CHAPTER 16 TROPICAL CYCLONES FORECASTS

16.1 Introduction *

16.2 Movement *

16.3 Intensity *

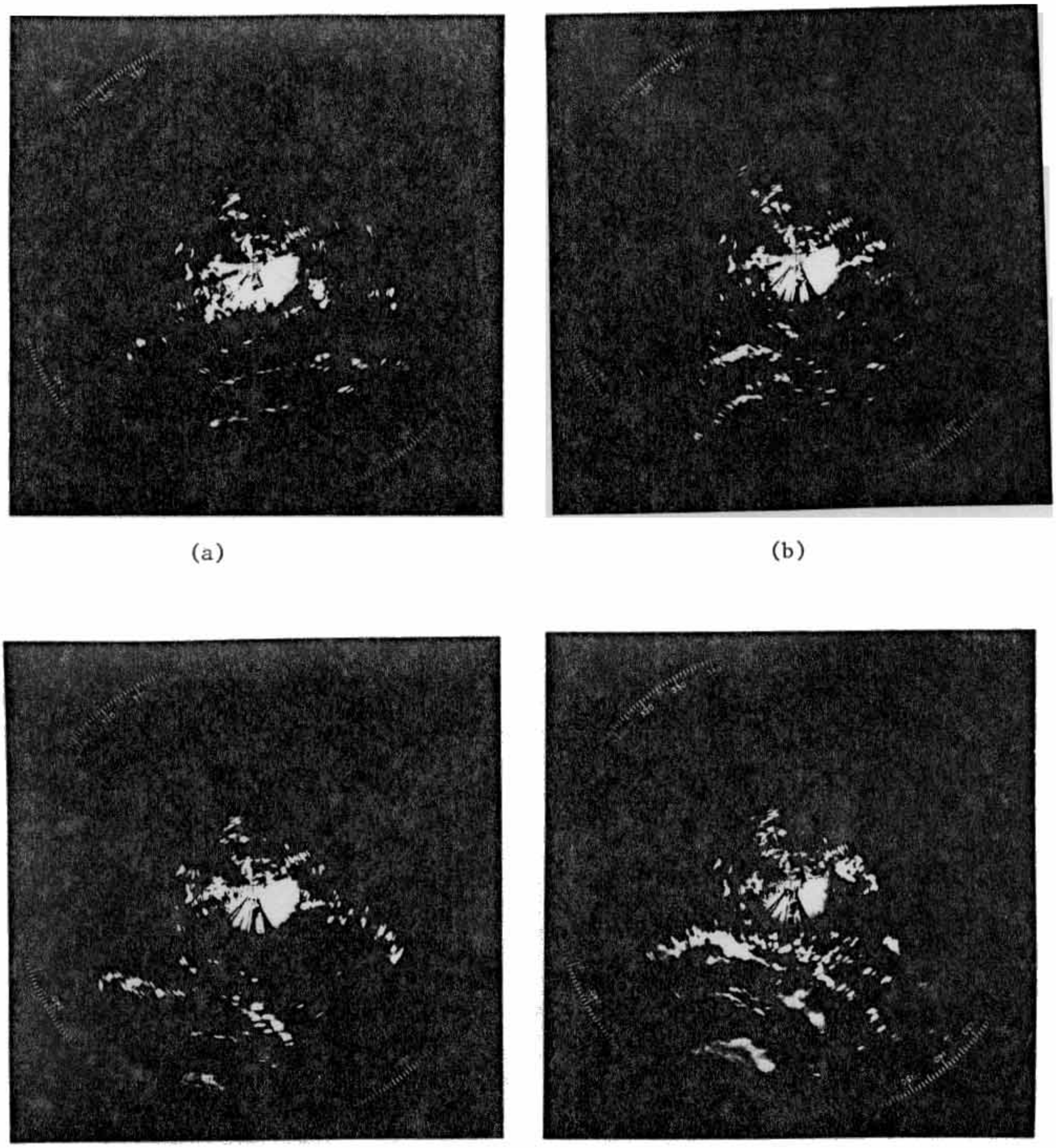
16.4 Difficult Situation *

16.5 Numerical Prediction

16.6 Rainfall and Storm Surge *

16.7 Long Range Forecasts *

** Not Completed*



(a) (b)

(c) (d)

Fig. 16. . Pictures of the Hong Kong radar display showing the development of a tropical depression and its intensification into tropical storm Ruby on 14 September 1980. The weak, nearly linear outer rainbands at 1305 GMT on the 13 September (a) are typical early indications of development. They were followed at 2025 GMT on the 13 September (b) and 0305 GMT on the 14 September (c) by stronger echoes which are less well organized into more curved rainbands. Finally, at 0700 GMT (d) tropical storm intensity is attained with winds of 17 m/s and central pressure about 995 mb.

16.5 Numerical prediction

Present objective methods of forecasting the movement and intensity of tropical cyclone consider only the effect of the environment on the storm, no allowance is made for any effects which the tropical cyclone may have on this environment. However, there is strong evidence that tropical cyclones are not passive relative to the larger synoptic scales (Elsberry 1975). It seems unlikely therefore that any improvement will be made in tropical cyclone forecasts for periods in excess of 24 h until the detailed environmental flow can be predicted including any changes that may be attributable to interaction with the tropical cyclone. This requires that the methods of numerical prediction be used. However, a small grid size is needed to resolve the essential features of a tropical cyclone and it would be neither necessary nor feasible to maintain such a small grid size over the whole of the extended area which has to be considered when making forecasts for periods in excess of 24 h. A fine mesh model is only required in the region in which two-way interaction is taking place and since this is confined to an area around the tropical cyclone itself a moveable fine grid, centred on the storm, can be used with simultaneous integration to properly resolve the scale interaction. Because an eightfold increase in computer time is required if the horizontal resolution is doubled it is necessary to keep the fine mesh region as small as possible.

Elsberry (1975) has discussed the problems and developments associated with using 'nested' grids for this purpose. It is unsatisfactory to use a coarse grid to compute values at the boundary of the nested grid because firstly, there is no export of influence from the tropical cyclone to the large scale and secondly, there are computational difficulties which arise at the boundary due to grid size change and these result in the reflection of waves. It is necessary to integrate on both scales simultaneously if two-way interactions are to be entertained; in other wards, the solutions of the equations in the two grids are not allowed to develop separately. The computational arrangements must allow for mass, momentum and energy transfer from one grid to the other. The technical complications that arise in these computations and the attempts to solve them are too involved to discuss here, sufface it to say that it is generally considered that these problems will soon be solved so that, given adequate initial data, routine numerical forecasts of tropical cyclone movement and intensity can be prepared.

Elsberry (1975) argues that because numerical models have been shown to be sensitive to the initial conditions in the typhoon centre, particularly with respect to the radius and intensity of the maximum winds, it is unlikely that these perameters will, in general, be known with sufficient accuracy to permit computed forecasts for 24 h to show any improvements on current techniques. Aerial reconnaissance and well sited Dopplar radars will have increased value because of their ability to accurately determine conditions in the centre of the storm for input to future computer models. This high resolution information on the high energy core of the storm can be combined with coarser satellite derived information, particularly cloud motions, to define the complete wind field in and around the storm.

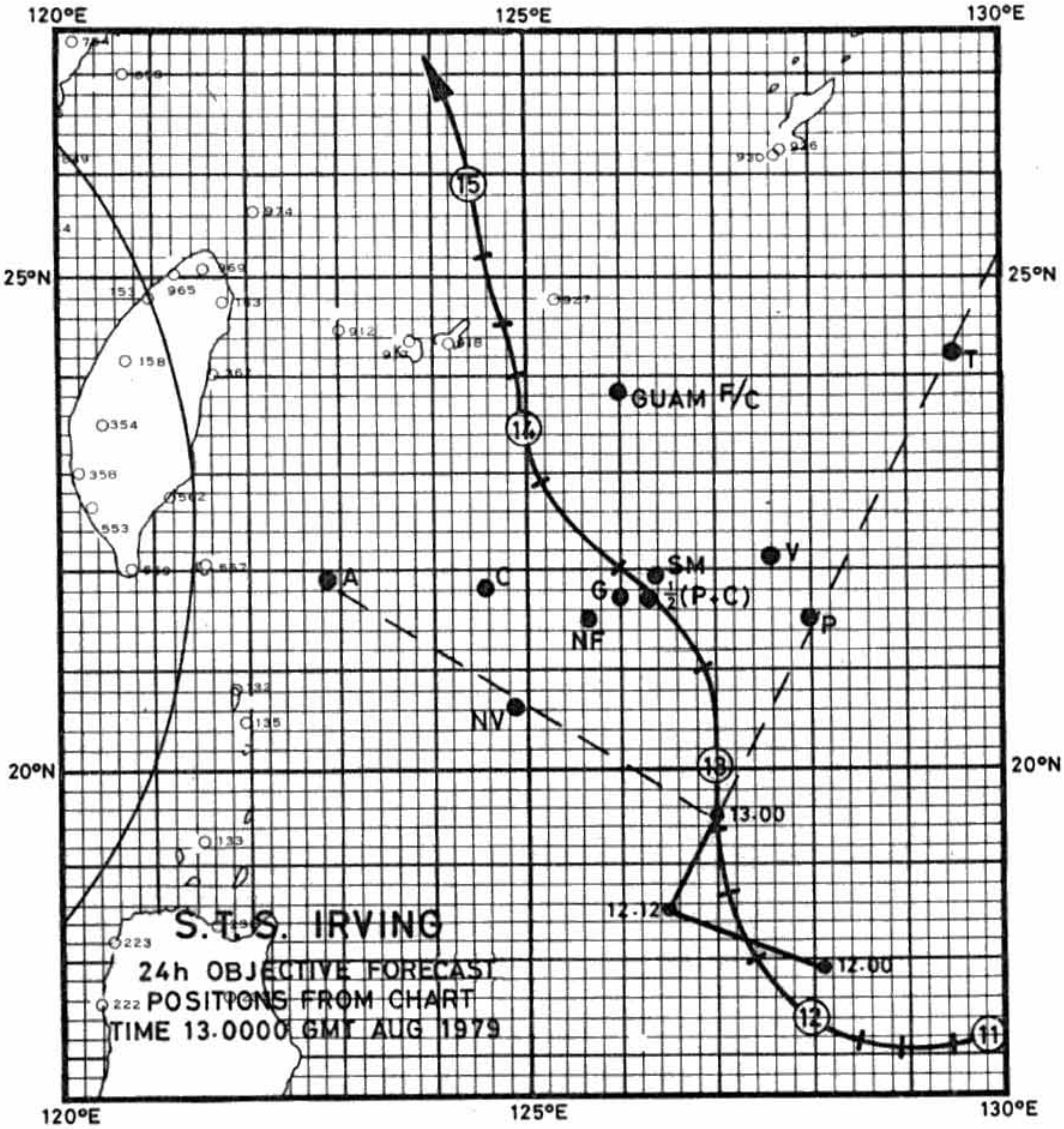


Fig. 16. . Typical spread of objective 24h-forecast positions. The best historical track is shown by open circles, operational fixes are small black dots and 24h-forecast positions ~~as~~ are the larger filled circles - see text.

REFERENCES

Elsberry, R.L. 1975. Feasibility of an operational tropical cyclone prediction model for the Western North Pacific area. GERAEPS Tech. Rep. No. 1. Naval Postgraduate School, Monterey.