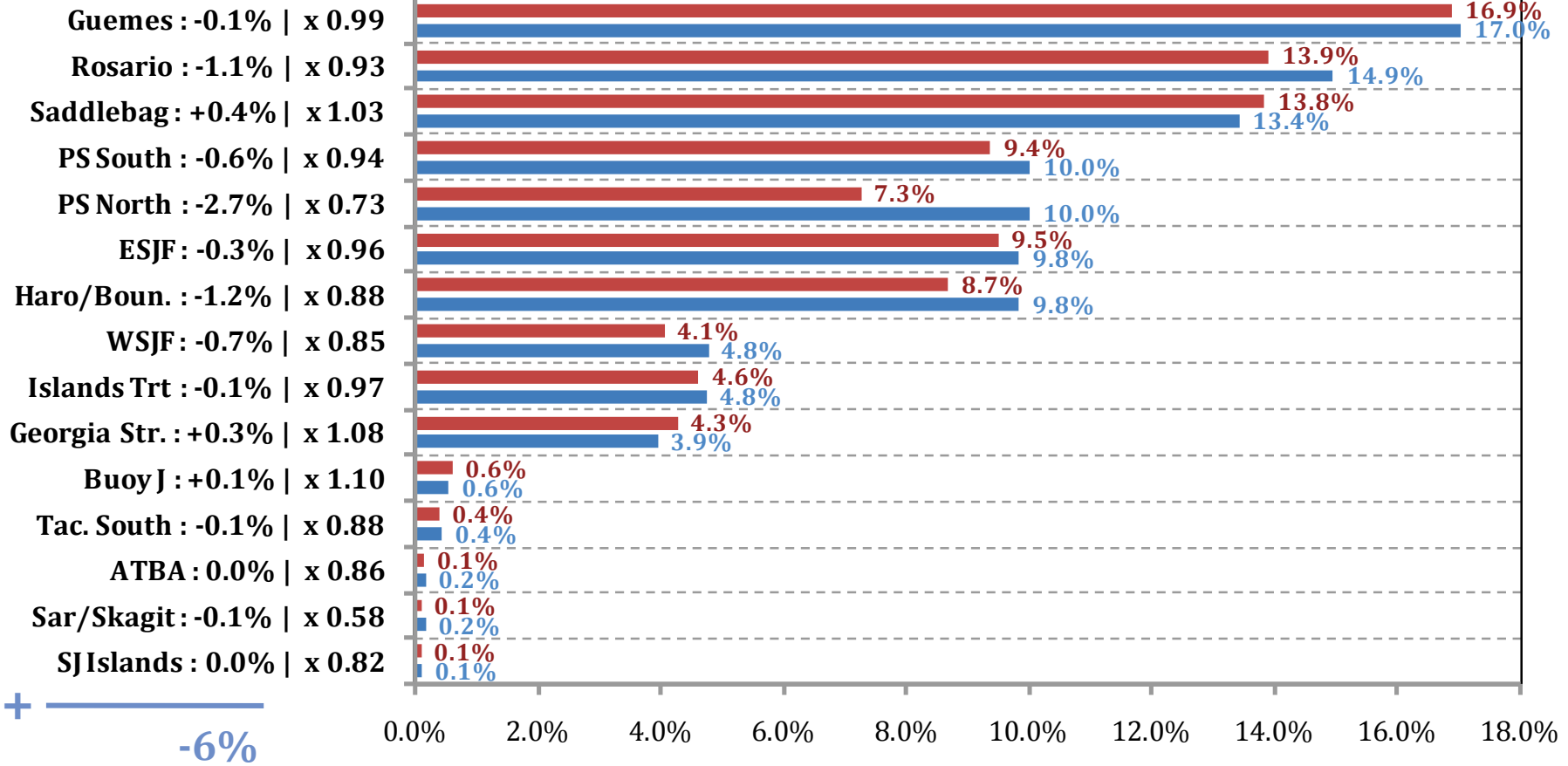
VTRA 2010 Waterway Zones

- | | |
|-----------------|-----------------|
| 1. Buoy J | 9. Haro/Boun. |
| 2. ATBA | 10. PS North |
| 3. WSJF | 11. PS South |
| 4. ESJF | 12. Tacoma |
| 5. Rosario | 13. Sar/Skagit |
| 6. Guemes | 14. SJ Islands |
| 7. Saddlebag | 15. Islands Trt |
| 8. Georgia Str. | |

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

% Base Case Oil (Coll. + Grou.) Loss - ALL_FV

Waterway Zone:



% Base Case Oil (Coll.+Grou.) Loss (OL) - ALL_FV

P & 17KNTS

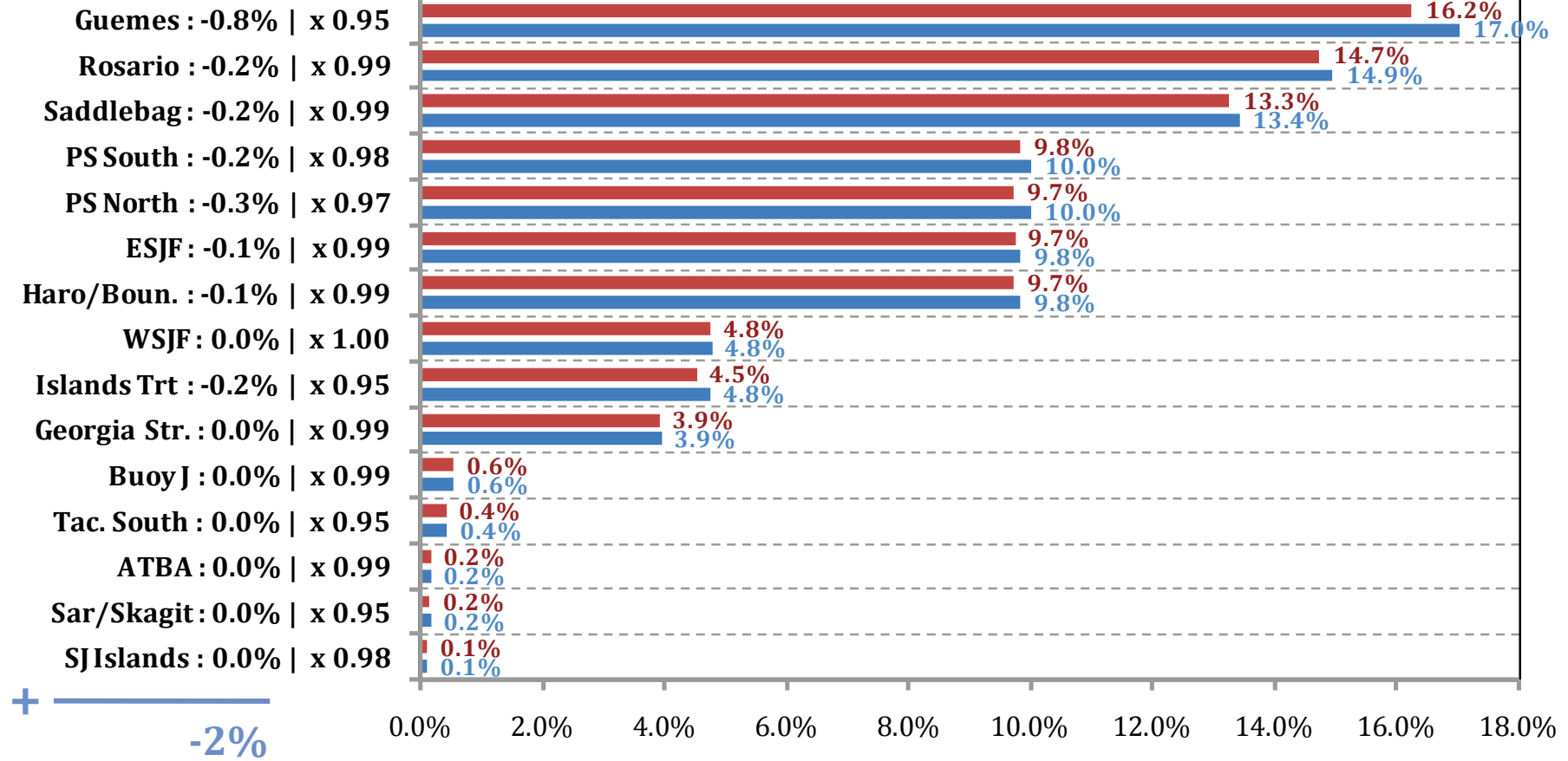
■ P: BC & CONT 17KNTS: 94% (-6% | x 0.94)

■ P: Base Case: 100%

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

% Base Case Oil (Coll. + Grou.) Loss - ALL_FV

Waterway Zone:



% Base Case Oil (Coll.+Grou.) Loss (OL) - ALL_FV

■ P: BC & OB HE50: 98% (-2% | x 0.98)

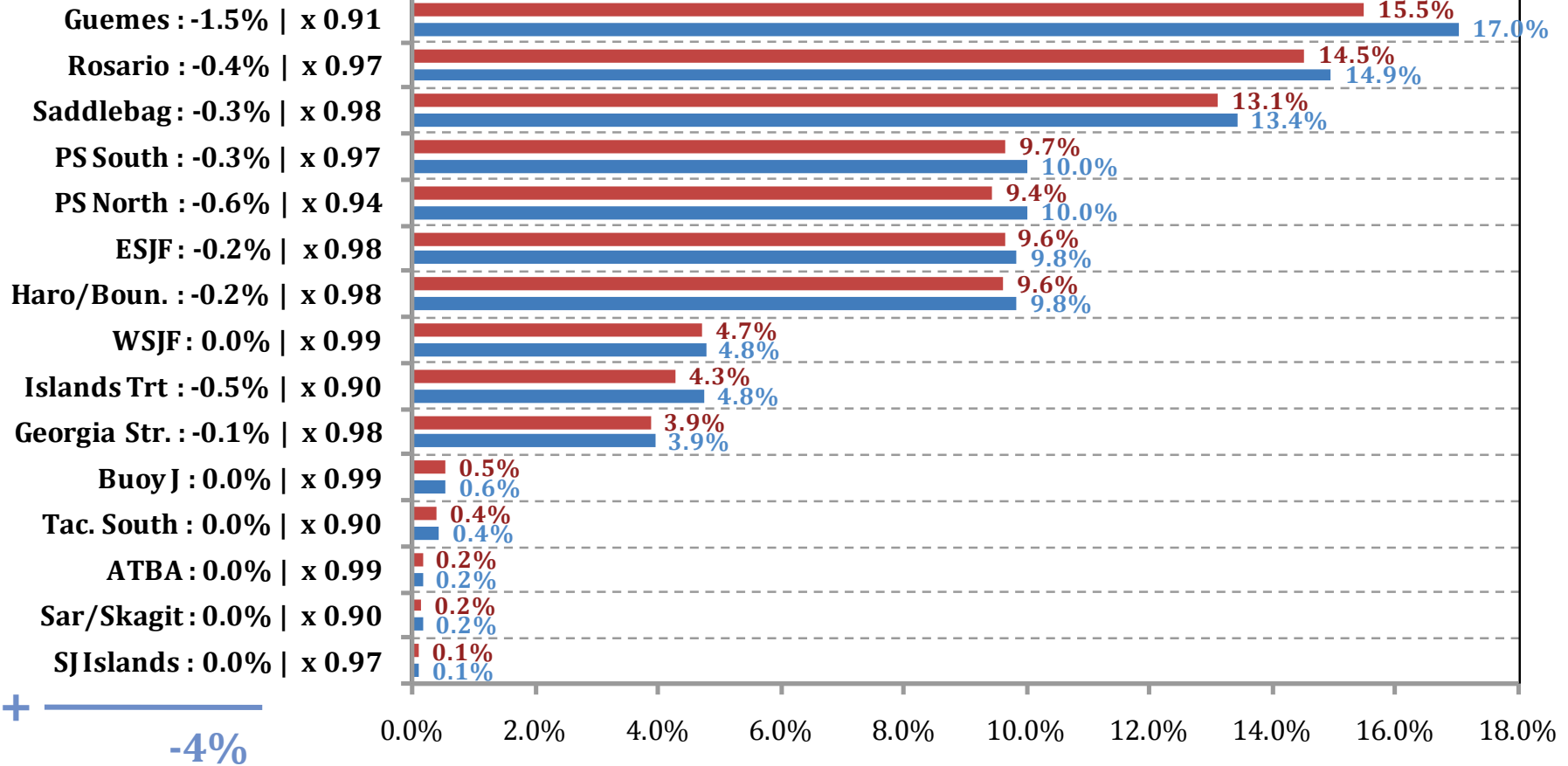
■ P: Base Case: 100%

P & HE50

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

% Base Case Oil (Coll. + Grou.) Loss - ALL_FV

Waterway Zone:



% Base Case Oil (Coll.+Grou.) Loss (OL) - ALL_FV

P & HE00

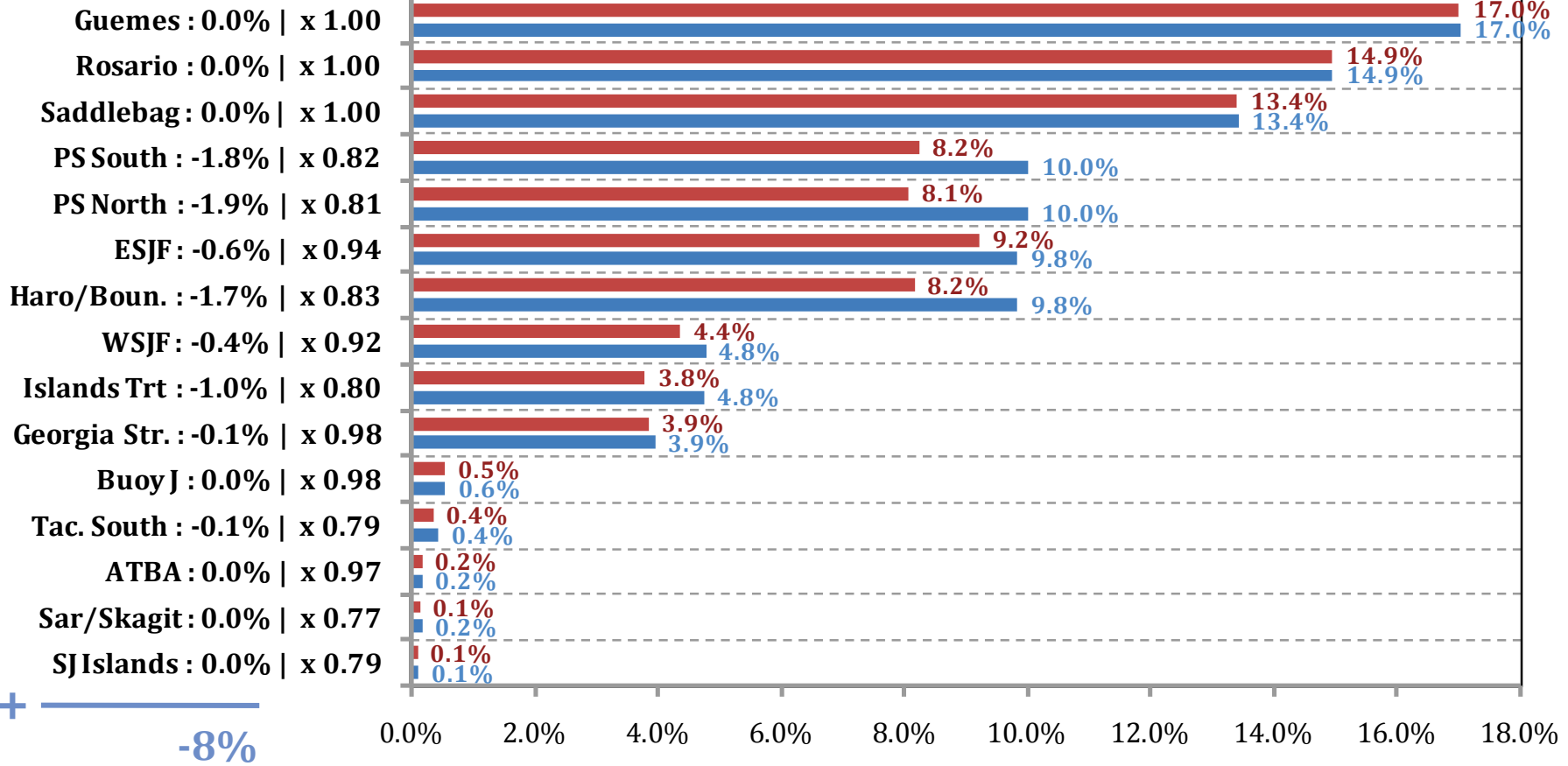
■ P: BC & OB HE100 : 96% (-4% | x 0.96)

■ P: Base Case: 100%

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2010

% Base Case Oil (Coll. + Grou.) Loss - ALL_FV

Waterway Zone:



% Base Case Oil (Coll.+Grou.) Loss (OL) - ALL_FV

■ P: BC & DH100: 92% (-8% | x 0.92)

■ P: Base Case: 100%

P & DH100