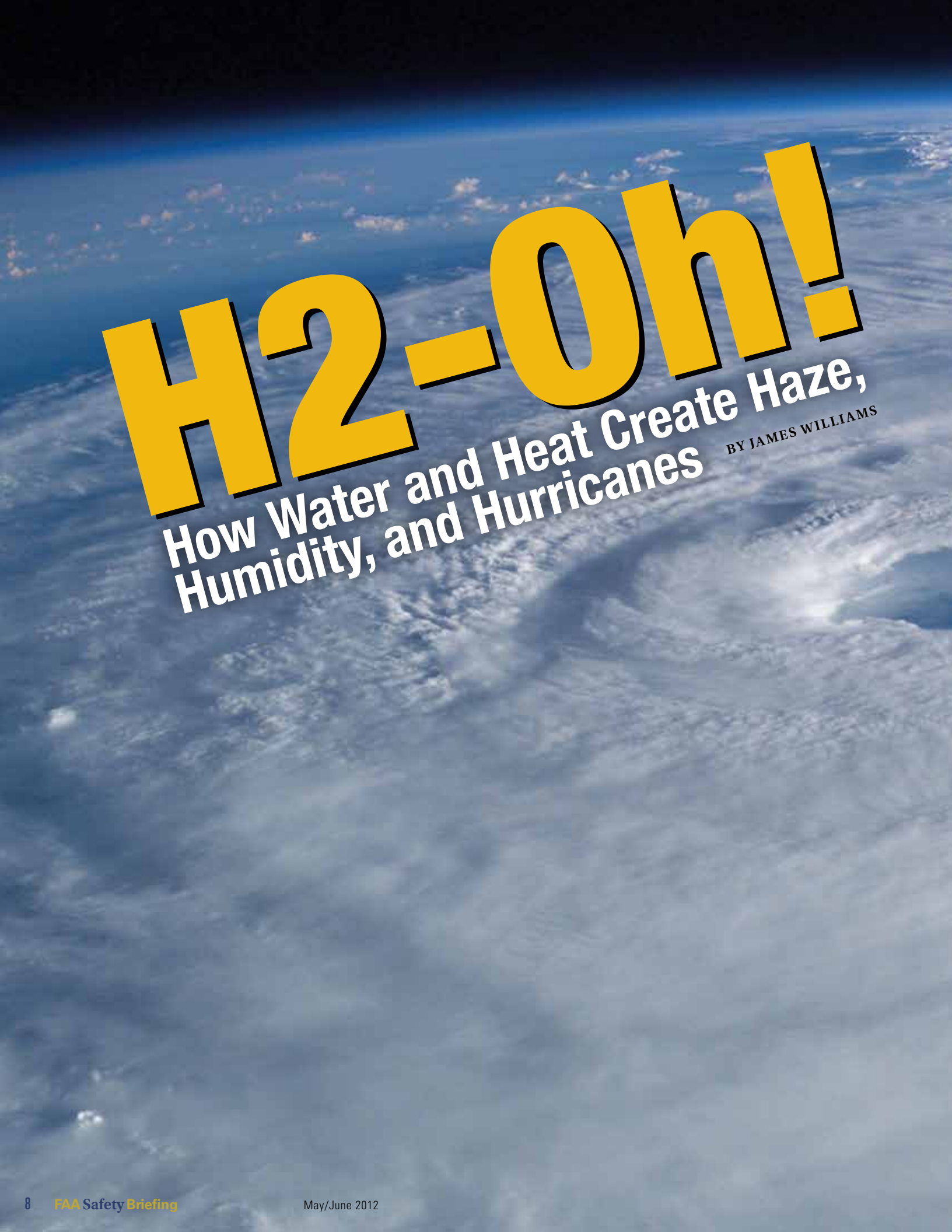

H2-Oh!

How Water and Heat Create Haze, Humidity, and Hurricanes

BY JAMES WILLIAMS

What comes to mind when you think of water? Chances are good that it conjures up images of something like a placid lake, or memories of how good a glass of fresh water can taste when you are really tired and thirsty.

Now think about heat – an especially appealing idea as we collectively emerge from the dark and dreary cold of winter. As with placid water, the notion of heat's soothing warmth conveys calm and cozy comfort.

Now put them together. Oops. Different story. Like certain binary compounds, water and heat each have an individual set of known characteristics. When these elements combine, though, results can range from the dreariness of haze to the discomfort of humidity to the deadliness of hurricanes – a truly explosive combination of water and heat. And, as I learned from spending a decade in this nation's hot, hazy, and humid southeast, all three have implications for the safety of flight.

The Nebulous Nature of Haze

The dictionary definition for haze makes it sound almost pretty. In one instance, haze is defined as "an aggregation in the atmosphere of very fine, widely dispersed, solid or liquid particles, or both, giving the air an opalescent appearance that subdues colors." It forms from microscopic particles in the air that can either act on their own, or as condensation nuclei for atmospheric moisture. In other words, haze can be similar to a cloud, but is far less organized.

When there is a combination of stagnant air and heat, the haze thickens. That is because heat increases the amount of water vapor a given mass of air can hold. Every 20° F increase in temperature doubles the amount of moisture that an air mass can hold. So an 80° F air mass would have double the moisture carrying capacity of a 60° F air mass. Adding stagnant air to the mix simply allows a haze layer to form more easily.

In many parts of the country, haze is a common condition during the summer. While it is not outright deadly, haze is perhaps the most insidious of the weather villains in this piece. Opalescence may be beautiful and desirable in jewelry, but in the atmosphere, not so much. It creates conditions

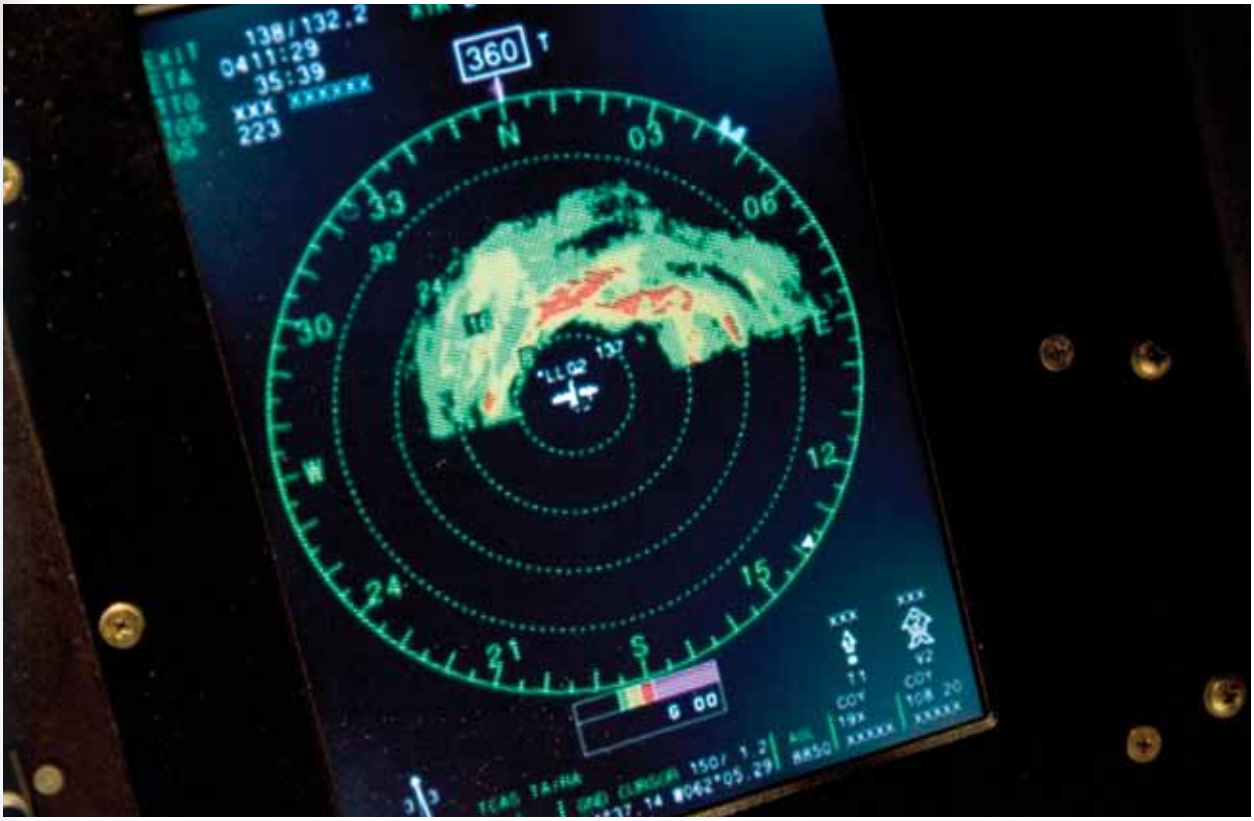

Photo courtesy of the U.S. Air Force

that can be as relatively benign as the lack of a clear horizon or as bad as visibility more suited to an IFR flight plan.

Here's the real challenge. The nebulous and subtle nature of haze makes it painfully easy to drift into conditions that we neither expect nor intend to enter. Unlike clouds or precipitation, haze is hard to spot – which is why it is hazardous. We humans much prefer hard and fast decisions. Haze often produces very subtle changes we may not notice until our circumstances have worsened considerably.

I write from experience, having seen this progression during a human factors experiment in graduate school. The goal was to determine whether a properly calibrated display would keep pilots from venturing into adverse weather conditions while flying under VFR. We set up the simulator to offer deteriorating visibility. There were two runs, one with and one without a second display that would show the visibility decreasing in an overhead view similar to a radar display. In both sessions, the pilots could clearly see the visibility decreasing on the visual display of our simulated outside conditions. It was an eye-opening experience to see how consistently they continued into the worsening conditions when they lacked the second display to validate their actual visual observations.

Awareness is one key defense, but it involves more than the necessary weather briefings and updates. Consider adopting the checkpoint strategy. There is no regulatory requirement for distance between VFR checkpoints, but a good rule of thumb is to ensure that they are close enough that you can see the next one on your list. Assuming that you have established checkpoints that are 2 to 4 nm apart, you should start hearing the mental alarm bells go off when visibility is too poor to let you spot the next one. That's when you know it is time to divert: Get on the ground and get a new plan.

Speaking of planning, another defense against the hazards of haze is to have personal minimums for weather, as well as operational factors (e.g., short runway). For tips on how to make and maintain truly personal minimums, see "Getting the Maximum from Personal Minimums" in the May/June 2006 issue of *FAA Safety Briefing* magazine.

The High Cost of Humidity

The same elements that create haze – water and heat – also create humidity. And don't think that the discomfort it creates is limited to human beings. As Jim Reynolds explains in "Higher Than You Think" on page 19, humidity increases density altitude, which has adverse impacts on both your airframe (e.g., airfoils) and your powerplant.

Here's why. Remember high school science? A basic concept is that air density decreases as temperature increases. Humidity further decreases air density. Just like human beings, airfoils and airplane engines suffer "discomfort" – and decreased performance – in these conditions. Planning, to

Photo courtesy of the U.S. Air Force

include careful performance calculations for both the human and mechanical participants in the flight, is essential to flight safety in high humidity conditions.

The Horror of Hurricanes

The most powerful – and potentially destructive – combination of water, heat, and humidity is more commonly called a hurricane. Having experienced several during the years I lived in the Sunshine State, I came to think of these events as a giant, incredibly destructive, warm car wash for a city. Imagine the peak intensity of a bad thunderstorm that normally lasts 20 to 45 minutes…only it continues for many hours. Depending on the forward speed of the storm, it could even last a day from initial onset to final clearance.

Along with the deluge of water, hurricanes unleash very destructive winds. Did you ever wonder how fast the wind has to blow before you can't stand up any more? Your mileage may vary, but in my experience, it takes somewhere between 75 and 100 mph to force a normal-sized human being to the ground. And if that wind can make bipedal locomotion a problem, just imagine what it could do to an airplane. In a hurricane, by the way, the hurricane-strength gusts are typically not as damaging as the event's sustained high winds. Over a long period of time, sustained high winds will impose lengthy periods of high stress on structures …including airframes. So what to do?

Because hurricanes and airplanes don't play well together, even when the latter lives in a so-called "storm-proof hangar," the best defense for planes and their pilots is to fly out of harm's way. That means having a good evacuation plan which, in turn, requires careful and thorough advance planning. It may be hard to do while the sun is shining, but good weather provides a good time to develop the detailed disaster-avoidance template you need to have. For general guidance please visit: http://www.nhc.noaa.gov/prepare/ or http://www.ready.gov/. Even though they are under no obligation to do so, it's worth checking with your insurance company to see if they will help pay for your evacuation. Some companies might view a small payout to subsidize your evacuation beforehand as preferable to a much larger one to cover the damage after the fact.

As with certain binary compounds, the result of combining water and heat can range from the dreariness of haze to the discomfort of humidity to the deadliness of hurricanes.

As a veteran of the hurricane experience, I firmly believe that timely and accurate information is one of the most important considerations. For this activity, make sure you know how to obtain and use information developed through the National Hurricane Center (NHC) in Miami, Fla (http://www.nhc.noaa.gov/). The NHC normally issues advisories every six hours at 5:00 AM EDT, 11:00 AM EDT, 5:00 PM EDT, and 11:00 PM EDT (or 4:00 AM EST, 10:00 AM EST, 4:00 PM EST, and 10:00 PM EST). NHC sometimes issues mid-point updates when coastal watches or warnings are issued.

It also pays to pay attention to the forecast issued with the advisories. Keeping track of the storm's track – or at least the pros' best guess-timate of what that track might be – will help your preparation and evacuation planning.

As with any other part of flying, you can mitigate the consequences of H2-Oh! type phenomena by learning as much as you can, planning as carefully as you can, and consistently doing the right thing for flight safety.

James Williams is FAA Safety Briefing's assistant editor and photo editor. He is also a pilot and ground instructor.

Learn More

***Pilot's Handbook of Aeronautical Knowledge*, Chapter 10, p. 10-5**
http://www.faa.gov/library/manuals/aviation/pilot_handbook/