Metadata for 2025 12km CONUS Bidirectional-CAFO run of November 2014_v2 – CMAQv5.0.2 Simulations

Abstract

CMAQ annual deposition files for 2025 using 2011 meteorology with adjusted wet deposition for the continental US using 12km grids.

The dataset is based on output from the Community Multiscale Air Quality modeling system (CMAQ) run using the bidirectional flux option for the 12-km grid size for the US, Canada, and Mexico. There are separate files for deposition in units of kg/ha and meq/m^2.

The CMAQ output has been post-processed using R scripts to adjust the wet deposition for errors in the location and amount of precipitation and for regional biases in the TNO_3 (HNO_3 + NO_3), NH_x (NH_4 + NH_3), and sulfate wet deposition. These adjustments are based on those calculated for the 2011 case where the precipitation is the same and regional wet deposition biases are assumed to occur at the same magnitude.

Model-predicted values of dry deposition were not adjusted.

The wet deposition has been adjusted by PRISM precipitation and by a bias adjustment field.

The precipitation adjustment is based on increasing/decreasing the modeled wet deposition based on the bias in the modeled precipitation (bias=PRISM precipitation regridded to 12kmx12km CMAQ grid/modeled precipitation). The bias field is based on regionally smoothing the bias at National Atmospheric Deposition Program (NADP) sites by averaging the bias across all sites within 500km of a given monitor (bias = observed value/model value). These new averaged bias values at each NADP site are then kriged across space to all of the CMAQ grid cells to produce a smooth spatial map of a regional bias correction field for the CMAQ wet deposition predictions. (Note that since we are dealing with ratios, the averaging and kriging procedures are done on the log scale and then back-transformed.) This bias adjustment was applied to the entire Continental United States (CONUS) domain, including the West Coast. The dry deposition is added, without adjustment, to the adjusted wet deposition to calculate total deposition.

Purpose

Provide annual adjusted CMAQ deposition fields for 2025, with a bi-directional NH_3 formulation and a dynamic CAFO emissions profile for critical loads analyses and as input to other ecological models where the most accurate wet deposition fields are desired (via precipitation and bias adjustments).

Supplemental Information

The CMAQ modeling system was run for the CONUS domain using a 12 km grid size and a Lambert Conformal projection assuming a spherical earth with radius 6370.0 km. The following model options and inputs were used:

- Chemical Transport Model version is CMAQ v5.0.2 with bi-directional NH_3 air-surface exchange using Massad formulation, CB05TUCL chemical mechanism, aero6 aerosol module
- CMAQ v5.0.2 lightning NOx adjusted to lightning strike data
- GeosCHEM v 8-03-02 model created boundary conditions with hourly values from 2011 simulation using Geos5 meteorology
- Economic Policy Integrated Climate (EPIC) chemical fertilizer application schedule that is year specific with chemical specification of form applied.
- New confined animal feeding operations (CAFO) resistance and thermodynamics-based diurnal profile calculation for NH3 emissions

- Biogenic Emissions Landuse Database, version 4 (BELD4) crop distributions in EPIC and CMAQ, and biogenic emissions.
- Anthropogenic emissions are from the 2025ef_v6_11g data set. These emissions are projected from the 2011 NEI emission inventories and the EGU forecasts were done using the IPM model. Mobile emissions are from MOVES T3FRM.
- Weather Research Forecast model, version 3.4 (WRF v3.4) meteorology simulated for 2011 with 2006 NLCD land cover data and using version2 four-dimensional data assimilation with no nudging in the planetary boundary layer and based on blended 3-hourly reanalysis fields (combination of 6-hour *(*Meteorological Assimilation Data Ingest System*)* MADIS data and intermediate North American Mesoscale Model (NAM) 3-hour forecast) organized into 12km NAM Data Assimilation System (NDAS) fields up to 50 hPa,
- WRF v3.4 with Kain-Fritsch Ma and Tan (2009) trigger; with NLCD woody wetlands land use category recognized (wetlands-100); with Pleim-Xiu land-surface model.
- WRF post-processing to create inputs for CMAQ was done with the Meteorology-Chemistry Input Processor (MCIP) v4.1.3. There are 35 vertical layers from the surface to the top of the free troposphere with layer 1 nominally 19m tall.
- November 2014 simulation date.

Major Control Regulations Incorporated

- Power plant Rules: MATS (mercury & air toxics) and CAIR
- Industry Rules: CSAPR + local rules, consent decrees, Portland Cement controls and closures
- Adjustments for new Biofuel futures due to EISA
- Light-Duty Vehicle Tier 2 Rule
- Tier-3 Motor Vehicle Emissions and Fuel Standards Rule
- Heavy Duty Diesel Rule
- Renewable fuel standards (RFS2)
- Light Duty Greenhouse Gas/CAFÉ standards
- Heavy Duty Greenhouse Gas Rule
- Local I/M programs
- National Low Emission Vehicles (NLEV)
- Ozone Transport Commission LEV programs
- Clean Air Nonroad Diesel Rule
- Small Engine Spark Ignition Rule
- Locomotive and Marine Engine rules

Emissions Growth

- Aircraft growth
- Livestock emissions growth based on animal census figures
- Biofuel impacts on agricultural activities

Use Constraints

None

Contact Person

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Currentness

May 2011 bias adjustment procedure (current); August 2013 CMAQ5.0.2; January 2013 WRFv3.4 with 2006 NLCD;

Update Frequency

Occasional

kg/ha units set

AWD_OXN_T = Bias+Precip Adjusted Wet Deposition of Oxidized N (kg-N/ha)

AWD_REDN_T = Bias+Precip Adjusted Wet Deposition of Reduced N (kg-N/ha)

AWD_S_T = Precip Adjusted Wet Deposition of Total Sulfur (kg-S/ha)

AWD_SS_S = Precip Adjusted Wet Deposition of Sea Salt Sulfur (kg-S/ha)

AWDEP_CL = Precip Adjusted Wet Deposition of chloride (kg-Cl/ha)

AWDEP_Na = Precip Adjusted Wet Deposition of sodium (kg-Na/ha)

DD_OXN_T = Dry Deposition of Total Oxidized N (kg-N/ha)

DD_REDN_T = Dry Deposition of Total Reduced N (kg-N/ha)

DD_S_T = Dry Deposition of Total Sulfur (kg-S/ha)

DD_SS_S = Dry Deposition of Sea Salt Sulfur (kg-S/ha)

DDEP_CL = Dry Deposition of Chloride (kg-Cl/ha)

DDEP_Na = Dry Deposition of Sodium (kg-Na/ha)

TD_OXN_T = Total Deposition of Total Oxidized N (kg-N/ha)

TD_REDN_T = Total Deposition of Total Reduced N (kg-N/ha)

TD_S_T = Total Deposition of Total Sulfur (kg-S/ha)

TD_SS_S = Total Deposition of Sea Salt Sulfur (kg-S/ha)

TDEP_CL = Total Deposition of Chloride (kg-Cl/ha)

TDEP_Na = Total Deposition of Sodium (kg-Na/ha)

TD_N = Total Deposition of Nitrogen (Oxidized + Reduced) (kg-N/ha)

SIM_DATE = November 2014

File Names

precip_adj_bias_adj_500kmMW_V2_2025_CMAQv5.0.2_bidi_cafo_12km_CONUS_kg_ha_Nov2014sim.shp