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CLIMATOLOGY OF THE CLOUDINESS ON THE INTERNATIONAL AIRPORT ZUMBI OF PALMARES MACEIÓ - ALAGOAS – BRAZIL

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The presented research search to extract a climatologic treatment of the description and configuration of the behavior of clouds under the aerodrome of the International Airport being observed the months most favorable for the accomplishment of procedures of security in the air transportation. Objective also to study the predominance of heights of the cloud bases to the long of the year and esteem the diverse types of clouds with its main effect on the flights during the year of 2004, observed in the station of the Division of Aeronautical Meteorology of the International Airport Zumbi of Palmares (DMA/AIZP).

The landing and the take-off of aircraft depend mainly on the orientation of determined devices that lead the aircraft in these processes called for "procedures". An official procedure to guide the aircraft until a track, when a visual descending will not be possible, is called "instruments of approach procedures" (IAP in English). The IAP's describes the route and the altitude where an aircraft must fly to effect the transistion for the landing. There are two basic types of instruments of approach procedures (not necessary and necessary). The not necessary approaches do not make use of an electronic slope of glide destined to provide the vertical orientation necessary to land an aircraft. Examples of not necessary approaches include VOR/DME, NDB, localizer and GPS. The precision approaches have electronic slopes of glide that to provide necessary vertical orientation. The approach of more common precision is ILS (Instrument Landing System). The ILS is equipment that are indicate, with precision, the landing trajectory that the aircraft must follow, enabling the pilots to land in favorable meteorological conditions, with almost null visibility (ALLSTAR).

Other procedures are the ILS/DME that can be classified as CAT1 or CAT2, and the radar of approach. But these devices operate under pre-defined conditions, of which the horizontal visibility and the height of the bases of clouds under the aerodrome (that many times are assigned by "Ceiling") are the main ones. The comment of clouds and the conditions of the sky allows the pilots, many times, to delineate the atmospheric conditions that go to find during the flights. The clouds are constituted basically by drops of water or ice crystals, depending on the height where they develop. In aviation, the data are registered in the METAR, that is the abbreviation for Routine Meteorological Bulletin of Aviation; the report standard for the comments of time in the airports, emitted hourly. The United States had recently adopted the METAR in substitution to the QAM. A METAR includes the following information: type of report; assignment of the station; hour of the report; wind; visibility; conditions of the weather and blockages to the visibility; condition of the sky; temperature and dew point; adjustment of the altimeter and comments. Comment METAR uses the following form of codification: Cloud amount; Layers; Height of Clouds; Cloudiness. Fogaccia (2001) in its article on the "Analysis of Events of Turbulence and Shear of the Wind in the Area of the International Airport of São Paulo/Guarulhos" arrived at the conclusion of that some complementary studies are necessary so that the methodology of forecast in this direction is implemented in the operation of the Meteorological Centers of Aerodrome.

In view of the difficulty of if carrying through one detailed climatologic of clouds, on the basis of information METAR, had been applied the following criteria for the climatologic treatment: Sky covering, where, the information are given by order of layers, not being informed the total sky covering, the biggest indication of sky covering was taken as reference, or either, the layer that to present the biggest sky covering will have its considered reference as if was the total covering, much even this is kept, meaning that, at the very least, this covering has occurred. Height of the Base of Clouds, where, the height of the cloud layer was considered lowest, that does not correspond necessarily to the indicated sky covering previously. The clouds can be liquid (constituted of drops of water), solids (constituted of ice crystals) and mixing (constituted of drops of water and ice crystals). In accordance with the Cloud Atlases International of OMM (World Meteorological Organization) exist three types of clouds: High Clouds: base above of 6 km height - solid. Middle clouds: base enters 2 to 4 km height in the Polar Regions, km enters 2 to 7 km in average latitudes, and enters 2 to 8 km in the equator - liquid and mixing. Low clouds: base up to 2 km height - liquid (INMET). With relation to the flight conditions and its association with the diverse types of clouds

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acquainted in Cloud Atlases International (1956), edited World-wide the by Meteorological Organization it can, of summary form, to trace the following profile: Clouds of High stage (Cirrus, Cirrocumulus and Cirrostratus); Clouds of medium stage (Altocumulus, Altostratus) and Clouds of Low stage (Nimbostratus, Stratus and Stratoscumulus); Clouds of vertical Development (Cumulus and Cumulonimbus). A climatologic treatment on the behavior of clouds not only can be something very excellent for the area of meteorology or the area of the aeronautics, but for several other ends.

The analyses of the heights of clouds had been developed from the hourly data, considering the base of the layer lowest, yielded for the Department of Protection to the Flight of the International Airport of Maceió - Alagoas, through one of the next located automatic station to the track. After that, a distribution of frequency for selected bands of heights was applied, classified clouds as low (0 2000m), averages (2001 5000m) and high (above of 5000m). Moreover, the cloud situations formed with next base to the surface and minors had been considered who 100m (normally stratus associates the fogs) and clouds formed between 100m and 500m (normally associated to the effect of deriving circulation of the ocean and resultant of an intense advection of humidity and cold air).

Thus, the considered bands of height had been the following ones: >100m, 101-500m, 501-1000m, 1001-2000m, 2001-2000m, 3001-4000m, 4001-5000m and >5000m. The study of the cloudiness it was developed with hourly data METAR of the year of 2004 available by the Ministry of the Aeronautics of the International Airport Zumbi of Palmares. To similar way to the study of the heights of clouds, these data had been dealt with form that could be compared and also to supply the monthly averages of the cloudiness comments, making possible the comparison enter the corresponding months in the twelve observed months. After that with these available data, a profile of each type of cloud was traced and its influence on the aerial flights to associate with the results of the analyses of data. The analysis of the type of clouds was also developed from hourly data comprising the types of classified clouds as: Cirrus and/or Cirrocumulus (CI and/or CC); Cirrostratus (CS); Altocumulus (AC); Altostratus (); Nimbostratus (NS); Stratoscumulus (SC); Stratus (ST); Cumulus (CU); Towering Cumulus (TCU) and Cumulonimbus (CB).

To follow, the graphs will be made uses that distribute the average values of frequency of the types of clouds for diverse heights. Figure 1 mentions the general analysis to it, considering the grouping of all the hourly data throughout 2004. A predominance of situations with cloud presence can be verified gifts in the field of comment of the AIZP possessing bases between 501 and 1000 m (53%). Considering the grouped band of 101 the 2000 m, low clouds, the percentage of occurrence if raises approximately for 68,83%. The high clouds show themselves with percentages of only 7.18%, being associated to situations of approaches of cold, jet streams and convective systems. The percentage of middle clouds arrived to reach 23.92% of the occurrences to the long of the year.

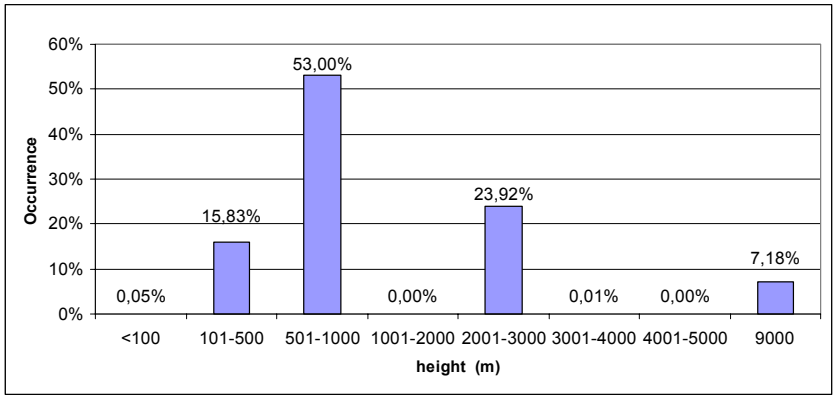
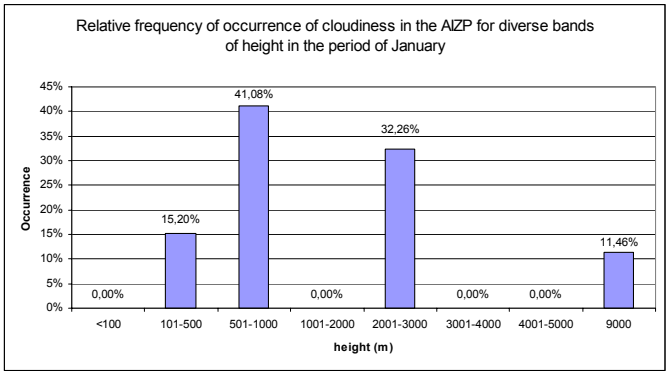
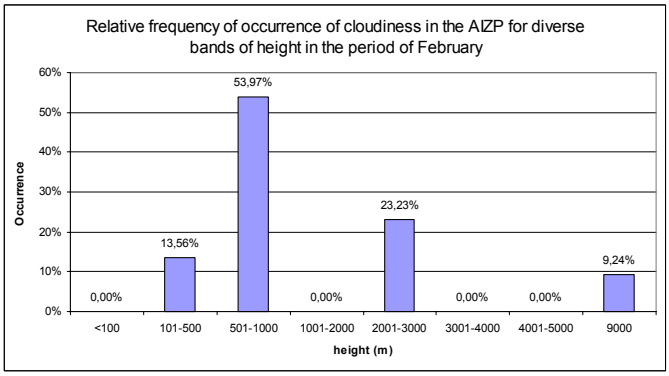


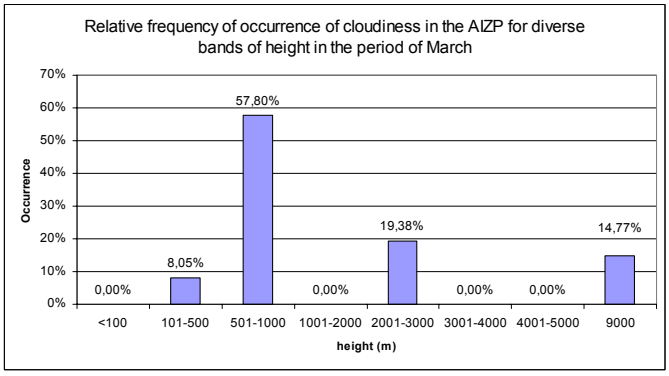
FIGURE 1 - Relative frequency of occurrence of cloudiness in the AIZP for diverse bands of height in the period of Jan - Dec of 2004.

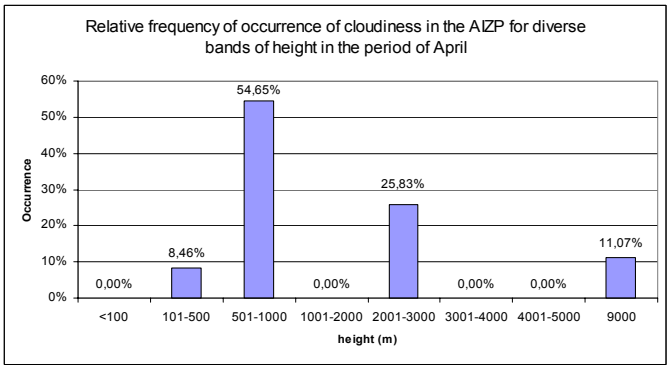
Figure 2 discloses the behavior average of the bases of clouds, for bands of heights, to the long of the months. The monthly analyses can be made from of these figures, from which are detached the following comments: The biggest high cloud predominance, with 5000 m bases, was found during the summer (11,02%), being that in the spring months this number arrives to reach in average 4.42%, in the autumn (8,89%) and in winter (1,08%). The biggest low clouds predominance was found during the spring (76,43%), in the months of summer (68%), in the autumn (63,6%) and the winter (43%). The biggest middle cloud predominance was found during the winter (32,17%), in the autumn (24,15%), summer (20,25%) and spring (19,15%).

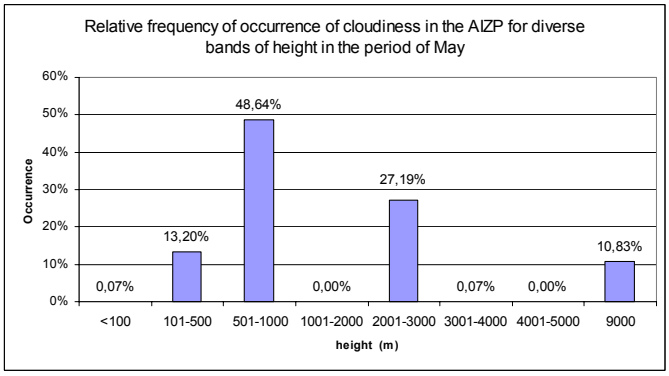
The bases lower than 100m represent sporadical, but perfectly viable cases for some situations of winter or square rainy of the State of Alagoas (May-August), being normally associates to fogs, mist or clouds stratus with very next base to the surface. Bonanza, such cloud levels can occur in other months of the year, but they are little common, what it did not occur. The occurrence of cloud bases between 100 and 500m is more frequent in the winter months or season rainy, due to convective power minor in temporary combination with humid and colder circulation proceeding from the ocean.

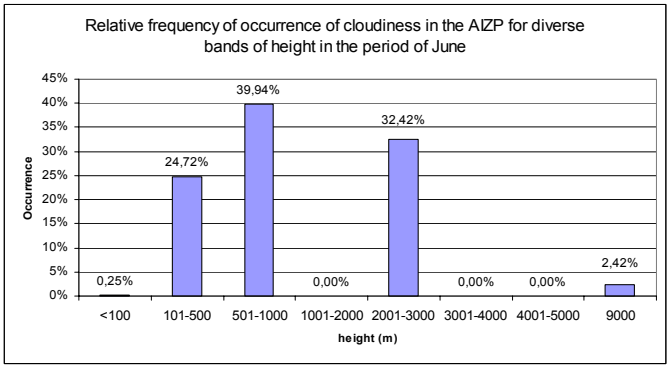












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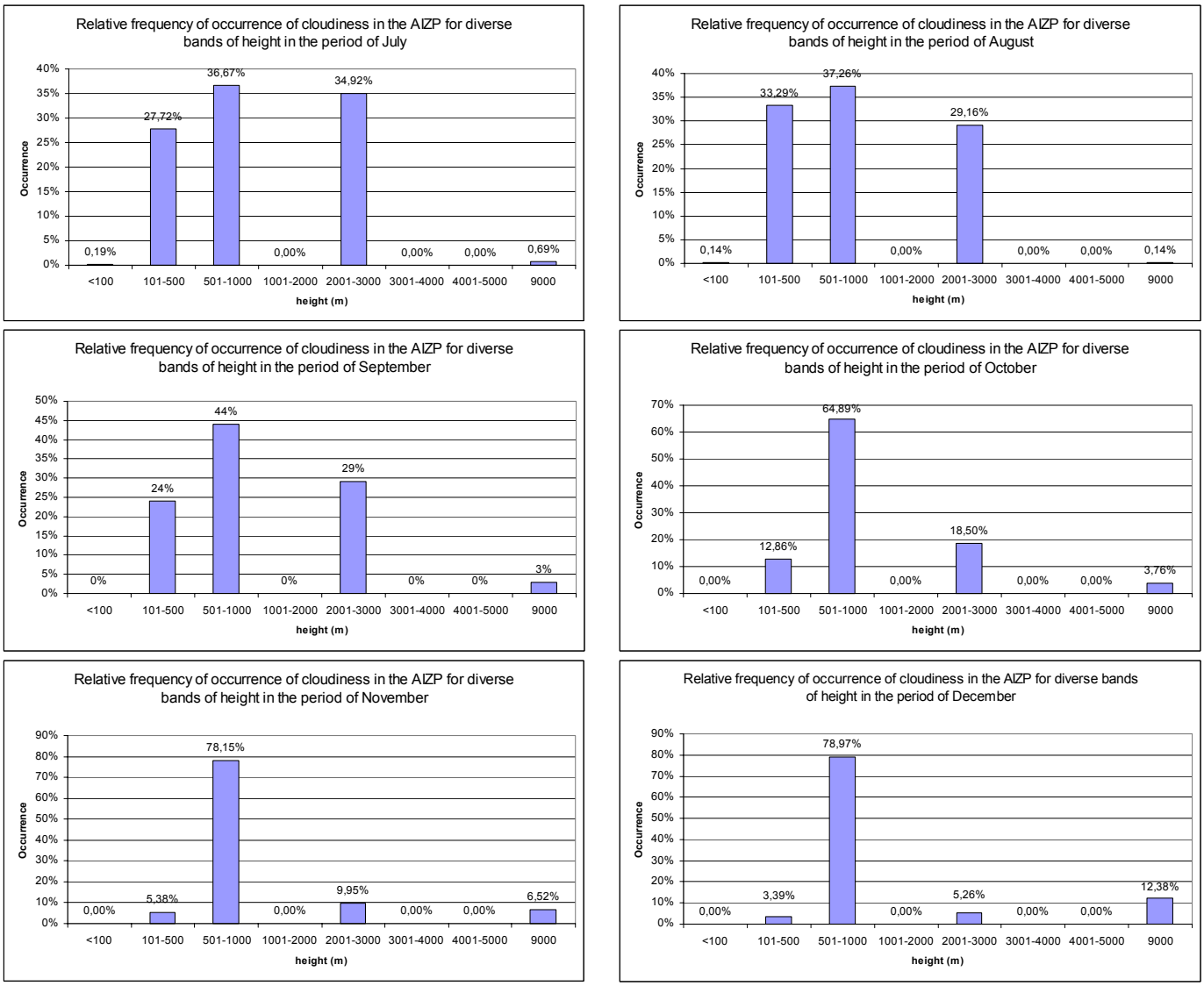

FIGURE 2 - Relative frequency of occurrence of cloudiness in the AIZP for diverse bands of height in the period of Jan - Dec of 2004.

In Figure 3 observes the behavior of the diverse cloud bands and its respective types to the long one of the year. It is noticed that the band of height between 501 and 1000m mentions clouds to it of the Cumulus type (CU), between 100 and 500 m clouds of the Stratocumulus type (SC), between 2001 and 3000m clouds of the Altocumulus type (AC), greater that 5000m clouds of the type Cirrus (CI) or Cirrocumulus (CC).

The cloud occurrence of the Stratus type (St) with smaller base than 100m is indicated in the Figure 3a, between months the of May-August. This figure comes to complement the figures above indicating its behavior to the long the year of 2004, where, the months of greater and minor are observed influence of each type of cloud over the aerodrome of the AIZP.

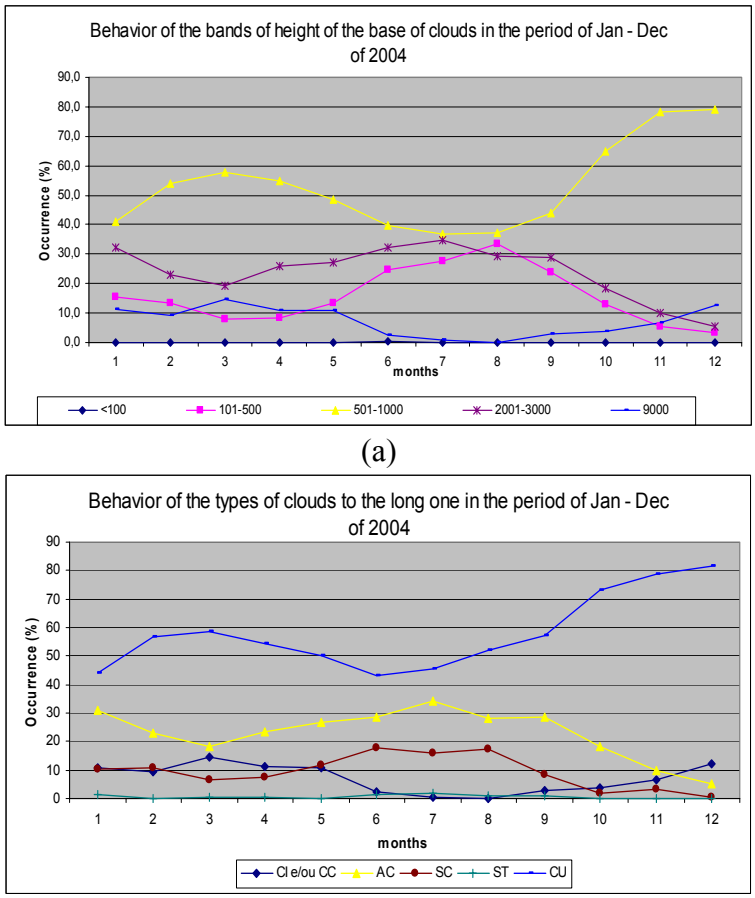

FIGURE 3 - Behavior of the occurrence of the height of the base of the cloud (a) and type of cloud (b) in the AIZP in the period of Jan - Dec of 2004.

It can be observed that to the long of this year, the clouds percentage with inferior base 100m in the AIZP, is practically zero (Figure 1), with only some few register between the months of May and August possibly being about the occurrence of stratus associated to fogs since this is a propitious period to the occurrence of this phenomenon. However the indices of cloud occurrence with inferior base 100m had been minimum, corresponding to the period of the morning or in the beginning of the dawn, representing sometimes obstacles to the security of aerial operations, since, the AIZP operated through devices and for sometimes it had suspended the landing and the take-off. The clouds occurrence with bases between 100-500m arrived at the index of 15,83% (15 days) of the annual clouds occurrence. In average, these days are not good for the use of the approach radar and nor the ILS CAT1, and the VOR/DME has its compromised functioning; only ILS CAT2 finds success on such conditions. In 193 days (53%) of the year of 2004, it has greater occurrence of cloud layers between 500m and 1Km, and when the Ceiling of clouds is superior to 500m the VOR/DME can be used. Although to a large extent of the year it has cloud presence, the best conditions of operations readiness's of landing and take-off in function of the height of the bases of clouds (501-9000m) using the approach radar are of 84,1% (307 days), what it demonstrates that the cloud presence nor always is associated the harmful factors the maneuvers of landing and take-off of aircraft. And can still be noticed that in 23,62% (24 days) clouds the are of average levels with base between 2001m and 5000m and consequently, clouds the kind altocumulus, Altostratus, nimbostratus or stratocumulus. Despite this work presenting a study on the behavior of clouds over the aerodrome of the AIZP, important for aeronautical ends, using a bigger period of comment the results would have greater precision. Increasing the amostral space it is possible to collect statistics more elaborated and to develop a much more comprising and outstanding climatology of the behavior of clouds for the meteorological center of the aerodrome of the

AIZP that can the same come to be reference for type of research in other airports of Brazil.

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