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Change of Dew Point Temperature and Density of Saturated Water Vapor with High and its Impact on Cloud Cover

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Abstract: - Clouds make up more than 50% of the earth planet, where absorb, reverse, dispersing and scattering radiation connecting to it, while sending a red thermal radiation according to their temperature. In this work the calculation the daily and seasonally of the rate of change dew point temperature and density of saturated water vapor to high (0.2 - 13) km to seasons (winter and spring) and high (0.2 - 18) km to seasons (summer and autumn) by using Model Cloudy Atmosphere (MCA) for the days of the study for one year for Baghdad International Airport station in Iraq. Through drawing relationship vertical change for each of the dew point temperature and density of saturated water vapor found that both decreases with height to the height of 12 km, though the clouds at all the increase have different characteristics in terms of the dew point temperature, density and pressure of saturated water vapor and water content so the atmosphere is a heterogeneous.

Keywords: *- Cloud cover, Dew point temperature, Thermal radiation, saturated water vapor density, Baghdad.*

I. INTRODUCTION

The variation in temperature on the surface of the Earth caused by variation in the amount of solar radiation reaching the surface and height above sea level. Where increasing the amount of solar radiation, the more solar radiation fall vertical angle [1]. And the topography of the earth's surface vary in their ability to absorb solar radiation but the rocks, vary in it, as well as land and water contrast. Consisting of the continents rocks are metal compounds and be faster than ocean water in the heat absorption and its lack given the low thermal capacity compared to thermal capacitive high water so the water surfaces (seas and oceans) are warmer in the winter of land next to it and colder than in summer [2].

In the Troposphere layer temperature decreases with altitude because of the Earth's surface as a result of solar radiation since the fall of these rays pass through the air and do not work on heated. So the source of heating this layer is from the bottom (Earth Surface). The temperature decreases with height at a rate 6.5 ℃ per 1 km up to the end of the layer, and sometimes it happens that the temperature increases with height in limited locations of this layer and this is known as Thermal Inversion and the boundary between this layer and above called Tropopause layer, where the lowest values for temperature and dew point temperature near the surface in the winter months and then begin to increase in the spring months and up to a maximum value which is in the summer months and then begin to decline in the autumn months, largely due to the length of daylight hours in the summer, making the land is exposed for a longer period of solar radiation and thus retain more warmly, as well as the axis tilt of the Earth that makes the sun's rays vertically up in the summer and diagonally in a season for the winter in addition to that there are several changes in temperature are [3][4]:

1. The daily change in temperature: is the change that occurs as a result of the Earth's rotation around itself.
2. The seasonally change in temperature: This is caused by the Earth's rotation around the sun and the resulting four seasons.
3. The change in temperature due to the latitude: as the temperature at least stay away from the equator toward the poles because of the decrease of solar radiation.
4. Temperature change due to the terrain: the warming rate is different from the desert temperature rate of coastal areas. The temperature change in the desert a lot while changing a bit in the coastal areas.

The humidity is the amount of water vapor in the air, especially in the Troposphere [5]. Where humidity varies depending on the temperature and air pressure, the more the warmer air increased water vapor carried by and when the air contains the maximum amount of water vapor can carry under the temperature and pressure of certain, then said the amount of the air may saturation of water vapor and that the Troposphere contains the most atmospheric water vapor as they are the most affected by the irregular distribution of temperature on the surface of the earth, so they layer where clouds and made up most of the air in which he spoke as activities sometimes called the Weather Layer [6][7].

II. THE DATA AND STUDY AREA

It has been taking dew point temperature and Saturated water vapor density data for days (15/1, 10/2, 15/3, 20/4, 20/5, 5/6, 5/7, 5/8, 10/9, 15/10, 15/11, 15/12) for the year 2013 from Baghdad International Airport station, which is located at the latitude 33˚16'17.2" N and longitude 44˚13'21.6" E, (see "Fig. 1").

Figure 1. Study area.

III. MODEL CLOUDY ATMOSPHERE (MCA)

Where the model calculates the following:

1. Calculate Saturated vapor pressure change with altitude using Clausus - Clapeyron equation [8][9]:

$$e_s = e_o * \exp\left[\frac{L}{R_V} \left(\frac{1}{T_0} - \frac{1}{T_d} \right) \right] \quad \text{.. (1)}$$

Where:
e_s: The saturated vapor pressure for every high in Millibars (mb) unit.
e_o: Surface vapor pressure equal to (6.11 mb).
L: Latent heat, a temperature change with height but in the Troposphere layer change latent heat a very small proportion and equal to (2.5×10^6 J/kg).
R_V: Specific gas constant for wet air equal to (461.5 J/kg. K).
T_o: Surface temperature equal to (273.15 K)
T_d: Dew point temperature in Kelvin (K) unit.

2. Calculate change the saturated water vapor density with altitude using the following equation [10] [11]:

$$\rho_s = \frac{e_s \; T_d}{R_v} \quad \text{.. (2)}$$

Where ρ_s is Density of saturation water vapor in unit (g/cm^3).

The model of atmosphere cloudy shows that the atmosphere is homogeneous that there is a difference in dew point temperature, vapor pressure and saturated water vapor density with high.

IV. RESULTS AND DISCUSSION

The implementation of the Model Cloudy Atmosphere (MCA) using MATLAB language the model to calculate the daily change and the seasonal rate of change of the dew point temperature and saturated water vapor density with high.

1. The daily change of dew point temperature and saturated water vapor density.

The calculation of daily change of the dew point temperature and saturated water vapor density with the height of the days (15/1, 10/2, 15/3, 20/4, 20/5, 5/6, 5/7, 5/8, 10/9, 15/10, 15/11, 15/12) for the year 2013 for the Baghdad International Airport station, where found it that the dew point temperature and saturated water vapor density decreases with height and reach height 12 km (Tropopause layer) and then begin to increase with high, as in “Fig. 2”.

2. The seasonal rate of change of the dew point temperature and saturated water vapor density.

The calculation seasonal of the rate change dew point temperature and saturated water vapor density with the high for the year 2013 for the Baghdad International Airport station, where found it that the seasonal rate of change dew point temperature and the density of the saturated water vapor is decreases with high and reach height 12 km, and then begins to increase with high, as in “Fig. 3, 4, 5, and 6” respectively (winter, spring, summer and autumn).

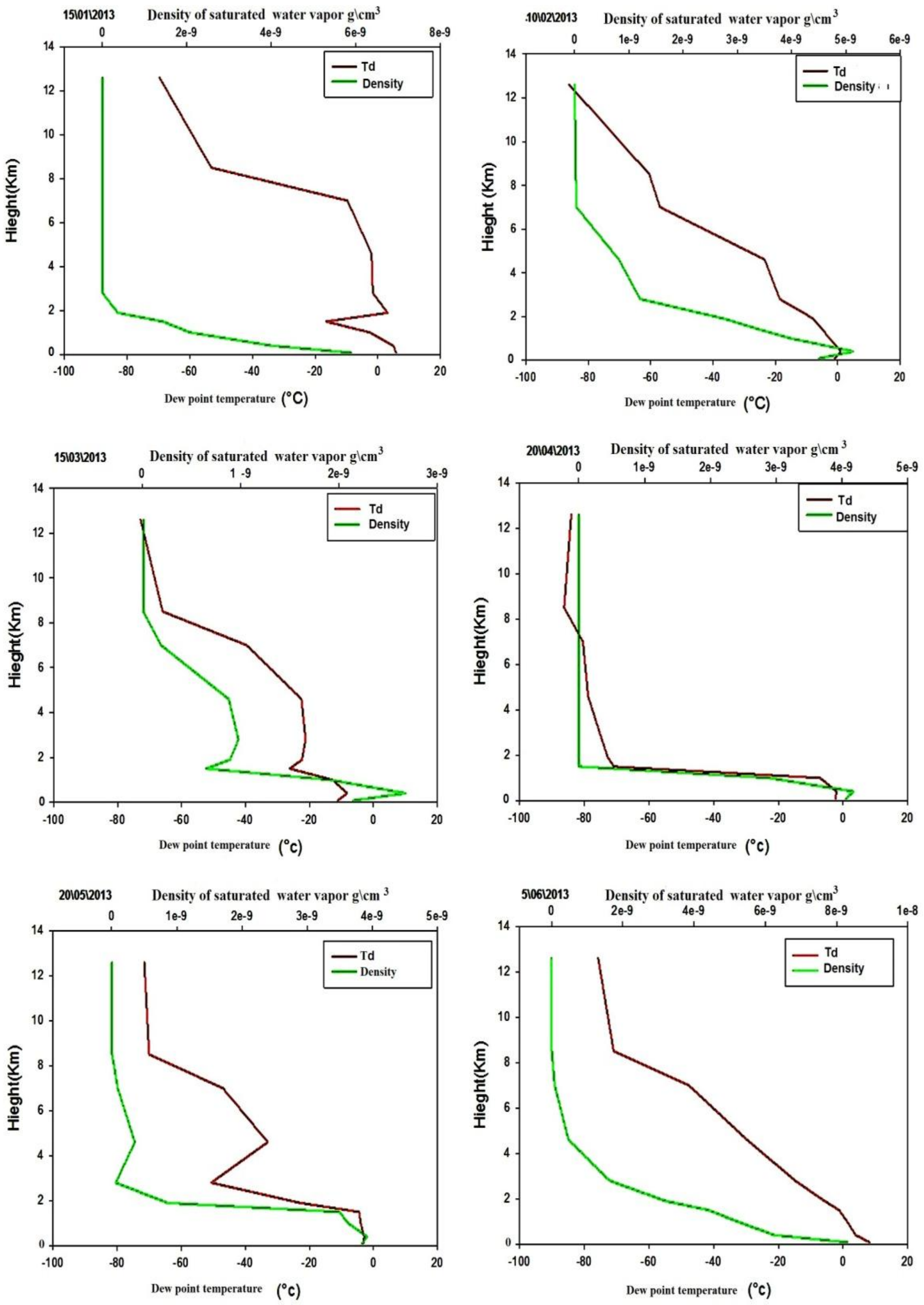
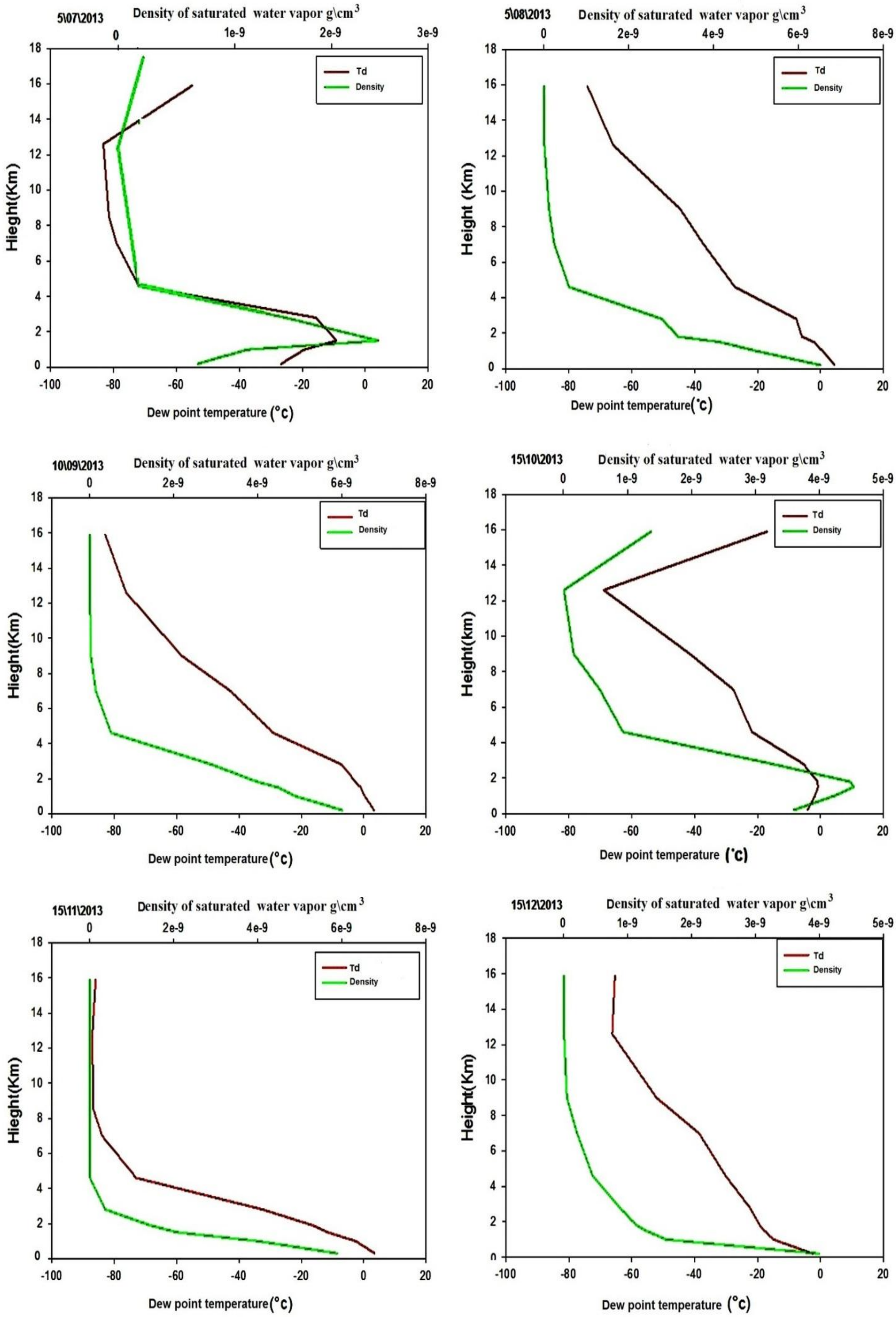


Figure 2. The daily change of the dew point temperature and saturated water vapor density with the height for the days of the study, 2013.



Followed "Fig. 2"

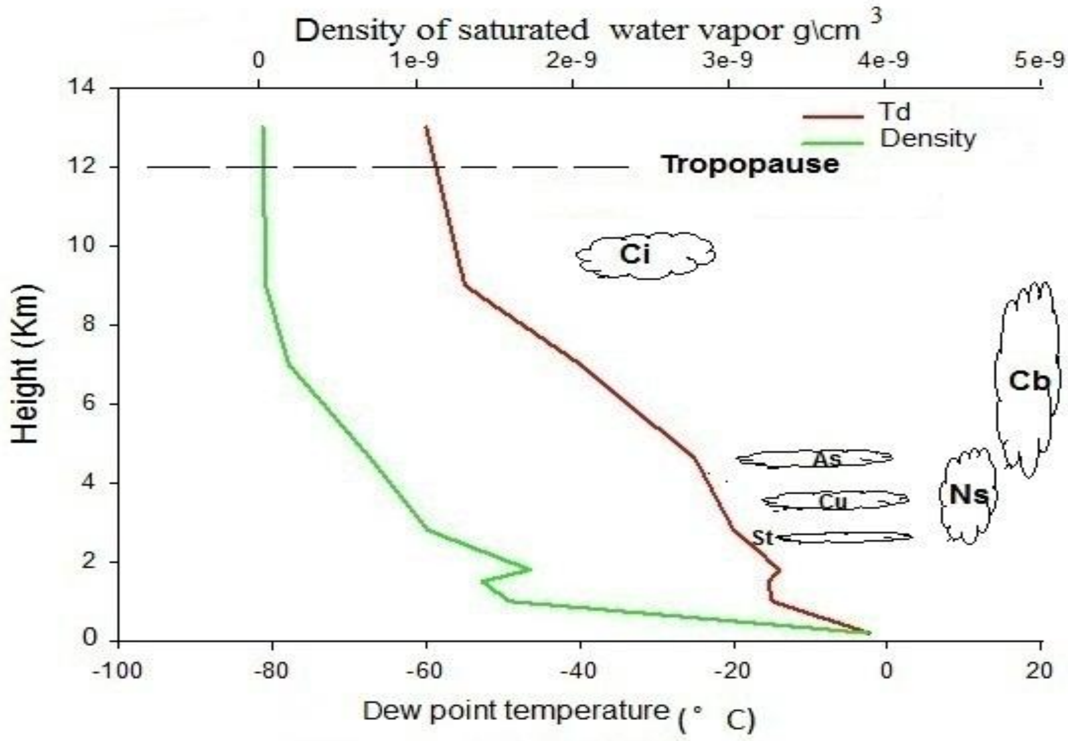


Figure 3. The seasonal rate of change of the dew point temperature and saturated water vapor density with high for the winter, 2013.

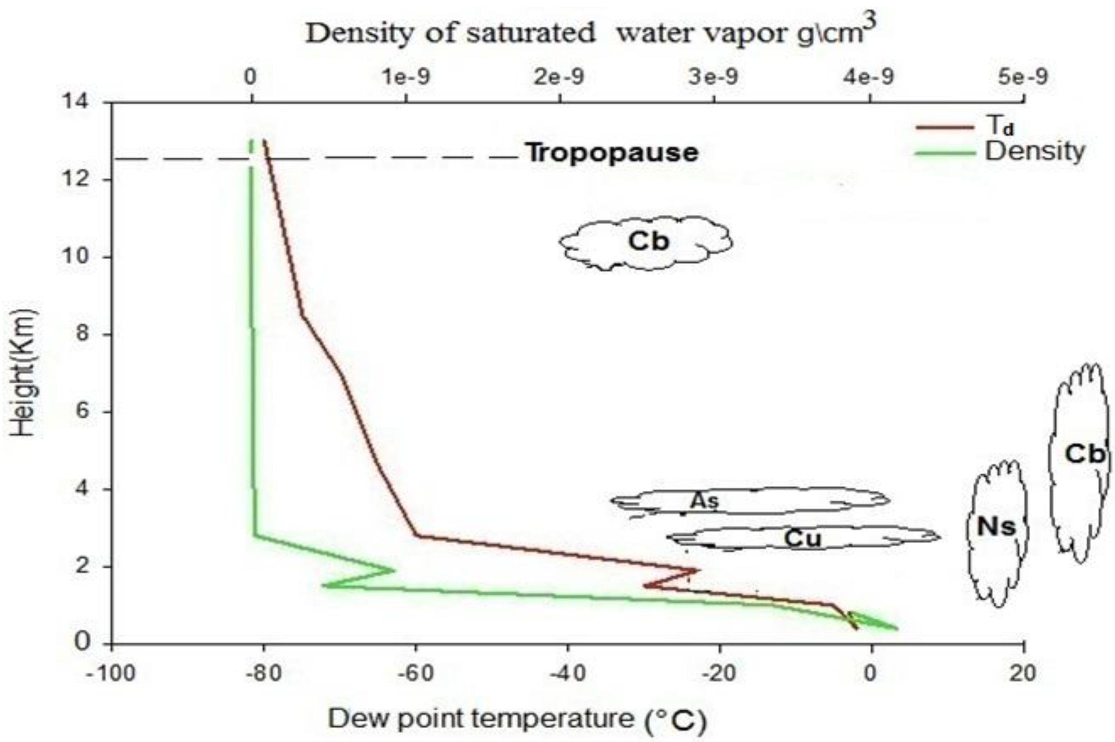


Figure 4. The seasonal rate of change of the dew point temperature and saturated water vapor density with high for the spring, 2013.

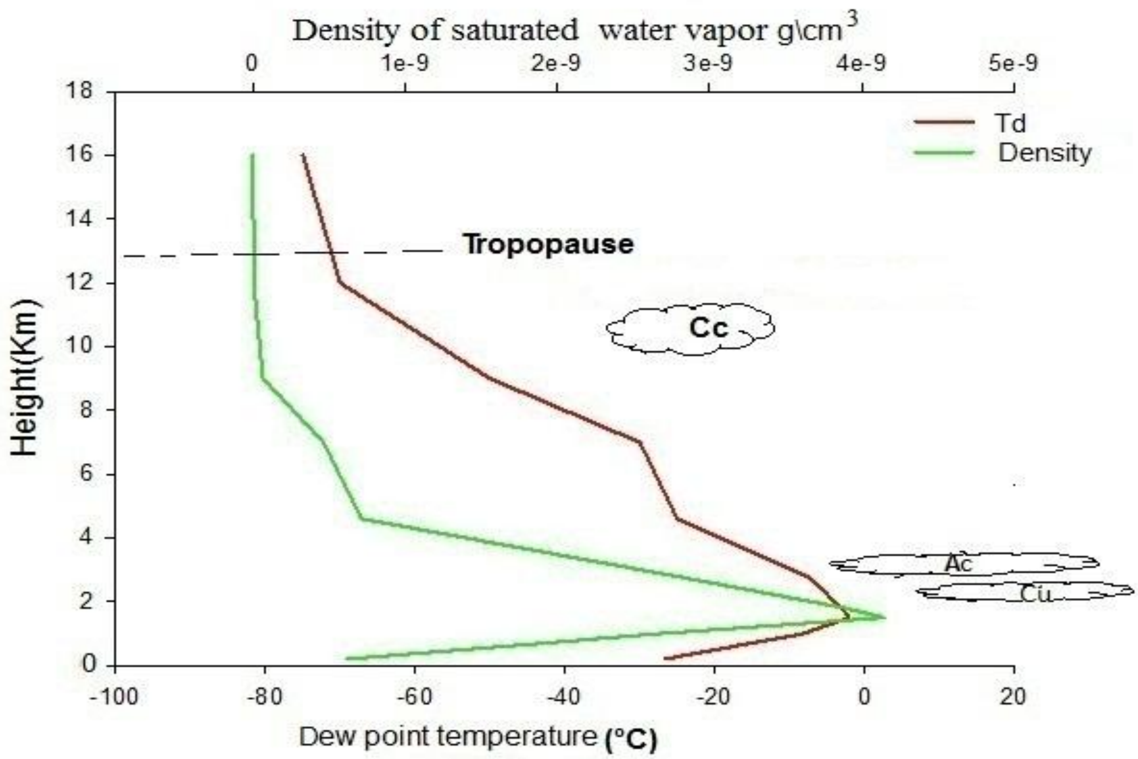


Figure 5. The seasonal rate of change of the dew point temperature and saturated water vapor density with high for the summer, 2013.

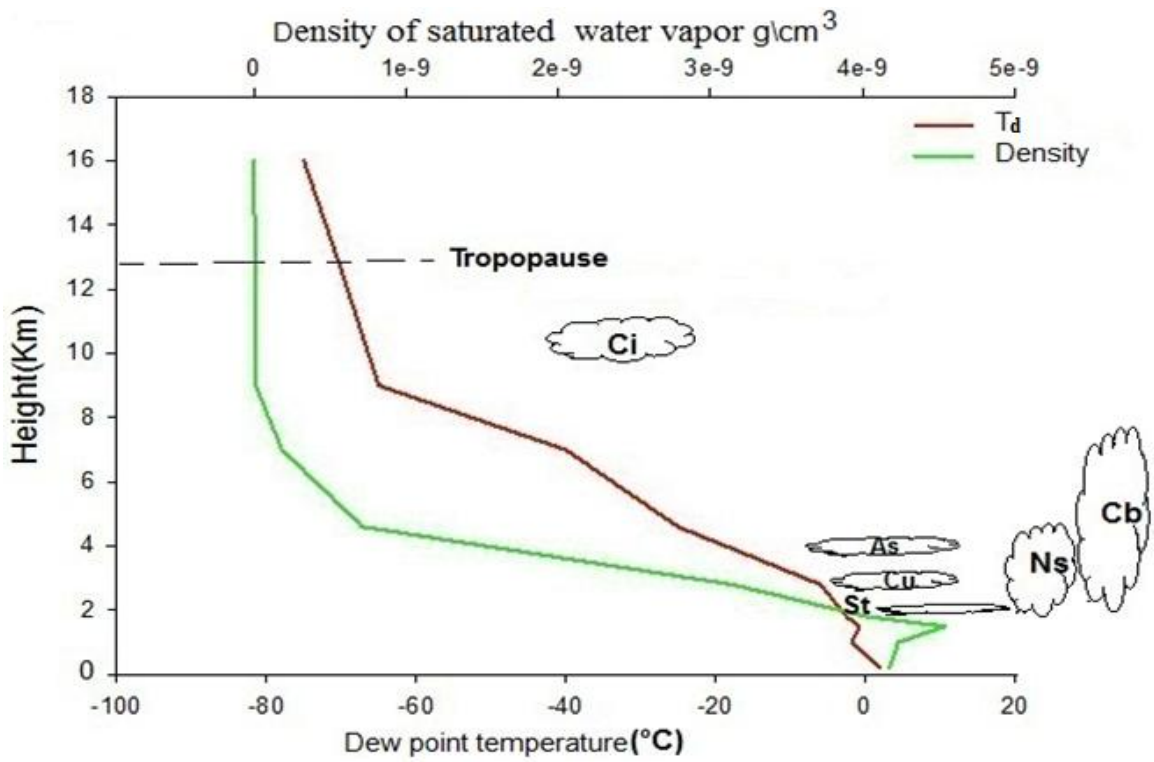


Figure 6. The seasonal rate of change of the dew point temperature and saturated water vapor density with high for the autumn, 2013.

V. CONCLUSION

- The daily change and the rate of seasonal change of the dew point temperature and saturated water vapor density in the Troposphere layer decreases with height to the height of 12 km and after the high (in the Stratosphere layer) the dew point temperature increases and the density of water vapor saturated with the high, due to the effect of ultraviolet radiation on oxygen molecules Ozone in the production of energy, who is editing the form of heat. In addition to that air expands when rising from the earth's surface due to the low atmospheric pressure and loses heat.
- The atmosphere is a homogeneous, where changing the dew point temperature and saturated water vapor density withe clouds at each height.
- The lowest values of temperature and dew point temperature exist near the surface of the ground in the winter and then begin to increase in the spring and then reach maximum values in the summer and then begin to decline in the autumn, where the reason is due to the length of daylight hours in the summer, making the land exposed for a longer period of solar radiation and thus retain more warmly, as well as the axis tilt of the Earth that makes the sun's rays vertically up in the summer and diagonally in the winter.

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