Reductions in September Arctic sea ice linked to fewer summer storms

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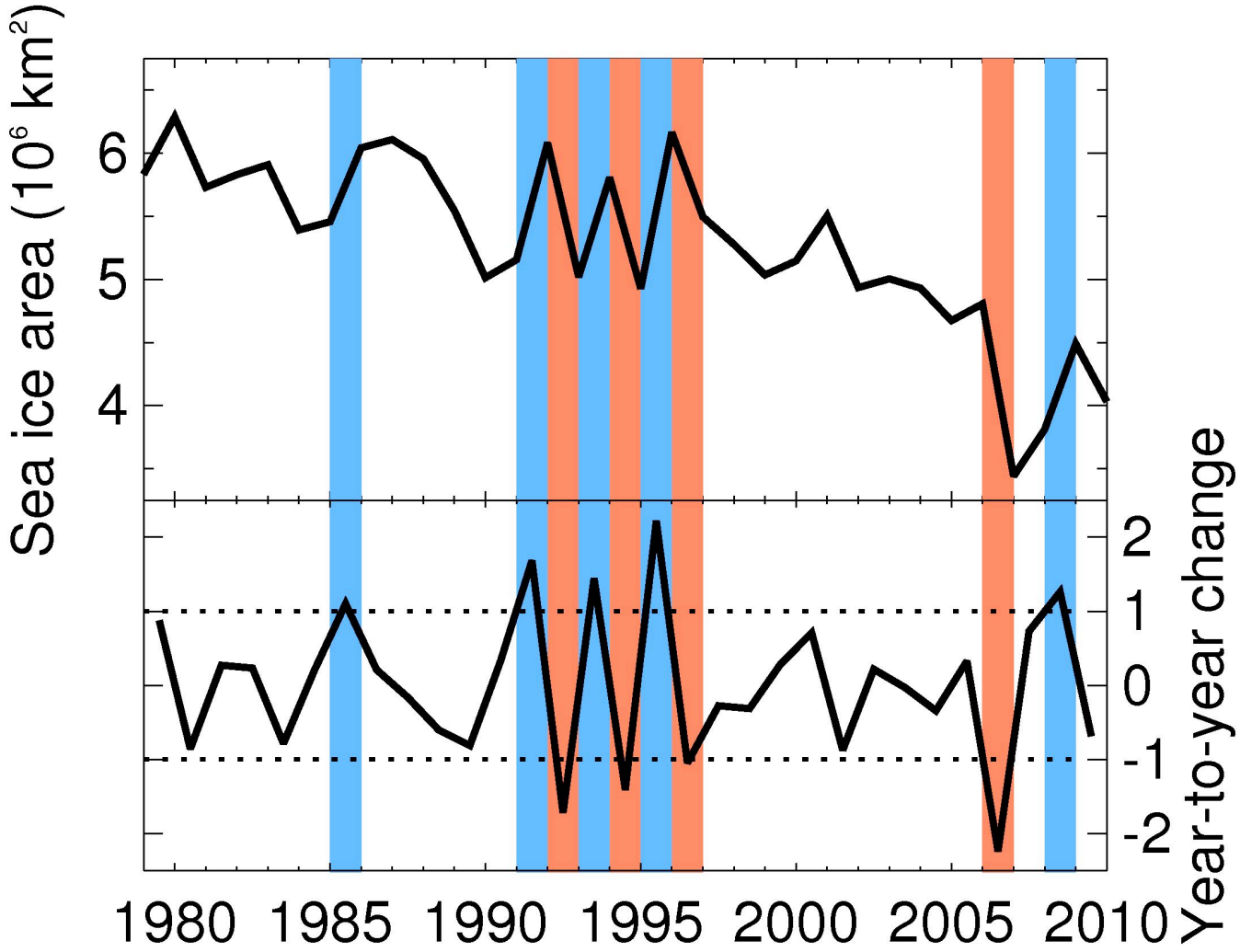
Motivation: large sea ice variability



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Background

- Previous studies have shown sensitivity of September Arctic sea ice to, for example:
    - MSLP (Ogi and Wallace, 2007; Deser and Teng, 2008)
    - Wind (Wang et al., 2009; Ogi et al., 2010)
    - Cloud (Kay et al., 2008; Eastman and Warren, 2010)
- All these are intimately connected to cyclones.
- Are these relationships due to changes in storms, or changes in the larger scale (temporal and spatial) circulation, or both?
- Run cyclone finding and tracking algorithm of JRA-25 MSLP fields, 1979-2009.
- Identifies open and closed low pressure systems.
- Results are largely insensitive to the choice of reanalysis.

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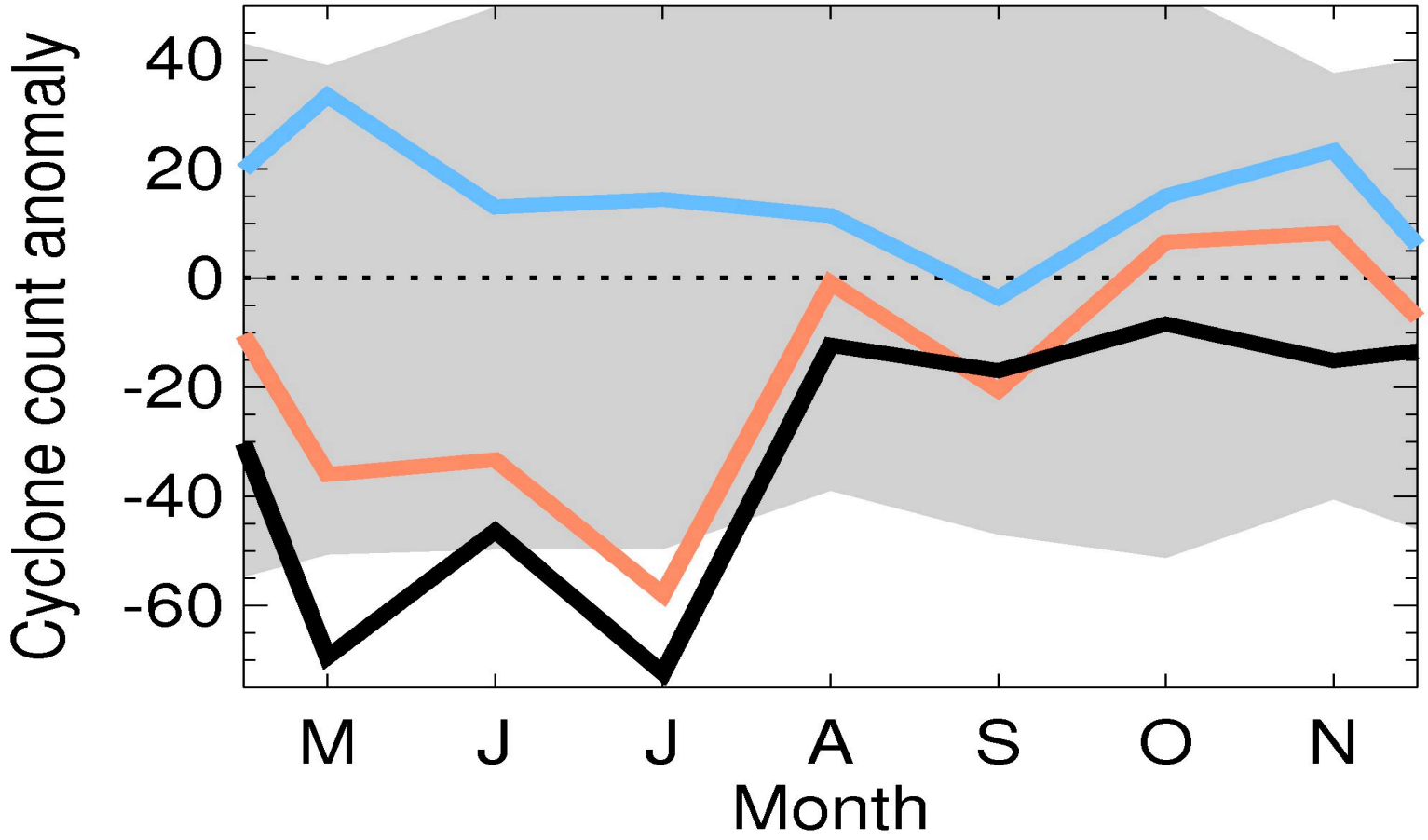
Cyclone occurrence



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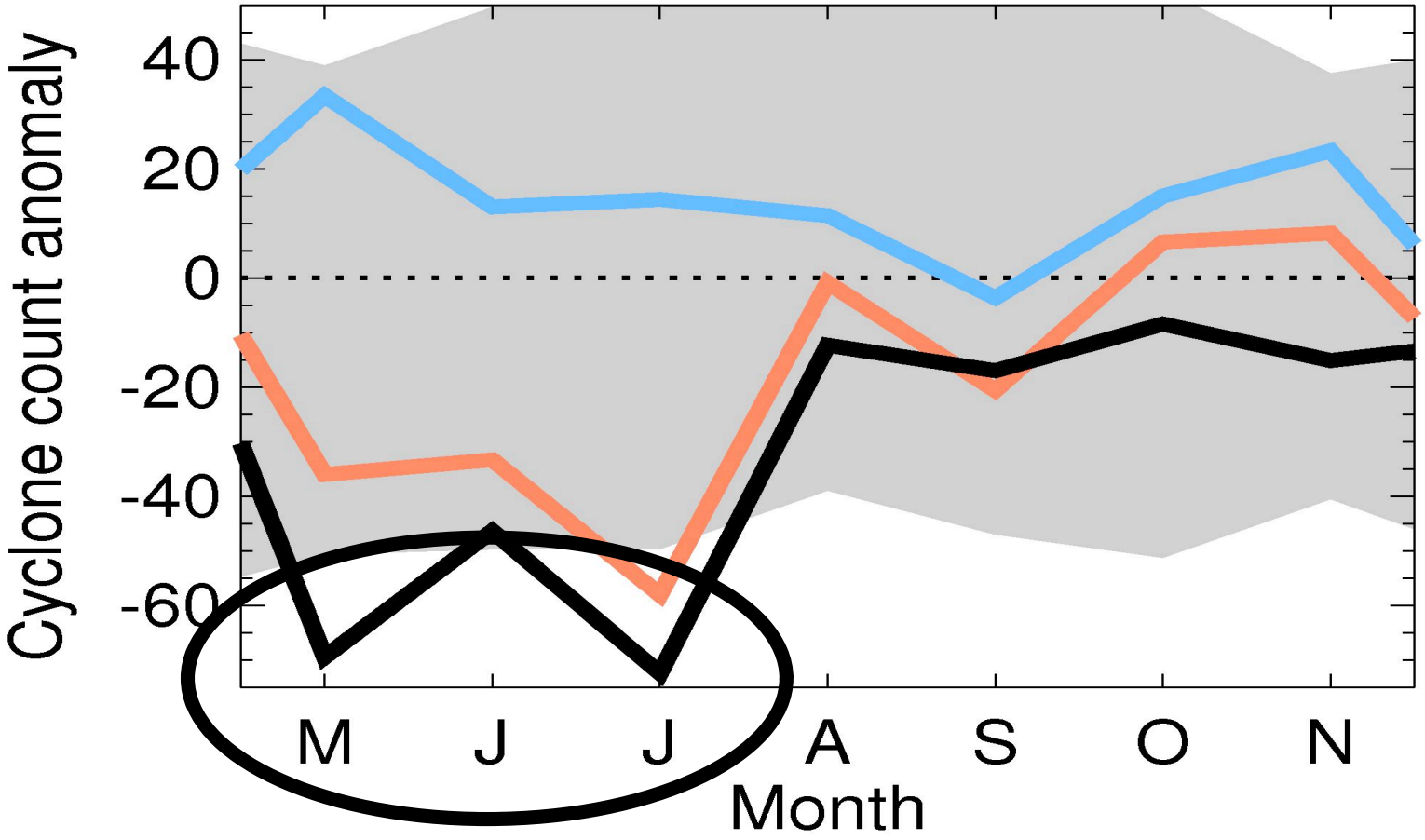
Cyclone occurrence



Low September sea ice linked to fewer spring/ summer storms

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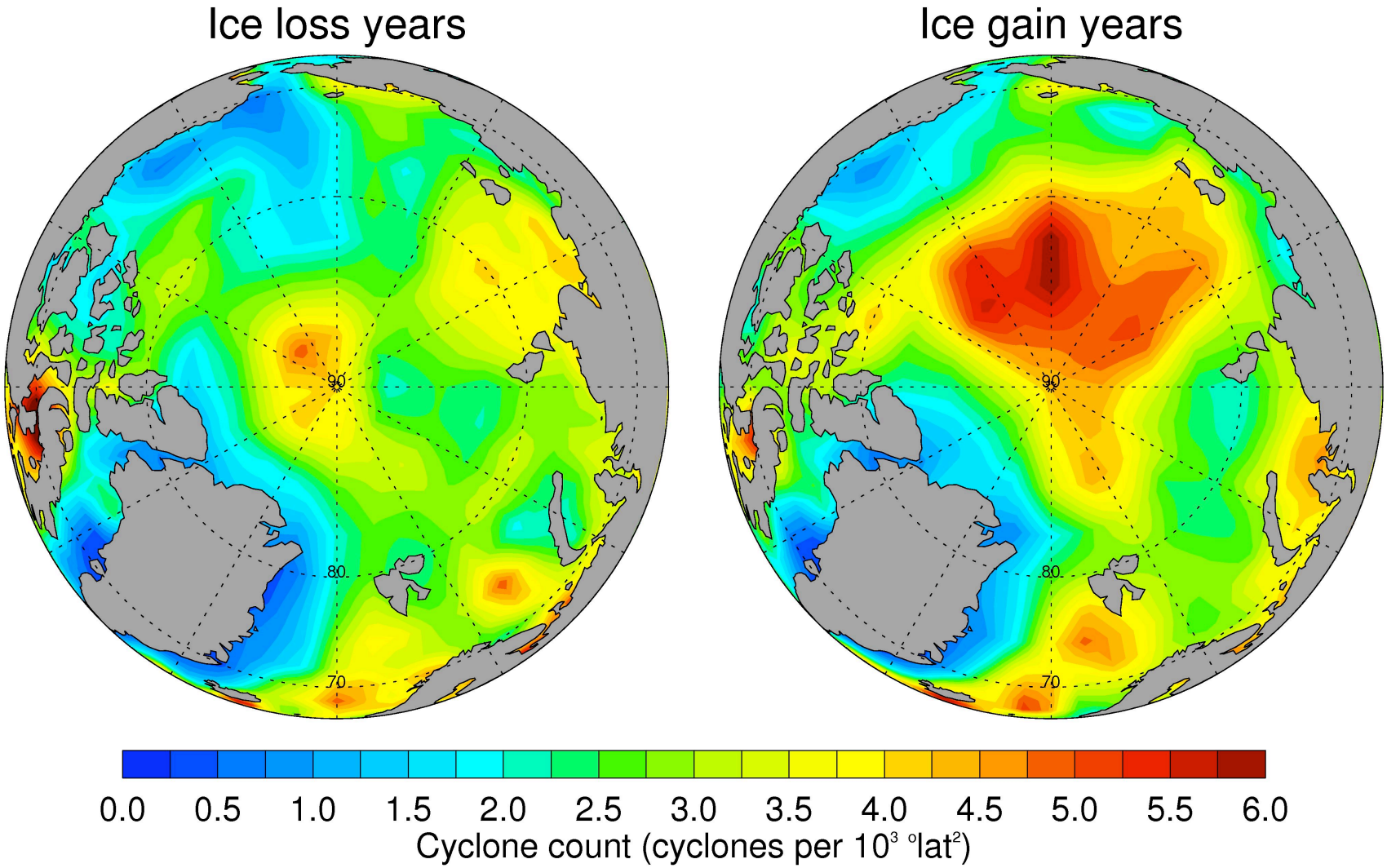
Cyclone occurrence



Source data: JRA-25

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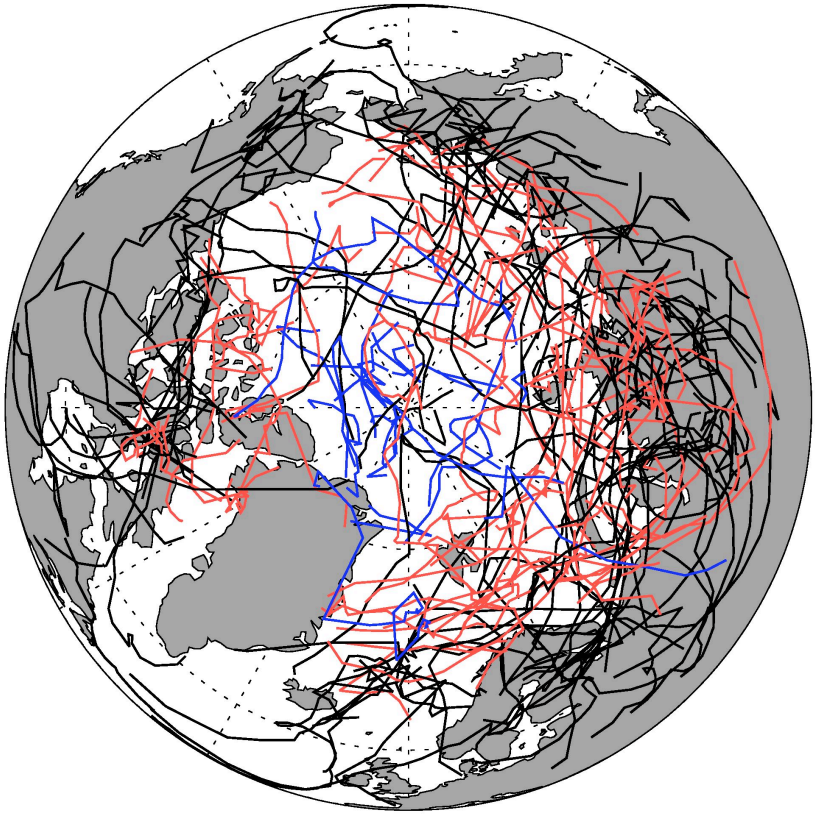
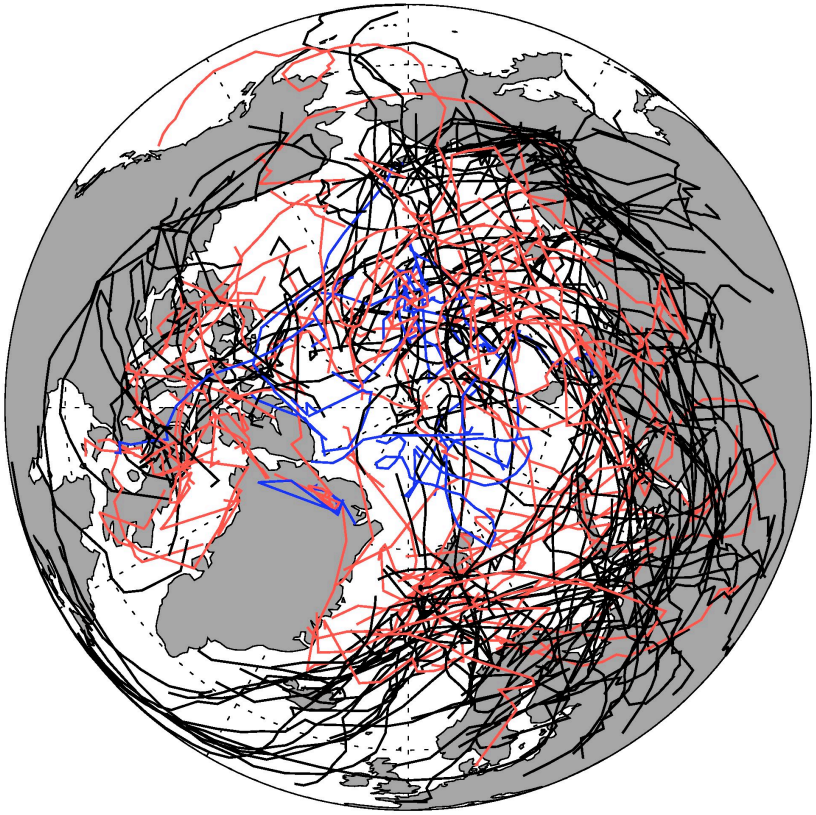
Cyclone tracks

Ice loss years



Ice gain years



Source data: JRA-25

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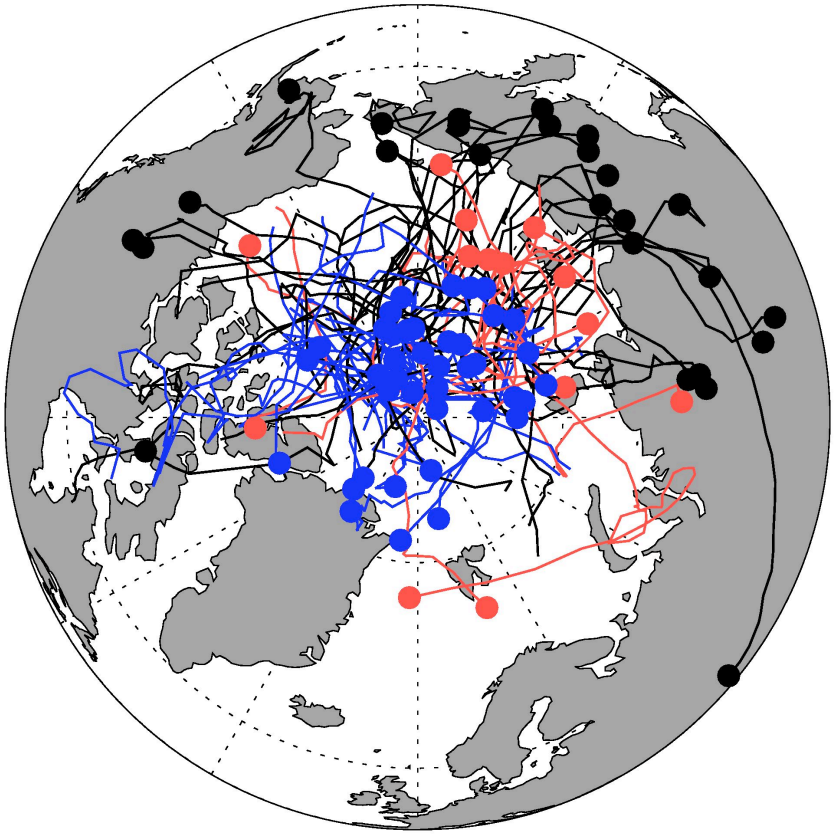
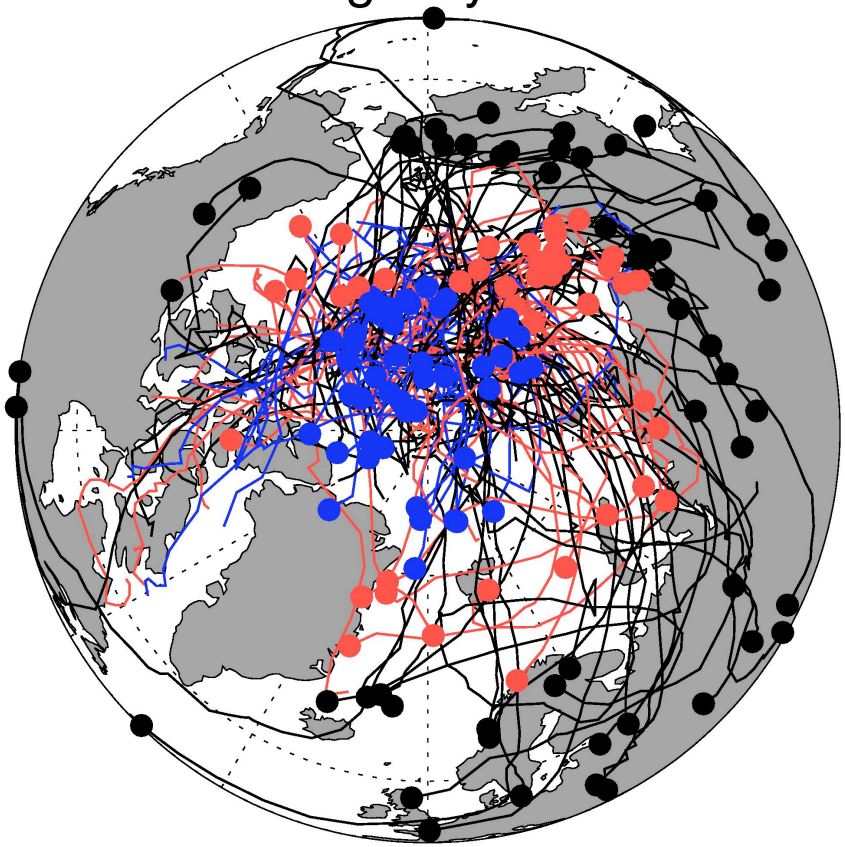
Cyclogenesis locations

Ice loss years



Ice gain years



Source data: JRA-25

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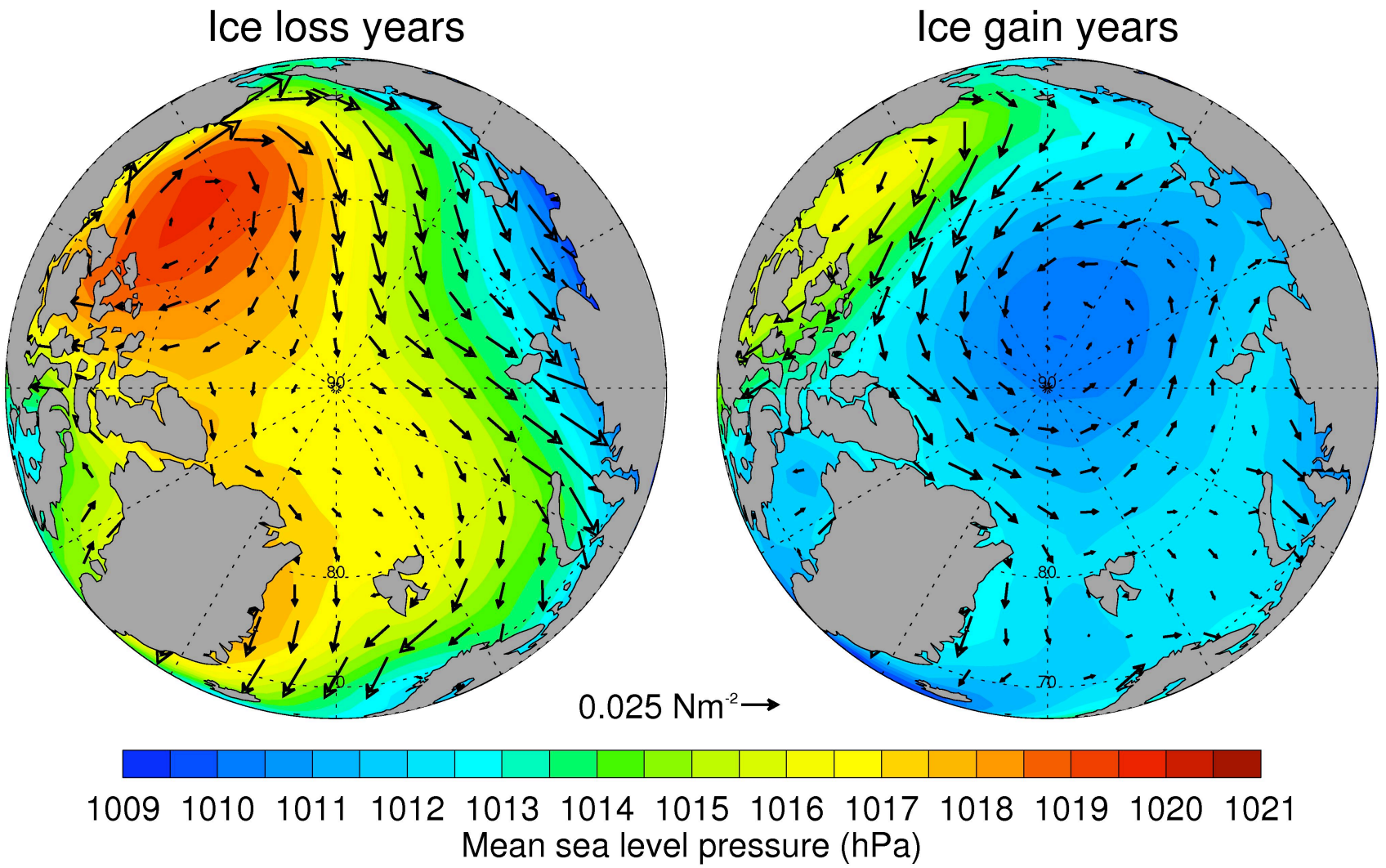
Sea level pressure and winds



Source data: JRA-25

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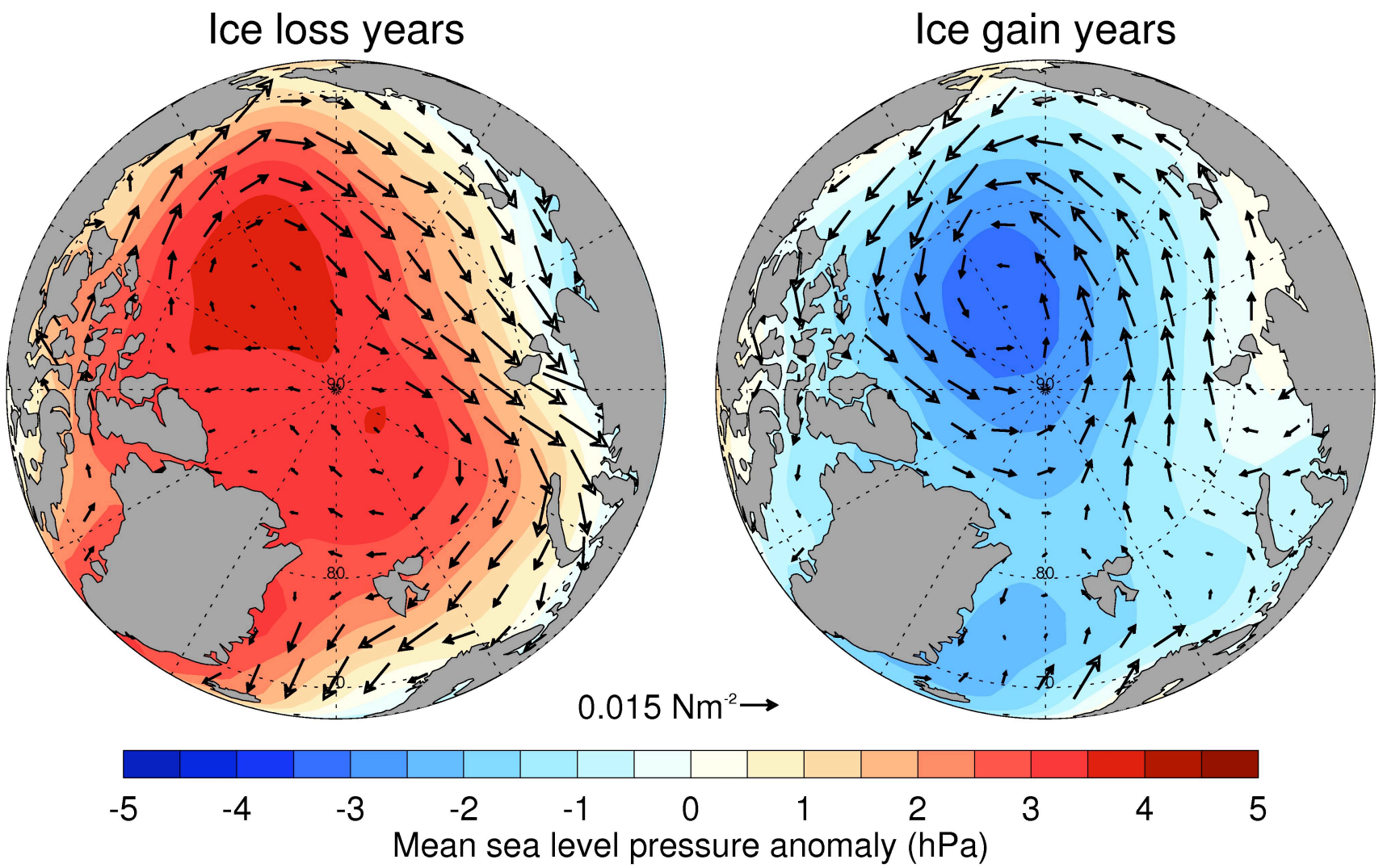
Sea level pressure and wind anomalies



Source data: JRA-25

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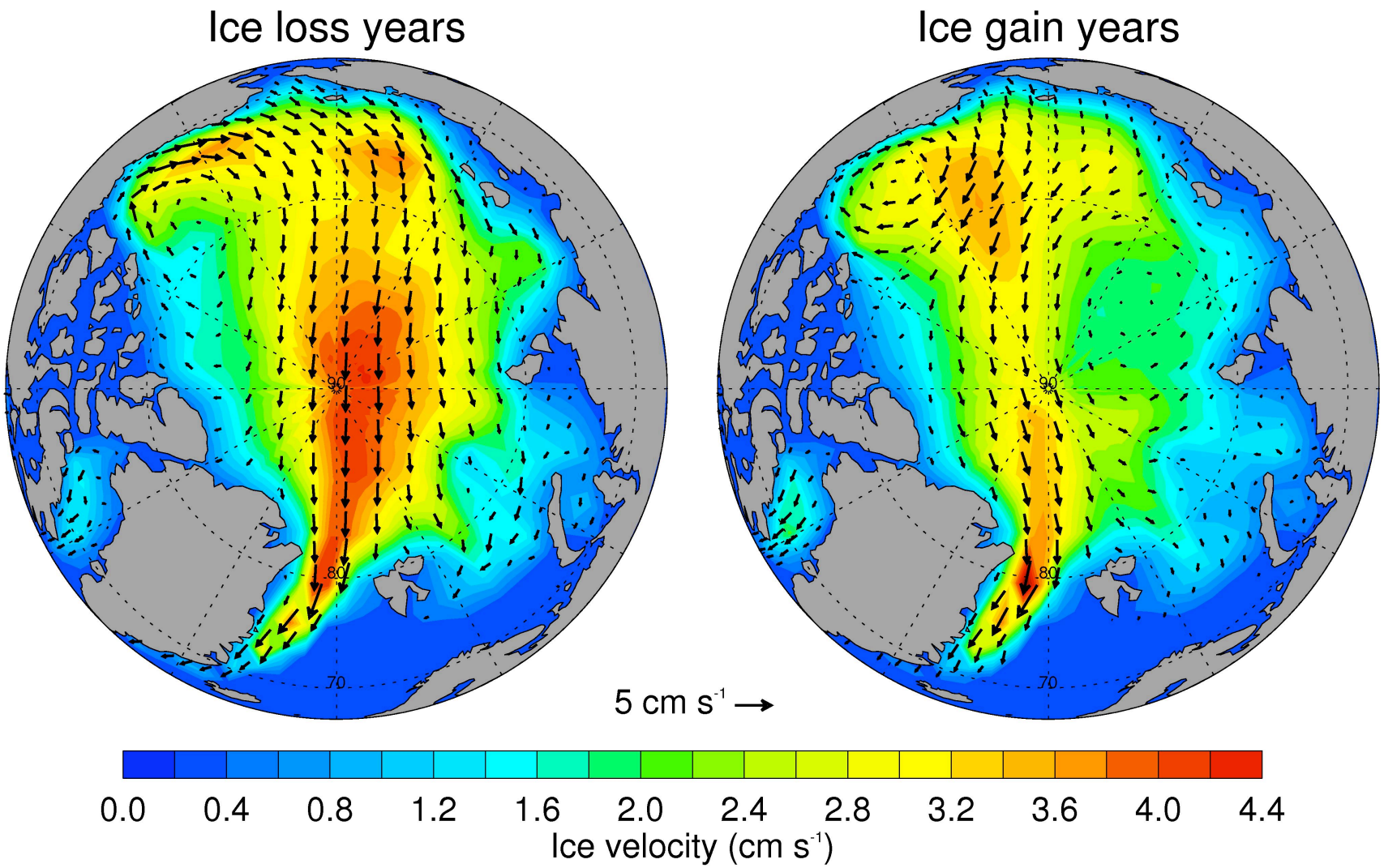
Sea ice motion



Source data: Polar Pathfinder

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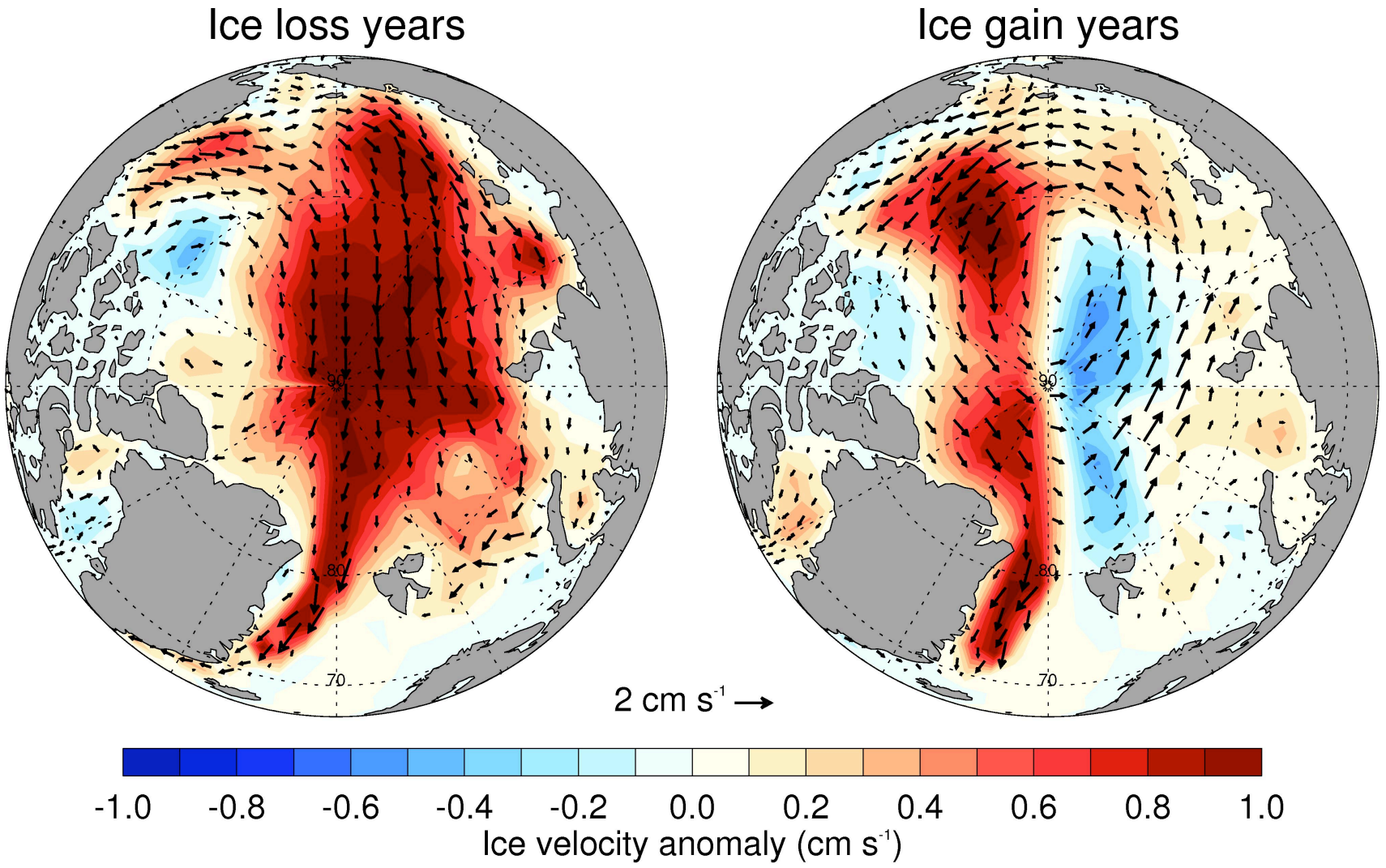
Ice motion anomalies



Source data: Polar Pathfinder

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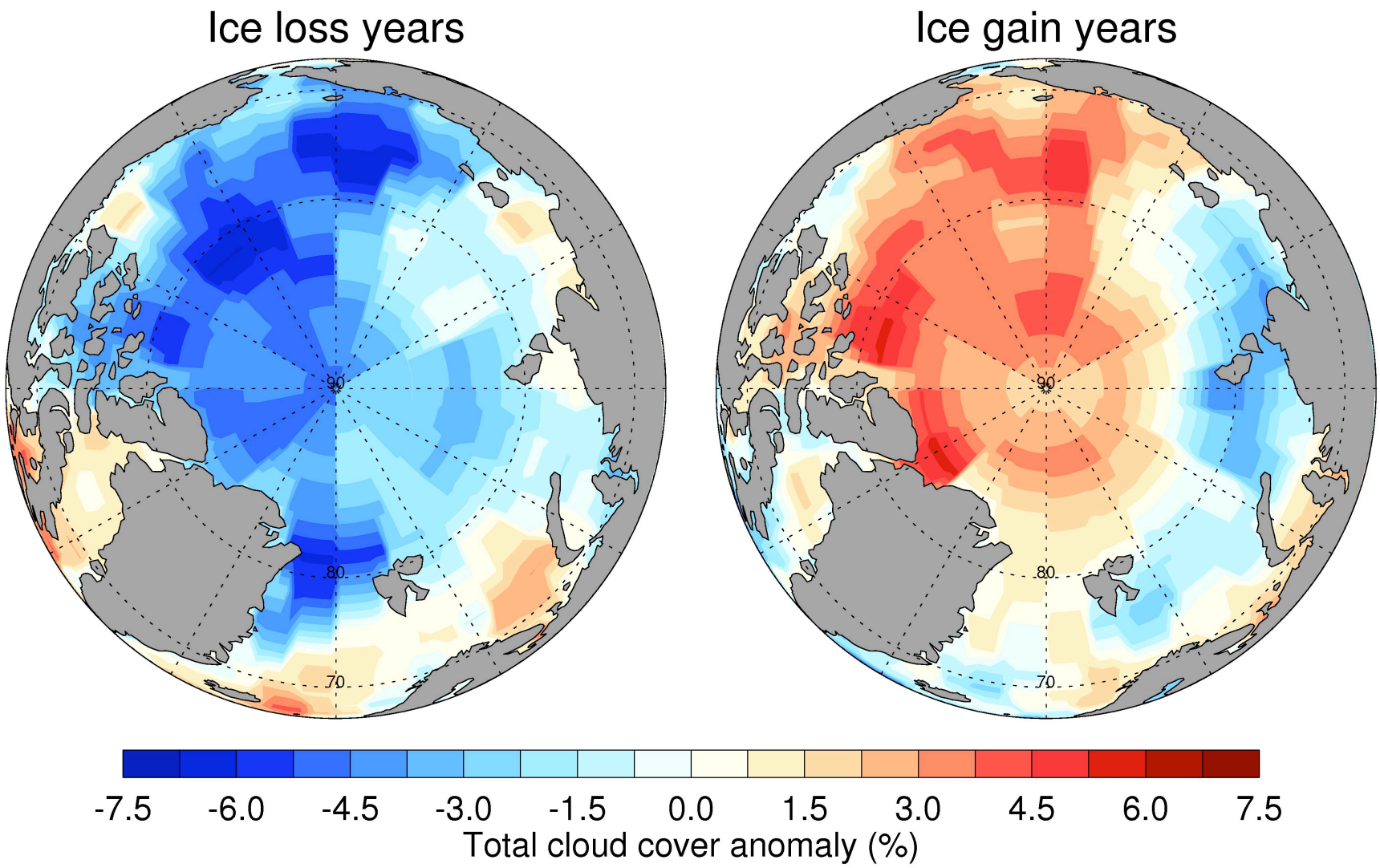
Cloud cover anomalies



Source data: ISCPP

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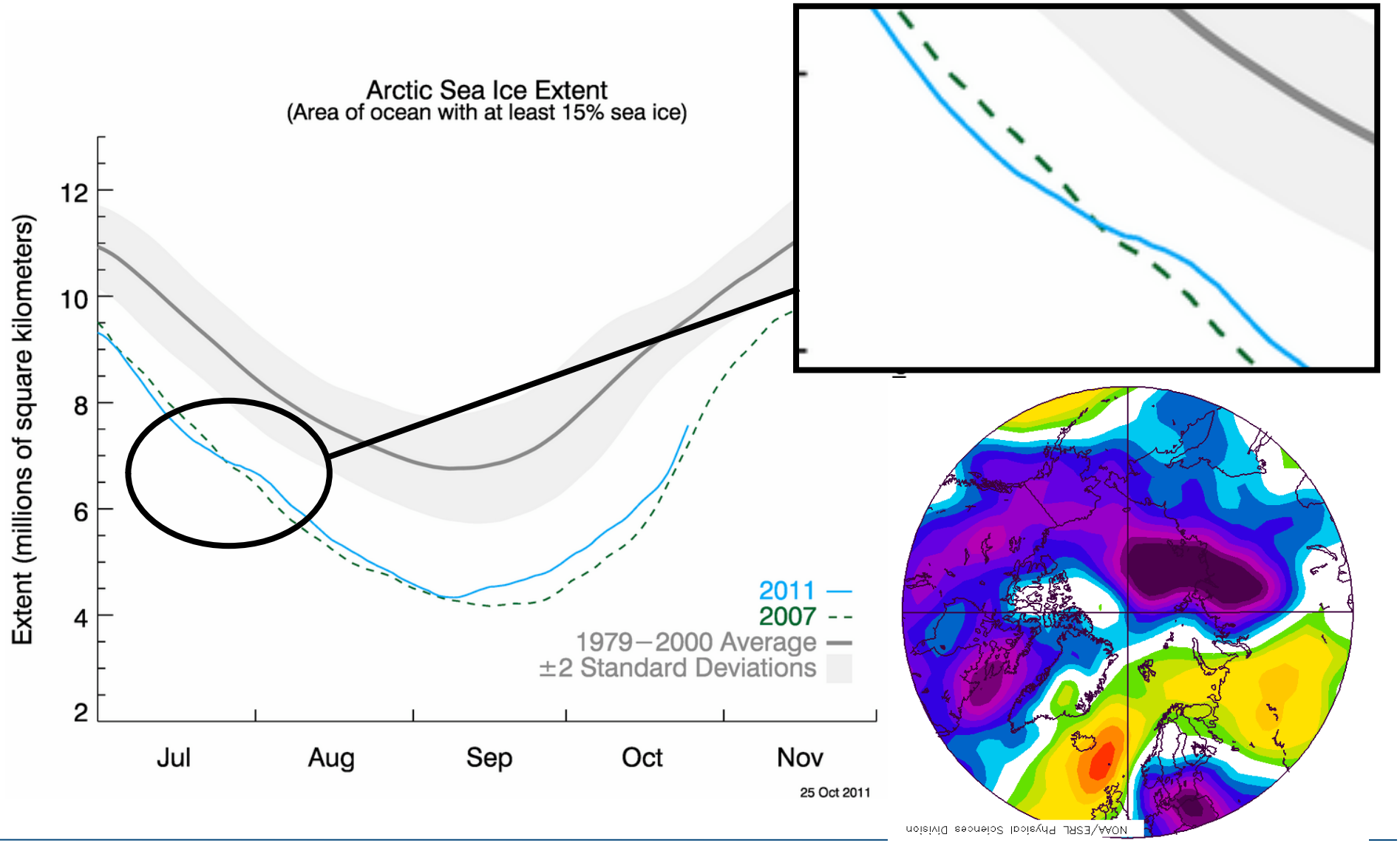
Did storms prevent a new record in 2011?



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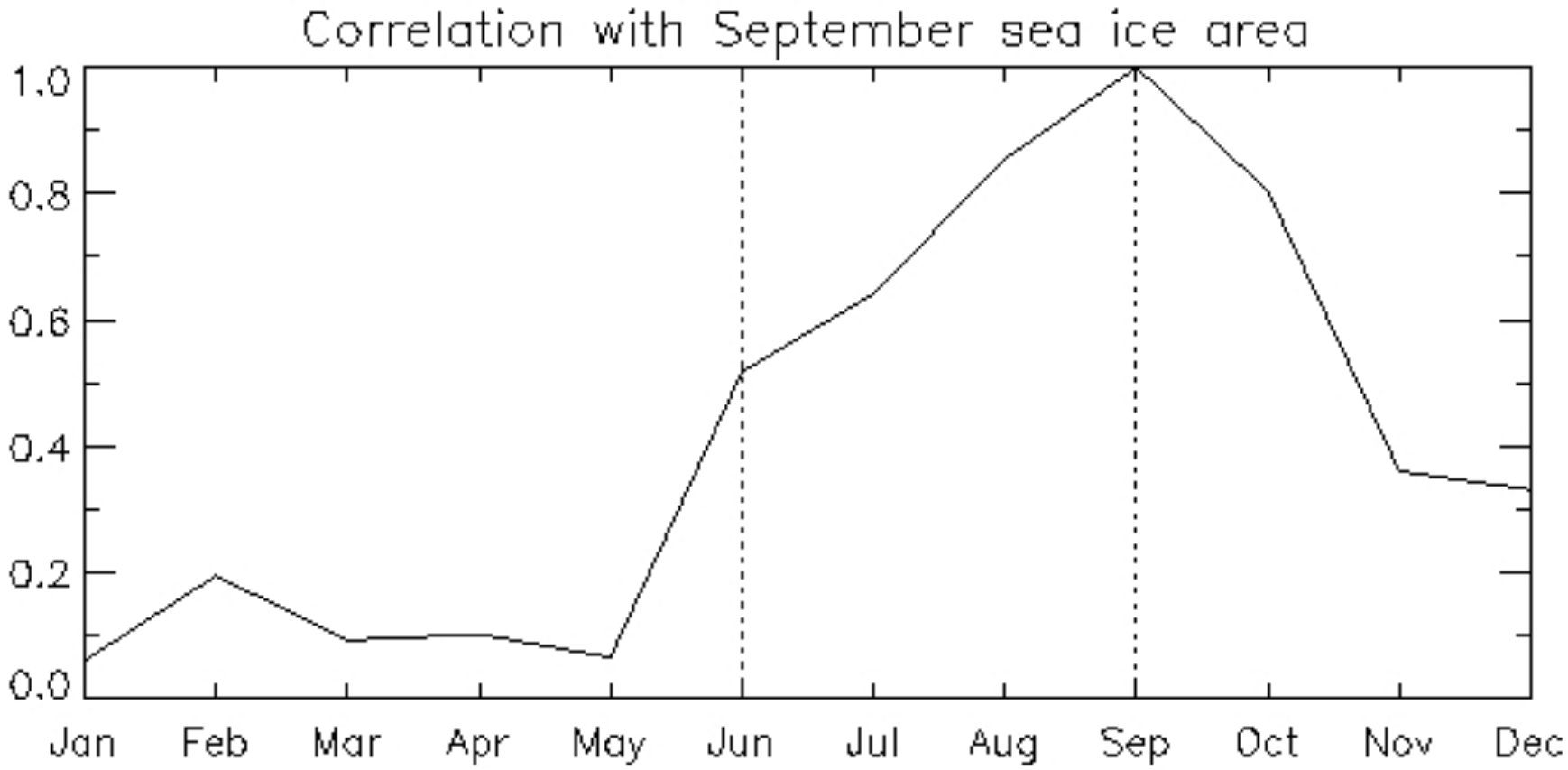
Sea ice predictability



Little predictability of September sea ice before June

Emphasizes the importance of the **summer** weather conditions

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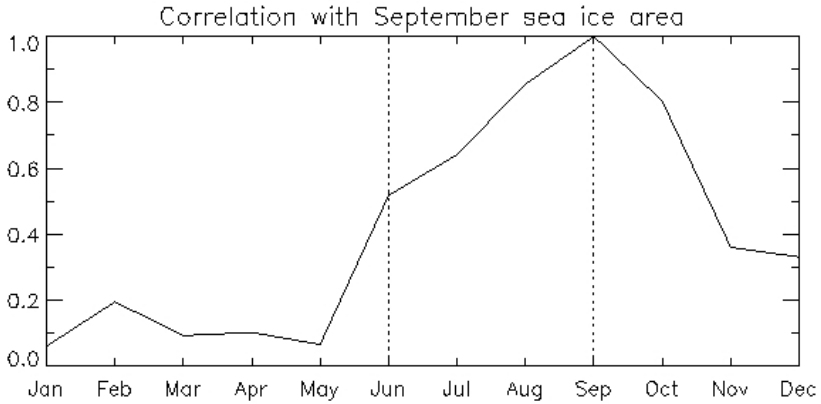
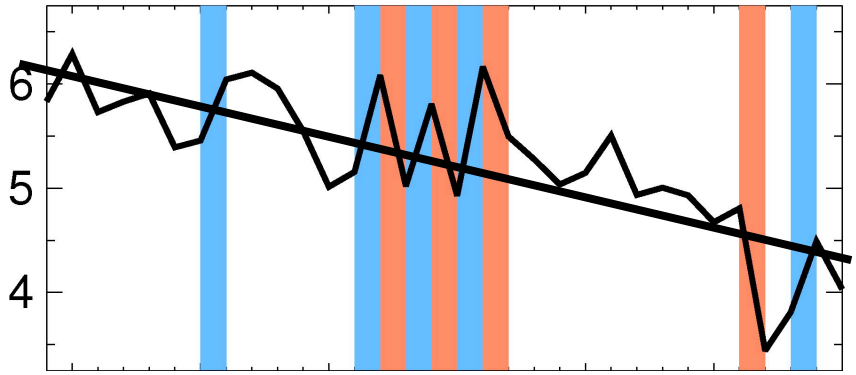
September sea ice predictability





Good predictability on timescales ~1-3 months (persistence and feedbacks)

Good predictability on decadal timescales (from long-term trend)

Can we predict summer weather i.e. storm activity?

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Conclusions

- Fewer cyclones over the Arctic Ocean during May, June and July favour low September sea ice.
- Years with large sea ice losses are characterized by abnormal storm activity: they lack the usual central Arctic cyclone maximum and cyclones that tack from Eurasia are largely absent.
- Fewer storms associated with above-average MSLP, strengthened anticyclonic winds, intensification of transpolar drift stream, less cloud – all impact the sea ice.
- Cyclone occurrence during late spring and early summer have preconditioning effects on the sea ice cover and exert a strong influence on the amount of sea ice that survives the melt season.

Screen et al., (2011) Dramatic inter-annual changes of perennial Arctic sea ice linked to abnormal summer storm activity, *J. Geophys. Res.,* 116, D15105.