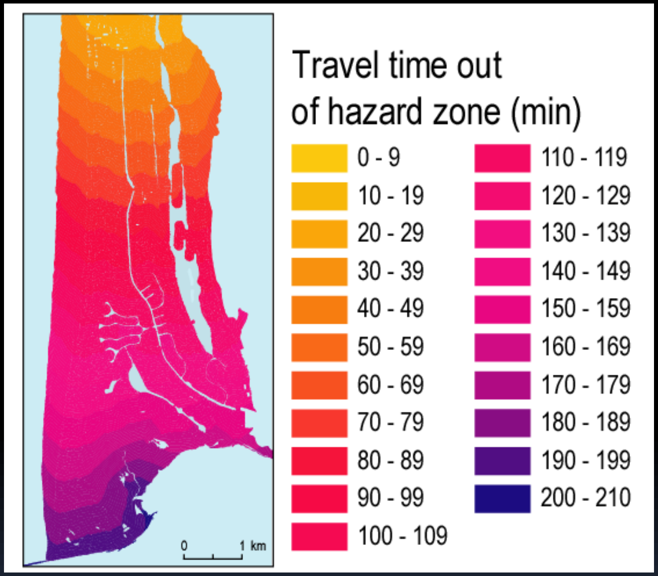
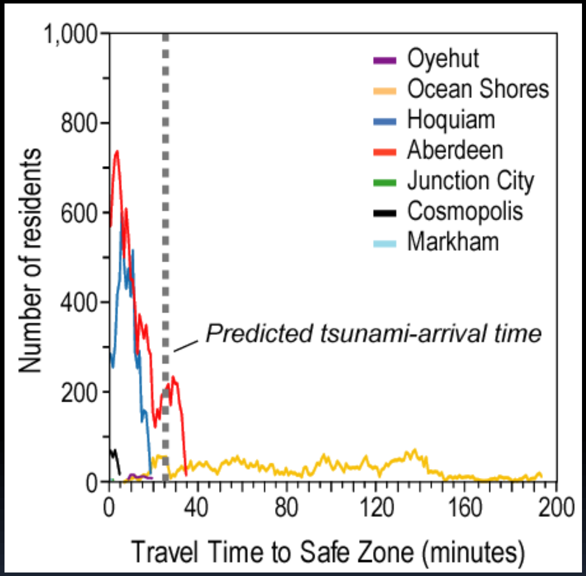
Pedestrian-evacuation modeling for near-field tsunami threats





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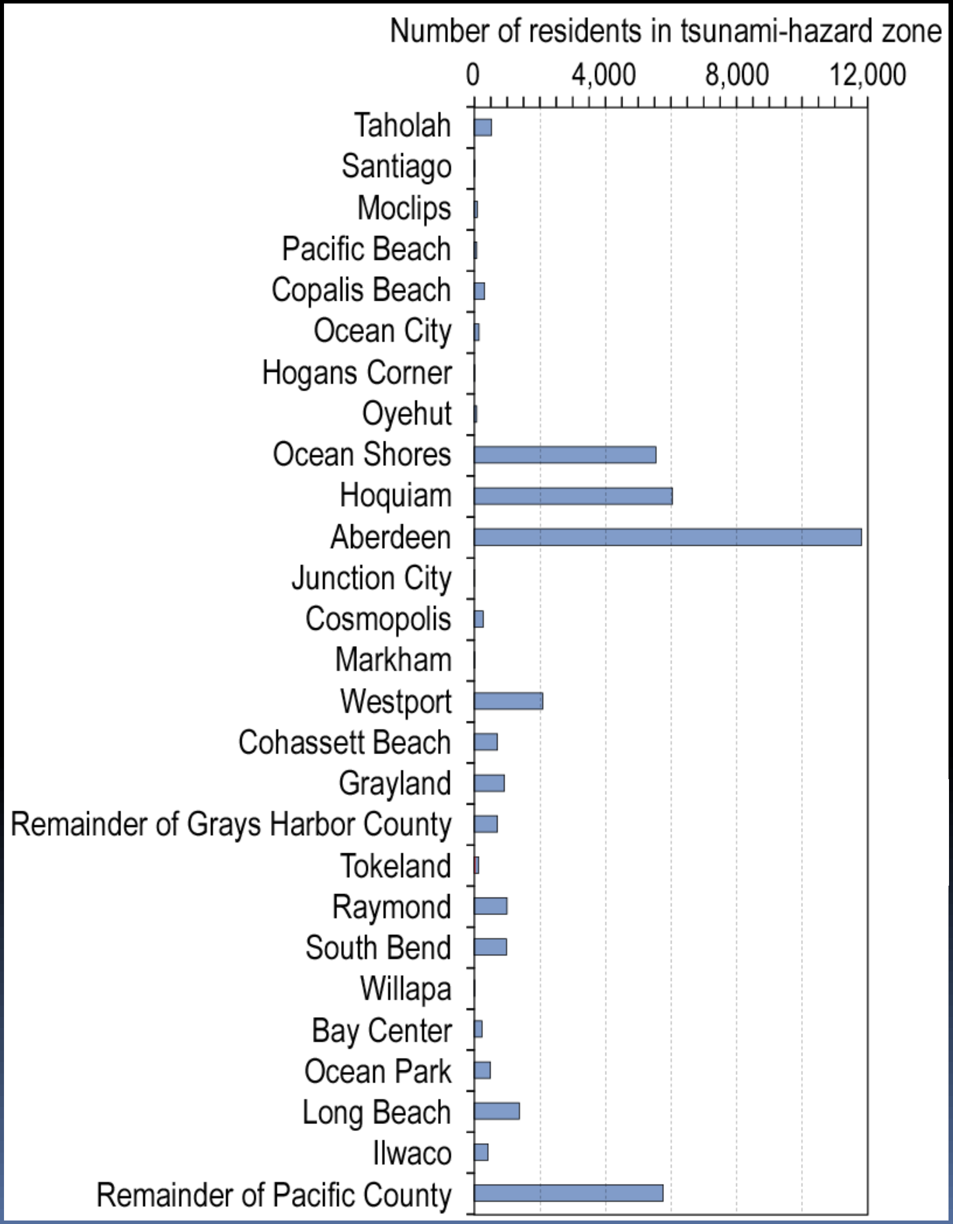
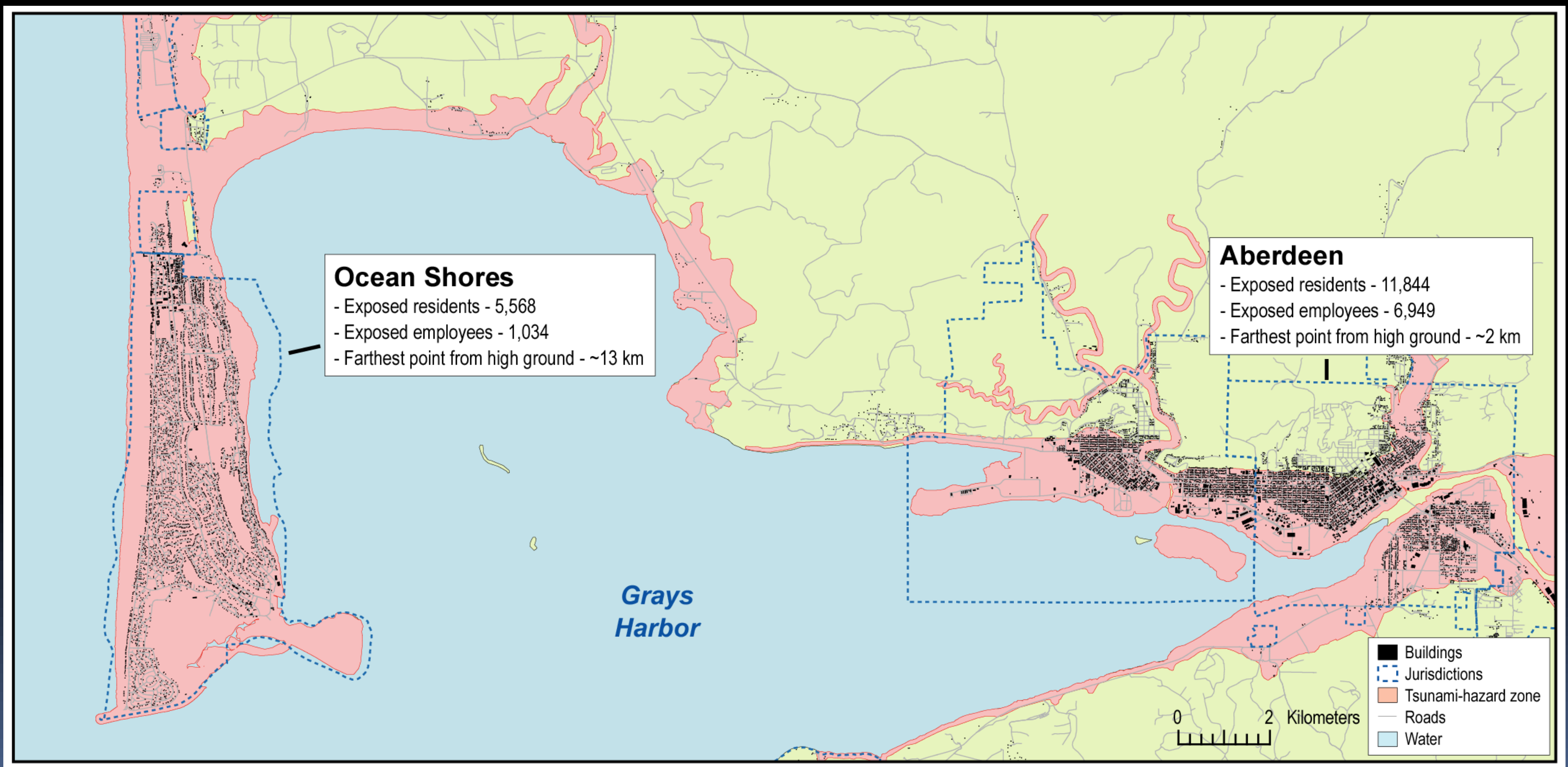
U.S. Geological Survey

2010 resident exposure to tsunami hazards in Pacific and Grays Harbor Counties, Washington



Basic exposure numbers don't tell the full risk story



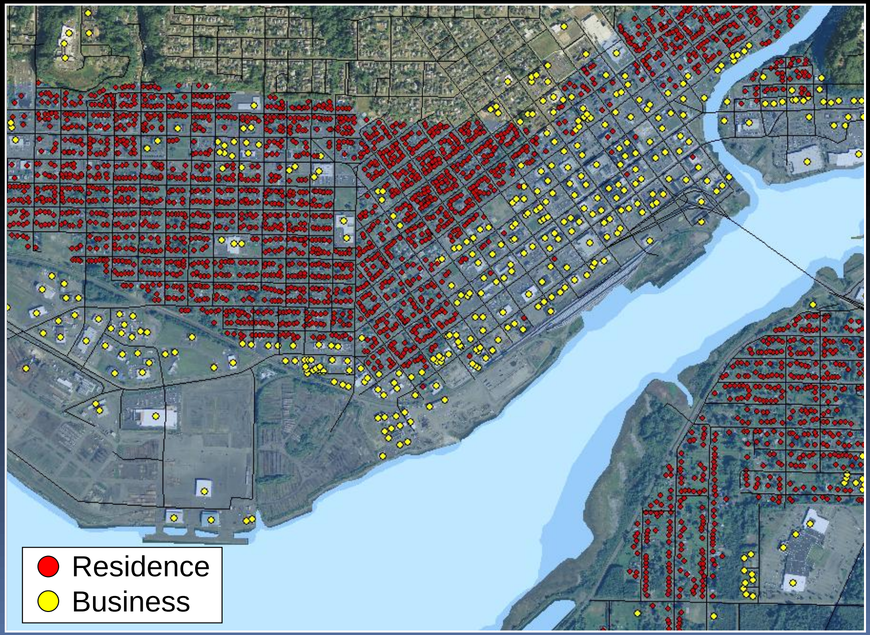
Modeling Pedestrian Evacuation

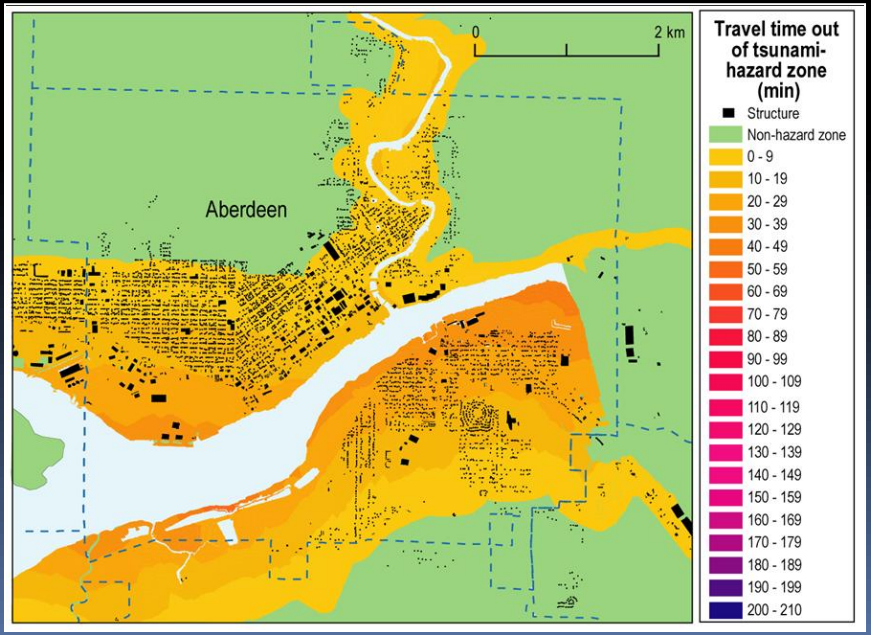
Agent-based

- Approach - tracks individual movement across network (roads)
- Product – mortality estimates
- Results – sensitive to people number, distribution, and interactions
- Use - specific scenarios; bottlenecks

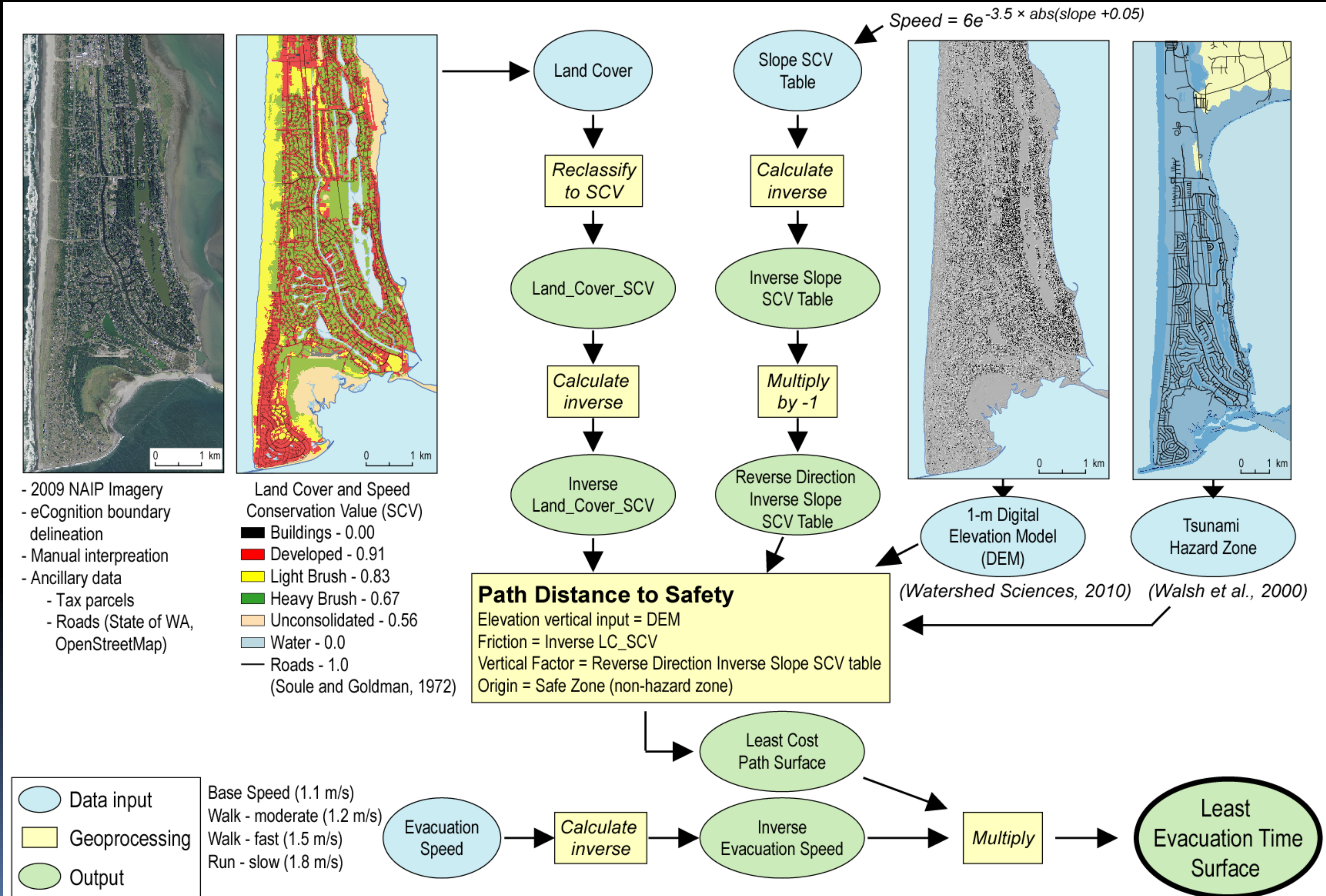
Least-cost distance

- Approach - calculates "costs" associated with travel across entire landscape
- Products – maps, time/exposure profiles
- Results - flexible with regard to arrival times, population dynamics
- Use – outreach, priority setting, response

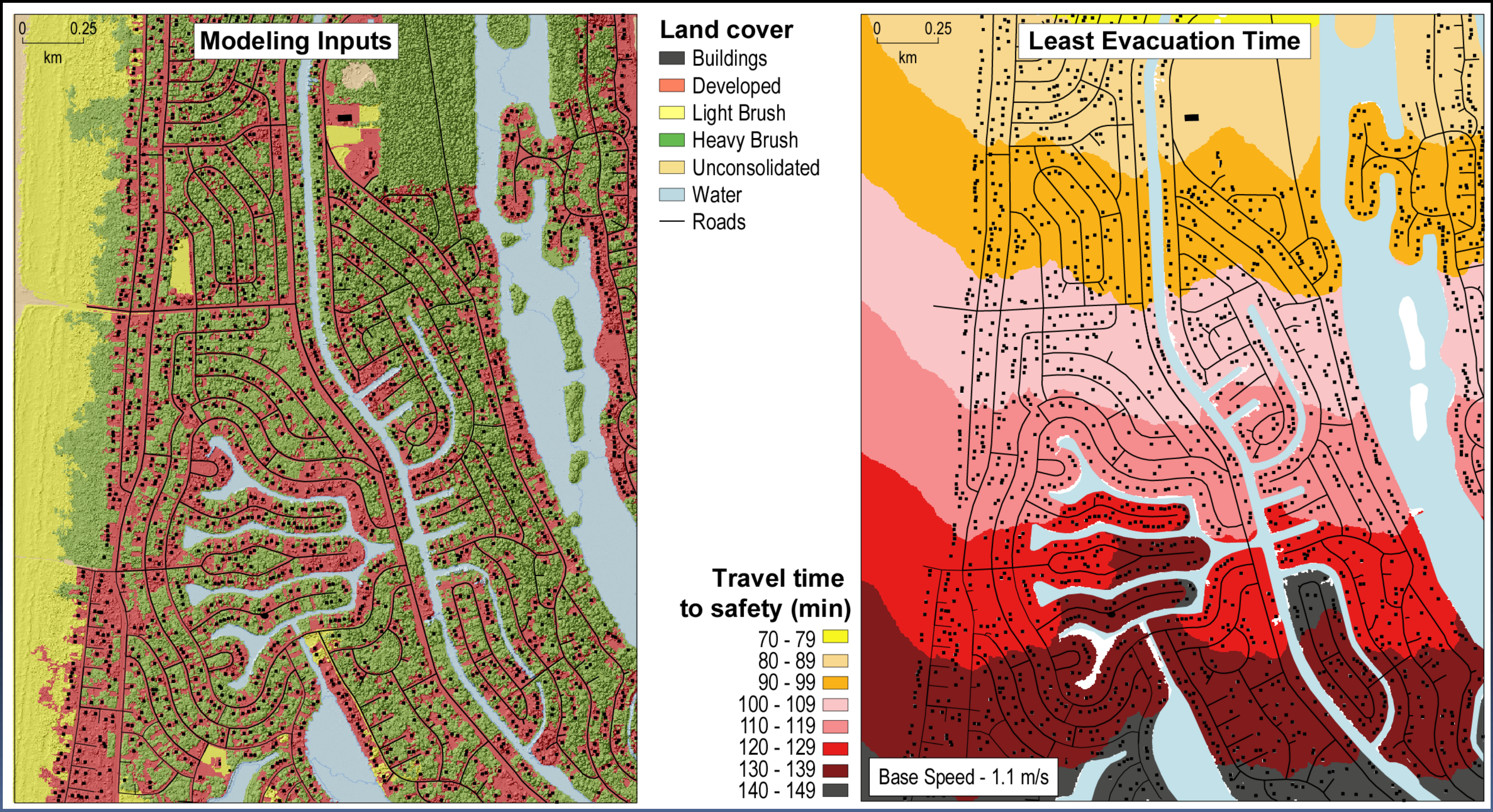




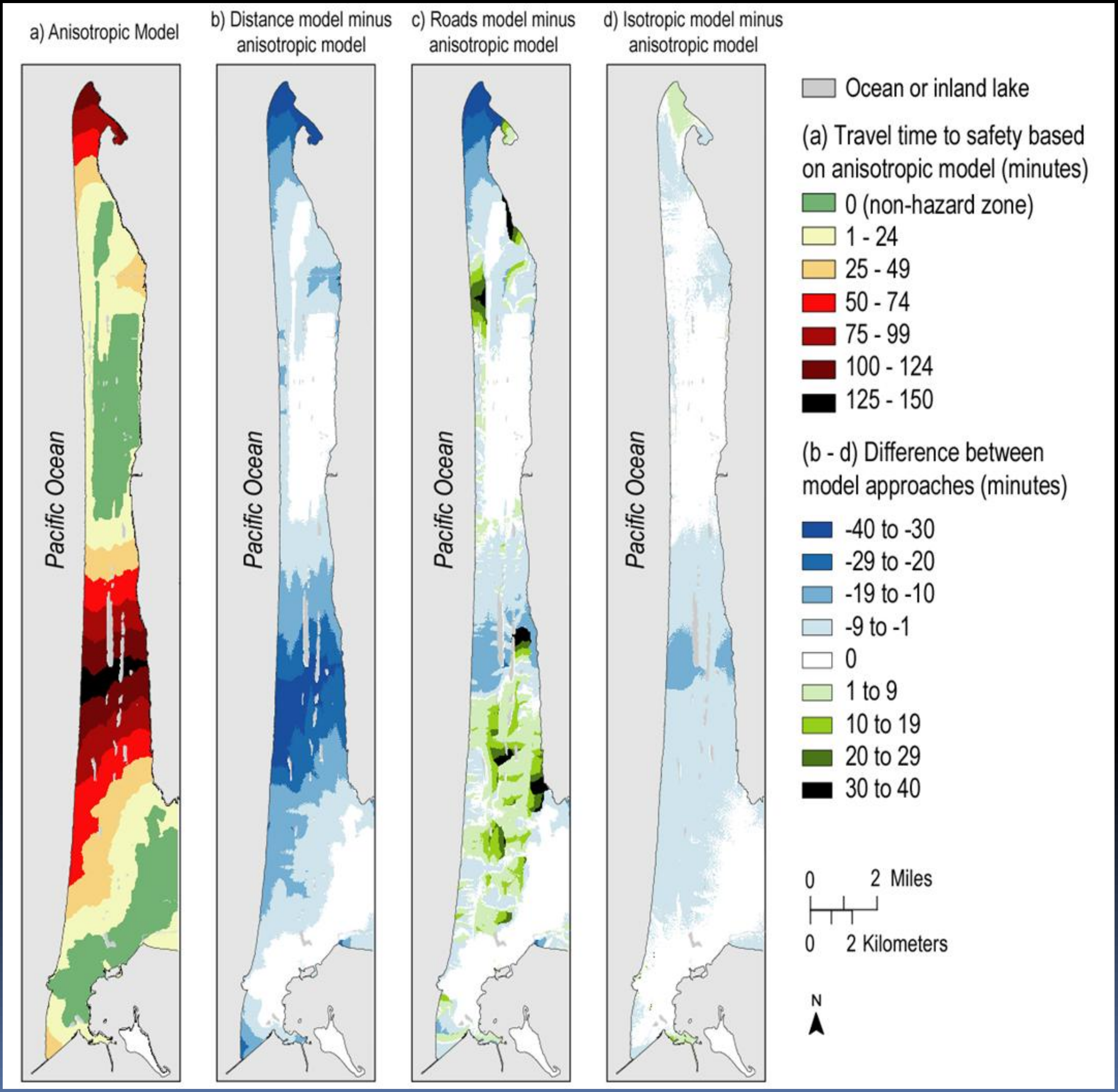
Anisotropic Path Distance Modeling



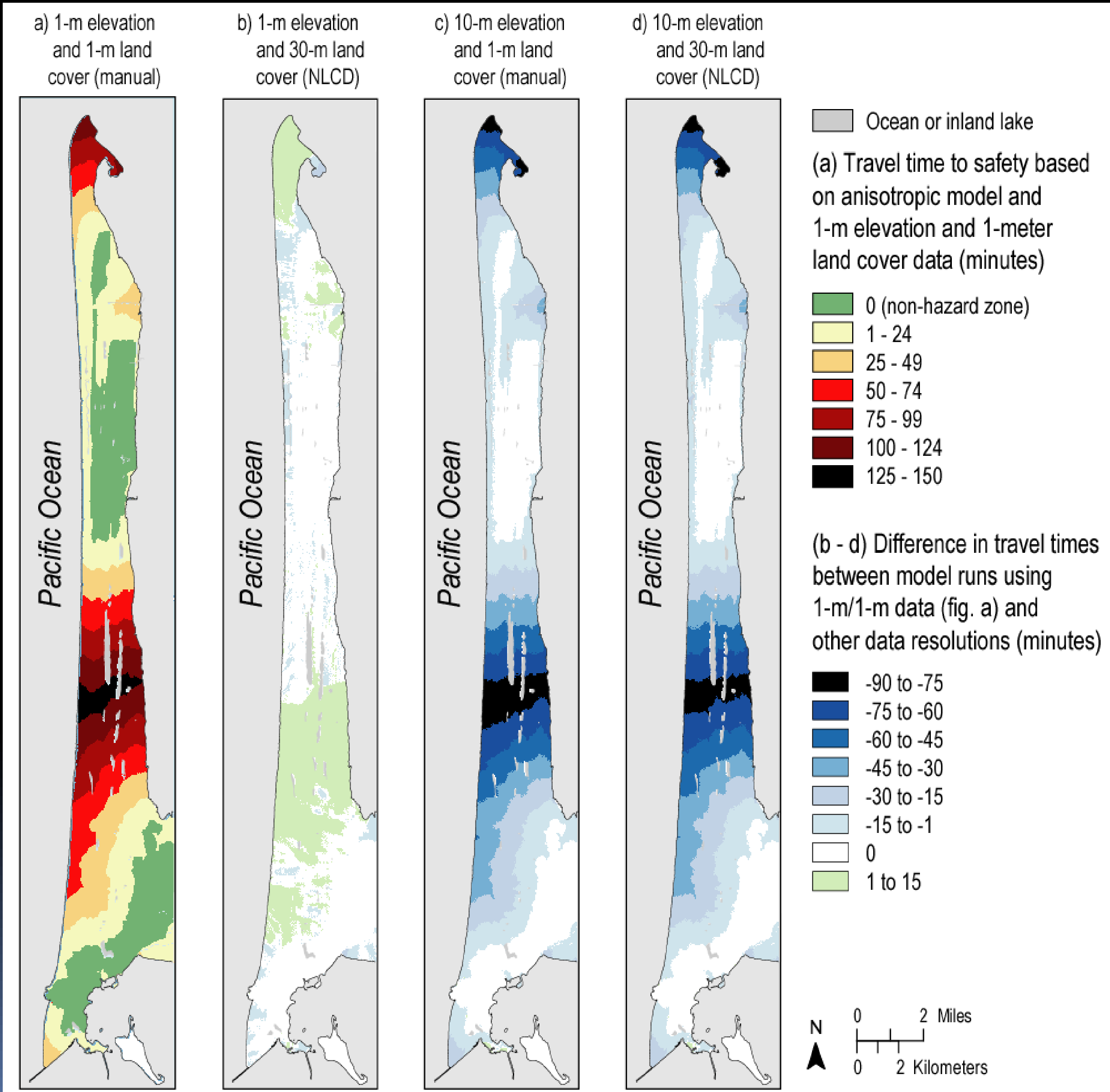
Least Evacuation Time Surfaces for Ocean Shores, Washington



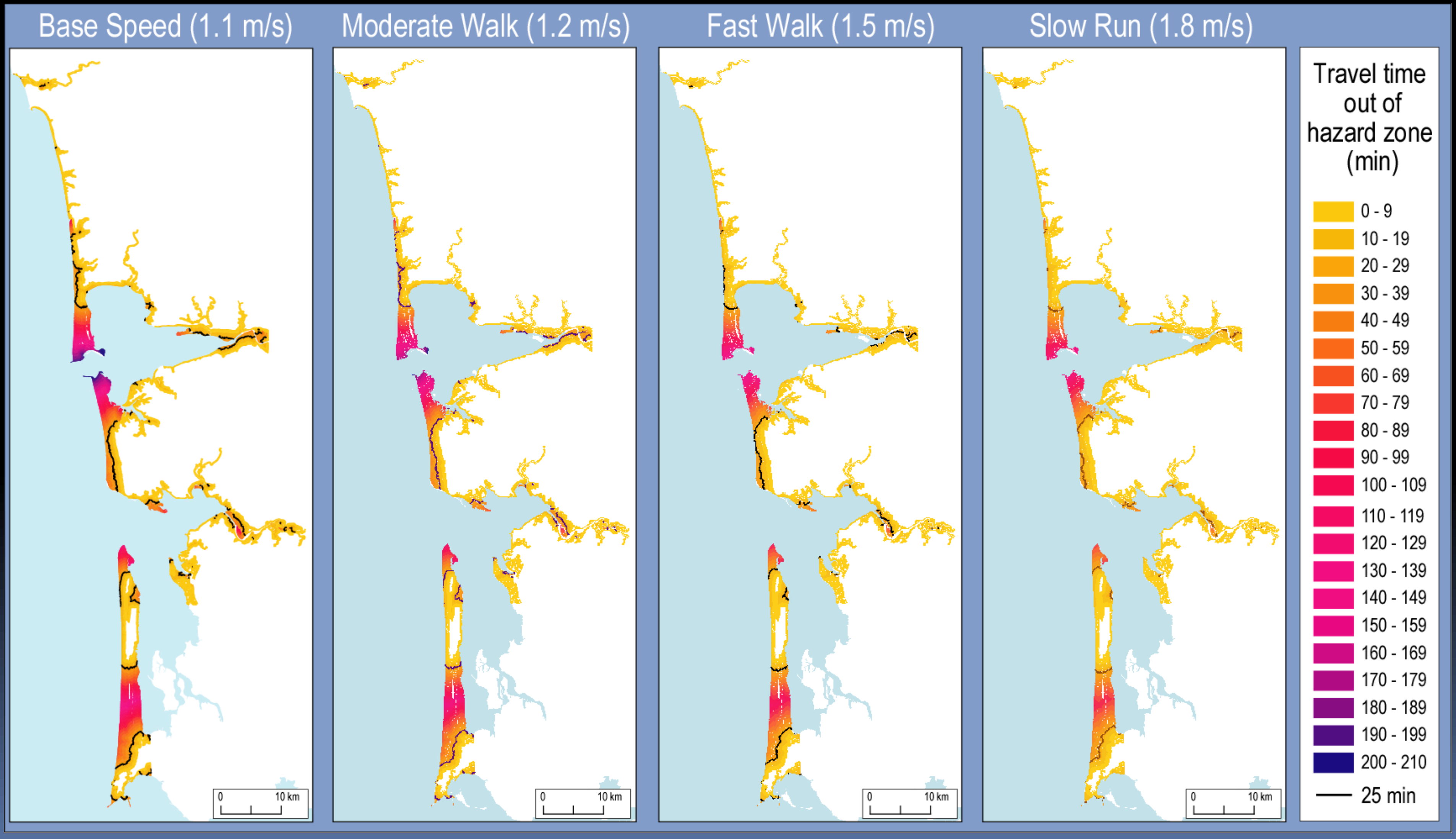
Deviating from anisotropic approach impacts evacuation results



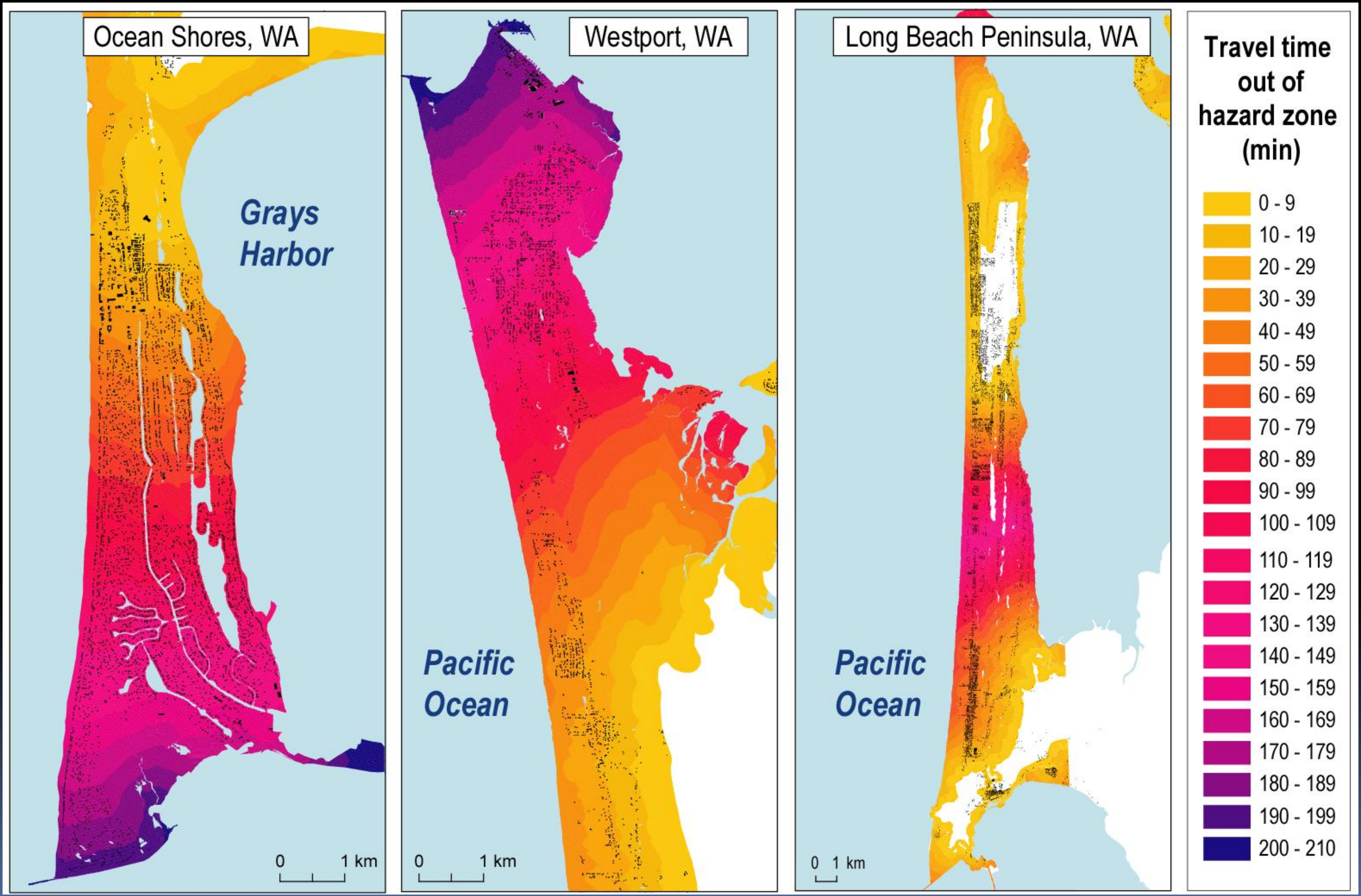
Poor input elevation and land cover data results in poor modeling results



Least-Evacuation-Time Surfaces for Study Area

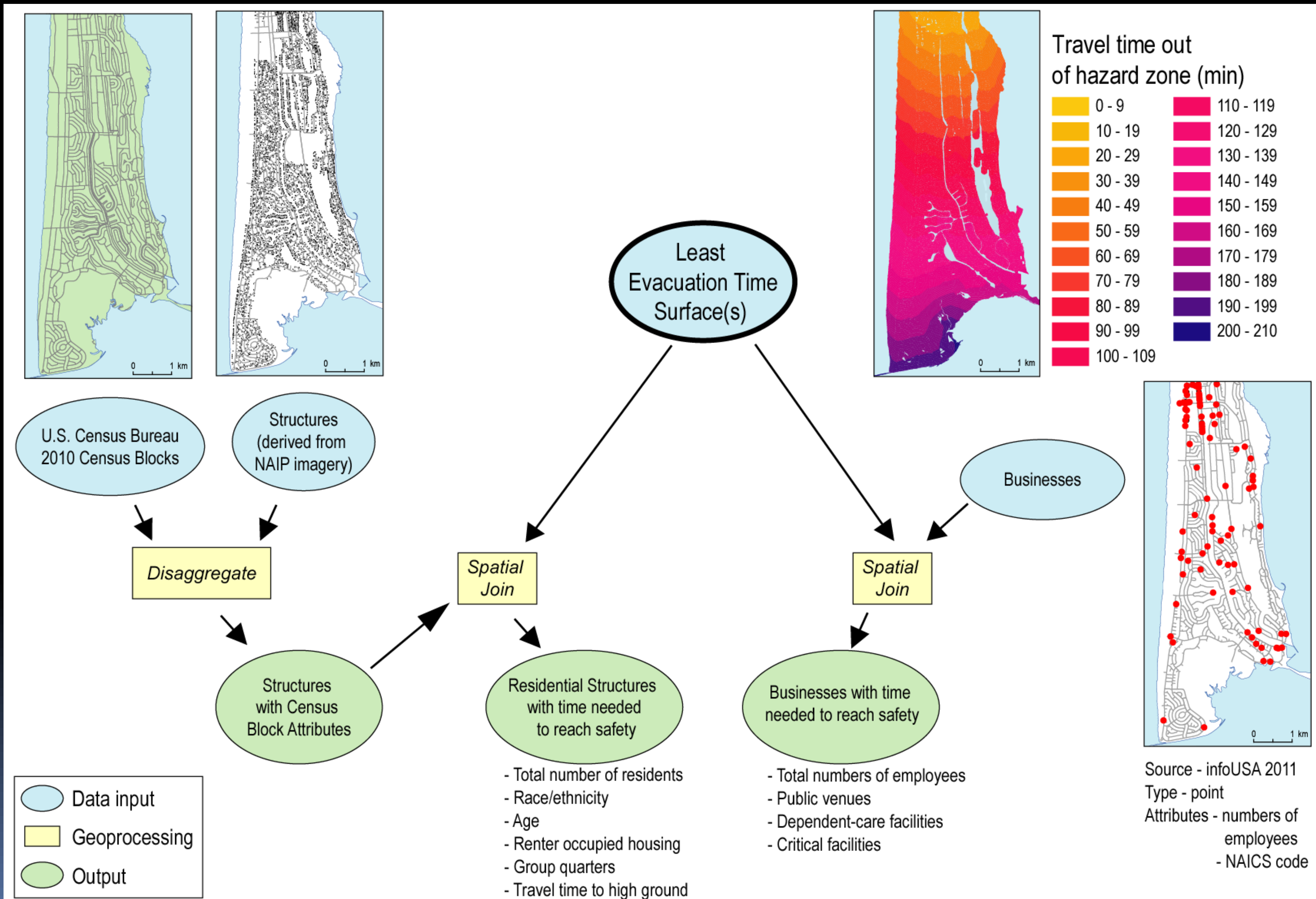


Hotspots of Evacuation Challenges

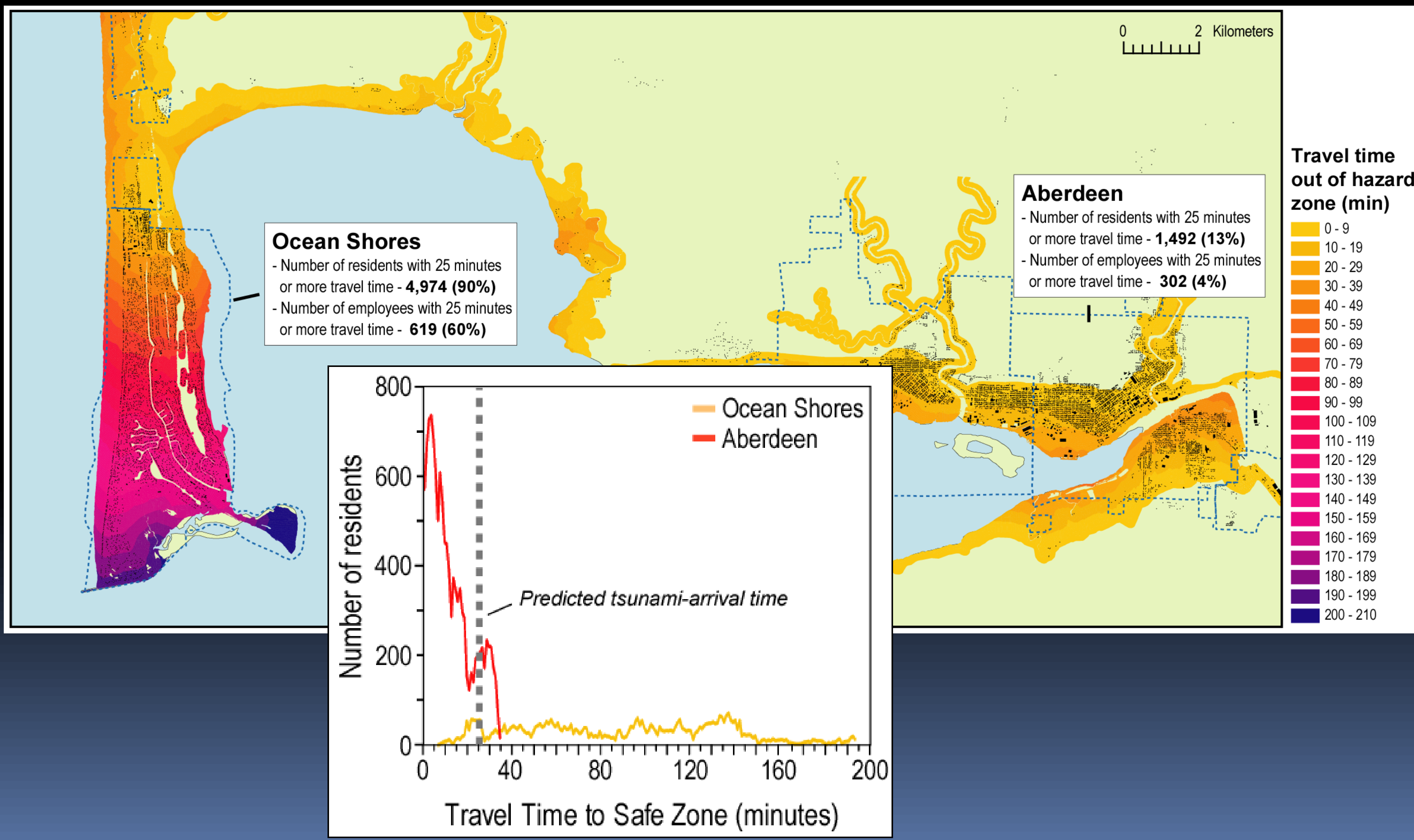


Based on 1.1 m/s travel speed

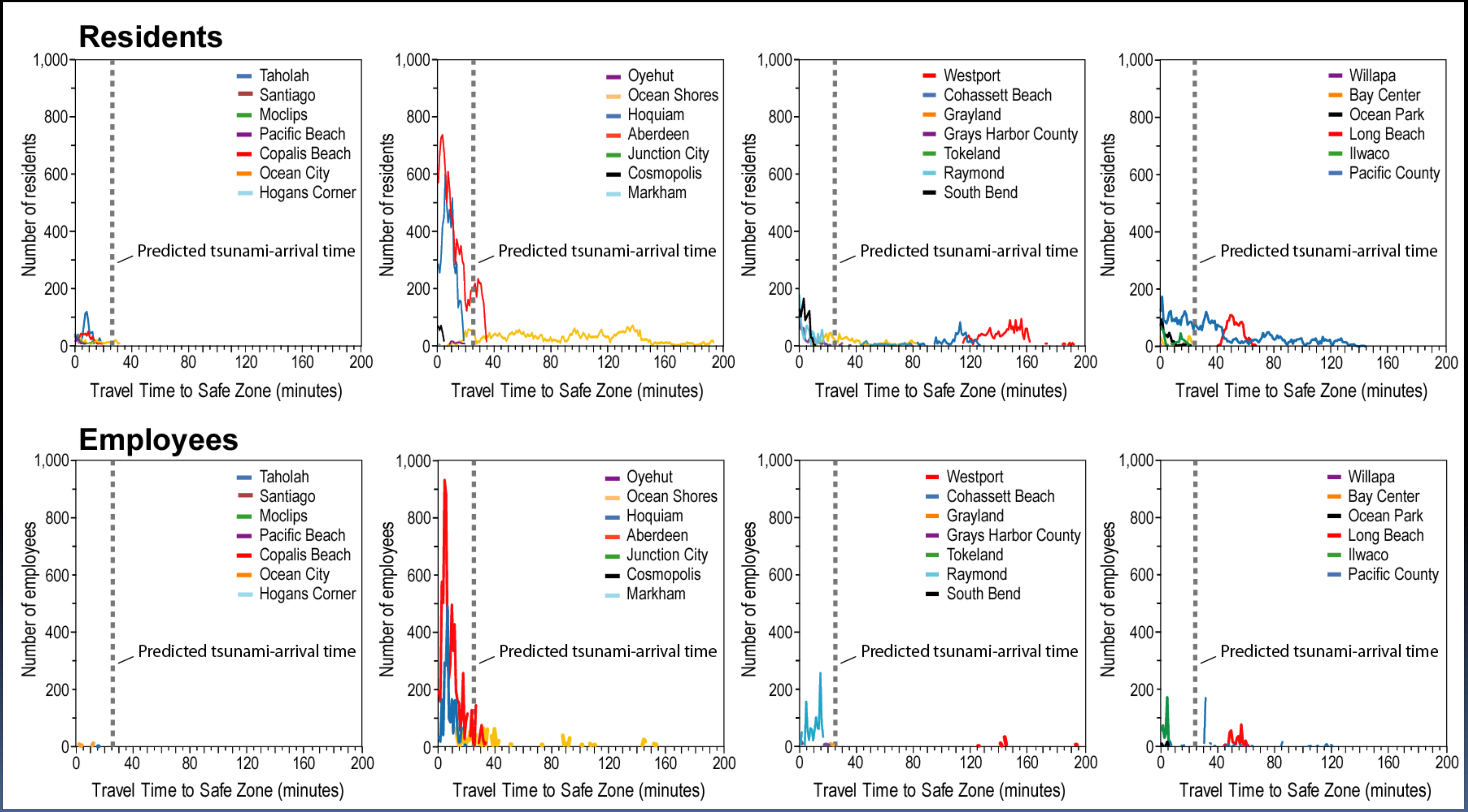
Integrating Evacuation Results with Population Data



Distance to safety changes the risk story

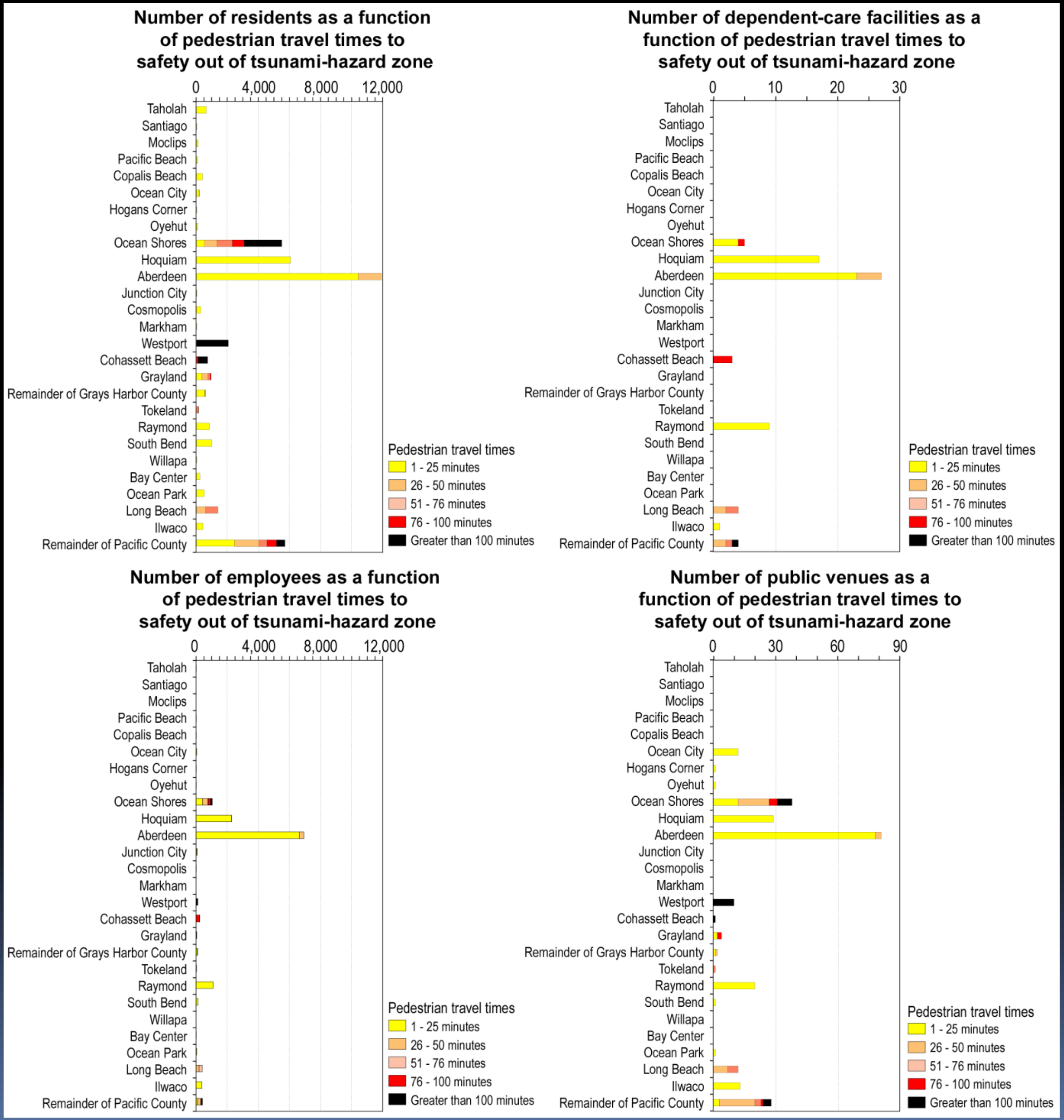


Distribution of residents and employees based on pedestrian travel time to safety



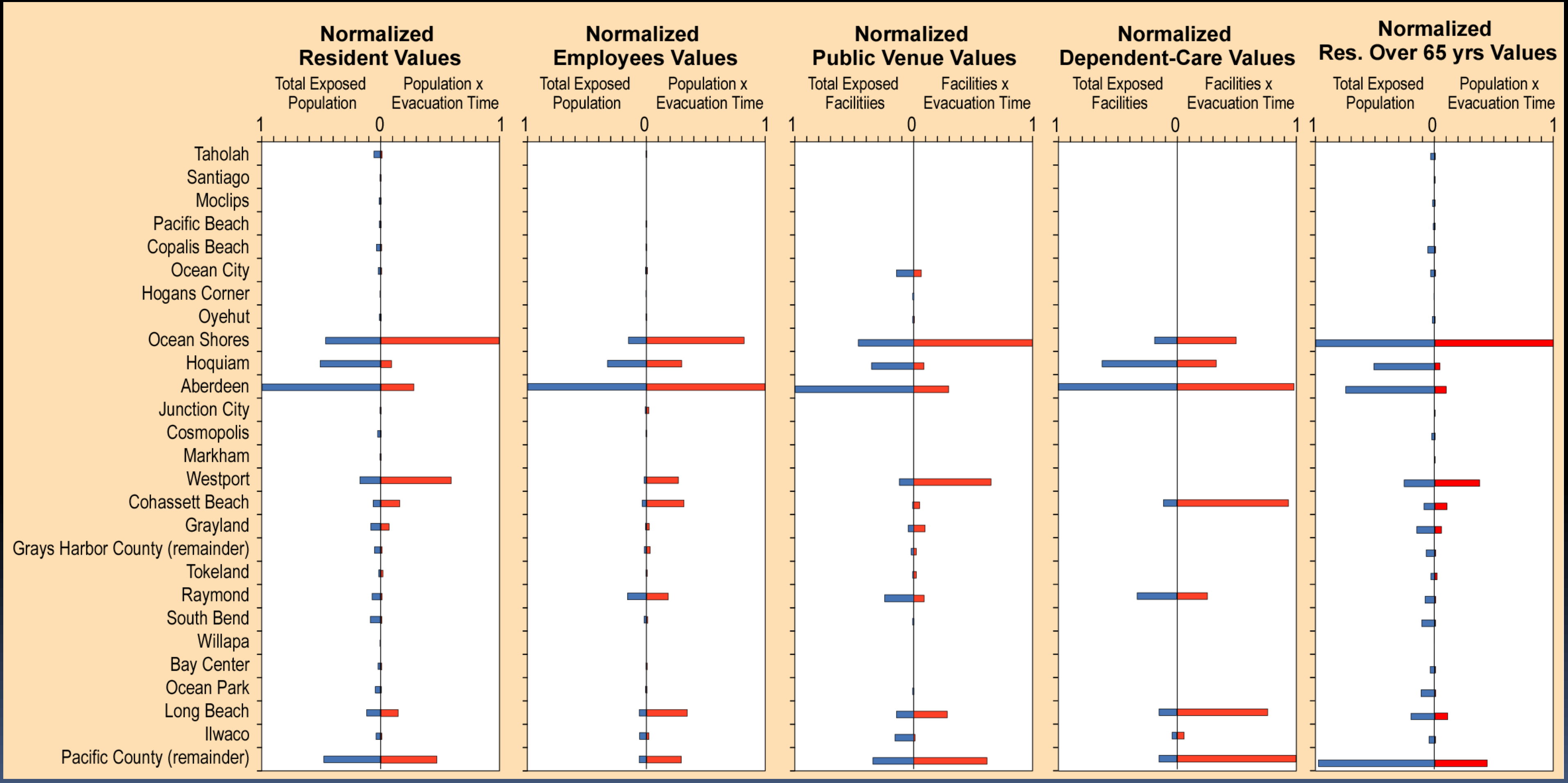
All graphs assume a pedestrian travel speed of 1.1 m/s ("base speed")

Variations in population exposure as a function of pedestrian travel time to safety



Based on 1.1 m/s travel speed

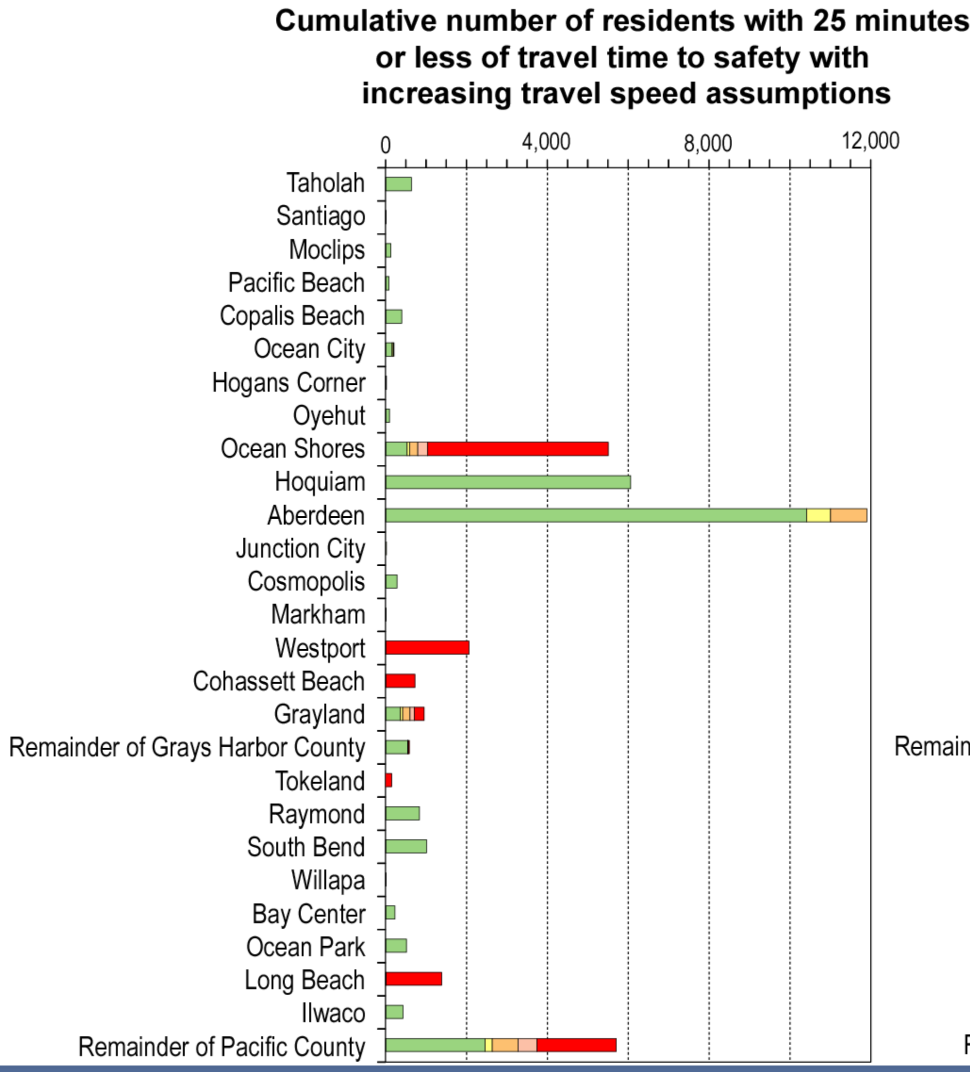
Normalized values of total exposed population and weighted population that incorporates travel time to safety (population x time)

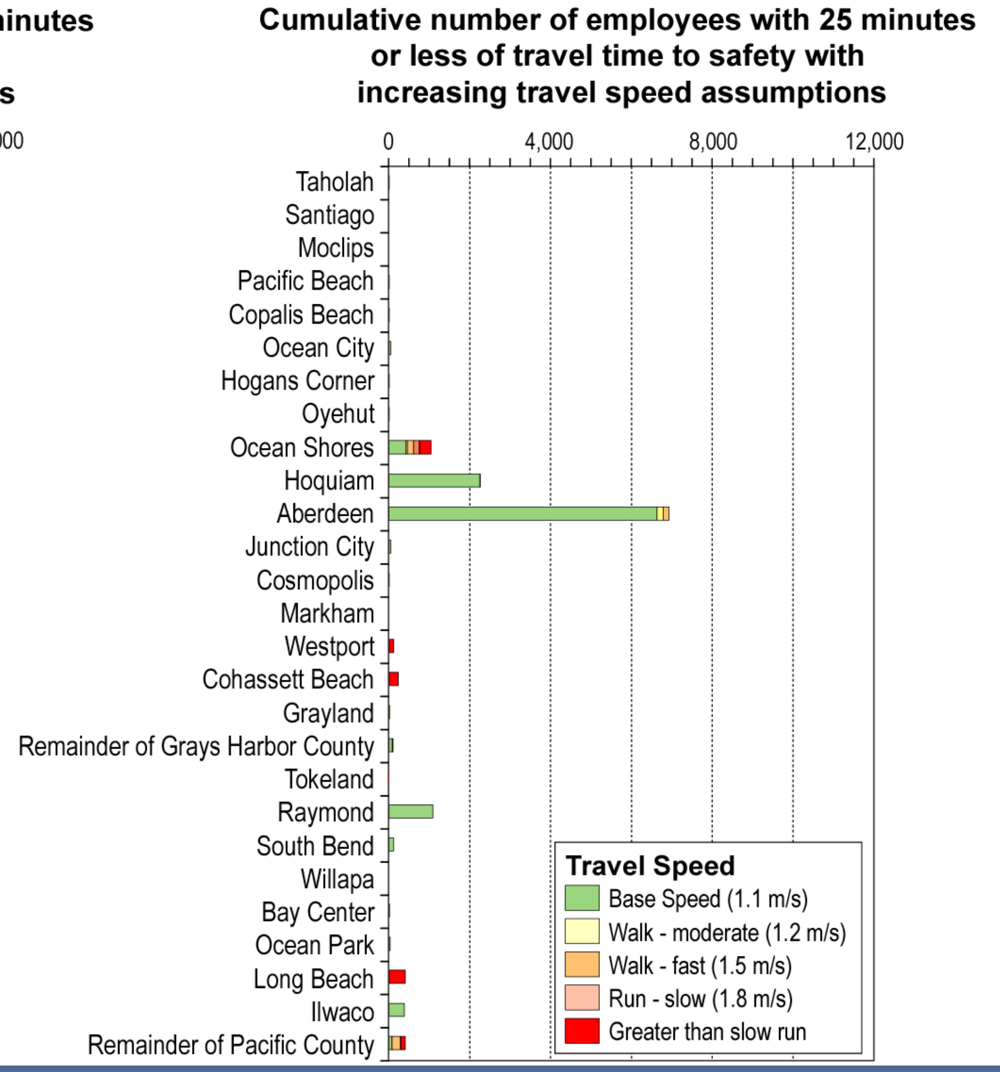


All values were normalized to the maximum value in that category

Based on 1.1 m/s travel speed

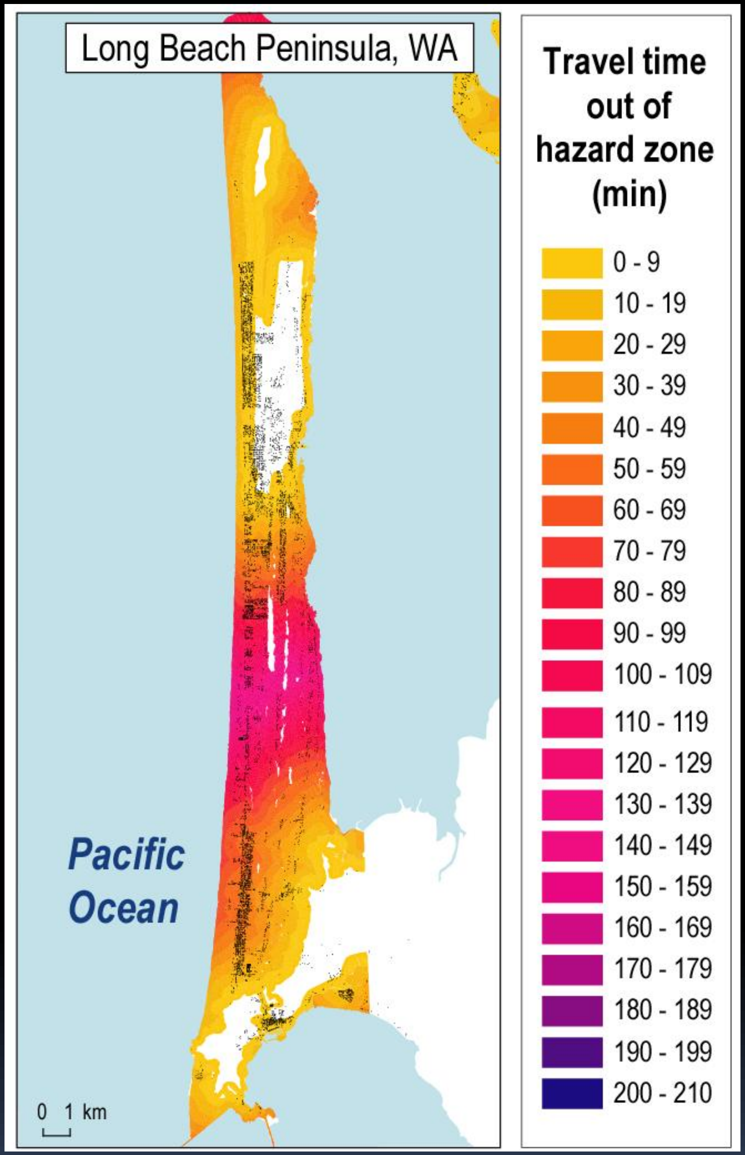
Cumulative number of residents and employees with increasing travel speed assumptions





Conclusions

- Population vulnerability is an essential element of tsunami loss estimation, especially for near-field tsunami threats
- Population vulnerability is a function of landscape conditions and individual’s ability
- Traditional exposure assessments can be inadequate for estimating life loss
- Exposure indices weighted by travel times to safety are a better way to characterize population vulnerability than simple overlays



More information on methods

Wood, N., and Schmidtlein, M., in press, Anisotropic path modeling to assess pedestrian-evacuation potential from Cascadia-related tsunamis in the U.S. Pacific Northwest, *Natural Hazards (free download available)*