

Investigation of the Meteorological Aerodrome Warnings of the Atatürk International Airport Meteorology Office

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Abstract

Meteorological aerodrome warnings that were prepared and published by the Istanbul Atatürk International Airport Meteorology Office in Istanbul were analyzed in this study. A 1-year period, from April 1, 2016 to April 1, 2017, was selected as the study period. A total of 60 meteorological aerodrome warnings and nine meteorological evaluation reports were prepared and published. Aerodrome warnings were analyzed, including eight different meteorological events and combinations of these events. Meteorological aerodrome warnings were made in response to the following events: thunderstorms (27 warnings; 45%), surface wind speeds ≥ 30 kn and gusts ≥ 30 kn (13 warnings; 21.7%), and wind speeds ≥ 20 kn and gusts ≥ 30 kn with snow (12 warnings; 20.0%). The consistency of these events were 77.8%, 76.9%, and 100%, respectively. The consistency of all events was 83.3%. The consistency of nine meteorological evaluations was 88.9%.

Introduction

Meteorological aerodrome warnings are prepared and published when meteorological events occur or are predicted to occur that are important to flights. The area covered by these warnings includes the airport and its surroundings. Warnings can be released for a single event or for more than one event. The purpose of preparing and publishing meteorological aerodrome warnings is to warn the authorities in charge of operating the airports in a timely manner to ensure that necessary precautions are taken. We can define the scope of the meteorological aerodrome warnings as follows: services for flight operations at airports include informing about meteorological events that are important for aeronautics in the event that parked aircraft are adversely affected or expected to be impacted in the future [1].

As a result of competition in the aviation sector, air transportation has grown immensely in recent years. Accordingly, passenger and commercial aircraft traffic, the number of passengers, baggage, cargo, and mail have increased considerably. In 2007 to 2018, Turkey's total aircraft traffic increased by 124.3%, commercial air traffic increased by 133.4%, passenger traffic increased by 200.1%, and load traffic increased by 166.3% (Table 1) [2].

Istanbul Atatürk International Airport has the highest rate of air traffic in Turkey, followed by the Istanbul Sabiha Gokcen International Airport located in Istanbul. Except for transit passages, total aircraft traffic is 1,544,169 units (data from 2018) (Table 1). Istanbul Atatürk International Airport accounts for

30.1% (464,646) and Istanbul Sabiha Gokcen International Airport accounts for 15.0% (232,275) of all aircraft traffic. There are a total of 210,498,164 passengers; of these passengers, 112,911,108 are domestic passengers and 97,587,056 are international passengers. Istanbul Atatürk International Airport accounts for 32.3% (68,346,784) of the total number of incoming and outgoing passengers. Based on these data, Istanbul Atatürk International Airport is the largest airport in Turkey for passenger and aircraft traffic [2].

Istanbul is located in the northwest part of the Republic of Turkey. The Black Sea is north of Istanbul and the Marmara Sea is south of the province. The Bosphorus, which bisects the city of Istanbul, connects two seas (Black Sea and Marmara Sea) (Fig. 1). Istanbul is the most populous province in the Republic of Turkey (total population of 15,067,724 people, data from 2018, [3]). Istanbul Atatürk International Airport (40°58'34"N, 28°48'50"E) is north of the Marmara Sea and is the largest airport in Istanbul. The airport is 49.75 m high and the width of the terminal building is 345.270 m² (Fig. 1) [4] – [7].

In this study, 527 fatal accidents were identified in a 10-year period (2005 to 2014) of the accident-incident reports in the European Region [8]. Of these fatal accidents, 40% were due to technical reasons, 31% were caused by pilotage, 15% were caused by meteorological events, and 14% were due to other causes (passenger, tower fire). The aviation sector is growing and its importance is increasing day-by-day. The number of aviation studies in Turkey is also increasing [9] – [11]. Additionally, many national and international studies about aviation meteorology have been published [12] – [20].

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Year	All Aircraft Traffic	Commercial Aircraft Traffic	Passenger Traffic (incoming-outgoing)	Load Traffic (Luggage+Cargo+Mail) (Ton)
2007	688,468	573,835	70,296,532	1,447,603
2008	741,765	653,317	79,438,289	1,644,014
2009	788,469	693,210	85,508,508	1,726,345
2010	919,411	809,141	102,800,392	2,021,076
2011	1,042,369	892,139	11,7620,469	2,249,473
2012	1,093,047	946,897	13,0351,620	2,249,134
2013	1,223,795	1,059,391	149,430,421	2,595,318
2014	1,345,954	1,159,837	165,720,234	2,893,000
2015	1,456,673	1,254,615	181,074,531	3,072,830
2016	1,452,995	1,234,635	173,743,537	3,076,914
2017	1,500,457	1,272,341	193,045,343	3,481,211
2018	1,544,169	1,339,301	210,947,639	3,855,231

Table 1: Number of all aircraft, commercial aircraft, and passenger and freight traffic information for Turkey between 2007–2018 (except transit).

The aviation sector in Turkey has grown by over 100% in the last nine years. As a result, the need for aeronautical meteorology at airports continues to increase day-by-day. In order to make flights safer, the need for airport notices has increased in parallel with the development and growth of the aviation sector in Turkey. The purpose of this study is to analyse the meteorological aerodrome warnings prepared by the Istanbul Atatürk International Airport within a 1-year period, from 1 April 2016 to 1 April 2017, and to make recommendations.

Data and Methodology

According to [21], “Aerodrome warnings should be prepared by the airport meteorological office. These warnings will pro-

vide precise information about expected meteorological conditions that may adversely affect aircraft on the ground, including parked aircraft, airport facilities, and services”. As a recommendation, if the expected conditions at the airport do not occur and/or are no longer expected, these warnings should be canceled.

If one or more of the following meteorological phenomena occur or are predicted to occur, a meteorological aerodrome warning is issued (Table 2) [21]).

In Turkey, the acceptable threshold value for wind gusts is 30 knots, whereas the threshold value is 28 knots in the UK (United Kingdom) [22]. As a recommendation to [21], for example, criteria and thresholds for the expected maximum wind speed or expected total snow accumulation warning should be determined by meteorological offices and the respective users of each airport.

Meteorological aerodrome warnings prepared and published by the Istanbul Atatürk International Airport Meteorology Office in Istanbul were analyzed in this study (according to Table 2). A 1-year study period, from April 1, 2016 to April 1, 2017, was selected.

The Istanbul Atatürk International Airport Meteorology Office is affiliated with the Turkish State Meteorological Service. Meteorological aerodrome warnings prepared by the Istanbul Atatürk International Airport Meteorological Office were analyzed according to Table 2. Meteorological Terminal Air Report (METAR) reports, routinely prepared by the Istanbul Atatürk International Airport Meteorology Office, were used to assess the consistency of the meteorological aerodrome warnings. It has also benefited from the Aviation Selected Special Weather Report (SPECI).



Fig. 1: Location of Atatürk International Airport.

Tropical cyclone (10-minute mean surface wind speed should be expected to be 17 m/s or more)	Thunderstorm	Hail
Snow (includes observed snow accumulation or expected)	Freezing precipitation	Hoar frost or rime
Snow storm	Dust storm	Rising sand or dust
Strong surface wind and gusts (average 20 kt or more, and/or 30 kt or more for gust)	Squall	Frost
Volcanic ash	Tsunami	Volcanic ash or its deposition
Toxic chemicals	Other phenomena	-

Table 2: Meteorological events that require meteorological aerodrome warnings.

If a meteorological aerodrome warning corresponded to more than one expected meteorological event, the expected occurrence of a meteorological event at Istanbul Atatürk International Airport was considered to be 100% consistent. In addition, vicinity (within 16 km) that occurred in visibility in the assessment of thunderstorms is included in the evaluation of thunderstorms.

Analysis, Results and Discussion

During the 1-year study period between April 1, 2016 and April 1, 2017, 60 meteorological aerodrome warnings and nine meteorological evaluation reports were made by the Atatürk International Airport Meteorological Office. Thunderstorms were the most reported meteorological event, accounting for 45% of the total, followed by average wind value and/or gust value with a rate of 21.7% (Table 3). This information was also presented in the meteorological evaluation reports when the Istanbul Atatürk

International Airport Meteorological Office needed to produce a report of the meteorological aerodrome warning for the average wind value and the gust value.

Between April 1, 2016 and March 31, 2017, nine meteorological evaluations were conducted, including one with an expected temperature of 30°C or higher, four concerning fog and its dispersion, one concerning wind and temperature decrease, two concerning wind and precipitation, and one concerning wind. Only one of these meteorological assessments was a false alarm.

Some of these meteorological warnings appear to have been made approximately 24 hours before the event, which is a very long time. Considering that models run by the General Directorate of Meteorology are updated every six hours, there is a benefit in terms of consistency when not used for such a long period. In addition, meteorological aerodrome warnings for four or five-day forecasts are made on the challenge notices, during which the forecast period is very long.

	Just thunderstorm event	Surface wind speed is 20 kn or more with thunderstorm	Gust is 30 kn or more with thunderstorm	Surface wind speed is 20 kn or more and gust is 30 kn or more with thunderstorm	Surface wind is 20 kn or more	Surface wind speed is 20 kn or more and gust is 30 kn or more	Just snow event	Wind speed is 20 kn or more and gust is 30 kn or more with snow	Total
Number of aerodrome warnings	27	1	2	2	1	13	2	12	60
True alarm	21	1	1	2	1	10	2	12	50
False alarm	6	-	1	-	-	3	-	-	10
% True alarm	77.8	100	50	100	100	76.9	100	100	83.3
% False alarm	22.2	-	50	-	-	23.1	-	-	16.7

Table 3: Between April 1, 2016 and March 31, 2017, meteorological aerodrome warnings prepared by the Atatürk International Airport, true and false alarm situations as well as their percentages and totals.

On May 2, 2016, the meteorological aerodrome warning (30 warning number) was made to indicate three periods (17 hours and 30 minutes, 21 hours and 30 minutes, and 44 hours and 30 minutes) in which a two-hour period was to contain a thunderstorm with rain showers. This plaintiff's report reduced the predictive coherence of predictions made for thunderstorms to zero in three different times. The incident did not occur during the three time periods. In the selected days thunderstorm showers occurred but not at the specified times. Consequently, if a thunderstorm is expected, nowcasting products should be used, such as radar, lightning tracking systems, and satellite images. There is no need to have a meteorological aerodrome warning announcement in advance.

Meteorological aerodrome warnings should only be made for the meteorological events shown in Table 2. Light rainfall, temperature expectancies, low-intensity wind forecast are not included in Table 2, and these should not be included in meteorological aerodrome warnings. Also, meteorological aerodrome warnings should be given when the duration of expected thunderstorms exceed 2 hours, taking into consideration that thunderstorms lasted for 7.5 hours in 2009 (8-9 September) and 2010 (23 June) [6].

Conclusions and Suggestions

In this study, meteorological aerodrome warnings prepared and published by the Istanbul Atatürk International Airport Meteorology Office in Istanbul were analyzed. The 1-year period between April 1, 2016 and April 1, 2017 was selected as the working period. A total of 60 meteorological aerodrome warnings and nine meteorological evaluation reports were prepared and published. The aerodrome warnings analyzed in the study included eight different meteorological events and combination of these events. Meteorological aerodrome warnings were made in response to the following events: thunderstorms (27 warnings; 45%), surface wind speeds ≥ 30 kn and gusts ≥ 30 kn (13 warnings; 21.7%), and wind speeds ≥ 20 kn and gusts ≥ 30 kn with snow (12 warnings; 20.0%). The consistency of these events were 77.8%, 76.9%, and 100% respectively. The consistency of all events was 83.3%. The consistency of nine meteorological evaluations was 88.9%.

A list of proposals to be used in the preparation of meteorological aerodrome warnings are listed below:

1. As used by the Met Office in the UK, the maximum period of validity of the notifications must be six hours and, if necessary, reconstructed every six hours.
2. Thunderstorm warnings must be made within a maximum of 30 minutes in advance (nowcasting, satellite, radar, and lightning observations must be used).
3. The expected period should be more than two hours and should be in the expected range (such as four hours, six hours).

4. Meteorological aerodrome warnings should be released only if the event/events are specified in the warnings.
5. In addition to making meteorological evaluations, the authorities of the aerodrome should also take into consideration the cloud ceiling height and the closeness of a fog incident, or waiting for the temperature to exceed 30°C (other phenomena of Table 2).
6. No warnings should be made more than six hours in advance.
7. Abolition of synoptic observations at airports (reduction of workload).
8. The automatic construction of METAR and SPECI observations at airports, and the specialisation of personnel on topics such as satellite, radar, lightning, digital weather forecasting, and research.

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