Modeling pedestrian evacuations

*a very quick comparison of two approaches*

Nathan Wood, PhD
Western Geog. Sci. Center
nwood@usgs.gov

U.S. Department of the Interior
U.S. Geological Survey
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

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