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How integrated weather and chemistry/aerosol model impact regional Numerical Weather Prediction skill over South America

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Several works have been discussing the importance of integrated weather-chemistry models to numerical weather prediction (NWP) accuracy. However, it is not clear whether a more complex modeling system can improve the accuracy of near-surface NWP. Recent studies indicate that in a global scale, errors associated with the miss-representation of chemical processes are comparable with model uncertainties, but in a regional scale, like over South America, where the smoke from biomass burning during the dry season is intense, a fully integrated modeling system can improve the skill of NWP. A historical set of near-surface NWP of the Brazilian developments on the Regional Atmospheric Modeling System (BRAMS) was evaluated in an observational-basis over South America considering a fully integrated model versus a pure-weather forecast version. It was considered a 20km (coarse) horizontal resolution fully coupled meteorology-chemistry version and a 5km (high) resolution weather version to analyze the 2-meter temperature, dew-point and precipitation forecasts up to 72h forecast length. The results indicate that, during the periods with averaged aerosol optical depth at 550 nm higher than 1.0 there is an improvement in the fully integrated model skill specially over areas with high number of fire spots, even in coarse resolution, compared with the higher resolution model. During the wet season, the higher resolution meteorology model shows a significant improvement compared with coarse resolution fully coupled model. A NWP experiment using the fully coupled model in high resolution during the dry season of 2016 over Southeastern Brazil showed the improvement in model skill compared with the weather version. The more prominent differences in the skill of the model verified in the near-surface temperatures can be explained by the direct effect associated with the aerosol-radiation interaction.