Numerical Study on Impacts of the Wet Land Boundary Layer Fluxes on the Sustention of Typhoon Nina and Its Rainfall

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1. Introduction

Typhoon Nina（7503）went deep inland and sustained for 4-5 days after it made landfall in south east coast of mainland China on 4 Aug.,1975. It re-strengthened over inland resulting in extreme rainfall of 1062mm/24 hours. Its underlying ground was almost saturated. Previous study (Chen, 2002) indicates that a landfalling typhoon could sustain a longer time if it stagnated over a huge water surface. Study (Kong, 2002) showed that the development of convection over a warm and wet ground likely contributed to the inland intensification of the remnant of the tropical storm Allison. Shen (2002) studied the impacts of the water surface in ground on the hurricane sustention with GFDL hurricane model and found that the water layer with 0.5m depth could obviously slow down the decaying rate of a hurricane over land. However, such effects of wet land are often neglected in the operational forecasts.

In this paper, the impacts of land-air flux transfer in saturated wet land boundary layer have been investigated in order to get better understanding on the mechanism of typhoon sustention over land and its rainfall.

2. Methodology

PSU/NCAR model MM5v3 and its TC Bogus scheme was employed to simulate the intensification process of Nina over inland. Several sets of sensitive experiments were performed with different boundary layer fluxes and contrasted them with control one. Bi-directional feed-back double nested grid mesh was used with NCEP 2.5*2.5 reanalysis grid data. Blackadar high resolution parameterized scheme was employed in those experiments.

3. Result

Fig.1 provides differences of the minimum sea level pressure (P_{min}) between the the sensitive simulations and the control one. Nina's intensity would decrease if without heat flux from boundary layer during integral process (pane line). It is found that both of latent heat flux (triangle line) and sensible heat flux (cross line) are favorable to the remnant maintenance, but the former one plays a dominant role. On the other hand, the remnant of typhoon Nina will be intensified distinctly if without the momentum flux from boundary layer(star line).

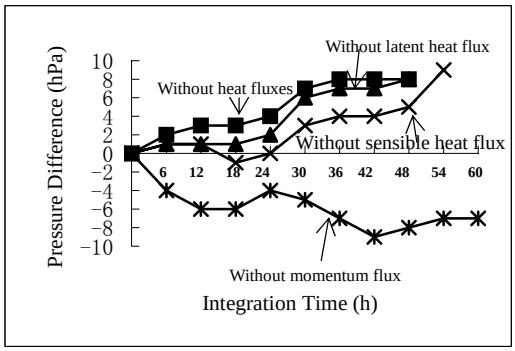

Fig.1 P_{min} differences between the different sensitive Exps. and the Control Exp.(pane curve: without heat fluxes, triangle curve: without latent heat flux, cross curve: without sensible heat flux, star curve: without momentum flux.)

Various precipitation associated with Nina was also found in different simulations. The rainfall would be obviously reduced if the latent and sensible heat fluxes were taken off from the model except the local heavy rainfall near the position (31°N,112°E) where is a mountainous area. However, Nina's rain band is presented a kind of spiral distribution if without momentum flux but the local severe rainfall would disappear.

4. Conclusion

The wet ground is favorable to Nina's sustention and its rainfall. Fluxes of latent heat and sensible heat in saturated wet land boundary layer are favorable to tropical cyclone intensification and rainfall increase, but the former would play a major role. On the other hand, momentum flux would weaken Nina's intensity obviously but it is somewhat to increase the typhoon rainfall in local area.

References

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