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Interactive Comment

Interactive comment on "Prediction of tropical cyclonegenesis over the South China Sea using SSM/I satellite" *by* C. Zhang et al.

C. Zhang et al.

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I greatly appreciated the review for my manuscript and the comments from the reviewer. This is my answers and explanation for referee#2.

General comments

1) The author's method of using the Illinois Listserv to obtain their sample is not a controlled procedure. These bulletins come from (I would guess) various tropical cyclone warning centers that provide forecasts and analysis in the region (e.g. JTWC, HongoKong, PAGASA, Vietnam, Malaysia and maybe Darwin)...all except NHC. The authors did not explain how they could distinguish between true tropical disturbances (without a closed circulation at the surface) and those tropical depressions that may

have had closed surface circulations, but for whatever reason were not yet warned on. Also,which agency (ies) did they use to determine when the system became a tropical depression:was it based on a ‘warning’ or on a post analysis (i.e. ‘best track’). I also think it matters whether the systems pre-existed and moved into the SCS from the Philippine Sea or whether they formed totally within the South China Sea basin. Finally how many of these systems pre-existed as monsoon disturbances or depressions (systems with large circulations either at the surface or aloft, but with no distinctive surface position).

Response: We thank the reviewer for correcting the errors in describing the data used in the original manuscript. As my answer in referee#1, I have modified the description of data source in the following way: “The records of tropical disturbances over the SCS used in this study are from tropical disturbance alert messages forwarded by the University of Illinois at Urbana-Champaign (UIUC) weather server as Tropical Storm and Hurricane WX (WX-TROPL) products. The originator of these alert messages includes the various national weather services, including the Joint Typhoon Warning Center (JTWC), the Japan Meteorological Agency (JMA), the Hong Kong Observatory (HKO), and the National Hurricane Center (NHC).” UIUC considered all the information and issued an advisory of tropical disturbances. Our judgment of whether a circulation is a disturbances or not and the location of tropical disturbances using in the manuscript are both based on the advisory. The disturbances discussed in the manuscript formed originally within the South China Sea, most of which are monsoon disturbances. In our future research, the criterion will be used to predict the disturbances including cases that formed in the easterly wave in the Northwest Pacific region.

2) I would like to know what was unique to the use of the 500km radius. Did they try larger and smaller sizes with weaker results (using the same methodology)? As far as I know, 500km may be unique to a SCS system, but I would need to know if they tried any other size. In addition were these size criteria the same for all areas of the SCS basin (i.e. we often think of smaller systems forming closer to the equator (e.g. Vamei

in 2001) and, of course, there is a general size difference usually found between a developing large monsoon depression versus a smaller westward moving cloud cluster (disturbance) moving in from the Philippine Sea.

Response: Thank you for your comments. This is an interesting question. There is a general size difference usually found between a larger developing monsoon depression versus a smaller westward moving cloud cluster (disturbance) moving into the South China Sea (SCS) from the Philippine Sea. In our manuscript, we only study the disturbances that formed originally in the SCS, most of which are generated along the monsoon trough. So we think a static radius of 500 km is reasonable for tropical disturbances formed in the SCS. There is still a lot of uncertainty in the technology to locate the center of the disturbances from satellite observations. In most actual conditions, a disturbance is often composed by several cloud clusters and we do not know which one would develop into the center of the depression. A static radius of 500 km is used in our study in order to cover all cloud clusters for one disturbance. We have also tried 600 km and found that there are nearly no differences in the results from those when using 500 km. It will be interesting to test other radius smaller than 500 km. And we agree that if we can detect the size of disturbances correctly, the forecasting correct rate may be increased. Wang et al. (2008) analyzed disturbances over the SCS in 2000 and 2001, indicating that $2\times10\hat{}14$W and $6\times10\hat{}14$W may be two important values of mean total latent heat release within 500 km of the center of tropical disturbance to distinguish the developing and non-developing tropical disturbances. This manuscript kept on the same algorithm in Wang et al. (2008). The forecasting system based on the method proposed in this manuscript has been run in real time by Chinese Meteorological Agency (CMA) from June 2010, and we are also working on the technical system to detect the size and center of disturbances using satellite observation. We will continue our study after that system is established.

3) I have a question regarding the author's major results concerning the amount of precipitation as a driving criterion as opposed to a necessary but not sufficient condition.

Previous works using satellite data and size such as by Dvorak (1975), McBride and Zehr (1981) and many others have established that it is not the 'amount' of convection, but the organization of the convection that is most important: : :and then a requirement of a lack of persistent vertical wind shear that is most important. Do the author's believe their work contradicts these earlier studies: : :and how can they be sure without knowing the wind structure about each of the systems that they studied?

Response: Thanks for your comments. Wang (2008) compared 30 non-developing and 13 developing disturbances over the SCS in 2000 and 2001 using satellite and reanalysis data sets in order to understand why some disturbances developed into cyclones, while others did not. One index of latent heat release (ILHR) combining five factors including (1) sea surface temperature; (2) vertical wind shear; (3) relative humidity at 500hPa; (4) relative vorticity at 850 hPa; and (5) outgoing long wave radiation is defined to predict the development of disturbances. Fig. 1 presents the scatter plot of ILHR based on five environmental factors and TLHR from SSM/I satellite. The correlation coefficient between ILHR and TLHR is 0.780, which is statistically significant with 95% confidence level. Therefore, the latent heat release through condensation and precipitation processes is essential and enough to predict the development and maintenance of tropical disturbances. We think our result did not conflict with earlier studies. Under suitable environment conditions which include SST, VWS, RH in 500 hPa, relative vorticity in 850 hPa and so on, convection became organize, enough moisture can be lifted to mid-upper level, and release enough latent heat to generate a low pressure in the surface. We added a short description of results from PH. D thesis Wang (2008) in our text.

4) In the author's methodology (unless I misunderstood), they stated that as long as the system maintained their TLHR criterion as a mean over several days and also on the 'latest day', that it was considered a developing disturbance; otherwise it was a nondeveloping disturbance. Although I could understand the mean day over day criterion, I did not understand the 'latest day requirement'. This appears to be an observation that

‘if’ the convection ‘goes away’, it will not form (which might be a requirement, in general, for the SCS as the size of the basin might not allow enough time for the system to ‘redevelop’ before it runs into land). I would think that the reasoning why the convection weakened to be an important factor, as well.

Response: You did not misunderstand. The statistics in the manuscript implied that once ‘the average daily mean TLHR’, but not ‘the latest day’ is less than 3×10ˆ14W, it would never reach the level of depression. The reason we add the second criterion is more like technical scheme. As from our statistic result, the TLHR in the first day may be much larger than 3×10ˆ14W, and even if the TLHR is smaller than 3×10ˆ14W in the second and the third day, as a mean TLHR over several days is still greater than 3×10ˆ14W. Normally, most of these systems would weaken and few of them would develop. As shown in fig. 2, based on day-to-day forecast, if we add the second criterion there are 18 more correct days (green bar) and 5(red bar) more incorrect days, as compared with that only the first criterion is used. The reasoning why the convection weakened to be an important factor is a quite interesting question. We guess a disturbance need a trigger to became a depression and that trigger might release enough energy of 3×10ˆ14W.

5) A final general point I will make concerns the relationship of the ‘center’ to the actual center of the surface circulation. Was there any attempt to ensure that for both developing and non-developing systems that if a surface circulation existed (perhaps from surface observations or QuikSCAT) that the centers of the convective center (stated by the various agencies) and the surface center were one in the same? This knowledge may help the author’s establish a physical reasoning for their results through inertial stability principles (Schubert and Hack, 1982); since unless this occurs, I do not see why the TLHR from convection would not dissipate via gravity waves, advection, mixing and friction, etc. rather than contribute directly to a surface pressure drop.

Response: The center of the surface circulation using in the manuscript is totally from the tropical disturbances and cyclones advisory of UIUC. Therefore, we did not per-

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sonally test whether the centers of the convection center and the surface center were the same one. But it is interesting to do one test in our future study. As mentioned in the manuscript, the TLHR from convection would dissipate via gravity waves, advection, mixing and friction, Since if the TLHR is smaller than 2×10ˆ14W, the disturbance will die, 'the energy of 2×10ˆ14W is assumed to maintain itself', including dissipate via gravity waves, advection, mixing and so on, and the rest '1×10ˆ14W is used to heat the upper level of cumulus',that contribute directly to a surface pressure drop. That is why a daily basics 3×10ˆ14W is needed.

Specific comments

1) The references that the authors mentioned at the beginning of the paper such as by Katsaros et al (2001) and Sharp et al (2002) are both discussions on how these authors used the confusing winds in the QuikSCAT data to establish a surface circulation and are not discussing the actual criteria for tropical cyclone genesis.

Response: We agree they were not discussing the actual criteria. Katsaros et al. (2001) assumed that the presence of closed circulation in the surface winds before depressions provide valuable guidance for cyclone forecasting. Sharp et al. (2002) found positive vorticity signals which exceed a certain threshold magnitude and horizontal extent within the swath of vector wind observations are useful for early detection of TC genesis. Both of them proposed some method or phenomenon to detect and forecast TC genesis, which have the same purpose of us, but they were not discussing the actual quantitative criteria. The value of our manuscript is that it firstly provides an actual quantitative criterion for day-to-day requirements to make formation predictions

2) I was not quite sure what algorithm in the Wentz papers that the author's were referring to.

Response: We thank the reviewer for correcting the errors in describing the data used in the original manuscript. For SSM/I satellite, the propagation of the microwave radiation through the atmosphere is influenced by the integrated amounts of water vapor and

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liquid water in the atmosphere column. Therefore, the brightness temperatures carry signals can then be converted into geophysical parameters using retrieval algorithms (Wentz, 1997; Wentz et al., 1998). Text revised.

3) I did not understand the X-axis in Figure 1.

Response: The disturbances in figure 1 are arranged in a descending order of latent heat release. Therefore, the x-axis in figure 1 is not labeled. We have added a description in Text.

Technical corrections

This work would have to have another thorough review of the English grammar and terminology used before it could be finalized. Although I understood most of what the authors intended, I believe there were many places where the sentence structure or use of words was not quite correct. Even the title of the paper mentions a 'SSM/I satellite' which I know the authors also know is actually a 'DMSP' satellite and the sensor is the 'SSM/I".

Response: Thank you for your suggesting. We have rectified these issues with the help from an English editor.

Reference

Wang, L., Lau, K., Zhang, Q., and Fung, C.: Observation of non-developing and developing tropical disturbances over the South China Sea using SSM/I satellite. Geophys. Res. Lett., 35, L10802, doi:10.1029/2008GL033446, 2008. Wang L. Study of tropical cyclogenesis over the South China Sea. Hong Kong: Hong Kong University of Science and Technology, 2008. (PH. D thesis) Wentz, F. J.: A well-calibrated ocean algorithm for Special Sensor Microwave/Imager. J. Geophys. Res., 102, 8703-8718, 1997. Wentz, F. J., and Spencer, R.W.: SSM/I rain retrievals within a unified all-weather ocean algorithm. J. Atmos. Sci., 55, 1613-1627, 1998.

Figure explanation

Figure 1: The relationship between ILHR based on five environmental factors and TLHR from SSM/I satellite. The linear least-squares regression line is statistically significant (Wang, 2008).

Figure 2: the correct and incorrect prediction of each disturbance in their lifetime. The developing disturbances are on the left of the dot line, while the non-developing disturbances are on the other side. The grey bar stands for the correct day, and the black one stands for the incorrect day. The green bar stands for the more correct day, while the red one stands for the more incorrect day if the second criterion is added.

Please also note the supplement to this comment:
http://www.atmos-meas-tech-discuss.net/3/C817/2010/amtd-3-C817-2010-supplement.pdf

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Interactive comment on Atmos. Meas. Tech. Discuss., 3, 1495, 2010.

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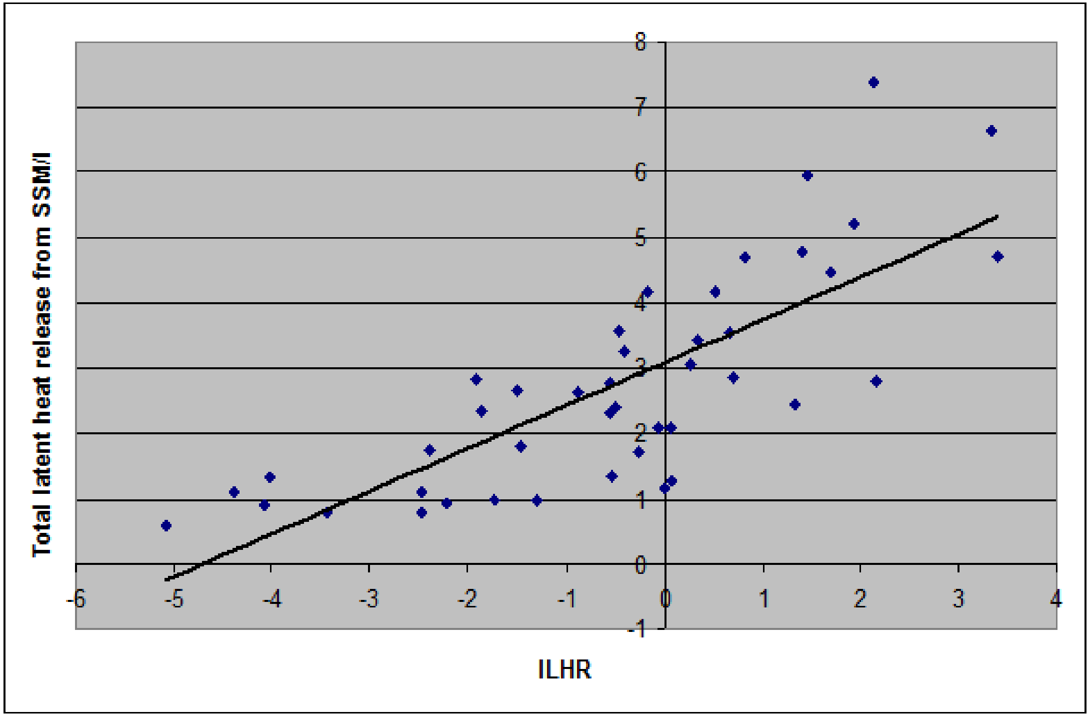

Fig. 1.

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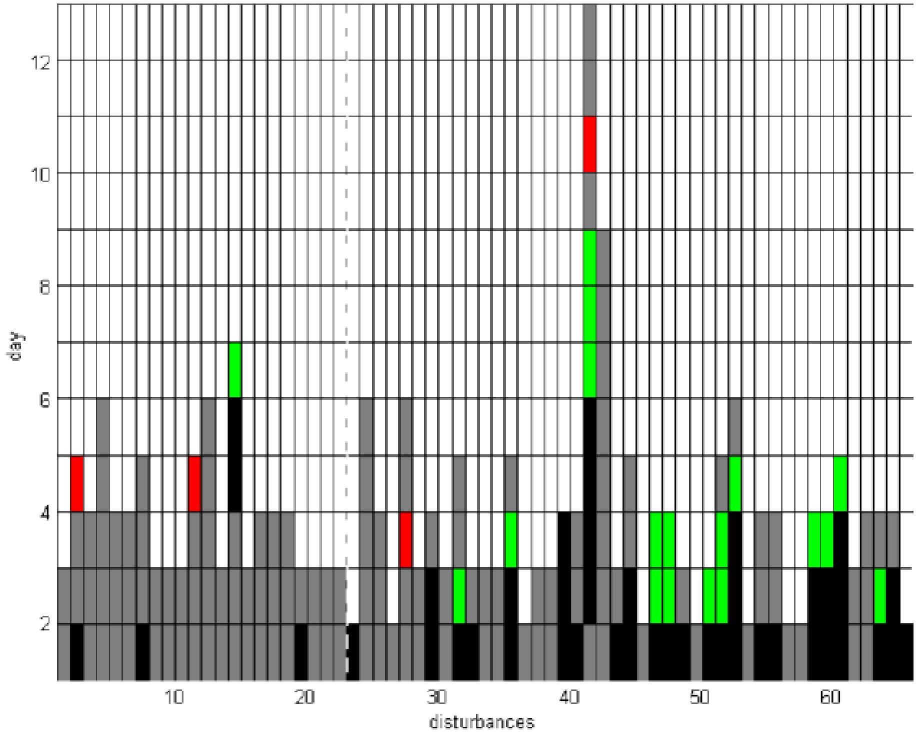

Fig. 2.

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