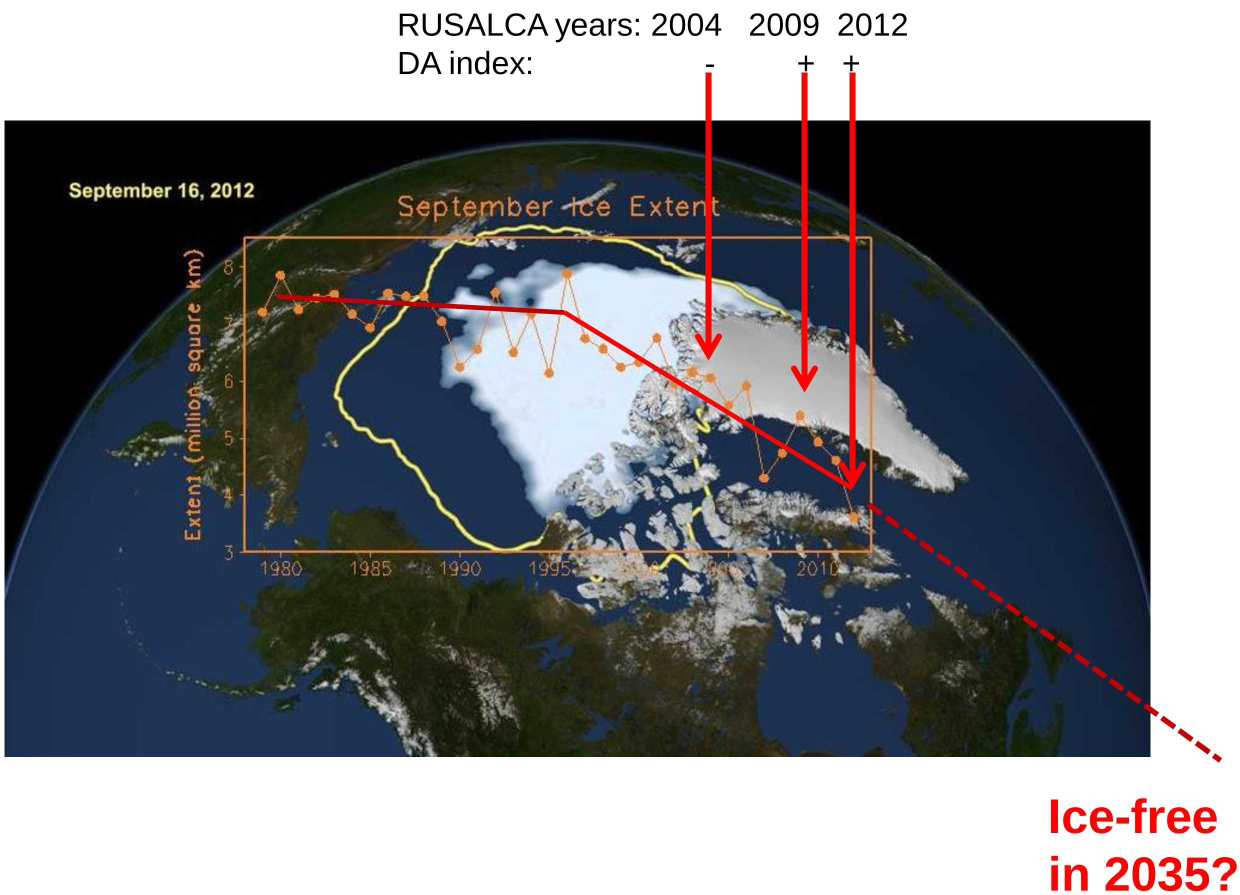
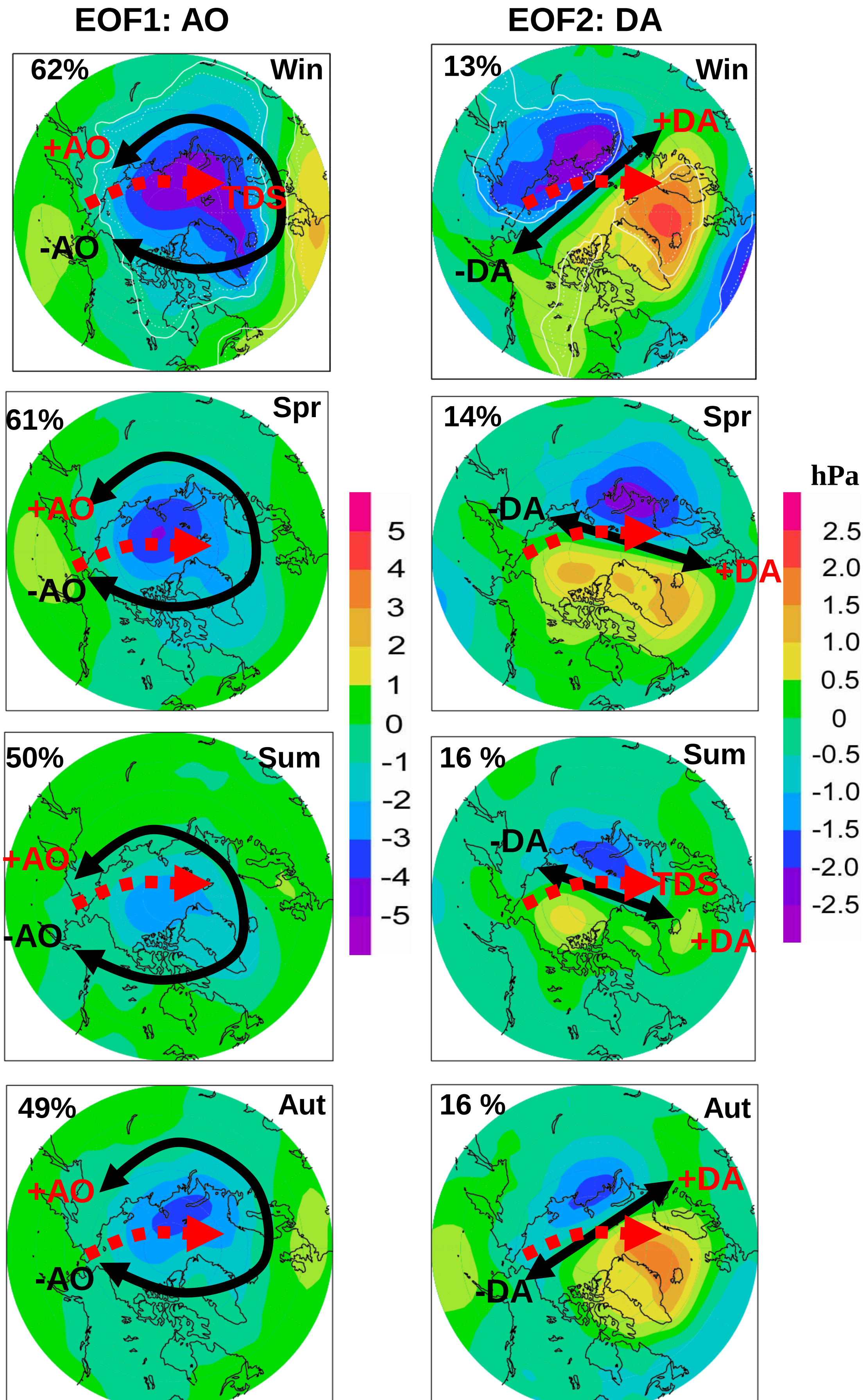


Figure 1. Time series of average September sea ice extent from satellite measurements from 1979 to 2012 and the spatial minimum sea ice extent on September 16, 2012. A linear trend is fit to the period of 1979-1996, and a second trend is fit to 1996-2012. The second trend is illustrated with a dashed line and is extended to an ice- free summer at ~2035, conservatively assuming that the ice/ocean albedo feedback and ice/cloud feedback processes maintain the same rate between now and then.



EOF1: AO
EOF2: DA
62%
Win
+AO
TDS
-AO
13%
Win
+DA
-DA
61%
Spr
+AO
-AO
14%
Spr
-DA
+DA
50%
Sum
+AO
-AO
16 %
Sum
-DA
TDS
+DA
49%
Aut
+AO
-AO
16 %
Aut
+DA
-DA
5
4
3
2
1
0
-1
-2
-3
-4
-5
hPa
2.5
2.0
1.5
1.0
0.5
0
-0.5
-1.0
-1.5
-2.0
-2.5

Fig. 3

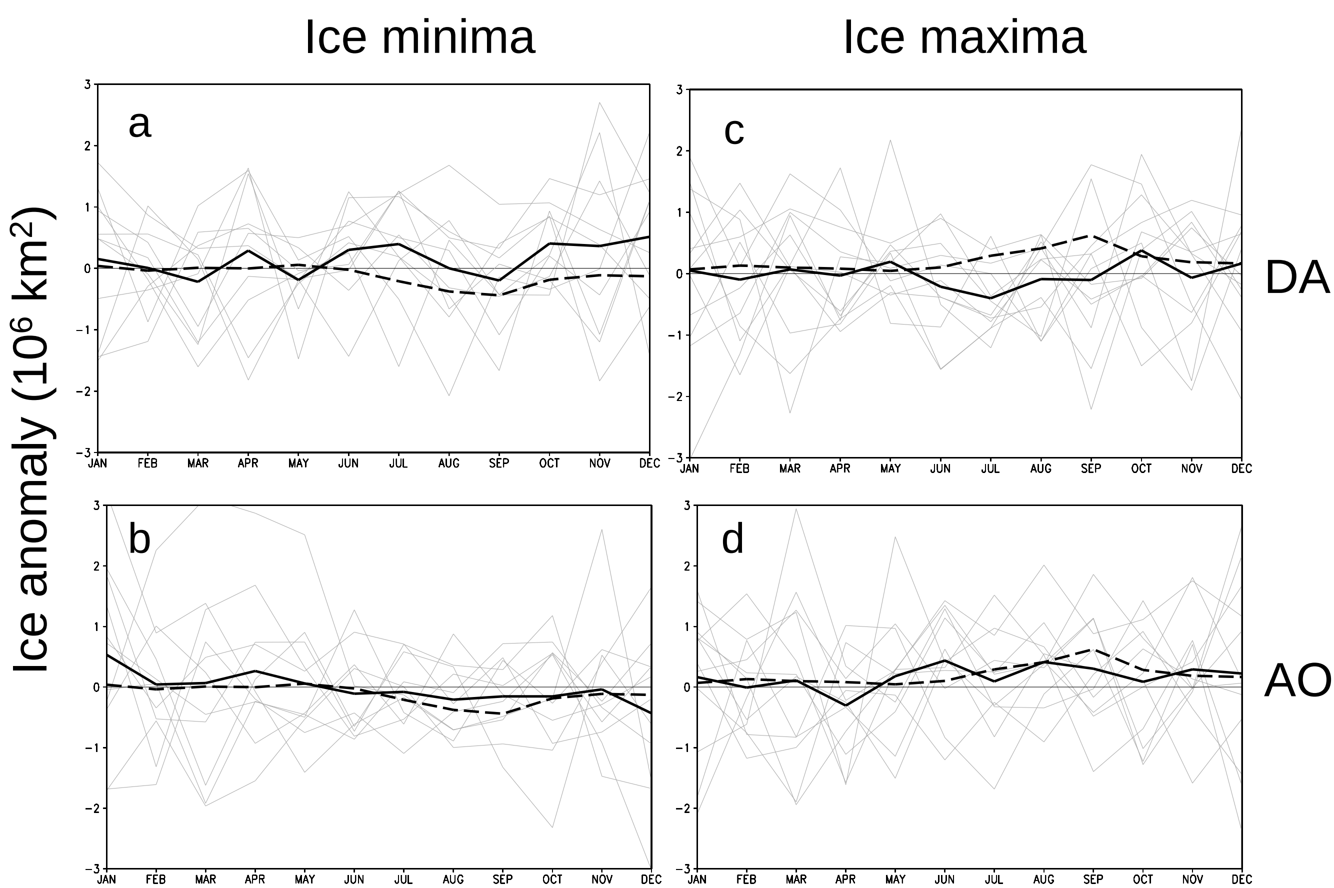


Figure 2. Monthly DA indices (a) and AO indices (b) during the ice minimum years, and monthly DA indices (c) and AO indices (d) during the ice maximum years. The pale lines are the DA and AO monthly indices for individual years. The thick solid lines are the mean DA and AO monthly indices, while the thick dashed lines are the mean monthly sea ice extent anomalies.

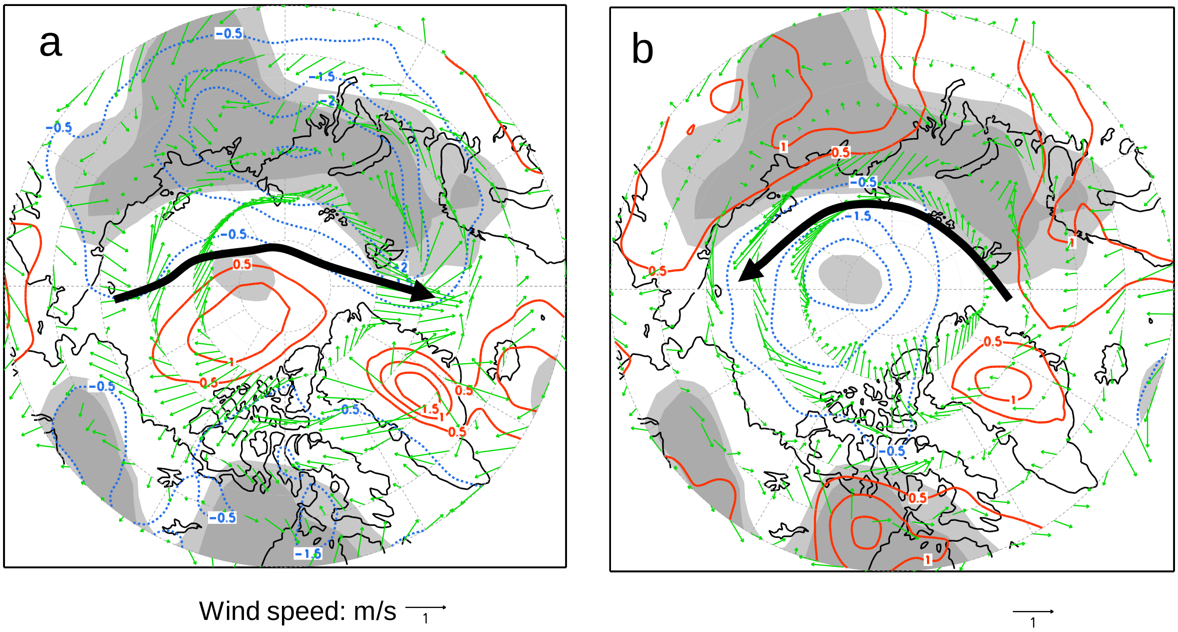


Figure 3. Composite SLP anomaly and anomalous wind vectors during the ice minimum (a) and maximum (b) years. The spatial SLP differences between ice minimum and maximum years are computed at the 95% (heavy shaded) and 90% (light shaded) significance levels based on a Student t-test. The pressure intervals are in 0.5hPa increments. The thick arrows indicate the directions of maximum wind velocity anomalies.

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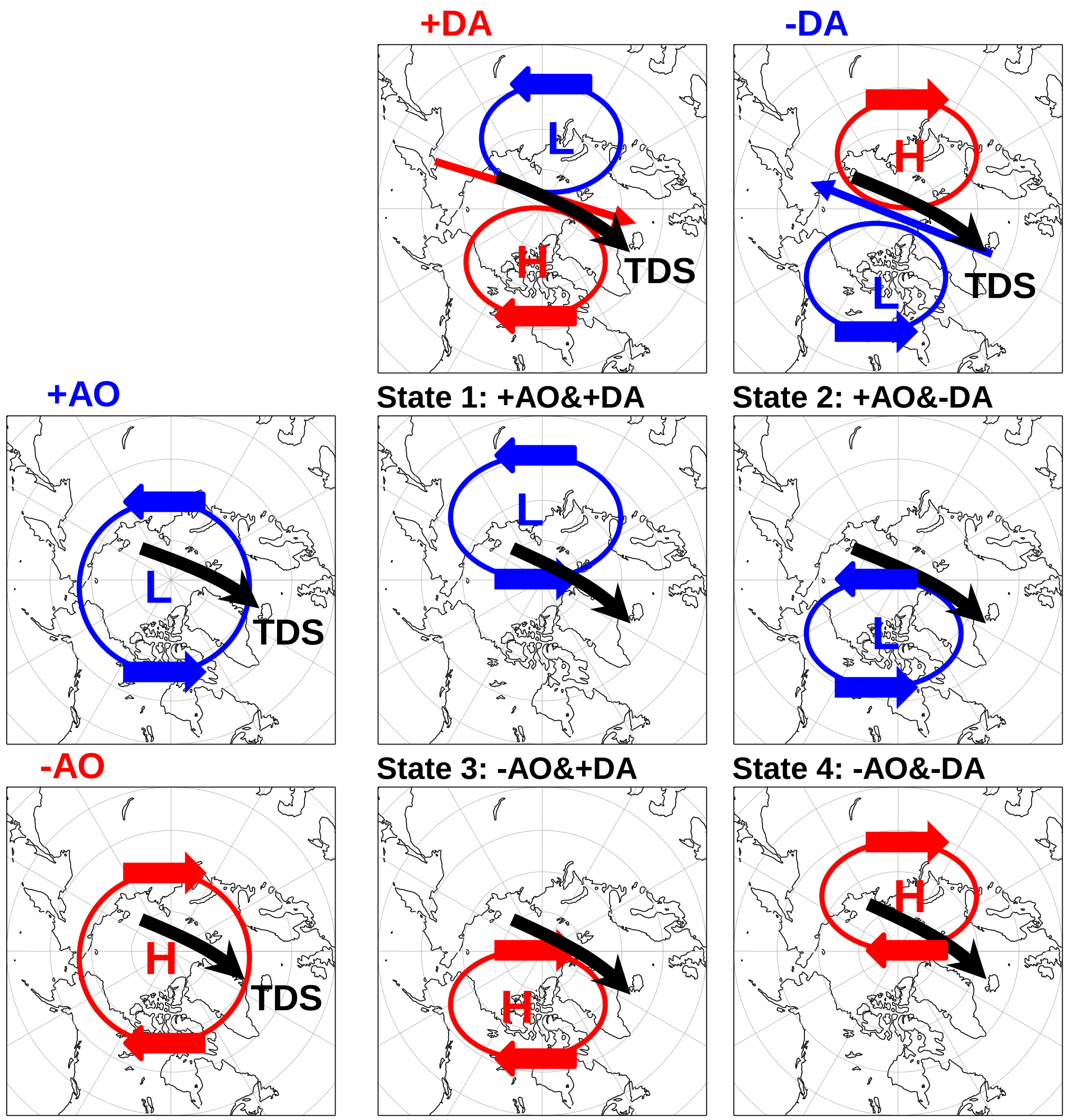

Figure 4. The first leading mode (AO, left column) and the second leading mode (DA, upper panels) from an EOF analysis of the SLP are reconstructed into four climate states in the high Arctic. Black arrows indicate the TDS. L and H indicate the low and high SLP action centers. Other arrows indicate the anomalous wind directions.

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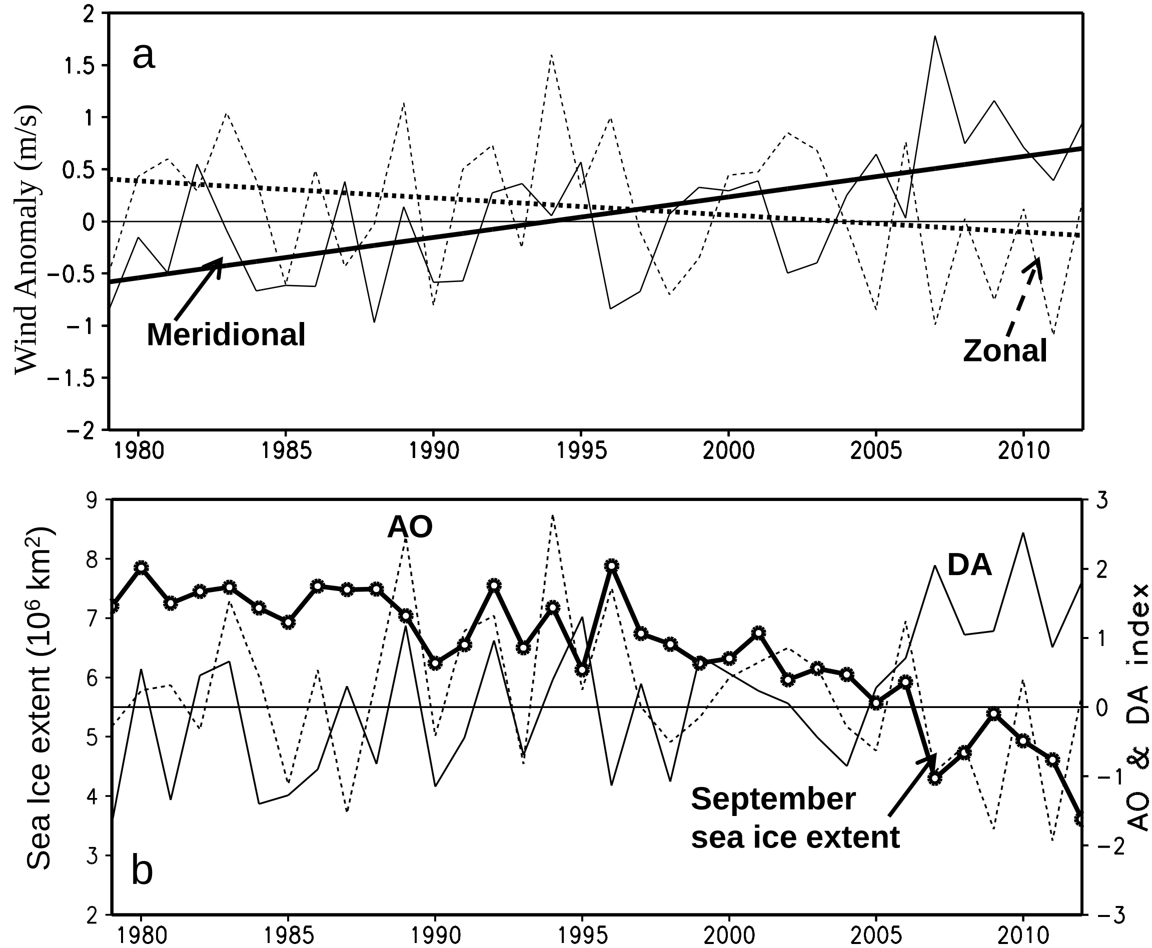

Figure 5. a) Time series of meridional, Wm (solid, with an upward slope of .0388 (m/s per year)), and zonal, Wz (dashed, with a downward slope of -.016 (m/s per year)), wind speed anomalies, respectively, over the TDS region (a rectangular box from 160W-160E and 20W-20E) for the period from 1979-2012. The trends are estimated using squares linear regression model.
b) Time series of Arctic September sea ice extent (circled solid line), summer DA index (solid), and summer AO index (dashed). Correlation coefficients were calculated for each pair-wise comparison among these variables (see Table 1).

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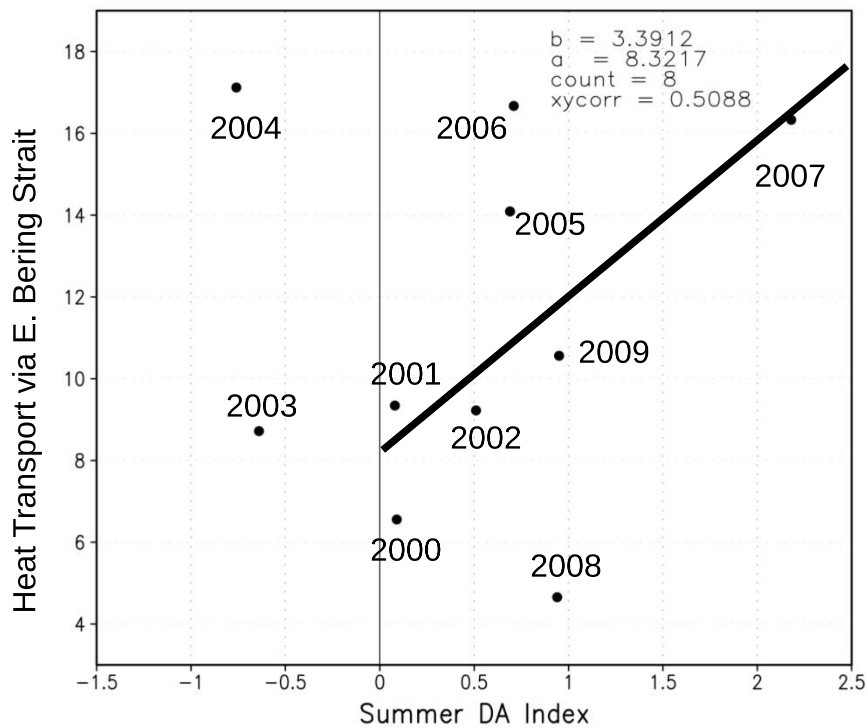

Figure 11. Scatter plot between the summer DA index (x-axis) and northward heat transport via the eastern Bering Strait (y-axis) from 2000 to 2009. Units is in 10^{19} J yr^{-1} (June-October). The correlation between the heat flux and summer DA index is 0.51, which is lower than 0.71, the 95% significance level.

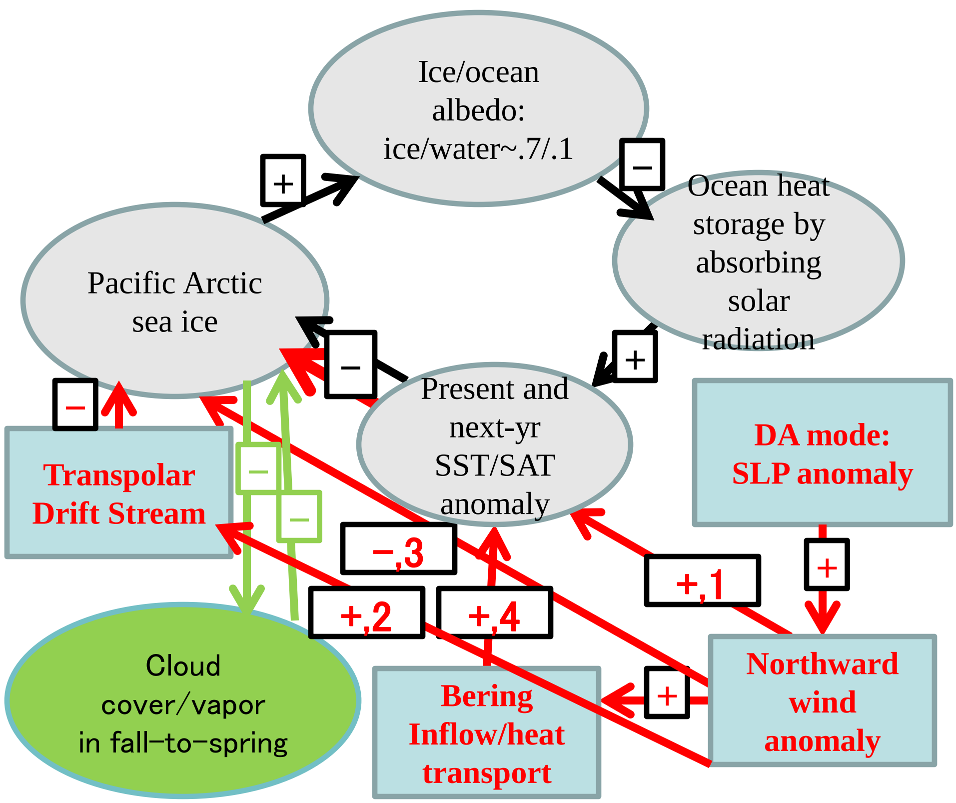

Figure 6. An ice/ocean albedo feedback loop and ice/cloud feedback loop are accelerated by a series of intermittent +DA forcings. The red arrows are associated with +DA forcing, which applies the positive feedback to the SST/SAT, or negative feedback to the sea ice, causing the unprecedented loss of Arctic summer sea ice and a series of record-breaking ice minima. + and – signs denote the positive and negative feedback, respectively. The positive feedback means that a change in one item (say *A*) affects the other item (say *B*), which feeds back so that *A* makes the change in the same direction as the original change. Note that associated with +DA, red arrow 1 indicates the northward advection of warmer SAT in the northern North Pacific to the Arctic by the anomalous meridional wind; Red arrow 2 denotes that anomalous meridional wind directly accelerates the TDS, which promotes export of more ice out of the Arctic; Red arrow 3indicates the direct advection of sea ice by the anomalous meridional wind; and red arrow 4 denotes the warming impact of the ocean heat transport from the Bering Sea promoted by the anomalous northward (or meridional) wind.

Future Effort

- RUSALCA years were driven by DA forcing (2004-negative, 2009-positive, 2012-positive, record breaking)
- Provide AO and DA indices to PIs for their analyses
- Synthesis analysis on key climate forcing (DA and AO) on the RUSALCA region, linking volume and nutrient fluxes