NWS Aviation Weather Center

Kansas City, MO

Jennifer Stroozas - Warning Coordination Meteorologist CDR John Rossi - NOAA Aircraft Operations Center WP-3D Hurricane AC/King Air Instructor Pilot





Causes of National Airspace System Delays



As much as 67% of the delay in the NAS can be attributed to weather, resulting in US economic losses of roughly 23,000,000,000 USD annually.

Air Traffic Refresher



Thunderstorm Impacts to Air Traffic



Organizational Structure



1 national headquarters
6 regional headquarters
122 local weather forecast offices (WFO)
13 river forecast centers (RFC)
1 national water center
21 Center Weather Service Units (CWSU)
9 national centers

9 Specialization Centers

- Aviation (AWC)
- Climate (CPC)
- Modeling (EMC)
- Supercomputing & data flow (NCO)
- Hurricanes (NHC)
- Oceans (OPC)
- Severe storms (SPC)
- Space weather (SWPC)
- Hydrometeorology (WPC)

National Centers for Environmental Prediction (NCEP)



Environmental Modeling Center

Weather Prediction Center

SWPC AV Space Weather Prediction Center Boulder, Colorado

Aviation Weather Center Kansas City, Missouri College Park, Maryland

Ocean Prediction Control Operations

SPC-Storm Prediction Center Norman, Oklahoma

> National Hurricane Center Miami, Florida

http://www.weather.gov/jetstream/nws/ncep.html



http://www.weather.gov/jetstream/nws/wfos.html



http://www.weather.gov/jetstream/nws/cwsus.html

NOAA/NWS Aviation Program



122 Weather Forecast Offices





21 Center Weather Service Units



3 Meteorological Watch Offices



2 Volcanic Ash Advisory Centers

NWS Meteorologists provide embedded Impact-Based Decision Support Services at the ATCSCC as well as the 21 ARTCCs



Aviation Weather Center

www.aviationweather.gov



OUR MISSION STATEMENT

The Aviation Weather Center delivers consistent, timely and accurate weather information for the world airspace system.

We are a team of highly skilled people dedicated to working with customers and partners to enhance safe and efficient flight.

OUR VISION

To be the trusted authority and leading innovator for aviation weather information.

Warrenton, VA

NAMs are embedded with the FAA at the ATCSCC



- 4 branches
 - 2 locations
- ~80 people
 - Forecasters
 - Researchers/developers
 - IT staff
 - Administrative support staff
 - Managers & supervisors
 - NOAA Corps Officer

Aviation Weather Advisories and Warnings

Aviation Weather Advisories and Warnings

- G-AIRMETs (shown below) are advisories for hazardous weather
- Cig/Vis, Turb, Icing



Low clouds/visibility & mountain obscuration

 Number lower
 Surface Winds
 Freezing Level

 Image: Surface Winds
 Freezing Level
 Image: Surface Winds
 Freezing Level

 Image: Surface Winds
 Image: Surface Winds
 Freezing Level
 Image: Surface Winds
 Freezing Level

 Image: Surface Winds
 Image: Surface Winds</t

Turbulence, strong winds & wind shear



Icing & freezing levels

Aviation weather advisories and warnings

A SIGMET is a weather warning for aviation. SIGMET stands for <u>Significant Meteorological Information</u>.



SIGMETs are issued by the Aviation Weather Center. They're meant for aircraft in flight. SIGMETs tell pilots where to expect severe conditions such as:

Severe turbulence >>> Severe icing Volcanic ash Areas of widespread sandstorms or dust storms

Areas of thunderstorms C



Tropical cyclones

Your local Weather Forecast Office will issue weather warnings for people on the ground. These warnings tell people where to expect large hail, very strong wind gusts, flash flooding, or tornadoes.

Weather Forecasts

Ground-based weather

- Daily high and low temperature
- How much total cloud cover
- Wind speed and direction
- Chance of precipitation
 - Type (rain, snow, mixed, etc.)
 - Timing (when will it start/stop?)
 - How much?

Aviation weather

- Where, when, and at what height(s)
 - Turbulence
 - Icing potential
 - Freezing level(s)
 - Cloud layers
 - Obstructions to visibility
 - Wind speed and direction
 - Other hazardous conditions
- Convection
- Weather conditions at departure and arrival (may be different locations)

AWC Operations



Kansas City, MO



Aviation Weather Center Operations



CONUS · coastal waters



AIRMETs · TFM convective forecast · Low-level SIGWX



CWSUs \cdot Airlines \cdot FAA



Convective SIGMET · TCF · Turbulence · Icing · Clouds & visibility

AVIATION WARNINGS

AVIATION FORECASTS

Global Significant Weather (SIGWX) · Area Forecasts for Gulf of Mexico & Caribbean

COLLABORATION

International meteorological services



DESKS

Tropical · SIGWX North · SIGWX South









International Operations

Aviation Weather Center Support Branch







PRODUCTS & SERVICES

DATA, TECHNOLOGY, & INFRASTRUCTURE

SCIENCE & TECHNOLOGY

Graphical Forecasts for Aviation (GFA)

- WAFS Internet File Service (WIFS)
 - Computer models · Operational shift fill-in

IT architecture & security · Production systems · Data management · Support for remote forecast operations

Aviation Weather Testbed (AWT) • Aviation Weather Research Program • Research initiatives

AWC Support to ATCSCC



Our goal is to paint a cohesive national weather picture to the Command Center to improve safety, efficiency, and decision making.

NOAA Aircraft Operations Center

NOAA Corps Officers

- Pilots, Navigators
- CDR John Rossi WP-3D Hurricane AC/King Air Instructor Pilot at AWC

- Civilians
 - Meteorologists, Technicians, Mechanics, Engineers, Support Staff



Science in the Sky: NOAA Aviation from 500' to FL450



Photos: NOAA, Scott Slocum



CDR John F. Rossi

- Current: XO, Aviation Weather Center//WP-3D Hurricane AC/King Air 350 IP
- 2008: NOAA Ship: "Ronald H Brown"
- 2010: Aerial Snow Survey Program, Chanhassen, MN
 - AC-500 Shrike Commander and DHC-6 Twin Otter
- 2013: Safety Officer, AOC, Tampa, FL
- 2015: VP-30 NAS Jax/VXS-1 ASO NAS PAX River
 - P-3C Orion
- 2017: Hurricane Hunters, AOC, Lakeland, FL
 - WP-3D Orion and King Air 350-CER
- 2019: AC/HAC Qualified
- 2020: Chief, SST, AOC//Busiest Hx Season on Record/COVID-19 Pandemic
- 2022: XO, Aviation Weather Center





NOAA Aircraft Operations Center

- NOAA Corps Officers
 - Pilots, Navigators
- Civilians
 - Meteorologists, Technicians, Mechanics, Engineers, Support Staff





Our Home: Lakeland, FL





Photos: Lunz Group; NOAA



What Kind of Aircraft Do We Fly?











DHC-6 Twin Otter

- Low-level surveys
 - Marine mammals
 - Air Chemistry
 - Coastal Mapping
 - Snow Survey
- Callsigns:
 - NOAA46
 - NOAA48
 - NOAA56
 - NOAA57









Focus: Right Whale Surveys





Photos: NOAA; NOAA permit 20556-0 by the Clearwater Marine Aquarium Research



Focus: Right Whale Surveys



Photos: Entangled Right Whale (NOAA); Twin Otter Disentanglement Effort, Summer 2019





Beechcraft King Air 350CER

- Coastal Mapping & Emergency Response
 - Before storm: Baseline imagery
 - After storm: Post-disaster imagery
- Snow Survey
 - Missions at 500 ft collecting water content of the soil/snow
 - Determines flood forecasts, water supply forecasts when snow melts in the spring









Callsigns: NOAA68, NOAA67

Focus: Emergency Response

Hurricane Michael

- Aircraft and crew pre-staged to respond
- Near real-time images available



Mexico Beach, Florida | View this location on the map.



Focus: Snow Survey



Twin Otter snow survey line in the fall and winter near Lake Tupper, NY



Lockheed WP-3D Orion

- Hurricane Hunters that fly inside the storm environment
- Gather data on storm intensity
- Callsigns:
 - NOAA42 "Kermit"
 - NOAA43 "Miss Piggy"










Gulfstream IV-SP

- High altitude hurricane surveillance (45,000')
- Mission: above and around storm environment to determine hurricane track
- Callsign:
 - NOAA49 aka "Gonzo"











NOAA and The Muppets

- P-3 Crew Chief Greg Bast and Flight Engineer Steve Kirkpatrick decided to improved the cosmetic appearance of one of our P-3s
- Greg drew up a logo using the Miss Piggy Muppet character. He and Steve used the logo inside the P-3 on their tool boxes
- The name caught on and "Miss Piggy" became "one of the nicest looking aircraft we had"
- One of our pilots suggested contacting Henson Productions to see if we could expand on this idea
- Director of Muppet Productions Michael Firth and the NOAA team came up with the idea of using something similar to the World War II nose art
- Michael came up with the idea of using Kermit on the other P-3, as Kermit and Miss Piggy are such good friends and the two aircraft are very close
- Our Gulfstream IV was given the nickname "Gonzo" when we acquired the plane in 1996



Before The Muppets, Another Disney Mascot





DeHavilland (DHC-5) Buffalo



Why Fly Hurricane Missions?





G-IV (left) vs WP-3D (right) Flight Patterns Hurricane Matthew – October 2016





Hurricanes Flown





Photo: Nick Underwood, NOAA

More Than Hurricanes

- Year-Round Light Aircraft Missions
- WP-3D:
 - Tornado/Supercell Research
 - North Atlantic Winter Storms
- G-IV:
 - Atmospheric Rivers





Photos: NOAA/ Seattle Times



Questions?

Website: https://www.omao.noaa.gov/learn/aircraft-operations

Social Media:

- Facebook: The NOAA Hurricane Hunters
- Twitter: @NOAA_HurrHunter
- Instagram: @FlyNOAA





NOAA AOC Projects - TORUS 2022







Operational Feedback to AWC





NOAA AOC Projects – TORUS 2019





Hurricane Surveillance









Hurricane Florence – CAT 4







AviationWeather.gov

www.aviationweather.gov



beta.aviationweather.gov



Why upgrade?



Adapt to evolving internet usage patterns

- Over half of all internet traffic is now on mobile devices (cell phones & tablets)
- Existing website is difficult to use on cell phones b/c it wasn't designed for them
- New website was designed mobile-first and can gracefully accommodate varying screen sizes







S AWC EXPERIMENTAL VVIIAL SHEVV: **Current Conditions (i)** Graphical Forecasts for Aviation 6+ 0----

Cell phones

Desktops & large screens



Welcome!

Experimental site. Not to be used for flight planning purposes.



Sign in to submit PIREPs

Toggle between regular/day mode and dark/night mode

Graphical Forecasts for Aviation

Guided Tour for First-time Visitors



New: Low-Altitude Mode in GFA



Use these icons to toggle between general aviation mode (airplane) and low-altitude mode (helicopter)

Helicopter Emergency Medical Services (HEMS) tool is now part of GFA as "low-altitude mode"

Archive View





*usa 🗸



Header bar changes color and a banner is displayed when the site is in archive mode

Experimental



20

21

Privacy Policy Freedom of Information Act NWS Glossary Information Quality Disclaimer





Questions?

jennifer.stroozas@noaa.gov john.rossi@noaa.gov

AviationWeather.gov Beta.AviationWeather.gov Weather.gov/Aviation

Back-Up Slides



Aviation Weather Center Operations

AVIATION WARNINGS	AVIATION FORECASTS	COLLABORATION	DESKS
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Aviation Weather Center Operations

AVIATION WARNINGS AVIATION FORECASTS COLLABORATION DESKS	AVIATION WARNINGS	AVIATION FORECASTS	COLLABORATION	DESKS
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Aviation Weather Center Operations



CONUS · coastal waters

AVIATION WARNINGS AVIATION FORECASTS COLLABORATION DESKS	AVIATION WARNINGS	AVIATION FORECASTS	COLLABORATION	DESKS
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Atlantic · Pacific



International Operations

Aviation Weather Center Operations







AIRMETs · TFM convective forecast · Low-level SIGWX

· Area Forecasts for Gulf of

AVIATION WARNINGS AVIATION FORECASTS COLLABORATION DESKS Global Significant Weather (SIGWX) Global Significant Weather (SIGWX) DESKS

Atlantic · Pacific





International Operations

Aviation Weather Center Operations



CONUS \cdot coastal waters



AIRMETs · TFM convective forecast · Low-level SIGWX



CWSUs · Airlines · FAA

COLLABORATION

DESKS

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International meteorological services



Atlantic · Pacific





International Operations

NWS Careers

Career Path

- University of Wisconsin → BS Atmospheric & Oceanic Science
- Met Intern \rightarrow Elko, NV
- Met \rightarrow Glasgow, MT
- Incident Met \rightarrow various wildfires
- Lead Met \rightarrow Glasgow, MT
- Warning Coordination Met → Aberdeen, SD



- Aviation & Fire Weather Program Manager → Central Region HQ Kansas City
- Emergency Response Specialist Met \rightarrow CRH KC
- Stay-at-Home Parent
- Met-In-Charge → KC Center
 Weather Service Unit w/FAA
- Warning Coordination Met → Aviation Weather Center KC

Career Path

- University of Missouri
 - BS, Atmospheric Science
 - USAF ROTC Det 442
- 26 OWS \rightarrow Barksdale AFB, LA \circ Officer-in-Charge
- 30 WS \rightarrow Vandenberg AFB, CA
 - Launch Wx Officer
 - CONR-1AF / 601 AOC (ONE)
- Naval Postgraduate School
 - MS, Meteorology
- Dept of Air Force \rightarrow Las Vegas, NV
 - Staff Meteorologist
 - Operations Officer



- 7 AF \rightarrow Osan AB, Korea
 - \circ $\,$ Chief, Wx Ops $\,$
- 2 WS \rightarrow Offutt AFB, NE
 - $\circ \quad \text{Operations Officer}$
- AWC \rightarrow Kansas City, MO
 - Aviation Forecaster
- ZSE CWSU \rightarrow Auburn, WA \circ Met-in-Charge
- ATCSCC/NAM \rightarrow Warrenton, VA
 - Met-in-Charge

Career Tips

- It's all about relationships...
- Be curious! Be kind! Be a helper!
- Find a way to get to "YES!"
- Learn about agencies / specialties
- Find a mentor...be a mentor
- Science communication skills
- Leadership development

Aviation Hazards - Turbulence

Turbulence Classification

Intensity	Aircraft Reactions		Human Experience			
Light ∧	<i>Light turbulence</i> Slight erratic changes in altitude and/or attitude (pitch, roll, yaw).	<i>Light chop</i> Slight, rapid, & somewhat rhythmic bumpiness. No appreciable changes in altitude or attitude.	Slight strain against belts	Slight displacement of unsecured objects	Easy to walk	Food service is easy
Moderate _/_	<i>Moderate turbulence</i> Similar to light turbulence but of greater intensity. Aircraft remains in positive control at all times. Usually causes variations in indicated airspeed.	<i>Moderate chop</i> Similar to light chop but of greater intensity. Rapid bumps or jolts without appreciable changes in altitude or attitude.	Definite strain against belts	Unsecured objects are dislodged	Difficult to walk	Food service is difficult
Severe	Large, abrupt changes in altitude a Usually causes large variations in Aircraft may be momentarily out c	and/or attitude. indicated airspeed. of control.	Violently forced	d Unsecured objects are tossed about	Impossible to walk	Food service is impossible
Extreme	Aircraft is violently tossed about. Aircraft is practically impossible t May cause structural damage.	o control.		Strong desire to	land	



The missing engine on this aircraft was torn off by turbulence

Source: https://www.transportation.gov/sites/dot.gov/files/docs/kulesa_Weather_Aviation.pdf

Aviation Hazards - Icing

lcing





Туре	Clear	Mixed	Rime
Photo	Greatest threat Photo credit: NASA	NWS photo available at: https://www.weather.gov/source/zhu/ZHU_Training_Pa ge/icing.stuff/icing/icing.htm	Rime Ice Rime Ice Operative Nost common State Data https://www.weather.gov/source/zhu/ZHU_Training_Page/icing.stuff/icing/icing.htm
Color	Clear or translucent	Mix of clear and opaque	Milky and opaque
Texture	Hard, glossy, smooth	Mix of glossy and rough	Brittle, rough , coarse, knobby
How it forms	Large supercooled water droplets spread out or "smear" and slowly freeze as a sheet of ice.	When both large and small supercooled water droplets coexist, a mix of ice forms because the droplets freeze in different ways.	Small supercooled water droplets freeze instantaneously on contact with cold aircraft surfaces.
Temperature range	0° C to -10° C	-10° C to -15° C	-15° C to -20° C

Aviation Hazards - Cig/Vis

Flight Categories

Category	Designation		Ceiling (ft)	Visibility (miles)
9	VFR		None	> 6
8	VFR	Visual Flight Rules	6500 - 12000	
7	VFR		3000 - 6000	б
6	MVFR	Madified Viewal Flight Dulas	2000 - 3000	3 - 5
5	MVFR	Moullieu visual Flight Rules	1000 - 1900	
4	IFR	Instrument Flight Dules	500 - 900	2 - 2 ¾
3	IFR	instrument Flight Rules		1 - 1 ¾
2	LIFR	Low Instrument Flight Rules	200 - 400	½ or ¾
1	VLIFR	Very Low Instrument Flight Rules	< 200	< 1/2

Aviation Hazards - Volcanic Ash

Volcanic Ash



- Volcanic ash clouds are an IMMEDIATE and DIRECT hazard to aircraft
- Ash clouds form when volcano eruptions send ash into the upper atmosphere
- Worldwide detection and monitoring
 - 9 Volcanic Ash Advisory Centers (VAAC)
 - <u>https://www.ssd.noaa.gov/VAAC/vaac.html</u>
- AWC issues aviation weather warnings (SIGMETs) for Volcanic Ash

Why We Are Here



Southern Airways Flight 242 crash in New Hope, GA on April 4, 1977...72 souls lost (22 on-board survived)

Total loss of thrust from both engines due to damage from ingest of water/hail while penetrating an area of severe thunderstorms

NTSB recommendation A-77-068 to formulate procedures for the timely dissemination of all available severe weather information by controllers

One year later FAA had 3x NWS meteorologists in 13 ARTCCs...by August 1981, FAA had 4x NWS meteorologists in all 21 ARTCCs...that partnership continues to this day!

Multi-Million Dollar Losses to Aviation

211,226 Min of Delay

8/20/15 - Thunderstorms

~\$74 Loss / Minute

18,411 Cancellations

1/22-1/25 2016 - Winter Storm/Thunderstorms

~\$8K Loss / Flight (variable per flight/aircraft type)







Cancellations 🛣 Mostly due to Snow/Ice Diverts 🔀 Mostly due to TS/CIGs/VSBY Delays 🛣 Mostly due to TS/CIGs/VSBY

Cancel/Divert/Delay Data Provided by



JFK & PHL (Routes Blocked) AM TS

AM & PM TS

EWR, LGA,

 $IAH \leftrightarrow DFW$ (Routes Blocked & TS at Terminal)







322 Diversions

6/15/15 Thunderstorms

~\$8K Loss / Flight (variable per flight/aircraft type)



TS Impacting: ORD - NY/PHL/DC ORD - DFW DFW - IAH

budgets

Types of Losses

Airline Crew (timeout) Missed connection Missed meeting/vacation Hotel (airline/passengers) *Some airlines **Reimbursing Tickets** build divert Food costs into Taxis Rental Cars Fuel (airlines & passengers) Maintenance (airlines) Lost demand (passenger uses other means) GDP reduced Tarmac rule (>3 hours) \$27,500 per passenger (paid to Trans Dept)

Source: Eckert, 2017