



Assessing Coastal Implications due to Sea Level Rise

Colin Ferguson
Leah Golden-Sea
Jessica Leonard



Research Question

- How will the Oregon coast be effected by the impending sea level rise due to global warming?

Tillamook, OR

Reasons for Rise in Sea Level

- Increase in concentration of Global Greenhouse Gas
- Glacier melt
- The temperature of the water is increasing
 - Water expands when heated

The Greenhouse Effect?

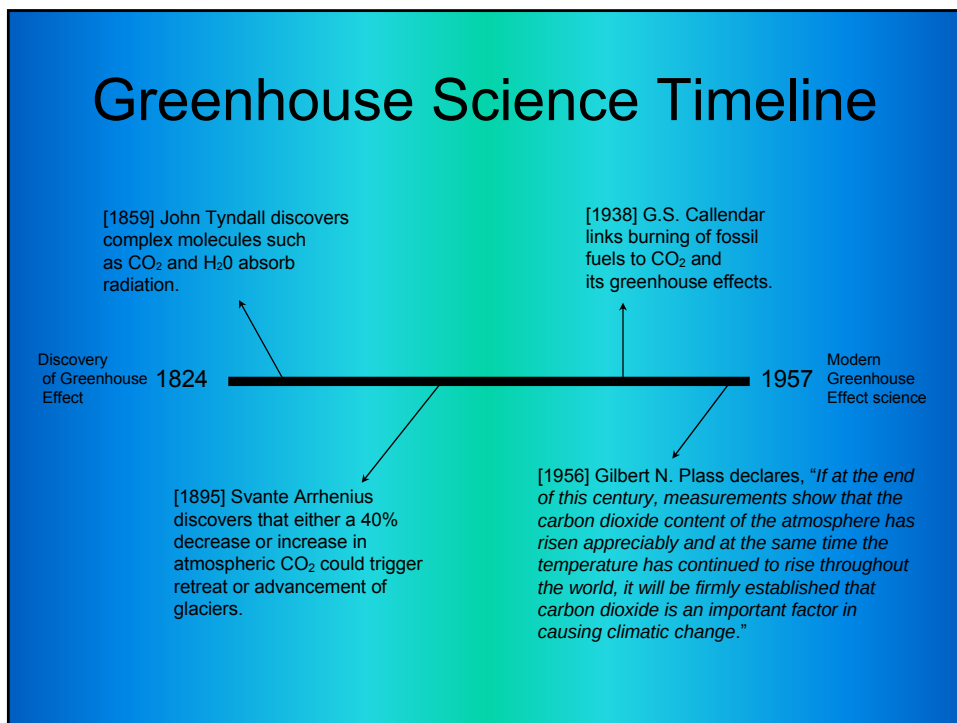
- The Earth: complex interactive system that includes the atmosphere, land, water bodies, snow and ice, and living things.
- Solar radiation powers the climate system.
- How temperature changes:
 - Change in Earth's orbit
 - Increase in the fraction of solar radiation
 - Altering the path non-luminous radiation, e.g. absorption by greenhouse gases.
- Concerns: Change in weather patterns, temperature, and sea level rise.

Greenhouse Effect History

“... the temperature [of the Earth] can be augmented by the interposition of the atmosphere, because heat in the state of light finds less resistance in penetrating the air, than in repassing into the air when converted into non-luminous heat.

(Joseph Fourier, 1824)

Greenhouse Science Timeline



IPCC Predictions

- Since the last Glacial Maximum about 20,000 years ago, sea level has risen by over 120 m.
- Western Antarctic Ice Sheet (WAIS) has enough impact to add 6 m (19.5 ft) to the sea level, but IPCC does not expect significant melting by 2100.
- The Greenland Ice Sheet will contribute a 3 meter sea level rise in 1000 years.
- IPCC Predicted sea-level rise by 2100:
 - Conservative: 0.11 m (.36 ft) to 0.77 m (2.5 ft)
 - SRES projection: 0.09 m (.29 ft) to 0.88 m (2.87 ft)

EPA Predictions

- Humanity is reversing millions of years of natural evolution putting back into the atmosphere carbon that had sequestered as fossil fuels.
- CO₂ concentrations could double, possibly triple by 2100.
- 1.5C – 4.5C (2.7F - 8.1F) increase in temperature caused by CO₂, water vapor, and other pollutants absorbing infrared radiation.
- Scenarios by 2100:
 - Conservative: 1.8 ft
 - Mid-range low: 4.7 ft
 - Mid-range high: 7.1 ft
 - High: 11.3 ft

USNCAR Predictions

- US National Centre for Atmospheric Research in Boulder, Colorado
 - › 3C – 5C (5.4F – 9F) by year 2100.
 - › Most studies assume Antarctic Ice Sheets will remain stable at these temperatures.
 - › Equal to temperatures 129,000 and 116,000 years ago.
 - › Sea Levels were 20 ft higher than present day.
- USNCAR Prediction for 2100
 - 6 m (20 ft)

USGS Doomsday Scenario

- Sea Level has been rising an average of 1 – 2 millimeters per year in the last 100 years.
- At the current rate, all glaciers at Glacier National Park, Montana by 2050.
- 40% reduction of Iceland's glaciers by 2100 and 100% by 2200.
- Complete melting of Greenland, East and West Antarctic ice sheets could increase sea levels by 80m (262 ft)!

– <http://pubs.usgs.gov/fs/fs2-00/>

Study Area

- Clatsop and Tillamook counties in Oregon



Methodology

- Created 3 scenarios
 - 3, 11.3, 20 foot rise in sea level
 - Also a doomsday scenario of 262 feet if all of the world's glaciers were to melt
- HAZUS-MH was used for layer files
 - Hospitals, schools, bridges, ports, demographics, agriculture
- Assessed output in maps, incorporating local knowledge and Google maps for place names

Flood Modeling

- Used raster calculator Con statement to find areas of certain elevation within the DEM that are potential flood zones
- Added layer files to see what buildings and utilities would be at risk

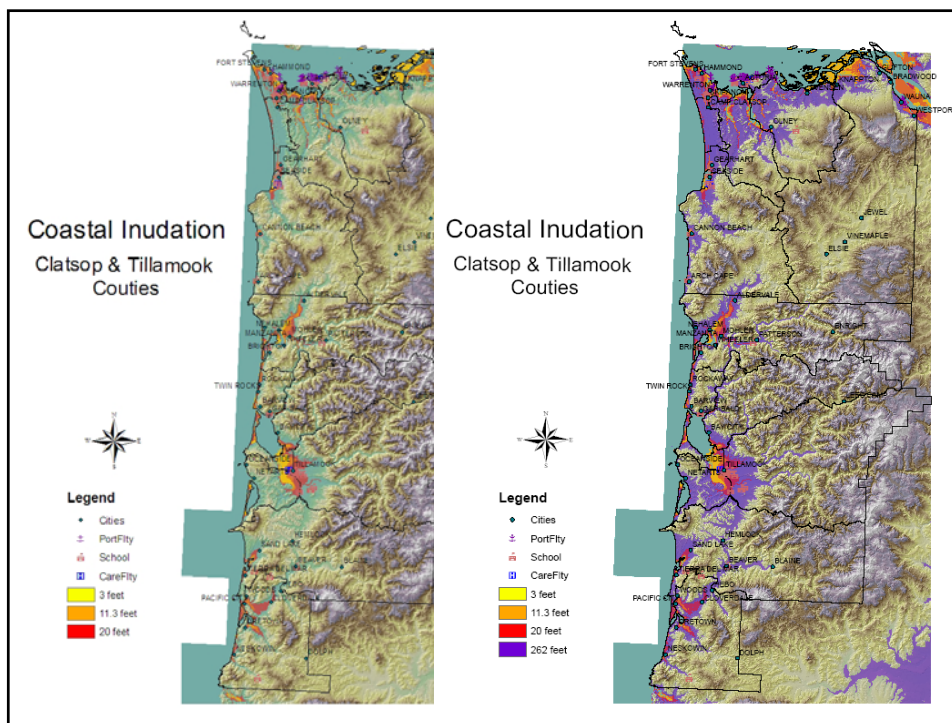
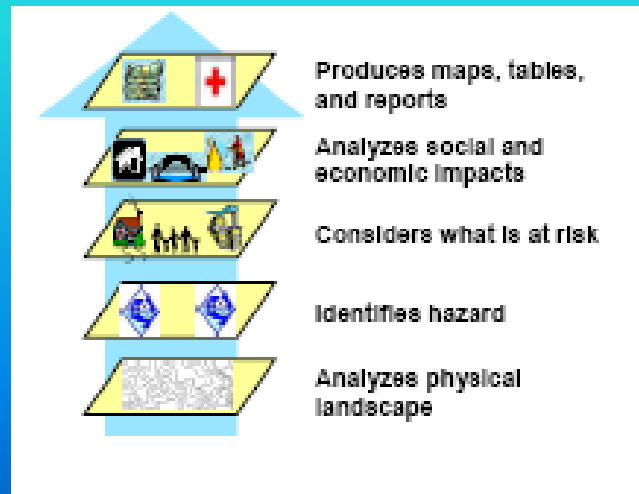
Highway 101 North

What is HAZUS-MH?

- GIS-based tool used on personal computer
- Created by the Federal Emergency Management Agency (FEMA)
- Distributed free of charge upon request
- Helps communities prevent losses to life and property by better understanding the risks from natural hazards



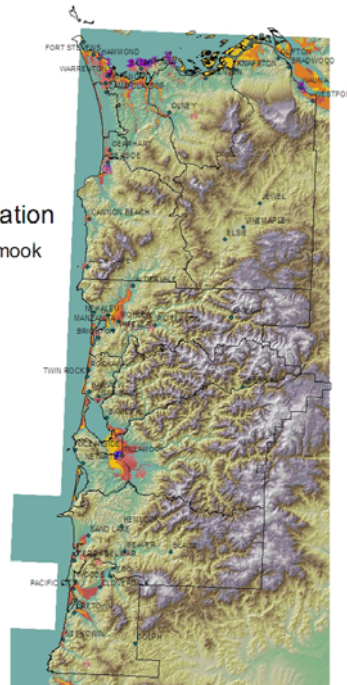
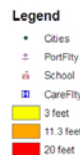
How HAZUS-MH Estimates Losses



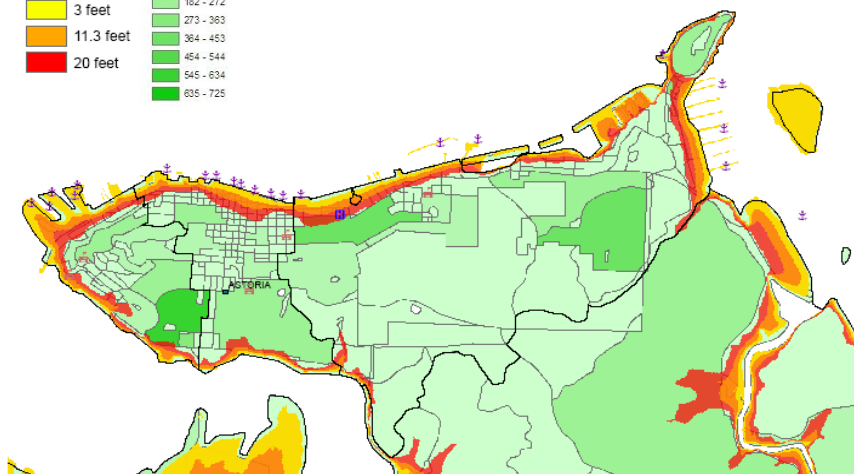
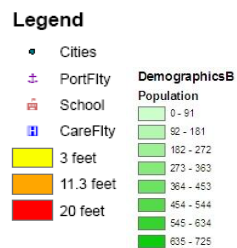
Results

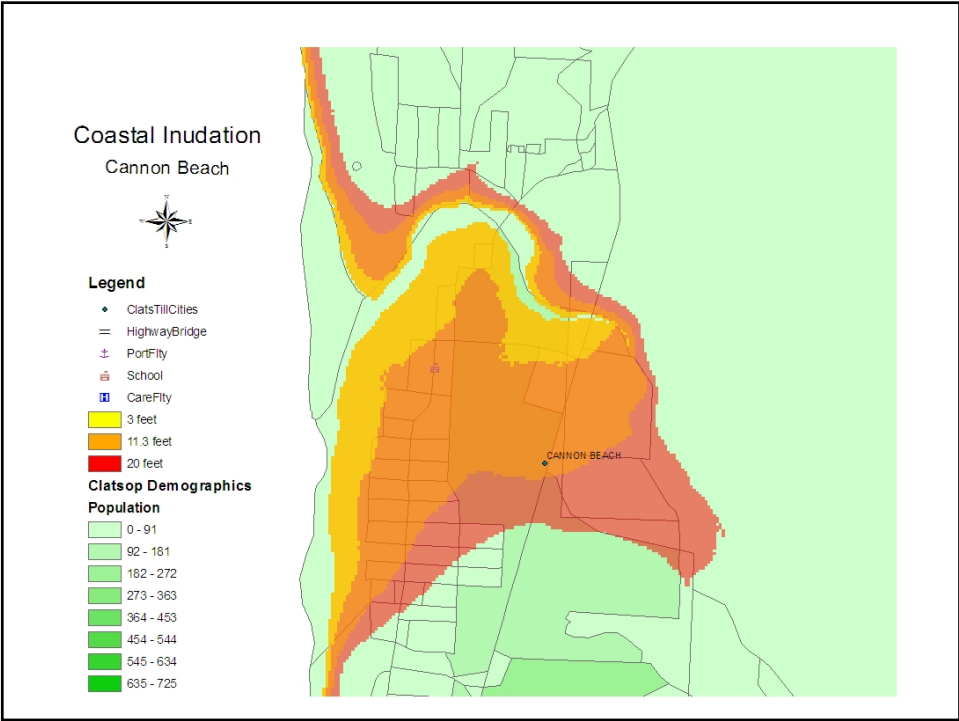
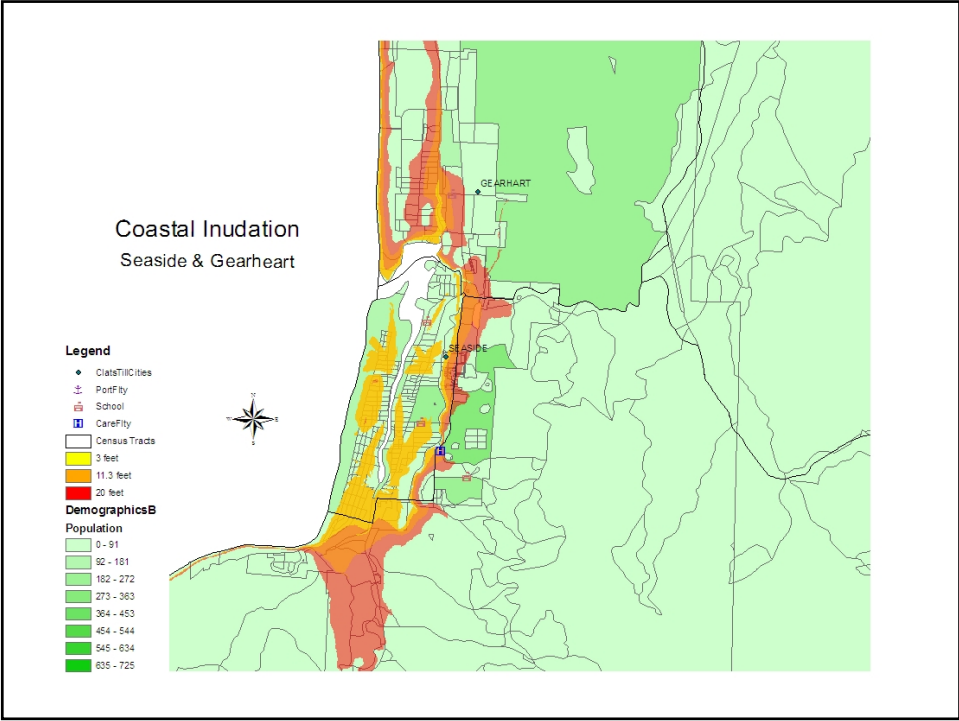
- Best case scenario
- Soil and river analysis would dramatically alter our results

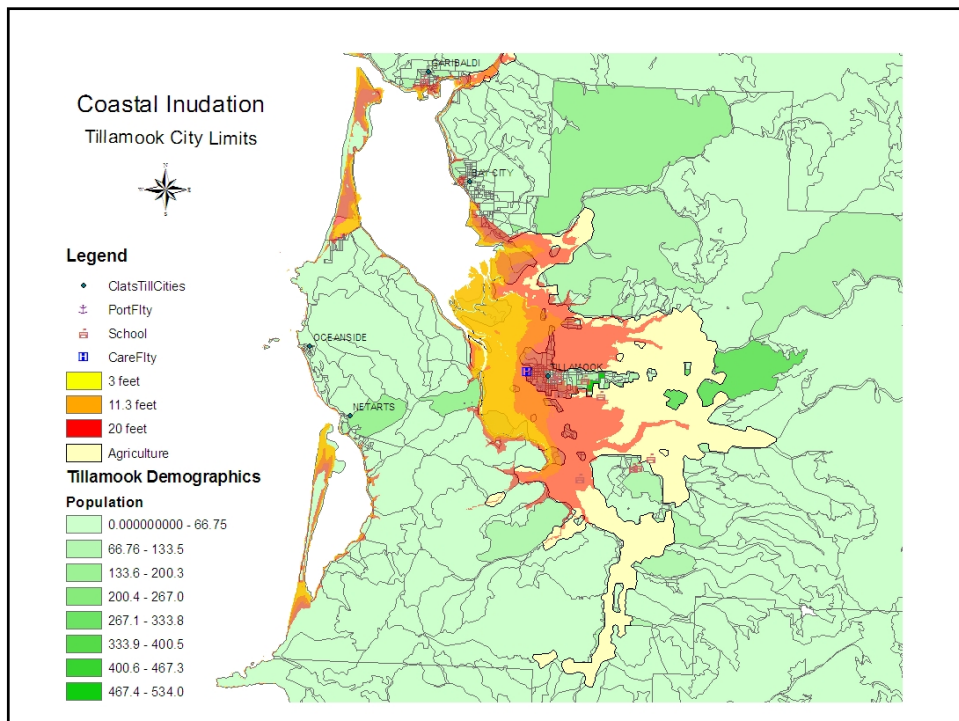
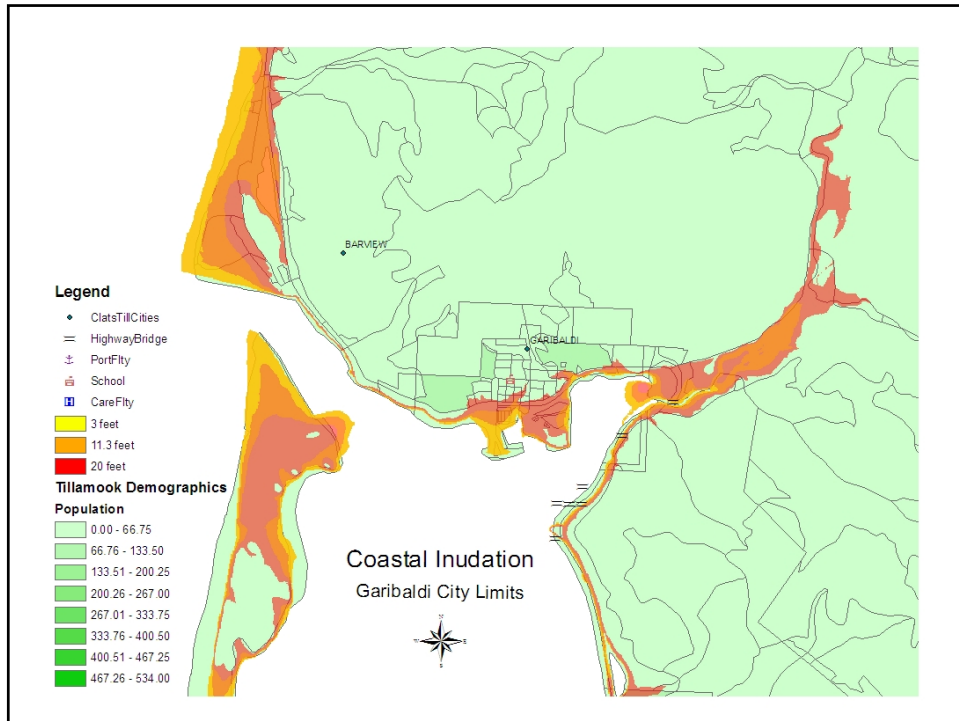
Coastal Inudation
Clatsop & Tillamook
Couties

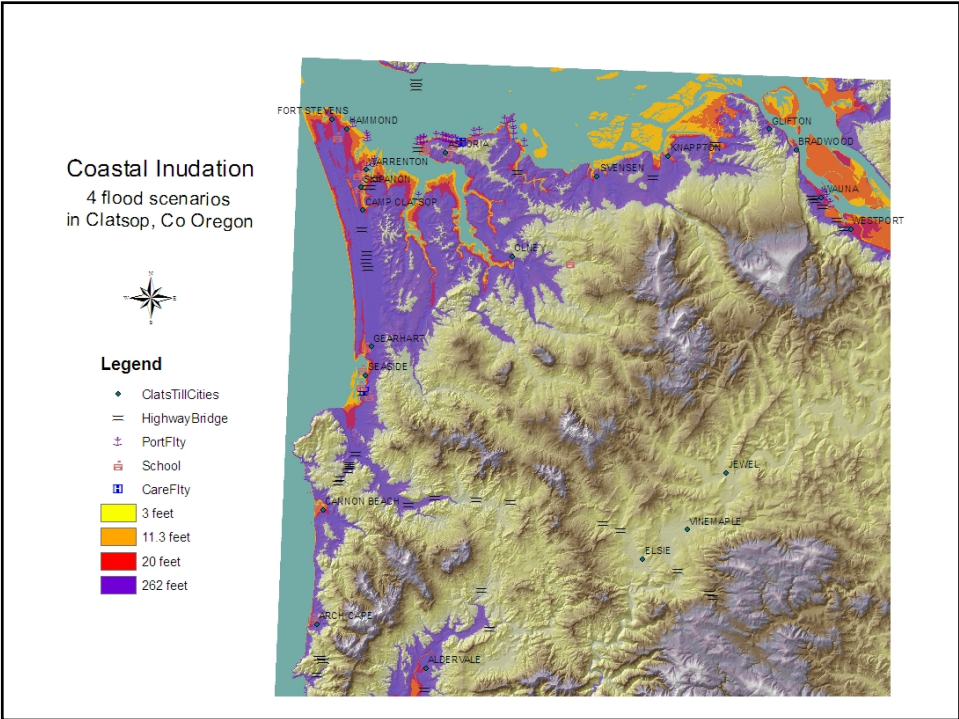
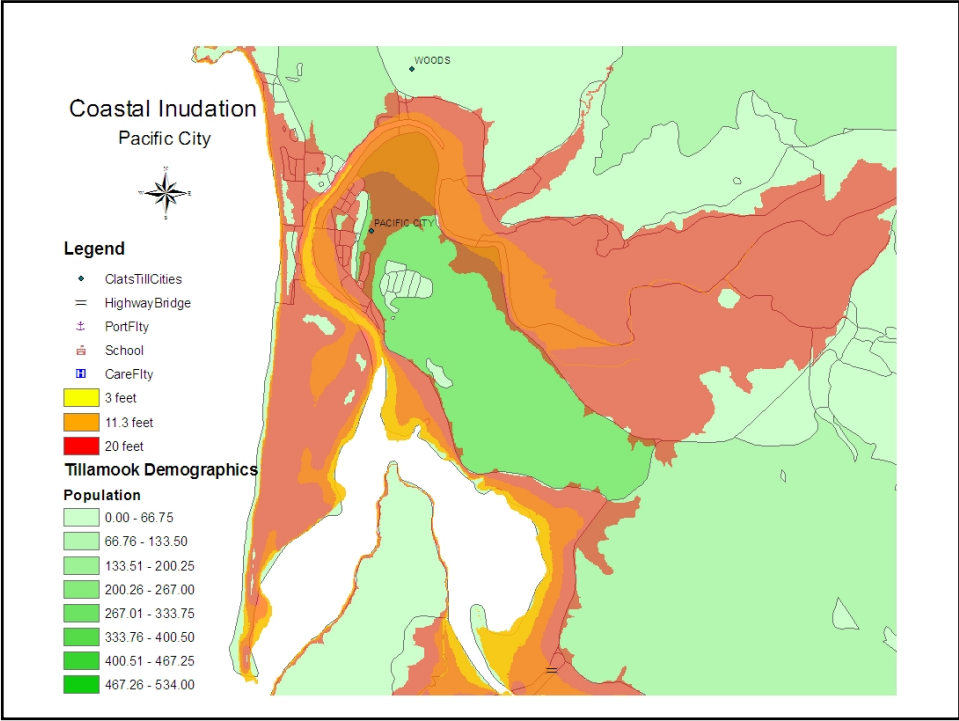


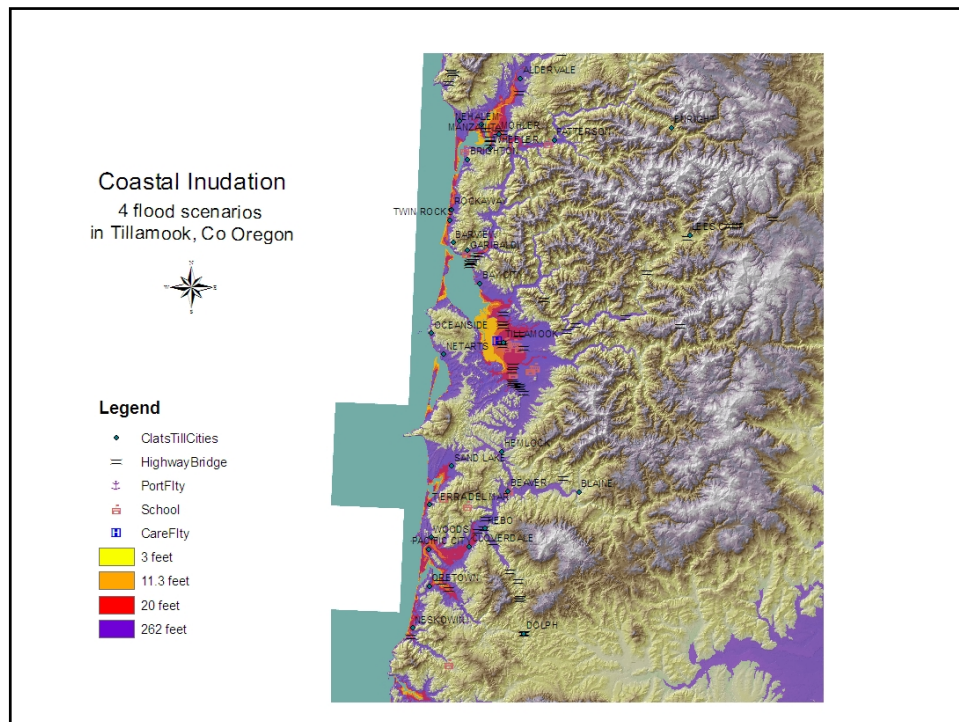
Coastal Inudation
Astoria City Limits











Conclusions

- Significant cost of rebuilding schools, hospitals, personal property
- Local economy will suffer
- Population displacement
- Loss of habitat and other ecological concerns

Limitations

- HAZUS software difficult for first time users
- Soils and rivers would have a large impact on coastal flooding, but were not analyzed due complexity and availability of the data
- Bathymetric data would also be useful in showing impact

Sources

- Le Treut, H., R. Somerville, U. Cubasch, Y. Ding, C. Mauritzen, A. Mokssit, T. Peterson and M. Prather, 2007: Historical Overview of Climate Change. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_Ch01.pdf.
- Bindoff, N.L., J. Willebrand, V. Artale, A. Cazenave, J. Gregory, S. Gulev, K. Hanawa, C. Le Quéré, S. Levitus, Y. Nojiri, C.K. Shum, L.D. Talley and A. Unnikrishnan (2007): Observations: Oceanic Climate Change and Sea Level. In: *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Print_Ch05.pdf.
- D.L. Albritton, L.G. Meira Filho, U. Cubasch, X. Dai, Y. Ding, D.J. Griggs, B. Hewitson, J.T. Houghton, I. Isaksen, T. Karl, M. McFarland, V.P. Meleshko, J.F.B. Mitchell, M. Noguer, B.S. Nyenzi, M. Oppenheimer, J.E. Penner, S. Pollonais, T. Stocker, K.E. Trenberth (2001): Changes in Sea Level. In: *Climate Change 2001: Working Group I: The Scientific Basis. Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. http://www.grida.no/climate/ipcc_tar/wg1/409.htm.
- Titus, Jame G. and Michael C. Barth (1984). An Overview of the Causes and Effects of Sea Level Rise. In: *Greenhouse Effect and Sea Level Rise: A Challenge for this Generation*. New York, NY: Van Nostrand Reinhold Company Inc. <http://yosemite.epa.gov/oar/globalwarming.nsf/content/ResourceCenterPublicationsSLRChallenge.html>.
- Henderson, Mark (2006, March 24). London 'under water by 2100' as Antarctica crumbles into the sea. London Times. <http://www.timesonline.co.uk/tol/news/uk/article694819.ece>.

