BIS 241 Winter 2010

The Abiotic Underpinnings of Nature in the Northwest

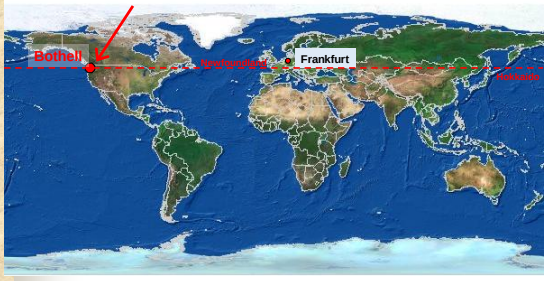
The Abiotic Environment of the Northwest

1. Where are we? : Global / Continental Position
2. An Overview of our Place:
   Regional Geography & Landforms
3. How were these Landforms Created?
4. The Ground Below Us: Geology & Soils
5. Climate

Global / Continental Position

A) Where are we on the globe ?

Latitude:



Global / Continental Position

B) Where are we on the continent ?

Continental Position:

Global / Continental Position

C) What the ecological implications of our position?

It affects our

I. Present-day Climate

1) Precipitation & Temperature
2) Daily & Seasonal Changes

II. Past Environment

1) Past Climate
2) Geological history

Global / Continental Position

C) What the ecological implications of our position?

It affects our

I. Present-day Climate

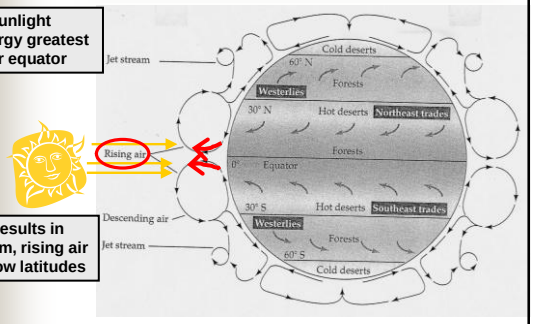
1) Precipitation & Temperature
   A. Atmospheric circulation
   B. Oceanic circulation
   C. Maritime influences
2) Daily & Seasonal Changes

II. Past Environment

1) Past Climate
2) Geological history

Atmospheric Circulation is a major determinant of global precipitation & temperature patterns

1. Sunlight energy greatest near equator

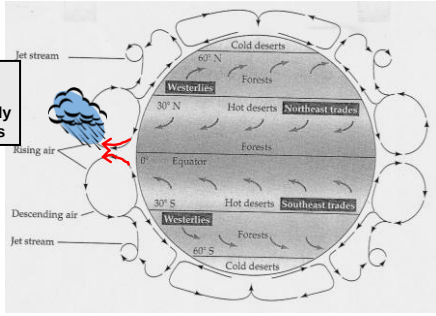


2. Results in warm, rising air at low latitudes

Campbell (2001)

Atmospheric Circulation is a major determinant of global precipitation & temperature patterns

3. Rising air cools & rain falls abundantly at low latitudes



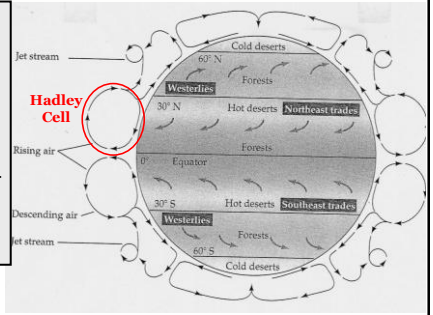
Campbell (2001)

Atmospheric Circulation is a major determinant of global precipitation & temperature patterns

4. Rising air leaves low pressure area behind.

Surface air from N and S flow into area.

Results in large-scale circular flow of air masses (Hadley Cells)

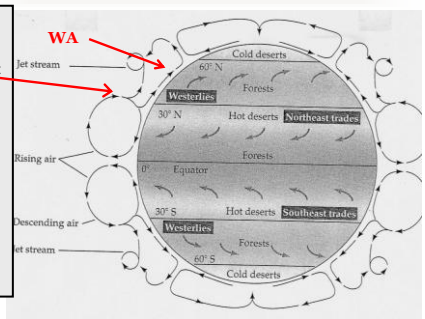


Campbell (2001)

Atmospheric Circulation is a major determinant of global precipitation & temperature patterns

5. Hadley Cells create dry latitudes of descending air at about 30 °N & S

WA sits at the edge of another rising air mass region – hence the tendency for higher levels of precipitation.

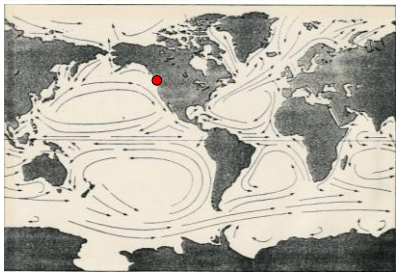


Campbell (2001)

Oceanic Circulation can be a major determinant of regional precipitation & temperature patterns

Ocean currents determine the temperature of surface waters.

This has large influences on coastal climates



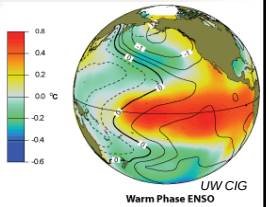
Ricklefs (1997)

ENSO: El Nino – Southern Oscillation Events

ENSO Events

El Niño *(warm phase)*

La Niña *(cool phase)*

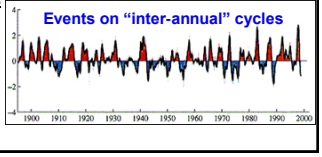


UW CIG
Warm Phase ENSO

ENSO PNW Climate Impacts

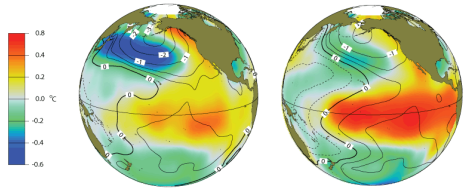
El Niño *(warm phase)*

La Niña *(cool phase)*



PDO: Pacific Decadal Oscillations

Similar to El Niño events, warm-phase PDO events show cooling of north Pacific; warming of central, eastern Pacific



PDO – warm phase **ENSO – warm phase**

UW CIG

PDO: Pacific Decadal Oscillations

But PDO Oscillations are decades – long; rather than the annual variations of ENSO

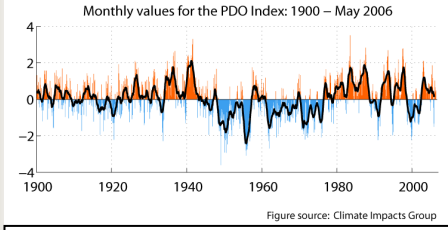
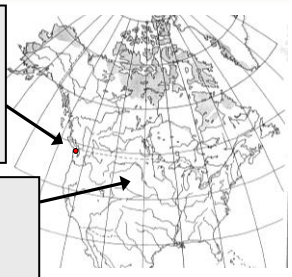


Figure source: Climate Impacts Group

Our coastal position results in strong maritime influences on our regional precipitation & temperature patterns

Our coastal location allows large water body to



Locations further from large water bodies experience

Global / Continental Position

C) What the ecological implications of our position?

It affects our

I. Present-day Climate

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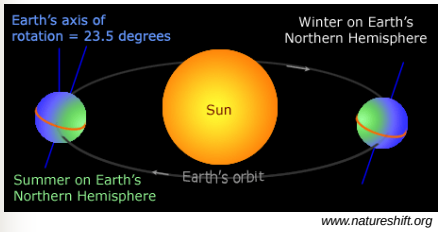
II. Past Environment

1) Past Climate

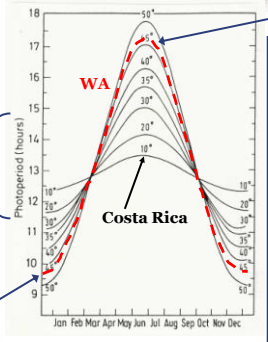
2) Geological history

Our location determines the patterns of seasons & day length we experience



www.natureshift.org

Our location determines the patterns of seasons & day length



 # hours it is light during 24-hour period

July: 17 hours of light

January: 10 hours of light

Ecological implications:

Ricklefs (1997)

Global / Continental Position

C) What the ecological implications of our position?

It affects our

I. Present-day Climate

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II. Past Environment

1) Past Climate

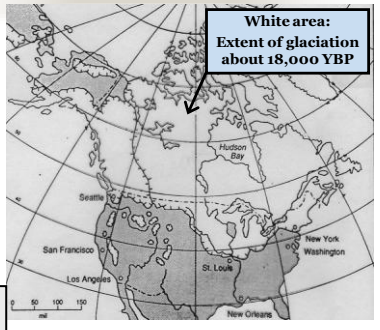
2) Geological history

Our location defines our past environments

Global Position

Present Climate

Past Climate



Global / Continental Position

C) What the ecological implications of our position?

It affects our

I. Present-day Climate

1) Precipitation & Temperature

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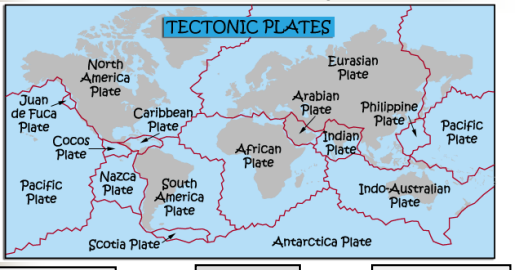
2) Geological history

Our location defines our past geological history

Our Tectonic Setting

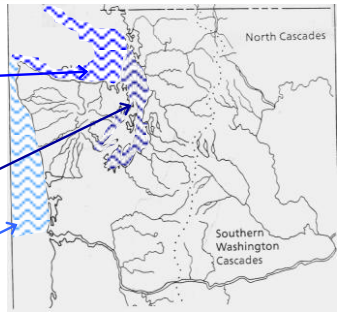


Geological History

Regional Geography

A) Water Bodies:

Marine



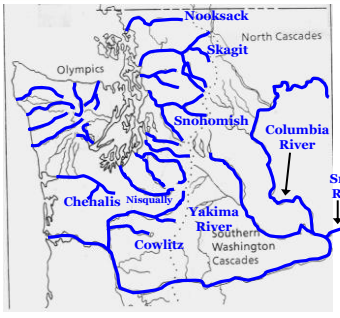
Regional Geography

A) Water Bodies:

Freshwater

Major Streams of WA

East side	West side
Columbia	Columbia
Snake	Cowlitz
Yakima	Chehalis
Spokane	Nisqually
Okanogan	Puyallup
	Green
	Snoqualmie
	Snohomish
	Stillaguamish
	Skagit
	Nooksack
	Skokomish
	Quinault
	Hoh

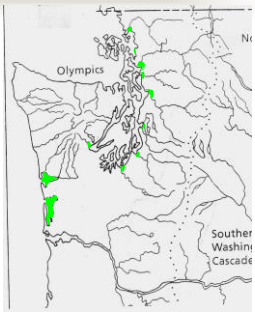


Regional Geography

A) Water Bodies:
Marine / Freshwater

Major Estuaries of Western Washington

- **Grays Harbor** (Chehalis River)
- **Willapa Bay** (Willapa & Naselle Rivers)
- **Nisqually River**
- **Puyallup River**
- **Cedar / Green River**
- **Snohomish River**
- **Stillaguamish River**
- **Skagit River**
- **Nooksack River**
- **Skokomish River**



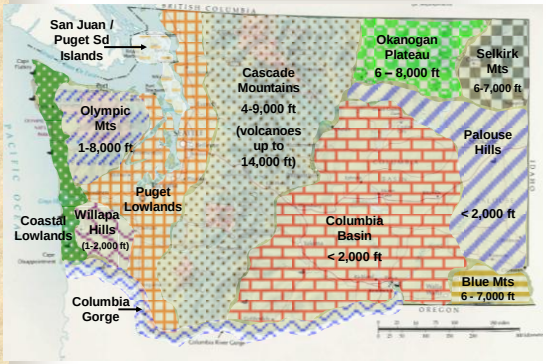
Regional Geography

B) Landscape Units

Landscape units based upon _____

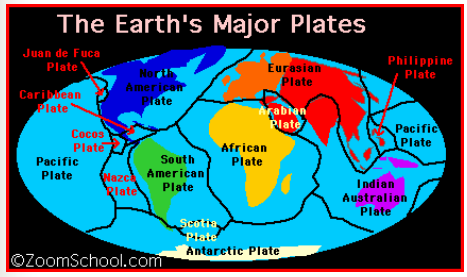
Note: These are arbitrary physiographic divisions for use in our class. Many different schemes exist.

Physiographic Regions of WA



Forces that Shape our Land

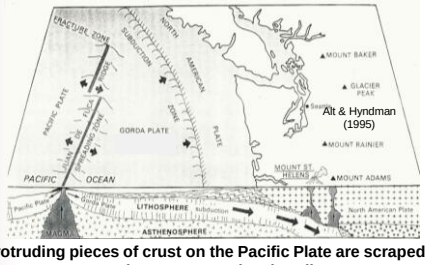
1. Tectonic Processes



Forces that Shape our Land

1. Tectonic Processes

Subduction – the Pacific Plate is being forced down under the North American plate as it pushes eastward



Alt & Hyndman (1995)

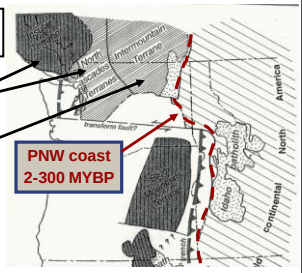
Protruding pieces of crust on the Pacific Plate are scraped off and accrete onto the shoreline

Forces that Shape our Land

1. Tectonic Processes

(A) Creating Landforms:

Tectonic terrane:

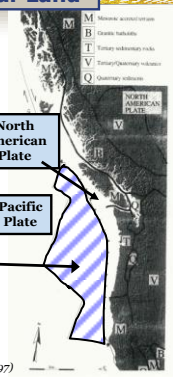


Alt & Hyndman (1995)

Forces that Shape our Land

1. Tectonic Processes

(B) Creating Landforms:

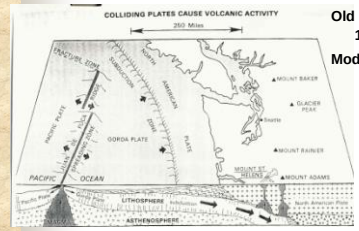


Montgomery (1997)

Forces that Shape our Land

1. Tectonic Processes

(C) Creating Landforms:



Old Basin & Range Basalt Flows:
13 - 16 MYBP

Modern Cascade Volcanoes:
3 – 500,000 YBP

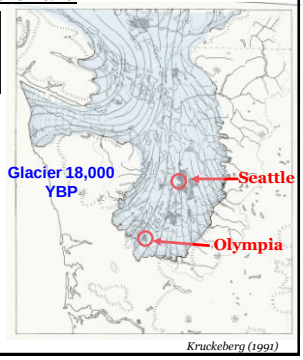
Alt & Hyndman (1994)

Forces that Shape our Land

2. Processes Reshaping the Land

(A)

- Puget trough & islands
- N – S valley topography
- Moraines



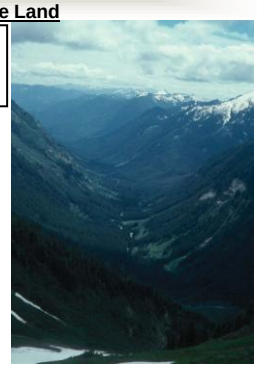
Kruckeberg (1991)

Forces that Shape our Land

2. Processes Reshaping the Land

(B)

- Mountain carving
- Moraines



Forces that Shape our Land

2. Processes Reshaping the Land

(C)

1) Hill & valley local topography

2) Mountain valley topography

3) Eastern WA scablands & coulees

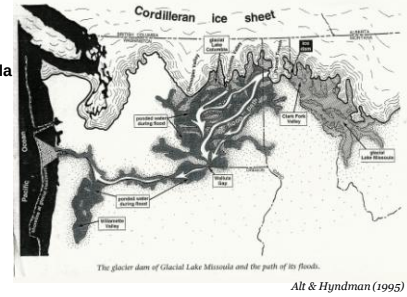
Forces that Shape our Land

2. Processes Reshaping the Lands

Great Floods reshaping the lands of Eastern WA

Lake Missoula Floods

15,000 YBP



The glacier dam of Glacial Lake Missoula and the path of its floods.

Alt & Hyndman (1995)

Forces that Shape our Land

2. Processes Reshaping the Land

(C) _____

1) Hill & valley local topography

2) Mountain valley topography

3) Eastern WA scablands & coulees

4) Columbia River gorge

5) River deltas (estuaries):

Forces that Shape our Land

2. Processes Reshaping the Land

(D) _____

Geology & Soils

Geology influences ecosystems at different spatial scales

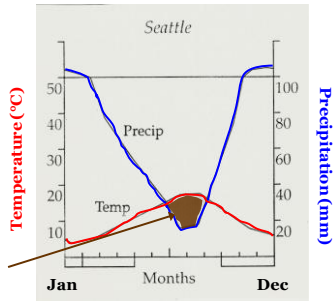
Large scale: Tectonics	Landform creation
Medium scale: Regional	Landform modification Groundwater – surface water connections Surface rock diversity weathers into diverse soils
Small scale: microhabitats	Boulders create unique microsites Influences on erosion Soil chemistry & physical properties

Modified from Montgomery (1997)

Northwest Climate

1) Climate diagrams

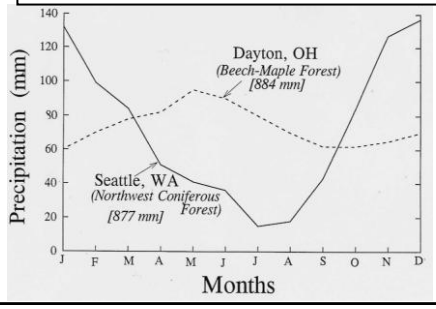
1. Temperature
2. Precipitation
3. Drought



Northwest Climate

2) Climate patterns

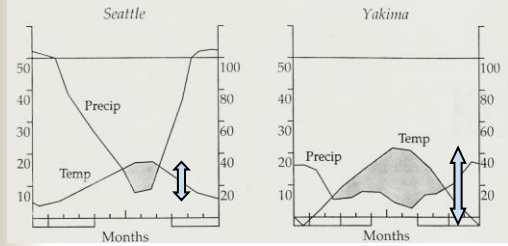
WA State: _____



Northwest Climate

2) Climate patterns

Western WA: _____ Eastern WA: _____



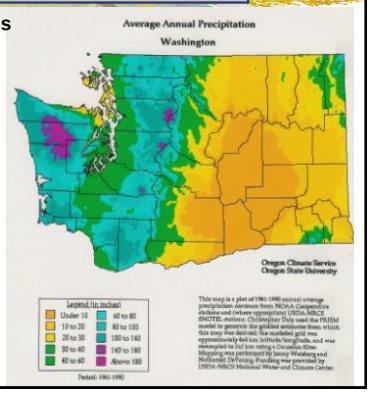
Why are these different ?

Kruckeberg (1991)

Northwest Climate

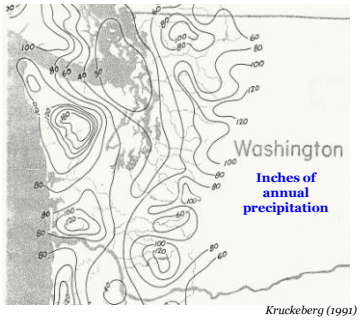
2) Climate patterns

Spatial patterns in precipitation – across WA State



Northwest Climate

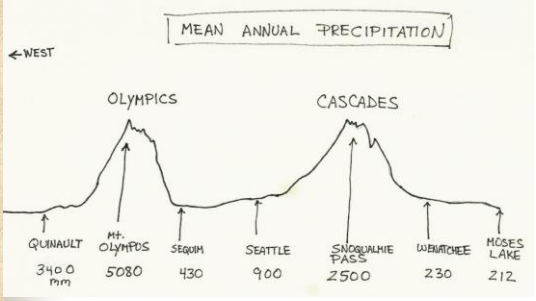
2) Climate patterns



Kruckeberg (1991)

Northwest Climate

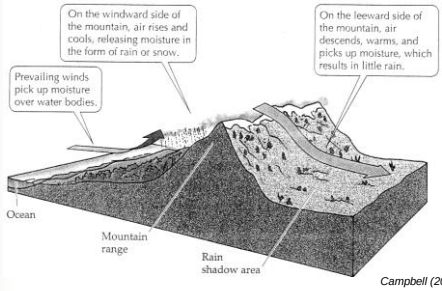
2) Climate patterns



Washington Climate

2) Climate patterns

What causes these rainshadows?

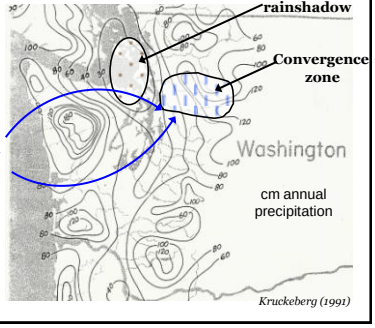


Campbell (2001)

Northwest Climate

3) Local variations in climate patterns

Prevailing Storm Track in Fall, Winter & Spring



Kruckeberg (1991)

The Abiotic Environment of the Northwest

1. Global / Continental Position
2. Regional Geography & Landforms
3. Forces Behind Landforms
4. Geology & Soils
5. Climate