P8.16 A COMPARISON OF TWO VERSIONS OF THE AVIATION DIGITAL DATA SERVICE PILOT REPORT DECODER

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1. INTRODUCTION

Pilots' Reports (PIREPs) are observations of weather situations that occur during specific flights. The reports are generally reported to and recorded by an air traffic controller when a flight encounters a phenomenon like turbulence or icing or when a report is requested by a controller. PIREPs include many pieces of information that are vital to the aviation weather community, for enhancing safety as well as other purposes. The specific variables contained in PIREPs include the time, location, aircraft type, icing/turbulence conditions, sky conditions, and visibility. The reports are complex but often lack key information such as location, time, or flight level. In addition, the reports for variables like turbulence and icing are subjective because they are based solely on the pilots' views of a situation. Therefore, the reports can be dependent on the pilot's flight experience, or possibly the type of aircraft involved. Further, reports are often made even more uncertain by inconsistencies that are sometimes introduced when the PIREPs are recorded by controllers (Kane et al., 1998).

To make use of PIREPs in research and to make it possible to display them, the text information in the reports must be decoded into a digital form. The Aviation Digital Data Service (ADDS; http://adds.aviationweather.noaa.gov/) and the National Center for Atmospheric Research (NCAR) Research Applications Program's (RAP) verification group have used an automatic PIREP decoder over the past several years. This decoder has also been used by numerous other groups, including the Aviation Weather Research Program (AWRP) product development teams, the Aviation Weather Center, and the NOAA Forecast Systems Laboratory Real-Time Verification System (FSL/RTVS; Mahoney et al. 2002). The decoder was developed in an attempt to consistently decipher as much information from a raw coded PIREP as accurately as possible. While the decoder has been fairly successful, an upgrade to the current system was undertaken in order to increase the accuracy of the decoding process. A change was made to the decoder in order to identify PIREPs that are incomplete (e.g., no flight level, no lat/lon) but still include valuable information. In many cases, the decoder is able to determine the missing information from other variables in the report. For example, if a PIREP lacked flight level information, other fields (icing/turbulence level, cloud information) might be used in order to preserve the report. Both the older and newer versions of the PIREP decoder are able to accomplish this, but only the new decoder has the ability to "flag" the PIREP to allow for the report to be eliminated if the assumption is not acceptable to the end user.

The output from the new decoder populates a database and simple commands can now perform fairly complex data queries. Thus, the information from the decoder can be more easily accessed and analyzed.

This study compares the two versions of the decoder and the total numbers of reports that are successfully decoded over a three month time period (01 January to 31 March 2004). The numbers of reports that are flagged by the new decoder because of assumptions made in populating

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certain fields are also examined. Explanations of the flags are provided, along with some examples.

A comparison between two sets of verification results, derived from the PIREPs from the two different decoders, is also performed in order to assess the consistency of the observations from the upgraded decoder with observations that were decoded in the past.

2. DATA

2.1 Pilots' Reports (PIREPs)

PIREPs from 01 January 2004 to 31 March 2004 are decoded using both the old and new decoders from all reports over the CONUS.

2.2 Graphical Turbulence Guidance - 2 (GTG2)

GTG2 is a turbulence algorithm that uses output from the 20-km Rapid Update Cycle (RUC) model (Benjamin et al. 1999), PIREPs and various indices to forecast aircraft turbulence (Sharman et al., 2004). Verifications analyses for GTG2, with both the old and new PIREPs used as observation datasets, are performed from 01 January to 31 March 2004.

3. QUALITY CONTROL FLAGS

As mentioned in the introduction, the main upgrade to the PIREP decoder was the introduction of Quality Control (QC) flags. Six QC flags were added in order to notify the user when an assumption is made in the decoding process. Definitions of these flags, as well as examples of problem PIREPs representing each flag, are presented in the following subsections.

3.1 QC Flag – Midpoint

This flag is turned on when the exact location of the PIREP is not provided, but two locations are specified in the "/OV" group. The midpoint between the two locations is assumed to be the location of the report.

BUO UA **/OV PSP-FUL** /TM 2250 /FL 045 /TP M20P /SK SCT040 /TB LGT /RM AWC

Figure 1. Example of PIREP with midpoint location assumed.

Figure 1 presents an example of a PIREP where an exact location is not available. The report indicates light turbulence along a route from Palm Springs, CA to Fullerton, CA. The decoder flagged this report and assigned a latitude of 33.8723N and longitude of 117.1197W, which is the midpoint between the two locations. Figure 2 shows the locations specified in the PIREP with the assumed location plotted in between.

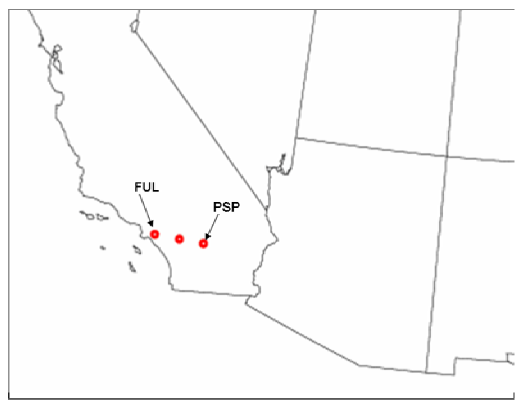

Figure 2. Locations of FUL and PSP with the assumed observation point plotted between the two locations.

3.2 QC Flag – No time stamp

This flag is turned on when a time stamp is wrong or is not provided. In general, a raw PIREP will have a time stamp immediately following the "/TM" portion of the report. If a report is entered with a time stamp that is not believable or is missing, then the flag is turned on and the time that the report was entered is used.

RIC UA /OV FAK/**TM 2140**/FL290/TP JETS/TB MOD 290-310/RM NMRS JETSBPCT

Figure 3. Example of PIREP with bad time stamp.

In Figure 3, the time issued to the report was 2140Z, but the report was entered into the system before that time at 1540Z. Therefore, the report was flagged and the time that the report was issued (1540Z) was used as the time stamp.

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3.3 QC Flag – Flight Level Range

This flag is turned on when a range, instead of a specific altitude, is given for the flight level information. When this occurs, the decoder takes the midpoint between the two levels.

ALS UA /OV ALS 090010/TM 2224/FLDURC/TP LJ35/IC MOD RIME/RM **160-FL185** TA -05 TO -10-ZDV

Figure 4. Example of PIREP with flight level range.

In Figure 4, moderate rime icing was reported at a flight levels from 16,000 to 18,500 ft. The decoder flagged this report and a flight level of 17,300 ft was recorded.

3.4 QC Flag – Above ground level (AGL)

This flag is turned on when the flight level is expressed as AGL as opposed to mean sea level (MSL). It also is turned on when the surface is reported as the flight level or if the flight level is recorded as “during descent” (DURD). When this occurs, surface elevation plus 100 ft. is used from the closest identifier.

TUL UA /**OV TUL**/TM 2151/**FLDURD**/TP LJ55/RM CORR LLWS +/- 10KT ON FAP 18R

Figure 5. Example of PIREP with flight level ”during descent” available.

In the report shown in Fig. 5, low-level windshear (LLWS) was reported during descent over Tulsa, Oklahoma but no altitude was reported. Thus, the elevation for Tulsa (675ft) plus 100ft (775ft) was recorded as the flight level and this QC flag was turned on.

3.5 QC Flag – No flight level

This flag is turned on when no flight level information can be deciphered from the raw PIREP. When this occurs, the decoder fills in the flight level with altitude of cloud observation. If that information is not available, then the altitude of icing is used. If icing information is not available, then altitude of turbulence is used.

MKC UA /OV RIS014008/TM 28/**FLUNKN**/ TP GLF4/SK **BKN040**-TOPUNK//RM BASES RGD

Figure 6. Example of PIREP with no flight level available. Flight level is assumed from the cloud altitude information.

In Figure 6, the flight level is listed as unknown. Therefore, the flag was turned on and the altitude of the clouds (4,000 ft.) was used for the flight level.

3.6 QC Flag – Bad location

This flag is turned on if the location from the “/OV” group is greater than 500 km from the leading identifier or if the location identifier is not available. If this occurs, the latitude and longitude from the leading identifier are used.

PRC UA /OV OVR MINGUS/TM 2/FL085/ TP PA44/SK 090BKN

Figure 7. Example of PIREP with a location listed that is not available in the decoder location look-up file.

In the report shown in Fig. 7, the "/OV" group lists a location named "MINGUS". The coordinates of this location are not available in any of the decoder look-up files. Thus, the latitude and longitude of Prescott, AZ (PRC) is recorded for the location.

3.7 PIREP counts

Table 1 lists the QC flags and the numbers of PIREPs that were flagged for the period 1 January – 31 March 2004. Flags 3.1 (Midpoint) and 3.5 (No flight level) are the most frequent types of flagged PIREPs (8.9% and 18.8%, respectively) and could cause the biggest problems with uncertainty when the reports are used as "ground truth" observations. The rest of the flags are turned on less than 2.2% of the time and therefore pose little risk.

Table 1. Numbers and percentages of PIREPs flagged for the 01 January – 31 March 2004 dataset.

QC Flags	***Number***	***%***
No flag	71,417	67.2
3.1	9,511	**8.9**
3.2	995	0.9
3.3	1,003	0.9
3.4	1,183	1.1
3.5	19,934	**18.8**
3.6	2,231	2.1
Total	106,274	

4. VERIFICATION COMPARISON

To examine the consistency of the old versus the upgraded decoder, a comparison of a statistical verification analysis is performed. In particular, the GTG2 algorithm is evaluated using both sets of decoded PIREPs. For the verification, some basic statistics are computed for each dataset and compared. The statistics that are compared are the probability of detecting YES observations (PODy) and the probability of detecting NO observations (PODn).

Figure 1 is a plot of PODy(MOG) vs. 1-PODn for the two analyses. This diagram shows that there is virtually no difference in the verification results based on the two sets of decoded pilot reports.

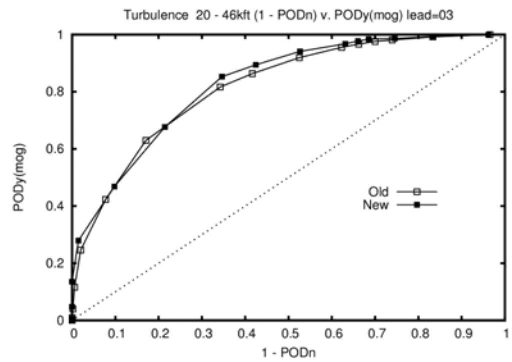

Figure 8. Plot of PODy(MOG) versus 1-PODn for GTG2 from 01 January – 31 March 2004. Points and lines are presented for analyses based on both the old and new decoders.

5. CONCLUSION

The addition of the quality control flags to the ADDS PIREP decoder will be valuable for future analyses. Even though only two of the QC flags are turned on a significant amount of time, the observation datasets based on the new decoder will be more useful for a variety of applications because of the added information provided regarding assumptions that are made by the decoder. A comparison of the two verification analyses for the GTG2 turbulence algorithm indicates that the changes made in the decoder did not affect the basic character and consistency of the observations.

Perhaps the most significant change to the decoder is the database feature that was included in the upgrade. This will save valuable research and engineering time because of the ease with which one will be able to query this data for specific studies.

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