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Antarctic sea ice spatial patterns and South America winter and spring climate

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The winter-spring sea ice variability is driven by atmospheric and oceanic conditions however, due to sea ice can persist for long periods, it has the potential to affect the atmosphere and its circulation. For this reason, the main winter-spring spatial pattern of
sea ice concentration anomalies (SICA) and how they are coupled to atmospheric circulation anomalies and, the temperature and the precipitation over South America is presented in this paper.

SICA over Weddell, Amundsen and Bellingshausen Seas of Antarctica coming from Satellite data were analyzed between 0º and 120º West, on a regular grid (25 km x 25 km) for the period 1979-2000. Principal Component (PCs) analysis under T-mode (correlation between monthly spatial SICA) rotated Varimax was used to obtain the main principal spatial patterns throughout the year. Three of the first six PC scores, represent the most important winter-spring spatial features that rule sea ice variability. The connection between sea ice condition and atmospheric circulation is analyzed by mean of 850 hPa, surface air temperature, surface wind, 200 hPa wind, tropopause temperature and pressure anomaly field (NCEP/NCAR reanalysis II) and with precipitation and temperature over South America (University of Delaware data set) composites coupled with each SICA pattern.

The lead SICA pattern for the direct (inverse) phase is a dipole anomaly structure with a positive (negative) centre located at 60˚ S in the Weddell Sea extended to the north extreme of Antarctic Peninsula over Bellingshausen Sea and another core with opposite sign at the Amundsen Sea centred at 67˚

S. A strong dipole also is present in the atmospheric variables anomalies. Anticyclonic (cyclonic) centre of 850 hPa anomalies over the Bellingshausen and Amundsen Seas strength (weak) the gradient between the climatic low pressure in the external sector of the Weddell Sea and the ridge of high pressure over the Antarctic Peninsula. It enhances (weakens) the climatic south winds parallel to the east side of the Peninsula near surface that aligned with the equator ward (pole ward) ice drift. They are connected with negative (positive) surface air temperature anomalies (SATa) which extends up to 30ºS. Therefore the meridional temperature gradient is enhanced (reduced) and the subtropical jet stream is reinforced (weakened) and shifts to the south (north) over subtropical South America and the Atlantic Ocean. South Brazil and Uruguay have positive (negative) while tropical and equatorial South America have negative (positive) precipitation anomalies. The second pattern positive (negative phase) corresponds to a similar dipole structure shifted 30˚ eastward the location of the first one. The circulations anomalies shifted together with the SICA centers in a manner that the anticyclonic (cyclonic) anomaly centre is located over the Weddell Sea with the consequently change in the others circulation variables. The cooling (warming) induced by the SICA positive (negative) in the eastern Weddell Sea affect middle to tropical South America. It is connected with negative (positive) precipitation anomalies over South Brazil, Uruguay, Buenos Aires Province and Central Andes.

The third pattern positive (negative) phase is a non-dipolar structure represented by two positive (negative) SICA over the external regions of the seas at both sides of Antarctic Peninsula with a small opposite anomaly located over the north of Antarctic Peninsula. Anticyclonic (cyclonic) anomalies are again located over the areas with strong negative (positive) SICA anomalies. Positive (negative) SATa extend from Antarctica throughout South America surrounding Oceans giving a baroclinic (barotropic) area over Santa Catarina Gulf in Brazil with an increase (decrease) of precipitation in the area.

A comparison between the SICA patterns and their associated circulation patterns for South America and the 2001-05 winter-spring precipitation, 850 hPa height and surface air temperature is performed to analyze the possibility forecast for the region based on sea ice behaviour.