Estimate performance of Global Satellite Mapping of Precipitation and influence of wind on the performance

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1. Introduction

Hanoi urban area, the northern center of Vietnam, is located in the Red River Delta. The growing urban area is faced with the vulnerability by floods. The purpose of this study is to obtain basic knowledge to improve the realtime hydrological forecast system. We examined estimate performance (EP) of Global Satellite Mapping of Precipitation (GSMaP; Aonashi et al. 2009; Ushio et al. 2009) and wind influence on the EP on heavy-rain days.

2. Data and Method

We used daily precipitation of GSMaP RNL version 6 in 2001–2007. Vietnam Gridded Precipitation (VnGP; Nguyen-Xuan et al. 2016) was used to validate the GSMaP precipitation as the ground truth. The both data have a resolution of 0.1 degrees. Utilized wind profiles were what operationally observed with rawinsonde at Hanoi. Analyzed months were May, June, July and August with daily precipitation over 3 mm day^{-1} (Nguyen-Le et al. 2015) and dominant westerly winds in the lower troposphere (Nguyen-Le et al. 2014) almost all over North Vietnam at climatology. The 4 months had most of heavy-rain days with precipitation larger than 50 mm day^{-1} over North Vietnam. A rectangle region including the Lo River basin, one of the Red River branch, is chosen as a reference region. We analyzed heavy-rain days with at least one grid over 50 mm day^{-1} in VnGP. GSMaP EP was defined as a ratio of precipitation in GSMaP to that in VnGP for both grid and regional mean precipitation.

3. Results

The regional mean precipitation was basically underestimated by GSMaP. Thus, we took a strategy to clarify a reason for underestimate. We defined better and worse estimation (BE and WE) cases as cases with EP from 0.5 to 1.2 and less than 0.5, respectively. Zonal winds were significantly larger in the BE cases than in the WE cases below 500 hPa (Fig. 1). The EP was less than 0.5 in most cases on the days with zonal wind less than 2 m s^{-1} at 700-hPa level (Fig. 2). We compared case-mean EP distribution between the relatively westerly and easterly wind cases (WWC and EWC) at 700-hPa level (Fig. 3). The EP in the WWC was higher over North Vietnam including the reference region than in the EWC (Figs. 3a and b). In the upstream of the Red River, the higher EP region was along the River and the northeastern foot of the Hoang Lien Son Mountains in the WWC (Fig. 3c), while the EP was lower in the southwestern foot. The EP in the WWC is much higher than in the EWC in the downstream of the River. GSMaP even largely overestimated the precipitation in the southward of the Delta. The EP difference between the WWC and the EWC was smaller in the northward than the southward both in the downstream and the upstream. The EP difference was relatively small commonly in the southwestern foor of the mountainous region.

4. Discussion and Conclusion

These results imply that relatively strong streams made underestimate over the windward region. It is expected that interaction between the topography and winds affected on the EP through the deformation of the hydrometeor distribution on the horizontal-vertical surface. We will investigate the relation between the hydrometeor distribution and the winds in the next step.

References

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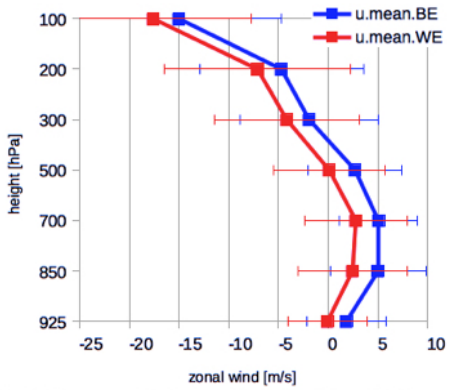

Fig. 1. Mean zonal wind profile in the BE and WE cases in May, Jun, August and September in 2001–2007 at Hanoi.

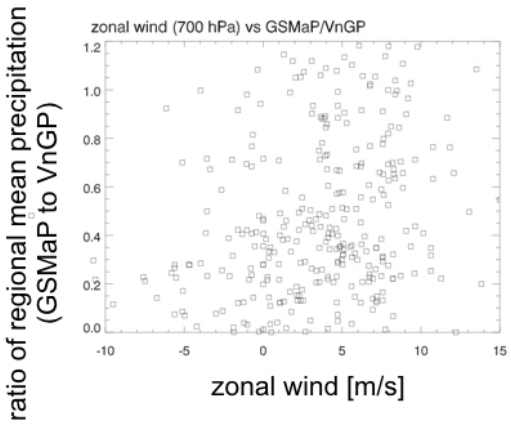

Fig. 2. Relationship between zonal wind at 700 hPa at Hanoi and the estimate performance of regional mean precipitation by GSMaP on heavy-rain days.

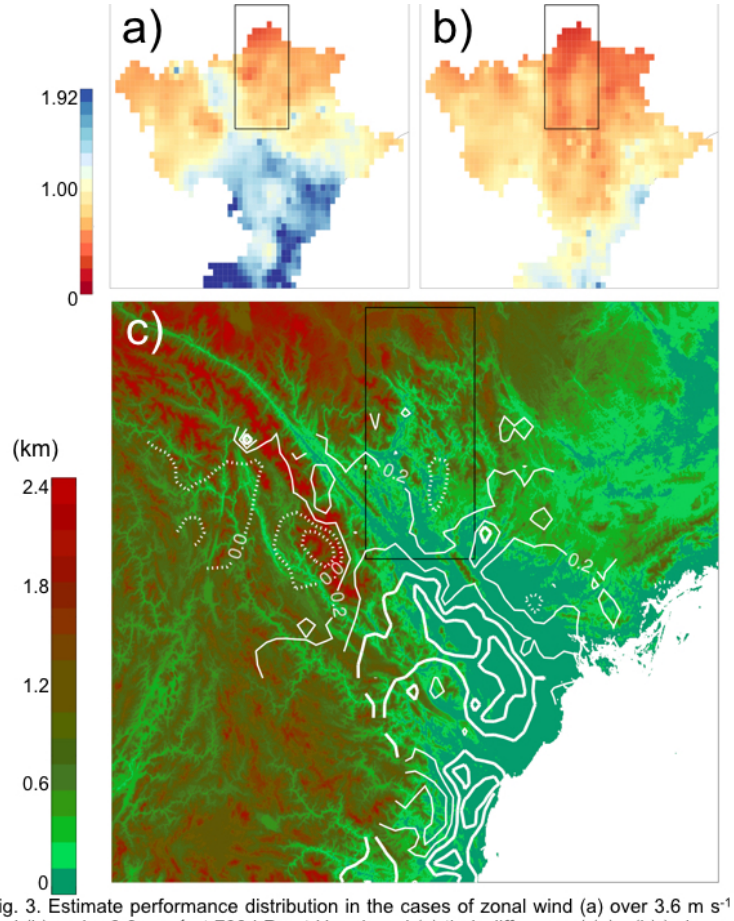

Fig. 3. Estimate performance distribution in the cases of zonal wind (a) over 3.6 m s^{-1} and (b) under 3.6 m s^{-1} at 700 hPa at Hanoi, and (c) their difference ((a) - (b)) shown by solid contours (positive values at interval 0.2, starting at 0.2) and dotted contours (negative values at interval 0.2, starting at 0.0) superposed on the topography map.