1D5) The SMOKE Modeling System and its Extensive Applications

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1. Introduction

The emission modeling is a very complex and difficult procedure. It requires the wide range of knowledge and experience on emission inventory preparation for air quality models. The emission modeling process includes emission inventories, chemical speciation factors, temporal allocation factors, spatial allocation factors, growth factors, and control factors. Figure 1 represents the parallel approach to emission processing in the SMOKE modeling system to create a model-ready output for all air quality models.

The Office of Air Quality Planning and Standards (OAQPS) from U.S. Environmental Protection Agency (U.S. EPA) has been developing an Emission Modeling Framework (EMF) to provide better management, versioning, quality assurance, and tracking of data used for emissions modeling to those who need. A key component of frameworks is the Sparse Matrix Operator Kernel Emissions (SMOKE) modeling system that can provide the emissions modeling capabilities to prepare emissions input data for many of the models used by U.S. EPA.

This document describes the updates made in SMOKE version 2.5 and ongoing updates in SMOKE version 2.6. It also discusses its prospective applications of SMOKE. More details regarding to the most updated version of SMOKE are available at www.smoke-model.org

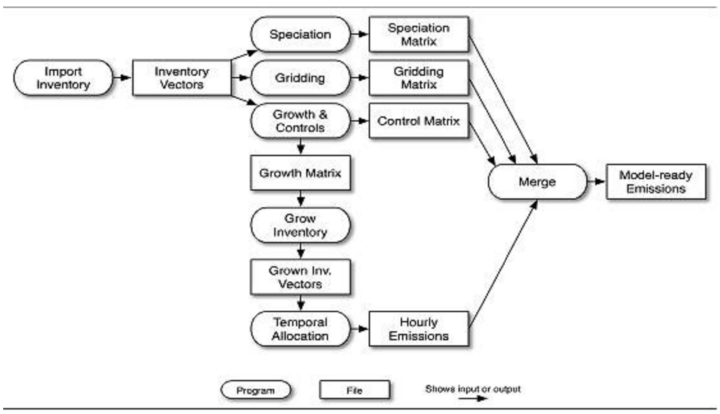

Fig. 1. Parallel approach to emissions processing in the SMOKE modeling system.

2. Recent SMOKE Updates

The main goal of the EMF is to provide more transparency in emissions modeling in regards to data and modeling parameters to those who need. The SMOKE modeling system provides the emissions modeling capabilities including the further integration of toxics and criteria processing and the integration of SMOKE with the EMF[1,2]. Many updates in support of this effort have been

completed[3,4] and others are currently underway or planned for the upcoming release of SMOKE version 2.6.

The major feature updates of SMOKE are following:

- Supports in-line plume rise calculation in CMAQ version 4.7 to reduce the size of "traditional" 3-D model-reday input files generated by off-line plume rise calculation in SMOKE.
- The latest Biogenic Emission Inventory System (BEIS) model version 3.14 is integrated to the SMOKE v2.5 including the "sesquiterpene" emission factor and 34 species/compounds.
- Compatible with the Federal Aviation Administration (FAA)'s Emission Modeling and Dispersion Modeling System (EDMS) used to estimate emissions from airports. A new utility program EDMS2Inv creates SMOKE-ready inventory from EDMS output.
- Supports new wild and Rx fires emission inventory estimated by the EPM/CONSUME model in the Bluesky modeling framework.
- Enhancement on combining aggregated criteria VOC and hazardous air pollutant (HAP) inventories were made throughout the SMOKE.

Along with these updates, there have been several extensive researches/applications to enhance the quality and representation of various types of emissions, such as aircrafts, wildfires/prescribed fires, and fleets. (1) The integration of toxics and criteria modeling, (2) the integration of BEIS v3.14, (3) the wildfire/prescribed fire emissions modeling using the EPM/CONSUME model in the wildfire Bluesky modeling framework, and (4) the application of FAA's EDMS interface to improve the representation of aviation emissions in all layers of the model facilitates developing new sensitivity scenarios that can subsequently be used to assess the impacts of the rapid growth of aviation in the United States on local-to-regional air quality and public health.

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