Experimental Global to Regional Seasonal Forecast for Taiwan

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I. Introduction

A virtual regional climate of Taiwan prediction laboratory has been set up since October 1997. Images of these forecast at seasonal time scales are provided on the World Wide Web (http://wu.as.ntu.edu.tw). Up-to three months, statistical forecasts have been made monthly, while dynamical experimental near real-time regional forecasts have been made weekly and extended to twelve weeks. Dynamical global forecasts were made by Scripps Experimental Climate Prediction Centers (ECPC) with National Centers for Environmental Prediction (NCEP) global spectral model (GSM, Kalnay et al. 1996) which also be used for the reanalysis. The initial conditions and SST boundary conditions of these experimental global forecasts are from the NCEP Global Data Assimilation (GDAS) 0000 UTC operational analysis. Transforming NCEP's higher resolution operational reanaysis to lower (spatial) resolution initial conditions for the global model, 7-day global forecast are made everyday. Every weekend these forecast are extended to twelve weeks while persistent SST anomalies applied (Roads et. al., 2001). The performance of these global forecasts has been evaluated (Roads et al. 2001, Chen et al. 2001). Dynamical regional seasonal forecasts for Taiwan, driven by the global forecast were made by the Department of Atmospheric Sciences, National Taiwan University with NCEP Regional Spectral Model (NCEP/RSM, Juang and Kanamitsu 1994, Juang et al.1997) of two versions, RSM96v and RSM97v. Are these forecasts for Taiwan useful? Some preliminary verification on precipitation is presented.

II. Methodology

Evaluation on the performances of the experimental forecasts is majorly on precipitation. To see the characteristics of precipitation inside, Taiwan is devided to north, central, south, and east, the four sub-areas according to its precipitation climate. Figure 1 shows the topography, rain-gauge stations, and the four sub-areas. Besides the simple statistics, such as mean, correlation, frequency distribution, equtible threat score and bias score (Juang et al. 1997) are used to evaluate the ensemble precipitation forecast.

III Forecast verification

Caused by the steep topography as well as complex monsoon system and intrusion of tropical storm, precipitation over Taiwan showed a counter-clockwise shift in annual march (Figure 2). Precipitation amount is large during summer season over the Central Mountain and in autumn over the eastern Taiwan. Basically, monthly forecasts both with RSM96v and RSM97v can catch these specific characteristics (Figure 2). However, RSM96v tends to over predict over northern and eastern Taiwan during the cool seasons. RSM97v tends to severely over predict everywhere all year around. Forecasts with longer leading time showed same characteristics. These properties also appeared in the monthly means in the sub-areas. Forecasts with RSM96v fail to reflect the annual cycle truly over the northern and eastern Taiwan. On the other hand, forecasts with RSM97v showed the annual cycle but tended to over predict everywhere.

Usually, the purpose of the seasonal forecast is on predicting the inter-annual variability. Correlations between the area monthly precipitations of observed and predicted with RSM96v with various leading times showed that area precipitation forecasts with various leading times with RSM 96v tend to predict inter-annual variability skillfully, especially during the spring over the central and southern Taiwan. On the other hand, forecasts with RSM97v did not show forecasting skill.

The ETS of daily mean precipitation shows that only forecasts with RSM96v and RSM97v of short leading time have marginal skill in dry or little rain during the cold seasons. Forecasts with GSM did not show any skill. Bias scores of daily mean precipitation showed that all the forecasts with RSM96v and RSM97v tend to over predict while the forecasts with GSM tend to under predict. RSM97v showed severely wet bias. The accumulate frequency distribution plots of the precipitation revealed the same feature.

IV. Summary and Discussion

Precipitation over Taiwan showed unique characteristics in different sub-areas. Precipitation over

the northern and eastern Taiwan is abundant year round with peaks in fall. Precipitation over the central and southern Taiwan is large in summer but scare in cold seasons. Precipitation forecasts with RSM96v can catch the annual cycle in the Central and Southern Taiwan while it is severely over-predict in the northern and eastern Taiwan during cold seasons. On the other hand, forecasts with RSM97v, although the precipitation annual cycle over the four sub-areas are shown, the precipitation amount are severely over-estimated all year round, especially in four sub-areas during summer and in the northern and eastern Taiwan during cold seasons. Spatial distribution of precipitation forecasted showed the same characteristics as sub-area means.

Usually the purpose of seasonal forecasts is on the inter-annual variability. The correlations among the forecasts with different lag to the observations indicate that RSM96v can predict spring precipitation well. Precipitation forecasts with RSM96v in the other seasons and forecasts with RSM97v did not show significant skill. The daily precipitation accumulated frequency distribution, ETS scores and bias scores further reveal this feature of discrepancy. On the other hand, the scores of the forecasts made by the GSM were even worse. These poor performances in the regional forecast inherit from global forecast could not be ignored.

Acknowledgment

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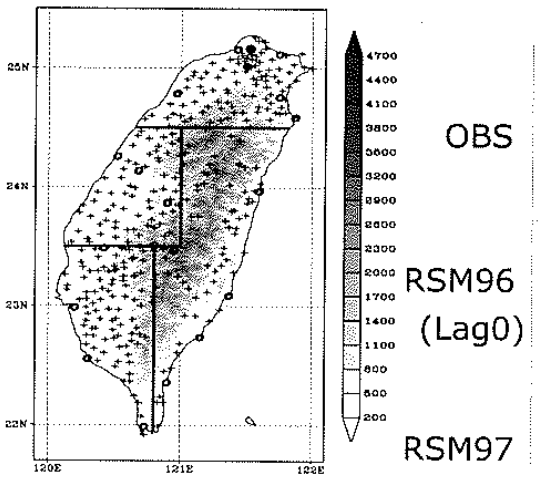

Fig 1 Topography (shaded) and locations for 21 surface stations ("o") and 338 raingauge stations ("+") over four portioned area, North (N), Central or West (W), South (S), and East (E) of Taiwan.

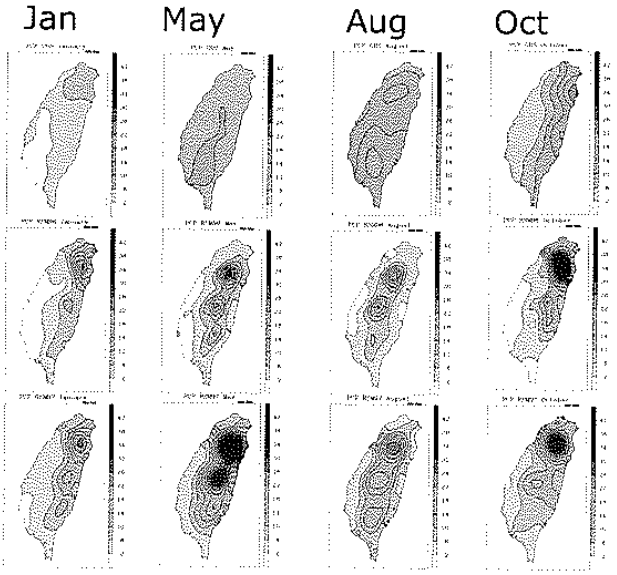

Fig 2 1998-2000, 7 years averaged daily mean precipitation in January, May, August, and October of observed (Obs) and monthly forecasts with RSM96v (RSM96v Lag0), and with RSM97v (RSM97v Lag0).