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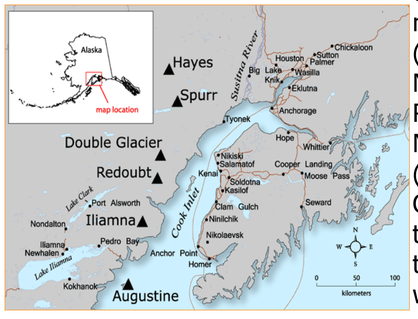
A Volcanic and Seismic Risk Assessment of the Populous Cook Inlet, Alaska

Introduction

After the eruption of Mount Redoubt in Southwestern Alaska in 2009, and again exemplified by the impact of Iceland's Eyjafjallajokull the next year, volcanic ash has been a major concern for airline travelers. In order to fully realize the scale of devastation an eruption can pose, it is necessary to look not only at the media's focus—temporary hiatus on transportation by ash—but also the direct interaction between ash fallout, lava flows, pyroclastic density currents (PDCs), lahars (some of most dangerous natural occurrences attributed to volcanoes), tsunamis and earthquakes associated with a geologically active area.

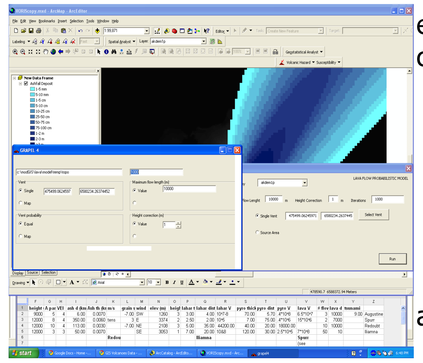
The southern coast of Alaska lies along the edge of the overriding plate involved in a tectonic subduction zone. The consequence of this location is that the subducting slab melts at a certain depth as it sinks, and the resulting magma rises to the surface, extruding suddenly and violently at the surface. For Alaska, this process has created much of its land area, such as the Aleutian Islands. However, for those who brave the dangers, there are many necessary precautions, recommended by the Alaska Volcano Observatory (AVO), United States Geological Survey (USGS) and University of Alaska.

This project is an attempt to compile data and use the Observatorio Geofisico Central (IGN) VORIS volcano modeling tool for several volcanoes closest to the most populated part of Alaska (Anchorage) in Cook Inlet: Mount Saint Augustine, Mount Redoubt, Mount Iliamna, and Mounts Spurr and Crater Peak (one volcano with two vents). One map is generated showing the areas where another eruption at any of the 4 volcanoes would be most devastated.



Methods

The first step to this final hazard map was to find and obtain the data necessary. As a basemap, 2-minute Digital Elevation Models (DEMs) were downloaded from the USGS. The location of the 4 peaks of interest. To locate areas of highest societal impact, several shapefiles denoted areas of high population, airports, major transportation (roads, waterways, highways, railroads), urban built-up locations, habitat preserves, and sources of energy (electrical lines) and economical prophet for the cities and towns (coal deposits, oil and gas reserves, pipelines), and flight paths.



. Seismic hazard data (both earthquakes by magnitude, and hazard polygons by peak ground acceleration) were retrieved. Volcanic hazards were modeled using the ArcMap plugin developed by IGN in Madrid, Spain, called VORIS (Volcanic Risk Information System). Inputs for the various VORIS modules included:

biggest eruptions (including grain size, height of plume, distance of flows, etc)

basic geology and geometry,

wind azimuth

By using the DEMs for elevation, and inputting data obtained into the VORIS program, three rasters (ash, lava, and PDC) were created for each volcano.

All rasters were prepared for weighted overlay analysis by merging with a base boundary and reclassifying based on relative severity and likelihood of the event. Two overlays were produced for both the geologic hazards and the most populous areas. The weights were estimated based on how deadly the specific hazard can be, and how populous areas were involved. Those two maps together created a final map.

Name	Last Erupted	V (km3)	Ht (m)	"A"	VEI	Grain size(phi)	Height corr.	Pyro thick.	Pyro dist.	Pyro V	Lava V	Lava dist.	# lava paths
Augustine	2006	.17	9000	5	4	-7	3	70	5.7	.4*10^8	6.5*10^7	10000	1000
Redoubt	2009	.49	16000	10	4	-7	3	40	20	18000		10000	1000
Iliamna	1953	.05	13000	3	3	-2	1	120	30	2.5*10^5	7*10^8	1000	5000
Spurr	1992	.41	15000	8	4	3	2	7	75	.4*10^6	15*10^6	7000	2000

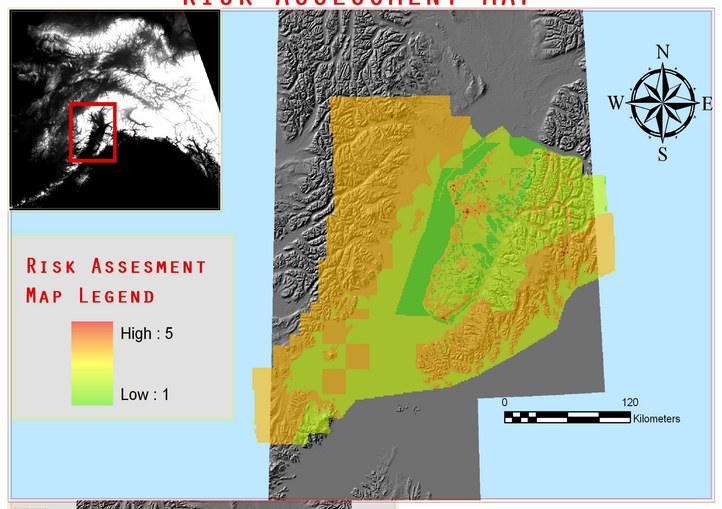
Winds	Augustine					Redoubt						Spurr				Iliamna			
Altitude (km)	1	3	5	7	9	1.35	3	5.5	0.9	1.2	2	4	6.5	10	12	3	6	9	12
Wind Direction	231	211.5	221	224	229.5	260	315	225	255	275	275	305	325	280	275	120	120	110	120
Wind Speed (m/s)	6	14.4	26	30	26	10	7	13.9	19.4	13.9	6.3	8	12.5	7.6	6.3	6.3	12.5	7.6	6.3

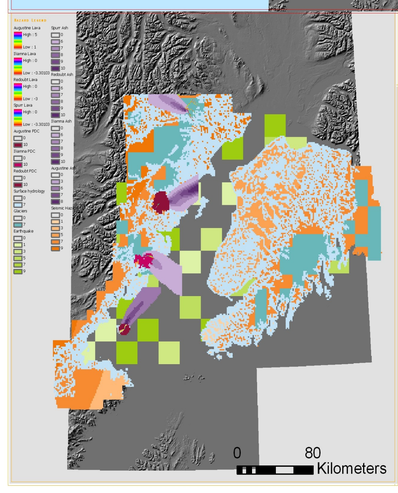
Conclusion

The final map produced has a few flaws. Although many vagaries in the VORIS program were overcome, a PDC could not be calculated for Mount Spurr and the sparse population in Alaska created an almost rudimentary map.

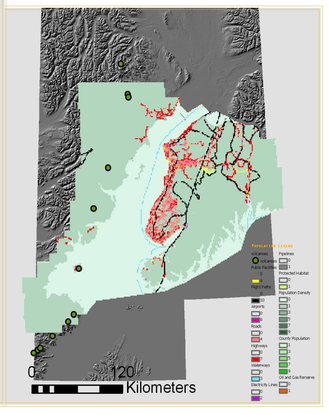
Nonetheless, a hazard map was generated, depicting a relatively low risk of geological impact in populated areas in Cook Inlet, Alaska. Still, perhaps this type of educational map could prevent damage to Alaskans and world travelers, such that few lives will be directly impeded during inevitable future events like Redoubt's ash wall.

RISK ASSESSMENT MAP





FINAL MAPS



Hazard Layers

Population Layers

Acknowledgements

Huge thank you to Jake Benner for his patience and help through the many VORIS complications!

And to VORIS: http://www.gvb-csic.es/GVB/VORIS/VORIS.htm

DEMs from: USGS Seamless Data Warehouse http://seamless.usgs.gov/

Volcano data from: AVO's Volcano Information http://avo.alaska.edu/volcanoes/cook_inlet.php

Earthquake data from: National Atlas and Alaska Earthquake Information Center http://www.nationalatlas.gov/atlasftp.html?openChapters=chpbound%2Cchpgeol#chpgeol