

The logo consists of the letters 'UC' in a bold, sans-serif font. The 'U' is a solid orange color, while the 'C' is a lighter, semi-transparent orange. The background of the slide is a textured orange-to-red gradient with abstract, wavy patterns in shades of blue and purple on the right side.

UC

# Geovisualization of shipping noise exposure for whales in Canada

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# Introduction

ANTHROPOGENIC NOISE, SHIPPING AND CETACEANS



# ANTHROPOGENIC NOISE AND MARINE MAMMALS

## NOISE AFFECTS SEVERAL ASPECTS OF CETACEAN ECOLOGY:

- Intense, high-energy sounds cause both temporary and permanent auditory threshold shifts
- Chronic exposure to noise causes increases in stress and communication (social interaction) as well as echolocation (feeding) sounds
- All these effects are thought to reduce animals' survival probability and reproduction rates



# SHIPPING IN THE SALISH SEA

THE FASTEST GROWING SECTOR OF THE GLOBAL ECONOMY:

- Commercial shipping represents approximately 90% of the global trade occurring worldwide
- Currently, the world's commercial fleet accounts for more than 90,900 vessels
- In 2013, the West coast of Canada accounted for more than 50% of the ship traffic density occurring at the national scale

# CETACEANS IN THE SALISH SEA

## STATUS ACCORDING TO THE SPECIES AT RISK ACT:

### NOT AT RISK

- Dall's porpoise (last assessment 1989)
- Pacific white sided dolphin (last assessment 1990)
- Minke whale (last assessment 2006)

### SPECIAL CONCERN:

- Harbour porpoise (last assessment 1989)
- Gray whale (last assessment 2004)

### THREATENED:

- Humpback whale (last assessment 2011)
- Transient killer whale (last assessment 2008)
- Northern resident killer whale (last assessment 2008)

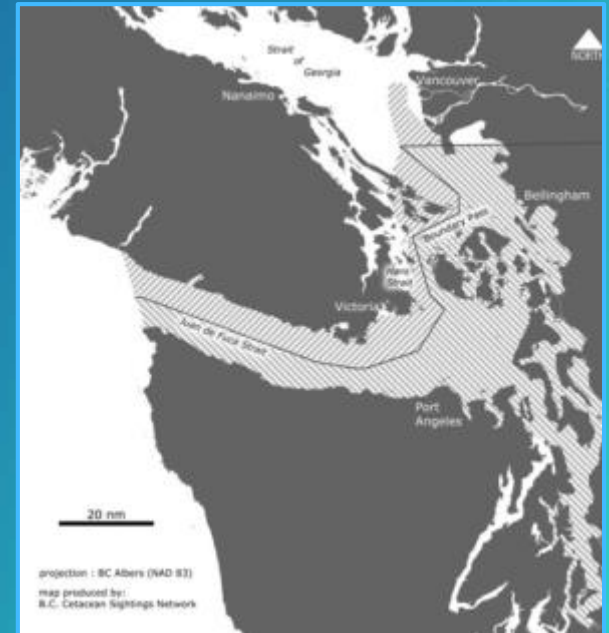


# CETACEAN IN THE SALISH SEA

STATUS ACCORDING TO THE SPECIES AT RISK ACT:

## ENDANGERED:

- Southern Resident Killer Whale (SRKW)
- One of only a few fish-eating orca ecotypes
- Threatened by:
  - declining salmon populations
  - increasing concentration of pollutants
  - expanding oil and gas industry
  - chronic anthropogenic noise



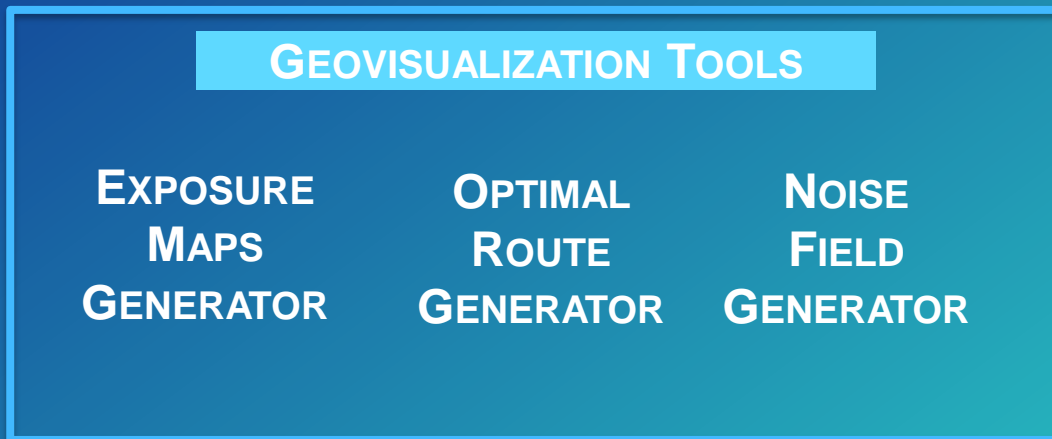
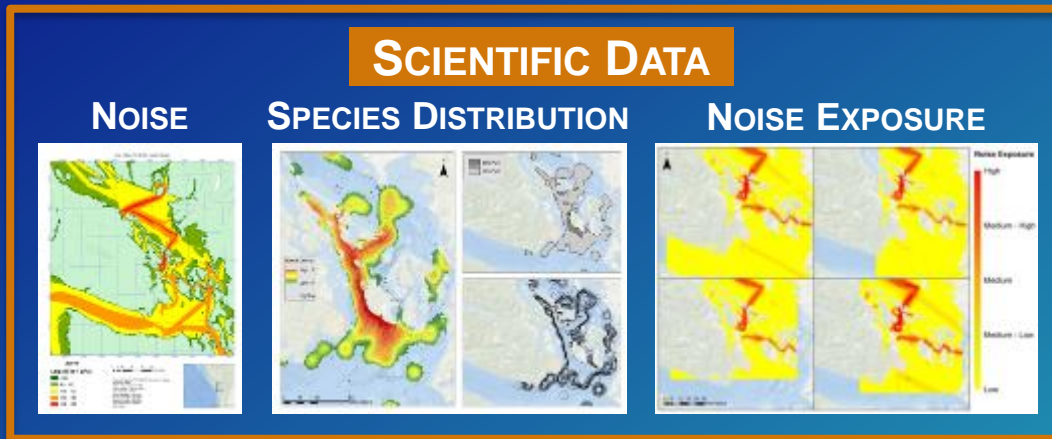
# SOME CONSIDERATIONS

## UNDERWATER ANTHROPOGENIC NOISE AND GEOVISUALIZATION:

- Legislators and decision makers often do not possess the expertise required for interpretation of acoustic models
  - There is a growing need for regulations, mitigation measures and guidelines addressing the issue of ocean noise
    - Geovisualization tools and techniques could help to bridge the gap between acoustic research and marine spatial planning

# OBJECTIVES:

- To create a set of Geovisualization tools for the exploration and analysis of acoustic and biological data collected in the Salish Sea



**Python + ArcGIS Pro**

The text 'Python + ArcGIS Pro' is enclosed in a light green oval. Two green arrows point towards this oval from the 'SCIENTIFIC DATA' and 'GEOVISUALIZATION TOOLS' boxes.

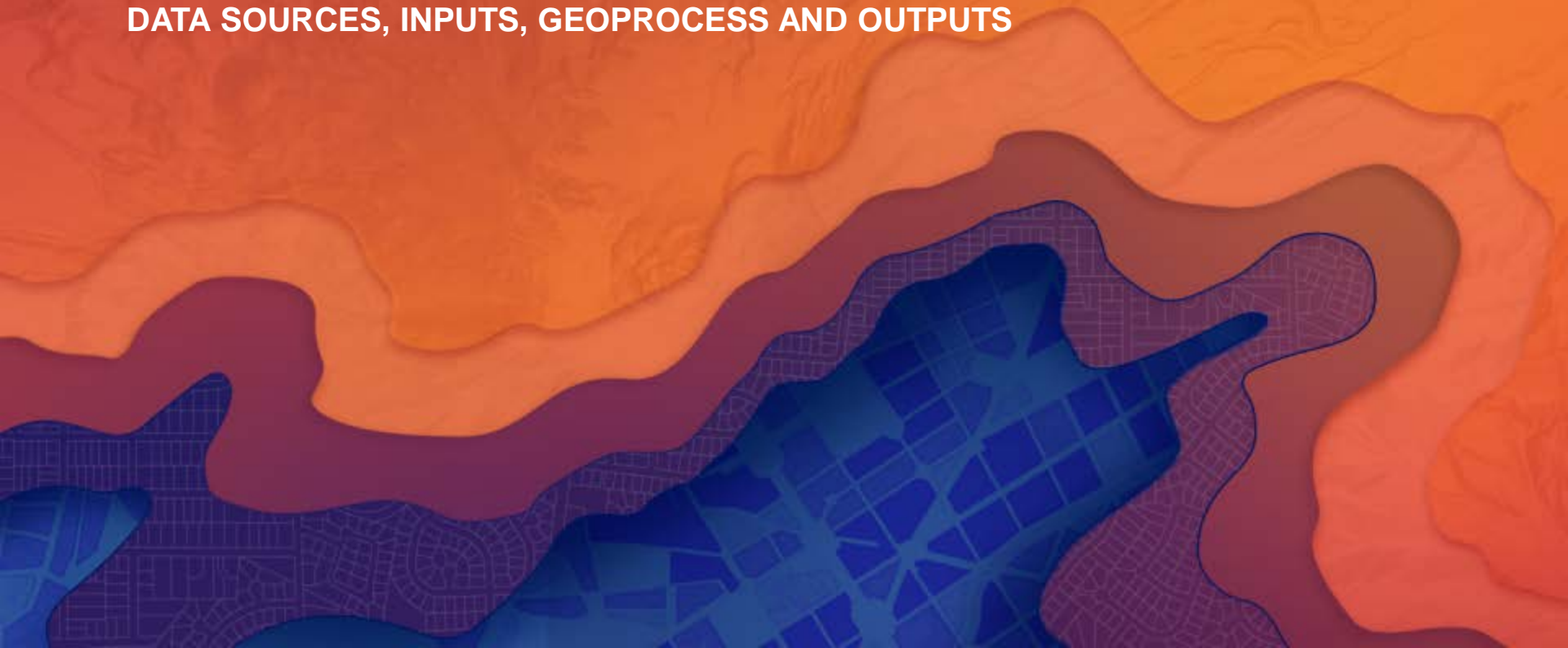


# OBJECTIVES:

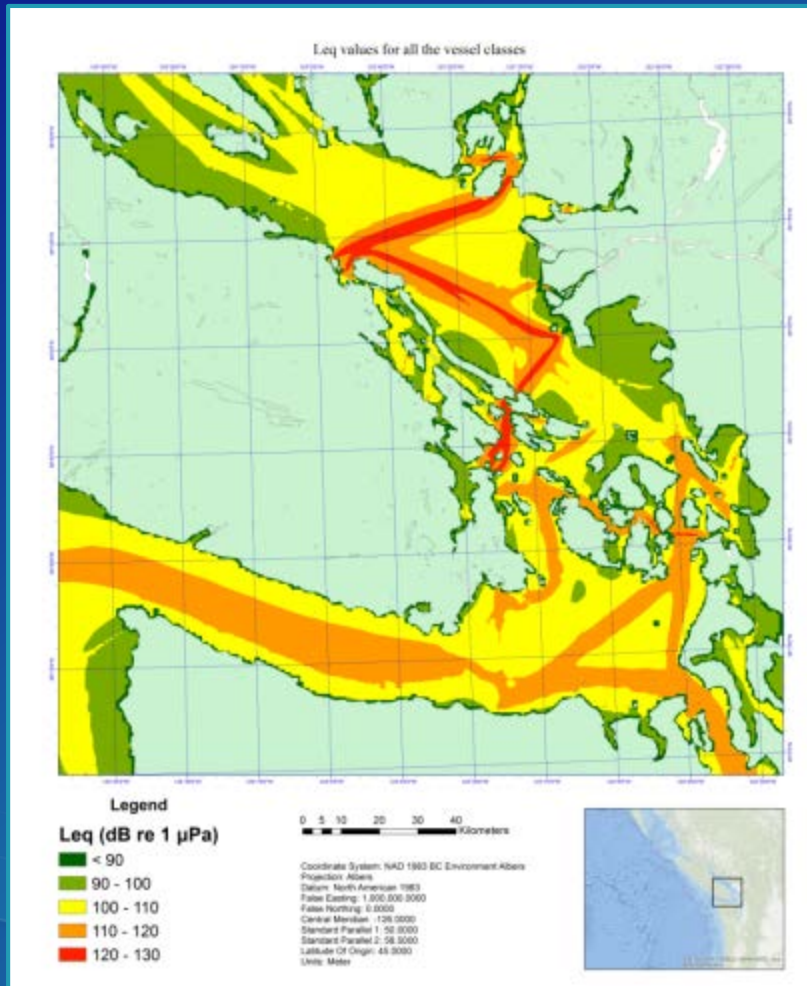
- To explore the use of 3d technology for the visualization of complex phenomena

# The NEMES toolbox

DATA SOURCES, INPUTS, GEOPROCESS AND OUTPUTS



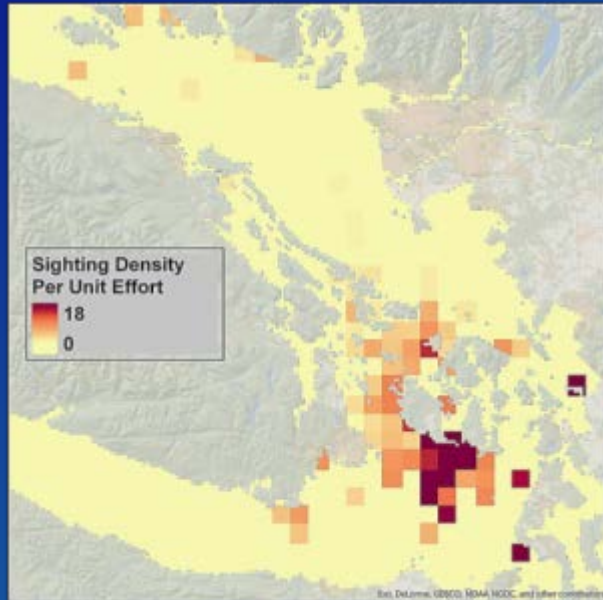
# DATA SOURCES - CUMULATIVE NOISE



- Based on Satellite AIS and environmental variables
- Sound produced by 21 different vessel classes in one month of traffic
- Noise expressed as **Equivalent Continuous Sound Pressure Level (Leq)**

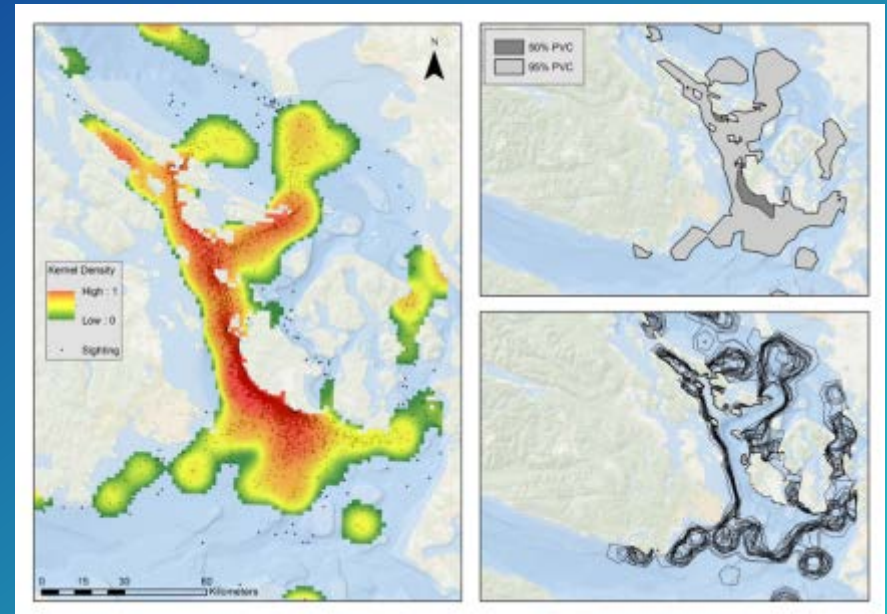
# DATA SOURCES – CETACEAN DISTRIBUTION

## B.C. CETACEAN SIGHTINGS NETWORK



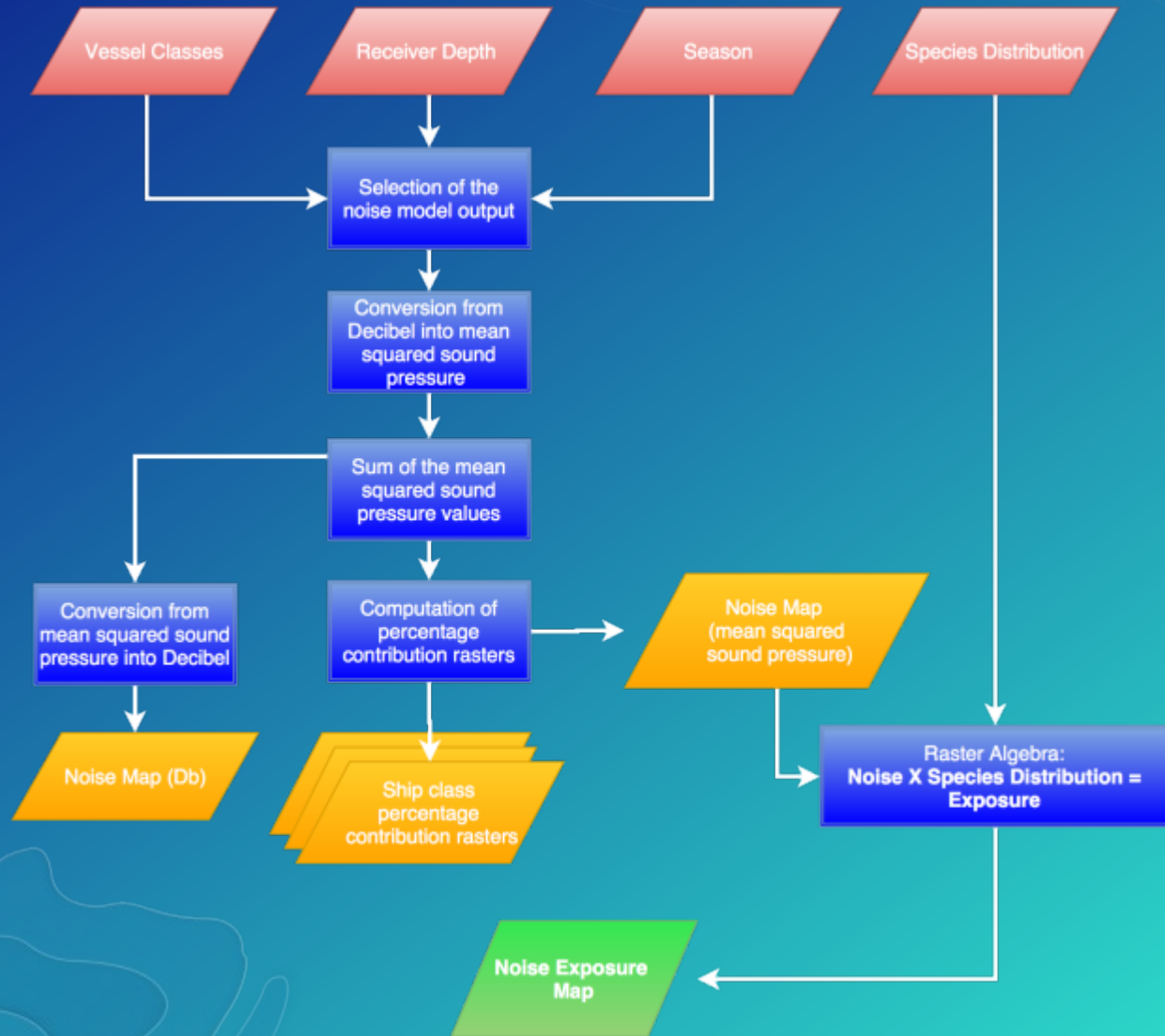
- One map for each cetacean species
- Extent covers the entire study area
- Resolution: 5 x 5 km

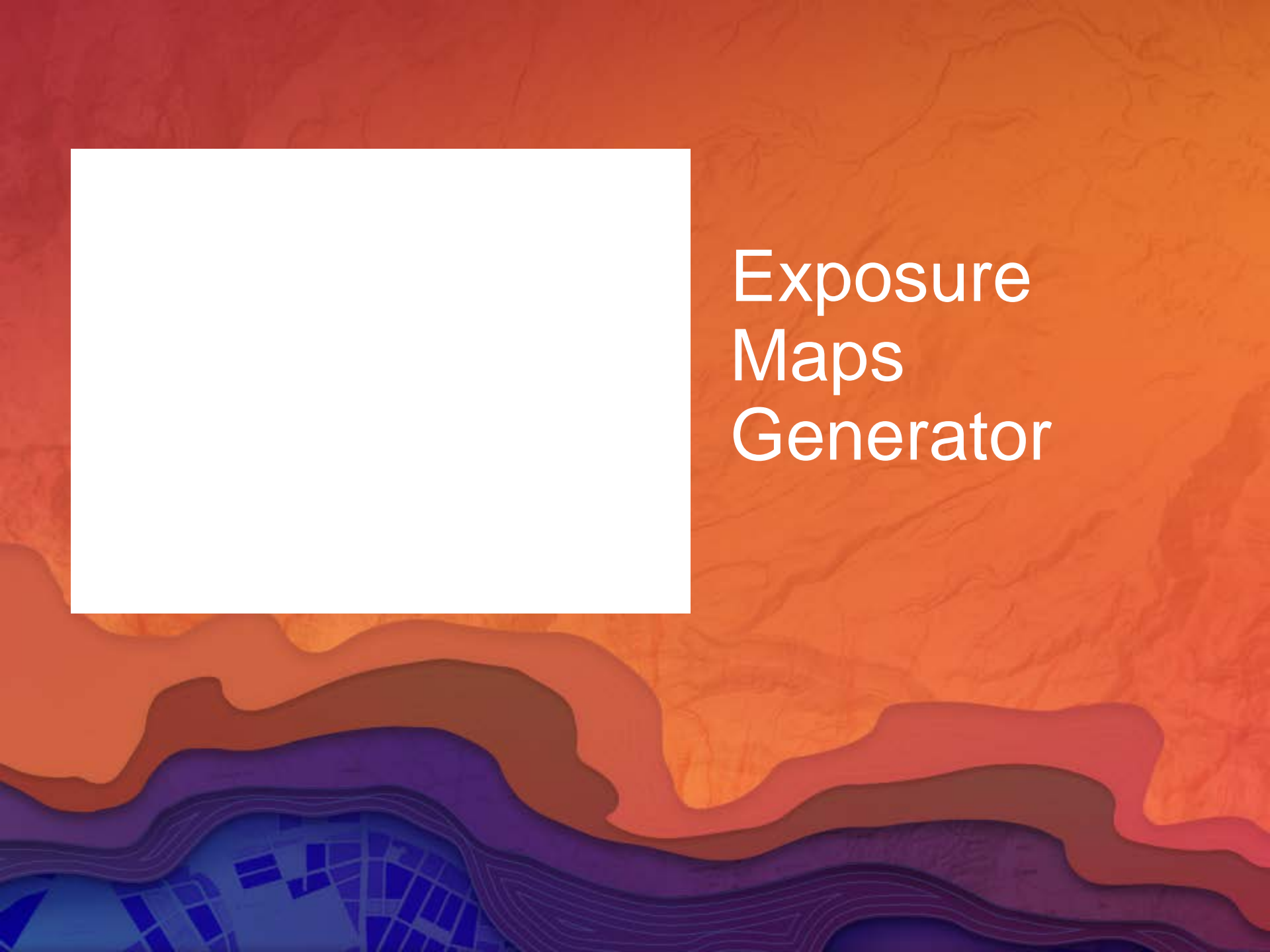
## SOUTHERN RESIDENT KILLER WHALE (SRKW) CORE AREAS



- Set of 4 maps dedicated to SRKW
- Limited extent
- Resolution: 800 x 800 m

# EXPOSURE MAPS GENERATOR





# Exposure Maps Generator

# OPTIMAL ROUTE GENERATOR





# Optimal Route Generator



# NOISE FIELD GENERATOR





# Noise Field Generator

# ARC-GIS PRO PLUG-IN

The screenshot displays the ArcGIS Pro interface with the NEMES Planning Tool plug-in. The tool is configured for a "Least Cost Path Analysis" for the "Southern Resident Killer Whale" species. The simulation name is "Default". The selected cetacean species is "Southern Resident Killer Whale", and the distribution model is "J-POD Summer Core Habitat (Kernel Density Estimation)". The vessel types selected are "Ferry <30m", "Ferry <50m", and "Passenger <130m". The receiver depth is set to "33 m", and the season is "Summer 2015". The input layers for the cost surface are "J-POD Summer Core Habitat (Kernel Density Estimation)" and "Noise Exposure", both with a weight of 1.0. The safe depth for navigation is set to 30.0. The vessel type for noise field simulation is "Crude Oil Tankers >200m", with an average speed of 20.0 and a source noise level of 180.0. The waypoints are set to "Waypoints".

The interface shows three main maps: 1) A map of the study area with a red path and a blue dashed line. 2) A map showing noise exposure with a color scale from blue (low) to red (high). 3) A 3D visualization of the noise field simulation, showing a large area of high noise exposure (red) around the vessel path.

The "NEMES Analysis Results" panel displays the "NEMES Planning Tool Results". It shows the simulation name "Default" and a line graph titled "Accumulated Cost (shortest vs. least-cost)". The graph plots "Accumulated Cost" on the y-axis (0 to 34) against "Travelled distance using the route (km)" on the x-axis (0 to 30). Two lines are shown: a red line representing the shortest path and a blue line representing the least-cost path. The least-cost path is significantly higher than the shortest path. Below the graph is a bar chart titled "Accumulated Sound Exposure" showing "Accumulated Sound Exposure Level (dB)" on the y-axis (300 to 200) against "Log Distance from the source (km)" on the x-axis (0 to 20<sup>-4</sup>). The bar chart shows a decreasing trend in sound exposure level as distance increases.

# Conclusions

The background features a gradient from dark red at the top to bright orange at the bottom. A large, dark blue, wavy shape is positioned at the bottom, containing a lighter blue grid pattern. The overall aesthetic is modern and abstract.

# CONCLUSIONS

## THE NEMES TOOLBOX ALLOWS A USER TO:

- **Combine information from cumulative noise models and species distribution models**
- **Create alternative routes for the reduction of animals' exposure to anthropogenic impacts**
- **Visualize and compare the noise produced by different classes of vessels**

## FURTHERMORE:

- **The functionalities of these tools could be applied to other contexts for the visualization of wildlife exposure to different sources of anthropogenic disturbance**