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The atmospheric characteristics associated with sea ice temporal variability in the Amundsen and Bellingshausen Seas

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Sea ice is an important, highly variable feature of the Earth's surface, both reflecting and influencing climatic conditions. Sea ice covers approximately 7 percent of the world oceans, significantly reduces the amount of solar radiation absorbed at the Earth's surface, greatly restricts the transfer of heat from the ocean to the atmosphere in winter, and influences global atmospheric and oceanic circulation. In this paper, monthly through interannual variability of the sea ice between 0˚ and 120˚W is analysed for the 22-year period 1979 through 2000.

Monthly Polar Gridded Sea Ice Concentrations data set derived from the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) and the Defence Meteorological Satellite Program's (DMSP) DMSP-F8, F11 and F13, Special Sensor Microwave/Imager (SSM/I) generated by NASA team algorithm were used. This data were acquired from the National Snow and Ice Data Center (NSIDC) and are gridded on the SSM/I polar stereographic grid (25 x 25 km) provided in two-byte integer format.

Principal Components Analysis in S-Mode (correlation between temporal series) was performed on pre-processed sea ice data (monthly anomalies from which have been removed continent and perennial open water), in order to investigate which are the main temporal patterns, where they are homogenous and how they are coupled to different atmospheric variables. These analysis provide 9 patterns (4 in the Amundsen and Bellingshausen Seas and 5 in the Weddell Sea) that represent the most important temporal features that dominate sea ice variability in the Weddell, Amundsen and Bellingshausen Seas for the 1979-2000 period.

The temporal patterns that have their influence over the Amundsen and Bellingshausen Seas will be described. The area where the first pattern series is homogeneous is centered in 125˚W and 67˚S over west Amundsen Sea. It is negative correlated with tropical sea surface temperature (SSTs) for lags +1 to +24 months, with a maximum in +12 months. This area has its most important temporal variability during winter and spring period, so this correlation means that if tropical SSTs anomalies are positive (negative) then sea ice concentration anomalies would be negative (positive) at the west of the Amundsen until to 2 years later of the ENSO positive (negative) event. On the other hand, there is a very strong positive correlation for the leads -12 to -9 months meaning that positive (negative) sea ice concentration anomalies in this area could be related with positive (negative) subsequent tropical SSTs. 850 hPa is strongly negative correlated for lags +2 to +6 at the Amundsen and Bellingshausen Seas. This means that cyclonic anomalies develop and move to the east previously to the positive anomaly in the sea ice series. The cyclonic anomaly produces a cold air flux that helps the development and expansion of the sea ice edge to the north. Noticeable are the high positive correlation that exists between 30˚ and 60˚S that mark the existence of a 3 wave pattern dominated by high pressure centers that strengthen the South Hemisphere anticyclones. The meridional surface wind shows dipole behaviour for lags +3 to +5. This means that previously to the sea ice positive (negative) anomaly over the west of the Amundsen there will be wind from the south (north) in sea ice in the Amundsen Sea and the opposite will happens over the Bellingshausen and Weddell Seas. The 200 hPa jet shows a diminished of intensity between +2 and +3 month previous to the positive sea ice anomaly. This negative jet correlation is associated with a meridional wave train in the Pacific Ocean.

The other three temporal patterns are centered in 90˚W, 64˚S; 110˚W and 70˚S and 90˚W and 73˚ S and will be described at the presentation.