4A.1 RESULTS OF THE NATIONAL AVIATION WEATHER PROGRAM'S 10-YEAR GOAL TO REDUCE WEATHER-RELATED ACCIDENTS BY 80 PERCENT

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ABSTRACT

The White House Commission on Aviation Safety and Security in 1997 set a goal of reducing fatal aviation accidents by 80 percent in 10 years, and the federal meteorological community incorporated this goal into the National Aviation Weather Program (NAWP) with a focus on reducing weather-related accidents.

In 1999, the National Aviation Weather Program Council (NAW/PC) released a report documenting 86 initiatives by the Federal agencies to reduce accidents and achieve this goal.

The Office of the Federal Coordinator for Meteorological Services and Supporting Research (OFCM) recently completed an analysis of National Transportation Safety Board accident data for the 10-year period (1997-2006) to ascertain whether the 10-year goal was met. While not meeting the 80% reduction goal, the weather-related accident rate decreased at a faster rate than the overall accident rate in most categories. Trend lines showed that general aviation experienced accident rate decreases of 34 and 43% for all weather-related and fatal weather-related accidents, respectively. The airline weather-related accident rate decreased by 24%, while the weather-related fatal accident rate remained effectively zero. A closer look at accident experience in certain types of weather showed that a disproportionate number of fatal general aviation accidents are associated with restricted visibility and ceiling hazards; most weather-related airline accidents were associated with turbulence and convection. The OFCM and the NAWP will continue to facilitate activities to sustain improvements in weather-related aviation accident rates.

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1. INTRODUCTION

1.1 Origin of the 10-Year Initiative

In 1995 the National Research Council documented a study of weather support to aviation with a final report, *Aviation Weather Services—A Call for Federal Leadership and Action* (NRC 1995). In response to that challenge for improved aviation weather safety, the NAW/PC, one of several interagency program councils within the OFCM infrastructure, approved and published a National Aviation Weather Program Strategic Plan in April 1997 (OFCM 1997). At about the same time, the White House Commission on Aviation Safety and Security recommended government and industry set a national goal to reduce the rate of fatal aviation accidents by a factor of five (an 80 percent reduction) within 10 years. Subsequently, both the Federal Aviation Administration (FAA) and the National Aeronautics and Space Administration (NASA) adopted the 80 percent reduction goal in their strategic plans.

In February 1999, the NAW/PC approved and released *National Aviation Weather Initiatives* (OFCM 1999), which implemented the 1997 Strategic Plan. In the *Initiatives* document, the NAW/PC cited the 80% fatal accident rate reduction challenge and acknowledged the responsibility of the aviation weather community to contribute to achieving that national goal. To track progress toward achieving the goal, it was assumed that the 10-year period would span 1997 through 2006, and the baseline for comparison would be the years leading up to 1997.

1.2 Activities

The *Initiatives* report documented recommendations for specific areas of improvement to be addressed by the Federal agencies and, by extension, academia and industry. The 86 initiatives cited were based on the following "Strategic

Elements" identified in the *Strategic Plan* or added in the *Initiatives* report:

- Improving the quality of weather information
- Enhancing the ability of decision makers to use that information
- Improving the capability of aircraft to fly safely and efficiently in all types of weather
- Forging institutional arrangements to facilitate improvements
- Directing and applying aviation weather research.

The individual initiatives were tied to one or more of eight "Service Areas," which described the weather challenges being addressed (e.g., ceiling and visibility, turbulence, convective hazards). The final initiatives were selected from a larger group of candidate initiatives and then ranked based on a cost/benefit analysis.

To identify and monitor the efforts being made by the aviation weather community to improve support, OFCM gathered information on relevant programs and projects that were completed, underway, or planned. This work was documented in three status reports, including a baseline report (OFCM 2001), and two updates (OFCM 2003a and OFCM 2004). These reports also highlighted the initiatives that were not being addressed, an approach that ultimately expanded the scope of the programs and projects to reduce the number of unaddressed initiatives.

In recognition of the importance of training to aviation weather safety, a survey of training programs and initiatives was conducted and published (OFCM, 2002). This report focused on training for recently-implemented and emerging programs related to aviation weather.

When accident data covering the first five years of the 10-year initiative were made available from the National Transportation Safety Board (NTSB), the *National Aviation Weather Program Mid-Course Assessment* was published (OFCM 2003b). Overall, the weather-related accident data showed a significant trend downward, which suggested the possibility of approaching or achieving the 80% accident reduction rate goal in some categories of operation and/or service areas.

When final data for the last year of the initiative (2006) became available from the NTSB, OFCM began an analysis of accident rate trends over the full 10 years. The basic statistical analysis has been completed, and a high-level look at the results of that analysis is presented here.

2. BACKGROUND

2.1 Stratification of Data by Type of Operation

Different types of aviation operations are subject to different rules defined by parts of the Federal Aviation Regulations, which constitute Title 14 of the U.S. Code of Federal Regulations. Because of the different rules and nature of operations, the NTSB categorizes accident data according to these "parts," which are defined as follows:

- *Part 91.* All aviation other than military or commercial. In addition to privately owned and operated single- and multiple-engine propeller craft often thought of as general aviation, it includes private company jets, rotorcraft, gliders, balloons, experimental aircraft, aerial application flying (e.g., agricultural aviation), and instructional flying.
- *Part 121.* Major passenger airlines and cargo carriers that fly large transport-category aircraft in revenue service. Since March 1997, Part 121 also includes all passenger aircraft operated in scheduled revenue service with ten or more seats (most "commuter airlines").
- *Part 135.* Scheduled passenger service in aircraft with fewer than ten seats and nonscheduled operations (revenue-earning flights in which the departure time, departure location, and arrival location are negotiated) in aircraft with 20 or fewer seats, nonscheduled cargo flights with aircraft having a payload capacity of 7,500 pounds or less, and air taxi services.

2.2 Expansion of Analysis to Consider All Accidents

The goal of the 10-year initiative was articulated in terms of a reduction in the fatal accident rate. Once actual accident data were available, it became evident that considering only accidents that resulted in deaths would limit the sample size in the most common accident situations to the point where results could become suspect or, at least, difficult to generalize. Moreover, in other situations where there were even fewer cases, considering just the fatal accidents would render the results statistically unusable. To enhance the validity of the conclusions drawn from the data and to allow for analysis of a wider range of weather impact factors, rates for all accidents regardless of whether they resulted in fatalities were also calculated and analyzed. This approach proved to help illustrate the validity of the fatal accident rates, in that the time-series curves of the two rates (all accidents and fatal accidents) assumed the same shape in most cases.

2.3 Data

Source. The NTSB performs an investigation of every aircraft accident occurring in the United States resulting in damage to the aircraft or property on the ground, or death or injury to people in the aircraft or on the ground. The depth of the investigation depends on the nature of the accident, but certain basic information is gathered on every accident. This information includes the type of operation (Part, as described earlier); whether or not the accident resulted in fatalities; and what, if any, weather elements were considered to be a factor in the accident. The results of these investigations are maintained in a data base. Each year NTSB queried the data base and provided tailored output to OFCM to support this analysis. In addition to the NTSB accident data, data on overall aviation activity used to normalize the accident data were obtained from FAA (see "Normalization" below).

Categories. The data received from NTSB were already stratified by type of operation (Part). Information in the accident records was used to sort the accidents into four categories based on whether the accidents involved fatalities and whether weather elements were cited as factors in the accidents. The four categories are illustrated in Figure 1. It should be noted that Figure 1 does not represent the type of contingency table familiar to weather forecasters in that the information in the table is not exclusive (i.e., the "All" data includes the fatal and/or weather data). Most of the analysis for this paper and most of the results presented were based on the bottom row in the table or subsets of that data for specific weather impacts. In a few cases information from the middle row in the table is presented to highlight important aspects of the accident data.

		Fatality Factor	
		All	Fatal
Weather Factor	All	All Accidents	All Fatal Accidents
	Weather Related	All Weather Related Accidents	Weather Related Fatal Accidents

Figure 1. Accidents are categorized based on whether there were fatalities and whether weather was a factor.

Normalization. Because of annual variations in aviation activity, it was necessary to normalize the accident data. Data describing annual aviation activity level were provided by FAA. For Part 121 (large commercial air carriers) FAA uses the number of departures as a "reflection of commercial passenger risk" (FAA 2001 [note—this is FAA Strategic Plan 2001 Supplement]). To conform to this practice, this paper uses *accidents per 100,000 departures* as the rate statistic for Part 121. Estimates of annual departures were not available for Part 91 and some of Part 135, so this paper uses *accidents per 100,000 flight hours* as the rate statistic for those operational categories. The accident statistics for Part 91 were based on "accident involved aircraft" rather than accidents, so in rare cases where more than one general aviation aircraft were involved in an accident, that accident was included in the data more than once. The impact of this feature of the data was considered to be negligible.

2.4 Weather Hazard Categories

The NTSB data included, where applicable, the weather factors associated with each accident. To gain further insight into weather impacts on aviation accidents, an effort was made to analyze

the accident statistics for specific types of weather. However, the NTSB process includes the selection from among 45 weather elements to be assigned as weather factors in accident reports. Investigating each weather element separately would have been overly cumbersome and involved statistically small populations in most cases. To alleviate these problems, the weather factors were grouped into eight categories as shown in Figure 2. Note that this logical grouping does not result in categories with similar populations—the largest category (turbulence and convection hazards) includes 17 specific weather factors, while two of the categories contain only two factors. Even with this grouping there were categories containing too few accidents to derive meaningful statistics, so results are not presented for all categories. In particular, graphical results for Electrical and Airborne Solids Hazards for Parts 91 and 135 are not shown, and only Turbulence and Convection graphics are presented for Part 121.

Hazard Category	Weather Factors
Restricted visibility and ceiling	Obscuration Clouds Fog Haze/smoke Low ceiling Whiteout Below approach/landing mins
Precipitation (non-icing)	Rain Drizzle/mist Snow
Icing conditions	Icing conditions Ice fog Freezing rain Carburetor icing conditions
Turbulence and convection	Thunderstorm Thunderstorm (outflow) Turbulence (thunderstorms) Turbulence, convection induced Microburst/dry Microburst/wet Updraft Downdraft Gusts Wind shear Dust devil/whirlwind Sudden wind shift Variable wind Mountain wave Turbulence Turbulence, clear air Turbulence in clouds Turbulence (terrain induced)
Temperature and lift	Temperature inversion High density altitude Temperature, high Temperature, low Thermal lift No thermal lift
En route and terminal winds	Unfavorable wind Crosswind High wind Tail wind
Electrical hazards	Lightning Static discharge
Airborne solids	Sand/dust storm Hail

Figure 2. Hazard Categories and Associated Weather Factors. To simplify the analysis process and increase sample size, NTSB-assigned weather factors were grouped into weather hazard categories.

It should also be noted that the NTSB system allows investigators to assign more than one weather factor to an accident. Thus, accidents can be counted more than once in a category and/or counted in more than one category. In fact, for Part 91 the number of weather factors cited was about one-third greater that the number of weather-related accidents. As a result, the Part 91 accident rates in the three largest weather factor categories add up to more than the total weather-related accident rate. This artifact does not affect the validity of the conclusions drawn from the analysis.

3. RESULTS

Quantifying accident reduction performance was approached in two ways. The first method simply compared the accident rates at the beginning and the end of the 10-year period, and did not address particular weather hazard categories. The second method involved taking a closer look at year-to-year trends in accident rates, and included consideration of accident rate reductions in the more common weather hazard categories. These two methods lent themselves to different analytical processes in terms of establishing baseline and final accident rates. As a consequence, slightly different accident rate reduction results are obtained from the two approaches. However, in almost all cases the results from the two approaches are qualitatively similar and representative of the data.

3.1 10-Year Accident Rate Reduction—the Big Picture

It was clear early in the analysis process that, while the accident rates had dropped significantly, the goal of reducing accident rates by 80

percent had not been achieved. In an effort to get a clearer picture of the progress made in the weather-related accident rates, a comparison was made between the overall accident rates and weather-related accident rates. This comparison was made for all accidents and fatal accidents, and included Part 91, 121, and 135 data. To reduce the effect of the year-to-year variability in the data, the mean of the three years preceding the 10-year period (1994 through 1996) was used as the baseline for calculating the accident rate reduction, and the mean of the last two years of period (2005 and 2006) was used as the final rate. Because there were no Part 121 weather-related fatal accidents during either the baseline or the final period, the Part 121 fatal accident rate reduction was not considered as part of this analysis.

Figure 3 shows the results of this analysis. Table A-1 in Appendix A presents the data

		Accident Rate Reduction	
Part	**Weather Factor Category**	**All Accidents**	**Fatal Accidents**
91	All Accidents	17%	17%
	Weather-Related Accidents	33%	49%
121	All Accidents	17%	N/A
	Weather-Related Accidents	30%	N/A
135	All Accidents	7%	63%
	Weather-Related Accidents	23%	37%

Figure 3. Comparison of weather-related accident rate reduction with overall accident rate reduction—the reduction in the weather-related accident rate was greater than the reduction in the overall rate in most cases.

supporting this figure, and Table A-2 includes the resulting means on which the reduction percentages were based. In all but one category (Part 135 Fatal Accidents), the accident rate reduction was greater for weather-related accidents than for all accidents—in most cases over twice as large. This difference would have been even greater had the weather-related accidents been removed for the "all accidents" statistics (creating a "non-weather-related" category).

3.1 10-Year Accident Rate Trends for Weather-Related Accidents

To investigate year-to-year progress in meeting accident rate reduction goals, rates were plotted for each year and a least squares line was fit to the data. Curves were plotted separately for Parts 91, 121, and 135; both all weather-related and fatal weather related accident rates were plotted on the graphs. Results for Parts 91, 121, and 135 are shown in Figures 4, 5, and 6, respectively. The goals shown in text on the graphs represent an 80 percent reduction in the mean accident rates for 1994 through 1996 (the same baseline used in generating the reduction rates in Figure 3). The end result, however, is shown as a "trend," which represents the least squares value for 2006, rather than the mean of the final two years. Table A-2 in Appendix A presents accident reduction results for weather-related accidents supporting Figures 4 through 6.

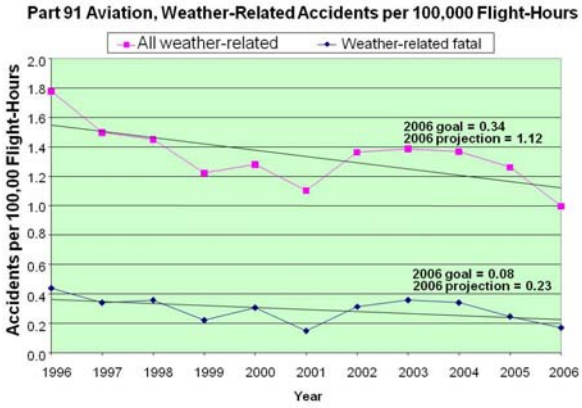


Figure 4. Time series of Part 91 accident rate for all weather-related accidents (top curve) and fatal weather-related accidents (bottom curve) in weather factor citations per 100,000 flight hours.

Part 91. The Part 91 (General Aviation) accident experience exhibited in Figure 4 showed a fairly steady drop for the first five years, after which the rate rose for two years before starting another steady drop. It is interesting that the shapes of the two curves are so similar, suggesting that a certain percentage of the accidents naturally result in fatalities. However, this relationship was not evident in the data from Parts 121 and 135. Note for comparison purposes that there were between 1 and 2 accidents per 100,000 flight hours.

Part 121. The Part 121 (Larger Commercial Carriers) accident rate experience shown in Figure 5 is considerably noisier than the Part 91 data. This is probably due to the smaller sam-

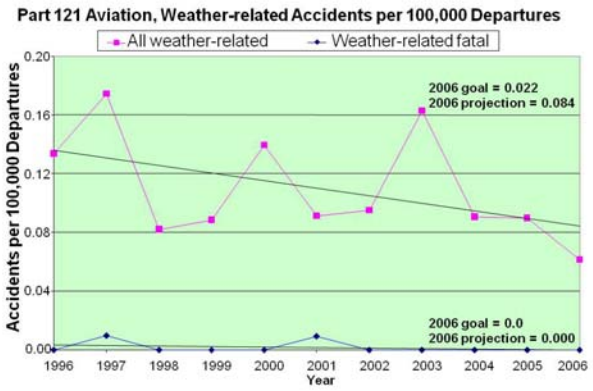


Figure 5. Time series of Part 121 accident rate for all weather-related accidents (top curve) and fatal weather-related accidents (bottom curve) in weather factor citations per 100,000 departures.

ple size reflected in the significantly lower accident rates. In spite of the scatter in the data, however, a distinct downward trend is evident in the all weather-related accident rate curve. As mentioned earlier, there were insufficient weather-related fatal accidents to establish a trend—an encouraging result in itself.

Part 135. The Part 135 (Non-Scheduled and Smaller Scheduled Commercial Carriers) data in Figure 6 show rates of .30 to .75 accidents per 100,000 flight hours, about a third of the Part 91 rates based on about one-sixth of the flight hours. This lower sample size may account for some of the year-to-year variability in the Part 135 data. In spite of its variability, however, the all weather-related accident rate shows a recognizable downward trend, as confirmed by the least squares line. The weather-related fatal ac-

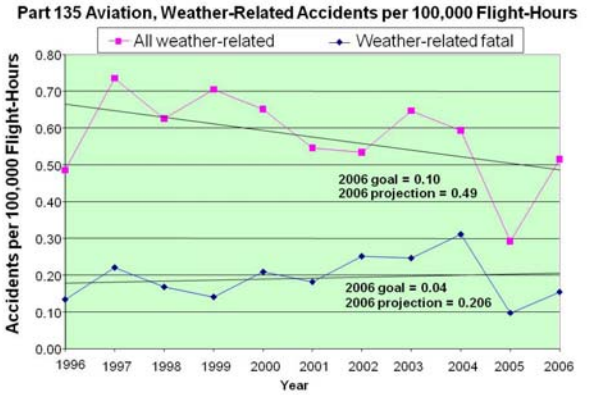


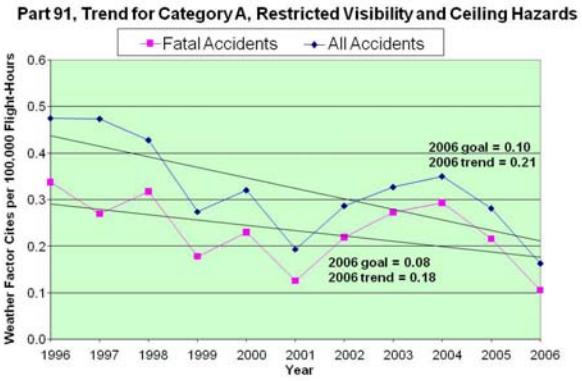
Figure 6. Time series of Part 135 accident rate for all weather-related accidents (top curve) and fatal weather-related accidents (bottom curve) in weather factor citations per 100,000 flight hours.

cident rate, on the other hand, is the only category in which the least squares line shows an increasing accident rate. Recall, however, that the initial calculation of fatal accident rate reduction for this category (Figure 3) showed a significant decrease. This new, contrary result could be an artifact of the anomalously low value for the 1996 accident rate (compared to 1994, 1995, and 1997). On the other hand, the earlier result could reflect the sudden drop in the rate for the final two years of the period. In any case, the significant difference in results derived from two relatively straightforward treatments of the data suggests that conclusions should be based only on more careful analysis of the situation, which is beyond the scope of this paper.

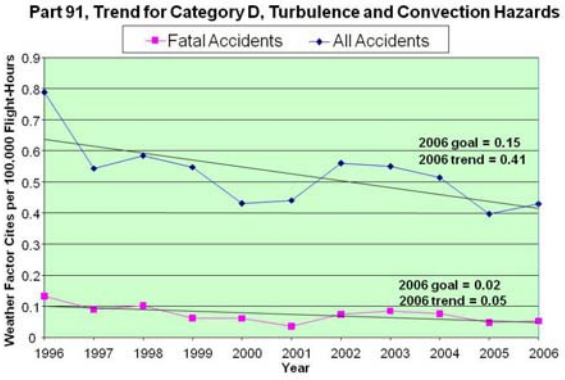
3.2 10-Year Accident Rate Reduction by Weather Hazard

During the 10-year period of the accident rate reduction initiative, over one hundred programs or projects were in progress or undertaken by Federal agencies or other partners (industry, academia, etc) to improve the effectiveness of weather support to aviation. Some were fairly broad, addressing, for example, the implementation of improved forecast models or the ability to get up-to-date weather information to the pilot in the cockpit. However, many of the programs addressed specific weather hazards. To gauge the effectiveness of these targeted initiatives, an analysis of the rates for accidents related to specific weather factors was conducted. The nature of the data used in this analysis was discussed above. Results of the analysis follow.

Limitations. Consolidation of the 45 NTSB weather impact factors into 8 categories did not entirely eliminate the problem of small sample size. For Part 91, three of the categories accounted for about 81 percent of the weather factor citations, while two of the categories had less than 10 citations. This section focuses on results from the more populous weather factor categories with the more interesting and revealing results. The detailed data for all weather factors and hazard categories for Parts 91, 121, and 135 are presented in Tables A-3 through A-8 in Appendix A. Part 91 and 135 graphical results for the six more populous weather factor categories are presented in Appendix B. Note from Tables A-3 through A-8 that data broken out by weather factors were not available until 1995. In the absence of 1994 data, the goals shown in these tables and on the figures in Appendix B are



(a)



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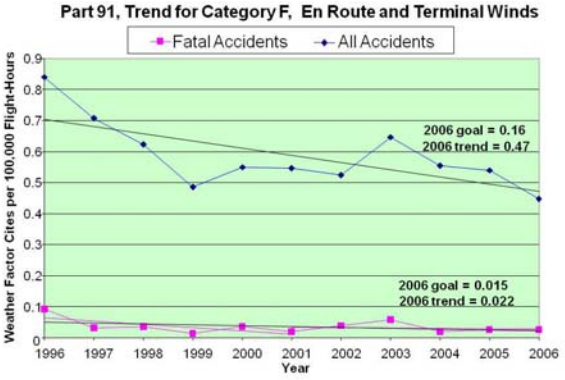

(c)

Figure 7(a). Time series of Part 91 accident rate for all reduced visibility and ceiling-related accidents (top curve) and fatal reduced visibility and ceiling-related accidents (bottom curve) in weather factor citations per 100,000 flight hours. Figures 7(b) and (c) are the same as 7(a) except for turbulence and convection-related accidents, and en route and terminal wind-related accidents, respectively.

based on a two-year average of 1995 and 1996 data rather than the three-year average used in the earlier consideration of all weather hazard accident rates (Tables A-1 and A-2, and Figures 4, 5, and 6).

Part 91 Hazard Category 10-Year Trends. Part 91 results for three hazard categories are presented here. Figure 7 shows weather-related accident rate trends for restricted visibility and ceilings (a), turbulence and convection (b), and en route and terminal winds (c). Two features of these graphics are particularly noteworthy. First, all three curves take, to a greater or lesser degree, the shape of the curve for all weather accidents shown in Figure 4. They show an initial downward trend for several years followed by an increase and ending with a final drop. This suggests that one particular type of weather hazard was not responsible for the overall trend. The second noteworthy feature is the relationship between the "all weather-related" accident rates and the "fatal weather-related" accident rates—the two curves on each chart. There is significant separation between the curves for turbulence and convection, and even greater separation for en route and terminal winds. Accidents related to these weather factors usually are not fatal. However, the fatal accident rate for restricted visibility and ceilings hazards is always at least 50 percent of the all-accident rate, and is 75 to 85 percent of that rate in some years. Clearly, programs that improve the ability of general aviation pilots and aircraft to deal with restricted visibility and ceilings have the greatest potential to save lives.

Part 121 Turbulence and Convection Experience. Large commercial airlines (Part 121) have enjoyed a remarkable safety record during the previous 10 to 15 years. Overall accident rates have been low, and fatal accidents have become rare. For the most part, weather-related accidents are so rare that they defy

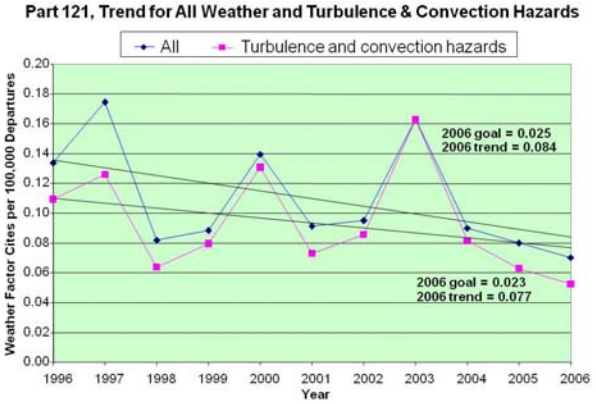

Figure 8. Time series of Part 121 accident rate for all weather-related accidents (top curve) and turbulence and convection-related accidents (bottom curve) in weather factor citations per 100,000 departures.

meaningful statistical analysis. The exception to this rule is the impact of turbulence and convection on Part 121 aviation operations. Figure 8 illustrates this situation. The upper curve in this figure is the accident rate for all weather-related accidents (that is, all weather hazard categories combined), and the lower curve shows the rate for accidents in which factors in the turbulence and convection category were cited. At its lowest, the rate for accidents in which turbulence and convection were cited as an impact was 72 percent of the rate for all weather-related accidents, and in one year one or more impacts from the turbulence and convection category was cited in every weather-related accident. In the case of Part 121 operations, programs that address the impact of turbulence and convection show the greatest potential for reducing accidents.

4. SUMMARY AND FUTURE WORK

4.1 Summary

Analysis of NTSB aviation accident data showed a downward trend in weather-related accidents and weather-related fatal accidents in most categories of operations in the 1997 to 2006 period. Although weather-related accident rates dropped significantly, the reduction did not meet the 80% goal. General aviation showed the greatest reduction, much of which occurred in the first five years. Most weather-related general aviation accidents were associated with turbulence and convection, ceiling and visibility, or en route and terminal winds; and accidents associated with ceiling and visibility were much more likely to result in fatalities than accidents in which other weather factors were cited. Most large airline weather-related accidents were associated with turbulence and convection.

4.2 Future Work

OFCM plans to publish a formal report presenting these findings in the context of the NAWP. In addition to adding data for future years as they become available and updating the analysis as appropriate, a review of the plans and programs that were completed during the 10-year period and how they may have resulted in features of the weather-related accident trend will be conducted.

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APPENDIX A

NTSB ACCIDENT DATA AND FAA FLIGHT ACTIVITY ESTIMATES

Table A-1. Accident and Flight Activity Data by NTSB Category of Service

Part 91, General Aviation[a]

	Accident-Involved Aircraft				Flight Hours	Accident-Involved Aircraft per 100,000 Flight Hours			
Year	All	Wx All	Fatal	Wx Fatal		All	Wx All	Fatal	Wx Fatal
1994	2,021	344	404	87	22,235,000	9.09	1.55	1.82	0.39
1995	2,056	426	413	109	24,906,000	8.26	1.71	1.66	0.44
1996	1,908	442	361	109	24,881,000	7.67	1.78	1.45	0.44
1997	1,844	383	350	87	25,591,000	7.21	1.50	1.37	0.34
1998	1,905	370	365	91	25,518,000	7.47	1.45	1.43	0.36
1999	1,905	357	340	65	29,246,000	6.51	1.22	1.16	0.22
2000	1,837	356	345	85	27,838,000	6.60	1.28	1.24	0.31
2001	1,727	280	325	38	25,431,000	6.79	1.10	1.28	0.15
2002	1,715	348	345	80	25,545,000	6.71	1.36	1.35	0.31
2003	1,740	360	352	93	25,998,000	6.69	1.38	1.35	0.36
2004	1,619	340	314	85	24,888,000	6.51	1.37	1.26	0.34
2005	1,669	292	321	57	23,168,000	7.20	1.26	1.39	0.25
2006	1,515	227	303	39	22,800,000	6.64	1.00	1.33	0.17
2006 goal						1.67	0.34	0.33	0.08
2006 (proj.)		272		56		6.57	1.12	1.30	0.23

Part 121, Larger Commercial Air Carriers

	Accidents				Departures	Accidents per 100,000 Departures			
Year	All[b]	Wx All	Fatal[b]	Wx Fatal		All	Wx All	Fatal	Wx Fatal
1994	23	6	4	0	8,238,306	0.27	0.073	0.049	0.0000
1995	36	10	3	0	8,457,465	0.43	0.118	0.035	0.0000
1996	37	11	5	0	8,228,810	0.45	0.134	0.061	0.0000
1997	49	18	4	1	10,318,383	0.47	0.174	0.039	0.0097
1998	50	9	1	0	10,979,762	0.46	0.082	0.009	0.0000
1999	51	10	2	0	11,308,762	0.45	0.088	0.018	0.0000
2000	56	16	3	0	11,468,229	0.49	0.140	0.026	0.0000
2001	46	10	6	1	10,954,832	0.38	0.091	0.018	0.0091
2002	41	10	0	0	10,508,473	0.39	0.095	0.000	0.0000
2003	54	17	2	0	10,433,164	0.52	0.163	0.019	0.0000
2004	30	10	2	0	11,023,128	0.27	0.09	0.018	0.00
2005	40	10	3	0	11,130,407	0.36	0.09	0.027	0.00
2006	31	7	2	0	11,410,000	0.27	0.06	0.018	0.00
2006 goal						0.076	0.022	0.0097	0.000
2006 (proj.)						0.33	0.084	0.01	0.000

All accident statistics from NTSB. Flight-hour and departure estimates from FAA.

[a] For Part 91 sector (general aviation), the data are for numbers of accident-involved aircraft, rather than numbers of accidents.

[b] For 1994, includes one accident due to an illegal act. For 2001, includes 9/11/01 terrorist acts.

Table A-1. Accident and Flight Activity Data by NTSB Category of Service (Cont'd)

Part 135 (Scheduled and Nonscheduled)

	Accidents				Flight Hours	Accidents per 100,000 Flight Hours			
Year	All	Wx All	Fatal	Wx Fatal		All	Wx All	Fatal	Wx Fatal
1994	95	31	29	13	5,249,129	1.81	0.59	0.55	0.25
1995	87	25	26	11	5,113,866	1.70	0.49	0.51	0.22
1996	101	29	30	8	5,976,755	1.69	0.49	0.50	0.13
1997	98	30	20	9	4,080,764	2.40	0.74	0.49	0.22
1998	85	26	17	7	4,155,670	2.05	0.63	0.41	0.17
1999	87	25	17	5	3,546,731	2.45	0.70	0.48	0.14
2000	92	28	23	9	4,299,535	2.14	0.65	0.53	0.21
2001	79	18	20	6	3,297,432	2.40	0.55	0.61	0.18
2002	67	17	18	8	3,184,559	2.10	0.53	0.57	0.25
2003	75	21	19	8	3,246,206	2.31	0.65	0.59	0.25
2004	70	21	23	11	3,540,217	1.98	0.59	0.65	0.31
2005	72	12	11	4	4,110,034	1.75	0.29	0.27	0.10
2006	57	20	11	6	3,880,000	1.47	0.52	0.28	0.15
2006 goal						0.35	0.10	0.10	0.040
2006 (proj.)						1.87	0.49	0.44	0.206

Table A2. Accident Reduction Results by NTSB Category of Operation

	Baseline	2006 Goal	2006 actual		Reduction Achieved	
	1994-1996	(80% reduction)	trend*	2-yr avg.	trend*	2-yr avg.
Part 91, General Aviation, accidents per 100,000 flight-hours						
All weather-related	1.678	0.336	1.123	1.128	33%	33%
Fatal weather-related	0.422	0.084	0.227	0.209	54%	49%
Part 121, Larger Commercial Carriers, accidents per 100,000 departures						
All weather-related	0.108	0.022	0.084	0.076	22%	30%
Fatal weather-related	0.000	0.000	0.000	0.000	N/A	N/A
Part 135, Commercial Nonscheduled & Smaller Scheduled, accidents per 100,000 flight-hours						
All weather-related	0.522	0.104	0.487	0.404	7%	23%
Fatal weather-related	0.199	0.040	0.206	0.126	-3%	37%

Table A-3a. Part 91 Weather Factor Trend Analysis, All Accidents

Factor Citations, All Accidents

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
A. Restricted Visibility and Ceiling Hazards													
Below Approach/Landing Minimums(1)	3	10	3		2	5	1	1	1	2	1	3	32
Clouds (1)	16	16	17	22	16	12	4	17	20	30	9	7	186
Fog (1)	45	37	35	29	16	25	16	17	22	18	17	6	283
Haze/smoke (1)	7	3	6	4	1	2	3	5	2	2	3	1	39
Low ceiling (1)	59	45	52	41	34	36	19	29	38	31	28	17	429
Obscuration (1)	8	7	8	12	10	8	3	3	1	3	5	2	70
Whiteout (1)	2			1	1	1	3	1	1	1	2	1	14
Total hazard class citations	140	118	121	109	80	89	49	73	85	87	65	37	1053
Frequency per 100,000 flight-hours	0.56	0.47	0.47	0.43	0.27	0.32	0.19	0.29	0.33	0.35	0.28	0.16	0.34
2006 goal	0.10												
2006 trend	0.21												
B. Precipitation (Non-Icing) Hazards													
Rain (1)	11	7	13	9	9	5	6	4	8	7	5	3	87
Snow (1)	17	11	9	6	7	17	8	6	4	5	4	4	98
Drizzle/mist (1)	1	4	1	3	3	3	3	2	1	5	1	1	28
Total hazard class citations	29	22	23	18	19	25	17	12	13	17	10	8	213
Frequency per 100,000 flight-hours	0.116	0.088	0.090	0.071	0.065	0.090	0.067	0.047	0.050	0.065	0.043	0.035	0.070
2006 goal	0.020												
2006 trend	0.040												
C. Icing Hazards													
Icing conditions (5)	25	18	11	9	13	9	3	15	13	11	12	6	145
Ice Fog (5)							1		1	1			3
Freezing rain (5)	1		1	2		2	1	1					8
Carburetor Icing Conditions (9)	28	17	24	26	18	18	17	18	19	18	18	12	233
Total hazard class citations	54	35	36	37	31	29	22	34	33	30	30	18	389
Frequency per 100,000 flight-hours	0.217	0.141	0.141	0.145	0.106	0.104	0.087	0.133	0.127	0.121	0.129	0.079	0.127
2006 goal	0.036												
2006 trend	0.103												

Table A-3b. Part 91 Weather Factor Trend Analysis, All Accidents

Factor Citations, All Accidents

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
D. Turbulence and Convection Hazards													
Turbulence (thunderstorms) (2)	1	5	3	2		1		2	4	1			19
Thunderstorm (2)	13	12	3	3	7	5	3	2	4	10	4	5	71
Thunderstorm (outflow) (2)	3	1	2				1	3			1		11
Microburst/dry (2)	1			1	1		1					1	5
Microburst/wet (2)	1												1
Updraft (2)				1	1	1	1	1	2				7
Downdraft (2)	30	22	12	16	23	21	11	19	15	15	15	14	213
Gusts (6)	74	105	87	75	74	51	62	78	85	69	55	58	873
Windshear (6)	8	9	1	6	8	9	5	8	5	9	6	7	81
Dust devil/whirlwind (6)	3	5	2	1	9	4	6	3	2	3	1	2	41
Variable wind (6)	6	11	5	10	9	9	12	9	4	4	3	2	84
Sudden windshift (6)	11	6	8	12	12	6	6	5	9	6		5	86
Mountain wave (7)	2	1	2	3	1	1		2	2		1	1	16
Turbulence (7)	13	10	7	9	13	4	3	7	7	7	4	2	86
Turbulence, clear air (CAT)(7)		3	1	2		1		1		1	1		10
Turbulence in clouds (7)		1	1	2	1	2			3		1	1	12
Turbulence (terrain induced) (7)	6	5	5	6	1	5	1	3	1	3			36
Total hazard class citations	172	196	139	149	160	120	112	143	143	128	92	98	1652
Frequency per 100,000 flight-hours	0.691	0.78 8	0.54 3	0.58 4	0.54 7	0.43 1	0.44 0	0.56 0	0.55 0	0.51 4	0.39 7	0.43 0	0.540
2006 goal	0.15												
2006 trend	0.41												
E. Temperature and Lift Hazards													
Temperature Inversion (3)							1						1
High density altitude (6)	25	36	33	37	48	29	15	34	30	20	29	14	350
Temperature, high (6)	3	4	5		1	1	1			1	2	1	19
Temperature, low (6)	2				1	1		1	3	1			9
Thermal Lift (9)		1	1				3			1		1	7
No thermal lift (9)	4	4	2	4	5	2	2	3	3		5	5	39
Total hazard class citations	34	45	41	41	55	33	22	38	36	23	36	21	425
Frequency per 100,000 flight-hours	0.137	0.18 1	0.16 0	0.16 1	0.18 8	0.11 9	0.08 7	0.14 9	0.13 8	0.09 2	0.15 5	0.09 2	0.14
2006 goal	0.032												
2006 trend	0.105												

Table A-3c. Part 91 Weather Factor Trend Analysis, All Accidents

Factor Citations, All Accidents

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
F. En Route and Terminal Winds													
Unfavorable wind (3)	20	14	17	7	6	7	1	6	9	5	2	9	103
Crosswind (6)	90	123	111	87	78	80	77	71	94	64	67	53	995
Tailwind (6)	50	36	36	46	46	52	41	45	43	49	46	31	521
High wind (6)	18	36	17	19	12	14	20	12	22	20	10	9	209
Total hazard class citations	178	209	181	159	142	153	139	134	168	138	125	102	1828
Frequency per 100,000 flight-hours	0.715	0.840	0.707	0.623	0.486	0.550	0.547	0.525	0.646	0.554	0.540	0.447	0.598
2006 goal	0.155												
2006 trend	0.472												
Low Frequency Hazards													
G. Electrical Hazards													
Lightning (2)	1				1	1			1				4
Static Discharge (9)		1											1
Total hazard class citations	1	1	0	0	1	1	0	0	1	0	0	0	5
Frequency per 100,000 flight-hours	0.0040	0.004	0.000	0.000	0.003	0.004	0.000	0.000	0.004	0.000	0.000	0.000	0.002
2006 goal	0.0008												
2006 trend	0.0003												
H. Airborne Solids Hazards													
Sand/dust storm (1)	1												1
Hail (2)		2			1				3				6
Total hazard class citations	1	2	0	0	1	0	0	0	3	0	0	0	7
Frequency per 100,000 flight-hours	0.004	0.008	0.000	0.000	0.003	0.000	0.000	0.000	0.012	0.000	0.000	0.000	0.002
2006 goal	0.001												
2006 trend	0.001												
I. Other													
Other								4	2	2	1		9
Total hazard class citations	0	0	0	0	0	0	0	4	2	2	1	0	9
Frequency per 100,000 flight-hours	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.016	0.008	0.008	0.004	0.000	0.003

Table A-4a. Part 91 Weather Factor Trend Analysis, Fatal Accidents

Factor Citations, Fatal Accidents

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
A. Restricted Visibility and Ceiling Hazards													
Below Approach/Landing Minimums(1)	2	4			1	4		1	1	1	1	2	17
Clouds (1)	14	11		16	11	10	3	14	18	28	6	3	134
Fog (1)	34	30	22	22	9	15	11	13	17	14	9	3	199
Haze/smoke (1)	3		3	2		1	2		1	1	3		16
Low ceiling (1)	47	34	36	33	23	27	13	24	33	27	25	14	336
Obscuration (1)	5	5	8	8	8	6	3	3	1	2	5	2	56
Whiteout (1)						1		1			1		3
Total hazard class citations	105	84	69	81	52	64	32	56	71	73	50	24	761
Frequency per 100,000 flight-hours	0.42	0.34	0.27	0.32	0.18	0.23	0.13	0.22	0.27	0.29	0.22	0.11	0.249
2006 goal	0.08												
2006 trend	0.18												
B. Precipitation (Non-Icing) Hazards													
Rain (1)	3	6	9	7	5	2	3	3	7	4	3	1	53
Snow (1)	13	8	6	5	2	9	4	2	1	5	4	1	60
Drizzle/mist (1)	1	2	1	2	3	2	2	2	1	5	1	1	23
Total hazard class citations	17	16	16	14	10	13	9	7	9	14	8	3	136
Frequency per 100,000 flight-hours	0.068	0.064	0.063	0.055	0.034	0.047	0.035	0.027	0.035	0.056	0.035	0.013	0.044
2006 goal	0.013												
2006 trend	0.025												
C. Icing Hazards													
Icing conditions (5)	14	11	4	5	6	4		9	8	6	5	3	75
Ice Fog (5)							1			1			2
Freezing rain (5)	1			2		1		1					5
Carburetor Icing Conditions (9)	1	1	4	1		2	1	1	1			2	14
Total hazard class citations	16	12	8	8	6	7	2	11	3	3	3	3	96
Frequency per 100,000 flight-hours	0.064	0.048	0.031	0.031	0.021	0.025	0.008	0.043	0.012	0.012	0.013	0.013	0.031
2006 goal	0.011												
2006 trend	0.009												

Table A-4b. Part 91 Weather Factor Trend Analysis, Fatal Accidents

Factor Citations, Fatal Accidents

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
D. Turbulence and Convection Hazards													
Turbulence (thunderstorms) (2)	1	4	2	2		1		2	2	1			15
Thunderstorm (2)	8	8	3	2	6	3	3	2	1	7	3	4	50
Thunderstorm (outflow) (2)	1							2					3
Microburst/dry (2)	0										1		1
Microburst/wet (2)	1												1
Updraft (2)									1				1
Downdraft (2)	3	2	1	1	2	1	2	1	4	3		1	21
Gusts (6)	5	9	9	7	2	3	3	7	7	3	4	2	61
Windshear (6)		1		2		4		1	1			1	10
Dust devil/whirlwind (6)	1												1
Variable wind (6)					1					1		1	3
Sudden windshift (6)				1		1							2
Mountain wave (7)	1	1	2	1	1			1	2		1	1	11
Turbulence (7)	4	3	4	3	4	2	1	1	3	3	2	1	31
Turbulence, clear air (CAT)(7)		1		1				1					3
Turbulence in clouds (7)		1		2	1	1			1			1	7
Turbulence (terrain induced) (7)	3	3	2	4	1	1		1		1			16
Total hazard class citations	28	33	23	26	18	17	9	19	22	19	11	12	237
Frequency per 100,000 flight-hours	0.112	0.133	0.090	0.102	0.062	0.061	0.035	0.074	0.085	0.076	0.047	0.053	0.077
2006 goal	0.025												
2006 trend	0.048												
E. Temperature and Lift Hazards													
Temperature Inversion (3)													0
High density altitude (6)	3	9	10	8	9	6	2	11	4	4	3	1	70
Temperature, high (6)						1							1
Temperature, low (6)	1									1			2
Thermal Lift (9)													0
No thermal lift (9)		1				1			0				2
Total hazard class citations	4	10	10	8	9	8	2	11	4	5	3	1	75
Frequency per 100,000 flight-hours	0.016	0.040	0.039	0.031	0.031	0.029	0.008	0.043	0.015	0.020	0.013	0.004	0.025
2006 goal	0.006												
2006 trend	0.010												

Table A-4c. Part 91 Weather Factor Trend Analysis, Fatal Accidents

Factor Citations, Fatal Accidents

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
F. En Route and Terminal Winds													
Unfavorable wind (3)	2	2	1								1		6
Crosswind (6)	5	7		1	1			2	4				20
Tailwind (6)	6	7	2	6	2	7	3	5	1	1	3	4	47
High wind (6)	2	7	5	2	1	3	2	3	10	4	2	2	43
Total hazard class citations	15	23	8	9	4	10	5	10	15	5	6	6	116
Frequency per 100,000 flight-hours	0.060	0.092	0.031	0.035	0.014	0.036	0.020	0.039	0.058	0.020	0.026	0.026	0.038
2006 goal	0.015												
2006 trend	0.022												
Low Frequency Hazards													
G. Electrical Hazards													
Lightning (2)	1				1	1							3
Static Discharge (9)		1											1
Total hazard class citations	1	1	0	0	1	1	0	0	0	0	0	0	4
Frequency per 100,000 flight-hours	0.0040	0.004	0.000	0.000	0.003	0.004	0.000	0.000	0.000	0.000	0.000	0.000	0.001
2006 goal	0.0008												
2006 trend	0.0000												
H. Airborne Solids Hazards													
Sand/dust storm (1)	1												1
Hail (2)		1			1				1				3
Total hazard class citations	1	1	0	0	1	0	0	0	1	0	0	0	4
Frequency per 100,000 flight-hours	0.004	0.004	0.000	0.000	0.003	0.000	0.000	0.000	0.004	0.000	0.000	0.000	0.001
2006 goal	0.001												
2006 trend	0.000												
I. Other													
Other								0		1			1
Total hazard class citations	0	0	0	0	0	0	0	0	0	1	0	0	1
Frequency per 100,000 flight-hours	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.004	0.000	0.000	0.000

Table A-5a. Part 121 Weather Factor Trend Analysis, All Accidents

Factor Citations, All Accidents

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
All Factors	10	11	18	9	10	16	10	10	17	10	10	8	148
Frequency per 100,000 departures	0.118	0.134	0.174	0.082	0.088	0.140	0.091	0.095	0.163	0.090	0.080	0.070	
2006 goal	0.025												
2006 projection	0.084												
A. Restricted Visibility and Ceiling Hazards													
Fog (1)		1										1	2
Low ceiling (1)							1						1
Whiteout (1)			1										1
Total hazard class citations	0	1	1	0	0	0	1	0	0	0	0	1	4
B. Precipitation (Non-Icing) Hazards													
Rain (1)		1	1					1	1				4
Snow (1)			1					1			1		3
Drizzle/mist (1)				1									1
Total hazard class citations	0	1	2	1	0	0	0	2	1	0	1	0	8
C. Icing Hazards													
Icing conditions (5)			1										1
Total hazard class citations	0	0	1	0	0	0	0	0	0	0	0	0	1

Table A-5b. Part 121 Weather Factor Trend Analysis, All Accidents

Factor Citations, All Accidents

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
D. Turbulence and Convection Hazards													
Turbulence (thunderstorms) (2)		1	1	3			2	1	2	1	1		12
Thunderstorm								1	1				2
Turbulence, convection induced (2)						1	1	1	3	3			9
Gusts (6)						1		1	2		2	1	7
Windshear (6)	1					1							2
Mountain wave (7)						1							1
Turbulence (7)	5	1	3	1	5	6	3	2	5	2	3		36
Turbulence, clear air (CAT)(7)	3	7	7	2	3	2		2	3	2		2	33
Turbulence, terrain induced												1	1
Turbulence in clouds (7)	1		2	1	1	3	2	1	1	1	1	2	16
Total hazard class citations	10	9	13	7	9	15	8	9	17	9	7	6	119
Frequency per 100,000 departures	0.118	0.109	0.126	0.064	0.080	0.131	0.073	0.086	0.163	0.082	0.063	0.053	0.094
2006 goal	0.023												
2006 projection	0.077												
E. Temperature and Lift Hazards													
Temperature, high (6)		1					1						2
Total hazard class citations	0	1	0	0	0	0	1	0	0	0	0	0	2
F. En Route and Terminal Winds													
Unfavorable wind (3)	1			1									2
High Wind												1	1
Crosswind (6)		1	2			1			1	1	2		8
Total hazard class citations	1	1	2	1	0	1	0	0	1	1	2	1	11
H. Airborne Solids Hazards													
Hail (2)				1									1
Total hazard class citations	0	0	0	1	0	0	0	0	0	0	0	0	1
I. Other			1		1								2
Total hazard class citations	0	0	1	0	1	0	0	0	0	0	0	0	2

Table A-6a. Part 121 Weather Factor Trend Analysis, Fatal Accidents

Factor Citations, Fatal Accidents

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
All Factors	0	0	1	0	0	0	1	0	0	0	0	0	2
Frequency per 100,000 departures	0.000	0.000	0.010	0.000	0.000	0.000	0.009	0.000	0.0	0.0	0.0	0.0	0.002
2006 goal	0.0000												
2006 projection	0.000												
A. Restricted Visibility and Ceiling Hazards													
Fog (1)													0
Low ceiling (1)													0
Whiteout (1)													0
Total hazard class citations	0	0	0	0	0	0	0	0	0	0	0	0	0
B. Precipitation (Non-Icing) Hazards													
Rain (1)													0
Snow (1)													0
Drizzle/mist (1)													0
Total hazard class citations	0	0	0	0	0	0	0	0	0	0	0	0	0
C. Icing Hazards													
Icing conditions (5)													0
Total hazard class citations	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A-6b. Part 121 Weather Factor Trend Analysis, Fatal Accidents

Factor Citations, Fatal Accidents

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	Total
D. Turbulence and Convection Hazards													
Turbulence (thunderstorms) (2)													0
Thunderstorm													0
Turbulence, convection induced (2)													0
Gusts (6)													0
Windshear (6)													0
Mountain wave (7)													0
Turbulence (7)													0
Turbulence, clear air (CAT)(7)			1										1
Turbulence, terrain induced													
Turbulence in clouds (7)													0
Total hazard class citations	0	0	1	0	0	0	0	0	0	0	0	0	1
Frequency per 100,000 departures	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001
2006 goal	0.000												
2006 projection	0.000												
E. Temperature and Lift Hazards													
Temperature, high (6)							1						1
Total hazard class citations	0	0	0	0	0	0	1	0	0	0	0	0	1
F. En Route and Terminal Winds													
Unfavorable wind (3)													0
High Wind													
Crosswind (6)													0
Total hazard class citations	0	0	0	0	0	0	0	0	0	0	0	0	0
H. Airborne Solids Hazards													
Hail (2)													0
Total hazard class citations	0	0	0	0	0	0	0	0	0	0	0	0	0
I. Other													
Total hazard class citations	0	0	0	0	0	0	0	0	0	0	0	0	0

Table A-7a. Part 135 Weather Factor Trend Analysis, All Accidents

	Factor Citations, All Accidents												
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
A. Restricted Visibility and Ceiling Hazards													
Below Approach/Landing Minimums(1)							1		1		1		3
Clouds (1)	2	1	3	2		2	2			2	2	1	17
Fog (1)	5	9	6	3	1	3	1	2	3	5		3	41
Low ceiling (1)	7	10	9	6	5	7	3	3	4	3		1	58
Obscuration (1)	2	2	2					2	1			3	12
Whiteout (1)	1	3	2	3	4	3	1	1		2		2	22
Total hazard class citations	17	25	22	14	10	15	8	8	9	12	3	10	153
Frequency per 100,000 flight-hours	0.33	0.42	0.54	0.34	0.28	0.35	0.24	0.25	0.28	0.34	0.07	0.26	0.32
2006 goal	0.08												
2006 projection	0.18												
B. Precipitation (Non-Icing) Hazards													
Rain (1)	2		1	2		1	2		1	1	1	1	12
Snow (1)	2	2	2	2	3	4	1	3	3			1	23
Drizzle/mist (1)	1	1						1	1			1	5
Total hazard class citations	5	3	3	4	3	5	3	4	5	1	1	3	40
Frequency per 100,000 flight-hours	0.10	0.05	0.07	0.10	0.08	0.12	0.09	0.13	0.15	0.03	0.02	0.08	0.08
2006 goal	0.0148												
2006 projection	0.078												
C. Icing Hazards													
Icing conditions (5)	4	3	4	4	3	3	2	4	1	2	1	1	32
Freezing rain (5)	1				1	1		1					4
Carburetor Icing Conditions (9)			1			2							3
Total hazard class citations	5	3	5	4	4	6	2	5	1	2	1	1	39
Frequency per 100,000 flight-hours	0.10	0.05	0.12	0.10	0.11	0.14	0.06	0.16	0.03	0.06	0.02	0.03	0.08
2006 goal	0.015												
2006 projection	0.044												
2006 goal	0.002												
2006 projection	0.003												

Table A-7b. Part 135 Weather Factor Trend Analysis, All Accidents

	Factor Citations, All Accidents												
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
D. Turbulence and Convection Hazards													
Turbulence (thunderstorms) (2)						1							1
Thunderstorm (2)				1					1	3		1	6
Downdraft (2)	2	1	5	2	3			1	2			1	17
Microburst/wet (2)											1		1
Gusts (6)	4	3	2	3	2		2	1	2	4	2	1	26
Windshear								1				2	3
Sudden windshift (6)											1		1
Variable wind (6)	1	1					1		1				4
Turbulence (7)					1	1	1		1				4
Turbulence (convective induced) (7)										1			1
Turbulence in clouds (7)	1												1
Mountain wave (7)											1		1
Turbulence (terrain induced) (7)	1		2			1	1				1		6
Total hazard class citations	9	5	9	6	6	3	5	3	7	8	6	5	72
Frequency per 100,000 flight-hours	0.18	0.08	0.22	0.14	0.17	0.07	0.15	0.09	0.22	0.23	0.15	0.13	0.15
2006 goal	0.026												
2006 projection	0.163												
E. Temperature and Lift Hazards													
High density altitude (6)	1		2	3	1	3						1	11
Temperature, low (6)				1									1
Total hazard class citations	1	0	2	4	1	3	0	0	0	0	0	1	12
Frequency per 100,000 flight-hours	0.02	0.00	0.05	0.10	0.03	0.07	0.00	0.00	0.00	0.00	0.00	0.03	0.02
2006 goal	0.002												
2006 projection	0.003												

Table A-7c. Part 135 Weather Factor Trend Analysis, All Accidents

	Factor Citations, All Accidents												
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
F. En Route and Terminal Winds													
Unfavorable wind (3)	1	1	1		1	2						1	7
Crosswind (6)		5	4	5	1	3	3	1	3		2	2	29
High wind (6)	2	1	2	1	1		1	1	3	1			13
Tailwind (6)		4	4	3	4	2	1	4	1	4		1	28
Total hazard class citations	3	11	11	9	7	7	5	6	7	5	2	4	77
Frequency per 100,000 flight-hours	0.06	0.18	0.27	0.22	0.20	0.16	0.15	0.19	0.22	0.14	0.05	0.10	0.16
2006 goal	0.0243												
2006 projection	0.1048												
G. Electrical Hazards													
Lightning (2)	1												1
Total hazard class citations	1	0	0	0	0	0	0	0	0	0	0	0	1
Frequency per 100,000 flight-hours	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2006 goal	0.0020												
2006 projection	0.00												
H. Airborne Solids Hazards													
Sand/dust storm (1)										1			1
Total hazard class citations	0	0	0	0	0	0	0	0	0	1	0	0	1
Frequency per 100,000 flight-hours	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
2006 goal	0.0000												
2006 projection	0.01												

Table A-8a. Part 135 Weather Factor Trend Analysis, Fatal Accidents

	Factor Citations, Fatal Accidents												
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
A. Restricted Visibility and Ceiling Hazards													
Below Approach/Landing Minimums(1)									1				1
Clouds (1)	2	1	3	2		1	1	2		2	1		15
Fog (1)	3	2	2	2	1	2		1	2	4			19
Low ceiling (1)	6	5	4	1	2	5	3	3	2	3		1	35
Obscuration (1)	2	1						1				3	7
Whiteout (1)			1		1	1	1			1			5
Total hazard class citations	13	9	10	5	4	9	5	7	5	10	1	4	82
Frequency per 100,000 flight-hours	0.25	0.15	0.25	0.12	0.11	0.21	0.15	0.22	0.15	0.28	0.02	0.10	0.17
2006 goal	0.04												
2006 projection	0.14												
B. Precipitation (Non-Icing) Hazards													
Rain (1)	1			1		1			1	1			5
Snow (1)	1			2	1	1	1	0	1			1	8
Drizzle/mist (1)		1						1					2
Total hazard class citations	2	1	0	3	1	2	1	1	2	1	0	1	15
Frequency per 100,000 flight-hours	0.04	0.02	0.00	0.07	0.03	0.05	0.03	0.03	0.06	0.03	0.00	0.03	0.03
2006 goal	0.0056												
2006 projection	0.029												
C. Icing Hazards													
Icing conditions (5)	1	1	2	2	1	2	2	1	1	2			15
Freezing rain (5)								1					1
Carburetor Icing Conditions (9)													0
Total hazard class citations	1	1	2	2	1	2	2	2	1	2	0	0	16
Frequency per 100,000 flight-hours	0.02	0.02	0.05	0.05	0.03	0.05	0.06	0.06	0.03	0.06	0.00	0.00	0.03
2006 goal	0.004												
2006 projection	0.026												

Table A-8b. Part 135 Weather Factor Trend Analysis, Fatal Accidents

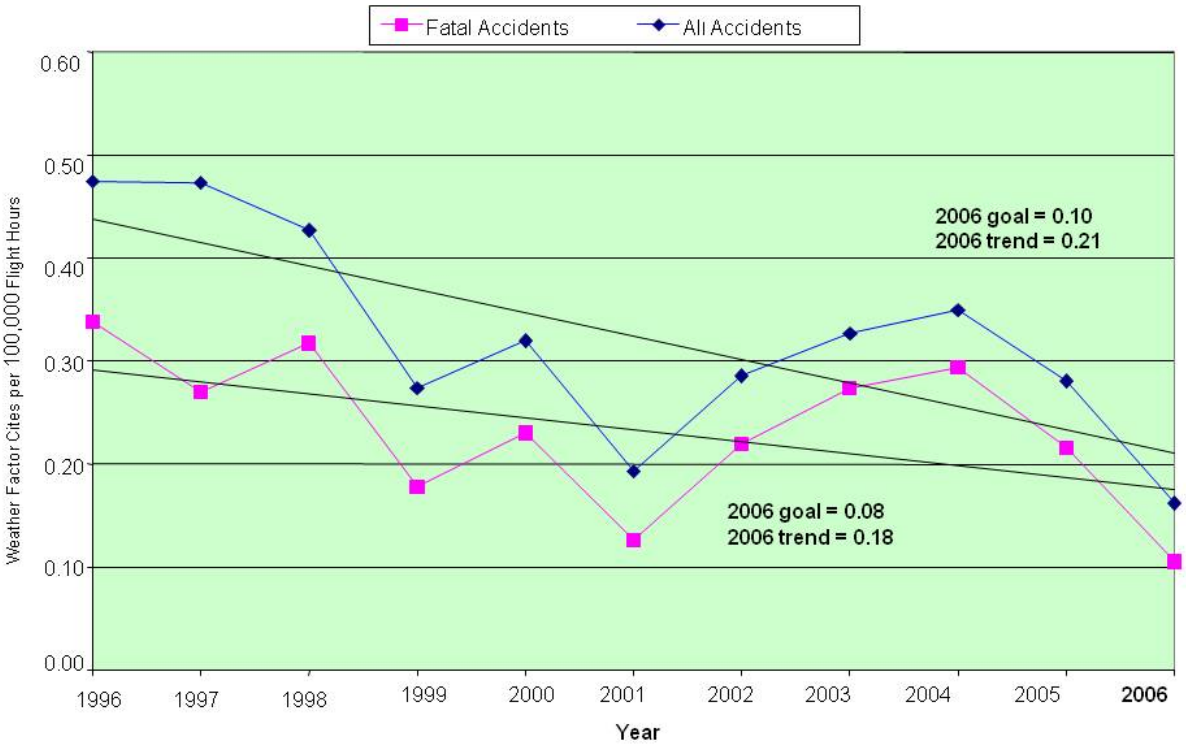
	Factor Citations, Fatal Accidents												
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
D. Turbulence and Convection Hazards													0
Turbulence (thunderstorms) (2)						1							1
Thunderstorm (2)									1	2			3
Downdraft (2)	1		1						2				4
Microburst/wet (2)											1		1
Gusts (6)		1								1			2
Windshear								1	1				2
Sudden windshift (6)													0
Variable wind (6)													0
Turbulence (7)													0
Turbulence (convective induced) (7)										1			1
Turbulence in clouds (7)	1												1
Mountain wave (7)											1		1
Turbulence (terrain induced) (7)	1		1								1		3
Total hazard class citations	3	1	2	0	0	1	0	1	4	4	3	0	19
Frequency per 100,000 flight-hours	0.06	0.02	0.05	0.00	0.00	0.02	0.00	0.03	0.12	0.11	0.07	0.00	0.04
2006 goal	0.008												
2006 projection	0.067												
E. Temperature and Lift Hazards													
High density altitude (6)	1				1								2
Temperature, low (6)				1									1
Total hazard class citations	1	0	0	1	1	0	0	0	0	0	0	0	3
Frequency per 100,000 flight-hours	0.02	0.00	0.00	0.02	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
2006 goal	0.002												
2006 projection	0.000												

Table A-8c. Part 135 Weather Factor Trend Analysis, Fatal Accidents

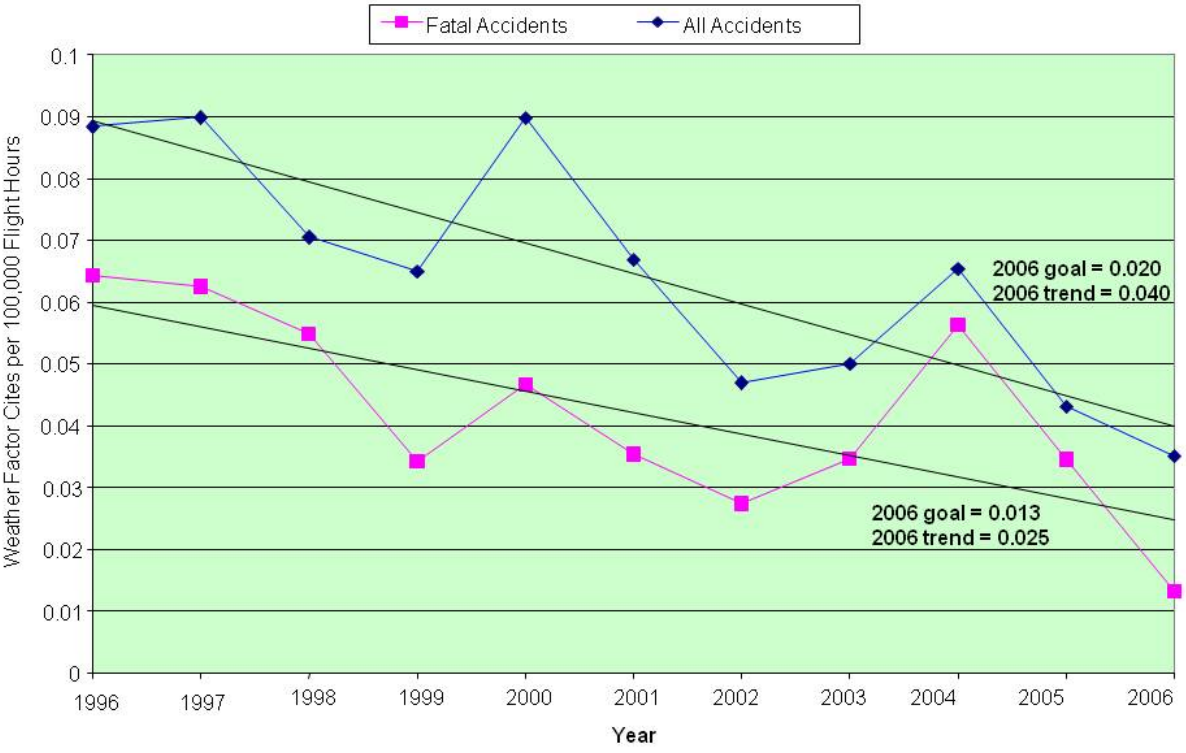
	Factor Citations, Fatal Accidents												
	1995	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**Total**
F. En Route and Terminal Winds													
Unfavorable wind (3)												1	1
Crosswind (6)								1	2		1		4
High wind (6)	1	1	1	1				1	3				8
Tailwind (6)		1							0			1	2
Total hazard class citations	1	2	1	1	0	0	0	2	5	0	1	2	15
Frequency per 100,000 flight-hours	0.02	0.03	0.02	0.02	0.00	0.00	0.00	0.06	0.15	0.00	0.02	0.05	0.03
2006 goal	0.0053												
2006 projection	0.052												
G. Electrical Hazards													
Lightning (2)													0
Total hazard class citations	0	0	0	0	0	0	0	0	0	0	0	0	0
Frequency per 100,000 flight-hours	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2006 goal	0.000												
2006 projection	0.000												
H. Airborne Solids Hazards													
Sand/dust storm (1)										1			1
Total hazard class citations	0	0	0	0	0	0	0	0	0	1	0	0	1
Frequency per 100,000 flight-hours	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
2006 goal	0.000												
2006 projection	0.000												

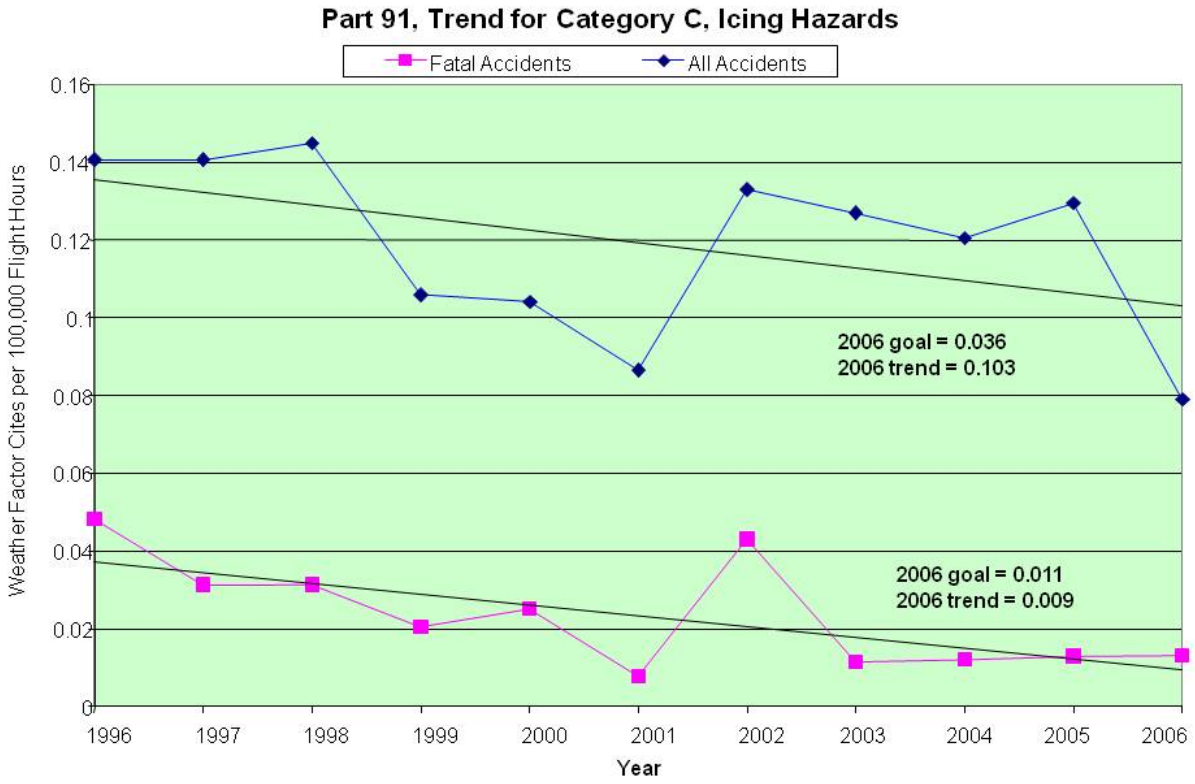
APPENDIX B
GRAPHS OF WEATHER-RELATED ACCIDENT DATA SERIES BYWEATHER HAZARD CATEGORYWITHIN NTSB CATEGORY OF OPERATION

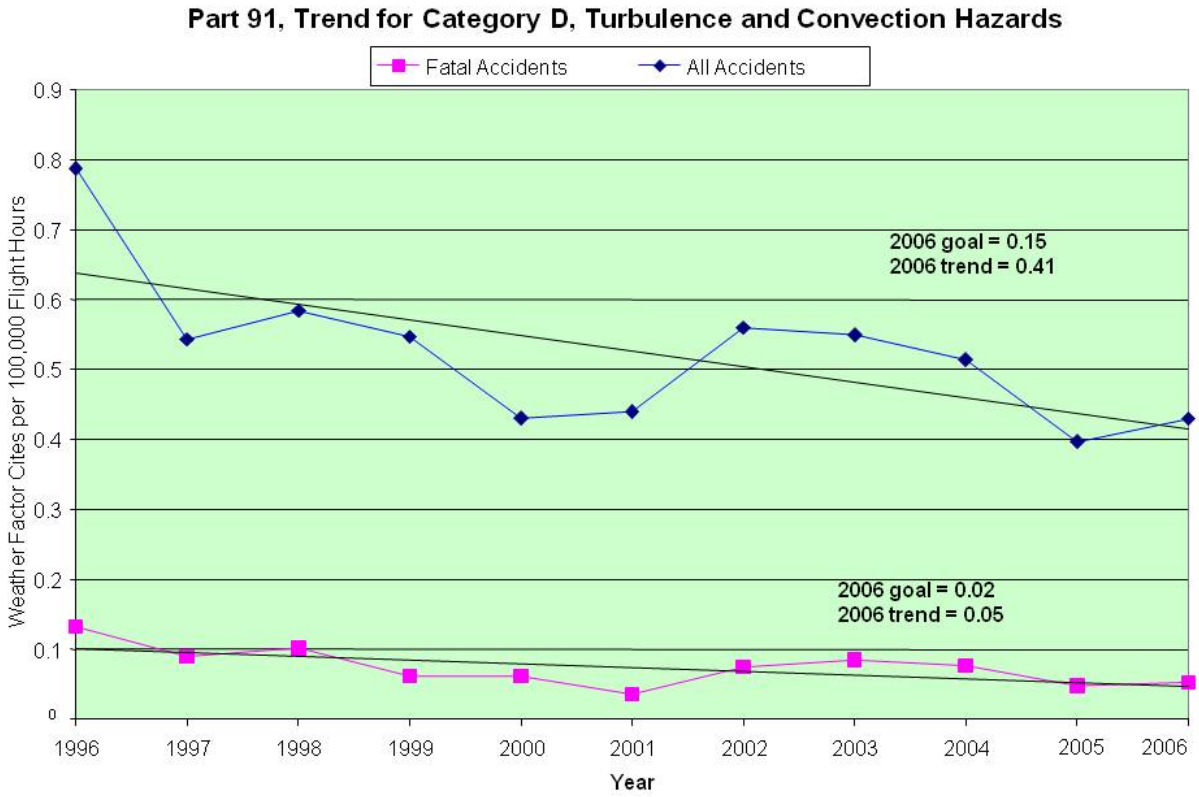
Part 91, Trend for Category A, Restricted Visibility and Ceiling Hazards



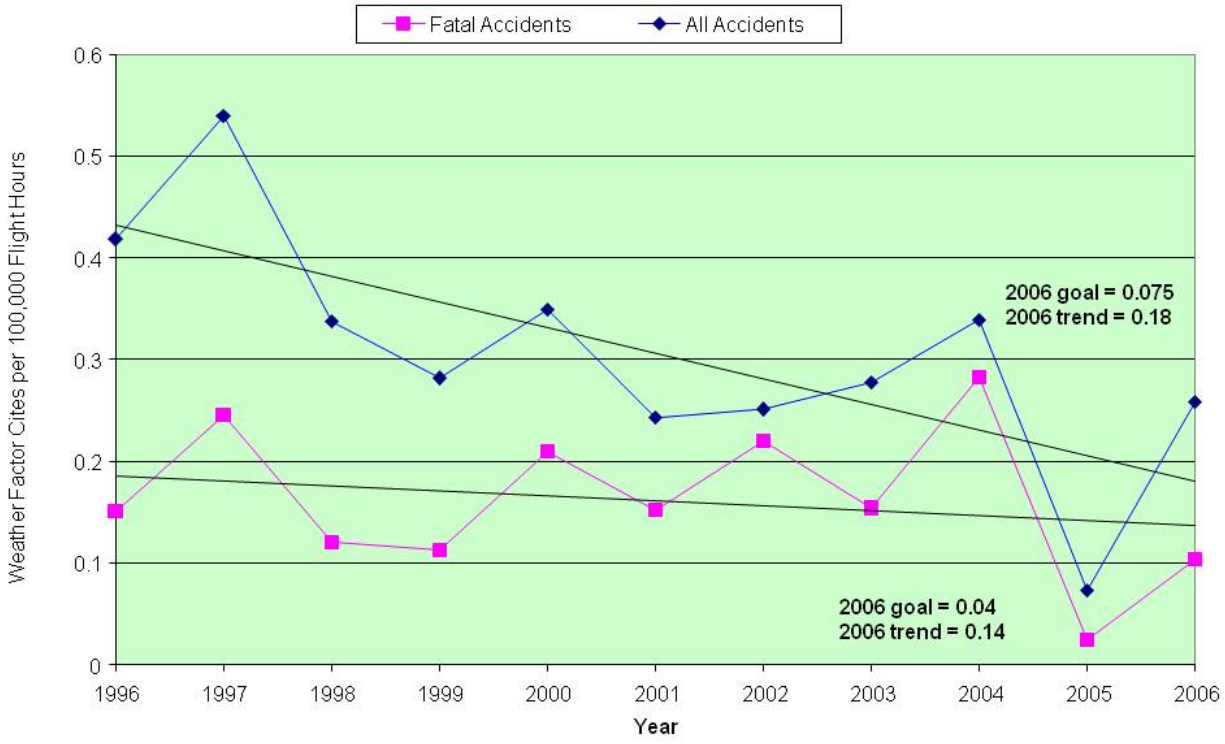
Part 91, Trend for Category B, Precipitation (Non-Icing) Hazards



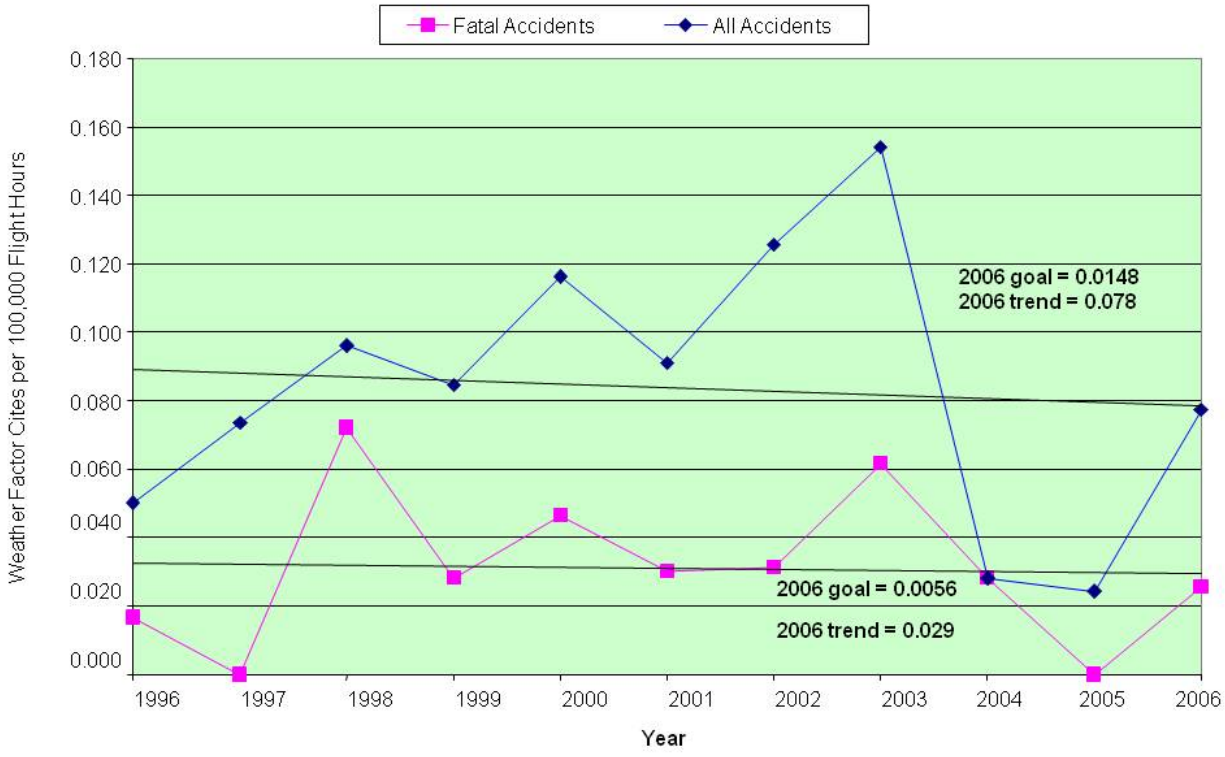

Part 91, Trend for Category C, Icing Hazards
Fatal Accidents
All Accidents
Weather Factor Cites per 100,000 Flight Hours
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2006 goal = 0.036
2006 trend = 0.103
2006 goal = 0.011
2006 trend = 0.009
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Year


Part 91, Trend for Category D, Turbulence and Convection Hazards
Fatal Accidents
All Accidents
Weather Factor Cites per 100,000 Flight Hours
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
2006 goal = 0.15
2006 trend = 0.41
2006 goal = 0.02
2006 trend = 0.05
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
Year

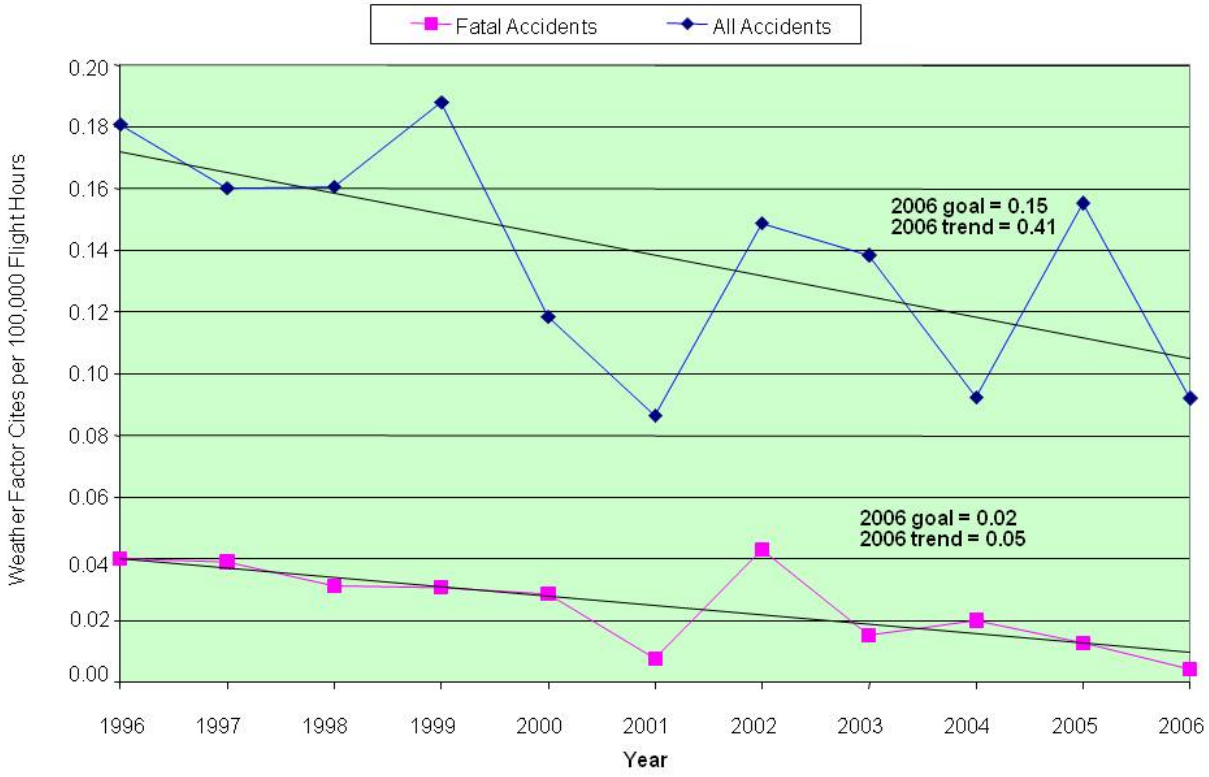
Part 135, Trend for Category A, Restricted Visibility and Ceiling Hazards



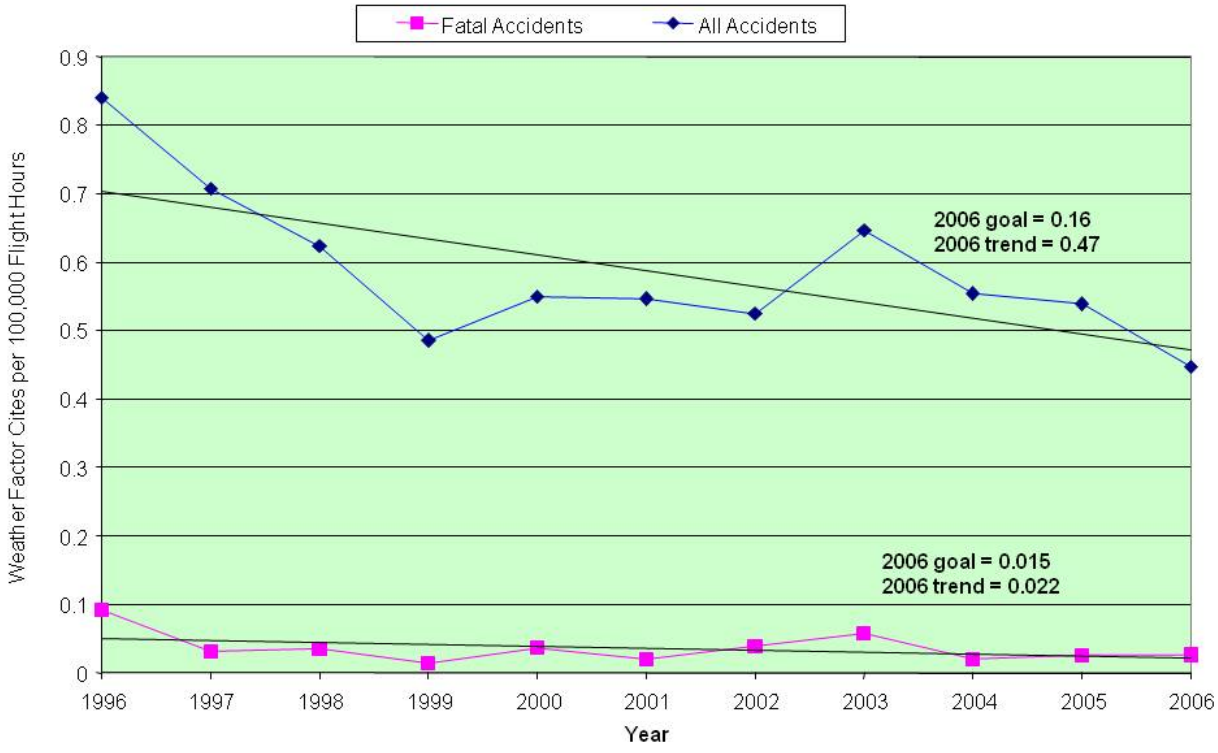
Part 135, Trend for Category B, Precipitation (Non-Icing) Hazards



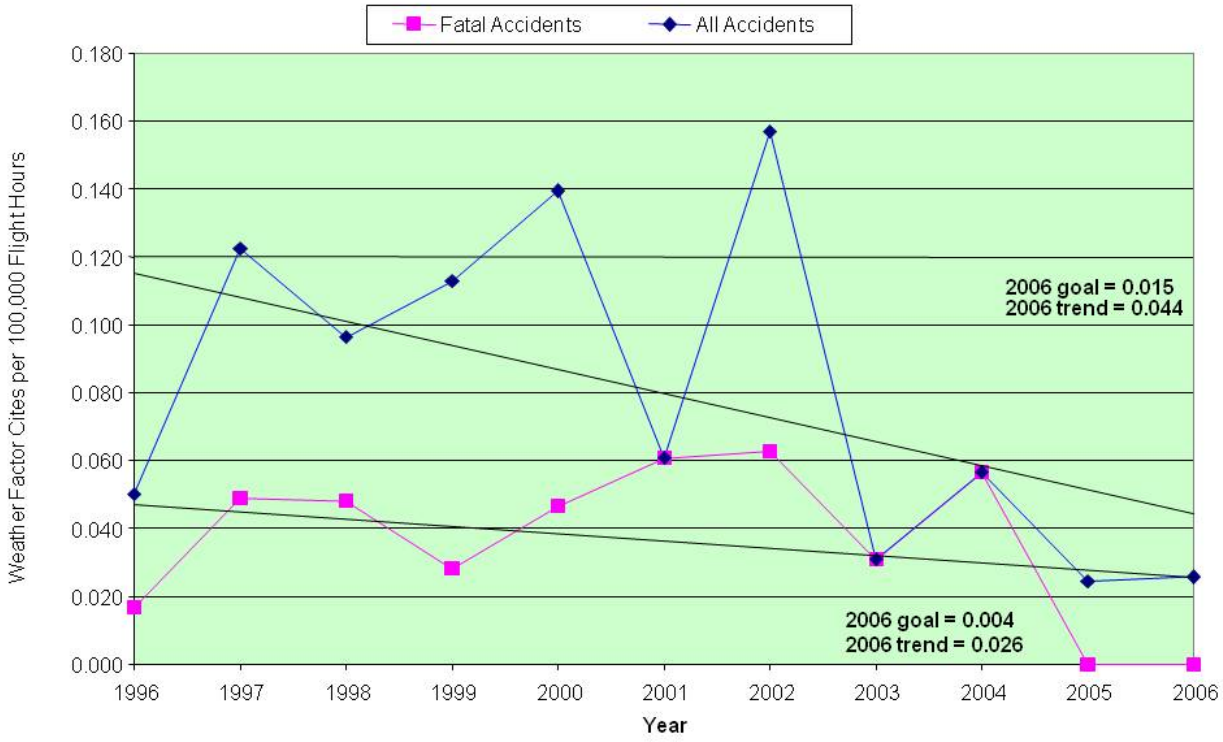
Part 91, Trend for Category E, Temperature and Lift Hazards



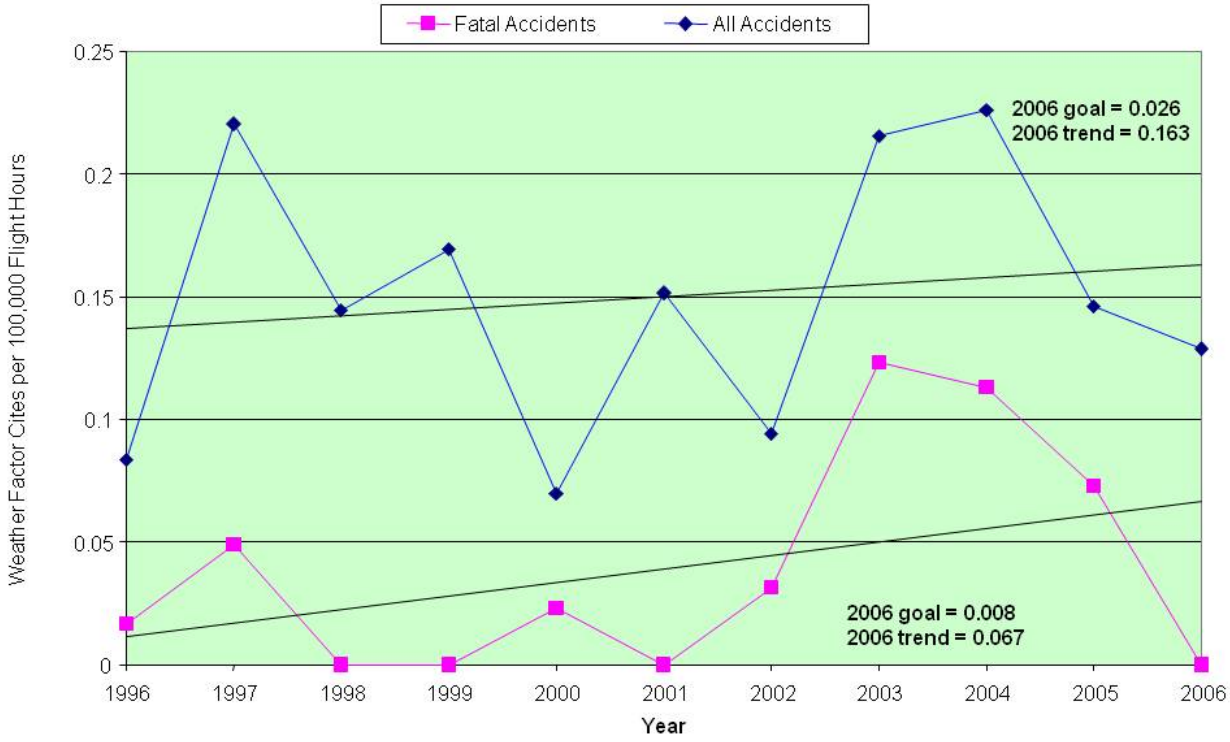
Part 91, Trend for Category F, En Route and Terminal Winds



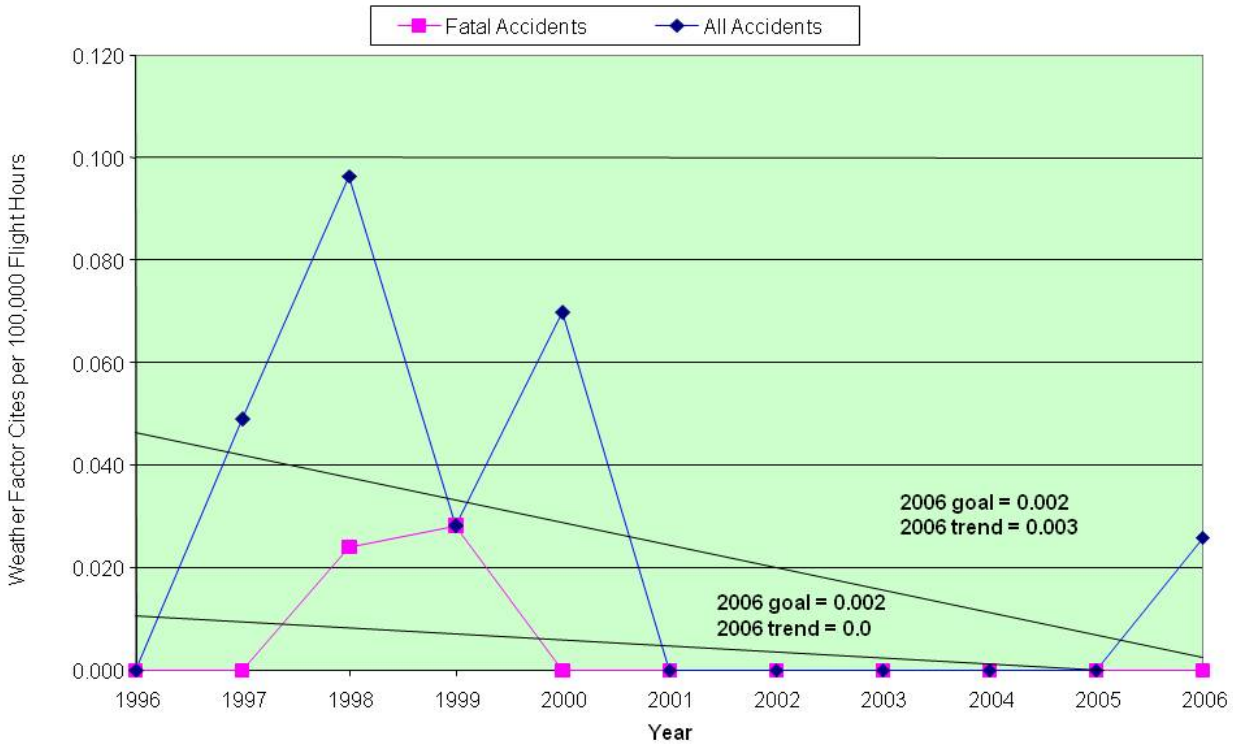
Part 135, Trend for Category C, Icing Hazards



Part 135, Trend for Category D, Turbulence and Convection Hazards



Part 135, Trend for Category E, Temperature and Lift Hazards



Part 135, Trend for Category F, En Route and Terminal Winds