2A.3 **Seasonal forecasting for tropical cyclones affecting Shanghai**

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1. Intoduction

The anomaly of tropical cyclone (TC) activity bears relation to the anomalous change of global climate. Nicholls (1979) document that TC activity in the Australian region has an interannual variation and related to ENSO phenomenon. Gray (1984) and Shapiro (1989) found the relationship between TC activity in the Atlantic and the stratospheric quasi-biennial oscillation (QBO) phenomena. Then, the methods for forecasting Australian and the Atlantic seasonal TC activity have established by Nicholls (1992) and Gray (1992). Therefrom, the seasonal variability and forecasting of TC activity over each of the ocean basins has received considerable attention. Over the Western North Pacific (WNP), Chan (1985) found that TC activity is very much related to the ENSO phenomenon. Dong (1988) also showed that this activity is correlated with the sea-surface temperature (SST) over the eastern equatorial Pacific that can be considered to be a proxy of ENSO. Chan (1993) pointed out that the correlation between the number of landfalling TCs over China and the ENSO and QBO phenomena should be possible to make the predictions.

In this study, an attempt is made to establish the method for operational predicting the TC number of affecting Shanghai. The 'affecting', in this paper, is specifically refer to that the distance from TC's center position to Shanghai within three latitude-longitude degree, or causing more than 50 mm storm precipitation, or issue in flatus eight and more Beaufort wind scale over Shanghai.

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2. Statistic features

According to the six-hourly best-track positions of TC over the WNP and the Shanghai's winds and precipitation when TC affecting Shanghai between 1949 and 1996, the TC affecting Shanghai appear from May to November, and the average is 2.89 for each year. It is far less then that over Australian and Atlantic, NWP and China, and the number of affecting Shanghai in entire year is changing relatively large from 7 to 0.

3. Forecast factors

Popularly, to find out the factors related to the TC interannual variation is the firstly step for establishing the forecast method, so analyzing the relationship between affecting TC and atmospheric/oceanic factors is very important. But the types of these factors is too much to analyze one by one, and take into account the forecasting method is operational, we must select the factors that relation to the affecting TC and we can get its value by operational meteorological net. On the other hand, we wish some potential physical relationship existent among these selecting factors with affecting TC.

Firstly, from the precipitation monthly distance and thermodynamic balance equations, in this study, conclude the dynamical equation of affecting TCs:

$$TCs = A_1 + A_2 T_s + A_3 \varphi + A_4 \frac{\partial \varphi}{\partial x} + A_5 \frac{\partial \varphi}{\partial y} + A_6 \nabla^2 \varphi + A_7 \frac{\partial \varphi}{\partial t} \qquad (1)$$

where T_s surface temperature, φ geopotential height, A_1 to A_7 constant.

4. Forecast methods

Then, based on the correlation of TCs and the term in equation (1) right side, the methods for forecasting the TCs of affecting Shanghai are established and have been operational forecast since 1998. That include the optimal climate normal method, the time alignment or mean generation model, and the method of based on sea surface temperature (SST), the height of 500hPa and its space-time evolve, and using the numerical model（T63）outputs by dynamical outstretched with month scale.

5. Skill

Finally, the assessment parameters of TCs forecasting skill are defined as determine index, absolute error and skill score comparatively optimal stochastic forecasting. And using those skill parameters, the seasonal forecasting skills are assessed according to the operational forecast during 1998 to 2001.

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