Aviation Wind Research Overview

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Sponsored by FAA ANG-C6
Winds can impact all phases of flight

Need to understand frequency, impact, and challenges related to adverse wind conditions
Runway Crosswinds

Assessed Historical Surface Winds Relative to Runway Configurations

- Crosswinds possible at all Core airports
- Spring, fall most favored seasons
- Most events short-lived (< 2 hrs)
- Events typically begin in afternoon
Winds can impact all phases of flight

Need to understand frequency, impact, and challenges related to adverse wind conditions
Wind Compression – Problem Definition

- Path-based wind shear present during sufficient arrival demand can create challenging wind compression situation in attempt to maintain spacing
  - Requires *both* sufficiently high air traffic volume and variability in winds by altitude
  - Results in adjustments to aircraft approach profile and operational impacts

Aircraft Spacing

Upper Level Winds

Due to stronger headwinds not experienced prior to turn on final, compression is experienced

9 Dec 2014

Holding

135 min GS
26 rate GDP
31 Cancellations
1 Diversion

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Wind Compression Challenges

- Identified and catalogued wind compression challenges through stakeholder feedback

Many challenges related to information interchange and conversion

- Limited Controller Access to Compression Guidance
- Limited Common Awareness – Weather

Meteorological Support
- Forecast Accuracy
- Limited Constraint Context

Conversion of Shear to Compression
- Workload
- Feasibility
- Adoption

Air Traffic Operations
- Operational Environment Configuration
- Limited Awareness of Impacts & Responses

Conversion of Shear to Compression
Developed to convert wind shear information to path-specific potential compression

CWSU Compression Tool
Under evaluation at multiple airports
### Forecast Accuracy Shortfall Scenarios

- Evaluated forecast accuracy to identify environments with limited performance, or shortfall scenarios
  - At least one accuracy shortfall scenario at each focus airport

#### Operational Environment

<table>
<thead>
<tr>
<th>Airport</th>
<th>Combinations</th>
<th>Wind Shear</th>
<th>Shear Magnitude</th>
<th>Onset Timing</th>
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<tr>
<td>JFK</td>
<td>Nom IFR</td>
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</tbody>
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#### Forecast Tools

- High Resolution Rapid Refresh (HRRR)
- Short Range Ensemble Forecast (SREF)

#### Data Limitations

- Onset Timing Accuracy Shortfall Scenario
- Shear Magnitude Accuracy Shortfall Scenario
- Both Shear Magnitude and Onset Timing Offset Accuracy Shortfall Scenario
- Good Forecast Performance Overall
- Data Limitation Prohibited Evaluation of One or Both Characteristics
Wind Compression Contributing Climatology

- Characterized winds during adverse shear / potential wind compression periods and variation from overall “background” climatology
  - Leveraged ACARS airborne wind observations
  - Focus on altitudes most sensitive to wind compression (0-10 kft)

Diurnal Variability

- Most common early in day at Eastern airports
- Most common later in day at ORD, DFW

Vertical Distribution of Mean Winds

- Greater mean wind speed amid adverse shear
- Directional & speed shear at Northern & DFW airports
- Primarily speed shear in ATL

At what altitudes was adverse shear observed?
Was shear due to directional or speed shear?
How different were winds than in overall climatology?
Wind Compression Needs Assessment

- Assess needs to address wind compression guidance usage and adoption challenges
  - How do controllers and planners use and would like to use wind compression guidance?
  - Conduct operational observations and interviews (fall/winter 2016-2017)
  - Evaluate accuracy of automated vertical headwind profile Compression Tool guidance

Due to stronger headwinds not experienced prior to turn on final, compression is experienced.