The Front

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Air Traffic Control System Command Center

Minimizing weather impacts efficiently and safely

Jim Roets, Lead Forecaster
Aviation Weather Center

Nestled within the high-tech corridor of Northern Virginia, just outside of Washington, Dulles International Airport, is the nerve center for air traffic operations in the United States. Called the Air Traffic Control System Command Center (ATCSCC), it occupies one section of a building owned by EDS, Incorporated - a technology giant and a government contractor for military and other agencies for data services.

Once inside the building, I was struck by the massive screen displays in the front of the room. The main control room itself is fairly large and contains several dozen people all performing tasks designed to keep air traffic in this country moving without delay. Their job is massive. With five- to six-thousand aircraft in the air at any given time during the peak air traffic periods, the ATCSCC must react to any one of myriad complex interactions caused by weather, equipment outages, security concerns, and the push of traffic, in order to keep the traveling public on their way to their destinations safely and efficiently.

The role of the ATCSCC is to manage this flow of air traffic within the continental United States. The ATCSCC has been operational since 1994. There are many support components that aid in the successful balance of air traffic demand with system capacity. They are:

Airport Reservation Office (ARO)

The The Airport Reservation Office (ARO) processes all requests for IFR operations at designated high density traffic airports and allots reservations on a first come, first served basis.

The high density traffic airports are:
John F. Kennedy International
La Guardia
Chicago O´Hare International
Ronald Reagan Washington National

Figure 1. The main operations room at the ATCSCC is a high tech overview of the NAS. Air Traffice Control Specialists work out alternative routing for the high volume of air traffic that is frequently disrupted by thunderstorms.

In this issue:

Mission Statement

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

The ARO also allocates reservations to and from airports with above-normal traffic demand due to special events such as the Olympics, major Golf Tournaments, and other special events such as NASCAR races.

Collaborative Decision Making (CDM)

CDM is a phrase that has very broad implications. It is really more a philosophy on how to conduct business between the various components of aviation transportation, both government and industry. There are 24 airlines currently participating in this initiative. CDM is a specific FAA program, managed by FAA Headquarters and sponsored by the ATCSCC. There are two central principles to CDM:

- Better information will lead to better decision making

- Tools and procedures need to be in place to enable the ATCSCC and the National Airspace System (NAS) users to more easily respond to changing conditions

Central Altitude Reservation Function (CARF)

CARF supports United States peace and war plan objectives and other special activities. The CARF is responsible for coordinating military and civilian altitude reservations for operations within the NAS.

CARF personnel must be able to determine when military operations, national security aircraft operations, and other civilian emergency operations require special traffic management coordination. CARF is also the coordination point for all Open Skies Treaty Operations.

Enhanced Traffic Management System (ETMS)

ETMS is the system used by Traffic Management Specialists to predict, on national and local scales, traffic surges, gaps, and volume based on current and anticipated airborne aircraft. Traffic Management Specialists evaluate the projected flow of traffic into airports and sectors, then implement the least restrictive action necessary to ensure that traffic demand does not exceed system capacity.

Flight Inspection Liasion Office (AVN)

The mission of the AVNis to:

Improve response to customer needs by providing a national focal point for flight inspection

Create a tactical team with the National Operations Control Center and the Air Traffic Management staff to improve FAA ´s management of the

Facilitate the assurance that AVN flight inspection mission is aligned with NAS priorities

Strengthen the partnership between service providers and customers through CDM with Airway Facilities and Air Traffic management staff at the ATCSCC

International Operations and Procedures (IOP)

IOP Specialists provide advisory and technical support to other federal agencies, the airspace user community, and international Air Traffic Service providers. They serve as the focal point for developing and promoting activities with international Air Traffic Flow Management Units.

Traffic Management Specialists develop global traffic flow management programs and procedures, and represent the FAA at forums addressing the development of procedures and aviation systems that have an impact on the NAS and international community.

National Operations Control Center (NOCC)

The NOCC was established to provide national coordination of facility restoration activities and to provide status information on NAS equipment. The NOCC is staffed 24 hours per day, 7 days a week, and is responsible for collecting, tracking and reporting data from field organizations for NAS status, facility and service interruptions, special events and disasters.

The NOCC monitors critical situations as they evolve and notifies, mobilizes or directs key organizations while coordinating these events with Air Traffic and Airway Facilities. The NOCC is a conduit to the regional Maintenance Control Centers (MCC) for restoration of key NAS facilities and services, and communicates electronically with FAA technicians responsible for maintaining the NAS.

Notices to Airmen (NOTAM) Office

Since the National Airspace System (NAS) is continually evolving, a focal point is essential in tracking current NAS status. The NOTAM office is the most up-to-date resource for information related to the NAS. This office disseminates information on unanticipated or temporary changes to components of or hazards in the NAS until the associated charts and related publications have been amended.

Severe Weather (SVRWX) Unit

Near and dear to my heart is the SVRWX Unit. This is the group that I actually went to see.

When the weather is predicted to go bad, the Severe Weather Unit team springs into action.

The task of the Severe Weather Management team is to minimize the impact of severe weather on the airspace system. Traffic Management Specialists collect meteorological information from a variety of sources, and devise a suitable plan with other Air Traffic facilities and system users for routing traffic around the bad weather.

Through coordination with affected air traffic facilities and users, an operational plan is developed every two hours to ensure the safe and orderly flow of air traffic around impacted areas. As the weather changes, the plan can be revised , and, if necessary, new routings or restrictions are issued.

Each of these units within ATCSCC coordinate activities continuously throughout the day. It is a tremendous undertaking. Their job, in concert with the twenty-one Air Route Traffic Control Centers, is to get you to and from your destination as safely and efficiently as possible. When weather or other problems are unavoidable for what ever reasons, the ATCSCC is ready to jump in to resolve the problems.

Jim Roets is a Lead Forecaster at the Aviation Weather Center in Kansas City. He works all positions including Area Forecast, SIGMET, Convective SIGMET, and CCFP. Prior to that he served as an aviation advisory meteorologist at Olathe Center, and was promoted to NWS Headquarters as the CWSU program manager. During the mid 1990s, Mr. Roets served in management positions during the massive NWS modernization.

Use of the Collaborative Convective Forecast Product at the ATCSCC

Jim Roets, Lead Forecaster,
Aviation Weather Center

A plan for smooth traffice flow begins with a clear idea of weather that is expected across the nation. Since its inception, The Air Traffic Control System Command Center (ATCSCC) in Herndon, VA, has relied on a variety of forecasts from several sources, including the major airlines, private weather vendors, and the National Weather Service (NWS). This ‘shopping for forecasts' often caused confusion especially when the forecasts conflicted as they often did. Since the Collaborative Convective Forecast Product (CCFP) came into existence in 1998, its use among those who make air traffic decisions has grown remarkably. The CCFP is a joint venture involving telcons are very busy - usually with a couple dozen participants who are trying to handle air traffic through their respective airspace in the most efficient manner. It's much like the trading floor of the New York Stock Exchange - where orders are shouted and others accept what's being shouted at them. A casual outside observer might think the process to be some form of organized chaos. But, there is a very organized and structured method underlying all the give and take you are hearing. Routes are being planned. Ground stops are being implemented. The Canadians are advising us of their airspace capacity in case we need to fly domestic airlines through their sectors.

On top of all this is the CCFP. This forecast is used at nearly every level of the ATCSCC decision-making process.

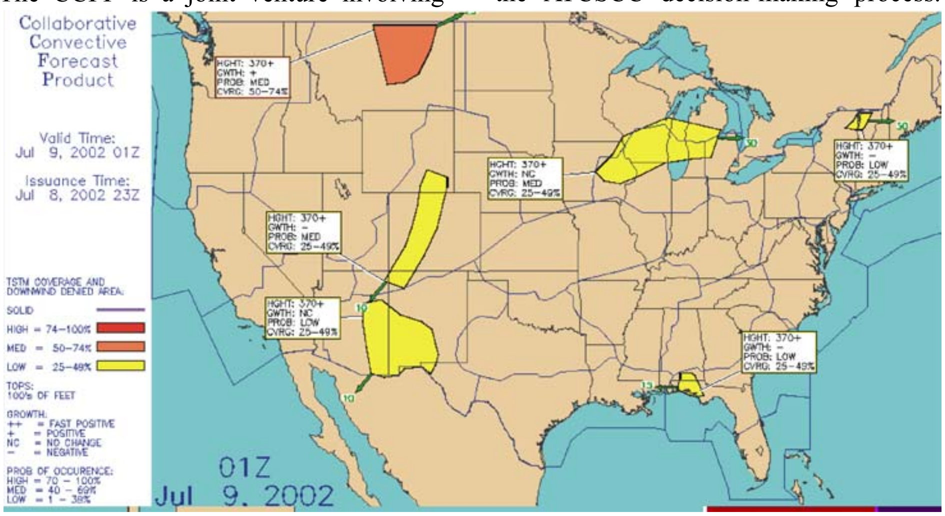

Figure 2. The CCFP forecast graphic for thunderstorms displays areas in which severe weather may impact the efficient and safe flow of air traffic. The forecasts are issued by the Aviation Weather Center and are the result of consultation between meteorologists in the Center Weather Service Units and major airlines.

meteorologists from the NWS, major airlines, and Center Weather Service Units (CWSU), to produce a coordinated forecast that can be used as a sole source of information to the traffic planners at the ATCSCC.

Every two hours, the severe weather group at the ATCSCC holds teleconferences (telcons) with some or all of the twenty-one Air Route Traffic Control Centers (ARTCC) and representatives from several major airlines. The purpose of these telcons is to plan national routing for air traffic in order to help avoid delays and cancellations caused by weather. The Depending upon where the thunderstorms are forecast, the impact to an average day's flights could be tremendous. The CCFP represents the combined efforts of many meteorologists, and the ATCSCC now likes to say that it's singing from the same sheet of music regarding the weather forecasts.

The job of the ATCSCC is to plan effectively for a variety of contingencies. Weather often throws a monkey wrench into the gears. Delays and cancellations cost a tremendous amount of money every year. The CCFP forecast is a way to keep the monkey wrench from doing so much damage and to keep the airspace as safe and efficient as it can possibly be.

Examine these forecasts for yourself so you have a clear picture of why controllers may impose rerouting or ground delays. Find the suite of products at the AWC web site.

http://cdm.aviationweather.noaa.gov/ccfp/forecast/?fcst=final

Clear Air Turbulence (CAT)

A View From Space

Gary Ellrod (NOAA/NESDIS)

Clear-air turbulence (CAT) is commonly encountered along the airways, especially from late Fall to early Spring. CAT is potentially dangerous due to its localized nature, sudden onset, variable intensity, and the fact that it's difficult to predict. CAT is actually defined as any non-convective turbulence above FL180, so it can occur in cirrus clouds, as well as in clear air. CAT forms when undulating waves develop along stable layers (inversions) in the upper troposphere, increase in amplitude, and break down into chaotic motion in a manner similar to the breaking of ocean waves. This entire cycle can occur in a period of five minutes or less. The effects of CAT on crew and passengers varies from discomfort for light-to-moderate turbulence, to loss of flight control during the rare extreme turbulence event. The strongest episodes, such as an extreme CAT encounter by a United Airlines jet between Japan and Hawaii in December, 1997, can result in injuries or fatalities. Unrestrained crew and passengers are especially vulnerable.

Needless to say, it's important to diagnose and forecast situations where strong CAT may be likely to occur. Unfortunately, it's difficult to forecast CAT location and intensity precisely due to factors previously mentioned, so the use of a wide range of observing and forecasting tools is needed, ranging from mesoscale numerical prediction models, to aircraft-mounted sensors, to space-based weather satellites. High resolution prediction models that utilize all available data and are frequently updated, such as the new 20 km resolution Rapid Update Cycle (RUC) model over the Continental

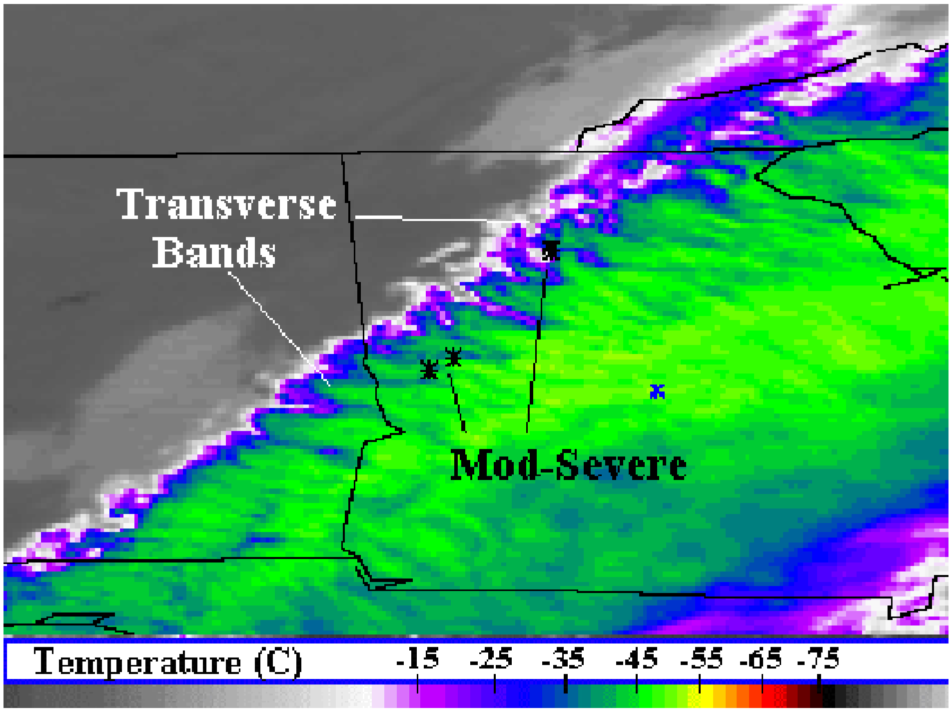

Figure 1. GOES IR image showing well-defined transverse cirrus bands along a strong jet stream and frontal cloud system on 24 November 1995. Turbulence reports were from large jet aircraft between FL200 - FL300.

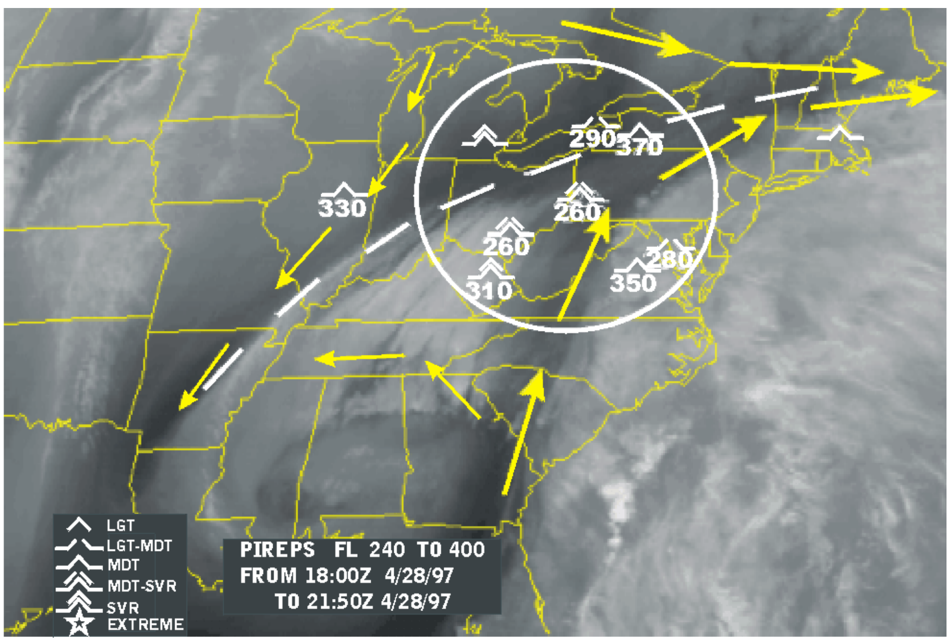

Figure 2. GOES WV image of a deformation zone (white dashed line) associated with a large scale low pressure system on 28 April 1997. Jet streams are shown by large arrows. Smaller arrows indicate direction of weaker flow. Circle indicates the likely region of strongest CAT. Note the pronounced dark zone shown along the deformation zone and jet stream.

United States, hold promise for improved forecasts on the short time scale. Since observational data over oceanic areas are sparse, forecasts become less reliable, and aircraft and satellite reports become critical.

The advent of the geostationary weather satellites (such as the U. S. GOES series) in the latter half of the 20th century provided a useful tool for monitoring regions of potential turbulence. Although satellite images cannot actually detect turbulence on the scale that affects aircraft (resolutions are only 1 - 5 km), their image frequency (15 min - 1hr) and near-global coverage can provide helpful clues for the presence of CAT. Forecasters use the visible, infrared (IR) and water vapor (WV) channels most often for this purpose. Images from polar orbiting satellites (such as the NOAA series) are available less frequently (every 2-6 hr, depending on latitude), but can augment GOES, especially in Polar regions where GOES coverage is poor. In addition to images, satellites can provide cloud motion vectors and temperature soundings to aid the prediction models, especially over the oceans.

Satellite imagery helps to locate regions where CAT forms, that is, near jet streams and upper level fronts. The two go hand-in-hand, since fronts contain sharp temperature contrasts that produce vertical wind shear. These features can be identified in satellite photos because they are often associated with well-defined cloud or moisture boundaries. The characteristics of these boundaries can be important. For example, zones of turbulence associated with the jet stream are often denoted by well-defined cirrus cloud bands that are oriented nearly perpendicular (transverse) to the flow and are located near the jet stream axis. An example of this cloud feature over the southeastern United States on 24 November 1995 is shown by the IR image (Figure 1). Wider, thicker transverse cloud bands (such as those seen near Atlanta) usually relate to a greater likelihood of moderate to severe CAT. Nearby upper air soundings indicated that there was extremely strong vertical winds shear near the cloud edge on that day. Similar cloud bands can even be observed during the summer, such as on the northern side of persistent thunderstorm systems that interact with the jet stream in the central United States.

What about situations where little or no cirrus clouds are present? This is where GOES WV images can be important. Pronounced warming (darkening) observed over a period of a few hours in a series of WV images has been associated with strong subsidence (also known as tropopause "folding") in the vicinity of upper level jet streams and troughs, and a corresponding increase in the risk of CAT. This is often a subtle feature requiring close examination of animated WV images. Elongated warm regions seen in WV images along and just downwind from the Rocky Mountains during the winter can also indicate possibly intense, high altitude, mountain wave turbulence. In general, WV images often depict a greater area coverage of mountain wave conditions at high altitudes than either visible or IR due to its greater sensitivity to atmospheric moisture variations.

A scenario where widespread moderate to severe CAT can usually be expected is when a large storm system (an "extratropical cyclone") develops, accompanied by strong winds aloft, and an amplifying upper level ridge-trough system. The most active area of CAT is just north of the developing cloud system, in a region known as a "deformation zone." Deformation zones are elongated regions where the upper winds converge toward a cloud or moisture boundary, while spreading laterally along that same boundary. The result is the development of a strong upper level front that may contain considerable CAT. Figure 2 is an example of how a deformation zone (dashed white line) appears in GOES WV imagery on 28 April 1997. A dark zone (indicating sinking motion) can be seen along the north side of the deformation zone. The CAT is typically strong and frequent where the jet stream approaching from the south (large yellow arrows) intersects the deformation zone (circled region). In summary, combined use of satellite imagery, upper winds, pilot reports, and model forecasts can be used to effectively diagnose and predict areas of CAT in many situations.

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GARY P. ELLROD is a research meteorologist with NOAA's National Environmental Satellite, Data and Information Service (NESDIS) in Camp Springs, Maryland, where he has specialized in aviation weather applications since 1983. He earned a Department of Commerce Silver Medal (1992) for developing techniques to detect fog, turbulence, and other hazards using weather satellites. He also earned the National Weather Association Research Achievement Award (1990). Mr. Ellrod recently co-authored a chapter on Clear Air Turbulence for the Encyclopedia of Atmospheric Science.

NEXRAD radar for ARTCC controllers

Tom Amis, Meteorologist in Charge
Center Weather Service Unit
Fort Worth ARTCC

A major milestone of the FAA, NWS, and Harris corporation, to display real-time weather radar data on the air traffic controllers' consoles was accomplished on May 20th, 2002 at the Fort Worth Air Route Traffic Control Center (ARTCC).

The road to achieving this success began in the mid 1990s and had numerous technical and engineering obstacles to overcome. Initial testing of hardware and software began in the summer of 1999 at the Seattle ARTCC. During this testing, a number of technical items came to light, which the FAA, NWS, and the Harris team realized we would have to overcome. Chief among these technical items was to prevent a bulls eye pattern (Figure 1) used during maintenance

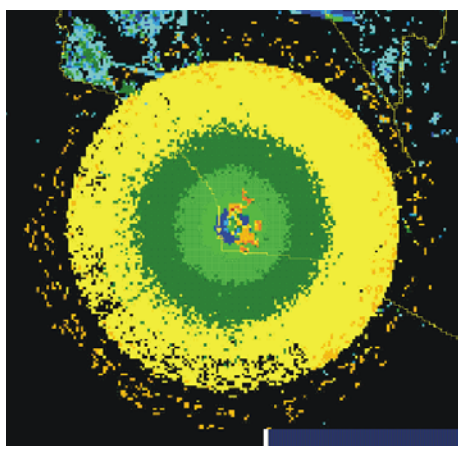


Figure 1 NEXRAD bulls eye test pattern

from reaching the controllers display. Another was to accurately eliminate anomalous propagation and ground clutter or false, non-weather return from being displayed with legitimate echos. (Figure 2).

The testing and evaluation moved to Fort Worth ARTCC after the team had noted the lack of convective events available for analysis, depiction and testing in the Pacific Northwest. The new hardware and software began aggressive testing at the Fort Worth ARTCC during 2001 and 2002. Software filters were designed to eliminate the bull's eye pattern and filters (dubbed quality enhancements) were developed and are still

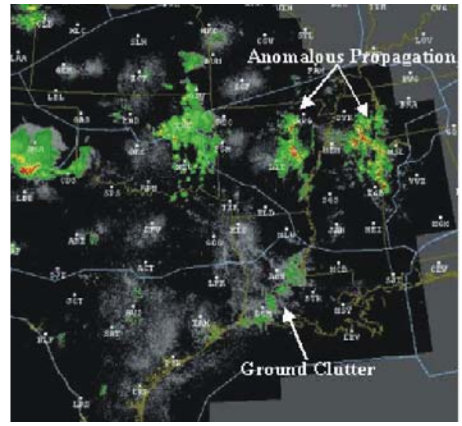


Figure 2 Anomalous Propagation & Ground Clutter

undergoing testing to reduce the amount of anomalous propagation (false echo return) and ground clutter.

During the development and human factors design phase of the Harris Weather and Radar Processor (WARP) radar products, it was decided that the control room staff would display the NEXRAD data in 3 varying shades of blue. This of course compressed the 16 level data that the meteorologists are familiar with into three levels, the lowest reflectivity level being 30 dBz.

Additionally, the controllers have several options with which to display the radar data. By making a key stroke at their display a controller can depict a composite reflectivity map (0-60,000 feet) (Figure 3) or layered products (0-24,000 feet, 24,000 - 33,000 feet, and 33,000 - 60,000 feet), these layers approximate a sectors stratum setup of low, high and ultra high sectors that can be controlled at an ARTCC.

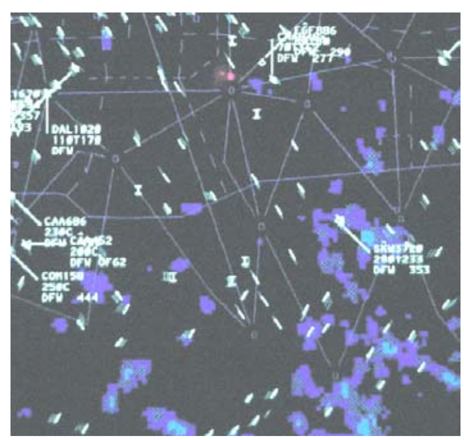


Figure 3 Air Traffic Controllers Display with NEXRAD Radar

Since using the data operationally in May, the Center Weather Service Unit (CWSU) staff has received nothing but praise for the new data available to the controllers. One supervisor noted that "this is the best new technology I have seen in my 30 years as a controller". Another example of controller-displayed weather radar information occurred during an evening with thunderstorms affecting the Dallas Fort Worth (DFW) Terminal Radar Approach Control (TRACON) and the Possum sector. In this particular event a supervisor stated that they were able to move an additional 15 aircraft through a weather-impacted sector before closing DFW airport operations due to thunderstorms. The net effect of the radar data is that the controllers have a real sense of situational awareness with regards to weather and the aircraft, which has tremendously increased their confidence level. Even though better radar data has arrived at the sectors, the controllers' primary job, to separate aircraft, has not changed. Center controllers are not in the business of offering vectors around thunderstorms.

For the CWSU meteorologist much of this new capability is a stepping stone to further improvements expected in WARP this fall. At that time, a new two kilometer resolution national radar mosaic and four kilometer resolution echo tops and composite reflectivity mosaics will be available for the first time.

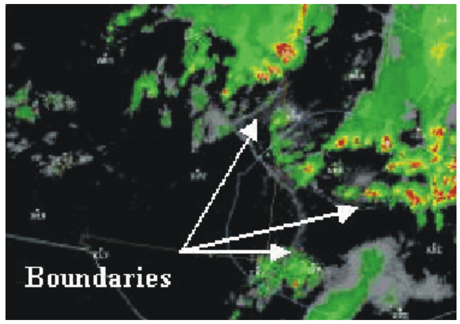


Figure 4 Boundaries produce by cold air outflow from thunderstorms.

Finally, the Fort Worth CWSU meteorologists have documented several cases of convective initiation based on the WARP-generated two kilometer resolution radar mosaic.

Figure 4. shows intersecting boundaries over west Texas that led to thunderstorm development. The CWSU was able to confidently identify this development and advise Traffic Management and the affected sectors. The ARTCC implemented timely flow management around the area of thunderstorms.

The Forth Worth CWSU meteorologists are looking forward to new improvements and products from WARP, which should be deployed over the next several months and following years.

Tom Amis is the Meteorologist in Charge at the Center Weather Service Unit at Forth Worth Center. He also has a 23 Year Naval Reserve career as a Meteorologist, and is currently the Commanding Officer of Naval Meteorology Oceanography Reserve Activity 1570, Ft. Worth, TX.

just for fun

Sally Pavlow, Forecaster, NWS Indianapolis

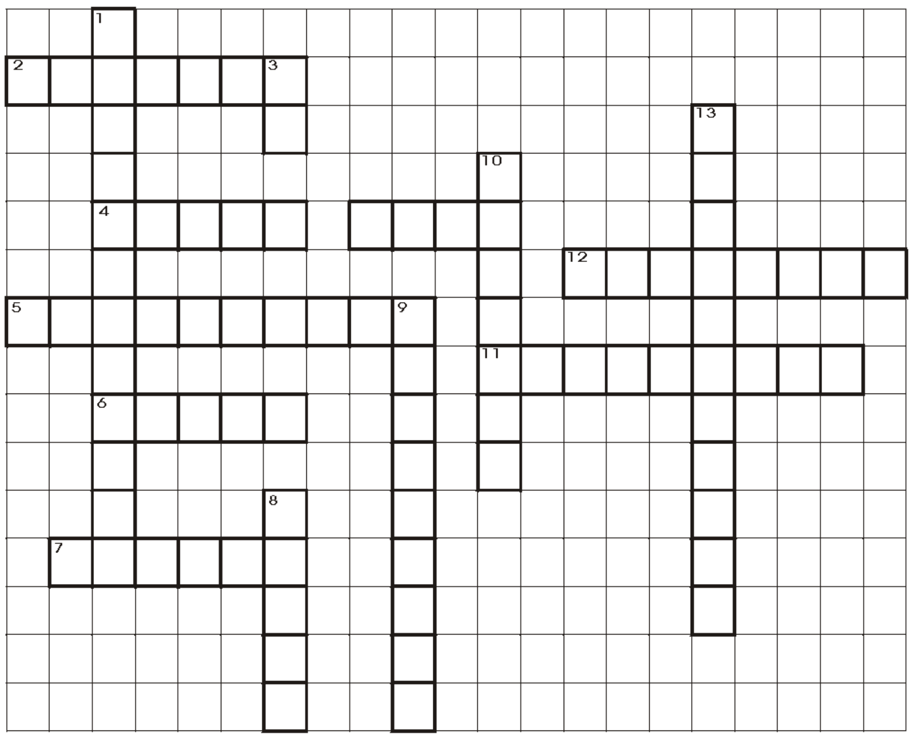
Down:

1. Parent cloud for thunderstorms.
3. METAR code for liquid precipitation.
8. Transition zone between two air masses.
9. That which occurs after sunset.
10. Lowest broken or overcast cloud layer.
13. All weather occurs in this portion of the atmosphere.

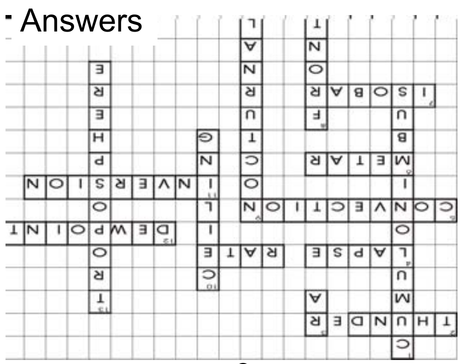
Across:

2. Loud sound caused by rapid heating and expansion of the air.
4. Change of temperature with altitude. (two words) The normal value is 3.5 F for every 1000 ft.
5. Vertical development of clouds and storms due to surface heating and instability.
6. Formerly named SAO.
7. Line of constant pressure on a surface map.
11. A point in the atmosphere where temperature begins to *increase* with increasing altitude.
12. The temperature to which the air must be cooled in order to reach saturation.

Sally Pavlow has a degree in Aeronautical Scinece with a concentration in meteorology from Parks College of St. Louis University.



Answers



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