

# MPAR Technology & Potential for Aircraft Birdstrike Risk Management

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# Introduction

## Bird-Aircraft Strikes (Birdstrikes):

- Awareness has increased since the US Airways 1549 birdstrike-related crash
- Aircrew & passenger safety
  - Strikes put the lives of aircraft crew members & their passengers at risk
  - Over 219 people have been killed worldwide as a result of wildlife strikes since 1988
- Economic impact:
  - Bird and other wildlife strikes to aircraft annually cause well over \$1 billion in damage to U.S. civil & military aviation
  - Worldwide birdstrikes to commercial aviation cost over \$2 billion in damage & delay costs

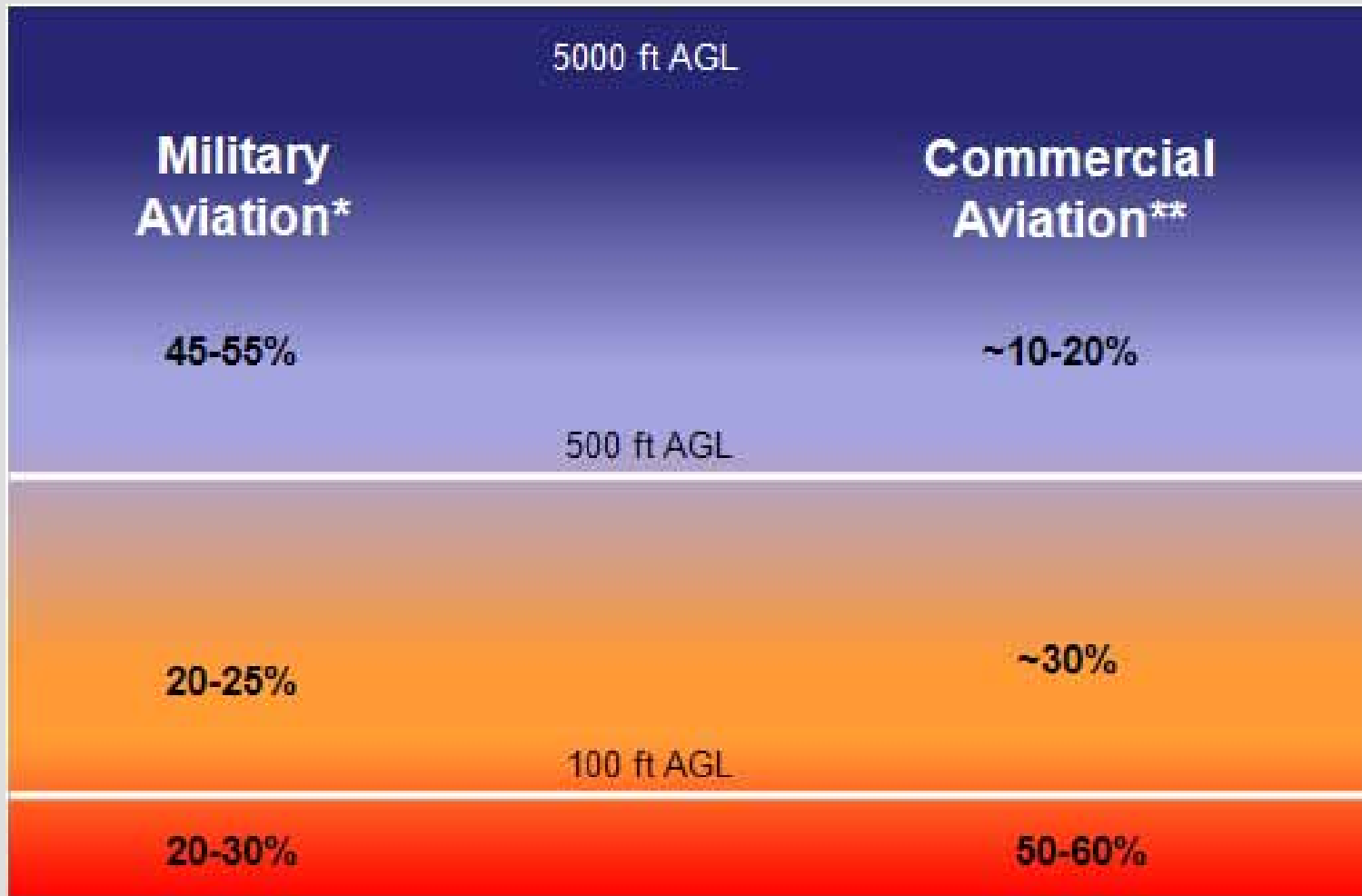


# Operational Birdstrike Avoidance – Challenges

- The atmosphere is full of birds, bats & insects MOST of the time
- We cannot “see & avoid” all of birds
  - Especially in low ‘g’ maneuvering commercial aircraft
- To manage risk, must define what constitutes a hazard to aircraft:
  - Mass
  - Quantity
  - Type



# Where Do Birdstrikes Occur ?



# Military Aircraft Birdstrikes

- Over 50% of birdstrikes to military aircraft occur:
  - Away from the airfield
  - Majority during low level training operations (500 – 3000 ft AGL)
- Increased safety risk & associated damage costs
  - Low level, high airspeed operations
  - Lighter, single engine airframes
- USAF reported >5,000 birdstrikes in 2007
  - Included a pilot fatality & loss of 4 aircraft



# Commercial Aviation Birdstrikes

- Over 7,500 bird & other wildlife strikes were reported for US civilian aircraft in 2008
  - FAA estimates less than 20% of commercial birdstrikes are actually reported
  - 85% of commercial birdstrikes occur within 6 miles of airport & under 500 ft AGL
- Reduced risk due to heavier airframes & multi-engine aircraft
  - Major economic impact - \$1-2 billion annually
  - \$75K primarily delay cost for non-damaging birdstrike (\$50K for secondary delays)





# What is a Bird Hazard to Aircraft ?

- 95% of strikes cause no or only minimal damage
- The FAA does not have a standard for civil aviation for **unacceptable strike risk** to aircraft
- We assume that the standard is a bird or flock of birds that is:
  - Large enough to penetrate any structure of the aircraft
  - Damage an engine so it cannot produce useful power
  - Render the aircraft incapable of continued flight
- Standard needs to be set by the authority (FAA, NTSB, etc.) in order for industry to design sensors to accurately identify & alert when these conditions exist



# What are we doing today to detect birdstrike risk?

## Avian Hazard Advisory System (AHAS)

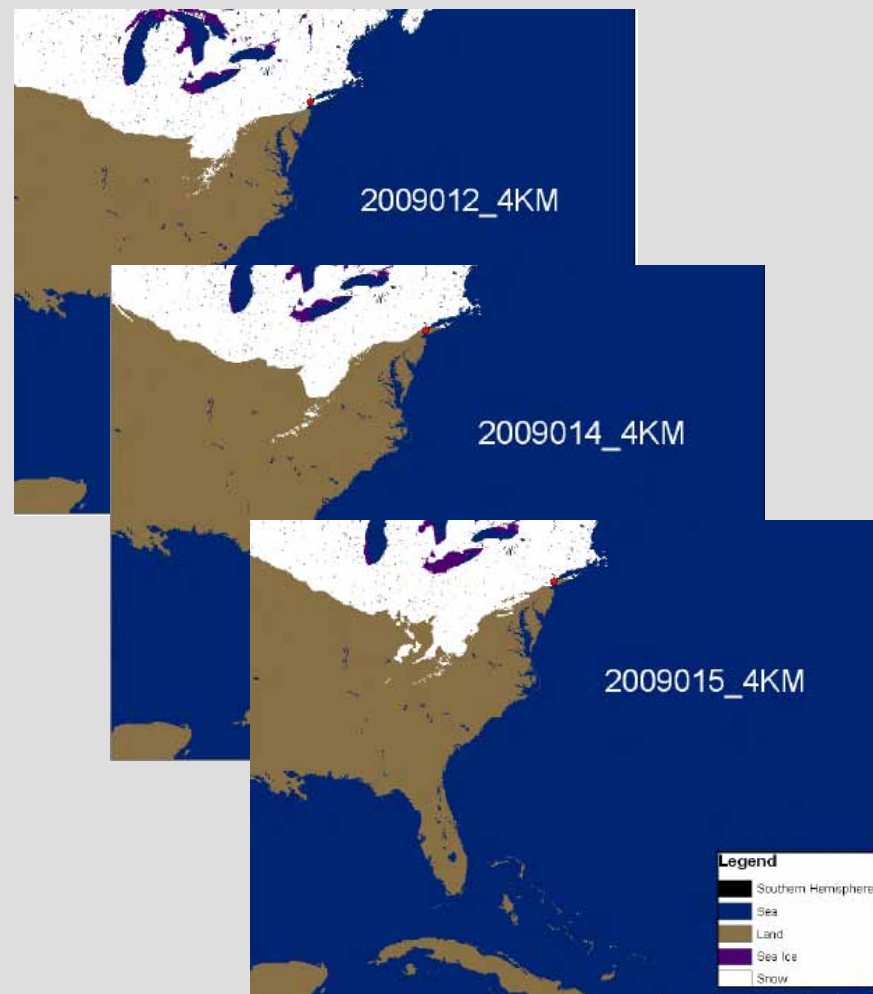
- USAF system uses NEXRAD (WSR-88D) weather radars to assess bird activity in near real-time with ~6 minute updates
  - Assesses biological density based on radar data & underlying resource datasets
  - Operating & available since 1998 through public web portal ([www.usahas.com](http://www.usahas.com))
- Tabular & GIS risk formats for all US military routes, ranges, areas & airfields
  - Coverage includes the continental U.S.
  - Extrapolates risk for coverage gaps
- **Limitations:** low resolution & coverage gaps





# AHAS – US Airways 1549 Birdstrike

- Strike occurred outside the classic migratory season
  - Large eruptive southward movement of geese
  - AHAS condition for area at time of strike was MODERATE
- Preceded by a shift in the snowline 24 hrs before the strike
  - AHAS has forecast capabilities for the classic migratory seasons
  - Snow line & freezing water data used to predict eruptive movements of waterfowl & forecast risk



# Dedicated On-airport Bird Radar Systems

USAF, Navy, NASA & RAF have used bird radars for airfield support since 2003

- Bird detection & tracking within ~6 miles
  - Current generation systems such as MERLIN & VESPER include automated strike risk alerting
  - Higher resolution, specific data to air traffic control, pilots, airport operators & bird control units (level & location)
  - Documented record for reducing birdstrikes & increasing airspace utilization
- Current systems likely would have detected & warned of the geese flock that brought down US Airways 1549



# MPAR Opportunities - Birdstrike Avoidance

- Bird radar technologies at current level have proven ability manage & reduce bird-aircraft strike risk
- Users are willing to invest more in the technology to increase reliability & performance as ROI is demonstrated
- Improved sensors will increase coverage, data quality & specificity of information provided
- MPAR technology particularly offers potential to significantly increase value of AHAS
  - Especially with dual polarization



# Challenge 1 : How to estimate target size?

- The challenge is how to estimate target size to determine strike risk to each airframe
- Dual polarization offers one of the richest datasets for
  - Separation of birds from insects
  - Measurement of bird sizes
  - Current systems like MERLIN & VESPER can be used to groundtruth evaluation & development of radar systems



# Challenge 2 : Predicting birdstrike risk

- The challenge:
  - Birds detected at point A and heading for point B ... may well go somewhere else!
  - Birds do not always follow a predictable, linear trajectory
- HOWEVER birds seen upstream on migration can foretell issues downstream in other areas, possibly without radar coverage, or out beyond the bird detection range of the radar
  - We need to continue to pool advisories out of AHAS to manage the 'big picture' & not just think in terms of vectoring aircraft
- We likely will never have full coverage in the mountains at low level where the military aircraft train & will need AHAS type assessment of conditions to manage the risk



# Challenge 3 : Real time bird strike avoidance

- Human factors:
  - Human operator relaying advisories, as is done today, is not ideal
  - ATC is task saturated & action introduces time lag
- **Answer:** birdstrike advisories direct to the cockpit
  - We do it for aircraft for midair collision avoidance
  - Similar approach for birdstrike warning is possible
  - Requires high reliability & low false positives





# Summary

## MPAR & Birdstrike Avoidance:

- Offers potential to significantly improve AHAS through increased capability & coverage, especially with dual polarization
- Can potentially be used to manage inroute bird strike risk with direct intervention when line of sight view of birds and aircraft is possible
- Can help manage the low level & range airspace by both direct and indirect observations
  - If birds are seen up- and/or down- stream of a low level route we can infer where they are in between (as is currently done with AHAS)
  - Birds migrate up to 12,000 ft in USA and so it provides a tool to better manage the airspace for military and civilian users
- MPAR will not replace systems like MERLIN at the airport
  - These systems however can be used to validate MPAR



# Questions?

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