

LIDAR AND BATHYMETRIC REMOTE SENSING APPLICATIONS IN MAPPING COASTAL EROSION **YAQUINA HEAD, OREGON**

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Geography 493/593 – Digital Terrain Analysis



Photo: Friends of Yaquina Head Lighthouse, (2012)

* KEY QUESTION *

CAN **LIDAR** AND OTHER REMOTE SENSING
TECHNIQUES BE USED TO EFFECTIVELY MODEL
AND LOCATE COASTAL AREAS AT-RISK OF A
DOWNSLOPE EVENT?



Photo: Faith Cathcart/The Oregonian, (2012)

* RESEARCH OBJECTIVES *

1. WHICH AREAS ARE MOST SUSCEPTIBLE TO EROSION FACTORS SUCH AS **TIDES, WAVES, GRAVITY AND SOIL LOSS?**
2. BASED ON THE WEIGHT OF RISK FACTORS, CAN **THE POTENTIAL FOR A DOWNSLOPE EVENT BE MODELED?** (STATISTICS!)
3. WHAT OTHER FACTORS COME INTO PLAY?

* ASSUMPTIONS*

1. MACRO FACTORS > LOCALIZED FACTORS.

WAVES, TIDES, AND WIND ARE KEY PLAYERS.

TIER 1 – WAVE ACTION
TIER 2 – GRAVITY (SLOPE/CUT)
TIER 3 – SOIL COMPOSITION
TIER 4 – TIDE ACTION
TIER 5 – WIND ACTION

Hilary F. Stockdon, Asbury H. Sallenger Jr., Jeffrey H. List and Rob A. Holman - "Estimation of Shoreline Position and Change Using Airborne Topographic Lidar Data" Journal of Coastal Research, Vol. 18, No. 3 (Summer, 2002), pp. 502-513

2. VEGETATION IS **NEGLIGIBLE.** ☹️☹️☹️

* BACKGROUND INFO *

1. YAQUINA HEAD

* 2.15 MILE STUDY AREA.

* PAC-NW CLIMATE; (CSB) DRY SUMMER SUBTROPICAL

* PEAK PRECIP: DEC – JAN, 12"/MONTH

* TIDAL RANGE: 8.2 – 2.55

* WINTER SEASONAL STORM PATTERN

* AVG. PEAK SWELL HEIGHT 10.0'+

* MOD. WEAK COASTAL SOILS (S-L/SAND)

Newport, OR Weather Underground, Weather Underground, Inc. (2013)
USGS, WSS, Oregon Soils, Newport, OR (2010)

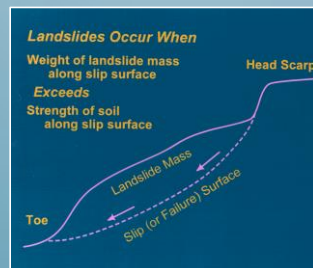
* BACKGROUND INFO *

1. YAQUINA HEAD

* CASCADIA SUBDUCTION ZONE!

* EARTHQUAKE/TSUNAMI(?)

* FREQUENT STORMSWELLS, HIGH WINDS,
AND DOWNSLOPE EVENTS.

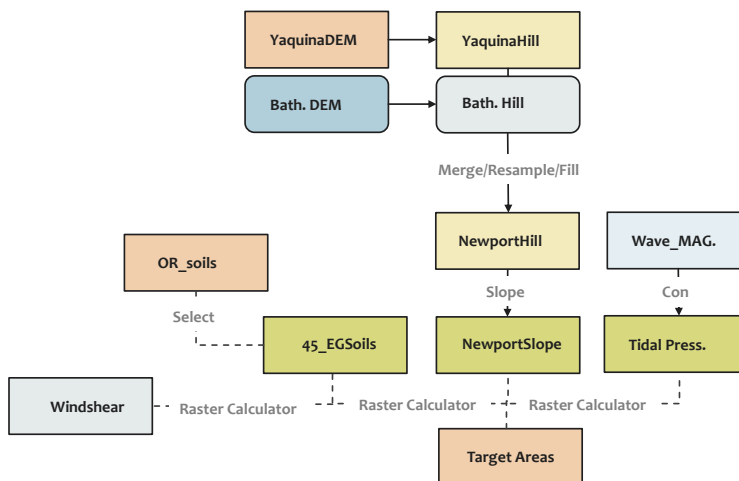


George Crawford and Hal Mofjeld "Puget Sound Tsunami/Landslide Workshop"
Washington State Military Department, Emergency Management Division (2001)

* KEY INITIAL DATA LAYERS *

1. NOAA COASTAL DEM: **OR 1/3 ARC-SECOND NAVD 88 DEM.**
2. NOAA BATHYMETRY: **1 ARC-MINUTE BATHYMETRIC RELIEF MODEL.**
3. FUGRO VESSEL-BASED LIDAR: **PELAGOS MULTIBEAM SURVEY.** ☹☹☹
4. NVS SHORELINE EROSION DATA: **(COUNTOUR CHANGE.)**
5. WUNDERGROUND TIDAL AND WIND DATA.

* METHODOLOGY & WORKFLOW *



* CRITERIA FOR DETERMINING PROBLEM AREAS *

1. TIDAL PRESS X TOPO. GRADIENT = 15.0
AS PER NOAA. **ACCOUNTS FOR TIERS 1,2 AND 4!**

2. SOIL ORDERS = 45G, 42E

45G - NESKOWIN-SALANDER SILT LOAMS, 35 TO 65 PERCENT SLOPES.

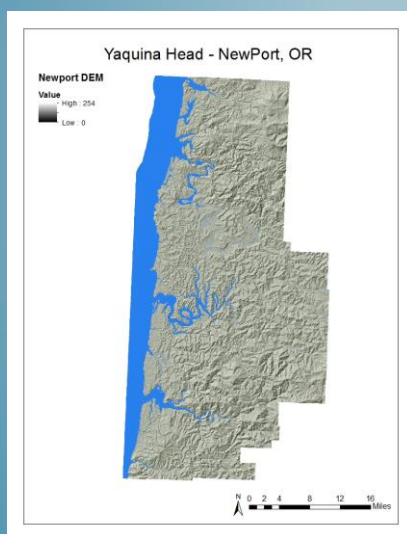
42E - NELSCOTT LOAM, 12 TO 50 PERCENT SLOPES. **ACCOUNTS FOR TIER 3!**

3. WINDSHEAR GRADIENT/SPEED. **TIER 5?!?!?**

TREAT AS AN ADDITIONAL SLOPE (?)
SET ARBITRARY CUT POINT.

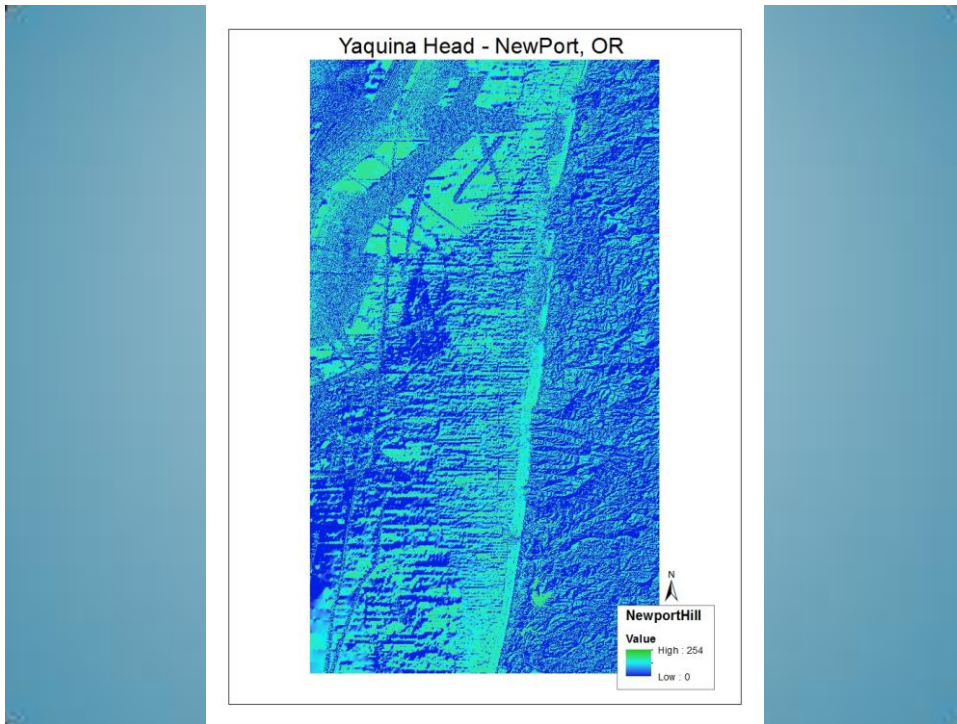
* STEP-BY-STEP: DEMS*

LAND

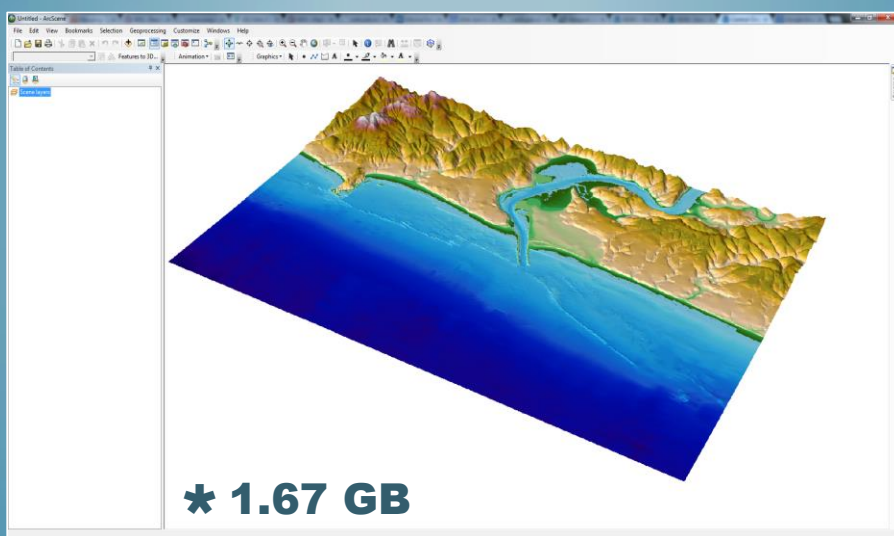


SEA

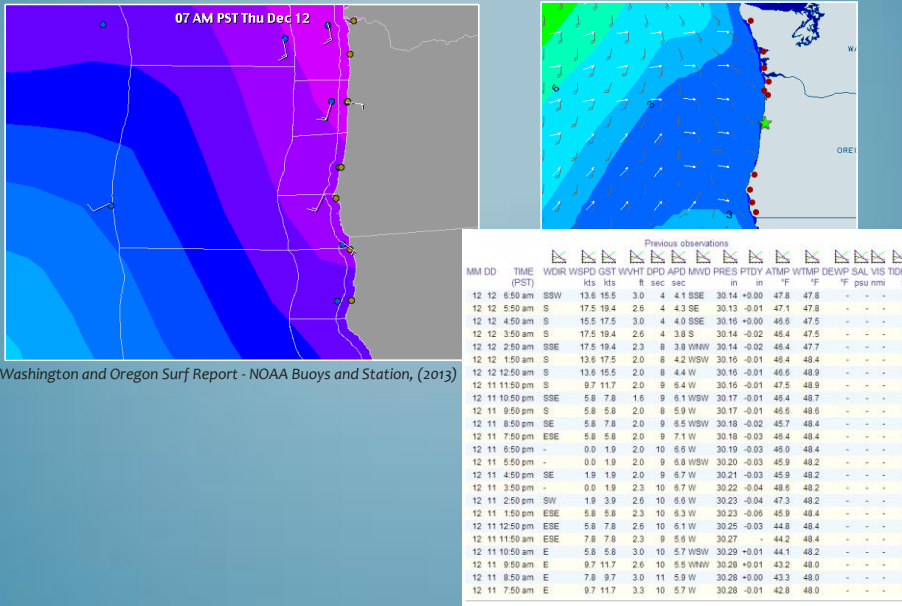




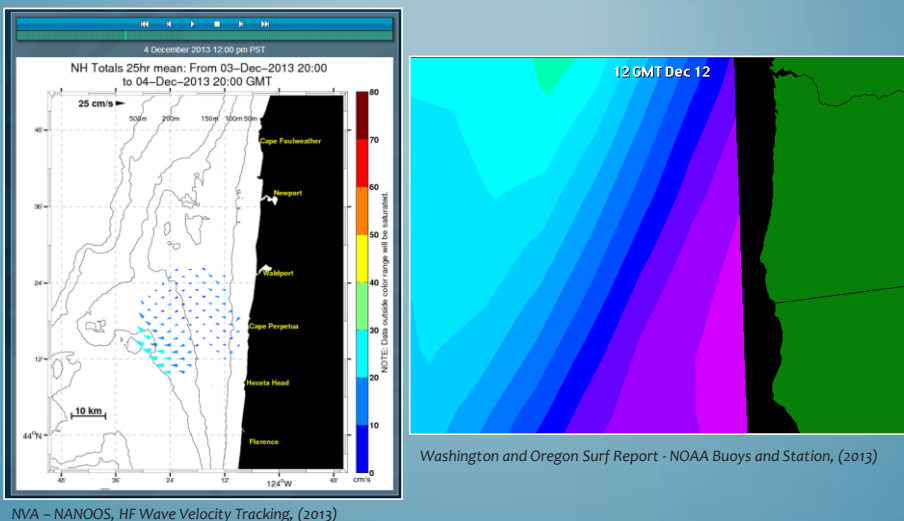
* STEP-BY-STEP: THE MERGED MODEL *



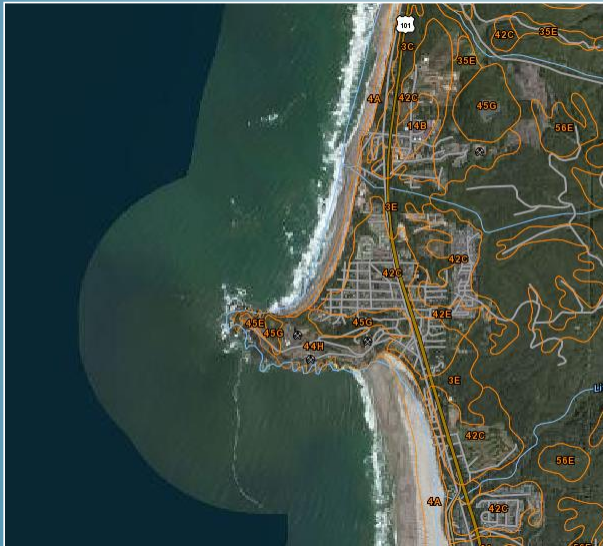
* STEP-BY-STEP: WAVE ACTION*



* STEP-BY-STEP: TIDE ACTION*



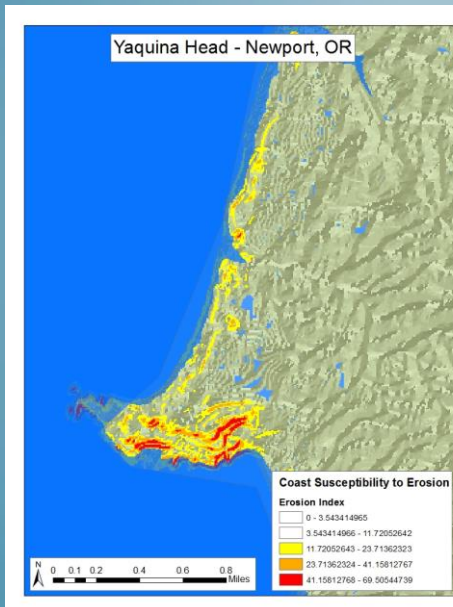
* STEP-BY-STEP: SOIL ORDERS*



Map Unit Symbol	Map Unit Name	Acres in AOT	Percent of AOT
3C	Bandon fine sandy loam, 3 to 12 percent slopes	68.1	0.5%
3E	Bandon fine sandy loam, 12 to 50 percent slopes	246.3	1.9%
4A	Beaches, 1 to 3 percent slopes	164.0	1.3%
9A	Brenner silt loam, 0 to 2 percent slopes	28.9	0.2%
14B	Depoe loam, 0 to 7 percent slopes	29.3	0.2%
32G	Klotchie-Neotsu silt loams, 30 to 60 percent slopes	24.8	0.2%
35E	Lint silt loam, 5 to 25 percent slopes	191.6	1.5%
42C	Nelscott loam, 3 to 12 percent slopes	536.9	4.2%
42E	Nelscott loam, 12 to 50 percent slopes	27.9	0.2%
44H	Neskowin-Rock outcrop complex, 20 to 99 percent slopes	82.3	0.6%
45E	Neskowin-Salander silt loams, 5 to 35 percent slopes	4.1	0.0%
45G	Neskowin-Salander silt loams, 35 to 65 percent slopes	109.3	0.9%
46A	Nestucca silt loam, 0 to 2 percent slopes	107.3	0.8%

USDA NGS, Natural Resources Conservation Service Web Soil Survey (WSS)

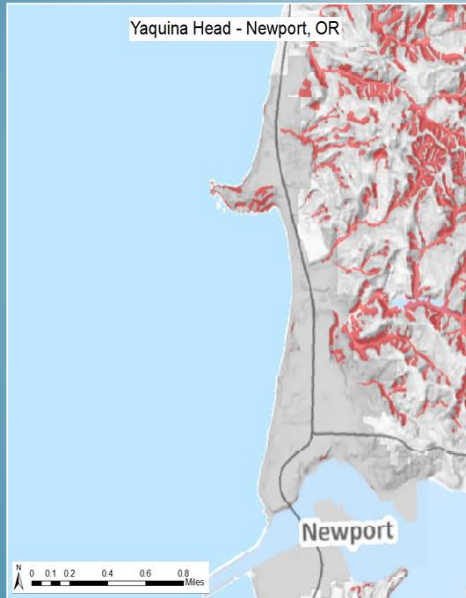
* PUTTING IT ALL TOGETHER...*



MODEL SEEMS TO SUGGEST THAT SOUTHERN EDGE COAST OF YAQUONA HEAD IS MOST SUSCEPTIBLE TO EROSION FACTORS!

DOES THIS COINCIDE WITH NOAA'S FINDINGS?

* THE NOAA MODEL*



**MY MODEL GROSSLY
OVERESTIMATES THE
VOLUME OF LAND IN
THE AT HIGH-RISK
CATEGORY.**

WHY?

MISSING FACTORS?

We apologize for the inconvenience, but Windows did not start successfully. A recent hardware or software change might have caused this.

If your computer stopped responding, restarted unexpectedly, or was automatically shut down to protect your files and folders, choose Last Known Good Configuration to revert to the most recent settings that worked.

If a previous startup attempt was interrupted due to a power failure or because the Power or Reset button was pressed, or if you aren't sure what caused the problem, choose Start Windows Normally.

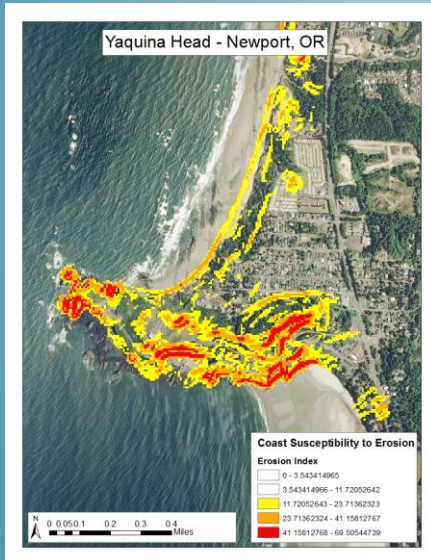
Safe Mode
Safe Mode with Networking
Safe Mode with Command Prompt

Last Known Good Configuration (your most recent settings that worked)

Start Windows Normally

Use the up and down arrow keys to move the highlight to your choice.
Seconds until Windows starts: 24

* SEVERAL OF MY ASSUMPTIONS WERE ERRONEOUS *



1. VEGETATION IS FAR MORE IMPORTANT THAN SOIL QUALITY!

2. WIND OVERESTIMATED.

3. VESSEL-BASED LIDAR NOT PRACTICAL FOR STUDIES OF THIS NATURE.

***HISTORICAL (EL NINO) SURVEYS.**

4. ESSENTIALLY, ENTIRE MODEL WAS CORRECT BUT SKEWED.

* REFERENCES *

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Jeffrey D. Colby "Spatial characterization, resolution, and volumetric change of coastal dunes using airborne LIDAR: Cape Hatteras, North Carolina" National Oceanic and Atmospheric Administration (NOAA), National Ocean Service (NOS), National Geodetic Survey (NGS), Remote Sensing Division, Silver Spring, MD. 2009

Hilary F. Stockdon, Asbury H. Sallenger Jr., Jeffrey H. List and Rob A. Holman - "Estimation of Shoreline Position and Change Using Airborne Topographic Lidar Data" Journal of Coastal Research, Vol. 18, No. 3 (Summer, 2002), pp. 502-513

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George Crawford and Hal Mofield "Puget Sound Tsunami/Landslide Workshop" Washington State Military Department, Emergency Management Division (2001)

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* QUESTIONS? *



Photo: Oregon Chamber of Commerce (2010)