

Introduction and
motivation

Atmosphere

Biosphere

Ocean and the
cryosphere

Mitigation and
policy

References

Climate: A whirlwind tour

Open Seminar Series, Department of Physics

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Climate change

Climate: A
whirlwind tour

Aditya Narayanan

Introduction and
motivation

Atmosphere

Biosphere

Ocean and the
cryosphere

Mitigation and
policy

References

Regional warming in the decade 2006-2015 relative to preindustrial

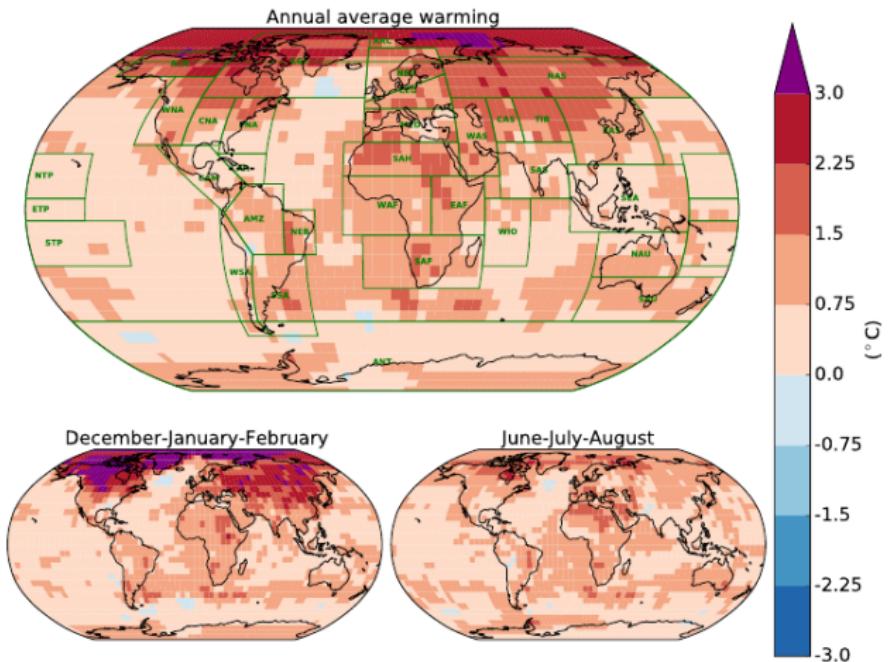


Figure 1 : Temperature change (2005 - 2015) with respect to
pre-industrial (1850-1900). Source: *IPCC SR15, 2018*.

Historical CO₂ levels

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Aditya Narayanan

Introduction and motivation

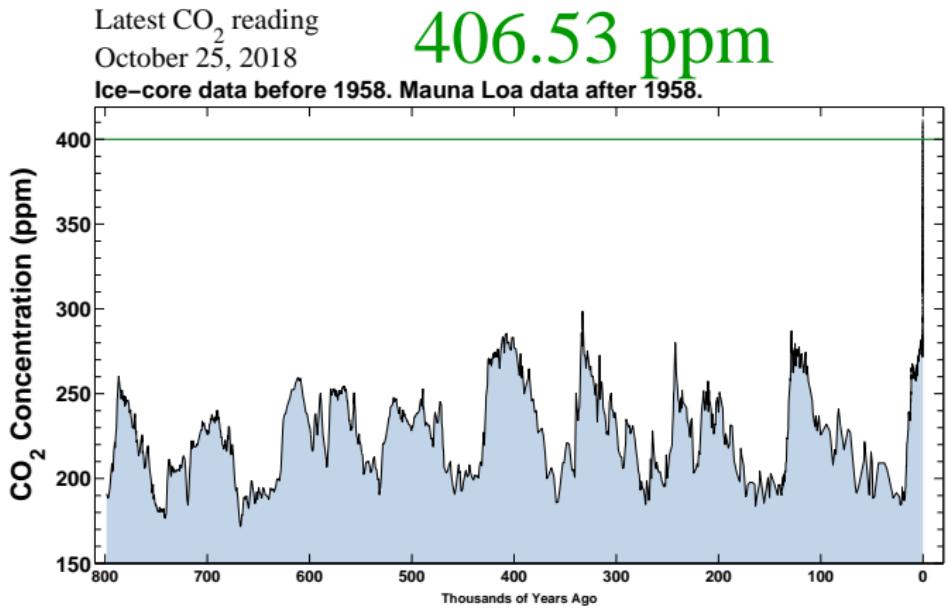


Figure 2 : Historical CO₂ levels. Source: *Scripps, UCSD*

Palaeo record

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Introduction and
motivation

Atmosphere

Biosphere

Ocean and the
cryosphere

Mitigation and
policy

References

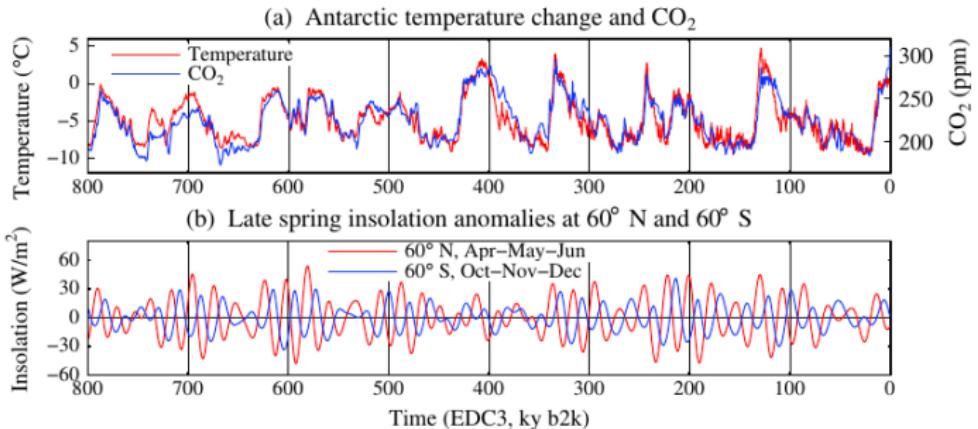


Figure 3 : (a) Antarctic (Dome C) temperature anomaly relative to 10ky, CO₂ levels (Lüthi et al., 2008); (b) Insolation anomalies.

Source: (Hansen et al., 2016)

Radiative forcing

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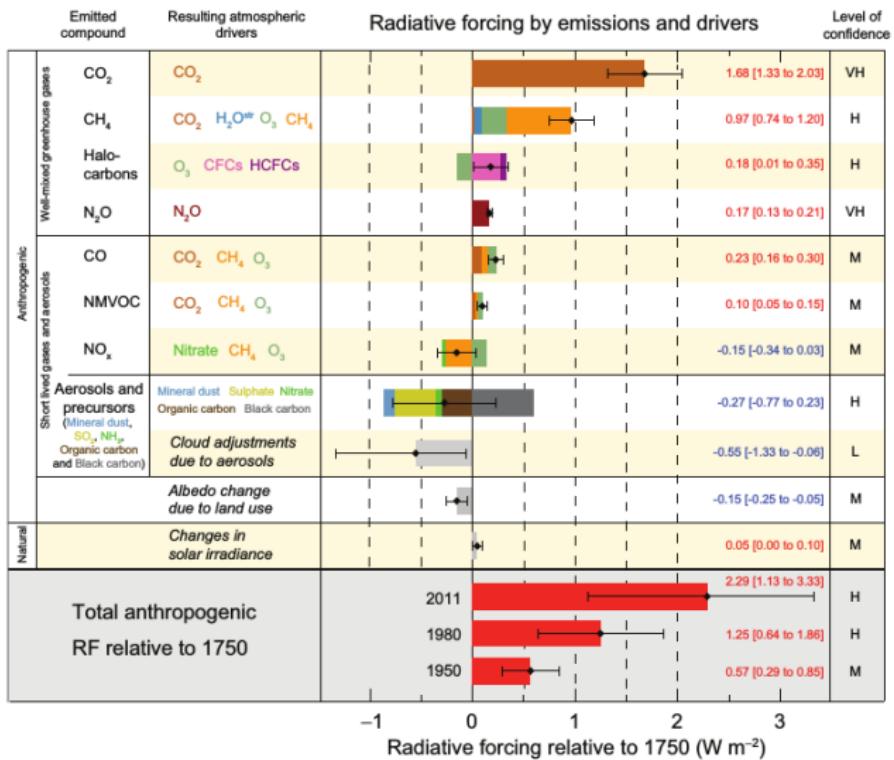


Figure 4 : Radiative forcing. Source: IPCC-WG1, 2013

Earth's energy budget

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Aditya Narayanan

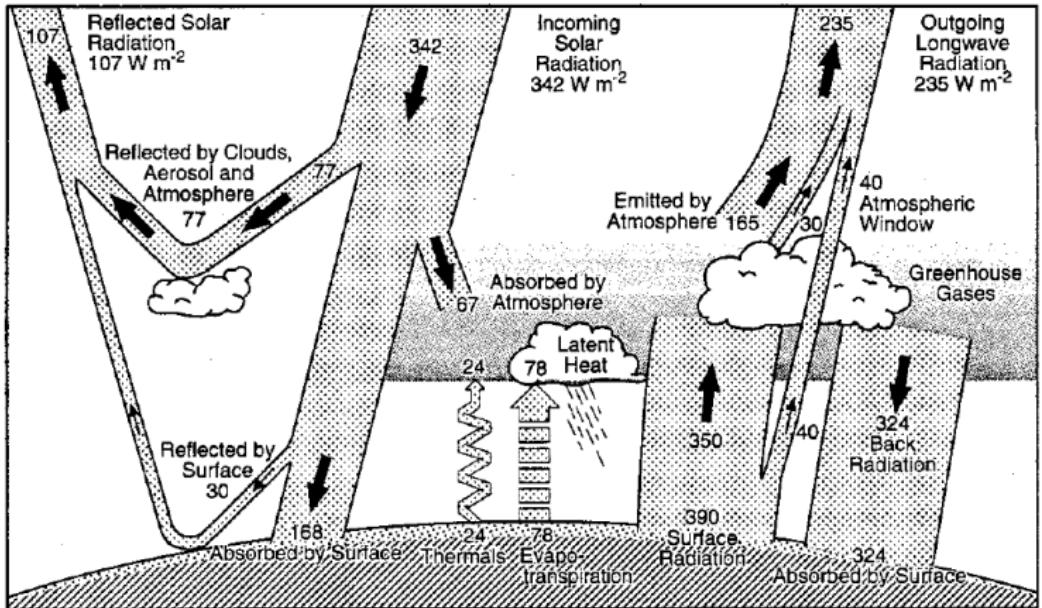


Figure 5 : (Kiehl and Trenberth, 1997)

Aerosols

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Aditya Narayanan

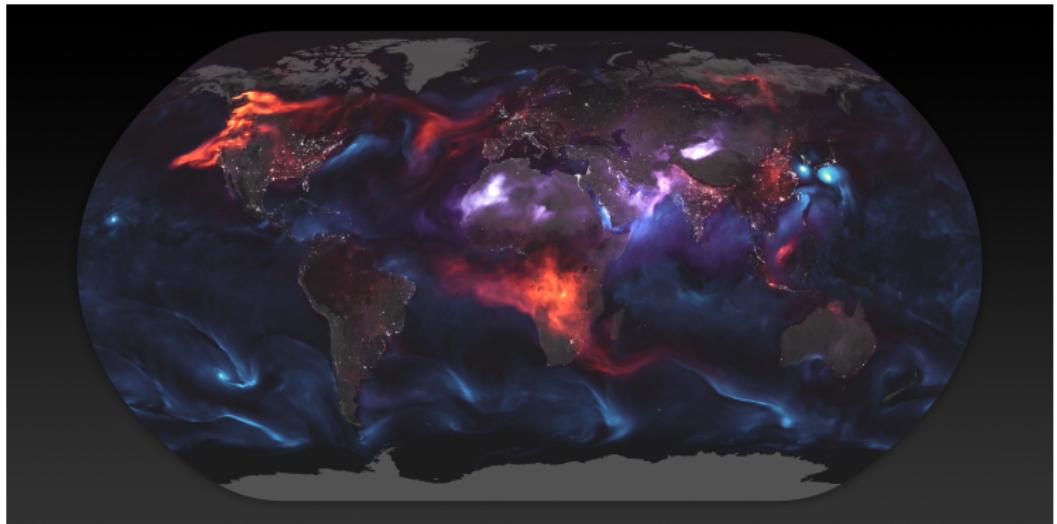


Figure 6 : Wildfires, dust, and sea salt - August 23rd, 2018. Source:

NASA GEOS-FP

Introduction and
motivation

Atmosphere

Biosphere

Ocean and the
cryosphere

Mitigation and
policy

References

Biosphere

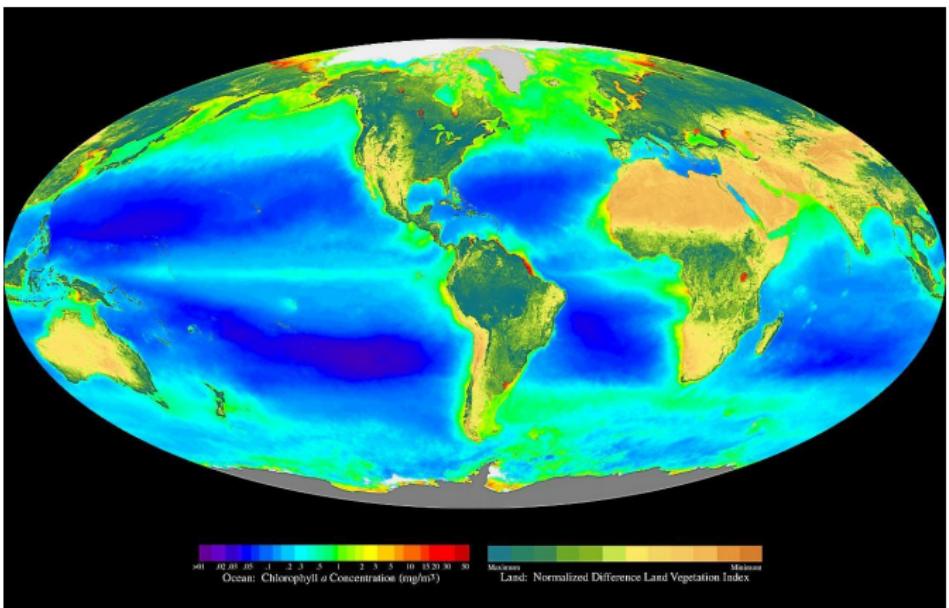


Figure 7 : Abundance of photosynthesizing organisms. Source: NASA, GSFC (SeaWiFS)

Introduction and
motivation

Atmosphere

Biosphere

Ocean and the
cryosphereMitigation and
policy

References

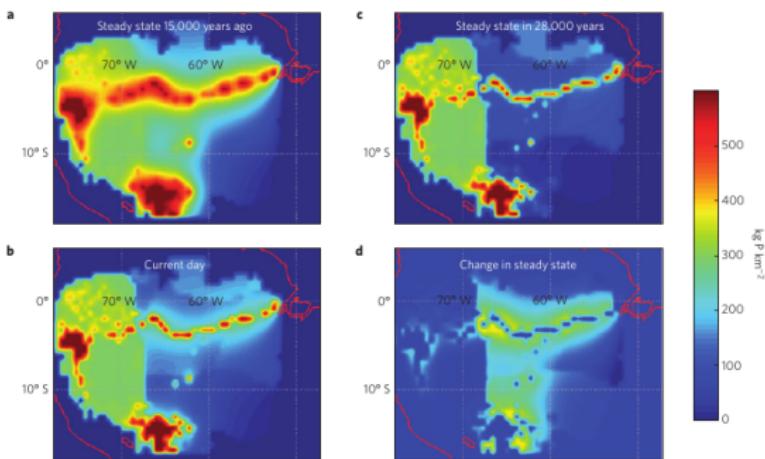


Figure 3 | Map showing changing ecosystem P concentrations in South America due to megafauna extinctions. **a**, The steady-state estimate of P concentrations in the Amazon basin before the megafaunal extinctions with a lateral diffusivity Φ_{excreta} value of $4.4 \text{ km}^2 \text{ yr}^{-1}$. **b**, The current-day estimate of P concentrations 12,000 years after the extinctions with current animals and a Φ_{excreta} value of $0.027 \text{ km}^2 \text{ yr}^{-1}$. **c**, Estimated P concentrations in the Amazon basin 28,000 years in the future. **d**, The difference between the pre- and post-extinction equilibrium (**a** and **c**).

Table 1 | Average $\Phi_{\text{excreta}} * \alpha B (\text{km}^2 \text{ yr}^{-1})$ for each continent calculated for modern species and modern plus extinct species.

	North America	South America	Australia	Eurasia	Africa
Number of species extinct	65	64	45	9	13
Mean weight of extinct animals (kg)	846	1,156	188	2,430	970
Modern $\Phi_{\text{excreta}} * \alpha B$	13,876	12,934	21,804	21,779	265,621
Modern + extinct fauna $\Phi_{\text{excreta}} * \alpha B$	140,716 ($\pm 38,000$)	283,854 ($\pm 81,000$)	48,250 ($\pm 8,000$)	118,349 ($\pm 29,000$)	324,848 ($\pm 18,000$)
Percentage of original	10% ($\pm 2\%$)	5% ($\pm 1\%$)	45% ($\pm 6\%$)	18% ($\pm 4\%$)	82% ($\pm 4\%$)

Bottom row is the percentage of the original $\Phi_{\text{excreta}} * \alpha B$ remaining. The error represents an uncertainty in extinct species distribution of 30%.

Biosphere

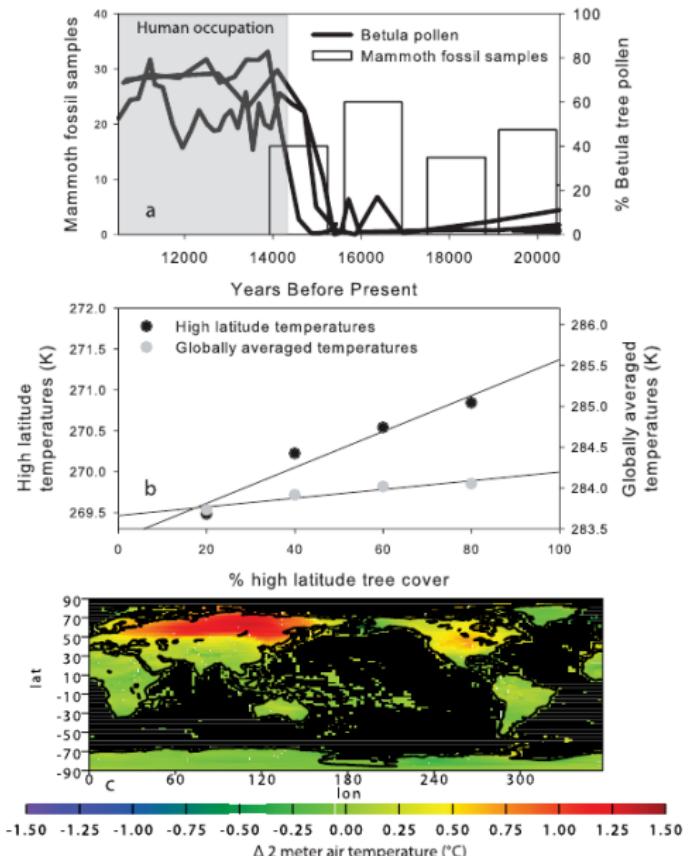


Figure 9 : Source: (Doughty et al., 2010)

Introduction and
motivation

Atmosphere

Biosphere

Ocean and the
cryosphere

Mitigation and
policy

References

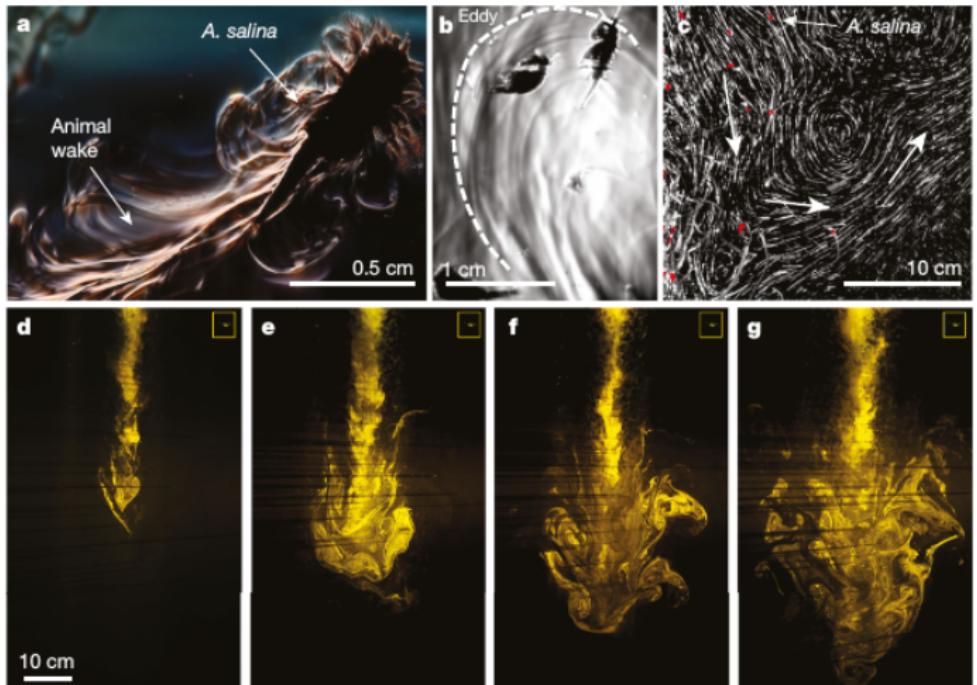


Figure 10 : Flow visualization of diffusion caused by the vertical migration of *A. Salina* (brine shrimp). $\nu_{\text{eff}}/\nu_{\text{mol}} \approx 10^3$ Source:
(Houghton et al., 2018)

Introduction and
motivation

Atmosphere

Biosphere

Ocean and the
cryosphereMitigation and
policy

References

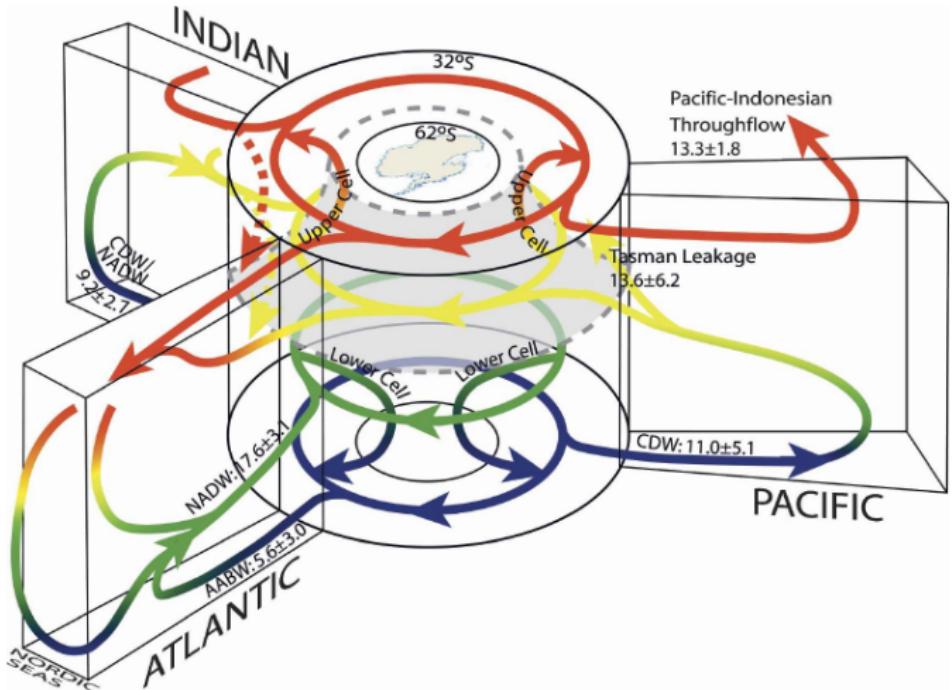


Figure 11 : Global thermohaline circulation source: Lumpkin and Speer, 2007
(Lumpkin and Speer, 2007)

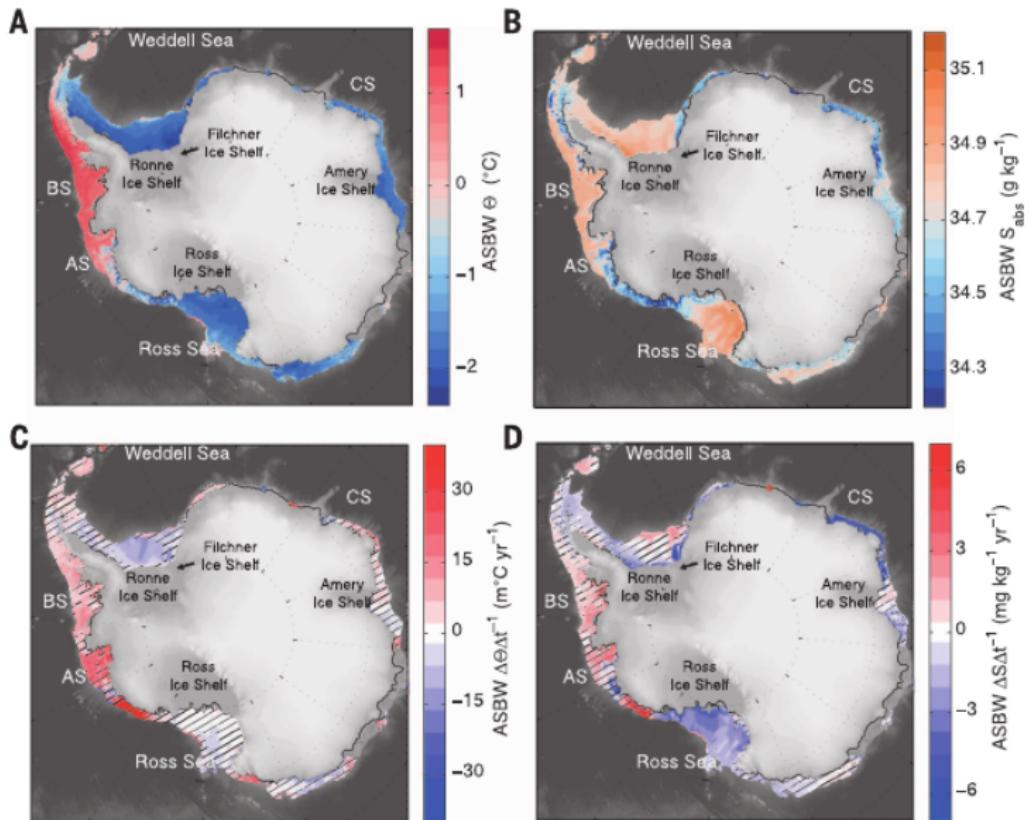


Figure 12 : Antarctic shelf sea bottom water properties and trends. Source: (Schmidtko et al., 2014)

Introduction and motivation

Atmosphere

Biosphere

Ocean and the cryosphere

Mitigation and policy

References

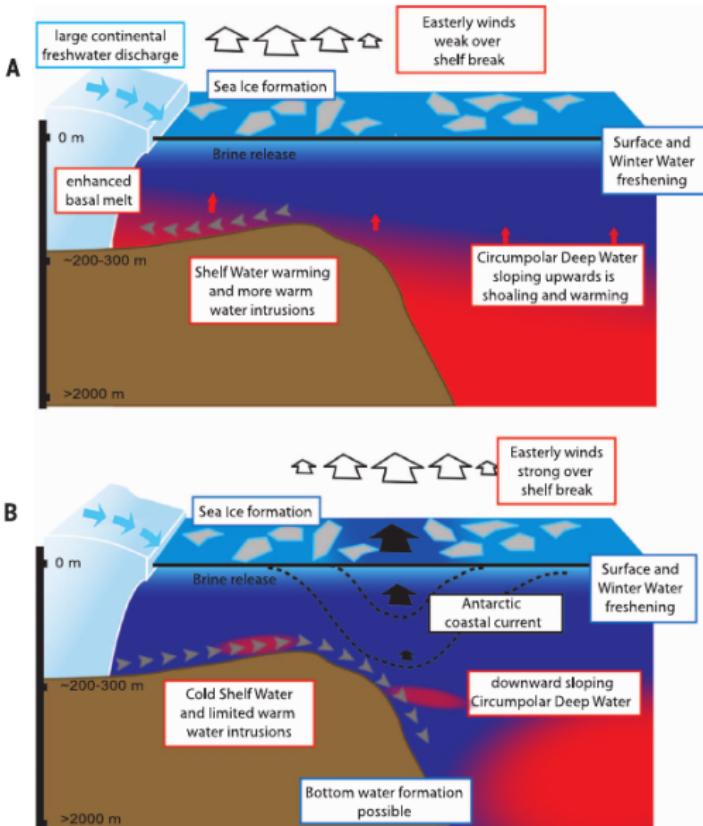


Figure 13 : Mechanisms of ocean currents warming the continental ice shelves of the Antarctic. Source: (Schmidtko et al., 2014)

Introduction and
motivation

Atmosphere

Biosphere

Ocean and the
cryosphere

Mitigation and
policy

References

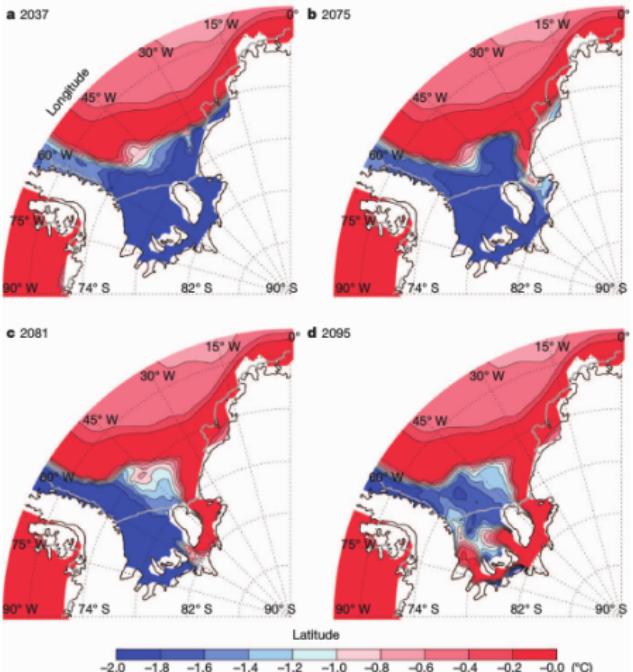


Figure 14 : Modelling the future shelf bed of the Weddell Sea.

Source: (Hellmer et al., 2012)

Climate: A whirlwind tour

Aditya Narayanan

Ocean and the cryosphere

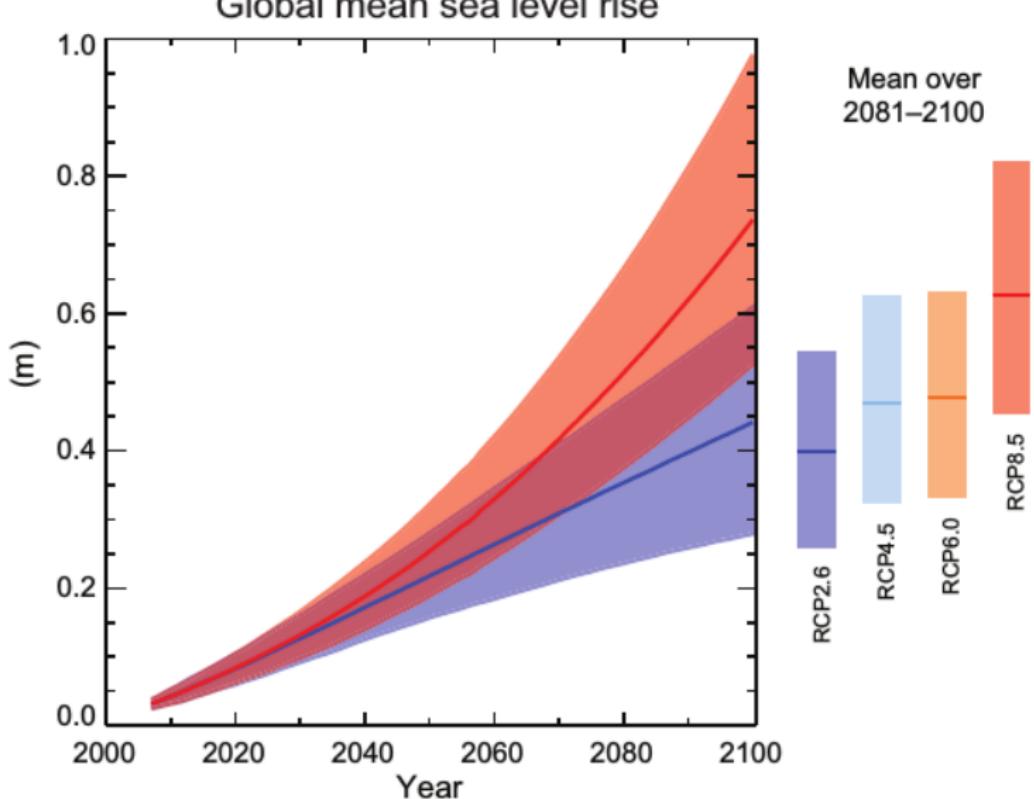


Figure 15 : IPCC 2013, sea level rise projections. Source: IPCC 2013,

Introduction and motivation

Atmosphere

Biosphere

Ocean and the cryosphere

Mitigation and policy

References

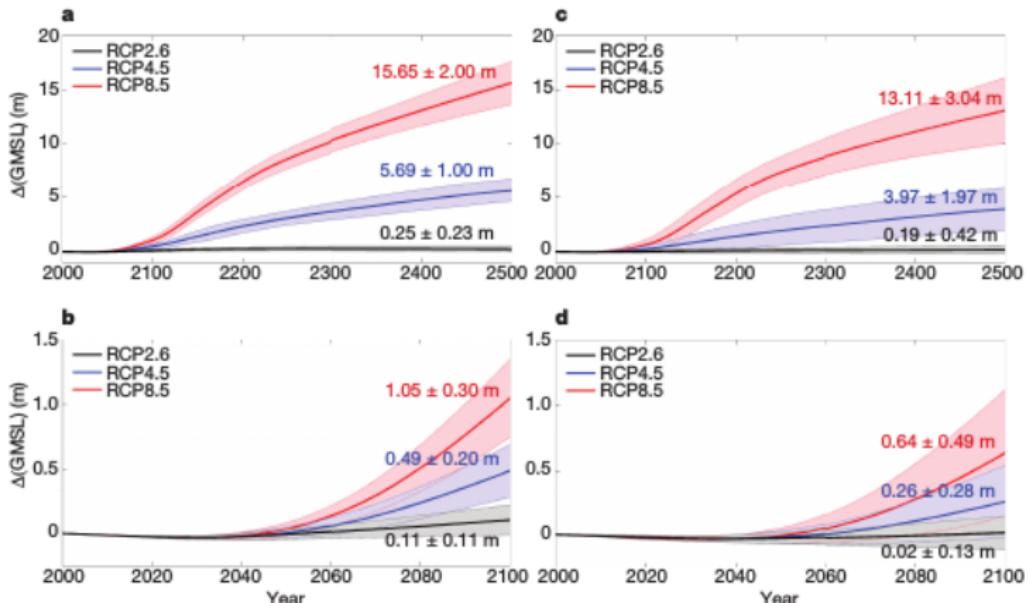


Figure 16 : Model analyses of future Antarctic contribution to sea level rise. Source: (DeConto and Pollard, 2016)

Introduction and motivation

Atmosphere

Biosphere

Ocean and the cryosphere

Mitigation and policy

References

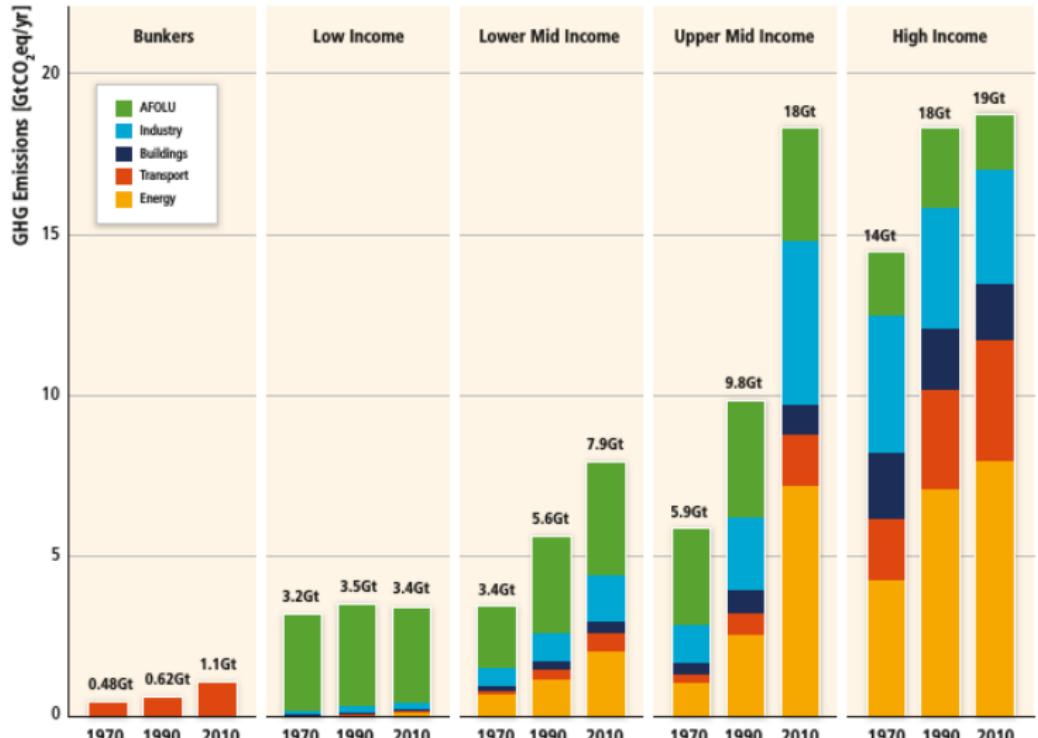


Figure 17 : Source: Fig. TS3, IPCC, 2013, WG-3

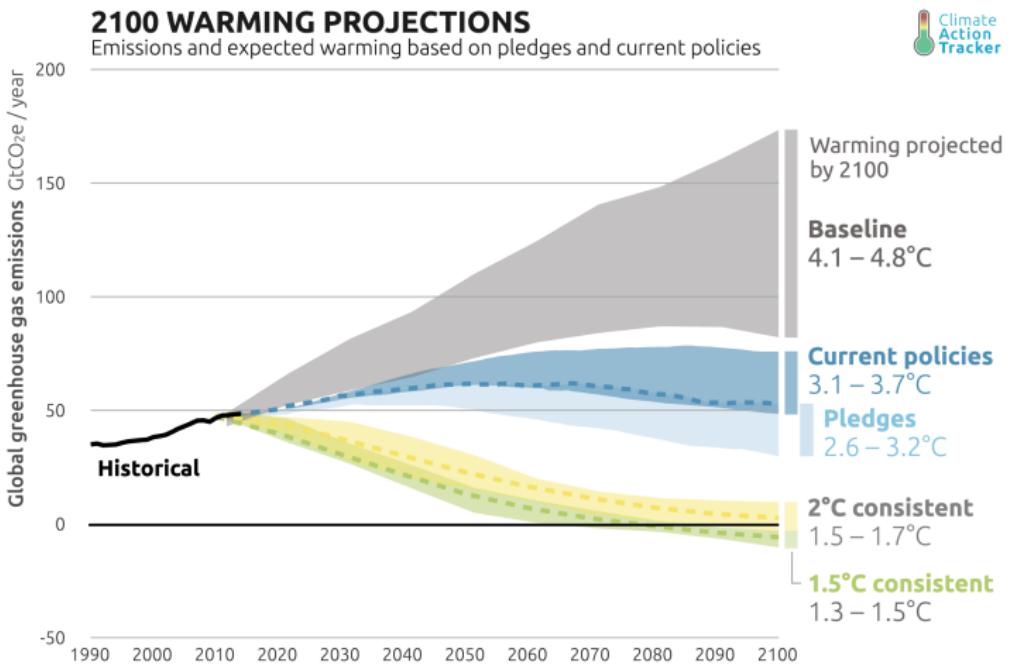


Figure 18 : Source: Climate Action Tracker

Reference I

Climate: A
whirlwind tour

Aditya Narayanan

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