IFR

The Magazine for the Accomplished Pilot

Sturdy boots only get you so far ... page 6

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INTERNET ICE GETS SEVERE

Predicting the icing potential and severity of cold clouds is the Holy Grail for winter IFR. The quest just moved one step closer.

by Scott Dennstaedt

It's wintertime again and Convective SIGMETs morph into icing AIRMETs. The briefing doesn't bode well for that long, cross-country, IFR flight. A low freezing level and overcast sky adds a lump in the back of the throat. Sound familiar?

Ice happens, that's for sure. But it doesn't happen without any warning. An icing accident cannot be compared with a controlled-flight-into-terrain mishap or midair collision. Forecast or not, you should never be blindsided by a flight into icing conditions.

When you see clouds (or rain) outside the windscreen and the OAT is below zero degrees C, then icing is highly likely. It's that simple. While you should never be surprised by an encounter with supercooled liquid water, you may be astonished by the intensity of the icing that you actually experience.

Icing forecasts can be confusing while providing only general and sometimes vague guidance. AIRMETs are issued by the Aviation Weather Center (AWC) to provide freezing level data and to warn pilots

of the potential of moderate icing. After an NTSB ruling (*Administrator v. Watkins*) in 1998, the National Weather Service (NWS) wanted a clean break between a forecast for

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This combination of icing intensity with icing probability is what is sought by pilots.

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severe icing and a forecast for moderate icing. To that end, they mandated that AIRMET Zulu should never reference the word "severe" anywhere in the AIRMET text. Only SIGMETs have the official authority to forecast widespread severe icing.

Short of SIGMETs that are valid for at most four hours or AIRMETs that are valid for six hours, there are no other icing forecasts, official or not, that attempt to predict or identify the intensity of icing, until now.

Pilots have been using the ADDS Current Icing Potential (CIP) for some time now, but there has been some confusion about what it delivers and the limits to its usability. CIP is only a recent glimpse of the past and only describes the likelihood of icing right now. That's any kind of icing too, since it says nothing about icing severity.

The dark-red, red, and orange regions within CIP indicate a high likelihood of icing but not severe icing, as some pilots believe. A large area marked as a dark-red region might have a 95 percent likelihood of light icing. CIP in its current form doesn't tell the complete story.

The New, New Thing

During December 2006, the current uncalibrated version of CIP will be replaced by a new, calibrated version (http://adds.aviationweather.noaa.gov/icing). As a result, CIP will undergo a subtle name change to the "Current Icing Product" and will contain three distinct fields. Each individual field will have its own name: Probability, Severity, and Supercooled Large Droplets (SLD). The probability and severity fields have been available on the Aviation Digital Data Service (ADDS) experimental web site, but are now considered ready for operational status. The SLD field will not change and will continue to remain uncalibrated.

A significant change with the calibrated version of CIP, called CIP probability, is that probability values of 75 percent and higher have been combined into a single color (red), whereas the uncalibrated version used three different colors in this same range. This may appear to provide pilots with a lower resolution product; however, at these likelihoods of icing, I don't believe this will alter your decision-making in any way.

Left: Severe icing can overwhelm any de-ice system. You want to know where it lurks ... and stay away.

AIRMETs and SIGMETs smear the location and intensity of structural icing in time and space (see "End of AIRMETs," January 2006 *IFR*). Within the AIRMET valid period, a portion of the AIRMET may not contain icing conditions. It's also possible that icing conditions that are not widespread could exist without the heads-up from an AIRMET. This can happen at higher altitudes during the summer within towering cumulus clouds.

The Current Icing Product (CIP) provides pilots with a better diagnosis of where icing may currently exist. The CIP consists of three distinct products: Probability, Severity, and Supercooled Large Droplets (SLD).

For pilots, the masked CIP severity that combines the probability product with the severity product is key. The masked diagrams tell you the probability of icing, then the most likely category for that icing (e.g., there's a 50 percent or greater chance and it's most likely to be light, or there's a 25 percent or greater chance and it's most likely to be moderate).

Typically, if heavy icing is expected, the probability will be high because CIP severity and CIP probability use many similar ingredients in their determination.
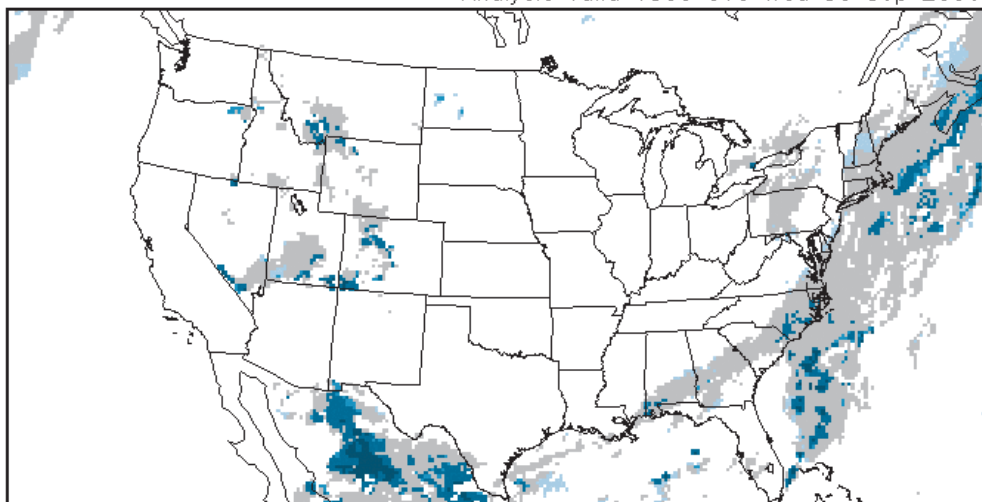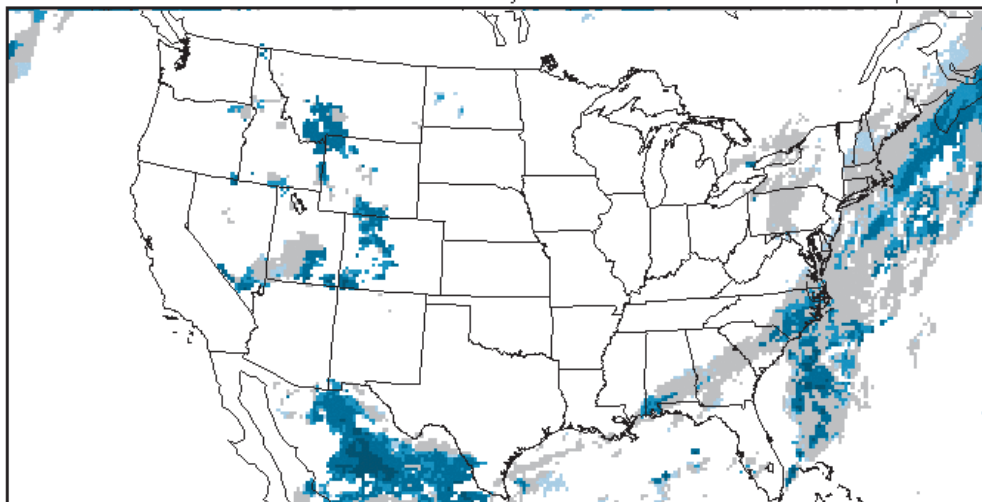
Icing severity (prob>50%) at FL180
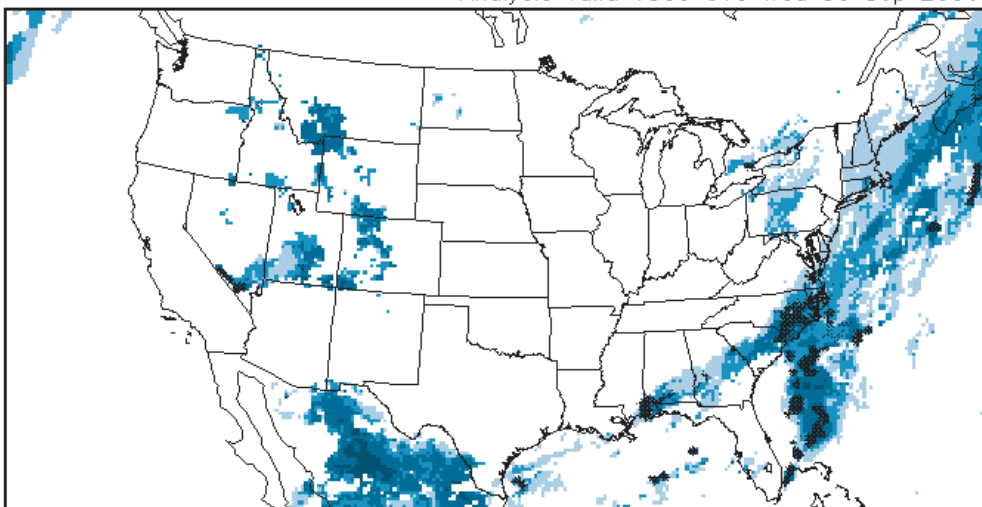
Analysis valid 1500 UTC Wed 06 Sep 2006

Icing severity (prob>25%) at FL180

Analysis valid 1500 UTC Wed 06 Sep 2006

Icing severity at FL180

Analysis valid 1500 UTC Wed 06 Sep 2006

SLD potential

5%   50%

Icing Severity

Trace   Light   Moderate   Heavy

Icing PIREP Symbols

Negative   Trace—Light
Trace   Light
Light—Moderate Moderate—Severe
Moderate   Severe

DEVIL IS IN THE DETAILS WITH CIP

Each and every hour CIP provides a three-dimensional diagnosis of icing for the CONUS and Alaska. CIP combines a three-hour *forecast* from the Rapid Update Cycle (RUC) model with satellite, surface observations, radar, lightning, and pilot reports (PIREPs). PIREPs of icing are ingested into CIP, so be sure you are reporting icing conditions accurately and explicitly as possible.

Consider the following PIREP from a pilot over Amarillo, Texas.

AMA UA/OV AMA/TM 1500/FLUNKN/TP PA60/SK OVC TOP072/IC LGT RIME/RM DURGC AMA-SE BND

The pilot of this Piper Aerostar reported light rime icing during the climb and popped out on top at 7200 feet MSL. The PIREP decoder, which is upstream of CIP, would interpret the PIREP as light rime at 7200 feet MSL. We know the icing occurred during the climb, but CIP has no idea what range of altitudes below 7200 feet the icing actually occurred.

Report icing explicitly. Icing encountered while climbing from 5000 feet to the cloud tops at 7200 feet MSL should be "IC LGT RIME 050-072." PIREPs of negative icing are not used within CIP, but they are used within CIP severity.   — *S.D.*

Predicting or identifying the intensity of icing is one of the more difficult tasks in aviation weather. According to the researchers at the National Center for Atmospheric Research (NCAR), forecasters must be able to describe three distinct parameters to accurately describe the intensity of icing: temperature, liquid water content in the cloud, and droplet size. Temperature and liquid water content are the two dominant parameters.

Temperature is forecast well by modern numerical weather prediction models such as the Rapid Update Cycle (RUC) model used within the CIP algorithm. The other two parameters—droplet size and liquid water content—are not.

Even if you could model a cloud perfectly, other important processes such as stability, moisture availability, upward vertical motion and timing are critical factors in determining the intensity of icing.

The aircraft and the pilot are also part of the equation when it comes to denoting icing severity.

The type of aircraft, availability of ice protection, the pilot's perception of the icing event, and the pilot's past experience all have an effect. Two pilots flying different aircraft through the same airspace can give two significantly different pilot reports. The meteorology alone is hard enough, so CIP severity doesn't take these man and machine elements into consideration.

The Bad Stuff

The first attempt to highlight icing intensity was CIP SLD. For a couple of years, CIP SLD has been available to pilots to identify the presence of supercooled large droplets, which always produce severe icing conditions.

Any supercooled droplet over 40 microns in diameter for stratus clouds or 50 microns in diameter for cumuliform clouds is considered large and exceeds the certification standards for *all* ice protection systems. For reference, a human hair is approximately 100 microns and the average raindrop is 2000 to 3000 microns (two to three millimeters) in diameter.

Typical SLD scenarios include freezing rain or freezing drizzle. (Keep in mind that CIP doesn't predict within 1000 feet of the surface, where many freezing rain/drizzle events occur.)

If you are not using the higher-resolution flight path tool (http://adds.aviationweather.noaa.gov/flight_path/index.php) available from ADDS, the resolution of CIP is presented at 3000-foot increments with the first level starting at 3000 feet MSL. This coarse resolution will certainly miss many classical freezing rain events.

The other case for SLD is deep convection found in vertically-developed (cumuliform) clouds. Droplet sizes can easily exceed 50 microns, which means that a 30-second encounter can be deadly. Some of the worst SLD icing can occur during the summer at 15,000 feet MSL and higher within building towering cumulus.

New Look, New Product

CIP severity does not follow the traditional CIP colors of blue, green, yellow, orange, and red. CIP severity uses shades of blue to represent icing intensity, starting with the lightest shade of blue as trace icing and the darkest shade of blue representing heavy icing. The term *severe icing* is reserved for how the aircraft reacts to the meteorological conditions, not the meteorological conditions themselves.

As a result, the NWS is reluctant to use "severe" as a category in the new CIP severity product. Instead, CIP severity uses the term "heavy" to indicate conditions that could easily overwhelm most ice protection systems.

The severity product is great, but a combination of icing intensity with icing probability is what is sought by pilots. Wait no more, in addition to the basic CIP severity product, there will be three additional severity products. Two of these are

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referred to as "masked" severity products that combine the basic severity product with the probability product all on one chart. The third product combines severity with SLD probability.

The masked severity products obviate the need for flipping between CIP probability and CIP severity charts. Each masked product is displayed on two separate charts representing two thresholds: greater than 50 percent and greater than 25 percent. On each masked severity chart the shades of blue representing icing intensity will only be shown when the probability of icing is greater than 50 percent or greater than 25 percent, respectively.

Any area that exhibits probabilities less than one of these two thresholds is shown in a single light gray color. Given how the icing severity is calculated, you will rarely see a moderate or heavy intensity masked (grayed-out), but will often see light or trace intensity masked.

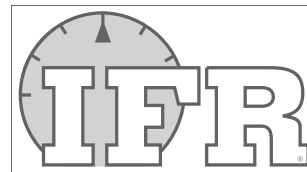CIP severity has a night bias that is evident when you loop through the hourly charts. During the day, the CIP algorithm has the best information for determining severity, including visible satellite imagery, which is used to "tone down" the icing severity when there are thin-looking clouds. This key ingredient is lost at night and the severity appears to go up at night and down in the morning. The folks out at NCAR are developing a way to smooth that transition and/or get better cloud information at night.

Looking Forward

What about Forecast Icing Product (FIP) severity? You're going to have to wait on that for a while. FIP severity should appear on the AWC experimental site in March 2007 with operational status occurring in December 2007 if all goes as planned.

Don't hold your breath, though. It's one thing to try to determine the current icing severity based on observational data and a whole new world to determine future icing severity using a purely model-based method.

Scott Dennstaedt offers aviation weather seminars and flight training. His web site is www.chesavtraining.com.