FORECASTING -LAB

(THIRD GRADE)

LUCTURERS

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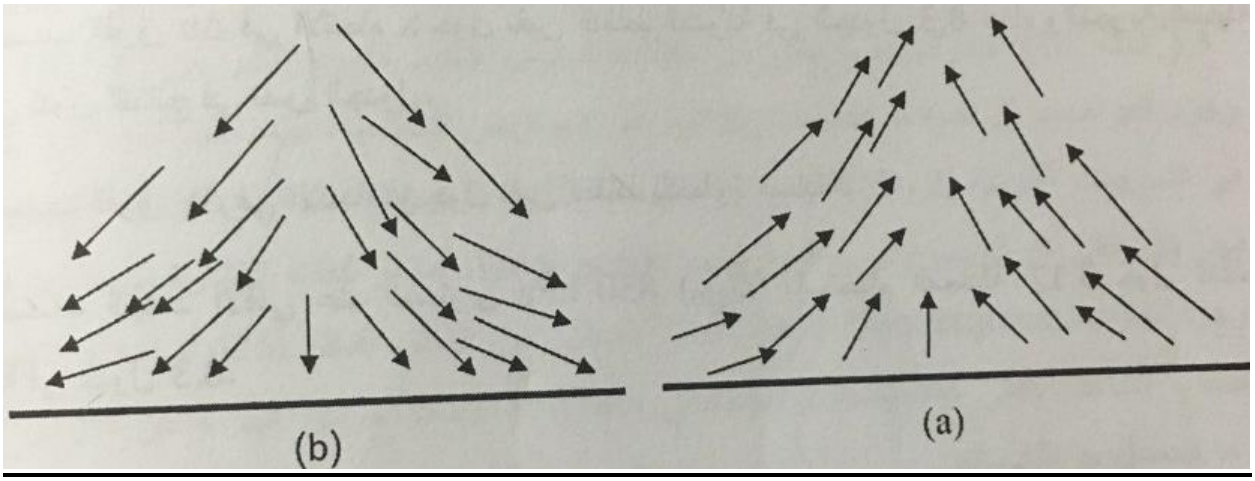
Experiment No.5

Experiment Name: Calculate speed of vertical wind.

The aim of the experiment: Calculate speed of vertical wind at pressure level of 850hpa, and then calculating it through the depth of boundary layer.



Theory: Vertical wind has important effects on air temperature and thus their effect on condensation and cloud formation, especially convective clouds and precipitation. This wind arises as a result of the impossibility of accumulating air when it converges, which leads to its rise to the top, as shown in Figure (8.7a), and it does not create a vacuum when it diverges, which leads to its descent to the bottom, as shown in Figure (8.7b).

The vertical wind speed is measured in the Cartesian axes (w) in units of m/s, while in the pressure axes (ω) (the z axis is replaced by the pressure p axis) in units of hpa.hr-1, its value ranges between (1-10) cm/s, considering it to be zero At the surface of the earth, therefore, the direction of the vertical movement when the diverging or converging flow above the surface of the earth will be determined by the continuity equation:

$$\frac{\partial u}{\partial x}+\frac{\partial v}{\partial y}+\frac{\partial w}{\partial z}=0 - - - - - - - - -1.12$$

This equation becomes at the pressure axes in the following form:

$$D=\partial\omega p/\partial p \text{ ---------- } 1.13$$

And when the integration is carried out from ω = 0 at the surface of the earth to the pressure level 850 hpa, we get the practical value for calculating the vertical wind at this level **ω850:**

$$\omega_{850} = -3.5 * \nabla^{2} p_o + 3.2 * D_{850} \text{ ----------} 1.14$$

The values of **∇**oP2 in the first term are the intensity values, while the values of (850D) in the second term were calculated in the previous experiment.

Finally, the vertical velocity can be calculated within the bounded layer, whose height is 1 km, from the following relationship:

$$\omega_h = \alpha_h * \omega_{850} \text{ ---------- } 1.15$$

Where hα: an experimental constant and its value according to heights h is written in Table 1.5 below.

Table (1.5) values of the constant hα as a value for heights.

h (m)	0	100	200	300	400	500	600	> 700
α_h	0	0.22	0.42	0.59	0.72	0.83	0.9	1

Methodology:

1- Transfer the Laplacian pressure values given in the laboratory at all points recorded in the table (1.2) and put them in a table (1.5.)
2- Multiply the above values by the constant (-3.5) to get the value of the first term of the equation (1.14).
3- From the previous experiment, transfer the values of (D850) for all points of the first step to the table (1.6).
4- Multiply the values of the third (previous) step by the constant (3.2) to get the second term of the equation (1.14).
5- Add the values obtained from the second and fourth steps to get the vertical wind speed ω850.
6- From the values of the fifth step (i.e. the last row of table (6.1)), calculate the values of ω within the specified layer. For all points in Table 1.6 using equation (1.15) and arrange your results in Table (1.7) below.

جدول 1.6: قيم حدود معادلة 1.14 وسرعة الرياح الرأسية عند المستوى 850 hpa .

8	7	6	5	4	3	2	1	0	رقم النقطة
									$\Delta^2 P_o$
									$-3.5*\Delta^2 P_o$
									D_{850}
									$3.2* D_{850}$
									$\omega_{850}(m/s)$

Discussion:

Q 1: What is the weather that accompanies the rising or falling vertical winds, according to the results of the experiment?

Q2: Identify areas of high values and low values of vertical winds? And what do you infer from that?

Q 3: Draw the relationship between the depths of the definite layer recorded in Table 1.7 with the values of ω for some separate points?

جدول 1.7: حساب قيم ω ضمن اعماق الطبقة المحاددة .

8	7	6	5	4	3	2	1	0	النقطة / h (m)
									>700
									700
									600
									500
									400
									300
									200
									100
									0

Note:

Atmospheric boundary layer: It is the lower part of the troposphere layer that is directly affected by the characteristics of the Earth's surface, as it responds to surface forces such as frictional clouds, evaporation, transpiration, heat transfer, pollutant emission, and terrain for a time scale of an hour or less. As for its depth, it changes completely with time and space. which generally extends from hundreds of meters to a few kilometers.