Session K08 – Invited speaker

Seasonal prediction of summer rainfall anomalies over China using CAS-ESM and machine learning technique

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Abstract: Reliable sub-seasonal to seasonal climate prediction is important for disaster preparedness and mitigation, and advanced earth climate system model is the key component for the improvement of climate prediction skill. In this report, we firstly introduce the brand-new Earth System Model of the Chinese Academy of Sciences (CAS-ESM), and then present the framework and performance of IAP climate prediction system based on the CAS-ESM component model, with introduction of a land surface initialization scheme. Utilizing a 30-year ensemble hindcast experiment results from 1991 to 2020, we evaluated its seasonal prediction skill for summer precipitation anomalies over China. The results demonstrate that IAP-DCPv3.5 exhibits reasonable predictive capability for summer precipitation anomalies in eastern China, with the bias correction method significantly improve the system's prediction skills for summer precipitation. Evaluation of prediction skills for summer monsoon circulation shows that IAP-DCPv3.5 can successfully predict the interannual variation of East Asian Summer Monsoon Index and reasonably reproduce the relationship between monsoon activity and precipitation anomalies in eastern China, indicating that the East Asian summer monsoon prediction skill can significantly affect the predictive ability of summer precipitation over China.

It's noted that the integration of machine learning technique is an effective approach to enhance the sub-seasonal to seasonal prediction skills. In this study, we further develop a U-net based machine learning technique (IAVC-Unet), with consideration of the model's deficiency in reproducing the observed interannual variability of summer rainfall. It is found that the prediction skill of the IAP-DCPv3.5 has been improved, with MAE (mean absolute error) reduced by approximately 30%, and pattern correlation coefficient (PCC) between the prediction and observation has also been significantly increased. Furthermore, a diffusion model guided by physical fields is proposed for the super-resolution downscaling for summer rainfall prediction. It is also found the seasonal rainfall prediction skill can also be significantly improved, with the resolution of the rainfall prediction product increased from 100km to 10km. The MAE of rainfall prediction can also be reduced by about 20%, and the spatial correlation coefficient (PCC) between predicted and observed rainfall anomalies increased from 0.04 to 0.21.

REFERENCES

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