



## Winter arctic sea-ice cover variability and the prediction of spring vegetation growth over Eurasia

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The changes in Eurasian vegetation not only have important effects on regional climate, but also have effects on global temperatures and the carbon cycle. In this study, the interannual linkage between spring vegetation growth over Eurasia and winter sea-ice cover over the Barents Sea (SICBS), as well as the prediction of spring Eurasian vegetation are investigated. The Normalized Difference Vegetation Index (NDVI) derived from the advanced very high resolution radiometer is used as the proxy of vegetation growth. During 1982–2015, the winter SICBS is significantly correlated with the spring NDVI over Eurasia (NDVIEA). The positive (negative) winter SICBS anomalies tend to increase (decrease) the spring NDVIEA. The increased winter SICBS corresponds to higher winter surface air temperature and soil temperature over most parts of Eurasia, and in turn, corresponds to less winter snow cover and less snow water equivalent. The persistent less and thinner snow cover from winter to spring over Eurasia, especially over Western and Central Siberia, tends to induce increased surface air temperature through decreased surface albedo and less snowmelt latent heat. Subsequently, the increased surface air temperature corresponding to increased SICBS contributes to higher vegetation growth over Eurasia in spring and vice versa. Based on this linkage, seasonal predictions of spring NDVI over Eurasia are explored by applying the year-to-year increment approach. The prediction models were developed based on the coupled modes of singular value decomposition analyses between Eurasian NDVI and climate factors. One synchronous predictor, the spring surface air temperature from the NCEP's Climate Forecast System (SAT-CFS), and three previous-season predictors (winter SICBS, winter sea surface temperature over the equatorial Pacific (SSTP), and winter North Atlantic Oscillation (NAO)) were chosen to develop four single-predictor schemes: the SAT-CFS scheme, SICBS scheme, SSTP scheme, and NAO scheme. Meanwhile, a statistical scheme that involves the three previous-season predictors (i.e., SICBS, SSTP, and NAO) and a hybrid scheme that includes all four predictors are also proposed. To evaluate the prediction skills of the schemes, one-year-out cross-validation and independent hindcast results are analyzed, revealing the hybrid scheme as having the best prediction skill in terms of both the spatial pattern and the temporal variability of spring Eurasian NDVI.

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