CO-VARIABILITY BETWEEN SUMMER SOUTHEASTERN SOUTH AMERICA RAINFALL ANOMALIES AND TROPICAL SEA SURFACE TEMPERATURES ANOMALIES IN CMIP5 DECADAL PREDICTIONS

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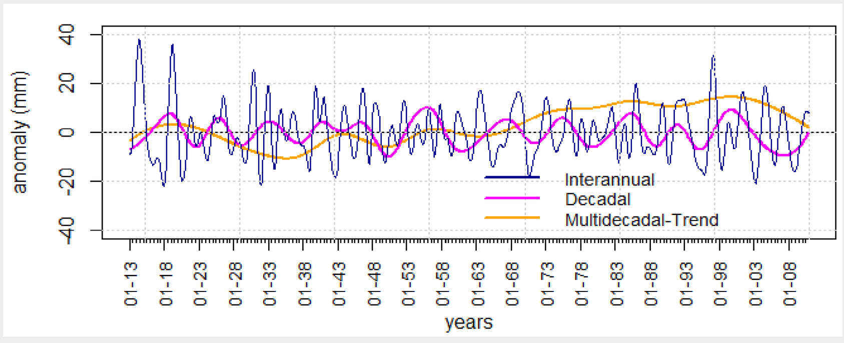
MOTIVATIONS



Southwest SESA rainfall anomalies
Skansi et al., 2014. WCRP OSC

The year-to-year variability of summer rainfall anomalies in Southeastern South America (SESA) along the last century exhibits the combination of variability in different time scales (**Interannual**, **Decadal**, **Multidecadal**) and **trends**.

How the rainfall in the region will evolve in the next years-decades largely depends on the combined influence of the **internal natural variability**, mostly associated with the tropical ocean evolution, and the **external climate forcing**, associated with both natural and anthropogenic sources.

GOAL

- **How is the influence of the large-scale interannual variability of the sea surface temperatures (SST) on austral summer rainfall in SESA?**
- **Are CMIP5 decadal hindcast simulations able to reproduce it?**

METHODOLOGY

Data

Observations

SST: NOAA Extended Reconstructed Sea Surface Temperature Version 3b (ERSSTv3b)

Precipitation: Global Precipitation Climatology Centre (GPCC)

CMIP5 Models

Initialized or Hindcasts (Init)

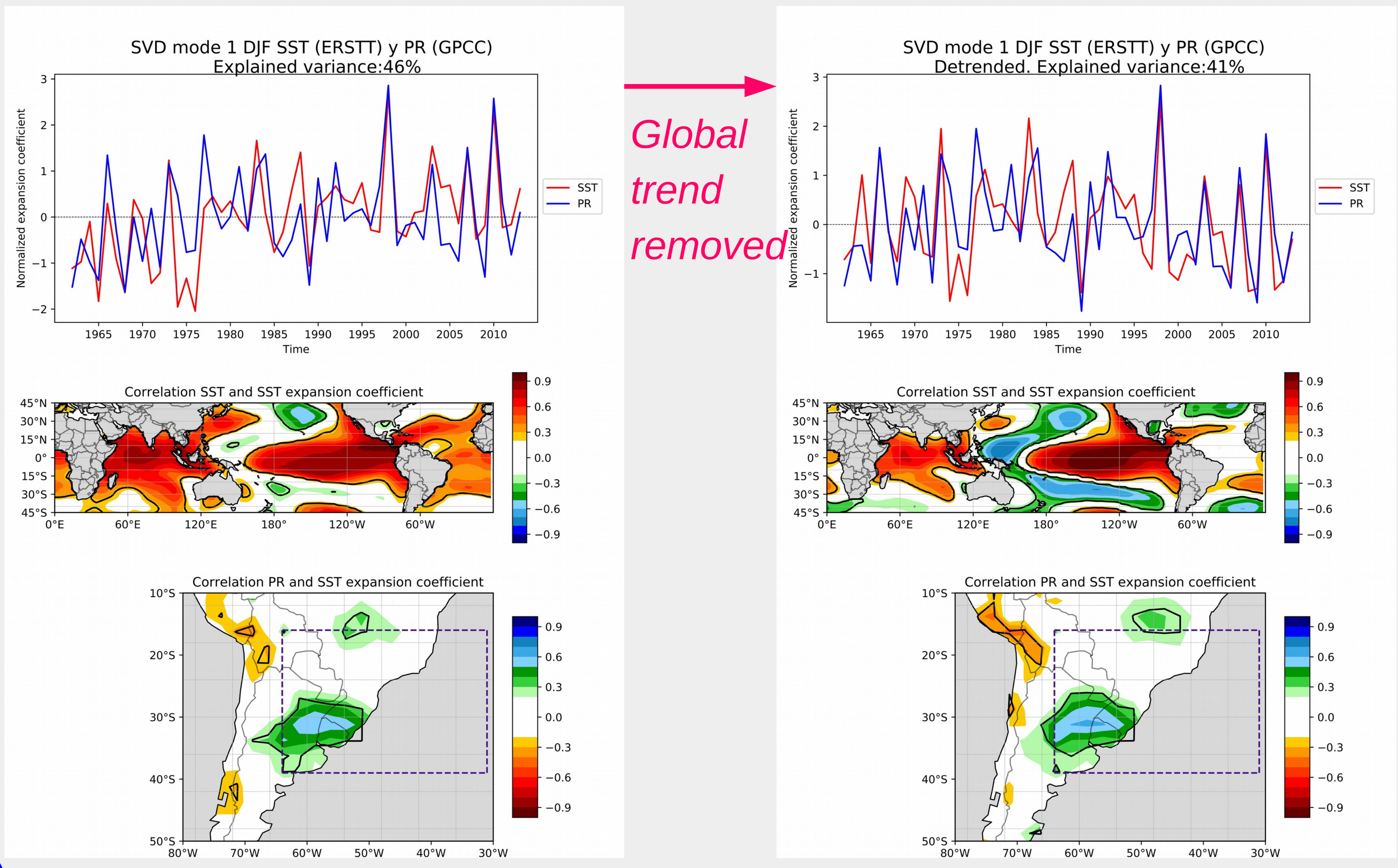
Uninitialized or Historical (NoInit)

Model	Members	
	Init	NoInit
BCC-CSM1.1	3	3
CanCM4	10	10
GFDL-CM2.1	10	10
HadCM3	10	10
MIROC5	6	3

A **singular value decomposition (SVD)** analysis was performed between December-January-Febrauary SST anomalies (45°S-45°N) and SESA precipitation anomalies from observational datasets and CMIP5 decadal hindcasts at each lead year, from 1960-onward. **Non-linear trends** were removed through a linear regression between global mean SST time series and those for SST or precipitation anomalies at each grid point.

SVD1 was computed for mean **multi-model ensemeble (MEM)** and for mean multi-member ensemble for each model, for each lead year.

How is the influence of the large-scale interannual variability of the SST on austral summer rainfall in SESA?



Díaz et al., 2017 Clivar Exchanges N°71

The leading co-variability mode (**SVD1**) shows a clear **global warming signal**, mainly related to **warming in the Pacific and Indian Oceans**, in association with a **rainfall increase in SESA**.

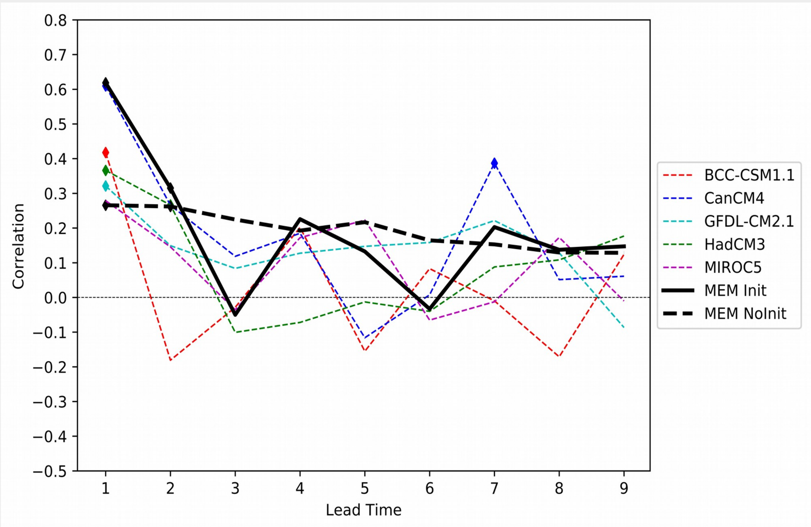
The mode exhibits significant variability ranging from the interannual scale to long-term trends, with a remarkable **decadal variability.**

After detrending the series, the spatial distribution of both SST anomalies and precipitation anomalies in SESA associated with the first mode resembles that typically related with El Niño-Southern Oscillation (**ENSO**).

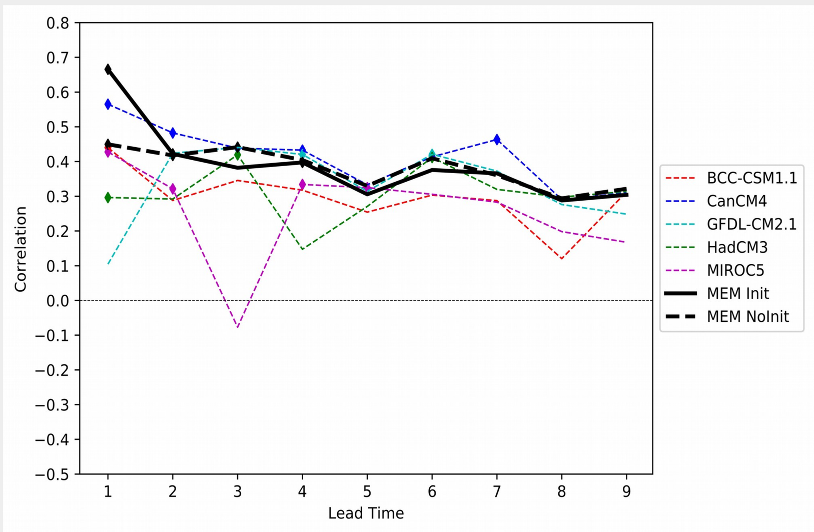
Are CMIP5 decadal hindcasts able to represent austral summer SVD1?

Anomaly correlation between observed and simulated SVD1 temporal series for each lead year

Detrended anomalies



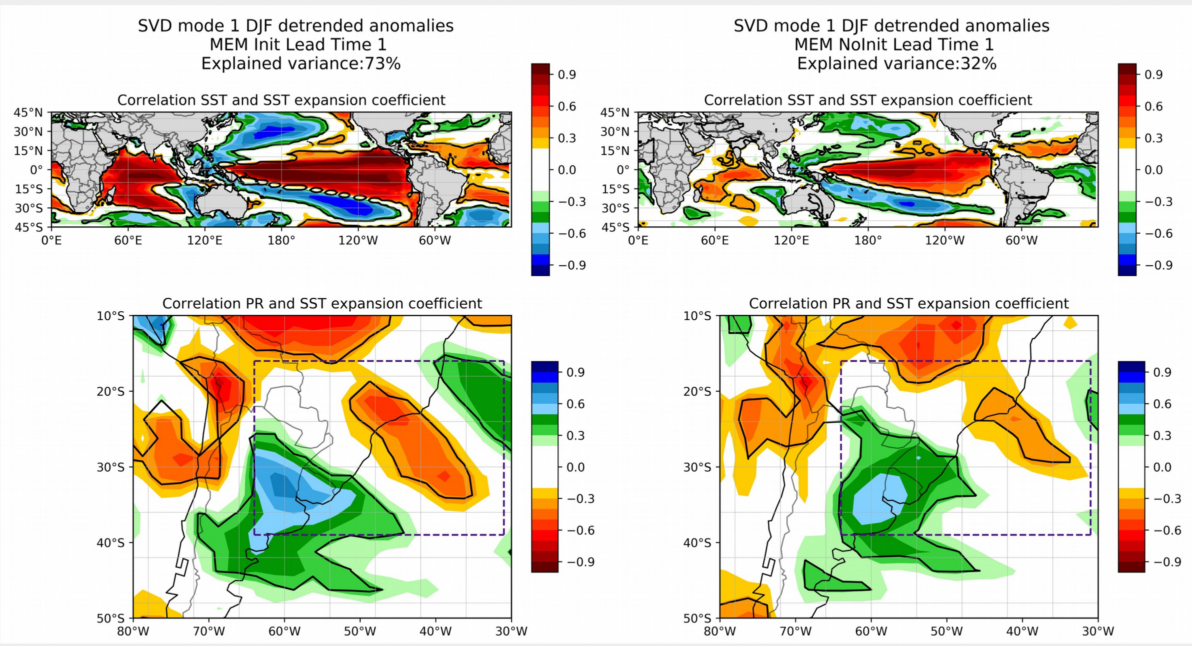
Undetrended anomalies



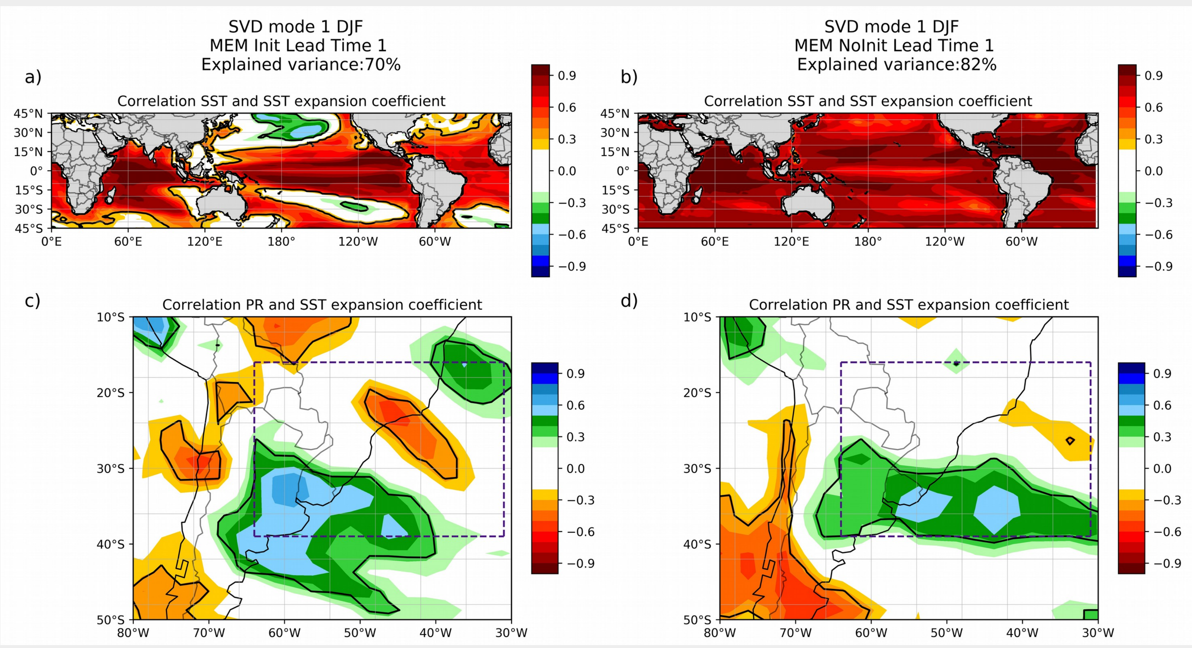
Detrended SVD1 activity shows **skill** in the **first two prediction years.** When trends are also considered, skill increases in the successive prediction years, indicating additional value from global warming effect over climate variability.

Observed and simulated SVD1 spatial structures for lead year 1

Detrended anomalies



Undetrended anomalies

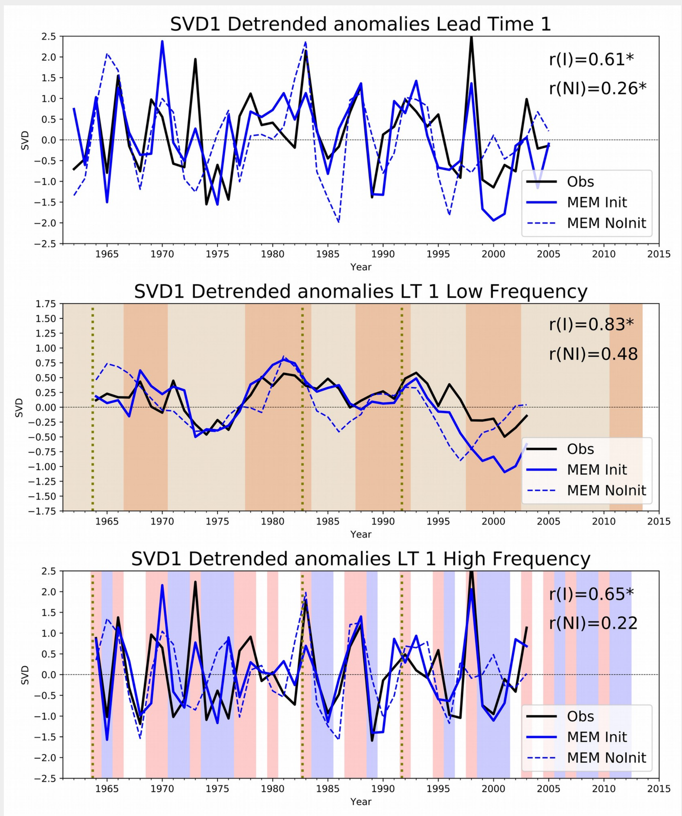


Init and NoInit **simulations are able to represent SVD1 spatial structures** with and without considering trends. **Initialization improves** spatial structure representation for the first lead years. NoInit is higlhly dominated by trends.

Observed and simulated SVD1 time series for lead year 1

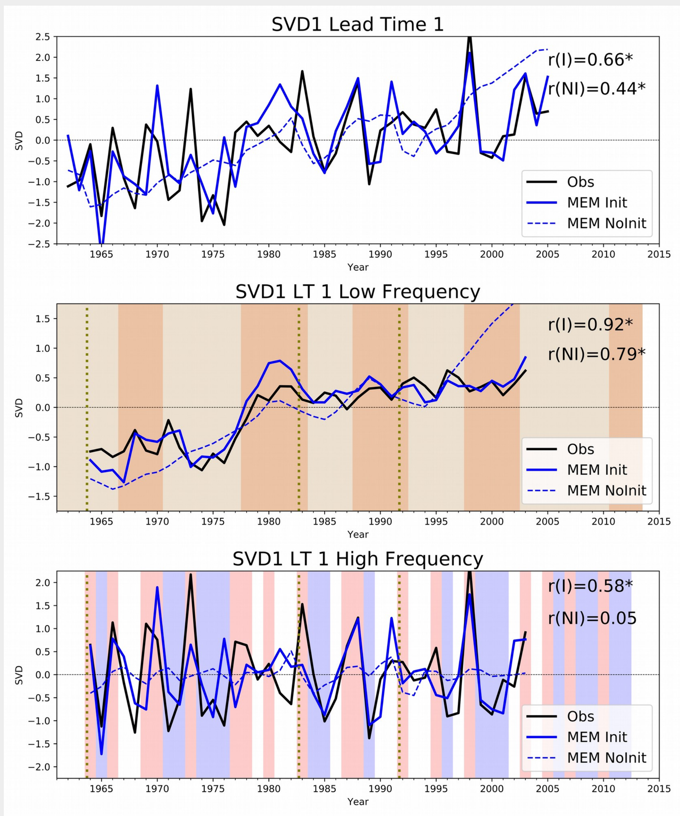
Low frequency: 5-Year running mean
High frequency: Original series – Low frequency

Detrended anomalies



Dark brown: High solar activity
Light brown: Low solar activity

Undetrended anomalies



Red: El Niño events
Blue: La Niña events

Better SVD1 activity skill in **initialized** simulations is due to representation of both **low** and **high frequency**. High frequency skill is lost for longer lead years.

When **trends** are also considered, higher skills are obtained for **low frequency**, mainly related to non-linear trend.

Relationships between SVD1 activity skill and explored sources of natural variability are not evident and requires further investigation.

CONCLUSIONS

- The leading austral summer co-variability pattern reflects mostly the influence of Pacific and Indian oceans on rainfall in SESA, and exhibits significant variability ranging from the interannual scale to long-term trends.
- Austral summer SVD1 activity shows skill in the first two prediction years. Skills are higher when trends are also considered, suggesting an added-value in skill from global warming. SVD1 spatial structures are reasonably represented in initialized and non-Initialized simulations.
- These results suggest that valuable climate information in SESA region could be obtained with longer anticipation than presently.

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