Estimation of Seasonal Forecasts for Temperature and Precipitation in Korea using Statistical Method

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1. Introduction

To improve long-range forecast various forecast approaches, from purely empirical to comprehensive dynamical hybrid or simple model, have been used from the early 1980(Stern and Miyakoda 1995). While forecasting on a long-lead time scale is still in a early stage, forecast skill continues to improve. Advances in that field are attributed to recognizing changes of low-frequency mode in atmosphere such as El Niño and La-Nina, and teleconnected climate anomalies.

As of now statistical approachs for seasonal forecast have produced better results than dynamic modelling. Among several statistical methods CCA(Canonical Correlation Analysis), which is adopted as one method of seasonal forecast by NCEP(National Center for Environmental Prediction), is statistical technique of relating variation in predictor fields to variation in predictand fields using a specific variation of EOF analysis (Barnett and Preisendorfer 1987). In this study, CCA is used to explore evaluation of skill and its origin of seasonal forecast in the Far East. The CCA version used in NCEP is adopted as methodology and analysis to do this study.

2. Data

The data here consist of 1) quasi-global SST(OISST from NCEP), 2) North Hemisphere 700hPa height which are identical with those used in Barnston(1994), and 3) the Far East (most in South Korea and Japan) monthly surface temperature and precipitation spanning the 1961~1997 period.

3. Analysis method

Predictor is defined as variable used for predicting temperature or precipitation what is called predictand. In case of forecasts for precipitation, SST and 700hPa height is used as predictor. Both predictor and predictand field consist of seasonal 3-month averaged data set.

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The lead time is defined the number of months between the final predictor season and the predictand season.

4. Results

4.1 Skill for Temperature

Peaks in skill (Cross-validated Anomaly Correlation Coefficient) attain a maximum of about 0.35 in early spring FMA (i.e. Feb-Mar-Apr) and MAM, as well as 0.2 in late summer ASO (Fig. 1a). Increasing the lead time by months doesn't lower the skill up to 13 months. Geographical distribution of skill turns out to be higher in Japan than in Korea. The leading CCA mode for these forecasts shows long-term warming trend in the canonical component predictor time series. And second mode reflects ENSO(El Niño and Southern Oscillation) variations in the SST predictor. The origin of skill is different from U.S. where ENSO mostly contributes.

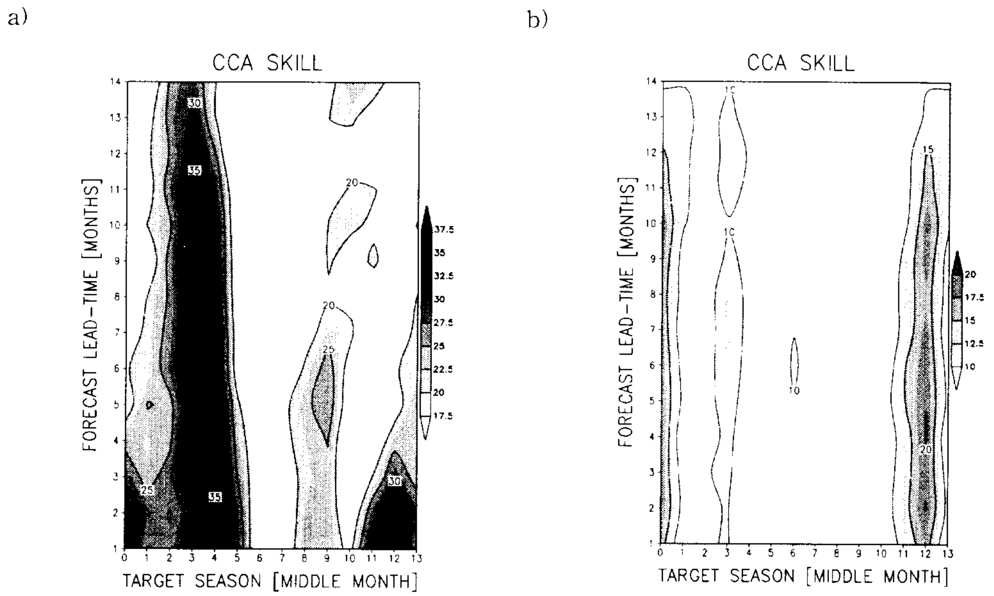


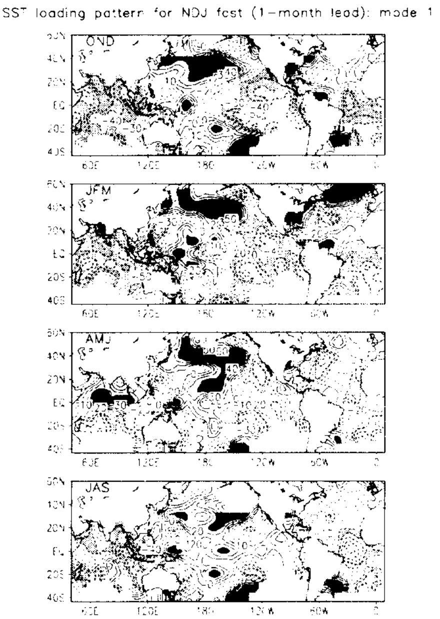
Fig. 1. The area average cross-validated ACC for forecasts of surface air temperature and precipitation.

4.2 Skill for Precipitation

The skill maximum for precipitation is confined to the early winter season NDJ with lower magnitudes of nearly 0.20 than forecasts for temperature(Fig. 1b). In NDJ very low skill appears in Korea geographically. And 2nd skill appears in spring season. It is difficult to find dominant loading pattern of predictor fields, but forecasts for precipitation seems to be related to ENSO and other forcings. The SST predictor loading pattern for the four consecutive

3-month predictor seasons for the leading canonical mode is shown in Fig. 2a. The patterns seem to portray the combination of the decay of cold tropical Pacific SST ENSO event and long-term trend feature. The secondary mode of 700hPa predictor loading patterns shows ENSO related teleconnection pattern like PNA and NAO(Fig. 2b). The canonical component time series associated with the mode 1 and 2 imply that interdecadal variation and ENSO event are more important factor in this case(Fig. 3). Meanwhile, skill for precipitation is lowered after detrending but to remain weakly in winter season.

a)



b)

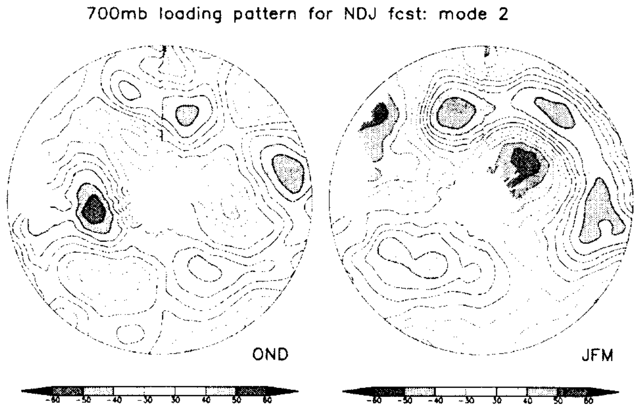


Fig. 2. The canonical component (a) SST predictor and (b) 700hPa predictor loading patterns for forecasts of precipitation with 1-month lead time.

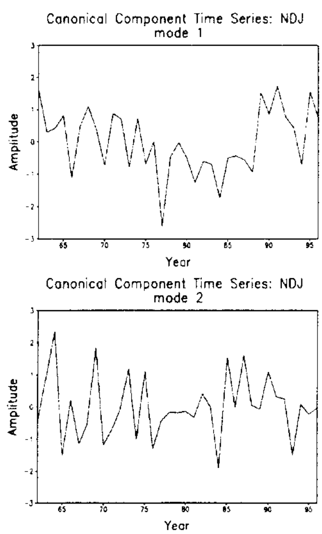


Fig. 3. The canonical time series for mode 1 and 2.

5. Conclusion

Using CCA method, seasonal predictablility for temperature is modest in some season, but for precipitation is somewhat lower. Most skills are insensitive to the forecast lead time. Variability of Long-term(interdecadal) trend contributes to the skill of prediction for temperature and precipitation. In Korea it is a little different from the result of U.S. (Barnston 1994), Northern Europe (Johansson et al, 1998), and Canada (Shabbar and Barnston 1996) where ENSO or related teleconnected forcing is dominant.

6. Acknowledgement

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7. Reference

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