A Comparative Study on Reanalysis Data between GAME and NCEP/NCAR

During the Period of HUBEX in 1998

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Abstract

1. Introduction

This paper is about a comparison of the GAME reanalysis data(GRD) with the NCEP/NCAR reanalysis data(NRD) on 2.5×2.5° horizontal resolution in 1998, which GRD assimilated more raw data observed by HUBEX and TIPEX, etc, than NRD. So what differences exist between the both sets of reanalysis data in the experimental regions of GAME? And what good qualities are there in GRD? Whether the main cause of good qualities is the different assimilation system or the experimental raw data used by GRD? These problems are the aims of the paper, and have been gotten satisfactory answers in the paper, meanwhile which indicate that the HUBEX as the Eastern Asia part of the GAME is necessary to continue, and increasing the temporal and spatial resolution of observed meteorological elements is important to improve our forecasting accuracy of the weather and climate.

2. The comparative analysis

On the basis of the weather processes of Huaihe River basin from June to August in 1998, the difference and reliability of the two reanalysis data from the fields of basic element, derivative, precipitation, and surface flux were studied by dynamic diagnosis and statistics methods.

2.1 The comparisons in the basic element and derivative fields

Fig. 1 includes the comparisons of daily mean height fields for different pressure levels (Fig. 1(a)) and the height field of 850hPa pressure level for 4 times of daily (Fig. 1(b), other levels omitted), between both sets of reanalysis data. It is obvious that the bigger contrast exists in lower and upper troposphere, however in which the contrasts of 06:00 and 18:00 UTC are more distinct than other two times. Then it is easy to be understood that 4 times observed raw data assimilated in GRD, i.e. 0Z, 06Z, 12Z, and 18Z, vs. only 2 times observed raw data assimilated in NRD, i.e. 0Z, and 18Z, is the root of the discrepancy for the both sets of reanalysis data but not the different assimilation systems employed by both sets of reanalysis data.

The aforementioned judgment supported by another proof that the discrepancy of both sets of reanalysis data reaches the maximum value in experimental regions (seeing the contrast

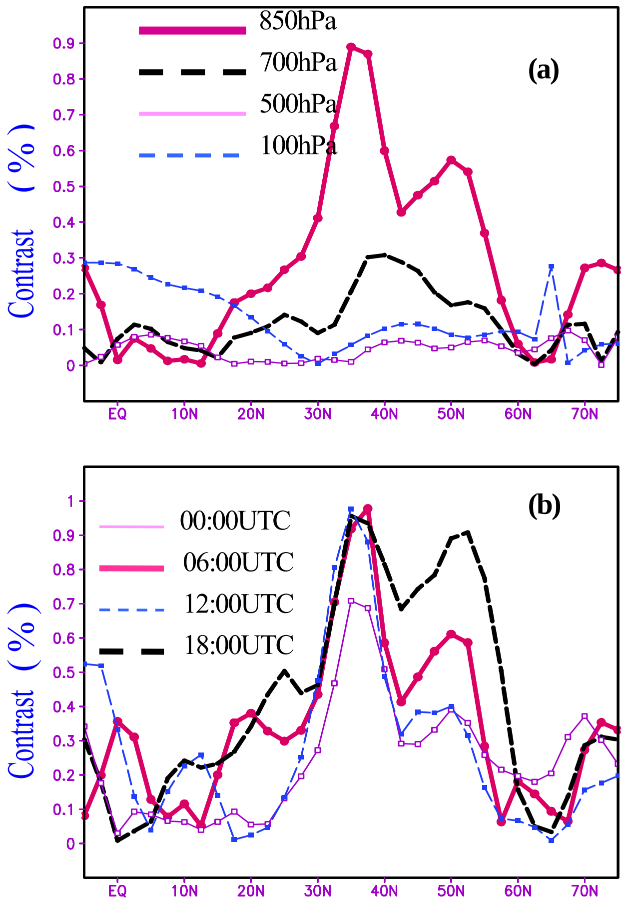
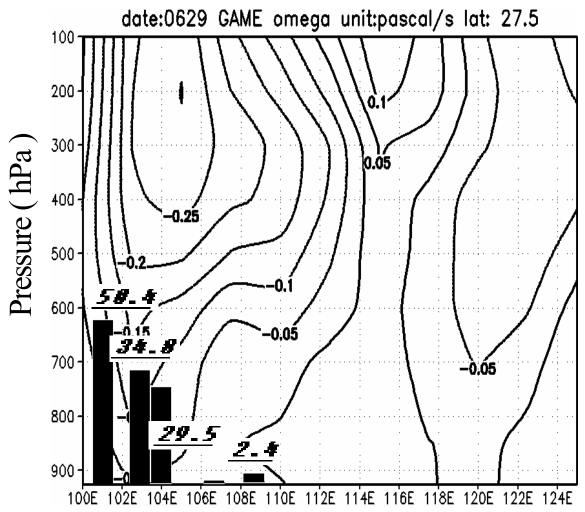


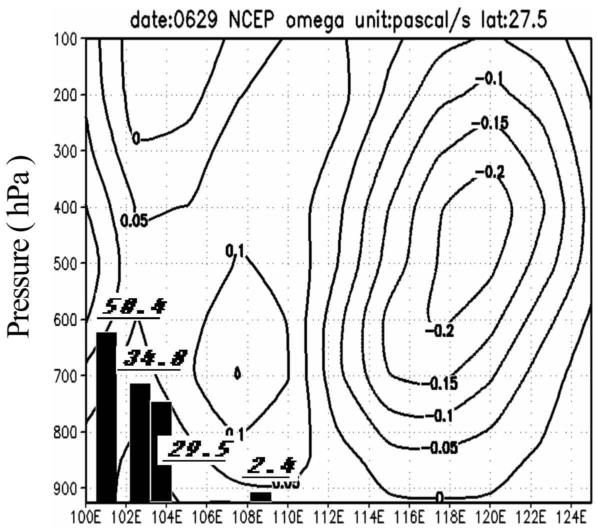
Fig. 1. The relative contrast lies in GAME and NCEP data in height field. The contrast is defined as $\frac{100}{100}\times\left|\frac{H_{GAME}-H_{NCEP}}{(H_{GAME}+H_{NCEP})/2}\right|$

(a) Height averaged from June-August and 100~120°E respectively in pressure levels

(b) Averaged as (a) but only 850hPa height at different times



a



b

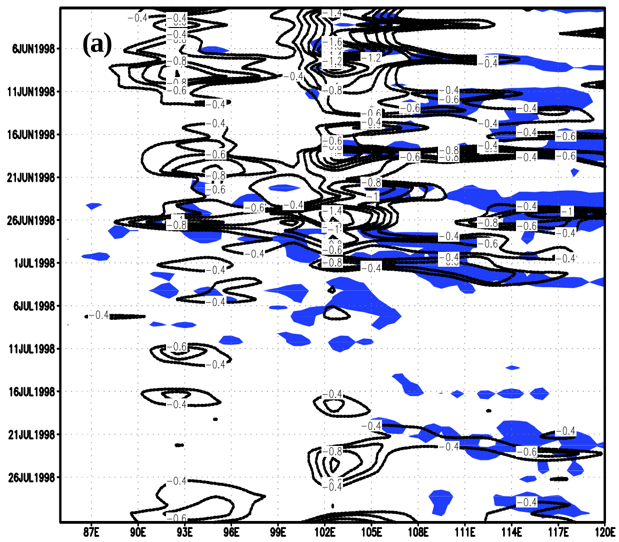
Fig.2. Longitude-pressure section of vertical velocity(from calculation; 06:00UTC; contour, units: Pa . S^{-1}) and 24h observed rainfall (black bars, units: mm)along 27.5°N.

(a) GAME vertical velocity data.

(b) NCEP vertical velocity data.

The vertical velocity (contour) calculated from the equation of conservation of mass in P coordinate and the 24h observed rainfall (black bars and the values underlined) are showed in Fig.2, and then the strongly ascending motion (negative vertical velocity) was accompanied with rainfall while weak ascending motion and downdraft matched the rainless zones in GRD (seeing a), whereas the vertical motions namely not only ascending motion but also downdraft can not accord with the actually observed state in particular for NRD (seeing b).

The aforementioned situation is only at 06Z, and the same as at 18Z, however no so remarkable differences at other two times (Fig. omitted). So the evidences emphasize again the fact that intensive observation is important in GAME.



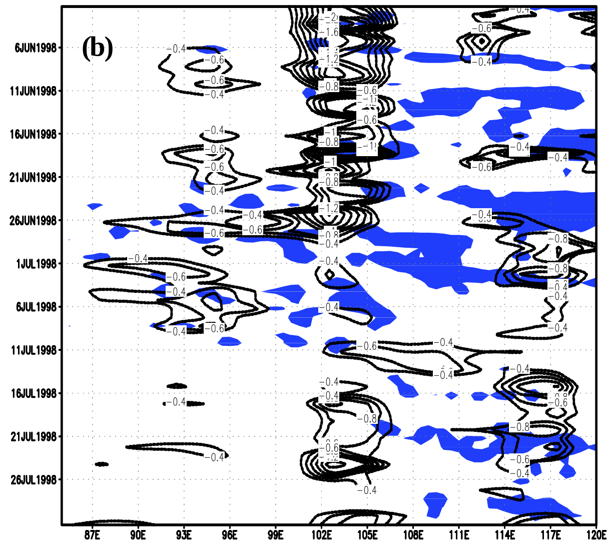


Fig.3. Time-longitude section of negative divergence (implies $\nabla \cdot (P_s \vec{V}_h)$in б coordinate, б=0.75; contour, units: Pa . S^{-1}) and 24h observed rainfall (shaded area, units: mm)along 30°N.

(a) GAME divergence data.

(b) NCEP divergence data.

The divergence evolution for lower troposphere of Tibet plateau to Yangtze River basin in summer is presented on same chart at б coordinate, in which GRD took on the development of southwest vortexes, but did not NRD. Furthermore GRD detected apparently its origin of southeast of Tibet, which is differ from the traditional opinions.

2.2 The comparisons in precipitation and surface flux fields

The regional mean daily-rainfall comparative analysis has been done among two sets of reanalysis data and observed precipitation in Huaihe River basin (32.5°-35.0°N, 112.5°-120.0°E), and the results denoted that GRD precipitation is more close to the observed precipitation in evidence (Fig omitted).

By calculating the instantaneous moisture flux for four vertical sections of south, north, east and west surface of Huaihe River basin respectively, then the instantaneous net moisture flux can be obtained. At 0Z and 12Z, the differences for the instantaneous net moisture fluxes of two sets of reanalysis data are small (Fig omitted), but the differences are rather large at 06Z and 18Z (seeing Fig.4).

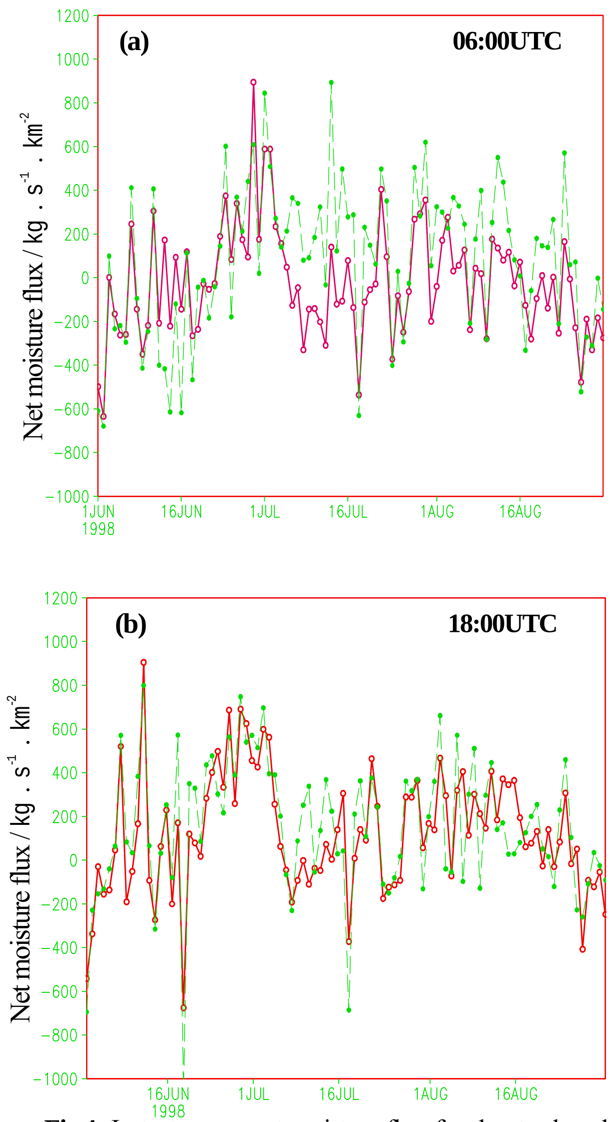


Fig.4. Instantaneous net moisture flux for day to day change from June-August in Huaihe River basin(32.5°-35.0°N, 112.5°-120.0°E, and aerial range from 1000hPa to 300 hPa). Red solid lines mean GAME data and green dashed lines are about NCEP data.

Referring to observed rainfall, the change of instantaneous net moisture flux of GAME is more reasonable according to the actual rainfall changes, e.g. seeing Fig.4 (a), in July13th no obvious rainfall occurred, but the net moisture flux of NCEP increased rapidly. There are the same examples in July16th seeing (a) and (b), etc.

The latent and sensible heat flux always decrease markedly in rainy days, and subsequently increase greatly in sunny days, so that the comparisons of regional mean latent and sensible heat flux respectively between GRD and NRD in Huaihe River basin are valid, and the results indicate that the changes of latent and sensible heat flux of GRD are more reasonable according to the actual precipitation processes during HUBEX period (Fig. omitted).

3. Conclusion

1. The results showed that the GRD is more reliable than NRD at the bottom and mid-high levels of troposphere, and at the precipitation and surface flux fields the case is just the same.
2. The paper revealed that the GRD can show the evolution of the southwest vortex but the NRD can not do so. In addition, GRD detected apparently the origin of southwest vortexes in southeast of Tibet, which is differ from the traditional opinions.
3. Meanwhile the main cause of which the GRD being better than the NRD is GRD including the sonde data of the GAME but not the different assimilation modes used by the two reanalysis data because the advantages of GRD excelling to NRD exist chiefly at 06Z and 18Z, and are not evident at 0Z and 12Z.
4. It is very necessary to continue carrying out the HUBEX as the Eastern Asia part of the GAME, and it is considerably important that increasing the temporal and spatial resolution of observed meteorological elements lead to improve our forecasting accuracy of the weather and climate.

Keyword: HUBEX, Reanalysis data, Comparison analysis

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