4A.13 AN EXPLORATION OF AN AUTOMATED ANALYSIS PRODUCT FOR CEILING AND VISIBILITY: POTENTIAL IMPACTS ON GENERAL AVIATION WEATHER DECISION MAKING

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1. INTRODUCTION

From 1994 through 2003, impacted ceiling and visibility (C&V) events were the second-most prevalent condition leading to weather-related accidents in the United States. These C&V-related accidents predominantly affected the general aviation (GA) and commuter/air taxi communities. Currently, GA pilots have a wide range of weather data and products available to them to assist their pre-flight weather planning and in-flight weather decision-making processes.

This paper will address how our ConUS C&V analysis product will introduce a value-added tool to these communities by investigating examples of situations in which pilots might have benefited from additional information. In the near-term, the product will be utilized during pilots' pre-flight planning phase. We will also discuss the product's future as it becomes available as a cockpit display. This advance will provide decision-making assistance as the in-flight weather evolves.

2. BACKGROUND

<u>Terminology and Definitions</u>

In aviation, Visual Meteorological Conditions (VMC) are weather conditions in which visual flight rules (VFR) flight is permitted; that is, conditions in which pilots have sufficient visibility to fly the aircraft without reference to instruments and can maintain visual separation from terrain and other aircraft. They are the opposite of Instrument Meteorological Conditions (IMC).

Instrument Meteorological Conditions (IMC) is an aviation term that describes weather conditions that normally require pilots to fly primarily by reference to instruments, and therefore under Instrument Flight Rules (IFR). The boundary criteria between VMC and IMC are known as the VMC minima.

Instrument Flight Rules take effect under the following conditions: when the ceiling is less than or equal to 1000' AGL, or when the visibility is less than or equal to 3 statute miles. Flight category (VFR, MVFR, IFR, and LIFR) is determined by the lowest (worst) condition of either ceiling or visibility.

<u>Accident Surveys</u>

Between 1994 and 2003, there were 19,562 aircraft accidents in the U.S. Weather was a contributing or causal factor in 4,159 (21.3%) of these accidents. FAR Part 91 General Aviation operations constituted 3,617 of the weather-related accidents during this time period, or 86.8% of the total number. Of these, the major weather factors were: wind (51.0% of weather-related citings) and visibility/ceiling (19.8% of weather-related citings). Impacted ceiling and visibility conditions therefore helped contribute to 716 accidents during this 10-year period.

The National Transportation Safety Board (NTSB) is responsible for investigating accidents for causality and subsequently releasing reports describing those accidents.

Part of the Aircraft Owner's and Pilot's Association (AOPA), the Air Safety Foundation (ASF), gathers NTSB data on accidents and maintains an accident database for the pilot community. It also provides summaries such as the Nall Report, which focuses on fixed-wing GA aircraft weighing 12,500 lbs. or less. These sources provide invaluable data when discussing trends and causalities of accidents.

While weather represents a relatively low rate of causing accidents with respect to total pilot-related incidents, it has been identified as one of the leading causes of fatal accidents. For instance, weather-related accidents that occurred in 2003 had a 71.4% probability of being the cause of a fatality.

This high rate of lethality as a proportion of all flights holds true for all aircraft (single-engine fixed-gear, single-engine retractable gear, and multiengine aircraft), certificate levels, and type of operation.

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Causes of fatal accidents are linked to the length of the trip, time of day, and whether the flight was operating under IFR or FVR conditions. It is worth noting that perhaps many of these fatalities could have been avoided had the pilot not departed or reversed course once IMC were first encountered.

This situation argues for a need for more representative weather information to be disseminated to users.

3. NATIONAL CEILING AND VISIBILITY PRODUCT

The National Ceiling and Visibility (NCV) product development team has developed a system that produces gridded analyses of current ceiling, visibility, and flight category conditions. We present these analyses on a graphical Java-based tool that allows users to view the aforementioned fields in addition to other product (METARs, TAFs, AIRMETs, and satellite imagery) information on a national scale. The system is automated and produces updates at the National Digital Forecast Database resolution of 5km every five minutes.

Key features of this tool include its high temporal and spatial resolution, high glance value, ability to display information from multiple sources, and automation.

4. USING THE PRODUCT

Two of the most problematic conditions that exist for GA pilots are flights at night and flights involving IMC. The combination of these two present GA pilots with the most difficult conditions under which they might operate. Below are examples of actual fatal flights that occurred under the following conditions: night & IMC, night & VMC, day & IMC, and day & VMC. Examples from the NCV product are also presented to allow an examination of how it could be utilized under similar circumstances.

<u>Night during IMC</u>

On March 15, 2003 at 2226 EST, a Cessna 320D collided with trees 8 miles south of Perry-Houston County Airport near Perry, Georgia. Weather conditions from nearby Macon, GA at 2254 EST were reported as: wind from 030 degrees at 5 knots, visibility at 8 miles, ceiling at 600', temperature of 51 degrees F, dew point of 48 degrees F and the altimeter reading was 30.00" of mercury. There is no record that the pilot received a pre-flight weather briefing.

The pilot was in radio contact with the local controller immediately prior to the crash and requested information regarding location of a nearby airport. The NTSB narrative contained the following: "The pilot continued visual flight into instrument meteorological conditions, and failed to maintain altitude/terrain clearance."

Two NCV analysis examples from 27 Oct 2006 (Figures 1a and 1b) show that conditions requiring instrumented flight can exist with little to no transition from visual conditions.

With the NCV product, flight service station briefers, dispatchers, controllers and pilots will be able to look at identical display information prior to flights. As conditions evolve while flights are in the air, the display will enable all users to be able to view the same data. Pilots will be benefited with a cockpit display. With this display, they will be able to see the same data as controllers. In cases similar to the one described above, controllers and pilots will have a better idea how far from reporting stations IMC conditions are likely to exist and can redirect flight paths accordingly.

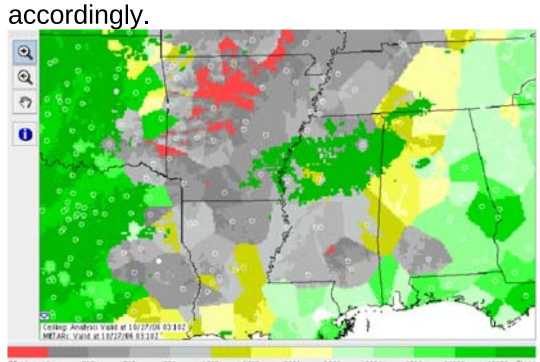

Figure 1a. Nighttime IMC: Ceiling (AGL) data layer on 27 Oct 2006 at 0310Z.

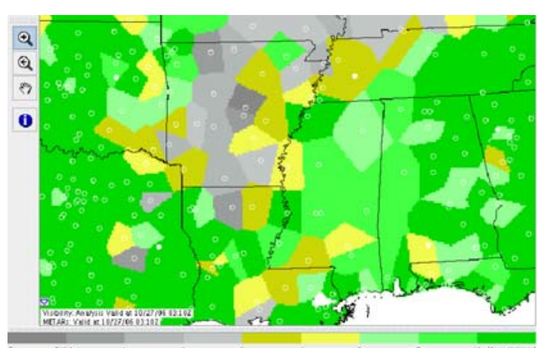

Figure1b. Nighttime IMC: Visibility (statute miles) data layer on 27 Oct 2006 at 0310Z.

Night during VMC

On August 8, 2003 at 2132 PDT, a Cessna 340A collided with terrain after a loss of control in the takeoff initial climb from the Bishop Airport (BIH), Bishop, California. The airplane was operated by the owner under 14 CFR Part 91. Visual meteorological conditions prevailed as reported by the Bishop weather station at 2156 PDT: the wind was from 010 at 6 knots, visibility was 10 miles, no ceiling was reported, the temperature was 75 degrees F, the dew point was 39 degrees F, and the altimeter read 30.03" of mercury.

According to the accident report, no flight plan was filed. The NTSB narrative reads: "The pilot's in-flight loss of control due to a spatial disorientation. Factors in the accident were the dark lighting conditions and the pilot's lack of familiarity with the airplane."

Nighttime VMC are common. An example (Figure 2) is provided. Many of the cases for nighttime VMC included references to spatial disorientation. These incidents are examples that a very important factor to flying is experience in varying conditions as well as having experience with the aircraft.

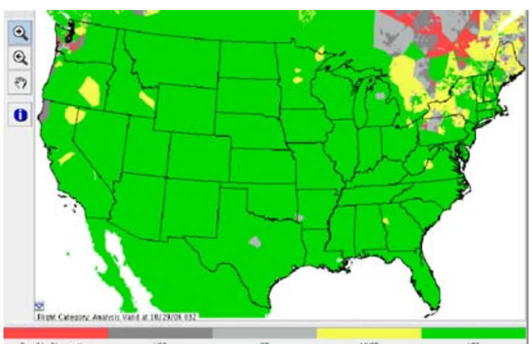

Figure 2. Nighttime VMC: Flight category data layer on 29 Oct 2006 at 0300Z.

Day during IMC

On June 9, 2003 at 0900 PDT, a Rockwell International Aero-Commander 112TC collided with mountainous terrain approximately 7 miles west of Santa Nella, California.

A complex weather situation was associated with this accident. Visual meteorological conditions prevailed at the time the flight left from Reid-Hillview Airport at 0750 PDT: the wind was from 150 degrees at 8 knots, the ceiling was reported at 1100', the visibility was 1100', the temperature was 15C and the dew point was 12C.

The nearest reporting station to the accident was at Salinas, 30 miles to the southwest. The conditions there were reported to be 800' overcast with a 10 mile visibility reading. Meanwhile, a resident whose house was one mile from the crash site reported ground fog with visibility less than 300ft.

The NTSB investigation write-up included: "The pilot's inadequate in-flight planning/decision by conducting VFR flight into IMC, and his failure to maintain terrain clearance. Contributing factors were low clouds, fog, and mountainous terrain."

Clearly, the flight in this example could have benefited from information available from the NCV product. The combination of changing and variable weather conditions during the flight and the interaction between that weather and terrain presented the pilot with a challenging set of circumstances. If the pilot and local controllers had access to the NCV product, different choices could have been made both prior to and during the flight.

Numerous examples of daytime IMC which resulted in impacts with terrain, including water, were found in the ASF database. These types of situations were taken into account during the NCV analysis product's development. If the NDFD-5km terrain grid and the interpolated ceiling height values intersect, "obscuration" is clearly indicated in the ceiling field. When planning for flights, special care should be given to these conditions.

Figure 3 demonstrates extensive instrument conditions that occurred during the day on 17 Oct 2006.

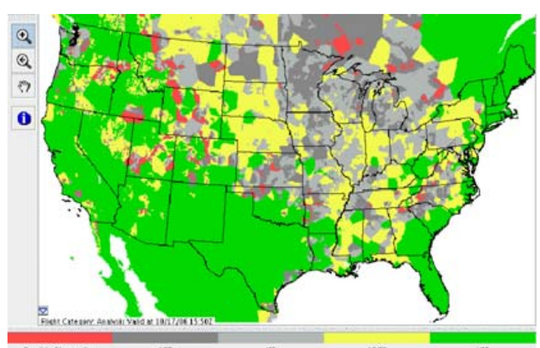

Figure 3. Daytime IMC: IFR conditions stretch across the north-central U.S. as reported by flight category on 17 Oct 2006 at 1550Z.

Obscured terrain is highlighted by Figure 4, which shows a zoomed-in portion of the U.S. It shows how a VFR flight could quickly encounter terrain that is obscured by low cloud ceilings over the mountains.

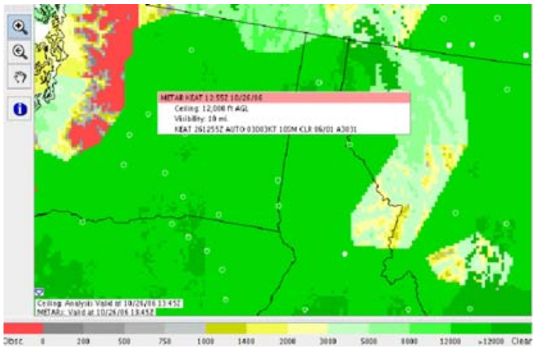

Figure 4. Daytime IMC: VFR conditions at KEAT with obscured terrain over the mountains to the west on 26 Oct 2006 at 1345Z.

<u>Day during VMC</u>

The majority of GA flights occur during the day with VMC conditions. It is therefore understandable that the majority of accidents also occur in the day with VMC conditions. The NCV Analysis product can of course be utilized to verify VMC along a desired flight route. Accidents that occur under these conditions are usually a result of lack of training or non-adherence to best practices, fuel mismanagement, or other factors that this product was not designed to address.

A typical case of daytime visual meteorological conditions is shown in Figure 5.

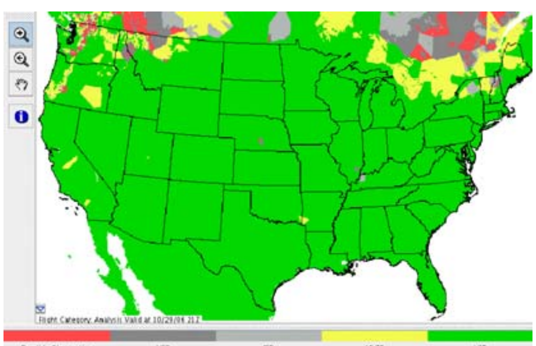

Figure 5. Daytime VMC: The flight category data layer for the U.S. on 29 Oct 2006 at 2100Z.

5. SUMMARY

This paper presents a ceiling and visibility tool that adds value to the current state of technology available to the general aviation community by combining different information streams in an easy to use display.

This display has a high temporal and spatial presentation of these different data. Using the display and interpreting the data presented is intuitive in nature.

The NCV product will aid the GA community by providing the latest information available to all users simultaneously. With training and familiarization, this product should improve flight safety by aiding users' decision making processes.

Acknowledgements

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