An Insight into the Equatorial-developed Typhoon Vamei via Satellite-Derived Energy Parameters

Gin-Rong Liu[1,2], Chin-Soon Huang [2], Tsung-Hua Kuo[1]

1 Center for Space and Remote Sensing Research,
National Central University, Chung-Li, Taiwan 320
2 Institute of Atmospheric Physics, National Central
University, Chung-Li, Taiwan 320

Abstract

Examination based upon satellite-derived air-sea parameters, especially for time-series energy variations in different rainfall convective stages, shows that the significant higher latent heat release (up to two times than similar case occurred in the previous year) during rainfall activities is the most crucial factor to maintain the typhoon, Vamei, formation process.

Introduction

As early as 1968, Gray (1968) indicated that the Coriolis force is one of the most important factors to consider. It is logical to assume that within 5 degrees of the equatorial belt, it is generally tropical cyclone-free. However, a typhoon was born near the Singaporean ocean in December 2001 and have a maximum wind speed of 39m/s near 1.5^{o}N, called Vamei (Chang et al. 2003).

Methodology

It is a reasonable line of thought to consider how energy plays its role in a typhoon's formation and evolution. Therefore, in order to provide additional insights, this study attempts to look into the energy flux and variations associated with Typhoon Vamei.

Satellite Data

The DMSP satellites' SSM/I data (5^{o}N-5^{o}S, 102.5-112.5^{o}E) were used to retrieve the air-sea parameters and rainfall rates for 1999 and 2001. The parameters and rain rates were retrieved by various empirical equations (Chiu, 1990, Liu et al., 2001, 2002).

Results

Figure 1 shows that the air-sea energy parameters' variations for December of 1999 and 2001. The parameters depicted that a typhoon could possibly occur in these two periods, due to the suitable air-sea environment conditions. The periods in 1999 and 2001 both had sufficient LHF to support the formation of typhoon cloud clusters. Evidently, more energy conditions were required for the sustaining and strengthening of these cloud clusters. As seen in Table 1., the LHF values for Dec. 20-25, 1999 and Dec. 21-26, 2001 had similar energy LHF values and dynamic conditions. Cloud clusters were both observed in the area during these two periods. Comparison in LHR values showed that the value in 2001 was two times larger than the value in 1999, revealing the importance of the LHR. Larger LHR released from the rainfall activity ensured a larger energy influx for the typhoon to continue growing. Moreover, it also induced stronger convections and additional energy releases to form a positive feedback of a newly developed typhoon.

Conclusion Remark

Through satellite-derived air-sea fluxes, this study showed that conducive energy conditions in 2001 assisted in the formation of Typhoon Vamei, which was stemmed from stronger LHR released from the rainfall activity, during the pre-formation period. However, more simulations and low-latitude typhoon case analysis are recommended for the investigations of such rare typhoons, as well as how global warming impacts the LHR variations.

References

Chiu, L. S., 1990：Rain estimation from satellite: Effect of finite field of view. *J. Geophys. Res.*, **120**, 2723-2737.

Chang, C. P., C. H. Liu, and H. C. Kuo, 2003: Typhoon Vamei: An equatorial topical cyclone formation. *Geo. Res. Let.*, **30**, 50-1-50-4.

Gray, W. M., 1968: Global view of the origin of the tropical disturbances and storm. *Mon. Wea. Rev.*, **96**, 669-700.

Liu, G. R., C.C. Liu, and T.H. Kuo, 2001: A contrast and comparison of near-sea surface air temperature/ humidity form GMS and SSM/I Data with an Improved Algorithm. *IEEE Trans. Geosci. Remote Sensing*, **39**, 2148–2157.

Liu, G. R., C. C. Liu and T. H. Kuo, 2002: A Satellite-derived Objec-tive Potential Index for MCS Develop- ment during the Mei-Yu Period. *Journal of the Meteorological Society of Japan*, **80**, 503-517.

Table 1. Fluxes of SHF, LHF and LHR during three different time periods.

	1999 (12/20~12/25)	2001 (12/21~12/26)
SHF (W) *10^{14}	**0.92**	**1.21**
LHF (W) *10^{14}	**12.72**	**16.25**
LHR (W)*10^{14}	**26.04**	**55.25**
Total HR (W)*10^{14}	**39.68**	**72.71**

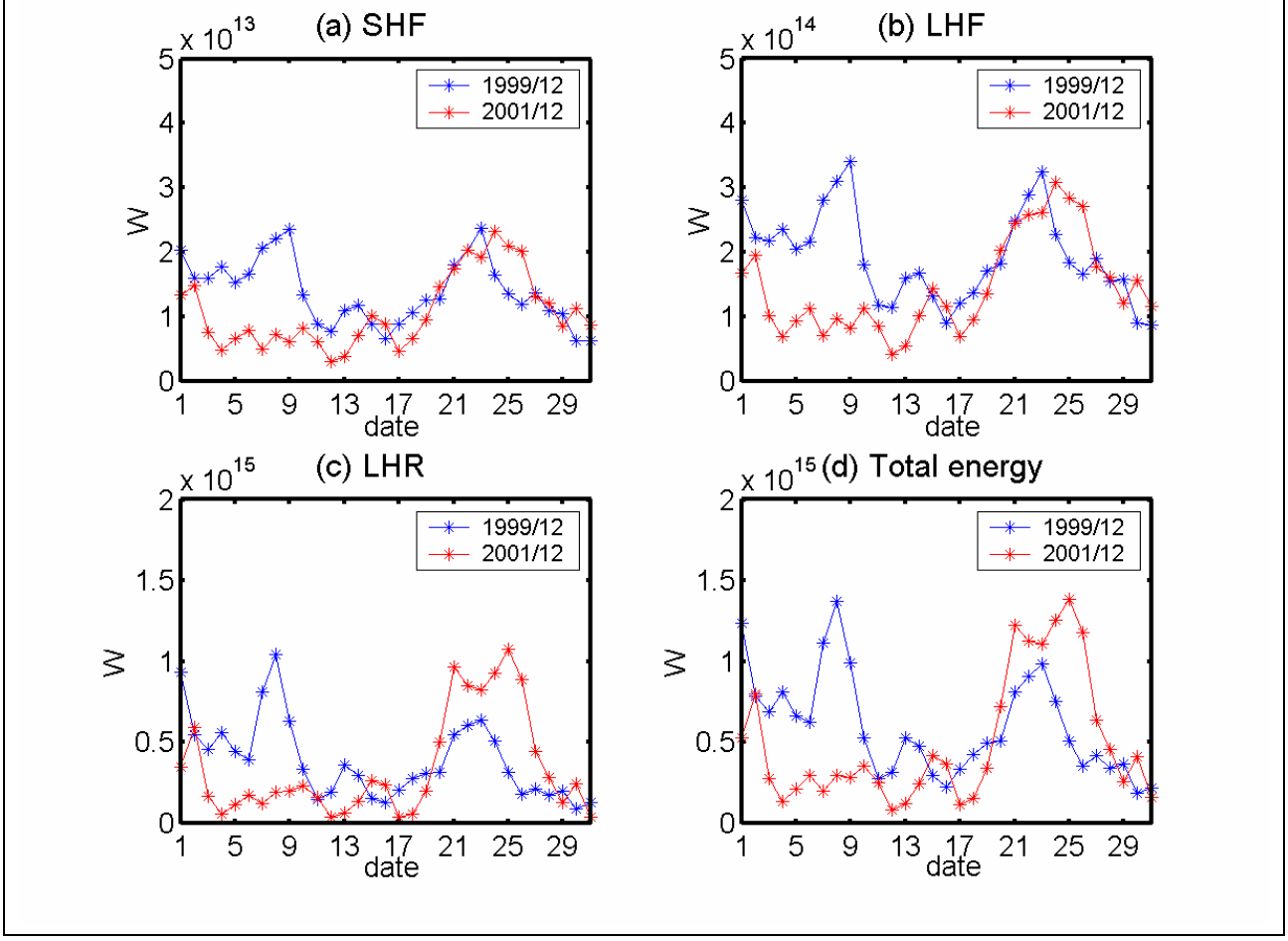

Fig. 1. Comparisions of (a) SHF, (B) LHF, (c) LHR and (d) Total energy in December of 1999 and 2001.