Climatological Analysis of Model Precipitation Forecast for China

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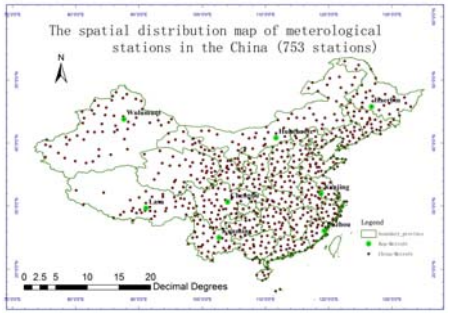
Introduction

Precipitation is an important issue in global climate change impact research. Because of its importance, precipitation climatology products are desired to be extensively used for several studies on probabilistic quantitative precipitation forecast (PQPF) calibration, systematic characters of Global Ensemble Forecast System (GEFS) precipitation forecast (such as model forecast bias, bias distributions for different regions, bias changes with forecast lead-time etc), hydrological ensemble forecast model, uncertainty of maximum extreme precipitation estimation and so on. Therefore, the performance of model precipitation forecast should be assessed firstly. An unbiased and robust linear moment method is used to compute the PQPF and assess the ability to identify the uncertainty of GEFS precipitation forecast over China.

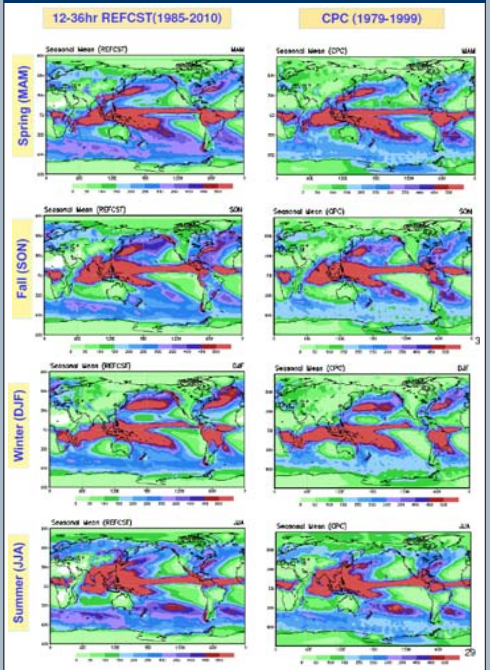
Seasonal mean precipitation and the systematic characteristics of daily precipitation are analyzed in this study. Firstly, considering the high reliability of Climate Prediction Center (CPC) dataset, seasonal mean precipitation of GEFS reforecast is compared with CPC's analysis. Secondly, GEFS reforecast precipitation climatology is calculated by using L-moment, and the systematic bias and correlation of climatological model precipitation are calculated to validate against the observed china station data on a daily timescale.

Data and Methods

Based on the precipitation forecast from the National Centers for Environmental Prediction (NCEP) GEFS reforecast for the period of 1985-2010 and daily precipitation observations in China, climatological analysis of GEFS precipitation forecast (first 24 hours) is studied over China. Reforecast climatology is calculated using unbiased and robust linear moment method and assess the ability to identify the uncertainties of GEFS precipitation forecast over China. Linear moment method and assumption of a gamma distribution are used to fit precipitation forecast for each day of the year and each 1*1 degree grid point. Total 286 samples (11member*26years) is used to calculate the linear moment ratio and to estimate the gamma distribution parameters in each grid point. The systematic biases of model forecasts are investigated by selected eight representative rain-gauge stations over the northern, western, the Yangtze River valley and southeast coast area of China. The spatial map of meteorological stations in the China is shown in the following map.

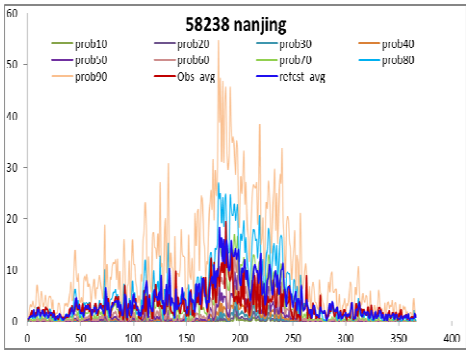


Comparison of GEFS reforecast and CPC

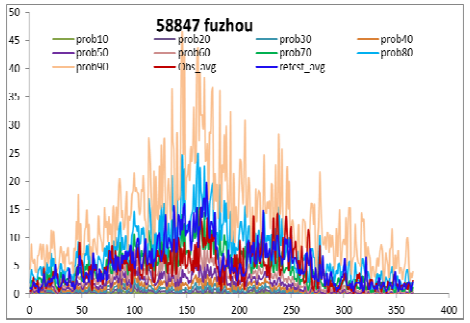


Seasonal mean precipitation from GEFS reforecast (first 24 hours) are fairly closed to CPC longer climatological mean in terms of quantity and spatial distribution. It can be seen from summer season that an intense rainfall center is mainly located in the southeast coast of China, GEFS reforecast indicates the same area with over 500mm, which is largely agree with climatological mean of ground observations.

Comparison of GEFS and observation (1)

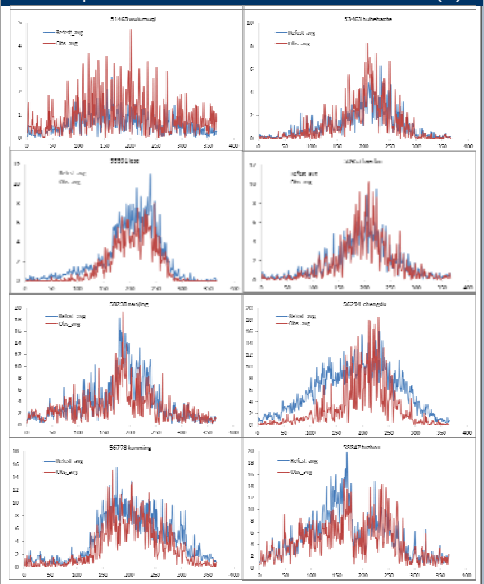


Comparison of GEFS and observation (1)



It can be seen from the 10% to 90% probability that there is a good consistency in whole time trend. As for precipitation, it rises slowly at lower probability, and then goes up with it apparently fast at greater than 50% probability. Model forecast precipitation of 80% probability is close to observation in arid climate region, and precipitation of 60% or 70% probability is close to observation in semi-humid or humid climate region.

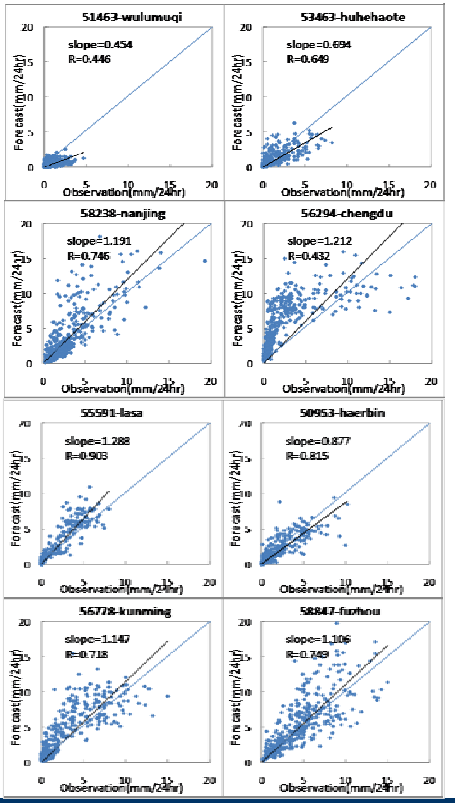
Comparison of GEFS and observation (2)



It is found that climatological mean daily precipitation from model forecasts were in good consistence with observations from rain-gauge stations to a large extent. However, there are either different underestimates or overestimates in different climatological areas in China. For example, there is a systematic bias (underestimate) in Wulumuqi, and a seasonal bias (overestimate) in Lasa and Fuzhou.

Comparison of GEFS and observation (3)

The results show that there are higher correlation coefficients between reforecasts and observations except for Wumuluqi and Chengdu stations. Generally speaking, there is an underestimate in the arid area, and an overestimate in the humid area.



Conclusions

Based on the climatological analysis of GEFS precipitation forecast with linear moment methods, the following conclusions can be drawn :

- Seasonal mean precipitation shows that the quantity and spatial distribution from GEFS reforecast is fairly closed to CPC long-term climatological mean, which is largely agree with climatological mean of ground observations.
- Daily mean precipitation shows that forecasts were in good consistence with observations from rain-gauge stations to a large extent although systematic bias and seasonal bias exist. Generally, there is an underestimate in the arid area, an overestimate in the humid area. There is a good correlation between forecast and observation. Correlation coefficients are greater than 0.65 except for Wumuluqi and Chengdu stations.