Determining inter-annual variability of meteorology, emissions, and air quality observations in the western US to assess representativeness for regional modeling and air quality planning

WRAP Regional Technical Operations Work Group (RTOWG) – January 12, 2018 final draft

Introduction

Significant resources are required to periodically develop and exercise an annual air quality modeling platform, and these systems are applied across a number of issues of concern, including ground-level ozone, regional haze, and nitrogen deposition. It is therefore important to establish the "degree of representativeness" for the year chosen for the annual simulation, such that air quality modelers and planners understand "how representative" the selected modeling base year will be for projecting the future. At a minimum, the next annual western regional modeling platform to be employed by the WRAP RTOWG will be based on either 2014 or 2016, and we are requesting proposals to examine the available meteorology, trends in fire emissions and other key sources, and air quality observations for these candidate years, other recent years (2012, 2013, 2015) - to compare them to each other and the meteorological data to climatological normals. Further, if the contractor-defined analysis methodology is efficient and cost-effective to implement, analysis of each year, 2000 through 2016, will be considered for funding in this analysis.

Scope

The WRAP agencies that are involved in regional modeling and analyses have been organized into a Regional Technical Operations Work Group (RTOWG). RTOWG Members and Advisors are representatives of the WRAP member agencies and other experts from federal agencies and academia.

The focus of the following tasks will be to examine available meteorology and air quality observations from monitoring networks in the western and central US (i.e., WRAP and selected CENRAP states within the contiguous US), including:

- Meteorology
  - Surface temperature
  - Wind speed
  - Precipitation
  - Synoptic climatology variation and typing
- Emissions trends and important changes/variation in source categories
- Air Quality
  - Ozone
  - PM2.5 total mass and species and PM10 total mass
  - Wet deposition of nitrogen (NH4+, NO3-)

In addition, as funding permits, the following additional tasks will be considered:

- Emission inventory trends
- Special study results for model evaluation

Tasks

I. Identify which routine monitoring network observations are suitable for this evaluation

a. Meteorology
    i. Remote Automated Weather Stations (RAWS)
        1. Wind direction and speed, Precipitation, Pressure, Temperature, Relative humidity, Fuel moisture and temperature
    ii. Clean Air Status and Trends Network (CASTNet)
        1. Wind direction and speed, Precipitation, Pressure, Temperature
    iii. Parameter-elevation Relationships on Independent Slopes Model (PRISM)
        1. Precipitation
    iv. Synoptic climatology typing schemes
    v. Other?
b. Air Quality
    i. Rural and Class I area monitoring sites operated by states, tribes, and local agencies and reported to the EPA Air Quality System (available via the Intermountain West Data Warehouse using: http://views.cira.colostate.edu/tsdw/DataWizard/Default.aspx)
    ii. Federally-managed monitoring networks:
        1. Clean Air Status and Trends Network (CASTNet)
            a. Ozone, nitric acid, nitrate(?), ammonium
        2. Interagency Monitoring of Protected Visual Environments (IMPROVE)
            a. Sulfate, nitrate, OC, LAC, soil, coarse mass
        3. National Atmospheric Deposition Program (NADP)
            a. Nitrate, ammonium
        4. Ammonia Monitoring Network (AMoN)
            a. Ammonia

II. Identify length of time period for analysis

a. Minimum effort is for 2012, 2013, 2014, 2015, and 2016 for air quality data
b. Meteorological analysis would be for 2014 and 2016
c. Also consider expansion to include 2000 through 2016

III. Identify individual sites to be used for analysis

a. Focus on western US (15-state WRAP region) and central US (NE, KS, OK, TX)
b. Preferred focus will be on rural / Class I area sites
c. Apply data completeness criteria in selecting sites and monitors for evaluation (how much missing data is allowed from observational record)

IV. Format meteorology and air quality observations for analysis and delivery

a. What is most useful for analysts (comma-delimited text, R, etc.)?

V. Perform time series analyses

a. Develop a set of algorithms that can be routinely applied to meteorology and air quality times series
    i. R, SAS, Mathematica?

VI. Perform spatial clustering of observation sites

a. Can observational sub-regions be identified?
b. Cross-correlation of observational sites?
    i. Threshold R2?

VII. Recommend a methodology and evaluate "how different" recent candidate model platform years (2014, 2015, and 2016) are from each other

a. Develop criteria to determine if one or more individual years are "typical"
b. Possible additional comparison to 2000 through 2013 years

VIII. "Meta" analyses of longer-term meteorology and air quality observations

a. Do "outlier" meteorological years correspond to "outlier" air quality years?
b. Are variations in air quality observations correlated?
    i. Does a high ozone year also correspond with high PM and high wet deposition for that year? Inversely correlated (e.g., low ozone and high wet nitrogen deposition)?

IX. Trends in emission inventories

a. Identify which major source sectors have changed since 2000
    i. Will likely be constrained by NEI years (e.g., 2008, 2011, etc.)

X. Available special air quality studies that were conducted 2014-2016

a. Additional observations for model evaluation
    i. e.g., FRAPPE (2014, Colorado)
    ii. other

Deliverables

Draft and final memoranda for Tasks I through X

SQL format files for Task V and other tasks to be identified

Schedule

Complete within 12 weeks from start date