Assignment: Terrestrial Greenhouse-Gases

Mode

Partner work allowed: yes, maximum groups of three.

Create a text document of 3-5 pages (A4, 11 pt) that answers the content points listed below. You may structure the document along the given questions or as you like. Make sure that references in your text are correctly cited and that each statement is referenced. Ideally, your responses are complemented by a figure from original sources for each point. The document may be handed in as a Word, RMarkdown, or Quarto document that can be added to the repository of the LES textbook (https://geco-bern.github.io/les/).

Present this work in a presentation of 30 min.

Supervised by Benjamin Stocker.

Content points

1. What are the most important greenhouse gases (besides CO_2 and in terms of their greenhouse warming potential and their radiative forcing) with terrestrial sources?
    - (Intergovernmental Panel On Climate Change, 2023) Chapters 5.2.2, 5.2.3, 7.3.5; Table 7.15
2. What sources (processes, regions, ecosystem types) contribute how much to average annual emissions of CH_4 and N_2O?
    - (Intergovernmental Panel On Climate Change, 2023) Chapters 5.2.2, 5.2.3
3. What has been the evolution of atmospheric CH_4 and N_2O concentrations over glacial-interglacial cycles, since the Last Glacial Maximum, and since the Industrial Revolution? And how strong is the radiative forcing of their increase since the Industrial Revolution?
    - (Joos and Spahni, 2008)
    - (Intergovernmental Panel On Climate Change, 2023) Chapters 5.2.2, 5.2.3
4. What is the atmospheric lifetime of CH_4 and N_2O and what affects their sinks (and thus their lifetimes)?
    - (Joos et al., 2001)
    - (Intergovernmental Panel On Climate Change, 2023) Chapters 5.2.2, 5.2.3
5. What are the most important controls on terrestrial CH_4 and N_2O emissions? What determines their evolution in future climate change and land use scenarios? What is the feedback of CH_4 and N_2O on anthropogenic climate change?
    - (Intergovernmental Panel On Climate Change, 2023) Chapters 5.2.2, 5.2.3
    - (Stocker et al., 2013)

6. How do emission-concentration relationships differ between CO_2 and CH_4 (and equally between CO_2 and N_2O)?
    - (Joos et al., 2001)

References

Intergovernmental Panel On Climate Change: Climate Change 2021 – The Physical Science Basis: Working Group I Contribution to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change, 1st ed., Cambridge University Press, https://doi.org/10.1017/9781009157896, 2023.

Joos, F. and Spahni, R.: Rates of change in natural and anthropogenic radiative forcing over the past 20,000 years, Proceedings of the National Academy of Sciences, 105, 1425–1430, https://doi.org/10.1073/pnas.0707386105, 2008.

Joos, F., Prentice, I. C., Sitch, S., Meyer, R., Hooss, G., Plattner, G.-K., Gerber, S., and Hasselmann, K.: Global warming feedbacks on terrestrial carbon uptake under the Intergovernmental Panel on Climate Change (IPCC) Emission Scenarios, Global Biogeochemical Cycles, 15, 891–907, https://doi.org/10.1029/2000GB001375, 2001.

Stocker, B. D., Roth, R., Joos, F., Spahni, R., Steinacher, M., Zaehle, S., Bouwman, L., Xu-Ri, and Prentice, I. C.: Multiple greenhouse-gas feedbacks from the land biosphere under future climate change scenarios, Nature Clim Change, 3, 666–672, https://doi.org/10.1038/nclimate1864, 2013.