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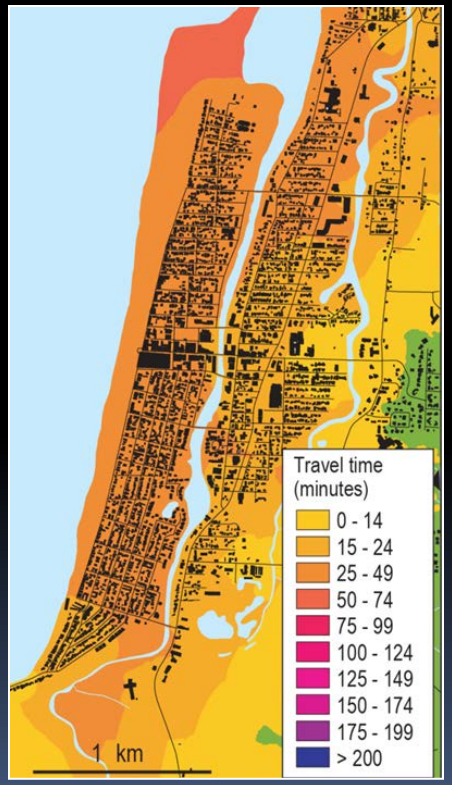
Modeling pedestrian evacuations

a very quick comparison of two approaches



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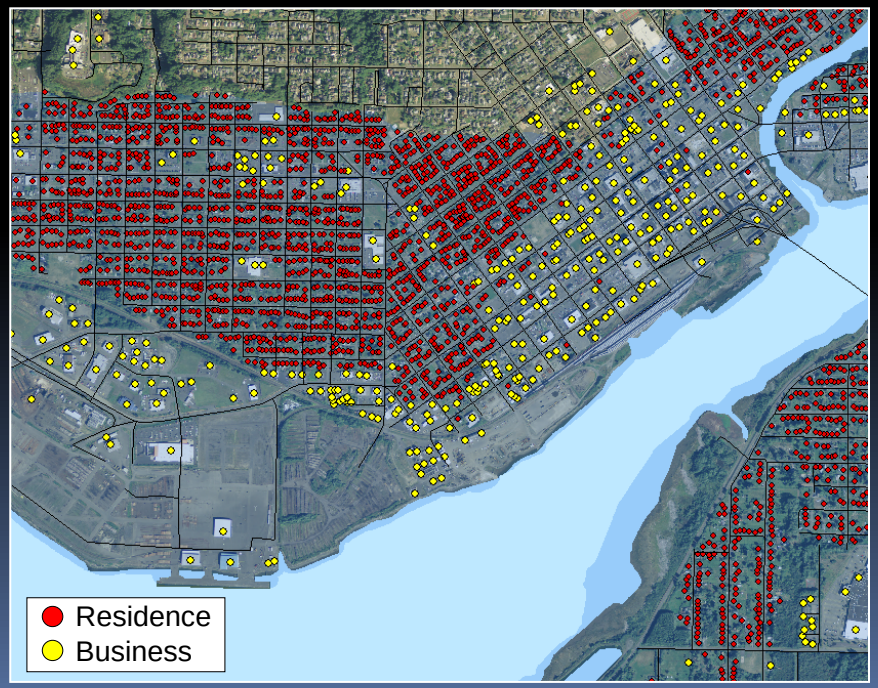
Purpose and Focus

Agent-based model

- To track individual movement along road network to safe point
- Focus on human behavior
- Good for bottlenecks, congestion, and urban areas



Least-cost-distance model

- To map travel times to safe zone by calculating “costs” due to varying land
- Focus on evacuation landscape
- Good for mixed populations, open areas, and varied landscape

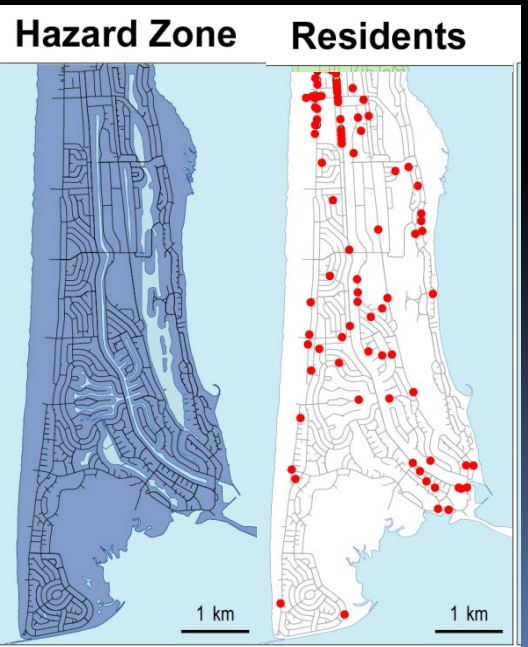
Data input

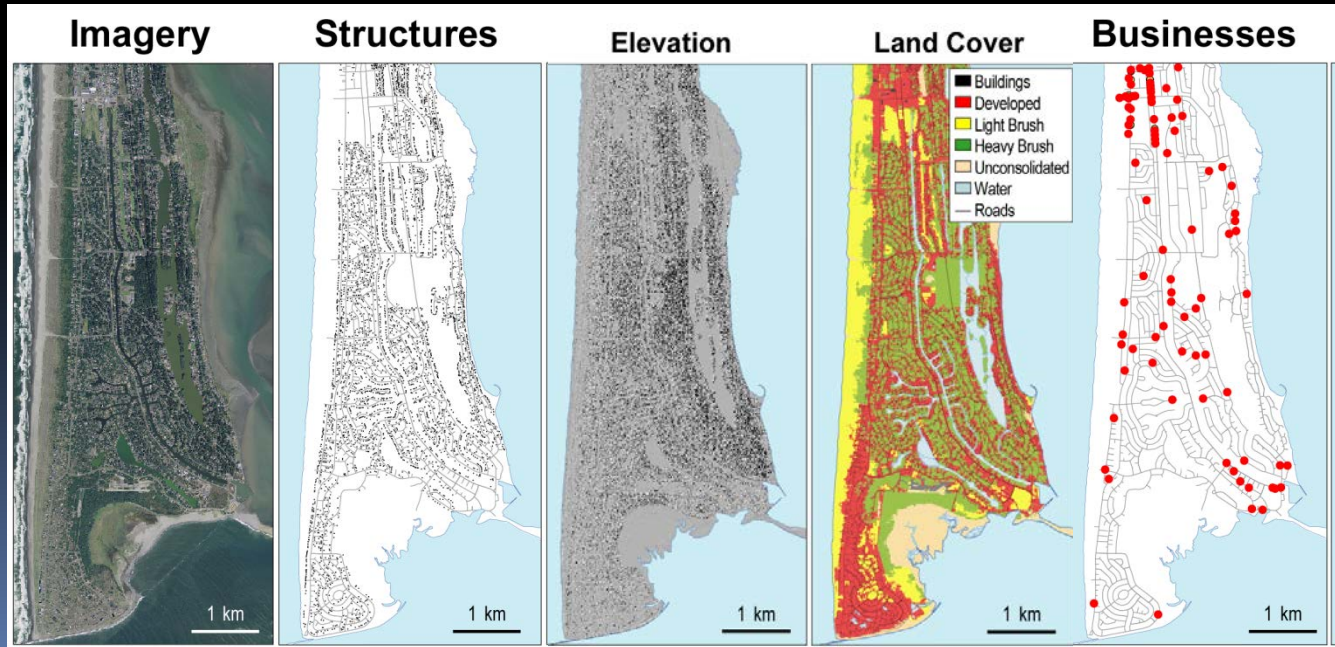
Agent-based model

- Roads
- Flat surface area
- Population points (parcels)
- Census block resident #
- Time-dependent hazard map

Least-cost-distance model

- Roads, landcover, obstacles
- Elevation (slope, directionality)
- Population points (parcels, user)
- Census, businesses, user supplied
- Static hazard/safe zone





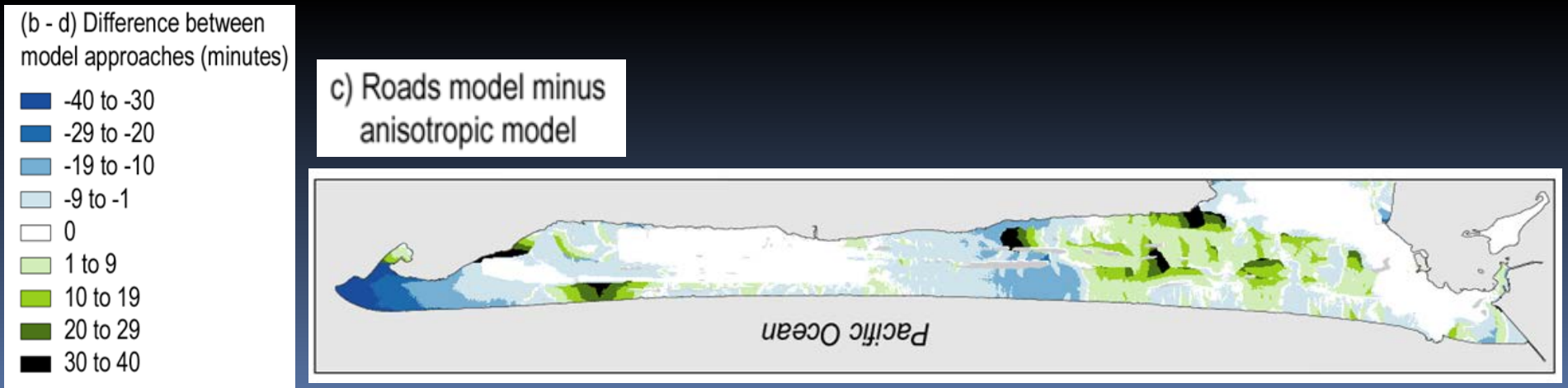
Modeling assumptions

Agent-based

- Road only travel
- Residents only
- Sensitive to population numbers and locations
- No influence of elevation change, slope, or directionality
- Single study area/jurisdiction
- People may behave differently

Least-cost distance

- Travel allowed everywhere (w/ cost)
- Residents, employees, tourists
- Flexible with regard to population numbers and locations
- Elevation, slope, and direction of travel all matter
- Multiple jurisdictions possible
- Constant behavior

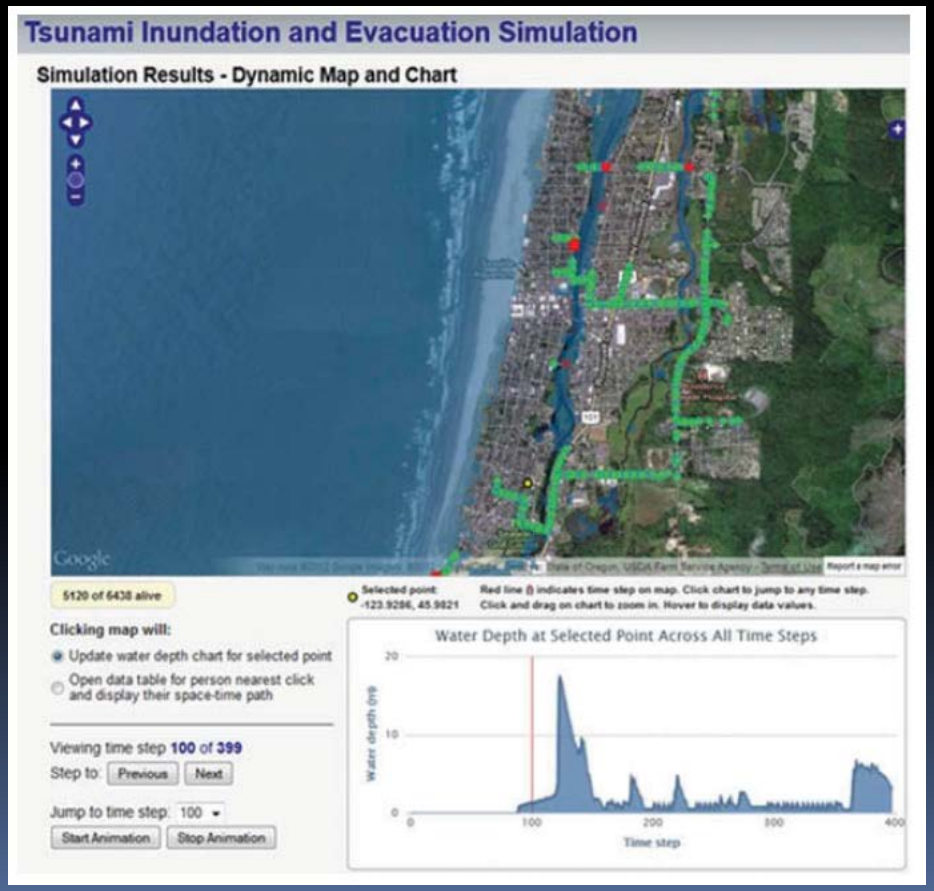


Agent-based Outputs

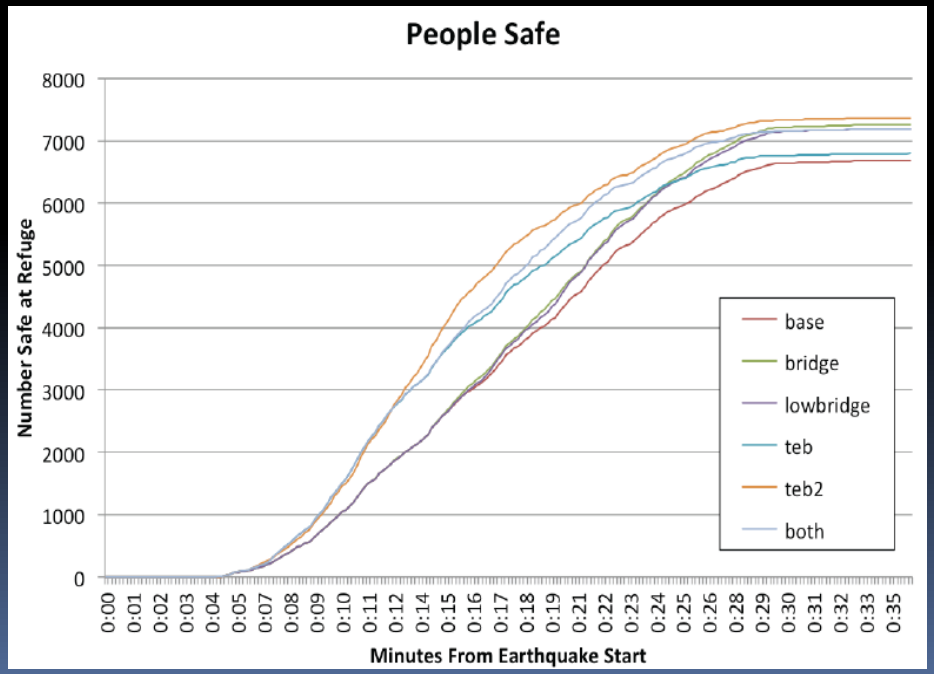
- Mortality & casualty estimates for specific scenarios
- Animations of movement
- Time-based snapshots

Table 1. Summary of simulations (casualties and survivors).

Refuge Sites	1	2	3	4	5	6	7	8	9	TEB	TOTAL
(a) Base Case											
Saved	1015	357	2282	1794	357	549	180	186	9	0	6729
Killed	45	42	150	768	0	30	0	0	21	0	1056 (*)
(b) TEB											
Saved	1015	357	2276	156	357	549	180	186	9	1761	6846
Killed	45	42	150	0	0	30	0	0	21	651	939 (– 11 %)
(c) Bridge											
Saved	1015	936	2282	1794	357	549	180	186	9	0	7308
Killed	45	123	150	108	0	30	0	0	21	0	477 (– 55 %)
(d) TEB + Bridge											
Saved	1015	750	2276	156	357	549	180	186	9	1761	7239
Killed	45	48	150	0	0	30	0	0	21	252	546 (– 48 %)
(e) Low Bridge											
Saved	1015	864	2282	1794	357	549	180	186	9	0	7236
Killed	45	105	150	198	0	30	0	0	21	0	549 (– 48 %)
(f) TEB (Alt.)											
Saved	1015	357	2282	663	357	549	180	186	9	1818	7416
Killed	45	42	150	3	0	30	0	0	21	78	369 (– 65 %)



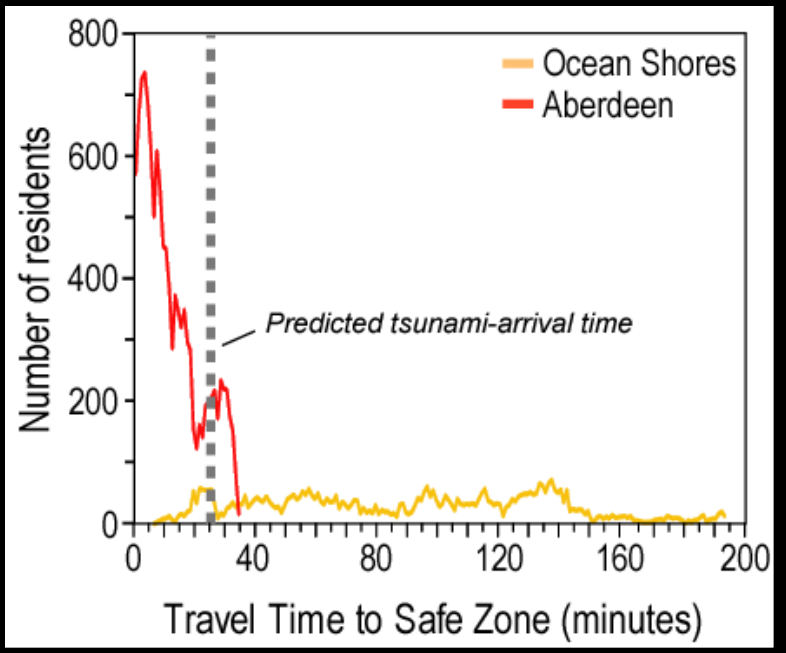
Keon et al., 2014

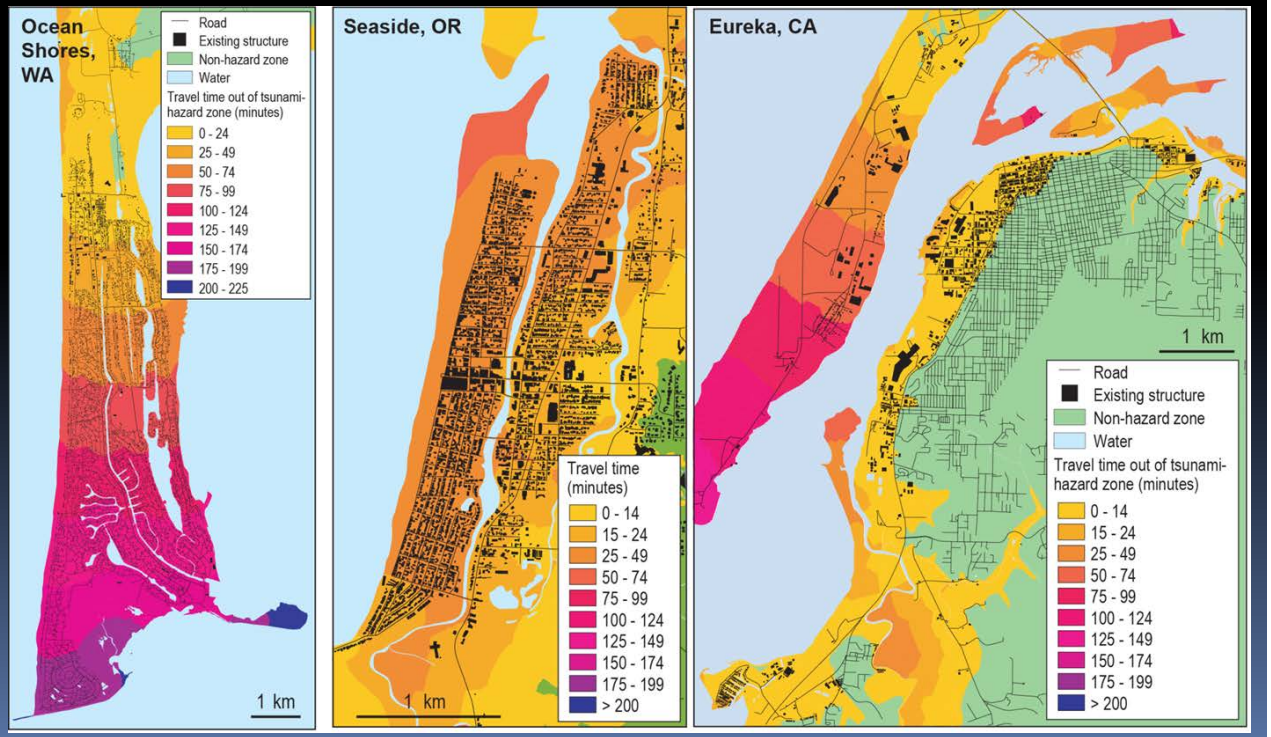


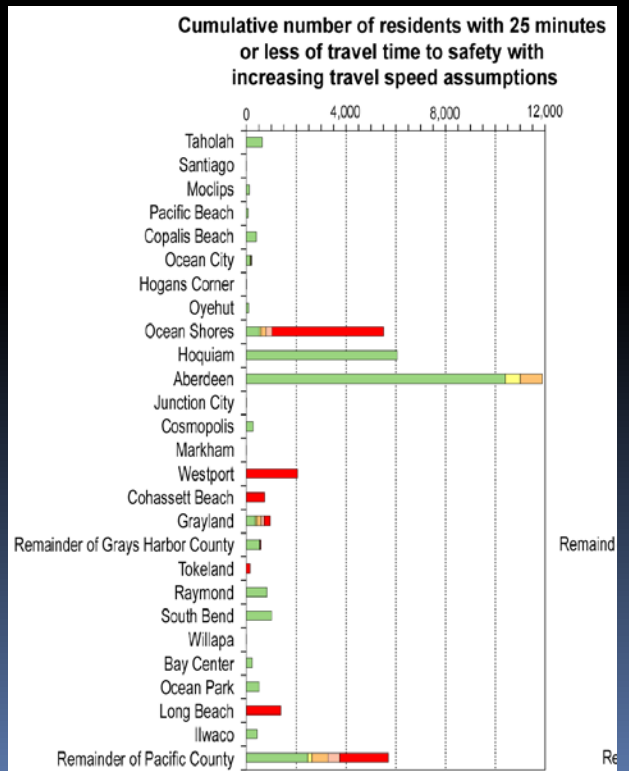
Cannon Beach Evacuation simulator, Karon and Yeh, 2011

Least-cost distance outputs

- Maps of travel time
- Exposure numbers and profiles as a function of travel time
- Comparisons by community, change in travel speeds, population types
- Useful for outreach, response, priority setting across region







Summary

Both approaches are useful for evacuation modeling but in different ways

Agent-based

- Population #'s & sites well constrained
- Focus on population movement
- Focus on specific scenario
- Loss estimation numbers
- Post-disaster assessments
- Influence of behavior change

LCD-based

- Desire for flexibility in population
- Focus on evacuation landscapes
- Focus on worst case @ site
- Maps and graphs
- Outreach product for public
- Mitigation product for VE siting