Supplement of

Persistent La Niñas drive joint soybean harvest failures in North and South America

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Table S1. Conditional independence claims for local causal diagram

- $\text{SM}_{\text{spring}} \perp \text{Heat}_{\text{summer}} \mid \{\text{SM}_{\text{summer}}\}$
- $\text{SM}_{\text{spring}} \perp \text{yield}_{\text{anomaly}} \mid \{\text{SM}_{\text{summer}}, \text{Heat}_{\text{summer}}\}$
- $\text{RF}_{\text{summer}} \perp \text{Heat}_{\text{summer}} \mid \{\text{SM}_{\text{summer}}\}$
- $\text{RF}_{\text{summer}} \perp \text{yield}_{\text{anomaly}} \mid \{\text{SM}_{\text{summer}}, \text{Heat}_{\text{summer}}\}$

Where ("$\perp$") implies statistically independent given ("$\mid$") the conditioning set $W = \{\ldots\}$.

Table S2. Conditional independence claims for remote causal diagram

- $\text{ENSO}_{\text{summer}} \perp \text{SM}_{\text{spring}} \mid \{\text{ENSO}_{\text{spring}}\}$
- $\text{ENSO}_{\text{summer}} \perp \text{NP/SA}_{\text{pattern}} \mid \{\text{ENSO}_{\text{spring}}\}$
- $\text{ENSO}_{\text{summer}} \perp \text{Yield}_{\text{anomaly}} \mid \{\text{SM}_{\text{summer}}\}$
- $\text{ENSO}_{\text{spring}} \perp \text{SM}_{\text{summer}} \mid \{\text{ENSO}_{\text{summer}}, \text{SM}_{\text{spring}}, \text{NP/SA}_{\text{pattern}}\}$
- $\text{ENSO}_{\text{spring}} \perp \text{Yield}_{\text{anomaly}} \mid \{\text{SM}_{\text{summer}}\}$
- $\text{SM}_{\text{spring}} \perp \text{NP/SA}_{\text{pattern}} \mid \{\text{ENSO}_{\text{spring}}\}$
- $\text{SM}_{\text{spring}} \perp \text{Yield}_{\text{anomaly}} \mid \{\text{ENSO}_{\text{spring}}, \text{SM}_{\text{summer}}\}$
- $\text{NP/SA}_{\text{pattern}} \perp \text{Yield}_{\text{anomaly}} \mid \{\text{ENSO}_{\text{spring}}, \text{SM}_{\text{summer}}\}$

Where ("$\perp$") implies statistically independent given ("$\mid$") the conditioning set $W = \{\ldots\}$.

Figure S1. Spatial covariance timeseries based on highlighted SST correlation pattern for SESA and CB regions.
Figure S2. Correlation maps for same-season JFM ENSO 3.4 index against austral summer SST (JFM), soil moisture (JFM) and yield anomaly in CB and SESA.

Figure S3. PDO index (dataset source: Huang et al., 2017) averaged over JAS and NP pattern averaged over JAS. Correlation between the two time-series is statistically significant.

Figure S4. Correlation maps for same-season JAS ENSO 3.4 index against boreal summer SST (JAS), soil moisture (JAS) and yield anomaly in the US.

References