Climate Change 2013: The Physical Science Basis

Working Group I contribution to the IPCC Fifth Assessment Report

IPCC AR5 WGI : Polar Regions

Polar Amplification , Permafrost, Sea ice changes

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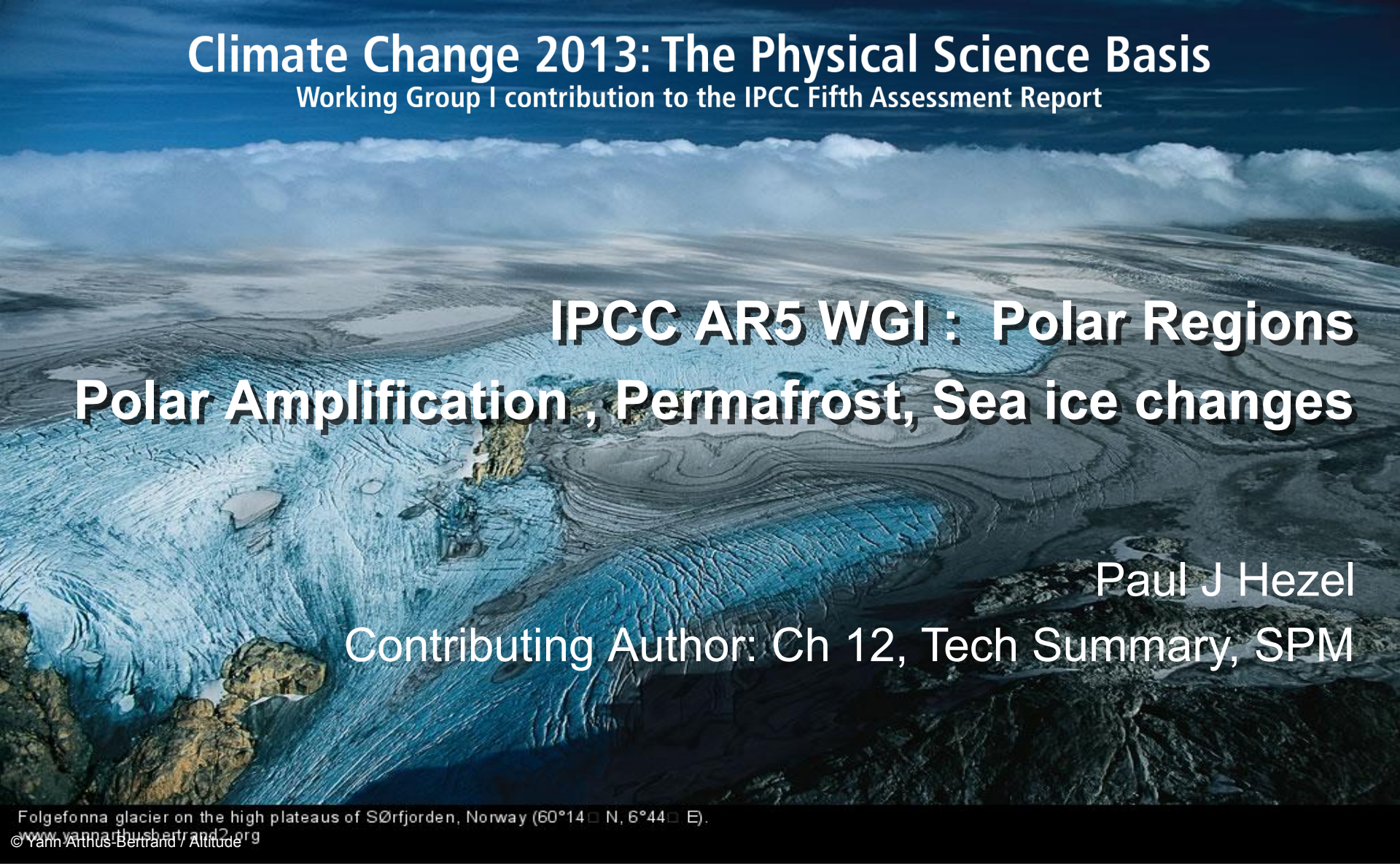
Contributing Author: Ch 12, Tech Summary, SPM



Folgefonna glacier on the high plateaus of SØrfjorden, Norway (60°14□ N, 6°44□ E).

Summary for Policymakers (SPM):

Over the last two decades, the Greenland and Antarctic ice sheets have been losing mass, glaciers have continued to shrink almost worldwide, and **Arctic sea ice** and Northern Hemisphere spring snow cover have **continued to decrease** in extent (*high confidence*).

It is *very likely* that the **Arctic sea ice cover** will **continue to shrink and thin** and that Northern Hemisphere spring snow cover will decrease during the 21st century as global mean surface temperature rises. Global glacier volume will further decrease.

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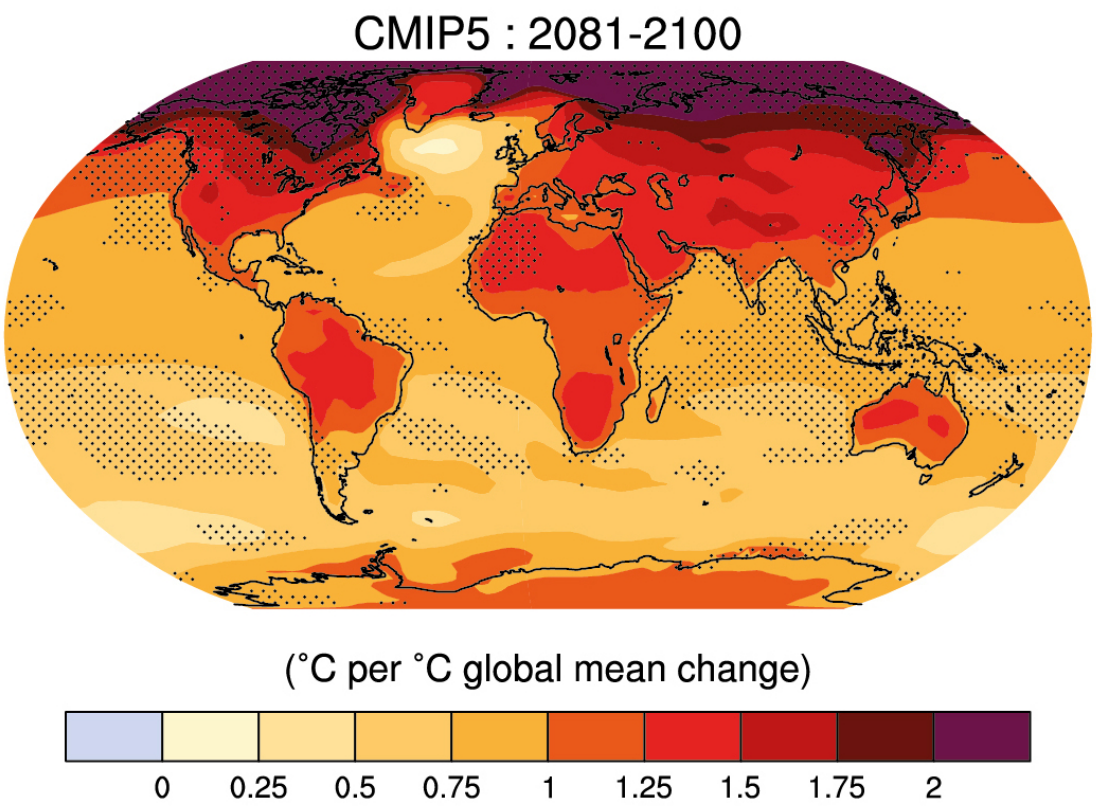
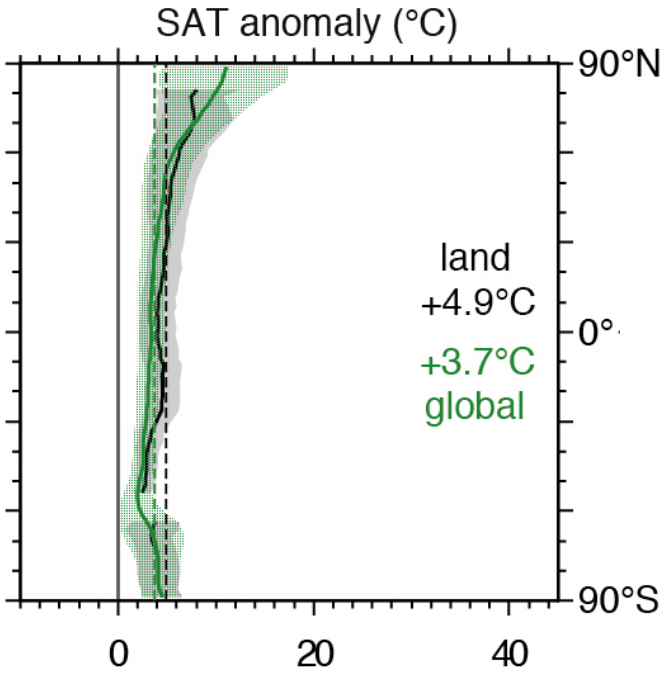
Polar Amplification

Fig. 12.41; Box 5.1, Fig. 1

Polar amplification

Polar Amplification – zonal mean surface temperature warming at high latitudes exceeds global average temperature change.





Polar amplification

Polar Amplification – zonal mean surface temperature warming at high latitudes exceeds global average temperature change.

New temperature reconstructions and simulations of past climates show with *high confidence* **polar amplification** in response to changes in atmospheric CO_2 concentration.

In the absence of a strong reduction in the Atlantic Meridional Overturning, the **Arctic region** is projected to **warm most** (*very high confidence*)

Impact on ice sheet stability and global sea level, carbon cycle feedbacks e.g. permafrost melting

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Permafrost

Permafrost and frozen ground

There is *high confidence* that **permafrost temperatures have increased** in most regions since the early 1980s.

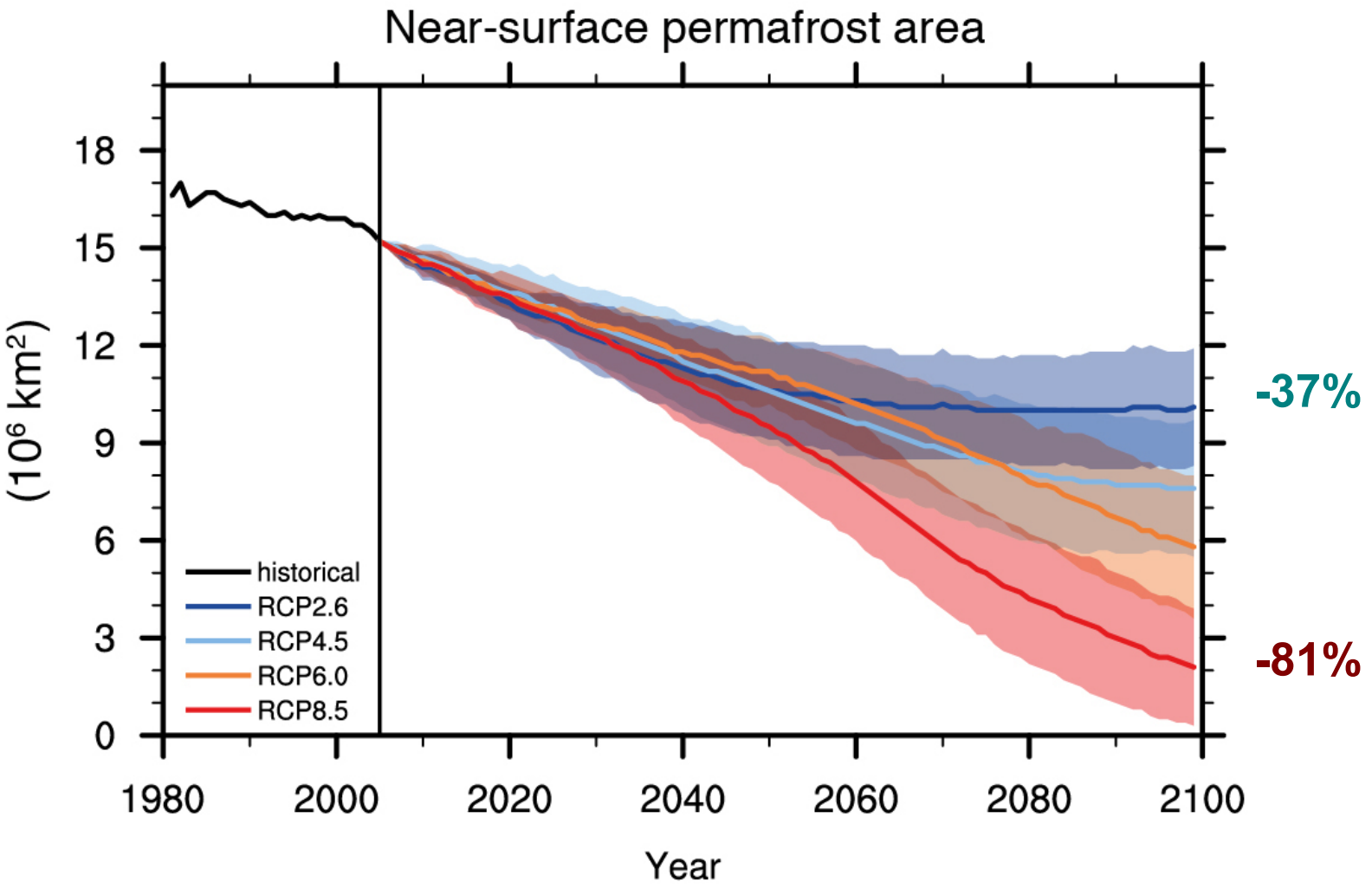
Strong warming of permafrost

- 3°C in parts of Northern Alaska
- 2°C in parts of the Russian European North
  - Reduction in permafrost thickness and areal extent.
  - S. boundary moves northward
    continuous permafrost – 50 km
    discontinuous permafrost – 80 km

Active layer thickness – generally increasing

Figure 12.33

Near surface permafrost area (frozen ground up to 3.5 m depth)



Permafrost and frozen ground

It is *virtually certain* that **near-surface permafrost** extent at high northern latitudes **will be reduced** as global mean surface temperature increases.

Important because carbon and methane reservoirs are very large

- moderate feedback on decades to centuries
- important on millenial time scales because of size of reservoirs

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Arctic sea ice

Arctic sea ice

The annual mean **Arctic sea ice extent decreased** over the period 1979 to 2012 with a rate that was *very likely* in the range 3.5 to 4.1% per decade (range of 0.45 to 0.51 million km^2 per decade), and *very likely* in the range 9.4 to 13.6% per decade (range of 0.73 to 1.07 million km^2 per decade) for the summer sea ice minimum (perennial sea ice).

There is *medium confidence* from reconstructions that over the past three decades, **Arctic summer sea ice retrea**t was **unprecedented** and sea surface temperatures were anomalously high in at least the last **1,450 years**.

Figure 4.3

Annual and seasonal Arctic sea ice extent, 1979-2012

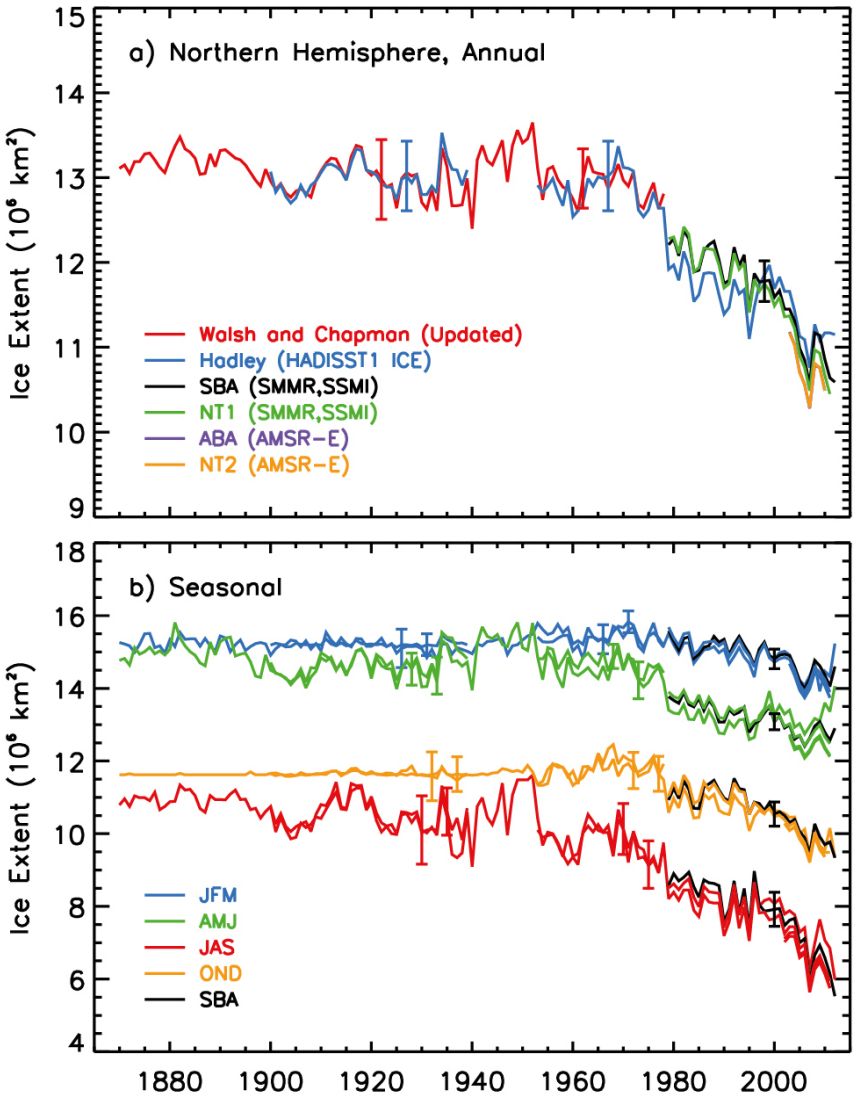


Figure 9.24a

Modeled Arctic sea ice extent, 1900-1912

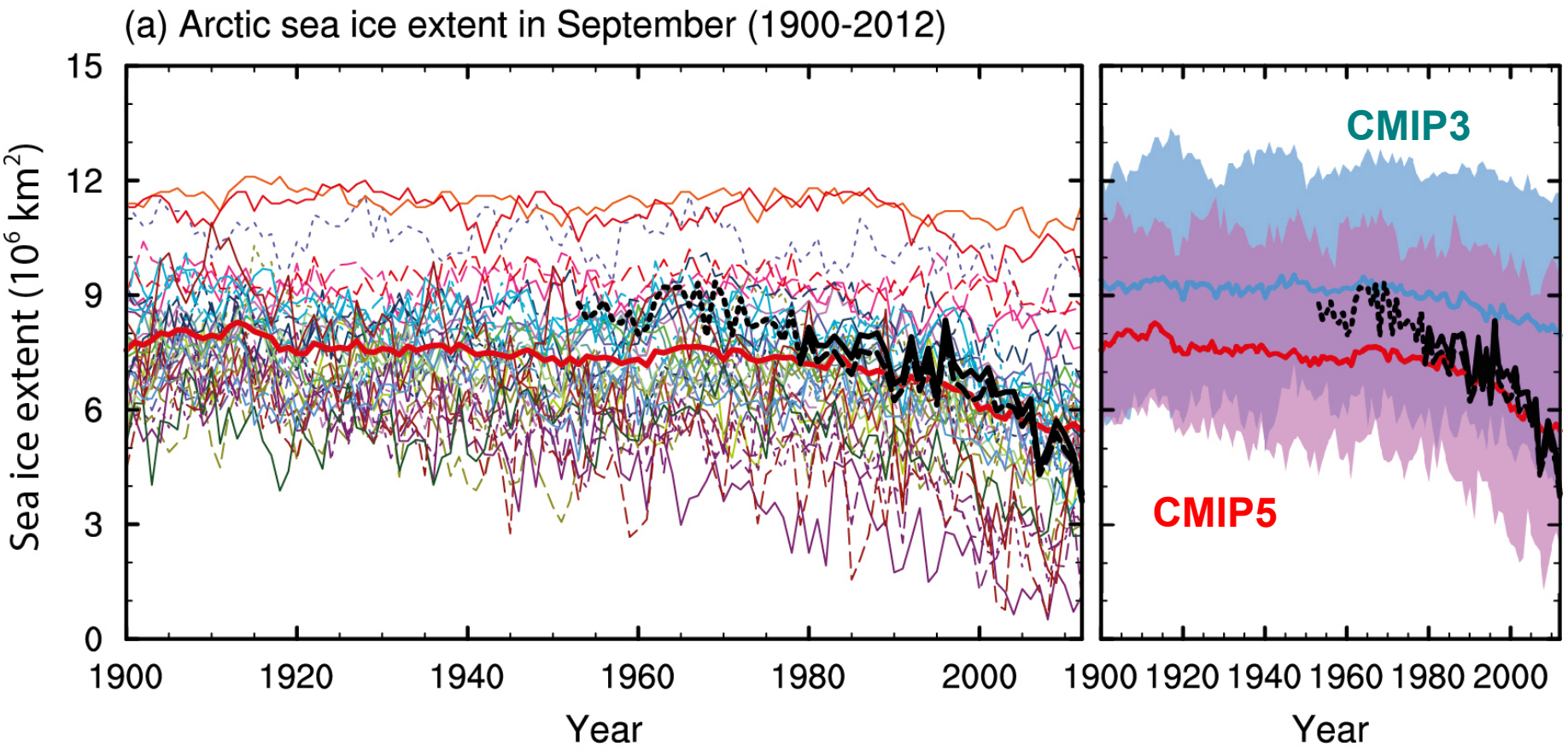


Figure 9.24c

Distribution of observed Arctic sea ice extent trends

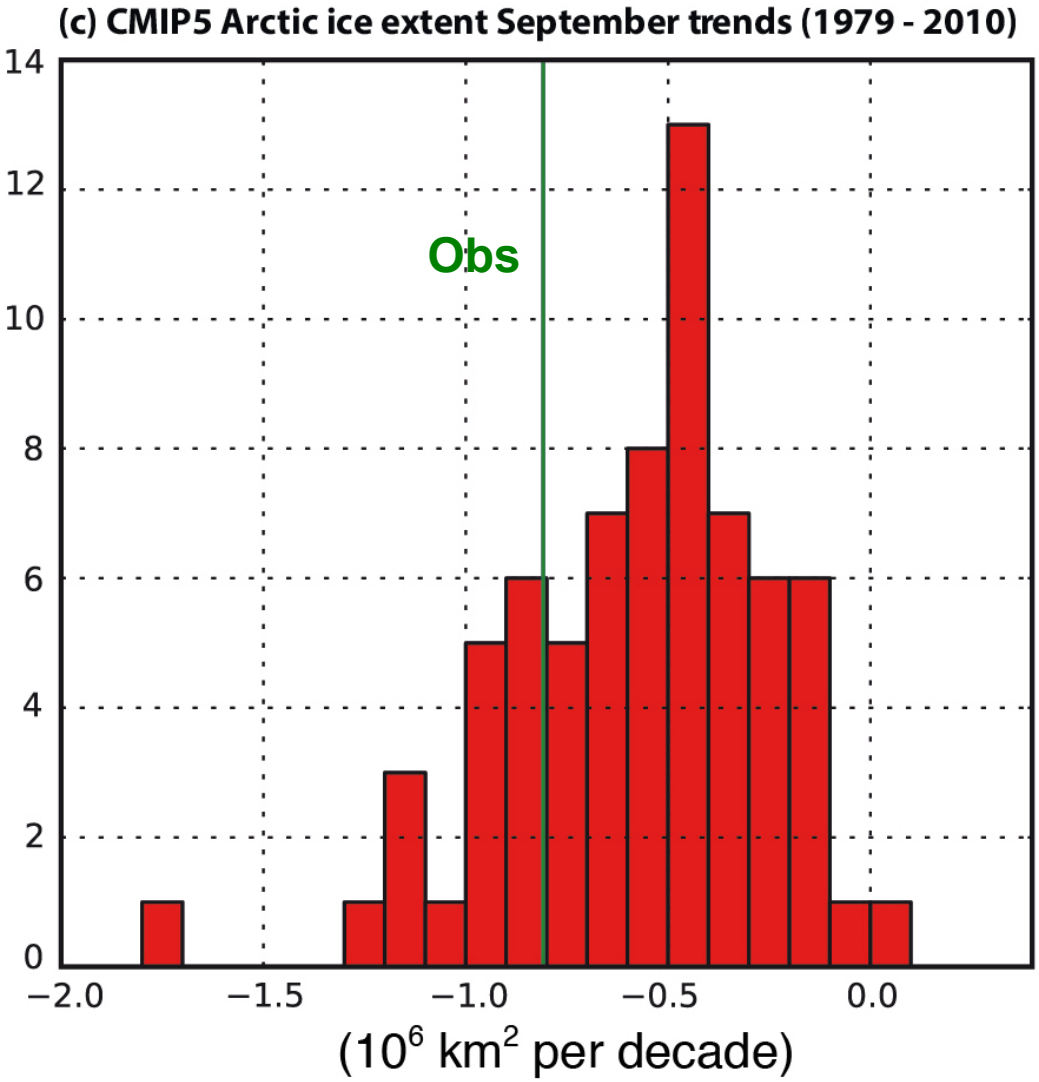


Figure 12.28ab

Projected Arctic sea ice extent changes

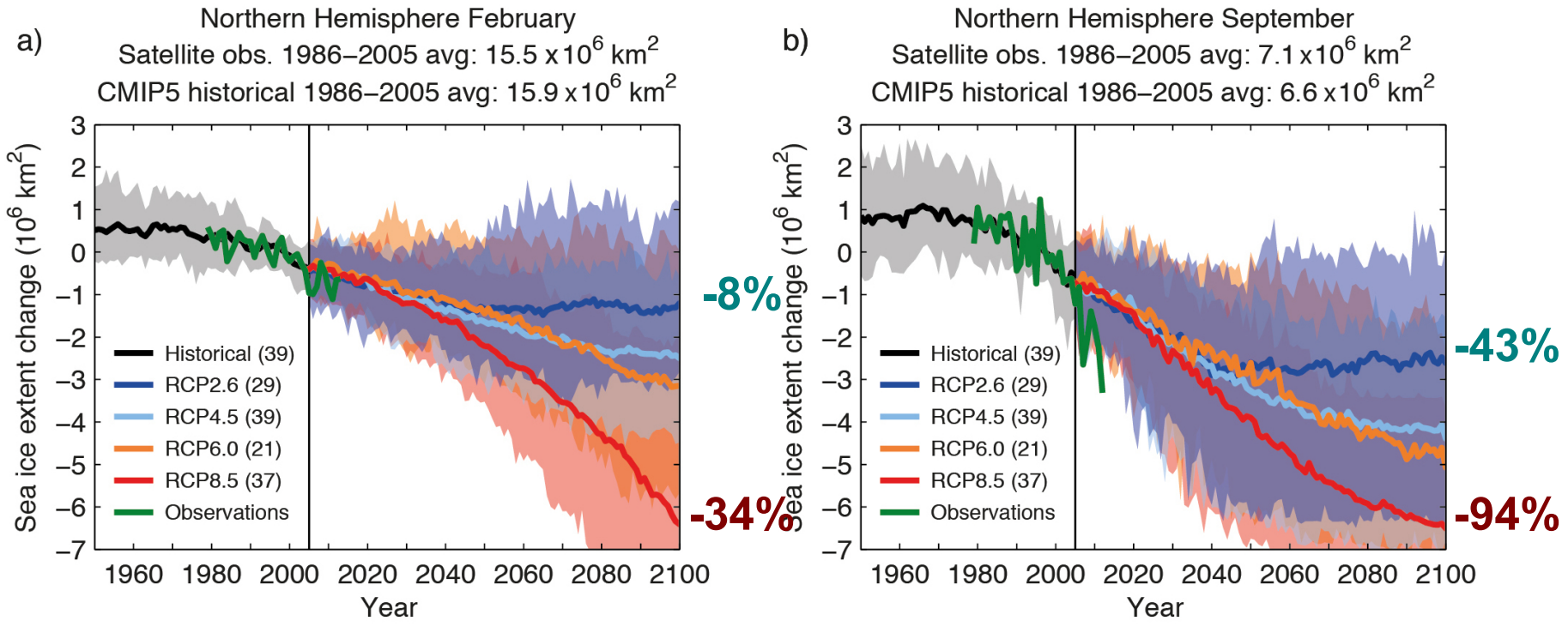


Figure 12.29a,c

Maps of multimodel mean Arctic sea ice concentration

1986-2005
(39 models)

RCP 8.5, 2081-2100
(37 models)

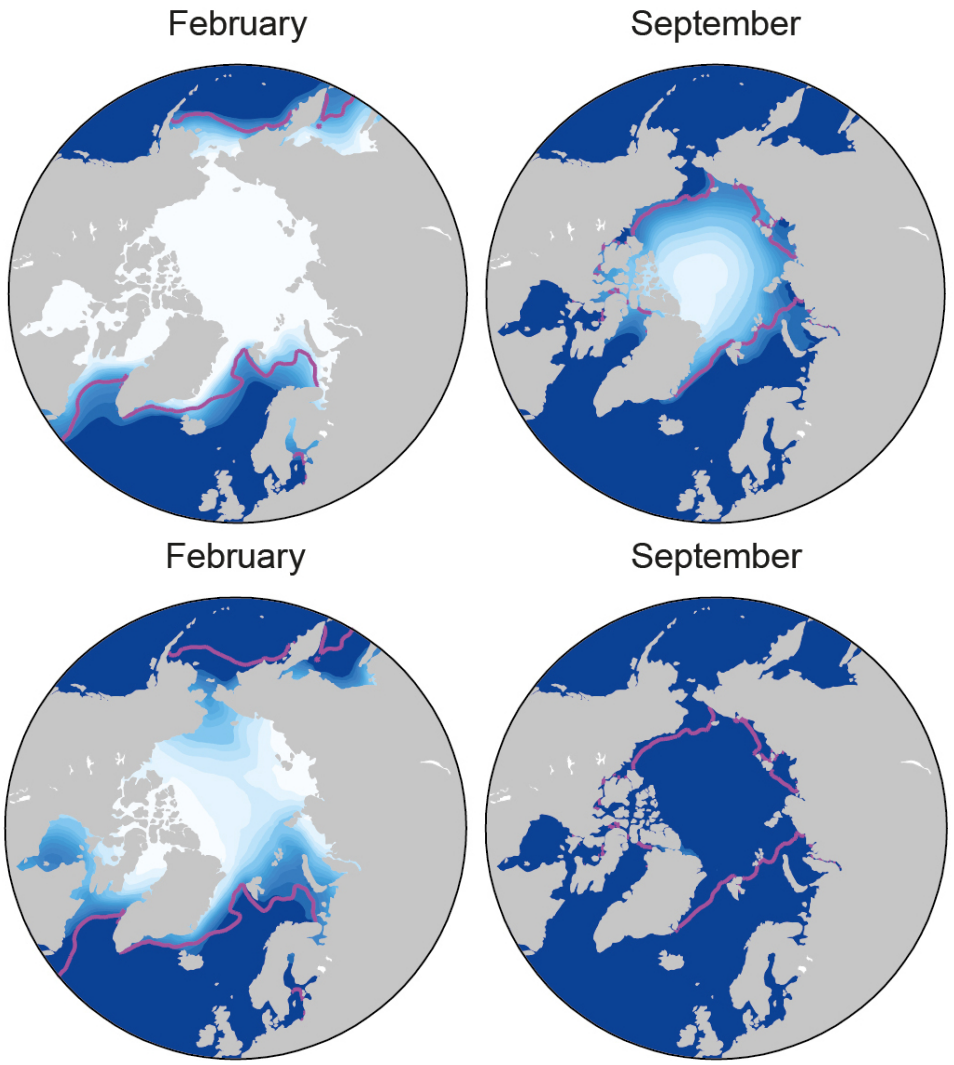
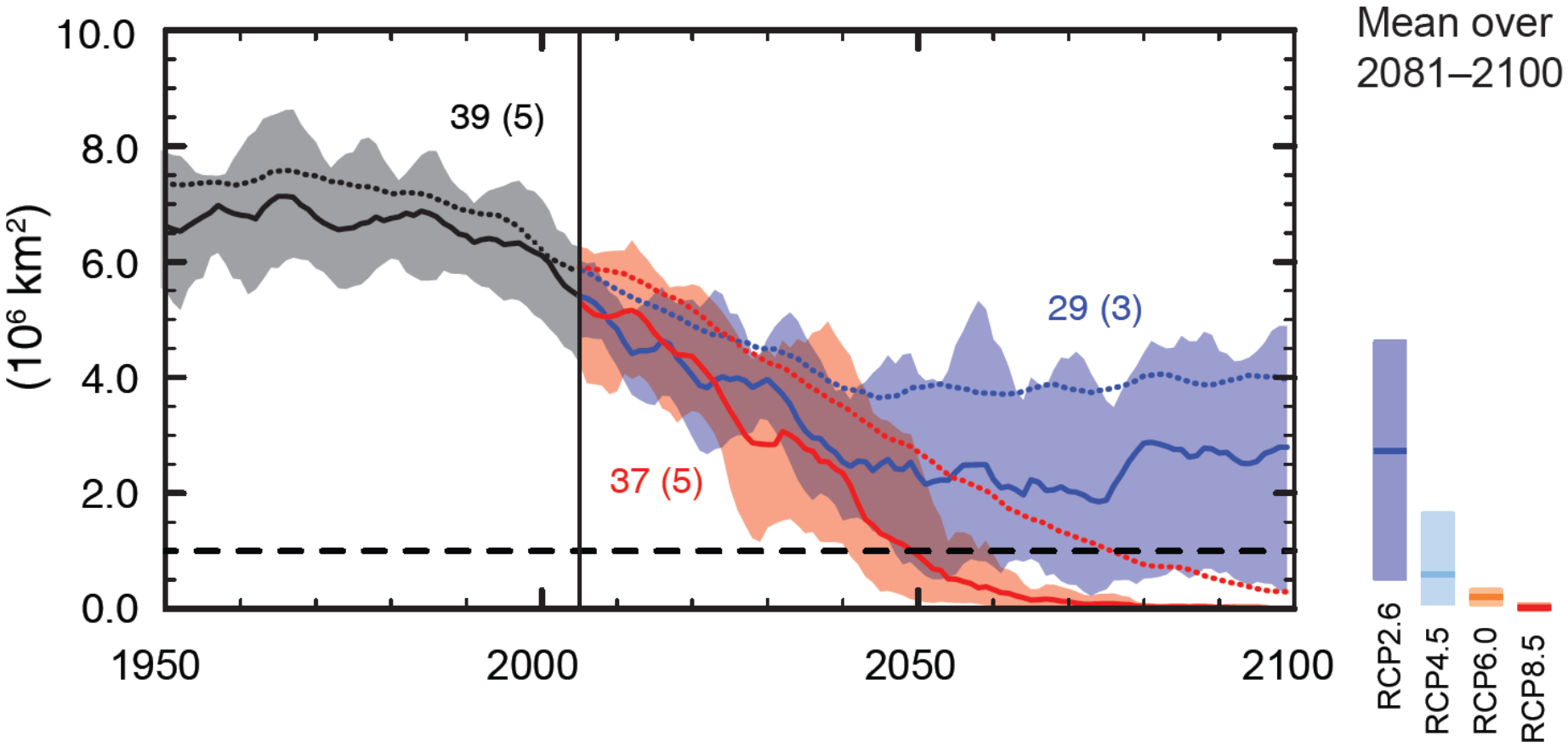


Figure SPM.7b

Northern Hemisphere September sea ice extent



A **nearly ice-free Arctic Ocean** in **September** is likely before mid-century under RCP8.5 (*medium confidence*)

Cryosphere (SPM)

It is *very likely* that the **Arctic sea ice cover will continue to shrink and thin** and that Northern Hemisphere spring snow cover will decrease during the 21st century as global mean surface temperature rises.

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Full Report and Background Information

www.climatechange2013.org

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