



Matt’s Mountain Flying

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1) Mountain Checkout minimum requirements (RE: RMFlight):

- This applies to ‘Rocky Mountain Flight School’ mountain checkouts, but in general it makes a good guideline for anyone planning to head west into the mountains.
- When considering a “Mountain Checkout” it is important to get experience by way of 3-4 flights across at least the North, Middle, South areas.
 - o The example routes below are not required to be flown exactly, they are simply common waypoints and directions.
 - Ground School covering the subject areas below
 - Work through the Mountain Flying Checkout Quiz

2) Matts Mountain Flying Example Routes

I think of mountains as 4 main areas, **North, Middle, South, and Far South**. We want to ensure pilots get an opportunity to fly in each of these areas, at least the North, Middle, and South. This includes as many mountain airports as possible and as many mountain passes as possible. Simply because they are all different and in practical terms, they are the routes you would actually fly to fun/goal destinations. Below are some example scenarios that work great for experiences and challenges. It is important to think about place you will actually go someday and include them in one or more of the routes. For example, if “Rifle is a place I plan to go someday”, then including Rifle with a middle Glenwood flight would be ideal.

(see the map below for the ‘big picture’)

North Scenario: “North Area of the Mountains” (tends to be 2.5 – 3.0 hobbs)

- Metro Airport (KBJC)
- Rollins Pass
- Granby Airport (KGNB)
- Kremmling Airport (20V) (can skip if need to save time, just overfly)
- Rabbit Ears Pass
- Steamboat Springs Airport (KSBS)
- Back to KBJC (return the same way, or north over Cameron Pass)
- This is a great “first mountain flight” since lower terrain, more options to navigate, least dense mountain area.
- Here is the example route: [Example of this route](#).
- Also see links to Videos of the mountain passes and airports (links below or in gallery tab)

Middle Scenario: “Middle Mountain area” (this tends to be 3.0 – 3.5 hobbs)

- Metro Airport (KBJC)
- Kenosha Pass
- Mosquito Pass
- Leadville Airport (KLXV)
- Independence Pass
- Aspen Airport (KASE)
- Glenwood Springs Airport (KGWS)
- Can include Eagle Airport (KEGE)
- Vail pass
- Loveland pass
- Back to KBJC
- Mosquito pass, the highest pass in North America.
 - If unable, south to Weston Pass or south to Trout Creek Pass (good example of options to Leadville)
- Leadville KLXV, Highest airport in North America (10,000ft)
- Aspen KASE, one of the top 5 most exciting airports in North America.
- Link: [Example of this Route](#).
- Link: [Example of this Route](#). (with Glenwood and Eagle airports)
- Also see links to Videos of the mountain passes and airports (links below or in gallery tab)

South Scenario: “South area but not too far south”

- Metro Airport (KBJC)
- Kenosha Pass

- Trout Creek Pass or Weston Pass
- Can include Buena Vista (KAEJ)
- Cottonwood Pass
- Gunnison Airport (KGUC)
- Monarch Pass
- Salida Airport (KANK)
- Wilkerson Pass (or backside of Pikes Peak)
- Back to KBJC
- Spectacular mountains separate Salida side with Gunnison side.
- Link: [Example of this Route](#).
- Also see links to Videos of the mountain passes and airports (links below or in gallery tab)

Far South Scenario: “Southern and South-West Colorado”

- Airport options include:
 - Telluride
 - Telluride is the marque airport on a plateau and considered the #1 most exciting airports in North America
 - Durango
 - Pagosa Springs
 - Mineral County
 - Cortez
 - Alamosa
- To Telluride: There are many different ways to get to Telluride, each with different values:
 - Fastest Most direct: [Link to Example Route](#)
 - Middle most interesting/value: [Link to Example Route](#)
 - South most airports (longest): [Link to Example Route](#)
- Also see links to Videos of the mountain passes and airports (links below or in gallery tab)

Videos of Mountain Airports

- Some good examples: (see all Colorado Airport videos: [Colorado-Airports](#))
 - [Telluride](#) – considered the #1 most interesting/challenging airports in North America
 - [Aspen](#) – I feel is one of the top 3 most challenging airports
 - [Glenwood Springs](#) – My opinion...the number 1 most challenging airport
 - [Crawford](#) – Ok probably the really most challenging airport

Videos of Mountain Passes

- Some good examples: (see (many) mountain pass videos: [Mountain-Passes](#))
 - [Cinnamon-Pass](#) – buried in very dense mountains down south by Telluride:
 - [Cottonwood-Pass](#) – get you into Gunnison area
 - [Independence-Pass](#) – get you into Aspen area
 - [Mosquito-Pass](#) – get you into the Leadville area. Highest pass in North America

Weather Resources

Here is a quick shortcut for links to various official and unofficial weather sources:

- <https://www.mattbeyer.com/weather/>

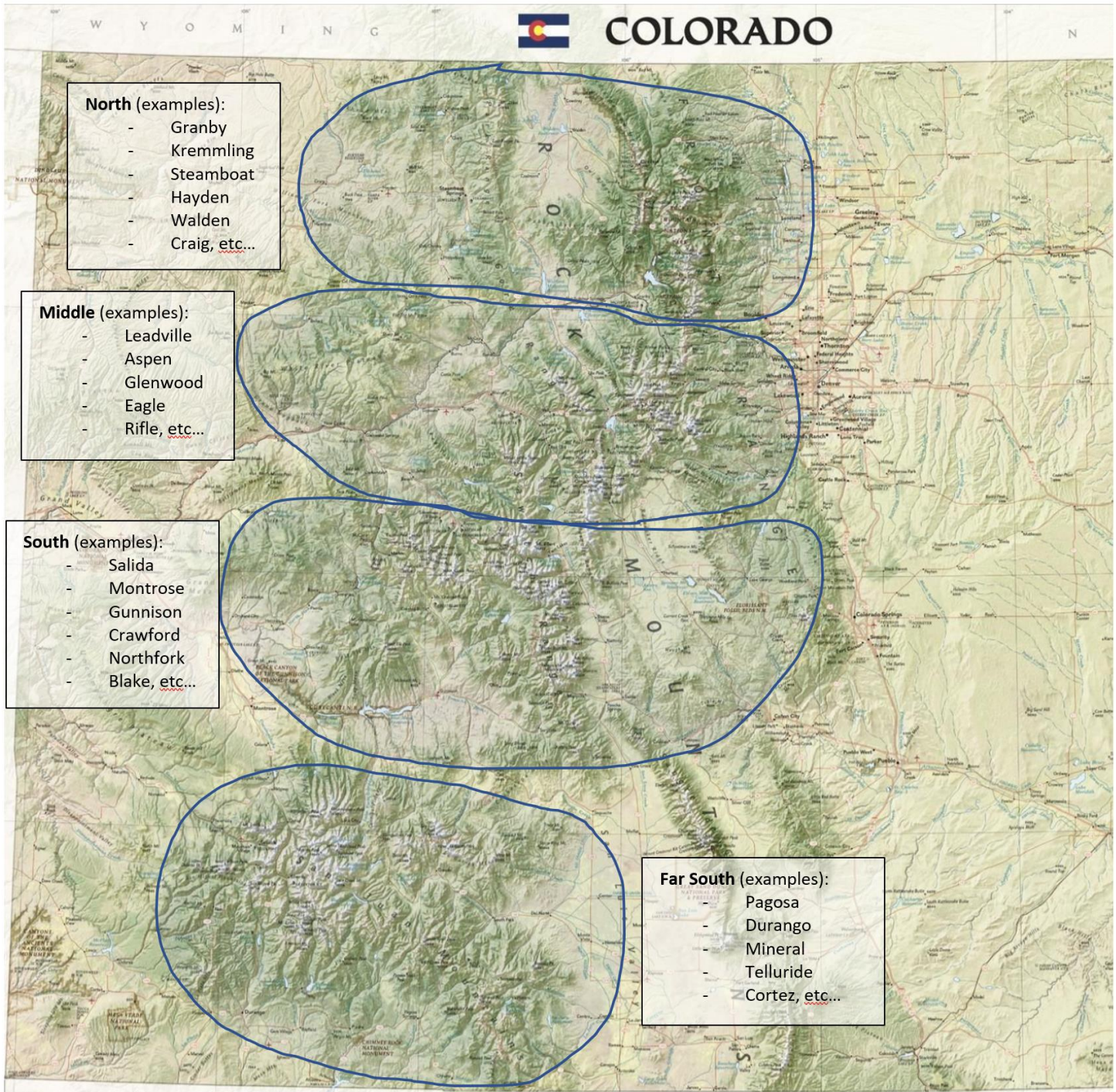
- These buttons for each area are a convenient way to see it all at a glance for “past 4 hours”, “current”, and “forecast” conditions at the various airports. This is a good way to see the trend

Mountains North

METAR/TAF (4 hour)

- Example button

The Big Picture



3) Matt Mountain Flying Techniques/Notes

General

- Don't enter an area of mountains without 1000ft+ of clearance. Don't depart from Denver and enter the foothills until 10000ft has been reached as an example. Don't expect to climb "with the rising terrains"
- The rows of mountains will all blend together in your view when at a lower altitude. It may look like 1 big mountain but be looking for the distinct rows to appear as you gain altitude. They won't look so bad. More altitude early to see the spaces between rows.
- Always have an escape route to the right or left. ALWAYS
- Always have an escape route to lower terrain. Know where you would plan to retreat to if needed.
- Cooler temperatures in the morning equal a lower density altitude (better).
 - o Fly in the mornings is the point.
 - o In the summer months, do not expect to fly in the afternoon warm
- Mountain flying at night tips: don't fly in the mountains at night.

Navigation

- Expect and plan for deviation from a planned route become normal while:
 - o Avoiding areas of turbulence
 - o Looking for lift (updrafts)
 - o Vacating an area of down-drafts
 - o Terrain avoidance due to altitude
 - o Sightseeing specific locations
- Won't be able to create or fly a VOR based navigation flight plan.
 - o Navigation methods will be pilotage and GPS, do not expect to pick up VOR's
- Become familiar with G430/G530 terrain page
- Become familiar with ForeFlight hazard advisor feature

Airplane/Performance

- Performance: A non-turbo airplane loses 3% of horsepower for every 1000ft of altitude
 - o Example: A 4-seater Cessna 172 flies like a 2-seat Cessna 152 (when in the mountains)
 - o Example: An airplane rated at 300HP, will only have 200HP at 10,000ft.
- Radio and communication: Will be unable to pick up AWOS when blocked by a mountain or hill, can pull the squelch so that you can hear it further out (choppy but usable)
- Weight and fuel management, keeping down gross weight can be a better advantage than excess fuel.
- Study and know runway lengths and POH performance at Density altitude.
 - o You can usually land and get into runways that you might not be able to get out of
- Gently lean the mixture every 3000ft of climb. Enrichen on approach!
 - o Do not go fully rich when landing in case you need to go around.
- Don't expect the POH to have valid performance data for these density altitudes.
 - o Expect extrapolated horrible performance, always round conservative side of POH
- Lean the engine for best power before takeoff from your POH.

Updrafts/Downdrafts

- Be watching the VSI and pay attention to lift and sink. VSI is now a critical instrument.
- Keep track of where you saw any lift or any sink, you may need to go back to where you saw lift to climb up.
 - o You can backtrack and find a previous spot that provided lift.
 - o Be keeping a mental note of where you last saw good lift
- If area of sink, consider increasing speed to get through it. 'consider'
 - o If sink persists for more than 20 seconds, alter course significantly and find the corresponding lift in the area.

- Make big changes in course as needed to find lift or to at least get out of the sink.
- Updrafts: Pitch for V_x when in an updraft. Ride it up like an elevator with a slower airspeed to stay in it longer
 - When the updraft is over, resume V_yit's done
- If turbulence, get below maneuvering speed asap, lower the gear, reduce the power, lift the nose, slow down
- Note groundspeed changes, if it changes significantly or a big headwind, expect turbulence.
- Be a glider pilot, anticipate where the updrafts are by considering wind direction and ridges
 - Alter your course to look for lift from the ridges, go find it by changing course
 - Even if this alters your planned course, deviate to find ridge lift
 - Fly under 'building clouds' to gain lift.
- If using autopilot, pay attention to how much trim the autopilot is using (can cross check with airspeed).
 - Autopilot may be fighting a downdraft too much and best to alter course (airspeed dropping etc.)
- Note: Fun example of a big updraft at 14000 ft, reminding us the value of the VSI to detect them.



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Mountain Passes

- Always plan to cross a pass at a 45-degree intercept angle.
 - If need to abort crossing the pass, the escape is only a 90 degree turn to get away
 - Return to lower terrain
 - Turn into the pass and cross when clearly going to make it
- Wind speed can double when it is crossing a mountain range/ridge
 - Plan for turbulence, updrafts, and significant downdrafts, watch VSI
- Always have escape route to the right or left. ALWAYS
- As always with pass flying, attain maximum altitude before approaching the pass. Do not attempt to climb while crossing (expect to sink and fly with this conservative approach)
 - Be 'at crossing altitude' at least 5 miles before the pass
 - Give 1000ft+ of margin when crossing
 - Give 2000ft+ of margin when winds exceed 20knots
- Keep a line of sight on the other side,
 - If the terrain beyond the pass starts to go away then you won't make it, you are sinking
 - If more of the other side keeps coming into view, you will clear the pass.
- Expect downdrafts that show a -1000fpm descent. Don't expect it magically to get better as you keep approaching the pass
 - Plan to cross at a higher altitude and tolerate the loss from the downdraft
 - Or, look for a different location to cross (different winds different terrain)

Canyon and Valley Turns

- Never fly up or into any part of a mountain canyon where you cannot do a U-turn.
 - o Always know how to turn back, always have the plan to turn back.
- Stay glued against one side of the valley (the side with lift). ALWAYS
 - o Get close and stay close to allow more 'turn around' space.
 - o Never fly down the middle!
- The downwind side should have the updraft
- Use 45-degree steep turns and slower airspeed to reduce radius.
 - o Can use up to 60-degree bank turns if allowed to descend (if you are not trying to maintain altitude).
 - o Suggest 30-45degree Vy climbing turns for normal U-turn.
- Practice U-turns on flatlands with different speeds and flaps and climbs to see turn radius

Mountain Airports

- All mountain airports have short runways. AND density altitude is higher!
 - o Your groundspeed is higher.
 - o It is important to fly a normal approach and normal airspeeds and full flap landings. Fly the normal POH approach and landing Vs speeds
 - o Any excess airspeed or being high, you won't be able to land the plane. So be very diligent with airspeed on final
- All mountain airports are to be full stop taxi back (taxi back for departure).
 - o No touch and goes. Runways are short. Performance is lower.
 - o Terrain may also dictate you need to go out the same way you came in (Aspen...)
- Mountain airports may not support a normal pattern, don't try to force a normal pattern!

Descending

- Add drag, flaps, gear, etc. to allow keeping some power in (engine cooling)
- Avoid shock cooling the engine on descents.
 - o Manage a nice descent profile, close the cowl flaps, make all descents powered to maintain some engine heat.

Approach and Landing

- Do not add airspeed on approach/landing, fly the published numbers in the POH and fly indicated airspeed. Increase speeds to accommodate gust factor as usual.
- Groundspeed will be higher; you will notice it. Expect long landing and takeoff rolls
- Be aware of how high you are and make sure to descend to pattern altitude well in advance
 - o DO NOT be so high that a landing can't be made, go-arounds may not exist
 - o And don't be fast on approach, it's going to be a long float and maybe a go around. S turns, Slips, lower the landing gear, lower the flaps....
 - o Get down early, **Do not save the large descent for final**
- No touch-and-goes at mountain airports. Always taxi back and depart
- While approaching, look at the go-around AND the departure scenario.
 - o This is the last best look to see the terrain before being on the ground
- A go-around at high altitude can be tricky, watch your flaps and airspeed.

Takeoff/Departure

- Slowly adjust mixture during runup at high altitude airports, don't stall the engine.
 - o Lean for taxi
- Depart with a minimum weight.
- Treat ALL mountain airports as short field takeoff technique.
 - o DO NOT waste any inch of runway by lining up 200ft down the runway.
 - o Hold the brakes as you apply power, then release the brakes...
- Perform a mixture re-leaning procedure before takeoff so maximum performance is assured
- Do not climb slower than V_x on departure.
 - o If you are still not climbing, lifting your nose further will NOT help.
- Stay in ground effect while building airspeed. Be patient with the airspeed buildup.

Weather/Clouds:

- Avoid flight above building cumulous clouds
- VFR on top is not likely in the summer due to high bases.
- If rotors or strong winds, cross the ridge/pass over at a height that is equivalent to the height of the pass over the valley.
 - o Stay above the rotors
- Rotors tend to be at or below the ridge elevation. Their effects stop typically twice the ridge height (over the valley).
- See "Cloud Example Pictures" section below

Winds and Winds

- The winds reported at mountain airports may not be the same as winds reported aloft or winds reported at non-mountain airports.
- Mountain airport winds, look at the previous few hours to sense the trend
 - o If the winds are high or gusty, the entire journey will be bumpy and maybe skip
 - o If the wind does not align with a usable runway, skip (some airports are 1 direction only)
 - (Example: Runway 9 at KTEX for departure is unusable. If winds are from anywhere other than the west, do not plan to land!!)
- Winds Aloft forecast is an excellent resource for go/no-go decision making
 - o Look at various levels from 9000ft/12000ft/18000ft from GJT/DEN/PUB
 - o Look for high change in velocity (>15kts per level). Shear layer = bumps and ups/downs
 - o Look for high change in direction (>30degrees). Shear layer = bumps
 - o Winds aloft at 12000ft >30 knots typically come with turbulence and ups/downs.
 - FAA cautions against mountain flying if winds aloft exceed 25knots.
- Winds reported at mountain AWOS will generally be higher. Not a crisis.
 - o AWOS winds reported at a mountain pass >30knots will mean turbulence and ups/downs. Advise alternate route.
- Fuel and ETE planning must be conservative accounting for headwinds as you may not be able to select any other altitude.
- Winds aloft data for Grand Junction Colorado shows:

Wind/temps

Region: Rocky Mountains ▾ Forecast (hrs): 06 ▾

(Extracted from FBUS31 KWNO 141357)

FD1US1

DATA BASED ON 141200Z

VALID 141800Z FOR USE 1400-2100Z. TEMPS NEG ABV 24000

FT	3000	6000	9000	12000	18000	24000	30000
PHX	1109	1607+15	2109+10	2210+05	2329-09	2343-22	234538
PRC			2117+10	2318+04	2339-10	2353-23	236339
TUS		2107+17	2310+11	2415+05	2220-07	2225-21	222938
ALS				2726+04	2440-10	2550-23	266439
DEN			28(11)+08	26(27)+03	26(50)-11	2656-25	267340
GJT			23(19)+02	25(31)-01	25(59)-13	2569-25	258140
PUB				2718+11	2725+05	2541-10	2650-24 266239

- Winds 19kts -> 31kts -> 59kts at altitudes of 9000/12000/18000
- Denver reporting location shows similar
- Wind direction all consistent from ~230 - ~250
- Assessment:
 - Very strong winds, and stronger just a few thousand feet above. Strong mountain wave.
 - Expect turbulence, strong or impossible headwind, up and down drafts
 - From western Colorado going east as typical
 - Flying toward a pass with a huge headwind and high likelihood of downdrafts and turbulence.
- Watch my time lapse of a 'Mountain Wave' producing rotor and roll clouds
 - This shows the violence of the winds/rotors/rolls and motion: [TimeLapseMountainWave](#)

Oxygen and Altitude

- Oxygen FAR requirements are based on 'Cabin' pressure altitude and not 'indicated altitude'.
 - Can approximate with the 1000ft per inch of pressure
 - On a high-pressure day, you can actually fly higher than the indicated altitude
 - 12500 and 14000 FAR limits may be reached with a higher indicated (good news)
 - You may want to use that extra 300ft and be at 14300 on a high-pressure day.
 - Which also means, a lower than standard pressure day means you cannot fly indicated 14000.
 - A Low-pressure day may prevent certain routes that require 14000.
- Hypoxia will impact people differently. It can impact people at different altitudes (different for everyone)
 - Factors influencing tolerance to hypoxia: General fitness, do you live at sea level, fatigue, illness, ...
- Learn your personal symptoms. Could fly with a friend on oxygen and look at how different high altitudes impact you. Could sign up for the altitude chamber testing.
 - Euphoria, dizziness, headache, tingling toes fingers lips, purple fingers/lips, reduced ability to process and focus, sleepiness, unconscious, rapid heart rate, confusion.
- Own a 'Pulse Ox' device that clips on your finger. Cheap, own it, use it, characterize yourself
 - Study your baseline Oxygen level and test during flight at various altitudes
 - Readings in the 90's (great). Readings in the 80's (ehhhhhh ok for now). Readings in the low 80's or lower (descend or use supplemental oxygen asap)
- Owning and carrying supplemental oxygen is a great idea. A small 9 cuft system will work great for 2 people or more and allow you to 'get to higher altitudes to cross those passes'.
 - Breathe through your nose and enjoy the improvement when on supplemental oxygen.
 - Don't consider "Boost Can" as a solution. A can of 'Boost' actually does work and improve your oxygen level. BUT IT DOES NOT sustain your levels as it is not continuous and attached to your face or nose. It's maybe nice for passengers, but it does not count as a good tool to support pilot oxygen levels.

- Link to an extreme example of a hypoxic pilot, AND how quickly it goes away when at much lower altitude.
 - o [Pilot Declares Emergency Because Of Extreme Hypoxia](#)

General Weather for each Season

Generally all 4 seasons work well for flying locally or in the mountains (with considerations):

- **Winter:**
 - o Precipitation is in the form of snow or ice.
 - o Be ready to defrost your airplane in the morning (ice/snow/frost).
 - o Lack of daylight. Sunset is early and gets dark quickly, and sunrise is late.
 - o Lower clouds when there are clouds.
 - o Windy mountain wave potential.
 - o **But a wonderful time of year to fly**
- **Spring:**
 - o Precipitation in the form of lower and widespread clouds.
 - o The start of spring storms (pre-thunderstorms season) with heavy rain when it rains.
 - o Windiest season due to the Jetstream. Strong or gusty conditions may exist in the afternoons.
 - o **But a wonderful time of year to fly**
- **Summer:**
 - o Density altitude is very high in the afternoon.
 - o Very little to no flying in the afternoon with high density altitude.
 - o Convective activity and thunderstorms in the afternoon....just avoid them and watch for building clouds.
 - o Strong or gusty conditions may exist in the afternoons (or even microbursts)
 - o **But a wonderful time of year to fly.**
- **Fall:**
 - o Less convective activity, but windy in the afternoons...
 - o Starting to lose daylight.
 - o **But what a wonderful time of year to fly.**

Additional Resources

- <http://www.mountainflying.com/>
- Mountain passes: http://coloradopilots.org/mtnfly_passes.asp
- How much flaps to use?
 - o Good article. Basically, use as much flaps as the max aileron deflection since in theory this is the best lift/drag for that wing. Extend flaps to max aileron and use it in the mountains.
 - o http://www.mountainflying.com/Pages/mountain-flying/max_lift_flaps.html
 - o Full Flaps Good: Slowest landing speed for short runways
 - o Full Flaps BAD: Lots of drag...go around will suffer big time.
- Looking at cameras around the state can be very useful: [Cameras-Link](#)

4) Videos to learn from

Fortunately, there are many useful videos to learn from out there.

And unfortunately, accidents and almost-accidents do happen, and we can all learn from them.

Here are some good videos each having some valuable takeaway.

- Matt Beyer/Jan Aleman and: 'crossing Rollins Pass instruction' (7/2024): [Youtube-Link](#)
- Blancolirio review: 'almost crash' at Rollins Pass (7/2024): <https://www.youtube.com/watch?v=fcM7O9JYXKU>
- Civil Air Patrol crash review by AOPA (11/2024): <https://youtu.be/LSilGn5akok>
- Article written about a good mountain experience (Spring 2024): [By Philip Arthur with Matt Beyer](#)
- <More to add>

5) Preparedness and Safety

Every flight into the mountains should include a pre-flight of the gear you carry. It is always a good idea to plan for all possibilities including an off-airport landing and outdoor conditions.

Items you will want to always have directly with you "On Person" (with you, vest, pockets...)

- A charged cell phone (charged before flight)
- Small wallet with ID and some basic cash
- Multi-tool or knife
- Be sufficiently warm for the outside environment without having to access cargo gear area

Things readily available to you or your crew (back seat, cargo area...)

- Personal Locator Beacon (PLB) device like SPOT or InReach
- First aid kit with bandages and antiseptic wipes.
- Pen and notepad
- Multitool and or knife
- Battery and charging cables for phone and other devices
- Re-usable water bottle filled (basically not plastic one time use water bottle)
- Nonperishable food with high caloric value, e.g., protein bars
- Winter hat and gloves, warm jacket, appropriate clothing/layers
- High visibility vest or clothing or tarp
- Compass, Signaling mirror, Whistle, Flashlight, Lighter/Fire starter

Take additional steps and other suggestions:

- Make sure someone knows your intended route and flight plan (intended airports etc.).
- Establish ETE and ETD estimates and provide to others.
- Check-in with people via text or call along the way or at destinations.
- File and activate a VFR flight plan (remember to close it when mission completed).
- Be sure the ELT has activated as it may not have activated automatically in a crash.
- Use parts from the aircraft for survival gear
- Be careful of fuel leaks and potential for fire. Move away from fuel areas on the ground.
- Common sense, "You are the most important survival tool on board"
- Brief passengers before flight on all emergency equipment present and how to use it
- Dress for colder temperatures and the ability to hike.

6) Cloud Examples

“Flowing over the ridge”



- Clouds rolling over Rollins Pass
- It visually shows how the air typically flows over a mountain ridge. Upslope on the side the wind is coming from, and a downslope on the left side of the picture.
- Good example of how a cloud may just ‘sit on the ridge’ all day but doesn’t exist anywhere else. This can certainly block you from passing this ridge in this area.
- Don’t assume you have the power/performance to go over these.

“Rows of clouds from mountain wave”



- From the ground looking west as if there is a strong mountain wave occurring.
- As the wind is forced up and down it cools and condenses and forms a cloud, then is forced back down and no more condensing. Continues east well into the flatland.
- Mountain wave will certainly have lots of ups and downdrafts and may exceed the performance of our airplane.
- This shows the violence of the winds/rotors/rolls and motion: [TimeLapseMountainWave](#)

“High winds aloft, standing lenticular clouds”



- General look of ‘high winds aloft’ and ‘standing lenticular’ clouds.
- High winds aloft....turbulence conditions may exist and exceed the performance of our airplane. However very high-altitude events like this may just make it bumpy, but not come with significant downdrafts at our sub 14000ft levels.
- Concerns of rotors below these clouds may exist.

“Starting to build in the distance”



- At the moment, nothing to worry about. A thin layer of clouds and not socked in. However, the building of cumulus in the distance may indicate this will expand outward and upward....blocking you from returning home from the mountains.
- Potentially pre-thunderstorm activity. Reconsider going beyond these if you need to go this same way to get home.

“Non Convective, probably enough room”



- Non convective clouds (late in the season)
- High enough and sparse enough to avoid. Enough spacing to alter route for most margin.
- The cloud bases not going to lower, no growth, non-convective....ok to keep going.
- They might become more widespread, but plenty of room/margin under them.

“Cute little clouds to watch”



- Small, boring, scattered/few clouds. Ok fine but they are at a low altitude. However, as they grow more of them... well you might not fit under them when crossing a ridge, and you might not have performance or oxygen to get over them.

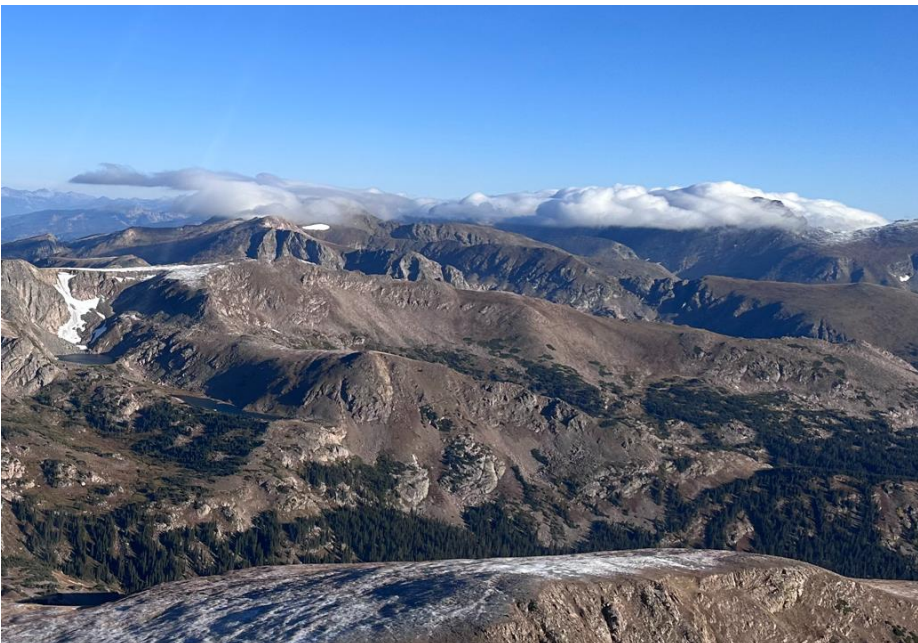
- Leads to reduced margin for now, maybe no big deal, but if further accumulation you might not have an opening on the way home. Don't go out and get trapped out there. Watch them grow and have an alternative route back.

“Small indicator of high winds at a ridge”



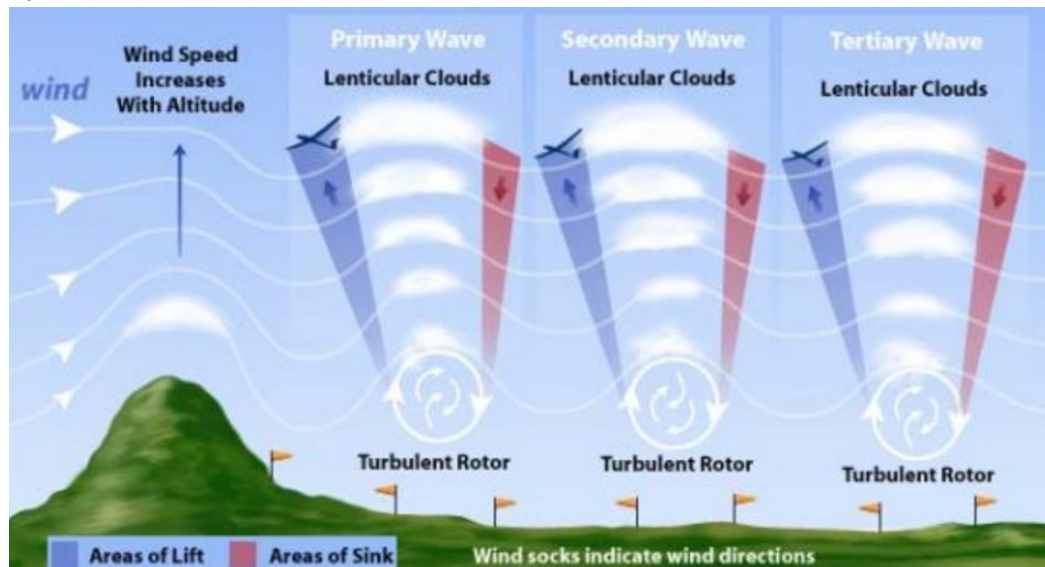
- Cute little pretty clouds. But watch out. Shows higher winds going up and over these peaks and ridges.
- A nice opportunity/indicator to see what is going on and plan for higher winds at a crossing and turbulence

“Clouds sitting and Blocking”



- Clouds sitting on the top....no adverse weather but...you would have to go over them or around them. Don't assume you have the performance to go over them. Notice there is no room to go under them.
- Be careful if these grow to cover the route intended for your return. These simple clouds might be blocking your return in a couple hours.

Good representation of where we live in Colorado



Matt's To Do List:

----- NOTES to incorporate -----

Discuss this direct route...

