Constraining projections of summer Arctic sea ice

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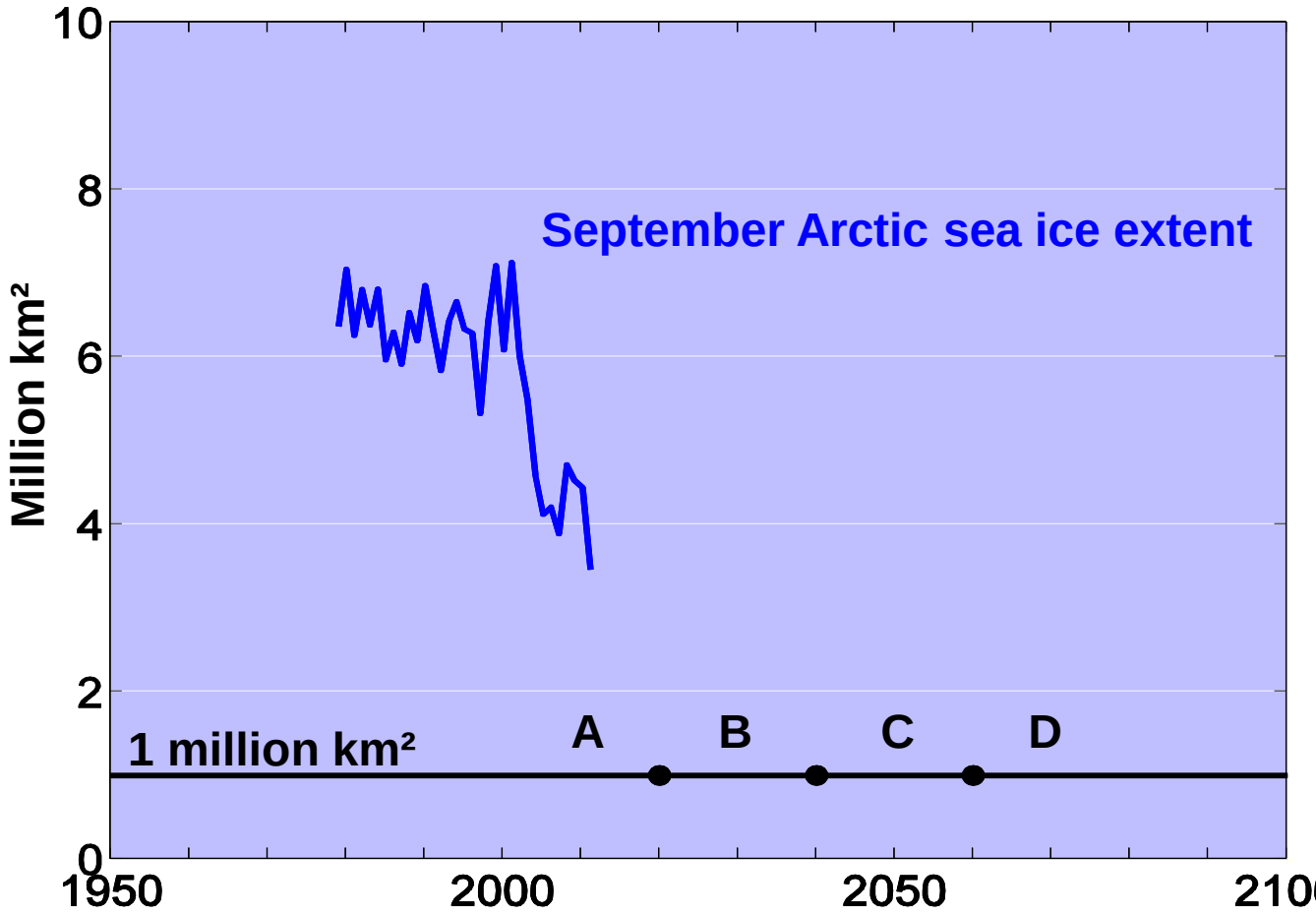
The one million dollar question



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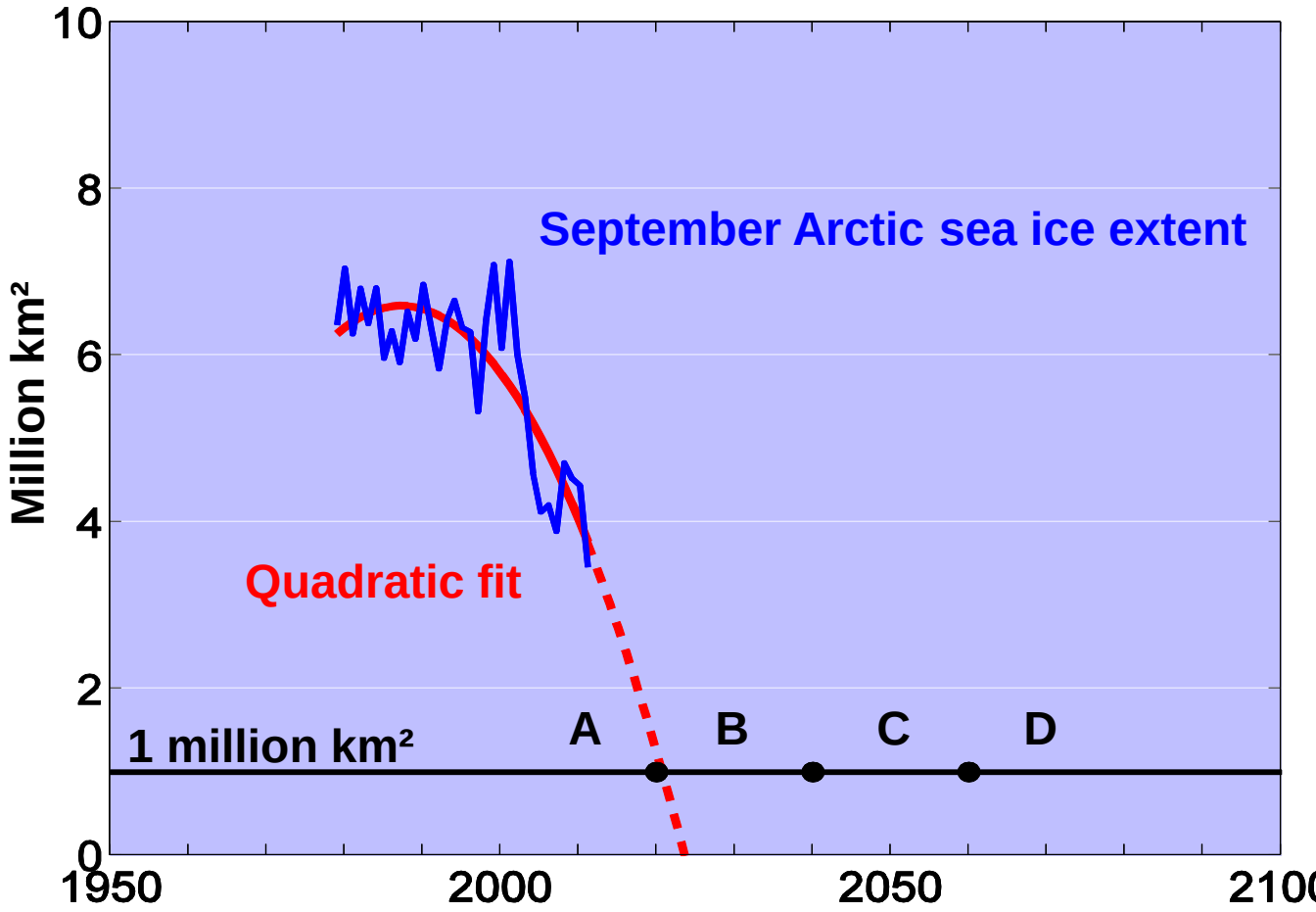
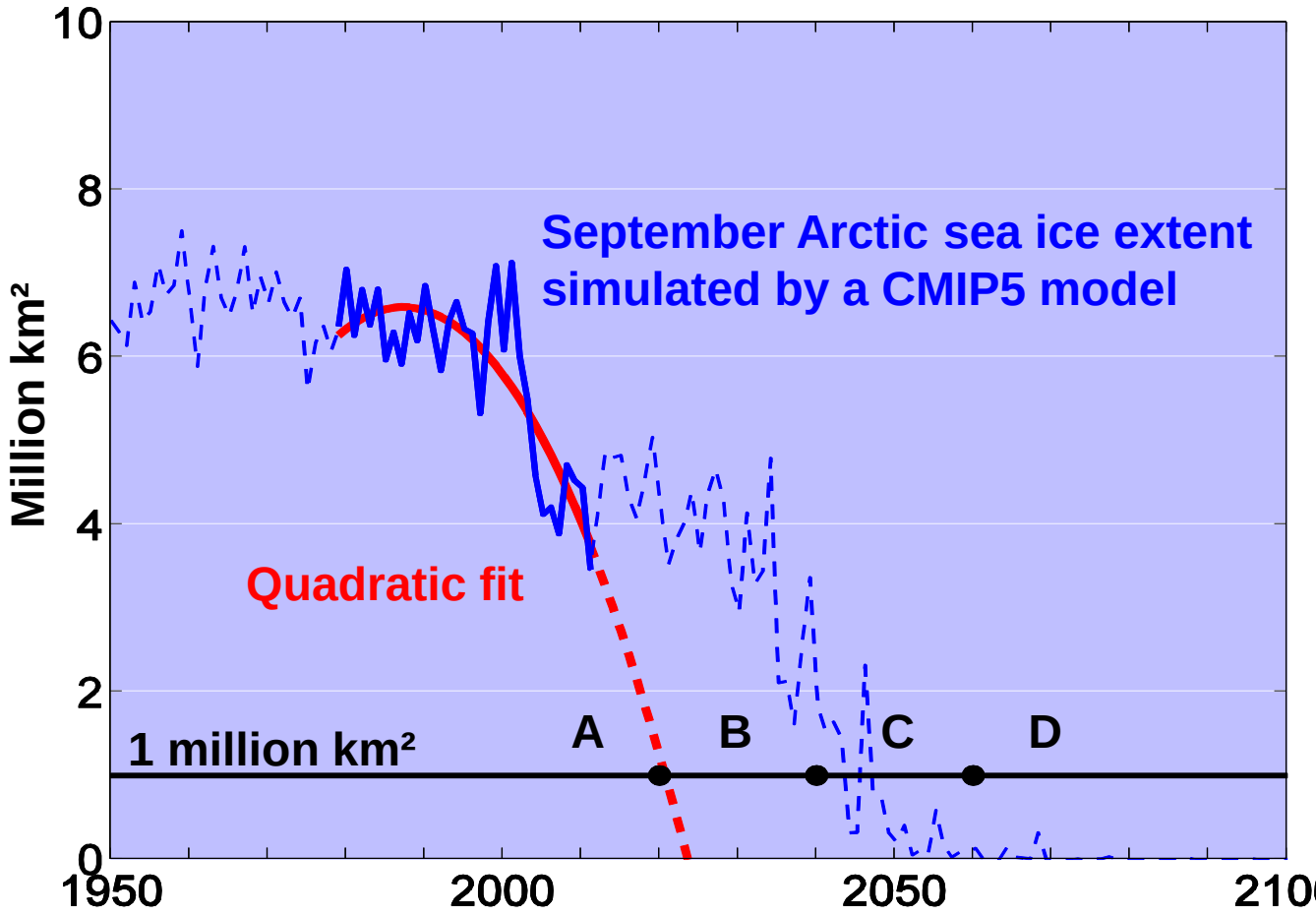


In climate change science, never rely on your intuitions



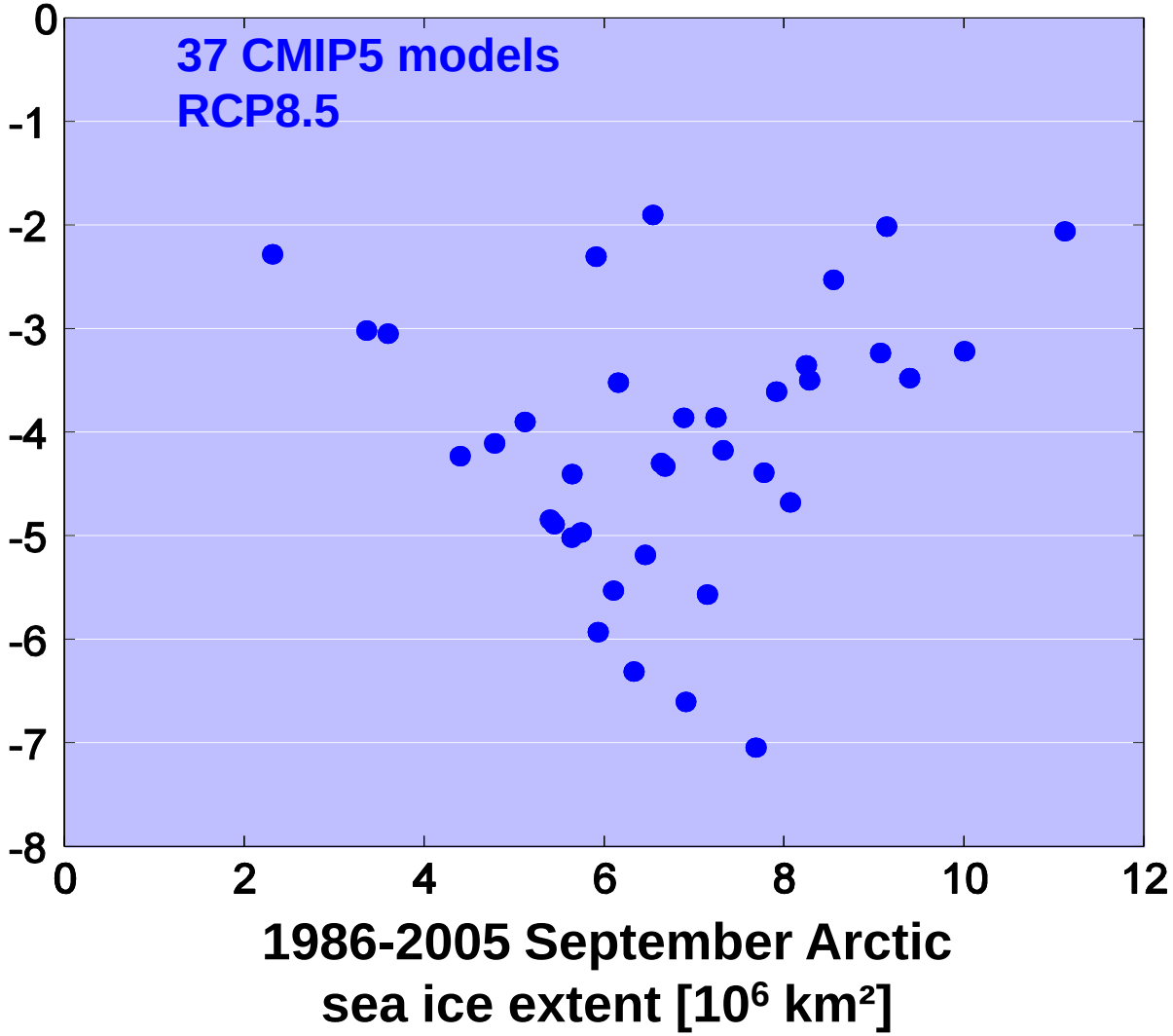
- Future summer sea ice changes

- Present-day constraints

- A careful model selection

Summer Arctic sea ice changes are by definition highly nonlinear

September Arctic sea ice extent loss between 1986-2005 and 2041-2060 [10^6 km^2]



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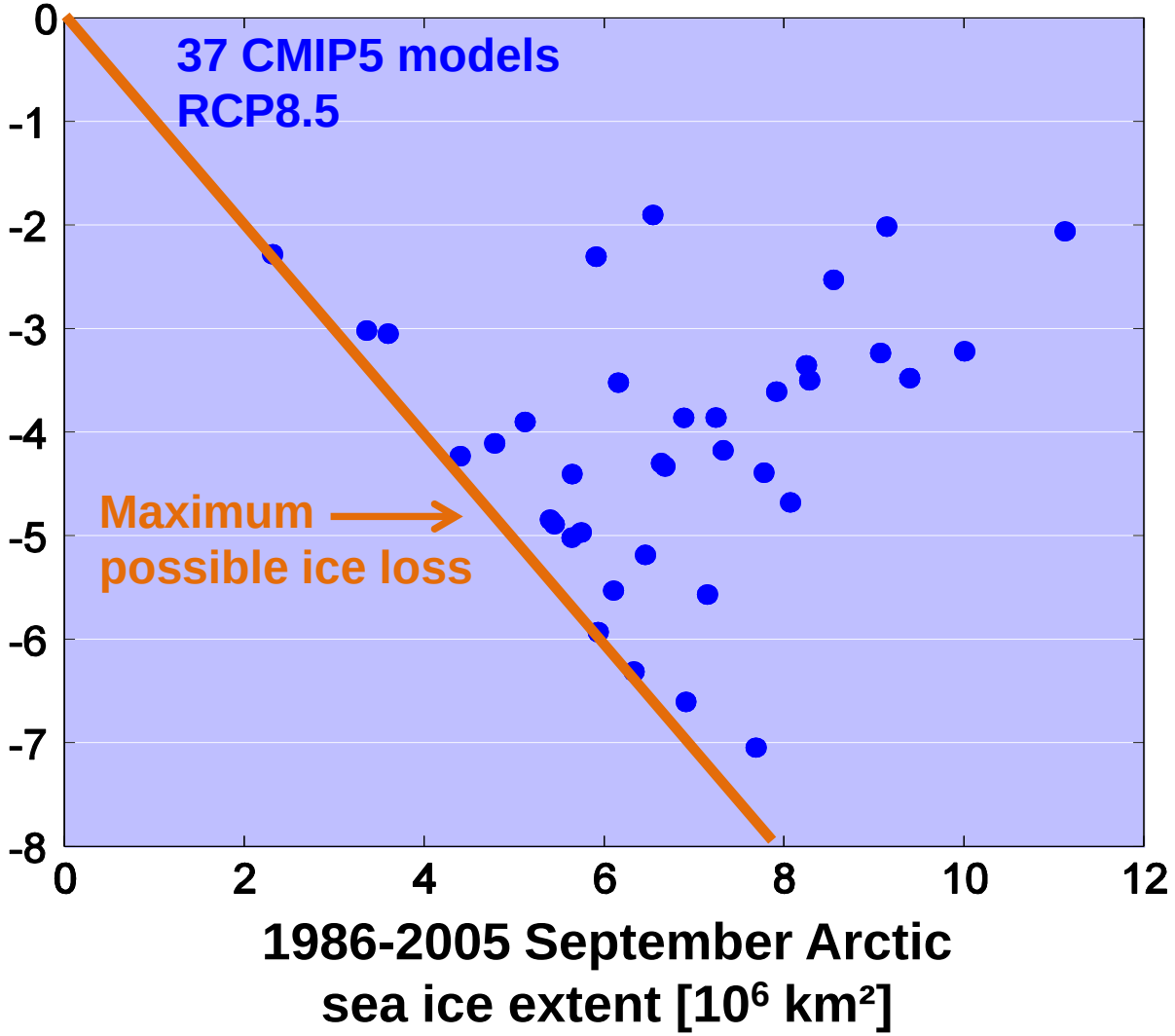

Impossible to infer future sea ice losses with simple recalibration

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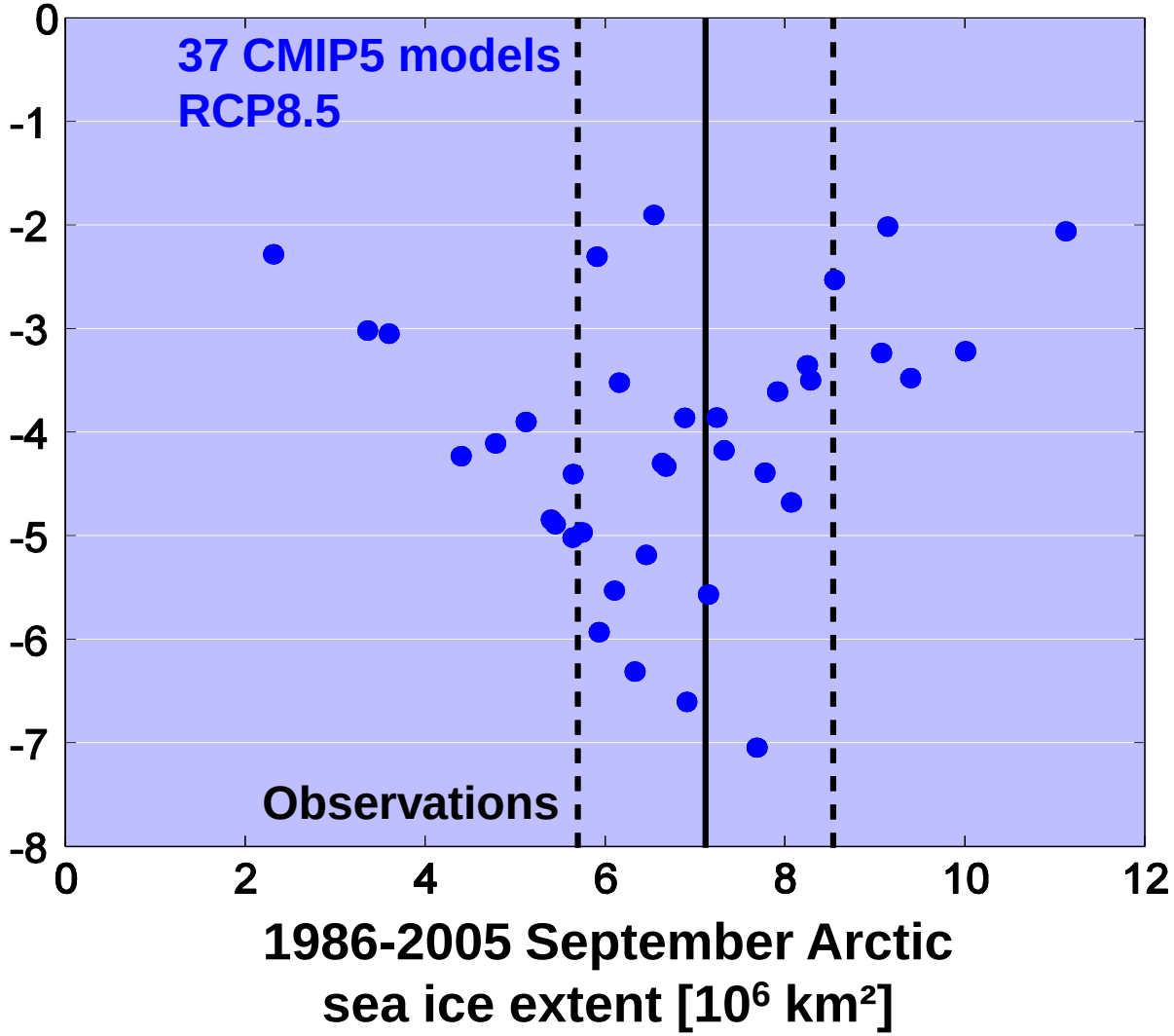

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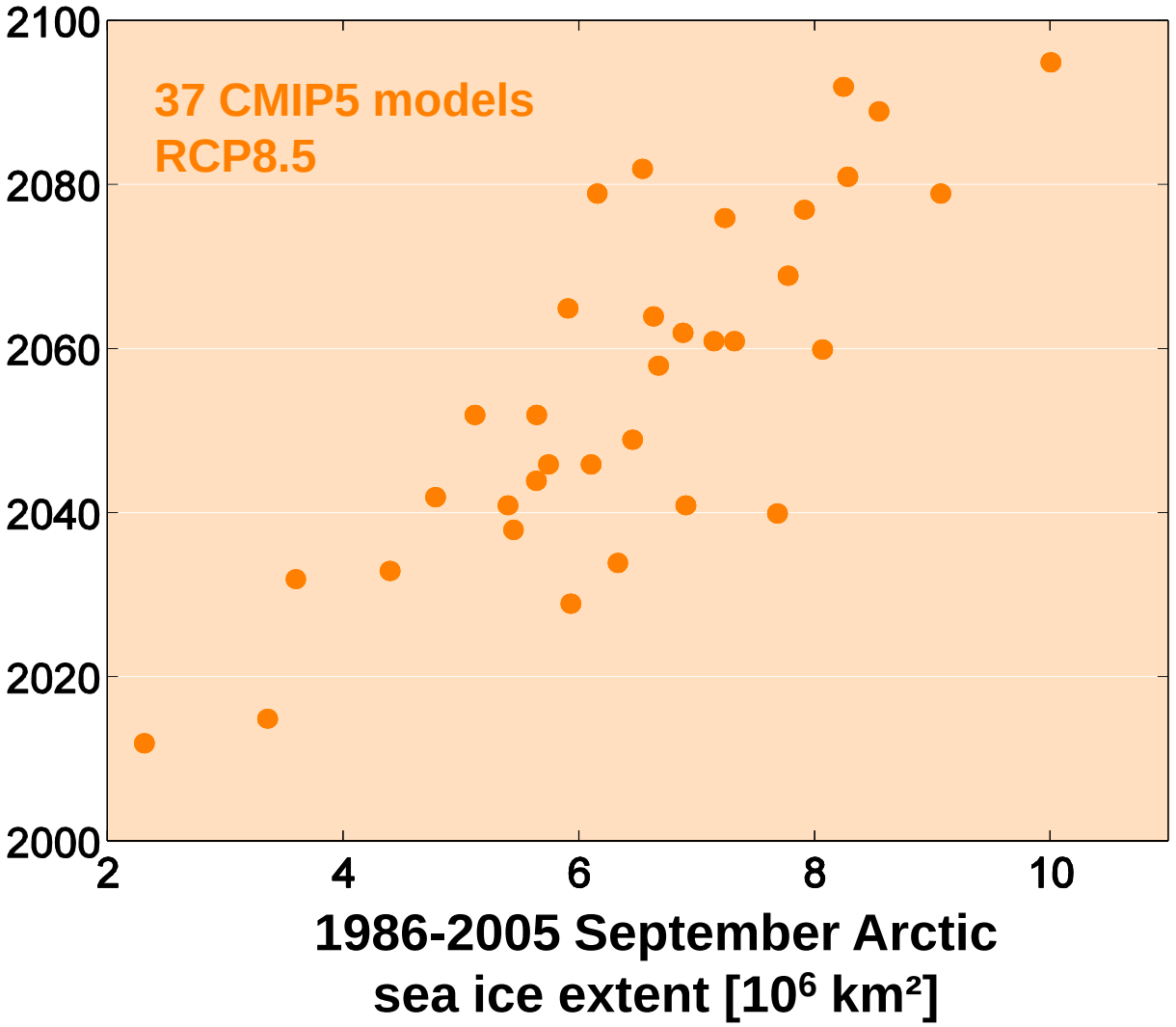
Year of summer sea ice disappearance relates linearly to the baseline state

First year with Arctic sea ice extent < 1 million km²



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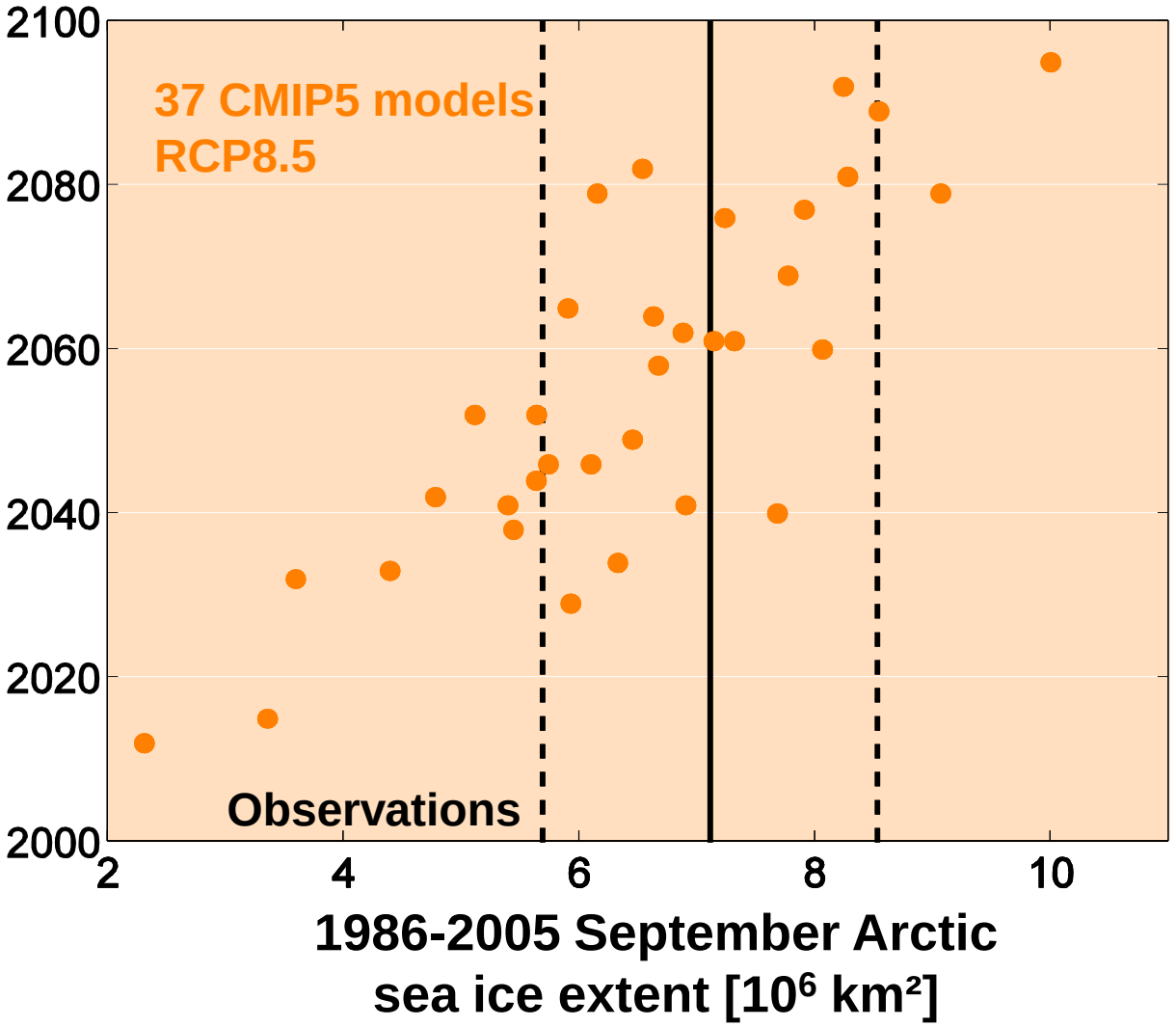

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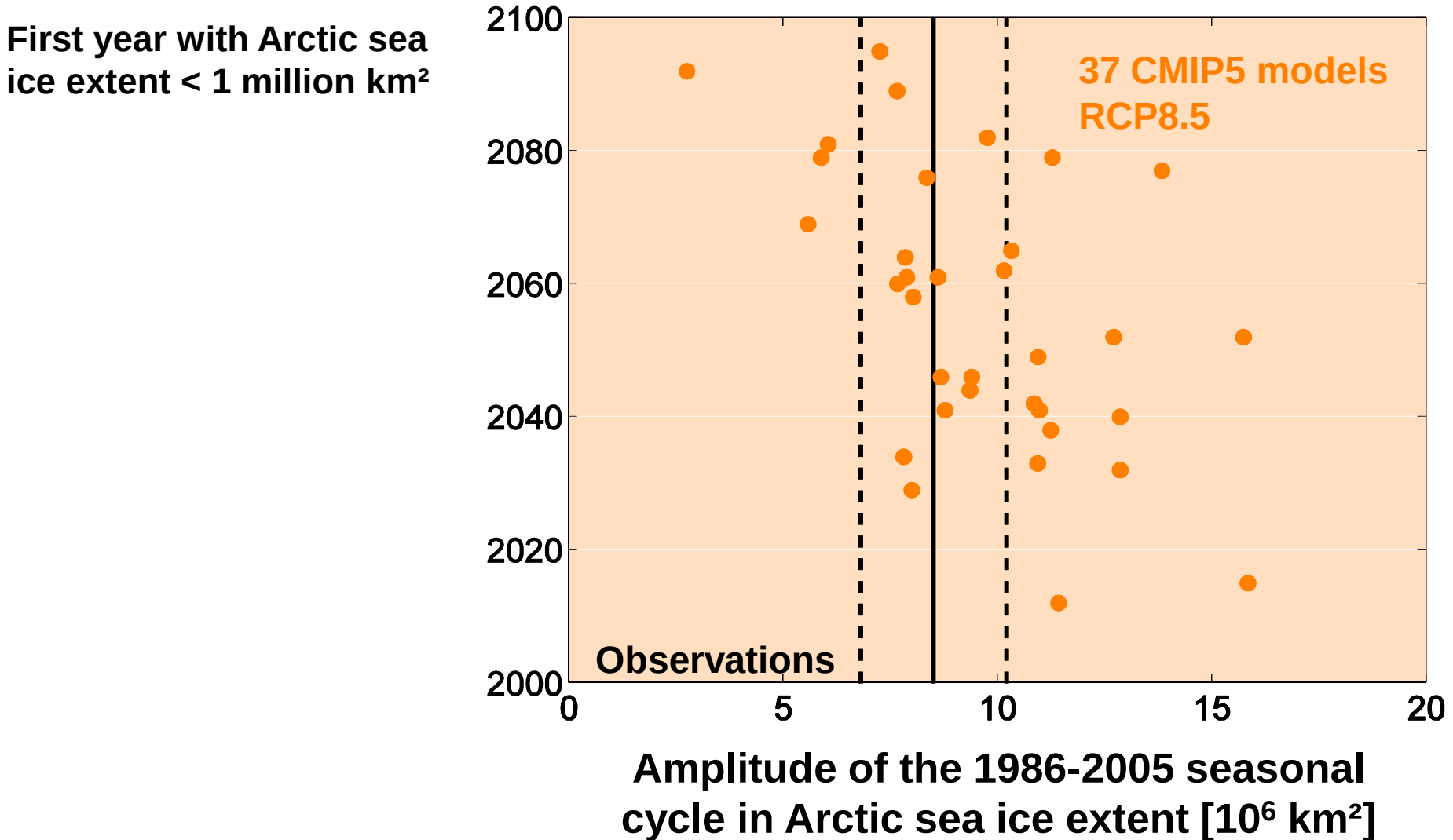

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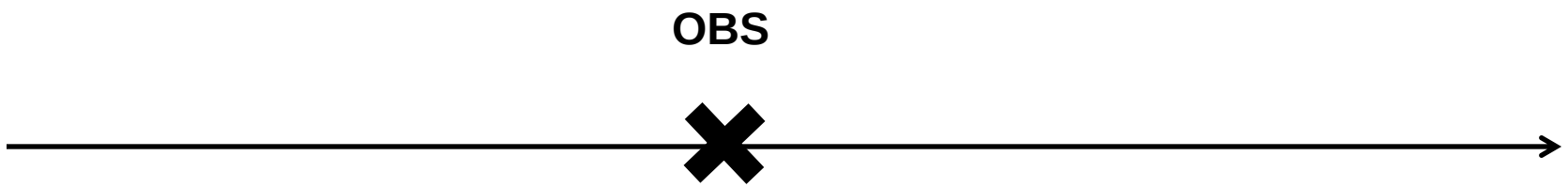
Beware the effects of internal variability



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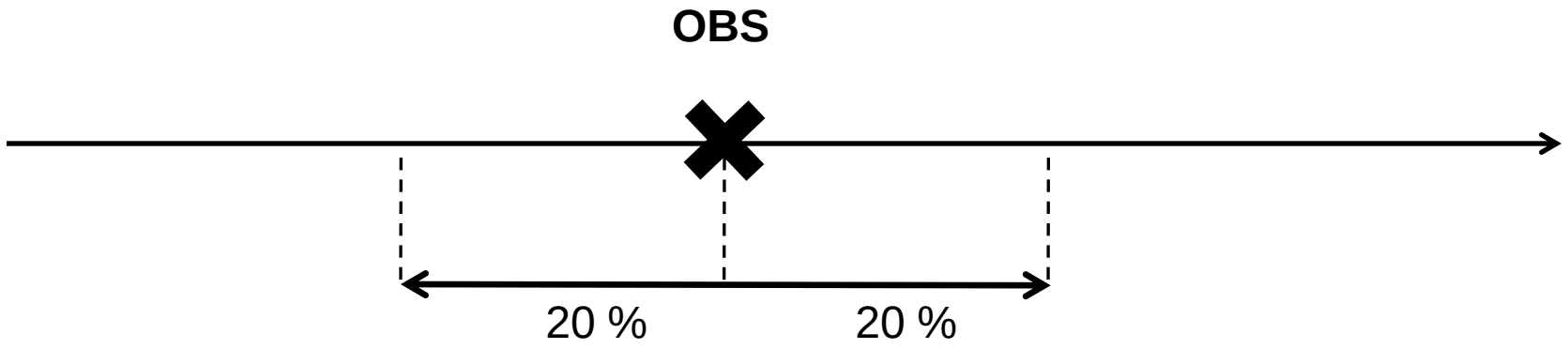

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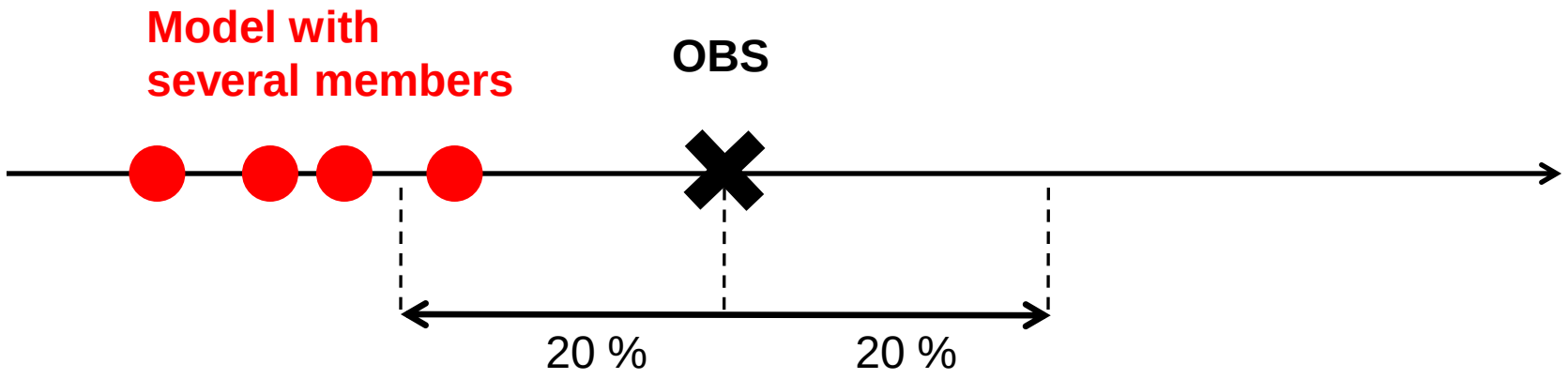

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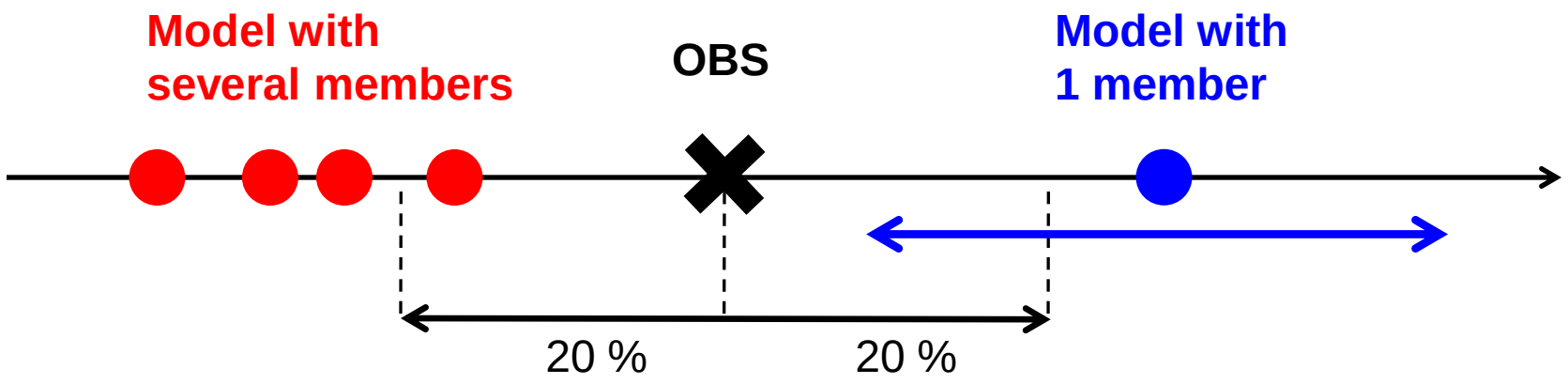

CMIP5 models are not inconsistent with available Arctic sea ice data

How many CMIP5 models successfully simulate …

Average 1986-2005 September Arctic sea ice extent	26 out of 37
Amplitude of the 1986-2005 seasonal cycle of Arctic sea ice extent	19 out of 37
Trend in 1979-2012 September Arctic sea ice extent	23 out of 37
Annual mean 1986-2005 annual Arctic sea ice volume (PIOMAS reanalysis)	19 out of 37
All four criteria	5 out of 37

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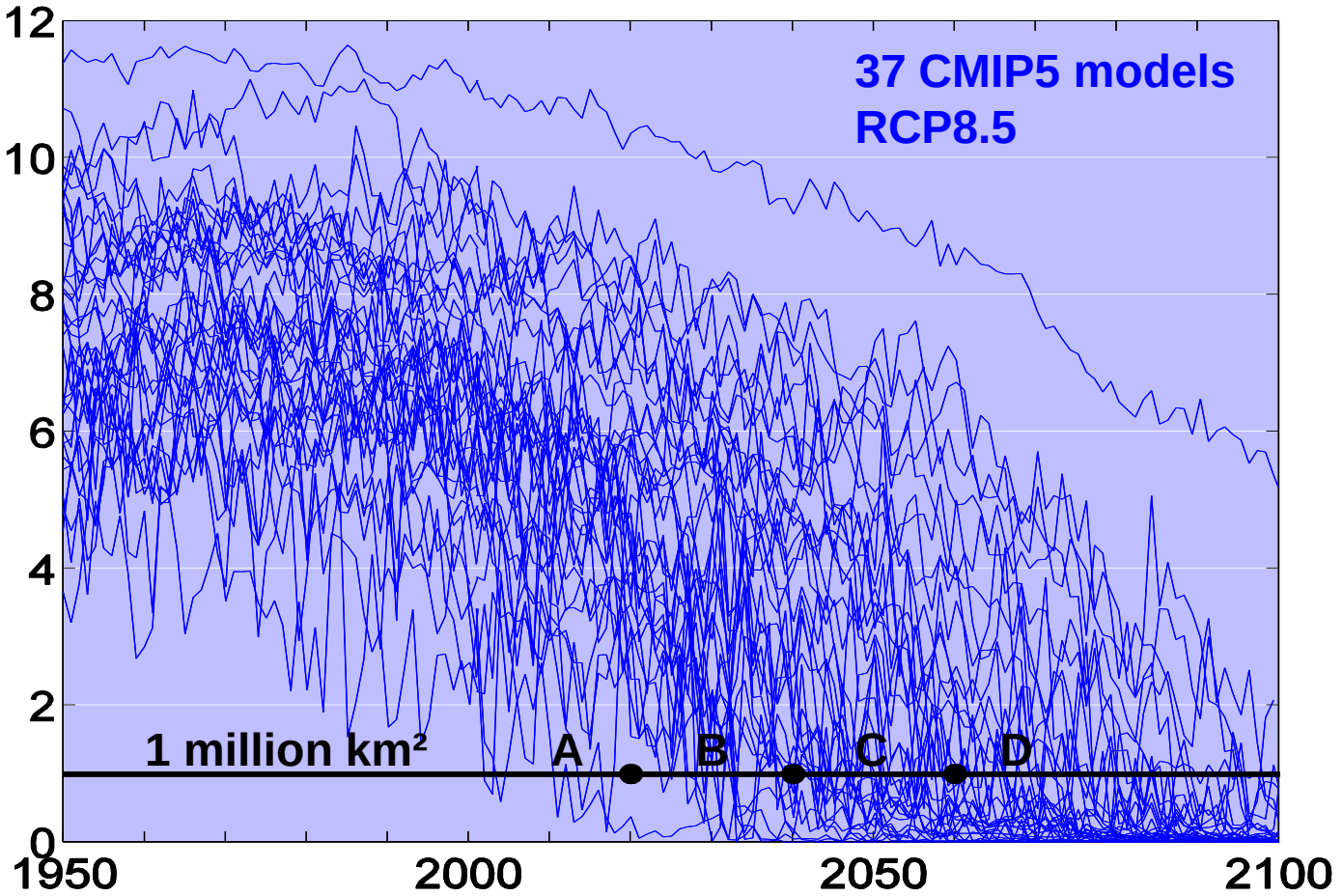
should absolutely take the models
internal variabilty into account

The large spread in CMIP5 summer sea ice projections

September sea ice extent [10^6 km^2]



A possible summer ice-free Arctic by mid-century

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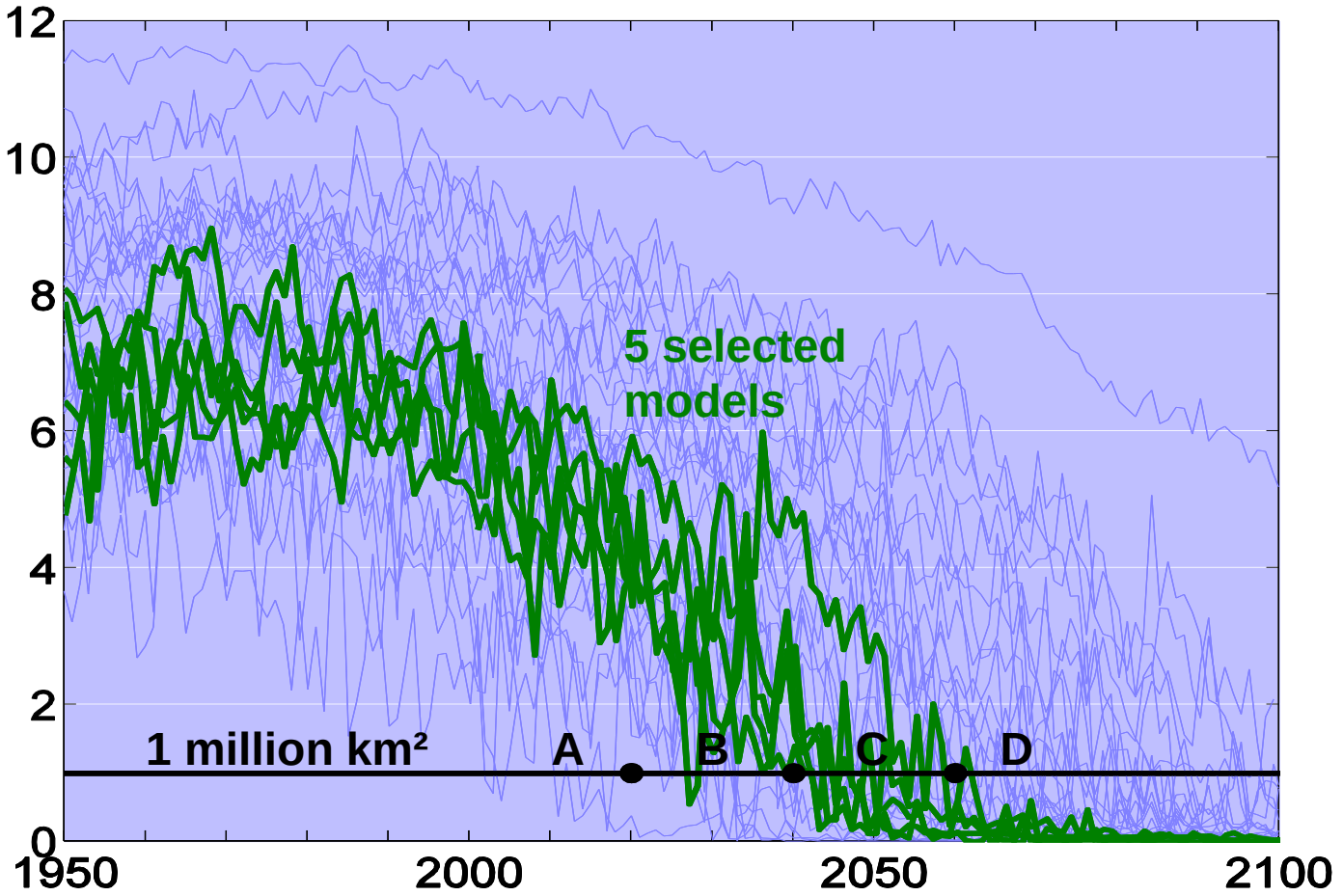

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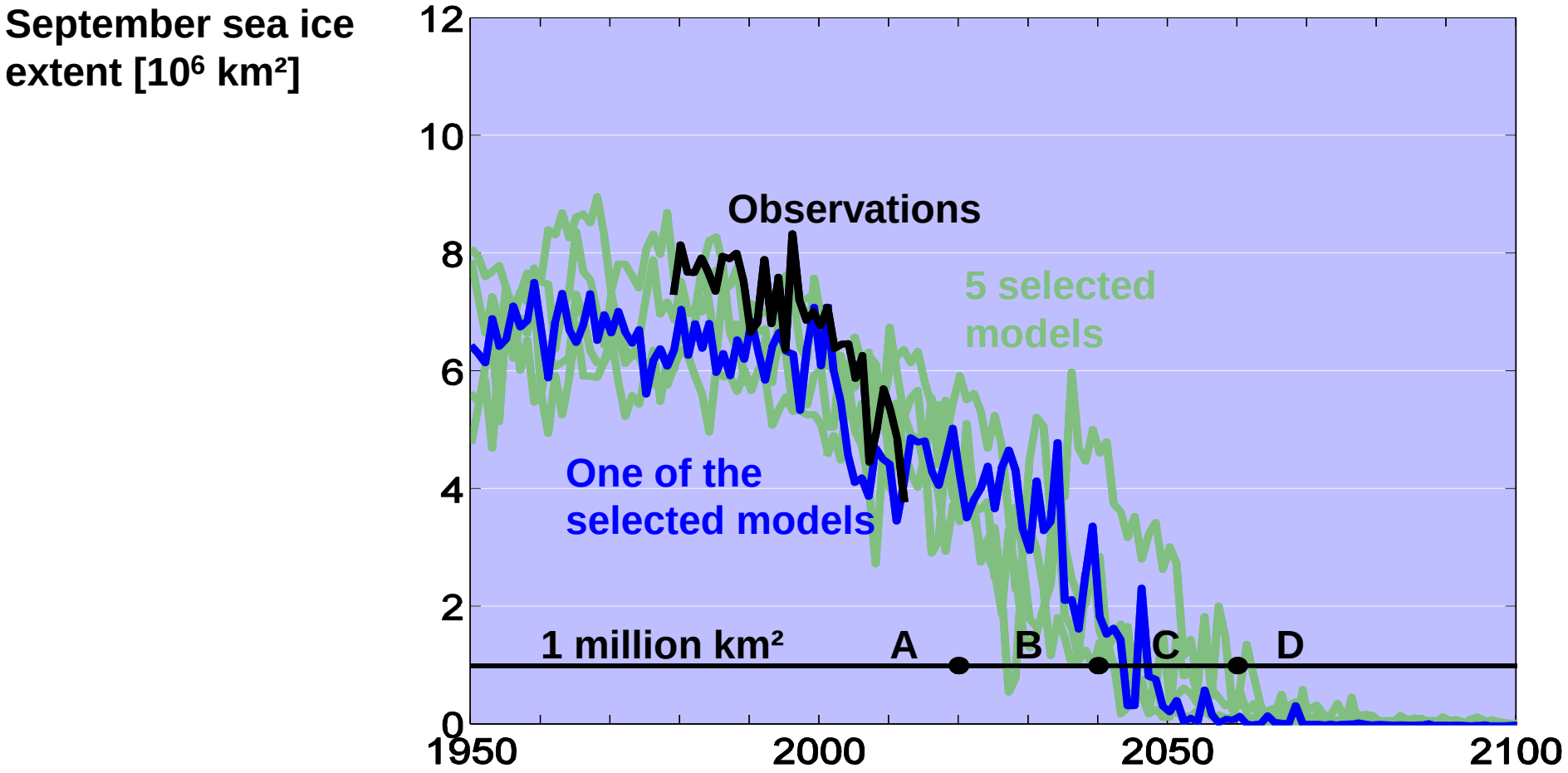

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