Letters to the Editor

On Syōnos Initial stages of Typhogenesis

Dear Sir,

In a recent paper in Tellus (SYŌNO, 1953) a physical picture of a typhoon model is presented. First, it is questioned whether the stages described by Syōno should be referred to as "typhogenesis". He states that: "It is well-known that at the initial typhogenetical stage, there occur numerous scattered local convective showers and squalls, but no systematic wind. Then we may assume that there is no mean systematic converging current within the region, where the typhoon is about to form." Such a picture of the formation of tropical storms is in sharp disagreement with the views of many authors (e.g. RIEHL, 1951; PALMER, 1952) who visualize the formation process as the intensification of an existing disturbance which often has been evident as a synoptic entity for days. The fact that many of the travelling disturbances in the easterlies and along the equatorial trough – some of which may deepen to typhoon intensity – produce rainfall amounts of the same magnitude as found in typhoons suggests that very definite convergence-divergence patterns exist prior to the typhoon stage. The divergence of opinions cited may partly be a matter of terminology, but it would seem that the Syōno model for the initial stage would be satisfied by innumerable small scale systems which never develop beyond the convective cloud cell stage. It would therefore be misleading to refer to these minor developments as "typhogenesis". According to the other viewpoint "typhogenesis" should properly refer to the mechanisms whereby an existing tropical disturbance, having cold core characteristics in most cases, is able to take on the thermal and circulation characteristics of the typhoon.

Secondly, it would seem that the mechanism proposed by Syōno for the pressure fall in the initial stage of "typhogenesis" is open to some doubt. He assumed that non-divergent flow is found about the initial convective cell so that the local pressure tendency is dependent only on the vertical motion term of the tendency equation; i. e. $\frac{\partial p}{\partial t} = g\,\overline{\varrho w}$

The vertical mass transport term was separated into that due to moist air $(\overline{\varrho w})_a$ and to liquid water $(\overline{\varrho w}_r)$[1].

$$\frac{\partial p}{\partial t} = g(\overline{\varrho w})_a + g(\overline{\varrho w})_r$$

After making the statement that: "At the present (initial) stage, since numerous local convective cells are surrounded by downward currents, the mean upward mass transport in the form of air is expected to be very small", the local pressure change is discussed by considering only the liquid water transport. From this reasoning the conclusion is reached that: "In fact the pressure tendency is 1 mm/hour corresponding to an intensity of the rainfall of 10 mm/hour." Static reasoning shows that this statement can be true only if the precipitable water in a vertical column has been decreased by this amount – which is a sizeable percentage of the total precipitable water even in a tropical atmosphere – since it has been assumed that no divergence is present. Clearly, from this argument the most effective means of obtaining a pressure fall would be rapid dissipation of the cloud system and a complete precipitation. Since the intensification of a convective cloud in the usual sense is associated with an increase in precipitable water in vertical columns through the cloud, Syōno's mechanism for the initial pressure fall does not appear physically realistic. It could, of course, be argued that a net mass convergence of liquid water could take place in a non-divergent system provided that it is exactly balanced by mass divergence of air. However, the mechanics of such a system would appear to be as obscure as that of the pressure fall which it purports to explain.

[1] The division of the transport term in this manner presumably implies that the liquid water is in hydrostatic equilibrium. If the water is falling such may not be the case.

REFERENCES

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