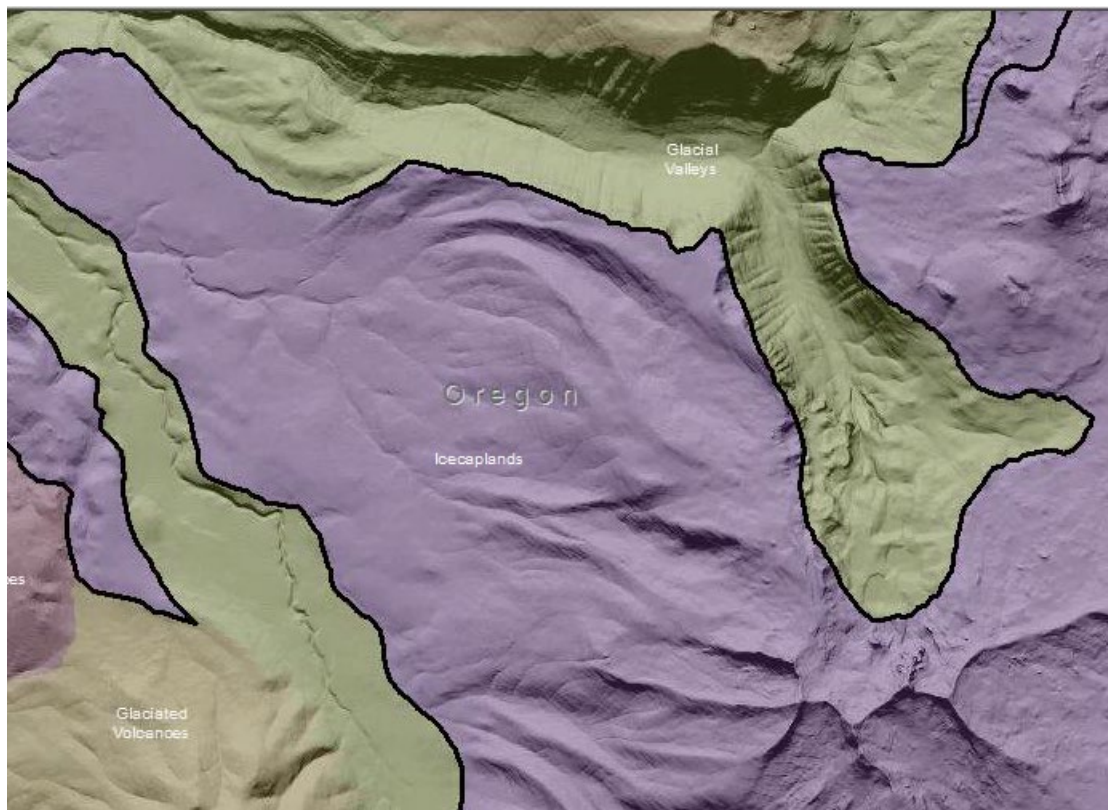


Cascades Icecaplands

Terrain Class: Mountains - No one process responsible for construction of mountains. They can be uplifted, tectonic, subduction of plates, folding, uplift, up and down warping of the mantle, inflation of molten lower crustal (batholiths), etc. Erosion of mountain systems occurs over time. The rate of erosion is dependent on the geomorphic process, the underlying rock structure, and the climate, including both freeze thaw and the amount and intensity of precipitation and runoff. Mountains are further defined and distinguished based on morphology, including the pattern and density of drainages, depth of drainages, overall morphology of the area between the drainages, evidence of a strong imprint of a surficial process such as glaciation, and presence of visible underlying rock structure.

Mountains have simple to very complex forms that have arisen due to inherited rock structure, rock history, and are the net result of local to regional spatial scales of competing rates of upbuilding/uplift and downgrading/erosion. Mountains will have an inherited history from weathering and degradation of the underlying stack of earth materials that forms them. Vegetation, habitat, water interception, collection and transport will share a similar history in the same type of uplift and rock.

Landform Association: Icecaplands



Icecaplands are a relatively new concept in mapping in the Cascades. This is terrain that has hosted or is hosting an ice cap. The terrain is a broadly scoured area and remnant glaciers may be present. The Olympic Mountains and North Cascades are examples of current icecaps. Upland areas show evidence of glaciation of an even greater magnitude than that which formed the adjoining glacial valley. Scouring

and some deposition are evident at all elevations. In ranges where volcanism was present the tops of buttes that were extruded under the ice sheet have flat topped, fan or propeller shaped forms as a result of contact with the overlaying ice sheet. The ice sheet sheared the sub-glacial magma flows leaving these distinctly shaped forms. Eskers are left behind, as the ice cap melted. The eskers appear as cobble/sediment ridges and are the remains of deposits left in sub glacial channels. As water flowed under the ice cap there were areas of aggradation. As the ice cap melted these aggraded areas have a higher and linear relief above the scoured surrounding terrain. Eskers can be found ascending ridges as well as along valley floors. Moraines are also present with successive terminal moraines common and forming curvilinear ridges that fan across the landscape for miles. Medial moraines, that indicate the flow lines of glaciers long vanished, are often visible as ridges. Seemingly stranded in the landscape moraines or ice cap margins can indicate the borders of Pleistocene lakes and delineate icecap borderlands, landforms not entirely glacier formed that existed on the glacial margins. Ice cap uplands are mountains that the icecap flowed over and sculpted.

This Landform Association has an abundant spatial extent on National Forest System Lands.

Landtype Associations: Landtype Associations are formed by intersecting vegetation series or groups of vegetation series with Landform Associations.

Topography:

The following tables represent the average conditions for the Landform Association. Only lands within and adjacent to National Forest System Lands were mapped by this project. The entire EPA Level III Ecoregion is not covered by this mapping.

The percent of Landform Association (% of LfA) in bold in the table below refers to the percent of the Ecoregion represented by that Landform Association. The (% of LfA) numbers not in bold in the table below refer to the percent of each Landtype Association within the Landform Association.

Landform Association/Landtype Association	% of LfA	Mean % Slope	Minimum Elevation (m)	Maximum Elevation (m)	Mean Elevation (m)	% Northerly Aspect (226° - 134°)	% Southerly Aspect (135° - 225°)
Icecaplands	9.8%	22	1144	1490	1309	73%	27%
Icecaplands, Douglas-Fir - Pacific Silver Fir - mix	0.1%	55	871	1788	1420	31%	69%
Icecaplands, Douglas-Fir - Western Hemlock - mix	0.1%	40	941	1614	1346	52%	48%
Icecaplands, Grand Fir - Parkland	0.0%	63	1195	1896	1545	30%	70%
Icecaplands, Grand Fir-White Fir	6.4%	17	1194	1491	1332	70%	30%
Icecaplands, Grand Fir-White Fir - Developed	0.0%	7	1341	1445	1377	99%	1%
Icecaplands, Grand Fir-White Fir - Mountain Hemlock	0.4%	12	1358	1485	1412	68%	32%
Icecaplands, Grand Fir-White Fir - Pacific Silver Fir	0.5%	33	1249	1585	1401	51%	49%
Icecaplands, Grand Fir-White Fir - Pacific Silver Fir - mix	0.0%	14	1264	1431	1306	90%	10%
Icecaplands, Grand Fir-White Fir - Ponderosa Pine	0.3%	11	1439	1600	1494	78%	22%
Icecaplands, Grand Fir-White Fir - Rock	0.1%	9	925	1086	1015	93%	7%
Icecaplands, Grand Fir-White Fir - Shasta Red Fir	0.1%	21	1552	1767	1639	64%	36%
Icecaplands, Grand Fir-White Fir - Subalpine Fir	0.1%	8	1426	1508	1461	71%	29%
Icecaplands, Grand Fir-White Fir - Western Hemlock	0.6%	15	1154	1415	1270	70%	30%
Icecaplands, Mountain Hemlock	62.0%	24	1295	1813	1546	83%	17%
Icecaplands, Mountain Hemlock - Grand Fir	0.0%	42	1274	1639	1520	63%	37%
Icecaplands, Mountain Hemlock - Pacific Silver Fir	0.6%	21	1107	1399	1251	74%	26%
Icecaplands, Mountain Hemlock - Parkland	0.1%	36	1254	1869	1589	42%	58%
Icecaplands, Mountain Hemlock - Parkland - mix	0.0%	5	1475	1530	1499	52%	48%
Icecaplands, Mountain Hemlock - Ponderosa Pine	0.0%	15	1514	1585	1545	100%	0%
Icecaplands, Mountain Hemlock - Shasta Red Fir	0.2%	5	1264	1365	1285	76%	24%
Icecaplands, Mountain Hemlock - Subalpine Fir - mix	0.0%	9	1444	1498	1466	79%	21%
Icecaplands, Mountain Hemlock - Western Hemlock	0.0%	26	1193	1468	1328	97%	3%
Icecaplands, Pacific Silver Fir	12.3%	23	1042	1423	1225	76%	24%
Icecaplands, Pacific Silver Fir - Douglas-Fir	0.0%	66	988	1675	1366	78%	22%
Icecaplands, Pacific Silver Fir - Grand Fir	0.0%	48	1318	1745	1601	46%	54%
Icecaplands, Pacific Silver Fir - Grand Fir-White Fir	0.7%	24	1164	1488	1322	67%	33%
Icecaplands, Pacific Silver Fir - Mountain Hemlock	0.3%	13	1088	1304	1169	74%	26%
Icecaplands, Pacific Silver Fir - Parkland	0.0%	51	1177	1649	1408	95%	5%
Icecaplands, Pacific Silver Fir - Water	0.0%	6	985	1151	1009	78%	22%
Icecaplands, Pacific Silver Fir - Western Hemlock	3.4%	24	1013	1401	1183	77%	23%
Icecaplands, Parkland	0.6%	15	1713	1946	1818	79%	21%
Icecaplands, Parkland - Rock	0.2%	37	1535	2138	1930	77%	23%
Icecaplands, Parkland - Shasta Red Fir	0.1%	39	1835	2273	2103	68%	32%
Icecaplands, Ponderosa Pine	1.2%	6	1464	1745	1574	86%	14%
Icecaplands, Ponderosa Pine - Mountain Hemlock - mix	0.1%	6	1439	1612	1482	82%	18%
Icecaplands, Rock	0.1%	19	1753	2087	1961	72%	28%
Icecaplands, Shasta Red Fir	0.2%	9	1581	1737	1652	84%	16%
Icecaplands, Shasta Red Fir - Grand Fir-White Fir	0.1%	13	1468	1671	1542	89%	11%
Icecaplands, Subalpine Fir	0.1%	11	1377	1515	1448	74%	26%
Icecaplands, Water	0.1%	1	1261	1280	1261	95%	5%
Icecaplands, Water - Pacific Silver Fir	0.0%	3	1452	1460	1453	54%	46%
Icecaplands, Western Hemlock	5.9%	27	785	1173	970	67%	33%
Icecaplands, Western Hemlock - Douglas-Fir	0.1%	40	938	1530	1252	30%	70%
Icecaplands, Western Hemlock - Grand Fir-White Fir	0.6%	15	1049	1300	1156	81%	19%
Icecaplands, Western Hemlock - Grasslands / Meadows	0.0%	12	1218	1369	1289	87%	13%
Icecaplands, Western Hemlock - Mountain Hemlock	0.4%	12	1081	1311	1173	80%	20%
Icecaplands, Western Hemlock - Pacific Silver Fir	1.1%	25	1034	1368	1203	64%	36%
Icecaplands, Western Hemlock - Pacific Silver Fir - mix	0.5%	9	1030	1240	1124	76%	24%

Climate:

Landtype Association	Mean Annual Precipitation (mm)	Mean Annual Temperature °C	AET/PET Ratio July, Aug, Sept
Icecaplands	1711	7	0.46
Icecaplands, Douglas-Fir - Pacific Silver Fir - mix	2278	6	0.53
Icecaplands, Douglas-Fir - Western Hemlock - mix	2209	7	0.55
Icecaplands, Grand Fir - Parkland	2290	6	0.42
Icecaplands, Grand Fir-White Fir	1476	7	0.43
Icecaplands, Grand Fir-White Fir - Developed	1399	7	0.40
Icecaplands, Grand Fir-White Fir - Mountain Hemlock	1401	6	0.38
Icecaplands, Grand Fir-White Fir - Pacific Silver Fir	1607	7	0.49
Icecaplands, Grand Fir-White Fir - Pacific Silver Fir - mix	1545	7	0.35
Icecaplands, Grand Fir-White Fir - Ponderosa Pine	967	5	0.27
Icecaplands, Grand Fir-White Fir - Rock	2206	8	0.39
Icecaplands, Grand Fir-White Fir - Shasta Red Fir	1061	6	0.25
Icecaplands, Grand Fir-White Fir - Subalpine Fir	960	6	0.31
Icecaplands, Grand Fir-White Fir - Western Hemlock	1487	7	0.52
Icecaplands, Mountain Hemlock	1821	6	0.40
Icecaplands, Mountain Hemlock - Grand Fir	2121	6	0.51
Icecaplands, Mountain Hemlock - Pacific Silver Fir	1798	6	0.53
Icecaplands, Mountain Hemlock - Parkland	2007	6	0.33
Icecaplands, Mountain Hemlock - Parkland - mix	1037	6	0.23
Icecaplands, Mountain Hemlock - Ponderosa Pine	1047	6	0.26
Icecaplands, Mountain Hemlock - Shasta Red Fir	1567	7	0.34
Icecaplands, Mountain Hemlock - Subalpine Fir - mix	955	6	0.28
Icecaplands, Mountain Hemlock - Western Hemlock	1360	8	0.53
Icecaplands, Pacific Silver Fir	1874	7	0.52
Icecaplands, Pacific Silver Fir - Douglas-Fir	2164	7	0.51
Icecaplands, Pacific Silver Fir - Grand Fir	2275	6	0.44
Icecaplands, Pacific Silver Fir - Grand Fir-White Fir	1731	7	0.48
Icecaplands, Pacific Silver Fir - Mountain Hemlock	1778	7	0.57
Icecaplands, Pacific Silver Fir - Parkland	2558	5	0.51
Icecaplands, Pacific Silver Fir - Water	1467	6	0.48
Icecaplands, Pacific Silver Fir - Western Hemlock	1703	7	0.54
Icecaplands, Parkland	1767	5	0.25
Icecaplands, Parkland - Rock	2605	4	0.26
Icecaplands, Parkland - Shasta Red Fir	1838	5	0.21
Icecaplands, Ponderosa Pine	931	6	0.27
Icecaplands, Ponderosa Pine - Mountain Hemlock - mix	1063	6	0.27
Icecaplands, Rock	3072	3	0.16
Icecaplands, Shasta Red Fir	1343	6	0.24
Icecaplands, Shasta Red Fir - Grand Fir-White Fir	1245	6	0.29
Icecaplands, Subalpine Fir	932	6	0.35
Icecaplands, Water	1413	6	0.30
Icecaplands, Water - Pacific Silver Fir	1199	6	0.32
Icecaplands, Western Hemlock	2011	8	0.54
Icecaplands, Western Hemlock - Douglas-Fir	2074	7	0.57
Icecaplands, Western Hemlock - Grand Fir-White Fir	1491	8	0.55
Icecaplands, Western Hemlock - Grasslands / Meadows	1863	6	0.52
Icecaplands, Western Hemlock - Mountain Hemlock	1488	7	0.56
Icecaplands, Western Hemlock - Pacific Silver Fir	1631	7	0.52
Icecaplands, Western Hemlock - Pacific Silver Fir - mix	1197	7	0.54

The ratio of Actual Evapotranspiration to Potential Evapotranspiration (AET/PET) is used as a broad-scale indicator of potential drought stress. We obtained modeled actual and potential evapotranspiration datasets from the Numerical Terradynamic

Simulation Group at the University of Montana (<http://www.ntsg.umt.edu/project/mod16>) for a 30 year climate average. AET/PET ratio in the table above is based on a scale of zero to one. A value closer to 1 means the vegetation is transpiring close to its potential. A value farther from 1 means that the Actual Evapotranspiration is below potential based on this climatic zone (Ringo, et. al. 2016 in draft).