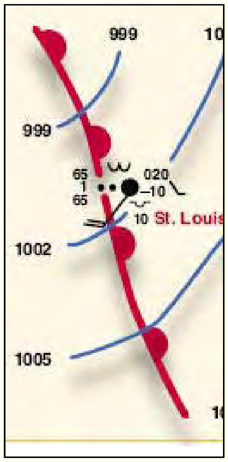


Beware of the WARM front and the LOW!!!

If you want to start a lively debate among pilots standing around the coffee pot, introduce the topic of airframe icing into the discussion. You will soon hear scary tales from one side of the group on how airplanes instantly turn into flying popsicles the moment they penetrate any sub-freezing cloud. The most vocal members among this group are generally the fellows and girls with the least real winter flying experience.

The other half of the group offers a more enlightened view on airframe icing. These members are typically the more experienced veterans with a logbook packed with winter flying hours. They'll tell you that varying levels of airframe icing occurs in some but not all sub-freezing clouds.

Okay . . . what is the real truth about icing and sub-freezing clouds?

Answer: The answer to this time-honored question can be found in the structure of the atmosphere at any given place (altitude) and time.

Let's take a brief look at the atmospheric structure that produces airframe icing. First, examine the atmospheric ingredients that produce icing:

1. Visible moisture:

Visible moisture ranges from fog to clouds to rain drops. If you do not "see" moisture in the atmosphere, airframe icing cannot occur. *Note: Turn your landing light on when flying at night.*

2. Water droplet size:

Visible moisture (fog, clouds, raindrops) exists in the form of tiny water molecules (H_2O) ranging in size from less than 10 microns in diameter to over 600 microns in diameter. *Note: 1 micron equals one thousandth of a millimeter.*

Whether or not a sub-freezing cloud produces airframe icing depends on the size of the microscopic water droplets that form the cloud. Generally speaking, clouds formed by water droplets less than 20 microns in diameter will NOT adhere to the airframe.

It is reassuring to know that the majority of all clouds are comprised of water droplets of <u>less</u> than 20 microns. Hence, most sub-freezing clouds do NOT produce airframe icing.

Water droplets between 30 microns and 500 microns in diameter are known as super-cooled large droplets (SLDs). These droplets DO adhere to the airframe. Fortunately, SLDs form a small percentage of all clouds.

3. Atmospheric disturbance:

Question: How are SLDs formed? SLDs begin as microscopic water drops less than 20 microns wide. That's the size they remain unless some form of atmospheric disturbance "lifts" them higher into the atmosphere. As they lift, they acquire additional "layers" of moisture, eventually growing into full-fledged visible raindrops that we see falling from clouds.

If there is no atmospheric disturbance (absence of frontal, low pressure areas, or convective activity), we can fly all day in sub-freezing clouds and likely not accumulate any airframe icing.

On the other hand, a front, low pressure area, or convective activity often produces a great deal of atmospheric instability that, in turn, lifts these 20 micron wide water drops up to higher altitudes where they grow steadily into SLDs.

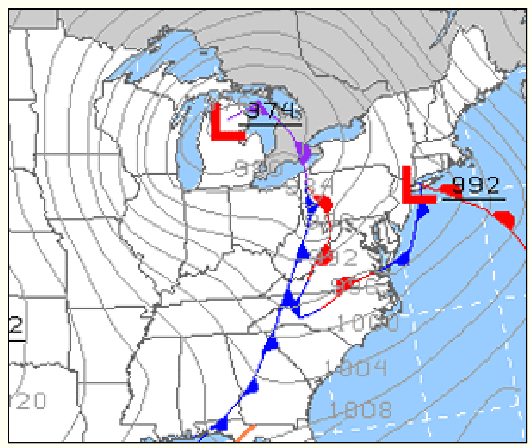
4. Temperatures between 0 deg C and -24 deg C:

Lastly, we have temperature. Sub-freezing water droplets must be in liquid form before they can adhere to the airframe. Hmm . . . sub-freezing and liquid. Is that not an oxymoron?

Curiously, sub-freezing water molecules can and often do exist in liquid form all the way down to between -20 and -24 deg C. That's why they are called super-cooled water droplets. Once disturbed by a passing wing or propeller, for example, these liquid droplets instantly freeze on the passing surface. The larger the droplets (SLDs), the greater the intensity of airframe icing.

Happily, these SLDs cannot remain in liquid form once their temperature drops down to between -20 and -24 deg C. Instead, these SLDs solidify (freeze) and, thus, no long pose an airframe icing risk.

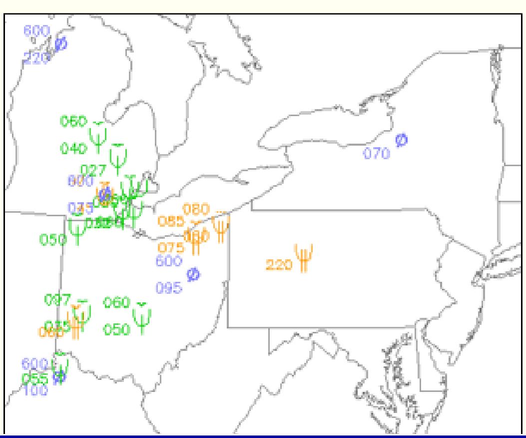
Okay . . . so what about the warm front and the low?



Remember, we need three things to produce airframe icing: (1) visible moisture; (2) sub-freezing temperatures; and (3) an atmospheric disturbance.

When we have either a warm front or a low (or both) along our route of flight through sub-freezing clouds, we have the winter icing equivalent to a monstrous summer thunderstorm. This is where we nearly always find moderate to severe icing inside sub-freezing clouds!

The surface analysis image (upper right) was posted on Wednesday, December 9, 2009. Notice the presence of the low over the Great Lakes and a warm front marching up from Pennsylvania. Temperatures aloft were below freezing. All in all, lots of airframe icing is present.



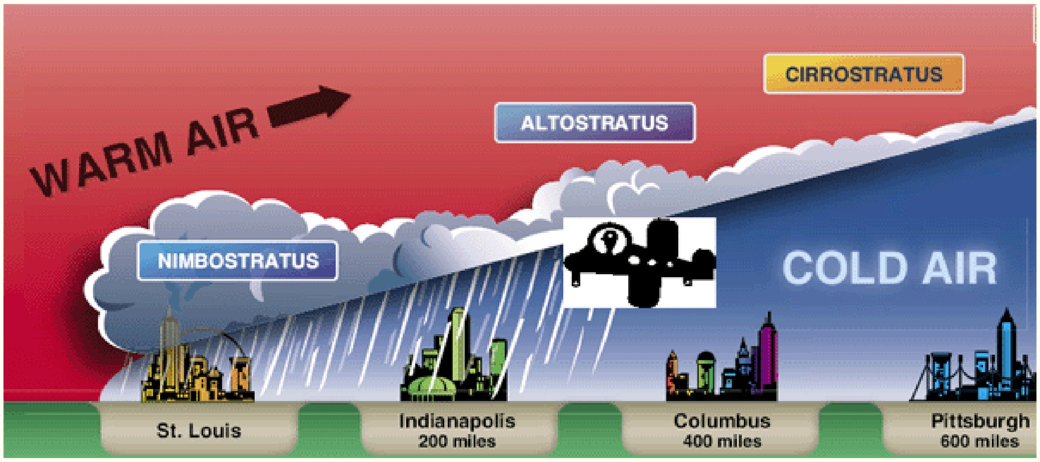
Not surprisingly, the image on the left displays icing PIREPs that were posted earlier that same day.

In summary, most sub-freezing clouds do not produce airframe icing simply because fronts and lows do not blanket the globe.

But where fronts and lows do exist, beware. You do NOT want to go there!

Lastly, a word about freezing rain

No discussion of airframe icing would be complete without a mention of freezing rain.



If encountering moderate to severe icing in clouds is bad, know that freezing rain is even worse!!!!

Freezing rain occurs just as easily in clear air as it does in clouds. The weather-maker that creates freezing rain is generally a passing warm front causing a temperature inversion. In essence, as depicted in the illustration above, above-freezing rain drops fall down through sub-freezing temperatures below.

When this occurs, the still liquid water droplets pass through a super-cooled state that occupies just a couple hundred feet of altitude. If we happen to be flying through this narrow altitude occupied by these super-cooled rain drops, watch out. You'll hear and see them splashing and instantly freezing on your windscreen, propeller, and airframe.

Seconds count here! An immediate change an altitude, generally up, is required.

Fortunately, there are several new weather information products coming on the market that can help us to predict the presence or absence of icing and freezing conditions before we launch. One of these products can be viewed by clicking HERE.