

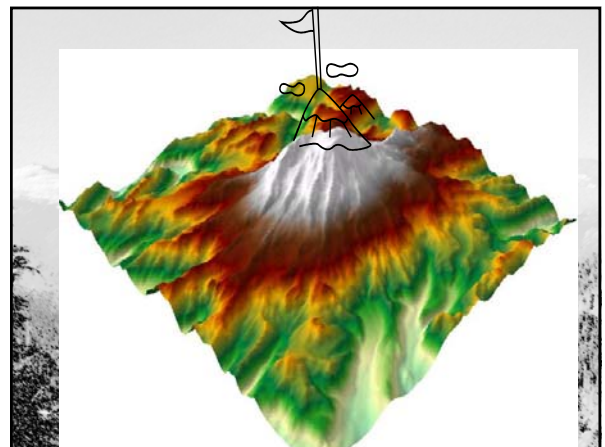
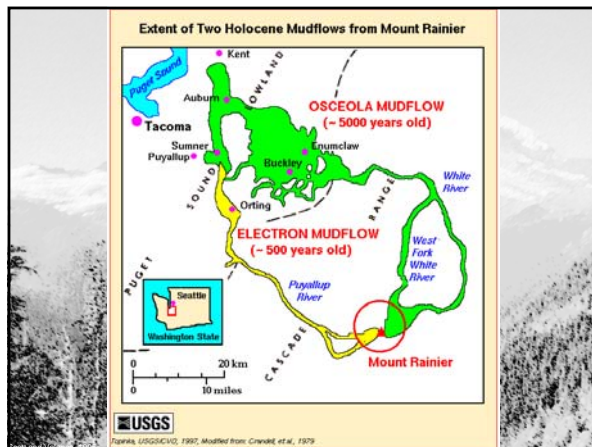
Risk Assessment of Mount Rainier Lahars on Urban Populations

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Portland State University
December 4, 2007

Lahar Definition

- Definition- Indonesian word mudflow composed of water and volcanic ash (80% solid material by weight).¹
- Triggered by the flash melting of the snow cap of a volcanic mountain or from heavy rain.²
- Travels at great speeds.

Mount St. Helens, 1980



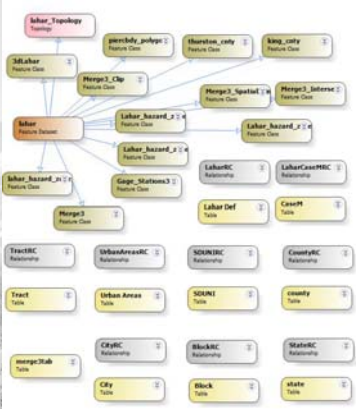
- Shapefile tables are full of redundant data

Attention of King, 1616																						
	ED	TH	DAY	DATE	CITY	CITY MD	TRACEL	TRACET	BLOCK	BLOCKP	BLOCK	PLAC1	PLAC MD	ANALYSIS	TRUST	ADR MD	STATUS	CD	TR	FAZ	FL	
1	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
2	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
3	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
4	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
5	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
6	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
7	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
8	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
9	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
10	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
11	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
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13	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
14	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
15	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
16	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
17	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
18	Ed	Th	Wed	2000-00-00	King		0000000		1	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	00000	
Records (1) 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 Show All Selected Records (3 out of 2475 Selected) Options																						

- Redundant fields in the Shapefiles can be removed and put into attribute tables to give more tables with less data

The screenshot displays three Excel spreadsheets side-by-side, each showing a list of bus routes. The first spreadsheet, titled 'AllBuses of NZBN', has columns for 'LINE' and 'NAME'. The second spreadsheet, partially visible and titled 'All...', has columns for 'CNTY', 'CNTY_NM', and 'NAME'. The third spreadsheet, titled 'AllBuses of City', has columns for 'PLACE' and 'PLACE_ID'. The 'All...' spreadsheet also shows a dropdown menu for 'CNTY' with options '33 King' and '55 Pierce', and a dropdown menu for 'CNTY_NM' with options '67 Thurston' and '84 ...'.

- Consists of
 - Lahar Hazard Zone
 - Gage Stations
 - County Boundaries
 - Lahar Definitions
 - Merged County Census Data
 - Census Tables



Lahar Topology Rules

- Based on counties, census blocks
- Created to ensure census block were correct with the counties

Topology Properties

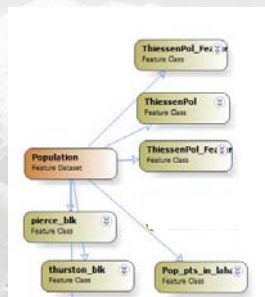
General | Feature Classes | Rules | Errors

Generate Summary | Export To File...

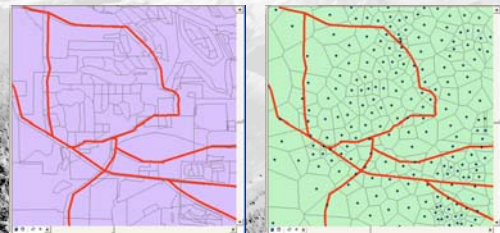
Rule	Errors	Exceptions
Must Be Larger Than Cluster Tolerance	0	0
Must Be Covered By		
thurston_only, Merge3	0	0
pierdohy_polygon, Merge3	0	0
king_only, Merge3	0	0
Must Not Overlap With		
pierdohy_polygon, thurston_only	0	0
pierdohy_polygon, king_only	0	0
Total	0	0

OK Cancel Apply

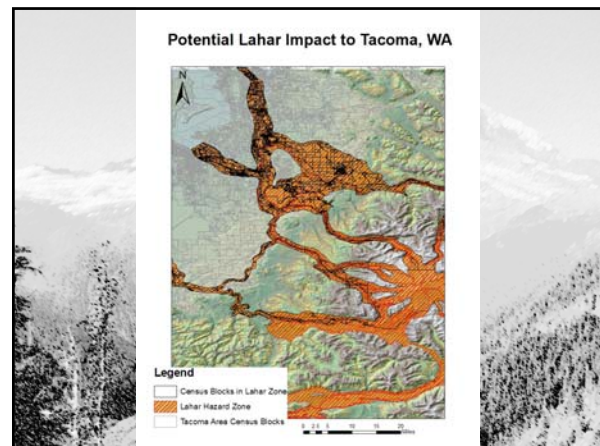
- Consists of
 - Census data for King, Pierce, and Thurston counties
 - Thiessen Polygons



- Created Thiessen Polygons from block centroids
- Found Centroids of the Thiessen Polygons

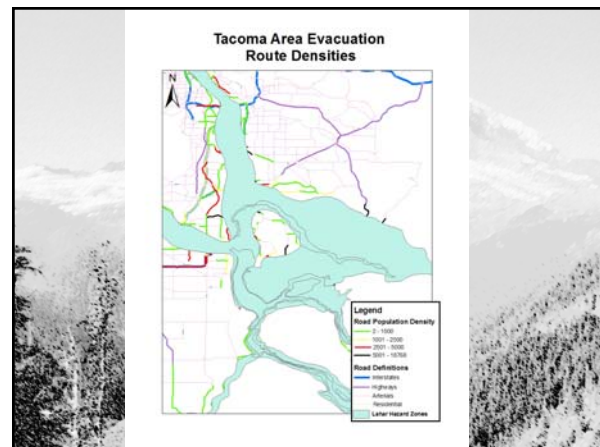


Data Query



2. Roads

- Data Consists of:
 - Washington roads
 - Roads definition table
 - Tables based on feature id
 - pop_30c
 - pop_30f
 - pop_30h
 - pop_30i
 - pop_30j
 - pop_30k
 - pop_30l
 - pop_30m
 - pop_30n
 - pop_30o
 - pop_30p
 - pop_30q
 - pop_30r
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 - pop_30v
 - pop_30w
 - pop_30x
 - pop_30y
 - pop_30z

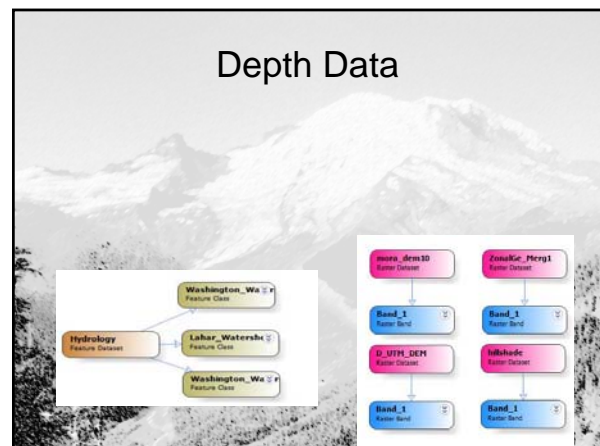


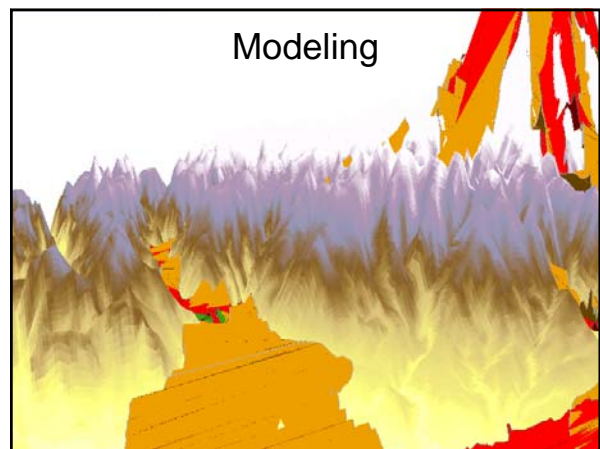
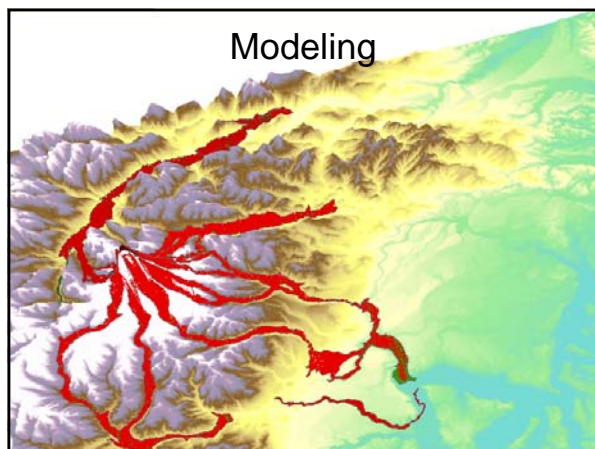
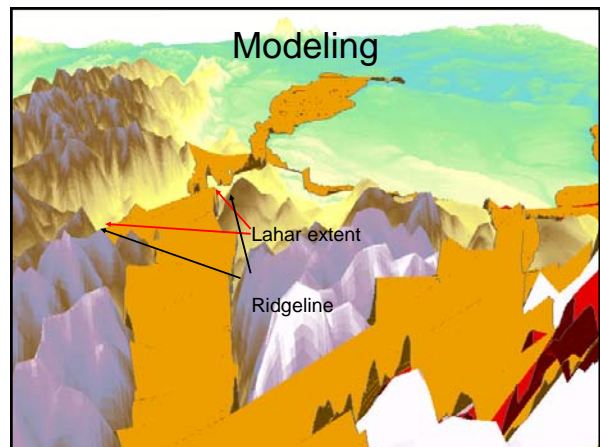
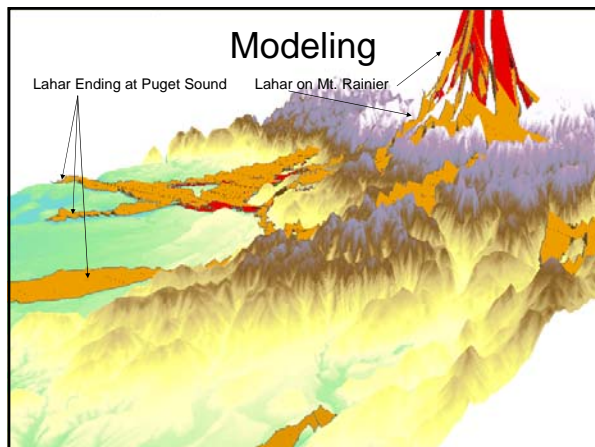
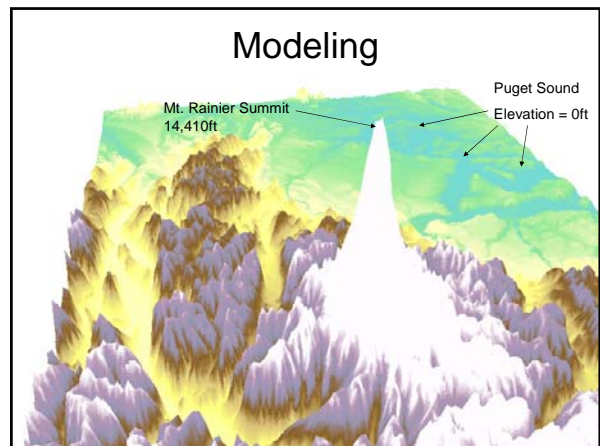
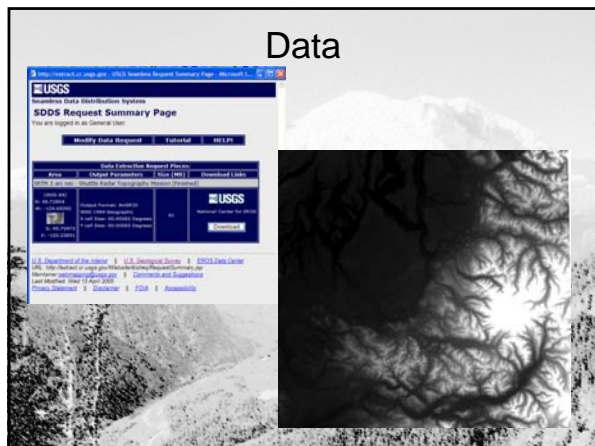
3. Lahar Depth Calculations

Lahar Volume

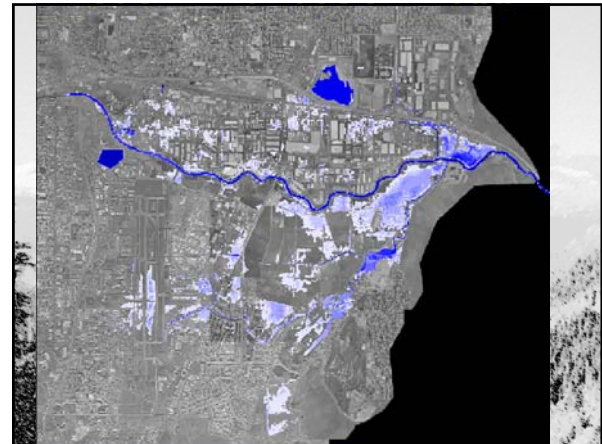
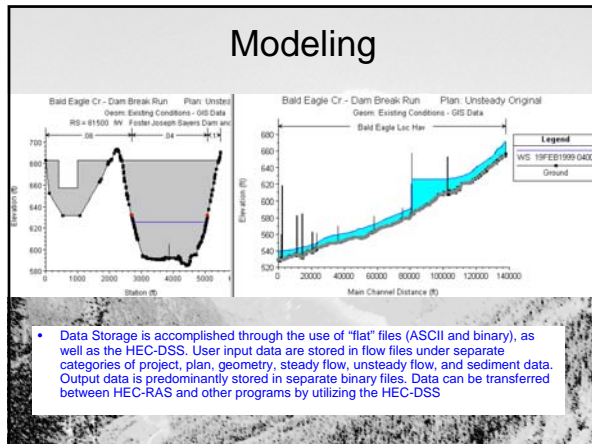
Feature Name	Water Volume km ³	*Solids volume km ³	Total volume Km ³
Emmons & Winthrop	1.28**	3.41	4.69
All Mount Rainier Glaciers	4.21**	11.22	15.43
-Crater Lake (for comparison)	17.46		

* Approximately 80% of a lahar volume is estimated to be solids.

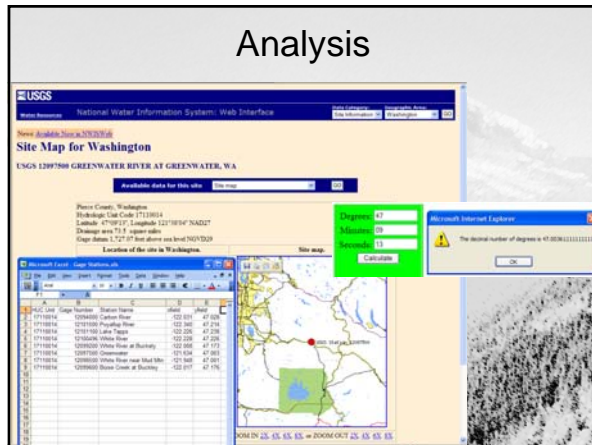




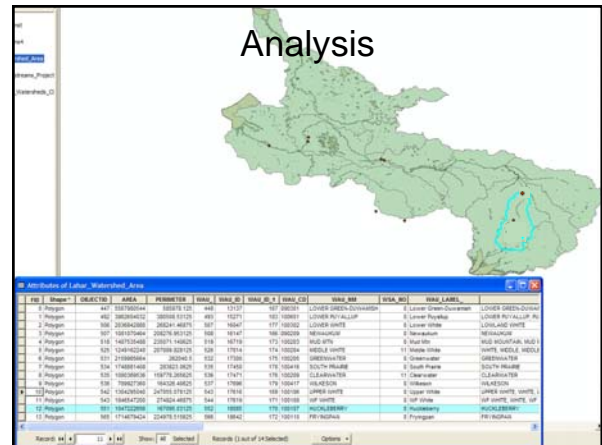
Modeling



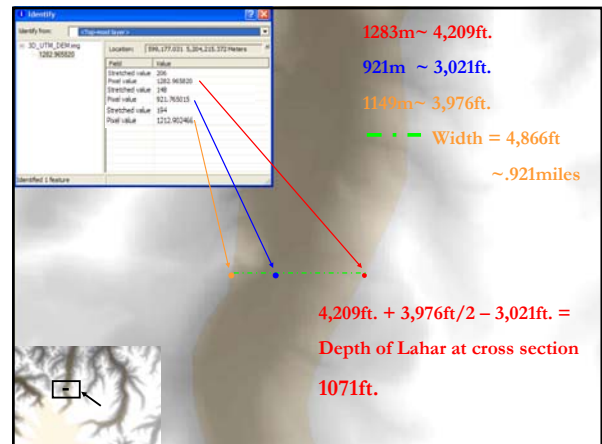
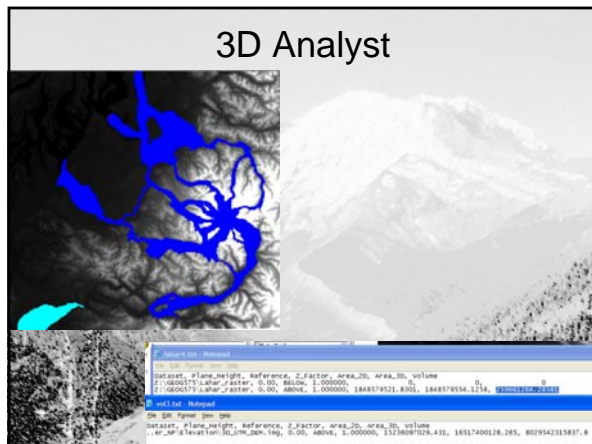
Analysis

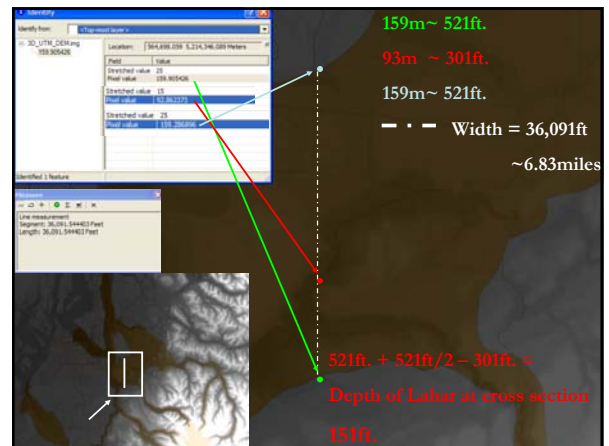
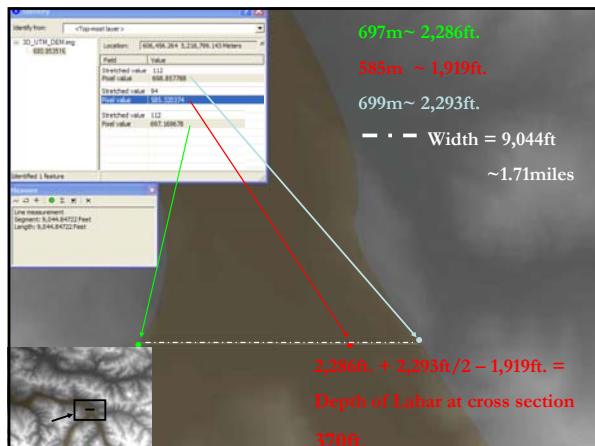


Analysis



3D Analyst





Answers

1. Population affect > 215,000
2. Road evacuation densities up to 18,000 on secondary roads

Conclusions

- Database diagramming-
 - necessary for construction and modification
- PGDB- useful for projection consistency (limited user access)
 - Relationship classes – special attention to tables
 - SQL queries
 - Topology- data integrity

Limitations and Future Work

- Limitations
 - Census
 - Lack of evacuation routes
- Future work
 - Future population growth
 - Dasymetric mapping with land use
 - File geodatabase and new database software
 - Flood software and lahar raster DEM

References

- Arctur, D., Zeiler, M. 2004. *Designing Geodatabases case studies in GIS Data Modeling* p. 76-79
- Crandell, D.R. 1969. Surficial Geology of Mount Rainier National Park Washington, *Geological Survey Bulletin 1288* p. 22-26.
- Geography Network Services Hosted by ESRI
- HEC-RAS, US Army Core of Engineers <http://www.hec.usace.army.mil/software/hecras/>
- Hoblitt, R.P., Walder, J.S., Driedger, C.L., Scott, K.M., Pringle, P.T., and J.W. Vallance, 1995. Volcano Hazards from Mount Rainier, Washington: U.S. Geological Survey Open-File Report 95-273.
- Marabaux, P., Nicholls, R. J., 2007. Breakout Lahar from New Zealand's Crater Lake, *EOS*, Vol. 88, 243: 442- 443.
- Nylen, T. 2004. Spatial and Temporal Variations of Glaciers on Mount Rainier between 1913 and 1994, Master's Thesis, Portland State University.
- Scott, W. and J.W. Vallance, 1995. Debris Flow, Debris Avalanche, and Flood Hazards At and Downstream from Mount Rainier, Washington: Hydrologic Investigations Atlas HA-729.
- US Geological Survey Stream Gages
<http://waterdata.usgs.gov/wa/nwis/current/?type=flow>
- Washington Office of Financial Management <http://www.ofm.wa.gov/geographic/00tiger.asp>

Questions

- http://www.youtube.com/watch?v=N_cyG2dJPpc

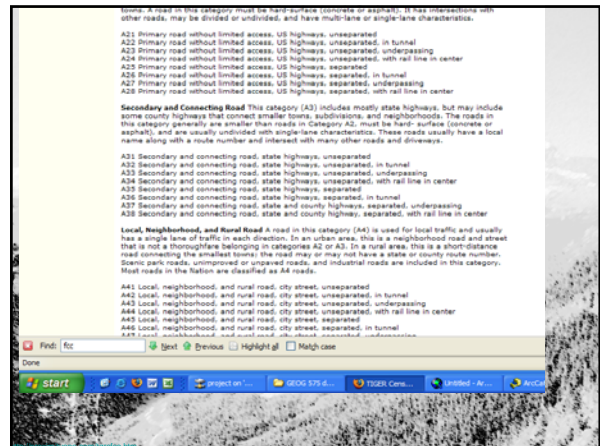
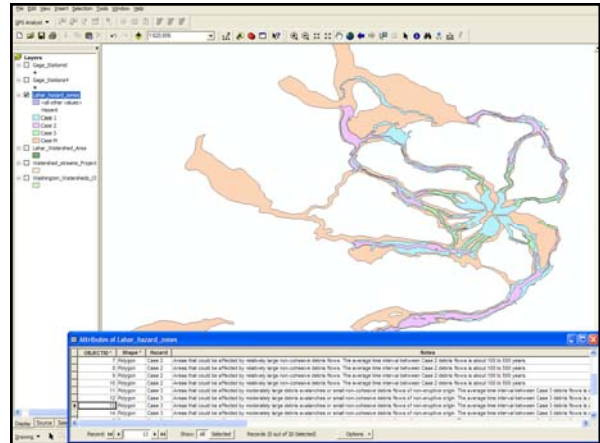
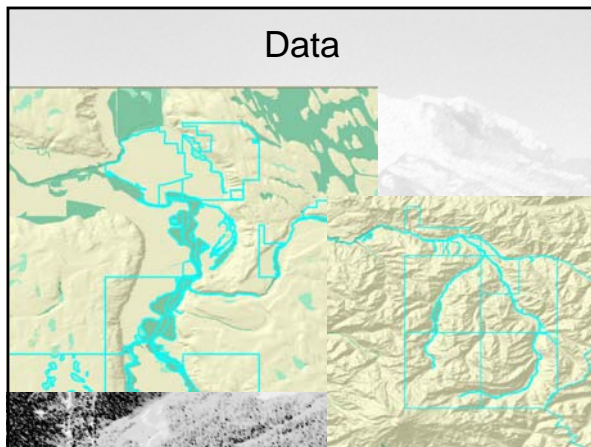


Table 13: Measured (bolded) and estimated volume of all Mt. Rainier glaciers.

	1913		1971		Dunlap and Kennel, 1984		1994	
	Thesis	Error	Thesis	Error	Km ²		Thesis	Error
Carlson-Russell	0.86	0.10	0.76	0.05	0.80	0.74	0.05	
Columbia Crest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Cowlitz Ingletham	0.57	0.12	0.40	0.04	0.37	0.41	0.05	
Edwards	0.05	0.02	0.04	0.01	0.03	0.04	0.01	
Emmons	0.81	0.15	0.64	0.07	0.67	0.60	0.07	
Flem	0.02	0.01	0.01	0.00	0.01	0.01	0.00	
Frying Pan	0.30	0.07	0.19	0.02	0.08	0.18	0.02	
Inter	0.03	0.01	0.02	0.00	0.02	0.02	0.00	
Kautz	0.08	0.03	0.07	0.01	0.04	0.05	0.01	
Liberty Cap	0.08	0.03	0.07	0.01	0.00	0.07	0.01	
Mar Snowfield	0.03	0.01	0.02	0.01	0.02	0.02	0.01	
Nisqually-Wilson	0.25	0.08	0.26	0.04	0.27	0.26	0.04	
North Mowich	0.43	0.10	0.31	0.04	0.27	0.31	0.04	
Olumapocosh	0.11	0.04	0.04	0.01	0.04	0.04	0.01	
Paradise	0.12	0.04	0.03	0.01	0.02	0.03	0.01	
Peyakap	0.24	0.06	0.18	0.02	0.29	0.19	0.02	
Pymad	0.04	0.02	0.01	0.00	0.01	0.01	0.00	
Sacred	0.03	0.01	0.02	0.00	0.01	0.02	0.00	
South Mowich	0.21	0.06	0.17	0.02	0.13	0.17	0.02	
South Tahoma	0.14	0.04	0.11	0.02	0.13	0.08	0.01	
Succors	0.01	0.01	0.02	0.00	0.01	0.01	0.00	
Tahoma	0.49	0.11	0.40	0.05	0.46	0.38	0.04	
Van Trump	0.04	0.02	0.02	0.00	0.01	0.02	0.00	
Whitman	0.08	0.03	0.08	0.01	0.12	0.08	0.01	
Widened	0.01	0.01	0.00	0.00	0.00	0.00	0.00	
Wierberg	0.58	0.12	0.48	0.05	0.52	0.40	0.06	
Total	5.62	1.38	4.35	0.51	4.34	4.21	0.51	



Data



Data

