OSU Geography

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Climate change, mountain hydrology, water resources in Oregon Cascades

1. Snow & climate change
2. Snow Mountain Sensitivity — Mountain extrapolation in Cascades
3. Snow–Vegetation – Fire

Historic observations vs. Future Prediction

1. Sparse Mountain System
2. "Snow-dominated Mountain"

Model validation

"Willamette water 2100"

Change in Snow Cover = "Calorimeter"

Hydrologic Sensitivity

Hydrologic Sensitivity

Eco Hydrology Snow – Vegetation – ET

Basin topography

Heat Assumption

"Disturbance" – Pest, Beetle, Logging – Fire

Climate – Eco Model – Global Climate Change

Adaptive Mgt

Social System

Landsat MODIS → remote sensing

Basin Scale

3-D FLOW CHARTS

NEXTGEN 2100 PROJECT - NSF: BOISE & MCDONALD

ECOSYSTEM SERVICES VS. HUMAN NEEDS (SUPPLY VS. DEMANDS)

MAIN FOCUS - SNOW ZONE HIGH CASCADES & WESTERN CASCADES

↓

CLIMATE WARMING

[SO% SNOW + SO% RAIN] → CASCADES HAVE WINTER

ANNUAL

CLIMATE WARMING

10's - 100's years

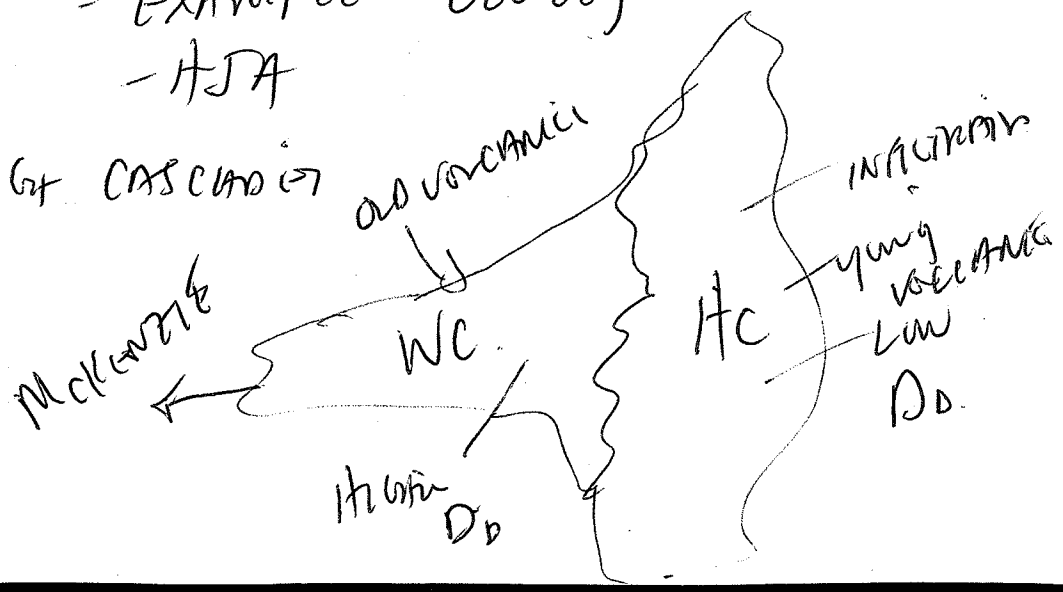
MODEL - CLIMATE CHANGES & WATER AVAILABILITY

USES
- DAMS
- HYDRO POWER
- MUNICIPAL
- IRRIGATION

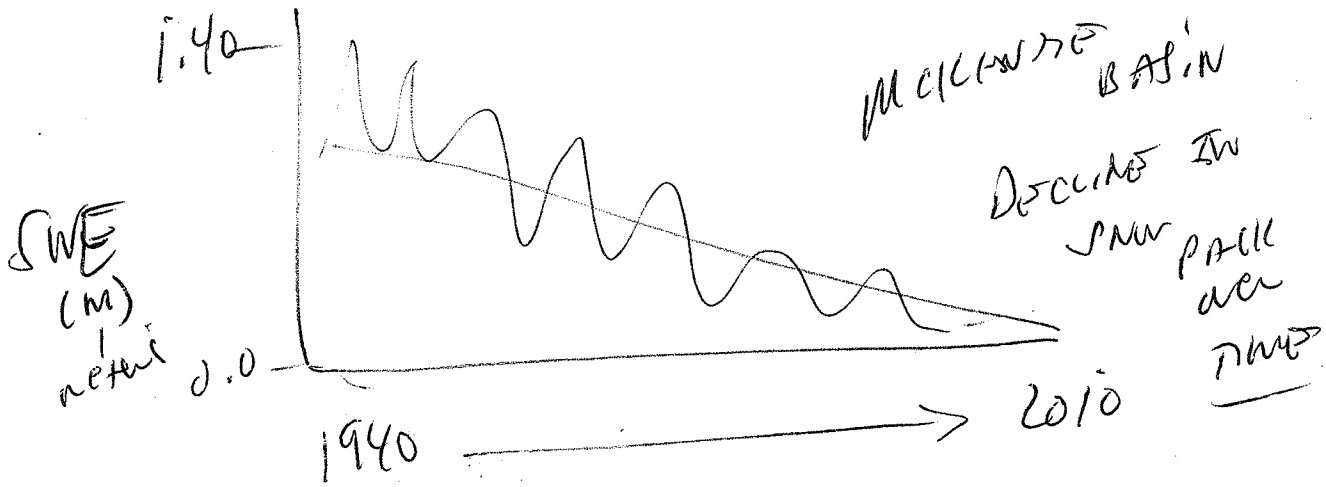
FOCUS IN MCKENZIE BASIN

↳ WIDE RANGES OF SNOW CLASSES
- EXAMPLE GEOLOGY OF W. CASCADES
- HJA

↳ HIGH CASCADES



SWE = SNOW WATER EQUIVALENT = IN METRIC STATE



"NO SNOW ZONE"
"RAIN-SNOW TRANSITION"

NRCS - SNOTEL

"SNOW MODEL" CAN. STATE
PROCESS - PHYSICS MODEL

MICRO MET → ENSAR → SNOW PACK → SNOW MASS

SPATIAL
T, precip.
RELATIVE HUM
RADIATION

PT DATA

SNOWPACK ENERGY

SNOWPACK MASS BALANCE

SNOW MOD 30

↓
EXTRAPOLATE TO GRIDDED MODEL

MODEL RESULTS

Model 100-m Resolution
1989–2009 Daily time step
Validate with Field Checking & Remote Sensing

Permafrost – ~ April 1 SWE in Mackenzie Basin

2.15 m SWE MAX
↳ much storage of liquid water

climate models
↳ 2020's, 2040's
↳ Common outputs, Summit downscaling
warmer Trend
> T over Drift; > % Precip. winter; < % Precip. summer

"Uncertainty" Hunt for precip models
"Sensitivity Analysis"
↳ empirical testing changing parameters
↓
Model Basin Vol. Loss = < 0.5 km³

SCI Blog Idea –
Room Comments & Mtgs. to Record Lessons & Logs.
↳ Streaming?

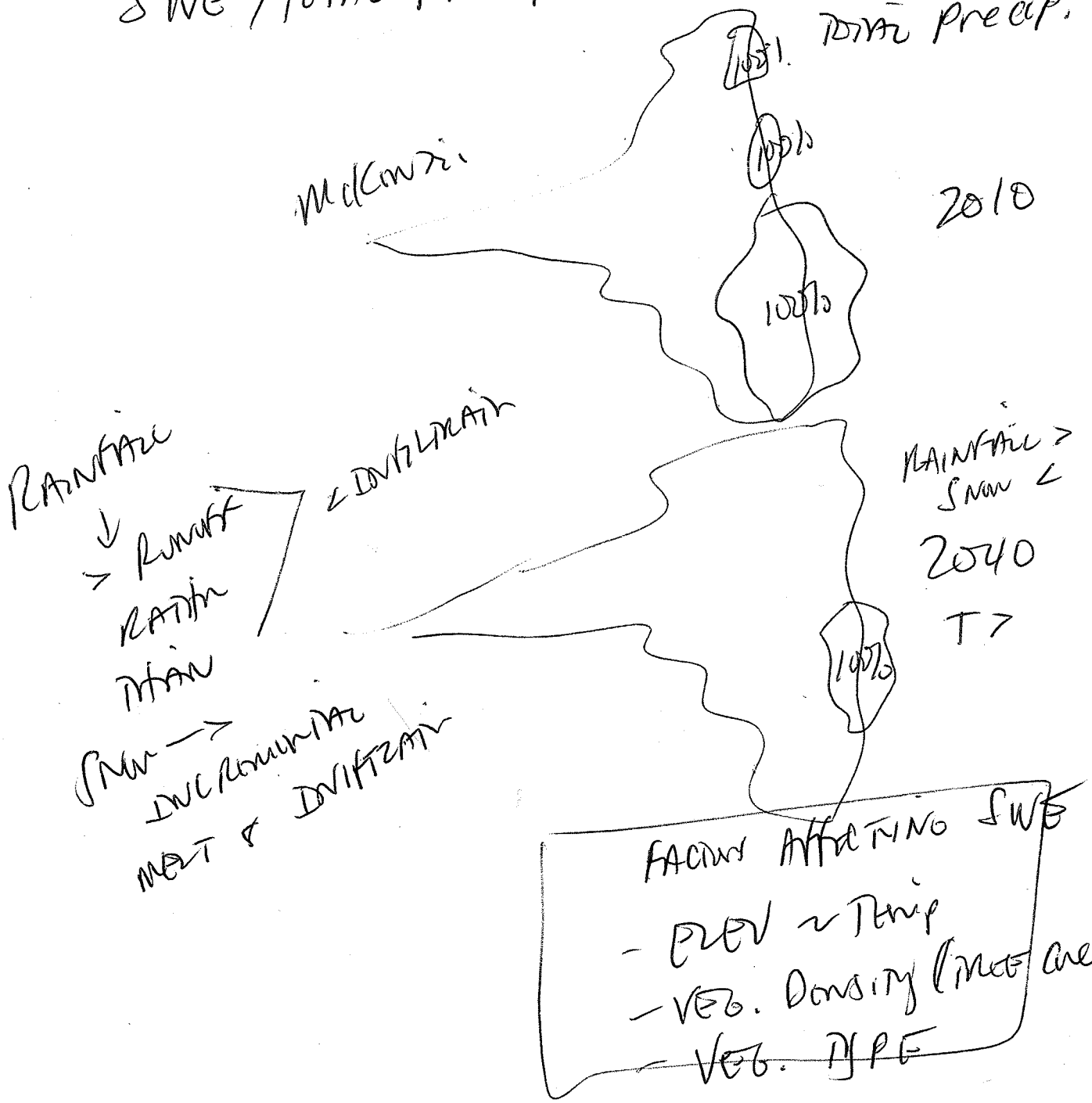
DN

Models

For every 1°C Temp >,
Storage Loss of Snow ~ 33%

Temp change: controlling factor

SWE / Total Precip. Annual SWE / Total Precip.



Factors affecting SWE
- Elev ~ Temp
- Veg. Density (more dense)
- Veg. Type

GIS - SPATIAL MODELING
GRID ANALYSIS

SNOW MONITORING SYSTEMS
SNOW DEPTH,

FORECAST vs. CLIMATE
CALIBRATE SNOW SENSORS - T, RH, WIND.
1x/month @ 6 SITES - SOLAR RADIATION.
- WIND SPEED, DIRECTION
- SOIL TEMP & MOISTURE

RECENT
NEW STUDY: EFFECTS OF FIRE ON SNOW PACK
"SHADOW LAKE" FIRE SEPT-OCT 2011
SOUTH OF SANDISFIELD PASS
- HOW DOES CHANGE IN FOREST CANOPY CHANGE SNOW PACK?
↓ WIND ?? HEAT ?? RADIATION ??
- ALBEDO OF SNOW IN BURN AREA
↳ SNOW SURFACE AFFECTED BY BURN-
↓ CARBON AS FINE DETRITUS
↓ albedo, - "CARBON SOOTING"
- MELTING SNOW
↓ ALBEDO
> HEAT ABSORPTION
> RATE MELTING EARLIER

SUMMARY
- MODELS - VARIOUS
- SNOWPACK ENERGY
- VEGETATION VS. SNOW COVER

MODEL
↓
OPTIMIZATION OF PARAMETERS

How important SNOW VS. RAIN?
WILLAMETTE 2100 - WHOLE BASIN
LOW BASIN of 70's OREGON