Tagging Technique for Tropospheric Ozone Study using the WRF-Chem version 3.7.1 model

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Ground-level ozone (O3) is both an air pollutant and a climate forcer that affects the human health and crop growth (Stevenson et al., 2013). It has been shown that the background O3 concentrations have increased during the last several decades due to the increase of overall global anthropogenic emissions of O3 (HTAP, 2010), and big cities are facing serious challenges in surface ozone pollutions due to the urbanization and motorization processes (e.g. Chan and Yao, 2008). Chemical transport models are an effective tool that can help the policy makers to develop effective strategies for emission reductions rely on accurate predictions of O3 knowing the impact of source emissions of NO and VOC such as surface anthropogenic sources, fires, soil, lightning, and the stratosphere on total ozone production.

Tagging techniques have been used in modeling studies to determine source attributions for pollutants at given locations and source-receptor relationships. Pollutants with relatively low chemical reactivities such as carbon monoxide (CO), can be easily “tagged” according to its emission sectors or regions for attribution studies (e.g. Pfister et al., 2011). A procedure for tagging ozone produced from NO sources through updates to an existing chemical mechanism was described by Emmons et al. (2012). Tagging techniques can also be applied in calculation of the ozone production potential of Volatile Organic Compounds (VOC). Butler et al. (2011) presented a new approach using an extensively tagged chemical mechanism, in which the degradation sequence of each of the VOC is tagged. In contrast with the Emmons et al., (2012) approach, Butler's et al.(2011) tagging approach calculates the direct effects of VOC on ozone using a single model run, and deliver much more detailed information about the VOC intermediate oxidation products involved in the production of ozone.

In this work, we present an expanded tagging technique applied to the MOZART chemical mechanism implemented in the WRF-Chem model that is based on the procedures described by Emmons et al. (2012) and Butler et al. (2011). This expanded tagging technique could be used for quantifying source contributions of tropospheric ozone and analyzing ozone production potential of its precursors, by “tagging” emissions of NO or VOC and corresponding resulting products and following them to the production of ozone. This technique adds tracers to the chemical mechanism, and multiple tags can be defined in every single model run.

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