How much does livestock actually contribute to global warming?

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Motivation

- **How much <u>actual warming</u> is due to GHG emissions from livestock?**
  How important is this in the context of the 2°C global warming limit?

  CO_2-equivalent GHG emissions are an imperfect way of comparing actual warming from different GHGs over the 21st century

  - ✓ CH_4 has much shorter lifetime than CO_2, doesn't accumulate
  - ✓ radiative efficiency changes with atmospheric concentrations
  - ✓ GWP_{100} is contested in science, policy & farming community

- **Use a detailed climate model to calculate the <u>actual warming</u> due to estimated emissions of CH_4, N_2O and CO_2 from global livestock**

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Methods

- **Historical emissions:** direct CH_4 and N_2O livestock emissions from EDGAR database (~9% of total GHGs); estimates for 1860-1970

  CO_2: assume 50% of deforestation due to livestock (rough estimate)

- **Future scenarios to 2100:**
  - ✓ **Business as usual:** FAO projects ~30% growth to 2050; assume moderate further growth that flattens out by 2075
  - ✓ **Stringent mitigation:** assume livestock emissions 40% below BAU by 2100; consistent with range from global assessment models
- **Climate model:** MAGICC v6, RCP8.5/2.6 emissions for other sectors (as in IPCC 2014; reproduces outputs from complex climate models)

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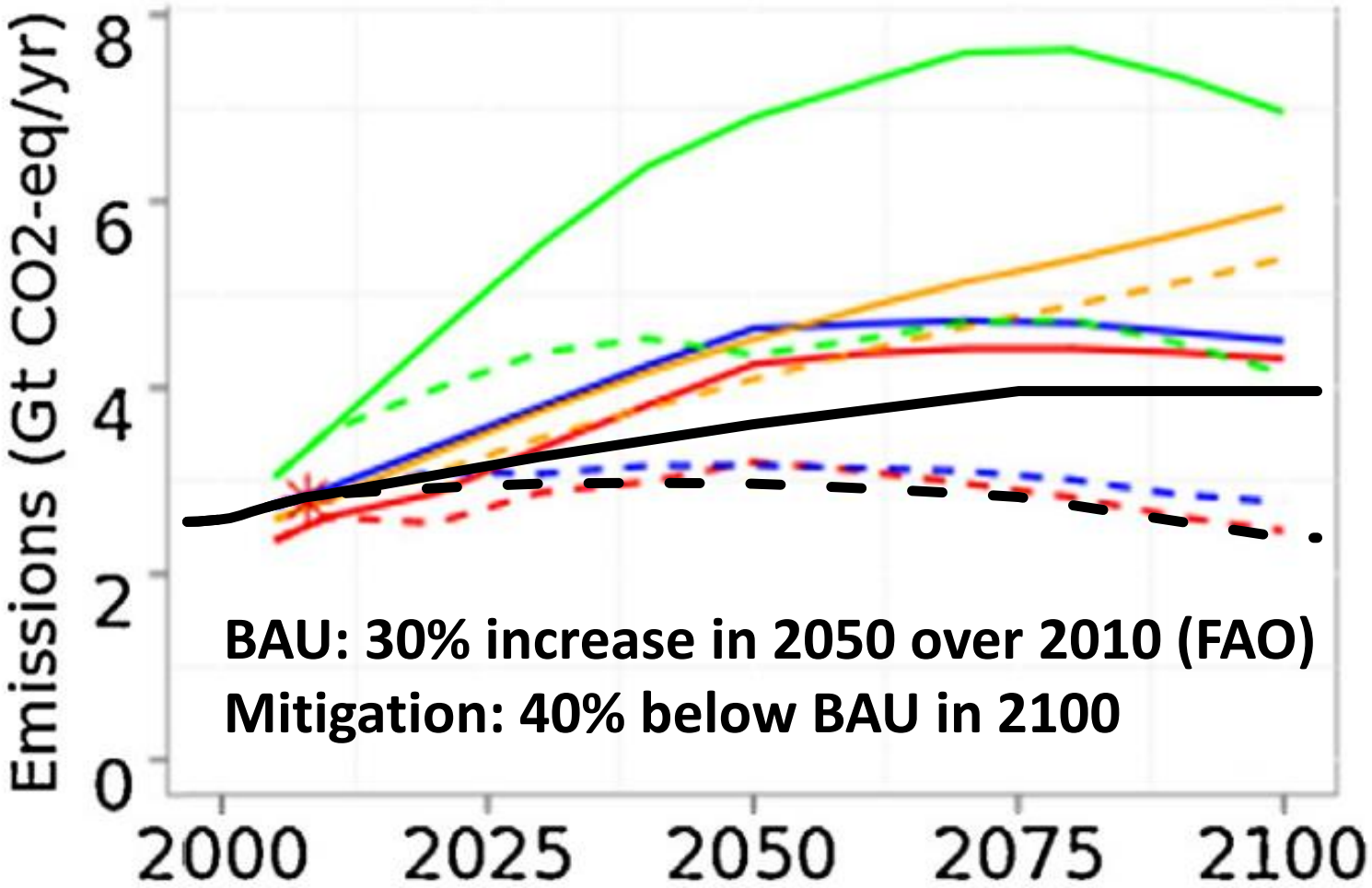
Livestock CH_4 emissions (enteric + manure)



Gernaat et al. 2015, GEC

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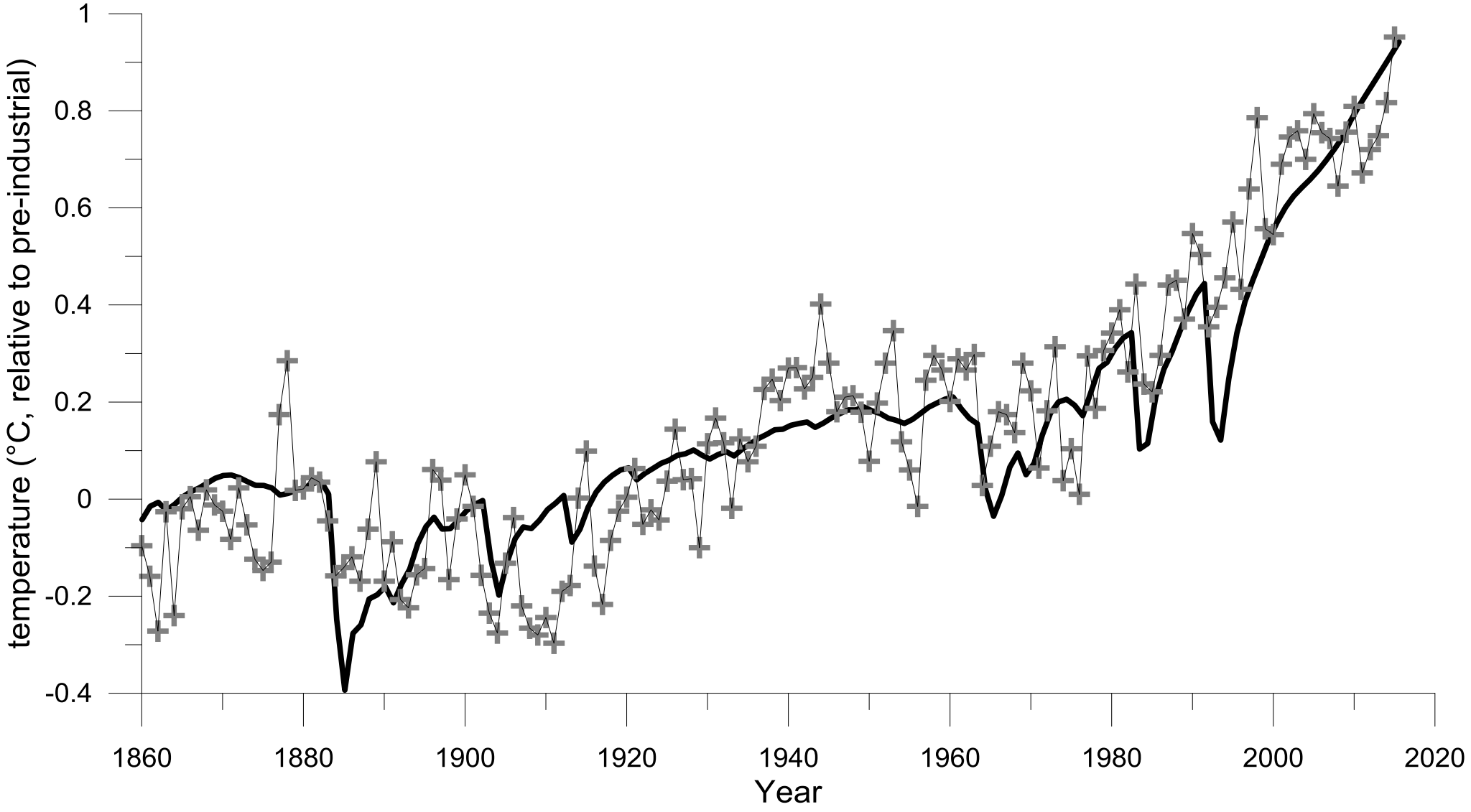
Livestock contribution to historical warming



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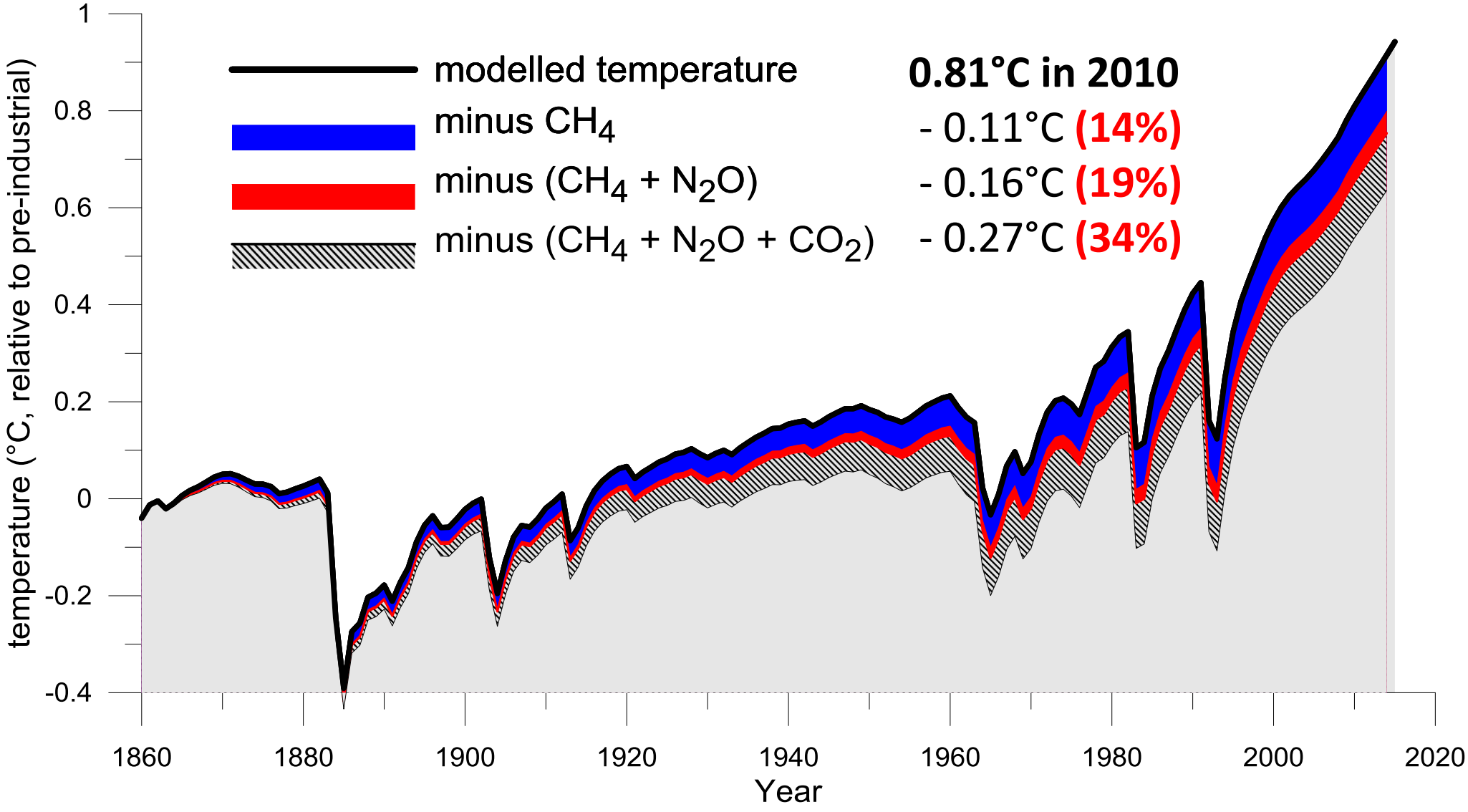
Livestock contribution to historical warming



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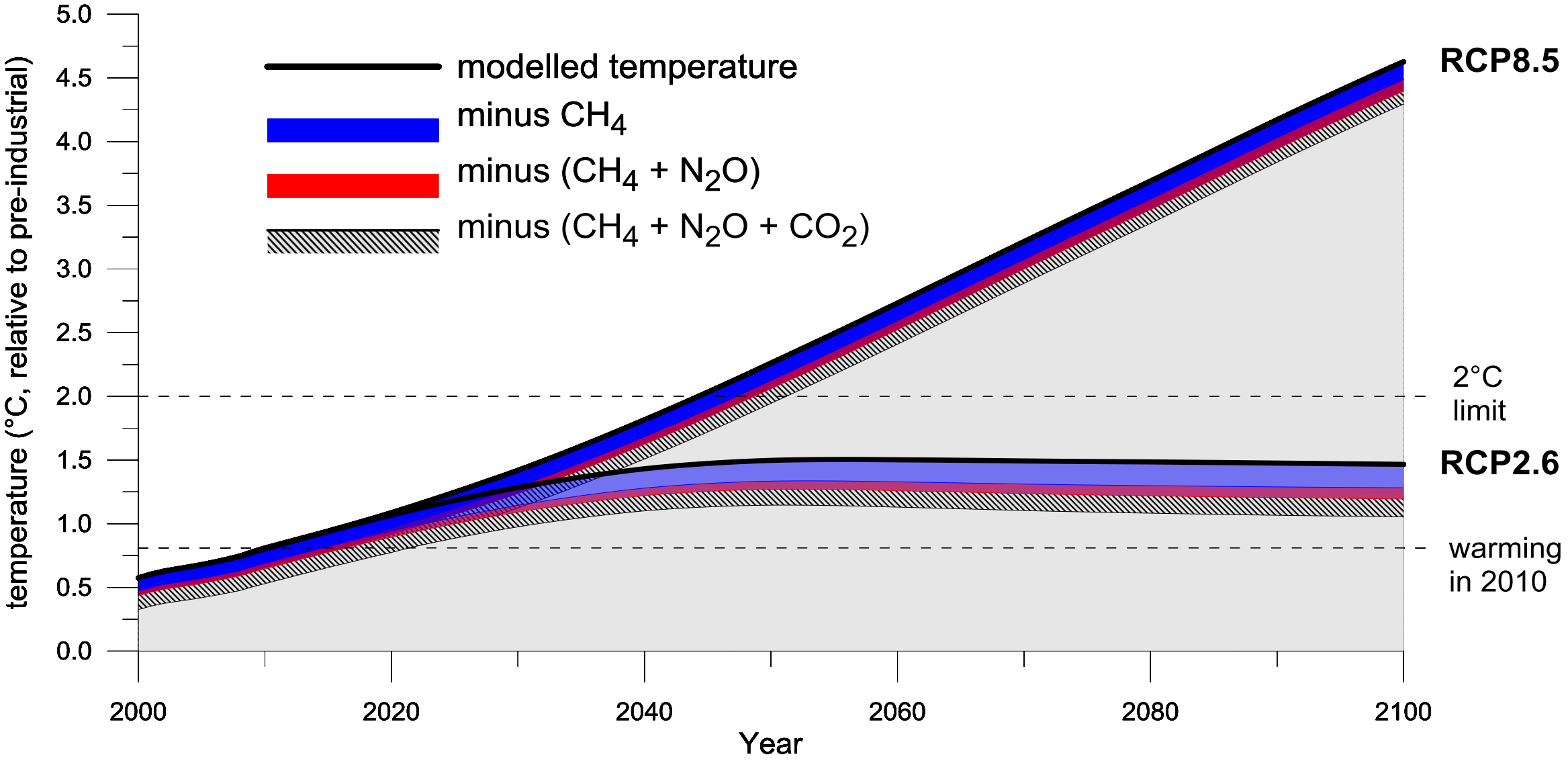
Livestock contribution to future warming



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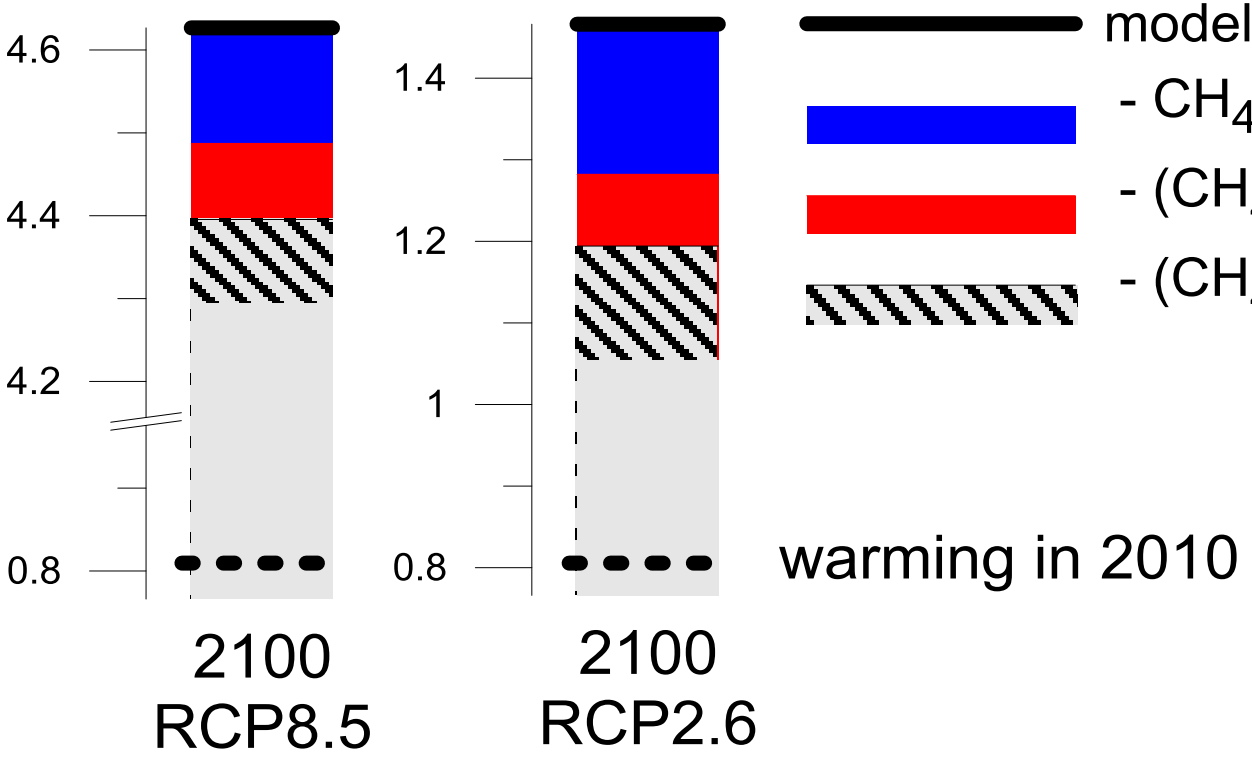
Livestock contribution to future warming



	RCP8.5	RCP2.6
	4.63°C	1.47°C
- CH_4	- 0.14°C **(4%)**	- 0.18°C **(27%)**
- (CH_4 + N_2O)	- 0.23°C **(6%)**	- 0.27°C **(41%)**
- (CH_4 + N_2O + CO_2)	- 0.34°C	- 0.43°C

of the warming 2010-2100

Direct non-CO_2 emissions from livestock could make a major (>40%) contribution to warming between 2010 and 2100

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Conclusions

- **Livestock non-CO_2 emissions make a greater contribution to actual warming in 2010 than indicated by GWP (19%, not ~9%)**
- **The importance of livestock emissions for future warming depends on the global emissions scenario:**
  - ✓ If the world continues with business as usual, livestock non-CO_2 emissions contribute only 6% to warming between 2010 and 2100 (more than 4.6°C)
  - ✓ If other sectors stringently reduce emissions consistent with the 2°C limit, livestock non-CO_2 emissions alone could make up **>40%** (0.27°C) of the warming yet to come between 2010 and 2100 – <u>even if</u> livestock emissions are reduced by 40% below business as usual by 2100

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Conclusions

Expanding the mitigation potential for livestock would make a significant contribution to allow the world to achieve the ambitious mitigation goals agreed in Paris in 2015

Acknowledgements

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