A polar bear is standing on a large, textured ice floe in the Arctic ocean. The ice has a distinct, wavy, layered appearance. The water is a deep, dark blue. The title text is overlaid on the right side of the image.

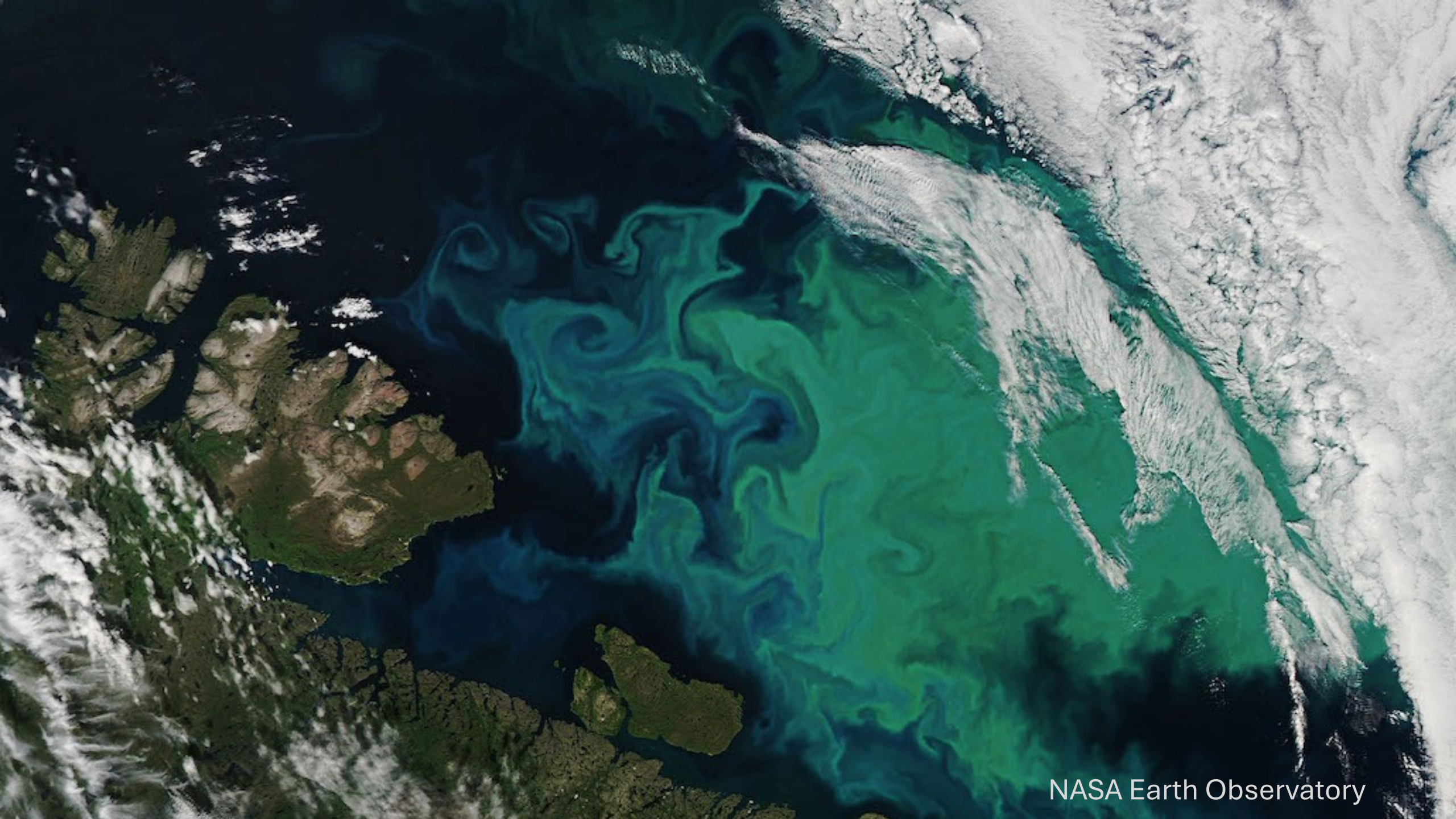
# Quantifying the potential predictability of Arctic primary production

Courtney Payne<sup>1,2</sup>, Nicole Lovenduski<sup>1</sup>, Marika Holland<sup>2</sup>, Kristen Krumhardt<sup>2</sup>, Alice DuVivier<sup>2</sup>

<sup>1</sup> ATOC and INSTAAR, University of Colorado Boulder

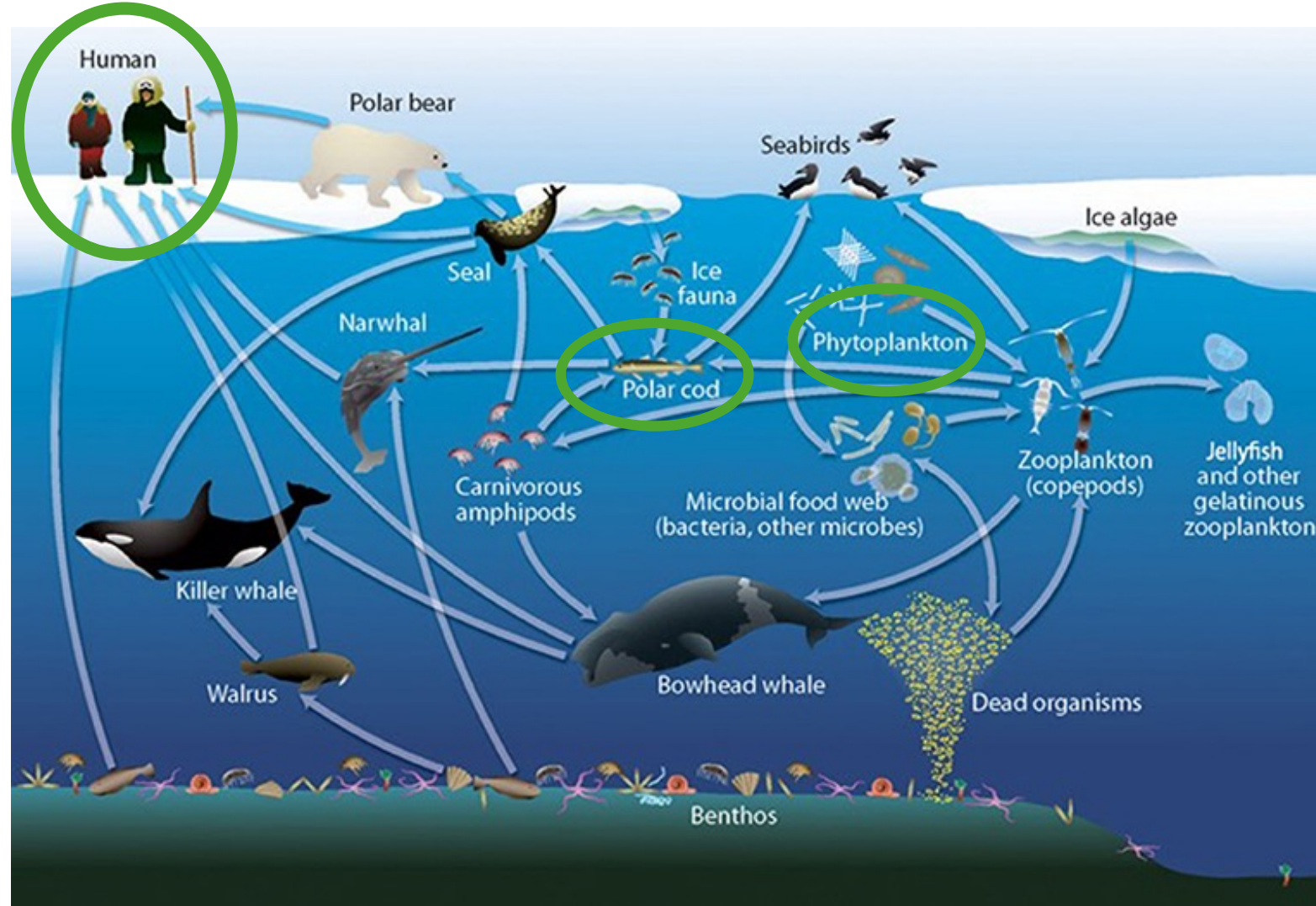
<sup>2</sup> NSF National Center for Atmospheric Research



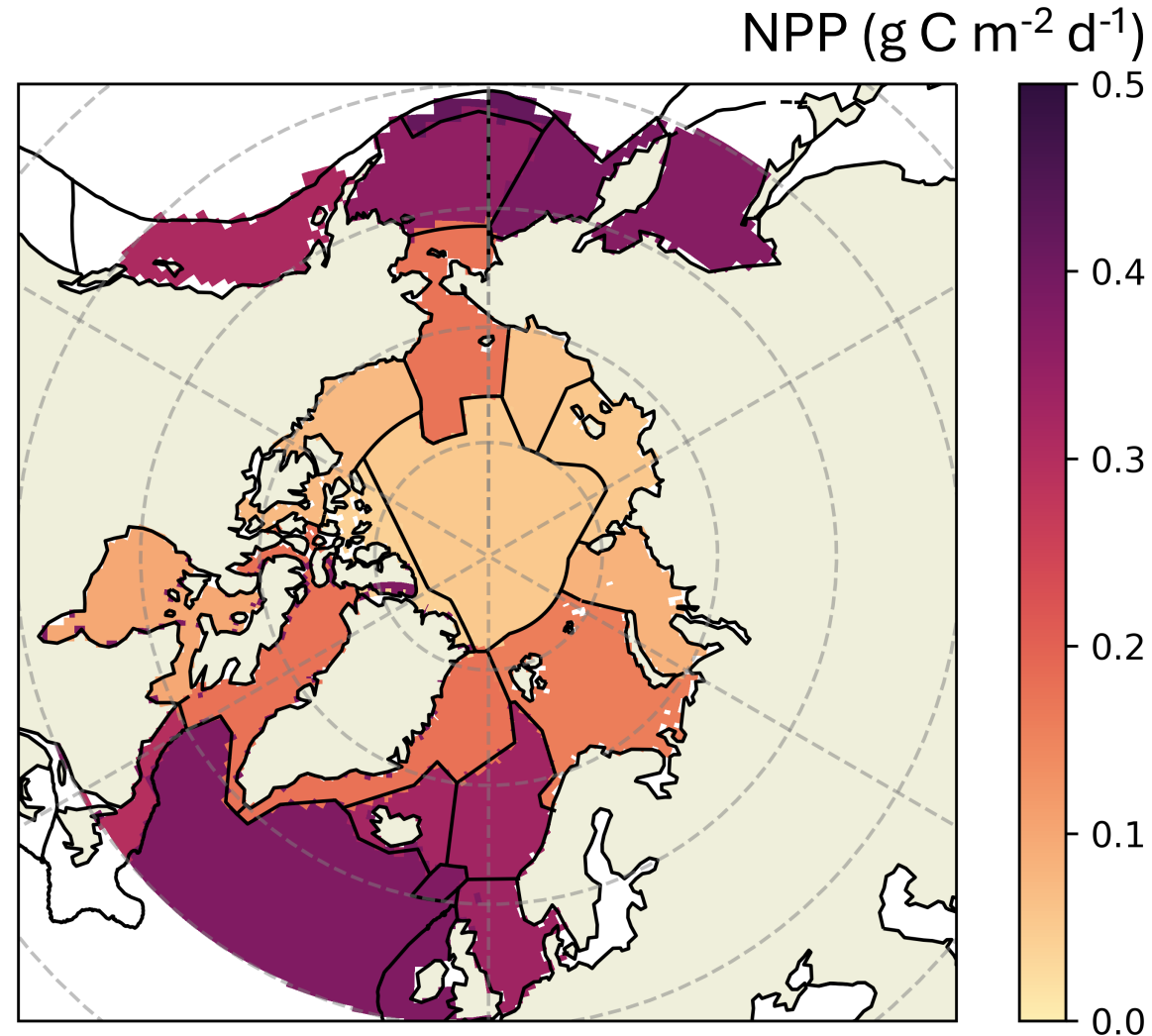




# Phytoplankton net primary production (NPP) supports a diverse and dynamic food web.



Arctic fisheries are expected to expand substantially on Arctic shelves under future climate change.



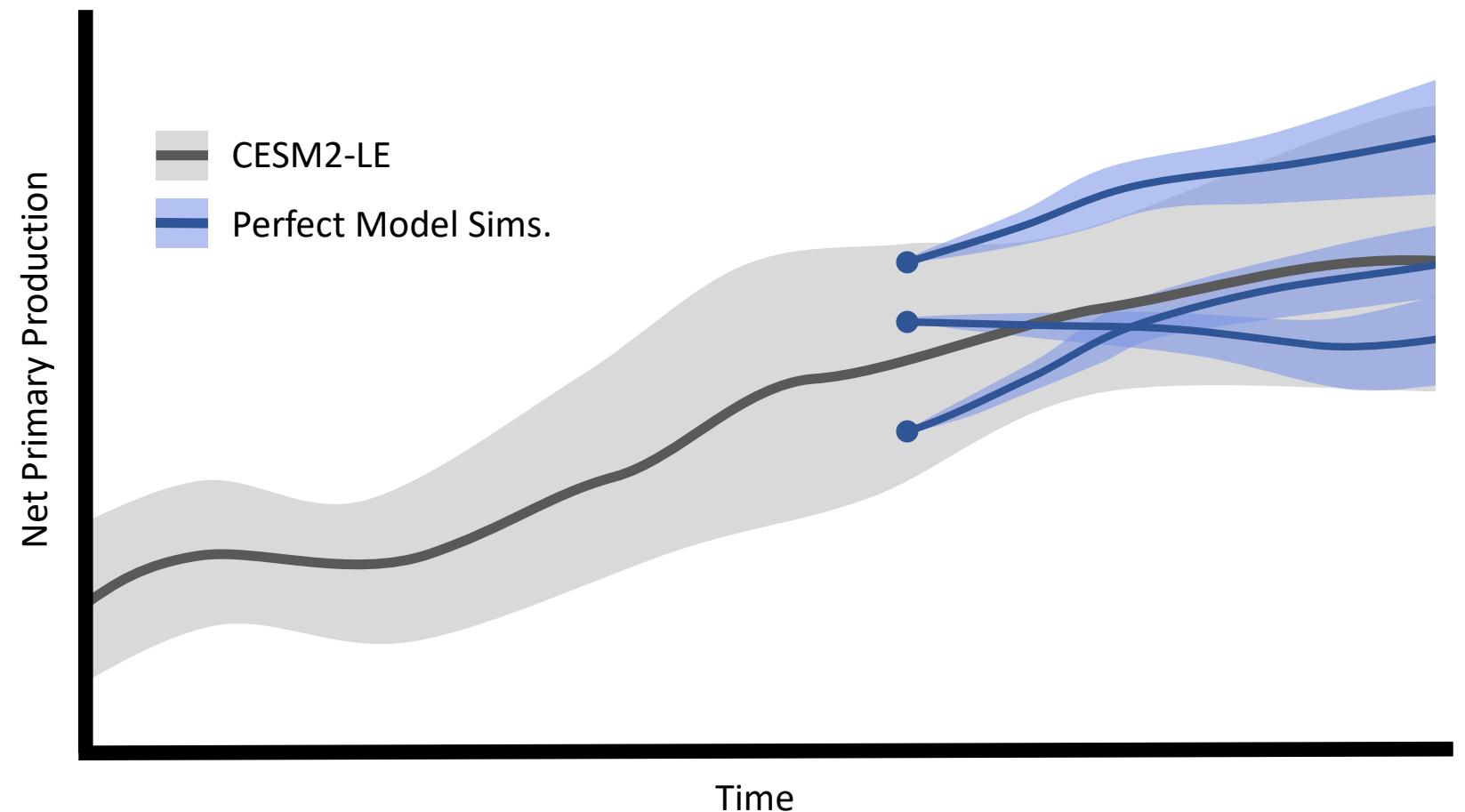


# Is Arctic NPP predictable?

- How might predictability change in the future as sea ice is lost?
- What regions are the most predictable?
- What physical drivers control predictability?



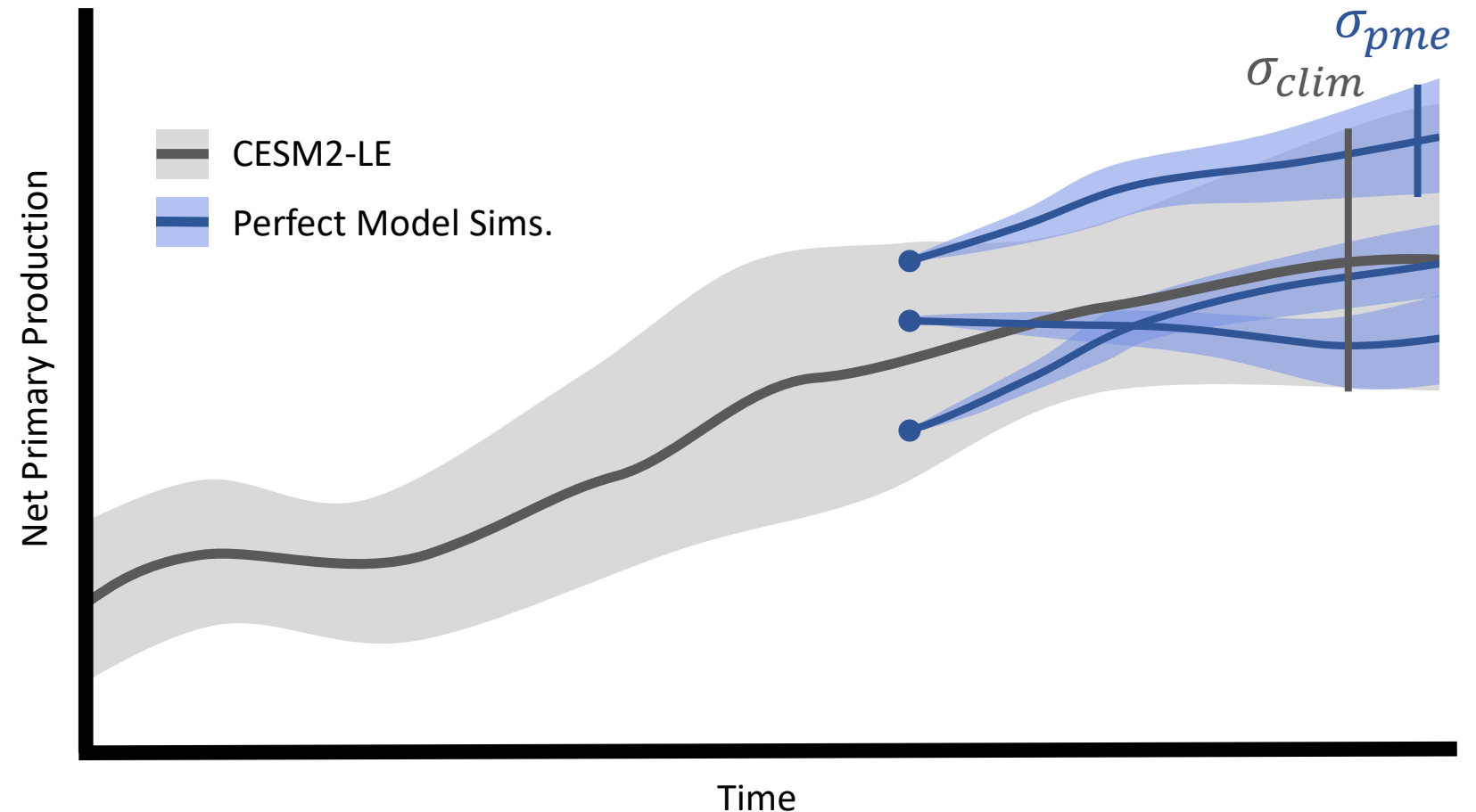
We used the CESM2-LE and two-year perfect model forecast simulations initialized every other month in 2010 and 2030.





To evaluate the predictability of NPP, we used potential prognostic predictability (PPP).

$$PPP = 1 - \frac{\sigma_{pme}^2}{\sigma_{clim}^2}$$





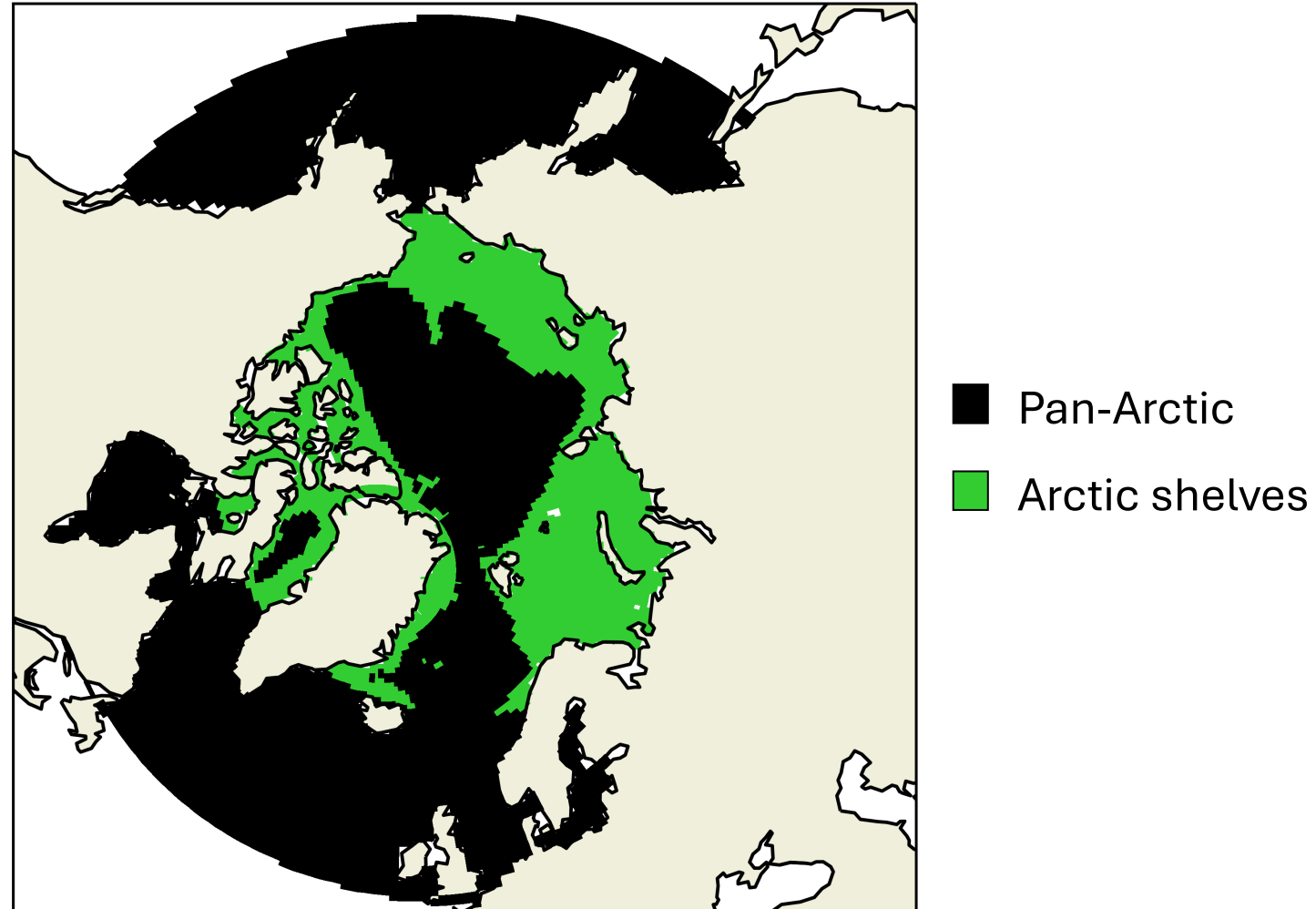
# We analyzed predictability on a pan-Arctic scale



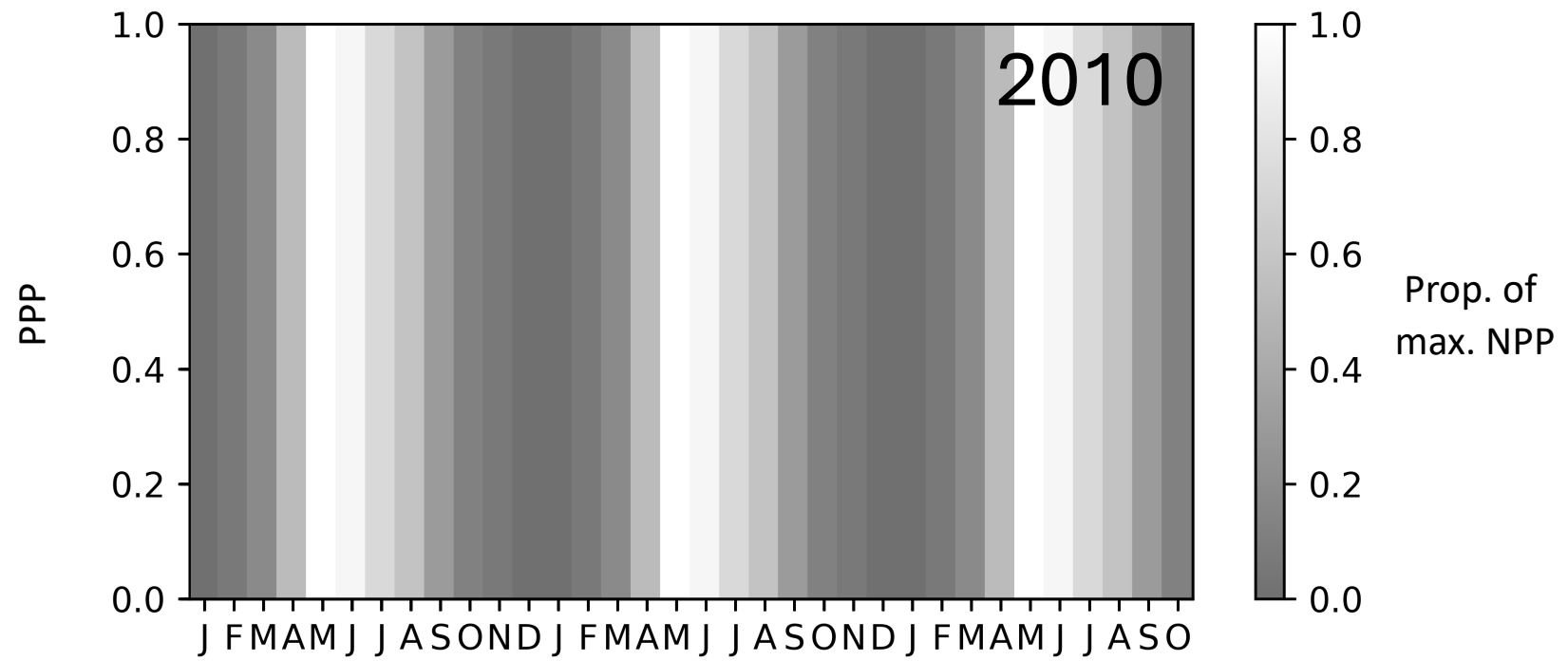
■ Pan-Arctic



We analyzed predictability on a pan-Arctic scale and for the Arctic shelves for the 2010s and 2030s.

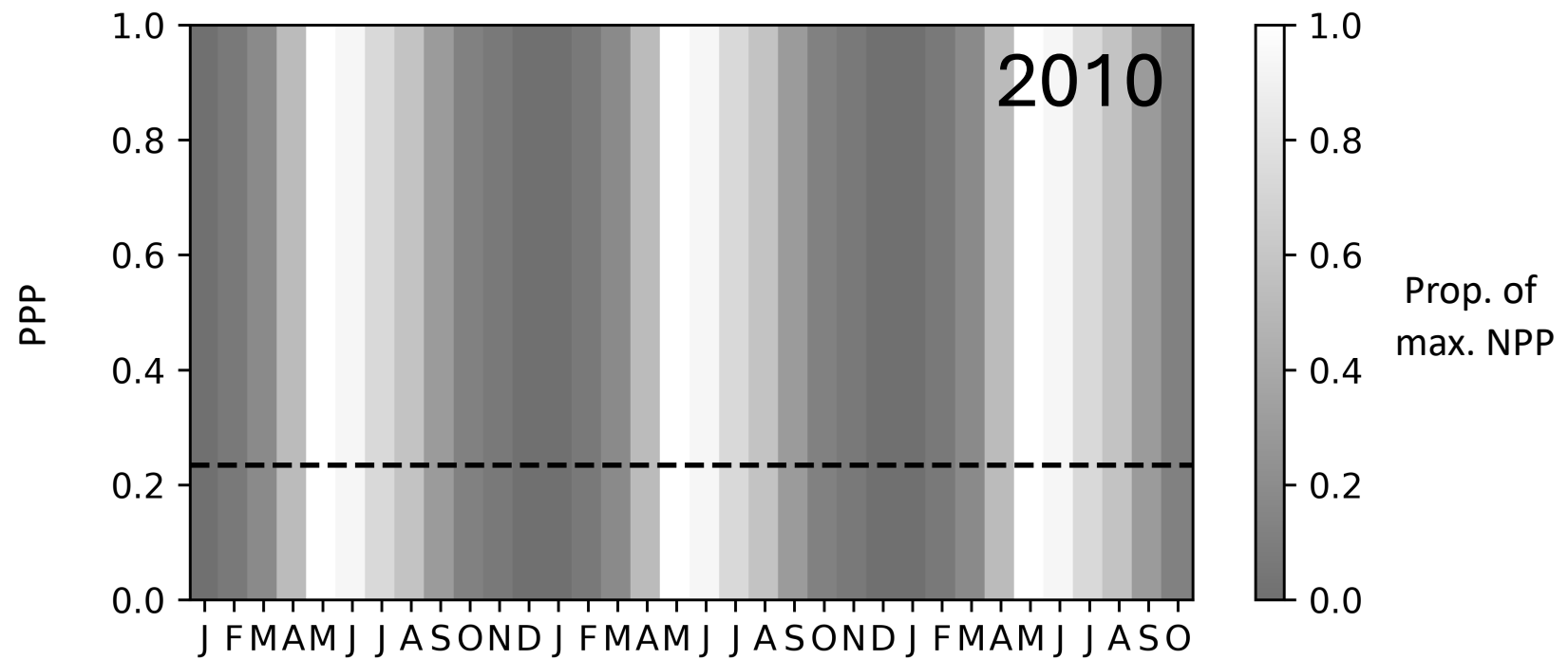


NPP is highly seasonal in the Arctic.





NPP is highly seasonal in the Arctic.

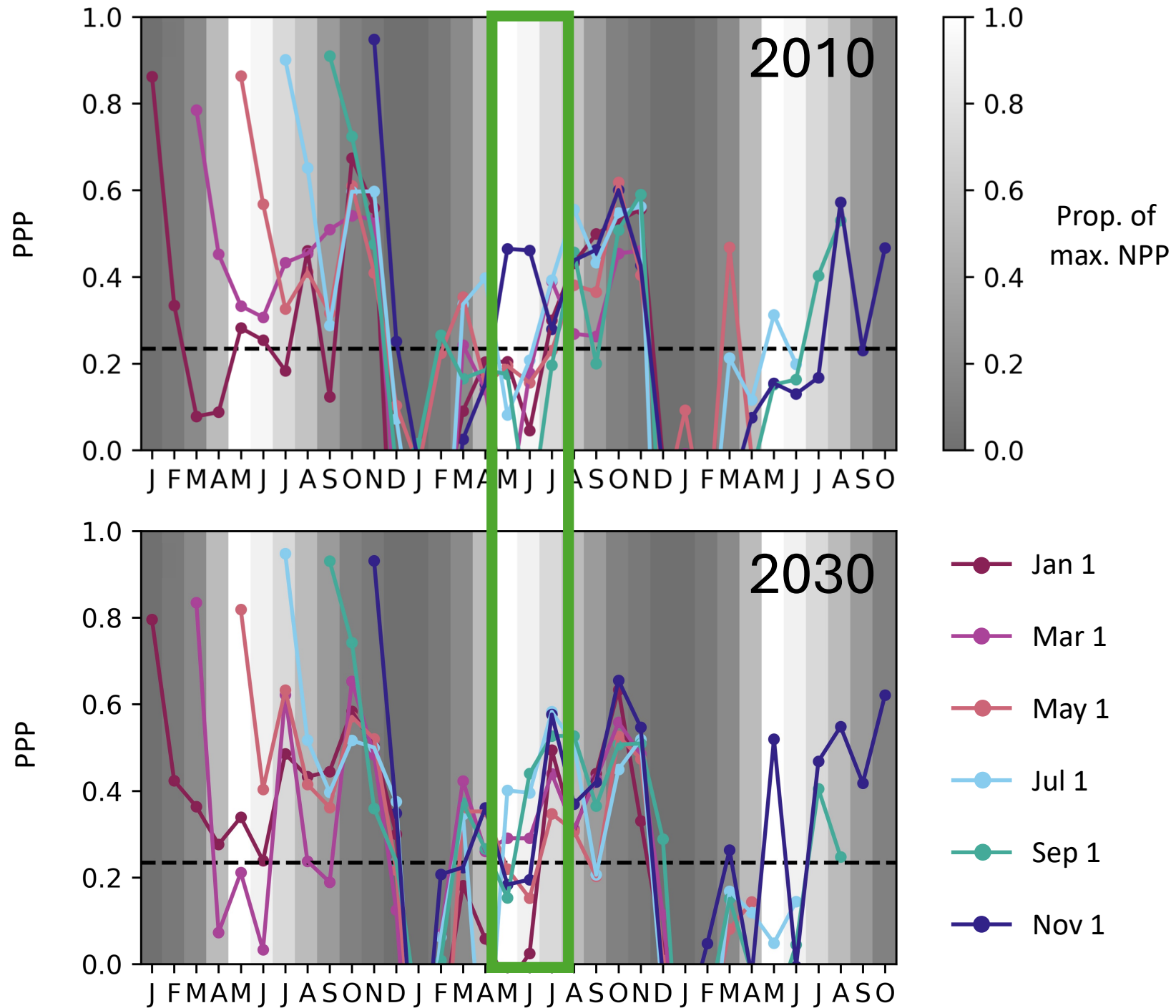
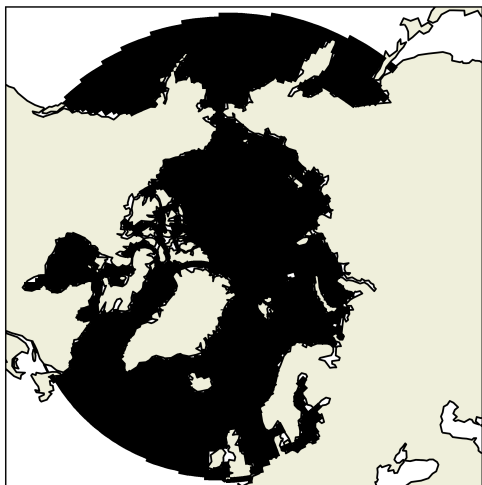


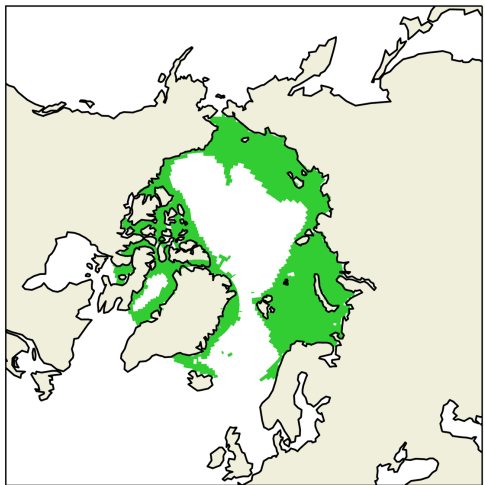
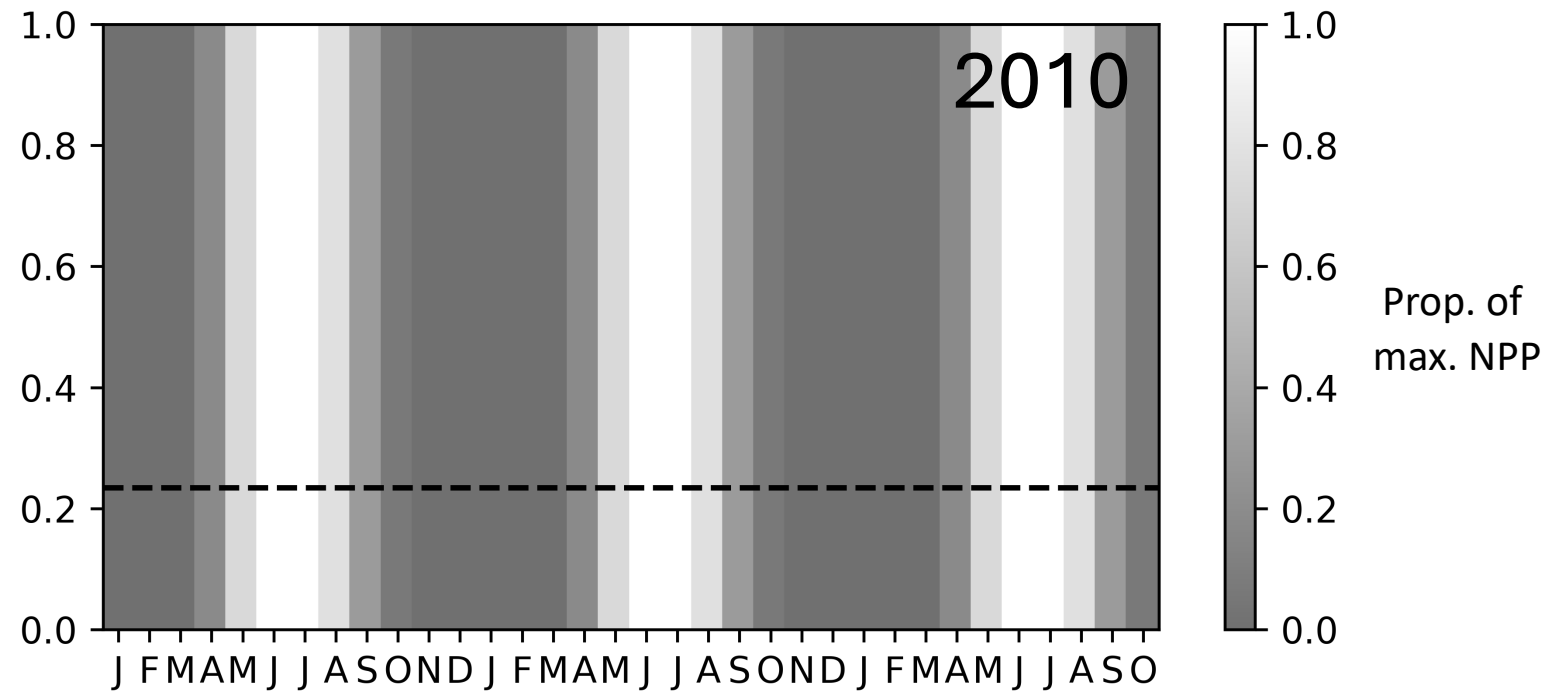




NPP is likely to be more predictable in the 2030s than the 2010s.

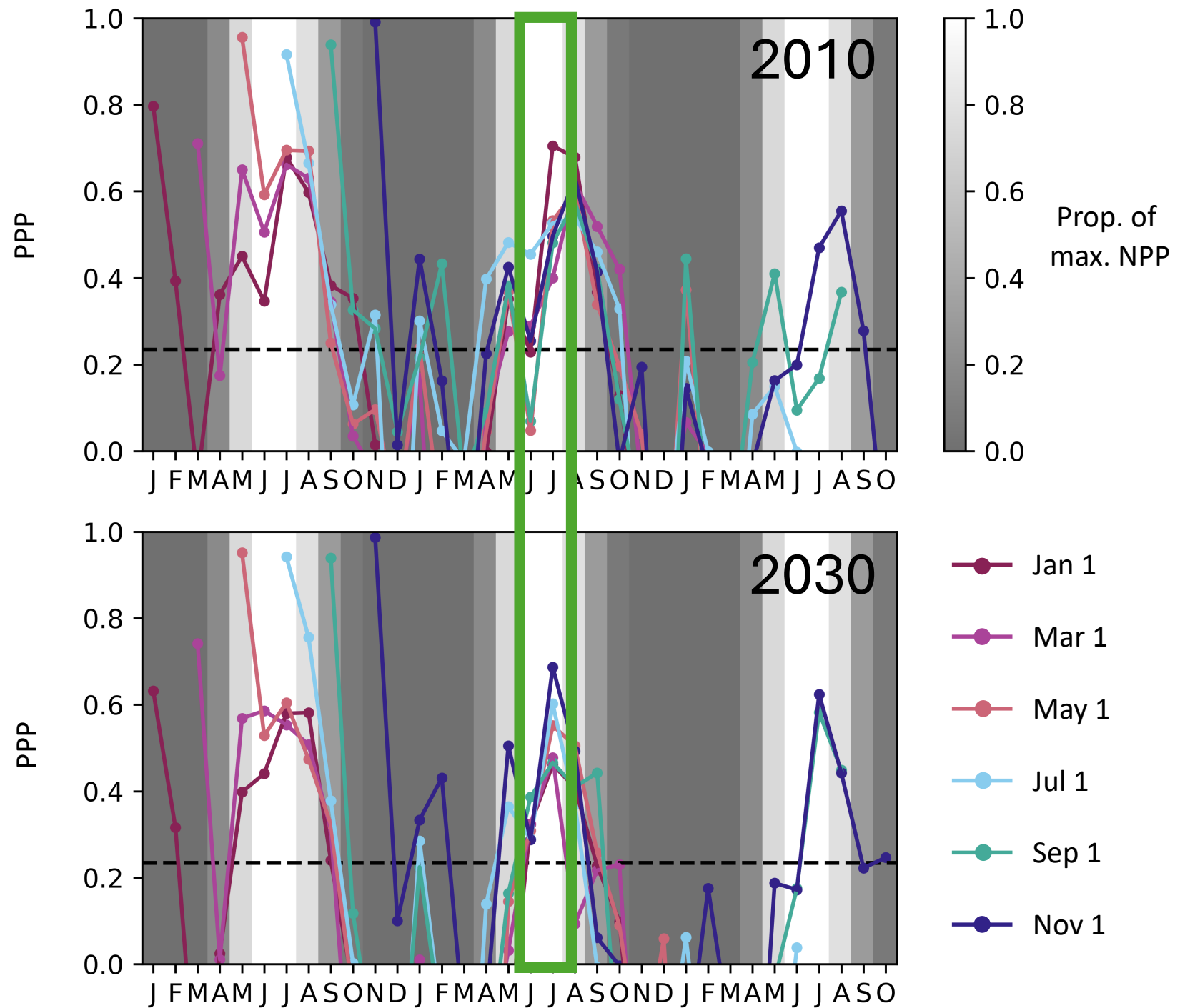
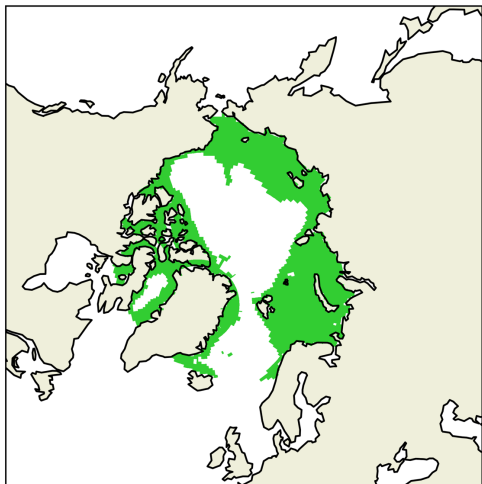
2010s: 2.8 predictable months  
 2030s: 3.7 predictable months

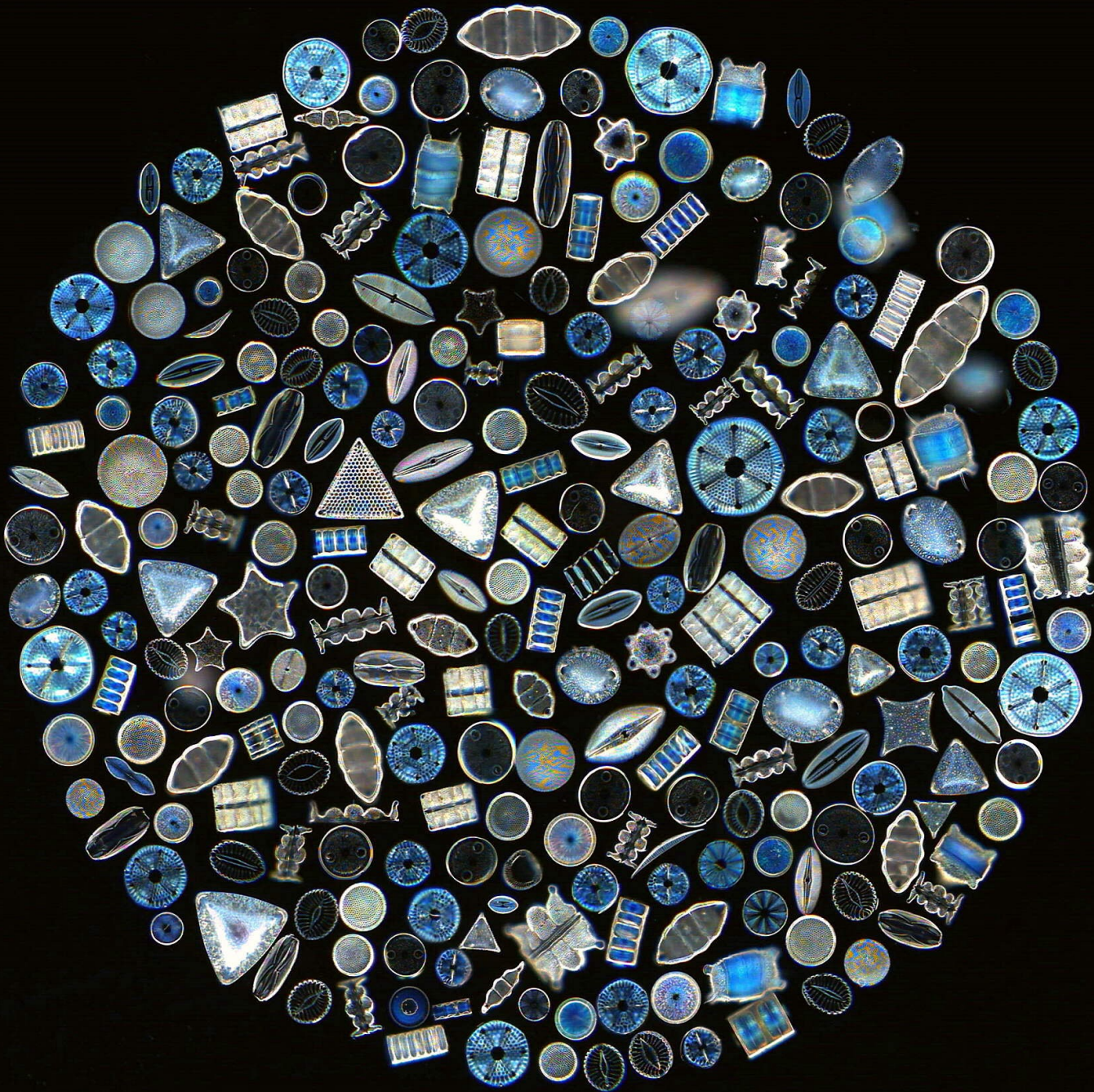




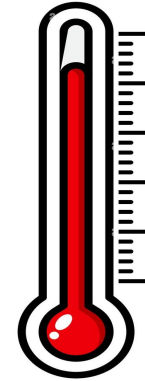


The Arctic shelves remain highly predictable for two years.





Light



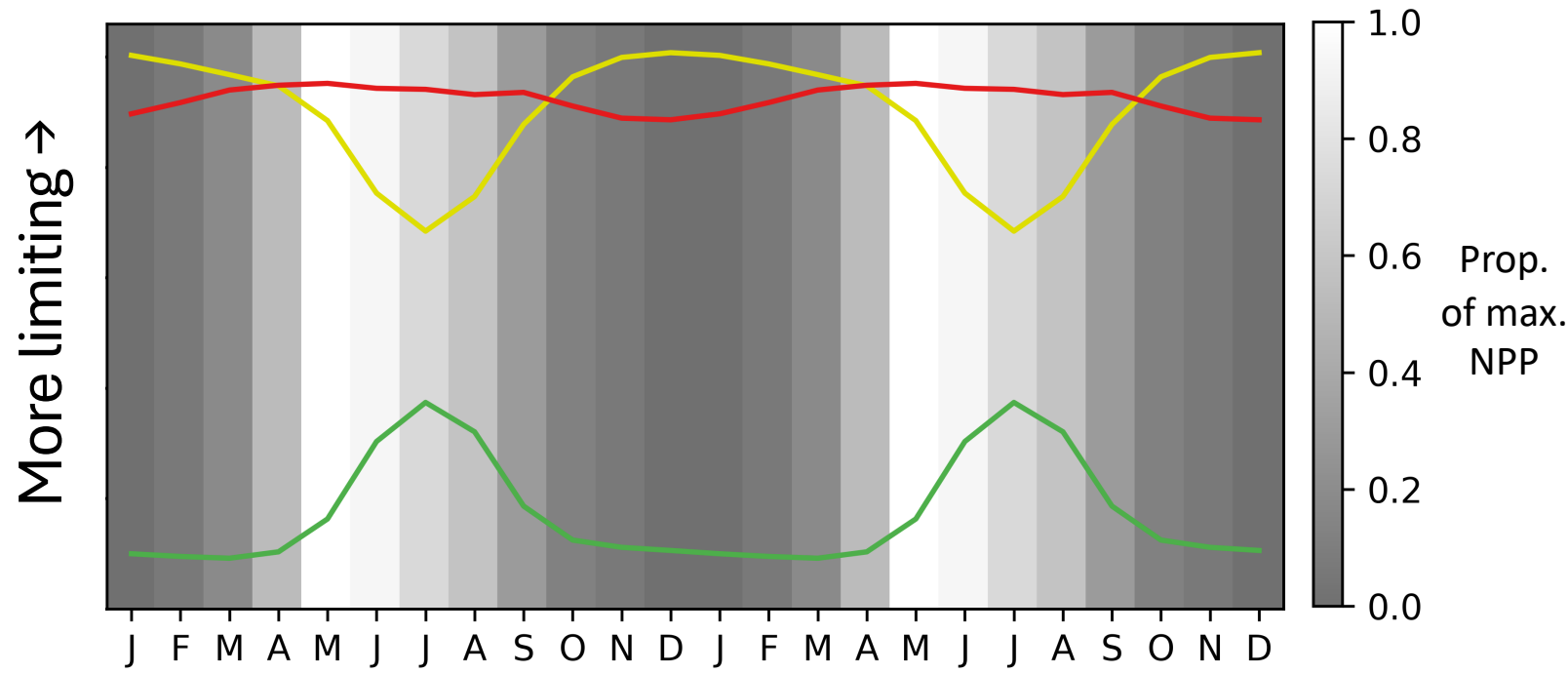
Temperature



Nutrients

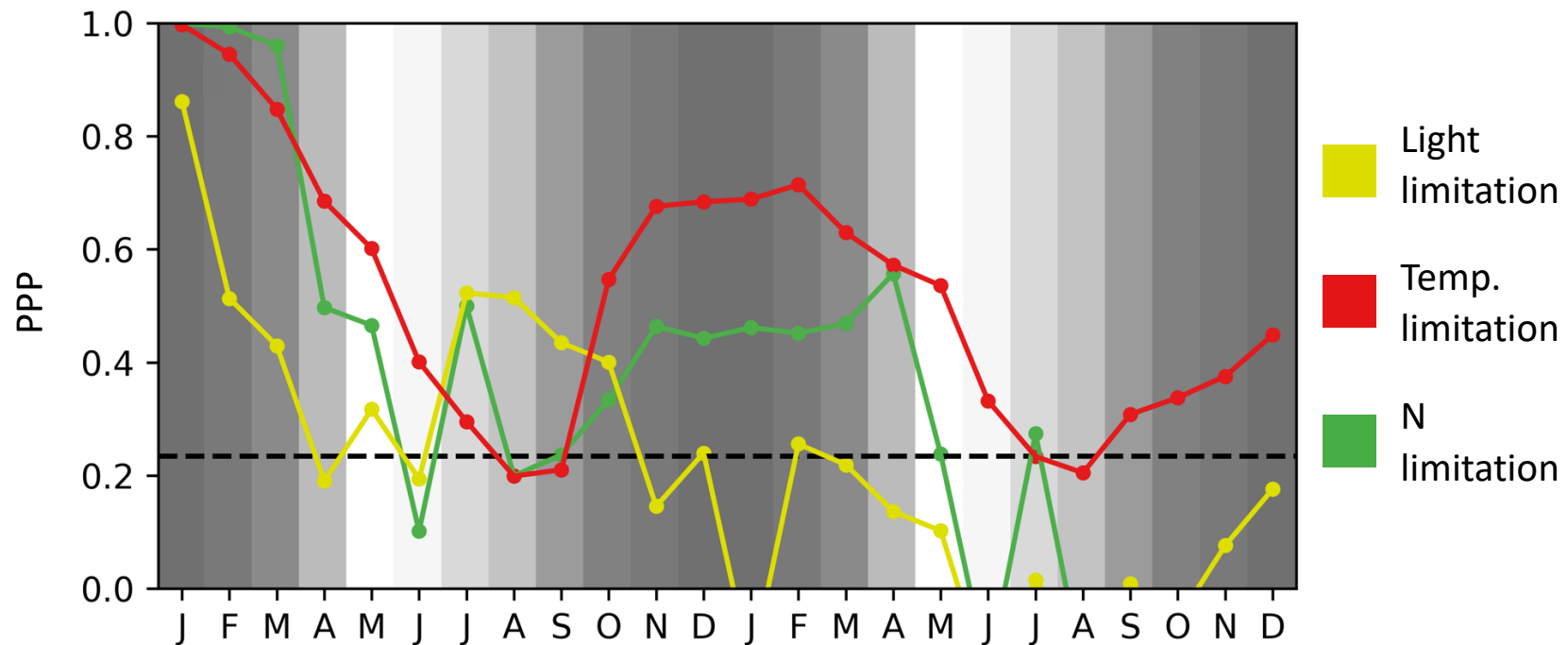
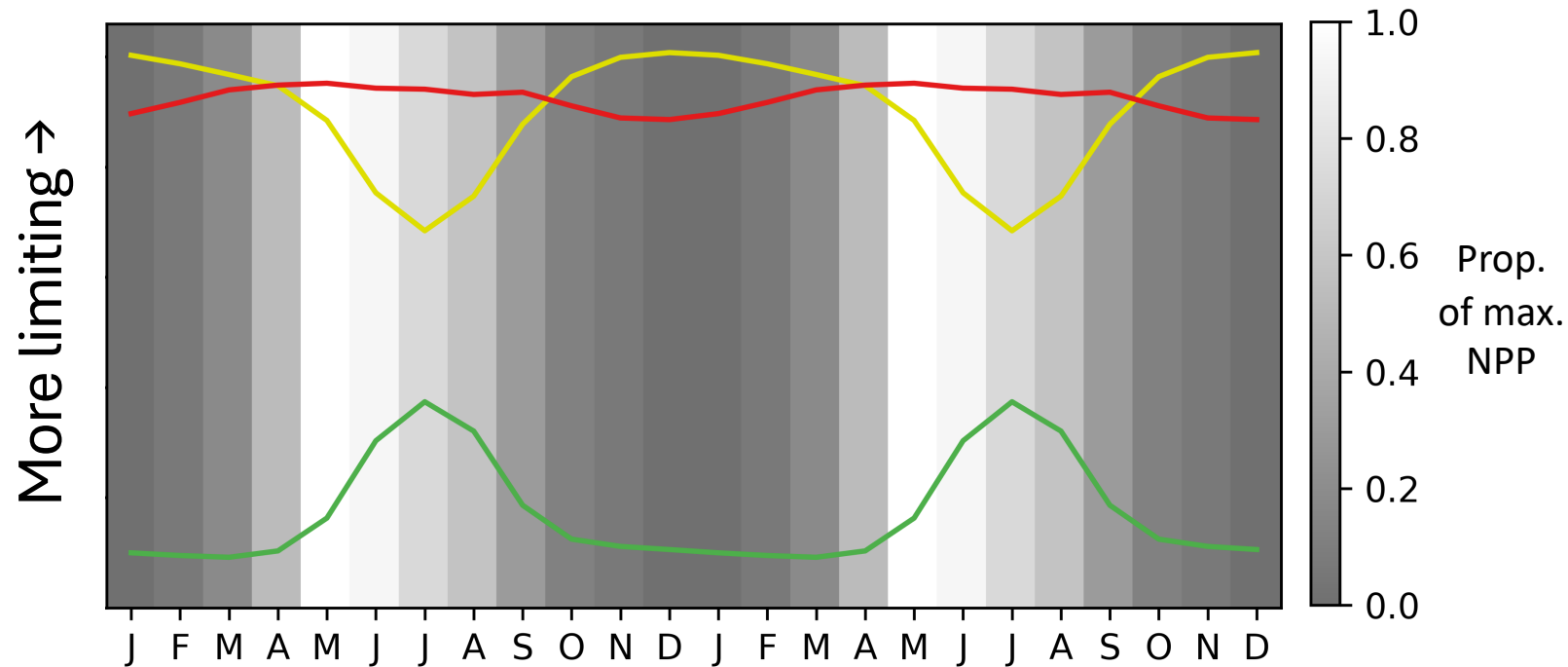
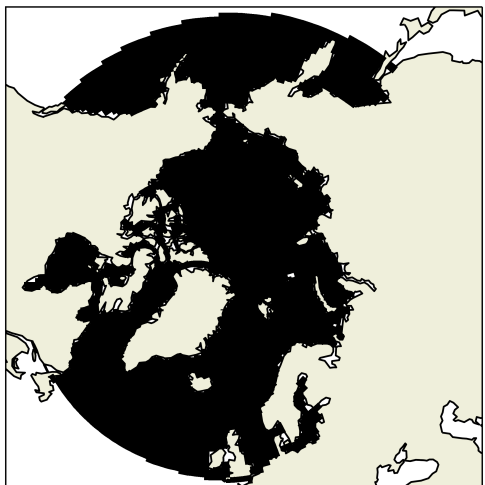


Temperature most controls phytoplankton growth during the most productive months.



- Light limitation
- Temp. limitation
- N limitation

Temperature remains predictable over these two year forecasts.





# Summary

- Phytoplankton NPP in the Arctic Ocean is likely predictable for at least two years, due largely to high predictability on Arctic shelves.
- Ocean temperatures, the most important limit on phytoplankton growth during the productive summer months, drive much of this predictability.
- NPP may become more predictable in the future as more sea ice is lost.