Supplement of "National CO_2 budgets (2015–2020) inferred from atmospheric CO_2 observations in support of the Global Stocktake"

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1 Introduction

This supporting information contains one text section listing the countries within the regional groupings, and 12 supplementary figures.

Text S1. Regional groupings

- **ASEAN:** Brunei, Cambodia, Indonesia, Laos, Malaysia, Mayanmar, Philippines, Singapore, Thailand, Vietnam
- **African Union (AU):** Algeria, Angola, Benin, Botswana, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Comoros, Democratic Republic of Congo, Djibouti, Egypt, Equatorial Guinea, Eritrea, Eswatini, Ethiopia, Gabon, The Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Kenya, Lesotho, Liberia, Libya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, The Congo, Rwanda, Western Sahara, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, Togo, Tunisia, Uganda, Zambia, Zimbabwe

- **AU North:** Algeria, Egypt, Libya, Mauritania, Morocco, Western Sahara, Tunisia
- **AU South:** Angola, Botswana, Eswatini, Lesotho, Malawi, Mozambique, Namibia, South Africa, Zambia, Zimbabwe
- **AU West:** Benin, Burkina Faso, The Gambia, Ghana, Guinea, Guinea-Bissau, Ivory Coast, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo
- **AU East:** Comoros, Djibouti, Eritrea, Ethiopia, Kenya, Madagascar, Mauritius, Rwanda, Seychelles, Somalia, South Sudan, Sudan, Tanzania, Uganda
- **AU Central:** Burundi, Cameroon, Central African Republic, Chad, Democratic Republic of Congo, Equatorial Guinea, Gabon, The Congo
- **CELAC+Brazil:** Antigua and Barbuda, Argentina, Bahamas, Belize, Bolivia, Chile, Columbia, Costa Rica, Cuba, Dominica, Dominican Republic, Ecuador, El Savador, Grenada, Guatemala, Guyana, Haiti, Honduras, Jamaica, Mexico, Nicaragua, Panama, Paraguay, Peru, Saint Kitts and Nevis, Saint Lucia, Saint Vincent and Grenadines, Suriname, Trinidad and Tobago, Uruguay, Venezuela, Brazil
- **ECO:** Afghanistan, Azerbaijan, Iran, Kazakhstan, Kyrgyzstan, Pakistan, Tajikistan, Turkey, Turkmenistan, Uzbekistan
- **European Union (EU):** Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden
- **SAARC:** Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, Sri Lanka
- **North America:** Canada, USA, Mexico
- **Middle East:** Bahrain, Cyprus, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Oman, Palestine, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, Yemen
- **Europe:** Albania, Andorra, Austria, Belarus, Belgium, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Liechtenstein, Lithuania, Luxembourg, Malta, Moldova, Monaco, Montenegro, Netherlands, North Macedonia, Norway, Poland, Portugal, Romania, San Marino, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Ukraine, United Kingdom, The Vatican

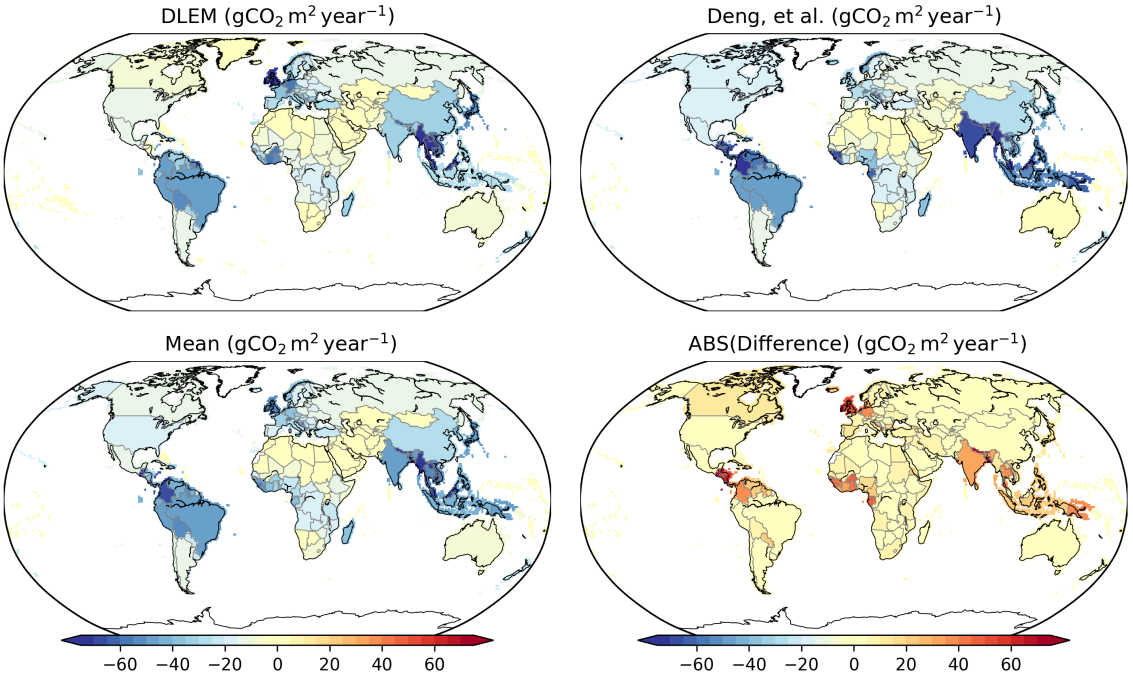

Figure S1. 2015–2020 mean $F_{\text{rivers export}}$ for countries estimated by (top-left) the DLEM model, (top-right) Deng et al. (2022), (bottom-left) mean of these two estimates, and (bottom-right) the absolute difference between these two estimates

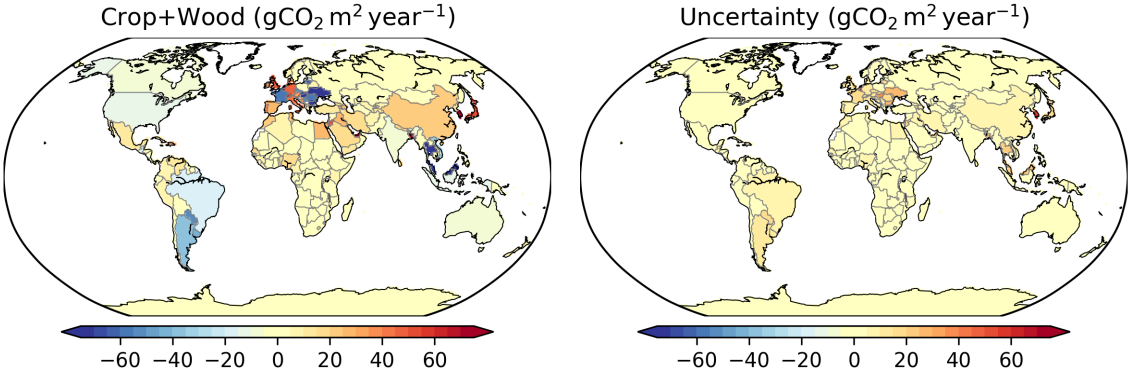

Figure S2. 2015–2019 mean $F_{\text{crop trade}}$+$F_{\text{wood trade}}$ and their uncertainty (assumed to be a 30% of the flux).

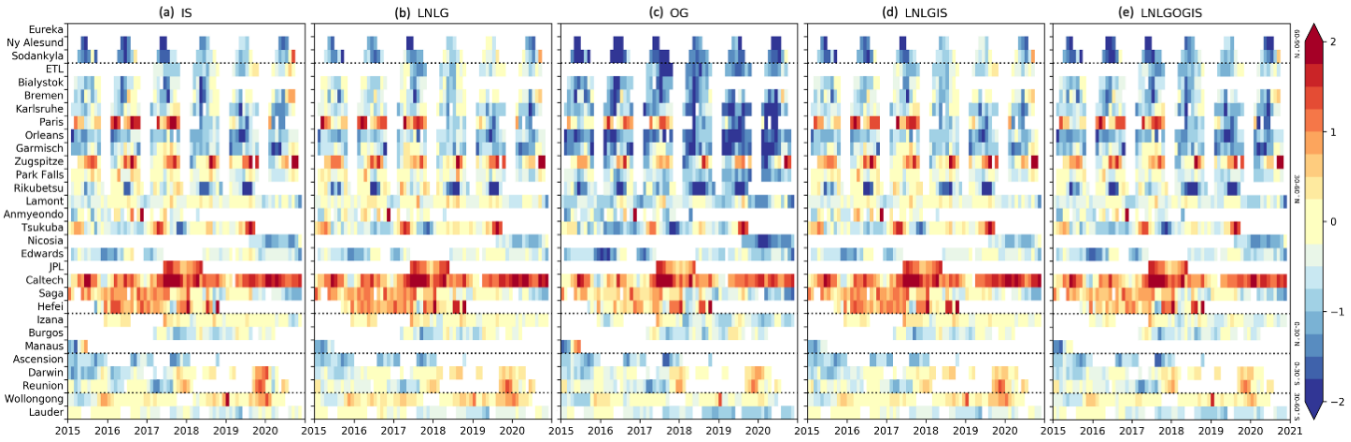

Figure S3. Monthly mean difference between retrieved and simulated X_{CO_2} for the v10 OCO-2 MIP median model (data minus model) at each TCCON site. Biases are shown for each experiment: (a) IS, (b) LNLG, (c) OG, (d) LNLGIS, and (e) LNLGOGIS. Dashed black lines demarcate 30° latitude bounds.

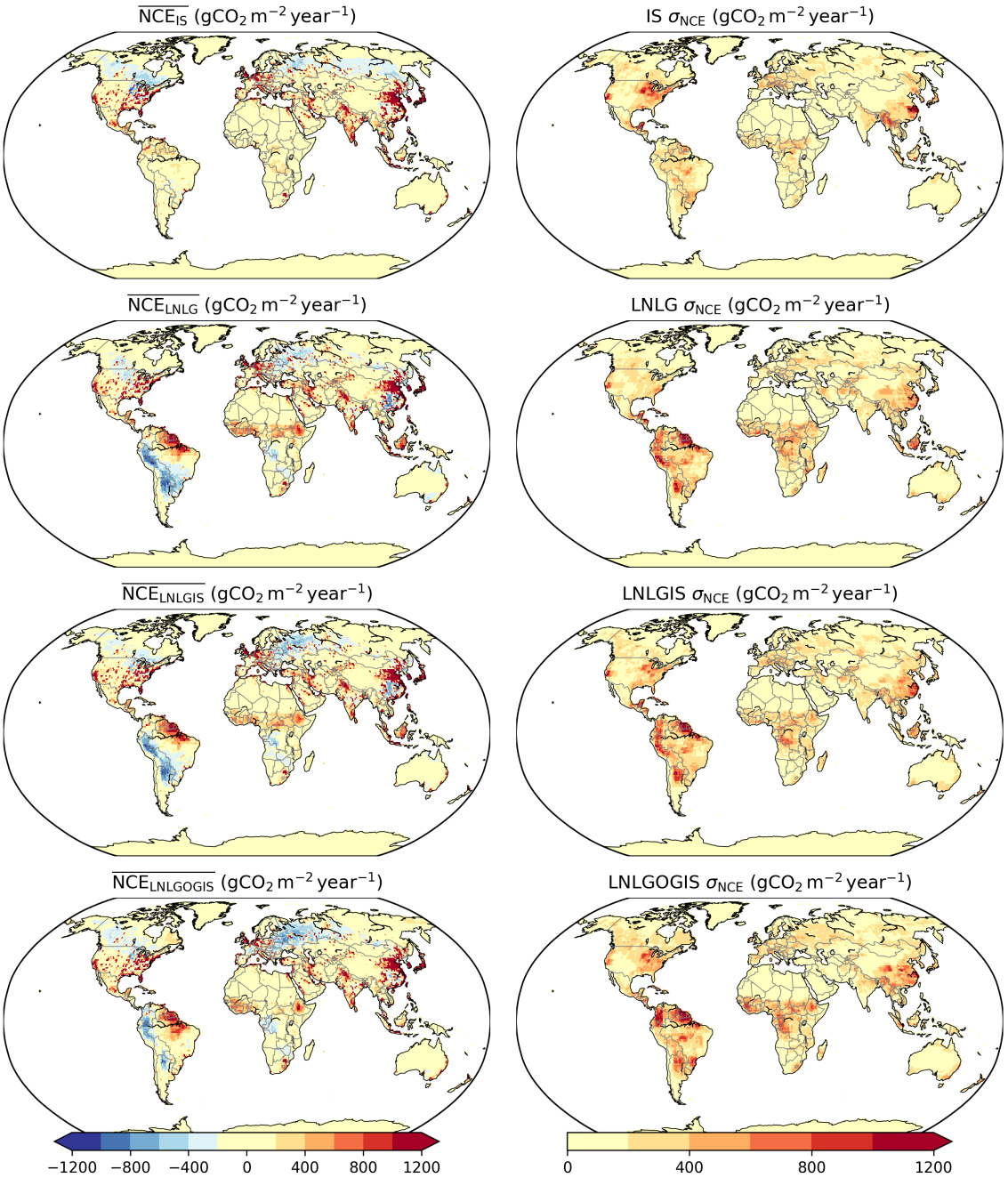

Figure S4. $1^\circ \times 1^\circ$ grid median and standard deviation of NCE ($\mathrm{gCO_2\,m^{-2}\,yr^{-1}}$) over 2015–2020 from the v10 OCO-2 MIP for the (1st row) IS, (2nd row) LNLG, (3rd row) LNLGIS and (4th row) LNLGOGIS experiments.

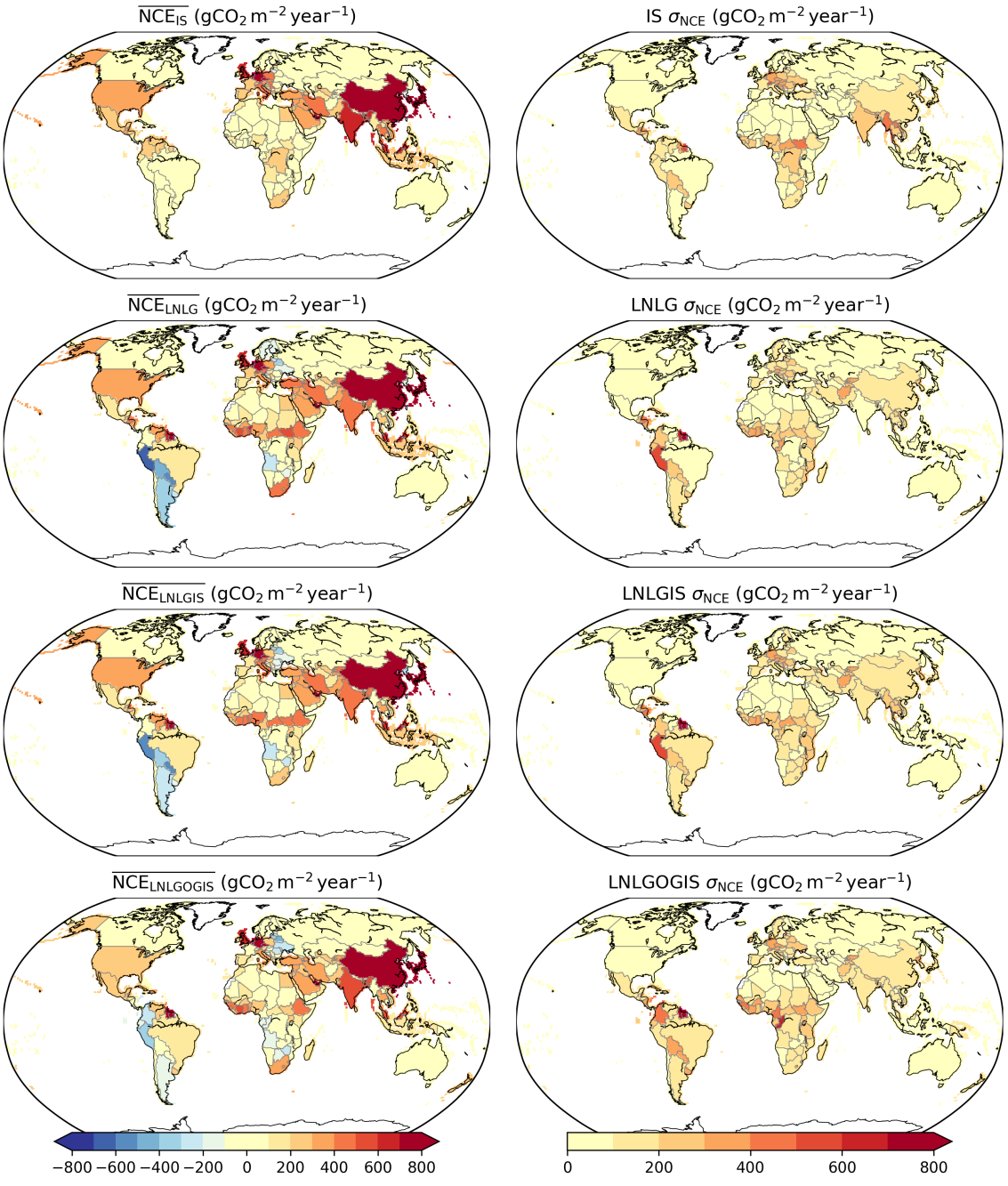

Figure S5. Country level median and standard deviation of NCE ($\text{gCO}_2\,\text{m}^{-2}\,\text{yr}^{-1}$) over 2015-2020 from the v10 OCO-2 MIP for the (1st row) IS, (2nd row) LNLG, (3rd row) LNLGIS and (4th row) LNLGOGIS experiments.

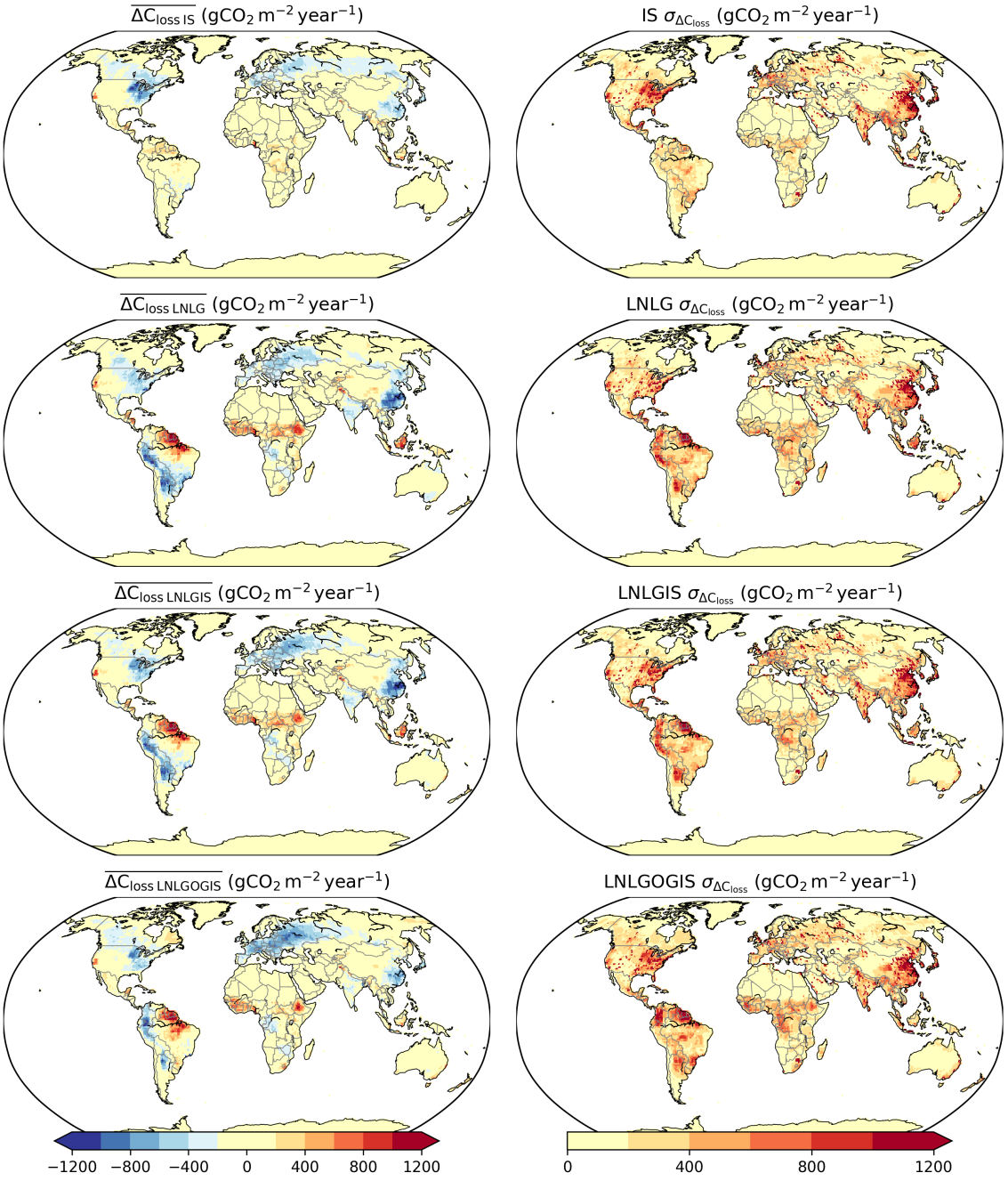

Figure S6. 2015–2020 mean annual net ΔC_{loss} ($\text{gCO}_2\,\text{m}^{-2}\,\text{yr}^{-1}$), and their uncertainties.

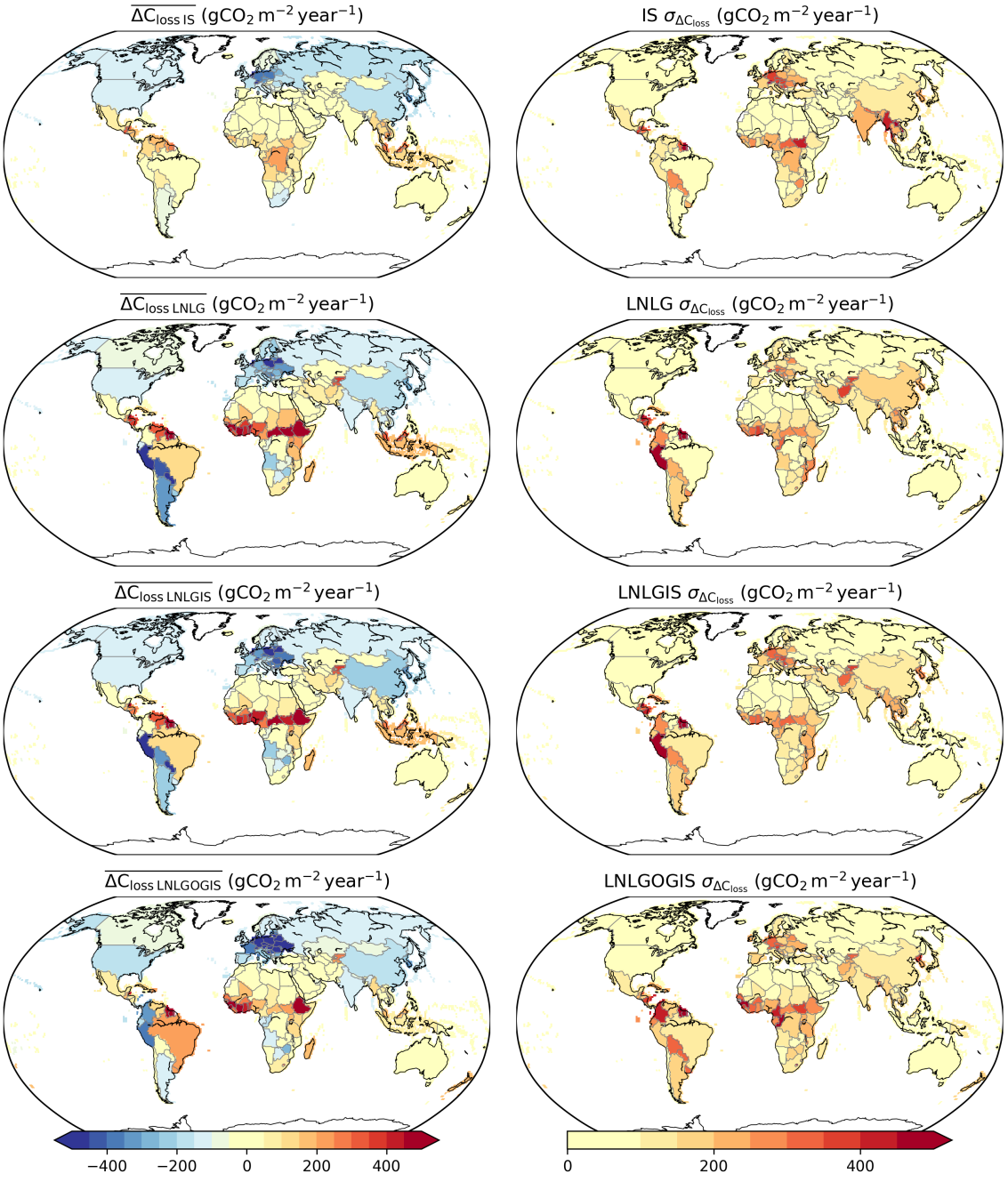

Figure S7. 2015–2020 mean annual net ΔC_{loss} ($\text{gCO}_2\,\text{m}^{-2}\,\text{yr}^{-1}$) and their uncertainties.

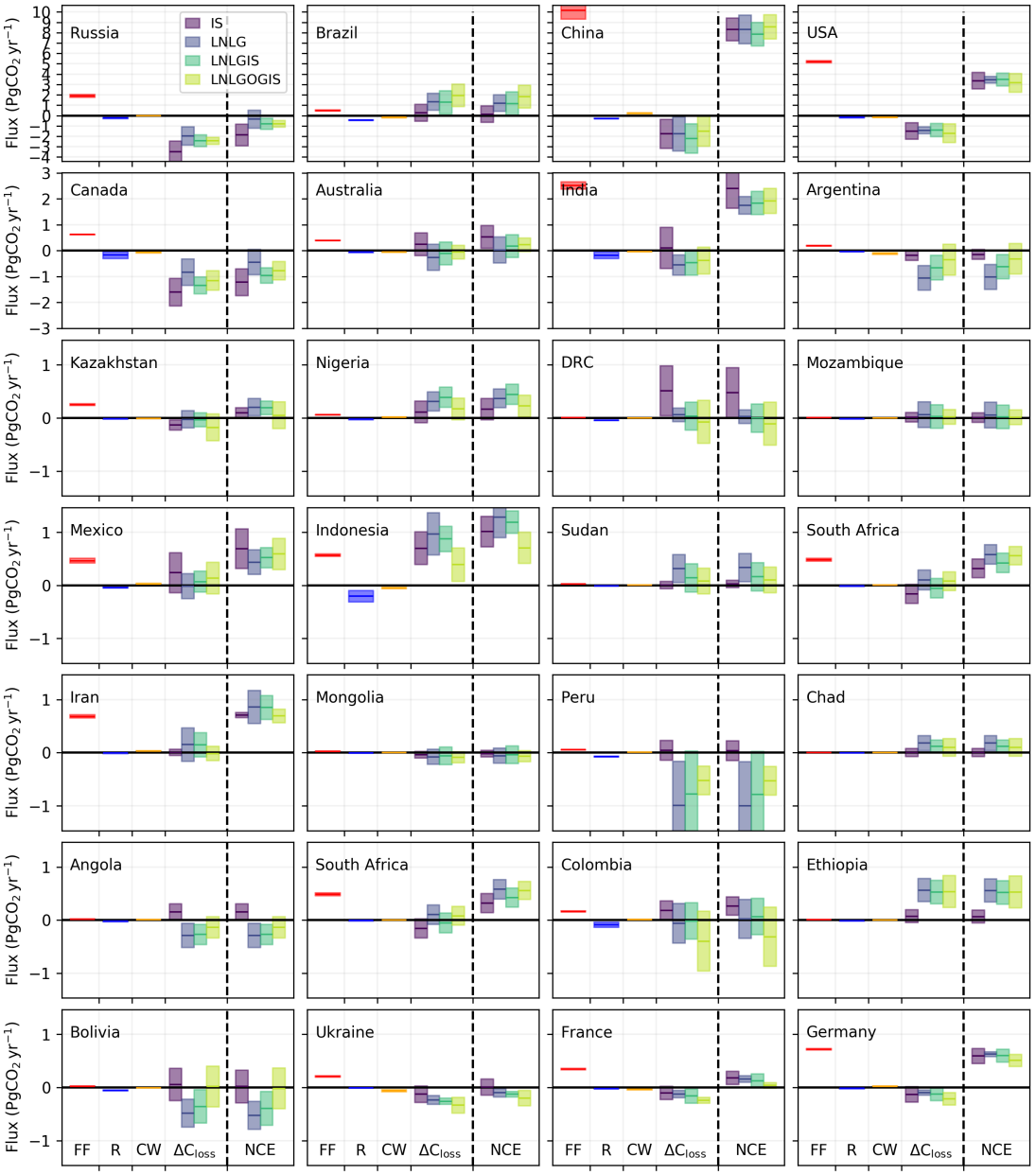

Figure S8. Bar plot of 2015–2020 median +/- standard deviation of FF, $F_{\text{rivers export}}$ (R), $F_{\text{crop trade}}$+$F_{\text{wood trade}}$ (CW), ΔC_{loss}, and NCE for 28 countries. Note that different rows have different y-axis limits.

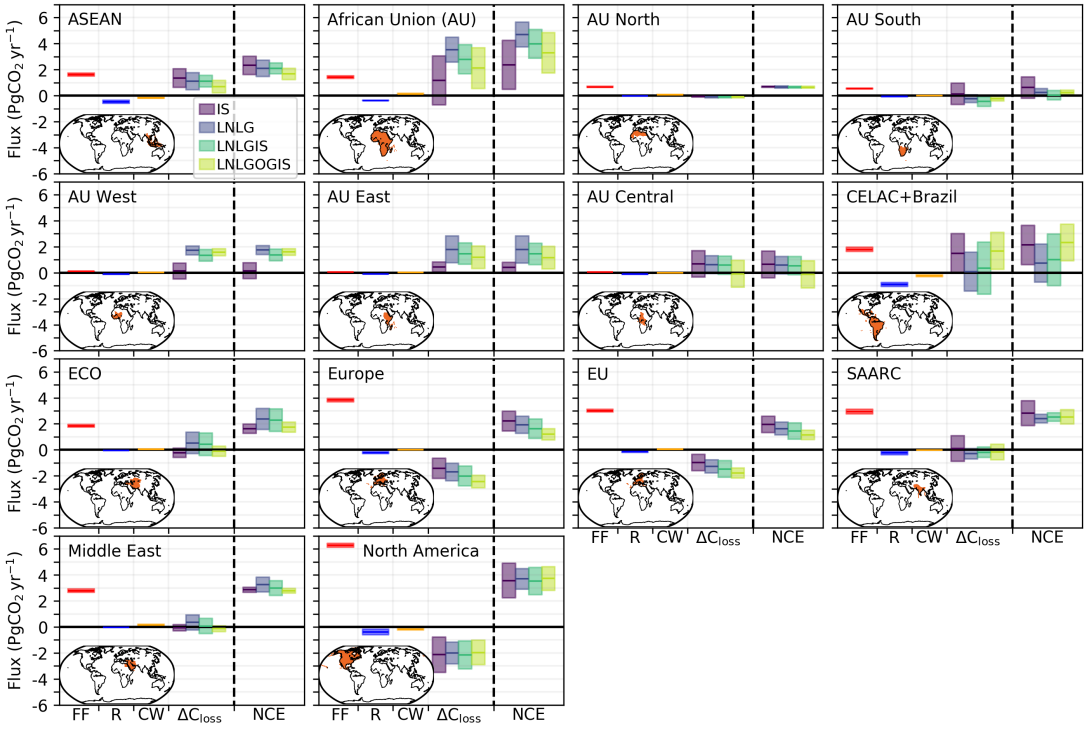

Figure S9. Bar plot of 2015–2020 median +/- standard deviation of FF, $F_{\text{rivers export}}$ (R), $F_{\text{crop trade}}$+$F_{\text{wood trade}}$ (CW), ΔC_{loss}, and NCE for 14 regions composed of multiple countries.

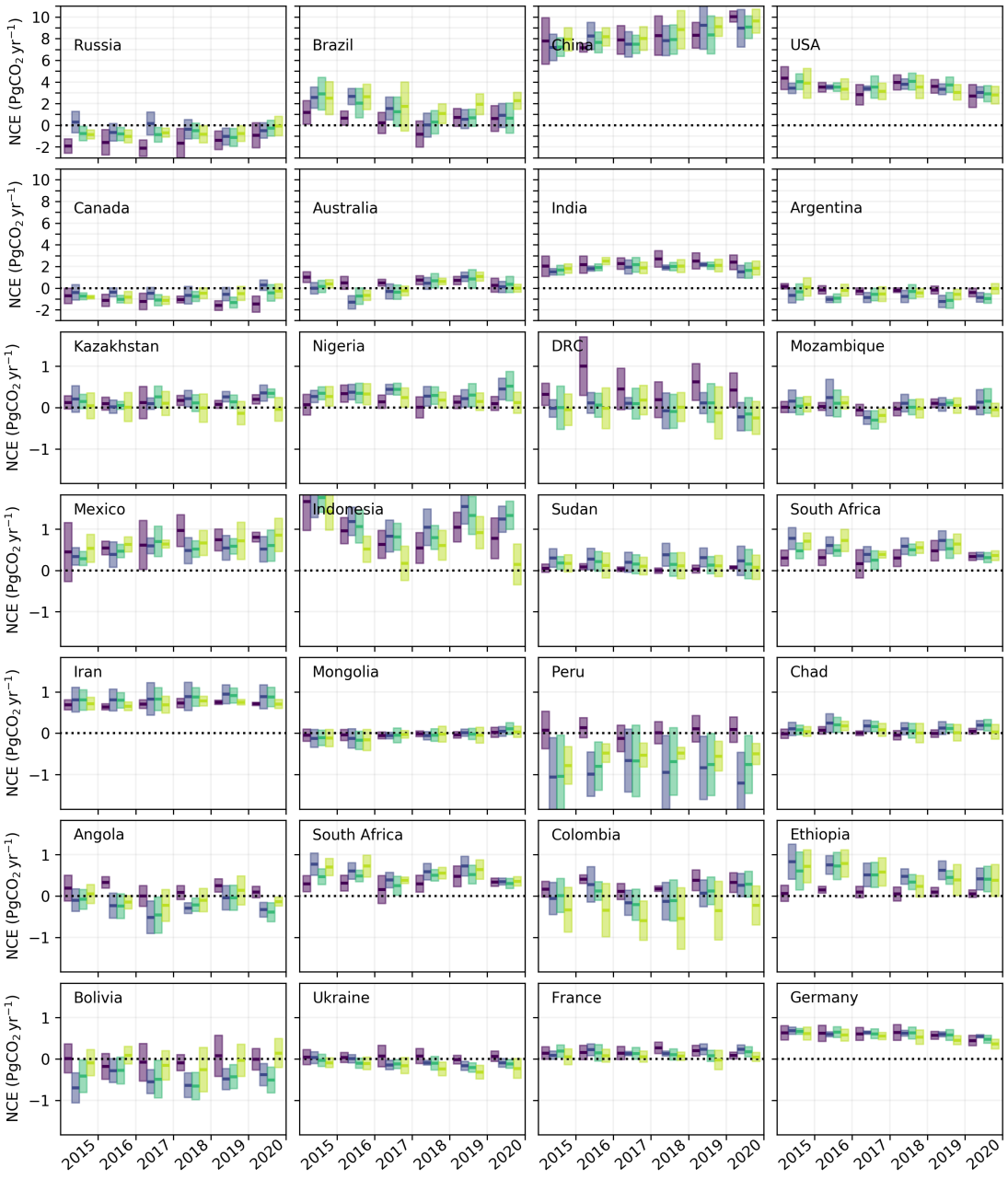

Figure S10. Timeseries of NCE for 28 countries (median +/- standard deviation) for the IS, LNLG, LNLGIS, and LNLGOGIS inversions.

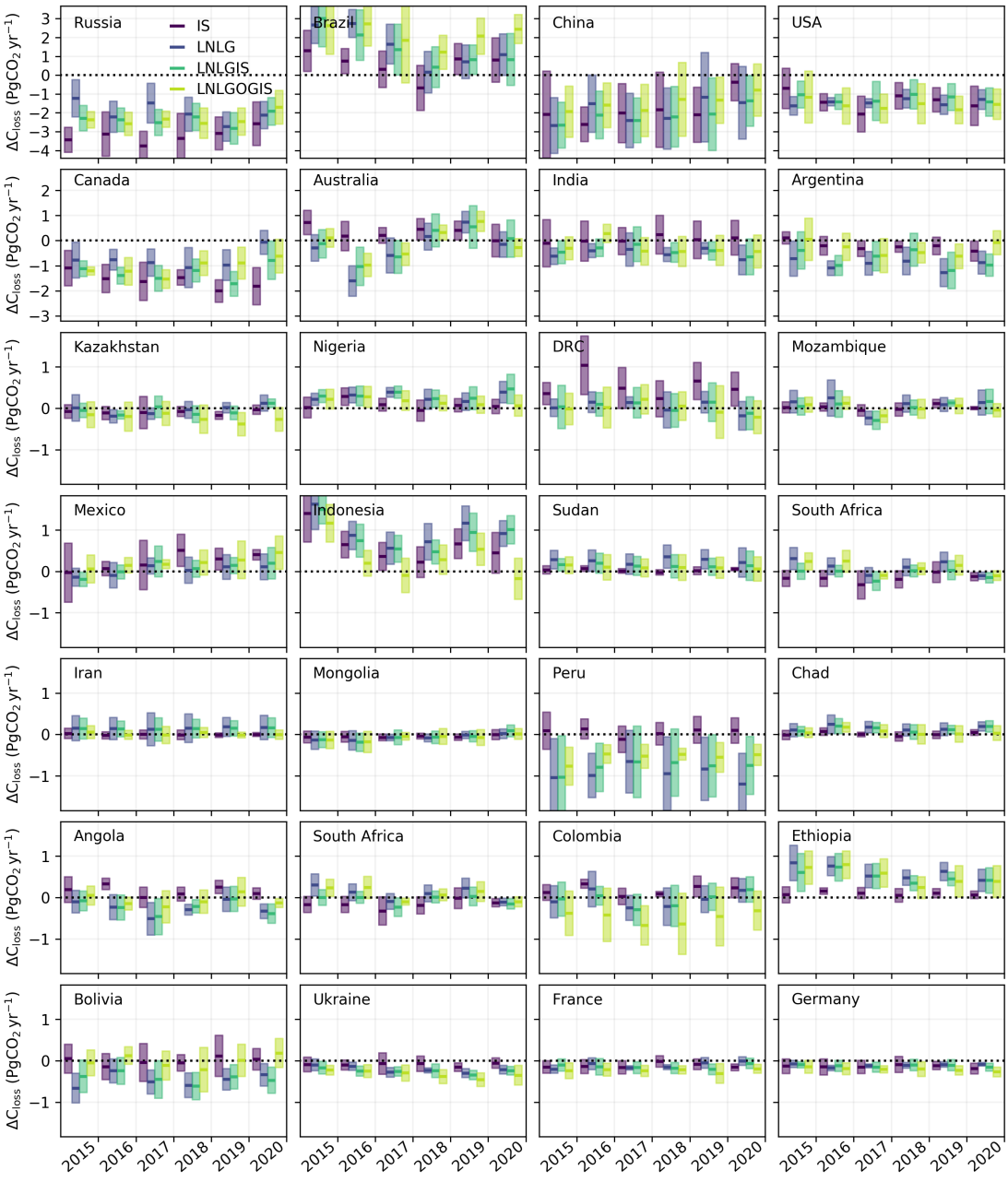

Figure S11. Timeseries of ΔC_{loss} for 28 countries (median +/- standard deviation) for the IS, LNLG, LNLGIS, and LNLGOGIS inversions.

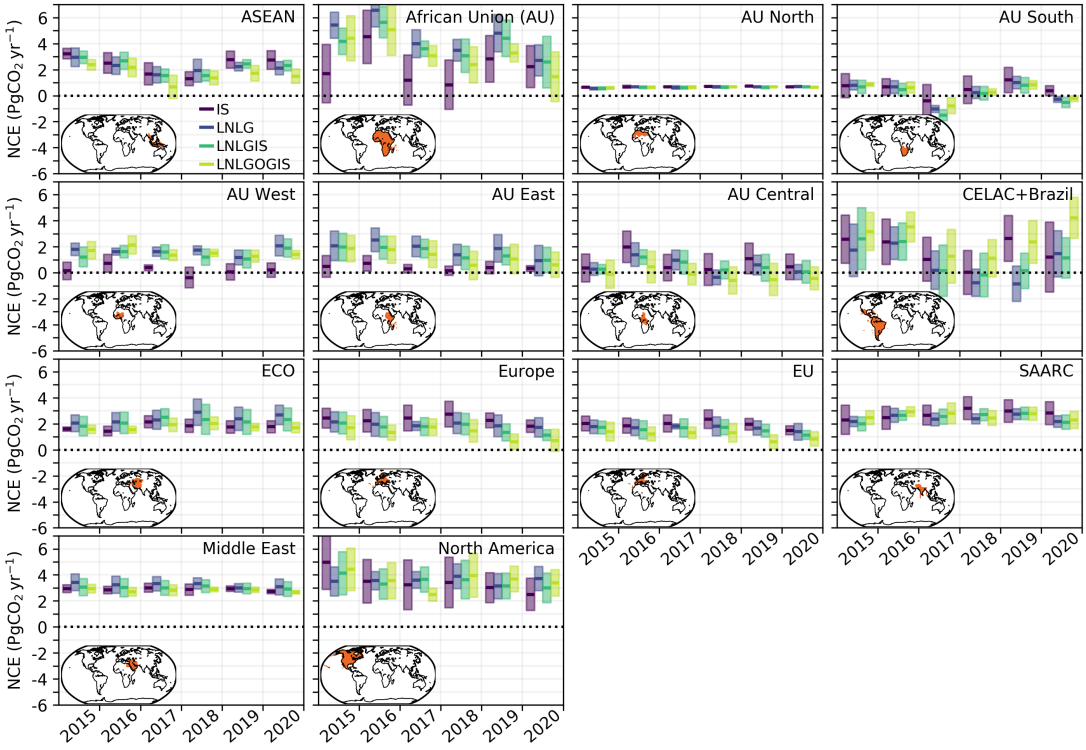

Figure S12. Timeseries of NCE for 14 regions composed of multiple countries (median +/- standard deviation) for the IS, LNLG, LNLGIS, and LNLGOGIS inversions.

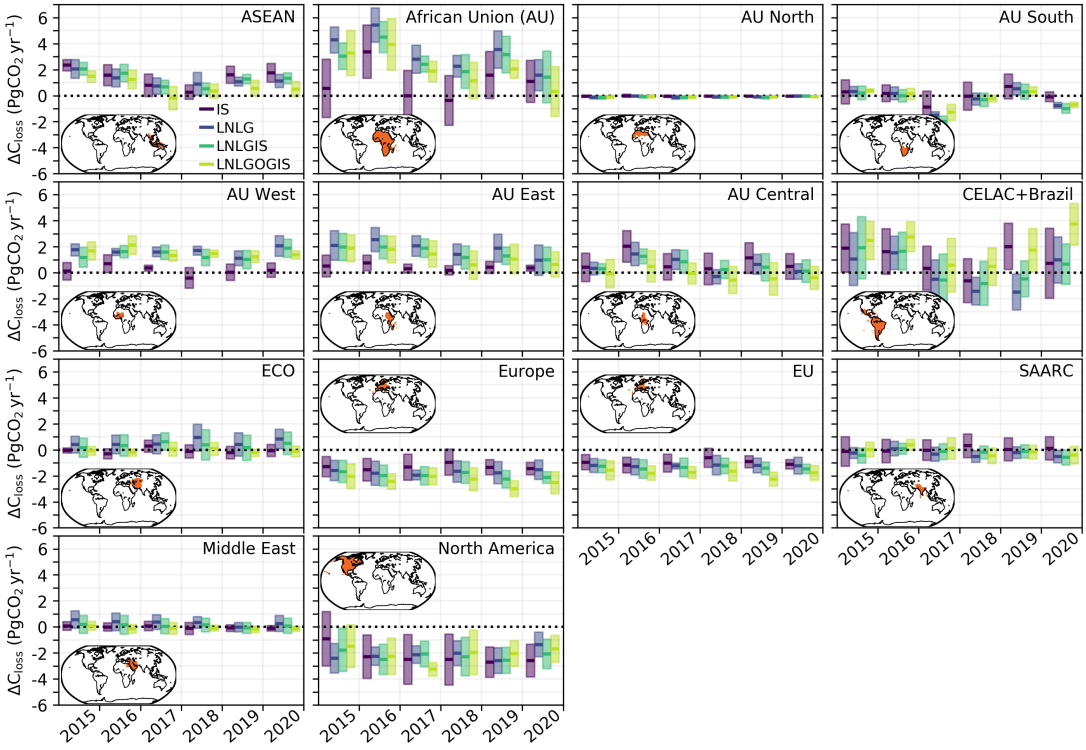

Figure S13. Timeseries of ΔC_{loss} for 14 regions composed of multiple countries (median +/- standard deviation) for the IS, LNLG, LNLGIS, and LNLGOGIS inversions.

References

Deng, Z., Ciais, P., Tzompa-Sosa, Z. A., Saunois, M., Qiu, C., Tan, C., Sun, T., Ke, P., Cui, Y., Tanaka, K., Lin, X., Thompson, R. L., Tian, H., Yao, Y., Huang, Y., Lauerwald, R., Jain, A. K., Xu, X., Bastos, A., Sitch, S., Palmer, P. I., Lauvaux, T., d'Aspremont, A., Giron, C., Benoit, A., Poulter, B., Chang, J., Petrescu, A. M. R., Davis, S. J., Liu, Z., Grassi, G., Albergel, C., Tubiello, F. N., Perugini, L., Peters, W., and Chevallier, F.: Comparing national greenhouse gas budgets reported in UNFCCC inventories against atmospheric inversions, Earth Syst. Sci. Data, 14, 1639–1675, https://doi.org/10.5194/essd-14-1639-2022, 2022.