



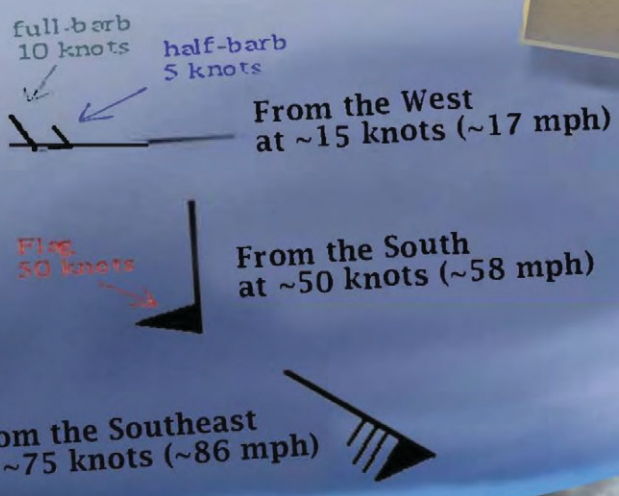
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Aviation Weather Handbook



U.S. Department of Transportation
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Aviation Weather Handbook

2026

United States Department of Transportation
FEDERAL AVIATION ADMINISTRATION
Flight Standards Service

Preface

This handbook is designed as a technical reference for all who operate in the National Airspace System (NAS). Pilots, dispatchers, and operators will find this handbook a valuable resource for flight planning and decision making.

This handbook conforms to pilot weather training and certification concepts established by the Federal Aviation Administration (FAA). The discussion and explanations reflect the most commonly used weather products and information.

It is essential for persons using this handbook to also become familiar with and apply the pertinent parts of Title 14 of the Code of Federal Regulations (14 CFR) and the Aeronautical Information Manual (AIM). Title 14 CFR, the AIM, this handbook, current advisory circulars (AC), and other FAA technical references are available via the internet at the FAA home page at <https://www.faa.gov>.

This handbook is available for download in Portable Document Format (PDF) from the FAA's Regulations and Policies web page at https://www.faa.gov/regulations_policies/handbooks_manuals/aviation.

This handbook was signed and published by the U.S. Department of Transportation (DOT), FAA Aviation Safety, Flight Standards Service (FS) on April 2, 2026.

The guidance and recommendations in this handbook are not legally binding in their own right and will not be relied upon by the FAA as a separate basis for affirmative enforcement action or other administrative penalty. Conformity with the guidance and recommendations is voluntary only and nonconformity will not affect rights and obligations under existing statutes and regulations.

NOTE: Recently the National Weather Service's (NWS) Aviation Weather Center's (AWC) updated their website (<https://aviationweather.gov>). There have been numerous and significant changes to that website. This revision of the Aviation Weather Handbook includes references to that website. To prevent the need for many updates to this Handbook there are fewer AWC Website images copied from there.

Comments regarding this publication should be sent, in email form, to the following address: 9-AWA-AFS400-Coord@faa.gov.

Acknowledgements

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This important FAA reference is printed and distributed by Aviation Supplies & Academics, Inc. ASA has provided aviation training materials to pilots and mechanics since 1940.

SAMPLE

Notice

The U.S. Government does not endorse products or manufacturers. Trade or manufacturers' names appear herein solely because they are considered essential to the objective of this handbook.

SAMPLE

Major Revisions

- Updated the Preface.
- Updated references throughout the handbook changing Notices to Air Mission (NOTAM) to Notice to Airmen (NOTAM).
- In Section 2,
 - Added NASA to the Aviation Weather Service Program description
 - Added wording on WAFS grids
 - Added CERAP to the Section 2.3.3 title
 - Added Alaska's new dedicated phone number information
- In Section 3,
 - Added new Section 3.3.3.4
 - Changed "GTG" to "GTGN", Added "GTG" to the Forecast section on Table 3-1
 - Added "NDFD" to Table 3-1 and Table 3-2
- In Section 4, added a note on Figure 4-1.
- In Section 5,
 - Added "For additional information on how temperature may affect flight performance, please see Chapter 8" to Section 5.1
 - Removed reference to specific heat capacity to Section 5.7
 - Removed "capacity" from the name and column heading on Table 5-4
 - Removed "capacity" from the two paragraphs at the bottom of page 5-9
 - Adjusted wording in Section 5.7 (first paragraph) to improve accuracy
- In Section 15, added a new section on chaff and figure showing radar image of chaff.
- In Section 16, added an enhancement to Figure 16-6 for clarity.
- In Section 19, added wording for clarity in Section 19.2.2.
- In Section 20,
 - Changed SLD minimum size to 50 microns
 - Deleted a reference to altitude in Section 20.4.1
 - Replaced wording in Section 20.4.1 for clarity
- In Section 22, added "Do not" to the front of #7.
- In Section 23,
 - Reworded Section 23.1's introduction for clarity
 - Updated language on our understanding of the physics of sunspots
 - Updated language around magnetic fields
 - Updated the range of frequencies of solar electromagnetic emissions

- Added a definition of corona
- Refined the description of the cause of an aurora
- Changes percentage of GCR flux for consistency with recent publications
- In Section 24,
 - Due to changes on the AWC website, language was updated and multiple figures were deleted
 - Changed “sm” to “SM” in several locations.
 - Deleted “, or Dust/Sand Whirl (Dust Devil)” from the first column in Table 24-2
 - Added a note in Section 24.4.3.7 saying “Note: The link to the RVR website is located in Appendix G.”
 - Deleted Section 24.6.1.5 and Figure 24-18, both are no longer used
 - Updated Section 24.9.1 provided the new Weather Camera Program information
- In Section 25,
 - Added Analyzed Weather to the Introduction
 - Removed reference to the AWC website
 - Changed Figure 25-3 and 25-16
 - Deleted graphic references no longer available
 - Deleted Figures 25-25, 25-26, and 25-27
 - Enhanced the description of the weather products that are used to generate CIP 2 changes
 - Deleted “icing” from “AWC’s icing website”
 - Changed Section 25.6’s title for clarity
 - Corrected Section references in Section 25.5
- In Section 26, deleted Figure 26-8 and all references to the figure.
- In Section 27,
 - Deleted references to the AWC GFA Tool
 - Deleted Figures 27-1, 27-2, 27-33, 27-34, 27-35
 - Deleted Section 27.12.3 and 27.12.4, sections renumbered
 - Removed missing reference information from end of Section 27.12.3 sentence
 - Deleted sentence referencing the AWC website
 - Changed the typo at the end of Section 27.2.1.1.2 (4th line) under “Sample winds aloft text message” and top of next page from 550252 to 750252
 - Updated PROB 30 wording to reflect NWS changes
 - Added language around the use of temperature information from the LAMP/MOS product
 - Added text “The NWS will continue producing text FAs for Alaska for the foreseeable future”

- Added language for clarity, deleted PIREPs from FIP sourcing, and removed bullets referencing CIP and FIP
- Added language around use of the LAMP product for destination forecast planning
- Removed “Implementation of additional levels are planned in 2024” and specific location in AWC website
- Removed references to FAs for Hawaii, Gulf of America, and the Caribbean
- Deleted Sections 27.6.4.2, 27.6.4.3, and 27.6.4.3
- Changed definition of heavy ice to Section 27.12
- Removed reference to CIP from Section 27.12
- In Section 28,
 - Deleted Figure 28-1 (and references to the figure), Figure 28-2, and Section 28.4
 - Changed the HEMS Tool to Graphical Forecast for Aviation (Low Altitude, GFA-LA)
 - Added language in Section 28.2 regarding the change from HEMS to GFA-LA
- In Appendices,
 - Appendix D: Added a reference to RVR in Table D-1
 - Appendix E Added CERAP and GTG-N
 - Appendix G: Added FAA Runway Visual Range (RVR) and multiple NWS Website URLs

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1 Introduction

This handbook describes the United States (U.S.) aviation weather program, products, and services. It also documents weather theory and its application to aviation. The objective of this handbook is to help the pilot and operator understand the basics of weather, aviation weather hazards, and aviation weather products. The information included is not prescriptive. Furthermore, the guidance and recommendations in this handbook are not legally binding in their own right and will not be relied upon by the FAA as a separate basis for affirmative enforcement action or other administrative penalty. Conformity with the guidance and recommendations is solely voluntary and nonconformity will not affect rights and obligations under existing statutes and regulations.

The handbook is a consolidated source of weather information and, in some cases, best practices to assist with providing safety for flight.

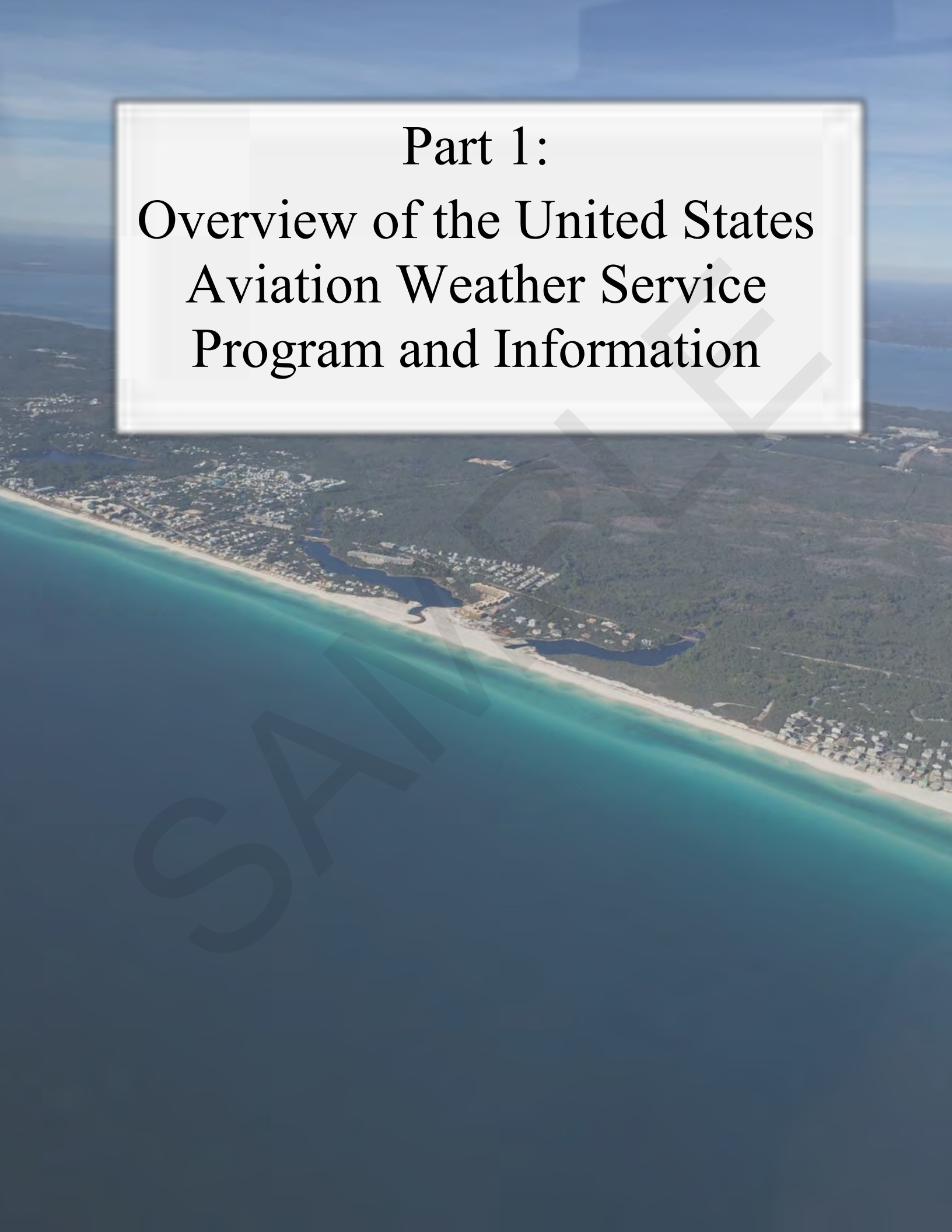
The visualization of the products discussed in this handbook has evolved over the past decade with the use of internet websites. The use of static black and white depictions of aviation forecasts is quickly becoming a thing of the past. Today's websites provide the products in color and offer options to select and overlay multiple pieces of weather information.

Today's aviation weather websites, including those of the National Weather Service (NWS), continue to improve the content and visualization of products. Unfortunately, it is not practical to update this handbook with every change to a weather product.

Examples of weather products in this handbook represent one way of how they can be visualized on a user's viewing device (e.g., computer, tablet, mobile phone, or cockpit display). The examples shown in this handbook are from NWS websites.

This handbook is broken into three parts:

- Part 1: Overview of the United States Aviation Weather Service Program and Information.
- Part 2: Weather Theory and Aviation Hazards.
- Part 3: Technical Details Relating to Weather Products and Aviation Weather Tools.

An aerial photograph of a coastal town with a sandy beach and turquoise water. The town is built on a hillside overlooking the ocean. The water is a vibrant blue-green color, and the beach is a light tan. The town has many buildings and a winding road. The sky is a clear, pale blue.

Part 1:
**Overview of the United States
Aviation Weather Service
Program and Information**

An aerial photograph taken from the perspective of someone looking out of an airplane window. The view shows a winding river or canal cutting through a vast, flat landscape of green and brown fields. A straight road or path runs parallel to the waterway. In the distance, a small cluster of buildings is visible. The sky is clear and blue. The wing and fuselage of the airplane are visible in the foreground, framing the view.

2 Aviation Weather Service Program

2.1 Introduction

The aviation weather service program is a joint effort of the National Oceanic and Atmospheric Administration (NOAA), the Federal Aviation Administration (FAA), the Department of Defense (DOD), NASA, and commercial aviation weather providers.

2.2 National Oceanic and Atmospheric Administration (NOAA)

NOAA is an agency of the Department of Commerce (DOC). NOAA conducts research and gathers data about the global oceans, atmosphere, space, and Sun, and applies this knowledge to science and service, which touches the lives of all Americans. Among its six major divisions are the National Environmental Satellite, Data, and Information Service (NESDIS) and the NWS.

2.2.1 National Environmental Satellite, Data, and Information Service (NESDIS)

NESDIS manages the U.S. civil operational remote-sensing satellite systems, as well as other global information for meteorology, oceanography, solid-earth geophysics, and solar-terrestrial sciences. NESDIS provides this data to NWS meteorologists and a wide range of other users for operational weather forecasting.

2.2.1.1 Satellite Analysis Branch (SAB)

NESDIS' Satellite Analysis Branch (SAB) serves as the operational focal point for real-time imagery products and multidisciplinary environmental analyses. The SAB's primary mission is to support disaster mitigation and warning services for the U.S. Federal agencies and the international community. Routine environmental analyses are provided to forecasters and other environmental users and are used in the numerical models of the NWS. The SAB schedules and distributes real-time satellite imagery products from global geostationary and polar-orbiting satellites to environmental users.

The SAB coordinates the satellite and other information for the NOAA Volcanic Hazards Alert Program, under an agreement with the FAA, and works with the NWS as part of the Washington, DC, Volcanic Ash Advisory Center (VAAC). The Washington, DC, VAAC area of responsibility stretches from 40° W to 130° E and includes the areas of the contiguous United States (CONUS), New York and Oakland Oceanic flight information regions (FIR), and southward through Central America and the Caribbean to 10° S in South America.

2.2.2 National Weather Service (NWS)

The NWS provides weather data, forecasts, and warnings for the United States, its territories, adjacent waters, and ocean areas for the protection of life and property and the enhancement of the national economy. NWS data and products form a national information database and infrastructure that can be used by other government agencies, the private sector, the public, and the global community. The following sections provide a description of NWS offices associated with aviation weather.

2.2.2.1 National Centers for Environmental Prediction (NCEP)

The National Centers for Environmental Prediction (NCEP) is where virtually all global meteorological data is collected and analyzed for the United States. The NCEP then provides a wide variety of national and international weather guidance products to NWS field offices, government agencies, emergency managers, and private sector meteorologists. The NCEP is a critical resource in national and global weather prediction and is the starting point for nearly all-weather forecasts in the United States.

The NCEP is comprised of nine distinct centers and the Office of the Director. Each center has its own specific mission. The following NCEP centers provide aviation weather products and services.

2.2.2.1.1 NCEP Central Operations (NCO)

The NCEP Central Operations (NCO) in College Park, MD, sustains and executes the operational suite of the numerical analysis and forecast models and prepares NCEP products for dissemination. It also links all nine of the national centers together via computer and communications-related services.

2.2.2.1.2 Aviation Weather Center (AWC)

The Aviation Weather Center (AWC) in Kansas City, MO, issues a suite of aviation weather forecasts in support of the National Airspace System (NAS) that are described in this handbook, including Airmen's Meteorological Information (AIRMET), significant meteorological information (SIGMET), Convective SIGMETs, and various icing, turbulence, and convective forecast products. The AWC is a Meteorological Watch Office (MWO) for the International Civil Aviation Organization (ICAO). The AWC, in conjunction with the NCO, also serves as one of two ICAO World Area Forecast Centers (WAFc), known as WAFc Washington, issuing flight planning data (winds and temperatures) and Significant Weather (SIGWX) forecasts.

The AWC's website provides the aviation community with textual, digital, and graphical forecasts, analyses, and observations of aviation-related weather variables. Additionally, the website provides information for international flights through the World Area Forecast System (WAFS) grids which are used to support the Internet File Service (WIFS), which is a separate system.

2.2.2.1.3 Weather Prediction Center (WPC)

The Weather Prediction Center (WPC) in College Park, MD, provides analysis and forecast products specializing in multiday, quantitative precipitation forecasts and weather forecast guidance, weather model diagnostics discussions, and surface pressure and frontal analyses.

2.2.2.1.4 Storm Prediction Center (SPC)

The Storm Prediction Center (SPC) in Norman, OK, provides tornado and severe weather watches for the CONUS along with a suite of hazardous weather forecasts.

2.2.2.1.5 National Hurricane Center (NHC)

The National Hurricane Center (NHC) in Miami, FL, provides official NWS forecasts of the movement and strength of tropical weather systems and issues the appropriate watches and warnings for the CONUS and surrounding areas. It also issues a suite of marine products covering the tropical Atlantic, Caribbean, Gulf of America, and tropical eastern Pacific. In support of ICAO, the NHC is also referred to as a Tropical Cyclone Advisory Center (TCAC).

2.2.2.1.6 Space Weather Prediction Center (SWPC)

The Space Weather Prediction Center (SWPC) in Boulder, CO, provides space weather information (e.g., current activity and forecasts) to a wide variety of users. The SWPC is also an ICAO Space Weather Center and is responsible for issuing global advisories for space weather events affecting communication and navigation systems as well as events that pose a potential health hazard to passengers and crew.

2.2.2.1.7 Alaska Aviation Weather Unit (AAWU)

The Alaska Aviation Weather Unit (AAWU), located in Anchorage, AK, is an MWO for ICAO. The AAWU is responsible for the entire Anchorage FIR. They issue a suite of aviation weather products for the airspace over Alaska and adjacent coastal waters, including AIRMETs, SIGMETs, FAs, and SIGWX Prognostic Charts.

The AAWU is also designated as the Anchorage VAAC. The VAAC area of responsibility includes the Anchorage FIR and Far Eastern Russia and is responsible for the issuance of Volcanic Ash Advisories (VAA).

2.2.2.1.8 Center Weather Service Unit (CWSU)

Center Weather Service Units (CWSU) are units of NWS meteorologists under contract with the FAA that are stationed at, and support, the FAA's air route traffic control center (ARTCC).

CWSUs provide timely weather consultation, forecasts, and advice to managers within ARTCCs and to other supported FAA facilities.

Special emphasis is given to those weather conditions that are hazardous to aviation or that could impede the flow of air traffic within the NAS. CWSU meteorologists issue the following products in support of their respective ARTCC: Center Weather Advisories (CWA) and Meteorological Impact Statements (MIS).

2.2.2.1.9 Weather Forecast Office (WFO)

The NWS has 122 Weather Forecast Offices (WFO) across the United States and select territories. An NWS WFO is a multipurpose, local weather forecast center that produces, among its suite of services, aviation-related products. In support of aviation, WFOs issue Terminal Aerodrome Forecasts (TAF) and Aviation Forecast Discussions (AFD), with some offices issuing Airport Weather Warnings (AWW), Soaring Forecasts, and Balloon Forecasts. The WFO also issues weather warnings such as tornado and severe thunderstorm warnings.

The Honolulu WFO is unique among NWS WFOs in that it provides multiple services beyond the typical WFO. WFO Honolulu is also designated as an MWO for ICAO. As a result of this unique designation, WFO Honolulu is the only WFO to issue the following text products: AIRMETs and SIGMETs. WFO Honolulu is co-located with the Central Pacific Hurricane Center (CPHC). The CPHC provides official NWS forecast of the movement and strength of tropical weather systems and issues the appropriate watches and warnings for the central Pacific, including the State of Hawaii. WFO Honolulu also issues a suite of marine products covering a large portion of the Pacific Ocean. In support of ICAO, the CPHC is also referred to as a TCAC.

2.3 Federal Aviation Administration (FAA)

The FAA, a part of the Department of Transportation (DOT), provides a safe, secure, and efficient airspace system for the promotion of U.S. aerospace safety.

Per Title 49 of the United States Code (49 U.S.C.) § 44720, Meteorological Services, the FAA establishes all requirements for aviation weather reports and forecasts.

The FAA provides a wide range of services to the aviation community. The following sections provide a description of those FAA facilities that are involved with aviation weather and pilot services.

2.3.1 Air Traffic Control Systems Command Center (ATCSCC)

The air traffic control systems command center (ATCSCC) has the mission of balancing air traffic demand with system capacity. This ensures maximum safety and efficiency for the NAS, while minimizing delays. The ATCSCC utilizes the Traffic Management System (TMS), aircraft situation displays, monitor alert, follow-on functions, and direct contact with ARTCC and Terminal Radar Approach Control (TRACON) facility Traffic Management Units (TMU) to manage flow on a national level.

Because weather is the most common reason for air traffic delays and rerouting, NWS meteorologists support the ATCSCC. These meteorologists, called National Aviation Meteorologists, coordinate NWS operations in support of traffic flow management within the NAS.

Aviation Weather Handbook



U.S. Department
of Transportation
**Federal Aviation
Administration**

FAA-H-8083-28B

This edition supersedes FAA-H-8083-28A, dated November 26, 2024

This important Federal Aviation Administration (FAA) Handbook updates and consolidates information previously available in six different Advisory Circulars:

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- AC 00-24, *Thunderstorms*
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- AC 00-57, *Hazardous Mountain Winds*

Pilots and dispatchers must understand all aspects of weather. The ability to appreciate good weather, recognize and respect marginal or hazardous weather, and avoid violent weather as well as make sound weather decisions is critical for successful outcomes of all flights. This book examines each aspect of weather as it relates to aircraft operation and flight safety and introduces the tools available for flight planning and in-flight weather decisions, including observations, analyses, and forecasts.

This updated edition reflects key changes for today's pilots with improved accuracy, modernized terminology, and updated weather products.

Coverage is expanded to include enhancements to aviation weather services and global forecasting tools,

updates to turbulence and forecast products (including GTG-N and NDFD), and alignment with current National Weather Service guidance. New content is added on icing, radar interpretation (including chaff), and space weather, while outdated tools are replaced with modern resources, such as the Graphical Forecast for Aviation (GFA), giving pilots access to the most relevant, real-world weather information available today.

The information in this handbook applies to students, experienced pilots, and flight instructors alike and offers a key reference for meteorology and weather services applicable to FAA Knowledge Tests and airman certification. This comprehensive weather resource addresses flight safety in both visual (VMC) and instrument (IMC) meteorological conditions. Subjects covered also include meteorology; mountain, tropical, and arctic weather; observations (ASOS, AWOS, METAR, PIREP, radar); advisories (including AIRMET, SIGMET, wind shear); forecasts (TAF, FA); and much more.

Examples and explanations are supported with online references for further weather resources, definitions, and related FAA publications along with detailed, full-color drawings and photographs throughout.

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