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JUNEAU AIRPORT WIND HAZARD ALERT SYSTEM DISPLAY PRODUCTS

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1. INTRODUCTION

The Juneau International Airport is vulnerable to a variety of weather-related aviation hazards, including poor-visibility, wind shear and severe turbulence (Cohn *et al.*, 2004; Wilson, 2004). The National Center for Atmospheric Research has developed a hazard mitigation product, the Juneau Airport Wind System (JAWS) that synthesizes and processes real-time measurements from anemometers and wind profilers to inform relevant users of current wind conditions and issue alerts when these conditions are likely to be associated with problematic levels of turbulence.

This paper describes the JAWS display, which is the primary interface between the operational system and its users. The interface has been designed to efficiently convey necessary information in a user-friendly manner.

JAWS uses data from seven anemometer sites (including three mountain top) and three wind profilers. Wind data is processed and the results are accessible by the relevant user community (Barron and Yates, 2004).

The primary purpose of the JAWS sensor data is as input to regressions that estimate the expected level of turbulence (Morse *et al.*, 2004). The regression models were constructed on the basis of correlations between sensor data and aircraft measurements of turbulence during two field projects (Fowler *et al.*, 2004).

Turbulence alert levels are as follows: none, moderate turbulence for a KingAir-type aircraft (MDT BE20), moderate turbulence for a B737-type aircraft (MDT B737), severe turbulence for a B737-type aircraft (SVR B737), and an "Out of Service" designation (OTS). Turbulence alert levels are discussed in more detail in Morse *et al.* (2004). Turbulence estimates based on incomplete sensor data are considered to be impaired and are indicated by a stippled color pattern for all levels except SVR B737, which is simply reported as severe turbulence.

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2. JAWS DISPLAY OVERVIEW

The JAWS display is a multi-panel user interface that is updated approximately once per minute. Data that has expired due to a failure of the system to update is indicated by a red "X" across the corresponding data panel.

The upper portion of the display consists of a small UTC time indicator above four time-stamped status panels that summarize the alert status for the JAWS alert areas, the anemometer winds, runway wind conditions (head wind and cross wind speeds), and the runway status as determined by the FAA-mandated Part 121Juneau Airport Operational Specification. The Operational Specification is a procedure-specific "Go – No Go" indicator that is currently operational. The JAWS alerts are intended to replace the Ops Spec and a display of the latter allows a direct real-time comparison of the two approaches.

Turbulence alerts are geographically specific. As currently implemented, JAWS consists of eight alert areas, each of which corresponds to a segment of a departure and/or arrival procedure that is known to be particularly vulnerable to wind-related aviation hazards. Note that two of these alert areas (08D and 26D) are geographically redundant because they are direction specific and refer to the outgoing complement of an incoming flight segment. In addition, two other alert areas (GC SFC-2 and GC 2-6) represent different altitude ranges over the same geographic area.

The lower (and primary) panel is selected using a tab-type button panel. Selection of the appropriate tab will display the associated information. There are seven such panels: a geographic display, airport anemometer wind history, mountain top anemometer wind history, profiler wind history, a turbulence alert summary, a sensor status summary, and a user reference page.

3. GEOGRAPHIC DISPLAY

The geographic display (Figure 1) depicts the current sensor data (along with sensor locations) and JAWS alert area warnings on a background of local topography. Anemometer winds are indicated by green wind barbs and 1200 m profilers winds are indicated by blue wind barbs. Calm winds (< 3 kts) are indicated by a circle, rather than a barb and data interruptions or low-quality data are indicated by a small "X" at the sensor location. JAWS alert areas are indicated by polygons with fill colors and textures that correspond to the turbulence alert level. The alert box is clear when turbulence levels are predicted to be below the minimum alert threshold.

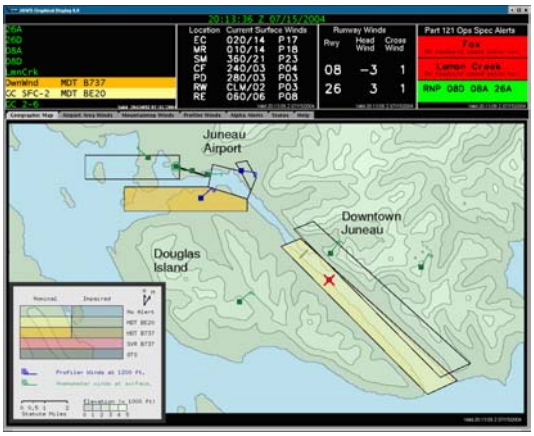

Fig. 1: The geographic display presents the most recent sensor data on a map background.

When data outages or quality control constraints preclude any assessment of turbulence risk, the corresponding alert area is shaded gray. Turbulence estimates based on incomplete sensor data sets are reported, but the impaired nature of the estimate is indicated by stippling of the color fill associated with the predicted level of turbulence. This is not true, however, for the highest alert level (SVR B737), since a more complete data set could not predict a higher level.

It should be emphasized that a direct correspondence between an alert area and a specific suite of sensors does not exist. The turbulence potential for each alert area is based on a regression of all available sensor data, although, in most cases, physically proximal sensors are likely to receive more weight in the relevant regression.

4. ANEMOMETER WINDS

The one-hour histories of anemometer winds (Weekley *et al.*, 2004) are displayed in two panels. One panel reports the winds in the vicinity of the airport, including anemometer data from both ends and the center of the runway, as well as an anemometer located along a frequently used flight path just west of the airport. A second anemometer winds panel (Figure 2) displays the one-hour history of the mountain top winds. This panel also includes data from the center runway anemometer for comparison.

For each sensor location, the anemometer wind panels consist of three subpanels. The largest subpanel, at the left, is a record of the past hour of one-minute statistics summarizing wind speed and direction, which are represented by different color points. The wind speed is in knots and the wind direction is degrees from magnetic north. Wind speed is displayed as an average value bounded by the minimum and maximum values that characterized the one-minute interval. Although wind plots are scaled to display the maximum value, for convenience of comparison, all anemometers on the same page are depicted using the same scale.

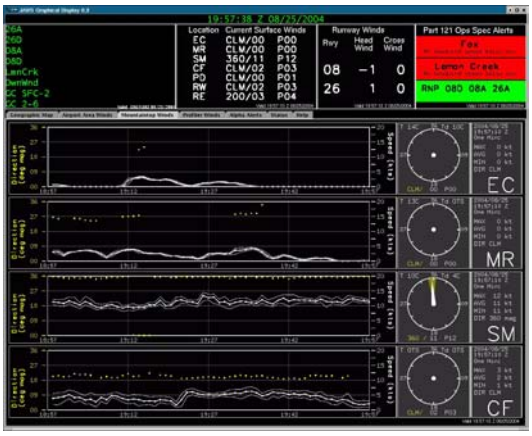

Fig. 2: One of two anemometer winds displays. Each display summarizes the most recent one-hour history of anemometer data.

The second anemometer subpanel represents a compass-view summary of the most recent one-minute statistics on the wind data. A compass needle indicates the average one-minute wind direction and a shaded region bounding the needle indicates the greatest excursions from this average. Beneath the compass, the average wind direction is indicated numerically, along with the average wind speed for the corresponding one-minute interval and the peak wind for this same period. When available, the average

temperature and dew point temperature values are displayed above the compass.

The third anemometer subpanel displays a variety of information in numerical format, including the date and UTC time, the maximum wind speed during the last one minute period, the average wind speed during this period, the minimum wind speed during this period, and the average magnetic wind direction during this period. A two-letter indicator is included that specifies the anemometer location.

5. PROFILER WINDS

The profiler winds panel (Figure 3) displays a one-hour time history, updated at ten-minute intervals, of the three wind profiler sensors. Data from each profiler is plotted with height (feet AGL) as the vertical axis and UTC time as the horizontal axis. Wind speed and direction are indicated by barbs.

Wind data is reported to an altitude that slightly exceeds 5000 feet and profiler wind barbs represent an average over the most recent ten-minute interval.

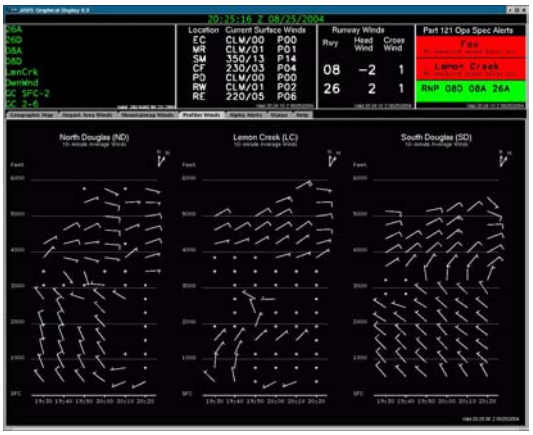

Fig. 3: Profiler winds display summarizes a one-hour history of profiler winds.

6. ALPHA ALERTS

The Alpha Alerts panel is a text-based summary of the JAWS turbulence alerts that is primarily intended to facilitate concise ground-to-air communications. The alert area name is depicted along with any turbulence alert designation on a color-coded text line. The color scheme coincides with that described in the Geographic Display section.

7. STATUS DISPLAY

The status display summarizes the current status of all JAWS sensors. Impaired sensors, which are reporting incomplete data (usually due to quality control issues) are indicated by a yellow text line. Sensors that are “down,” meaning that the data stream has been interrupted are indicated by a red text line.

8. HELP PAGE

A help page is included that includes a list of frequently asked questions and mouse-navigable set of explanatory pages.

ACKNOWLEDGEMENTS

This research is in response to requirements and funding by the Federal Aviation Administration (FAA). The views expressed are those of the authors and do not necessarily represent the official policy or position of the FAA. NCAR is operated by the University Corporation for Atmospheric Research under sponsorship of the NSF.

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