Supplement of

Global atmospheric inversion of the NH_3 emissions over 2019-2022 using the LMDZ-INCA chemistry-transport model and the IASI NH_3 observations

Pramod Kumar[1], Grégoire Broquet[1], Didier Hauglustaine[1], Maureen Beaudor[1,7], Lieven Clarisse[2], Martin Van Damme[2,3], Pierre Coheur[2], Anne Cozic[1], Bo Zheng[4], Beatriz Revilla Romero[5], Antony Delavois[6], and Philippe Ciais[1]

[1]Laboratoire des Sciences du Climat et de l'Environnement (LSCE/IPSL), CEA-CNRS-UVSQ, Université Paris-Saclay, 91191 Gif-sur-Yvette, France
[2]Spectroscopy, Quantum Chemistry and Atmospheric Remote Sensing, Université libre de Bruxelles (ULB), Brussels, Belgium
[3]Royal Belgian Institute for Space Aeronomy, Brussels, Belgium
[4]Institute of Environment and Ecology, Tsinghua Shenzhen International Graduate School, Tsinghua University, Shenzhen, China
[5]GMV, Remote Sensing & Geospatial Analytics Division, Spain
[6]European Space Agency, ESRIN, Via Galileo Galilei, Frascati, Italy
[7]Currently at: High Meadows Environmental Institute, Princeton University, NJ, 08540, USA

Correspondence: Pramod Kumar (pramod.kumar@lsce.ipsl.fr)

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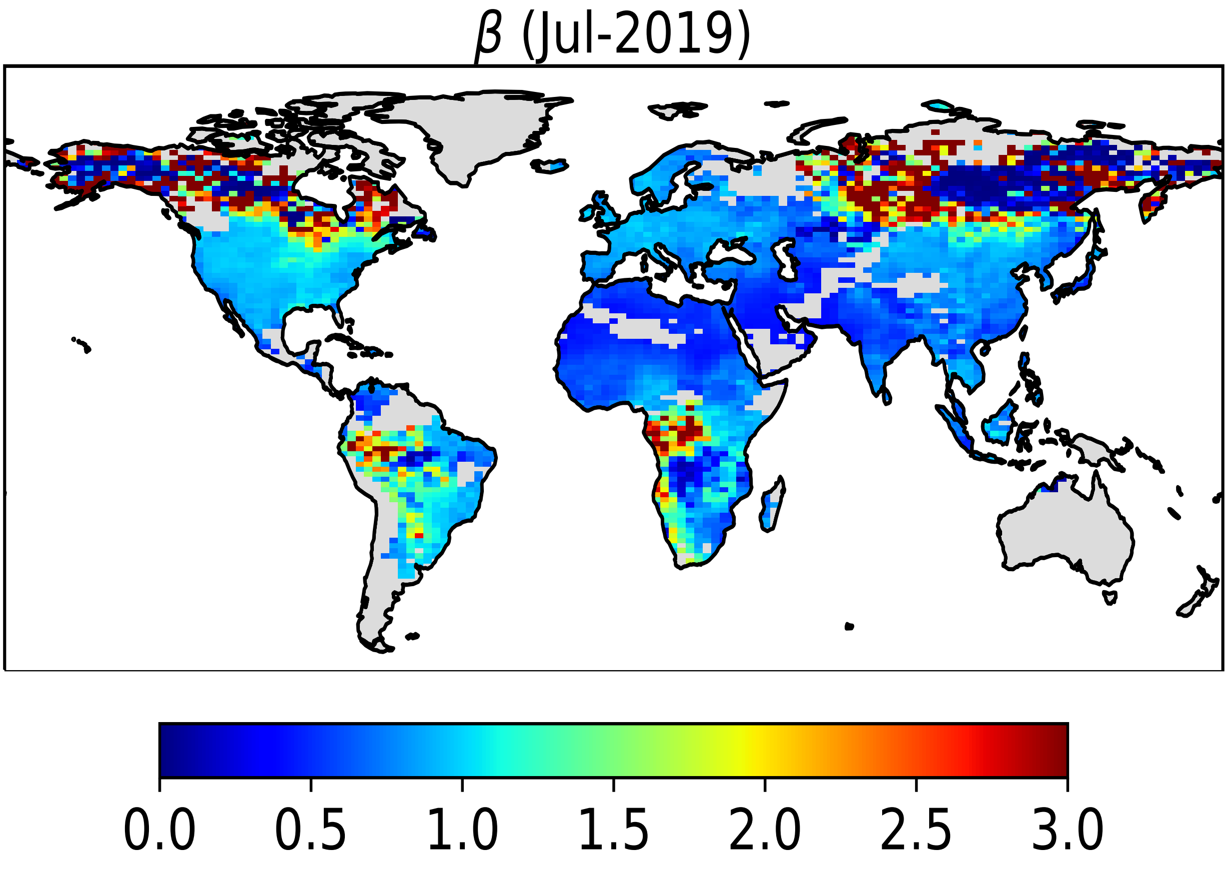


Figure S1. Spatial distribution of monthly mean β for July 2019.

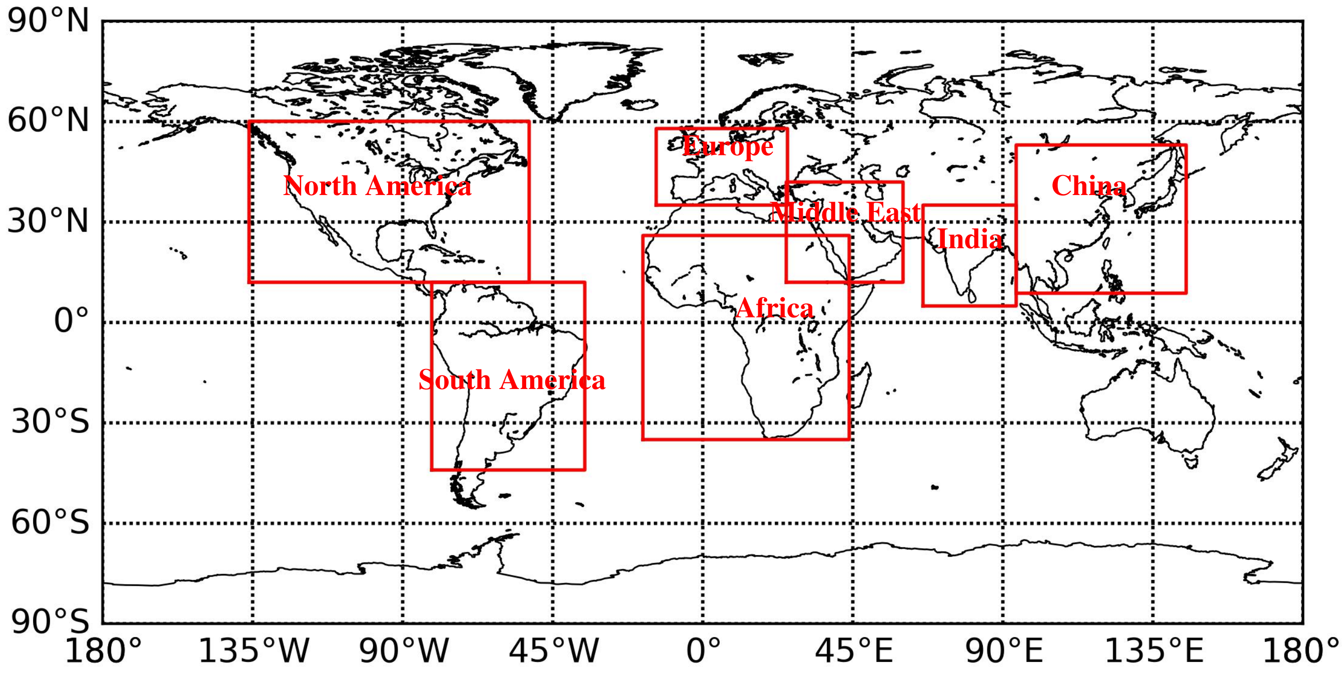


Figure S2. The regions selected for the regional analysis.

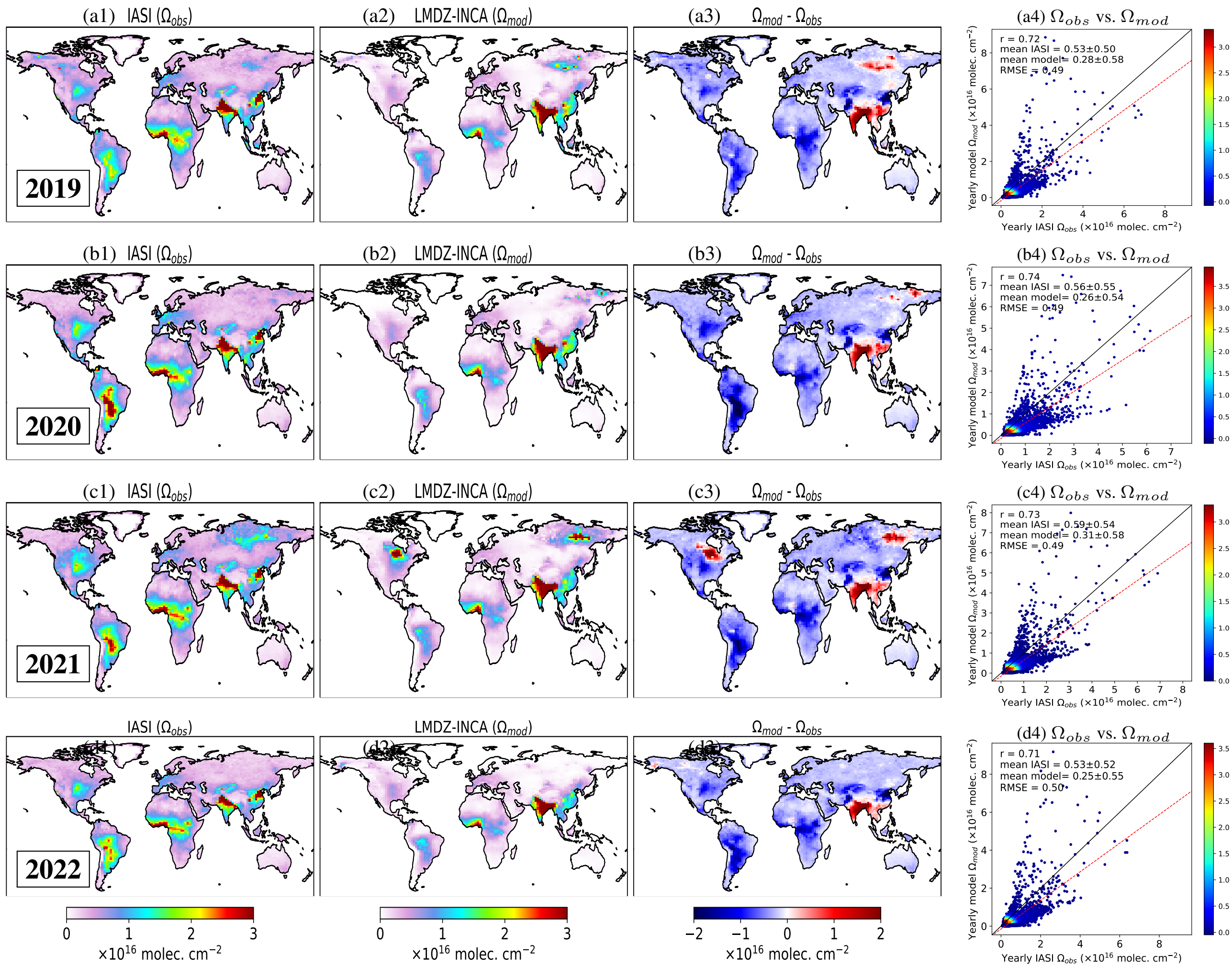


Figure S3. The spatial distributions of the annual mean NH_3 total columns for all four years from 2019 to 2022. The first and second columns in each row show annual mean from IASI ANNI-NH3-v4 observations (Ω_{obs}) and LMDZ-INCA model simulated columns after applying the averaging kernel (Ω_{mod}), respectively. The third column's figures show the differences Ω_{mod}- Ω_{obs} between. The last column figures show the scatter density plots between the observed IASI and the LMDZ-INCA model NH_3 columns. In the scatter plots, the solid blue line represents the one-to-one line, while the dashed red line represents the regression line.

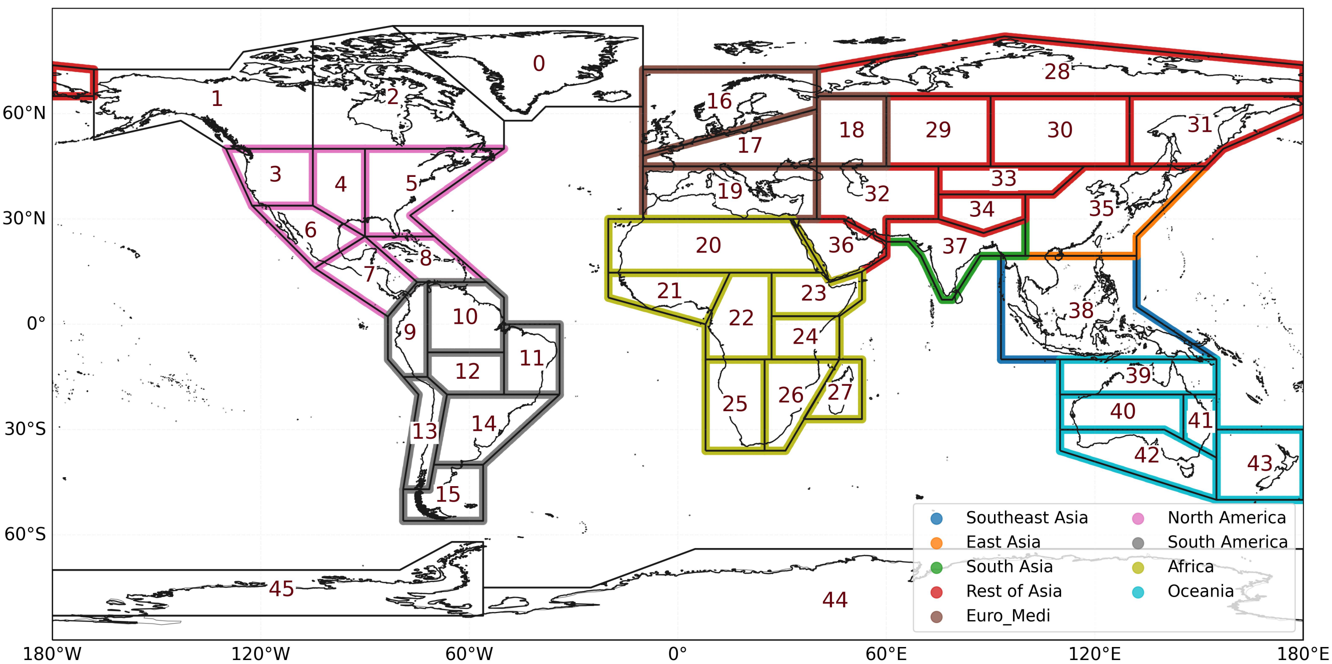


Figure S4. The boundaries of the 9 world regions from the 10 regions defined by Ge et al. (2022) (based on the IPCC reference regions described in Iturbide et al. (2020) used to gap filling the unconstrained emissions in this study.

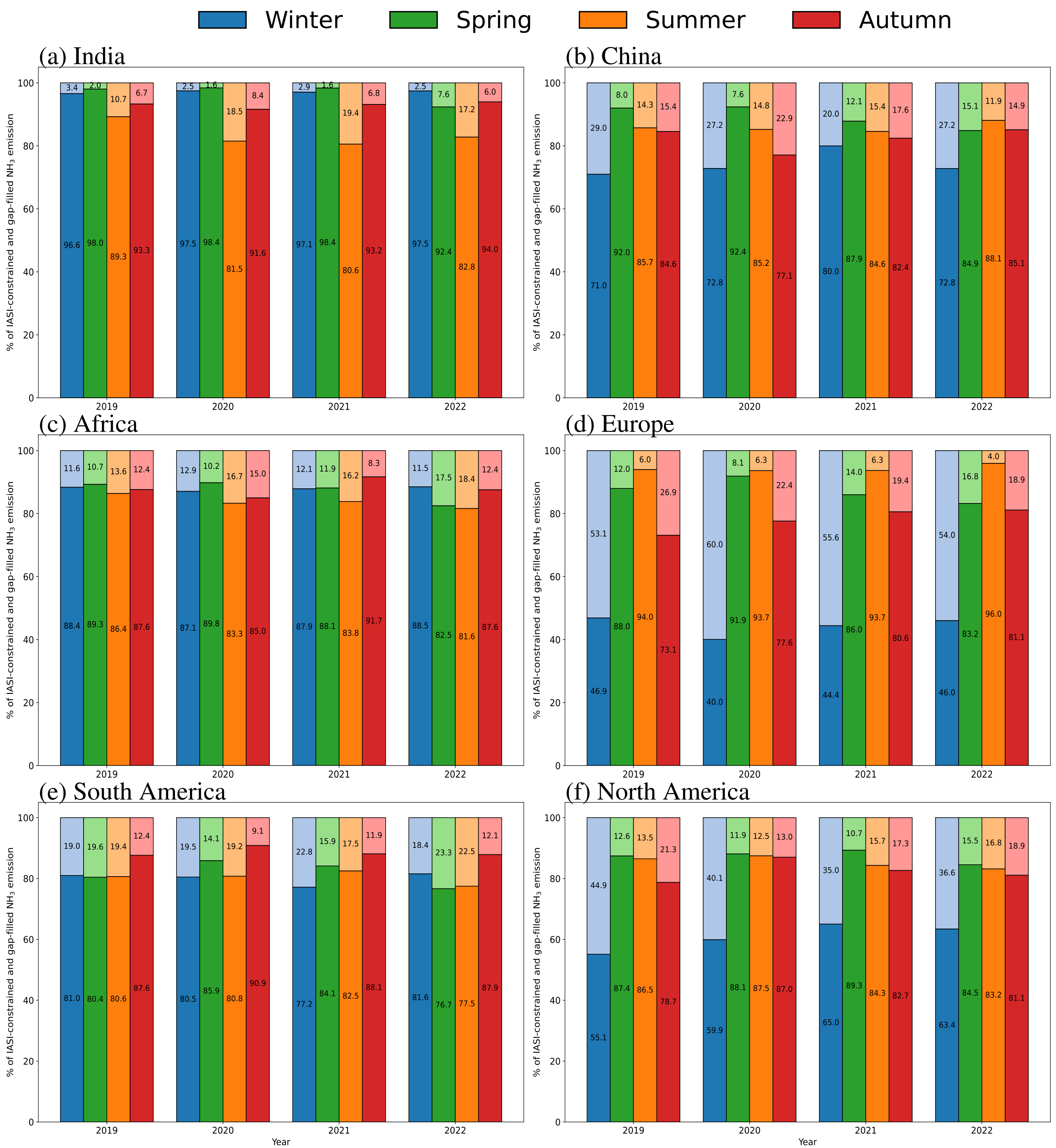


Figure S5. IASI-constrained (lower stack bars) and gap-filled (upper stack bars) NH_3 percentage (%) of seasonal total emissions across six regions over the land from 2019 to 2022.

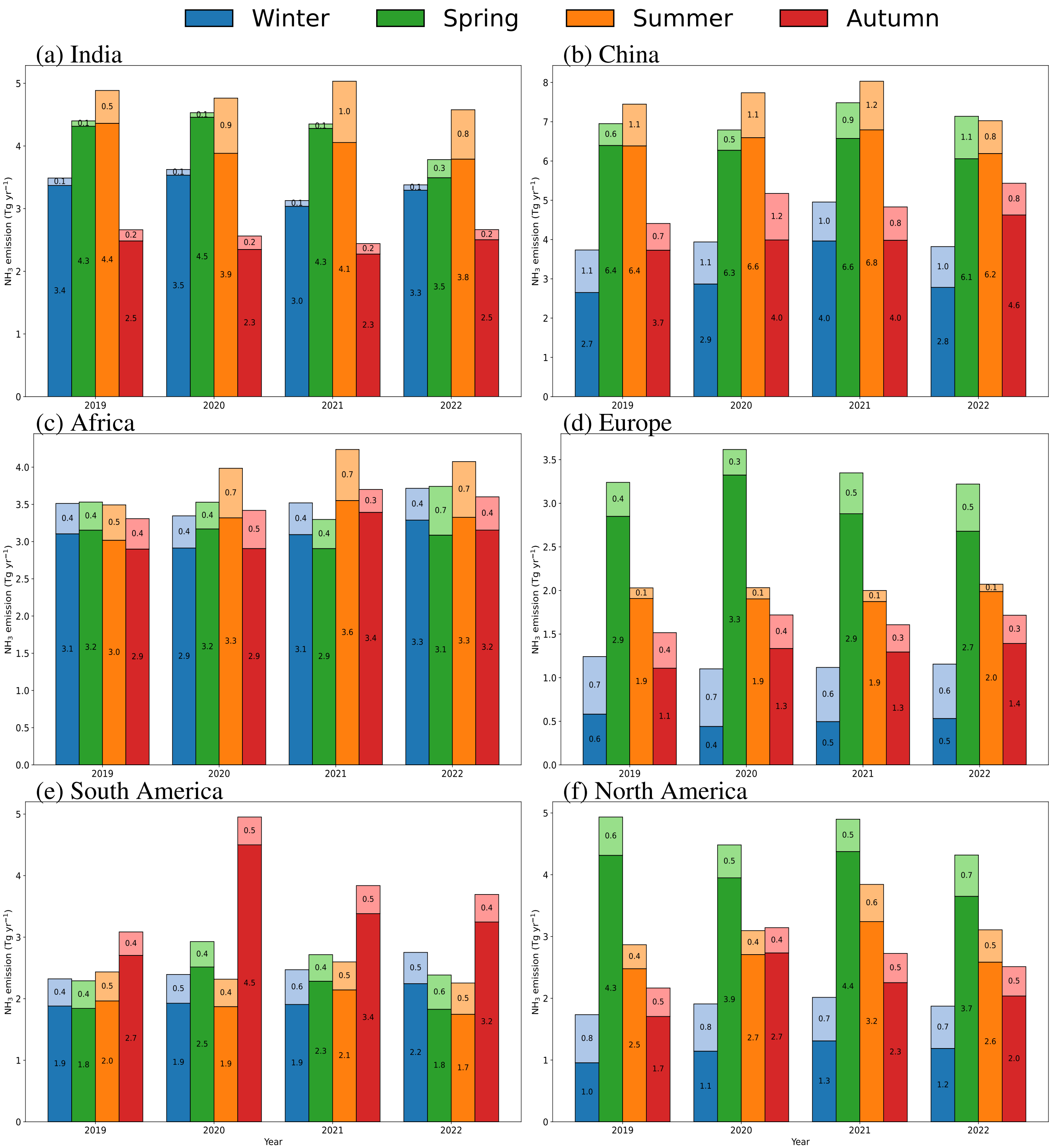


Figure S6. Seasonal NH_3 emissions (IASI-constrained (lower stack bars) and gap-filled (upper stack bars)) across six regions over the land from 2019 to 2022.

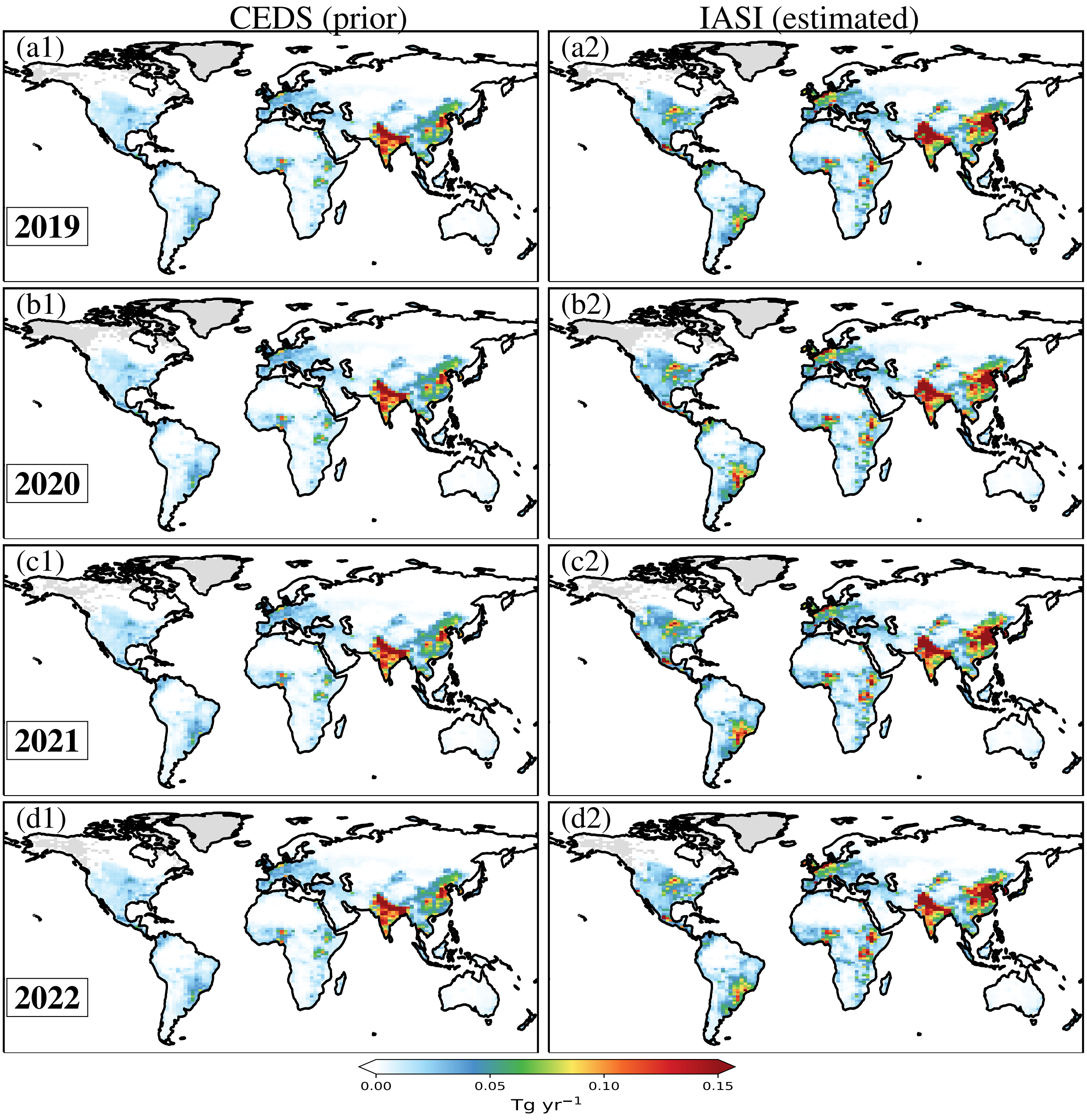
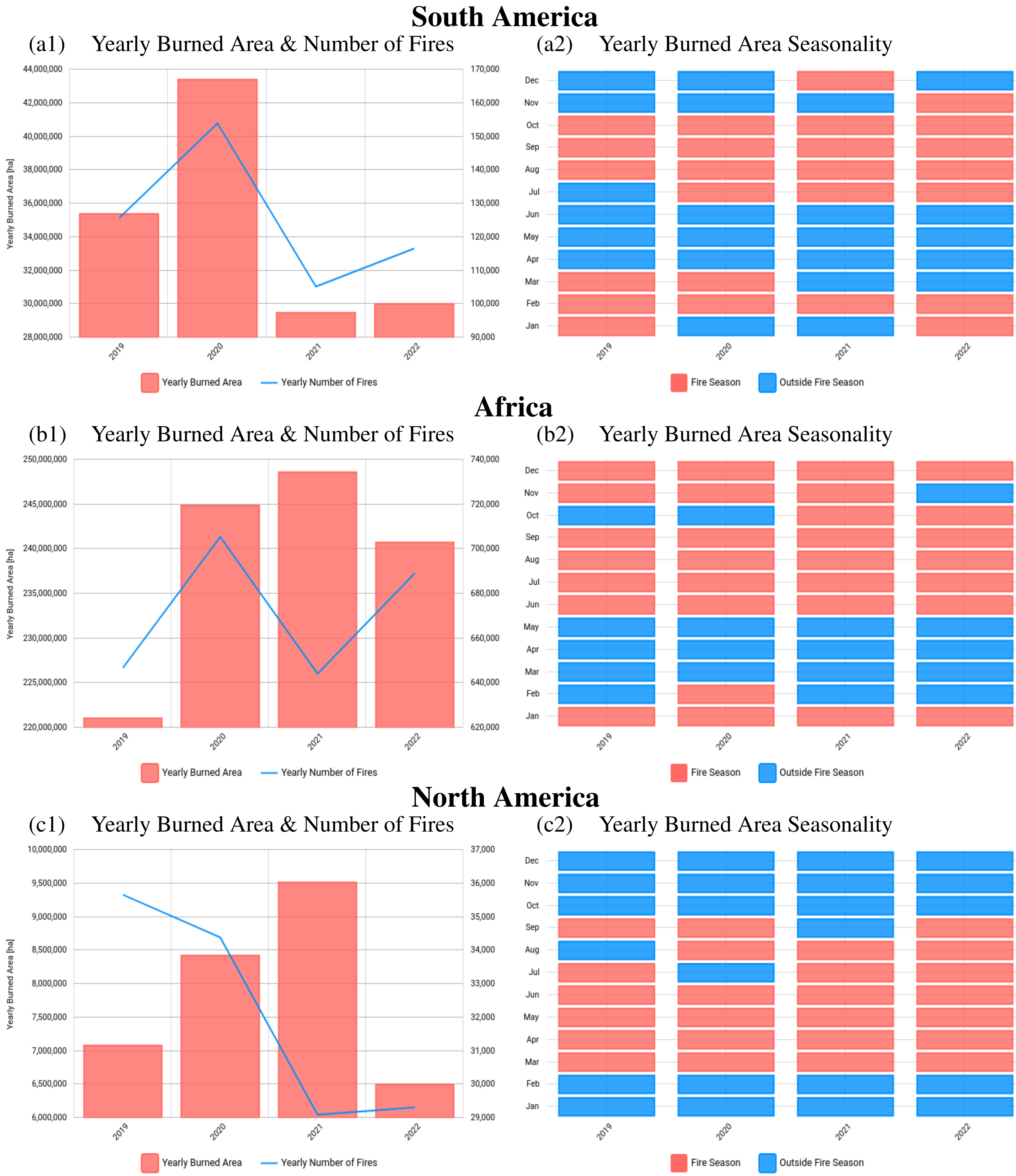


Figure S7. Spatial distribution of the total annual NH_3 emissions for a period of four years from 2019 to 2022, showing the bottom-up prior CEDS emissions (first column), and IASI-constrained emissions ($E_{\mathtt{IASI}}$) (second column).



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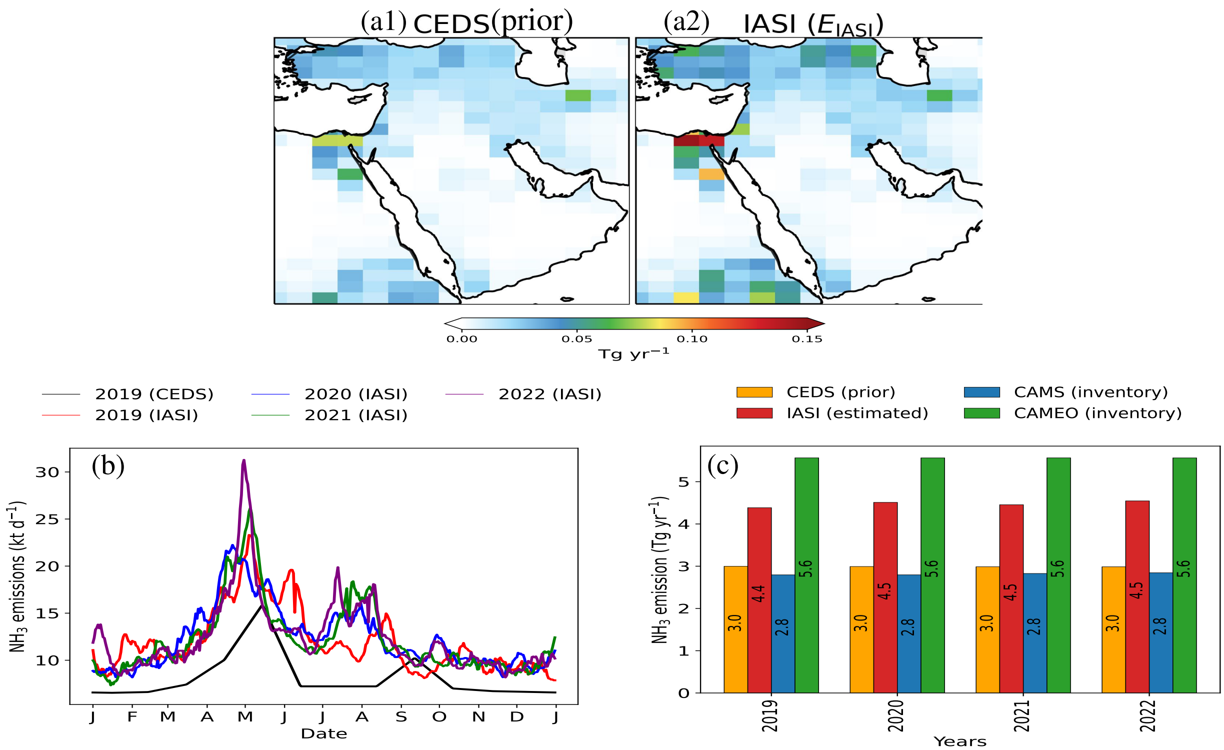

Figure S9. NH_3 Emissions over the Middle East region. First row shows the spatial distribution of the total annual emissions averaged over four-year period (2019-2022), showing (a1) the bottom-up prior CEDS emissions (first column), (a2) IASI-constrained emissions ($E_{\mathtt{IASI}}$). Figure (b) shows the daily variation of the estimate NH_3 emissions for all four years and (c) shows the annual estimated, prior CEDS, and other bottom-up inventories emissions.

References

Ge, Y., Vieno, M., Stevenson, D. S., Wind, P., and Heal, M. R.: A new assessment of global and regional budgets, fluxes, and lifetimes of atmospheric reactive N and S gases and aerosols, Atmospheric Chemistry and Physics, 22, 8343–8368, https://doi.org/10.5194/acp-22-8343-2022, 2022.

Iturbide, M., Gutiérrez, J. M., Alves, L. M., Bedia, J., Cerezo-Mota, R., Cimadevilla, E., Cofiño, A. S., Di Luca, A., Faria, S. H., Gorodetskaya, I. V., Hauser, M., Herrera, S., Hennessy, K., Hewitt, H. T., Jones, R. G., Krakovska, S., Manzanas, R., Martínez-Castro, D., Narisma, G. T., Nurhati, I. S., Pinto, I., Seneviratne, S. I., van den Hurk, B., and Vera, C. S.: An update of IPCC climate reference regions for subcontinental analysis of climate model data: definition and aggregated datasets, Earth System Science Data, 12, 2959–2970, https://doi.org/10.5194/essd-12-2959-2020, 2020.