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SATURATION DEFICIT IN VARIOUS AIR MASSES

Air humidity is one of the most important meteorological elements in climatic processes. With air humidity are connected not only all physical phenomena occurring in the atmosphere, but also organic life existing on the terrestrial globe. Saturation deficit is a particularly important indicator of air humidity since it describes the evapotranspiration strength of the atmosphere. The basic role in the shaping of this element is played by meteorological conditions, that is physical properties of the inflowing air. The finding typical connections between the types of air masses and saturation deficit may constitute a basis for better weather forecasting.

The purpose of this paper is to determine quantitative changes of saturation deficit with regard to season of the year and the present air mass. In order to determine the connections, mean daily values of saturation deficit (d) were used, which had been registered at the meteorological station Warszawa-Bielany in the period 1956—1960. In order to increase the statistical mass, the types of air masses were restricted to the basic types: maritime polar (mP), continental polar (cP) and arctic (A) air masses. The last one was not taken into consideration in the period between June and August as well as in December since it occurred only in a small number of cases.

In the period under study the mean monthly values of saturation deficit range between 0.8 hPa in winter to 7.4 hPa in June (Fig. 1a). Depending on the inflowing air mass, the deficit is very different. The largest differences are observed in the warm season of the year (Fig. 1b). In winter the mP air mass is characterized by higher dryness than cP. Despite the fact that in winter the maritime air carries more water vapour than continental air (Olszewski 1975), much higher temperatures of the former cause a rise in the maximum pressure of water vapour and thus also the saturation deficit. In the arctic air deficit oscillates around the values observed in both polar masses depending on the temperature. The latter element significantly determines saturation deficit

In the warm season of the year when the temperatures in cP air mass are higher than in mP, also deficit in the first mass has higher

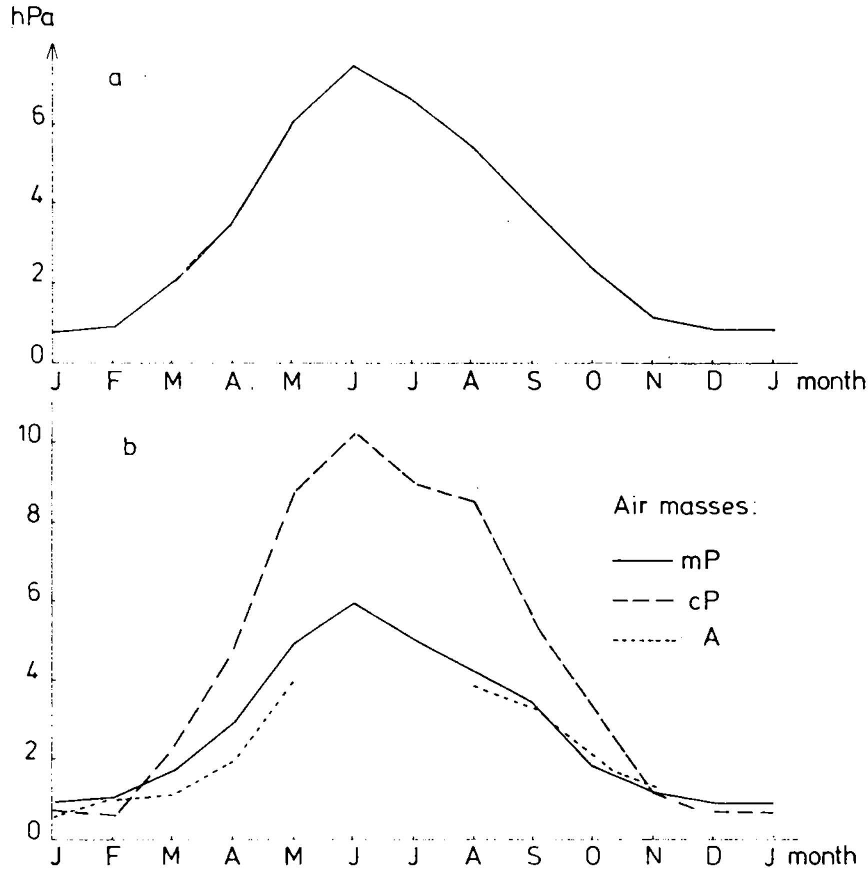

Fig. 1. Annual course of saturation deficit. Warszawa-Bielany, 1956—1960, (a) without division into air masses, (b) in various air masses.

values (almost double). Mean values in cP air mass in June exceed 10hPa and in mP air mass reach only 6.0 hPa. Air temperature also determines the content of water vapour in A air mass. That is why deficits in the summer period are the lowest from among all the air masses studied here.

To illustrate better the above statements, two months were selected (January 1960, August 1959) which are characterized by changeability of types of air masses (Fig. 2). Higher saturation deficit is clearly visible in winter in mP air mass and in August in cP. Particularly in summer a change of air mass is manifested by a rapid change of deficit.

Usage of mean values does not give a full picture of formation of

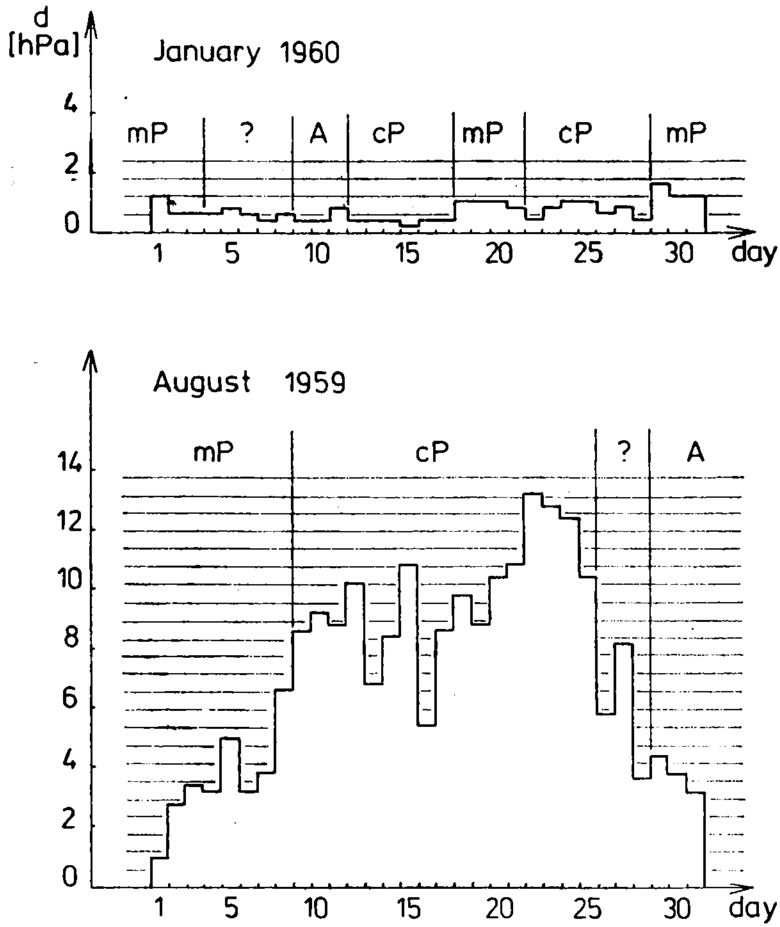

Fig. 2. Monthly course of saturation deficit in selected months. Warszawa--Bielany.

saturation deficit. An element of dynamism is introduced by an analysis of frequency of occurrence of individual mean daily values of deficit. Thus distributing series were formed with a width of interval of 2.0 hPa (Fig. 3). In individual air masses, depending on the season of the year, the distributing series are differentiated with regard to the number of intervals as well as the most frequently occurring values. The lowest changeability, that is the lowest number of intervals, is observed in winter time. Most often the mean daily deficits are within the range 0.1 — 2.0 hPa, they never exceed 4.0 hPa. Higher differentiation is noted in summer time which is dependent on the inflowing air mass. Higher values usually occur in cP air mass than in mP. For instance,

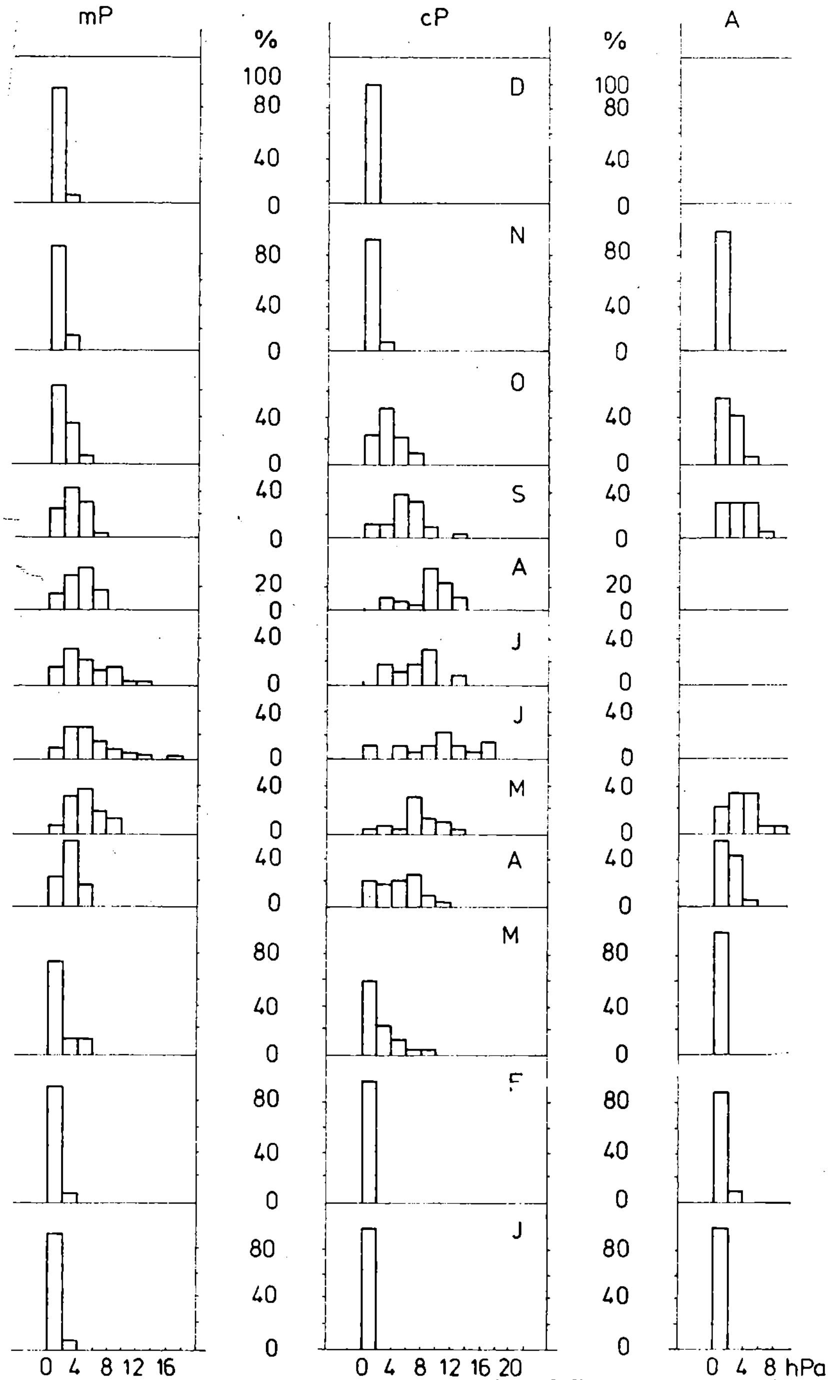

Fig. 3. The percentage frequency of saturation deficit in various air masses. Warszawa-Bielany, 1956—1960.

in July in maritime polar air mass most often occurs a saturation deficit of 2.1 — 4.0 hPa, never exceeding 13.0 hPa, and in continental polar air mass in the range of 8.1—10.0 hPa, but the highest values can reach 22.0 hPa and are not lower than 2.0 hPa. This means that in summer, with an inflow of continental air, the evapotranspiration strength of air is higher and that it can absorb more water vapour. That is why evaporation in this air mass is high (Olszewski 1982), which results in a higher content of water vapour than in maritime (Olszewski 1975).

The distribution of frequencies of deficit in A air mass is similar to the distribution observed in mP, but in no month does the saturation deficit exceed 10.0 hPa.

Summing up, it is necessary to say that the inflowing air mass is of great significance in formation of saturation deficit of the air. The significance grows along a growth of temperature of the present air mass. That is why in the cool season of the year the deficit assumes similar values in all air masses, and the largest differences are seen only in summer when in the continental polar air the values can be as much as twice higher than in the maritime polar air mass.

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