



# The Front



October 2006

NOAA's National Weather Service

Volume 6, Number 3

## Creating an Improved Understanding of Flight Weather

By Scott J. Carpenter, NWS Billings, MT; James Brusda, NWS Great Falls, MT

This article summarizes information presented at the 2006 Montana Aviation Conference in Helena, MT. This annual conference is sponsored by the Montana Department of Transportation Aeronautics Division. The conference offers a great opportunity for those with aviation interests to interact with local NWS staff.

The process of pre-flight planning must include a thorough preview of the weather during the planned flight time. As a pilot, your responsibility is to take advantage of the official briefings from flight service personnel. You should

### In this Issue:

**Creating an Improved Understanding of Flight Weather** 1

**Radar Talk Turned into Plain Speaking** 3

### When's the Next *Front*?

Would you like an email alert when a new edition of *The Front* is published? Write [melody.magnus@noaa.gov](mailto:melody.magnus@noaa.gov).

The screenshot shows the NOAA's Aviation Weather Center (AWC) website. At the top, it says "NOAA's National Weather Service Aviation Weather Center". Below this are navigation tabs for "Home", "News", and "Organization". A search bar for "Local forecast by City, St or Zip Code" is present. A sidebar on the left lists various services like "Advisories", "Forecasts", "Observations", and "Java Tools". The main content area features "Top News of the Day" with an update about AIRMET implementation, a map of the United States with weather symbols, and "Other News" with links to TIN announcements and a Space Weather link.

The Aviation Weather Center, <http://aviationweather.gov> is the starting point for aviation weather information.

## The Front

Managing Editor: Michael Graf

[Michael.Graf@noaa.gov](mailto:Michael.Graf@noaa.gov)

Editor/Layout: Melody Magnus

[Melody.Magnus@noaa.gov](mailto:Melody.Magnus@noaa.gov)

Editors: Donna Ayres, Deborah Lavine

### Mission Statement

To enhance aviation safety by increasing the pilot's knowledge of weather systems and processes and National Weather Service products and services.

add supplemental information to ensure you understood all aspects of the briefing. The Web offers numerous resources for determining preliminary flight weather information before your official weather briefing from flight services.

NWS Websites offer free, all-inclusive sources for aviation weather information. The place to start is the [Aviation Weather Center \(AWC\)](#). The AWC offers a vast storehouse of easily accessible information, entitled the [Aviation Digital Data Service \(ADDS\)](#). The tabs at the top of this Web page list the available categories of up-to-date and localized reports and forecasts. These categories include the following:

- |                     |                     |
|---------------------|---------------------|
| ◆ Turbulence        | ◆ TAFs              |
| ◆ Icing             | ◆ PIREPs            |
| ◆ Convection        | ◆ AIRMETs/SIGMETs   |
| ◆ Winds/Temperature | ◆ Satellite Imagery |
| ◆ Prog Charts       | ◆ Radar Imagery     |
| ◆ METARs            | ◆ Java Tools        |

Many of the products listed above are forecasts from one of the local NWS Forecast Offices. The regional Center Weather Service Units (CWSU) and the AWC generate additional forecasts. With the ongoing reorganization of flight service stations, it is especially important to ensure you, as a pilot, have information from experts with access to localized, small-scale details.

Some of the latest techniques to produce a graphical forecast are also available on the ADDS site. If you select the “Java Tool” tab on ADDS, it will lead to a page that produces altitude specific displays of weather conditions ranging from the surface up to 45,000 feet above mean sea level. Cross sections can also be generated along a planned flight route, combining user-defined weather variables.

**NOAA's National Weather Service**  
**Aviation Weather Center**  
**Aviation Digital Data Service (ADDS)**

Home    News    Organization    Search

Local forecast by "City, St" or Zip Code  
 City, St    Go

Advisories  
 SIGMET/AIRMET »  
 Center Weather

Forecasts  
 Convection »  
 Turbulence  
 Icing  
 Winds/Temps »  
 Prog Charts »  
 TAF / FA »

Observations  
 PIREPs »  
 METARs »  
 Radar »  
 Satellite »

Java Tools »

Related Information  
 Home »  
 Flight Folder  
 Standard Briefing  
 Aviation Testbed  
 Aviation Links

Contact Us  
 FAQ  
 Feedback »

Home    @adds    Turbulence    Icing    Convection    Winds/Temps    Prog Charts    Java Tools    FYI/He  
 Home    METARs    TAFs    PIREPs    AIR/SIGMETs    Satellite    Radar

**Top News of the Day . . .**

**Update:** The implementation of the standardized text AIRMET will be delayed to make necessary software changes. A follow-up notification will be issued when a new implementation date is set. Please see the [Technical Implementation Notice](#), [examples](#) and [Frequently Asked Questions](#) for further information.

The **Aviation Digital Data Service (ADDS)** makes available to the aviation community text, digital and graphical forecasts, analyses, and observations of aviation-related weather variables. ADDS is a joint effort of NCAR Research Applications Program (RAP), Global Systems Division (GSD) of NOAA's Earth System Research Laboratory (ESRL), and the National Centers for Environmental Prediction (NCEP) Aviation Weather Center (AWC).

The **National Weather Service** operationally supports this site as well as the following operational products:

<ul style="list-style-type: none"> <li>• METARs</li> <li>• TAFs</li> <li>• PIREPs</li> <li>• AIR/SIGMETs</li> <li>• Satellite</li> <li>• Radar</li> </ul>	<ul style="list-style-type: none"> <li>• Analysis &amp; Prognostic Charts</li> <li>• Graphical wind &amp; temperature charts</li> <li>• National Convective Weather Forecast</li> <li>• Current &amp; Forecast Icing Potential</li> <li>• Graphical Turbulence Guidance</li> </ul>
---	--

The **Federal Aviation Administration** funds and directs the continuing development of ADDS as well as other experimental products being developed by the **FAA Aviation Weather Research Program (AWRP)**.

The results of the latest ADDS development efforts along with new experimental AWRP algorithm results can be viewed on the [experimental ADDS site](#).

**Current AIR/SIGMETs:**

Aviation Digital Data Service home page: <http://adds.aviationweather.gov/>

An additional resource available through the [NWS Home Page](#) is the Area Forecast Discussion (AFD). During significant weather events, and at all-times in the Eastern and Western Coastal states, your local NWS Forecast Office has a dedicated section for aviation weather in the AFD. To obtain your local AFD, go to [www.weather.gov](http://www.weather.gov) and click on your area of interest. This step will take you to the local NWS Forecast Office site. Once there, click on the map to go to the Total Forecast page for that site. On the Total Forecast page, scroll down to find the Forecast Discussion in the “Additional Forecasts and Information” section.

Pilots often report that the information communicated during the official briefing from flight service comes in a rapid-fire sequence, usually lasting 10 minutes or less. Pilots around Montana have reported receiving enormous value from the information available at [www.weather.gov](http://www.weather.gov) and [www.aviationweather.gov](http://www.aviationweather.gov). They use these sites as free, self-briefing tools, before contacting the local flight service personnel.

If you have a well-formed picture of the expected weather before the official briefing, the information from the flight service station will be more beneficial. More importantly, the information obtained through self-briefing may present questions to ask flight service about a particular weather system. The large amount of information required in a standard weather briefing from flight service can cause a briefer to overlook significant information he or she deems insignificant.

The potentially condensed briefing is where issues about a specific forecast product may suggest questions. For example, a flight service briefing in the West may not include information from a TWEB route forecast unless specifically prompted by you, the pilot.

You can count on the weather experts at your 122 local Weather Forecast Offices, at the CWSUs, and at AWC to continue producing the best aviation forecasts possible in support of the NWS mission to protect lives and property and to enhance our national economy. ➔

---

## Radar Talk Turned Into Plain Speaking

*By Doug Boyette, Meteorologist-in-Charge, Center Weather Service Unit, Memphis, TN*

Many long-time pilots, and even a few rookies, are familiar with the “VIP level” terminology used throughout the years by NWS and Automated Flight Service Station briefers in describing weather radar echoes. You’ve probably heard weather briefers use jargon such as “you’ve got a line of level 5-6 cells approaching from the west” when describing approaching thunderstorms, for example. Once airborne, those same cells were described as “moderate to heavy” by air traffic controllers using their on-screen radar.

When the FAA installed their new digitized Next Generation Radar (NEXRAD) enhancement for its controller scopes, known as WARP, the phraseology didn’t change much. Weather intensities were still described as light, moderate or heavy. At the same time weather briefers and meteorologists were still referring to six levels of weather, something left over from the pre-NEXRAD days. Adding to the confusion, terminal controllers had different weather radar equipment and used slightly different phraseology.”

Adding to the confusion, terminal controllers had different weather radar equipment than en-route folks and used different wording.

Sadly, there have been a number of recent accidents involving aircraft that ventured too close to or directly into thunderstorms and paid the price. The National Transportation Safety Board recently released a “Safety Alert” all pilots should read.

In an effort to address all of this, the FAA recently changed its formal policy regarding weather products for pilots. Controller to pilot phraseology was changed to better streamline information relayed from Terminal, En-Route sources. As a result, some weather products also changed slightly. The following is a synopsis of the changes. First, some background. Here are the classic pre-NEXRAD VIP levels

VIP 1	18-29 dBZ	Light precipitation
VIP 2	30-38 dBZ	Light to moderate rain
VIP 3	39-44 dBZ	Moderate to heavy rain
VIP 4	45-49 dBZ	Heavy rain
VIP 5	50-57 dBZ	Very heavy rain, hail possible
VIP 6	> 57 dBZ	Very heavy rain and hail, large hail possible

Here is how the NEXRAD radar displays dBZ values in reflectivity precipitation mode:

LEVEL 1,2	0-9 dBZ
LEVEL 3,4	10-19 dBZ
LEVEL 5,6	20-29 dBZ
LEVEL 7,8	30-39 dBZ
LEVEL 9,10	40-49 dBZ
LEVEL 11,12	50-59 dBZ
LEVEL 13,14	60-69 dBZ
LEVEL 15	70-74 dBZ
LEVEL 16	75 or > dBZ

When NEXRAD arrived in the early to mid 90's, the aviation community decided against using 16 levels, which required the development of an 8 level chart that essentially halved the above values. It was still not directly correlated with the old VIP levels, but the radars themselves were not correlated—the NEXRAD beam was more focused and powerful.

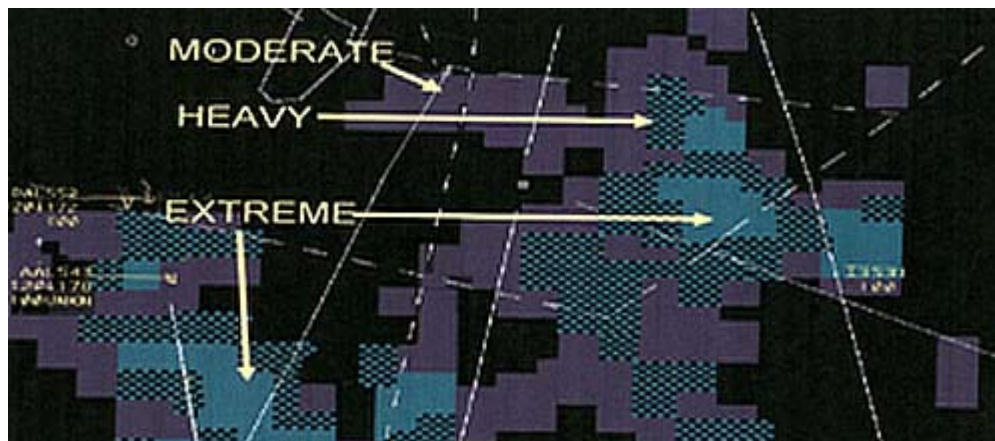
<b>OLD PHRASEOLOGY</b>	<b>NEW PHRASEOLOGY</b>	<b>RADAR INTENSITY</b>
<b>LEVEL 1</b> "Light"	LIGHT PRECIPITATION	<30 dBZ
<b>LEVEL 2</b> "Moderate weather"	MODERATE PRECIPITATION	30-39 dBZ
<b>LEVEL 3,4</b> "Heavy weather"	HEAVY PRECIPITATION	40-49 dBZ
<b>LEVEL 5,6</b> "Heavy weather"	EXTREME PRECIPITATION	50 or > dBZ

The FAA's phraseology change was designed to eliminate all references to "levels" in the pilot-controller environment, including any weather products and verbal communications and/or briefings. Pilots will continue to see levels on radar from both commercial and government sources, the important thing here is to get a sense of power return, ie, dBZ values, and how that relates to pre-flight weather briefings and advisory service provided by controllers on frequency. The difference is the word precipitation, which now will be used whenever speaking of weather radar echoes. In the past, controllers might say, "moderate weather," or "moderate echoes." Some used "moderate precipitation." Using precipitation is now mandatory. The category of "extreme" was added to better describe the heavier cells. The figure below offers a view of what En-Route controllers see at Air Route Traffic Control Centers (ARTCC) on the WARP system.

The digitized appearance (see below) is an improvement over the older display, which used hatched lines and "H's" to show intensity. The older display obtained its weather information from the 23 cm fan radar used to scan for air traffic.

The new WARP data comes from the same source used by the Weather Channel and many Internet sites—the local NWS office. The data is still derived from NWS NEXRAD Doppler. The only difference is the customized display.

## NEXRAD Display



*Controllers are reminded to adjust display settings to ensure that all three weather intensity levels are readily discernible and distinguishable.*

WARP uses a different color scheme than most commercial weather displays. The FAA worked with its employee groups to find the optimum color scale that wouldn't interfere with traffic separation responsibilities. The end result was a display of only 4 levels; NWS radars display from 8 to 16 levels.

## Caveats to Consider

While the NEXRAD data is state of the art and should improve controller and pilot situational awareness, there are also some important caveats. Weather radars operate by sending out a narrow beam of focused energy, then awaiting a reflection of that energy back to the radar, such as from rain or snow. The result is known as "reflectivity". When NEXRAD scans for wind, wind shears or tornadoes it uses the same narrow beam of energy but applies mathematical algorithms to apply the Doppler principle in an effort to determine how fast an object might be moving either towards or away from the radar.

WARP displays only reflectivity. Center Weather Service Unit (CWSU) meteorologists in the ARTCC can access Doppler data and brief decision makers on wind shears and tornadoes as well. Most terminal facilities also have Terminal Doppler Radar integrated with Integrated Terminal Weather System (ITWS), which indicates areas of wind shear and microbursts and can show “tornado vortex signatures,” which often indicate the presence of a tornado.

NEXRAD is many times more powerful than previous weather radars and therefore has a tendency to find reflectivity levels of 50 dBZ in just about every thunderstorm. Because this reflectivity equates to “extreme precipitation,” it might sometimes be hard to differentiate between an average storm and an intense one; however, to most pilots all thunderstorms are intense.

There are several factors a pilot needs to track. Not everything weather radars detect equates to rain or snow. Other phenomena may skew the returns, such as large wet hail, graupel, melting snow or sleet. With the exception of hail, these other phenomena often occur when no thunderstorm is in sight.

The controllers have no way of knowing conclusively whether thunderstorms are producing the returns without consulting a meteorologist. This vagueness is one of the reasons the FAA changed the phraseology. Many controllers and pilots assume that anything showing on weather radar is precipitation: liquid, freezing or frozen. As a pilot, you should also understand the following points before flying:

- ◆ Controllers are not experts at interpreting weather radar. They can provide only a description of what their scope shows and general guidance.
- ◆ ARTCC controllers cannot “see the wind” the way meteorologists using NEXRAD can. Therefore, they cannot advise pilots on locations of tornadoes, hook echoes or wind shear. Most controllers do not know the exact location of NWS-issued Tornado or Severe Thunderstorm Warnings because those products are not on their scopes. The CWSU meteorologist can provide that information. Tower controllers have the ITWS, which indicates wind shear alerts.
- ◆ In the spring and fall when upper winds are strong, the position of weather echoes might be offset by as much as 10 miles. This offset occurs because NWS radars take a minimum of 4 minutes to complete each “volume scan” sweep of the atmosphere. Although the FAA display is a mesh of many NWS radars, they are not time-synched, therefore several radars might be contributing data simultaneously for a given airspace. In general, when a weather system is moving at less than about 35 knots, displacement should not be a problem. At faster speeds, you will need to watch for displacement.

## Weather Products Affected

The new phraseology rules also affect aviation weather products distributed from CWSUs. Both Center Weather Advisories (CWA) and Meteorological Impact Statements (MIS) will contain the new terms whenever discussing thunderstorm intensity. Here’s a comparison using a CWA:

### Old Way:

**AREA OF SCT LVL 4-6 TS MOV FM 24040KT. TOPS ABV FL450. SEV TS PSBL.**

### New Way:

**AREA OF SCT SEV TS WITH HVY TO EXTRM PCPN MOV FM 24040KT. TOPS ABV FL450.**

References to “levels” are now officially gone. Meteorologists are not required to list intensity. For example, the sample above could be worded “AREA OF SCT TS MOV FM . . .,” however, if they choose to do so, it must be phrased as precipitation.

The use of “SEV” pertains to the intensity of the thunderstorm, not intensity of precipitation. In other words, a lot of storms might contain extreme precipitation (old level 5) but are not automatically classified as severe to the general public. A NWS meteorologist might use the term “SEV” in front of “TS” to denote a known severe thunderstorm, defined as having surface winds of 50 knots or greater or hail at the surface of 3/4 inches. This is optional, however, since ALL thunderstorms can be severe to pilots.

Commercial airlines still stress using a 20 mile avoidance strategy for all thunderstorms, taking into account the fact that lightning, hail and wind shears can extend many miles outside the storm circumference. Too many pilots needlessly crash every year because they get too close to a thunderstorm in their effort to save time or due to poor pre-flight or in-flight response.

Weather uplinks in the cockpit are becoming more popular and more affordable each year. When combined with storm scopes, advisories from controllers using WARP, and good planning based on a thorough pre-flight weather briefing, pilots can increase awareness and reduce accidents. Doppler in the cockpit, however, doesn’t make a pilot a meteorologist anymore than WARP makes a controller one. If you’re uncertain about potentially dangerous weather signatures appearing on your cockpit weather equipment or even out the wind screen, contact the En Route Flight Advisory Service or ask a controller. En Route ARTCC controllers may even have time to ask their in-house meteorologist for further clarification. It’s better to ask for help than to risk a crash. →