CWB Dynamical-statistical downscaling system

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Abstract

A dynamical-statistical downscaling system is developed at the CWB, aiming at performing the short-term climate (month-to-seasonal) prediction for rainfall in Taiwan. This system includes several major components (Fig. 1). The dynamical system is the SMIP(Seasonal Model Intercomparison Project)-type ensemble climate prediction conducted with the CWB Global Forecast System (GFS) model, using the predicted SST. The model output is then bias corrected with the SVD (singular value decomposition)-based adjustment procedure. After this process, the model output is considered to resemble the observed. A characteristic large-scale observed pattern associated with rainfall variability in Taiwan is obtained from their correlation coefficient pattern. The corresponding large-scale pattern of the bias-corrected model output is then coupled with the observed rainfall anomaly in Taiwan and subjected together to the SVD analysis. Based upon the couple modes between the model pattern and rainfall anomaly in Taiwan during the period 1979-1999, a projection model for downscaling of rainfall in Taiwan is built. This downscaling model is then used to project rainfall anomaly in Taiwan for the verification period 2000-2004. The prediction results are verified with a 3-category method. The prediction result is categorized into three types: above normal, near normal, or below normal. By comparing the categories between the prediction and observed, the hit ratio (correct cases/total cases) is computed. If the hit ratio is larger than 1/3, which is the averaged probability associated with the 3-category method, the downscaling prediction can be considered to be skillful. In our downscaling model, four large-scale variables are used, including 850-mb wind field, 850-mb circulation, vertically-integrated moisture transport, and velocity potential of moisture transport. Prediction results from these four variables are finally merged into an ensemble prediction, using their hit ratio during the training period as the weighing function in the merge. For the total nine major stations in Taiwan to be predicted, the downscaling is performed with three different spatial coverages, one station at once, three stations at once, and 9 nine stations at a whole. The different spatial coverage leads to different prediction skill. Taking the rainfall in Taiwan's major rainy season (May-October) as the prediction target, the sum of hit ratio of these nine stations for each month is shown in Fig. 2. Overall, the sum is larger than 3 (9 x 1/3 =3), the sum of random probability when uses the 3-category method, indicating this dynamical-statistical downscaling system as a skillful tool for performing rainfall prediction for Taiwan during the major rainy season. It is also shown that the 3-station and 9-station methods have a skill more stable and slightly higher than that of the 1-station method. In other words, this downscaling system tends to better perform when the spatial coverage of the target area increases.

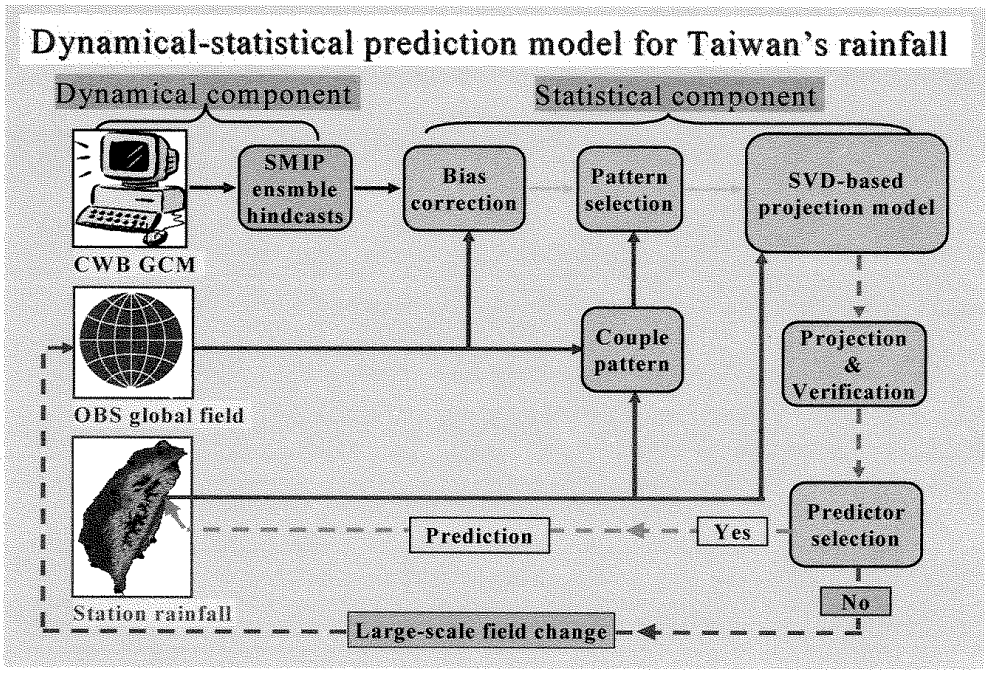

Fig. 1: The dynamical-statistical downscaling system for short-term climate prediction of rainfall in Taiwan.

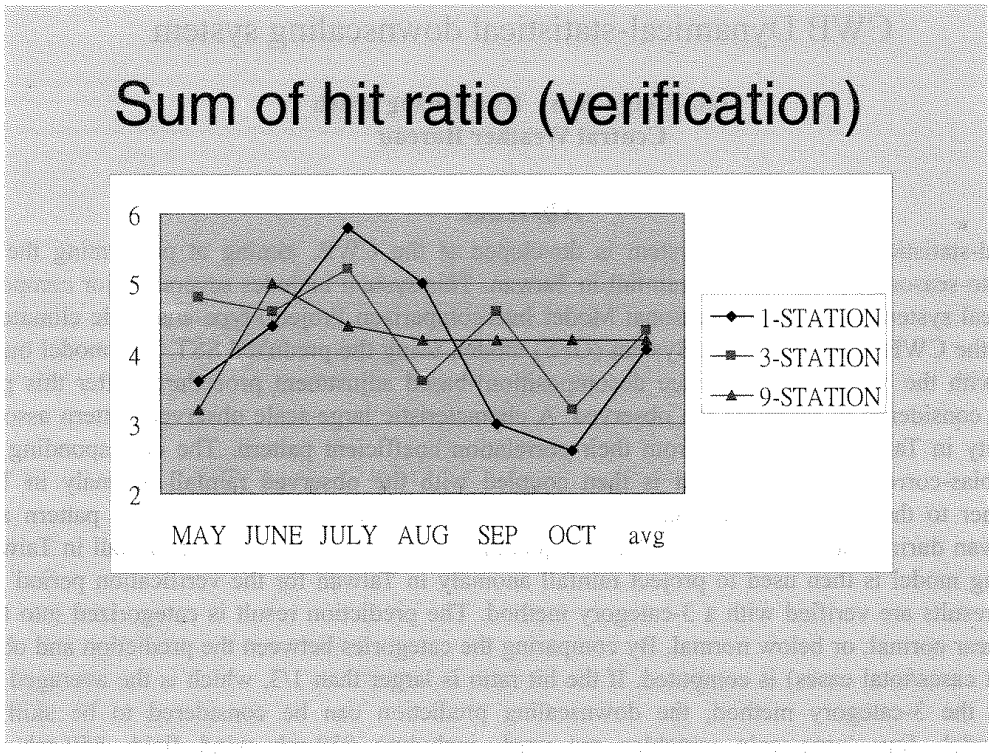

Fig. 2: The sum of hit ratio from 9 major stations in Taiwan as predicted by the 1-station, 3-station, and 9-station downscaling methods.