ConCEPT – Consolidated Community Emissions Processing Tool An Open-Source Tool for the Emissions Modeling Community

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CONCEPT
Introduction

- The new CONCEPT (CONsolidated Community Emissions Processing Tool) Emissions Processor is now available for use by the emissions modeling community.
- Developed as joint project between Alpine Geophysics, LLC and ENVIRON Corporation, with Midwest RPO and joint RPO funding, the CONCEPT model combines the best attributes of current emissions modeling systems into an open source model.

CONCEPT
Goals

- Open Source
  - Public domain software
    - POSTgres, POSTGis, perl
  - GPL Compliant
  - Users encouraged to customize and share
  - Code and documentation available at:

    conceptmodel.org

CONCEPT
Goals

- Transparent
  - Database Structure easy to understand
  - Self-documenting tables and naming conventions
  - Extremely well documented code

CONCEPT
Goals

- Quality Control
  - Multiple levels of QA analysis
  - Interim products maintained to facilitate QA
  - Easy review of calculation procedures and assumptions
  - Multiple debug and report levels

CONCEPT
Overview

- NEI Format Compatible
- RPO Data Exchange Protocol Compatible
- CAMx and CMAQ
- CBIV, SAPRC, PM speciation
- Multiple map projections

CONCEPT
Area Source Model

- Temporal Allocation
  - NEI format for temporal definition
  - Selects most appropriate record for modeling episode
  - Accounts for timezone shift

CONCEPT
Area Source Model

- Speciation
  - Pollutant-to-pollutant conversion
  - Lumped profile application
  - Mechanism independent

- Spatial Allocation
  - Surrogates applied at Country, state, county, tribal and/or SCC level

CONCEPT
Area Source Model

- Tribal Emissions
  - Explicitly coded to accept tribal emissions independently of any state or county identifiers
  - Extracts and corrects double counted emissions when both tribal-level and county-level are reported.
  - Spatial allocation includes tribal spatial overlays for correct spatial distribution

CONCEPT
Point Source Model

- Hourly CEM data
  - NEI format for hourly emissions
  - CEM-specific formats for hourly data
    - emissions
    - stack parameters
  - Currently replacement only

CONCEPT
Point Source Model

- Spatial Validity of Point Data
  - Uses grid overlay to assign stack locations
  - Validates stack location

CONCEPT
Point Source Model

- Validity of Stack Parameter data
  - Recalculates missing or invalid values
  - Supplies default values
  - Database maintain flags of all default values
  - QA reporting

CONCEPT
On-Road Motor Vehicle Source Model

- Combines MOBILE6 emission factors with link-based or county-level activity data.
- Maintain maximum flexibility while minimizing run times.
  - On the link
  - Off the link
  - Temperatures
  - Speed

CONCEPT
On-Road Motor Vehicle Source Model

- Transportation Demand Model Transformation Tool (T3) for Network (link-based) activity data
- RPO format for county-level activity data
- Inputs:
  - VMT
  - trips
  - volumes
  - network capacity
  - speeds
  - network definitions
  - speed adjustments
  - meteorological data

CONCEPT
On-Road Motor Vehicle Source Model

- MOBILE6 Run for each Combination of:
  - Representative County
  - Min/Max temperature
  - Calendar year
  - Season
  - Roadway Type
  - Speed Bin

CONCEPT
On-Road Motor Vehicle Source Model

- Speed Bins and Temperature Tolerance are User Defined
- Runs made for Freeway and Arterial
- Speed hardcoded in MOBILE6 for Freeway Ramps and Local Roads
- Emission Factors for Ramps/Locals taken from Freeway or Arterial runs with same Parameters

CONCEPT
On-Road Motor Vehicle Source Model

- Custom MOBILE6 Version
  - New DATABASE GROUPS command
  - MOBILE6 Vehicle Types Collapsed to MOBILE5 Types
  - Vehicle Ages Collapsed
- Pollutants – Currently HC CO NOX
- HC expressed As TOG
- All Emission Modes

CONCEPT
On-Road Motor Vehicle Source Model

- Temporal Allocation
  - Selects closest activity match for episode
  - Apply profiles by states, county, roadway type, year, month, day of week
  - Applies time-weight allocation to partial hourly values.
  - Temporal adjustments applied to
    - VMT
    - volume
    - capacity
    - trip counts

CONCEPT
On-Road Motor Vehicle Source Model

- Speeds
  - Average speeds
  - Hourly distributed speeds
- Speed Adjustment
  - Adjusts speeds using volume delay functions
    - Bureau of Public Road (BPR) curves
    - Detail tables
  - Can vary by network link, speed, volume-capacity

CONCEPT

On-Road Motor Vehicle Source Model

$$S_a = MAX\left(S_{cg}, \frac{S_{ff}}{1+\left[A*VCR_{adj}{}^{B}\right]} \right)$$

where:

S_a	=	actual link speed (mph)
S_{ff}	=	reported link free flow speed (mph)
S_{cg}	=	reported link congested speed (mph)
S_{cg}	=	0 if not reported
VCR_{adj}	=	adjusted volume-capacity ratio
VCR_{adj}	=	$MIN(VCR, VCR_{cap})$
VCR_{cap}	=	cap value on volume-capacity ratio
VCR_{cap}	=	∞ if not reported
VCR	=	reported volume-capacity ratio
A, B	=	curve calibration coefficients
A, B	~	*curve number,* S_{ff}

CONCEPT
Non-Road Motor Vehicle Source Model

- EPA's NONROAD Model Used to Calculate Emissions
  - County level
  - Standard Temperature
  - User may supply local activity data
  - By episode month

CONCEPT
Non-Road Motor Vehicle Source Model

- CONCEPT Enhancements
  - Applies gridded, hourly temperature adjustments
  - Weekend/weekday adjustments
  - NH3 emissions estimation based on fuel consumption and fuel type

CONCEPT
Biogenic Source Model

- Mimics BIOME3 Processing
  - BEIS2
  - BEIS3
  - GLOBEIS canopy model
- Based on SMOKE-BEIS3 (v0.9) Foundation Data
  - BELD3 datasets
- Includes Projection and Extraction Methodology for the BELD3 data

CONCEPT
Spatial Allocation Tools

- POSTGis Based
  - Fully integrated into CONCEPT system
- Grid Development
- Develops Spatial Surrogates
- Overlays Point Source Locations

CONCEPT
Spatial Allocation Tools

- Input Options
  - Lambert conformal
  - geographic
  - stereographic
  - UTM
- Output Options
  - Lambert
  - UTM

CONCEPT
Spatial Allocation Tools

- Grid Extraction Utility
  - Extract sub-grid regions
  - Aggregates cells to larger grids
  - CONCEPT includes the National RPO domain at 4k.

CONCEPT
Speciation Development Tools

- Supports Update of Speciation Profiles
  - Input of revised chemical profile data
  - Creates new lumped speciation factors.

CONCEPT
Forecasting Tools

- Creates Grown and/or Controlled Files
  - Multiple level application heirarchy
  - NEI format output
  - Extensive reporting and QA
  - Control cost estimates

CONCEPT
Upcoming Developments

- Incorporation of Process Based NH3 model
- CEM tool
- QA and Reporting Enhancements
- Graphics Reporting and Analysis Package
- EmisView