Caution: Slide Area! Surface Roughness Dating of Coastal Landslides Along the South Whidbey Island Fault, WA

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Introduction and Background

- Landslides are agents of erosion in wet and mountainous regions and can have a long-lasting impact on the landscape.
- In the Puget Lowland of Washington, landslides are prevalent along steep coastal bluffs, presenting a hazard for coastal communities.
- To improve our understanding of landslides and their hazard assessment, we need to document spatial and temporal patterns of landsliding. However, dating these deposits is costly and challenging.
- In this study, I estimate landslide ages from surface roughness to establish a better chronology of coastal landslides in South Whidbey Island.

Methods

1. Using Washington Geological Survey 24k Mapping, we identify five areas of landslides in proximity to the South Whidbey Island Fault (Figure 1).
2. Ledgewood- Bonair 2013 landslide is used as a reference of absolute age.

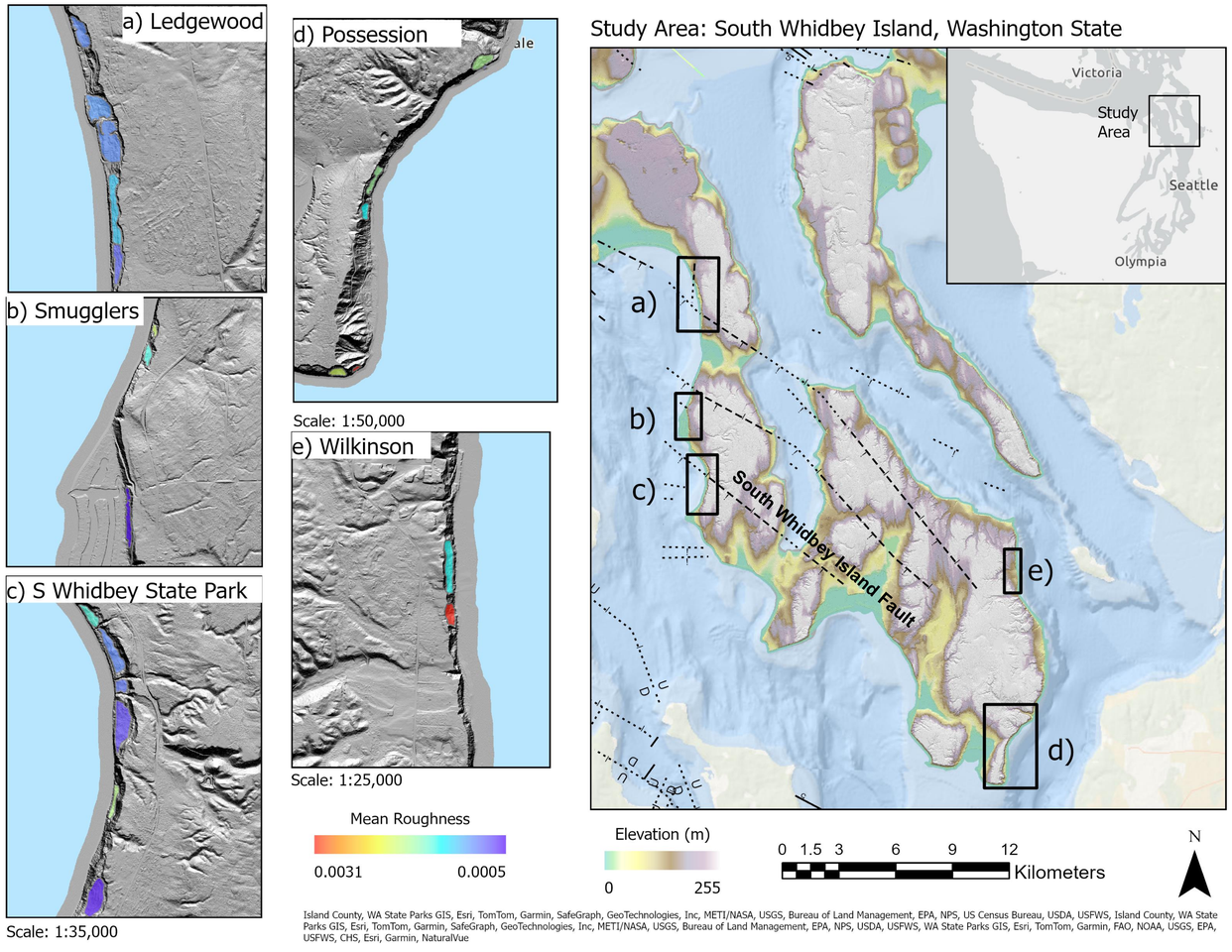


Figure 1: Study area showing elevation over hillshade from Island Lidar 2014. Subareas from a-e expanded to the right show areas of detailed landslide mapping. Landslides polygons are colored by roughness values.

Picture 1: Ledgewood-Bonair Landslide in 2013 (Photo credit to Gravel Beach Blog). **Picture 2:** Landslide in 2025 (Photo credit to Paul Morgan).

Our model age results range from 0 to 3000 ybp

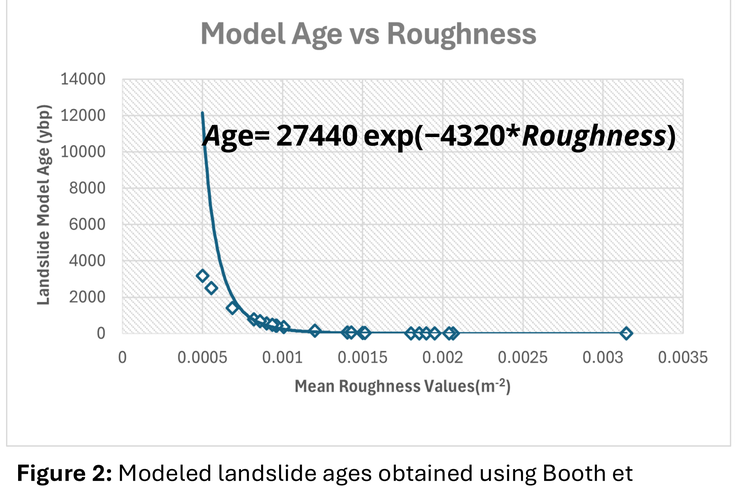


Figure 2: Modeled landslide ages obtained using Booth et al., 2017 calibrated equation.

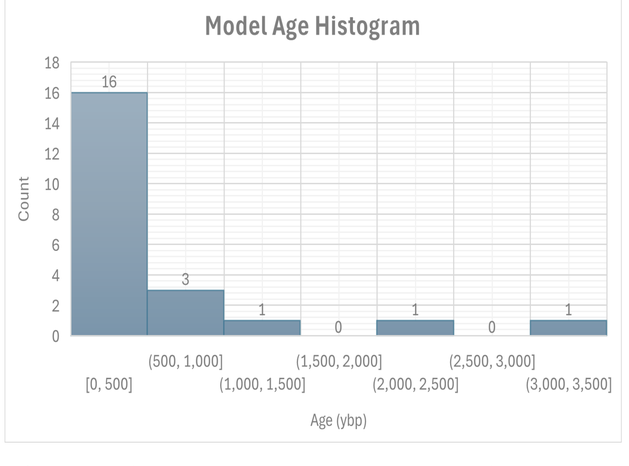


Figure 3: Histogram of the twenty-two landslides modeled ages using mean roughness.

3. **Surface Roughness is used as a proxy for landslide age.** Older landslides are much less rough as they experience erosion and diffusion over time. We use *Pytopocomplexity* from Lai et al. (2024) to calculate roughness using a Mexican Hat method at a scale of 15 m wavelength.

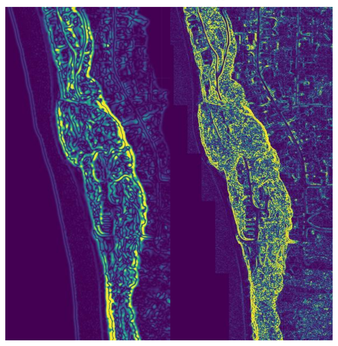


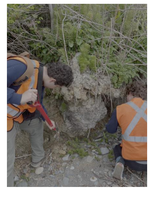
Figure 4: Left, roughness values raster made with a wavelength of 15 m. Right, roughness values raster made with a wavelength of 4 m.

Discussion

- Most of our landslides are relatively young compared to Booth et al (2017) in the N. Fork Stillaguamish River.
- Wave erosion might impact the preservation of older landslides, explaining bias towards more young landslides.
- The Ledgewood-Bonair landslide's model age is off by 350 years from the absolute age, suggesting that the model is a useful approximation for order of magnitude age but a precise approach.

Next Steps

We need more absolute ages to improve the age-roughness model . We sampled wood from two landslides to date using C14.



Acknowledgements

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References

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