

COLD FRONT AND ITS INFLUENCE ON WEATHER AT AIRPORTS IN WESTERN SLOVAKIA

Miriám Jarošová

Air Transport Department
University of Žilina
Univerzitná 8215/1
010 26, Žilina
miriam.jarosoval@fpedas.uniza.sk

Abstract

Weather is limiting factor in planning of our activities. We often have to change our plans to avoid problems that the weather could bring. Transport, especially air transport is very sensitive to sudden changes of weather. For any mode of transport, safety, speed and efficiency is heavily dependent on current and expected weather conditions. Therefore, it is important to know very well the phenomena related to the atmosphere and selected mode of transport.

Keywords

Cold front, dangerous weather phenomena, aviation

1. Why frontal area is so dangerous?

Weather is one of the most critical factors relating to safe air transport. (Galieriková, Materna & Sosedová, 2018). One of the most dangerous weather events in the atmosphere in our latitudes is the movement of the frontal interface. (Dvořák, 2010). Frontal interfaces are related to the low air pressure area and can be divided into warm, cold and occlusive according to the prevailing processes in the atmosphere associated with them. Cold frontal interface is probably the most dangerous weather phenomenon for aviation.

When a cold front pass through the area, a cooler mass of air, which moves forward as a "front" replaces a warmer mass of air by lifting it as it passes. By lifting warmer air, the cold front helps to form a distinctive, often very massive, convection clouds. Because the cold front moves faster, often up to about 50 km / h, the cold front brings more intense weather (Zverev, 1986).

2. How could cold front be detected?

Cold cloud cover can be determined relatively easy.

There are cumulonimbus type clouds near the frontal line. Thunderstorms, heavy rains, and squalls are formed - especially in the summer months. In aviation, it is necessary to count on heavy icing, turbulence, electrical activity, downburst and also heavy rains and hail. Behind the front, one can expect the following cloud types:Ns, As, Cs, Ci. (Zverev, A)

In general, the cold front is more significant during summer days, when the conditions for air instability are the most suitable (Bednář et al., 1993).

3. How do individual meteorological elements change before arrival of the front?

The temperature is stable or slightly rises up before the arrival of the front. The temperature drops significantly after the transition, but it has a variable character in the rainfall zone.

Visibility is very good, it worsens in the rainfall zone, it is lower when there are heavy showers and thunderstorms. Atmospheric pressure steadily decreases with the approach of a cold front; with frontal passage, the pressure rises sharply. Before the arrival of a cold front, there are rain showers falling out of the cumulous clouds in the range of 50 - 100 km from the front line. After the passage of the cold front, the sky usually clears. The precipitation zone reaches approximately 200 km from the front line. Before the arrival of a cold front, the prevailing wind direction is SE to S. Wind speed increases with the approach of the front. Heavy winds are also typical. After the passage of a cold front, the prevailing wind direction is S to NW due to a cold advection that turns the flow to the left (Dvořák, 2010).

4. Work methodology.

METAR reports and reports from the SHMU Bulletins were used to analyse the occurrence of the Cold Fronts across the country and its occurrence at international airports in western Slovakia. Data from 2014 to 2017 were analysed for Bratislava, Piešťany and Žilina international airports. However, more detailed analysis would require data from a longer period of time, but these years will give us some idea of the behaviour of the advancing cold front in western Slovakia. Analysis of the meteorological information revealed:

In the period of 2014 - 2017, a total of 188 cold fronts were registered in Slovakia, an average of 47 cold fronts each year. The table contains numerical expression as well as the percentage occurrence of the phenomenon. The following information was recorded at the selected stations:

Table1: Summary of phenomena observed during the cold front process as analysed by METAR 2014-2017. Source: Author.

	Bratislava	Piešťany	Žilina
Strong wind	161 85 %	123 65 %	64 34 %
Lower visibility	69 37 %	98 52	95 51 %
Convective clouds/thunderstorm	52/28 thunderstorm 28 % / 54 %	28/14 thunderstorm 15 % / 50 %	43/35 thunderstorm 23 % / 81 %
Precipitation	75 40 %	82 44 %	109 58 %

The table shows that the cold front most frequently occurred as a strong wind at the Bratislava and Piešťany airports. At the Airport Žilina, it occurred in the form of precipitation that impaired visibility. The least apparent phenomenon at each airport is convective clouds and thunderstorms, but this figure is greatly distorted by the storm season, which usually lasts in the warm months of the year - roughly from March to October. If TCU and CB cloud cover were not taken into account, the least visible phenomenon at Bratislava airport would be impaired visibility. In Piešťany, the phenomenon with the least occurrence is rainfall. In Žilina, the phenomenon with the least occurrence is strong wind, which occurred 3 times less in comparison with Bratislava and about 2 times less when compared with Piešťany. In the case of strong winds, there is a risk of crosswinds or wind shear, which can be dangerous during take-off and landing phases. It can also cause damage to the aircraft. Visibility in the event of very rapid deterioration, with the rapid onset of precipitation, is mainly a problem for VFR or less experienced pilots (Záhumenský, 1998). Thunderstorms, or globally convective clouds, are particularly dangerous due to severe turbulence, possible discharges, reduced visibility, showers and thunderstorms with a potential hailstorm. The storm also interrupts the airport operations because operations in storm could lead to injuries of ground personnel due to lightning strikes or another related phenomenon. The interruption of airport operations may have a significant effect on the delay of the check-in and therefore it negatively influences on the time performance of flights. Of course, all of the phenomena mentioned here may affect the overall delay or even diversions to other airports.

There are some aspects of the cold front evident from the analysis. The atmospheric pressure drops before the arrival of the front. After the passage of the front, the prevailing wind direction is W and NW, TCU and CB type clouds are present (especially in summer), permanent precipitation is present and temperature drops.

5. Conclusion

The weather changes gradually as the cold front progresses through the territory. Many of the weather changes are very evident and affect operational conditions of airports. When forecasting the progress of the cold front, meteorologists must take into account dangerous phenomena that are connected to the front and they vary between airports (Novák Sedláčková, 2018). A The proper forecast can improve the safety of air traffic and it can increase quality and comfort of air transport.

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