Hydrologic Response to Timber Harvest and Forest Management Practices in Western Oregon

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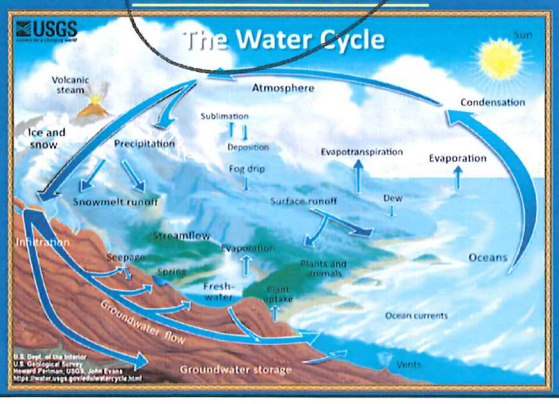
Outline

- Introduction to the Hydrologic cycle
- Methods/Locations
- Effects of Forestry Treatments
  - Streamflow/peak discharge response
  - Soil moisture response
  - Stream Temperature response
- Summary

INTRODUCTION

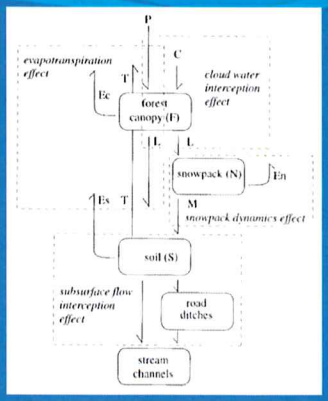


Water Storage Locations

- Forest Canopy
- Snowpack
- Soil and Regolith

Movement Mechanisms

- Precipitation
- Evaporation
- Transpiration
- Snowmelt
- Throughfall



Responses

Evapotranspiration effect:

- Reduces canopy storage
- Increases throughfall to soil
- Reduces evapotranspiration
- Decreases cloud water interception

Cloud water interception effect:

- Decreases cloud water interception (seasonal)

Snowpack Dynamics Effect:

- Decreased canopy evaporation
- Increased snowpack accumulation/storage
- Rain-on snow-events= increased soil moisture and runoff

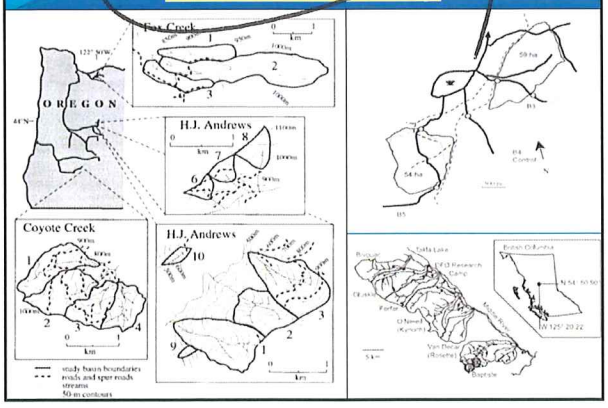
Subsurface Flow interception effect

- Road construction= canopy gaps
- Alters water routing to streams

Methods

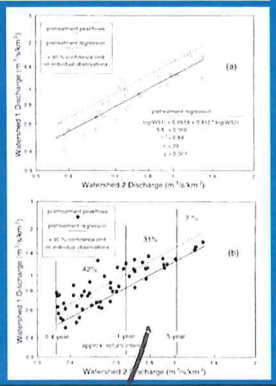
- LTER forest basins with stream gages, dataloggers
- Control: untreated forest basins
- partial or complete canopy removal
- roads= canopy removal, hydrologic reroute

Areas of study



Streamflow & Peak Discharge

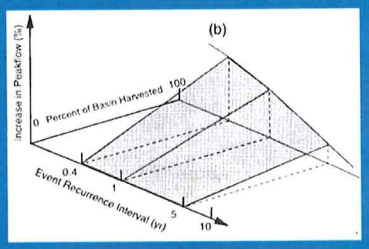
- 14 experimental basins, 3 LTERs (HJA, Fox Creek, Coyote Creek)
- comparing average magnitude of peak discharge events
- Size of event= 0.22-0.28 (4-5 largest peak discharge events/year)
- 100%, 50%, and 25% forest canopy removal groups



ADD TITLE

"Peak flow Response"

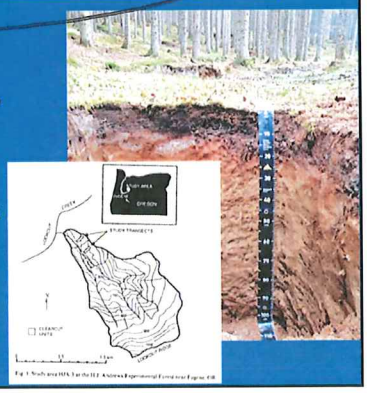
- Large increases in peak discharge after forest canopy removal
- Decreasing effect over time
- Proportional to canopy removal percentages
- Consistent in all 3 locations



AC CAPS
NO UNDERLINE

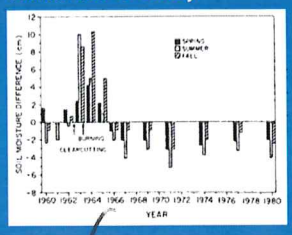
Soil moustire response

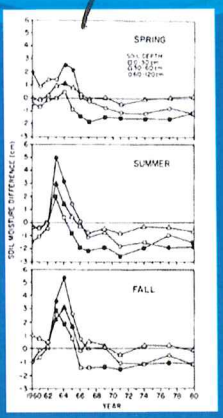
- Varies seasonally
- Plant cover decreases moisture content
- Wilting-point: no coming back
- Clearcut, broadcast burned forest examined



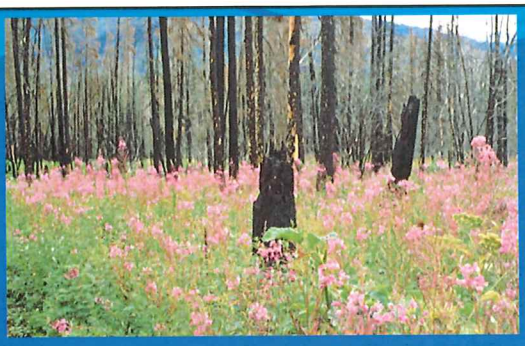
DISCUSS RESULT

- Soil moisture initially increases after treatment
- Decreases after reclamation
- Persistent deficit for remainder of study





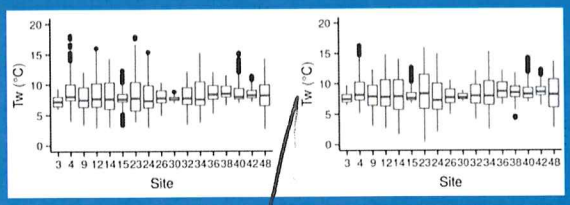
DISCUSS RESULTS



- Revegetation rapidly decreases soil moisture
- Persistent moisture decrease= decreased forest regeneration
- Burning reduces wettability, infiltration

Stream Temperature

- Stream temperatures legally mandated
- Temperature affects ecosystem service providers
- Currently measured on a scale thats ignores local heterogeneity



EXPLAIN THIS DIAGRAM

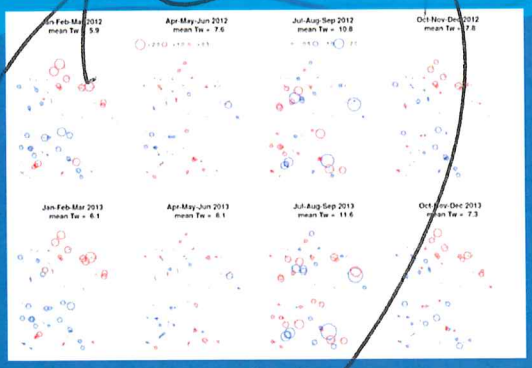
ALL WITH IS BACKGROUND

DISCUSS RESULTS

SNOW??

ADJUST CONTENT

LARGER GRAPHIC



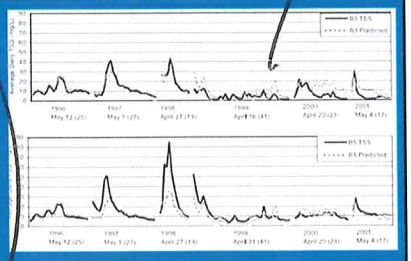
- Spatial variability is higher in smaller order streams
- Land management models don't work on fine spatial scale

Suspended Sediment Concentrations

- Cutblocks accumulated more snow
- Increased snow= increased peak flow

&

Increased mean daily discharge



7 FONT SIZE

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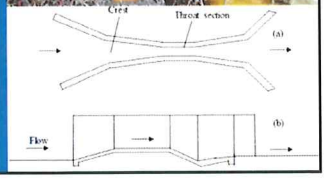
ADJUST & CLEAN

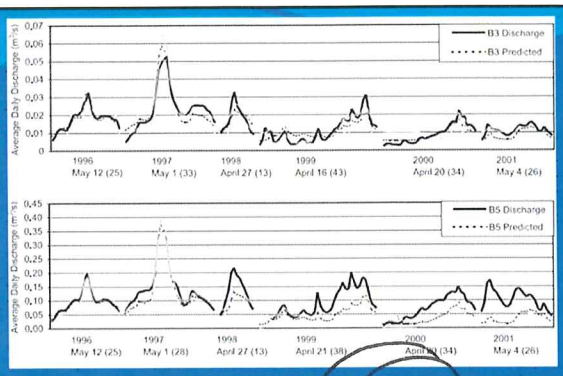
BULLETS AT ACROSS/ BOTTOM

NO UNDERLINE
BE CONSISTENT

Suspended Solids

- Riparian treatments:
  - increase TSS, discharge in freshet events
  - increase daily peak discharge
  - -increase snowpack accumulation
  - -protect streambanks BUT alter balance





- Increase in peak snowmelt and total freshet discharge - persisting
- Increase in TSS- effects degrade over 3 years

ADD "SUMMARY AND CONCLUSIONS" SLIDE

BLACK FONT. ALL WHITE BACKGROUNDS

NO UNDERLINE

SUMMARY

- Increased canopy removal=increased runoff
- Increased roads=increased runoff
- Roads reroute surface and subsurface water flow
- Riparian treatments:
  - increase TSS, discharge in freshet events
  - increase daily peak discharge
  - -increase snowpack accumulation
  - -protect streambanks BUT alter balance

WITH "FRESHET" BE CONSISTENT OF JARGON

CUT

INCREASE FONT / BOLD

ADD "ACKNOWLEDGEMENTS" SLIDE

Sediment Dynamics and Erosion Response to Forest Management Practice in Western Oregon

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Outline and Overview

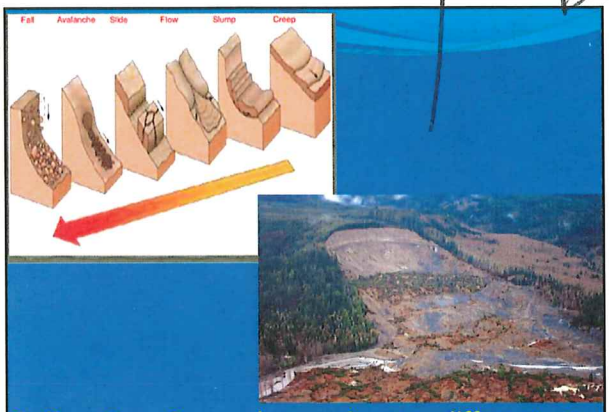
Outline

- Introduction
- Timber Harvest and Forest Management Practices
  - Locations: Western Cascades, Coast Range, PNW
  - Methods: Treated Vs. Untreated (Control)
- Effects / Response on Erosion Rates and Sediment Transport in Streams
  - Erosion Rates
- Summary / Conclusion

INTRODUCTION

Introduction

- Sediment In the PNW
  - Man made
  - Natural
- Problems from sediment
  - Fish
  - Water quality
- Many experiments with data
- Sources type



Sediment erosion can happen in many different ways

Timber Harvest and Forest Management Practices

Locations

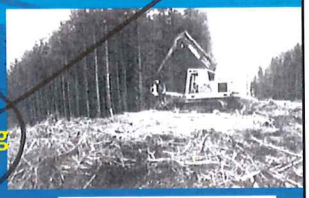
- PNW
- Western Cascades
- Controlled water sheds
  - H.J Andrews
  - Alsea

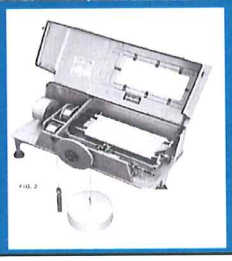
Methods

Sediment monitoring equipment:
- Weirs
- Flumes

Controlled experiments

Logging methods
- Clear cut
- Patch cut





Clear cut from Watershed 1 H.J Andrews

Effects / Response on Erosion Rates and Sediment Transport in Streams

Erosion Rates

Rates depend on method / location

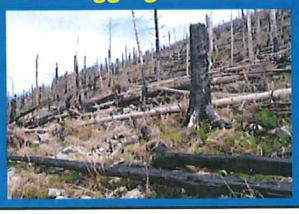
Weather
- storms

Rates are highest after logging

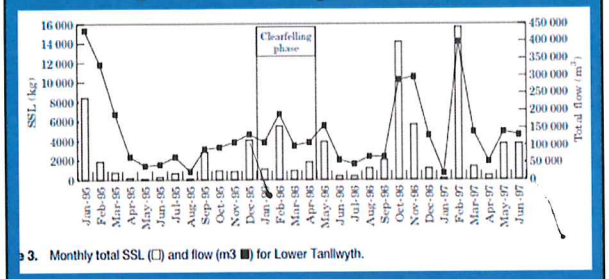
General trend

Other reasons

Fire



Rates highest after logging with weather



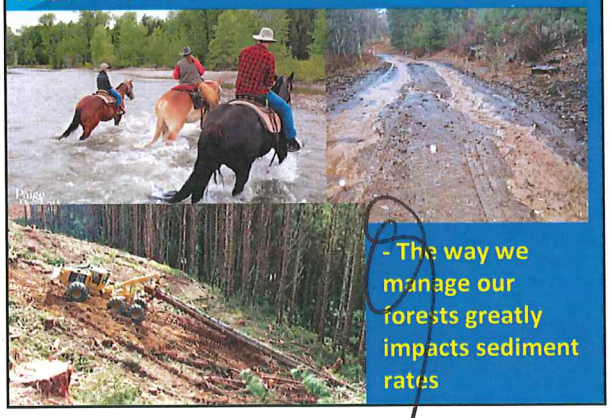
3. Monthly total SSL (□) and flow (m3 ■) for Lower Tanllwyth.

Chart from Plynlimon United Kingdom experiment

Forest fires

- Fires leave the ground exposed to weather and erosion

Man made sources



- The way we manage our forests greatly impacts sediment rates

SUMMARY & Conclusion

ALL CAPS

Conclusion

Sediment erosion in the PNW is a problem for fish and water quality

The methods we used change rates of sediment run off

Sediment erosion is always highest after logging with wet months

The PNW is a prime location for sediment erosion

Thank You

ADJUST / USE CONSISTENT BUFFER

Forest Road Construction and Sediment Production in Western Oregon

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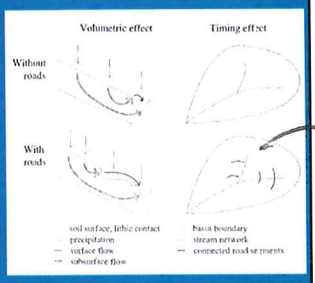
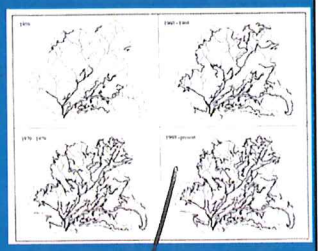
Outline

- Introduction
- Areas of Study
- Treatment Methods
- Common Effects
- Corroborating Studies
- Results and Data
- Conclusion



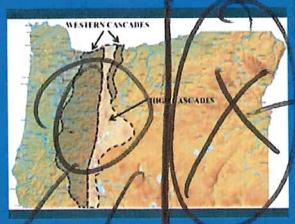
Introduction

- Logging and logging roads have increased exponentially
- Roads are necessary for efficient harvesting and transport
- Mitigation of damage is the goal



Study Areas

- Western Cascades of Oregon
- Lookout Creek, Blue River Basin
- HJ Andrews Experimental Forest
- Alsea Watershed



"Methodology"

Treatment Methods

- Road Grading
  - Helps to level the road
  - Ensures proper drainage
- Ditch Blading
  - Allows for more consistent sediment flow

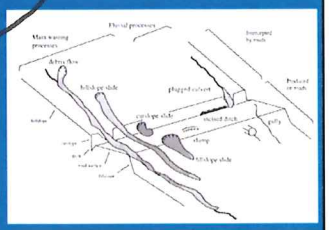
Treatment Methods

- Vegetation removal
  - Decreases stability
  - Increases sediment transport
- Culverts
  - Helps direct flow
- Aggregate Distribution
  - Fines removal

"Experimental Results"

Common Side Effects

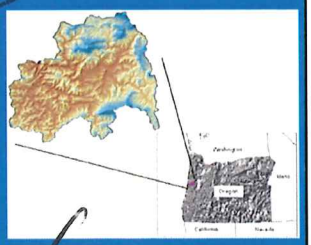
- Debris Flow
  - Oversteepened slope
- Plugged culverts
  - Creates gullies
- Hillslope Slide
  - Oversaturation and slope failure
- Increased turbidity



Alsea Watershed Study

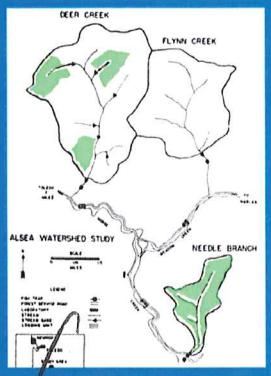
Fall 1958- 1973
3 Watersheds were involved
- Needle Branch Watershed (75 ha)
- Deer Creek (304 ha)
- Flynn Creek (202 ha)-- Experimental Control

Treatments
- Needle Branch Watershed 82% clear cut
- Deer Creek Watershed 25% clear cut
- Flynn Creek left untreated



Alsea Watershed Study

- Focuses on long-term effects of sediment increase
- Some effects are immediate
- Changes in the environment can be seen years after treatment



Alsea Watershed Study

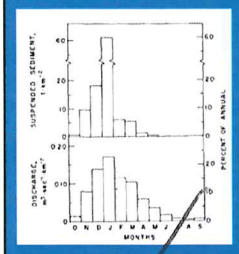
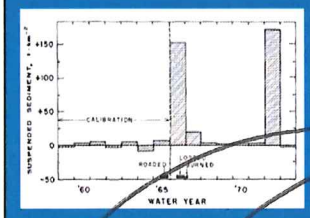


TABLE Average Annual Sediment Yields of the Alsea Study Watershed

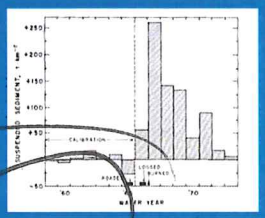
Period	Water Years	Flynn Creek Untreated, t km⁻²	Deer Creek 25% Patch Cut, t km⁻²	Needle Branch 82% Clear Cut, t km⁻²
Pretreatment	1959-1965	102	97	53
Posttreatment	1966-1971	336	336	146

- Suspended sediment correlation with discharge
- Annual vs monthly sediment yields of study area

Suspended Sediment by Year (Alsea)



Deer Creek (25% clear cut)



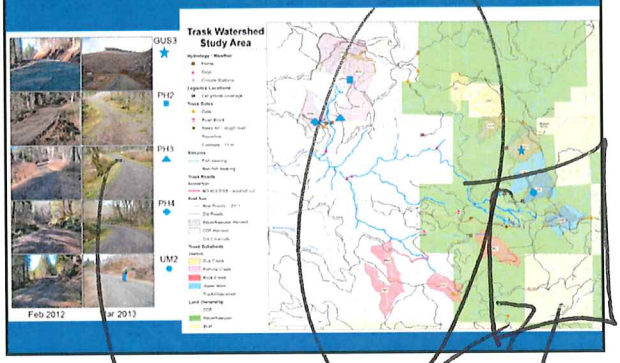
Needle Branch (82% clear cut)

Trask Watershed Study

- 5 Road crossings studied
- Sensors are placed above and below harvest site
- Measurements of turbidity, SSC, and discharge are taken
- Data is collected at 3 separate times in the forestry process
- Data is then analyzed and compared to determine statistical relationships

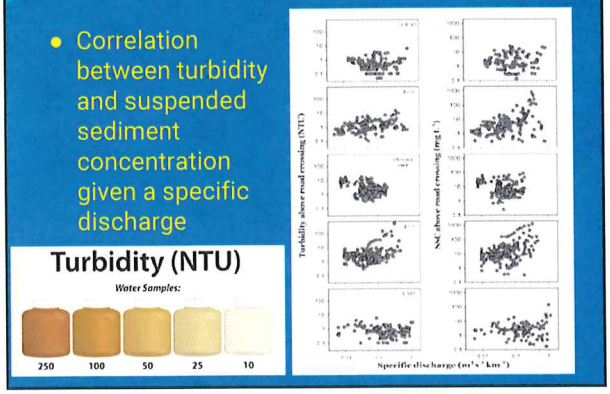
GIS Trask Watershed inset Clip

Trask Watershed Study

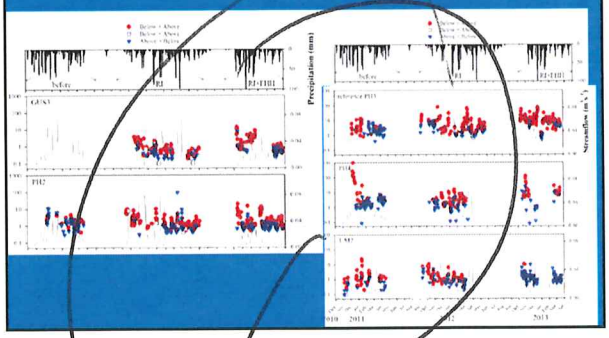


Trask Watershed Study

- Correlation between turbidity and suspended sediment concentration given a specific discharge

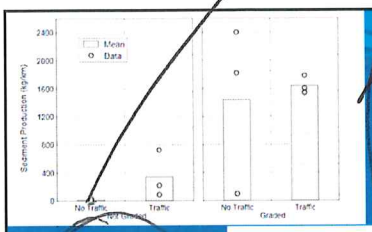


Trask Watershed Study



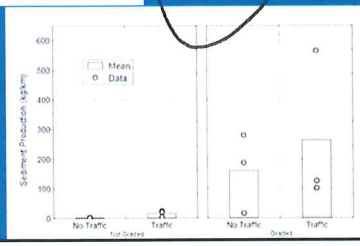
Effects of Traffic and Road Maintenance on Sediment Production

- 12 road segments split into 4 categories
  - No traffic, No ditch grading (NTNG)
  - Traffic and no ditch grading (TNG)
  - No traffic, Grading (NTG)
  - Traffic and Grading (TG)
- As similar environments as possible
- Trucks make 10 round trips per day from Nov. 15 to Dec. 14
- Sediment collected and measured in runoff tanks



- Sediment production during traffic period

- Sediment production post-traffic period (7 month span)



Results

Conclusion

Hunter
LESS OVERVIEW MORE DATA/ DETAILS — PRACTICE 5 TIMES — BULLETS USE YELLOW FONT

Landslide and Debris Flow Occurrence in Forested Landscapes of Western Oregon

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Outline

- Introduction
- Timber Harvest/Forest Management Practices
  - Methods
  - Locations
- Styles of Mass Wasting/Controlling Factors
  - Slump, flow , slide
- Effects of Forest Management on Mass Wasting
  - Deep Seated Landslides
  - Shallow Landslides/Debris Flow
- Summary/Conclusion

KEEP TITLES OFF OF "SMOOTH"

USE CONSISTENT BULLET SIZE & COLOR

INTRODUCTION

Why is this important?

- Forests cover almost half ORs total land mass
- Forest harvest practices wreak havoc on multiple environments
  - Riparian (river)
  - Forest Landscape
  - Fish Habitats
- Removal of trees causes reduced soil stability and more mass wasting events

SHOW 3-4 SLIDES WITH DATA/GRAPHS FROM YOUR READINGS — DISCUSS RESULTS

FONT COLOR

Timber Harvest/Forest Management Practices

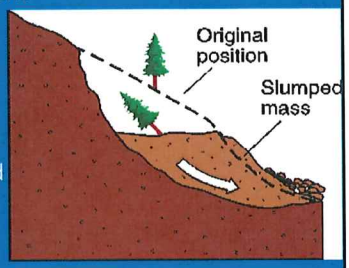
Methods

- Treated (harvested) vs untreated forest areas
- Different "age classes" of trees
- Christine May study (2002) observes frequency of debris flows based on tree "age"

Styles of Mass Wasting/Controlling Factors

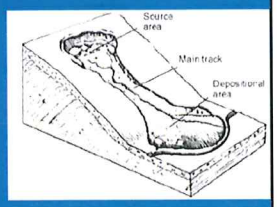
Slump

- Short mass movement
- Coherent mass
- Loose sediment
- Caused by:
  - Shaking
  - Excessive water
  - Loss of slope bed
  - Undercutting

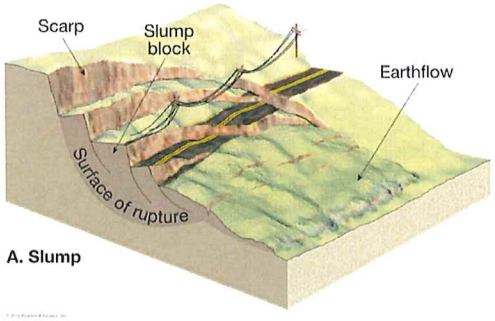


Earthflow

- Downslope viscous flow
- Generally fine grained
- Flow of sediment
- Causes:
  - Gravity driven
  - Saturation of sediment load
  - In between creep and mudflow

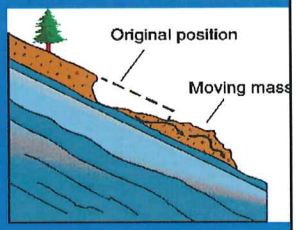


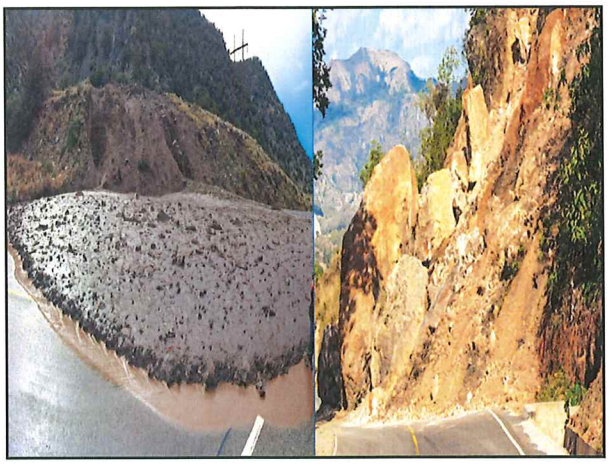
A slump with an earthflow at the base



Landslide

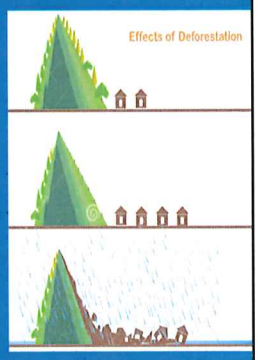
- More broad category name
- Involves processes less associated with water
- Can be a part of complex terrains
  - Contributes to other mass wasting events





Controlling Factors

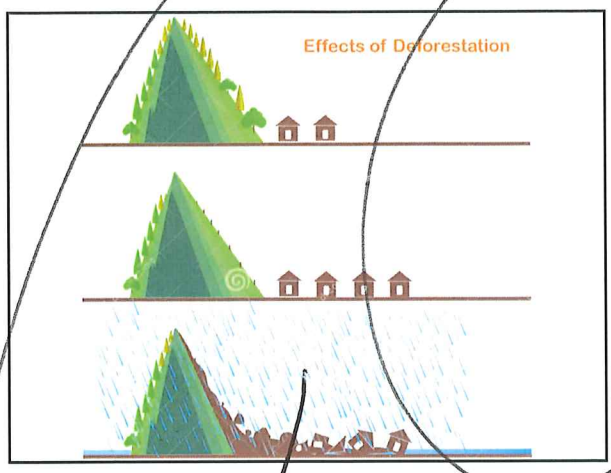
- Three main contributing factors to mass wasting events
  - Vegetation: soil stability
  - Water Saturation
  - Underlying Geology/Sediment loads



Effects of Forest Management on Mass Wasting

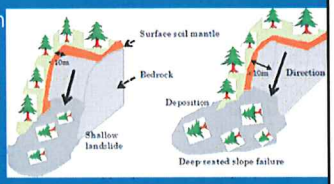
This is all General Info

Show Field Photos



Deep Seated Landslides

- Much greater effect on river environment
- As well as surrounding topography
- Initiated by seismic activity, stream erosion, high groundwater levels
- https://www.youtube.com/watch?v=5KSS4A1Z8xc



Explain Loss of River Structure in photos?

Show Data Discuss Results

??

DSL data

Shallow Landslides/Debris Flow

We need some actual science/data on your own

"Summary and Conclusion"

SUMMARY

CONCLUSION

Add Acknowledgments Slide

Perspectives on Climate Change and Forest Hydrology in the Oregon Cascades

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Western Oregon University
Monmouth, Oregon
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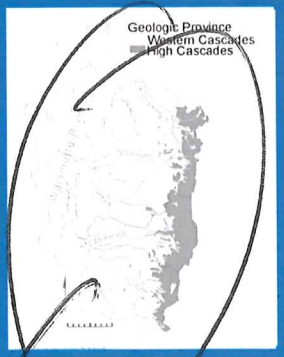
Outline

- Introduction
- Climate & Climate Change Models
  - Historic / Present Models
  - Predicted Future Models
- Implications on Forest Management
- Conclusion

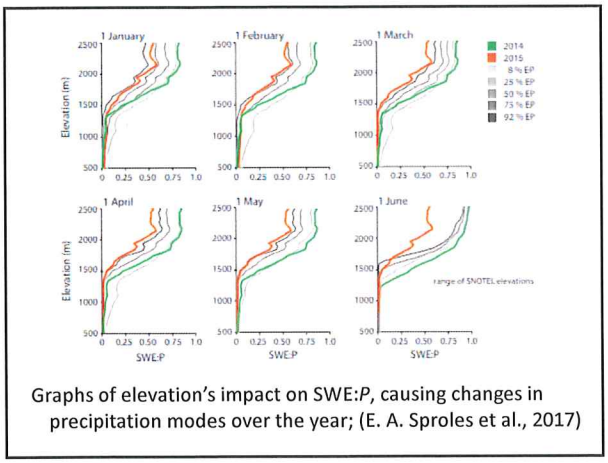
Introduction



- Willamette Basin
- Climate change
  - Less snow/pack
    - Earlier melt
  - Drier summers
- Oregon Cascades
  - Western Cascades
    - Surface flows
  - High Cascades
    - Spring-fed

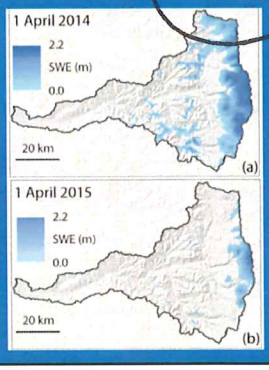
CLIMATE & CLIMATE CHANGE MODELS

Historic / Present Models



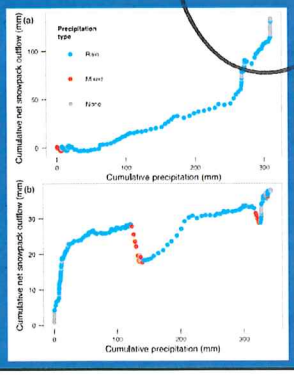
Graphs of elevation's impact on SWE:*P*, causing changes in precipitation modes over the year; (E. A. Sproles et al., 2017)

Snowpack



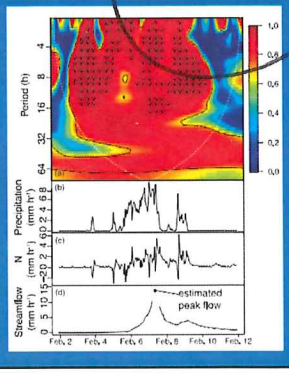
- + 2°C model
  - WY 2014 above average
  - WY 2015 well below
- April 1 storage
  - 1300–1800 m
  - WY 2015: snow free

Rain-on-Snow Events



- Largest floods were r-o-s
  - 26 storms from 1992 to 2012
- Outflow positively related to precipitation
  - < 4 mm hr-1
- Precipitation pulses = pulses of net outflow
  - 12–32 hrs

Rain-on-Snow Events



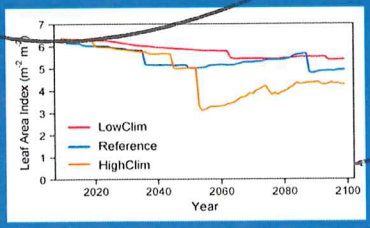
- Feb 2, 1996 event
- Wavelet coherence
  - 1 = high degree of precipitation-outflow
- Black contours = statistically significant coherence
- N = net snowpack outflow

CLIMATE & CLIMATE CHANGE MODELS

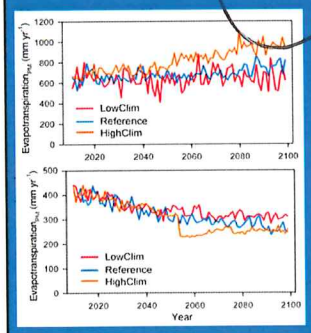
Predicted Future Models

Leaf Cover

- Private vs. public ownership
  - Effects harvest rate
- Highest ET at mid-elevations, high LAI
- Low at lower because of clearcutting
- Basin-wide response to fire
- LAI decrease 12-30%

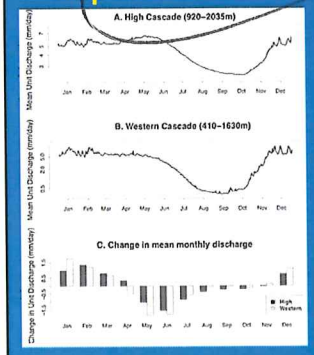


Evapotranspiration



- Above; just mean ET
  - 40% increase in evaporative demand
- Below; vegetation change, soil water, vapor pressure, CO_2
  - General decrease
  - Additional 11-18% reduction by CO_2

Implications on Forest Management

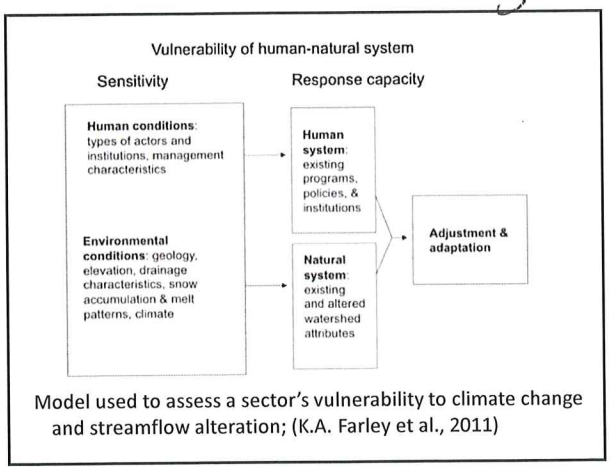


- Climate change
  - Drier summers
  - Greater reliance on Western Cascade flows
  - Less fish habitat
  - More flood risk in winter
    - Early melt
  - Problems of water use in the dry season

ADD AN IMAGE OF "SNOW"

"CONCLUSION"

ADD TITLE SLIDE



Model used to assess a sector's vulnerability to climate change and streamflow alteration; (K.A. Farley et al., 2011)

Conclusion

- Climate change
  - Drier summers, wet winters
  - Early melt, r-o-s
- Snowpack retreating
- Rain-snow transition line already shifting up elevation
- Leaf cover expected to decrease
  - Fire
  - Timber harvest
- Overall evapotranspiration decrease
- Some sectors prepared, some not

ADD ACKNOWLEDGEMENTS" "ACKNOWLEDGEMENTS"