

Pave the World?

The soil ecosystem under threat by expanding cities and towns.

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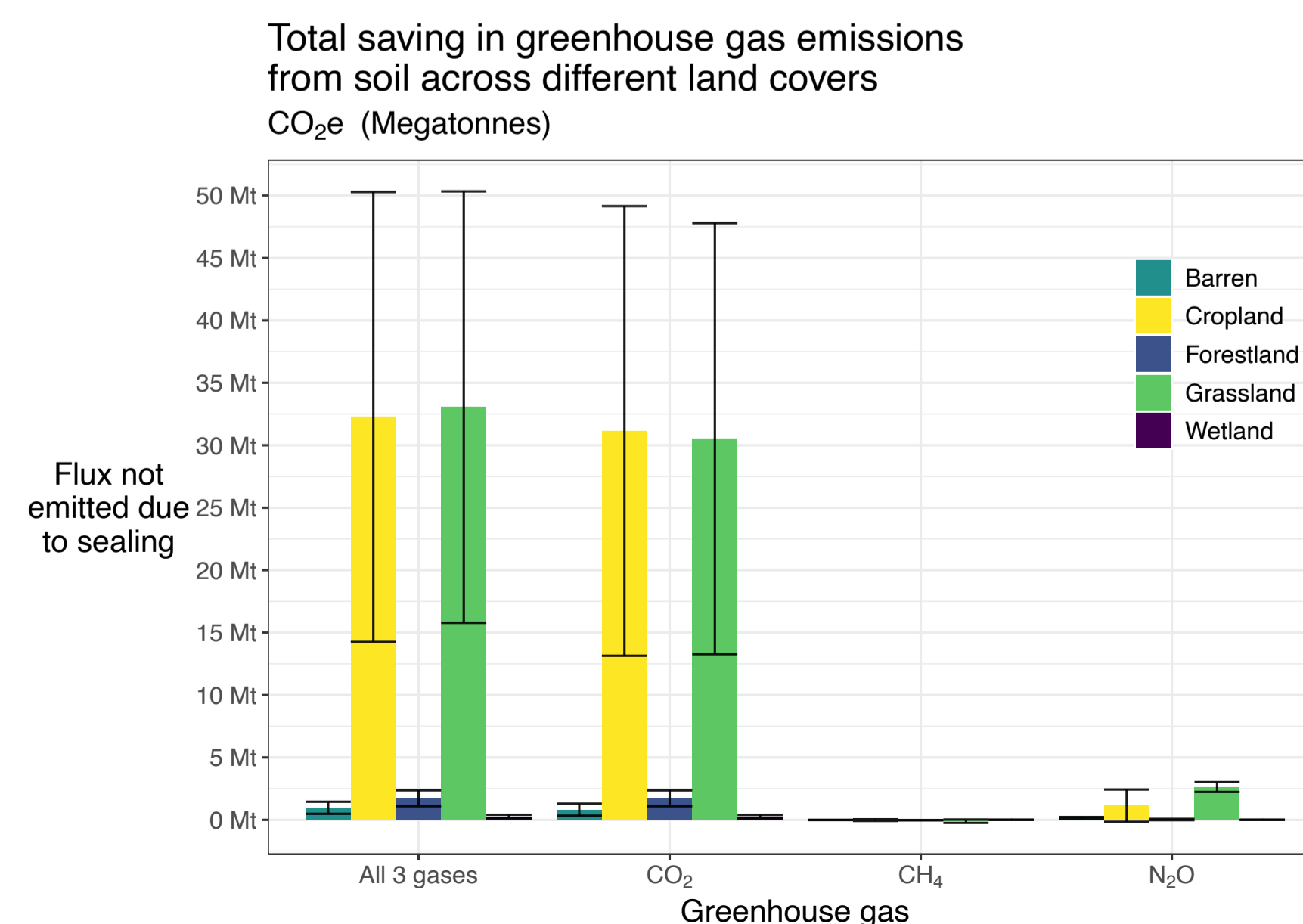
Introduction

- Microbes in soil can take in and emit greenhouse gases - **this is the flux.**
- As urban areas expand, soil microbes are *sealed*, and their greenhouse gas *fluxes* are reduced.
- We therefore answer the question:

How does paving over soil affect greenhouse gas emissions from soil?

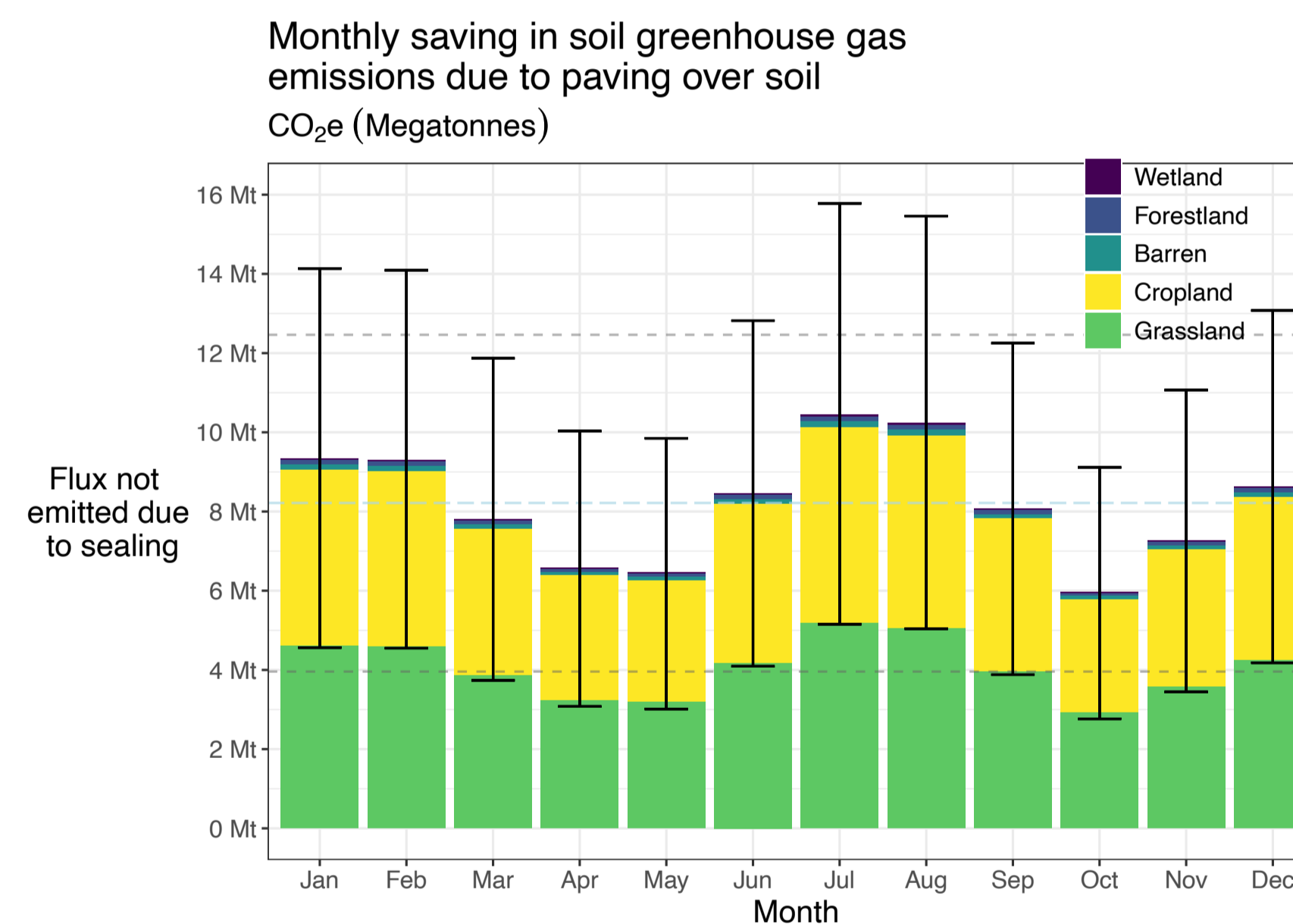
Methods

- We estimated an *unsealed map* of the UK. This included the soils expected beneath urban regions.
- Simulated multivariate normal soil emissions were assigned to each square kilometre in this *unsealed map*.
- Soil greenhouse gas emissions forgone due to paved soil in the UK were summed – both annually and monthly.
- 95% confidence intervals were established based on multivariate normal simulations.



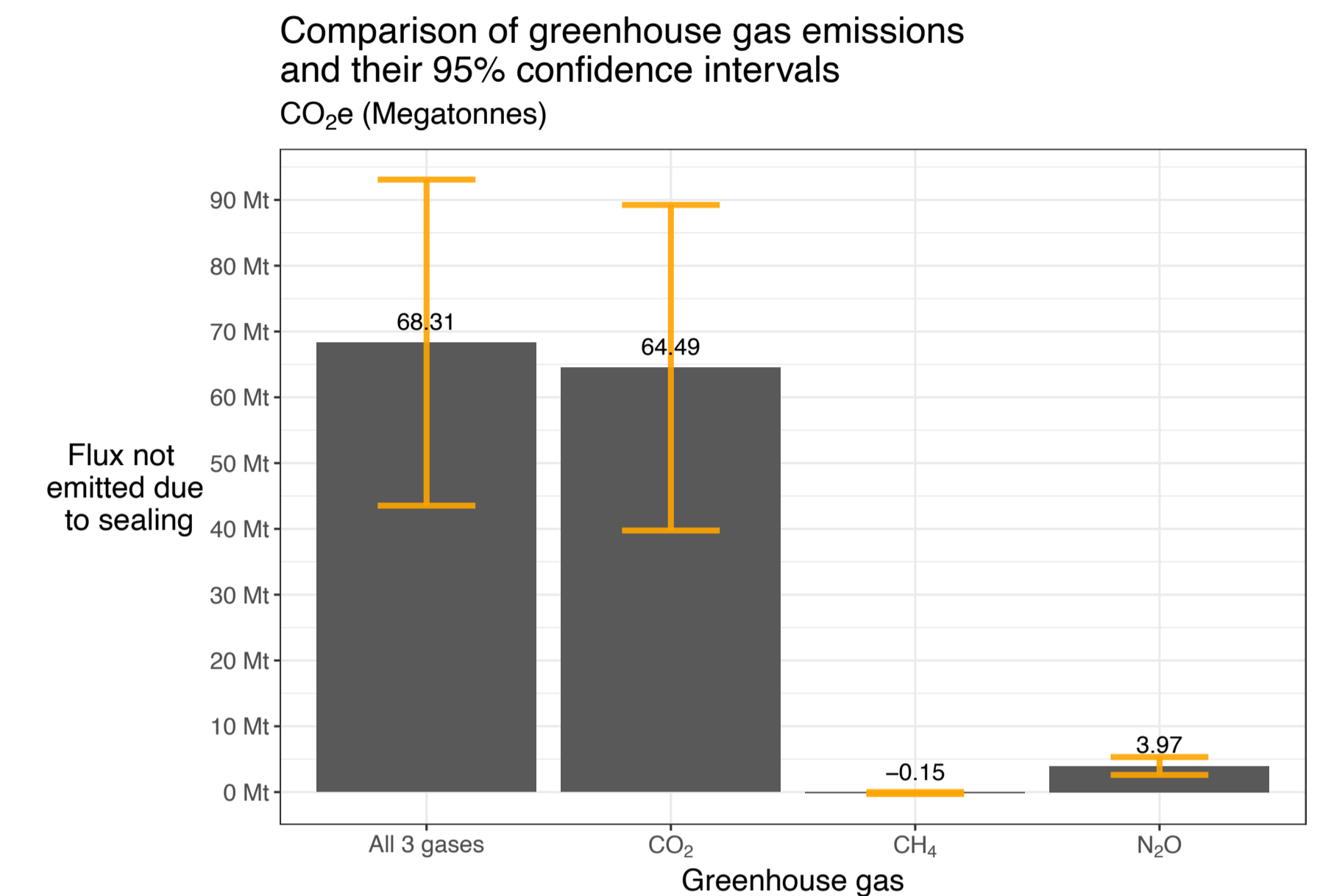
Results

- Overall, **paving over soil reduced soil greenhouse gas emissions.**
- The **seasonal savings** of both CO₂ and N₂O were **more pronounced** in the **summer** and **winter** seasons.
- Regardless of the month, **CO₂ savings** from **grassland** and **croplands** dominated total savings. Furthermore, these savings had very **substantial uncertainty.**



What next?

- To be best utilised, our results need to be combined with **other side-effects of paving over soil**, for instance, the:
 - **Additional ecosystem services** of unsealed soil (increased flood risk, biodiversity, CO₂ sequestration from plants).
 - **Life-cycle emissions** of different paving materials
 - The **urban heat effect** of different urban materials compared to unsealed soil.



Conclusions

- **Substantial overall saving (43.5 Mt CO₂e)** even at the **lower end of the 95% confidence interval.**
- **CO₂ emission savings** from soil were an **order of magnitude higher** than the other gases.
- Paving over **grassland** and **cropland** soils accounted for **90% of savings** in greenhouse gas emissions.

References

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 - For greenhouse gas emission rates and temperature sensitivities
- Qiu, L., He, J., Yue, C. et al. Substantial terrestrial carbon emissions from global expansion of impervious surface area. *Nat Commun* 15, 6456 (2024).
 - On the release of plant biomass due to the expansion of paved regions