

Redução das emissões para o atendimento dos padrões de qualidade do ar



Leonardo Hoinaski



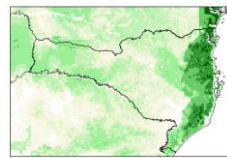
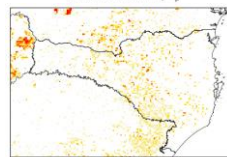
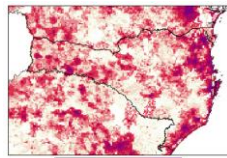
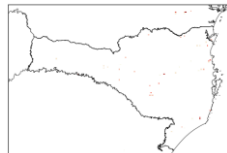
Como cheguei aqui?

- Professor Adjunto do Departamento de Engenharia Sanitária e Ambiental da Universidade Federal de Santa Catarina;
- Estudando poluição do atmosférica desde 2007;
- Interesse por modelagem da qualidade do ar, monitoramento da qualidade do ar e efeitos da poluição no meio ambiente;
- Desenvolvimento de bases de dados.



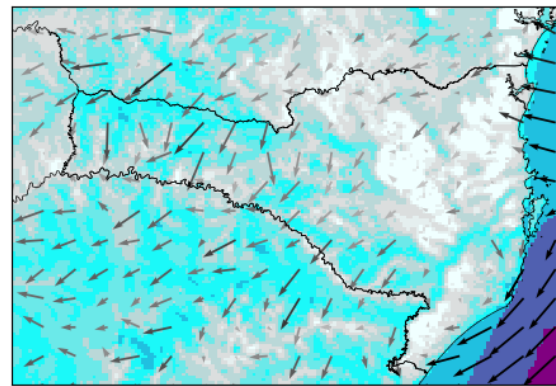
Projeto – Gestão da qualidade do ar em SC

Emissões



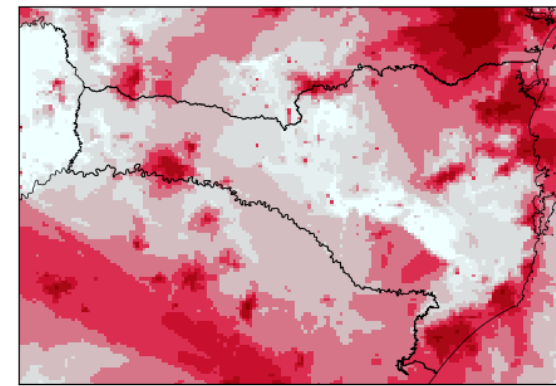
Modelos de emissão

Meteorologia



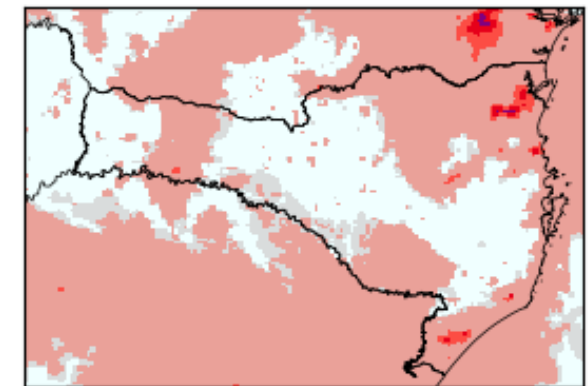
Modelo meteorológico

Qualidade do ar



Modelo de qualidade do ar

Avaliação do impacto



Análise de risco



GOVERNO DE SANTA CATARINA

Secretaria do Desenvolvimento Econômico Sustentável

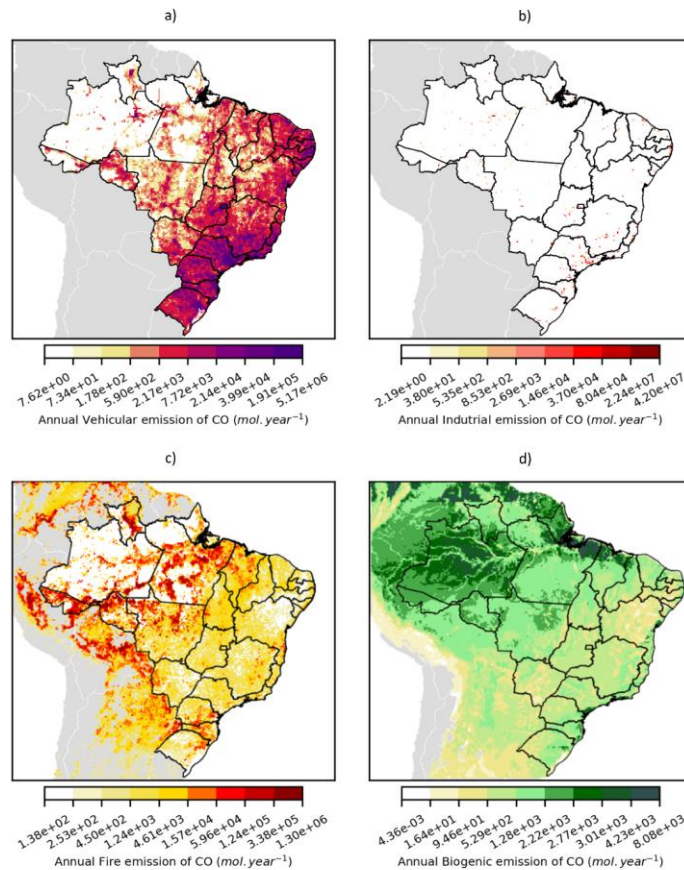


FAPESC

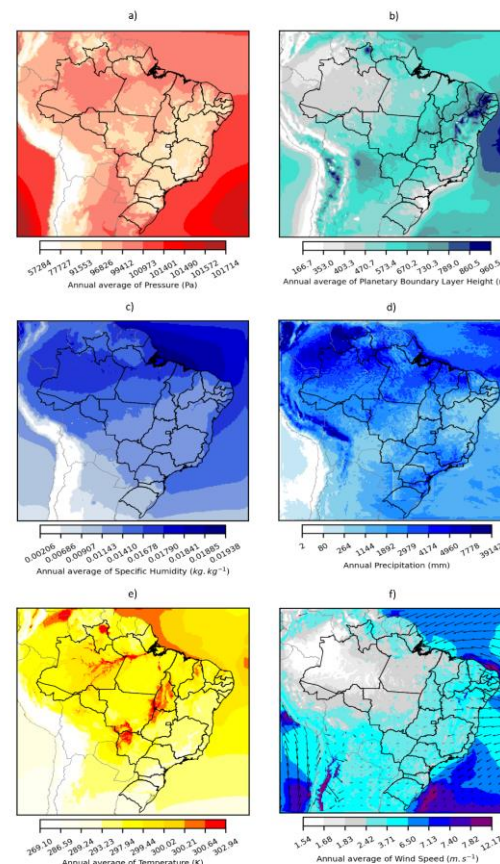
FUNDAÇÃO DE AMPARO À PESQUISA E INOVAÇÃO DO ESTADO DE SANTA CATARINA

BRAIN – Brazilian Atmospheric Inventories

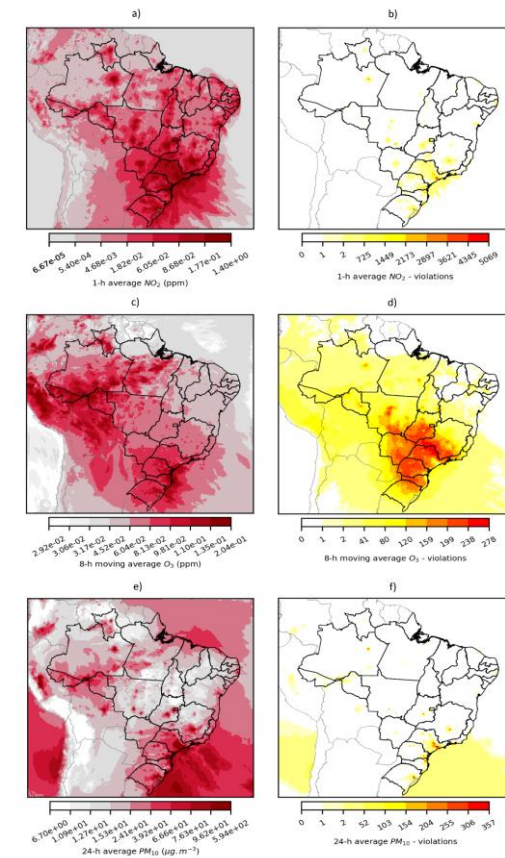
Emissões



Meteorologia



Qualidade do ar



BRAIN – Brazilian Atmospheric Inventories

Earth System Science Data

ARTICLES & PREPRINTS ▾ SUBMISSION POLICIES ▾ PEER REVIEW ▾ LIVING DATA PROCESS EDITORIAL BOARD ABOUT ▾ ↗

Preprint

Preprints / Preprint [essd-2023-305](https://doi.org/10.5194/essd-2023-305)

<https://doi.org/10.5194/essd-2023-305>
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Abstract Assets Discussion Metrics

05 Oct 2023

Status: a revised version of this preprint is currently under review for the journal *ESSD*.

Brazilian Atmospheric Inventories – BRAIN: A comprehensive database of air quality in Brazil

Leonardo Hoinaski ✉, Robson Will, and Camilo Bastos Ribeiro

a) Annual Vehicular emission of CO (mol. year⁻¹)

b) Average NO₂ - violations

c) Annual Fire emission of CO (mol. year⁻¹)

d) Average O₃ - violations

e) Annual average of Temperature (K)

f) Annual average of Wind Speed (m. s⁻¹)

g) 24-h average PM₁₀ (µg. m⁻³)

h) 24-h average PM₁₀ - violations

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- Preprint (2772 KB)
- Metadata XML
- Supplement (38300 KB)
- BibTeX
- EndNote

Short summary

We introduce the Brazilian Atmospheric Inventories – BRAIN, the first comprehensive database for...

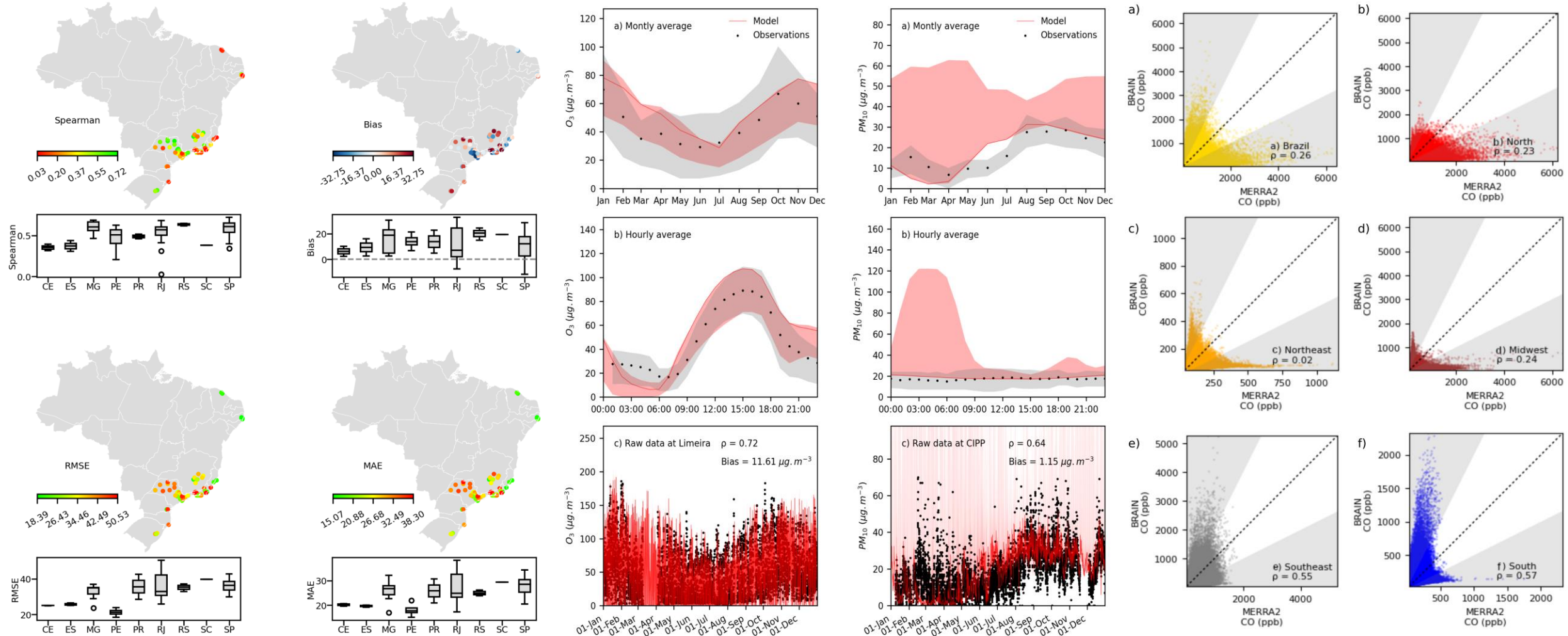


Secretaria do Desenvolvimento Econômico Sustentável



Qual a qualidade destes dados?

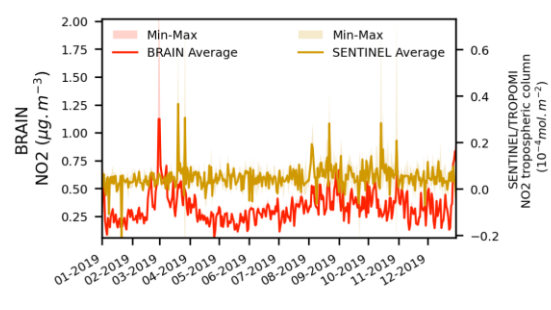
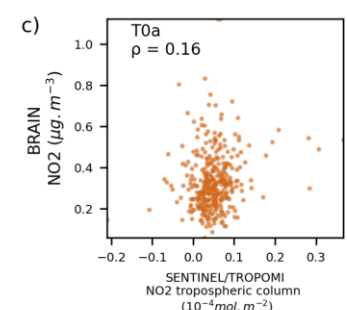
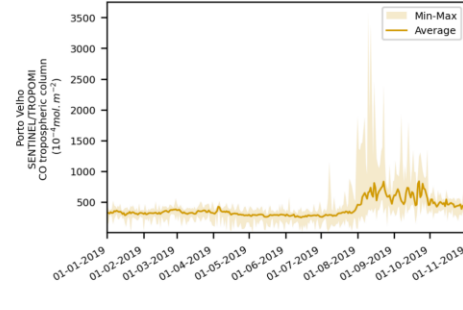
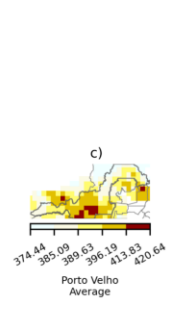
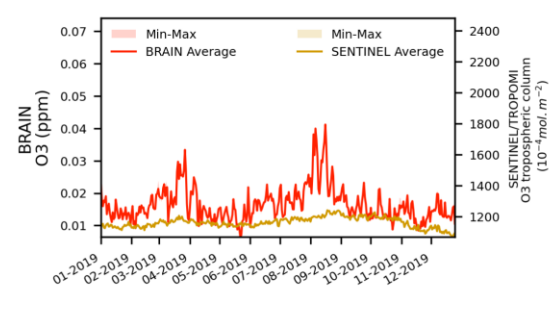
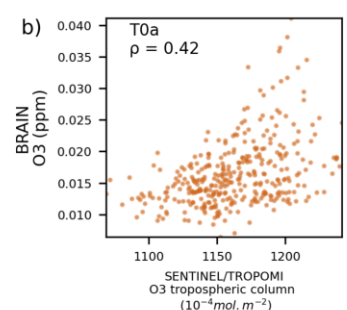
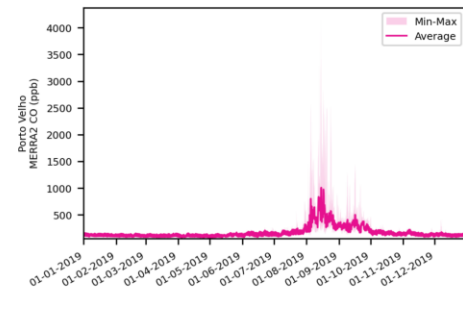
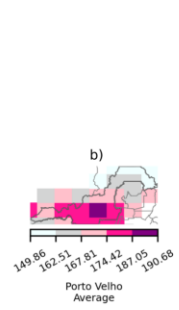
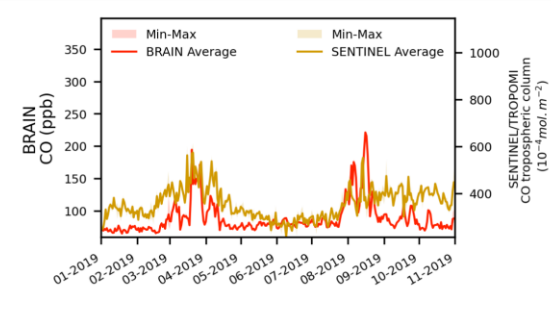
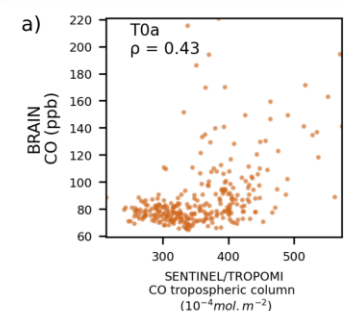
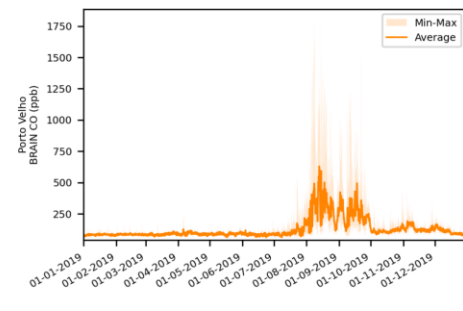
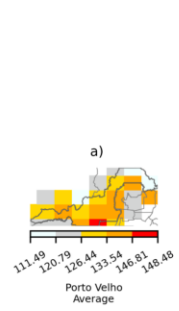
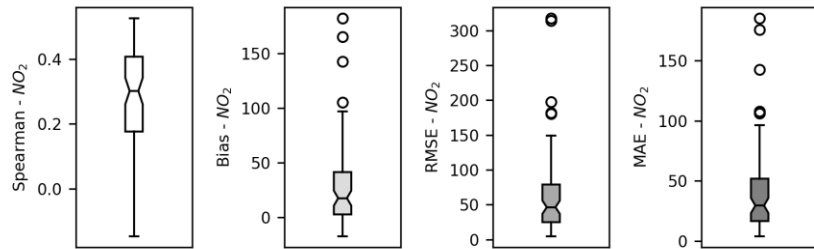
Performance do BRAIN



Performance do BRAIN

Desempenho em locais onde a queima de biomassa é dominante;

Desempenho em áreas preservadas.



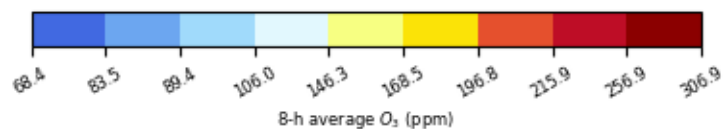
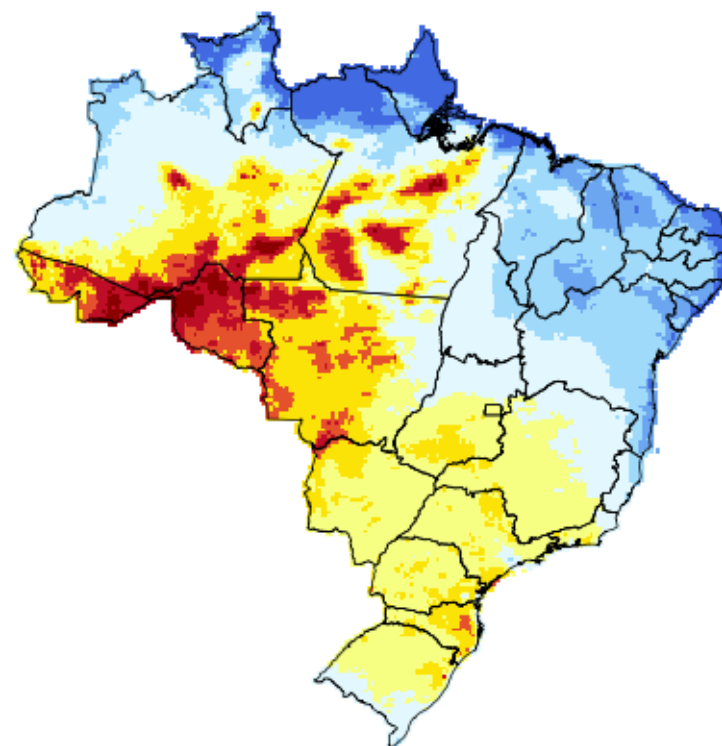
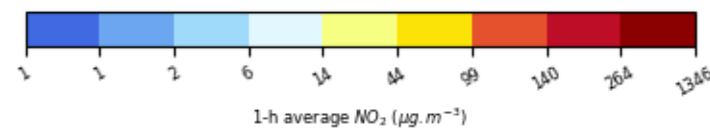
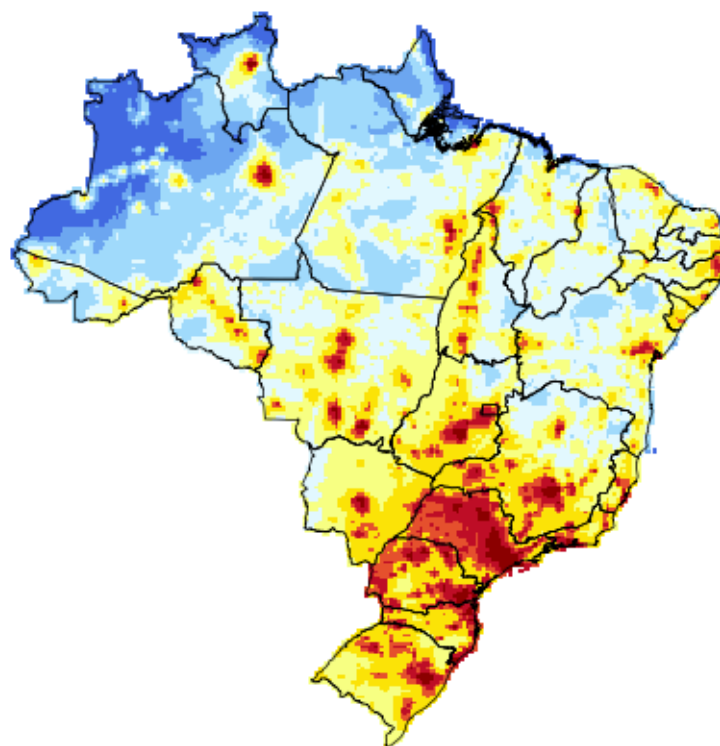
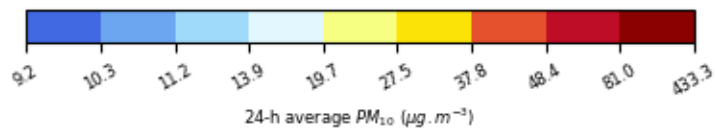
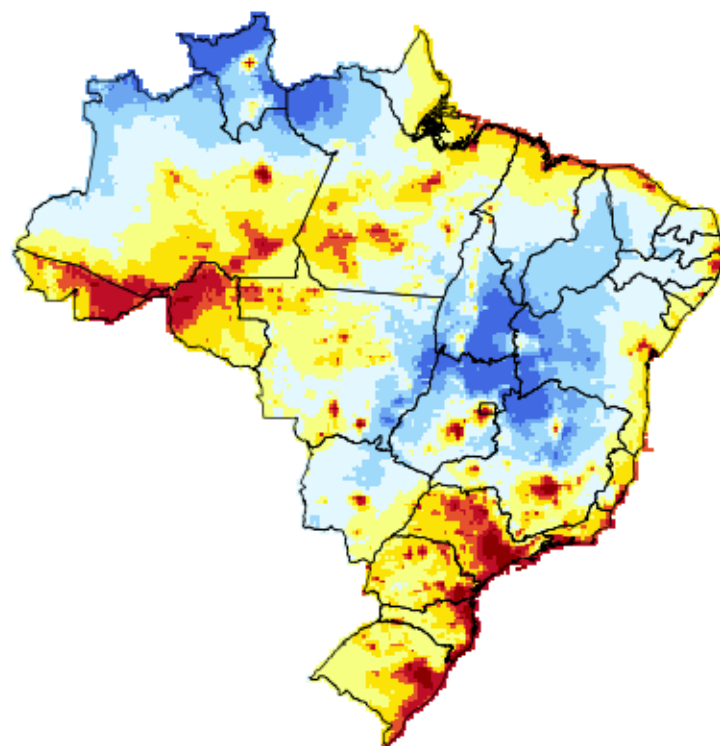
O que podemos fazer com o BRAIN?

- Preenche lacunas de monitoramento da qualidade do ar;
- Fornece dados de emissão para averiguar o efeito na qualidade do ar;
- Dados com a mesma resolução espacial e temporal;
- Formulação de políticas públicas em todo Brasil.

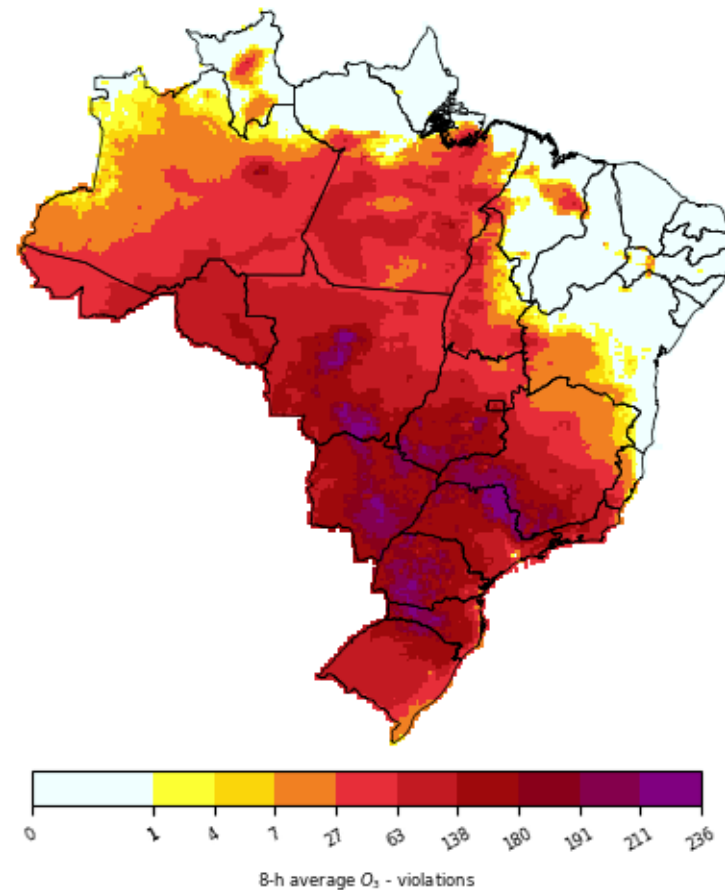
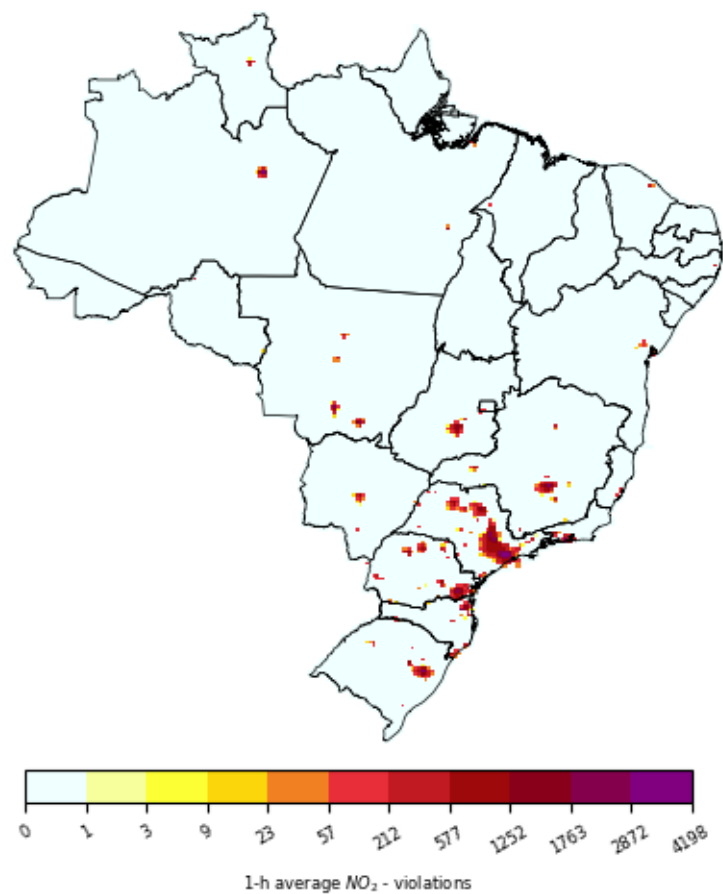
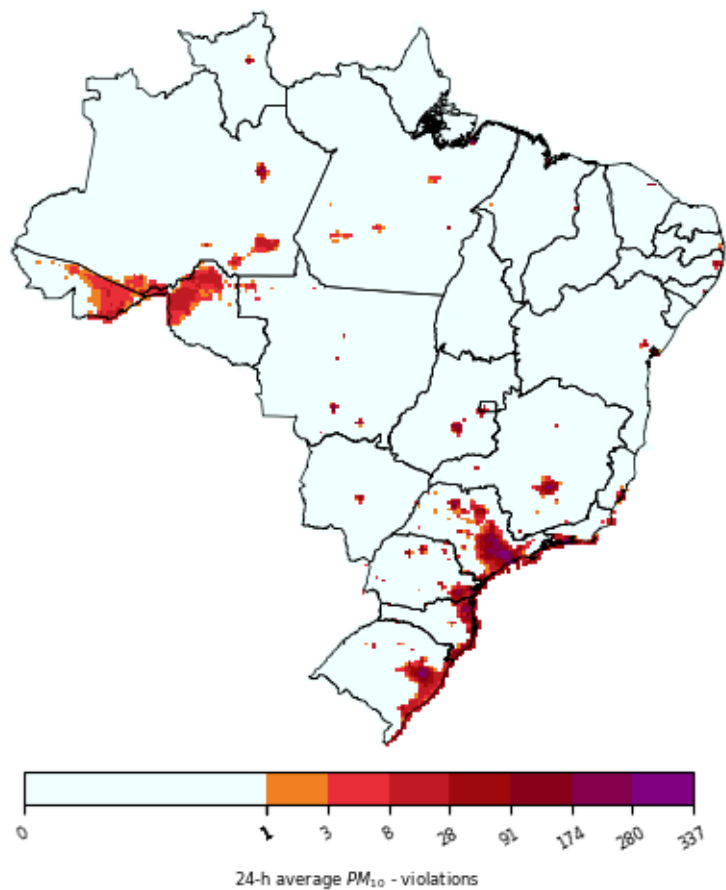
Pergunta de 1 milhão

Qual a redução das emissões necessária para atender os padrões de qualidade do ar?

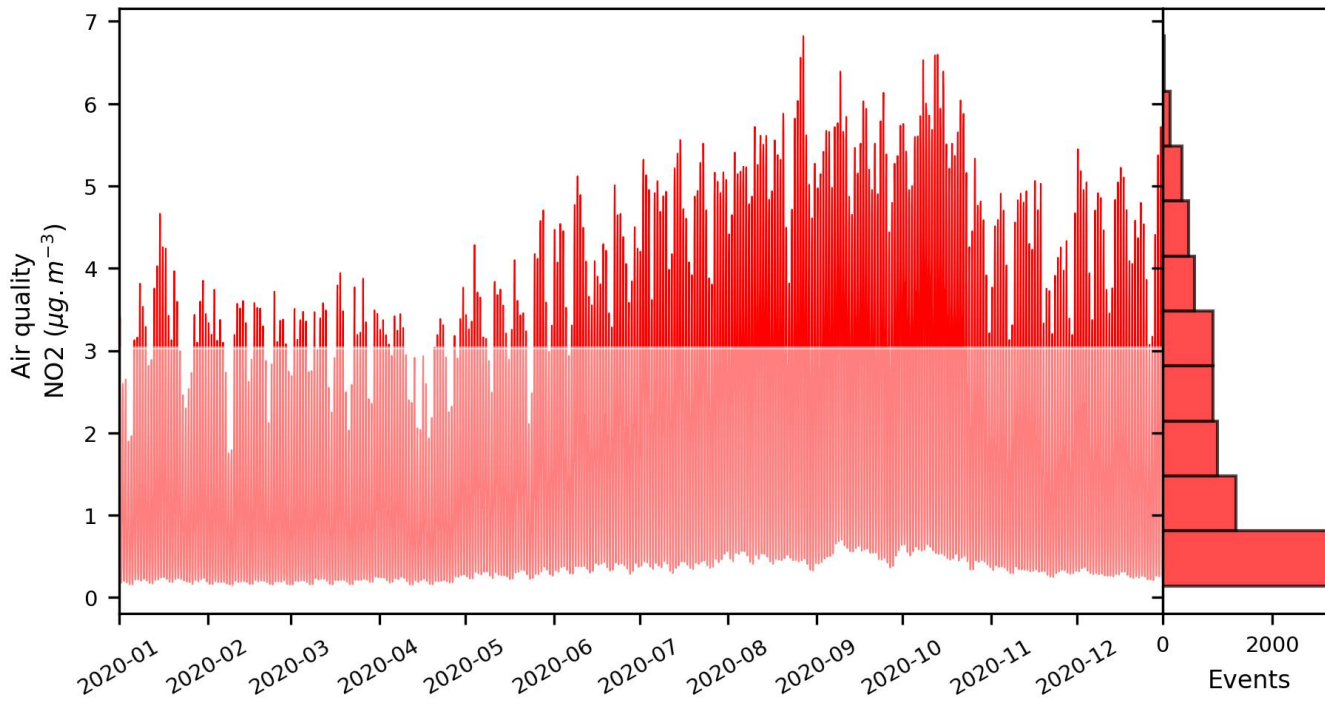
Cenário atual



Cenário atual

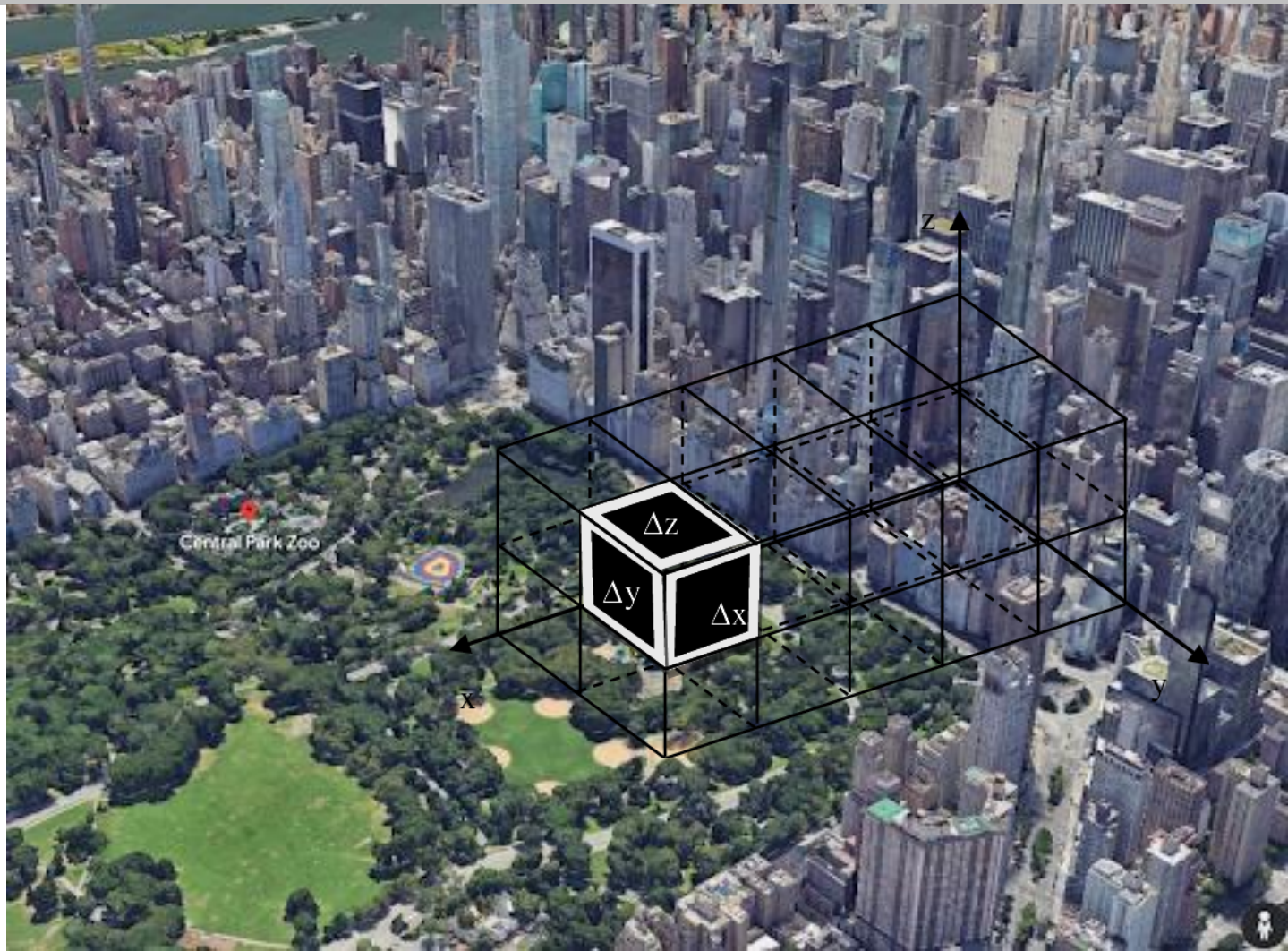
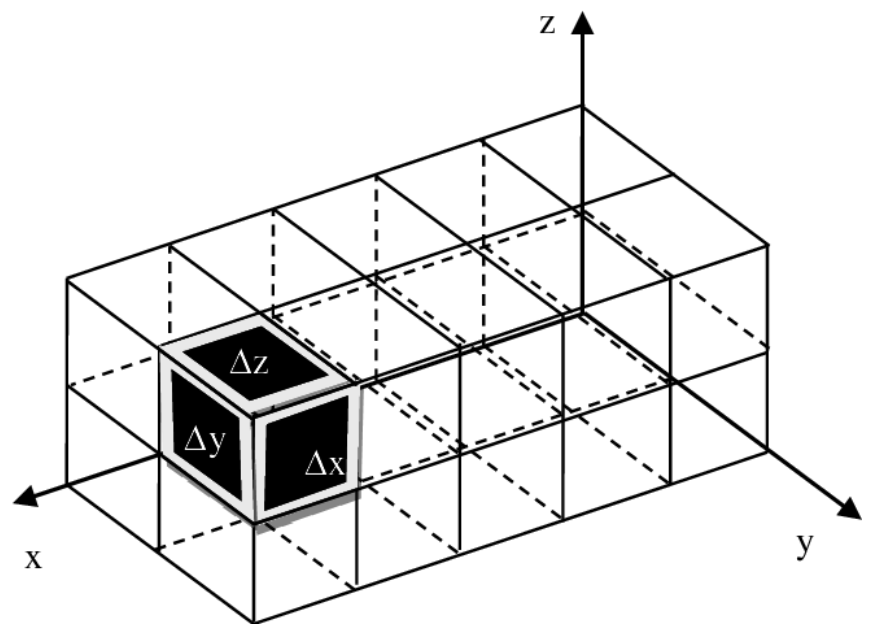


Seleção de eventos críticos

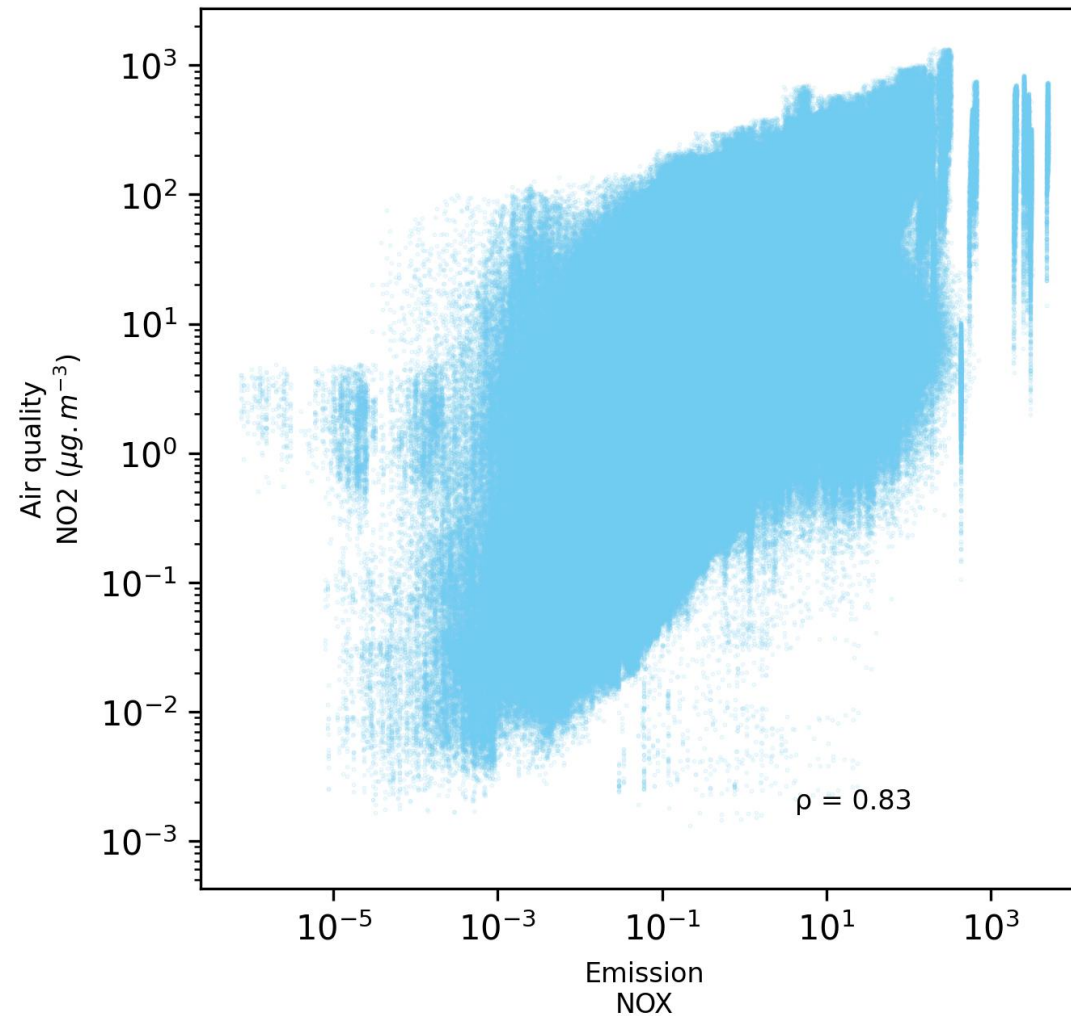


- Removendo 1% das maiores concentrações
- Selecionando dados dentro do Brasil
- Média do domínio em cada hora/8horas/dia
- Seleção de 25% maiores eventos

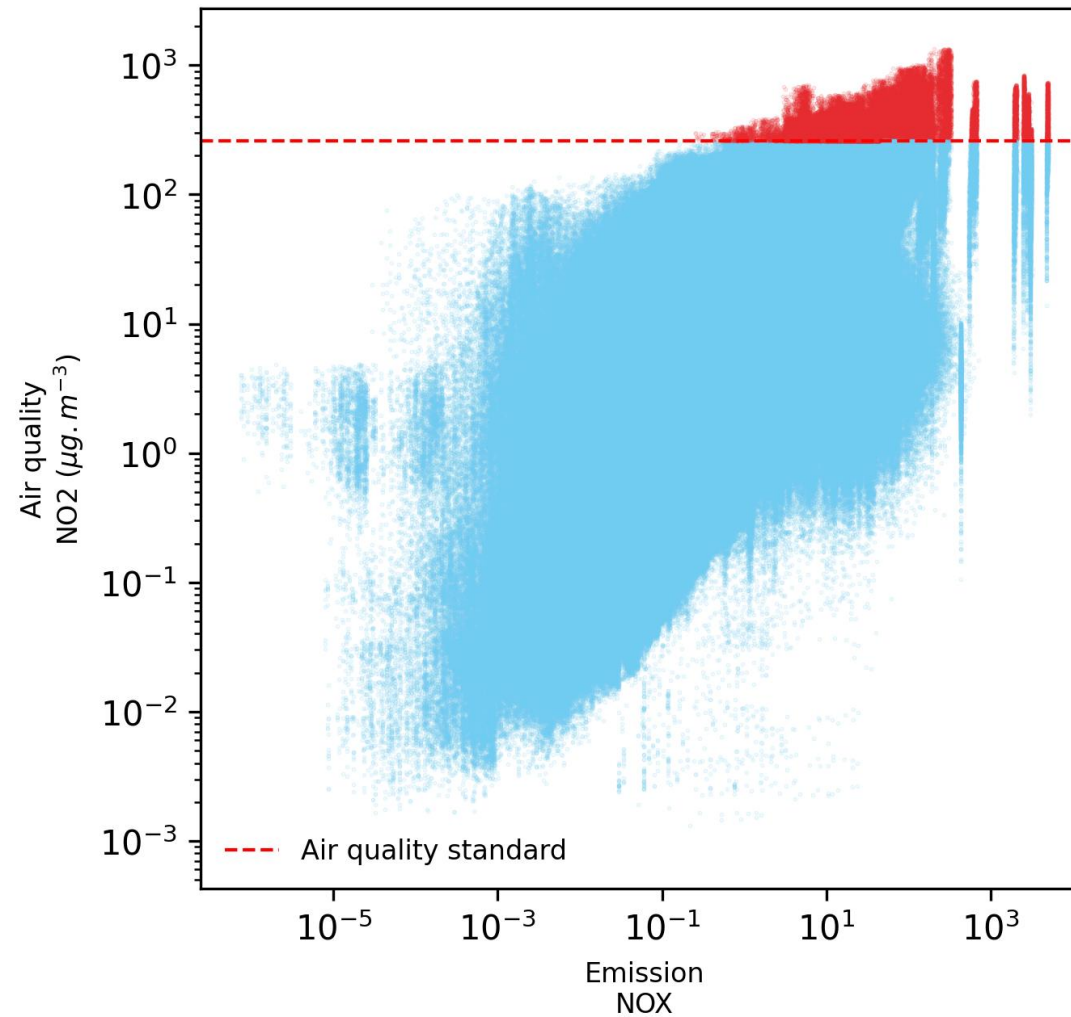
Análise por pixel



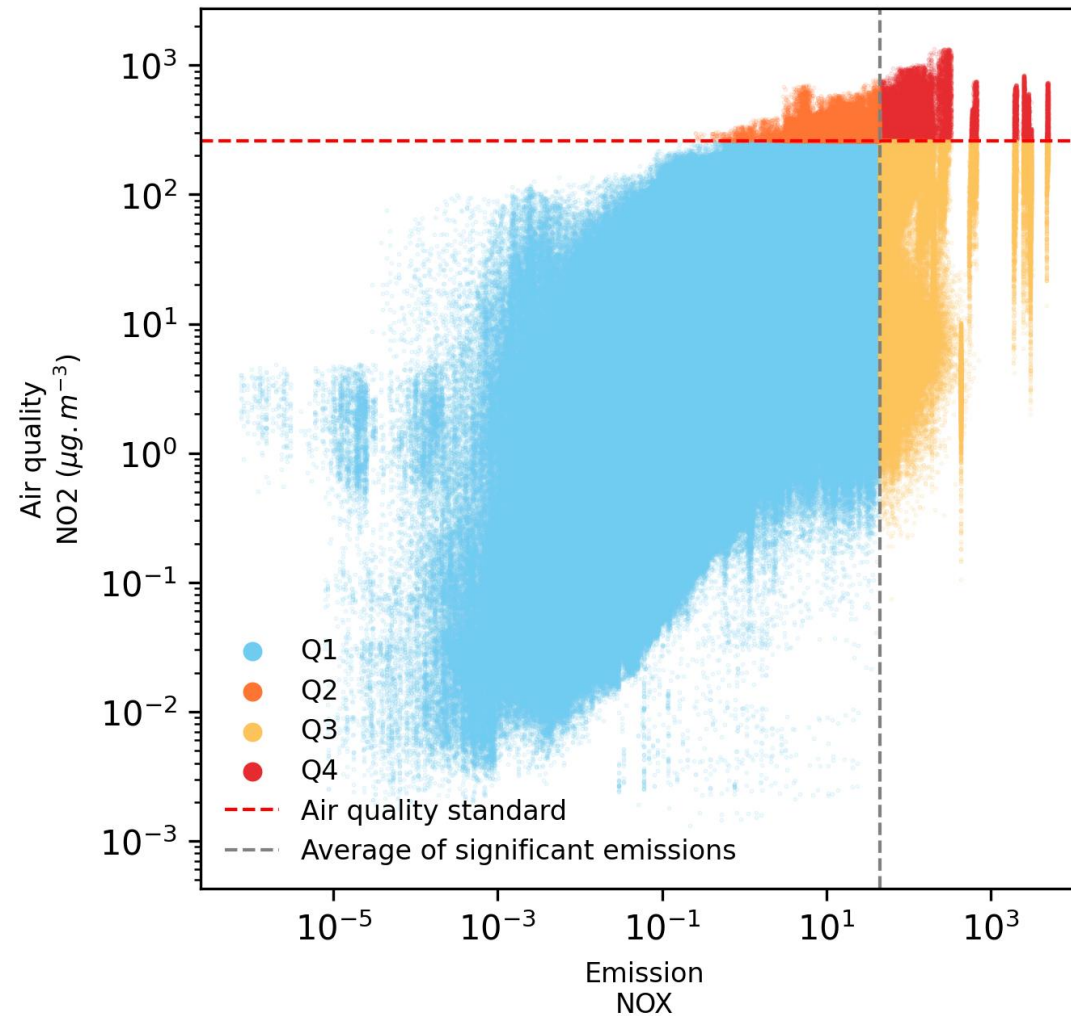
Categorização dos dados



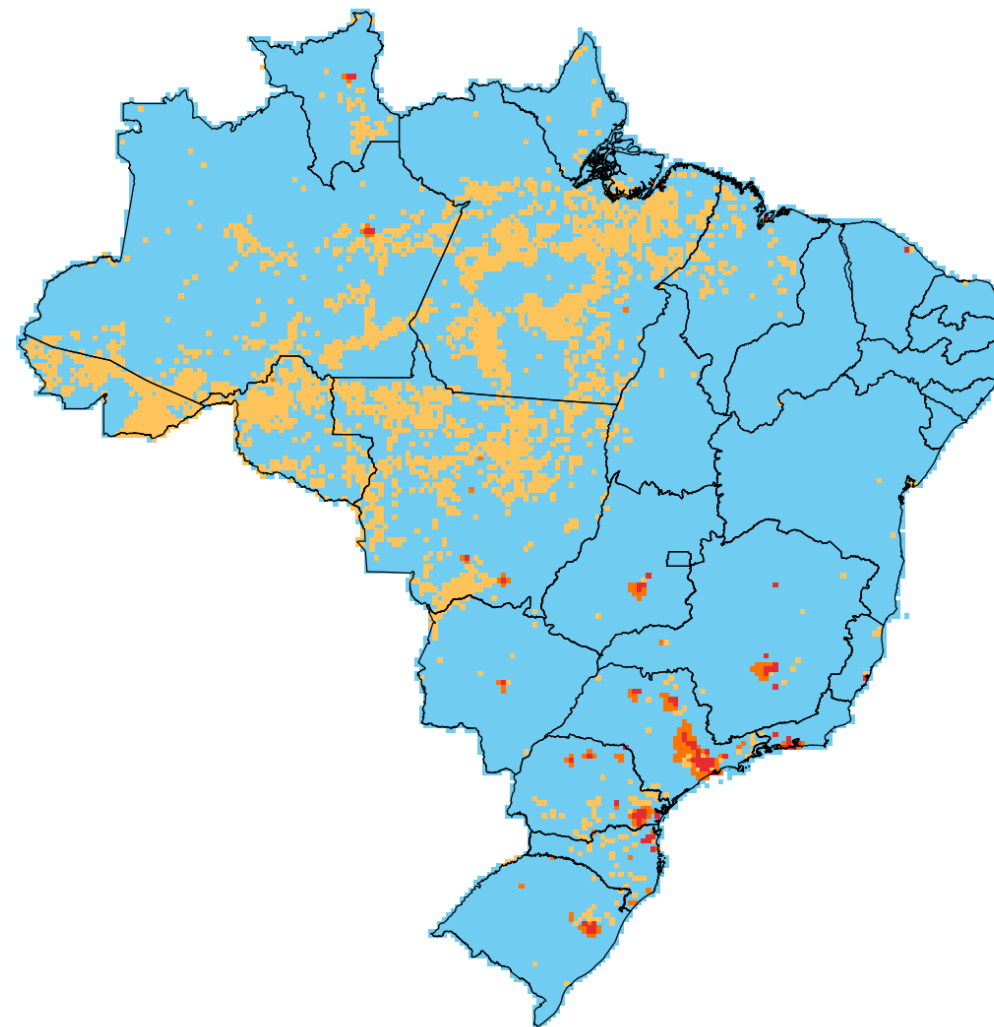
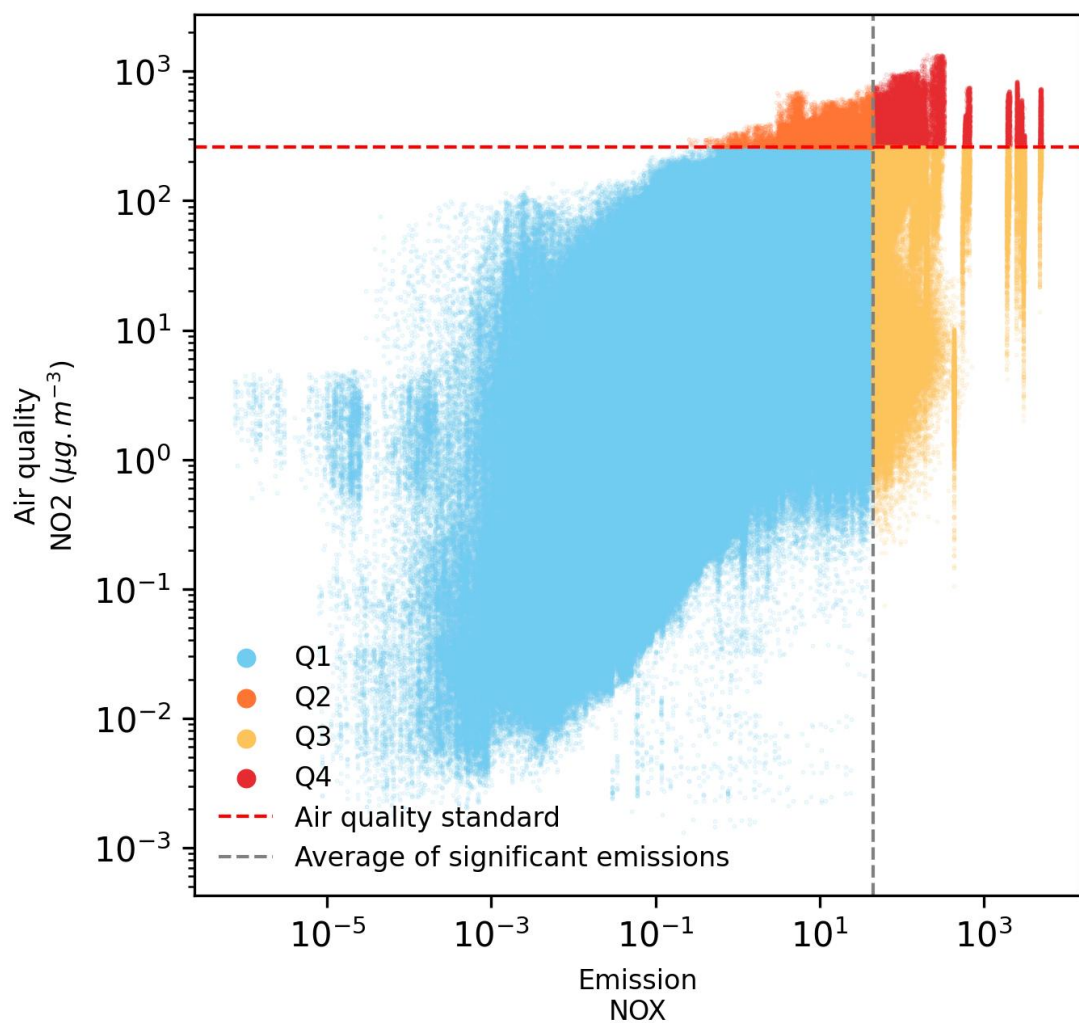
Categorização dos dados



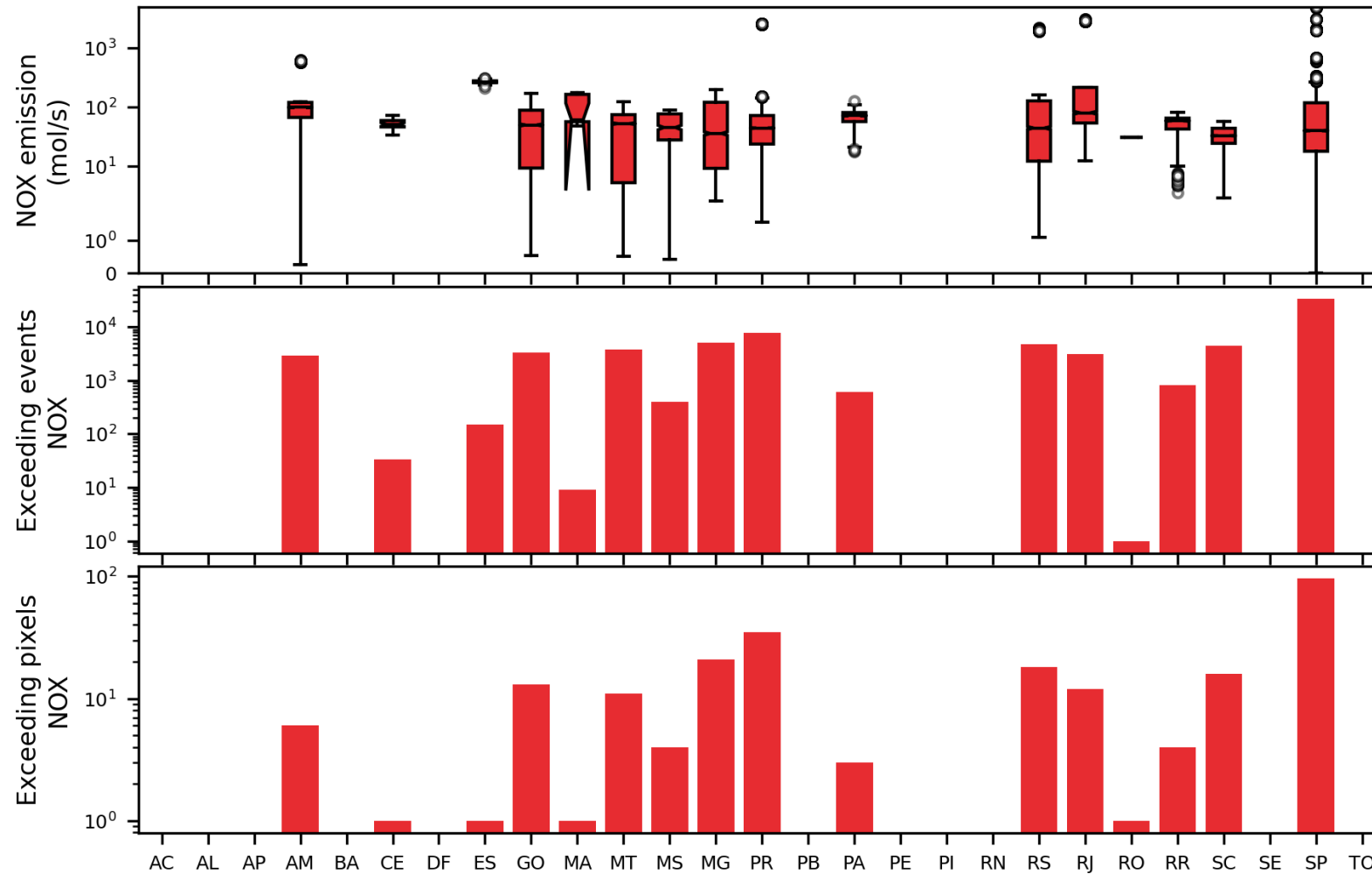
Categorização dos dados



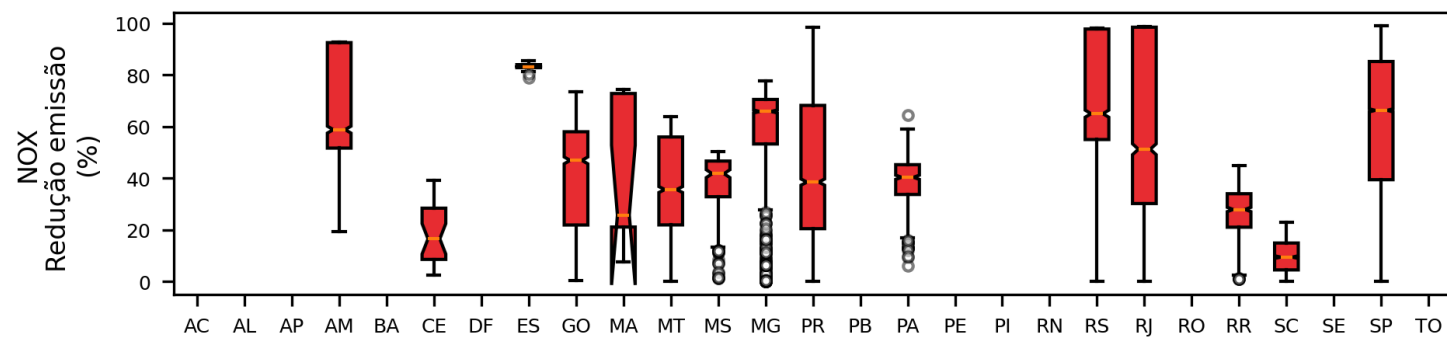
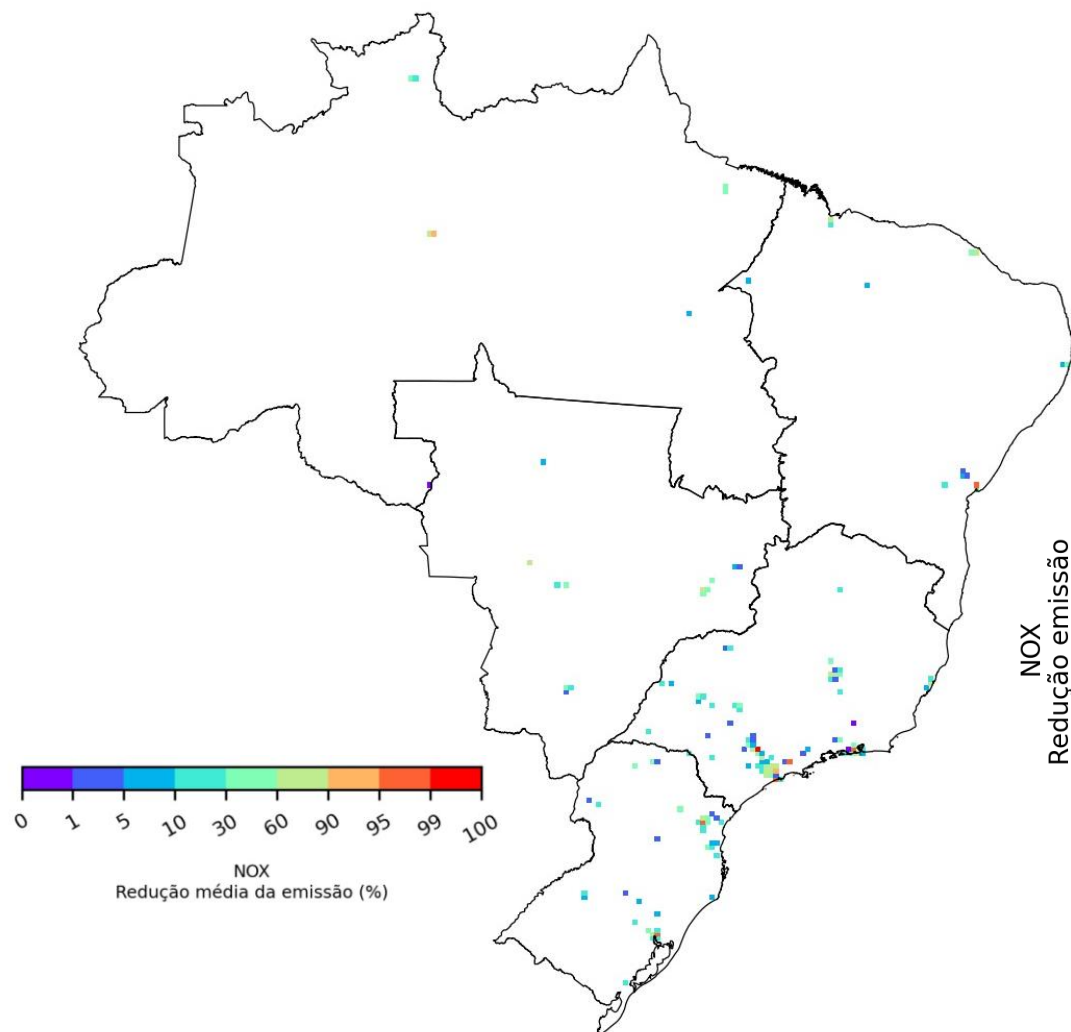
Categorização das áreas



Análise das áreas críticas

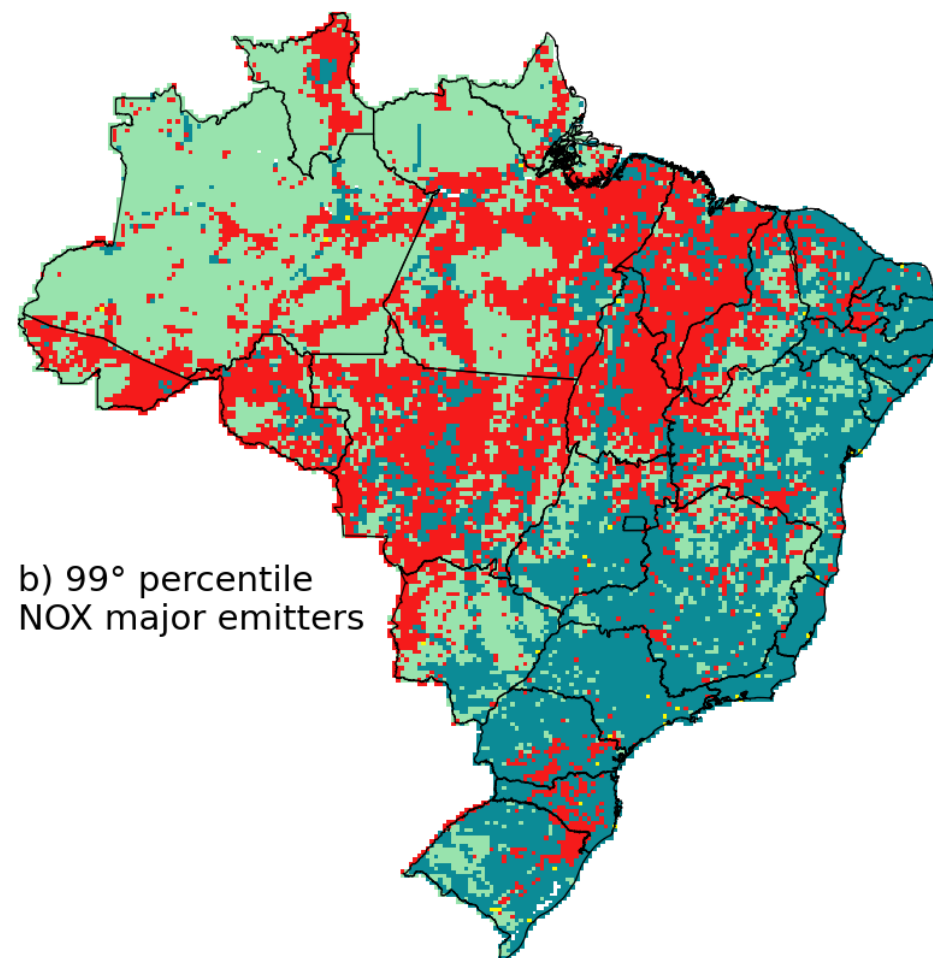
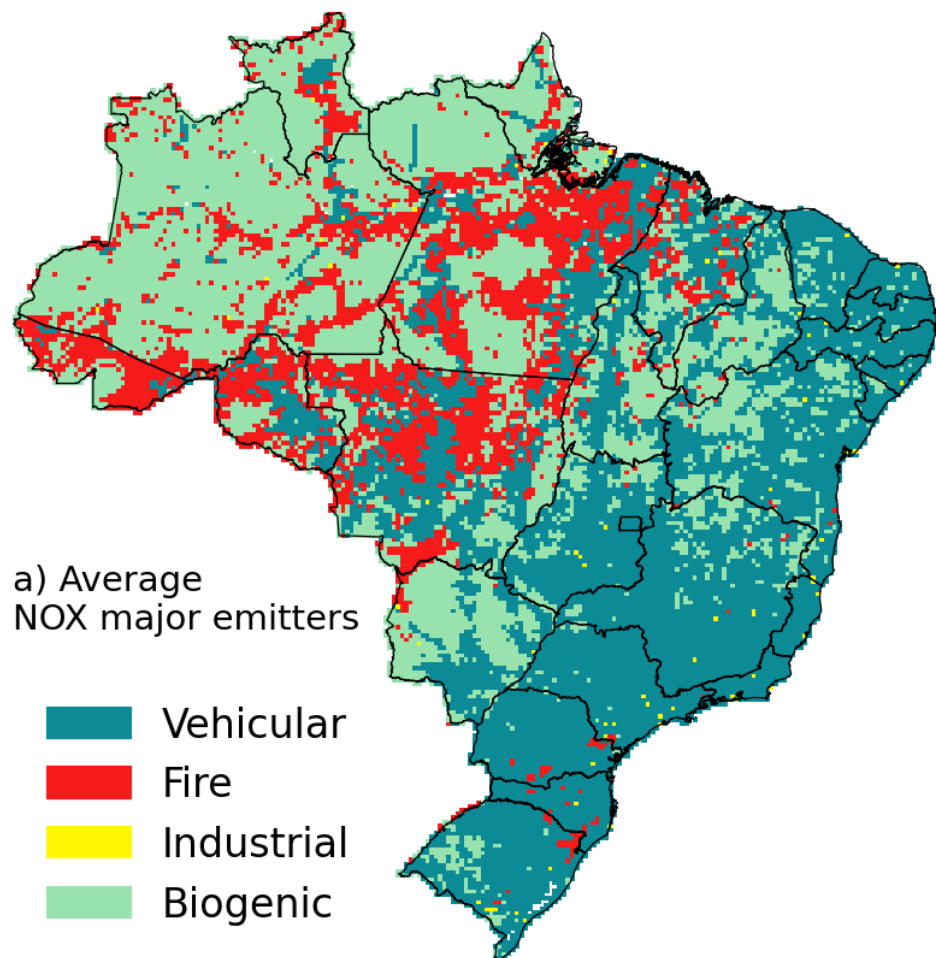


Redução das emissões nas áreas críticas

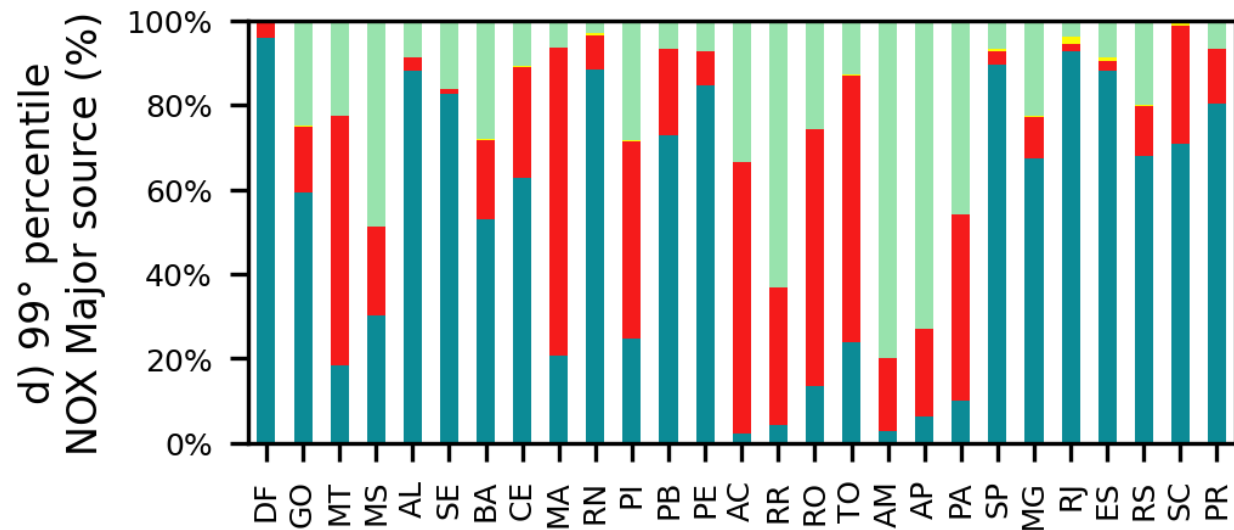
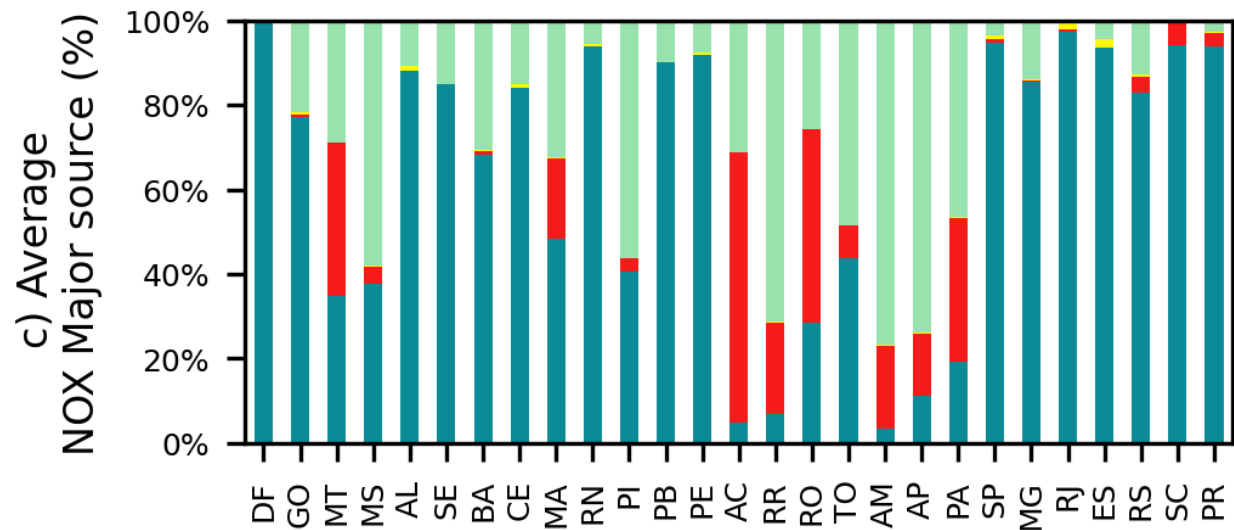


Identificação do problema

Principais emissores



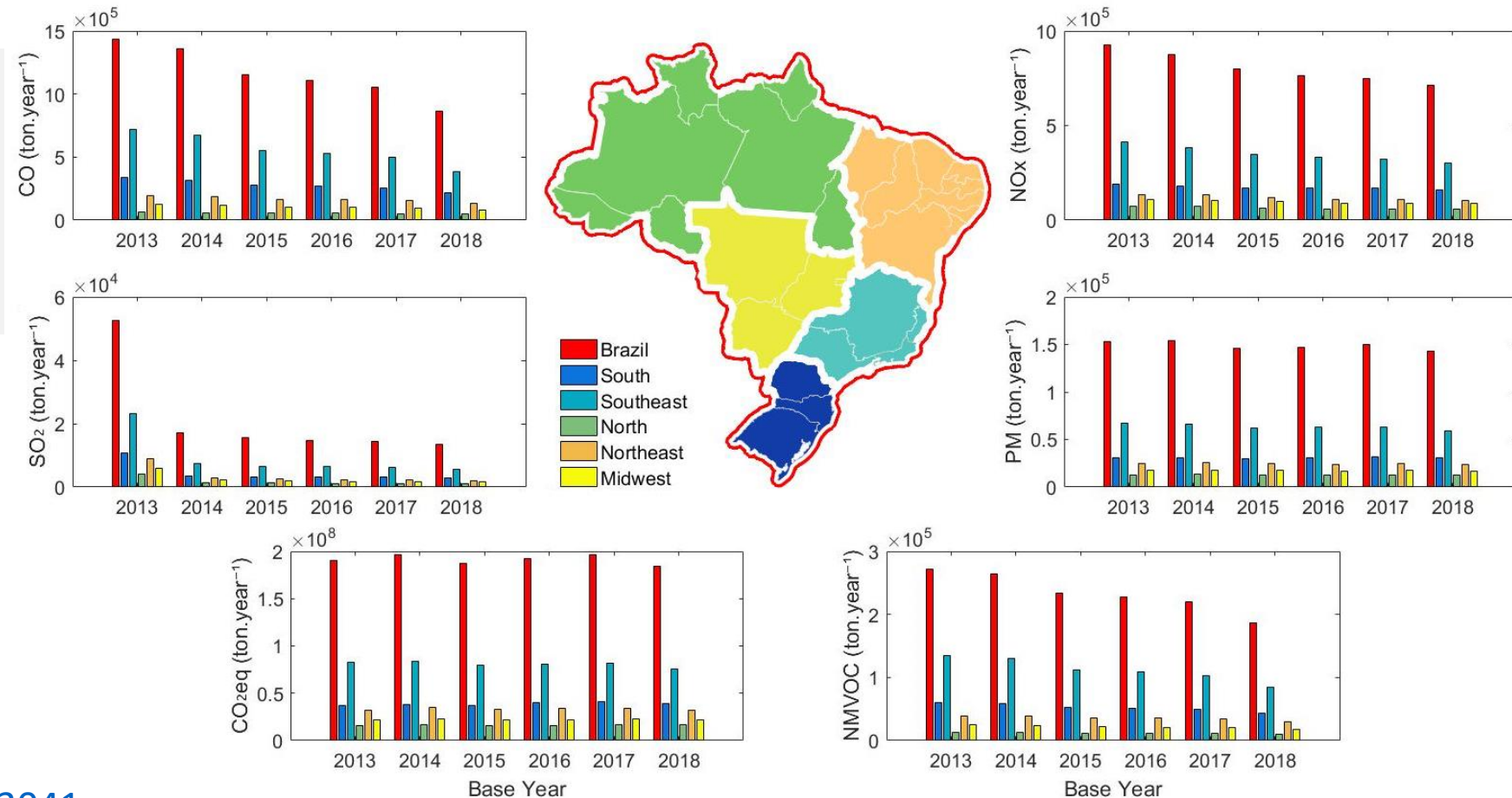
Principais emissores



Quais medidas devemos tomar?

Mitigação das emissões veiculares

Redução das emissões observadas em todos os estados, para a maioria dos poluentes.



Transportation Research Part D 100 (2021) 103041

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Brazilian vehicular emission inventory software – BRAVES

Thiago Vieira Vasques^a, Leonardo Hoinaski^{b,*}

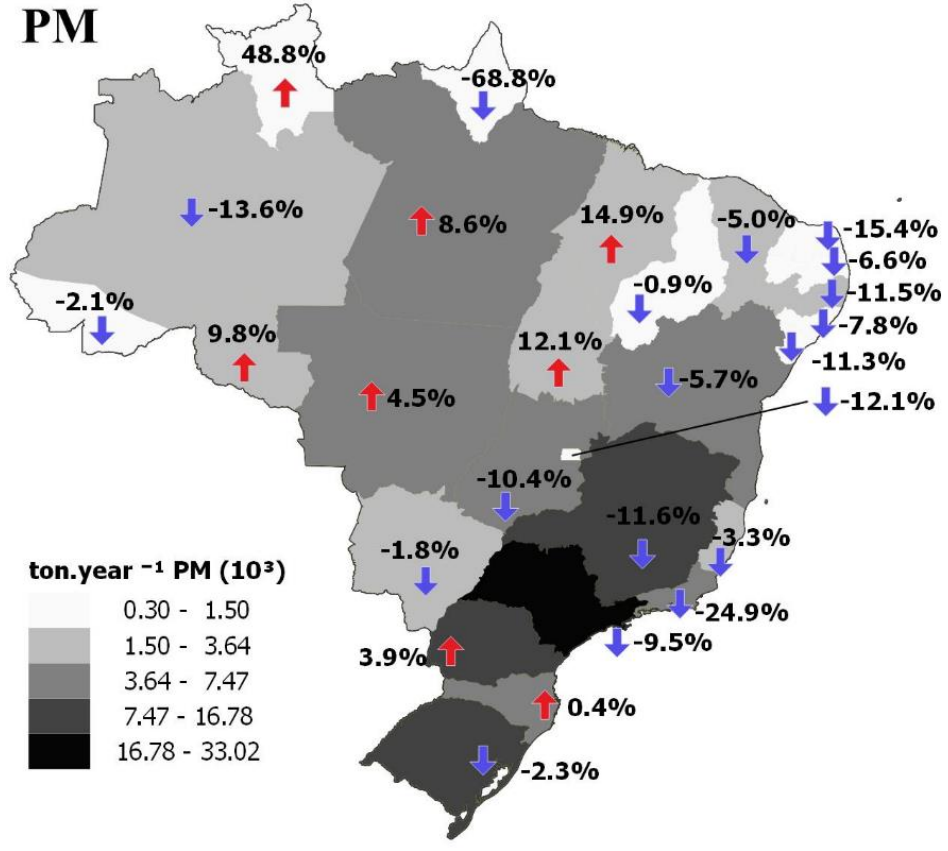
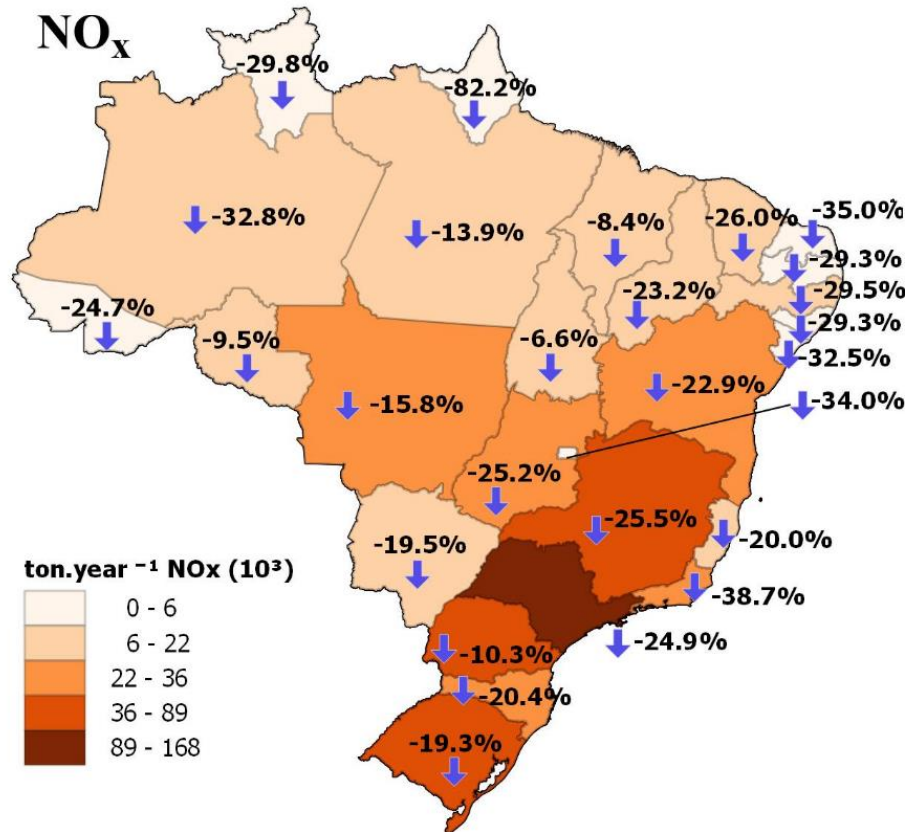
^a Postgraduate Program in Environmental Engineering, Federal University of Santa Catarina, Florianópolis, Santa Catarina, Brazil
^b Department of Sanitary and Environmental Engineering, Federal University of Santa Catarina, Florianópolis, Santa Catarina, Brazil

<https://doi.org/10.1016/j.trd.2021.103041>

Mitigação das emissões veiculares



Redução entre 2013 e 2018;
Melhoria da tecnologia;
Material particulado é dominado pela ressuspensão do solo.



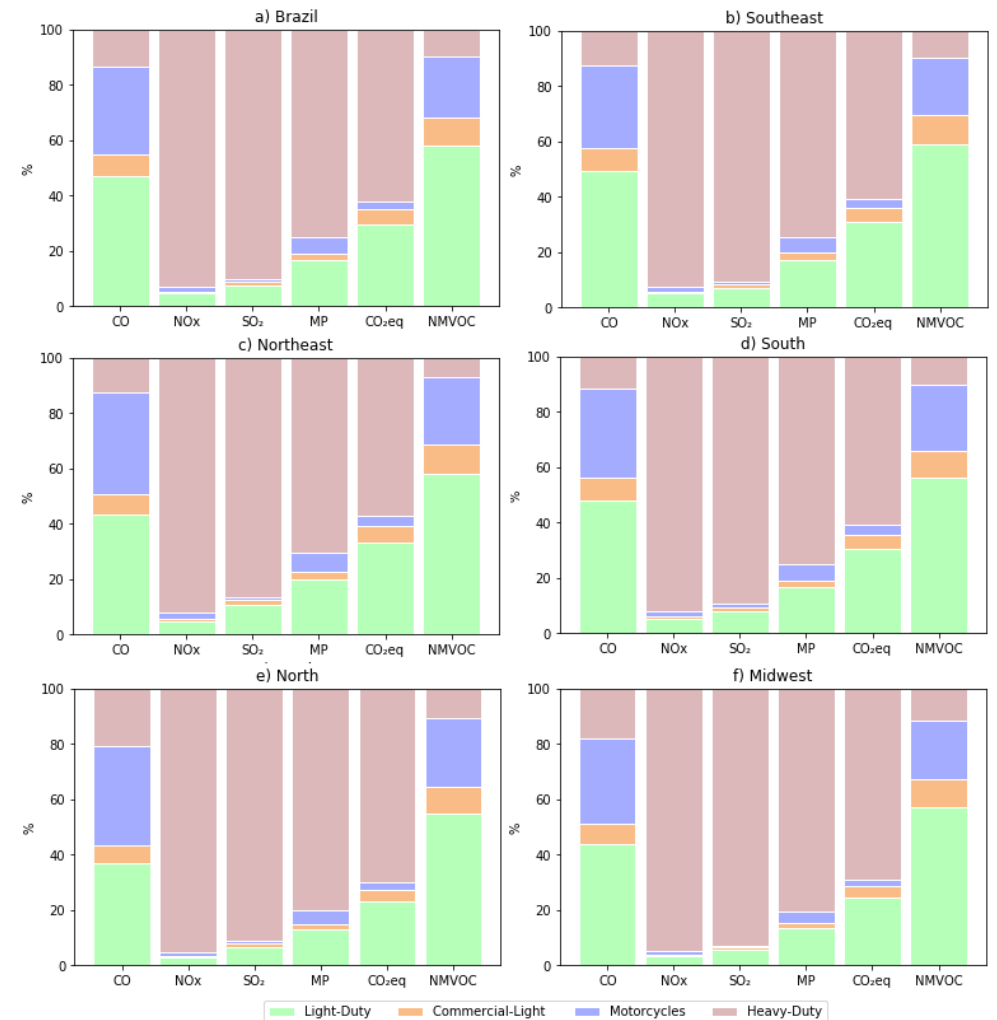
Mitigação das emissões veiculares



Veículos pesados dominam a emissão de NOx, SOx e PM10;

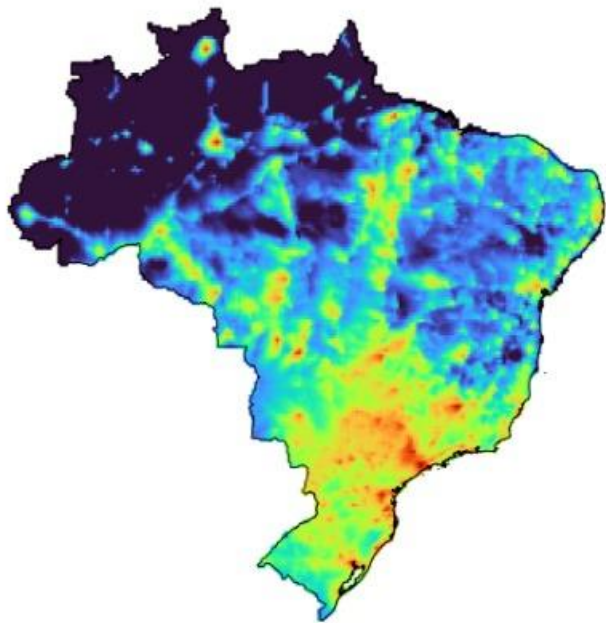
Veículos leves dominam as emissões de NMVOC e CO;

Perfil semelhante nas regiões.

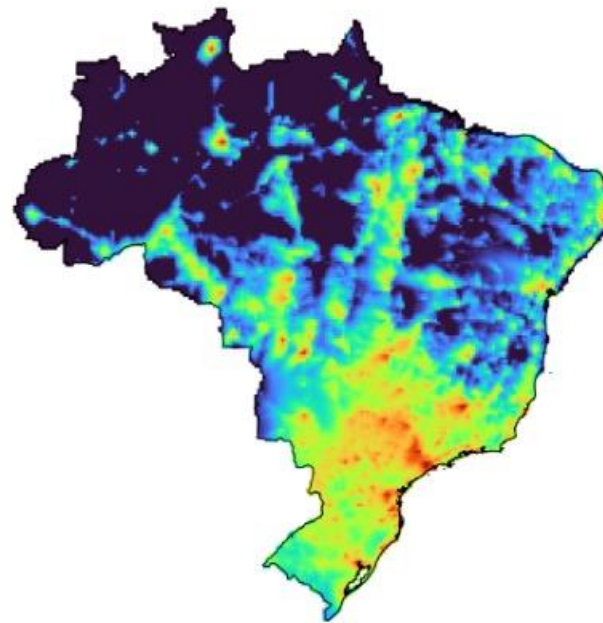


Mitigação das emissões veiculares – Simulações NO₂

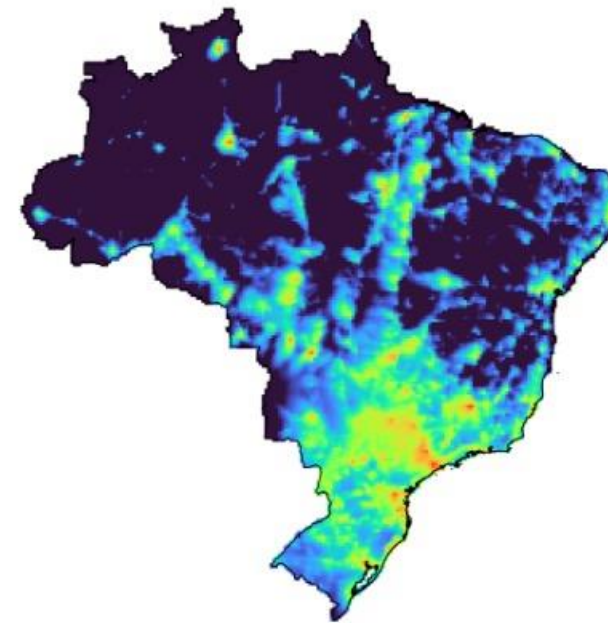
(a) baseline



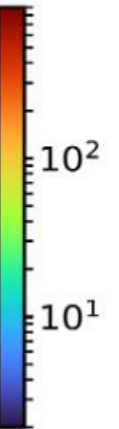
(b) vehicular



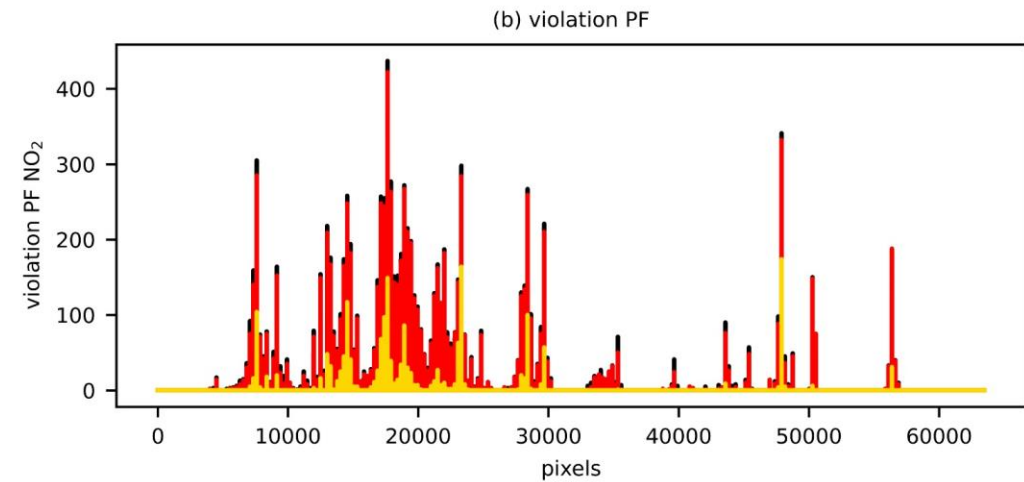
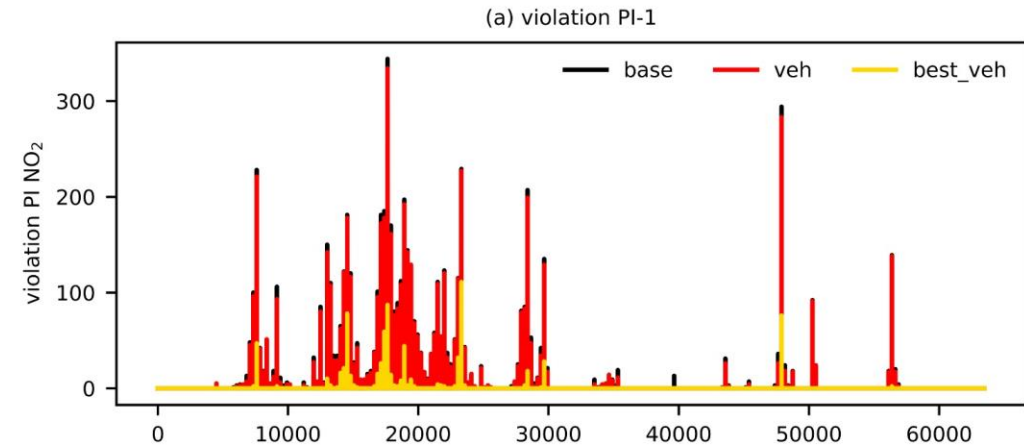
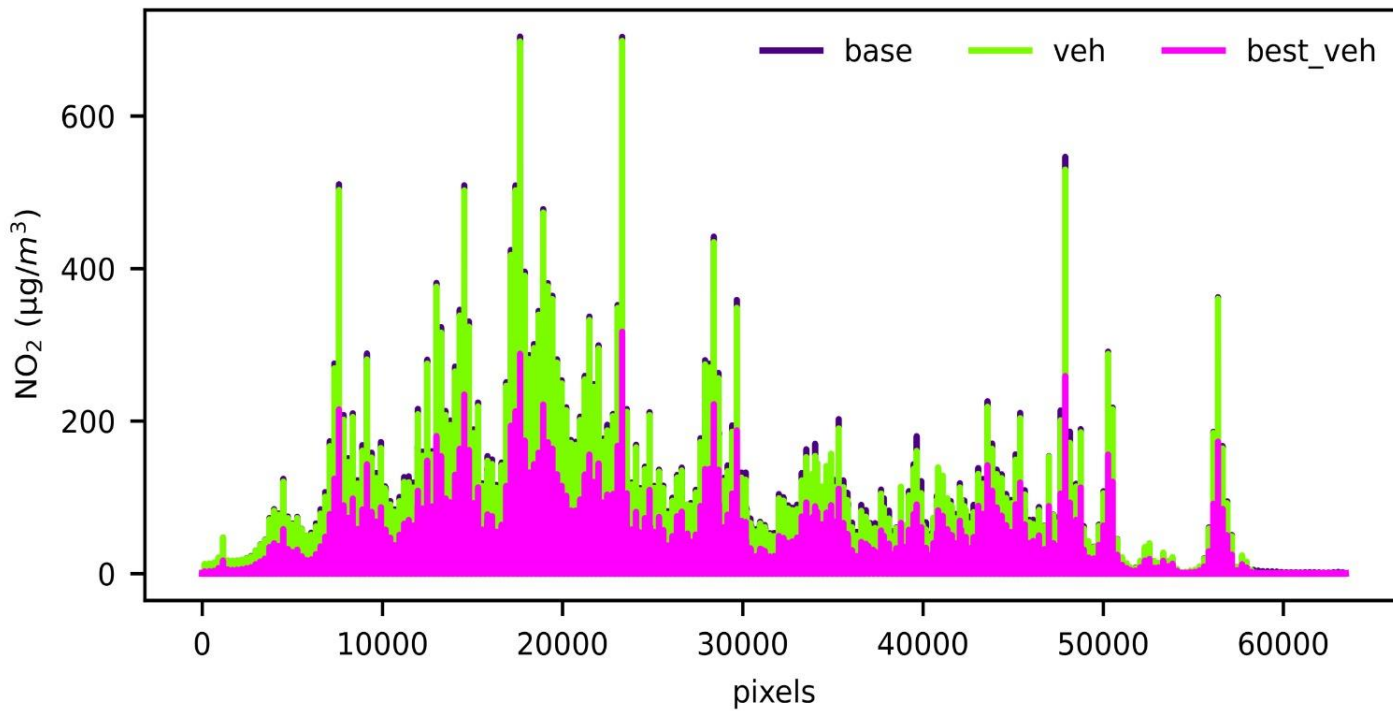
(c) best vehicular



NO₂ ($\mu\text{g}/\text{m}^3$)



Mitigação das emissões veiculares – Simulações NO₂



Mitigação das emissões veiculares – Simulações O₃

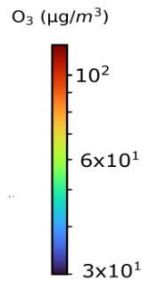
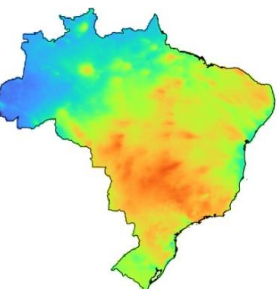
(a) baseline



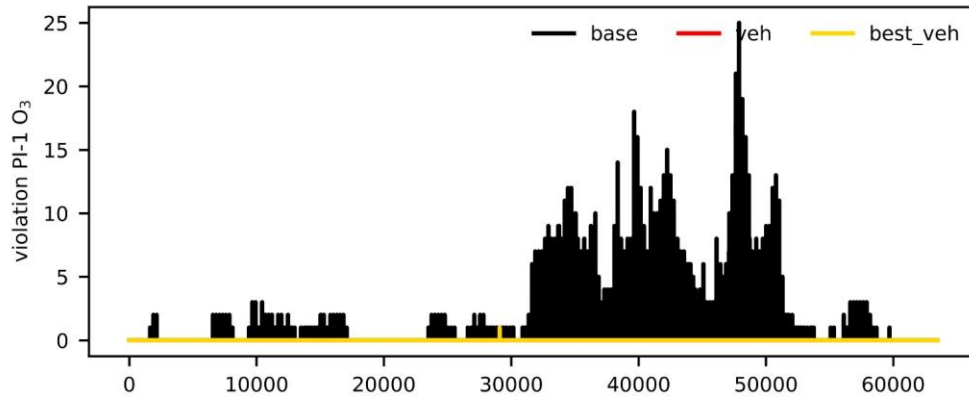
(b) vehicular



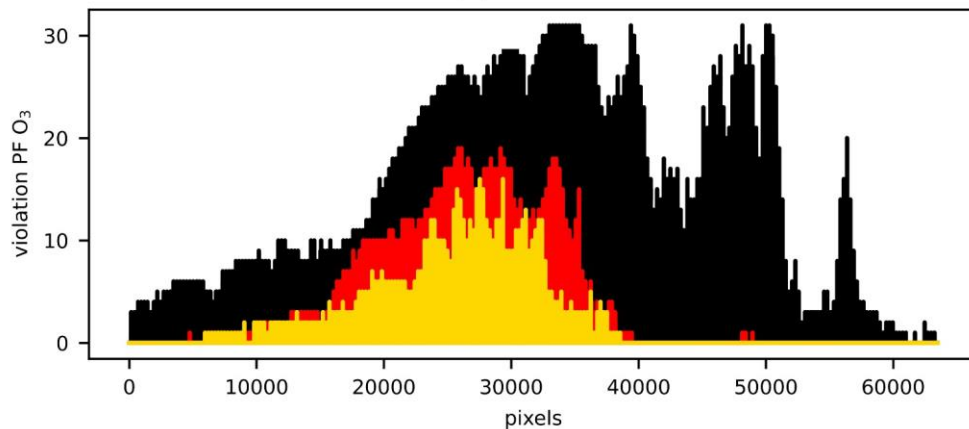
(c) best vehicular



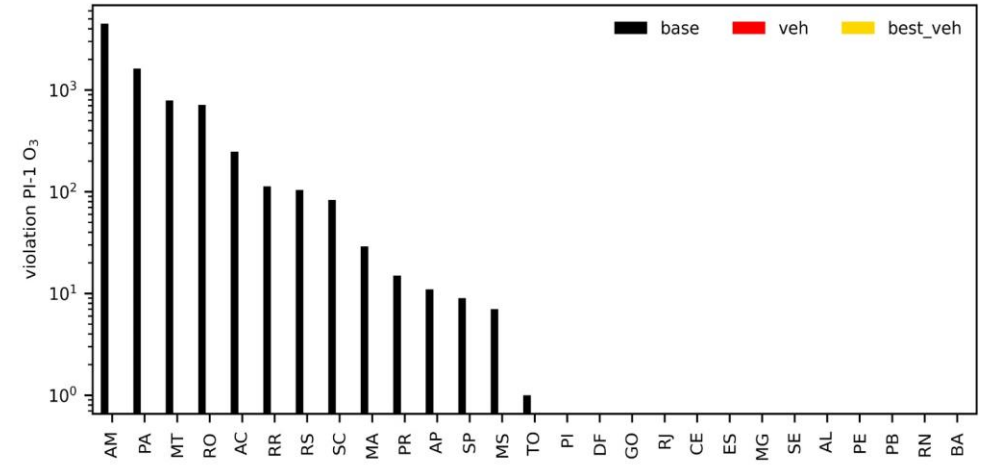
(a) violation PI-1



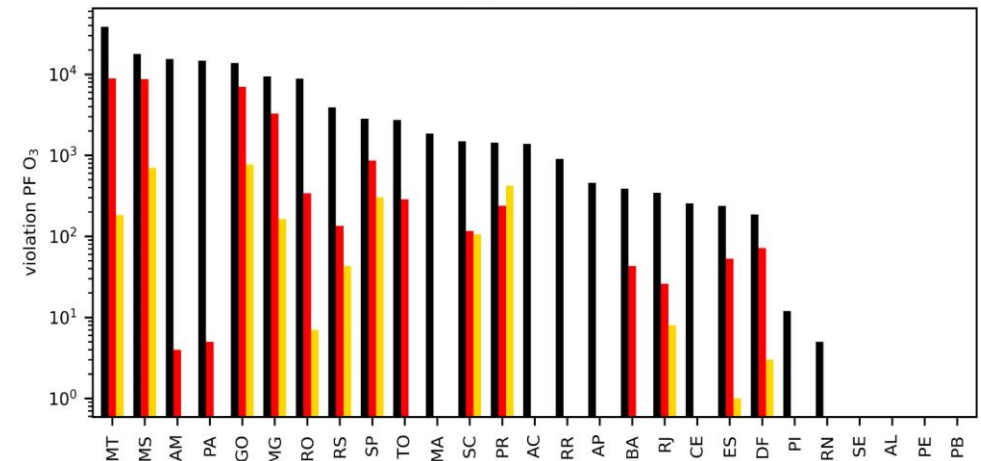
(b) violation PF



(a) violation PI-1



(b) violation PF

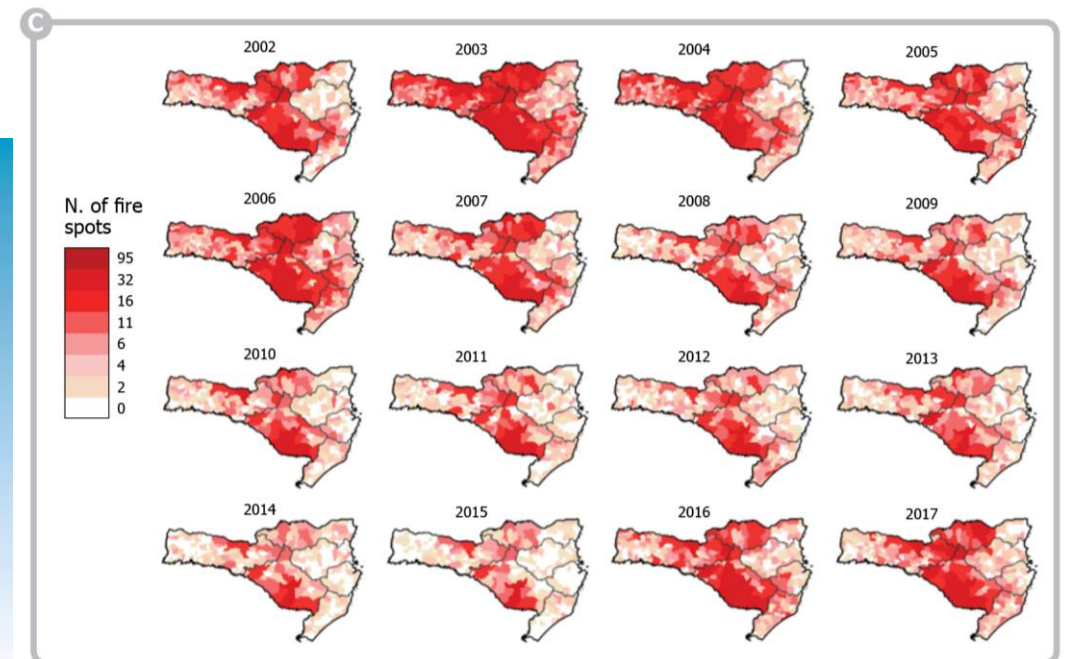
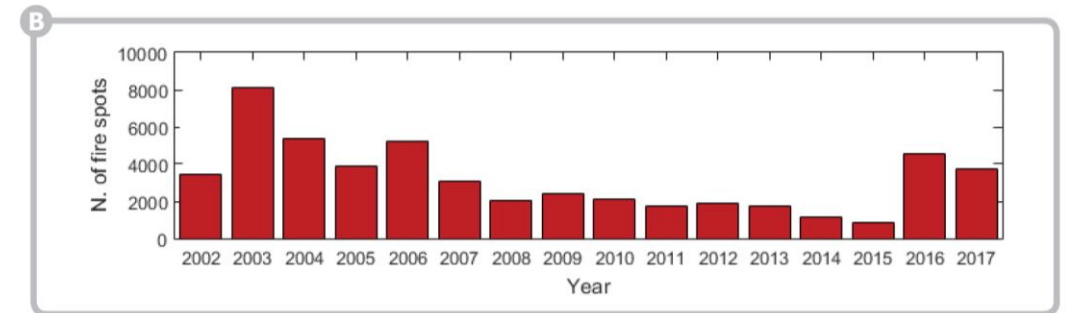


Mitigação das queimadas

Já observamos reduções bruscas nas emissões das queimadas em outros anos;

Exemplo de SC;

Vasta literatura.



Mitigação das emissões industriais

Revisão dos procedimentos de licenciamento;

Avaliação de impacto considerando concentração de fundo e emissores colocalizados;

Definição de áreas que não atendem os padrões para melhoria dos processos industriais (melhor tecnologia disponível);

Usar experiência de órgãos internacionais de referência no controle da poluição.



LCOAR
LABORATÓRIO DE CONTROLE DA QUALIDADE DO AR

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lcqar.ufsc.br

Mitigação das emissões industriais



Referências

- Hoinaski, L., Vasques, T.V., Ribeiro, C.B., Meotti, B.: Multispecies and high-spatiotemporal-resolution database of vehicular emissions in Brazil, *Earth Syst. Sci. Data*, 14, 2939–2949, <https://doi.org/10.5194/ESSD-14-2939-2022>, 2022.
- Hoinaski et al.: Avaliação do impacto das emissões veiculares, queimadas, industriais e naturais na qualidade do ar em Santa Catarina, https://lqcar.ufsc.br/novo/wp-content/uploads/2021/06/Avalia%C3%A7%C3%A3o-do-impacto-das-emiss%C3%B5es_Santa-Catarina_2020.pdf, (last access Jul 2023), 2020.
- Hoinaski, L., Will, R., Ribeiro, C.B.: Brazilian Atmospheric Inventories - BRAIN version 1: emission dataset in Brazil[DS/OL]. V1. Science Data Bank, 2023[2023-08-02]. <https://cstr.cn/31253.11.sciencedb.09858>. CSTR:31253.11.sciencedb.09858, 2023a.
- Hoinaski, L., Will, R.: Brazilian Atmospheric Inventories - BRAIN version 1: meteorology dataset in Brazil[DS/OL]. V1. Science Data Bank, 2023[2023-08-01]. <https://cstr.cn/31253.11.sciencedb.09857>. CSTR:31253.11.sciencedb.09857, 2023a.
- Hoinaski, L., Will, R.: Brazilian Atmospheric Inventories - BRAIN version 1: air quality dataset in Brazil[DS/OL]. V1. Science Data Bank, 2023[2023-08-01]. <https://cstr.cn/31253.11.sciencedb.09859>. CSTR:31253.11.sciencedb.09859, 2023b.
- Hoinaski, L., Will, R., Ribeiro, C.B.: Brazilian Atmospheric Inventories - BRAIN version 1: emission dataset in Southern Brazil[DS/OL]. V1. Science Data Bank, 2023[2023-08-02]. <https://cstr.cn/31253.11.sciencedb.09886>. CSTR:31253.11.sciencedb.09886, 2023b.
- Hoinaski, L., Will, R.: Brazilian Atmospheric Inventories - BRAIN version 1: meteorology dataset in Southern Brazil[DS/OL]. V1. Science Data Bank, 2023[2023-08-02]. <https://cstr.cn/31253.11.sciencedb.09885>. CSTR:31253.11.sciencedb.09885, 2023c.
- Hoinaski, L., Will, R.: Brazilian Atmospheric Inventories - BRAIN version 1: air quality dataset in Southern Brazil[DS/OL]. V1. Science Data Bank, 2023[2023-08-02]. <https://cstr.cn/31253.11.sciencedb.09884>. CSTR:31253.11.sciencedb.09884, 2023d.
- IEMA - Instituto de Energia e Meio Ambiente, Recomendações para a expansão e a continuidade das redes de monitoramento da qualidade do ar no Brasil, https://energiaambiente.org.br/wp-content/uploads/2022/07/IEMA_policypaper_qualidadedoar.pdf (last access Jul 2023), 2022.
- Kawashima, A.B., Martins, L.D., Rafee, S.A.A., Rudke, A.P., de Morais, M.V., Martins, J.A.: Development of a spatialized atmospheric emission inventory for the main industrial sources in Brazil, *Environ. Sci. Pollut. Res.*, 27, 35941–35951, <https://doi.org/10.1007/S11356-020-08281-7>, 2020.
- Vasques, T.V., Hoinaski, L.: Brazilian vehicular emission inventory software – BRAVES, *Transp. Res. Part D Transp. Environ.*, 100, 103041, <https://doi.org/10.1016/J.TRD.2021.103041>, 2021.
- Wiedinmyer, C., Kimura, Y., McDonald-Buller, E.C., Emmons, L.K., Buchholz, R.R., Tang, W., Seto, K., Joseph, M.B., Barsanti, K.C., Carlton, A.G., Yokelson, R.: The Fire Inventory from NCAR version 2.5: an updated global fire emissions model for climate and chemistry applications, *Geosci. Model Dev.*, 16, 3873–3891, <https://doi.org/10.5194/gmd-16-3873-2023>, 2023.