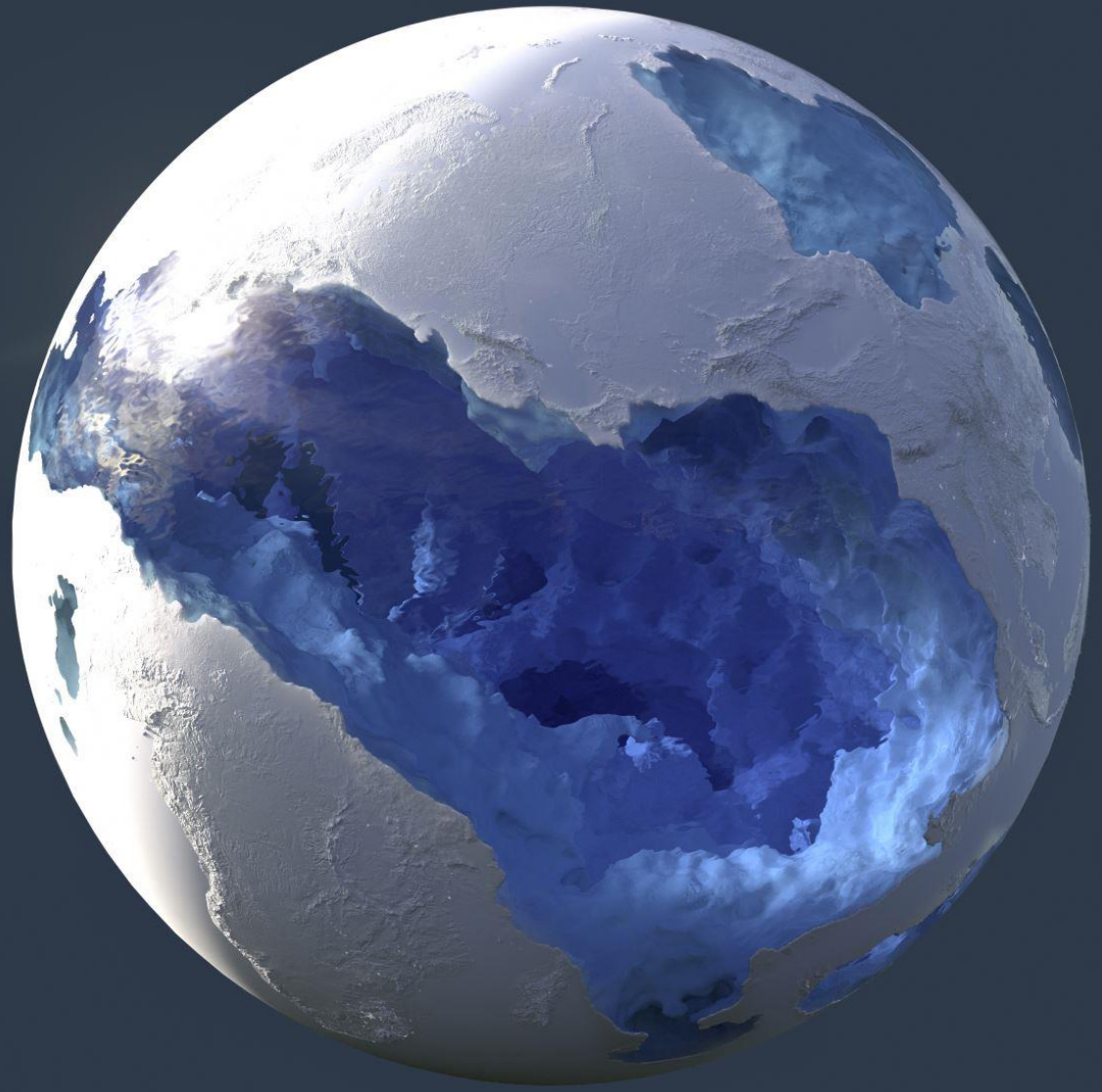
Current Climate Science

Tuesday, 11 June

[1.2] Week 1, Day 2



Agenda

- Climate Science Background
  - Watch Neil de Grasse Tyson & colleagues for 2023 updates from NASA
- Watch IPCC summary
- Forster, *et al*. (2023)
- Geology V. PoliSci
- Assignments

Climate Science Background

1860s

John Tyndall theorized the greenhouse effect from Joseph Fourier's & Eunice Foote's work on atmospheric composition

1896

Svante Arrenhuis first predicted carbon level changes could alter surface temperature through greenhouse effect

1938

Guy Callendar connected increased atmospheric CO_2 to global warming

1970s

Systematic analyses henceforth.

- 1972: Stockholm Conference (UN)
- 1977: Army gets involved (Rest of military got more involved just before the 2010s.)

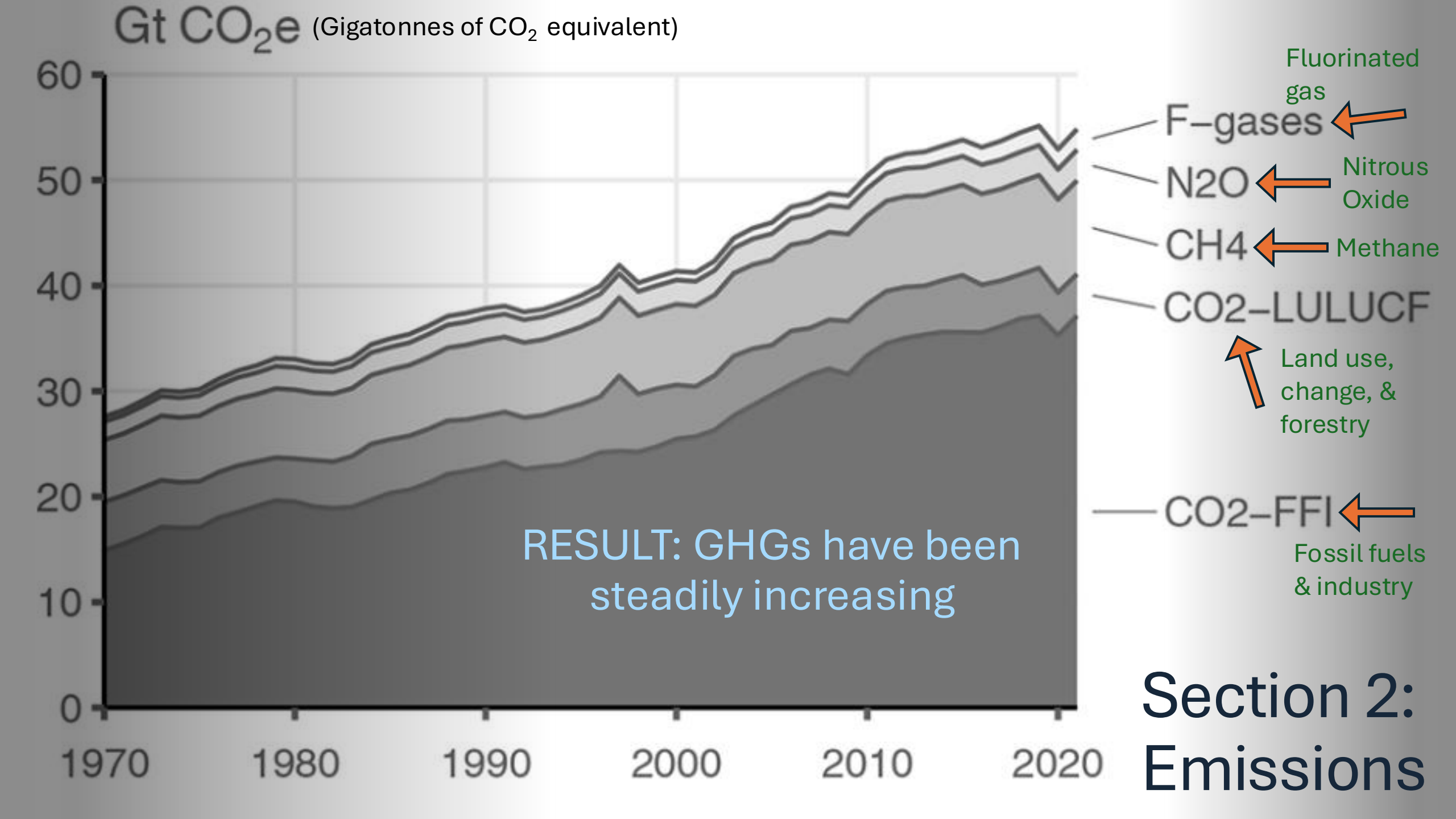
1985

Carl Sagan testified to Congress.

**These years (1850-1900) are important as the baseline temp (13.68ºC/56.62ºF) scientists & policymakers use (±1.5ºc) comes from this period.

Forster, *et al.* (2023), Abstract

- Goal: Fill the temporal gap in IPCC scientific reports (5-10 years)
  - Create an open-source annually updated data-driven site
- Methods & variables: as close to IPCC as possible, but combine model & observational data (to author expertise!)
- Results
  - 2013-2022: *M*=1.14 ºC [CI: .9-1.4]
  - 2022: 1.26 ºC
  - 2013-2022 warming: increased .2ºC per decade



Section 2: Emissions

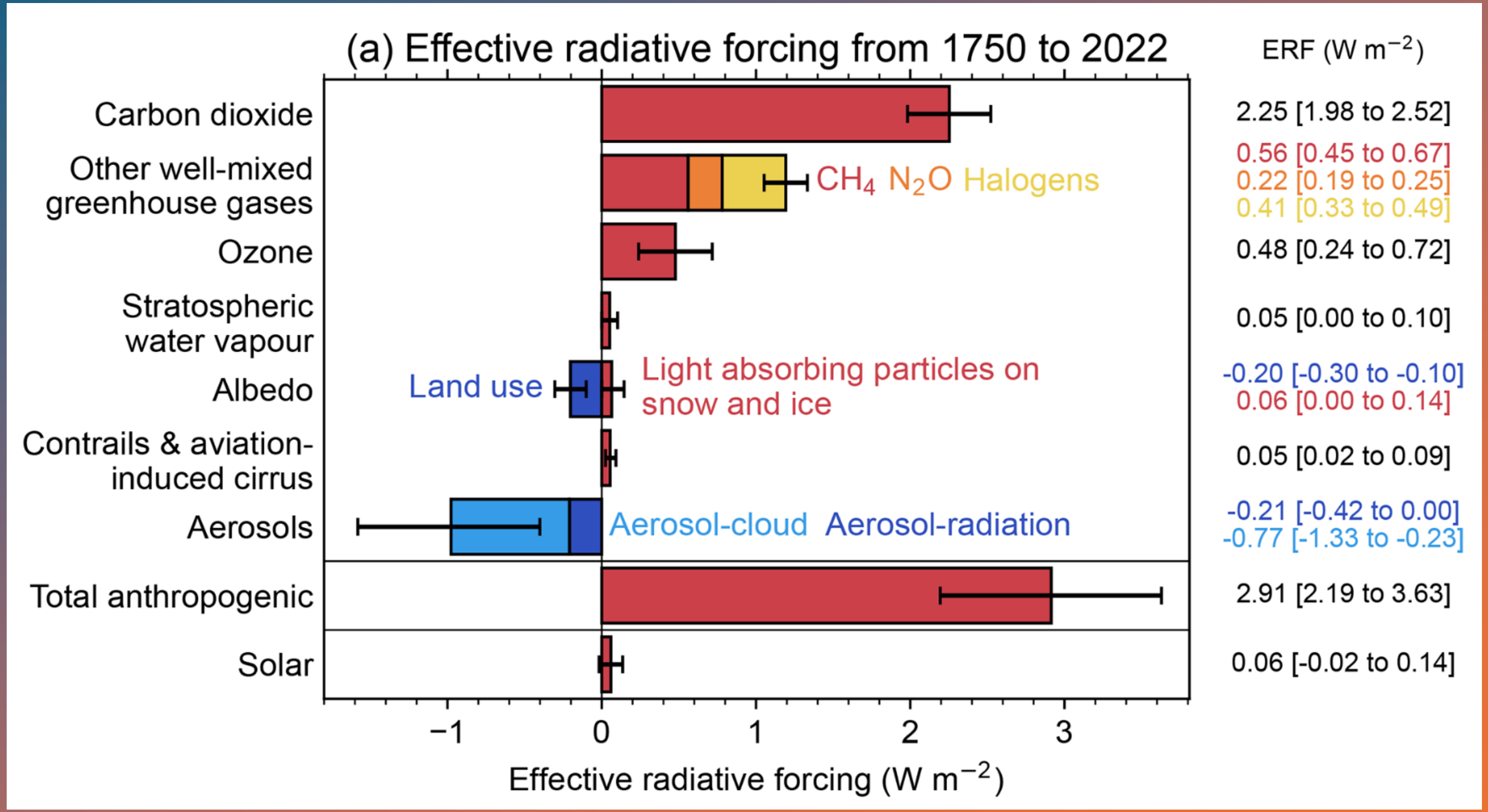
Section 3: GHG concentration

- Expanded on IPCC's AR6 to include all 52 GHGs
- RESULT: Gases excluded from Montreal Protocol have increased.

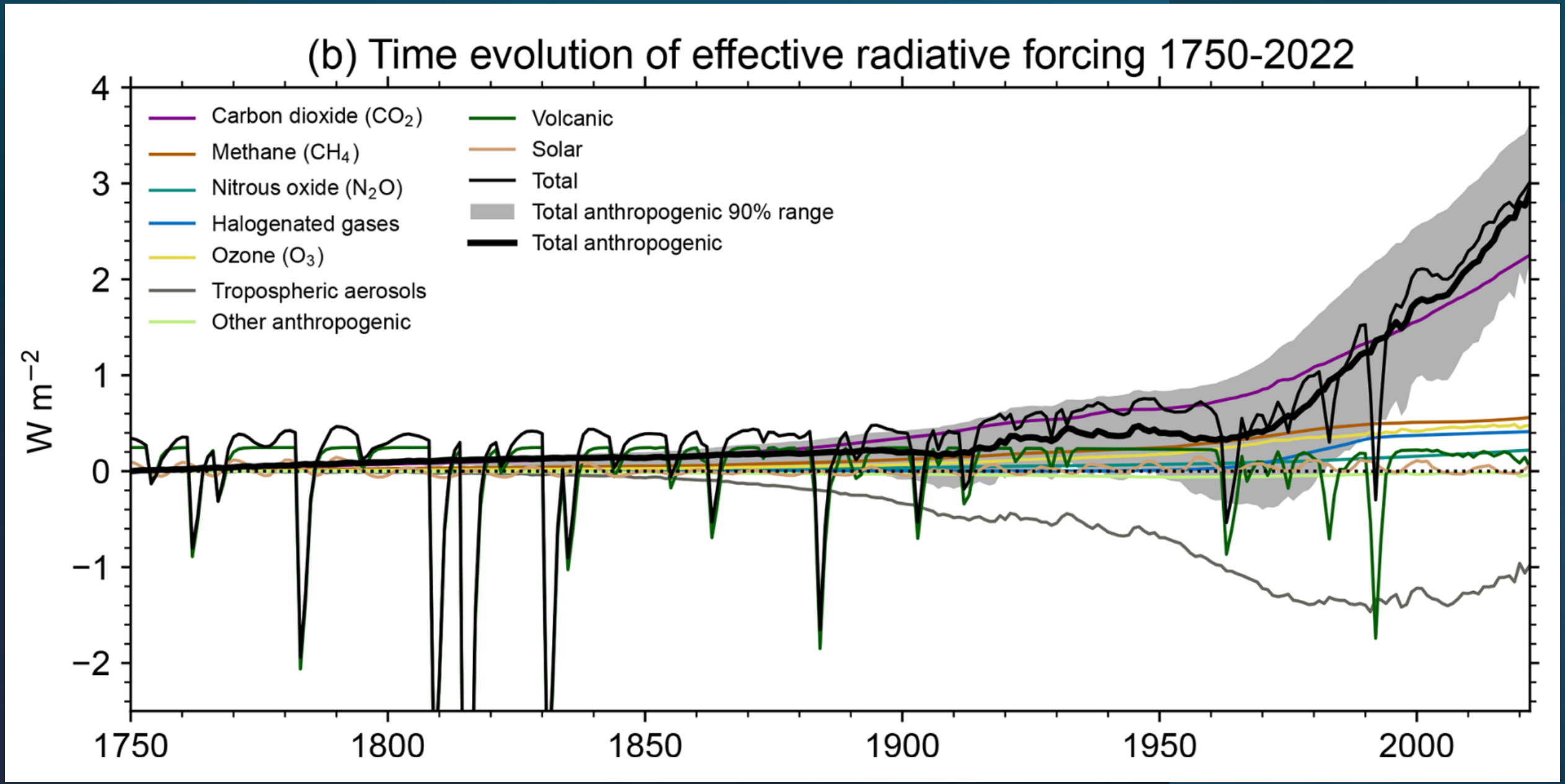
Greenhouse gas	1750	1850	2019	2022
CO_2 [ppm]	278.3	285.5	410.1	417.1
CH_4 [ppb]	729.2	807.6	1866.3	1911.9
N_2O [ppb]	270.1	272.1	332.1	335.9
HFCs as HFC-134a-eq	0	0	237.7	287.2
Montreal gases as CFC-12-eq	8.5	8.5	1031.8	1016.6

Section 4: Effective radiation forcing estimates

- ERF: Effective radiative force = the change in Earth's atmospheric energy balance
  - Positive force = warming
  - Negative force = cooling
- Adjusted an IPCC measurements
  - Excluded volcanic eruptions because they are too sporadic
- RESULT: Increases in GHG concentrations
  - Decreases in aerosol emissions and precursors & land use



P.2305, Figure 2



P.2305, Figure 2

Section 5: Global surface temp. change

- RESULT: consistent with AR6
- 1850-1900 to 2013-2022 = 1.14 ºC [CI: .9-1.4]
  - .06ºC warmer than AR6 2020 prediction
  - .019ºC increase in temp/year

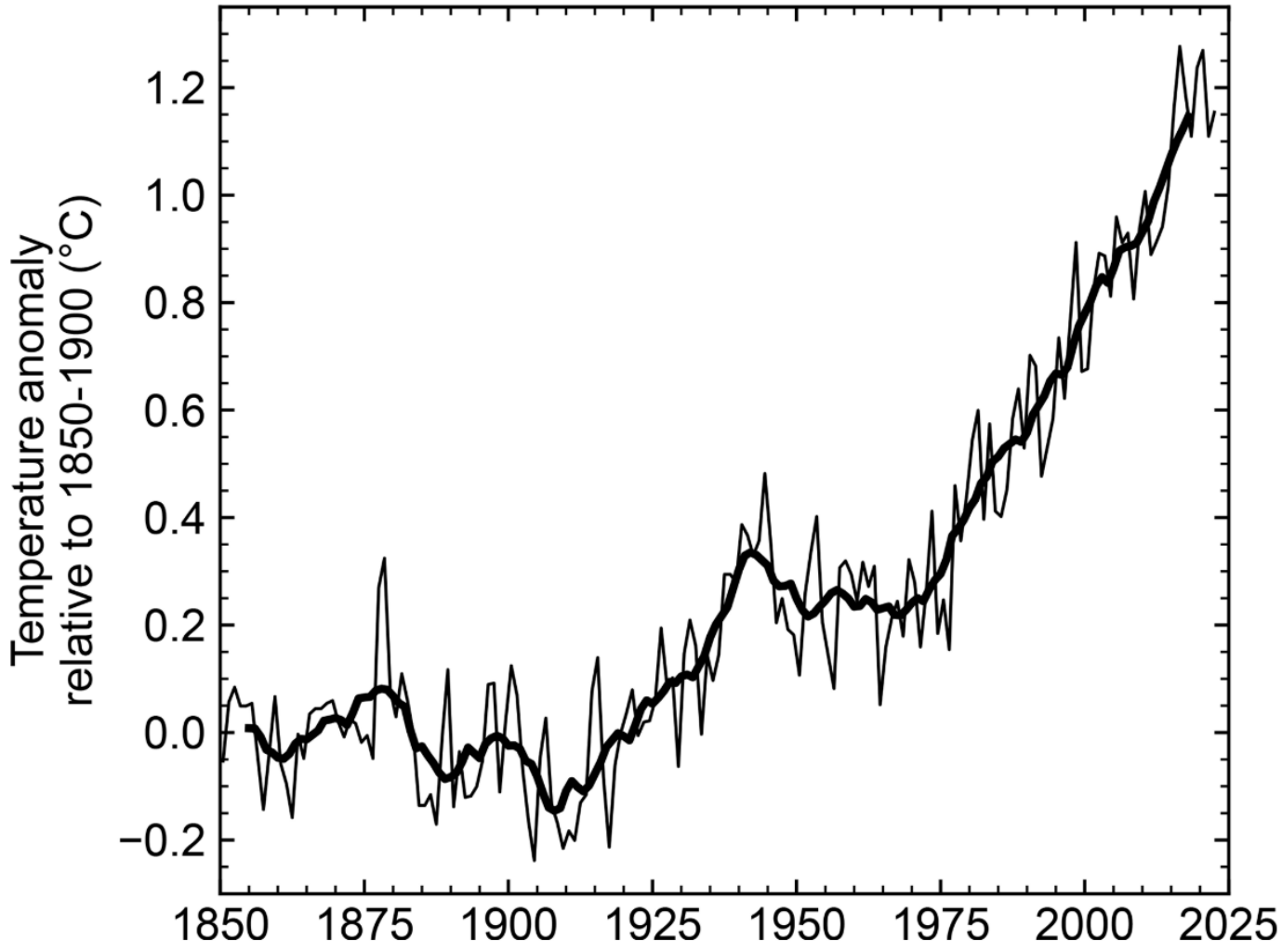
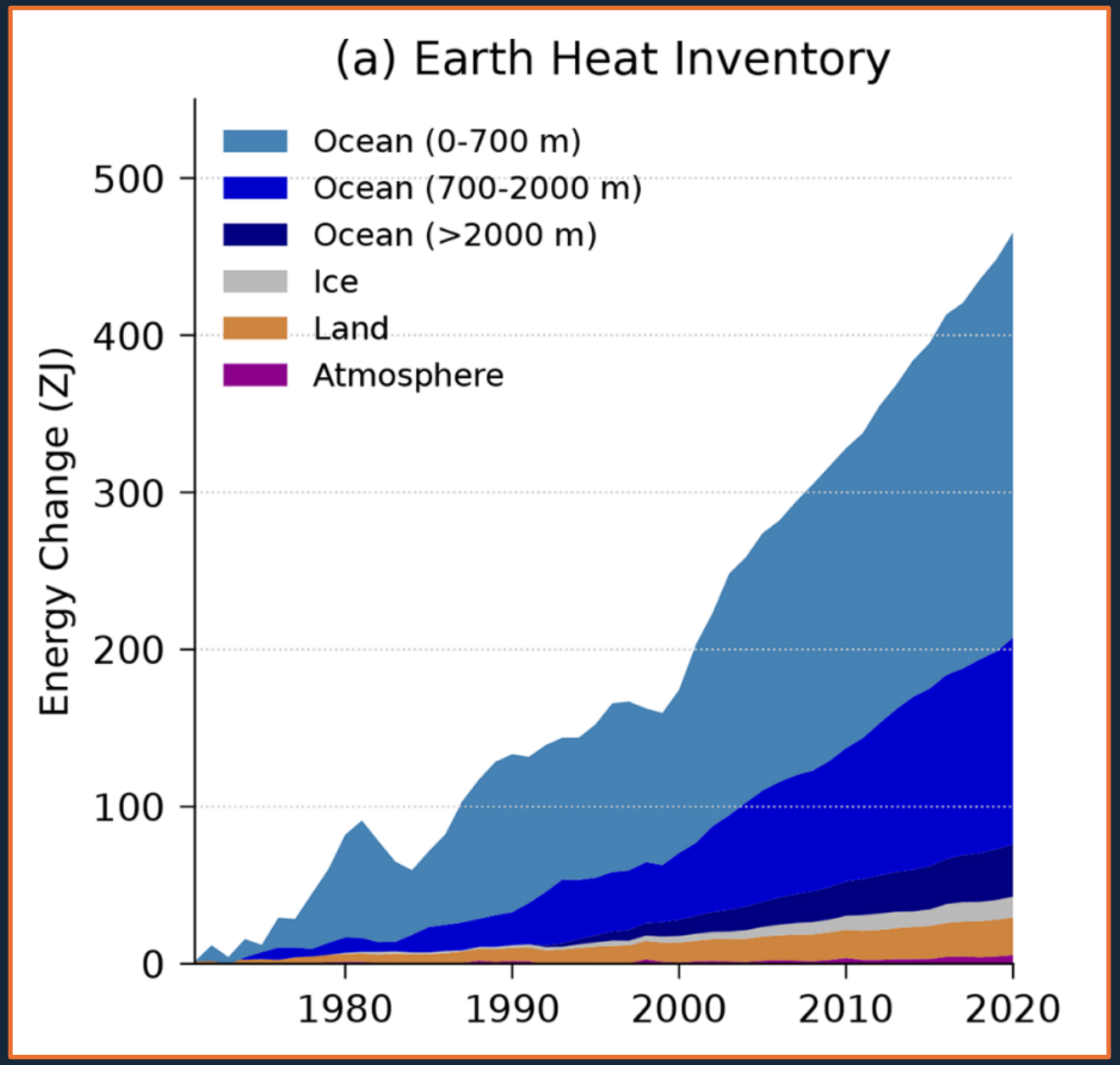


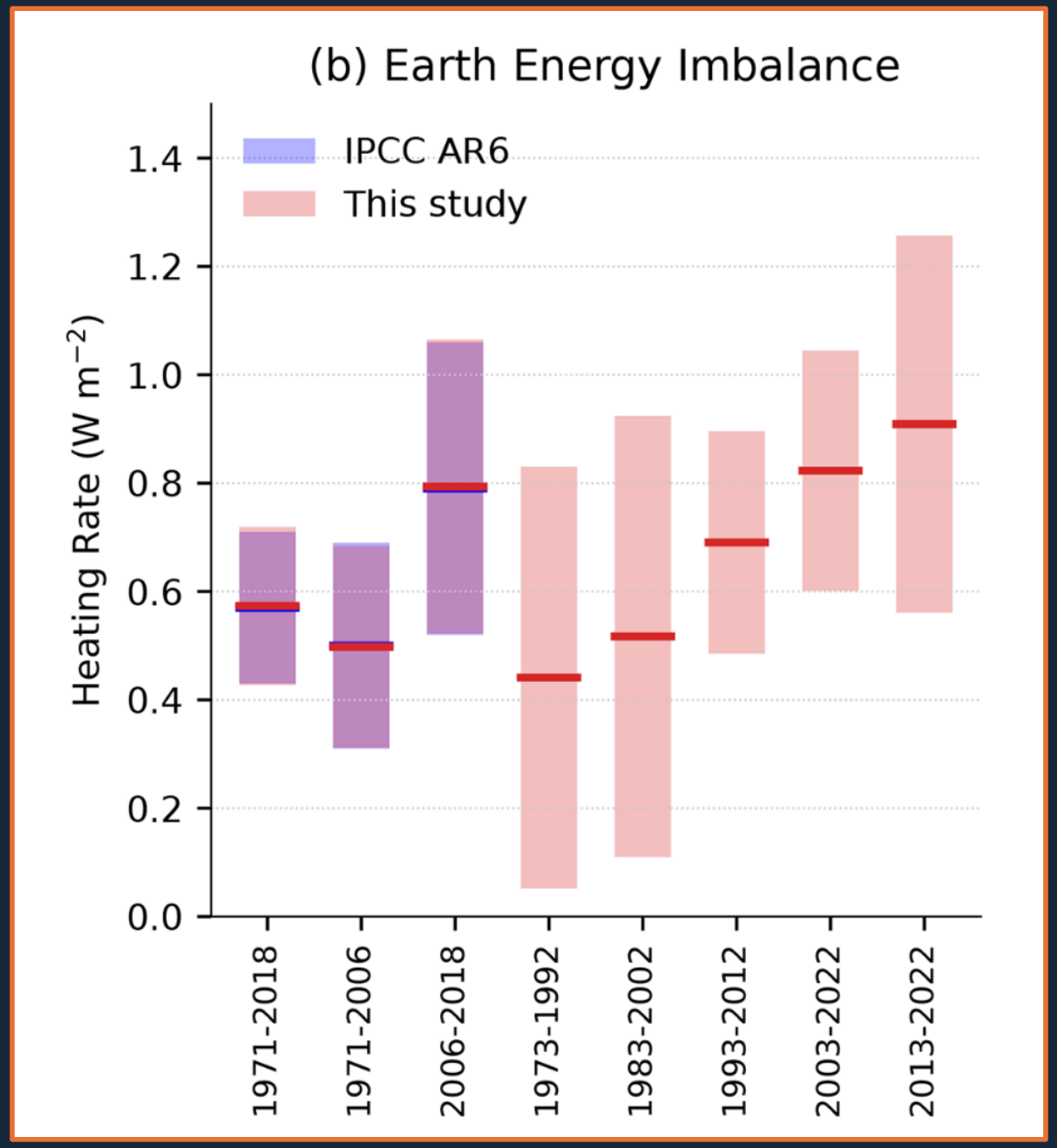
Figure 3. Annual (thin line) and decadal (thick line) means of global surface temperature (expressed as a change from the 1850–1900 reference period).

Section 6: Earth's energy imbalance

Time period	Temperature change from 1850–1900 (°C)	
	IPCC AR6	This study
Global, most recent 10 years	1.09 [0.95 to 1.20] (to 2011–2020)	1.15 [1.00 to 1.25] (to 2013–2022)
Global, most recent 20 years	0.99 [0.84 to 1.10] (to 2001–2020)	1.03 [0.87 to 1.13] (to 2003–2022)
Land, most recent 10 years	1.59 [1.34 to 1.83] (to 2011–2020)	1.65 [1.36 to 1.90] (to 2013–2022)
Ocean, most recent 10 years	0.88 [0.68 to 1.01] (to 2011–2020)	0.93 [0.73 to 1.04] (to 2013–2022)

RESULT: EEI increases over time





Sect. 7: Human activity

- Compared AR6 to SR1.5 (single year update)
- Human-induced warming: human-only forces/gases in a specific timeframe
- Total warming: natural (non-human) + human influences
- METHODS: 3 retained from AR6; updated data from IPCC can change results!
- RESULT: .07ºC increase within 3 years.
  - High (increasing) decadal rate of change

Sect. 8: Carbon budget for Policy temp thresholds

- Carbon budgets are a way for some states that emit less to sell/trade their ‘credits’ to other countries (e.g., China or US) that are certain to emit more. Thus, they are allowed to!
- [Table wasn’t easy to understand.]
- RESULTS: Budgets are tight!
  - Still need to plan/allow for non-CO_2 warming
  - LOTS more uncertainty than anything else.
  - Also: only good for CO_2. *What about other gasses?*

Sect. 9: Indicators for extreme land temps

METHODS: Included different data (HadEX3)

AR6 Conclusion: 2009-2018 Mean = 1.55ºC

RESULTS: 2013-2022 Mean = 1.74ºC

PoliSci v. Geology debate:
Are we in a new geologic era?

Political Scientists: Yes!

Holocene: 9676_{BC} – 1950_{AD}

Anthropocene: 1950 – current

WHY?

The global industrial development pollution (i.e., fossil fuels) + Nuclear testing from 1945 has permanently altered the chemical atmospheric makeup

Geologists: No.

Holocene: 9676_{BC} – Current

Anthropocene: [Not a thing.]

WHY?

There is no evidence of a geologic event occurring.

"Events" are temporary, spatially heterogenous, and naturally occurring phenomenon that transform the Earth's system and contribute to geological strata (layers of sediment in rocks).

EX: earthquakes, tsunamis, or asteroids

Aren’t humans a part of the Earth’s natural phenomena? Thus, the things we do would then be “natural”?

Is the question of what is “natural” to Earth the difference between the disciplinary opinions?

ASSIGNMENTS

Today (Tuesday)

- READ: Powys-White (2023)
- WATCH: YouTube IPCC 6th Asmt Report Summary

ASSIGNMENT: Discussion Post 1 Responses

Tomorrow (Wednesday)

Commons Tragedy & Social Justice

- READ: Frischmann, *et al*. (2019)
- Watch: YouTubes
- Listen: Podcast

ASSIGNMENT: Discussion Post 2