The spatio-temporal dynamics of the peak of growing season and its responses to climatic driving factors in Africa

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Research Question

- Evaluate the spatial distribution of POS over Africa
- Investigate the temporal trends in long time series on POS over Africa
- Determine the potential major drivers of POS using partial correlation coefficient on time series.

Materials & Methods

Given the seasons spanning different calendar years and the large spatial heterogeneity of phenology in the northern and southern hemispheres, we divided Africa into two sub-regions (Regions A and B).

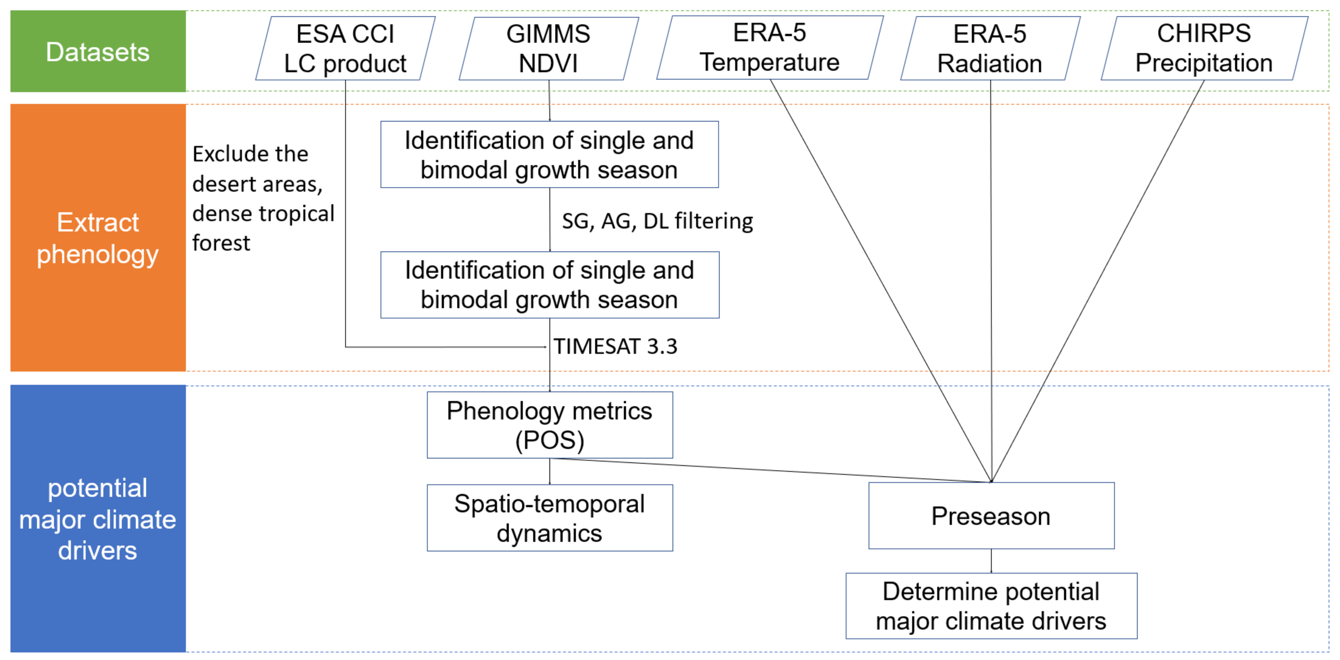
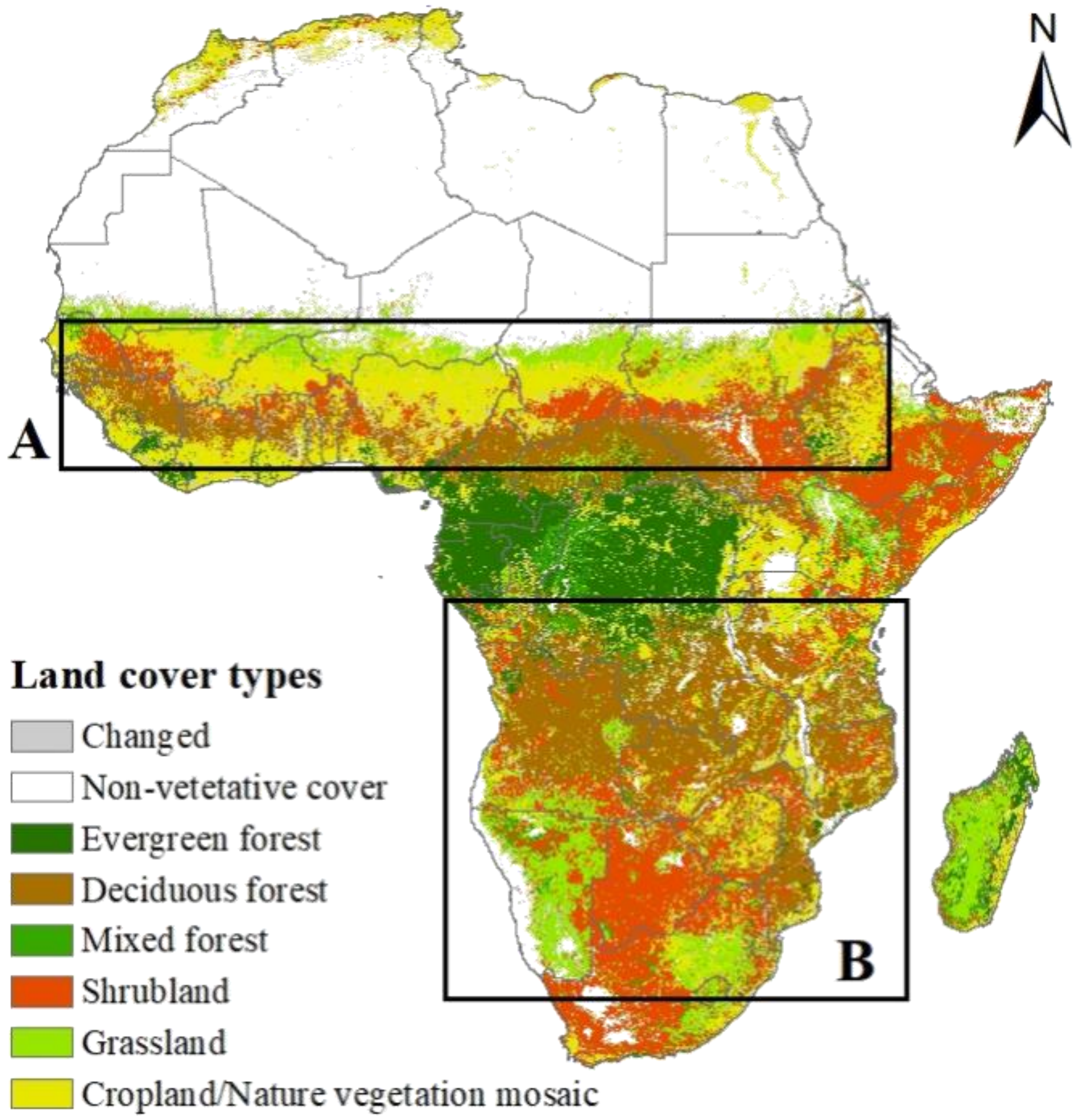


Fig. 1 Research framework



Shifting of NDVI cycles

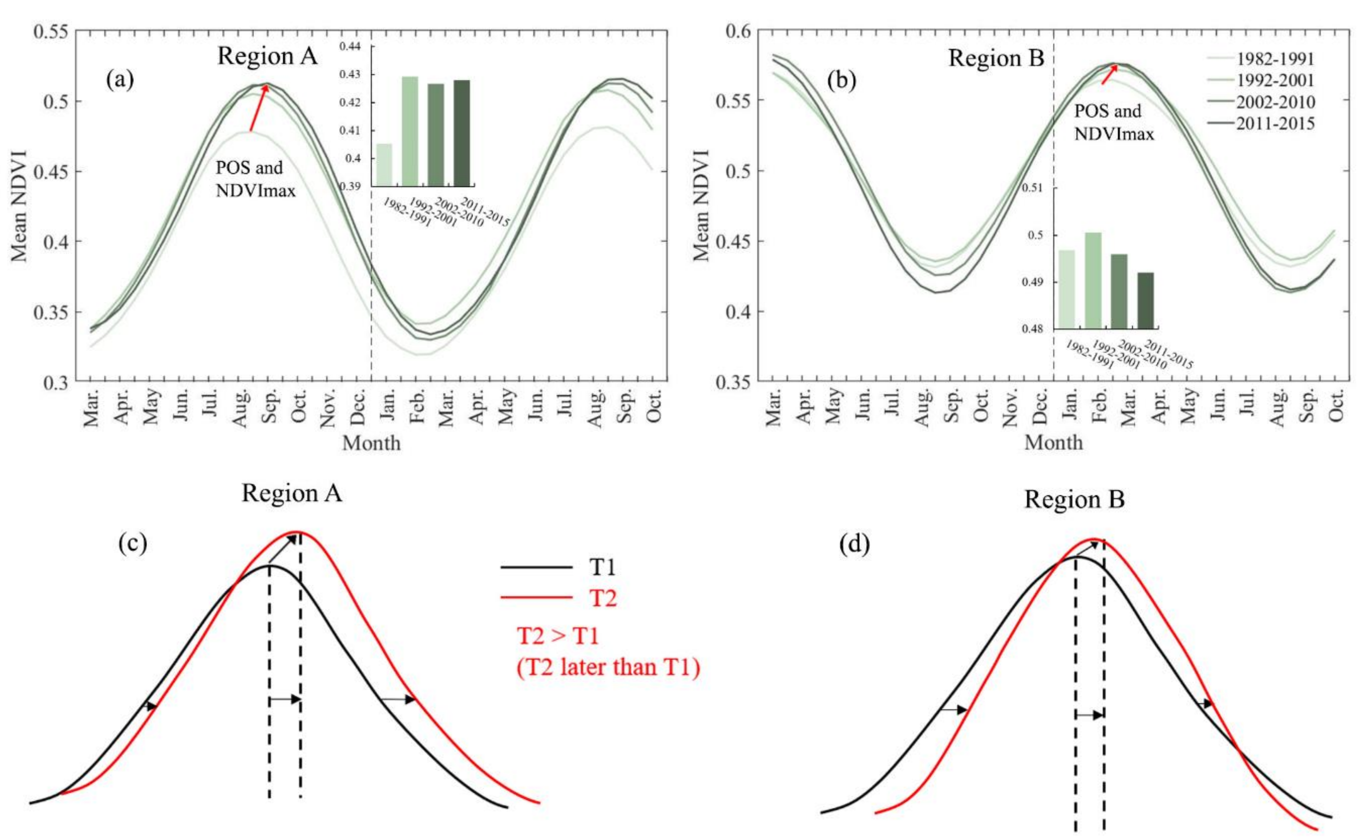


Fig. 2 Mean monthly NDVI during 1982-1991, 1992-2001, 2002-2010, and 2011-2015 averaged across regions A and B in Africa (a and b). For visual clarification, the presented NDVI values are 5-month moving averages with the x-axis indicating the center month of each window. Inset: mean annual NDVI of each period.

Spatial variations of POS

- In northern Africa, the POS shifted from July to October with 2.48 days per degree of latitude increase.
- In southern Africa, POS was mainly concentrated in January-March, and a one degree increase would results in 3.56 days for POS.

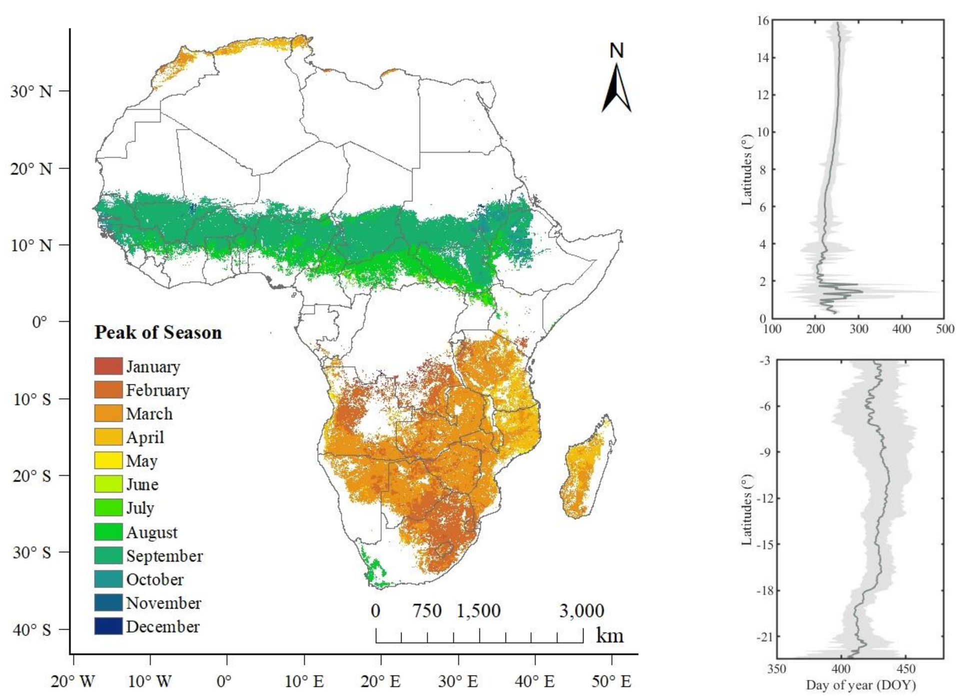


Fig. 3 The average values of POS using SG, AG, DL filters derived from GIMMIS NDVI data. The latitudinal variation in POS for all season cycles was showed in right side.

Temporal variations of POS

- Most areas experienced delayed dates, while only south Angola and northeast Tanzania experienced advanced POS.
- Significantly delayed trends could be observed in both of Regions A and B. It was consistent with the NDVI cycle shifts in Fig.2.

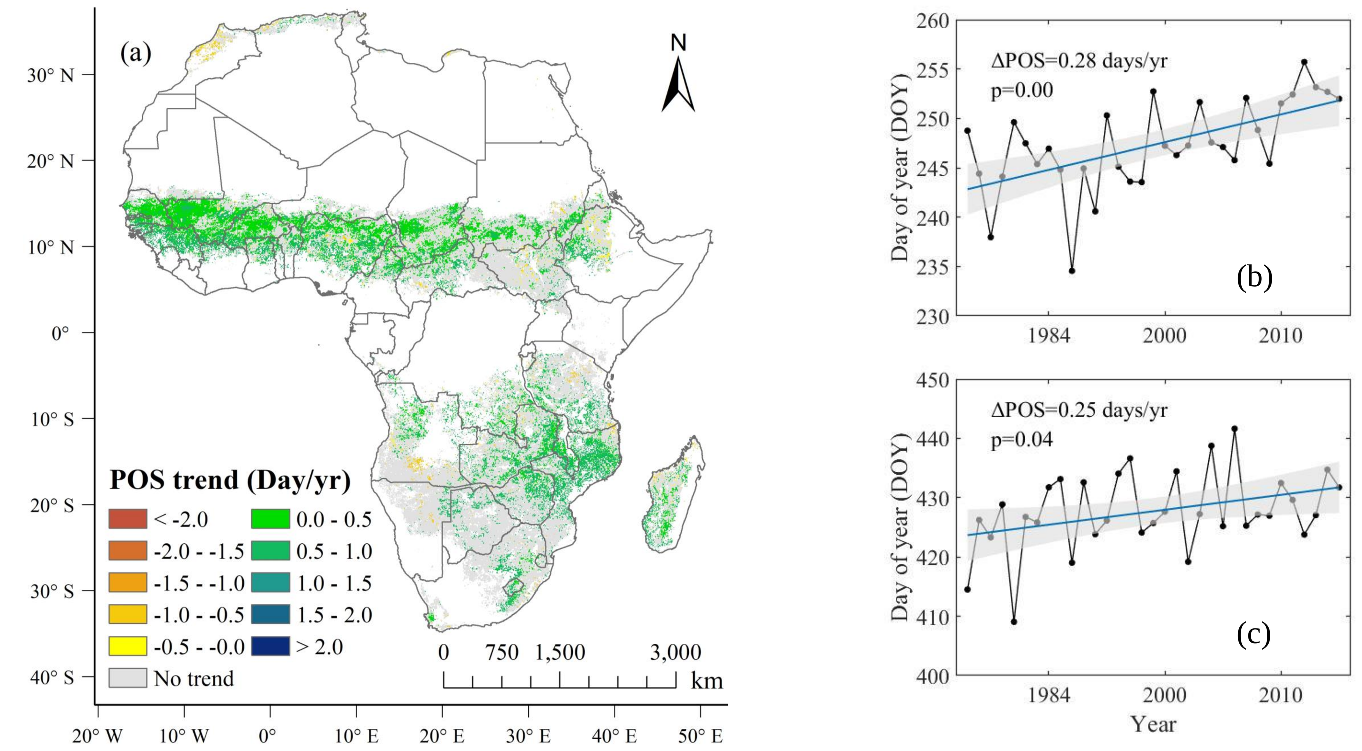


Fig. 4 The spatial distribution of temporal trends in POS for 1982-2015 (a, p<0.05). Gray areas represent non-significant. Trends of POS of spatially averaged values in Regions A (b) and B (c).

Climate controls of POS

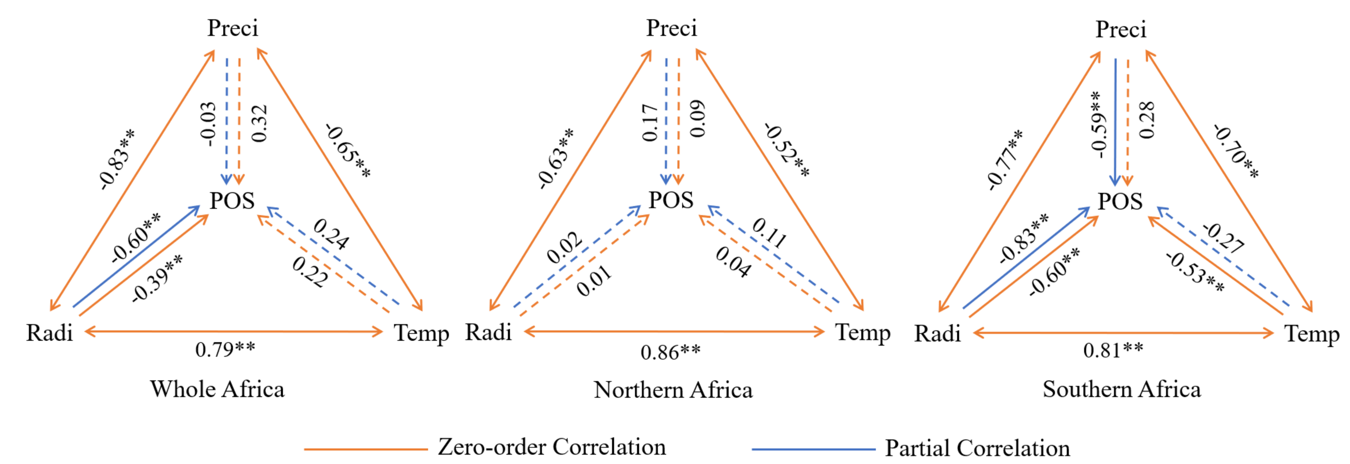


Fig. 5 Partial correlation coefficients and Pearson correlation (Zero-order Correlation) coefficients among the POS, precipitation, radiation, and temperature.

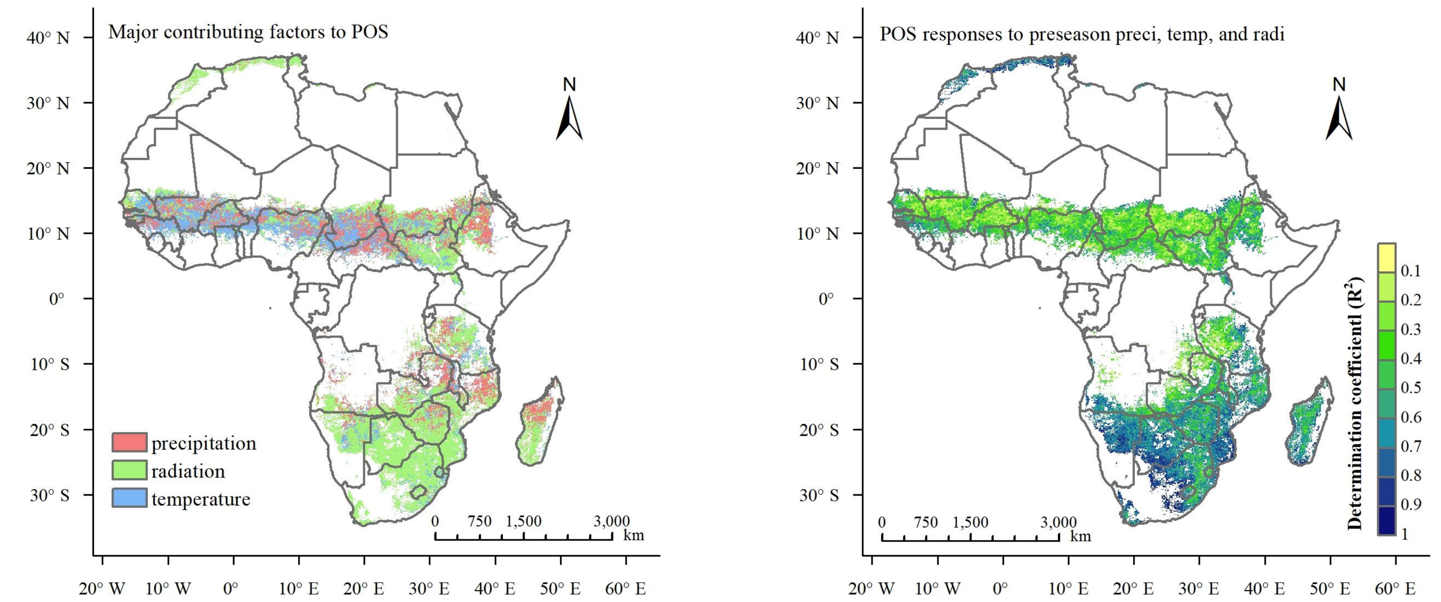


Fig. 6 Spatial patterns of the association between climatic factors and POS. (a) Major climate drivers. (b) The determination coefficient (R2) of the multiple linear regression.

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