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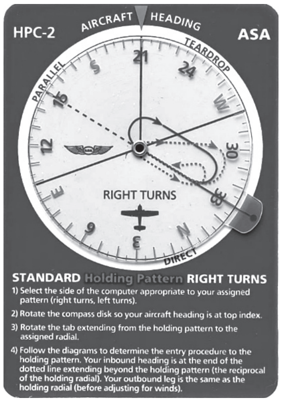

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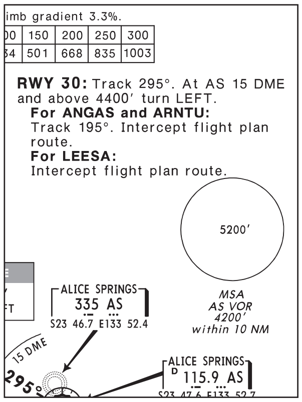

Fly the track ... page 14

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FLY THROUGH A FORECAST

No matter what you fly, getting the most from your aircraft means matching your weather plan with your performance envelope.

Photo: Mike Shore

by Scott C. Dennstaedt

Last October I flew across the country from Rock Hill, S.C., to Bend, Ore., with a Columbia 400 driver, providing some instruction on his new airplane on the way. The trip took us over the Continental Divide where the threat of thunderstorms and mountain wave turbulence haunts just about every flight. The Rockies can also mean ice even in the middle of summer

The trip went fine, but our success came from the right combination of reading the weather and exercising the capabilities of a seriously high-performance, four-place, piston airplane.

Getting into Position

The goal on the first day was to make it to Rocky Mountain Metropolitan Airport (KBJC) to the northwest of Denver before dusk. This would put us in a leap-frog position to get over the Rockies in the morning. Timing is everything and being able to find a window of opportunity is critical.

The trip to Denver was benign. We chose an altitude to stay in the stable layer above the thermal turbulence, but low enough to minimize the over-50-knot headwinds aloft. With one stop at North Little Rock Airport (1M1) to fill the tanks with fuel and our bellies with food, we made it before sundown.

The buzz at the FBO the next morning was the winter storm that was on its way. The local forecast placed a six-inch coating of snow overnight in the Denver region. We wanted to get out of Dodge before the winter storm, but beating the snow wasn't our immediate concern.

By 1200 Zulu on the morning of our flight, a cold front was quickly approaching the Colorado-Utah border moving southeast to meet up with the remnants of Hurricane Paul moving in from the Pacific across Texas.

The front had few breaks in the clouds and little or no chance to go under the cloud deck the entire route.

A Columbia 400 has twin turbochargers and 98 gallons of usable fuel, so flying high (up to FL250) and far is a viable option. This Columbia 400 was equipped with the Garmin G1000 avionics, including satellite weather.

Continuous monitoring of weather en route is like the finest gold when there are significant weather challenges ahead. You can confirm the conditions that were forecast and adjust to new weather threats that unfold. The combination of graphic representation of en route advisories along with text makes the onboard weather worth every penny.

The ability to fly at FL250 is like having a pair of pocket aces while playing Texas hold 'em — it's a strong hand that's easy to play. With the exception of big thunderstorms and the occasional unpleasant encounter with clear air turbulence, most challenging weather is contained below FL180. Many non-convective fronts top out at FL180 or lower. Even convectively active fronts generally don't exceed FL250 during the cold season.

Outside of convective activity, icing isn't a problem during most of the year at FL250.

Building Confidence

My primary concern was the potential for thunderstorms en route as we approached the frontal zone. It was clear from the Storm Prediction Center's (SPC) enhanced thunderstorm outlook that our route included a moderate risk (40 percent) of thunderstorms.

On the other hand, as of 1300 UTC, the Aviation Weather Center (AWC) had not issued a Convective

Outlook along our planned route. Not yet, anyway. The Convective Outlook produced by the AWC is a six-hour forecast identifying larger areas that will likely see the issuance of one or more convective SIGMETs within the forecast period.

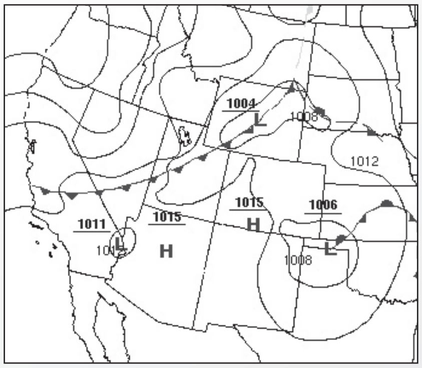
The absence of a Convective Outlook or a Convective SIGMET, however, does not mean the absence of thunderstorms. It simply implies that any thunderstorms that have developed or will develop are not expected to reach Convective SIGMET criteria (see "Convective SIGMETs," April 2005 *IFR*). Of course, even an isolated thunderstorm can spell trouble for a four-seat piston airplane.

This particular front was fairly messy — a technical term for a front that has few breaks in the clouds along the front and little or no chance to go under the cloud deck the entire route. No thunderstorms knocking down our front door, so I wasn't as concerned about the time of onset. I needed to know where the tops of the thunderstorms would be when they developed.

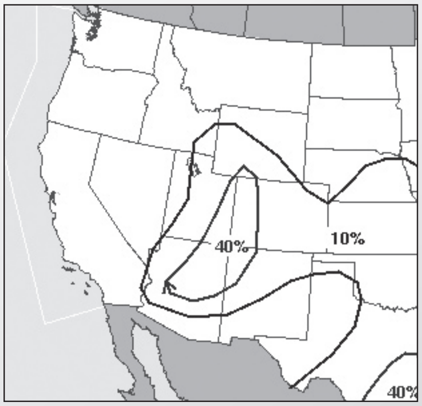
Every thunderstorm is eventually capped by a temperature inversion aloft. In the worst case, the tropopause is the mother of all inversions and generally defines the upper limit on all thunderstorms. Without active thunderstorms present, you must enlist the help of thermodynamic diagrams such as the Skew-T Log P diagram (see http://rucsoundings.noaa.gov) or the expertise of the weather forecasters. Based on the Enhanced Thunderstorm Outlook, forecasters at the SPC have already warned us that some instability exists.

Air that is lifted by the advancing cold front will expand and cool to reach saturation in the form of cumulus clouds. Since the rising parcel of air doesn't mix with the environment (adiabatic process), it's a race between how quickly the rising saturated air parcel (cumulus cloud) cools with increasing altitude versus how quickly the environmental air around the parcel cools with increasing altitude.

PUTTING THE PIECES TOGETHER



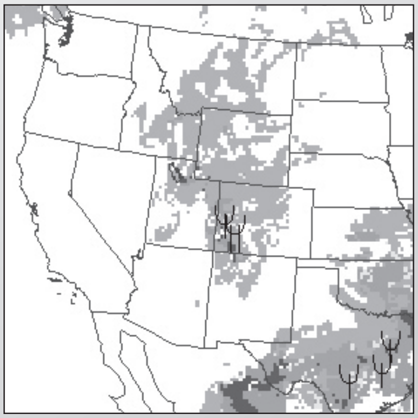
By 1500 UTC, the frontal system was located in the middle of Utah and dropping to the southeast. This wasn't an exceptionally strong front, but did have enough instability to provide the potential for thunderstorms ahead of the front. The Enhanced Thunderstorm Outlook from the Storm Prediction Center (SPC) provided a moderate chance that convection was possible ahead of the cold front.



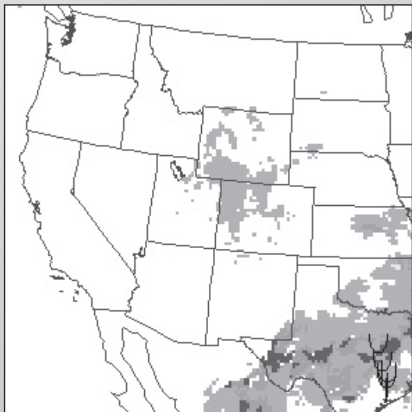
An AIRMET is a time-smeared product and, especially when AIRMETs are large, it is possible that only a small portion of this total area would be affected at any one time. With blue skies showing through holes in the broken layer, icing would not be an issue on our climb. The AIRMET did provide us with an important clue that the icing layer terminated at FL200. Outside of convective activity, FL200 should keep us clear of structural icing.

The Current Icing Product (CIP Severity) is not a forecast of icing potential in the future and will not tell you the tops of convective activity that hasn't formed. However, it provides a great gauge on the approximate height of the top of the icing layer outside of convective activity. The masked CIP Severity (> 50 percent) depicted a high likelihood of moderate icing at 17,000 feet MSL, but little chance of icing at FL210. This agreed completely with the AIRMET and gave us confidence that we could fly over top of any icing. — *S.D.*

Icing severity (prob>50%) at 17000



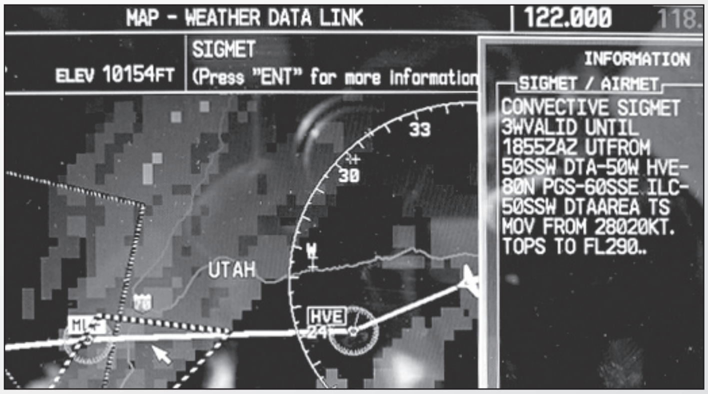
Icing severity (prob>50%) at FL210



The latent heat of condensation in the developing cloud keeps the parcel from cooling off as quickly as if it were unsaturated air. If the saturated parcel's temperature remains warmer than the environmental temperature, then the atmosphere is said to be unstable with respect to the saturated parcel. The saturated parcel has *positive buoyancy*.

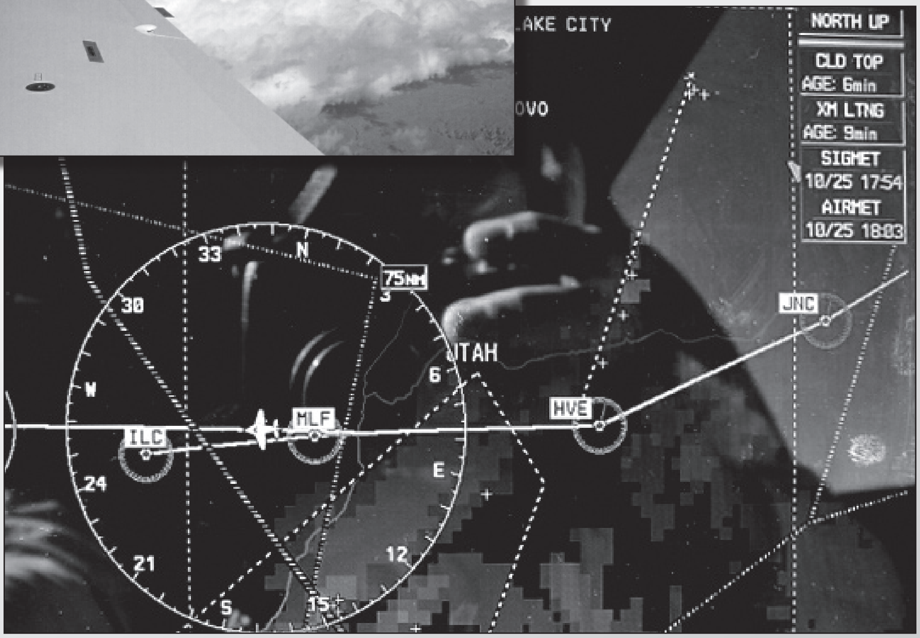
Eventually, the environmental temperature will become warmer than the rising saturated air parcel. This point of crossover is called the

WEAVE YOUR WAY THROUGH THE TEXT AND GRAPHICS OF WX



The G1000 satellite weather display not only depicts the convective SIGMET graphically, but allows the pilot to scroll over to the convective SIGMET to display the text associated with the advisory. In this image, we could see that Convective SIGMET 3W was in our direct flight path and the area of convection was moving easterly at 20 knots with tops to FL290.

Turning to the north to avoid the convective SIGMET in our path wasn't a viable option given the convection that was beginning to build in that general direction. Shortly after we passed south of this area, convective SIGMET 5W was issued for a 20-nm wide line of thunderstorms to the north of the HVE VOR as can be seen by the dashed line. Also take note of the "plus" signs that designate the location of cloud-to-ground lightning strikes.



When flying around or over convection using satellite weather on the G1000, I like to be displaying NEXRAD, satellite cloud tops, lightning, and SIGMETs/AIRMETs on the Weather Data Link Map page. In mountainous areas, there are plenty of "holes" in coverage for NEXRAD.

Consequently, ground-based lightning may be your only indication of convection in these regions. Satellite cloud tops provide a good indication to the extent of the convection, but the image may be 30 or more minutes old.

Finally, at 55 minutes past each hour, you can witness any newly issued AIRMETs and convective SIGMETs issued by the AWC. — *S.D.*

equilibrium level and represents the upper limit of the convective updraft. Once this parcel hits the equilibrium level, it has nowhere to go, and it typically spreads out as it is sheared by the winds aloft producing the classic thunderstorm anvil. Stronger updrafts with a lot of upward momentum in the core of the thunderhead will often "overshoot" the equilibrium level and can rise above the anvil. Lower topped thunderstorms will often not contain an anvil.

As I looked over the Skew-T Log P soundings for our planned route, the highest equilibrium level over the front was approximately FL200. Consequently, we filed for FL200. There wasn't a tremendous amount of instability, so I was pretty confident that the atmospheric pot wasn't likely to boil over along our route of flight. Even so, FL200 would give us 5000 feet of wiggle-room up to our certified ceiling of FL250 if we needed to climb above any overshooting tops.

Looking for Ice

Icing was the next piece of the puzzle. Even if we were able to stay outside of any convective activity, could we be reasonably sure to stay out of clouds that contained supercooled liquid water? AIRMET Zulu covered most of Colorado and Utah at the time of our departure, for occasional moderate icing in clouds and precipitation from the freezing level through FL200. Freezing levels were running roughly 12,000 feet MSL over Denver.

Conditions at the surface were light westerly winds with 60-mile visibility, temperature of 10 degrees Celsius, and a broken ceiling of 10,000 feet. Since we were just outside the Mile-High City, this meant we wouldn't even enter the clouds until about 15,000 feet MSL.

As we were driving to the airport, there were plenty of breaks in the clouds with blue sky showing through, especially to the west. Virga was visible to the east.

Blue sky provides important clues. If you are looking toward the horizon and you can see blue sky, the cloud layer is likely fairly thin. Thicker layers generally will block the view to the clear sky above the clouds unless you are looking straight up.

If blue sky can be seen, dryer air exists in and around the thin layer of clouds. Consequently, even if you find yourself in a cloud or two, the liquid water content in the cloud typically is low, assuming it is not a vertically-developed cloud. You can nearly always negotiate with ATC to find one of these holes and climb through it to keep you clear of supercooled liquid water.

Ice Online

What about the Current Icing Product (CIP)? Why not just use CIP to determine the top of the icing layer?

Indeed we did. The new CIP Severity icing product (see "Internet Ice Gets Severe," December 2006 *IFR*) at 1300 UTC was showing a good chance for moderate icing at 17,000 feet just ahead of the front and nose-to-nose with our route. At FL190, the area decreased in size and the likelihood for icing also decreased. Finally, by FL210 the potential icing along our route nearly diminished.

Once again, I felt confident that a flight at FL200 would keep us out of ice as long as we remained clear of any convective clouds.

One thing worth noting is that CIP is only a recent glimpse of the past and says nothing about the future. If convection did develop, icing levels might have been considerably higher than what CIP was showing. That's why knowing the equilibrium level was so important for this flight.

About 20 minutes before we planned to depart, a pilot of a CRJ7 reported that he entered the bases

(continued on page 22)

THE CFI-I'S TOP TEN

If you gather a bunch of pilots and ask 'em what makes a good pilot, you can anticipate an earful. Here's the best of the chatter.

By Ken Holston

Much in the way Dennis Quaid (as *The Right Stuff*'s Gordo Cooper) grinningly asked, "Who's the best pilot you ever saw?" I've wanted to collect the nutshell essence of the quintessential instrument pilot. With few actual hangar flying sessions in my life these days, the only practical way to pool my mentors and aviation influences would be in a virtual hangar — a cyber bull-session of sorts.

The plus side of this technique was that I could rack and stack the results. Here's a Top 10 list of thoughts from the pilots I most respect, not so much as a Letterman-style countdown, but in a "basics first," multi-course menu. They are tips and tricks worth reviewing for both the novice and the experienced.

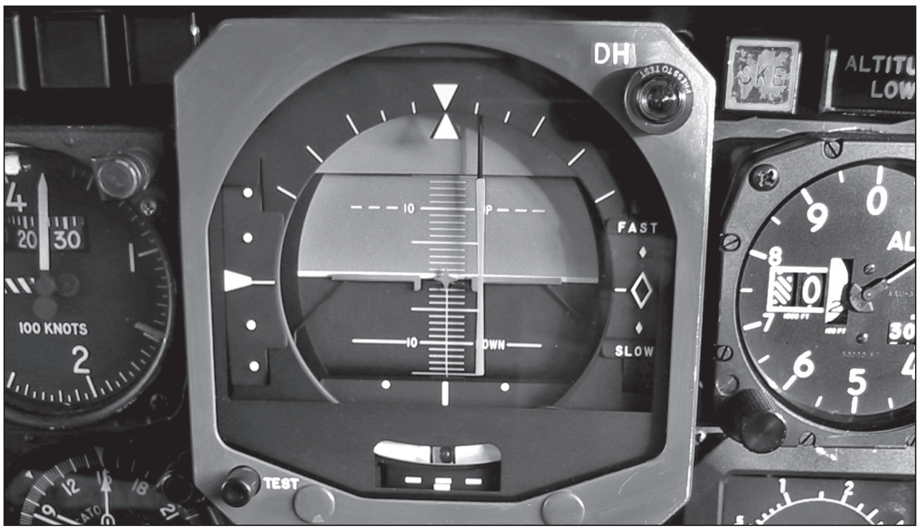
AI Flying

Although the comments were phrased differently, I received more input on this topic than any other. Also known as Control and Performance instruments, the Attitude Instrument (AI) method states that the only two inputs a pilot can make are via the stick or the throttle. Stick inputs are seen on the attitude indicator and throttle inputs are seen on the power gauges. Everything else on the panel is just a snapshot of past-tense performance. (I won't repeat the diverse slurs on the FAA's Primary and Supporting method.)

Applying the AI concept, one can construct a ballpark list of pitch and power settings for any configuration and reduce workload. Want to climb at Vy? Pitch four degrees nose up. Want to make a non-precision descent? Set 16 inches of manifold pressure. Settings may vary with weight or winds, but sharp pilots know at least four basic settings: climb, cruise, radar pattern/procedure turn, and final approach.

The topper came from a long-time designee (DE) and NAFI CFI of the

Below: *Don't think the pros fly by attitude? Check out this AI that gives the pilot single degrees of pitch for super-precise flying.*



FLY THROUGH A FORECAST

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at 14,500 ft MSL, was on top of the overcast layer at FL180, and picked up light to moderate rime on the climb out of Aspen, Colo. Aspen is about 130 nm south of our planned route, but this pilot report gave me a good sense of where the current tops were located and that corresponded well with the AIRMET.

I looked at the sum of all our information:

1. Top of icing layer was FL200 according to the AIRMET;
2. Departure airport had a broken ceiling with blue sky to the west (in our general direction of flight);
3. Thunderstorm tops not more than 20,000 feet according to the forecast soundings;
4. Recent pilot report of tops to FL180 about 140 nm to the south of our route;
5. Low risk of icing shown over FL190 using the masked CIP Severity product;
6. Destination airport forecast clear skies and a VFR descent; and
7. 5000 feet to spare if tops were higher than expected.

All of these points provided me with the confidence to file our route with a final altitude of FL200.

In the Hot Seat

With breaks still in the clouds to the west, we departed Denver about 1330 UTC and climbed to FL200 toward our next stop, Tonopah, Nev., (KTPH). After some vectoring in the climb, we popped out on top of the broken layer obscuring the mountain peaks below. The temperature through the cloud layer was -13 degrees Celsius. We didn't collect any ice on the climb and logging any IMC would have been in the hundredths of an hour.

As we progressed further west, the thin broken layer became a much thicker overcast that slowly began to creep up to our altitude. With a few light precipitation returns on the satellite weather, I knew we were getting closer to the front.

About one hour at FL200, the temperature aloft was at -18 degrees Celsius and steadily falling; this was another indication that we were pressing up against the frontal zone. With NEXRAD, cloud tops, ground-based lightning, and SIGMETs/AIRMETs displayed on the Weather Data Link Map page on the G1000 MFD, we began to keep watch for lightning strikes and newly issued convective SIGMETs.

Satellite cloud tops are best used to help determine the extent of the cloud cover. The satellite image may be more than 30 minutes old. In a rapidly developing situation, the current tops may be 10,000 feet or higher than depicted.

Like clockwork, at 55 minutes past the hour, Convective SIGMET 3W was issued for an area of thunderstorms moving east at 20 knots with tops to FL290. The MFD Weather Data Link Map Page allowed us to see our route in relation to the newly issued Convective SIGMET and our present route took us right through the northern edge. A couple of lightning strikes popped up on the southern edge as well.

One knee-jerk reaction would have been asking ATC for a turn to stay north of the Convective SIGMET area. The view out the window, however, didn't look promising in this direction. The clouds to the north were definitely in the early stages of development and appeared to already be at or above our current flight level. Additionally, lightning strikes were starting to form a line to our north. Our current route looked like our best option.

Adjusting the Plan

As we got closer to convective SIGMET 3W, it became obvious that FL200 wasn't going to be quite high enough. We asked ATC for a climb to FL220. FL220 kept us just in the wispy edge of the tops with a few overshooting tops to our north. Significant overshooting tops should be avoided as they may contain severe icing and extreme turbulence.

With a temperature of -32 degrees Celsius, a few bumps and about 0.1 hours of IMC, we easily cleared the convective SIGMET area.

Past the worst weather, we noticed on the MFD that convective SIGMET 3W morphed into convective SIGMET 4W and Convective SIGMET 5W had been issued just to the north of our route for a line of thunderstorms with tops to FL270.

By this time, about a dozen lightning strikes could be seen stretching northeast to southwest with our flight path splitting the two convective SIGMETs in two.

No Guarantees

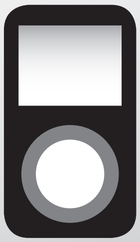
Coincidently, an instrument-rated Cirrus SR22 pilot, his wife, and two children died crossing through this same frontal zone about 30 minutes later and about 200 miles further south of our flight path. They departed Lake Tahoe and were headed southeast to Grand Canyon National Park Airport in northwest Arizona when they apparently encountered icing conditions at 13,000 feet MSL. This region wasn't under the area of AIRMET Zulu, but was convectively active including the southern edge of convective SIGMET 4W just to the north of the accident site. This accident is still under investigation by the NTSB.

At some point you must make a decision to launch. Do you have enough information to make a safe flight? Are you confident that you have the flexibility to avoid painting yourself into a corner? If not, then you stay on the ground and wait for a better opportunity. It's that simple.

For this flight, I had several key data points that I could hang my hat on. Many flights that have weather challenges always seem to end with a sigh of relief, "We made it." Having confidence in your preflight analysis and monitoring the weather while en route keeps your deodorant fresh throughout the entire flight.

HEAR MORE HERE

For more information on …. , log onto our sister publication, www.avweb.com and click the podcast button, then the podcast index. This month's feature includes an interview with Pacific ferry pilot Fred Sorenson about what it's like to fly extremely long distances and plan for winds, weather, emergencies, and anything else that might come up in a 20-hour flight over inhospitable ocean.



Scott C. Dennstaedt is a former NWS meteorologist and an active flight instructor. See www.chesavtraining.com.