

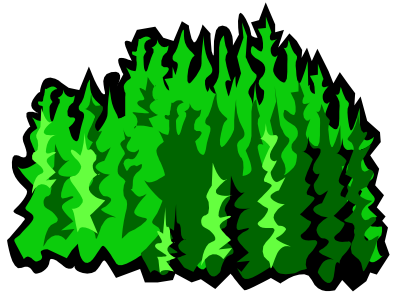


Comparison of Modeled Plume Rise for Wx and Rx Fire Emissions

Fire Emissions Joint Forum

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Background – Fire Plume Rise Comparison

- Part of 2005-06 Regional Modeling Center workplan - “Fire Sensitivity Modeling” task funded by FEJF
- Plume rise for fire – analogous to emissions modeling of large elevated point sources (smokestacks)
- SMOKE emissions model – uses Briggs’ equations
- SMOKE outputs feed air quality models
  - CMAQ & CAMx
- Objective of this work is to compare and evaluate existing and new fire emissions plume rise results

Fire Plume Rise Comparison Task

- **Compare Plume Rise Methods for both Wx and Rx Fire Emissions:**
  - **FEJF "hard-wired" approach**
    - **Consensus method – distributes emissions in model**
    - **Applies to all Wx and Rx fire sizes**
  - **SMOKE model "event-specific" approach**
    - **Beyond the inputs from the "hard-wired" approach above, this approach uses acres burned/day, and daily heat flux from FEPS**
    - **Buoyancy estimates from FEPS drive plume rise**

Fire Plume Rise Comparison Inputs

- Use FEJF 2002 Phase 2 actual fire EI
- Select 4 fire events (2 Wx, 2 Rx)
  - Duration – one day
  - Location – 2 SW (AZ/NM) & 2 NW (WA/OR)
  - Acreage
    - Rx events - 1k to 5k
    - Wx events – 5k to 10k
  - Tests response of 2 plume rise methods to different fuel types/loadings in different ecosystems

Fire Emissions Modeling With SMOKE

- All current fire inventories input to SMOKE specify location (lat lon & state/county code), event date, and daily emissions fluxes
- Single approach for spatial, temporal, and chemical allocation of the emissions
  - Look up tables based on source classification codes
- Two different approaches available for vertical allocation of the emissions (plume rise)
  1. WRAP FEJF plume rise
  2. New SMOKE plume rise

WRAP FEJF Plume Rise Approach

- Additional inventory inputs include precomputed hourly plume rise parameters
  - Fraction of emissions in model layer 1
  - Plume bottom in meters
  - Plume top in meters
- SMOKE allocates the emissions above layer 1 into the model layers bounded by the precomputed plume top and bottom
  - Results in discontinuous vertical allocation between layer 1 and the layer containing the plume bottom
- Layer fractions weighted by sigma (terrain following pressure coordinate)

New SMOKE Plume Rise Approach

- Additional inventory inputs include daily heat flux (btu/day) and acreage burned (acres/day)
- Internal Briggs plume rise algorithm uses plume buoyancy to allocate emissions vertically
  - Plume buoyancy derived from the daily heat flux to calculate plume bottom and top
- Smoldering fraction, or portion of plume below the plume bottom, derived from buoyancy efficiency (as a function of acreage burned).
  - Continuous allocation of emissions between layer 1 and the layer containing the plume top
- Layer fractions derived from layer volume, as opposed to sigma weighting

Configuring SMOKE to Model Fires

- Script options allow the choice between the WRAP-FEJF or internal SMOKE plume rise approaches
- Emissions layers typically constrained to the mixed layer (~ <3km)
- As fire plumes go well above the mixed layer (both approaches), important to configure SMOKE to carry enough emissions layers to capture the top of the highest plumes
  - Otherwise all of the emissions get synthetically allocated to the top emissions layer

Fire Plume Rise – Next Steps

- Select fire events, and run FEPS to obtain inputs for new SMOKE plume rise approach
- For selected events, apply SMOKE emissions model to generate plume rise data for:
  - FEJF “hard-wired” approach
  - SMOKE “event-specific” approach
- For each event, for the 2 approaches, generate stacked bar hourly time series plots and tables comparing:
  - Mass emissions by layer
  - Height of plume rise
- Conference call to review?