

2014.02.24 Maldives



Summary and Implications by IPCC WG1- AR5

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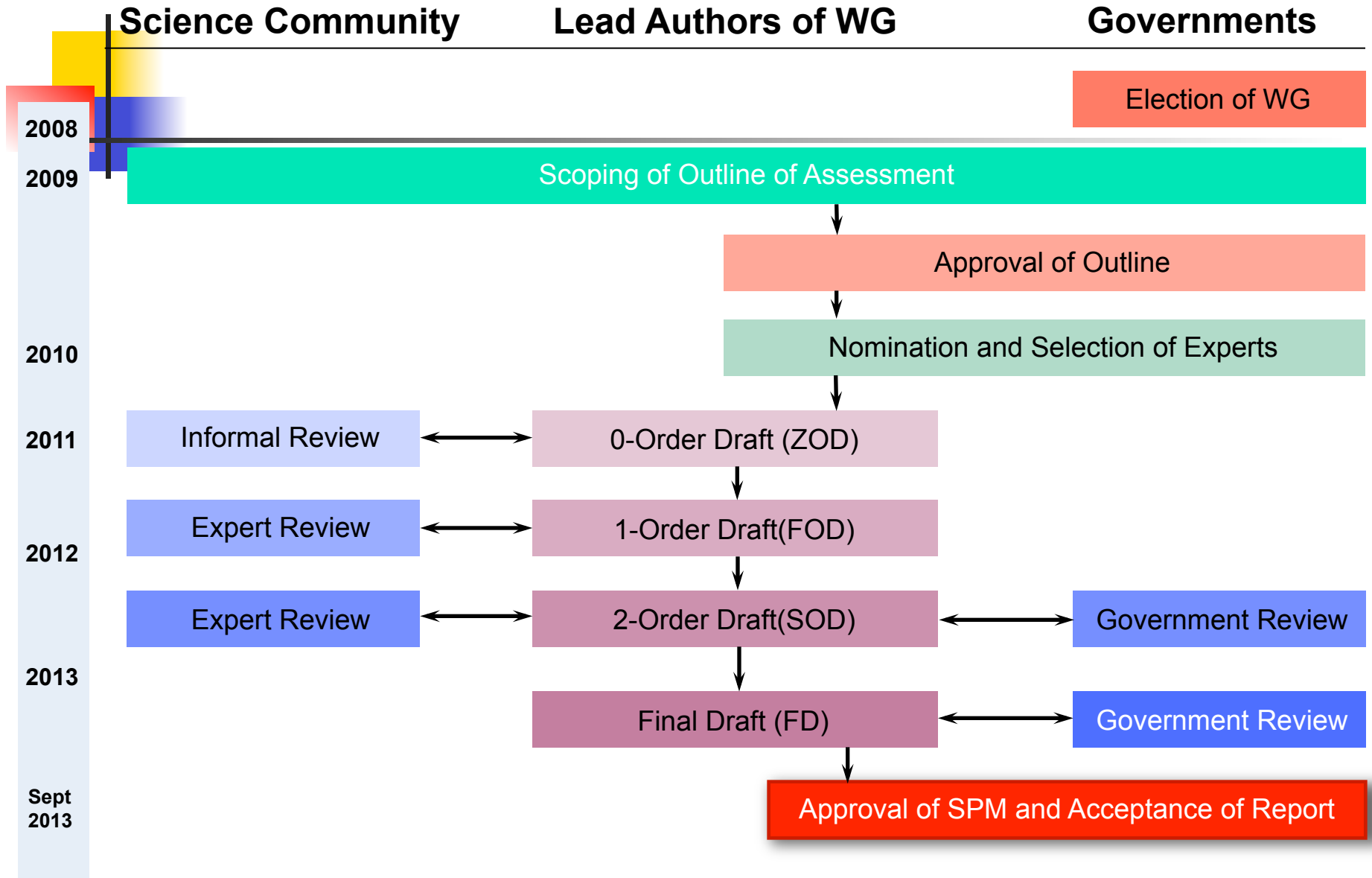
3. Lead Author Meeting
Marrakech, Morocco

259 **Scientists**
39 **Countries**
18% **Female**
24% **DC/EIT**



4. Lead Author Meeting
Hobart, Australia

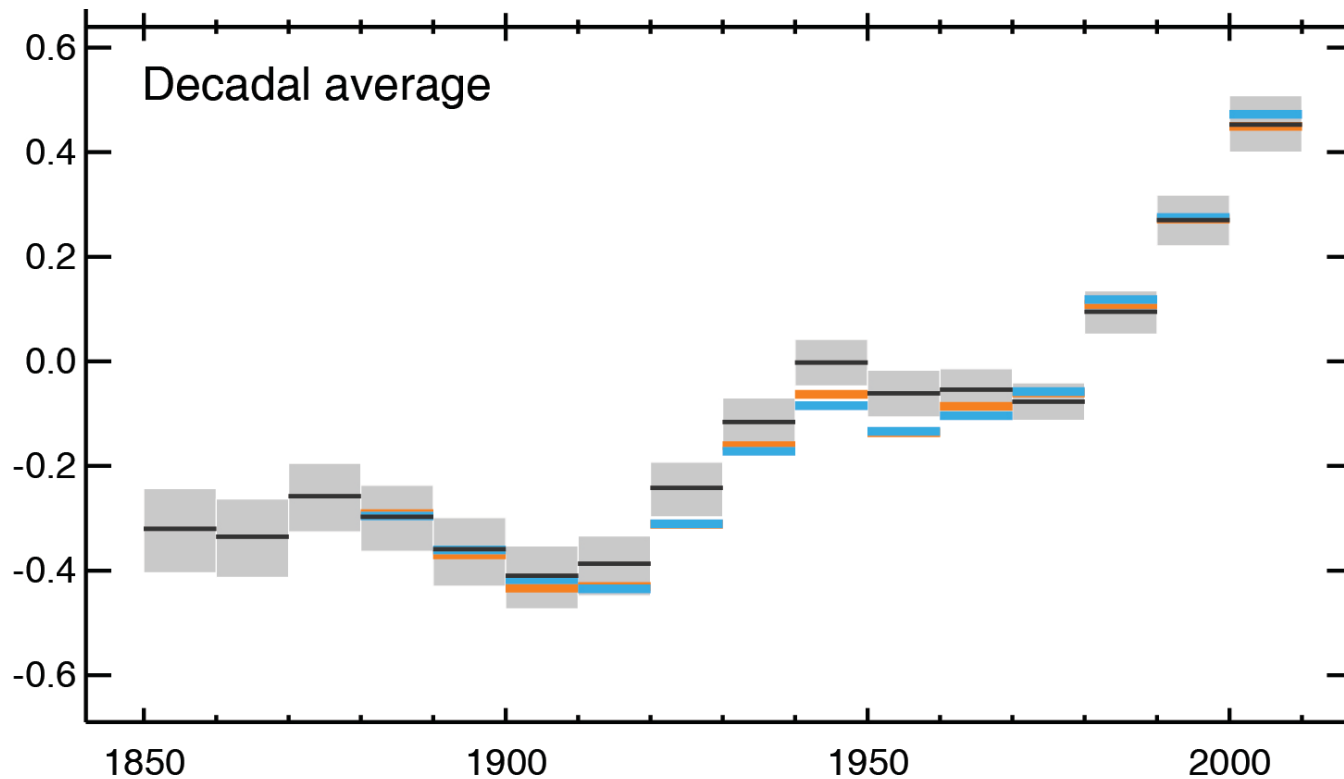
IPCC Process (WGI):





Observation

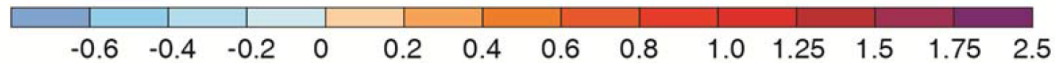
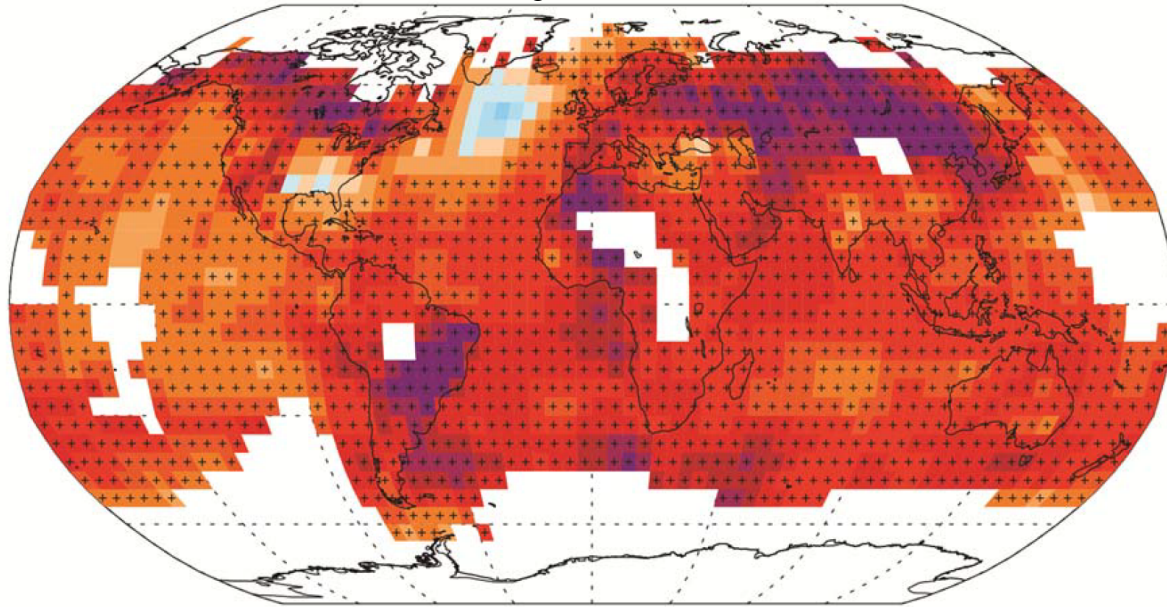
What has changed?



Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850.

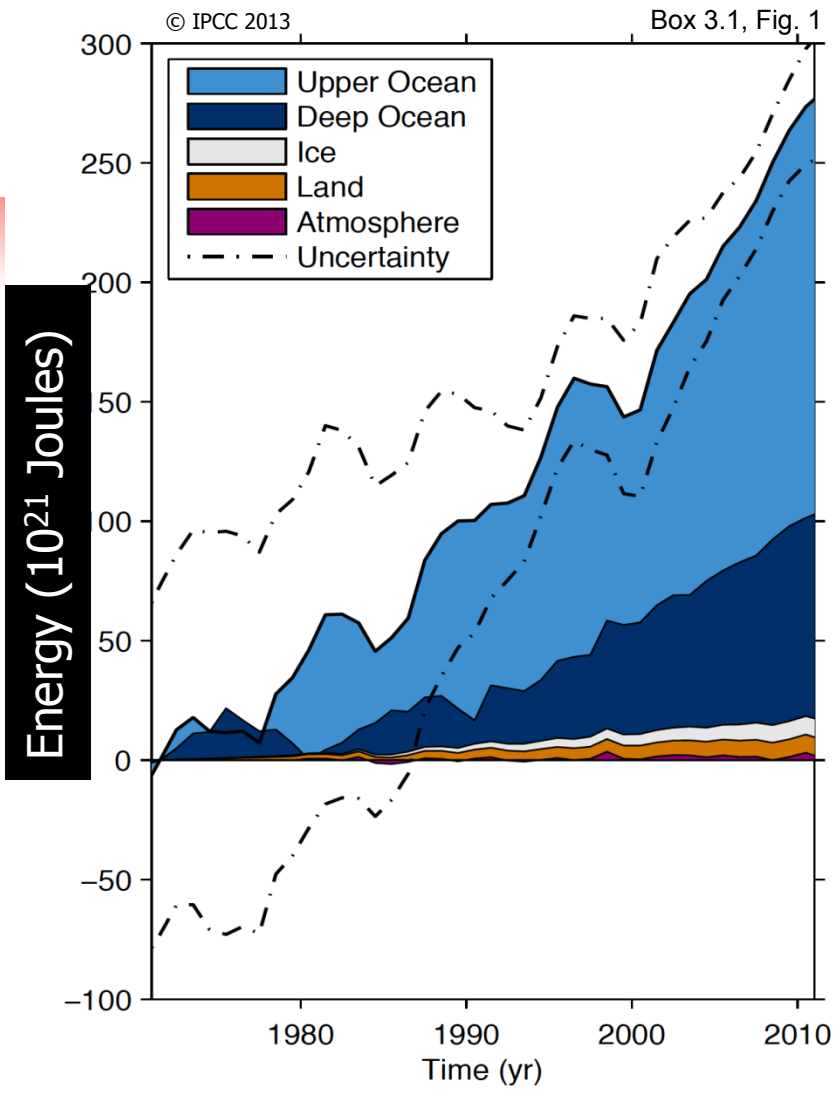
In the Northern Hemisphere, 1983–2012 was *likely* the warmest 30-year period of the last 1400 years (*medium confidence*).

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Temperature Difference 1901 to 2012 based on trend (°C)

Warming of the climate system is unequivocal, [...]



Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90% of the energy accumulated between 1971 and 2010 (*high confidence*).



Understanding

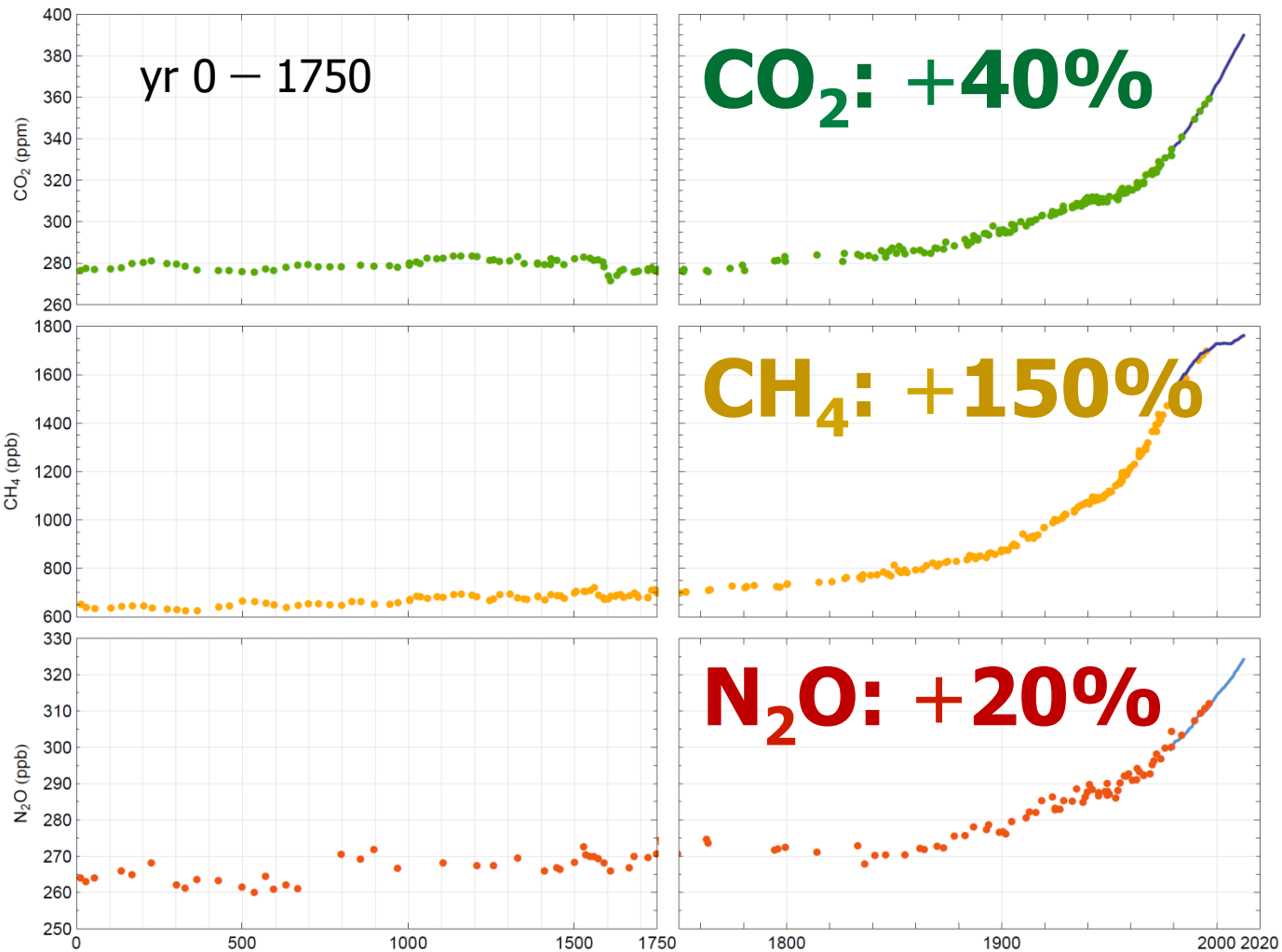
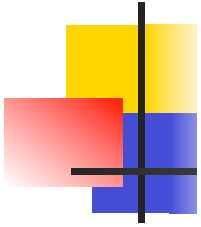
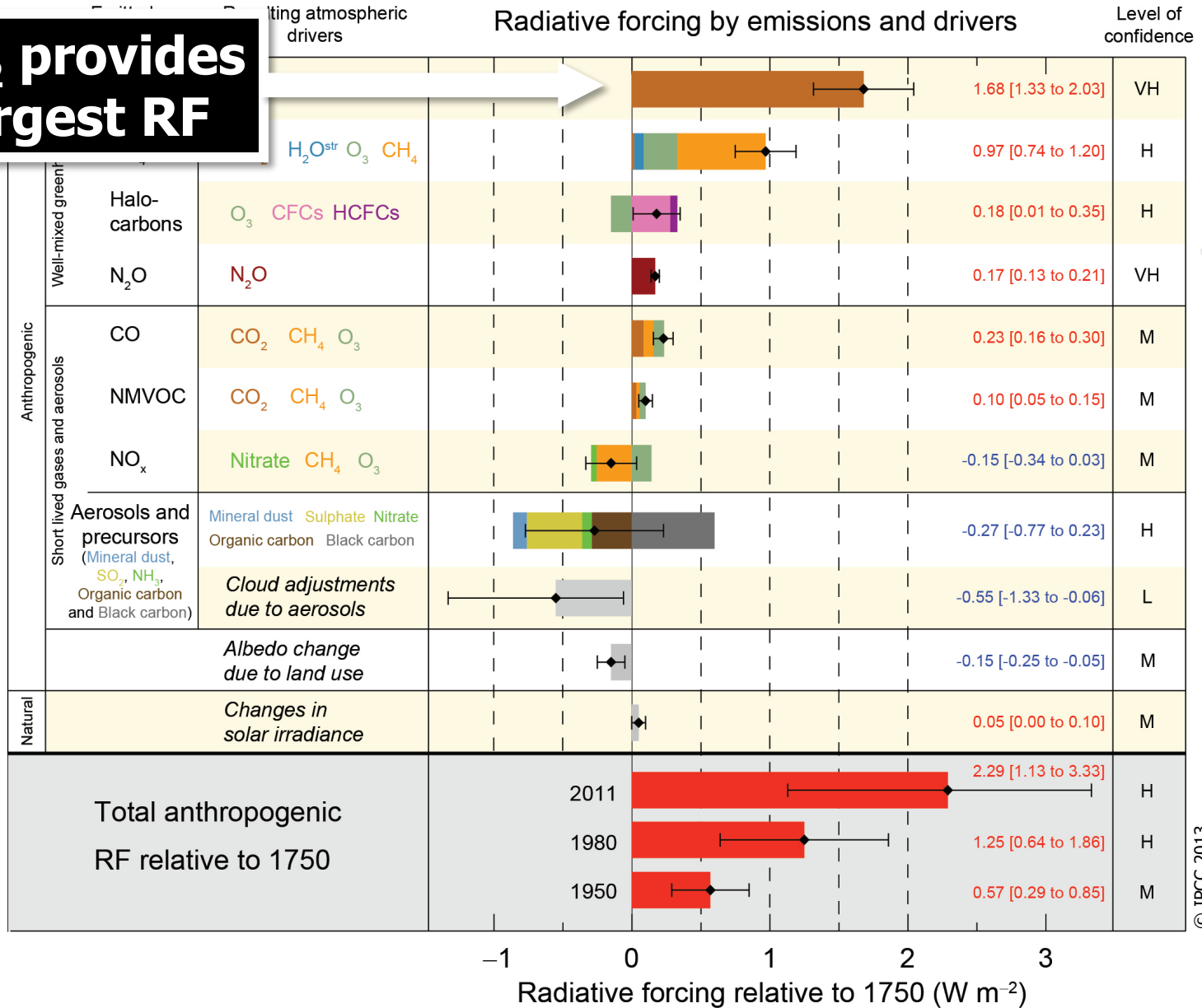


Fig. 6.11

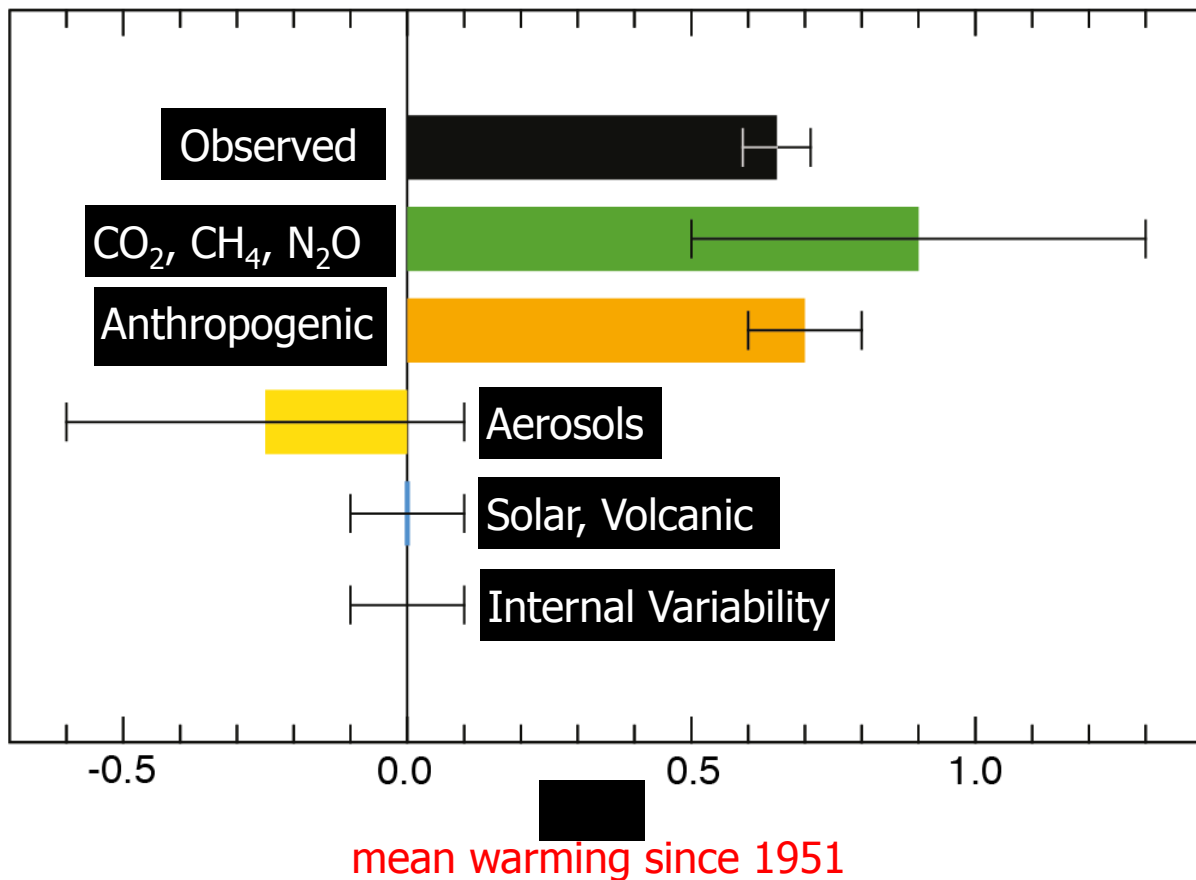
The atmospheric concentrations of carbon dioxide, methane, and nitrous oxide have all increased since 1750 due to human activity.

CO₂ provides largest RF



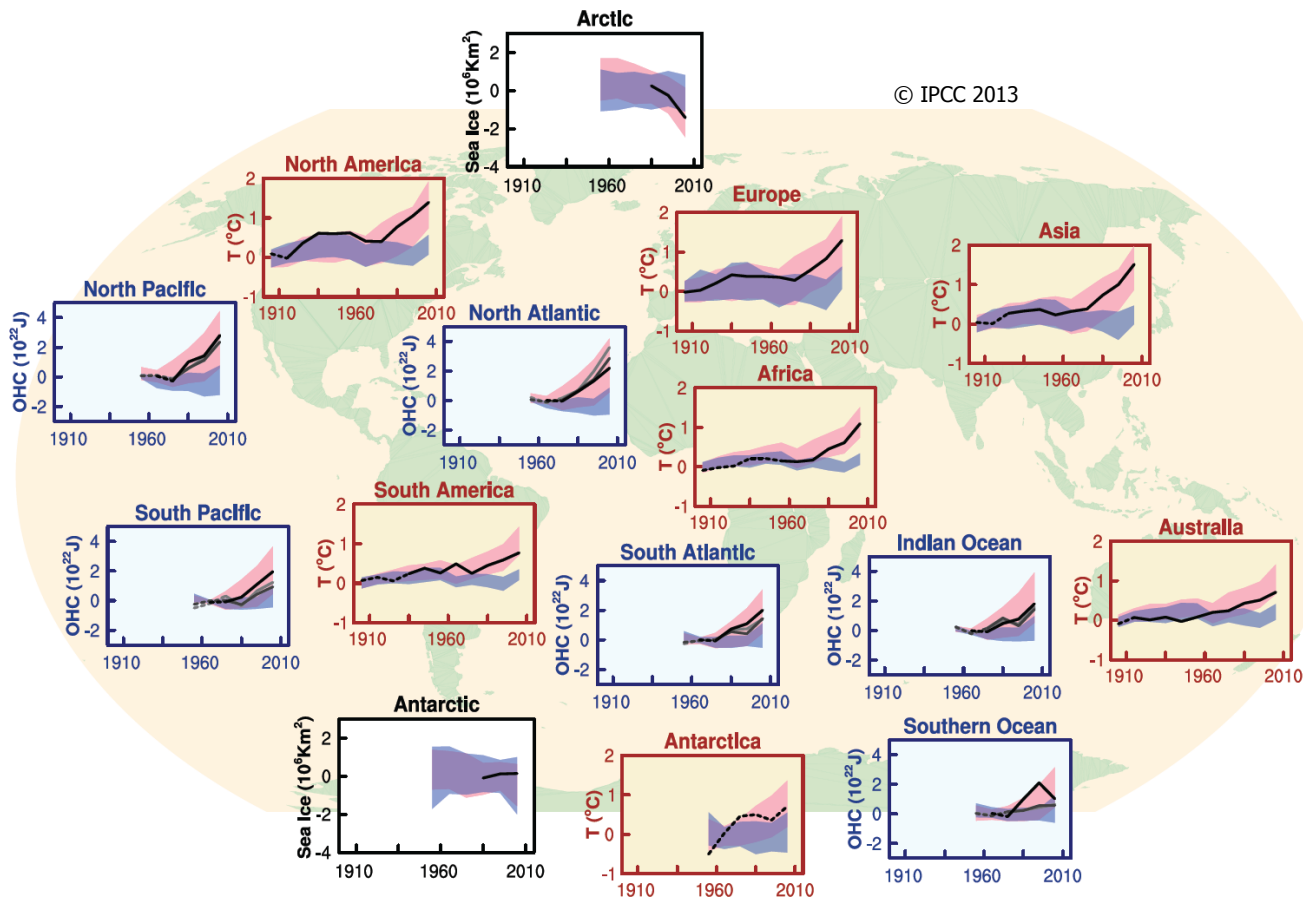
© IPCC 2013

Fig. SPM.5



© IPCC 2013

The observed warming 1951–2010 is approximately 0.6°C to 0.7°C.



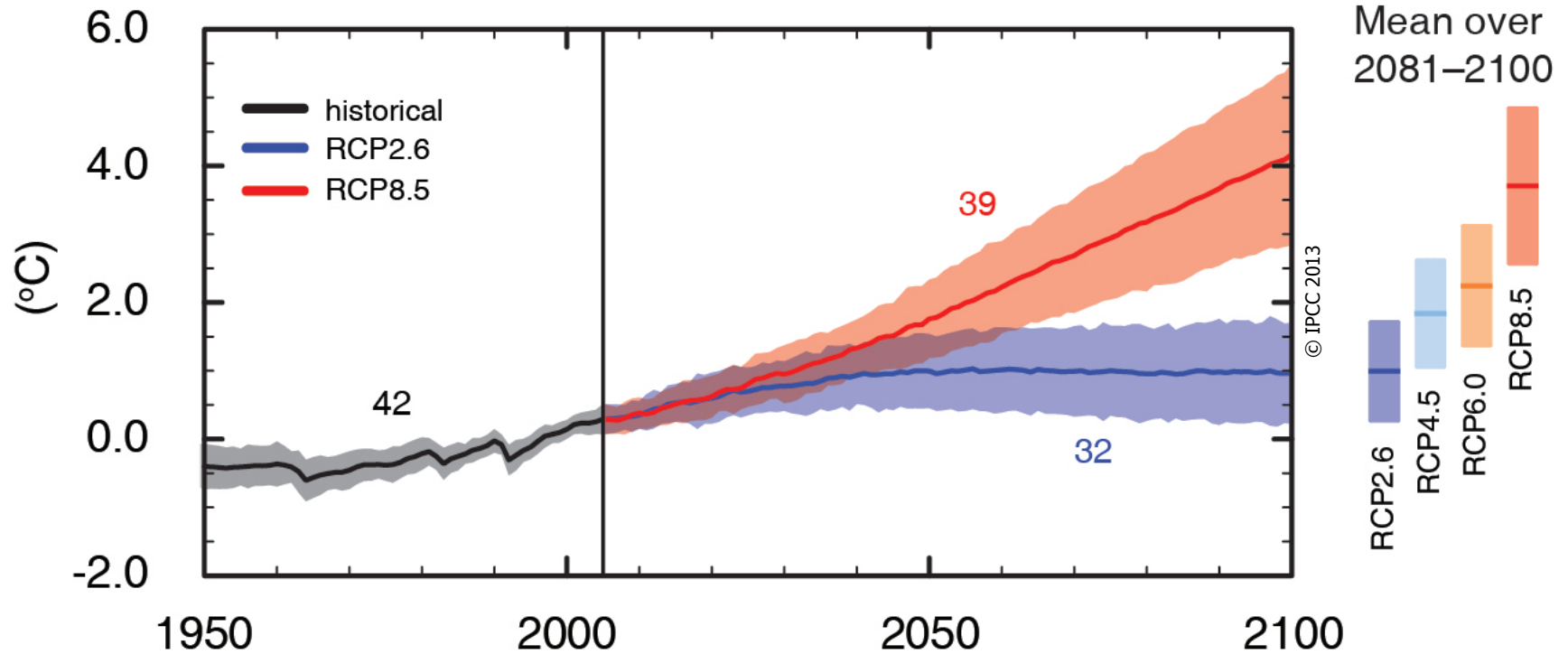
Human influence on the climate system is clear.



Future

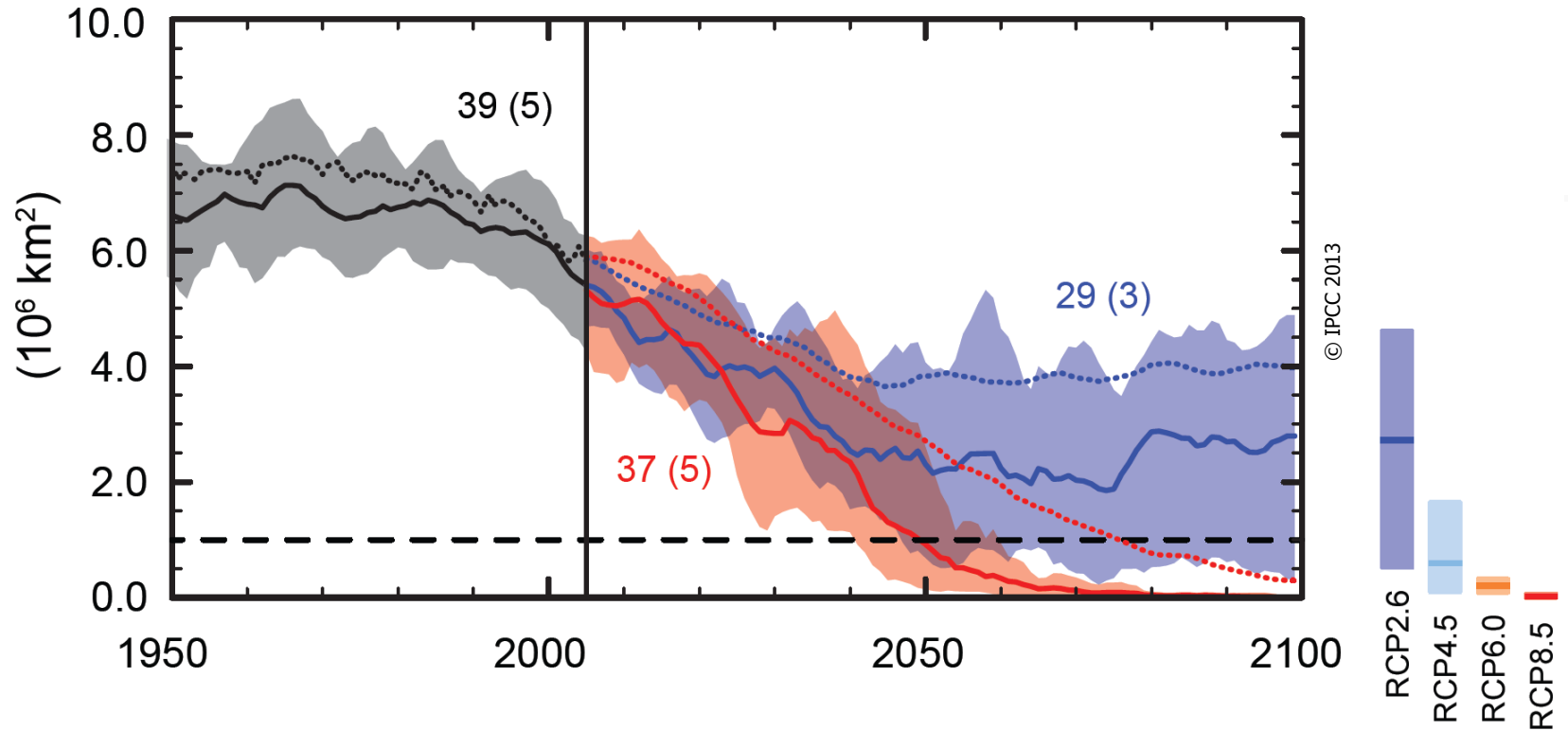
(a)

Global average surface temperature change

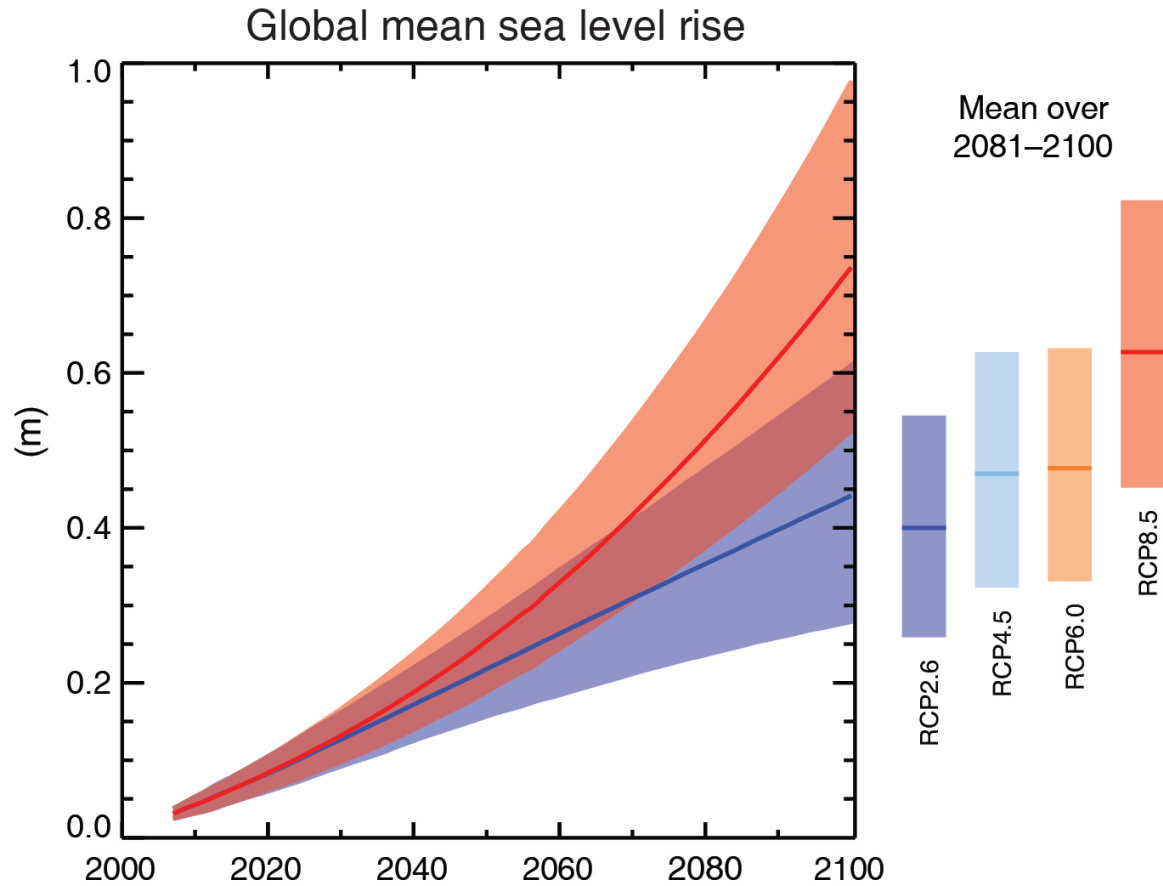


Global surface temperature change for the end of the 21st century is *likely* to exceed 1.5°C relative to 1850–1900 for all scenarios except RCP2.6.

Northern Hemisphere September sea ice extent

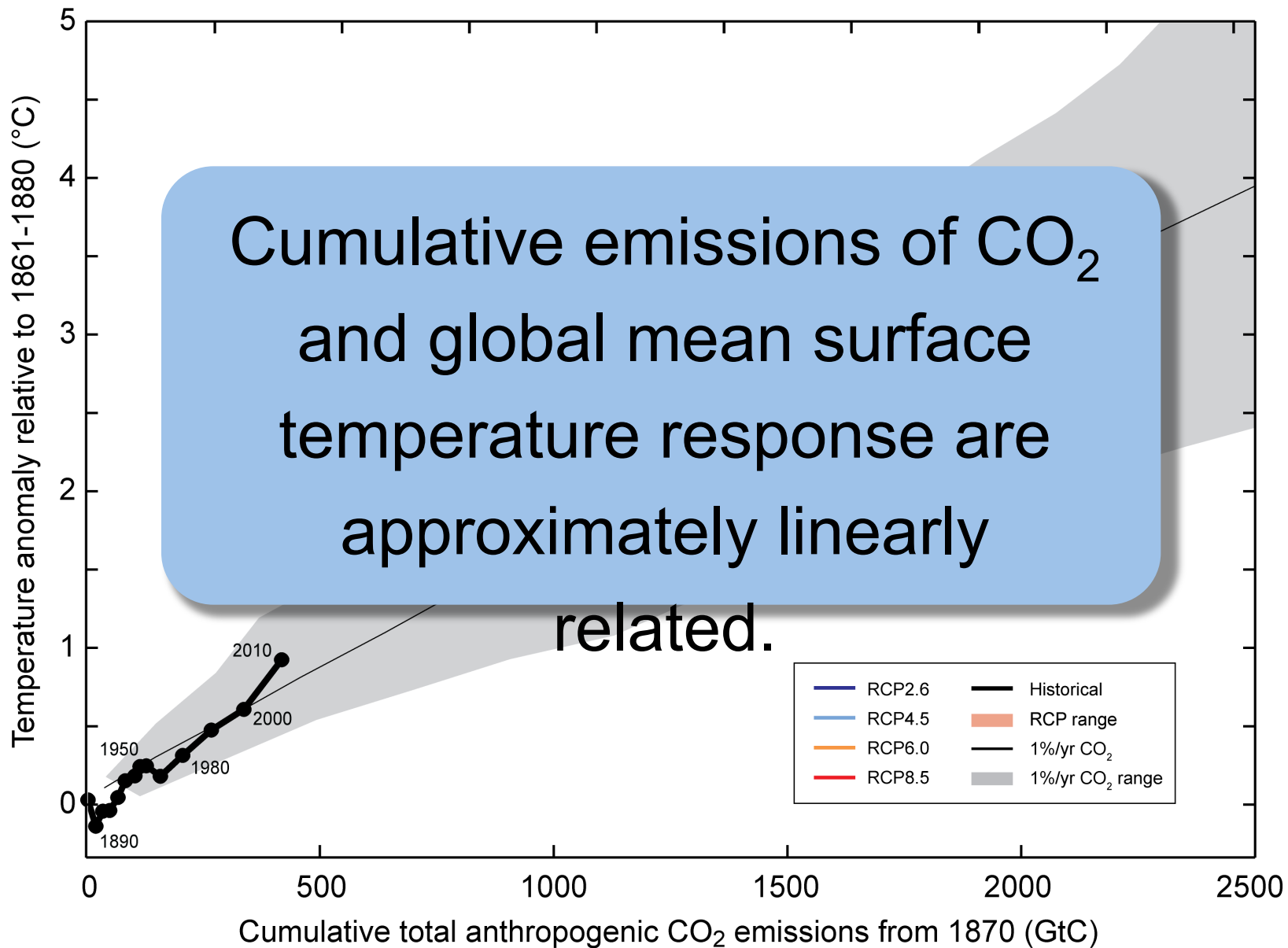


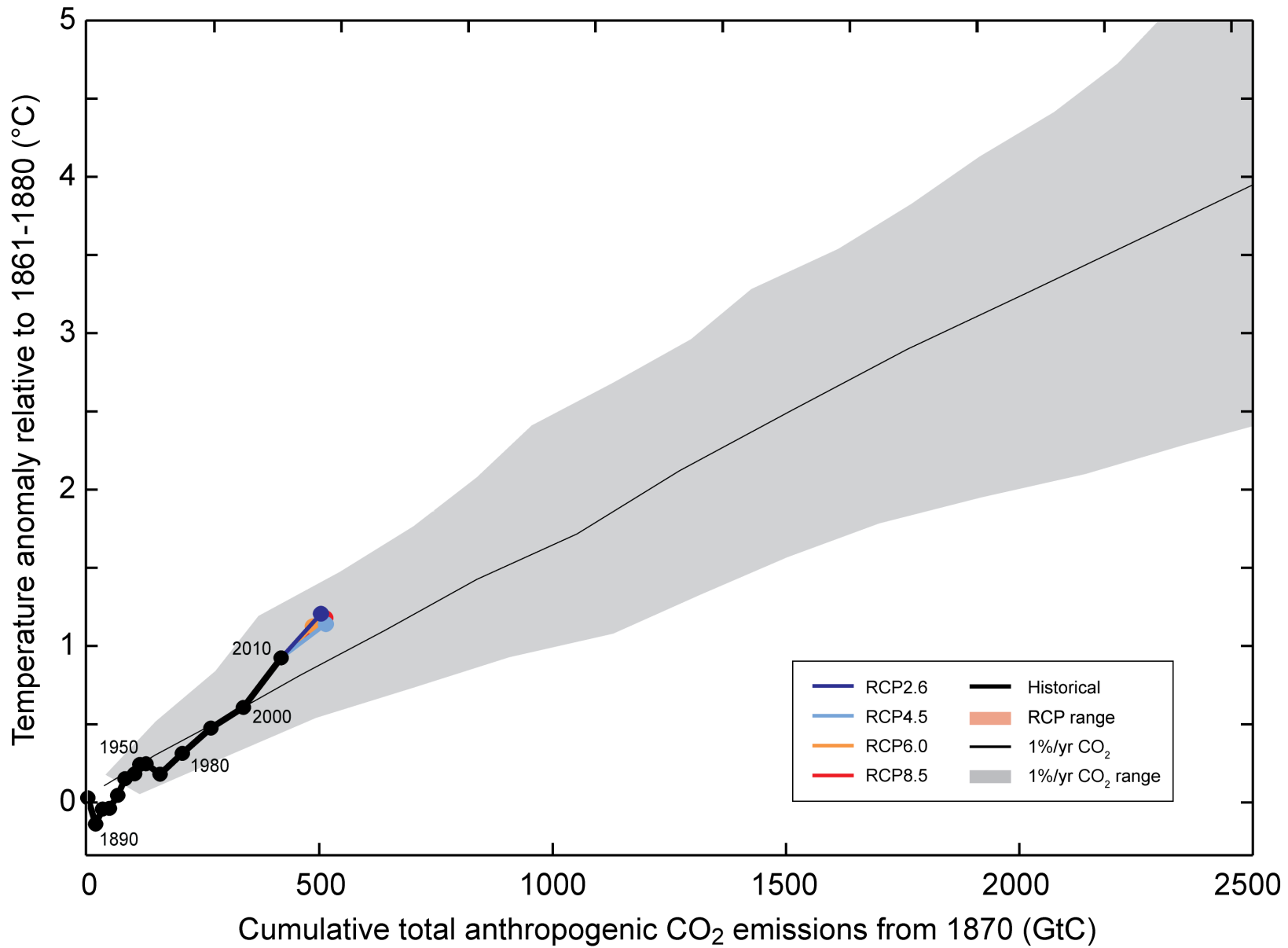
[...], a nearly ice-free Arctic Ocean in September before mid-century is *likely* for RCP8.5 (*medium confidence*).

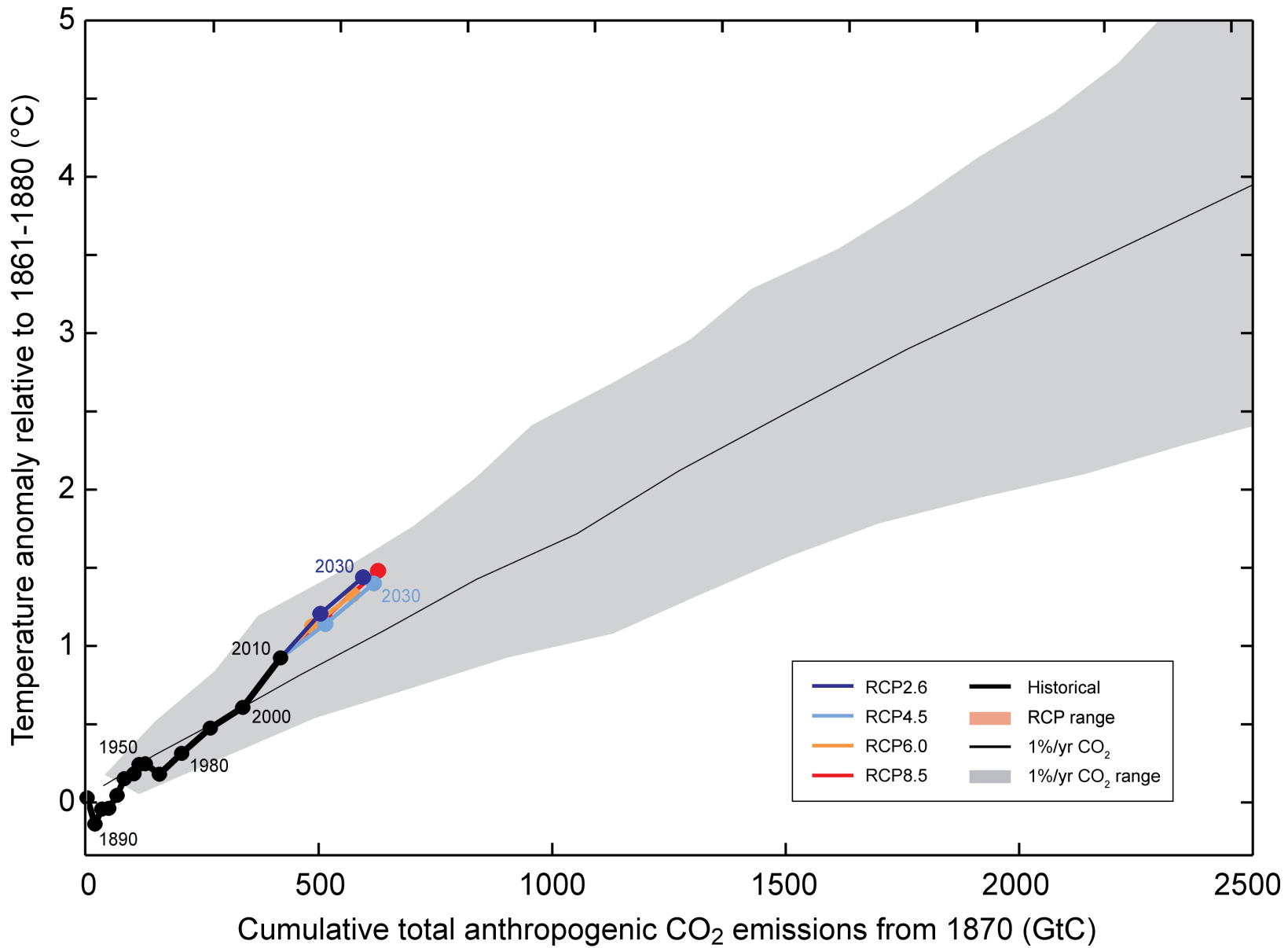


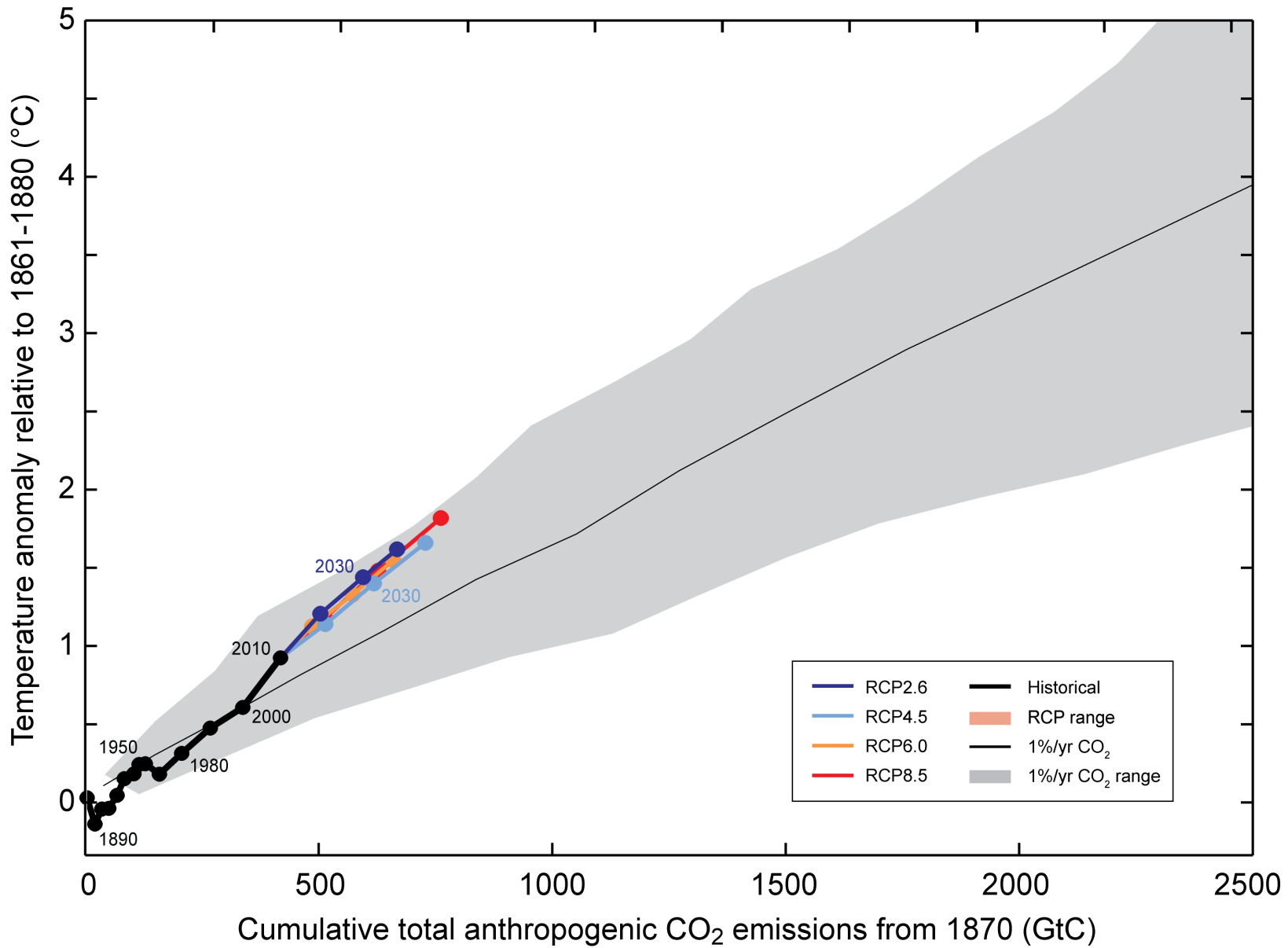
RCP2.6 (2081-2100), *likely* range: 26 to 55 cm

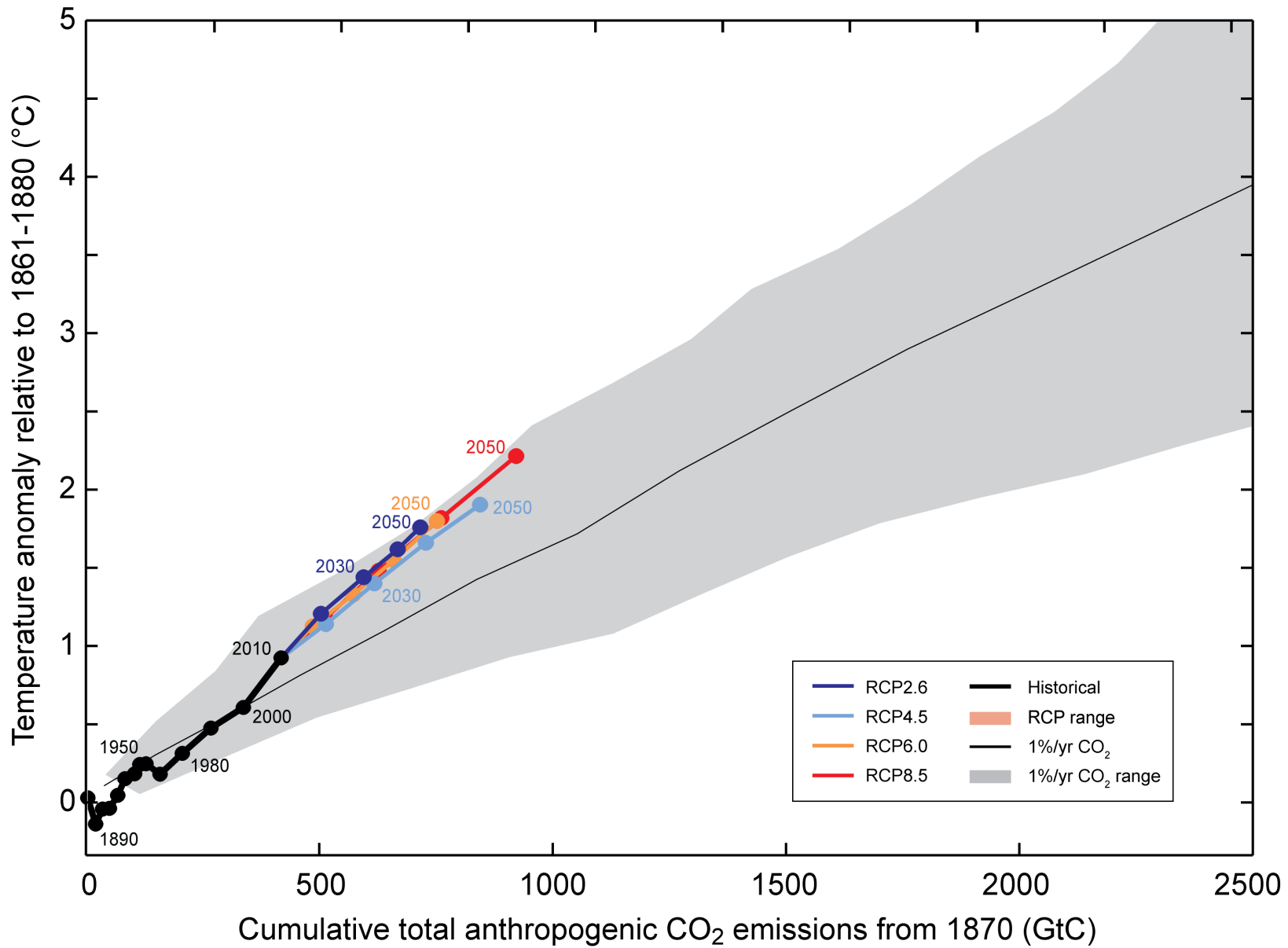
RCP8.5 (in 2100), *likely* range: 52 to 98 cm

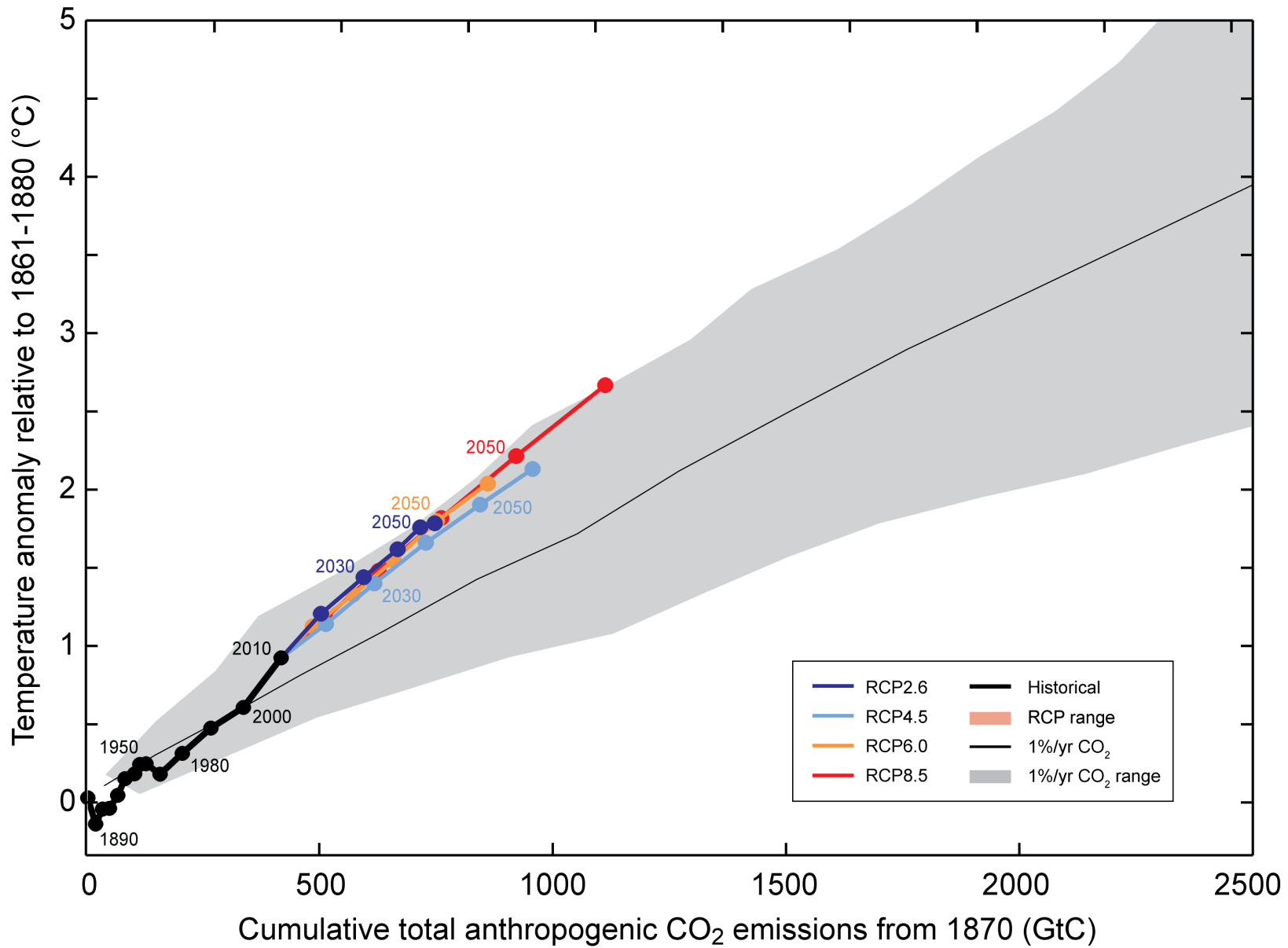


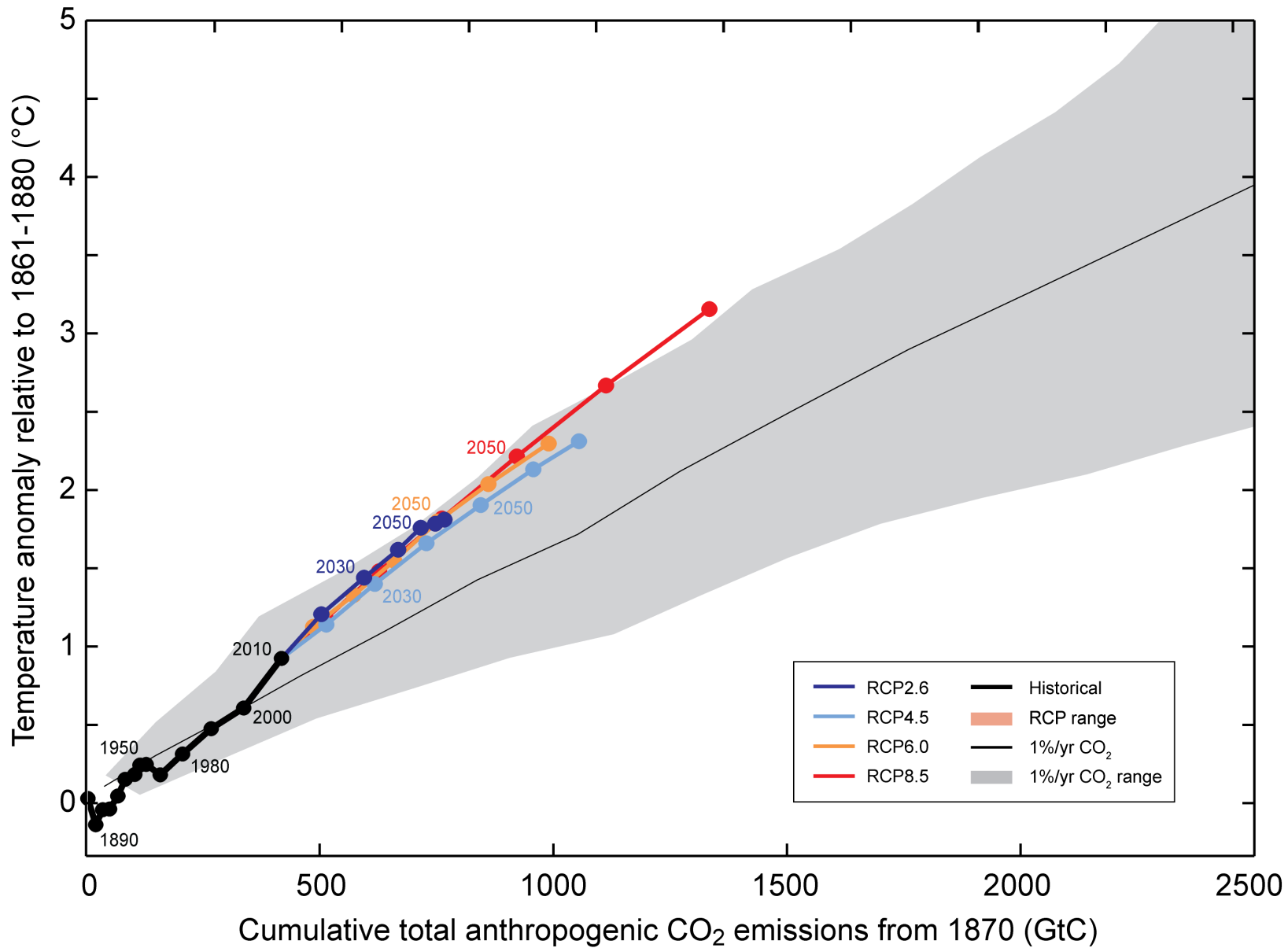


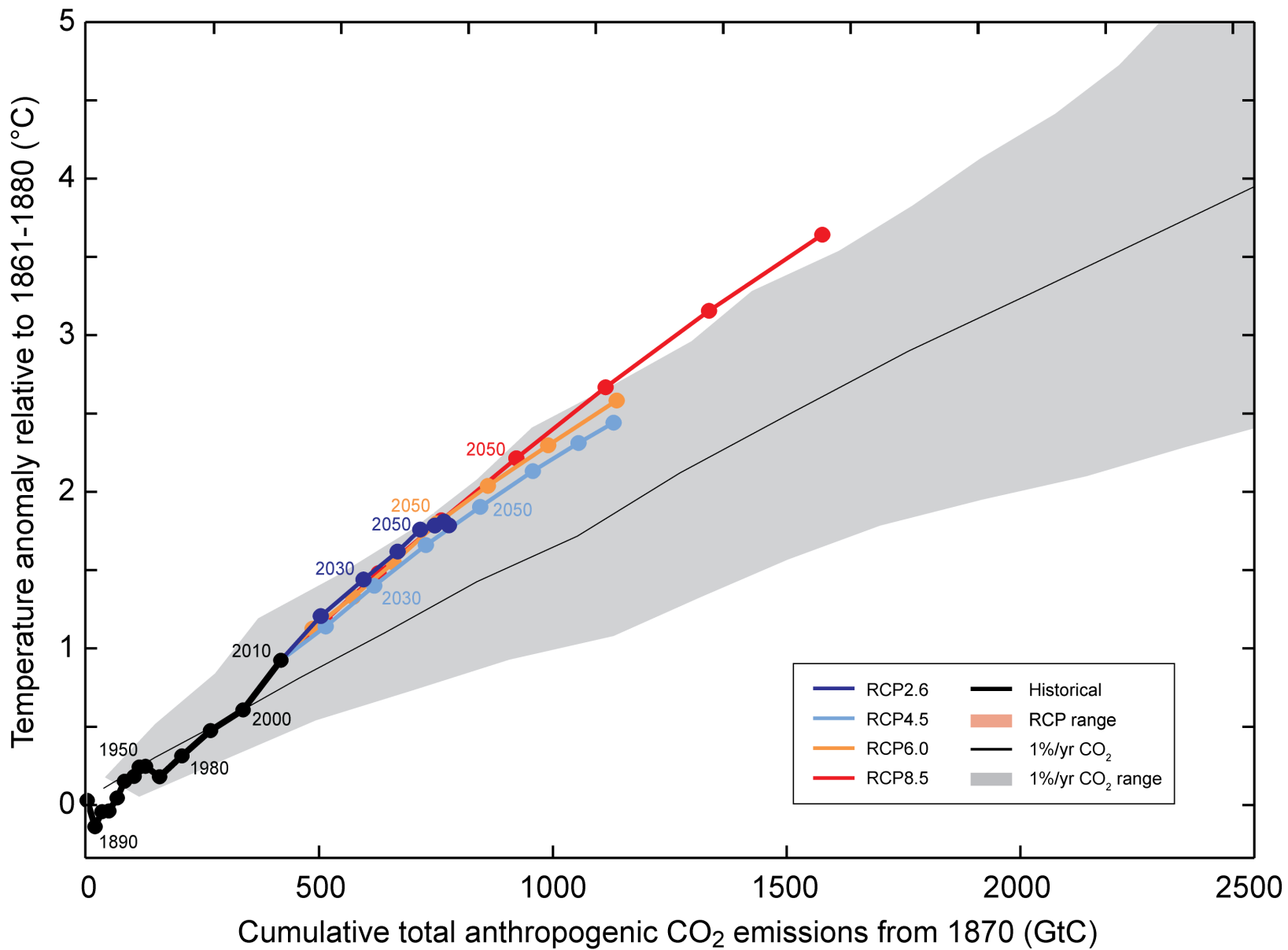


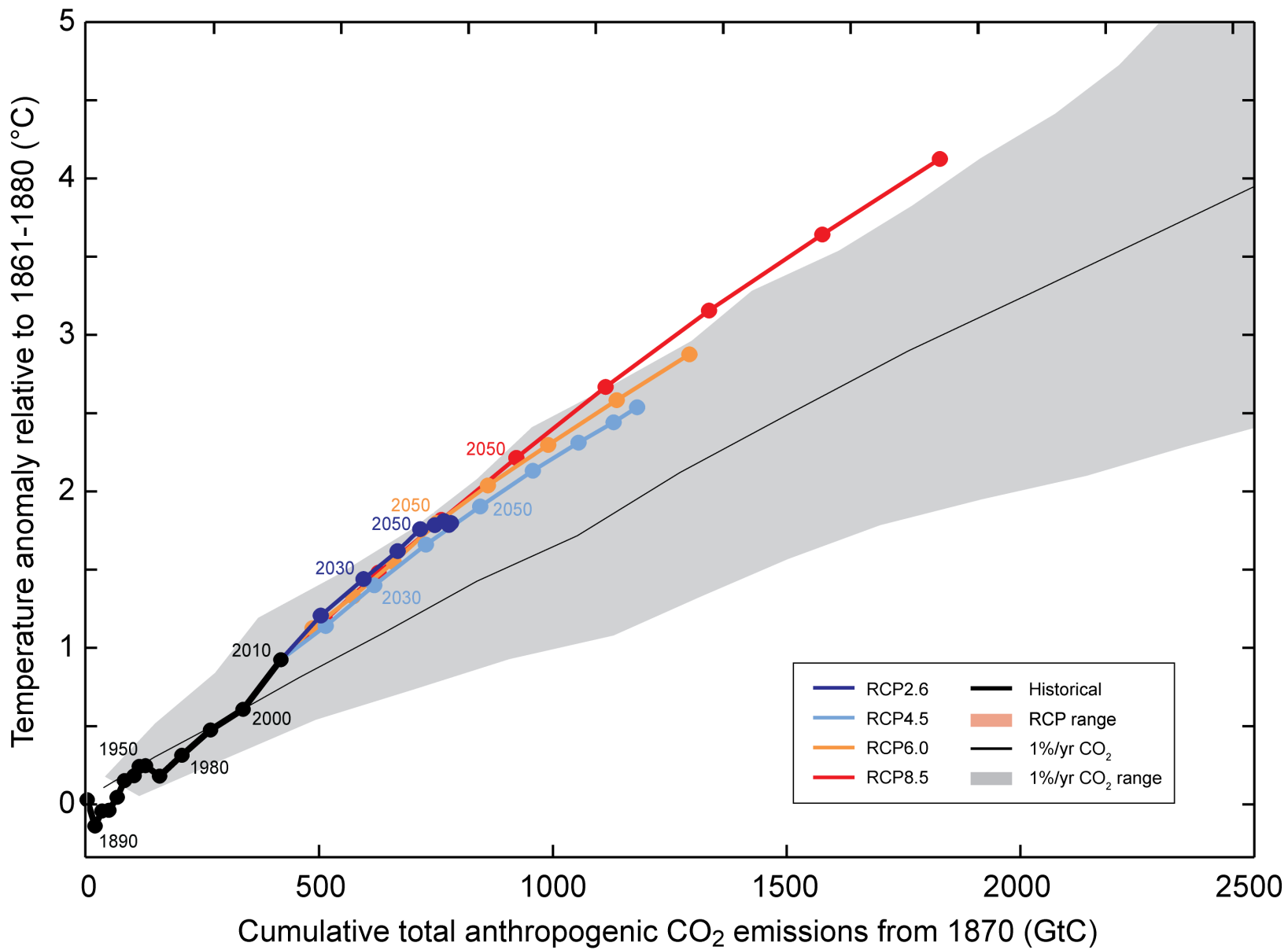


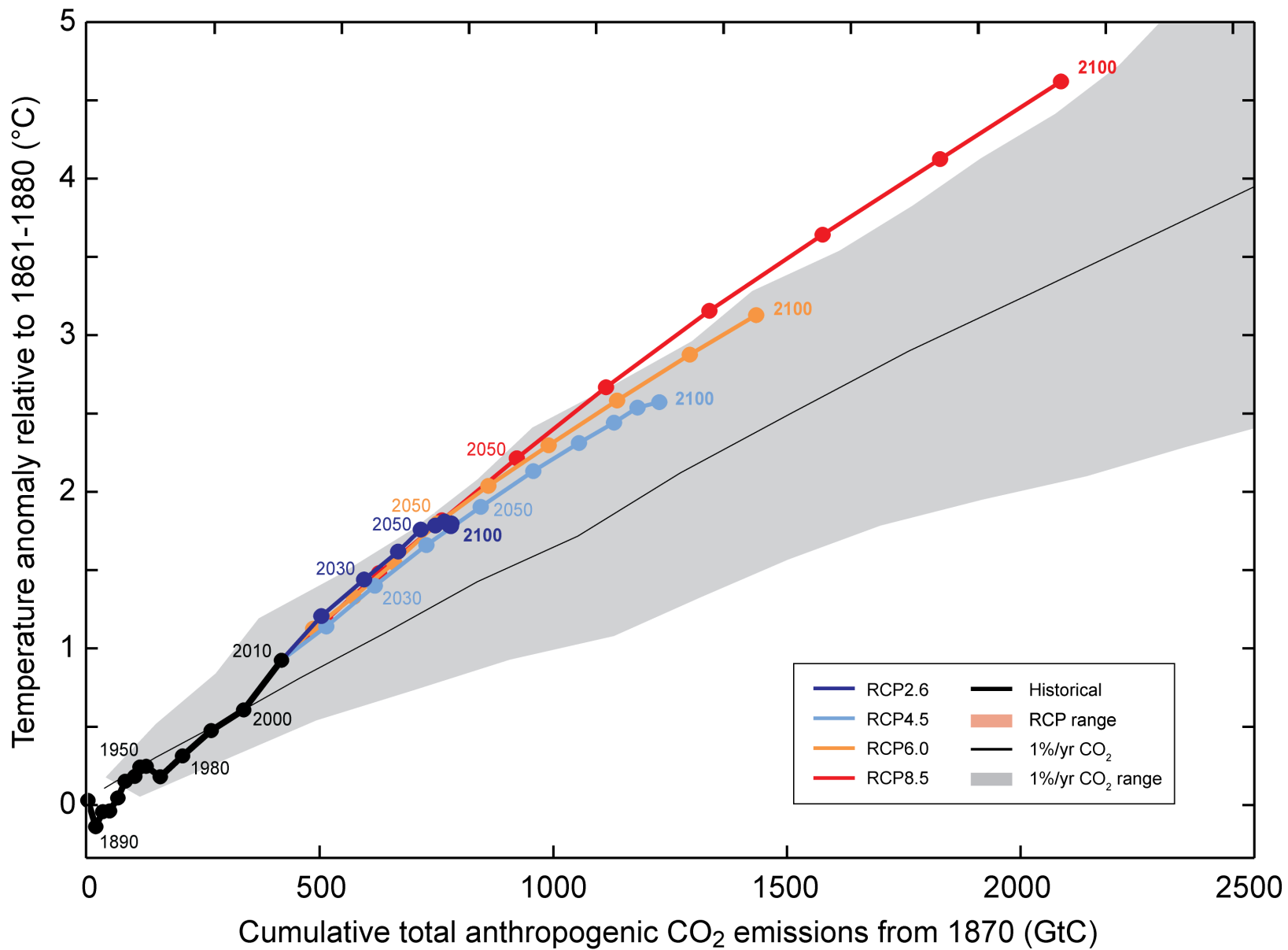


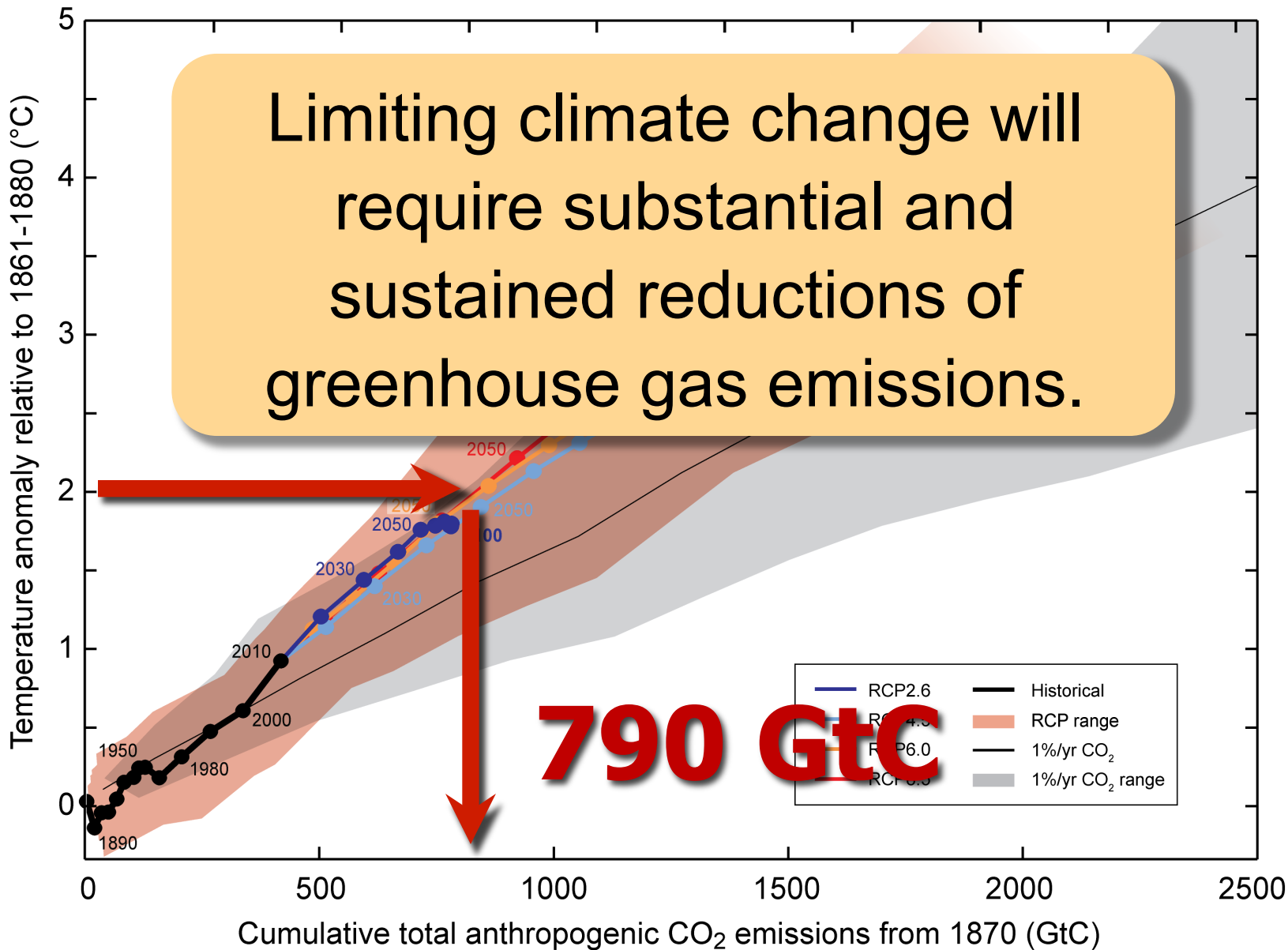












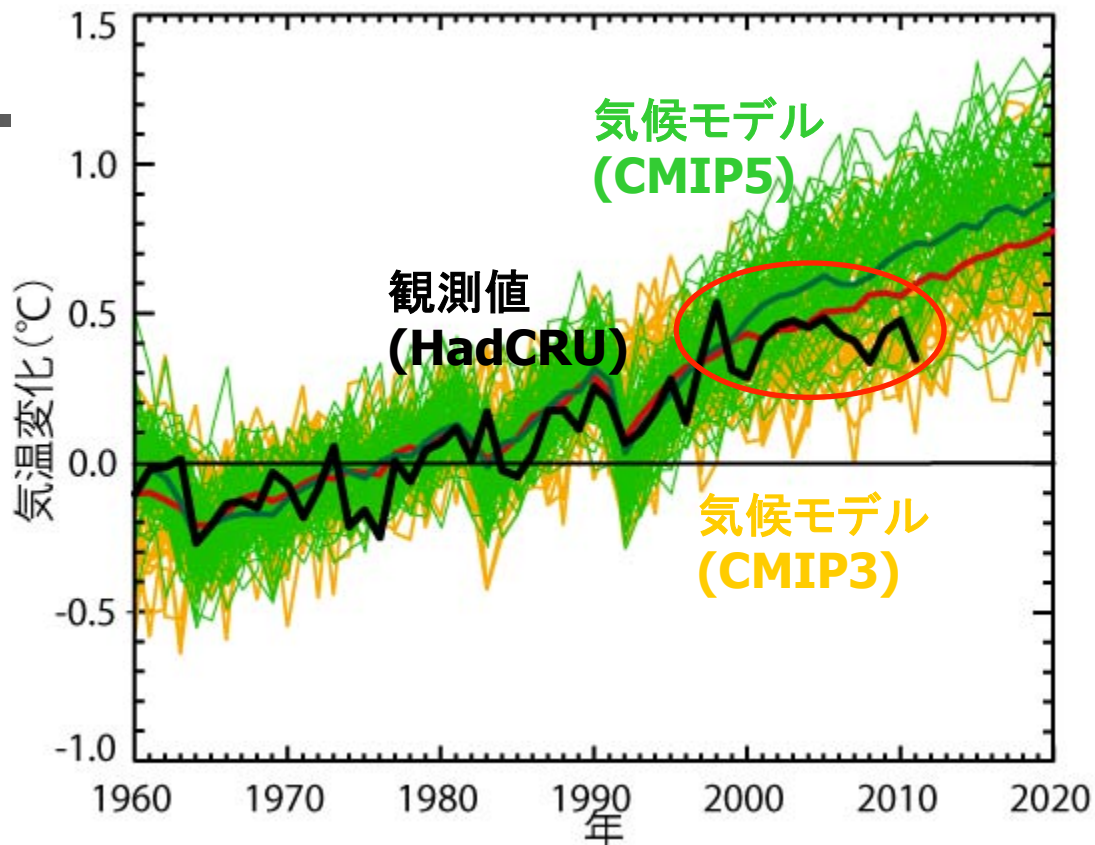
Limiting climate change will require substantial and sustained reductions of greenhouse gas emissions.

790 GtC

地球温暖化の停滞 (hiatus)

近年の温暖化の鈍化

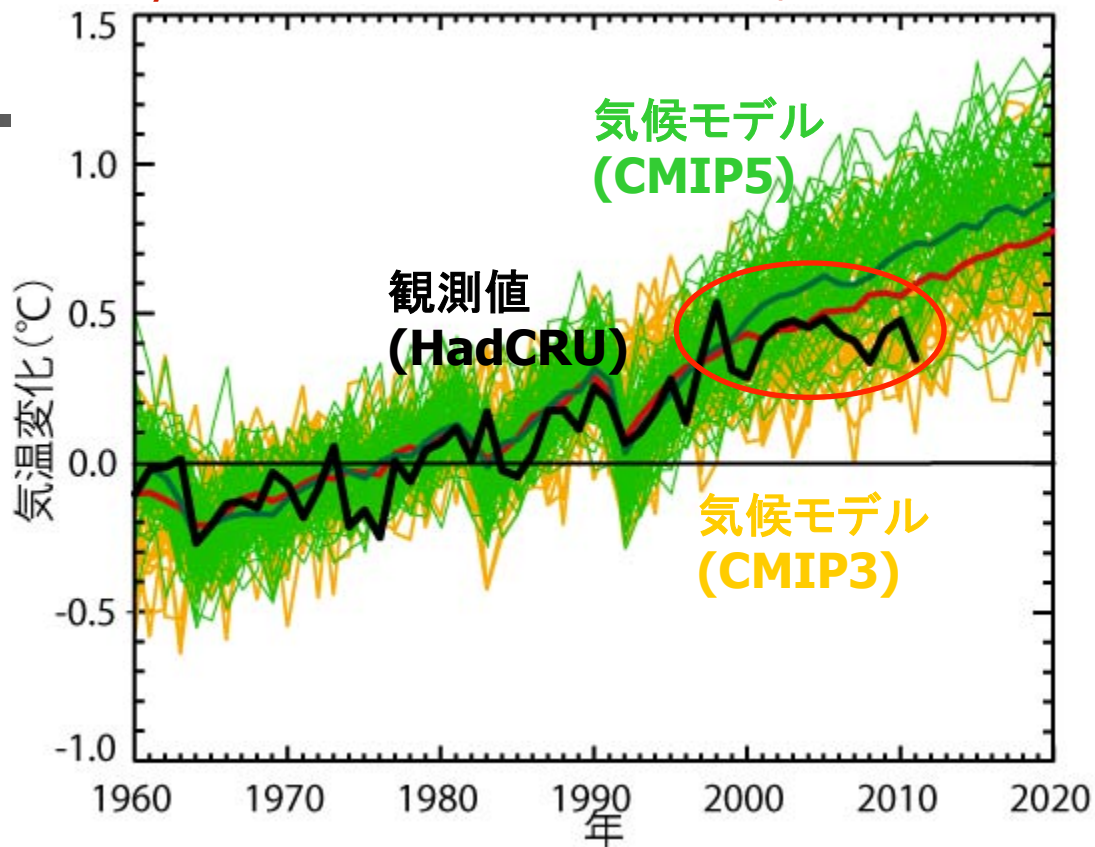
- 2000年頃から、全球地表気温はほぼ一定 (10年で 0.03°C の昇温)
- 気候モデルは、最近10年の全球平均気温変化をうまく再現できていない
⇒ 温暖化予測と違い、現実には温暖化が鈍っていることを意味するのか？



Hiatus

Assumptions

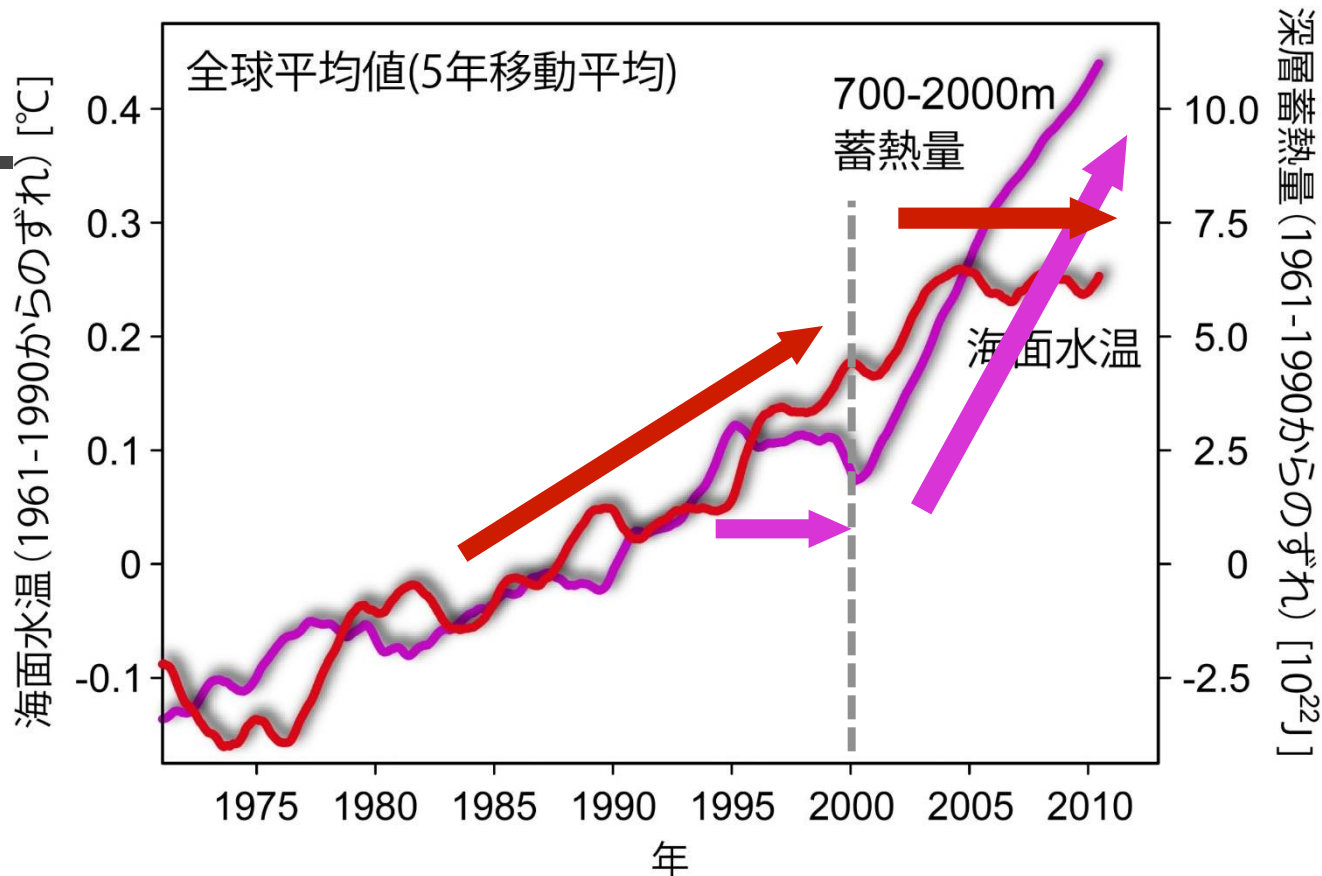
- Decrease of Water Vapor in the Stratosphere (Solomon et al. 2010)
- Reduction of the solar Activity (Kaufmann et al. 2011)
- Increase of Heat-Uptake in the Ocean (Meehl et al. 2011; Watanabe et al. 2013)
- Natural Variability with PDO (Meehl et al. 2012; Kosaka and Xie 2013)



Intensity of Heat-Uptake in the Ocean

Observational Facts

- ❑ Net Rad. Balance at the TOA is negative (=heating the climate system)
- ❑ Increase of Accumulated Heat in the ocean (deeper than 700m)
- ❑ Recent Accumulated Heat is larger than before

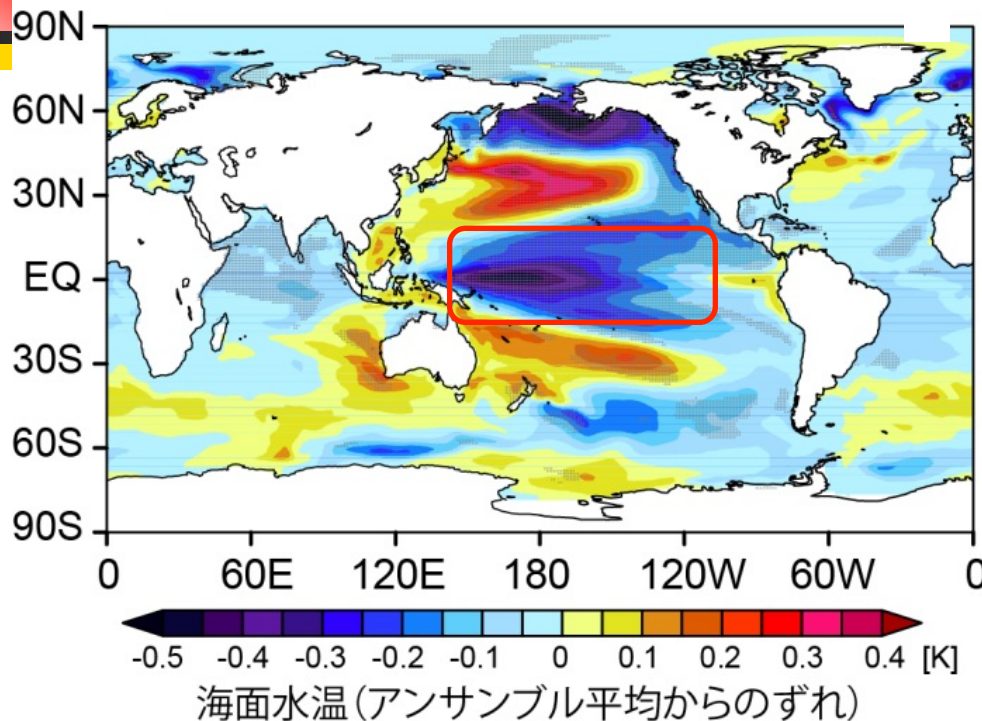


Hiatus in a Climate Model

モデルアンサンブルから

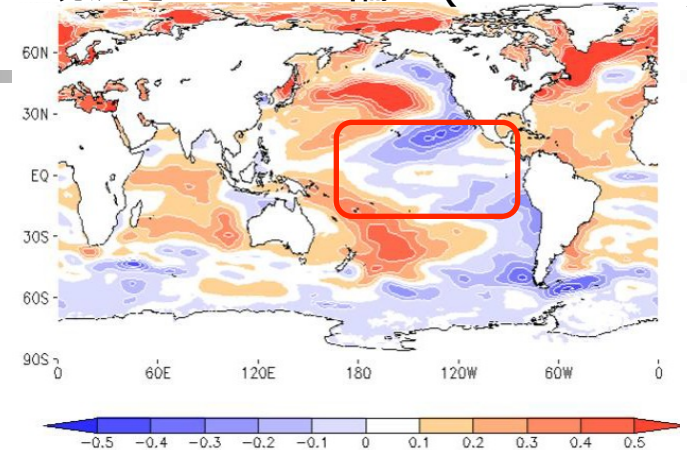
- 気候モデルは、(平均として)hiatusをうまく再現できていない
- が、初期値アンサンブルを調べると、hiatusが現れているメンバもある
- Hiatusが現れているときには、PDOの負位相に似た海面水温(SST)偏差

MIROC5における2001-2010年平均SST偏差
(11メンバ間のspreadに対する線形回帰)



Watanabe et al. (2013)

観測されたSST偏差(2000-2012)



PDOの指標が正から負に変化する時期と、hiatusの出現が同期している

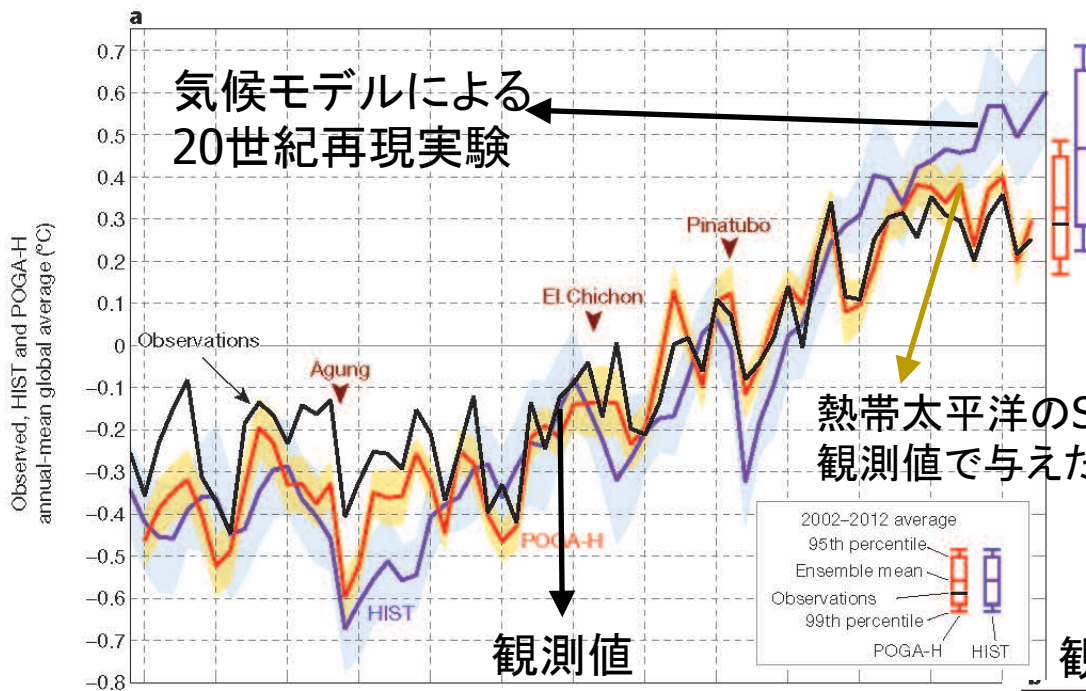
(Meehl et al.

2012)

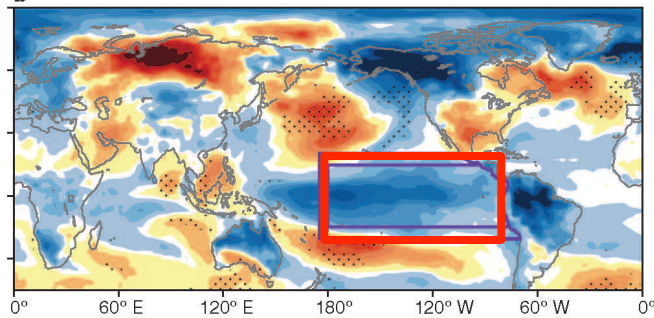
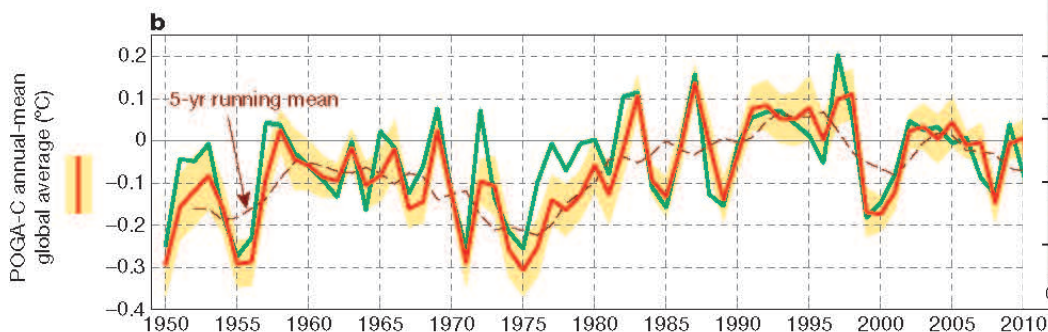
PDOと hiatus

気候モデル感度実験から

気候モデルが熱帯太平洋の寒冷化を再現できていたらhiatusが現れる

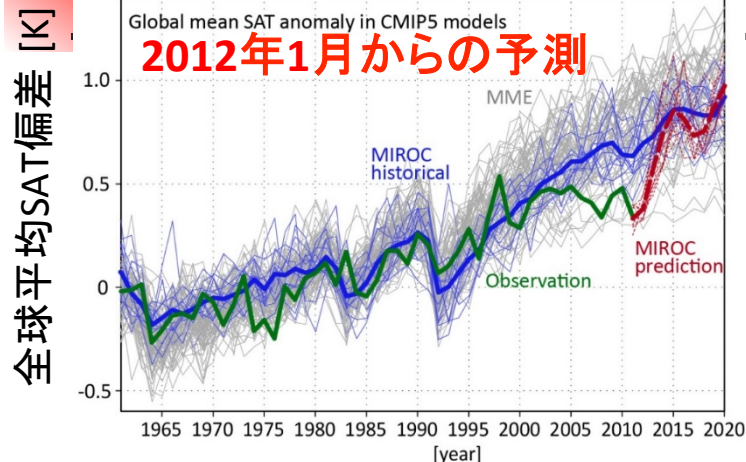


観測値SSTを与えている領域

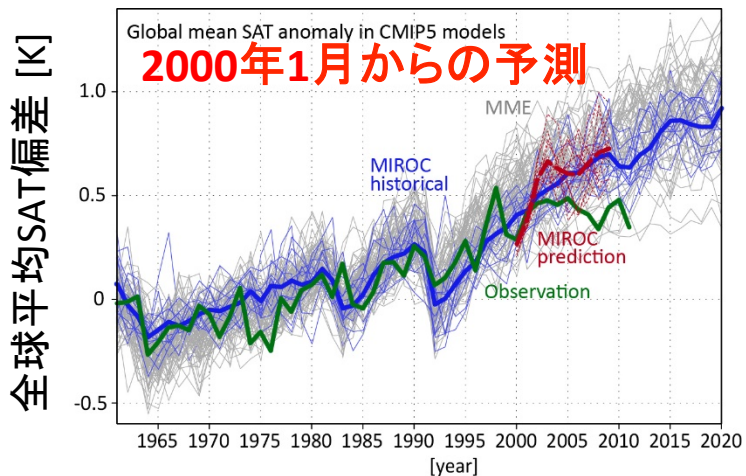


2000年代の熱帯太平洋SSTの予測(近未来)

MIROC5 decadal prediction



Hiatusはやがて終わる?



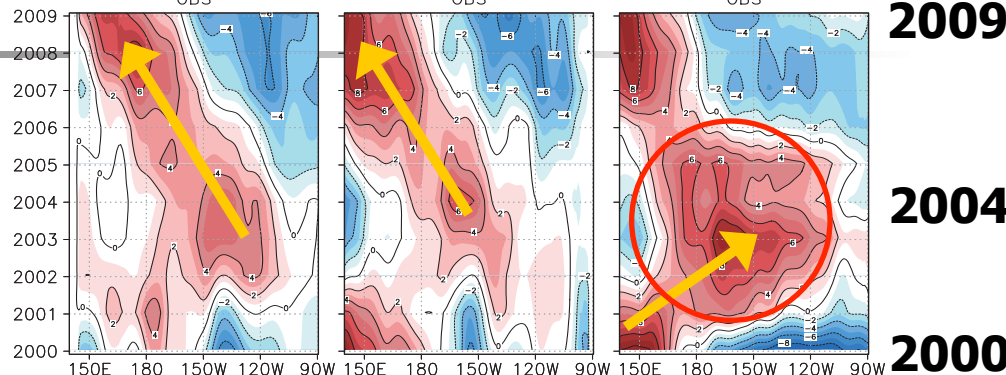
太平洋域HC300偏差 (3yr RM)

15S

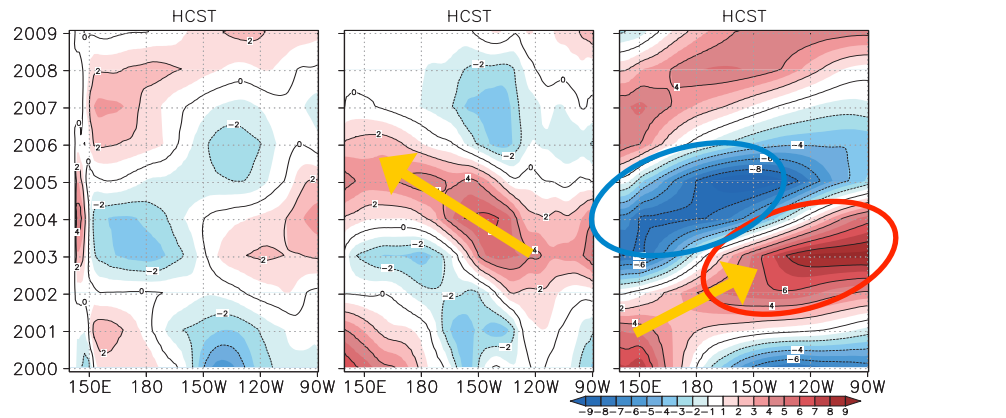
15N

赤道

観測値



予測値



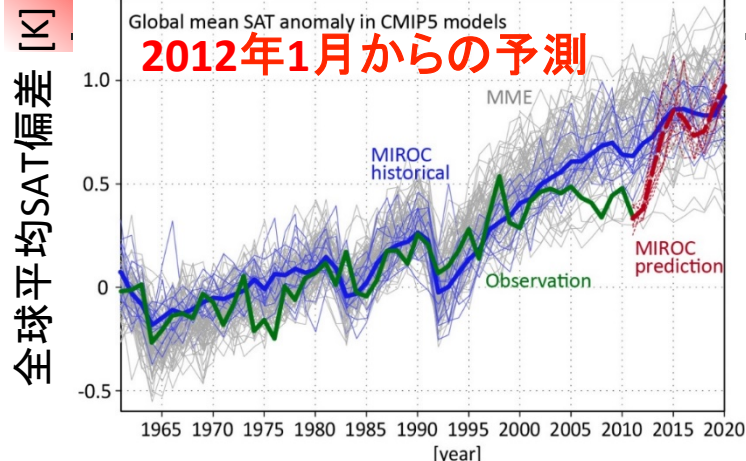
(観測)暖水が中部太平洋で止まるのは何故か?

なんだ、予測はモデル本来のtrajectoryに戻っているだけじゃないか.....?

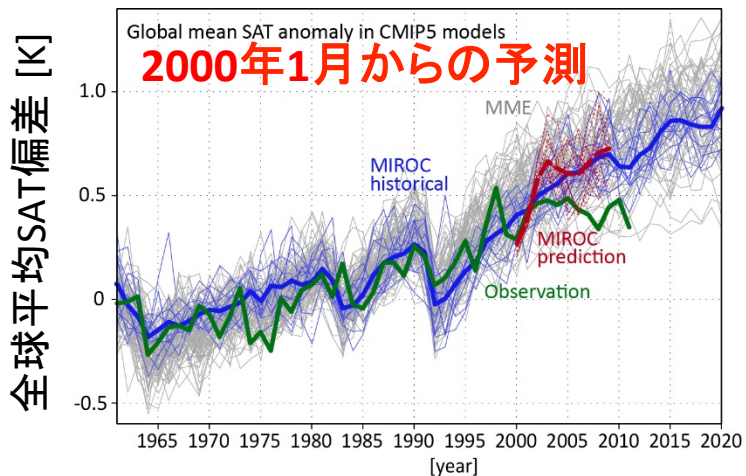
Slide courtesy of T. Mochizuki

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MIROC5 decadal prediction



Hiatusはやがて終わる?



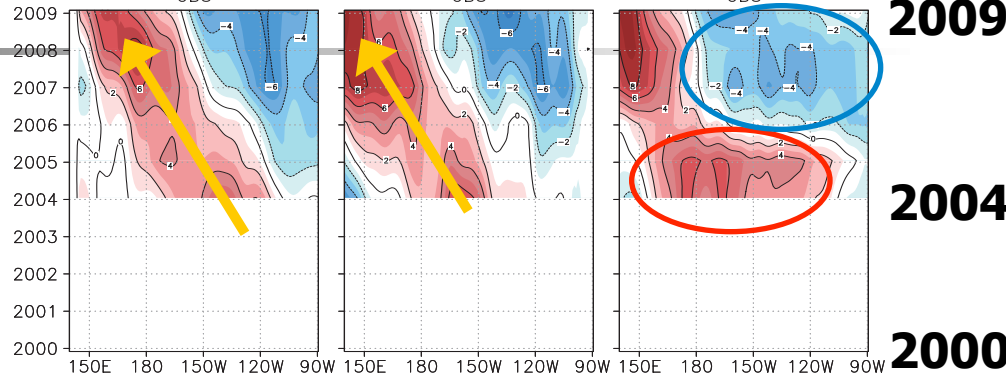
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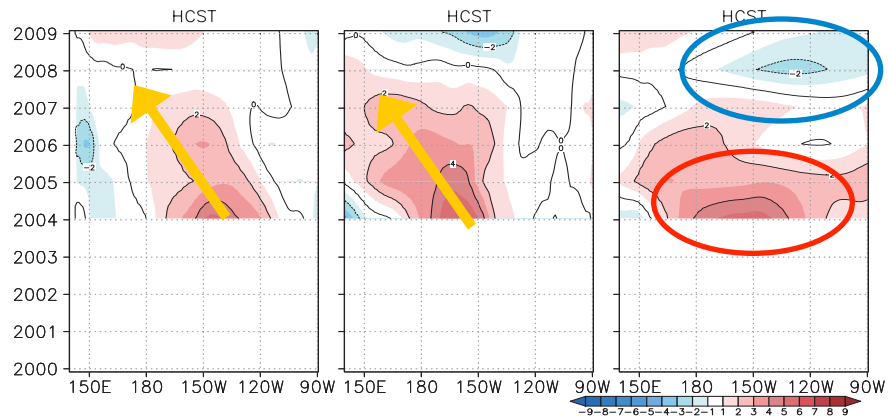
15N

赤道

観測値



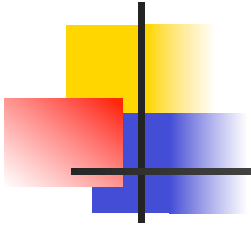
予測値



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Slide courtesy of T. Mochizuki



Thank you !