Coastal Vulnerability Modeling: Balancing Land Use in a Changing Climate

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Agenda

01 PROJECT BACKGROUND

02 InVEST MODELS & APPLICATION

03 MODEL RESULTS IN VANCOUVER

04 HOW MODEL OUTPUTS SHAPE PERCEPTION

Project Background

SUPPORTED BY OCEAN WISE

OCEAN ACTION GRANT

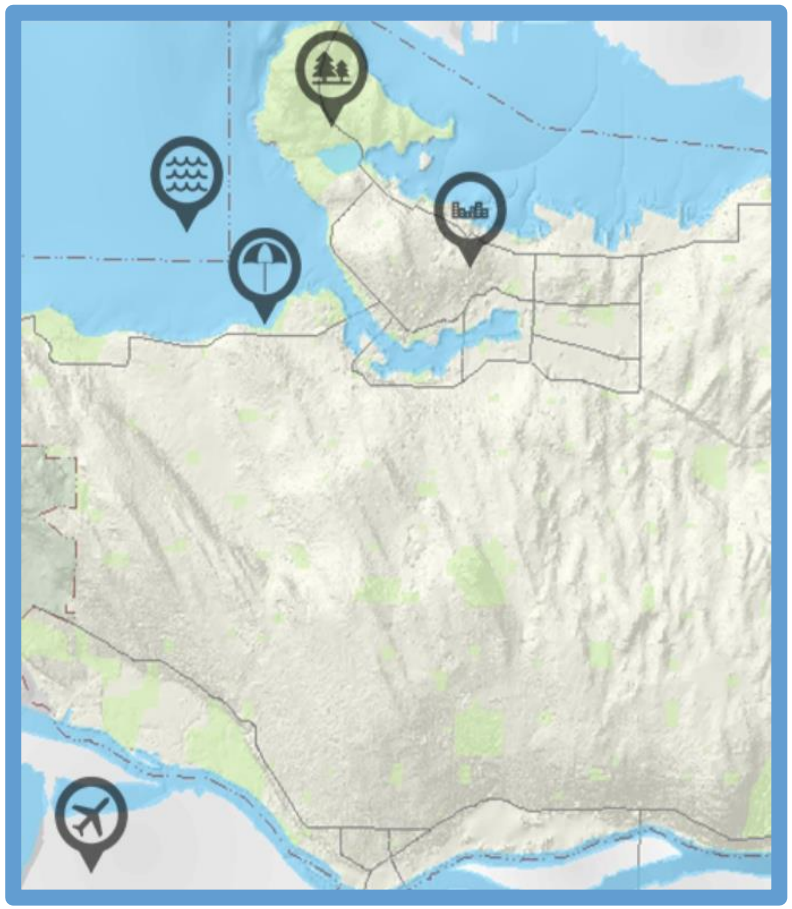
- A microgrant that will provide youth across Canada with up to $5000 in funding to lead a project that contributes to positive change for the environment.

WATERLUTION'S Y4RC PROGRAM

-Y4RC is a national leadership and action program from Waterlution designed to engage Canadian youth in addressing climate and water resilience challenges in their communities.

Y4RC Youth for Resilient Communities
waterlution

Coastal Risk Problem in Changing Climate



CURRENT (2025)

YEAR 2100 (w/o mitigation)

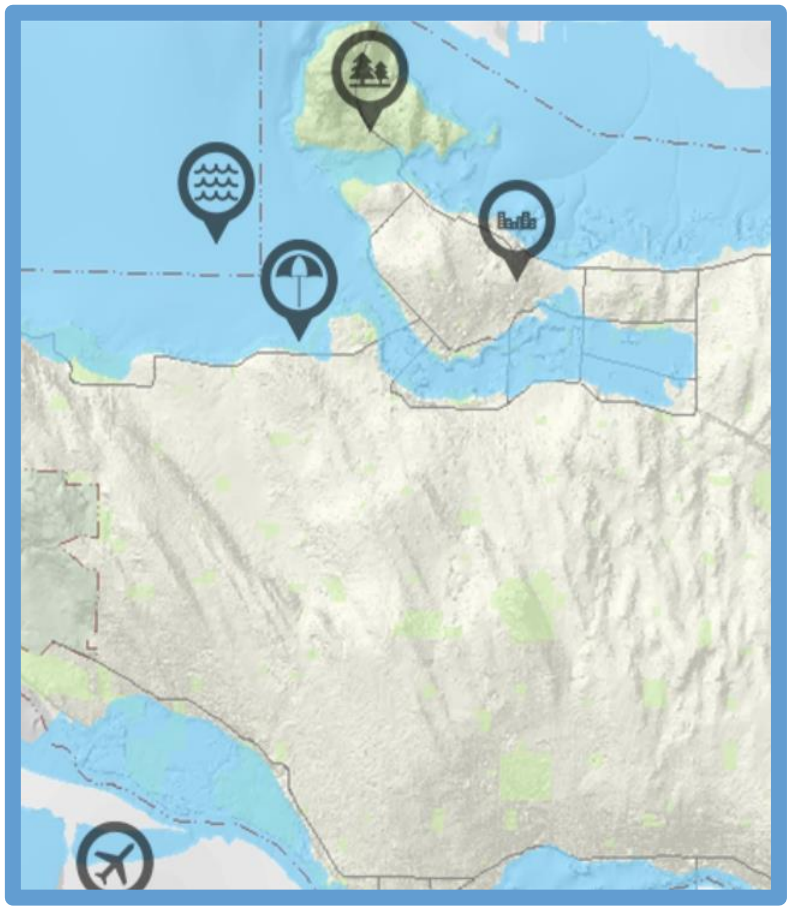


Photo reference: The City of Vancouver (2025). *Adapting to sea level rise.* Vancouver.ca. Retrieved from https://vancouver.ca/green-vancouver/sea-level-rise.aspx

Purpose Of The Project

KEY RESEARCH QUESTIONS

-Where are the most vulnerable coastal areas under current and future SLR conditions?
-How do coastal habitats influence spatial patterns of coastal vulnerability?
-How does ecosystem modeling help shape people's perspective on coastal vulnerability?

Photo reference: Stanford's NatCap project case study: **Innovations in Climate Resilient Coastal Zones (The Bahamas) (2022/2023)**

Mapping The Vulnerable Shorelines

The Natural Capital Project is a global research partnership led by Stanford University that works to integrate the value of nature into decision-making.

InVEST® is a suite of free, open-source software models used to map and value the goods and services from nature that sustain and fulfill human life.

InVEST Coastal Vulnerability Model

01

INPUTS

Model inputs include spatial data representing coastal physical conditions, shoreline characteristics, and the presence of protective ecosystems.

02

PROCESSING

Input datasets are spatially aligned, ranked, and combined along shoreline segments to calculate a relative exposure index.

03

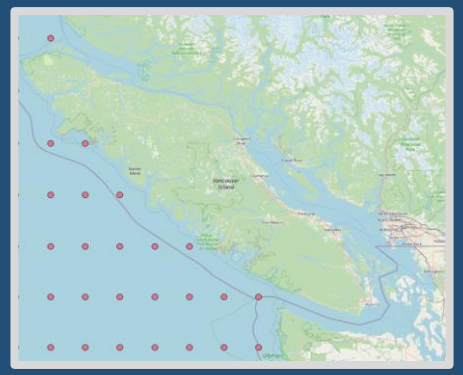
OUTPUTS

The primary output is a dataset representing the shoreline. Each segment is assigned Individual ranked exposure variables and a final Coastal Exposure Index (RELATIVE score)

Model Inputs

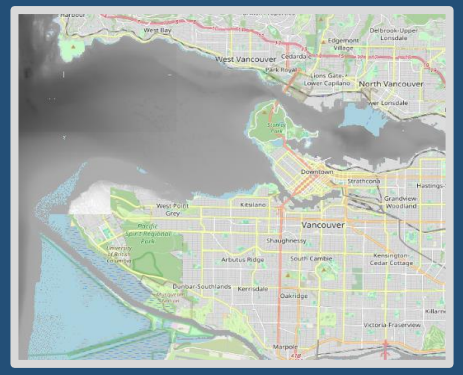
WAVE EXPOSURE

WaveWatch III (WW3) (2008-2016 trend) Global Wave Model developed by NOAA



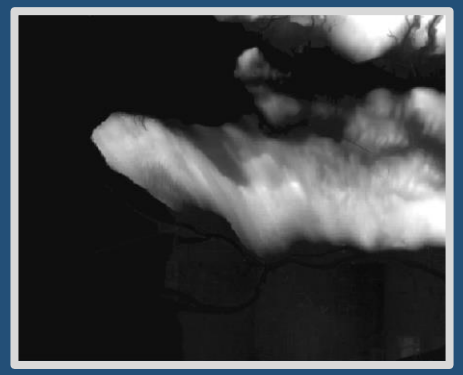
BATHYMETRY

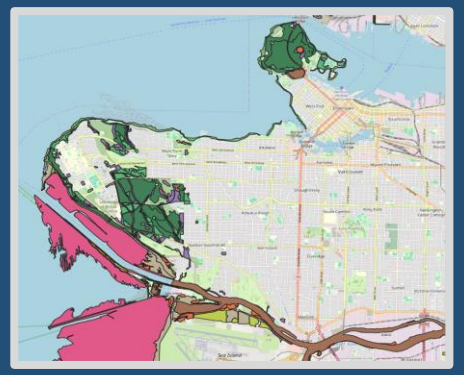
CHS NONNA - 10m (2023) by the Canadian Hydrographic Service (CHS).



DIGITAL ELEVATION MODEL (DEM)

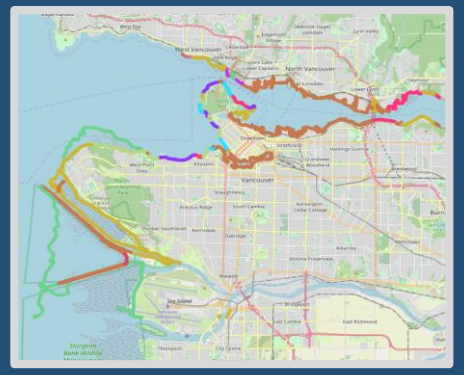
25 m gridded elevation dataset by Government of BC (2018), derived from TRIM (Terrain Resource Information Management) data.





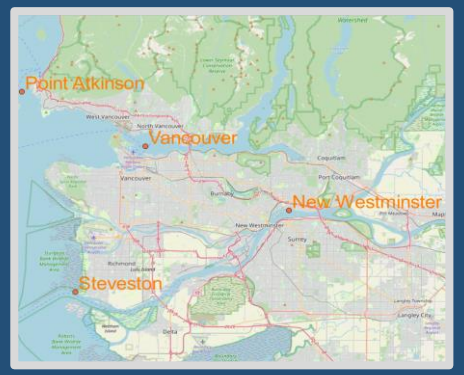
COASTAL HABITAT

The Sensitive Ecosystem Inventory (SEI) led by Metro Vancouver, 2023.



GEOMORPHOLOGY

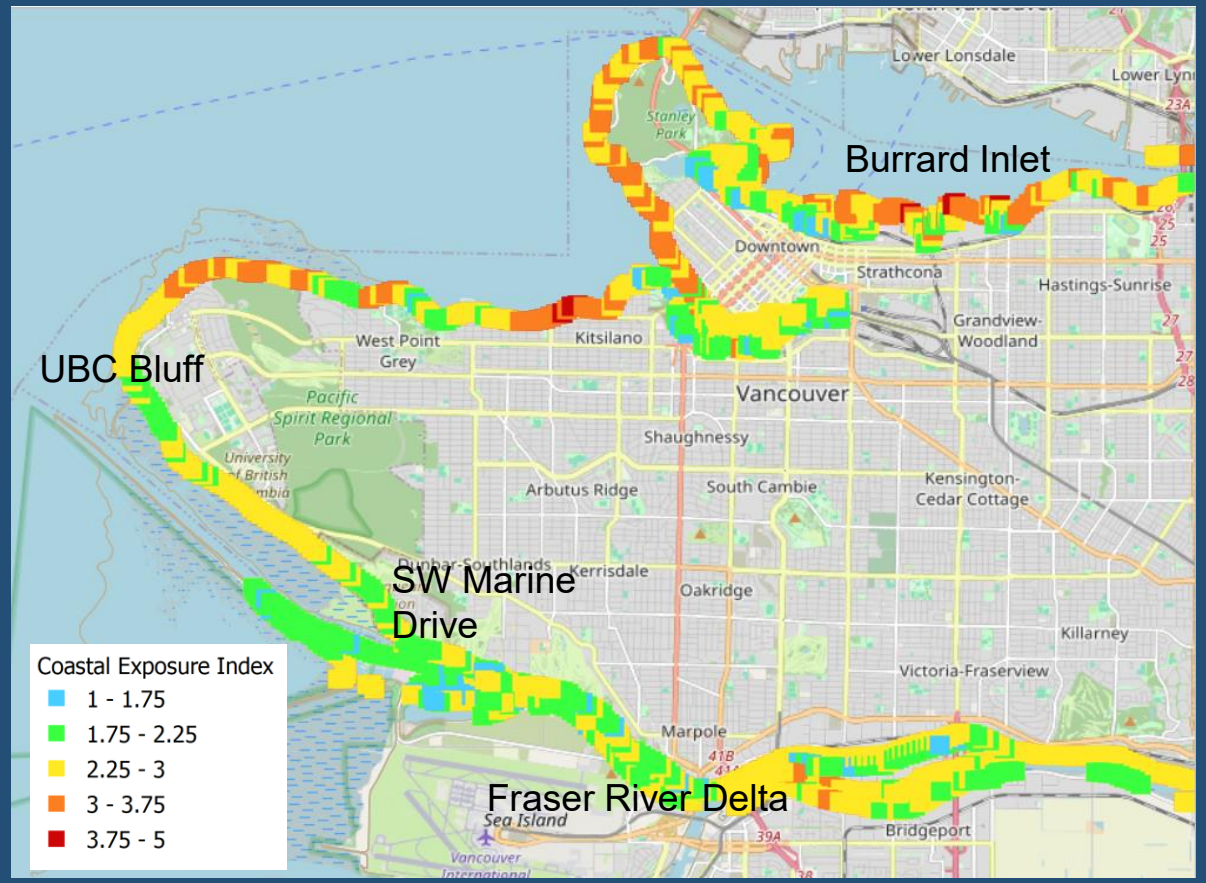
Benthic Marine Ecounits - Coastal Resource Information Management System (CRIMS) by BC Government. (2018)



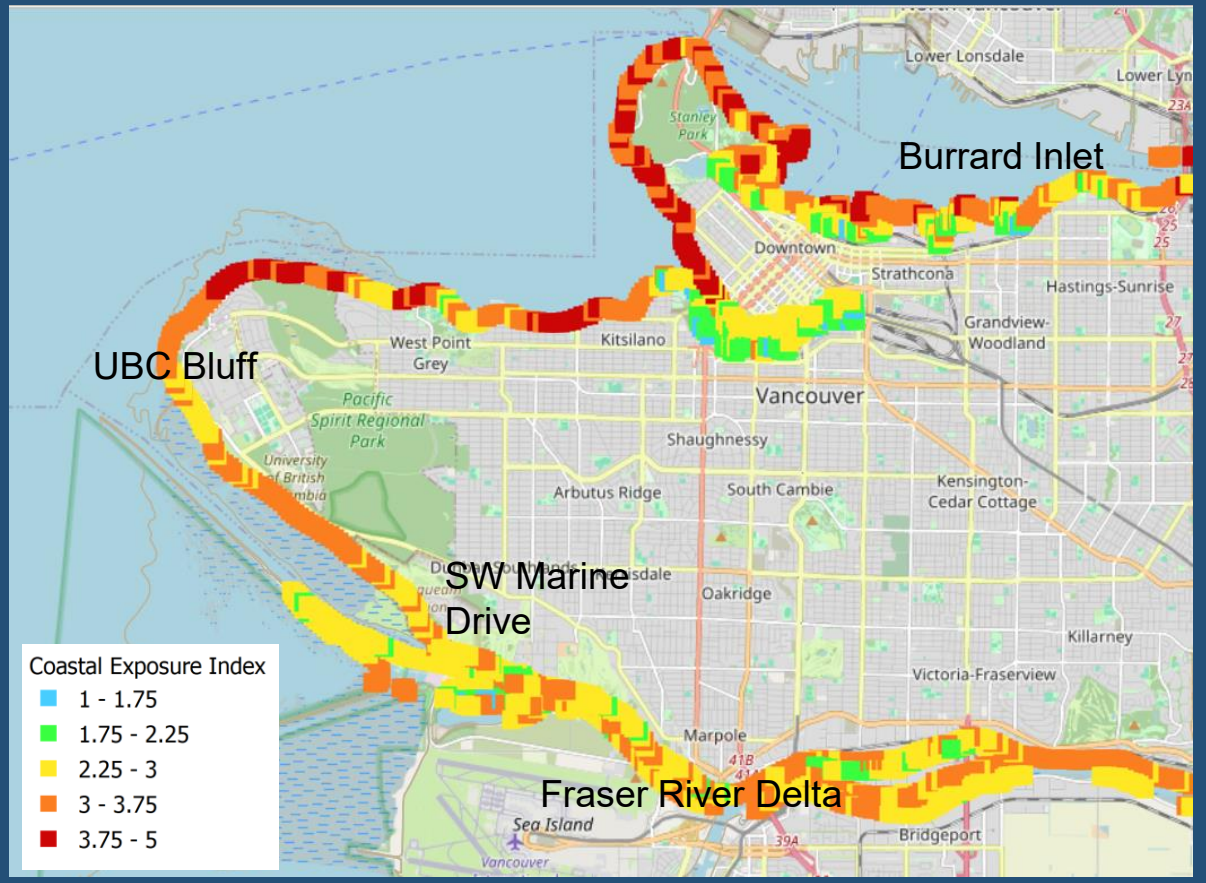
SEA LEVEL RISE

Projected Sea Level Rise until 2150 from four stations near Vancouver, under emission scenario SSP5-8.5.

BASELINE SCENARIOS



With Habitat



W/O Habitat

Key Findings

17%

of shoreline are considered “highly vulnerable” with an Coastal Exposure Index >3.5, if all the natural habitat are gone.

~89 km

Out of the 106km of shoreline in the AOI is protected by coastal forests, shrublands, wetlands, and other coastal habitats, by different extent.

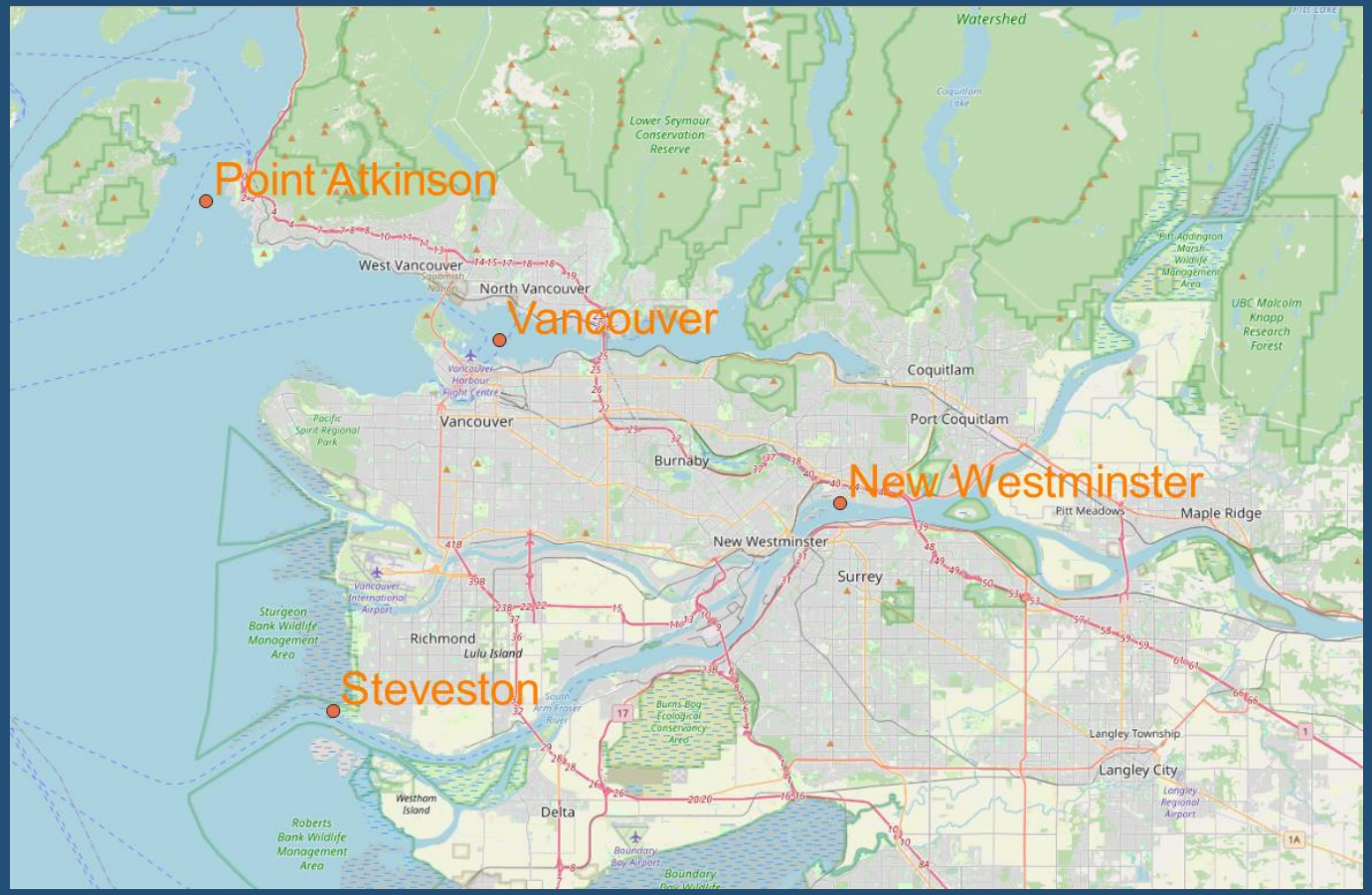
>4 km

of shoreline become highly vulnerable (>3.5 exposure index) without geomorphology taken into consideration, mostly man-made structure.

Emission Scenario

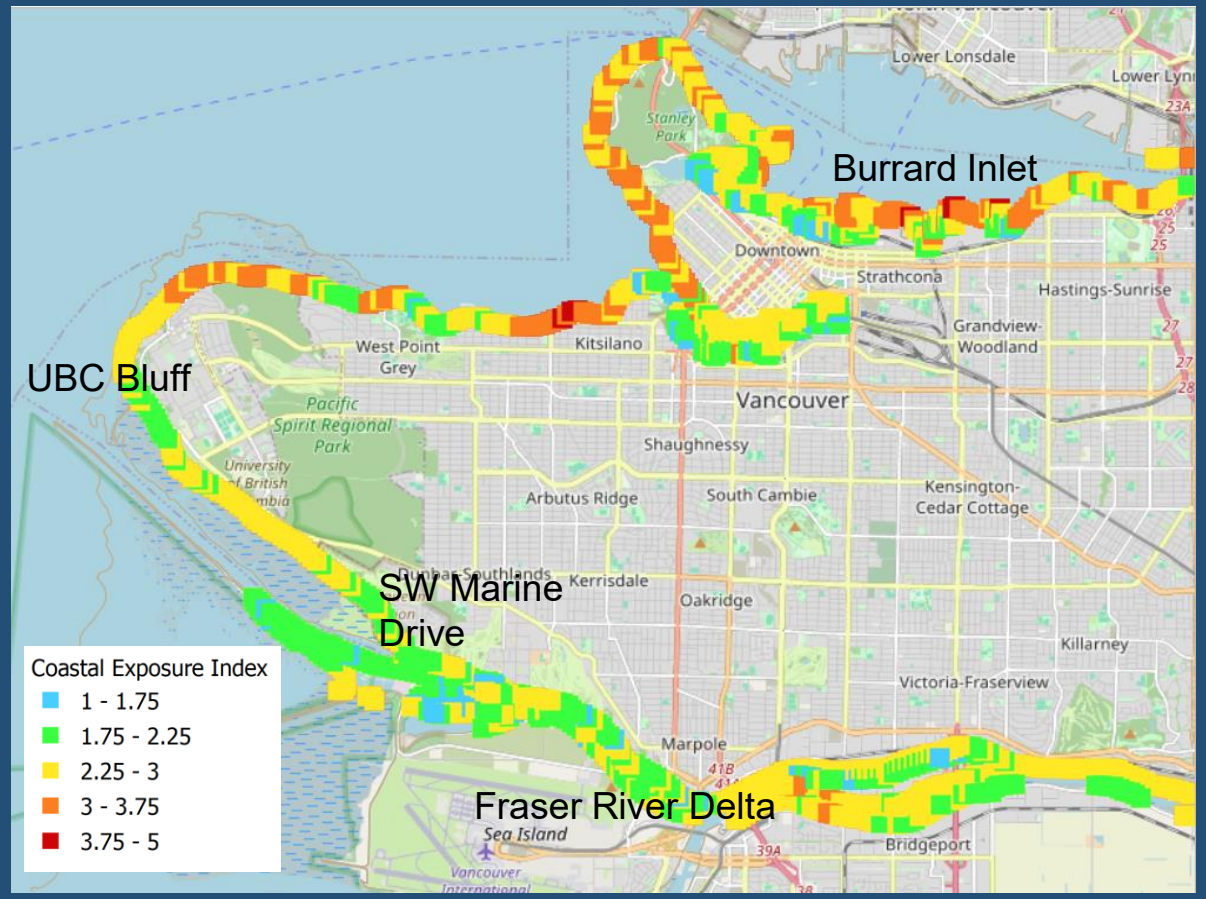
Sea-level rise is projected to vary spatially across the study area, resulting in differences in coastal exposure. Under the SSP5-8.5 emissions scenario, the projected annual sea-level rise rates are listed below:

- **Steveston:** 0.96 m
- **Point Atkinson:** 0.91 m
- **Vancouver:** 0.86 m
- **New Westminster:** 0.74 m

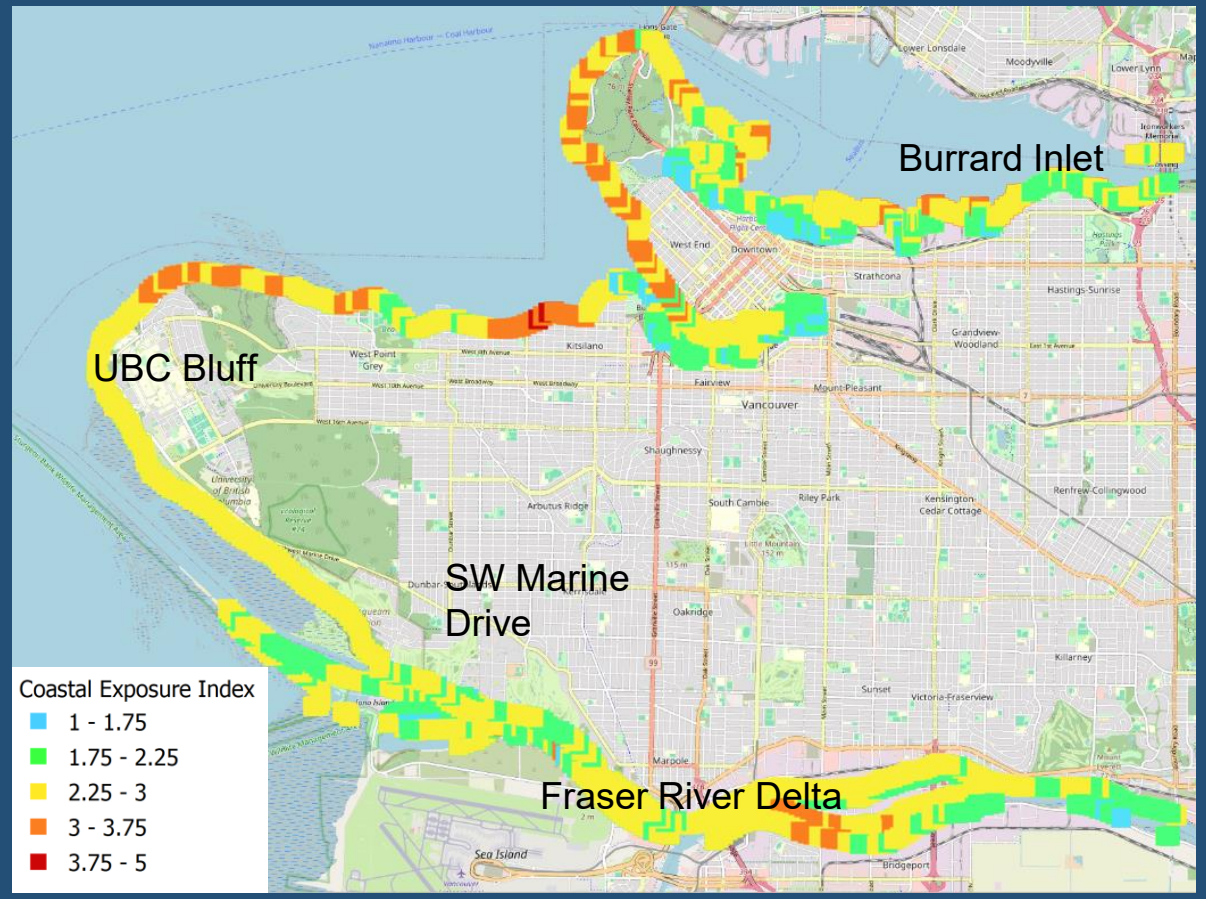


Data source: NASA Earth Data:Sea Level Rise (2025):https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool?type=global.

Current v.s. Year 2150



Baseline



SLR YEAR 2150

Key Findings

>60 km

of shoreline become relatively more vulnerable when projected sea level rise at different areas is considered, mostly in southern Vancouver/Fraser River delta area.

~43 km

of shoreline becomes relatively less vulnerable when projected sea level rise at different areas is considered, mostly in north shore areas.

-0.07

of habitat protective role when sea-level rise is accounted for. The average habitat role declines from 0.532 to 0.461 reflecting an estimated 13% loss in natural buffering capacity.

In Person Mapping Event

Real-time capture of articipant erspectives by using Slido to collect immediate responses.

Comparison with model results highlighted differences between intuitive understanding and integrated system-level analysis.

Bridging diverse levels of expertise and creating a shared space where different knowledge systems could interact.

Interactive mapping translated perceptions into spatial decisions, making vulnerability tangible and place-based.

Key Perspectives from Survey Responses

- **Built environments are seen as key areas of concern**
  → Participants frequently highlighted urban shorelines and infrastructure
- **Physical features shape interpretation of risk**
  → Elevation and wave exposure are commonly used as reference points
- **Observations are grounded in visible landscape characteristics**
  → Locations with noticeable coastal processes (e.g., erosion, flooding) have been reported.

Perception vs Model Interpretation

Perception		Model
Urban areas and manmade structures are seen as most vulnerable	→	Highest vulnerability does not always correlate to high density areas.
Focus on single factors (elevation, waves)	→	Integrates multiple interacting variables
Recognition of ecosystem protection in certain areas	→	Different habitats provide different buffering effects across different segments of shoreline

Let’s continue the conversation!

Message me your questions or comments in the IAIA26 app.

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