

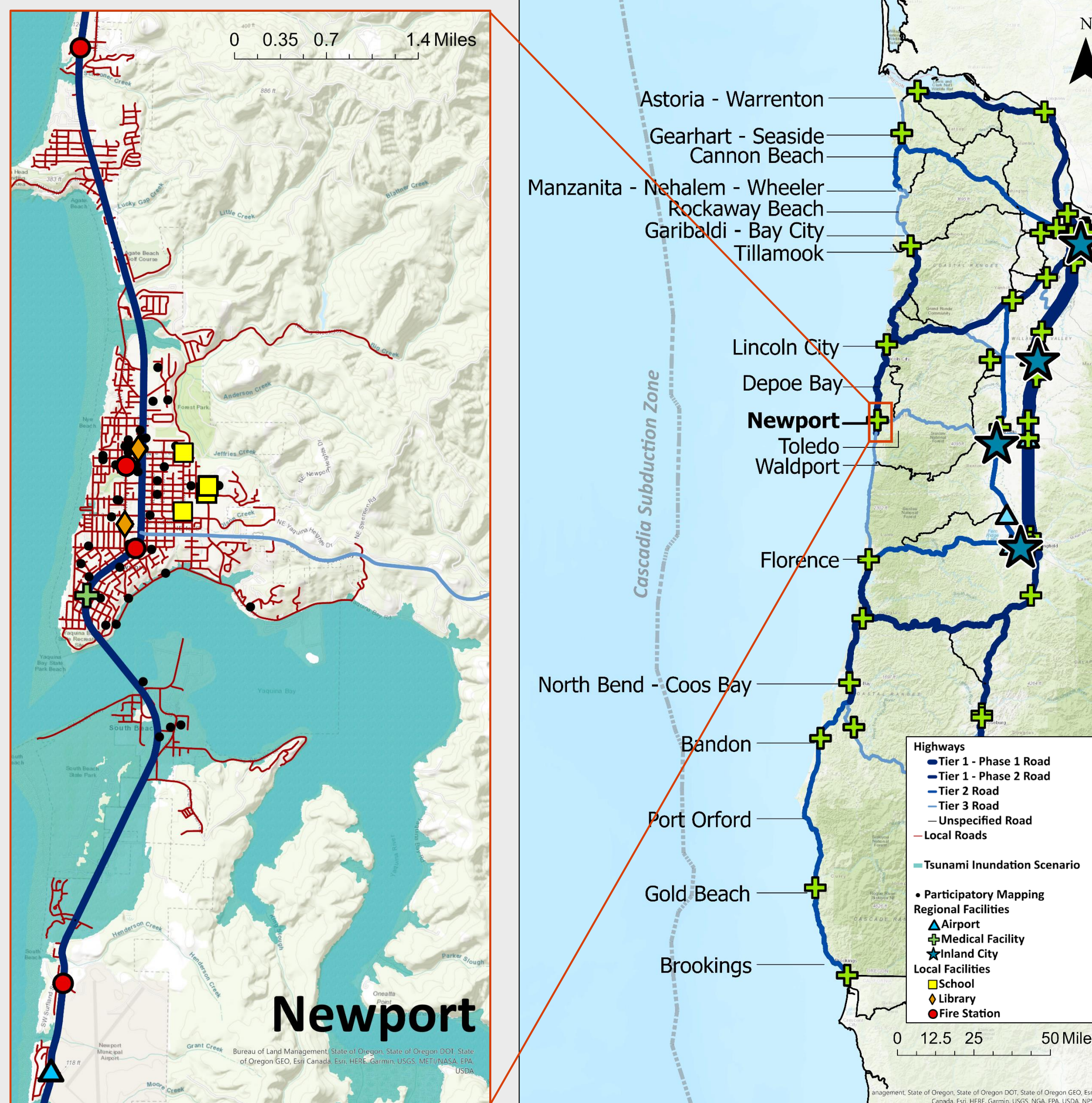
HUMAN-CENTERED CONNECTIVITY AND TRANSPORTATION NETWORK RECOVERY FOLLOWING A CASCADIA SUBDUCTION ZONE EARTHQUAKE AND TSUNAMI

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PERSONALIZED RESILIENCE

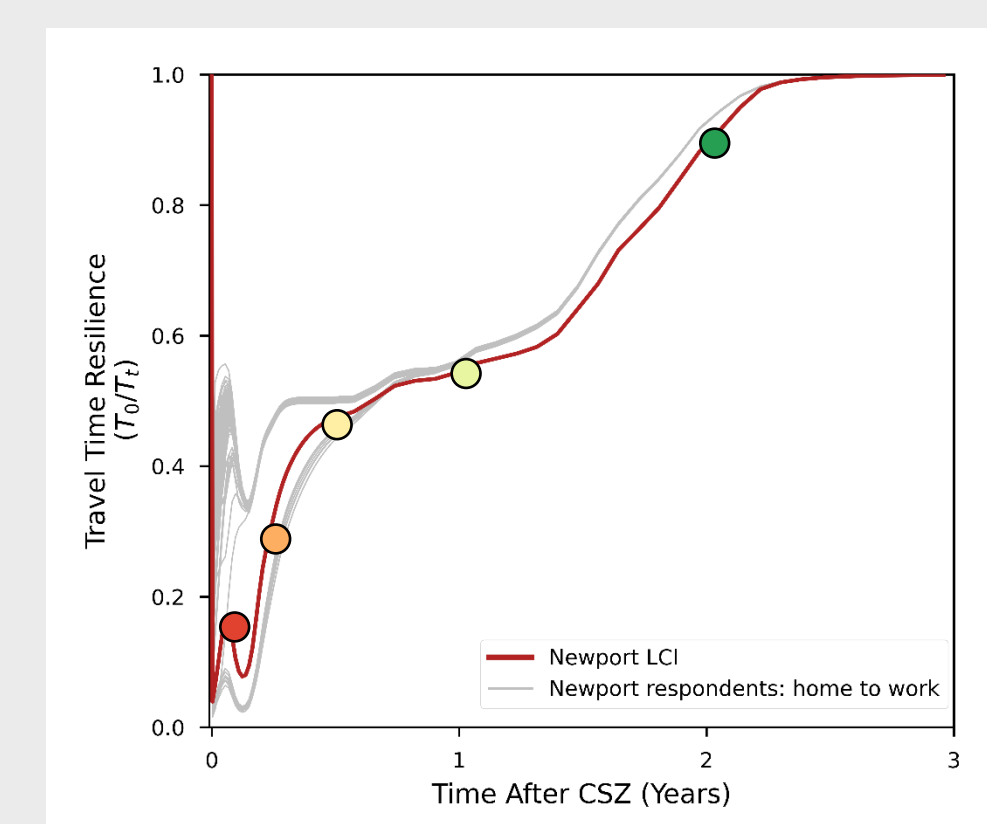
Access to where?

People use transportation networks in diverse ways (to get to resources, places, other people).

Critical infrastructure vs community assets:

- The difference between use in times of emergency and continuous day to day services.
- Studies and resilience plans commonly consider access to critical facilities like hospitals, fire stations, and airports.
- There is a need to extend research to the connectivity to services such as food, education, and community.

Travel Time Resilience

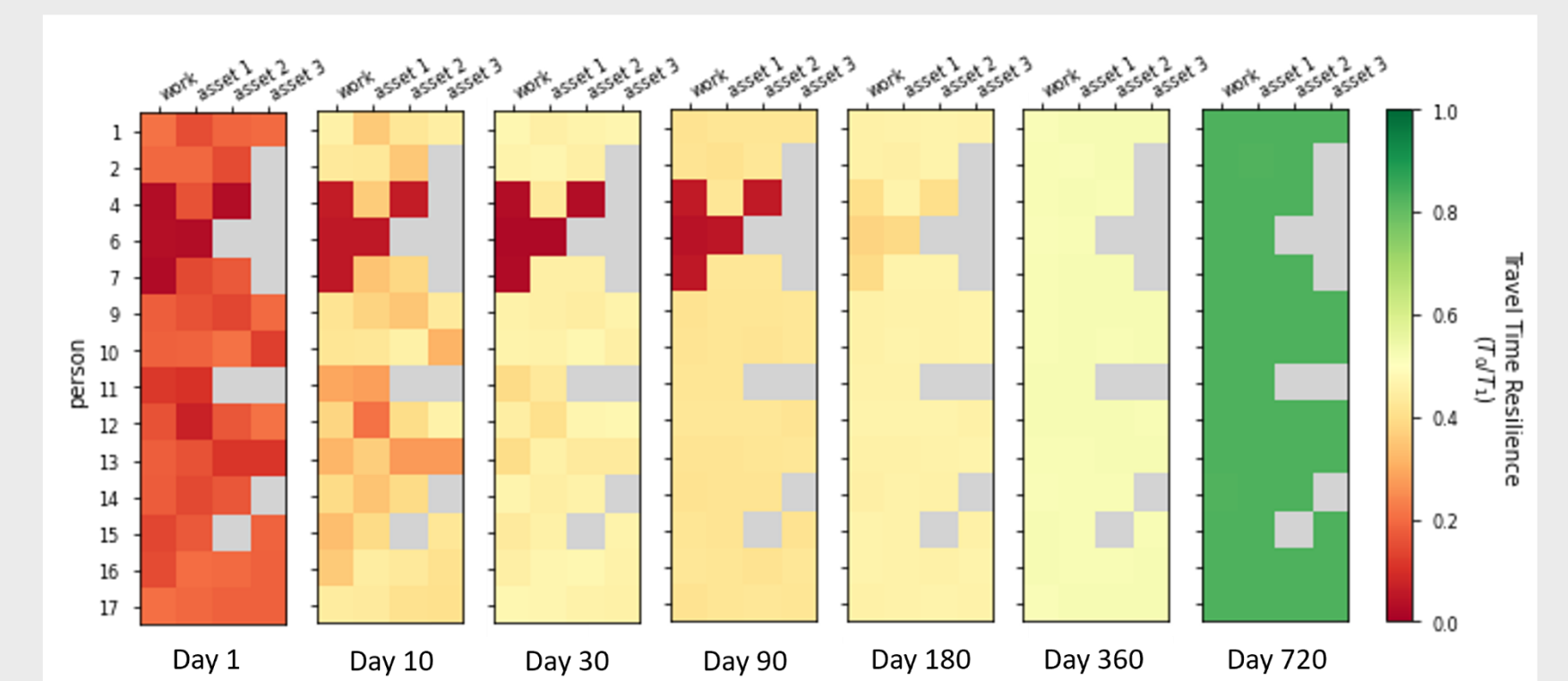


The local connectivity index for Newport compared to specific assets defined by community members.

- Assets include their homes, workplaces, and participant-defined assets like:
- Schools
 - Libraries
 - Churches
 - Grocery stores

Network Resilience: Home to Community Assets

The matrix shows the ability for specific community members to access important assets at different intervals following a CSZ event.



Community members with assets on the other side of the Newport bridge see a significantly longer delay in connectivity.

Key Takeaways

1. Regional assets used to measure resilience can provide very different values of recovery.
2. Local differences are less pronounced, likely due to a higher road density with alternative route options.
3. There are larger geographic patterns associated with recovery. (not shown)
4. Human-centered asset considerations show unique measures of individual risk compared to averages.

Future Work

These findings will be used to evaluate how resilience is measured. Potential next steps include:

- Incorporating building damage state and recovery into connectivity and functionality measures, and
- Accounting for landslide hazards and other infrastructure analyses (e.g. water, power)

Acknowledgements

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References

Meselhe A, DR Anderson, DT Cox, J Tilt. "Human-centered connectivity and network recovery following a Cascadia Subduction Zone earthquake and tsunami" in preparation for Journal of Sustainable and Resilient Infrastructure.
D Sanderson, D Cox, AR Barbosa, J Bolte (2022) "Modeling regional and local resilience of infrastructure networks following disruptions from natural hazards," Journal of Infrastructure Systems.

MOTIVATION

- Pacific Northwest is at risk due to rupture of Cascadia Subduction Zone (CSZ).
- CSZ expected to result in road and bridge damage.
- Communities and individuals may face a sense of isolation or "islanding".
- Looking at resilience through the lens of accessibility
 - *Local accessibility*: Individual access to assets within their community (home to school, home to grocery, etc.).
 - *Regional accessibility*: Community access to rest of region (Newport to Portland, Newport to Waldport, etc.).

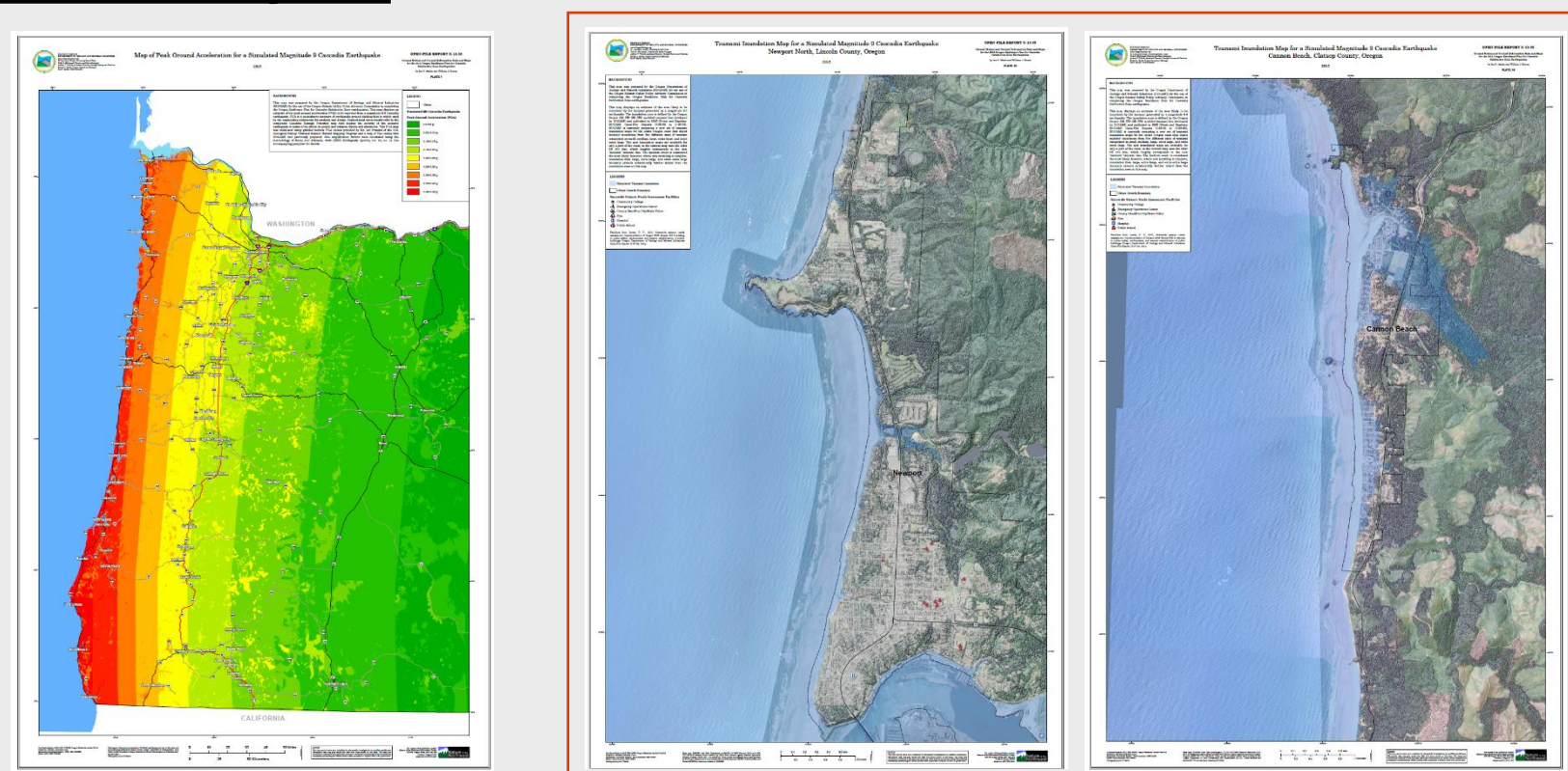
Research Question: How do we measure community resilience and connectivity thinking about:

- Network performance at varying scales
- Access to critical facilities
- Access to community-defined assets

METHODS

The model simulates probabilistic damage and recovery.

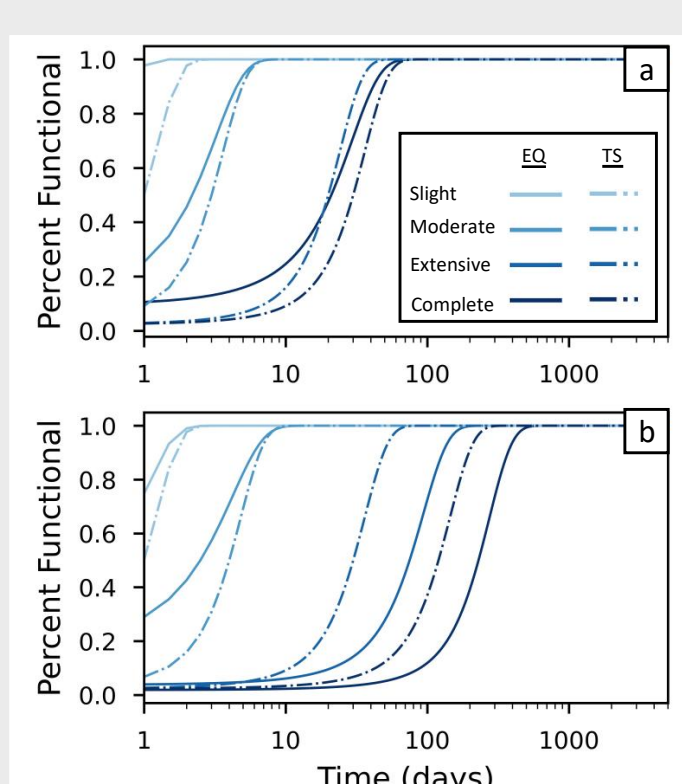
Hazard Layers



DOGAMI M9 Earthquake

DOGAMI "L" Tsunami

Damage and Restoration



- Hazus road/bridge fragility curves.
- Hazus road/bridge restoration curves.
- Prioritize regional restoration by Oregon Resilience Plan highway tiers.
- Local restoration dependent on access to regional maintenance facilities.

Regional and Local Metric Data

Facility Type	Tier 1	Tier 2	Tier 3	Distinctions	Data Source
Regional Assets					
▲ Airport	13	8	14	As defined in the Oregon Resilience Plan	IRIS Dataset
Ⓜ Medical Facility	53	41	-	1. Hospitals 2. Urgent care centers	IRIS Dataset
★ Inland City	1	2	2	Top 5 cities by population of the metropolitan area 1. 500,000 <= <= Portland 2. 100,000 <= <= Eugene, Salem 3. X < 100,000: Corvallis, Medford	Oregon Secretary of State
Local Assets					
Schools	62	15	23	1. Public and public charter schools 2. Private schools 3. Higher education (career and community schools)	IRIS Dataset + Geospatial Dataset
Libraries	21	9	-	1. Public libraries 2. Special, academic, volunteer, and tribal libraries	Oregon Library Directory + IRIS Dataset
Community Services	51	3089	967	1. Emergency services (fire stations) 2. Business/professional/technical services 3. Average personal and repair services	1. IRIS Dataset 2&3. NSI Dataset
Individual Assets					
• Community Identified Assets	42 persons surveyed All assets weighted equally			1. Home 2. Work 3-5. Various other assets	(Stanton and Tilt, 2022)

Used to compare when each asset is used to measure resilience

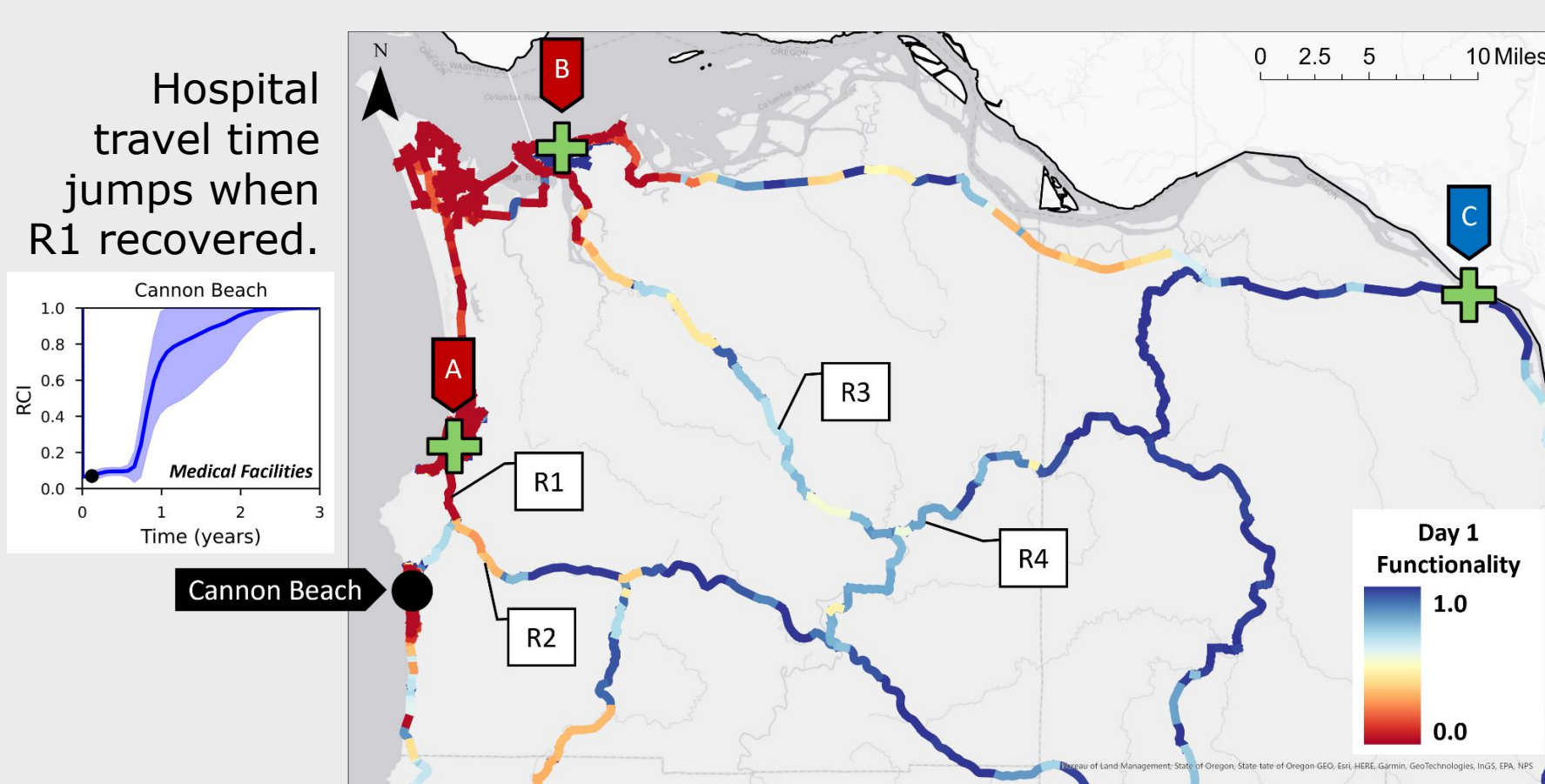
Regional and Local Resilience

Measure of travel time before CSZ to travel time after CSZ.

Regional Connectivity Index (RCI):

Regional access from cities to airports, medical facilities in other areas, and inland cities.

Travel time can change drastically due to reconstruction of specific road segments. Immediately following the CSZ the most accessible asset may be deeper inland until the coastal roads are functional.



Local Connectivity Index (LCI):

Local access from random start points to schools, community services, and random end points within a given city.

