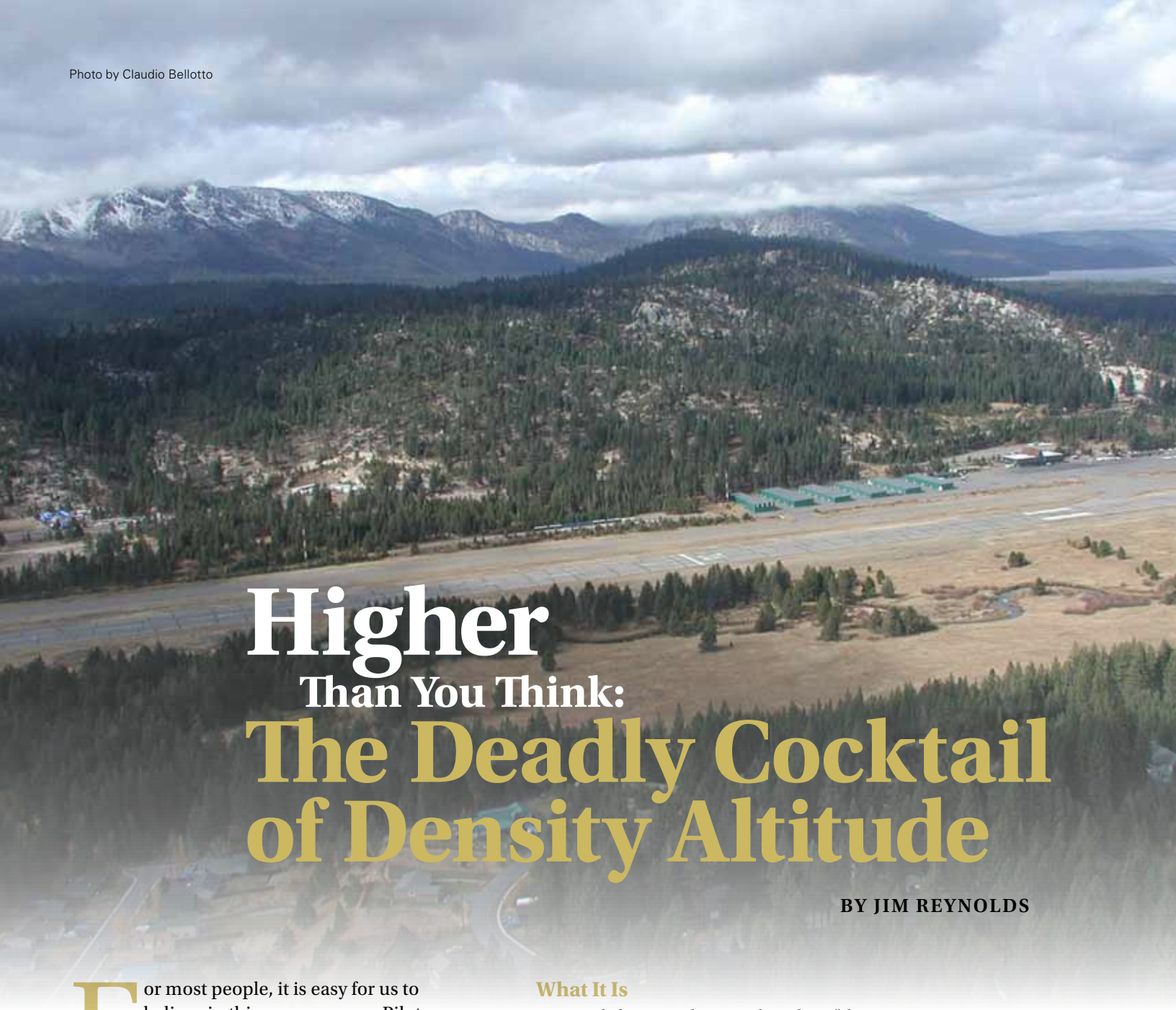

Photo by Claudio Bellotto

Higher Than You Think: The Deadly Cocktail of Density Altitude

BY JIM REYNOLDS

For most people, it is easy for us to believe in things we can see. Pilots are no exception. Just about any pilot can tell you in detail about the impacts that such visible weather phenomena as thick haze, a solid low ceiling, or a wall of rain under black thunderstorm clouds will have on a flight. But for many pilots, and especially those new to flying, it is often difficult to muster as much respect for the negative effects that density altitude can have on a flight because this condition is invisible to the eye. Density altitude can really be "seen" – or, more accurately, experienced – only through the performance of the aircraft. Unfortunately, by the time the pilot does perceive this condition through degradation in aircraft performance, the adverse consequences of density altitude have already appeared. And they can be deadly.

What It Is

By definition, density altitude is "the pressure altitude adjusted for non-standard temperature." Simply put, increasing temperature at a particular atmospheric pressure causes the density of air at that pressure to appear as though it resides at a higher physical altitude.

The problem of density altitude for pilots begins with the fact that aircraft fly through an atmosphere of air that is composed of invisible gases. Only when there is an excess of particulate matter or water vapor in the air can anything actually be seen in the flight environment. Because air is otherwise invisible, it is not possible to see that air becomes thinner due to the increased spacing between air molecules when an air mass is raised in elevation (high), when it is warmed (hot), or when water vapor is added to it (humid).

Photo by H. Dean Chamberlain

What It Does

Whether due to height, heat, or humidity, the increased spacing between air molecules and the resulting thinner air, has the following three effects on aircraft performance:

- Aircraft accelerate more slowly on takeoff or go-around because the thinner air adversely affects combustion, and thus results in a power production reduction.
- To produce the same lift associated with a lower density altitude condition, aircraft need a higher true airspeed, which generally requires a longer takeoff roll to achieve.
- The reduction in both power production and lift means that aircraft climb more slowly.

Any mix of high, hot, or humid atmospheric conditions creates what we call "high density altitude" situations. Density altitude can be quite dangerous, especially if the aircraft is operating at, or close to, its maximum gross weight.

How to Spot It

Though it is inevitable that a pilot will be unable to literally see developing high density altitude situations, there are a number of other cues to its existence. First, it is easy to get a general sense of the temperature just by noting what we experience when we step outside. Similarly, we are very likely to sense an increase of humidity, or "mugginess," in our surroundings, and we can observe the hazy conditions that sometimes accompany the hot and humid characteristics of density altitude.

At higher elevations, we might also have clues from the physiological impact of altitude. For instance, we find ourselves catching our breath when undertaking physical tasks that don't usually cause us to breathe deeply. However, these physical signs are not enough for pilots to gain a true understanding of how their aircraft will perform under their given current conditions. The only way to truly ascertain how an aircraft will perform is to first compute density altitude according to a chart or a calculator, and then correlate this information with aircraft performance data in the aircraft's operating handbook. If you don't have a physical copy of a density altitude chart in an aviation book of some sort, these charts can easily be found on the Internet by doing a search for a "density altitude computation chart" (Fig. 1).

An even easier way to determine density altitude is to use an online calculator. The National Weather Service office in El Paso, Texas, has a handy calculator that can be found at: www.srh.noaa.gov/epz/?n=wxcalc_densityaltitude.

While most density altitude effects are experienced at higher elevations, it is important to note that extremely high temperatures at lower elevations can lead to equally negative aircraft performance problems. Case in point: high

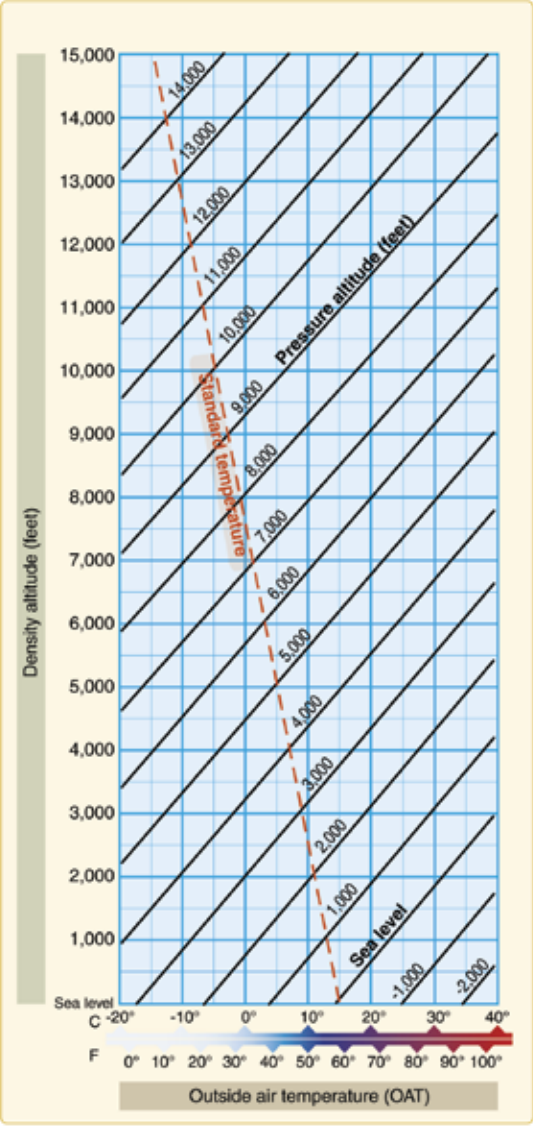

Fig. 1 – Density Altitude Computation Chart

temperatures across portions of the U. S. desert southwest can easily exceed 115 F throughout the summer months. Chris Kesler, Operations Support Manager for the Terminal Radar Control facility at the Phoenix Sky Harbor Airport observes that "while high density altitude situations do not officially cause the closure of the airport, a temperature of 120 F will generally cause most pilots to choose not to fly into or out of the airport until temperatures cool down." The fact that the elevation of Phoenix Sky Harbor Airport is only 1,124 feet above sea level provides a good indication of just how severe the impact of high temperatures can be on density altitude.

What To Do

While the effects of density altitude can be insidious, there are ways to beat this foe. Here are a few tactics and techniques.

If at all possible, fly early or late in the day when it is typically cooler. Any reduction in temperature may add some flexibility with regards to your functional elevation – i.e., the altitude the airplane "feels" when it flies.

Fly as light as possible. Leave behind all of the baggage you don't really need. Ask yourself - will you actually play golf with the clubs you're planning to bring? Lastly, bring along only those passengers that are necessary for the trip. High density altitude situations are bad ones for those individuals that just want to "tag along."

Know before you go - take the time to calculate aircraft performance. If the conditions are beyond the aircraft's performance envelope, you want to discover that fact before you launch, not while you're struggling to launch and climb.

In short, don't let the cocktail of "hot, high and heavy" be hazardous to your health!

Photo by James Williams

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