Incorporating the Fire Plume-Rise Scheme in the Model for Prediction Across Scales Atmosphere

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ABSTRACT

Plume injection height plays an important role in the wildfire smoke dispersion, which can affect regional and global air quality and atmospheric radiation budget. However, the plume rise mechanism is not represented in most global atmospheric transport models. This study aims to describe the implementation of the 1-D parameterization of the vertical transport of hot gases and particles emitted from vegetation fires (Plume Rise Model - PRM), described in Freitas et al. (2007, 2010), in the Model for Prediction Across Scales Atmosphere (MPAS-A). The implementation was performed in the physics suite of the stand alone MPAS-A v8.2.1 model, where the 1-D PRM was embedded in each column of the 3-D MPAS-A. In this technique, the 3-D model feeds the plume model with the environmental conditions (temperature, pressure, wind, water vapor mixing ratio, land use information), allowing the plume rise to be simulated explicitly. In addition, the PRM recognizes which columns have fires based on the fire properties (fire size and energy release) provided by inventories previously mapped in the same grid resolution as the host model. The estimated height of the plume is then used in the source emission field of the host model to determine the effective injection height, releasing the material emitted during the flaming phase at this height. As an ongoing work, we are conducting a preliminary 2-day simulation starting at August 2, 2019, 00 UTC, on a globally uniform mesh with 60-km cell spacing. The meteorological initial and boundary conditions will be provided by GFS analysis and the fire properties will be from FINNv2.5 (MODIS + VIIRS) data at 0.1 degree resolution, available on a daily basis. By using this methodology the study can contribute to improving the representation of wildfire smoke dispersion in the MPAS-A.

Keywords: Plume Rise Model, Wildfire Smoke, MPAS-A.