
Think Globally
Act Locally

Global Warming

Strategic and Tactical Considerations for Conservation

of the

Upland Forest Communities in the Johnson Creek Watershed

JCWC Science Symposium
May 26 2016

Mart Hughes
Portland Parks & Recreation
City Nature East

Global Warming, Strategic and Tactical Considerations for Conservation of the Upland Forest Communities in the Johnson Creek Watershed

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- The projected impacts are modeled studies conducted by academic institutions,
- and by the Federal land management organizations including the US Forest Service.

Global Warming, Strategic and Tactical Considerations for Conservation of the Upland Forest Communities in the Johnson Creek Watershed

This literature provides little guidance to local environmental workers on how to address local actions to promote environmental conservation and restoration.

Global Warming, Strategic and Tactical Considerations for Conservation of the Upland Forest Communities in the Johnson Creek Watershed

- Strategic Conservation: The setting of landscape scale goals to address future climatic changes that promote ecological function, species diversity, and community resilience.

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- Tactical Conservation: Restoration and stewardship activities that benefit the current biological community structure.
  - Mulching
  - Watering
  - Weed control
  - Restoration plantings that benefit the current community

Goals

Review of the biological response to environmental forces

Review of the current environmental norms

Review of the current vegetative communities

Estimation of the magnitude of global warming in the Portland metropolitan area

Estimation of the biological impacts and physiological stress on key components of the local upland forests

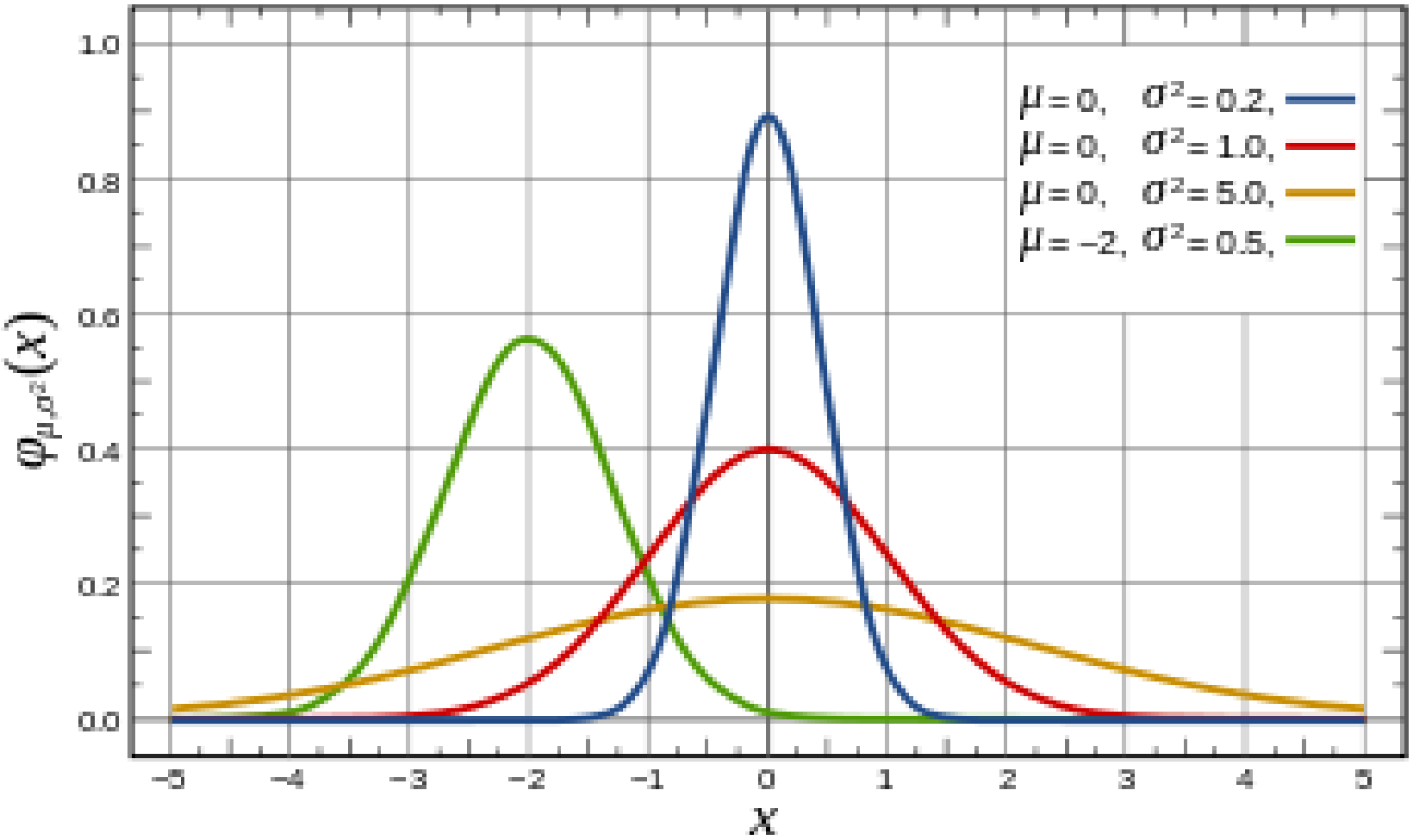
Identify natural resource management goals for an uncertain future

Biological Response to Environmental Forces

- All species respond to environmental forces in a similar pattern.
- This pattern is referred to as a bell-curve or as a normal distribution
- and may be described by mathematical means.
- Each curve may be described by a unique set of expressions the mean and variance.

Biological Response to Environmental Forces

Ideal species distributions and groups of species as communities

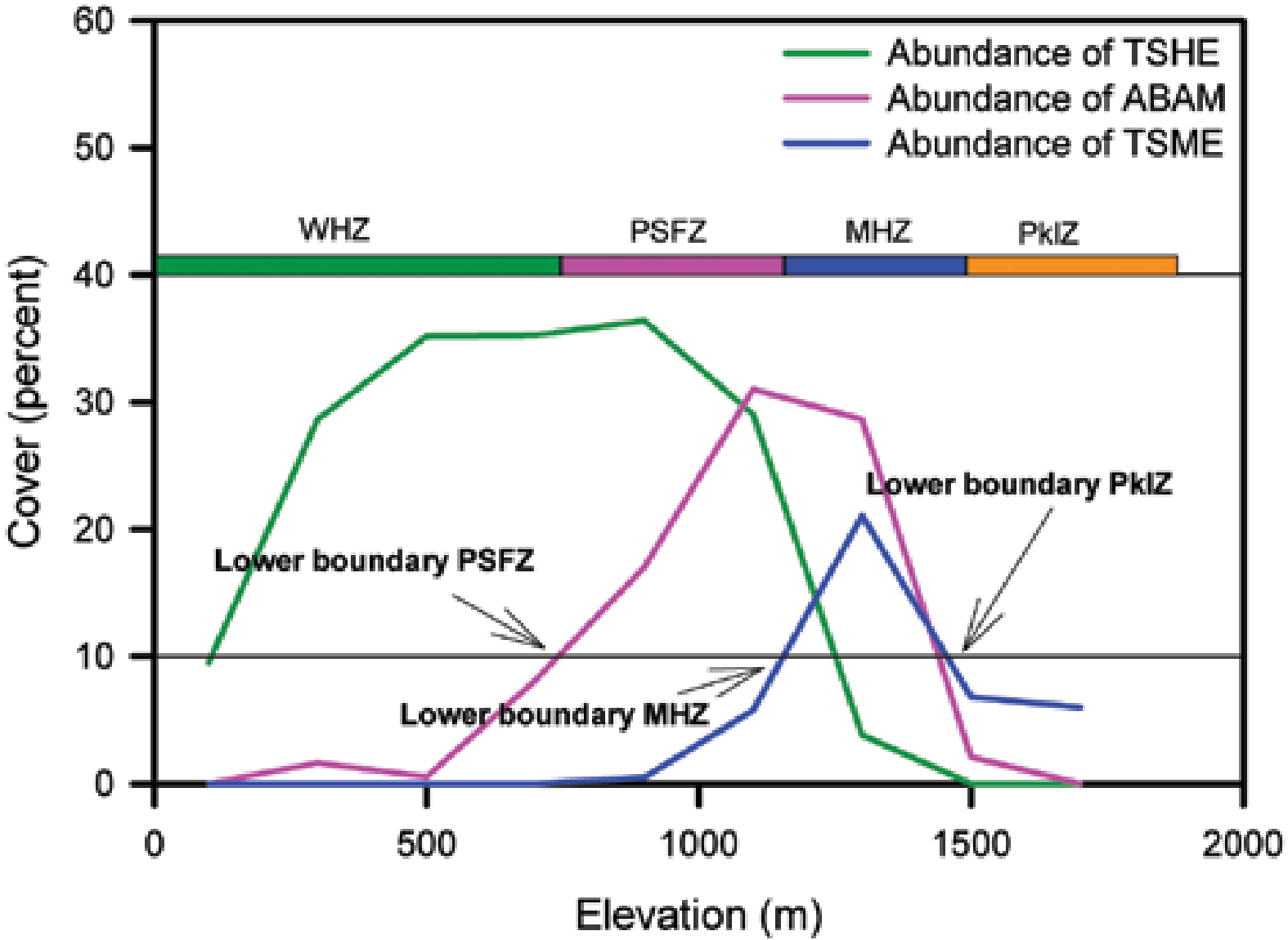


The Distribution of Forest Types Across Elevation

A Landscape Model
for
Predicting Potential Natural Vegetation
of the
Olympic Peninsula USA
Using Boundary Equations
and
Newly Developed Environmental Variables

Jan A. Henderson, Robin D. Lesher,
David H. Peter, and Chris D. Ringo

General Technical
Report
PNW-GTR-841
August 2011



Key Environmental Controls

- Primary
  - Precipitation
  - Temperature
- Secondary
  - Soil hydrological-chacteristics
  - Aspect

Vegetation Patterns

- Local Communities
- Dominate Species

Key Environmental Controls

Temperature and precipitation define around 80% of the worlds biomes

Primary

Temperature

Precipitation

Global warming impacts

A 2 degree Centigrade increase in temperature is expected.

Key Environmental Controls

Primary

Global warming impacts

Temperature

A 2 degree Centigrade increase in temperature is expected.
Lower increase of 1.5 degree is also predicted.

Precipitation

Key Environmental Controls

Primary

Global warming impacts

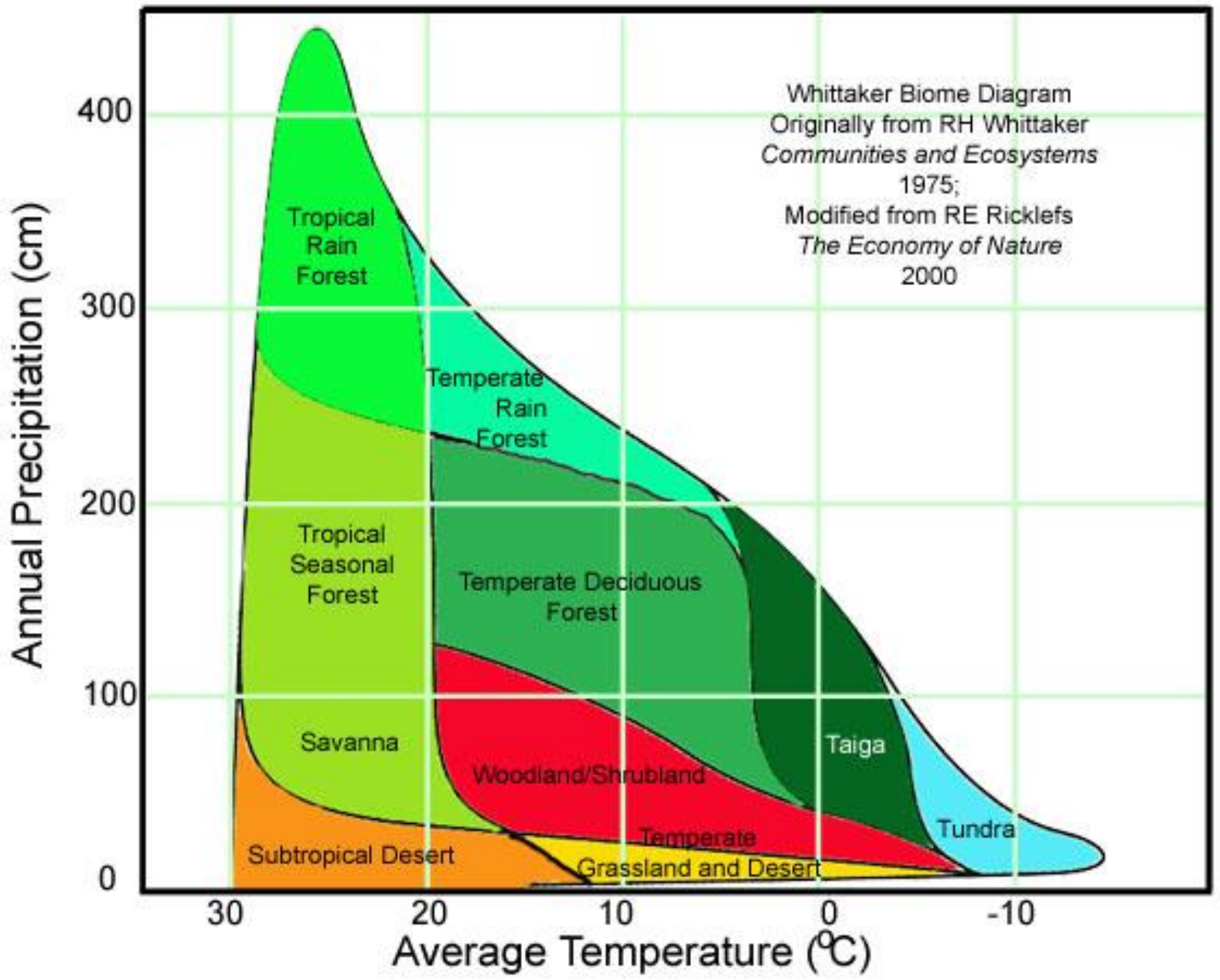
Temperature

A two degree Centigrade increase in temperature is expected.

Precipitation

Predictions of precipitation are uncertain. Despite the uncertainty future precipitation any increase in precipitation is negated by increase of evapotranspiration rates resulting in less growing season moisture is available to plants with or without an increase in growing season precipitation.

The world scale biomes mapped in environmental space.

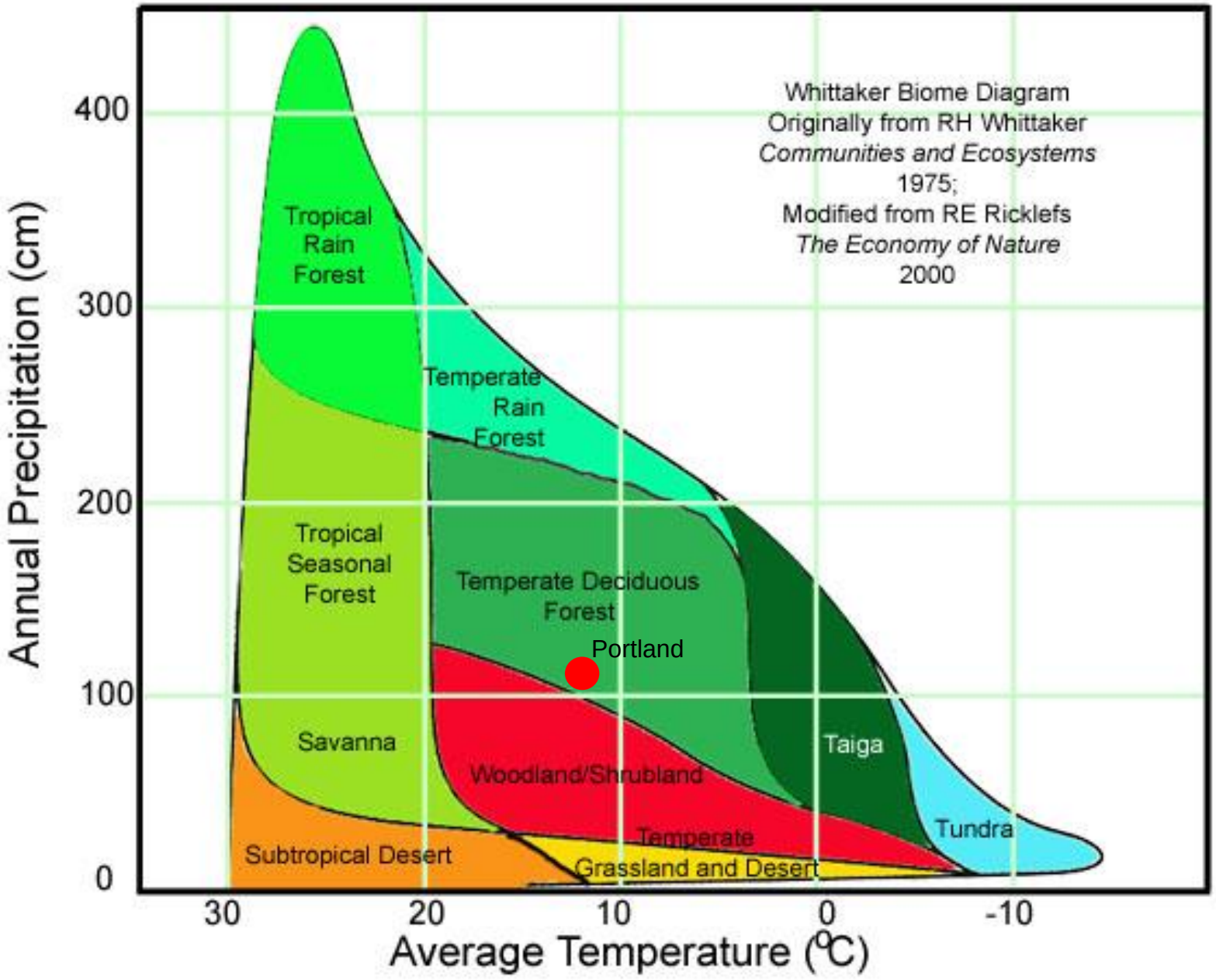


The Climatic View of the Worlds Biomes

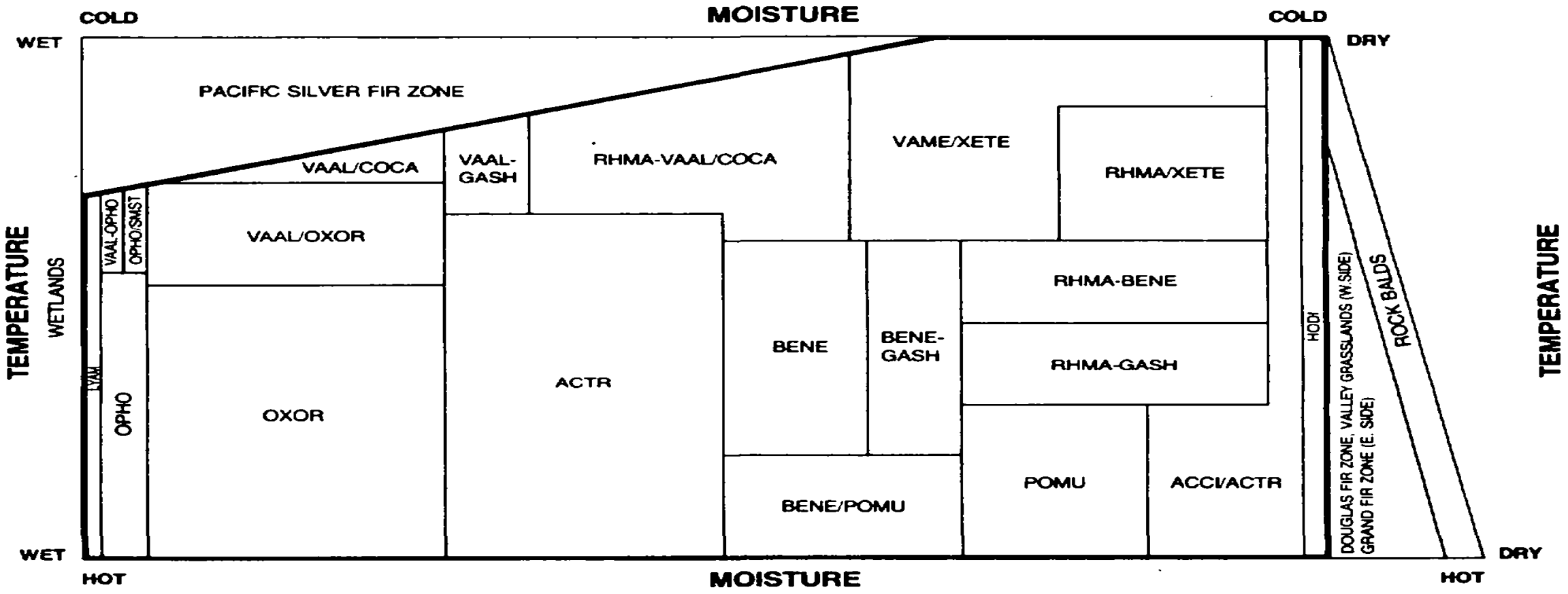
Portland Climate

Temperature	54.5^{F}	12.5^{C}
Precipitation	43.2”	109.7^{cm}

The Climatic View of the Worlds Biomes



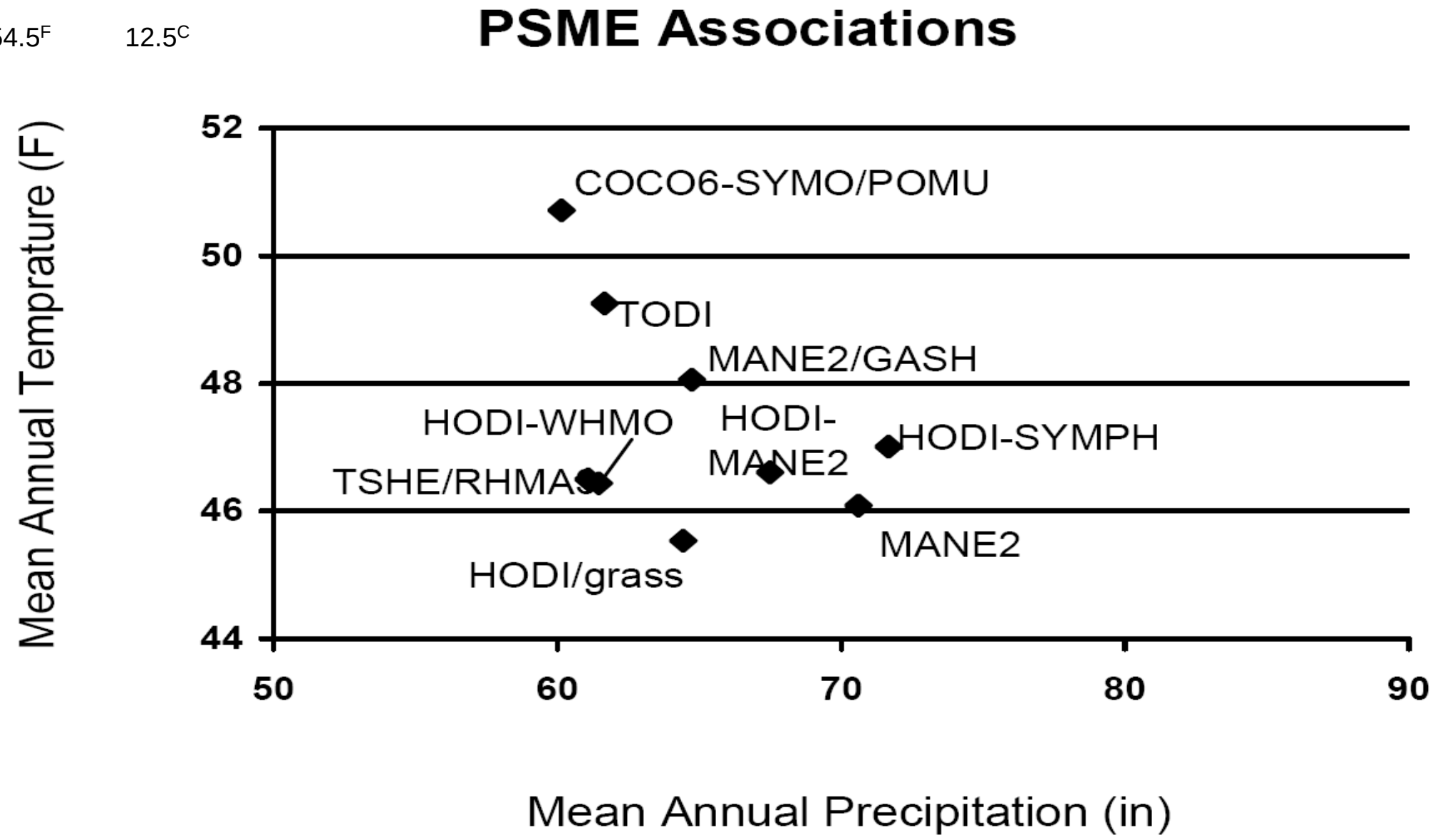
Western Hemlock Zone Communities



Plant Associations and Management Guide for the Western Hemlock Zone, Halverson 1986

Portland Climate

Temperature 54.5^{F} 12.5^{C}
Precipitation



McCain and Diaz, June 2002

Vegetation Patterns

Local Communities

Upland Communities

Soil moisture is derived only from annual precipitation. Two species dominate the landscape. The response of these two species will determine the qualitative impact of global warming.

Douglas-fir

Big-leaf Maple

Riparian and Wetland Communities

Soil moisture is largely independent of climatic precipitation and is a function of topography and watershed area.

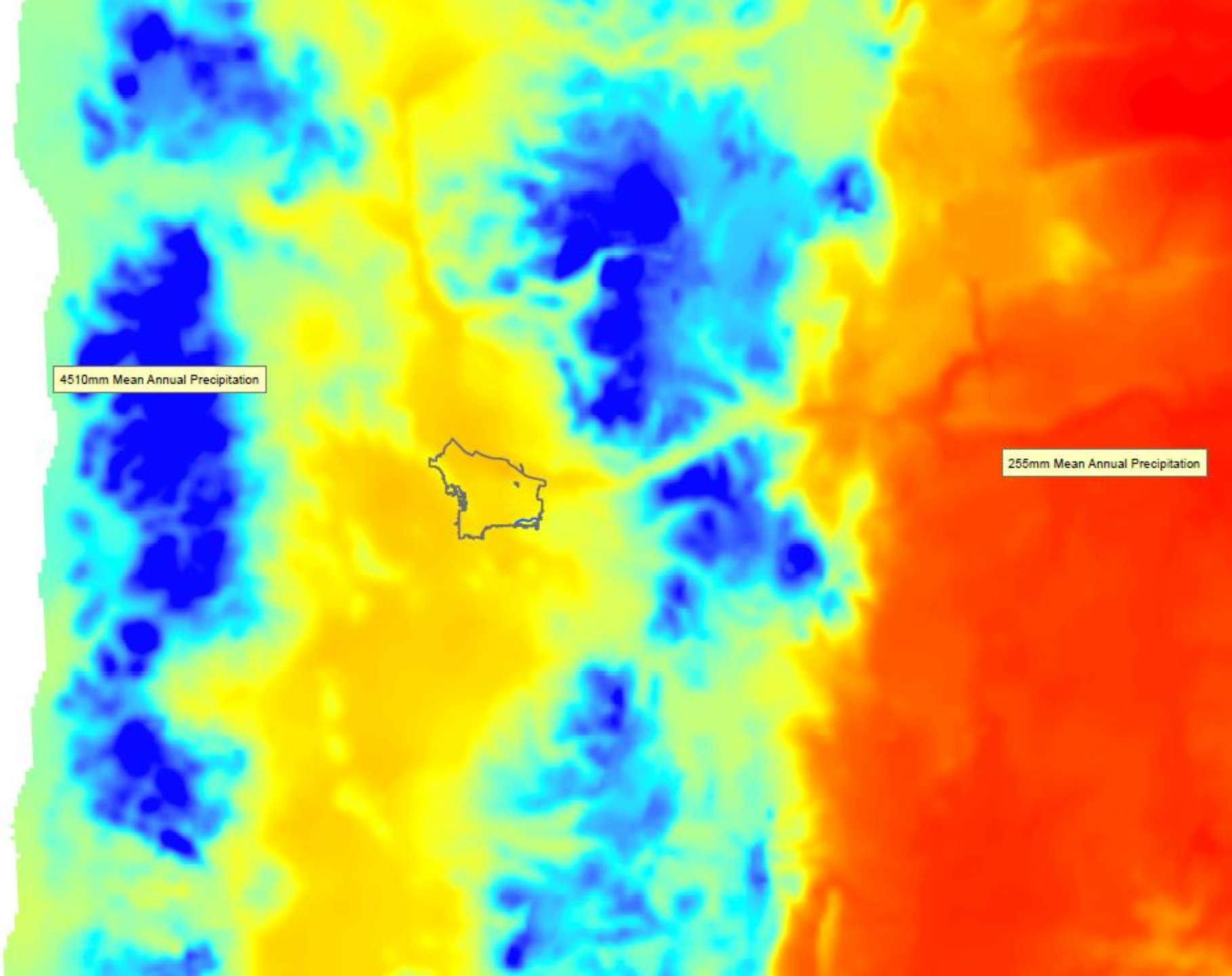
Vegetation Patterns

Dominate Species

Portland Metropolitan Area	Community Dominance
Species	Canopy Class
• Abies grandis	Minor
• Acer macrophyllum	Minor, Sub-dominant, Dominant
• Alnus rubra	Minor, Sub-dominant, Dominant
• Arbutus menziesii	Minor
• Frangula purshiana	Minor
• Fraxinus latifolia	Minor, Sub-dominant, Dominant
• Pinus ponderosa	Minor
• Pseudotsuga menziesii	Minor, Sub-dominant, Co-dominant, Dominant
• Quercus garryana	Minor, Co-dominant, Dominant
• Thuja plicata	Minor
• Tsuga heterophylla	Minor

North Western Oregon Precipitation Range

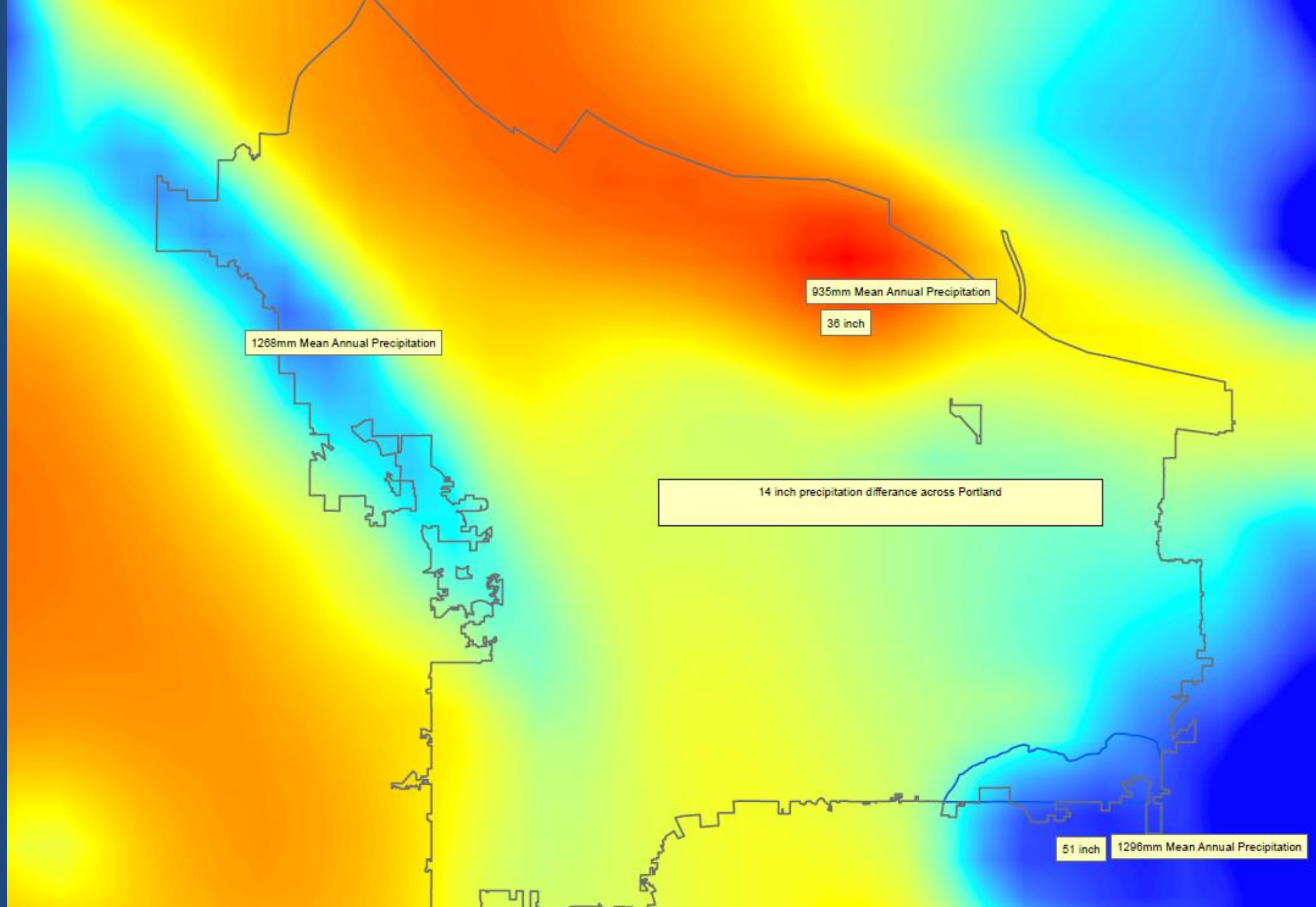
17 Times more Annual Precipitation in the Coast Range than in Eastern Oregon



PRISM
Climate Group
Northwest Alliance for Computational Science & Engineering
http://www.prism.oregonstate.edu/

PRISM

30 Year Mean Annual Precipitation For the Portland Area



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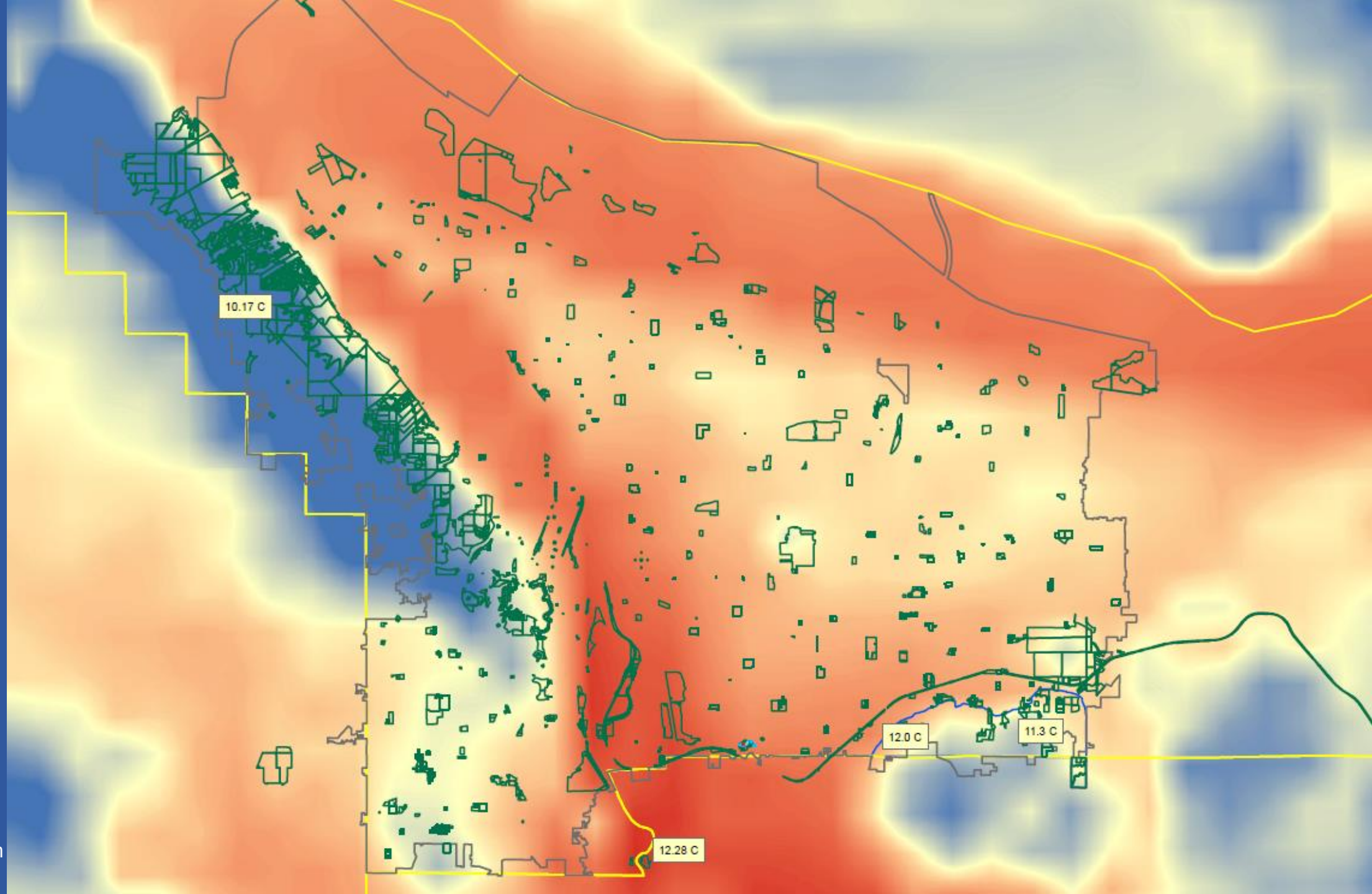
30 Year
Mean Annual
Temperature



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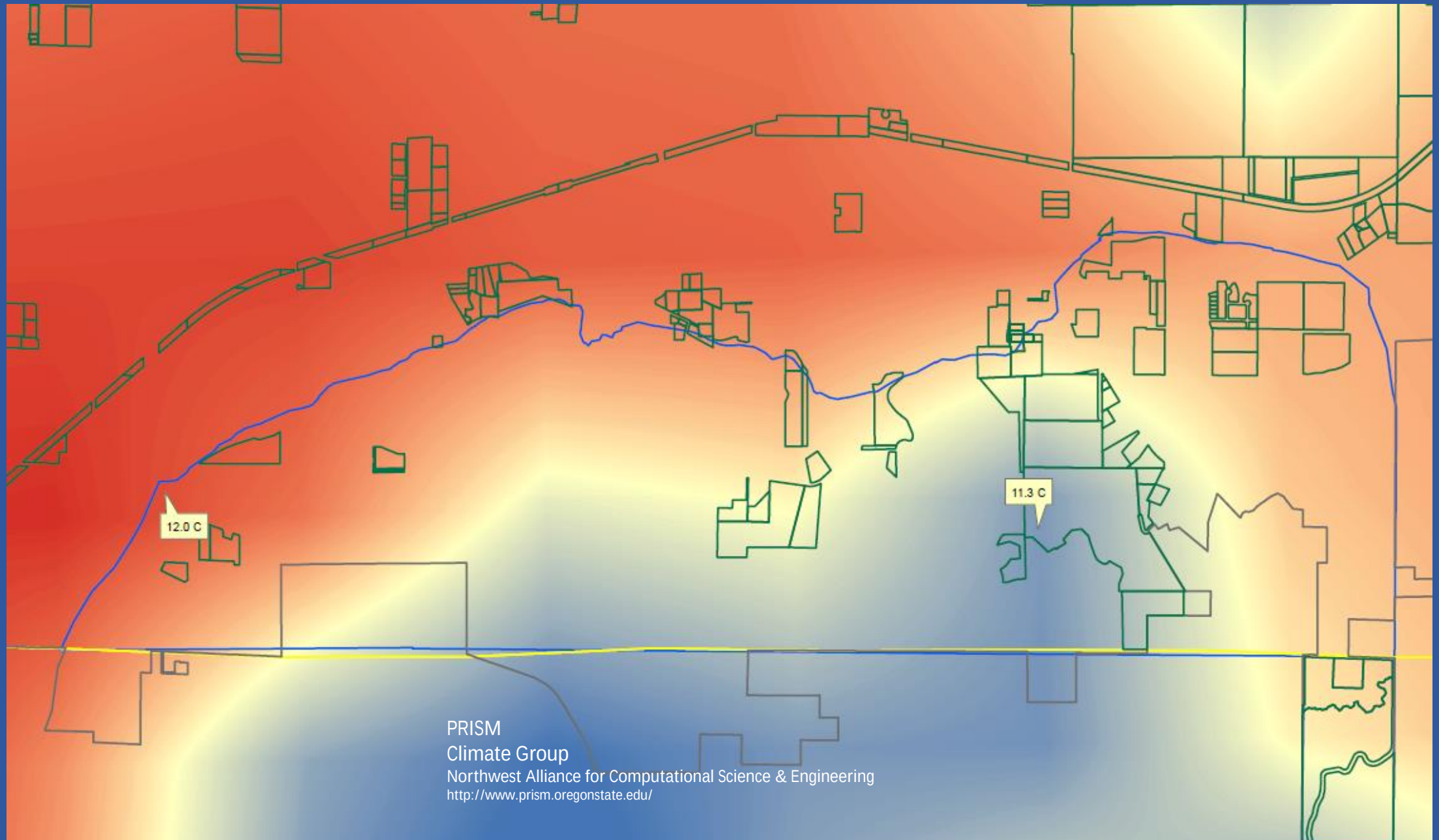
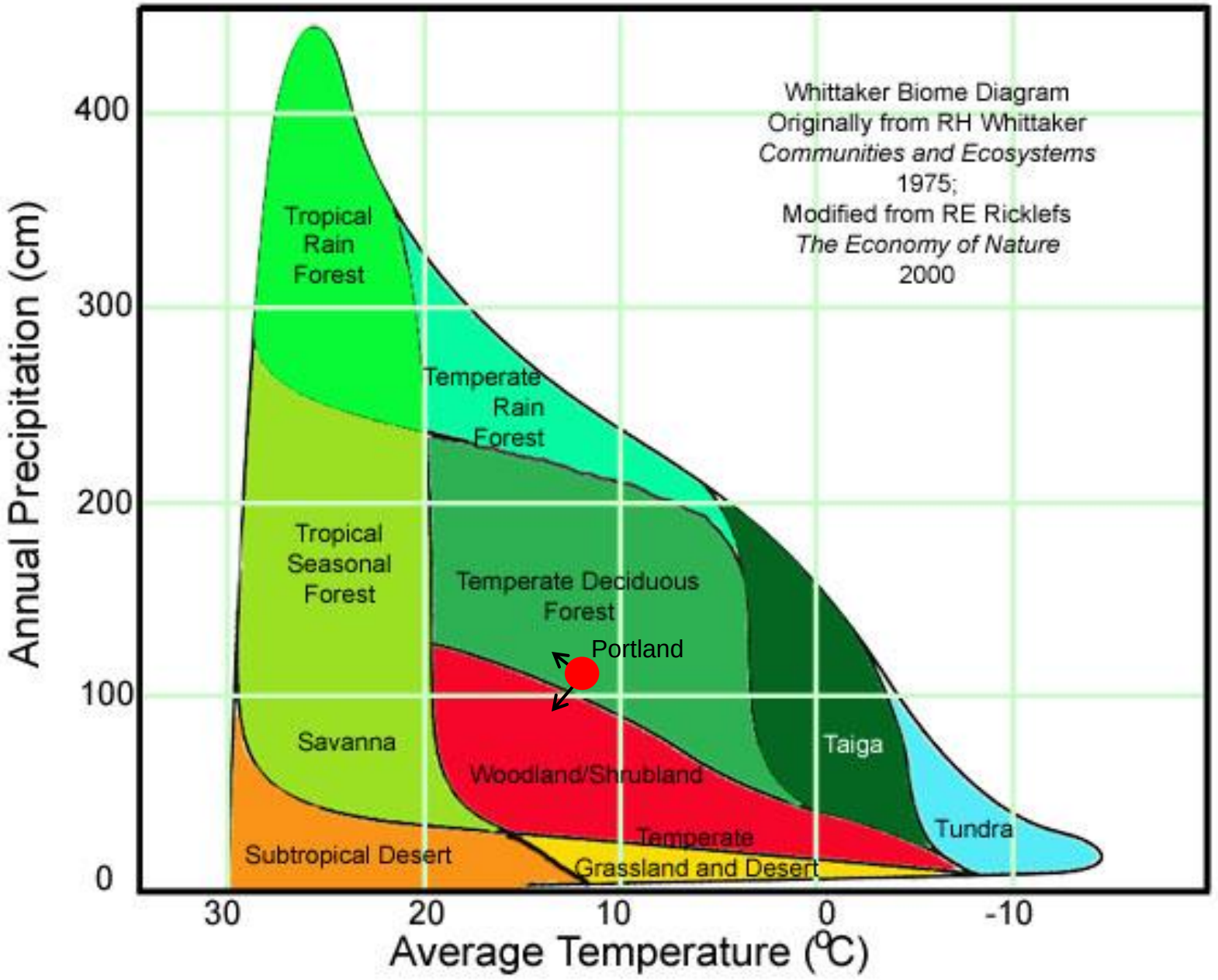
PRISM
30 Year Mean
Temperature
In the
BLD



Portland Climate
with
Climate Change in
Temperature
and
Precipitation

Assumed temperature increase with an increase or decrease in precipitation.

The Climatic View of the Worlds Biomes



Portland Climate
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Climate Change in
Temperature
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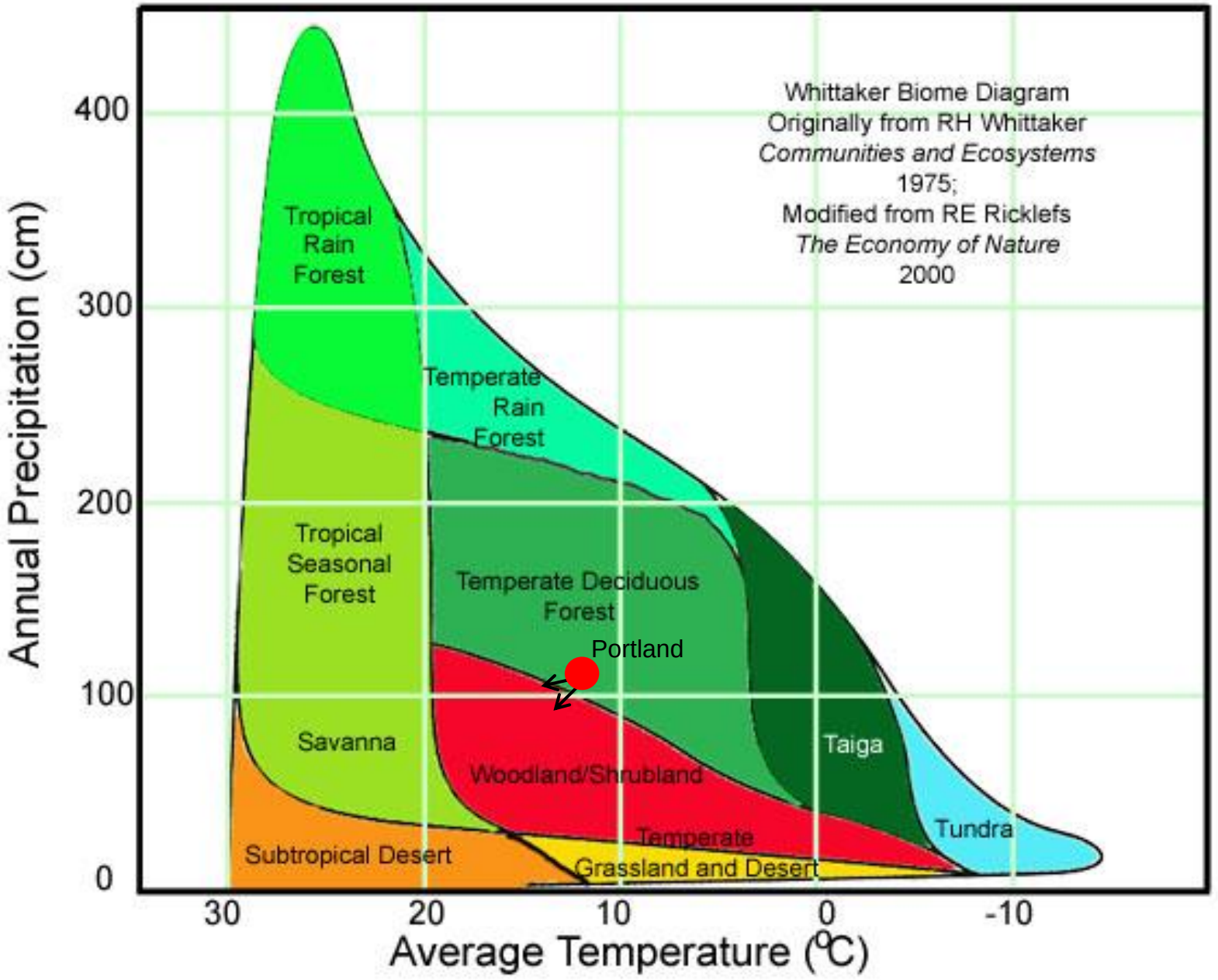
Precipitation

Assumed temperature increase with an increase or decrease in precipitation.

Probable vectors with an increase in evapotranspiration.

The Climatic View of the Worlds Biomes



Seasonal Vegetative Growth

soil, water, and temperature interaction

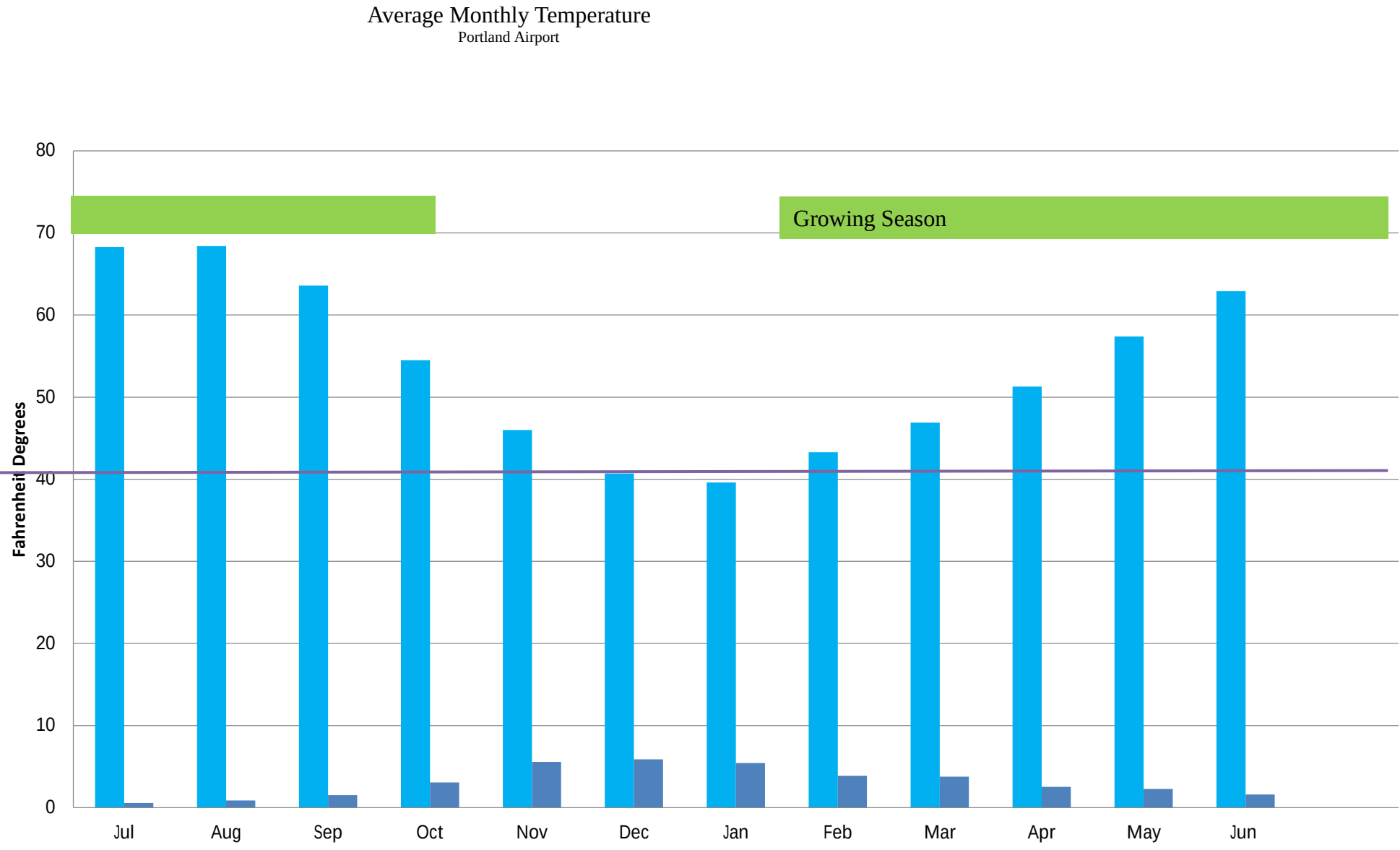
- Portland is located in a Mediterranean type climate.
- This climatic pattern establishes a key role in soils in determining the vegetative pattern.

Seasonal Temperature and Growing Season

The growing season is unique for each species. The commencement of the growing season is characterized by bud brake, flowering, and leaf development.

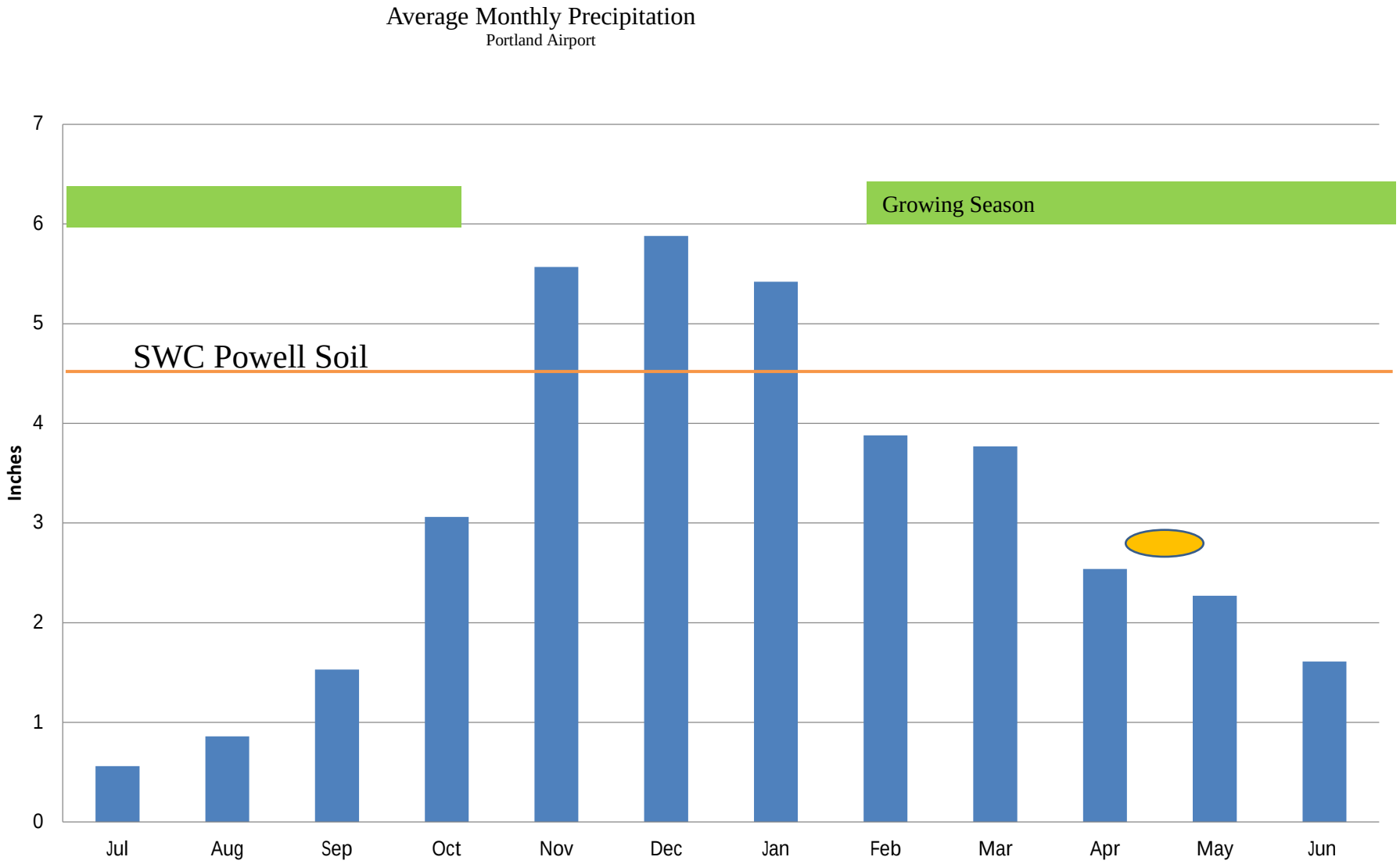
Biological 0

Biological zero is defined by 42.5 degrees C.



Soil Water Capacity

Cascade	4.6-5.7”
Powell	3.4-4.5”
Latourell	8.4-11.8”
Multnomah	6.2-8.2”



Soil

Secondary Environmental Control

Soil Water Capacity[13]

Soil	A&B Horizon Depth	Available Water Capacity ”/inch soil		Total WSC	Available* Water
Cascade	0-27”	0.17-0.21”	4.6-5.7”	117-144 mm	2.8-3.4”
Powell	0-16”	0.21-0.28”	3.4-4.5”	85-114 mm	2.0-2.7”
Haplumbrepts					
Latourell	0-56”	0.15-0.21”	8.4-11.8”	213-299 mm	5.0-7.1”
Multnomah	0-39”	0.16-0.21”	6.2-8.2”	158-208 mm	3.7-4.9”

*Available Water is 60% of the Water Storage Capacity

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Seasonal Precipitation Soil Water Capacity and Growing Season

SWC Latourell Soil

Soil Water Capacity

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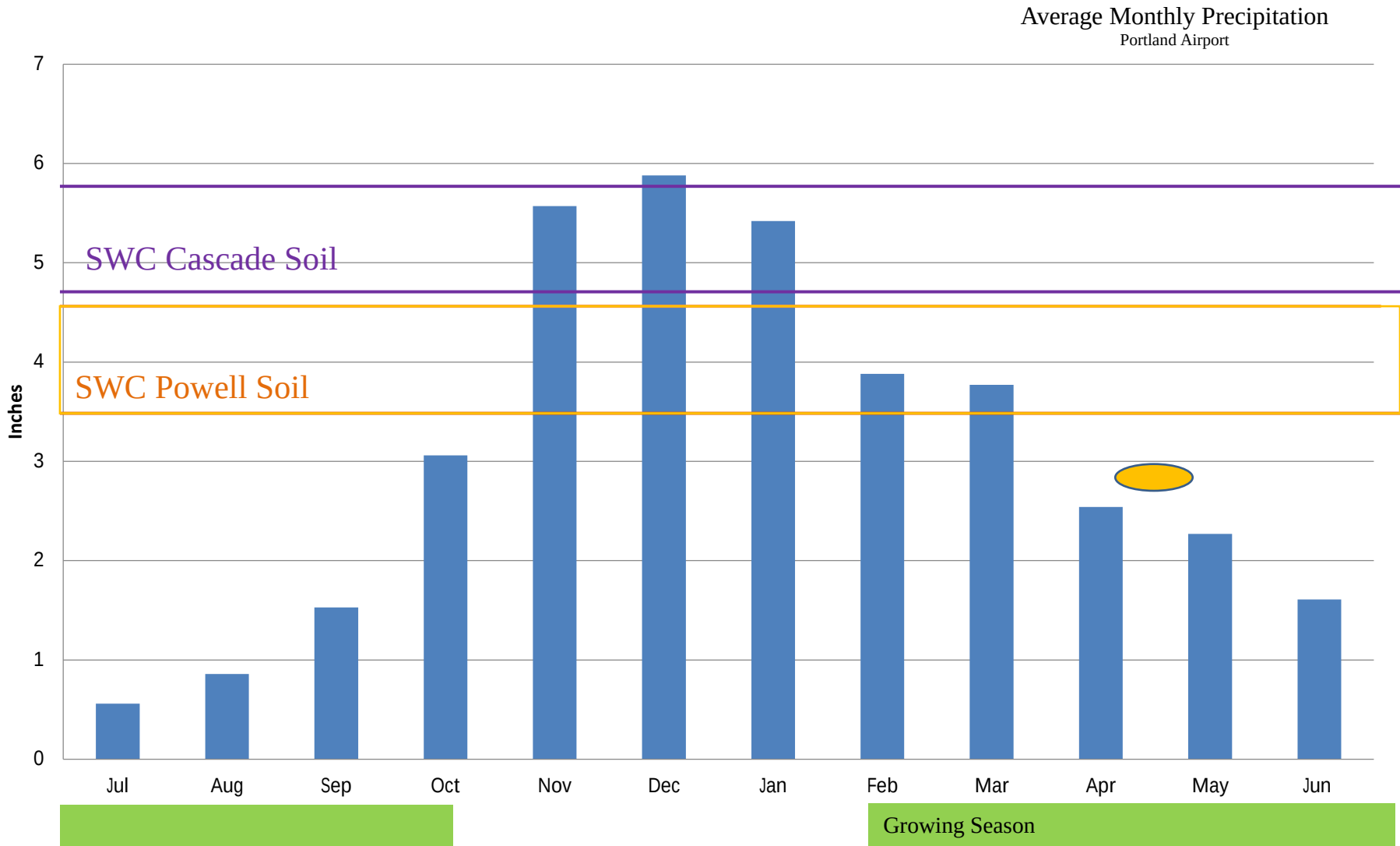
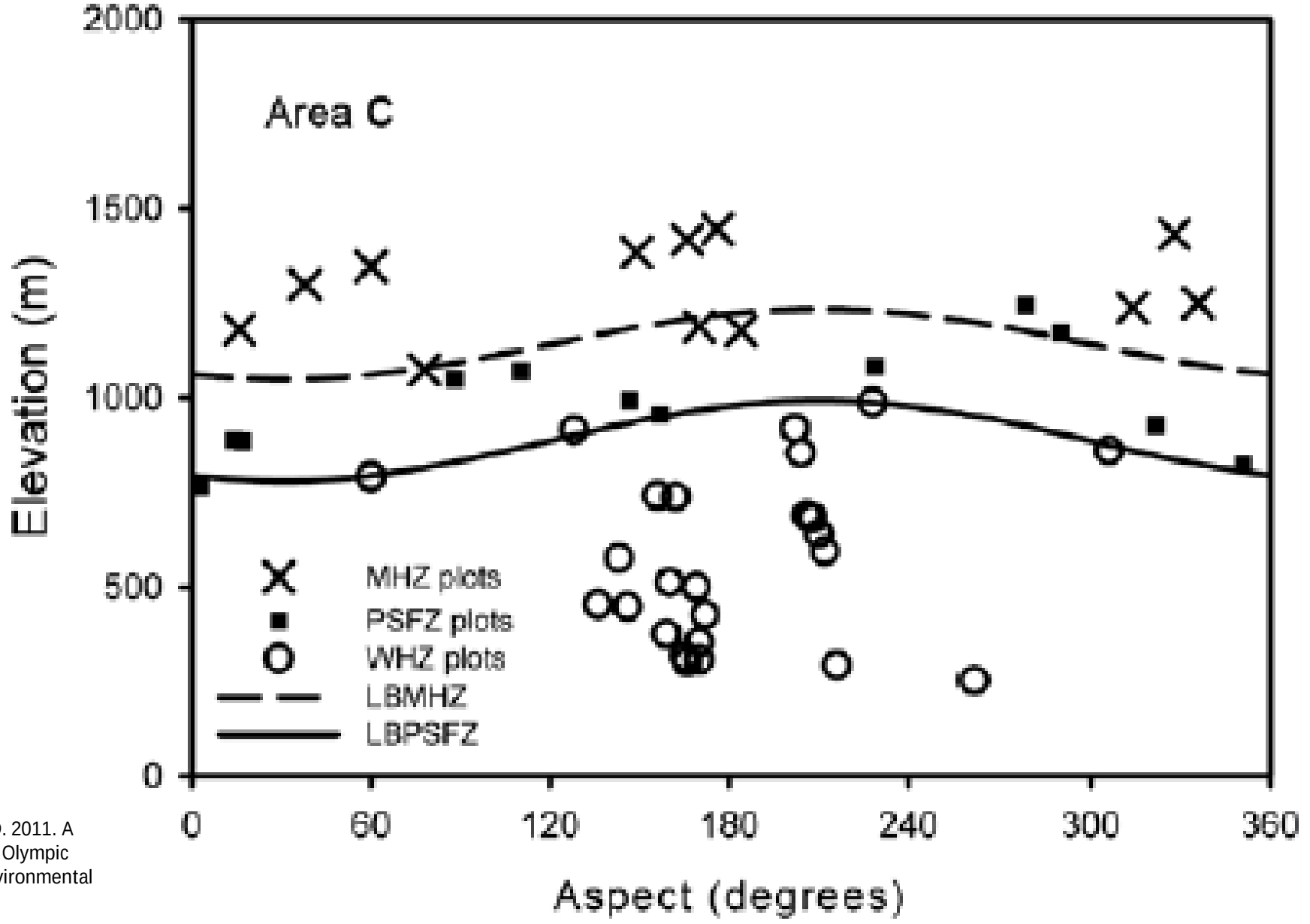
Powell	3.4-4.5”
Latourell	8.4-11.8”
Multnomah	6.2-8.2”



Response of Vegetation to Aspect



Henderson, Jan A.; Lesher, Robin D.; Peter, David H.; Ringo, Chris D. 2011. A landscape model for predicting potential natural vegetation of the Olympic Peninsula USA using boundary equations and newly developed environmental variables.

The Species Response to Annual Precipitation

- Comparison of a species normal distribution to precipitation with the current and future local norm allows an estimation of which species can thrive in the local environment.

Portland Mean Annual Precipitation	43.2”

Precipitation Ranges Scientific Name	Precipitation (Minimum)	Precipitation (Maximum)	Precipitation (Range)	Precipitation Range (Median)	Community Dominance Positon	Precipitation Diff PDX	Negative number suggests a negative response to global warming. The species mean is higher then the local mean annual precipitation mean.
Abies grandis	11	100	89	44.5	55.5	-12.3	
Acer circinatum	24	80	56	28	52	-8.8	
Acer macrophyllum	22	260	238	119	141	-97.8	
Alnus rubra	24	220	196	98	122	-78.8	A species of subsurface hydrology
Amelanchier alnifolia	12	140	128	64	76	-32.8	
Arbutus menziesii	15	163	148	74	89	-45.8	
Cornus nuttallii	12	101	89	44.5	56.5	-13.3	
Cornus sericea ssp. occidentalis	18	60	42	21	39	4.2	Riparian Species
Cornus sericea ssp. sericea	18	60	42	21	39	4.2	
Corylus cornuta	20	80	60	30	50	-6.8	
Corylus cornuta var. californica	14	100	86	43	57	-13.8	
Crataegus douglasii	16	260	244	122	138	-94.8	
Frangula purshiana	14	45	31	15.5	29.5	13.7	
Fraxinus latifolia	20	118	98	49	69	-25.8	Riparian Species

Precipitation Ranges Scientific Name	Precipitation (Minimum)	Precipitation (Maximum)	Precipitation (Range)	Precipitation Range (Median)	Community Dominance Positon	Precipitation Diff PDX	
Malus fusca	33	120	87	43.5	76.5	-33.3	Riparian Species
Oemleria cerasiformis	16	33	17	8.5	24.5	18.7	
Pinus ponderosa	15	25	10	5	20	23.2	
Populus balsamifera ssp. trichocarpa	10	125	115	57.5	67.5	-24.3	Riparian Species
Prunus emarginata	16	32	16	8	24	19.2	
Prunus virginiana	13	65	52	26	39	4.2	
Pseudotsuga menziesii	18	100	82	41	59	-15.8	
Quercus garryana	10	104	94	47	57	-13.8	
Quercus kelloggii	12	100	88	44	56	-12.8	
Rhododendron macrophyllum	55	125	70	35	90	-46.8	
Salix lucida ssp. lasiandra	16	24	8	4	20	23.2	Riparian Species
Salix scouleriana	11	40	29	14.5	25.5	17.7	Riparian Species
Salix sitchensis	35	60	25	12.5	47.5	-4.3	Wetland Species
Sambucus nigra ssp. cerulea	10	60	50	25	35	8.2	
Sambucus racemosa var. racemosa	24	60	36	18	42	1.2	
Taxus brevifolia	24	60	36	18	42	1.2	
Thuja plicata	30	120	90	45	75	-31.8	
Tsuga heterophylla	38	150	112	56	94	-50.8	

Vegetation Patterns

Dominate Species

Portland Metropolitan Area

Community Dominance

Species	Canopy Class
• Abies grandis	Minor
• Acer macrophyllum	Minor, Sub-dominant, Dominant
• Alnus rubra	Minor, Sub-dominant, Dominant
• Arbutus menziesii	Minor
• Frangula purshiana	Minor
• Fraxinus latifolia	Minor, Sub-dominant, Dominant
• Pinus ponderosa	Minor
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• Quercus garryana	Minor, Co-dominant, Dominant
• Thuja plicata	Minor
• Tsuga heterophylla	Minor

Local Community Types

NVCS Alliance	NVCS Association
Abies grandis Giant Forest Alliance	Abies grandis - Acer macrophyllum / Acer circinatum - Corylus cornuta
	Abies grandis - Tsuga heterophylla / Polystichum munitum Forest
Acer macrophyllum Forest Alliance	Acer macrophyllum - Alnus rubra / Polystichum munitum - Tellima grandiflora Forest
	Acer macrophyllum - Thuja plicata / Oemleria cerasiformis Forest
	Acer macrophyllum / Acer circinatum Forest
Acer macrophyllum Seasonally Flooded Forest Alliance	Acer macrophyllum / Rubus spectabilis Forest
	Acer macrophyllum / Symphoricarpos albus / Urtica dioica ssp. gracilis Forest
	Acer macrophyllum / Urtica dioica ssp. gracilis Forest
	Acer macrophyllum / Symphoricarpos albus
Alnus rubra Forest Alliance	Alnus rubra / Polystichum munitum Forest
Alnus rubra Seasonally Flooded Forest Alliance	Acer macrophyllum - Alnus rubra / Urtica dioica
	Alnus rubra / Acer circinatum / Claytonia sibirica Forest
	Alnus rubra / Athyrium filix-femina - Lysichiton americanus Forest
	Alnus rubra / Rubus spectabilis Forest
	Alnus rubra / Cornus sericea - westside forb

Local Community Types

Fraxinus latifolia Temporarily Flooded Forest Alliance	Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Corylus cornuta - Physocarpus capitatus Forest
	Fraxinus latifolia - Populus balsamifera ssp. trichocarpa / Symphoricarpos albus Forest
Juncus effusus Seasonally Flooded Herbaceous Alliance	Juncus effusus var. brunneus Pacific Coast Herbaceous Vegetation
Lemna spp. Permanently Flooded Herbaceous Alliance	Lemna minor Herbaceous Vegetation
Populus balsamifera ssp. trichocarpa Temporarily Flooded Forest Alliance	Populus balsamifera ssp. trichocarpa - Acer macrophyllum / Symphoricarpos albus Forest
	Populus balsamifera ssp. trichocarpa - Alnus rubra / Symphoricarpos albus Forest
	Populus balsamifera ssp. trichocarpa - Fraxinus latifolia Forest
	Populus balsamifera ssp. trichocarpa - Pseudotsuga menziesii
	Populus balsamifera ssp. trichocarpa / Cornus sericea / Impatiens capensis Forest
Pseudotsuga menziesii - Acer macrophyllum Forest Alliance	Acer macrophyllum - Pseudotsuga menziesii / Acer circinatum / Polystichum munitum Forest
	Acer macrophyllum - Pseudotsuga menziesii / Acer circinatum / Polystichum munitum Forest
	Acer macrophyllum - Pseudotsuga menziesii / Corylus cornuta / Hydrophyllum tenuipes Forest
Pseudotsuga menziesii - Quercus garryana Woodland Alliance	Arbutus menziesii - Pseudotsuga menziesii - Quercus spp. / Toxicodendron diversilobum Woodland
	Pseudotsuga menziesii - Quercus garryana / Symphoricarpos albus Woodland

Local Community Types

Pseudotsuga menziesii - Tsuga heterophylla Forest Alliance	Pseudotsuga menziesii - Tsuga heterophylla / Gaultheria shallon Forest
	Pseudotsuga menziesii - Tsuga heterophylla / Mahonia nervosa Forest
	Pseudotsuga menziesii - Tsuga heterophylla / Polystichum munitum Forest
Pseudotsuga menziesii Forest Alliance	Pseudotsuga menziesii - Arbutus menziesii / Gaultheria shallon Forest
	Pseudotsuga menziesii / Acer circinatum - Holodiscus discolor Forest
	Pseudotsuga menziesii / Acer circinatum Forest
	Pseudotsuga menziesii / Gaultheria shallon Forest
	Pseudotsuga menziesii / Symphoricarpos albus - Holodiscus discolor Forest
Pseudotsuga menziesii Giant Forest Alliance	Pseudotsuga menziesii / Corylus cornuta / Polystichum munitum Forest
	Pseudotsuga menziesii / Gaultheria shallon / Polystichum munitum Forest
	Pseudotsuga menziesii / Mahonia nervosa
	Pseudotsuga menziesii / Polystichum munitum Forest
Quercus garryana Woodland Alliance	Quercus garryana / Viburnum ellipticum - Toxicodendron diversilobum Woodland
Salix hookeriana Seasonally Flooded Shrubland Alliance	Salix geyeriana - Salix hookeriana Shrubland
	Salix lucida ssp. lasiandra / Salix sitchensis / Lysichiton americanus

Towards a Strategic View of the Regional Floristic Communities Global Warming Impacts will Vary in Respect to

- Slope and Aspect
- Soil
- Ecological Structure
- Current Ecological Community

Restoration Ecologist

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Avocations

- Kayaking
- Sailing
- Botany and Plant Geography
- Photography
- Kendo & Iaido
- Cooking

So long and thanks for the fish!

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