A Method of Tropical Cyclone Generation Prediction in South China Sea

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Introduction

There are about 1,600 tropical cloud clusters (TCCs) each year in the whole global, of which only about 6.4% develop tropical cyclones (TC). The development of TC in the South China Sea is fast and its life cycle is short. And some of TCs in the South China Sea from generation to landing last for less than 48 hours. So, the operational forecast of this type TC is very difficult.

In this paper, the environmental fields of developing and non-developing TCCs are analyzed, and an operational method is proposed to predict the TC generation.

Tropical Cloud Cluster definition, identification and tracking

The TCC is defined as the non-frontal weather system, and the space scale is more than 200km, the time scale of deep convection cloud is more than 24 hours.

The other conditions of the target cloud clusters as the following:
(1) The TBB $\leqslant -32℃$ area of TCC is larger than $1 \times 10^5 km^2$;
(2) The TBB$\leqslant -52℃$ area of TCC is larger than $1 \times 10^4 km^2$;
(3) The gravity center of the tropical cloud cluster is located the north of 8N.

Firstly, the TCC is identified using the convective characteristics of TCCs such as open pits, long and short axes, center of gravity, area index, boundary, etc.
Based on motion and similarity matching, the TBB images at two continuous times are utilized to track the clouds.

Comparison of the developing versus non-developing TCCs.

The ambient atmosphere, ocean heat flux (OHC) and sea surface temperature (SST) of the developing and non-developing TCCs are examined using the data sets of GFS, TMI sea temperature and HYCOM ocean assimilation. There are 15 non-developing TCCs and 13 developing TCCs in the South China Sea from 2008 to 2010.The result shows that there is no obvious difference in SST, wind vertical shear and OHC between the developing and non-developing TCCs(Fig.1).
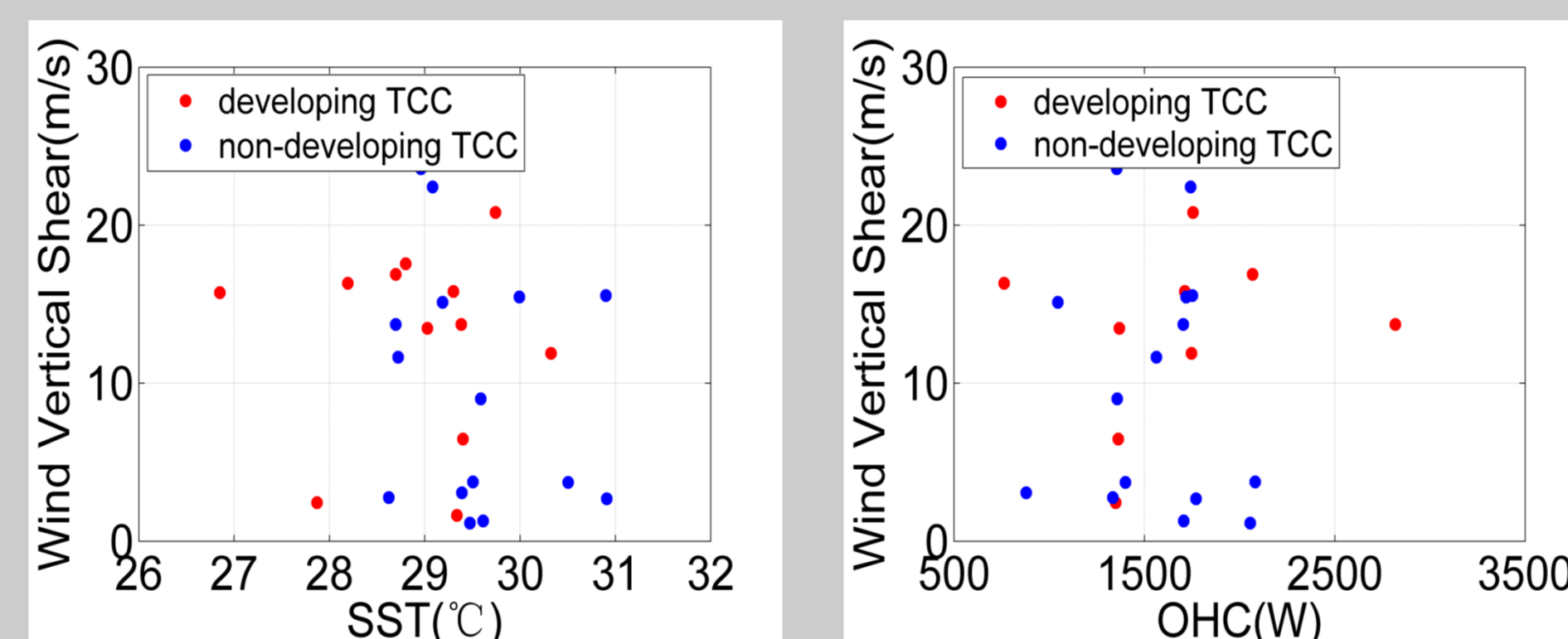

Fig1 SST/Wind Vertical Shear (left) and OHC/Vertical Wind Shear (right) of the developing and non-developing TCCs.

The composite and individual analysis reveal that there are large differences in the vertical profiles of low-level vorticity and relative humidity between the developing   and   non-developing   TCCs(Fig.2a and Fig.2b).
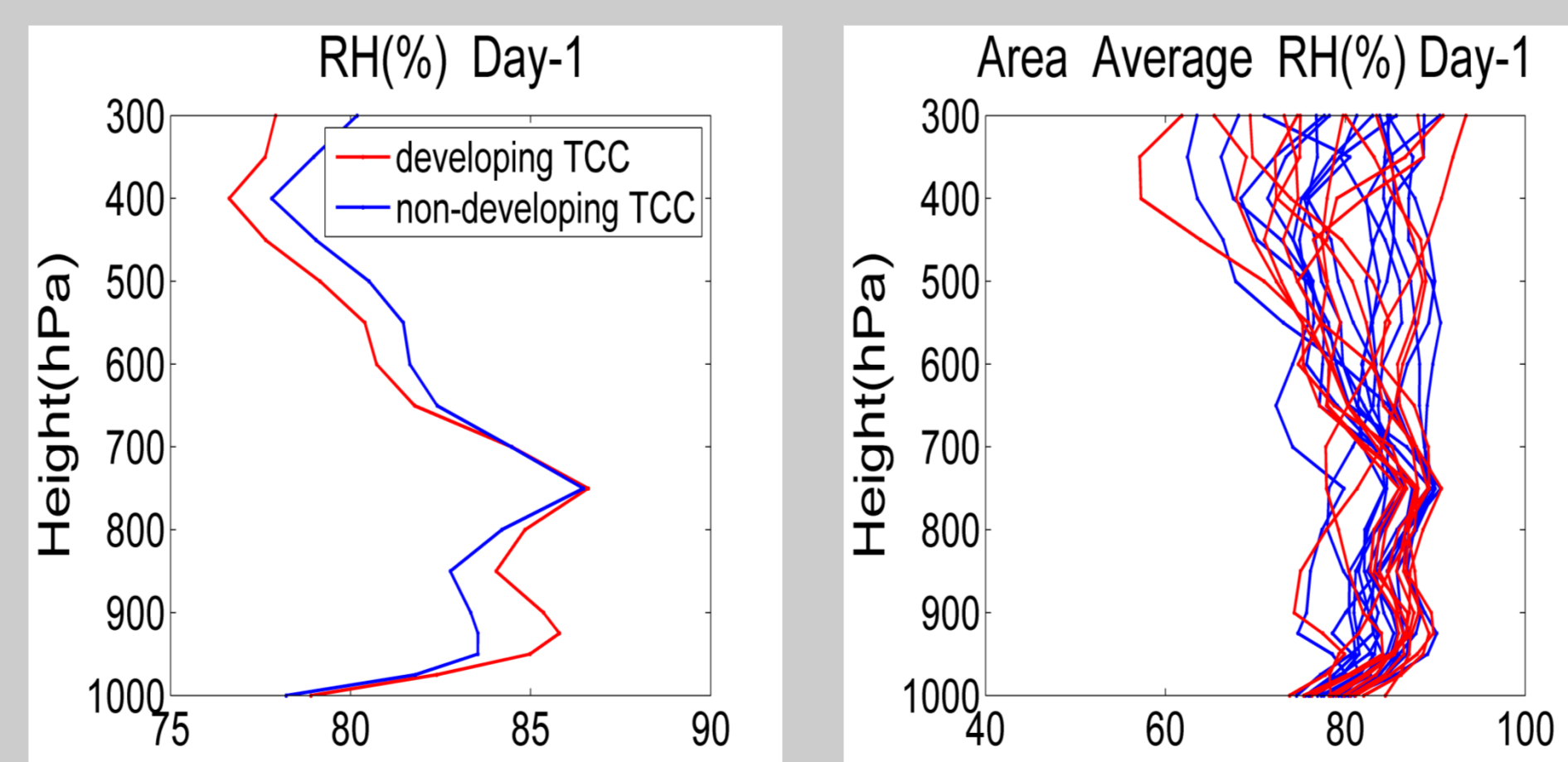

Fig.2a The vertical profiles of composite(left) and individual(right) RH averaged area over 500km of the developing (red line) and non-developing (blue line) TCCs.
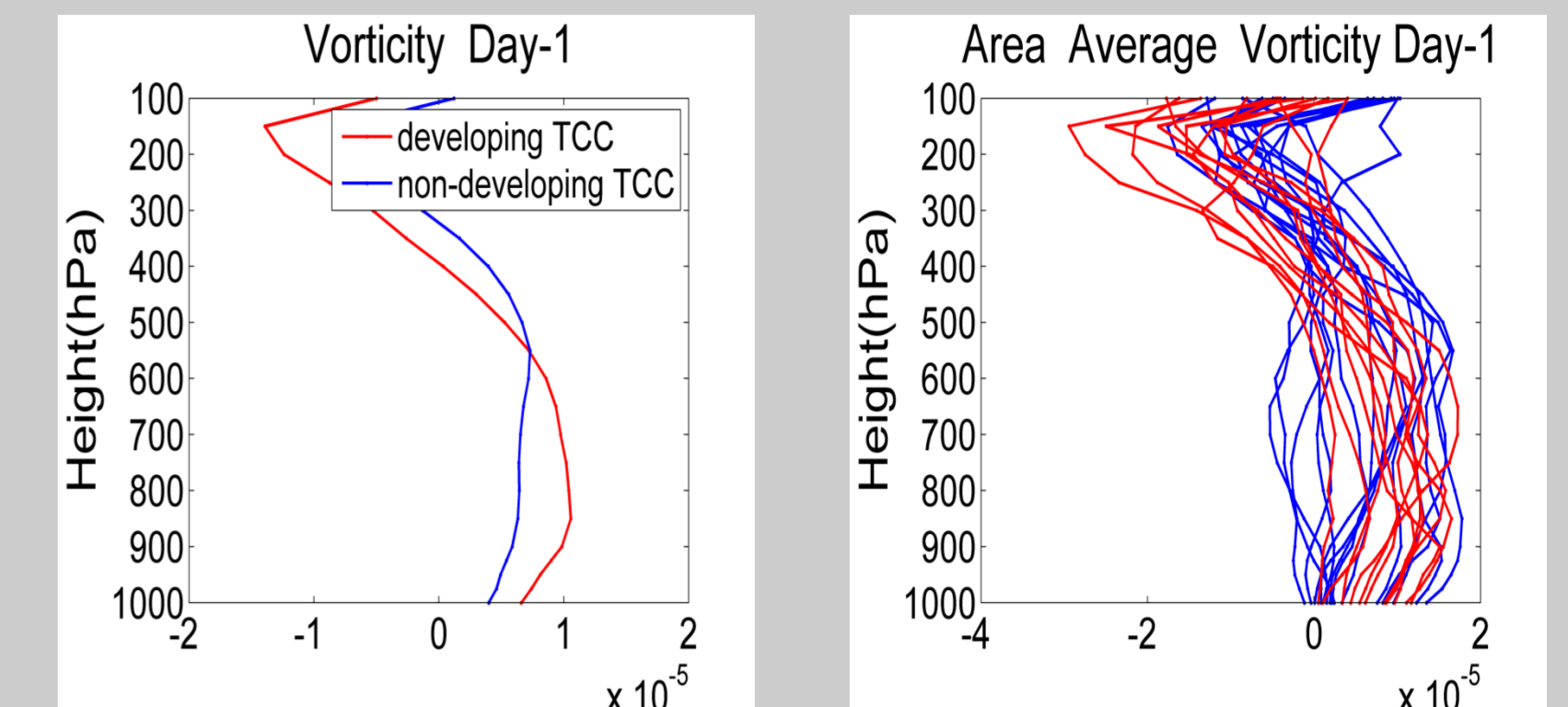

Fig.2b The vertical profiles of composite(left) and individual(right) Vorticity averaged area over 500km of the developing (red line) and non-developing (blue line) TCCs.

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The diagnostic model is set up based on the target cloud convective characters, and the dynamic and thermal conditions.

The TCC must not develop, when the vorticities are negative at low levels and the relative humidity is less than 78% below 900hPa .

The TCC may develop, when there are the positive vorticity at lower level and the relative humidity being greater than 85% at 900-950hPa. And if the relative humidity of 900-950hPa is less than 85%,but the vorticities at least two layers below 900hPa are greater than their thresholds, the TCC also can develop.

The accuracy of the prediction model is 80% or so in 2013-2015 real-time forecasting.

Conclusion and Reference

The comparison between developing and non-developing of TCCs shows that the vertical profiles of vorticity and humidity averaged are the main indicator for the generation of TCs. The model of tropical cyclones generation in the South China Sea is established. And The forecasting accuracy is 80% or so.

Reference:
[1]Holweg, E. J. (2000), Mariner's guide for hurricane awareness in the North Atlantic Basin, report, 72 pp., Natl. Weather Serv., Silver Spring, Md.

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