Constructing a Landslide Hazard Map with Frequency Ratios

Geo 593 / Teresa Pett

Introduction

- **Frequency ratios assess the spatial correlation between an event and a particular factor.**
- **The ratio is the number of events divided by the area for a sub-factor.**

Factor	Class	Frequency Ratio
Geology (georas1)	mixed grained sediment	0.48
	mudflow breccia	0.22
	coarse grained sediment	0.00
	basalt	1.48
	fine grained sediment	4.05

Purpose

To construct a landslide hazards map using frequency ratios based on relevant criteria (factors).

The FR will be used assign a Landslide Hazard Index (LHI) to each cell.

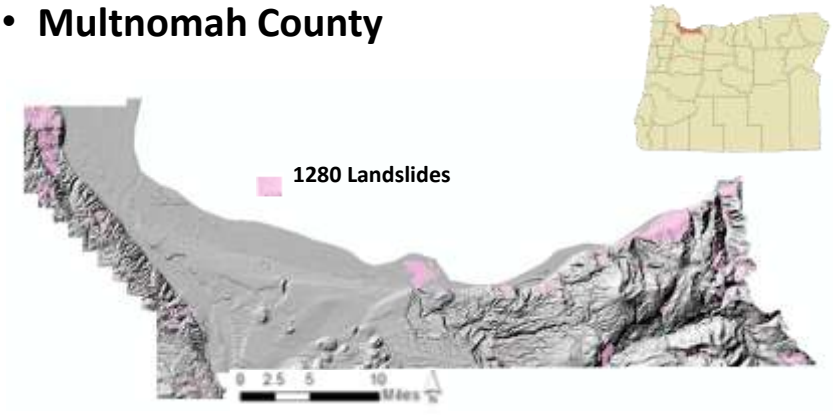
Validate model.

Factors

- Slope
- Aspect
- Curvature
- Distance from stream drainage
- Rock type
- Distance from faults
- Soil type
- Land cover

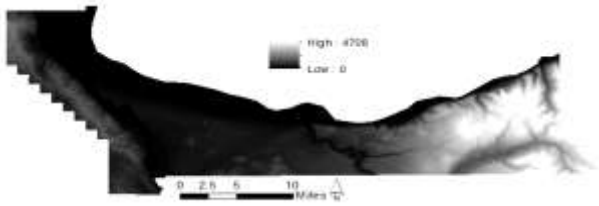
Study Area

- Multnomah County



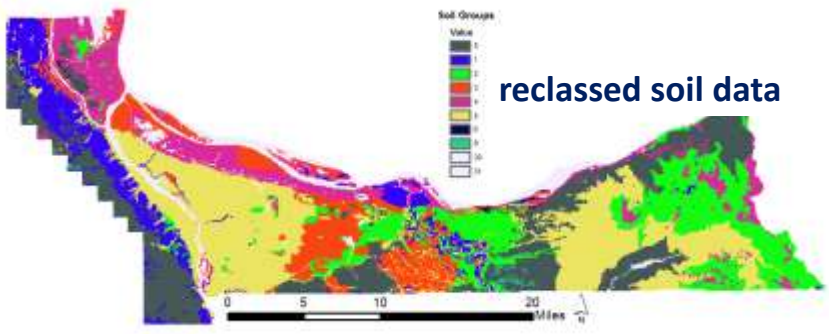
Data Sets Used

- *Geology (DOGAMI) 1:100,000*
- *Vegetation (OregonGAP Analysis Program) 1:100,000*
- *Digital Elevation Model 10m*
- *Soil (NCRS Soil Survey OR051) 1:20,000*
- *Landslide Data (DOGAMI SLIDO)*

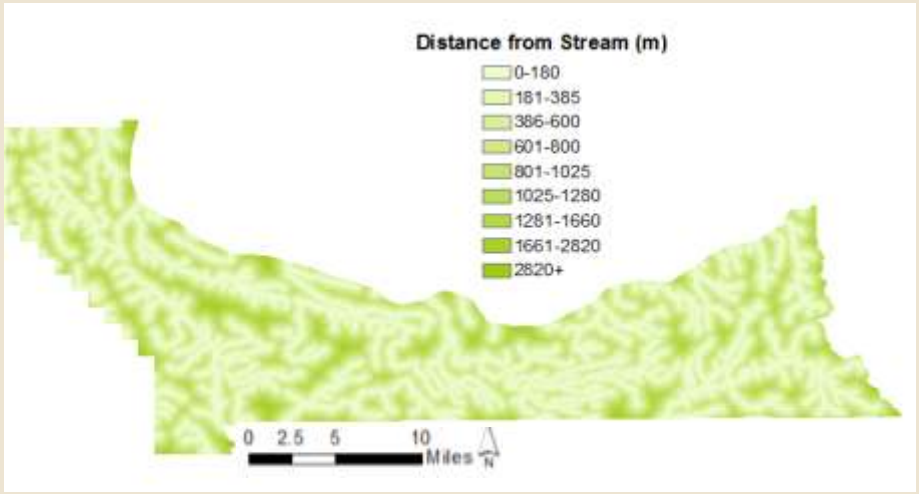


Methods

- **Data preparation**
  - **clip, rasterize, resample, reclassify**
  - **decisions on data**

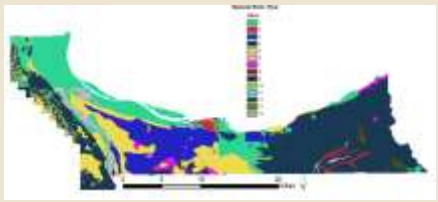


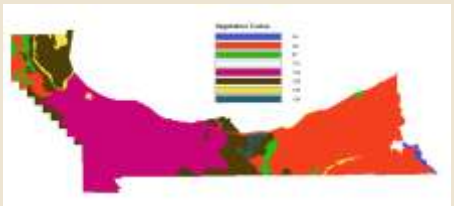
reclassed soil data


Distance from Stream (m)
0-180
181-385
386-600
601-800
801-1025
1025-1280
1281-1660
1661-2820
2820+
0 2.5 5 10
Miles
N


Slope (degree)
0 2.5 5 10
Miles
N


Curvature





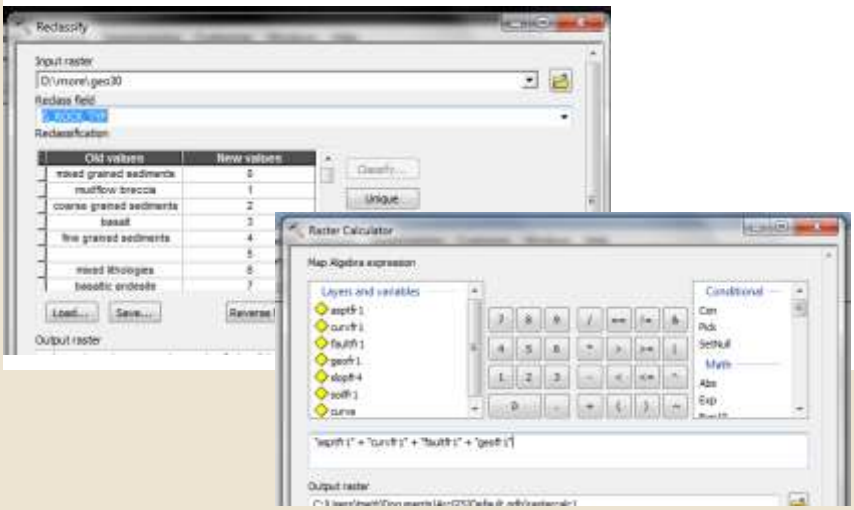
Methods

- Calculate area for each factor by class
- Calculate number of events for each factor by class
- Frequency Ratio (FR)

Factor	Class	area with landslide occurrence	% pixels showing landslide occurrence	# Landslides in domain	Pixel %	Frequency Ratio
Geology (georas1)	mixed grained sediment	36594900	47.52	291	22.73	0.48
	mudflow breccia	2443500	3.17	9	0.70	0.22
	coarse grained sediment	241200	0.31	0	0.00	0.00
	basalt	32213700	41.83	792	61.88	1.48
	fine grained sediment	2464200	3.20	166	12.97	4.05
	mixed rock type	469800	0.61	2	0.16	0.26
	mixed lithologie	1855800	2.41	8	0.63	0.26
	basaltic andesite	249300	0.32	3	0.23	0.72
	conglomerate	68400	0.09	5	0.39	4.40

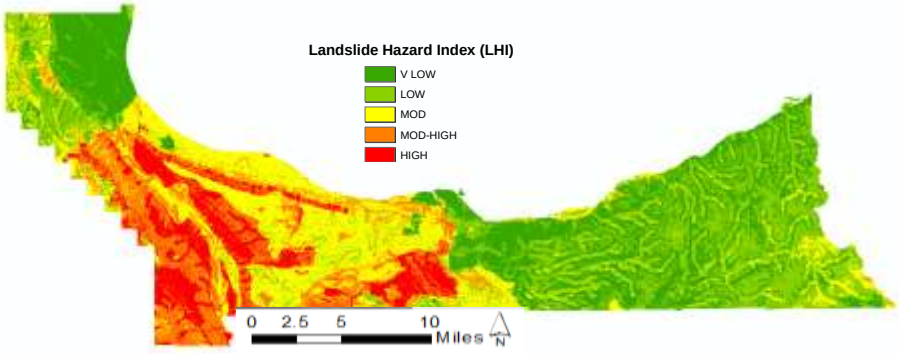
Methods

- Construct a Landslide Hazard Index (LHI) by replacing factor class values with FR values.



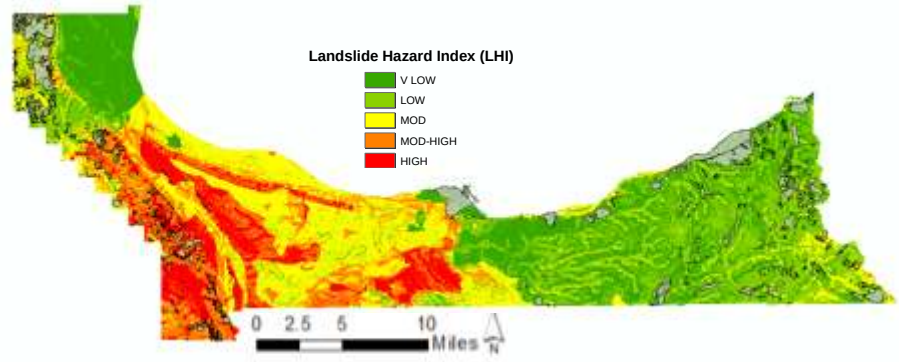
Methods

- **Combine all factors into a single output based on their Landslide Hazard Index (LHI).**



Result

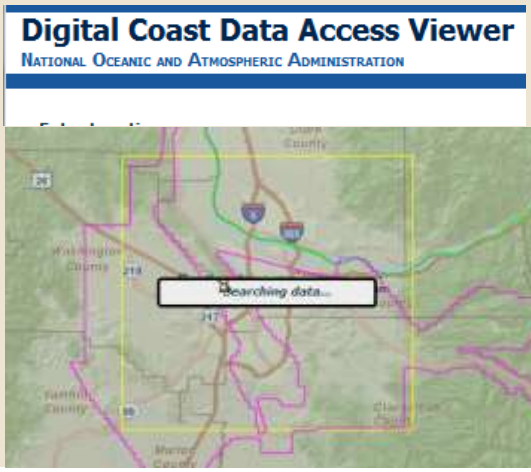
- **Combine all factors into a single output based on their Landslide Hazard Index (LHI).**



59% of landslides occurred in High LHI areas
21% occurred in Mod to Mod-High areas
20% occurred in Low-V Low areas

Improvements

- Replace vegetation layer with IR data → % vegetation cover.



References

- *Lee S. and Pradhan B. Landslide hazard mapping at Selangor, Malaysia using frequency ratio and logistic regression models. Landslides (2007) vol 4, p 33-41*