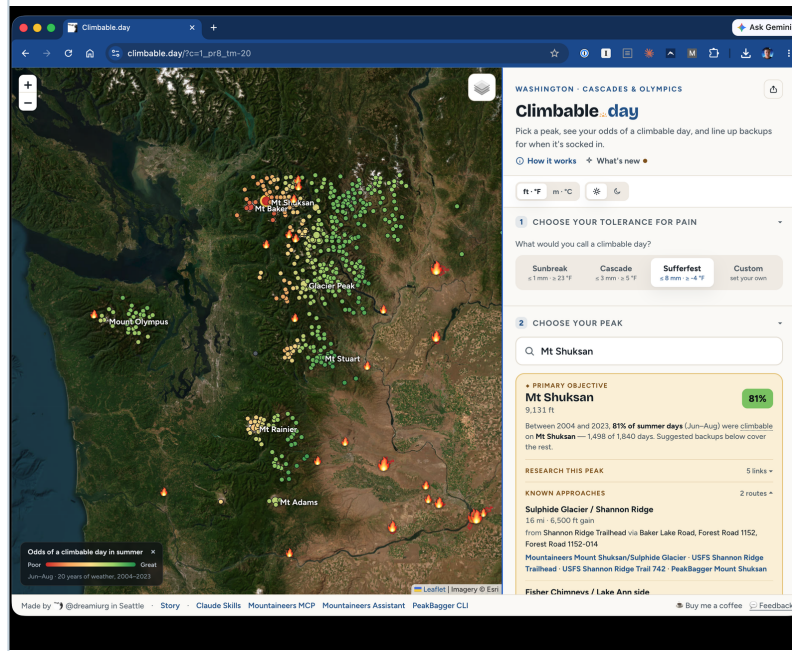


Somewhere It's Climbable

Pacific Northwest · Washington Cascades & Olympics

A data-driven guide to backup climbing objectives when the weather won't cooperate



Explore it live → climbable.day

Pick your primary peak, see which backups have the best odds for the incoming pattern.

By Dmytro Gaivoronsky · dreamiurg.net

Part of the Climbable-Day series

This is self-contained research on one region — the **Pacific Northwest**, focused on the Washington Cascades. It stands on its own, but it belongs to a larger idea: **climbing weather is regional**. Whatever you climb, the winning move is the same — pick a primary objective, then line up a Plan B and Plan C that *don't all fail on the same day*, and choose among them from the odds rather than hope. What changes from region to region is the local detail: **which variable decides whether a day is climbable**, and **which lever buys you a genuinely independent backup**. This report works out those two things for the Cascades. Its companion, **Somewhere It's Climbable — Mojave** (Red Rock and the greater Las Vegas desert), does the same for the desert Southwest, where the answers turn out to be different. The live planner at climbable.day puts both regions against a real forecast.

THE SHORT VERSION — **The goal:** give a Washington mountaineer a data-backed way to answer “my objective looks bad — where do I go instead?” without guessing. **What we did:** we scored 20 years of daily weather (2004–2023) for 500 Cascade peaks against a simple definition of a “climbable day,” and measured which backups actually hold when a primary is out. **What we found:** whether a day is climbable is decided mostly by precipitation, and precipitation is organized by two things —

where a peak sits relative to the Cascade crest, and *what weather pattern* is moving in. Peaks fall into six climatic zones that behave as units. When a wet southwest storm is coming, the dry east side is your refuge; when it's dry and settled, almost anything goes and the south is clearest. The one rule that falls out: **match your objective to the pattern, not the other way around** — and this report gives you the map to do it.

1. Why this exists

Every Washington mountaineer knows the feeling: you've planned a route on Mt Shuksan for the weekend, and the forecast turns sour. Do you go anyway, wait, or switch to something else? And if you switch — to *what*? The good news is that the mountains don't all get bad weather at the same time. When it's pouring on Shuksan, it may be dry and climbable a hundred miles east. The trick is knowing which backup actually improves your odds, and that answer isn't fixed — it changes with the season and with the kind of weather system moving through.

This report is a practical decision aid. It doesn't forecast the weather; it tells you what the weather *usually does* across the whole state, so you can build a primary plus two or three backups that don't all fail together. Everything here comes from real data — 20 years of daily records for 500 Washington peaks — and the same analysis powers the interactive planner at climbable.day, where you can explore any peak against a live forecast.

2. What makes a day climbable

Before we can compare peaks, we need a definition of a "climbable day" that a computer can apply to every peak on every one of 7,300 days. We use a deliberately simple one: a day is climbable if it is **dry enough and not too cold**. Specifically, the default (the "Cascade" tolerance) is **0.12 inches of precipitation or less and an overnight low of 5 °F or warmer**. That's a normal alpine day — not a bluebird guarantee, but conditions you can work with.

This is intentionally crude. It doesn't know about avalanche hazard, route conditions, or your fitness — it's a *weather filter*, not a go/no-go call. But applied consistently across two decades, it reveals the patterns that matter for planning. Across all 500 peaks and 20 years, **63% of days come out climbable** by this measure — but that average hides enormous structure: **92% in July, 43% in January**, and a spread from the wet west to the dry east that is the single most important fact in this whole report.

Deep dive — why precipitation, and why these thresholds? We tested which factor actually decides the outcome. In summer, precipitation is the binding constraint on essentially every non-climbable day; the temperature threshold almost never bites (it rules out just **190 of ~130,000** non-climbable summer days). That's because summer precipitation in the Cascades is close to all-or-nothing — a day is either dry (near 0 mm) or it's a genuine storm well past any reasonable cutoff — so the exact precipitation threshold barely changes which days qualify. The temperature floor matters in the shoulder seasons and winter, when clear-but-frigid days appear. Section 6 shows how the three tolerance presets (Sunbreak / Cascade / Sufferfest) shift the odds.

3. The rain shadow is the master pattern

Air coming off the Pacific hits the Cascade crest, is forced up, cools, and dumps its moisture on the west side. By the time it crests and descends the east side, it's wrung out. The result is one of the sharpest precipitation gradients in North America, and it's visible directly in our data: peaks a short distance apart on opposite sides of the crest differ by an order of magnitude in yearly precipitation.

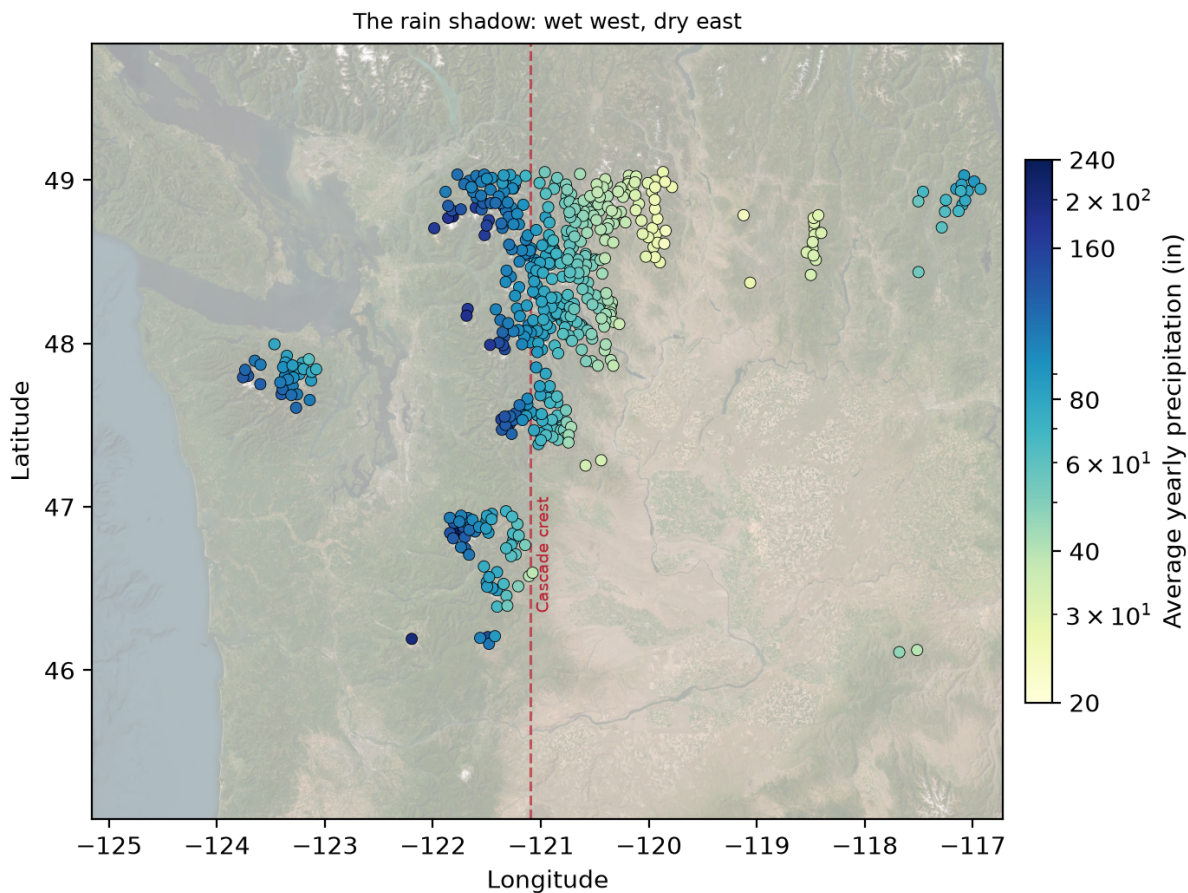


Figure 1. Average yearly precipitation across 500 WA peaks. The Cascade crest (dashed) splits a wet west from a dry east — a tenfold gradient.

In our roster, **Mt Rainier** collects about **223 inches** of precipitation a year while **Muckamuck Mountain** on the dry east side sees about **23 inches** — a tenfold difference. For planning, this is the first lever: **if the west is getting hammered, look east**. The dashed line marks the crest; the color flips from deep blue (wet) to pale yellow (dry) as you cross it. Nearly every plan-B decision in this report is, at bottom, an application of this one gradient.

4. Bad weather is regional — and the regions change with the season

Here's the catch that makes naive planning fail: on a given day, nearby peaks tend to be bad *together*. A storm doesn't hit one summit; it hits a whole region. So a backup three miles down the ridge from your primary isn't really a backup at all — it's the same weather. A useful backup has to sit in a part of the state that the *current* system isn't hitting.

How coupled peaks are depends on the season. We measured how similarly different parts of the state behave in summer versus winter. In **winter**, big frontal systems blanket everything at once, so the zones

move together (correlations 0.76–0.91). In **summer**, weather is more local and the zones decouple — the Olympics and the dry east can be having completely different days (correlation drops to 0.58).

Zones move together in winter, apart in summer

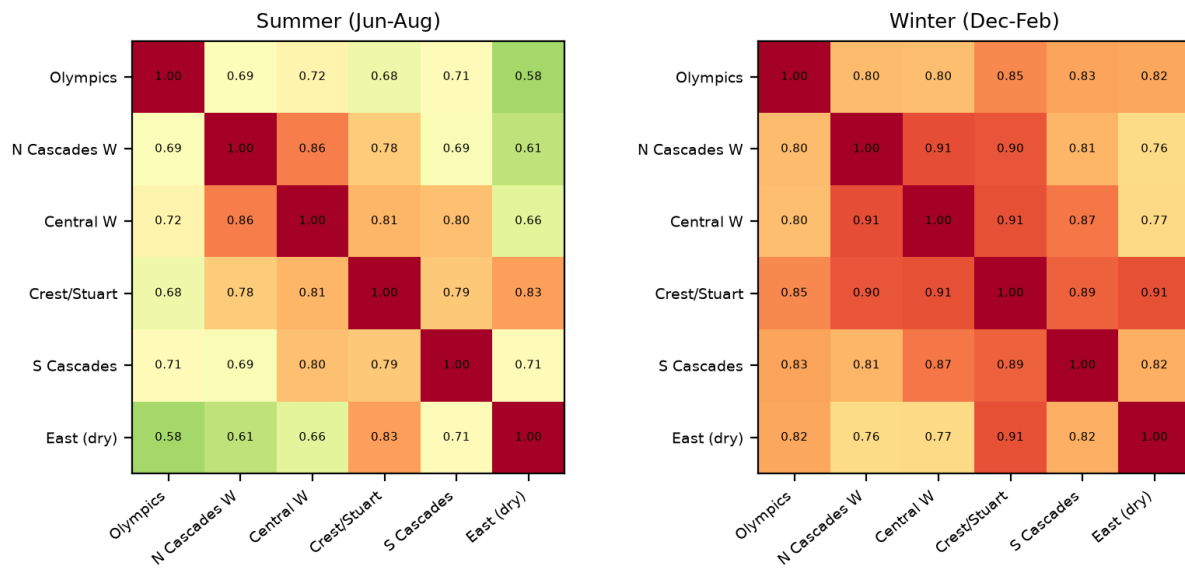


Figure 2. How similarly mountain zones behave. Green = independent (summer); red = coupled (winter).

The practical reading: **in summer, a backup in a different zone genuinely helps** — the zones are independent enough that one can be good while another is bad. In winter, you often have to wait out the system or accept that most of the state is socked in together. This is why the plan-B strategy is a summer strategy first.

There's a seasonal timing angle too. Because the dry east gets so much less precipitation, its peaks come into climbable condition **earlier in spring and hold it later into fall** than the wet west — the shoulder seasons belong to the east side.

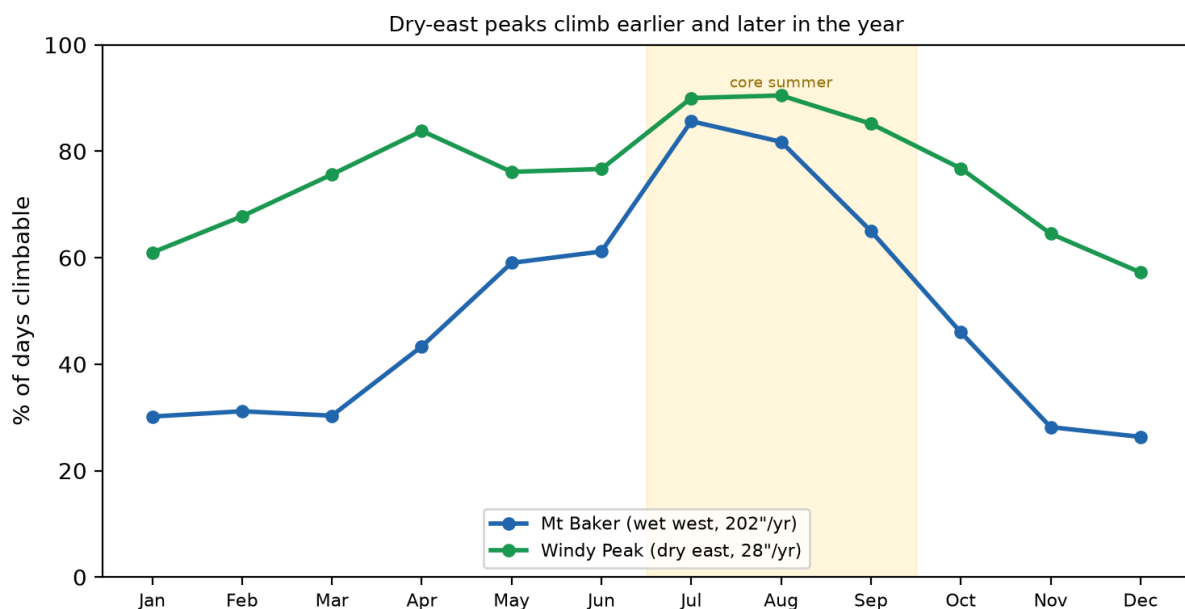


Figure 3. Climable days by month: a wet-west peak (Mt Baker) vs a dry-east peak (Windy Peak). The east side opens earlier and stays climable later.

5. Weather patterns decide where you go

Washington's summer weather isn't random — it comes in a handful of recurring **patterns** (meteorologists call them regimes), each with its own signature and its own best backup strategy. We identified them from the data by grouping days with similar precipitation and wind. Two dominate the decision:

- **Dry NW ridge** (about **51%** of days): high pressure, light northwesterly flow, almost no precipitation (0.9 mm average). This is the good-weather pattern — most peaks are climable and you can prioritize the objective you most want.
- **Wet SW storm** (about **18%** of days): moist southwesterly flow, the classic Pacific storm track (17 mm average precipitation). This is the pattern that ruins west-side plans — and the one where knowing your backups pays off most.

The key insight — and the one that reshaped this whole project — is that **the same peak being out means different things under different patterns**. Watch what happens to the backups for Mt Shuksan:

Same peak out, opposite backup strategy - it depends on the pattern

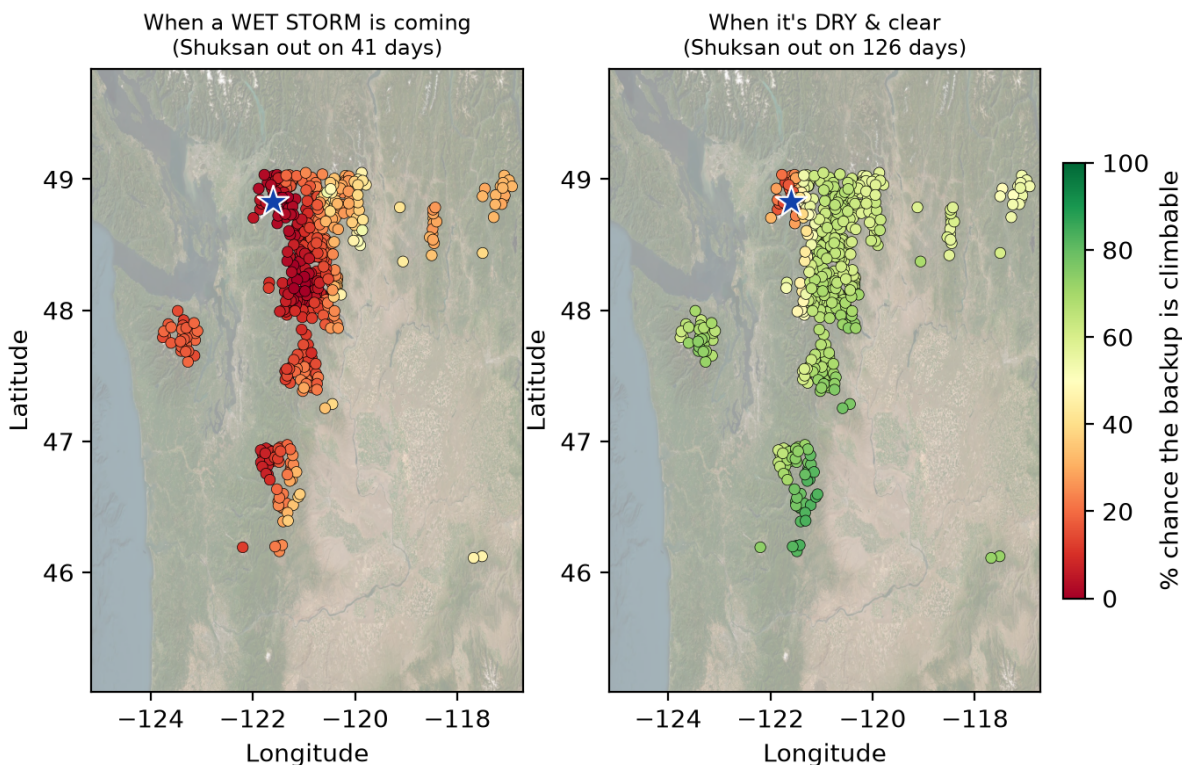


Figure 4. Backups for Mt Shuksan (star), by pattern. A wet storm sends you far east; a dry spell favors the south.

When a **wet storm** is coming (left), Shuksan's whole neighborhood is red — the entire west side goes down together, and the only green is far east. When it's **dry** (right), the picture inverts: the failures are scattered and the south Cascades light up green. Same peak, opposite advice. **A backup is only meaningful relative to the pattern** — which is exactly what the live planner conditions on.

6. How much does "climbable" depend on your tolerance?

"Climbable" is your call, not a law of nature. The planner at climbable.day lets you pick a tolerance, and this report uses three presets:

- **Sunbreak** — bluebird only: ≤ 0.04 in precipitation and ≥ 23 °F overnight low.
- **Cascade** (*the default used throughout*) — a normal alpine day: ≤ 0.12 in and ≥ 5 °F.
- **Sufferfest** — you'll go unless it's truly foul: ≤ 0.31 in and ≥ -4 °F.

How the three 'climbable day' definitions change your odds

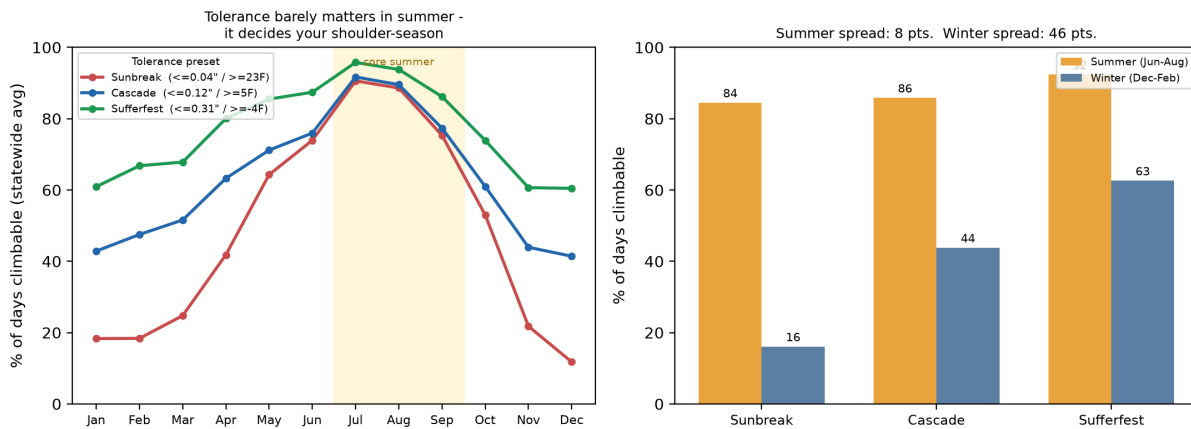


Figure 5. Climbable odds under the three tolerance presets: near-identical in summer, a 46-point spread in winter.

The surprise is how little this choice matters in summer and how much it matters the rest of the year. In July and August all three land within about **8 points** of each other — even strict "Sunbreak" gives you roughly 85% of days. But in **winter the spread is 46 points** (16% under Sunbreak vs 63% under Sufferfest). As Section 2's deep dive explained, summer precipitation is nearly all-or-nothing, so the exact cutoff barely changes the count. Your tolerance mostly decides **how early in spring and how late into fall your season runs**, not how many midsummer days you get.

7. Six climatic zones — and whether they hold

If peaks fail together by region, a natural question follows: **what are the regions?** Not political or geographic regions, but *climatic* ones — groups of peaks that genuinely get wet and dry together. We let the data draw them, grouping the 500 peaks purely by how their daily weather co-varies over 20 years. Six zones emerge cleanly:

Washington's climatic zones and how stable they are under different flow patterns

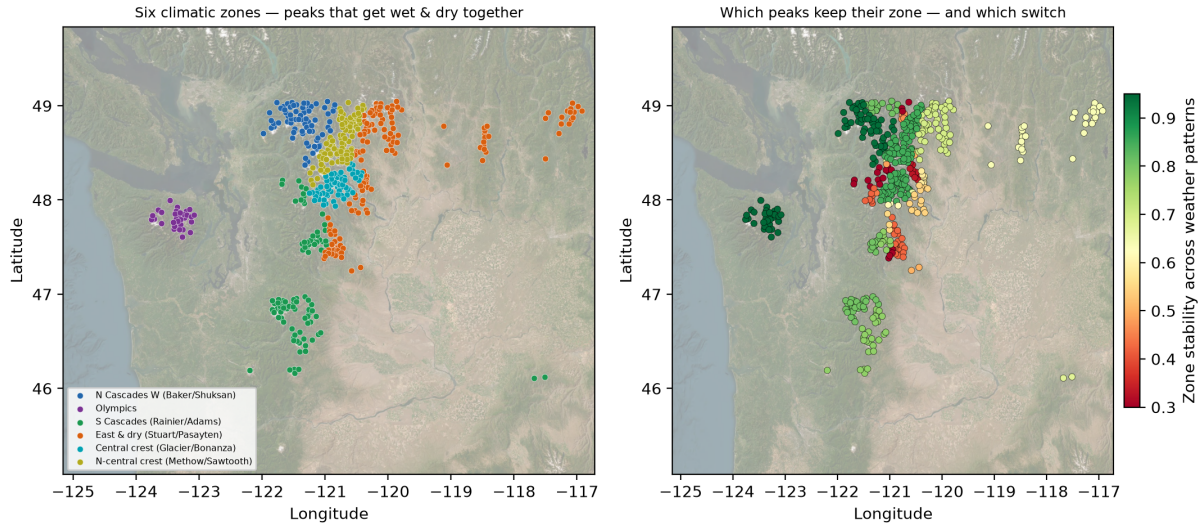


Figure 6. Left: six climatic zones drawn from 20 years of co-variability. Right: which peaks anchor their zone (green) vs switch (red).

The six zones (left) are immediately recognizable to anyone who climbs here: the wet **North Cascades west** (Baker, Shuksan); the isolated **Olympics**; the **South Cascades** (Rainier, Adams, St Helens); the vast **dry east** (Stuart, the Enchantments, the Pasayten); the **central crest** (Glacier Peak, Bonanza); and the **north-central crest** (the Methow and Sawtooth country). These aren't arbitrary — they're where the rain shadow, latitude, and terrain jointly organize the weather.

But do these zones *hold* under different weather, or do they re-draw? We tested it by re-deriving the zones separately within each pattern and measuring how much the membership changed. The answer is the interesting part: **the zones partly re-draw with the flow**. They're most stable in winter (83% agreement with the baseline), and loosest in dry, settled weather (53%). The stability map (right) shows *which* peaks are reliable anchors (green) and which switch allegiance depending on the pattern (red).

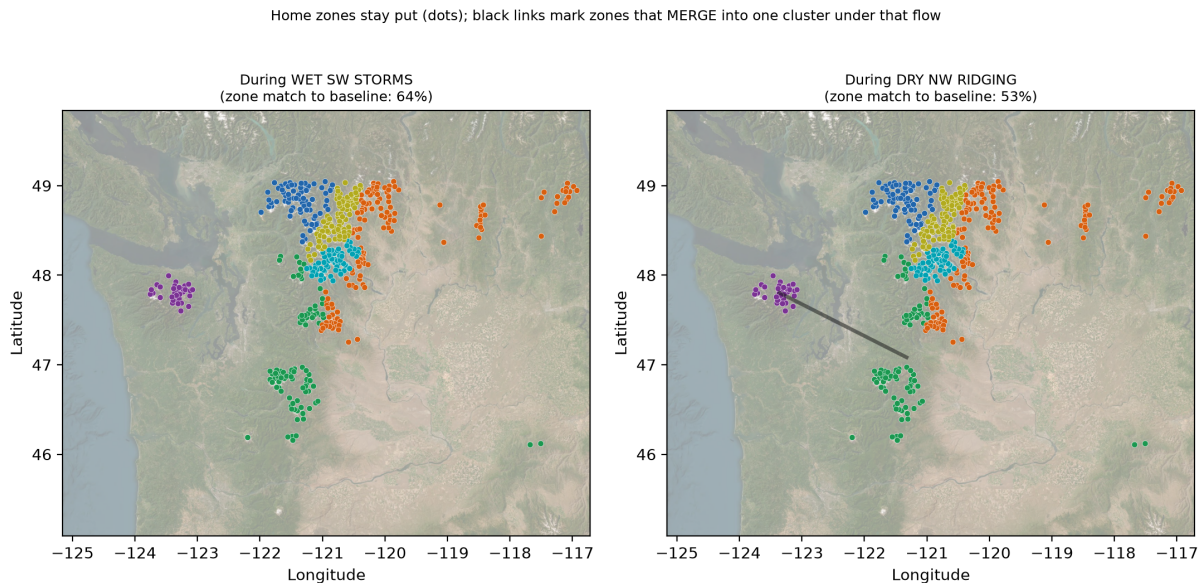


Figure 7. Zones stay put under wet storms but the Olympics and South Cascades merge into one cluster under dry ridging.

What's actually happening under dry weather isn't chaos — it's a **merge** (right panel). The Olympics never break apart internally (they're the most stable zone in the state, walled off by Puget Sound), but in fair weather they and the South Cascades behave so much alike that the analysis groups them together. Under wet storms, nothing merges — the storm track keeps the zones distinct.

For planning, this gives a clean vocabulary. **Anchor peaks** (399 of 500) reliably represent their zone — Baker and Shuksan almost never leave the North Cascades west; Rainier anchors the south. **Switchers** (33 peaks), concentrated right along the Cascade crest around Mt Stuart and the Enchantments, are the ones worth checking against the specific incoming pattern rather than assuming — they behave like the west in one regime and the east in another.

Deep dive — how the zones were drawn. We can't just correlate raw precipitation, because in winter *everything* gets wet together and the whole state collapses into one blob. To see spatial structure we first remove each day's statewide average (the shared "everyone's wet" signal), leaving the *anomaly* — who is wet when others are dry. Clustering peaks on the correlation of those anomalies (Ward's method, six groups) produces the zones. "Stability" is then the fraction of a peak's zone-mates it keeps when we repeat the clustering inside each weather pattern; averaged over four patterns, that's the green-to-red scale on the map.

8. A simple decision framework

Putting the principles together, here is the practical sequence — matched to how far out you're planning:

- **~1 month out.** You can't forecast weather this far ahead. Use the *typical* seasonal odds to shortlist a primary plus two or three backups **in different zones** — ideally one wet-west objective and one dry-east alternative, so a single storm track can't take out your whole list.
- **~1–2 weeks out.** Check the extended forecast and identify the dominant pattern. If wet southwest storms dominate, lean toward the dry east; if it's dry and settled, almost anything goes and you can prioritize the peak you most want.
- **~2–3 days out (commit).** This is the reliable window. Confirm the pattern, pick the specific peak with the best odds for *that* pattern, prefer an **anchor** peak in the zone you're targeting, and — always — check a real mountain forecast and avalanche bulletin before you go.

The rule of thumb behind all of it: **match your objective to the pattern, not the other way around.** A dry-east peak isn't just a foul-weather fallback — as Section 6 shows, it stays climbable far longer into spring and fall, extending your whole season.

9. How the analysis works

This section explains the method in plain terms; the deep-dive boxes and the appendix give the technical detail for anyone who wants to reproduce or scrutinize it.

9.1 The peaks

We use **500 Washington peaks**. The backbone is the **Bulger List** — the 100 highest peaks in the state, included verbatim — extended with **400 more** from OpenStreetMap, spread across the Olympics, both sides of the Cascades, the northeast highlands, and the Blue Mountains, so the whole state is represented

rather than just the popular ranges. Elevations range from about **6,300 to 14,411 feet** (Rainier). The OSM peaks carry approximate elevations; the Bulger peaks are authoritative.

9.2 The weather

For each peak we pulled **20 years of daily weather (2004–2023)** — about **7,300 days per peak** — from two free, public, government datasets. **Daymet** (Oak Ridge National Laboratory) provides precipitation, daily minimum and maximum temperature, and snowpack. **NASA POWER** (from the MERRA-2 reanalysis) provides cloud cover, wind speed and direction, and snowfall. Both are gridded model/observation blends at roughly 1 km (Daymet) and 50 km (POWER) resolution — good for climatology, not a substitute for a point mountain forecast.

9.3 From weather to zones and patterns

Two analyses do the work. First, we group **days** into weather patterns (regimes) by their precipitation and wind, which is what lets the planner say "this looks like a wet-storm pattern, bail east." Second, we group **peaks** into climatic zones by how their daily weather co-varies, which is what lets us reason about backups by region. Both are standard clustering methods; the appendix gives the exact recipe.

Deep dive — the two clustering steps. *Regimes (grouping days):* each day is described by its statewide precipitation, an east–west precipitation gradient, and the dominant wind direction (as sine/cosine so that 350° and 10° are close). K-means with five clusters yields the regimes; the two decision-relevant ones are the dry NW ridge (51% of days) and the wet SW storm (18%). *Zones (grouping peaks):* we take the log of daily precipitation, subtract each day's statewide mean to remove the shared seasonal signal, and cluster peaks on the correlation of the resulting anomalies using Ward's hierarchical method into six zones. Stability is measured by re-running the zone clustering within each regime and computing the Adjusted Rand Index against the all-days baseline (winter 0.83, summer 0.59, wet-SW 0.64, dry-NW 0.53).

10. Limitations — please read

This is a climatology tool, and it has real limits you should keep in mind:

- **It is not a forecast.** Everything here is *typical* behavior over 20 years. On any specific day the weather can and will depart from the average. Always check a current mountain forecast.
- **It says nothing about avalanche hazard or route conditions.** A "climbable" day by our weather filter can still be deadly. Consult the Northwest Avalanche Center and current route beta.
- **The grids are coarse.** NASA POWER's ~50 km cells can't resolve individual summits, so wind and cloud are regional approximations. Daymet's 1 km precipitation is better but still a model.
- **Two variables are approximations.** We ship a *freezing-level estimate* (from a standard lapse rate, not a true synoptic value) and lack true wind *gusts* (only sustained wind). Both are documented in the appendix as known gaps.
- **Elevations for the OSM peaks are approximate**, and a handful of obscure summits may carry small location errors.

11. Sources & tools

Data

- **Daymet** — daily surface weather, 1 km, Oak Ridge National Laboratory / NASA (daymet.ornl.gov). Precipitation, min/max temperature, snowpack (SWE). Free, keyless, no rate limit.
- **NASA POWER** — daily meteorology from the MERRA-2 reanalysis, NASA Langley (power.larc.nasa.gov). Cloud cover, 10 m and 50 m wind speed, wind direction, snowfall, 2 m temperature. Free, keyless, no rate limit.
- **Live forecast** — Open-Meteo (open-meteo.com) powers the 14-day outlook on the interactive planner.
- **Peak roster** — the **Bulger List** (100 highest WA peaks) plus **OpenStreetMap** (openstreetmap.org) for the statewide extension.
- **Basemaps** — Esri World Imagery, OpenTopoMap, and USGS topographic tiles.

Methods & tools

- Analysis in **Python** — NumPy, SciPy, scikit-learn (clustering), and Matplotlib (figures).
- Weather patterns via **k-means**; climatic zones via **Ward hierarchical clustering** on deseasonalized precipitation-anomaly correlations; stability via the **Adjusted Rand Index**.
- The interactive planner is a browser application (Leaflet mapping) with the full 20-year dataset packed to a compact binary and decoded client-side.

Author

Try it yourself: the interactive planner lives at climbable.day — every peak, every pattern, with a live forecast.

By **Dmytro Gaivoronsky** · dreamiurg.net · [companion write-up](#).

Built as a personal decision aid for planning climbs in Washington. Always verify against official forecasts and avalanche bulletins before committing to any objective. Weather can kill; this document cannot.

Appendix A. Methods in detail

A.1 Data acquisition

For each of the 500 peaks we requested a 2004–2023 daily time series (7,305 calendar days, aligned to a 365-day year by dropping leap days, giving 7,300 rows per peak). Daymet was queried through its single-pixel API; NASA POWER through its point API. Both are keyless and unthrottled, so the full 500-peak pull runs in minutes and is fully reproducible from the fetch scripts. The resulting archive is 15 variables × 7,300 days × 500 peaks, stored at full precision.

A.2 The climbable-day filter

A day at a peak is **climbable** if precipitation ≤ threshold **and** minimum temperature ≥ threshold. The default ("Cascade") thresholds are 3.0 mm (0.12 in) and −15 °C (5 °F). These exact defaults reproduce the app's shipped climbable bitfield **byte-for-byte** — a property we verify on every rebuild (0 mismatches across all 3,650,000 peak-days). The two alternate presets are Sunbreak (1.0 mm / −5 °C) and Sufferfest (8.0 mm / −20 °C).

A.3 Weather regimes (grouping days)

Each day is represented by three features: log-scaled statewide mean precipitation, an east–west precipitation gradient, and the dominant wind direction encoded as (sin, cos). K-means ($k = 5$) yields five regimes. Frequencies and mean precipitation: **Dry NW ridge 51%** (0.9 mm), **Wet SW storm 18%** (17.0 mm), Transitional 12% (4.5 mm), Moderate SW 11% (4.2 mm), Frontal 9% (8.3 mm). A lightweight classifier reproduces the two decision-critical regimes from a live forecast with 87% recall on the dry pattern and 70% on the wet pattern.

A.4 Climatic zones (grouping peaks)

Raw daily precipitation is log-transformed ($\log_{10}$) and each day's statewide mean is subtracted, removing the common seasonal signal so that spatial contrast is visible. Peaks are clustered on the correlation matrix of these anomalies using Ward's method; six clusters give balanced, spatially coherent zones (sizes 32–141). Cutting at four to eight clusters is stable; six is the point where every zone is both geographically compact and climatically distinct.

A.5 Zone stability

The zone clustering is repeated inside four day-subsets — wet-SW storms, dry-NW ridging, all summer days, all winter days. Agreement with the all-days baseline is measured by the Adjusted Rand Index (**winter 0.83, wet-SW 0.64, summer 0.59, dry-NW 0.53**). Per-peak stability is the fraction of a peak's baseline zone-mates it retains across the four subsets, averaged; peaks above 0.6 are "anchors" (399), 0.4–0.6 "moderate" (68), below 0.4 "switchers" (33).

A.6 Known data gaps

Two variables could not be sourced at 20-year daily resolution from free APIs and are shipped as documented approximations: **freezing level** is estimated from a standard atmospheric lapse rate applied to modeled temperature and elevation (not a true synoptic freezing level), and **wind gusts** are unavailable (only sustained wind is provided). Neither affects the default climbable-day definition, which uses only precipitation and temperature.