Predictability of Seasonal to Annual Rainfall Variations for Tropical Islands in the Northwestern Pacific

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Climate prediction is vital to many human activities and drought has been a troublesome and recurrent problem for many tropical islands in the Pacific Ocean, including Taiwan (e.g., Chu, 1998). Managers need to know rainfall forecasts well before the season so that they can make a scientifically based decision regarding whether to issue water conservation or water rationing for the regions expected to be affected. By incorporating the forecast information into long-range planning and management, decision-makers can take more pro-active instead of reactive action.

In this study, rainfall predictability from seasonal to annual time scales is attempted based on the Pacific sea surface temperatures (SSTs) as the only predictor variable. Monthly rainfall totals for 9 stations (Koror, Yap, Guam WSO, Andersen Air Force Base in Guam, Chuuk, Pohnpei, Wake, Kwajalein, and Majuro) in the western Pacific are selected as predictands. Two statistical models, canonical correlation analysis (CCA) and multivariate principal component regression (MPCR), are used to forecast seasonal to annual rainfall variations.

The CCA cross-validated predictive skills show an pronounced seasonality. JFM is the most accurately forecast period at one to two seasons lead time with average correlation skill of 0.53 and 0.41, respectively (Fig. 1).

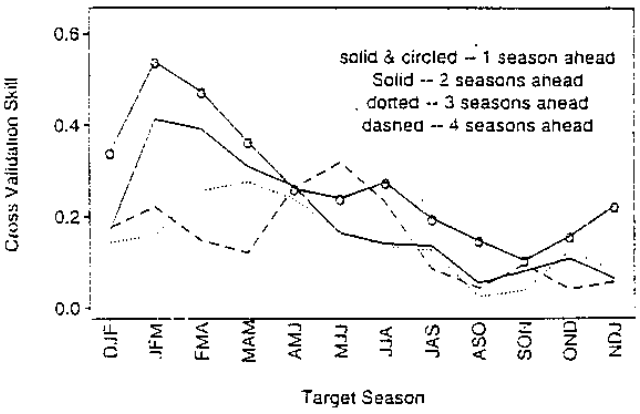

Fig. 1. CCA cross validation skills averaged for 9 stations. High predictability is generally found in winter and spring while low predictability of rainfall is found in summer and fall.

The poor forecast skills resulting from AMJ SSTs as predictors suggest that the so-called spring-barrier effect may exist for SST-based predictions in linear statistical models. Our study (Yu, Chu and Schroeder, 1997) also indicates that low CCA skills in summer and

fall may be due to the strong tropical cyclone activity during these periods (Fig. 2). The relatively high predictability in winter and early spring may be attributed to the least SST barrier in fall, the low tropical cyclone activity, and the pronounced ENSO responses in winter and spring. MPCR and CCA provide comparable skills.

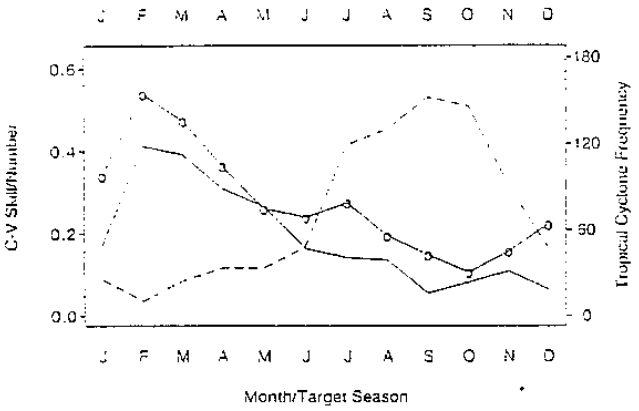

Fig. 2. CCA cross-validation skills and tropical cyclone frequency. Solid line with open circle and solid line denote one season ahead and two season ahead forecasts. Tropical cyclone frequency over the domain between 0°-20°N and 130°E-180° from 1949 to 1994 is plotted as dashed line and its scale is shown in the right vertical axis.

References

Chu, P.-S., 1998: Short-term climate prediction of Mei-Yu rainfall for Taiwan using CCA. Int. J. Climatol., in press.

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