Last Edit: 12/30/2024

Flying in the Lee and Avoiding OD:

Hazardous Flying Conditions on the Front Range

A Disclaimer/Introduction:

I am by no means an expert on any of these subjects. I haven't been flying for very long and am not a formally trained meteorologist. This guide is aimed at beginner pilots looking to get an initial feel for what hazardous flying conditions look like at North Boulder without diving *too* deep into forecasting tools.

Flying decisions are always the decision of the pilot in command **(That's you!)**. I'm going to do my best to stop short of throwing out hard numbers, rules, and absolute guidelines, **because the turbulent nature of weather rarely, if ever, follows simple rules.** In the end, you're responsible for making your own flying decisions. These are very basic building blocks to help you identify possibly hazardous flying days and are **not intended** to give you the tools to see how far you can push the limits of your flying. Ask around, get as much info from as many sources as possible, and never stop learning!

The "Big 3":

In my opinion, the main hazardous weather concerns when flying Boulder can be broken into three main categories:

1) **West Wind**
2) **Overdevelopment**
3) **Cold Fronts**

Each of these hazards has their own sub-parts, and we'll break them down in their own individual sections. We'll go over some **theory** first for these three hazards, then **how to spot them** in the forecast, and then **tools to monitor them** as they are happening. Let's jump right in.

Note: If you really don't have the time to review the theory, you can skip to the forecasting section...Or if you're really in a rush, you can check out the "Condensed Forecast Flow" section...But I'd suggest you invest the 20 minutes to expand your understanding about what's actually going on.

Theory:

West Wind:

Like it or not, North Boulder is a "lee side" flying site. It is defined that way because the hill faces East, and [prevailing winds] in Colorado blow from the West to the East. While it may be blowing East on the ground, at some altitude it is pretty much always blowing from the West. These "Westerlies" are driven by a very powerful mechanism, and when they blow over the continental divide, they create rotor and turbulence.

When this west wind mixes down, it usually does so very rapidly, turning pleasant flying conditions turbulent and scary **quickly.**

On a "normal" flying day, the East wind that allows us to fly at Boulder is driven by daytime heating, and creates an easterly upslope "bubble" of wind. This bubble pushes the westerlies up, giving us a safe area to fly in.

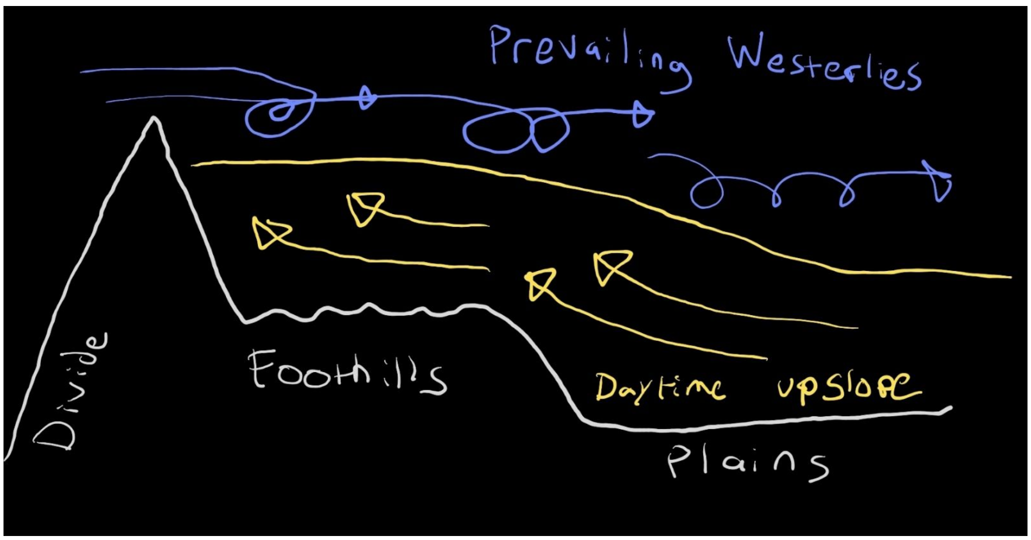


Fig 1:Profile view of the front range: Upslope "bubble" shown in yellow

The potential for hazardous west winds is dependent on how this bubble interacts with westerlies above. The prevailing theory is that this bubble erodes from top to bottom as thermals move air upwards. The air that is displaced up mixes with the westerlies up high and subsequently brings some of the westerlies and the associated turbulence down lower as the day progresses. We'll talk about this interaction between the bubble and the westerlies a bit later in the forecasting section, but first…

West Wind Part 1: Wave

An especially hazardous bit of west wind is called **“mountain wave.”** It is caused by layers of stable and unstable air as wind crosses the terrain of the continental divide. The mountain wave can propagate for many miles East of the continental divide. When it’s present, it usually shows up with two types of clouds: **Lenticulars** and **Rotor Clouds**.

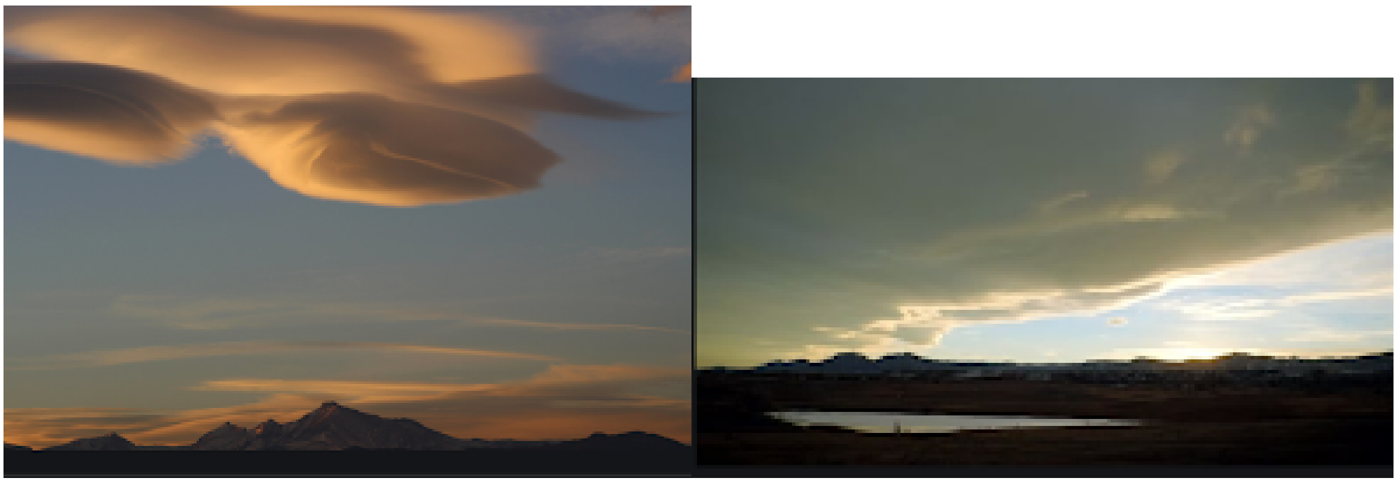


Fig 2: A couple examples of Lenticular clouds over Boulder: A sure sign of Mountain Wave!

To understand why the wave can be hazardous for us paragliders, take a look at a profile view of the front range:

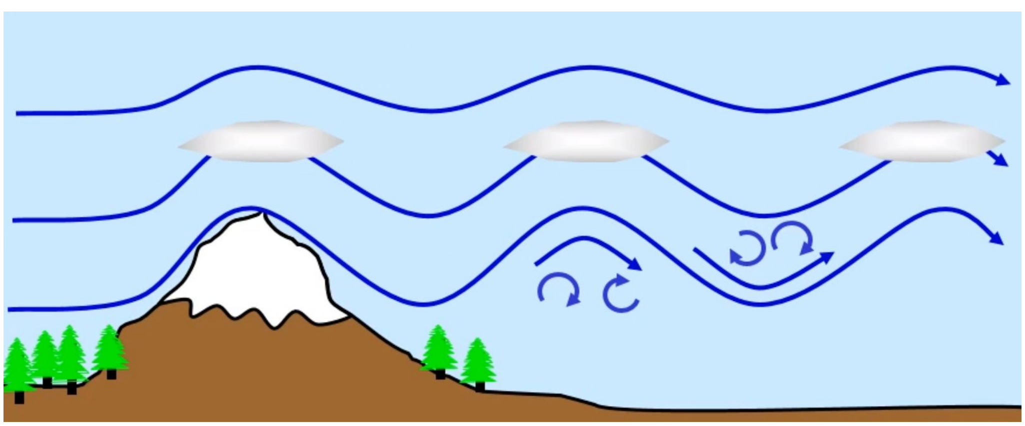


Fig 3: Profile view of the front range with mountain wave

In figure 3, the wave winds are shown in blue. The lenticular clouds are found in crests of the wave. **Be aware that sometimes the wave can be present without the lenticular clouds!** The real hazard for us paragliders comes from the rotor and shear that the wave creates.

On the ground on a wave day, it is usually very gusty. If you're in the right spot, it can also feel pretty calm, and the wind might even be blowing lightly from the east. This rotor can be large-scale enough to create an east wind on the ground and at the paragliding hill.

The insidious part of mountain wave is that the wave is always changing. While some wave days have widespread strong West wind on the ground (obviously unsafe to fly), The troughs and crest patterns of the wave can make it strong and gusty in some areas and almost dead in others. The rotor and mixing can also bring strong upper winds to the surface rapidly. I've been kiting on days with mountain wave, and have had to learn this lesson the hard way multiple times. One moment you're kiting in reasonable west wind, and then BAM, you're much further off than ground than you intended, trying to figure out what the hell happened while setting up an impromptu "landing"

Fig 4: For your entertainment: This is me flying a power kite on a day with mountain wave. Whoops.

The other insidious part of mountain wave is "rotor clouds.". These rotor clouds can look quite similar to friendly cumulus clouds. The difference is their shape: cumulus clouds have nice flat bottoms, while rotor clouds are usually more rounded at the bottom and appear to be constantly getting shredded up by the rotor they are showing. These rotor clouds are a far cry from the cumulus clouds us paragliders know and love, and you don't want to get tangled up with one. **Just because a cloud is white and fluffy doesn't mean it's friendly!** Rotor clouds also don't necessarily need mountain wave to be present. They can also occur in general lee side conditions with enough humidity.

Fig 5: Wave Rotor clouds over boulder as seen from 17500 ft. (From a sailplane)

Now that we have Mountain Wave mostly sorted out, let's explore more of the "garden variety" west wind that can be hazardous at Boulder.

West Wind Part 2: Mixdown

Another disclaimer: the theory described below is just a quick and dirty explanation, simplifying some things and glossing over others.

First off, let's talk about thermals. Thermals are parcels of air that start at the ground when the sun heats the ground. This warm ground in turn heats the air right next to it. If the airmass is "unstable," this warmed section of air will rise off the ground and continue to rise until it cools down and loses energy. The rising thermal pushes into the air above it, and in turn displaces some of this air downwards.

From now on, we will refer to this upward motion of thermals and the downward motion of displaced air as "mixing." **Mixing only happens in unstable layers of the atmosphere. Stable sections of the atmosphere stop the mixing.** Mixing increases as the day goes on, and it's how the thermal interacts with the top of our "protective bubble" that makes all the difference.

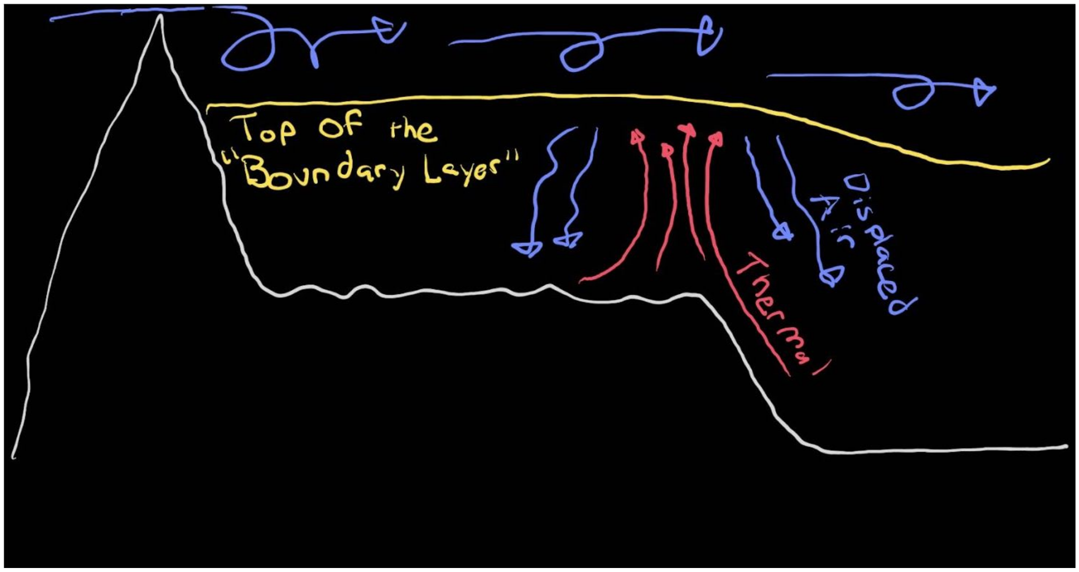


Fig 6: Stable top of the boundary layer keeping westerlies from "mixing down"

To use a more scientific term, the top of our "bubble" is called the top of the boundary layer. If the top of the boundary layer is "stable," the mixing will not include the turbulent westerlies above. A stable top of the boundary layer is shown in figure 6.

On the other hand, if the top of the boundary layer isn't capped by a layer of stability, the westerlies can defeat our nice easterly upslope and penetrate to the surface. Watch out! Keep in mind the top of this protective bubble can change throughout the day from stable to unstable. The westerlies can "erode" a stable top throughout the day, **and sometimes the breakdown of this top layer can be fast and violent.**

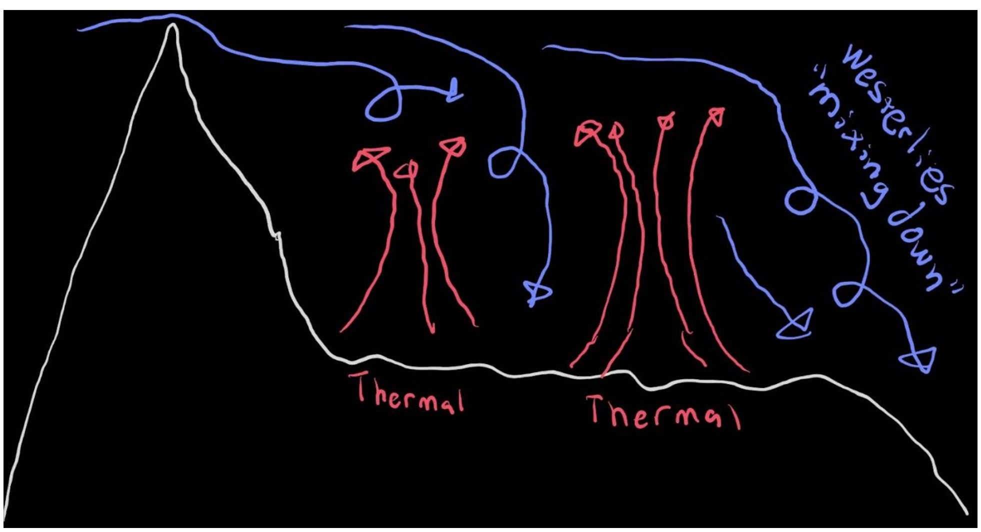


Fig 7: Unstable top of the boundary layer allowing thermals to mix with turbulent westerlies

We'll talk about how to determine whether the top of the boundary layer is stable or unstable in the "forecasting" section. But for now, let's move onto the next weather beast: Overdevelopment!

Overdevelopment:

Overdevelopment is just a fancy paragliding term for **rain and thunderstorms**. From here on out, we'll just call it "OD" for short. It seems obvious that thunderstorms are hazardous. I mean, come on...Huge bolts of lightning come out of them! The hazards of overdevelopment go well beyond the massive voltage though, and are much sneakier than 200,000 Amps tearing the sky apart.

OD part 1: The Suck

Thunderstorms are just garden variety thermals that got a hold of some industrial strength steroids and turned into monsters. In this metaphor, the "industrial strength steroids" is just plain old water vapor. As thermals carry this water vapor up, the water vapor condenses and turns into a cloud. This condensing action releases a ton of heat, supercharging the thermal and sending it into the stratosphere.

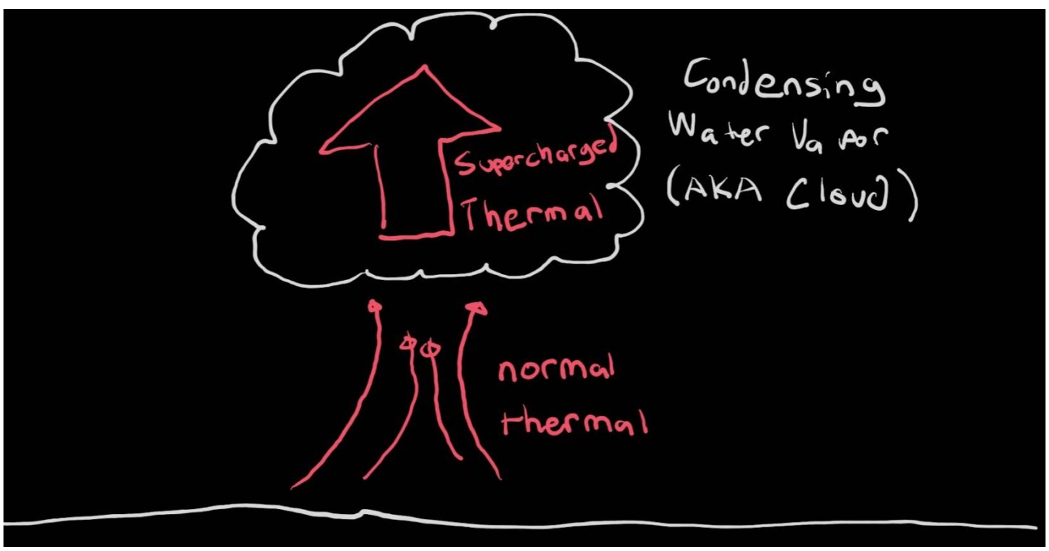


Fig 8: Thermal getting "supercharged" by condensing water vapor

As this supercharged thermal starts to accelerate, it starts pulling in more and more air from below. This "vacuum" effect can be quite substantial, and can create strong horizontal "sucking" winds far away from the thunderstorm. Once pulled into the main column of rising air, it would be quite the challenge to escape, as thunderstorm updrafts can reach in excess of 150 mph **(that's a 13200 foot per minute / 67 meter per second thermal!)**

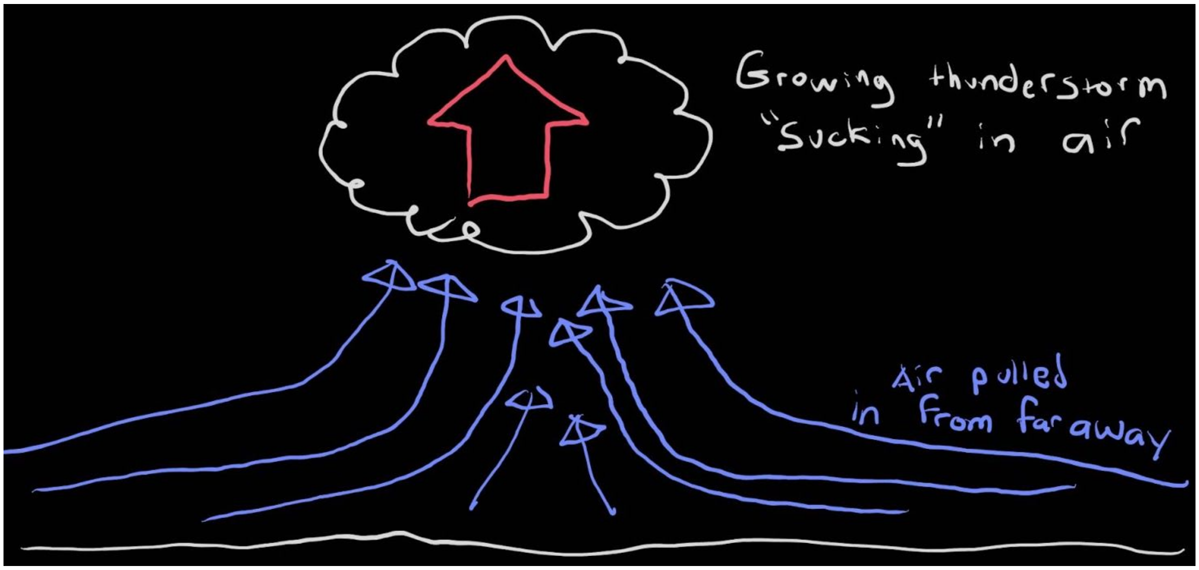


Fig 9: Thunderstorm "Vacuum" effect

OD part 2: The Blow (Gust Fronts)

What goes up must come down. The same rule us paragliders live by applies to thunderstorms and rain as well. Our "monster thermal" will eventually run out of gas. Before it ran out of gas though, it brought up a whole lot of moisture with it. As we discussed earlier, this moisture condensed and cooled. This moisture is now rain, and it is now falling.

As the rain falls, it starts pulling air with it. The rain falls lower and it starts to get warmer. Warmer air can hold more water vapor, so the rain starts evaporating. Evaporation has the opposite effect of condensation, so the evaporating rain starts to cool the air around it. Cold air sinks, and this rapidly cooling air starts to accelerate faster and faster towards the ground...

Sometimes, all of the rain evaporates before it hits the ground. This is called "virga," and I'm sure you've seen it before.

Fig 10: Rain not reaching the ground, AKA virga

Whether or not the rain reaches the ground doesn't matter. This chunk of rapidly falling air is on a collision course with the ground! When this cold air smashes into the ground, it has nowhere to go but outward. This air moving outward from the downdraft is now called a "gust front."

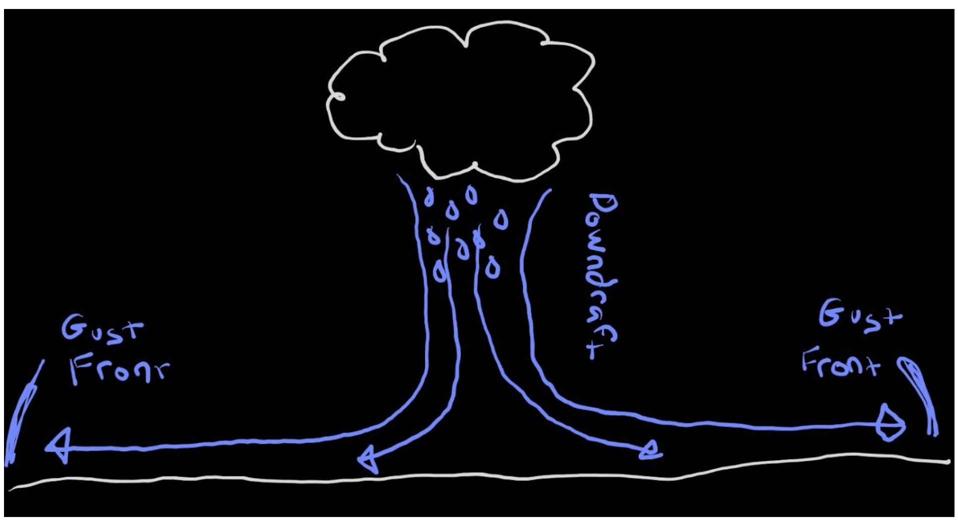


Fig 11: Gust front formation from downdraft

These gust fronts are extremely turbulent, come on quickly with very strong winds, **and can travel extremely long distances.** How far?

I once saw a gust front travel 350 miles over the course of 8 hours: A thunderstorm spat out a downdraft in South Dakota at 2AM, and the gust front slammed into the Boulder flying hill at 10AM the next day, and got close to blowing a new pilot over the back. Gust fronts that originate closer to the hill can have much more disastrous consequences.

Cold Fronts:

Cold fronts are an interesting beast. On the right day in the right season, they can provide fun soarable conditions, and even XC conditions in the dead of winter. On the wrong day though, they come on quickly with wind speeds that exceed the trim speed of our paragliders and lift that requires a hard spiral to overcome.

Cold fronts are waves of cold air that move from North to South across the USA. They can have slight easterly or westerly motion as well due to terrain and other effects. These waves move at different speeds depending on the season. Since cold air is heavier than warm air, this cold front slides underneath the warm air, lifting the warm air. This lifting of air can trigger a line of storms in unstable conditions. Winds at the frontal boundary are usually gusty and turbulent.

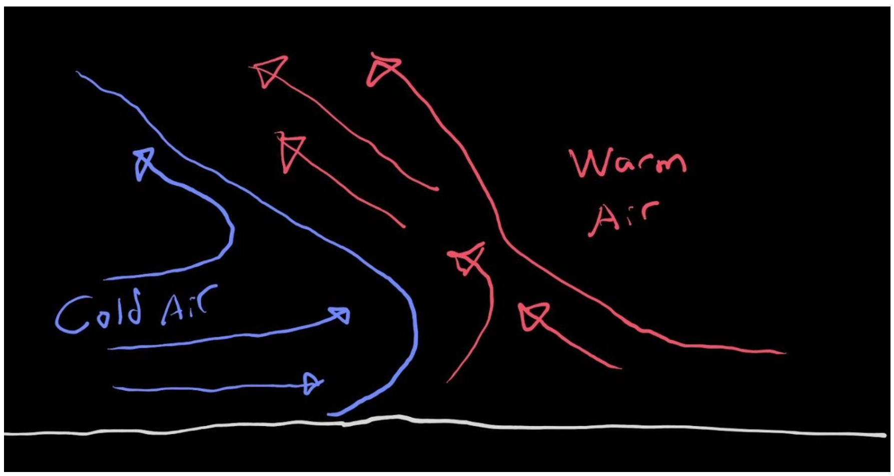


Fig 12: General air movement with a cold front

There's a lot more one can learn about cold fronts and their effect on flying weather, but for flying safety, that's about all the theory you need to know!

Forecast:

For this section, we'll focus on **basic** tools to spot these potential hazards in the forecast. Keep in mind that these tools are just the foundation of forecasting, and forecasts will never be 100% accurate. Talk to others, ask questions, and always leave more margin than the forecast calls for.

Also, it should be noted that forecasts usually improve continuously leading up to the day they're forecasting. Always check the forecast on the morning you're planning on flying, as conditions can change overnight in our dry high desert environment.

West Wind:

Some days, forecasting west wind is easy. You can look on Windy's surface level wind forecast and see the west wind widespread across the area. Quick tips: use Windy's "Wind gusts" layer to get a feel for how gusty these winds may be. Also, compare all the models you have available to you. Windy gives you the ECMWF, NAM, and GFS. Some models may pick up a trend that other models miss. XCskies gives you even more models to compare.

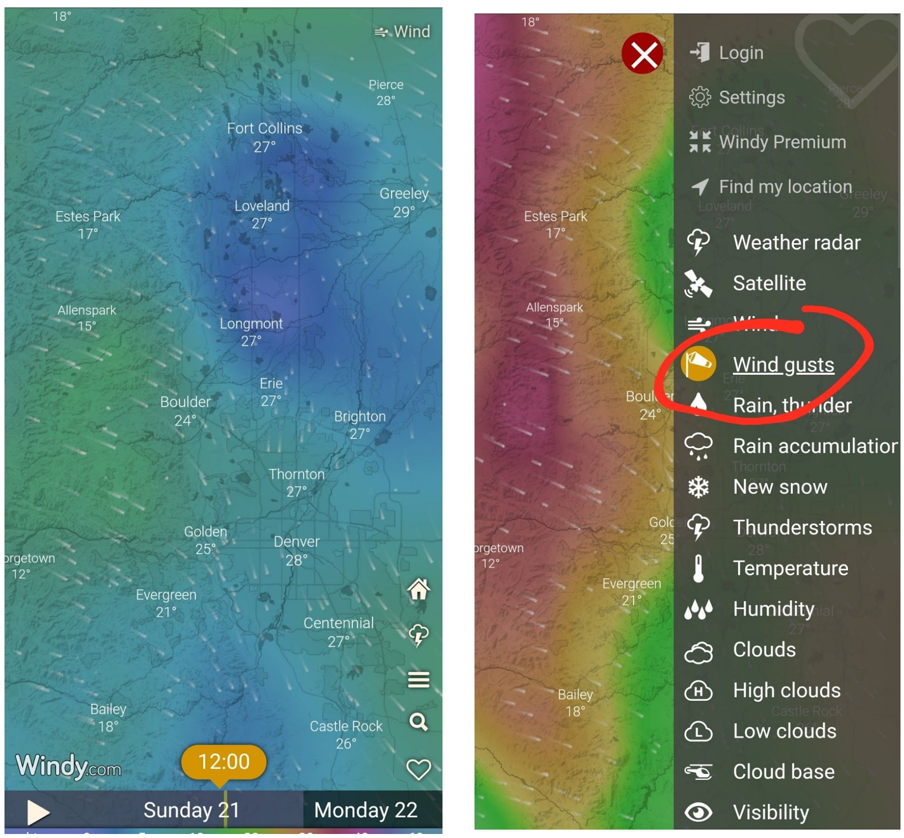


Fig 13: An obviously bad day for flying on the front range & Windy's "Wind gusts" layer

Other high-level forecasting tools can also be used for these "easy to forecast" West wind days (NWS point forecast, windalert forecast, weather underground, etc.). Whatever service you do use, ensure you're looking throughout the day to see any trends. Days can switch from flyable to hazardous faster that the forecast, so it's good to know which way the day is trending.

It's also a good idea to read the NWS Area Forecast Discussion, also referred to as the "AFD"(https://forecast.weather.gov/product.php?site=BOU&issuedby=BOU&product=AFD&format=ci&version=1&glossary=1) Keywords to look out for include: **Downsloping, mountain wave, westerly flow aloft, jet, and anything else that refers to west winds.**

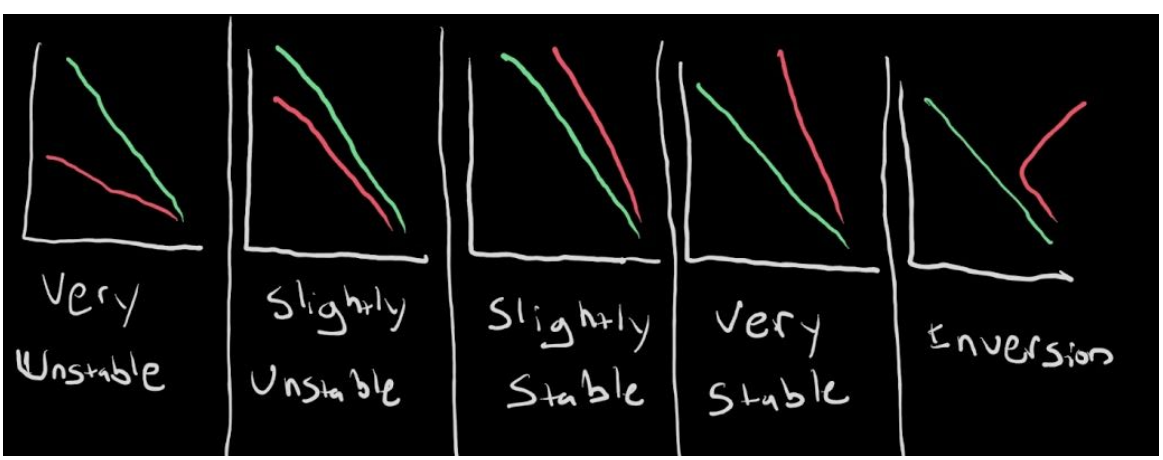
Let’s re-open Windy and take a look at the upper winds. Below Windy’s layer menu, there’s a slider that allows you to look at winds at certain altitudes. The altitudes I usually look at are 6400ft, FL100(10,000ft) and FL140 (14,000ft). Some people have very firm thresholds on these upper winds and won’t fly if the uppers are above a certain number at a certain altitude. I don’t rely on this method, as it doesn’t take into account the whole picture. **With just basic numbers and limits, you could miss some perfectly safe flyable days and underestimate the danger of potentially hazardous days.**

To round out our understanding of what’s going on, we need to break out the skew-T’s! ***GASP.*** Don’t worry, we’re not going to jump in too deep here. I’ll keep it as easy as possible. A skew-T is just a graph of temperature at different altitudes. Temperature is on the X axis and altitude is on the Y axis. Next to the Y axis is wind speeds at those altitudes. Knowing how the temperature changes with altitude gives us an idea of if the air is “stable” or “unstable.” Skew-T charts are also referred to as “soundings,” as they’re made in real life by sending a weather balloon into the atmosphere with a temperature probe attached.

I use the “Skew-T” app on android, but there’s other resources out there for forecasted skew-T charts. RUCSoundings(https://rucsoundings.noaa.gov/), the Skew-T point forecast on XCskies are both good sources, and Windy even has sounding feature built in, but it’s too low of resolution for really good insight.

All skew-T charts have “Dry Adiabats.” These lines start at ground level and go up at about a 45 degree angle to the left, then get more vertical as you get higher. They represent the temperature of a parcel of air if you lifted it up into the atmosphere, but you actually don’t need to know that. All you need to know is how the actual temperature line relates to the steepness of the Dry Adiabat line.

If the actual temperature line is less steep than the dry adiabat line, the air is “unstable.” If the temperature line is steeper than the dry adiabat line, the air is “stable.” If the temperature line reverses direction and starts going to the right, that’s called an inversion. **Keep in mind that it isn’t an either/or system. Things can be marginally stable, slightly unstable, super stable, extremely unstable, etc.**



<u>Fig 14: Variations in stability (Red: Actual Temperature, Green: Dry Adiabat Line)</u>

Now, if we remember the "theory" section, **mixing only happens in unstable sections of the atmosphere.** Let's take a look at a couple forecasted Skew-T's to understand the risk of west winds mixing down.

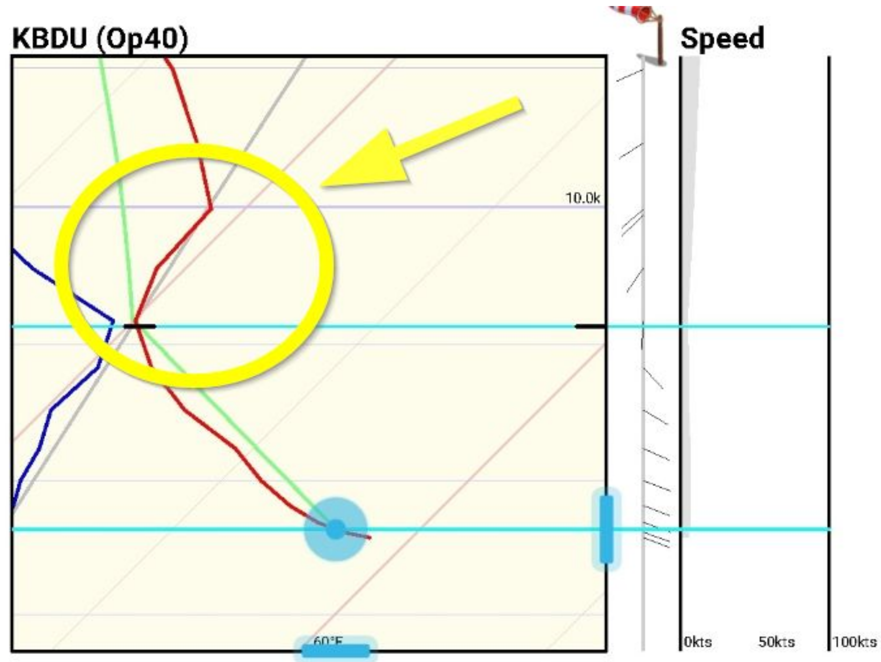


Fig 15: A day with an upper level "capping" inversion

The skew-T above shows an upper level "capping" inversion. This is good for us, as the capping inversion means that the top of the boundary layer is stable. You can see that the winds above the inversion are West, but that stable inversion will keep the westerlies from mixing down. See figure 6 for a review of what a cross section of this day looks like. The capping inversion limited climb heights this day, but there was no risk of west wind mixing down.

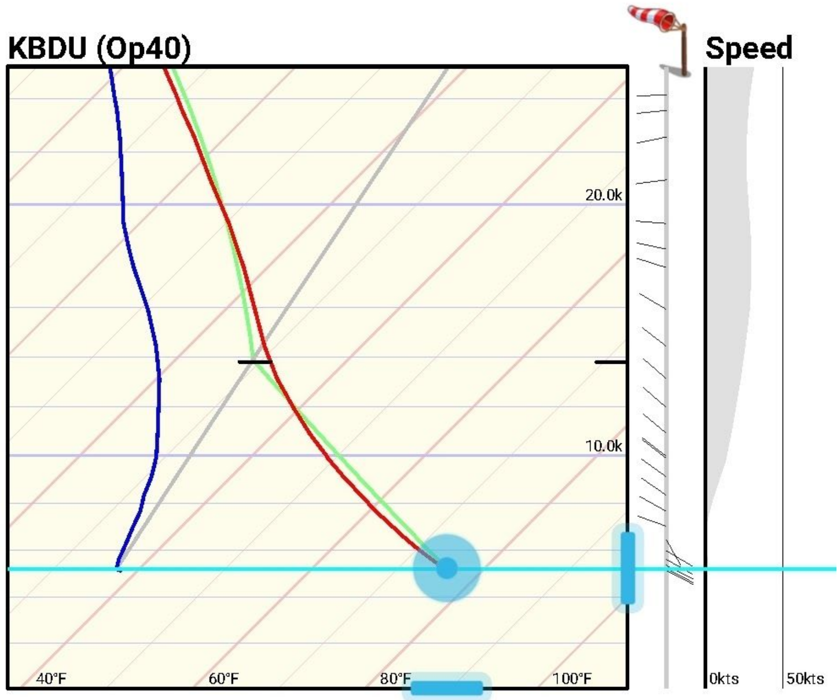


Fig 16: A day with westerlies in the unstable boundary layer

The skew-T above shows westerlies within the unstable boundary layer. **Even though there's east wind at the surface, any thermal activity will cause these westerlies to mix down.** The force that these westerlies mix down is related to how strong they are, how high they are, and thermal strength. See figure 7 for a cross section of what this day looks like.

Overdevelopment:

Compared to forecasting west wind, forecasting for overdevelopment is really easy! Any high-level tool that shows you the chance of precipitation is a good starting point, but let's dive a little deeper.

First, read the AFD! Is there anything in there about rain or thunderstorms? **Do they mention "gusty outflow winds" or gust fronts?** They'll usually also talk about where the storms will form, when they'll form, and other hazards, including virga. The AFD will also usually update throughout the day.

Next, let's take a look at Windy. I've found Windy's **"Rain, thunder"** layer to be amazingly accurate. The usual recommendations apply: Look at all the models, look at the trend throughout the day, and be conservative. Remember, it doesn't have to even be raining on the ground to create a gust front! **Some of the strongest gust fronts I've experienced were from extremely small tendrils of virga.**

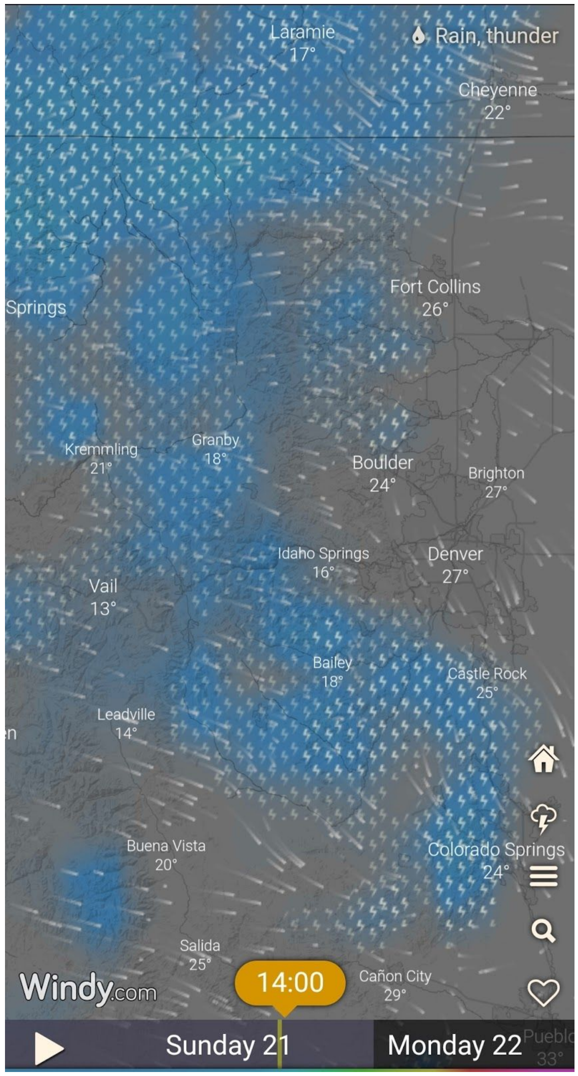


Fig 17: A day with widespread overdevelopment

You can go as deep as you want into forecasting overdevelopment, but my forecasting usually stops here. Other more in-depth tools include: “CAPE” layer on XCSkies and Windy, “lifted index” layer on XCSkies, and Windy’s “Cloud” and “Low/Middle/High Cloud” Layers.

Cold Fronts:

Forecasting cold fronts is also quite easy. The AFD will pretty much always mention the strength and timing of any cold fronts. Since cold fronts always move in some variation of north-south, you can also see them in the surface wind forecasts on XCSkies or Windy. Make sure you are looking at Windy's and/or XCSkies "Wind Gusts" layer to get a full picture of the strength of the cold front.

Keep in mind that cold fronts can move faster or slower than the forecast, can be stronger or weaker than the forecast, and can come in waves (AKA can sometimes re-intensify after the first wave starts dying down).

Monitoring Tools:

West Wind:

Look at the wind stations! A lot of people use windalert, but keep in mind that windalert is a secondary source. That means that windalert is taking a bunch of data from a bunch of different sources and putting all in one place. **This is great for looking at overall trends, but it can introduce some issues.** Issues include: delay in reporting time, averaging problems that show lower values than actuals, and location errors. Here's a list of wind stations I use:

- Front Range:
  - North Boulder Ridge: https://www.wunderground.com/dashboard/pws/KCOBOULD45
  - NCAR: https://archive.eol.ucar.edu/cgi-bin/weather.cgi?site=ml&units=english
    - NCAR will sometimes show west wind before North Boulder
- Directly Behind the Hill:
  - EW7311: http://www.findu.com/cgi-bin/wxpage.cgi?last=8&call=EW7311
  - EW4338: http://www.findu.com/cgi-bin/wxpage.cgi?last=8&call=EW4338
    - This one is located at: 40.053415, -105.346368 and I think it's pretty reliable.
- Sugarloaf Area:
  - STS LLC: https://www.wunderground.com/dashboard/pws/KCOBOULD363
  - Gold Hill: https://www.wunderground.com/dashboard/pws/KCOBOULD543
  - 2x Stations on Windalert: Sugarloaf East and West
  - **These 4x stations usually go west before Boulder does. If they're west, treat Boulder like a loaded gun.**
- Further Back:
  - Nederland and Ward on Windalert
  - CAIC Weather Stations:https://avalanche.state.co.us/observations/weather-stations/

Another great method of monitoring the west wind is looking at the clouds if they're present. Lenticulars and rotor clouds are great indicators that mountain wave is in the area. Looking up at the clouds can give you a good idea of what the uppers are doing. **How fast are the clouds moving? Can you see them getting sheared apart? Are they moving faster or slower as the day progresses? How high are they?** All these questions will give you insight into what the west wind is doing.

Even though you already looked at the sounding forecasts, you can also take a look at the real sounding. The weather balloon is released at DEN at 6AM and is usually posted here around 7AM: http://weather.uwyo.edu/upperair/sounding.html. Do you see any inversion layers? Are the westerlies within the unstable boundary layer? Keep in mind this sounding is done 35 miles from the hill, and things will be slightly different against the foothills.

Finally, west wind being displaced down almost always causes a drying action. If you see clouds suddenly disappear, this may indicate large scale downsloping wind. Also, upper westerlies mixing down can cause the dewpoint to drop at weather stations that record humidity. Keep an eye on it!

Overdevelopment:

The best way of monitoring Overdevelopment is just looking at clouds. Flying on days with overdevelopment can be dangerous, as water vapor can make the day change from "fun lift" to "Oh god I can't get down lift" very quickly. As soon as you see clouds getting taller than they are wide, it's probably time to go land. If it's suddenly really easy to stay up, you also should probably consider going to land. **If you see any virga or rain shafts, it's probably not a good time to be in the air.**

Even if you don't see OD in the immediate area, you need to be aware of the surrounding area. As mentioned earlier, gust fronts can travel extremely long distances. It's wise to keep an eye on radar. I use Radarscope on Android, but there are other apps out there. You can watch as storms develop, and sometimes you can see gust fronts propagating as storms drop out. These walls of humidity and kicked up dust can show up as light blue lines on radar spreading out from the storm they came from:

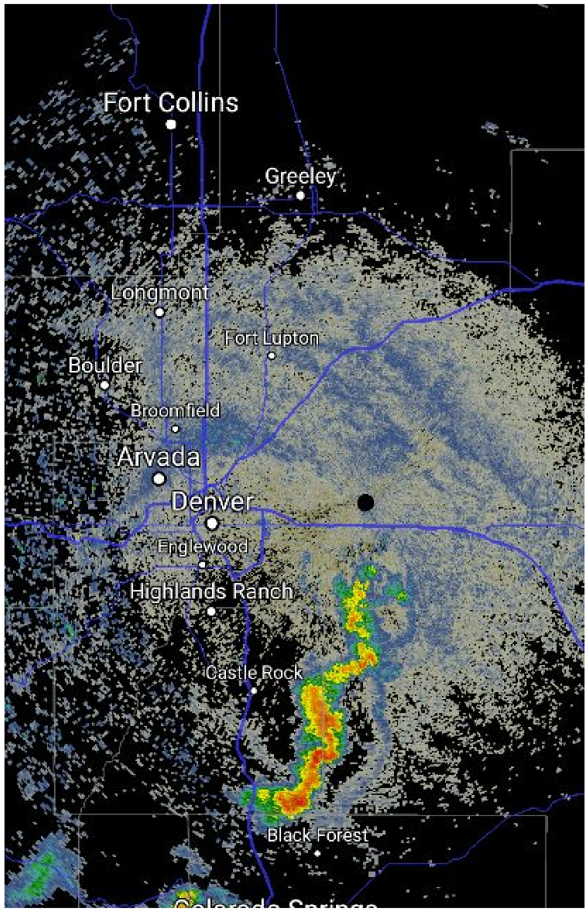


Fig 18: A gust front propagating out from a storm on radar. Even though the storm was south of Denver, this gust front hit the hill with enough strength to blow a pilot over the back

Gust fronts will also show up on wind stations, just keep in mind that some wind reporting is delayed.

Cold Fronts:

Cold Fronts will show up on wind stations, and it's a good idea to monitor them there. They'll occasionally show up on radar as well in a similar manner to gust fronts. Sometimes you can even see them coming with a line of clouds, a dust cloud, or haze.

<u>Condensed Forecast Flow:</u>

Yet another disclaimer: This list may be incomplete and may miss some hazardous flying conditions.

- Read the AFD
    - Any mention of **downsloping, mountain wave, westerly flow aloft, jet, and anything else that refers to west winds?**
    - Any mention of **thunderstorms, gusty outflow winds, gust fronts?**
    - Any mention of a **cold front?**

- Open up either Windy or XCskies
    - Check wind **throughout the whole day** and on **multiple models** for **DIRECTION** and **STRENGTH**
        - Surface
        - 6000-8000ft
        - 10000ft (FL100)
        - 14000ft (FL140)
    - Check the gust layer on windy on the ECMWF and NAM model
        - Cold fronts may show up better here
        - Sometimes may pick up on storm outflow winds
    - Review the OD (again, **multiple models** and **all day**)
        - **Rain/thunder layer on windy**
        - Precipitation layer on XCSkies

- Check the sounding
    - SkewT app on android or RUCsoundings
        - If winds aloft are high, is the top of the boundary layer stable?
            - How stable?
            - If the top is stable, does it erode throughout the day?
                - Do you see the uppers mixing down?

- **Unsure about anything?**
    - **Ask other pilots!**

- Once at the hill
    - Review AFD for any updates/changes
    - Review morning sounding
    - **Monitor wind stations behind the hill for west wind**. See list above.
        - Especially sugarloaf stations
    - In case of cold front, monitor wind stations to the east and north
        - Dangerous wind speeds present?
    - Look up at the sky
        - Are there any lenticulars?

        - Are there any cumulus?
            - Are you sure they aren't rotor clouds?
            - How fast are they moving?
            - Which direction are they moving?
            - Are they moving faster or slower throughout the day?
            - Do they look shredded, or are they holding together nicely?
        - Are there any blue holes suddenly appearing?
        - Are there any Cirrus clouds?
            - Speed/Direction?
        - Any clouds overdeveloping?
            - Taller than they are wide?
        - Any storm cells in the distance?
        - Any virga?
    - If cells in distance
        - Could it blow up near the hill too?
        - Review radar
            - Look for long travel gust fronts

    - Feel the wind
        - Does it feel steady from the east?
        - Any crazy gusts?
            - May indicate you are in rotor
        - Any wild direction changes?
            - May indicate you are in rotor

    - **Unsure about anything?**
        - **Ask other pilots!**

Mitigation Strategies:

I could put all the warnings and disclaimers in the world in the above writeup, but you may end up caught in one of these hazardous weather scenarios during your flying career. If you do, here's some strategies to stay alive:

- West wind
  - Stay high on any day that could mix down! If you're prone to scratching, make an even stronger effort not to scratch on marginal days
    - If you're scratching for whatever reason, weight shift away from the hill. In the event of a collapse, having this weight shift already in will help turn you away from the hill.
  - If it goes west and gets turbulent, run with the tailwind out east. The further you can get away from terrain, the better.
  - Make sure your radio is on! Someone on the ground may see the west wind coming before you do!
  - Reserve

- Overdevelopment
  - Learn fast descent techniques, or even better, learn to spiral. If you're uncomfortable with spirals, look up ways of reducing the G's
    - Big ears speedbar spiral, Anti-G chute, big ear spiral, etc.
  - If you're getting sucked into a cloud, it may be wiser to head to the edge of the cloud instead of fighting to get down
  - Be wary of embedded cells if there's widespread clouds. These can develop rapidly out of sight without your knowledge
  - At Boulder, storms usually form over the foothills then move over the plains, pushed by the westerlies
    - Running East prior to landing can be a useful tactic.
  - If you see a gust front coming, you have two options:
    - Spiral down and land rapidly if you can make it down in time
    - Stay high and ride out the nastiest part of the gust front
  - If it begins to rain on you, your wing will stall easier. Some speedbar may help in this scenario
  - Reserve, although reserve descent speed may be slower than cloud suck.

- Cold Fronts
  - Be familiar with the operation of your speedbar.
  - Be familiar with possible LZs behind the hill if you get blown back
    - Getting high and then turning and running to sugarloaf can be an option, and is probably a better option than landing directly behind the front ridge
  - Reserve if you're getting rotored close to the ground

Conclusion:

I hope this writeup was helpful and that you learned something. Keep in mind that it is a basic overview, and that there is a lot more to learn! These tools, when used correctly, will help you choose the right days to fly and allow you to be better informed before you make the decision to launch. Beyond safety, you may even save some time by avoiding sitting around on launch on marginal days...

If you see something that you don't quite understand in the forecast, ask someone about it! If you're at the hill and something doesn't feel quite right, speak up!

Fly safe!