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Barcelona, 16 Jan 2018

Barcelona Supercomputing Center
Centro Nacional de Supercomputación

EXCELENCIA SEVERO OCHOA

Sea ice modes of interannual variability

WP5 - Task 5.2.3: Sources of predictability for polar climate and its influence on the mid-latitudes

Juan C. Acosta Navarro, Virginie Guemas, Alasdair Hunter, Pablo Ortega

APPLICATE
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Aims

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- Identify **sources of predictability** for Arctic sea ice.
- Provide a **framework** to evaluate the capacity of a given model to simulate Arctic sea ice variability.

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  - Information for shipping, fishing, local communities.

Methods

Data: **38 years** (1979-2016) of continuous observations of monthly **Sea Ice Concentration** (SIC) from NSIDC & monthly North Atlantic Oscillation Index (**NAOI**) from NCEP-NOAA (http://www.cpc.ncep.noaa.gov/).

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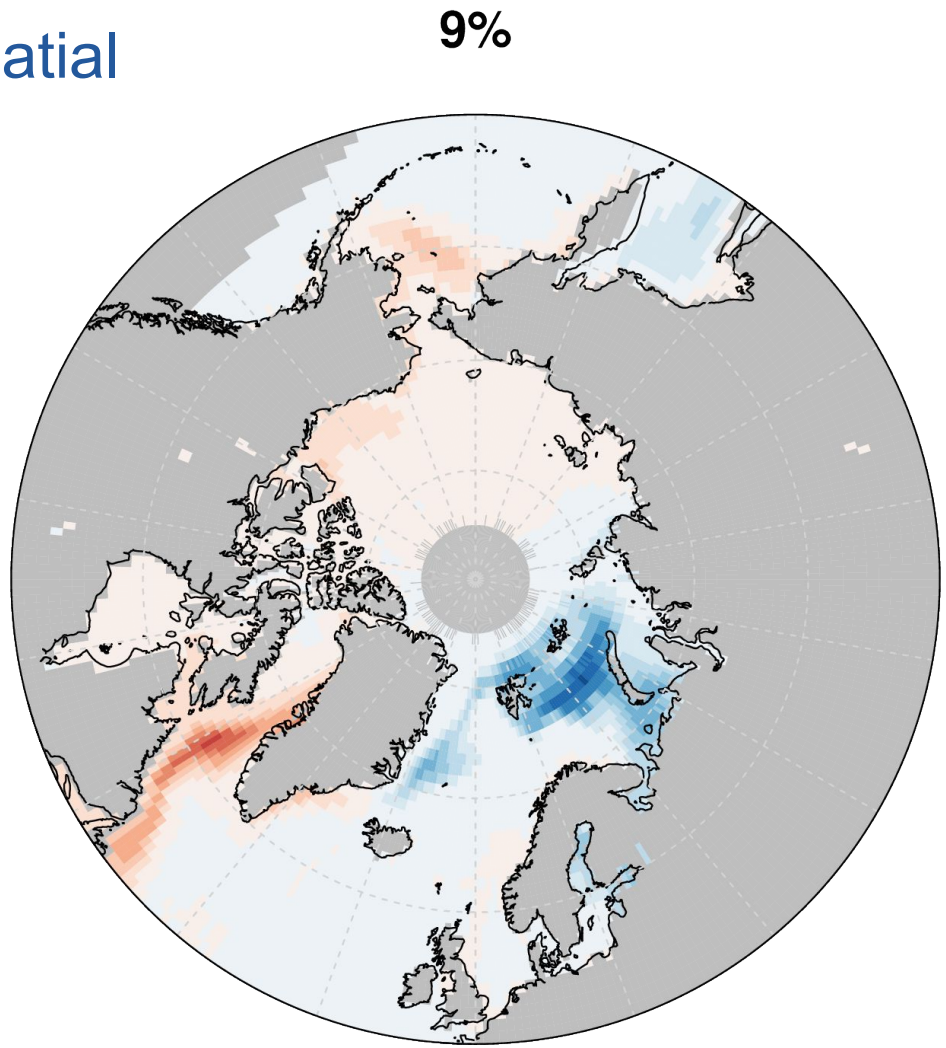
Associated **Principal Component** (PC) time series.

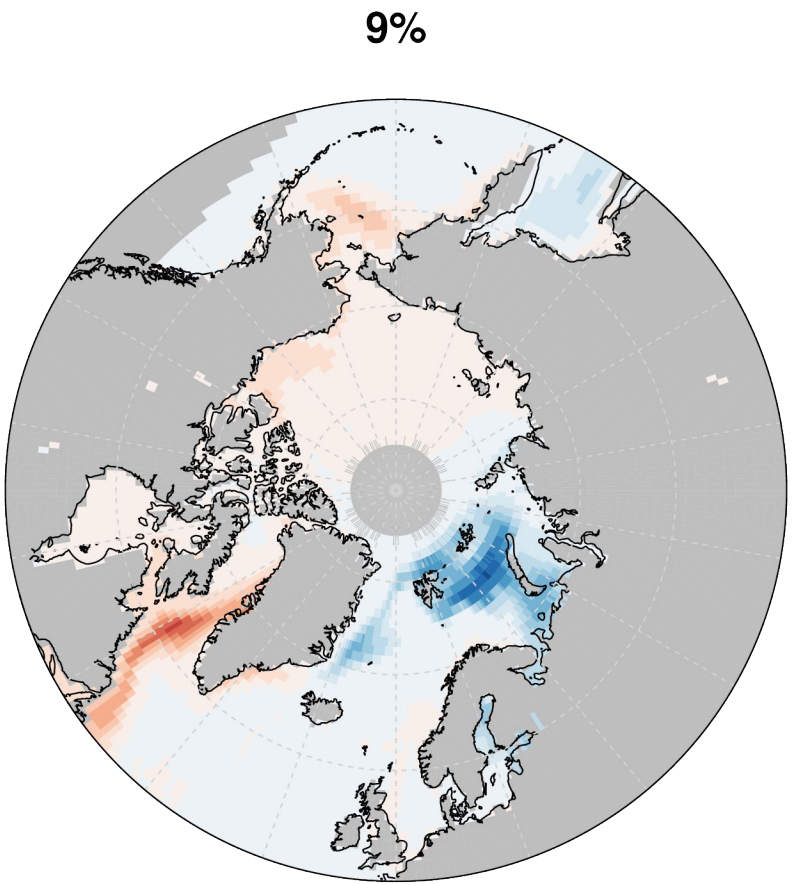
Results

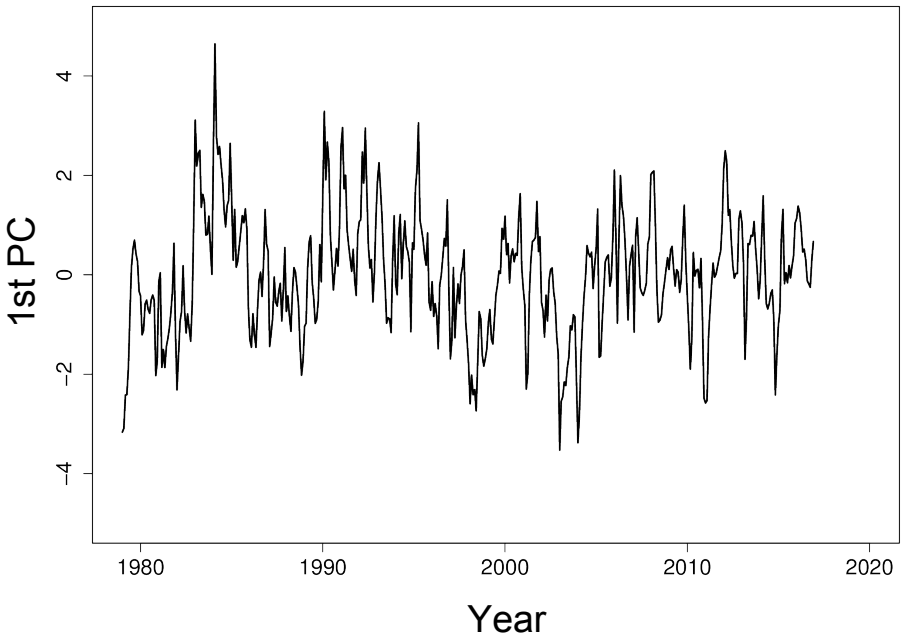
First SIC mode: spatial pattern



See e.g.: Deser et al. 2000-2004, 2007

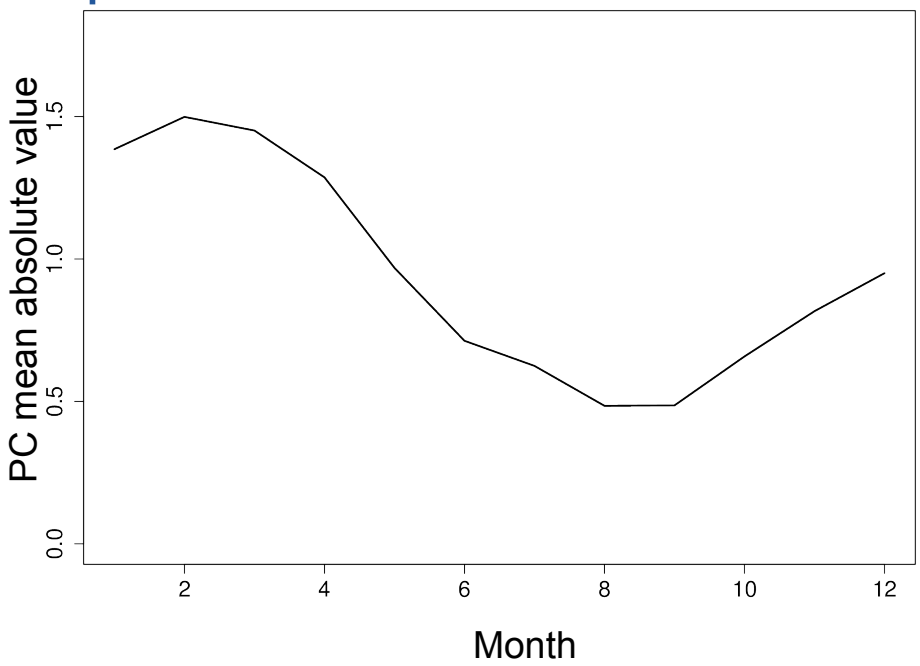
First SIC mode: principal component series

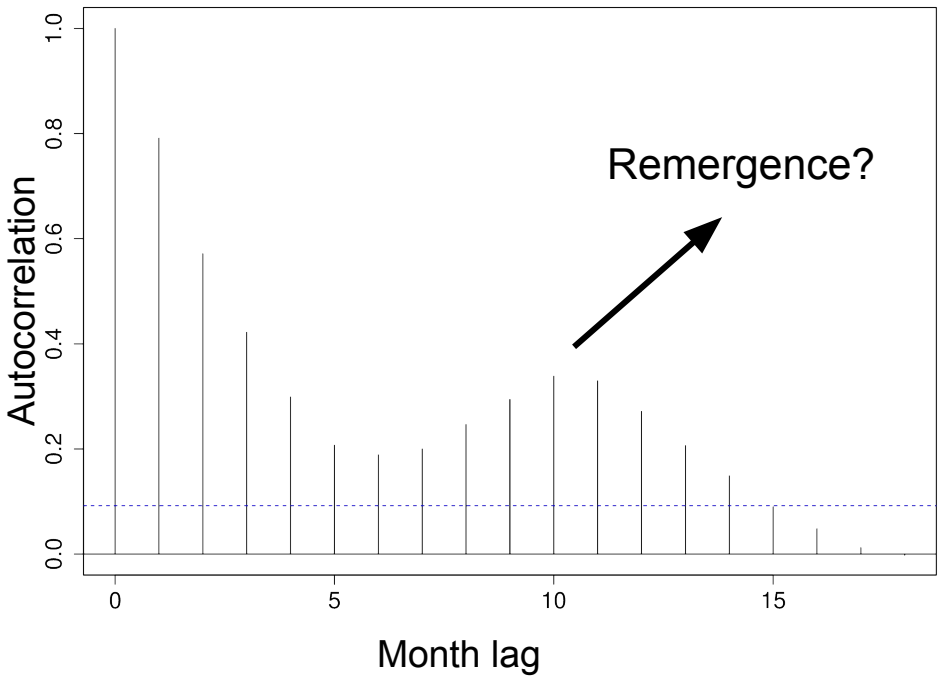




Results

First SIC mode: seasonality & persistence





- Typical mode of variability during winter (Max. in Feb.).
- Persistence decays (~4-5 months).
- Possible reemergence in the following winter.

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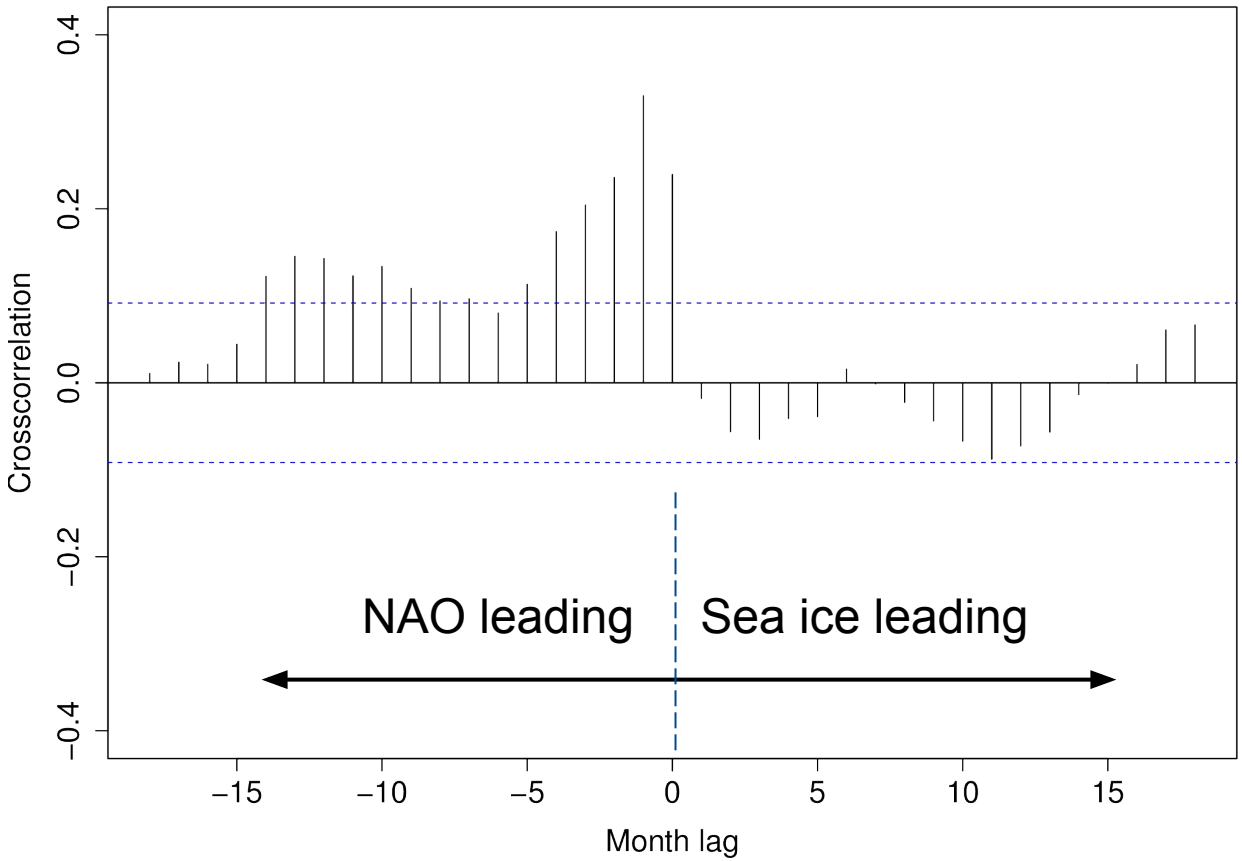
Crosscorrelation between North Atlantic Oscillation Index (NAOI) & First SIC mode

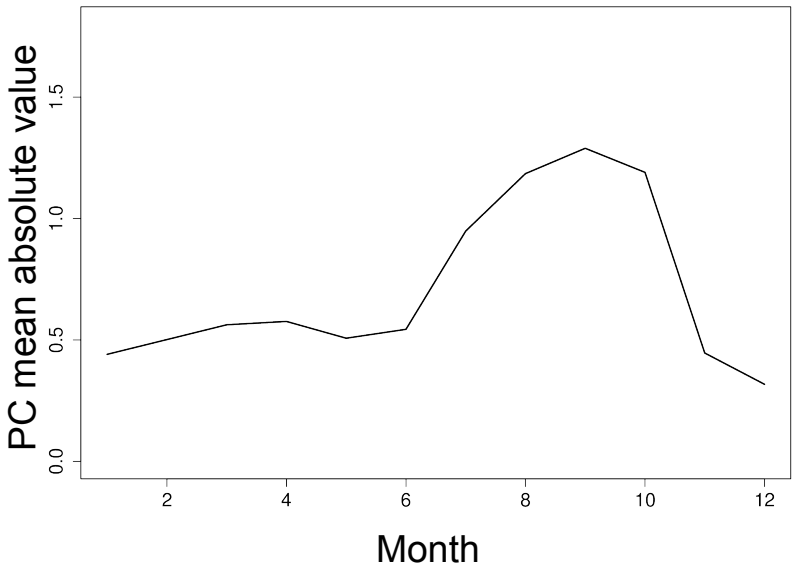


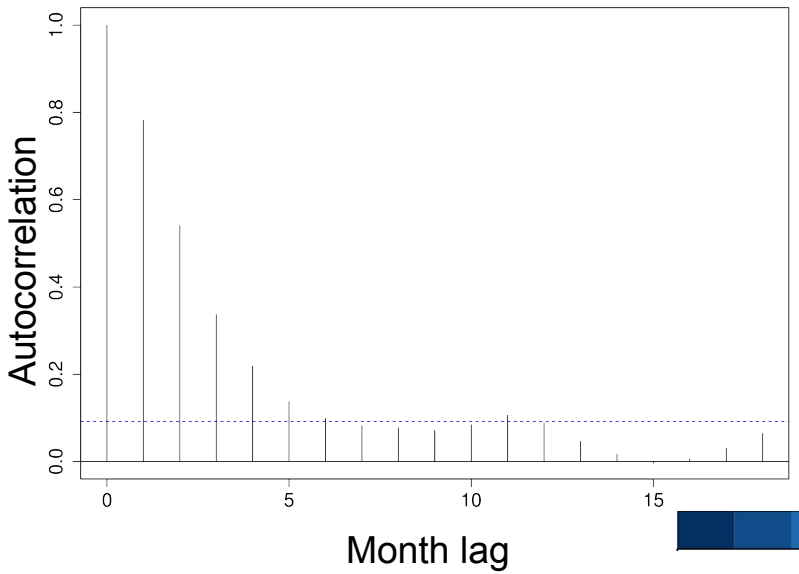
- NAOI **precedes** 1st PC of sea ice concentration.
- Maximum correlation (r = 0.33) with **one month** lag.

Summary of modes

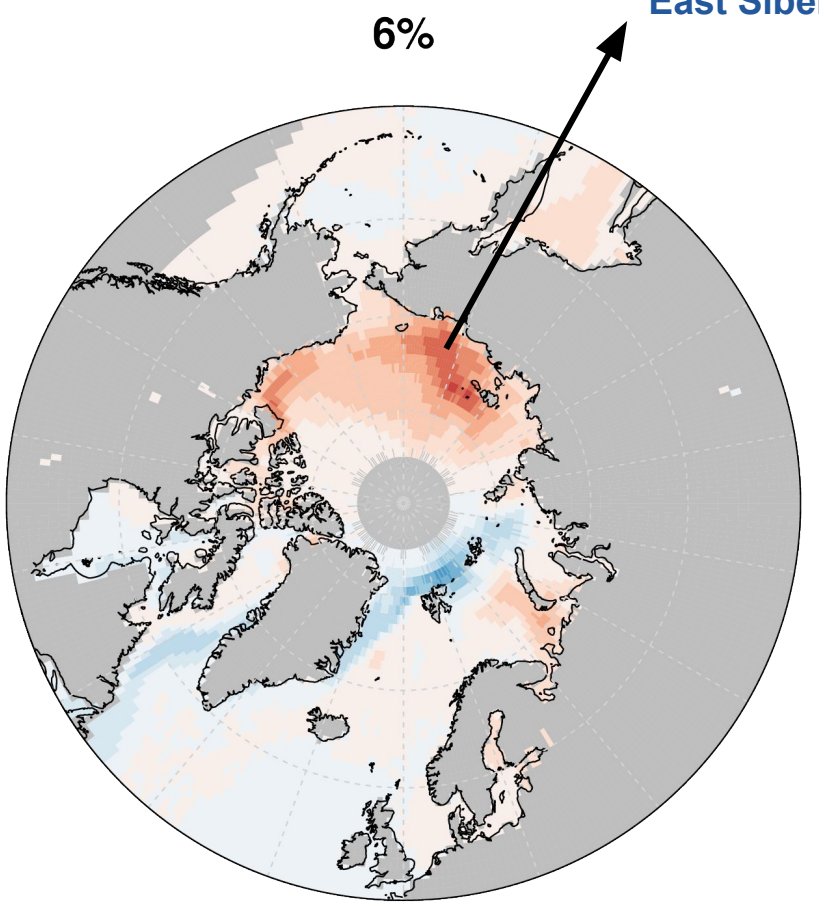
Mode (variance expla.)	|PC| max value
1 (9%)	Feb
2 (6%)	Sep
3 (5%)	Oct
4 (4%)	Sep
5 (4%)	Feb & Sep
6 (4%)	Feb
7 (3%)	Sep
8 (3%)	Feb
9 (3%)	Sep
10 (2%)	Dec
11 (2%)	Dec
12 (2%)	Jun

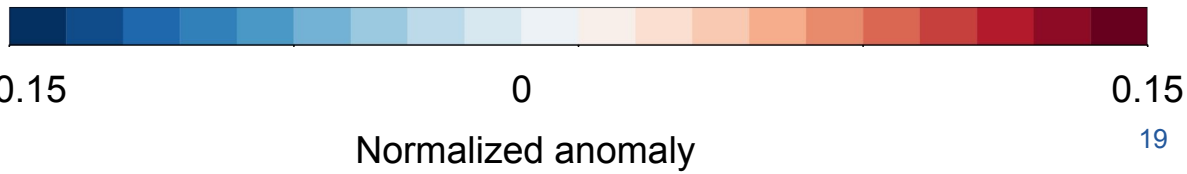
Results: Second mode



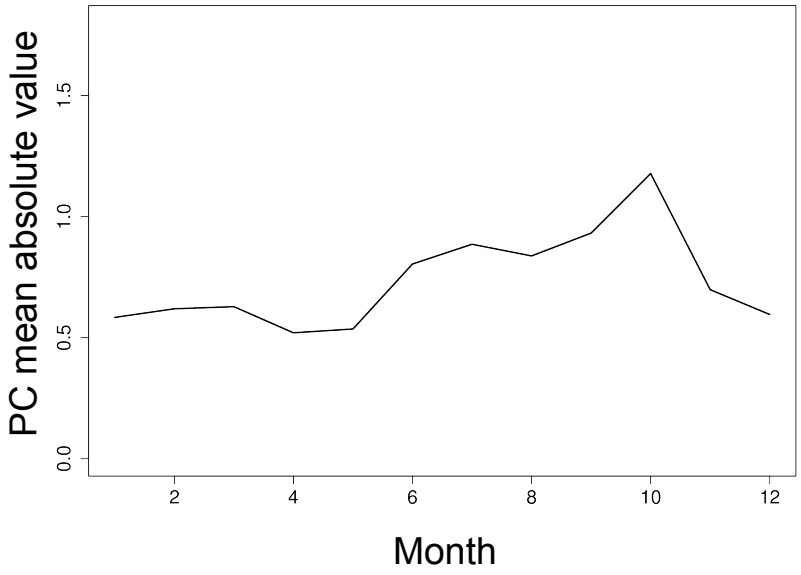


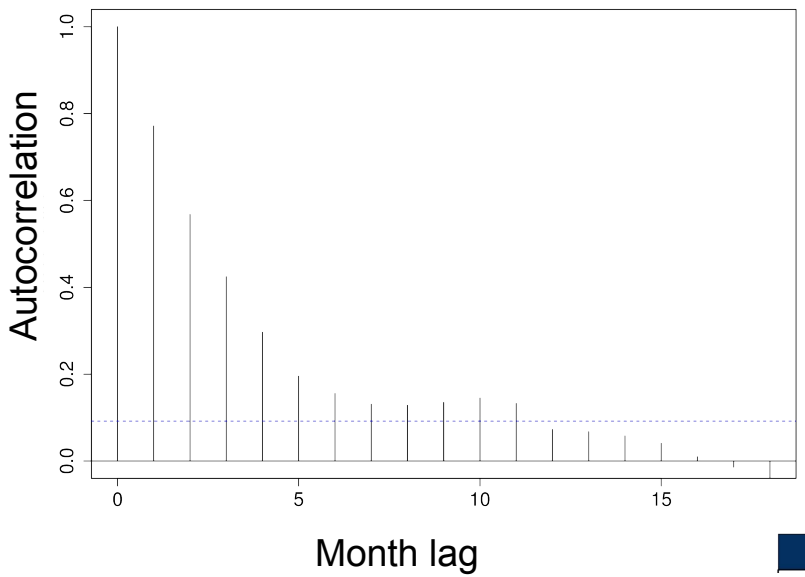
Main center of action: East Siberian Sea

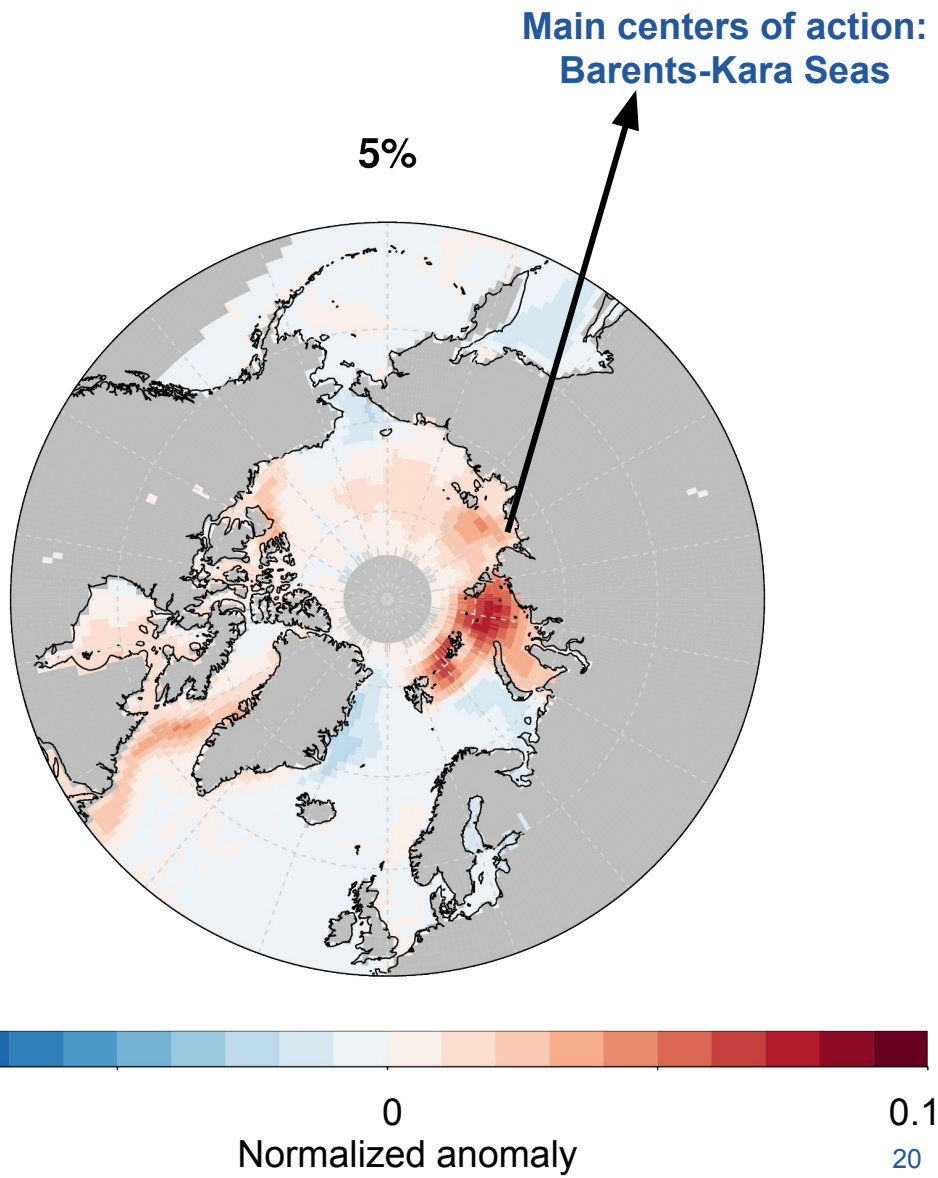




Results: Third mode







See e.g.: Yang and Yuan, 2014

Preliminary results

- **First EOF (mode)** explains **9%** of Arctic SIC **variability**, typical of **winter**, persistence loss after **5-6 months** with possible remergence in following winter & is often preceded by NAO.

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- **Second EOF (mode)** explains **6%** of Arctic SIC **variability**, typical of **summer**, persistence of **~5 months**.

- **Third EOF (mode)** explains **5%** of Arctic SIC **variability**, typical of late **summer early autumn**, persistence of **~6 months,** remergence in following summer(?).

Next steps to refine analysis

- **Normalizing** adequately the monthly **variance** to have **fair** EOF comparison.

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- Take into account the **autocorrelation** in time series.

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- Compare against other large scale climatic **indices**
  - Study other potential sources of predictability
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- Any other ideas?

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Thank you!

For further information please contact **jacosta@bsc.es**

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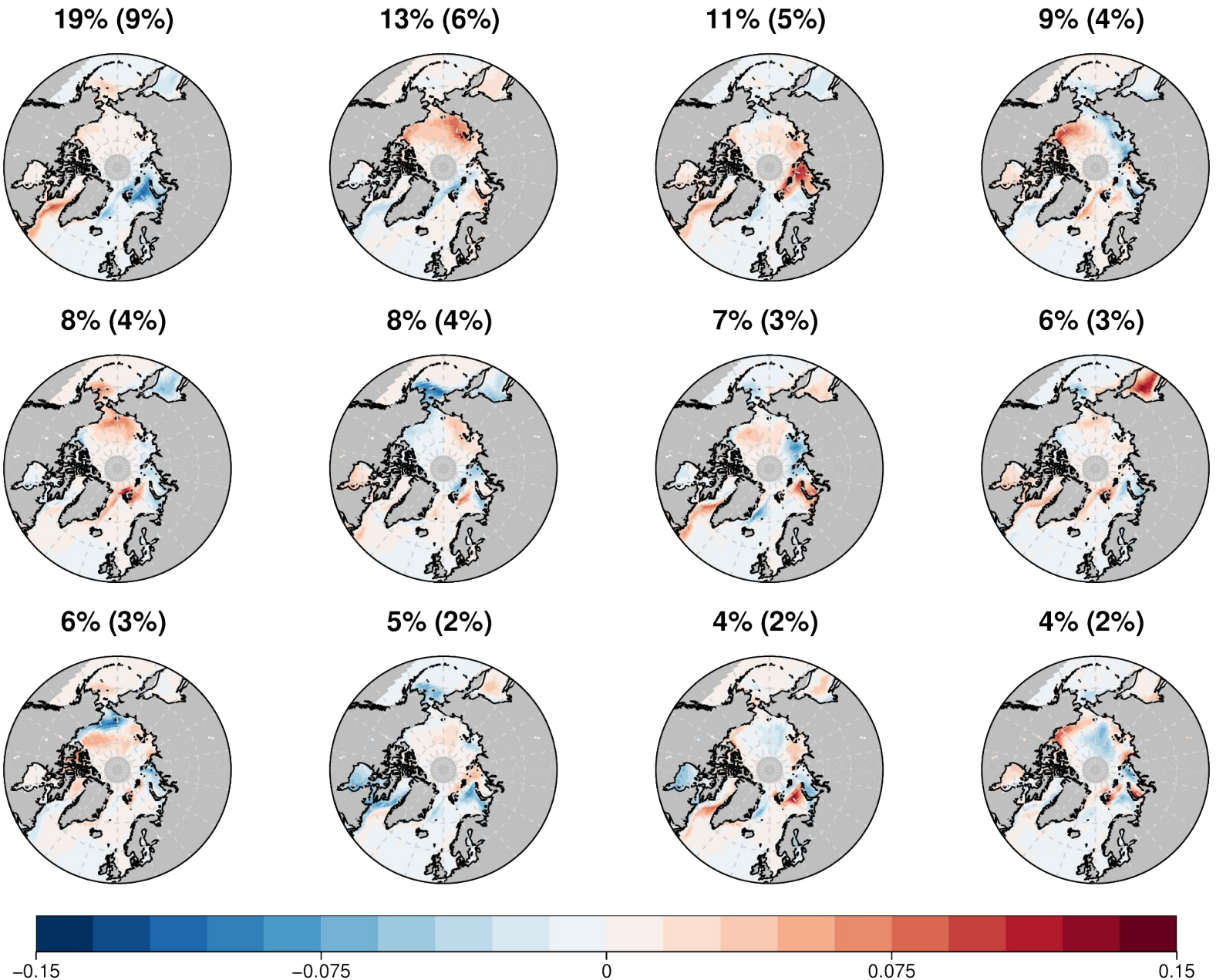
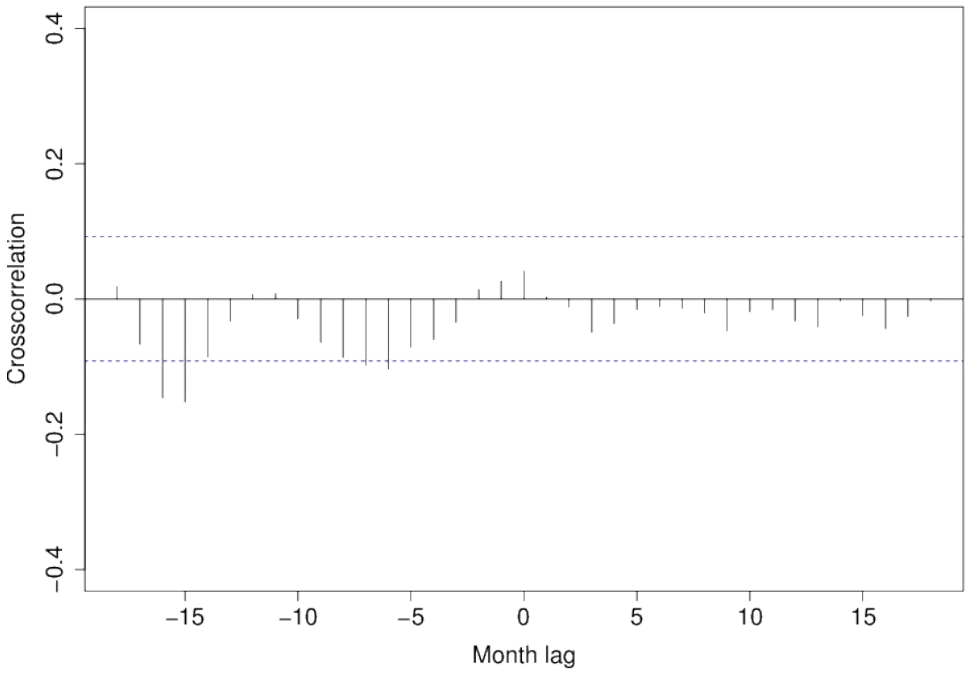
Extra slides

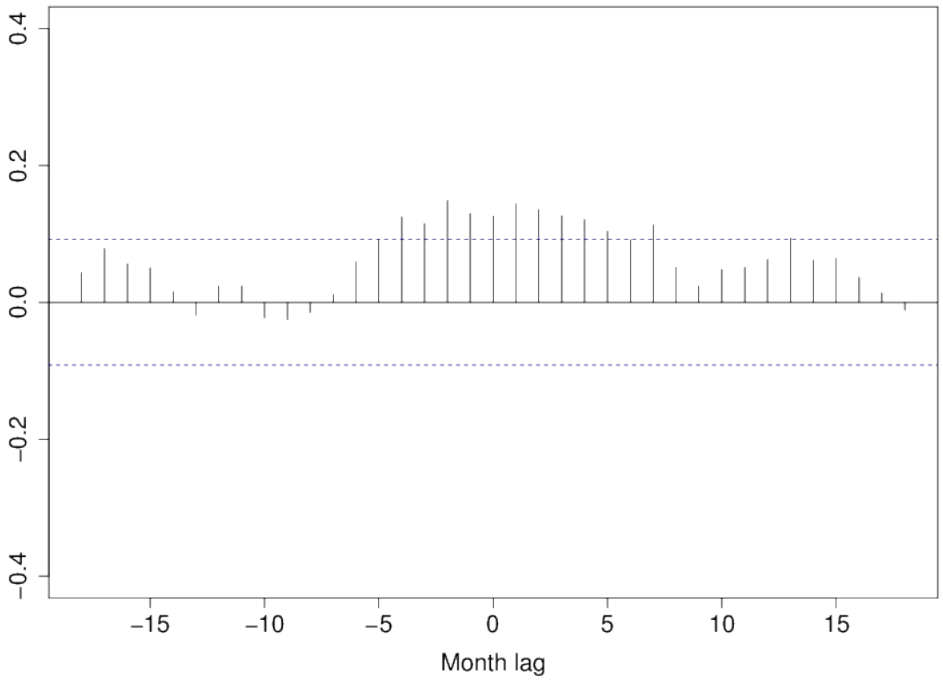


Extra slides

NAOI vs. PC2



NAOI vs. PC3



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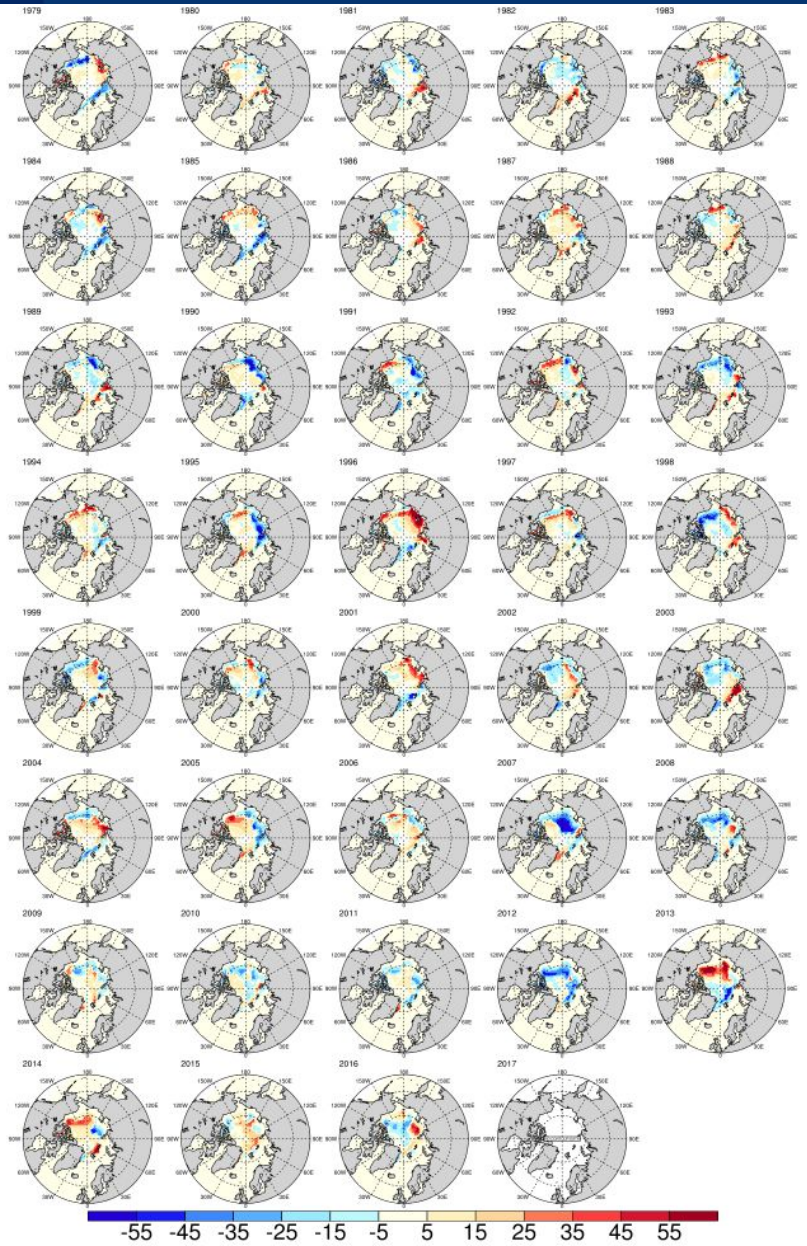

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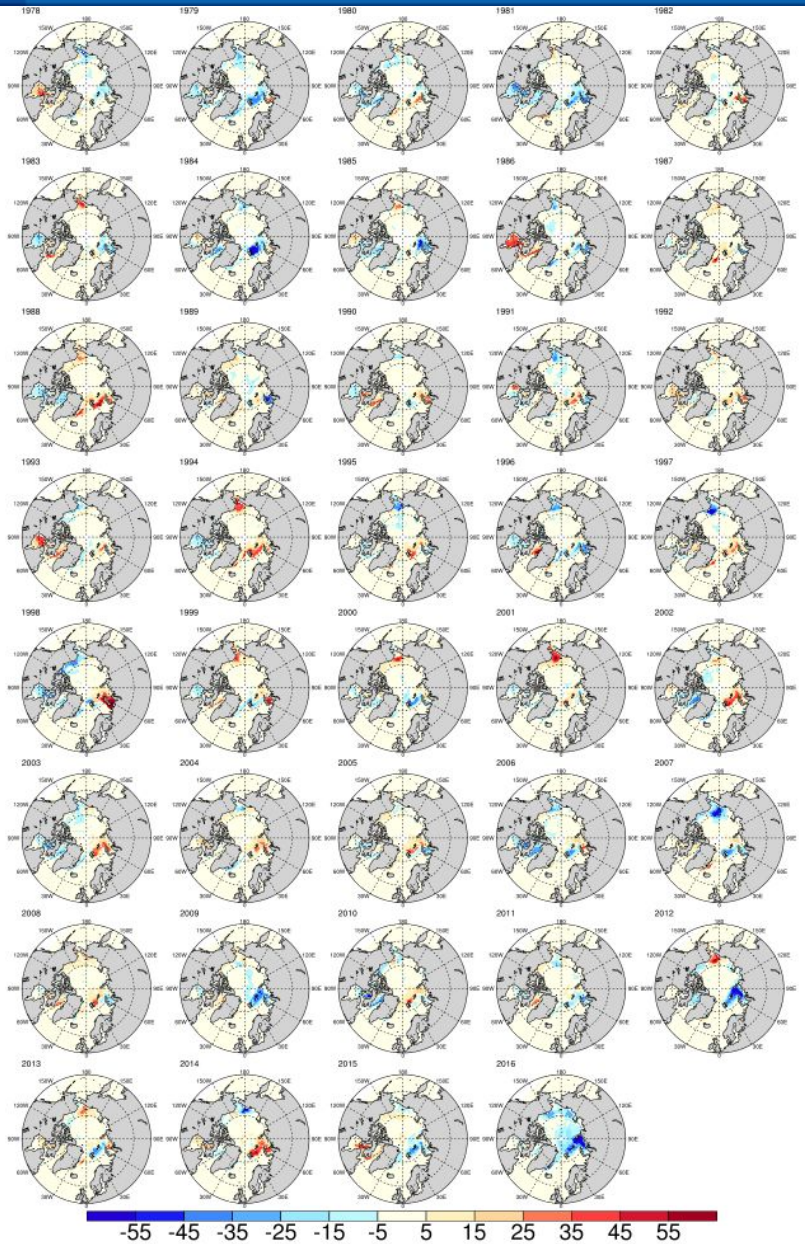

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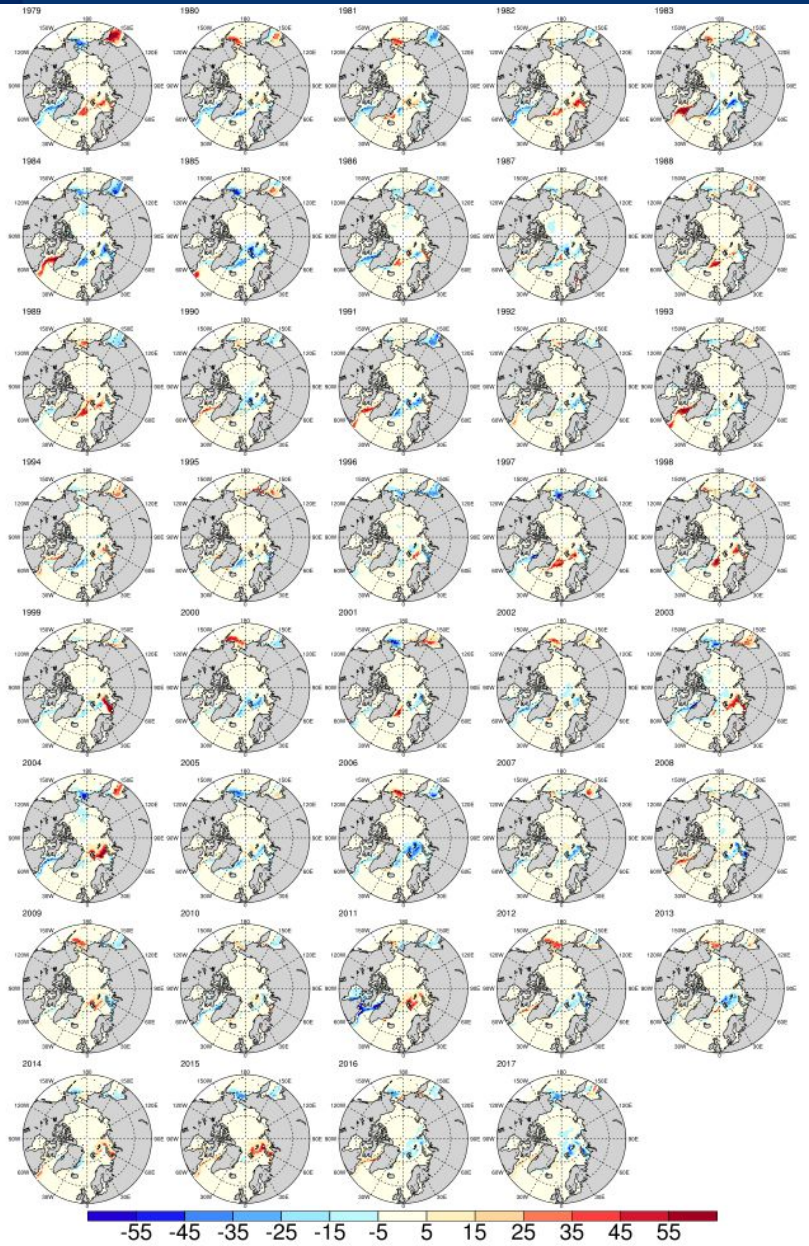


Methods

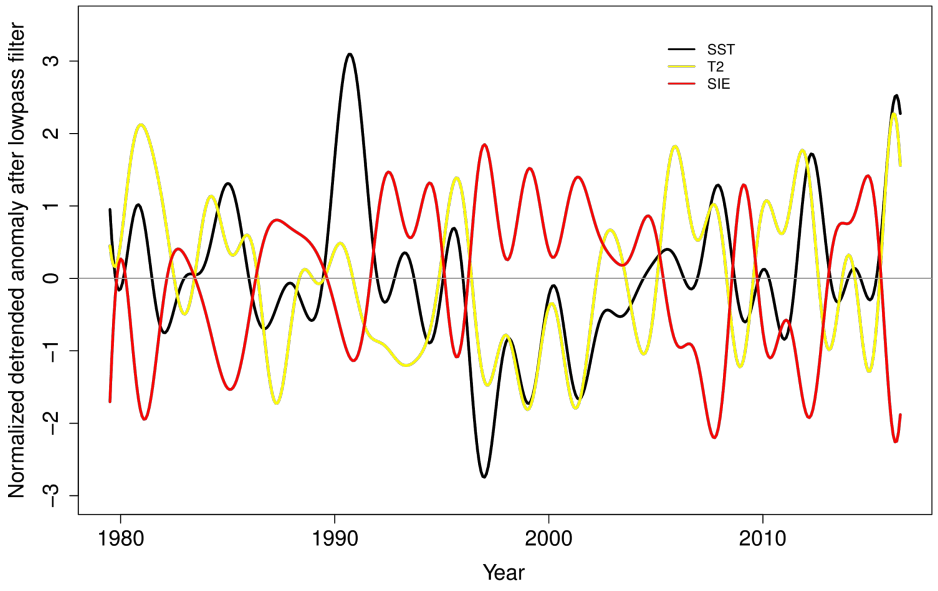
Advantages:

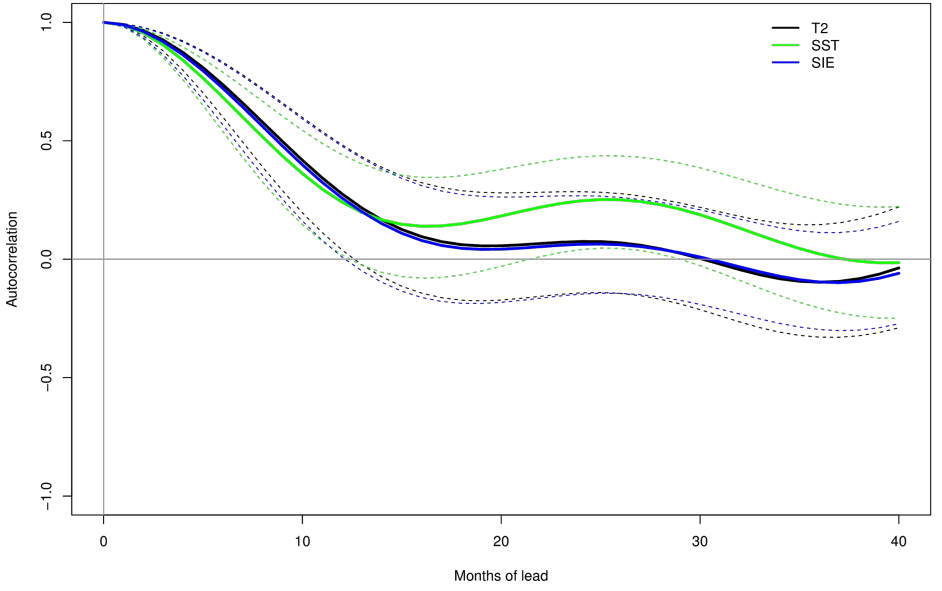
- Broad and general
- No a-priori assumptions made
-

Limitations:

-

Pan-Arctic SST (HadSST), T2m (ERA-Int) and SIE (NSIDC)





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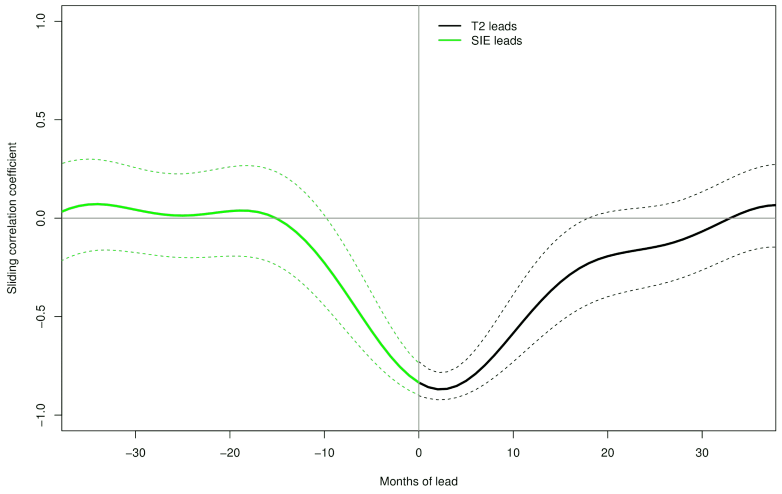
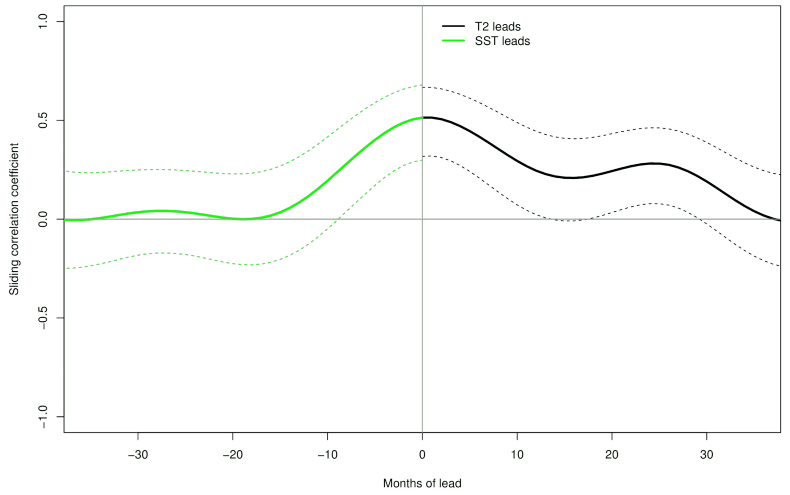
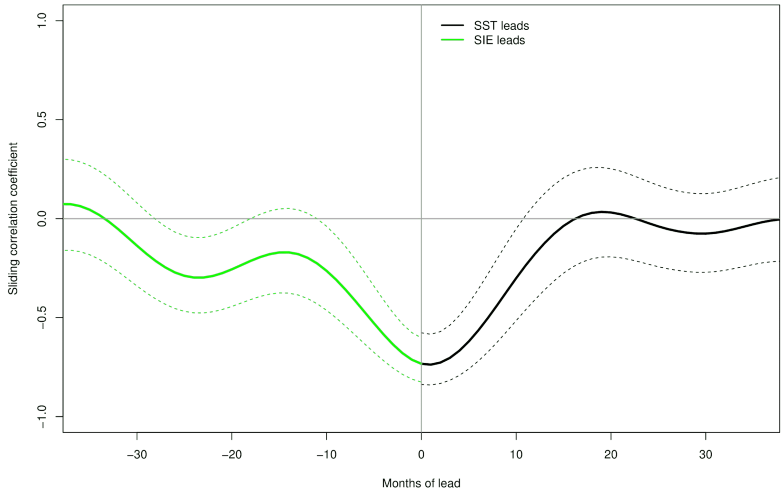
- Linearly detrended after low-pass filter.

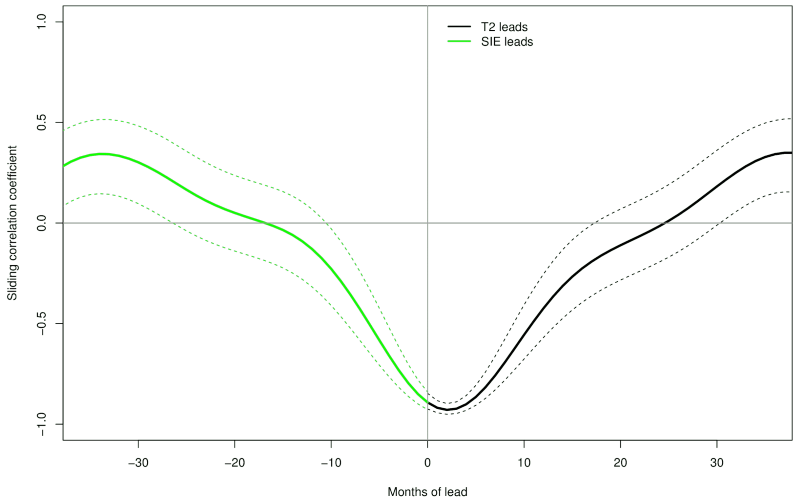
Lag-lead series (NH)

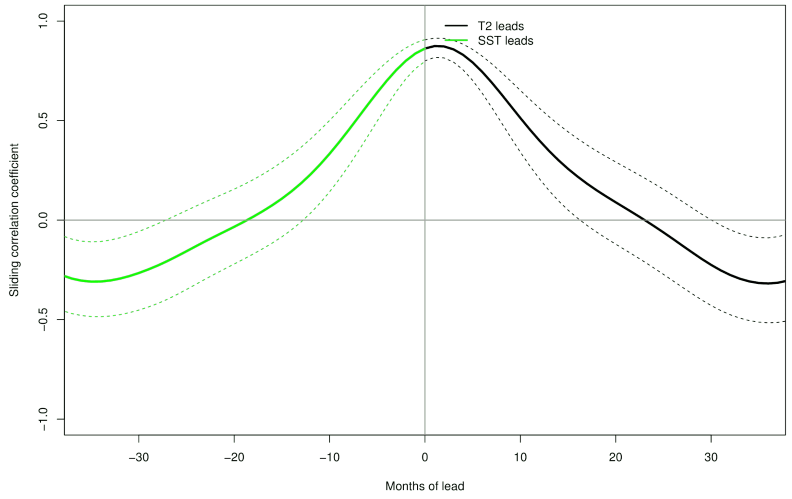


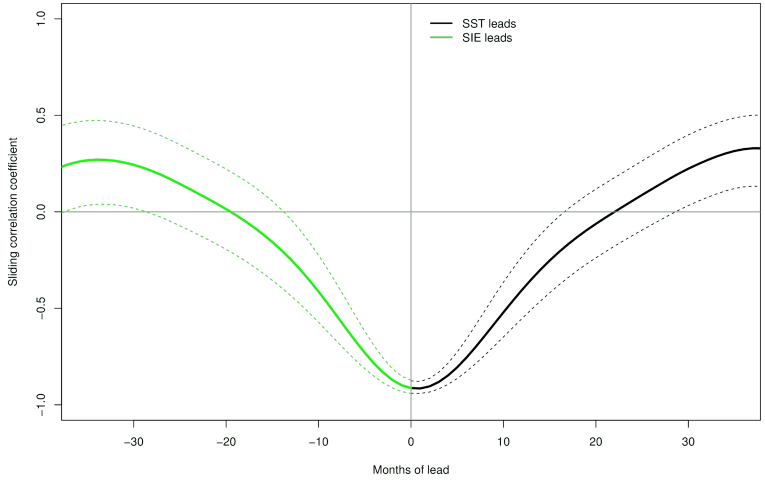




Lag-lead series (Barents & Kara seas)







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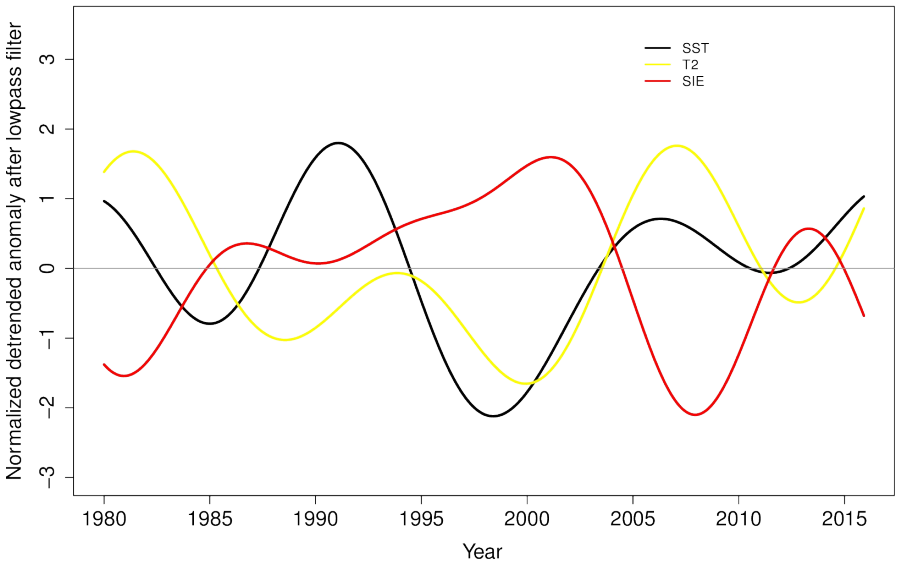

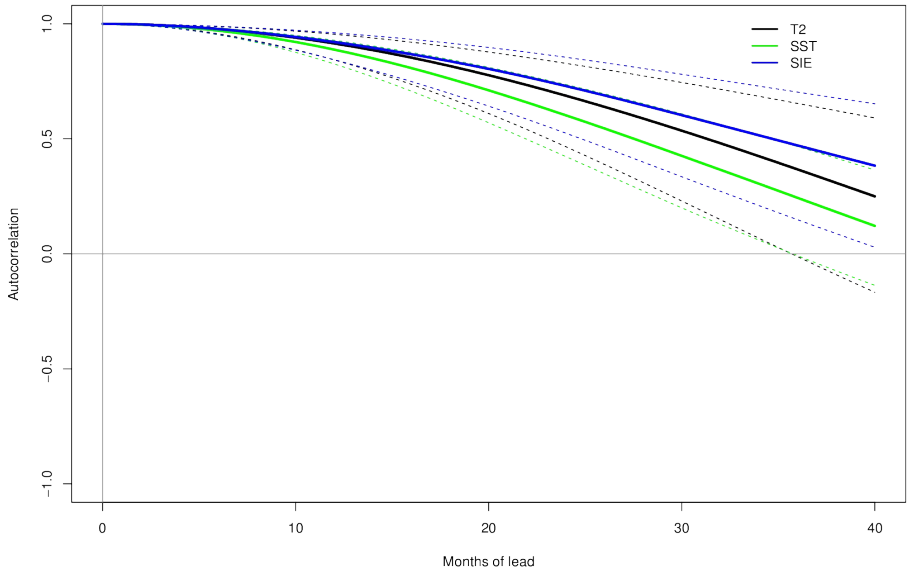

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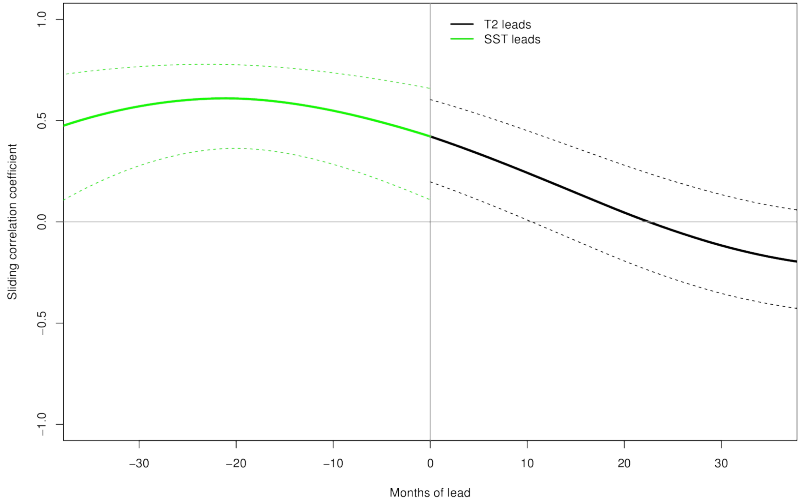
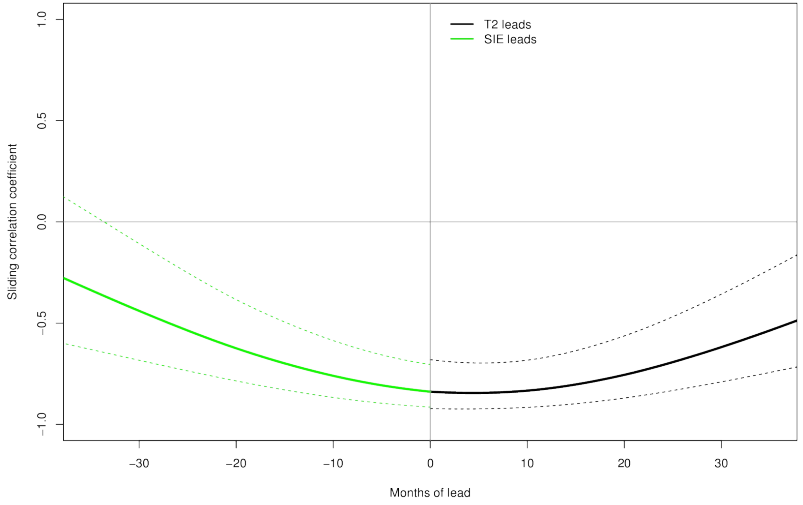
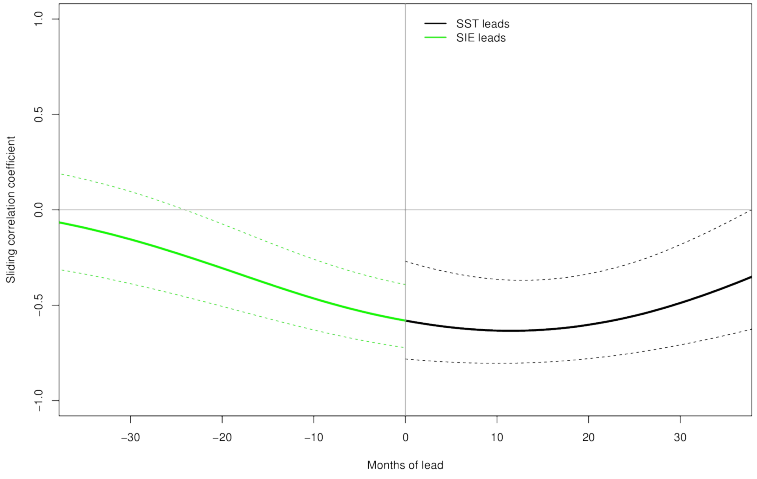






47% – 1.6 years

37% – 1.6 years

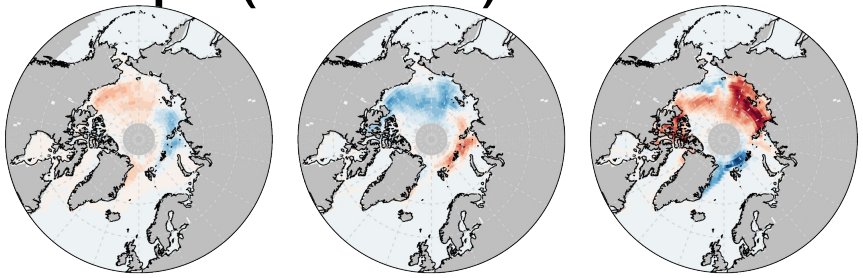
16% – 1 years

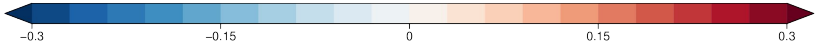
43% (17%)

32% (13%)

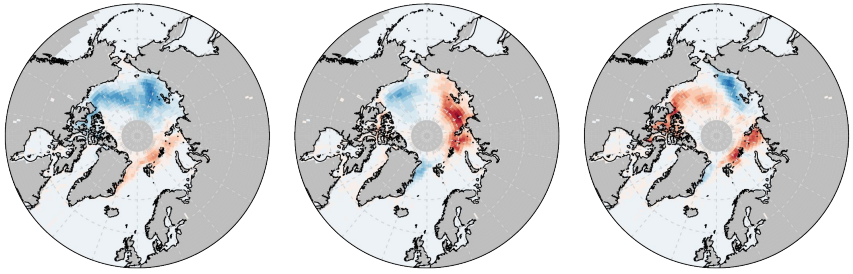
25% (10%)

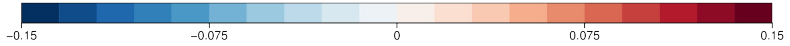
Sept (cluster)

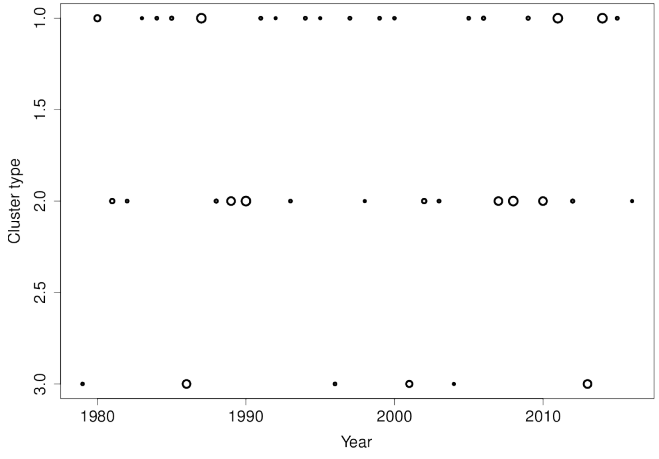


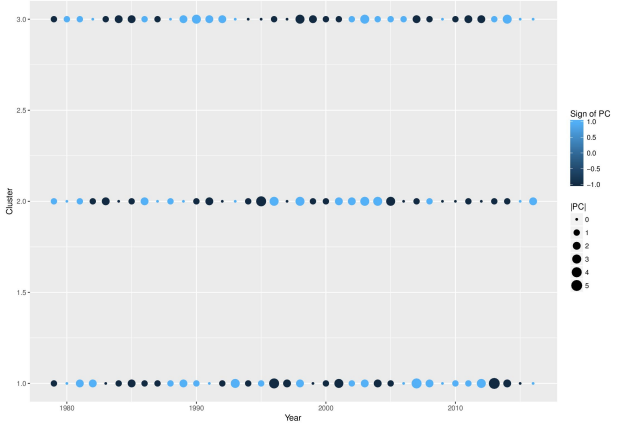


Sept (PC)









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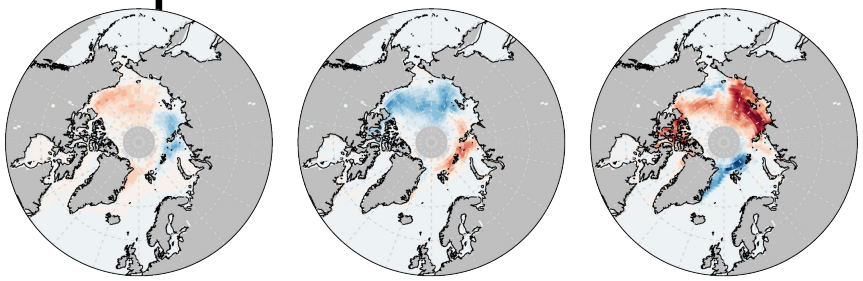
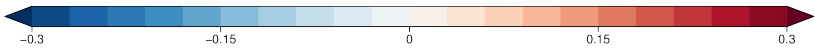
39% – 1.5 years

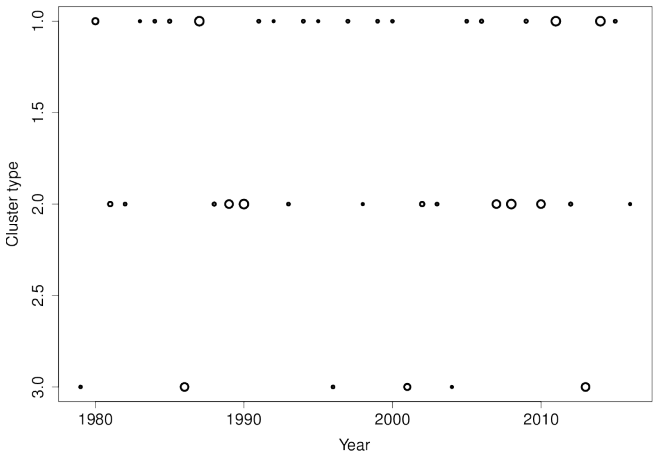
37% – 1.8 years

24% – 1.1 years

Sept







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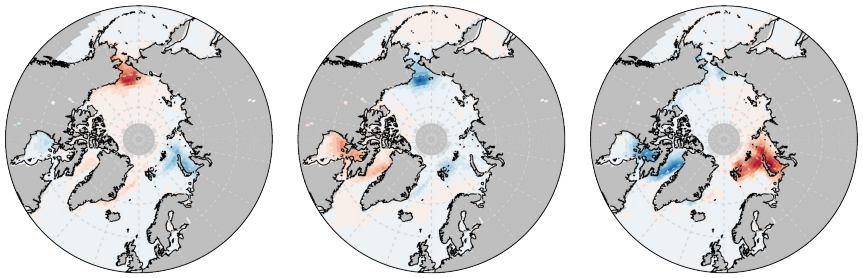
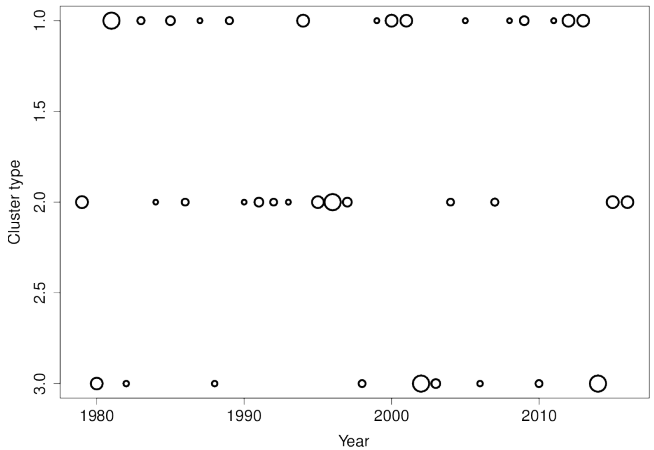




39% – 1.5 years

37% – 1.8 years

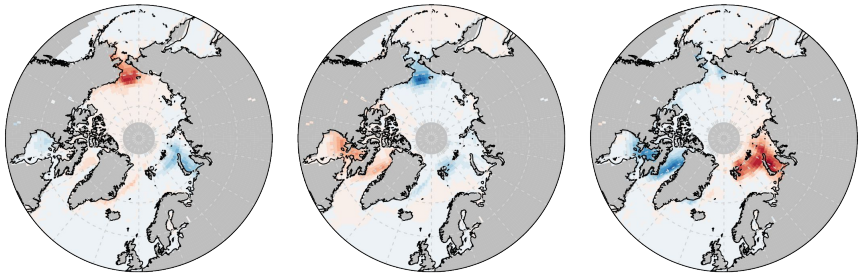
24% – 1.1 years

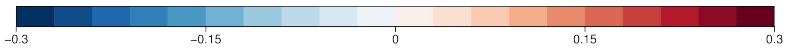
39% – 1.9 years

37% – 1.6 years

24% – 1.5 years

Nov





Jan