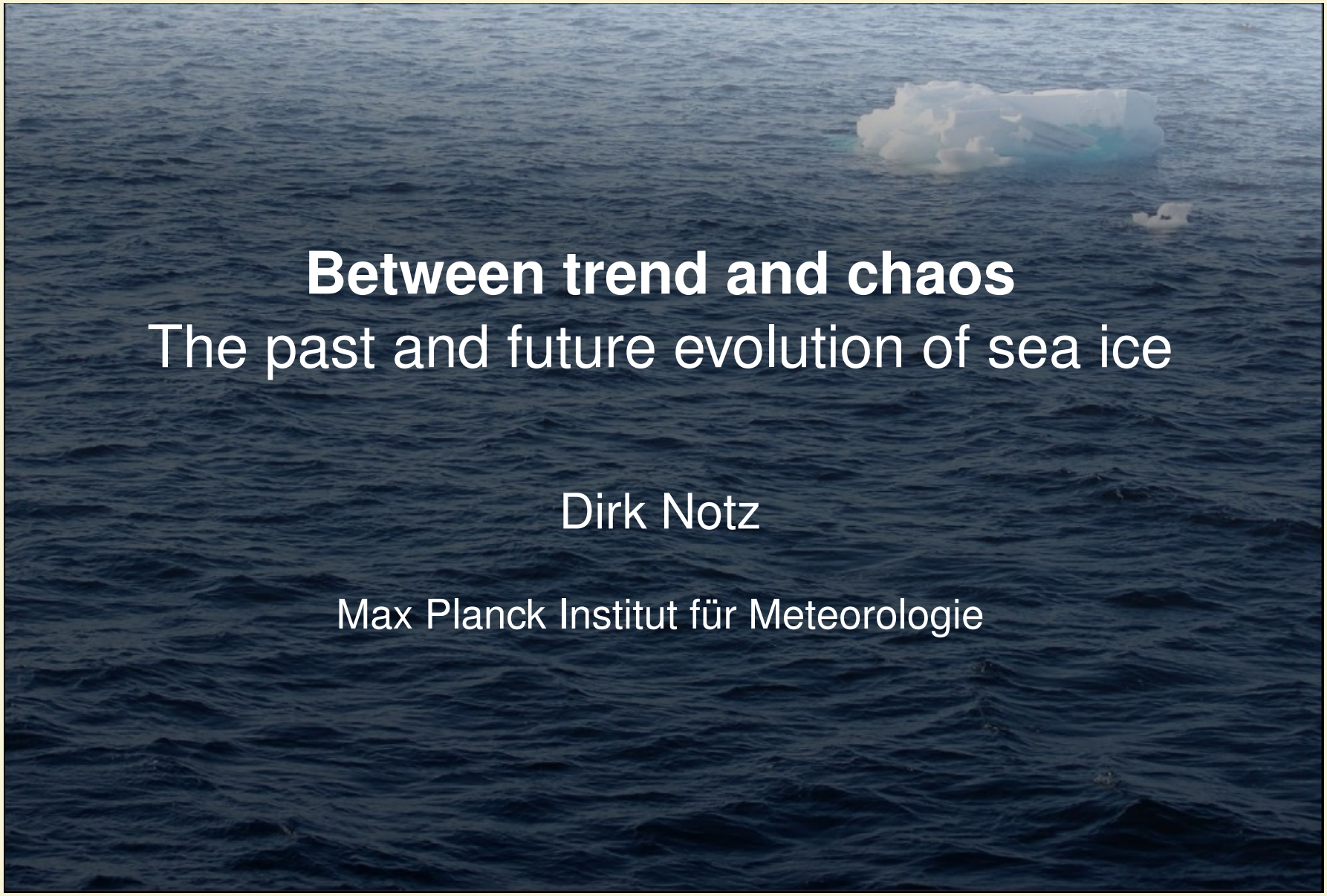
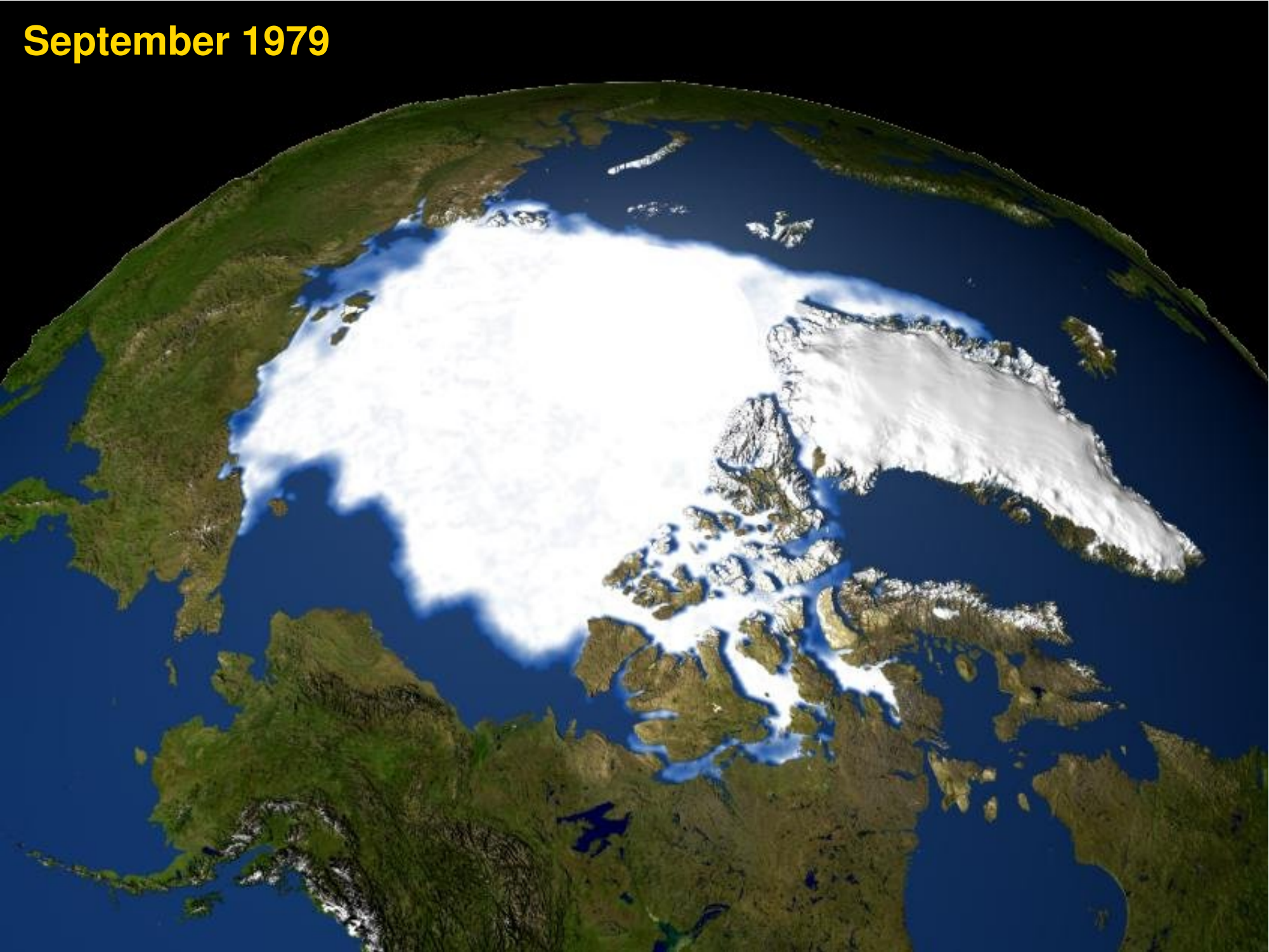
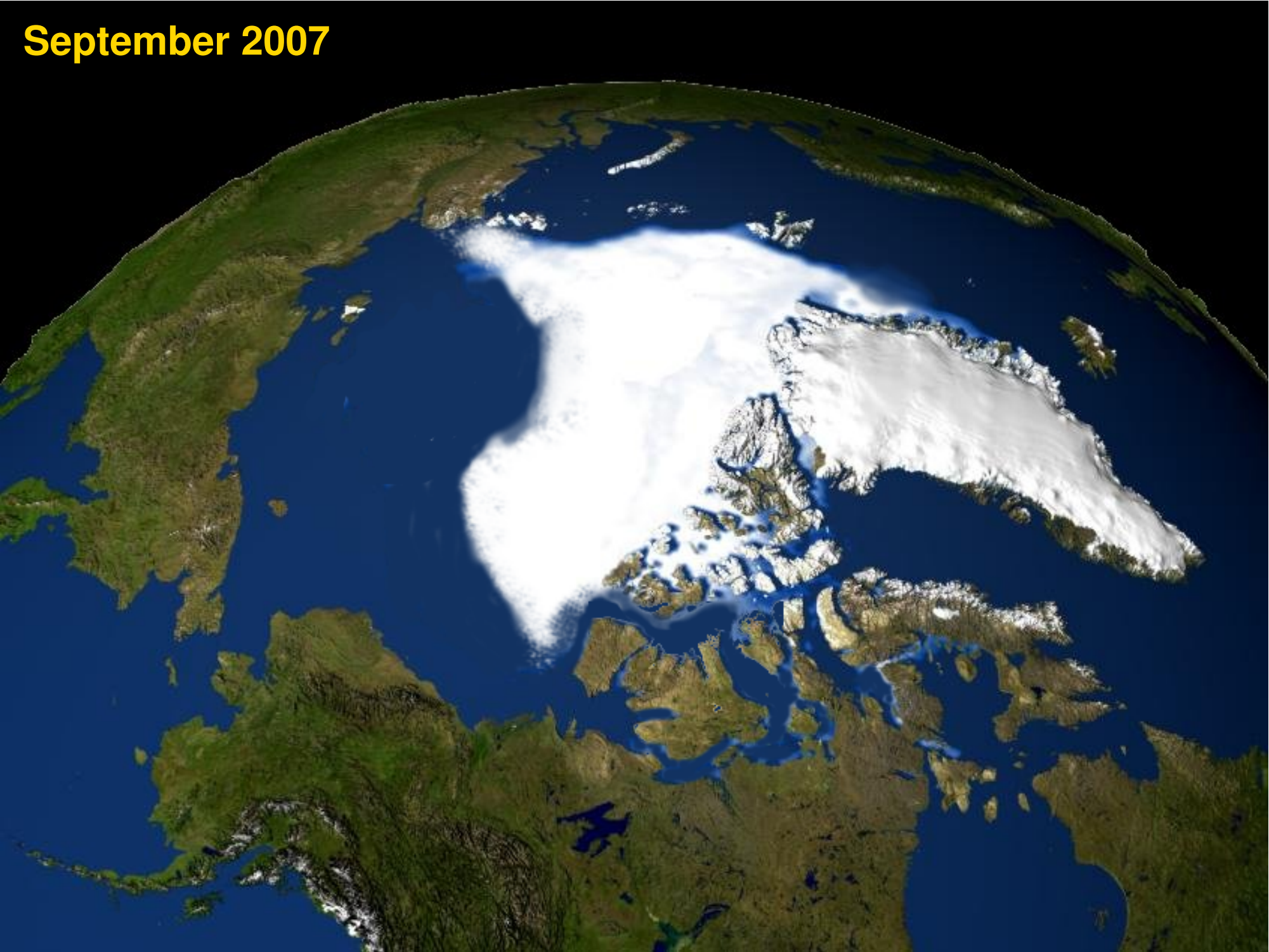


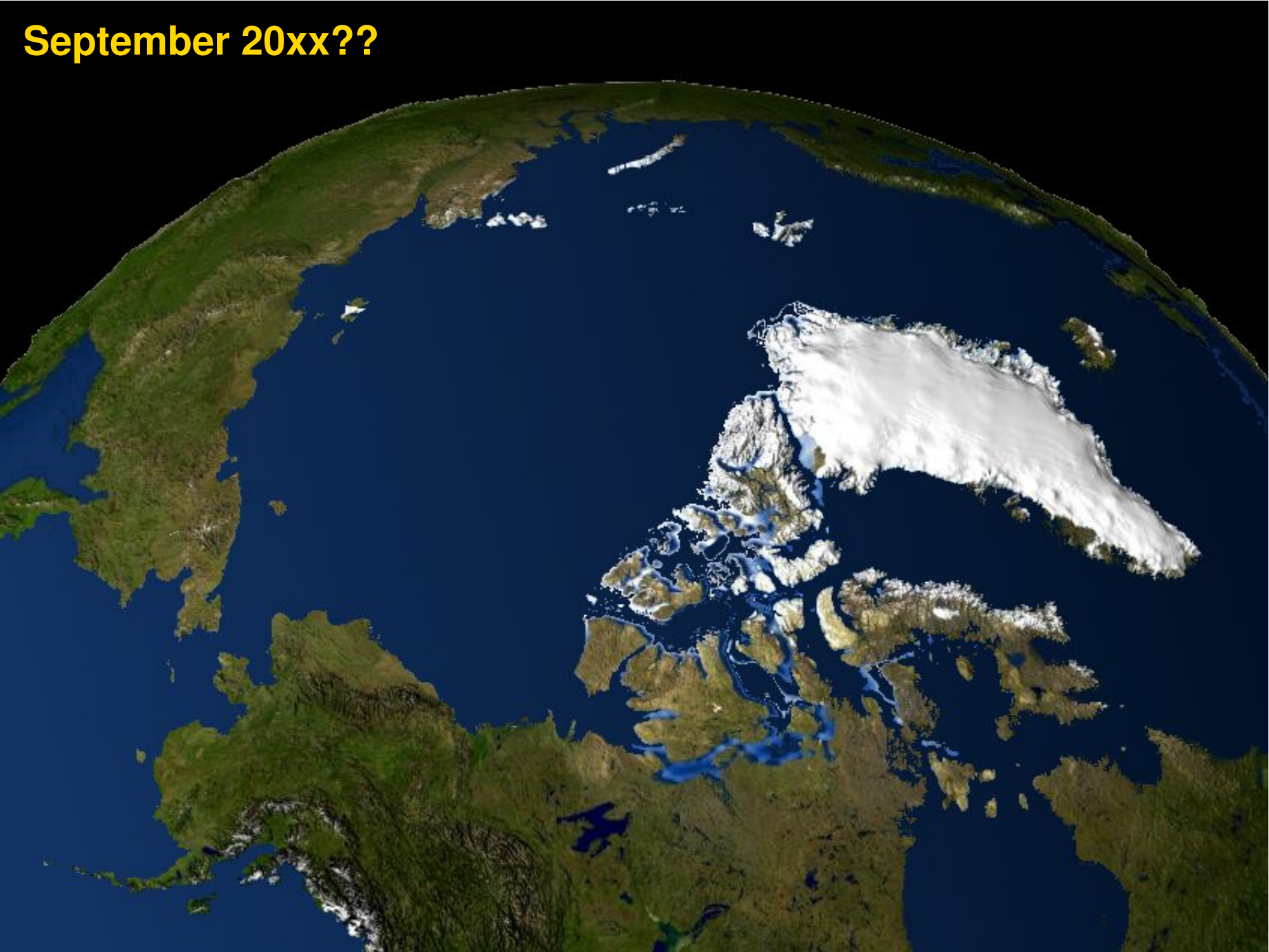
Between trend and chaos
The past and future evolution of sea ice

Dirk Notz

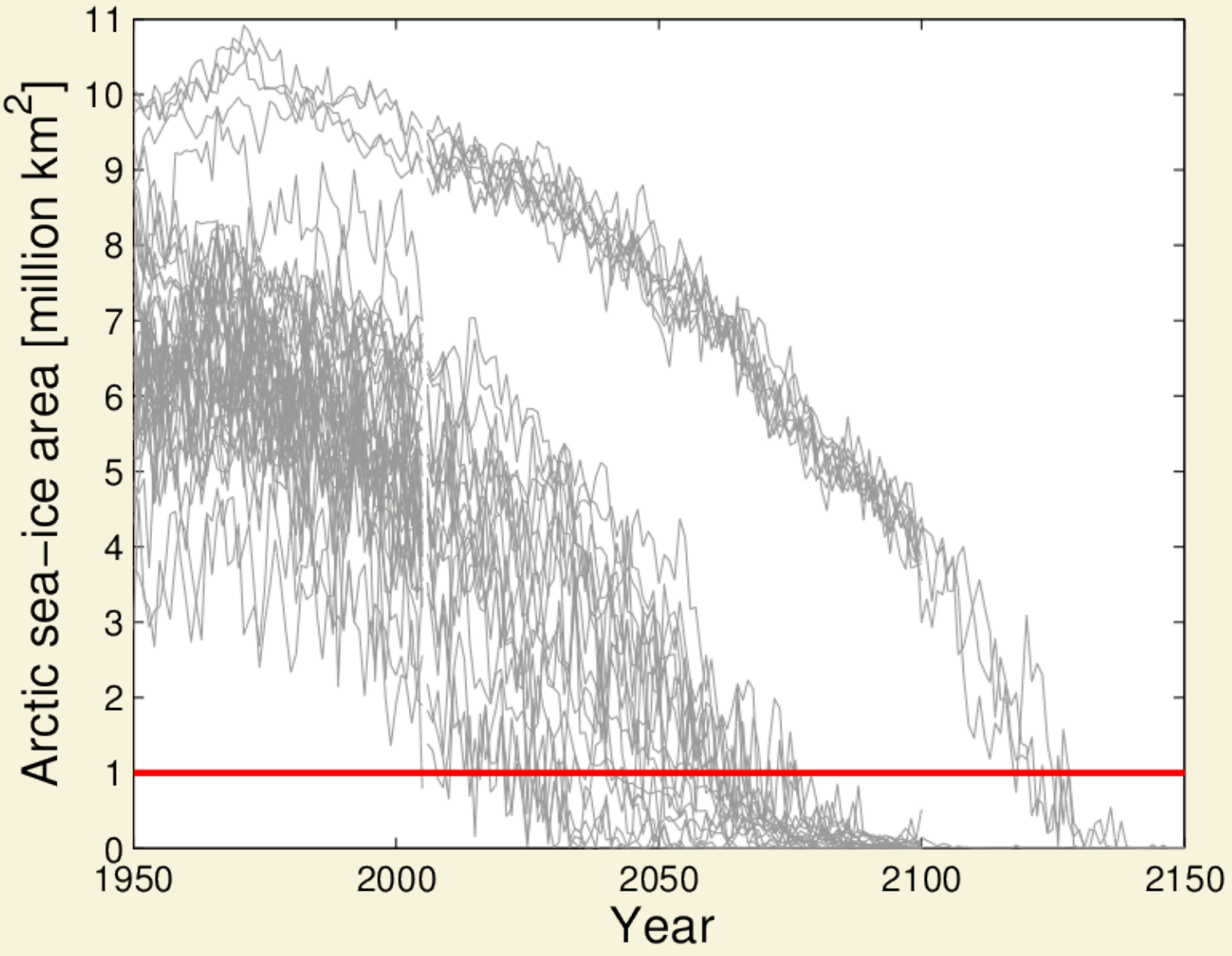
Max Planck Institut für Meteorologie


September 1979


September 2007


September 20xx??

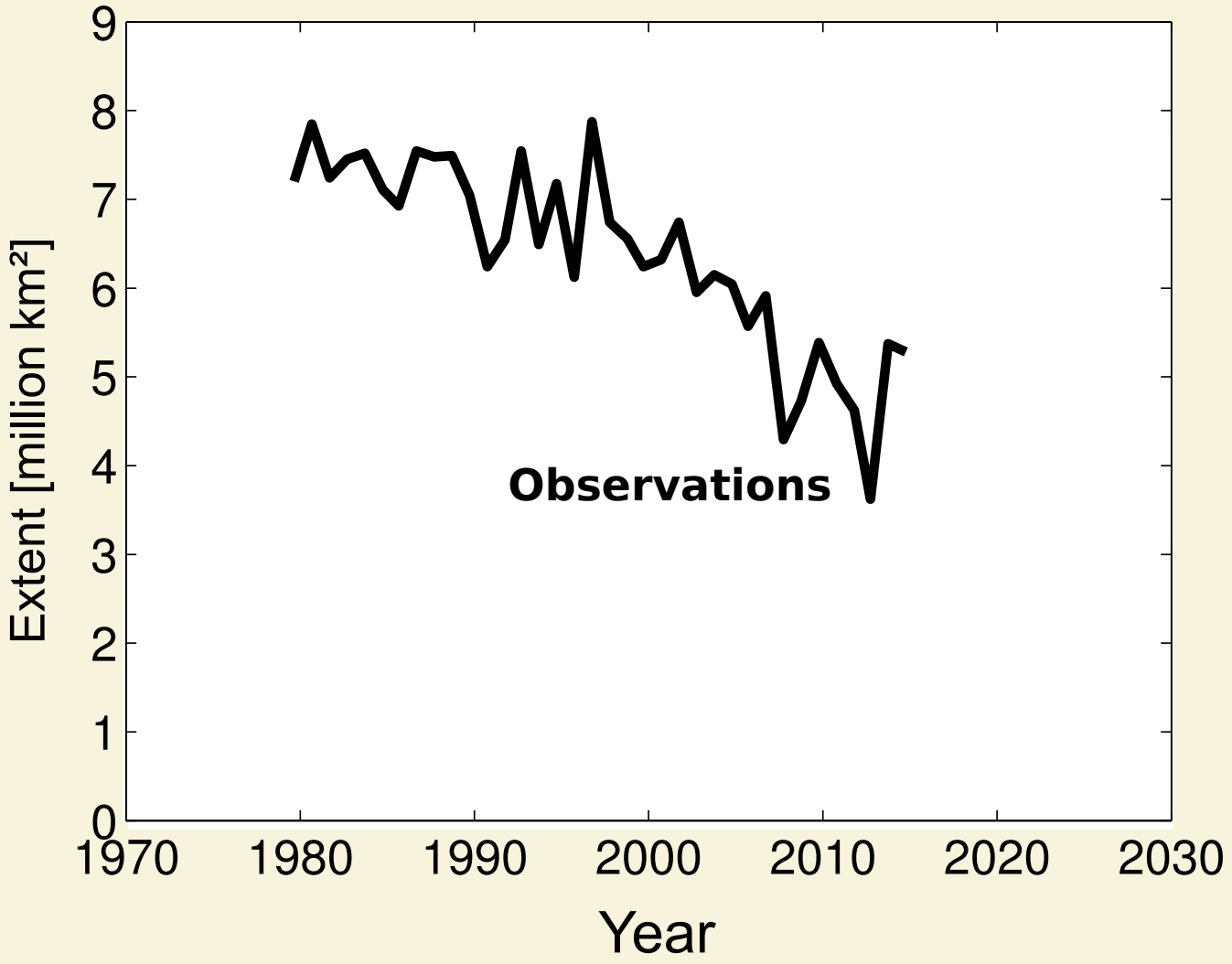
RCP 8.5: Arctic summer sea ice gone by 2005–2130



Overview

1. Why is it hard to figure out when sea ice is gone?
2. Ways forward

September Arctic sea-ice extent



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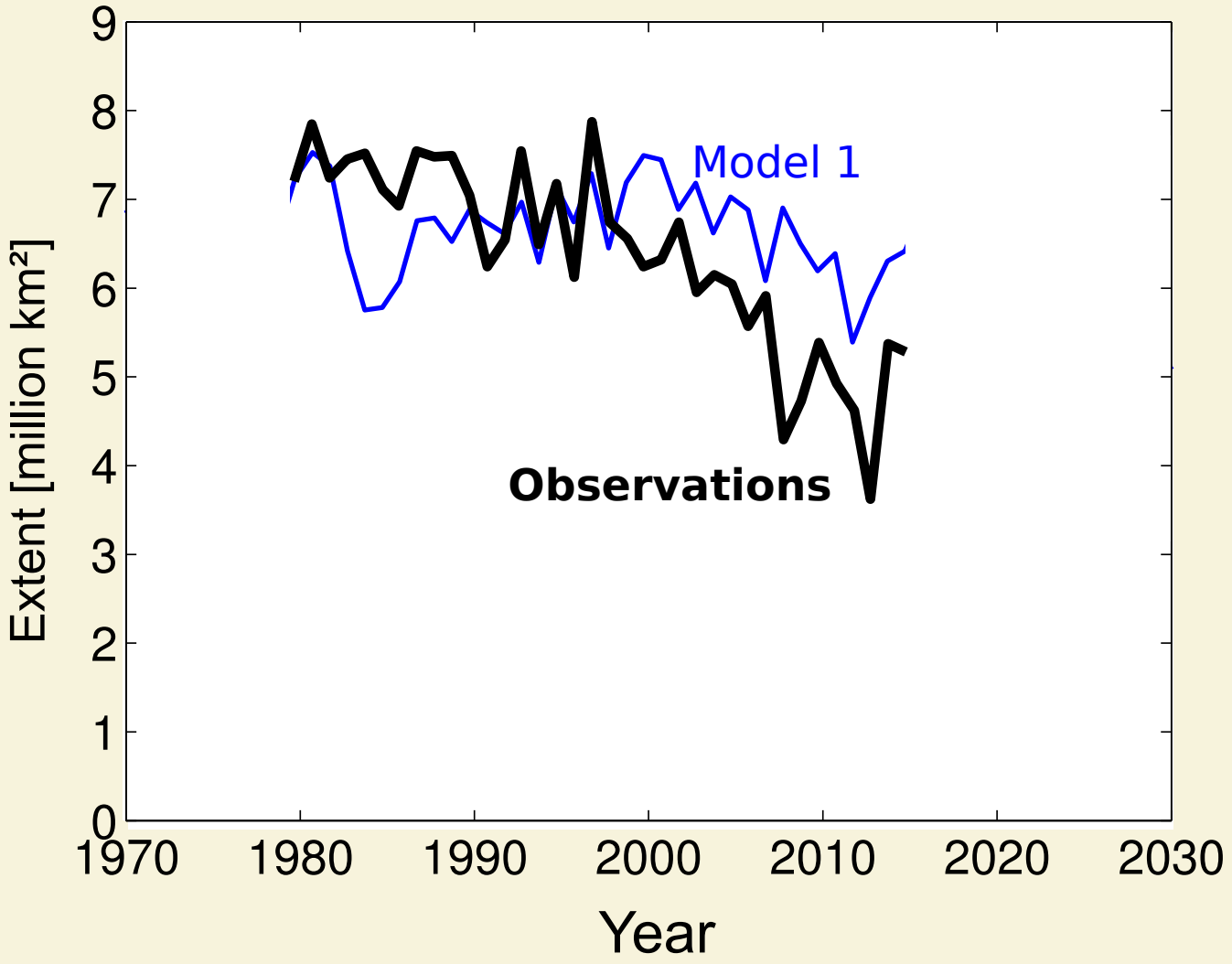

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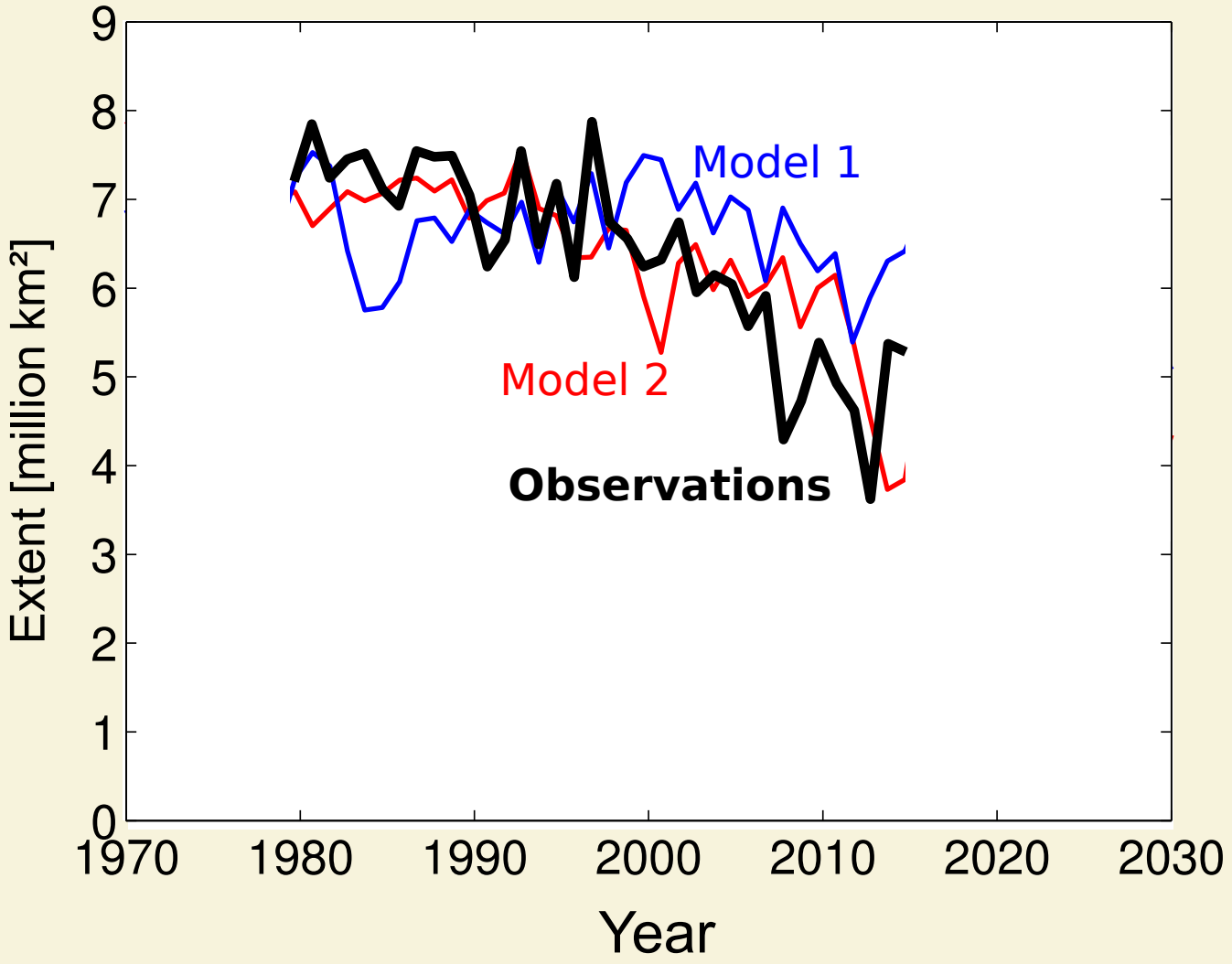

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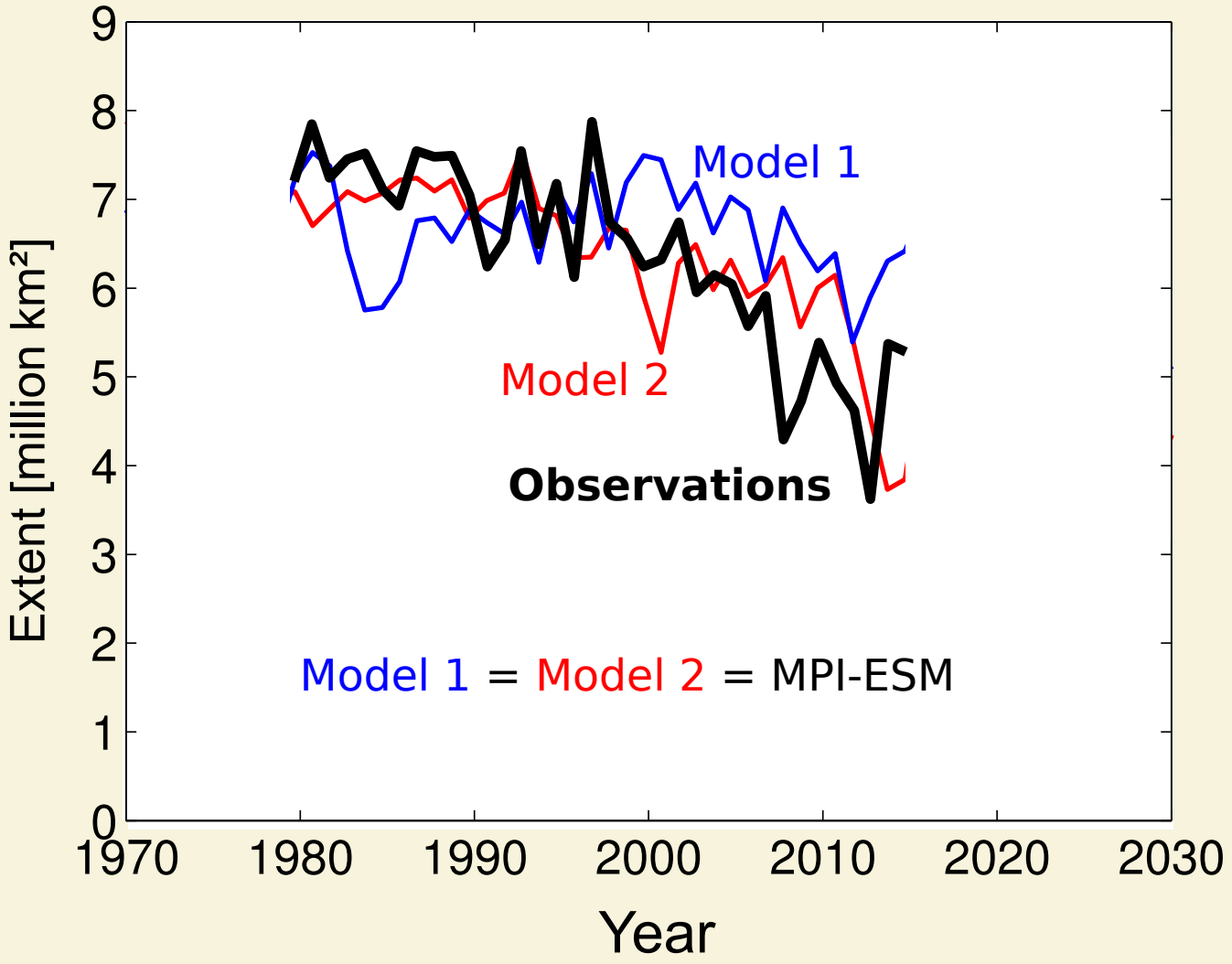

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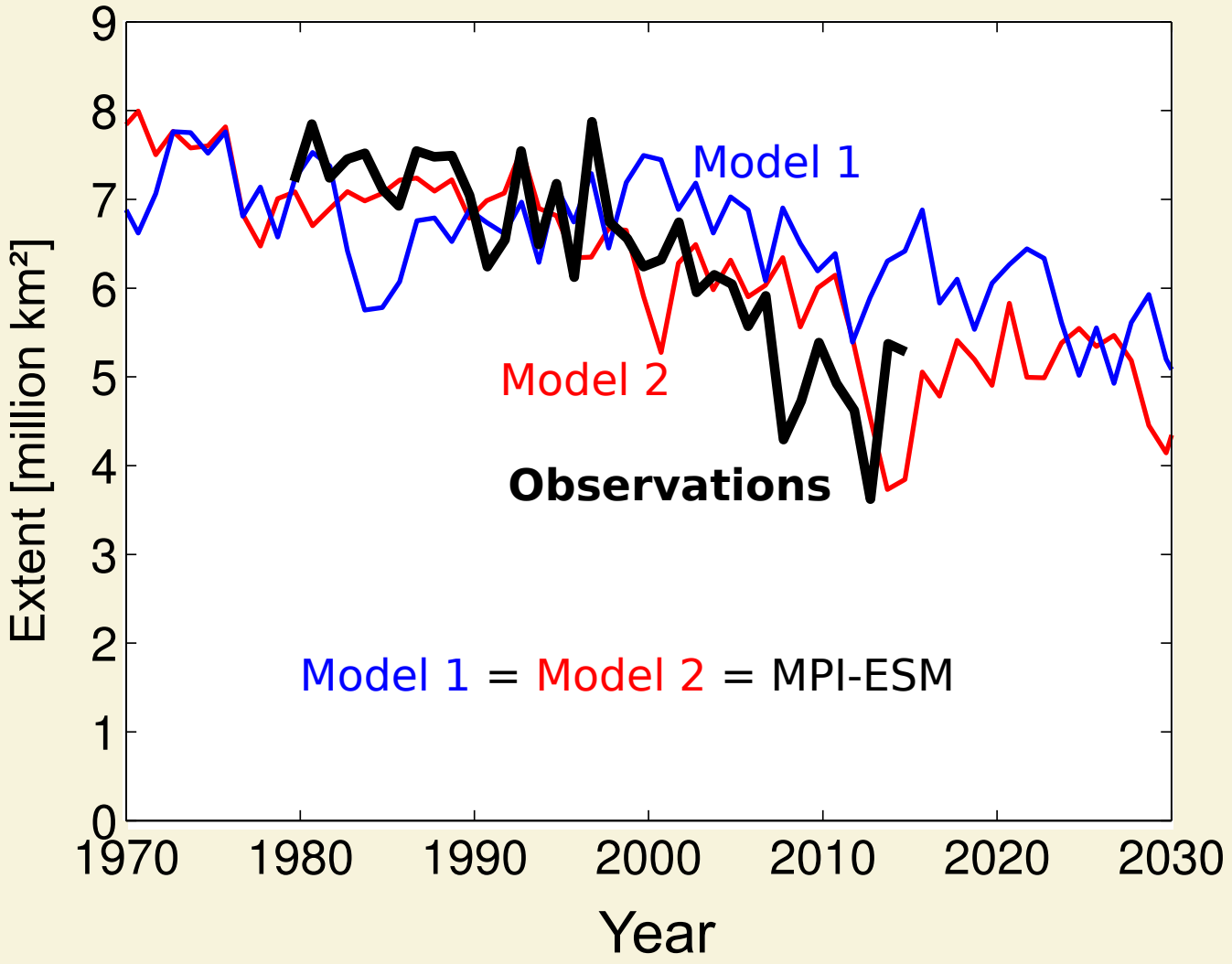
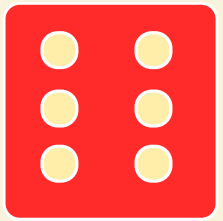


“Let’s pick models that best capture the trend”

Reality



Notz, “How well must climate models agree with observations”, Phil. Trans. R. Soc. A, 2015

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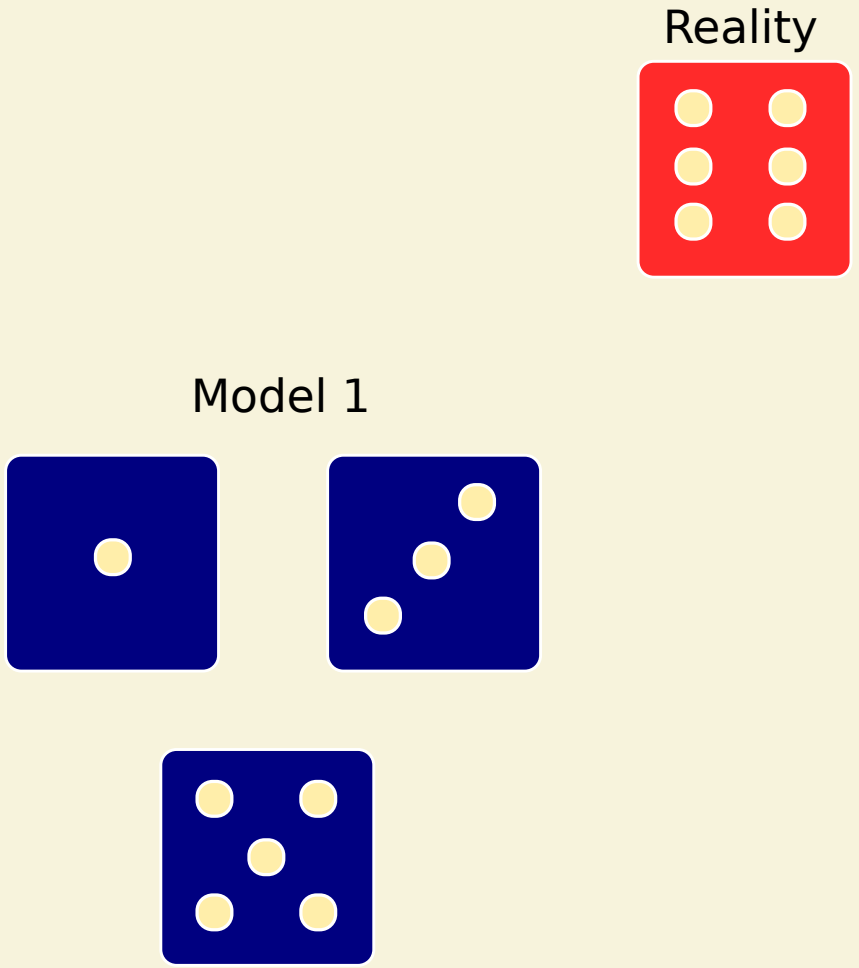

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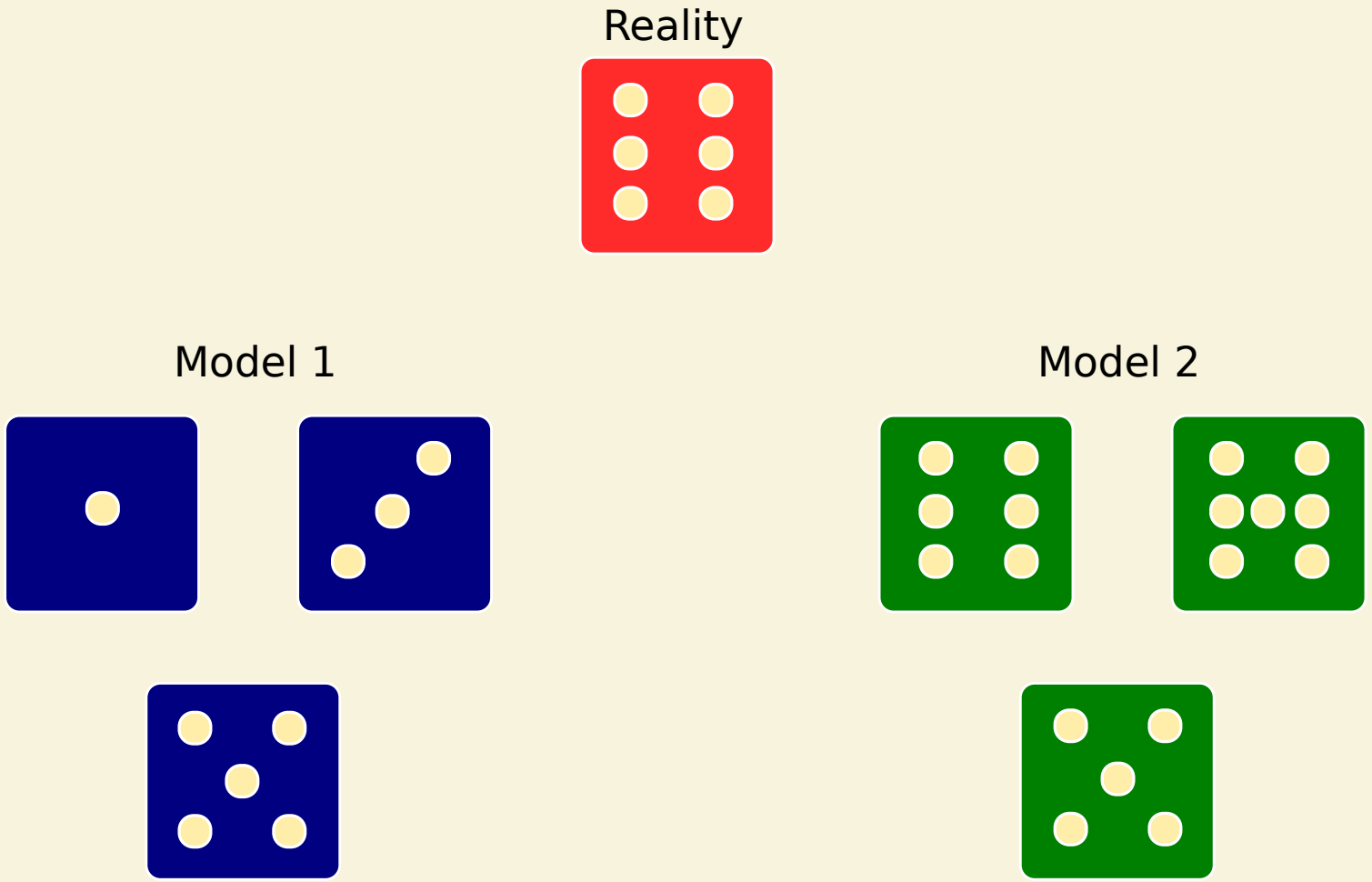

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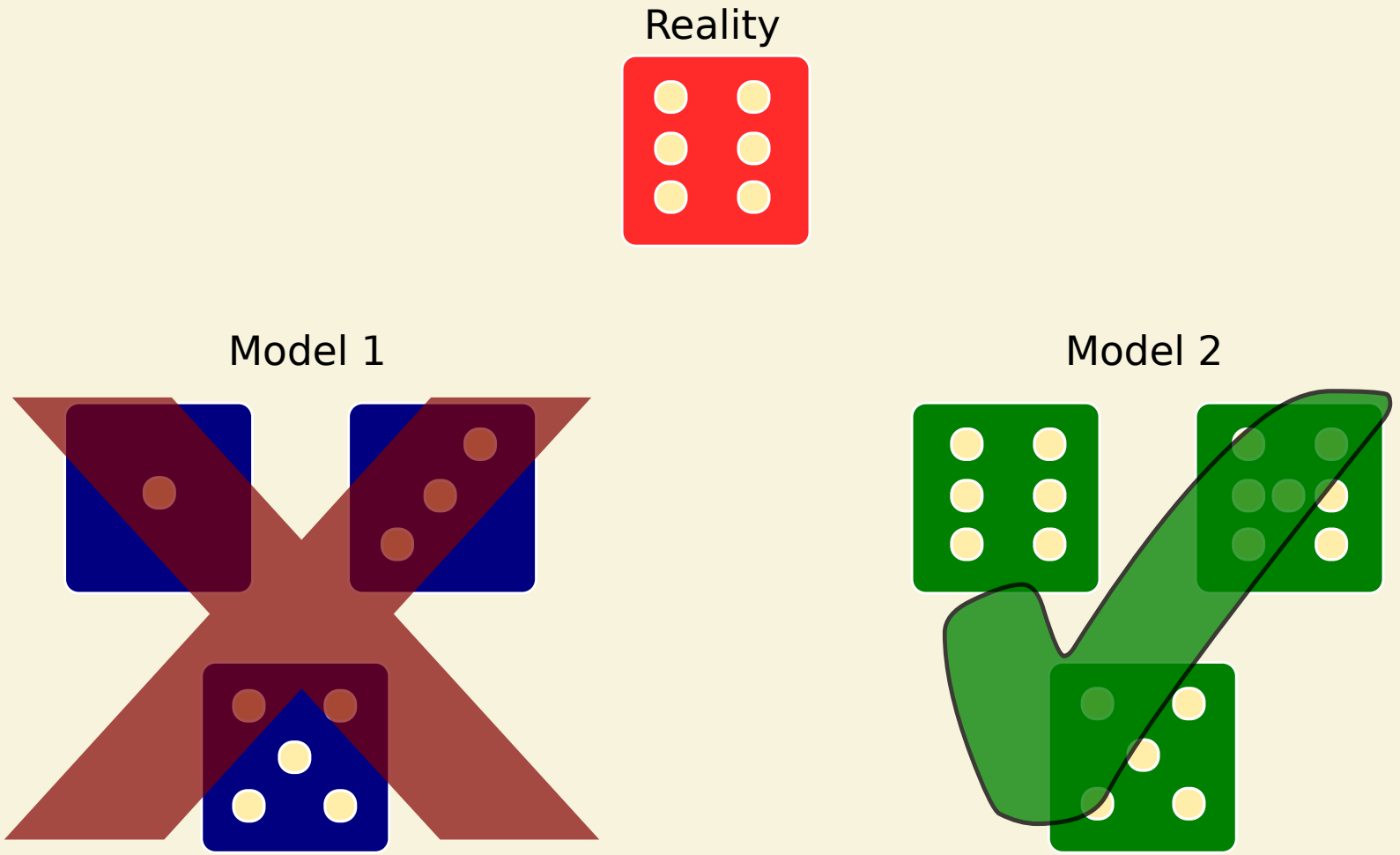

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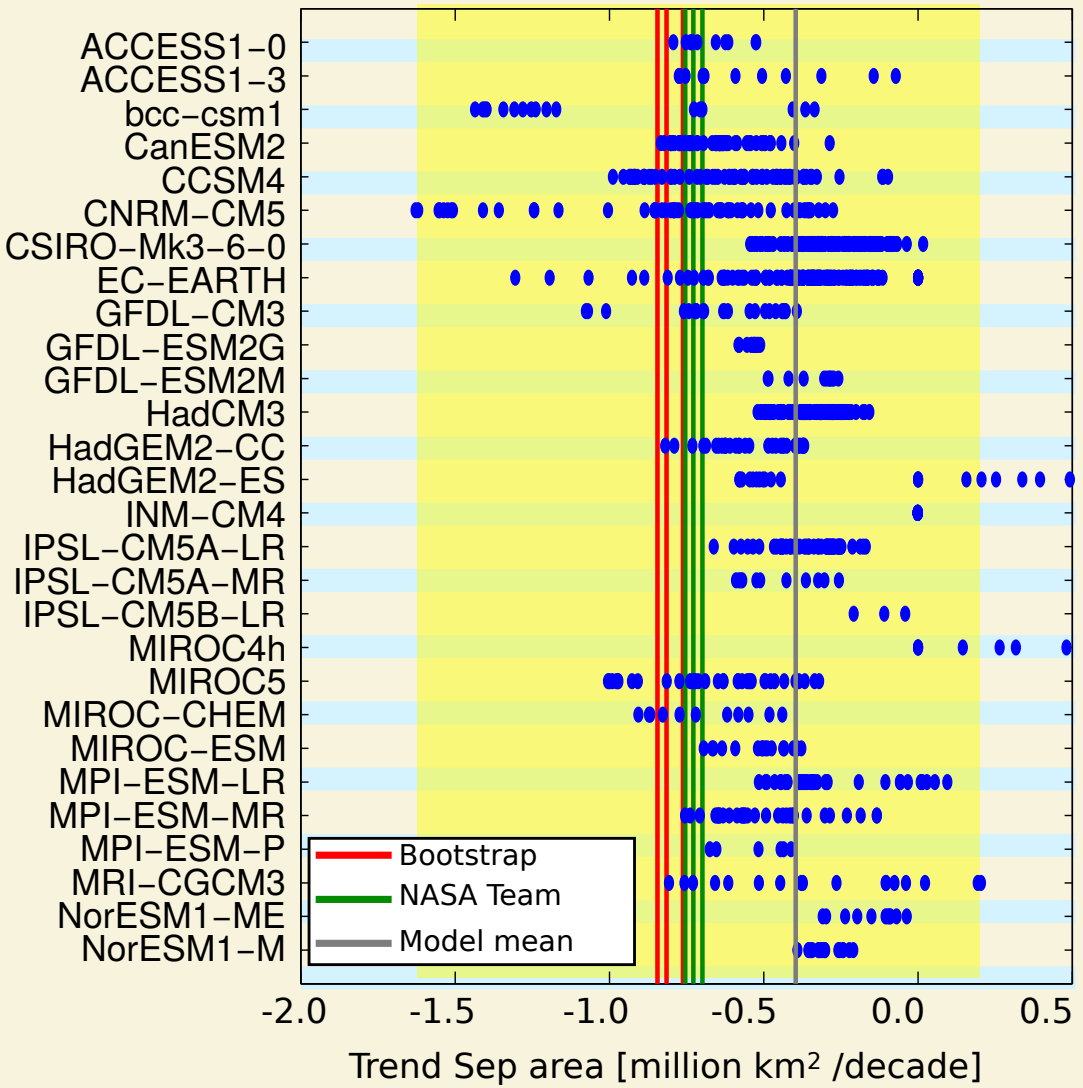
Obvious (?) take home messages

1. The model that best agrees with observations is not necessarily the best model

Trends in Arctic sea-ice area from CMIP5

30-year trends, synthetically increased ensemble



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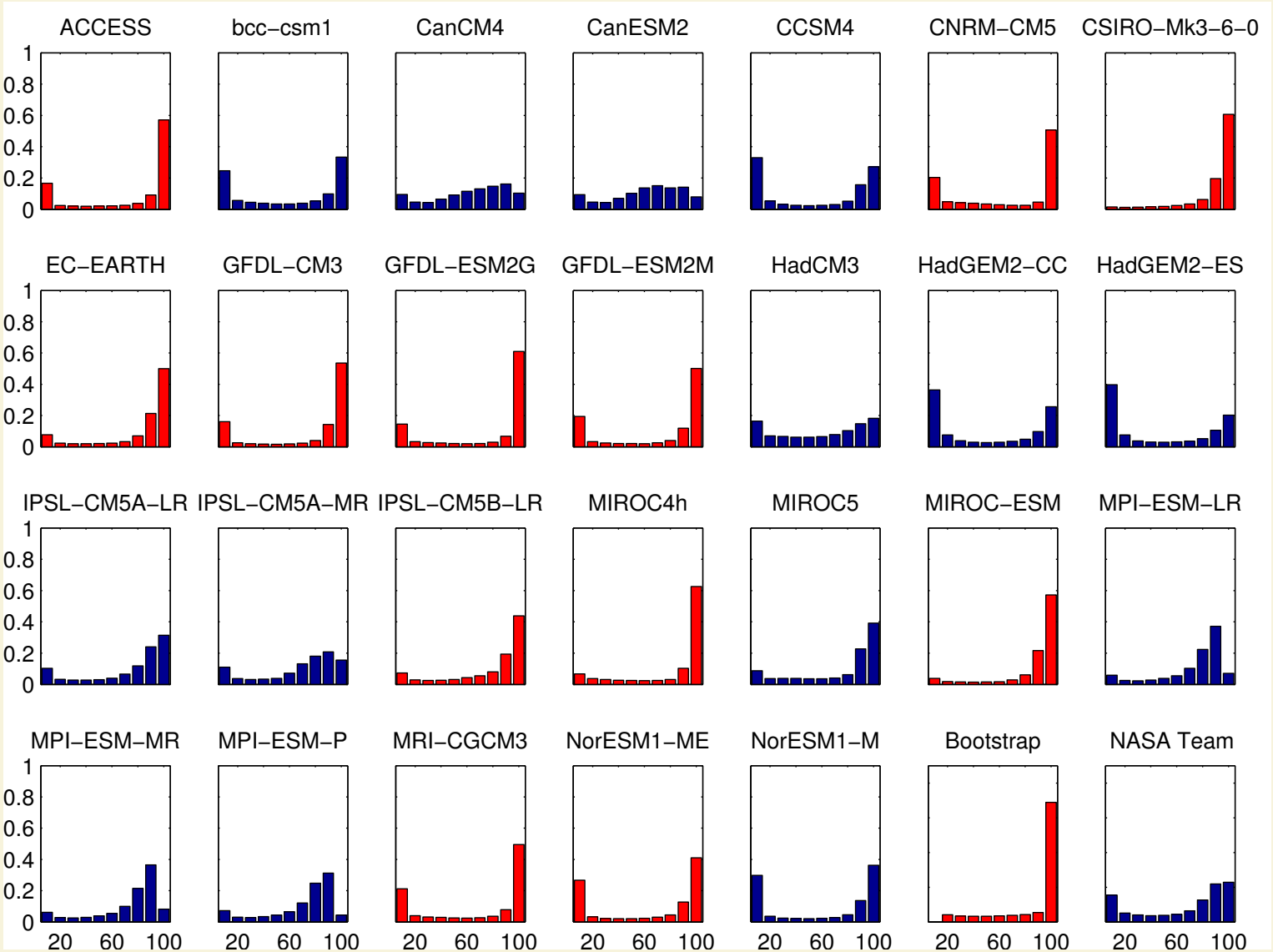
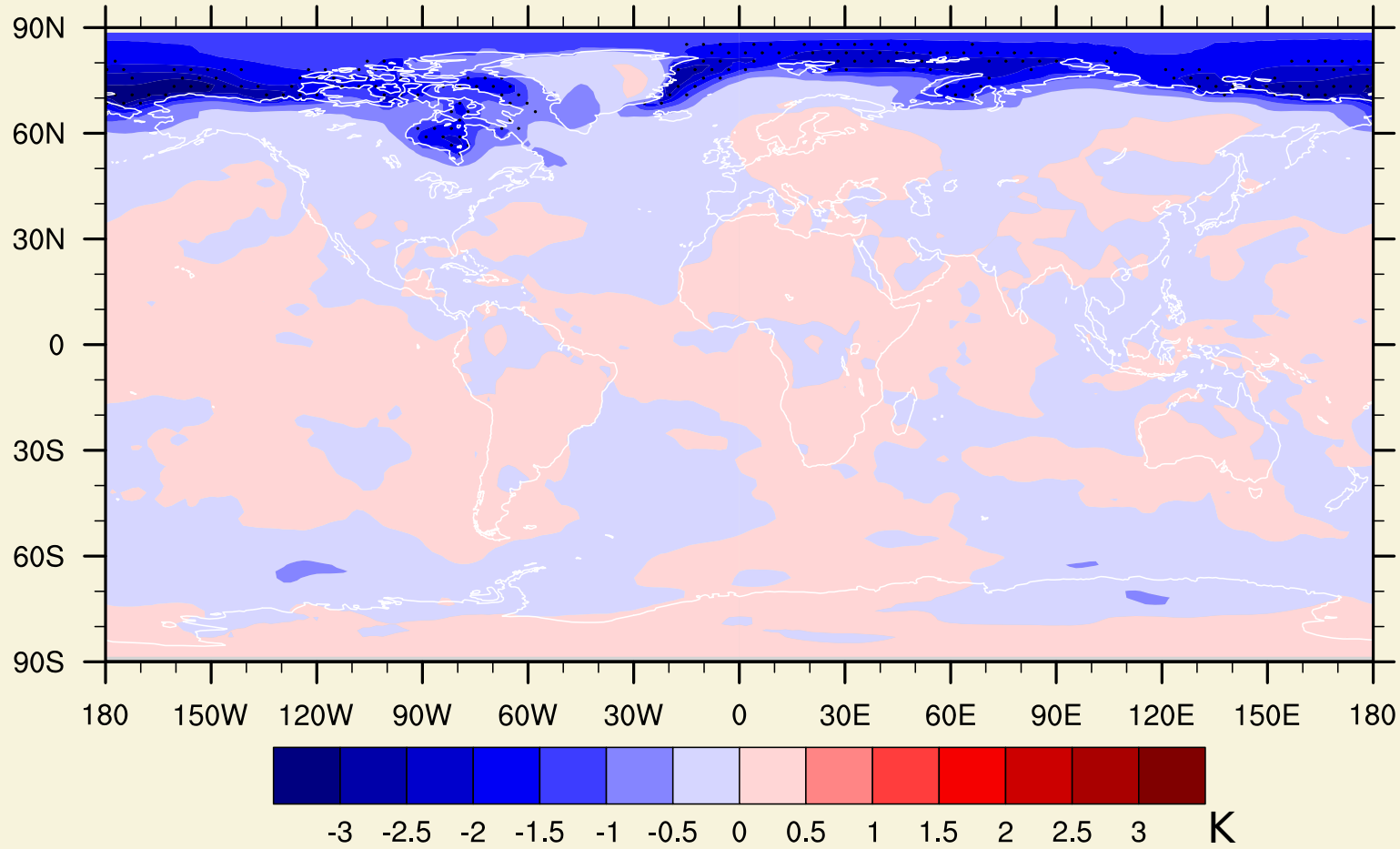
Histograms of Arctic summer sea-ice concentration



Observational uncertainty can have large impact



ΔSST in September between two simulations initialised in May with either NASA Team or Bootstrap sea-ice area

Bunzel et al., GRL, submitted

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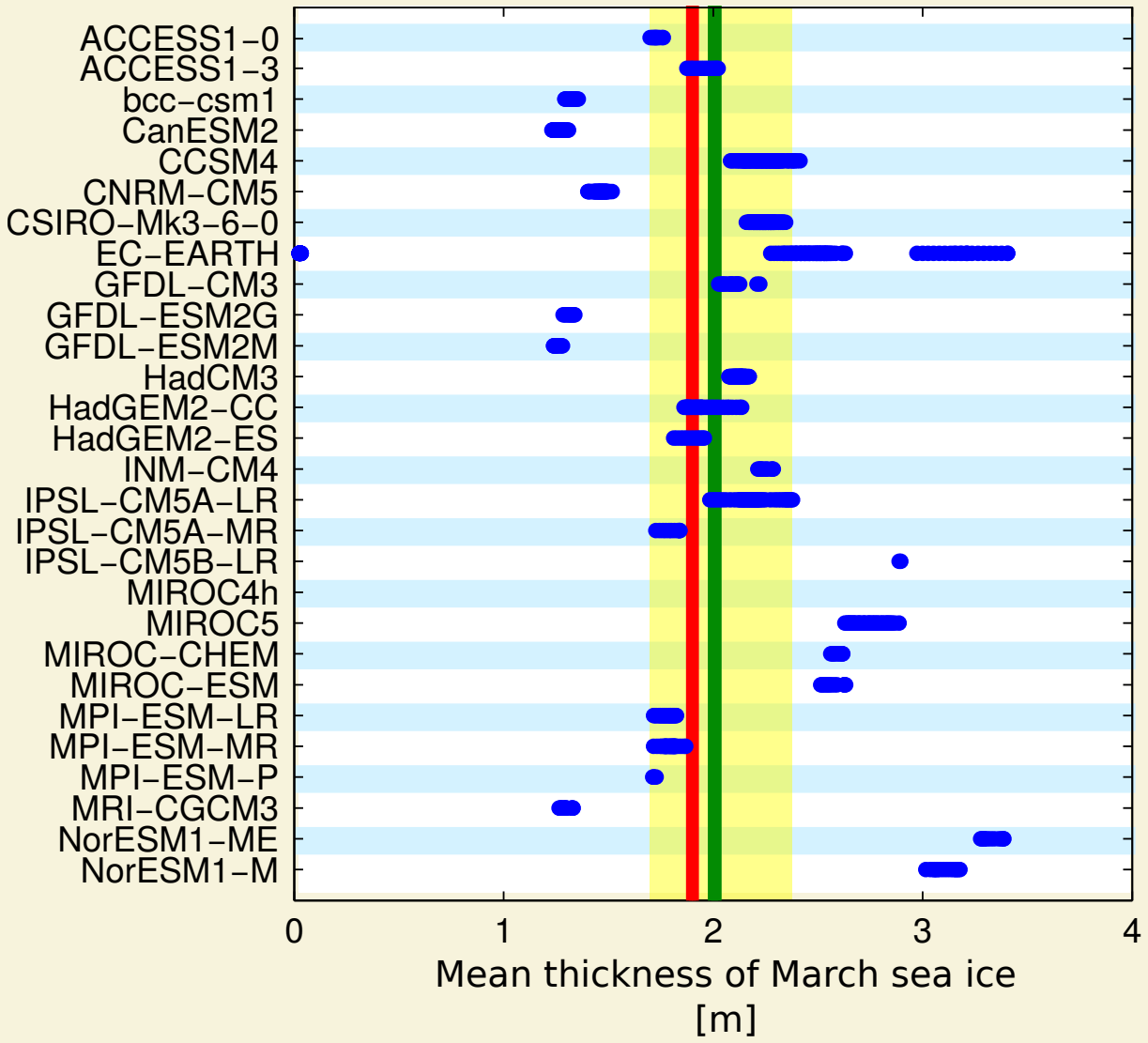
30-year mean thickness of March sea ice



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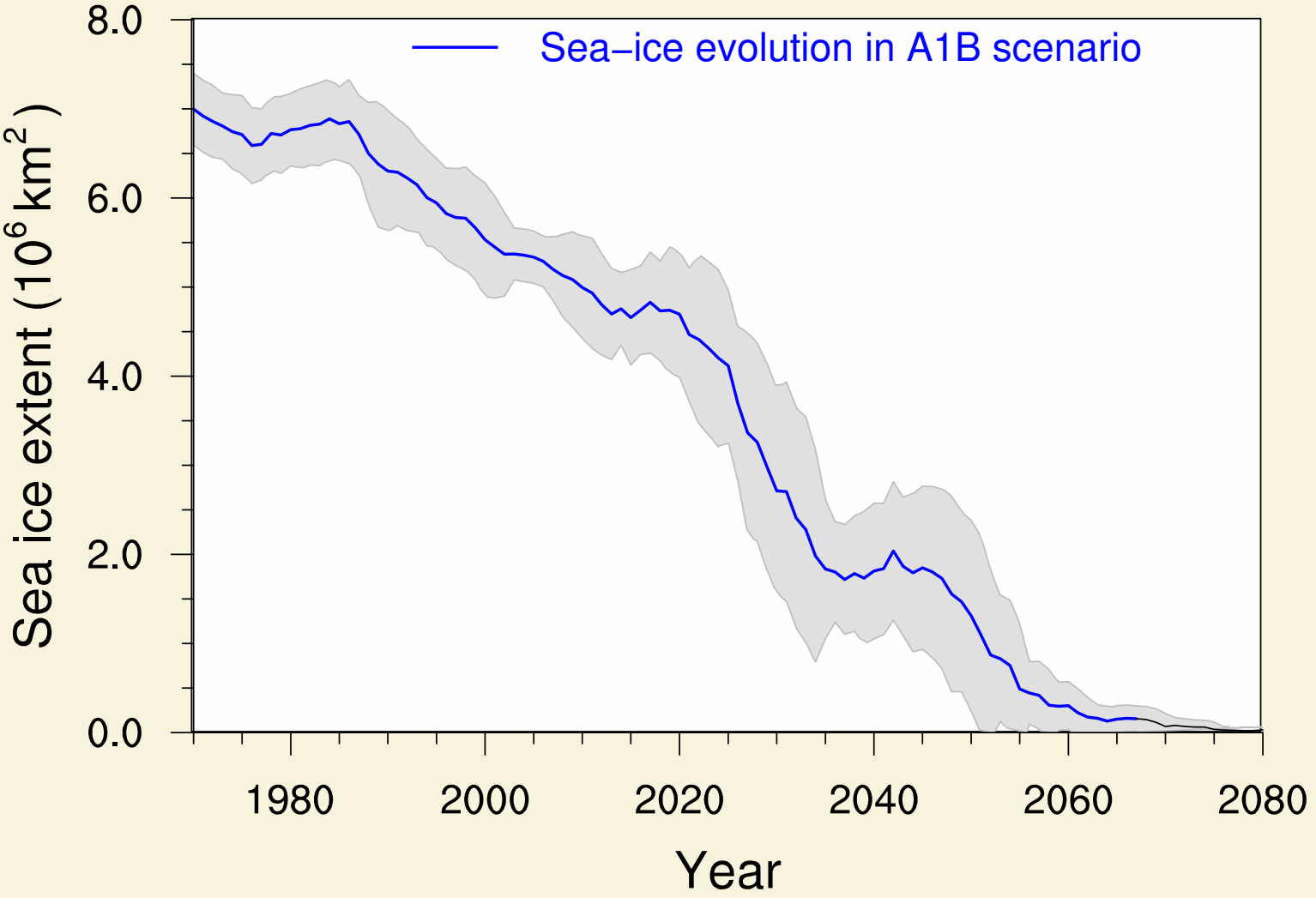
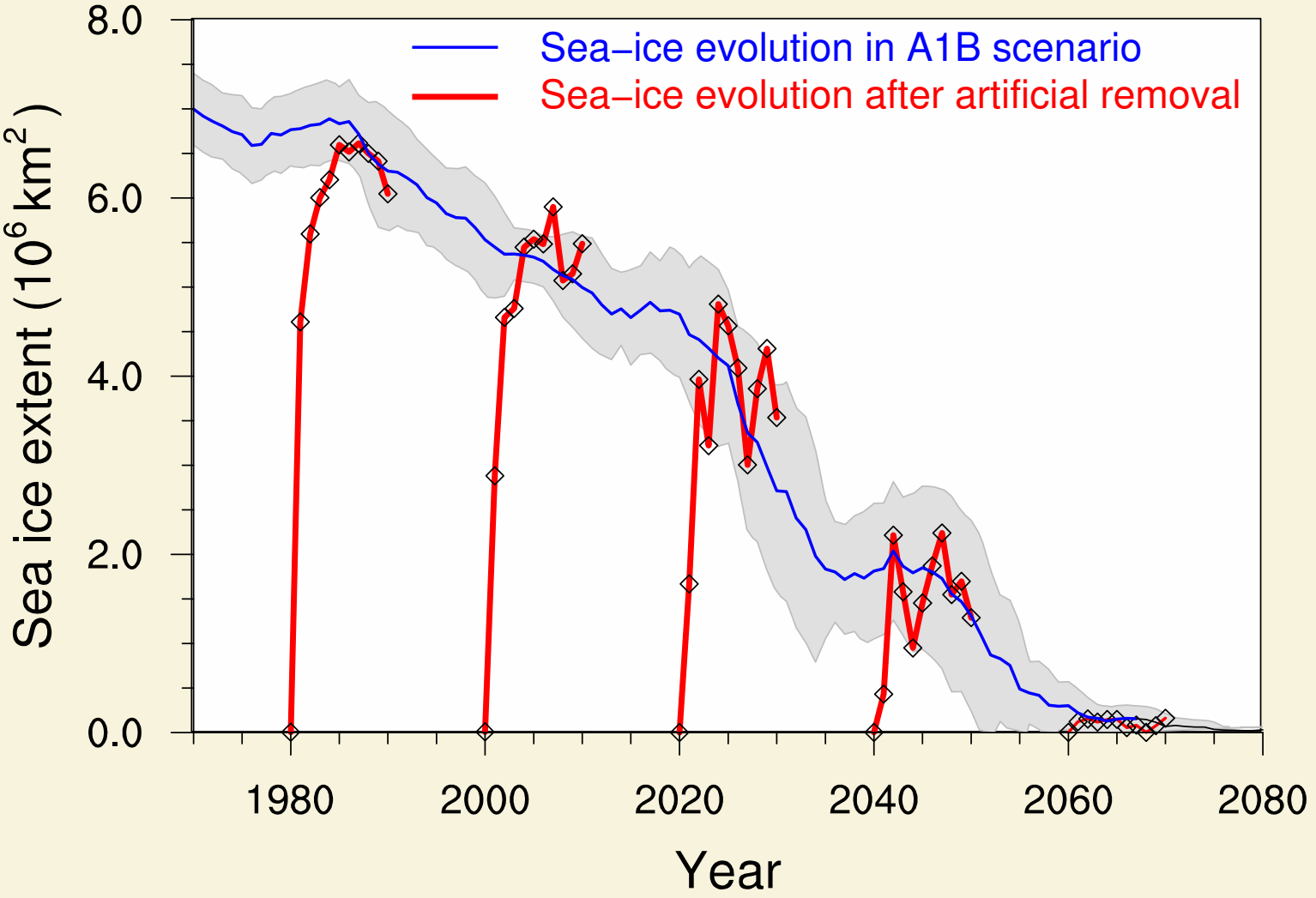
Role of feedbacks



Tietsche et al., 2011

Negative feedbacks reset possible decadal memory



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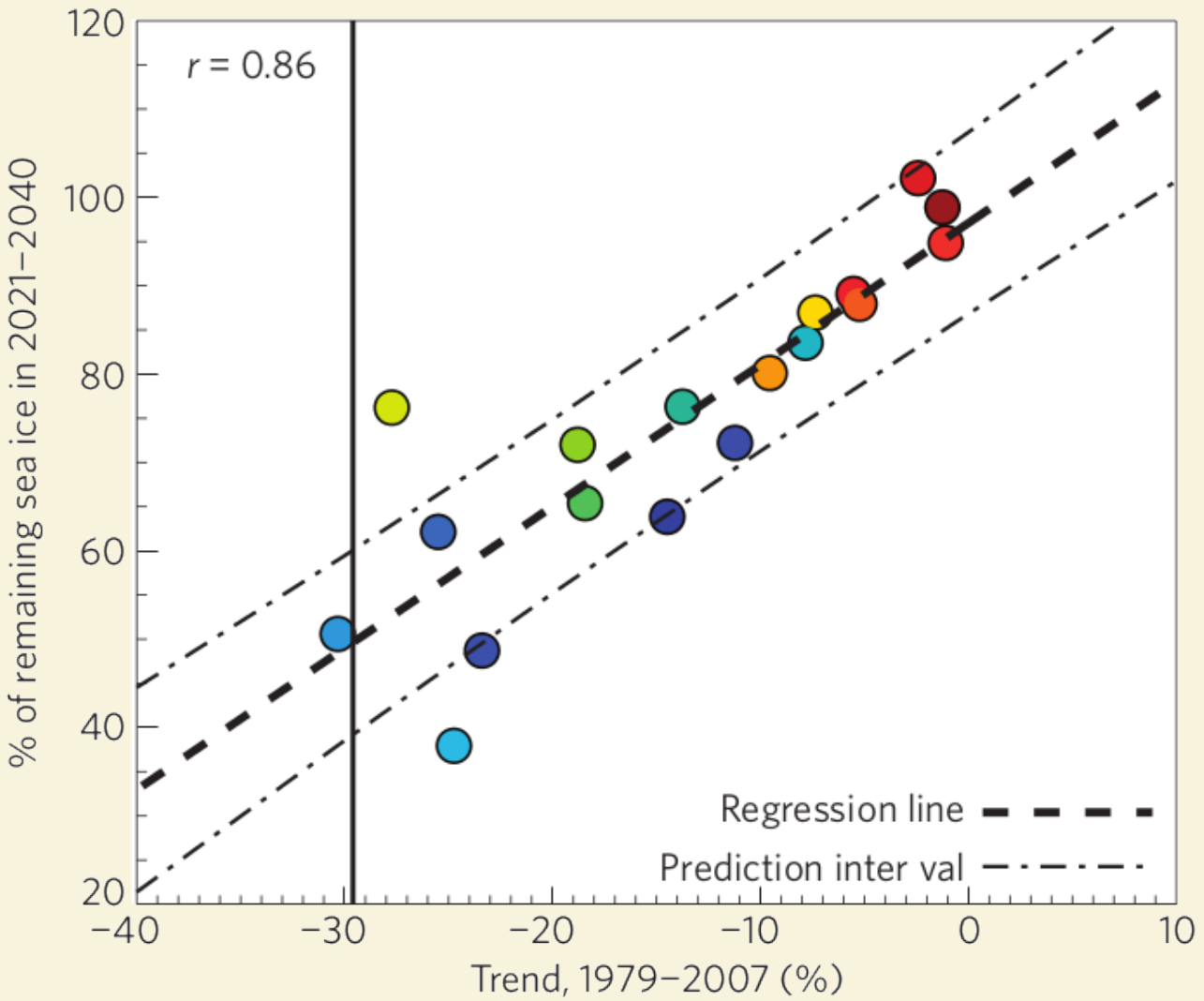
6. Negative feedbacks make it hard to beat persistence forecasts

Overview

1 Why is it hard to figure out when sea ice is gone?

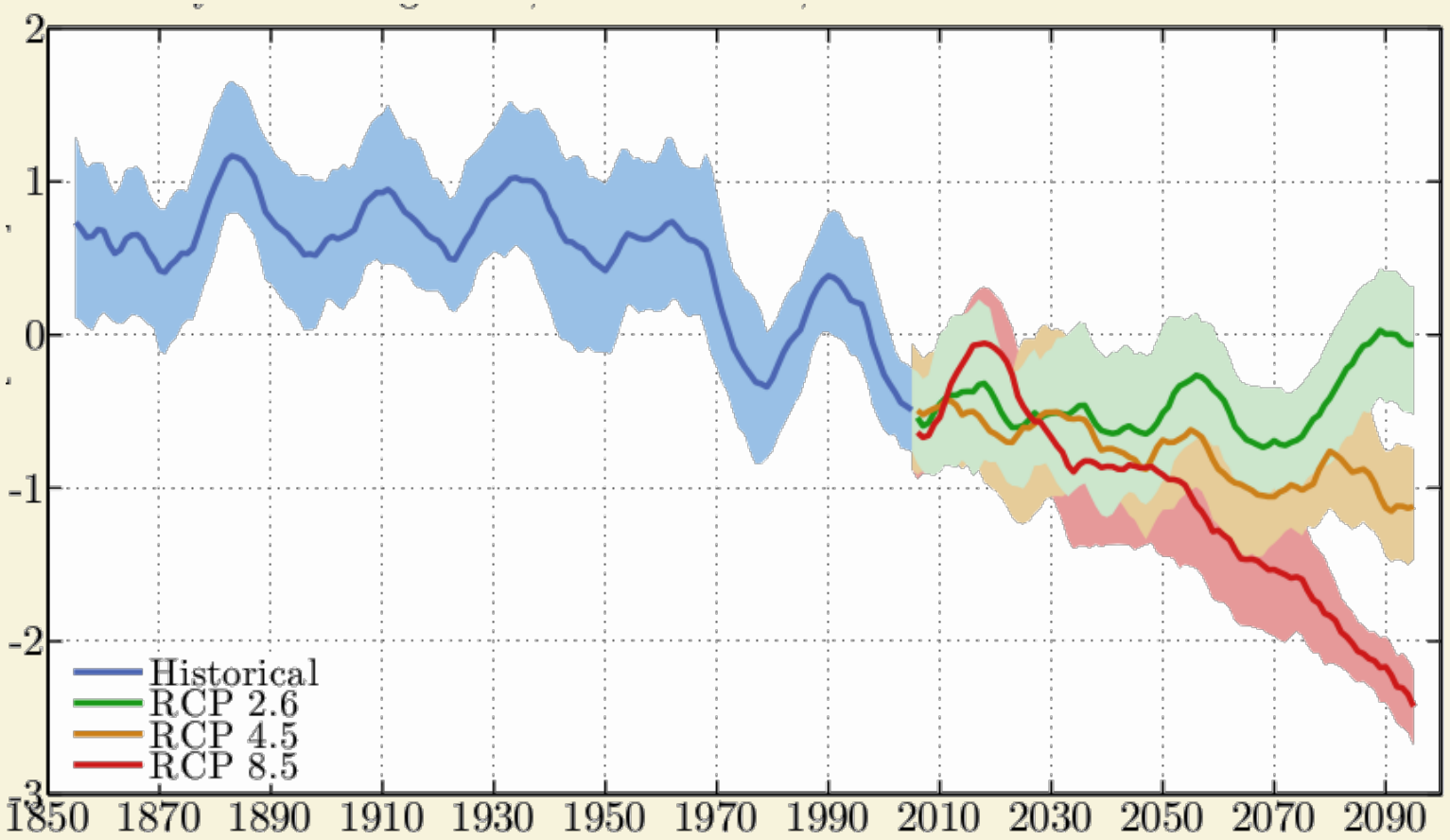
2 Ways forward

Model convergence is not necessarily desirable



Boe, Nature Geoscience, 2009

Trends in Antarctic sea-ice area from MPI-ESM-LR



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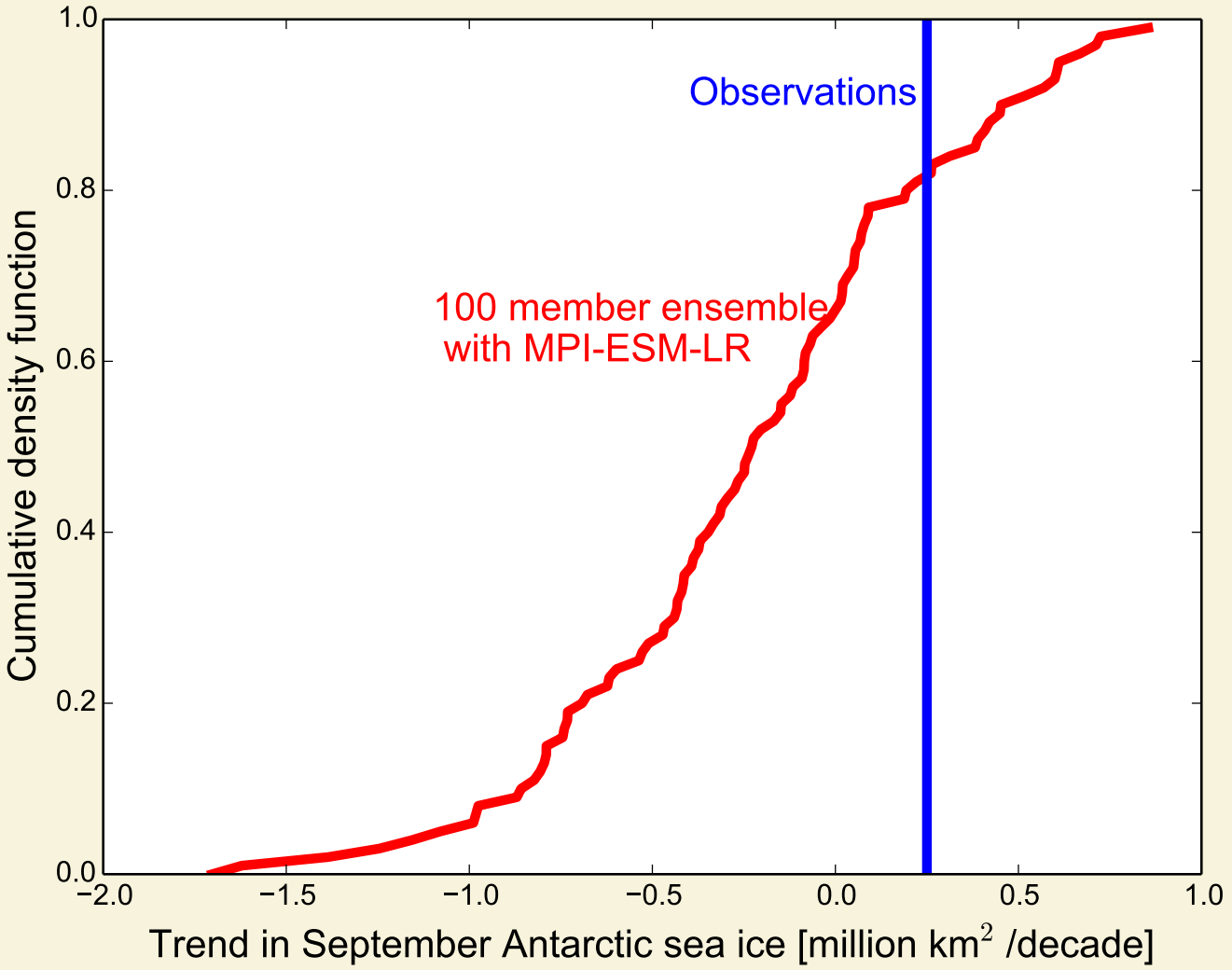
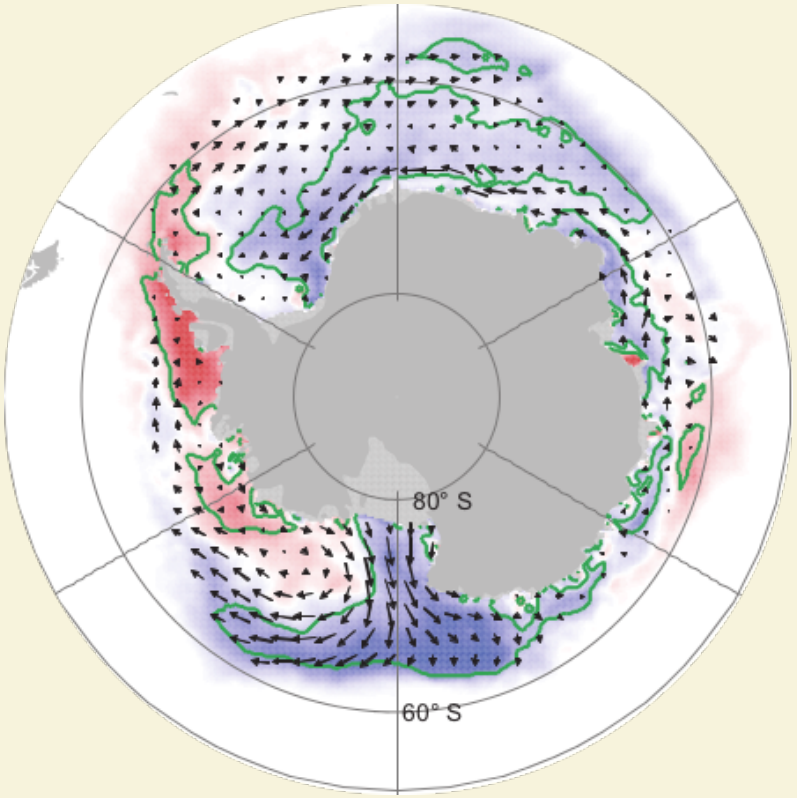
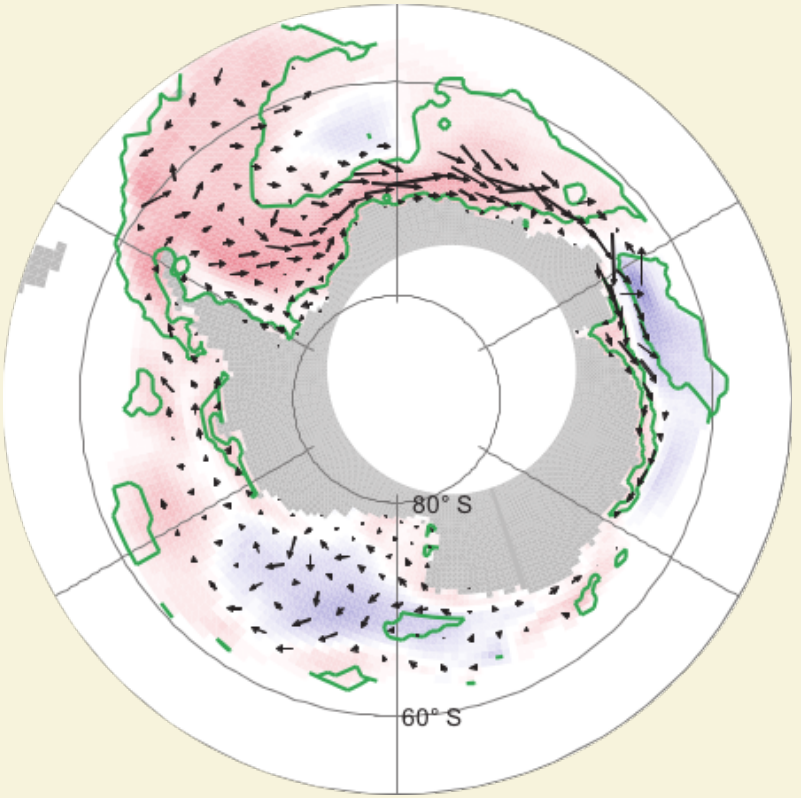


Trends of Antarctic winter sea ice

ERA-Interim Reanalysis



MPI-ESM-LR



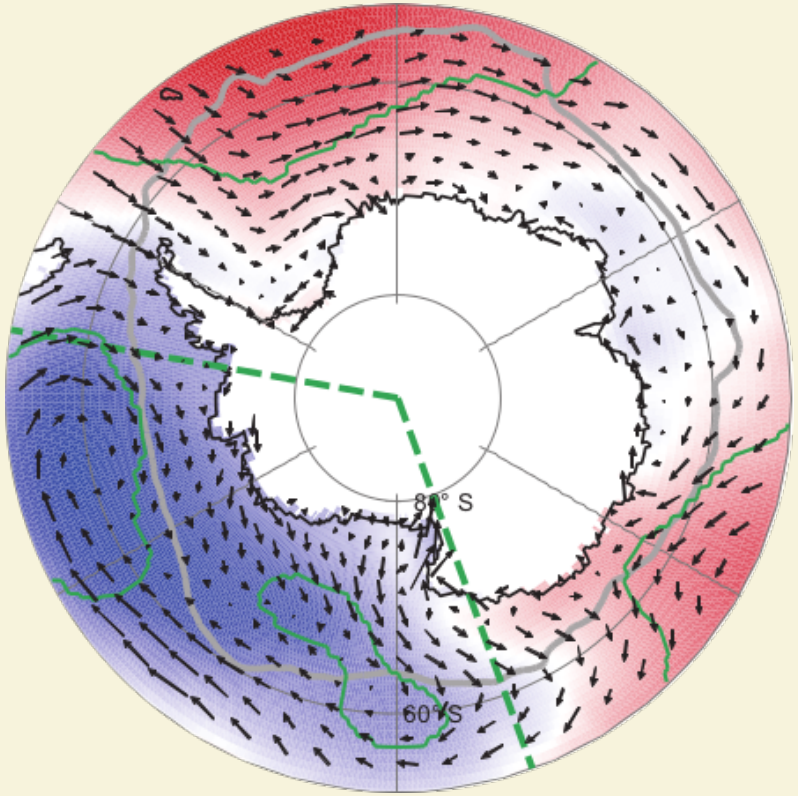
+8 %/decade

-8 %/decade

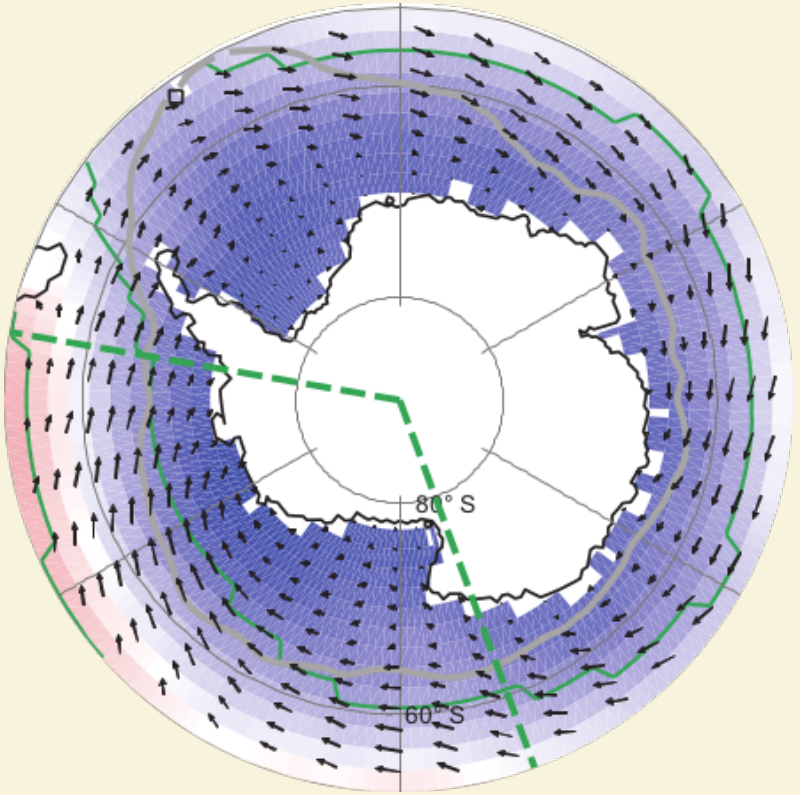
Haumann et al., Geophys. Res. Lett, 2014

Trends of Antarctic winter surface pressure

ERA-Interim Reanalysis



MPI-ESM-LR



-1 hPa/decade + 1hPa/decade

Haumann et al., Geophys. Res. Lett, 2014

Ways forward

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