

## Relative role of the ocean for interannual and decadal variations in summer monsoon onset over the South China Sea

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In this study, we reveal a difference of mechanisms with interannual variation a 15-years variation in the South China Sea Summer Monsoon (SCSSM) onset. The SCSSM onset occurs in active convections over the South China Sea (SCS), when convections are active over the Philippine Sea (PS). Variations in the SCSSM onset are affect by the variations in the convective activities over SCS and PS. The increase in the sea surface temperature (SST) over the Western Pacific in recent years causes the more active convection over the PS, therefore the SCSSM onset is advanced in 15-years variation as already pointed out by Kajikawa and Wang (2012).

Moreover, we elucidate the relation between the SCSSM onset date anomaly and aggregated SST over the SCS from January to March. The correlation is good between the SCSSM onset date anomaly and the aggregated SST over SCS, while a poor relation founds between the 15-years variation oriented signal in onset date and the SST in SCS. When SCSSM onset date is delayed, the aggregated SST in SCS has tend to high temperature. On the other hand, the correlation is good between the 15-years variation in the SCSSM onset date and the aggregated SST over the PS. The SST anomalies over the SCS are influenced by the frequencies and strength of cold surges during boreal winter. Strong and longer cold surges bring the lower SST over the SCS. The cold surges are brought about the anticyclone over the Eastern Eurasian continent. An arctic sea-ice decline instigates the high-pressure deviation over the Eurasian Continent. Then relatively lower land surface temperature in middle latitude, and bring the cold surge over the SCS.

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