AOD and CO global distribution with CAM-CHEM simulations and comparison with satellite data

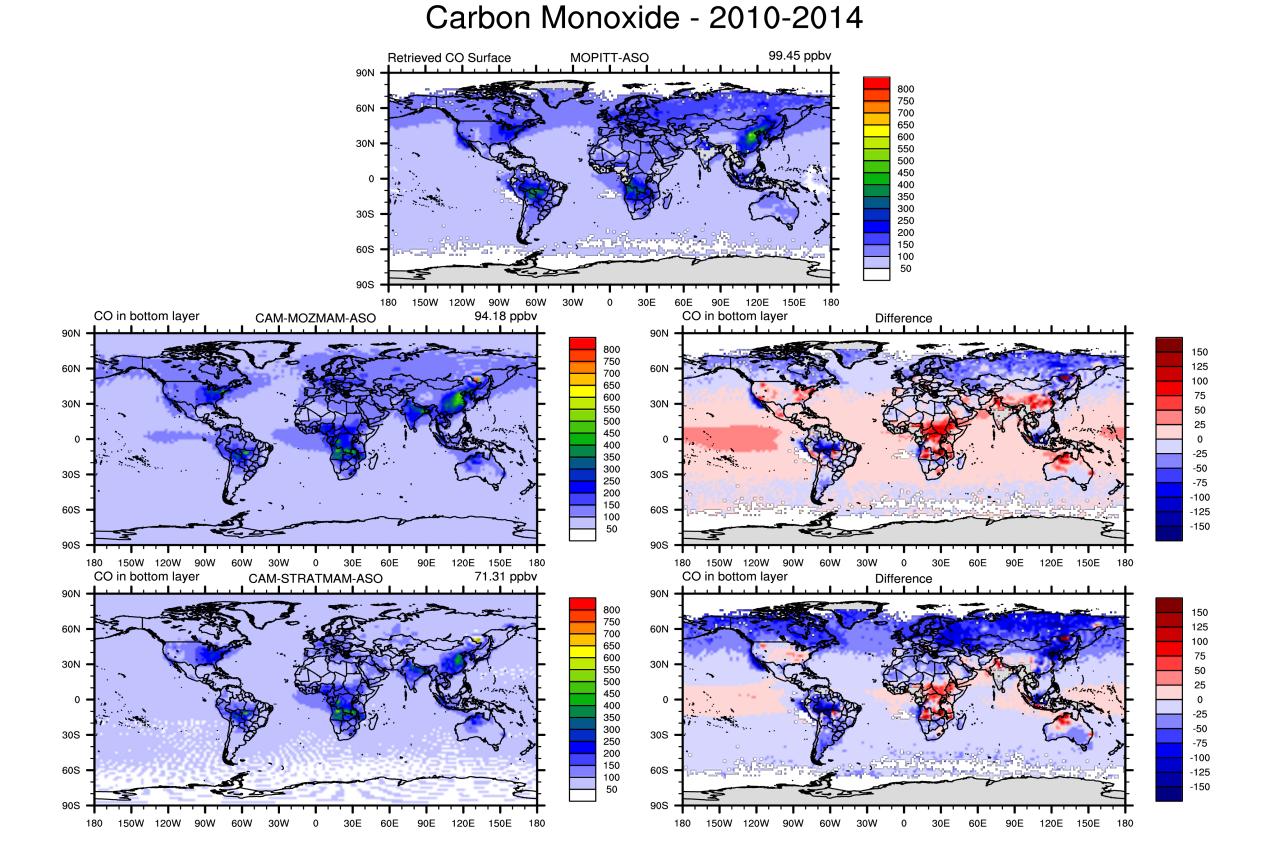ALVIM, D.S.[1]*; PENDHARKAR, J.[1]; CHIQUETTO, J.[2]; D'AMELIO, M.T.S.[3]; HERDIES, D.L.[1]; NOBRE, P.[1]; FIGUEROA, S. N.[1]; CORREA, S.M.[2]; ROZANTE, J.R.; SILVA, J.[1]; KUBOTA, P.Y[1]; SILVA, M.B.[1]

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Introduction

Both atmospheric gases and aerosols have been increasingly recognized as key components of the dynamic and complex Earth system composition and evolution. The impact of chemistry on the atmosphere or vice versa is a strongly coupled process that has remained one of the most challenging tasks for the modeling community. The two-way feedbacks between meteorology and chemistry are important in applications like Numerical Weather Prediction (NWP), Air Quality (AQ) forecasting, climate modeling and Earth System modeling with a marked difference in the details of represented processes among the applications.

In this work, we used the CAM-chem model that considers only tropospheric chemistry (tropm), and another model with the same configurations, but with added mechanisms of reactions in the stratosphere (tropstratm). Observations of AOD from Moderate Resolution Imaging Spectroradiometer sensor (MODIS) and CO from satellite Measurements of Pollution in Troposphere sensor (MOPITT) were compared to the results of the CAM-chem simulations.
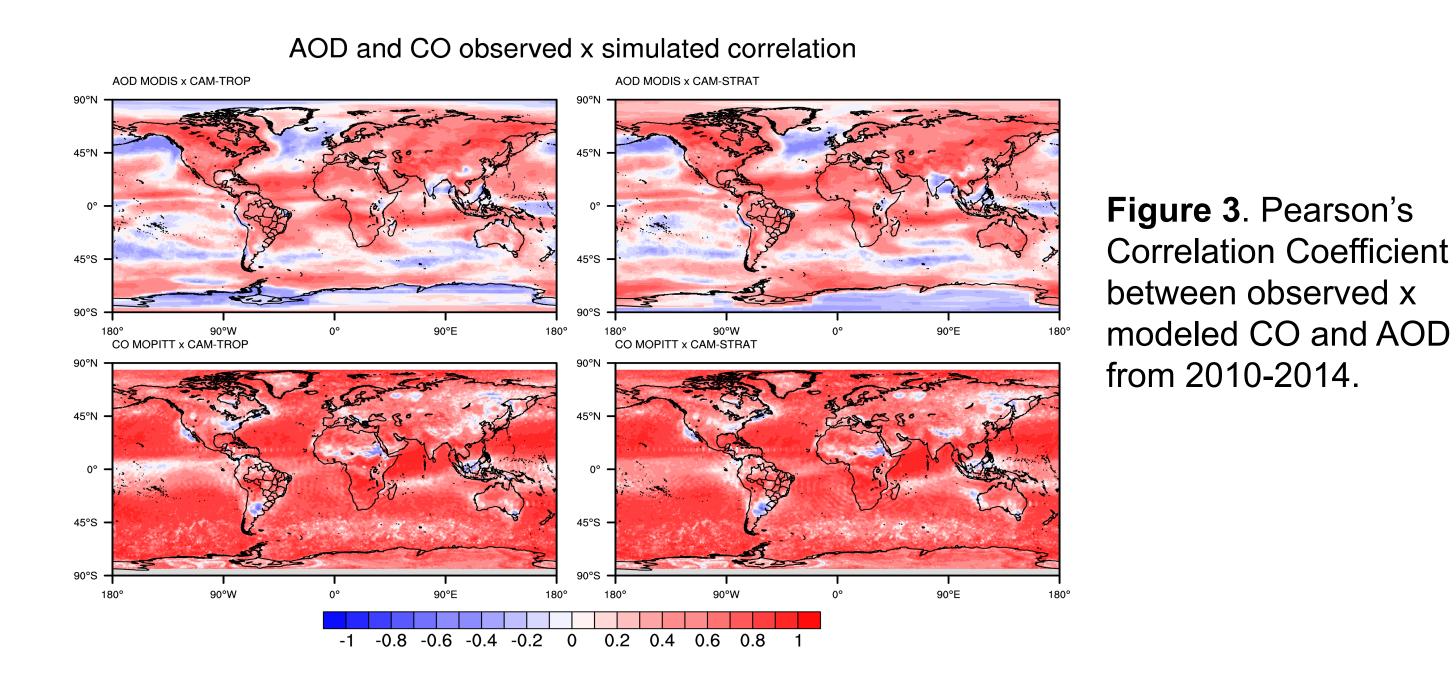
Methods

We used satellite data of **AOD** from **MODIS** and **CO** from **MOPITT**, for the period January 2010 to December 2014.

Simulations: CAM-Chem model with tropospheric chemistry (103 species) and another simulation with stratospheric chemistry (122 species).

Spatial Resolution: 1.9x2.5° horizontal grid (96x144 lat/lon grid).
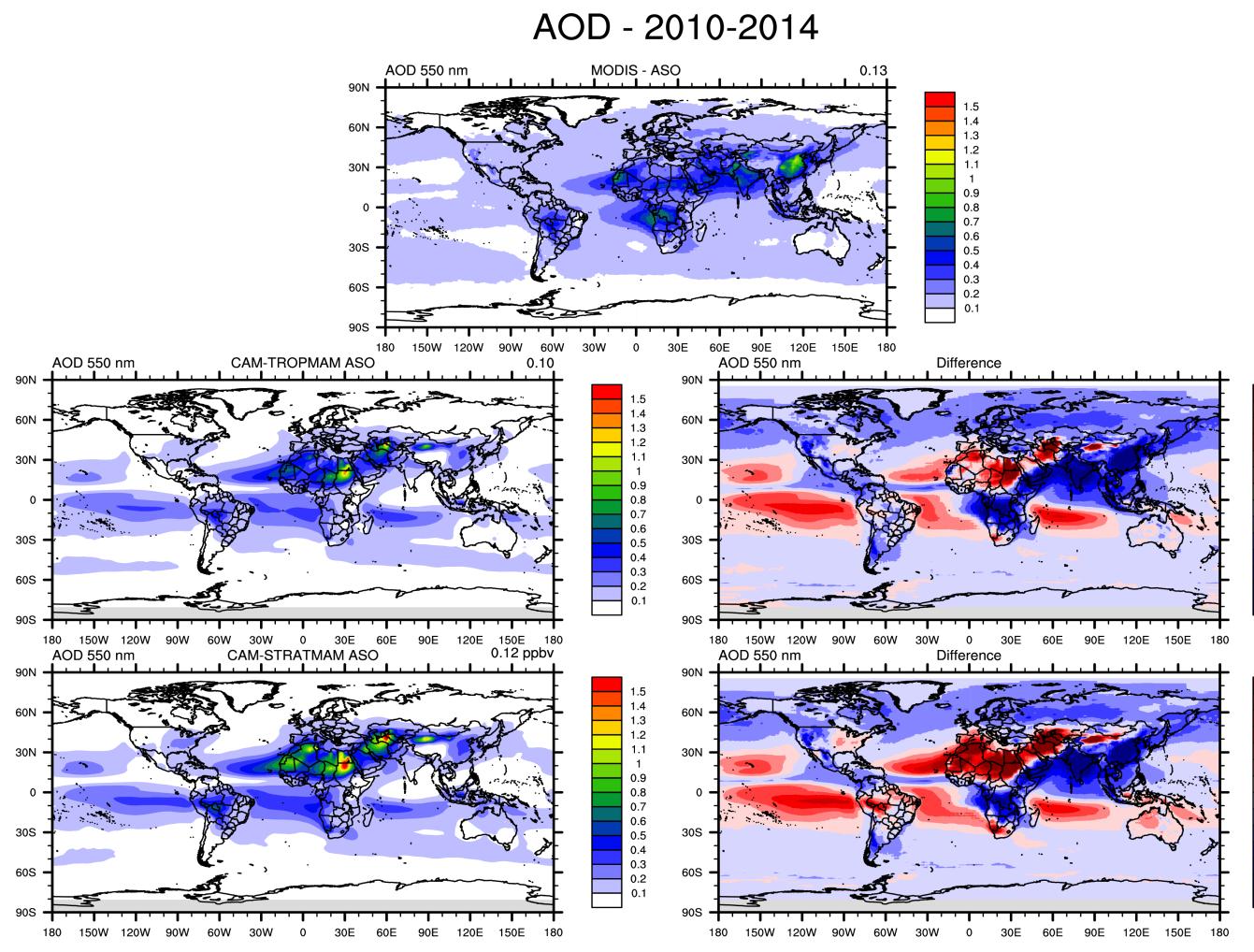**Vertical Resolution:** 30 vertical levels, from surface level to 10 hPa.

Results

Figure 1. Comparison of mean annual simulated AOD at 550 nm of CAM-chem models with the MODIS sensor for the period of ASO in 2010-2014.

Figure 2. Comparison of mean annual simulated CO of CAM-chem models with the MODIS sensor for the period of ASO in 2010-2014.

Figure 3. Pearson's Correlation Coefficient between observed x modeled CO and AOD from 2010-2014.

Conclusions

The satellite derived observations for AOD (MODIS) and CO (MOPITT) were used to subjectively compare the CAM-Chem model results with two different configurations, tropm and tropstratm. The comparison between the simulations and satellite observations show that both models can reproduce the temporal and spatial distributions of both pollutants.

Contrariwise, the inclusion of stratospheric chemistry did not improve the results, in spite of increasing computational time. Both models, tropm and tropstratm, present very similar results for AOD. CAM-Chem tropstratm simulation presents an increased positive BIAS for a vast area ranging from central Asia in Khazakhstan, through the Middle East and Central-North Africa almost to the Caribbean Sea. The tropm simulation presents overestimation of CO concentrations, with an intense positive BIAS in central Africa, western China and Equatorial regions, specially in the Atlantic and in the Western Pacific Oceans. When stratospheric chemistry was added (tropstratm), there was a decrease in the positive BIAS in these regions.

The annual cycle was estimated by the Pearson correlation coefficient (calculated from the monthly averages of modeled and observed data), which ranged from 0.4 and 0.8. This indicates a reasonable representation of the seasonal variations of AOD and CO, specially for CO with coefficients of 0.8 in large areas in the Indian and Pacific Oceans. For AOD, the best representations occurred over North America and Central Asia.