

An assessment of regional sea ice predictability in the Arctic Ocean

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Polar Prediction Workshop

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**Barcelona
Supercomputing
Center**

Centro Nacional de Supercomputación

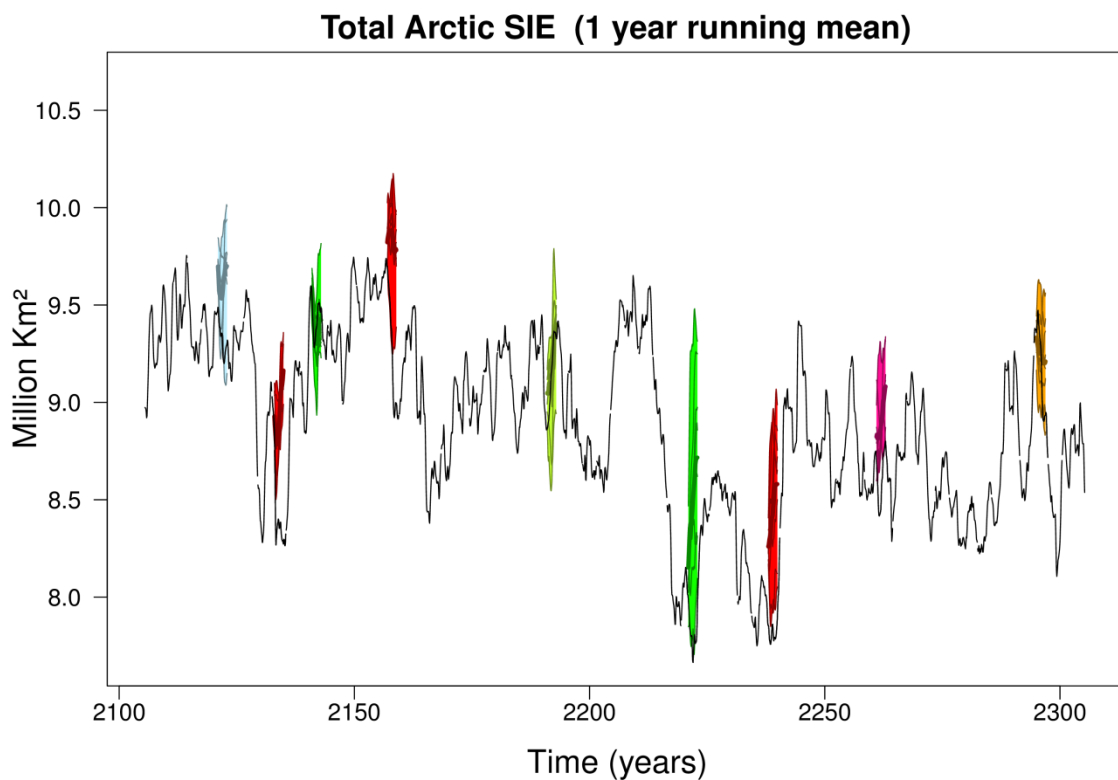
- **Potential predictability of Arctic sea ice assessed in EC-Earth.**
- **Pan-Arctic sea ice predictability.**
- **Sources of regional Arctic sea ice predictability.**

Motivation

- Potential predictability of sea ice in Arctic sub-basins.
- Can the regional perspective explain the pan-Arctic picture?

Methodology

Perfect model approach → EC-Earth 2.3 (IFS T159L62 ~125 km, NEMO~LIM2, ~1°)



- **ControlRun:** 200-year long control experiment (1 member; 2005 forcing).
- **IdealPred:** 3-year long idealized predictions initialized from *ControlRun* (8 members; 9 start dates from July 1st).

APPOSITE Protocol → [Day et al. \(2015, GMD\)](#)

Methodology

Diagnostics

- ***Prognostic Potential Predictability (PPP) of IdealPred:***

PPP = 1, perfectly predictable.

- ***Lagged ControlRun properties.***

Methodology

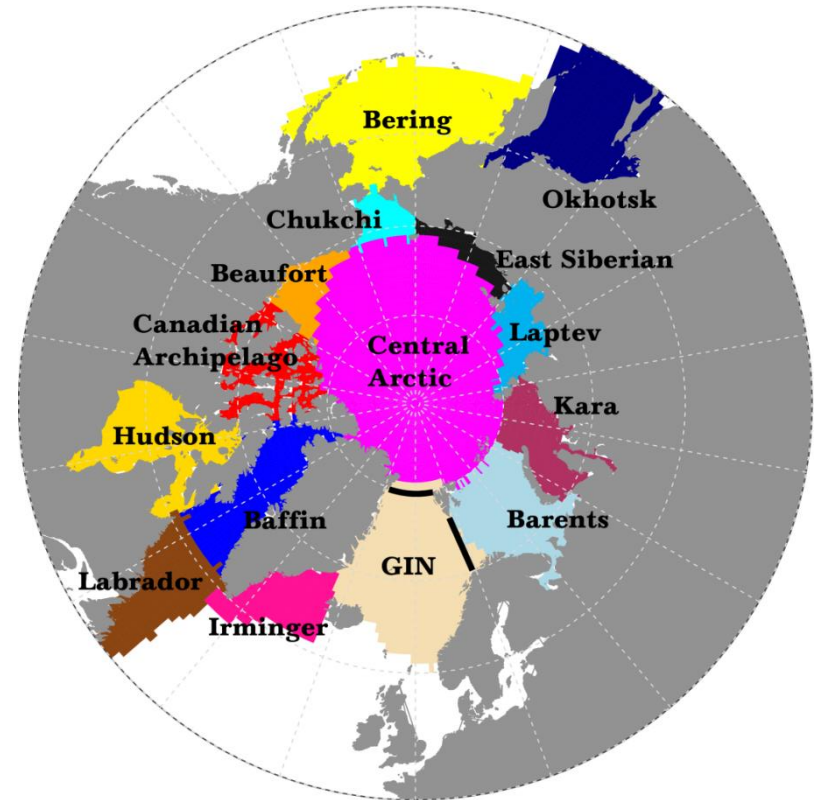
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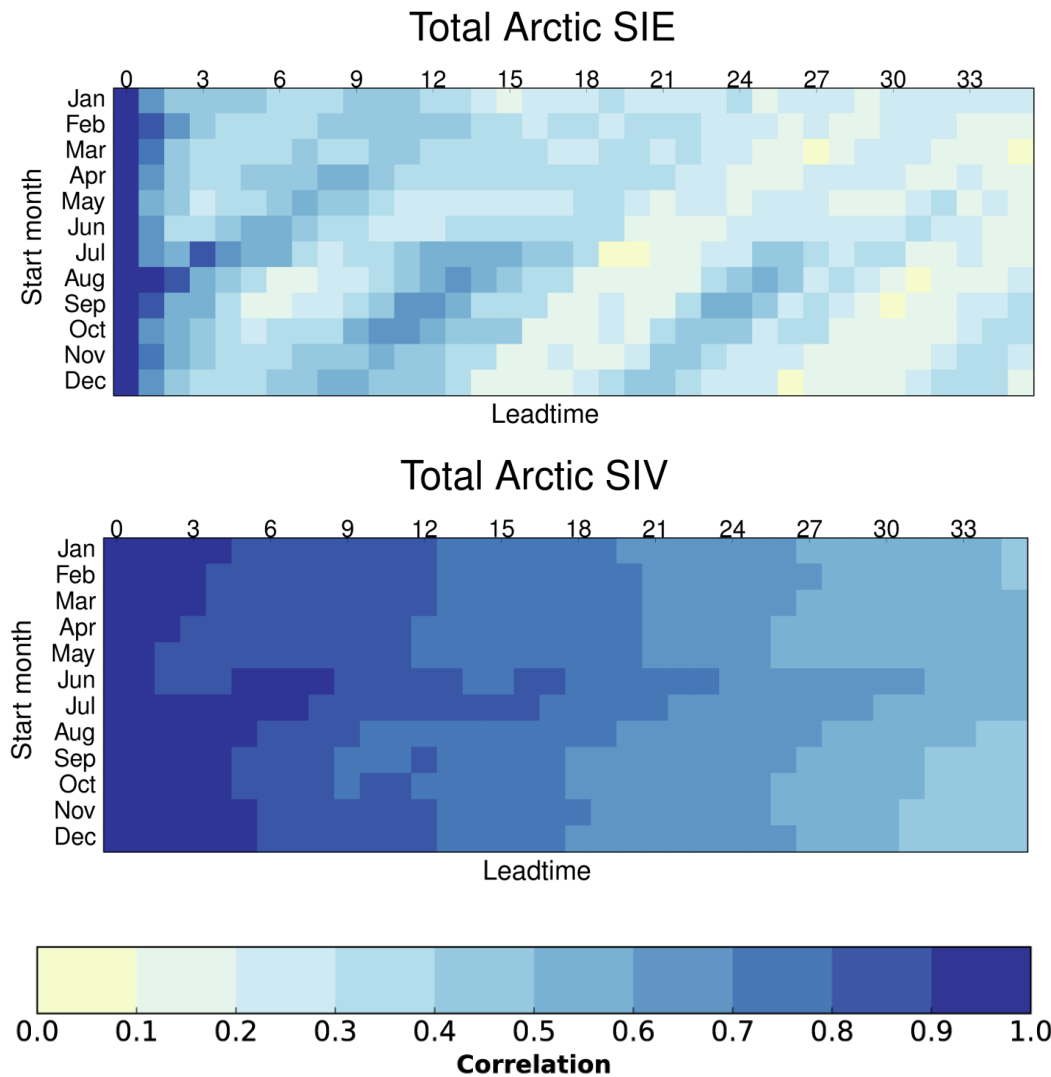
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Regions



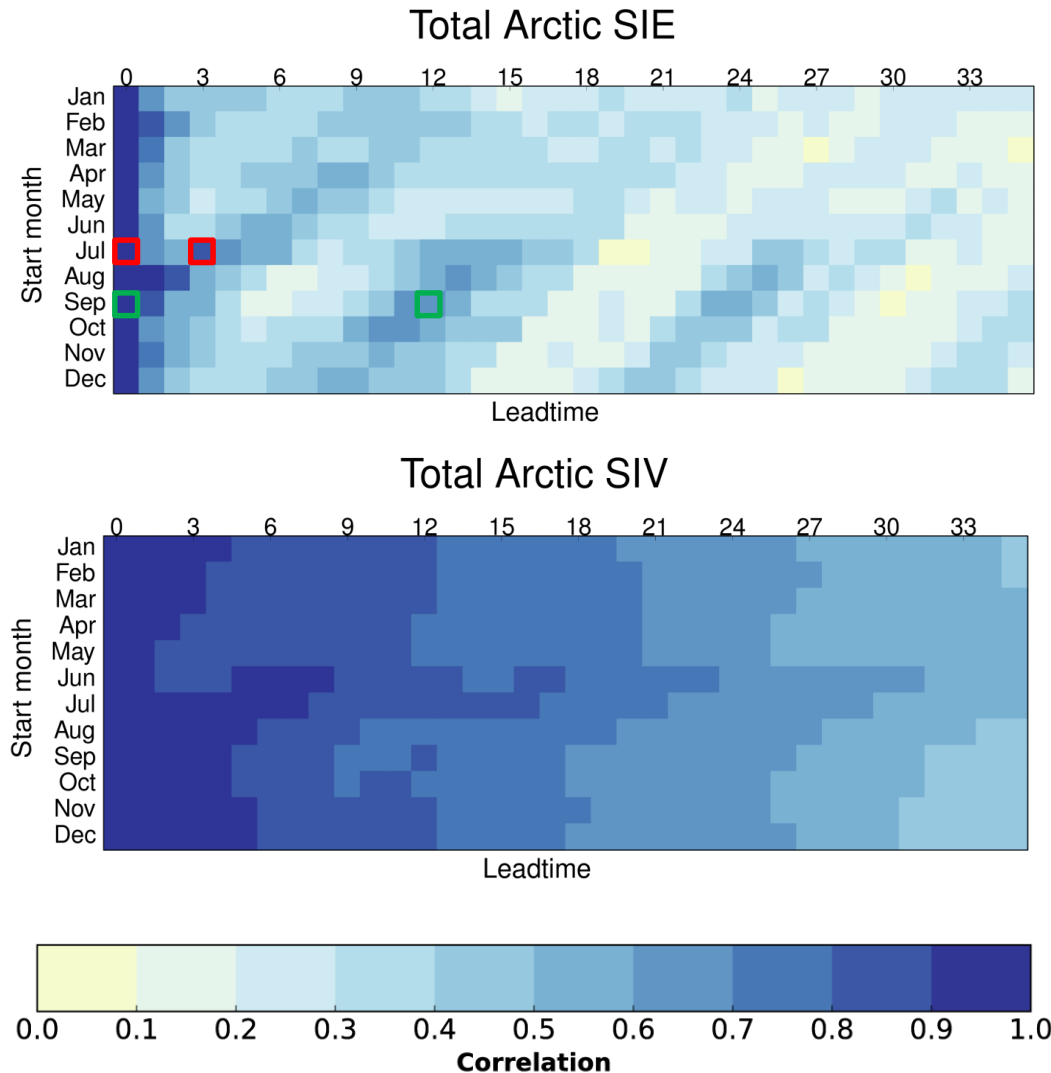
Pan-Arctic: lagged correlations in *ControlRun*



Pan-Arctic: lagged correlations in *ControlRun*

Melt-to-freeze

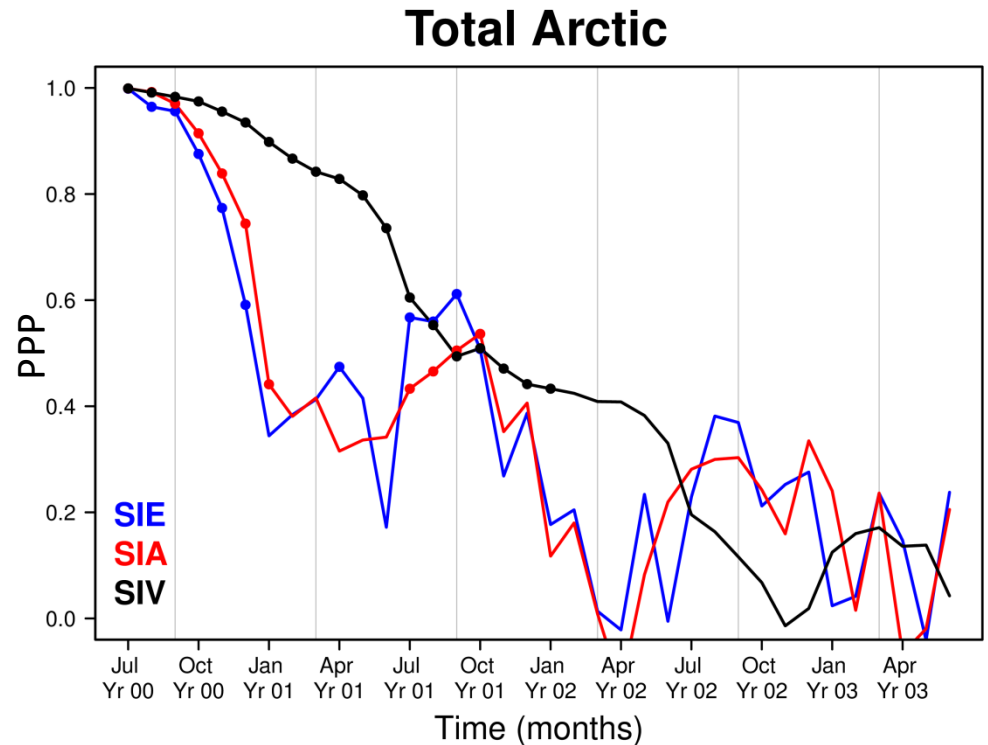
Summer-to-summer



Re-emergence mechanisms: consistent with previous studies (Blanchard-Wrigglesworth et al. (2011, AMS); Day et al. (2015, AMS))

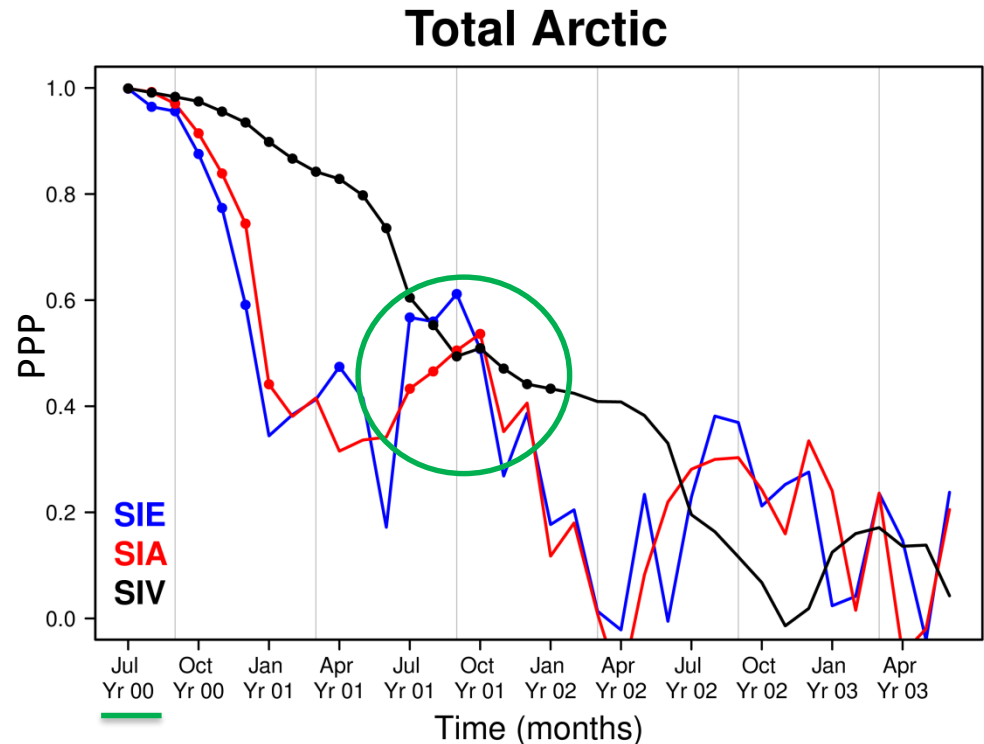
Pan-Arctic: PPP in *IdealPred*

- **Summer-to-summer:** In the PPP and in the lagged correlations.
- **Long SIV persistence** both in the prognostic and the diagnostic estimates.



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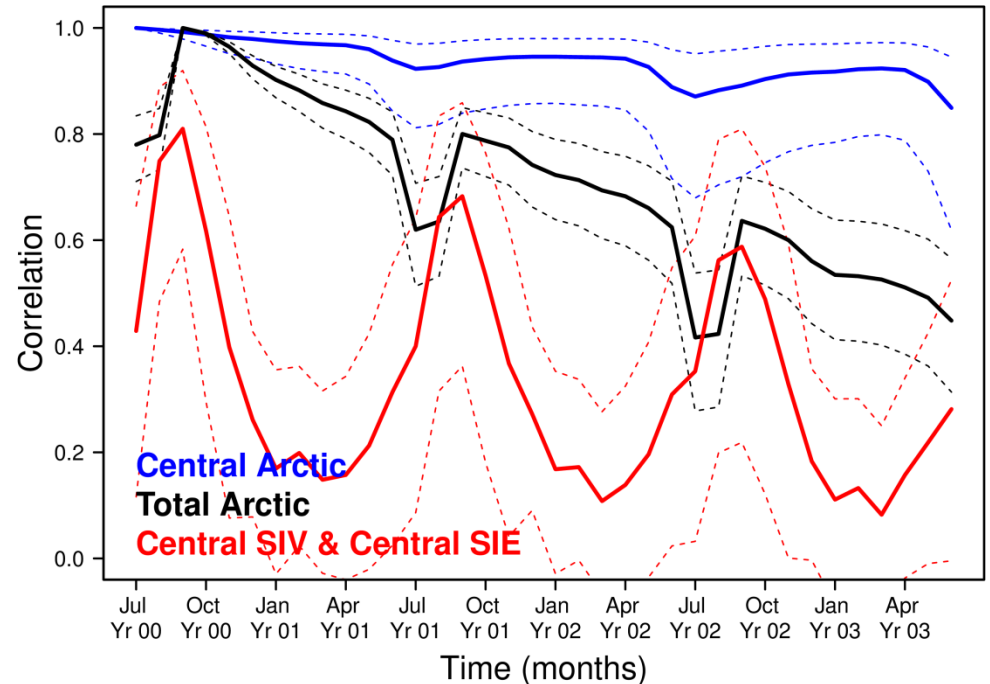


Pan-Arctic: PPP in *IdealPred*

- *Pan-Arctic SIV persistence arises almost entirely from the central Arctic SIV persistence.*

***How can we explain
September re-emergence in
IdealPred?***

- *Summer-to-summer SIE re-emergence →
Summer SIT memory.*



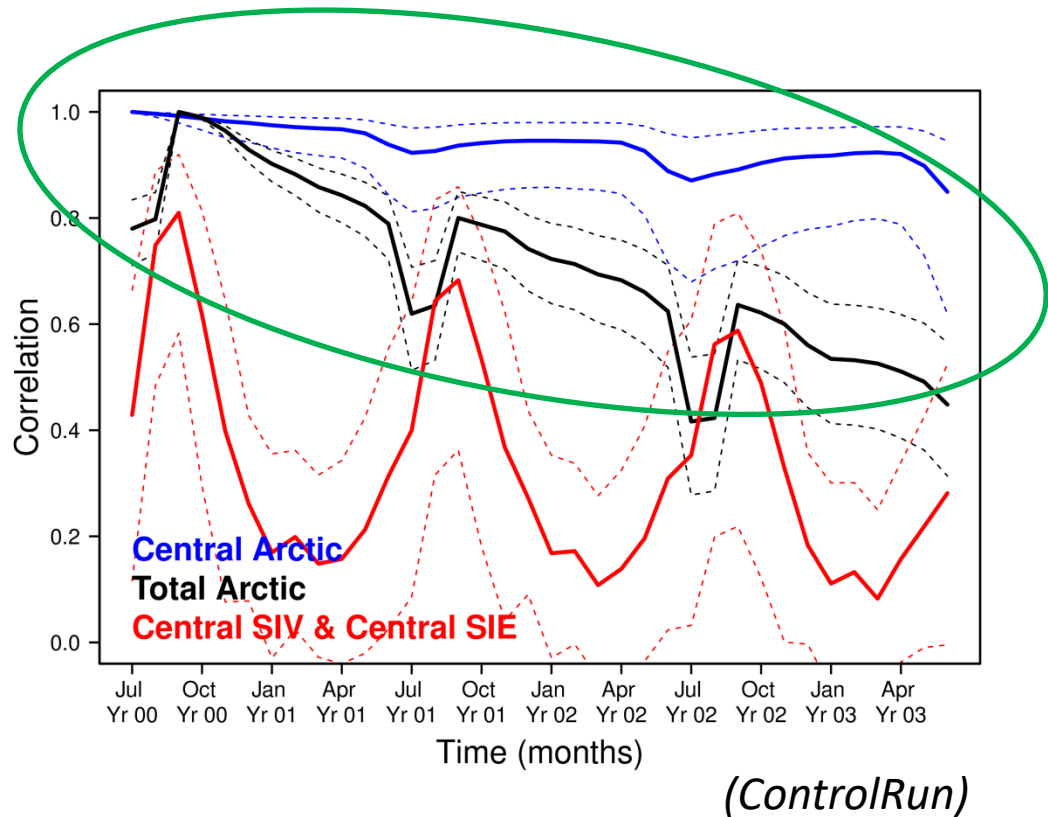
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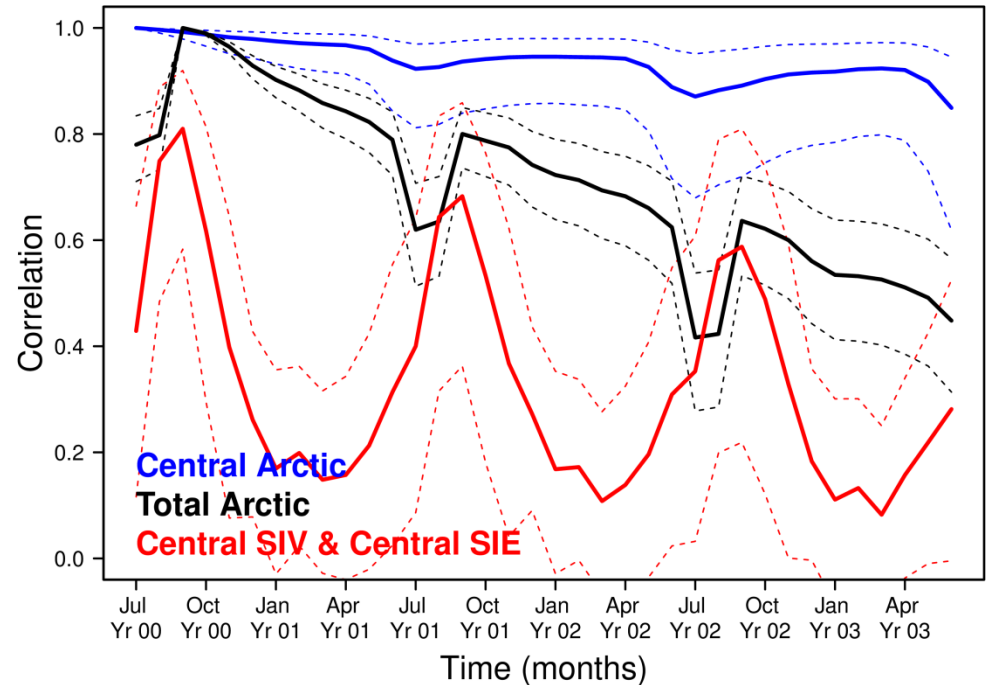


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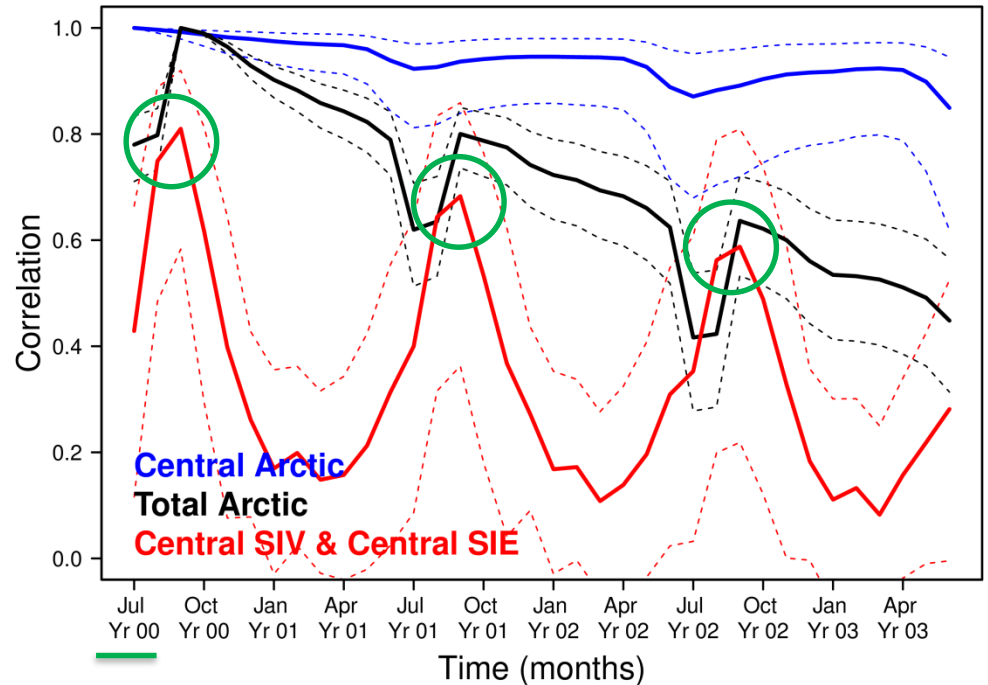
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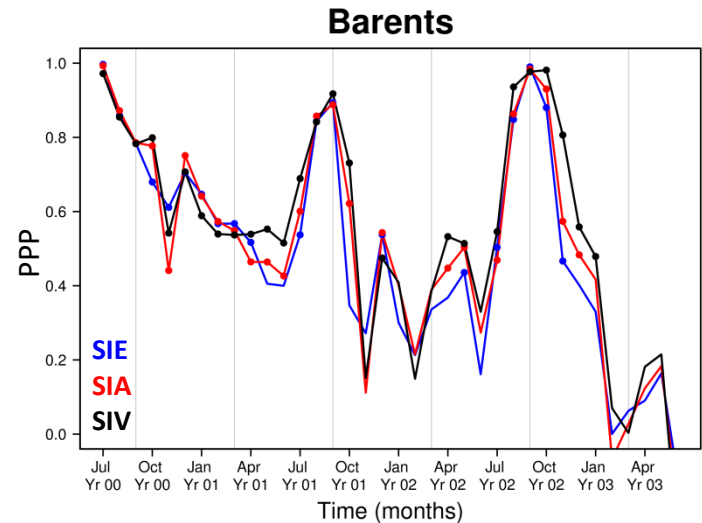
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Regional Arctic sea ice

- *Based on PPP in IdealPred, Arctic basins are classified in 3 types:*

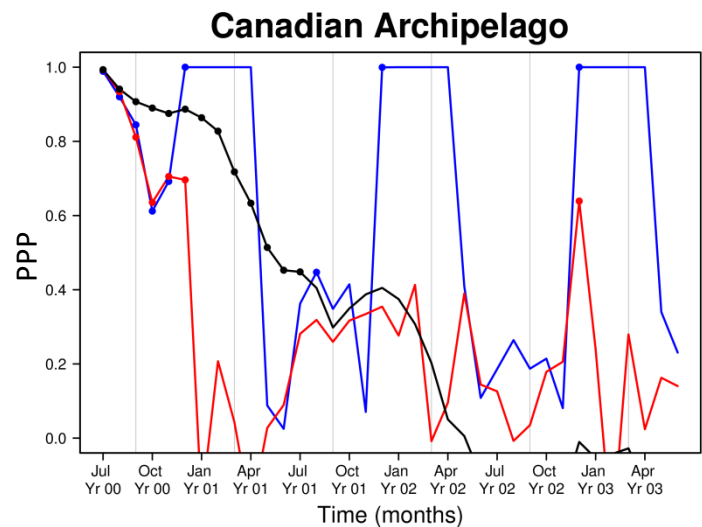
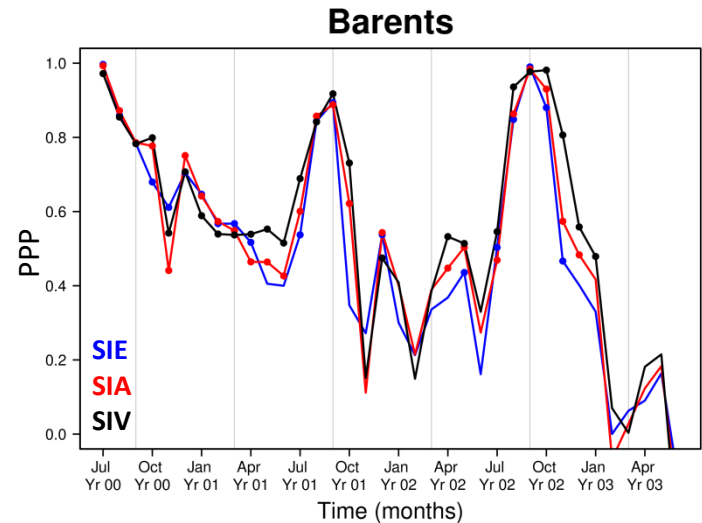
Regional Arctic sea ice

- *Based on PPP in IdealPred, Arctic basins are classified in 3 types:*
 - › ***Peripheral seas***



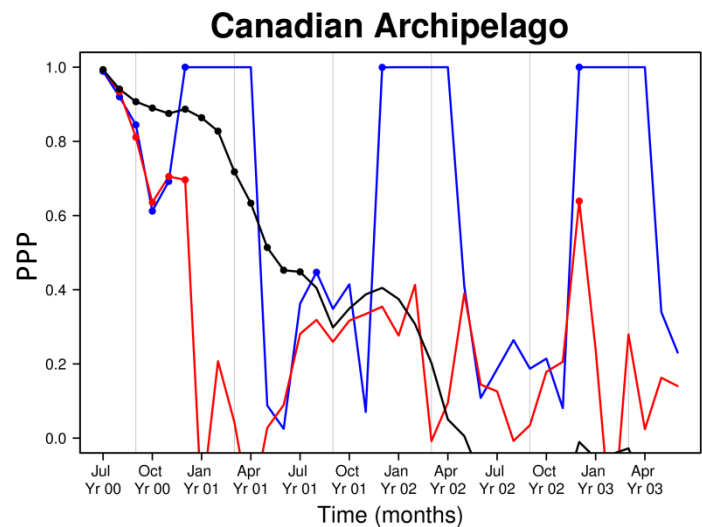
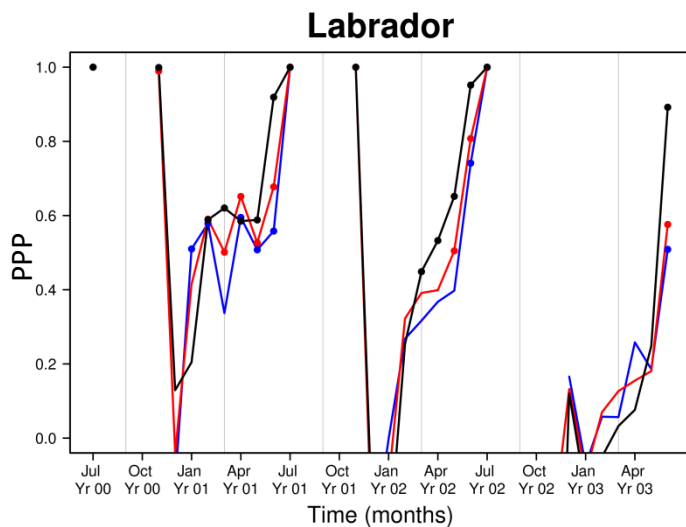
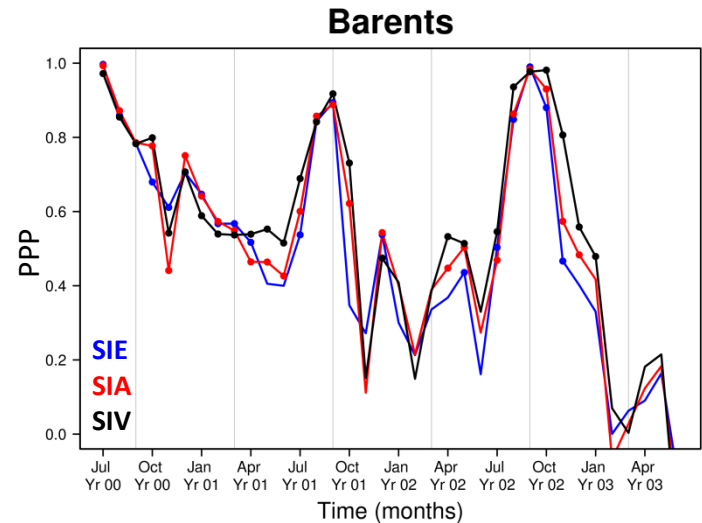
Regional Arctic sea ice

- Based on PPP in IdealPred, Arctic basins are classified in 3 types:
 - › **Peripheral seas**
 - › **Central regions**

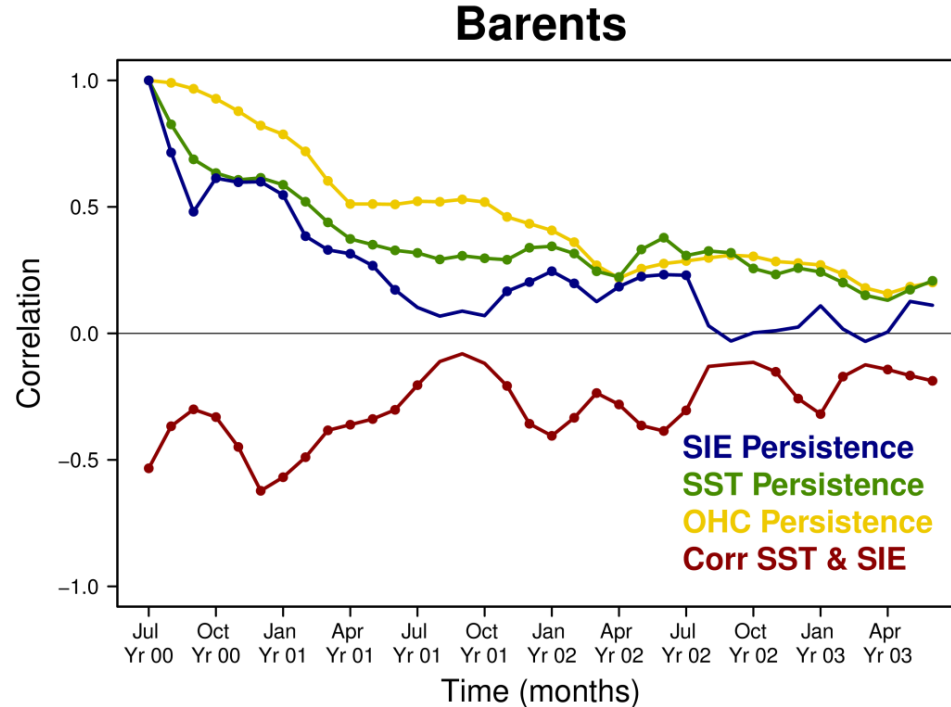


Regional Arctic sea ice

- Based on PPP in IdealPred, Arctic basins are classified in 3 types:
 - › **Peripheral seas**
 - › **Central regions**
 - › **Labrador Sea**



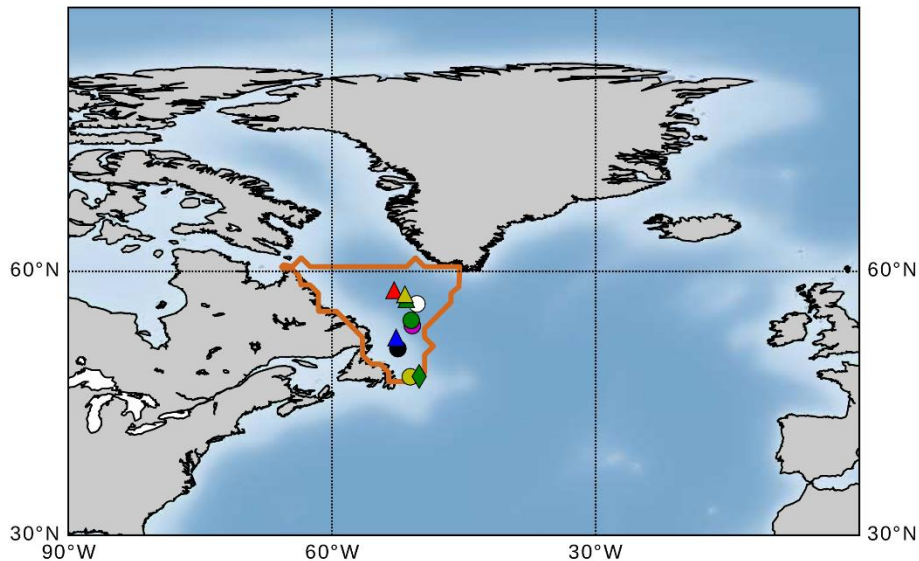
Ocean persistence in the Barents Sea



- Persistence of *-ControlRun-* summer ocean anomalies appears to be a source of SIE predictability.

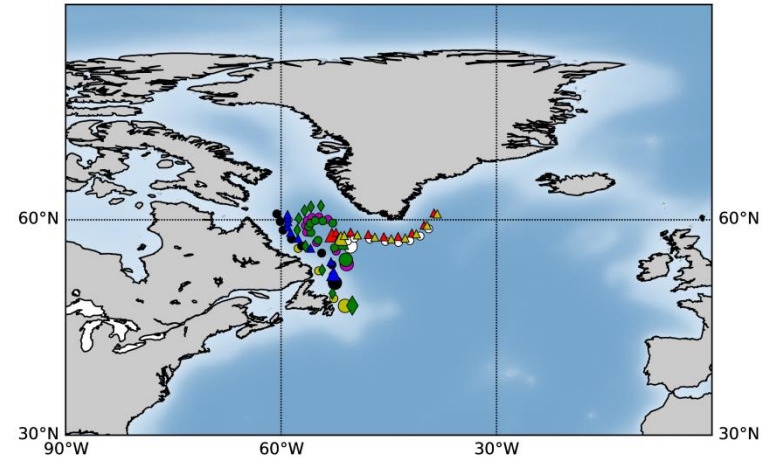
Ocean re-emergence in the Labrador Sea

- Lack of ice in July prevents to attribute the re-emergence peak of winter to sea ice re-emergence.



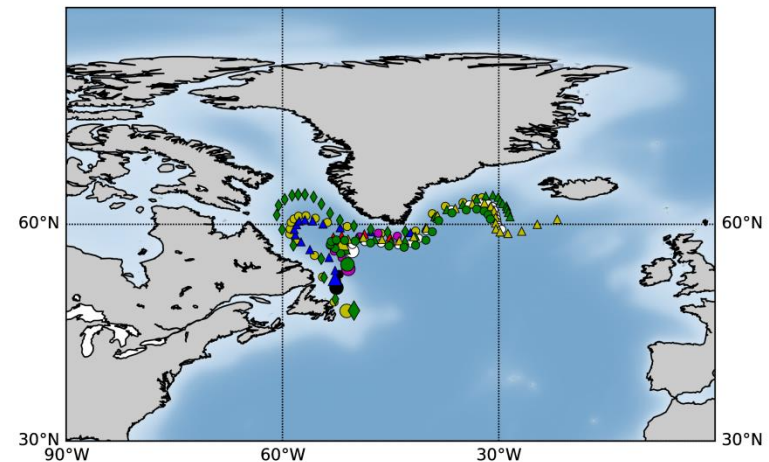
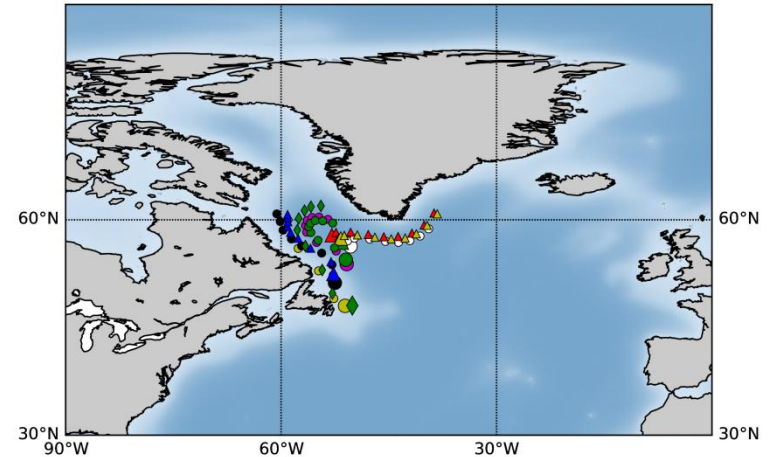
Ocean re-emergence in the Labrador Sea

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- Backward water mass trajectories to find where they were the first July:
 - 8 months before (Feb yr 1)



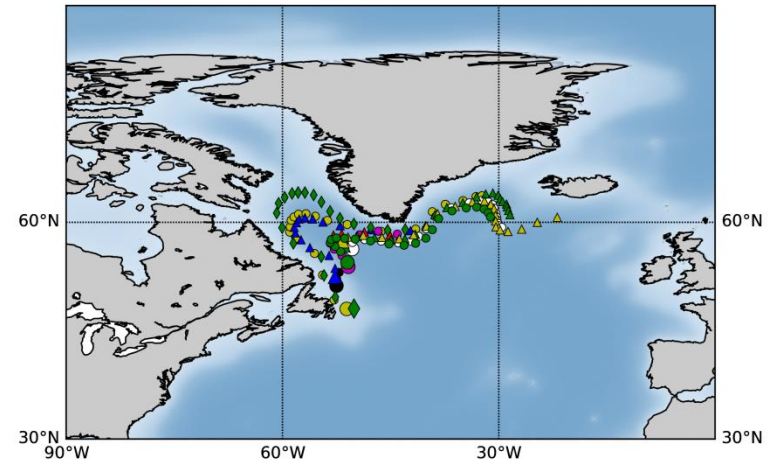
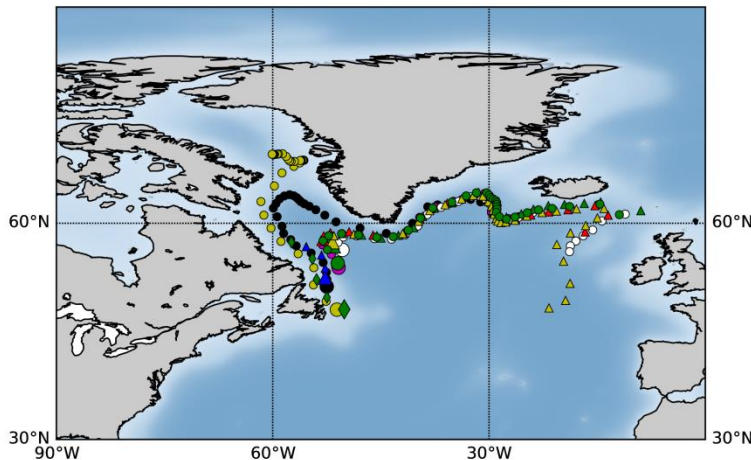
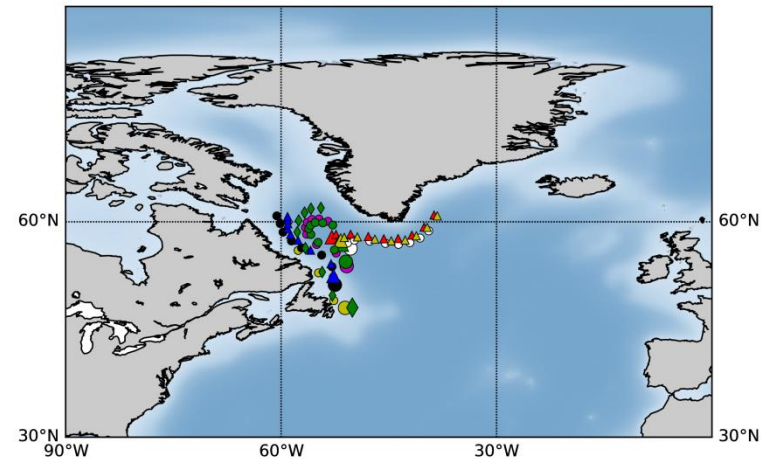
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 - 20 months before (Feb yr2)

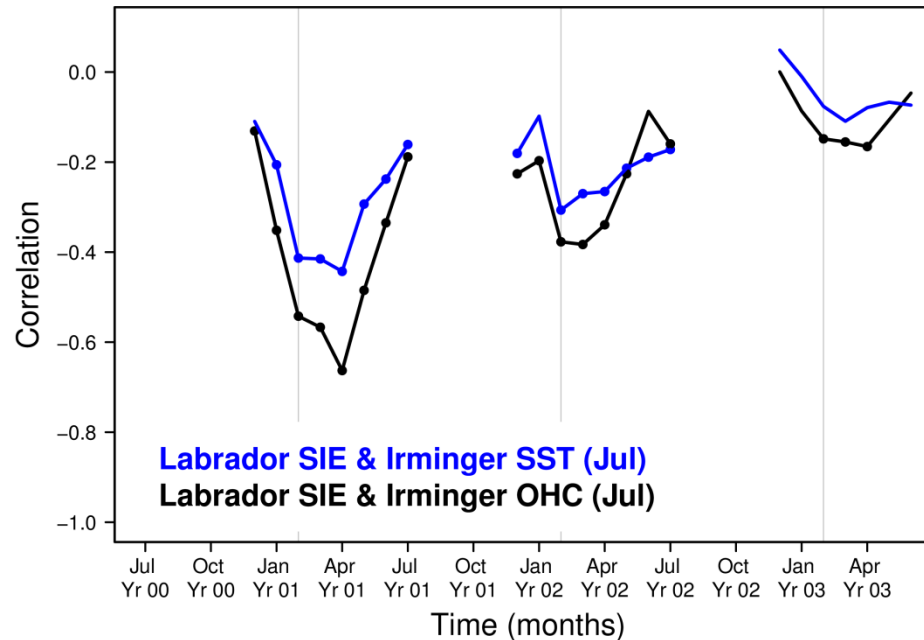


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 - 20 months before (Feb yr2)
 - 32 months before (Feb yr 3)



Ocean re-emergence in the Labrador Sea



- Significant anti-correlation between the SST anomalies in the Irminger Sea in July and the SIE anomalies in the Labrador Sea 8 and 20 months later for *ControlRun*.
- Labrador Sea ice predictability driven by Subpolar Gyre predictability?

Conclusions

- **Pan-Arctic SIE summer-to-summer re-emergence** in the PPP and the control lagged correlations.
 - **Pan-Arctic SIE summer-to-summer memory re-emergence** and large **SIV predictability** driven by **persistence of SIT** in the **central Arctic**.
 - **Peripheral seas (Atlantic Sector) re-emergence** driven by **persistence of local oceanic thermal anomalies**.
 - **Labrador Sea predictability re-emergence** in winter lead by **advection of ocean temperature anomalies** from the **Irminger Sea**.
-
- Mechanisms at play in EC-Earth in present-day conditions: what about other models? Role of model biases? Changes in future climate?
 - Local and remote oceanic sources of predictability for sea ice: importance of ocean initialization to enhance regional sea ice predictions.



Thank you

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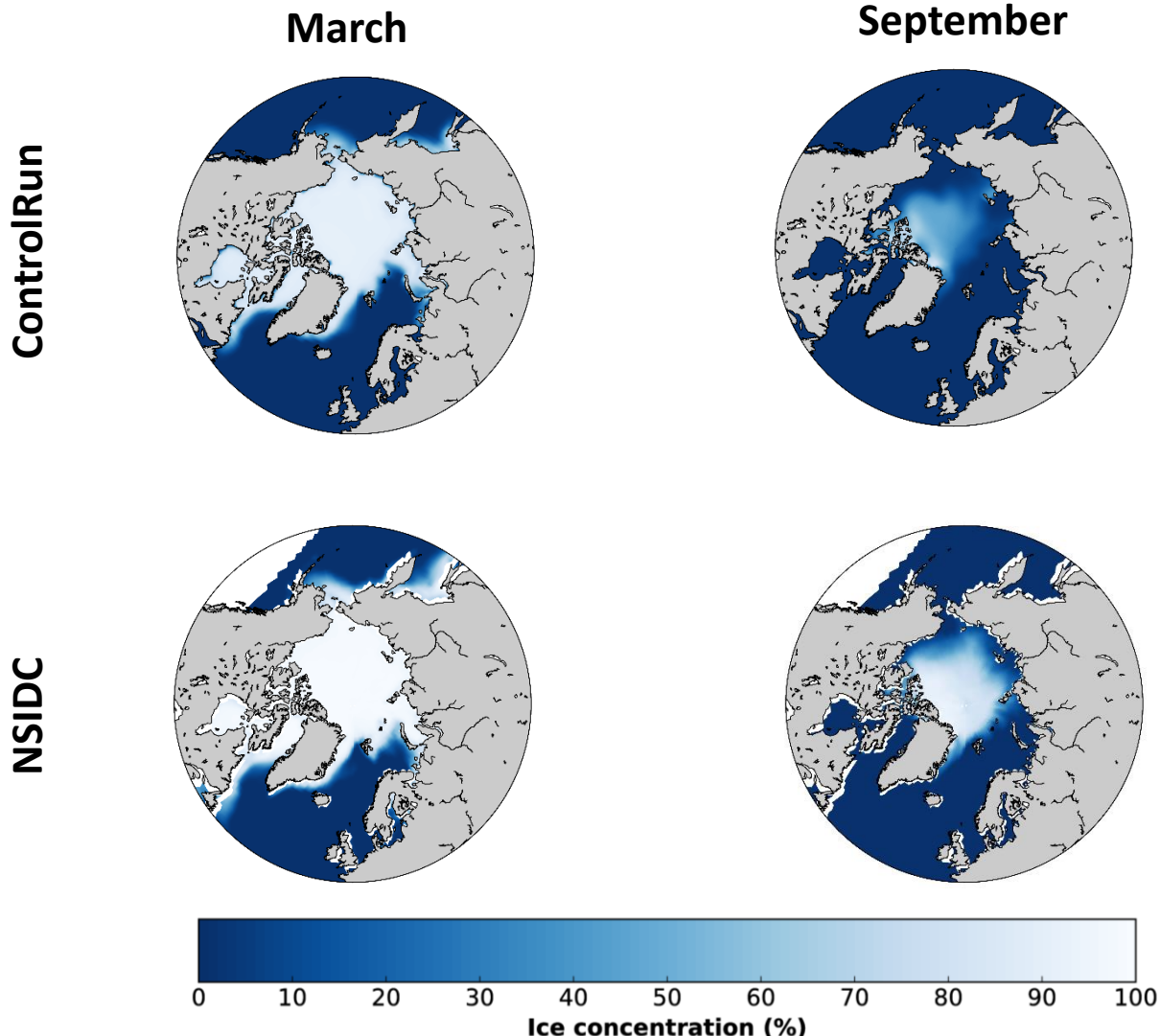
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Sea ice concentration climatology



Model biases?

Control sea ice extent climatology

