FORECASTING -LAB

(THIRD GRADE)

LUCTURERS

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Experiment No.5

Experiment Name:

calculate relative vorticity by using finite-difference method

The aim of the experiment:

Calculating Vorticity at pressure level 850 hpa by finite difference method.

Theory:

The Vorticity (ζ) physically represents a microscopic measure of the rotation in a fluid. The vorticity is a vector quantity defined as the curl (cross-product) of the velocity vector. The absolute vorticity, therefore, is given by $\omega\_a = \nabla \times V\_a$ while the relative vorticity is given by equation:

$$\zeta \cong \frac{\partial v}{\partial x} - \frac{\partial u}{\partial y} \quad \text{-----------------------(1)}$$

So, it can be calculated for any point from the components (u, v) of wind speed analysis. The derivatives $\frac{\partial u}{\partial y}, \frac{\partial v}{\partial x}$ calculated by using grid point,

$$\left.\begin{aligned} \frac{\partial u}{\partial y} &\cong \frac{\Delta u}{\Delta y} = \frac{u2 - u4}{\Delta y} \\ \frac{\partial v}{\partial x} &\cong \frac{\Delta v}{\Delta x} = \frac{v1 - v3}{\Delta x} \end{aligned}\right] \quad \text{--------------------(2)}$$

By substation equation (2) in (1) we find (note $\Delta x = \Delta y = H$):

$$\zeta = \frac{(v1 - v3) - (u2 - u4)}{H} \quad \text{---------------(3)}$$

the positive values of vorticity (+ζ) indicate low pressure and the negative values of vorticity (–ζ) indicate high pressure.

Tools: Pressure map at 850hpa level, grid point used in the previous experiment.

Methodology:

1-Prepare (A4) of the grid point used in divergence wind experiment, which contain of wind speed components u, v at level 850 hpa.

2- Calculate the difference Δu along the axis (y) around the same points in divergence wind experiment.

3- Calculate the difference Δv along the axis (x) around the same points in the previous step and write the results in the table below.

4-Calculate ζ by using equation (3).

Table (1): Values of horizontal and vertical speed differences and divergence.

8	7	6	5	4	3	2	1	0	Point number
									Δu(m/s)
									Δv(m/s)
									ζ (s^{-1})

Discussion:

1-What is the indication of positive vorticity + ζ?

2- specify where is the maximum and minimum value of ζ?