Atmospheric Research 93 (2009) 93–98

Contents lists available at ScienceDirect

Atmospheric Research

journal homepage: www.elsevier.com/locate/atmos

Statistical analysis of the storms event at the airdrome Baku Modeling of the accuracy isolines of the storms registration systems

Nazim Huseynov, Bahruz Malikov *

National Academy of Aviation, Azerbaijan

ARTICLE INFO

Article history:
Accepted 18 November 2008

Keywords:
Storms
Statistical analysis
Electromagnetic waves
Mathematical modeling
Spatial coordinates
Data processing

ABSTRACT

In this article the brief climatic characteristic of storms at the airdrome Baku (Azerbaijan) is investigated on the basis of the statistical analysis of observation data for the period 1999–2007. Further program modeling of accuracy isolines of storm registration systems is developed on the basis of the mathematical method.

1. Introduction

Studies of the physics of severe-storm phenomena are the task of primary importance in the science of applied meteorology.

In aeronautical meteorology, definition of physical and climatic peculiarities of storms in a certain geographical region, and precise definition of their coordinates is important for maintenance of aircrafts on ground as well as flight routes, thus it generally serves safety.

In this article the brief climatic characteristic of storms at the airdrome Baku (Azerbaijan) is investigated on the basis of the statistical analysis of observation data for the period 1999–2007. Further program modeling is developed on the basis of method of mathematical calculation of accuracy isolines of storm registration systems.

In an effort to achieve satisfactory experimental and theoretical results, modern technologies (Doppler radars, lightning detection networks, etc.) whose measurements are based on distinctive physical properties of storm clouds (e.g. the reflection and emission of electromagnetic waves) are utilized to locate and track storms.

Development of a storm-detection network necessitates the determination of the precision and accuracy of the resultant measurements.

Toward this end, a software package has been developed which is a mathematical model of the accuracy isolines of the storm-cloud detection network.

The mathematical model has been applied to the data collected by the lightning-detection network at the international airports of the Azerbaijan Republic.

2. Climatic peculiarities of storms development

According to the results of statistical analyses (Bruks and Krauzers, 1963) the main annual storms event in this area is defined as 14 days. Rear storms at the Absheron peninsula (where the airdrome Baku is located) is conditioned by the climatic peculiarities of this region. In Fig. 1, the main monthly event of Cb and storms (N_s) at the airdrome Baku is showed.

According to the statistics in September $N_s = 22.7\%$, in July and August $N_s = 17.5\%$ per each month. It is obvious, that winter Cb here doesn't develop highly enough to transform into storm.

* Corresponding author. Tel.: +994 50 429 7667; fax: +994 12 497 2758.
E-mail address: melikov@azans.az (B. Malikov).

0169-8095/$ – see front matter © 2008 Elsevier B.V. All rights reserved.
doi:10.1016/j.atmosres.2008.11.002

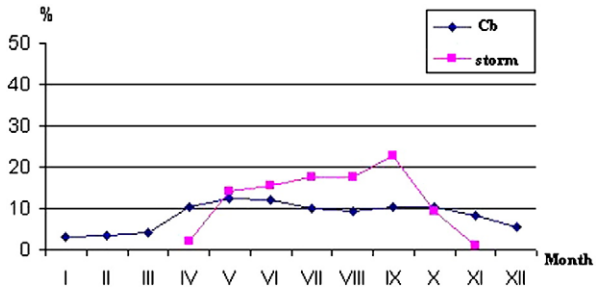

Fig. 1. Monthly average repeatability (%) Cb and storms.

On Fig. 2(a–d), daily course of Cb and storms for the periods of year is showed. Such seasonable investigation of daily course Cb and storms is connected with seasonal nature of the phenomena.

According to the diagram (Fig. 2a) during the winter period due to rather weak activity of convective processes in an atmosphere storms were not observed.

Storms in Absheron peninsula basically have a frontal origin, intramass is observed extremely seldom. Storms are usually formed in three types of synoptic conditions (Pashsayev et al., 2007):

1. Most frequently in a warm season when cold air masses from the Caspian Sea at the presence of relatively high pressure in warm air masses above Northern Africa advect in mid-tropospheric layer.
2. Intrusion of the cold air masses, on cold front.
3. In the course of year, particularly in the spring when the advected warm air masses on warm fronts can cause the development of storm activity.

Owing to location of the airdrome on a coast of the Caspian Sea, development of storm activity was restrained by breeze circulation. According to the climatic characteristic of storms on Absheron peninsula (Climate of Azerbaijan, 1968) they basically develop in second half of day: 2.6 h of the annual duration (65%) of storms comes to the period from 6 pm up to 6 am. During daytime – from 6 a.m. up to 6 p.m. storms are rather rare – only 1.5 h/year (35%).

According to Fig. 2a, in airdrome Baku during the winter period nighttime Cb sharply reduced and since early morning hours up to the midday sharply grow, further Cb sharply decreases and since evening hours till midnight go stable.

During the spring period storms were observed only in April (2.1%) as in March the surface of the ground doesn't get warm enough. According to the statistical data in April the main temperature is 10.3 °C though by the end of the month the temperature rises to 20–23 °C. According to Fig. 2b, during the daytime Cb has a stable course with insignificant fluctuations within 10–14%. The peak of storm activity comes in the morning at 7–9 a.m. and also sharp growth is observed in the evening.

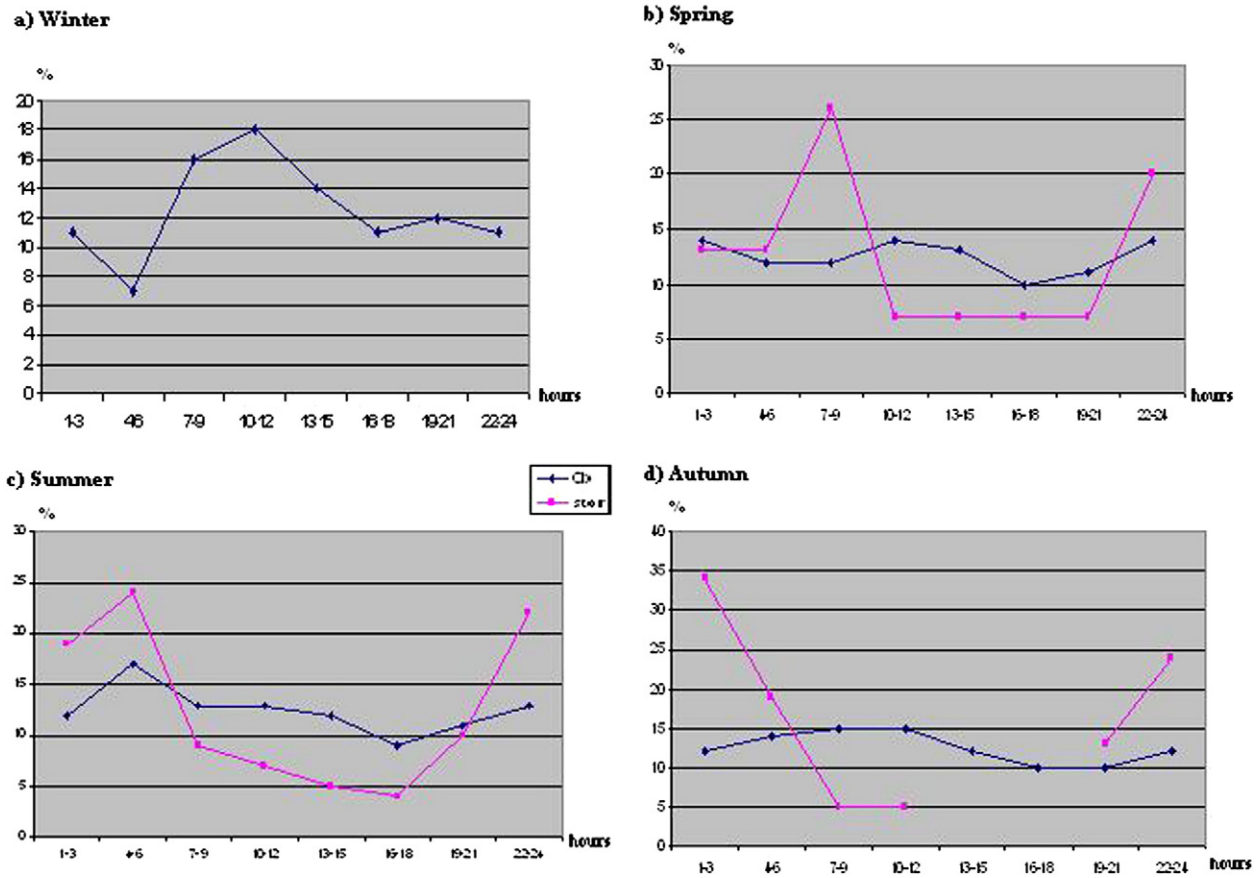

Fig. 2. Daily course of Cb and storms for the periods of a year.