Interannual Variations of sea ice in the Pacific side of the Arctic and its relation with the Pacific Inflow

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Northern Hemisphere Extent Anomalies Sep 2008

1979-2000 mean = 7.0 million sq km

slope = -11.1(+/-3.3) % per decade

http://www-nsidc.colorado.edu/data/seaice_index/n_plot.html

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PICES2008, Dalian
Ice Area (1978.11-2007.12)

Monthly data from NSIDC

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Comparison of yearly minimum ice extent in Arctic Ocean

solid: 1979-2000; dash: 2005
What we want to know and understand:

- What’s the special features of the sea ice inter-annual variation in Pacific side of Arctic (Total four regions; Separate regions)
  - Spatial distribution of variational trend
  - Abrupt test
  - Periodicity

- Links to AO and PDO
- Links to the Pacific Inflow

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Distribution of sea ice concentration trend (1979-2007)

March

September

Data from Met Office Haddley Center’s HadISST1.1 (1871.01-2007.12), 1×1;
We use 1979.01-2007.12)

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Bering Sea: Apr. (Jan.-Apr.)

The fact

The threshold

Abrupt change test
Abrupt change test

The fact
The threshold

Beaufort Sea

East Siberian Sea

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Periodicity

Sea ice area abnormal

- Ice area ($10^5 \text{km}^2$)
- 1980-2005

- Total
- Chukchi
- Bering
- Beaufort
- East Siberian
Filter the seasonal signal and subtract the trend

**Periodicity**: 18 months lowpass
Whole Arctic

Total Four Regions

Monthly mean after filter

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Is there any link to AO and PDO?

Figure 4. Regimes of surface currents and ice drift in the Arctic Ocean redrawn from Sokolov [1962]. (a) Type A circulation, corresponding to prevailing Arctic High atmospheric pressure; (b) Type B circulation, corresponding to prevailing Icelandic Low atmospheric pressure. Numbered features are 1, Beaufort Gyre; 2, Transarctic Drift Current; 3, Laptev Sea cyclonic circulation; 4, Barents Sea currents; 5, East Siberian Sea circulation; and 6, Kara Sea coastal flow.
The opinion of AO connection and two regimes theory can't explain this!

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Total four regions monthly sea ice area Fitting

Rate: \(-0.10 \times 10^4 \text{km}^2/\text{year}\)

Total four regions Fitting monthly sea ice area subtract trend
A parameter to represent Pacific Inflow’s intensity

**Accumulated heat:** \( Q_t \)

\[
Q_t = \sum w_i T_i S_i
\]

\[
w_i = \begin{cases} 
0 & T_i < T_{\text{threshold}} \\
1 & T_i \geq T_{\text{threshold}}
\end{cases}
\]

\( S_i \): area of a grid, \( T_{\text{threshold}} = -1.0 ^\circ\text{C} \)
conclusion

- In summer, Sea ice concentration decreased more significant in Pacific side of Arctic. Except Bering Sea, sea ice area has significant interannual variation during Aug.-Oct.
- The four regional sea don’t share the same interannual change in the trend as well as in the periodicity.
- There is a abrupt (change, shift) around 1997 in Chukchi Sea, Bering Sea and East Siberian Sea.
- The two regimes theory of AO is difficult to explain interannual variation of sea ice area, while PDO index matches with the filtered sea ice area series with 2-4 years lag.
- A parameter Qt is defined to represent the strength of Pacific inflow. Qt in Bering sea matches well with sea ice area of Chukchi Sea during Jun.-Nov. Qt in North Pacific shows earlier and earlier warm in a year cycle these years.
Thank you!