CHAPTER VI

DISCUSSIONS AND CONCLUSIONS

In this chapter we will discuss about the results of weather forecasting experiment from the previous chapter and then make conclusions and comments.

Discussions and Results

In the previous chapter, we applied the two-level model to forecast the weather. This model is based on the quasi-geostrophic vorticity equation which is a simplified equation. And the one important assumption is that the vertical vorticity (ζ) is omitted and replace Coriolis parameter by constant value (f_0) in the divergence term. This assumption will be true in the case of the vertical vorticity (ζ) is less than the Coriolis parameter (f), that is better in the mid-latitude region (30N-60N) and the initial data should be at level 250 hPa and 750 hPa. But the initial wind field that we can only get from ECMWF by TMD are at level 200 hPa and 850 hPa, covered region (45S-45N,90E-180E), so we select regions (0-45N,90E-180E) and the initial streamfunction at level 250 hPa and 750 hPa can be obtained by linear interpolating.

The results of weather forecasting are shown in Fig.(5.3)-Fig.(5.7) in the previous chapter. From these streamfunction patterns we can calculate the wind fields by the relation

$$\vec{V} = \hat{k} \times \nabla \psi$$

So, the initialized wind fields at 250 hPa and 750 hPa can be shown in Fig.(6.1) as follows:

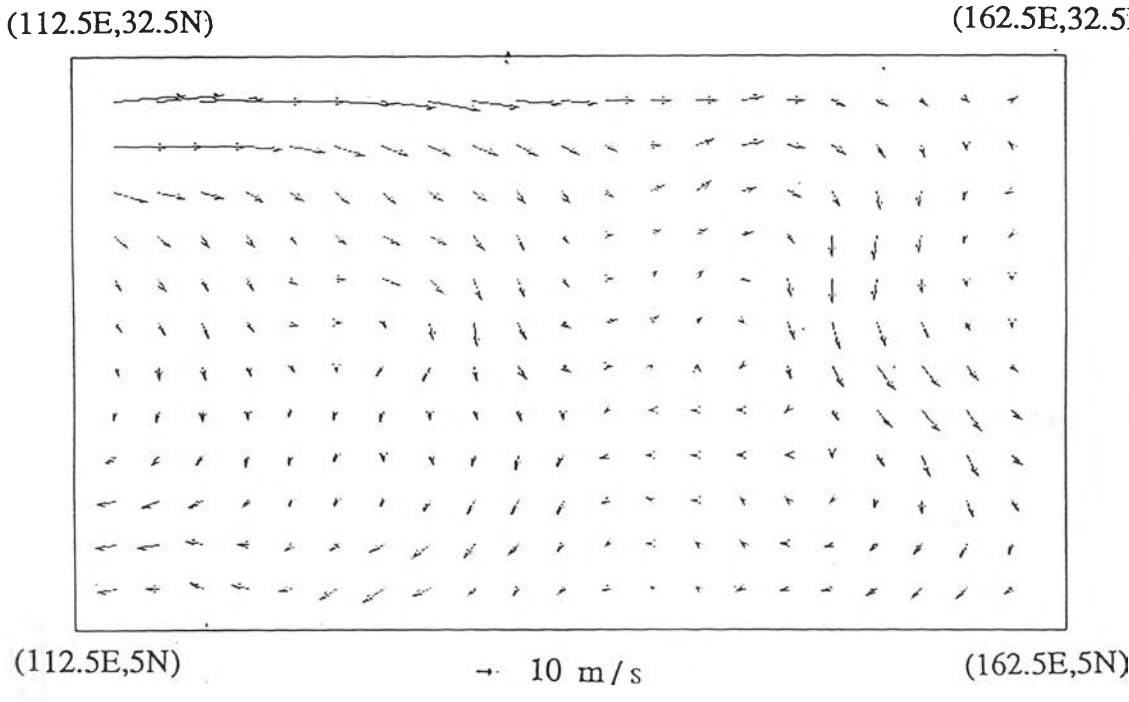

Figure 6.1a The initialized wind field at 250 hPa

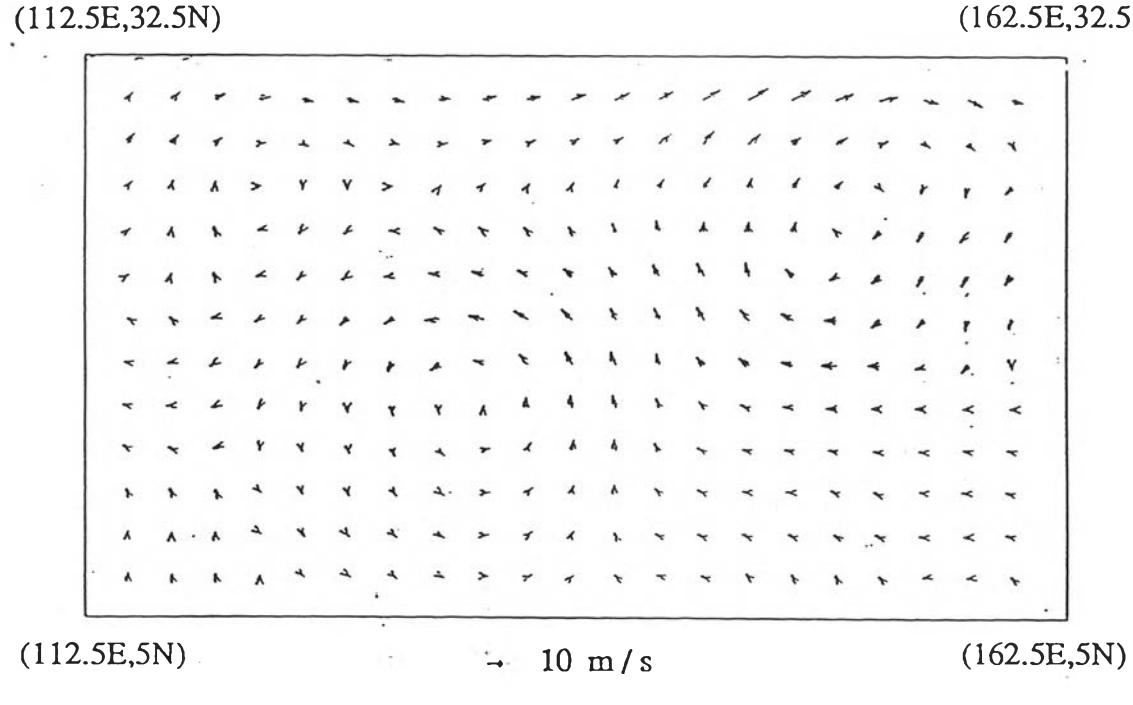

Figure 6.1b The initialized wind field at 750 hPa

From the initialized wind fields in Fig. 6.1 and the results of weather forecast in the previous chapter, we can see the circulations or rotations. These patterns are negative and positive rotations which are not pure rotations, they are consist of deformation and translation. We can discuss these types of wind fields by considering the instant velocity components u and v which may be regarded as functions of x and y

$$u = u(x,y), \qquad v = v(x,y)$$

Choosing the origin at an arbitrary point, and expanding these expressions in a Taylor series, we obtain

$$u = u_0 + \left(\frac{\partial u}{\partial x}\right)_0 x + \left(\frac{\partial u}{\partial y}\right)_0 y + \text{higher order terms}$$

$$v = v_0 + \left(\frac{\partial v}{\partial x}\right)_0 x + \left(\frac{\partial v}{\partial y}\right)_0 y + \text{higher order terms}$$

Where u_0 and v_0 are the velocity components at the chosen origin. If we omit the higher order terms and introduce their sums and differences ;

$$D = \left(\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y}\right)_0 \qquad F = \left(\frac{\partial u}{\partial x} - \frac{\partial v}{\partial y}\right)_0$$

$$\zeta = \left(\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y}\right)_0 \qquad R = \left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right)_0$$

The above equation may now be written

$$u = u_0 + \frac{1}{2}(D + F)x + \frac{1}{2}(R - \zeta)$$

$$v = v_0 + \frac{1}{2}(R + \zeta)x + \frac{1}{2}(D - F) \qquad (6.1)$$

It is found that D and ζ are independent of the rotation, while the values of F and R depend upon the choice of system. So we may rotate the axes a certain angle ϕ_0 such that $R = 0$. Eq.(6.1) may then be written

$$u = u_0 + \frac{1}{2}F x + \frac{1}{2}D x - \frac{1}{2}\zeta y$$
$$v = v_0 - \frac{1}{2}F y + \frac{1}{2}D y + \frac{1}{2}\zeta x \qquad (6.2)$$

The terms in eq.(6.2) represent four types of motion with different properties, these motions are

u_0, v_0 = translation

$\frac{\partial u}{\partial x} - \frac{\partial v}{\partial y} = F$ = deformation

$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = D$ = divergence

$\frac{\partial v}{\partial x} - \frac{\partial u}{\partial y} = \zeta$ = rotation, or vorticity

And these components motions can be shown in Fig.(6.2)

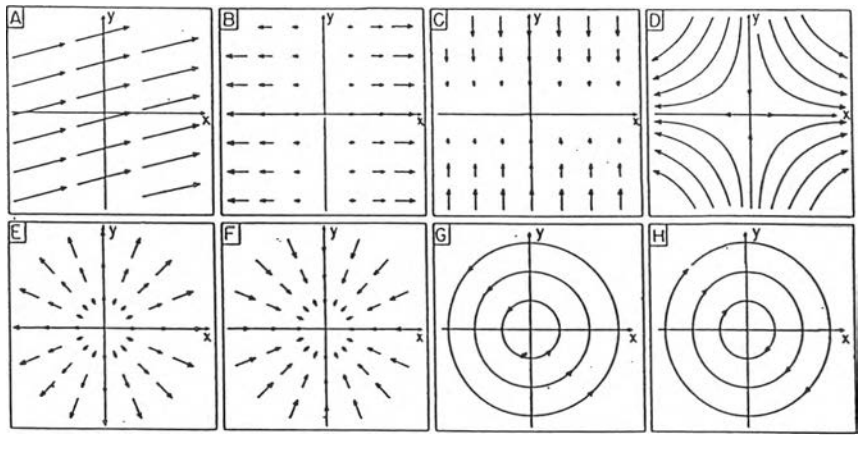

Fig.6.2 The component motions of a linear field. A, uniform translation; B, the x-component of deformation; C, the y-component of deformation; D, the total deformation; E, divergence; F, convergence; G, positive rotation; H, negative rotation.

From the types of wind fields discussions we can explain the results of weather forecast at level 250 hPa and level 750 hPa as follow :

At level 250 hPa:

Fig.(5.3a) and Fig.(6.1a) show the inflow of streamfunction from the north-west domain to the north-east domain, some parts of the streamfunction return back to the south-west domain like a hyperbola, there is a negative circulation occurring centered at (166E,22.5N). The errors of the fields occur at the east boundary, this might be affected by the use of cyclic condition assumptions.

Fig.(5.4a) shows the results of 24-hr forecast, there are a few change in weather patterns at northern domain but in the middle domain the streamfunction seem to spread from the western domain to the eastern domain and finally turn over at the eastern domain. There is no circulation occurring.

Fig.(5.5a), the spreading of streamfunctions from the western domain still go on.

Fig.(5.6a) and Fig.(5.7a), at the northern and southern domain, there are still a few changes in streamfunction patterns in contrast to the continuous change at middle domain.

At level 750 hPa :

In Fig.(5.3b) and Fig.(6.1b), the streamfunction patterns are complicate, because there are two circulations occurring. One is a negative circulation centered at (156E,33N) and the other is a positive circulation centered at (134E,19N). There are also errors at eastern boundary, this might be affected by the use of cyclic condition assumption and linear interpolation.

Fig.(5.4b) shows the westward movement of streamfunction pattern. The negative circulation moves to position (148E,30N) and decrease its velocity. And also the positive circulation moves to position (127E,19N) and decrease its velocity. It seems to be arising a new circulation at the north-west domain.

Fig.(5.5b) is the result of 48-hr forecast, which shows a continuous change of streamfunction pattern following from fig.(5.4b), there is a new negative circulation occurring at position (103E,30N). The old negative circulation is still moving westward to position (140E,30N) and decreasing its velocity. But the positive circulation can not be seen now.

In Fig.(5.6b), the streamfunction pattern is still moving westward. the old negative circulation goes to position (133E,30N) and the new one goes to position (101E,33.5N).

Fig.(5.7b) is the result of 96-hr forecast, the streamfunction pattern is continuous change by still moving westward. And now the old and the new circulation move to position (130E,32N) and (101E,36N) respectively.

Conclusion and Comments

From this study, the techniques, methodology and processes in preparing a weather forecast using the numerical model are being investigated. The experimental results show that the model is of ability of the numerical forecast. Although, we can not indicate the acceptable results forecasts, because of the lack of the observed data, but they can show an arising, a movement and a changing of circulation which are useful for preliminary study and a useful experience for further research.