Influence of synoptic and local circulations on high ozone concentration episode

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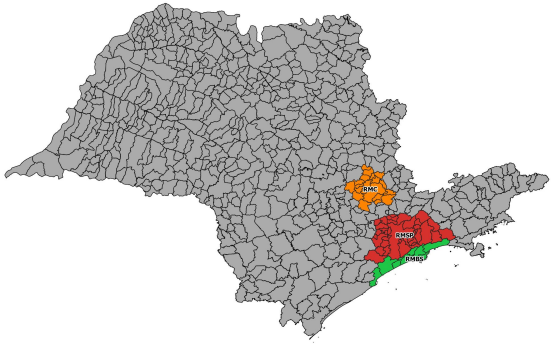
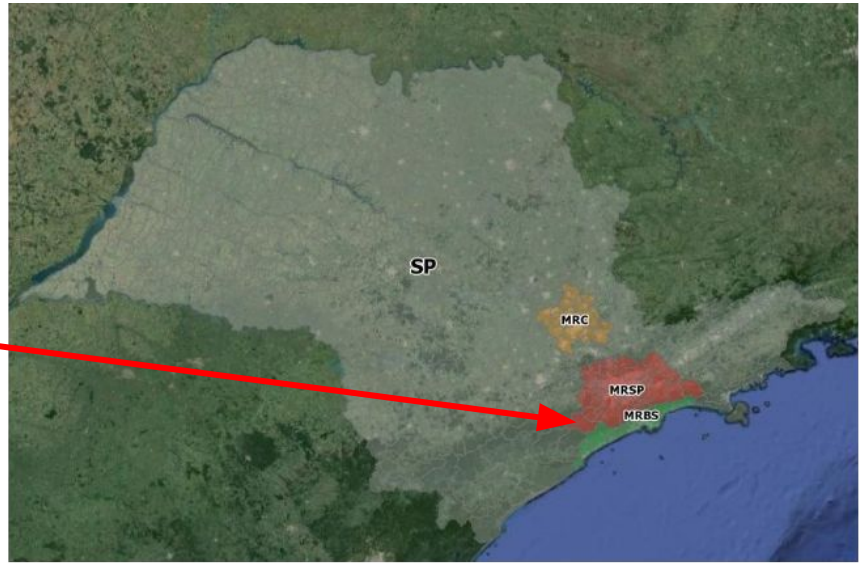
Motivation



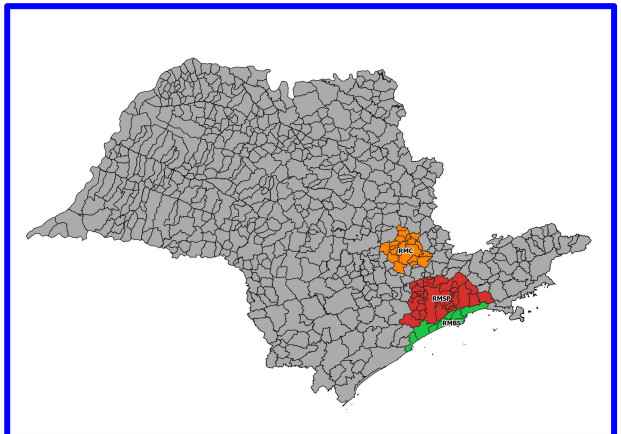
Three economically and socially relevant Metropolitan Areas in São Paulo state, Brazil



Motivation

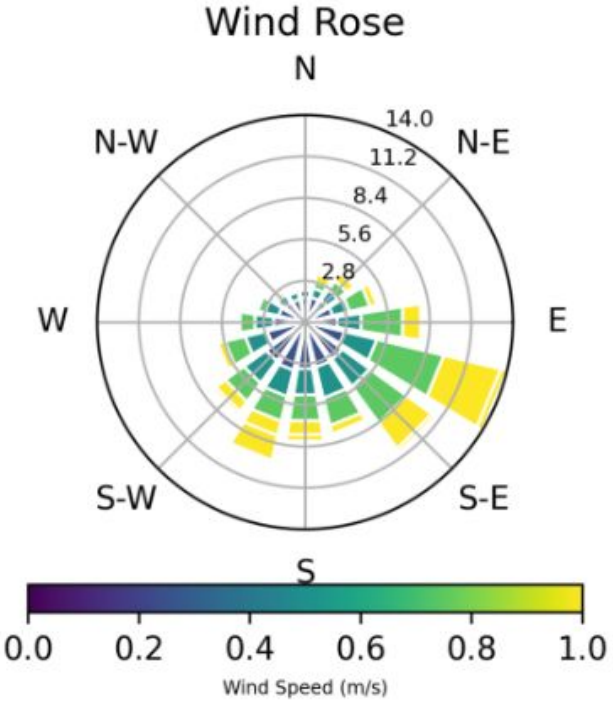
São Paulo Metropolitan Area:

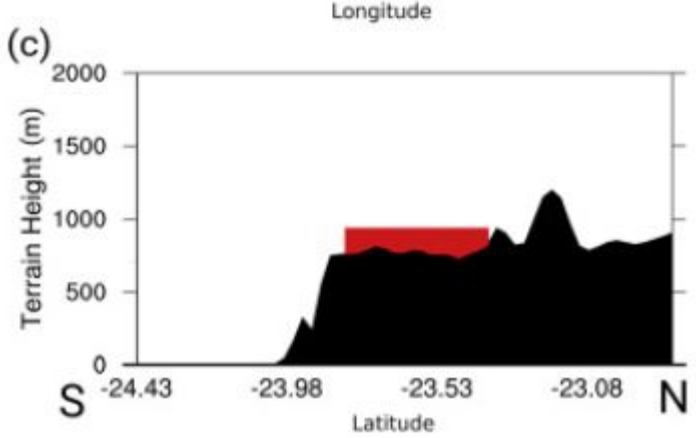
- 39 municipalities
- nearly 12 millions inhabitants (11% of Brazil's population)
- economy mainly based in services, still a few industries
- 7 millions vehicular fleet

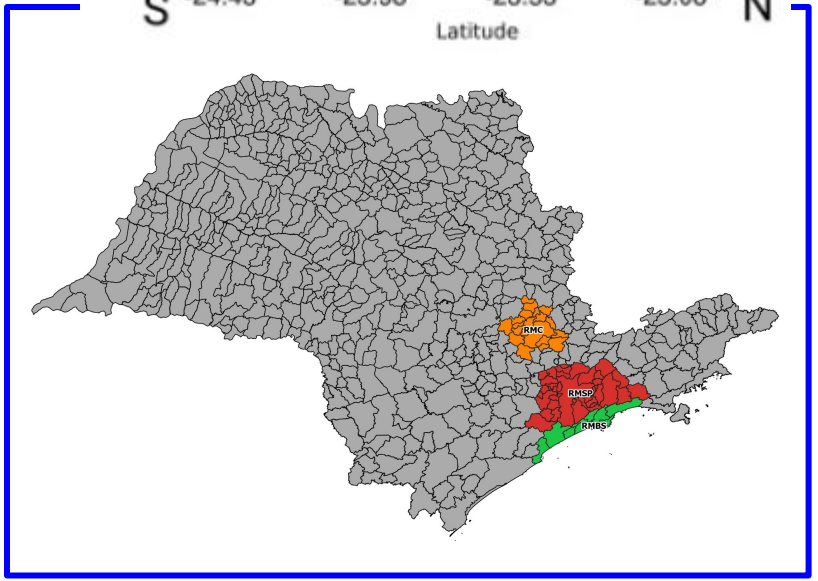


Motivation

- Predominant wind







Goal

- study the influence of synoptic and local circulations during a high ozone epidsode in São Paulo, considering emissions from three Metropolitan areas (Sao Paulo, Campinas, and Baixada Santista)
  - sea breeze
  - pre-frontal conditions
  - cold front conditions

Methodology

WRF

- Version 4.3.3
- parameterization: tropical suite
- initial and boundary conditions from GFS
- two nested domains:
  - outermost: 150 x 150 horizontal grid points, 5 km horizontal spacing
  - innermost: 270 x 270 grid points, 1 km horizontal spacing
- from 30 Sep to 06 Oct 2019
- 3 urban classes

SMOKE/EDGAR/MEGAN:

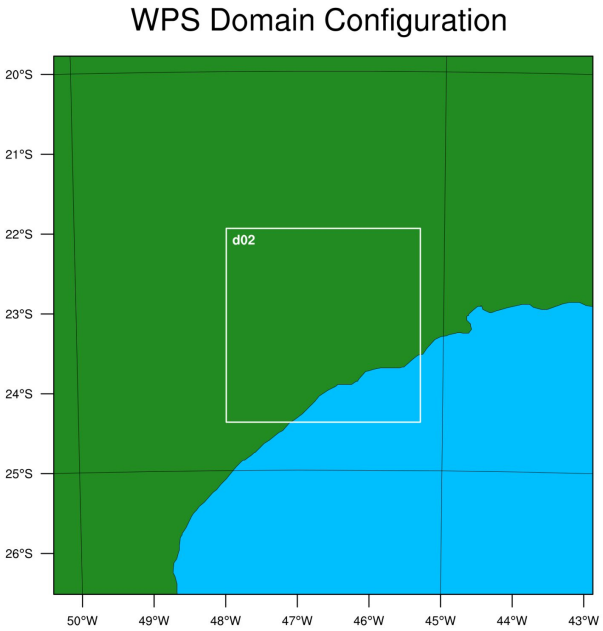
- https://edgar.jrc.ec.europa.eu/emissions_data_and_maps
- EDGAR sectors: Agriculture, Air, Energy, Industry, Residential, Ships
- MEGAN: conversion classification (Gomes, 2020)

CMAQ

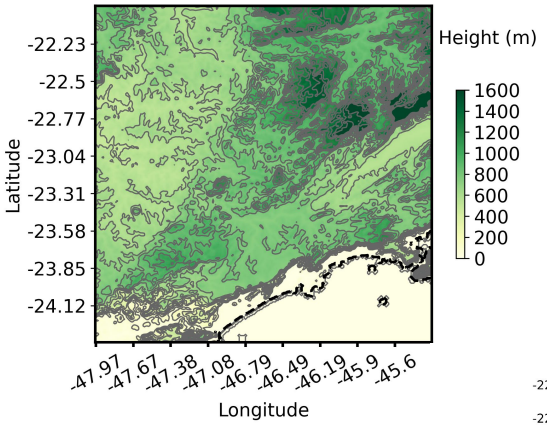
- using WRF and SMOKE outputs
- cb06_aer7_aq scheme
- 1st run for the outermost domain, using profile initial and boundary condition
- 2nd run for the innermost domain, using the 1st run to generate initial and boundary conditions

Methodology

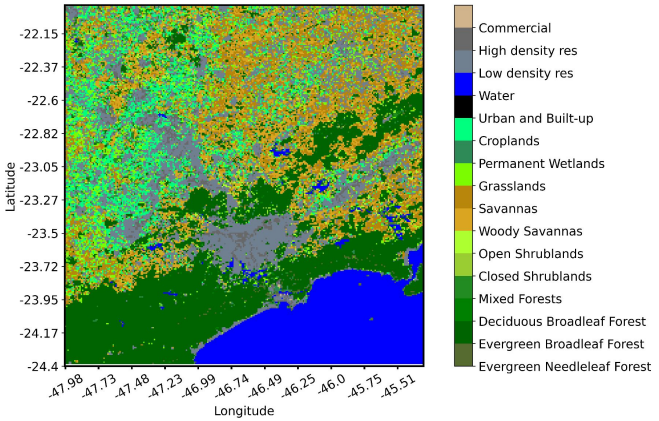
Domains



Topography-innermost

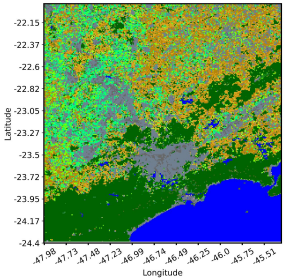


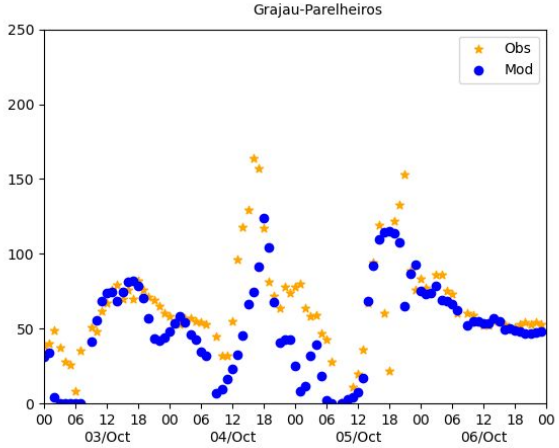
Land Use-innermost

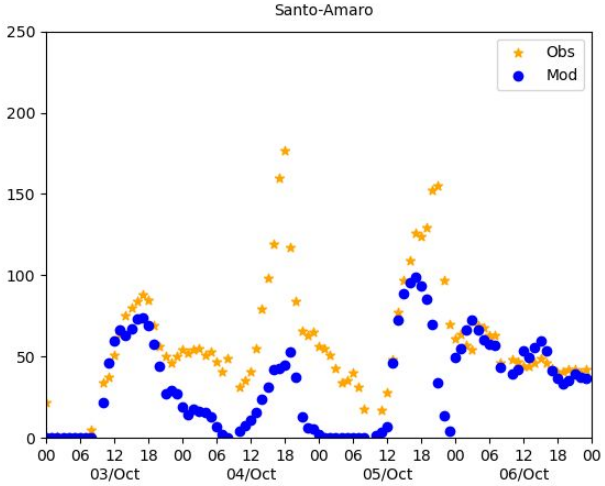


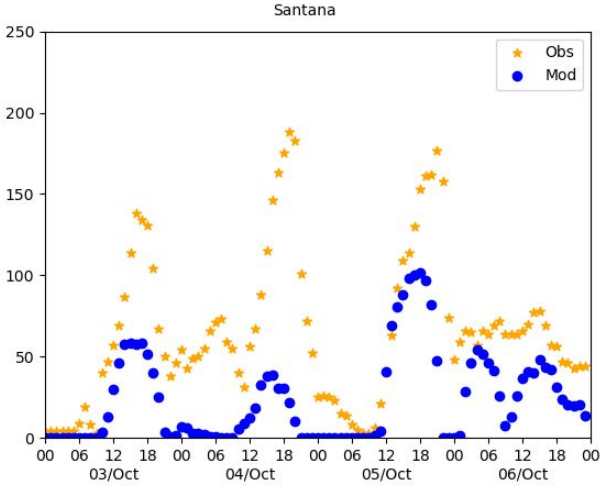
Results

Validation



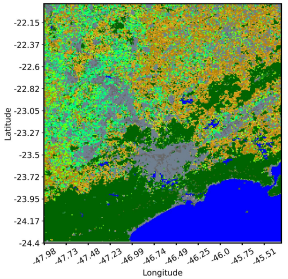


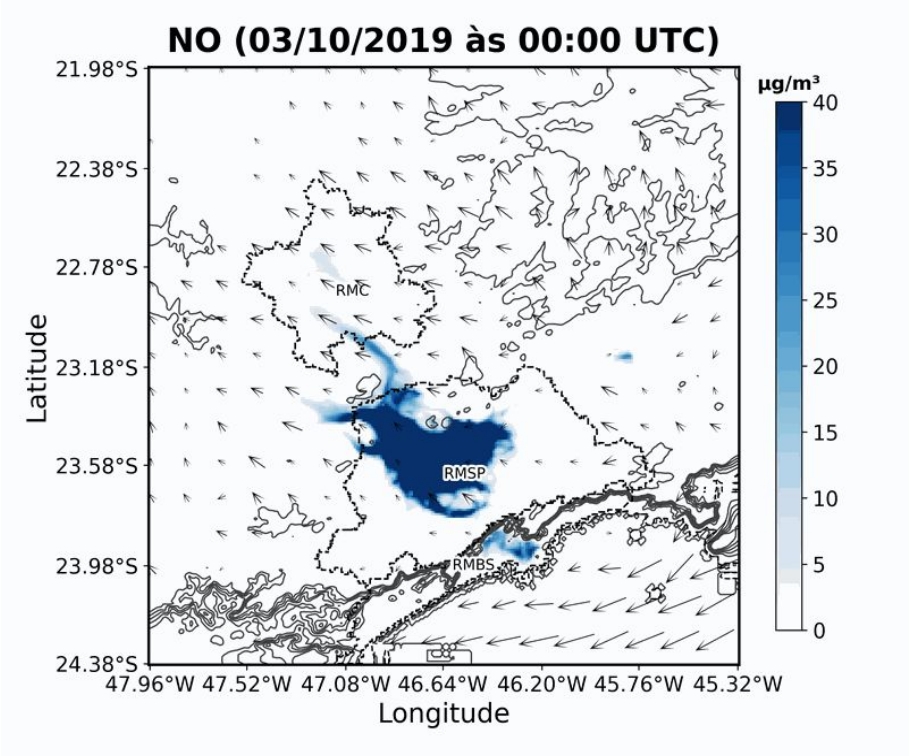


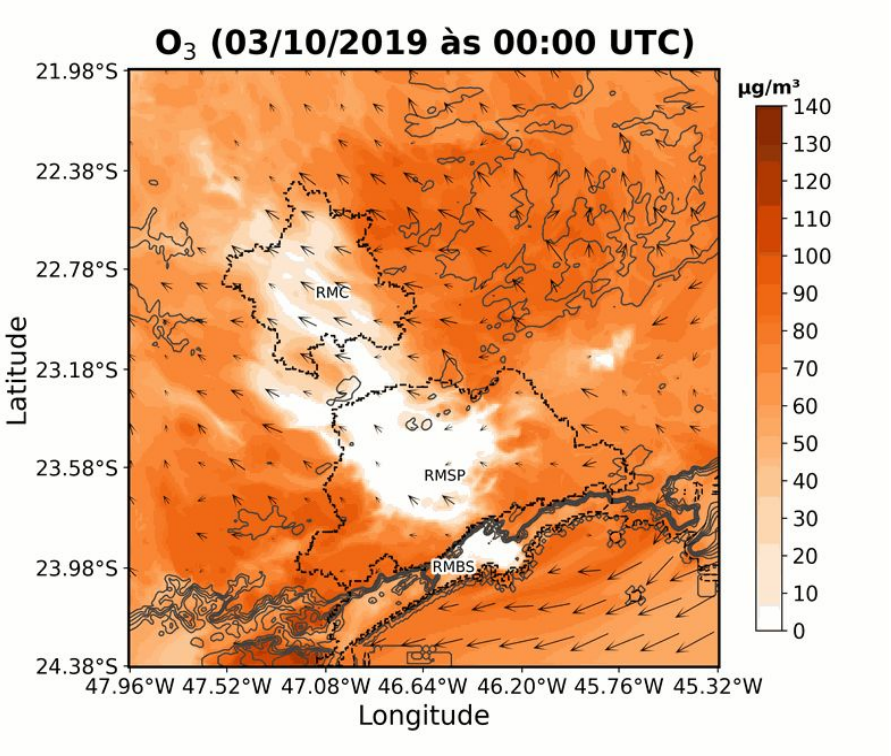


Results - Day 03 - coastal flow

CMAQ NO O3







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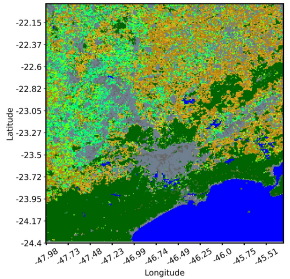


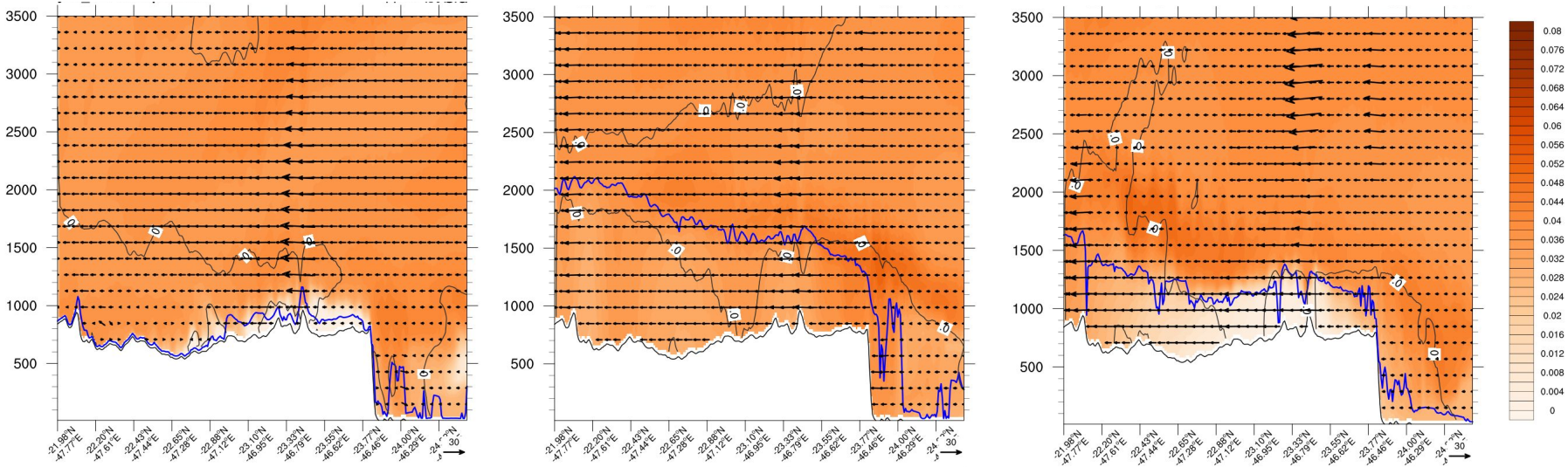
CMAQ

O3

09 UTC

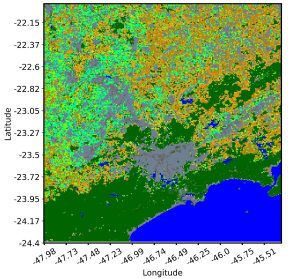
18 UTC

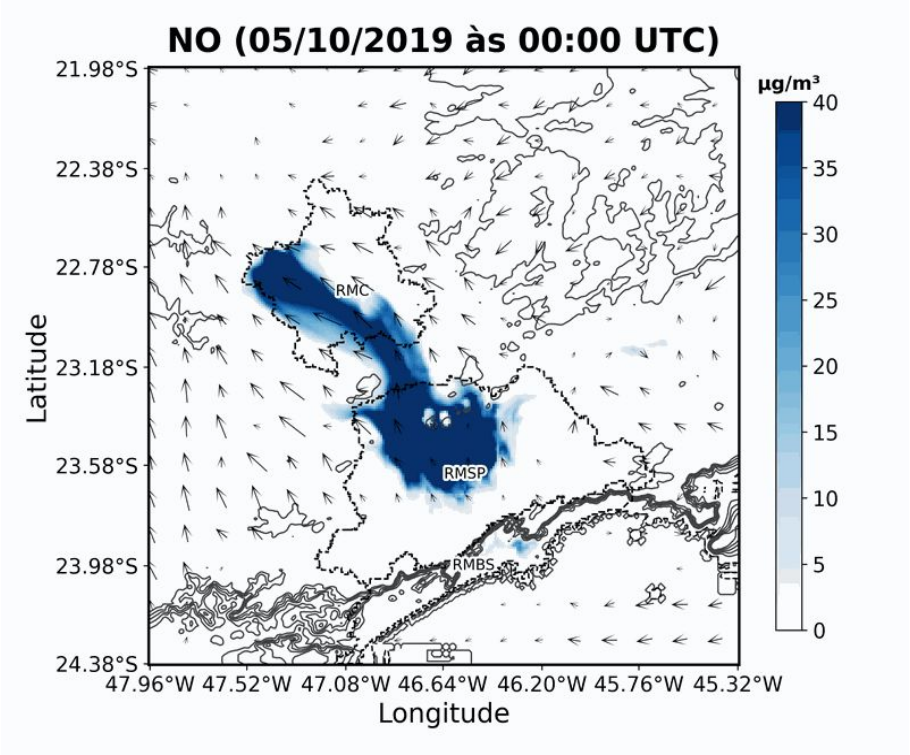
21 UTC

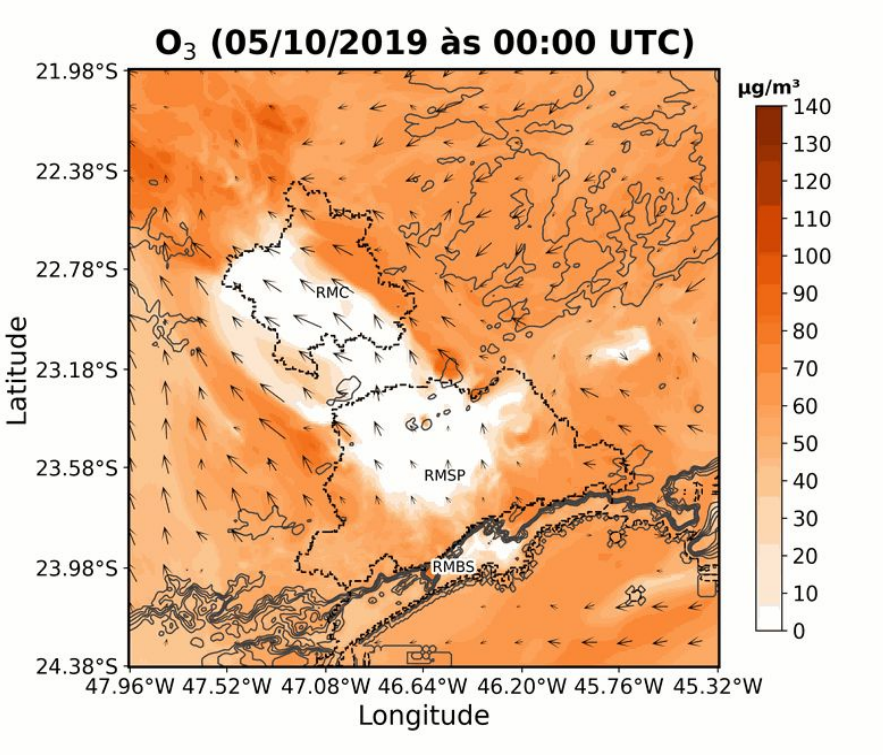


Results - Day 05 - pre-frontal

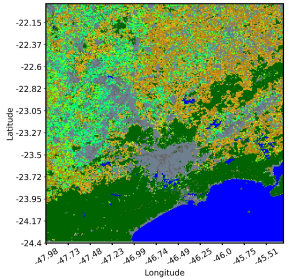
CMAQ NO O3







Results - Day 05 - pre-frontal



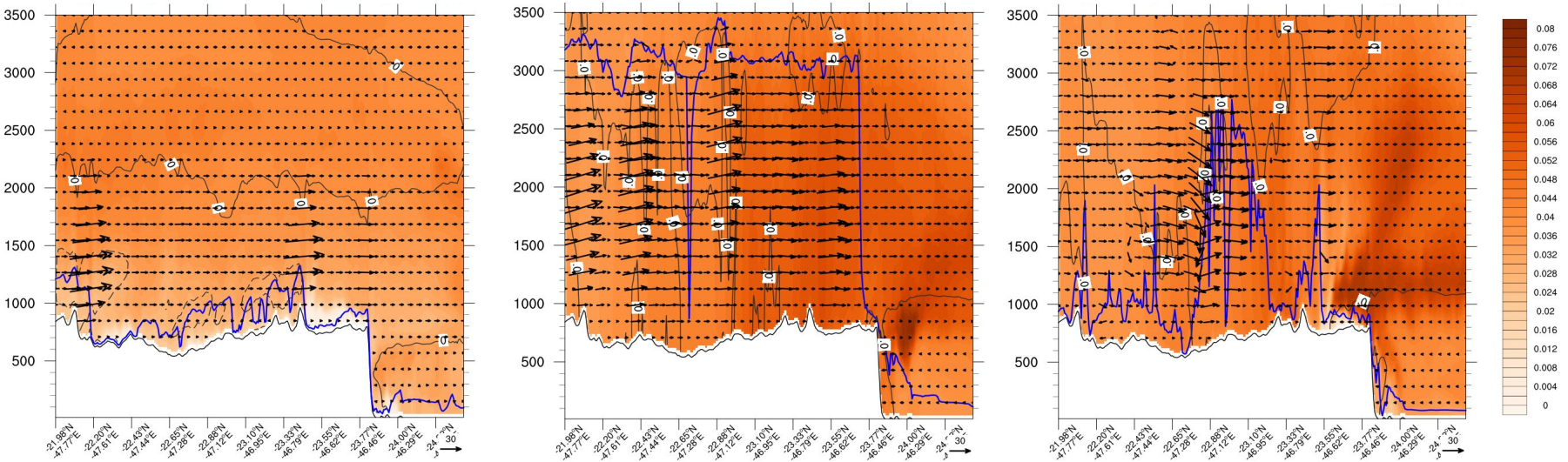
CMAQ

O3

09 UTC

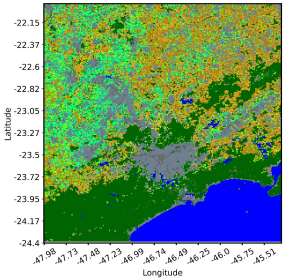
18 UTC

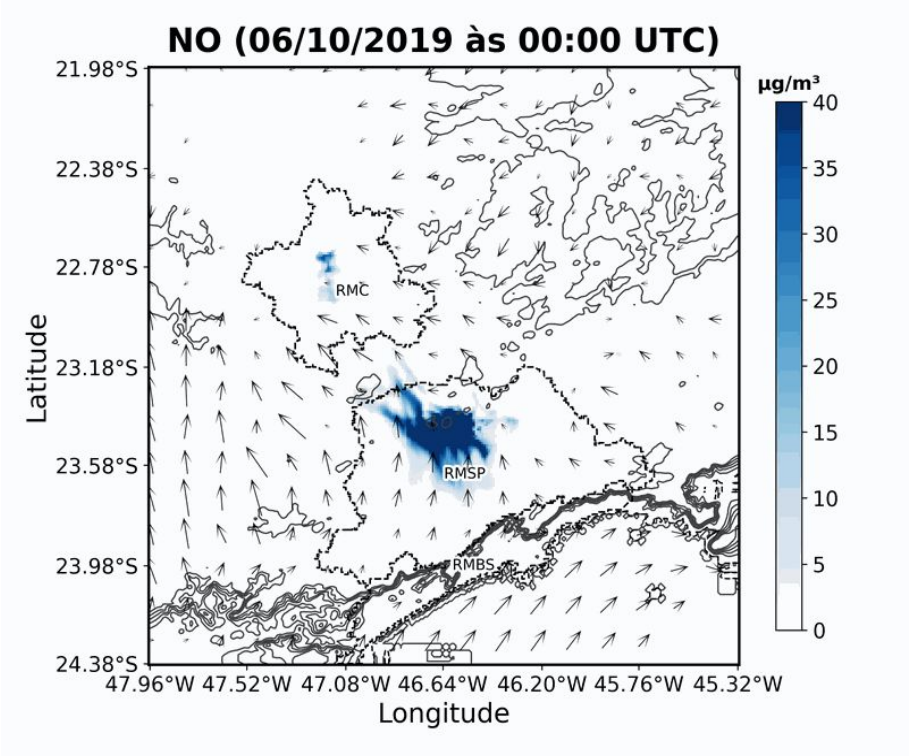
21 UTC

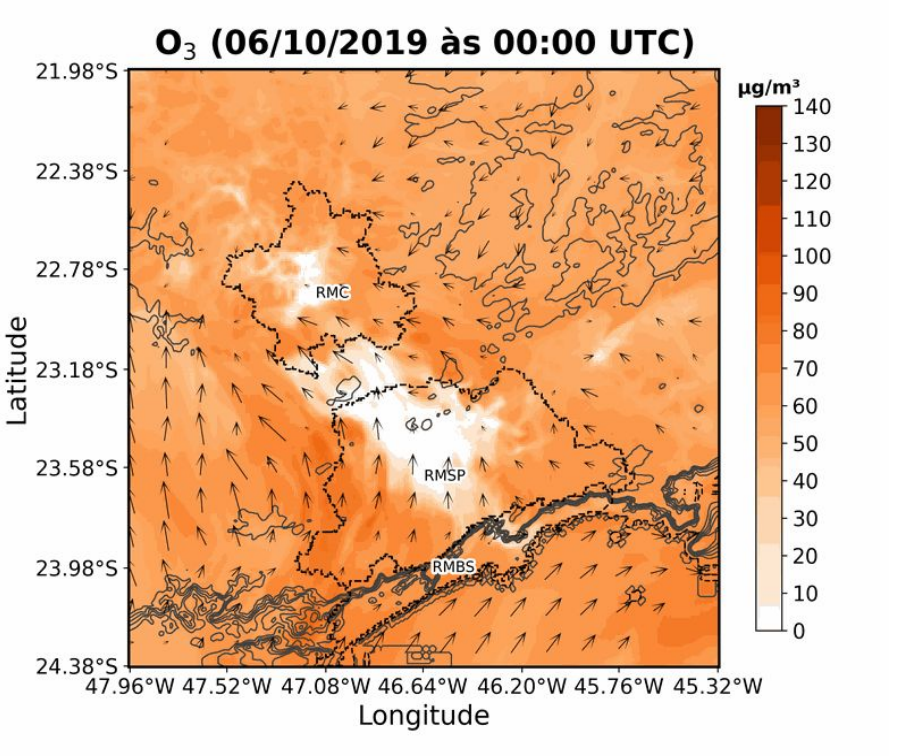


Results - Day 06 - front passage

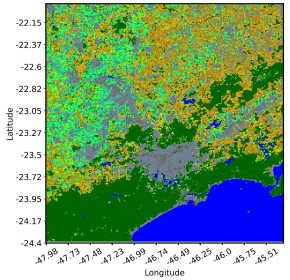
CMAQ NO O3







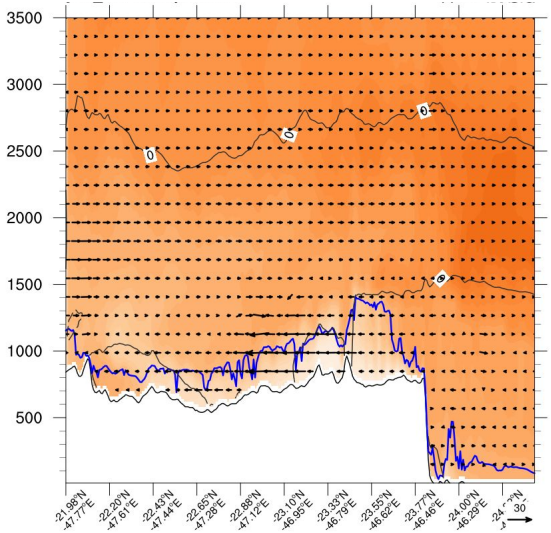
Results - Day 06 - front passage



CMAQ

O3

09 UTC



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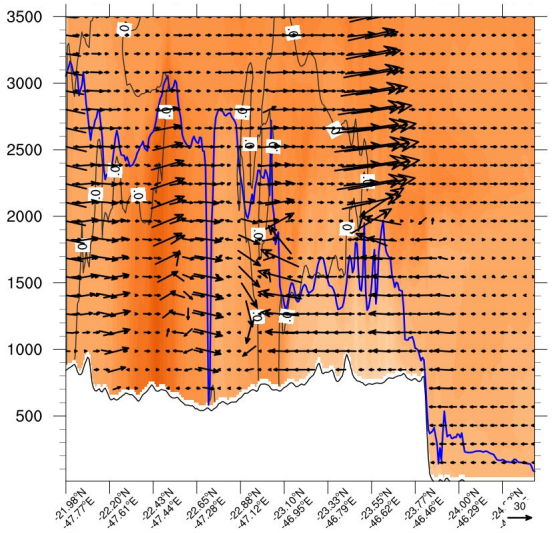

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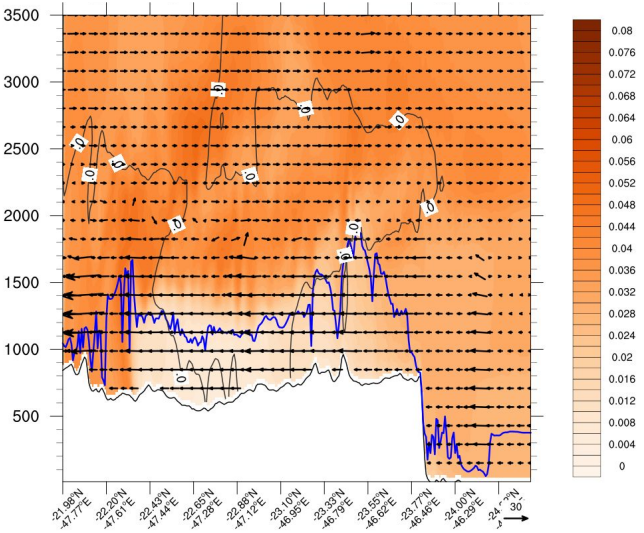

Considerations

1) There is transport of precursors between the regions, with Sao Paulo being a substantial source of pollution, despite the industrial activities in Campinas and Santos
2) Coastal flow day: flow from the coast helps decrease pollutant concentrations
3) Pre-frontal conditions: warmer conditions and flow from the continent (transport) increases ozone concentration in São Paulo
4) Frontal conditions: lower temperatures and higher wind speeds (transport) decrease precursors concentration; ozone concentration does not increase
5) Model does not capture the nighttime concentrations very well

Acknowledgement

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THANK YOU!

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