Landslide Susceptibility Model of Tualatin Mountains, Portland Oregon

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Landslide Closes Highway 30 at St. John's Bridge

Introduction:

Study Area:
Tualatin Mountains (West Hills)
Portland, Or

- Range up to 1,270 feet (Cornell Mountain)
- Steep slopes and periodic landslides
- Multiple earthquake faults
- Many residences and roads despite risks
- Increasing precipitation due to climate change in an area of already high precipitation
- Urban growth due to influx of people puts population and property at risk.

Causes

- Groundwater Pressure
- Loss or lack of vegetation
- Erosion
- Earthquakes and volcanic eruptions
- Deforestation
- Machinery, traffic and blasting
- Construction

Types

- Debris Flow
- Earthflow
- Debris Landslide
- Sturzstrom
- Shallow Landslide
- Deep-seated Landslide

Purpose of Susceptibility Analysis

- Analyze a series of metrics that directly influence the landslide susceptibility in our study area and combine these factors into a final susceptibility map that shows a weighted combination of risk factors showing the areas that are most (and least) likely to generate landslides. We hypothesized that areas found to be prone to landslides in our analysis would correlate with historic landslides in the area.

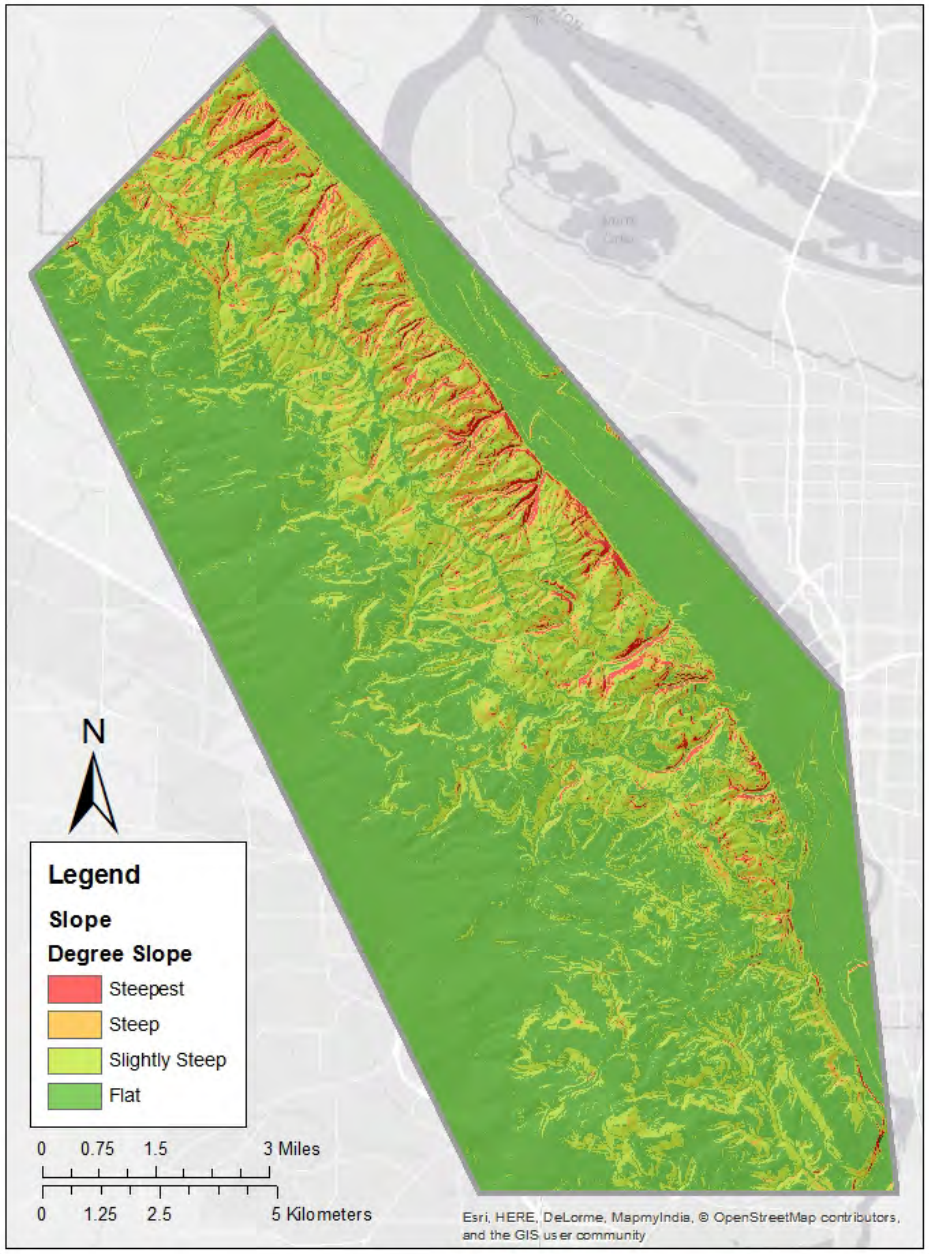
Data and Sources

- Historic landslide data from Statewide Landslide Information Database for Oregon (SLIDO)
- DEM from Portland State University (PSU)
- Soil data from Orergon Geospatial Enterprise Office (GEO)
- Fault lines, scarps and deposits from Oregon Spatial Data Library (OSDL)
- PRISM Precipitation normalized 30 year monthly average from Oregon State University (OSU)
- Land cover data from National Land Cover Database (NLCD)

Methodology

- Reclassify datasets to a common scale according to geospatial aspects that influence landslides

Slope Map


N
Legend
Slope
Degree Slope
Steepest
Steep
Slightly Steep
Flat
0 0.75 1.5 3 Miles
0 1.25 2.5 5 Kilometers
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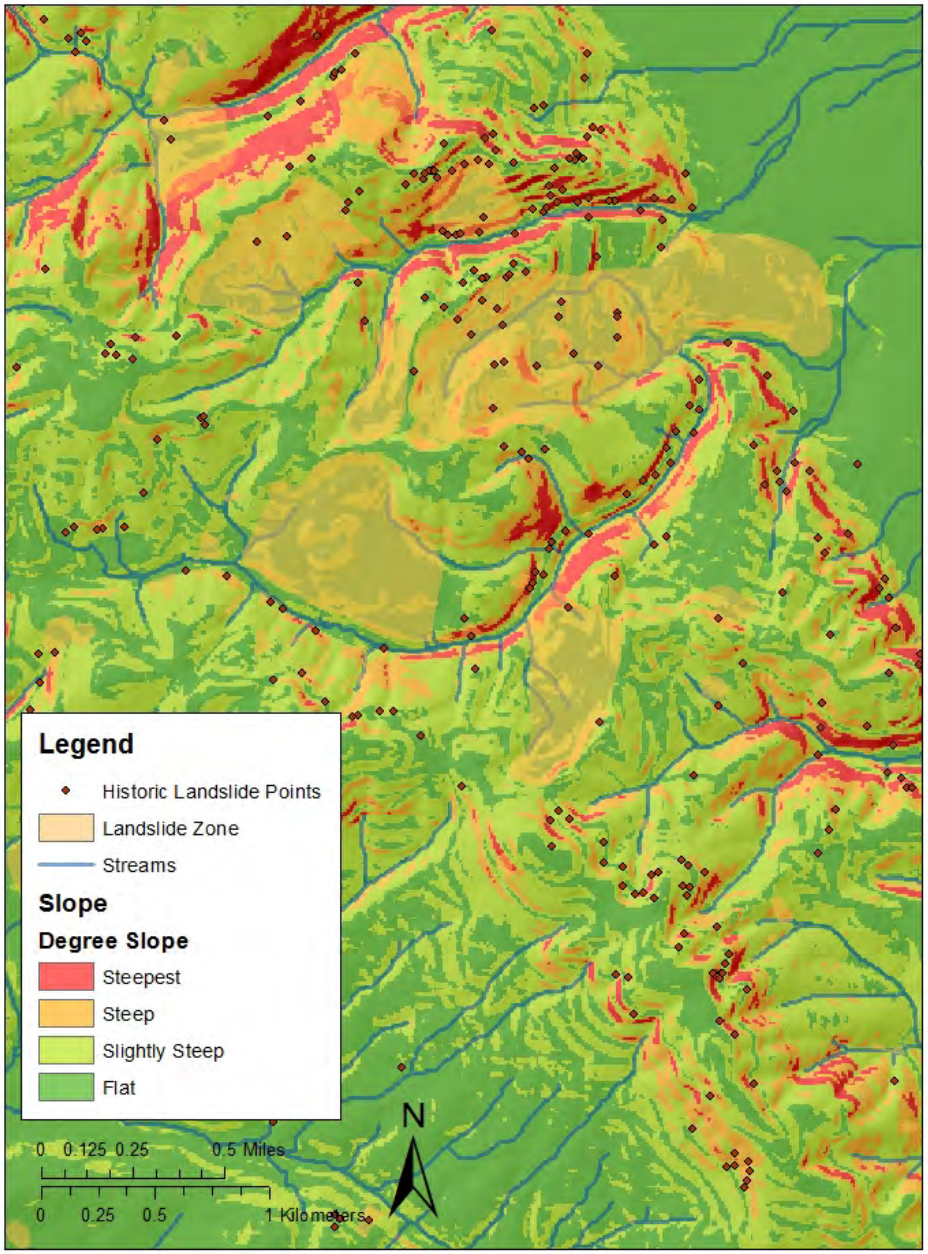
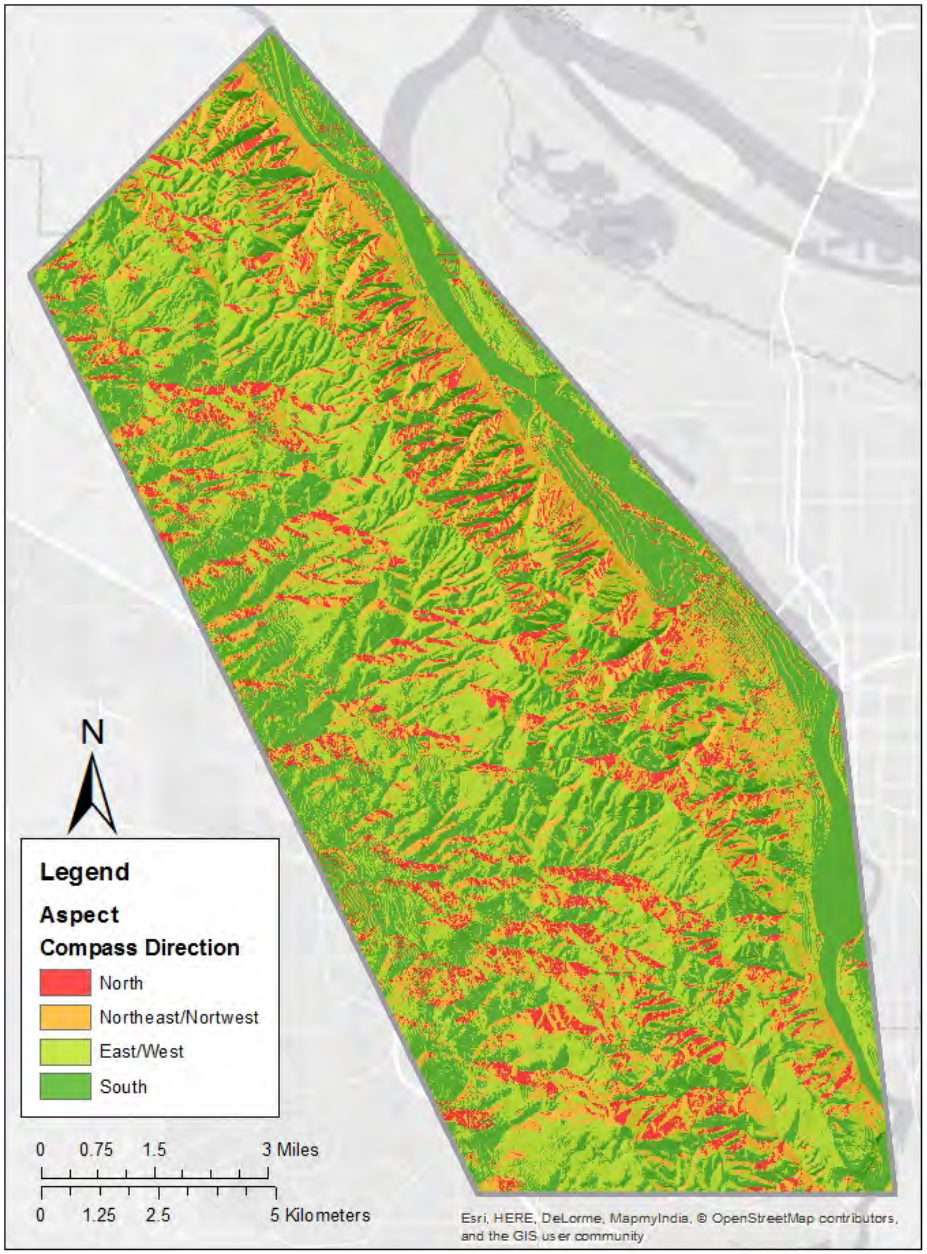
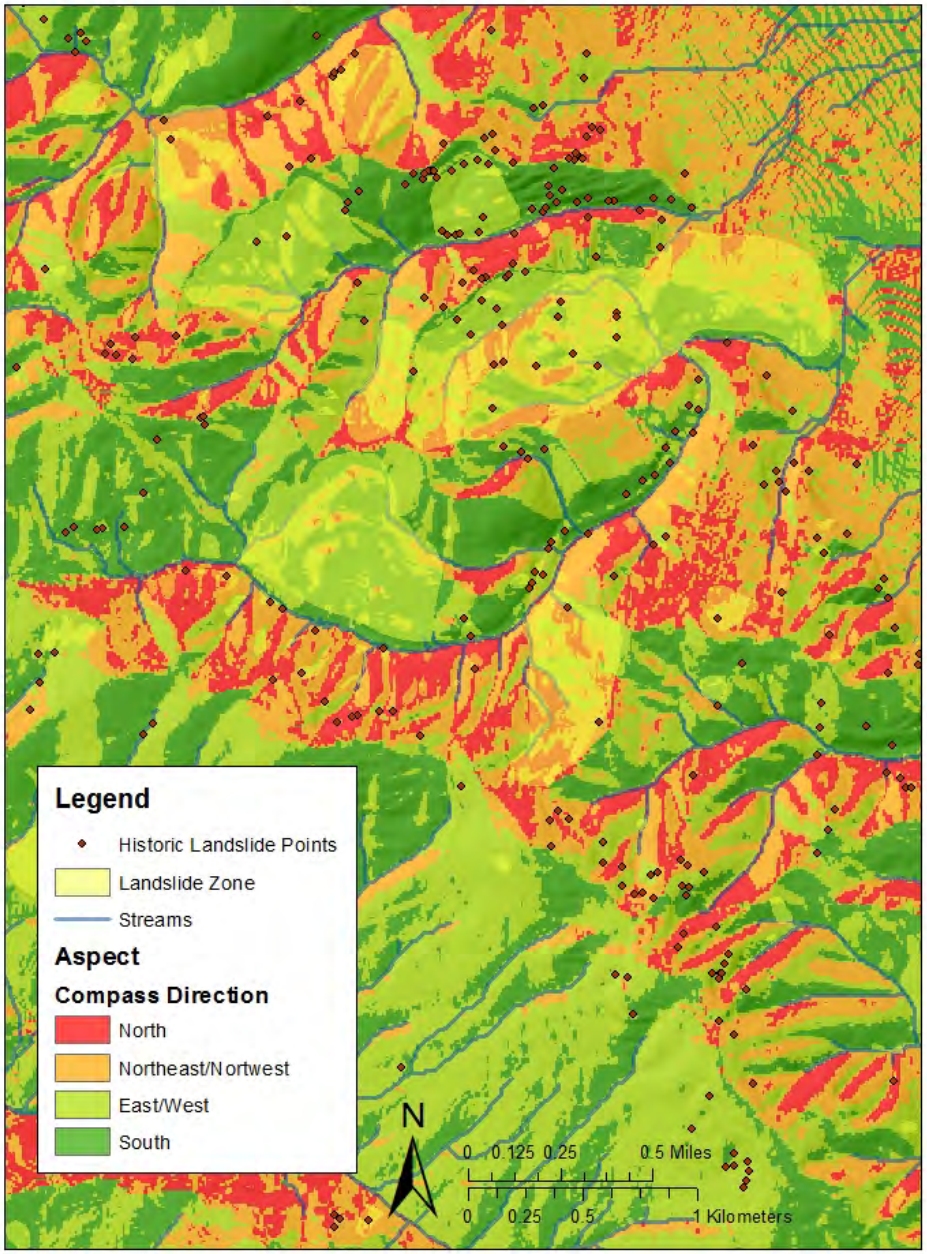
Detail Slope Map



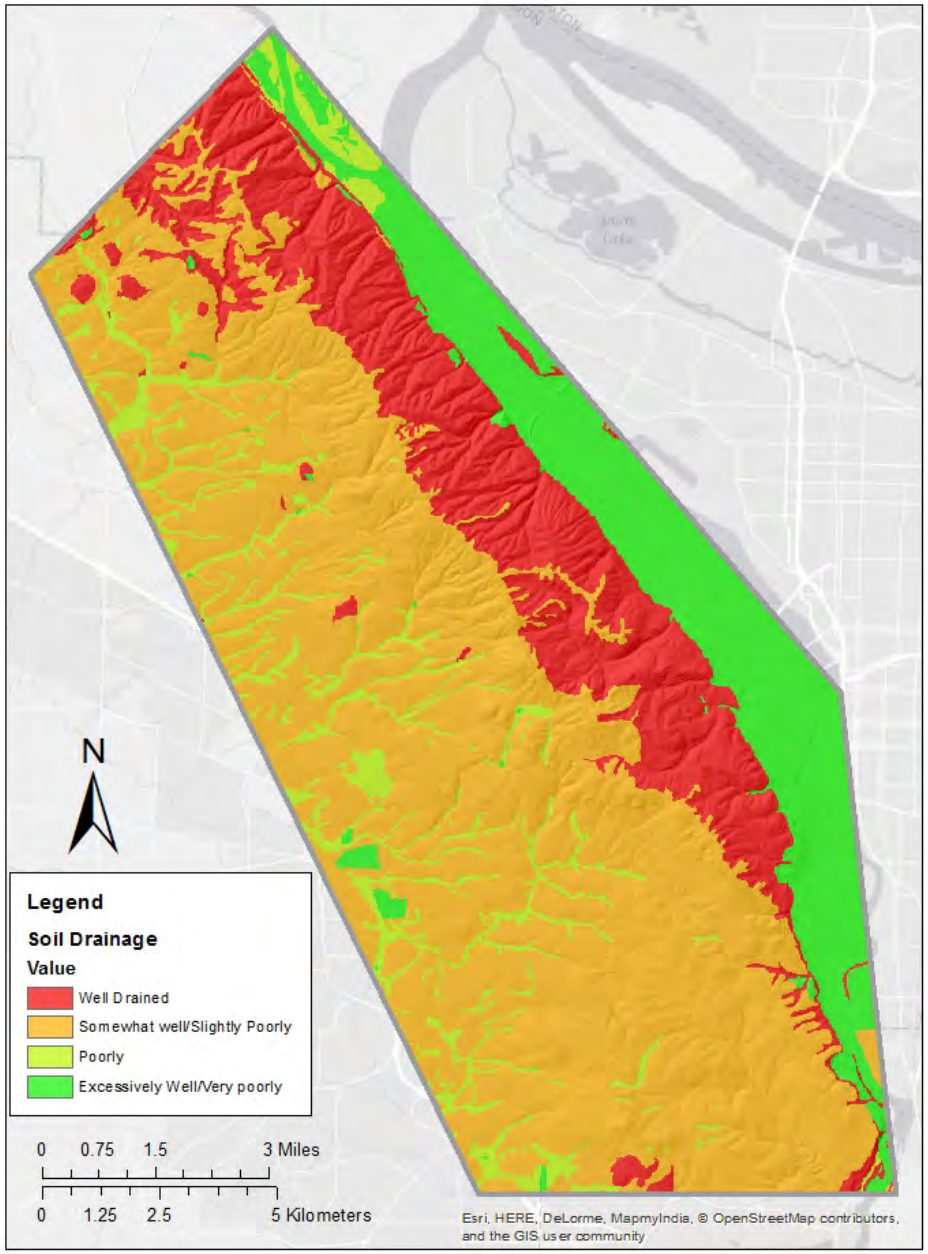
Aspect Map


N
Legend
Aspect
Compass Direction
North
Northeast/Nortwest
East/West
South
0 0.75 1.5 3 Miles
0 1.25 2.5 5 Kilometers
Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

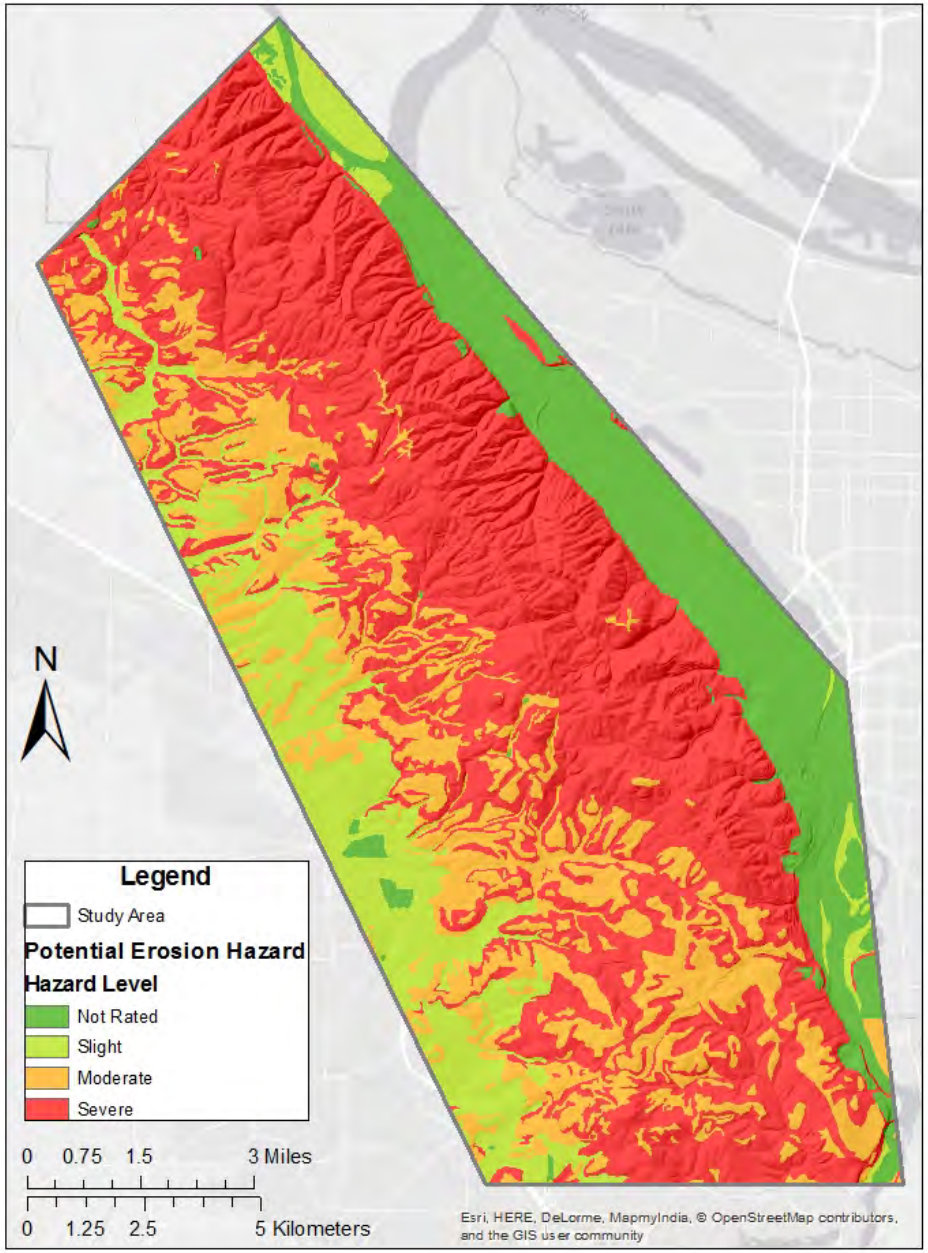
Detail Aspect Map



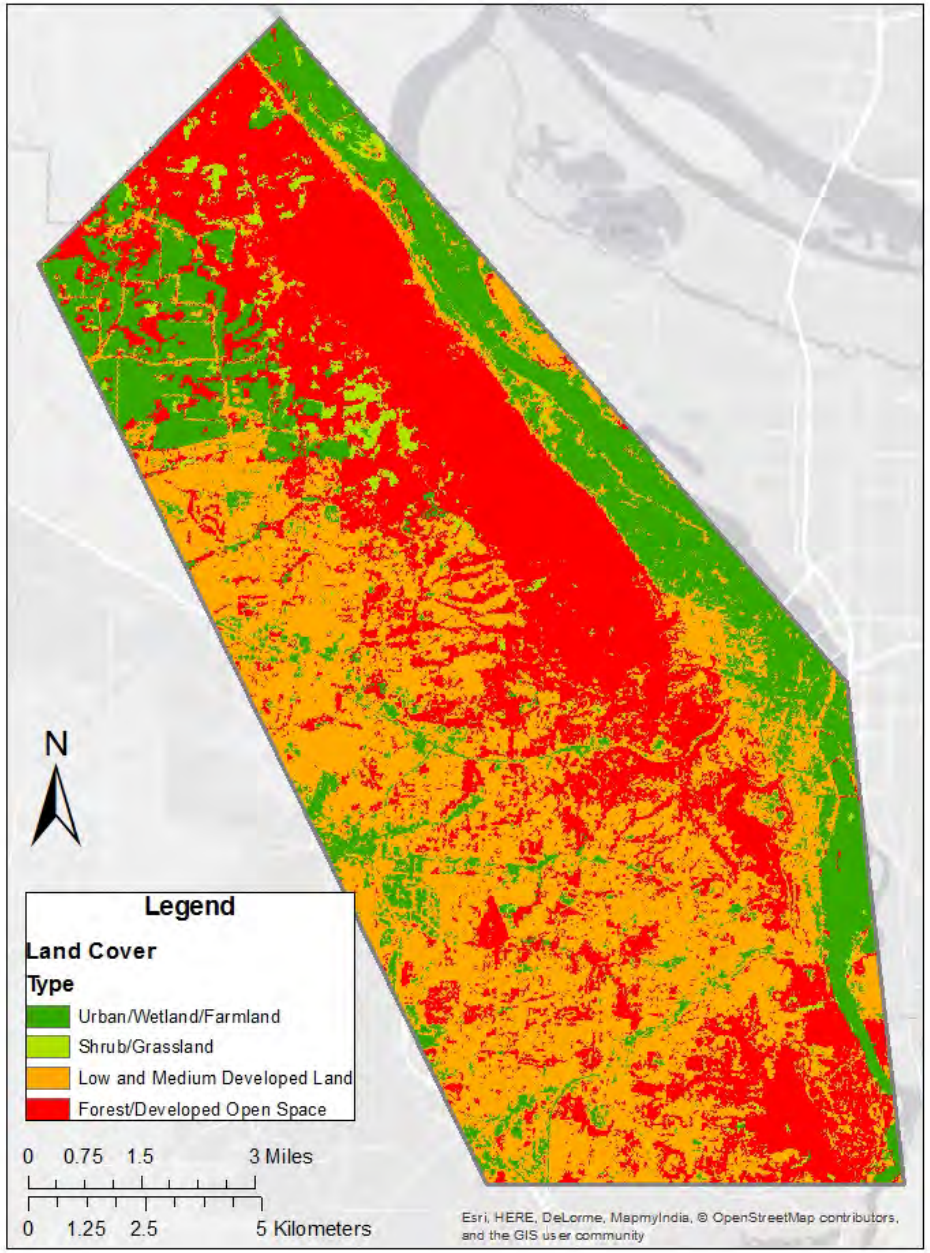
Soil Drainage Map



Potential Erosion Hazard



Land Cover


N
Legend
Land Cover
Type
Urban/Wetland/Farmland
Shrub/Grassland
Low and Medium Developed Land
Forest/Developed Open Space
0 0.75 1.5 3 Miles
0 1.25 2.5 5 Kilometers
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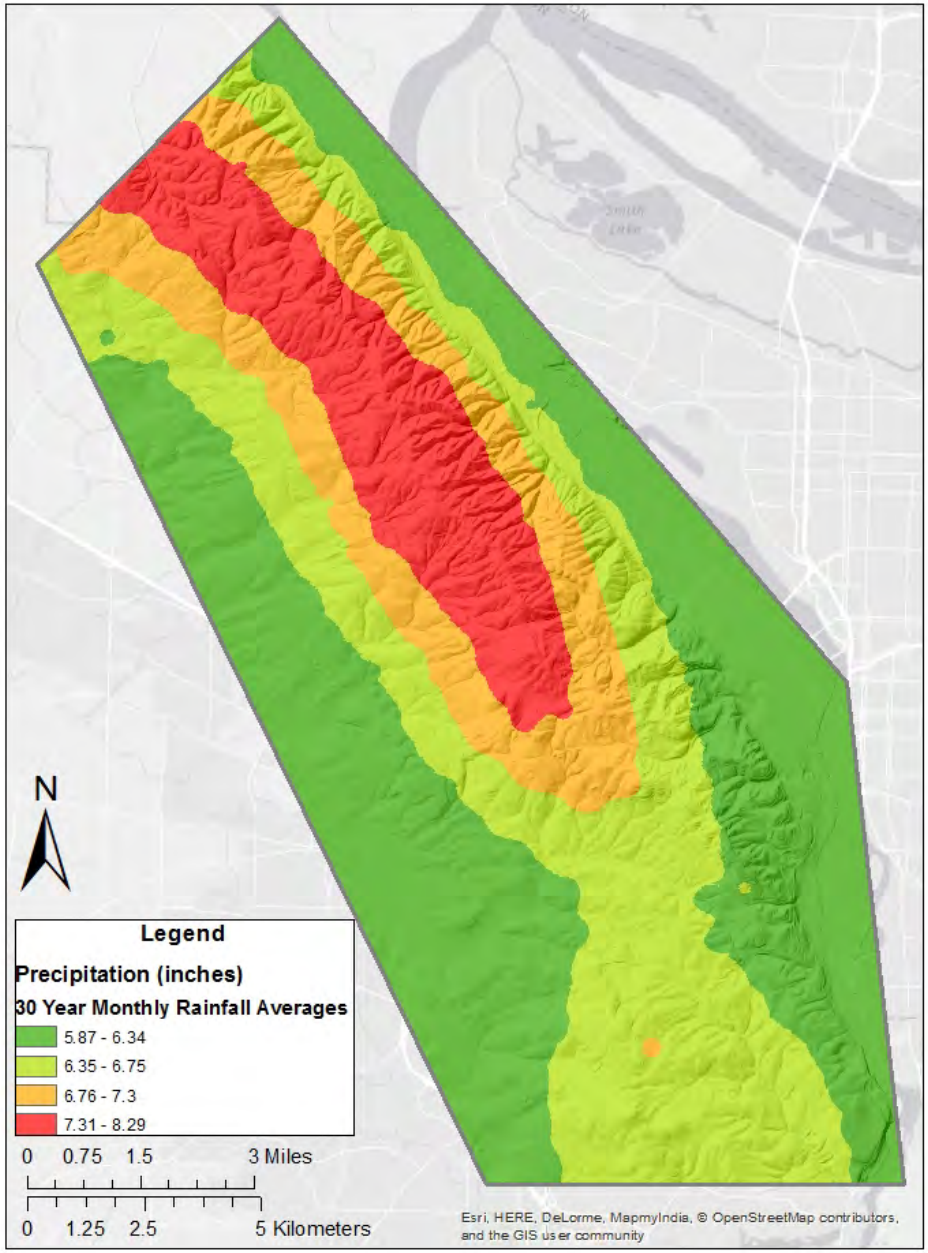
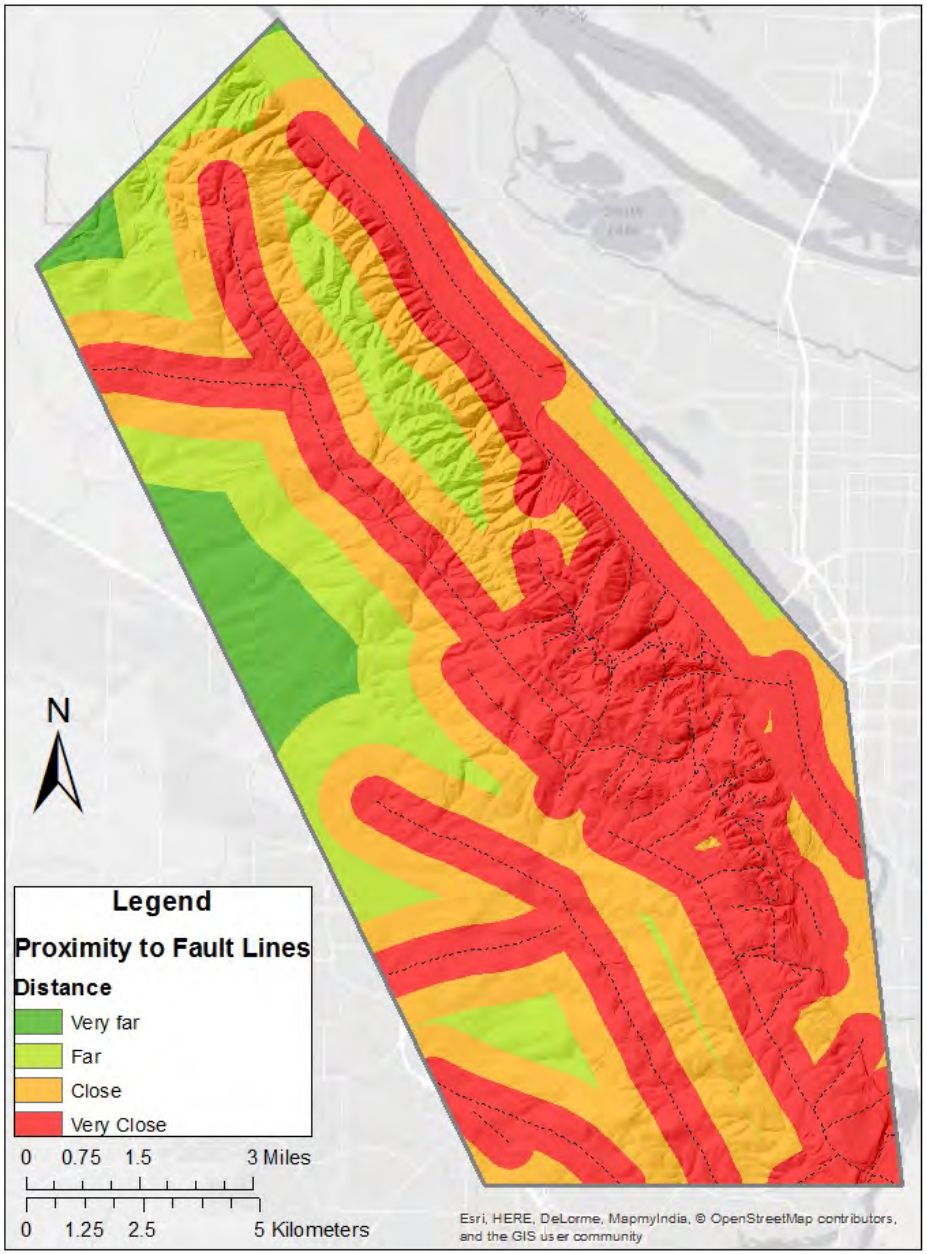
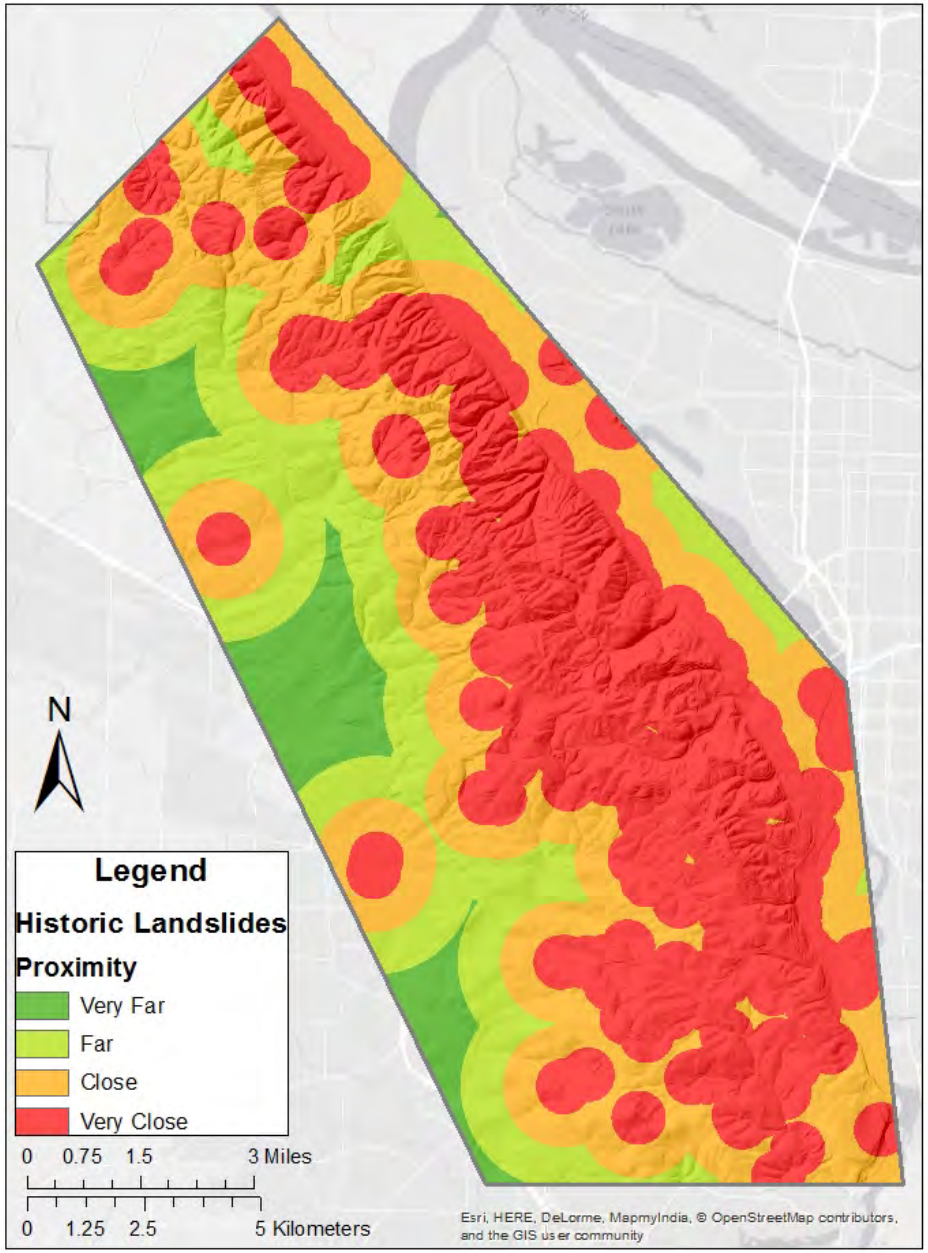
PRISM Precipitation Averages



Proximity to Fault Lines



Proximity to Historic Landslides

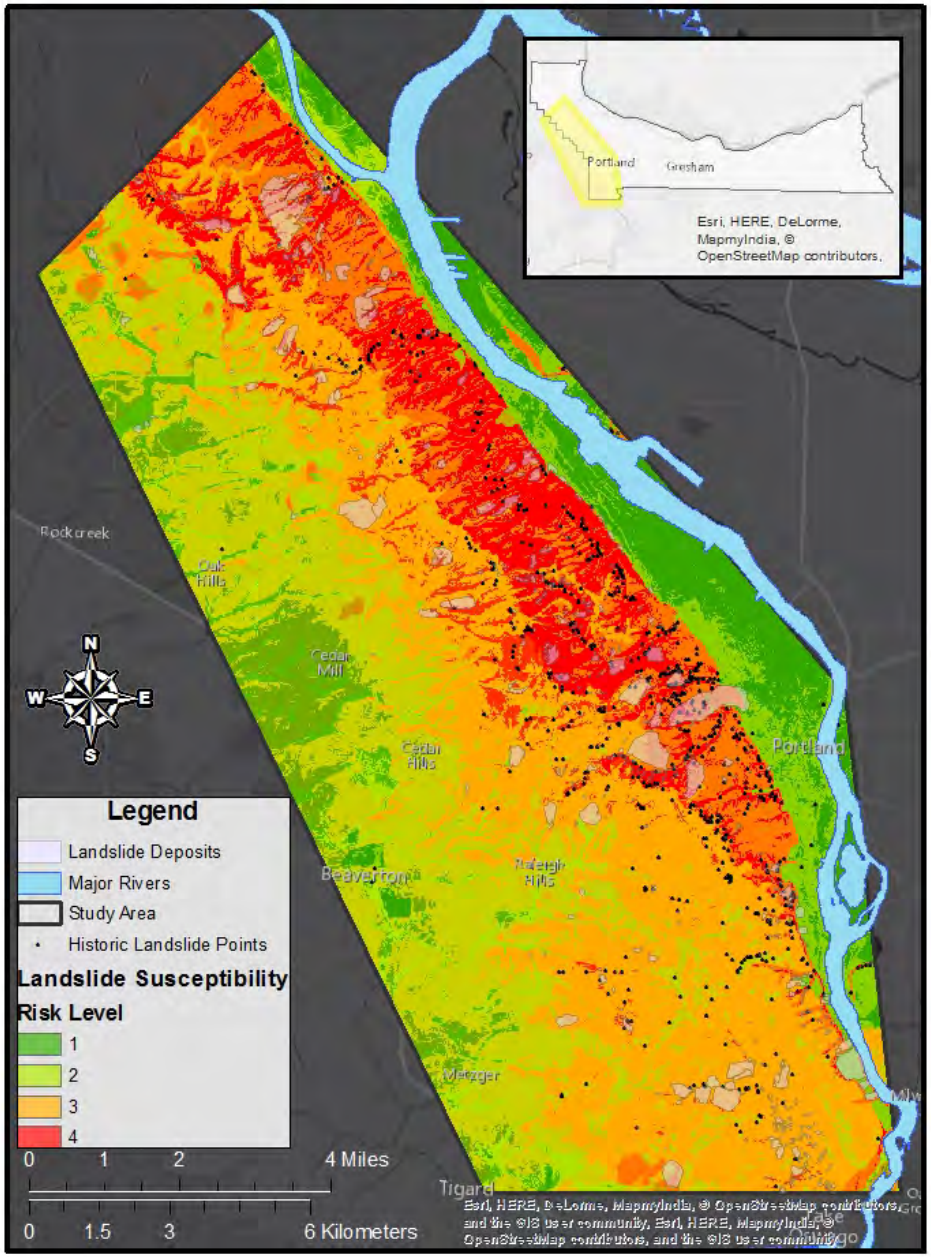


Methodology

- After our 8 datasets were reclassified and given a numeric value between 1 and 4 for landslide susceptibility we used raster calculator to create a simple equation to weight and combine the raster into a final susceptibility map.
- Slope, erosion, land cover and historic landslides were multiplied by .15, while drainage, aspect, precipitation and fault distance were multiplied by .1, giving the first four datasets twice the weight of the others.
- After this all of the rasters were added together creating a cohesive susceptibility map.

Landslide Susceptibility Index

Forest Park, Portland, Oregon.



Discussion

- The index shows strong correlation with prior landslides and therefore our hypothesis looks to be correct and we seem to have a degree of accuracy in our results.
- This study isn't scientific enough to be used for city planning or actual mitigation practices.
- Susceptibility is an initial step before analyzing landslide run out, and then landslide consequences for an area.

Conclusion

- Landslide Susceptibility Indices and analysis provide a good starting point for finding problem areas when it comes to predicting possible landslides but are limited in accuracy and omit some crucial factors necessary for protecting people and property from landslides. Never the less our methods provided a seemingly accurate result in predicting high-risk zones for landslide occurrence.

Possible Improvements

- More data and better classification of landslide causal factors for more accurate analysis.
- Wildfire data as wildfires strongly influence landslides.
- Further analysis of run out and expected consequences of landslides occurring in high-risk zones of study areas
- Formulation of a more scientific weighting scale to create even more accurate results.
- Take it further with statistical analysis.

Questions?

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